

Initial Environmental Examination

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India: Sustainable, Inclusive, and Climate-Resilient Tourism Development at Tehri Lake Area Project Transport Infrastructure Components

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CURRENCY EQUIVALENTS

(as of 15 October 2024)

Currency Unit	–	Indian rupee/s (₹)
₹1.00	=	\$0.01190
\$1.00	=	₹84.064

ABBREVIATIONS

ADB	–	Asian Development Bank
DPR	–	Detailed Project Report
EHS	–	Environment Health and Safety
EIA	–	Environmental Impact Assessment
EMP	–	Environmental Management Plan
EPA	–	Environmental Protection Act
GHG	–	Greenhouse Gas
GOI	–	Government of India
GRC	–	Grievance Redress Committee
GRM	–	Grievance Redress Mechanism
IEE	–	Initial Environmental Examination
IRC	–	Indian Roads Congress
ISBT	–	Inter-State Bus Terminus
IUCN	–	International Union for Conservation of Nature
PIU	–	Project Implementation Unit
PMDSC	–	Project Management Design and Supervision Consultant
PMU	–	Project Management Unit
PPE	–	Personal Protective Equipment
PWD	–	Public Works Department
REA	–	Rapid Environmental Assessment
TADA	–	Tehri Special Area Tourism Development Authority
UJS	–	Uttarakhand Jal Sansthan
UKPCB	–	Uttarakhand Pollution Control Board
UTDB	–	Uttarakhand Tourism Development Board
WHO	–	World Health Organization

WEIGHTS AND MEASURES

dB	–	decibel
ha	–	hectare
km ²	–	square kilometer
km	–	kilometer
m	–	meter
m ³ /s	–	cubic meter per second
l	–	liter

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I. EXECUTIVE SUMMARY

1. The Sustainable, Inclusive, and Climate-Resilient Tourism Development at Tehri Lake Area Project (the project) will support the development of tourism linked with livelihoods, environmental protection, and climate resilience in the Tehri Lake area of Tehri Garhwal District in Uttarakhand State, India. The project area comprises (i) the lands and communities around Tehri Lake, within the administrative area managed by the Tehri Special Area Tourism Development Authority (TADA) – a zone about 1 kilometer (km) wide and which encompasses about 50,700 residents in 98 villages (widely dispersed between 600–2,000 m elevation), and (ii) New Tehri Town (about 36,330 people). The project will focus on structural components, including construction and/or upgrade of visitor facilities, sanitation and solid waste management, road upgradation, reforestation, and slope protection to address landslide risk. Non-structural components include tourism planning, capacity building, vocational training, and private sector participation. The goal is to establish sustainable, inclusive, and climate-resilient tourism in the Tehri Lake area. The project has four expected outputs, as follows.

2. **Output 1: Climate-smart institutional framework for tourism strengthened.** The project will: (i) prepare the first climate-smart and gender-responsive tourism master plan for the Tehri Lake area, which will establish travel circuits and land and lake zoning based on hazard mapping, to increase the safety of residents and visitors from climate-induced risks; targets to support training and tourism enterprises led by women, youth, and MSME; visitor programs to encourage longer stays; and planning aligned with hydropower operations; (ii) build the capacity of the TADA for sustainable, accessible and gender-responsive destination management, through preparation of a business plan, staff appointments, and training, especially to engage with community service providers and hydropower operations; (iii) prepare the first PPP tourism toolkit for Uttarakhand State, with a focus on women's entrepreneurship; (iv) strengthen selected district policies to facilitate private sector entry for tourism and establish operational standards and requirements for green building designs, regulated water use, and energy efficiency; and (v) establish a tourism sustainability monitoring program for the Tehri Lake area.

3. **Output 2: Climate-resilient, gender-responsive, and accessible infrastructure for tourism established.** This output will establish the facilities required for connectivity, water supply, waste management, and recreation to generate livelihood and tourism benefits. The designs encompass five clusters—New Tehri Town and four village clusters around Tehri Lake (Map). The project will: (i) establish a 25-kilometer (km) low-carbon public transport network with land and water travel, around and across Tehri Lake, to benefit 71 villages with improved connectivity to the nearest urban center (New Tehri) and as a visitor travel circuit. This will comprise: (a) 12 electric buses (e-buses) and five e-boats for public transport, serviced by 13 bus stops and 5 floating jetties with solar charging stations; (b) upgrade of 15.7 km of lakeside road, 12.8 km of village paths, and one cable car system (a vital transport node for communities), serviced by solar lighting and a roadside retaining wall—for improved durability, safety from floods and landslides, and transport capacity; (c) upgrade of one small bus terminal (gateway to the lake area) and adjacent shop arcade (to increase vendor income) at New Tehri Town; and (d) construction of 4.7 km walking and cycling promenades; (ii) strengthen water security and solid waste management for 12 villages (6,158 residents) closest to the lake and subject to highest seasonal visitor numbers, through rainwater harvesting and storage facilities and waste composting pits; (iii) achieve at least 90.0% sewage and solid waste treatment coverage and last-mile household connections for New Tehri Town, through upgrading (a) one STP and 21.5 km of sewage pipelines—with reuse of treated wastewater for greenbelt watering, and (b) one landfill—with waste segregation, recycling, collection vehicles, composting of organic material, and a methane flare; (iv) construct one information center, food court, and a tourism park; and (v) install

a smart command system for transport and waste management, linked with district DRM early warning systems, to maximize safety, disaster preparedness, energy savings, and operational efficiency. The designs emphasize gender-responsive features and universal access.

4. **Output 3: Tourism led by women, youth, and the private sector scaled up.** This output will: (i) implement a livelihood matching grant program (LMGP) for 71 villages in the Tehri Lake area, to generate jobs and income diversification by catalyzing local goods and services. Grants will prioritize community ventures led by women, youth, CSOs, and MSME and which benefit the poor, food security, water and energy efficiency to enhance climate resilience, and environmental protection; (ii) train LMGP beneficiaries in basic business management and start-up skills, digitalization, access to online markets, and support to prepare grant applications; (iii) facilitate MSME to achieve tourism certification, to benefit the quality and promotion of goods and services and to apply certified standards for social and environmental sustainability; and (iv) facilitate PPP for O&M of selected facilities (output 2) with high potential for private sector investment.

5. **Output 4: Nature-based solutions for environmental protection and women-led DRM enhanced.** This output will: (i) restore and/or protect about 113 ha of degraded hillslopes, through afforestation (about 100 ha) for locations of high landslide risk, using native tree species; integrating existing natural vegetation in the project designs (about 13 ha); and applying traditional knowledge for erosion control (including mulching and percolation pits) and forest fire management—to improve water retention and soil quality and reduce the risks of landslides, floods, fire, and soil erosion; (ii) mobilize about 71 community forestry councils (one per village, representing about 50,700 residents) to co-implement the afforestation program—applying the knowledge and role of rural women for agroforestry; and (iii) pilot a women-led program to strengthen DRM, sanitation, and stream protection at 12 villages at Tehri Lake and a roadmap to scale up the program to other villages in the lake area.

6. The executing agency is the Department of Tourism of Uttarakhand State, acting through the Uttarakhand Tourism Development Board (UTDB). A project management unit (PMU) has been established under the UTDB and will coordinate the project activities including management of the loan proceeds, procurement, monitoring, and reporting. The PMU is headed by the Additional Chief Executive Officer (ACEO) of UTDB as the Project Director; and comprises positions for project administration, technical, procurement, financial, and livelihoods support.

7. There are four implementing agencies for the project, which have each established a project implementation unit (PIU): (i) UTDB, with support from TADA—for all project components except listed otherwise (12 PIU positions); (ii) PWD—for the tourism road and pedestrian suspension bridge subprojects (four PIU positions); (iii) Department of Forestry—green cover and afforestation subproject (five PIU positions); and (iv) Uttarakhand Jal Sansthan (UJS)—sanitation and wastewater treatment components (four PIU positions). Each PIU is headed by a project manager and comprises administrative and technical positions. The PIUs are responsible for subproject implementation, monitoring, and reporting.

8. **Project initial environmental examinations (IEEs).** The project is categorized “B” for environmental risk under the Safeguard Policy Statement (SPS, 2009) of the Asian Development Bank (ADB) and require the preparation of IEE(s). This IEE covers the transport components of the project, specifically:

- Tourism Road (Koti Colony to Dobra Chanti)
- Upgradation/construction of ropeway Tipri to Madan Negi
- Water Public Transport Stations at 5 locations

- Designing, supply and installation of signages, and last mile connectivity.
- Smart Infrastructure (Traffic management component in Smart digital infrastructure, Charging infrastructure for EVs - EV taxis and e-Autos), Weather monitoring, prediction / forecasting systems, broadcasting

9. **Scope of the IEE.** The proposed tourism road from Dobra Chanti to Koti Colony is a 15.77 km long subproject aimed at enhancing connectivity and promoting tourism in the New Tehri area. Starting from Koti Colony and ending at Dobra Chanti, the road will serve as a vital link for tourists and locals, providing access to the scenic Dobra Chanti Bridge and nearby villages. Designed to accommodate the challenging mountainous terrain, the road will primarily maintain a 14-meter width for two-lane traffic with paved shoulders, expanding to 20 meters at six designated viewpoints to facilitate parking, sightseeing, and tourist amenities. The project incorporates robust engineering features such as flexible and rigid pavement standards, drainage systems, and retaining walls—using a combination of gabion and reinforced concrete walls—to ensure stability and durability. Safety measures include adequate sight distances, super-elevation, stopping sight distance, and road signage, all conforming to the Indian Roads Congress standards. The design also features a 3.0-meter-wide combined pedestrian and cycling track in specific sections to promote non-motorized transport and provide a safe environment for tourists to enjoy the surroundings. The road will be equipped with EV charging stations utilizing public electricity and solar panels, catering to the growing trend of electric vehicles. To ensure safety and usability, street lighting will be installed along the entire road length, supported by an earthing system and lightning protection infrastructure. Strategic viewpoints and a viewing deck are integrated into the design to offer tourists breathtaking vistas of the Tehri Lake and the Himalayan foothills.

10. The proposed ropeway subproject will improve the reliability, safety, and capacity of an existing cable car system between Tipri and Madan Negi stations over a 960-meter span across the Tehri Lake. As being proposed, a twin track bi-cable double reversible jig back ropeway system will offer enhanced stability and operational efficiency with a capacity to transport 150 passengers per hour each way. The system will feature two carriers running simultaneously on twin track ropes, powered by a 100 HP motor and supported by a robust haulage rope and track rope configuration designed to withstand high tension and varying weather conditions. The gondolas, each with a capacity of 20 passengers, will offer a safe and comfortable journey with advanced safety features such as fixed grips, emergency brakes, and anti-sway mechanisms. The ropeway's design speed is set at 3.6 meters per second, with a travel time of approximately 7 minutes and 46 seconds one way. The Tipri Drive Station and Madan Negi Return Station will be equipped with modern amenities, including waiting areas, parking facilities, bio-toilets, and drinking water systems, ensuring convenience for both tourists and locals. The system will be supported by a comprehensive electrical network with backup power from a 250 KVA diesel generator, ensuring uninterrupted operation. The subproject also includes a water supply system with overhead storage tanks, a biodigester-based wastewater management system, and safety features like communication systems and emergency rescue capabilities.

11. The proposed water transport stations, comprising jetties at five strategic locations around Tehri Lake, will be developed to improve connectivity and accessibility between various towns in the Bhilangana and Bhagirathi Valleys. The jetties will be located at Sandana and Dharkot in the Bhilangana Valley, and at Raulakot, Dobra Chanti, and Tiwar Gaon in the Bhagirathi Valley. Each site will be selected based on proximity to nearby towns, villages, and accessibility, with design elements tailored to suit local conditions and land availability. For instance, the Sandana and Dharkot jetties will not include station buildings due to land constraints, while the Raulakot and Tiwar Gaon stations will feature amenities such as waiting areas, baby feeding rooms, washrooms for all genders, first aid rooms, and firefighting systems. Raulakot and Tiwar Gaon will also be

equipped with food stalls and external waiting areas to enhance the visitor experience. Each station's infrastructure will be supported by dedicated approach roads and pedestrian pathways to ensure accessibility for all users, including those with mobility challenges. The jetties will also include water and power supply systems, wastewater management through packaged treatment plants, and stormwater drainage systems to manage environmental impact effectively.

12. The proposed design and installation of signs at various locations and last mile connectivity shall benefit tourists coming to New Tehri Area, in way finding and improved access and ease in commuting. The signage will introduce the tourists to the lesser-known locations around Tehri Lake which can be explored. This shall help increase the tourist stay duration. Signage will build a unique image of the tourist destination. It shall add aesthetic and character to the place. It will indirectly benefit the locals by giving them income earning opportunities by increasing the footfall, range of places visited and duration of stay of the tourists.

13. The proposed smart infrastructure project in New Tehri aims to enhance urban efficiency, safety, and connectivity through the development of a smart street loop and the establishment of an Integrated Command and Control Centre (ICCC). The smart street loop will connect major locations such as the Inter-State Bus Terminus (ISBT), College Road, and Baurari Stadium, linking key public buildings including the City Centre, Government Pratap Inter College, and Saint Anthony Public School. The smart loop will incorporate intelligent poles equipped with environmental sensors, surveillance cameras, public address systems, and digital billboards, while traffic signal poles will feature adaptive signal control technology to optimize traffic flow and reduce congestion. The ICCC will serve as the centralized monitoring and decision-making hub, integrating various city services like smart parking, e-governance, CCTV surveillance, emergency response, and disaster management. The subproject will also deploy 21 smart bus shelters equipped with real-time bus schedule displays, Wi-Fi connectivity, and charging ports to improve public transportation. Additionally, the initiative includes the installation of 12 electric auto-rickshaws, EV charging stations, and a city surveillance system to ensure public safety and efficient service delivery.

14. **Policy Requirement.** The subprojects in the Tehri Lake region are required to comply with both the ADB policies and India's environmental and social legal framework. ADB's SPS mandates the integration of environmental and social safeguards, including the preparation of this IEE. These assessments ensure that environmental risks, particularly in ecologically sensitive areas like Tehri Lake and the surrounding forests, are identified and mitigated. The ADB also emphasizes public consultation, ensuring that local communities are informed about the projects and have the opportunity to provide input. Additionally, the ADB's social safeguards ensure that vulnerable populations, such as women and indigenous groups, benefit from the projects through improved livelihoods, infrastructure, and services.

15. The subprojects must also adhere to key Indian environmental laws, such as the Environment (Protection) Act, 1986, and the Forest (Conservation) Act, 1980. The tree cutting for the tourism road subproject from Dobra Chanti to Koti Colony must comply with the Forest Conservation Act, 1980 and the Uttarakhand Tree Protection Act, 1976. These regulations require the removal of trees must obtain prior approval from the relevant forest authorities and adhere to guidelines for compensatory afforestation and replantation on a 1:10 basis. Additionally, the Water (Prevention and Control of Pollution) Act, 1974, and the Air (Prevention and Control of Pollution) Act, 1981 are crucial for ensuring that the construction and operation of the projects do not result in pollution, particularly around the sensitive water bodies of Tehri Lake. To ensure the safety and welfare of the workforce involved in constructing the subprojects, compliance with the Building and Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 is

essential. This law provides guidelines on fair wages, safe working conditions, and access to facilities such as housing and healthcare for construction workers. The integration of ADB's international safeguards with India's environmental laws ensures that the subprojects are developed sustainably, protecting the natural environment, supporting community development, and enhancing the region's tourism potential without compromising ecological and social values.

16. The subprojects must comply with stringent environmental standards for air quality, water quality, and noise levels, as per both Indian regulations and international guidelines, particularly those set by the World Health Organizations (WHO). For air quality, India's Air (Prevention and Control of Pollution) Act, 1981, and the National Ambient Air Quality Standards (NAAQS) regulate key pollutants such as PM₁₀, PM_{2.5}, NO_x, and SO₂. However, if WHO guidelines are more stringent the subprojects must meet the more stringent standards, ensuring air quality control. For water quality, Indian laws under the Water (Prevention and Control of Pollution) Act, 1974 govern water parameters like pH, dissolved oxygen, and biological oxygen demand, with ADB imposing stricter safeguards in sensitive ecosystems like Tehri Lake to protect aquatic life and sustain the lake as a recreational asset. Similarly, for noise levels, the subprojects must adhere to India's Noise Pollution (Regulation and Control) Rules, 2000, while WHO guidelines may require more stringent limits ensuring noise pollution is minimized during construction and operation to protect both communities and wildlife.

17. **Baseline environment.** The project is located within the Himalayan foothills, characterized by undulating topography and varying elevation. Tehri Lake is a large, artificial reservoir formed by the Tehri Dam on the Bhagirathi River. The soil types across the project sites are alluvial in nature near the lake and rockier and loamier on the elevated regions surrounding Tiwar Gaon and Madan Negi. These soils support a range of vegetation, from grasslands near the lake to dense forests in the higher elevations. The areas with forest cover exhibit high organic content, making them conducive for forest regeneration and biodiversity conservation projects, while the loamy soils are well-suited for infrastructure development without significant engineering challenges. The terrain in Tiwar Gaon and Madan Negi features gradual to moderate slopes, which are ideal for the development of walking trails, biodiversity parks, and village upgrades. The well-drained soil in these areas supports stable construction conditions for eco-tourism facilities such as yoga and meditation centers.

18. The climate of the region is temperate, with distinct monsoon, summer, and winter seasons. The annual rainfall averages around 1,000 to 1,200 mm, most of which occurs during the monsoon months of June to September. This climatic profile is advantageous for developing green landscapes and water harvesting projects, which can be integrated into the Koti Colony and Lake Cluster. The temperate climate also favors outdoor recreational activities such as cycling and walking along the lakeside promenades.

19. The forested areas surrounding Tiwar Gaon, Madan Negi, and parts of Koti Colony are classified as sub-tropical coniferous and broad-leaved forests, supporting a variety of tree species such as *Cedrus deodara* (Deodar), *Pinus roxburghii* (Chir PAine), and *Rhododendron arboreum*. These trees provide a natural canopy and serve as an ecological buffer, making these areas well-suited for the development of biodiversity parks and nature trails. The presence of such forests contributes to cooler microclimates and cleaner air quality, enhancing the overall experience for visitors to the biodiversity parks and forested promenades in these clusters.

20. The fauna in the forested areas includes mammals like Barking Deer, Leopard Cats, and Himalayan Palm Civets, making the region a prime location for eco-friendly tourism that highlights wildlife conservation. The biological diversity of Tehri area have a naturally rich environment,

making them ideal for eco-tourism and sustainable development that emphasizes the preservation of the natural habitat. Vegetative stabilization using native species in the subprojects, especially along promenades and slopes, ensures erosion control and contributes to the area's biodiversity.

21. The water resources in the project area are dominated by Tehri Lake, which is the largest reservoir in the region. The lake not only provides water for irrigation and hydroelectric power generation but also forms the basis for numerous tourism-related activities. Its expansive surface area, which covers approximately 42 square kilometers, offers ample space for the development of marinas, boat docks, and promenades. The water quality in Tehri Lake is consistently high, with low pollution levels due to the region's natural filtration processes through forested catchment areas, making it suitable for recreational activities such as swimming, boating, and fishing.

22. The socio-economic environment of the project sites is rooted in the rich cultural and religious heritage of the Garhwal region. Communities in villages such as Tiwar Gaon, Madan Negi, and Koti Colony maintain a strong connection to the land through traditional farming, fishing, and artisanal crafts. The cultural fabric is deeply intertwined with local festivals, religious rituals, and the presence of sacred temples such as the Mahadev Temple in Madan Negi. This cultural richness provides a robust foundation for the development of tourism that highlights local traditions and religious sites, making the area particularly attractive for spiritual tourism.

23. The population in these areas is predominantly rural, with most residents engaged in agriculture, horticulture, and animal husbandry. The project sites offer an opportunity to diversify local income through the promotion of eco-tourism, cultural tourism, and adventure sports, particularly around Tehri Lake. The growing interest in wellness tourism, supported by the temperate climate and scenic landscapes, makes the region a prime candidate for developing yoga and meditation retreats in places like Tiwar Gaon. The introduction of upgraded infrastructure in these areas will boost local businesses, create employment opportunities, and improve overall living standards without compromising the cultural integrity of the communities.

24. In New Tehri, the socio-economic environment is more urbanized, providing a platform for larger infrastructure projects such as the ISBT and the City Center. These developments will facilitate increased tourism and provide enhanced connectivity, enabling easier access to the region for both domestic and international tourists. The socio-economic dynamics of New Tehri also support the growth of commercial hubs and retail spaces that will cater to the influx of visitors to the region.

25. The existing infrastructure in the project sites varies between the more rural areas of Tiwar Gaon, Madan Negi, and Koti Colony, and the urbanized environment of New Tehri. In the rural clusters, infrastructure primarily consists of small roads and basic utilities, with local roads serving as vital connectors between villages and the main highway leading to New Tehri. The planned upgrades to roads and public amenities as part of the project will improve connectivity and facilitate the movement of tourists and goods. Water supply infrastructure is supported by natural springs and rainwater harvesting systems in the rural clusters, while New Tehri benefits from a more developed municipal supply system. The region's electricity network is expanding, with renewable energy initiatives such as solar power being increasingly adopted, particularly for public lighting and small-scale power needs in the more remote clusters.

26. **Potential impacts and mitigation measures.** Based on the findings of the IEE, several environmental and social impacts have been identified, primarily related to the removal of vegetation, alteration of the natural landscape, and increased human activity. The most significant

impact is the proposed cutting of 3,124 trees along the road alignment, which will result in reduction in the land cover of the area. This large-scale removal of trees may disrupt local fauna, reduce presence of biodiversity, and contribute to increased soil erosion. The alteration of topography due to cut-and-fill activities for road widening and slope stabilization may further exacerbate soil instability, particularly in the hilly terrain of the Tehri Lake region. The IEE also recognizes potential negative impacts during the construction phase, including increased dust, noise pollution, and disruptions to the local community's daily activities.

27. To mitigate these impacts, the IEE outlines several comprehensive mitigation measures aimed at preserving the environmental integrity of the region while enabling infrastructure development. First and foremost, it proposes a compensatory afforestation program, where 10x the number of trees removed will be replanted in suitable areas to restore green cover and provide habitat for displaced wildlife. Native species will be prioritized to maintain ecological balance and support biodiversity. The plan also includes slope stabilization techniques, such as bioengineering and the construction of retaining walls, to minimize soil erosion and reduce the risk of landslides. To address air and noise pollution during construction, the IEE recommends regular watering of exposed areas, the use of low-noise machinery, and the installation of noise barriers near sensitive receptors like schools and residential areas. Additionally, the report emphasizes strict waste management practices to handle construction debris and prevent contamination of water bodies due to accidental spills or sediment runoff.

28. **Public consultations.** The public consultations conducted from December 2023 to June 2024 were conducted in accordance with the Asian Development Bank's requirements to ensure comprehensive stakeholder engagement for proposed subprojects. The consultations involved a diverse range of participants, including temporary affected persons, farmers, beneficiaries, the poorest households, gram panchayat members, public representatives, and institutional stakeholders such as the PWD, Forest Department and UTDB. A total of 249 participants attended these consultations, with 32.93% female representation.

29. The consultations were held at multiple locations, including Tiwar Gaon, Dobra Chanti, and Koti Village. In Tiwar Gaon, discussions focused on potential environmental impacts, such as displacement of local wildlife and increased dust and noise generation during construction. Participants suggested the implementation of pollution control measures, erosion prevention strategies, and scheduling construction activities during less intrusive hours. In Koti Village, the community expressed the need for sustainable tourism development, focusing on zoning regulations to define specific areas for commercial, residential, and agricultural activities. They proposed the development of eco-friendly tourism facilities to promote low-impact tourism that supports conservation and provides economic benefits to the local population. Further consultations with institutional stakeholders highlighted the importance of implementing a comprehensive forest management plan to prevent forest fires and protect vulnerable species. Government officials emphasized the need for joint forest verifications and the selection of suitable muck disposal sites to avoid compromising slope stability during construction activities. In September 2024, consultations were extended to additional villages, where primary concerns were related to tree cutting and solid waste management. The PWD confirmed that compensation and replanting would occur in compliance with domestic laws and regulations, while the UTDB outlined plans for Solid Waste Management at the village level.

30. **Grievance Redress Mechanism.** The grievance redress mechanism (GRM) established for the project is a structured system designed to address, evaluate, and resolve grievances related to social and environmental concerns arising from all project's activities. The GRM is intentionally designed to be accessible, inclusive, gender-sensitive, and culturally appropriate,

ensuring that all affected parties can easily report their issues. The mechanism involves multiple levels of grievance redressal, starting from the local level at the Project Implementation Units (PIUs) and extending up to the PMU. Each tier is equipped with clear responsibilities and timelines for addressing grievances, with designated officials at each level to oversee the process. The intent is to provide a transparent, accountable framework that respects the rights and concerns of affected communities while promoting timely and effective solutions to problems that may arise during the project's implementation.

31. At the first level, grievances are handled directly by the PIUs, where affected individuals can submit their complaints through various means such as complaint boxes, emails, or direct submissions at community offices. The PIU staff is responsible for the initial registration, acknowledgment, and preliminary evaluation of the complaints. Information is meticulously documented, including details like the complainant's name, contact information, and a description of the grievance. Initial resolutions are attempted at this level, with a focus on quick, localized solutions to straightforward issues. If a complaint cannot be resolved at the PIU level or if it is of a serious nature, it is escalated to the next level within the PMU. This escalation is designed to ensure that more complex issues receive the necessary attention and resources for a thorough investigation and resolution.

32. The PMU represents the higher level of the grievance redress mechanism, where unresolved grievances from the PIU level are reviewed by a broader team of specialists, including environmental, social, and community development experts. This level of the GRM will address more complex issues that may require an in-depth review and substantial corrective actions. The PMU also plays a crucial role in monitoring the effectiveness of the grievance redress process, ensuring that all actions taken are in compliance with environmental and social safeguards. Furthermore, the PMU is tasked with maintaining a comprehensive database of all grievances and resolutions, providing a critical feedback loop that helps in refining project strategies and improving future grievance handling procedures. This structured approach ensures that every grievance is given due consideration and that the affected parties are kept informed throughout the resolution process, ultimately leading to more sustainable and accepted project outcomes.

33. **Monitoring and reporting.** The monitoring and reporting mechanisms within the project are structured to maintain stringent oversight and ensure adherence to environmental standards throughout its duration. The PIU, working closely with the Project Management Design and Supervision Consultant (PMDSC), is responsible for producing monthly monitoring reports. These reports are then submitted to the PMU, which escalates them to the ADB on a semi-annual basis. This reporting process is critical for documenting environmental performance and identifying necessary adjustments or corrective actions to the EMP. Additionally, any severe environmental incidents must be reported immediately to facilitate swift mitigation actions, underscoring the project's commitment to rapid response and minimal environmental disruption. During the operational phase, the District Tourism Development Officer of Tehri plays an essential role in overseeing environmental monitoring, ensuring that the project continues to comply with environmental regulations and promotes sustainable practices in the long term.

34. **Conclusion and recommendations.** The transportation components of the Project, classified as Category B, was evaluated through an IEE following the ADB's SPS 2009. The IEE confirms that the project, which focuses on the development of transport infrastructure, will have moderate environmental impacts that are site-specific, manageable, and can be mitigated through proper planning and the implementation of a robust EMP. The project involves four key subprojects: the 15.77 km tourism road from Koti Colony to Dobra Chanti, a twin-track bi-cable ropeway from Tipri to Madan Negi, water public transport stations at five jetties around Tehri Lake,

and the establishment of smart infrastructure, including intelligent poles, EV charging stations, and traffic management systems. Public consultations, held from December 2023 to September 2024, involved stakeholders and ensured community concerns were integrated into the project planning. Mitigation measures include regular dust control, low-noise machinery, and comprehensive erosion prevention strategies. The IEE, which will be disclosed to the public and updated as necessary based on design modifications, also recommends strict adherence to government environmental regulations and the integration of EMP compliance clauses into bidding documents. This will ensure that all contractors, including the Design-Build-Operate (DBO) contractor, understand their environmental responsibilities and contribute to the sustainable development goals of the project, fostering economic growth, environmental protection, and community well-being in the Tehri Lake region.

II. INTRODUCTION

35. The Sustainable, Inclusive, and Climate-Resilient Tourism Development at Tehri Lake Area Project (the project) will support the development of tourism linked with livelihoods, environmental protection, and climate resilience in the Tehri Lake area of Tehri Garhwal District in Uttarakhand State, India. The project area comprises (i) the lands and communities around Tehri Lake, within the administrative area managed by the Tehri Special Area Tourism Development Authority (TADA) – a zone about 1 kilometer (km) wide and which encompasses about 50,700 residents in 98 villages (widely dispersed between 600–2,000 m elevation), and (ii) New Tehri Town (about 36,330 people).

36. Uttarakhand State is in northern India and has 13 districts. In 2011 the state population was about 10.1 million (5.1 million males and 4.9 million females) with 69.77% of the population living in rural areas.¹ Uttarakhand State has a large and expanding tourism sector. In 2019, prior to the coronavirus disease (COVID-19) pandemic, the state received 39.2 million visitors and was the tenth-most visited state in India. Tourism accounted for 11.80% of state employment and 4.40% of GDP. The pandemic (2020–2021) resulted in a decline of visitor numbers by 80.0%. The sector is rebounding strongly and in 2022, the state received 20.0 million visitors. Tourism has been largely limited to two subsectors—religious tourism and yoga-based wellness—with intense seasonal visitation (pilgrimages) to sacred sites in a limited season (March–June), subject to heavy congestion, depletion of water supplies, and impacts to fragile mountain ecosystems.² The state supports a rich diversity of natural and cultural values and in 2023 the government launched the Uttarakhand Tourism Policy 2030, which aims to establish Uttarakhand as a diversified, all-weather tourism destination. The policy prioritizes the development of new destinations, hill regions and community- and private sector-led tourism, and women employment. The Tehri Lake area is prioritized for tourism development.

37. **Tehri Lake area—hill region poverty, climate change, and tourism potential around a hydropower lake.** Tehri Garhwal District supports the lowest employment rates in Uttarakhand State. Tehri Lake, in the center of the district, is a large, linear reservoir formed in 2006 by the construction of Tehri Dam (India's tallest dam) for hydropower. The lake is surrounded by mountains rising to 2,000 meters elevation, which support small villages and one town, New Tehri. Since 1991, over 200 forest fires, landslides, floods, drought events, and two major earthquakes have occurred in the district. These have caused loss of life and property and water and food shortages. Despite these issues, Tehri Garhwal was the fourth-most visited district of Uttarakhand in 2021. The Tehri Lake area does not support any of the state's major pilgrimage sites yet has rich scenic and cultural values and is accessed within 3–4 hours by vehicle from the state capital (Dehradun). Connectivity is improving and the area is being intensively promoted by the government for tourism.³

¹ Ministry of Home Affairs. 2024. [Census Tables](#). The next national census will be in 2024–2025.

² In Uttarakhand State, during 2000–2019 the number of annual visitors increased from 11.1 million to 39.2 million (99.5% domestic). Uttarakhand State supports some of Hinduism's most sacred holy sites. Domestic visitors are mainly from the national capital, New Delhi, and other northern cities. Government of Uttarakhand. 2023. [Uttarakhand Government Portal](#); and National Council of Applied Economic Research. 2021. [Tourism Satellite Account, 2018–19 Uttarakhand](#).

³ In 2011 the Tehri Lake area supported 87,030 residents (14.1% of the district population; 618,931), within 71 of 98 villages (50,700 people) (27 villages are no longer occupied due to outmigration) and New Tehri Town (36,330 people; the gateway to the lake area). District GDP per capita in 2016–2017 was \$1,001.0 versus the state mean of \$1,923.3. The poverty rate was 7.9%. The average annual duration of employment was 32.5 days; most (70.9%) of residents were in the lowest income bracket; and for most (64.9%) employed residents, work was limited to casual labor or self-

38. The project will comprise (i) structural components, for the construction and/or upgrade of visitor facilities, sanitation and solid waste management facilities, road upgradation, reforestation, and slope protection to address landslide risk, disaster risk management (DRM), and (ii) non-structural components, including tourism planning, capacity building, vocational training, and participation of the private sector. The tourism facilities will be focused on six thematic clusters—New Tehri Town, four clusters around Tehri Lake, and cross-cutting works and goods for the whole lake area. The outcome is that sustainable, inclusive, and climate-resilient tourism in Tehri Lake area is established. The project will have four outputs, as follows.

39. **Output 1: Climate-smart institutional framework for tourism strengthened.** The project will: (i) prepare the first climate-smart and gender-responsive tourism master plan for the Tehri Lake area, which will establish travel circuits and land and lake zoning based on hazard mapping, to increase the safety of residents and visitors from climate-induced risks; targets to support training and tourism enterprises led by women, youth, and MSME; visitor programs to encourage longer stays; and planning aligned with hydropower operations; (ii) build the capacity of the TADA for sustainable, accessible and gender-responsive destination management, through preparation of a business plan, staff appointments, and training, especially to engage with community service providers and hydropower operations; (iii) prepare the first PPP tourism toolkit for Uttarakhand State, with a focus on women's entrepreneurship; (iv) strengthen selected district policies to facilitate private sector entry for tourism and establish operational standards and requirements for green building designs, regulated water use, and energy efficiency; and (v) establish a tourism sustainability monitoring program for the Tehri Lake area.⁴

40. **Output 2: Climate-resilient, gender-responsive, and accessible infrastructure for tourism established.** This output will establish the facilities required for connectivity, water supply, waste management, and recreation to generate livelihood and tourism benefits. The designs encompass five clusters—New Tehri Town and four village clusters around Tehri Lake (Map). The project will: (i) establish a 25-kilometer (km) low-carbon public transport network with land and water travel, around and across Tehri Lake, to benefit 71 villages with improved connectivity to the nearest urban center (New Tehri) and as a visitor travel circuit. This will comprise: (a) 12 electric buses (e-buses) and five e-boats for public transport, serviced by 13 bus stops and 5 floating jetties with solar charging stations; (b) upgrade of 15.7 km of lakeside road, 12.8 km of village paths, and one cable car system (a vital transport node for communities), serviced by solar lighting and a roadside retaining wall—for improved durability, safety from floods and landslides, and transport capacity; (c) upgrade of one small bus terminal (gateway to the lake area) and adjacent shop arcade (to increase vendor income) at New Tehri Town; and (d) construction of 4.7 km walking and cycling promenades; (ii) strengthen water security and solid waste management for 12 villages (6,158 residents) closest to the lake and subject to highest seasonal visitor numbers, through rainwater harvesting and storage facilities and waste composting pits; (iii) achieve at least 90.0% sewage and solid waste treatment coverage and last-mile household connections for New Tehri Town, through upgrading (a) one STP and 21.5 km of sewage pipelines—with reuse of treated wastewater for greenbelt watering, and (b) one landfill—with waste segregation, recycling, collection vehicles, composting of organic material, and a

employment. During 2000–2019, annual visitor numbers to Tehri Garhwal District rose from 395,936 to 2,348,041 (annual average of 940,626; equivalent to 4.0% of average total annual visitor numbers to Uttarakhand State [23.4 million] in the same period). The average annual number of international visitors was 18,169 (1.8%). Post-pandemic visitor numbers are small but recovering (492,812 in 2021; the most recent year for which published data is available). Government of Uttarakhand. 2022. [Sustainable Development Goals Implementation Framework. Tehri Garhwal](#); and Government of Uttarakhand. 2022. [SDG District Profile: Tehri Garhwal District, 2021–22](#).

⁴ The program will be led by the TADA. Indicators will include greenhouse gas emissions in the Tehri Lake area, water use, waste management, and the number of registered women-led and youth-led tourism services.

methane flare; (iv) construct one information center, food court, and a tourism park; and (v) install a smart command system for transport and waste management, linked with district DRM early warning systems, to maximize safety, disaster preparedness, energy savings, and operational efficiency. The designs emphasize gender-responsive features and universal access.

41. **Output 3: Tourism led by women, youth, and the private sector scaled up.** This output will: (i) implement a livelihood matching grant program (LMGP) for 71 villages in the Tehri Lake area, to generate jobs and income diversification by catalyzing local goods and services. Grants will prioritize community ventures led by women, youth, CSOs, and MSME and which benefit the poor, food security, water and energy efficiency to enhance climate resilience, and environmental protection; (ii) train LMGP beneficiaries in basic business management and start-up skills, digitalization, access to online markets, and support to prepare grant applications; (iii) facilitate MSME to achieve tourism certification, to benefit the quality and promotion of goods and services and to apply certified standards for social and environmental sustainability;⁵ and (iv) facilitate public-private partnership (PPP) for O&M of selected facilities (output 2) with high potential for private sector investment.⁶

42. **Output 4: Nature-based solutions for environmental protection and women-led DRM enhanced.** This output will: (i) restore and/or protect about 113 ha of degraded hillslopes, through afforestation (about 100 ha) for locations of high landslide risk, using native tree species; integrating existing natural vegetation in the project designs (about 13 ha); and applying traditional knowledge for erosion control (including mulching and percolation pits) and forest fire management—to improve water retention and soil quality and reduce the risks of landslides, floods, fire, and soil erosion; (ii) mobilize about 71 community forestry councils (one per village, representing about 50,700 residents) to co-implement the afforestation program—applying the knowledge and role of rural women for agroforestry; and (iii) pilot a women-led program to strengthen DRM, sanitation, and stream protection at 12 villages at Tehri Lake and a roadmap to scale up the program to other villages in the lake area.⁷

43. **Implementation arrangements.** The executing agency is the Department of Tourism of Uttarakhand State, acting through the Uttarakhand Tourism Development Board (UTDB). A project management unit (PMU) has been established under the UTDB and will coordinate the project activities including management of the loan proceeds, procurement, monitoring, and reporting. The PMU will be headed by the Additional Chief Executive Officer (ACEO) of UTDB as the Project Director. The PMU will be manned by positions for administration, technical, procurement, financial, and livelihoods support.

44. There are four implementing agencies for the project, which have each established a project implementation unit (PIU): (i) UTDB, with support from TADA—for all project components except listed otherwise (12 PIU positions); (ii) PWD—for the tourism road subprojects (four PIU

⁵ The LMGP will be financed by a \$12.0 million allocation from the project loan. Grants will support up to 60.0% of the cost of subprojects subject to a maximum ceiling. Subprojects are anticipated to include growing of climate-resilient organic crops, herbs and spices, homestay improvements, guiding services, shop upgrades, and home office equipment. Procedures for eligibility, applications, screening, safeguards and financial management have been prepared. Digital skills training will include start-up hardware and software. Certification programs recognize tour operators which comply with benchmark indicators for social and gender workplace standards and sustainability. The LMGP will be implemented in synergy with national livelihood schemes to scale up benefits and sustainability.

⁶ ADB's PPP screening tool was applied to the project components. About seven facilities (under output 2) with estimated value of \$31.7 million (25.0% of the loan amount) have medium-high PPP potential for O&M. The project consulting support includes a PPP position to reconfirm financial viability and facilitate PPP transaction assistance.

⁷ The program will mobilize community members for DRM and include training on disaster preparedness, sanitation, rainwater harvesting, and stream protection. It will complement the village water supply component under output 2.

positions); (iii) Department of Forestry—green cover and afforestation subproject (five PIU positions); and (iv) Uttarakhand Jal Sansthan (UJS)—sanitation and wastewater treatment components (four PIU positions). Each PIU is headed by a project manager and comprises administrative and technical positions. The PIUs are responsible for subproject implementation, monitoring, and reporting. The PIU under UTDB will support the other PIUs as needed.

45. Project oversight and guidance is led by a state-level High-Powered Committee, headed by the Chief Secretary, and a Technical Screening Committee.

46. **Proposed subproject.** The proposed transport infrastructure development interventions are proposed to be implemented in the form of four subprojects:

- i. Tourism Road (Koti Colony to Dobra Chanti)
- ii. Upgradation/construction of ropeway Tipri to Madan Negi
- iii. Water Public Transport Stations at multiple locations
- iv. Designing, supply, and installation of signages at various locations and last mile connectivity.
- v. Smart Infrastructure (Traffic management component in Smart digital infrastructure, charging infrastructure for EVs - EV taxis and e-Autos), Weather monitoring, prediction / forecasting systems, broadcasting services - Includes services for adventure and other outdoor activities.

47. **Purpose of the IEE.** ADB requires the assessments of environmental impacts in all aspects of the Bank's operations, and the requirements for environmental assessment are described in ADB's Safeguards Policy Statement (2009). Accordingly, this Initial Environmental Examination (IEE) has been conducted to assess the environmental impacts and provide mitigation and monitoring measures to ensure that there are no significant impacts because of the subprojects.

48. The transportation subprojects are classified as environmental Category B as per ADB SPS 2009 as no significant impacts are envisioned. Thus, this initial environmental examination (IEE) has been prepared in accordance with ADB SPS requirements for environment Category B projects.

49. This IEE is prepared for the transport infrastructure development components of the project located in Tehri. The subprojects include civil works, project implementation and management, and non-physical investments. Thus, this IEE is based on the prepared detailed project report. The IEE is based mainly on field reconnaissance surveys, and primary, and secondary sources of information. Stakeholder consultation is an integral part of the IEE.

50. This IEE will be updated to reflect changes in the scope of works, changes in the location of components and changes in costs due to the addition or subtraction of components which can change the environmental impacts. The revised IEE shall supersede the earlier version of the IEE and shall be contractually applicable to the contractor after approval from PMU and ADB.

51. The implementation of the subprojects will be governed by Government of India (GoI) and the state of Uttarakhand and other applicable environmental acts, rules, regulations, and standards. Environmental safeguards will be followed in accordance with the ADB SPS, 2009. During the design, construction, and operation of the project, the PMU UTDB will apply pollution prevention and control technologies and practices consistent with ADB SPS, 2009 and international good practice, as reflected in internationally recognized standards.

52. **Report Structure** The report has been structured in compliance with ADB SPS, 2009 and contains the following ten (10) sections including the executive summary at the beginning of the report:

- I Executive Summary
- II Introduction
- III Description of the Project.
- IV Policy, Legal, and Administrative Framework
- V Description of the Environment
- VI Anticipated Environmental Impacts and Mitigation Measures
- VII Analysis of Alternatives
- VIII Public Consultation and Information Disclosure
- IX Grievance Redress Mechanism
- X Environmental Management Plan
- XI Conclusion and Recommendations

III. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

53. The ADB mandates compliance with its environmental and social safeguard policy requirements as detailed in the Safeguard Policy Statement (SPS) of 2009. This policy framework establishes comprehensive guidelines to ensure that all ADB-financed projects conform to environmental and social protection standards. Key elements of the SPS 2009 include rigorous environmental assessments, stakeholder engagement processes, and the implementation of mitigation strategies to minimize potential adverse effects on affected communities and ecological systems. The SPS 2009 framework aims to uphold environmental and social sustainability by prescribing a hierarchy of actions: to avoid adverse impacts where possible, minimize and mitigate such impacts when avoidance is not feasible, and to enhance positive environmental and social outcomes throughout the project lifecycle.

54. In parallel, the Government of India has robust institutional and legislative framework to address various environmental components, including air quality, water resources, soil integrity, terrestrial and aquatic ecosystems, natural resource management, and the conservation of sensitive habitats. This framework comprises a range of laws and regulations such as the Environment (Protection) Act, 1986; the Forest (Conservation) Act, 1980; the Water (Prevention and Control of Pollution) Act, 1974; and the Air (Prevention and Control of Pollution) Act, 1981. These legal instruments provide a strong foundation for environmental governance, ensuring that development activities are conducted in a manner that safeguards the environment and promotes sustainable development.

55. As a committed member of the international community, India is a signatory to several treaties, conventions, and protocols related to environmental and social safeguards. These include commitments under the Convention on Biological Diversity (CBD), the United Nations Framework Convention on Climate Change (UNFCCC), the Ramsar Convention on Wetlands, and various other international agreements that address critical areas such as biodiversity conservation, climate change mitigation, and sustainable management of natural resources. By adhering to these international agreements, India demonstrates its commitment to upholding global standards of environmental protection and sustainable development.

56. The primary purpose of this section of the IEE is to evaluate the applicability of national laws, regulations, international conventions, and protocols to the proposed solid waste management infrastructure subprojects. It aims to ensure that all relevant legal and regulatory requirements are identified and integrated into the project design and implementation processes. Furthermore, the assessment will guide the project in adhering to ADB's SPS 2009, ensuring that all environmental and social risks are adequately identified, mitigated, and managed. This dual compliance approach—aligning with both national and ADB standards—ensures a comprehensive framework for managing potential risks and enhancing sustainable development outcomes. This section summarizes the following:

- ADB safeguard policies and Categorization of the project,
- National (India) Environmental Legislation and Administrative Framework,
- International Treaties, Conventions, Protocols and applicability to the project.

A. ADB Safeguard Policy Statement 2009

57. This report has been prepared in accordance with the ADB's Safeguard Policy Statement-2009 (SPS 2009), which governs the environmental and social safeguards of ADB's operations. Environmental Safeguard Requirements of the SPS outlines the requirements that

borrowers/clients are required to meet when delivering environmental safeguards for projects supported by the ADB. These requirements include assessing impacts, planning and managing impact mitigations, preparing environmental assessment reports, disclosing information and undertaking consultation, establishing a grievance mechanism, and monitoring and reporting. SPS requirements also include specific environmental safeguard requirements pertaining to biodiversity conservation and sustainable management of natural resources, pollution prevention and abatement, occupational and community health and safety, and conservation of physical cultural resources.

58. ADB requires the consideration of environmental issues in all aspects of ADB's operations, and the requirements for environmental assessment are described in ADB SPS, 2009. This states that ADB requires an environmental assessment of all ADB investments.

59. **Screening and Categorization:** The nature of the environmental assessment required for a project depends on the significance of its environmental impacts, which are related to the type and location of the project; the sensitivity, scale, nature and magnitude of its potential impacts; the availability of cost-effective mitigation measures. Projects are screened for their expected environmental impacts and are assigned to one of the following four categories.

- (i) **Category A.** A proposed project is classified as category 'A' if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An Environmental Impact Assessment (EIA) is required.
- (ii) **Category B.** A proposed project is classified as category 'B' if its potentially adverse environmental impacts are less adverse than those of category 'A' projects. These impacts are site-specific, few of them are irreversible, and in most cases, mitigation measures can be designed more readily than for category 'A' projects. An Initial Environmental Examination (IEE) is required.
- (iii) **Category C.** A proposed project is classified as category 'C' if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed.
- (iv) **Category FI.** A proposed project is classified as category 'FI' if it involves an investment of ADB funds to or through a Financial Intermediary (FI). An Environmental and Social Management System (ESMS) is required.

60. The proposed Project falls under Category "B" per ADB's initial risk screening, and which was reconfirmed during the preparation of this IEE. Site-specific environmental effects of construction include soil disturbance from earthworks, elevated noise levels, short-term hazards to worker health and safety, and a moderate reduction in air quality from civil works.

61. **Analysis of Alternatives.** The best fit option should be identified for the implementation of the project in terms of location, design, technology and/or components that would avoid, and, if avoidance is not possible, minimize adverse environmental impacts and risks.

62. **Anticipated Adverse Impact Mitigation and Management.** When the potentially significant adverse impacts and risks cannot be avoided or prevented, appropriate mitigation measures and management actions have to be identified so that the project/subprojects are designed, constructed, and operated in compliance with ADB SPS 2009.

63. **Environmental Management Plan (EMP):** An EMP, which addresses the potential impacts and risks identified by the environmental assessment, has been prepared. The level of detail and complexity of the EMP and the priority of the identified measures and actions are

commensurate with the project's impact and risks.

64. **Grievance Redress Mechanism (GRM).** Establish a grievance redress mechanism (GRM) to receive and facilitate resolution of the affected person's concerns and grievances regarding the project's environmental performance.

65. **Public Disclosure:** ADB will post the safeguard documents on its website as well as disclose relevant information in an accessible manner to the local communities:

- (i) Final or updated IEE upon receipt but prior to ADB Board consideration; and
- (ii) Environmental monitoring reports submitted by the borrower upon receipt.

66. **Consultation and Participation.** Carry out meaningful consultation⁷ with affected people and facilitate their informed participation. Ensure women's participation in consultation. Involve stakeholders, including affected people and concerned nongovernment organizations, early in the project preparation process and ensure that their views and concerns are made known to and understood by decision makers and taken into account. Continue consultations with stakeholders throughout project implementation as necessary to address issues related to environmental assessment. Establish a grievance redress mechanism to receive and facilitate resolution of the affected people's concerns and grievances regarding the project's environmental performance.

67. **Monitoring and Reporting.** The implementation progress of the EMP shall be monitored and documented in the form of monitoring report, with identification of the necessary corrective actions, and action plan.

68. **Unanticipated Environmental Impacts.** Where unanticipated environmental impacts become apparent during project implementation, the environmental assessment and EMP will be updated or prepare a new environmental assessment and EMP detailing identified potential impacts, alternatives analysis, proposed, mitigation measures and resources to address those impacts.

69. **Biodiversity Protection and Natural Resources Management.** Do not implement project activities in areas of critical habitats, unless (i) there are no measurable adverse impacts on the critical habitat that could impair its ability to function, (ii) there is no reduction in the population of any recognized endangered or critically endangered species, and (iii) any lesser impacts are mitigated. If a project is located within a legally protected area, implement additional programs to promote and enhance the conservation aims of the protected area. In an area of natural habitats, there must be no significant conversion or degradation, unless (i) alternatives are not available, (ii) the overall benefits from the project substantially outweigh the environmental costs, and (iii) any conversion or degradation is appropriately mitigated. Use a precautionary approach to the use, development, and management of renewable natural resources.

70. **Occupational Health and Safety.** Project will take steps to prevent accidents, injury, and disease arising from, associated with, or occurring during the course of work, including: (i)

⁷ Per ADB SPS, 2009, meaningful consultation means a process that (i) begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle; (ii) provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people; (iii) is undertaken in an atmosphere free of intimidation or coercion; (iv) is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and (v) enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues

identifying and minimizing the causes of potential hazards to workers; (ii) providing preventive and protective measures; (iii) providing appropriate equipment to minimize risks and requiring and enforcing its use; (iv) training workers and providing them with appropriate incentives; (v) documenting and reporting occupational accidents, diseases, and incidents; and (vi) having emergency prevention, preparedness, and response arrangements in place.

71. **Community Health and Safety.** ADB SPS 2009 requires identification and assessment of risks to, and potential impacts on, the safety of affected communities during the design, construction, operation, and decommissioning, and shall establish preventive measures and plans to address them in a manner commensurate with the identified risks and impacts. Ensure to apply (i) preventive and protective measures for both occupational and community health and safety consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines, and (ii) necessary protocols in response to infectious diseases such as the corona virus disease (COVID-19) consistent with the guidelines of relevant government healthcare agencies and the World Health Organization WHO.

72. **Physical Cultural Resources.** The siting and designing the project components does not envisage any damage to physical cultural resources as none of the proposed project components is nearby any physical cultural resources. The chance finds procedures and appropriate actions shall be included in the EMP.

73. **Pollution Prevention and Control Technologies.** During the design, construction, and operation of the project, apply pollution prevention and control technologies and practices will be applied in consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines⁸. These standards contain performance levels and measures that are normally acceptable and applicable to the project infrastructures. When the government's regulations differ from these levels and measures, the project shall achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, detailed justification for any proposed alternatives will be presented in the IEE or EIA.

74. **Bidding and Contract Documents.** The EMP shall be included in bidding and contract documents. The PMU shall also ensure that bidding and contract documents include specific provisions requiring contractors to (i) comply with all other conditions required by ADB, and including (ii) proposed sites/locations for construction work camps, storage areas, hauling roads, lay down areas, disposal areas for solid and hazardous wastes; (iii) specific mitigation measures following the approved EMP; (iv) monitoring program as per EMP; and (v) budget for EMP implementation, among others as may be required. A copy of the EMP will be always kept on site during the construction period. Non-compliance with, or any deviation from, the conditions set out in the EMP constitutes a failure in compliance and shall require corrective actions.

75. **Conditions for Award of Contract and Commencement of Work.** There will be no awarding of any works contract until (i) relevant provisions from the EMP are incorporated into the works contract; (ii) PMU has obtained ADB's clearance of final IEE and EMP; and (iii) other necessary permits from relevant government agencies have been obtained.

⁸ World Bank Group. 2007. Environmental, Health, and Safety General Guidelines. Washington, D.C.; <https://www.ifc.org-ehs-guidelines>

B. National (India) Environmental Legislation and Administrative Framework

76. The Government of India has laid down various policy guidelines, regulations, acts and legislations pertaining to sustenance and protection of environment and its various components.

77. **Constitutional Provisions of Government of India on Environment.** The Constitution of India in its Article 48 provides for the protection and preservation of the environment and states "the state shall endeavor to protect and improve the environment and to safeguard forests and wildlife of the country." Further Article 51-A (g) on fundamental duties emphasizes that, "It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures." These two provisions of the constitution are the guiding principles for various environmental legislations in the country and to safeguard the environment. Simultaneously; there is provision of Right to life and clean environment as per Article 21 of the constitution of India.

78. **Water (Prevention and Control of Pollution) Act, 1974.** The Water Act is the first environmental regulation that was introduced at the State and Centre levels, Pollution Control Boards to control/regulate environmental pollution in India. The Act was amended twice in the year 1978 and 1988. The Act vests regulatory authority on State Pollution Control Boards and empowers them to establish and enforce effluent standards for industries and local authorities discharging effluents. This provides for the prevention and control of water pollution besides maintaining and restoring of the wholesomeness of water. 'Pollution' means such contamination of water or such alteration of the physical, chemical or biological properties of water or such discharge of any sewage or trade effluent or of any other liquid, gaseous or solid substance into water (whether directly or indirectly) as may, or is likely to, create a nuisance on health or safety, or to domestic, commercial, industrial, agricultural or other legitimate uses, or to the life and health of animals or plants or of aquatic organisms.

79. **Air (Prevention and Control of Pollution) Act, 1981.** The Air Act vests regulatory authority on the State Pollution Control Boards and empowers them to enforce air quality standards to prevent air pollution in the country. This Act provides for prevention, control and abatement of air pollution. 'Air Pollution' means the presence in the atmosphere of any 'air pollutant', which means any solid, liquid or gaseous substance (including noise) in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment. The Uttarakhand Pollution Control Board (UKPCB) is empowered to set air quality standards, monitor, and prosecute offenders under The Air (Prevention and Control of Pollution) Act, 1981. Section 21 of the Act requires an application to be made to the State Board to establish or operate any industrial operation.

80. The Acts resulted in the establishment of the Central and State level Pollution Control Boards whose responsibilities include managing water quality and effluent standards, air pollutant emission monitoring and control as well as monitoring water quality, prosecuting offenders and issuing licenses for construction and operation of certain facilities.

81. **The Environment (Protection) Act, 1986.** The Environment (Protection) Act, popularly known as EP Act, is an umbrella legislation that supplements existing environmental regulations. Empowered by the EP Act, the Ministry of Environment Forests and Climate Change (MoEF&CC), Government of India has issued the following notifications regulating siting of industry and operations, procuring clearance to establish industries and development of projects with appropriate EIA studies, coastal zone regulations and other aspects of environment care:

- Empowers the Government of India (section 6) to make rules to regulate environmental pollution by stipulating standards and maximum allowable limits to prevent air, water, noise, soil and other environmental pollutants.
- Prohibits operations that emit pollutants in excess of standards (section 7).
- Regulates handling of hazardous substances and identifies persons responsible for discharges and pollution prevention (section 9).
- Section 17 deals with offences committed by Government Departments.
- Formulated Hazardous waste and management rules, E-waste rules, C&D waste rules etc. in accordance with the sections 6, 8 and 25 of EP Act.

82. **EIA Notification, 1994 and 2006.** The EIA notification dated 27th January, 1994 imposes restrictions and prohibitions on the expansion and modernization of any activity or new projects listed in the Schedule I of the notification unless Environmental Clearance has been accorded by the MoEF&CC. Subsequent to it, EIA notification was published on 14th September, 2006 for imposing certain restrictions and prohibitions on new projects or activities, or on the expansion or modernization of existing projects or activities based on their potential environmental impacts as indicated in the schedule to the notification, being undertaken in any part of India, unless prior environmental clearance has been accorded in accordance with the objectives of National Environment Policy as approved by the Union Cabinet on 18th May, 2006 and the procedure specified in the notification, by the Central Government or the State or Union territory Level Environment Impact Assessment Authority (SEIAA).

83. The notification has listed out the Projects or activities requiring prior environmental clearance under Category “A” and “B” based on the spatial extent of potential impacts and potential impacts on human health and natural and manmade resources. Category “A” projects require prior environmental clearance from MoEF&CC on the recommendations of an Expert Appraisal Committee (EAC) and Category “B” projects require prior environmental clearance from State or Union territory Level Environment Impact Assessment Authority (SEIAA) on the recommendations of a State or Union territory Level Expert Appraisal Committee (SEAC). In the absence of a duly constituted SEIAA or SEAC, a category “B” project shall be treated as a Category “A” project.

84. The project components of tourism road are not included in the schedule of the EIA notification 2006 which lists projects that require prior environmental clearance.

85. **The Forest (Conservation) Act, 1980 amended 2023.** The Forest (Conservation) Act, 1980 prohibits large-scale diversion of forestland for non-forest use. As amended in 1988, no State Government or authority shall make such diversions except with the prior approval of the Central Government. Salient features of the act are summarized below:

- Section 2 of the Act restricts the state Government on the de-reservation of forests or use of forest land for non-forest purposes.
- The Forest (Conservation) Act, 1980 pertains to the cases of diversion of forest area and felling of roadside plantation. Depending on the size of the tract to be cleared, clearances are applied for at the following levels of Government.
- If the area of forests to be cleared or diverted exceeds 20ha (or 10ha in hilly area) then prior permission of Central Government is required;
- If the area of forest to be cleared or diverted is between 5 to 20ha, the Regional Office of Chief Conservator of Forests is empowered to approve;
- If the area of forest to be cleared or diverted is below or equal to 5Ha, the State Government can give permission; and

- If the area to be clear-felled has a forest density of more than 40%, permission to undertake any work is needed from the Central Government, irrespective of the area to be cleared.

86. **The Forest (Conservation) Rules, 1981.** The Rule 4 of the Act lays down the procedure for State Governments to make a proposal seeking prior approval in case of Reserved Forest (RF) is involved to de-reserve a forest for non-forest purposes (section 2 of Forest Act or Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980), provided all proposals involving clearing of naturally grown trees in forest land or portion thereof, for the purpose of using it for afforestation, shall be sent in the form of a working plan / management plan.

87. **Wildlife (Protection) Act, 1972 amended 2022.** Wildlife (Protection) Act, 1972 as amended was enacted with the objective of effectively protecting the wildlife of the country and to control poaching, smuggling and illegal trade in wildlife and its derivatives. It defines rules for the protection of wildlife and ecologically important protected areas. Wildlife Clearance is applicable under the following conditions also:

- i. If the project requires Environmental Clearance and it is in a notified eco sensitive zone (ESZ) or in the absence of delineation of ESZ, or if the ESZ is in draft stage and the project is within 10 kms from the boundaries of the protected area;
- ii. If the project is in a notified Tiger Corridor (irrespective of requirement of Environmental Clearance).

88. **Wetlands (Management and Conservation) Rules, 2010.** This rule defines a wetland – which according to the rule is ‘an area of marsh, fen, peat land or water; natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six meters and includes all inland waters such as lakes, reservoirs, tanks, backwaters, lagoons, creeks, estuaries and manmade wetlands and zones of direct influence of wetlands that is to say drainage areas or catchment areas of the wetlands as determined by the authority, but does not include main river channels, paddy fields and the coastal wetlands covered under the notification of the Government of India in the Ministry of Environment and Forests, S.O. 114 (E) dated 19 February, 1991 published in the Gazette of India Extraordinary, Section 3, Sub-Section (ii) of dated the 20th of February, 1991. The rules also identify various types of wetlands including those in United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage sites, ecologically sensitive areas, below 2,500 meters with an area of at least 500 ha, or other notified wetlands or those identified by the Wetland Authority.

89. Activities not permitted in such areas are identified and include reclamation, setting up of new or expansion of existing industries, dumping of waste or discharge of effluents, any activity that adversely impacts the wetland ecosystem, amongst others.

90. **The Motor Vehicles Act, 1988.** In 1988, the Indian Motor Vehicles Act empowered the State Transport Authority (usually the Road Transport Office) to enforce standards for vehicular pollution and prevention control. The authority also checks emission standards of registered vehicles, collects road taxes, and issues licenses. In August 1997, the Pollution under Control Certificate (PUC) program was launched in an attempt to crackdown the vehicular emissions in the States. Since this Act is applicable for all states, this will be applicable for this project also.

91. **The Ancient Monuments and Archaeological Sites and Remains Act, 1958.** The Ancient Monuments and Archaeological Sites and Remains Act, 1958 According to this Act, an area within the radius of 100 m and 300 m from the "protected property" is designated as

"protected area" and "controlled area" respectively. No development activity (including building, mining, excavating, blasting) is permitted in the "protected area" and development activities likely to damage the protected property are not permitted in the "controlled area" without prior permission of the Archaeological Survey of India (ASI) if the site / remains / monuments are protected by ASI or the State Directorate of Archaeology, if these are protected by the State.

92. An overview of all the other relevant legislations is provided in the following Table 1.

Table 1. Overview of all relevant legislations

Legislations	Descriptions	Project Status
Environmental (Protection) Act of 1986, its rules and amendments	This is an umbrella act under which several applicable rules have been framed.	There are rules/ notifications that have been brought out under this Act, which are relevant to project, and are listed below.
Environmental impact assessment (EIA) Notification, 2006 and 2009	The EIA Notification of 2006 and 2009 (replacing the EIA Notification of 1994) set out the requirement for environmental assessment in India. This states that environmental clearance is required for certain defined activities/projects, and this must be obtained before any construction work or land preparation (except land acquisition) may commence. Projects are categorized as A or B depending on the scale of the project and the nature of its impacts. Category A projects require environmental clearance from the MOEFCC, GoI. Category B projects require environmental clearance from the SEIAA.	The proposed project components do not fall under the Schedule list of the notification; no EIA study or environmental clearance is required. Sand mining for construction works (if required), requires environment clearance under EIA act. (list of already approved sand mines in Uttarakhand is available on Uttarakhand Pollution Control Board website ⁹) PIU/PMU must ensure that contractor is procuring mining material from approved mines only or get EC for new mines. For the Operation of Ropeway Compliance of the MoEFCC Notification No. S.O. 1953 (E) dt. 27.04.22 has exempted from environmental clearance. (Appendix 1)
Doon Valley Notification vide Notification Number S.O 102 (E), dated 1st February 1989 and subsequent amendments under 3(2)(v) of Environment (Protection) Act, 1986, and Rule 5(3)(d) of Environment (Protection) Rules, 1986	MOEF&CC has imposed restrictions on restricting location of industries, mining operations and other development activities in the Doon Valley in erstwhile Uttar Pradesh (now Uttarakhand) keeping in view of the environmental impacts in the region. This notification states that "The obnoxious and hazardous industries are those using inflammable, explosive, corrosive or toxic substances are prohibited".	Not Applicable-none of the project component is in notified area.

⁹ <https://ueppcb.uk.gov.in/pages/display/66-public-hearing>

Legislations	Descriptions	Project Status
Wildlife Protection Act (1972) amended in 2022	The Wildlife Protection Act 1972 provides for protection to listed species of flora and fauna and establishes a network of ecologically important protected areas. The Act empowers the State and Central Governments to declare any area a wildlife sanctuary, national park or closed areas.	Not applicable – none of the project components are located within the boundaries of protected areas.
Wetlands (Management and Conservation) Rules, 2010 and 2017	This rule defines a wetland and identifies various types of wetlands including those in UNESCO World Heritage sites, ecologically sensitive areas, below 2,500 m with an area of at least 500 ha, or other notified wetlands or those identified by the Wetland Authority. Activities not permitted in such areas are identified and include reclamation, setting up of new or expansion of existing industries, dumping of waste or discharge of effluents, any activity that adversely impacts the wetland ecosystem, amongst others.	Not applicable as project components are not located in or near to designated wetland area.
Water (Prevention and Control of Pollution) Act of 1974, its rules and amendments	Control of water pollution is achieved through administering conditions imposed in consent issued under provision of the Water (Prevention and Control of Pollution) Act of 1974. These conditions regulate the quality and quantity of effluent, the location of discharge, and the frequency of monitoring of effluents. Any component of the investment program having the potential to generate sewage or trade effluent will come under the purview of this act, its rules and amendments. Such projects must obtain consent to establish (CTE) before starting implementation, and consent to operate (CTO) before project commissioning. The Water Act also requires the occupier of such sub projects to take measures for abating the possible pollution of receiving water bodies.	All relevant forms, prescribed fees and procedures to obtain the CTE and CTO can be found on the UKPCB website. (http://ueppcb.uk.gov.in) for construction camp during construction phase of the project.
Air (Prevention and Control of Pollution) Act of 1981, its rules and amendments	The subprojects having potential to emit air pollutants into the atmosphere must obtain CTE before starting implementation, and CTO before project commissioning. The occupier of the project/facility has the responsibility to	Required CTE and CTO from UKPCB for: Establishment of DG sets more than 1 MVA. Batching Plant, and Hot mix plants, ready mix concrete and hot mix bitumen is procured from third party,

Legislations	Descriptions	Project Status
	adopt necessary air pollution control measures for abating air pollution.	contractor must ensure that the plants, from where material is being purchased is having valid CTE and CTO and copy should be collected from third party and submitted to PIU. If not purchased from third party then CTE and CTO are needed for installation by contractor. Pollution Under Control (PUC) certificates shall be required for the vehicles used during construction stage. The diesel generators shall require CTE and CTO from UKPCB for operational stage, if installed.
Noise Pollution (Regulation and Control) Rules of 2000 as amended up to 2011	Rule 3 of the act specifies ambient air quality standards with respect to noise for different areas/zones.	The noise is not expected to be impacted during the project implementation. In this regard, periodic noise monitoring is suggested to be carried out as part of the Environmental Monitoring Plan. Also, mitigation measures to maintain the noise levels as per the standards for the area / zone should be implemented.
Ground Water (Regulation, Development and Management) Act 2005	An act to regulate and control the development and management of ground water and matters connected therewith or incidental thereto.	Applicable for new tube wells and bore wells, if used in proposed project for ground water extraction.
Central Pollution Control Board – environmental Standards	Emissions and discharges from the facilities to be created or refurbished or augmented shall comply with the notified standards notified.	The applicable standards for ambient air including noise, surface water discharges etc. should be adhered to during the project implementation.
Fly Ash Notification, as amended 22nd April 2021	Reuse fly ash to minimize land requirement for disposal and soil contamination	Most of the project components are located within 300 km from Thermal Power Plant.
Ancient Monuments and Archaeological Sites and Remains Act, 1958 and Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act, 2010.	The Rules designate areas within a radius of 100 m and 200 m from the “protected property/ monument/ area” as “prohibited area” and “regulated area” respectively. Henceforth, no permission for construction of any public projects or any other nature shall be granted in the prohibited areas of the protected monument and protected area In respect of regulated area, the Competent Authority may grant permission for construction, reconstruction, repair and renovation on the basis of	There are no protected properties in the subproject area. However, in case of chance finds, the contractors will be required to follow a protocol as defined in the Environmental Management Plan.

Legislations	Descriptions	Project Status
	recommendation of the National Monument Authority duly taking note of heritage bye-laws, which shall be prepared in respect of each protected monument and protected area	
Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016	According to the Rules, hazardous wastes are wastes having constituents specified in Schedule II of the Rules if their concentration is equal to or more than the limit indicated in the said schedule. The rules provide procedures for transportation, storage, handling and disposal of hazardous wastes	No hazardous waste is expected to be generated during the project implementation. However, if any hazardous wastes are generated, its management shall be done after obtaining the necessary approval from the UKPCB.
Solid Waste Management Rules, 2016	This Act lists out procedures to be adopted for solid waste management generated in municipalities and metropolitan cities. It is also applicable for large campsites, as well	No large campsites are expected to be established during the construction of the project. However, the solid wastes generated at the construction sites or at the workers' camp sites should be managed in an environmentally friendly manner, preferably using the services offered by the local municipality or urban local body.
Construction and Waste Debris Management Rules, 2016	This Act lists out procedures to be adopted for environmental-friendly management of construction waste and debris generated at construction sites.	The Contractor should abide by the rule and obtain an approval form the local authority to the Construction Waste and Debris Management Plan and implement the approved plan.
Plastic Waste Management Rules, 2016	These rules shall apply to every waste generator, local body, manufacturer, Importers and producer	The Construction Contractor is expected to: • Take steps to minimize generation of plastic waste and segregate plastic waste at source in accordance with the Solid Waste Management Rules, 2016 or as amended from time to time. • Not litter the plastic waste and ensure segregated storage of waste at source and handover segregated waste to urban local body or agencies appointed by them or registered waste pickers', registered recyclers or waste collection agencies.
E-Waste (Management) Rules, 2016 as amended in 2018	Applicable during construction and operation used e-waste must be properly disposed to UKPCB authorized and registered recyclers.	The Contractor will ensure to minimize generation of e-waste and manage through approved vendors.
Biomedical Waste Management Rules, 2016	These rules are applicable to all persons who generate, collect, receive, store, transport, treat, dispose, or handle bio medical waste in any form including	The Construction Contractor is expected to provide First Aid in case of injuries to workers / staff during project construction phase. The Construction

Legislations	Descriptions	Project Status
	hospitals, nursing homes, clinics, dispensaries, veterinary institutions, animal houses, pathological laboratories, blood banks, ayush hospitals, clinical establishments, research or educational institutions, health camps, medical or surgical camps, vaccination camps, blood donation camps, first aid rooms of schools, forensic laboratories and research labs. The rules outline methods to store bio medical wastes generated by various generators.	Contractor needs to store any bio medical waste generated at the site and ensure its safe disposal by tying up with the nearest Authorised Common Bio-Medical waste disposal facilities.
Forest (Conservation) Act, 1980 and Forest Conservation Rules, 2003 as amended	As per Rule 6, every user agency that wants to use any forest land for non-forest purposes shall seek approval of the central government.	No forest land diversion for non-forest purpose is required for the project components.
Forest Panchayat Act was enacted under Section 28(2) of the Indian Forest Act, 1927	The Village Forest Council (Van Panchayats) implement the rules for accessing and distributing forest resources, monitoring them, imposing penalties on violators, and generating and judiciously using income for forest welfare. It is applicable for tourism road component involving forest range may be part of such village council forest ranges and must adhere to village council requirements.	The need to take consent/NOC from village council along with approval from state forest department.
Uttar Pradesh Tree (Protection), Act 1976, as adopted in Uttarakhand	Applicable for cutting of non-forest trees for the project component implementation.	PIU/PMU should abide by the rule and obtain an approval form the Uttarakhand Forest Department for tree cutting.
Biodiversity Act of 2002	This Act primarily addresses access to genetic resources and associated knowledge by foreign individuals, institutions or companies, to ensure equitable sharing of benefits arising out of the use of these resources and knowledge to the country and the people.	Not Applicable
The Petroleum Rules 2002	Applicable for the supply and storage of diesel for generator sets and for vehicles etc.	The Contractor must take approval for storage of fuel for the construction of project.
National Policy on Safety, Health and Environment in the workplace	The National Policy on Safety, Health and Environment has been developed with a purpose of establishing safety and health culture in the country through elimination of incidents of work-related injuries, diseases, fatalities, disasters and to enhance well-being of employees in all sectors of economic activity in the	The Contractor must abide by all the laws pertaining to the Safety, Health and Environment at the workplace. A binding clause to this effect is also included in the Contract Agreement.

Legislations	Descriptions	Project Status
	country. Under this purview are All the statutes and legislations pertaining to Occupational Health and Safety come under this purview. Some of the key ones are listed below:	
Building and Other Construction Workers (Regulations of Employment and Conditions of Service) Act, 1996 and the Uttaranchal Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Rules, 2005	This Act covers construction workers at construction sites wherein the enforcement is by the Directorate General Labor Welfare in the central sphere and by the Labour Commissioners / Factory Inspectorates in the State / UTs. Further, Uttarakhand Government constituted the Building and Other Construction Workers Welfare Board (Board) in October 2005 to carry out welfare schemes for construction workers. As per the provision of the BOCW Act, Cess Act and Uttarakhand Rules, establishments which had employed on any day of the preceding twelve months, 10 or more building workers in any building or other construction work are required to pay cess at the rate of 1% of the total cost of construction incurred by an employer. The cess so collected is required to be spent for the welfare of building and other construction workers.	Contractors are required to follow all the provisions of BOCW Act. Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 (BOCW Act) and Building and Other Construction Workers' Welfare Cess Act, 1996 (Cess Act) was passed to address the concerns regarding safety, health and welfare of larger number of labour force employed in the building and other constructions sector.
Contract Welfare Labor (Regulation and Abolition) Act, 1970; The Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979	Provides for welfare measures to be provided by the Contractor to contract labor and in case the Contractor fails to provide, the same are required to be provided by the Principal Employer by Law. The principal employer is required to take Certificate of Registration and the Contractor is required to take a License from the designated Officer. The Act is applicable to the establishments or Contractor of principal employer if they employ 20 or more contract labor. The inter-state migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, traveling expenses from home up to the establishment and back, etc.,	Applicable to all construction works in the project. Principle employer to obtain Certificate of Registration from Department of Labour, as principal employer. Contractor to obtain license from designated labor officer. Contractor shall register with Labor Department, if Interstate migrant workmen are engaged adequate and appropriate amenities and facilities shall be provided to workers including housing, medical aid, traveling expenses from home and back, etc.
The Public Liability Insurance Act	An Act to provide for public liability insurance for the purpose of providing immediate relief to the persons affected	The Contractor should obtain the relevant insurance cover for the entire duration of the contract.

Legislations	Descriptions	Project Status
	by accident occurring while handling any hazardous substance and for matters connected therewith or incidental thereto.	
Minimum Wages Act, 1948 and Equal Remuneration Act, 1979	Minimum wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of buildings, roads and runways are scheduled employment. Provides for payment of equal wages for work of equal nature to male and female workers and not for making discrimination against female employees in the matters of transfers, training and promotions etc.	Applicable to all construction works in the project. All construction workers should be paid no less than the prescribed minimum wage. Equal wages for work of equal nature to male and female workers.
Workers' Compensation Act, 1923 amended in 2009	This Act provides for payment by Employers to their employee's compensation for injury by accident. This covers all Employees including Contract Workmen that meet with an Accident or are affected by Occupational Disease.	The Contractor should obtain the relevant insurance cover for the entire duration of the contract.
The Public Liability Insurance Act Workers' compensation Act, 1923 amended in 2009. Employees State Insurance Act, 1948	The objective of the Act is to provide for certain benefits to employees in case of sickness, maternity and 'employment injury' and to make provision for certain other matters in relation thereto.	The Contractor should obtain the relevant insurance cover for the entire duration of the contract.
Child Labour (Prohibition and Regulation) Amendment Act, 2016	No child under 14 years of age will be employed or permitted to work in any of the occupations set forth in the Act's Part A of the Schedule or in any workshop wherein any of the processes set forth in Part B of the Schedule. Child can help his/her family or family enterprise, which is other than any hazardous occupations or processes set forth in the Schedule, after his school hours or during vacations	No children between the age of 14 and 18 years will be engaged in hazardous working conditions.
Uttarakhand Contract Labour (Regulation and Abolition) Rules 1978	Deals with hiring of labourers by a licensed labor contractor. It also provides for provision of rest rooms, canteens, toilets (one for every 25 laborers), first aid facilities, wages etc. It is applicable to construction and operation as more than 25 construction laborers will be hired for the Project.	The Contractor should provide the listed facilities or as per instructions from Directorate of Labour, Govt. of Uttarakhand for the workmen hired for the project for the entire duration of the contract.
Uttarakhand Occupational Safety, Health and Working Conditions Rules, 2021	Applicable as workers will be involved during construction and operation as health and safety risks are involved.	The Contractor should maintain good working conditions on Occupational Health, Safety and Health for workers during the entire period of the contract.

Legislations	Descriptions	Project Status
The Sexual Harassment of Women at workplace (Prevention, Prohibition and Redressal) Act, 2013	Whereas sexual harassment results in violation of the fundamental rights of a woman to equality under article 14 and 15 of the Constitution of India and her right to life and to live with dignity under article 21 of the Constitution and right to practice any profession or to carry on any occupation, trade or business which includes a right to safe environment free from sexual harassment.	Applicable.
National Disaster Management Act, 2005	The National Disaster Management Act is an act to provide for the effective management of disasters and matters connected therewith or thereto. It identifies, among others, the roles and responsibilities of different agencies of the Government and other stakeholders in responding to any threatening disaster situation or disaster.	The project components are in high-risk zone state that are prone to natural disasters. Hence, the Contractor is duty bound to follow all the norms as per this Act and required preparedness by PIU during operational stage.

CTE = consent to establish, CTO = consent to operate, DG = diesel generator, EIA = environmental impact assessment, EMP = environmental management plan, MSDS = material safety data sheet, MSIHC = manufacture, storage and import of hazardous chemicals, NOC = no objection certificate, PIU = project implementation unit, PMU = project management unit, PUC = pollution under control, UNESCO = United Nations Educational, Scientific and Cultural Organization, UKPCB = Uttarakhand Pollution Control Board.

93. **Permit and Clearances.** Table 2 shows the list of clearances/permissions required for project construction. This list is indicative, and the contractor should ascertain the requirements prior to start of the construction and obtain all necessary clearances/permission prior to start of construction.

Table 2. Clearances and Permissions required for Construction Activities

S. No.	Activity	Statute under which clearance is required	Responsibility
1	Land for project activity	Allotment and approval for specific land use	PIU
2	Groundwater abstraction	Permissions from Central Ground Water Board Authority under Section 4 of the EPA (1986) or permission from CGWA.	PIU/PMU
3	Tree cutting	State forest department/ Revenue (Tehsildar)	PIU/PMU
4	Establishment of construction camps	Allotment and approval for specific land use, Consent for discharge of Sewage	Contractor
5	Hot mix plants, construction camp, crushers and batching plants	Consent to establish and consent to operate under Air Act, 1981 from State Pollution Control Board, Uttarakhand.	Contractor
6	Material sourcing- approval for sourcing stones and sand from quarries and sand mining and borrow areas	Permission from District Collector/ State Department of Mining, Uttarakhand	Contractor
7	New quarries and borrow areas	Environmental clearance under EIA Notification 2006	Contractor

S. No.	Activity	Statute under which clearance is required	Responsibility
8	Temporary traffic diversion measures	District traffic police, Government of Uttarakhand	Contractor
9	Construction Waste and Demolition Debris Management	Approval from Nagar Nigam for disposal site is required per Construction and Demolition Waste Management Rules 2016	Contractor
10	Labour License under Building and Other Construction Workers (Regulations of Employment and Conditions of Service) Act, 1996,	Labour Commissioner, Government of Uttarakhand	Contractor
11	The Public Liability Insurance Act, Workers' Compensation Act, 1923 amended in 2009, Employees State Insurance Act, 1948	All the required insurances to cover Project Risk, Employees Health and Safety Risk, Disaster Risk, Employees Family Welfare including contract and sub-contractor workers.	Contractor
12	DG Sets Operation	Operation License from Uttarakhand State Pollution Control Board	Contractor
13	Use of Vehicles and Equipment- Pollution Under Control (PUC) Certificate	Motor Vehicle Rules, 1989	Contractor
14	Storage, handling, and transport of hazardous materials	Hazardous Wastes (Management and Handling) Rules, 2024 Manufacturing, Storage, and Import of Hazardous Chemicals Rules, 1989	Contractor

EPA= Environmental Protection Act; CGWA = Central Ground Water Authority; PIU= Project Implementation Unit; PMU= Project Management Unit

C. International Treaties, Conventions, Protocols and Applicability to the Project

94. In addition to national and state rules and regulations, India is a party to several international conventions such as the International Union for Conservation of Nature (IUCN), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Convention on Migratory Species of Wild Animals (CMS), and the Ramsar Convention on Wetlands of International Importance. These international commitments need to be adhered to during the selection and screening of project under restricted/sensitive areas. These are described in following sections.

95. **International Union for Conservation of Nature.** The IUCN Red List of threatened species (also known as the IUCN red list or red data list), founded in 1963, is a comprehensive inventory of the global conservation status of plant and animal species. A series of regional red lists are produced by countries or organizations, which assess the risk of extinction to species within a political management unit. The IUCN red list is set upon precise criteria to evaluate the extinction risk of thousands of species and subspecies. These criteria are relevant to all species and all regions of the world. The aim is to convey the urgency of conservation issues to the public and policy makers, as well as to help the international community reduce species extinction.

96. **Convention on Migratory Species (CMS) of Wild Animals.** CMS was adopted in 1979 and came into force in 1983. CMS, also known as the Bonn Convention, recognizes that states must be the protectors of migratory species that live within or pass through their national

jurisdictions, and aims to conserve terrestrial, marine, and avian migratory species throughout their ranges. Migratory species threatened with extinction are listed in Appendix I of the convention. CMS parties strive towards strictly protecting these species, conserving or restoring the places where they live, mitigating obstacles to migration, and controlling other factors that might endanger them. Migratory species that need or would significantly benefit from international cooperation and CMS encourages the states to conclude global or regional agreements.

97. **Convention on International Trade in Endangered Species (CITES) of Wild Fauna and Flora.** This is an international agreement between governments that aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival. CITES was first formed in the 1960s. Annually, the international wildlife trade is estimated to be worth billions of dollars and to include hundreds of millions of plant and animal specimens. The trade is diverse, ranging from live animals and plants to a vast array of wildlife products derived from them, including food products, exotic leather goods, wooden musical instruments, timber, tourist curios, and medicines. Levels of exploitation of some animal and plant species are high, and their trade, together with other factors such as habitat loss, is capable of heavily depleting their populations and even bringing some species close to extinction.

98. **Ramsar Convention on Wetlands of International Importance, 1971.** The Convention on Wetlands of International Importance is an inter governmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. According to the Ramsar List of Wetlands of International Importance, there are 25 designated wetlands in India which must be protected. If any of the subproject activities are undertaken in the proximity of designated wetlands, the subproject shall follow the guidelines of the convention, provisions of the Wetlands (Conservation and Management) Rules, 2010. There are no Ramsar sites in or near project area, thus Not applicable to this project.

99. **Convention on Biodiversity.** This convention discusses the need for countries to conserve and manage their biodiversity through development of national strategies, programs and projects. The conventions also talk of integration and conservation of biodiversity in relevant sector and cross-sectoral plans, policies and programs. This, in the Indian context is covered through the Biodiversity Act, 2002 which is discussed in the section on Indian legislation. Based upon this Act several biodiversity hotspots exist in Tehri Garhwal District.

100. **Montreal Protocol 1992.** India is a signatory of this convention which aims to reduction in the consumption and production of ozone-depleting substances (ODS), while recognizing differences in a nation's responsibilities. Ozone depleting substances are divided in two groups Chlorofluorocarbons (CFCs) and Hydro chlorofluorocarbon carbons (HCFCs). Not applicable in this project as no ODS are involved in construction works.

101. **Basel Convention on Trans-boundary Movement of Hazardous Wastes, 1989.** India is a signatory of this convention which aims to reduce trans-boundary movement and creation of hazardous wastes. Contractor to follow the provisions of Hazardous Waste Rules 2016 for storage, handling, transport and disposal of any hazardous waste emerged during construction works Under this Convention, asbestos or asbestos waste in the form of dust and fibers is classified as hazardous waste. There is no usage/ disposal of asbestos in the project.

D. Applicable Standards

102. Environmental standards for air, water, soil, noise, and vibration, among others will follow

applicable Central Pollution Control Board, World Bank Group (WBG)/International Finance Corporation (IFC) Environment Health and Safety (EHS), or State-imposed limits, whichever is most stringent. When national regulations differ from the performance levels and measures presented in EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent measures are appropriate in view of specific project circumstances, full and detailed justification of the applied standard or guideline should be presented in the environmental assessment. The justification should demonstrate that the chosen alternative's performance level is protective of human health and the environment. Central Pollution Control Board and International Finance Corporation EHS guidelines are provided in following Tables.

Table 3. Ambient Air Quality Standards

Parameter	Location ^(a)	National Ambient Air Quality Standards ^(b)	WHO Air Quality Guidelines ($\mu\text{g}/\text{m}^3$)	
			Global Update 2005 ^(c)	2021 ^(d)
Particulate Matter PM ₁₀ ($\mu\text{g}/\text{m}^3$)	Industrial	60 (Annual)	20 (Annual)	15 (Annual) 45 (24-hr)
	Residential, Rural and Other Areas	100 (24-hr)	50 (24-hr)	
	Sensitive Area	60 (Annual) 100 (24-hr)	20 (Annual) 50 (24-hr)	
Particulate Matter PM _{2.5} ($\mu\text{g}/\text{m}^3$)	Industrial	40 (Annual)	10 (Annual)	5 (Annual) 15 (24-hr)
	Residential, Rural and Other Areas	60 (24-hr)	25 (24-hr)	
	Sensitive Area	40 (Annual) 60 (24-hr)	10 (Annual) 25 (24-hr)	
Sulphur Dioxide SO ₂ ($\mu\text{g}/\text{m}^3$)	Industrial	50 (Annual)	20 (24-hr)	40 (24-hr)
	Residential, Rural and Other Areas	80 (24-hr)	500 (10-min)	
	Sensitive Area	20 (Annual) 80 (24-hr)	20 (24-hr) 500 (10-min)	
Nitrogen Dioxide NO ₂ ($\mu\text{g}/\text{m}^3$)	Industrial	40 (Annual)	40 (Annual)	10 (Annual) 25 (24-hr)
	Residential, Rural and Other Areas	80 (24-hr)	200 (1-hr)	
	Sensitive Area	30 (Annual) 80 (24-hr)	40 (Annual) 200 (1-hr)	
Carbon Monoxide CO ($\mu\text{g}/\text{m}^3$)	Industrial	2,000 (8-hr)	-	4 (24-hr)
	Residential, Rural and Other Areas	4,000 (1-hr)		
	Sensitive Area	2,000 (8-hr) 4,000 (1-hr)		
Ozone (O ₃) ($\mu\text{g}/\text{m}^3$)	Industrial	100 (8-hr)	100 (8-hr)	100 (8-hr)
	Residential, Rural and Other Areas	180 (1-hr)		
	Sensitive Area	100 (8-hr) 180 (1-hr)	100 (8-hr)	
Lead (Pb) ($\mu\text{g}/\text{m}^3$)	Industrial,	0.5 (Annual)	-	-
	Residential, Rural and Other Areas	1.0 (24-hr)		
	Sensitive Area	0.5 (Annual) 1.0 (24-hr)		
Ammonia	Industrial	100 (Annual)	-	-

Parameter	Location ^(a)	National Ambient Air Quality Standards ^(b)	WHO Air Quality Guidelines ($\mu\text{g}/\text{m}^3$)	
			Global Update 2005 ^(c)	2021 ^(d)
(NH ₃)	Residential, Rural and	400 (24-hr)		
($\mu\text{g}/\text{m}^3$)	Other Areas			
	Sensitive Area	100 (Annual) 400 (24-hr)		
Benzene (C ₆ H ₆) ($\mu\text{g}/\text{m}^3$)	Industrial	5 (Annual)	-	-
	Residential, Rural and Other Areas			
	Sensitive Area	5 (Annual)		
Benzo(o) Pyrene (BaP) (ng/m^3)	Industrial	1 (Annual)	-	-
	Residential, Rural and Other Areas			
	Sensitive Area	1 (Annual)		
Arsenic (As) (ng/m^3)	Industrial	6 (Annual)	-	-
	Residential, Rural and Other Areas			
	Sensitive Area	60 (Annual)		
Nickel (Ni) (ng/m^3)	Industrial	20 (Annual)	-	-
	Residential, Rural and Other Areas			
	Sensitive Area	20 (Annual)		

Note: Per ADB SPS, the government shall achieve whichever of the ambient air quality standards is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the executing agency of the government will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in ADB SPS.

^a Sensitive area refers to Ecologically sensitive areas notified by the India Central Government

^b *The Gazette of India*. 2009. [National Ambient Air Quality Standards](#). 18 November

^c WHO Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide And Sulphur Dioxide. *Global update 2005*. WHO. 2006.

^d Global Air Quality Guidelines. WHO 2021.

Table 4. Ambient Noise Standards

Receptor/ Source	India National Noise Level Standards ^a (dBA)		WHO Guidelines Value For Noise Levels Measured Out of Doors ^b (One Hour LA _q in dBA)		Applicable Per ADB SPS ^c (dBA)	
	Day	Night	07:00 – 22:00	22:00 – 07:00	Day time	Nighttime
Industrial area	75	70	70	70	70	70
Commercial area	65	55	70	70	-	-
Residential Area	55	45	55	45	55	45
Silent Zone	50	40	55	45	-	-

WHO= World Health Organization; SPS = Safeguard Policy Statement; dBA = A-weighted decibels

^a Noise Pollution (Regulation and Control) Rules, 2002 as amended up to 2010.

^b Guidelines for Community Noise. WHO. 1999

^c Per ADB SPS, the government shall achieve whichever of noise standards is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the executing agency of the government will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in ADB SPS.

Table 5. Indian Standard Drinking Water Specification: IS 10500:1991

Sl. No.	Substance/Characteristic	Desirable Limit	Permissible limit	Remarks	WHO Guidelines ⁸
1	Color, Hazen units, Max	5	25	Extended to 25 if toxic substance is not suspected in absence of alternate sources	Not specified
2	Odour	Unobjectionable		Test cold and when heated Test at several dilution	Not specified
3	Taste	Agreeable		Test to be conducted only after safety has been established	Not specified
4	Turbidity NTU, Max	5	10		5 NTU
5	pH value	6.5 to 8.5	No relaxation		6.5 to 8.5
6	Total Hardness (CaCO ₃ mg/lit)	600	600		500 mg/l
7	Iron (Fe mg/lit, Max)	0.3	1.0		0.3 mg/l
8	Chlorides (Cl mg/lit Max)	250	1000		250 mg/l
9	Residual Free Chlorine, mg/lit Max	0.2		To be applicable only when water is chlorinated. Treated at consumer end. When protection against viral infection is required, it should be Min 0.5 mg/lit	0.5 mg/l (minimum)
10	Dissolved Solids mg/l, Max	500	2000		1000 mg/l
11	Calcium (Ca) mg/l, Max	75	200		75 mg/l
12	Copper (Cu) mg/l, Max	0.05	1.5		2 mg/l
13	Manganese (Mn) mg/l Max	0.1	0.3		0.4 mg/l
14	Sulphate (SO ₄), Max	200	400	May be extended up to 400 provided (as Mg) does not exceed 30	250 mg/l
15	Nitrate (NO ₃) mg/l, Max	45	100		50 mg/l
16	Fluoride (F) mg/l, Max	1.0	1.5		1.5 mg/l
17	Phenolic Compounds (C ₆ H ₆ OH) mg/l Max	0.001	0.002		0.002 mg/l
18	Arsenic (As mg/l)	0.05	No relaxation	To be tested when pollution is suspected	0.01 mg/l
19	Lead (Pb) mg/l	0.05	No relaxation		0.01 mg/l
20	Anionic Detergents (MBAS) mg/l	0.2	1.0		0.2 mg/l
21	Chromium (Cr) mg/l	0.05	1.0	To be tested when pollution is suspected	0.05 mg/l
22	Mineral Oil mg/l	0.01	0.03		Not specified
23	Alkalinity mg/l	200	600		Not specified

Sl. No.	Substance/Characteristic	Desirable Limit	Permissible limit	Remarks	WHO Guidelines ⁸
24	Total Coliform	95% of the sample should not contain coliform in 100 ml. 10 coliform /100 ml			Must not be detectable in any 100 ml sample

Table 6. Effluent Discharge Standards for Sewage Treatment Plant

Sl. No.	Parameters	Parameters Limit
1	pH	5.5-9.0
2	BOD (mg/l)	Not more than 10 mg/l
3	COD (mg/l)	Not more than 50 mg/l
4	TSS (mg/l)	Not more than 20 mg/l
5	P-Total (mg/l)- for discharge into ponds/lakes	Not more than 1.0 mg/l
6	N-Total (mg/l)	Not more than 10 mg/l
7	Faecal Coliform (MPN/100ml)	Desirable- 100 MPN/100ml Permissible- 230 MPN/100ml

Source: Central Pollution Control Board, Ministry of Environment, Forests and Climate Change, Government of India, Dated 15th April 2015 and NGT Order Dated 30th April 2019

Table 7. Vehicle Exhaust Emission Norms (Passenger cars and heavy diesel vehicles)

Norms (Passenger Cars)		CO(g/km)	HC+ NOx(g/km)	
1991Norms		14.3-27.1	2.0(Only HC)	
1996 Norms		8.68-12.40	3.00-4.36	
1998Norms		4.34-6.20	1.50-2.18	
India stage 2000 norms		2.72	0.97	
Bharat stage-II		2.2	0.5	
Bharat Stage-III		2.3	0.35 (combined)	
Bharat Stage-IV		1.0	0.18 (combined)	
Bharat Stage-VI (Petrol)		1.0	0.16 (Combined)	
Norms (Heavy Diesel Vehicles)	CO(g/kmhr)	HC (g/kmhr)	NOx (g/kmhr)	PM(g/kmhr)
1991Norms	14	3.5	18	-
1996 Norms	11.2	2.4	14.4	-
India stage 2000 norms	4.5	1.1	8.0	0.36
Bharat stage-II	4.0	1.1	7.0	0.15
Bharat Stage-III	2.1	1.6	5.0	0.10
Bharat Stage-IV	1.5	0.96	3.5	0.02
Bharat Stage-VI (Diesel)	0.5	0.17 (HC+NOx)		0.0045

Source: Central Pollution Control Board.

CO= Carbon Monoxide; g/kmhr = grams per kilometer-hour; HC=Hydrocarbons; NOx=Oxides of Nitrogen; PM = Particulates Matter

E. Institutional Arrangement of the Project

103. The executing agency is Uttarakhand State, acting through the Uttarakhand Department of Tourism. Project oversight and guidance is led by a state-level High-Powered Committee (HPC), headed by the Chief Secretary of Uttarakhand State. The HPC members comprise the Secretary of Finance, Secretary Karmik (Personnel Department), Secretary Planning, Secretary Tourism, Program Director, and any other related departments necessary to support the project management and coordination. A Technical Screening Committee (TSC) is responsible for review

and endorsement of the domestic detailed project reports (DPRs). The HPC and TSC were established on 23 August 2023 (by Government Order of the Department of Tourism) with powers and responsibilities defined by the Department of Finance (Order 8 March 2023).

104. The Uttarakhand Tourism Development Board (UTDB) under the Uttarakhand Department of Tourism is the principle implementing agency. A project management unit (PMU) will be established under the UTDB, which will coordinate the project activities including management of the loan proceeds, procurement, monitoring, and reporting. The PMU is headed by the Additional Chief Executive Officer (ACEO) of UTDB as the Project Director. The PMU comprises positions for administration, technical, procurement, financial, and livelihoods support. The UTDB and PMU are the main contact points for ADB during project implementation.

105. There are four implementing agencies for the project, which will each establish a PIU: (i) UTDB, with support from TADA—for all project components except listed otherwise; (ii) PWD—for the tourism road components; (iii) Department of Forestry—green cover and afforestation subproject; and (iv) Uttarakhand Jal Sansthan (UJS)—sanitation and wastewater treatment components. Each PIU will be headed by a project manager and comprise administrative and technical positions. The PIUs are responsible for subproject implementation, monitoring, and reporting. The PMU under UTDB will manage the project finances and support the other PIUs as needed. The detailed organizational structure is in Figure 1.

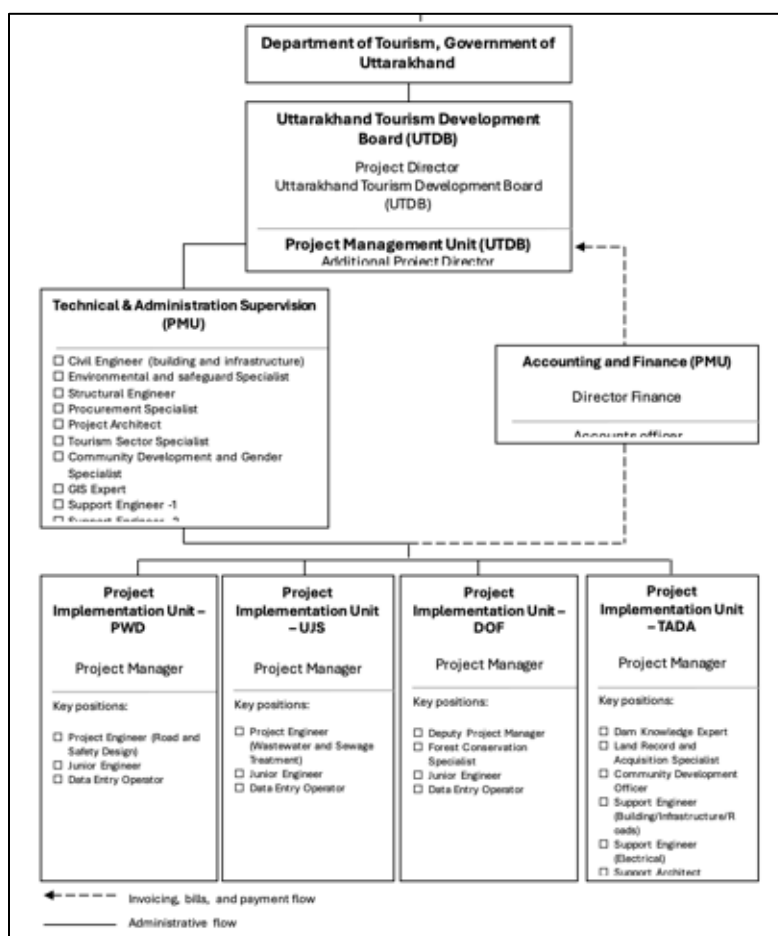


Figure 1. Organizational structure of the Project.

106. Uttarakhand Tourism Development Board (UTDB) is the primary implementing agency for the India: Sustainable, Inclusive, and Climate-Resilient Tourism Development at Tehri Lake Area Project. UTDB is responsible for providing overall guidance, coordination, supervision, and management to ensure the effective preparation and implementation of the project. It establishes the strategic direction and ensures that all project activities align with the objectives of developing the Tehri Lake area as a sustainable and climate-resilient tourism destination. This includes coordination with various government agencies, stakeholders, and funding entities to facilitate smooth operations and timely completion of project activities.

107. A key function of UTDB is providing strategic guidance on interagency coordination. This involves ensuring synergy between various government departments and agencies to address any issues that may arise during project implementation. UTDB provides policy guidance to the project implementing agencies to ensure adherence to the relevant regulations and frameworks. This guidance is critical in maintaining alignment with the overarching goals of enhancing tourism in the Tehri Lake area while considering the sustainability and resilience of the region's natural resources.

108. Financial management is a core responsibility of UTDB in the context of this project. It oversees and ensures the adequacy of overall project funding, establishing and maintaining project accounts, submitting withdrawal applications to the ADB, and administering statements of expenditure. UTDB also maintains supporting financial documentation and operates the single nodal account for project funding. Separate project accounts are maintained, and financial statements are prepared and audited independently. The audited project financial statements are submitted to ADB on a timely basis, ensuring transparency and accountability in all financial aspects of the project.

109. In terms of day-to-day project execution, UTDB takes charge of supervising and managing project activities. This includes monitoring project progress, providing regular updates to ADB on the procurement plan, and ensuring compliance with project safeguard requirements. UTDB has the authority to exercise all the powers and responsibilities as defined in the administrative order of the Government of Uttarakhand. It works closely with other government agencies and ADB to expedite procurement processes, ensure the allocation of necessary budgetary and staffing resources, and maintain adherence to the project schedule to achieve timely completion.

110. Tehri Area Development Authority (TADA). It plays a pivotal role in the overall supervision and coordination of development projects, operating under the administrative and financial powers delegated by the High-Powered Committee. TADA's responsibilities include providing leadership and guidance to ensure that all project activities are conducted in alignment with the strategic goals set by the Government of Uttarakhand. By coordinating various stakeholders and maintaining oversight, TADA ensures that the project is executed smoothly and effectively, thereby contributing to the sustainable development of the Tehri Lake area.

111. TADA provides essential policy guidance to Project Implementation Units (PIUs) by setting up and monitoring physical and financial targets for these units. This oversight ensures that PIUs adhere to their objectives and deliver on their commitments within the stipulated timelines and budgets. TADA's role in guiding and monitoring PIUs helps maintain consistency in project execution, ensures efficient use of resources, and addresses any challenges that may arise during implementation.

112. A key responsibility of TADA is to oversee and monitor project implementation as well as ensure the adequacy of overall project funding. This includes assessing project progress,

identifying any shortfalls in funding, and coordinating with the Asian Development Bank (ADB) and other funding agencies to secure the necessary resources. TADA is responsible for preparing comprehensive project progress reports that highlight achievements, challenges, and financial status. These reports are crucial for keeping stakeholders informed and ensuring transparency in project execution.

113. Financial management is a core function of TADA. The authority establishes and maintains project accounts, submits withdrawal applications to the ADB, administers the statement-of-expenditure, and maintains supporting financial documents. TADA also manages the single nodal account for project funds, ensuring that separate project accounts are maintained for transparency and accountability. TADA prepares project financial statements, arranges for independent audits, and submits the audited financial statements to the ADB in a timely manner. This meticulous financial management ensures that project funds are utilized efficiently and in accordance with the funding agency's requirements.

114. TADA is responsible for the day-to-day project execution, supervision, and management. This involves overseeing the implementation of project activities, resolving any operational issues, and ensuring that project milestones are achieved as planned. TADA's proactive approach in managing day-to-day operations helps in maintaining the momentum of project execution and addressing any potential delays or bottlenecks.

115. TADA also monitors and provides updated procurement plans to the ADB, ensuring that procurement activities are conducted in compliance with ADB's guidelines and that any changes are communicated promptly. This helps in maintaining transparency and accountability in the procurement process.

116. Ensuring environmental compliance is another critical responsibility of TADA. The authority ensures that all project activities comply with environmental safeguards and that any potential adverse environmental impacts are effectively mitigated. TADA's commitment to environmental compliance ensures that the project contributes positively to the ecological sustainability of the Tehri Lake area.

117. Finally, TADA exercises all the powers and responsibilities of the Project Management Unit (PMU) as defined in the administrative order no. 86/XXVII(7)36/20201-11/2019, issued by the Finance Department, Government of Uttarakhand. This order provides TADA with the necessary authority to execute its functions effectively and ensure that the project is implemented in accordance with the established policies and frameworks. By executing these responsibilities, TADA plays a central role in ensuring the successful completion of development projects in the Tehri Lake area, thereby supporting the region's growth and sustainability.

118. **PIUs.** The successful implementation of the project components—road infrastructure, sanitation and solid waste management, and afforestation—requires active participation and collaboration among the Public Works Department (PWD), Uttarakhand Jal Sansthan (UJS), and the Department of Forests (DoF). Each agency, serving as a Project Implementation Unit (PIU), has distinct yet complementary roles to ensure the seamless execution of their respective project components.

119. The Public Works Department (PWD) is responsible for managing the road infrastructure components, which include the development and maintenance of tourism roads, access roads, carparks, bus stops, laybys, and road safety measures. This involves supervising day-to-day execution of civil works, conducting regular site inspections, and ensuring that all construction

activities are aligned with the approved project plans and standards. PWD works closely with the UTDB to integrate the road components into the broader framework of sustainable and climate-resilient tourism development. This collaboration ensures that the road infrastructure enhances accessibility to key tourism sites and promotes safe, smooth transportation for visitors. By coordinating with consultants and contractors, PWD ensures that technical specifications are met and that any construction challenges are addressed promptly, keeping the project on schedule and within budget.

120. The Uttarakhand Jal Sansthan (UJS) oversees the sanitation and water supply components. UJS's primary responsibility is to ensure the effective implementation and supervision of these components, with a focus on improving sanitation services and managing water distribution in the Project areas. This involves coordinating with UTDB to ensure that sanitation and water supply infrastructure supports tourism development goals. UJS regularly liaises with consultants and contractors to address any technical or operational issues, conducts quality assurance checks, and ensures compliance with environmental and social safeguards. By maintaining accurate project-related documentation, such as quarterly and annual progress reports, UJS provides stakeholders with a transparent overview of project performance and compliance with safeguard requirements.

121. The Department of Forests (DoF) plays a critical role in managing the afforestation component of the project. DoF is responsible for planning and executing activities such as planting, nurturing, and maintaining trees in designated areas to restore and enhance the forest cover. Coordination with UTDB is essential to ensure that afforestation activities complement the sustainable tourism objectives of the project. DoF's close coordination with consultants and contractors ensures that planting techniques and maintenance activities meet the required technical standards. Quality assurance is conducted through regular inspections to verify that planting density, species selection, and survival rates are aligned with project requirements.

122. All three agencies—PWD, UJS, and DoF—are responsible for ensuring compliance with project safeguard requirements throughout their respective components. This involves implementing mitigation measures to minimize environmental and social impacts and addressing any grievances that arise through an established Grievance Redressal Mechanism (GRM). The GRM provides a structured platform for stakeholders to raise concerns, ensuring that these grievances are addressed transparently and efficiently, fostering community support for the project.

IV. DESCRIPTION OF THE PROJECT

A. Project Area

123. The project area falls in Tehri Garhwal District of Uttarakhand. The district of Tehri Garhwal is one of the largest and the westernmost districts of the state of Uttarakhand. Its administrative headquarters is at New Tehri. The district has a population of 618, 931 (2011 census), a 2.35% increase over the previous decade. It is surrounded by Rudraprayag District in the east, Dehradun District in the west, Uttarkashi District in the north, and Pauri Garhwal District in the south. Tehri Garhwal is a part of the Himalayas. The project area is situated at 30.3012° N, 78.5661° E and is at an elevation between 1550 to 1950 m from the mean sea level. The Tehri Garhwal District covers 4421 Square Km of area.

124. Tehri District has four famous routes of pilgrimage to Kedarnath, Badrinath, Yamnotri and Gangotri through it. The project area is connected through Old Chamba Road NH 707A. The nearest airport is Jolly Grant Airport which is at a distance of 80 km and the nearest railway station is Rishikesh Railway Station which is located 55 km from the project area.

125. The Project comprised structural and non-structural components, which are summarized in the Table 8:

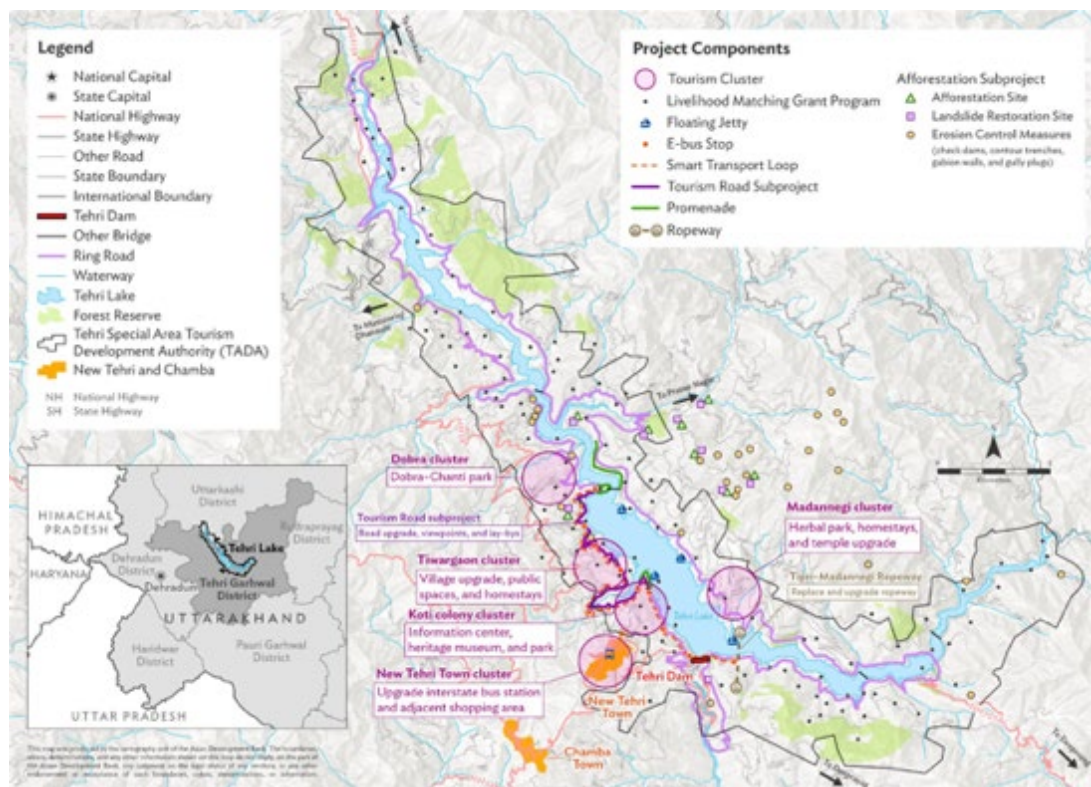
Table 8. Components of the Project

Project Output	Cluster	Subproject
Non-structural Components		
1	Lake	Tourism master plan for the Tehri Lake area
1	Lake	TADA business plan; and training for TADA and district agencies in tourism management
1	Lake	Strengthen policies to facilitate tourism development, green entry fees, and PPP to promote private sector entry for Tehri Lake
1	Lake	Uttarakhand State PPP Toolkit
1	Lake	Tourism sustainability monitoring program
3	Lake	LMGP – establish and implement LMGP; training in grant applications, business management, vocational skills
3	Lake	Facilitate eco-certification for MSMEs
3	Lake	Facilitate PPP for O&M of selected subprojects under output 2
4	Lake	Women-led pilot DRM-WASH-stream conservation program
Structural Components		
2	Dobra Chanti	Dobra Chanti Park – (i) landscaping, temple-oriented development, amphitheatre, parking, kiosks, Himalayan Haat area, Uppu Garh, (ii) water fountain, light, and sound laser show, (iii) production center for vernacular architecture (e.g., doors, windows, frames, courtyard wooden columns, roof beams, etc), (iv) promenade with retaining Wall
2	Koti	Development of Koti Colony – (i) integrated information center (heritage museum, tourist information center, central control center / Jal Police Unit, first aid room), (ii) children's park, sculpture garden, (iii) food court and landscaping
2	Lake	Tourism Road- from Koti Colony to Dobra Chanti
2	Lake	Improvement of public transport and last mile connectivity (upgrade of existing short access roads to villages, tourism sites, lake shore, jetties, and junction of these access roads with main road, for improved vehicle and pedestrian safety and flow)
	Lake	Entrance gateway at New Tehri, Koti and Dobra
	Lake	Designing, supply and installation of signages at various locations

Project Output	Cluster	Subproject
2	Lake	Waste Management Facility and Solid Waste Management (rehabilitation and upgrade of Mokhri landfill; waste collection trucks; village sorting stations and transport)
4	Lake	Tehri Green Cover and Afforestation
2	Lake	Village water supply (12 villages)—decentralized water storage, rainwater harvesting, gravity-fed pipelines
2	Madan Negi	Village infrastructure upgradation and facilities development at Khola, Kangsali, Sandana, Dharkot, Madan Negi
	Madan Negi	Upgradation of Madan Negi Temple
2	Madan Negi	Development of Herbal Park
	Madan Negi	Upgradation of Mahadev temple at Sandana
2	Madan Negi	Upgradation/Construction of Ropeway from Tipri to Madan Negi
2	New Tehri	Upgradation of existing Interstate Bus Terminus and City Center (Development of Commercial Hub and Retail at New Tehri area)
2	New Tehri	Construction of 5 MLD STP at New Tehri
2	Tiwar Gaon	Village Infrastructure upgradation and facilities development at Tiwar Gaon
2	Tiwar Gaon	Development of (i) Bio-diversity Park and Horticulture Garden
	Tiwar Gaon	Yoga and Panchakarma and Meditation Center at Tiwar Gaon
Goods		
2	Lake	Water Public Transport Stations at multiple locations
2	Lake	Procurement of machinery and equipment for transportation and processing of solid waste
2	Lake	Procurement of Electric Buses, boats and e-bikes and Electric Vehicle charging infrastructure
2	Lake	Smart Components (ICCC, traffic management component in smart digital infrastructure, charging infrastructure for EVs - EV taxis and e-Autos), weather monitoring, prediction / forecasting systems, DRM early warning systems, broadcasting services - includes services for adventure and other outdoor activities)

CS = consulting services, CW = civil works, DRM = disaster risk management, ICCC = integrated command and control center, LMGP = livelihood matching grant program, MLD = million liters per day, MSME = micro, small, and medium-sized enterprises, N/A = not applicable, O&M = operation and maintenance, PPP = public-private partnership, STP = sewage treatment plant, TA = technical assistance, TADA = Tehri Special Area Tourism Development Authority, WASH = water, sanitation, and hygiene.

126. The location of the project area is given in the Figure 2:



Source: ADB

Figure 2. Location of the project area

127. There are subprojects spread across 6 clusters within the TADA area. These subprojects have been clustered into four groups to carry out environmental assessment. This IEE is prepared for transport components subprojects as described below.

B. Proposed components covered in this IEE:

128. The following are proposed projects combined to form the Transport Infrastructure subprojects component are covered in this IEE.

Table 9. Subprojects covered under this IEE.

S. No.	Project components
1.	Tourism Road (Koti Colony to Dobra Chanti)
2.	Upgradation/construction of ropeway Tipri to Madan Negi
3.	Water Public Transport Stations at multiple locations
4.	Designing, supply, and installation of signages at various locations and last mile connectivity
5.	Smart Infrastructure (Traffic management component in Smart digital infrastructure, charging infrastructure for EVs - EV taxis and e-Autos), Weather monitoring, prediction / forecasting systems, broadcasting services - Includes services for adventure and other outdoor activities

B.1. Tourism Road (Koti Colony to Dobra Chanti)

129. **Existing condition.** The entire subproject road (Koti colony–Dobra Chanti) lays along the Tehri Lake in the New Tehri area. The proposed subproject road is part of the ambitious ring road project, which spans 234 km and encircles the New Tehri area along the lake. The project road

is situated in the Tehri-Garhwal district. New Tehri is the adventure hub and headquarters of the Tehri-Garhwal district.

130. The subproject road starts from Ch 0+00 at Panch Koti and goes to Dobra Chanti suspension bridge, Ch 15+77. The project road starting from Panch Koti passes through the Jakh diversion, Tiwar Gaon, Le Roi floating huts, and terminates at the existing Dobra Chanti suspension bridge. The road subproject is passing through 12 villages, namely i. Jakh, ii. Handasu, iii. Jaspur, iv. Palli Chak, v. Ramgaon, vi. Tiwar Gaon, vii. Maroda, viii. Goran, ix. Hadgi, x. Godi Sirahi, xi. Palas, and xii. Dobra. The existing row for the road varies between 6 and 8 meters in general. It does exceed 8 meters at a few locations. Other than the existing road, PWD has land in accordance with the 10 m ROW. This land is towards the hill portion of the road.



Figure 3. Roadside slope along the proposed tourism road.

131. This road connecting Koti Colony to Dobra Chanti currently lacks essential pedestrian and cyclist infrastructure. The absence of footpaths and cycle tracks poses significant safety risks to pedestrians and cyclists, making them vulnerable to accidents. The road infrastructure is deficient in proper signage, with many road markings faded or entirely missing. Additionally, the placement of reflectors behind the crash barriers negates their intended safety function, further compromising road safety.

132. Effective road signage and markings are essential for safe navigation, but the current state is deficient. Many of the road markings, including lane dividers and pedestrian crossings, are faded or completely worn away, leading to confusion and unsafe driving practices. Additionally, there is a noticeable lack of road signs to guide drivers, indicate speed limits, or warn of upcoming bends, intersections, or pedestrian crossings. This lack of information can lead to erratic driving and increased accident risk.

133. Reflectors are crucial for road safety, particularly at night, but their current placement renders them ineffective. Reflectors are currently positioned behind the crash barriers, where they cannot be seen by oncoming traffic. Properly placed reflectors are essential to enhance visibility during low-light conditions and alert drivers to the road's edges and curves.

134. The physical state of the road is another critical issue. The road surface has numerous patches where the asphalt has worn away, leading to a bumpy and uncomfortable drive. These potholes and cracks not only damage vehicles but also pose a safety risk, especially for two-wheelers. In some sections, poor drainage has led to water pooling on the road during rains,

accelerating surface degradation and increasing the risk of hydroplaning accidents.

135. The road traverses multiple villages and is a critical connector between Koti Colony and Dobra Chanti, both of which are tourist destinations in Tehri. Despite its importance, the road lacks several amenities that could enhance the tourist experience. The current state of the road infrastructure does not support the area's tourism potential, particularly considering the volume of tourists visiting these sites.

136. The road also serves as a vital connection for local villages. It passes through several villages, providing them with essential connectivity. However, the current road conditions hinder efficient travel and transportation of goods and services. Improved road conditions can significantly impact the local economy by facilitating better access to markets, healthcare, and educational facilities.



The image clearly illustrates the lack of dedicated footpaths on the road, forcing pedestrians to walk on the narrow shoulder dangerously close to vehicular traffic. This absence of footpaths poses a significant safety risk, as pedestrians are left with no choice but to navigate alongside moving vehicles.



The picture highlights the poor condition of the asphalt on the road. Significant portions of the road surface are worn away, revealing patches where the asphalt has deteriorated. This degradation leads to a rough and uneven driving surface, which can be uncomfortable and potentially hazardous for vehicles, especially two-wheelers. The edge of the road is also visibly damaged, contributing to safety concerns for both drivers and pedestrians.

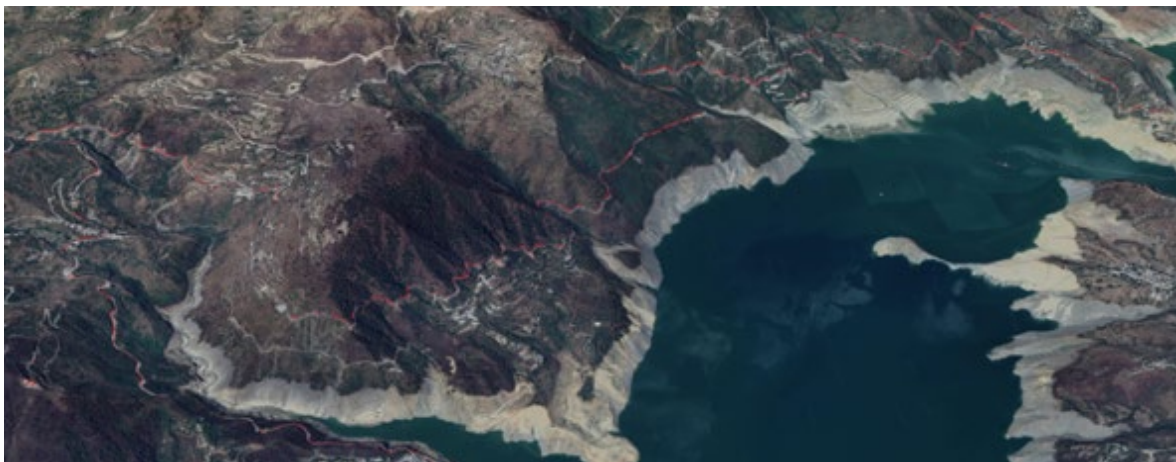


The image shows several road safety features that are currently inadequately implemented. While there is a crash barrier installed along the edge of the road, the reflectors meant to enhance visibility are placed behind the barrier, making them ineffective. Proper placement of these reflectors is crucial for night-time visibility and overall road safety. Additionally, the road markings appear to be fading, which can cause confusion for drivers, especially in low visibility conditions. These safety deficiencies highlight the need for improved and correctly installed safety features to ensure the protection of all road users.

Figure 4. Current conditions of the road from Koti Colony to Dobra Chanti

137. **Proposed Tourism Road component:** The project road of Koti colony to Dobra Chanti is envisaged to be developed as a tourism road for the New Tehri area. The road is used by tourists and locals to visit the beautiful Dobra Chanti Bridge and other villages on the way. The location key map of the road is shown below.

138. The subproject starts at 30°24'41.23"N - 78°27'13.14"E and ends at 30°26'52.16"N - 78°25'59.05"E.



Source: Google Maps

Figure 5. Proposed Tourism Road (shown in red line)

139. When planning the improvement of the proposed tourism road, two types of standards have been adopted to guide the design and construction: desirable standards and minimum standards. Desirable standards are the ideal guidelines that should be followed as much as possible. These standards ensure the highest quality and safety for the road, providing a smooth and efficient driving experience. They represent the best practices in road design and are used as the default criteria when conditions allow. Minimum standards are used in situations where applying the desirable standards would be too costly or impractical, especially on difficult stretches of the road. These standards still ensure safety and functionality but are less stringent to accommodate challenging conditions, such as steep terrain or limited space.

140. For the improvement tourism road, the design standards for geometric elements of the road have been proposed under both "desirable" and "minimum" categories. This approach allows flexibility in the design and ensures that the improvements can be practically implemented without excessive costs. The standards adopted for this project align with the guidelines recommended by the Indian Roads Congress, ensuring consistency with national road design practices. The adopted values for these design standards have been carefully selected to balance practicality and cost-effectiveness. By using desirable standards where feasible and minimum standards where necessary, the project aims to achieve a high-quality road that meets safety and efficiency requirements while remaining within budget.

141. **Design Speed (km/hr).** The design speed for the road as per Indian Road Congress (IRC) SP:48-2023⁹ for mountainous terrain is set at 50 km/hr as the ruling speed and 40 km/hr as the minimum speed. This means that the road is designed to allow vehicles to travel at a maximum

⁹ IRC SP:48-2023 for mountainous terrain, the design speed for such roads is determined by various factors, including the terrain, alignment, and anticipated traffic volume.

of 50 km/hr under normal conditions, with a minimum acceptable speed of 40 km/hr on more difficult or constrained sections. This standard ensures a balance between safety and efficiency, accommodating the challenging topography of the region.

142. **Level of Service.** The level of service is categorized as B, which indicates a stable flow of traffic where vehicles can travel at their desired speed without significant delays. This classification reflects the intent to provide a high-quality driving experience, minimizing congestion and improving overall traffic management on the road.

143. **Roadways width (m).** For the mountainous terrain, as per IRC SP:73-2018¹⁰, the roadway width is specified to be 11 meters for a 2-lane road with paved shoulders. This includes an earthen shoulder on one side (hill side) and a valley side. The design ensures sufficient width to accommodate two lanes of traffic with additional shoulder space for safety and operational efficiency.

144. **Roadway Elements.** The design standards for the roadway elements follow IRC SP:73-2018 guidelines, suitable for mountainous terrain with retaining walls and parapets. The carriageway is designed as a 2-lane road, each lane being 3.5 meters wide. Paved shoulders are provided on both the hill and valley sides, each 1.5 meters wide. Additionally, an earthen shoulder of 1.0 meter is provided on the valley side, enhancing safety and stability.

145. **Camber.** To facilitate effective drainage, the camber (cross-fall) for the pavement and paved shoulders is set at 2.5% for flexible pavements and 2.0% for rigid pavements. For unpaved shoulders, the camber is set at 3.5% for flexible pavements and 3.0% for rigid pavements. This design ensures that water drains off the road surface efficiently, reducing the risk of waterlogging and damage.

146. **Right of Way.** The right of way is determined as per the plan and profile specific to the project. This includes considerations for land acquisition and alignment to ensure that the road meets the required standards and fits within the available space while minimizing environmental and social impacts.

147. **Fill Height.** The fill height requirements different slopes for various height ranges to ensure stability and safety. For fill heights up to 3.0 meters, the slope is set at 1V:2H (Vertical to Horizontal). This gentle slope is designed to prevent erosion and landslides, ensuring the road's stability. For fill heights ranging from 3.0 meters to 6.0 meters, the slope changes to 1V:1.5H to accommodate the increased height while maintaining stability. For fill heights exceeding 6.0 meters, designs are based on soil parameters as per IRC:75-1979¹¹, providing a customized approach to handle specific soil conditions and prevent structural failures. In cutting, regardless of the fill height, a slope of 1V:1H is used to ensure the stability of the cut sections.

148. **Stopping Sight Distance.** This is a critical safety measure that ensures drivers have adequate visibility to stop their vehicles in time to avoid obstacles. For example, at a design speed of 20 km/hr, the stopping sight distance is 20 meters, increasing incrementally up to 60 meters

¹⁰ This standard outlines the specifications and best practices for designing road geometry to ensure safety, durability, and efficiency. It covers aspects such as road alignment, cross-sections, sight distances, super-elevation, and drainage, ensuring that rural roads are constructed to handle expected traffic loads and environmental conditions effectively.

¹¹ This provides guidelines for soil testing, classification, and stabilization in road construction. It ensures that the soil used in road foundations and embankments meets specific criteria for strength and stability, helping engineers design durable and reliable roads.

for a design speed of 50 km/hr. These distances allow drivers sufficient time to react to hazards, significantly reducing the risk of accidents.

