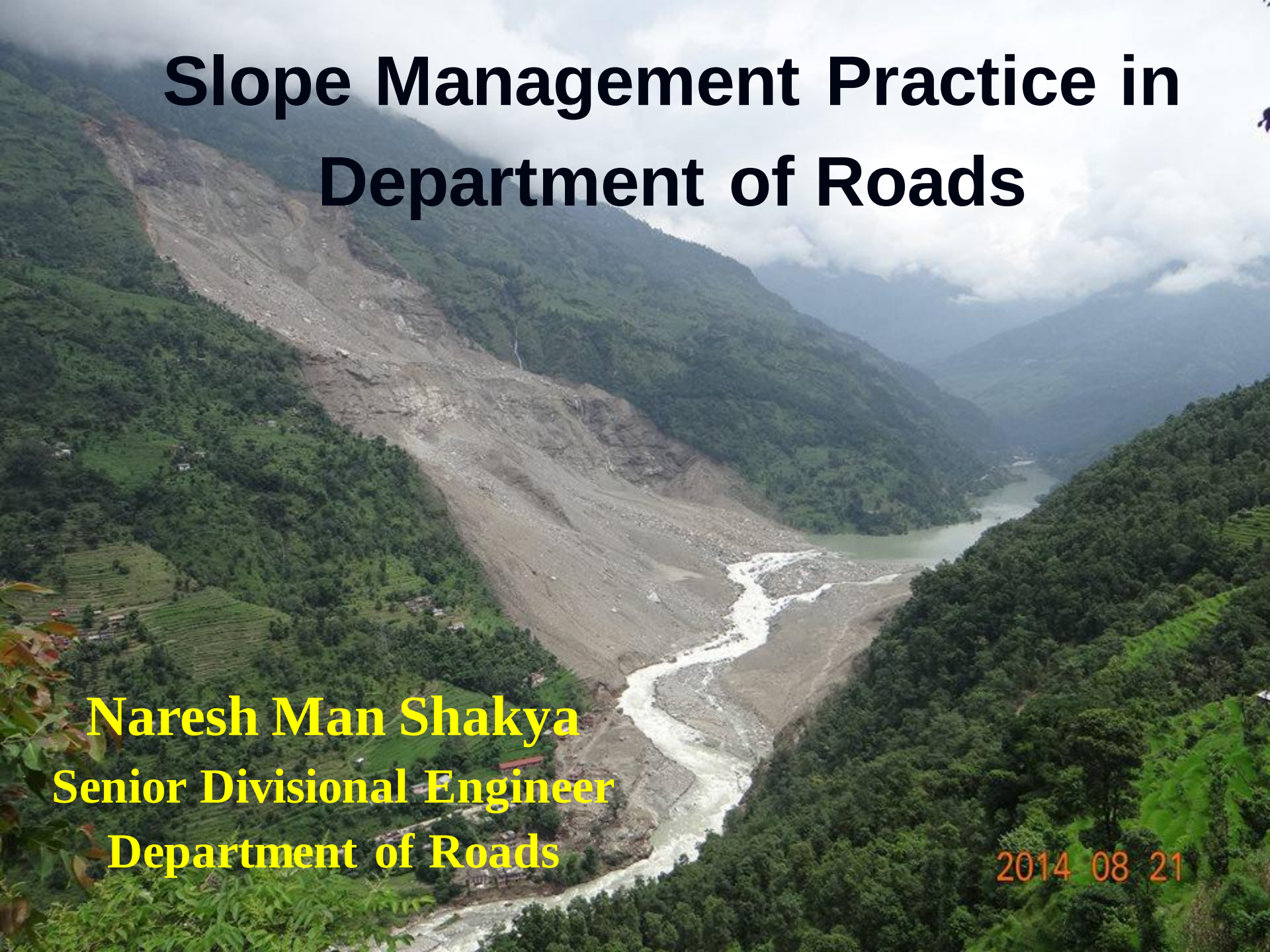
Slope Management Practice in Department of Roads



Naresh Man Shakya
Senior Divisional Engineer
Department of Roads

Nepal in Brief

- Total Area : 147,181 sq km
- Total Road Network: approx. 71,079 kms

  (13,447 kms Strategic Roads, 57,632 kms Local Roads)
- Around 80% of the road network passes through hilly/mountain terrain.

