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RURAL ROAD SECTOR (DOLIDAR): MUSTANG VULNERABILITY ASSESSMENT REPORT

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Version	A

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1 DISTRICT ASSETS/SYSTEM PRIORITIES

1.1 Briefing on Mustang District

Overall View

Mustang district is located in Dhaulagiri zone of the Western Development Region of Nepal. It has borders with Tibet to the North, Manang to the East, Myagdi to the South and Dolpa to the West. The district has 16 VDCs, 9 Ilakas and 1 constituency area. The total area of the district is 3,573 sq. km having various types of topography. The lowest elevation point is 1,372 m and the highest elevation point is 8,167 m from the mean sea level. As a result of the elevation differences, the district has two different types of climate: sub-tropical from 1000-2000 m and temperate above 2000 m. Tourism and herbs are the main source of occupation and livelihood of the majority of the population. The total population of the district is 17,163 of which 9,017 are male and 8,146 are female (source: Nepal Population Report 2011, Ministry of Health and population, GoN). The headquarter of the district is Jomsom. It is located at the bank of Kali Gandaki River.

Major rivers in the district are; Kaligandaki, Lete, Yamkin, Marhang, Tukche etc.

Rural Road Network

District Road Master Plan (DTMP) of Mustang was prepared in July 2013. The DTMP has identified 4 district roads (total length = 27.34 km) and 16 village roads (linking VDC headquarter, total length = 79.51 km) in the district. At present these roads are being upgraded or constructed.

All the infrastructure works including rural roads of the district are being managed by District Technical Office (DTO). Mustang DTO is headed by an Engineer. The other staffs in the DTO are: 2 Sub-engineers, 1 Nayab Subba and 4 support staffs.

Climatological Record

The climatological record and monthly rainfall of the district is presented in Table 1 and 2.

Table 1: Climatological Record of Mustang District

Location: Gurja Khani Latitude: 28^{o} 36' N; Longitude: 83^{o} 13E; Elevation: 2530 amsl (2008)

Air Temperature					Relative Humidity		Precipitation (mm)		No. of Rainy Days
Mean			Absolute Extreme		Observed at				
Max.	Min.	Daily	Max. & Date	Min. & Date	08:45 NST	17:45 NST	Total	Max. in 24 hrs. & Date	1:100
8.2			25.2/Aug.		67	80	2090	47/Sept	148

Source: Department of Hydrology and Meteorology

Table 2: Monthly Rainfall of Mustang District (mm)

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
0	3.6	27.6	14.3	104.3	119.8	375.4	420	176.1	101.8	2	3.3

Source: Department of Hydrology and Meteorology (2009)

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1.2 Criteria for Identifying Priority Assets/Systems for the Vulnerability Assessment

In the road sectors (both DoR and DoLIDAR) it is considered that the primary assets or systems are the road links joining important centres of population or production; for example a feeder road joining a national highway to a district centre is considered as a system. The priority assets in that system are the parts or sections of the link which, if affected by an extreme weather event, would cause serious disruption to the movement of traffic on the link.

The key criteria for prioritisation include:

- Infrastructure of national strategic importance
- Infrastructure of district strategic importance
- Infrastructure that has been impacted by past extreme events
- Infrastructure located in areas prone to past extreme events

In each district the consultant in consultation with the division chief prepared final lists of the priority structures of the district. The list was prepared following the criteria provided in District Office Report.

1.3 Description of Priority System

In total three assets were covered in baseline report. Among them Kaligandaki Bridge at Jomsom and Bank protection works at Kagbeni are selected for vulnerability assessment and adaptation planning.

Kaligandaki Bridge at Jomsom (under construction) (Asset 1)

The proposed structure is a RCC bridge across the Kaligandaki River. It is located very near to Jomsom Bazar. The estimated cost of the bridge is 29 million rupees. The amount includes cost of bridge, approach road, bank protection and other miscellaneous works. Construction works of this bridge was started one year ago. Until now the contractor has completed the foundation works of pier (see photo). Indian Government is the main financer and DDC/DoLIDAR is the implementing agency of the bridge.