149. Intermediate Sight Distance. This is necessary for safe overtaking maneuvers and overall road safety. Design considerations of the proposed road ranges from 40 meters for a design speed of 20 km/hr to 120 meters for a design speed of 50 km/hr. These distances ensure that drivers have clear visibility to overtake slower vehicles safely, which is particularly important in mountainous terrain where road visibility can be limited.

150. Super-elevation. This refers to the banking of the roadway at curves to counteract centrifugal force and improve vehicle stability. This design element is crucial for preventing vehicles from skidding or overturning on curves. The adopted maximum for the proposed road is 10%, ensuring vehicles can navigate curves safely even at higher speeds, which is essential for maintaining control and reducing the likelihood of accidents.

151. Radii for Horizontal Curves. The radii for horizontal curves are designed to ensure safe turning, especially in mountainous terrain. As per IRC SP:48-2023¹², a ruling minimum radius of 80 meters, with an absolute minimum of 50 meters. In snowbound areas, the ruling minimum is slightly higher at 90 meters. These specifications ensure that vehicles can safely navigate curves without losing control, which is crucial for preventing accidents. The larger radii in snowbound areas account for the reduced traction on snowy and icy roads, further enhancing safety.

152. Gradient (As per IRC SP:48-2023 Table 6.11). In mountainous terrain, the ruling gradient is set at 5%, which is considered the ideal slope for maintaining a balance between ease of construction and road usability. This gradient ensures that the road remains functional and safe for vehicles without incurring excessive construction costs. However, in more challenging sections of the terrain where it is difficult to maintain this gradient, a limiting gradient of 6.00% is permitted. This slightly steeper slope allows for greater flexibility in road design while still adhering to safety standards.

153. In steep terrain, the gradients are adjusted to accommodate the more difficult conditions. The ruling gradient is increased to 6%, reflecting the need for steeper slopes in such areas. Similarly, the limiting gradient is set at 7%, which is the maximum permissible gradient in extremely steep areas. These gradients ensure that the road remains navigable while balancing construction feasibility and safety considerations.

154. Minimum k Factor. The k factor is a critical design parameter used to determine the curvature of vertical curves, ensuring safe and comfortable transitions between different gradients. For summit curves in mountainous terrain, the ruling k factor is set at 15. This value ensures a smooth and gradual transition over the crest of a hill, enhancing visibility and driving comfort for motorists. However, in constrained conditions, a minimum k factor of 8.4 can be used, although this results in a sharper transition that may slightly reduce comfort and visibility.

155. For valley curves in mountainous terrain, the ruling k factor is also set at 15, providing a smooth transition at the bottom of a slope. This ensures that vehicles can safely and comfortably navigate these areas, minimizing the risk of accidents due to abrupt changes in gradient. The minimum k factor for valley curves is not specified in the provided table, but it would generally be higher than for summit curves to account for the different dynamics involved in transitioning

¹² This standard includes specifications for various geometric elements such as alignment, gradients, sight distances, super-elevation, and cross-sections tailored to the unique challenges posed by hilly and mountainous areas.

through a valley.

156. **Vertical Clearance.** The vertical clearance standard, as per IRC SP:48-2023, is set at 5.0 meters. This clearance height is essential for ensuring that all types of vehicles, including heavy trucks and buses, can safely pass under overpasses, bridges, and other structures without any risk of collision. This standard is crucial for maintaining the functionality and safety of the road network, especially in areas with significant commercial and freight traffic.

157. **Cross-Sectional Elements:** They are fundamental components of road design that determine the layout and dimensions of the roadway. These elements ensure that the road can accommodate various types of vehicles and traffic volumes while maintaining safety and functionality. The key cross-sectional elements typically include the carriageway, shoulders, medians, and drainage systems.

158. **Carriageway.** The carriageway is the portion of the road intended for vehicular traffic. Its width and structure are designed to accommodate the expected traffic volumes and types of vehicles using the road. For instance, the width of a two-lane road in rural areas may differ from that in urban settings due to varying traffic demands. The carriageway must be designed to provide a smooth and safe surface for vehicles, with adequate structural strength to handle the loads imposed by traffic.

159. **Shoulders.** These are strips of land adjacent to the carriageway. They provide a safety buffer for vehicles that need to pull over in emergencies and offer additional space for maintenance activities. Shoulders also play a critical role in supporting the pavement structure by distributing the loads from the carriageway and enhancing drainage. The width of the shoulders varies based on the type and function of the road, with rural highways typically having wider shoulders than urban streets.

160. **Medians.** These are used to separate opposing lanes of traffic, enhancing safety by reducing the likelihood of head-on collisions. Medians can be either raised or flush with the pavement and may include barriers or vegetation. The design and width of medians depend on the road type, traffic volumes, and safety requirements. On high-speed highways, medians are crucial for preventing crossover accidents, whereas in urban areas, they may also serve aesthetic and environmental functions.

161. **Drainage Systems.** Effective drainage is essential for maintaining the structural integrity of the road and ensuring safe driving conditions. Cross-sectional elements must include provisions for adequate drainage to prevent water accumulation on the road surface. This involves designing the road with proper slopes (camber) and integrating drainage features such as ditches, culverts, and stormwater management systems. Proper drainage design helps prevent water-related damage to the pavement and reduces the risk of hydroplaning accidents.

162. The existing road right of way varies from 6 meters to 8 meters, although it exceeds at a few places. Three typical cross sections have been proposed: Majorly the proposed ROW is 14 m. The ROW of 20m is proposed at the locations where 6 viewpoints are proposed to be constructed, and at the remaining chainages 10m ROW is proposed. The chainage-wise ROW details are presented in the following Table 10.

163. **Proposed Road Widths:** For the majority of the road, the proposed width is 14.0 meters totaling 14.11 km. This standard width is used from CH:0.00 M to CH:0+300, CH:0+425 to CH:0+2600, CH:3+225 to CH:6+800, CH:6+925 to CH:7+425, CH:7+725 to CH:9+950,

CH:10+050 to CH:14+550, CH:14+700 to CH:15+375, and CH:15+550 to CH:15+706. The consistent use of this width indicates its suitability for accommodating two lanes of traffic along with shoulders, ensuring smooth traffic flow and enhancing safety. The 14.0-meter width provides ample space for vehicles, facilitating efficient and safe travel along these sections.

164. The road design strategically increases the road width to 20.0 meters at several points designated as viewpoints and total of 0.775 km. These include CH:0+300 to CH:0+425 (Viewpoint-1), CH:6+800 to CH:6+925 (Viewpoint-2), CH:7+425 to CH:7+525 (Viewpoint-3), CH:9+950 to CH:10+050 (Viewpoint-4), CH:14+550 to CH:14+700 (Viewpoint-5), and CH:15+375 to CH:15+550 (Viewpoint-6). The increased width at these locations is designed to provide additional space for vehicles to stop and for tourists to safely enjoy the scenic views. By expanding the road width to 20.0 meters at these points, the design accommodates parking and sightseeing activities, ensuring that traffic flow is not disrupted and enhancing the overall safety and convenience for road users.

165. A notable narrowing of the road occurs between CH:2+600 and CH:3+225, where the width is reduced to 10.0 meters, where only .626 km in length. This reduction is likely due to physical constraints such as challenging terrain or the need to minimize environmental impact in sensitive areas. The narrower width requires careful traffic management and design considerations to ensure safety and functionality. This section underscores the need to balance road construction with environmental and topographical challenges, ensuring that the road remains safe and usable even in constrained conditions.

Table 10. ROW details – Tourism Road

CH Marking	Proposed road width (m)	Remarks
CH:0.00 m - CH:0+300	14	
CH:0+300 - CH:0+ 425	20	Viewpoint -1
CH:0+425 - CH:0+2600	14	
CH:2+600 - CH:3+225	10	
CH:3+225 - CH:6+800	14	
CH:6+800 - CH:6+925	20	Viewpoint - 2
CH:6+925 - CH:7+425	14	
CH:7+425 - CH:7+525	20	Viewpoint-3
CH:7+725 - CH:9+950	14	
CH:9+950 - CH:10+050	20	Viewpoint-4
CH:10+050 - CH:14+550	14	
CH:14+550 - CH:14+700	20	Viewpoint-5
CH: 14:700 - CH:15+375	14	
CH:15+375 - CH:15+550	20	Viewpoint-6
CH:15+550 - CH:15+706	14	

CH = Chainage

166. The last section is 20 m wide section where a 7-meter carriageway will be at the ridge side along with a 1.5-meter paved shoulder at LHS and a 1.5 m paved shoulder at RHS. 750 mm drains are proposed all along adjacent to the ridge. Parking area along with footpath, viewpoints are being proposed at valley side. Through retaining wall and extension of widened part tourism facilities are proposed. All benches and kiosks are proposed in this chainage. Appendix 2 shows the alignment of the proposed road upgrading.

167. **Road Width at 10m.** The 10-meter wide road features has several critical design elements aimed at ensuring structural integrity, safety, and functionality. The design showcases a detailed layout of the road's components, from the surface layers down to the subgrade, ensuring that

every element works cohesively to provide a durable and efficient roadway.

168. **Carriageways.** The road includes two main carriageways, each 3.5 meters wide. The left carriageway is designed to accommodate traffic moving in one direction, while the right carriageway handles traffic in the opposite direction. These carriageways are constructed with multiple layers of materials to ensure a smooth and durable driving surface. The width of 3.5 meters meets standard lane width requirements, providing ample space for vehicles to maneuver safely and efficiently. The design ensures that the carriageways can handle varying traffic volumes, contributing to the overall flow and safety of the roadway.

169. **Shoulders.** The design incorporates 1.0-meter wide shoulders on both the hill and valley sides of the road. These shoulders play a crucial role in enhancing road safety by providing space for emergency stops and maintenance activities. They act as a buffer zone, offering additional space for vehicles that need to pull over. The shoulders also facilitate effective road drainage, preventing water accumulation that could lead to erosion and structural damage. By including these shoulders, the design ensures that the road can accommodate unforeseen circumstances and maintain its integrity over time.

170. **Pavement Layers.** The road structure comprises several layers, each designed to serve a specific function in ensuring the road's durability and strength. The topmost layer is 65mm of bituminous concrete, which provides a smooth, wear-resistant surface. This is followed by an 80mm layer of dense bituminous macadam, adding structural strength and distributing the load from the surface. Beneath this is a 250mm layer of wet mix macadam, which offers a solid foundation and enhances stability. The 200mm granular sub-base layer provides additional support and aids in drainage, while the 500mm subgrade, made up of compacted earth with a minimum California Bearing Ratio (CBR) of 5%, forms the base of the road. This multi-layered construction ensures that the road can withstand heavy traffic and adverse weather conditions, maintaining its functionality and safety over time.

171. **Additional Features.** To address drainage needs, the design includes 100x100 cutouts spaced at 10-meter intervals along the carriageway. These cutouts are essential for preventing water accumulation on the road surface, which can lead to hydroplaning and structural damage. Effective drainage is crucial for maintaining the road's safety and longevity. Additionally, the road features a 2.5% camber or cross-slope on both carriageways. This slight slope facilitates water runoff, ensuring that the road surface remains dry and safe during rain. The camber design prevents water from pooling on the road, reducing the risk of accidents and extending the road's lifespan.

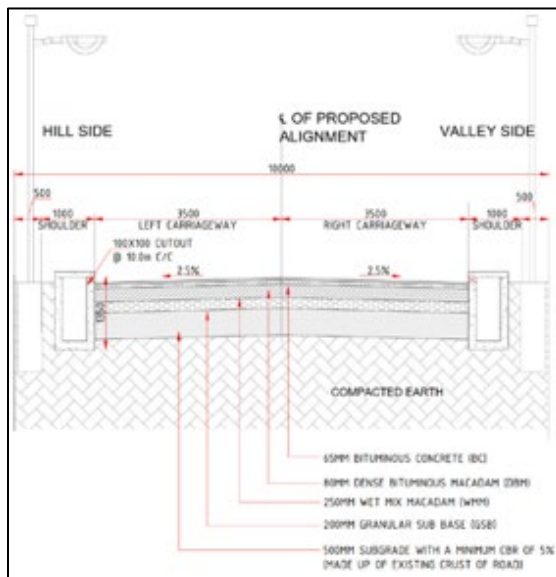


Figure 6. Cross section design of the 10-m width of the road

172. **Road Width at 14m.** The 14m width road design encompasses various functional and safety features essential for a modern roadway. Each element in the design is meticulously planned to ensure durability, safety, and efficiency.

173. **Carriageways.** The road includes two primary carriageways, each with a width of 3.5 meters. The left carriageway is designated for traffic moving in one direction, while the right carriageway caters to vehicles traveling in the opposite direction. These carriageways are constructed with multiple layers of materials to provide a smooth and durable driving surface. The standard lane width of 3.5 meters ensures that vehicles have sufficient space to maneuver safely, reducing the risk of collisions and enhancing overall traffic flow.

174. **Shoulders.** The design incorporates 1.5-meter wide shoulders on both the hill and valley sides of the road. These shoulders serve multiple purposes, including providing space for emergency stops and maintenance activities. They act as a buffer zone, enhancing road safety by offering additional space for vehicles to pull over if needed. The shoulders also facilitate effective drainage, preventing water accumulation on the road surface, which can lead to erosion and structural damage over time.

175. **Pavement Layers.** The pavement structure is composed of several layers, each contributing to the road's strength and longevity. The topmost layer is 65mm of bituminous concrete, providing a smooth, durable surface. Beneath this, an 80mm layer of dense bituminous macadam adds structural integrity and helps distribute the load from the surface. A 250mm layer of wet mix macadam forms a solid foundation, further enhancing stability. The 200mm granular sub-base provides additional support and aids in drainage. At the base is a 500mm subgrade made of compacted earth with a minimum CBR of 5%, ensuring a stable foundation for the road structure. This multi-layered construction ensures the road can withstand heavy traffic and adverse weather conditions, maintaining its functionality and safety over time.

176. **Camber (Cross-Slope).** Both the left and right carriageways feature a 2.5% camber or cross-slope. This slight slope is crucial for effective water drainage, directing rainwater off the road surface to prevent water accumulation. Proper drainage reduces the risk of hydroplaning

and minimizes structural damage, thereby extending the road's lifespan and maintaining safe driving conditions.

177. **Additional Features.** The design includes several additional features to enhance functionality and safety. Drainage cutouts, measuring 100x100 and spaced at 10-meter intervals, are incorporated along the carriageway to ensure effective water drainage. A 3.0-meter wide combined footpath and cycle track is provided on the valley side, offering a safe space for pedestrians and cyclists, separated from vehicular traffic. Additionally, drain pipes are installed at every 30 meters to further improve water drainage. Reinforced cement concrete retaining walls are shown on both the hill and valley sides, supporting the road structure and preventing soil erosion, which is particularly important in hilly terrain.

178. **Footpath and cycle track.** The incorporation of a combined pedestrian and cycling track that is three meters wide on the valley side is a characteristic that stands out as being particularly noteworthy about this design. The purpose of this designated area is to provide a separate area that is separated from the flow of vehicular traffic to improve the safety of walkers and motorcycle riders. Both tourists and locals will be able to enjoy the picturesque vistas in a secure manner thanks to the walkway and cycling track, which will also encourage the use of non-motorized modes of transportation. This characteristic is especially significant in locations that are intended for tourists because there is a greater likelihood of pedestrian and cyclist traffic in those regions. The design fosters modes of transportation that are better for the environment and people's health by providing a secure atmosphere in which these activities can take place.

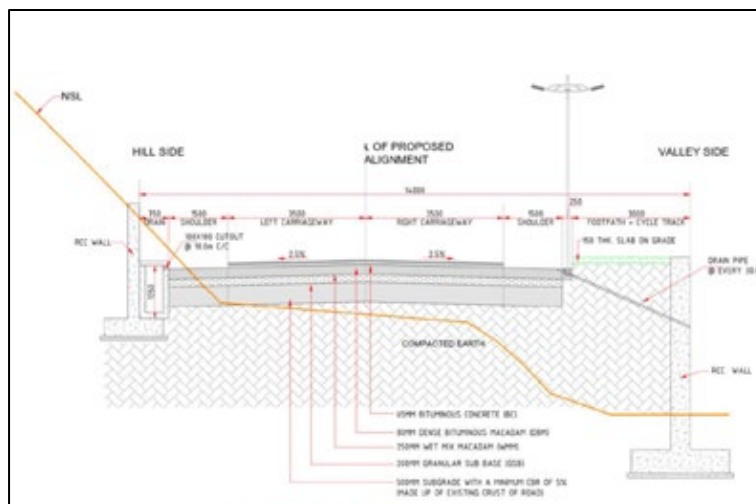


Figure 7. Cross section design of the 14-m width of the road

179. **Road Width at 20m.** The 20-meter wide road section incorporates various features to enhance the road's functionality, safety, and usability, especially in areas with high tourist activity such as viewpoints.

180. **Carriageways.** The road design includes two primary carriageways, each with a width of 7.0 meters. These carriageways are designed to accommodate two lanes of traffic moving in opposite directions. The construction of the carriageways with multiple layers of materials ensures a smooth and durable driving surface that can withstand heavy traffic loads and adverse weather conditions. This design is particularly beneficial in managing the expected traffic volume at popular sightseeing points.

181. **Shoulders.** The design incorporates 1.5-meter wide shoulders on both the hill and valley sides of the road. These shoulders serve multiple purposes, including providing space for emergency stops and maintenance activities. Acting as a buffer zone, the shoulders enhance road safety by offering additional space for vehicles to pull over if needed. They also facilitate effective drainage, preventing water accumulation on the road surface, which can lead to erosion and structural damage over time. The inclusion of shoulders is a crucial safety feature, ensuring that the road remains functional and safe even in emergency situations.

182. **Footpath and Cycle Track.** A notable feature of this design is the inclusion of a 3.0-meter wide combined footpath and cycle track on the valley side. This dedicated space is designed to enhance the safety of pedestrians and cyclists by providing a separate area away from vehicular traffic. The footpath and cycle track ensure that tourists and local residents can enjoy the scenic views safely, promoting non-motorized transportation. This feature is particularly important in sightseeing areas where pedestrian and cyclist traffic is likely to be higher. By providing a safe space for these activities, the design encourages healthier, more environmentally friendly modes of transport.

183. **Pavement Layers.** The pavement structure comprises several layers, each contributing to the road's strength and durability. The topmost layer is 65mm of bituminous concrete, providing a smooth, durable surface resistant to wear and weather conditions. Below this, an 80mm layer of dense bituminous macadam adds structural integrity and helps distribute the load from the surface. A 250mm layer of wet mix macadam provides a solid foundation, enhancing the road's stability. The 200mm granular sub-base supports the upper layers and aids in drainage, while the 500mm subgrade, made up of compacted earth with a minimum California Bearing Ratio of 5%, ensures a stable foundation for the entire road structure. This multi-layered construction approach ensures that the road can withstand significant wear and tear, maintaining its integrity over time.

184. **Camber (Cross-Slope).** Both the left and right carriageways feature a 2.5% camber or cross-slope. This design element is crucial for effective water drainage, directing rainwater off the road surface to prevent water accumulation. Proper drainage reduces the risk of hydroplaning and minimizes structural damage, thereby extending the road's lifespan and maintaining safe driving conditions.

185. **Additional Features.** The design includes several additional features to enhance functionality and safety. The diagram includes 100x100 cutouts spaced at 10-meter intervals, which are essential for effective water drainage to prevent water accumulation on the road surface. Additionally, a drain pipe is indicated at every 30 meters, ensuring proper water drainage from the road surface. Reinforced cement concrete (RCC) retaining walls are shown on both the hill and valley sides to support the road structure and prevent soil erosion, which is particularly important in hilly terrain. These features collectively ensure that the road remains structurally sound and safe for users.

186. **Viewing Deck.** The design includes a viewing deck, strategically positioned on the valley side of the road. The viewing deck is an essential feature in areas with high tourist activity, offering a safe and designated space for visitors to enjoy the scenic views. The deck is accessible from the combined footpath and cycle track, ensuring that pedestrians and cyclists can easily reach it without crossing vehicular lanes. The inclusion of a viewing deck enhances the tourist experience by providing a picturesque spot for photography and relaxation, thereby promoting tourism and local engagement.

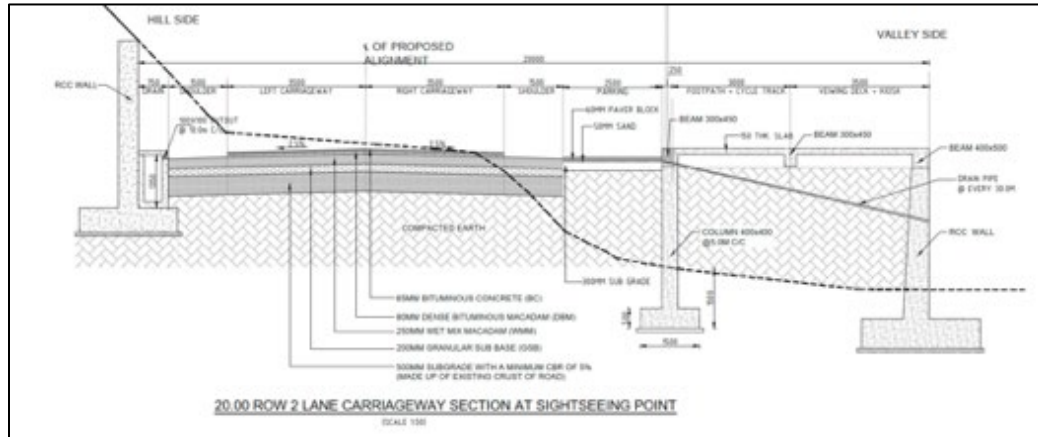


Figure 8. Cross section design of the 20-m width of the road

187. **Bridge Upgrading.** The proposed road project includes the construction of a new bridge at Ch 3+838.75 to Ch 4+175 with a total length of 114.630M and 94 culverts are also proposed to be constructed. EV Charging Infrastructure is also proposed to be installed as part of the proposed road subproject.

188. The bridge spans a total length of 36 meters, divided into six equal segments of 6 meters each. This segmentation ensures a balanced distribution of loads across the bridge, enhancing structural integrity. The bridge deck is elevated to a deck level at EL.944.00, ensuring it is well above the surrounding terrain and any potential flood levels.

189. The bridge is supported by two primary abutments on either end. These abutments are designed to transfer loads from the bridge deck down to the foundations, which are embedded into the ground. The abutments are reinforced with retaining walls to prevent soil erosion and maintain stability. The base of the abutments is designed to spread the load over a larger area, reducing ground pressure and enhancing stability.

190. The bridge deck features a gentle gradient, with the left side having a downward slope of -3.962% and the right side an upward slope of 6.610%. This gradient ensures proper drainage of rainwater, preventing water accumulation on the bridge surface which could lead to slippery conditions and potential structural damage over time. The road profile follows this gradient, providing a smooth transition for vehicles moving onto and off the bridge.

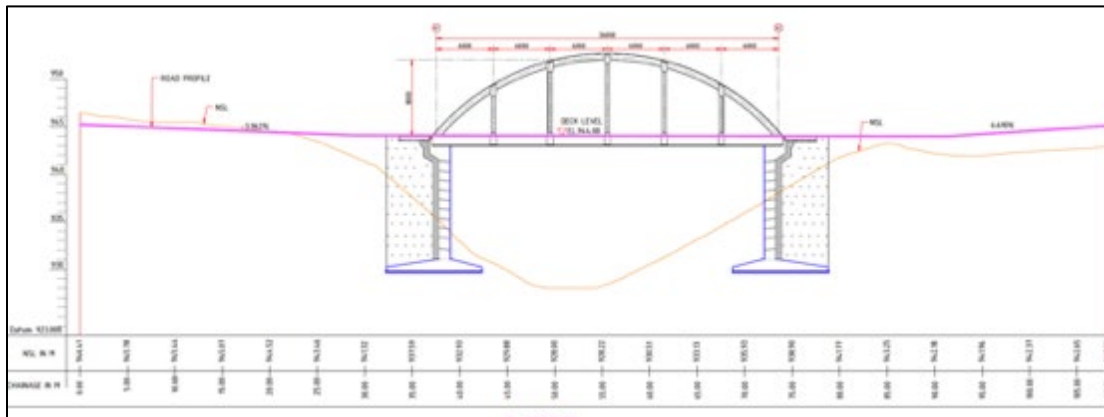


Figure 9. Bridge Design details

191. **Street Lighting.** Key components of the street lighting design include 8-meter poles with a single arm and 90-watt LED fixtures for electrical supply and 60-watt fixtures for solar supply. The design aims for a minimum lux level of 15 and complies with standards specified in IS 1944, IS 1919, IS 10322, and other relevant codes, ensuring safety and performance. The design aligns with the latest standards for road lighting installations, incorporating guidelines from the IEE, BS EN 13201-2:2003, and BS 7671.

192. The design calculations for the street lighting include each pole being 8 meters high, with the luminaires outputting 80 watts, providing 110 lumens per watt. The required lux level is set at 15 lux, with a maintenance factor of 0.75. Luminaire spacing is 28 meters apart along the road length of 15.75 km, resulting in an illuminated area of 165,375 square meters. The average lumen calculation ensures the right amount of light is provided, resulting in the use of a 90-watt LED fixture for street lighting to ensure adequate illumination. The total number of poles required is determined by dividing the total road length by the spacing between the poles, resulting in 562 poles. This number can be adjusted based on specific site conditions.

193. **Charging stations.** Petrol and diesel vehicles, known for their high pollution levels, are being swiftly replaced by fully electric vehicles, which have zero tailpipe emissions and are significantly better for the environment. A major obstacle to the widespread adoption of electric vehicles is the lack of accessible charging stations. Unlike petrol stations, charging points are not ubiquitously available, leading to concerns about what happens if a vehicle runs out of battery. Many people prioritize straightforward and fast commuting methods over environmental benefits. The proposed road improvement will address this issue by enhancing the accessibility of charging stations, utilizing public electricity and solar panels to facilitate the easy and hassle-free charging of electric vehicles. A universal charging station can accommodate vehicles from different manufacturers with various battery types and charging capabilities, thereby increasing the demand for EVs and ensuring reliability.

194. An electric vehicle operates using one or more electric motors or traction motors for propulsion. It can be powered through a collector system by electricity from off-vehicle sources or be self-contained with a battery, solar panels, or an electric generator to convert fuel to electricity. An EV charging station, also known as an electric recharging point, charging point, charge point, or electronic charging station (ECS), is part of an infrastructure that provides electric energy for recharging plug-in electric vehicles, including electric cars, neighborhood electric vehicles, and plug-in hybrids.

195. An electric vehicle charging station consists of several charging machines, each containing a transformer, capacitor, and a control unit with a high-quality processor and built-in memory for operating the station. The station includes a charging cord and plug designed to fit the vehicle's charging port. Electrical power from the grid is transferred to the charging machine through a distribution and control panel, which includes various safety and fail-safe devices to handle the electric load appropriately. The charging machine uses a transformer to adjust the input AC voltage to the required value based on the user's selected level of charging. There are three levels of charging options: (i) Level 1: Provides 110-120V AC at the charger point, (ii) Level 2: Provides 220-240V AC at the charging point, and (iii) Level 3: Requires a three-phase input AC supply, which is then converted to DC power for charging.

196. **Cables.** For the proposed project, 1.1KV grade multicore aluminum conductor cables, insulated with XLPE and sheathed with PVC as per IS: 7098:1988 (including the latest amendments), will be used. Control cables will consist of copper conductors, while power cables will utilize aluminum conductors. All control and lighting circuit cables will be single core copper

conductors with a minimum size of 1.5 mm². The proposed cables will be of copper or aluminum conductors, of the FRLS (Flame Retardant Low Smoke) and XLPE type. The selection of cables will ensure that the system voltage drop does not exceed 3% from the transformer output to the main panel. All wires will be PVC insulated with FRLS copper conductors. Additionally, a separate PE earthing wire will be provided for bollards, street lights, and other lighting fixtures.

197. **Earthing system and lightning protection.** Given the hazardous nature of electrical energy, it is crucial to implement stringent safety measures. The earthing system will comply with Indian Standards BIS-3043-1987 and other statutory regulations. All non-current carrying metal parts of the electrical system will be connected to the earthing system in accordance with Indian Electricity Rules. The earthing system will be designed to ensure that the resistance of the earthing network is less than 1.0 ohm at any point. All panels will be equipped with suitable sizes of two G.I. strips along their full length, and separate dedicated earthing will be provided. Additionally, all feeder pillars will be earthed.

198. **Traffic control:** The proposed upgradation and widening of the project road aims to transform it into a more safe corridor, necessitating an efficient traffic control system. The primary purpose of this system is to provide road users with a smooth and hazard-free passage while ensuring adequate safety for all, including pedestrians.

199. Traffic signs on the project roads will be provided in accordance with the IRC Code of Practice for Road Signs (IRC 67-2010). These signs fall into three main categories: (i) mandatory or regulatory signs, (ii) warning signs, and (iii) informatory signs. The road signs will be retro-reflectorized and made of high-intensity grade encapsulated lens type reflective sheeting fixed over aluminum sheets. The signposts will be made of aluminum alloy, steel posts, or hollow sections of cast or sheet metal. These signs will be erected on a refuge, an island, or the earthen shoulder of the road and mounted on the ground. Their orientation and siting with respect to the carriageway will conform to IRC standards.

200. Suitable carriageway markings are essential for conveying warnings, requirements, or information to road users, ensuring smooth and hazard-free movement. These markings help maintain safety and orderly use of the carriageway according to traffic regulations, define lanes, and guide vehicles at junctions. Provisions have been made for road markings along the entire length of the project road, including center lines, carriageway edge lines, lane lines, and pedestrian crossings.

201. **Drainage and culverts.** The culverts designated for the proposed road, where each differing in size and type. The types of culverts are:

- Type 1 Culvert (14 x 6 x 2.5m) is the largest in the list, with dimensions of 14 meters in length, 6 meters in width, and 2.5 meters in height. This type is likely used in locations where a significant volume of water needs to be managed or where larger streamlets and runoff need to be channeled under the road.
- Type 2A Culvert (10 x 3 x 2.5m) is a medium-sized culvert with dimensions of 10 meters in length, 3 meters in width, and 2.5 meters in height. Type 2A is typically used in areas with moderate water flow, providing adequate passage for water while maintaining structural stability.
- Type 2B Culvert (14 x 3 x 2.5m) is like Type 2A in height and width but longer, with dimensions of 14 meters in length, 3 meters in width, and 2.5 meters in height. Type 2B is suitable for stretches requiring extended coverage under the road without a significant increase in width.

- Type 2C Culvert (20 x 3 x 2.5m) is the longest among the medium-sized types, with dimensions of 20 meters in length, 3 meters in width, and 2.5 meters in height. Type 2C is designed for areas with extensive road coverage needs, ensuring water is channeled efficiently over a longer distance.

202. Each type of culvert is chosen based on specific site conditions, water flow requirements, and structural considerations to ensure the longevity and safety of the road infrastructure.

203. **Retaining Walls.** Different types of retaining walls are proposed to ensure the stability and safety of the road. These retaining walls are designed to cater to the specific needs of the terrain and the height requirements. The types of retaining walls included in the proposed tourism road are categorized based on their construction materials and specific uses.

204. Gabion Walls (GW) are used for hill-side protection with heights ranging from 0.0m to 3.0m. Gabion walls consist of wire mesh baskets filled with rocks, providing flexibility and effective drainage. This makes them particularly suitable for areas with unstable soils where water needs to pass through the structure without causing erosion. The flexibility of gabion walls allows them to adjust to ground movements, which is crucial in hilly terrains.

205. There are retaining walls (RW1, RW2, RW3) constructed using reinforced concrete. These walls are designed to hold back soil and prevent landslides, especially in areas with higher slope heights. The heights of these walls vary, with RW1 being 3.0m to 4.0m, RW2 from 4.0m to 5.0m, and RW3 from 5.0m to 6.0m. Reinforced concrete retaining walls provide strong and durable support, making them ideal for higher and more critical sections of the road. Their rigidity ensures that they can withstand significant pressure from the retained soil.

206. Random rubble masonry walls (RRV1, RRV2, RRV3) are utilized on the valley side to prevent soil erosion and landslides. These walls are constructed using irregularly shaped stones laid in mortar, giving them a rustic appearance. The heights for these walls are RRV1 from 0.0m to 1.0m, RRV2 from 1.0m to 2.0m, and RRV3 from 2.0m to 3.0m. Random rubble masonry walls are used in less critical areas where the aesthetic appearance of the stonework is also a consideration. These walls provide effective erosion control and are well-suited to areas where the soil is less prone to movement.

207. The retaining walls are constructed using high-grade materials such as M35 concrete and Fe-500 steel bars. The minimum clear cover to reinforcement is specified as 50mm for footings and 40mm for the retaining wall itself. Weep holes are provided to prevent water accumulation behind the wall, which can increase the hydrostatic pressure. These are 100 mm diameter AC pipes extending through the full width of the structure with a slope of 1V:20H towards the drainage face. A layer of filter media composed of granular materials or crushed stone aggregates is laid behind the wall. This layer, not less than 600 mm thick, prevents soil erosion and promotes proper drainage. The backfill soil is compacted in layers not exceeding 300mm of compacted thickness, achieving at least 95% of the standard proctor density to ensure stability.

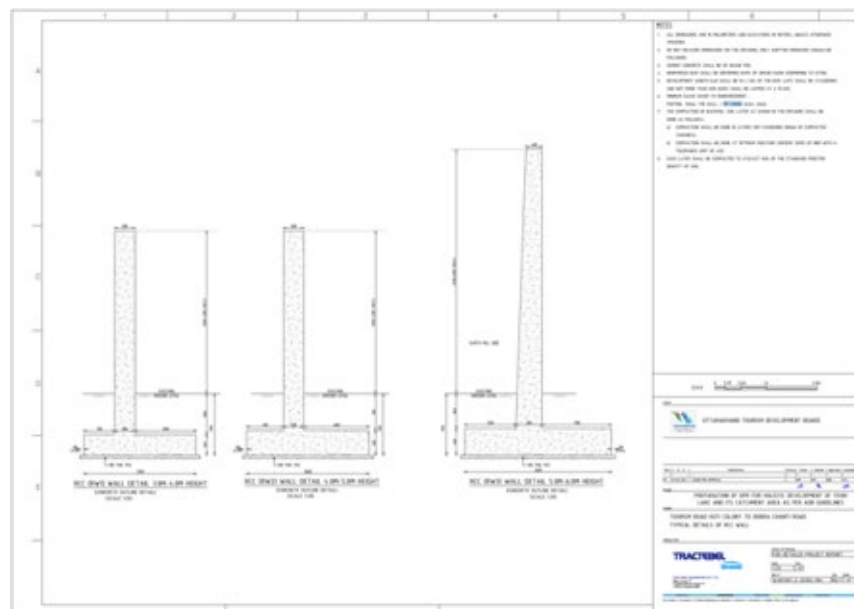


Figure 10. Detailed Design Drawings of Retaining Walls for Different Heights (3.0m to 6.0m)

B.2. Upgradation/construction of Ropeway Tipri to Madan Negi

208. The Tipri-Madan Negi ropeway is an essential transportation system connecting the villages of Madan Negi and Tipri across the Tehri Lake. This ropeway, primarily used by locals, offers a panoramic view of the Tehri Dam, making it an attractive option for tourists as well. The ropeway system is a twin track bi-cable jig back system, a configuration chosen for its stability and efficiency in handling the steep and exposed terrain characteristic of the region.

209. The drive station at Tipri is located at an elevation of 922 meters with coordinates 30°22'45.49"N and 78°29'17.89"E. The return station at Madan Negi is situated at a lower elevation of 860 meters, with coordinates 30°23'14.82"N and 78°29'32.36"E. The horizontal length between the stations is 958 meters, but the total length covered, considering the drive and return sheaves, is 988 meters. This system overcomes a vertical rise of 65 meters, making it a significant engineering feat in the rugged terrain of the Tehri Lake area.

210. The ropeway operates with a single cabin that can accommodate 11 passengers and one attendant. It has a maximum speed of 3.5 meters per second, though it typically operates at 2.5 meters per second to ensure passenger safety and comfort. For rescue operations, the speed is further reduced to 0.6 meters per second. This setup allows the ropeway to transport up to 60 passengers per hour, providing a vital link between the two villages that drastically reduces the travel time from approximately three hours by road to just around 700 seconds by ropeway.

211. Constructed and initially operated by the State Industrial Development Corporation of Uttarakhand (SIDCUL), the ropeway is currently managed by BM Enterprises. The fare structure is designed to be accessible, with locals paying Rs 10 per journey and tourists charged Rs 150 for a one-way trip. This pricing strategy ensures that the ropeway remains a viable transportation option for daily commuters while also capitalizing on the scenic views to attract tourists.

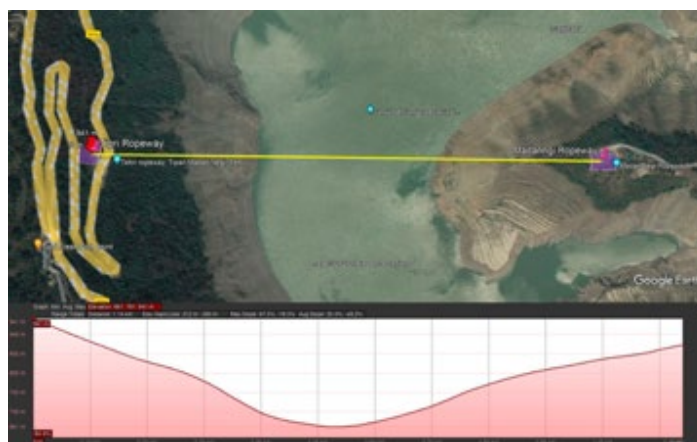


Figure 11. Aerial View and Elevation Profile of Tipri-Madan Negi Ropeway across Tehri Lake

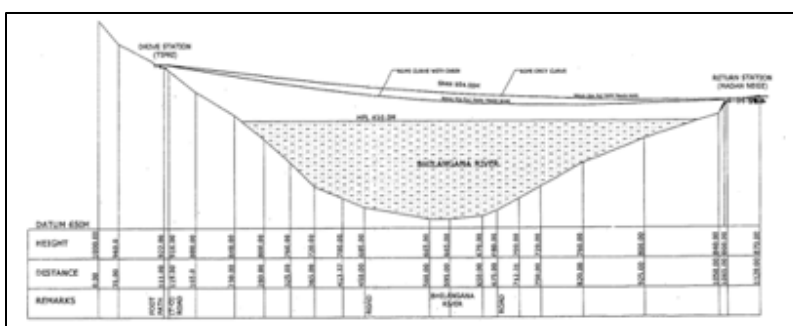


Figure 12. Structural Elevation and Alignment Plan Ropeway across Bhilangana River

212. Madan Negi is part of Sandana village located in Pratapnagar Tehsil of Tehri Garhwal District in Uttarakhand, India. It is situated 40km away from subdistrict headquarter Pratapnagar (Tehsildar office) and 75km from district headquarters New Tehri. As per 2009 stats, Sandana is the gram panchayat of Sandana village.

213. The total geographical area of the village is 153.93 hectares. Sandana has a total population of 233 people, out of which the male population is 101 while the female population is 132. The literacy rate of Sandana village is 72.96% out of which 88.12% and 61.36% of males and females are literate respectively. There are about 55 houses in Sandana village.

214. When it comes to administration, Sandana village is administrated by a sarpanch who is elected representative of the village by the local elections. As per 2019 stats, Sandana village comes under the Pratapnagar assembly constituency and Tehri Garhwal parliamentary constituency. Tehri is the nearest town to Sandana for all major economic activities, which is approximately 75km away. The villages in close vicinity of Madan Negi are; Punsara, Gadoli, Pathiyana, Dov Lamoli, Rampur, Jalwal Gaon Talla, Jalwal Gaon Malla, Khola, Bangdwara, Dharkot, and Patur. The residents of these villages are traversing through the existing ropeway.

215. Tipri village is located in the Jakhnidhar Tehsil of Tehri Garhwal District in Uttarakhand, India. It is situated 14km away from the subdistrict headquarter Jakhnidhar (Tehsildar office) and 35km away from District headquarters of New Tehri. As per 2009 stats, Tipri is the gram panchayat of Tipri village.

216. The total geographical area of the village is 273.07 hectares. Tipri has a total population of 697 people, out of which the male population is 306 while the female population is 391. The literacy rate of Tipri village is 65.57% out of which 79.74% males and 54.48% females are literate. There are about 188 houses in Tipri village.

217. Tehri is nearest town to Tipri for all major economic activities, which is approximately 35km away. The nearby billages of Tipri are Raud Dhar, Kulakandi, Kandi, Kashi Gaon, Chami, Uthar, Gadugadmai Chopra, Pakwa Chak, Gainwali May Dawaisari, Bhatkanda, and Pipola Maya Lumbungadi.



Tipri Ropeway Station



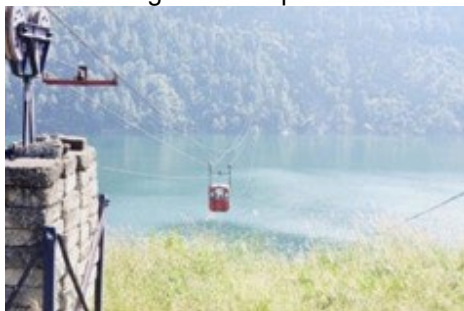
Station (Tipri Ropeway)



Waiting area at Tipri station



Cabin Parking at Tipri station



Ropeway line from Madan Negi to Tipri



Parking at Tipri side



Madan Negi Station and Rescue cabin



Waiting Area at Madan Negi Station

Figure 13. Existing conditions of the ropeway.

218. **Ropeway Improvement:** The proposed improvement of ropeway aims to upgrade the existing transportation system, enhancing connectivity and supporting the development of border villages around the subproject area. This initiative promises several significant advantages:

- **Enhanced Connectivity:** The ropeway will offer a reliable and efficient mode of transportation between Tipri and Madan Negi. This improved connectivity is crucial for facilitating the movement of people and goods across the challenging hilly terrain.
- **Tourism Sector Boost:** By providing a scenic and adventurous journey, the ropeway is expected to attract more tourists, thereby boosting the local tourism sector. Additionally, it will alleviate parking issues, making the area more accessible and attractive to visitors.
- **Employment Opportunities:** The construction and operation of the ropeway will create new job opportunities for residents. Furthermore, improved access to workplaces will benefit the community by enhancing economic activities and livelihoods.
- **Adventure Tourism:** The ropeway offers an adventurous travel experience, which will appeal to tourists seeking unique and exciting activities. This aspect is likely to increase the overall appeal of the Tehri region as a tourist destination.
- **Goods Transportation:** The ropeway's capability to transport goods adds flexibility and utility to its design. This feature is particularly advantageous in hilly areas where traditional transportation methods may be challenging or inefficient.

219. Overall, the proposed ropeway subproject is poised to deliver substantial benefits by improving transportation infrastructure, enhancing tourism potential, providing employment, and facilitating goods movement, thereby contributing to the socio-economic development of the Tehri region.

220. The development of a modern ropeway is a good effort to develop an eco-friendly connectivity between Tipri and Madan Negi, factors like landslides, narrower roads, unpredicted rainfalls and other environmental effects are kept in mind while conceptualizing the project plan.

221. The objectives of upgrading the existing ropeway with new ropeway is as follows:

- Uses the latest technology for operation and higher safety standards than the existing ropeway facility.
- Save time and money for the tourists and local people from long travels.
- Higher capacity than the existing ropeway.
- Cabin of the new ropeway gives better visibility of Tehri Lake.
- Attraction point for the tourists coming to Tehri Garhwal.
- Due to steep gradient and narrow road, the idea is to improve connectivity and convenience for commuters, besides promoting tourism.

222. **Proposed Ropeway component.** Developing an efficient transportation network in hilly terrains presents significant challenges. Rail and air transportation networks in these areas are limited due to geographical constraints, while road network development faces numerous technical obstacles. In this context, ropeways have emerged as a practical and safe form of transportation, offering several benefits. The implementation of ropeways provides a viable solution for enhancing mobility in remote hilly areas. This mode of transportation facilitates the integration of people living in isolated regions into broader society by improving their access to essential services and economic opportunities. Additionally, the ropeway system's requirement for only a single operator contributes to substantial labor cost savings, enhancing its economic feasibility and operational efficiency.

223. The selected technology for this project is the Twin Track Bi-Cable Double Reversible Jig Back Ropeway system, chosen for its suitability to the terrain and operational requirements. The proposed ropeway system is characterized by its use of two track ropes and a single haulage rope. This configuration provides enhanced stability, particularly important for high-altitude and undulating terrains. The ropeway consists of two carriers that travel back and forth between the stations in opposite directions, driven by the haulage rope. The haulage rope is propelled by a drive system at one station and tensioned by a counterweight at the other. The recommendation is based on the following factor:

- Length of Ropeway is long about one kilometer and there is no possibility of placing tower between station.
- Cabin have stability in wind as it run on twin track rope.
- Capacity requirement is easily met by a jig back system.
- Operating and maintenance cost is less as compared to other systems.
- Jig back system offers comfortable boarding/deboarding operation as the cabin will be brought to a halt at the terminals.

224. The Bi-directional ropeway system consists of two carriers that are firmly attached to a haulage rope and supported by twin track rope. These carriers travel back and forth between the stations in opposite directions simultaneously which start and stop at the terminal stations. These carriers are propelled along two track ropes by means of a haul rope. The carriages of the carriers, which travel along the track ropes, are connected by haul rope. In one of the stations the haul rope is propelled by the drive system; in the other station it is loaded by means of a counterweight to achieve the necessary tension.

225. Capacity and Dimensions. The ropeway is designed to transport 150 passengers per hour (PPH) each way at full speed, making it an efficient solution for both local commuters and tourists. The horizontal length between the station fronts is 958 meters, while the inclined length of the ropeway is 960 meters, with a vertical rise of 65 meters. This configuration allows the ropeway to cover significant elevation changes, providing a quick and scenic journey across the Tehri Lake.

226. Speed and Gauge. The design speed of the ropeway is set at 3.6 meters per second, with an operating speed ranging from 0 to 3 meters per second. This variable speed capability ensures smooth and safe operation, accommodating different passenger loads and weather conditions. The ropeway gauge, or the distance between the two track ropes, is 5 meters, which provides stability and minimizes sway during operation.

227. Rope Specifications. The haulage rope used in the system has a diameter of 20 mm and is constructed with a 6x19S(9-9-1) configuration, featuring a fibre core and a breaking load (MBL) of 208 kN. The tensile grade of the rope is 1570 N/mm², with a weight of 1.49 kg/m, and it is galvanized and laid in the RHLL (Right Hand Lang Lay) direction. The track ropes are 36 mm in diameter, fully locked coil, with a tensile grade of 1570 N/mm², an MBL of 1230 kN, and a unit weight of 7.27 kg/m. These specifications ensure that the ropes are strong, durable, and capable of handling the high tension required for safe operation.

228. Grips, Power, and Gondolas. The system utilizes fixed grips, which securely attach the cabins to the haulage rope, ensuring stability during travel. The main motor powering the ropeway is rated at 100 HP (75 kW), providing sufficient power for efficient operation. The ropeway features two gondolas, one on each side, each with a capacity of 20 passengers. This setup ensures a balanced and continuous flow of passengers in both directions.

229. Travel Time and Auxiliary Power. The travel time for a one-way trip on the ropeway is

approximately 7 minutes and 46 seconds, offering a swift and convenient mode of transportation across the lake. The power supply at the stations is 415 volts, 3-phase, 50 Hz, ensuring consistent and reliable energy for operation. Additionally, a 250 KVA standby diesel generator (D.G. set) is provided to ensure uninterrupted power supply in case of outages.

230. **Tension and Safety.** The applied tension in each track rope is 28 tons, while the tension in the haulage rope is 4 tons. These high-tension values ensure that the ropes remain taut and secure, preventing sagging and maintaining the safety and reliability of the system.

231. The proposed ropeway system summary is presented in below:

Table 11. Ropeway system - proposed technical details

Sr. No	Description	Details
1.	Type of Ropeway	Twin Track Bi-Cable Double reversible Jig Back Ropeway system
2.	Capacity of Transportation	150 PPH each way at full speed
3.	Horizontal Length (between station front)	958 m
4.	Vertical Rise	65 m
5.	Inclined Length	960 m
6.	Ropeway Gauge	5 m
7.	Design Speed	3.6 m/s
8.	Operating Speed	0 to 3 m/s
9.	Haulage Rope Dimension	20 mm diameter rope 6x19S(9-9-1), Core- FMC MBL-208kN, Tensile Grade- 1570N/mm ² , Wt-1.49Kg/m, galvanised, Lay direction - RHLL
10.	Track Rope Dimension	36 mm Diameter, full locked coil, Tensile Grade-1570/mm ² , MBL 1230 kN, unit wt.- 7.27Kg/m, Galvanized.
11.	Type of Grip	Fixed Grip
12.	Rated Power of Main Motor	100 HP/ 75 KW
13.	No. of Gondolas	2 (1 on each side)
14.	Travel Time (One Way)	7 Min 46 Sec
15.	Cabin Capacity	20 Pax
16.	Power Supply at Station	415v. 3Ph, 50Hz
17.	Stand by D.G. Set	250 KVA
18.	Applied tension in track rope	28 ton each rope
19.	Applied tension in track rope	4 ton

Source: DPR

232. Almost all ropeway systems have the same basic components, irrespective of the technology used. The basic components of any ropeway system include carriers (cabins), terminals, towers, ropes, grip, sheave assemblies, electric drive and control systems and evacuation and rescue system. Important component of Twin Track Bi-Cable Double reversible Jig Back Ropeway system are as under:

233. **Drive Station (at Tipri).** The Drive Terminal Station have driving and controlling system and support structure. Speed of an incoming cabin on approaching the station shall be automatically retarded and the cabins shall stop at a pre-determined area. Where After deboarding of the passengers, who will arrive after taking the ropeway ride, and after boarding of new incoming passengers waiting in the queue, the station attendant shall communicate to the Drive Operator. The drive operator shall start the drive. Cabins shall proceed towards the other station. A Drive Control Room will be constructed to house control equipment and operate the

system in such a way that he is able to see the boarding and debarking of passenger clearly.

234. The drive station will consist of:

- Drive station building/housing
- Steel structure for launching and conveying system: Made of Galvanized Steel Structure.
- Upper Machinery Frame
- Main AC Drive motor arrangement
- Gear Box
- Coupling
- Drive Bull wheel
- Emergency Drive
- Service and Emergency Brake
- Main Electric cabinets and control
- Emergency Diesel Engine
- Track rope anchorage.
- Sheave/Roller Assembly
- Communication Systems: P A System, Intercom System, Wireless System
- Earthing and Lightning Protection
- Run-Out or Run-In Sections: The ropeway track at the return station
- typically includes run-out or run-in sections. These sections are designed to allow a smooth transition for carriers arriving or departing from the station
- Independent driven Rescue Drive system with cabin.

235. **Drive Unit.** The drive system of a ropeway is a critical component responsible for providing the necessary power to move the cabins or carriers along the cable. This system comprises several key components, each playing an integral role in the overall functionality of the ropeway. The drive unit is powered by electric motors, which are commonly used for their efficiency and reliability. These motors provide the power needed to move the cabins along the cable through the drive sheave. The gearbox, connected to the motor, adjusts the speed and torque to match the operational requirements, converting high-speed, low-torque input into low-speed, high-torque output suitable for the drive sheave. Coupling connects the gearbox to the drive sheave, ensuring the seamless transmission of power.

236. The drive sheave, or bull wheel, is a large wheel around which the haul rope (main cable) is wound. It is directly connected to both the gearbox and the motor, and its rotation moves the haul rope, consequently propelling the cabins. A robust braking system is essential for safety and operational efficiency. The emergency brake engages in the event of an emergency or power failure, bringing the ropeway to a controlled stop, while the service brake is used for routine slowing down and stopping during normal operations. Both brakes work in tandem to ensure maximum safety.

237. The control system is the brain of the ropeway's drive system, managing speed, acceleration, and deceleration of the cabins. It integrates various safety features and monitors the overall performance of the system. Sensors and feedback devices, such as speed sensors, load sensors, and position sensors, provide real-time data to the control system for accurate and safe operation. Regular maintenance and inspections of these components are crucial to ensure the ongoing reliability and safety of the ropeway drive system.

238. **Rescue System.** An independent rescue system is also an essential feature of modern ropeways, designed specifically for emergency evacuation purposes. Unlike the primary drive system or auxiliary/emergency drive, the independent rescue system is solely dedicated to safely

evacuating passengers in the event of a malfunction that renders the primary drive system inoperable. This redundancy enhances the overall safety of the ropeway system.

239. **Return Station Madan Negi.** The return station, such as the one at Madan Negi, is equipped with several key components to ensure the smooth and safe return of the cabins to the starting point after completing a one-way journey. The return station includes track rope anchoring arrangements and a hauling ropeway tension arrangement. The return terminal building serves as a hub where passengers board and deboard from the carriers. It may also house control rooms, ticketing facilities, and other passenger amenities. The designated areas for carrier arrival and departure include boarding and de-boarding zones to facilitate safe handling of passengers.

240. Run-out or run-in sections at the return station allow a smooth transition for carriers arriving or departing from the station. A tensioning system adjusts and maintains the tension in the hauling rope, ensuring it remains within the required limits for safe operation. The counterweight system helps balance the weight of the carriers and maintain proper tension in the hauling rope, optimizing efficiency and safety. Integrated sensors and control systems monitor various parameters, such as rope tension, carrier positions, and operational status, contributing to the overall safety and efficiency of the ropeway.

241. Maintenance and inspection facilities at the return station are crucial, providing access points and facilities for regular checks and maintenance to ensure the proper functioning of all components. Various safety features, including emergency stop buttons, interlocks, and visual or audible alarms, enhance passenger safety and prevent accidents. Ensuring compliance with industry standards and regulations is vital for the safety and reliability of the ropeway system.

242. **Cable (Hauling rope and Track Rope).** The cables, or ropes, are the heart of any aerial ropeway transit system, providing the essential support and propulsion for the cabins. In the Twin Track Bi-Cable Double Reversible Jig Back Ropeway system, three ropes are utilized: two track ropes and one haulage rope.

243. **Track Rope/Carrying Rope:** Track ropes are fixed (anchored) at each end at stations. These ropes are large wire rope cables that span from station to station and tower to tower that support the weight of the Gondola cabins. The size (diameter) of track rope is depends on the load of that section. In this project 36 mm Diameter, full locked coil, Tensile Grade-1570/mm², MBL 1230kN, unit wt-7.27Kg/m, Galvanized rope is suggested.

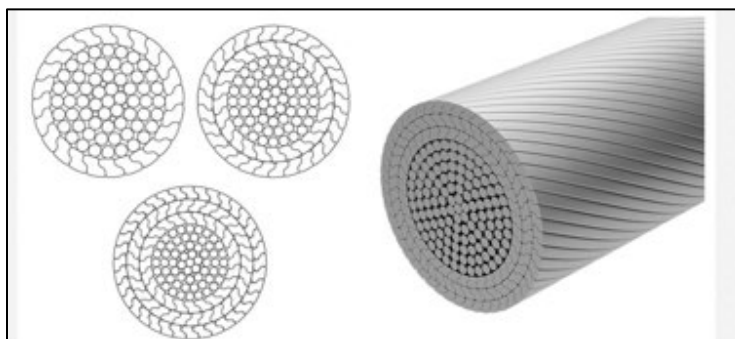


Figure 14. Sample image of Track rope

244. Haulage rope is continuous and looped wire rope cable that provides propulsion to the cabins. The haul rope wraps around large pulleys called “bull wheels” at the stations. The rope is

propelled by a large motor attached to the bull wheel at one or more stations. The size of haulage rope, no. of strands etc. depends on the load. In this project 20 mm diameter rope 6x19S(9-9-1), Core-FMC MBL-208kN, Tensile Grade-1570N/mm², Wt-1.49Kg/m, galvanized, lay direction - RHLL haulage rope is proposed.

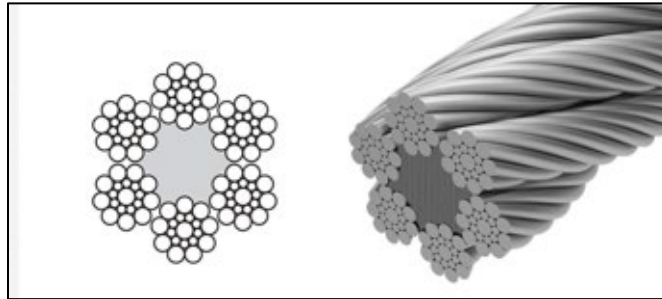


Figure 15. Sample image of Haulage rope

245. The term "Fixed Grip" refers to a mechanism in which the grip, which holds and moves the cabin or carrier, remains fixed to the haul rope throughout the operation. The device that attaches the gondola cabin assembly to the haul rope. On a Gondola system, the grip assembly or carriage has wheels that roll on the track ropes. Cabins have non-detachable (fixed) grip systems. Cabins cannot be detached from the cable when in the station. A Fixed grip is one that is attached to haulage rope. This type of grip does not detach from hauling rope at the station. This type of grip is suitable for low-capacity ropeway and low space availability of turning cabin at station area.



Figure 16. Sample image of Grip

246. **Cabins.** They are closed vehicles in which passengers ride from station to station. The cabins used in the proposed ropeway system are designed with a focus on safety, comfort, and functionality. These closed vehicles are crucial for transporting passengers from station to station, providing protection from weather conditions and external elements. The cabins are constructed using high-strength aluminum materials, which are durable, weather-resistant, lightweight, and easy to maintain. This choice of material ensures longevity and reduces the need for frequent maintenance. The characteristics of the cabins are as in the following:

247. Each cabin has a capacity of up to 20 passengers, with configurations that primarily accommodate standing passengers while also providing seating for the elderly and handicapped. This design ensures inclusivity and comfort for all passengers. The cabins can run at a maximum speed of 3.6 meters per second, offering a swift and efficient mode of transportation across the ropeway.

248. Safety is a paramount concern in the design of these cabins. Each carriage is equipped with a unique vehicle detector that indicates potential roller defects, allowing operators to know exactly where to inspect track rollers. The cabins also feature an emergency braking system that can bring the cabin to a rapid stop in the event of a malfunction or emergency, minimizing the risk of accidents. Additionally, anti-sway mechanisms are implemented to reduce cabin swaying or swinging, particularly in windy conditions, ensuring stability and passenger comfort.

249. The cabins are equipped with advanced communication systems, such as intercoms and emergency buttons, which enable passengers to communicate directly with the ropeway operator or control center if assistance is needed. Doors are designed for quick and safe operation, secured during travel, and emergency doors are provided at the top for additional safety. Some cabins also incorporate comfort features such as padded seating, ventilation systems, and heating or cooling elements to enhance the passenger experience, especially during extreme weather conditions.

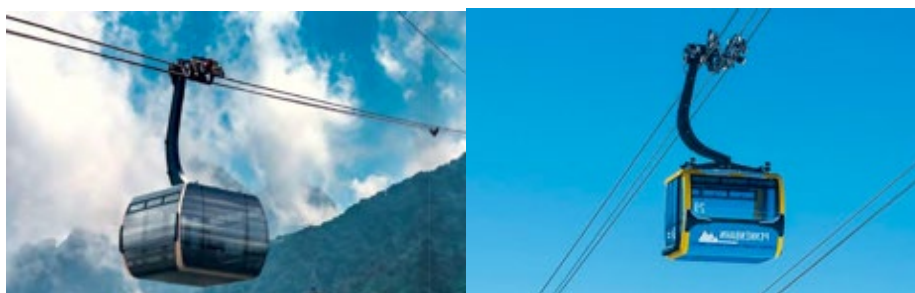


Figure 17. Sample images of cabin

250. Sheave assemblies serve to track the haul rope on the towers and station for continuous movement of aerial ropeways. Sheave assemblies are generally manufactured in three different designs viz. support, hold-down and combined sheave Assemblies. The design of the proposed sheave assemblies allows for load distribution from the rope in accordance with BIS. The proposed sheave assemblies will be equipped with adjusting facility to ensure proper rope tracking.

251. The major specifications of the proposed sheave assemblies are as follow:

- Use of latest generation of sheave liners, reduction of energy cost of up to 20% due to less friction.
- Boltless sheaves with conductive rubber liners.
- Rope catching shoes and break fork switches on all sheave assemblies.
- Frames and suspension galvanized.
- Nitrated main axles for higher corrosion resistance.
- Designed for easy disassembling for replacement of sheave liners (only one hydraulic sheave liner mounting tool required for different sheaves)
- Maintenance free sheave bearings, no lubrication of sheave bearings required.
- Number of sheave assemblies according to profile; and
- Spare sheave assemblies (for each type) for quicker service during yearly shutdown.

252. The control system monitors the operation and takes care of passenger safety during operation of the system. The operator gets real-time data and information on the control panel necessary for the operation of the ropeway installation. It enables the machine operator to regulate the service as required. The drive technology controls the travel speed and the response

of the installation when it starts and stops. Motor powers are adjusted precisely as per the requirements of the mechanical system by control algorithms. The control system is located at drive station.

253. The ropeway will be operated through a variable voltage variable Frequency Controller. Acceleration, deceleration, and stoppage shall be controlled. The ropeway control systems shall be supplied with 24 V DC by two maintenance-free gel batteries placed at each station, so that in the event of a power outage the control system can still be operated for approximately 1.5 hours.

254. **Variable Speed Drive of ropeway (VSD).** VSD is a crucial component in a ropeway system, as it allows for precise control of the speed of the drive motor, ensuring smooth and efficient operation. Here are the key details about the VSD in a ropeway.

255. **Motor Control and Energy Efficiency.** The VSD adjusts the speed of the drive motor to match the operational requirements of the ropeway system. This not only ensures smooth and efficient operation but also contributes to energy efficiency. By matching the power supplied to the motor with the actual requirements of the system, the VSD reduces energy consumption during periods of lower demand. This efficient use of energy is beneficial for both operational cost savings and environmental sustainability.

256. **Acceleration, Deceleration, and Adaptive Control.** Controlled acceleration and deceleration facilitated by the VSD are vital for ensuring passenger comfort and preventing sudden jolts. Modern VSD systems often employ adaptive control algorithms that adjust the speed based on various factors such as passenger load, wind conditions, or temperature. This adaptability ensures optimal performance under different operating conditions.

257. **Integration with Control System and Sensor Integration.** The VSD is integrated into the ropeway's overall control system, receiving commands from the central control system or local control panels. It is often connected to sensors that monitor parameters like speed, tension, and temperature. The real-time data from these sensors enable the VSD to make precise adjustments, ensuring safe and efficient operation of the ropeway system.

258. **Additional Features and Safety.** The VSD may also coordinate with the braking system, ensuring that the braking force is applied smoothly and efficiently. Features such as overload protection prevent the system from operating under conditions that could cause damage. Some VSD systems include regenerative braking, where energy generated during braking is fed back into the power supply system, enhancing overall energy efficiency.

259. **Fault Detection, Redundancy, and User Interface.** Diagnostics features in the VSD help detect faults in the system, aiding in maintenance and troubleshooting. Critical VSD systems may incorporate redundancy to ensure continued operation in case of a failure in one part of the system. A user interface allows operators or maintenance personnel to monitor and adjust parameters, ensuring the system operates efficiently and safely.

260. **Electromagnetic Compatibility (EMC).** VSD systems must comply with electromagnetic compatibility standards to prevent interference with other electronic systems and ensure reliable operation. This compliance is crucial for maintaining the integrity and performance of the ropeway system.

261. **Control panel of ropeway.** The control panel of a ropeway, also known as the local control panel, is a user interface located at various stations along the ropeway system. It allows

local operators to control and monitor specific sections of the ropeway, providing a means for manual intervention and emergency procedures.

262. Local control panels are essential for the day-to-day operation and maintenance of ropeway systems, providing a means for operators to manage the ropeway at specific stations and respond to various operational scenarios. They serve as a critical interface for manual control, emergency response, and communication with the central control system.

263. **Tipri Station (Drive Station).** The Tipri Station, designated as the drive station will cater to the needs of both tourists and local residents. The station's layout includes essential utilities such as a waiting area, parking facilities for vehicles (including spaces for 30 cars and 20 bikes), drinking water facilities, and bio-toilets. This comprehensive design ensures convenience and accessibility for all users.

264. The proposed layout of the Tipri Station incorporates multiple functional areas to enhance the overall user experience. A significant focus is placed on providing ample parking space, which is a critical need in hilly areas where parking can often be a challenge. Additionally, the station includes amenities like a waiting area to ensure passenger comfort while waiting for the ropeway. The inclusion of bio-toilets and drinking water facilities further underscores the station's commitment to hygiene and user convenience.



Figure 18. Proposed Tipri Ropeway Station Plan

265. **Madan Negi Station (Return Station).** The Madan Negi Station, acting as the return station, is similarly designed with a focus on the needs of both tourists and local residents. The station layout includes utilities such as a waiting area, parking facilities for vehicles (18 cars and

16 bikes), drinking water facilities, and bio-toilets. The design ensures that passengers have access to necessary amenities, enhancing their overall experience.

266. The proposed layout of the Madan Negi Station includes a roof plan and an elevation plan, providing a comprehensive view of the station's structural design. These plans are aimed at ensuring the station is not only functional but also aesthetically pleasing. The station's design incorporates a blend of modern amenities and environmental considerations, making it a comfortable and convenient stop for passengers.

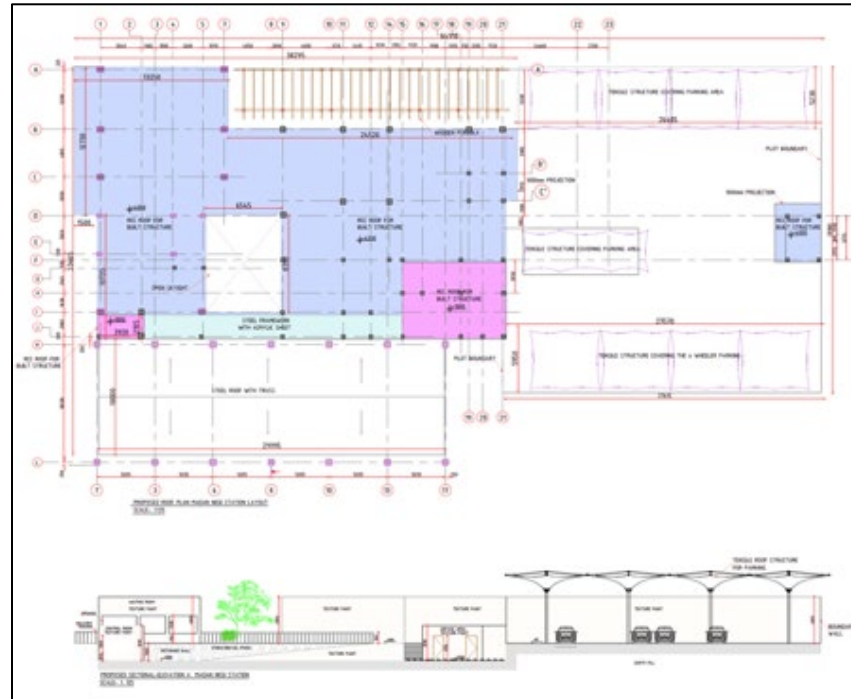


Figure 19. Proposed Madan Negi Return Station Plan

267. **Structural Foundations and Supporting Structures:** The foundations and supporting structures of the Tipri-Madan Negi ropeway are designed to ensure the system's stability and durability. These structures are crucial as they bear the entire load of the ropeway, including the cabins, passengers, and the dynamic forces acting on the system during operation.

268. **Concrete and Steel Frames.** The construction of both the Tipri and Madan Negi stations utilizes a combination of concrete and steel frames. Concrete provides a solid and stable foundation, capable of withstanding the significant loads and stresses imposed by the ropeway system. Steel frames add flexibility and strength, allowing the structure to absorb and distribute these loads efficiently. The use of these materials ensures that the stations are robust and resilient, capable of supporting the continuous operation of the ropeway without structural failure.

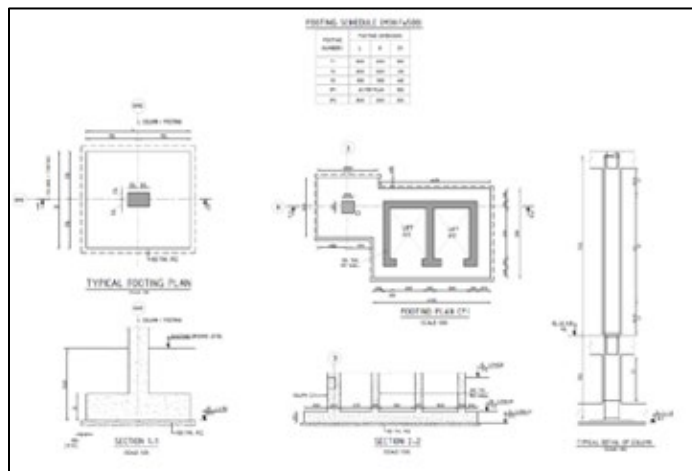


Figure 20. Footing layout plan of Tipri Station

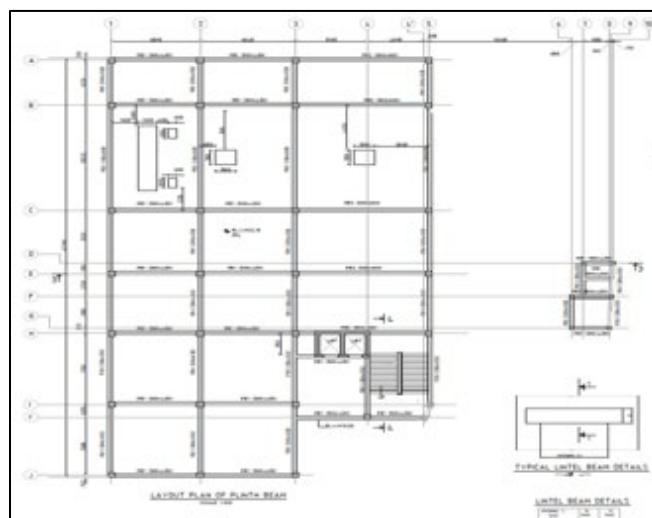


Figure 21. Plinth beam layout plan and details in Tipri Station

269. **Sloped Truss Roof.** The stations feature sloped truss roofs, which serve multiple purposes. Structurally, the sloped design enhances the integrity of the building by providing additional support against vertical and lateral loads. This design also helps in efficient water runoff, preventing water accumulation and potential damage. Aesthetically, the sloped roofs contribute to the visual appeal of the stations, blending harmoniously with the surrounding hilly terrain.

270. **Special Anchor Bolts.** In areas where towers are utilized, they are securely connected to concrete foundations using special anchor bolts. These bolts are designed to provide a strong and stable connection between the towers and their foundations, ensuring that the towers remain firmly in place under various load conditions. The anchor bolts play a critical role in maintaining the stability of the ropeway, especially in challenging weather conditions.

271. **Foundation Calculations.** The design and construction of the foundations involve detailed calculations using specialized software. These calculations ensure that the foundations meet both the ultimate limit state (ULS) and serviceability limit state (SLS) criteria. The ULS ensures that the foundation can withstand maximum loads without failure, while the SLS ensures that it remains functional and undamaged under normal operating conditions. By optimizing the fatigue strength

of the foundations, the design ensures long-term durability and safety of the ropeway system.

272. **Structural Design Standards.** The structural design of the ropeway system adheres to stringent Indian Standards, ensuring compliance with national regulations and guidelines. The relevant standards include:

- IS 456: This standard covers the design and construction of reinforced concrete structures, providing guidelines on materials, structural design, and construction practices.
- IS 1893:2016: This standard deals with the criteria for earthquake-resistant design of structures, ensuring that the ropeway can withstand seismic forces without significant damage.
- IS 875:2015: This standard specifies the loading conditions for buildings and structures, including wind loads, ensuring that the design can withstand various environmental forces.

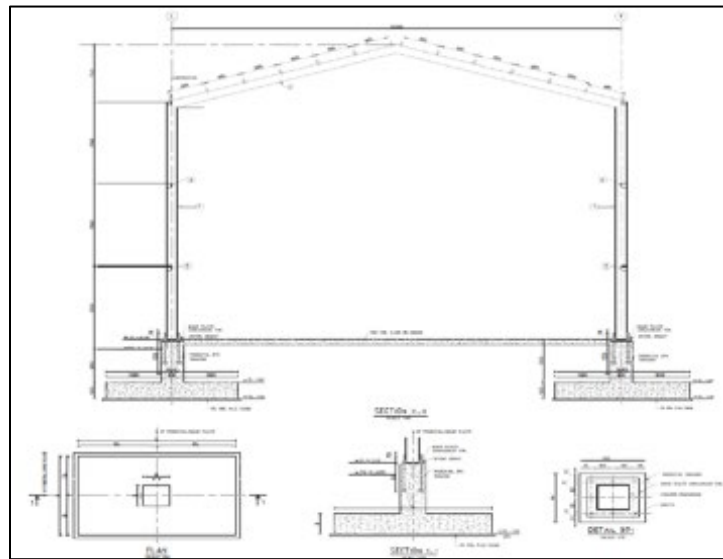


Figure 22. Column and footing layout plan in Madan Negi Station

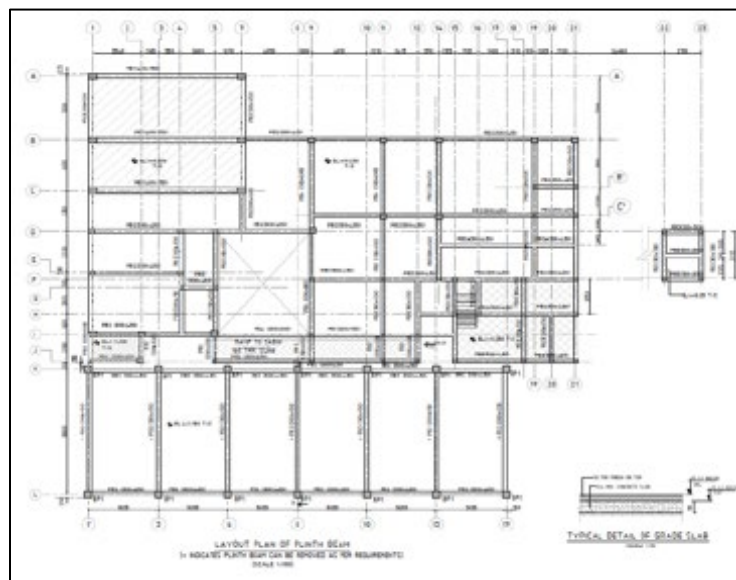


Figure 23. Plinth beam layout plan in Madan Negi Station

273. Electrical System in the Ropeway. The electrical design of the Tipri-Madan Negi ropeway system is a crucial aspect ensuring its efficient and safe operation. This design encompasses several components and systems working in harmony to provide reliable power, control, and safety mechanisms for the ropeway.

274. General Electrical System. The electrical energy required for the ropeway system is primarily provided through a connection to the electrical grid. This ensures a consistent and reliable power supply, which is essential for the continuous operation of the ropeway. The electrical components include wiring, switches, and other necessary elements that ensure the smooth flow of electricity to various parts of the system.

275. Power Supply and Backup. The main power supply for the ropeway system is derived from the electrical grid, which powers all the main components, including the drive motors and control systems. In the event of a power outage, the system is equipped with diesel generators (DG sets) at both Tipri and Madan Negi stations. These generators are designed to provide backup power, ensuring that the ropeway can continue to operate even during grid failures. This redundancy is critical for maintaining the operational reliability of the ropeway.

276. Transformers and Voltage Regulation. Transformers are installed to convert the supply voltage to the required levels for operating the ropeway system. This step-down process ensures that all electrical components receive the correct voltage, preventing damage and ensuring efficient operation. Proper voltage regulation is essential for the longevity and performance of the ropeway's electrical systems.

277. Main Drive Equipment. The main drive equipment includes an AC/DC motor of the required horsepower, which drives the ropeway system. This motor is coupled with a frequency converter, allowing for precise control of the motor's speed and torque. This setup ensures smooth acceleration and deceleration of the ropeway cabins, enhancing passenger comfort and system efficiency.

278. Control Systems. The control systems of the ropeway are modern and utilize Programmable Logic Controllers (PLCs) to manage the main drive, emergency drive, and tension unit. These systems integrate various safety devices, sensors, and interlocking mechanisms to monitor and control the ropeway's operation. The PLCs ensure that the system operates within safe parameters, automatically adjusting speeds and initiating emergency protocols if necessary.

279. Safety Devices. Safety is a paramount concern in the ropeway design. The system includes various safety devices such as overvoltage protection systems, circuit breakers, and fuses to protect the electrical components from damage. Additionally, the system is equipped with emergency brakes that can be activated in case of a power failure or other emergencies, bringing the ropeway to a controlled stop.

280. Communication and Monitoring Systems. Effective communication and monitoring are facilitated by intercoms, alarms, and sensors placed at strategic locations. These systems enable real-time communication between the stations and the control center, ensuring that any issues can be promptly addressed. Sensors monitor critical parameters like rope tension, cabin positions, and operational status, providing data to the control systems for maintaining safe and efficient operation.

281. Lighting and Power Outlets. The stations and surrounding areas are illuminated using various lighting solutions such as bollard lights, floodlights, and uplighters. These lights ensure

visibility and safety for passengers during boarding and deboarding. Additionally, power outlets are provided for different systems within the stations, ensuring that all operational and passenger needs are met.

282. Water System of the Ropeway. This system includes the installation of pipelines and storage tanks to ensure the availability of clean and potable water. The total water requirement for the ropeway system is met by bore well water or the civic supply. Water usage is primarily for flushing, drinking, hand washing, and miscellaneous purposes. The water demand is calculated based on the anticipated tourist footfall and staff requirements.

283. According to the recommendations of the Central Public Health and Environmental Engineering Organization, the design water demand is considered as 45 liters per capita per day (lpcd) for staff and 15 lpcd for visitors. For a tourist footfall of 150 persons per hour with 10 working hours per day, the total water demand is approximately 3.4 kiloliters per day. The CPHEEO manual specifies that piped water supplies should maintain adequate pressure at all points. For single-story buildings, like the ropeway stations, a residual pressure of 7 meters is required at all terminal points. This ensures efficient water distribution throughout the stations, meeting the needs of all users.

284. The water supply system adheres to the CPHEEO standards for physical, chemical, and bacteriological quality, ensuring that the water provided is safe for consumption. The primary source of water is the municipal supply, which is treated to meet these stringent quality standards. Regular testing and monitoring are conducted to maintain the required water quality.

285. Pipelines and Storage Tanks. A network of pipelines and overhead storage tanks will be installed to ensure a continuous supply of water. The overhead tanks, each with a capacity of 3 kiloliters, are located at the terraces of both Tipri and Madan Negi stations. These tanks store water for daily use, ensuring availability even during peak demand periods.

286. Sanitation Facilities. Modern toilet facilities will be provided at both stations to cater to the staff and visitors. The sanitation facilities are designed to handle the calculated water demand efficiently.

287. Maintenance and Safety. Regular maintenance of the plumbing system is essential to ensure its efficient operation. Safety features such as pressure relief valves and backflow preventers are installed to protect the system from damage and contamination. These measures ensure the longevity and reliability of the water supply system, contributing to the overall functionality and sustainability of the ropeway project.

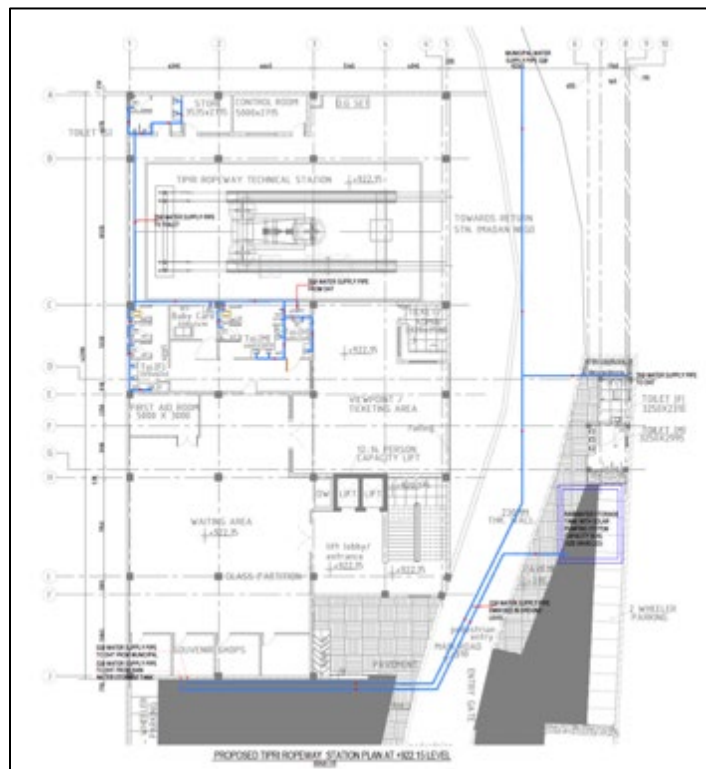


Figure 24. Water supply system in Tipri Station

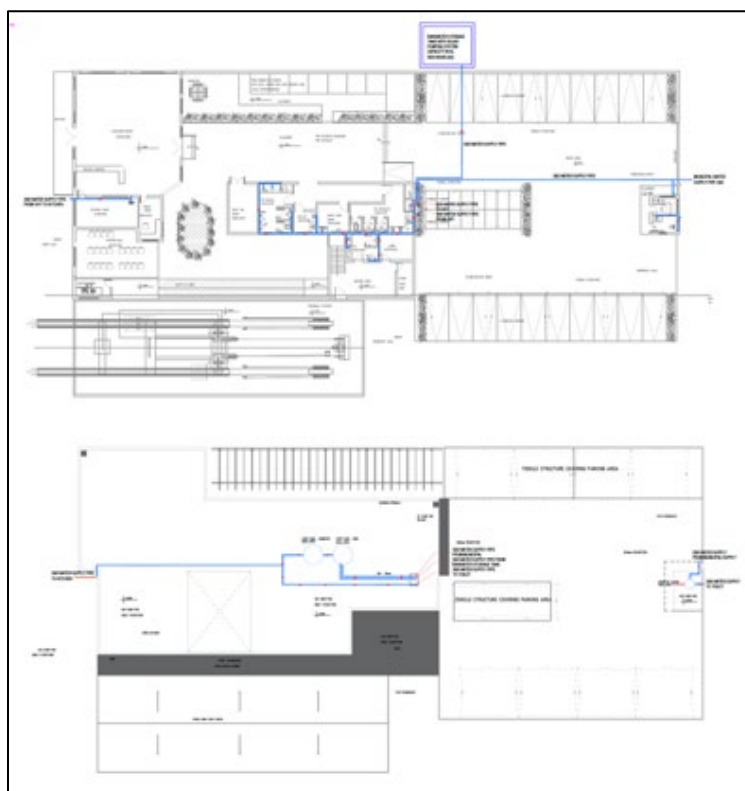


Figure 25. Water supply system in Madan Negi

288. **Wastewater System of the Ropeway.** The wastewater system is designed to handle the wastewater generated from the daily activities at both stations, ensuring proper sanitation and hygiene for staff and visitors. The system includes the following components:

289. Sanitation Facilities (Toilet Facilities). Modern toilet facilities are provided at both stations to cater to the needs of staff and visitors. The water demand for these facilities is calculated based on a tourist footfall of 150 persons per hour with a working period of 10 hours per day. The estimated water demand is 3.4 kiloliters per day, assuming that 15% of visitors will use the toilet facilities.

290. Wastewater Management. The wastewater generated at both Tipri and Madan Negi stations will be systematically managed using the biodigester system. The sewage generation calculations for the stations are based on the anticipated population and water consumption rates:

- Tourist Population: Estimated at 1500 tourists with a water consumption rate of 15 liters per capita per day (LPCD), resulting in a total sewage generation of 2.7 kiloliters per day (KLD).
- Staff: Estimated at 30 staff members with a water consumption rate of 45 LPCD, resulting in a total sewage generation of 1.08 KLD.

291. The biodigester system will ensure that all generated sewage is treated efficiently, contributing to improved environmental sanitation and health within the locality. The treated wastewater is safe for reuse in watering landscape.

292. Environmental Compliance. The wastewater management system will adhere to the guidelines and standards set by relevant environmental authorities, ensuring that the system operates within the permissible limits for discharge and treatment. Regular monitoring and maintenance of the wastewater system are carried out to ensure its efficient operation and compliance with environmental standards. This includes periodic checks of the septic tanks, soak pits, and drainage lines to prevent any blockages or leaks.

B.3. Water Transport Stations at multiple locations

293. The development of Water Transport Stations and Construction of jetties is proposed at five locations around Tehri Lake: three in the Bhagirathi Valley and two in the Bhilangana Valley. Jetty locations are proposed at Sandana, Raulakot, Dobra, Tiwar gaon and Dharkot. The locations for the proposed Water Transport Stations have been decided based on the ground conditions, land availability, population distribution and the distance from nearby towns and existing connectivity. The map indicating the locations of the proposed Water Transport Stations is provided below.



Figure 26. Proposed locations of the Water Transport Stations

294. Existing condition at the proposed water transportation stations :

295. Sandana village is located in the Pratapnagar Tehsil of Tehri Garhwal District. It is 40 km from the sub-district headquarters in Pratapnagar (Tehsildar Office) and 75 km from the district headquarters in New Tehri. There is an existing 984-meter-long single-car ropeway at Madan Negi, which takes approximately 10 minutes to reach Tipri on the other side.

296. Raulakot village is situated in the Pratapnagar Tehsil of Tehri Garhwal District. It is 10 km from the sub-district headquarters in Pratapnagar (Tehsildar Office) and 120 km from the district headquarters in New Tehri.

297. Dobra village is located in the Tehri Tehsil of Tehri Garhwal District. It is 14 km from the sub-district headquarters in Tehri (Tehsildar Office) and 14 km from the district headquarters in New Tehri. The distance from New Tehri to Dobra Chanti is 35.7 km, which takes approximately 1 hour and 8 minutes to cover.

298. Tiwar Gaon village is located in the Tehri Tehsil of Tehri Garhwal District. It is 25 km from both the sub-district headquarters in Tehri (Tehsildar Office) and the district headquarters in New Tehri. The distance from New Tehri to Tiwar Gaon is 24.7 km, which takes approximately 47 minutes to travel.

299. There is an existing floating jetty at Koti Colony, which attracts tourists seeking adventure and water activities. Several adventure sports vessels are using this existing jetty under the management of the Tehri Special Area Tourism Development Authority (TADA). The details of the vessels are given below:

Table 12. Boats operating in Tehri Lake

Sl. No.	Types of Boats Operating in Tehri Lake	Number
1	Motor boats operating in Tehri Lake	78
2	Jet ski operating in Tehri Lake	14
3	Jet attack operating in Tehri lake	14
4	Parasailing boat operating in Tehri lake	3
5	Shikara boat operated in Tehri lake	3
6	Cruise boat	1

Source: DPR

300. **Proposed Water Transport Stations :**

301. Water Transport stations/Jetties are proposed at five locations around Tehri Lake: two in the Bhilangana Valley; i. Sandana, ii. Dharkot. And three in the Bhagirathi Valley; i. Raulakot, ii. Dobra Chanti, iii. Tiwargoan. The proposed Water Transport Stations/jetties are strategically placed to facilitate better connectivity between towns in these areas.

302. **Sandana.** The project location has been selected based on the proximity to nearby towns and villages, as well as the accessibility of the site. It is situated in the Bhilangana Valley. The Water Transport Station building is not proposed here due to a lack of availability of land.



Figure 27. Proposed jetty location at Sandana

303. **Dharkot.** The location has been strategically selected for its proximity to surrounding towns and villages, which ensures ease of access for both visitors and staff. Situated in the scenic Bhilangana Valley, the site is well-connected to existing infrastructure, enhancing its suitability for the proposed development. The Irrigation Department will be responsible for developing both the station building and the approach road, providing necessary support facilities to ensure smooth operations. Given that the Dharkot Jetty falls within the administrative jurisdiction of the Irrigation Department, no separate jetty station building will be constructed at that location. Instead, resources will be focused on enhancing connectivity and accessibility to the main site.



Figure 28. Proposed jetty location at Dharkot

304. **Raulakot.** The project location is selected based on its proximity to nearby towns and villages, as well as the accessibility of the site. The Raulakot Jetty station with 352.4 sqm area, will be accessible solely on foot, with no parking facilities available. The design includes food stalls and waiting areas situated outside the station building for the convenience of visitors. The Water Transport Station building will feature a baby feeder room, washrooms for males, females, and differently-abled individuals with changing facilities, a first Aid Room, and a waiting area accommodating 30 people. Additionally, the station is proposed to be equipped with fire-fighting arrangements, a panic button, emergency services, and first aid services.



Figure 29. Proposed jetty location at Raulakot

305. **Dobra Chanti.** The project location has been chosen with reference to the Dobra Chanti Suspension Bridge. Water transport station is not planned for this location because of non-availability of land.



Figure 30. Proposed jetty location at Dobra Chanti Suspension Bridge

306. **Tiwar Gaon.** The project location was selected based on the proposed site for a pedestrian suspension bridge.. The proposed Water transport Station at Tiwar Gaon will have a built-up area of 298.5 sqm and will be accessible only by foot, with no parking facilities provided.

The Water Transport Station building will include a baby feeder room, washrooms for males, females, and differently-abled individuals with changing facilities, a First Aid Room, and a waiting area for 30 people. It will also be equipped with firefighting equipment, a panic button, emergency services, and first aid capabilities. The design also includes food stalls and waiting areas outside the station building to accommodate visitors.



Figure 31. Proposed jetty location at Tiwar Gaon

307. **Approach Roads.** An approach road will connect the Water Transport Station building to the jetty location. This pathway, approximately 1 km long with a user-friendly slope of 1:12, is designed exclusively for pedestrian use. Pedestrians include individuals who walk, sit, stand in public spaces, or use mobility aids such as walking sticks, crutches, or wheelchairs. The approach pathway, which will be constructed with water-resistant paver blocks, ensures accessibility for all. The elevation difference between the Water Transport Station building and the Jetty location is approximately 80 to 90 meters. Approach roads will be provided at three locations: Tiwar Gaon, Raulakot, and Sandana. Additionally, the approach road proposed as part of Dobra Chanti subproject will be utilized for the Dobra Chanti Jetty. The details of the proposed approach road sections is provided below:

Table 13. Proposed approach roads for water transport stations

S. NO.	Location	Existing Road Length (m)	Proposed additional Road Length (m)	Total Road Length (m)
1	Tiwar Gaon	717	326	1043
2	Raulakot	123	595	718
3	Sandana	747	182	929

Source: DPR

308. **Raw material.** Raw material requirement for the entire project has been assessed for various materials like High-Density Polyethylene (HDPE) for pontoons, Reinforced Cement Concrete and Steel for jetty station building. The Grade of RCC used is M25 and Grade of Steel is Fe 500. Most of the materials will be procured from local vendors only to reduce the environmental footprint of the project.

309. **Water requirement.** The total water demand has been estimated by considering a footfall

of 60 persons per hour at each Water Transport Station/Jetties, over a 12-hour period daily. The water needs of a working staff of 70 individuals have also been included in this calculation. The calculation for the same has been shown below:

310. A dependable and efficient water supply system is crucial for fulfilling the daily water needs of the Water Transport Station Building. To ensure a steady supply of clean and potable water for staff and visitors, pipelines and storage tanks will be installed. The primary source of water will be the Pey Jal Jeevan water supply. The per capita water supply requirements are as follows:

- 45 liters per staff member per day, as per NBC 2016 Part 9.
- 15 liters per visitor per day, as per NBC 2016 Part 9.

311. Since there are no landscaped areas planned at any of the Water Transport Stations, water usage will be strictly for essential purposes. A drinking water cooler with a storage capacity of 1,000 liters, equipped with an RO plant, will be provided to meet the drinking water needs of both staff and visitors. Water from the Pey Jal Jeevan supply will be stored in an overhead tank, from where it will be distributed by gravity to the necessary fixtures and outlet points.

312. The total water demand for the water transport station has been calculated based on the anticipated usage patterns at each jetty station. The estimation considers a footfall of 60 visitors per hour at each station over a 12-hour period daily, which results in a total of 720 visitors per day. Additionally, the water needs of 70 working staff members have been incorporated into the calculation, though only 20 staff members are expected to be present at the jetties daily.

313. The water demand for visitors is calculated with a design basis of 15 liters per capita per day (Lpcd), resulting in a total requirement of 10.8 kiloliters per day (KLD). For the staff, a higher design basis of 45 Lpcd is used, considering their more frequent and varied use of water facilities, leading to a demand of 0.9 KLD. Summing up the requirements for both staff and visitors, the total freshwater demand at the jetty stations amounts to 11.7 KLD.

314. This estimation ensures that the water supply system at the jetty stations is designed to meet the daily needs of both staff and visitors, ensuring adequate water availability throughout operational hours. The allocation of water resources based on the specific design criteria helps in effective planning and management of water supply, thereby supporting the smooth functioning of the stations.

315. **Power requirement.** The electrical infrastructure for the proposed Water Transport Stations/Jetty area and approach road is designed to ensure a redundant power supply and maintain power quality. Power will be supplied by the State Electricity Department and metered at a single point for the station building (LT metering) for billing purposes. In line with current electricity regulations, the required power supply from the local electricity board will be provided at 0.415 KV. It is assumed that the power supply to the park premises will be sourced from the State Electricity Department.

316. **Labor requirement.** Job opportunities will be generated during both the construction and the operation and maintenance (O&M) phases of the subproject. It is expected that approximately 70-75 individuals will be employed for the O&M activities at each jetty location. On average, 31-34 boats will be in operation, each requiring two personnel to operate, in addition to other operational staff who will also be engaged.

317. **Waste water disposal.** A two-pipe system is implemented for the wastewater collection at the jetty station's toilet block, utilizing gravity for waste flow. One pipe handles waste from floor

traps, washbasins, and pantry sinks, while the other is dedicated to water closets and urinals. A sewage treatment plant with a capacity of 10 KL is proposed near each jetty station. Wastewater will be channeled through the pipes, collected by gully traps and manholes, and then directed to the sewage treatment plant. The selection of treatment technology will be based on a techno-economic feasibility assessment, which will consider several key factors:

- Required degree of treatment
- Capital cost of the project
- Power requirement
- Land requirement
- Ease of construction
- Operation and maintenance
- Proven process effectiveness
- Ability to handle hydraulic and organic shock loads

318. **Sewage Generation.** The calculation for sewage generation at the proposed Water Transport Station building considers both the staff and visitors. The total population served by the facility includes 20 staff members and an estimated 720 daily visitors. The water demand is estimated based on a consumption rate of 45 lpcd for staff and 15 lpcd for visitors. This results in a total freshwater demand of 11.70 kld. The wastewater generated is estimated at 80% of the total water demand, amounting to approximately 9.36 kld.

319. For the staff, with a consumption rate of 45 lpcd, the total water demand is 0.9 kld, leading to wastewater generation of 0.72 kld. Visitors, consuming 15 lpcd, contribute a total water demand of 10.8 kld, resulting in 8.64 kld of wastewater. The cumulative freshwater demand and wastewater generation are calculated to be 11.70 kld and 9.36 kld, respectively. This estimation ensures that the facility's water supply and sewage treatment system can effectively cater to the needs of the users.

320. A 10 kld packaged treatment plant has been proposed to treat the wastewater generated at the Water Transport Station building. With a capacity of 10 kld, the plant is adequately designed to handle the estimated 9.36 kld of wastewater. This allows for efficient treatment of sewage and ensures that environmental compliance and hygiene standards are maintained at the facility.

321. **Storm water drainage system.** The storm drainage system is designed to function on a gravity basis. Rainwater from the Water Transport Station roof will be gathered by Khurra outlets, with the roof sloped towards these collection points. The rainwater will then flow through down take pipes connected to manholes at ground level. At ground level, the rainwater will be collected via the manholes and the connected pipe network. For buildings located close to the lake, the rooftop rainwater will be discharged directly into the nearby lake.

B.4. Designing, supply, and installation of signages and Last Mile Connectivity

322. The Tehri Lake region is envisioned for comprehensive development into a world-class tourist destination. This subproject focuses on a crucial element of tourism destination development, specifically iconicity and branding. Establishing a distinct identity and brand for Tehri Lake is essential for promoting it as a new and attractive destination, thereby driving tourism growth. The goal is to create a recognizable image that resonates with visitors, ultimately fostering increased tourist inflows and contributing to the region's economic and social development

323. The area currently suffers from a lack of a cohesive and integrated signage system, which makes navigation and connectivity challenging for visitors. Additionally, the public transportation

network is inadequate, resulting in poor connectivity between key points of interest. At present, various agencies have installed ad-hoc signage based on immediate needs, leading to inconsistent designs and placements. This lack of standardization not only affects the aesthetic appeal but also hampers the overall visitor experience. Examples of these scattered and uncoordinated signages are shown below:



Figure 32. Sample random signages at various locations across project area

324. The current signage installed across various locations around Tehri Lake lacks uniformity and a cohesive design language. Inconsistent color schemes, text, font sizes, typefaces, languages, materials, and overall design create visual clutter, detracting from the area's aesthetic appeal. Furthermore, most of the signage is made from modern materials like painted iron boards, printed flex banners, and wall paintings. While these materials are cost-effective and low maintenance, they fail to reflect the local architectural style and artistic elements, missing an opportunity to enhance the cultural richness of the area.

325. The absence of a comprehensive signage system makes navigation difficult for visitors. Many lesser-known attractions, such as the Madan Negi cluster, Mahadev Temple, Dobra Chanti Bridge, and Tipri Madan Negi Ropeway, remain underpromoted. Additionally, the design of signage is largely unregulated, especially in commercial areas, where businesses compete for attention, creating visual chaos. To improve the overall experience, there is a need for regulated guidelines that cover aspects such as color schemes, signage size, installation height, typography, and maintenance.

326. Another issue is the fragmented ownership of signage, with various stakeholders—executing or funding agencies, business owners, operating agencies, and local governments—each responsible for different signage. This has led to discrepancies in budgets, maintenance, and design standards. Many signs also fail to comply with codes regarding text size, color contrast, and placement, compromising their effectiveness. Moreover, the destination lacks signage provisions for differently abled visitors, such as tactile paving, adequate lighting, Braille, and public address systems, making it less inclusive for all visitors.

327. *Design Concept.* The signage system across Tehri Lake currently suffers from a lack of cohesion, as inconsistent design elements such as color schemes, fonts, and materials result in visual clutter that detracts from the overall aesthetic appeal. Despite the use of modern, low-maintenance materials, these signs miss the opportunity to incorporate local cultural and architectural elements, which would enhance the region's unique identity. Furthermore, the absence of a comprehensive signage strategy hampers navigation, leaving many lesser-known

attractions underpromoted. Without regulated design standards, commercial signage creates visual chaos, further diminishing the visitor experience. Compounding these issues is the fragmented ownership of signage, with different stakeholders managing their installations independently, leading to inconsistent budgets, maintenance, and design. This disjointed approach not only affects the visual quality but also leads to non-compliance with codes, particularly those that ensure signage is accessible to differently abled individuals. To create a more cohesive, functional, and inclusive wayfinding system, it is essential to implement regulated guidelines and promote a unified design language across the region. The strategy will be:

- Tourists need to be guided, informed, and engaged from the moment they arrive at the destination—and even before that. In today's world, people often research locations well in advance through the internet. To facilitate this, a web-based user application is being developed to provide essential information to tourists as they plan their visit to Tehri
- Upon arrival, visitors will be greeted by grand entrance gateways, proposed along all major approach routes. As they travel along the tourism road, they will also see panels promoting local tourist destinations.
- For those arriving by bus, there will be an information center featuring interactive displays, regional maps, and facility maps right at the terminal. Information centers have been proposed at prominent locations within the project area, such as the ISBT and Koti Colony, which experience high tourist traffic, enabling visitors to make well-informed decisions for the remainder of their stay.
- Prominent buildings will be identified by individual lettering mounted on their façades. At major tourist spots, a signage wall will be installed outside the facility to welcome visitors.
- Various tourist destinations will be enhanced with directional signage, amenity signage, parking signage, instructional signage, tactile paving, and local and regional maps to create a comprehensive wayfinding and information system for visitors.

328. The proposed signage system for Tehri has been designed to address several key shortcomings identified in the existing setup. The first defining feature of this new system is its integration, which ensures that signage across the entire project area works cohesively. By creating a unified signage system, the different parts of the area will be better coordinated, leading to improved synergy. This integrated approach is crucial to establishing a smooth, coherent experience for visitors, allowing them to easily navigate the project area.

329. Another important characteristic is uniformity. The signage design will be consistent throughout the project area, which will help create a strong sense of identity and improve placemaking. A uniform signage system also ensures that visitors can easily recognize their surroundings, making the area more accessible and enhancing their overall experience. By standardizing colors, fonts, and materials, the signage system will not only be more visually appealing but also more functional in guiding tourists efficiently to their destinations.

330. Accessibility has been a major focus in designing this signage system. The inclusion of tactile signage maps, Braille text, tactile paving, and audio-visual interactive displays ensures that the system is user-friendly for all visitors, including those who are differently abled. In addition, the regional tourist map will specifically highlight EWCD-friendly (Elderly, Women, Children, and Differently Abled) areas, ensuring that these groups have a seamless experience navigating the area. This accessibility feature represents a significant improvement, making Tehri a more inclusive destination.

331. The signage system will also be code compliant, adhering to all applicable regulations and standards. This guarantees that the signage meets the required specifications for text size, color

contrast, and placement, ensuring both safety and clarity. Furthermore, the proposed signage has been designed with an eye for aesthetics, carefully incorporating local materials and forms. The blend of sophistication and ruggedness will reflect the natural, hilly landscape of Tehri, creating an appropriate visual balance for a tourist destination in a hill region.

332. The design components of the signage system can be divided into two major categories: road signage and tourism signage. Road signage includes mandatory, cautionary, and informational signs, all following IRC:67-2012 standards. These signs will be installed along the tourism road and as part of the ring road project. Meanwhile, the tourism signage system will focus on guiding visitors to their desired locations, informing them of additional attractions to encourage longer stays, and helping them make informed decisions about their itineraries. This system will also play a key role in communicating the identity of the Tehri area, while remaining harmonious with the natural surroundings. Moreover, tourism signage will provide essential emergency warnings where necessary, ensuring the safety of visitors.

333. The proposed signage system for Tehri has been carefully designed to guide and inform visitors at multiple levels, ensuring that navigation is easy and seamless throughout their journey. The first key focus is on transportation nodes, which include major hubs such as the ISBT in New Tehri, water transport stations, ropeway stations, and hop-on hop-off stations. These are crucial entry points for tourists, and the signage here will play a significant role in helping visitors orient themselves and find necessary information immediately upon arrival. Clear, well-placed signage at these locations will enhance the visitor experience by providing direction and ensuring smooth transitions from one mode of transport to another.

334. Beyond transportation nodes, the signage system will extend along major routes such as the Tourism Road and the last mile connectivity routes that lead visitors to various destinations. These signs will help tourists navigate the main routes efficiently, whether they are exploring by car, on foot, or using local transport. The last mile connectivity signage is particularly important for guiding visitors to more remote locations and lesser-known attractions, ensuring that they do not get lost or miss out on any key destinations.

335. At tourist destinations, the signage system will provide essential guidance at prominent locations, such as the Koti Colony Lake Cluster, Dobra Chanti Park, Herbal Park, Biodiversity Park & Horticulture Garden, and the Yoga-Meditation & Panchkarma Center. In addition to these major attractions, the signage will also cover important villages like Tiwar Gaon, Khola, Kangsali, Dharkot, and Sandana, as well as lake promenades and temples. These signs will not only direct tourists to these locations but also offer information about the history, culture, and significance of each site, enriching the visitor experience.

336. Finally, the signage system will be supported remotely through a Tourist Mobile Application, which will be accessible via QR codes integrated into the physical signage throughout the project area. This app will allow visitors to access detailed information about their surroundings, upcoming events, and suggested itineraries, making the entire experience more interactive and engaging. By integrating modern technology with traditional signage, this system ensures that tourists can access up-to-date information, no matter where they are in Tehri.

B.4.1. Types of Tourism Signages

337. At the entry points of major tourist destinations, a prominent signage wall will be installed. This wall will feature the name of the location displayed in large, brass letters, visible from a significant distance. The design uses natural materials, with the base constructed from slate

bricks. Above this, ashlar stone masonry, utilizing locally sourced stone, will create a sturdy and aesthetic structure. The backdrop will consist of Kadappa stone, complementing the brass lettering with a refined contrast between matte and glossy materials for a sophisticated appearance. The UTDB logo will be placed on the right side, alongside a QR code that links to the tourism mobile application. On the left side, a copper sheet will be etched with a line drawing and a descriptive text of the site, such as Koti Colony or Dobra Chanti Park. The text will also be provided in Braille to accommodate visually impaired visitors. The copper sheet will be framed within a traditional wooden arch, reflecting local architectural styles and enhancing the cultural identity of the signage.

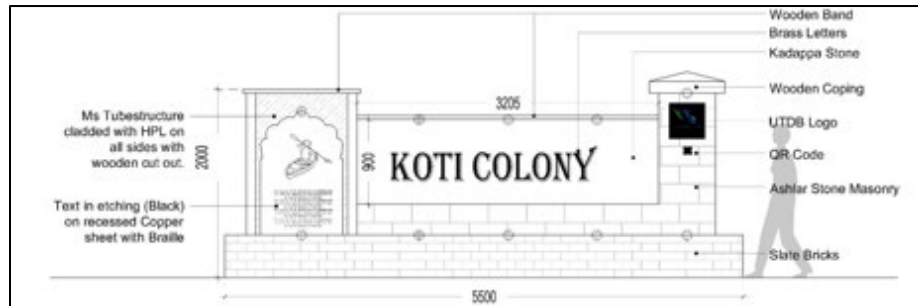


Figure 33. Sample design for welcome signage wall at entrance

338. Instructional and warning signage is a critical component at all tourist destinations. These signs will be integrated into traditionally styled walls made from slate bricks, with the instructional text embedded in an aluminum composite panel. These signs will provide essential instructions and warnings regarding the site, including guidelines for the differently abled, safety warnings for areas like the lake promenade, and facility-specific dos and don'ts. Important contact numbers will also be displayed. General information, such as 'No Smoking Zone', and 'Don't Drink and Drive', will also be included. All text will be accompanied by Braille to ensure accessibility for the visually impaired.

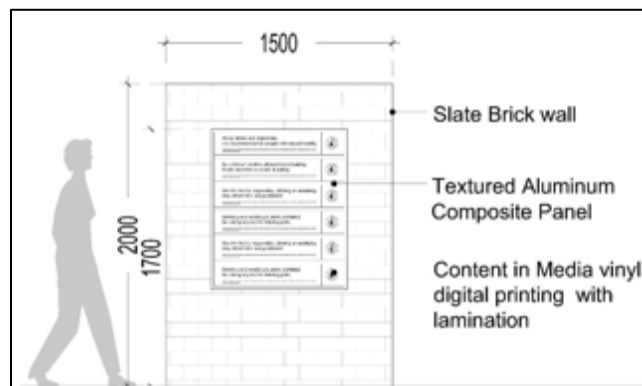


Figure 34. Sample design for instruction/warning signage

339. *Regional Map.* This signage will present a detailed map of the entire tourist destination, covering Tehri Lake and New Tehri town. Major points of tourist interest will be marked and listed, with all key locations highlighted. The map will be designed to be tactile, with embossed or etched lines and icons to represent tourist spots, making it accessible to all visitors, including those with visual impairments.

340. **Facility Map.** Each specific facility, such as Tiwar Gaon or Herbal Park, will have a detailed map that highlights utilities, important points of interest, and routes. These maps will be installed at strategic locations within each facility and will include a 'You are here' marker to assist with wayfinding.

341. Both maps will be etched on a wooden panel, encased in High-Pressure Laminate (HP) for durability and installed on a mild steel frame. The use of HP panels will protect the wood, ensuring the maps' longevity. A QR code will be integrated into the panel, allowing visitors to scan and access the mobile tourism app for further information.

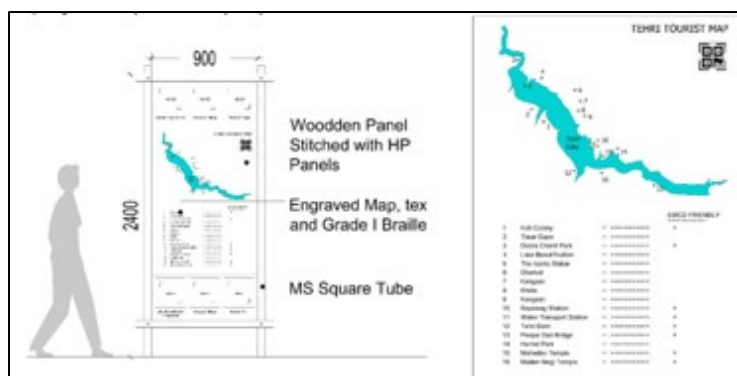


Figure 35. Sample design for regional and facility map

342. No wayfinding system is complete without directional signage. Multi-directional posts will be installed at all critical decision points within each facility to guide visitors to nearby attractions such as markets, food outlets, and children's parks in Koti Colony. For longer routes, single-directional posts will be strategically placed along the way to reassure visitors of their path. These posts will be constructed from wrought iron for durability and a robust aesthetic, with wooden panels fitted into HP laminate frames. The text will be engraved in contrasting colors, such as black on an oakwood background, for maximum visibility and readability.

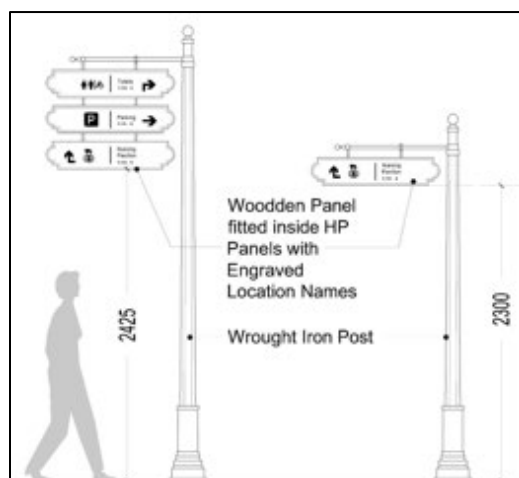


Figure 36. Sample design for directional signage

343. Advertisement signage will be placed along the tourism road and in high-footfall areas like

Biodiversity Park, Horticulture Garden, Yoga and Meditation Centers, Model Villages, bus stops, water transport stations, and ropeway stations. These advertisement boards will use backlit clip-on frames with static fabric displays, giving the appearance of digital signage but remaining static to minimize the risk of vandalism in public spaces. TADA will be responsible for the operation and maintenance of these advertisement boards. Interested advertisers will submit requests through the respective O&M entities, with both revenue and responsibilities shared between the O&M entity and TADA.

344. Interactive displays will be strategically installed in select facilities with controlled environments, monitored by camera or manual surveillance. These displays will provide visitors with audio-visual information about the location, including real-time updates on weather, road conditions, and emergencies, if applicable. The displays will also provide critical information about potential hazards, such as flood alerts, landslide warnings, red alerts, seismic activity, wind speed, and expected rainfall, along with emergency contact numbers.

345. The variable message display boards will be installed along the tourism road as part of the Smart Infrastructure subproject, with boards placed at intervals of every 250 meters. These boards will display important, real-time information regarding weather conditions, road statuses, and any emergencies that may arise. Additionally, they will provide general driving safety instructions, helping travelers stay informed and navigate the roads safely. The inclusion of these displays will significantly enhance communication with visitors and improve safety throughout the area.

346. The project will introduce building identification signage using stainless steel lettering for building labels across the project area. This approach will follow the current design used on prominent buildings such as the Integrated Information Center in Koti Colony. The signage will be backlit to ensure visibility at night, promoting safety and uniformity in design. By standardizing signage across all buildings, the project will create a cohesive visual identity while making navigation easier, especially after dark.

347. Utility signage with braille will be installed across the facilities for essential utilities such as washrooms, drinking water stations, and baby feeding rooms. These signs will ensure that all visitors, including those who are visually impaired, will have access to important information, ensuring a fully inclusive experience.

348. Parking signage will also be installed, with parking labels mounted along driving routes before the first turning lane, making it easier for drivers to locate parking lots. Special signs will be placed for spaces reserved for differently abled visitors and electric vehicle parking, making these amenities easily identifiable and improving the accessibility of the facilities.

B.4.1.2. Signage design regulations

349. A signage design regulation will be established to guide future signage design and installation. This regulation will ensure that all new signage aligns with the overall project vision. The regulations will apply to shops, whether located on roadsides or inside buildings (such as the ISBT or covered markets), vending kiosks, and buildings used for official, commercial, or public purposes. The regulation will prevent visual clutter and ensure the signage contributes to the overall aesthetic of the area.

350. The project will define types of signage based on location and use. For example, shops will be allowed hand-painted signage on fascia panels or rolling shutters in the absence of fascia,

while vending kiosks will display signs on the uppermost part of the stall. Buildings with three or more floors (G+2 and beyond) will use individually mounted stainless steel channel letters for identification. The signage will follow a minimalist design, ensuring consistency and refinement.

351. Several prohibitions will be enforced to maintain the area's visual appeal. Only the building's logo or that of the principal tenant/owner will be allowed at beam level, while small hand-painted signs will be permitted for upper-floor tenants. Additionally, projecting signs, banners, and sandwich boards will be prohibited to prevent visual clutter and maintain the streetscape's aesthetic integrity.

352. The Project's key design recommendations will emphasize simplicity and legibility. Fascia panels will only contain the shop name and number, and plastic fascias or projecting box signs will not be allowed. Shop names will either be hand-painted or use individually mounted lettering, with simple and legible designs. Lettering will typically be in a sans serif font and no more than 40 cm in height. Retailers will be encouraged to display their shop numbers, while large upper-floor signage will not be allowed. Modest nameplates at entrances or lettering on upper-floor windows will be considered acceptable, ensuring that the building's design remains unobstructed and visually appealing.

353. Lastly, lettering will be a key aspect of the shopfront design, respecting the character of the building and the street. The size of the lettering will be designed for legibility without overwhelming the shopfront or fascia. The lettering style will reflect the shop's image while complementing the building's other design elements. Each shop will be required to display its street number clearly, contributing to an overall sense of cohesion and clarity across all signage in the project area.

B.4.2. Last Mile Connectivity

354. The necessity of an effective public transport (PT) system is widely acknowledged by planners and policymakers. It is often justified to reduce vehicular pollution, alleviate congestion, and decrease traffic accidents. In recent years, the availability of high-quality PT systems has gained importance due to the United Nations Sustainable Development Goals (UN SDGs), which aim to promote sustainable infrastructure globally. Public transport, along with last-mile connectivity for tourism destinations, is crucial to the development of a successful tourist destination. The selection of an appropriate PT system depends on an in-depth understanding of commuters' preferences, land-use patterns, and expected changes in these factors. Additionally, the performance characteristics of various PT systems must be considered to ensure optimal functionality.

B.4.2.1. Connectivity Concept

355. Various mass rapid transit systems or public transport options can be proposed for the Tehri region. Currently, small-sized buses and shared vehicles are operating in and around Tehri. PT systems can be categorized based on the right of way (ROW—shared, partially shared, or exclusive) and ownership (private, public, or hybrid). The design, operation, and performance of the system are influenced by these factors. Existing road-based bus systems and intermediate PT systems have a shared ROW, typically 7-10 meters wide. However, the proposed ring road will expand the ROW to 20-24 meters, with a carriageway of 7 meters. Bus systems can be assigned exclusive lanes along the entire route or part of the route. Hop-on/hop-off bus services, a flexible sightseeing option, will also be introduced to allow tourists to explore the region at their own pace, boarding and disembarking at multiple stops along the route. The flexibility of these

services encourages extended exploration without the constraints of a guided group.

356. A network of bus routes will be created, with different bus sizes deployed to meet commuter demand at various times of the day. Identified bus stop locations along the tourism road are presented in the table below. This hop-on/hop-off service will be optimized for the tourism road, with route expansion and additional stops considered to increase ridership and enhance the tourism experience. Properly planned public infrastructure and amenities along these routes will significantly improve the performance of the service.

357. Bust stop names at ADB-assisted project area:

- ISBT Burari
- Boating Point Bus Stop (Near Panch Koti) (0+000 chainage in Tourism Road)
- THDCL Colony (0+300) (view point 1)
- Jakh waterfall Bus Stop (2+775 chainage in Tourism Road)
- Chamba diversion (02+950) Tourism road
- Jakh Diversion (3+500)
- Tiwar Gaon Village (5+600)
- Tiwargaon View Point 2- Bus Stop (06+825)
- Tiwar Gaon – View Point 3 (07+435)
- Marora – 08+250
- DobraChanti (View point 6) 15+725
- View point 4- 09+975 to 10+075
- View Point 5- 14+600 to 15+375



Figure 37. Proposed Bus stop location under ADB assisted project

358. The proposed bus stops on the left bank of the Tehri Lake on PWD ring road are: Stations: Bhauniyara (Dowal Moli), Sandana, Madan Negi Health Center, Kangsali, Bhengi, Sem, Kanda (Koldhar), Chanthi, Motna, Bisatali, Khola, Kutani ka Gaon (Maa Bhagwato Mandir), Dharkot Adventure, Dharkot, Peepal Daali, Herbal Park, Sandana Spice Garden, Raulakot, , Madan Negi, Ropeway Station, Madan Negi Temple, Gwar, Okhala Market, Kodga, Banali, Pratap Nagar-1, Partap Nagar-2



Figure 38. Tentative proposed Bus stop locations in Public Works Department ring road

B.4.2.2. Core Features of Bus Shelters

359. For passengers, long granite seating ledge is provided for seating which is comfortable and long lasting. There is a tendency of people sleeping on seating facility. To avoid this hand rests are designed in between the ledge.



Figure 39. Sample design of bus shelters with seating Facility

360. Signages play important role in bus shelter design as these will assist people to locate them. There are two signage boards in the bus shelter design. One is marker element or tall element which is visible from far to people walking on the side pathways and other one in the front visible to the people across the road.

361. Signages play important role in bus shelter design as these will assist people to locate them. There are two signage boards in the bus shelter design. One is marker element or tall element which is visible from far to people walking on the side pathways and other one in the front

visible to the people across the road. Both signage boards are distinctively coloured to grab the attention of people. It is recommended that no advertisement boards are provided adjacent to this signage as the signage boards may get unnoticed or remain hidden in presence of advertisement boards.

362. Information board bus schedule, route information, and a map should be located/displayed in or next to bus shelters. Such display installed at bus stops provides arrival times of approaching buses to waiting passengers. Details may include line number, destination, and arrival time.

363. Disability-friendly access city bus service can now be made more easy, not only physically disabled people but also to the blind and deaf, due to make bus stops more accessible to these individuals. Provision of ramps, Digital display boards for both audio and visual makes bus shelter more disabled friendly.

364. Dependent on-site conditions, bus bay are provided most of the locations. These are bus pull out of the flow of traffic to pick up and drop off passengers. It is often indented into the sidewalk or other pedestrian area. Creating bus bay helps in reducing traffic jams.

B.4.2.3. None-Core Feature of Bus Stops

365. Advertisement Board is noncore element of bus shelter, which brings revenue. These advertisement boards are back lit and helps for lighting the bus shelter during the nighttime. There is provision of light points in the ceiling also. But these advertisement boards will give additional light for shelters.

366. Kiosks are additional facility for commuters. During the waiting time they may require newspapers, magazines, some dry snacks, water bottles etc. For such facilities small kiosk are better solutions. Kiosks are designed with very light structural elements. These are non-permanent structures and located at end of the bus bay so that the crowd around it should not disturb the passengers to use busses.

367. Electronic toilets (e-toilets), one of the major innovations in the public health, hygiene, and sanitation sector. E-Toilet incorporates full cycle approach in sustainable sanitation by integrating convergence of electronics, mechanical, web-mobile technologies thereby controlling entry, usage, cleaning, exit, and remote monitoring capabilities with multiple revenue options. The insertion of a coin opens the door of the e-toilet for users, switches on a light—thus saving energy—and even directs the person with audio commands. The toilets are programmed to flush 1.5 liters of water after 3 minutes of usage or 4.5 liters if usage is longer It can also be programmed to clean the platform with a complete wash down after every 5 or 10 persons use the toilet.

368. Safety is one prime consideration in any public facility buildings. Introduction of cameras reduced crime by approximately 25%, with 15%.

B.4.2.4. Types of Bus Shelters

369. There are Three Types of Bus shelter are proposed in proposed locations depending on commuter density and space availability at site: (i) Type A- 12 mts. Bus shelter with Kiosk and Bus bay, (ii) Type B- 12 mts. Bus shelter with bus bay, (iii) Type C- 9 mts. Bus Shelter.

370. Type A- 12 m bus shelter. These shelter are 12 m wide and 2.4 m high. Light in structure having all the elements like signage, seating, waiting stands, information boards, kiosk, bollards,

advertisement boards, landscaping, bus bay etc.

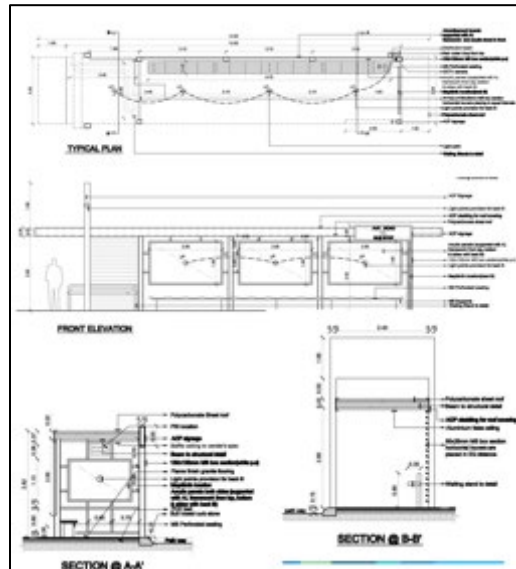


Figure 40. Sample design of 12 m bus shelter

371. Type B-12 m bus shelter with bus bay. With a bus bay, featuring similar elements as Type A, however without a kiosk.

372. Type C-9 m bus shelter. These shelters are 9 m wide and 2.4 m high. Light in structure having the elements like signage, seating, waiting stands, information boards, bollards, advertisement boards, landscaping etc. designed for smaller sites with lower commuter density, including seating, signage, and information boards.

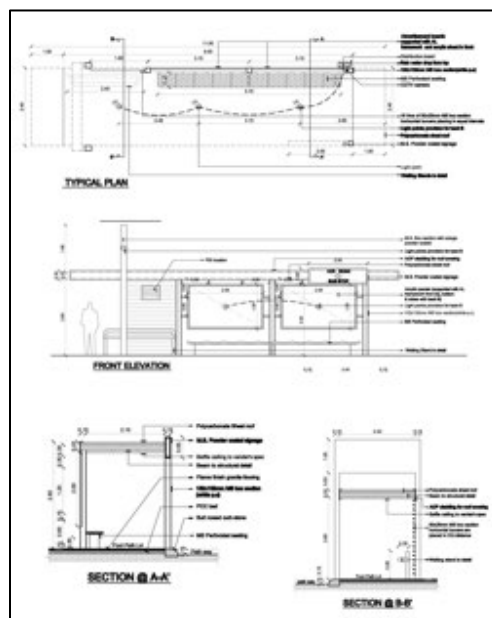


Figure 41. Typical 9 m bus shelter design

B.5. Smart Infrastructure

373. The smart street loop in New Tehri is a planned road network that starts from the ISBT and connects significant roads such as College Road and the road abutting Baurari Stadium, incorporating parts of Old Tehri Road. This loop is designed to link major public buildings, including the Baurari Stadium complex, Government Pratap Inter College, Saint Anthony Public School, the City Centre (Covered Bazaar), and the ISBT, making it a critical movement corridor in the town. The Baurari Stadium complex, a hub for public functions, includes the stadium, Clock Tower, New Tehri Talkies (cinema hall), Nagar Palika Parishad, and Nagar Palika Park. The objective of the project is to install appropriate check points for solutions implemented, so that the services delivered to the public are to the at most satisfaction of public.

374. The objective of the smart loop and smart infrastructure in New Tehri is to enhance urban efficiency, safety, and convenience through integrated transportation and public service systems. This includes optimizing traffic flow, reducing congestion, and promoting sustainable mobility with eco-friendly transport options. The initiative aims to improve public safety through advanced surveillance and real-time monitoring, increase the efficiency of public services with smart management systems, and facilitate data-driven decision-making. Additionally, it seeks to boost citizen engagement and satisfaction by providing real-time information and efficient service delivery, while also optimizing resource management through predictive maintenance and continuous service delivery. Overall, the goal is to create a smarter, safer, and more sustainable urban environment that benefits residents and visitors alike.