Our Roads

Slope Problems

- Erosion (Rill/gulley),
- Slides: (both translational and deep seated)
- Debris Flow;
- Rock falls.

Erosion : Ramche (Trisuli-Dhunche) 2008

Slides :

(Jure)

Shallow debris slides at close intervals from km 78 to 79 (nearby Mugling) 2003

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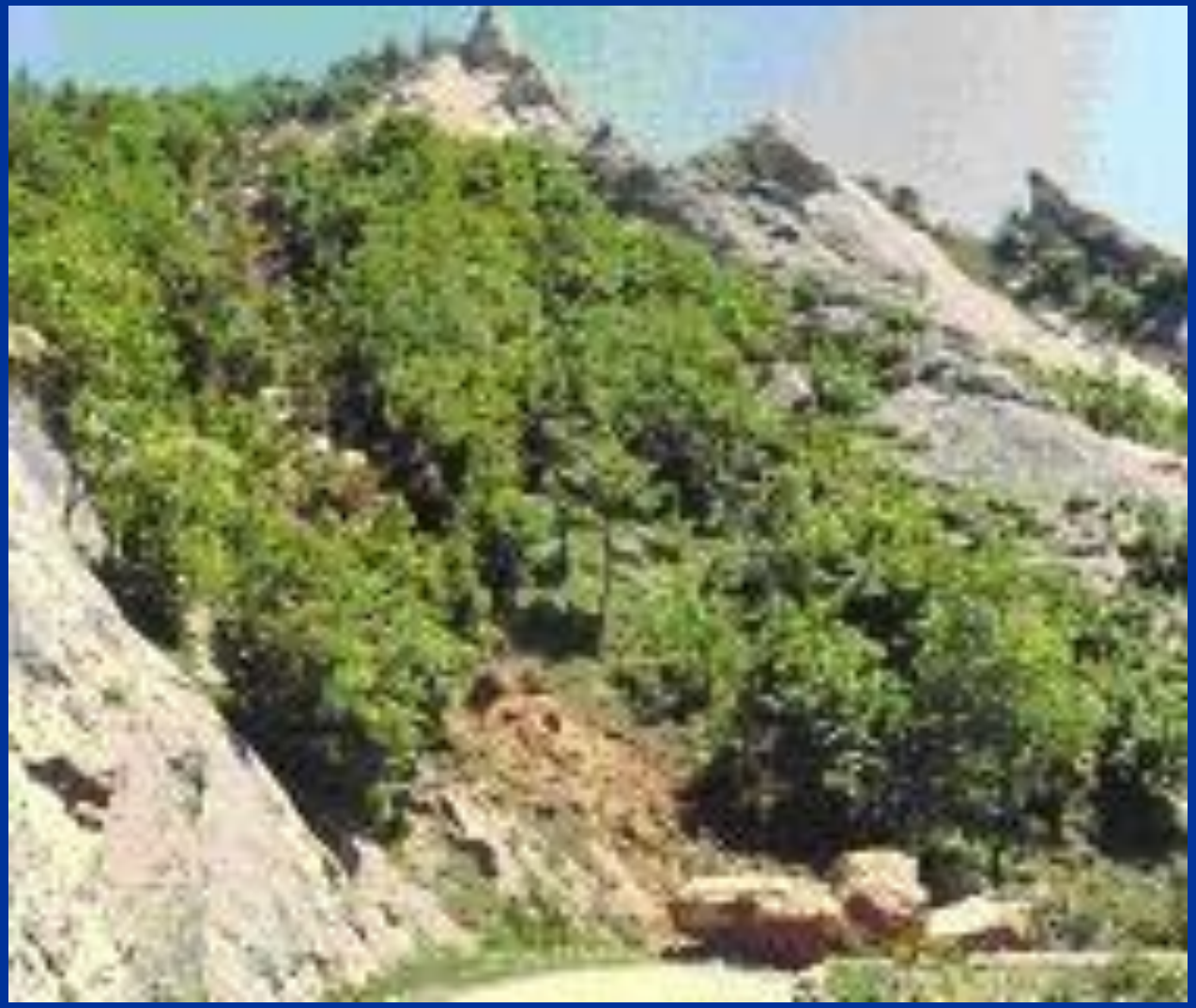
Rotational Slide (Deep Seated Failure)