Bank protection works at Kagbeni (Asset 2)

DDC Mustang is constructing concrete bank protection wall at the left bank of Kaligandaki River near its confluence with Kag Khola. The confluence is considered as one of the holiest places of Hindus in that area.

The main objective of the wall is to protect Kagbeni Bazaar. The length of the wall at upstream and downstream from the confluence is about 120m and 20m respectively. The average height of the wall from the bed level is about 2m. This asset is also being financed by the Indian Government.

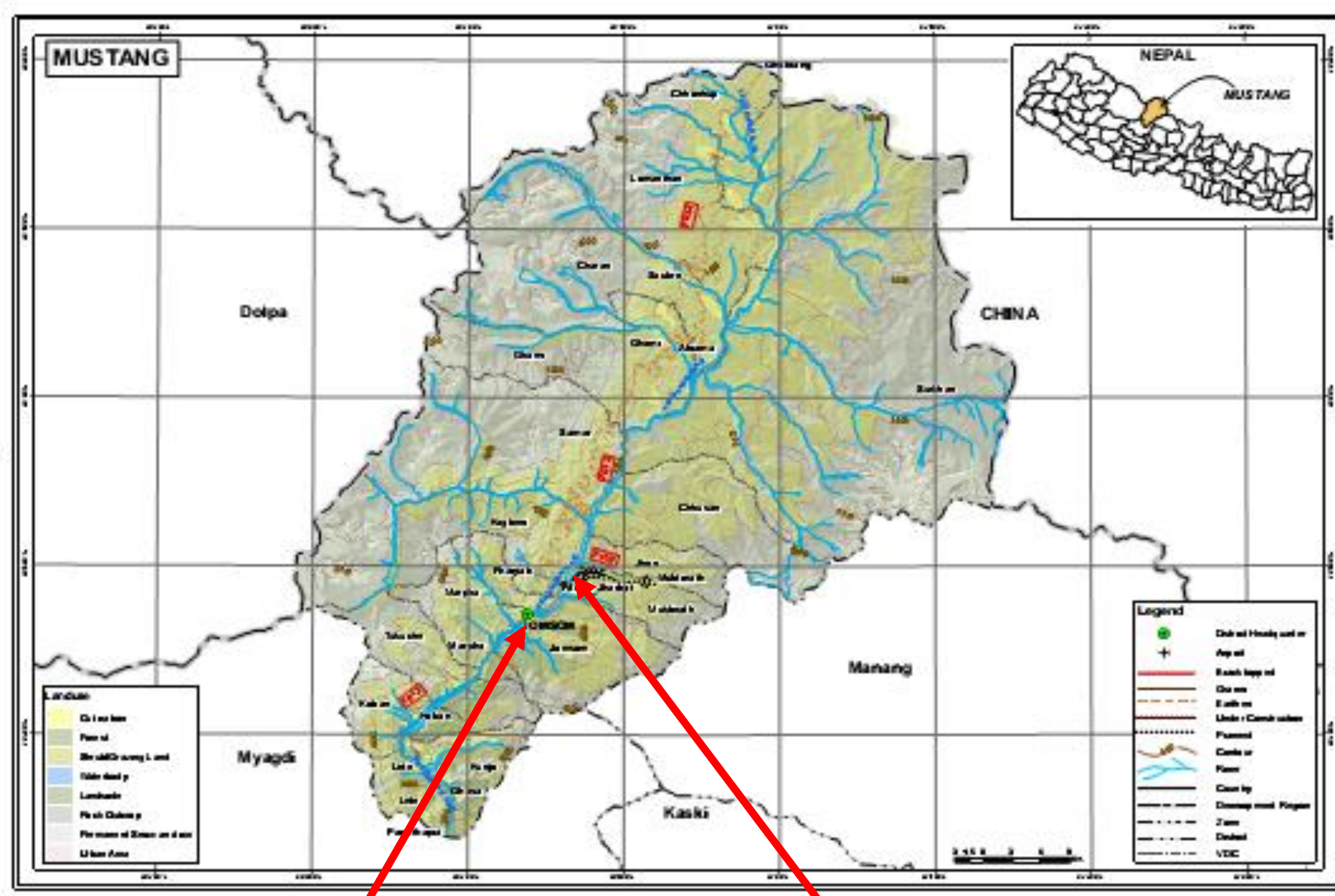

Fig 1: Map of Mustang District showing asset locations

Kaligandaki Bridge **(Asset 1)**

Bank Protection works at Kagbeni **(Asset 2)**

2 VULNERABILITY ASSESSMENT METHOD

2.1 Summary of method/process

The VA of the assets is carried out following the procedure as outlined below:

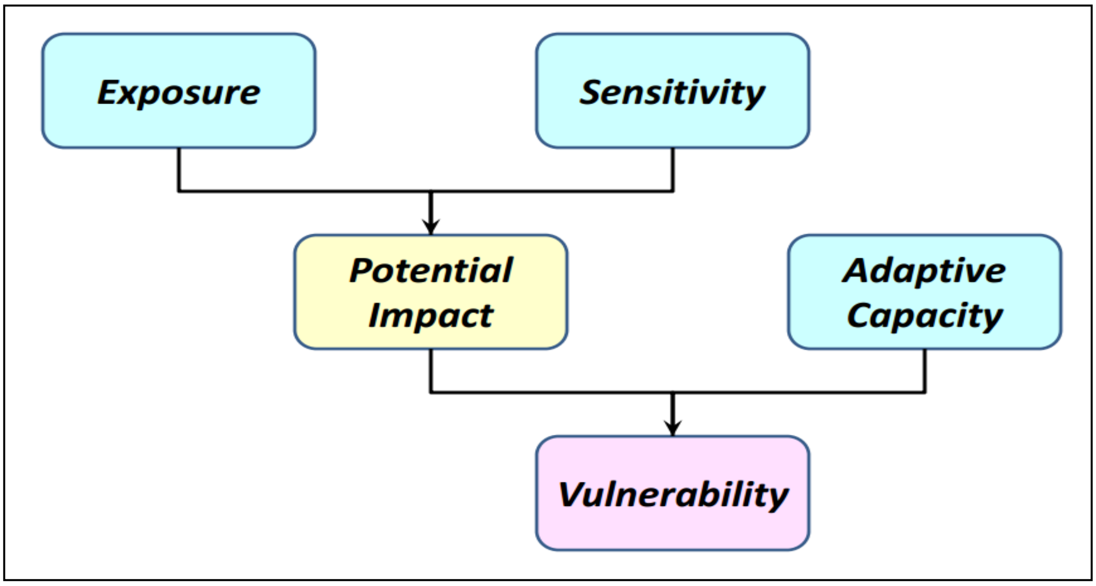

Fig 2: VA Process

There are two components in this phase

1. Assessing the impact of a climate threat on an asset and system; and
2. Defining the level of vulnerability of the asset and system to the projected threats.

Impact Assessment

The potential impact (or level of risk) is a function of the level of **exposure** to climate change induced threats and the **sensitivity** of the target asset or system to that exposure.

Exposure: exposure is the degree of climate stress on a particular asset. It is influenced by long-term changes in climate conditions and by changes in climate variability, including the magnitude and frequency of extreme events.

The following criteria influence exposure:

- Duration (e.g. hours or days of flooding)
- Location (e.g. distance from flood)
- Intensity (e.g. strength of rainfall, speed of flow)
- Magnitude (e.g. volume, flow or size of event)

Sensitivity: Sensitivity is the degree to which a system will be affected by, or be responsive to, climate change exposure.