Figure 42. Map of smart infrastructure components

375. The scope of the subproject includes the implementation of identified smart ICT solutions including Integrated Command and Control Centre (ICCC) and integration of the implemented solutions with ICCC. The scope also includes conducting a detailed assessment of the current state of city services being provided and accordingly, plan, design a comprehensive technical architecture of ICCC so that relevant current and future ICT projects may be integrated with ICCC. The project aims to integrate various ICT initiatives of the city with ICCC. These ICT initiatives may be from other departments also like Police, Transport etc. The scope and objective of the subproject are:

376. **Integrated Command and Control Center (ICCC).** Setting up ICCC with 15 operators control room and operations and maintenance of the command center for the contract duration. CCC Solution should have a central infrastructure and Services management platform to centrally monitor and manage all the services.

377. ISBT area which has now been suggested is centrally located and is an ideal site for ICCC. However, it will require some civil work to make it waterproof. There are some partitions which have to be and the whole floor has to be converted into ICCC.

378. Key objectives of the ICCC are listed as:

- To serve as the centralized monitoring and decision-making hub for managing equipment, devices, resources and assets
- To serve as a centralized decision-making center which supports and strengthens coordination in response to incidents / emergency situations
- To serve as central information, communication, incident management hub for BSCL
- To provide integration points for other existing or proposed command center from other government agencies e.g. police, disaster, etc.

379. ICCC will enable city administration and its stakeholders in the following:

- Effective decision making
- Delivering effective governance by aggregating various data feeds from sensors and systems
- Providing interface/ dashboards to generate alert and notifications in real time.
- Quick and effective response to emergency or disaster situation



Figure 43. Command Operation Room Layout

380. Following is the service-wise brief scope of integration for various initiatives of Tehri Garhwal City.

- Integration with various E-governance Initiatives like Lodge Your Grievance i. Trade License ii. Building Licenses iii. Birth and Death Registration and iv. Any Other Services

- Future Integration of Smart Parking
- Integration with CCTV Surveillance (Police Dept.)
- Integration with Emergency Response and Disaster Mgmt. (Services like Fire and Ambulance)
- Future Integration of Smart Lighting
- Integration with Area-Based Development (ABD) Services: i. Utilities ii. Lighting iii. Metering iv. Surveillance
- Integration of Crowdsourcing Data with ICCC

381. **Data Center.** The data center is the technological heart of the ICCC, hosting critical IT infrastructure that supports the storage, processing, and management of vast amounts of data generated by the city's smart systems. It includes high-capacity storage solutions, powerful servers, and robust data management systems designed to ensure data integrity, availability, and security. The data center supports real-time analytics, machine learning algorithms, and data visualization tools, providing actionable insights for city management. Additionally, it is equipped with advanced security measures, such as firewalls, encryption, and intrusion detection systems, to protect sensitive information from cyber threats.

382. **Application Server.** Application servers within the data center are responsible for hosting and running the software applications that power the smart city's operations. These servers handle the processing of data, facilitate communication between different systems, and ensure that applications perform efficiently. They support a wide range of functionalities, from traffic management and surveillance to public information dissemination and environmental monitoring. The application servers are designed to be scalable and flexible, allowing for the integration of new applications and services as the smart city infrastructure evolves.

383. **Intelligent Poles (7 no's).** Intelligent poles are multi-functional structures equipped with various smart components, including environmental sensors, public address systems, digital billboards, and surveillance cameras. These poles provide real-time data on air quality, noise levels, temperature, and other environmental parameters, contributing to urban planning and environmental management. The public address systems on these poles can broadcast important announcements, emergency alerts, and public safety messages. Digital billboards on the intelligent poles offer a platform for displaying advertisements and public information, generating revenue and enhancing communication with residents. Surveillance cameras mounted on the poles enhance public safety by monitoring public areas and deterring criminal activities.

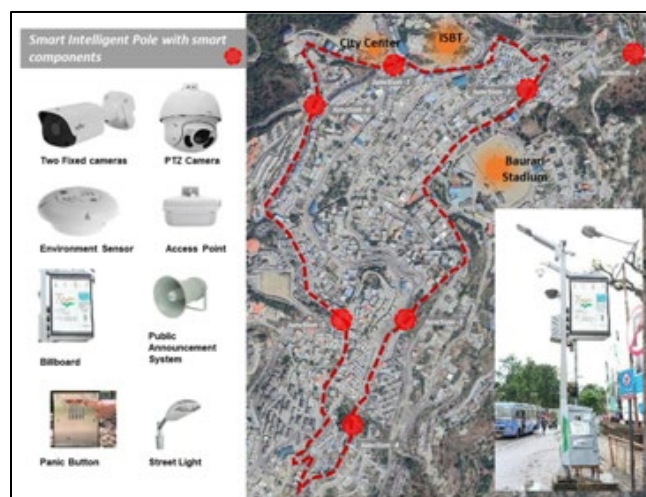


Figure 44. Locations of intelligent poles

384. **Traffic Signal Poles (7 no's).** Traffic signal poles are critical for managing urban traffic and ensuring road safety. These poles are equipped with adaptive signal control technology, which dynamically adjusts signal timings based on real-time traffic conditions. This optimizes traffic flow, reduces congestion, and minimizes wait times at intersections. The traffic signal poles also feature energy-efficient LED lights that provide better visibility and reduce energy consumption. Integrated with the ICCC, these poles allow for remote monitoring and control, enabling quick adjustments to traffic signals in response to changing conditions and improving the overall efficiency of the traffic management system.

385. **ANPR with 7 Junctions (with 2 Arms) for Revenue Generation.** The Automatic Number Plate Recognition (ANPR) system is installed at seven key junctions, each equipped with two camera arms. These systems use high-resolution cameras and optical character recognition technology to capture and read vehicle number plates in real-time. ANPR systems play a vital role in traffic enforcement by automatically detecting violations such as speeding, red light jumping, and unauthorized parking. They also help in identifying stolen or wanted vehicles, enhancing security and law enforcement capabilities. By generating revenue through fines and tolls, ANPR systems contribute to the financial sustainability of the smart city project. The data collected by ANPR systems also provides valuable insights for traffic analysis and urban planning.

386. **Smart Transport (and 21 Bus Shelters).** The smart transport system includes the deployment of 21 smart bus shelters, each equipped with modern amenities such as real-time bus schedule displays, Wi-Fi connectivity, charging ports, and surveillance cameras. These shelters enhance passenger convenience by providing up-to-date information on bus arrivals and departures, reducing wait times and improving the overall commuting experience. The smart transport system also features real-time tracking of buses, enabling better route management and operational efficiency. By promoting the use of public transport, this system aims to reduce traffic congestion and environmental pollution, contributing to sustainable urban mobility.

387. The 21 smart bus shelters will be strategically installed at critical points within New Tehri to ensure they serve the maximum number of passengers efficiently. Key locations include areas such as Chanti, Raulkot, Koldhar, Dhar Madan Pati, Khola, Jalwal Gaon, Madanegi Bus Stop, Sandhna, Madanegi Ropeway, Barkot, and Uthad. These locations have been selected based on passenger traffic patterns and accessibility to ensure that the bus shelters are placed where they are most needed and can provide the greatest benefit.

388. The smart bus shelters are integrated with the ICCC, which plays a crucial role in monitoring and managing the transportation system in real-time. This integration allows for efficient route management, ensuring that buses operate on time and routes are optimized based on real-time data. The ICCC can monitor passenger flow and manage resources more effectively, contributing to reduced traffic congestion and lower environmental pollution. Data collected from the bus shelters and the transport system can be analyzed to improve urban mobility strategies and enhance the efficiency of public transport services.



Figure 45. Location of smart bus shelters around Tehri Lake and sample design.

389. Access Points on Smart Poles. Access points installed on smart poles provide wireless connectivity for various smart city components and services. These access points enable seamless communication between devices, sensors, and the ICCC, facilitating the exchange of real-time data and enhancing the overall functionality of the smart city infrastructure. The access points also support the deployment of public Wi-Fi networks, improving connectivity for residents and visitors. Additionally, they enable the integration of new smart applications and services, ensuring the scalability and flexibility of the smart city infrastructure.

390. City Surveillance System. The city surveillance system consists of a network of CCTV cameras strategically installed throughout the city. These cameras provide real-time video feeds to the ICCC, enabling continuous monitoring of public areas. The surveillance system enhances public safety by deterring criminal activities and assisting law enforcement agencies in incident response. Advanced video analytics capabilities allow for the detection of suspicious behaviour, traffic violations, and other incidents, providing valuable data for urban management and planning. The surveillance system is integral to maintaining a secure and orderly urban environment.

391. Variable Message Display (VMD) Board (7 no's). Variable Message Display (VMD) boards are digital signboards installed at key locations across the city. These boards display real-time information such as traffic updates, weather forecasts, public announcements, and advertisements. VMD boards play a crucial role in disseminating important information to the public, helping to manage traffic flow and enhancing communication. They also generate revenue through commercial advertisements, supporting the financial sustainability of the smart city project. By providing timely and relevant information, VMD boards contribute to the overall efficiency and safety of the urban environment.

392. EV Auto Rickshaw (12 no's) and Charging Stations (2 no's). The deployment of 12 electric auto-rickshaws and two EV charging stations promotes sustainable urban mobility. Electric auto-rickshaws offer an eco-friendly alternative to traditional fossil-fuel-powered vehicles, reducing the city's carbon footprint and contributing to cleaner air. The charging stations ensure that these vehicles remain operational, supporting the widespread adoption of electric transport. Real-time tracking and monitoring of the auto-rickshaws enhance operational efficiency, provide valuable data for optimizing routes, and help in managing demand. This initiative not only supports environmental sustainability but also improves the efficiency and reliability of urban transport.

services.

393. Project Management and Infrastructure Setup, Effective project management and infrastructure setup are critical for the successful implementation and operation of the smart city components. This involves comprehensive planning, coordination, and oversight of the deployment of various smart infrastructure elements. It includes ensuring that all systems are integrated seamlessly, setting up the necessary IT infrastructure, and managing resources efficiently. Project management also encompasses continuous monitoring, maintenance, and upgrades to ensure the long-term sustainability and effectiveness of the smart city project. By providing strategic direction and operational oversight, project management ensures that the smart city initiatives are implemented successfully and deliver the intended benefits.

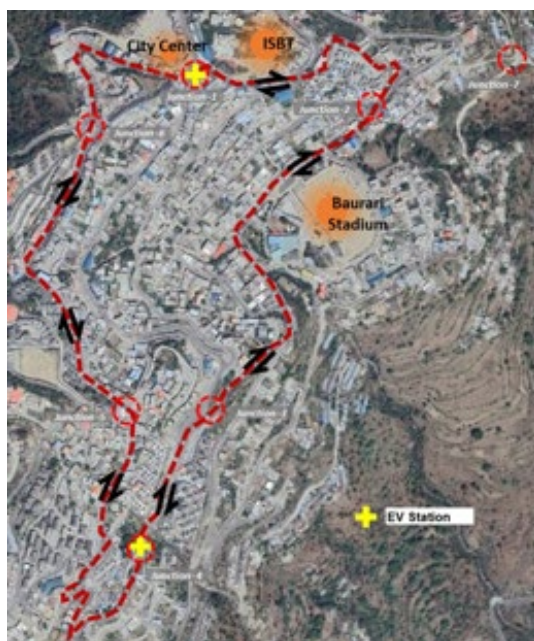


Figure 46. Proposed locations of electric vehicle charging stations

394. Shifting of Utilities. Utilities like telephone cables, electrical lines along with water supply lines may be required to shift for the execution of the Transport Infrastructure component subprojects. A proper scheme for relocating these shall be worked out before executing the subprojects. Strip plans showing existing utilities and a relocation plan for the affected utilities shall be prepared and submitted for the approval of PIU.

395. Construction Materials: The proposed subproject comprises of simple construction activities and most of the material required for the construction is easily available. If new sites are required to be opened for extraction of materials, necessary licenses or approvals shall be obtained from concerned agencies. The assumed material and properties for the design of the structures are mentioned below.

Table 14. Required Construction Material

No	Material	Properties
1.	Concrete	Grade of Concrete – M35 (For RCC Member) Density of Concrete – 25 kN/m ³
2.	Reinforce	Density of Steel – 78.5 kN/m ³

No	Material	Properties
	ment Steel	Grade of steel to be used as reinforcement in the structural concrete members shall comply with IS 1786 and will have minimum strength as: Yield Strength – 500 MPa <i>However, use of higher-grade steel in the detail design is subject to availability of higher-grade steel meeting with ductility requirements (as per revised latest Code)</i>
3.	Cover to reinforce ment.	Clear cover to main reinforcement shall be as follows: For Footings and Tie Beams: Top, Bottom and Sides: 50MM For Columns and Pedestals: Top and Sides: 40MM
4.	Structural Steel	Density of Steel – 78.5 kN/m ³ Yield Strength – 250 MPa Young's Modulus, E – 2×10^5 MPa

RCC = Reinforced Cement Concrete; IS= Indian Standards ; Source: DPR

396. **Project Benefits:** The subprojects under Transport Infrastructure components are expected to benefit the population living in and around Tehri besides benefitting the visiting tourist population.

397. The development of Transport infrastructure has several potential benefits for the local community and tourists visiting the area. Tehri District is known for its natural beauty and is expected to become a popular destination for tourists seeking adventure, tranquillity, and rejuvenation. Here are some reasons why the proposed interventions could be beneficial.

- **Tourist Attraction and Diversification:** Tehri attracts a diverse range of tourists, including those seeking adventure sports, cultural experiences, and relaxation. Proposed interventions would cater to the growing demand from tourists who seek holistic experiences in addition to adventure and cultural offerings.
- **Health and Well-being:** After the execution of the project the area would provide both locals and tourists with better access to services that promote physical, mental, and emotional well-being.
- **Holistic Tourism:** Eco-tourism is a rapidly growing sector globally. Many travelers are now seeking destinations that offer a holistic approach to travel, including experiences that support their physical and mental health. By offering improved facilities, Tehri can tap into this trend and attract a new segment of conscious travelers.
- **Local Economy and Employment:** The establishment and operation of new and improved facilities would create job opportunities for the local population. From tourist guides to receptionists and maintenance staff, the Tehri-developed area could employ a variety of professionals.
- **Branding and Differentiation:** Establishing a developed infrastructure could help Tehri stand out among the many tourist destinations in the region, creating a unique selling point that differentiates it from others.

V. DESCRIPTION OF THE ENVIRONMENT

A. Introduction

398. This section presents a description of the existing environment surrounding the subproject areas, including its physical resources, ecological resources, socioeconomic development, and social and cultural resources. Broad aspects of various environmental parameters such as physical, biological, sociocultural, and economic development parameters that are likely to be affected by the proposed subprojects have also been discussed. For completing the baseline description, emphasis was given to data collection on the physical environment, biological environment, and socio-economic environment of the project area. These data are considered to be of prime importance considering the nature and location of the proposed subproject focused on the Tehri area in the Tehri District of Uttarakhand.

399. **Data Collection and Stakeholder Consultations:** The data for this report was primarily gathered through a comprehensive literature review, discussions with stakeholder agencies, and field visits to the proposed subproject sites.

400. The literature survey broadly covered the following areas:

- i. Project details, reports, maps, and other relevant documents.
- ii. Discussions with the technical team of UTDB, municipal authorities, and other relevant government agencies, such as the Uttarakhand State Pollution Control Board.
- iii. Secondary data from previous project reports and published articles.
- iv. Literature on land use, soil, geology, hydrology, climate, socioeconomic profiles, and other planning documents collected from government agencies and websites.

401. **Location of Subprojects.** The subprojects are in the Tehri Garhwal District of Uttarakhand, one of the largest and westernmost districts of the state. The administrative headquarters is situated in New Tehri. Tehri Garhwal is bordered by Rudraprayag District to the east, Dehradun District to the west, Uttarkashi District to the north, and Pauri Garhwal District to the south. Positioned in the Himalayas, the project area lies at coordinates 30.3012° N, 78.5661° E, with an elevation ranging from 1550 to 1950 meters above mean sea level. The district spans an area of 4421 square kilometers. Tehri District is traversed by four renowned pilgrimage routes to Kedarnath, Badrinath, Yamunotri, and Gangotri. The project area is accessible via the Old Chamba Road (NH 707A). The nearest airport, Jolly Grant Airport, is 80 kilometers away, while the closest railway station, Rishikesh Railway Station, is 55 kilometers from the project area. Tehri Garhwal District is divided into two subdivisions: Kirti Nagar and Tehri-Pratap Nagar. It comprises seven tehsils, one sub-tehsil, nine blocks, two municipalities, and four town area committees. The district includes 76 Nagar Panchayats and 928-gram panchayats, with a total of 1,847 revenue villages and 2,508 clusters.



Figure 47. Map showing Tehri District - Tourism infrastructure (Source: Tehri District Administration)

402. **Location of Tourism Road.** It spans approximately 15.77 kilometers, connecting the prominent tourist locations of Koti Colony and Dobra Chanti. This road segment is part of the ambitious 218 km ring road project encircling the New Tehri area along the lake. The project road is situated in the Tehri-Garhwal district, with New Tehri serving as the adventure hub and district headquarters.

403. The project road begins at Panch Koti (Ch 0+00) and extends to the Dobra Chanti suspension bridge (Ch 15+77). Along its route, the road passes through notable points such as the Jakh diversion, Tiwar Gaon, and Le Roi floating huts, ultimately terminating at the existing Dobra Chanti suspension bridge. The section from Koti Colony to Dobra Chanti is envisioned as a tourism road for the New Tehri area. It is frequently used by tourists and locals to visit the scenic Dobra Chanti Bridge and other villages along the way.

404. The key map showing the location is attached below. The subproject begins at coordinates 30°24'41.23"N, 78°27'13.14"E and ends at 30°26'52.16"N, 78°25'59.05"E. The road passes through 12 villages in Table 15.

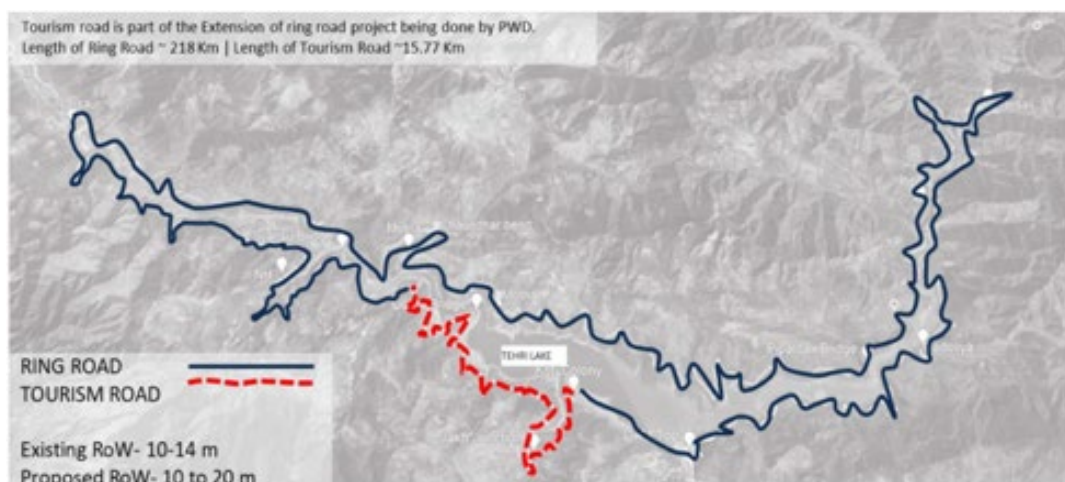


Figure 48. Location of the tourism road along the Their Lake ring road

Table 15. Villages along the 15.7 km tourism road subproject

S. no.	Name of the Village	Private Land (Sq m)	Civil Land (Sq m)
1	Jakh	7,376	11,536
2	Jundasu	5,240	960
3	Jasipur	1,880	1,200
4	Palli Chak	1,640	0
5	Ramgaon	12,000	7,160
6	Tiwar Gaon	1,240	6,840
7	Maroda	1,064	4,320
8	Goran	15,600	0
9	Hadgi	0	1,040
10	Godi Sirahi	18,440	0
11	Palas	5,840	11,520
12	Dobra	2,800	0
Total		73,120	44,576

Source: Design Report

405. Location of Ropeway. Tipri is strategically positioned as the drive station in the Tipri-Madan Negi ropeway project, playing a crucial role in the efficient operation of the system. Situated at an elevation of 922 meters above sea level, Tipri's higher altitude provides an advantageous gradient necessary for the ropeway's function. This elevation helps in minimizing the energy required for the gondolas' ascent, leveraging gravity for a smoother descent. The station is conveniently reachable via local roads, making it easily accessible for both tourists and local residents. To enhance accessibility, the station is equipped with ample parking facilities, accommodating cars and bikes. This infrastructure supports the anticipated influx of visitors, ensuring that transportation to and from the station is seamless.

406. Madan Negi serves as the return station for the ropeway project, located at a lower elevation of 860 meters above sea level. This lower altitude creates a natural gradient that is essential for the ropeway's operation, facilitating the smooth return of gondolas. The elevation difference between Tipri and Madan Negi ensures that the ropeway can function efficiently, utilizing the natural topography to reduce operational energy requirements. Like Tipri, Madan Negi is also designed with accessibility. The station is accessible via local roads, and it includes parking facilities to accommodate vehicles. This ensures that visitors can easily reach the station, whether

they are arriving by car or bike. The design of the station prioritizes ease of access, making it user-friendly for tourists and local residents alike.



Tipri Station



Madan Negi Station



Figure 49. Location of the proposed ropeway improvement in Tipri and Madan Negi

407. **Location of smart infrastructures and smart transportation system.** The smart loop starts at the ISBT, a major transportation hub that connects New Tehri to other regions. From ISBT, the loop extends along College Road, a significant thoroughfare providing access to various educational institutions and public buildings. This road is a vital part of the town's infrastructure, facilitating smooth transportation and easy access to essential services. Continuing from College Road, the smart loop includes the road abutting Baurari Stadium, a central location for public gatherings and events. The Baurari Stadium complex itself is a hub of various public functions, including the stadium, Clock Tower, New Tehri Talkies (cinema hall), Nagar Palika Parishad, and Nagar Palika Park. Integrating this road into the smart loop ensures that these vital public facilities are easily accessible to residents and visitors alike. Furthermore, part of the Old Tehri Road is also incorporated into the loop, linking older parts of the town with new developments and maintaining the historical connection within the urban fabric.

408. The smart loop strategically connects several key public buildings and areas within New Tehri town. Among these are the Government Pratap Inter College and Saint Anthony Public School, significant educational institutions that serve the local population. Additionally, the loop encompasses the City Centre (Covered Bazaar), a central commercial hub where shopping and business activities flourish, attracting both residents and tourists. The City Centre's integration into the smart loop promotes economic activity and accessibility.



Figure 50. Map showing the location of smart loop in New Tehri.

409. Two crucial junctions, Ganesh Chowk and Sai Chowk, are included in the smart loop. These junctions are currently characterized by complicated traffic circulation and unorganized vehicular movement. The reorganization of these junctions within the smart loop aims to streamline traffic flow, reduce congestion, and enhance safety for both vehicles and pedestrians.

410. The smart transport system in New Tehri town includes several innovative features aimed at enhancing public transportation. There are 21 proposed smart bus shelters, strategically located at crucial points to facilitate smart transport management. The smart bus shelters are specifically located at the following places to maximize accessibility and service coverage: Chanti, Raulkot, Koldhar, Dhar Madan Pati, Khola, Jalwal Gaon, Madan Negi Bus Stop, Sandhna, Madan Negi Ropeway, Barkot, Uthad, ISBT, Burari Stadium, Their Dam view point, Shiv Mandir, boating point, P.S.B., camping Jakh waterfall, Tiwar Gaon, Goran wellness, floating restaurant, and Dobra Chanti. Each location has been carefully selected based on passenger demand and strategic importance to the transportation network. These sites ensure that major residential and tourist areas are well-served, facilitating easy access to public transportation for daily commuters and visitors alike.

411. **Locations of the water transport stations:** The Sandana water station is strategically chosen based on its proximity to nearby towns and villages, as well as the ease of accessibility. It is situated in the Bhilangana Valley. Similarly, at Dharkot, which is also located in the Bhilangana Valley, no Jetty Station building will be constructed as the area falls under the jurisdiction of the Irrigation Department. The Raulakot Jetty will have a built-up area of 352.4 sq.m. and will be accessible only by foot, without any parking facilities. The station will include various facilities such as washrooms, first aid room, and a waiting area for 30 people. It will also be equipped with fire-fighting arrangements, emergency services, and first aid equipment to ensure visitor safety. Similarly, at Dobra Chanti, the water transport Station is not planned due to non-availability of land. Finally, at Tiwar Gaon, the project location is selected near the site proposed for a pedestrian suspension bridge. The proposed water transport station at Tiwar Gaon will have a built-up area of 298.5 sq.m. The station will feature food stalls and waiting areas for 30 people.

B. Physical Environment Conditions

412. **Land use.** The Tehri District's land use map provides an overview of how land resources

are distributed and utilized within the district, reflecting its diverse topography and mixed land use. Tehri district is shaped by a variety of land-use categories, including extensive agricultural areas, forests, barren lands, and urban settlements, all coexisting within the landscape. At the heart of the district is the iconic Tehri Lake, formed by the Tehri Dam, which plays a central role in water management, energy production, and tourism development.

413. Agriculture is the backbone of Tehri's economy and occupies a significant portion of the district's land, particularly in the lower plains and valleys, as indicated by the 68.23% of land designated for agriculture (485,517 hectares). These agricultural lands are highlighted in yellow on the map, strategically located near rivers and streams to take advantage of water resources for irrigation. This reliance on natural water sources underscores the importance of agriculture in sustaining local livelihoods and supporting economic growth.

414. Covering approximately 34% of the district's area (321,564 hectares), forests is an important feature, especially in the northern and hilly regions, where agricultural practices are limited by rugged terrain and less fertile soil. These forested areas, shown in green on the map, are essential for biodiversity, water retention, and soil erosion control. The forests act as carbon sinks, playing a key role in climate resilience and mitigating the effects of deforestation and land degradation. The zoning policies in forested regions likely focus on protecting biodiversity and preventing unsustainable exploitation, ensuring that these areas continue to provide ecological services that support agriculture and water management. Forests also play a crucial role in maintaining Tehri district's ecological balance, especially in higher altitudes, where they help regulate water flow and prevent landslides, thus safeguarding both rural communities and agricultural lands.

415. In contrast, the barren lands (approximately 5,784 hectares), shown in brown on the map, represent the challenging topography of the district, where steep slopes and rocky surfaces make cultivation and forestry difficult. These areas are primarily located in the rugged, mountainous regions of the district and are largely uninhabitable or unsuitable for agricultural use. Additionally, snow-covered areas in the northernmost part of the district further emphasize the high-altitude, uninhabitable nature of certain regions, particularly near the boundaries with Rudraprayag District. These zones are important for natural water flow and climate regulation, but zoning policies likely restrict human activities to protect the fragile environment.

416. At the heart of the district's zoning and resource management is the Tehri Dam and the associated Tehri Lake, represented in blue on the map. The dam harnesses water from the Bhagirathi River for hydroelectric power generation, water storage, and flood control, serving as a multi-purpose resource. Beyond its role in energy production, the dam also supports the district's agriculture through irrigation and provides opportunities for tourism, with the lake attracting visitors for boating and other recreational activities.

417. The zoning around the dam and lake is critical for managing water quality, ensuring that agricultural runoff and urban expansion do not lead to contamination or overuse. The dam area's influence on neighboring areas extends into water management, regulating the district's water resources and ensuring a balance between economic development and environmental conservation.

418. The district's urban settlements, shown in red, are concentrated in key locations such as New Tehri, Chamba, and Koti Colony. While these urban areas are sparse compared to the overall land distribution, they serve as vital hubs for commerce, administration, and tourism. Despite Tehri's large geographical area, only a small portion of the land is dedicated to non-

agricultural uses (13,927 hectares) of the district's landscape.

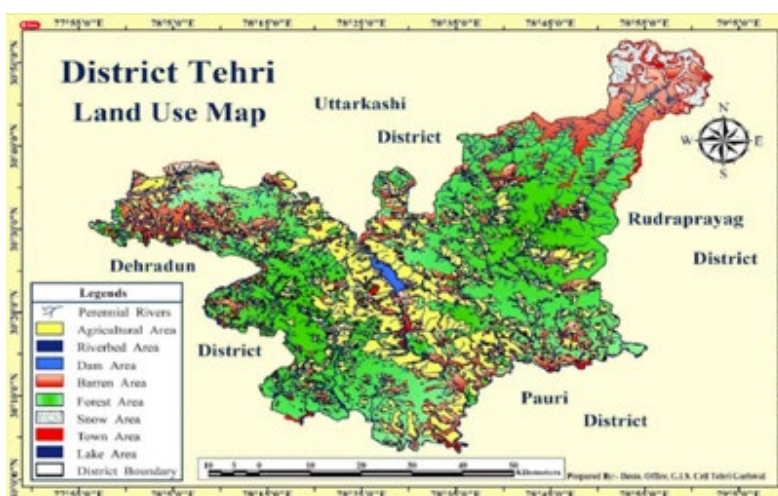


Figure 51. Land use map of Tehri District (2021-2022)

419. Land cover changes. The Tehri Lake region, situated in the Garhwal Himalayas, has undergone significant land cover changes over the past decades due to a combination of human activities and natural factors. The construction of the Tehri Dam has been a major catalyst, leading to extensive transformations in land use. The changes in land cover have resulted in environmental impacts such as soil erosion, loss of biodiversity, and altered hydrological regimes, which have had notable socio-economic and ecological implications for local communities and ecosystems.

420. The completion of the Tehri Dam in the early 2000s led to dramatic shifts in land use and land cover patterns within the Bhilangana basin and surrounding areas. The inundation of vast tracts of land by the reservoir caused a 5.7% reduction in forest cover, equating to a loss of approximately 54.71 square kilometers. Additionally, there was a decline in agricultural land (-0.4%) and scrubland/grass cover (-0.28%). The newly formed reservoir submerged significant portions of upstream catchments, drastically altering the landscape and displacing local communities. The construction activities associated with the dam and resettlement further accelerated land degradation, causing fragmentation of natural habitats and reducing the availability of critical ecosystem services.

421. During the period from 2010 to 2020, efforts such as compensatory afforestation were undertaken to recover lost vegetation, leading to a 5.65% increase in forest cover. However, this regrowth primarily consisted of younger and less diverse vegetation, which altered the structure and composition of the forest, reducing its capacity to support a diverse range of species. Furthermore, the introduction of new infrastructure, including roads, settlements, and tourism facilities, has continued to drive the transformation of the landscape, further altering land use patterns around Tehri Lake.

422. The construction of the Tehri Dam and associated infrastructure, such as roads, resettlement sites, and tourism facilities, led to the large-scale clearing of forested areas. The submergence of upstream catchments for the reservoir and the establishment of new settlements disrupted the natural landscape, resulting in the loss of vegetation and soil cover. The clearing of land for construction and development has had long-lasting impacts on the region's ecological

balance, contributing to soil erosion, habitat fragmentation, and increased vulnerability to landslides.

423. The resettlement of people displaced by the Tehri Dam, along with new economic opportunities created by infrastructure development, has put additional pressure on the region's natural resources. The need for fuelwood, grazing land, and agricultural expansion has led to deforestation and land conversion. This human-induced land conversion has caused soil compaction, reduced water infiltration, and increased runoff, leading to accelerated erosion and diminished capacity of the land to support natural vegetation.

424. The creation of a large water surface area in the form of the Tehri reservoir has significantly modified the local microclimate, affecting temperature, precipitation patterns, and atmospheric humidity. The altered albedo and increased humidity have influenced the hydrological cycle and vegetation dynamics, leading to new environmental challenges. The presence of a large water body has also contributed to increased local air temperatures and changes in precipitation patterns, which have impacted the resilience of natural ecosystems.

425. The steep slopes and fragile geological formations of the Garhwal Himalayas make the region particularly vulnerable to natural processes such as soil erosion and landslides, especially after the removal of protective vegetation cover. The loss of forest cover has reduced slope stability, increasing the frequency and intensity of landslides, which further degrade the land and lead to the loss of soil and vegetative cover. Additionally, the region's topography and the construction of new roads and settlements on steep slopes have exacerbated soil instability, making the land more susceptible to erosion and degradation.

426. With the degradation of natural habitats and changes in vegetation composition, there has been an increase in species such as *Lantana camara* and *Parthenium hysterophorus*. These species outcompete native vegetation, further reducing biodiversity and altering soil and nutrient cycles. Invasive species often thrive in disturbed soils and contribute to the loss of native flora, creating a negative feedback loop that hampers restoration efforts and reduces the overall ecological health of the region.

427. **Topography.** The altitude in Tehri Garhwal District ranges from 369 meters to 6672 meters. The major ridges generally trend in an NNW-SSE direction, parallel to the strike of the country rocks. However, ridges trending E-W, NW-SE, and N-S are also observed, which are mainly structurally controlled.

428. The area's drainage is mainly controlled by major perennial rivers such as the Bhagirathi, Bhilangana, and Alaknanda, along with their tributaries like the Bal Ganga and Dharma Ganga. The Bhagirathi River flows from north to south and meets the Alaknanda River at Devprayag. The Bhilangana River flows from northeast to southwest, joining the Bhagirathi River near Old Tehri. The Bhagirathi and Bhilangana Rivers drain the central part of the district, while the Alaknanda River flows in the southernmost part near the district boundary. Besides the major rivers, numerous seasonal streams and rivulets (locally called gad and gadhera) drain the area. Important among them are Nailchami Gad, Lastar Gad, Nagun Gad, Bhadri Gad, Chandrabhaga Gad, and Bandal Nadi. The most common drainage patterns in the area are sub-trellis and sub-dendritic. The perennial rivers are primarily fed by snowmelt, with a relatively smaller contribution from groundwater. However, during the lean period, the rivers are fed by groundwater occurring as base flow. The district's drainage map is provided as Figure 41.

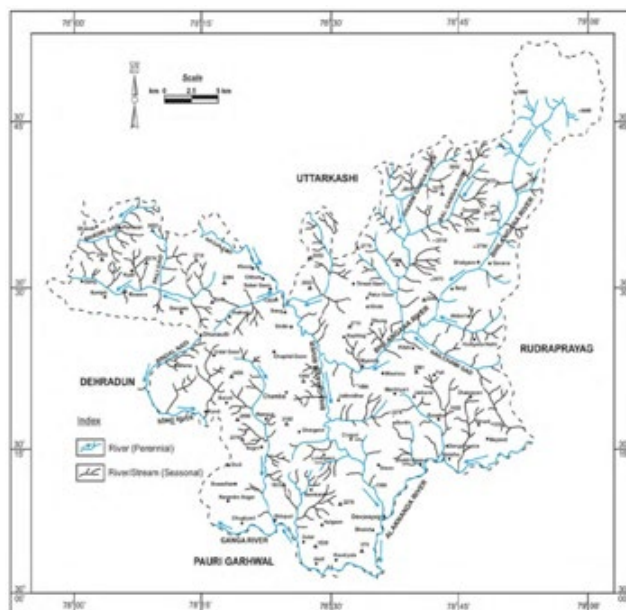


Figure 52. Drainage Map of Tehri Garhwal District

429. **Drainage Network along Tourism Road.** The drainage network along the proposed Tourism Road in the Tehri-Garhwal district exhibits several notable characteristics. The area features a dense network of natural drainage channels, indicative of surface water flow, particularly during the monsoon season. These channels are crucial for directing runoff and preventing water accumulation in low-lying areas, thus maintaining the region's hydrological balance.

430. The road intersects these drainage channels at multiple points, necessitating the construction of culverts to facilitate uninterrupted water flow. These culverts are strategically placed at key locations where the road crosses the drainage channels, ensuring that the road infrastructure does not impede the natural drainage patterns. This measure is essential to prevent flooding and erosion, which could compromise the road's structural integrity and the surrounding environment.

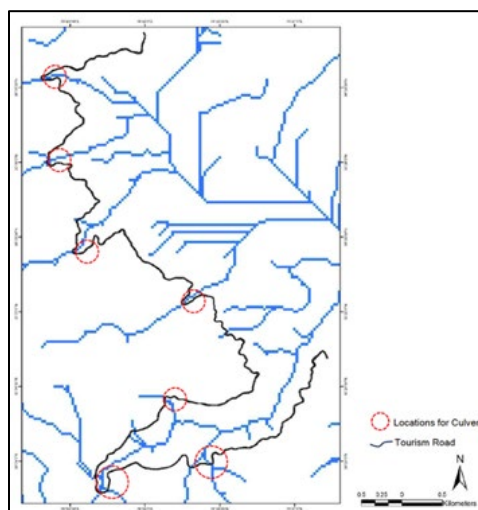


Figure 53. Drainage map along the hilly areas of the tourism road

431. **Geographic Aspect of the Tourism Road.** Aspect maps have been produced using Digital Elevation Model (DEM) data, which provide insights into the orientation of slopes of the tourism road. By analyzing the DEM data, these maps highlight the directions that various slopes face, such as north, south, east, and west, along with intermediate directions like northeast, southeast, northwest, and southwest. This information is crucial for understanding how different geographical aspects influence factors such as sunlight exposure, water runoff, soil stability, and vegetation growth. The aspect maps thus serve as an essential tool for planning and implementing construction projects, as they help identify potential challenges and opportunities related to the terrain's orientation.

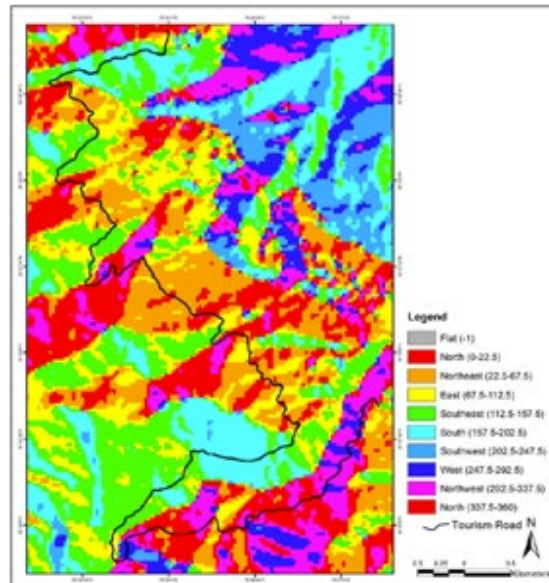


Figure 54. Aspect map of the tourism road from DEM

432. Based on the DEM, the proposed tourism Road in the Tehri-Garhwal district traverses a diverse range of geographical aspects, each influencing various factors such as water runoff, soil stability, and vegetation growth. Analyzing the alignment of the road with these aspects provides insight into the construction and maintenance challenges that may arise. The results of the analysis are shown in the following:

- North-facing Slopes (0-22.5°). Approximately 10% of the road aligns with north-facing slopes, which are cooler and retain more moisture, leading to higher vegetation density and potentially softer soil conditions.
- Northeast-facing Slopes (22.5-67.5°). Around 15% of the road runs through northeast-facing slopes. These areas receive moderate morning sunlight, which aids in drying out the soil and supporting stable vegetation growth.
- East-facing Slopes (67.5-112.5°). Approximately 10% of the road is aligned with east-facing slopes. These slopes receive ample morning sunlight, facilitating quick drying of soil and reducing moisture retention. They generally have moderate inclines, which help with effective drainage, although proper water management systems are still necessary.
- Southeast-facing Slopes (112.5-157.5°). The road passes through southeast-facing slopes for about 20% of its length. These slopes receive significant sunlight from morning to mid-day, leading to drier soil conditions. They can vary from moderate to steep inclines.
- South-facing Slopes (157.5-202.5°). Around 15% of the road aligns with south-facing slopes, which receive the most sunlight throughout the day. This results in higher temperatures and drier conditions.

- Southwest-facing Slopes (202.5-247.5°). Approximately 10% of the road runs through southwest-facing slopes. These areas are exposed to strong afternoon sunlight, leading to increased evaporation and potential for dry soil conditions.
- West-facing Slopes (247.5-292.5°). About 5% of the road is aligned with west-facing slopes, which receive late afternoon sunlight. These slopes have moderate inclines but still present construction challenges.
- Northwest-facing Slopes (292.5-337.5°). Around 5% of the road runs through northwest-facing slopes, which receive late afternoon sunlight. These slopes generally have moderate inclines, and their cooling patterns and soil stability can be affected by the sunlight exposure.
- North-facing Slopes (337.5-360°). Another 5% of the road aligns with north-facing slopes, similar to the initial north-facing slopes. These areas are cooler and retain more moisture, leading to higher vegetation density and potentially softer soil conditions.
- Flat Areas (-1°). Approximately 5% of the road passes through flat areas. These regions lack slope, making them easier for construction. However, they still require effective drainage systems to prevent water accumulation and potential flooding, which can undermine the road's foundation and surface.

433. **Slope Gradient along Tourism Road.** The proposed road traverses a diverse range of slope gradients based on the slope map below. Analyzing the alignment of the road with these slope categories provides insight into the challenges and requirements for building and maintaining this road.

- Gentle Slopes (0-7°). Approximately 30% of the road runs through gentle slopes. These sections present the least construction challenges due to their minimal gradient. The gentle slopes require less intensive stabilization measures, making them favorable for straightforward construction. The risk of erosion and landslides is relatively low in these areas, which helps in reducing maintenance efforts.
- Moderate Slopes (7-13°). Around 20% of the road is aligned with moderate slopes. While still manageable for construction, these slopes require careful planning for drainage and erosion control. The moderate gradient ensures relatively stable conditions but necessitates moderate stabilization efforts to prevent soil erosion. Proper engineering solutions, such as moderate retaining walls and well-designed drainage systems, are essential to maintain road stability in these areas.
- Moderate to Steep Slopes (13-19°). The road intersects moderate to steep slopes for about 15% of its length. These areas pose more significant challenges compared to gentler slopes.
- Steep Slopes (19-24°). Approximately 10% of the road traverses steep slopes. These sections present considerable construction challenges, necessitating intensive stabilization measures such as retaining walls and advanced drainage systems.
- Very Steep Slopes (24-33°). The road runs through very steep slopes for about 20% of its length. These areas are highly susceptible to erosion and landslides, posing significant challenges for construction and maintenance. Advanced engineering techniques, including strong retaining structures and comprehensive erosion control systems, are crucial to prevent soil instability.
- Extremely Steep Slopes (33-46° and 46-65°). A minimal portion of the road, approximately 5%, passes through the steepest slopes. These sections present the most severe construction and maintenance challenges, with extremely high risks of erosion and landslides.

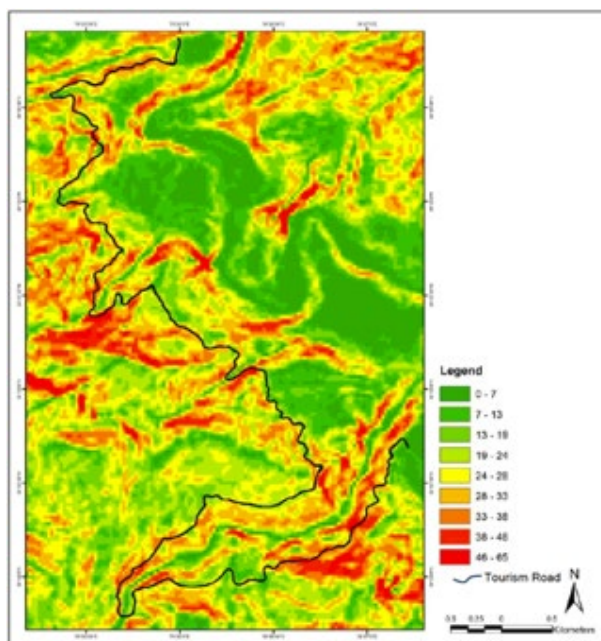


Figure 55. Slope Map of the Tourism Road

434. **Soil Characteristics.** Soil in Tehri Gharwal. The soils in this district can be broadly classified into two types: soils of the Central/Higher Himalaya and soils of the Lesser Himalaya. Soils of the Central Himalaya are categorized into four main types: soils of summits, ridge tops, and mountain glaciers found at the highest elevations; soils of side slopes located on the slopes of mountains; soils of upper glacio-fluvial valleys present in valleys formed by glacial and fluvial processes; and soils of cliffs found on steep and rocky cliff faces.

435. The Lesser Himalaya region primarily features soils that can be subdivided into three types. The first type, Dystric Eutrudepts, are moderately shallow, excessively drained, thermic (warm) and fine loamy, moderately eroded, and slightly stony, typically found in areas with moderate slopes. The second type, Lithic Udorthents, are very shallow, excessively drained, severely eroded, and strongly stony, with thermic loamy soils and loamy and sandy surfaces, found on steep slopes. The third type, Typic Udorthents, are moderately shallow, excessively drained, moderately eroded, and slightly stony, loamy soils on moderate slopes with loamy surfaces. These classifications provide a comprehensive understanding of the soil types present in the district, highlighting their drainage capacity, depth, erosion level, and typical locations.

436. The soil quality of the project area was sampled and analyzed at the village of Dobra Chanti on May 30, 2024. The coordinates for the sampling location are Lat 30.4473330° N, Long 78.4340740° E. The soil quality results at this selected location are presented in Table 16.

Table 16. Soil Test Report at Dobra Chanti (at starting point of Tourism Road Subproject)

S. No.	Parameters	Test Method	Results	Units
1.	pH (1:2 suspension)	IS:2720 (P-26)1987, RA2021	8.17	NA
2.	Conductivity(1:2 suspension)	IS: 14767:2000, RA2021	248.0	μs/cm
3.	Exchangeable Potassium	Ministry of Agriculture Method	88.3	Kg/ha
4.	Organic Matter	IS:2720 (P-22)1972,	0.27	%

S. No.	Parameters	Test Method	Results	Units
		RA2020		
5.	Nitrogen (as N)	IS:146841999, RA2019	56.2	Kg/ha
6.	Phosphate (as P)	Ministry of Agriculture Method	38.0	Kg/ha
7.	Exchangeable Calcium		592.3	mg/kg
8.	Exchangeable Magnesium		142.4	mg/kg
9.	Copper		22.4	mg/kg
10.	Nickel		< 0.1	mg/kg
11.	Chromium		< 0.1	mg/kg
12.	Iron		0.25	mg/kg
13.	Lead		1.44	mg/kg
14.	Sulphate		0.12	%
15.	Mercury		< 0.05	mg/kg
16.	Arsenic		4.39	mg/kg

IS: Indian Standards

437. The soil quality analysis indicates that the soil in the Dobra Chanti area is generally suitable for road construction. The slightly alkaline pH, low organic matter, and adequate levels of essential minerals like potassium, calcium, and magnesium contribute to soil stability and strength. However, the moderate electrical conductivity and high arsenic levels require careful monitoring and management to ensure they do not negatively impact the construction process or long-term road stability. Overall, with appropriate engineering measures, the soil conditions appear favorable for the planned road construction.

438. **Geology.** District Tehri Garhwal is represented by the rocks of Lesser Himalaya and Central Himalaya. The geological set up is very complex due to the repeated tectonic disturbances caused by different orogenic cycles. Valdiya (1980) carried out extensive geological and structural mapping in the area. The salient features of geology are depicted in the geological map of Tehri Garhwal district. The map is based on Geological Survey of India, 2002. The rock units exposed in various parts of Tehri Garhwal district are exposed in two broad geotectonic zones viz. Central or Higher Himalaya and Lesser Himalaya. The Central Himalaya lies to the north of Main Central Thrust (MCT) whereas the Lesser Himalaya occurs to the south of it. A group of regionally metamorphosed rocks known as Central Crystallines are exposed in the Central Himalaya. The Central Crystallines occur as thrust sheets over the metasedimentary and sedimentary rocks of Lesser Himalaya in varied tectonic settings. Major rock types of Central Crystallines are migmatites, psammitic and mica gneiss, calc gneiss, quartzite, marble, mica schist and amphibolite. Granites of different ages ranging from Paleoproterozoic to Mesozoic-Tertiary intrude the Central Crystallines. The Lesser Himalaya occupies major part of the district and comprises of different groups like Jaunsar Group, Blaini-Krol Group and Tal Group. The groups are subdivided into various formations like Bhilangana Formation, Rautgara Formation, Bijni Formation. A suite of granitic intrusives known as Granitoids of Kedarnath and basic volcanics of Garhwal Group are also exposed in parts of the district. Generally, the rocks of the Lesser Himalayan

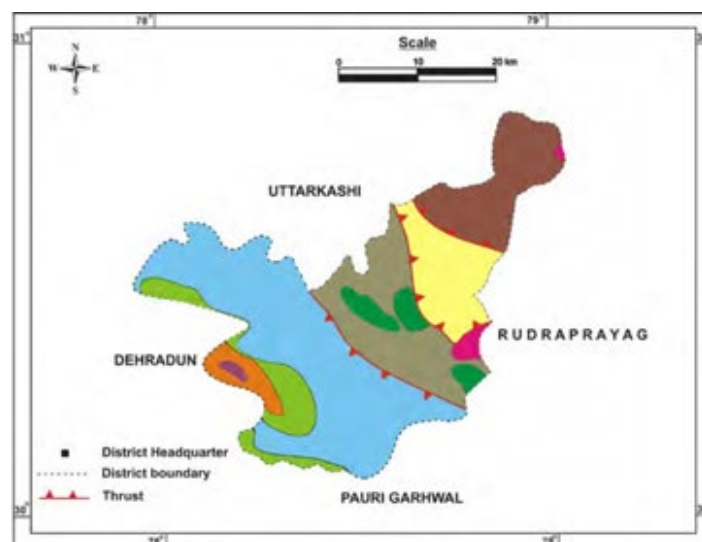


Figure 56. Geological map of Tehri Garhwal District (Source: Ground Water Brochure, District Tehri Garhwal)

439. **Seismic Hazard.** The state of Uttarakhand, India is located in high to very high seismic zone along the Himalayan Belt. In past, the region has experienced a huge loss of lives and assets due to frequent seismic events. The State of Uttarakhand which lies in a high to very high seismic zone corresponding to Zone IV and V, comprises of thirteen districts. Districts Pithoragarh, Bageshwar, Chamoli and Rudraprayag and some parts of the districts of Almora, Champawat, Tehri, Uttarkashi and Pauri lie in seismic Zone V and the rest of the region falls in seismic Zone IV, as seen in the seismic map of the State of Uttarakhand in figure below.

440. The subproject area comes under seismic zone V as defined by Urban Earthquake Vulnerability Project (UEVP) and the Atlas prepared by the Building Materials Promotion and Technology Council (BMTPC), Government of India and UNDP [IS 1893 (Part I : 2002)]. All subproject components have been designed considering seismic hazard.

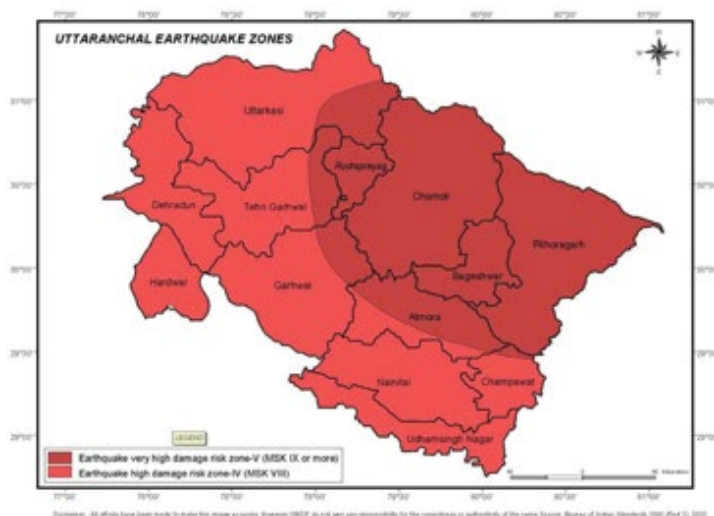


Figure 57. Uttarakhand Earthquake Hazard Map

441. **Geotechnical Survey at Tourism Road.** The geotechnical investigation for the road alignment in the Tehri Lake area, conducted by WAPCOS, plays a pivotal role in informing the design and construction phases of the proposed road expansion project. This comprehensive investigation encompasses the drilling of boreholes, laboratory testing of soil samples, and the analysis of geotechnical properties of the encountered materials. The primary aim is to gain a thorough understanding of the subsurface conditions, ensuring the structural integrity and longevity of the road infrastructure.

442. **Boreholes and Locations.** The investigation involved the drilling of eight strategically positioned boreholes along the road alignment at Koti Colony and Dobra Chanti. These boreholes provided crucial data on the subsurface conditions. The specific coordinates and elevations of these boreholes were meticulously recorded. For instance, borehole BH-1 in Koti Colony is situated at 30°24'49.2" N and 78°27'18.2" E with an elevation of approximately 866.68 meters. Similar detailed information was gathered for all boreholes, aiding in the precise assessment of geological conditions at each site.

Table 17. Locations of the bore holes

Bore Hole (BH)	Location	Geocoordinates		Elevation
		North	East	
BH-1	Koti Colony	30°24'49.2"	78°27'18.2"	866.68±8M
BH-3	Koti Colony	30°24'43.9"	78°27'16.2"	836.5±3M
BH-4	Koti Colony	30°24'52.3"	78°27'15.2"	842.65±24M
BH-5	Koti Colony (Bridge)	30°24'42.5"	78°27'09.0"	889.36±11M
BH-6	Dobra Chanti	30°26'45.3"	78°26'04.6"	868.25±4M
BH-7	Dobra Chanti	30°26'46.5"	78°26'06.3"	859.05±5M
BH-14	Koti Colony Parking	30°24'26.6"	78°27'11.8"	921.2±10M
BH-15	Koti Colony Parking	30°24'31.2"	78°27'09.1"	940.6±5M



Figure 58. Locations of the boreholes along the road

443. **Properties of Drill Holes:** The analysis of the boreholes revealed significant insights into the soil composition and geotechnical properties. The soil composition predominantly consisted of fractured rock, with the exception of borehole BH-5, which contained silty sand with gravel up to a depth of six meters. Laboratory tests provided detailed data on bulk density, dry density,

moisture content, specific gravity, cohesion, and angle of friction. For instance, the bulk density for boreholes in Koti Colony ranged from 1.93 to 2.01 t/cum, while the dry density varied from 1.82 to 1.85 t/cum. These properties are crucial for understanding the stability and load-bearing capacity of the soil, guiding the design of road structures.

Table 18. Laboratory test result of the boreholes

Borehole (BH) ID	Bulk Density (t/cum)	Dry Density (t/cum)	Moisture Content (%)	Specific Gravity	Cohesion (C)	Angle of Friction (Φ)
BH-1	1.93 - 2.01	1.82 - 1.85	6.10 - 8.39	2.82 - 2.91	0	33 - 35
BH-3	1.95 - 1.98	1.84 - 1.86	6.13 - 6.21	2.82 - 2.89	0	34 - 36
BH-4	1.96 - 1.99	1.85 - 1.87	6.15 - 6.18	2.81 - 2.88	0	35 - 36
BH-5	1.86 - 2.00	1.75 - 1.88	6.15 - 6.19	2.65 - 2.92	0	30 - 36
BH-6	1.97 - 1.99	1.86 - 1.87	6.12 - 6.19	2.82 - 2.87	0	34 - 35
BH-7	1.98	1.87	6.11 - 6.14	2.81 - 2.85	0	33 - 34
BH-14	1.90 - 1.92	1.79 - 1.81	6.18 - 6.21	2.86 - 2.89	0	34 - 35
BH-15	1.88 - 1.89	1.77 - 1.78	6.21 - 6.25	2.87 - 2.91	0	35

444. **Geomorphological and Geological Observations.** The road alignment traverses through highly to moderately dissected hills and valleys, characterized by a complex geomorphology. The predominant rock types encountered are phyllite and quartzite, interspersed with bands of shale and limestone. The entire alignment falls within Toposheet No. 53 J/7 and lies in Zone IV of the seismic zoning map of India, indicating a significant seismic risk that must be accounted for in the design. Moreover, the investigation identified several locations susceptible to landslides, necessitating careful consideration and mitigation strategies in these areas.

445. The findings from the geotechnical investigation provide critical recommendations for the tourism road subproject. Given the shallow depth to bedrock, reinforced concrete (RCC) walls are suggested to enhance stability. Additionally, the high water levels encountered in some boreholes necessitate the implementation of robust drainage systems to prevent water-related damage. Specific viewpoints and design elements may need adjustments based on the identified landslide-prone zones to ensure safety and durability. These detailed geotechnical insights and recommendations are integral to the successful execution of the tourism road subproject, ensuring it meets the required safety and performance standards.

446. **Geotechnical Survey at Ropeway.** The California Bearing Ratio (CBR) tests for boreholes BH-8, BH-9, and BH-10 at the Madan Negi location offers critical insights into the soil characteristics essential for designing the ropeway's foundations. The CBR tests are fundamental in evaluating the soil's strength and load-bearing capacity, which is crucial for ensuring the stability and safety of the ropeway structures.

447. **Borehole Information and Sample Description.** The borehole data specifies the locations and descriptions of the soil samples taken from three different boreholes. Borehole BH-8 is located at Ropeway Madan Negi and contains boulders and fractured rock. Boreholes BH-9 and BH-10, also at Ropeway Madan Negi, are described as containing fractured rock. These descriptions indicate that the subsurface materials at these locations are predominantly rocky. Rocky substrates are generally preferred for construction due to their inherent high strength and stability, which are ideal for supporting heavy structures like ropeway towers.

448. **Grain Size Analysis.** The grain size analysis reveals the composition of the soil in terms of gravel, sand, and fines (silt and clay). BH-8 and BH-10 both have 96% gravel and 4% sand, while BH-9 has 95% gravel and 5% sand. None of the samples contain fines. The high gravel content and absence of fines imply excellent drainage properties and high shear strength. This type of soil is advantageous for construction as it minimizes the risks of water retention and soil instability, ensuring a solid foundation for the ropeway.

449. **Atterberg Limits.** The Atterberg limits, which include the Liquid Limit (LL) and Plastic Limit (PL), are marked as "NA" (Not Applicable) for all samples, indicating that the soil is non-plastic. Non-plastic soils do not exhibit significant volume changes with variations in moisture content. This characteristic is beneficial for construction because it ensures that the soil maintains its volume and strength regardless of moisture changes, contributing to the overall stability of the foundations.

450. **Specific Gravity.** The specific gravity of the soil samples ranges from 2.83 to 2.86, which is typical for gravelly and rocky soils. Specific gravity measures the density of soil particles relative to water. Higher specific gravity values indicate denser soil particles, which contribute to the soil's ability to support structural loads. The consistent specific gravity values across the samples confirm the uniformity and suitability of the soil for construction purposes.

451. **Modified Proctor Test.** The test results provide insights into the soil's compaction characteristics. The Maximum Dry Density (MDD) values for BH-8 and BH-10 are 1.88 t/m³, and for BH-9, it is 1.87 t/m³. The Optimum Moisture Content (OMC) values are 6.15% for BH-8, 6.21% for BH-9, and 5.32% for BH-10. These results indicate the soil's ability to achieve high density when compacted at the optimum moisture content, which is essential for creating a stable and durable foundation.

452. **Soaked CBR Values.** The Soaked CBR values at 97% compaction for BH-8, BH-9, and BH-10 are 35.7%, 35.9%, and 35.4%, respectively. These high CBR values demonstrate the soil's excellent load-bearing capacity, even when saturated with water. This is a critical factor in foundation design, especially in regions prone to heavy rainfall or waterlogging. High CBR values ensure that the foundations will remain stable and capable of supporting the ropeway structures under wet conditions.

453. The comprehensive analysis of the CBR test results for the boreholes at Madan Negi highlights the favourable characteristics of the subsurface soil for supporting the ropeway infrastructure. The details of the results are shown in Appendix 5. Table 19 shows the summary.

Table 19. Summary of the CBR tests for the 3 bore holes in ropeway site

SUMMARY OF CBR TESTS																
S. No.	BORE HOLE NUMBER	LOCATION	Co - ordinates		Description of Sample	Quality of soil, Class	Grain Size Analysis			Atterberg Limits			SPECIFIC GRAVITY	Modified Proctor		Soaked C.B.R at 97% of
			Easting	Northing			Gravel	Sand	Fines	LL	PL	PI		M.D.D, t/m ³	O.M.C, %	
1	BH-8	ROPEWAY MADAN NEGI	-	-	BOULDERS / FRACTURED ROCK	SQ3	96	4	0	NA	NA	-	2.83	1.88	6.15	35.7
2	BH-9	ROPEWAY MADAN NEGI	-	-	FRACTURED ROCK	SQ3	95	5	0	NA	NA	-	2.85	1.87	6.21	35.9
3	BH-10	ROPEWAY MADAN NEGI CENTRE POINT	-	-	FRACTURED ROCK	SQ3	96	4	0	NA	NA	-	2.86	1.88	5.32	35.4

454. **Climate.** The climate in Tehri Garhwal district varies from cold temperate, tropical to sub-tropical. The northern and northwestern parts of the district experiences sub-zero temperatures during the winter whereas the central and southern parts are comparatively warm and humid. In the southern part, at TADA and New Tehri, the weather is very cold in winter and pleasant in summer. Snowfall is common during the winter in these areas. Other parts of the district experience dry, hot summers and cold winters.

455. Temperature, Relative Humidity and Wind based on long-term climatological data of the district, it is surmised that January is the coldest month with a mean maximum temperature of 19.6 °C and a mean minimum temperature of 4.6 °C. Temperature becomes highest usually during June, having a mean minimum and mean maximum temperature of 32.6 °C and 36.5 °C respectively. Relative Humidity in the area increases rapidly with the onset of monsoon and reaches maximum (85% in the morning and 84% in the evening) during August when the peak monsoon period sets in. Relative Humidity is minimal during the summer month (from April to June) with May being the driest month (47% morning and 25% in the evening). Skies are heavily clouded during the monsoon months and for short spells when the district is affected by western disturbances. Two broad wind patterns are observed in the district viz. north-easterly to easterly (May to September) and south-easterly to westerly (October to March). The average wind speed is minimum (0.8 km/hr) in December and maximum in July (4.1 km/Hr) whereas the average annual wind speed is 2.3km/Hr.

456. Rainfall, in the district, occurs almost throughout the year. Maximum rainfall is recorded during the monsoon period i.e. from July to September. During the non-monsoon season, rainfall is quite low in November and increases from December onward till March. Winter precipitation is associated with the passage of the Western Disturbances and is in the form of snowfall at higher elevations. The monthly and annual rainfall in Tehri Garhwal District is quite variable and ranges between 956 mm and 2449 mm at TADA. The annual rainfall at Tehri Observatory is 1028.6 mm whereas the average number of rainy days (having daily rainfall > 2.5 mm) is 61.5 days. The annual rainfall at Mukhim Observatory is 1708.8 mm and the average number of rainy days is 87.4 days.

Table 20. Climatic Condition of Project Area

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg. Temp. °C (°F)	7.5 (45.4)	9.4 (48.9)	13.5 (56.4)	18.3 (64.9)	21.4 (70.5)	22.5 (72.5)	21.4 (70.5)	21 (69.8)	19.7 (67.5)	16.6 (61.9)	13.1 (55.5)	9.5 (49.1)
Min. Temp. °C (°F)	0.9 (33.6)	2.3 (36.2)	5.6 (42.2)	10 (50)	14.2 (57.6)	17.6 (63.7)	18.9 (66)	18.5 (65.3)	15.9 (60.7)	10.7 (51.3)	6.8 (44.3)	3.1 (37.6)
Max. Temp. °C (°F)	13.6 (56.5)	15.5 (59.9)	19.9 (67.7)	24.7 (76.4)	27 (80.6)	26.7 (80)	24.4 (76)	24 (75.3)	23.6 (74.4)	21.8 (71.2)	19 (66.2)	15.9 (60.6)
Rainfall mm (in)	48 (1)	80 (3)	56 (2)	43 (1)	62 (2)	189 (7)	509 (20)	458 (18)	209 (8)	25 (0)	8 (0)	20 (0)
Humidity (%)	66%	64%	55%	44%	48%	63%	88%	88%	83%	67%	62%	62%
Rainy days	4	6	6	6	8	13	21	21	16	4	1	2
Avg. sun hours	8.6	9.2	10.4	11.4	11.5	9.8	6.8	6.5	8.1	9.5	9.2	8.7

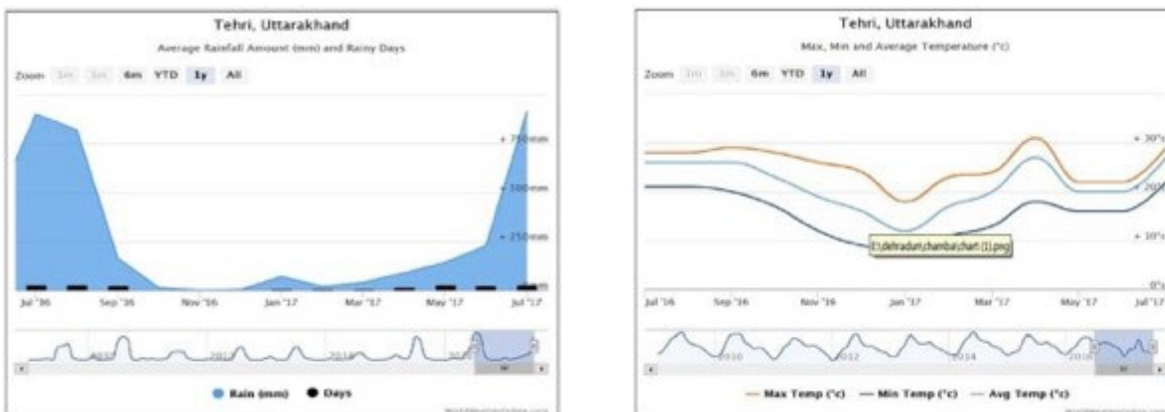


Figure 59. Temperature and Rainfall of Project Area, 2022

457. The wind speeds are generally low to moderate during the study period (April, 2022 to June, 2022). The wind rose diagram for Dehradun IMD station (Nearest IMD station from project site) was developed during the study period and shown in Figure 49. The data reveals that pre-dominant wind direction is from South West with an average wind speed of 0.93 m/s. The meteorological Data recorded by the IMD station at Dehradun is presented in Figure 48. The wind direction has been drawn on the basis of data obtained from source IMD.

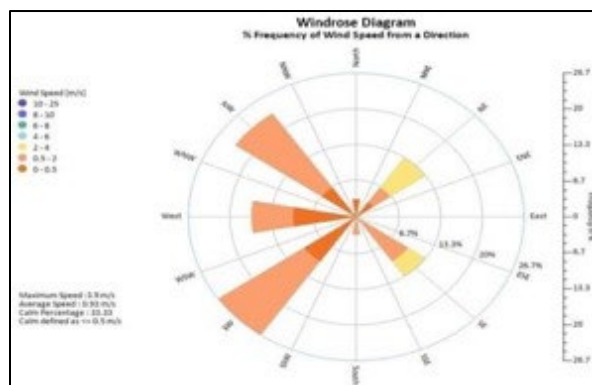


Figure 60. Wind Rose Diagram for Tehri Lake

458. **Climate Projections:** The study of climate projections for the Tehri Lake are based on the NEX-GDDP-CMIP6 dataset, which includes global downscaled climate scenarios derived from General Circulation Model (GCM) runs. These projections were developed under the Coupled Model Intercomparison Project Phase 6 (CMIP6). The dataset provides daily projections of climate variables, including temperature and precipitation, based on two key greenhouse gas emissions scenarios: SSP2-4.5 and SSP5-8.5. SSPs, or Shared Socioeconomic Pathways, are narrative frameworks used to describe different trajectories of societal development, including population growth, energy use, and governance, which influence climate outcomes. SSP2-4.5 represents a moderate emissions scenario where climate protection measures are implemented, while SSP5-8.5 assumes high emissions driven by continued reliance on fossil fuels with minimal climate mitigation efforts.

459. The study used a 30-year historical baseline (1980–2010) and future projection periods from 2041 to 2070 (near future) and 2071 to 2100 (far future) to assess changes in key climate

variables for the Tehri Lake Area. The projections indicate a clear trend of increasing temperatures and changing precipitation patterns. Under the SSP2-4.5 scenario, the near future is expected to see an average temperature increase of 1.78°C from the baseline, with a potential rise of 2.47°C by the far future. In the more extreme SSP5-8.5 scenario, the temperature increase is projected to be 2.56°C in the near future and as much as 4.80°C by the far future. This warming trend could exacerbate the heat island effect, increase discomfort for tourists, and lead to greater demand for energy-intensive cooling solutions, which in turn could contribute further to greenhouse gas emissions. The rise in both maximum and minimum temperatures also poses risks to biodiversity and the natural ecosystems in the region, potentially leading to ecological imbalances.

460. In terms of precipitation, the projections suggest that rainfall in the Tehri Lake Area will increase under both SSP2-4.5 and SSP5-8.5 scenarios. For the near future (2041–2070), precipitation is expected to increase by 14.73% under SSP2-4.5 and by 23.81% under SSP5-8.5. This trend continues into the far future (2071–2100), with projected increases of 19.25% and 38.59% under SSP2-4.5 and SSP5-8.5, respectively. These changes indicate a wetter future for the region, with more frequent and intense rainfall events. While increased precipitation may seem beneficial for water resources, the erratic nature of future rainfall patterns—coupled with more extreme weather events such as floods, cloudbursts, and landslides—could pose significant risks to infrastructure, particularly in the tourism sector. Frequent flooding and landslides may damage roads, buildings, and tourism facilities, while also disrupting local economies and livelihoods that depend on tourism.

461. The projections highlight that future climate conditions in the Tehri Lake Area will likely involve increased variability in both temperature and precipitation, making the region more vulnerable to extreme weather events. The consequences of these changes include not only physical damage to infrastructure but also broader socio-economic impacts such as tourism disruption, health risks from extreme heat, and challenges to water management. The increased frequency of extreme rainfall events, for instance, may lead to severe flash floods and landslides, which can overwhelm local infrastructure and result in economic losses for the tourism sector. Additionally, the rise in winter temperatures could accelerate the melting of glaciers and snow cover in the upstream regions, increasing the risk of flooding during the summer months.

462. In conclusion, the Tehri Lake Area is poised for a future characterized by significant increases in temperature and precipitation, with the potential for more extreme weather events. The SSP5-8.5 scenario, in particular, underscores the need for immediate and robust climate adaptation and mitigation measures to address the challenges posed by these changes. Planning and implementing effective risk management strategies will be crucial to minimizing the adverse impacts on infrastructure, ecosystems, and communities, while also promoting sustainable development in the face of a changing climate.

463. Details of the climate risk assessment is shown in Appendix 6.

464. **Air quality.** It was monitored at five locations to cover the subprojects in this IEE. The monitoring locations were selected based on the presence of sensitive receptors, land-use patterns, and competitive users. These locations are shown in the map given at Figure 50. The results of the ambient air quality monitoring are presented in the following tables.



Figure 61. Locations of air quality and noise level monitoring stations.

Table 21. Results of air quality monitoring in Dobra Chanti (or PS1)

S. No.	Parameters	Test Method	Test Results	Units	NAAQS#
1.	Particulate Matter (PM ₁₀)	IS:5182 (P-23):2006, RA2022, (Cyclonic Method)	76.3	µg/m ³	100
2.	Particulate Matter (PM _{2.5})	IS:5182 (P-24)2019, (Gravimetric method)	31.8	µg/m ³	60
3.	Sulphur Dioxide (SO ₂)	IS:5182 (P-2):2001, RA2022	18.2	µg/m ³	80
4.	Nitrogen Dioxide (NO ₂)	IS:5182 (P-6):2006, RA2022	26.0	µg/m ³	80
5.	Carbon Monoxide (CO)	IS:5182 (P-10)1999, RA 2019	0.14	µg/m ³	4

Table 22. Results of air quality monitoring in Tiwar Village at Panwar Ji House (or PS2)

S. No.	Parameters	Test Method	Test Results	Units	NAAQS#
1.	Particulate Matter (PM ₁₀)	IS:5182 (P-23):2006, RA2022, (Cyclonic Method)	68.2	µg/m ³	100
2.	Particulate Matter (PM _{2.5})	IS:5182 (P-24)2019, (Gravimetric method)	24.0	µg/m ³	60
3.	Sulphur Dioxide (SO ₂)	IS:5182 (P-2):2001, RA2022	12.3	µg/m ³	80
4.	Nitrogen Dioxide (NO ₂)	IS:5182 (P-6):2006, RA2022	25.0	µg/m ³	80
5.	Carbon Monoxide (CO)	IS:5182 (P-10)1999, RA 2019	0.11	µg/m ³	4

Table 23. Results of air quality monitoring near ISBT (or PS3)

S. No.	Parameters	Test Method	Test Results	Units	NAAQS#
1.	Particulate Matter (PM ₁₀)	IS:5182 (P-23):2006, RA2022, (Cyclonic Method)	72.8	µg/m ³	100
2.	Particulate Matter (PM _{2.5})	IS:5182 (P-24)2019, (Gravimetric method)	27.3	µg/m ³	60
3.	Sulphur Dioxide (SO ₂)	IS:5182 (P-2):2001, RA2022	14.8	µg/m ³	80
4.	Nitrogen Dioxide (NO ₂)	IS:5182 (P-6):2006, RA2022	23.0	µg/m ³	80
5.	Carbon Monoxide (CO)	IS:5182 (P-10)1999, RA 2019	0.12	µg/m ³	4

Table 24. Results of air quality monitoring in Mokri (or PS5)

S. No.	Parameters	Test Method	Test Results	Units	NAAQS#
1.	Particulate Matter (PM ₁₀)	IS:5182 (P-23):2006, RA2022, (Cyclonic Method)	88.9	µg/m ³	100
2.	Particulate Matter (PM _{2.5})	IS:5182 (P-24)2019, (Gravimetric method)	47.0	µg/m ³	60
3.	Sulphur Dioxide (SO ₂)	IS:5182 (P-2):2001, RA2022	21.3	µg/m ³	80
4.	Nitrogen Dioxide (NO ₂)	IS:5182 (P-6):2006, RA2022	36.0	µg/m ³	80
5.	Carbon Monoxide (CO)	IS:5182 (P-10)1999, RA 2019	0.76	µg/m ³	4

Table 25. Results of air quality monitoring in Sandana Village at Mahadev Temple (PS6)

S. No.	Parameters	Test Method	Test Results	Units	NAAQS#
1.	Particulate Matter (PM ₁₀)	IS:5182 (P-23):2006, RA2022, (Cyclonic Method)	74.9	µg/m ³	100
2.	Particulate Matter (PM _{2.5})	IS:5182 (P-24)2019, (Gravimetric method)	22.6	µg/m ³	60
3.	Sulphur Dioxide (SO ₂)	IS:5182 (P-2):2001, RA2022	11.7	µg/m ³	80
4.	Nitrogen Dioxide (NO ₂)	IS:5182 (P-6):2006, RA2022	21.6	µg/m ³	80
5.	Carbon Monoxide (CO)	IS:5182 (P-10)1999, RA 2019	0.09	µg/m ³	4

465. At Dobra Chanti, the levels of air quality parameters show moderate concentrations. The PM₁₀ is recorded at 76.3 µg/m³, which is below the NAAQS limit of 100 µg/m³. PM_{2.5} is 31.8 µg/m³, also within the NAAQS limit of 60 µg/m³. SO₂ and NO₂ are measured at 18.2 µg/m³ and 26.0 µg/m³ respectively, both well within the NAAQS limits of 80 µg/m³. CO is significantly lower at 0.14 µg/m³ against the limit of 4 µg/m³. These results indicate relatively good air quality at this station with all parameters within permissible limits.

466. In Tiwar Village, the levels of PM₁₀ and PM_{2.5} are slightly lower than those in Dobra Chanti, recorded at 68.2 µg/m³ and 24.0 µg/m³ respectively, indicating cleaner air in terms of particulate

matter. SO_2 and NO_2 concentrations are $12.3 \mu\text{g}/\text{m}^3$ and $25.0 \mu\text{g}/\text{m}^3$, both within safe limits. CO is at $0.11 \mu\text{g}/\text{m}^3$, much lower than the NAAQS limit. This data suggests that Tiwar Village area has a slightly better air quality than Dobra Chanti, particularly in terms of PM concentration.

467. The area in ISBT and City Centre similar air quality to Dobra Chanti with PM_{10} at $72.8 \mu\text{g}/\text{m}^3$ and $\text{PM}_{2.5}$ at $27.3 \mu\text{g}/\text{m}^3$. SO_2 levels are at $\mu\text{g}/\text{m}^3$, and NO_2 is $23.0 \mu\text{g}/\text{m}^3$, both comfortably below the NAAQS limits. CO levels are slightly lower at $0.12 \mu\text{g}/\text{m}^3$. This station's air quality is indicative of urban areas with moderate vehicular activity, maintaining all pollutant levels within acceptable limits.

468. The air quality station at Mokri, located at a landfill site, shows the highest concentration of particulate matter among all stations. PM_{10} is recorded at $88.9 \mu\text{g}/\text{m}^3$, and $\text{PM}_{2.5}$ is at $47.0 \mu\text{g}/\text{m}^3$. Both values are still within NAAQS limits however are notably higher compared to other stations, likely due to activities related to waste handling and disposal. SO_2 is recorded at $21.3 \mu\text{g}/\text{m}^3$, and NO_2 at $36.0 \mu\text{g}/\text{m}^3$, both within permissible limits but again higher than other locations. CO levels here are significantly higher at $0.76 \mu\text{g}/\text{m}^3$, though still within the NAAQS limit. This station reflects the impact of landfill operations on air quality, with higher levels of pollutants, particularly particulate matter.

469. The Sandhna Village's air quality parameters are generally lower compared to other stations. PM_{10} is $74.9 \mu\text{g}/\text{m}^3$, and $\text{PM}_{2.5}$ is $22.6 \mu\text{g}/\text{m}^3$, both within the NAAQS limits. SO_2 and NO_2 levels are at $11.7 \mu\text{g}/\text{m}^3$ and $21.6 \mu\text{g}/\text{m}^3$ respectively, showing the lowest concentration of these pollutants among all stations. CO is at $0.09 \mu\text{g}/\text{m}^3$, the lowest recorded across all locations. This data suggests that area, being in a village setting, experiences better air quality with lower pollutant concentrations, likely due to less industrial and vehicular activity.

470. Overall, the data indicates that air quality varies significantly across different locations in Tehri. Urbanized and busy areas like Dobra Chanti and ISBT City Centre show higher levels of pollutants, particularly particulate matter, whereas more rural or residential areas like Tiwar Village and Sandhna Village tend to have lower concentrations. All stations, however, remain within the safe limits set by the NAAQS, indicating that the air quality in these areas is generally acceptable. The higher levels of pollutants at Mokri highlight the impact of landfill activities on local air quality, necessitating targeted measures to manage and mitigate pollution in such areas. Appendix 8 shows the air quality report in 5 stations.

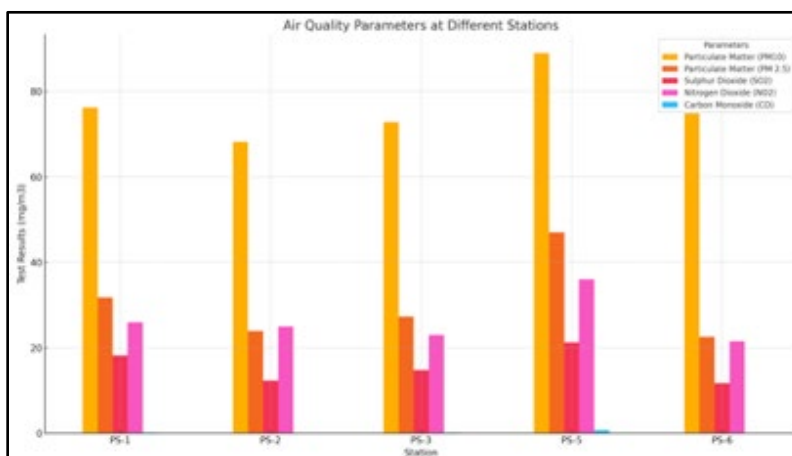


Figure 62. Levels of air quality parameters at different stations during monitoring.

471. **Noise Levels.** Ambient noise levels were monitored at the same stations as the air quality. The noise level monitoring was carried out continuously for 24 hours. Daytime monitoring took place from 6:00 AM to 10:00 PM, while night time monitoring occurred from 10:00 PM to 6:00 AM. The ambient noise levels recorded during the day and night time are presented in the following Table 26.

Table 26. Results of noise level monitoring in all stations

S. No.	Parameters	Test Method/ Unit	Test Results				
			Dobra Chanti	Tiwar Village	ISBT	Mokri	Sandana Village
1.	Equivalent Noise Level (6.00 AM to 10.00 PM) Day Time	IS:9989:1981 RA2020 dB	62.3	55.2	51.5	57.3	45.8
2.	Equivalent Noise Level (10.00 PM to 06.00 AM) Nighttime		51.4	48.8	47.0	51.5	42.6

dB = decibel, ISBT = interstate bus terminus.

472. At Dobra Chanti, located near the Dobra Chanti Bridge in Tehri, the noise monitoring results indicate a moderately high level of noise pollution. During the daytime (6:00 AM to 10:00 PM), the equivalent noise level recorded is 62.3 dB. This relatively high level can be attributed to the traffic and various activities associated with the bridge, which likely acts as a significant conduit for vehicular movement and human activity. At night (10:00 PM to 6:00 AM), the noise level drops to 51.4 dB. Although lower than the daytime level, it remains significant, suggesting that the area experiences continuous noise, possibly from vehicles traveling at night or other nocturnal activities.

473. The noise levels in Tiwar Village, are relatively lower compared to Dobra Chanti. During the day, the equivalent noise level is 55.2 dB, indicating a quieter environment, likely due to the residential nature of the area with less traffic and fewer commercial activities. At night, the noise level further decreases to 48.8 dB. This reduction highlights a quieter nighttime environment, typical of residential areas where activities slow down significantly after dark, leading to reduced noise pollution.

474. Monitoring location near the ISBT City Centre, exhibits moderate noise levels. The daytime noise level is recorded at 51.5 dB, reflecting the steady traffic and commercial activities characteristic of a city center. This station's proximity to the city center and a transportation hub likely contributes to these noise levels. During the night, the noise level drops to 47.0 dB, indicating a reduction in activities and vehicular movement. Despite being in an urban setting, the noise levels at night are relatively well controlled, suggesting effective urban noise management practices.

475. In Mokri site, the noise levels are notably higher compared to other stations. The daytime noise level is 57.3 dB, which can be attributed to the operational activities at the landfill, such as waste processing and machinery use. At night, the noise level remains relatively high at 51.5 dB, like the nighttime levels at PS-1. This suggests continuous noise from ongoing operations or related activities even during the night, highlighting the need for noise mitigation strategies in and around landfill sites.

476. In Sandhna Village at Mahadev Temple, records the lowest noise levels among all the

monitored stations. During the daytime, the noise level is 45.8 dB, reflecting a very quiet environment. This low level is likely due to the village setting, characterized by fewer activities and minimal traffic. At night, the noise level further decreases to 42.6 dB, the lowest nighttime noise level recorded across all stations. This data suggests a very peaceful environment, typical of rural areas with low population density and limited nocturnal activities.

477. Overall, the noise monitoring results highlight the variations in noise pollution across different locations. As presented in the Figure 52, urban and busy areas such as Dobra Chanti and Mokri experience higher noise levels due to continuous activities and traffic, while residential and rural areas like Tiwar Village and Sandhna Village exhibit lower noise levels, providing quieter environments. The noise level monitoring reports and the sampling pictures are shown in Appendix 9.

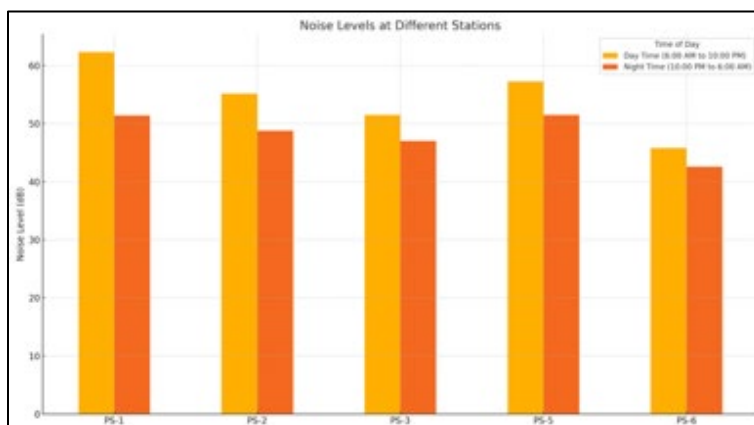


Figure 63. Noise levels at different stations during monitoring.

478. **Water quality.** Water quality monitoring and analysis in regard to physio-chemical as well as biological parameters were carried out on samples collected from the Tehri lake at Dobra Chanti location Lat 30.448695° Long: 78.438407° in the project area on 28.05.2024. The results of the analysis are presented in Table 27, which and these are compared with the water quality criteria of designated best use given by the Central Pollution Control Board.



Figure 64. Location of water quality monitoring station

Table 27. Surface Water Quality Result – Subproject Area

S. No / Parameters		Test Method	Results	Limit of as per IS: 10500:2012 with amd. 1,2,3and 4 Reaff.2018		Units
				Acceptable Limit	Permissible Limit	
1.	pH (at 25°C)	IS:3025 (P-11)2022 Electrometric Method	7.53	6.5-8.5	No Relaxation	NA
2.	Colour	IS 3025 (P-4) 2021, Platinum cobalt (visual comparison method)	< 5.0	5.0	15.0	Hazen
3.	Temperature	IS:196 Amend.1	20.2	N/A	N/A	°C
4.	Odour	IS 3025 (Part-7) 2017	No Smell	Agreeable	Agreeable	NA
5.	Chloride, Cl	IS 3025 (P-32)1988, RA 2019 Argentometric Method	7.4	250	1000	mg/l
6.	Total Dissolved Solids	IS 3025 (P-16)2023 Gravimetric method	106.0	500	2000	mg/l
7.	Sulphate, SO ₄	IS 3025 (P-24/ Sec-1) 2022 Turbidity method.	15.2	200	400	mg/l
8.	Dissolved Oxygen	APHA- 23rd ED-4500-OC Winkler Method with Azide Modification	10.3	N/A	N/A	mg/l
9.	BOD (BOD for 3 days at 27°C)	IS-3025 (P-44)1993,RA2019	< 5.0	N/A	N/A	mg/l
10.	Total Suspended Solid	APHA 23rdEdi.2017 -2540 B, Gravimetric Method	46.8	N/A	N/A	mg/l
11.	Total Nitrogen	APHA 24th Edn.4500 Norg.B	3.28	N/A	N/A	mg/l
12.	Ammonical Nitrogen(NH ₃ N)	APHA 24th Edn.4500 NH ₃ .B	0.14	N/A	N/A	mg/l
13.	Fluoride, F	APHA 23 rd Edi.2017, 4500 F-D SPADNS Method	** BDL(#DL-0.5)	1.0	1.5	mg/l
14.	Nitrate, NO ₃	IS:3025 (P-34) 1988, RA 2019, (a)Chromotropic acid method	0.13	45	No relaxation	mg/l
15.	Zinc, Zn	IS:3025(P-49)1994, RA2019, (b)Atomic Absorption Method	** BDL (#DL-0.07)	5	15	mg/l
16.	Copper, Cu	IS 3025(P-42)1992, RA2019, (b)Atomic Absorption Method	** BDL (#DL-0.02)	0.05	1.5	mg/l
17.	Manganese, Mn	IS:3025(P-59) 2023 (b)Atomic Absorption Method	** BDL (#DL-0.10)	0.1	0.3	mg/l
18.	Cadmium, Cd	IS:3025(P-41)2023 (b)Atomic Absorption Method	** BDL (#DL-0.001)	0.003	No relaxation	mg/l
19.	Lead, Pb	IS:3025:(P-47)1994, RA2019, (b)Atomic Absorption Method	** BDL (#DL-0.001)	0.01	No relaxation	mg/l
20.	Selenium, Se	IS:3025(P-56)2003, RA2019, (b)Atomic Absorption Method	** BDL (#DL-0.01)	0.01	No relaxation	mg/l

S. No / Parameters		Test Method	Results	Limit of as per IS: 10500:2012 with amd. 1,2,3and 4 Reaff.2018		Units
				Acceptable Limit	Permissible Limit	
21.	Arsenic, As	IS:3025(P-37) 2022 (b)Atomic Absorption Method	** BDL (#DL-0.01)	0.01	0.05	mg/l
22.	Mercury, Hg	IS:3025;(P-48) 1994, RA 2019	** BDL (#DL-0.01)	0.001	No relaxation	mg/l
23.	Free Ammonia	IS:3025(P-34);Sec-4	0.051	0.5	No relaxation	mg/l
24.	Oil and Grease	APHA 24 th Edn.5520B,Partition Gravimetric Method	** BDL (#DL-2.0)	N/A	N/A	mg/l
25.	Chromium (Cr6+)	IS 3025 (P-52) 2003,RA 2019 Diphenylcarbazide method,	** BDL(#DL-0.001)	N/A	N/A	mg/l
26.	Iron, Fe	IS 3025 (P-53) 2003, RA 2019, 1,10 Phenanthroline Method	** BDL (#DL-0.05)	1.0	No relaxation	mg/l
27.	Phosphate, PO ₄	APHA 24 TH Edn.4500PD,Stannus Chloride Method	0.18	N/A	N/A	mg/l
28.	Chemical Oxygen Demand	APHA 23rdEdi.2017.5220B, Open Reflux Method	5.4	N/A	N/A	mg/l
29.	Sulphide, H ₂ S	IS:3025(P-29)	** BDL (#DL-0.05)	0.05	No relaxation	mg/l
Microbiological Parameter						
30.	Total Coliform	IS: 15185:2016, RA2021	Absent	Shall not be detectable in any 100 ml sample		ml
31	Cyanide, CN	APHA 23 rd Edi.2017, 4500 F-D SPADNS Method	**BDL (#DL-0.02)	0.05	No relaxation	mg/l
32.	Phenolic Compound	IS:3025 (P-34) 1988, RA 2019, (a) Chromotropic acid method	**BDL (#DL-0.001)	0.001	0.002	mg/l
33.	Anionic Detergents, MBAS	IS:3025(P-55)2003, RA2019	**BDL (#DL-0.05)	0.2	1.0	mg/l

***BDL= Below Detected limit, DL= Detection Limit, N/A= Not Applicable.

479. The surface water monitoring at Dobra Chanti Bridge in Tehri reveals excellent water quality when compared against the Indian Standard (IS) 10500:2012. The pH level of 7.53 is well within the acceptable range of 6.5 to 8.5, indicating neutral water, which is optimal for most uses. The color of the water is below 5.0 Hazen units, suggesting clear water with minimal color impurities. The water temperature is recorded at 20.2°C, typical for the region, and there is no detectable odor, indicating the absence of organic or industrial contaminants.

480. Chloride levels at 7.4 mg/l are significantly lower than the acceptable limit of 250 mg/l, indicating no salinity issues. Total Dissolved Solids (TDS) are measured at 106.0 mg/l, well within the acceptable limit of 500 mg/l, suggesting low levels of dissolved minerals and overall good

water quality. Sulphate levels are low at 15.2 mg/l, far below the acceptable limit of 200 mg/l, indicating no significant pollution from industrial or agricultural runoff.

481. The dissolved oxygen (DO) level is high at 10.3 mg/l, which is beneficial for aquatic life and indicates good water quality. Biological Oxygen Demand (BOD) is below 5.0 mg/l, suggesting minimal organic pollution. The presence of Total Suspended Solids (TSS) at 46.8 mg/l is moderate, which is typical for surface water bodies. Nitrogen and ammoniacal nitrogen levels are low, indicating minimal contamination from agricultural or sewage sources.

482. Key heavy metals such as fluoride, zinc, copper, manganese, cadmium, lead, selenium, arsenic, mercury, chromium, and iron are all below detectable limits, indicating no contamination. This is a significant indicator of the absence of industrial pollution. Phosphate levels are low at 0.18 mg/l, suggesting minimal agricultural runoff or sewage contamination. The chemical oxygen demand (COD) is also low at 5.4 mg/l, indicating minimal organic pollution.

483. Importantly, the absence of total coliforms in the water sample reflects excellent sanitary quality, with no fecal contamination detected. This further underscores the good quality of water at this location. Overall, the surface water at PS-1 demonstrates excellent quality across all parameters tested, with key indicators well within acceptable limits or below detectable levels. Continuous monitoring is essential to maintain these high standards and ensure the safety and sustainability of this vital water resource. The monitoring report is shown at Appendix 10.

484. Water quality monitoring at the upstream dam. There is another surface water monitoring activity done for the lake, which was performed by UTDB for the WTP subproject. Water sample was received on December 28, 2023, and the analysis commenced on the same day at a designated laboratory. The sample was taken from the upstream of the dam reservoir, and varied volumes of the sample, specifically 2000 ml, 300 ml, and 200 ml, were analyzed. The completion of this analysis was recorded on January 19, 2024. This forms another basis for evaluating the water quality against IS:10500-2012 standards and baseline information for this IEE.

485. The results of the water quality monitoring indicated that most parameters are within the acceptable limits set by IS:10500-2012, ensuring the water's safety and suitability for consumption. For instance, the pH value recorded at 7.1 falls well within the acceptable range of 6.5-8.5, indicating a balanced aquatic environment. Similarly, turbidity, which can significantly affect water clarity and quality, measured at 1.84 NTU, is below the permissible limit of 5 NTU, suggesting minimal particulate presence which is vital for both aesthetic and health standards. Further analysis shows that TDS and TSS are considerably lower than permissible limits, with values of 62 mg/L and 8 mg/L respectively against limits of 2000 mg/L and 500 mg/L. These lower values indicate clean water, free from excessive minerals and pollutants that can affect water taste, color, and health impact. Similarly, essential minerals like Calcium and Magnesium recorded at 10 mg/L and 20 mg/L respectively are well below the maximum permissible limits, indicating an optimal mineral balance that does not pose health risks.

486. Critical to health, parameters such as Coliform levels were also tested, showing a Total Coliform count of 10 MPN/100 ml which is within safe limits as no Coliform should be detectable in any 100 ml sample. The absence of Fecal Coliform further corroborates the microbiological safety of the water. Additionally, parameters like Iron, Nitrogen, and Chloride were all found to be significantly below limits that could pose health hazards, which is encouraging for public health implications. Based on this analysis, water quality monitoring report for this part of the lake presents a reassuring picture of water safety and compliance with national standards. The adherence to IS:10500-2012 guidelines across a broad spectrum of chemical and microbiological

parameters underscores the robustness of the water treatment and monitoring systems in place. The summary of monitoring report is shown in the second table of Appendix 10.

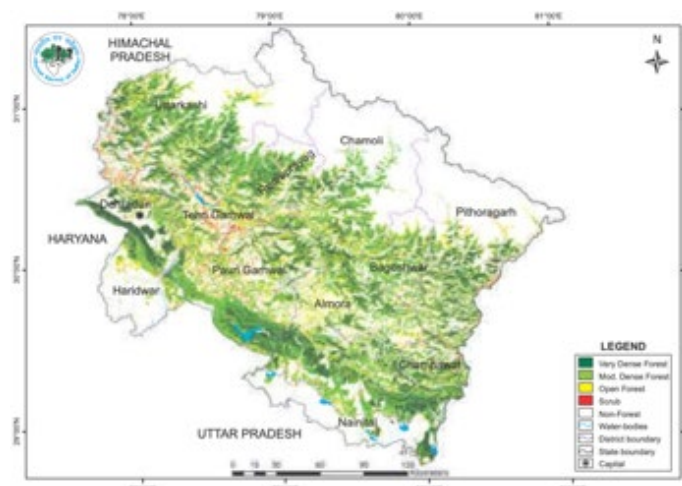
487. Secondary water quality monitoring data. There are secondary information from THDC in mid-year of 2023. The water quality monitoring results for the samples labelled SW2 and SW3 indicate that the water largely adheres to the stringent standards set by IS 10500:2012. Both samples display excellent quality metrics, particularly in color and turbidity, both registering values under 1.0 Hazen and 1.0 NTU respectively, which are well below the acceptable limits. This suggests that the water is aesthetically clear without significant sediment or particulate matter that might obscure clarity or pose health risks.

488. The pH levels of 7.23 and 7.88 for SW2 and SW3 respectively fall comfortably within the ideal range of 6.5 to 8.5, indicating a well-balanced aquatic environment that is neither too acidic nor too alkaline. Such balance is crucial for both the health of aquatic life and the safety of the water for human consumption. Other critical parameters such as Total Dissolved Solids are measured at 480 mg/l for both samples, which is also under the maximum permissible limit of 2000 mg/l, pointing to relatively low mineral content and absence of harmful constituents.

489. In terms of chemical contaminants, the concentrations of heavy metals such as Iron, Zinc, Cadmium, and Copper are all reported to be well within safe consumption limits. Specifically, Iron levels at 0.34 mg/l and 0.164 mg/l are just over the acceptable limit but well under the permissible limit of 1.0 mg/l, ensuring safety from health risks associated with higher iron content. Similarly, for other potentially toxic substances like Lead, Mercury, Arsenic, and Chromium, the results are significantly below detection thresholds, suggesting excellent filtering and treatment processes are in place. These findings underscore the efficacy of the water treatment facilities serving this area, ensuring that the water not only meets but, in many aspects, exceeds the safety standards required for public use. The summary of data is shown in Appendix 10.

C. Biological Environment Conditions

490. **Biological Resources – Forest.** Uttarakhand is rich in forest resources. As per the Champion and Seth Classification of Forest Types (1968), the forests in Uttarakhand belong to nine Forest Type Groups, which are further divided into 43 Forest Types. Physiographical, the State can be divided into three zones namely, the Himalayas, the Shiwalik and the Terai region. The human and livestock populations are largely dependent on forests due to agrarian economy and pastoralism. Van Panchayats in Uttarakhand are unique institutions of community forest management which came into existence in 1921. At present, there are 12,167 Van Panchayats in the State which manage an area of 7,32,688 hectares of forest. The occurrence of forest fires at regular intervals is a major problem in the State. Recorded Forest Area (RFA) in the State is 38,000 sq km of which 26,547 sq km is Reserved Forest, 9,885 sq km is Protected Forest and 1,568 sq km is Unclassed Forests. In Uttarakhand, during the period 1st January 2015 to 5th February 2019, a total of 2,850.87 hectares of forest land was diverted for non-forestry purposes under the Forest Conservation Act, 1980 (MoEFCC, 2019). Six National Parks, seven Wildlife Sanctuaries and four Community Reserves constitute the Protected Area network of the State covering 3.24% of its geographical area. The Corbett National Park is located in the State.



Source: <https://fsi.nic.in/isfr19/vol2/isfr-2019-vol-ii-uttarakhand.pdf> and India State of Forest Report, 2019

Figure 65. Forest Cover Map of Uttarakhand

491. Out of the total geographical area of 3642 sq km of Tehri Garhwal District 2,065.98 sq.km is the total forest area comprising of 272.71 very dense forest, 1084.08 of Moderately dense forest and 709.19 of open forest.

492. Except for the civil forests, the catchment area of Tehri lake is primarily located within three ranges of Tehri Forest Division, namely New Tehri range, Paukhal range, and Lambgaon range. Most of the area is hilly area and at downstream partial area is flat land. Tehri Lake catchment area within Tehri Forest cover area is only 133.64 sq km (ref Figure 55). This area is open forest land.



Figure 66. Forest ranges within Their District

493. **Protected Areas of the State.** Uttarakhand presents a storehouse of biodiversity, where flora and fauna vary extensively with climatic diversity from one region to the other. There is a diverse range flora and fauna habitat in the state. The state has rich and diverse floral, faunal and microbial wealth including rare and threatened species of plants and animals.

494. The state of Uttarakhand is known for its unique biodiversity. Due to geographic and

climatic diversity in different areas of the state different forest types are found spanning from the Himalayas to the plains of the Terai. Due to biodiversity present in the state 12 percent of the total geographical area is protected areas which includes 6 National Park, 7 Wildlife Sanctuary, 4 Conservation and 1 Biosphere Reserve.



Figure 67. Protected Areas of Uttarakhand¹³

495. The protected areas surrounding Tehri Garhwal play a vital role in conserving the region's biodiversity, ensuring the survival of rare and endangered species, and maintaining ecological balance. These areas include Rajaji National Park, Kedarnath Wildlife Sanctuary, Gangotri National Park, and others, which together form a network of diverse ecosystems ranging from subtropical forests to alpine meadows. Each protected area is distinct in terms of its habitat types and species compositions. Below is discussion of the protected areas and their proximity to the Tehri Lake region.

496. Rajaji National Park, (Distance to Tehri Lake: Approximately 90-110 km southwest). Covering 820 sq. km, the park is a key component of the Shivalik Elephant Reserve and is one of northern India's most significant protected areas. It is home to large mammal species such as Asian Elephants, Bengal Tigers, Leopards, and Sloth Bears, along with a variety of ungulates like Sambar, Chital, and Barking Deer. The park's diverse habitats include tropical and subtropical forests, grasslands, and riverine ecosystems, which support over 300 bird species, making it an important area for avian biodiversity, including migratory birds. The park's unique combination of flora and fauna highlights its critical role in regional conservation. Rajaji National Park is located near Sonanadi Wildlife Sanctuary, and both areas already function as a continuous wildlife corridor, particularly for wide-ranging species such as elephants and tigers. Additionally, the natural river systems, including the Ganga and Yamuna, enhance connectivity by providing migratory paths for wildlife.

497. Kedarnath Wildlife Sanctuary (Distance to Tehri Lake: Approximately 80-100 km northeast). The sanctuary is one of the largest protected areas in the Garhwal Himalayas (975 sq. km.) and is known for its rich biodiversity, particularly at higher elevations. The sanctuary is a critical habitat for populations of Snow Leopards, Musk Deer, Himalayan Black Bears, and Bharal (Blue Sheep). It also harbours a wide variety of avian species, including the Himalayan Monal,

¹³ Source. https://ars.els-cdn.com/content/image/1-s2.0-S2666719322000140-gr1_lrg.jpg

which is the state bird of Uttarakhand, as well as other alpine birds and pheasants. The sanctuary's ecosystems, which range from alpine meadows and subalpine forests to coniferous woodlands, provide essential habitats for cold-adapted species and support the ecological balance of the Garhwal region. Kedarnath Wildlife Sanctuary shares similar ecological characteristics with Gangotri National Park, and both areas could be linked through alpine corridors, particularly along the Bhilangna and Bhagirathi river valleys. Species like the snow leopard and musk deer, which require large, undisturbed territories, would benefit from increased connectivity between these areas.

498. Gangotri National Park (Distance to Tehri Lake: Approximately 120-140 km north). Gangotri National Park (2,390 sq. km.) is situated in the upper reaches of the Western Himalayas and is renowned for its iconic Gangotri Glacier, a major source of the Ganga River. The park provides a pristine habitat for Snow Leopards, Himalayan Tahr, Brown Bears, and Ibex, along with a variety of alpine flora such as rhododendrons and medicinal plants. Its high-altitude ecosystems are essential for preserving the fragile biodiversity of the Himalayas, including rare bird species like the Himalayan Snowcock and Golden Eagle. Gangotri's role in maintaining the region's hydrological balance and supporting key wildlife populations underscores its ecological importance.

499. Govind Pashu Vihar Sanctuary (Distance to Tehri Lake: Approximately 120-140 km north). The sanctuary, located in the Uttarkashi district, is another key protected area for high-altitude species like the Snow Leopard, Himalayan Black Bear, and Musk Deer. The sanctuary's ecosystems range from subalpine forests to alpine meadows, supporting a rich diversity of flora and fauna, including rare plants such as the Brahma Kamal, which is sacred in Hinduism. The sanctuary plays a vital role in the conservation of high-altitude wildlife, especially snow leopards, which face growing threats from habitat loss and climate change.

500. Govind Pashu Vihar is naturally linked to Gangotri National Park, and the two areas could be connected through protected river corridors and forested valleys. The Bhagirathi and Tons Rivers, which flow between these protected areas, provide important migratory paths for wildlife. These natural pathways, combined with forest cover along the valleys, could also serve as corridors connecting the high-altitude habitats of Govind Pashu Vihar with lower-elevation regions near Tehri Lake, ensuring that species can move freely between different zones.

501. Binsar Wildlife Sanctuary (Distance to Tehri Lake: Approximately 200-220 km southeast). Binsar Wildlife Sanctuary (47 sq. km.), located in the Almora district, is renowned for its temperate broadleaf forests and its diverse birdlife. The sanctuary is home to species such as the Leopard, Himalayan Black Bear, and Barking Deer, along with numerous bird species, including the Himalayan Monal, Woodpeckers, and Flycatchers. Although smaller in size compared to other sanctuaries, Binsar is a vital refuge for mid-elevation species and plays an essential role in preserving biodiversity within its forested landscape.

502. Nanda Devi National Park (Distance to Tehri Lake: Approximately 110-130 km northeast). The park, a United Nations Educational, Scientific and Cultural Organization World Heritage Site, is one of the most biodiverse regions in the Himalayas. The park is home to species such as the Snow Leopard, Himalayan Musk Deer, and Himalayan Tahr, along with numerous rare and endemic plant species. The park's ecosystems, ranging from subalpine forests to alpine meadows and glaciers, make it a critical area for the conservation of high-altitude flora and fauna. The park's isolation has preserved its pristine environment, making it a crucial refuge for endangered species that are vulnerable to habitat loss.

503. Nanda Devi National Park (624 sq. km.) is connected to both Kedarnath Wildlife Sanctuary and Gangotri National Park through a network of alpine meadows and river systems. Protecting these transition zones, particularly along the Alaknanda and Bhagirathi rivers, would facilitate the movement of species such as the snow leopard and Himalayan tahr between these high-altitude habitats. Establishing these ecological corridors would also help link the park to lower-altitude areas near Tehri Lake, creating a more integrated and resilient conservation landscape.

504. Tehri Garhwal, while home to the large and significant Tehri Lake, does not have any officially designated protected areas within its immediate vicinity. The surrounding landscape consists primarily of human settlements, agricultural lands, and forest patches, but lacks formal wildlife corridors that would support the free movement of species across the region. Although protected areas such as Rajaji National Park, Kedarnath Wildlife Sanctuary, and Gangotri National Park play vital roles in conserving biodiversity, there are no established wildlife corridors connecting these areas to the Tehri Lake region.

505. **Ecological Survey.** The baseline study for the current ecological environment was conducted along the tourism road. Field sampling encompassed the proposed project alignment and its area of influence, with surveys focusing on vegetation and animals. Additionally, public consultations were held in the project area during site visits. A phased consultative approach was adopted for the ecological assessment, involving (i) secondary data collection through a desktop review of available literature, (ii) onsite data collection to determine vegetation and wildlife in the project area along with a reconnaissance survey, and (iii) public consultation.

506. An extensive desktop review of available published literature (including books, websites, scientific papers, articles, etc.) was conducted. Forest Working Plans of Forest Divisions were also consulted for secondary information. Further information was gathered from the project proponent, Divisional Forest Office, Forest range office, governmental institutions, and residents of the survey area. Before conducting the field survey, an extensive literature survey was performed to prepare an inventory on Tehri Garhwal. This inventory was created with the help of local floras, various journals, working plans of the forest department, and websites of institutions, NGOs, etc.

507. Primary data was collected along the entire alignment (0 to 15.77 km stretch) through quadrat sampling every 500 meters. A psychosocial study focused on tree species with a diameter greater than 12 cm. To understand the vegetation pattern, primary surveys were conducted to calculate density, frequency, and abundance. Samples of unidentified plants were collected, preserved, and sent to an herbarium for further identification. Wildlife observations were conducted both during the day and night to cover diurnal and nocturnal animals. The existing road edge along the hill slope, spanning 7 to 12 meters of the tourism road, was studied using the Quadrat Method (Curtish and Mc. Intosh 1950) after listing the trees on one slope. In some locations, the left-side alignment up to 4 meters was also included in the study.

508. The proposed alignment does not form a part of any wildlife sanctuary, National Park and biosphere reserve. There is no wildlife corridor along the proposed alignment.

509. The primary survey for the project road starts from Koti colony to Dobra Chanti suspension bridge was considered for the study period. During the survey it was observed that the mostly chir trees are dominating all along the alignment.

510. During the primary survey, tree assessments were conducted randomly using 10x10 meter quadrats. Trees with a diameter greater than 12 cm, located along the hillside of the existing

road within an area of up to 11.5 meters, were recorded. It is observed that there are approximately 3,124 trees within the existing road edge along the stretch of Tourism Road from Koti Colony to Dobra Chanti. Out of the recorded species about 10 species are invasive, and rest of the species are native to the area. On an average around 314 trees on 100 m length require to be removed while road widening activity. The list of the tree species and plant (with >12 cm) recorded during the primary survey is presented below.

Table 28. Tree and plant species within alignment area of Tourism Road from Koti Colony to Dobra Chanti (15.77 km stretch)

S.N.	Species	Local Name	Family
1	<i>Aegle marmelos</i>	Bael	Rutaceae
2	<i>Acacia indica</i>	Pangri	Hippocastanaceae
3	<i>Albizia mollis</i>	-	Mimosaceae
4	<i>Ailanthus excelsa</i>	-	Simaroubaceae
5	<i>Bauhinia variegata</i>	Kachnar	Caesalpiniaceae
6	<i>Bombax ceiba</i>	Semal	Bombacaceae
7	<i>Bauhinia tomentosa</i>	-	Caesalpiniaceae
8	<i>Cassia fistula</i>	Amaltas	Caesalpiniaceae
9	<i>Cedrela toona</i>	Toona	Meliaceae
10	<i>Delonix regia</i>	Gulmohar	Caesalpiniaceae
11	<i>Dalbergia latifolia</i>	Sisam	Fabaceae
12	<i>Ficus benghalensis</i>	Bar	Moraceae
13	<i>Dalbergia sissoo</i>	Sisam	Fabaceae
14	<i>Toona ciliata</i>	Tyuni	Meliaceae
15	<i>Ficus palmata</i>	Bedu	Moraceae
16	<i>Ficus religiosa</i>	Peepal	Moraceae
17	<i>Jacaranda mimosifolia</i>	Plum	Bignoniaceae
18	<i>Grewia optiva</i>	Bhimal	Malvaceae
19	<i>Hevea brasiliensis</i>	Rubber	Euphorbiaceae
20	<i>Holoptelea integrifolia</i>	Elm	Ulmaceae
21	<i>Lantana camara</i>	Raimuniya	Verbenaceae
22	<i>Morus alba</i>	Tut	Moraceae
23	<i>Mangifera indica</i>	Aam	Anacardiaceae
24	<i>Melia azedarach</i>	Darek	Meliaceae
25	<i>Pithecellobium dulce</i>	Jungle Jalebi	Fabaceae
26	<i>Pterospermum acerifolium</i>	Kanak Champa	Sterculiaceae
27	<i>Punica granatum</i>	Anar	Lythraceae
28	<i>Prunus dulcis</i>	Badam	Rosaceae
29	<i>Schleichera oleosa</i>	Kusum	Sapindaceae
30	<i>Syzygium cumini</i>	Jamun	Myrtaceae
31	<i>Salmalia malabarica</i>	Semal	Bombacaceae
32.	<i>Agave americana</i>	Rambans	Agavaceae
33.	<i>Adhatoda vasica</i>	Basuti	Acanthaceae
34.	<i>Euphorbia hirta</i>	Dudhi	Euphorbiaceae
35.	<i>Jatropha gossypifolia</i>	-	Euphorbiaceae
36.	<i>Ipomoea carnea</i>	Besharam	Convolvulaceae
37.	<i>Nerium oleander</i>	Kaner	Apocynaceae

511. Based on the ecological survey, on the application of different criteria of IUCN for the

assessment of conservation status of taxa, no taxa were found endangered and critically endangered. *Aegle marmelos* species is near threatened species. It is an invasive species planted by the local and reported at chainage 10 km to 1.5 km and 13 km to 14 km stretch of the alignment. Approximately 3 to 4 species were observed in the entire alignment. As per the IUCN record the *Cedrela odorata* is a vulnerable species and distributed all along the road alignment. Approximately 20 to 25 individual were observed all along the alignment.

512. Based on secondary information, floristic composition within the ecological project area which is 10 km area of the proposed road alignment is mainly Chir forest and Deodar forest types. Due to altitudinal difference, there are different types of the forest are present. In lower altitude the Chir forests are very dense and associated with species of Timla, Bedu, Tynuni etc. In high altitude areas deodar, rhododendron are the main dominant species. The list of the floral species present in the study are presented in the Table 29:

Table 29. Floral Composition within the 10km radius of the proposed tourism road.

S.N.	Species	Local Name	Family
Trees			
1	<i>Aegle Marmelos</i>	Bail	Rutaceae
2	<i>Aesculus indica</i>	Pangar	Hippocastanaceae
3	<i>Agave americana</i>	Rambans	Agavaceae
4	<i>Albizia mollis</i>	Siris	Mimosaceae
5	<i>Azadirachta indica</i>	Neem	Miliaceae
6	<i>Bauhinia purpurea L.</i>	Gyural	Caesalpiniaceae
7	<i>Bauhinia variegata L.</i>	Kuiral	Caesalpiniaceae
8	<i>Bombax ceiba L.</i>	Semal	Bombacaceae
9	<i>Butea monosperma</i>	Dhak	Fabaceae
10	<i>Callistemon</i>	Bottle brush	Myrtaceae
11	<i>Cassia fistula</i>	Amaltash	Caesalpiniaceae
12	<i>Castanea sativa</i>	Chestnut	Fagaceae
13	<i>Cedrela odorata Royle</i>	Cedar	Meliaceae
14	<i>Cedrela serrata Royle</i>	Toona	Meliaceae
15	<i>Cedrus deodara</i>	Devdaar	Pinaceae
16	<i>Cornus capitata</i>	Bhamora	Cornaceae
17	<i>Dalbergia sissoo</i>	sheesham	Fabaceae
18	<i>Elaeagnus umbellata</i>	Geowin	Elaeagnaceae
19	<i>Erythrina suberosa Roxb.</i>	Mandar	Papilionaceae
20	<i>Eucalyptus globulus</i>	Safeda	Myrtaceae
21	<i>Euphorbia royleana</i>	Khinu	Euphorbiaceae
22	<i>Ficus auriculata</i>	Timla	Fabaceae
23	<i>Ficus palmata</i>	Bedu	Fabaceae
24	<i>Ficus religiosa</i>	Peepal	Fabaceae
25	<i>Flacourtia indica</i>	plum	Bixaceae (Flacourtiaceae)
26	<i>Grewia optiva</i>	Bhimal	Tiliaceae
27	<i>Hevea brasiliensis</i>	Rubber	Euphorbiaceae
28	<i>Holoptelea integrifolia</i>	Elm	Ulmaceae
29	<i>Indigofera cassioides</i>	Sakena	Fabaceae
30	<i>Juglans regia L.</i>	Akhrot	Juglandaceae
31	<i>Mangifera indica L.</i>	Aam	Anacardiaceae
32	<i>Melia azedarach</i>	Dekand	Meliaceae
33	<i>Myrica esculenta</i>	kaphal	Myricaceae
34	<i>Phyllanthus emblica L.</i>	Aonla	Phyllanthaceae
35	<i>Pinus roxburghii</i>	cheer	Pinaceae
36	<i>Punica granatum</i>	Anar	Punicaceae

S.N.	Species	Local Name	Family
37	<i>Pyrus pashia</i>	Melu	Rosaceae
38	<i>Quercus leucotrichophora</i>	Banjh	Fagaceae
39	<i>Rhododendron arboreum</i>	Burans	Ericaceae
40	<i>Rhus parviflora</i> Roxb.	Tungla	Anacardiaceae
41	<i>Rhus wallichii</i>	Sumac	Anacardiaceae
42	<i>Toona ciliata</i>	Tyuni	Meliaceae
Shrub and Shrubs			
43	<i>Carissa opaca</i>	Karaunda	Apocynaceae
44	<i>Berberis aristata</i> DC.	Darul Haldi	Berberidaceae
45	<i>Cannabis sativa</i> L.	Bhang	Cannabinaceae
46	<i>Berberis lycium</i> Royle	Kingod	Berberidaceae
47	<i>Coriarianepalensis</i> Wallich	Makroli	Coriariaceae
48	<i>Datisca cannabina</i>	Hemp	Datisceae
49	<i>Lantana camara</i>	Lantana	Verbeneaceae
50	<i>Adhatoda vasica</i>	Basing	Acanthaceae
51	<i>Murraya koenigii</i>	Gandela	Rutaceae
52	<i>Euonymus pendulus</i>	Frilly	Celastraceae
53	<i>Diplazium esculentum</i>	Lingura	Dryopteridaceae
54	<i>Chenopodium album</i> L.	Bathua	Chenopodiaceae
55	<i>Centella asiatica</i> L.	Brahmi	Apiaceae
56	<i>Dioscorea belophylla</i>	Turad	Dioscoreaceae
57	<i>Adhatoda vasica</i>	Basa	Anacardaceae
58	<i>Amaranthus viridis</i> L.	Janglichaulai	Amaranthaceae
59	<i>Bauhinia vahlii</i> Wt. & Arn	Malu	Caesalpiniaceae
60	<i>Lantana camara</i>	Lantana	Verbenaceae
61	<i>Lyonia ovalifolia</i>	Bush	Ericaceae
62	<i>Ocimum sanctum</i>	Tulsi	Lamiaceae
63	<i>Pisonia umbellifera</i>	Bird lime	Nyctaginaceae
64	<i>Prunus cerasoides</i>	Sour	Rosaceae
65	<i>Rubus ellipticus</i>	Hisalu	Rosaceae
66	<i>Senegalia catechu</i>	Khair	Mimosaceae
67	<i>Strobilanthes atropurpureus</i>	Kangdai	Acanthaceae
68	<i>Thuja orientalis</i>	Morpankhi	Cupressaceae
69	<i>Viburnum cotinifolium</i>	Bhatnoi	Caprifoliaceae
70	<i>Benthamedia capitata</i>	Bhamra	Cornaceae
71	<i>Rotala densiflora</i>	Jalmukhi	Lythraceae
72	<i>Rotala Mexicana</i>	Jalmukhi	Lythraceae
73	<i>Passiflora suberosa</i>	Corcky	Passifloraceae
74	<i>Begonia picta</i>	Begonia	Begoniaceae
75	<i>Justicia adhatoda</i>	Vasing	Acanthaceae
76	<i>Agave americana</i>	Ram baans	Agavaceae
77	<i>Rhus parviflora</i>	Tunga	Anacardiaceae
78	<i>Semecarpus anacardium</i>	Bhilao	Anacardiaceae
79	<i>Centella asiatica</i>	Mandukparni	Apiaceae
80	<i>Acorus calamus</i>	Vacha	Araceae
81	<i>Calotropis procera</i>	Aka	Asclepiadaceae
82	<i>Artemisia nilagirica</i>	Nagdona	Asteraceae
83	<i>Eclipta prostrata</i>	Bhringraj	Asteraceae
84	<i>Erigeron asteroids</i>	Bangua	Asteraceae
85	<i>Berberis aristata</i>	Daru haldi	Berberidaceae
86	<i>Berberis asiatica</i>	Kilmora	Berberidaceae
87	<i>Berberis lycium</i>	Kingore	Berberidaceae

S.N.	Species	Local Name	Family
88	<i>Asparagus recemosus</i>	Satawar	Liliaceae
89	<i>Gloriosa superba</i>	Languli	Liliaceae
90	<i>Woodfordia fruticosa</i>	Dhaura	Lythraceae
91	<i>Abutilon indicum</i>	Kanghi	Malvaceae
92	<i>Sida cordifolia</i>	Bala	Malvaceae
93	<i>Cissampelos pareira</i>	Pari	Menispermaceae
94	<i>Tinospora cordifolia</i>	Giloy / Gurchi	Menispermaceae
95	<i>Mimosa pudica</i>	Chui mui	Mimosaceae
96	<i>Rumex hastatus</i>	Chilmora	Polygonaceae
97	<i>Prunus cerasoides</i>	Painya	Rosaceae
98	<i>Urtica dioica</i>	Kandali	Urticaceae
99	<i>Taxus baccata</i>	Thunera	Taxaceae
100	<i>Solanum surattense</i>	Kanteli	Solanaceae
101	<i>Solanum nigrum</i>	Makoi / Giwai	Solanaceae
102	<i>Solanum indicum</i>	Kantkari	Solanaceae
103	<i>Datura stramonium</i>	Dhatura	Solanaceae
104	<i>Verbascum thapsus</i>	Ekalveer	Scrophulariaceae
105	<i>Bergenia ligulata</i>	Silphora	Saxifragaceae
106	<i>Zanthoxylum armatum</i>	Timur	Rutaceae
107	<i>Hedychium spicatum</i>	Van haldi	Zingiberaceae
108	<i>Roscoealpinia</i>	Kanda-mula	Zingiberaceae
109	<i>Roscoeaprocera</i>	Kanda-mula	Zingiberaceae

513. Several species listed above are native to the Indian subcontinent and have localized distributions within the specific ecological niches of the Tehri region. For instance, *Cedrus deodara* is native to the Himalayan region and is an iconic coniferous tree of the western Himalayas. It thrives in altitudes ranging from 1,500 to 3,200 meters, particularly in the higher altitudes of Uttarakhand. Its presence highlights its ecological significance, as it provides habitat and shelter for a variety of bird species, small mammals, and insects. It plays a critical role in stabilizing soils on steep slopes, making it vital for the protection of watersheds in the region. Similarly, *Quercus leucotrichophora* (Banjh), also known as the Himalayan oak, is another important species to the Himalayas, particularly in the mid-altitude ranges between 1,500 to 2,400 meters. It is crucial for maintaining forest structure, soil quality, and water retention. Oak forests support a variety of flora and fauna that are unique to the Himalayan region, including understory plants, small mammals, and a variety of birds.

514. Shrubs such as *Myrica esculenta* (Kaphal), found predominantly in the lower Himalayan region at altitudes of 900 to 2,100 meters, contribute both ecologically and culturally to the region. Kaphal is known for its edible berries, which are consumed by local communities as well as wildlife, such as birds and small mammals. These berries also have medicinal properties and are used in traditional herbal remedies. Additionally, *Berberis lycium* (Kingod), another local shrub, plays a significant role in stabilizing soils in hilly areas due to its extensive root systems. This plant, native to the Himalayan ranges, is used traditionally for medicinal purposes, and its berries are also consumed by local wildlife.

515. The presence of *Lyonia ovalifolia* and *Rhododendron arboreum* (Burans) further illustrates the uniqueness of the flora in the Tehri region. *Rhododendron arboreum*, in particular, is one of the most iconic species of the mid-Himalayas and thrives at altitudes between 1,500 to 3,000 meters. The vibrant red flowers of Burans are not only an important source of nectar for pollinators, such as bees and birds, but they also have significant cultural value, with the flowers being used to make local beverages and medicines. These species contribute to the structural

diversity of the forest ecosystem, providing essential shelter and food for insects, birds, and small mammals.

516. *Habitat Diversity and Complexity:* The Tehri region supports a variety of forest types, including coniferous, broadleaf, and mixed forests, each contributing to a complex and layered ecosystem. These forests have a distinct vertical structure that enhances biodiversity and creates a variety of microhabitats. At the uppermost layer, tall trees such as *Cedrus deodara*, *Pinus roxburghii* (Cheer), and *Quercus leucotrichophora* dominate the canopy. These species play a crucial role in regulating temperature, providing shade, and controlling moisture levels on the forest floor, making the environment more hospitable for species in the lower layers.

517. Beneath the canopy, the understory is made up of smaller trees and shrubs like *Rhododendron arboreum*, *Myrica esculenta*, and *Berberis lycium* (Kingod). This layer benefits from moderate sunlight, supporting a variety of species by providing food and shelter for small mammals and birds. The ground layer, closer to the forest floor, features herbs, ferns, and grasses such as *Diplazium esculentum* (Lingura), *Chenopodium album* (Bathua), and *Adhotoda vasica* (Basing). These plants help sustain insects, soil organisms, and decomposers, which are critical for nutrient cycling.

518. The diverse species across these layers add to the structural complexity of the ecosystem. The multi-layered vegetation creates habitats that support various life forms, from pollinators and herbivores to decomposers, fostering a rich and thriving ecosystem. This high level of biodiversity is crucial for maintaining the ecological balance and resilience of the region.

519. In areas where the forest has been cleared or disturbed, species like *Lantana camara* and *Cannabis sativa* (Bhang) dominate the open landscapes. These species often form dense thickets in disturbed areas, reducing light penetration and altering the structure of natural habitats. While these areas are not as biodiverse as mature forests, they still provide habitat for herbivores and ground-nesting birds.

520. Open scrublands in the Tehri region are often characterized by shrubs and small trees, such as *Berberis aristata* (Darul Haldi) and *Adhotoda vasica*. These plants thrive in rocky, well-drained soils and are adapted to dry conditions. Scrublands are typically less dense but play a crucial role in providing food and shelter for smaller mammals and reptiles. Additionally, these areas contribute to soil retention in sloped landscapes, preventing erosion and supporting secondary succession.