Loss of road formation and pavements

Debris Flow

Fall



Consequence

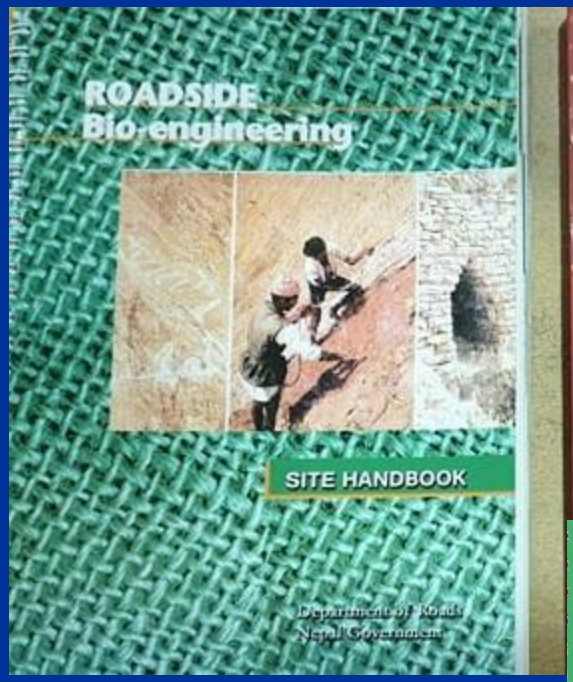
Damaged Khahare Khola Bridge at km 11+300 (Jugedi)

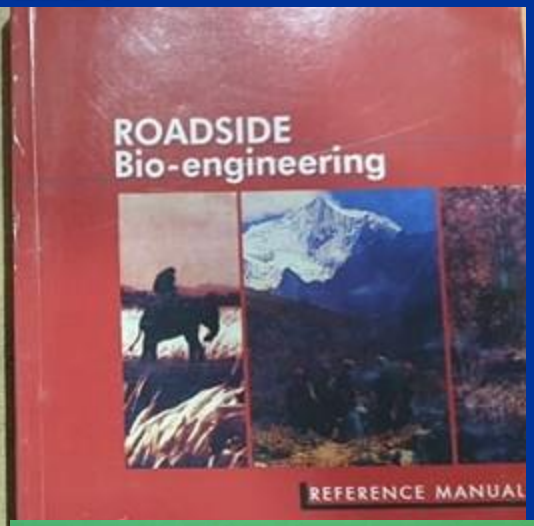
DoR Effort for Slope Management

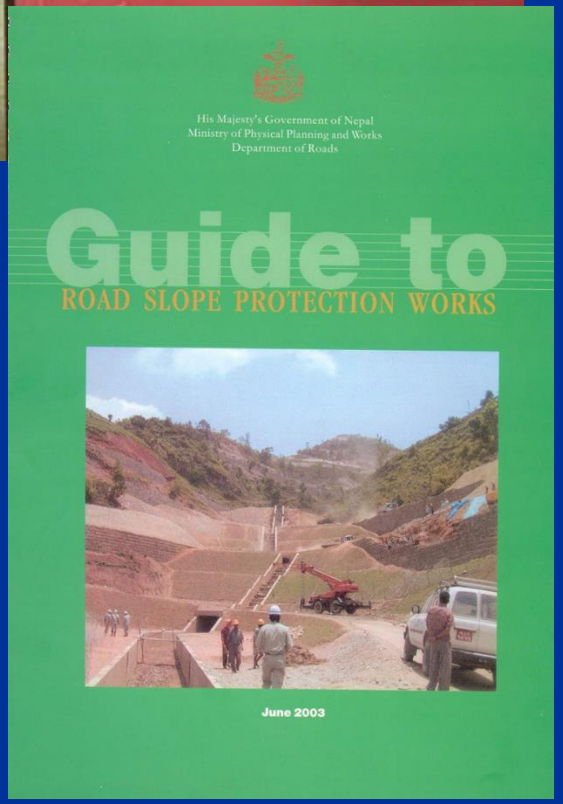
- Dedicated unit : Geo-Environment and Social Unit (GESU) under Design and Planning Branch;