The following variables affect infrastructure sensitivity:

i. Construction quality
ii. Levels of maintenance
iii. Protective system (e.g. river training wall to protect asset)
iv. Design (including safety margins)

A key tool in the process is the use of the **Climate Change Impacts Matrix** (Fig.3). The matrix is completed using descriptors for exposure and sensitivity, for example, ‘very low’ to ‘very high’. If the exposure of a bridge to the threat of high flash floods is **High**(due to catchment area and topography) and its sensitivity to scour is **Very High** (due to soil type and foundation design) then the Matrix tells us that the **Impact** of the threat is **Very High**.

		Exposure of system to climate threat				
Sensitivity of system to climate threat		Very Low	Low	Medium	High	Very High
	Very High	Medium	Medium	High	Very High	Very High
	High	Low	Medium	Medium	High	Very High
	Medium	Low	Medium	Medium	High	Very High
	Low	Low	Low	Medium	Medium	High
	Very Low	Very Low	Low	Low	Medium	High

Fig.3: Impact Assessment Matrix

Vulnerability Assessment (VA)

A vulnerable system or asset is one that is sensitive to changes and extremes in climate and hydrology and one for which the ability to adapt is constrained. The vulnerability of an asset is therefore a function of the potential impact of changes in climate and the ability **(Adaptive Capacity)** of the responsible authority to respond to any possible impact.

The following variables affect the **adaptive capacity** of the responsible institution:

i. Institutional Strengths/Weaknesses
ii. Financial Resources
iii. Technical Capacity
iv. Ability to respond effectively to extreme events in the District

The Vulnerability of an asset is determined by applying the Impact value given by the Impacts matrix and the assessed value of adaptive capacity to the **Vulnerability Assessment Matrix** (Fig. 3).

This value of **Vulnerability** obtained (from Very High to Very Low) is then carried forward to the Adaptation Planning phase of the Climate Change Risk Management methodology.

		Impact				
		Very Low *Inconvenience (days)*	*Low* *Short disruption to system function (weeks)*	*Medium* *Medium term disruption to system function (months)*	*High* *Long term damage to system property or function (years)*	*Very High* *Loss of life, livelihood or system integrity*
Adaptive Capacity	*Very Low* *Very limited institutional capacity and no access to technical or financial resources*	*Medium*	*Medium*	*High*	*Very High*	*Very High*
	Low *Limited institutional capacity and limited access to technical and financial resources*	*Low*	*Medium*	*Medium*	*High*	*Very High*
	Medium *Growing institutional capacity and access to technical or financial resources*	*Low*	*Medium*	*Medium*	*High*	*Very High*
	High *Sound institutional capacity and good access to technical and financial resources*	*Low*	*Low*	*Medium*	*Medium*	*High*
	Very High *Exceptional institutional capacity and abundant access to technical and financial resources*	*Very Low*	*Low*	*Low*	*Medium*	*High*

Fig 4: Vulnerability Assessment Matrix

2.1 Interpretation of the Climate Vulnerability Assessment Methodology Criteria for the Roads Sector

In the highways sectors there are two major elements which make up a road link:

1) Road Pavement & Side Drainage
2) Cross drainage structures

It is necessary to consider for both these elements their sensitivity and exposure to the various increased threats due to climate change.

Sensitivity

The following tables outline the sensitivity of the two road elements to various climate threats.

Table 3. Road pavement and side drains sensitivity to climate threats

CLIMATE THREAT	SENSITIVITY	IMPACT
Increased rainfall Increased intensity of rainfall	Depends on condition of existing pavement – a pavement in poor condition will have a High sensitivity	Damage to surface of pavement
Increased rainfall Increased intensity of rainfall	Side drains which are in good condition and well maintained will have a low sensitivity	Damage to side drains
Increased rainfall increases instability of hillside Increased intensity of rainfall increases instability of slope High flow in river scours base of hillside & causes landslide	A road across an hillside prone to landslides will have a Very High sensitivity A road above a river which is eroding the toe of the hillside will have a Very High Sensitivity	Landslide destroys road & side drains

Increased rainfall causes high monsoon flood Intense rainfall causes flash flood	A road constructed next to a river will have a Very High sensitivity	Road running along river valley damaged by adjacent river