521. Human activities, particularly agriculture, have created modified habitats that support a different set of flora species. *Mangifera indica* (Aam) and *Punica granatum* (Anar) are examples of species cultivated for their fruits in agricultural landscapes. *Juglans regia* (Akhrot) is another economically important species that is often planted in orchards. These modified ecosystems lack the complexity of natural forests but still contribute to the cultural and economic landscape of the region.

522. Agricultural fields and plantations are often less complex in terms of vertical structure but may still harbour a range of wild species in boundary areas and under-utilized patches. The loss of natural habitat in agricultural regions has fragmented the landscape, yet some native plants, such as *Ficus religiosa* (Peepal), continue to persist in sacred groves and near human settlements, offering cultural and ecological benefits.

523. *Ecosystem services of floral species:* The region's floral diversity offers a wealth of

essential goods directly relied upon by the local communities for food, timber, and medicinal purposes. *Aegle marmelos* (Bail), for example, produces a fruit that is highly prized for its medicinal properties, particularly for its use in treating digestive issues. The fruit is commonly used in Ayurvedic medicine, where it is known for its ability to regulate bowel movements, and its anti-inflammatory properties are widely recognized in traditional healing practices. Similarly, *Juglans regia* (Akhrot), the walnut tree, not only provides walnuts, a crop with significant economic value, but its timber is also in high demand. Walnut wood is known for its fine grain, making it ideal for furniture and carpentry. The high market demand for both walnuts and walnut wood supports local economies, providing an essential source of income for the region's residents.

524. *Rhododendron arboreum* is another critical species with wide-ranging benefits. Its striking red flowers are celebrated in local culture, being used in festivals and processed to make traditional beverages. Moreover, Burans holds medicinal value—its extract is used by local communities for treating ailments such as respiratory problems and inflammations. In a similar vein, *Cedrus deodara* (Devdaar) provides high-quality timber used in construction and furniture-making, and its essential oils are revered for their anti-inflammatory and antifungal properties. The oils are often used in traditional healing methods, further enhancing the tree's value to local healthcare.

525. In terms of regulating services, many species play pivotal roles in stabilizing the natural environment. *Quercus leucotrichophora*, or the Himalayan oak, is fundamental in regulating water flow and preventing soil erosion, particularly on the steep slopes that characterize the Tehri region. These oak forests play a significant role in the region's hydrology, aiding water retention during monsoon seasons and minimizing landslides. Likewise, *Cedrus deodara* helps protect the soil from erosion while regulating local climate by providing a buffer against landslides in areas where deforestation has occurred. The *Pinus roxburghii* (Cheer) also contributes to soil health by adding nutrients through its leaf litter, which replenishes the soil and supports carbon sequestration efforts.

526. When it comes to supporting services, many species underpin the broader ecological systems that maintain biodiversity. *Myrica esculenta*, for instance, supports pollinators such as bees and butterflies, along with small mammals that rely on its berries as a vital food source. These berries are also harvested by local communities for consumption, providing both ecological and economic benefits. *Rhododendron arboreum* serves as an essential habitat for birds, insects, and other wildlife, with its dense foliage providing shelter and its nectar-rich flowers sustaining pollinator populations critical for the reproduction of plant species across the region.

527. The cultural services provided by the region's flora are just as significant. In the Tehri Lake region, many plants are deeply interwoven into local traditions and spiritual practices. *Rhododendron arboreum*, for example, is a focal point in cultural festivals where its flowers are not only admired for their beauty but are also used to make beverages. Similarly, *Ficus religiosa* (Peepal), considered sacred in Hinduism, plays a profound role in local religious and spiritual practices. Peepal trees are often found near temples, symbolizing enlightenment and serving as a connection between the natural and the divine in Hindu belief systems.

528. *Disturbance:* *Cedrus deodara*, *Quercus leucotrichophora*, and *Pinus roxburghii* dominate the forests in the Tehri region and contribute significantly to ecosystem functions such as soil stabilization and carbon sequestration. *Cedrus deodara* is a keystone species in the higher altitude forests (1,500–3,200 meters) of the Himalayas, where it thrives in relatively undisturbed environments. However, the deforestation of these forests for timber and agriculture has led to habitat fragmentation, limiting the continuous stretches of mature forest necessary for the survival

of species that depend on them. For instance, *Pinus roxburghii*, commonly found at lower altitudes (500–2,000 meters), has seen its forests fragmented by human settlements and infrastructure projects, such as the construction of the Tehri Dam and roads leading to remote villages.

529. These species are also vital in regulating water flow and preventing soil erosion on the steep slopes of the Tehri region. However, forest clearing for agriculture and development has reduced the natural areas available for these trees to perform these functions. The reduced forest cover has contributed to an increased risk of landslides and soil degradation, which further threatens the long-term stability of the ecosystem.

530. Understory shrubs such as *Myrica esculenta* and *Rhododendron arboreum* play significant roles in the biodiversity and ecological balance of the Tehri region. *Myrica esculenta*, found between 900 and 2,100 meters, supports pollinators and small mammals by providing a critical food source in the form of its edible berries. These berries are also collected by humans, but overharvesting has led to localized declines in its population. In areas where human disturbance is low, *Myrica* forms dense stands, supporting a rich array of wildlife, but in more disturbed areas, its numbers dwindle, reducing its role in the ecosystem.

531. *Rhododendron arboreum*, with its vibrant red flowers, grows at altitudes between 1,500 and 3,000 meters. It is widely used in local festivals and for medicinal purposes, making it a valuable species both ecologically and culturally. However, its habitats are often cleared for agriculture, and logging for firewood has further disturbed its natural stands. The reduction of *Rhododendron* forests negatively impacts biodiversity as they serve as habitats for a variety of bird species and insects. In areas where human impact is minimal, these shrubs thrive, contributing to forest regeneration and supporting diverse wildlife populations.

532. Species like *Lantana camara* and *Berberis lycium* are often indicators of disturbed landscapes. *Lantana camara*, an invasive species, is common in areas where deforestation and agricultural expansion have created open, degraded lands. It competes with native species and alters the natural vegetation structure, reducing the biodiversity value of the region. In contrast, *Berberis lycium*, found between 1,500 and 3,000 meters, is a native shrub that plays a crucial role in soil stabilization and providing habitat for birds and small mammals. It is often found on the edges of forests and in disturbed areas, where it helps to prevent further soil erosion. Despite its ability to grow in disturbed habitats, *Berberis* thrives best in regions where naturalness is higher, and human disturbance is minimal.

533. The Tehri region has seen significant human disturbance due to infrastructure projects like the Tehri Dam, which submerged vast areas of forests and displaced local flora. The fragmentation of forests has led to the isolation of species populations, reducing genetic diversity and affecting ecosystem resilience. Agricultural expansion and the development of roads and settlements have further reduced natural areas, particularly in the lower and mid-altitude regions where species like *Pinus roxburghii* and *Rhododendron arboreum* are most affected. Additionally, logging, firewood collection, and overgrazing by livestock have exacerbated habitat degradation in the region.

534. Areas with minimal human impact, particularly at higher altitudes, continue to support higher biodiversity levels. In these regions, species such as *Cedrus deodara* and *Quercus leucotrichophora* form dense, continuous forests that provide essential ecosystem services like carbon sequestration, water retention, and soil stabilization. These regions are crucial for maintaining the naturalness and biodiversity of the Tehri region.

535. **Rabi season.** It generally start from November to April in the area but at the project site, it is observed that November to May occurs in higher altitude. The main crops like wheat, barley, sarson, pea, gram, masoor, muli, rai, dhaniya, gobi, palak, methi etc. are cultivated during the Rabi season. Almost all the crops are garean in whole area but at higher altitude cash crops like gobi, potato, matar and leafy vegetables are prefer. Mostly mixed cropping pattern (wheat-sarson, wheat-masoor, wheat gram, wheat-pea) is adopted in the area.

536. **Kharif Season.** The period of Kharif season is from May-June to September-October, but in high altitudinal areas it is from June-July to October-November. During the Kharif (rainy crops) season the main agriculture crops are grown in the area are Dhaan, Mandua, Jhangora, Kauni, Cheena (rarely), Chaulai, Makki and pulses like Urd, Rajma, Soyabean, Bhat, Kulathi (Gahat), Riyans, Tor, Sonta (Lobiya) etc. In vegetables like Bhindi, Beans, Baigan, Shimla Mirch, Lal Mirch, Turai, Chachinda, Kaddu, Lauki, Kheera etc. are cultivated in the region. Most of the crops are cultivated in rainfed area, whereas Dhaan is cultivated in both rainfed as well irrigated areas. The list of main agriculture crops are given below:

Table 30. Agricultural Crop in the project area

S.No.	Common Name	Scientific Name	Family
1	Dhaan	<i>Oryza sativa</i>	Poaceae
2	Gehun	<i>Triticum aestivum</i>	Poaceae
3	Jau	<i>Hordeum vulgare</i>	Poaceae
4	Masoor	<i>Lens culinaris</i>	Fabaceae
5	Matar	<i>Pisum sativum</i>	Fabaceae
6	Makki	<i>Zea mays</i>	Poaceae
7	Mandua	<i>Eleusine coracana</i>	Poaceae
8	Methi	<i>Trigonella foenum</i>	Fabaceae
9	Pili sarson	<i>Brassica campestris</i>	Brassicaceae
10	Kali sarson	<i>Brassica nigrum</i>	Brassicaceae
11	Jhangora	<i>Echinochloa colona</i>	Poaceae
12	Kauni	<i>Setaria italica</i>	Poaceae
13	Cheena	<i>Panicum milaaceum</i>	Poaceae
14	Chaulai	<i>Amaranthus tricolor</i>	Amaranthaceae
15	Urd	<i>Vigna mungoL</i>	Fabaceae
16	Bankala	<i>Vicia faba</i>	Fabaceae
17	Rajma	<i>Phaseolus vulgaris</i>	Fabaceae
18	Soyabean	<i>Glycine max</i>	Fabaceae
19	Til	<i>Sesamum indicum</i>	Pedaliaceae
20	Sem	<i>Vigna unguiculata</i>	Fabaceae
21	Tor	<i>Cajanus cajan</i>	Fabaceae
22	Kulthi, Gahat	<i>Macrotyloma uniflorum</i>	Fabaceaea
23	Dhania	<i>Coriandrum sativum</i>	Apiaceaea
24	Lauki	<i>Lagenaria siceraria</i>	Cucurbitaceae
25	Tori, Godari	<i>Luffa acutangula</i>	Cucurbitaceae
26	Kaddu	<i>Cucurbita maxim</i>	Cucurbitaceae
27	Kakari	<i>Cucumis sativus</i>	Cucurbitaceae
28	Karela	<i>Momardica Charantia</i>	Cucurbitaceae
29	Chachinda	<i>Trichosanthes dioica</i>	Cucurbitaceae
30	Muli	<i>Raphanus sativus</i>	Brassicaceae
31	Bhindi	<i>Hibiscus esculentus</i>	Malvaceae
32	Adarak	<i>Zingiber officinale</i>	Zingiberaceae
33	Haldi	<i>Curcuma domestica</i>	Zingiberaceae
34	Aaloo	<i>Solanum tuberosum</i>	Solanaceae

S.No.	Common Name	Scientific Name	Family
35	Pinalu, Gagli	<i>Colocassia esculenta</i>	Araceae
36	Mirch	<i>Capsicum frutescens</i>	Apocynaceae
37	Pyaj	<i>Allium cepa</i>	Amaryllidaceae
38	Lehsun	<i>Allium sativum</i>	Amaryllidaceae
39	Gobhi	<i>Brassica oleracea</i>	Brassicaceae
40	Tamatar	<i>Lycopersicum esculentum</i>	Solanaceae

Source: Social Survey with Villagers by Tractebel Team

Table 31. Horticulture species in the project area

SN	Local Name	Scientific Name	Family Name
1	Aam	<i>Mangifera indica</i>	Anacardiaceae
2	Amrood	<i>Psidium guajava</i>	Myrtaceae
3	Aaru	<i>Prunus persica</i>	Rosaceae
4	Akharot	<i>Juglans regia</i>	Juglandaceae
5	Jamun	<i>Syzygium cumini</i>	Myrtaceae
6	Nibu/malta/narangi	<i>Citrus species</i>	Rutaceae
7	Nashpati	<i>Pyrus communis</i>	Rosaceae
8	Chullu	<i>Prunus armeniaca</i>	Rosaceae
9	Anaar	<i>Punica granatum</i>	Lythraceae
10	Kela	<i>Musa paradisaca</i>	Musaceae
11	Awanla (Grafted)	<i>Embllica officinalis</i>	Euphorbiaceae

Source: Social Survey with Villagers by Tractebel Team

537. A total of forty species of grains, millets, vegetables, and spices are recorded in the project area, however, eleven fruit plant species are found in the project area during the field survey.

538. Analysis of both secondary and primary data indicates that the peripheral zone of the tourism road is home to a variety of mammal species, including *Felis bengalensis*, *Felis chaus affinis*, *Lepus nigricollis*, *Muntiacus muntjak vaginalis*, *Maccaca mulata*, *Vulpes bengalensis*, *Herpestes edwardsi*, *Sus scrofa*, and *Rattus rattus*, among others. As per the primary and secondary analysis there are 12 species of mammals, 5 species of reptiles, and 26 species of avifauna reported from the project area. During the primary survey, eight mammal species, three reptile species, and twenty bird species were observed. The site visit confirmed the presence of jungle cats, monkeys, Indian hares, barking deer, mongooses, langurs, rats, and foxes among the mammals. The complete list of fauna observed during the site visit and reported through secondary sources is detailed in Table 32.

539. Four species reported from the project area are listed under Schedule I of the Wildlife Protection Act 1972 (amended 20 Dec 2022). None of the reported species are listed as rare or threatened under the IUCN Red List.

Table 32. List of fauna species observed along the tourism road.

S.N.	Scientific Name of Fauna	Local Name	IUCN Status
Reptiles			
1	<i>Naja naja</i>	Cobra/Naag	Not Evaluated
2	<i>Ancistrodon himalayanus</i>	Viper	Least Concern
3	<i>Natrix natrix</i>	Natrix (Grass snake)	Least Concern
4	<i>Ptyas mucosa</i>	Rat snake	Least Concern
5	<i>Calotes versicolor</i>	Girgit	Least Concern
Aves			
6	<i>Gallus gallus</i>	Red Jungle Fowl	Least Concern

S.N.	Scientific Name of Fauna	Local Name	IUCN Status
7	<i>Spilopelia chinensis</i>	Ghughuti	Least Concern
8	<i>Passer domesticus</i>	Gouraya/Sparrow	Least Concern
9	<i>Megaceryle lugubris</i>	Himalayan Pied Kingfisher	Least Concern
10	<i>Otus spilocephalus</i>	Spotted Scops Owl	Least Concern
11	<i>Larivora brunnea</i>	Indian Blue Chat	Least Concern
12	<i>Certhia himalayana</i>	Himalayan Tree Creeper	Least Concern
13	<i>Acridotheres tristis</i>	Common or Indian Myna	Least Concern
14	<i>Corvus macrorhynchos</i>	Jungle Crow	Least Concern
15	<i>Acridotheres fuscus</i>	Bank myna	Least Concern
16	<i>Aethopygia siparaja</i>	Yellow backed sunbird	Least Concern
17	<i>Anthracerous malabicus</i>	Indian pied hornbill	Least Concern
18	<i>Apus affinis</i>	House swift	Least Concern
19	<i>Ceromela fusca</i>	Brown rock chat	Least Concern
20	<i>Cettia pallidipes</i>	Pale footed bush warbler	Least Concern
21	<i>Dicurus annectans</i>	Crow billed drongo	Least Concern
22	<i>Dinopium benghalense</i>	Lesser golden backed wood pecker	Least Concern
23	<i>Dinopium shorii</i>	Himalayan golden backed three toed wood pecker	Least Concern
24	<i>Gallus padisea</i>	Red surp fowl	Least Concern
25	<i>Gallus gallus</i>	Red jungle fowl	Least Concern
26	<i>Glaliocidium radiatum</i>	Jungle owlet	Least Concern
27	<i>Hirundo tahitica</i>	House swallow	Least Concern
28	<i>Pelargopsis capensis</i>	Stock billed kingfisher	Least Concern
29	<i>Perdica asiatica</i>	Jungle bush quail	Least Concern
30	<i>Picoides nanus</i>	Pigmy woodpecker	Least Concern
31	<i>Turdus merula maximus</i>	Black bird	Least Concern
Mammals			
32	<i>Felis bengalensis</i>	Leopard Cat	Least Concern
33	<i>Felis chaus affinis</i>	Jungle Cat	Least Concern
34	<i>Lepus nigricollis</i>	Indian Hare	Least Concern
35	<i>Muntiacus muntjak vaginalis</i>	Kakhad (Barking Deer)	Least Concern
36	<i>Herpestes edwardsi</i>	Mongoose	Least Concern
37	<i>Hystrix indica</i>	Porcupine	Least Concern
38	<i>Macaca camulata</i>	Monkey	Least Concern
39	<i>Sus scrofa</i>	Wild Boar	Least Concern
40	<i>Axis axis</i>	Chital	Least Concern
41	<i>Presbytis entellus</i>	Langoor	Least Concern
42	<i>Rattus rattus</i>	Rat	Least Concern
43	<i>Vulpes bengalensis (India)</i>	Indian fox	Least Concern

540. The ecological survey also accounted for animal species within a 10 km radius of the road alignment based on secondary data. This information aimed to capture the diversity of fauna present in the broader area surrounding the proposed subproject sites. The complete list of species that may be found within this radius is shown below, encompassing a variety of mammals, reptiles, and birds.

Table 33. List of species that can be found within 10km radius of the tourism road based on secondary information.

S.N.	Scientific Name of Fauna	Local Name	IUCN Status
Reptiles			
1	<i>Naja Naja</i>	Cobra/Naag	Least Concern

S.N.	Scientific Name of Fauna	Local Name	IUCN Status
2	<i>Bungarus</i>	Krait	Least Concern
3	<i>Natrix natrix</i>	Natrix (Grass snake)	Least Concern
4	<i>Ptyas mucosa</i>	Rat snake	Least Concern
5	<i>Calotes versicolor</i>	Girgit	Least Concern
Avifauna			
6	<i>Acredotheres focus</i>	Bank myna	Least Concern
7	<i>Acridotheres tristis</i>	Common or Indian Myna	Least Concern
8	<i>Aethopyga siparaja</i>	Yellow backed sunbird	Least Concern
9	<i>Anthraccerosmalabricus</i>	Indian pied hornbill	Least Concern
10	<i>Apus affinis</i>	House swift	Least Concern
11	<i>Ceromela fusca</i>	Brown rock chat	Least Concern
12	<i>Certhia himalayana</i>	Himalayan Tree Creeper	Least Concern
13	<i>Cettia pallidipes</i>	Pale footed bush warbler	Least Concern
14	<i>Corvus macrorhynchos</i>	Jungle Crow	Least Concern
15	<i>Dicurus annectans</i>	Crow billed drongo	Least Concern
16	<i>Dinopium benghalense</i>	Lesser golden backed wood pecker	Least Concern
17	<i>Dinopium shorii</i>	Himalayan golden	Least Concern
18	<i>Galloperdix spadicea</i>	Red surpfowl	Least Concern
19	<i>Gallus gallus</i>	Red jungle fowl	Least Concern
20	<i>Glaliocidium radiatum</i>	Jungle owlet	Least Concern
21	<i>Gyps indicus</i>	Indian long billed vulture	Critically Endangered
22	<i>Hirundotahitica</i>	House swallow	Least Concern
23	<i>Larvivora brunnea</i>	Indian Blue Chat	Least Concern
24	<i>Megaceryle lugubris</i>	Himalayan Pied Kingfisher	Least Concern
25	<i>Otus spilocephalus</i>	Spotted Scops Owl	Least Concern
26	<i>Passer domesticus</i>	Gouraya/Sparrow	Least Concern
27	<i>Pelargopsis capensis</i>	Stock billed kingfisher	Least Concern
28	<i>Perdica asiatica</i>	Jungle bush quail	Least Concern
29	<i>Picoides nanus</i>	Pigmy woodpecker	Least Concern
30	<i>Spilopelia chinensis</i>	Ghughuti	Least Concern
31	<i>Turdus merula maximus</i>	Black bird	Least Concern
Mammals			
32	<i>Felis bengalensis</i>	Leopard Cat	Least Concern
33	<i>Felis chaus affinis</i>	Jungle Cat	Least Concern
34	<i>Pagumalarvatagayi</i>	Himalayan Palm Civet	Least Concern
35	<i>Lepus nigricollis ruficaudatus</i>	Indian Hare	Least Concern
36	<i>Muntiacus muntjak vaginalis</i>	Kakhad (Barking Deer)	Least Concern
37	<i>Lutra lutra monticola</i>	Common Otter	Least Concern
38	<i>Herpestes edwardsi</i>	Mongoose	Least Concern
39	<i>Hysrix</i> sp.	Porcupine	Least Concern
40	<i>Maccaca mulata</i>	Monkey	Least Concern
41	<i>Axis axis</i>	Chital	Least Concern
42	<i>Oryctolagus</i> sp.	Rabbit	Least Concern
43	<i>Presbytis entellus</i>	Langoor	Least Concern
44	<i>Rattus rattus</i>	Rat	Least Concern
45	<i>Sus scrofa</i>	Wild boar	Least Concern
46	<i>Melursus ursinus</i>	Bear	Vulnerable

541. Habitat for Species and Resilient Ecosystem. The existing biodiversity status along the 15 km road from Koti Colony to Dobra Chanti supports a range of flora and fauna, which thrive due to the unique ecological characteristics and relatively stable environmental conditions of the

region. The presence of species indicates that the area provides essential habitats and resources for different species to survive and flourish.

542. The road passes through a variety of habitats, including open scrubland, dense tree patches, and rocky outcrops, creating distinct microhabitats that support plant and animal species. The presence of both shaded and sunlit areas, along with varying soil types and moisture conditions, has allowed species like *Grewia optiva* (Bhimal), *Bauhinia variegata* (Kachnar), and *Cassia fistula* (Amaltas) to establish themselves in different sections of the road. These plants provide food and shelter for herbivores such as the Indian Hare, Barking Deer, and Himalayan Palm Civet (*Paguma larvata*). The variation in microhabitats also supports flowering plants such as Wild Himalayan Cherry (*Prunus cerasoides*) and *Rhododendron arboreum*, which are crucial nectar sources for pollinators like the Crimson Sunbird (*Aethopyga siparaja*) and Plain Tiger Butterfly (*Danaus chrysippus*).

543. In the riparian zones and low-lying areas near the lake, species such as *Bombax ceiba* (Semal), *Holoptelea integrifolia* (Indian Elm), and *Syzygium cumini* (Jamun) are predominant. These tree species support aquatic birds like the Common Kingfisher (*Alcedo atthis*) and Pied Kingfisher (*Ceryle rudis*), which rely on the fish population in the lake. The presence of these riparian species also creates suitable nesting and foraging habitats for reptiles like the Indian Cobra (*Naja naja*) and Grass Snake (*Natrix natrix*). Meanwhile, the upper hillsides are dominated by drought-tolerant species like *Toona ciliata* (Tyuni) and *Dalbergia sissoo* (Sisam), which are crucial in preventing soil erosion along steep slopes and provide perching sites for raptors like the Shikra (*Accipiter badius*).

544. The plant community also provides various food sources and nesting sites for the avifauna present in the area, such as the Spotted Scops Owl, Himalayan Bulbul (*Pycnonotus leucogenys*), and Yellow-backed Sunbird (*Aethopyga siparaja*), which prefer the dense foliage for roosting and nesting. Additionally, the presence of both deciduous and evergreen species ensures year-round food availability and habitat stability, supporting a continuous presence of species such as the Indian Pied Hornbill and Golden Jackal (*Canis aureus*).

545. The fauna observed along the road, such as the Leopard Cat, Jungle Cat, and Himalayan Palm Civet, depend on the native flora and smaller fauna for their food supply. These species are thriving because of the relatively undisturbed natural vegetation that provides both cover and prey species, such as small mammals, birds, and insects. For example, the presence of understory plants and shrubs like *Cassia fistula* (Amaltas), *Punica granatum* (Anar), *Desmodium* spp., and *Cenchrus ciliaris* attracts insects, small birds, and mammals like the Indian Crested Porcupine (*Hystrix indica*), creating a food web that supports a variety of predators.

546. Furthermore, the interdependency between plants and birds, such as the mutualistic relationship between fig trees (e.g., *Ficus palmata*) and frugivorous birds like the Indian Pied Hornbill and the Himalayan Tree Creeper (*Certhia himalayana*), facilitates pollination and seed dispersal, ensuring the reproductive success of these plant species and the availability of food resources for the avian population. This interlinked ecological network enhances the resilience of the local ecosystem, allowing it to support a wide array of species, even under changing environmental conditions.

547. The existing soil structure and hydrological patterns along the road provide a conducive environment for plant growth, which in turn supports diverse animal life. Tree species like Toona, Sisam, and *Schleichera oleosa* (Kusum), which are known for their deep root systems, help stabilize the soil and reduce erosion. Their presence indicates that the area has not experienced

severe soil degradation, making it a stable habitat for both flora and fauna. Additionally, the natural drainage patterns and occasional springs in the region provide water resources that sustain both plant and animal life during dry seasons, contributing to the overall ecological stability and resilience of the area.

548. Despite the presence of the road, certain sections of the area have remained relatively undisturbed by human activities. This has allowed native vegetation to thrive and create suitable habitats for species like the Jungle Cat, Spotted Scops Owl, and Indian Hare. The stable forest cover, consisting of species like *Toona*, *Kusum*, and *Ficus religiosa* (Peepal), has enabled these animals to establish territories and maintain their populations without significant disruptions to their foraging and breeding activities.

549. Many of the species observed along the road are categorized as 'Least Concern' on the IUCN Red List because they are generalists and have adapted to thrive in a variety of environmental conditions. For example, the Rhesus Monkey (*Macaca mulatta*), Indian Myna (*Acridotheres tristis*), and Golden Jackal (*Canis aureus*) are known for their adaptability to human-modified landscapes and ability to consume a range of food sources, including anthropogenic wastes. This adaptability, coupled with the availability of natural food sources such as fruits from *Punica granatum* (Anar) and *Morus alba* (Mulberry), has contributed to their stable population levels in the area. Similarly, plants like *Lantana camara*, *Parthenium hysterophorus*, and *Argemone mexicana* (Mexican Poppy), although invasive, have adapted to disturbed soils and altered habitats, filling ecological niches that might otherwise remain barren. While this is not beneficial for biodiversity in the long term, it illustrates the resilience and adaptability of certain species to environmental changes.

550. Supporting local livelihoods and climate resilience: The flora and fauna along the 15 km road from Koti Colony to Dobra Chanti contribute to the socio-economic stability and ecological health of the area, playing vital roles in supporting local livelihoods and providing climate-related benefits. The presence of a range of species, from large trees to small mammals and birds, highlights the ecological richness of the area and its importance for both human and wildlife communities. This biodiversity not only maintains the natural character of the site but also offers essential resources and services that are beneficial to the local population and contribute to climate resilience.

551. The plant species found along the road provide multiple socio-economic benefits to local communities. For instance, trees like *Aegle marmelos* (Bael) and *Syzygium cumini* (Jamun) produce fruits that are harvested and sold in local markets. The fruits of *Punica granatum* (Anar) and Mulberry are used for making traditional food products and are also valued for their medicinal properties. The leaves of Bhimal and Kachnar serve as fodder for livestock, which supports the traditional practice of animal husbandry in the region. The collection of non-timber forest products from these species provides an additional source of livelihood.

552. Additionally, several plant species, such as Peepal and Kusum, are used in traditional medicine to treat common ailments, making them integral to the healthcare practices of the local population. These medicinal plants are often harvested sustainably, ensuring their availability for future generations. The use of such traditional knowledge not only promotes health and well-being but also preserves cultural heritage. Moreover, the presence of culturally significant species like Banyan supports religious practices and community gatherings.

553. The natural vegetation along the road plays a critical role in regulating the local climate and supporting ecosystem resilience. Tree species such as *Toona ciliata* (Tyuni), *Dalbergia*

sissoo (Sisam), and *Bombax ceiba* (Semal) are known for their ability to sequester carbon, reducing atmospheric carbon dioxide levels and contributing to climate change mitigation. The presence of mature trees with extensive root systems helps stabilize the soil and prevent erosion, especially in the steep, hilly terrain of the Tehri Lake region. This function is particularly important in areas prone to landslides and soil degradation, where vegetation cover acts as a natural barrier against extreme weather events.

554. The interconnectedness of plant and animal species along the road supports ecosystem resilience by enhancing biodiversity, which is crucial for adaptation to climate change. For example, the presence of various pollinators, such as the Plain Tiger Butterfly (*Danaus chrysippus*) and the Common Mormon Butterfly (*Papilio polytes*), ensures the continued reproduction of flowering plants like Burans. Similarly, the role of frugivorous birds like the Himalayan Bulbul and Brown Shrike (*Lanius cristatus*) in seed dispersal promotes the regeneration of vegetation, enhancing the overall resilience of the ecosystem.

555. Fish species. The presence of *Schizothorax richardsonii*, commonly known as the Snow Trout, is of ecological significance in the Tehri Lake region. This species, which thrives in cold, oxygen-rich freshwater habitats, serves as an indicator of the health of Himalayan river systems. *Schizothorax richardsonii* is highly sensitive to changes in water quality and habitat structure, making its presence a testament to the relatively pristine environmental conditions in certain parts of the lake. The construction of the Tehri Dam, however, has altered the natural flow regimes and reduced the availability of suitable spawning grounds for this species. Efforts are underway to monitor and improve water quality, as well as restore critical habitats along the lake's periphery, to support the breeding and survival of the Snow Trout.

556. Another species, *Puntius chola* (Swamp Barb), is known for its adaptability to different water conditions and plays a vital role in controlling algal populations and aquatic vegetation. This small fish species contributes to maintaining the ecological balance by feeding on algae and detritus, thereby participating in the nutrient cycling within the lake. The conservation of *Puntius chola* involves managing water quality and controlling invasive species that could outcompete it for resources. The ongoing management efforts focus on reducing agricultural runoff and limiting the use of pesticides and fertilizers that could degrade water quality and threaten its population.

557. *Garra lamta*, another notable species found in Tehri Lake, is a bottom-dwelling fish known for its role in cleaning riverbeds and rocky substrates by feeding on biofilm and algae. This species is also considered an ecological indicator, as its presence suggests good water clarity and low levels of sedimentation. Habitat alteration due to construction activities and increased human intervention pose threats to *Garra lamta*. Conservation measures include implementing soil erosion controls and establishing buffer zones along the lake to minimize sedimentation, which can smother benthic habitats and disrupt the life cycle of these bottom-dwelling fish.

558. *Cyprinus carpio* (Common Carp), though introduced, has established a stable population in Tehri Lake. Its introduction has led to changes in the local aquatic ecology, particularly through its impact on native species and habitats. *Cyprinus carpio* is known to increase turbidity levels by stirring up sediments, which can negatively affect other fish species like *Schizothorax richardsonii* that rely on clear water for spawning. Managing the population of *Cyprinus carpio* through selective fishing and maintaining suitable habitats for native species is crucial for ensuring ecological balance within the lake.

559. The Tehri Lake also supports species such as *Nemacheilus montanus* and *N. zonatus*, which are adapted to fast-flowing streams and rocky substrates of the region. These species help

maintain the health of the benthic community. However, their populations are vulnerable to changes in water flow and sedimentation. Establishing protected areas and implementing catchment management plans are some of the key conservation strategies that can help preserve these fish populations and maintain the ecological integrity of the lake.

560. Conservation of the fish diversity in Tehri Lake not only helps protect these species but also ensures the stability of the entire aquatic ecosystem. Initiatives such as habitat restoration, pollution control, and sustainable fishing practices are essential to mitigate the adverse impacts of human activities and promote the long-term viability of the native fish populations in Tehri Lake. As a significant freshwater resource in the region, the lake's health is crucial for supporting local biodiversity and providing ecosystem services to the surrounding communities.

561. The presence of *Tor putitora* in Tehri Lake plays a critical role in maintaining the ecological balance and connectivity between the lake and its tributaries. As predator species, *Tor putitora* helps regulate the population dynamics of other fish species, ensuring a balanced food web within the aquatic ecosystem. Its presence indicates good water quality and healthy habitat conditions, making it a bioindicator of ecological health. Efforts to conserve *Tor putitora* have included captive breeding and release programs to bolster its population and mitigate the impacts of habitat fragmentation and environmental changes caused by dam construction and other human activities. These initiatives are crucial, not just for sustaining the population of *Tor putitora*, but also for enhancing biodiversity and ecosystem resilience.

562. Despite its ecological importance, Tehri Lake faces several threats, including pollution, habitat fragmentation, and the introduction of non-native fish species such as *Cyprinus carpio*. These invasive species can outcompete native fish for resources, disrupt the food chain, and alter the ecological dynamics of the lake. Conservation measures, such as habitat restoration, regulation of fishing activities, and the establishment of fish sanctuaries, are necessary to protect the native fish populations and preserve the lake's ecological integrity.

Table 34. Aquatic species in Tehri Lake based on secondary information

S.No.	Scientific Name	Common Name
1	<i>Nemacheilus montanus</i>	Tiliya Gadiyal
2	<i>N. zonatus</i>	Gadiyal
3	<i>Tor putitora</i>	Golden Mahseer
4	<i>Schizothoaichthys progsatrus</i>	Asela, Dhibura
5	<i>Tor tor</i>	Dansulu, Mahseer
6	<i>Garra lamta</i>	Gondal, Gunthala
7	<i>Puntius chola</i>	Damra, Sidhari
9	<i>Cyprinus carpio</i>	Common carp
10	<i>Glytothrax cavia</i>	Sipliya, River cat
11	<i>Pseudocenus sulcatus</i>	Mungria, Nowu
12	<i>Schizothorax richardsonii</i>	Asela, Snow trout
13	<i>Salmo truttafario</i>	Trout

563. **Critical Habitat Assessment.** Critical habitat refers to areas of high biodiversity value in which development would be particularly sensitive and require special attention. The purpose of a critical habitat assessment is to identify the level of high biodiversity value within the subproject areas. Critical habitat is defined in ADB SPS 2009 as areas or sites:

- With high biodiversity value, including habitat required for the survival of critically endangered or endangered species;
- Having special significance for endemic or restricted-range species;

- That are critical for the survival of migratory species;
- Supporting globally significant concentrations or numbers of individuals of congregatory species;
- With unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services;
- Having biodiversity of significant social, economic, or cultural importance to local communities

564. Moreover, based on ADB SPS 2009, critical habitats can be either natural or modified or a combination of both. These include legally protected areas or those officially proposed for protection, such as areas that meet the criteria of the World Conservation Union classification, the Ramsar List of Wetlands of International Importance, and the United Nations Educational, Scientific, and Cultural Organization's world natural heritage sites.

565. To support the critical habitat assessment in subproject sites, International Finance Corporation's (IFC) Guidance Note ¹⁴ on Biodiversity Conservation and Sustainable Management of Living Natural Resources is used to determine any trigger as per SPS 2009. The guidance note defines critical habitat as areas of high biodiversity value that include or meet at least one of the following:

- Criterion 1: Critically Endangered (CR) and/or Endangered (EN) species
- Criterion 2: Endemic or restricted-range species
- Criterion 3: Migratory or congregatory species
- Criterion 4: Key evolutionary processes
- Criterion 5: Areas having biodiversity of significant social, economic, or cultural importance to local communities
- Criterion 6: Protected or designated areas.

566. *Criterion 1: Critically Endangered (CR) and/or Endangered (EN) species.* Species threatened with global extinction and listed as CR and EN on the IUCN Red List of Threatened Species shall be considered as part of Criterion 1. Critically Endangered species face an extremely high risk of extinction in the wild. Endangered species face a very high risk of extinction in the wild. Thresholds and analysis for Criterion 1 are the following:

- Areas that support globally important concentrations of an IUCN Red-listed EN or CR species ($\geq 0.5\%$ of the global population AND ≥ 5 reproductive units of a CR or EN species).*
- Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds in (a).*
- As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species.*

567. The following species listed below are categorized as critically endangered (CR), and vulnerable (VU), and there have been no firsthand sightings of these animals in the subproject areas. Nevertheless, these species may be likely present in the project areas according to secondary information.

¹⁴ [International Finance Corporation's Guidance Note 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources \(ifc.org\)](https://www.ifc.org/~/media/International-Finance-Corporation/~/media/IFC%20Guidance%20Notes/Biodiversity%20Conservation%20and%20Sustainable%20Management%20of%20Living%20Natural%20Resources/IFC_Guidance_Note_6_Biodiversity_Conservation_and_Sustainable_Management_of_Living_Natural_Resources.pdf)

- *Gyps indicus*, CR (Long Billed Vulture): A CR species on the IUCN Red List, with a global population estimated to between 4,000 to 6,000 5,000-15,000 mature individuals across India. The species breeds in peninsular India south of the Gangetic plain, north to Delhi, east through Madhya Pradesh, south to the Nilgiris, and occasionally further south. The species was reported through secondary data collected for the project. The species has been declining as per the trend provided in IUCN data set. However, given the documented breeding area (primarily in the Gangetic plains) the species is unlikely to meet the thresholds for critical habitat.
- *Tor putitora*, EN (Golden Masheer): The species is naturally distributed throughout the rivers (and associated reservoirs) of the South Himalayan drainage (Ganges-Yamuna and Brahmaputra) from Pakistan in the West to Myanmar in the East. The species is reported to be present in the Tehri lake as per researches conducted in the recent years.¹⁵ While existing studies provide insights into growth patterns, mortality rates, and exploitation levels, there is no comprehensive count or survey that accurately reflects the number of individuals in the lake.
- *Cedrela odorata*, VU (Cedar): The species is an introduced (alien) species in India with its native range in the Caribbean and South America and is also considered as an invasive species.
- *Melursus ursinus*, VU (Sloth Bear): The northern distribution region of the species occurs largely within the state of Uttarakhand, Uttar Pradesh and the northwestern tip of Bihar bordering the southern and western areas of Nepal and includes trans-border populations. The extant of the species as per IUCB is much outside the project area and thus it shall not meet the thresholds for critical habitat. The population figures are also not available for the species

568. The species above unlikely trigger criterion 1.

569. **Criterion 2: Endemic and Restricted-range Species.** For terrestrial vertebrates and plants, restricted-range species are defined as those species that have an extent of occurrence less than 50,000 square kilometers (km²). The threshold for Criterion 2 is area holds $\geq 10\%$ of the global population size and ≥ 10 reproductive units of a species.

570. The species in the subproject areas can be found across multiple countries in South Asia, and while they may be significant to local ecosystems, these are not considered endemic or restricted range species limited to the specific subproject sites.

571. **Criterion 3: Migratory and Congregatory Species.** Migratory species are defined as any species of which a significant proportion of its members cyclically and predictably move from one geographical area to another (including within the same ecosystem). While, congregatory species are defined as species whose individuals gather in large groups on a cyclical or otherwise regular and/or predictable. The thresholds for Criterion 3 are:

- a. Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle.
- b. Areas that predictably support ≥ 10 percent of the global population of a species during periods of environmental stress.

572. The following species migratory in nature, and can be found at the subproject sites based on primary survey data:

¹⁵ Bhakta, D., Das, B., Singh, U., Ray, A., Johnson, C., Thakur, V., Mishra, S., Verma, S., Alam, A & Jha, D. (2023). Fishery, growth, mortality, and stock assessment of endangered *Tor putitora* from Tehri dam reservoir, Uttarakhand, Himalayan foothills of India in relation to environmental variables. *Environmental Monitoring and Assessment*. 195:1377. 10.1007/s10661-023-11936-w.

- *Apus affinis* (House swift): A migratory species having extant across Europe, Asia and Africa, Birdlife International estimates 1,800-5,000 mature individuals even though the global population size has not been quantified. The species extant (breeding) range is across the Indian subcontinent (except some areas of the eastern coast) along with Central Asia and the middle east. The species has been classified as Least Concern (LC) by IUCN
- *Larvivora brunnea* (Indian Blue Robin): The global population size has not been quantified, but the species is described as locally common to common as per IUCN. The migratory species is noted to be a resident in the Indian subcontinent and Myanmar with breeding ranges in Bhutan, People's Republic of China, Nepal and Pakistan, migrating during the breeding season. The species is Least Concern (LC) as per IUCN
- *Spilopelia chinensis* (Eastern Spotted Dove): An alien invasive species with native range in eastern and northeastern India (amongst other countries) and thus if recorded may be a vagrant. The species is classified as Least Concern (LC) by the IUCN

573. The species above do not trigger the criterion 3.

574. *Criterion 4: Key evolutionary processes.* Topography, geology, soil, temperature, vegetation, and their combinations can affect evolutionary processes that create regional species and ecological features. Unique landscape features have been linked to genetically distinct plant and animal populations. Physical or geographical elements are commonly linked to species diversification as surrogates or spatial accelerators for evolutionary and ecological processes. In recent decades, biodiversity conservation has focused on maintaining these crucial evolutionary processes in a landscape and the resulting species (or subpopulations). Genetic diversity conservation is especially important. In a rapidly changing climate, species variety and genetic variation within species enable evolutionary flexibility.

575. There is no such site within the project area that is characterized as above. Thus, this criterion is not triggered.

576. *Criterion 5: Areas having biodiversity of significant social, economic, or cultural importance to local communities.* Areas having biodiversity of significant social, economic, or cultural importance to local communities. This criterion focuses on regions where biodiversity is intrinsically linked to the well-being of local communities through various means such as traditional practices, economic benefits, cultural values, or social significance. Such areas often support livelihoods, maintain cultural heritage, and provide ecosystem services that are crucial for local communities. Identifying and conserving these areas is essential to ensure that biodiversity conservation efforts also support the social and economic fabric of the communities that depend on them.

577. There is no such site within the project area that is characterized as above. Thus, this criterion is not triggered.

578. *Critical Habitat Requirement 6 – Protected or designated areas.* Critical Habitat Requirement 7, as stipulated by the SPS 2009, focuses on areas that are either legally protected or officially proposed for protection.

579. There are no such protected areas nor officially proposed protection. Thus, this criterion is not triggered by the subprojects.

580. *Conclusion.* The critical habitat assessment for the subproject areas indicates that none of the criteria outlined in ADB SPS 2009 and IFC's Guidance Note 6 are triggered. While species like the Golden Mahseer (EN) and Long-billed Vulture (CR) are present based on secondary information, they do not meet the required population thresholds to classify the area as critical

habitat. Additionally, the assessment found no endemic or restricted-range species limited to the project sites, and migratory species such as the Indian Blue Robin and House Swift do not reach the necessary population percentages to trigger Criterion 3. Furthermore, no unique evolutionary processes, sites of social or cultural importance, or legally protected/designated areas were identified within the project area. Consequently, the subproject sites do not qualify as critical habitat and do not necessitate special management actions under these guidelines.

Table 35. Summary of critical habitat assessment

Critical Habitat defined by ADB (2009)	Quantitative Thresholds of Critical Habitat based in IFC PS-6	Species / sites	Likelihood to trigger criterion	Remark
Criterion 1: The area includes habitat required for the survival of critically endangered (CR) or endangered (EN) species	(a) Areas that support globally important concentrations of an IUCN Red-listed EN or CR species ($\geq 0.5\%$ of the global population AND ≥ 5 reproductive units GN16 of a CR or EN species).	<i>Gyps indicus</i> , CR (Long Billed Vulture)	Unlikely	It is estimated that presently 5,000-15,000 mature individuals are there across India. In India, the breeding area of the species is peninsular India south of the Gangetic plain, north to Delhi, east through Madhya Pradesh, south to the Nilgiris, and occasionally further south. The species was reported through secondary data collected for the project. Given the documented breeding area (primarily in the Gangetic plains) the species is unlikely to meet the thresholds for critical habitat.
		<i>Tor putitora</i> , EN (Golden Masheer)	Unlikely	The species is naturally distributed throughout the rivers (and associated reservoirs) of the South Himalayan drainage (Ganges-Yamuna and Brahmaputra) from Pakistan in the West to Myanmar in the East. In addition to exhibiting natural adaptation to changing riverscapes and the presence of thriving populations in reservoirs, multiple successful introductions have also been made to Himalayan lakes. No comprehensive range-wide population studies have been carried out on the species, although there are studies available from many individual river systems and reservoirs that make up the Himalayan landscape, which have observed declines from 25% to 90% in a 10–20-years period. Even though IUCN distribution

Critical Habitat defined by ADB (2009)	Quantitative Thresholds of Critical Habitat based in IFC PS-6	Species / sites	Likelihood to trigger criterion	Remark
				maps show the species as possibly extant on the edge of its range (the Tehri Lake is outside the boundary of the extant range map), research conducted in the recent years have conclusively proven the existence of the species in the Tehri Lake.
	(b) Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds of (a)	<i>Cedrela odorata</i> , VU (Cedar)	Unlikely	The species is an introduced (alien) species in India with its native range in the Caribbean and South America and is also considered as an invasive species.
		<i>Melursus ursinus</i> , VU (Sloth Bear)	Unlikely	The population figure of the species is not fully estimated amongst the five distinct regions (distribution range of the species) that is spread across the country. The extant map of IUCN notes does not show the species occupying the project area. In terms of likely global population, and considering this is a widespread VU species with ranges (though degraded) in India, Sri Lanka, Nepal and Bhutan, the population in the project area is unlikely to meet the thresholds for critical habitat.
	(c) As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species	NA	-	<i>Melursus ursinus</i> , VU (Sloth Bear): The northern distribution region of the species occurs largely within the state of Uttarakhand, Uttar Pradesh and the northwestern tip of Bihar bordering the southern and western areas of Nepal and includes trans-border populations. The extant of the species as per IUCN is much outside the project area and thus it shall not meet the thresholds for critical habitat.
Criterion 2: The area has special significance for endemic or	a) Areas that regularly hold $\geq 10\%$ of the global population size AND	NA	-	

Critical Habitat defined by ADB (2009)	Quantitative Thresholds of Critical Habitat based in IFC PS-6	Species / sites	Likelihood to trigger criterion	Remark
restricted-range species;	≥10 reproductive units of a species			
Criterion 3: The area represents a site that is critical for the survival of migratory species; or supports globally significant concentrations or numbers of individuals of congregatory species;	(a) Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle.	<i>Apus affinis</i> , LC (House swift)	Unlikely	Found across Europe, Asia and Africa with estimated 1,800-5,000 mature individuals even though the global population size has not been fully quantified. The species breeds across the Indian subcontinent (except some areas of the eastern coast) along with Central and middle east Asia.
		<i>Larvivora brunnea</i> , LC (Indian Blue Robin)	Unlikely	The species is described as locally common to common as per IUCN even though no quantification has been done at global level. The species migrates during the breeding season and is a resident in the Indian subcontinent and Myanmar with breeding ranges in Bhutan, People's Republic of China, Nepal and Pakistan
		<i>Spilopelia chinensis</i> , LC (Eastern Spotted Dove)	Unlikely	Native range in eastern and northeastern India (amongst other countries) and thus if recorded may be a vagrant. The global population is not quantified, but described as very common in its range and is estimated to have 20,000-200,000 breeding pairs in the People's Republic of China and Taipei, China
	(b) Areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress.	NA	-	
Criterion 4: The area includes unique assemblages of species that are associated with key evolutionary processes or provide key ecosystem services;		NA	-	
Criterion 5: The area holds biodiversity of		NA	-	

Critical Habitat defined by ADB (2009)	Quantitative Thresholds of Critical Habitat based in IFC PS-6	Species / sites	Likelihood to trigger criterion	Remark
significant social, economic, or cultural importance to local communities;				
Criterion 6: The area is either legally protected or officially proposed for protection, such as areas that meet the criteria of the World Conservation Union classification, the Ramsar List of Wetlands of International Importance, and the United Nations Educational, Scientific, and Cultural Organization's World Natural Heritage sites.		NA	-	

D. Socio-economic Conditions

581. The study of socio-economic component of environment incorporates various facets, viz. demographic structure, availability of basic amenities such as housing, education, health and medical services, occupation, water supply, sanitation, communication and power supply, prevailing diseases in the region as well as features such as places of tourist attraction and monuments of archaeological importance. The study of these parameters helps in identifying predicting and evaluating the likely impacts due to project activity in the surrounding region.

582. The district of Tehri Garhwal falls under the Garhwal division and is divided into five subdivisions, twelve tehsils, 2 sub tehsils and 1862 villages. 16 The five subdivisions are: a) Tehri, b) Pratapnagar c) Narendranagar d) Ghansali and e) Kirti Nagar. There are nine blocks, five municipalities and six Town Panchayats in the district.

Table 36. Administrative setup of Tehri Garhwal

Sl. No.	District	Revenue Subdivision	Revenue Tehsils/Sub Tehsils
1	Tehri Garhwal	Tehri	Tehri
2			Jakhnidhar
3			Dhanolti
4			Nainbag
5			Kandisaur
6		Pratapnagar	Pratapnagar
7			Madan Negi
8		Narendranagar	Narendranagar
9			Gaja
10			Pav ki Devi

¹⁶ Tehri Garhwal district, Government of Uttarakhand. <https://tehri.nic.in/revenue-admin/>

Sl. No.	District	Revenue Subdivision	Revenue Tehsils/Sub Tehsils
11		Ghansali	Ghansali
12			Balganga
13		Kirtinagar	Devprayag
14			Kirtinagar

Source: <https://tehri.nic.in/revenue-admin/>

583. The project area primarily falls under the Tehri, Pratapnagar and Jakhanidhar tehsils of the district. The district of Tehri is bounded by Uttarkashi district in the north, Rudraprayag district in the west, Garhwal district in the south and Dehradun district in the east.

584. The population of Uttarakhand as per Census 2011¹⁷ is 10,086,292 as compared to 8,489,349 in 2001. The state has a male population of 5,137,773 and female population of 4,948,519. The total children population between 0–6 years of age is 84,657. Tehri Garhwal has a population of 618,931 in 2011 as compared to 604,747 in 2001. The district has a sex ratio of 1077 females for every 1,000 males. Scheduled Castes and Scheduled Tribes make up 16.5% and 0.14% of the population, respectively. Average literacy rate of Tehri Garhwal in 2011 were 76.36%, male and female literacy were 89.76% and 64.28%, respectively. Total literate in Tehri Garhwal District were 6,880,953 of which male and female were 3,863,708 and 3,017,245 respectively. The details of the population of the state and districts are given in Table 36:

Table 37. Demographic details in Tehri Garhwal

Districts/State	Total Household	Total Population	Total Male	Total Female	Decadal Growth Rate (%) 2001-2011
Tehri Garhwal	132,714	618,931	297,986	320,945	2.35
Uttarakhand	2,056,975	10,086,292	5,137,773	4,948,519	18.81
India	249,501,663	1,210,854,977	623,270,258	587,584,719	17.72

Source: Census of India, 2011

585. The annual average growth rate in population of project affected area is 0.22% in affected tehsils of Uttarakhand. The Annual average growth rate shows that it is higher in Narendra Nagar tehsil and lower in Tehri tehsil.

Table 38. Tehsil-wise population in the project's districts

Sl. No.	Revenue Sub District	Tehsil	Population		AAGR
			2001	2011	
1	Tehri	Tehri	130,365	117,607	-0.98
2		Jakhnidhar	35,123	32,753	-0.67
3		Dhanolti	65,611	74,083	1.29
4		Nainbag	-	-	-
5		Kandisaur	-	-	-
6	Pratapnagar	Pratapnagar	69,556	73,592	0.58
7		Madan Negi	-	-	-
Total			300,655	298,035	0.22

Note: Data not found for Nainbag, Kandisaur and Madan Negi tehsils.

Source: Census of India, 2001 and 2011

586. **Household.** The district has 132,714 households out of which 115,691 are rural and

¹⁷ Office of the Registrar General and Census Commissioner, India. Ministry of Home Affairs, Govt. of India. https://censusindia.gov.in/census.website/data/data-visualizations/PopulationSearch_PCA_Indicators

17,023 in urban areas.

587. **Population Density.** The total area of Uttarakhand is 53,483 sq. Km with a population density of 189 persons per sq. km in 2011 which is lower than the national population density of 382 persons per sq. km. The project influence district of Uttarakhand state has population density of 170 persons per sq. km which is lower than the State's population density.

Table 39. Population density in Tehri Garhwal

Districts/State	Population Density (persons per sq. km.)
Tehri Garhwal	170
Uttarakhand	189
India	382

Source: Census of India, 2011

588. The project affected area shows the population density of 373 in tehsils of Uttarakhand State. Among all the tehsil it varies from 198 person/sq km in Jakhni Dhar tehsil to 648 person/sq km in Tehri tehsil.

Table 40. Tehsil wise Population Distribution and Density in Project District

Sl. No.	Revenue Sub District	Tehsil	Area (sq km)	Population	Population Density (Persons/sq km)
1	Tehri	Tehri	37.05	117,607	648
2		Jakhnidhar	141.74	32,753	198
3		Dhanolti	-	74,083	-
4		Nainbag	-	-	-
5		Kandisaur	-	-	-
6	Pratapnagar	Pratapnagar	109.01	62,618	272
7		Madan Negi	-	-	-
Total			287.8	287,061	372.67

Note: Data not found for Dhanolti Nainbag, Kandisaur and Madan Negi tehsils for year 2001 and Nainbag, Kandisaur and Madan Negi tehsils for 2011.

Source: Census of India, 2011

589. **Sex Ratio.** The sex ratio in Uttarakhand was 963 females for each 1,000 males in 2011 compared to a ratio of 962 females for each 1,000 males in 2001. The child sex ratio has reduced from 927 female children per 1000 male children in 2001 to 897 females per 1000 males in 2011. The details of the sex ratio for the state and district are given in Table 40:

Table 41. Tehsil wise Sex Ratio in Project Affected Tehsils

Sl. No.	Revenue Sub District	Tehsil	Sex Ratio	
			2001	2011
1	Tehri	Tehri	942	1,041
2		Jakhnidhar	1,167	1185
3		Dhanolti	-	997
4		Nainbag	-	-
5		Kandisaur	-	-
6	Pratapnagar	Pratapnagar	1,142	1,104
7		Madan Negi	-	-
Average			1083.67	1,081.75

Note: Data not found for Dhanolti Nainbag, Kandisaur and Madan Negi tehsils for year 2001 and Nainbag, Kandisaur and Madan Negi tehsils for 2011.

Source: Census of India, 2001 and 2011.

590. **Literacy Rate.** Literacy rate in Uttarakhand has seen an upward trend and is 78.82% as per Census 2011 out of which, male literacy rate stands at 87.4% while female literacy rate is 70.01%. In 2001, literacy rate in Uttarakhand stood at 71.6% out of which male and female literacy rate was 83.3% and 59.6% respectively. The literacy details of the state and districts are given in Table 41:

Table 42. Number of Literates and Literacy Rate for State and District

Districts/State	Number of Literates			Literacy Rate (%)		
	Persons	Male	Female	Persons	Male	Female
Tehri Garhwal	407,994	227,406	180,588	76.36	89.76	64.28
Uttarakhand	6,880,953	3,863,708	3,017,245	78.82	87.40	70.01
India	7,636,38,812	4,347,63,622	3,288,75,190	72.98	80.88	64.63

Source: Census of India, 2011

591. Tehri tehsil of has the highest literacy rate with 81.11% whereas Jakhni dhar tehsil has the lowest literacy rate with 77.4%.

Table 43. Tehsil wise Literacy Rate in Project Districts

Sl. No.	Revenue Sub District	Tehsil	Literate Population		Literacy Rate	
			2001	2011	2001	2011
1	Tehri	Tehri	117,588	83285	68.6	81.11
2		Jakhnidhar	-	22188	-	77.4
3		Dhanolti	-	47467	-	88.01
4		Nainbag	-	-	-	-
5		Kandisaur	-	-	-	-
6	Pratapnagar	Pratapnagar	51232	47609	63.5	92.12
7		Madan Negi	-	-	-	-
Total			168820	200549	66.05	84.66

Note: Data not found for Jakhni Dhar, Dhanolti Nainbag, Kandisaur and Madan Negi tehsils for year 2001 and Nainbag, Kandisaur and Madan Negi tehsils for 2011

Source: Census of India, 2001 and 2011

592. **Religion.** Muslim population in Tehri District is 1.2%, while Hindu population is 98.5% and Christian are 0.1% and others include 0.2% respectively as per as census 2011 report.

593. **Language.** At the time of the 2011 census, 98.42% of the population spoke Hindi, 0.13% spoke Bengali, 0.10% spoke Urdu, 0.09% spoke Punjabi and 1.9% spoke other languages.

594. **Vulnerable Groups.** The schedule caste population in Tehri Garhwal district is 102,130 (16.50%) and schedule tribe population in Tehri Garhwal district is 875 (0.14%). Dhanolti tehsil of has the highest schedule caste population 18.45% whereas Tehri tehsil has the lowest schedule caste population with 14.48%. Dhanolti tehsil of has the highest schedule tribe population 0.36% whereas Pratap Nagar tehsil has the lowest schedule tribe population with 0.04%.

Table 44. Vulnerable Groups in Project District

Districts/State	Population (2011)		% to Total Population	
	Scheduled Caste	Scheduled Tribe	Scheduled Caste	Scheduled Tribe
Tehri Garhwal	102,130	875	16.50	0.14
Uttarakhand	1,892,516	291,903	18.76	2.79
India	201,378,372	104,545,716	16.63	8.63

Source: Census of India, 2011

Table 45. Tehsil wise Vulnerable Groups in Project District

Sl. No.	Revenue Sub District	Tehsil	Population (2011)		% to Total Population	
			Scheduled Caste	Scheduled Tribe	Scheduled Caste	Scheduled Tribe
1	Tehri	Tehri	17,030	226	14.48	0.19
2		Jakhnidhar	5,896	70	18.00	0.21
3		Dhanolti	13,669	268	18.45	0.36
4		Nainbag	-	-	-	-
5		Kandisaur	-	-	-	-
6	Pratapnagar	Pratapnagar	11,863	31	16.12	0.04
7		Madan Negi	-	-	-	-
Total			48,458	595	16.88	0.20

Note: Data not found for Nainbag, Kandisaur and Madan Negi tehsils

Source: Census of India, 2011

595. **Work Participation Rate.** The work participation rate in Uttarakhand as per Census 2011 is 38.39% and 49.67% for male and 26.68% for female, while that of the rural and urban areas is 41% and 32.36% respectively. The work participation rate is less as compared to the national work participation rate in both rural and urban areas with similar geographical conditions. The details of the work participation rate are given in Table 45:

Table 46. Work Participation Rate

District/State	Classification by Sex		Classification by residence		Total
	Male	Female	Urban	Rural	Persons
Tehri Garhwal	47.5	43.5	-	-	45.31
Uttarakhand	49.67	26.68	32.36	41	38.39
India	53.26	25.52	35.31	41.83	39.80

Source: Census of India, 2011

596. The work participation rate of the project affected area is 46.48% which has increased from last census in 2001. Among the project affected area, highest work participation rate is found in the Jakhni Dhar tehsil and lowest rate is found in the tehri tehsil.

Table 47. Tehsil wise Work Participation Rate in Project Districts

Sl. No.	Revenue Sub District	Tehsil	Total Workers		AAGR of Workers (2001-2011)	Work Participation Rate	
			2001	2011		2001	2011
1	Tehri	Tehri	90,367	51,755	-4.27	44.5	44.01

Sl. No.	Revenue Sub District	Tehsil	Total Workers		AAGR of Workers	Work Participation Rate	
			2001	2011	(2001-2011)	2001	2011
2		Jakhnidhar	-	15,562	-	-	47.51
3		Dhanolti	-	34,755	-	-	46.91
4		Nainbag	-	-	-	-	-
5		Kandisaur	-	-	-	-	-
6	Pratapnagar	Pratapnagar	43,310	34,945	-1.93	44.7	47.48
7		Madan Negi	-	-		-	-
Total			133677	137017	-3.1	44.6	46.48

Note: Data not found for Jakhni Dhar, Dhanolti Nainbag, Kandisaur and Madan Negi tehsils for year 2001 and Nainbag, Kandisaur and Madan Negi tehsils for 2011

Source: Census of India, 2001 and 2011

597. The project affected area has main working population of 165,912 (26.81%) and marginal working population of 114,530 (18.50%). Dhanolti tehsil has the highest main working population (36.24%) and Jakhni Dhar tehsil has least main working population (23.47%).

Table 48. Tehsil wise Type of Workers (Year 2011) in Project Districts

Sl. No.	Revenue Sub District	Tehsil	Main Workers		Marginal Workers	
			No.	In%	No.	In%
1	Tehri	Tehri	31,937	27.16	19,818	16.85
2		Jakhnidhar	7686	23.47	7,876	24.05
3		Dhanolti	26,844	36.24	7,911	10.68
4		Nainbag	-	-	-	-
5		Kandisaur	-	-	-	-
6	Pratapnagar	Pratapnagar	17,986	24.44	16,959	23.04
7		Madan Negi	-	-	-	-

Note: Data not found for Nainbag, Kandisaur and Madan Negi tehsils

Source: Census of India, 2011

598. **Employment Pattern.** The Census 2011 further classifies the workers (both main and marginal) into four categories namely cultivators, agricultural labourers, household industries and other workers. The categorization of the workers revealed that there was an increasing share of the main and marginal workers over 2001 to 2011. The employment pattern is given in Table 48:

Table 49. Employment Pattern of Main and Marginal Workers in Project District

Classification	2001	% share	2011	% share
Cultivators	185,276	70.00	187,121	66.72
Agricultural Labourers	3,416	1.30	8,129	2.90
Household Workers	2,341	0.90	4,021	1.43
Other Workers	73,682	27.80	81,171	28.94
Total Workers	264,715	43.80	280,442	45.31

Source: Census of India, 2011

599. **State Income:** The net state domestic product (NSDP) has shown a cumulative annual growth rate (CAGR) of 11.15% over the period 2021-22. The annual growth rate of per capita is 10.80 for the year 2021-22. The details are given in Table 49:

Table 50. NSDP and Per Capita at Current Price (2011-12)

Year	NSDP (Cr.)	Growth (%)	Per Capita (Rs.)	Growth (%)
2020-21	238857	-	185761	-

Year	NSDP (Cr.)	Growth (%)	Per Capita (Rs.)	Growth (%)
2021-22	265488	11.15	205840	10.80

Source: Tehri Garhwal district, Government of Uttarakhand, <https://tehri.nic.in/document-category/statistical-report/>

600. The growth in Gross Domestic Product at constant prices was recorded as 7.05 percent during the year 2021-22. The main contribution is of Manufacturing (42.67%), Hotel industry (12.11%) and transport (8.09%).

Table 51. Growth in GDP at Constant Prices (2021-22) (in %)

Sector	Year 2021-22
GDP	7.05

Source: Tehri Garhwal district, Government of Uttarakhand, <https://tehri.nic.in/document-category/statistical-report/>

601. **Agriculture Profile.** Uttarakhand is one of the smaller States in India with 53,483 sq. kms. of land, forming 1.63% of the total geographical area of the country. The district has a total cultivated area of 61,920 ha, out of which area sown more than once is 18,349 ha. The major crops cultivated in the district are Wheat, Saanwa etc. The major horticultural crops (vegetables) grown in the district is potato. The following Table 51 provides a brief profile of agriculture in the district and area cultivated under major crops:

Table 52. Agricultural Base of Project District

Description	Area ('000 Ha.)
Total Cultivated Area	61,920
Net Area Sown	43,571
Area Sown more than once	18,349
Major Field Crops	
Wheat	14,223
Rice	9,201
Maize	1,879
Manduwa	7,471
Saanwa	10,792
Ramdana	717
Jau	1,875
Others	98

Source: Socio-economic analysis 2021-2022 (<https://tehri.nic.in/document-category/statistical-report/>)

602. **Tourism:** It is one of the fastest growing sectors with highest contribution in state's revenue. The sector has increased the standard of living and provided platform to local artisans. The most visited tourist places in Uttarakhand are Haridwar, Mussoorie and Dehradun. Uttarakhand has many interesting and unique tourism offerings i.e. pilgrim tourism, heritage tourism, jungle tourism and adventure tourism. The details of domestic and foreign tourist arrival in the Tehri Garhwal district during the year 2021 are shown in Table 52:

Table 53. Tourist Arrival (Indian and Foreigner) in Tourist Destinations

Name of Tourist destination	Year 2021		
	Indian	Foreigner	Total
Tehri	490,512	2,300	492,812
Uttarakhand	20,002,705	15,410	20,018,115

Source: UTDB. 2021. [Tourist Statistics Year 2021 of Major Tourist Destinations](#). Dehradun.

603. The analysis of Tehri tourists from 2012 to 2023 reveals an overarching trend of growth, punctuated by periods of significant fluctuation due to external factors. Initially, the data shows a decline in 2013, with the number of tourists dropping from 980,279 in 2012 to 571,047 in 2014, indicating a 58.2% decrease. However, the following year sees a remarkable recovery, with tourist numbers more than doubling to 1,160,335 in 2015, highlighting the region's resilience and potential attractiveness to tourists when conditions stabilize.

604. A steady increase in tourist is observed from 2014 to 2019, with annual growth rates ranging between 2.9% and 34.1%. This period signifies a robust phase for Tehri as a tourist destination, bolstered by possibly improved infrastructure, marketing efforts, and heightened interest in the region's attractions. By 2019, the tourist numbers had risen to 2,348,041, marking a prosperous period for the local tourism industry. However, the onset of the COVID-19 pandemic in 2020 led to a drastic decline in tourists, plummeting by 89.6% to just 242,205 visitors, a reflection of the global travel restrictions and health concerns.

605. The latter part of pandemic period from 2021 onwards demonstrates a strong recovery. Number of tourists rebounded to 492,812 in 2021, and by 2022, the numbers had dramatically increased to 3,202,494. The most significant surge occurred between 2021 and 2022, where tourists soared to 6.5 times increase. This surge underscores the pent-up demand for travel and the potential effectiveness of recovery measures and promotional strategies implemented by the region. The rapid increase in tourists during this period suggests that Tehri has successfully repositioned itself as a prime destination, capitalizing on the easing of travel restrictions and renewed interest in domestic and international tourism.

606. Parallely, the tourist per day data mirrors these trends, providing a granular view of tourist activity. The daily tourists number show a similar pattern of growth and fluctuation. In 2012, the daily tourist stood at 4,084, dipping to 2,068 in 2013, and then rising steadily to 9,784 by 2019. The pandemic year saw daily tourists drop to 1,009 and 2,593 (2020 and 2021 respectively), however a subsequent robust recovery was observed, with daily tourists reaching 17,459 in 2023. The sharp increase in daily tourists in recent years highlights the intensity of tourist activity, necessitating enhanced infrastructure, crowd management, and resource allocation to maintain a positive tourist experience.

607. **Projected Number of Tourists.** Based on economic analysis of the Project, the projections provided from 2025 to 2060 illustrate four different growth scenarios for the region: Business as Usual (BAU), Pessimistic (20%), Optimistic (20%), and a Shock Scenario. Each scenario reflects varying assumptions about future developments that could influence population growth and infrastructure demand. These projections are vital for strategic planning and policy formulation, enabling stakeholders to anticipate future needs and implement proactive measures for sustainable development.

608. The Business as Usual (BAU) scenario assumes that the region will continue to grow at its current trajectory without major deviations. This scenario accounts for ongoing economic activities, natural population growth, and current trends in migration. Potential reasons supporting the BAU scenario include stable economic growth, effective governance, and sustained investments in regional development and infrastructure. This results in a steady increase in population from 2.29 million in 2025 to 5.17 million by 2060, indicating a predictable demand for resources and public services over time.

609. The pessimistic (20%) scenario envisions a slower growth rate due to possible constraints such as economic downturns, higher outmigration, limited investment, or environmental

challenges such as water scarcity or increased vulnerability to climate change. This scenario anticipates lower population figures, starting from 2.20 million in 2025 and reaching 4.23 million by 2060. Such conditions could lead to reduced employment opportunities and lower attractiveness of the region for new residents, impacting both local economies and infrastructure requirements.

610. In contrast, the optimistic (20%) scenario reflects a more favorable environment where factors such as increased investment, tourism development, improved living standards, and enhanced connectivity contribute to higher-than-expected population growth. This could be driven by initiatives like the expansion of the tourism sector, successful implementation of development projects, and improved socio-economic conditions. In this scenario, the population could grow rapidly from 2.38 million in 2025 to 6.31 million in 2060, suggesting a greater strain on resources and the need for expanded infrastructure and services to support a booming population.

611. The Shock Scenario considers an abrupt and significant disruption, such as a natural disaster, severe economic recession, or a major public health crisis, resulting in a drastic decline in population growth. For example, an earthquake, landslide, or major flood could cause widespread damage, leading to outmigration and a temporary decline in population, as indicated by the sharp drop in population in 2040. This scenario illustrates the importance of resilient infrastructure and emergency preparedness to mitigate the effects of sudden shocks and ensure sustainable recovery and growth over time.

Table 54. Number of tourists projected for 2025-2060)

Year	BAU	Pessimistic (20%)	Optimistic (20%)	Shock Scenario
2025	2,288,393	2,200,453	2,379,125	2,288,393
2026	2,370,689	2,263,760	2,481,796	2,370,689
2027	2,452,984	2,326,627	2,585,179	2,452,984
2028	2,535,280	2,389,072	2,689,256	2,535,280
2029	2,617,576	2,451,112	2,794,009	2,617,576
2030	2,699,871	2,512,762	2,899,420	2,699,871
2031	2,782,167	2,574,036	3,005,474	2,782,167
2032	2,864,462	2,634,947	3,112,154	2,864,462
2033	2,946,758	2,695,508	3,219,449	2,946,758
2034	3,029,054	2,755,732	3,327,343	3,029,054
2035	3,111,350	2,815,627	3,435,822	3,111,350
2036	3,193,646	2,875,206	3,544,876	3,193,646
2037	3,275,942	2,934,479	3,654,492	3,275,942
2038	3,358,237	2,993,452	3,764,658	3,358,237
2039	3,440,533	3,052,138	3,875,365	3,440,533
2040	3,522,828	3,110,542	3,986,600	2,064,320
2041	3,605,124	3,168,674	4,098,356	1,445,024
2042	3,687,420	3,226,540	4,210,623	1,156,019
2043	3,769,715	3,284,147	4,323,389	1,040,417
2044	3,852,011	3,341,504	4,436,649	1,063,130
2045	3,934,306	3,398,615	4,550,391	1,085,843
2046	4,016,602	3,455,487	4,664,611	1,108,556
2047	4,098,898	3,512,127	4,779,298	1,131,270
2048	4,181,194	3,568,538	4,894,445	1,153,983
2049	4,263,490	3,624,728	5,010,047	1,176,696
2050	4,345,785	3,680,701	5,126,093	1,199,409
2051	4,428,081	3,736,462	5,242,581	1,222,122
2052	4,510,377	3,792,016	5,359,501	1,244,835

Year	BAU	Pessimistic (20%)	Optimistic (20%)	Shock Scenario
2053	4,592,672	3,847,366	5,476,847	1,267,548
2054	4,674,968	3,902,519	5,594,614	1,290,261
2055	4,757,264	3,957,477	5,712,796	1,312,974
2056	4,839,559	4,012,245	5,831,386	1,335,687
2057	4,921,855	4,066,827	5,950,380	1,358,400
2058	5,004,150	4,121,226	6,069,771	1,381,113
2059	5,086,446	4,175,447	6,189,556	1,403,826
2060	5,168,742	4,229,492	6,309,728	1,426,540

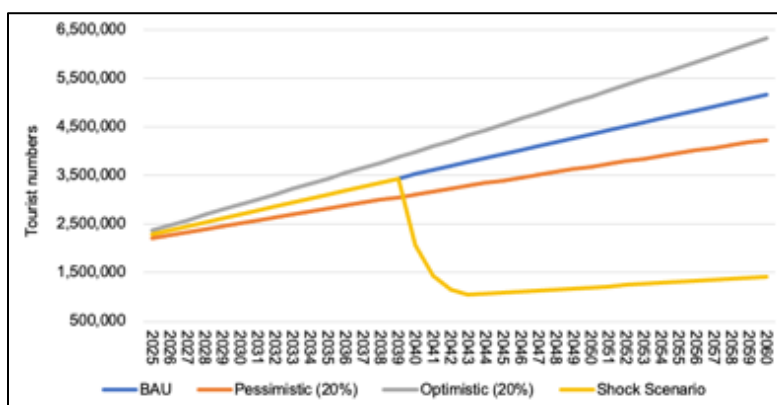


Figure 68. Trend of tourist's number from 2012 to 2060.

612. **Industrial Profile.** Tehri Garhwal is not industrially developed district. There are no public sector industries in this district. The district has total 6,443 industrial units which provides employment to almost 18,765 workers. The district has also 2,125 Khadi Gramodyog units which provides employment to 5,108 workers. The industrial profile of the district shows that majority of the people are employed in small industrial units. The summary of industrial scenario of the district is shown in the Table 54:

Table 55. Industrial Profile of Project District

Sl. No.	Particular	Number
1	Registered Industrial Units	72
2	Total Industrial Areas	6,443
3	Employment in large and medium Industries	18,765

Source: Socio-economic analysis 2021-2022 (<https://tehri.nic.in/document-category/statistical-report/>)

613. **Basic Amenities and Infrastructure.** Out of 1,862 inhabited villages in Tehri Garhwal district, 75.34 percent or 1403 villages are having access to primary education within villages, 3.11 percent or 58 villages are having access to primary medical facility within villages, 87.16 percent or 1,623 villages have access to roads within villages, 12.67 percent or 236 villages have telephone facilities within villages, 31.80 percent or 592 villages have access to transport facilities within villages, and 94.63 percent or 1762 villages are having access to power supply. However, most of the villages are not having access to post office and agriculture related facilities. Out of 1862 villages only 245 villages or 13.15 percent villages have post office within villages and only 83 villages or 4.46 percent recorded as having agriculture related facilities. Very few villages are having Bank facilities with only 4.02 percent or 75 villages.

614. **Power Supply.** Tehri Hydropower complex owned by THDC India Limited (a mini ratna

and PSU) is the major power generation source in Tehri Garhwal District. As per the Primary Census Abstract, 2011, Tehri Garhwal has 1762 electrified revenue villages and forest village. As per the Uttarakhand Power Corporation Limited, 2,374,191 are domestic consumers, 283,168 are non-domestic consumers, 6678 are govt. public utilities, 41,931 are PTW and agriculture allied activities, 16,100 are LT and HT industry, 80 are having mixed load and 02 railway traction consumers are present. The domestic consumers also include 4.28 lakhs BPL connections. The district has also established 459 solar street lights units.

615. **Irrigation.** Most of the area of state is under forests and wastelands thus leaving only a small amount of land i.e. 7.41 lakh ha (about 14%) (LUS 2009-10) for cultivation out of the total reported area of 56.72 lakh ha. Out of the total, about 89% are under small and sub marginal. As large number and area is under small and marginal holdings, scale of economies cannot be availed of, and so the input cost per unit of output is higher. The soil of tehri region is very fertile and support to number of crops. Indiscriminate use of chemicals and overexploitation of groundwater makes the soil of this region less fertile, causing the reduction in the sustainability in productivity. On the other hand, the hill region is prone to constant soil erosion due to steep slopes making it less and less fertile, which could be achieved through adoption of better management practices.

616. In the state, farmers adopt generally two types of agricultural practices i.e. the rainfed and the irrigated. Most of the agriculture in the state is rainfed. The net irrigated area of the state stands at 3.38 lakh hectares (2009-2010). The net irrigated area to net sown area for the state is 45 percent. Being large area under hills, irrigation is available mostly in the plains and valleys. So, there is a need to generate alternate sources of irrigation to increase the net irrigated area, which in turn shall also increase the cropping intensity of the state. These alternative sources can be rainwater harvesting, check dams, lift irrigation etc. Technologies like drip irrigation, sprinklers etc. can also be used for better water management.

617. As per district statistical handbook, 2022-23, the state irrigation department has constructed 14.026 kms Gool, 20 hauz, 7,167 meters pipeline and 2 solar pump set projects.

618. **Water Resource and Usage.** In Uttarakhand tap water is accessible by the households. In district, 3 drinking water facilities are being operated. Drinking water program are being implemented in 9 urban areas and 516 villages. In district, 1485 hand pumps are also being operated.

619. **Cooking Fuel.** For cooking majority about 87.61% of the urban households and 31.17% rural households use LPG/PNG in the district which is significantly much higher than the national average of 65.03% urban and 11.40% rural households according to the 2011 census. Besides LPG/PNG, about 66.91% rural population uses firewood in the state as cooking fuel. The details of sources of fuel are given in Table 55.

Table 56. Fuel Used for Cooking

Sl. No.	Households by fuel used for cooking	Uttarakhand	
		Percentage	
		Rural	Urban
1	Fire - wood	3.27	66.91
2	Crop residue	0.18	0.91
3	Cowdung cake	0.01	0.06
4	Coal, Lignite, Charcoal	0.05	0.03
5	Kerosene	7.14	0.68

Sl. No.	Households by fuel used for cooking	Uttarakhand	
		Percentage	
		Rural	Urban
6	LPG / PNG	87.61	31.17
7	Electricity	0.59	0.04
8	Bio-gas	0.01	0.04
9	Any other	0.03	0.01
10	No cooking	1.10	0.15

Source: Census of India, 2011

620. **Sanitation and Sewerage Facilities.** Proper sanitation facilities (for example, toilets and latrines) promote health because they allow people to dispose of their waste appropriately, preventing contamination of their environment and reducing risk to themselves and their neighbors. As per the Statistical Handbook of Tehri district, 2022-23, 2 sewerage systems are being implemented. 500 toilets have been constructed for individual households in FY 2022-23. Besides, community toilets have also been constructed under Swachh Bharat Mission.

621. **Health Condition and Prevalent Diseases.** As per the District Statistical Report 2022-23 for Tehri Garhwal, Govt. of Uttarakhand, 1 district hospital, 1 sub-district hospital, 11 Community Health Centre (CHC), 49 Primary Health Centre (PHC), 1 TB center, 71 Ayurvedic dispensary and 16 Homoeopathic Dispensary are available in the district.

622. Health facilities, which include different types of hospitals and dispensaries, are available in the area. The level of health facilities is found to be below average. Altogether there are 02 Community Health Centers, 03 Primary Health Centers, 7 Primary Health Sub Centers, 2 Maternity and Child welfare Centers, 1 TB Clinic, 1 Allopathic Hospital, 3 Dispensaries, 6 Mobile Health Clinic, and 3 Family Welfare Centers in the project area. The available health facilities are given below.

Table 57. Health Facility of Project Area

Community Health Centre	Primary Health Centre	Primary Health Sub Centre	Maternity and Child Welfare Centre	TB Clinic	Hospital Allopathic	Dispensary	Veterinary Hospital	Mobile Health Clinic	Family Welfare Centre
2	3	7	2	1	1	3	1	6	3

Source: Census 2011

623. **Transport, Power and Communication.** The district is well connected by rail, road and airport. It is accessible through air via Jolly Grant, which is about 76 kilometers away from Tehri. This physical proximity makes it accessible to visitors from various parts of India through Guwahati. The nearest railway station to the subproject interventions is Rishikesh Railway Station at a distance of approx. 70 kms. Tehri Garhwal District is connected to its neighboring cities and other cities of state via a well-maintained network of roads. As per the MORTH, the state has 3542 kms of National Highways up to 2018. Tehri Garhwal also has a total of 5463.79 km of metaled roads as per district statistical report, 2022-23.

624. **Electricity.** The THDC is the source of electricity generation located in the project area. All the power consumed in Tehri is received from Uttarakhand Power Corporation Limited. (U.P.C.L.). Almost all the villages are connected with electricity in the project area.

625. **Airport and Rail head.** Nearest railway station is Rishikesh Railway Station (55 km). Jolly

Grant Airport (80 km) West direction from project area.

626. **Post.** Post Office is within in nearby villages and few villages have Post office or Sub Post Office and most of all Villages are connected with mobile phone facilities in the project area.

627. **Bus.** The project components are connected with Black Topped (Pucca) Road facility (connected with PWD road Pvt. Bus and Jeeps are not available for transportation. There is no good network of road and most of the villages are connected with PAVED and MUD Road. The Bus facilities are available in few villages in the Project Influence Zone (Uttarakhand Transport Corporation) Buses facility is very poor in the areas.

628. The Primary data of socioeconomic status are collected in the project area. During study period FAE and his team has discussed to the Villagers, School Teachers, Aaganwadi Employees, Van Sahayak, Gram Sevak, Patwari, Sarpanch and Filled the socio economic survey formats by randomly in core and buffer zone. The details are given below:

629. **Economy,** The main occupation of the population is agriculture. Due to the lack of required infrastructure and the geography of the area, there are no major industries in the hilly part of the district. The people of the region go down to the plain areas like Haridwar and Dehradun for jobs as most of the Industrial units are located in these places. Although due to advancement in technology and progress in overall economy of the country various job opportunity are now avail in these regions.

630. **House pattern.** It is notable that almost 50% of houses are kutcha house/dilapidated house, 30% of houses are Pucca (brick) rest are Semi- pucca houses in project area. People are using Garhwali and Hindi language.

631. **Employment.** People here are nice, honest, hardworking and shy! More often they are short and stout. Toughness and difficult life of mountains make them special. A reasonable percentage of Uttaranchal enjoys their share in Armed Forces and many works outside the state/country for better job prospects, for a better earning. Horticulture, Agriculture and Tourism are three major activities after Government Service Sector, which is also a prime engagement. However, Agriculture, Tourism and Horticulture are not fully utilized in the Hills.

632. **Fuel.** Most of the villagers use firewood and LPG for cooking purposes.

633. **Agriculture.** Agriculture is not a profitable means of employment in this hilly district due to its uneven geographical conditions, small terraced fields and non-availability of proper irrigation facilities. The Nayyar (the main river system of the district) catchments are richly endowed with various natural resources viz. Soil, Water, Minerals, Rocks, Forests and a Scenic Landscape. It is still economically under developed. The present form and level of agro-economy of the area is considerably poor.

634. **Main Crops.** crop grown by the farmer of project area are rice, wheat, barley, maize, mandua, and pulses such as urd, moong, masoor, chana, matar, arhar etc.oil containing seeds like sarson, alsii, til, sunflower, soyabean etc.

635. **Migration.** During survey it was found that local population were migrating for employment purpose. Male from families are migrated to other cities in search of work leaving females behind at home.

636. **Sanitation.** Sanitation facility coverage as found in primary survey may be comparatively better in the urban areas, but in rural areas. The sanitation program is going on in project area under "Swachh Bharat Mission" and people are well aware about sanitation and its sustainability. Most of households are creating toilets in project area and rest of household's work is going on.

637. **Drinking Water Facilities.** Spring water is the main source of water providing life to people in the mountain region, especially in the project area. Spring is a natural source of groundwater. Unlike wells, which may be owned and controlled privately; springs are generally community-owned and community-managed. Thus, they give a sense of a "common" resource i.e. groundwater shared through a common mechanism, i.e. the spring. Some of respondents have individual taps in their houses for water, whereas most of respondent depends on the natural source of water for their daily requirement.

638. **Education Facilities.** Most of the villages had education facilities in the form of Anganwadi and Primary Schools. Higher education facilities were available in the range of 5-10 km. Colleges and other diploma courses were available at New Tehri

639. **Transportation Facility.** For transportation purpose Auto, Public and Private Bus services were available in project area. Transportation facilities were frequently available in the project area and connecting major cities. Private vehicles like Bicycles and Motor Cycles were mostly used by villagers for transportation purpose.

640. **Road Connectivity.** Most of the roads were pucca and connecting to villages. Dambar and cement roads were commonly seen inside the villages.

641. **Communication Facilities.** For communication purpose mainly mobile phones, newspaper and post offices were seen in the villages.

642. **Medical Facilities.** The availability of medical facilities in the project area is good, there are average numbers of dispensaries, maternity and family welfare centers are available.

643. **Electricity.** The power supply connections in Villages are majorly used for domestic purposes, Source/ Provider of Electricity is Uttarakhand power corporation, Dehradun.

644. **Market Facility.** Project area is predominantly rural. In villages, small shops were available for daily needs. Wholesale markets were available at New Tehri town place.

645. **Animal's husbandry.** Normally local villagers are based upon cattle, buffaloes, sheep, goats, pigs and poultry. etc. Villagers are generating daily income from these animals. They are selling Milk to dairy point and get appropriate rates during the year and also supply the milk in their village and nearby Hotels/ road side Dhaba.

646. **Savings.** At project area earnings of families are depend on agriculture crops, daily labor work and some of their small type of business. 55% families has source of income is agriculture. Their yearly income and expenditure is equal so they enable to do saving.

647. **Family assets.** For assessing the family condition as per movable (material) assets information has been taken from the project area. Its show that people have own Television sets, tape, radio, mobile, LPG connections and refrigerators respectively in their houses. Few populations have two-wheelers, 4 wheelers, and goods vehicles and own some other assets such as washing machines, telephones, VCD, sewing machines, etc.

E. Current Traffic along the tourism road

648. Understanding the baseline traffic conditions on the proposed road from Koti Colony to Dobra Chanti in Tehri Lake is crucial for assessing potential environmental impacts and developing appropriate mitigation measures. This section presents the historical traffic data for the years 2022 and 2023, which serves as the baseline information for the IEE.

649. The traffic volume analysis includes various types of vehicles: Buses, Light Commercial Vehicles (LCVs), 2 Axle Trucks, 3 Axle Trucks, and Multi-Axle Vehicles (MAVs). Buses are large motor vehicles carrying passengers by road, typically on fixed routes and for a fare. LCVs are motor vehicles with a gross vehicle weight of up to 3.5 tons, used for transporting goods and falling between passenger cars and trucks in size. A 2 Axle Truck, with two axles, is commonly used for transporting lighter loads over short to medium distances. The 3 Axle Truck, with three axles, is designed for carrying heavier loads over medium to long distances. MAVs, which have four to six axles, are used for transporting very heavy goods over long distances, essential for the movement of large and heavy loads.

650. Average Annual Daily Traffic (AADT). The AADT is a key metric used to assess the average number of vehicles passing a specific point on a road over the course of a year. It provides a comprehensive understanding of traffic flow and is crucial for infrastructure planning and environmental impact assessments. The traffic volume on the Koti Colony to Dobra Chanti road has been categorized into the above-defined types of vehicles. The historical records for the years 2021, 2022 and 2023 are summarized in below.

Table 58. Traffic Volume on the Koti Colony to Dobra Chanti Road

Year	Bus	LCV	2 Axle Truck	3 Axle Truck	MAV (4-6 Axle)
2021	28	39	16	4	1
2022	29	41	17	4	1
2023	31	43	18	4	1

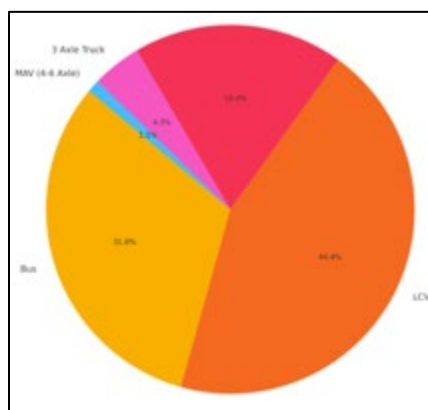


Figure 69. Overall total number of vehicle types from 2021 to 2023

651. For the year 2021, the daily traffic was 88 vehicles. Multiplying this by 30 days gives a monthly traffic volume of 2,640 vehicles. Over the course of the year, the total traffic volume amounts to 32,120 vehicles, calculated by multiplying the daily traffic by 365 days. In 2022, the daily traffic increased to 92 vehicles. This translates to a monthly traffic volume of 2,760 vehicles, considering 30 days in a month. Annually, the total traffic volume is 33,580 vehicles. In 2023, the daily traffic further increased to 97 vehicles. This translates to a monthly traffic volume of 2,910

vehicles, considering 30 days in a month. Annually, the total traffic volume is 35,405 vehicles. These calculations highlight the gradual increase in traffic volumes year-on-year.

652. The analysis of traffic volume data from 2021 to 2023 reveals several key trends. The number of buses increased from 28 in 2021 to 31 in 2023, indicating a growth of approximately 10.7%. This rise suggests a growing demand for public transportation along this route. Similarly, the volume of LCVs increased from 39 in 2021 to 43 in 2023, reflecting a 10.3% growth, indicative of increased commercial activities in the area. The number of 2 Axle Trucks rose from 16 in 2021 to 18 in 2023, showing a growth rate of around 12.5%, highlighting the growing freight transportation needs. In contrast, the traffic volume for 3 Axle Trucks remained constant at 4 vehicles for all three years, suggesting stability in this category of heavy freight transport. The number of MAVs (4-6 Axle) also remained constant at 1 vehicle for all three years, indicating no significant change in the movement of very heavy goods.

653. The baseline traffic data indicates a general upward trend in the number of buses, LCVs, and 2 Axle Trucks, while the volumes of 3 Axle Trucks and MAVs remain stable. These trends are essential for assessing the potential environmental impacts related to traffic, such as air quality, noise levels, and road safety. Increased vehicular traffic may contribute to higher emissions of pollutants, necessitating air quality monitoring to understand the impact of increased bus and LCV traffic. Similarly, the rise in traffic volumes, particularly buses and LCVs, is expected to increase noise levels, requiring baseline noise level assessments to evaluate the impact and necessary noise mitigation measures. Additionally, an increase in traffic volume may lead to higher risks of road accidents, making it crucial to understand current traffic patterns for planning safety measures and infrastructure improvements.

654. **Traffic Projections.** The traffic data for the road from Koti Colony to Dobra Chanti in Tehri Lake from 2024 to 2036 has been analyzed to understand the daily and monthly trends, as well as the overall increase in traffic over the years. The AADT provides insights into the average number of vehicles using the road each day. The daily traffic volume shows a consistent increase over the years, indicating a growing demand for road usage. In 2024, the daily traffic volume is 102 vehicles, which increases to 137 vehicles by 2030. By 2036, the daily traffic volume reaches 182 vehicles. This steady rise in daily traffic highlights the increasing pressure on the road infrastructure.

655. The monthly traffic volume, calculated by multiplying the daily traffic volume by 30 (assuming 30 days in a month), also shows a consistent upward trend. In 2024, the monthly traffic volume is 3,060 vehicles. By 2030, this volume increases to 4,110 vehicles, and by 2036, it reaches 5,460 vehicles. The monthly traffic trends mirror the daily trends, showing a steady increase over the years. This rise in monthly traffic volume underscores the need for continuous monitoring and management to ensure the road can handle the growing demand.

656. Analyzing the increase in traffic from 2024 to 2036 reveals a significant upward trend. The daily traffic volume increases by 80 vehicles from 2024 to 2036, representing a 78.4% increase over this period. Similarly, the monthly traffic volume increases by 2400 vehicles from 2024 to 2036, also reflecting a 78.4% increase. This consistent growth suggests that the road will experience almost double the traffic volume by 2036 compared to 2024. The increase in traffic is driven by the rise in each category of vehicles. For instance, the number of buses increases from 32 in 2024 to 58 in 2036. Similarly, LCVs increase from 45 to 81, 2 axle trucks from 19 to 33, 3 axle trucks from 5 to 8, and MAVs from 1 to 2.

657. **Ropeway users.** The traffic projections for the ropeway from 2025 to 2060 indicate a

substantial and consistent increase in passenger numbers, reflecting a growing demand for this transportation mode. Initially, from 2025 to 2030, the passenger load per hour per direction (P PHP DT) shows a steady rise. In 2025, the passenger load remains at 60 P PHP DT with an annual passenger count of 219,000. By 2026, this figure jumps to 86 P PHP DT, translating to 313,900 annual passengers. The growth continues progressively, reaching 96 P PHP DT by 2030, resulting in 350,400 passengers annually. This initial phase marks a critical period where the infrastructure must adapt to handle increased volumes efficiently.

658. From 2031 to 2040, the projections demonstrate sustained growth. In 2031, the passenger load increases to 99 P PHP DT, resulting in 361,350 annual passengers. By 2040, the load reaches 130 P PHP DT, equating to 474,500 annual passengers. This decade reflects a continuous rise in usage, indicating a stable and expanding demand for the ropeway services. This period necessitates ongoing improvements in infrastructure, safety measures, and service efficiency to maintain high standards and accommodate the growing number of passengers.

659. The period from 2041 to 2050 marks rapid expansion in passenger numbers. Starting in 2041 with 134 P PHP DT and 489,100 annual passengers, the growth is significant each year, reaching 174 P PHP DT and 635,100 passengers annually by 2050. This rapid expansion underscores the need for strategic investments and upgrades in the ropeway system to ensure it can handle the increasing demand. Enhancing capacity, improving operational efficiency, and maintaining safety standards will be crucial to support this rapid growth phase.

660. Finally, from 2051 to 2060, the projections indicate peak growth and the highest demand levels. In 2051, the passenger load is 179 P PHP DT, resulting in 653,350 annual passengers. By 2060, the load increases to 234 P PHP DT, equating to 854,100 passengers annually. This period demonstrates the maximum utilization of the ropeway system, highlighting its critical role in the transportation network. Ensuring that the system remains reliable, efficient, and safe during this peak demand phase will require continuous investment in technology, infrastructure, and operational management.

661. Overall, the projected increase in passenger numbers from 2025 to 2060 highlights the importance of strategic planning and investment in the ropeway infrastructure. Adapting to the rising demand will involve expanding capacity, enhancing safety measures, and maintaining high service standards. These efforts will ensure that the ropeway remains a vital and sustainable transportation solution, capable of meeting future needs effectively.

VI. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Rationale

662. This chapter presents the environmental analysis in addressing the environmental impacts and risk associated with the transport sector components of the project which include i. upgrading of tourism road 15.7km Koti Colony to Dobra Chanti, ii. upgradation of ropeway Tipri to Madan Negi, iii. water transport stations at multiple locations, iv. last mile connectivity and v. smart loop infrastructure. The analysis of potential environmental impacts is based on subproject phases: location impacts and design impacts (pre-construction phase), construction phase impacts, and operations and maintenance (O&M) phase impacts. Mitigation measures are provided for any negative impacts identified.

663. Pre-construction impacts are the potential environmental and social effects that occur before the actual construction activities begin. These impacts arise from the planning and preparatory phases of a project and can include various assessments, site selection processes, and design considerations. Key aspects of pre-construction impacts include:

- Location Impacts: These involve the selection of the project site and the potential effects on the natural and built environments due to this choice. It includes evaluating how the development might influence surrounding areas, considering factors like land use, existing ecosystems, and community settings.
- Design Impacts: These pertain to the planning and design of the project, focusing on how the proposed design and technological choices will impact the environment. This includes considerations related to the scale of the project, waste production, discharge specifications, pollution sources, and the necessary infrastructure to support the project.

664. Construction impacts are the environmental and social effects that occur during the construction phase of a project. These impacts arise from various activities and operations involved in building the infrastructure, such as site clearing, earthworks, the use of heavy machinery and construction vehicles, and the presence and activities of construction workers. These activities can lead to significant changes in the physical environment, such as alterations to the landscape, and disruptions to local ecosystems and communities. Effective management of construction impacts involves implementing measures to minimize negative effects on the environment and surrounding areas throughout the construction process.

665. Operation and maintenance (O&M) impacts are the environmental and social effects that occur during the regular operation and ongoing maintenance of a project once construction is complete. These impacts arise from the daily functioning and upkeep of the infrastructures. Key aspects of O&M impacts include safety and health of workers involved in the operation and maintenance activities, continuous monitoring of environmental parameters to ensure compliance with regulatory standards and to mitigate any potential negative impacts, and other associated impacts. Additionally, O&M impacts involve assessing the ongoing effects on the surrounding environment due to the facility's presence and operations. Managing these impacts requires implementing strategies to mitigate long-term environmental effects, ensuring sustainable operations, and maintaining safety standards for workers and the community.

666. Impact Magnitude and Duration: Understanding and classifying the magnitude and duration of environmental impacts is crucial for effective environmental management. This section delves into the criteria used to assess these two aspects and discusses their significance in the context of project planning and implementation. By categorizing impacts based on their intensity

and longevity, projects can develop targeted strategies to mitigate adverse effects and enhance positive outcomes.

667. **Impact Magnitude:** Magnitude refers to the intensity or severity of the environmental impact. It indicates the degree of change that the project will impose on the environment, ranging from minor alterations to significant disruptions. The classification of impact magnitude is typically divided into three categories: negligible, moderate, and severe.

668. Negligible impacts are minor that they are barely perceptible and do not cause any significant harm to the environment or human health. These impacts include minor increases in noise levels or slight changes in air quality that fall within acceptable limits. Often, negligible impacts do not require extensive mitigation measures beyond standard best practices, as their effects are minimal and easily manageable without significant intervention.

669. Moderate impacts are noticeable and may cause some level of disruption or harm but are generally manageable through mitigation measures. Examples include temporary disruption to local traffic during construction, moderate levels of dust and noise, or slight alterations to local water bodies. Mitigation measures such as dust suppression, noise barriers, and traffic management plans can effectively manage moderate impacts, ensuring that any adverse effects are minimized and controlled.

670. Severe impacts are significant and may cause substantial harm to the environment or human health. These impacts require immediate and robust mitigation strategies. Examples of severe impacts include major air and water pollution, or displacement of communities. Addressing severe impacts necessitates comprehensive environmental management plans, including habitat restoration, pollution control technologies, and relocation assistance for affected communities, to mitigate the profound and potentially long-lasting consequences.

671. **Impact Duration.** Duration refers to the length of time the impact will persist. This classification helps in understanding the long-term implications of the project and planning accordingly. The duration of impacts is typically categorized as temporary or permanent.

672. Temporary impacts occur for a limited period, usually during specific phases of the project such as construction. They are reversible and can be mitigated effectively once the activity causing the impact ceases. Examples of temporary impacts include increased noise levels during construction, short-term air quality deterioration due to dust, or temporary traffic disruptions. Managing temporary impacts can often be achieved through short-term mitigation measures like construction scheduling to avoid peak traffic times, using dust suppressants, and installing temporary noise barriers to minimize the duration and intensity of these impacts.

673. Permanent impacts cause lasting changes to the environment or human health that are not reversible. They continue to persist even after the project activities causing them have ceased. Managing permanent impacts requires a long-term perspective, involving measures such as ecological restoration, continuous monitoring, and adopting sustainable practices to prevent further degradation.

B. Identification and Assessment of Environmental Impacts

674. The identification of potential effects necessitates a thorough examination of the components of the physical, biological, and human environments that are at risk due to the

subproject. This analysis is crucial for understanding and mitigating the environmental impacts associated with the project.

675. The physical environment encompasses all abiotic factors that may be affected by the road upgrading project. This includes air quality, which can be influenced by emissions and dust generated during construction and operation. Land and soil are also key components, where activities such as excavation and construction can lead to soil erosion and land degradation. Additionally, surface water quality and quantity, as well as groundwater resources, may be impacted by the project, necessitating a thorough examination of potential contamination and alterations to hydrological systems.

676. The biological environment involves the study of all living organisms within the project area, including terrestrial vegetation, mammals, avifauna, and any special status species that may be present. This component assesses the potential impacts on local flora and fauna, including habitat loss, changes in species composition, and threats to biodiversity. The examination extends to understanding how the project might disrupt ecosystems and the survival of various species within the area.

677. Socio-economic focuses on the impacts of the subproject on human communities and their built surroundings. This includes the assessment of effects on private land and buildings, as well as public infrastructure such as roads, bridges, and utilities. Furthermore, the aesthetic and visual impact on the landscape, as well as the health and safety risks to both community members and workers, are critical components of this analysis. This ensures that potential disruptions to daily life, safety, and well-being are comprehensively addressed. This also includes religious sites nearby subprojects sites.

C. Typical Potential Beneficial Impacts

678. The immediate benefits of Transport component subprojects will come in the form of direct employment opportunities during construction for the subproject communities engaged as wage labourers, petty contractors and suppliers of raw materials. During the operation stage, roadside economic activities supporting transport like gasoline stations, automotive repair shops, lodging, and restaurants will increase due to the increased number of tourist visits and associated vehicular movement. An increase in homestay activities in Tiwargoan with better connectivity through proposed tourism road and water public transport Stations at multiple locations are also expected to take advantage of improved access to Tehri urban centers. The ropeway project will accelerate the economic opportunities for people living in Madan Negi and Tipri. The overall impact of the subproject components will result in reduced migration. Other benefits of project improvement are: (i) reduction in travel time (ii) better mode and frequency of transport (iii) access to quality health care, educational and other infrastructural facilities (iv) improved quality of life of the population living in and around subproject component areas (v) reduced accident events and (vi) better investment climate for industries creating more employment opportunities to local people.

D. Pre-construction Phase Impacts and Mitigations

679. **Cutting of trees along road alignment.** A total of 3,124 trees have been enumerated in the proposed right-of-way of the tourism road subproject. Most of these trees are indigenous, and none are categorized as rare, endangered, or threatened. Geometric adjustments will be made until the final design to minimize the number of affected trees. Additionally, tree cutting will be

restricted to the toe line of the formation width without compromising road safety elements. The Forestry Department will conduct mandatory compensatory planting on a 1:10 basis. Furthermore, additional planting will be implemented as a strategy to minimize greenhouse gas emissions resulting from increased traffic due to road upgrades. No trees will be uprooted without prior approval from the competent authority.

680. There are no anticipated impacts on trees in the other transport infrastructure components, such as the ropeway between Tipri and Madan Negi, smart loop, and water public transport stations at multiple locations. No section of the tourism road or any other subprojects under the transport infrastructure components passes through or infringes upon forest land; therefore, no diversion of forest land is involved in these components. However, if any forest land diversion becomes necessary, it will be regulated, and the UTDB and PWD will adhere to regulatory requirements, including the payment of net present value, allocation of equivalent degraded land for forest area development, and compensatory afforestation to secure the necessary forest clearance.

681. Mitigation measures will be implemented to address tree cuttings, including compensatory planting, geometric adjustments to minimize tree loss, and other measures such as the following:

- Restricting tree cutting within construction limit.
- Avoiding tree cutting at ancillary sites.
- Obtain necessary permission for tree cutting.
- Providing and maintaining compensatory tree plantation 10 times of cutting.
- Choose road alignments that avoid ecologically sensitive areas and minimize the need for tree cutting as much as possible. With the forest department and PWD, contractor to conduct a thorough survey to identify trees that can be preserved.
- Ensure all activities comply with national and local environmental regulations and guidelines.

682. **Camp establishment and construction mobilization.** Establishing construction camps and mobilizing resources for construction can have environmental impacts, which stem from the activities involved in setting up temporary facilities and infrastructure necessary for the construction phase. One of the primary environmental impacts of camp establishment is vegetation clearance. Setting up construction camps often requires clearing areas of land. Additionally, soil compaction and erosion are common issues due to the movement of heavy machinery and the establishment of temporary structures, which can degrade soil quality and increase sedimentation in nearby water bodies. Water resource management is another critical concern. Construction camps require water supply for domestic and operational uses, which can strain local water resources. The presence of construction camps also increases the risk of pollution from fuel spills, construction materials, and chemicals, further impacting soil and water quality. Air and noise pollution are notable pre-construction impacts associated with mobilization activities. The transportation of materials and machinery generates dust and emissions, contributing to air pollution and posing health risks to workers and nearby residents. Noise from machinery and construction activities can disturb local wildlife and communities, leading to stress and behavioral changes in animals and potential health issues in humans.

683. Camp establishment and construction mobilization often result in moderate environmental impacts because these activities typically involve localized disturbances rather than widespread ecological disruption. The environmental impacts of camp establishment and construction mobilization are typically temporary due to the transient nature of these activities. Once the

construction phase is complete, the temporary structures and facilities are dismantled, and the land can potentially be rehabilitated.

684. Mitigation measures to address the impacts of establishing labor camps and construction mobilization are:

- Labor camps will not be located on agricultural land and will be sufficiently distant from surface water sources and water bodies.
- Labor camps must be equipped with fire safety measures to mitigate electrical and other fire hazards.
- Hot mix plants and batching plants will be sited sufficiently away from settlements, agricultural operations, and any commercial establishments. These plants will be located at least 500 meters away from the nearest village or settlement, preferably in the downwind direction.
- The contractor shall submit a detailed layout plan for all such sites, and approval is necessary prior to their establishment.
- Arrangements to control dust pollution will be required at all construction sites.
- Specifications for crushers, hot mix plants, and batching plants will comply with the requirements of the relevant current emission control legislation.
- The contractor shall not initiate plant operations until the required legal clearances are obtained and submitted.

685. **Utility Shifting.** Prior to the commencement of any construction project, a critical task is the identification and relocation of the existing utility infrastructure, such as water pipes, electricity cables, and telecommunication lines, that could potentially interfere with the planned construction activities. This process, known as utility shifting, is essential to ensure the smooth and efficient execution of the project, while also minimizing the environmental impacts associated with construction. The process of locating, excavating, and relocating these utilities can result in land disturbance. Furthermore, the use of heavy machinery and equipment during utility shifting operations can exacerbate environmental issues by generating pollutants, such as particulate matter, which can degrade local air quality and have adverse effects on public health. In addition to the direct environmental impacts, the disruption caused by utility shifting can also lead to indirect consequences. For example, the temporary closure of roads or the diversion of traffic during utility relocation can result in increased emissions from vehicles, contributing to the overall environmental burden of the project.

686. The impacts of utility shifting are typically temporary and moderate because they are confined to the specific period and locations where the relocation activities occur. Once the utility infrastructure is successfully relocated and the associated construction activities are completed, the disturbed areas can often be restored, reducing long-term environmental damage. The moderate nature of these impacts stems from the localized scale of the operations and the controlled use of machinery, which, while it may disrupt local environments and increase emissions temporarily, does not generally lead to extensive or irreversible environmental degradation.

687. Mitigation measures to reduce the impacts of utility shifting are:

- Conduct necessary planning and coordination with the relevant authorities and local bodies. Provide prior notice and consult with these authorities, local bodies, and the public likely to be affected by road alignment.

- Organize initial meetings with all relevant utility service providers (e.g., water, gas, electricity, telecommunications) to discuss the scope and timeline of the road construction project. Establish agreements on responsibilities, timelines, and protocols for utility relocation to ensure a collaborative and efficient process.
- Develop a detailed schedule that aligns utility relocation activities with the overall construction timeline.
- Ensure the schedule accounts for all necessary permits, materials, labor, and equipment needed for the relocation.
- Create contingency plans for potential delays or unforeseen issues, such as weather-related interruptions or unexpected utility conditions.
- Map the precise locations of all existing utilities within the project area. Physically mark the locations of utilities on the ground using color-coded stakes or paint to guide construction crews and prevent accidental damage.
- Organize public meetings and consultations with local communities to inform them about the utility relocation plans and construction schedule. Use clear and accessible language to explain the project's purpose, benefits, and potential impacts.
- Provide information through various channels, such as community notice boards, local newspapers, radio announcements, and social media.
- Contractor to establish feedback mechanisms, such as suggestion boxes, hotlines, or online platforms, to collect community concerns and suggestions. Ensure that a dedicated team or individual is responsible for addressing community inquiries and feedback.

688. Sourcing of construction materials from quarries. The sourcing of construction materials has impacts, particularly in terms of air pollution and waste generation. The transportation of these materials, often over long distances, adds further emissions from diesel-powered vehicles, increasing the carbon footprint. Additionally, the extraction and processing of raw materials generate substantial air pollution, including dust and particulate matter, which can cause respiratory and cardiovascular health problems. Waste generation is another critical issue in the sourcing of construction materials. The extraction, processing, and transportation stages produce significant amounts of solid and hazardous waste, which, if not managed properly, can lead to soil and water pollution. Efficient waste management practices, including recycling and reusing materials, are essential to mitigate these impacts.

689. Sourcing construction materials from quarries typically results in temporary and moderate impacts due to the controlled and localized nature of the extraction activities. The temporary aspect arises because quarrying operations are generally confined to the duration of the project's construction phase. After material extraction is completed, quarries can often undergo rehabilitation processes where vegetation is replanted and the site is managed to promote natural recovery, thus reducing long-term environmental damage. The impacts are considered moderate because they are primarily localized around the quarry site. Modern quarrying practices often include measures to minimize environmental disruption, such as dust suppression, noise reduction techniques, and careful planning to avoid significant ecological areas. Moreover, regulatory frameworks require mitigation of impacts on the surrounding environment, which helps in managing and reducing the overall environmental footprint of quarrying activities. Few mitigation measures for sourcing of materials are the following:

- Use quarry sites and sources permitted by government.
- Verify suitability of all material sources, confirm permits of material sources and obtain approval from UTDB.

- If additional quarries are required after construction has started, obtain written approval from UTDB.

690. **Loss of land and assets.** No loss of land or assets is anticipated in any of the transport components except for the tourism road. The existing road right-of-way varies from 6 meters to 8 meters, although it exceeds this range in a few places. Three typical cross sections have been proposed: 10 meters, 14 meters, and 20 meters. Primarily, the proposed ROW is 14 meters, but at six locations where viewpoints are planned, the proposed ROW is 20 meters. To achieve the desired ROW, a few structures will need to be dismantled. A resettlement plan is prepared concurrently to address resettlement issues. Adequate compensation and rehabilitation assistance are being proposed for affected households, consistent with ADB and Government of India policies. Income restoration measures and livelihood options for vulnerable groups, resource-poor sections, and other affected persons, as recommended in the resettlement plan, will be implemented. All impacted common property resources will be relocated and reconstructed in consultation with the respective local communities under the project.

691. **Community safety considerations.** With increased traffic volume, communities including tourism road, ropeway and water public transport stations at multiple locations may be at risk of accidents in the absence of adequate safety provisions such as crash barriers, handrails, proper illumination etc. In the designs, safety provisions in accordance with IRC guidelines, which include provision of (i) rumble strips in habitat areas to regulate speed (ii) retro-reflective warning sign boards near schools, hospitals and religious places (iii) proper side-walks/pedestrian zones along the road near habitat areas, school, hospital, religious places, (iv) proper handrails for pedestrians, proper illumination and (v) and installation of safety devices safety brake and sensors in ropeway, etc., are included in preliminary design which will be further reviewed (iv) compliance with IRC provisions of state highway for curvature and grading. The provision of safety kerb at bridge sites is also proposed.

692. **Localized flooding/waterlogging from inadequate drainage.** The subproject areas are largely free from flooding. However, waterlogging was observed in several built-up sections along a few sections of the tourism road component due to inadequate drainage facilities. Some of the proposed designs are to: (i) construction of concrete pavement in village areas considering alignment level and drainage, (ii) raising road level above the nearby areas with the provision of adequate side drains to evacuate the rainwater and domestic discharges, (iii) provision of adequate CD structure, and improvement in their carrying capacity.

693. **Religious places.** Pre-construction activities, particularly those related to road works, can impact cultural and religious places in various ways. One of the primary concerns is physical damage to these structures. The use of heavy machinery for excavation and road laying can generate vibrations that may compromise the structural integrity of nearby cultural and religious buildings. This is particularly concerning for older structures, which are more vulnerable to such disturbances and may develop cracks or even collapse. Additionally, road widening or rerouting often necessitates the alteration or demolition of parts of these sites, resulting in the loss of historical artifacts and architectural heritage that cannot be replaced. Restricted access due to road closures and diversions further complicates the situation, disrupting regular religious practices and community gatherings. The noise and dust generated from construction activities can also disturb the serene environment essential for worship and meditation, negatively impacting the spiritual experience of visitors and caretakers.

694. The impact on the temple due to nearby construction activities, such as road works, is predominantly temporary and moderate. Disruptions like noise, dust, and vibrations are confined

to the construction phase and cease thereafter, allowing normal temple operations to resume promptly post-construction. To minimize disturbances, construction projects typically incorporate mitigation strategies such as adjusting work schedules to less sensitive times, utilizing noise-reducing construction techniques, and enforcing stringent dust control protocols.

695. It is noteworthy that the ropeway, water public transport stations at multiple locations, and smart loop subprojects do not impact religious or cultural sites, as these areas do not have any such sites nearby. Therefore, the environmental and social assessments for these specific projects can focus on other potential impacts without the need for extensive mitigation measures related to cultural and religious heritage.

- The PWD and contractor will consult the community before starting any works to share information about: (i) the proposed road designs, and (ii) the timing and dates of the works.
- Contractors will follow culturally appropriate and respectful procedures in case of any chance findings. Such findings must be immediately reported to the PWD, PMU, and district administrations. Necessary measures directed by the Engineer will be implemented.
- Contractor to conduct a detailed survey of the temple and its surroundings to document its current condition. Take photographs and videos to establish a visual record of the temple's state before construction begins.
- PWD and contractor will engage with the temple authorities and local community to discuss the construction plans and potential impacts. Incorporate their feedback into the construction planning process.
- Contractor to clearly mark the zone around the temple with fencing or barriers to prevent accidental encroachment.
- Contractor to install vibration monitors near the temple to track construction-induced vibrations. Set threshold levels for vibrations to prevent damage to the temple structure.
- Ensure that access to the temple is maintained for worshippers and visitors throughout the construction period.
- Provide safe and clearly marked pedestrian pathways around the construction site.
- Erect temporary protective structures, such as scaffolding or netting, around the temple to shield it from debris and construction materials.
- PWD will provide contact information for a dedicated liaison officer to address any concerns promptly.
- Contractor will train its construction workers on the importance of the temple and the specific mitigation measures in place.

696. The road upgrading and widening activities for the tourism road subproject will impact 2 small temples, which was constructed by the residents. These temple falls within the designated road right of way and will need to be removed to accommodate the road expansion. In recognition of the cultural and spiritual significance of this temple to the community, compensation measures will be provided. PWD and PMDSC will engage with the local community and temple custodians to determine a suitable relocation site for the. These efforts aim to ensure that the temple's cultural importance is preserved, and that its relocation is carried out in a manner that respects the religious sentiments of the residents. The following are measures to mitigate the impacts on these 2 small temples.

- Discuss potential relocation sites and gather community input to ensure that the new site meets the spiritual and cultural needs of the residents.
- Document the temple's current structure, including photographs, drawings, and written descriptions, to preserve its historical and cultural significance.
- Record any inscriptions, artifacts, and other culturally significant elements associated with the temple.
- Provide financial compensation or material support for the reconstruction of the temple at a new location agreed upon by the community.
- Ensure that compensation packages cover all costs associated with relocation, including materials, labor, and any additional facilities required at the new site.
- Identify and prepare a suitable relocation site in consultation with the local community.
- Ensure that the new site is accessible and offers a comparable or enhanced setting for worship and community gatherings.

697. **Climate risks of ropeway.** As per climate risk assessments for the region, the frequency and intensity of high wind events are projected to increase under both the SSP2-4.5 (medium emissions) and SSP5-8.5 (high emissions) scenarios. Specifically, the future climate scenario analysis for the Tehri Lake region projects a potential increase in wind speeds by up to 20% during the peak tourist seasons from June to September. This increase is attributed to extreme weather patterns becoming more prevalent due to global warming and changes in the atmospheric circulation over the region.

698. Historically, the maximum wind speed observed in the Tehri Lake region during monsoon seasons was around 60 km/h, which already posed challenges to the safe operation of ropeway. Projections indicate that maximum wind speeds could reach up to 75 km/h by 2041-2070, under the SSP5-8.5 scenario, significantly raising safety concerns for passengers and operational stability. This intensification of wind speeds can cause gondolas to sway excessively, increasing the risk of mechanical failure or even derailment, particularly during periods of high passenger load.

699. The ropeway system's design needs to accommodate the projected wind loads to ensure safety and operational efficiency. Current structural components, such as the supporting pylons and steel cables, may not be adequately designed for the anticipated increase in wind loads. The increase in wind speed will exert higher lateral forces on the pylons and cables, potentially leading to structural deformations or failures if the infrastructure is not upgraded.

- *Structural Load Analysis:* Current design standards assume a wind load of 1.5 kN/m² for the pylons, based on historical wind speeds. However, with projected wind speeds increasing by 20% in the coming decades, the design wind load should be recalculated to at least 1.8 kN/m² to accommodate future conditions. This recalculation is critical to prevent structural damage, as exceeding the design wind load could result in catastrophic failures of support structures.
- *Cable Tensile Strength:* The existing cables are rated for wind speeds up to 70 km/h. To enhance resilience, it is recommended to use cables with a higher tensile strength that can withstand wind speeds up to 90 km/h. This upgrade would increase the factor of safety, ensuring that the system can operate safely under extreme wind conditions projected in the SSP5-8.5 scenario.

700. Increased wind speeds present a direct risk to the operational safety of gondolas. High wind speeds can cause swaying of the gondolas, creating risks for passenger transport. Furthermore, operations may need to be suspended frequently during windy conditions, disrupting

connectivity and impacting the reliability of the ropeway system as a transportation mode.

- *Operational Shutting Points:* Currently, gondola operations are suspended when wind speeds exceed 50 km/h. Based on future climate scenarios, this threshold may need to be revised downwards to 40 km/h to ensure safety, as higher wind speeds could lead to rapid acceleration of gondola movements. The installation of real-time wind speed monitoring systems at multiple points along the route is essential to make informed decisions regarding operational safety.
- *Safety Margins:* The existing safety margins for gondola oscillations under high wind conditions should be revised. Presently, the system allows for a maximum sway angle of 5 degrees. With anticipated wind speed increases, it is necessary to reduce the permissible sway angle to 3 degrees, and implement automated emergency braking systems to halt operations when this threshold is crossed.

701. To mitigate the risks associated with increased wind speeds and other climate impacts, several adaptation strategies should be integrated into the design and operation of the ropeway system:

Structural Reinforcements and Upgrades:

- Replace existing cables with high-tensile strength cables designed to withstand increased wind loads. The tensile strength of the new cables should be at least 5000 MPa to accommodate wind speeds up to 60 km/h and gusts reaching 80 km/h.
- Incorporate vibration dampers in the cable system to reduce oscillations caused by wind-induced vibrations. This will help maintain stability and reduce wear and tear on mechanical components.
- Strengthen pylons and support structures using high-strength concrete or steel to enhance their load-bearing capacity and prevent structural failures due to increased wind loads.

Real-Time Weather Monitoring and Automated Safety Protocols:

- Install anemometers along the entire ropeway length to continuously monitor wind speeds. Automated alarms can be integrated into the system to alert operators when wind speeds approach unsafe levels, allowing for timely suspension of operations.
- Implement automated braking and shutdown systems that activate when wind speeds exceed safe operating limits. This will prevent accidents caused by sudden wind gusts.
- Utilize weather data analytics to predict extreme weather events and proactively manage ropeway operations. Implement a real-time monitoring system that integrates wind, rainfall, and temperature data to forecast potential shutdowns and avoid sudden operational disruptions.

Slope Stabilization and Erosion Control:

- The Tipri station, located on a steep slope, has been affected by landslides in the past due to heavy rainfall and soil erosion. Future climate scenarios project a 19% increase in precipitation by 2070 under the SSP2-4.5 scenario. This could further destabilize slopes, posing a risk to the ropeway infrastructure. Slope stabilization measures such as reinforced retaining walls, geotextile membranes, and bioengineering techniques (e.g., planting deep-rooted vegetation) should be implemented to prevent soil erosion and ensure slope stability.

Elevated Design Standards for Gondola Stations:

- Given that the ropeway stations are highly exposed to wind and rainfall, it is recommended to elevate the design standards for the stations. This includes using wind-resistant materials for roofs and side panels, and installing additional anchoring points for increased stability.

702. **Regulatory Compliance and Permits.** In the state of Uttarakhand, the issuance of government consents, permits, clearances, and no objection certificates (NOCs) is a critical part of the pre-construction process for infrastructure projects such as ropeway, tourism road, and smart loops. These regulatory requirements ensure that the projects comply with environmental, social, and legal standards set by various authorities. This comprehensive regulatory framework is designed to protect the state's natural and cultural heritage, ensure the safety and well-being of its residents, and promote sustainable development practices.

E. Construction Phase Impacts and Mitigations

703. **Topography.** The major project scope under the transport infrastructure component involves the refurbishment of an existing ropeway, development of water public transport stations at multiple locations and the expansion of an existing road. While no significant changes in topography and geology are anticipated for ropeway, water public transport stations at multiple locations and smart loop, the development of the tourism road presents unique challenges due to its traversal through predominantly hilly terrain. The cut-and-fill operations necessary for this road development are confined to the right-of-way of the proposed tourism road. These operations are crucial to improving and maintaining the road's profile, ensuring it is suitable for increased traffic and enhanced accessibility. The modification of the landscape through these activities will inherently alter the natural topography to some extent.

704. The total quantity of muck and debris generated from the development of the tourism road project is estimated to be 1,281,006 cubic meters. This substantial volume includes 1,311,778 cubic meters of muck from cutting hills and 30,772 cubic meters from filling activities. The alteration of the hillside topography is an unavoidable consequence of these earthmoving operations.

705. To manage the generated muck efficiently, disposal sites have been strategically planned at a density of 2 sites per kilometer, resulting in a total of 30 disposal locations along the 15-kilometer stretch of the tourism road. These sites are selected to minimize environmental impact and ensure the stability of the disposed material, preventing further erosion or landslide risks.

706. The cut-and-fill process will permanently disrupt the natural topography and could potentially lead to increased soil erosion, changes in drainage patterns, and the destabilization of slopes. To mitigate these impacts, it is essential to implement robust erosion control measures, such as constructing retaining walls, silt fences, and sediment basins. Additionally, re-vegetation of disturbed areas with native plant species will help stabilize the soil and restore the natural landscape over time. Other mitigation measures are the following:

- Install silt fences along the perimeters of disturbed areas to prevent soil erosion and sedimentation in nearby water bodies.
- Use erosion control blankets on slopes to stabilize soil and promote vegetation growth.
- Construct sediment traps or basins to capture eroded soil and prevent it from entering waterways.
- Maintain buffer strips of vegetation along watercourses and sensitive areas to protect habitats and water quality.

- Strip and stockpile topsoil separately for reuse in revegetation efforts to ensure soil fertility is maintained.
- Minimize soil compaction by restricting heavy machinery movement to designated paths and work areas.
- Regularly sprinkle water on exposed soil surfaces, stockpiles, and unpaved roads to suppress dust.
- Establish temporary vegetative cover on bare soil areas to reduce dust generation.
- Cover trucks transporting loose materials to prevent dust emissions during transit.
- Erect noise barriers around construction sites to reduce noise impact on nearby communities and wildlife.
- Implement vibration monitoring to ensure levels do not exceed thresholds that could cause structural damage or disturb sensitive wildlife.
- Establish buffer zones around water bodies to protect them from sediment runoff and contamination.
- Ensure all construction debris and vegetation waste are properly collected and disposed of in designated areas.
- Promote recycling and reuse of materials such as wood, metal, and concrete from clearing and grubbing activities.
- Use clear signage and fencing to delineate construction zones and prevent unauthorized access.
- Inform local communities about the clearing and grubbing activities, potential impacts, and mitigation measures through public meetings and information sessions.
- Provide training for construction workers on environmental protection practices and the importance of adhering to mitigation measures.

707. **Cut and fill.** The large-scale earthworks involved in the road construction from Koti Colony to Dobra Chanti will result in alterations to the natural terrain of the proposed road. The construction activities, such as excavation and grading, will lead to the removal of vegetation and topsoil, which are critical components of the hillside's stability. This alteration of the terrain may disrupt the natural contours of the landscape, causing changes in the natural water drainage patterns. When drainage systems are disrupted, the area can experience increased surface water runoff, which contributes to soil erosion. In hilly terrains like the Tehri Lake region, these changes can lead to slope instability and exacerbate the risk of landslides, particularly during the monsoon season when soil saturation levels are high. This disruption to the natural geography can have long-lasting impacts, making the land more vulnerable to erosion and landslides that may result in long-term environmental degradation.

708. The "cut and fill" construction method, which involves the cutting of soil and rock from hill side and filling valley areas to create a level roadway, will generate a substantial amount of land debris. This debris, if not managed appropriately, can lead to environmental impacts, such as siltation of nearby water bodies and alteration of natural drainage courses. Moreover, uncontrolled dumping of excess soil and rock can cause the smothering of existing vegetation, which in turn can lead to the reduction of soil fertility and creation of barren patches prone to erosion.

709. Once the topographical features of a landscape are altered through construction activities, it becomes challenging, if not impossible, to restore the natural landscape to its original state. The changes to the geographical and topographical features of the roadway alignment are unavoidable. This underscores the importance of adopting mitigation measures that minimize the extent of disruption to the natural landscape. For instance, efforts should be made to restore disturbed areas through re-vegetation using native plant species and slope stabilization

techniques, such as the use of retaining walls and bioengineering methods. While these measures can help stabilize the altered terrain, they may not fully replicate the original ecological conditions of the area. Therefore, it is essential to plan construction activities in a way that limits the extent of topographical changes, preserving as much of the natural environment as possible.

