PROJECT CLIMATE RISK ASSESSMENT AND MANAGEMENT REPORT

I. Basic Project Information

Project Title: Road Connectivity Improvement Project

Project Budget: $135.7 million

Location: Nepal

Sector: Agriculture, Natural Resources and Rural Development

Theme: Rural Market Infrastructure

The project will deliver two outputs: improved road conditions between the selected rural communities, productive agricultural areas and socioeconomic centers, and enhanced capacity of road agency. The two outputs will be achieved through two components: (i) *Road improvement component.* This component will improve, and maintain about 388 km of rural roads. The rural roads will be improved to all-weather standards with safety features and climate proofed,[1] and be maintained for 3 years.[2] (ii) *Capacity development component.* This component will build the capacity of DOLIDAR in project management, contract administration, road asset management, road safety, safeguards and detailed design preparation. Consulting services will be engaged to assist with development of the DOLIDAR's capacity.

II. Summary of Climate Risk Screening and Assessment

Trend analysis of the mean and extreme annual daily rainfall and temperature including spatial and temporal variation were carried out at the national level. This was overlay with the existing natural hazards based on the historical damage records. Based on projected climate change and extreme climate, the rural roads are vulnerable to flooding, erosion, and landslides. Vulnerabilities of each road were identified and confirm through transect survey. Both engineering and non-engineering measures were incorporated in the detailed project reports to address the vulnerabilities to enhance climate resilience.

A. Sensitivity of project component(s) to climate/weather conditions and sea level

Project component	*Sensitivity to climate/weather conditions*
Rural Roads	Flood, erosion, and landslide

B. Climate Risk Screening

Risk topic	*Description of the risk*
Temperature (°C) and precipitation	Between 2020-2040, almost coinciding with the project life, there is a change in temperature anomaly (difference between the baseline and predicted value) in Nepal ranging from 0.25-1.72 °C based on General Circulation Model ensemble average of the low (10%) and high (90%), RCP2.6 scenario. Limited change in annual average monthly rainfall is expected between -7.64 mm/month to 6,53 mm/month. However, seasonal variability is expected with an increase in rainfall during the months between July-September and December to March.
Precipitation	Total precipitation is expected to slightly increase between 2046-2065 between 1,096-2,344 mm. The percent of wet days per year with rainfall> 90-percentile wet-day precipitation, where percentiles are based on reference period between 1961- 1990 is expected to increase from 7.84-17.22%. Geographically, the southeastern and southern districts were majority of the project roads are located will experience heavier rainfall compared to the rest of the country
Flooding, erosion, and landslide	The implications of the projected increases in temperature and rainfall coupled with the existing natural hazards in the districts magnify the vulnerability of the project roads to climate change variability and extremes. The most dominant natural hazards to the projects roads that can be exacerbated by climate change are flooding and landslide. The project districts that are at risk from flooding are Jhapa, Morang, and Sunsari.

[1] Structural and non-engineering measures to cope with the predicted increase in intensity and variability in rainfall and temperature and resulting occurrence climatic induced disasters that includes floods, landslides and debris flows

[2] Performance-based maintenance (PBM) will be undertaken for 3 years after construction.

	Districts along the main frontal and boundary thrusts and on the south Tibetan Detachment System geological formations are prone to landslides which includes Sindhuli, Chitwon, Kavrepalanchok, Parbat, Rukum, and Rolpa.

Climate Risk Classification: ***Medium***

C. Climate risk assessment

a. Conducted climate change vulnerability assessment which forms part of the IEE report
b. Conducted risk mapping using the UN Risk Data Platform
c. Conducted assessment of temperature and precipitation future trend high A2 scenario using the World Bank's Climate Wizard.
d. Coordinated with the social assessment team and conducted transect survey of all roads in the identification of flood and erosion/landslide-prone areas based on local knowledge and inclusion in the engineering detailed project report.
e. Ensure that all IEES and EMPs addressed the climate change risks and vulnerabilities and adequate budget are incorporated in the BOQ in the bid documents.

III. Climate Risk Management Response within the Project

[redacted]The road sections fall on terai, hilly and mountainous terrains so particularly susceptible because of the location. Effects of climate change could include the possibility of flash floods/rapids, mud flows in rivers/streams, and an increase in incidence of landslides along the alignment. Other existing roads in the Hilly and mountain areas are also susceptible to landslides due to the limited drainage capability and nature of the soil type. For this reason, consideration has been given in the detail design of road formation and embankment heights and the size of waterways and soffit levels of cross drainage structures.

[redacted]The detail engineering design of project road have been done considering the potential effects of climate change. From a road development perspective in Nepal, impact of climate change mainly takes the form of concentrated high rainfall resulting in the accelerated surface run-off from slopes and increased flows in gullies, drainage channels, streams, and rivers. These phenomena have a consequent effect on the stability and performance of road sections, bridges, and other structures.

[redacted]During detailed design, detail hydrological study/analysis has been conducted to determine water ways, span/length and height (i.e. soffit, invert levels) of major cross-drainage works. Design flood has been calculated considering 50 years return period for cross drainage and 5 years for side drains. The road structures have been designed considering the probability of natural hazards (i.e. floods, earthquakes etc.). Pavement surface has been designed considering the effect of temperature variation

[redacted]There are 16 roads that are at risk from climate change variability and weather extremes that were climate proofed by increasing road embankment height on flood-prone areas; provision of side drains and new culverts; construction of bridges; and gabion retaining walls at a cost of NRs292 million (US$2.9 million) representing about 3% of the total civil work cost of these roads. Innovative contractual arrangements to extend the responsibility of the contractors on mandatory maintenance for a period of 3 years after 2 years' road construction address the need to more frequent maintenance and repairs exacerbated by climate change.