Table 4. Cross road drainage sensitivity to climate threats

CLIMATE THREAT	SENSITIVITY	IMPACT
Increased rainfall causes riverine flooding	A road with adequate cross drainage structures for today's floods will have an increasing sensitivity as climate change takes effect	Road on embankment crossing flood plain washed out
Increased intensity of rainfall causes large flash flood	Design and condition of bridge foundations will cause sensitivity to vary from Medium to Very High	Bridge on river with small catchment area is damaged by flood
Increased intensity of rainfall increases size of flash flood	Design and condition of causeway slab and retaining walls will mean sensitivity will vary from Medium to Very High	Causeway for stream with small catchment area washed out by flood
Increased temperature variation from cold to hot season	The condition and design of the expansion joints & bearings will cause the sensitivity to vary from Low to High	Large Bridge over major river – damage to bearings & expansion joints
Increased rainfall causes high monsoon flood	The condition and design of the bridge piers and abutments will cause the sensitivity to vary from Low to Very High	Settlement or scour at pier or abutment

Exposure

The above tables illustrate examples of the sensitivity of various elements in the highway infrastructure to climate change. It shows that for both roads & bridges the major climate change threats are increased rainfall and intensity of rainfall which result in high monsoon floods, riverine floods and flash floods. For large bridges, very high temperature variations will be a threat to the viability of expansion joints and bearings.

The Climate Change Threat Profile for Mustang District show that the flood magnitude will increase in the range of between 16-41 % in 2040 and 40-57 % in 2060 for different return periods.

The table below provides interpretation of exposure for different road and bridge assets to the climate threats identified for Mustang district. This general interpretation can be used along with consideration of the relative magnitude of the climate change threat at the target system site to assess the exposure of the assets of the target system.

The highway infrastructure in Mustang District will generally, depending also on upstream catchment area and topography, have a High or Very High Exposure to climate change.

Table 5. Interpretation of climate change threats and exposure for road and bridge assets

TYPE OF ASSET	CC THREAT	EFFECT OF THREAT	EXPOSURE
Large bridge on large river	Increase in max. temperature	Increase in expansion of deck – more stress on joints and bearings	Low to Medium
	Increase in wet season flow	Increased velocity of flow increases likelihood of scour to foundations	High to Very High
		Increased height of flood threatens stability of bridge deck and causes erosion of approach roads	Medium to Very High
		Increased sedimentation reducing clearance under bridge	Medium to Very High
Smaller bridge on smaller river	Increasing risk & severity of flash floods during wet season	Increased velocity of flow increases likelihood of scour to foundations	Medium to Very High
		Increased height of flood threatens stability of bridge deck and causes erosion of approach roads	Medium to Very High
Pipe culverts & causeways on roads crossing watershed	On hill roads - increasing risk & severity of flash floods during wet season	Increased velocity of flow threatens to wash out pipe/ causeway & headwalls	High to Very High
	On flood plain roads - increase in wet season flow	Increase volume of flow threatens to wash out pipe/ causeway & headwalls	High to Very High
Hill road crossing watershed on sloping ground	Increasing risk of landslides	Road blocked or totally destroyed	Medium to Very High
Hill road running along valley bottom adjacent to river	Increasing wet season flow	Road eroded by height & high velocity of flow	High to Very High
	Increasing risk & severity of flash floods		
	Increasing risk of landslides	Road destroyed as erosion to toe of hillside causes landslide	
Road crossing flood plain	Increasing wet season flow and water levels	Road overtopped by flood water and pavement/ embankment destroyed	Medium to Very High

Impact

The impact of an extreme weather event on an asset is a function of the Sensitivity and the Exposure and can be found by considering the Climate Change Impacts Matrix given in Fig. 2 and interpolating between the value of Sensitivity and the value of Exposure to give a value for Impact.