- Implement slope stabilization measures such as retaining walls, gabion walls, and reinforced concrete structures in areas prone to landslides and slope instability.
- Utilize bioengineering techniques like planting deep-rooted native species along slopes to enhance soil binding and reduce the risk of erosion.
- Introduce terracing on steep slopes to reduce surface water runoff velocity and minimize soil erosion. Terracing helps break the slope length, allowing water to infiltrate rather than flow rapidly down the slope.
- Establish designated debris disposal sites for the storage and stabilization of excess soil and rock material away from water bodies, forests, and agricultural lands.
- Reuse excavated soil and rock material for backfilling low-lying areas or as construction material for embankments, thereby reducing the need for additional material extraction and minimizing waste generation.
- Develop a soil conservation plan that includes mulching, use of geotextiles, and application of organic compost to improve soil structure and fertility in the affected areas.
- Construct lined drainage channels along the road to safely divert surface runoff away from unstable slopes and prevent water accumulation. These channels should be designed to handle peak flow during heavy rainfall events.
- Ensure that cross-drainage structures, such as culverts and causeways, are adequately designed to accommodate natural water flow and minimize changes in hydrology due to the road alignment.
- Provide training to construction workers on best practices for erosion control, debris management, and minimizing environmental impacts during excavation and grading activities.

710. **Subsurface conditions.** The geotechnical investigation conducted along the proposed road alignment in the Tehri Lake area is critical in informing the design and construction phases of the tourism road expansion. Eight strategically placed boreholes were drilled along the alignment at Koti Colony and Dobra Chanti to collect data on subsurface conditions (see discussion on geotechnical survey), ensuring the road's structural integrity and stability. The findings revealed that the subsurface conditions predominantly consist of fractured rock with variations in soil type in specific locations. For instance, Borehole BH-5 at Koti Colony contained silty sand with gravel up to a depth of six meters, which highlights the variable nature of the subsurface. Laboratory tests on the collected soil samples provided essential information on geotechnical properties such as bulk density, dry density, moisture content, specific gravity, cohesion, and angle of friction, guiding the structural design of the road to withstand local conditions and maintain long-term durability.

711. The geomorphological and geological observations indicate that the road alignment traverses through highly dissected hills and valleys with a complex terrain characterized by phyllite and quartzite rock formations interspersed with bands of shale and limestone. The area's seismic risk, classified under Zone IV of the seismic zoning map of India, poses additional design challenges that necessitate reinforced concrete structures to ensure stability. The identification of high groundwater levels in some boreholes also calls for the incorporation of robust drainage systems to mitigate water-induced soil instability. Additionally, the presence of landslide-prone zones along the alignment requires careful design and implementation of mitigation measures to

reduce potential hazards. Overall, the geotechnical findings provide a foundation for engineering solutions tailored to the challenging terrain, ensuring the road meets safety and performance standards.

712. Based on the existing conditions of the area and the geotechnical findings, the following mitigation measures are recommended to reduce the impacts associated with subsurface conditions along the road alignment:

- Implement slope stabilization techniques in areas where fractured rock and varying soil types have been identified. Construct reinforced retaining walls, gabion walls, and soil nailing in sections with unstable slopes and high landslide risk. For example, in locations like Koti Colony where silty sand and gravel were encountered at a shallow depth, additional soil reinforcement measures such as the installation of ground anchors should be considered.
- Use terracing or benching techniques to reduce slope steepness and improve slope stability. This will help to prevent soil and rockslides, particularly in sections with fractured phyllite and quartzite formations.
- Given the location of the road in Seismic Zone IV, it is essential to design reinforced concrete structures with adequate seismic resistance. Ensure that retaining walls, bridge abutments, and other structures are built to withstand seismic forces, considering the subsurface characteristics revealed by the borehole data.
- Incorporate robust drainage systems to manage surface water and high groundwater levels, as identified in some boreholes along the alignment.
- Use weep holes and drainage channels in retaining walls to allow groundwater to escape, thereby reducing the risk of water-induced instability.
- In areas where fractured rock formations dominate the subsurface, install rockfall barriers, catchment nets, and mesh coverings to prevent loose rocks from falling onto the road. Regularly inspect and maintain these structures to ensure they are effective in preventing rockfall incidents.
- Use rock bolts and shotcrete to stabilize exposed rock faces and reduce the likelihood of rockslides in cut sections along the road.
- To address areas with variable soil types and poor load-bearing capacity, use geosynthetic materials such as geogrids and geotextiles for soil reinforcement and slope stabilization. These materials can improve soil strength and provide additional support to weak soil layers.
- Implement bioengineering techniques like planting deep-rooted grasses and shrubs along slopes to enhance slope stability and reduce soil erosion. Select native species that are adapted to local conditions to ensure long-term effectiveness.
- Develop a detailed monitoring and maintenance plan to regularly assess the condition of slopes, retaining structures, and drainage systems. Use remote sensing tools and geotechnical instrumentation to detect early signs of instability or deformation.
- Carry out periodic inspections after extreme weather events or seismic activity to ensure the integrity of the road and associated structures.
- Map out landslide-prone zones along the alignment using the data collected from boreholes and geological surveys. Implement site-specific landslide mitigation measures, such as slope buttressing and the use of retaining berms, to prevent slope failure in high-risk areas.

713. Air quality impacts are discussed in the following paragraphs.

714. **Construction plants, equipment, and vehicles.** The deployment of heavy-duty construction equipment and vehicles is a source of air pollution, primarily due to their combustion engines which emit a variety of pollutants. These include particulate matter (both PM₁₀ and PM_{2.5}),

which can penetrate respiratory and circulatory systems causing health issues; nitrogen oxides and sulphur dioxides; and carbon monoxide, a toxic gas that can be harmful at high concentrations. The intensity of these emissions in tourism road area is further magnified by the region's topography—mountainous terrains, leading to higher local concentrations than might be seen in more open, flat areas. However, it's important to note that the impacts from these emissions are considered moderate and temporary. The impacts will be moderate because localized around the construction sites and do not usually reach levels that might cause wide-reaching health issues. These impacts are also temporary and closely tied to the construction timeline—once the construction phase concludes and the heavy machinery is withdrawn, the emissions quickly decrease as there are no longer any active sources.

715. Road traffic diversion and detour maintenance. During construction projects, particularly in areas at the tourism road area, road traffic diversions and detour maintenance are often required to facilitate ongoing construction activities and ensure worker and public safety. Such diversions reroute traffic away from the usual paths to alternative routes that may not be optimized for heavy or consistent traffic flows. These alternate routes often involve longer travel distances and may include challenging terrain, particularly in hilly or mountainous areas like Tehri Lake. This results in vehicles consuming more fuel and spending more time idling, especially in congested areas or where roads are narrow or less maintained. The increased idling times and longer travel distances directly contribute to elevated emissions of pollutants from vehicle exhausts. Additionally, the altered traffic patterns can disrupt the usual flow, leading to inefficient vehicle operation and increased fuel combustion. These changes can exacerbate air pollution in the local area, affecting not just the natural environment but also the health of residents and visitors who might experience increased exposure to harmful exhaust pollutants. However, the impacts of these diversions are moderate in nature, largely because they are contained within the specific area and duration of the construction project. They do not typically spread widely across the region but are more concentrated around the construction and detour zones. Moreover, these impacts are temporary, linked closely to the construction timeline. Once the construction is completed and normal traffic flow is restored, vehicle emissions quickly revert to their baseline levels.

716. Dust during construction, earth works, or from muck generation. Dust generation is a pervasive issue associated with construction activities, earthworks, and the management of muck/spoil dumps. During construction, activities such as excavation, grading, and the movement of earth materials are common and can significantly disturb the soil. These disturbances lead to the liberation of large quantities of dust particles into the air, which can be compounded by the vehicle movement commonly associated with such sites. The dust generated comprises a mix of particulate matter, including both coarse particles and fine particulates (PM₁₀ and PM_{2.5}), which can travel long distances from the source depending on wind conditions and topography.

717. The severity of dust impacts is generally moderate and confined to the active phases of the construction of the road. This is because the generation of dust is directly linked to specific activities that are temporary. Once these activities are completed, and the ground surfaces are stabilized—often through re-vegetation, paving, or the application of other ground cover—the release of dust particles into the air sharply declines. Additionally, the temporary nature of construction-related dust generation means that it does not contribute to long-term air quality degradation. The environment typically begins to recover post-construction as active dust sources are eliminated and ground surfaces are no longer being disturbed. As the construction sites are rehabilitated and the earth is resettled, the air quality gradually improves, returning to conditions more closely resembling those prior to the start of construction. This cyclical pattern underscores the temporary nature of the dust impact, which, although significant during construction, does not

result in permanent air quality degradation in the tourism road.

718. **Borrow Pits and Haul Road.** Borrow pits and haul roads are integral to road upgradation where materials such as gravel, sand, and soil are extracted and transported for use in construction activities. The operation of borrow pits involves the removal of large volumes of earth material, which significantly disturbs the soil and can lead to extensive dust and sediment generation. The mechanical actions of digging, loading, and unloading materials inherently produce fine particulate matter that can become airborne and contribute to air quality degradation. Haul roads, which are used to transport these materials to and from construction sites, are also major sources of dust emissions. These roads often lack the applicable engineering of public roadways, resulting in less stable surfaces that can easily be eroded by the frequent passage of heavy trucks and machinery. The constant movement, especially in dry conditions, churns up dust and particles from the road surface, which are then dispersed into the air and surrounding environment.

719. The impact of these activities on air quality, while notable, is typically moderate and confined to the construction phase. This moderation is due to the localized nature of the activities—impacts are most intense near the borrow pits and along haul roads but do not generally extend far beyond these areas. Additionally, the impacts are temporary, lasting only as long as the construction activities continue. Once the need for these borrow pits and haul roads diminishes, post-construction efforts can effectively minimize their long-term environmental impact.

720. **Storage of Construction Materials.** The storage of bulk construction materials such as sand, gravel, cement, and aggregate is a common practice on construction sites. These materials, when stored in large open piles, are susceptible to wind erosion, which can lead to the dispersal of dust particles into the surrounding air. The finer particles from these materials, particularly from products like cement and fine sand, can become airborne with even slight disturbances from wind or construction activity. These particles contribute to particulate matter levels in the air, which is a concern for both environmental health and human respiratory health.

721. The impact of dust emissions from the storage of construction materials is moderate, largely because the emissions are confined to the vicinity of the storage sites. This localized effect means that while the immediate area around the material storage sites might experience degraded air quality, regions farther away might not be significantly affected unless carried by strong winds. Additionally, these impacts are temporary and closely tied to the active phases of construction.

722. After construction, the removal of leftover materials plays a crucial role in further diminishing particulate matter levels in the air. Cleaning up the site and ensuring that all materials are either removed or securely stored prevents any residual dust from contributing to air quality issues after the construction has ended. This allows the local environment, particularly in sensitive areas like Tehri Lake, to recuperate and return to its baseline state, minimizing long-term impacts on air quality and supporting ecological recovery.

723. **Air quality impacts in the ropeway subproject.** The construction activities involved in upgrading ropeway system, specifically excavation, grading, and demolition, will affect local air quality. Excavation, which entails digging and moving soil or rock, releases dust and particulate matter. Grading, necessary for creating stable, level bases for infrastructure like station platforms and towers, disturbs large surface areas and generates considerable airborne dust, particularly under windy conditions. Furthermore, demolition activities required to clear existing structures

contribute additional pollutants to the air, including dust from concrete and masonry, and potentially hazardous materials from older constructions. These combined activities lead to a notable temporary increase in air pollution during the construction phase, posing health risks to workers. However, the impact on air quality is considered moderate and temporary because these activities are confined to the specific duration of the construction stage. Once construction ceases, and active disturbance of the soil and structures ends, the emission of particulates and other pollutants significantly decreases.

724. Air quality at the water public transport stations at multiple locations, smart component, last mile connectivity and smart loop. The construction activities are anticipated to impact air quality temporarily during the construction phase. These activities include site preparation and earthworks, such as clearing, excavation, and grading, which can generate dust and particulate matter, thereby degrading local air quality. Additionally, the transportation of materials to and from the site using heavy vehicles can emit pollutants, including particulate matter, nitrogen oxides, and carbon monoxide. The operation of construction machinery further contributes to air pollution with emissions of diesel exhaust. Moreover, the handling and disposal of construction waste can generate dust and particulate emissions if not properly managed. The use of volatile organic compounds (VOCs) from paints, solvents, and adhesives during construction can also release pollutants that contribute to the formation of ground-level ozone.

725. Mitigation measures to address impacts on air quality are the following:

- **Hot Mix Plants Location:** Hot mix plants should be strategically located at least 1.5 km from habitation, schools, hospitals, forests, and rivers, and at least 500 meters from ponds and national highways, or 250 meters from state highways. Securing a NOC from the UKPCB is mandatory. These plants must also be fitted with stacks of adequate height as prescribed by the UKPCB to ensure proper dispersion of exit gases.
- **Construction Materials Storage:** The location and layout plan for storage areas for construction materials should be submitted for approval by the PIUs. These storage areas must be positioned downwind of habitation areas to minimize the impact of dust and pollution on residents.
- **Transport and Handling:** To prevent dust emission, loose and fine materials should be transported, loaded, and unloaded using covered vehicles. Additionally, all loose materials and spoil piles must be covered with tarpaulins or similar materials. Speed limits for construction vehicles should be enforced, and wheel washing stations should be installed at entry and exit points of construction sites to prevent mud and dust from being carried onto public roads.
- **Dust Suppression:** Regular water spraying should be conducted on earthworks, unpaved haulage roads, and other dust-prone areas. Maintaining adequate moisture on any completed earthwork layer until the base course is applied can prevent dust emissions. Frequent cleaning of paved roads and construction site areas is necessary, and air quality monitoring stations should be set up to continuously measure dust levels and adjust mitigation measures as needed.
- **Machinery and Equipment:** Regular maintenance of machinery and equipment is crucial, with mandatory vehicular pollution checks being implemented. Using Liquefied Petroleum Gas (LPG) in construction camps instead of wood can significantly reduce air pollution and deforestation.
- **Personal Protective Equipment (PPE):** To maintain safety and health standards, all workers must be provided with PPE. Regular health checks should be conducted to

monitor and address any respiratory issues arising from exposure to construction-related air pollutants.

- **Community and Traffic Management:** Local communities should be informed about construction activities and the measures being taken to control dust and air pollution. Diversions and detours for road traffic must be maintained in good condition, with proper regulation of traffic. Speed limits and dust control measures on temporary roads should be enforced, and clear signage should be installed to inform drivers.
- **Environmental Monitoring:** Air quality should be monitored as per the environmental monitoring plan. Compliance with siting criteria for pollution control devices must be ensured, and necessary permissions to operate borrow pits should be obtained, adhering to IRC guidelines.
- **Specific Measures:** Specific measures include moistening muck before disposal, compacting spoil piles regularly, and using designated disposal sites away from populated areas and sensitive environments. Reducing idling time for construction vehicles and equipment is also recommended to minimize unnecessary emissions.
- **Regulatory Compliance:** It is essential to obtain CTE and CTO for hot mix plants, crushers, and diesel generators. All construction vehicles and machinery must meet emission standards set by the UKPCB and undergo regular maintenance. Regular air quality monitoring should be conducted during construction to ensure compliance with National Ambient Air Quality Standards NAAQS.

726. **Noise levels.** Increases in noise due to construction activities such as land clearing, site preparation, material/equipment/machinery movement, and the establishment of camps/site offices are expected. The noise exposure will significantly impact the community residing near the work zones, with varying intensity across different receptors. These impacts, though temporary, will occur during the construction period. The machinery involved in construction operations includes dozers, rollers, graders, pavers, tractors, brooms/rotary brushing, tippers, generators, and excavators, producing noise levels in the range of 80-85 dB(A) at a distance of about 5 meters from the source. This noise level, although higher than the permissible limit, will be intermittent and temporary, attenuating quickly with distance. Noise-sensitive receptors, such as religious temples and residents close to the Tourism road component, may be affected.

Table 59. Noise levels 15m from construction equipment

Equipment Category	Lmax Level dB (A)
Excavators	82
Dozers	82
Rollers	85
Pavers	80
JCB	80
Crane	85
Front End Loader	80
Generator	82
Pneumatic Tools	85
Tractor	84
Plant Equipment	85

727. During the construction phase, various activities will contribute to elevated noise levels,

potentially affecting the local environment and the well-being of nearby residents. The primary sources of construction noise include the operation of heavy machinery, material handling, the use of construction equipment, demolition works, and general construction activities. Each of these sources generates noise at different levels and durations, contributing to the overall noise pollution on the construction site. Excavation and earthmoving activities, involving heavy machinery such as bulldozers, excavators, and backhoes, generate high decibel levels necessary for tasks like digging, levelling, and moving large quantities of soil and rocks. Material handling and construction activities, including the operation of concrete mixers, pumps, electric saws, drills, and grinders, produce noise, especially when performed continuously over extended periods.

728. Continuous background noise from generators and air compressors, essential for providing power and operating pneumatic tools, is notable. Foundation work involving pile driving and boring is particularly noisy. Demolition works, if required, will also impact noise levels, especially when breaking concrete, dismantling walls, and removing debris using jackhammers and wrecking balls.

729. To mitigate the impacts of construction-related noise, it is essential to implement effective noise control measures and adopt smart infrastructure solutions. These measures will help minimize disturbance to the local environment and community, ensuring sustainable development during the construction phase.

- Stationary equipment will be placed along uninhabited stretches, as far as practicable, to minimize objectionable noise impacts, following the computed distance requirements.
- Schedule operations to coincide with periods when people are least likely to be affected.
- Provide ear plugs or earmuffs to workers operating near high noise-generating machines.
- Ensure construction equipment and machinery are fitted with silencers and are properly maintained.
- Use properly designed engine enclosures and intake silencers to control noise.
- Conduct noise measurements along all proposed transport infrastructure components to ensure the effectiveness of mitigation measures.
- Ensure vehicles and equipment used conform to the prescribed noise pollution norms.
- Restrict the movements of heavy construction vehicles and equipment near public properties.
- Restrict noisy construction activities to daytime hours (e.g., 9 AM to 6 PM) as per the Noise Pollution (Regulation and Control) Rules, 2000. Avoid night-time operations unless necessary and after obtaining permission from local authorities.
- Plan activities in consultation with PIU/PMDSC so that activities with the greatest potential to generate noise are conducted during periods of the day which will result in least disturbance.
- Provide advance notice to the local community about construction schedules and potential high-noise activities.
- Minimize noise from construction equipment by using vehicle silencers and fitting jackhammers with noise-reducing mufflers.
- Follow manufacturer's guidelines and UKPCB standards for equipment maintenance to operate efficiently and produce minimal noise.
- If specific noise complaints are received during construction, the contractor may be required to implement additional noise mitigation measures as directed by the project manager.
- Shut off idling equipment.

- Maintain records of noise monitoring results and make them available for inspection by regulatory authorities.
- Provide workers with PPE such as earplugs, noise-cancelling earmuffs, and other hearing protection devices, ensuring correct and consistent use.

730. **Vibration impacts.** The construction of the Tourism Road from Koti Colony to Dobra Chanti and the 1 km approach road as part of water public transport stations at multiple locations involves significant use of heavy machinery and construction activities that generate ground vibrations. Managing these vibrations is essential to prevent structural damage, minimize disturbance to local residents, and protect the environment. The extensive hill cutting and road expansion required for this project are likely to result in significant vibration impacts. In hilly areas, vibrations can contribute to slope instability, posing a serious risk to both the construction process and the long-term stability of the area. High levels of vibration can cause soil erosion and slope movements, especially when heavy machinery like excavators, dozers, and rollers are in use. The specific impacts will vary with the distance from the vibration source, with closer areas experiencing more severe effects. The primary sources of vibration during the construction phase include heavy machinery such as excavators, dozers, rollers, cranes, and pneumatic tools. Each of these pieces of equipment generates ground vibrations through their operations.

- **Excavators:** Used extensively for digging and earthmoving, especially during hill cutting. They generate vibrations through their hydraulic systems and the movement of their tracks or wheels on uneven surfaces. These vibrations are particularly significant when the excavators are used in rocky or hard soil conditions.
- **Dozers:** Generate vibrations through their powerful engines and tracks. Used for pushing large quantities of soil, sand, rubble, or other material during construction, including during hill cutting and road expansion. The continuous movement and heavy weight of dozers make them significant sources of ground vibrations.
- **Rollers:** Used to compact soil, asphalt, and other materials. They operate by vibrating a heavy drum, which densifies the material underneath. The intensity of the vibrations depends on the weight of the roller and the frequency and amplitude of the vibrations.
- **Cranes:** Particularly those used for lifting heavy materials, generate vibrations through their engines and the movement of their loads. Mobile cranes, which move on wheels or tracks, can also cause vibrations when traveling across construction sites.
- **Pneumatic Tools:** Tools such as jackhammers and pavement breakers generate high-frequency vibrations. These tools are used for breaking up concrete, asphalt, and rock, which is particularly relevant during hill cutting operations and can produce significant localized vibrations.
- **Heavy Trucks and Equipment Transport:** The movement of heavy trucks and equipment over uneven or unpaved surfaces generates vibrations. The impact is particularly significant in areas with poor road conditions, and along the hilly areas where road expansion is being carried out.

731. Vibration levels are commonly measured using Peak Particle Velocity (PPV), expressed in millimeters per second (mm/s). PPV measures the maximum speed at which particles in the ground move due to vibratory activity. The formula used to calculate PPV is:

$$PPV = k \times (D/W)^n$$

732. Where k is the site constant, W is the weight of the equipment, D is the distance from the source, and n is an exponent that depends on soil type. For example, a vibratory roller with a

weight of 10,000 kg operating at 10 meters from the measurement point generates a PPV of approximately 1,995.26 mm/s. Similarly, an excavator weighing 25,000 kg generates a PPV of around 5,590.17 mm/s under the same conditions.

Table 60. Matrix of Vibration Sources at 10-meter distance

Equipment	Weight (kg)	PPV (mm/s)	Primary Vibration Source
Excavator	25,000	26,101.56	Hydraulic systems, movement on surfaces
Dozer	20,000	10,471.12	Engine power, track movement
Roller	10,000	6,309.57	Vibrating drum for compaction
Crane	35,000	37,287.66	Engine and load movement
Pneumatic Tools	N/A	High-frequency localized vibrations	Breaking concrete, asphalt, rock
Heavy Trucks	30,000	15,848.93	Movement over uneven surfaces

733. The total vibration impact at a given location is the combined effect of all active equipment, calculated by summing the squared PPV values of each piece of equipment and taking the square root of the result. For example, if a roller, excavator, and dozer are operating simultaneously, their combined PPV can be calculated to be approximately 7,038.86 mm/s. This aggregate value provides a comprehensive measure of the vibration impact during construction.

734. Vibration impacts in ropeway. The construction phase of the ropeway project is expected to generate some level of vibration due to the use of heavy machinery and equipment. However, the impact of these vibrations is a minor issue because of the absence of settlements and sensitive sites near the construction area.

735. The primary sources of vibration during construction include activities such as drilling, piling, and the operation of heavy machinery like excavators and bulldozers. These activities can cause ground vibrations, which typically dissipate quickly with distance. In urban or densely populated areas, such vibrations could potentially affect nearby buildings, infrastructure, and residents. However, in the case of this ropeway project, the construction sites are located away from residential areas and sensitive receptors, such as hospitals, schools, and historical buildings.

736. The absence of nearby settlements means that there are no residential structures at risk of experiencing damage or disturbance from construction vibrations. This significantly reduces the potential for complaints and issues related to structural integrity or the comfort of residents. Additionally, the lack of sensitive sites, such as archaeological or heritage sites, further minimizes the risk of adverse effects from vibrations.

737. Given these factors, the vibrations generated during the construction of the ropeway are not expected to have significant negative impacts. Nonetheless, standard construction practices will still be employed to monitor and manage vibrations to ensure they remain within acceptable limits. This includes maintaining equipment in good condition to minimize excessive vibration and conducting regular monitoring to ensure compliance with vibration standards. By adhering to these practices, any potential minor issues related to vibration can be effectively mitigated, ensuring that the construction process proceeds smoothly without causing undue harm to the surrounding environment.

738. To mitigate the impacts of construction-related vibrations, it is essential to implement effective vibration control measures and adopt smart infrastructure solutions. These measures will help minimize disturbances to the local environment and community, ensuring sustainable development during the construction phase.

- No blasting should be done to widen road works.
- Conduct pre-construction surveys to assess the condition of buildings, infrastructure, and historical sites to identify vulnerabilities.
- Perform detailed slope stability analyses to identify areas at risk of landslides and other forms of slope failure.
- Install vibration monitoring systems to continuously measure vibration levels during construction activities.
- Establish threshold limits for vibration levels based on the sensitivity of nearby structures and natural features.
- Construct retaining walls and other protective structures to stabilize slopes and prevent landslides.
- Use shock absorption barriers or mats to reduce the transmission of vibration to sensitive areas.
- Schedule high-vibration activities during times when they will have the least impact on residents and wildlife, such as during daylight hours and outside of breeding seasons.
- Inform local communities about construction activities and potential vibration impacts and provide channels for feedback and complaints.
- Reinforce vulnerable structures, such as buildings and utility lines, to withstand vibration impacts.
- Conduct regular inspections of infrastructure during construction to identify and address any emerging issues promptly.

739. **Impact on Land and Soil - Soil Tourism Road and approach road for water public transport stations.** Soil erosion is a primary concern, particularly in hilly areas, as vegetation removal and construction activities expose the soil to wind and water erosion due to hill cutting and road widening. Heavy machinery can compact the soil, reducing its permeability and fertility, which negatively affects plant growth and water infiltration. Additionally, construction can introduce contaminants such as fuel and oil spills into the soil, leading to chemical alterations and potential health risks. Changes in the natural soil structure and drainage patterns due to excavation and grading can disrupt moisture retention and increase surface runoff, contributing to sedimentation in nearby water drainage. These activities also impact soil biodiversity by disturbing habitats and altering soil conditions, thus affecting the ecosystem services provided by the soil.

740. Soil erosion may take place near cutting areas, at steep and un-compacted embankment slope, at bridge locations and wherever vegetation is cleared. Soil erosion may have cumulative effects like siltation embankment damage, drainage problems etc. Loss of soil due to runoff from earth stock piles may also lead to siltation.

741. Extraction of the soil from borrow areas and boulders aggregates/ granular sub-base from the riverbeds can result in some direct and indirect impacts on the local and regional environment. Impacts may be positive or negative and vary from case to case. Borrow areas may cause some adverse impacts if left un-rehabilitated. It may cause people, particularly children and animals of accidentally falling into it as well as become potential breeding ground for mosquitoes and vector-borne diseases. Illegal quarrying may lead to unstable soil conditions, destroy the landscape of

the terrain, and air and noise pollution.

742. Soil of the haulage roads and construction camp area may be compacted due to the movement of construction vehicles, machinery and equipment, and due to the siting of construction camps and workshops. Soil may get contaminated due to inappropriate disposal of liquid waste, (lubricating oil and fuel spills, waste oil and lubricant and vehicle/equipment washing effluent) and solid waste (fuel filters, oily rags) likely to be generated from repair and maintenance of transport vehicles, construction equipment and machinery. Soil may also get contaminated due to inappropriate disposal of domestic solid waste and sewage from construction camps. Sub-soil contamination may also be attributed to scarified bitumen wastes, operation of the emulsion sprayer and laying of hot mix, storage and stockyards of bitumen and emulsion, and excess production of hot mix and rejected materials.

743. **Soil Ropeway.** Excavation and earthmoving activities for site preparation are among the primary construction practices that impact soil. These activities disturb the soil structure, leading to its loosening and increased susceptibility to erosion. The removal of topsoil, an essential layer for nutrient-rich plant growth, during construction can significantly degrade soil quality and reduce its fertility, thereby affecting local vegetation. Additionally, the use of heavy machinery for constructing foundations and other structures can lead to soil compaction, which reduces soil porosity. Trenching and digging for laying foundations, utilities, and other infrastructure disturb the soil profile, potentially leading to increased erosion. Moreover, the handling and storage of construction materials such as cement, chemicals, and fuels can result in soil contamination if spills and leaks occur. Improper containment of these materials can lead to the contamination of the soil with hazardous substances. Stockpiling construction materials on-site without proper containment can also lead to soil compaction and contamination, especially when these materials are exposed to the elements. The generation and improper disposal of construction debris can alter the chemical composition of the soil, leading to contamination. Temporary sanitation facilities for workers, if not properly managed, can result in the leaching of contaminants into the soil. Road construction and the installation of utility lines involve significant soil disruption through grading, levelling, paving, digging, and trenching, which can lead to further soil erosion and degradation if not properly managed.

744. **Soil Smart loop and last mile connectivity.** Regarding the construction of bus shelters and their impact on soil at the proposed sites, several key considerations must be taken into account to ensure minimal impact. Site preparation, which includes clearing and levelling the ground, can disturb the soil structure, leading to erosion and compaction. The foundation construction for bus shelters, involving digging and concrete pouring, can further disrupt the soil and potentially lead to contamination if not managed properly. Additionally, the installation of utilities such as electricity for lighting and digital displays requires digging and trenching, which can cause further soil disturbance and erosion. The construction process can also generate waste materials, including debris and potentially hazardous substances, which can contaminate the soil if not properly disposed of. Moreover, the use of heavy machinery during the construction of bus shelters can compact the soil, reducing its permeability and ability to support vegetation, while also increasing surface runoff and erosion.

745. To mitigate the impacts of construction-related activities on soil, it is essential to implement effective soil protection measures and adopt smart infrastructure solutions. These measures will help minimize disturbances to the local environment and community.

- Provide an impervious platform and oil and grease traps for collecting spillages from the maintenance of construction equipment and vehicles.

- Collect oil and lubricant drips in containers during the repair of construction equipment and vehicles.
- Provide an impervious platform and collection tank for managing spillages of liquid fuels and lubricants in storage areas.
- Segregate construction waste into categories such as recyclable, non-recyclable, and hazardous waste to facilitate proper disposal and recycling.
- Ensure regular collection and proper disposal of construction waste to prevent accumulation and potential pollution.
- Dispose of hazardous waste through authorized disposal facilities following environmental regulations.
- Store construction materials such as cement, sand, and gravel in covered areas to prevent contamination and runoff.
- Train workers on proper handling procedures for hazardous materials to minimize the risk of spills and leaks. Develop and implement spill response plans to address accidental releases of hazardous materials. Conduct regular emergency drills to ensure workers are prepared to respond effectively to spills and other pollution incidents.
- The contractor shall identify muck disposal sites. All arrangements for transportation during construction, including provision, maintenance, dismantling, and clearing debris, will be planned and implemented by the contractor.
- The existing bitumen surface can be utilized for paving crossroads, access roads, and paving works in construction sites and camps, temporary traffic diversions, and haulage routes.
- Debris generated from pile driving or other construction activities shall be disposed of in a manner that prevents it from flowing into surface water bodies or forming mud puddles in the area.
- These considerations will be made during the selection of soil disposal sites: (i) sites must be at least 1.5 km from habitation and forest areas and 500 meters from ponds, (ii) dumping sites should not contaminate any water sources, rivers, etc., and (iii) consent from the village council must be obtained before finalizing the location.
- Save topsoil removed during excavation and use to reclaim disturbed areas as soon as possible.
- Use dust abatement such as water spraying to minimize windblown erosion.
- Provide temporary stabilization of disturbed/excavated areas that are not actively under construction.
- Apply erosion controls (e.g., silt traps) along the drainage leading to the water bodies.
- Conduct routine site inspections to assess the effectiveness and maintenance requirements for erosion and sediment control systems.
- After construction, all temporary structures and debris must be removed, and the site should be restored to a near-natural or stable condition to prevent long-term soil degradation.

746. Loss of Productive Soil and Change in Land use: Loss of topsoil is envisaged during the construction stage if the construction plant, offices, workers camps, stockyards, and borrow areas are located in fertile areas. Change in land use is insignificant since widening and improvement is mostly within the available right of way except due to cutting of hill side which are inevitable. Mitigation measures to address impacts are:

- The topsoil will be stripped to a maximum of 1.5m depth and stored in stockpiles. At least 10% of the temporarily acquired area will be earmarked for storing topsoil.

- The stockpile will be designed such that the slope does not exceed 1:2 (vertical to horizontal), and the height of the pile will be restricted to 2m.
- Stockpiles will not be surcharged or otherwise loaded and multiple handling will be kept to a minimum and stockpile will be covered with gunny bags or tarpaulin.
- It will be ensured that the topsoil will not be trafficked either before stripping or when in stockpiles.
- To prevent any compaction of soil in the adjoining productive lands, the movement of construction vehicles, machinery and equipment will be restricted to project corridor as far as possible.
- The stored topsoil will be utilized for covering all disturbed areas including for the redevelopment of borrow areas after filling and dressing of the slopes of road embankment.

747. **Soil Erosion.** Soil erosion during construction is primarily driven by the removal of vegetation and extensive disturbance of land. These activities expose the soil, making it highly susceptible to being washed away by rainfall or carried off by wind. When this eroded soil enters nearby lakes, it increases the sediment load in these water bodies. Despite the effects, the impacts of soil erosion are generally considered to be at moderate levels. These impacts are largely confined to the active phases of the construction project. Once the construction is completed, efforts can be made to stabilize the soil and replant vegetation, significantly reducing the rate of erosion. Mitigation measures to address impacts due to soil erosion.

- Bank protection measures will be taken at erosion-prone areas.
- Provision of side drain to guide the water to natural outfalls.
- Retaining walls and breast walls have been included in the design.
- Covering the slope surface with grass and bushes, by simple planting of roots and saplings.
- In conditions where simple planting and seeding is not effective, the slopes covered with open mesh of natural fibres such as coir or jute, or of geo-synthetics, followed by planting of grass and bushes. This is often termed slope reinforcement method of vegetation; and, where slopes are of highly erodible materials or other adverse conditions prevail, the slope surface is covered with protective surfacing. Stone or brick pitching is most used in India for this purpose.
- Side slopes of the embankment will not be steeper than 2H: 1V. Turfing of embankment slopes will be done along the stretch.
- IRC: 56 -1974 recommended practice for the treatment of embankment slopes for erosion control will be taken into consideration.

748. **Borrow Areas and Quarries:** Extraction of the soil from borrow areas and boulders aggregates/granular sub-base from the riverbeds can result in some direct and indirect impacts on the local and regional environment. Impacts may be positive or negative and vary from case to case. Borrow areas may cause some impacts if left un-rehabilitated. It may cause accidents as well as become potential breeding ground for mosquitoes and vector-borne diseases. Illegal quarrying may lead to unstable soil conditions, destroy the landscape of the terrain, and air and noise pollution. Mitigation measures are:

- Borrow areas will not be located near habitation. The edges of borrow sites will be no closer than 3 metres from any fence line or boundary.
- Adequate clearance will be provided for the construction of catch drains. Borrow sites will have adequate drainage outlets unless the relevant landowner has agreed that the borrow

area is to create a permanent tank or dam. Written clearance from the landowner/village head will be obtained before leaving a site

- Obtain necessary permissions for opening of any new borrow area and renewal of quarries.
- Borrow pits will be selected from barren land/wasteland to the extent possible.
- The topsoil will be preserved, and depth will be restricted to 1.5 m to comply IRC guidelines.
- Borrow areas should be excavated as per the intended end use by the owner. The Indian Road Congress (IRC):10-1961 guideline should be used for the selection of borrow pits and the amount that can be borrowed.
- The depths in borrow pits to be regulated as per IRC guidelines. Borrow areas will be levelled with salvaged material or other filling materials which do not pose contamination of soil.
- Transportation of fine aggregates and earth material by covered trucks.
- Sprinkling of water near loading/downloading and stockpile locations.
- The contractors will prepare site-specific redevelopment plans for each borrow area, which will be implemented after the approval of the Supervision Consultant.

749. Compaction and Contamination of Soil. Soil of the haulage roads and construction camp area may be compacted due to the movement of construction vehicles, machinery and equipment, and due to the siting of construction camps and workshops. Soil may get contaminated due to inappropriate disposal of liquid waste, (lubricating oil and fuel spills, waste oil and lubricant and vehicle/equipment washing effluent) and solid waste (fuel filters, oily rags) likely to be generated from repair and maintenance of transport vehicles, construction equipment and machinery. Soil may also get contaminated due to inappropriate disposal of domestic solid waste and sewage from construction camps. Sub-soil contamination may also be attributed to scarified bitumen wastes, operation of the emulsion sprayer and laying of hot mix, storage and stockyards of bitumen and emulsion, and excess production of hot mix and rejected materials. To mitigate such impacts, the following will be applied:

- Fuel and lubricants will be stored at the pre-defined storage location. The storage area will be paved with a gentle slope to a corner and connected with a chamber to collect any spills of the oils.
- Unavoidable waste will be stored at the designated place prior to disposal. To avoid soil contamination at the wash-down and re-fuelling areas, "oil interceptors" will be provided. Oil and grease spill and oil-soaked materials are to be collected and stored in labelled containers and sold off to UKPCB/ MoEFCC authorized refiners.
- Movement of construction vehicles, machinery and equipment will be restricted to the designated haulage route.
- Approach roads will be designed along the barren and hard soil area to reduce the compaction-induced impact on soil.
- The productive land will be reclaimed after construction activity.
- Septic tank/mobile toilets fitted with anaerobic treatment will be provided at camp.
- Domestic waste at the construction camp will be segregated into biodegradable and non-biodegradable waste. Non-biodegradable waste will be given or sold to relevant agents for recycling or buried in nearby waste disposal sites following environmentally friendly practices.

750. Surface Water Quality:

751. Impact of tourism road on water quality. The construction of bridges and culverts is essential for managing water flow across a road network, but it can affect water quality through activities like excavation for foundations and handling of construction materials such as concrete, metals, and lubricants, which increase sediment in water and can disrupt riverbeds. Accidental spills during these activities can also introduce toxins directly into water bodies, altering flow patterns and potentially leading to downstream erosion and sedimentation. Additionally, cutting into hillsides to widen roads often destabilizes soil, leading to increased sedimentation in nearby streams and rivers as soil is washed away due to inadequate vegetation, which in turn increases turbidity. Moreover, general earthwork activities such as grading and excavation contribute to dust and soil dispersion, which, if not properly contained, leads to sedimentation in water bodies. Marginal spillage of construction materials like asphalt, concrete, paints, and solvents introduces additional pollutants that can degrade water quality.

752. Construction vehicles, essential for transporting materials and aiding in construction tasks, can have detrimental effects on water quality. Automotive fluids such as oils, fuels, and hydraulic fluids are common pollutants associated with construction vehicles. Leaks and spills from these vehicles can lead to the direct introduction of these toxic substances into nearby surface waters. Once in the water, these pollutants can be harmful to aquatic life, potentially leading to reduced oxygen levels in the water and poisoning species that are sensitive to changes in their habitat.

753. Despite these potential impacts, the level of pollution from construction vehicles is generally moderate and considered temporary. This moderation is because construction projects are finite, and the use of such vehicles ceases once the project is completed. The temporary nature of the pollution means that while there may be an immediate impact on water quality, these effects can be reversed over time through natural processes and remediation efforts. Sediment can settle, and with appropriate remedial measures, such as the installation of silt fences and sediment basins, the clarity and quality of the water can be restored. Additionally, best management practices like regular maintenance of vehicles to prevent leaks and the use of containment strategies during refueling can significantly mitigate these impacts during the construction phase, preserving the health of surface water ecosystems.

754. Construction and workers' camps are temporary setups that provide essential facilities for workers during the duration of construction projects. However, these camps can impact local water quality if not managed properly. The main issues arise from the disposal of domestic waste and wastewater, which if not adequately treated, can lead to the direct discharge of sewage and grey water into nearby water bodies. This discharge introduces various contaminants including nutrients (such as nitrogen and phosphorus), pathogens, and organic matter into the water. Despite these potential impacts, the effects of construction and workers' camps on water quality are generally moderate and temporary. This moderation is due to the fact that these camps are inherently temporary installations—once the construction project is completed, the camps are dismantled, and the direct sources of pollution are removed.

755. Impact of ropeway water quality. The construction of a ropeway system can impact nearby lake through runoff that carries various pollutants, including sediments, oils, chemicals, and other hazardous substances. This runoff primarily occurs when rainwater or other water sources flow over areas disturbed by construction activities, picking up and transporting pollutants into surface water systems. Sediments are one of the most significant pollutants associated with ropeway construction due to extensive earth-moving and excavation activities required for installations such as support towers and station platforms. Oils and fuels leakage from the heavy machinery used in construction are another concern, as they can create films on water surfaces. Despite the potential impacts, the overall impact on water quality from ropeway construction is

generally moderate and temporary. This is because the contamination is closely linked to the active phases of construction. Once the construction is completed, the primary sources of pollution—such as soil disturbance and heavy machinery operation—are significantly reduced.

756. Impact of water public transport stations on water quality. The construction of approach roads as part of the development of water public transport stations can impact nearby lake through runoff that carries various pollutants, including sediments, oils, chemicals, and other hazardous substances. Sediments are one of the most significant pollutants associated with construction due to earth-moving and excavation activities required for the construction of approach roads and installations of floating jetties such as oils and fuel leakage from the heavy machinery used in the construction of approach roads are another concern, as they can create films on water surfaces. Accidental spills during the construction phase can also introduce toxins directly into water bodies, altering flow patterns and potentially leading to downstream erosion and sedimentation. Despite the potential impacts, the overall impact on water quality from this project component is generally moderate and temporary. After the completion of the construction, the primary sources of pollution—such as soil disturbance and heavy machinery operation—are significantly reduced.

757. Extraction of sand from the riverbed may increase turbidity and affect the propagation of fishes and other aquatic life, mainly benthic organisms. The macro-benthic life which remains attached to the riverbed material may get dislodged and carried away downstream by turbulent flow. Mining and dredging activities, poorly planned stockpiling and uncontrolled dumping of overburden, and chemical/fuel spills from equipment and machinery involved in dredging may cause deterioration of water quality for downstream users and poisoning of aquatic life. The extraction of river bed material is regulated by different authorities like State Environmental Impact Assessment Authority, State Pollution Control Board and State Mining Department with an objective of to conserve top soil, avoid impact on aquatic biodiversity, hydrological regime etc. by haphazard and unscientific mining of minor minerals. The project will utilize riverbed materials from existing licensed quarries with all stipulated conditions of above-mentioned authorities.

758. To effectively mitigate the impacts of construction on water quality, a set of measures has been developed. The following mitigation strategies aim to minimize disruptions and ensure protection of water resources throughout the construction phase.

759. Water Flow Management. Effective water flow management is crucial during construction to prevent erosion and protect water bodies from sedimentation. This involves constructing and maintaining diversion channels, sedimentation basins, and dikes to temporarily channelize water flow from streams and rivers. These structures help control the movement of water, reducing the risk of flooding and sediment deposition in nearby water bodies. Additionally, diversion channels or berms can be used to redirect runoff away from disturbed areas into sediment control structures, further mitigating erosion risks. Temporary side drains, catch water banks, and sedimentation basins are necessary to manage water flow during construction, ensuring minimal environmental disruption.

760. Erosion and Sediment Control. To combat soil erosion and sedimentation, it is essential to install silt fences around construction sites to trap sediments and prevent them from entering water bodies. Erosion control blankets or mats should be used on slopes and disturbed areas to stabilize the soil and prevent erosion. Check dams in ditches or swales slow down water flow and capture sediments, while gravel or rock entrances at site access points reduce sediment tracking onto public roads. Limiting the area of soil disturbance to the minimum necessary for construction activities and implementing phased construction can significantly reduce the amount of exposed

soil at any given time. Regular inspections and maintenance of erosion and sediment control structures ensure they function properly, maintaining environmental integrity.

761. **Hazardous Materials and Spill Prevention.** Managing hazardous materials and preventing spills is critical in construction projects. Containment measures for fuels, oils, and other hazardous materials must be implemented to prevent spills. These materials should be stored in secure, well-labeled containers within designated areas with secondary containment measures. Refueling vehicles in designated areas equipped with spill containment measures further prevents accidental spills. All construction sites and vehicles should be equipped with spill kits containing absorbent materials, containment booms, and other tools to quickly address spills. Using drip trays under parked vehicles and during maintenance activities to catch any leaks and ensuring immediate clean-up of spills with appropriate materials and methods prevent contaminants from reaching water bodies.

762. **Earthwork and Material Storage.** Proper handling and storage of earthwork and construction materials are vital to preventing environmental contamination. Construction materials and excavated soil should be stored above high flood levels to avoid contamination during flooding events. Secure storage of construction materials prevents them from being washed into water bodies. Site clearing and grubbing should be planned to avoid leaving cleared sites exposed for long durations. Conducting earthwork in stages minimizes the amount of exposed soil at any given time, while scheduling major earthwork activities during dry weather conditions reduces the risk of erosion and sedimentation.

763. **Vehicle and Equipment Maintenance.** Regular maintenance of construction vehicles and equipment is essential to prevent leaks and spills. Conducting regular inspections ensures that vehicles are in good working condition and free from leaks. A preventive maintenance schedule should be implemented to replace worn-out parts and address potential issues before they result in leaks or spills. Proper disposal of vehicle-related waste materials, such as used oil filters and worn-out parts, should be done at designated facilities. Training all personnel on best practices for spill prevention, response, and proper waste disposal further enhances environmental management and safety on-site.

764. **Waste Management.** Effective waste management practices are necessary to minimize environmental impact. Proper waste collection and disposal facilities should be provided at camp sites, ensuring they are maintained at 500 meters from habitation and water bodies. Implementing waste segregation practices to separate recyclables, non-recyclables, and hazardous waste ensures proper disposal. Regular collection and disposal of solid waste through authorized disposal facilities help maintain cleanliness and prevent pollution. Recycling waste materials whenever possible reduces environmental impact, and proper disposal of construction waste and debris prevents contamination of runoff.

765. **Sanitation and Worker Facilities.** Maintaining adequate sanitation and worker facilities is critical to preventing environmental contamination. Installing well-maintained sanitation facilities, such as septic tanks and bio-digester toilets, prevents sewage contamination. Regular inspections and maintenance of sanitation systems prevent overflows and leaks, while portable or on-site wastewater treatment systems treat sewage before discharge. Training workers on proper handling and disposal of chemicals and fuels ensures they follow best practices, reducing the risk of spills and leaks.

766. **Monitoring and Inspection.** Ongoing monitoring and inspection are essential to ensure the effectiveness of mitigation measures. Regularly monitoring water quality parameters such as

turbidity and suspended solids helps assess the effectiveness of implemented measures. A water quality monitoring program should be implemented to regularly evaluate the effectiveness of mitigation measures and make necessary adjustments. Conducting regular inspections of erosion and sediment control measures ensures they are functioning effectively, with maintenance and repairs carried out as needed to prevent failure and ensure continued protection of the environment.

767. **Drainage.** Seven streams/nallahs drains pass through the proposed tourism road. Although most of them are seasonal in nature water logging/flood situations may arise due to the construction of road embankment which may act as an impediment to flow of water to its outfall in the absence of adequate cross drainage/side drain. Water logging along the road will also have ill effects on the stability of the embankment. Diversion of water channels during construction of cross drainage structures or otherwise is not envisaged. Substructure construction should be limited to the dry season and cofferdams may be constructed and utilized to lift the spoil directly out of it and carried to the riverbank for land disposal. The following mitigation measures will be useful to alleviate impacts on natural drainage along the tourism road.

- Adequate cross-drainage structures have been provided to avoid impediments to the natural flow of water. The embankment height has been designed to be consistent with the existing topography of the region.
- Construction works near waterways/water bodies will not be undertaken during the monsoon season
- Retaining walls, breast walls and gabion walls have been proposed to prevent erosion
- Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies.
- Effective drainage system will be provided to drain the storm water from the roadway and embankment and to ensure minimum disturbance to natural drainage of surface and subsurface water of the area.
- Surface runoff from the main highway, embankment slopes and the service roads will be discharged through longitudinal drains, designed for adequate section, bed slopes, invert levels and the outfalls. If necessary, the walls of the drains will be designed to retain the adjoining earth.

768. **Impact due to Construction Debris/Waste:** In the context of road upgradation, significant debris can be generated from the dismantling of pavement and the demolition of existing culverts and structures. Although such activities are typically confined to specific sections of the road, often only a few kilometers long, the volume of debris can be substantial. This debris includes materials such as asphalt, concrete, and reinforcing steel, which require appropriate management to minimize environmental impact. Quarry dust, resulting from the cutting and crushing of stone materials used in road construction, constitutes a significant portion of the waste generated. Unused iron bars and damaged support structures are also common types of waste found during road upgradation projects. If not properly managed, these materials can clutter the construction site and pose safety hazards. They also represent a waste of resources if not recycled or repurposed.

769. Construction activities generate a substantial amount of waste, which can have significant environmental impacts. One of the primary sources of environmental impact is construction debris and rubble, which includes materials such as concrete, bricks, wood, and metal. These materials are often produced during demolition, site preparation, and building activities. Excavated soil and

rock are also significant sources of construction waste. Excavation activities generate large quantities of these materials, and uncontrolled disposal of excavated soil can lead to erosion and sedimentation in nearby water bodies. Furthermore, loose soil can become airborne, contributing to dust pollution, which poses respiratory health risks for nearby residents and workers.

770. Organic waste from construction sites includes wood scraps, vegetation, and food waste from worker camps. The decomposition of organic waste in landfills produces methane, a potent greenhouse gas that contributes significantly to climate change. Additionally, accumulated organic waste can attract pests such as rodents and insects, leading to health and sanitation issues at construction sites and surrounding areas.

771. To address these challenges, effective waste management practices are essential. Recycling and reusing materials such as concrete, asphalt, and metals can significantly reduce waste volumes and conserve resources. Dust control measures, proper disposal of hazardous waste, and the segregation of different types of waste can mitigate the environmental impacts of construction activities. Implementing comprehensive waste management plans and educating construction workers on sustainable practices are crucial steps in minimizing the environmental footprint of road upgradation projects.

- The existing bitumen surface can be utilized for paving of crossroads, access roads, and paving works in construction sites and camps, temporary traffic diversions, haulage routes etc.
- All excavated materials from roadway, shoulders, verges, drains, and cross drainage, and will be used for backfilling embankments, filling pits, and landscaping.
- Unusable debris material should be suitably disposed of at pre-designated disposal locations to the satisfaction of PMDSC. The bituminous wastes will be disposed of in secure landfill sites only in an environmentally accepted manner.
- Unusable and surplus materials, as determined by the Project Engineer, will be removed and disposed of off-site.
- Recycle demolished concrete and asphalt for use as base material in new road construction. This reduces the need for new raw materials and minimizes waste.
- Collect and recycle unused iron bars and damaged support structures. Recycling metal conserves resources and reduces the demand for new metal production.
- Salvage usable wood and bricks for other construction projects or community uses.
- Regularly spray water on dust-prone areas, such as excavation sites and construction debris piles, to suppress dust generation.
- Implement a waste segregation system at construction sites to separate recyclable materials from general waste and hazardous waste.
- Store, handle, and dispose of hazardous materials according to local regulations to prevent soil and water contamination.
- Use designated disposal sites for construction debris to prevent illegal dumping and environmental degradation.
- Implement erosion control measures such as silt fences, sediment traps, and retaining walls to prevent soil erosion and sedimentation in nearby water bodies.
- Set up composting facilities at construction camps to manage organic waste such as food scraps and vegetation. Composting reduces waste sent to landfills and produces useful soil amendments.
- Implement pest control measures to manage rodents and insects attracted to accumulated organic waste.

- Treat construction wastewater to remove pollutants before discharge into local water bodies. This includes using sedimentation tanks, oil-water separators, and filtration systems.
- Ensure proper sanitation facilities at construction camps to prevent contamination of soil and water.
- Conduct regular inspections of construction sites to ensure compliance with environmental regulations and waste management practices.
- Provide training programs for construction workers on proper waste management practices, dust control techniques, and environmental protection measures.
- Place clear signage and instructions around the construction site to guide workers on waste segregation and disposal procedures.

772. Construction waste generation comes from various sources during different phases of ropeway subproject and the development of the water public transport stations subproject, starting with demolition and site clearance. For the ropeway subproject initial phase involves dismantling existing structures to make way for new construction, resulting in substantial amounts of debris while as the site clearance will be carried out for the water public transport stations subproject. During the construction and fabrication phase, a significant amount of waste is generated from off-cuts, packaging materials, and surplus materials like concrete, metal scraps, and wood. Temporary formwork and scaffolding, which are typically discarded after use, further add to the waste stream. Moreover, the use of hazardous materials such as solvents, adhesives, paints, and chemicals during construction poses a substantial risk. Improper disposal of containers and residues can contaminate soil and water, presenting health hazards to workers and nearby residents. The handling and storage of construction materials on-site, as well as the use of construction equipment and machinery, also contribute to waste generation. Improper storage conditions can render materials unusable, while spills of fuels and lubricants can contaminate soil and water. Maintenance activities for machinery produce waste materials like oils, filters, and tires that require proper disposal. Worker activities and temporary facilities generate additional waste, including food waste, packaging, and sanitary waste. Effective waste segregation, recycling, and disposal systems are necessary to manage this type of waste and reduce its environmental footprint. Other actions to mitigate impacts of waste generation in ropeway are as follows:

- Prepare and implement a waste management.
- Manage solid waste according to the following hierarchy: reuse, recycling, and disposal.
- Implement on-site segregation of construction and demolition waste into categories such as recyclables (metal, wood, glass, etc.), hazardous waste, and general waste. This facilitates proper disposal and recycling.
- Use color-coded bins for different types of waste to ensure proper segregation at the source.
- Establish recycling programs for materials such as concrete, metal, wood, and glass. Partner with local recycling facilities to ensure that these materials are processed and reused effectively.
- Follow guidelines for the safe handling, storage, and disposal of hazardous materials, such as asbestos, lead, and chemicals. Ensure that these materials are separated from non-hazardous waste.
- Dispose of hazardous waste at authorized hazardous waste treatment, storage, and disposal facilities (TSDFs) as per the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.
- Follow local municipal guidelines and obtain necessary permissions for waste disposal. Ensure compliance with the Solid Waste Management Rules, 2016.

- Provide appropriate PPE to workers handling waste to protect them from exposure to hazardous materials. This includes gloves, masks, and protective clothing.
- Conduct training programs for workers on proper waste management practices, including handling hazardous materials and emergency response procedures.
- Establish a feedback mechanism for the community to report concerns related to waste management. Address these concerns promptly to maintain good community relations.
- Avoid stockpiling and remove immediately all excavated soils, excess construction materials, and solid waste (removed concrete, wood, trees and plants, packaging materials, empty containers, oils, lubricants, and other similar items).
- Prohibit disposal of any material or wastes (including human waste) into drainage, nallah, or watercourse.

773. The smart component and smart loop subproject's construction phase is expected to generate various types of waste. The primary sources of waste generation during construction include construction debris, excess materials, packaging waste, and hazardous substances. Construction debris, such as concrete, wood, metal, and asphalt, is produced during site preparation, demolition, and construction activities. If not appropriately handled, this debris can accumulate on-site, creating unsightly conditions and potential safety hazards. Additionally, improper disposal can lead to soil and water contamination, affecting local ecosystems. Excess materials, including unused construction materials like cement, bricks, and tiles, contribute to waste generation. These materials, if not reused or recycled, end up in landfills, increasing the burden on waste management systems. Packaging waste, such as plastic, cardboard, and foam, is generated from the delivery of construction materials and equipment. This type of waste, if not segregated and disposed of correctly, can add to the volume of non-biodegradable waste, contributing to long-term environmental pollution. Hazardous substances, such as paints, solvents, adhesives, and oils, pose a significant risk during the construction phase. These materials can contaminate the soil and water if they leak or spill, leading to harmful effects on the environment and human health. Proper storage, handling, and disposal of these substances are crucial to minimizing their impact. Implementing waste management practices, such as recycling and reusing materials, can mitigate these issues. For instance, recycling concrete and asphalt can reduce the need for new raw materials, while reusing wood and metal can lower the volume of wastes. Other mitigation measures as follows:

- Where possible, reuse construction materials such as wood, metal, and concrete. This can involve repurposing materials from site demolitions or excess materials from other projects.
- Utilize prefabricated components to reduce on-site waste and enhance precision in material use.
- Implement on-site waste segregation to separate recyclable materials like metals, plastics, glass, and paper from non-recyclable waste.
- Develop and implement a comprehensive plan for the safe storage, handling, and disposal of hazardous materials such as paints, solvents, adhesives, and oils.
- Train construction workers on the proper handling and disposal procedures for hazardous substances to prevent spills and contamination.
- Ensure that hazardous waste is disposed of at licensed facilities equipped to handle such materials safely.
- Conduct regular waste audits to track the types and quantities of waste generated, identify areas for improvement, and ensure compliance with waste management plans.
- Implement monitoring systems to track waste management practices and ensure that waste is being handled, recycled, and disposed of correctly.

- Educate workers about the importance of waste reduction, recycling, and proper disposal practices.

774. **Biological Resources - Terrestrial Vegetation/Trees:** There are no national parks, wildlife sanctuaries or any other similar eco-sensitive areas in the subproject areas. There are no issues for the ropeway, water public transport stations and smart components and smart loop.

775. For the tourism road site, the ecological baseline study indicates that approximately 3,124 trees may need to be cut to accommodate the widening of the proposed road. This action is expected to have environmental impacts. Firstly, the loss of flora and fauna is a major concern. Trees serve as habitats and food sources for various wildlife species, particularly birds. The removal of these trees will disrupt local ecosystems, displacing animals and insects that rely on them for shelter and sustenance. The road expansion is anticipated to affect around 0.1261 km² of green area vegetation, leading to permanent flora loss. Despite the relatively small space required for the road, this area likely serves as a habitat or shelter for local wildlife, resulting in their permanent displacement.

776. According to the primary ecological survey, *Cedrela odorata* and *Aegle marmelos*, classified as vulnerable and near-threatened species respectively, are found along the proposed alignment. *Aegle marmelos* is cultivated by the local community along stretches of approximately 10 km to 15 km and 13 km to 14 km of the alignment, while *Cedrela* is frequently distributed along the road. The proposed widening will directly result in the loss of these species from the project area. Additionally, the project will impact Schedule-I fauna, including the Leopard Cat, Jungle cat, Porcupine, and Rat snake, as per the Wildlife Protection Act of 1972 (amended in December 2022). Although the project area harbors no threatened species as per IUCN criteria, the road widening will directly impact these Schedule-I species.

777. Moreover, soil erosion is another critical issue. Tree roots play a vital role in stabilizing soil, especially on slopes. Removing these trees can lead to increased soil erosion, particularly during heavy rains or storms. Furthermore, the removal of 3,124 trees will reduce the area's carbon sequestration capacity, potentially increasing greenhouse gas levels in the atmosphere and contributing to climate change. Finally, trees enhance the aesthetic appeal of landscapes and offer recreational opportunities for communities. Their removal will diminish these benefits for residents, impacting the area's visual and recreational value.

778. To mitigate the impacts of road expansion and removal of trees, the following will be performed to address impacts on flora and fauna.

- Avoid or minimize the number of trees to be cleared through minor geometric realignment or eccentric widening.
- Requisite permission from the Forest Department will be secured for cutting of roadside trees.
- Ensure timely commencement of compensatory plantation and roadside Plantation Strategy as per IRC, including manuring and controlled use of pesticides/fertilizers
- Additional plantation/avenue plantation is also proposed subject to the availability of land.
- Provision of LPG in construction camp as a fuel source to avoid tree cutting, wherever possible.
- For safe traffic operation, vertical clearance between the crown of the carriageway and lowest part of the overhang of the tree available across the roadway will conform to IRC:

SP: 21-2009. The pit size, fencing, watering, and manuring requirements will also conform to the standard above.

- In the event of design changes during construction, additional assessments including the possibility of saving trees shall be made.
- Planting native tree species in nearby areas under compensatory afforestation in lieu of cutting trees in accordance with the guidelines/terms of the forest department. Generally, in Uttarakhand, compensatory plantation shall be done in a ratio of 1:10 trees. This will provide new homes and food sources for wildlife present in the project area.
- Recommendation of the concerned forest department shall be followed for compensatory plantation.
- Compensatory plantation shall be done in nearby degraded forest areas.
- Identify and relocate *Aegle marmelos* and *Cedrela odorata* specimens from the project area to nearby suitable habitats. This can be done in consultation with the Forest department/botanical experts to ensure the survival of the relocated plants.
- Minor design adjustments to the road to minimize encroachment into areas where *Cedrela odorata* and *Aegle marmelos* are distributed. This might involve narrowing the road width or shifting the alignment to less sensitive areas to minimize tree cutting.
- For *Aegle marmelos* and *Cedrela odorata* species, the compensatory plantation shall be done in a ratio of 1:15 trees.
- Tree cutting shall only occur after obtaining permission from the forest department.
- Compensatory plantation shall be done to create new forested areas in nearby suitable locations, compensating for habitat loss and supporting local biodiversity.
- Native species shall be planted under the compensatory plantation.
- Develop green belts along the road by planting native tree species.
- Train construction workers and project staff on the importance of protecting Schedule-I species and the specific measures in place to avoid harming them. Ensuring everyone is aware of the species and their habitats helps in minimizing accidental impacts.

779. **Proliferation of invasive species.** Soil brought into the subproject areas from outside sources may contain seeds of alien invasive species, posing a significant ecological threat. Construction machinery and vehicles can inadvertently introduce seeds of these invasive plants if they are not properly cleaned before entering the project site. This unintentional introduction can occur when machinery is moved between different areas or when soil and other materials are transported without adequate precautions. Temporary facilities such as labor camps, dumping sites, and soil storage sites are particularly vulnerable to the establishment of invasive plant species. To mitigate these risks, it is crucial to secure soil from locations close to the project area, as this will reduce the likelihood of transporting alien invasive species seeds to the site. By sourcing soil locally, the project minimizes the chances of introducing non-native plant species that could disrupt the existing ecosystem. Furthermore, the land areas of labor camps, dumping sites, and soil storage sites should be regularly inspected for any signs of invasive plant growth. Frequent monitoring is essential to detect early stages of infestation, allowing for timely intervention. If invasive species are found, they should be eradicated promptly by burning and destroying them within the premises where they are discovered. This proactive approach will help prevent the spread of invasive species and protect the integrity of both the natural and constructed environments within the project area.

780. Implementing these measures requires a coordinated effort among project managers, construction teams, and environmental specialists. Regular training and awareness programs should be conducted to ensure all personnel are informed about the risks associated with invasive species and the importance of maintaining clean equipment and vehicles. Additionally,

establishing strict protocols for soil handling and site management will further reduce the risk of invasive species introduction. By taking these comprehensive steps, the project can significantly reduce its environmental impact and promote sustainable development practices.

- Secure soil from locations close to the project area to minimize the risk of transporting seeds of alien invasive species.
- Ensure all construction machinery and vehicles are thoroughly cleaned before entering the project site to prevent the accidental introduction of invasive plant seeds.
- Conduct frequent inspections of temporary facilities such as labor camps, dumping sites, and soil storage sites to detect any growth of invasive plant species early.
- If invasive plant species are found, promptly burn and destroy them within the premises where they are discovered to prevent their spread.
- Set up regular monitoring schedules for areas prone to invasive species establishment, ensuring early detection and rapid response.
- Conduct training sessions and awareness programs for project managers, construction teams, and environmental specialists about the risks of invasive species and the importance of maintaining clean equipment.
- Implement strict protocols for handling soil and other materials to prevent the introduction and spread of invasive species.
- Ensure a coordinated effort among all stakeholders involved in the project to maintain vigilance and adhere to mitigation measures effectively.

781. **Loss of vegetation and trees.** The hill cutting activities for the road widening project along the tourism road will result in the direct loss of local vegetation and tree cover. The removal of trees and shrubs from the hill side will disrupt the land cover of the area. This stretch is home to several tree species such as *Toona ciliata* (Tyuni), *Ficus benghalensis* (Banyan), and *Cedrela toona*, which not only provide shade and habitat for fauna but also play a role in maintaining soil stability. The removal of these mature trees and associated undergrowth will directly affect the microhabitats that support avifauna and small mammals. Birds like the Himalayan Pied Kingfisher and the Spotted Scops Owl, which rely on the dense canopy for nesting and feeding, will be forced to relocate, leading to a displacement in local biodiversity.

782. The hill cutting required for road widening will expose large areas of soil and rock, particularly on the hill side, making them highly susceptible to soil erosion and landslides. Vegetation, including the roots of species such as *Bauhinia variegata* (Kachnar) and *Dalbergia sissoo* (Sisam), plays a key role in stabilizing slopes and reducing soil loss. When these plants are removed, the natural root matrix that holds the soil together is disrupted, leading to increased surface runoff and the potential for soil erosion. During the monsoon season, heavy rainfall can rapidly wash away the exposed soil, resulting in the formation of rills and gullies on the hill slopes. The road alignment traverses through steep and winding sections where slope instability is a major concern. Without proper slope stabilization measures, the risk of landslides will be significantly heightened. The removal of larger trees like *Bombax ceiba* (Semal), which have extensive root systems that provide deep anchorage, will further compromise slope stability, potentially leading to slope failures. Landslides and soil erosion not only pose risks to road infrastructure and safety but also contribute to sedimentation in nearby water bodies and valleys, smothering existing vegetation and disrupting local hydrology.

783. The removal of vegetation and exposure of bare soil due to hill cutting will result in alterations to the microclimate and soil conditions along the road. Trees and shrubs play a vital role in moderating local temperatures and maintaining humidity levels. When these plants are

removed, there is a loss of shade, leading to increased surface temperatures and a decrease in soil moisture content. This creates a drier microenvironment that is less conducive for the growth of moisture-dependent species like *Ficus palmata* (Bedu) and various understory herbs. Additionally, the disruption of soil layers will change the physical properties of the soil. Compaction caused by construction machinery will reduce soil porosity and permeability, hindering root penetration and water infiltration. This will negatively affect the water-holding capacity of the soil, making it difficult for plants to access sufficient moisture. pH and nutrient levels will also impact plant health, reducing their growth and productivity. As a result, the plant community composition along the road will shift, leading to displacement of biodiversity and a decline in ecosystem services provided by vegetation and trees.

784. Based on the existing conditions of the area and the potential impacts due to hill cutting for road widening along the tourism road from Koti Colony to Dobra Chanti, here are mitigation measures to reduce the identified impacts:

- Implement selective clearing of vegetation to minimize loss, retaining mature trees and vegetation along the road alignment wherever feasible.
- Undertake compensatory reforestation in areas adjacent to the road or in identified ecological restoration zones. The ratio for compensatory planting should be at least 1:10 (for every tree removed, three should be planted). Use native species to restore the local flora composition.
- If any threatened species, protected, or medicinal plant species are encountered, consider translocating them to safer locations within the project area or to botanical gardens. Ensure proper techniques are followed to maintain plant health and survival rates. For instance are: *Dalbergia latifolia* (Sisam) are listed as Vulnerable (VU), and *Dalbergia sissoo* is Near Threatened (NT)
- Identify and designate nearby areas as biodiversity offset zones where intensive reforestation and habitat restoration can be carried out. These zones should be monitored and managed to support the recovery of native species and serve as wildlife corridors.
- Implement engineering solutions such as retaining walls, gabion structures, and soil nailing to stabilize slopes, particularly in steep areas.
- Use bioengineering methods like planting vetiver grass, bamboo, and other deep-rooted species on the hillside to stabilize the soil. Introduce live stakes and fiber rolls on vulnerable slopes to reduce surface runoff and soil erosion.
- Create terraces and contour trenches along the hillside to reduce the slope length and surface runoff velocity. Terraces should be planted with native shrubs and grasses to increase surface roughness and minimize erosion.
- Construct check dams and gully plugs in areas where water flow is concentrated to trap sediment and reduce the impact of erosion.
- Incorporate organic amendments such as compost or mulch into the soil to improve its structure, water-holding capacity, and fertility. This will enhance the establishment and growth of replanted vegetation in disturbed areas.
- Apply mulch or geotextile blankets on exposed soil surfaces to reduce evaporation, suppress weed growth, and maintain soil moisture levels. This will create a conducive environment for seed germination and seedling establishment.
- Establish a monitoring system to track changes in soil conditions, microclimate parameters, and vegetation health. Regularly evaluate the success of the revegetation and soil improvement measures and adapt management strategies as needed.

785. **Socio-Economic - Impacts due to Construction Camp and Immigration of Workers.**

Poor siting and improper management of construction camp may lead to several impacts on the environment like; (i) loss of vegetation due to use of wood as a fuel source for cooking, (ii) deterioration in nearby surface water bodies quality, (iii) contamination of soil due to uncontrolled disposal of solid waste, and (iv) poor sanitation may result to transmission of communicable diseases among the workers and the host communities. These include the possible spread of sexually transmitted diseases, diseases from improper handling and supply of foodstuffs, poor water supply, insect-borne diseases, and alcoholic and drug. To mitigate these impacts, the following measures will be performed.

- No productive land will be utilised for camps. All sites must be graded and rendered free from depressions to avoid water stagnation. Accommodation and ancillary facilities will be erected and maintained to standards and scales approved by the PMDSC. All camps will be sited at 500m from habitation and water bodies, as much as practicable.
- All construction camps will be provided with sanitary toilets with provision of septic tanks attached to soak pits. Storm water drains will be provided for the flow of used water outside the camp. Drains and ditches will be treated with bleaching powder on a regular basis. Garbage bins must be provided in the camp and regularly emptied and disposed of in a hygienic manner. LPG cylinders will be provided as a fuel source for cooking to avoid any tree-cutting for the purpose of cooking.
- At every workplace, the contractors will ensure that there is a readily available first-aid unit. Workplaces away from regular hospitals will have indoor health units. Suitable transport will be provided to approach the nearest hospital.
- The contractors will ensure the good health and hygiene of all workers to prevent sickness and epidemics. These include the HIV/AIDS prevention program to reduce the risk and transfer of HIV virus. Activities under the program will include monthly information, education, and communication campaigns to workers, drivers, delivery crew, and communities at risk.
- The contractors will provide adequate and safe water supply for workers. No alcoholic liquor or prohibited drugs will be imported, sold, given, and bartered to the workers of the host community.
- Migrant workers may be the potential carriers of various diseases. Regular health check-ups and immunization camps will also be organized for the workers and nearby population.

786. Occupational health and safety (OHS) in construction camps. Construction camps present several OHS risks that need careful management to ensure the well-being of workers. One major concern is poor sanitation and hygiene, which can lead to the spread of infectious diseases. Inadequate sanitation facilities and poor waste disposal practices can exacerbate these risks, creating conditions ripe for disease outbreaks. Additionally, poor hygiene can attract pests such as rodents and insects, which can further spread diseases and pose health hazards to the workforce. Inadequate living conditions are another significant issue. Overcrowded living quarters increase the risk of communicable diseases and create stressful living environments that can negatively affect workers' mental health. Insufficient ventilation and heating can lead to respiratory problems, especially in extreme weather conditions. Furthermore, the exposure to hazardous materials such as solvents, adhesives, and fuels, if not handled and stored properly, can result in chemical exposure causing skin irritations, respiratory issues, and other health problems. Exposure to hazardous substances like asbestos and lead, often found in older construction materials, can lead to serious long-term health issues such as cancer and neurological damage. Ergonomic hazards are also prevalent in construction camps. Workers performing repetitive tasks without proper ergonomic support can suffer from musculoskeletal disorders. Improper lifting techniques and handling of heavy materials can result in back injuries and other musculoskeletal

issues. Fire safety risks are another concern, given the presence of flammable materials and potentially improper electrical wiring, which increase the risk of fires. Inadequate fire safety measures, such as a lack of fire extinguishers and emergency exits, can result in severe injuries or fatalities in the event of a fire. Psychological risks also play a role in construction camps. Isolation from family, long working hours, and stressful working conditions can lead to mental health issues such as depression and anxiety. Furthermore, the high-stress environment and availability of alcohol or drugs can increase the risk of substance abuse among workers. Security risks, including theft and violence, can also affect the safety of construction camps. Workers may face harassment or physical harm, leading to both physical and psychological injuries. Additionally, inadequate health services in construction camps exacerbate these risks. A lack of medical facilities and first aid can delay necessary treatment, worsening health issues and injuries. Poor emergency response planning can lead to severe consequences in the event of accidents or health emergencies.

787. To mitigate these risks, it is essential to improve sanitation and hygiene by providing adequate facilities, clean water, and waste disposal systems. Enhancing living conditions by ensuring proper ventilation, heating, and adequate space in living quarters can reduce overcrowding and improve comfort. Strict protocols for handling hazardous materials can prevent chemical exposure, while providing ergonomic tools and training can reduce the risk of repetitive strain injuries and musculoskeletal disorders. Protective equipment and limiting exposure to high noise and vibration levels can prevent hearing loss and vibration-related injuries. Implementing fire safety measures, such as installing fire safety equipment and conducting regular fire drills, can ensure all workers are aware of emergency procedures.

788. OHS in construction sites: Ensuring the safety and health of workers is a fundamental obligation. It is imperative to provide an environment where workers can perform their tasks without the risk of injury or illness. Every worker has the inherent right to work in safe conditions, free from hazards that could jeopardize their well-being. This moral responsibility underscores the importance of prioritizing OHS in the construction sites. Even though the OHS risks associated with the subprojects may be considered moderate and temporary, addressing them effectively is crucial to maintaining a safe working environment. Adhering to OHS regulations and standards is not only a moral duty but also a legal requirement. Non-compliance with these regulations can result in severe penalties, including hefty fines, legal action, and reputational damage. Legal compliance ensures that construction sites meet the necessary safety standards, protecting both workers and the organization from legal repercussions. Ensuring compliance with safety regulations remains essential to avoid any legal and financial consequences.

789. Additionally, safe working conditions contribute significantly to higher productivity. Workers are more efficient and motivated when they feel safe and valued, leading to better performance and fewer disruptions in project timelines. Proactively managing these risks ensures continuous productivity and project efficiency. Moreover, preventing accidents and illnesses reduces costs associated with medical treatment, compensation, and lost workdays, making it economically beneficial for organizations to invest in robust OHS measures. The following are actions that will support OHS in the subproject sites.

- **Training and Education.** Providing comprehensive safety training for all workers is essential in maintaining a safe construction site. Training should include the proper use of equipment, hazard recognition, and emergency response procedures. This education helps workers understand the potential risks they face and how to mitigate them effectively. Additionally, educating workers on proper lifting techniques and ergonomics is crucial in preventing musculoskeletal disorders, which are common in construction due to

the physical nature of the work. Proper training on the safe handling, storage, and disposal of hazardous substances used in construction is also necessary to prevent accidents and health issues related to chemical exposure.

- **Personal Protective Equipment (PPE).** Ensuring that all workers use appropriate PPE, such as helmets, gloves, safety glasses, ear protection, high-visibility clothing, and respiratory protection, is fundamental in protecting them from various hazards on-site. The workers employed in the installation of floating jetties as part of the development of water public transport stations shall also be provided with life jackets apart from other PPE to prevent danger of the workers from drowning in the lake,
- **Regular inspections and maintenance of PPE** are critical to ensure it remains in good condition and functions correctly. This includes replacing any damaged or worn-out equipment promptly to maintain a high safety standard.
- **Equipment Safety.** Machinery and equipment used on construction sites must be equipped with appropriate guards and safety devices to prevent accidents. Implementing a routine maintenance schedule for all equipment ensures that it remains in safe working condition, reducing the risk of mechanical failures. Developing and enforcing safe operation procedures for machinery and equipment helps ensure that all workers operate these tools safely and effectively, minimizing the risk of accidents.
- **Traffic Control and Site Management.** Effective traffic control and site management are essential to protect workers from vehicle collisions and other site hazards. Using barriers, signage, and flaggers to manage traffic flow helps prevent accidents and keeps workers safe. Limiting access to construction zones to authorized personnel only and providing clear signage for hazards, safety zones, and emergency exits further enhances site safety.
- **Fall Protection.** Fall protection is critical for work at heights, which is common in construction. Installing guardrails, safety nets, and harnesses helps prevent falls and protects workers. Ensuring safe access to elevated work areas through scaffolding and ladders that comply with safety standards is also important. Training workers on the proper use of fall protection equipment ensures they can use these tools effectively to stay safe.
- **Health Monitoring and Medical Support.** Regular health screenings and monitoring for workers help detect and address health issues early, preventing more serious problems down the line. Implementing noise monitoring programs ensures exposure levels are within safe limits, protecting workers' hearing. Having first aid kits and trained personnel on-site to handle medical emergencies is essential for providing immediate care when needed.
- **Dust and Chemical Control.** Controlling dust and particulate matter on construction sites is crucial for maintaining air quality and protecting workers' health. Using water spraying, dust suppressants, and covers helps manage dust levels. Ensuring adequate ventilation in confined spaces and areas with hazardous substances reduces exposure to harmful chemicals. Using spill containment systems and proper storage for fuels, oils, and chemicals prevents spills and leaks, further protecting the environment and worker health.
- **Ergonomics and Worker Comfort.** Providing adjustable tools and equipment helps reduce ergonomic strain, preventing injuries and improving worker comfort. Encouraging regular rest breaks helps prevent fatigue and musculoskeletal strain, enhancing overall productivity. Designing workstations to minimize awkward postures and repetitive motions also contributes to worker safety and comfort.
- **Emergency Preparedness.** Developing and implementing emergency response plans for accidents, chemical spills, and other emergencies is crucial for ensuring workers can respond effectively. Regular emergency drills help prepare workers for real-life scenarios, enhancing their ability to act quickly and safely. Maintaining updated lists of emergency

contacts and procedures ensures that everyone knows whom to contact and what steps to take in an emergency.

- **Mental Health and Well-being.** Supporting workers' mental health is as important as their physical safety. Providing access to mental health counselling and support services helps workers manage stress and mental health issues. Promoting work-life balance through reasonable working hours and time off reduces stress and fatigue, contributing to overall well-being. Implementing programs such as stress management workshops provides additional support for workers' mental health.
- **Weather Protection.** Protecting workers from extreme weather conditions is essential for their safety and comfort. Providing hydration stations and shaded rest areas helps prevent heat stress, while supplying appropriate cold weather gear and warm-up areas protects against cold stress. Sun protection measures, such as sunscreen, hats, and UV-protective clothing, are also important for preventing sunburn and long-term skin damage.
- **Compliance and Monitoring.** Conducting regular inspections of the construction site ensures compliance with safety regulations and helps identify potential hazards before they cause harm. Establishing a system for reporting and investigating accidents and near-misses is essential for preventing future incidents. Using feedback from monitoring and incident reports to continuously improve safety practices helps mitigate risks and enhances overall site safety.

790. **Community Health and Safety.** Ensuring community health and safety during construction is critical for preventing accidents and fostering trust with local residents. Construction sites pose numerous risks not only to workers but also to nearby residents and passersby, necessitating robust safety measures like barriers, proper signage, and secure fencing. These measures prevent accidents and injuries, safeguarding both workers and the community. Additionally, minimizing health risks from pollution through dust suppression, noise control, and air quality monitoring is crucial to mitigate adverse health effects. Proper handling and storage of hazardous materials, alongside well-prepared emergency response plans, protect against soil and water contamination. Ensuring safe access and mobility around construction zones is vital to maintaining daily routines and access to essential services.

- **Comprehensive Traffic Management Plan.** Developing and implementing a comprehensive Traffic Management Plan is essential for maintaining traffic flow and ensuring safety during construction activities. This plan should outline strategies for minimizing disruption and maintaining access for both vehicles and pedestrians. By planning construction activities in phases, it becomes possible to reduce overall disruption and maintain essential access points.
- **Clear Signage and Communication.** Clear and visible signage is crucial to inform drivers and pedestrians about ongoing construction activities, detours, and alternative routes. Temporary traffic signals and flaggers can effectively manage traffic flow and ensure the safety of both workers and road users. Scheduling lane closures during off-peak hours, such as night time or weekends, can further reduce congestion and disruption. Additionally, designating and clearly marking detour routes is important for redirecting traffic away from construction zones. Communicating these detour routes to the public through websites, social media, local news, and community bulletins ensures that everyone is well-informed.
- **Coordination and Community Engagement.** Effective traffic management requires coordination with local traffic authorities, emergency services, and public transportation agencies. This coordination ensures seamless traffic management and allows for quick adjustments in case of unforeseen issues. Engaging with local communities to address

their concerns and gather feedback on traffic management strategies is also vital. Maintaining open communication with the community about construction activities, schedules, and potential impacts through regular updates and information sessions helps build trust and cooperation.

- **Traffic Monitoring and Enforcement.** Implementing traffic monitoring systems allows for real-time assessment of traffic flow and identification of congestion points, enabling immediate adjustments to traffic management strategies. Enforcing traffic laws and speed limits in construction zones is crucial to ensure the safety of both workers and road users. Providing and maintaining traffic management elements, such as diversion warnings, guiding and regulatory signage, channelizers, delineators, lighting, flagmen, and dust control systems, as specified in the contract, is also necessary. Adequate lighting in construction zones, especially if night work is permitted, ensures visibility and safety.
- **Training and Safety Measures.** Conducting induction and periodic training for all workers and supervisors on traffic control measures is essential. These measures include the use of signage, barriers, and flaggers to manage traffic flow and protect pedestrians and cyclists. Securing construction sites with fencing and signage to prevent unauthorized access and protect the community, especially children, is a critical safety measure. Ensuring that construction areas are well-lit and visible, particularly during night time operations, helps prevent accidents. Creating safe and clearly marked pedestrian pathways around construction sites also contributes to overall safety.
- **Community Relations and Emergency Coordination.** Maintaining open communication with the community about construction activities, schedules, and potential impacts is crucial. Providing regular updates through community meetings, newsletters, and social media ensures transparency and trust. Establishing a grievance mechanism allows community members to report concerns and receive timely responses. Public information campaigns to alert the public about construction activities and safety measures further enhance community awareness and cooperation. Coordinating with local emergency services ensures a rapid response in case of an incident, thereby safeguarding the community and workers.

791. Obstruction and Disruption of Access and Traffic. Disruption of access to infrastructure or social resource due to construction activity will cause nuisance and, to a certain extent, additional cost to the public in terms of longer travel periods due to diversion or heavier traffic. It will also pose a risk of accidents to motorists at night if these blockages and disruptions are not clearly demarcated. During the construction of the Ropeway, the people using the Ropeway to commute between Tipri and Madan Negi will face a disruption of access to commute between Tipri and Madan Negi.

- TADA will provide alternate feasible access by providing a ferry boat or a bus shuttle between Tipri and Madan Negi during the construction of Ropeway.
- The contractor will submit a traffic management plan to the PMDSC before the construction. This plan will recommend for approval, the safe and convenient temporary diversion of traffic during construction, the design of barricades, delineators, signs, markings, lights, and flagmen, among others.
- For widening of the existing carriageway and as part of it will be used for passage of traffic, a paved shoulder will be provided on one side of the existing road by the contractor.
- At least one 3.5 m lane to always remain open to traffic
- The surface used by the through traffic will be a firm bituminous compacted surface free of defects

- The maximum continuous length over which construction under traffic may take place is limited to 750 meters.
- Construction activity will be restricted to only one side of the existing road.
- Transportation of quarry material to the construction sites through heavy vehicles will be done through existing major roads to the extent possible. This will restrict wear and tear to the village/minor roads. Small vehicles/un-motorised vehicles can also be used for further transportation to the construction sites from temporary storage areas.

792. **Chance Find of Cultural:** During construction, structures or artifacts of archaeological, cultural or religious importance may be found. In such instances, all construction work must immediately be stopped in the respective construction area and the contractors and PMDSC environmental specialist must immediately inform the PIU. The PIU will then coordinate with the concerned local agency, following procedures for recovering the artefacts or restoring and maintaining the site.

F. Post-construction and Operations Impacts and Mitigation Measures

793. Aesthetics will be improved after tree plantation, landscaping of embankment slopes, improving the road cross sections, Cycling paths, footpaths, viewpoints, more bus bays, side drains, installation of safety signage, crash barriers, and road markings, improved movement for users of Ropeway between Tipri and Madan Negi and commuters on Tehri Lake using Jetty system. However, due to lack of proper maintenance, the condition of the new infrastructure may deteriorate over the years resulting in numerous problems such as a rise in accidents, disruption of transportation services, decreased tree survival, and functioning of side drains. UTDB and PWD will allocate adequate resources and logistics to ensure that the developed infrastructure and the ancillary structures are being maintained and intended benefits are generated thereof.

794. Adequate safety and rescue measures shall be put in place during the operation phase of Ropeway and Water Transport stations. A Standard Operating Procedure (SOP) for close coordination with the State Disaster Rescue Force (SDRF) shall be developed and adopted to ensure that the timely rescue services are provided in case of accidents.

795. **Site Restoration:** Contractors are responsible for preparing comprehensive site restoration plans. These plans are essential for ensuring that all areas affected by construction activities are adequately restored to their original or improved condition. The process involves meticulous planning and coordination to address various environmental and safety concerns. Prior to demobilization, contractors must implement the clean-up and restoration operations as detailed in the approved plans. This involves a thorough clean-up of all construction zones, including riverbeds, culverts, roadside areas, camps, hot mix plant sites, crushers, batching plant sites, and any other areas used or affected by the project. The goal is to leave these areas clean, tidy, and free from construction debris or hazardous materials. The clean-up activities are conducted at the contractor's expense, ensuring no additional costs are incurred by the project owner or local communities.

796. The clean-up and restoration efforts must meet the satisfaction of the PMU and PIUs. This involves adhering to specific environmental standards and guidelines to ensure that the restoration activities do not cause any further environmental harm and that they effectively mitigate any negative impacts caused by the construction process. All opened borrow areas used for extracting construction materials must be rehabilitated. Rehabilitation involves restoring these areas to a stable and safe condition, which may include recontouring the land, re-vegetating with

native plants, and ensuring proper drainage to prevent erosion. This process is critical for minimizing long-term environmental impacts and ensuring that the land can be safely used in the future.

797. The implementation of site restoration plans has several significant benefits. It helps mitigate the environmental impacts of construction activities, ensuring that natural habitats and ecosystems are preserved or restored. Additionally, it improves safety by removing potential hazards and stabilizing the land. Proper site restoration also enhances the aesthetic value of the area, contributing to the well-being of local communities. Moreover, by complying with regulatory requirements, the project maintains its social license to operate, fostering good relations with stakeholders and the public.

798. **Road Repair and Maintenance Work and Increase in Traffic:** Emissions from hot patchwork, fumes from pavement marking works, dust from concrete grinding, and dust from demolition debris may deteriorate local air quality. Mitigation measures recommended are:

- Provision of PPE to workers including life jackets to the staff employed at water transport stations
- Water sprinkling to control dust
- Covered haul trucks
- Maintaining an adequate vehicle road capacity as congestion decreases vehicle speed, deteriorates fuel efficiency, and increases emission per km travel.
- Maintain optimum range of vehicle speed. CO₂ emissions drastically increase when vehicles are travelling less than 30 kph and faster than 70 kph.
- Maintain good riding quality of the road, expressed in roughness

799. Along the project road, the inflow of water into ponds during rains causes erosion of the embankment besides seepage of water into embankment and sub-grade resulting in softening of the sub-grade. This may also increase siltation in water bodies. Project design includes provisions of retaining walls for the protection. Regular inspections will be made to check its effectiveness.

800. Enhancing the road drainage system will result in better stormwater management, reducing blockages and mitigating the risk of stagnant water bodies along the roadside. This is crucial for public health, as stagnant water often serves as breeding grounds for disease vectors, such as mosquitoes, which can spread illnesses like dengue and malaria. To ensure the effectiveness of the drainage system, the design should consider capacity for appropriate storm events, and regular maintenance must be conducted to minimize the risk of system failure.

801. Additionally, accidental oil spills, washing of vehicles, and improper disposal of used engine oils or paints during road maintenance can lead to water contamination. To prevent pollution, these chemicals must be handled with care under strict supervision. Rejuvenating the drainage system through the removal of encroachments and congestion will be a routine activity. During the operational phase, periodic clearing of the drains will be required to maintain unimpeded stormwater flow. It is recommended that the drainage system be thoroughly cleared of debris before the onset of each monsoon season. The PWD must oversee and support the implementation of these mitigation measures and regularly monitor their effectiveness to ensure long-term sustainability and environmental protection.

802. The enhancement of the road surface along the Koti Colony to Dobra Chanti route is expected to facilitate safer and smoother vehicle travel. This improvement may enable vehicles to travel at higher speeds, potentially increasing the risk of accidents, especially on curvy and hilly

sections of the road. The increase in speed could lead to a higher probability of accidents, particularly where visibility is limited and curves are sharp. To mitigate these risks, the following measures should be incorporated:

- Maintenance of centreline road marking, edge delineation etc.
- Maintenance of clearly marked signage at habituated areas, and sensitive areas such as potential wildlife crossings, schools, temples, etc.
- Enforcement of speed limits and other traffic rules, especially near potential wildlife crossings and built-up sections.
- The safety of road users could be ensured by regular repair of the carriageway and hydraulic structures and by placing standard sign boards, barricading of the repairing site, etc.
- Provision and maintenance of lighting, handrails, and road furniture.

803. During the operational phase, movement of traffic, traffic congestion, pedestrian interferences and increased use of horns due to interface between local/slow-moving traffic with through traffic will be the prime source of noise. The noise levels at nearby schools, religious places, etc., may cause nuisance and irritation. There will be a significant increase in the noise levels due to an increase in traffic intensity as well as the average speed of vehicles over the road's design life. However, with appropriate mitigation measures such as lowering speed from 80km/hour to 30km/hour in residential and commercial areas which have already been included in the project design, the natural barrier effect from the wall of houses, and the provision for noise barriers near sensitive receptors, the noise levels can be kept even below the baseline levels.

804. **Air Quality Decline due to Increased Traffic:** The projected increase in traffic volume along the Koti Colony to Dobra Chanti road in the Tehri Lake region from 2024 to 2036 is expected to result in increase in vehicular emissions. An analysis of the traffic data reveals that the annual average daily traffic (AADT) is projected to increase from 102 vehicles per day in 2024 to 182 vehicles per day by 2036, reflecting a 78.4% growth over the 12-year period. This increase in traffic is driven by a rise in all categories of vehicles, including light commercial vehicles (LCVs), buses, and heavy-duty vehicles like 2-axle trucks, 3-axle trucks, and multi-axle vehicles (Mavs). The increase in vehicle numbers indicates higher fuel consumption and emissions of key pollutants such as carbon dioxide (CO₂), nitrogen oxides (NO_x), and particulate matter (PM).

805. The daily traffic growth is reflected in the monthly traffic volume, which also shows a steady upward trend. The monthly traffic volume is expected to rise from 3,060 vehicles in 2024 to 5,460 vehicles by 2036. Such consistent growth patterns suggest that the road infrastructure will experience almost double the traffic volume by 2036, placing additional pressure on the road network and increasing the emission of pollutants. Emission factors vary based on the type and size of the vehicles, with heavier vehicles and buses contributing disproportionately higher emissions due to their larger engine sizes and longer operational hours.

806. The rise in different categories of vehicles will have varying impacts on overall emissions. For instance, buses and heavy vehicles are expected to emit significantly higher levels of NO_x and PM compared to passenger cars. The number of buses is projected to increase from 32 in 2024 to 58 in 2036, while the number of LCVs will rise from 45 to 81. Similarly, 2-axle trucks will increase from 19 to 33, 3-axle trucks from 5 to 8, and MAVs from 1 to 2 during this period. Each of these vehicle categories has distinct emission profiles, with heavy vehicles generally emitting more pollutants per kilometer travelled compared to smaller vehicles like LCVs and passenger cars.

Table 61. Emission factors for different vehicle types in India (CO₂, NO_x, and PM Emissions in g/km)

Vehicle Type	CO ₂ Emission Factor (g/km)	NO _x Emission Factor (g/km)	PM Emission Factor (g/km)
Passenger Vehicles	180	0.5	0.05
Light Commercial Vehicles (LCVs)	240	1.2	0.1
Buses	900	8	0.4
Heavy Vehicles (2-axle)	1200	10	0.5
Heavy Vehicles (3-axle and MAVs)	1500	12	0.6

807. The emission analysis takes into account different vehicle categories such as passenger vehicles, LCVs, buses, and heavy vehicles (including 2-axle, 3-axle trucks, and multi-axle vehicles). The emission factors, which are based on Bharat Stage VI (BS VI) standards, indicate that heavy-duty vehicles, due to their larger engine sizes and longer operating hours, will contribute disproportionately to overall emissions.

808. Passenger vehicles include cars and small utility vehicles, which are the most common types of vehicles on the road. Although the CO₂ emission factor for passenger vehicles is relatively low at 180 g/km compared to heavy vehicles, the sheer number of these vehicles can lead to a substantial increase in total CO₂ emissions. NO_x and PM emissions for passenger vehicles are also lower, at 0.5 g/km and 0.05 g/km respectively. However, as the number of passenger vehicles grows, their cumulative emissions will contribute significantly to the overall pollution levels. For instance, in 2024, passenger vehicles make up the majority of daily traffic volume. By 2036, the number of passenger vehicles is expected to increase, adding to the overall rise in CO₂ emissions by 75-80%.

809. LCVs such as small trucks and delivery vans are widely used for transporting goods and materials. With emission factors of 240 g/km for CO₂, 1.2 g/km for NO_x, and 0.1 g/km for PM, LCVs contribute significantly to air pollution, especially in rural and semi-urban areas. The projected increase in LCV numbers, from 45 in 2024 to 81 in 2036, suggests that emissions from this category will rise by approximately 80%. The growth in LCV numbers is primarily driven by increased demand for goods transportation, facilitated by the improved road infrastructure.

810. Buses, due to their larger engine sizes and longer distances covered, have higher emission factors—900 g/km for CO₂, 8 g/km for NO_x, and 0.4 g/km for PM. Despite their lower numbers compared to passenger vehicles and LCVs, buses contribute disproportionately to total emissions. By 2036, the number of buses is expected to increase from 32 to 58, leading to a sharp rise in NO_x and PM emissions. Buses also emit significant amounts of other pollutants, such as hydrocarbons and sulphur dioxide, which contribute to air quality deterioration in areas with high bus traffic.

811. Heavy vehicles, including 2-axle and 3-axle trucks, are used for transporting bulk goods and materials. Their emission factors are the highest among the categories analyzed, with 1200 g/km and 1500 g/km of CO₂ for 2-axle and 3-axle trucks respectively. NO_x emissions are also high, at 10 g/km for 2-axle trucks and 12 g/km for 3-axle trucks. The increase in the number of these vehicles is projected to significantly elevate total emissions, particularly NO_x and PM, by over 90%. The use of these heavy vehicles is expected to rise due to increased construction activities and freight movement in the region.

812. MAVs have the highest emission factors among all vehicle categories, at 1500 g/km for CO₂, 12 g/km for NO_x, and 0.6 g/km for PM. Although their numbers are expected to remain low (increasing from 1 to 2 MAVs by 2036), each vehicle contributes significantly to emissions. The steep emission factors are due to the larger engine sizes and high fuel consumption rates required to transport heavy loads over long distances.

813. Given the increase in the number of heavy vehicles and buses on the road, overall emissions are expected to rise substantially. NO_x emissions, in particular, are projected to increase by approximately 90%, due to the high emission factors of heavy-duty vehicles. PM emissions are also expected to rise by around 85%, primarily due to the increase in diesel-powered heavy vehicles and buses. The cumulative impact of rising emissions will pose significant health risks to local communities, as well as contribute to regional air pollution and climate change.

814. The environmental impact of the increased traffic volume will not only affect air quality but also contribute to climate change due to higher CO₂ emissions. If left unmanaged, the rise in emissions will negatively impact the ecological health. The projected increase in emissions also underscores the need for implementing mitigation measures to reduce the environmental footprint of road transport in the region.

815. To address the anticipated rise in emissions, several mitigation measures should be considered. Promoting the use of electric vehicles and cleaner fuels such as low-sulphur diesel and biofuels can help lower CO₂ and NO_x emissions from conventional vehicles. Traffic management strategies, such as reducing congestion and idle times, can further decrease emissions per vehicle. In addition, introducing stricter vehicle emission standards and regular maintenance checks will ensure that vehicles comply with emission regulations, minimizing their contribution to air pollution.

816. Furthermore, enhancing the road infrastructure to support EV charging stations and promoting the adoption of hybrid and electric buses for public transportation can significantly reduce the emission of pollutants. Developing policies that encourage the replacement of older, high-emission vehicles with newer, fuel-efficient models will also play a critical role in managing the overall environmental impact of the increased traffic volume. These strategies, combined with effective monitoring and enforcement, will help mitigate the adverse effects of rising vehicular emissions and support sustainable transportation development in the Tehri Lake region.

817. Given the projected increase in emissions due to rising traffic volume along the Koti Colony to Dobra Chanti road network, several mitigation measures can be implemented to minimize the environmental and health impacts associated with vehicular pollution. These measures should target the reduction of emissions from various vehicle categories and address the broader issues of air quality management, traffic regulation, and sustainable development.

- Promote the use of electric and hybrid vehicles, especially for public transport and commercial vehicles.
- Replace older vehicles with modern, fuel-efficient, and low-emission vehicles. Introduce policies that encourage the scrapping of outdated vehicles and incentivize the purchase of vehicles that comply with the latest Bharat Stage (BS VI) standards.
- Enforce strict adherence to Bharat Stage VI (BS VI) emission standards for all categories of vehicles. Conduct regular inspections and emission testing to ensure compliance.

- Enhance the public transport system by providing reliable and efficient bus services, improving last-mile connectivity, and promoting the use of shared mobility options to reduce the number of private vehicles on the road.
- Establish speed regulations to reduce emissions from vehicles traveling at inefficient speeds.
- Implement green infrastructure, such as green belts and buffer zones, along the road network to act as pollution sinks, reduce the dispersion of pollutants, and improve air quality.
- Create dedicated lanes for bicycles and pedestrians to encourage non-motorized transport, reducing the reliance on motor vehicles for short-distance travel.
- Use energy-efficient lighting, green construction materials, and sustainable water and waste management practices.
- Launch public awareness campaigns to educate residents and visitors about the environmental and health impacts of vehicular emissions.

818. **Forest Fires:** They have been a recurring issue in the Tehri region, as indicated by recent events. For instance, a major forest fire broke out in the New Tehri area in April 2021, spreading across at least one hectare of forest land and requiring the use of helicopters to control the blaze. Such incidents highlight the susceptibility of the region's forests to fires, which are often exacerbated by human activities like careless disposal of cigarettes and intentional burning of forest undergrowth. These activities not only increase the risk of fires but also result in significant ecological damage by reducing forest cover and altering local habitats. Additionally, human intrusion into forest lands for resource extraction (e.g., fuelwood collection) and the expansion of tourism-related infrastructure can disturb wildlife, degrade natural habitats, and increase the risk of illegal activities such as poaching and logging. The sparse human presence in the promenade area, coupled with the influx of tourists, can lead to a lack of immediate response to any forest fires, making the situation worse compared to the more populated areas along the proposed upgraded road network.

819. Addressing these challenges requires a comprehensive strategy, including community involvement in fire prevention, improved monitoring, and quick response mechanisms to deal with fires and intrusions. Effective implementation of these measures will be critical to safeguarding the natural resources and biodiversity of the Tehri Lake region as tourism and human activities continue to expand.

820. To address the risks of forest fires especially in areas with lesser human presence such as the proposed promenade, the following mitigation measures can be implemented:

- Create firebreaks and buffer zones around vulnerable forested areas to prevent the spread of fires. This could include clearing strips of vegetation or constructing barriers to isolate fires.
- Increase the frequency of patrols by forest guards and community volunteers to monitor human activity in forested areas and prevent illegal logging or encroachment.
- Conduct awareness programs targeting tourists and local communities to educate them on the impact of human activities on forests and the importance of conservation. Signage and information boards can be placed along the promenade to inform visitors about responsible behaviour.
- Restore degraded areas through reforestation and habitat improvement projects. Rehabilitating damaged lands can discourage further human intrusion and improve forest health.
- Strengthen collaboration with local fire departments and emergency services to ensure prompt and coordinated responses to fires.

- Designate specific zones for tourist activities and restrict access to vulnerable areas. Implement visitor management strategies such as limiting the number of visitors in certain areas to minimize human impact.
- Develop infrastructure along the promenade that minimizes ecological disturbance. Use sustainable materials, reduce the footprint of pathways, and ensure that construction activities do not compromise the integrity of nearby forests.
- Establish buffer zones between forest areas and tourist infrastructure to reduce human-wildlife conflict and protect sensitive habitats from direct human disturbance.

821. **Human-wildlife conflict, pollution, and habitat disruption:** The expansion of road infrastructure and improved accessibility will result in a rise in human activity along the tourism road, making the area more accessible to tourists. This increased presence of humans can lead to more frequent human-wildlife interactions and potentially escalate human-wildlife conflicts. Species such as the Rhesus Monkey (*Macaca mulatta*) and Barking Deer (*Muntiacus muntjak vaginalis*) are known to be curious and may approach roadsides, especially if they associate human presence with food availability or reduced vegetation cover. When these animals come closer to the road, the risk of vehicle collisions increases, leading to potential roadkill incidents that not only result in animal fatalities but also pose safety hazards to drivers. Additionally, animals attracted by the presence of humans may be perceived as nuisances or threats, prompting negative interactions such as chasing, feeding bans, or even harm to the animals. Such conflicts can disrupt the natural behaviour and distribution of these species, leading to a loss of habitat utilization along the roadside and increased stress on wildlife populations.

822. The increase in traffic volumes and human activities along the road network will elevate noise and light pollution levels, which can have a detrimental effect on the local fauna, especially sensitive and nocturnal species. Noise pollution generated by vehicle movements, honking, and construction activities can disrupt communication, feeding, and reproductive behaviors in species like the Jungle Cat (*Felis chaus*) and various owl species. These animals rely on auditory cues to hunt or communicate with conspecifics, and the increased background noise may reduce their hunting efficiency and alter their vocal communication patterns. Similarly, light pollution from streetlights and vehicular headlights can interfere with the natural day-night cycles of nocturnal species, reducing their ability to forage or breed successfully. For instance, nocturnal birds like the Spotted Scops Owl (*Otus spilocephalus*) may avoid illuminated areas, leading to a loss of foraging habitat, while other species may suffer from disorientation due to bright lights, making them more vulnerable to predation or accidents.

823. The increase in human presence and activity along the road network can disrupt breeding and nesting sites of sensitive and shy species. Birds like the Indian Pied Hornbill (*Anthracoceros malabaricus*) and the Spotted Scops Owl (*Otus spilocephalus*) require quiet and undisturbed areas for successful breeding. These species are sensitive to human disturbances and may abandon their nests if there is too much noise, movement, or human interference in the vicinity. Such disturbances can result in reduced reproductive success, with fewer chicks being raised to adulthood. The loss of suitable breeding sites will force these species to move to less optimal areas, potentially reducing their overall population in the region.

824. With an increase in the number of tourists and residents using the improved road network, there will likely be an increase in littering and waste generation along the road. Improper disposal of waste, such as food wrappers, plastic bottles, and other non-biodegradable materials, can attract scavengers like the Jungle Crow (*Corvus macrorhynchos*), altering the natural food chain. Scavengers that become dependent on human-generated waste can experience population booms, which may disrupt the balance of the local ecosystem. Additionally, littering can have

direct negative impacts on wildlife, as animals may ingest plastic or other harmful substances, leading to injuries, poisoning, or fatalities. Plastic waste, in particular, poses a significant threat to terrestrial and aquatic animals, as it can cause blockages in the digestive system, malnutrition, and suffocation. Moreover, the presence of litter can degrade the aesthetic and ecological quality of the area, reducing its value as a natural and recreational resource.

- Identify and designate wildlife crossing points along the road based on known animal movement patterns. Install signage and speed bumps at these crossing points to alert drivers and reduce vehicle speeds, minimizing the risk of wildlife-vehicle collisions.
- Install fencing along sections of the road that are prone to high wildlife activity to prevent animals from accessing the road directly. Use vegetation barriers, such as thick hedgerows or thorny bushes, along the road's edge to deter animals from venturing onto the road.
- Maintain natural vegetation buffers of at least 10 meters between the road and habitats to reduce visual and noise disturbances, allowing animals to utilize areas adjacent to the road without direct interaction with human activities.
- Noise barriers, such as berms or vegetative walls, along the road sections that pass through habitats, nesting sites, or breeding grounds. This will reduce the impact of vehicle noise on sensitive species like the Spotted Scops Owl (*Otus spilocephalus*) and the Indian Pied Hornbill (*Anthracoceros malabaricus*).
- Establish quiet zones with reduced speed limits and restrict the use of vehicle horns along specific road segments that are known to have high wildlife activity.
- Use low-intensity and downward-facing along the road to minimize light pollution. This will reduce disruption to nocturnal and crepuscular species such as the Jungle Cat and various owl species.
- Establish no-horn zones along sensitive areas of the road to minimize noise pollution and disturbance to wildlife. Place adequate signage and enforce penalties for non-compliance to ensure the effectiveness of these zones.
- Establish waste collection points at regular intervals along the road, especially in areas with high tourist activity. Use animal-proof waste bins to prevent scavengers like the Jungle Crow (*Corvus macrorhynchos*) from accessing the waste.
- Develop a waste management schedule that includes regular waste collection, transportation, and disposal in designated areas to prevent accumulation of litter along the roadside.
- Conduct awareness programs for local communities and visitors on the environmental impacts of littering and the importance of proper waste disposal. Use posters, leaflets, and social media campaigns to spread the message.
- Implement a "Leave No Trace" policy along the road and enforce strict fines for littering to promote responsible behaviour among road users.
- Organize clean-up drives involving local communities, schools, and tourists to periodically clear litter from the roadside and adjacent habitats. These drives should focus on removing plastic waste and other non-biodegradable materials that pose a threat to wildlife.

825. Balancing socio-economic development and environmental sustainability: The proposed improvement of the road network from Koti Colony to Dobra Chanti in the Tehri Lake region is expected to deliver socio-economic benefits by enhancing connectivity, supporting local livelihoods, and boosting tourism. This development is part of a broader strategy to transform Tehri Lake into a major tourism hub, integrating rural income diversification with environmental protection and sustainable land use.

826. Improved road infrastructure can act as a catalyst for economic development, increasing the accessibility of previously isolated communities and providing new opportunities for local businesses. The development of roads often leads to increased market linkages, allowing farmers to transport their produce to larger markets more efficiently and boosting agricultural profitability. Additionally, enhanced road connectivity can attract new businesses, hotels, restaurants, and tourism-related facilities, which could contribute to a rise in employment and income levels for the local population. The influx of new economic opportunities can sometimes lead to unintended consequences, such as land conversion, urban sprawl, and environmental degradation, especially in areas with ecological value.

827. The improved road network between Koti Colony and Dobra Chanti is expected to increase the region's attractiveness for residential and commercial developments. This could result in uncontrolled land conversion, where agricultural land is transformed into commercial or residential zones, potentially impacting local food production and disrupting traditional livelihoods. For example, the Tiwar Gaon and Dobra Chanti clusters, which feature a mix of agricultural terraces, forested hills, and proximity to water resources, could experience increased pressure for land conversion, resulting in the loss of agricultural land and a decline in local food security.

828. The potential for urban sprawl and uncontrolled development along the road network poses a significant risk to the environmental sustainability of the region. As seen in other parts of India, improved road connectivity can lead to fragmentation of forest, loss of biodiversity, and increased human-wildlife conflict. This is particularly concerning in regions like Tiwar Gaon, where the existing agricultural landscape, which supports local livelihoods, could be compromised by new developments. Similarly, the Dobra Chanti Cluster, which already shows signs of infrastructure development due to the presence of the Dobra Chanti Bridge, could face further encroachment into agricultural and forested lands, disrupting patches of lands and increasing soil erosion and water runoff.

829. To address the risks associated with uncontrolled development, robust regulatory frameworks and sustainable land-use planning are essential. Zoning regulations should aim to preserve agricultural lands, forested areas, and natural landscapes while designating specific zones for commercial and residential activities. Development control measures, such as limiting the height and density of buildings near sensitive ecological zones, can help manage urban sprawl and maintain the integrity of the region's natural environment. To ensure that the proposed development activities in the Tehri Lake region comply with Indian standards and legal frameworks, the following recommendations are aligned with specific laws, guidelines, and regulatory standards applicable in India and Uttarakhand.

830. *Zoning and Land Use Planning:*

- In accordance with the *Environment (Protection) Act, 1986* and the *Uttarakhand Hill Area Development Plan 2021-2031*, designate specific zones for residential, commercial, agricultural, and ecological uses. Ensure that zoning plans are developed based on the ecological sensitivity and topography of the region, and comply with the *Uttarakhand Town and Country Planning Act, 1973*.
- Define "No Development" zones as per the *Eco-Sensitive Zone Notification Guidelines 2011* issued by MoEFCC. Establish buffer zones around ecologically sensitive areas, such as forested lands, rivers, and agricultural terraces, in consultation with the Uttarakhand Forest Department. Such zones should prohibit any form of construction or land modification to prevent habitat fragmentation and maintain ecological integrity.

- Apply the standards outlined in the *National Disaster Management Guidelines on Landslide Hazard Zonation Mapping 2009* to identify and map landslide-prone areas and restrict land conversion in these zones.

831. *Development Control and Regulatory Frameworks:*

- Enforce the provisions of the *Hill Building Bylaws 2011*, which set parameters for building height, density, and construction materials in hill areas. Ensure that all development projects adhere to these bylaws to prevent destabilization of slopes, minimize visual disruption, and promote the use of sustainable and locally available materials.
- Mandate environmental impact assessments (EIAs) for all new infrastructure projects under the *EIA Notification 2006*. Obtain clearances from the *Uttarakhand State Pollution Control Board* and MoEFCC before initiating construction activities.
- Promote adherence to the *Indian Green Building Council (IGBC) Standards* and *Bureau of Indian Standards (BIS) Codes* for sustainable construction. This includes using energy-efficient designs, water management systems, and local resources to reduce the carbon footprint of infrastructure projects.

832. *Promoting Sustainable and Eco-Friendly Tourism:*

- Develop eco-friendly tourism facilities and activities based on the *Eco-Tourism Guidelines 2019* by MoEFCC and the *Uttarakhand Tourism Policy 2020*. Encourage sustainable tourism practices that emphasize conservation, such as low-impact camping sites, nature trails, and community-managed tourism initiatives.
- Limit the development of large-scale resorts, hotels, and tourism infrastructure in eco-sensitive zones as per the *Eco-Sensitive Zone Notification*. Implement guidelines that promote nature-based tourism, such as trekking, bird-watching, and eco-cultural activities that do not involve large-scale land modifications or construction.

833. *Soil and Water Conservation:*

- Implement soil conservation measures such as terracing, check dams, and contour trenching, as recommended by the *Indian Council of Agricultural Research (ICAR)* and *Central Soil and Water Conservation Research and Training Institute (CSWCRTI)*. These measures will help stabilize slopes, reduce soil erosion, and maintain soil health in the region.
- Design drainage systems that comply with the *Ministry of Road Transport and Highways (MoRTH) Specifications for Roads and Bridges*. Ensure that the drainage system is designed to accommodate high-intensity rainfall events and minimize waterlogging and soil erosion in the hilly terrain.

834. *Human-Wildlife Conflict Mitigation:*

- Establish wildlife corridors in consultation with the *State Wildlife Board* and local forest departments. Ensure that these corridors are delineated based on wildlife movement patterns and the *National Wildlife Action Plan 2017-2031*.
- Implement early warning systems and conduct community awareness programs on human-wildlife coexistence. Educate local communities about sustainable agricultural practices and waste management to reduce conflict situations and promote conservation.

835. *Community Involvement and Capacity Building:*

- Engage local communities through Gram Panchayats and Village Development Committees in land-use planning and decision-making processes. This participatory approach will ensure that development projects are aligned with the needs and priorities of local communities while preserving traditional livelihoods.
- Conduct training and capacity-building programs on sustainable agriculture, eco-tourism, and conservation practices in collaboration with local NGOs, academic institutions, and government agencies such as the *Uttarakhand Forest Department* and *Watershed Management Directorate*.

836. *Infrastructure for Sustainable Agriculture and Livelihoods*

- Support sustainable agricultural practices through the *Pradhan Mantri Fasal Bima Yojana (PMFBY)* and *National Mission for Sustainable Agriculture (NMSA)*. Encourage organic farming, agroforestry, and water management practices to enhance soil fertility and increase resilience to climate change.
- Develop market linkages and value chains for local agricultural products, handicrafts, and eco-tourism services through government schemes such as the *Deen Dayal Upadhyaya Grameen Kaushalya Yojana (DDU-GKY)*. This will provide alternative livelihood options and reduce dependence on environmentally harmful activities.

VII. ANALYSIS OF ALTERNATIVES

837. Alternative site locations for the Transport components under the project as well as alternative methods, technologies and designs were compared against technical, economic, social, and environmental criteria for the subcomponents in order to maximize environmental benefits and to minimize impacts. Analysis of alternatives comprised of (i) consideration of the “no project scenario”, (ii) site locations for the project facilities and (iii) alternative designs for various project components and O&M procedures.

A. No Project scenario

838. Visitor projections for the project area indicate a significant future increase in numbers. In addition, the population in the area governed by the Nagar Palika Parishad is steadily increasing. The population in New Tehri is projected to rise from the current number of 33,281 to 42,548 by the year 2051. The report provides a comprehensive analysis of the statistics, highlighting the importance of infrastructural development to accommodate the increasing number of residents and tourists. Considering these projections, opting for the ‘no project’ or ‘do nothing’ alternative poses considerable challenges and overlooks potential opportunities. If the current access routes are not improved, there is a risk of overcrowding in the region. This could put a strain on the existing infrastructure, resulting in environmental degradation, and potentially reducing the quality of the tourist experience. This could potentially hinder the economic progress that local communities could otherwise experience from the growth of the tourism sector. Without proper investment in infrastructure, the potential economic benefits that come with tourism, such as job creation, increased revenue for local businesses, and improved local facilities funded by tourism taxes and fees, may be missed.

839. Hence, given the projected surge in tourist arrivals and the expanding local population, it is clear that the ‘no project’ scenario is not feasible. It is crucial to approach the situation with meticulous planning and development in order to harness the potential benefits of increased tourism and population. This should lead to sustainable economic growth and better access and living conditions for the local community, all while safeguarding the destination's natural and cultural heritage. This development should be approached with a focus on environmental sustainability, social inclusivity, and economic benefits for local communities.

B. With Project Scenario

840. **Developing Infrastructure for Transport:** Considering the projected surge in tourist arrivals to around 300,000 overnight tourists per year, along with an equal number of day visitors over the next two decades, the development of the project's infrastructure becomes crucial. Given the rapid growth, it is essential to improve the access and road connectivity in the project area. This improvement in the transport components, like better connectivity between; i. Koti Colony and Dobra Chanti through an improved 15.77 KM road, ii. improved ropeway between Tipri and Madan Negi, iii. Water Public Transport Stations at multiple locations and iv. provision of smart infrastructure will add a lot of value to the developing tourism destination Tehri but it will also generate employment opportunities in the construction, hospitality, and service sectors, thereby making a positive impact on the local economy.

841. In addition, improving transportation networks, establishing easier access to tourist attractions, and constructing recreational facilities would greatly enhance the overall visitor experience. When developing the infrastructure, it is crucial to prioritize environmental

conservation and protect natural landscapes and biodiversity. This approach will not only safeguard the environment but also encourage eco-tourism.

842. Environmental Factors to Consider: A "with project" approach highlights the significance of having an Environmental Management Plan (EMP). This document will detail various measures to address environmental impacts, including waste management protocols, water conservation strategies, and the preservation of green spaces. Through the implementation of these measures, the project prioritizes the preservation of environmental health, ensuring that transport component development is carried out in a sustainable manner.

C. Design alternatives

C.1. Tourism Road (Koti Colony to Dobra Chanti)

843. Three alternatives have been drawn to finalize the project alignment by addressing Technical viability, environmental feasibility and social acceptability. The comparative table is shown in Table 61:

Table 62. Comparative table for three options

	Option 1: Valley Side Widening	Option 2: Hill side Widening	Option 3: Retrofitting Selected Option
Total Cut	8683.7555	25611332	1311778
Total Fill	3592.525	65321.05	30772.02
Design Speed	20km/h	20km/h	20km/h
No of tree felling	219	10000(estimated)	3124
No of Culverts	156	321	154
Land acquisition in Ha	24650	85060	731201
No of Structures to be dismantled	28	28	28
Total Cost	562	421	391

Source: DPR

844. From an improvement point of view, two types of standards have been adopted, namely:

- The desirable standards, which could be adopted as a rule.
- The minimum standards which could be accepted for difficult stretches where application of the desirable standards would lead to high costs.

845. The following cross-sectional elements have been considered in the selected option:

846. Lane Width As per IRC: SP:48 2018, the standard lane width of the project highway shall be 3.75 m.

847. Earthen Shoulders: It is proposed to have varying shoulder length of 0.5 – 1.5m wide earthen shoulders. 1.5 m all along the road and 0.5 m near the sightseeing points where a 2.5 m parking is provided.

848. Side Slopes: The slope of embankment is linked with its height. In accordance with the Manual for Safety in Road Design (MoRTH publication), 2H: 1 V has been proposed for the entire stretch.

849. **Culverts:** The rain falls very heavily on the hills and as the slopes are quite steep, the water reaches the roadside very quickly and creates drainage problems. The water thus collected should be disposed of in a proper way through the well-planned and designed drainage system. An appropriate number of 154 Culverts have been considered in the design.

C.2. Upgradation/construction of ropeway Tipri to Madan Negi

850. Selection of the suitable ropeway technology depends on the length of the project, capacity of the proposed system, ground profile of the terrain, and availability of land for stations as well as Intermediate towers. Considering these parameters three types of Ropeway system can be made between Tipri to Madan Negi.

Table 63. Three different types of ropeway system

S No	Item	Twin Track Bi-Cable Double Reversible Jig Back Ropeway (Option-1)	Single Track Bi-Cable Double Reversible Jig Back Ropeway (Option-2)	Tri-Cable Detachable Ropeway (Option-3)
1	System Transport Capacity (PPHPD)	500 to 1500	500 to 1500	3000 to 5000
2	Speed	Up to 7 m/s	Up to 7 m/s	Up to 8.5 m/s
3	Cabin Capacity	10 to 35	10 to 35	up to 35`
4	Per km Cost	50 to 65 Cr.	40 to 55 Cr.	95 to 110 Cr.
5	Remarks	Suitable for undulating terrain. High altitude terrain. High Cabin swing stability.	Suitable for undulating terrain. High altitude terrain.	Suitable for high-capacity transportation, high altitude terrain.

PPHPD = Passengers Per Hour Per Direction; Cr = Crore

851. Here option 1 has been selected. (Twin Track Bi-Cable Double reversible Jig Back Ropeway system) which is found best suitable for this project because of the following reasons.

- The Span of the ropeway is very long.
- Twin track Bi-cable has more stable cabin movement compared to single track Bi-cable ropeway.
- Capacity Per hour is low (100-150 PPH)
- The cost of construction is low as compared to other ropeways.
- It has a low station space requirement compared to a detachable grip continuous movement ropeway.

C.3. Water Public Transport Stations at multiple locations

852. Considering the expected increased footfall of Tourists and giving facilities for local people the development of water public transport stations at 5 locations by way of providing a floating jetty is proposed. Floating Jetty using HDPE Pontoon is considered at 5 different locations of Tehri Catchment Area. 3 Jetties are provided in Bhagirathi Valley and 2 in Bhilangana Valley. The location of the water public transport stations has been selected based on the availability of the approach road and location connectivity.

853. High-Density Polyethylene (HDPE) as a Floating Pontoon has been selected as a viable

option owing to following advantages:

- Floating jetties are crucial for areas with significant water level changes, as they adjust to these variations, making them ideal for maintaining functionality without risk of damage. Floating jetties provide a stable platform that adjusts to water levels, ensuring safe access to and from boats in varying conditions and allowing for easy access during emergencies.
- In hilly regions, where excavation for fixed jetties is challenging and costly, floating jetties require less intensive groundwork and minimal alterations to the natural landscape, preserving the area's natural beauty.
- By moving with the water, floating jetties reduce shoreline erosion, a critical factor in hilly areas where erosion could lead to landslides.
- The construction and maintenance of floating jetties are generally more cost-effective than fixed jetties, with less frequent and easier maintenance, leading to lower long-term costs.
- Floating jetties can be designed to harmonize with natural surroundings, enhancing the area's visual appeal while providing additional recreational opportunities, and potentially boosting local tourism.

C.4. Installation of signages at various locations

854. The alternatives considers for signages are:

Type of Signage	Option-1	Option-2 Selected option	Rationale
Multi-directional signage	Wrought iron pillar with wood texture polyurethane paint and mild steel plate in wood texture with vinyl content laminated and pasted over it.	Wrought iron pole with wooden panel encased in high-pressure panels, engraved with location names.	Wooden panels were selected over mild steel plates for a more local, rustic feel and cost-effectiveness.
Map signage	Steel frame with acrylic sheet, painted.	Mild steel square tube clad with wooden panel, encased in high-pressure panels, engraved with location names. Single panel.	Wooden panel was chosen over acrylic sheet as it is more sustainable, native, and cost-effective.
Instruction signage	Mild steel tube frame with brick-cut high-pressure laminate.	Slate brick wall with textured aluminum composite panel, content in 3M media vinyl, and digital printing with lamination.	Slate wall was selected over high-pressure laminate sheet for its sustainability, native appeal, and cost-effectiveness.

855. **Summary.** The “with project scenario” provides the opportunity for sustainable development that can be advantageous for both tourists and locals. By implementing strategic planning and promoting sustainable development practices, the proposed Transport infrastructure component aims to foster a vibrant and resilient community that capitalizes on its inherent natural beauty and cultural resources to achieve lasting prosperity.

VIII. INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

A. Overview

856. The active participation of stakeholders including the local community, CSOs, and media in project preparation and implementation is essential for the successful implementation of the project. It will ensure that the subprojects are designed, constructed, and operated with utmost consideration to local needs, ensure community acceptance, and will bring maximum benefits to the people. Public consultation and information disclosure are a must as per the ADB policy.

857. Most of the main stakeholders have already been identified and their representatives consulted during the preparation of this IEE. Any others identified during project implementation will be brought into the process. Primary stakeholders in the subproject are residents, farmers, shopkeepers, and businesspeople who reside and work in Tehri project area, particularly where works are proposed under this subproject. The stakeholders are the government and utility agencies responsible for the provision of services in the project area, PWD, Forest and Wildlife Department, DTDO Tehri, THDC Board, etc., NGOs and CBOs working in the area. Both primary and secondary stakeholders were consulted during the preparation of this IEE.

858. Public consultation meetings were held at few of the project intervention locations that are proposed under the Transport component. Consultations with the inhabitants of the subproject area were carried out through December 2023 to June 2024.

B. Public Consultation

859. The public consultation and disclosure program are a continuous process throughout the project implementation, including project planning, design and construction.

B.1. Consultation during Project Preparation

860. Institutional consultations were conducted with the relevant governmental departments such as the PWD, UTDB, DTDO, Forest and Wildlife Department, etc. The subproject proposals are formulated in consultation with PWD, Forest Department, UTDB and the District Tourism Development Officer (DTDO), concerned district administration, and local administrative bodies to suit their requirements.

861. Focus-group discussions with affected persons and other stakeholders were conducted to learn their views and concerns over the proposed subproject. The general public who are the people residing along the target subproject activity areas were consulted during visits. Formal panchayat-level consultation meetings were conducted in April 2024 in the subproject areas. Besides, several other meetings were also conducted at the village-level with communities. The details of the consultation are provided in Appendix 19. The main issues discussed are:

- (i) Awareness and extent of the project and development components.
- (ii) Benefits of the project for the economic and social upliftment of the community
- (iii) Labor availability in the project area or requirement and involvement of outside labor.
- (iv) Expected employment opportunities due to project intervention.
- (v) Local (expected) disturbances due to project construction work
- (vi) Necessity of tree felling etc. at project sites.
- (vii) Water logging and drainage problems if any.
- (viii) Climatic conditions.

- (ix) Drinking water availability and problems, if any.
- (x) Forest and sensitive area near the project area.
- (xi) Movement of wild animals etc.
- (xii) Pollution levels during the construction period especially dust and noise pollution.
- (xiii) Health and hygiene.
- (xiv) Safety of residents during the construction phase.
- (xv) Solid waste disposal system.
- (xvi) Requirement of enhancement of other facilities.

862. In line with the ADB's requirements, consultations were conducted with key stakeholders and community people about environmental and social considerations. These consultations helped in identifying felt needs/concerns and apprehensions of the communities related to the subproject and their priorities. Consultations were held with stakeholders including temporarily affected persons, farmers, beneficiaries/local people, poorest of poor households (non-titleholders on government land), gram panchayat pradhans, panchayat members/public representatives, PWD, Forest Department, UTDB, DTDO and field staff.

863. Public consultation meetings were held at some of the subproject component locations and the Table 63 provides a summary of the locations, and participants in the consultation meetings. A total of 249 participants were present in the consultation meetings out of which 32.93% were female participants. Consultations were also held with various institutional stakeholders at their offices. Since the consultations are an ongoing procedure, the column related to issues, suggestions and requests shall be updated on the progress of various requests and suggestions that may be received through official channels.