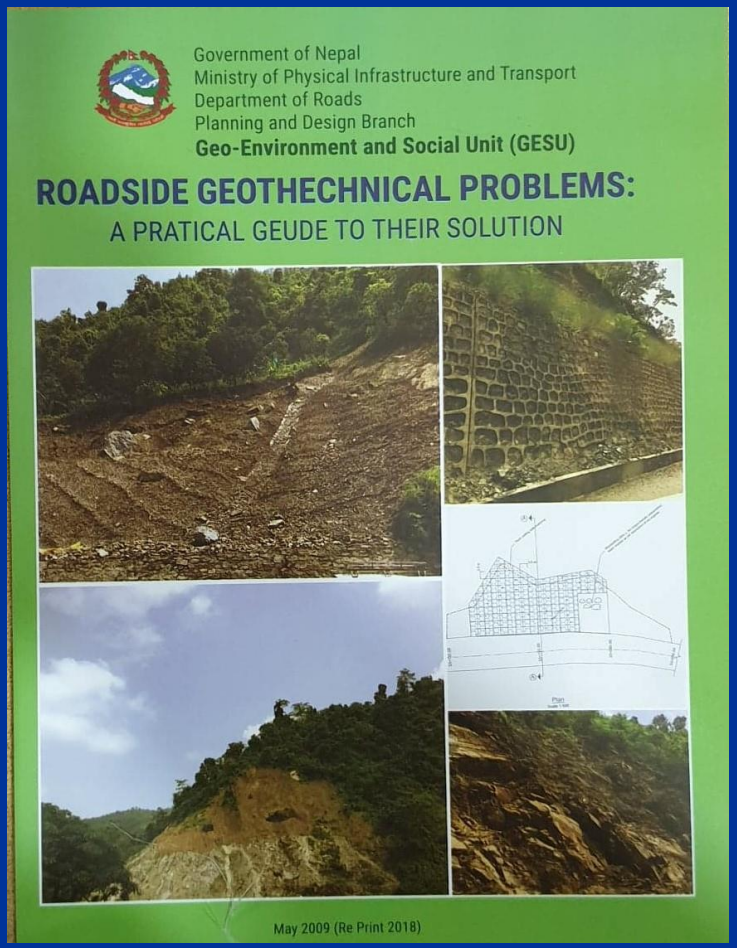
- Dedicated budget for Slope Stabilization e.g. bio-engg. Works, slope rehabilitation / mitigation,
- Emergency fund for dealing with slope related problems;

Publications:









Slope Management

Table 1.2: Framework of Implementation Plan

Time Frame	Time Period	Slope Criteria	Note
a) Emergency Plan	To be implemented urgently (from budget for Emergency works)	Evaluated as Risk Level I on highly important road sections	To be treated as urgent repair work
b) Short term Plan	Within 1 to 2 years	Rated as Risk Level I on important road	Budget & improvement of organisation should be planned
c) Medium-term Plan	Within 3 to 5 years	Master Plan for Strategic Road Network	
d) Long-term Plan	Within 6 to 10 years		