The value for Impact obtained by using the Impacts Matrix should be judged from a practical engineering point of view and if considered incorrect then the values used for Exposure and Sensitivity should be revisited. In particular, for road infrastructure, the value for sensitivity is very difficult to determine without carrying out detailed condition surveys for the particular asset under review. If sufficient design detail is unavailable, or the ground conditions difficult to judge, then an expert judgment of Sensitivity needs to be made and clear notes made justifying the decision.

Adaptive Capacity

Evaluating the Adaptive Capacity of DoLIDAR and DDC/DTO is not a simple task. Baseline assessments including consultations and site visits have shown that the DTO Mustang which is responsible for rural roads and bridges in the district has the following capacities:

- Sufficient experience in rural road and trail bridge construction;
- Do not have sufficient experience in design of roads and bridges
- Insufficient technical manpower in comparison to the number of projects;
- Inadequate financial resources;
- Inadequate management system; and
- Not very prompt in responding to disasters.

However, the efficiency and technical capability of DTO has increased in the last few years after the involvement of big donors such ADB, WB, DfID etc in the rural transport sector.. Considering the above factors, it is deemed that the adaptive capacity of DoLIDAR/DDC/DTO as **'Medium'.**

Vulnerability Scoring: Based on the impact and adaptive capacity assessments, the vulnerability of the asset against the climate change threats is estimated using the guiding Vulnerability Assessment Matrix provided in Fig.3.

3 VULNERABILITY ASSESSMENT OF ASSETS

3.1 Asset Description

Kaligandaki Bridge at Jomsom (under construction)

The important details of the asset is given in following table.

Table 6: Salient Features of the Kaligandaki Bridge (as provided by Mustang DTO)

Description	Data
1. Location (District)	**Mustang**
1.1 Name of River	Kaligandaki
1.2 Location (Chainage):	Km 80 of Beni-Jomsom Road
1.3 Geographical Location:	
- Latitude:	28^0 32'
- Longitude:	83^0 44
- Elevation	2740 amsl
2. Hydrological Data	
2.1 Maximum Discharge:	Not available
2.2 Mean Scour Depth	Not available
2.3 Highest Flood Level:	2746.94 amsl
2.4 Lowest Bed Level:	2741.94 amsl
2.5 Vertical Clearance:	1.6m

2.6 Skew Angle:	Perpendicular to river flow.
3. Design Data	
3.1 Type of Superstructure:	Perpendicular to river flow.
3.2 Length of Bridge:	53 m
3.3 Type of Foundation	Open
3.4 Number of Span	2
3.5 Width of Bridge:	7.2 m
3.6 Carriageway width:	6 m
4. Estimated cost of the bridge including protection Works and approach road	**29 million rupees**

Note: The Bridge is designed without calculating maximum discharge and maximum scour depth.

Fig. 5a: Bridge axis. The photo was taken from location of right abutment. The contractor has completed the foundation of the pier. Other works are still not started.

Fig. 5b: Upstream view of the Kaligandaki River from right bank.

Fig. 5c: Collapse of gabion protection works at right bank. Protection walls at both banks are damaged at several locations. These walls were constructed by DDC/local people.

Fig. 5d: Upstream view of the river. The river width at at upstream is about 300m. But the river width at the bridge site 40 m only. Jomsom Bazar is located at about 100m downstream from the bridge site. If the right bank of the river at upstream is not adequately protected, there is high probability of damage to bridge and Jomsom Bazar if there will be substantial increase in flood volume(climate change effect).

Bank protection works at Kagbeni

The following table describes the important aspects of the asset.

Table 7: Salient Features of the Asset

Name of the location	Kagbeni
Name of the road	Jomsom-Kagbeni-Ghoktan
Type of work	Bank protection works
Financed by	Government of India.
Implementing agency	DDC/DTO, Mustang
Location of Asset	About 10 km from Jomsom
Major Aspects of the Asset	- Bank protection walls
Existing Condition of different components	Concrete protection works: good (still under construction) Gabion walls: damaged at some locations

Fig. 6a: Photo showing bank protection wall at upstream from the confluence of Kaligandaki Rvier and Kag Khola. It is a concrete wall and is located at left bank of Kaligandaki River. Concrete walls are rarely used for bank protection works in Nepal. Generally they are made of gabions. It is to be noted that such concrete wall can be replicated at other locations if its performance will be satisfactory.