Table 64. Public consultations at the subprojects

Sl. No.	Date	Location	Total number of participants	Total number of female participants
1	19 Feb 2024	Tiwari Gaon	21	64
	02 Mar 2024		11	
	26 Apr 2024		70	
	01 Jun 2024		34	
2	20 Feb 2024	Dobra Chanti	7	0
	02 Mar 2024		10	
3	31 Dec 2023	Koti village	18	3
	23 Feb 2024		9	
4	28 Apr 2024	Julk Ramgaon	2	0
5	28 Apr 2024	Jakh-Chaura	15	6
6	30 Dec 2023	Madan Negi	13	9
	21 Feb 2024		22	
	02 Mar 2024		17	
TOTAL			249	82

864. **December 2023 to June 2024 Consultations:** Results of The community consultations for the proposed works were conducted at multiple locations, including Tiwari Gaon, Dobra Chanti, Koti Village, and other nearby areas, to gather input and address concerns from the local stakeholders. The consultations occurred on various dates and had varying numbers of participants, demonstrating strong community engagement and interest in the project. In Tiwari Gaon, a consultation held on February 19, 2024, involved 21 participants, of whom 64% were female. At Dobra Chanti, a consultation on February 20, 2024, had 7 participants, with no female

representation. Similarly, Koti Village's consultation on December 31, 2023, included 18 participants, 3 of whom were female. These consultations covered various aspects of the project, including socio-economic benefits, environmental impacts, and potential mitigation measures.

865. The consultations highlighted several environmental concerns and the need for protective measures. In Tiwar Gaon, participants emphasized the potential impact on local flora and fauna due to construction activities. The area is in proximity to forest lands, and participants were particularly concerned about the displacement of local wildlife during construction. They suggested implementing strict pollution control measures, and adopting strategies to prevent soil erosion and landslides. Moreover, the community expressed concerns regarding the impact of dust and noise generation on their health and daily activities during the construction phase. They recommended measures such as dust suppression and the scheduling of construction activities during less intrusive hours.

866. At Dobra Chanti, the consultation focused on the preservation of the natural landscape and sustainable development of tourism-related infrastructure. Participants noted that the construction could fragment local ecosystems. To address these concerns, they recommended the inclusion of green infrastructure such as buffer zones to minimize the impact on biodiversity. The local community expressed support for eco-friendly development that integrates conservation efforts with tourism growth. They suggested that construction activities be limited to designated zones to reduce damage to the local environment.

867. During the consultation at Koti Village, participants highlighted the potential for sustainable tourism development and expressed concerns about unregulated growth. The community recommended the implementation of zoning regulations to define specific areas for commercial, residential, and agricultural activities, preventing uncontrolled land conversion and urban sprawl. They also proposed the development of eco-friendly tourism facilities like nature trails, bird-watching sites, and camping areas to promote low-impact tourism that supports conservation and generates income for the local population. Participants expressed concerns about the temporary loss of access and closure of services during the construction phase. They suggested creating alternative routes and maintaining open communication with the community to ensure minimal disruption.

868. Consultations were also held with government officials and the Divisional Forest Office on May 3, 2024, which included 5 participants, 2 of whom were female. During these discussions, officials emphasized the importance of implementing a comprehensive forest management plan to prevent forest fires and protect vulnerable species. They highlighted the need to conduct joint forest verifications and establish a protection management plan to safeguard the valley sides during construction. They also emphasized the importance of selecting suitable muck disposal sites that do not compromise the stability of the slopes.

869. In summary, the stakeholder consultations indicated a strong commitment from local communities and government officials to balance the economic benefits of the road improvements with environmental protection. Community members across various locations provided valuable insights and suggestions to mitigate potential environmental impacts, demonstrating a collective interest in preserving the region's natural beauty and biodiversity.

870. **September 2024 Consultations.** In villages such as Tiwar Gaon, Marora, and Hadki, the primary environmental concerns were related to tree cutting. The PWD confirmed that tree felling would occur, but assured that compensation and replanting would be carried out as per domestic laws and regulations. Residents emphasized the need for useful species in tree replanting, which

was acknowledged and agreed upon by project representatives. Another concern raised was the potential increase in waste due to the anticipated growth in homestays and visitor numbers. The UTDB addressed this by outlining plans for Solid Waste Management (SWM) at the village level, which includes door-to-door waste collection and an upgrade to the Sewage Treatment Plant (STP).

871. In Ramgaon, residents were worried about the impact on a local temple and requested compensation or reconstruction. The PWD proposed either monetary compensation through a village committee or reconstructing the temple. Residents also requested prioritization of local youth for employment opportunities, dust control measures during construction, and timely initiation of the project. These concerns were noted, and the project authorities assured that these aspects would be integrated into project planning and implementation.

872. In Palash Village, participants expressed frustration over the frequency of consultations, citing that it interfered with their daily activities. Similarly, in Tiwargaon Village, concerns were raised about potential land loss due to the ADB and railway projects, with villagers seeking land-for-land compensation instead of financial remuneration. The District Magistrate's Office clarified that compensation would be provided in financial terms as per the existing procedures.

873. Residents across different villages anticipate multiple benefits from the tourism road project. In Palash Village, the community appreciated that the narrow road would be widened, improving overall accessibility. Villages like Tiwargaon and Marora highlighted the potential increase in tourism, which would create more job opportunities and boost local businesses. In Ramgaon, villagers foresee increased traffic bringing more customers for local products such as milk and boosting homestay and restaurant businesses.

874. Overall, most of the villages, including Tiwargaon and Marora, indicated that they had received adequate information about the tourism road subproject from the UTDB. However, residents in Ramgaon requested a quicker commencement of the roadwork to help them plan where to establish their businesses after construction is completed.

B.2. Consultation during construction

875. Prior to the start of construction, UTDB and PWD with the assistance of the Project Management, Design, and Support Consultant (PMDSC) will conduct information dissemination sessions at various places and solicit the help of the local community, leaders/prominent for the project work. At each neighborhood level, focus group meetings will be conducted to discuss and plan construction work with local communities to reduce disturbance and other impacts.

876. Regular communication will be established with the affected communities to respond to environmental issues likely to surface during construction phases and regarding the grievance redress mechanism. UTDB, PWD with support of PMDSC will organize public meetings and will appraise the communities about the progress on the implementation of EMP. Meetings will also be organized at the potential hotspots/sensitive locations before and during the construction.

B.3. Information Disclosure

877. Executive summary of the IEE will be translated in the local language-Hindi and made available at the offices of UTDB, PIU-PWD, Village Panchayat offices, and displayed on their notice boards. Hard copies of the IEE will be accessible to citizens to disclose the document and at the same time create wider public awareness. The electronic version of the IEE in English and

the Executive Summary in Hindi will be placed on the official website of the UTDB/PMU after approval of the IEE by the Government and ADB. Stakeholders will also be made aware of the grievance register and redress mechanism.

878. Public information campaigns to explain the project details to a wider population will be conducted. Public disclosure meetings will be conducted at key project stages to inform the public of progress and future. Prior to start of construction, the PMU/PIU will issue a Notification on the start date of implementation in local newspapers. A board showing the details of the project will be displayed at each construction site for the information of the general public.

879. Local communities will be continuously consulted regarding the location of construction camps, access, muck disposal sites, and hauling routes and other likely disturbances during construction. The road closure (if any) together with the proposed detours will be communicated via advertising, pamphlets, radio broadcasts, road signage, etc.

880. Project related information shall be disclosed through public consultation and making relevant documents available in public locations. PMU and PIU-PWD shall provide relevant safeguards information in a timely manner, in an accessible place and in a form and language understandable to affected persons and other stakeholders. For illiterate people, other suitable communication methods will be used.

881. At minimum, the following documents shall be available at the offices of UTDB, PMU, PIUs, and block level offices for public reference, and also uploaded on respective websites.

- I. Executive summary of the IEE (in Hindi);
- II. Draft IEE Report (in English);
- III. Final IEE Report (in English);
- IV. Updated/amended IEE, whenever updated/amended (in English);
- V. Corrective action plans prepared during project implementation (English);
- VI. Environmental Monitoring Reports (English).

882. A concise executive summary of the project (in Hindi) and final IEE report, providing details of proposals, implementation arrangements, subproject locations, environmental impacts and mitigation and monitoring measures, and grievance redress mechanism, shall be made available to the stakeholders at consultation meetings. This will also provide contact information of the project agency. This summary shall be displayed at notice boards of PMU, PIU and other public places. During project implementation, relevant information about any major changes to project scope will be shared with beneficiaries, affected persons, vulnerable groups, and other stakeholders. The above documents shall be submitted to ADB for disclosure on ADB website.

B.4. Adaptive Mechanism

883. In case of the recurrence of the COVID-19 outbreak and other diseases, adaptive mechanisms will be used to address limitations on environmental safeguard activities and consultations due to any government restrictions and COVID-19 risks. Surveys and data collection will be conducted through online platforms, brochures, questionnaires, and other forms of media as applicable to provide information and receive feedback from the people, beneficiaries, government agencies and other stakeholders.

IX. GRIEVANCE REDRESSAL MECHANISM

884. A project-specific grievance redress mechanism (GRM) has been designed to receive, evaluate, and facilitate the resolution of affected persons' concerns, complaints, and grievances about the social and environmental safeguards performance at the project level. The GRM aims to provide a time-bound and transparent mechanism to voice and resolve social and environmental safeguards concerns associated with the project. The GRM provides an accessible, inclusive, gender-sensitive, and culturally appropriate platform for receiving and facilitating the resolution of affected persons' grievances related to the project. The multi-tier GRM for the project is outlined below, with each tier having time-bound schedules and responsible persons identified to address grievances and seek appropriate persons' advice at each stage, as required. The GRM applies to the entire project including activities under the LMGP.

885. The PIU will ensure public awareness campaigns covering the project's urban local bodies (ULB) and village areas to generate awareness about the GRM. The nodal officer for the GRM at the field level PIU will ensure that all the affected persons, including vulnerable households, are aware of grievance redress procedures and entitlements. Contractors will provide leaflets/notices to shop owners, tenants, and the community before the start of work and put up billboards during construction that mention project work details. The leaflets and billboards will include relevant environmental and social safeguards, GRM information, and contact details of key personnel from the PIU and contractors.

886. Affected persons will have the flexibility of conveying grievances by dropping grievance registration forms in complaint boxes that are installed by project PIUs, by e-mail, by post, or by writing in a complaint register in ULB offices or at the contractor's work site. The sample grievance registration form is in Appendix 20. Careful documentation of the complainant's name, date of receipt of the complaint, address/contact details, location of the problem area, and how the problem was resolved will be undertaken, and feedback will be provided to the complainant on the action/decision taken.

887. The PMU and PMDSC safeguard experts, working closely with the GRM PIU Nodal Unit, will be responsible for timely grievance redressal on environmental and social safeguards issues and for the registration of grievances and related disclosures. In case of grievances that are immediate and urgent in the perception of the complainant, the PMU and PMDSC safeguard experts, PIU Project Manager, PIU Community Development Officer, and contractor, will provide the most easily accessible or first level of contact for quick resolution of grievances. Contact numbers and names of the concerned PIU officers and contractors will be posted at all construction sites at visible locations. Specific focal positions for the GRM are listed in the following paragraphs and Figure 59.

888. The three tiers of the GRM are as follows.

889. **PIU Level.** First level of registering and addressing grievances.

890. Members of the UTDB/TADA PIU include:

- (i) District Tourism Development Officer: Chairman till appointment of Project Manager, PIU-UTDB/TADA, who then will take over as Chairman
- (ii) ACEO-TADA or his/her representative: Member
- (iii) Community Development Officer – PIU: Member

- (iv) Social, Gender and Civil Society Specialist; Social Safeguards Specialist; and Environment Safeguards Specialist – PMDSC: Member
- (v) CSO peoples representative (at least one-woman representative from SHG): Member
- (vi) Village level representative: Gram Panchayat Vikas Adhikari (executive position attached to the Village Pradhan who plays an important role in implementation and monitoring of all government schemes at panchayat level)
- (vii) Contractor or his/her representative: Member

891. Members of the PWD/Forest/UK Jal Sansthan PIU include:

- (i) District Tourism Development Officer: Chairman till appointment of Project Manager PIU-PWD/Forest/UK Jal Sansthan, who then will take over as Chairman
- (ii) ACEO – TADA or His/her representative: Member
- (iii) Community Development Officer – PIU: Member
- (iv) Social, Gender and Civil Society Specialist; Social Safeguards Specialist; and Environment Safeguard Specialist – PMDSC: Member
- (v) CSO peoples representative (at least one-woman representative from SHG): Member
- (vi) Village level representative: Gram Panchayat Vikas Adhikari (executive position attached to the Village Pradhan who plays an important role in implementation and monitoring of all government schemes at panchayat level)
- (vii) Contractor or his/her representative: Member

892. Complaints related to social and environmental safeguards received through written or oral communication will be registered in the Complaint Register. Each complaint will be assigned a unique number, and details such as the date of receipt, the complainant's name, and contact information will be recorded. The PMU and PMDSC safeguard experts, PIU GRM nodal points, and subproject beneficiary, will review the complaint and direct the contractor for necessary action, aiming to resolve the issue within seven days from the date of receipt. Depending on the type or nature of the complaint, the contractor will be given reasonable time for corrective action. If the grievance does not fall under the purview of the project, this will be communicated to the complainant. The subproject beneficiary and contractor will take corrective action as directed by the PIU Project Manager. The action taken will be documented in the Complaint Register. If the complaint is satisfactorily addressed, it will be closed, and the complainant will be informed via email or telephone. This information will also be communicated to the PMU for office records. Complaints that cannot be addressed at the PIU level will be forwarded to the PMU Level 1.

893. **Functions of GRM/GRC at PIU level.** The concerned PIU will nominate one official to oversee the progress and provide response to the grievances raised by the affected person. Following are the functions of GRM/GRC at PIU level:

- (i) Before registering the complaint/query, a procedural step will be in place to assess its eligibility and check that issues raised in the complaint fall within the scope that the GRM is mandated to address.
- (ii) A Grievance Register will be maintained and digitized at the PIU level by this designated official to document the grievance register as per the prescribed format attached in Appendix 20, including details of the date and type of grievance received, the date of personal hearing provided to the complainant, the date when the grievance was redressed or if not redressed date of forwarding the grievance to the Grievance Redressal Committee.

- (iii) Provision will be made to record and maintain grievances received directly on-site and incorporated in the Grievance Register. This will serve as the First Level of Grievance resolution.
- (iv) With reference to the complaints related to Gender Based Violence (GBV)/Sexual Exploitation and Abuse (SEA), the committee will refer the case to the Internal Committee under the PMU and PIU and adhere to the principle of confidentiality while informing the same to the District Level GRC (if required) as the case may be.
- (v) The nominated official at the PIU will also be responsible for ensuring that a mechanism is put in place to address grievances of labor and staff deployed at project sites by the contractors.
- (vi) Grievances that cannot be resolved at the PIU level.
- (vii) PIU will be responsible for organizing monthly meetings for the smooth functioning of the GRM/GRC.
- (viii) PIU will ensure transparency and fairness in the grievance resolution process, and provide regular updates on GRM performance and outcomes.

894. The PIU will engage in one-on-one discussions or meetings with the complainant to understand their concerns fully and work towards providing the most effective resolution. The PIU will ensure that these interactions are conducted with confidentiality and respect and will document all communications and proposed solutions. Furthermore, the PIU will follow up to ensure that the resolution is implemented satisfactorily and that the complainant's concerns are fully addressed.

895. **PMU Level 1.** The grievance redress team at PMU Level 1, with the assistance of PMDSC, will initiate action and implement corrective measures as required. The PMU will inform the complainant about the action taken. If the complainant is satisfied, the case will be closed and marked as resolved within 15 days of receipt of compliance/grievance, with proper notification to the complainant and the PMU. The responsible persons for grievance redress will include:

- (i) Additional Project Director, PMU: Chairman
- (ii) Project Manager – PIU (PWD, Forest, Jal Sansthan and UTDB): Member
- (iii) Environment Safeguards Specialist; Community Development and Gender Specialist – PMU: Member
- (iv) Social, Gender and Civil Society Specialist; Social Safeguards Specialist; and Environment Safeguards Specialist – PMDSC: Member
- (v) CSO peoples representative (at least one-woman representative from SHG): Member
- (vi) Contractor or his/her representative: Member

896. **Functions of GRM/GRC at PMU level 1.** The concerned Project Implementation Unit will nominate one official to oversee the progress and provide response to the grievances raised by the affected person. Following are the function of GRM/GRC at PIU level:

- (i) Before registering the complaint/query, a procedural step will be in place to assess its eligibility and check that issues raised in the complaint fall within the scope that the GRM is mandated to address.
- (ii) If the complainant does not seek resolution from PMU level 1 then it must be escalated to PMU level 2.
- (iii) The GRC meetings will be organized quarterly or as complaints arise, whichever is more frequent.
- (iv) PMU Level 1 will monitor the functioning of the GRM at the PIU level and maintain consolidated data for further action.

- (v) PMU Level 1 is responsible for providing support and guidance for the GRM at the PIU level and ensuring the effective dissemination of information from the funder. Additionally, PMU Level 1 will facilitate the PIU staff on GRM procedures and ensure compliance with relevant regulations and standards.

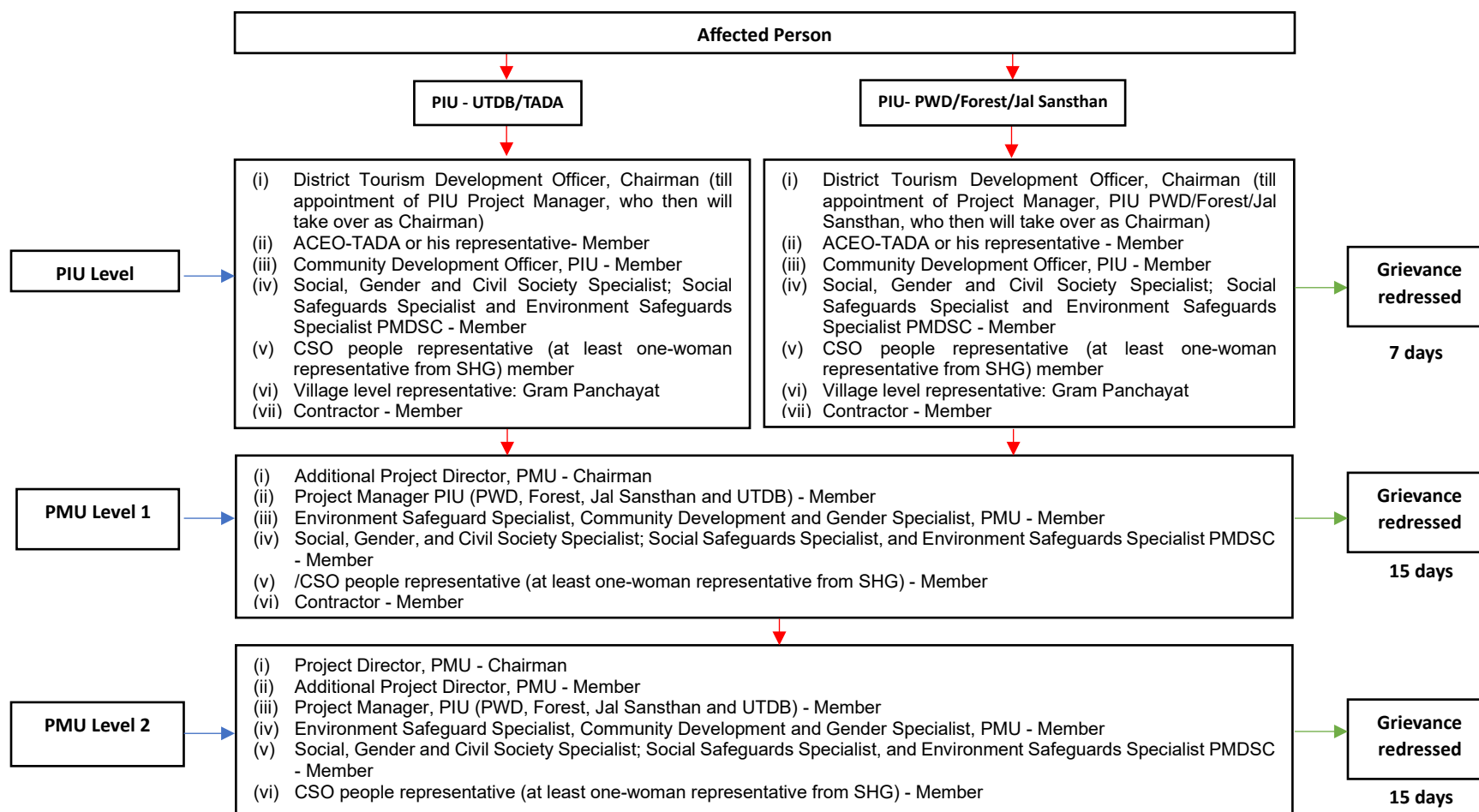
897. **PMU Level 2 GRC.** If a complainant is not satisfied with the action taken at PMU Level 1, the complainant can approach the Grievance Redress Committee at PMU Level 2 (it is expected that the grievance will be redressed within 15 days from the date of receipt. The GRC at PMU will comprise of the following members:

- (i) Project Director, PMU: Chairman
- (ii) Additional Project Director, PMU: Member
- (iii) Project Manager – PIU (PWD, Forest, Jal Sansthan and UTDB): Member
- (iv) Environment Safeguard Specialist, Community Development and Gender Specialist – PMU: Member
- (v) Social, Gender, and Civil Society Specialist; Social Safeguards Specialist; and Environment Safeguards Specialist – PMDSC: Member
- (vi) CSO people representative (at least one-woman representative from SHG): Member.

898. **Functions of GRM/GRC at PMU level 2.** The concerned Project Implementation Unit will nominate one official to oversee the progress and provide response to the grievances raised by the affected person. Following is the function of GRM/GRC at PIU level:

- (i) GRC meetings will be scheduled as needed, based on the emergence of complaints.
- (ii) The GRM at PMU Level 2 will serve as the final decision-making authority. Its decisions will be binding and must be adhered to by all relevant parties. If the complainant is dissatisfied with the resolution, they may seek recourse through the Indian judicial system or the ADB's Accountability Mechanism.

899. **Court of Law.** The GRM does not impede or conflict domestic laws and legal procedures. Affected persons have access to the country's legal system at any stage. The proposed project GRM is illustrated in Figure 59.



ACEO = Additional Chief Executive Officer, CSO = civil society organization, DTDO = District Tourism Development Officer, GRC = grievance redress committee, PMDSC = project management, design, and supervision consulting services, PIU = project implementation unit, PMU = project management unit, SHG = self-help group, TADA = Tehri Special Area Tourism Development Authority, UTDB = Uttarakhand Tourism Development Board.

Figure 70. Project Grievance Redress Mechanism

900. In cases of land acquisition, resettlement, and rehabilitation grievance, affected persons will have to approach a legal body or court specifically proposed under the RFCTLARRA, 2013¹⁸. However, since none of the impacts are complex, long-term, or significant, it is unlikely that there will be unresolved issues after the first three stages. The PMU will submit the RP/EMP implementation report to ADB's review and ensure that affected persons receive compensation and other assistance as per the entitlement matrix before the impact/displacement and before the commencement of civil works. Issues related to the environment will be addressed as per the guidance provided in EMP.

901. **ADB's Accountability Mechanism.** If the GRM is unable to resolve the issue, the affected person can also access the ADB's Accountability Mechanism by directly contacting (in writing) the Complaint Receiving Officer at ADB headquarters. People who are, or may in the future be, adversely affected by the project may submit complaints to ADB's Accountability Mechanism. This mechanism provides an independent forum and process through which people adversely affected by ADB-assisted projects can voice their concerns, seek resolution, and report alleged violations of ADB's operational policies and procedures. Before submitting a complaint to the Accountability Mechanism, affected people should make a good faith effort to solve their issues by working with the concerned ADB operations department. If they remain dissatisfied after this effort, they should then approach the Accountability Mechanism.¹⁹

902. **Confidentiality.** The complainant's confidentiality will be strictly maintained by limiting access to complaint details to authorized personnel only, storing physical records in locked cabinets or secure rooms with restricted access, and redacting personal identifiers (such as names and contact details) from documents and reports shared outside the immediate complaint handling team.

903. **Monitoring and reporting.** The PIU will keep records of grievances received, including contact details of the complainant, the date the complaint was received, the nature of the grievance, agreed corrective actions, the date these were affected and the outcome, all in a gender-segregated manner. The number of grievances recorded and resolved, along with their outcomes, will be available at the PMU and PIU offices and reported in monitoring reports submitted to ADB on a semi-annual basis. The sample grievance registration format is attached.

904. **Feedback to the complainant.** The PIU will be responsible for ensuring that decisions regarding complaints received (at any level) are reported back to the aggrieved party with an acknowledgment of the same. The PIU will maintain records of this, which will be available for review by PMU.

905. **Periodic review and documentation of lessons learned.** The PMU project safeguard officers will periodically review the GRM functioning at the PIU and record information on the mechanism's effectiveness, especially on the project's ability to transparently prevent and address the reported grievances.

906. **Costs.** As part of the EMP cost, the construction contractors will allocate budgets for pamphlets, billboards, and site-level grievance registers as per requirement. PIU will cover the costs involved in resolving the complaints (meetings, consultations, communication, and

¹⁸ The Authority admits grievances only with reference to the Land Acquisition and R&R issues under the RFCTLARRA, 2013.

¹⁹ <https://www.adb.org/who-we-are/accountability-mechanism/main>

reporting/information dissemination), while the PMU will handle costs related to further action on intensified grievances.

907. Rules and regulations of the GRC/GRM:

- (i) The GRC committee will be established for a term of three years, after which new nominations will be solicited.
- (ii) Monthly meetings should be organized for regular monitoring of the complaints by the GRM/GRC committee.
- (iii) Any member who fails to attend more than three meetings will be removed from the committee, as decided by the remaining committee members.
- (iv) In the event of a member's transfer or resignation, a new member will be nominated to fill the vacancy on the GRC committee.
- (v) At least three of the six members of the committee must be present to constitute a quorum. The committee shall try, to the extent possible, to act by consensus. In the event a consensus is not possible, the committee shall act by a majority vote of those present.
- (vi) There shall be as far as practicable, at least 2-woman members in the GRM/GRC committee.
- (vii) The Committee should encourage the inclusion of SC/ST representatives at each level.
- (viii) Capacity-building initiatives for GRC/GRM members should be conducted regularly.

X. ENVIRONMENTAL MANAGEMENT PLAN

A. Rationale

908. The Environmental Management Plans (EMPs) for the proposed transport infrastructure components—tourism road, ropeway, water transport stations, signages at various locations and last mile connectivity and smart infrastructure—under the Sustainable Inclusive and Climate-Resilient Tourism Development at Tehri Lake Area Project has been developed to guide the project's implementation in an environmentally responsible manner. The primary purpose of the EMPs is to provide strategies to mitigate potential environmental impacts associated with the construction and operation of these components. It serves as a framework to ensure compliance with both national regulations and international standards, particularly those outlined in the ADB SPS 2009.

909. The development of the tourism road from Koti Colony to Dobra Chanti, ropeway infrastructure from Tipri to Madan Negi, water transport stations, last mile connectivity and smart infrastructure like smart bus shelters and command systems, could lead to several environmental impacts if not managed properly. During the construction phase, there may be disturbances to the local environment, such as dust generation, soil erosion, and disruption of water resources, which could affect both terrestrial and aquatic ecosystems. In the operational phase, increased vehicular and foot traffic, as well as the waste generated from tourist activities, could strain local resources and impact the natural landscape. The EMP outlines specific mitigation measures, such as using pollution control technologies, implementing waste management strategies, and adhering to safety standards to minimize these adverse effects.

910. The potential impacts of the tourism road development include soil erosion, slope destabilization, and dust emissions during construction. The increased vehicular movement may also lead to air pollution and habitat fragmentation. The ropeway construction could cause significant noise pollution, affect bird habitats, and alter the landscape aesthetics. For water transport, impacts may include potential water contamination from oil spills, increased water turbidity, and disturbance to aquatic species. Finally, the development of smart infrastructure—such as smart bus stops, electric vehicle charging stations, and a command system—while beneficial in promoting sustainable tourism, may lead to short-term disruptions during construction and potential operational emissions if not carefully managed.

911. The EMP serves as a critical document developed to ensure that project activities are implemented in a manner that is environmentally responsible, sustainable, and compliant with applicable regulations and standards. Its primary purpose is to provide a systematic and structured approach for managing and mitigating potential environmental impacts that may arise during the planning, construction, and operational phases of a project. The EMP outlines specific measures, procedures, and guidelines that must be followed to minimize adverse environmental and social impacts while simultaneously enhancing positive outcomes. It acts as a proactive tool, enabling project proponents and contractors to identify, assess, and mitigate potential risks before they escalate. Additionally, the EMP serves as a guiding document to ensure that the recommendations from environmental assessments conducted for the project are not only designed but also effectively implemented and monitored.

912. The EMP will be included in the bid documents of respective packages and will undergo further review and updates as necessary during the subproject implementation phase. By integrating the EMP into the bidding documents, it becomes a legally binding requirement for all

contractors operating on the site and will be enforced through specific contractual clauses. This ensures that all contractors are fully aware of the environmental and safety standards that they are required to comply with. Any non-compliance or deviation from the conditions set out in the EMP will be considered a breach of contract and could lead to penalties, suspension of work, or other corrective actions as stipulated in the contract terms.

913. Contractors are obligated to follow the EMP's provisions diligently and must submit detailed site-specific environmental management sub-plans before commencing work. These sub-plans will outline how the contractors will implement the EMP's requirements, including measures for dust suppression, waste management, noise control, water resource protection, and health and safety practices. The EMP will serve as a tool for monitoring the contractor's environmental performance, with regular inspections and audits conducted to ensure adherence. This integration of the EMP into the bidding documents and contract clauses emphasizes the project's commitment to environmental sustainability and accountability, holding contractors responsible for maintaining the highest environmental and safety standards throughout the project lifecycle.

914. The contractor will be required to: (i) establish a robust operational system for effectively managing environmental impacts throughout construction; (ii) diligently carry out all monitoring and mitigation measures as specified in the EMP; and (iii) promptly implement any corrective or preventive actions identified in the safeguards monitoring reports prepared by the Project Management Unit (PMU) and the Project Implementation Unit (PIU). These reports will be generated periodically to assess the ongoing implementation of the Initial Environmental Examination (IEE) and EMP. To ensure full compliance with these EMP measures, requirements, and actions, the contractor shall allocate an adequate budget for the implementation of all environmental management activities, including monitoring, mitigation, and corrective actions. In case the IEE report and EMP appended to the contract agreement is not same as the one disclosed in the ADB's website then the version disclosed in the ADB's website shall be applicable.

B. Responsibilities for EMP Implementation

915. The following agencies will be responsible for EMP Implementation

916. The UTDB, Government of Uttarakhand, is the executing agency responsible for the overall management, coordination, and execution of all activities funded under the loan. In terms of EMP implementation, UTDB plays a key role in ensuring that the project adheres to environmental safeguards and compliance requirements. This includes integrating the EMP into bidding and contractual documents, monitoring contractor performance against EMP requirements, and providing oversight and guidance to ensure effective implementation of environmental management measures. UTDB will work in collaboration with the PMU and PIUs to review environmental monitoring reports, assess compliance, and ensure that corrective or preventive actions are promptly undertaken as needed.

917. PMU will be established in Dehradun to oversee the overall execution and coordination of the project, including ensuring compliance with the EMP. The PMU will play a pivotal role in managing and monitoring the implementation of the EMP by coordinating with contractors and consultants to ensure that all environmental mitigation and monitoring measures are effectively executed. The PMDSC at Dehradun will assist the PMU in all aspects of project execution, including procurement, technical quality assurance of design and construction, and regular

environmental performance monitoring. The PMU will be responsible for reviewing environmental monitoring reports, ensuring corrective actions are taken when necessary, and facilitating communication between stakeholders to maintain adherence to the EMP throughout the project lifecycle.

918. PWD in the Tehri region is a key government agency responsible for the planning, development, and maintenance of public infrastructure, including roads, bridges, and other transport facilities. Its primary objective is to ensure the provision of safe, efficient, and sustainable infrastructure that supports regional development and enhances the quality of life for local communities. As part of its mandate, the PWD is committed to implementing infrastructure projects in a manner that minimizes environmental impacts and adheres to national and regional environmental regulations. The PWD will play a critical role in the implementation of the EMP for the tourism road upgrades under the project. A PIU will be established within the Tehri PWD Division to oversee and coordinate the execution of the transport infrastructure component subproject. The PIU's role includes ensuring that all road construction and upgrade activities are carried out in compliance with the EMP, with a focus on mitigating adverse environmental impacts such as soil erosion, habitat disruption, and air and water pollution. The PIU, in collaboration with the PMDSC, will monitor the contractor's adherence to the EMP, review and update the IEE if necessary.

919. TADA is a key government agency established with the objective of promoting planned and sustainable development in the Tehri region. Its mandate includes ensuring the holistic development of infrastructure, tourism, and public services in a manner that enhances the quality of life for residents while preserving the environmental integrity of the region. As part of its role, TADA focuses on promoting sustainable tourism and smart urban infrastructure, aligning with the region's vision of becoming a premier tourism destination that offers modern amenities and connectivity. In line with these objectives, TADA will serve as the PIU for the ropeway, signage and last mile connectivity, and smart infrastructure components of the Project. As the PIU, TADA's primary role is to ensure the effective execution of these components in accordance with the EMP and other project requirements. TADA will oversee day-to-day activities related to the construction and operation of the ropeway system and the development of smart infrastructure, such as smart bus shelters, EV charging stations, and command systems. This includes coordinating with contractors and consultants to implement the EMP's mitigation measures, monitoring environmental performance, and ensuring compliance with safety and environmental standards. TADA will collaborate closely with PMDSC to review technical designs, suggest modifications based on site-specific environmental conditions, and supervise construction activities to ensure they align with the EMP. Additionally, TADA will facilitate community consultations and engagement to address any concerns related to environmental and social impacts during project implementation.

920. The contractor will be responsible for executing all construction works as per the project's scope and specifications. They will operate under the guidance and supervision of the PIUs and the PMDSC. All EMP mitigation measures relevant to the construction and operations (if design-build operate package) phase must be strictly implemented by the contractor. The PIU will monitor the contractor's adherence to contract procedures and specifications to ensure compliance with environmental and safety standards throughout construction activities. Environment Specialists, deputed at both the PMU and PMDSC, will regularly oversee and evaluate the environmental performance of the contractors to ensure that all EMP requirements are being effectively followed, and any deviations or issues are promptly addressed.

921. During the construction phase, the Environmental Specialist from the PMDSC and the

designated representative engineer and safeguards officer from the PIU will monitor the contractor's environmental performance daily to ensure compliance with the EMP. The PMDSC's Environmental Specialist will also conduct random checks to identify any issues and implement corrective measures as needed. During the operational phase, the responsibility for monitoring environmental performance will be transferred to the District Tourism Development Officer, Tehri, who will ensure that all operational activities continue to comply with the environmental standards set forth in the EMP.

922. The implementation of EMP for the ropeway component under the design-build-operate (DBO) model requires a detailed and structured approach to ensure that all environmental safeguards and mitigation measures are effectively executed throughout the project lifecycle. As the ropeway system is being developed under the DBO model, the contractor assumes a comprehensive role, encompassing not only the design and construction but also the operation and maintenance phases. This integrated responsibility mandates a strong focus on environmental management, as the contractor will be directly accountable for compliance with EMP requirements during all project stages. During the construction phase, the contractor must implement all the EMP measures aimed at mitigating potential impacts on air quality, noise levels, water resources, soil stability, and biodiversity. This includes deploying pollution control technologies, minimizing vegetation clearance, and using environmentally friendly construction practices. The contractor is also responsible for establishing on-site environmental management systems, such as dust and noise suppression measures, waste management systems, and erosion control mechanisms. Regular monitoring will be carried out by the Environmental Specialist from the PMDSC and the PIU's designated representative engineer and safeguards officer to ensure that all construction activities adhere to the EMP standards. Any deviations or non-compliance will require immediate corrective actions as recommended by the supervising experts. In the operational phase, as part of the DBO model, the contractor's responsibilities extend to maintaining the environmental performance of the ropeway system. This includes ensuring that operational emissions, waste generation, and noise levels are within permissible limits, and that safety protocols are strictly followed. The contractor will be required to implement routine monitoring and maintenance activities to uphold environmental quality and safety standards. Additionally, they must respond to any community concerns and ensure that the ropeway operation does not adversely affect the local environment and biodiversity. The contractor's adherence to EMP measures during this phase will be monitored by the District Tourism Development Officer, Tehri, who will oversee the environmental compliance and recommend corrective actions if necessary. Through this comprehensive implementation of the EMP, the DBO contractor is expected to deliver a sustainable and environmentally compliant ropeway system that aligns with the project's overarching goals of promoting climate-resilient and eco-friendly tourism infrastructure.

C. Roles and Responsibilities Roles related to Environmental Safeguards

923. The project's environmental safeguards are supported by a structure of roles and responsibilities across several key stakeholders, ensuring compliance with national regulations, international standards, and ADB's SPS, 2009. The UTDB, through the PMU, assumes the primary responsibility for ensuring adherence to EMPs, and all relevant legal frameworks. The PMU, with support from the PMDSC and the PIUs, will ensure compliance, oversee monitoring and reporting processes, and take proactive measures in environmental risk management. Contractors, PIUs, and Design-Build-Operate (DBO) teams have distinct roles in implementing and ensuring environmental safeguards at various project phases, while ADB provides oversight and guidance to ensure full compliance throughout the project lifecycle.

924. The UTDB, acting through the PMU, is responsible for ensuring that the project conforms with the loan agreement, ADB's SPS (2009), EMPs, environmental and social management system (ESMS), and all applicable government's legal and regulatory requirements. Safeguards compliance will be required for the project to be on track, timely identification of any safeguard issues and implementation of corrective action is a performance indicator that is monitored by ADB. With the support of PMDSC and PIUs, the PMU will:

- (i) adhere to all government regulations, standards, and other environmental-related legal requirements for the project;
- (ii) ensure compliance with ADB's SPS (2009), EMPs, ESMS, and loan covenants.
- (iii) ensure compliance with international good practices per the following the requirements of the International Finance Corporation's General EHS Guidelines, their guidelines on agribusiness/food production/forestry/water and sanitation, and the International Labor Organization's Code of Practice on Safety and Health in Construction.
- (iv) review and approve environmental safeguard related clauses and sections to be included in tender documents and civil works contracts of contractor(s).
- (v) evaluate and approve the construction environmental management plan that contractor(s) have prepared.
- (vi) ensure that the project and all contractors obtain permits, licenses, etc. for activities before the implementation of the respective construction activity.
- (vii) oversee applying for important documents and sending them to government offices for the processing of permits and clearances, such as environmental clearance certificates, tree-cutting permits, and other pertinent licenses and permits.
- (viii) ensure environmental clearances obtained for subprojects before issuing bidding documents and awarding any work contracts to any contractors.
- (ix) conduct training and workshops on environmental management and site induction for all staff and workers involved in the project implementation.
- (x) carry out regular (at least quarterly) field verification and review environmental compliances by the PIUs and contractor during project implementation, in coordination with the PMDSC, PIUs and the contractor's environmental focal person.
- (xi) carry out regular (at least quarterly) field verification and review environmental compliances by the LMGP grant recipients during project implementation.
- (xii) supervise and monitor all components, with a zero-tolerance approach to health and safety risk management, ensuring adequate health and safety supervision.
- (xiii) prepare and disclose EMRs including to ADB, in compliance with the required guidelines and timelines.
- (xiv) implement effective environmental monitoring during the pre-construction, construction, and operation phases, guided by the IEEs submitted to ADB. This includes, but is not limited to, inspections, reviews of monitoring forms prepared by the PIUs, contractors, and documentation of the issues received through GRM.
- (xv) provide and record environmental observations during any site visits that may include, but are not limited to, excessive dust, loud noises, improper disposal of waste, chemical or oil spills, camp hygiene, health and safety, and improper borrow area management.
- (xvi) in case of potential risks and hazards to health, environmental quality, and properties that may result from poor EMP implementation, immediately guide PIUs or grant recipients to cease the construction or operational activities that pose risk and conduct immediate containment and mitigation activities.
- (xvii) take proactive and timely measures to address any environmental safeguards-related challenges at the national, state, or district levels, such as (a) delays in the processing of clearances during the pre-construction stage and (b) significant grievances during the construction and operation stages.

- (xviii) review and approve corrective action plans (CAPs) for environmental safeguard noncompliance.
- (xix) inform ADB of any unanticipated environmental impact(s) that occurred during the project implementation phase.
- (xx) ensure the GRM is in place and fully operational from the onset of project implementation; and
- (xxi) perform other tasks relevant with environmental safeguards of ADB and government of India.

925. The project's implementation is led by four key agencies. The UTDB, under the Department of Tourism, is responsible for the overall supervision and coordination, providing policy guidance, and monitoring both physical and financial targets, as well as ensuring the adequacy of project funding. The Public Works Department (PWD) manages the day-to-day execution and supervision of road components, including tourism roads, access roads, and road safety features. Uttarakhand Jal Sansthan oversees the sanitation and solid waste components, ensuring their effective execution and management. Finally, the Department of Forests is tasked with supervising the afforestation component, handling its execution and management to ensure environmental sustainability within the project. The 4 PIUs will help implement the project EMPs including:

- (i) ensure that the project, and all contractors obtain permits, licenses, etc. before the implementation of the respective construction activity;
- (ii) carry out regular field verification and review of environmental compliances by contractors, in coordination with the PMDSC and the contractors' environmental focal person, and report to PMU on the results and findings;
- (iii) ensure that the project, and all grant recipients obtain permits, licenses, etc. before the implementation of the respective construction activity;
- (iv) conduct training and workshops on environmental management and site induction for all staff, workers and grant recipients involved in the project implementation;
- (v) implement effective environmental monitoring during the pre-construction, construction, and operation phases. This includes, but is not limited to, inspections, reviews of monitoring forms prepared by the contractors and grant recipients, and documentation of the issues received through GRM;
- (vi) gather information from the implementation of the EMP to be included in the EMR preparation by the PMU;
- (vii) PIUs provide and record environmental impact observations during any site visits;
- (viii) in case of potential risks and hazards to health, environmental quality, and properties that may result from poor EMP implementation, PIUs will immediately guide contractors and grant recipients to resolve construction activities that pose risk and conduct immediate containment and mitigation activities;
- (ix) for the LMGP and ESMS implementation, the relevant PIU (TADA) will implement the safeguard measures required in the ESMS for safeguard screening, monitoring, and reporting; including preparation of IEEs for subprojects rated as category 'B' for environment safeguards;
- (x) take proactive and timely measures to address any environmental safeguards-related challenges at the national, state, or district levels, such as (a) delays in the processing of clearances during the pre-construction stage and (b) significant grievances during the construction and operation stages;
- (xi) participate and/or lead public consultations and GRM processes;
- (xii) be part of the process and operations of GRM as envisaged in the IEE; and
- (xiii) perform other tasks relevant with the project environmental safeguards and domestic safeguard requirements.

926. The PMDSC will include two environment specialists, who shall:

- (i) ensure subprojects conform to national policies and the EMPs and ESMS;
- (ii) for the LMGP and ESMS, support the PMU and PIUs for safeguard screening, review and monitoring of applications and subprojects per ESMS for the LMGP; and to prepare simplified IEEs for category 'B' subprojects;
- (iii) provide technical expertise, implement and monitor environmental safeguard requirements;
- (iv) support the PMU, PIUs, contractors and community to implement EMPs, and the recommendations of the IEEs;
- (v) support the project on monitoring of environmental safeguards at subproject sites;
- (vi) provide technical expertise to PMU and PIUs in the preparation of environmental safeguard requirements;
- (vii) support PMU and PIUs to (a) conduct environmental site inductions to contractors, and (b) ensure understanding of EMPs, government's environmental laws and requirements, and ADB SPS requirements;
- (viii) assist the PMU to prepare the environmental monitoring reports for timely submission to ADB;
- (ix) participate and/or lead public consultations; and
- (x) provide support on any environmental management and safeguards matters of the project.

927. The contractor is the main body to implement the EMP and environmental quality monitoring during the pre-, construction, and operation stages. The contractors shall:

- (i) appoint environment, health, and safety focal person and attend the site induction workshop to be organized by the PMU, PIUs and PMDSC;
- (ii) oversee environmental management activities on the construction site, including pollution prevention, waste management, and environmental monitoring;
- (iii) obtain the necessary environmental license(s) and permits;
- (iv) ensure that construction sites comply with environmental, health, and safety regulations, standards, and codes of practice including environmental permits, building codes, and occupational health and safety regulations;
- (v) collect baseline data on the environmental quality of the construction sites before the start of physical works and continue the collection of information (e.g., air quality, noise level, and water quality) during civil works as per the initial EMP;
- (vi) conduct risk assessments and hazard identification to identify potential environmental, health, and safety risks associated with construction activities. This involves assessing workplace hazards, environmental hazards, and potential exposure pathways for workers and the surrounding community;
- (vii) develop safety plans, procedures, and protocols to mitigate identified risks and hazards. The contractor will revise and finalize the construction EMP and environmental quality monitoring plan;
- (viii) implement and document all mitigation measures in the EMP and environmental quality monitoring plan;
- (ix) ensure that all workers and site agents, including site supervisors and management, participate in all environmental safeguard related training sessions;
- (x) provides training and education to construction workers, sub-contractors, and other staff on environmental, health, and safety practices and procedures;
- (xi) conduct regular inspections and audits of the construction site to monitor compliance with environmental, health, and safety requirements;

- (xii) ensure compliance with environmental statutory requirements and contractual obligations;
- (xiii) conduct investigations to determine the root causes and contributing factors in the event of accidents, incidents, or near misses. This includes documenting incidents, analyzing data, and developing corrective actions to prevent recurrence. Contractor will ensure that incidents are reported to relevant authorities as required by regulations;
- (xiv) participate in resolving issues as a member of the GRM;
- (xv) respond promptly to grievances raised by the local community or any stakeholder and implement environmental corrective actions or additional environmental mitigation measures as necessary and inform PIUs and PMDSC;
- (xvi) based on the results of EMP monitoring, cooperate with PIUs and PMDSC to implement environmental corrective actions plans, as necessary;
- (xvii) develop and implement health promotion and wellness programs to support the physical and mental well-being of construction workers;
- (xviii) engage with local communities, regulatory agencies, and other stakeholders to address concerns, communicate project related information, and promote transparency and accountability;
- (xix) promote a culture of continuous improvement in environmental, health, and safety performance on the construction site; and
- (xx) Provide other environment safeguards activities as indicated in the contract.

928. Design, build and operate (DBO) contracts. The contractors will do the following:

929. Design phase:

- (i) appoint the environment, health and safety focal persons and attend the site induction workshop to be organized by the PMU and PIUs;
- (ii) obtain necessary environmental license(s), permits etc. from relevant agencies for the ancillary facilities and activities prior to commencement of works;
- (iii) collect baseline data on environmental quality of the construction sites before the start of physical works and continue collection of information (e.g., air quality, noise level, and water quality) per the initial EMP;
- (iv) integrate environmental considerations into the designs;
- (v) adapt recommendations and findings of the IEEs to mitigate potential into the design;
- (vi) revise and finalize the construction EMP and environmental quality monitoring plan; and
- (vii) engage with local communities, and stakeholders during the design process to understand and incorporate their concerns and recommendations.

930. Build phase:

- (i) implement all the measures outlined in the EMP during construction activities;
- (ii) utilize construction methods and materials that reduce the project's environmental impacts;
- (iii) ensure that all personnel are trained in environmental management practices relevant to their roles and responsibilities;
- (iv) conduct environmental quality assessment of the construction sites per EMP;
- (v) conduct regular environmental monitoring during construction to ensure compliance with the EMP and report findings to the PMU and relevant authorities;
- (vi) be prepared to adapt construction practices based on environmental monitoring outcomes or unforeseen environmental events; and
- (vii) implement and document all mitigation measures in the EMP and environmental quality monitoring plan.

931. Operation phase:

- (i) maintain and operate environmental control measures to mitigate environmental impact;
- (ii) continuously monitor environmental indicators and maintain compliance with all environmental regulations and permit requirements;
- (iii) incorporate new technologies and practices that increase the environmental sustainability over time;
- (iv) keep stakeholders informed about the environmental performance of the irrigation system and any significant environmental issues; and
- (v) based on the results of EMP monitoring, cooperate with PIUs to implement environmental corrective actions and corrective action plans, as necessary.

932. All phases:

- (i) maintain detailed records of all environmental compliance activities, monitoring data, and any incidents or corrective actions;
- (ii) participate actively in GRM, addressing any complaints related to environmental impacts promptly and effectively;
- (iii) regularly review and improve environmental safeguards practices based on lessons learned during the project;
- (iv) ensure compliance with environmental statutory requirements and contractual obligations; and
- (v) based on the results of EMP monitoring, cooperate with PIUs to implement environmental corrective actions and corrective action plans, as necessary.

933. ADB is responsible for the following:

- (i) review IEEs including EMPs and disclosing draft and final reports on ADB's website;
- (ii) review EMRs, and disclose the final reports on ADB's website;
- (i) explain policy requirements and safeguard covenants in the loan and project agreements to PMU and PIUs;
- (ii) monitor implementation of the EMP through due diligence missions;
- (iii) advise PMU on carrying out its responsibilities and in building capacity for safeguard compliance;
- (iv) monitor overall compliance of the subprojects to this PAM, and EMPs; and
- (v) If necessary, provide further guidance on the format, content, and scope of the periodic monitoring reports for submission to ADB.

D. Environmental Management Plan Tables

934. The succeeding EMPs have been developed to address the specific environmental challenges associated with each project component, including transport infrastructure, ropeway systems, water transport, and smart infrastructure. Each EMP outlines targeted mitigation measures, monitoring protocols, and implementation strategies designed to minimize adverse environmental impacts during the construction and operational phases. These EMPs serve as practical tools for ensuring compliance with environmental standards, promoting sustainability, and safeguarding the ecological integrity of the Tehri Lake region throughout the project's lifecycle.

Table 65. Environmental Management Plan for the Tourism Road

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
DESIGN and PRE-CONSTRUCTION PHASE				
Alignment, width of the road and to avoid any religious structures throughout corridor.	Damage to structure associated to religious sites.	- Proposed design adopted in accordance with the provisions of the following - IRC and BIS Codes/MoRTH guidelines/AASHTO specifications. - The existing alignment on junction point with existing road was selected by shifting/adjusting the centreline of the road, adopting of suitable cross-sections width to minimize land acquisition, loss of settlements and to avoid sensitive features like religious structures.	Design Consultant	PMU/UTDB
Pavement design. Flexible pavement is proposed throughout the corridor.		- Pavement has been designed as per manual of specifications and IRC Standards. 40mm BC has been considered as surface course and 80mm DBM. For flexible pavements, GSB 200 mm and WMM 250 mm has been considered. - The adopted CBR value for the tourism road is 5%.	Design Consultant	PMU/UTDB
Drainage Provisions. A new bridge at Ch 3+838.75 to Ch 4+175 with a total length of 114.630M and 94 culverts are proposed throughout the corridor.		- Raised embankment and provision of roadside drainage to prevent damage to pavement due to water logging on the - road and inconvenience caused to nearby community. - Provision of adequate nos. of cross drainage structures. - Increased (vent and height) in waterway of existing structures. - Roadside drains have been proposed with suitable outfalls. - Additional culverts and bridges	Design Consultant	PMU/UTDB
Safety along the proposed alignment	Road injuries and damage to properties	- Vertical and horizontal geometrics in consistent to adequate numbers of road signs and pavement markings IRC/MORTH guidelines. - Speed breakers proposed in habitat areas, near sensitive receptors and IRC-89-1997 curves to regulate speed. - Provision of retro- reflective warning followed in signboards near sensitive areas like school, hospital, religious places and semi-urban marketplaces. - Footpath with covered drains at built-up areas - Protection works such as retaining wall, toe wall at bridge approach and culverts and crash barriers, if necessary, at junctions' improvement locations. - Crash barriers at hazardous locations are proposed, likely accident-prone areas.	Design Consultant	PMU/UTDB

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
Tree cutting and vegetation removal along road alignment. Cutting and/or removal of about 3,124 trees during site clearance at the target hill and valley sides of the road.	Direct removal of land cover along the road	• Restricting tree cutting within construction limit. • Avoiding tree cutting at ancillary sites. • Obtain necessary permission for tree cutting. • Providing and maintaining compensatory tree plantation 10 times of cutting. • Choose road alignments that avoid ecologically sensitive areas and minimize the need for tree cutting as much as possible. With the forest department and PWD, contractor to conduct a thorough survey to identify trees that can be preserved. • Ensure all activities comply with national and local environmental regulations and guidelines. • PWD to acquire tree cutting permit prior to tree cutting.	Forest Dept. / PIU	PMU and PMDSC
Shifting of utilities such as for electricity, water, communication and other service structures.	Temporary interruptions of services at villages, and risk of damaging utilities.	• PWD and contractor must conduct necessary planning and coordination with the relevant authorities and local bodies. • Provide prior notice and consult with these authorities, local bodies, and the public likely to be affected by road alignment. This ensures that the work proceeds smoothly and minimizes the impact on the public. • PWD and contractor to organize initial meetings with all relevant utility service providers (e.g., water, gas, electricity, telecommunications) to discuss the scope and timeline of the road construction project. • Establish agreements on responsibilities, timelines, and protocols for utility relocation to ensure a collaborative and efficient process. • Contractor to develop a detailed schedule that aligns utility relocation activities with the overall road construction timeline. • Ensure the schedule accounts for all necessary permits, materials, labor, and equipment needed for the relocation. • Contractor will create contingency plans for potential delays or unforeseen issues, such as weather-related interruptions or unexpected utility conditions. • Contractor to conduct comprehensive surveys to map the precise locations of all existing utilities within the project area. • Physically mark the locations of utilities on the ground using color-coded stakes or paint to guide construction crews and prevent accidental damage. • PWD and contractor to organize public meetings and consultations with local communities to inform them about the utility relocation plans and construction schedule. Use clear and accessible language to explain the project's purpose, benefits, and potential impacts.	Concerned utility agencies PWD Contractor	PMU and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		• Contractor to provide information through various channels, such as community notice boards, local newspapers, radio announcements, and social media. • Contractor to establish feedback mechanisms, such as suggestion boxes, hotlines, or online platforms, to collect community concerns and suggestions. Ensure that a dedicated team or individual is responsible for addressing community inquiries and feedback.		
Cultural and religious structures and places that are affected by road works. All construction sites of the tourism road.	Disruption of road works can impede religious practices and cause damage to cultural structures.	• The PWD and contractor will consult the community before starting any works to share information about: (i) the proposed road designs, and (ii) the timing and dates of the works. • Contractors will follow culturally appropriate and respectful procedures in case of any chance findings. Such findings must be immediately reported to the PWD, PMU, and district administrations. Necessary measures directed by the Engineer will be implemented. • Contractor to conduct a detailed survey of the temple and its surroundings to document its current condition. Take photographs and videos to establish a visual record of the temple's state before construction begins. • PWD and contractor will engage with the temple authorities and local community to discuss the construction plans and potential impacts. Incorporate their feedback into the construction planning process. • Contractor to clearly mark the zone around the temple with fencing or barriers to prevent accidental encroachment. • Contractor to install vibration monitors near the temple to track construction-induced vibrations. Set threshold levels for vibrations to prevent damage to the temple structure. • Ensure that access to the temple is maintained for worshippers and visitors throughout the construction period. • Provide safe and clearly marked pedestrian pathways around the construction site. • Erect temporary protective structures, such as scaffolding or netting, around the temple to shield it from debris and construction materials. • PWD will provide contact information for a dedicated liaison officer to address any concerns promptly. • Contractor will train its construction workers on the importance of the temple and the specific mitigation measures in place.	PWD Contractor	PMU and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
Small temples along the road	Removal of small temples due to expansion	• Discuss potential relocation sites and gather community input to ensure that the new site meets the spiritual and cultural needs of the residents. • Document the temple's current structure, including photographs, drawings, and written descriptions, to preserve its historical and cultural significance. • Record any inscriptions, artifacts, and other culturally significant elements associated with the temple. • Provide financial compensation or material support for the reconstruction of the temple at a new location agreed upon by the community. • Ensure that compensation packages cover all costs associated with relocation, including materials, labor, and any additional facilities required at the new site. • Identify and prepare a suitable relocation site in consultation with the local community. • Ensure that the new site is accessible and offers a comparable or enhanced setting for worship and community gatherings.	PWD Contractor	PMU and PMDSC
Issuance of government consents, permits, clearances, no objection certificate (NOC), etc.	Obtaining government consents and permits ensures regulatory compliance but can delay project timelines and increase administrative burdens if not timely acquired.	• Contractor to conduct an early review of all applicable laws, regulations, and guidelines to identify the necessary consents, permits, clearances, and NOCs required for the project. Develop a comprehensive checklist of all required approvals, specifying the responsible authorities and the timeline for obtaining each permit. • Obtain all necessary consents, permits, clearances, no objection clearances (NOC) etc prior to start of civil works. • Include in detailed design drawings and documents all conditions and provisions if necessary • Organize meetings with relevant regulatory authorities, local bodies, and stakeholders to discuss the project scope and the required approvals. Maintain open lines of communication with regulatory authorities to address any queries and facilitate the approval process. • Prepare detailed documentation, including project plans, environmental impact assessments, and any other required studies or reports. Ensure all project activities and documentation comply with regulatory standards and guidelines. • Contractor to submit applications for consents, permits, clearances, and NOCs well in advance to account for any potential delays in the approval process. Regularly follow up with the respective authorities to track the status of applications and address any additional information requests	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		promptly. • Conduct training programs for project staff and contractors to familiarize them with the regulatory requirements and the process for obtaining necessary approvals. • Organize workshops to ensure all team members understand the importance of compliance and the procedures involved.		
Establishment of construction facilities (on-site and off-site)	Sites of labor camps, crushers, hot mix plants and batching plants. Operations may lead to noise pollution and water contamination.	• Labor camps will not be located on agricultural land and will be sufficiently distant from surface water sources and water bodies. • Labor camps must be equipped with fire safety measures to mitigate electrical and other fire hazards. • Hot mix plants and batching plants will be sited sufficiently away from settlements, agricultural operations, and any commercial establishments. These plants will be located at least 500 meters away from the nearest village or settlement, preferably in the downwind direction. • The contractor shall submit a detailed layout plan for all such sites, and approval from the Environmental Expert of PMDSC is necessary prior to their establishment. • Arrangements to control dust pollution, including the provision of windscreens, sprinklers, and dust encapsulation, will be required at all such sites. • Specifications for crushers, hot mix plants, and batching plants will comply with the requirements of the relevant current emission control legislation. Consent/NOC for all such plants shall be submitted to the PIU. • The contractor shall not initiate plant operations until the required legal clearances are obtained and submitted. The engineer will ensure compliance with regulatory and legal requirements.	Contractor	PWD and PMDSC
Sourcing of construction materials	Sourcing of construction materials can lead to resource depletion and landscape alteration.	• Use quarry sites and sources permitted by government. • Verify suitability of all material sources, confirm permits of material sources and obtain approval from UTDB. • If additional quarries are required after construction has started, obtain written approval from UTDB.	Contractor	PWD and PMDSC
CONSTRUCTION PHASE				
Clearing and grubbing	Clearing and grubbing, along	• Install silt fences along the perimeters of disturbed areas to prevent soil erosion and sedimentation in nearby water bodies.	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
Hill cutting and excavations along the road alignment (15.7 km)	with hill cutting and excavations, can cause soil erosion, habitat loss, and landscape degradation.	• Use erosion control blankets on slopes to stabilize soil and promote vegetation growth. • Construct sediment traps or basins to capture eroded soil and prevent it from entering waterways. • Maintain buffer strips of vegetation along watercourses and sensitive areas to protect habitats and water quality. • Strip and stockpile topsoil separately for reuse in revegetation efforts to ensure soil fertility is maintained. • Minimize soil compaction by restricting heavy machinery movement to designated paths and work areas. • Regularly sprinkle water on exposed soil surfaces, stockpiles, and unpaved roads to suppress dust. • Establish temporary vegetative cover on bare soil areas to reduce dust generation. • Cover trucks transporting loose materials to prevent dust emissions during transit. • Erect noise barriers around construction sites to reduce noise impact on nearby communities and wildlife. • Implement vibration monitoring to ensure levels do not exceed thresholds that could cause structural damage or disturb sensitive wildlife. • Establish buffer zones around water bodies to protect them from sediment runoff and contamination. • Ensure all construction debris and vegetation waste are properly collected and disposed of in designated areas. • Promote recycling and reuse of materials such as wood, metal, and concrete from clearing and grubbing activities. • Use clear signage and fencing to delineate construction zones and prevent unauthorized access. • Inform local communities about the clearing and grubbing activities, potential impacts, and mitigation measures through public meetings and information sessions. • Provide training for construction workers on environmental protection practices and the importance of adhering to mitigation measures.		
Cut (hill side) and fill (valley side)	Alterations to the natural terrain of	• Implement slope stabilization measures such as retaining walls, gabion walls, and reinforced concrete structures in areas prone to landslides and slope instability.	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
	the proposed road	• Utilize bioengineering techniques like planting deep-rooted native species along slopes to enhance soil binding and reduce the risk of erosion. • Introduce terracing on steep slopes to reduce surface water runoff velocity and minimize soil erosion. Terracing helps break the slope length, allowing water to infiltrate rather than flow rapidly down the slope. • Establish designated debris disposal sites for the storage and stabilization of excess soil and rock material away from water bodies, forests, and agricultural lands. • Reuse excavated soil and rock material for backfilling low-lying areas or as construction material for embankments, thereby reducing the need for additional material extraction and minimizing waste generation. • Develop a soil conservation plan that includes mulching, use of geotextiles, and application of organic compost to improve soil structure and fertility in the affected areas. • Construct lined drainage channels along the road to safely divert surface runoff away from unstable slopes and prevent water accumulation. These channels should be designed to handle peak flow during heavy rainfall events. • Ensure that cross-drainage structures, such as culverts and causeways, are adequately designed to accommodate natural water flow and minimize changes in hydrology due to the road alignment. • Provide training to construction workers on best practices for erosion control, debris management, and minimizing environmental impacts during excavation and grading activities.		
Subsurface conditions along the road	Topographic instability that may result to landslides	• Implement slope stabilization techniques in areas where fractured rock and varying soil types have been identified. Construct reinforced retaining walls, gabion walls, and soil nailing in sections with unstable slopes and high landslide risk. • Use terracing or benching techniques to reduce slope steepness and improve slope stability. • Given the location of the road in Seismic Zone IV, it is essential to design reinforced concrete structures with adequate seismic resistance. Ensure that retaining walls, bridge abutments, and other structures are built to withstand seismic forces, taking into account the subsurface characteristics revealed by the borehole data.	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		• Incorporate robust drainage systems to manage surface water and high groundwater levels, as identified in some boreholes along the alignment. • Use weep holes and drainage channels in retaining walls to allow groundwater to escape, thereby reducing the risk of water-induced instability. • In areas where fractured rock formations dominate the subsurface, install rockfall barriers, catchment nets, and mesh coverings to prevent loose rocks from falling onto the road. Regularly inspect and maintain these structures to ensure they are effective in preventing rockfall incidents. • Use rock bolts and shotcrete to stabilize exposed rock faces and reduce the likelihood of rock slides in cut sections along the road. • To address areas with variable soil types and poor load-bearing capacity, use geosynthetic materials such as geogrids and geotextiles for soil reinforcement and slope stabilization. These materials can improve soil strength and provide additional support to weak soil layers. • Implement bioengineering techniques like planting deep-rooted grasses and shrubs along slopes to enhance slope stability and reduce soil erosion. Select native species that are adapted to local conditions to ensure long-term effectiveness. • Develop a detailed monitoring and maintenance plan to regularly assess the condition of slopes, retaining structures, and drainage systems. Use remote sensing tools and geotechnical instrumentation to detect early signs of instability or deformation. • Carry out periodic inspections after extreme weather events or seismic activity to ensure the integrity of the road and associated structures. • Map out landslide-prone zones along the alignment using the data collected from boreholes and geological surveys. Implement site-specific landslide mitigation measures, such as slope buttressing and the use of retaining berms, to prevent slope failure in high-risk areas.		
Air quality	Construction plants, equipment and vehicles can be sources of emissions that will affect air quality	• Hot mix plants should be located at least 1.5 km from the nearest habitation, school, hospital, forest, and rivers, 500 meters from ponds and national highways, and 250 meters from state highways, unless otherwise specified by statutory requirements. This should be done after securing a NOC from the Uttarakhand Pollution Control Board (UKPCB). The hot mix plant will be fitted with a stack of adequate height as prescribed by the UKPCB to ensure the proper dispersion of exit gases.	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		• Submit the location and layout plan for storage areas for construction materials for approval by the PWD. • Transport, load, and unload loose and fine materials using covered vehicles to prevent dust emission. • Ensure storage areas are located downwind of habitation areas to minimize dust and pollution impact on residents. • Conduct regular water spraying on earthworks, unpaved haulage roads, and other dust-prone areas to suppress dust. • Regularly maintain machinery and equipment. Mandatory vehicular pollution checks will be implemented. • Use LPG as a fuel source in construction camps instead of wood to reduce air pollution and deforestation. • Ensure the provision of Personal Protective Equipment (PPE) to all workers to maintain safety and health standards. • Enforce speed limits on construction vehicles to reduce dust generation on unpaved roads. • Implement regular cleaning of paved roads and construction site areas to minimize dust accumulation. • Regularly maintain machinery and equipment to ensure they operate efficiently and with minimal emissions. • Mandatory vehicular pollution checks will be implemented. • Monitor air quality at construction site as per the environmental monitoring plan. • Comply with siting criteria for stone crushers, Hot Mix Plants (HMP), and concrete batching plants (CBP), including the installation and maintenance of pollution control devices. • Ensure no hot mix plant or other source of air pollution (especially dust) is located within degraded airsheds for particulate matter (SPM/PM₁₀). Adopt specific measures such as watering of roads to avoid generating additional SPM in degraded airsheds. Refer to Appendix 11 (Guidelines for Construction Plant Establishment) and Appendix 12 (Guidelines for Camp Site Establishment and Operations).		
Air Quality	Road traffic diversion and	• Maintain diversions and detours for road traffic in good condition and ensure traffic is properly regulated.	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
	detour maintenance can increase air pollution due to prolonged vehicle idling and increased travel distances.	• Conduct regular water sprinkling as necessary to suppress dust and maintain air quality. • Implement and enforce speed limits for vehicles using temporary diversion roads to minimize dust creation. • Install wheel washing stations at the entry and exit points of construction sites to prevent mud and dust from being carried onto public roads. • Ensure that all vehicles transporting loose materials are covered to prevent dust from escaping during transit. • Implement regular sweeping of paved temporary roads to remove dust and debris accumulation. • Set up air quality monitoring stations along diversion roads to continuously measure dust levels and adjust mitigation measures as needed. • Install clear signage to inform drivers about speed limits and dust control measures. • Raise public awareness about the importance of adhering to these measures. • Ensure all construction and transport vehicles meet emission standards and undergo regular maintenance to minimize exhaust emissions.		
Air Quality	Dust from construction and earthworks, including muck/spoil dumps, can exacerbate air pollution and pose respiratory health risks.	• Maintain adequate moisture on the surface of any earthwork layer, whether completed or not, until the base course is applied to prevent dust emissions. • Stockpile spoil in designated areas, ensuring that the piles are at least 5 meters away from traffic lanes. • Conduct regular water sprinkling on active earthwork areas, unpaved roads, and spoil piles to suppress dust. • Cover loose materials and spoil piles with tarpaulins or similar materials to prevent dust from becoming airborne. • Ensure that all trucks transporting spoil and loose materials are covered with tarpaulins to prevent dust emissions during transit. • Regularly maintain and clean haul roads to minimize dust generation from vehicle movement. • Implement and enforce speed limits for construction vehicles to reduce dust creation on unpaved surfaces. • Set up air quality monitoring stations around earthwork and muck disposal sites to continuously measure dust levels and adjust mitigation measures as needed.	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		• Moisten muck before disposal to minimize dust emissions during handling and transport. • Compact spoil piles regularly to reduce the surface area exposed to wind and minimize dust generation. • Use designated disposal sites for muck and spoil that are situated away from populated areas and sensitive environments. • Inform local communities about earthwork and muck disposal activities, including measures being taken to control dust and air pollution. • Ensure all construction machinery and equipment are regularly maintained and meet emission standards to minimize exhaust emissions. Refer to Appendix 13 (Guidelines for Debris Disposal)		
Air Quality	Borrow pits and haul roads contribute to air quality degradation through increased dust and vehicle emissions.	• Obtain necessary permissions to operate borrow pits. Construction materials should must only be sourced from sites with government approved operations. • Barren and uncultivated land to be selected as borrows area. • Depths of borrow pits to be regulated. • Topsoil to be stockpiled and protected for use at the rehabilitation stage. • Transportation of earth materials through covered vehicles. • Follow IRC guidelines (IRC 10: 1961) for its operation and rehabilitation. • Borrow areas not to be dug continuously. • To the extent borrow areas shall be sited away from habituated areas. • Borrow areas shall be levelled in environmentally friendly manner • Regularly sprinkle water on exposed surfaces, haul roads, and during excavation to suppress dust. • Cover stockpiles of excavated material with tarpaulins or other suitable materials to prevent wind erosion. • Implement and enforce speed limits for vehicles operating in and around borrow areas to reduce dust creation. • Ensure that all construction and excavation equipment is regularly maintained and operates efficiently to minimize emissions. • Use machinery that meets stringent emission standards to reduce exhaust pollution. • Ensure all vehicles transporting materials to and from borrow areas are covered to prevent dust escape.	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		• Install wheel washing facilities at exits from borrow areas to reduce dust carried out by trucks. Refer to Appendix 15 (Guidelines for Borrow Area Establishment and Operations)		
Air Quality	At construction sites and storage areas Storage of construction materials can release particulates affecting air quality.	• Regularly sprinkle water on storage piles and surrounding areas to minimize dust generation. • Cover all loose and fine materials with tarpaulins or plastic sheets to prevent wind erosion. • Use enclosed storage facilities or containers for storing fine and dusty materials. • Position storage areas downwind of populated or sensitive areas (e.g., residential zones, schools, hospitals) to reduce the impact of dust. • Establish buffer zones with vegetation or physical barriers around storage areas to trap and reduce dust. • Frequently clean the paved areas and surrounding roads to remove dust accumulation. • Ensure all vehicles transporting construction materials are covered to prevent dust from escaping. • Install wheel washing facilities at the exits of storage areas to clean vehicles before they leave the site. • Reduce drop heights when loading and unloading materials to minimize dust. • Use controlled methods and equipment (e.g., conveyors with dust suppression) for loading and unloading materials. • Provide dust masks, goggles, and other PPE to workers handling or working near stored materials to protect their health. • Schedule material handling activities during periods of low wind to reduce dust dispersion.	Contractor	PWD and PMDSC
Water quality Construction of bridges and culverts, and hillside cutting	Construction works and marginal spillage of construction materials lead to sedimentation and pollution of water bodies,	• Constructing and maintaining diversion channel, sedimentation basin, dykes, etc. as may be required to temporarily channelize water flow of streams / river. • Storage of construction material and excavated soil above high flood level. • Install silt fences around the construction site to trap sediments and prevent them from entering water bodies. • Construct diversion channels or berms to redirect runoff away from disturbed areas and into sediment control structures.	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
	degrading water quality.	• Implement containment measures for fuels, oils, and other hazardous materials to prevent spills. • Conduct earthwork in stages to reduce the amount of exposed soil at any given time. • Schedule major earthwork activities during dry weather conditions to reduce the risk of erosion and sedimentation. • Regularly monitor water quality parameters such as turbidity and suspended solids to assess the effectiveness of mitigation measures. • Frequently inspect and maintain erosion and sediment control structures to ensure they are functioning properly. • Store construction materials securely to prevent them from being washed into water bodies. • Transport materials in a manner that minimizes spillage, and clean up any accidental spills immediately.		
Water quality Operations of construction vehicles.	Construction vehicles contribute to water quality degradation through oil, fuel, and sediment runoff into water bodies.	• Conduct regular inspections and maintenance of construction vehicles to ensure they are in good working condition and free from leaks. • Implement a preventive maintenance schedule to replace worn-out parts and address potential issues before they result in leaks or spills. • Equip all construction sites and vehicles with spill kits containing absorbent materials, containment booms, and other tools to quickly address spills. • Use drip trays under parked vehicles and during maintenance activities to catch any leaks. • Ensure immediate clean-up of any spills using appropriate materials and methods to prevent contaminants from reaching water bodies. • Store fuels, oils, and chemicals in secure, well-labelled containers within designated areas with secondary containment measures. • Refuel vehicles in designated areas equipped with spill containment measures to prevent accidental spills. • Dispose of vehicle-related waste materials, such as used oil filters and worn-out parts, at designated facilities. • Recycle waste materials whenever possible to reduce environmental impact. • Train all personnel on best practices for spill prevention, response, and proper waste disposal.	Contractor	PWD and PMDSC
Water quality - soil erosion from construction activities	Construction activities can lead to	• Proper planning of site clearing and grubbing so as not to keep the cleared site before working for long duration.	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
	increased sedimentation in water bodies, deteriorating water quality.	• Providing temporary side drains, catch water bank or drains, sedimentation basin, as necessary to avoid or minimize erosion and prevent sedimentation to receiving water bodies. • Install silt fences around the perimeter of the construction site to trap sediments and prevent them from entering water bodies. • Use erosion control blankets or mats on slopes and disturbed areas to stabilize the soil and prevent erosion. • Use check dams in ditches or swales to slow down water flow and capture sediments. • Install gravel or rock entrances at site access points to reduce sediment tracking onto public roads. • Limit the area of soil disturbance to the minimum necessary for construction activities. • Implement phased construction to reduce the amount of exposed soil at any given time. • Store soil and construction materials away from water bodies and cover them to prevent erosion and runoff. • Store hazardous materials, such as fuels, oils, and chemicals, in secure, designated areas with secondary containment to prevent leaks and spills. • Ensure proper disposal of construction waste and debris to prevent contamination of runoff. • Conduct regular inspections of erosion and sediment control measures to ensure they are functioning effectively. Maintain and repair erosion and sediment control structures as needed to prevent failure and ensure continued protection. • Implement a water quality monitoring program to regularly assess the effectiveness of mitigation measures and make adjustments as necessary.		
Water quality Operation and maintenance of construction camp and workers' camp	Degrade water quality through release of untreated waste and increased sediment runoff.	• Proper waste collection and disposal facilities at camp sites. • Camps to maintain a distance of 500 m from the habitation, waterbodies. • Providing temporary side drains, catch water bank or drains, sedimentation basin, as necessary to avoid or minimize erosion and prevent sedimentation to receiving water bodies. • Install adequate and well-maintained sanitation facilities, such as septic tanks and bio-digester toilets, to prevent sewage contamination. • Regularly inspect and maintain sanitation systems to prevent overflows and leaks.	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		• Use portable or on-site wastewater treatment systems to treat sewage before discharge. • Implement waste segregation practices to separate recyclables, non-recyclables, and hazardous waste. • Ensure regular collection and proper disposal of solid waste through authorized disposal facilities. • Properly store and dispose of hazardous waste following regulatory guidelines. • Use secondary containment systems for fuel and chemical storage areas to capture spills and leaks. • Provide spill response kits and train workers in their use to quickly address any accidental spills. • Train workers on proper handling and disposal of chemicals and fuels. • Store construction materials in secure, covered areas to prevent them from being washed into water bodies. • Ensure proper disposal of leftover construction materials and debris. Refer to Guidelines for Appendix 12 (Guidelines for Camp Site Establishment and Operations).		
Groundwater quality	Wastewater logging at construction sites may contaminate groundwater	• All wastewater will be diverted to a ditch that will be managed for the period of construction and after construction such ditches will be filled and restored to original condition. • Construct and maintain effective surface drainage systems, such as ditches, channels, and swales, to quickly remove excess water from the construction site. • Train workers on proper handling and disposal of chemicals, fuels, and construction materials. • Ensure proper disposal of construction waste, debris, and materials to prevent contamination of the soil and groundwater. • Conduct regular inspections of drainage systems, erosion control measures, and other infrastructure to ensure they are functioning effectively.	Contractor	PWD and PMDSC
Groundwater quality	Borrow pit and excavation sites may lead to contamination	• Excavation of borrow pit should not touch the aquifer. • Store fuels, chemicals, and other hazardous materials in secure areas with secondary containment to prevent spills and leaks. • Ensure proper disposal of waste materials and avoid using borrow pits as disposal sites for hazardous waste.	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
	through leachate infiltration.	• Provide spill response kits on-site and train workers in their use to quickly address any accidental spills. • Implement phased excavation to reduce the exposed area at any given time and minimize the risk of contamination. • Implement measures to divert surface water away from borrow pits to prevent contamination and waterlogging. • Rehabilitate and reclaim borrow pits after excavation by filling them with clean material and restoring vegetation to stabilize the soil and prevent erosion. • Implement erosion control measures, such as silt fences, sediment basins, and vegetation, to reduce sediment runoff into borrow pits. • Ensure that all borrow pit activities comply with local, regional, and national regulations and obtain necessary permits before excavation.		
Groundwater quality	Human wastes and wastewater from construction camps can lead to groundwater contamination through infiltration of pollutants.	• Providing septic tanks for treating sewage from toilets before discharging through soak pits. • Locating soak pits at least 50m from any ground water sources. • Decanting and or controlled disposal of oil and grease as collected at collection tanks of maintenance yard and chemical storage areas. • Install well-designed and properly maintained septic systems to treat and safely dispose of human waste. • Use portable toilets with sealed tanks that are regularly emptied and serviced to prevent leakage. • Establish on-site wastewater treatment plants to treat sewage and wastewater before it is discharged or reused. • Conduct regular inspections and maintenance of sanitation facilities and wastewater treatment systems to detect and repair leaks promptly. • Implement waste segregation and recycling programs to reduce the amount of waste generated at construction camps. • Ensure that all sanitation and wastewater management practices comply with local, regional, and national regulations and standards. • Obtain necessary permits for wastewater discharge and adhere to the conditions set by regulatory authorities. Refer to Appendix 12 (Guidelines for Camp Site Establishment and Operations).	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
Noise level	Vehicles and construction machinery significantly contribute to noise pollution, affecting local communities and wildlife.	• Stationary equipment will be placed along uninhabited stretches, as far as practicable, to minimize objectionable noise impacts, following the computed distance requirements. • Schedule operations to coincide with periods when people are least likely to be affected. • Provide ear plugs or ear muffs to workers operating near high noise-generating machines. • Ensure construction equipment and machinery are fitted with silencers and are properly maintained. • Maintain all equipment properly to reduce noise emissions. • Use properly designed engine enclosures and intake silencers to control noise. • Conduct noise measurements along all proposed transport infrastructure components to ensure the effectiveness of mitigation measures. • Ensure vehicles and equipment used conform to the prescribed noise pollution norms. • Restrict the movements of heavy construction vehicles and equipment near public properties. • Provide ear protection equipment to construction workers in high noise level zones. Contractors will implement site-specific mitigation measures, particularly in sensitive and urban locations.	Contractor	PWD and PMDSC
Vibration levels Cutting of hills to widen road and other construction works	Road alignment site that would cause structural damage and disturb local ecosystems and human communities.	• No blasting to be done to widen road works. • Conduct pre-construction surveys to assess the condition of buildings, infrastructure, and historical sites to identify vulnerabilities. • Perform detailed slope stability analysis to identify areas at risk of landslides and other forms of slope failure. • Install vibration monitoring systems to continuously measure vibration levels during construction activities. • Establish threshold limits for vibration levels based on the sensitivity of nearby structures and natural features. • Construct retaining walls and other protective structures to stabilize slopes and prevent landslides. • Use shock absorption barriers or mats to reduce the transmission of vibration to sensitive areas.	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		• Schedule high-vibration activities during times when they will have the least impact on residents and wildlife, such as during daylight hours and outside of breeding seasons. • Inform local communities about construction activities and potential vibration impacts, and provide channels for feedback and complaints. • Reinforce vulnerable structures, such as buildings and utility lines, to withstand vibration impacts. • Conduct regular inspections of infrastructure during construction to identify and address any emerging issues promptly.		
Installation of electrical works as part of the road upgradation	Temporary disruption of vehicle movement, and risks on workers and community	• Ensure that machinery and vehicles used during installation are well-maintained and meet emission standards to minimize air pollution. • Use low-noise machinery and equipment to reduce overall noise levels during installation. • Ensure proper disposal of construction waste, including packaging materials, old poles, and electrical components through authorized disposal facilities. • Promote recycling and reuse of materials such as metal poles and wiring to minimize waste generation. • Conduct regular site clean-ups to prevent accumulation of debris and waste. • Implement traffic control measures such as signage, barriers, and flaggers to manage traffic flow and protect workers and pedestrians. • Secure the work site with fencing and signage to prevent unauthorized access and ensure public safety. • Provide safety training for workers on proper installation techniques, equipment handling, and emergency procedures. • Inform the community about the installation schedule, potential impacts, and mitigation measures through meetings, newsletters, and social media.	Contractor	PWD and PMDSC
Soil Health	Spillage from plant and equipment at construction camps can contaminate soil, affecting its health and ecosystem functions.	• Provide an impervious platform and oil and grease traps for collecting spillages from the maintenance of construction equipment and vehicles. • Collect oil and lubricant drips in containers during the repair of construction equipment and vehicles. • Provide an impervious platform and collection tank for managing spillages of liquid fuels and lubricants in storage areas. • Use bulk bituminous storage tanks instead of drums for storing bitumen and bitumen emulsion. • Provide an impervious base in bitumen and emulsion storage areas, and regularly clean up any bitumen spillages for controlled disposal.	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		• Reuse bitumen spillages wherever possible. • Dispose of non-usable bitumen spills in a deep trench with a clay lining at the bottom, covered with at least 0.5 meters of soil. • Segregate construction waste into categories such as recyclable, non-recyclable, and hazardous waste to facilitate proper disposal and recycling. • Ensure regular collection and proper disposal of construction waste to prevent accumulation and potential pollution. • Dispose of hazardous waste through authorized disposal facilities following environmental regulations. • Store construction materials such as cement, sand, and gravel in covered areas to prevent contamination and runoff. • Train workers on proper handling procedures for hazardous materials to minimize the risk of spills and leaks. • Develop and implement spill response plans to address accidental releases of hazardous materials. • Conduct regular emergency drills to ensure workers are prepared to respond effectively to spills and other pollution incidents. Refer to Appendix 12 (Guidelines for Camp Site Establishment and Operations) and Appendix 15 (Guidelines for Borrow Area Establishment and Operations)		
Soil health	Disposal of muck/debris from hillside cutting, dismantling structures, and road surface can lead to soil contamination and altered topography.	• The contractor shall identify 30 muck disposal sites, with 2 sites per kilometer of the proposed road. • The identified locations will be reported to the Environmental Expert of PMDSC, who will check these locations on site and approve them prior to any disposal of waste materials. • All arrangements for transportation during construction, including provision, maintenance, dismantling, and clearing debris, will be planned and implemented by the contractor as approved and directed by the Environmental Expert of PMDSC. • The pre-designed muck disposal locations will be part of a Comprehensive Muck Disposal Plan prepared by the contractor in consultation with and approved by the Environmental Expert of PMDSC. • The existing bitumen surface can be utilized for paving of crossroads, access roads, and paving works in construction sites and camps, temporary traffic diversions, and haulage routes.	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		• All excavated materials from roadways, shoulders, verges, drains, cross drainage, and similar areas will be the property of the EA and will be used for backfilling embankments, filling pits, and landscaping. • Debris generated from pile driving or other construction activities shall be disposed of in a manner that prevents it from flowing into surface water bodies or forming mud puddles in the area. • The following considerations will be made during the selection of dumping sites: ○ Sites must be at least 1.5 km from habitation and forest areas, and 500 m from ponds. ○ Dumping sites should not contaminate any water sources, rivers, etc. ○ Consent from the village council must be obtained before finalizing the location. Refer to Appendix 14 (Muck Disposal Plan)		
Soil health	Domestic solid waste and wastewater from camps can lead to soil and water contamination and attract pests, affecting local environmental health.	• Collecting kitchen waste at separate bins and disposing of in a pit at designated area/s. • Collecting plastics in separate bins and disposing in deep trench at designated area/s covering with soil. • Collecting cottons, clothes etc. at separate bins. • Solid waste to be stored, collected, transported, and disposed of to a suitably licensed engineered landfill with records of transfer notes kept i.e., no waste should be burned, bitumen spills and plastics should not just be disposed of in trench, kitchen waste should not be disposed of in a pit, etc.	Contractor	PWD and PMDSC
Soil health	Compaction, erosion, and potential contamination from various activities.	• The topsoil from all areas of cutting and all areas to be permanently covered shall be stripped to a specified depth of 150 mm and stored in stockpiles. At least 10% of the temporarily acquired area shall be earmarked for storing topsoil. • The stockpile shall be designed such that the slope does not exceed 1:2 (vertical to horizontal), and the height of the pile be restricted to 2m. To retain soil and to allow percolation of water, the edges of the pile shall be protected by silt fencing.	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		• Stockpiles will not be surcharged or otherwise loaded and multiple handling will be kept to a minimum to ensure that no compaction will occur. The stockpiles shall be covered with gunny bags or tarpaulin. • It shall be ensured by the Contractor that the topsoil will not be unnecessarily trafficked either before stripping or when in stockpiles. • Such stockpiled topsoil will be returned to cover the disturbed area and cut slopes. Residual topsoil will be distributed on adjoining/proximate barren/rocky areas as identified by the Authority's Engineer in a layer of thickness of 75mm – 150mm. Top soil shall also be utilized for redevelopment of borrow areas, landscaping along slopes and incidental spaces.		
Soil structure	All construction sites may impact soil by causing erosion from various activities.	• Bank protection measures will be taken at erosion-prone areas. • Provision of side drain to guide the water to natural outfalls. • Retaining walls and breast walls have been included in the design. • Covering the slope surface with grass and bushes, by simple planting of roots and saplings; • In conditions where simple planting and seeding is not effective, the slopes covered with open mesh of natural fibers such as coir or jute, or of geo-synthetics, followed by planting of grass and bushes. • Side slopes of the embankment will not be steeper than 2H: 1V. Turfing of embankment slopes will be done along the stretch. • IRC: 56 -1974 recommended practice for the treatment of embankment slopes for erosion control will be taken into consideration.	Contractor	PWD and PMDSC
Soil structure	Compaction and contamination of soil at construction sites and workers' camp	• Construction vehicle, machinery and equipment shall move or be stationed in the designated area (RoW or CoI, as applicable) only. While operating on temporarily acquired land for traffic detours, storage, material handling or any other construction related or incidental activities, topsoil from agricultural land will be preserved as mentioned above. • Fuel and lubricants will be stored at the pre-defined storage location. The storage area will be paved with a gentle slope to a corner and connected with a chamber to collect any spills of the oils. • Unavoidable waste will be stored at the designated place prior to disposal. To avoid soil contamination at the wash-down and re-fueling areas, "oil interceptors" will be provided. Oil and grease spill and oil-soaked materials are to be collected and stored in labelled containers and sold off to UKPCB/MoEFCC authorized refiners.	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		• Septic tank/mobile toilets fitted with anaerobic treatment will be provided at camp. • Domestic waste at the construction camp will be segregated into biodegradable and non-biodegradable waste. Non-biodegradable waste will be given or sold to relevant agents for recycling or buried in nearby waste disposal sites following environmentally friendly practices.		
Borrow areas and quarries operations	Habitat disruption, dust emissions, and landscape degradation, impacting local ecosystems and communities.	• Borrow areas will not be located near habitation. The edges of borrow sites will be no closer than 3 meters from any fence line or boundary. • Adequate clearance will be provided for the construction of catch drains. Borrow sites will have adequate drainage outlets unless the relevant landowner has agreed that the borrow area is to create a permanent tank or dam. Written clearance from the landowner/village head will be obtained before leaving a site • Obtain necessary permissions for opening of any new borrow area and renewal of quarries. • Borrow pits will be selected from barren land/wasteland to the extent possible. • The topsoil will be preserved, and depth will be restricted to 1.5 m to comply IRC guidelines. • Borrow areas should be excavated as per the intended end use by the owner. The Indian Road Congress (IRC):10-1961 guideline should be used for the selection of borrow pits and the amount that can be borrowed. • The depths in borrow pits to be regulated as per IRC guidelines. Borrow areas will be levelled with salvaged material or other filling materials which do not pose contamination of soil. • Transportation of fine aggregates and earth material by covered trucks. • Sprinkling of water near loading/downloading and stockpile locations. • The contractors will prepare site-specific redevelopment plans for each borrow area, which will be implemented after the approval of the Supervision Consultant.	Contractor	PWD and PMDSC
Road drainage installations	Poor installations may alter natural water flow patterns, potentially	• Adequate cross-drainage structures have been provided to avoid impediments to the natural flow of water. The embankment height has been designed to be consistent with the existing topography of the region. • Construction works near waterways/water bodies will not be undertaken during the monsoon season • Retaining walls, breast walls and gabion walls have been proposed to prevent erosion	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
	leading to erosion	• Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies. • Effective drainage system will be provided to drain the storm water from the roadway and embankment and to ensure minimum disturbance to natural drainage of surface and subsurface water of the area. • Surface runoff from the main highway, embankment slopes and the service roads will be discharged through longitudinal drains, designed for adequate section, bed slopes, invert levels and the outfalls. If necessary, the walls of the drains will be designed to retain the adjoining earth.		
Waste generation from construction and worker's camp	Can lead to environmental pollution if not properly managed, affecting soil and water quality, and may affect worker's health	• The existing bitumen surface can be utilized for paving of crossroads, access roads, and paving works in construction sites and camps, temporary traffic diversions, haulage routes etc. • All excavated materials from roadway, shoulders, verges, drains, and cross drainage, and will be used for backfilling embankments, filling pits, and landscaping. • Unusable debris material should be suitably disposed of at pre-designated disposal locations to the satisfaction of PMDSC. The bituminous wastes will be disposed of in secure landfill sites only in an environmentally accepted manner. • Unusable and surplus materials, as determined by the Project Engineer, will be removed and disposed of off-site. • Recycle demolished concrete and asphalt for use as base material in new road construction. This reduces the need for new raw materials and minimizes waste. • Collect and recycle unused iron bars and damaged support structures. Recycling metal conserves resources and reduces the demand for new metal production. • Salvage usable wood and bricks for other construction projects or community uses. • Regularly spray water on dust-prone areas, such as excavation sites and construction debris piles, to suppress dust generation. • Implement a waste segregation system at construction sites to separate recyclable materials from general waste and hazardous waste. • Store, handle, and dispose of hazardous materials according to local regulations to prevent soil and water contamination.	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		• Use designated disposal sites for construction debris to prevent illegal dumping and environmental degradation. • Implement erosion control measures such as silt fences, sediment traps, and retaining walls to prevent soil erosion and sedimentation in nearby water bodies. • Set up composting facilities at construction camps to manage organic waste such as food scraps and vegetation. Composting reduces waste sent to landfills and produces useful soil amendments. • Implement pest control measures to manage rodents and insects attracted to accumulated organic waste. • Treat construction wastewater to remove pollutants before discharge into local water bodies. This includes using sedimentation tanks, oil-water separators, and filtration systems. • Ensure proper sanitation facilities at construction camps to prevent contamination of soil and water. • Conduct regular inspections of construction sites to ensure compliance with environmental regulations and waste management practices. • Provide training programs for construction workers on proper waste management practices, dust control techniques, and environmental protection measures. • Place clear signage and instructions around the construction site to guide workers on waste segregation and disposal procedures.		
Land cover at the road alignment	Removal of trees and small vegetation	• Restricting tree cutting within corridor of impact. • Requisite permission from the Forest Department will be secured for cutting of roadside trees. • Minimize the area of vegetation cleared by using selective clearing techniques. Retain as much existing vegetation as possible. • Inform local communities about site clearance activities and potential impacts. Provide channels for feedback and complaints. • Ensure compliance with local, regional, and national environmental regulations and standards.	Contractor	PWD and PMDSC
Land cover at ancillary sites	Removal of trees and small vegetation	• Minimizing tree cutting and vegetation clearance during site selection. • Preservation of trees within ancillary sites and avoiding impact on forest resources by providing buffer area from boundary of forest areas of 1km for locating construction plants, construction camp, and quarry and 500 m for borrow areas.	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		• Preservation of trees of ecological, socio- cultural importance. • Providing cooking gas at camp for discouraging and prohibiting use of fire-wood, i.e. cutting of trees by the workers. • Ensure timely commencement of compensatory plantation and roadside Plantation Strategy as per IRC, including manuring and controlled use of pesticides/fertilizers • Additional plantation/avenue plantation is also proposed subject to the availability of land. • For safe traffic operation, vertical clearance between the crown of the carriageway and lowest part of the overhang of the tree available across the roadway will conform to IRC: SP: 21-2009. The pit size, fencing, watering, and manuring requirements will also conform to the standard above. • In the event of design changes during construction, additional assessments including the possibility of saving trees shall be made by the contractor and PWD. • Planting native tree species in nearby areas under compensatory afforestation in lieu of cutting trees in accordance with the guidelines/terms of the forest department. Generally, in Uttarakhand, compensatory plantation shall be done in a ratio of 1:10 trees. This will provide new homes and food sources for wildlife present in the project area. • Recommendation of the concerned forest department shall be followed for compensatory plantation. • Compensatory plantation shall be done in nearby degraded forest areas. • Identify and relocate <i>Aegle marmelos</i> and <i>Cedrela odorata</i> specimens from the project area to nearby suitable habitats. This can be done in consultation with the Forest department/botanical experts to ensure the survival of the relocated plants. • Minor design adjustments to the road to minimize encroachment into areas where <i>Cedrela odorata</i> and <i>Aegle marmelos</i> are distributed. This might involve narrowing the road width or shifting the alignment to less sensitive areas to minimize tree cutting. • For <i>Aegle marmelos</i> and <i>Cedrela odorata</i> species, the compensatory plantation shall be done in a ratio of 1:15 trees. • Tree cutting shall only occur after obtaining permission from the forest department.		

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		• Compensatory plantation shall be done to create new forested areas in nearby suitable locations, compensating for habitat loss and supporting local biodiversity. • Native species shall be planted under the compensatory plantation. • Develop green belts along the road by planting native tree species. • Train construction workers and project staff on the importance of protecting Schedule-I species and the specific measures in place to avoid harming them. Ensuring everyone is aware of the species and their habitats helps in minimizing accidental impacts. Refer to Appendix 16 (Biodiversity Action Plan)		
Wildlife	All construction sites. Construction may disrupt wildlife habitats, increase mortality due to vehicle collisions, and displace wildlife from their current locations	• Restore habitats that are disturbed during construction by replanting native vegetation and creating suitable habitat structures. • Enforce speed limits for construction vehicles to reduce the risk of wildlife-vehicle collisions. • Train construction workers to recognize and avoid wildlife, and to implement best practices for minimizing impacts on wildlife. • Establish procedures for safely clearing construction areas of wildlife before starting work. • Conduct regular monitoring of wildlife populations and their habitats to assess the impact of road works and the effectiveness of mitigation measures.	Contractor	PWD and PMDSC
Presence of invasive species	Proliferation of invasive species and weeds at construction sites and labor camps	• Secure soil from locations close to the project area to minimize the risk of transporting seeds of alien invasive species. • Ensure all construction machinery and vehicles are thoroughly cleaned before entering the project site to prevent the accidental introduction of invasive plant seeds. • Conduct frequent inspections of temporary facilities such as labor camps, dumping sites, and soil storage sites to detect any growth of invasive plant species early. • If invasive plant species are found, promptly burn and destroy them within the premises where they are discovered to prevent their spread. • Set up regular monitoring schedules for areas prone to invasive species establishment, ensuring early detection and rapid response.	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		• Conduct training sessions and awareness programs for project managers, construction teams, and environmental specialists about the risks of invasive species and the importance of maintaining clean equipment. • Implement strict protocols for handling soil and other materials to prevent the introduction and spread of invasive species. • Ensure a coordinated effort among all stakeholders involved in the project to maintain vigilance and adhere to mitigation measures effectively.		
Hill cutting activities for the road widening	Direct loss of local vegetation and tree cover.	• Implement selective clearing of vegetation to minimize loss, retaining mature trees and vegetation along the road alignment wherever feasible. • Undertake compensatory reforestation in areas adjacent to the road or in identified ecological restoration zones. The ratio for compensatory planting should be at least 1:10 (for every tree removed, three should be planted). Use native species to restore the local flora composition. • If any threatened species, protected, or medicinal plant species are encountered, consider translocating them to safer locations within the project area or to botanical gardens. Ensure proper techniques are followed to maintain plant health and survival rates. • Identify and designate nearby areas as biodiversity offset zones where intensive reforestation and habitat restoration can be carried out. These zones should be monitored and managed to support the recovery of native species and serve as wildlife corridors. • Implement engineering solutions such as retaining walls, gabion structures, and soil nailing to stabilize slopes, particularly in steep areas. • Use bioengineering methods like planting vetiver grass, bamboo, and other deep-rooted species on the hillside to stabilize the soil. Introduce live stakes and fiber rolls on vulnerable slopes to reduce surface runoff and soil erosion. • Create terraces and contour trenches along the hillside to reduce the slope length and surface runoff velocity. Terraces should be planted with native shrubs and grasses to increase surface roughness and minimize erosion. • Construct check dams and gully plugs in areas where water flow is concentrated to trap sediment and reduce the impact of erosion. • Incorporate organic amendments such as compost or mulch into the soil to improve its structure, water-holding capacity, and fertility. This will enhance the establishment and growth of replanted vegetation in disturbed areas. • Apply mulch or geotextile blankets on exposed soil surfaces to reduce evaporation, suppress weed growth, and maintain soil moisture levels. This	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		will create a conducive environment for seed germination and seedling establishment. Establish a monitoring system to track changes in soil conditions, microclimate parameters, and vegetation health. Regularly evaluate the success of the revegetation and soil improvement measures and adapt management strategies as needed.		
Operation of construction facilities and worker's camp	Can lead to noise and air pollution, and waste generation	- No productive land will be utilized for camps. Accommodation and ancillary facilities will be erected and maintained to standards and scales approved by the PMDSC. All camps will be sited at a distance of 500m from habitation and water bodies, as much as practicable. - All construction camps will be provided with sanitary toilets with provision of septic tanks attached to soak pits. Storm water drains will be provided for the flow of used water outside the camp. Drains and ditches will be treated with bleaching powder on a regular basis. Garbage bins must be provided in the camp and regularly emptied and disposed of in a hygienic manner. - First-aid unit shall be provided. Workplaces away from regular hospitals will have indoor health units. Suitable transport will be provided to approach the nearest hospital. - HIV/AIDS prevention program shall be conducted to reduce the risk and transfer of HIV virus. Activities under the program will include monthly information, education, and communication campaigns. - The Contractors will provide adequate and safe water supply for workers. No alcoholic liquor or prohibited drugs will be imported, sold, given, and bartered. - Migrant workers may be the potential carriers of various diseases. Regular health check-ups and immunization camps will also be organized for the workers and nearby population.	Contractor	PWD and PMDSC
Occupational health and safety of workers	Construction camp. Workers' exposure to hazardous materials, noise, and injury from machinery.	- Provide available water supply, sanitation, and medical health facilities at campsite. - Ground water must not be used for drinking purpose. - Providing and using PPEs. - Using working reverse horn for all construction equipment and vehicles. - Use of retro-reflectorized traffic signs, barricades, safety ribbons etc. - Providing earth link circuit breaker (ELCB) for all electrical connections. - Maintaining first aid at construction sites. - Maintaining emergency response system.	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		• Provide adequate safety measures for communities and workers working on landslide prone zones. Refer to Appendix 11 (Guidelines for Construction Plant Establishment) and Appendix 12 (Guidelines for Camp Site Establishment and Operations).		
Occupational health and safety of workers	All construction sites. Workers' exposure to hazardous materials, noise, and injury from machinery.	• Training and Education: ○ Provide comprehensive safety training for all workers, including proper use of equipment, hazard recognition, and emergency response procedures. ○ Educate workers on proper lifting techniques and ergonomics to prevent musculoskeletal disorders. ○ Train workers on safe handling, storage, and disposal of hazardous substances used in construction. • Personal Protective Equipment: ○ Ensure all workers use appropriate PPE, such as helmets, gloves, safety glasses, ear protection, high-visibility clothing, and respiratory protection. ○ Conduct regular inspections and maintenance of PPE to ensure it is in good condition and functioning properly. • Equipment Safety: ○ Equip machinery with appropriate guards and safety devices to prevent accidents. ○ Implement a routine maintenance schedule for all equipment to ensure they are in safe working condition. ○ Develop and enforce safe operation procedures for machinery and equipment. • Traffic Control and Site Management: ○ Use barriers, signage, and flaggers to manage traffic and protect workers from vehicle collisions. ○ Limit access to construction zones to authorized personnel only. ○ Provide clear signage for hazards, safety zones, and emergency exits. • Fall Protection: ○ Install guardrails, safety nets, and harnesses for work at heights. ○ Ensure safe access to elevated work areas through scaffolding and ladders that comply with safety standards. ○ Train workers on the proper use of fall protection equipment.	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		• Health Monitoring and Medical Support: ○ Conduct regular health screenings and monitoring for workers to detect and address health issues early. ○ Implement noise monitoring programs to ensure exposure levels are within safe limits and provide hearing protection. ○ Ensure availability of first aid kits and trained personnel to handle medical emergencies on-site. • Dust and Chemical Control: ○ Use water spraying, dust suppressants, and covers to control dust and particulate matter. ○ Ensure adequate ventilation in confined spaces and areas with hazardous substances to reduce exposure. ○ Use spill containment systems and proper storage for fuels, oils, and chemicals to prevent spills and leaks. • Ergonomics and Worker Comfort: ○ Provide adjustable tools and equipment to reduce ergonomic strain. ○ Encourage regular rest breaks to prevent fatigue and musculoskeletal strain. ○ Design workstations to minimize awkward postures and repetitive motions. • Emergency Preparedness: ○ Develop and implement emergency response plans for accidents, chemical spills, and other emergencies. ○ Conduct regular emergency drills to ensure workers are prepared to respond effectively. ○ Maintain updated lists of emergency contacts and procedures. • Mental Health and Well-being: ○ Provide access to mental health counselling and support services for workers. ○ Promote work-life balance through reasonable working hours and time off to reduce stress and fatigue. ○ Implement programs to support workers' mental health, such as stress management workshops. • Weather Protection: ○ Provide hydration stations and shaded rest areas to prevent heat stress. ○ Supply appropriate cold weather gear and warm-up areas to protect against cold stress.		

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		○ Provide sun protection measures such as sunscreen, hats, and UV-protective clothing. ● Compliance and Monitoring: ○ Conduct regular inspections of the construction site to ensure compliance with safety regulations and identify potential hazards. ○ Establish a system for reporting and investigating accidents and near-misses to prevent future incidents. ○ Use feedback from monitoring and incident reports to continuously improve safety practices and mitigate risks.		
Community safety	Project road and diversion roads. Increase in traffic, accident risks, and disrupting local transportation patterns.	● Develop and implement a comprehensive Traffic Management Plan outlining the strategies for maintaining traffic flow and safety during construction. ● Plan construction activities in phases to minimize disruption and maintain access for traffic and pedestrians. ● Install clear and visible signage to inform drivers and pedestrians about construction activities, detours, and alternative routes. ● Use temporary traffic signals and flaggers to manage traffic flow and ensure the safety of both workers and road users. ● Schedule lane closures during off-peak hours to reduce congestion and disruption. ● Designate and clearly mark detour routes to redirect traffic away from construction zones. ● Communicate detour routes to the public through various channels, including websites, social media, local news, and community bulletins. ● Schedule construction activities during off-peak hours, weekends, or night time to minimize disruption to traffic flow. ● Coordinate with local traffic authorities, emergency services, and public transportation agencies to ensure seamless traffic management. ● Engage with local communities to address concerns and gather feedback on traffic management strategies. ● Implement traffic monitoring systems to assess traffic flow, identify congestion points, and make real-time adjustments. ● Enforce traffic laws and speed limits in construction zones to ensure the safety of workers and road users.	Contractor	PWD and PMDSC
Community safety	Construction sites	● Providing and maintaining traffic management comprising diversion warning, guiding and regulatory signage; channelisers and delineators; lighting, flagmen; dust control system etc. as specified in the contract.	Contractor	PWD and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		• Providing adequate light at construction zone if working during night time is permitted by the Engineer. • Conducting induction and periodic training for all workers and supervisors. • Implement traffic control measures such as signage, barriers, and flaggers to manage traffic flow and protect pedestrians and cyclists. • Secure construction sites with fencing and signage to prevent unauthorized access and protect the community, especially children. • Ensure construction areas are well-lit and visible, especially during night-time operations, to prevent accidents. • Create safe and clearly marked pedestrian pathways around construction sites. • Maintain open communication with the community about construction activities, schedules, and potential impacts. Provide regular updates and information through community meetings, newsletters, and social media. • Establish a grievance mechanism for community members to report concerns and receive timely responses. • Conduct public information campaigns to alert the public about construction activities and safety measures. • Coordinate with local emergency services to ensure rapid response in case of an incident.		
OPERATIONS AND MAINTENANCE				
Site restoration	Disturbance to village people and road users	• All construction zones including culverts, road-side areas, camps, hot mix plant sites, crushers, batching plant sites and any other area used/affected by the project will be left clean and tidy • All the opened borrow areas will be rehabilitated. • Adhering to environmental standards and guidelines to ensure that the restoration activities do not cause any further environmental harm.	Contractor	PMDSC
Road repairs	Emissions from hot patchwork, fumes from pavement marking works, dust from concrete grinding, and dust from	• Provision of PPE to workers • Water sprinkling to control dust • Covered haul trucks • Maintaining an adequate vehicle road capacity as congestion decreases vehicle speed, deteriorates fuel efficiency, and increases emission per km travel. • Maintain optimum range of vehicle speed. CO₂ emissions drastically increase when vehicles are travelling less than 30 kph and faster than 70 kph. • Maintain good riding quality of the road, expressed in roughness	PWD	

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
	demolition debris may deteriorate local air quality			
Increase of vehicles along the road	Air quality decline	• Promote the use of electric and hybrid vehicles, especially for public transport and commercial vehicles. • Replace older vehicles with modern, fuel-efficient, and low-emission vehicles. Introduce policies that encourage the scrapping of outdated vehicles and incentivize the purchase of vehicles that comply with the latest Bharat Stage (BS VI) standards. • Enforce strict adherence to Bharat Stage VI (BS VI) emission standards for all categories of vehicles. Conduct regular inspections and emission testing to ensure compliance. • Enhance the public transport system by providing reliable and efficient bus services, improving last-mile connectivity, and promoting the use of shared mobility options to reduce the number of private vehicles on the road. • Establish speed regulations to reduce emissions from vehicles traveling at inefficient speeds. • Implement green infrastructure, such as green belts and buffer zones, along the road network to act as pollution sinks, reduce the dispersion of pollutants, and improve air quality. • Create dedicated lanes for bicycles and pedestrians to encourage non-motorized transport, reducing the reliance on motor vehicles for short-distance travel. • Use energy-efficient lighting, green construction materials, and sustainable water and waste management practices. • Launch public awareness campaigns to educate residents and visitors about the environmental and health impacts of vehicular emissions.	PWD on road related activities TADA on introduction of new technologies	UTDB
Noise Pollution	Disturbance to villages and wildlife	• Periodical monitoring of noise level will be carried out. If values exceed the standard limits, suitable measures will be taken. • Providing and maintaining signage on noise regulation at silence zones.	PWD	UKPCB
Fire hazards	Damage to road facilities and injury	• Create firebreaks and buffer zones around vulnerable forested areas to prevent the spread of fires. This could include clearing strips of vegetation or constructing barriers to isolate fires.	PWD and Department of Forest	UKPCB

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		• Increase the frequency of patrols by forest guards and community volunteers to monitor human activity in forested areas and prevent illegal logging or encroachment. • Conduct awareness programs targeting tourists and local communities to educate them on the impact of human activities on forests and the importance of conservation. Signage and information boards can be placed along the promenade to inform visitors about responsible behaviour. • Restore degraded areas through reforestation and habitat improvement projects. Rehabilitating damaged lands can discourage further human intrusion and improve forest health. • Strengthen collaboration with local fire departments and emergency services to ensure prompt and coordinated responses to fires. • Designate specific zones for tourist activities and restrict access to vulnerable areas. Implement visitor management strategies such as limiting the number of visitors in certain areas to minimize human impact. • Develop infrastructure along the promenade that minimizes ecological disturbance. Use sustainable materials, reduce the footprint of pathways, and ensure that construction activities do not compromise the integrity of nearby forests. • Establish buffer zones between forest areas and tourist infrastructure to reduce human-wildlife conflict and protect sensitive habitats from direct human disturbance.		

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
Pedestrian and commuter safety	Risk of accidents	• Maintenance as per Standard Highway Safety Signage and Traffic Management. • Maintenance of centerline road marking, edge delineation etc. • Maintenance of clearly marked signage at habituated areas, and sensitive areas such as potential wildlife crossings, schools, temples, etc. • Enforcement of speed limits and other traffic rules, especially near potential wildlife crossings and built-up sections. • Maintenance of handrails and road furniture. • Maintenance of lighting and electrical components of road. • PPE should be provided to workers during maintenance.	PWD	UKPCB
Human-wildlife conflict, pollution, and habitat disruption	Injury to wildlife and/or road users	• Identify and designate wildlife crossing points along the road based on known animal movement patterns. Install signage and speed bumps at these crossing points to alert drivers and reduce vehicle speeds, minimizing the risk of wildlife-vehicle collisions. • Install fencing along sections of the road that are prone to high wildlife activity to prevent animals from accessing the road directly. Use vegetation barriers, such as thick hedgerows or thorny bushes, along the road's edge to deter animals from venturing onto the road. • Maintain natural vegetation buffers of at least 10 meters between the road and habitats to reduce visual and noise disturbances, allowing animals to utilize areas adjacent to the road without direct interaction with human activities. • Noise barriers, such as berms or vegetative walls, along the road sections that pass through habitats, nesting sites, or breeding grounds. • Establish quiet zones with reduced speed limits and restrict the use of vehicle horns along specific road segments that are known to have high wildlife activity. • Use low-intensity and downward-facing along the road to minimize light pollution. • Establish no-horn zones along sensitive areas of the road to minimize noise pollution and disturbance to wildlife.	PWD Department of Forest	UKPCB

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		- Establish waste collection points at regular intervals along the road, especially in areas with high tourist activity. Use animal-proof waste bins to prevent scavengers like the Jungle Crow (<i>Corvus macrorhynchos</i>) from accessing the waste. - Develop a waste management schedule that includes regular waste collection, transportation, and disposal in designated areas to prevent accumulation of litter along the roadside. - Conduct awareness programs for local communities and visitors on the environmental impacts of littering and the importance of proper waste disposal. Use posters, leaflets, and social media campaigns to spread the message. - Implement a "Leave No Trace" policy along the road and enforce strict fines for littering to promote responsible behaviour among road users. - Organize clean-up drives involving local communities, schools, and tourists to periodically clear litter from the roadside and adjacent habitats. These drives should focus on removing plastic waste and other non-biodegradable materials that pose a threat to wildlife.		
Contamination of soil and water resources from spills due to traffic and accidents	Vehicular Traffic	- Contingency plans to be in place for cleaning up of spills of oil, fuel and toxic chemicals. - Spill of oil, fuel and automobile servicing units without adequate preventive systems in place to be discouraged.	PWD	UKPCB
Maintenance of drainage system	Clogging of drainage system that may result to water logging along roads	- The drains will be periodically cleared to maintain storm water flow. - Road drains will be cleared of debris before onset of every monsoon.	PWD	UKPCB
Land-use development	Uncontrolled development along the 15-km road.	Zoning and Land Use Planning: - In accordance with the Environment (Protection) Act, 1986 and the Uttarakhand Hill Area Development Plan 2021-2031, designate specific zones for residential, commercial, agricultural, and ecological uses. Ensure that zoning plans are developed based on the ecological sensitivity and topography of the region, and comply with the Uttarakhand Town and Country Planning Act, 1973. - Define "No Development" zones as per the Eco-Sensitive Zone Notification Guidelines 2011 issued by MoEFCC. Establish buffer zones around ecologically sensitive areas, such as forested lands, rivers, and agricultural	PWD	UTDB

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		terraces, in consultation with the Uttarakhand Forest Department. Such zones should prohibit any form of construction or land modification to prevent habitat fragmentation and maintain ecological integrity. • Apply the standards outlined in the National Disaster Management Guidelines on Landslide Hazard Zonation Mapping 2009 to identify and map landslide-prone areas and restrict land conversion in these zones. Development Control and Regulatory Frameworks: • Enforce the provisions of the Hill Building Bylaws 2011, which set parameters for building height, density, and construction materials in hill areas. Ensure that all development projects adhere to these bylaws to prevent destabilization of slopes, minimize visual disruption, and promote the use of sustainable and locally available materials. • Mandate environmental impact assessments (EIAs) for all new infrastructure projects under the EIA Notification 2006. Obtain clearances from the Uttarakhand State Pollution Control Board and MoEFCC before initiating construction activities. • Promote adherence to the Indian Green Building Council (IGBC) Standards and Bureau of Indian Standards (BIS) Codes for sustainable construction. This includes using energy-efficient designs, water management systems, and local resources to reduce the carbon footprint of infrastructure projects. Promoting Sustainable and Eco-Friendly Tourism: • Develop eco-friendly tourism facilities and activities based on the Eco-Tourism Guidelines 2019 by MoEFCC and the Uttarakhand Tourism Policy 2020. Encourage sustainable tourism practices that emphasize conservation, such as low-impact camping sites, nature trails, and community-managed tourism initiatives. • Limit the development of large-scale resorts, hotels, and tourism infrastructure in eco-sensitive zones as per the Eco-Sensitive Zone Notification. Implement guidelines that promote nature-based tourism, such as trekking, bird-watching, and eco-cultural activities that do not involve large-scale land modifications or construction. Soil and Water Conservation: • Implement soil conservation measures such as terracing, check dams, and contour trenching, as recommended by the Indian Council of Agricultural		

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		Research (ICAR) and Central Soil and Water Conservation Research and Training Institute (CSWCRTI). These measures will help stabilize slopes, reduce soil erosion, and maintain soil health in the region. - Design drainage systems that comply with the Ministry of Road Transport and Highways (MoRTH) Specifications for Roads and Bridges. Ensure that the drainage system is designed to accommodate high-intensity rainfall events and minimize waterlogging and soil erosion in the hilly terrain. Community Involvement and Capacity Building: - Engage local communities through Gram Panchayats and Village Development Committees in land-use planning and decision-making processes. This participatory approach will ensure that development projects are aligned with the needs and priorities of local communities while preserving traditional livelihoods. - Conduct training and capacity-building programs on sustainable agriculture, eco-tourism, and conservation practices in collaboration with local NGOs, academic institutions, and government agencies such as the Uttarakhand Forest Department and Watershed Management Directorate. Infrastructure for Sustainable Agriculture and Livelihoods: - Support sustainable agricultural practices through the Pradhan Mantri Fasal Bima Yojana (PMFBY) and National Mission for Sustainable Agriculture (NMSA). Encourage organic farming, agroforestry, and water management practices to enhance soil fertility and increase resilience to climate change. - Develop market linkages and value chains for local agricultural products, handicrafts, and eco-tourism services through government schemes such as the Deen Dayal Upadhyaya Grameen Kaushalya Yojana (DDU-GKY). This will provide alternative livelihood options and reduce dependence on environmentally harmful activities.		