Fig. 6b: Confluence of Kag Khola with Kaligandaki River. The protection wall are provided at upstream as well as at downstream. The building and platform seen at the left of the photo are constructed to perform Hindu rituals.

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Fig. 6 c: Gabion protection walls are provided along both banks of Kag Khola to protect the Kagbeni settlement. The walls are damaged at several locations due to steep river slope.

3.2 Climate Change Threat to Infrastructures in Mustang District

The study team prepared climate threat profile of Mustang District. The profile is presented in Annex 1 and its brief is presented below.

Threat due to Temperature Increase

As per the threat profiles, the average temperature increase in Mustang District will be 1.7^0 by 2050.

Adverse effect on the road and bridge assets due to above temperature rise will be nominal.

Threat due to Precipitation and Flood Increase

The threat profile indicated the following change on rainfall and flood patterns:

(i) Increasing number of extreme rainfall events – events that now occur every 10 years are projected to occur every 2 years

(ii) Increasing wet season flow on the Kali Gandaki River – peak monthly average flow in wet season will increase by up to 89%

(iii) Increasing flooding frequency of the Mustang River– the one in fifty year return period flow will increase by 78% (from 1006 m3/s to 1790 m3/s) at Mangla Ghat

The above findings show that there will be a substantial increase in frequency and magnitude of extreme discharge. Hence the following aspects need serious consideration while designing road and bridge structures:

Design life: At present the important bridges are designed for 100 years return period and rural road bridges for 50 years return period. The drainage structures, in general are designed for 10, 20 or 25 years depending upon the importance of the roads. In order to accommodate the increased flood volumes, bridges as well as drainage structures should be designed for higher return periods. For example there will be a need to design important bridges for more than 200 years return period (instead of 100), rural road bridges for 100 years return period (instead of 50) and drainage structures for 50 years return period (instead of 25) to accommodate the increasing flood volumes.

Invert level of bridges/culverts: Due to increase in discharge, the high flood level (HFL) will increase. This will require increasing the invert level of bridges/culverts.

Foundation depth of bridges/culverts: The increased discharge will cause more scouring requiring more foundation depth.

Size of drainage structures: Sizes of both side drainage and cross drainage structures should be increased to accommodate increased flood volumes.

Road pavement: Roads lying in low land and adjacent to rivers will be highly affected by increased flood. The wetting of subgrade for longer duration will decrease its strength (CBR) requiring thicker road pavement.

3.3 Vulnerability Assessment Results

The table below presents the vulnerability assessment for the differe*nt components of the asset are presented below.*

Table 8. Vulnerability assessment *of* Kaligandaki Bridge at Jomsom (Assumed that the bridge is already completed)

Climate change threats	Interpretation of threat	Exposure	Sensitivity	Impact Level	Impact Summary	Adaptive capacity	Vulnerability
Component 1: Superstructure							
• Increasing intensity and duration of rainfall • Increasing number of extreme rainfall events • Increasing in wet season flow.	The threat profile shows that the peak average monthly flow will increase by 89 %. If it is assumed that the 100 years return flood will also increase by same amount, the vertical clearance (which is 1.6m) will not be sufficient.	VH[1]	VH[2]	VH	The superstructure will be washed away.	M[3]	VH
Component 2: Sub-structure and foundation.							
• Increasing intensity and duration of rainfall • Increasing number of extreme rainfall events • Increasing in wet season flow	If the discharge increases as mentioned above, the scour depth and flood impact will substantially increase.	H[4]	VH[5]	VH	There is a high probability of foundation failure and impact damage to abutments and pier.	M[3]	VH
Component 3: Bank protection works							

• Increasing intensity and duration of rainfall • Increasing number of extreme rainfall events • Increasing in wet season flow	The bridge is constructed where the river width is minimum. With increase in flood, scouring effect and flood impact will be significantly higher.	VH[6]	H[7]	VH	The bank protection works are frequently damaged by present flood. Higher flood will wash away all protection works.	M[3]	VH
Component 4: Approach roads							
• Increasing intensity and duration of rainfall • Increasing number of extreme rainfall events • Increasing in wet season flow	The flood may overtop the approach roads.	H[8]	M[9]	H	The approach roads will be damaged.	M[3]	H

Notes:

1. *The probability of overtopping of superstructure is very high.*
2. *The sensitivity is very high because the traffic will be interrupted for several months. Bridge reconstruction will be very costly.*
3. *Refer to section 2.2.4.*
4. *The foundation depth and size of sub-structures are fixed without calculating maximum discharge and scour depth. There is high probability of foundation failure and impact damage to abutments and pier.*
5. *The sensitivity is high because the traffic will be interrupted for several months. Cost of bridge reconstruction will be very high.*
6. *The bank protection works are frequently damaged by normal flood. With increase in flood volume they will be washed away..*
7. *There will some loss of lives and properties. Reconstruction cost will also be high.*
8. *The approach roads will be damaged if there will be extreme flood.*
9. *There will be loss of some lives and properties. The road can be opened within few days. The reconstruction cost will not be very high.*

Table 9: Vulnerability assessment of Bank protection works at Kagbeni

Climate change threats	Interpretation of threat	Exposure	Sensitivity	Impact Level	Impact Summary	Adaptive capacity	Vulnerability
Component 1: Bank protection wall							
• Increasing intensity and duration of rainfall; • Increasing number of extreme rainfall events; • Increasing risk and severity due to higher flood	Increase in rainfall intensity/flood will cause more bank erosion and river impact.	VH[1]	H[2]	VH	There is high probability of wall failure	M[3]	VH

Notes:

1. *The wall is constructed very near to main river flow. It is highly exposed to scouring and flood impact.*
2. *There will be loss of lives and properties. The reconstruction cost could be high. The quality of wall is fair to good.*
3. *Refer to section 2.2.4.*

3.4 Asset Vulnerability Summary

Vulnerability summary of both the assets is provided in table 8 and 9.

Table 8. Summary of Vulnerability of Kaligandaki Bridge at Jomsom

THREAT	IMPACT	EXPOSURE	SENSITIVITY	IMPACT	ADAPTIVE CAPACITY	VULN.	COMMENTS
The vertical clearance as provided in design will not be sufficient.	The superstructure will be washed away.	VH	VH	VH	M	VH	The vertical clearance which is 1.6m in design will not be sufficient if the flood increases by 78%. The superstructure will be washed away and the vehicular traffic will be interrupted for years.
The scour depth and flood impact will significantly increase	There is high probability of foundation failure and impact damage to abutments and pier.	H	VH	VH	M	VH	Foundation depth of abutments and pier seems adequate for normal flood. But it is not certain whether they will be sufficient for increased flood.
The impact and scour depth will increase.	The bank protection works are frequently damaged by present flood. Higher flood will wash away all protection works	VH	H	VH	M	VH	The increased flood will transport large amount of gravels and boulders. They will break the gabion wires and cause collapse of the whole protection walls.
The river will overtop the road.	The approach roads will be severely damaged.	H	M	H	M	H	The approach roads are located at higher elevation. They will be damaged in case of extreme flood only. The roads can be rehabilitated within short period.

Table 9. Summary of Vulnerability of Bank protection works at Kagbeni

THREAT	IMPACT	EXPOSURE	SENSITIVITY	IMPACT	ADAPTIVE CAPACITY	VULN.	COMMENTS
Higher flood will cause more scour and impact.	There is high probability of wall failure	VH	H	VH	M	VH	Although the walls are made of concrete, they may fail due to scouring because the foundation depth of the wall, in general, is not more than 1.5 m.

Annex I: Climate Threat Profile of Mustang District (not provided)

Annex II: Design Drawing of Kaligandaki Bridge