Table 66. Environmental monitoring plan for the tourism road

Environmental Features / Stage	Parameters and Standards	Location	Frequency	Duration	Action if criteria exceeds standard	Responsible party	
						Implementation	Supervision
Air Quality and Noise Levels							
Construction	SPM, PM2.5, PM10, SO2,	Location of	Once in a	Continuous	Check and modify	Contractor	PIU

Environmental Features / Stage	Parameters and Standards	Location	Frequency	Duration	Action if criteria exceeds standard	Responsible party	
						Implementation	Supervision
Stage	NOx, CO, HC Leq - Noise levels on dB (A) scale	construction plant Along the project road at different zone including sensitive receptor zones as suggested by PWD's Engineer for regular monitoring	season excluding monsoon for 2 years	24 hours/ or for 1 full working day	control devices like bag filter/cyclones of hot mix plant Provide additional noise barriers	through approved monitoring agency	PMDSC
Operations Stage	SPM, PM2.5, PM10, SO2, NOx, CO, HC Leq - Noise levels on dB (A)	Along the project road at different zones as suggested by PWD's Engineer for regular monitoring	Once in a season excluding monsoon for 2 years	Continuous 24 hours/ or for 1 full working day	-	PWD	
Water Quality							
Construction Stage	Surface Water: pH, Temperature, DO, Oil and Grease, Conductivity, TSS, TDS, Alkalinity, Total Hardness, Calcium, Magnesium Chloride, Phosphate, Sulphate, Nitrate, COD, BOD, Iron, Total Coliform, Faecal Coliform, Salinity	At identified locations	Once in a season Excluding monsoon for 2 years	-	Check and modify petrol interceptors, Silt fencing devices.	Contractor through approved monitoring agency	PIU PMDSC
	Groundwater: pH, Temperature, Conductivity, TSS, TDS, Alkalinity, Total Hardness, Calcium, Magnesium Chloride, Phosphate, Sulphate, BOD, Coliform, Nitrate, Iron.	At identified locations	Once in a season excluding monsoon for 2 years	-	Check and modify petrol interceptors, Silt fencing devices.	Contractor through approved monitoring agency	PIU PMDSC
Operation Stage	pH, Temperature, DO, Oil and Grease, Conductivity, TSS, TDS, Alkalinity, Total Hardness, Calcium, Magnesium Chloride, Phosphate, Sulphate,	At identified locations	Once during Operation stage excluding monsoon for 2 years	-	Check and modify petrol interceptors, Silt fencing devices.	PWD	

Environmental Features / Stage	Parameters and Standards	Location	Frequency	Duration	Action if criteria exceeds standard	Responsible party	
						Implementation	Supervision
	Nitrate, COD, BOD, Iron, Total Coliform, Faecal Coliform, Salinity						
	pH, Temperature, Conductivity, TSS, TDS, Alkalinity, Total, Hardness, Calcium, Magnesium Chloride, Phosphate, Sulphate, BOD, Coliform, Nitrate, Iron.	At identified locations	Once during Operation stage excluding monsoon for 2 years	-	Check and modify petrol interceptors, Silt fencing devices.	PWD	
Soil Quality							
Construction	Chemical properties including oil and grease	At construction plants and camp sites	Once in a season excluding for 2 years	-	Check oil and chemical spillage	Contractor through approved monitoring agency	PIU PMDSC
Operation	Chemical properties including oil and grease	At identified locations	Once during Operation stage excluding monsoon for 2 years	-	Check oil and chemical spillage	Contractor through approved monitoring agency	PIU PMDSC
Tree Plantation							
Operation	Survival rate of plants	All along the project corridor	1 sample (quadrants) for each km	-	Once every year after monsoon for 3 years	Department of Forest	
Accidental and Health and Safety							
Construction	No. of accidents or near miss involving workers.	All along the proposed road	Once in a month	-	Corrective measures	Contractor	PWD PMDSC
Operation	No. of accidents or near miss involving workers.	All along the proposed road	Once in 3 months	-	Corrective measures	PWD	
Wildlife							
Construction	No. of wildlife accidents.	All along the proposed road	Once in a month	-	Corrective measures	Contractor	PMDSC, PIU Forest officials
Operation	No. of wildlife accidents.	All along the proposed road	Once in 3 months	-	Corrective measures	Department of Forest	

Table 67. Environmental Management Plan for the Ropeway, Water Transport Stations, Last Mile Connectivity and Smart Loop

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
Design Stage and Pre-construction Phase				
Climate adaptation design of ropeway	Increased wind speeds and other climate impacts to operations of ropeway	<i>Structural Reinforcements and Upgrades:</i> ○ Replace existing cables with high-tensile strength cables designed to withstand increased wind loads. The tensile strength of the new cables should be at least 5000 MPa to accommodate wind speeds up to 60 km/h and gusts reaching 80 km/h. ○ Incorporate vibration dampers in the cable system to reduce oscillations caused by wind-induced vibrations. This will help maintain stability and reduce wear and tear on mechanical components. ○ Strengthen pylons and support structures using high-strength concrete or steel to enhance their load-bearing capacity and prevent structural failures due to increased wind loads. <i>Real-Time Weather Monitoring and Automated Safety Protocols:</i> ○ Install anemometers along the entire ropeway length to continuously monitor wind speeds. Automated alarms can be integrated into the system to alert operators when wind speeds approach unsafe levels, allowing for timely suspension of operations. ○ Implement automated braking and shutdown systems that activate when wind speeds exceed safe operating limits. This will prevent accidents caused by sudden wind gusts. ○ Utilize weather data analytics to predict extreme weather events and proactively manage ropeway operations. Implement a real-time monitoring system that integrates wind, rainfall, and temperature data to forecast potential shutdowns and avoid sudden operational disruptions. <i>Slope Stabilization and Erosion Control:</i> ○ The Tipri station, located on a steep slope, has been affected by landslides in the past due to heavy rainfall and soil erosion. Future climate scenarios project a 19% increase in precipitation by 2070 under the SSP2-4.5 scenario. This could further destabilize slopes, posing a risk to the ropeway infrastructure. Slope stabilization measures such as reinforced retaining walls, geotextile membranes, and bioengineering techniques (e.g., planting	Contractor	TADA and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		deep-rooted vegetation) should be implemented to prevent soil erosion and ensure slope stability. <i>Elevated Design Standards for Gondola Stations:</i> Given that the ropeway stations are highly exposed to wind and rainfall, it is recommended to elevate the design standards for the stations. This includes using wind-resistant materials for roofs and side panels and installing additional anchoring points for increased stability.		
Consents, permits, clearances, no objection certificate (NOC), etc.	Failure to obtain necessary consents, permits, and clearances can result in design revisions and/or stoppage of the works.	- Contractor to conduct an early review of all applicable laws, regulations, and guidelines to identify the necessary consents, permits, clearances, and NOCs required for the project. Develop a comprehensive checklist of all required approvals, specifying the responsible authorities and the timeline for obtaining each permit. - Obtain all necessary consents, permits, clearances, no objection clearances (NOC) etc. prior to start of civil works. - Include in detailed design drawings and documents all conditions and provisions if necessary - Organize meetings with relevant regulatory authorities, local bodies, and stakeholders to discuss the project scope and the required approvals. Maintain open lines of communication with regulatory authorities to address any queries and facilitate the approval process. - Prepare detailed documentation, including project plans, environmental impact assessments, and any other required studies or reports. Ensure all project activities and documentation comply with regulatory standards and guidelines. - Contractor to submit applications for consents, permits, clearances, and NOCs well in advance to account for any potential delays in the approval process. Regularly follow up with the respective authorities to track the status of applications and address any additional information requests promptly. - Conduct training programs for project staff and contractors to familiarize them with the regulatory requirements and the process for obtaining necessary approvals. - Organize workshops to ensure all team members understand the importance of compliance and the procedures involved.	Contractor	TADA and PMDSC Government agencies
Preparation of construction	Without EHSMP and EMoP would	Site reconnaissance survey to verify the data provided in the bid document and collect information from community and field conditions.	Contractor	TADA and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
environmental, health and safety management plan (EHSMP) and environmental monitoring plan (EMoP)	result to unmanaged environmental impacts of construction and operations	• Preparation of construction EHSMP and EMoP based on the bid document, environmental management plan, results of survey and community consultation. • Prepare subplans to compliment EHSMP such as : ○ Campsite Subplan ○ Waste Management Subplan ○ Health and Safety Management Plan ○ COVID-19 and other diseases management Subplan ○ Construction and demolition Subplan ○ Submit construction EHSMP, EMoP, and subplans to UTDB for approval. ○ Biodiversity Action Plan		
Construction planning	Inadequate planning could lead to non-implementation of EHSMP during the construction phase and result in significant environmental impacts leading to non-compliance with ADB's environmental safeguard requirements.	• Recruit environmental specialist, health and safety specialist, safety supervisor and first aiders as per requirement of the bidding document. • Conduct training on the implementation of the EHSMP to enhance general understanding and clarify responsibilities regarding implementation, including monitoring and reporting, must also be provided to all relevant staff of contractors. • No works can commence prior to approval of EHSMP. For ropeway component, refer to Appendix 1 (Environmental safeguards as per MOEFCC).	Contractor	TADA and PMDSC
Camp establishment and construction mobilization	Clearing land for camps and construction can lead to soil erosion, and landscape alteration	• Establish proper sanitation facilities and wastewater treatment processes to prevent contamination of local water sources. • Use water sprays to reduce dust emissions. • Implement noise control measures such as sound barriers and restrict noisy activities to certain times of the day. • Provide workers with adequate living conditions, including safe housing, clean water, and sanitary facilities. • Implement the labor campsite plan as approved by UTDB.	Contractor	TADA and PMDSC Government agencies

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
	Presence of heavy machinery and equipment can increase air and noise pollution. Community safety risks	• Disposal will not be allowed near sensitive areas which will cause inconvenience to the community. • The construction camp, storage of fuel and lubricants should be avoided near waterbodies. • Schedule transport and hauling activities during non-peak hours. • Locate entry and exit points in areas where there is low potential for traffic congestion. • Keep the site free from all unnecessary obstructions. • Coordinate with the local government for temporary road diversions and for provision of traffic aids if transportation activities cannot be avoided during peak hours. • Notify affected sensitive receptors by providing sign boards with information about the nature and duration of construction works and contact numbers for concerns/complaints.		
Sourcing of construction materials from quarries	Unmanaged impacts on air and water resources. Risk on health and safety of workers	• Use quarry sites and sources permitted by government. • Verify suitability of all material sources, confirm permits of material sources and obtain approval from UTDB. • If additional quarries are required after construction has started, obtain written approval from UTDB.	Contractor	TADA and PMDSC
Construction				
Public transport (only for the ropeway)	Temporary disruption of access for the passengers using ropeway to commute between Tipri and Madan Negi	• Provision of alternate feasible access by providing a ferry boat or a bus shuttle between Tipri and Madan Negi. • Clearly communicate the disruption schedule and duration to all passengers well in advance. • Use multiple channels, including local newspapers, radio, social media, and notice boards at ropeway stations, to disseminate information. • Place clear and prominent signage at key locations to guide passengers to alternative transportation options. • Provide maps and directions both online and at the ropeway stations to help passengers navigate the changes. • Offer special assistance for elderly, disabled, or otherwise vulnerable passengers to ensure they can navigate the disruption smoothly.	TADA has the main responsibility to implement measures Contractor to provide support as needed by the PIU	PMU

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		• Deploy staff at key points to assist passengers with information and directions.		
Soil environment	Excavation and earthworks required for building foundations, and utility installations, can lead to soil disturbance, removal, and compaction. Soil Pollution due to fuel and lubricants, construction wastes	• Save topsoil removed during excavation and use to reclaim disturbed areas, as soon as it is possible to do so. • Use dust abatement such as water spraying to minimize windblown erosion. • Provide temporary stabilization of disturbed/excavated areas that are not actively under construction. • Apply erosion controls (e.g., silt traps) along the drainage leading to the water bodies. • Conduct routine site inspections to assess the effectiveness of and the maintenance requirements for erosion and sediment control systems. • After construction, all temporary structures and debris must be removed, and the site should be restored to a near-natural or stable condition to prevent long-term soil degradation. • The fuel storage and vehicle cleaning area will be stationed such that spillage of fuels and lubricants does not contaminate the ground. • Soil and pollution parameters will be monitored as per monitoring plan.	Contractor	TADA and PMDSC
Water resources (for the ropeway and water transport stations)	Construction activities can lead to the contamination of nearby water bodies through runoff containing sediments, oils, chemicals, and other pollutants.	• Schedule construction activities during non-monsoon season, to the maximum extent possible. • Ensure drainages and water bodies within the construction zones are kept free of obstructions. • Keep loose soil material and stockpiles out of drains and flow-lines. • Avoid stockpiling of excavated and construction materials (sand, gravel, cement, etc.) unless covered by tarpaulins or plastic sheets. • Silt fencing to be provided near construction sites of water transport stations to prevent sediments from the construction site to enter into the lake. • Dispose any residuals at identified disposal site by UTDB. Dispose waste oil and lubricants generated as per provisions of Hazardous Waste (Management and Handling) Rules, 1989. • Refuel equipment within the designated refueling containment area away from drainages, nallahs, or water body. • Inspect all vehicles daily for fluid leaks before leaving the vehicle staging area and repair any leaks before the vehicle resumes operation.	Contractor	TADA and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		- Follow the guidelines set by the State Pollution Control Board on reuse or disposal of used oil, and chemicals. - Dispose of hazardous chemicals and oils at designated hazardous waste disposal facilities as per the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016. - Ensure that construction camps and facilities are located at least 500 meters away from water bodies, as per the guidelines by MoEFCC. - Provide well-maintained sanitation facilities such as toilets and septic tanks in construction camps. - Treat effluents before discharge, following the Water (Prevention and Control of Pollution) Act, 1974. - Regularly monitor and maintain sanitation and wastewater facilities to prevent any leaks or overflows. - Store chemicals and fuels in designated areas with secondary containment to prevent spills, as per the guidelines of the Petroleum and Explosives Safety Organization (PESO). - Use appropriate storage tanks and containers that meet the standards set by the Bureau of Indian Standards (BIS). - Train workers on safe handling practices and emergency response procedures for chemical spills. - Regularly inspect and maintain storage facilities to ensure their integrity and compliance with safety regulations.		
Air quality	Activities such as excavation, grading, and demolition generate significant amounts of dust, which can affect air quality and pose health risks to workers and nearby residents	- Conduct regular water spraying on stockpiles. - Conduct regular visual inspection in the construction zones to ensure no excessive dust emissions. - Maintain construction vehicles and obtain "pollution under control" certificate from UKPCB. - Obtain CTE and CTO for hot mix plants, crushers, diesel generators, etc., if to be used in the project. - Use tarpaulins to cover trucks transporting construction materials such as sand, cement, and aggregates to prevent dust emissions during transit. - All construction machinery and vehicles are regularly maintained and comply emission standards set by the UKPCB.	Contractor	TADA and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		• Implement policies to minimize idling time for construction vehicles and equipment to reduce unnecessary emissions. • Conduct regular air quality monitoring during construction to ensure compliance with National Ambient Air Quality Standards (NAAQS) • Provide workers with PPE, such as masks and respirators, to protect them from inhaling harmful dust and pollutants. • Inform nearby residents of construction schedules and potential air quality impacts. • Conduct regular health checks for workers to monitor and address any respiratory issues arising from exposure to construction-related air pollutants		
Noise environment	Use of heavy machinery and construction equipment such as bulldozers, excavators, cranes, and concrete mixers can generate significant noise, affecting workers on-site and nearby residents	• Restrict noisy construction activities to daytime hours (e.g., 9 AM to 6 PM) as per the Noise Pollution (Regulation and Control) Rules, 2000. Avoid night-time operations unless absolutely necessary and after obtaining permission from local authorities. • Plan activities in consultation with PIU/PMDSC so that activities with the greatest potential to generate noise are conducted during periods of the day which will result in least disturbance. • Provide advance notice to the local community about construction schedules and potential high-noise activities. • Minimize noise from construction equipment by using vehicle silencers and fitting jackhammers with noise-reducing mufflers. • Ensure all construction equipment and machinery are regularly serviced and maintained to operate efficiently and produce minimal noise. Follow manufacturer's guidelines and UKPCB standards for maintenance. • If specific noise complaints are received during construction, the contractor may be required to implement one or more of the following noise mitigation measures, as directed by the project manager. • Locate stationary construction equipment as far from nearby noise-sensitive properties, such as the hospital, as possible. • Shut off idling equipment. • Maintain records of noise monitoring results and make them available for inspection by regulatory authorities. • Provide workers with PPE such as earplugs, noise-cancelling earmuffs, and other hearing protection devices. Ensure that workers use these PPEs correctly and consistently.	Contractor	TADA and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
Waste generation	Improper disposal of construction waste, including hazardous materials such as paints, solvents, and chemicals, can lead to soil and water contamination. Accumulation of construction waste can create unsightly conditions, affecting the visual appeal of the area and potentially impacting tourism and local businesses.	• Prepare and implement a waste management. • Manage solid waste according to the following hierarchy: reuse, recycling, and disposal. • Implement on-site segregation of construction and demolition waste into categories such as recyclables (metal, wood, glass, etc.), hazardous waste, and general waste. This facilitates proper disposal and recycling. • Use color-coded bins for different types of waste to ensure proper segregation at the source. • Establish recycling programs for materials such as concrete, metal, wood, and glass. Partner with local recycling facilities to ensure that these materials are processed and reused effectively. • Follow guidelines for the safe handling, storage, and disposal of hazardous materials, such as asbestos, lead, and chemicals. Ensure that these materials are separated from non-hazardous waste. • Dispose of hazardous waste at authorized hazardous waste treatment, storage, and disposal facilities (TSDFs) as per the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016. • Follow local municipal guidelines and obtain necessary permissions for waste disposal. Ensure compliance with the Solid Waste Management Rules, 2016. • Provide appropriate PPE to workers handling waste to protect them from exposure to hazardous materials. This includes gloves, masks, and protective clothing. • Conduct training programs for workers on proper waste management practices, including handling hazardous materials and emergency response procedures. • Establish a feedback mechanism for the community to report concerns related to waste management. Address these concerns promptly to maintain good community relations. • Avoid stockpiling and remove immediately all excavated soils, excess construction materials, and solid waste (removed concrete, wood, trees and plants, packaging materials, empty containers, oils, lubricants, and other similar items). • Prohibit disposal of any material or wastes (including human waste) into drainage, nallah, or watercourse.	Contractor	TADA and PMDSC
Wildlife	Physical disturbance and	• Marking of subproject site's boundaries and disseminate information about civil work areas to construction staff and labors. Delineate clearing limits in the	Contractor	TADA and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
	habitat disruptions	field using flagging or other means before any land disturbing activities, so only those areas needed to be cleared will be disturbed. Instruct construction workers that they are only authorized to cut or clear any vegetation within the designated clearing limits. • With support from PIU and PMDSC, all construction workers and staff will be informed about areas supporting habitats and species of conservation value, why these features are important and what activities allowed and not permitted in WHS. This will include details of regulations to protect biodiversity as well as staff obligations to comply norms. • Tree cutting shall be avoided for establishment of labor camp, material storage site, transferring of any machinery, equipment's and vehicles at subproject site. • No objection clearance (NOC) for tree cutting to be obtained by project proponent before construction. However, contractor will support the proponent if any NOC to be obtained for cutting of additional tree during construction stage. • Implement a Wildlife Shepherding Protocol before any land disturbing activities. This should involve an inspection of the land to be disturbed and identification of the presence of any wildlife species. Any slow-moving species (e.g., amphibians, reptiles, pangolins, and similar species) should be carefully captured by an experienced wildlife specialist and relocated to nearby habitat. • All construction staff should be informed about the importance of stream/river habitat and the importance of fish and aquatic species available in these streams. The Contactor will prepare and give this information as part of the staff inductions and will display relevant information and maps in the site offices. • Contractor will be required to ensure provision of basic amenities of drinking water, adequate number of toilets/mobile or portable toilets, washrooms, sanitation and cleanliness, at the labor camp to minimize the pollution, littering and dumping of wastes in the river • Contractor will also ensure provision of septic tanks to treat wastewater discharged from labor camp. No discharge of untreated wastewater shall be allowed to enter in stream • Contractor will ensure complete prohibition of fishing activities. Refer to Appendix 16 (Biodiversity Action Plan)		

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
Occupational health and safety	Poses several occupational health and safety risks, including exposure to hazardous materials, physical injuries, noise-induced hearing loss, ergonomic issues, respiratory problems, and heat stress.	• Comply with IFC EHS Guidelines on Occupational Health and Safety • Following best practice health and safety guidelines: IFC's General EHS Guidelines,²⁰ WHO Interim Guidance (and its updates) on Water, Sanitation, Hygiene and Waste management for the COVID19 virus • ADB's Interim Advisory Note on Protecting the Safety and Well-Being of Workers and Communities from COVID-19 (2020). In case of reoccurrence of COVID-19 outbreak strictly follow and implement the H&S guidance for COVID-19 at worksite. • Everyone entering the worksite must wear a mask, gloves and hard shoes. • Disallow worker exposure to noise level greater than 85 dBA for duration of more than 8 hours per day without hearing protection. The use of hearing protection shall be enforced actively. • Provide H&S orientation training to all new workers to ensure that they are apprised of the rules of work at the site, personal protective protection, and preventing injury to fellow workers. • Ensure that qualified first aid can be always provided. Equipped first aid stations shall be easily accessible throughout the site as well as at construction camps. • Provide medical insurance coverage for workers. • Secure construction zone from unauthorized intrusion and accident risks. • Provide supplies of potable drinking water. Provide clean eating areas where workers are not exposed to hazardous or noxious substances. • Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazard areas unescorted. • Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas. • Ensure moving equipment is outfitted with audible back-up alarms. • Mark and provide sign boards in the construction zone, and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate.	Contractor	TADA and PMDSC

²⁰<https://www.ifc.org/wps/wcm/connect/554e8d80488658e4b76af76a6515bb18/Final%2B%2BGeneral%2BEHS%2BGuidelines.pdf?MOD=AJPERES>

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		• Contractor should have fire prevention plan and designated location plan for provision of fire extinguishers and related tools and equipment. • Contractor should give training to the workers on using fire extinguisher and conduct mock drills for emergency preparedness. • Provide PPE, including respirators, protective suits, and gloves, to workers handling hazardous materials. Ensure PPE complies with the standards set by the Bureau of Indian Standards (BIS). • Implement safe handling procedures for chemicals. Store chemicals in labelled, secure containers and provide Material Safety Data Sheets (MSDS) for reference. • Provide life jackets to the workers involved in installation of floating jetties. • Conduct regular training sessions on chemical safety, emergency response, and proper use of PPE. • Ensure operators of heavy machinery are trained and certified. Provide refresher training and regular safety briefings. • Provide and maintain fall protection systems, such as guardrails, safety nets, and personal fall arrest systems, in compliance with the National Building Code of India and the Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996. • Conduct regular inspections of fall protection equipment and ensure timely repairs and replacements. • Provide hearing protection devices like earplugs and earmuffs to workers exposed to high noise levels. Ensure these devices meet BIS standards. • Conduct regular noise level monitoring to ensure compliance with the Noise Pollution (Regulation and Control) Rules, 2000. Implement corrective measures if noise levels exceed permissible limits. • Train workers on proper lifting techniques and ergonomics to prevent musculoskeletal injuries. Design Improvements: Design workstations and tools to reduce repetitive strain and improve worker comfort. Adjust heights of work surfaces to appropriate levels. • Enclose areas where high dust generation occurs and use ventilation systems to capture and filter dust. • Provide appropriate respiratory protection equipment like masks and respirators. Ensure they are suitable for the type of dust and meet BIS standards.		

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		• Ensure that workers have access to clean drinking water at all times. Provide shaded rest areas and schedule regular breaks to prevent heat stress. • Schedule strenuous activities during cooler parts of the day and rotate workers to minimize prolonged exposure to heat. Conduct training programs to educate workers about the signs of heat stress and preventive measures. Encourage workers to report symptoms early.		
Community Health and Safety	Construction activities may cause harm, disturbance and nuisance to local people and daily routines	• Regularly spray water on construction sites to suppress dust, especially during dry and windy conditions. • Cover stockpiles of materials and debris with tarpaulins. Ensure that trucks transporting loose materials are covered to prevent dust spread. • Limit noisy construction activities to daytime hours (e.g., 9 AM to 6 PM) to minimize disturbance to residents. Obtain necessary permissions for any night-time operations. • Provide advance notice to the local community about construction schedules and any expected high-noise activities. • Designate specific routes for construction vehicles to minimize disruption to local traffic. • Avoid routes passing through residential areas and sensitive zones like schools and hospitals. • Schedule deliveries and movement of heavy vehicles during off-peak hours to reduce traffic congestion. • Ensure safe pathways and crossings for pedestrians around the construction site. Use barriers and warning signs to guide pedestrian movement. • Conduct awareness campaigns to inform the local community about traffic changes and safety precautions. • Conduct structural assessments of nearby buildings before starting construction to identify and document their condition. • Perform post-construction surveys to identify any damage caused by vibrations and take necessary remedial actions. • Erect secure fences and barriers around construction sites to prevent unauthorized access and ensure public safety. • Inform the local community about construction activities, potential impacts, and safety measures through public meetings, notices, and social media updates. • Develop and implement an emergency response plan to handle accidents, spills, and other emergencies during construction.	Contractor	TADA and PMDSC

Environmental component/ Construction activities	Potential impacts and issues	Mitigation Measures	Institutional Responsibility	
			Implementing	Supervision
		Employ at least 50% of the labor force, or to the maximum extent, local persons within the 2-km immediate area if manpower is available.		

Table 68. Environmental Monitoring Plan (EMoP)

S.N.	Environmental Parameters	Locations	Frequency	Estimated Total Number of samples	Standards
1	Air quality monitoring (PM ₁₀ , PM _{2.5} , NO ₂ , SO ₂ , CO)	2 locations	Once before start of construction and annually during construction for 3 years period	2 locations * 4 = 8 samples	National Ambient Air Quality Standards, 2003 and World Health Organizations (WHO) standards
2	Ambient Noise monitoring (Day time and nighttime noise levels)	2 locations	Once before start of construction and annually during construction for 3 years period	2 locations * 4 = 8 samples	National Noise Standard Guidelines, 2012 and WHO standards
3	Water quality	Campsite	Annually during construction for 3 years period	3 samples	Water (Prevention and Control of Pollution) Act, 1974 and WHO Standards
4	Hazardous materials	Campsite Construction sites	Monthly during construction	NA	Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

Table 69. EMP for Ropeway and Water Transport Stations operations

Environmental Components and/or construction Activities	Environmental Impacts	Mitigation measures against environmental impacts	Measures implemented by	Responsible for Monitoring	Frequency of mitigation measures and monitoring
Water management	Unsustainable use of water during operations of facilities in the ropeway facilities. Water deficiency during operations	Recycling and Reuse: - Greywater Systems: Implement greywater systems to recycle water from sinks and showers for use in flushing toilets or dust control. - Rainwater Harvesting: Collect and store rainwater for use in non-potable applications such as cleaning and landscape irrigation. Regular Testing: - Quality Assurance: Conduct regular testing of water quality to ensure it meets health and safety standards. This includes testing for contaminants such as bacteria, heavy metals, and chemical pollutants. Spill Control: - Containment Systems: Install spill containment systems to capture and contain any accidental spills of lubricants, fuels, or other chemicals used in ropeway operations. - Proper Storage: Store chemicals and hazardous materials in secure, well-ventilated areas away from water sources to prevent contamination. Wastewater Treatment: - On-Site Treatment: Implement on-site wastewater treatment systems to treat greywater and other wastewater before it is released into the environment.	Contractor or Operator	TADA	Daily by contractor Monthly monitoring by PIU-TADA

Environmental Components and/or construction Activities	Environmental Impacts	Mitigation measures against environmental impacts	Measures implemented by	Responsible for Monitoring	Frequency of mitigation measures and monitoring
		- Compliance: Ensure that all wastewater treatment processes comply with local environmental regulations and standards. Restroom Facilities: - Water Sanitation: Ensure that restrooms are equipped with clean and safe water for washing hands and flushing toilets. Regularly inspect and maintain plumbing systems to prevent leaks and contamination. - Cleaning Protocols: Use environmentally friendly cleaning products and ensure that cleaning practices do not compromise water quality. Handwashing Stations: - Adequate Provision: Provide adequate handwashing stations with clean water, soap, and hand sanitizers at all ropeway facilities to promote hygiene and prevent the spread of diseases. - Regular Maintenance: Regularly maintain and refill handwashing stations to ensure they are always functional and well-stocked. Preparedness Plans: - Contingency Plans: Develop contingency plans for water supply disruptions, ensuring that alternative water sources are available in case of an emergency. - Training: Train staff on emergency water management procedures to ensure quick and effective responses to any water-related incidents.			

Environmental Components and/or construction Activities	Environmental Impacts	Mitigation measures against environmental impacts	Measures implemented by	Responsible for Monitoring	Frequency of mitigation measures and monitoring
		Backup Systems: • Water Storage Tanks: Install water storage tanks to provide a backup supply of water for essential operations during emergencies. • Pumps and Generators: Equip facilities with backup pumps and generators to ensure continuous water supply during power outages. For ropeway, refer to Appendix 1 (Environmental safeguard as per MOEFCC)			
Waste management	accumulation of waste can detract from the visual appeal of the ropeway environment, affecting tourism and visitor experience. Accumulated waste, especially organic waste, can produce unpleasant odors, affecting the air quality around ropeway stations.	• Provide clearly labeled bins for different types of waste (e.g., recyclables, compostable waste, general waste, and hazardous waste) at all ropeway stations and facilities. • Establish recycling programs for materials such as paper, plastic, glass, and metal. Partner with local recycling facilities to ensure these materials are processed and reused effectively. • Store hazardous materials, such as batteries, chemicals, and electronic waste, in secure, well-labeled containers. Ensure they are disposed of at authorized hazardous waste treatment facilities. • Implement initiatives such as encouraging the use of reusable items, reducing packaging waste, and promoting digital ticketing to minimize paper use. • Schedule frequent waste collection and ensure that bins are emptied before they reach capacity. Use covered and well-maintained vehicles for waste transportation to prevent spillage and odor. • Provide comprehensive training for staff on waste segregation, recycling, composting, and handling	Contractor or Operator	TADA	Daily by contractor Monthly monitoring by PIU-TADA

Environmental Components and/or construction Activities	Environmental Impacts	Mitigation measures against environmental impacts	Measures implemented by	Responsible for Monitoring	Frequency of mitigation measures and monitoring
		hazardous waste. Conduct regular refresher courses to keep staff updated on best practices. • Use signage, announcements, and educational materials to inform passengers about the importance of waste segregation and proper disposal. • Conduct regular audits of waste management processes and facilities. Track waste generation and recycling rates to measure progress and make necessary adjustments. • Stay informed about relevant waste management laws and regulations. Ensure that all waste handling, transportation, and disposal practices meet legal requirements.			
Mechanical safety	Mechanical failures can pose significant risks to passenger safety.	• Conducting routine inspections and maintenance of all mechanical components, including cables, pulleys, motors, and cabins, to ensure they are in optimal working condition. • Implementing redundant safety systems, such as backup cables and emergency braking systems, to prevent accidents in case of mechanical failure. • Adhering to international safety standards and obtaining certifications for all mechanical components to ensure they meet rigorous safety criteria.	Contractor or Operator	TADA	Daily by contractor Monthly monitoring by PIU-TADA
Structural safety	Structural failures can lead to serious accidents.	• Designing towers and cabins to withstand extreme weather conditions, seismic activity, and other environmental stresses. • Performing regular structural inspections to detect and address any signs of wear, corrosion, or damage. • Conducting periodic safety audits by independent experts to assess the structural integrity and compliance with safety standards.	Contractor or Operator	TADA	Daily by contractor Monthly monitoring by PIU-TADA

Environmental Components and/or construction Activities	Environmental Impacts	Mitigation measures against environmental impacts	Measures implemented by	Responsible for Monitoring	Frequency of mitigation measures and monitoring
Emergency response	In the event of an emergency, such as a mechanical failure, extreme weather, or fire, the ability to respond quickly and effectively is critical to passenger safety.	• Developing and regularly updating comprehensive emergency response protocols, including evacuation procedures, communication plans, and first aid measures. • Training staff on emergency response procedures and conducting regular drills to ensure preparedness. • Equipping cabins and stations with emergency supplies, such as fire extinguishers, first aid kits, and communication devices.	Contractor or Operator	TADA	Daily by contractor Monthly monitoring by PIU-TADA
Wildlife protection (for water transport stations)	Physical disturbance and habitat disruption	• Establish no-boating zones within 100 meters around identified sensitive areas and spawning sites. • Enforce a maximum speed limit of 5 km/h in sensitive areas and 10 km/h in the main navigation channels to reduce disturbance to aquatic species. • Limit the number of motorized boats within designated areas, with permits issued on a first-come, first-serve basis. • Impose a boating restriction from March to June, coinciding with the breeding and spawning season of key species like the Golden Masheer. • Prohibit boating activities between 7 PM and 7 AM to reduce nocturnal disturbances. • Install waste collection points along the lake shore and ensure boats are equipped with waste disposal units. • Conduct monthly inspections of boats for compliance on government requirements.	Contractor or Operator	TADA	
Passenger safety	Operational errors, such as improper loading or unloading of passengers, can result	• Providing extensive training for all operational staff on safe loading and unloading procedures, passenger assistance, and emergency protocols.	Contractor or Operator	TADA	Daily by contractor

Environmental Components and/or construction Activities	Environmental Impacts	Mitigation measures against environmental impacts	Measures implemented by	Responsible for Monitoring	Frequency of mitigation measures and monitoring
	in accidents and injuries.	• Conducting safety briefings for passengers before boarding to inform them of safety procedures and protocols. • Utilizing surveillance and monitoring systems to oversee operations and ensure adherence to safety protocols. • Provide support for rescue and Lifeguards in coordination with the State Disaster Response Force (SDRF).			Monthly monitoring by PIU-TADA

E. EMP Implementation Cost

935. The EMP budget is a critical component of project planning and implementation, ensuring that sufficient financial resources are allocated to support the effective execution of environmental safeguards and mitigation measures throughout the project lifecycle. The EMP budget covers a range of activities, including environmental monitoring, capacity building, implementation of mitigation measures, and community engagement. The objective of the EMP budget is to ensure that all environmental commitments made during project planning are translated into actionable and measurable outcomes during the construction and operational phases.

936. Key components of the EMP budget typically include costs for monitoring environmental parameters such as air quality, water quality, and noise levels. Regular monitoring helps assess the effectiveness of mitigation measures and ensures compliance with environmental standards. Additionally, the budget may cover training and capacity-building activities for project staff, contractors, and stakeholders to enhance their understanding of environmental management practices. Other typical costs include the procurement of personal protective equipment (PPE), dust suppression measures (e.g., water sprinkling), waste management systems, and safety signage. In some cases, the budget may also account for community consultations and awareness programs to ensure that local communities are informed and engaged in the project's environmental management process.

937. It is important to note that some environmental mitigation measures, such as site-specific safety provisions, drainage construction, and pollution control measures, may already be included in the overall project design and construction costs. As a result, these costs are often not duplicated in the EMP budget. Instead, the EMP budget focuses on covering additional activities that are not accounted for in the main construction budget, such as independent environmental monitoring, reporting, and capacity building during both the construction and operational phases. A well-defined EMP budget is essential to ensuring that all planned environmental actions are effectively implemented, contributing to the sustainable and environmentally sound execution of the project.

Table 70. Indicative EMP Budget for the tourism road

SN	Components	Unit and quantity	Amount (INR)	Source of fund
	A. Pre-construction			
1	Providing and maintaining compensatory tree plantation 10 times of cutting	3,200 seedlings	12,800,000	PIU
2	Mitigation measures during shifting of utilities.	Lump sum	1,000,000	Contractor
4	Temple and other religious site protection measures	Lump sum	500,000	Contractor
5	Mitigation measures during establishment of construction facilitates (on-site and off-site)	Lump sum	750,000	Contractor
	Sub-total		15,050,000	
	B. Construction			
6	Implementation of comprehensive air quality and emission measures	Lump sum	1,500,000	Contractor
7	Effective sediment control, spill prevention, and waste management measures to protect water quality at construction sites	Lump sum	1,000,000	Contractor

SN	Components	Unit and quantity	Amount (INR)	Source of fund
8	Noise and vibration generation management	Lump sum	1,500,000	Contractor
9	Soil health and structure protection measures	Lump sum	500,000	Contractor
10	Electrical works safety	Lump sum	500,000	Contractor
11	Borrow area and quarry management	Lump sum	750,000	Contractor
12	Waste handling and disposal	Lump sum	1,500,000	Contractor
13	Wildlife protection	Lump sum	500,000	Contractor
14	Measures to eliminate invasive species	Lump sum	100,000	Contractor
15	Safety measures during operation of construction facilities and worker's camp	Lump sum	2,000,000	Contractor
16	Occupational health and safety measures	Lump sum	2,500,000	Contractor
17	Community health and safety measures	Lump sum	1,500,000	Contractor
	Sub-total		13,850,000	
18	C. Implementation of management subplans			Contractor
19	Construction Plants Management	Lump sum	1,500,000	Contractor
20	Camp Site Management	Lump sum	1,500,000	Contractor
21	Debris Disposal Management	Lump sum	800,000	Contractor
22	Muck Disposal Plan	Lump sum	4,000,000	Contractor
23	Borrow Area Management	Lump sum	500,000	Contractor
24	Biodiversity Action Plan	Lump sum	500,000	Contractor
25	Other plans	Lump sum	1,000,000	Contractor
	Sub-total		9,800,000	
26	D. Environmental Quality Monitoring			
27	Air quality monitoring	3 locations @15,000 quarterly (except monsoon)	720,000	Contractor
28	Noise level monitoring	3 locations @10,000 quarterly (except monsoon)	480,000	Contractor
29	Water quality monitoring	3 locations @8,000 quarterly (except monsoon)	384,000	Contractor
30	Soil quality	Campsites and construction facilities (annually)	500,000	Contractor
	Sub-total		2,084,000	
	E. Operations			
31	Site restoration from construction works	Lump sum	2,000,000	Contractor
32	Air quality monitoring	3 locations @15,000 quarterly (except monsoon)	720,000	PIU/PMU
33	Noise level monitoring	3 locations @10,000 quarterly (except monsoon)	480,000	PIU/PMU
34	Water quality monitoring	3 locations @8,000 quarterly (except monsoon)	384,000	PIU/PMU
35	Other monitoring activities	Lump sum	500,000	PIU/PMU
36	Pedestrian and Commuter Safety	Lump sum	500,000	PIU/PMU
37	Tree plantation maintenance	Lump sum	600,000	PIU/PMU

SN	Components	Unit and quantity	Amount (INR)	Source of fund
38	Contamination of soil and water resources from spills due to traffic and accidents	Lump sum	150,000	PIU/PMU
39	Soil erosion and sedimentation	Lump sum	1000,000	PIU/PMU
40	Safeguards measures during maintenance of drainage system activities	Lump sum	100,000	PIU/PMU
	Sub-total		6,434,000	
	F. Contingency	5% of the sub-total costs	2,360,900	
	Total (A+B+C+D+E+F)		49,578,900	

Table 71. Indicative EMP budget for each subproject (i.e. ropeway, water transport stations, last mile connectivity and smart infrastructures)

SN	Components	Unit and quantity	Amount (INR)	Source of fund
	A. Pre-construction			
1	Mitigation measures during pre-construction phase	Lump sum	200,000	Contractor
2	Mitigation measures during establishment of construction facilities (on-site and off-site)	Lump sum	1000000	Contractor
	Sub-total		1200000	
	B. Construction			
3	Temporary public transportation services (ropeway only)		3,000,000	PIU/PMU
4	Implementation of comprehensive air quality and emission measures	Lump sum	300,000	Contractor
5	Management measures to protect water quality at construction sites	Lump sum	300,000	Contractor
6	Noise management	Lump sum	300,000	Contractor
7	Waste handling and disposal	Lump sum	1,500,000	Contractor
8	Occupational health and safety measures	Lump sum	1,500,000	Contractor
9	Community health and safety measures	Lump sum	1,000,000	Contractor
	Sub-total		79,00,000	
	C. Environmental Quality Monitoring			
10	Air quality monitoring	7 locations @15,000 annually (3 years)	315,000	Contractor
11	Noise level monitoring	7 locations @10,000 annually (3 years)	210,000	Contractor
12	Water quality monitoring	7 locations @8,000 annually (3 years)	168,000	Contractor
	Sub-total		693,000	
	D. Operations (Ropeway and Water Transport Stations)			
13	Air quality monitoring	7 locations @15,000 annually (3 years)	315,000	PIU/PMU Contractor
14	Noise level monitoring	7 locations @10,000 annually (3 years)	210,000	PIU/PMU Contractor

SN	Components	Unit and quantity	Amount (INR)	Source of fund
15	Water quality monitoring	7 locations @8,000 annually (3 years)	168,000	PIU/PMU Contractor
16	Hazardous materials monitoring	Lump sum	100,000	PIU/PMU Contractor
17	Water management measures	Lump sum	250,000	PIU/PMU Contractor
18	Waste management	Lump sum	1,000,000	PIU/PMU Contractor
19	Safeguard measures during mechanical safety activities (ropeway only)	Lump sum	1,000,000	PIU/PMU Contractor
20	Safeguard measures during structural safety activities	Lump sum	1,000,000	PIU/PMU Contractor
21	Emergency response activities	Lump sum	1,000,000	PIU/PMU Contractor
22	Passenger safety measures	Lump sum	1,000,000	PIU/PMU Contractor
	Sub-total		6,043,000	
	E. Contingency	5% costs	791,800	
	Total (A+B+C+D+E)		16,627,800	

XI. CONCLUSION AND RECOMMENDATION

938. The proposed Sustainable Inclusive and Climate-Resilient Tourism Development at Tehri Lake Area project, focused on transport infrastructure components, has been comprehensively evaluated through an Initial Environmental Examination (IEE) as per the Asian Development Bank's (ADB) Safeguard Policy Statement (SPS 2009) requirements. The IEE confirms that the project, classified as Category B, will have moderate environmental impacts, which are site-specific, manageable, and can be mitigated through proper planning and implementation of the recommended Environmental Management Plan (EMP).

939. The proposed transport infrastructure development under the Sustainable Inclusive and Climate-Resilient Tourism Development at Tehri Lake Area project focuses on four key subprojects aimed at enhancing connectivity, promoting sustainable tourism, and supporting local economic growth. The Tourism Road from Koti Colony to Dobra Chanti will stretch for 15.77 kilometers, featuring scenic viewpoints and dedicated pedestrian and cycling paths to promote non-motorized transport. The Ropeway Construction/Upgradation from Tipri to Madan Negi will include a twin-track bi-cable system across the lake, providing an efficient and eco-friendly transport alternative to navigate the hilly terrain. Furthermore, the development of Water Public Transport Stations at five jetties around Tehri Lake will enable water-based connectivity between various villages and towns, reducing road traffic and environmental impacts. The fourth subproject focuses on installation of signages at various locations and last mile connectivity, and fifth component is establishing Smart Infrastructure, incorporating intelligent poles, traffic management systems, EV charging stations, and digital infrastructure, enhancing operational efficiency and safety for tourists and locals alike.

940. These subprojects will collectively bring comprehensive benefits to the Tehri Lake area. Improved connectivity through upgraded road, ropeway, and water transport systems will reduce travel time and enhance accessibility, making it easier for locals and tourists to move around the region. Additionally, the use of eco-friendly technologies such as electric vehicles and slope stabilization methods will help preserve the natural environment and minimize adverse impacts. This development will also boost local economies by creating employment opportunities and fostering entrepreneurship through tourism-related activities. Overall, the project aligns with sustainable development goals, contributing to environmental protection, promoting community engagement, and supporting the long-term socio-economic growth of the region.

941. Public consultations for the Sustainable Inclusive and Climate-Resilient Tourism Development at Tehri Lake Area project were conducted extensively from December 2023 to September 2024 across various project-affected villages. The participants included affected persons, farmers, gram panchayat members, local community leaders, and representatives from government agencies such as the PWD, the Forest Department, and the UTDB. These consultations provided an opportunity for stakeholders to voice concerns related to potential environmental and social impacts, such as displacement of local wildlife due to tree cutting, increased dust and noise pollution during construction, potential disruptions to cultural and religious sites, and impacts on local livelihoods. In response, the community proposed key mitigation measures, including regular water sprinkling to control dust, use of low-noise machinery, scheduling construction activities during daytime hours to minimize disturbance, and implementing comprehensive erosion prevention strategies like retaining walls and bioengineering techniques.

942. The IEE will be made available at public locations and will be disclosed to a wider audience via the PMU and ADB websites. The consultation process will be continued during project

implementation to ensure that stakeholders are engaged in the project and have the opportunity to participate in its development and implementation. The project's grievance redress mechanism will provide the citizens with a platform for redressing their grievances, and describes the informal and formal channels, time frame, and mechanisms for resolving complaints about environmental performance.

943. Based on the results of the IEE, the following are recommendations for the subprojects covered in this report:

944. The EMP must be implemented rigorously to ensure all mitigation measures are applied effectively. This involves setting up a dedicated staff in the PMU and PIUs, with support from PMDSC, for environmental monitoring and ensuring that all mitigation measures, such as afforestation, pollution control, and waste management, are executed as planned. Regular environmental monitoring should be conducted, with monthly and quarterly reports submitted to PMU for review and records. Immediate corrective actions should be taken in case of non-compliance, and a dedicated environmental specialist should be appointed to oversee EMP implementation and reporting.

945. Continued engagement with local communities and stakeholders is crucial for the project's success. Regular consultations and community meetings should be held to update stakeholders on project progress and address their concerns. Establishing communication channels such as information centers, community notice boards, and social media platforms can help keep communities informed. The project should also form a community advisory group consisting of local leaders, women, and youth representatives to provide inputs on project activities and ensure inclusive decision-making.

946. Health and safety protocols must be strictly enforced to protect both workers and nearby communities. This includes conducting safety training programs, ensuring the use of personal protective equipment, and implementing emergency response plans for accidents or natural hazards. Environment, health and safety officers should be appointed in the construction and operations to oversee compliance, and regular audits should be conducted to identify and mitigate potential risks.

947. Given the biodiversity in the Tehri Lake region, special emphasis should be placed on wildlife protection and habitat conservation. The PMU and PIUs should implement wildlife monitoring programs to track the presence and movement of species, especially in areas close to the road, water transport sites and ropeway alignments. In areas where tree cutting is necessary, the project should conduct replantation using native species to restore lost habitats and enhance ecological balance. These efforts will ensure that the project supports biodiversity conservation while promoting sustainable development in the region.

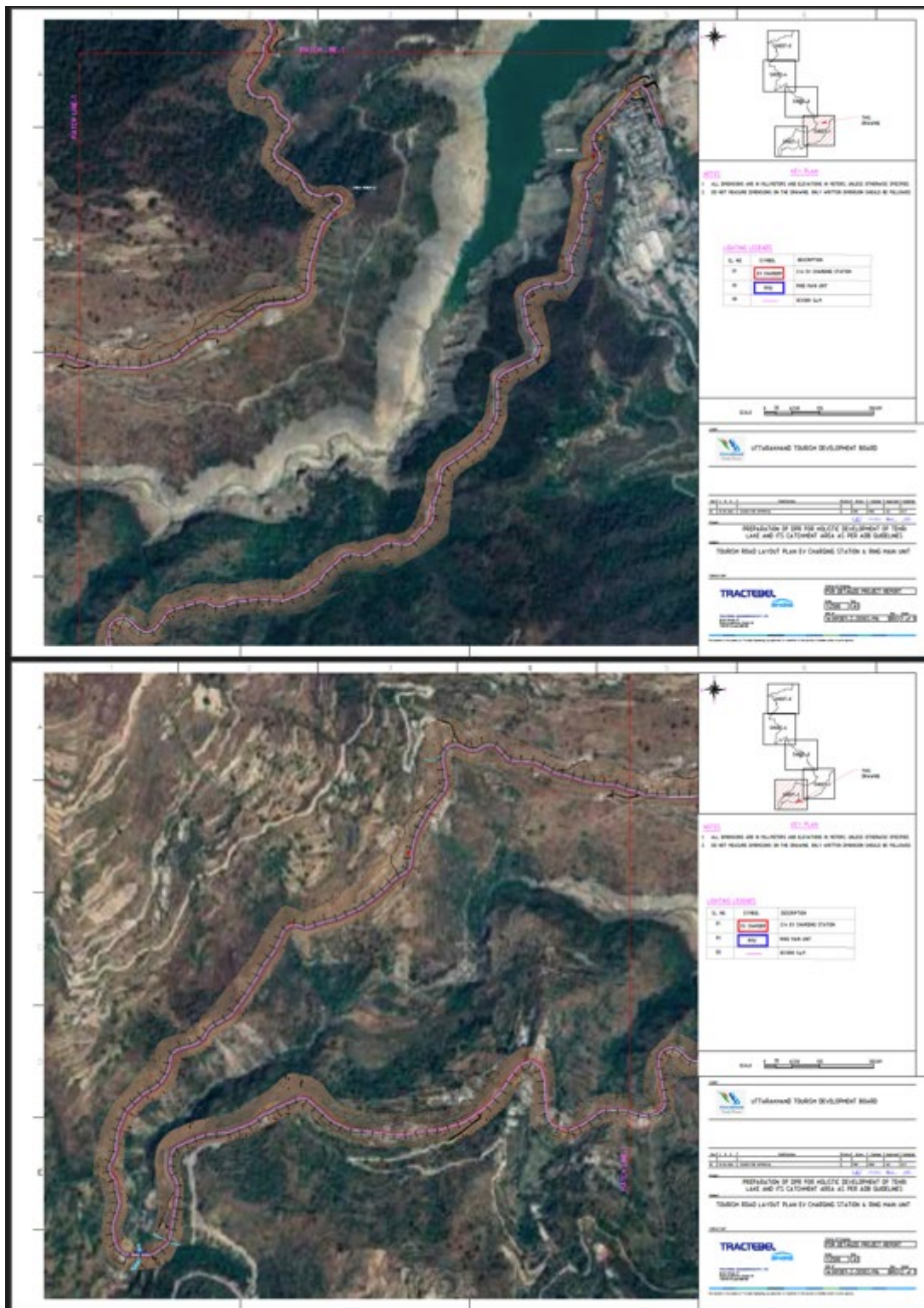
948. The project must strictly adhere to all national and state-level environmental laws and regulations to ensure compliance with statutory requirements. This includes obtaining necessary clearances such as consent to establish and consent to operate under the Water (Prevention and Control of Pollution) Act, 1974, and the Air (Prevention and Control of Pollution) Act, 1981. Compliance with the Forest (Conservation) Act, 1980, is mandatory for any tree cutting, and the Wildlife (Protection) Act, 1972, must be adhered to for any activities that will impacts Schedule I species. Regular coordination with regulatory authorities, timely submission of environmental compliance reports, and adherence to conditions stipulated in environmental clearances are crucial for maintaining legal compliance and minimizing environmental risks.

949. As the project progresses, any modifications or updates in the design of the road, ropeway, water transportation stations, and smart infrastructure should be reflected in the IEE. The IEE should be reviewed and updated to incorporate changes such as revised road alignments, adjustments in ropeway stations, new technical specifications for water transport stations, and additional smart infrastructure components. This process ensures that any new or unforeseen environmental and social impacts arising from design changes are properly assessed and managed. Updated IEEs should be submitted to the ADB and relevant government authorities for approval, and all contractors and project staff should be informed of the updated guidelines to ensure seamless implementation.

950. The bidding documents should include specific clauses that mandate the adherence to the EMP and all relevant environmental safeguards by the design-build-operate contractor (i.e. ropeway). This will ensure that all contractors are fully aware of their environmental responsibilities and comply with the mitigation measures outlined in the EMP. The bidding documents should clearly specify environmental performance standards, reporting obligations, and penalties for non-compliance. Additionally, contractors should be required to appoint an environmental, health and safety officers within their team to oversee EMP implementation, ensure compliance with environmental standards, and coordinate with PIUs. Periodic performance reviews and environmental audits should be conducted to ensure that the contractors adhere to the specified environmental requirements throughout the construction and operational phases of the Project.

Appendix 1. Environmental safeguards as per MOEFCC

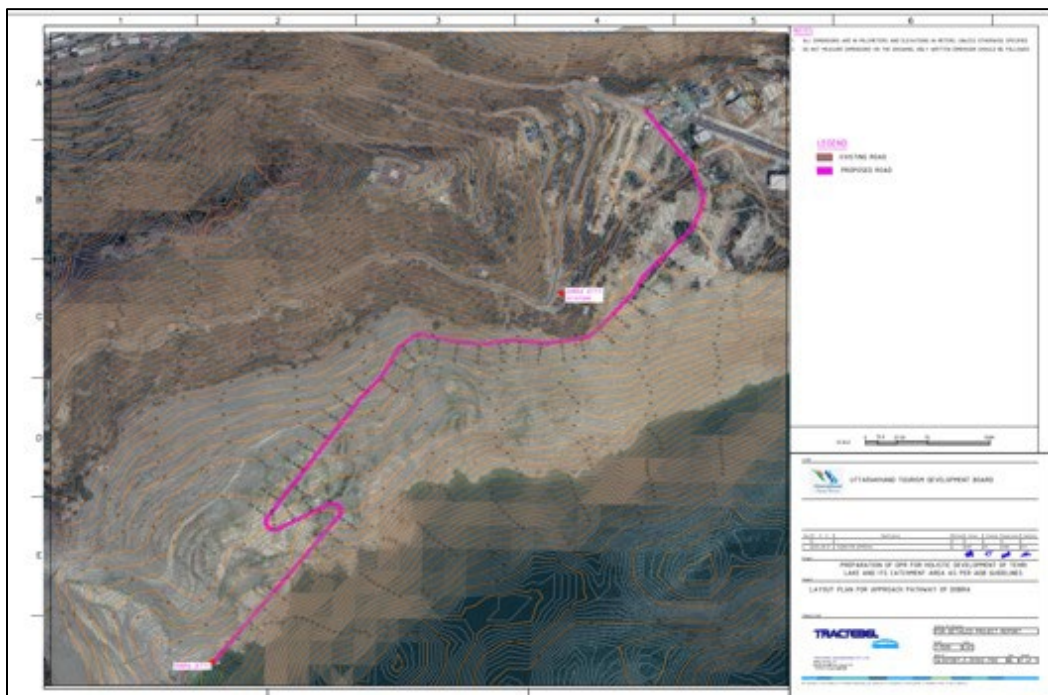
Appendix 2. Alignment of Tourism Road







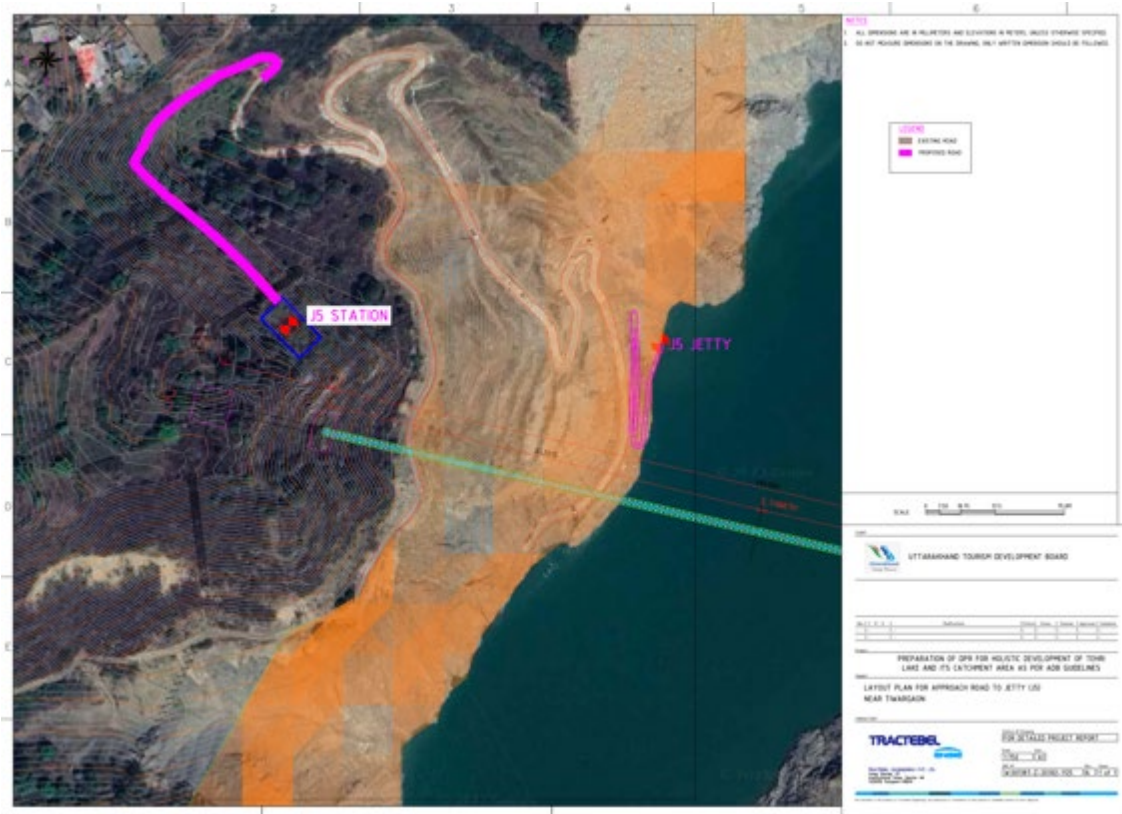
Appendix 3. Design Layouts in Water Transport Stations



Approach road in Dobra Chanti Station



Approach road in Raulakot Station



Approach road in Tiwar Gaon Station

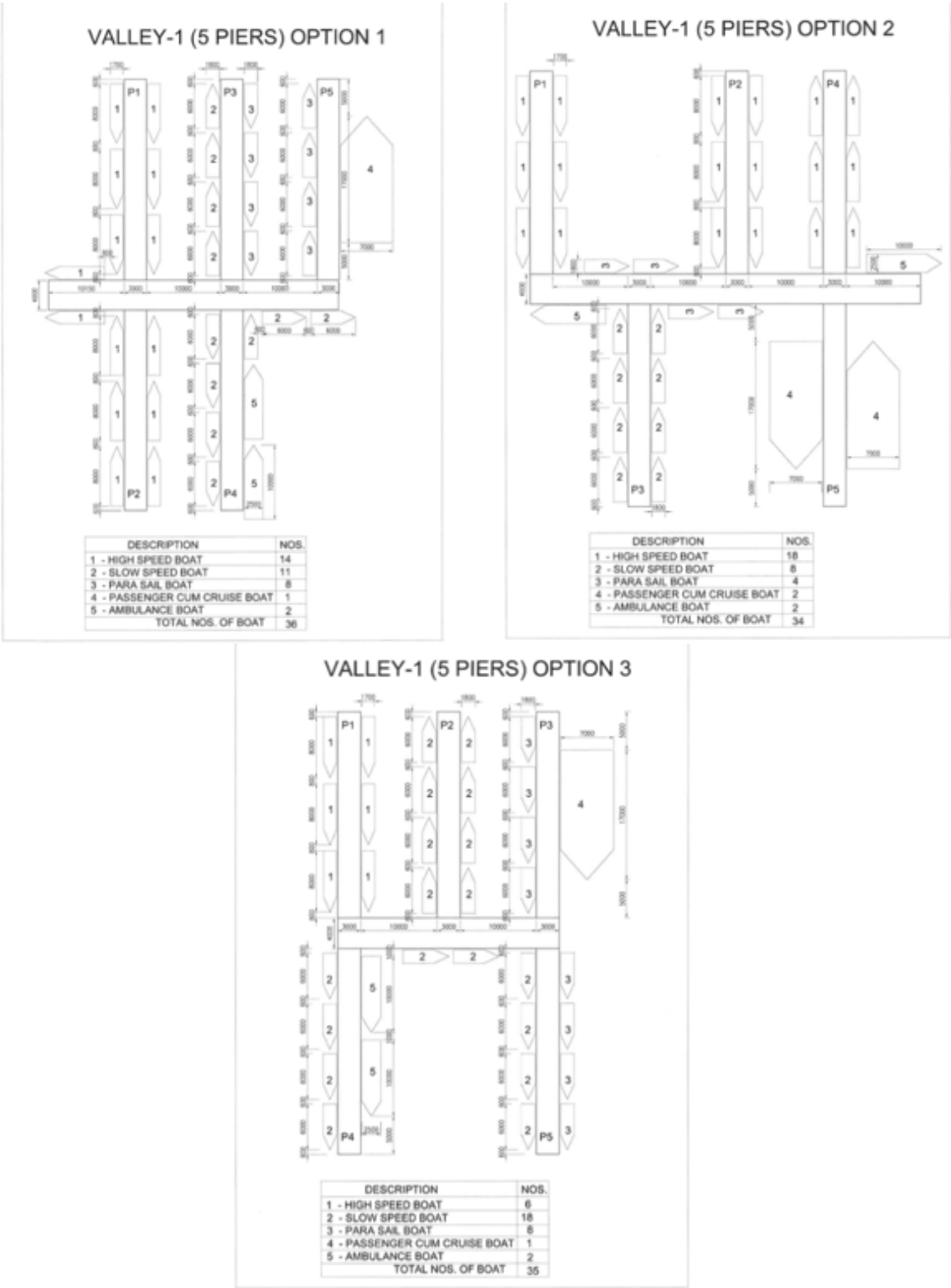


Approach road in Sandana Station



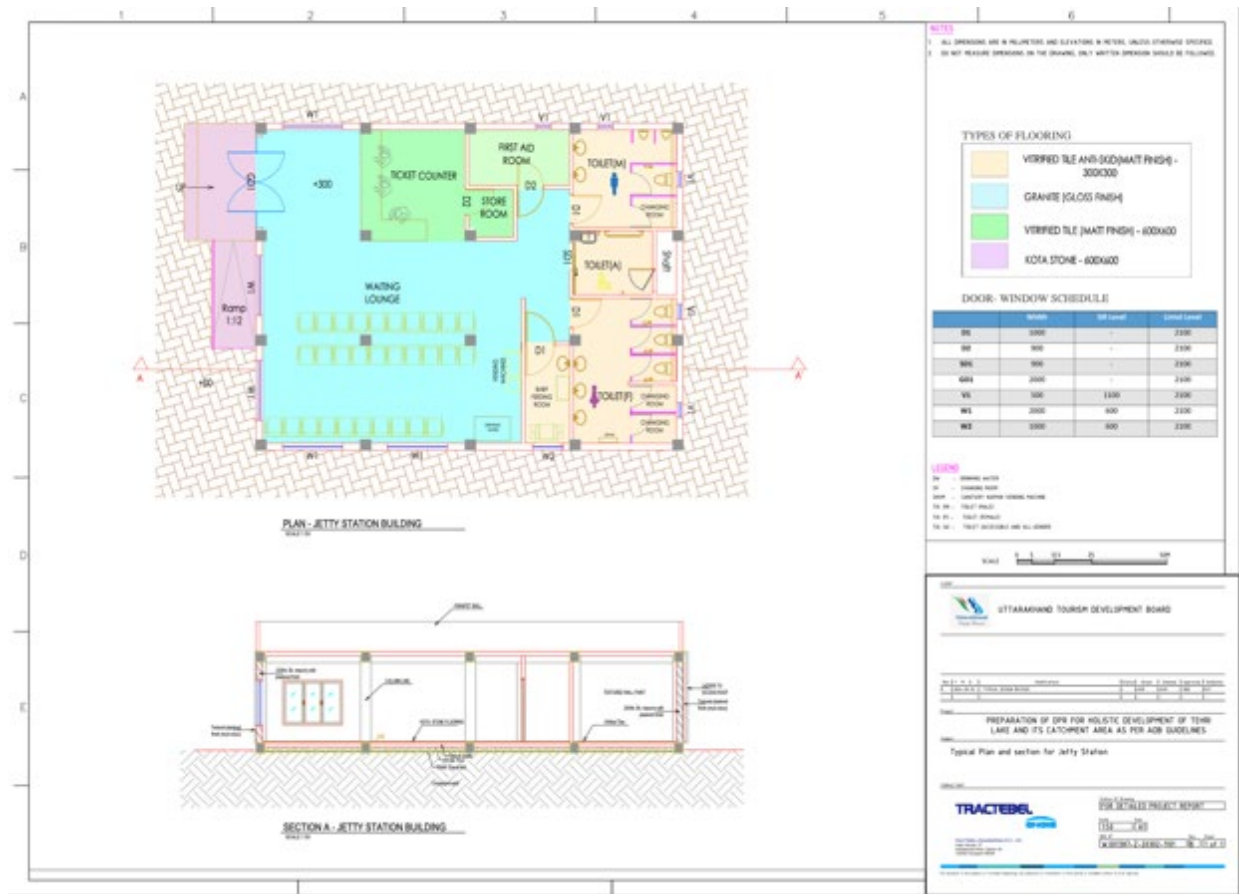
Approach road at jetty station near Madan Negi Ropeway

Sample floating Jetty Layouts

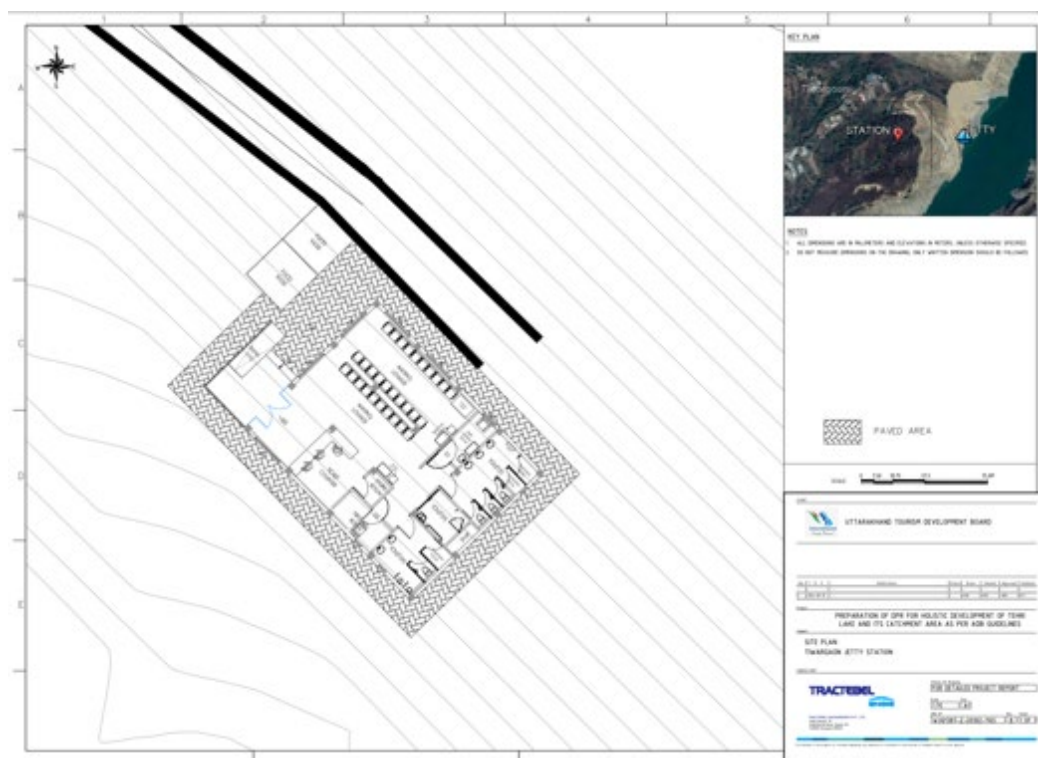


DESCRIPTION	NOS
1 - HIGH SPEED BOAT	6
2 - SLOW SPEED BOAT	18
3 - PARA SAIL BOAT	4
4 - PASSENGER CUM CRUISE BOAT	1
5 - AMBULANCE BOAT	2
TOTAL NOS. OF BOAT	31

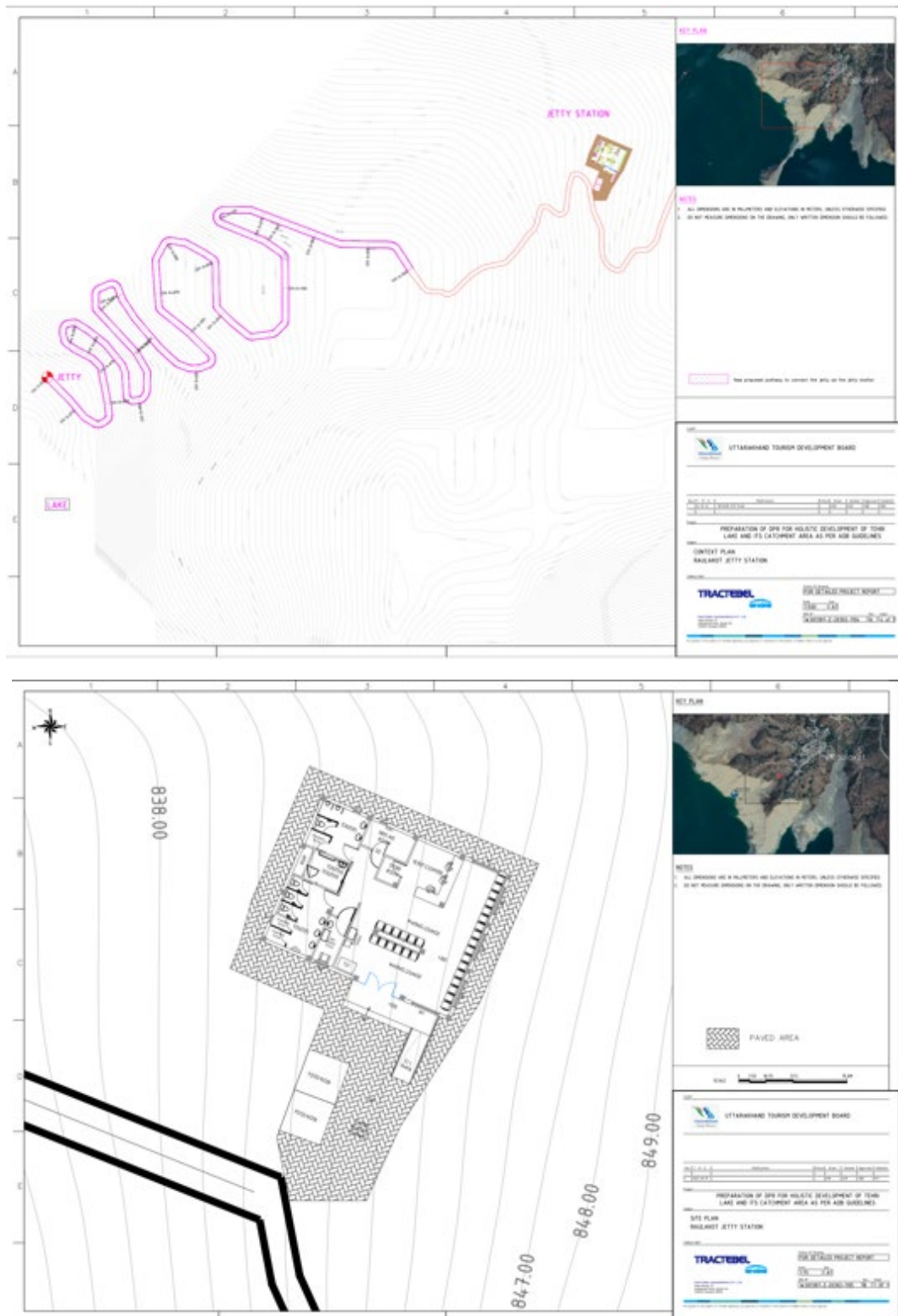
Typical layout of a jetty station



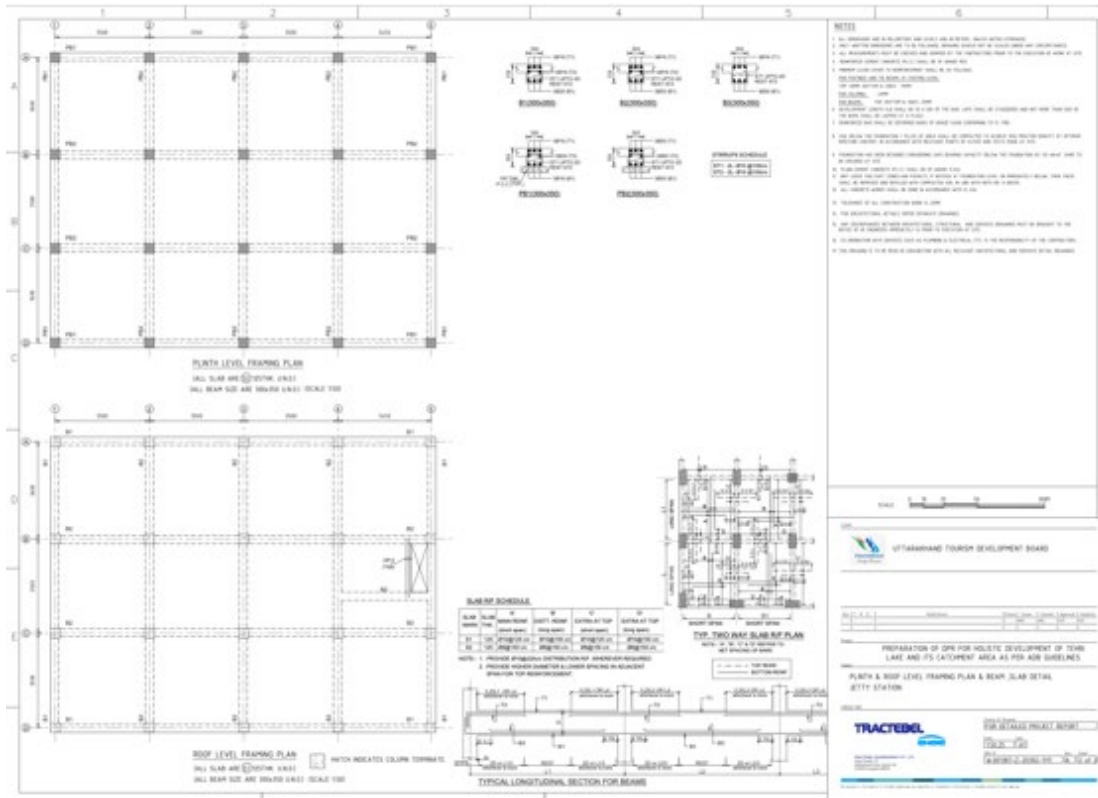
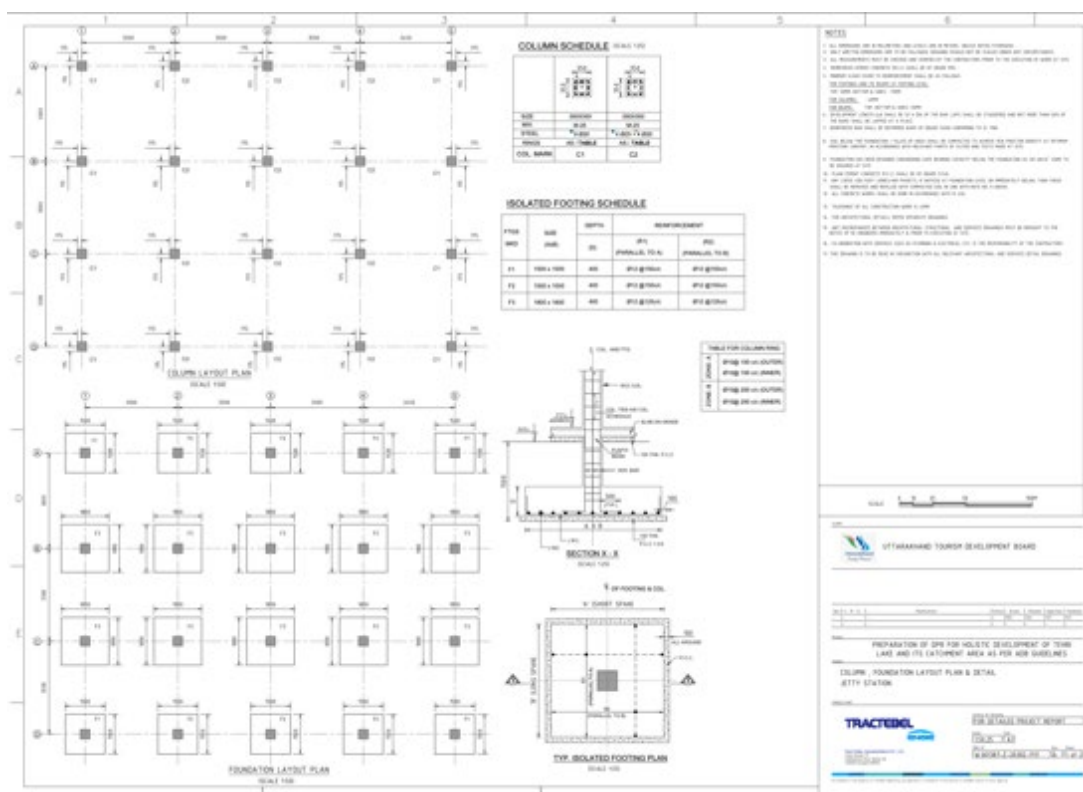
Layouts for Tiwar Gaon



Layouts for Raulakot Jetty Station

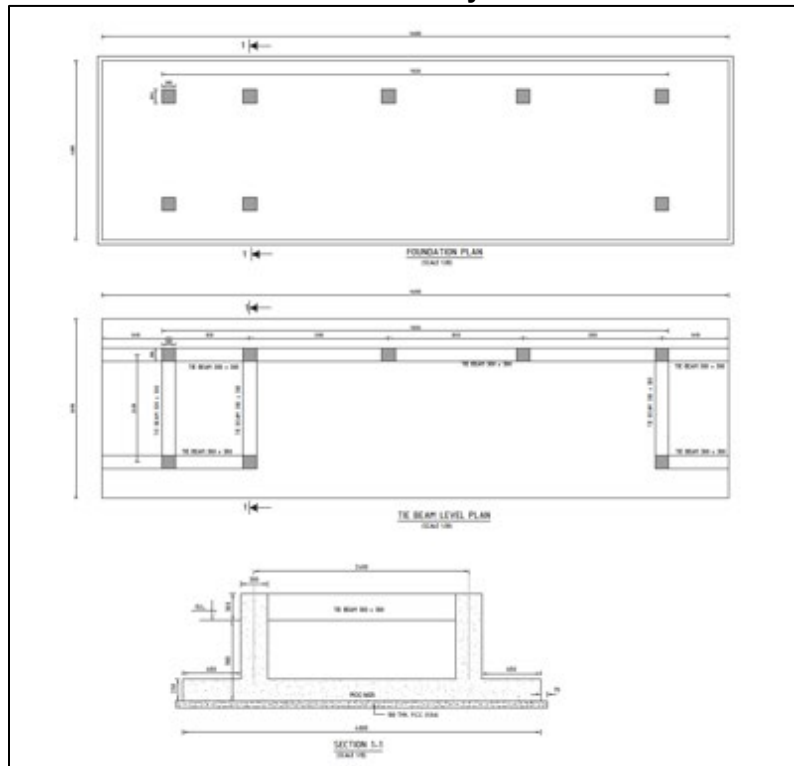


Sample foundation layout of water station

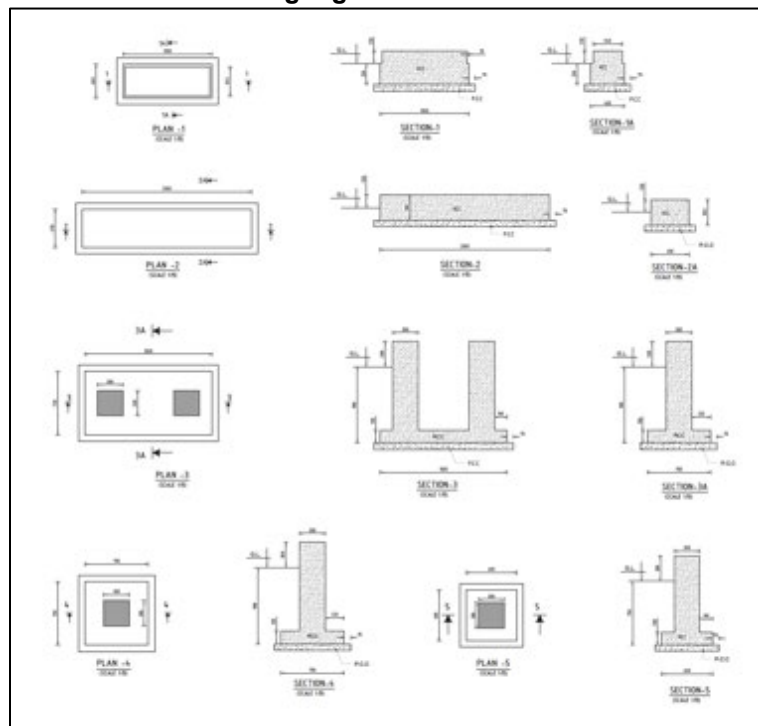


Appendix 4. Technical drawings for last mile connectivity component

Bus shelter layout



Signage foundations



Appendix 5. California boring tests for 3 bole holes at ropeway site

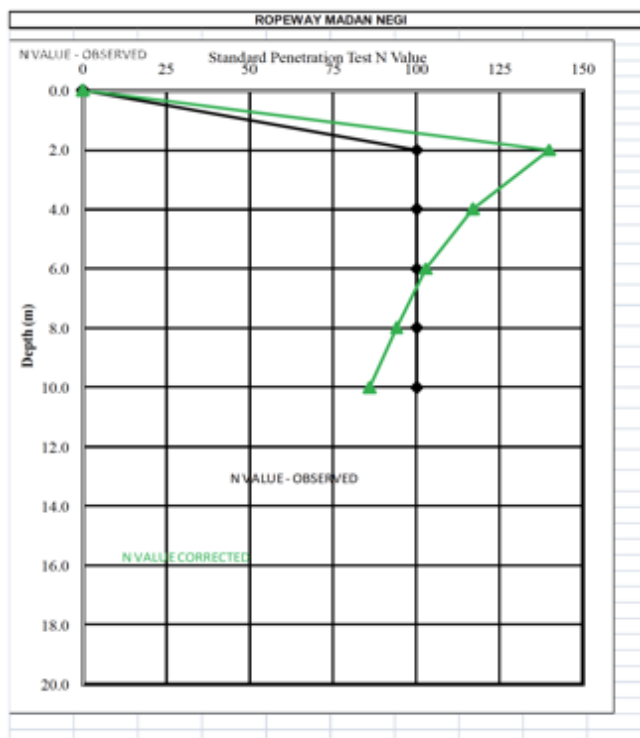
[illegible]

Figure 3.3 – SPT Graph Madonna

BOREHOLE NO. 9					DATE STARTED : 5/16/2021					SHEET 1 OF 1																									
LOCATION : PROPERWAY MAZAN NECH					DATE COMPLETED : 5/16/2021																														
REDUCED LEVEL OF BORHOLE : 100.00																																			
SITE NO : BOPEWAY MAZAN NECH																																			
FIELD TEST RESULTS										LABORATORY TEST RESULTS																									
ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	DEPTH OF SAMPLE BELOW REFERENCE LEVEL	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / LVL	SPT TEST RESULTS					NO. OF CASING USED (MM)	SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH U.S. CLASSIFICATION	TYPE OF TEST CONDUCTED IN THE LABORATORY	GRAIN SIZE ANALYSIS				LIQUID LIMIT (%)	PLASTIC LIMIT (%)	SHRINKAGE (%)	SPT DENSITY (blows)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	SHEAR STRENGTH CHARACTERISTICS		CONSOLIDATION TEST PARAMETERS								
						DEPTH IN METERS	NO. OF BLOWS	PERCENT FRACTURE (%)	N. VALUE (Normal)	N. VALUE (Corrected)					GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)							cohesion (kN/m ²)	angle of friction (degrees)	COMPRESSION INDEX (C _c)	VOID RATIO (e)							
100.0	0.0	DS	1.00	1	NA	0.00 - 2.0					100	FRACTURED ROCK																							
	1.0	SPT	2.00	1		2.00 - 2.45	100	30	100	140																									
	2.0		2.50	1		2.50 - 2.80																													
	3.0		3.00			3.00 - 3.45																													
	4.0	SPT	4.50	2		4.50 - 4.95	100	30	100	117																									
95.00	5.0		5.50	2		5.50 - 5.80																													
	6.0	SPT	6.00	3		6.00 - 6.45	100	30	100	103																									
	7.0		7.50			7.50 - 7.95																													
	8.0	SPT	8.50	4		8.00 - 8.45	100	30	100	94																									
	9.0		9.00			9.00 - 9.45																													
90.00	10.0	SPT	10.50	5	10.50 - 10.95	100	30	100	86																										
NOTE : 1. CLASSIFICATION OF SOIL AS PER IS : 1498																																			
2. ABBREVIATION USED : DS = DISTURBED SAMPLE UDS = UNDISTURBED SAMPLE LU = UNCONSOLIDATED UNRAINED DST = DIRECT SHEAR TEST																																			
BORE LOG CHART AND DATA SHEET																																			

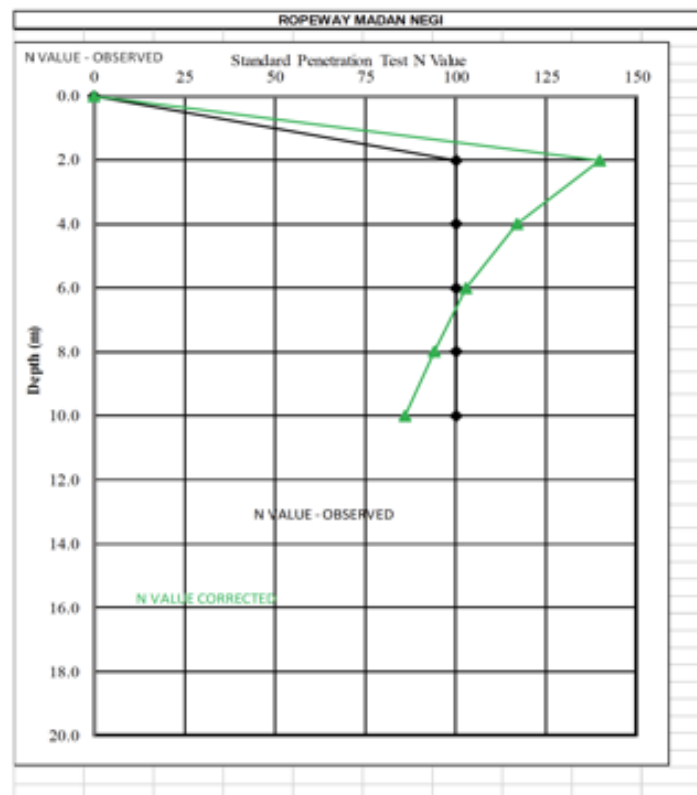


Figure 34 – SPT Graph Modannegi

BOREHOLE NO. 10					DATE STARTED : 7/10/2021					SHEET 1 OF 1																			
LOCATION : ROPEWAY MADAN NEGI CENTRE POINT					DATE COMPLETED : 7/10/2021																								
REDUCED LEVEL OF BOREHOLE : 100.00 m					FIELD TEST RESULTS					LABORATORY TEST RESULTS																			
SITE ID : ROPEWAY MADAN NEGI																													
ELEVATION METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	DEPTH OF SAMPLE BELOW REFERENCE LEVEL	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / N/A	SPT TEST RESULTS				SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH U.S. CLASSIFICATION	TYPE OF TEST CONDUCTED @ THE LABORATORY	GRAIN SIZE ANALYSIS				LIQUID LIMIT (%)	PLASTIC LIMIT (%)	BULK DENSITY (lb/ft³)	DRY DENSITY (lb/ft³)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	SHEAR STRENGTH CHARACTERISTICS		CONSOLIDATION TEST PARAMETERS				
						DEPTH IN METERS	NO. OF BLOWS	PENETRATION (CM)	N VALUE (Revised)				N VALUE (Corrected)	GRAVEL (%)	SAND (%)	SILT (%)							CLAY (%)	cohesion, C (lb/ft²)	Angle of Friction (Degree)	COMPRESSION INDEX	void ratio		
100.0	0.0	DS	1.00	1	N/A	0.00 - 2.0				150	FRACTURED ROCK																		
	1.0	SPT	2.00	1		2.00 - 2.45	100	30	100			140	DS*	96.0	4.0	0.0	0.0	NON PLASTIC					2.86						
	2.0		2.50	1		2.50 - 2.80								DS*						1.98	1.88	5.32		0.0	36				
	3.0		3.00			3.00 - 3.45									96.0	4.0	0.0	0.0	NON PLASTIC					2.87					
	4.0	SPT	4.50	2		4.50 - 4.95	100	30	100			117																	
95.00	5.0		5.50	2		5.50 - 5.80							DS*							1.98	1.88	5.33		0.0	36				
	6.0	SPT	6.00	3		6.00 - 6.45	100	30	100			104			97.0	2.0	1.0	0.0	NON PLASTIC					2.87					
	7.0		7.50			7.50 - 7.95																							
	8.0	SPT	8.50	4		8.00 - 8.45	100	30	100			94	DS*							1.98	1.88	5.33		0.0	36				
	9.0		9.00			9.00 - 9.45									97.0	2.0	1.0	0.0	NON PLASTIC					2.87					
90.00	10.0	SPT	10.50	5		10.50 - 10.95	100	30	100			86																	
NOTE : 1. CLASSIFICATION OF SOIL AS PER B. 148R																													
2. ABBREVIATION USED : DS = DISTURBED SAMPLE UDS = UNDISTURBED SAMPLE UI = UNCONSOLIDATED UNDRAINED DST = DIRECT SHEAR TEST																													
BORE LOG CHART AND DATA SHEET																													

NOTE : 1. CLASSIFICATION OF SOIL AS PER IS : 1498

2. ABBREVIATION USED : DS = DISTURBED SAMPLE, UDS = UNDISTURBED SAMPLE, UZ = UNCONSOLIDATED UNDRAINED, DST = DIRECT SHEAR TEST

BORE LOG CHART AND DATA SHEET

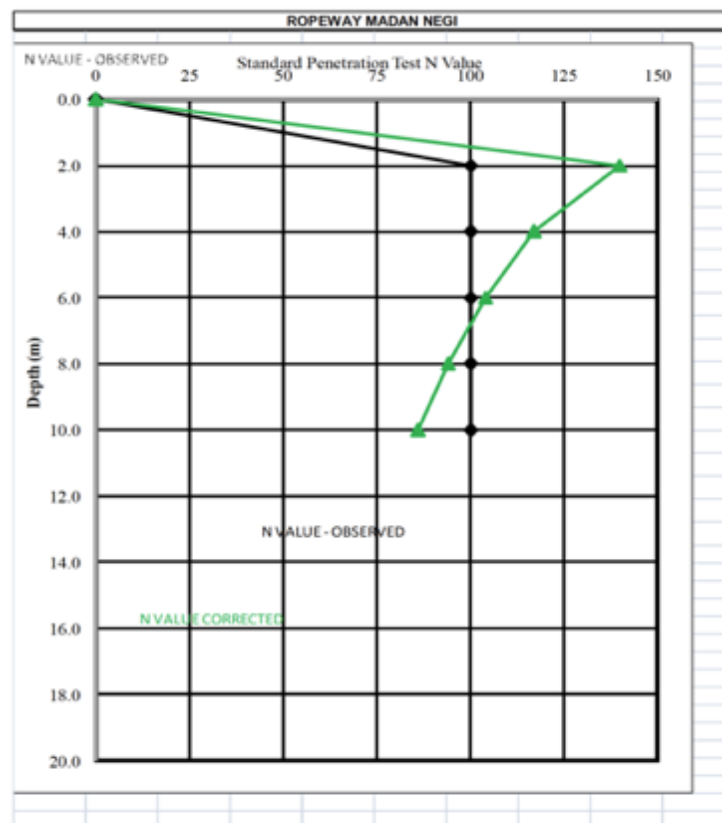


Figure 35 - SPT Graph Madannegi

Appendix 6. Climate Risk Vulnerability Assessment of Transport Components

1. **Introduction:** The Tehri Lake is positioned in the foothills of the Himalayas. The fragile landscape of the Himalayan region is highly susceptible to natural hazards and there is ongoing concern about current and potential climate change impacts. The Disaster Management Plan for Tehri Garhwal District recognizes landslides, cloud bursts, flash floods, thunderstorms, droughts, geological disasters, and forest fires as major disasters for this region. Flash floods have significant hazard exposure ratings; while landslides, forest fires, and droughts have a medium hazard exposure rating.

2. These hazards are expected to increase due to climate change, intensifying the negative impact on physical infrastructure, human population, and ecology. Pluvial flooding may cause localized damage to private and public properties. Rainfall-induced landslides may block road and storm drain networks and disrupt power, waste management systems and structural damages. Increased runoff and erosion will accelerate sediment deposition that would contaminate water reservoirs, treatment plants, and distribution networks. An increase in temperature will impact the health of the residents and tourists, reduce water availability, cause product quality reduction, and impact more energy consumption, leading to increased greenhouse gas (GHG) emissions. Drought will increase water demand, affect water resources, and reduce the dilution of pollutants.

3. **Links between project activities and climate change :** Based on the climate vulnerability of the region, climate risks to this project include heavy rainfall and floods, landslides and erosion, wildfires and extreme high temperatures, and drought and water shortage. The proposed project sites will be in dispersed geographic locations, and the climate risks to those project subcomponents have been assessed site by site. Based on relevant ADB guidelines and the potential climate risks of this project, four steps were applied to the study: (i) analysis of historic climate and events; (ii) analysis of projections of future climates; (iii) assess climate change impact and vulnerability; and (iv) work with other transaction technical assistance (TRTA) consultants, project executing agency and design firm to develop adaptation options for the project design.

4. **Current climate and future climate projections:** Tourism activities in the Tehri Lake area are closely linked to climatic conditions. In addition to access to the destination and its facilities, weather conditions play a vital role in tourists' decision-making process and overall experience. This chapter presents analyses of historical observed climate and future climate change scenarios as the first step of climate risk and adaptation option assessment for this project. The analyses of historical climate patterns and identifies trends, while the future scenarios assess the likelihood and intensity of future extreme weather events.

5. **Historical climate analysis:** The historical climatic analysis includes the monthly variation of temperature and precipitation, annual variation of temperature and precipitation, yearly variation of wet days, and extreme precipitation events. The following list contains climate-related indicators employed in this study, each accompanied by an explanation of its potential impact on the system. It's essential to note that the general impacts outlined here are individual subprojects presented in subsequent sections.

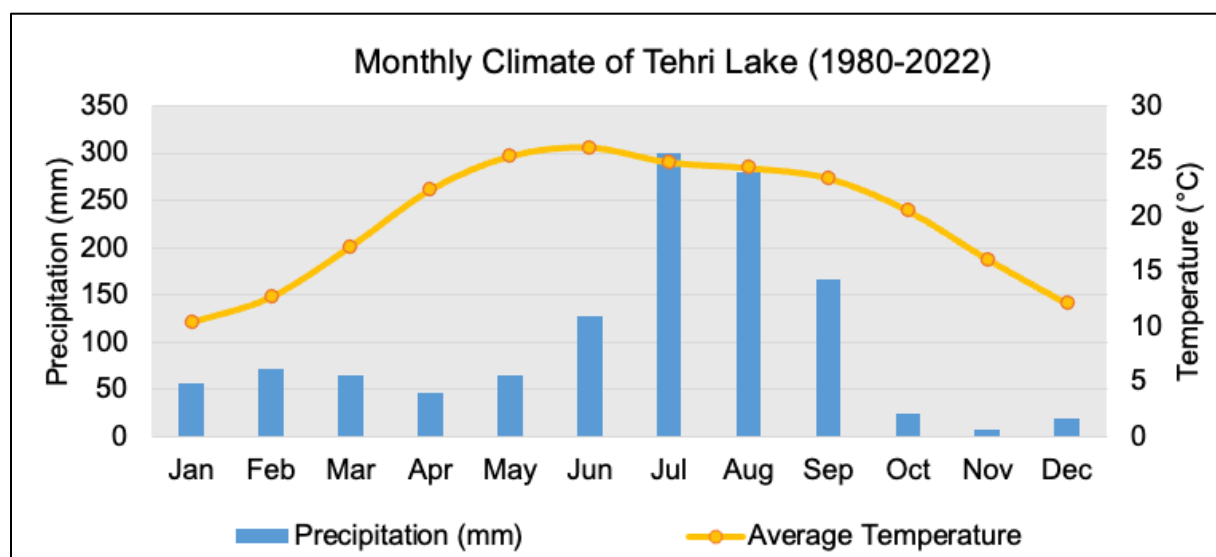
Table 72. Key climate indicators and probable impact on the system

Indicator	Description	Probable Impact on System
Total precipitation	The total amount of rainfall received over one year.	Changes total water in the system
Number of wet days	Number of days which had precipitation over 1mm over a	Effect on infrastructure. (Structural damage)

Indicator	Description	Probable Impact on System
	year period	Flood and disaster prone
Average annual temperature	Average temperature over a year period.	Changes in biodiversity ; Tourist uneasiness Changes water demand
Maximum and Minimum temperature	Maximum and minimum temperature over a year period.	Changes water demand; Health impact, change in crop yield and effect to flora and fauna Heat Island effect

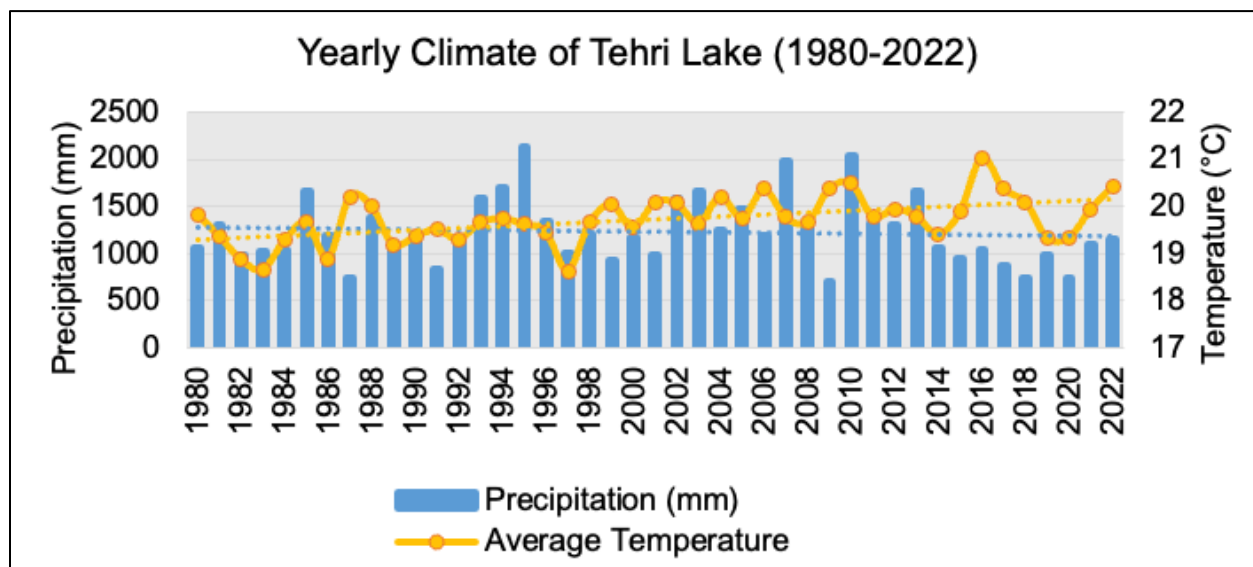
6. The historical climate analysis effectively utilized gridded data from the India Meteorological Department for temperature and precipitation with a resolution of $0.25^\circ \times 0.25^\circ$ for precipitation and $1^\circ \times 1^\circ$ for temperature. To ensure data integrity, the precipitation data were validated data with primary rain gauge stations. In contrast, the temperature data underwent quality checks to identify and correct outliers and repeated temperature values over consecutive days. Consequently, the resulting datasets exhibited minimal error and were well-aligned with the spatial variation over India.

7. The maximum temperature in Tehri occurs during May and June, while the maximum precipitation happens in July and August. Summers are mild, with temperatures usually not exceeding 28°C , while winters are harsh. The average monthly rainfall can exceed 250 mm in July for the region, as shown in Figure 60.



Historic monthly precipitation and mean temperature trends

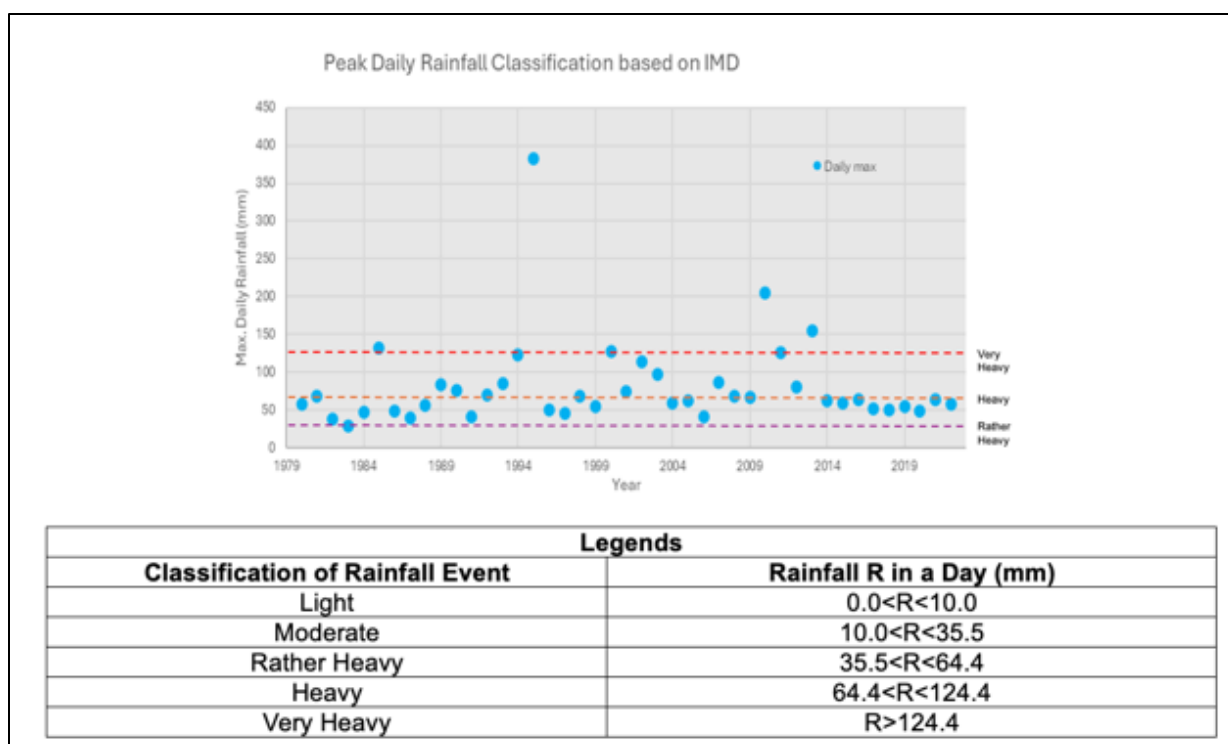
8. The analysis of the historical meteorological data indicates an increase in mean temperature, a cyclical pattern in annual precipitation, a rise in rainfall intensity, and more frequent dry spells. The data also indicates a warming trend in the area. If this continues, there is a chance of increased heat-related health issues that can be exacerbated among residents and tourists. Additionally, the intensified rainfall results can overload drainage systems, causing flooding and damage to the tourist infrastructure. Droughts can strain water resources and increase the risk of wildfires.



Historic annual precipitation and mean temperature trends

9. The Indian Meteorological Department classifies rainfall greater than 125 mm/day as very heavy. The maximum daily rainfall analysis indicates a noticeable increase in intense precipitation events (exceeding 124.4 mm) since 2010. This trend is illustrated by the fact that from 1980 to 2009, there was one year per decade with such extreme events. On the other hand, there were three occurrences in the decade from 2010 to 2019, indicating a significant rise in the intensity of rainfall patterns during these years. There is also a noticeable increase in high intensity rainy days. The Tehri region confronts flood and landslide risks due to cloud bursts and heavy precipitation, resulting in flash floods and landslides.

10. In 2013, Tehri and part several parts of the state received an unusual amount of rainfall led to devastating floods and landslides. This recurrence event was of lesser magnitude in Tehri in 2010, further underlining the need for increased preparedness and risk reduction strategies. Notably, there has been a surge in extreme cloud bursts in the Himalayan region, with Uttarakhand witnessing a substantial number of incidents in recent years. These findings of historical events underscore the urgency of implementing robust measures to address the escalating risks in the region.



Historic Peak Daily Rainfall Classification (1980-2022)

11. Future climate change projections: Climate change refers to long-term shifts in global or regional climate patterns, encompassing various components that collectively contribute to Earth's climate system alterations. Some key components and trends of climate change include:

- Temperature increase
- Change in precipitation patterns
- Extreme weather events

12. **Data used:** The study used NEX-GDDP-CMIP6 dataset. This dataset entails global downscaled climate scenarios derived from General Circulation Model (GCM) runs conducted under the Coupled Model Intercomparison Project Phase 6 (CMIP6) [Eyring et al. 2016]. These scenarios are based on two of the four "Tier 1" greenhouse gas emissions scenarios known as Shared Socioeconomic Pathways (SSPs) [O'Neill et al. 2016; Meinshausen et al. 2020]. Furthermore, the dataset includes downscaled projections from Scenario MIP model runs [O'Neill et al. 2016; Tebaldi et al. 2021], featuring daily scenarios distributed through the Earth System Grid Federation.

13. The NEX-GDDP-CMIP6, dataset is generated using the Bias-Correction Spatial Disaggregation method, a statistical downscaling algorithm. It's specifically designed to overcome the limitations of global GCM outputs. The algorithm compares GCM outputs with actual climate observations over a common period and uses this information to adjust future climate projections. This adjustment is made to ensure that the projections are more consistent with historical climate records and provide more realistic results for the specific area of interest. Additionally, the algorithm uses spatial data from observationally derived datasets to increase the resolution of the GCM outputs.

14. SSPs are narrative pathways developed for the 2021 Sixth Assessment Report of the IPCC. They outline five different trajectories of societal development, including demography, economy, energy, agriculture, land use, and governance, without considering additional climate policies. These pathways provide a way to examine the feasibility of mitigation and adaptation strategies under different socioeconomic conditions.

15. There are five SSPs, each representing a different potential future based on various societal factors. A brief overview is the following:

- i. SSP1: Sustainability – Taking the Green Road. This pathway envisions a world with an increasing dedication to achieving development goals, reducing inequality, improving energy access, and advancing technology. It emphasises sustainable growth within the planet's boundaries.
- ii. SSP2: Middle of the Road.; This pathway illustrates a future where trends closely align with historical patterns. Economic, demographic, and technological patterns remain consistent with recent history. The challenges related to mitigation and adaptation are moderate.
- iii. SSP3: Regional Rivalry – A Rocky Road. This pathway envisions a world characterised by increasing nationalism and regional self-reliance, prioritising security and economic concerns at the regional level. It foresees a society with reduced emphasis on achieving globally agreed-upon goals
- iv. SSP4: Inequality – A Road Divided. This pathway represents a highly unequal world, where a wealthy few benefit from technological advancements and high-quality education, while a poor majority sees low economic growth and development.
- v. SSP5: Fossil-Fuelled Development – Taking the Highway. This pathway imagines a world pursuing personal wealth and economic growth as the overriding social and economic objectives, with energy demand dominated by fossil fuels. Technological advancements are market-driven.
- vi. SSP5-8.5: With an additional radiative forcing of 8.5 W/m² by the year 2100, the SSP5 scenario represents the upper boundary of the range of scenarios described in the literature. It can be understood as an update of the CMIP5 scenario RCP8.5, now combined with socioeconomic reasons.
- vii. SSP2-4.5: As an update to scenario RCP4.5, SSP2-4.5 with an additional radiative forcing of 4.5 W/m² by the year 2100 represents the medium pathway of future greenhouse gas emissions. This scenario assumes that climate protection measures are being taken.

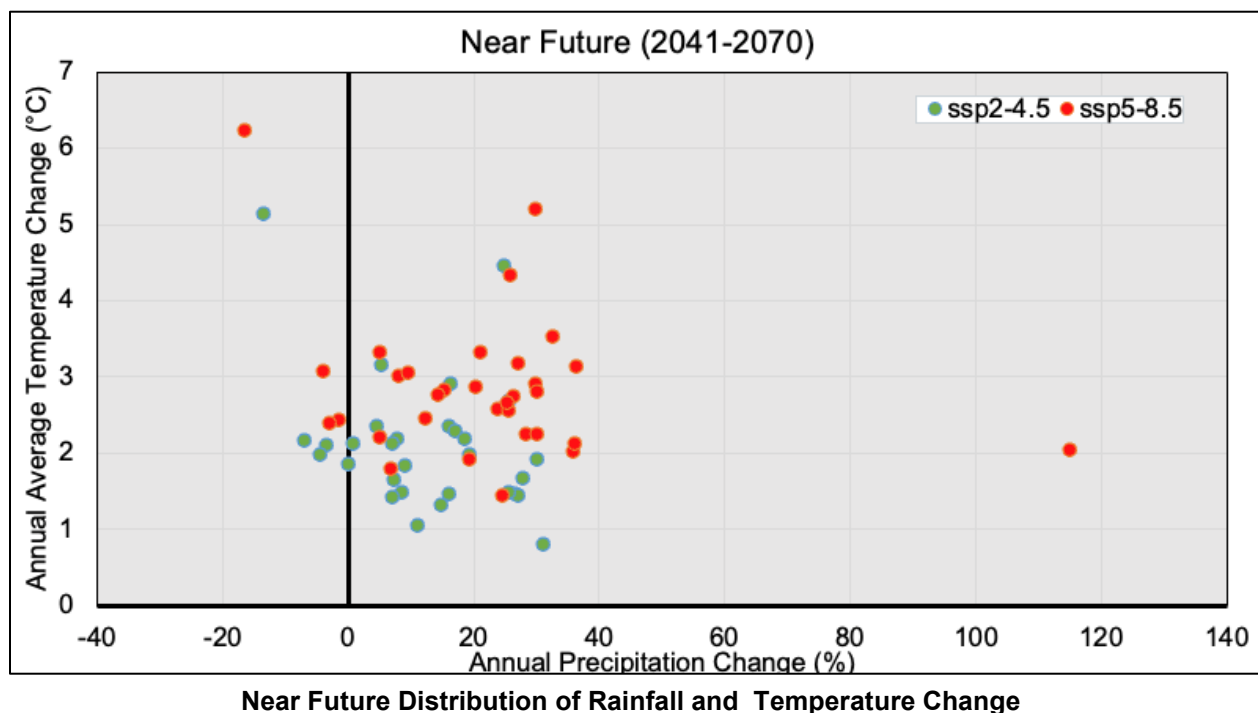
16. A conservative or precautionary approach to use SSP2-4.5 as reference scenario and SSP5-8.5 as challenging scenario for CRA studies of this assignment. Future climate hazards, such as floods, landslides, and temperature extremes, etc. are derived by analyzing those two scenarios at regional scale. This is to ensure that both risk assessments and adaptation measures are adequate for proposed project subcomponents.

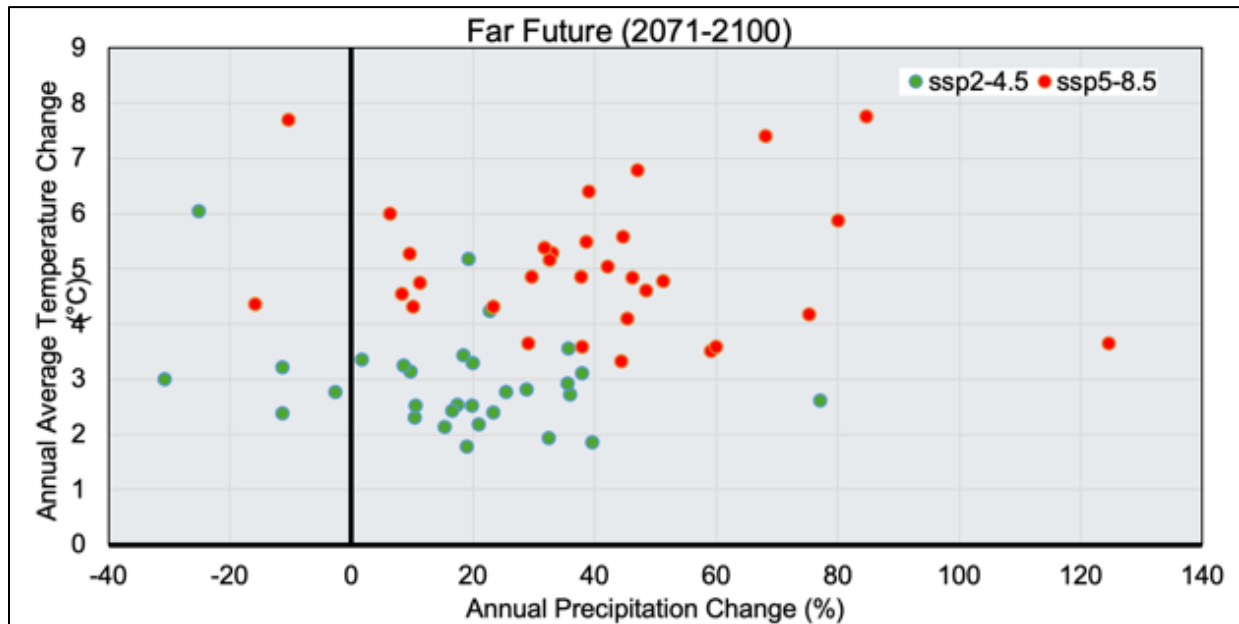
17. Historical baseline period from 1980 to 2010, and 30 years projection periods from 2041 to 2070 (referred as near future), and from 2071 to 2100 (referred as far future) were used in assessing future climate change risks. Climate change scenarios for this study are constructed using downscaled CMIP6 GCM data from NASA's NEX-GDDP-CMIP6 project. The analyses are carried out for precipitation, maximum and minimum temperature using multi-model ensemble at a spatial resolution of 0.25 degrees and a daily temporal resolution is used. The ensembles

include data for 32 GCMs and 35 GCMs for precipitation and temperature under the SSP2-4.5 and SSP5-8.5 climate change scenario, respectively. 30 GCMs were taken for temperature under the SSP2-4.5 scenario and 32 GCMs under the SSP5-8.5 scenario. The annual extreme values of rainfall and temperature for each period and scenario were calculated. The projected changes in magnitude and frequency of these variables are assessed.

18. **GCM projection scenarios:** From the evaluation of all the GCMs available in CMIP6, the following results were obtained regarding the expected changes in temperature and precipitation in the future.

- Under the SSP2-4.5 scenario for the near future (2041-2070), out of 33 Global Climate Models (GCMs), 5 predict a decrease in precipitation, while 28 predict an increase. Out of 30 GCMs, 8 predict an increase in temperature of less than 1.50°C, 13 predict an increase between 1.50°C and 2.00°C, and 9 predict an increase of greater than 2.00°C.
- Under the SSP2-4.5 scenario for the far future (2071-2100), out of 33 GCMs, 5 predict a decrease in precipitation, while 28 predict an increase. Out of 30 GCMs, a certain number predict an increase in temperature: less than 1.5°C, between 1.5°C and 2°C, and by greater than 2°C. (The specific numbers for each category are missing from the input.)
- Under the SSP5-8.5 scenario for the near future (2041-2070), out of 35 GCMs, 4 predict a decrease in precipitation, while a specific number predict an increase. Out of 32 GCMs, 2 predict an increase in temperature of less than 1.5°C, 4 predict an increase between 1.5°C and 2.00°C, and 26 predict an increase by greater than 2.00°C.
- Under the SSP5-8.5 scenario for the far future (2071-2100), out of 35 GCMs, 2 predict a decrease in precipitation, while 33 predict an increase. All 32 GCMs predict an increase in temperature by greater than 2.00°C.





Far Future Distribution of Rainfall and Temperature Change

19. Figures above suggest that the Tehri Lake area is very likely facing increases in both temperature and precipitation in 2041-2070 under both climate change scenarios. Majority of the GCMs indicate a likely increase in average yearly rainfall and temperature for the SSP2-4.5 and SSP5-8.5 scenarios for both near and far future projections. This indicates that the Tehri region is poised for a wetter and hotter future. The (SSP5-8.5) scenario points to much more severe changes in future climate conditions, underscoring the compelling need for immediate action to address this climate.

20. It is crucial to recognize that the rise in rainfall and temperature will directly result in floods, landslides and water scarcity in the summer months. Furthermore, these changes will also have a direct impact on tourism sector

21. **Future projections of rainfall:** The analysis of the GCM projections shows that most GCMs indicate an increase in precipitation for both the near and far future. The SSP2-4.5 scenario, the precipitation is likely to increase by 14.73% in median value from the base period median value (ranging from -13.65% to 40.12%). Similarly, under SSP5-8.5, the increase is 23.81%, (ranges from -16.65% to 114.87%). In the far future, under the SSP2-4.5 scenario, the precipitation is likely to increase by 19.25% (ranging from the -30.7% to 77.01%). Similarly, under SSP5-8.5, the increase is 38.59% from the median value baseline.

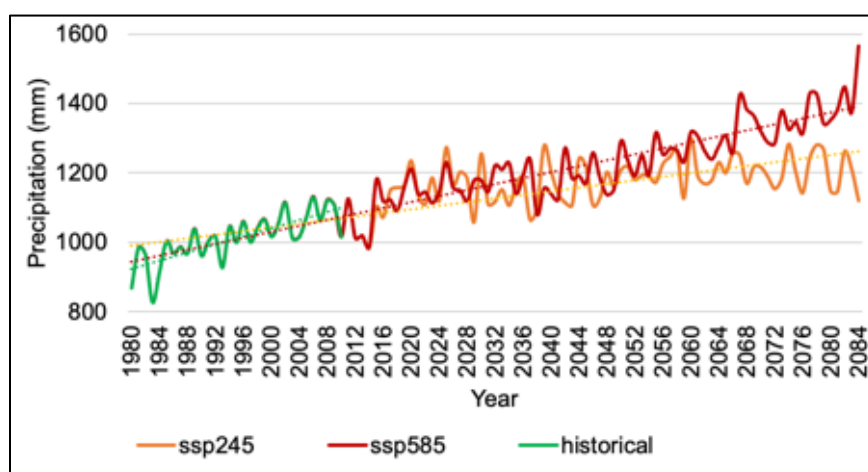
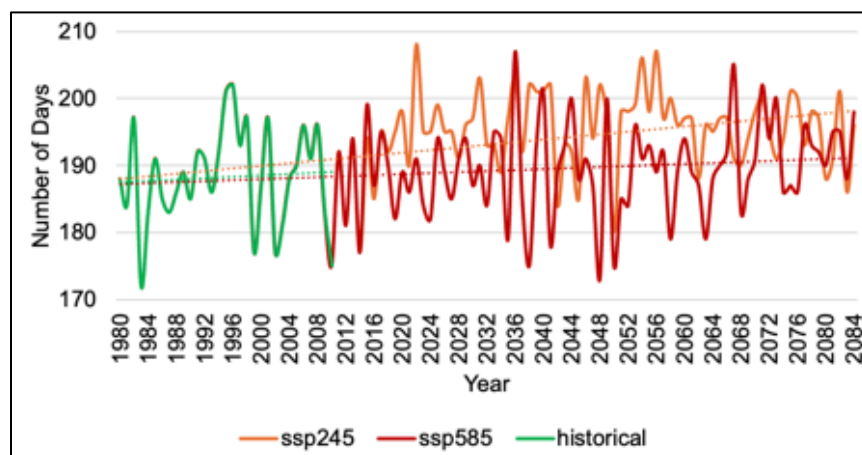
22. It is evident that both SSP2-4.5 and SSP5-8.5 scenarios predict increased rainfall in the area. Precipitation will also be more erratic with increased extreme events in the future. Increasingly erratic precipitation and more frequent extreme weather events seriously threaten tourism infrastructure, which could lead to breaching of infrastructure thresholds, causing more urban and river floods, severe flash floods, cloudbursts, and landslides. Apart from structural damage to the infrastructure, disruptions to tourism activities can lead to economic losses and livelihood.

Table 73. Projected change in Rainfall with Base period (1980-2010)

Near Future (2041-2070)				
Location	Scenario	*Precipitation change (%)	GCMs Dryer	GCMs Wetter
Tehri Lake Area	SSP2-4.5	14.73	5.00	28.00
	SSP5-8.5	23.81	4.00	31.00
Far Future (2071-2100)				
Location	Scenario	*Precipitation change (%)	GCMs Dryer	GCMs Wetter
Tehri Lake Area	SSP2-4.5	19.25	5.00	28.00
	SSP5-8.5	38.59	2.00	33.00

SSP = Shared Socioeconomic Pathways, GCM = General Circulation Models (GCMs)

*Change in ensemble median value of future period with respect to ensemble median value of base period

**Historic and Projected Precipitation Trend (1980-2084)****Observed and Projected Number of Wet Days Trend (1980-2084)**

23. **Future projection of temperature:** The ensemble median of the GCMs was taken to analyze the near and far future temperature trends, like precipitation analysis. During the period under analysis, both the maximum and minimum temperatures have shown an increasing trend

over time. Also, there is a rising trend in the annual average temperature. This temperature rise can cause discomfort and health issues to tourists. Similarly, increased air conditioning use at tourist destinations will be common, and it can contribute further to greenhouse gas emissions.

24. The analysis of the GCM projections shows that all the GCMs indicate an increase in temperature for both the near and far future. In the near future, SSP2-4.5 scenario indicates average temperature is likely to increase by 1.78°C from the base period median value (variation from 0.53°C to 5.36°C). Similarly, for SSP5-8.5, the increase is 2.56°C (variation from 1.40°C to 5.92°C). In the far future scenarios, under SSP2-4.5, it is likely to increase by 2.47°C from the base period median (variation ranging 1.41°C to 6.05°C) and for SSP5-8.5, the increase is 4.80°C respectively.

25. The extreme temperature will further likely increase by 2.09°C and the minimum temperature will rise further by 1.75°C from the base period median value. Similarly, under SSP5-8.5, the increase in maximum temperature is 2.79°C. In the far future, under the SSP2-4.5 scenario, the maximum temperature is likely to increase by 2.89°C and the minimum temperature will increase by 2.51°C from the base period median value. Similarly, under SSP5-8.5, the increase in maximum temperature is 5.00°C and minimum temperature rise is 4.78°C respectively from base median values.

Table 74. Projected change in Temperature with Base period (1980-2010)

Near Future (2041-2070)					
Location	Scenario	*Chang Table 3. Projected change in Temperature with Base period (1980-2010) e in Avg. Temperature Median (°C)	GCMs <1.5°C	GCMs ≥1.5°C and <2°C	GCMs ≥2°C
Tehri Lake Area	SSP2-4.5	1.78	8.00	13.00	9.00
	SSP5-8.5	2.56	2.00	4.00	26.00
Far Future (2071-2100)					
Location	Scenario	*Change in Avg. Temperature Median (°C)	GCMs <1.5°C	GCMs ≥1.5°C and <2°C	GCMs ≥2°C
Tehri Lake Area	SSP2-4.5	2.47	1.00	5.00	24.00
	SSP5-8.5	4.80	0.00	0.00	32.00

SSP = Shared Socioeconomic Pathways, GCM = General Circulation Models (GCMs)

*Change in ensemble median value of future period with respect to ensemble median value of base period

26. The ensemble median of both the annual maximum and minimum temperatures from the base period to the far future shows an increasing trend, which could have impacts on human health, tourists and the biodiversity in the area. This temperature increase could also exacerbate the heat island effect and lead to ecological damage. A rise in winter maximum temperature may result in melting glaciers and permanent snow cover in the upstream area, increasing the risk of flooding. Detailed climatic change risks and impacts are discussed in the following.

27. **Climate Change Risk Assessment:** The previous chapter shed light on the significant

anticipated changes in precipitation and temperature due to climate change in the future. These changes entail varying levels of climate risk for the proposed subprojects, which are dispersed across five clusters within the project area. This chapter aims to delineate the potential impacts of climate change on these subprojects, drawing from analyses of climate projections for the near future. The subprojects are susceptible to hazards such as landslides, floods, and wildfires. Areas in close proximity to the lake, including Dobra Chanti and Koti Colony, are especially at risk of flooding. Madan Negi, on the landslide-prone left bank of the river, is highly vulnerable to landslides. These combined factors create a heightened risk of damage to tourism facilities, transportation infrastructure, and attractions, hindering tourism activities and impacting local economies. In this chapter, we delve into the different components/sectors of the projects to understand the risks the sector will face in the changing climate scenarios of the future.

28. Climate risks assessment of the multi-modal transport: The multi-modal transport infrastructure in the Tehri Lake area faces significant future climate-related risks as extreme weather events are expected to become more frequent and intense. The region's hilly terrain and proximity to the lake increase the vulnerability of tourism roads, ropeways, electric buses, boats, and e-bikes to landslides, flooding, and heavy wind. Anticipated increases in rainfall could lead to more frequent road blockages and structural damage, while rising temperatures may accelerate the deterioration of road surfaces and transport equipment. Future high winds and heavy rains are likely to pose operational risks to ropeways and water public transport stations, potentially disrupting services and compromising safety. Additionally, the region's electric vehicle charging infrastructure could face an increased risk of damage from future flooding and temperature fluctuations, highlighting the need for elevated, weatherproof charging units.

29. There are four subprojects related to this category: tourism road, the ropeway, procurement of electric buses, boats and e-bikes, electric vehicle charging infrastructure and water public transport stations at multiple locations.

30. Tourism road (connecting Koti Colony to Dobra Chanti and Tiwar Gaon village)

31. Subproject activity. Tourists and villagers traverse by road transport, which connects villages to the Dobra Chanti Bridge and other nearby tourist destinations. PWD, has proposed a ring road around the Tehri Lake. A 234 km road encircling the lake is proposed to be developed by PWD Chamba. This road will benefit Tehri Garhwal and Uttarkashi's 173 villages, with an estimated population of 84000. From the ring road, a road section of 15.77 km connects Koti Colony to Dobra Chanti of the ring road is proposed as a subproject- "Tourism Road". The proposed road section is 6-7 m of carriageway connecting three clusters: Koti colony, Tiwar Gaon and Dobra Chanti. In addition to improving the road network, several activities are proposed in this cluster to boost tourism.

32. A major attraction of the tourism road will be the viewpoints along the route-designated areas with planned parking and amenities for tourists. The areas along the road will have Food and beverage(Fand B) facilities and public amenities like selfie points, rest areas, and washrooms. Roads will help generate employment by setting up kiosks in these areas and improving the local economy. Tourists visiting New Tehri for either business or leisure will benefit from the availability of improved road infrastructure. The development of tourism roads aims to benefit both locals and tourists. These roads will help improve transportation safety for passengers. Well-constructed roads with clear signage and proper facilities will enhance road safety, making it easier for vehicular traffic, pedestrians, and cyclists. As a result, this will increase the frequency of tourist travel.

33. **Climate risk.** The climate risk associated with this road will be its exposure to landslides and intermittent water logging during rainy seasons (as shown in below images). The road has six viewpoints exposed to landslide risk, out of which there is increased risk in viewpoint 8 (VP), which is demarcated as a landslide-prone area. The existing ROW varies from 6m to 8m, and elevation ranges from 840m to 990m. There are 7 locations on the proposed road where the drainage streams pass. Hence, proper drainage and culverts catering to future precipitation increase will be required at these locations.

34. At present, there is no dedicated facility for pedestrians and cyclists. The road has a carriageway of 6-7m, whereas the proposed road has a uniform carriageway of 7m plus a shoulder of 3 m throughout the alignment. Proper footpaths and cycle tracks will be boons for pedestrians and tourists. With the rising number of health enthusiasts, such facilities also attract long-term tourists, athletes who stay longer to train at such places.

35. This project proposes a multi-modal transport approach, including energy-efficient public transport, walking/cycling, and water transport, to respond to climate change by reducing greenhouse gases and tourism growth in the region.

36. Some glimpses of climate risks to this road are shown in the images below:



Landslide-prone areas in tourism road



Landslide prone areas in tourism road



Water logging at some places in tourism road

37. **Ropeway Tipri to Madan Negi:** Developing an efficient transportation network is a significant difficulty in a hilly terrain. Since in these places, rail and air transportation networks are limited, and road network development has technical obstacles. In this context, ropeways have evolved as a practical and safe form of transportation. In the case of benefits, this mode of transportation will provide mobility to people living in remote places, allowing them to access public services and job opportunities around the area. It will be a preferred, ecologically sustainable alternative to conventional roads in difficult hilly areas.

38. The current ropeway was installed in 2008 on government land and began operating in 2010. It connects the two banks of the Madan Negi and Tipri rivers. The Tipri (Drive station) is at a higher elevation, while the Madan Negi (Return station) is at a lower elevation. The distance between the two stations is approximately 988.00 m. This ropeway allows locals and tourists to travel between Tipri and Madan Negi in 10 minutes, covering an actual on-road distance of 30.80 km and saving about 2 hours of travel time. The Madan Negi and Tipri ropeway stations serve the mobility needs of several nearby villages. The cable cars accommodate 11 passengers and

one attendant at a time.

39. The current ropeway system has higher operation and maintenance (O&M) costs and lower safety standards compared to modern ropeway systems. A higher capacity ropeway is needed to handle the expected increase in tourism.

40. **Climate risk.** The Tipri station, situated on a steep slope, has been affected by landslides in the past and requires reinforcement to enhance its resilience to landslides. The ropeway is also susceptible to high winds and heavy rainfall disruptions, posing climate risks that can hinder operations for a couple of hours.

41. **Electric buses, boats, e-bikes and electric vehicle charging infrastructure:** The rise in tourism and implementing electric buses, boats, e-bikes, and electric vehicle charging infrastructure will bring positive impacts. However, these developments are susceptible to climate risks in the Tehri region. Extreme temperatures can have a significant impact on the performance and lifespan of batteries used in electric buses and e-bikes. High temperatures can reduce efficiency, while cold temperatures can lower performance and range. Furthermore, heavy rainfall and flooding pose risks to the reliability and safety of electric vehicle charging stations and electric boats. Water damage can compromise charging infrastructure, and electric boats may face operational difficulties due to fluctuating water levels and increased vulnerability to high winds. Additionally, extreme weather events can disrupt the power supply, affecting the availability and consistency of EV charging. It's important to carefully consider these climate risks to ensure the resilience and effectiveness of the electric transport infrastructure in the region.

42. **Water public transport stations at multiple locations:** In the past, jetty stations in Dobra Chanti, Tiwar Gaon, Sandhana, and Raulakot were operational but suffered from poor infrastructure and maintenance bottlenecks. These jetty stations benefited villagers by significantly reducing their travel time and attracting tourists interested in adventure activities and exploring nearby villages. The subproject proposes to establish five new jetty stations with improved infrastructure in Tiwar Gaon, Dobra Chanti, Raulakot, Barkot, and Sadhana. These new stations aim to enhance connectivity, support local economies, and boost regional tourism.

43. The primary climate risk associated with the water public transport stations is riverine flooding. With climate change expected to increase precipitation, these areas face a heightened risk of floods. It is essential to design and construct jetty stations that can withstand the High Flood Level (HFL) and account for potential future increases in flooding. Additionally, strong winds pose a significant risk to water transport, potentially affecting the docking and safety of boats at these stations. The infrastructure must be designed to handle high wind conditions to ensure the safety and reliability of water transport operations.

44. **Climate Change Adaptation Options:** A broad suite of actions characterizes the adaptation options. This involves behaviour solutions ranging from changing operational practices and preferences to reducing the exposure of new assets to future climate risks, complimented with low-carbon technologies, climate-smart intervention and use of recycling materials. Integrating grey and blue infrastructures like water retention pond structures to optimize storm drainage systems. Propose engineering design improvement to accommodate future climate allowance, complementing with nature-based designs.

45. The adaptation practices are informed by embedding future climate changes into the planning process for promoting climate-resilient tourism. The proposed tourism master plan (2025-2045) and destination management will chart a path for resilient tourism development and

bolster the capacity of UTDB and other stakeholders. Recognizing that adaptation is specific to communities, involving the community and citizens in risk identification and adopting measures to reduce vulnerabilities is essential. To improve resilience at the grassroots level, the Women-led Village Disaster Management System will anchor the role of awareness and capacity buildings to the communities.

46. The proposed adaptation measure is addressed at a systemic level, taking into account; behaviour and technical adjustments, as well as planning and engineering designs to accommodate future climate risks. It also includes capacity building for institutions and communities.

47. The identified future climate risks in the previous chapter are addressed at the subproject level. The adaptation measures are categorized as structural and non-structural measures.

Structural Measures : Adaptation options for multi-modal transport - related subproject subcomponents

Tourism road (connecting Koti Colony to Dobra Chanti and Tiwar Gaon village)

48. Culverts and Drainage Design: The proposed culverts and drainage systems are designed to withstand future climate scenarios based on the SSP 4.5 scenario, which predicts a 14.7% increase in precipitation

- Enhance design Capacity: The culverts on the tourism road are designed to handle heavy rainfall events caused by future climate change. The new design estimated future runoff volumes derived from anticipated rainfall intensity and frequency projections to adopt the augmented capacity of the culvert and drainage systems, There are 90 culverts planned for the road to ensure adequate stormwater drainage system. In addition, box drains, measuring 450 mm in width and 1250 mm in depth, are provided along the road length, particularly in the sliding zones and in areas with a high likelihood of stormwater influx.
- Slope protections include geotextile membranes, bioengineering designs, gabion walls, in landslide-prone areas. This combination of hard measures and complimented with natural measures is effective in reducing impact of landslides and soil erosion, which are likely to increase due to heavier and more frequent rainfall events.
- Geotextile membranes are proposed to stabilize slopes and prevent soil erosion by reinforcing the soil structure. They enhance the durability of the slopes and support vegetation growth, further stabilising the area.
- Bioengineering Design incorporates vegetation and natural materials to stabilise slopes. This approach not only prevents soil erosion but also improves the area's ecological value.
- Gabion Walls are made of wire mesh filled with stones, providing flexible and permeable solutions for slope stabilisation. They are effective in areas with high erosion risk and help dissipate the energy of flowing water.

Ropeway Tipri to Madan Negi

49. A combination of adaptive measures from green building standards for the stations, enhanced operation management due to real-time weather information and sustainable slope

stabilization measures are proposed

- Installing wind speed recorders (anemometers) and rainfall measurement equipment will help ropeway operations to manage extreme events. These tools will provide real-time data on weather conditions, allowing operators to take informed decision and enhance safety during extreme weather events.
- **RCC Retaining Wall with Geotextile Membrane:** At Tipri station, constructing a retaining wall with a geotextile membrane will reduce the risk of landslides. The geotextile membrane will stabilise the soil, while the retaining wall will provide vital support against potential slope failures.

Water public transport stations at multiple locations

50. Introducing ferries and water taxis will provide a low-carbon transportation alternative, easing road traffic congestion and reducing greenhouse gas emissions. This approach will help build a more resilient transportation system, offering a sustainable travel option that reduces reliance on land-based transport. The project not only improves transportation reliability but also supports local tourism and economic growth, providing a safe and continuous mobility option for residents and visitors

51. The new jetty stations are designed to have elevated platforms that are above the anticipated future High Flood Levels (HFL). They will use durable, water-resistant materials. The design ensures that the jetties can accommodate higher water levels and reduce the risk of damage from extreme events with a 1 in 50-year return period.

Smart infrastructure

52. The smart infrastructure would include Automated Weather monitoring stations, integrating prediction/forecasting systems and early warning alert services. The Forecasting and alert system will facilitate better planning and preparation for frontline workers, government officials, and communities. Watch towers are proposed for the early detection of forest fires. Anemometers are proposed to be installed in the ropeway from Tipri to Madan Negi to monitor wind velocity. These alert and disseminations will facilitate reducing the future climate risk

53. **Climate Change Mitigation Activities:** An activity qualifies as climate mitigation if it actively reduces or limits GHG emissions or enhances GHG sequestration. The Tehri Subprojects will undoubtedly contribute to climate mitigation. By carrying out abatement measures, these projects will significantly reduce their carbon emissions and align with the global objective of limiting temperature increases to less than 1.5°C above pre-industrial levels. Additionally, GHG reduction measures often lead to enhanced economic efficiency through waste reduction, energy optimization, and process efficiency improvements, resulting in reduced operational expenses. Moreover, investments in renewable energy and energy-efficient technologies can effectively lower long-term energy costs. Quantifying GHG emissions is therefore crucial for the Sustainable, Inclusive, and Climate-Resilient Tourism Development project at Tehri Lake. The reduction in GHG emissions has been calculated through the identification of mitigation options for subprojects, which are categorized into renewable energy, efficient technology, carbon sequestration, additional mitigation transportation, and water management.

54. **Mitigation measures in the multi-modal transport:** The mitigation measures in the transportation sector primarily focus on increasing the use of EVs for both private and public transport, promoting non-motorized modes of transport, and enhancing public transportation

infrastructure. It also includes infrastructure upgrades such as dedicated cycling lanes, which have been implemented to promote walking and cycling. Thus, specific actions include:

- Deployment of EV buses instead of conventional fossil fuel-driven buses is proposed.
- Deployment of EV Rickshaws instead of conventional fossil fuel-driven rickshaw is proposed.
- Use of ropeway instead of the roadway

55. The total emissions abatement due to increased EV usage, promotion of non-motorized transport, and improved public transportation is 3284 tCO₂e/year. This estimate is based on several key initiatives: increasing the use of EV vehicles, promoting non-motorized modes of transportation such as cycling and walking, reducing the use of private vehicles, and increasing the use of public transportation and the use of ropeway instead of roadway.

56. Several estimating assumptions are made to calculate the emissions abatement for each initiative. A fully charged electric car with a 40kW battery pack has a range of 400 km, consuming 0.1 kW/km. The average CO₂ emission for a car in India is 0.12 kg/km, while the average CO₂ emission for electricity generation in India is 0.82 kg/kW. The average carrying capacity of a car is 4 persons. For buses, the average CO₂ emission is 0.82 kg/km, with an average capacity of 50 passengers. On average, 1,500 persons travel per day (calculated as 30 buses with 50 persons each). The electricity consumption of E-Rickshaw is 31.2Wh/km. The average distance covered by rickshaw in a day is 100km. Conventional fossil fuel driven rickshaw consumes 18km/liter of petrol. Burning of 1 liter of petrol generates 2.3kg CO₂e/liter. The absolute emission from multi modal transport is 3186 tCO₂e/year.

57. **Accounting Of Climate Finance and GHG Emission:** The climate finance of this project is accounted separately for adaptation activities and mitigation activities. The adaptation finance is estimated according to the Guidance Note on Counting Climate Finance at ADB for project outputs. The mitigation finance is estimated according to the MDB Common Principles For Climate Mitigation Finance Tracking ²¹ for all eligible mitigation finance activities of the project.

58. **Estimates of GHG reduction and mitigation finance:** There are several eligible mitigation activities identified according to the MDB Common Principles for Climate Mitigation Finance Tracking (as MDB Common Principles from here), which are briefly reported here.

59. The multi-modal transport is considered as eligible mitigation activity based on the activity 1 and 2 under *the Urban and rural transport* category in Table 8 for Transport of the MDB Common Principles. It is estimated that this activity will avoid 3284 tCO₂e/year of GHG emission. The cost of \$16.50 million used for mitigation for this activity is counted as mitigation finance.

60. Use of renewable energy is considered as eligible mitigation activity based on the Eligible activity 1 and 2 in Table 2 for Energy of the MDB Common Principles. The renewable generation activities in this project include solar powered lighting and charging stations across the project area. The total design solar power capacity is 0.2 MW. It is estimated that solar power will avoid 792 tCO₂e/year of GHG emissions. The cost of \$1.26 million for this activity is counted as mitigation finance.

61. Use of high-efficiency equipment in buildings is considered as eligible mitigation activity based on the Eligible activity 6 in Table 2 for Energy of the MDB Common Principles. Those

²¹ [Common Principles for Climate Mitigation Finance Tracking](#).

include replacing conventional streetlights with LED lighting and adopting of more efficient VRV/VRF air conditioning systems in upgrading existing buildings. It is estimated that adopting more efficient lighting and air conditioning equipment will avoid 2647 tCO₂e/year of GHG emissions. The cost of \$1.13 million for this activity is counted as mitigation finance.

62. The project's afforestation and plantation activities are considered as eligible mitigation activity based on the Eligible activity 6 in Table 5 for Agriculture, forestry, land use and fisheries of the MDB Common Principles. This project will have about 295 ha of hill slopes afforested and 13 ha of vegetation protected within project areas. It is estimated that this activity will avoid 191 tCO₂e/year of GHG emissions. There is not mitigation finance counted for this activity because full cost of the output 4 is counted as adaptation finance already.

63. The project adopted new methodology and equipment in upgrading the existing WWTP that raises the energy efficiency from the current 0.667 kwh to 0.296 kwh for treating per m³ of wastewater. This activity will avoid 443 tCO₂e/year of GHG emissions and the related cost of \$0.84 million is counted as mitigation finance.

Appendix 7. Sector-wise GHG emission calculations

Renewables	
Subproject	Tiwar Gaon
Mitigation measures	Illumination of road by solar streetlight
Given	Number of streetlights installed as per DRP is 437
Assumptions	1. Operational time for all solar street light is 12 hours in a day 2. Power generation capacity of one solar street light = 50 watts 3. Average CO ₂ emission for electricity generation in India is 0.82 kg/kw
Calculations	CO ₂ emission when power is generated through solar light= 0 CO ₂ emission if the HPSV street of same capacity is installed $437 \times 365 \times 12 \times 50 \times 0.82 = 78.47$ tCO ₂ e/year Total emission reduction = 78.47 tCO ₂ e/year
Subproject	Koti Colony
Mitigation measures	Illumination of roads, by solar streetlights
Given	Number of streetlights installed as per DRP is 32
Assumptions	1. Operational time for all streetlight is 12 hours in a day 2. Power generation capacity of one solar streetlight = 50 watts 3. Average CO ₂ emission for electricity generation in India is 0.82 kg/kw
Calculations	CO ₂ emission when power is generated through solar light= 0 CO ₂ emission if the HPSV street of same capacity is installed $32 \times 365 \times 12 \times 50 \times 0.82 = 5.75$ tCO ₂ e/year Total emission reduction = 5.75 tCO ₂ e/year
Subproject	Tipri to Madan Negi Ropeway
Mitigation measures	Illumination of roads, by solar streetlights
Given	Number of streetlights installed as per DRP is 30
Assumptions	1. Operational time for all streetlight is 12 hours in a day 2. Power generation capacity of one solar streetlight = 50 watts 3. Average CO ₂ emission for electricity generation in India is 0.82 kg/kw
Calculations	CO ₂ emission when power is generated through solar light= 0 CO ₂ emission if the HPSV street of same capacity is installed $30 \times 365 \times 12 \times 50 \times 0.82 = 5.39$ tCO ₂ e/year Total emission reduction = 5.39 tCO ₂ e/year
DPR-	Smart Components and Smart Loops
Mitigation measures	Usage of solar power system
Given	Number of solar power system installed as per DRP is 7
Assumptions	1. Let us assume that one solar system has 8 solar panels. 2. Operational time for all solar panel is 12 hours in a day 2. Power generation capacity of one solar panel = 330 watts 3. Average CO ₂ emission for electricity generation in India is 0.82 kg/kw
Calculations	CO ₂ emission when power is generated through solar light= 0 CO ₂ emission if the HPSV street of same capacity is installed $7 \times 8 \times 365 \times 12 \times 330 \times 0.82 = 66.37$ tCO ₂ e/year Total emission reduction = 66.37 tCO ₂ e/year
Subproject	Tipri to Madan Negi Ropeway
Mitigation measures	Installation of Solar water Pump
Given	Number of solar water pumps installed as per DRP is 2

Assumptions	1. Operational time for all solar water pump be 12 hours in a day 2. Power generation capacity of one solar pump is 500 watts 3. Average CO2 emission for electricity generation in India is 0.82 kg/kw
Calculations	Total CO2 emission, if 500 watts of solar water pump is used is 0 Total CO2 emission is the 500 watts capacity electric pump is used = $2*365*12*500*0.82=3.6\text{tCO}_2\text{e/year}$ Total emission reduction = 3.6 tCO ₂ e/year
Energy Efficiency	
Subproject	Tiwar Gaon
Mitigation measures	Illumination of roads, major village junctions, viewing points, parking etc by LED streetlights
Given	Number of streetlights installed as per DRP is 368
Assumptions	1. Average CO2 emission for LED streetlight is 0.82 Kg/KW 2. Operational time for all streetlight is 12 hours in a day 4. Power consumption of one LED streetlight = 80 watts 5. Power consumption of conventional halogen streetlight = 250 watts
Calculations	CO2 emission for all the LED streetlight is $368*365*12*80*0.82 = 105.7\text{ tCO}_2\text{e/year}$ CO2 emission for all the conventional streetlight is $368*365*12*250*0.82 = 330.42\text{ tCO}_2\text{e/year}$ Total emission reduction = 224.72 tCO₂e/year
Subproject	Tipri to Madan Negi Ropeway
Mitigation measures	Illumination of roads, major village junctions, viewing points, parking etc by LED streetlights
Given	Number of streetlights installed as per DRP is 388
Assumptions	1. Average CO2 emission for LED streetlight is 0.82 Kg/KW 2. Operational time for all streetlight is 12 hours in a day 3. Power consumption of one LED streetlight = 80 watts 4. Power consumption of conventional halogen streetlight = 250 watts
Calculations	CO2 emission for all the LED streetlight is $388*365*12*80*0.82 = 111.48\text{ tCO}_2\text{e/year}$ CO2 emission for all the conventional streetlight is $388*365*12*250*0.82 = 348.38\text{ tCO}_2\text{e/year}$ Total emission reduction = 236.90 tCO₂e/year
Subproject	Tourism Road (Koti Colony to Dobra Chanti)
Mitigation measures	Illumination of roads, major village junctions, viewing points, parking etc by LED streetlights
Given	Number of streetlights installed as per DRP is 759
Assumptions	1. Average CO2 emission for LED streetlight is 0.82 Kg/KW 2. Operational time for all streetlight is 12 hours in a day 3. Power consumption of one LED streetlight = 80 watts 4. Power consumption of conventional halogen streetlight = 250 watts
Calculations	CO2 emission for all the LED streetlight is $759*365*12*80*0.82 = 218.08\text{ tCO}_2\text{e/year}$ CO2 emission for all the conventional streetlight is $759*365*12*250*0.82 = 681.50\text{ tCO}_2\text{e/year}$ Total emission reduction = 463.42 tCO₂e/year
Mitigation measures	Illumination of roads, major village junctions, viewing points, parking etc by LED streetlights
Given	Number of streetlights installed as per DRP is 102
Assumptions	1. Average CO2 emission for LED streetlight is 0.82 Kg/KW 2. Operational time for all streetlight is 12 hours in a day

	3. Power consumption of one LED streetlight = 80 watts 4. Power consumption of conventional halogen streetlight = 250 watts
Calculations	CO ₂ emission for all the LED streetlight is $102 \times 365 \times 12 \times 80 \times 0.82 = 29.30 \text{ tCO}_2\text{e/year}$ CO ₂ emission for all the conventional streetlight is $102 \times 365 \times 12 \times 250 \times 0.82 = 91.58 \text{ tCO}_2\text{e/year}$ Total emission reduction = 62.27 tCO₂e/year
Carbon Sequestration	
Transport	
Subproject	Tourism Road (Koti Colony to Dobra Chanti)
Mitigation measures	Increase in the usage of EV vehicle
Given	1. Proposed road length is 234 km
Assumptions	1. A fully charged electric car (40kW battery pack has a range of 400 km) (Tata Nixon); electricity consumed by EV is 0.1KW/Km. 2. Average CO ₂ emission for car in India is 0.12 Kg/Km. 3. Average CO ₂ emission for electricity generation in India is 0.82 Kg/KW 4. Average vehicle on road per day is 100.
Calculations	CO ₂ emissions for 100 EV on road $= 0.1 \times 0.82 \times 234 \times 100 \times 365 = 700.36 \text{ t CO}_2\text{e/year}$ CO ₂ emission for 100 fuel cars in India is $0.12 \times 234 \times 100 \times 365 = 1024.92 \text{ tCO}_2\text{e/year}$ Total emission reduction = 324.55 tCO₂e/year
Mitigation measures	Rise in the utilization of non-motorized modes of transportation, such as cycling and walking.
Given	1. Proposed tourism road length is 15.77 km
Assumptions	1. Average people travel per day on road through cycle /walking is 100. 2. Average CO ₂ emission for car in India is 0.12 Kg/Km. 3. Carrying capacity of a car is 4 people at a time 4. Assuming same number of people will travel by car in the same road.
Calculations	CO ₂ emission generated by using car in a year $= 0.12 \times 100 / 4 \times 15.77 \times 365 = 17.26 \text{ tCO}_2\text{e/year}$ CO ₂ emission released if the same number of people travel by walking or cycling = 0 Total emission reduction = 17.26 tCO₂e/year
Subproject	Tipri to Madan Negi Ropeway
Mitigation measures	Reduce the usage of private vehicle and reduce traffic congestion
Given	1. Distance between the two towns by road is 75km 2. Rated load of drive train is 75 KW/hour 3. Carrying capacity of ropeway is 150PPH
Assumptions	1. Average CO ₂ emission for per KW of power consumption is 0.82 Kg/KW 2. Average CO ₂ emission for car in India is 0.12 Kg/Km. 3. Average carrying car capacity is 4 persons 4. Let the operational hour of a ropeway be 10 hour/day 4. Assume that same number of people travelled by car and ropeway in a year
Calculations	Person travelled in year $= 150 \text{ PPH} \times 10 \times 365 = 547500 \text{ Person /year}$ Emission generates by a ropeway in a year $= 75 \times 10 \times 365 \times 0.82 = 224.47 \text{ tCO}_2\text{e/year}$ Emission generates by car if same number of people travel by road $= 0.12 \times 75 \times 547500 / 4 = 1231.87 \text{ tCO}_2\text{e/year}$ Hence reduction in the emission is 1007.4 tCO₂e/year
DPR	Smart Components and Smart Loops
Mitigation measures	Usage of EV auto rickshaw
Given	No. of proposed auto rickshaw is 12

Assumptions	1. On an average, 31.2 Wh/km (0.031KWh/km) of electricity consumed by E auto rickshaw in a day. 2. On an average auto rickshaw consumes 18 km/litre of petrol. 3. Assume average distance covered by auto rickshaw in a day is 100km. 4. Burning of 1 litre of petrol produce 2.3 kg CO ₂ e/Litre 5. Average CO ₂ emission for electricity generation in India is 0.82 kg/kw
Calculations	The total CO ₂ emission by petrol auto rickshaw in a day = $12 \times 100 / 18 \times 2.3 \times 365 = 56.01$ tCO ₂ e/year The total CO ₂ emission by E-autorickshaw in a day = $12 \times 0.031 \times 100 \times 365 \times 0.82 = 11.13$ tCO ₂ e/year Total CO ₂ reduction is 44.88 tCO₂e/year

Appendix 8. Air Quality Monitoring Test Report



ECON Laboratory and Consultancy

(ISO: 9001, 14001, 45001, NABL Accredited and CPCB Recognized Lab)

Vill: Khabarwala, P.O.: Jaintanwala, Near Garhi Cantt., Dehradun, And Uttarakhand-248003

Contact No: +91-8534957815, 8126534344,

Web: www.econlaboratory.com Email: uk@econlaboratory.com, econlab.consultancy@yahoo.in

TEST REPORT

Name & Address of client:	ULR No.	TC55072400000 3583F
M/s.IPE GLOBAL LIMITED	Reporting Date:	07/06/2024
B-84,Defence Colony, New Delhi-110024.	Receipt Date:	03/06/2024
	Period of Testing:	03/06/2024- 07/06/2024
	Format No.:	7.8 F-01
	Party Reference No.:	PO.No.9840

SAMPLE DESCRIPTION

General Information

Sample Collected by

Sampling Location

Sampling Coordinates

Instrument Used

Instrument Code

Instrument Calibration Status

Meteorological condition during monitoring

Date of Monitoring

Time of Monitoring

Ambient Temperature (°C)

Surrounding activity

Scope of Monitoring

Control measure if any

Sampling & Analysis Protocol

Parameters Required

: AMBIENT AIR QUALITY MONITORING

: Lab Representative

: PS-1 (Dobra Chanti Near Bridge, Tehri)

: Lat: 30.447497°

: Long: 78.434047°

: RDS with PM 2.5 Attachment

: ECON/RDS/01

: Calibrated

: Clear Sky

: 28/05/2024 to 29/05/2024

: 3.48 PM -3.40 PM

: Min.25.0, Max. 35.0

: Human & Vehicular Activities

: Regulatory Requirement

: No

: IS:5182

: As per Work Order

Project Name: ADB Funded-Sustainable, Inclusive and Climate Resilient Tourism Development at Tehri Lake Area Project					
TEST RESULT					
S. No.	Parameters	Test Method	Test Results	Units	NAAQS#
1.	Particulate Matter (PM ₁₀)	IS:5182 (P-23):2006, I A 2022, (Cyclonic Method)	76.3	µg/m ³	100
2.	Particulate Matter (PM _{2.5})	IS:5182 (P-24):2019, (Gravimetric method)	31.8	µg/m ³	60
3.	Sulphur Dioxide (SO ₂)	IS:5182 (P-2):2001, I A 2022	18.2	µg/m ³	80
4.	Nitrogen Dioxide (NO ₂)	IS:5182 (P-6):2006, I A 2022	26.0	µg/m ³	80
5.	Carbon Monoxide (CO)	IS:5182 (P-10):1999, I A 2019	0.14	mg/m ³	4

Note:-# NAAQS-National Ambient Air Quality Standard: Schedule-VII, [Rule 3 (3B)], [Part-II-Sec.-3(i) 16.



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Vill: Khabarwala, P.O.: Jaintanwala, Near Garhi Cantt., Dehradun, And Uttarakhand-248003

Contact No: +91-8534957815, 8126534344,

Web: www.econlaboratory.com Email: uk@econlaboratory.com, econlab.consultancy@yahoo.in

TEST REPORT

Name & Address of client:	ULR No.	TC55072400000 3584F
M/s.IPE GLOBAL LIMITED	Reporting Date:	07/06/2024
B-84,Defence Colony,	Receipt Date:	03/06/2024
New Delhi-110024.	Period of Testing:	03/06/2024- 07/06/2024
	Format No.:	7.8 F-01
	Party Reference No.:	PO.No.9840

SAMPLE DESCRIPTION

General Information

Sample Collected by

Sampling Location

Sampling Coordinates

Instrument Used

Instrument Code

Instrument Calibration Status

Meteorological condition during monitoring

Date of Monitoring

Time of Monitoring

Ambient Temperature (°C)

Surrounding activity

Scope of Monitoring

Control measure if any

Sampling & Analysis Protocol

Parameters Required

: AMBIENT AIR QUALITY MONITORING

: Lab Representative

: PS-2 (Tiwari Village at Panwar Ji House, Tehri)

: Lat: 30.413477°

Long: 78.445238°

: RDS with PM 2.5 Attachment

: ECON/RDS/02

: Calibrated

: Clear Sky

: 28/05/2024 to 29/05/2024

: 5.15 PM -5.10 PM

: Min.25.0, Max. 35.0

: Human & Vehicular Activities

: Regulatory Requirement

: No

: IS:5182

: As per Work Order

Project Name: ADB Funded-Sustainable, Inclusive and Climate Resilient Tourism Development at Tehri Lake Area
Project

TEST RESULT

S. No.	Parameters	Test Method	Test Results	Units	NAAQS#
1.	Particulate Matter (PM ₁₀)	IS:5182 (P-23):2006, RA 2022, (Cyclonic Method)	68.2	µg/m ³	100
2.	Particulate Matter (PM _{2.5})	IS:5182 (P-24):2019, (Gravimetric method)	24.0	µg/m ³	60
3.	Sulphur Dioxide (SO ₂)	IS:5182 (P-2):2001, RA 2022	12.3	µg/m ³	80
4.	Nitrogen Dioxide (NO ₂)	IS:5182 (P-6):2006, RA 2022	25.0	µg/m ³	80
5.	Carbon Monoxide (CO)	IS:5182 (P-10):1999, RA 2019	0.11	mg/m ³	4

Note-# NAAQS-National Ambient Air Quality Standard: Schedule-VII, [Rule 3 (3B)], [Part-II-Sec.-3(i) 16.



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Contact No: +91-8534957815, 8126534344,

Web: www.econlaboratory.com Email: uk@econlaboratory.com, econlab.consultancy@yahoo.in

TEST REPORT

Name & Address of client:	ULR No.	TC550724000003585F
M/s.IPE GLOBAL LIMITED	Reporting Date:	07/06/2024
B-84,Defence Colony,	Receipt Date:	03/06/2024
New Delhi-110024.	Period of Testing:	03/06/2024- 07/06/2024
	Format No.:	7.8 F-01
	Party Reference No.:	PO.No.9840

SAMPLE DESCRIPTION

General Information

Sample Collected by

Sampling Location

Sampling Coordinates

Instrument Used

Instrument Code

Instrument Calibration Status

Meteorological condition during monitoring

Date of Monitoring

Time of Monitoring

Ambient Temperature (°C)

Surrounding activity

Scope of Monitoring

Control measure if any

Sampling & Analysis Protocol

Parameters Required

: AMBIENT AIR QUALITY MONITORING

: Lab Representative

: PS-3 (Near ISBT City Centre at roof of DTDO Office, New Tehri)

: Lat: 30.383448°

: Long: 78.440846°

: RDS with PM 2.5 Attachment

: ECON/RDS/01

: Calibrated

: Clear Sky

: 29/05/2024 to 30/05/2024

: 11.48 PM -11.40 PM

: Min.25.0, Max. 35.0

: Human & Vehicular Activities

: Regulatory Requirement

: No

: IS:5182

: As per Work Order

Project Name: ADB Funded-Sustainable, Inclusive and Climate Resilient Tourism Development at Tehri Lake Area Project

TEST RESULT

S. No.	Parameters	Test Method	Test Results	Units	NAAQS#
1.	Particulate Matter (PM ₁₀)	IS:5182 (P-23):2006, RA 2022, (Cyclonic Method)	72.8	µg/m ³	100
2.	Particulate Matter (PM _{2.5})	IS:5182 (P-24):2019, (Gravimetric method)	27.3	µg/m ³	60
3.	Sulphur Dioxide (SO ₂)	IS:5182 (P-2):2001, RA 2022	14.8	µg/m ³	80
4.	Nitrogen Dioxide (NO ₂)	IS:5182 (P-6):2006, RA 2022	23.0	µg/m ³	80
5.	Carbon Monoxide (CO)	IS:5182 (P-10):1999, RA 2019	0.12	mg/m ³	4

Note-# NAAQS-National Ambient Air Quality Standard: Schedule-VII, [Rule 3 (3B)], [Part-II-Sec.-3(i) 16.



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Contact No: +91-8534957815, 8126534344,

Web: www.econlaboratory.com Email: uk@econlaboratory.com, econlab.consultancy@yahoo.in

TEST REPORT

Name & Address of client:	ULR No.	TC55072400000 3586F
M/s.IPE GLOBAL LIMITED	Reporting Date:	07/06/2024
B-84,Defence Colony,	Receipt Date:	03/06/2024
New Delhi-110024.	Period of Testing:	03/06/2024- 07/06/2024
	Format No.:	7.8 F-01
	Party Reference No.:	PO.No.9840

SAMPLE DESCRIPTION

General Information

Sample Collected by

Sampling Location

Sampling Coordinates

Instrument Used

Instrument Code

Instrument Calibration Status

Meteorological condition during monitoring

Date of Monitoring

Time of Monitoring

Ambient Temperature (°C)

Surrounding activity

Scope of Monitoring

Control measure if any

Sampling & Analysis Protocol

Parameters Required

: AMBIENT AIR QUALITY MONITORING

: Lab Representative

: PS-5 (Solid Waste Landfill Site, Mokri, Tehri)

: Lat: 30.368514°

: Long: 78.474858°

: RDS with PM 2.5 Attachment

: ECON/RDS/01

: Calibrated

: Clear Sky

: 30/05/2024 to 31/05/2024

: 11.48 PM -11.40 PM

: Min.25.0, Max. 35.0

: Human & Vehicular Activities

: Regulatory Requirement

: No

: IS:5182

: As per Work Order

Project Name: ADB Funded-Sustainable, Inclusive and Climate Resilient Tourism Development at Tehri Lake Area

Project

TEST RESULT

S. No.	Parameters	Test Method	Test Results	Units	NAAQS#
1.	Particulate Matter (PM ₁₀)	IS:5182 (P-23):2006, RA 2022, (Cyclonic Method)	88.9	µg/m ³	100
2.	Particulate Matter (PM _{2.5})	IS:5182 (P-24)2019, (Gravimetric method)	47.0	µg/m ³	60
3.	Sulphur Dioxide (SO ₂)	IS:5182 (P-2):2001, RA 2022	21.3	µg/m ³	80
4.	Nitrogen Dioxide (NO ₂)	IS:5182 (P-6):2006, RA 2022	36.0	µg/m ³	80
5.	Carbon Monoxide (CO)	IS:5182 (P-10)1999, RA 2019	0.76	mg/m ³	4

Note-# NAAQS-National Ambient Air Quality Standard: Schedule-VII, [Rule 3 (3B)], [Part-II-Sec.-3(i) 16.



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Contact No: +91-8534957815, 8126534344,

Web: www.econlaboratory.com Email: uk@econlaboratory.com, econlab.consultancy@yahoo.in

TEST REPORT

Name & Address of client:	ULR No.	TC550724000003588F
M/s.IPE GLOBAL LIMITED	Reporting Date:	07/06/2024
B-84,Defence Colony,	Receipt Date:	03/06/2024
New Delhi-110024.	Period of Testing:	03/06/2024- 07/06/2024
	Format No.:	7.8 F-01
	Party Reference No.:	PO.No.9840

SAMPLE DESCRIPTION

: AMBIENT AIR QUALITY MONITORING

General Information

Sample Collected by

: Lab Representative

Sampling Location

: PS-6 (Sandhra Village at Mahadev Temple)

Sampling Coordinates

: Lat: 30.395726°

Long: 78.496691°

Instrument Used

: RDS with PM 2.5 Attachment

Instrument Code

: ECON/RDS/01

Instrument Calibration Status

: Calibrated

Meteorological condition during monitoring

: Clear Sky

Date of Monitoring

: 31/05/2024 to 01/06/2024

Time of Monitoring

: 04.35 PM -04.30 PM

Ambient Temperature (°C)

: Min.25.0, Max. 35.0

Surrounding activity

: Human & Vehicular Activities

Scope of Monitoring

: Regulatory Requirement

Control measure if any

: No

Sampling & Analysis Protocol

: IS:5182

Parameters Required

: As per Work Order

Project Name: ADB Funded-Sustainable, Inclusive and Climate Resilient Tourism Development at Tehri Lake Area Project

TEST RESULT

S. No.	Parameters	Test Method	Test Results	Units	NAAQS#
1.	Particulate Matter (PM ₁₀)	IS:5182 (P-23):2006, RA 2022, (Cyclonic Method)	74.9	µg/m ³	100
2.	Particulate Matter (PM _{2.5})	IS:5182 (P-24):2019, (Gravimetric method)	22.6	µg/m ³	60
3.	Sulphur Dioxide (SO ₂)	IS:5182 (P-2):2001, RA 2022	11.7	µg/m ³	80
4.	Nitrogen Dioxide (NO ₂)	IS:5182 (P-6):2006, RA 2022	21.6	µg/m ³	80
5.	Carbon Monoxide (CO)	IS:5182 (P-10):1999, RA 2019	0.09	mg/m ³	4

Note-# NAAQS-National Ambient Air Quality Standard: Schedule-VII, [Rule 3 (3B)], [Part-II-Sec.-3(i) 16.

Appendix 9. Noise Level Monitoring Test Reports



ECON Laboratory and Consultancy
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 Vill: Khabarwala, P.O.: Jaintanwala, Near Garhi Cantt., Dehradun, And Uttarakhand-248003
 Contact No: +91-8534957815, 8126534344,
 Web: www.econlaboratory.com Email: uk@econlaboratory.com, econlab.consultancy@yahoo.in

TEST REPORT

Name & Address of client:	ULR No.	TC55072400000 3589F
M/s.IPE GLOBAL LIMITED B-84,Defence Colony, New Delhi-110024.	Reporting Date:	07/06/2024
	Receipt Date:	03/06/2024
	Period of Testing:	04/06/2024-07/06/2024
	Format No.:	7.8 F-01
	Party Reference No.:	PO.No.9840

SAMPLE DESCRIPTION

: AMBIENT NOISE MONITORING

General Information

Sample Collected by	: Lab Representative
Sampling Location	: PS-1 (Dobra Chanti Near Bridge, Tehri)
Sampling Coordinates	: Lat: 30.447414° Long: 78.434049°
Instrument Used	: Sound Level Meter
Instrument Code	: ECON/SLM/01
Instrument Calibration Status	: Calibrated
Meteorological condition during monitoring	: Clear Sky
Date of Monitoring	: 28/05/2024-29/05/2024
Time of Monitoring	: 3:52 PM to 3:50 PM
Ambient Temperature (°C)	: Min.25.0, Max.35.0
Surrounding activity	: Human & Vehicular Activities
Scope of Monitoring	: Regulatory Requirement
Control measure if any	: No
Sampling & Analysis Protocol	: CPCB Guideline &IS:9989:1981, RA2020
Parameters Required	: As per Work Order

Project Name: ADB Funded-Sustainable, Inclusive and Climate Resilient Tourism Development at Tehri Lake Area Project				
TEST RESULT				
S. No.	Parameters	Test Method	Test Results	Units
1.	Equivalent Noise Level (6.00 AM to 10.00 PM) Day Time	IS:9989:1981 RA2020	62.3	dB
2.	Equivalent Noise Level (10.00 PM to 06.00 AM)Night Time	IS:9989:1981 RA2020	51.4	dB
Requirement as per CPCB Guideline				
		Day	Night	
1.	Industrial Area, dB	75	70	
2.	Commercial Area, dB	65	50	
3.	Residential Area, dB	55	45	
4.	Silence Area, dB	50	40	



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Contact No: +91-8534957815, 8126534344,

Web: www.econlaboratory.com Email: uk@econlaboratory.com, econlab.consultancy@yahoo.in

TEST REPORT

Name & Address of client:	ULR No.	TC55072400000 3590F
M/s.IPE GLOBAL LIMITED	Reporting Date:	07/06/2024
B-84, Defence Colony,	Receipt Date:	03/06/2024
New Delhi-110024.	Period of Testing:	04/06/2024-07/06/2024
	Format No.:	7.8 F-01
	Party Reference No.:	PO.No.9840

SAMPLE DESCRIPTION

: AMBIENT NOISE MONITORING

General Information

Sample Collected by

: Lab Representative

Sampling Location

: PS-2 (Tiwar Village at Panwar Ji House, Tehri)

Sampling Coordinates

: Lat: 30.413478°

Long: 78.445279°

Instrument Used

: Sound Level Meter

Instrument Code

: ECON/SLM/02

Instrument Calibration Status

: Calibrated

Meteorological condition during monitoring

: Clear Sky

Date of Monitoring

: 28/05/2024-29/05/2024

Time of Monitoring

: 5:20 PM to 5:20 PM

Ambient Temperature (°C)

: Min.25.0, Max.35.0

Surrounding activity

: Human & Vehicular Activities

Scope of Monitoring

: Regulatory Requirement

Control measure if any

: No

Sampling & Analysis Protocol

: CPCB Guideline &IS:9989:1981, RA2020

Parameters Required

: As per Work Order

Project Name: ADB Funded-Sustainable, Inclusive and Climate Resilient Tourism Development at Tehri Lake Area Project

TEST RESULT

S. No.	Parameters	Test Method	Test Results	Units
1.	Equivalent Noise Level (6.00 AM to 10.00 PM) Day Time	IS:9989:1981 RA2020	55.2	dB
2.	Equivalent Noise Level (10.00 PM to 06.00 AM) Night Time	IS:9989:1981 RA2020	48.8	dB
Requirement as per CPCB Guideline				
		Day	Night	
1.	Industrial Area, dB	75	70	
2.	Commercial Area, dB	65	50	
3.	Residential Area, dB	55	45	
4.	Silence Area, dB	50	40	



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Contact No: +91-8534957815, 8126534344,

Web: www.econlaboratory.com Email: uk@econlaboratory.com, econlab.consultancy@yahoo.in

TEST REPORT

Name & Address of client:	ULR No.	TC55072400000 3591F
M/s.IPE GLOBAL LIMITED	Reporting Date:	07/06/2024
B-84,Defence Colony,	Receipt Date:	03/06/2024
New Delhi-110024.	Period of Testing:	04/06/2024-07/06/2024
	Format No.:	7.8 F-01
	Party Reference No.:	PO.No.9840

SAMPLE DESCRIPTION

General Information

Sample Collected by

Sampling Location

Sampling Coordinates

Instrument Used

Instrument Code

Instrument Calibration Status

Meteorological condition during monitoring

Date of Monitoring

Time of Monitoring

Ambient Temperature (°C)

Surrounding activity

Scope of Monitoring

Control measure if any

Sampling & Analysis Protocol

Parameters Required

AMBIENT NOISE MONITORING

Lab Representative

PS-3 (Near ISBT City Centre at the roof of DTDO Office, New Tehri)

Lat: 30.383454°

Long: 78.440792°

Sound Level Meter

ECON/SLM/01

Calibrated

Clear Sky

29/05/2024-30/05/2024

11:50 PM to 11:30 PM

Min.25.0, Max.35.0

Human & Vehicular Activities

Regulatory Requirement

No

CPCB Guideline &IS:9989:1981, RA2020

As per Work Order

Project Name: ADB Funded-Sustainable, Inclusive and Climate Resilient Tourism Development at Tehri Lake Area Project				
TEST RESULT				
S. No.	Parameters	Test Method	Test Results	Units
1.	Equivalent Noise Level (6.00 AM to 10.00 PM) Day Time	IS:9989:1981 RA2020	51.5	dB
2.	Equivalent Noise Level (10.00 PM to 06.00 AM)Night Time	IS:9989:1981 RA2020	47.0	dB
Requirement as per CPCB Guideline				
		Day	Night	
1.	Industrial Area, dB	75	70	
2.	Commercial Area, dB	65	50	
3.	Residential Area, dB	55	45	
4.	Silence Area, dB	50	40	



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Contact No: +91-8534957815, 8126534344,

Web: www.econlaboratory.com Email: uk@econlaboratory.com, econlab.consultancy@yahoo.in

TEST REPORT

Name & Address of client:	ULR No.	TC55072400000 3592F
M/s.IPE GLOBAL LIMITED	Reporting Date:	07/06/2024
B-84, Defence Colony,	Receipt Date:	03/06/2024
New Delhi-110024.	Period of Testing:	04/06/2024-07/06/2024
	Format No.:	7.8 F-01
	Party Reference No.:	PO.No.9840

SAMPLE DESCRIPTION

: AMBIENT NOISE MONITORING

General Information

Sample Collected by	: Lab Representative
Sampling Location	: PS-5 (Solid Waste Landfill Site, Mokri, Tehri)
Sampling Coordinates	: Lat: 30.368499° Long: 78.474874°
Instrument Used	: Sound Level Meter
Instrument Code	: ECON/SLM/01
Instrument Calibration Status	: Calibrated
Meteorological condition during monitoring	: Clear Sky
Date of Monitoring	: 30/05/2024-31/05/2024
Time of Monitoring	: 11:54 PM to 11:50 PM
Ambient Temperature (°C)	: Min.25.0, Max.35.0
Surrounding activity	: Human & Vehicular Activities
Scope of Monitoring	: Regulatory Requirement
Control measure if any	: No
Sampling & Analysis Protocol	: CPCB Guideline & IS:9989:1981, RA2020
Parameters Required	: As per Work Order

Project Name: ADB Funded-Sustainable, Inclusive and Climate Resilient Tourism Development at Tehri Lake Area Project				
TEST RESULT				
S. No.	Parameters	Test Method	Test Results	Units
1.	Equivalent Noise Level (6.00 AM to 10.00 PM) Day Time	IS:9989:1981 RA2020	57.3	dB
2.	Equivalent Noise Level (10.00 PM to 06.00 AM) Night Time	IS:9989:1981 RA2020	51.5	dB
Requirement as per CPCB Guideline				
		Day	Night	
1.	Industrial Area, dB	75	70	
2.	Commercial Area, dB	65	50	
3.	Residential Area, dB	55	45	
4.	Silence Area, dB	50	40	



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 Contact No: +91-8534957815, 8126534344,
 Web: www.econlaboratory.com Email: uk@econlaboratory.com, econlab.consultancy@yahoo.in

TEST REPORT

Name & Address of client:	ULR No.	TC55072400000 3594F
M/s.IPE GLOBAL LIMITED	Reporting Date:	07/06/2024
B-84, Defence Colony,	Receipt Date:	03/06/2024
New Delhi-110024.	Period of Testing:	04/06/2024-07/06/2024
	Format No.:	7.8 F-01
	Party Reference No.:	PO.No.9840

SAMPLE DESCRIPTION

: AMBIENT NOISE MONITORING

General Information

Sample Collected by	: Lab Representative
Sampling Location	: PS-6 (Sandhra Village at Mahadev Temple)
Sampling Coordinates	: Lat: 30.395692° Long: 78.496666°
Instrument Used	: Sound Level Meter
Instrument Code	: ECON/SLM/02
Instrument Calibration Status	: Calibrated
Meteorological condition during monitoring	: Clear Sky
Date of Monitoring	: 31/05/2024-01/06/2024
Time of Monitoring	: 04:45 PM to 04:40 PM
Ambient Temperature (°C)	: Min.25.0, Max.35.0
Surrounding activity	: Human & Vehicular Activities
Scope of Monitoring	: Regulatory Requirement
Control measure if any	: No
Sampling & Analysis Protocol	: CPCB Guideline &IS:9989:1981, RA2020
Parameters Required	: As per Work Order

Project Name: ADB Funded-Sustainable, Inclusive and Climate Resilient Tourism Development at Tehri Lake Area Project				
TEST RESULT				
S. No.	Parameters	Test Method	Test Results	Units
1.	Equivalent Noise Level (6.00 AM to 10.00 PM) Day Time	IS:9989:1981 RA2020	45.8	dB
2.	Equivalent Noise Level (10.00 PM to 06.00 AM) Night Time	IS:9989:1981 RA2020	42.6	dB
Requirement as per CPCB Guideline				
		Day	Night	
1.	Industrial Area, dB	75	70	
2.	Commercial Area, dB	65	50	
3.	Residential Area, dB	55	45	
4.	Silence Area, dB	50	40	

Appendix 10. Surface Water Quality Monitoring Report



ECON Laboratory and Consultancy

(ISO: 9001, 14001, 45001, NABL Accredited and CPCB Recognized Lab)
 Vill: Khabarwala, P.O.: Jaintanwala, Near Garhi Cantt., Dehradun, And Uttarakhand-248003
 Contact No: +91-8534957815, 8126534344,
 Web: www.econlaboratory.com, Email: uk@econlaboratory.com, econlab.consultancy@yahoo.in

TEST REPORT

Name & Address of client:		ULR No.	TC550724000003595F
M/s.IPE GLOBAL LIMITED B-84,Defence Colony, New Delhi-110024.		Reporting Date:	07/06/2024
		Date of sampling:	28/05/2024
		Receipt Date:	03/06/2024
		Period of Testing:	04/06/2024 to 07/06/2024
		Sample Collected By:	Mr. Himanshu Rana
Sample Description		Sample Type:	Composite
Sample Location:		Preservation:	Refrigerated
Latitude:		Format No.:	7.8-F-01
Sample Quantity:		Longitude:	78.438407 ⁰
Sampling Protocol:		Party Reference No.:	PO.No.:9840
Sample Quantity:		Parameter Required:	As Per work Order

Project Name: ADB Funded-Sustainable, Inclusive and Climate Resilient Tourism Development at Tehri Lake Area Project						
TEST RESULTS						
S. No.	Parameters	Test Method	Results	Limit of as per IS: 10500:2012 with amd. 1,2,3&4 Reaff.2018		Units
				Acceptable Limit	Permissible Limit	
1.	pH (at 25°C)	IS:3025 (P-11)2022 Electrometric Method	7.53	6.5-8.5	No Relaxation	NA
2.	Color	IS 3025 (P-4) 2021, Platinum cobalt (visual comparison method)	< 5.0	5.0	15.0	Hazen
3.	Temperature	IS:196 Amend.1	20.2	N/A	N/A	°C
4.	Odor	IS 3025 (Part-7) 2017	No Smell	Agreeable	Agreeable	NA
5.	Chloride as Cl	IS 3025 (P-32)1988, RA 2019 Argentometric Method	7.4	250	1000	mg/l
6.	Total Dissolved Solids	IS 3025 (P-16)2023 Gravimetric method	106.0	500	2000	mg/l
7.	Sulphate as SO ₄	IS 3025 (P-24/ Sec-1) 2022 Turbidity method.	15.2	200	400	mg/l
8.	Dissolved Oxygen	APHA- 23rd ED-4500-OC Winkler Method with Azide Modification	10.3	N/A	N/A	mg/l
9.	BOD (BOD for 3 days at 27°C)	IS-3025 (P-44)1993,RA2019	< 5.0	N/A	N/A	mg/l
10.	Total Suspended Solid	APHA 23rdEdi.2017 -2540 B,Gravimetric Method	46.8	N/A	N/A	mg/l
11.	Total Kjeldahl Nitrogen	APHA 24th Edn.4500 Norg.B	3.28	N/A	N/A	mg/l
12.	Ammonical Nitrogen(NH ₃ N)	APHA 24th Edn.4500 NH3.B	0.14	N/A	N/A	mg/l

ULR No. TC550724000003595F						
S. No.	Parameters	Test Method	Results	Acceptable Limit	Permissible Limit	Units
13.	Fluoride as F	APHA 23 rd Edi.2017, 4500 F-D SPADNS Method	** BDL (#DL-0.5)	1.0	1.5	mg/l
14.	Nitrate as NO ₃	IS:3025 (P-34) 1988, RA 2019, (a)Chromotropic acid method	0.13	45	No relaxation	mg/l
15.	Zinc as Zn	IS:3025(P-49)1994, RA2019, (b)Atomic Absorption Method	** BDL (#DL-0.07)	5	15	mg/l
16.	Copper as Cu	IS 3025(P-42)1992, RA2019, (b)Atomic Absorption Method	** BDL (#DL-0.02)	0.05	1.5	mg/l
17.	Manganese as Mn	IS:3025(P-59) 2023 (b)Atomic Absorption Method	** BDL (#DL-0.10)	0.1	0.3	mg/l
18.	Cadmium as Cd	IS:3025(P-41)2023 (b)Atomic Absorption Method	** BDL (#DL-0.001)	0.003	No relaxation	mg/l
19.	Lead as Pb	IS:3025(P-47)1994, RA2019, (b)Atomic Absorption Method	** BDL (#DL-0.001)	0.01	No relaxation	mg/l
20.	Selenium as Se	IS:3025(P-56)2003, RA2019, (b)Atomic Absorption Method	** BDL (#DL-0.01)	0.01	No relaxation	mg/l
21.	Arsenic as As	IS:3025(P-37) 2022 (b)Atomic Absorption Method	** BDL (#DL-0.01)	0.01	0.05	mg/l
22.	Mercury as Hg	IS:3025(P-48) 1994, RA 2019	** BDL (#DL-0.01)	0.001	No relaxation	mg/l
23.	Free Ammonia	IS:3025(P-34);Sec-4	0.051	0.5	No relaxation	mg/l
24.	Oil & Grease	APHA 24 th Edn.5520B,Partition Gravimetric Method	** BDL (#DL-2.0)	N/A	N/A	mg/l
25.	Chromium (as Cr6+)	IS 3025 (P-52) 2003,RA 2019 Diphenylcarbazide method,	** BDL (#DL-0.001)	N/A	N/A	mg/l
26.	Iron(as Fe)	IS 3025 (P-53) 2003, RA 2019, 1,10 Phenanthroline Method	** BDL (#DL-0.05)	1.0	No relaxation	mg/l
27.	Phosphate(as PO ₄)	APHA 24 th Edn.4500PD,Stannous Chloride Method	0.18	N/A	N/A	mg/l
28.	Chemical Oxygen Demand	APHA 23 rd Edi.2017.5220B, Open Reflux Method	5.4	N/A	N/A	mg/l
29.	Sulphide (as H ₂ S)	IS:3025(P-29)	** BDL (#DL-0.05)	0.05	No relaxation	mg/l
Microbiological Parameter						
30.	Total Coliform	IS: 15185:2016, RA2021	Absent	Shall not be detectable in any 100 ml sample		ml

TEST REPORT

Report						
No.EC/SW/2405/3595						
S. No.	Parameters	Test Method	Results	Acceptable Limit	Permissible Limit	Units
31.	Cyanide as CN	APHA 23 rd Edi.2017, 4500 F-D SPADNS Method	**BDL (#DL-0.02)	0.05	No relaxation	mg/l
32.	Phenolic Compound	IS:3025 (P-34) 1988, RA 2019, (a) Chromotropic acid method	**BDL (#DL-0.001)	0.001	0.002	mg/l
33.	Anionic Detergents as MBAS	IS:3025(P-55)2003, RA2019	**BDL (#DL-0.05)	0.2	1.0	mg/l

***BDL: Below Detected limit, DL: Detection Limit, N/A: Not Applicable.

End of Report]

Water Quality monitoring results at the upstream of Tehri dam

S. No.	Parameter (Units)	Results	Acceptable Limits (IS:10500-2012)	Permissible Limits (IS:10500-2012)
1	Air Temp. (°C)	16.1	Recovery	
2	Water Temp. (°C)	14.4		
3	Colour (Hazen units)	17	5	15
4	Odour	Agreeable	Agreeable	Agreeable
5	Taste	Agreeable	Agreeable	Agreeable
6	pH	7.1	6.5-8.5	6.5-8.5 (No relaxation)
7	Turbidity (NTU)	1.84	1	5 (Relaxation)
8	Conductivity (µS/cm)	284		
9	ORP (mV)	197		
10	Secchi Depth (m)	1.5		
11	UV-Absorbance (350 nm) (mg/m ³)	0.044		
12	Chlorophyll (mg/m ³)	0.14		
13	Total Coliform (MPN/100 ml)	10U	Not detected in any 100 ml sample	
14	Fecal Coliform (MPN/100 ml)	ND		
15	TSS (mg/L)	8	500	2000
16	TDS (mg/L)	62	500	2000
17	Total Alkalinity as CaCO ₃ (mg/L)	200	200	600
18	Total Hardness as CaCO ₃ (mg/L)	38	200	600
19	Magnesium as Mg (mg/L)	20	30	100
20	Calcium as Ca (mg/L)	10	75	200
21	Chloride as Cl (mg/L)	15	250	1000
22	Nitrogen as NO ₃ (mg/L)	0.65	45	100
23	Iron as Fe (µg/L)	48.6	300	No relaxation
24	Sodium (mg/L)	6.5	200	400
25	Potassium (mg/L)	3.4	12	200
26	Total Organic Carbon (TOC) (mg/L)	2.391	10	25
27	Total Nitrogen (mg/L)	1.93	10	20
28	Dissolved Oxygen (DO) (mg/L)	8.4	6	5
29	Silica as SiO ₂ (mg/L)	3.41	30	100

Water Quality Monitoring Results (Secondary Data)

Source of data is from THDC. The locations of the SW2 and SW3 stations are shown in the map below this matrix.

Parameter + Unit	SW2	SW3	IS 10500:2012 Standards Acceptable	IS 10500:2012 Standards Permissible
Color (Hazen)	<1.0	<1.0	5	15
pH (-)	7.23	7.88	6.5 - 8.5	-
Turbidity (NTU)	<1.0	<1.0	1	5
Total Dissolved solids (mg/l)	480	480	500	2000
Aluminium (as Al) (mg/l)	<0.01	<0.01	0.03	0.03
Total Ammonia (mg/l)	<0.10	<0.10	0.5	1.5
Anionic Surface Detergents (as MBAS) (mg/l)	<0.10	<0.10	0.2	1
Barium (as Ba) (mg/l)	<0.10	<0.10	0.7	1.2
Boron (as B) (mg/l)	<0.10	<0.10	0.5	1
Calcium (as Ca) (mg/l)	65.23	52.21	75	200
Chloramines (as Cl ₂) (mg/l)	<1.00	<1.00	0.2	1
Chloride (as Cl) (mg/l)	48.18	20.19	250	1000
Copper (as Cu) (mg/l)	<0.05	<0.05	0.05	1.5
Fluoride (as Fu) (mg/l)	0.68	0.47	1	1.5
Free Residual Chlorine (mg/l)	<0.1	<0.1	0.2	1
Iron (as Fe) (mg/l)	0.34	0.164	0.3	1
Magnesium (as Mg) (mg/l)	23.06	35.8	30	100
Manganese (as Mn) (mg/l)	<0.1	<0.1	0.1	0.3
Mineral Oil (mg/l)	<0.50	<0.50	0.01	0.03
Nitrate (as NO ₂) (mg/l)	3.12	4.08	45	No Relaxation
Selenium (as Se) (mg/l)	<0.01	<0.01	0.01	No Relaxation
Silver (as Ag) (mg/l)	<0.05	<0.05	0.1	No Relaxation
Sulphate (as SO ₄) (mg/l)	27.5	28.46	200	400
Sulphide (as H ₂ S) (mg/l)	<0.05	<0.05	0.05	No Relaxation
Total Hardness (mg/l)	310	198	300	600
Zinc (as Zn) (mg/l)	278	202	5	15
Cadmium (as Cd) (mg/l)	0.24	0.25	0.003	No Relaxation
Cyanide (as CN) (mg/l)	<0.001	<0.001	0.05	No Relaxation
Lead (as Pb) (mg/l)	<0.01	<0.01	0.01	No Relaxation
Mercury (as Hg) (mg/l)	<0.01	<0.01	0.001	No Relaxation
Molybdenum (Mo) (mg/l)	<0.001	<0.001	0.07	No Relaxation
Nickel (as Ni) (mg/l)	<0.05	<0.05	0.02	No Relaxation

Parameter + Unit	SW2	SW3	IS 10500:2012 Standards Acceptable	IS 10500:2012 Standards Permissible
Polynuclear Aromatic Hydrocarbons (mg/l)	<0.001	<0.001	0.002	No Relaxation
Polychlorinated Biphenyl (mg/l)	<0.001	<0.001	0.0001	No Relaxation
Arsenic (as as) (mg/l)	<0.0001	<0.0001	0.01	No Relaxation
Total Chromium (as Cr) (mg/l)	<0.01	<0.01	0.05	No Relaxation



Location for water quality monitoring stations

Appendix 11. Guidelines for Construction Plant Establishment

64. Purpose

- To ensure that statutory / regulatory requirements are complied with
- To ensure that safeguard measures are taken to avoid / mitigate / minimize environmental impacts

65. Site selection criteria

Following criteria are to be met wherever possible for crusher and HMP:

- 1.5 km away from settlement, school, hospital on downwind directions
- 1.5 km from any archaeological site
- 1.5 km from ecologically sensitive areas i.e. forest, national park, sanctuary etc.
- 1.5 km from rivers, streams and lakes
- 500 m from ponds
- 250 m from State and National Highway boundary
- No hot mix plant or other source of air pollution (especially dust pollution) within the degraded airshed for particulate matter (SPM/PM10).
- away from agricultural land
- preference to barren land

Concrete batching plant should be located at least 200 m from the settlement, preferably on the leeward side, whenever possible.

The format for submission of details to the Engineer during finalization of plant site is given as follows (Site identification for Plants).

66. Statutory Requirements

- Obtaining Consent-for-Establishment (CFE) under Air and Water Acts from the Uttarakhand State Pollution Control Board (UKPCB) before start of installation
- Obtaining Consent-for-Operation (CFO) under Air and Water Acts from the UKPCB before start of commissioning and trial run
- Complying with the terms and conditions laid down in the CFE and CFO, which generally include providing metallic road inside plant campus for movement of vehicles, plantation, periodic (monthly) pollution monitoring i.e. ambient air, noise and stack emission
- The suspended particulate matter contribution value at a distance of 40 m from a controlled isolated as well as from a unit located in a cluster should be less than 600 g/m³ or as shall be prescribed by UKPCB.
- Obtain certificates from manufacturer for Type Approval and Conformity of Production for Diesel Generator (DG) set/s.
- For DG sets of capacity up to 1000 kVA, the noise level at 1 m from the enclosure surface shall not exceed 75 dB (A).

67. Pollution control measures

- Dust control measures in stone crusher plant i.e. water sprinkling at primary crusher and secondary crusher, conveyor and return belts, covered conveyor system, chute at outfall of aggregates, cyclone separator, wind braking wall etc.

- For HMP, ensure adequate stack height as stipulated in CFE, install emission control devices such as bag house filters, cyclone separators, water scrubbers etc., as attached with the plant by the manufacturer or stipulated in CFE.
- Prefer bulk bitumen storage with mechanized handling facilities that storage in drums with manual operation at HMP to prevent / minimize bitumen spillage and thereby contaminating soil and ground water.
- Impervious platform for storage of bituminous and other liquid hazardous chemical
- Bag house filter / multi-cone cyclone for emission control. For bag house, cartridge filters reported to be more efficient than fabric filters
- Pollution control measures for Diesel Generator (DG) set i.e. stack height, acoustic enclosure etc.
- Greenbelt along the periphery of plant site.

SITE IDENTIFICATION FOR PLANTS

Construction Stage Report: One Time Date:

Installed Capacity (tph): Location of Plant (Ch. and offset):

Sl. No.	Item / Requirement	Details as per Actual
1	Predominant wind direction	
2	Size and area of the proposed plant site (m xm and Sq.m)	
3	Present land use (barren or fallow land having no prominent vegetation should be preferred)	
4	No dwelling units within 1.5km from the plant boundary in downwind direction	
5	Distance of nearest boundary of State Highways and National Highways (should be at least 250 m from the plant boundary)	
6	Sensitive areas such as religious places, schools/educational institutions, reserved / protected forest, sanctuary etc. within 1.5 km (should be nil)	
7	River/Stream/Lake within 1.5 km and ponds within 500 m	
8	No other trees of girth>0.3m present and will be affected (no tree should be affected)	
9	Width of Haul Road (m)	
10	Total Length of Haul Road (km)	
11	Length of non-metal Haul Road (km) (should be as minimum as possible)	

Documents to be attached:

Site plan showing wind direction, haul road and other environmental features.

Certified that the furnished information is correct and all relevant information as required is attached.

Contractor:

Appendix 12. Guidelines for Camp Site Establishment and Operations

68. **Purpose:** Campsite of a contractor represents the single potentially most polluting location during implementation of any road project. Air pollution may be caused by emissions from Crushers, HotMix, and Concrete Batching Plants. Water pollution may be caused by discharge of sediment, oil and grease, and organics laden run-off from these plants and their ancillary facilities as well as workshops, residential quarters for the labor. Land may be polluted due to indiscriminate disposal of domestic waste or (accidental) release of hazardous solids from storage areas.

69. While the installation and operation of Crushers and Hot-Mix Plants are regulated by the respective Pollution Control Boards, the other sources described above usually do not appear to be causes of significant concern. Items to be considered for labor camps are mentioned briefly in Clause 105.2 (as part of 105: Scope of Work) of the Ministry of Road Transport and Highways (MoRTH) publication: Specifications for Road and Bridge Works. Some specific requirements for labor accommodation and facilities are to be met by the Contractor in line with Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996.

70. Currently, there is no one-point guidance regarding the environmental management aspects of the Contractor's campsite. This guideline on Campsites is designed to fill this gap.

71. **Scope:** This guideline covers the Contractors' camp sites – whether used by in-house crew or by any sub-contractors' crew. It covers siting, operation, maintenance, repair and dismantling procedures for facilities for labor employed on project (and ancillary) activities as well as equipment and vehicles. ***It does not include siting, operation, maintenance, repair and dismantling of major plants – Hot-mix Plant, Concrete Batching Plant, Crusher or Wet Mix Macadam Plant.***

Siting, Establishing, Operation and Closure of Construction Camp

72. **Potential Environmental Impacts:** Construction camps require large areas for siting facilities like major plants, storage areas for material, residential accommodation for construction labor and supervisors, and offices. Removal of topsoil and vegetation from the land to be utilized for camps is the first direct impact of any such establishment. In addition, local drainage may be impaired if proper drainage is not effected by grading. Other impacts may include damage to ecologically important flora and fauna, if campsites are located close to such areas. Water pollution because of discharge of sediment, fuel and chemicals is also a possibility. Pollution of land due to indiscriminate disposal of construction wastes including scarified pavement, concrete and even substantial quantities of domestic wastes from residential areas can also be potentially disastrous, especially if the site is reverted to its original use after the project (mostly agriculture).

73. **Mitigation Measures - Siting of Construction Camps:** The following guidelines will assist the Contractor to avoid any environmental issues while siting construction camps:

- Maintain a distance of at least 1.5 km from boundaries of designated Reserved Forests, Sanctuary or National Park area for locating any temporary or permanent camps.
- Maintain 1.5 km from river, stream and lake and 500m from ponds
- Maintain 250 m from the boundary of state and national highways
- Locate facilities in areas not affected by flooding and clear of any natural or storm water courses.
- Locate campsites in the (most prevalent) downwind direction of nearest village(s). The boundary of the campsite should be at least 1.5 km from the nearest habitation so that the incoming labor does not stress the existing local civic facilities.

- The ground should have gentle slope to allow free drainage of the site.
- Recorded consultations should be held with residents of the nearest settlement and/or their representatives to understand and incorporate where possible, what they would like to see within their locality.

74. **Establishment, Operation, and Closure of Camps**

- The facilities within the camp site should be laid out so that the separation distances suggested in other guidelines are maintained. A notional lay-out of the facilities except the major plants is included in this guideline.
- Topsoil from the area of the plant shall be stored separately for the duration of the operation of the camp and protected from being washed away, unless agreed otherwise in writing with the owner. If stored, it will be returned on to its original location at the time of closure of the site.
- The Contractor shall prepare, make widely available (especially to staff responsible for water and material management), and implement a Storm water Management Plan (SWMP) for (all) the site(s) following approval of the same by the Engineer. .
- The Contractor shall prepare an Emergency and Spill Response Plan as per the requirements of Appendix 1 to Clause 501 of Specifications for Road and Bridge Works to cover the spillage of bitumen and/or chemicals like retarders, curing compounds, etc.
- The Contractor shall prepare a Waste Management Plan describing the types and quantities that are likely to be generated from within the camp site, with the period and duration during the construction schedule; methods to be adopted to minimize these; methods of removal, treatment and (on-site or off-site) disposal for each type; as well as location of final disposal site, if any.
- The Contractor shall provide safe ingress and egress for vehicles from the site and public roads and shall not impact existing through traffic.
- Water tankers with sprayers must be available at the camp site at all times to prevent dust generation.
- In case of stockpiles of stored material rising higher than wind-breaking perimeter fencing provided, sprinklers shall be available on site to prevent dusting from the piles during windy days.
- On completion of works, the Contractor shall restore the site to the condition it was in before the establishment of the campsite, unless agreed otherwise in writing with the owner(s) of the site(s). If such a written agreement has been made, the Contractor shall hand over the site to the owner(s) in accordance with such an agreement.
- Construction waste disposal should be disposed only at landfill facilities which are selected, designed, constructed and operated to ensure environmentally safe disposal, and these facilities have to be approved by the regulators.

75. **Equipment and Vehicle-related issues**

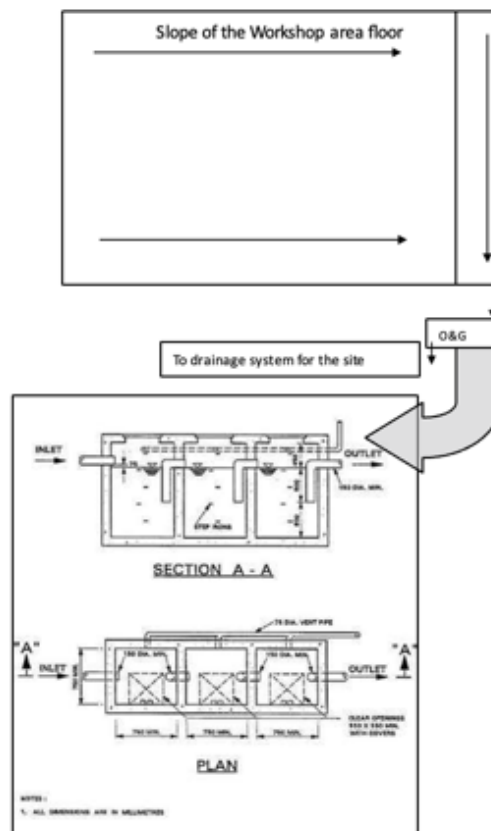
76. **Potential Environmental Impacts:** The maintenance and repair of equipment and vehicles in Contractor's camp are activities that can have significant adverse impacts if not carried out properly. The concern mainly arises from discharge of wash water contaminated with oil and grease, whether from washing of vehicles or degreasing of equipment and vehicle parts. Vehicle washing, especially dirt from tires, also gives rise to sediment-laden run-off. No such discharges should be directly allowed into surface water bodies since they can be harmful to aquatic species.

77. Mitigation Measures - Vehicles :

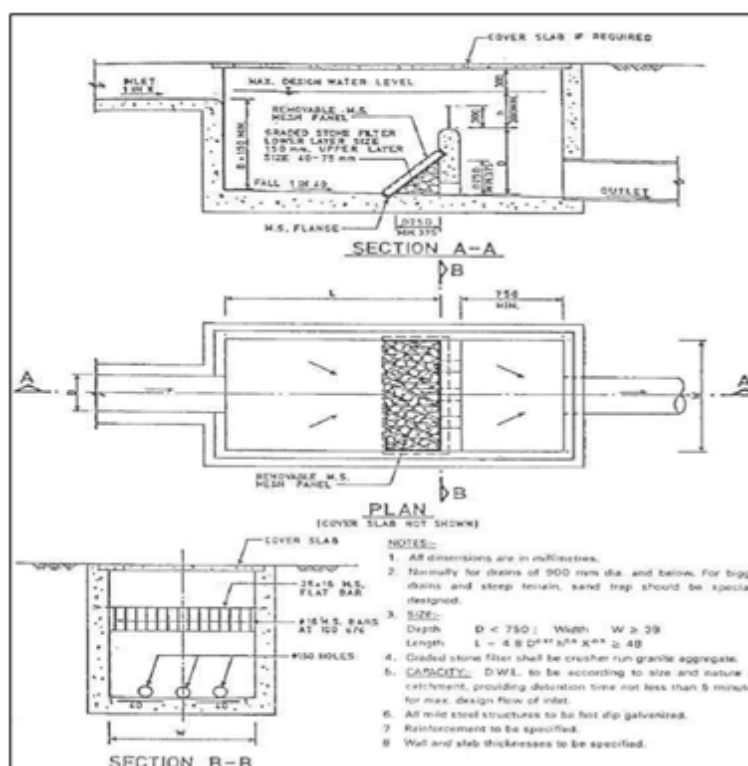
- All vehicles used by the Contractor must have copies of currently valid Pollution Under Control Certificates displayed as per the requirement of the Motor Vehicles Department for the duration of the Contract.
- All vehicles and equipment will be fitted with silencers and/or mufflers which will be serviced regularly to maintain them in good working condition and conforming to the standard of 75dB (A) at 1m from surface of enclosure.

78. Mitigation Measures - Workshop and Maintenance areas :

- These areas must have impervious flooring to prevent seepage of any leaked oil and grease into the ground. The area should be covered with a roof to prevent the entry of rainwater.
- The flooring shall be sloped to from both directions to one corner where an oil-and grease trap with sufficient capacity should be installed. All discharges from the workshop area must pass through the trap to remove the floating oil and grease before entering the drainage system of the site. The trap should be designed to provide a hydraulic residence time of about 20 minutes for the peak hourly discharge anticipated from the area (as per following figure).
- Alternatively, degreasing can also be carried out using mechanical spray type degreaser, with complete recycle using an enclosure with nozzles and two sieves, coarse above and fine below, may be used as shown in the adjacent photograph. This arrangement will require some initial investment and running cost for the pump, but the payback period, in terms of the use of diesel, under Indian conditions, has been reported to be less than 1 year.



- All the waste oil collected, from skimming of the oil trap as well as from the drip pans, or the mechanical degreaser shall be stored in accordance with the Environment Protection (Storage and Disposal of Hazardous Wastes) Rules, 1989. For this purpose, metallic drums should be used. These should be stored separately in sheds, preferably bunded. The advantage of this arrangement is that it allows for accurate accounting in case the waste material is sold to oil waste recyclers or other users like brick-kiln owners who can burn such inferior fuel.
- A separate vehicle washing ramp shall be constructed adjacent to the workshop for washing vehicles, including truck mounted concrete mixers, if any, after each day's construction is over, or as required. This ramp should have an impervious bottom and it should be sloped so that it drains into a separate chamber to remove the sediment from the wash water before discharge. The chamber should allow for a hydraulic residence time of about 10 minutes for discharge associated with the washing of each truck. Following Figure 71 shows an outline sketch for a sedimentation chamber.



Sedimentation Chamber for vehicle washing ramp discharge

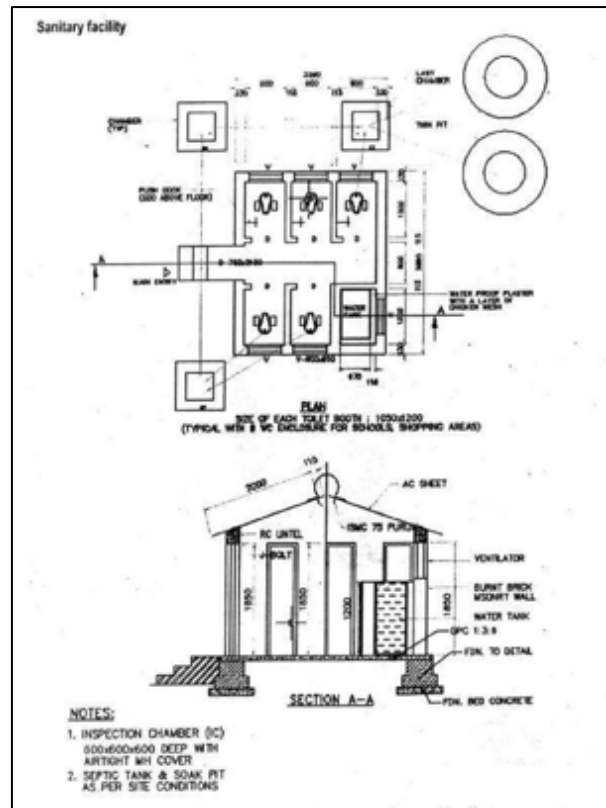
Facilities for Labour

79. **Potential Environmental Impacts:** The sudden arrival and relatively longer duration of stay of construction crew can cause substantial strain on the existing infrastructure facilities like water supply, sanitation and medical care, especially in rural areas. Pollution from domestic wastes can affect local sources of water supply and may harm the crew themselves as well as local residents. Improper sanitation and inadequate health care also potential bottlenecks that the Contractor can eliminate with relatively little effort.

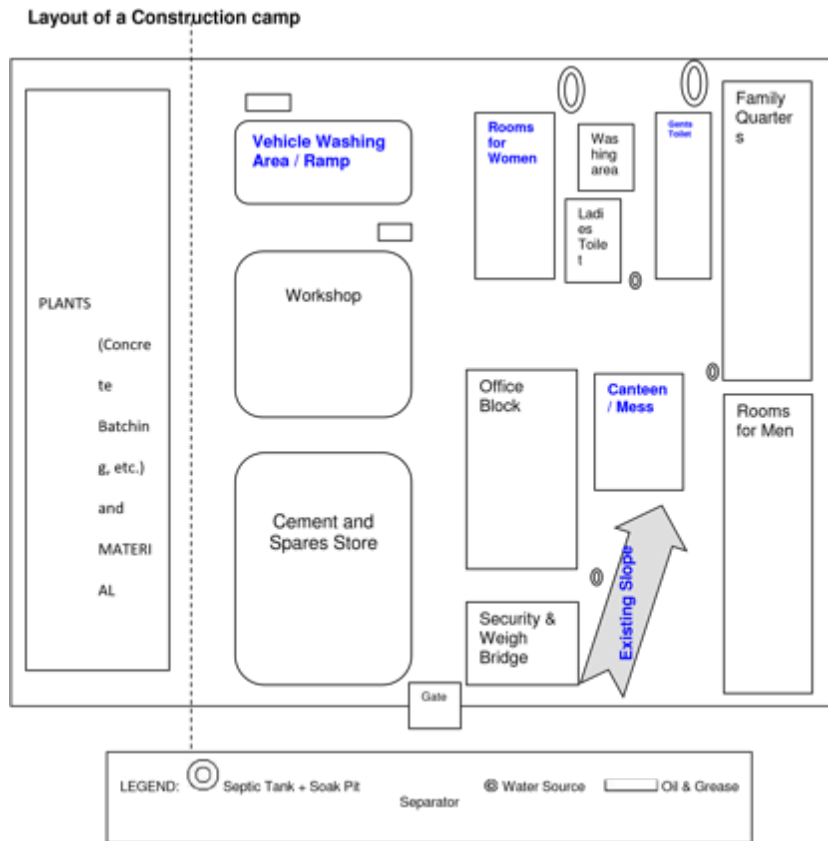
80. **Mitigation Measures:** It should be emphasized that the Indian Law requires that the Contractor provide several facilities to for the workers as per Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996. Some of the provisions

described herein are more stringent to act as benchmark for improved environmental performance of road projects:

- The contractor shall provide free-of-charge temporary accommodation to all the labor employed for the project. The accommodation includes separate cooking place, bathing, washing and lavatory facilities. At least, one toilet will be provided for every 35 people and one urinal will be provided for every 20 persons. More toilets and/or urinals may have to be provided if the Engineer decides that these numbers are insufficient. In case female labourers are employed, separate toilet and urinals will be provided in locations clearly marked “Ladies Toilets” in a language understood by most labourers.
- The contractor shall ensure the supply of wholesome water for all the labor, including those employed by any other agency working for the contractor. These locations will be marked “Drinking Water” in the language most commonly understood among the labor.
- In hot season, the contractor shall make efforts to ensure supply of cool water. No water point shall be located within 15 m of any washing place, urinal, or latrine.
- The contractor shall ensure that adequate cooking fuel, preferably kerosene or LPG, is available on-site. The contractor will ensure that wood/ coal are not used as fuel on the site. Workers need to be made aware of this restriction. In cases where more than 250 labors are employed, canteen facility should be provided by the Contractor.
- A crèche must be provided in each campsite where more than 50 female labourers are employed, whether directly or indirectly, for the project or its ancillary activities.
- Contractor must provide adequate facilities for first-aid treatment at the campsite. A doctor / ambulance should be available on call for the duration of project implementation.
- The contractor shall obtain the approval of the Engineer for these facilities within 30 days of mobilization.



Typical drawing of workers' camp sanitary facility



Layout of construction camp

Appendix 13. Guidelines for Debris Disposal

A. Purpose

- To maximize re-use of material generated during construction and
- To avoid environmental hazards due to improper disposal of construction waste material.

B. Procedure

81. The following procedures should be followed for upkeep of storage and disposal sites:

- Contractor shall maintain register for keeping records on kilometer-wise quantities of material generated during grubbing, stripping, excavation and scarifying;
- Contractor shall re-use construction material to the extent possible based on engineering properties. Possible re-use areas are fill sections, embankment slope, village approach roads etc. Debris without bitumen could be used for backfilling of quarry / borrow areas as recommended by the Engineer. At locations identified for dumping of residual bituminous wastes, the dumping shall be carried out over a 60mm thick layer of rammed clay so as to eliminate the possibility of the leaching of the wastes into the ground water. The contractor shall ensure that the filled area is covered with a layer of preserved topsoil layer of preserved topsoil.
- Contractor shall estimate the chainage-wise quantities of various waste material to be disposed of;
- Contractor shall restrict waste disposal strictly at approved site/s only;
- Contractor shall prepare a plan including detailed lay out plan and cross-section for disposal of debris and bitumen waste and get approval of the same by the Engineer;
- Bentonite slurry or similar debris generated from pile driving or other construction activities shall be disposed such that it does not flow into the surface water bodies or form mud puddles in the area;
- Contractor and Engineer shall ensure that disposal areas are properly treated as per agreed plan;
- Contractor and Engineer's representatives shall undertake joint weekly inspection to ensure compliance of various environmental requirements.
- Engineer's representatives shall issue non-compliance if disposal site is not managed as per agreed plan;
- All arrangement for transportation during construction including provision, maintenance, dismantling and clearing debris, where necessary will be considered incidental to the work and should be planned and implemented by the contractor as approved and directed by the SC.
- Construction waste disposal should be disposed only at landfill facilities which are selected, designed, constructed and operated to ensure environmentally safe disposal, and these facilities have to be approved by the regulators.

C. Site Inspection

82. Weekly joint site inspection shall be undertaken for all the storage areas. The details of attributes, which are to be inspected, are given as follows. The Contractor shall ensure compliance of the requirements.

Details to be inspected for Monitoring Construction Material Reuse and Disposal

Attributes	Requirements
Construction material generation and re-use	• Segregating debris and bitumen during generation; • Segregating re-usable portion of debris and bitumen and storing preferably near areas of re-use; and • Temporary storage of waste material at sites as directed by the Engineer.
Waste disposal	• Disposal of waste material at approved disposal site within a week of generation; • Disposal site should be properly demarcated; • Proper levelling / grading at disposal site/s; • Recommended / agreed safeguard measures to avoid ground water contamination by leachate from disposal of scarified material are to be implemented; • Recommended / agreed safeguard measures to avoid soil erosion are to be implemented; • Recommended / agreed plan for surface treatment of waste disposal site/s are to be implement.

Appendix 14. Muck Disposal Plan

83. The muck disposal plan outlined herein serves as a critical component of our broader project management strategy. With a focus on safety, environmental responsibility, and efficiency, this plan details our approach to managing excavation materials throughout the project lifecycle.

84. The primary objective of our muck disposal plan is to ensure the safe and responsible handling of excavation materials while minimizing environmental impact. Key goals include:

- Identifying suitable disposal sites compliant with local regulations.
- Implementing efficient transportation methods to minimize costs and emissions.
- Exploring opportunities for recycling and reuse to promote sustainability.
- Maintaining a transparent and proactive communication process with stakeholders.

Quantity of Muck Generated and its Consumptive Use

85. During the construction of the Tourism Road, muck is generated both from Cutting and Filling of Hill. Total quantity of muck/debris, generated due to the project, shall be 1515805 cum. Out of the total muck generated is 640500 cum.

Selection of Muck Utilization Site

86. The Site Selection of Muck is 1 Per Km. So, total muck generated location will be 15 for the 15-km Tourism Road.

87. The Calculation of muck disposal is as under:

Cutting Volume= 1515805 m³

Muck Volume= 640500 m³

Assuming Per Km 1 Muck Disposal Location is Proposed

So, for 15.7 Km No. of Muck Disposal Location will be = 15

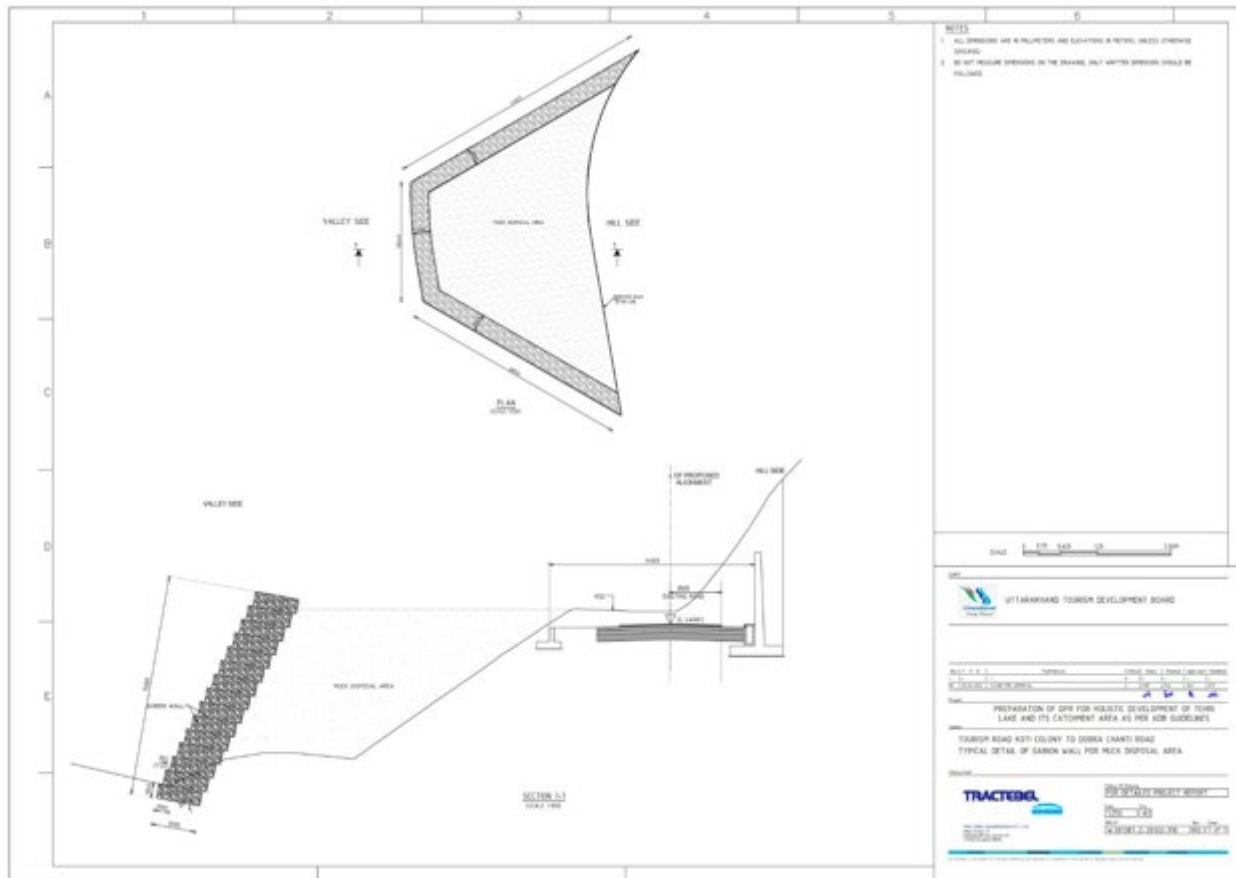
Per Muck Volume Required (Capacity of Muck)= 42700.2 m³

Assuming Height of Muck Disposal is = 15 m

Area of Muck Disposal Will be = 2846.68

Assuming Width = 30 m

Length = 94.88933



Muck disposal site layout

Typical Uses of Stones, Rocks, and Reusable Debris from Road Construction Base and Sub-base Material for Roads:

- **Crushed Stone:**
 - Crushed stones and rocks can be used as base and sub-base material for road construction.
- **Gravel:**
 - Smaller stones and gravel can be used for the sub-base layer, which helps in drainage and reduces the risk of road surface deformation.

Gabions:

- Stones can be used to fill gabion baskets, which are wire mesh containers used for erosion control, retaining walls, and slope stabilization.

Landscaping and fencing:

- **Decorative Stone:**
 - Stones and rocks can be used in landscaping projects as decorative elements for gardens, pathways, and water features.
- **Stone Walls and Edging:**
 - Reusable debris can be used to construct stone walls for fencing.

Reclamation and Fill Material:

- Reclamation Projects:
 - Reusable debris can be used fill low-lying areas along the valley side of the road.
- Embankments:
 - Stones and rocks can be used to construct embankments of roads.

Recycled Construction Materials:

- Recycled Aggregate:
 - Debris from road construction can be processed and recycled into aggregates for use in new construction projects, reducing the need for virgin materials.
- Crushed Concrete:
 - Concrete debris can be crushed and reused as a substitute for gravel in various construction applications, including road bases and foundations.

Retaining Structures:

- Retaining Walls:
 - Larger rocks and stones can be used to construct retaining walls that support soil and prevent landslides on steep slopes.
- Terracing:
 - Stones can be used to create terraces on sloped land, which helps in soil conservation and provides level ground for agriculture or construction.

Foundation and Structural Fill:

- Structural Fill:
 - Stones and rocks can be used as structural fill material to provide a stable foundation for buildings, bridges, and other structures.
- Underpinning:
 - Reusable debris can be used in underpinning projects to strengthen and stabilize existing foundations.

Appendix 15. Guidelines for Borrow Area Establishment and Operations

88. **Purpose:** Borrow areas are generally required to provide material for road construction sites, can have significant adverse environmental effects, especially on ecologically sensitive areas. Borrow areas can become environmental hotspots and can significantly affect the visual appearance of an area. Special mitigation and management measures are often required to avoid or minimize the environmental and social impacts of borrow areas.

89. **Scope:** These guidelines for borrow areas cover:

- statutory approvals
- environmental and social impacts of borrow areas
- selection of borrow areas
- operation of borrow areas
- rehabilitation of borrow areas

90. The guidelines seek to ensure that Contractors:

- comply with the regulatory requirements in force at the time
- reasonably manage any impacts
- reinstate and rehabilitate the land appropriately
- consult with affected communities

91. **Impacts:** Some of the potential impacts of borrow areas are:

- trucks transporting materials to the site causing air pollution, and noise and vibrations
- ponds of stagnant water forming in excavated areas giving rise to the breeding of mosquitoes and the spreading of malaria and other mosquito-borne diseases
- natural beauty of the landscape being affected by excavations and the removal of vegetation
- natural drainage systems in the area being affected by excavations
- agriculture land and productive soils being lost, especially in paddy field areas

92. Borrow areas are not generally specified in Contract documents but rather it is generally the responsibility of Contractors to identify borrow areas and obtain the necessary consent from land owner and approval from SC.

93. In IRC: 10 and Clause 305.2.2.2 of MoRTH Specification, exclusive guideline has been given for borrow areas located alongside the road and only some of the requirements have been indicated for borrow areas located outside the road land. Following guideline is proposed to supplement the existing stipulation in IRC:10 and Clause 305.2.2.2 of MoRTH Specification for Roads and Bridge Works:

94. **Location**

- Identify areas having present land use as barren land, riverside land. Otherwise, un-irrigated agriculture land or land without vegetation and tree cover;
- Prefer borrow areas on bed of irrigation water storage tank;
- Prefer areas of highland with respect to surroundings;
- Avoid locating borrow area close to any road (maintain at least 30 m distance from ROW and 10 m from toe of embankment, whichever is higher);
- Should be at least 1.5 km away from inhabited areas;

- Maintain a distance of about 1.5km from ecologically sensitive area i.e. Reserve Forest, Protected Forest, Sanctuary, wetland etc.;
- Maintain a distance of about 1.5 km from school, hospital and any archaeological sites;
- Having adequate approach road with minimum length of earthen road;
- Ensure that unsuitable soft rock is not prominent within the proposed depth of excavation which will render rehabilitation difficult;
- Depth of excavation should be decided based on natural ground level of the land and the surroundings, and rehabilitation plan. In case higher depth of excavation is agreed with backfilling by unsuitable excavated soil (from roadway), then filling should be adequately compacted except topsoil which is to be spread on topmost layer (for at least 20cm thick).

95. **Operation**

- Controlled operation as per agreed / approved plan;
- Preservation of topsoil at designated areas e.g. corners of the area etc.;
- Maintain necessary buffer zone in all directions and go for vertical cut within this area. Final cut slope should be maintained within the buffer zone;
- Step-wise excavation if borrow area is located on inclined area having more than 2% slope;
- Restricting excavation up to 2m for each stages of operation if allowed depth is more;
- Avoid cutting of any tree of girth size > 30cm²². If any tree cutting is inevitable, prior permission (written) from the competent authority should be taken and compensatory plantation has to be raised.

96. **Rehabilitation**

- Prior approval of Rehabilitation Plan considering terrain, land use and local need;
- Restricting operation as agreed by landowner and approved by the Engineer;
- Rehabilitation within agreed timeframe and before taking over;
- Integrate debris disposal and borrow area redevelopment.

97. **Management Procedure**

98. The important aspects of this procedure are:

- The first and foremost thing is to have tentative estimate of borrow material requirement chainage-wise. For this, BoQ quantity for earth work, which is given as total quantity for the entire package/milestone, has to be distributed chainage wise. The requirement of borrow material chainage-wise then has to be estimated based on the suitability of roadway excavation material for reuse and BoQ.
- Contractor to site borrow areas fulfilling environmental requirements and obtaining one time approval of the Engineer both on quality as well as environmental consideration thereby integrating environmental safeguard measures into day-to-day activities;
- Contractor to submit environmental information in prescribed format for obtaining Engineer's approval, as given in the following format (Borrow Area Identification).
- The format has been so designed that it stipulates the requirements as well as what is actual for each borrow areas and could be easily understood by any person, whoever in-charge of identifying borrow areas;

²² Plant having girth size more than 30cm is considered as tree.

- Contractor to submit Borrow Area Layout Plan as attachment to the format showing the land use of the proposed and surrounding area along with the presence of other environmental features such as water bodies, forests, settlement, temple and any sensitive receptor i.e. health and educational institution, roads etc. within a radius of 1.5km area from the boundary of the borrow area;
- Contractor to prepare and submit Block Contour Map of each borrow area
- (especially which are located close to road and on undulating terrain) for deciding on operation and redevelopment plan;
- Contractor to prepare Operation Plan and submit as attachment to the format including cross sections on both directions (x,y) mentioning natural ground level, depth of topsoil (if any), total depth of excavation, cut side slope and bed slope;
- Contractor to prepare Redevelopment Plan and submit as attachment to the format include cross sections on both directions (x,y) mentioning natural ground level, excavated profile, finished profile after redevelopment etc.;
- Contractor to maintain Borrow Material Register;
- Periodic joint inspections of each borrow area until rehabilitation is complete as agreed and approved.
- The checklist for periodic inspection is given in this appendix.

99. **Borrow Areas Identification**

Construction Stage Report: One Time Date:

Location of Borrow Area (Ch. and Offset): Revenue Survey No.:

Borrow areas identification requirements

Sl. No.	Item / Requirement	Details as per Actual (to be filled by Contractor and checked by Engineer)
1	Date of Borrow Area planned to be operational	
2	Current Land use (preference to barren land, riverside land, otherwise, un-irrigated agriculture land or land without tree cover)	
3	Size (Sq.m) and area (m x m) of Borrow Area	
4	Proposed maximum depth of pit in m (IRC 10 and Clause 305.2.2 of MoRTH Spec.)	
5	Details of riverside borrow area (inner edge should not be less than 10m from the toe of the bank and bottom of pit should not cut the imaginary line of 1:4 from embankment top)	
6	Borrow area in cultivable land (should be avoided or restricted to total depth of 45cm including preservation of 15cm topsoil)	
7	Quantity Available (Cum)	
8	Quantity of topsoil to be removed (Sq.m and depth in cm)	
9	Details of preservation (storage) and management (re-use / re-laid) of topsoil	
10	Width of Haul Road (m)	
11	Total Length of Haul Road (km)	
12	Length of Non-metal Haul Road (should be as minimum as possible)	

Sl. No.	Item / Requirement	Details as per Actual (to be filled by Contractor and checked by Engineer)
13	No of settlements within 200 m of Non-metal Haul Road (should be as minimum as possible)	
14	Distance from settlement (should be minimum 1500 m)	
15	Should be away from water bodies. Give details of water bodies within 250 m.	
16	Details of water sources for dust suppression	
17	Quantity of water required for dust suppression i.e. sprinkling at borrow area and on haul road (Cum)	
18	Availability of water required for dust suppression (Cum)	
19	Details of ecologically sensitive area i.e. RF, PF, Sanctuary etc. within 1500m (should be nil)	
20	Details of school, hospital and any archaeological sites within 1500m (should be nil)	
21	Distance from nearby road embankment, fence line / boundary (should be minimum 30m from ROW and 10m from toe of embankment, whichever is higher)	
22	No of Trees with girth more than 0.3 m (No tree should be affected)	

Documents to be attached:

- 1) Site plan and layout plan of borrow area;
- 2) Proposed borrow area operation and redevelopment plan;
- 3) Written consent from competent authority for use of water for dust suppression
- 4) Written consent of landowner on agreed operation and redevelopment plan

Certified that the furnished information is correct and all relevant information as required is attached
Contractor's Representative:

Checklist For Monitoring Borrow Area Operation and Management

Attributes	Requirements
Access road	• Only approved access road shall be used
Topsoil preservation	• Topsoil, if any, shall be stripped and stored at corners of the area before start of excavation for material collection; • Topsoil should be re-used / re-laid as per agreed plan
Depth of excavation	• For cultivable (agriculture) land, total depth of excavation should be limited to 45 cm including top 15 cm for topsoil preservation; • For riverside borrow area, the depth of excavation shall be so regulated that the inner edge of any borrow pit should not be less than 10m from the toe of the bank and bottom of pit should not cut the imaginary line of 1:4 from embankment top; • If borrow area is located within 1500 m of towns or villages, they should not exceed 30 cm in depth and should be properly drained; • Borrow areas close to ROW should be rectangular in shape with one side parallel to center line of the road and depth should be so regulated that it should not cut an imaginary line having slope of 1 in 4 projected from the edge of the final section of the embankment.
Damage to surrounding land	• Movement of man and machinery should be regulated to avoid damage to surrounding land.

Attributes	Requirements
Drainage control	• The surface drainage in and around the area should be merged with surrounding drainage; • No water stagnation shall occur.
Dust suppression	• Water should be sprayed on <i>kutch</i>a (earthen) haul road twice in a day or as may be required to avoid dust generation during transportation of material; • Depending on moisture content, 0.5 to 1.5% water may be added to excavated soil before loading during dry weather to avoid fugitive dust emission.
Covering material transport vehicle	• Material transport vehicle shall be provided with tarpaulin cover
Personal Protective Equipment	• Workers should be provided with helmet, gumboot and air mask and their use should be strictly enforced.
Redevelopment	• The area should be redeveloped within agreed timeframe on completion of material collection as per agreed rehabilitation plan.

Appendix 16. Biodiversity Action Plan

100. **Overview:** This section presents the Biodiversity Action Plan (BAP), which outlines the mitigation measures/actions to ensure that the subproject will have no significant adverse impact on wildlife, and comply requirements in accordance with government rules and ADB's Safeguards Policy Statement 2009.

101. Conservation actions have been developed for concerns on biodiversity features as result of the proposed project implementation to ensure the application of the mitigation hierarchy i.e. avoid, reduce (minimize), remedy (restore) and offset. This will allow for the careful management of risk and the best possible outcomes for the project without compromising the health, function and integrity of the ecological system and biodiversity features. Following are the action proposed for protection of wildlife:

102. **Actions to avoid or minimize loss/degradation of habitats during construction:**

- Marking of subproject site's boundaries and disseminate information about civil work areas to construction staff and labors. Delineate clearing limits in the field using flagging or other means before any land disturbing activities, so only those areas needed to be cleared will be disturbed. Instruct construction workers that they are only authorized to cut or clear any vegetation within the designated clearing limits.
- With support from PIU and PMDSC, all construction workers and staff will be informed about areas supporting habitats and species of conservation value, why these features are important and what activities allowed and not permitted in WHS. This will include details of regulations to protect biodiversity as well as staff obligations to comply norms.
- Tree cutting shall be avoided for establishment of labor camp, material storage site, transferring of any machinery, equipment's and vehicles at subproject site.
- No objection clearance (NOC) for tree cutting to be obtained by project proponent before construction. However, contractor will support the proponent if any NOC to be obtained for cutting of additional tree during construction stage.
- Prohibition to collect firewood, plants etc. to minimize the impact on natural habitat.
- Select suitable area for material storage, quarries, borrow areas, spoil/muck disposal areas, construction laydown areas, access roads, and other facilities to minimize forest clearing and environmental impacts. The locations for material storage, quarrying areas, spoil deposits, muck disposal, construction laydown areas, roads, and other have all been selected based on the minimum likely ecological and environmental impacts.
- Speed limits will be imposed, which should also minimize the dust levels. Limit speeds for construction vehicles to 30 km/hr to minimize the generation of fugitive dust and to minimize the risk of wildlife strikes. All construction vehicles will be limited to designated access roads and the construction site with no off-road vehicle use will be permitted.
- The movement contractor vehicles across the subproject areas will be strictly monitored and drivers will be required to use designated roads only.
- Implement a Wildlife Shepherding Protocol before any land disturbing activities. This should involve an inspection of the land to be disturbed and identification of the presence of any wildlife species. Any slow-moving species (e.g., amphibians, reptiles, pangolins, and similar species) should be carefully captured by an experienced wildlife specialist and relocated to nearby habitat.

Timeline and Responsibility				
Start: before start of construction	End: Before start of construction	Frequency: Complete before start of construction at Site	Responsibility: Contractor	Supervision: PIU/PWD UJS

103. Actions to minimize loss/degradation/pollution of water bodies and impact on fish species population during project construction

- All construction staff should be informed about the importance of stream/river habitat and the importance of fish and aquatic species available in these streams. The Contactor will prepare and give this information as part of the staff inductions and will display relevant information and maps in the site offices.
- Contractor will be required to ensure provision of basic amenities of drinking water, adequate number of toilets/mobile or portable toilets, wash rooms, sanitation and cleanliness, at the labor camp to minimize the pollution, littering and dumping of wastes in the river
- Contractor will also ensure provision of septic tanks to treat wastewater discharged from labor camp. No discharge of untreated wastewater shall be allowed to enter in stream
- Contractor will ensure complete prohibition of fishing activities.

During Operations

Mitigation Measures for Water Transport:

- Establish no-boating zones within 100 meters around identified sensitive areas and spawning sites.
- Enforce a maximum speed limit of 5 km/h in sensitive areas and 10 km/h in the main navigation channels to reduce disturbance to aquatic species.
- Limit the number of motorized boats within designated areas, with permits issued on a first-come, first-serve basis.
- Impose a boating restriction from March to June, coinciding with the breeding and spawning season of key species like the Golden Masheer.
- Prohibit boating activities between 7 PM and 7 AM to reduce nocturnal disturbances.
- Install waste collection points along the lake shore and ensure boats are equipped with waste disposal units.
- Conduct monthly inspections of boats for compliance on government requirements.

Mitigation Measures for Water Abstraction:

- Use mesh screens with openings no larger than 2 millimeters to prevent the entry of juvenile fish and other small aquatic organisms into abstraction systems.
- Ensure water intake velocity is less than 0.5 meters per second to allow fish to swim away from the abstraction point.
- Conduct water quality monitoring at strategic locations within the lake on a bi-monthly basis to detect changes in parameters such as dissolved oxygen, pH, and turbidity.
- Maintain dissolved oxygen levels above 6 mg/L and pH levels between 6.5 and 8.5 for optimal fish health.
- Establish a 50-meter radius buffer zone around each water abstraction point, within which no fishing, boating, or other activities are allowed.

- Limit water abstraction to less than 10% of the lake's total volume during the dry season and avoid abstraction during March-June (breeding season of Golden Mahseer).

Timeline and Responsibility				
Start: before start of construction	End: Till end of the construction	Frequency: On regular basis during construction	Responsibility: Contractor	Supervision: PIU/TADA

104. **Action Plan for Protection of Terrestrial and Avi-Fauna (Birds)**

- This will involve awareness program for contractor and construction staff on the conservation importance of protected Mammals, Reptiles and Amphibia Species and the national legislation (Wildlife Protection Act 1972) protecting them, including the fines and provision of imprisonment that are imposed on those who violate the law. Appropriate information will be given to all staff as part of their site induction and display of leaflets will be displayed in site offices.
- Avoid tree clearance in the breeding season for priority species (if any) reported and to undertake mitigation
- The time excavations and trenches are left open will be minimized or to be barricaded to avoid mammals and reptiles being trapped and injured.
- All the equipment likely to generate high noise shall be appropriately enclosed or inbuilt noise enclosures be provided so as to meet the ambient noise standards as notified under the Noise Pollution (Regulation and Control) Rules, 2000, as amended in 2010 under the Environment Protection Act (EPA), 1986
- Proper guideline should be issued so that noisy equipment's are not operated during the night time.
- Undertake maintenance of the equipment as simple maintenance can reduce noise levels. All stationary noise generating equipment's such power generators etc. should be used away from the biodiversity sensitive area.
- Movement of vehicles should be restricted to working hours only.
- The DG set should also be provided with proper exhaust muffler with insertion loss of minimum 25 dB(A).
- Restriction on pressure horns.

105. **Reporting and Communication:**

- PIU (TADA and PWD) will document all activities, observations, and mitigation measures in detail.
- Submit regular reports to wildlife authorities and other stakeholders including ADB.
- Secure necessary permits and approvals (if any) from relevant authorities before implementing any actions.

106. **Implementation of BAP**

107. Construction contractor will be responsible for ground-level implementation of BAP measures suggested in the EHSMP. Environmental Health and Safety Officer (EHSO) who will look after day-to day implementation of EHSMP and safeguard compliance will also be responsible for

implementation of BAP. EHSO will work with Environmental Specialist of PMU. EHSO of contractor will maintain records of BAP implementation and submit the progress to the PIUs as part their monthly progress reports on environment safeguard monitoring report.

108. Monitoring and Evaluation

109. Successful BAP requires continuous monitoring of its actions and periodic evaluation of their effectiveness complying the BAP conservation objectives and timeline. These monitoring activities need to be undertaken during construction and post construction period by PIUs . Outcomes of BAP implementation and monitoring should be reflected by PIUs in their environmental progress and monitoring reports to PMU.

Appendix 17. Sample Environmental Site Inspection Checklist

Project Name _____

Contract Number _____

NAME: _____ DATE: _____

TITLE: _____ DMA: _____

LOCATION: _____ GROUP: _____

WEATHER: _____

Project Activity Stage	Survey	
	Design	
	Implementation	
	Pre-Commissioning	
	Guarantee Period	

Monitoring Items	Compliance
Compliance marked as Yes / No / Not applicable (NA) / Partially Implemented (PI)	
EHS supervisor appointed by contractor and available on site	
Construction site management plan (spoils, safety, schedule, equipment etc.,) prepared	
Traffic management plan prepared	
Dust is under control	
Excavated soil properly placed within minimum space	
Construction area is confined; no traffic/pedestrian entry observed	
Surplus soil/debris/waste is disposed without delay	
Construction material (sand/gravel/aggregate) brought to site as and when required only	
Tarpaulins used to cover sand and other loose material when transported by Vehicles	
After unloading , wheels and undercarriage of vehicles cleaned prior to leaving the site	
No chance finds encountered during excavation	
Work is planned in consultation with traffic police	
Work is not being conducted during heavy traffic	
Work at a stretch is completed within a day (excavation, pipe laying and backfilling)	
Pipe trenches are not kept open unduly	
Road is not completely closed; work is conducted on edge; at least one line is kept open	
Road is closed; alternative route provided and public informed, information board provided	
Pedestrian access to houses is not blocked due to pipe laying	
Spaces left in between trenches for access	
Wooden planks/metal sheets provided across trench for pedestrian	
No public/unauthorized entry observed in work site	

Children safety measures (barricades, security) in place at works in residential areas	
Prior public information provided about the work, schedule and disturbances	
Caution/warning board provided on site	
Guards with red flag provided during work at busy roads	
Workers using appropriate PPE (boots, gloves, helmets, earmuffs etc)	
Workers conducting or near heavy noise work is provided with earmuffs	
Contractor is following standard and safe construction practices	
Deep excavation is conducted with land slip/protection measures	
First aid facilities are available on site and workers informed	
Drinking water provided at the site	
Monitoring Items	Compliance
Toilet facility provided at the site	
Separate toilet facility is provided for women workers	
Workers camps are maintained cleanly	
Adequate toilet and bath facilities provided	
Contractor employed local workers as far as possible	
Worker's camp set up with the permission of PIU	
Adequate housing provided	
Sufficient water provided for drinking/washing/bath	
No noisy work is conducted in the nights	
Local people informed of noisy work	
No blasting activity conducted	
<i>Pneumatic drills or other equipment creating vibration is not used near old/risky buildings</i>	

Signature

Name

Position

Name

Position

Appendix 18. Outline of an Environmental Monitoring Report

110. Introduction

- (i) Project Background
- (ii) Categorization of the Project
- (iii) Report Purpose
- (iv) Project Implementation Progress
- (v) Institutional Framework and Staff on Environment Safeguards

111. Government Policies and Requirements: Discussions on the relevant government policies and corresponding requirements for implementing the project and their status on compliance.

112. Incorporation of Environmental Requirements into Project Contractual Arrangements: The manner by which EMP requirements are incorporated into contractual arrangements, such as with contractors or other parties.

113. Summary of Environmental Mitigation Measures Implemented: Based on EMP, it may include measures related to air quality, water quality, noise quality, pollution prevention, biodiversity and natural resources, health and safety, physical cultural resources, capacity building, and others.

114. Summary of Environmental Monitoring

- (i) Compliance Inspections (if relevant)
- (ii) Summary of Inspection Activities
- (iii) Mitigation Compliance²³
- (iv) Mitigation Effectiveness²⁴
- (v) Emission Discharge (Source) Monitoring Program (if relevant)
- (vi) Summary of Monitoring
- (vii) Results
- (viii) Assessment²⁵
- (ix) Ambient Monitoring Program (if relevant)
- (x) Summary of Monitoring
- (xi) Results

²³ Overall compliance with mitigation implementation requirements could be described in qualitative terms or be evaluated based on a ranking system, such as the following:

- 1. Very Good (all required mitigations implemented)
- 2. Good (most required mitigations implemented)
- 3. Fair (some mitigations implemented)
- 4. Poor (few mitigations implemented)
- 5. Very Poor (very few or no mitigations implemented)

²⁴ Effectiveness of mitigation implementation could be described in qualitative terms or be evaluated based on a ranking system.

²⁵ Discharge levels should be compared to the relevant discharge standards and/or performance indicators noted in the EMP. Any exceedances should be highlighted for attention and follow-up. In addition, discharge levels could be compared to baseline conditions (if baseline data is available) and described in qualitative terms or be evaluated based on a ranking system, such as the following:

- 1. Very Good (overall conditions are generally improved)
- 2. Good (conditions are maintained or slightly improved)
- 3. Fair (conditions are unchanged)
- 4. Poor (conditions are moderately degraded)
- 5. Very Poor (conditions are significantly degraded)

Additional explanatory comments should be provided as necessary.

(xii) Assessment²⁶

115. Key Environmental Issues

- (i) Key Issues Identified
- (ii) Action Taken
- (iii) Additional Action Required

116. Health and Safety

- (i) Overall Status of Health and Safety Implementation
- (ii) Work Related Injuries (if any)
- (iii) Lost Time Incidents²⁷ (if needed)

117. Grievance Redress Mechanism (GRM) : Provide discussions on the process of GRM and the occurrence of grievances, complaints, and relevant information from affected people as recorded during the reporting period.

118. Conclusion

- (i) Overall Progress of Implementation of Environmental Management Measures²⁸
- (ii) Problems Identified and Actions Recommended

119. Attachments

- (i) Site Inspection / Monitoring Reports
- (ii) Ambient Monitoring Results
- (iii) Photographs and other documents

²⁶ Ambient environmental conditions should be compared to the relevant ambient standards and/or performance indicators noted in the EMP. Any exceedance should be highlighted for attention and follow-up. In addition, ambient environmental conditions could be compared to the baseline conditions (if baseline data is available) and described in qualitative terms or be evaluated based on a ranking system, such as the following:

1. Very Good (overall conditions are generally improved)
2. Good (conditions are maintained or slightly improved)
3. Fair (conditions are unchanged)
4. Poor (conditions are moderately degraded)
5. Very Poor (conditions are significantly degraded)

Additional explanatory comments should be provided as necessary.

²⁷ Sample reference method in <https://www.safeopedia.com/calculating-your-companys-lost-time-injury-frequencyhttps://www.safeopedia.com/calculating-your-companys-lost-time-injury-frequency-rate/2/5085rate/2/5085>.

²⁸ Overall sector environmental management progress could be described in qualitative terms or be evaluated based on a ranking system, such as the following:

1. Very Good
2. Good
3. Fair
4. Poor
5. Very Poor

Appendix 19. Public Consultation Details

Date	Location	No. of Participants	Female Participants	Topics Discussed	Issues and Perception of community
19 Feb 2024	Tiwar Gaon	21	64	- Information of the upcoming project and benefits of the project. - Impacts of the project in environmental quality - Presence of protected forest areas around project areas, - Importance of road to the development of village - People have been queried about their utilization of the tourism road for daily purposes. - The villagers were asked that during which period of the year is traffic congestion on the tourism road at its peak - They were questioned about the prevalent species of flora and fauna found, and whether any migratory birds visit the villages during any season of the year. - They have been inquired about the presence of any areas prone to landslides. - Villagers were queried about whether they are experiencing any issues with water supply or drainage and if they are involved in the practice of rainwater harvesting.	- During consultation, participants informed that they know about this project and sub projects, and they are willing to provide all types of support during execution of work. - The people consulted expressed happiness about the proposed road subproject and hoped that it will provide better road connectivity to the nearby facilities. - People are looking forward for the project components. They are positive about the outcomes of the project objectives, however concerned about the timeframe for execution of the project. - They are aware of the temporary, short-term impact on air quality- dust generation, noise level, access problem, inconvenience for public and movement of vehicle, and are ready to cooperate. - The villagers primarily use the tourism road to commute to schools, hospitals, and other essential necessities. - The consulted people suggested that the alignment of the road should be fixed to minimize the resettlement impacts and the people affected must be paid appropriate compensation. - Local people were informed that the villagers that a few religious fairs, namely at the Pauranik Bhairav Mandir and Thal ka mela, take place during Makar shankranti and Bhairav Jayanti. Approximately 100 to 500 people come to visit at that time and additionally, they noted that during tourist visits, traffic congestion increases. - The people consulted informed that amla, papaya, mango, banana, pomegranate, bael, lemon, Kharki, and pine trees are predominantly found, wild goat, pig, goat, Barasingha etc. are generally commonly found fauna, Seven Sisters, Ghughut, quail, kite, and woodpecker are common. - During the months of winter migratory birds like Himalayan Bulbul are cited at the village. - The people consulted informed that two landslide prone areas exist on Tourism Road at Nekheyantok and Barora. During landslides road get blocked for a maximum of 1 hour - People responded that they get 30 min to 1 hour of water supply per day which is not sufficient to fulfil their daily needs and iron content is very high which is not suitable for drinking.
02 Mar 2024		11			
26 Jun 2024		70			
01 Jun 2024		34			

Date	Location	No. of Participants	Female Participants	Topics Discussed	Issues and Perception of community
					• The people are concerned about the duration of supply and the quality of water. The water has high iron content with bad odor which makes it difficult to drink or use it for other household purposes. • They informed us that there is no proper drainage system in the village and the villagers are involved in rainwater harvesting • The villagers are keen to ensure that local laborers are given priority for construction work and they want to ensure that ongoing construction does not result in soil falling onto their homes or disruptor of water supply lines, nor the blockage of their access road.
20 Feb 2024	Dobra Chanti	7	0	• Information of the upcoming project and benefits of the project road were shared with the people consulted. • Prevalent flora and fauna • Expected employment opportunities due to project • Declining tourist footfall • Impacts of the project in environmental quality • Lack of Water sports/recreational activities along the Tiwar Gaon to Dobra Chanti • Presence of protected forest areas around project areas • Importance of the project to the development of the area.	• The people consulted informed that during the implementation and initial opening of the suspension bridge, Dobra Chanti attracted numerous tourists and villagers. However, over the years, there has been a decline in tourist numbers. Presently, the tourists and travelers visiting the area, including those staying at the nearby Hotel Le Roi, comprise the majority of visitors to the location. • The people consulted expressed that arterial road leading to Dobra Chanti holds religious significance as it connects the Char Dhams. Peak traffic occurs during the Char Dham season, which spans from May to October. However, despite the influx of visitors during this time, the site and surrounding areas do not reap the benefits of this seasonal crowd. • The participants mentioned that the light show on the bridge has become outdated and has been duplicated in numerous locations. This has impacted the overall appeal of the location. • Vendors and adjacent landowners are hopeful about the outcome of proposed Tourism Road subproject and development of Dobra Park. The people suggested to establish an adventure hub at Dobra Chanti similar to Panch Koti, enhancing the park's appeal and offering unique experiences for visitors. • The informal vendors established on site have been set up since the inauguration of the bridge and hoping to benefit from this project. • With the park and tourism growing, the participants indicated growth possibilities in nearing villages (Uppu village) and towards the development of Homestays. • The participants expressed support for the project and are hopeful that the project will be beneficial to the community.
02 Mar 2024		10			
21 Feb 2024		6			
02 Mar 2024		15			
22 Feb 2024		19			
04 Mar 2024		47			

Date	Location	No. of Participants	Female Participants	Topics Discussed	Issues and Perception of community
31 Dec 2023	Koti village	18	3	• Information about the project scope • Tourism Branding • Night Tourism • Affordable accommodation • Tourist Time Spent • Activity diversification • Impact during construction • Acceptance	• Panch Koti primarily draws tourists and adventurers for its adventure sports and water activities. However, there is currently no proposal for annual events or programs aimed at attracting athletes and tourists from across the country. • Koti has hosted two national water sports championships and an international paragliding competition, indicating its potential as an adventure destination. It is recommended to brand the location as a hub for annual events, which shall attract tourists consistently and establish Tehri as a prominent tourism destination. • The absence of proper lighting infrastructure at Koti restricts night time tourism activities. • Local suggestions propose the development of Koti to include plazas, OATs, and a well-illuminated promenade. This enhancement would foster the growth of cultural activities and events in the area. • The geographical positioning of Koti, coupled with limited affordable accommodation options, presents significant challenges for establishing it as a prominent tourism destination. • Currently, the accommodation options available are on the higher tariffs and affordable accommodations are only available at Chamba and New Tehri. • Furthermore, the participants suggested that provisions for tented accommodation spaces (provisions for private camping and/or government-facilitated camping) and basic public infrastructure amenities (washrooms, eateries, drinking water etc) shall attract tourists and increase their duration of visit. • The rugged terrain poses challenges for tourists to travel during late hours, and the absence of adequate accommodation facilities results in tourists typically spending limited time in Koti, usually until approximately 5:00 PM. • The strategic location of Koti makes it ideal for paragliding, and local participants have proposed exploring the possibility of establishing paragliding platforms or points in nearby villages situated at higher elevations. • The participants were informed about the temporary impacts on air quality, noise levels and disruption of access during the construction of
23 Feb 2024		9			

Date	Location	No. of Participants	Female Participants	Topics Discussed	Issues and Perception of community
					Tourism Road. The communities and locals welcome the tourism road project and tourism developments for Koti.
28 Apr 2024	Julk Ramgaon and Jakh-Chaura	2	6		- The people consulted were informed about the scope of the project road. The people welcomed the project and expressed to extend all support in the execution of the project. - The participants were informed about the temporary impacts on air quality, noise levels and disruption of access during the construction of Tourism Road. - The villagers primarily use the Tourism Road to commute to schools, hospitals, and other essential necessities. - The consulted people suggested that the alignment of the road should be fixed to minimize the resettlement impacts and the people affected must be paid appropriate compensation. - People are looking forward for the project execution. They are positive about the outcomes of the project objectives, however concerned about the timeframe for execution of the project. - The people consulted suggested that the local labor force must be given preference for employment during execution of the project.
28 Apr 2024		15			
30 Dec 2023	Madan Negi	13	9	- Information of the upcoming project and benefits of the project. - Temporary loss of access - Temporary closure of services - Commuting alternatives - Loss of livelihood - Tariffs/ Ticketing - Operational restrictions - Inaccessible for the differently abled - Institutional restrictions - Infrastructure Inadequacy	- With the project implementation, the existing ropeway will be shut down and decommissioned. This places a total of 14 operators and maintenance staff currently employed for the existing system at risk of job security. - Compensations for lost income should be documented, considering that these staff members are the sole earners for their households and most of them have been working in the operations of the ropeway for the last 9 years. - The commuters and community stressed the importance of maintaining the current fare of INR 10 for locals and villagers with the introduction of the new ropeway system. Any increase in costs would significantly impact students and women who rely on the ropeway for transportation to work and education. - Commuters highlighted the advantages of the ropeway in connecting their villages, citing time and cost savings compared to traveling by road. The existing system enables a 9-minute commute from Tipri to Madan Negi, with a capacity of carrying 10 people.
21 Feb 2024		22			
02 Mar 2024		17			

Date	Location	No. of Participants	Female Participants	Topics Discussed	Issues and Perception of community
					• Commuters and villagers expressed concerns regarding the temporary closure of the existing ropeway and requested alternative arrangements to ensure continued connectivity. • Some participants highlighted that during the construction period, local people would be compelled to travel by road, resulting in increased travel time of 1-2 hours. To address this, commuters suggested that the government reinstate the previous boat service. The infrastructure for the boat services from the pre-ropeway period still exists but is not operational, as confirmed by local communities. • The commuters and community mentioned that the current ropeway closes by 17:00 hours (5:00 pm), posing difficulties for those traveling late. • The current entry to the ropeway at the Tipri end is not accessible for differently-abled persons. Presently, ropeway operators assist differently-abled individuals to access the complex. It was suggested that the provision for the differently-abled persons must be made in the proposed project. • The Central Industrial Security Force (CISF) and Dam security restrict road access across the dam by 7:00 PM, occasionally preventing tourist crossings. These constraints diminish the attractiveness of the ropeway system for tourists by impacting their experience. • At present ropeway complex lacks adequate illumination, signages washrooms, waiting areas, and dining facilities. The persons consulted suggested that the improvements to basic infrastructure and viewpoints are necessary to enhance the experience for tourists wishing to spend time around the complex. • There is insufficient parking space and limited recreational activities available around the ropeway complex area. The people consulted asked that the project must envisage improvement to the parking facility.
Stakeholder consultations with Govt officials					
01 May 2024	PWD office Tehri	7	3	• Project design and scope • Involvement of Forest land in Project Road • Resettlement issues	• The consulted PWD officials confirmed that no reserve forest land will be required for the proposed widening of the Koti colony to Dobra Chanti Road., although joint forest verification will be conducted after finalizing of the road alignment.
31 May 2024		7			

Date	Location	No. of Participants	Female Participants	Topics Discussed	Issues and Perception of community
				• Impact on Trees and presence of RETs • Requirement of Environment Clearance (EC) and Forest Clearance (FC) • Proposed widening on the hill side or valley side • Identification of muck disposal site	• The officials said that it was understood that the number and species of trees to be felled are yet to be identified. • The PWD officials said that it understood that one muck disposal site is proposed per kilometer of the road which is more than required. • The PWD officials expressed their view that a protection management plan should be prepared for protecting the valley side during construction. • The PWD officials insisted that in order to minimize noise generation, only rock breakers should be used for rock cutting. • The provisions for EWCD features like railings for the safety of children, expecting mothers and Differently Abled are incorporated in the Design throughout the tourism road stretch. • The access paths, roads for the local population have been identified in Jakh-Chaura, Ramgaon, Tiwar Gaon should be protected • Alternative route for temporary traffic diversion has been identified from existing link road to NH 34 and must be used when needed.
30 Apr 2024	(Circle Officer), UK Police, Tehri	8	3	• Project design and scope • Required safety features • Lighting and EWCD features	• Circle Officer, Uttarakhand Police, Tehri informed that the department is providing self-Défense Trainings to the Women and Girls of the community • Proper lighting arrangements and CCTVs must be installed at the mentioned locations to ensure the safety of Women, Tourists and local community. • Provisions for EWCD features like railings for the safety of children, expecting mothers and Differently Abled are incorporated in the Design throughout the tourism road stretch.
3 May 2024	Office of the Divisional Forest Officer, New Tehri	5	2	• Statistics of forests cover in the project area/ district/state and its legal status i.e. Reserved, Protected, Unclassified. • Forest land involvement in the proposed project • Impact of forest fire near the project area	• As per consultation with SDO it was understood that no reserve forest land will be required for the proposed widening of the Koti colony to Dobra Chanti Road. The proposed SWM site may have come under Mokhri reserve forest area due to the shifting alignment of the forest area. • No wildlife sanctuary is present at the proximity of the tourism road. • As SDO informed us that there is no wildlife sighted near the proposed project location. However, faunal diversity is available in the forest area such as Leopards, barking deer (Kakad), wild cats and Tanteri/Titri and major flora species are found in this area are Pine, Vimal and Shimul.

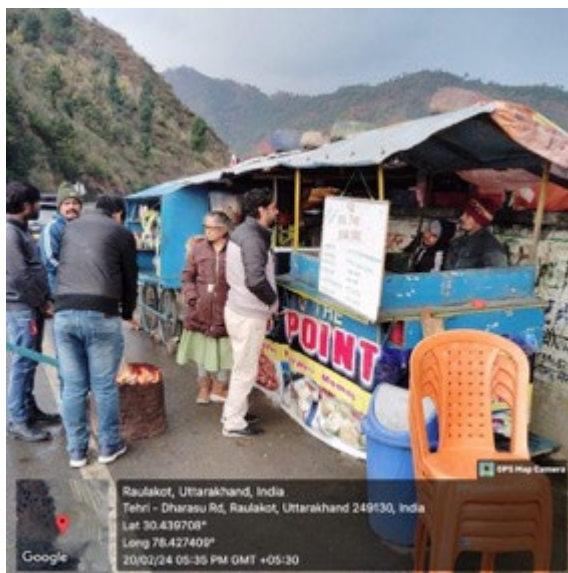
Date	Location	No. of Participants	Female Participants	Topics Discussed	Issues and Perception of community
				• Flora and Fauna and endangered species in the project area/ district/state • Scope of the proposed road development/SWM construction/ STP construction/ sewer line and likely impacts on flora and fauna • Forest Management Plan	• She has discussed forest fires, which mostly occur from December to July. Until May 30, 2024, 290 forest fire cases have been reported for this year. • She also emphasized on forest fire prevention through awareness programs like campaigns and rallies conducted in schools, colleges, and villages. Additionally, clearing ground cover strips in forests is done to prevent fires from spreading. • The Forest Officials showed a copy of Forest Management Plan and asked the visiting team to scan the required pages.

Photo documentation

Public consultation at Tiwar Gaon



Public consultation at Dobra Chanti



Public consultations at Koti Village



Public consultation at Julk-Ramgaon



Public consultation at Jakh-Chaura



Public consultation at Madan Negi



Consultation with Forest Officials



Consultation with PWD Officials



Consultation with Circle Officer, Tehri Police



Attendance Sheets

Note: The attendance sheets are intentionally blurred to hide personal details and signatures that can be used for unintended purposes.

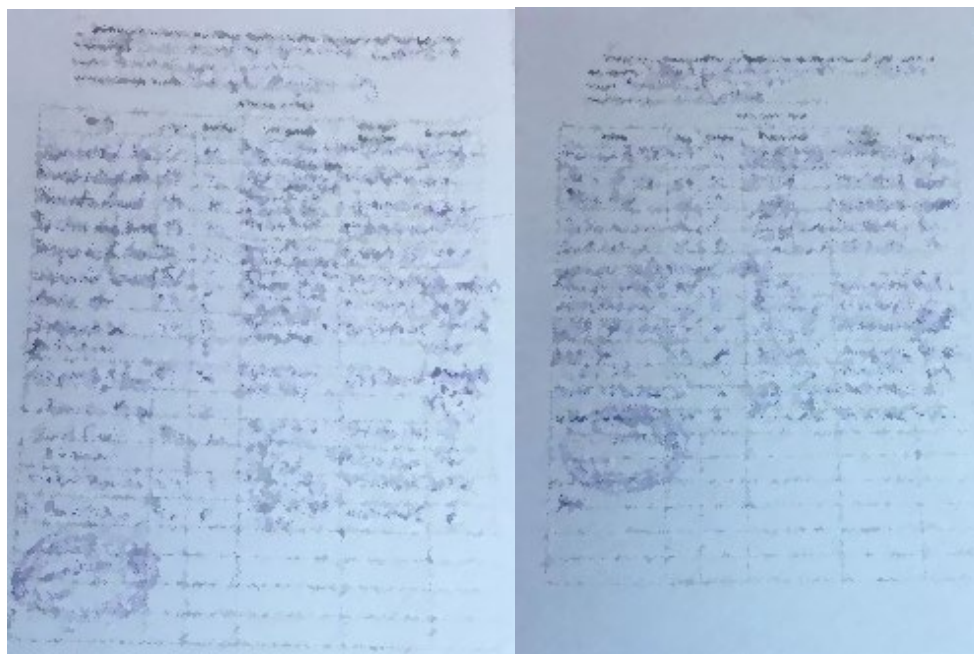


Table 1. Summary of the results of the first round of the survey (n = 100)				
Age	Gender	Education	Occupation	Income
18-24	Male	High school	Student	Low
25-34	Female	University	Teacher	Medium
35-44	Male	University	Engineer	High
45-54	Female	University	Manager	High
55-64	Male	University	Retired	Medium
65+	Female	University	Retired	Medium
18-24	Male	High school	Student	Low
25-34	Female	University	Teacher	Medium
35-44	Male	University	Engineer	High
45-54	Female	University	Manager	High
55-64	Male	University	Retired	Medium
65+	Female	University	Retired	Medium

Table 2. Summary of the results of the second round of the survey (n = 100)				
Age	Gender	Education	Occupation	Income
18-24	Male	High school	Student	Low
25-34	Female	University	Teacher	Medium
35-44	Male	University	Engineer	High
45-54	Female	University	Manager	High
55-64	Male	University	Retired	Medium
65+	Female	University	Retired	Medium
18-24	Male	High school	Student	Low
25-34	Female	University	Teacher	Medium
35-44	Male	University	Engineer	High
45-54	Female	University	Manager	High
55-64	Male	University	Retired	Medium
65+	Female	University	Retired	Medium

Appendix 20. Sample Grievance Registration Form

(To be available in Hindi and English)

The _____ Project welcomes complaints, suggestions, queries, and comments regarding project implementation. We encourage persons with grievance to provide their name and contact information to enable us to get in touch with you for clarification and feedback.

Should you choose to include your personal details but want that information to remain confidential, please inform us by writing/typing *(CONFIDENTIAL)* above your name. Thank you.

Date	Place of registration	Project Town Project:			
Contact information/personal details					
Name		Gender	* Male * Female	Age	
Home address					
Place					
Phone no.					
E-mail					
Complaint/suggestion/comment/question Please provide the details (who, what, where, and how) of your grievance below:					
If included as attachment/note/letter, please tick here:					
How do you want us to reach you for feedback or update on your comment/grievance?					

FOR OFFICIAL USE ONLY

Registered by: (Name of official registering grievance)	
Mode of communication: Note/letter E-mail Verbal/telephonic	
Reviewed by: (Names/positions of officials reviewing grievance)	
Action taken:	
Whether action taken disclosed:	Yes No
Means of disclosure:	