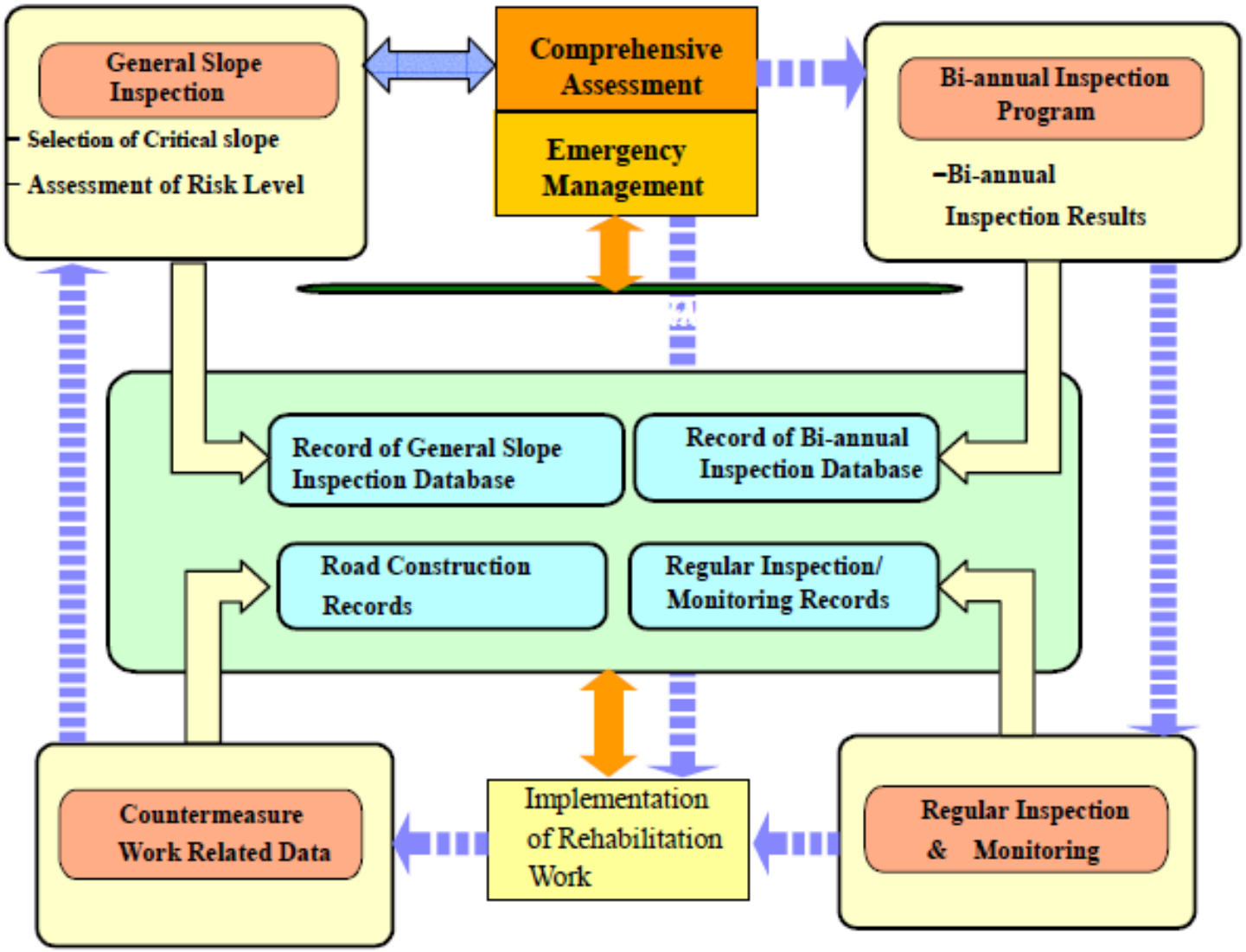


Figure 1.2 Proposed System of Road Slope Disaster Management

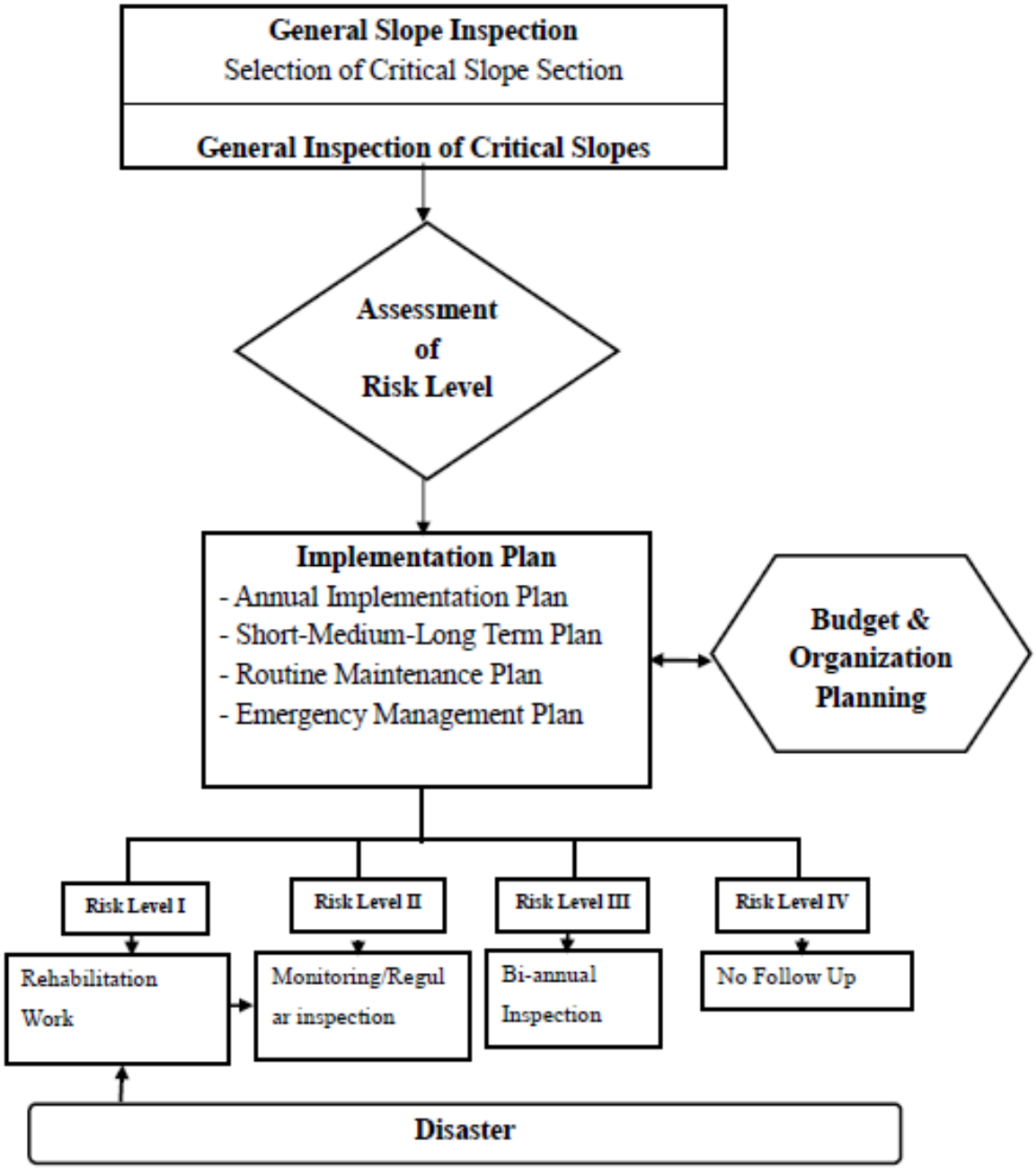


Figure 1.3: General Flow of Risk Assessment

	Hazard		
Consequence	I-High	II-Medium	III - Low
Major a	Ia	IIa	IIIa
Medium b	Ib	IIb	IIIb
Slight c	Ic	IIc	IIIc

Risk = Hazard x Consequences

Risk	DRO Action
High Ia, Ib, IIa	Likely to require DoR/GESU investigation and/or design input
Moderate Ic, IIb, IIc, IIIa, IIIb	Likely to handled by DRO engrs, although specific cases may require budget support
Slight IIIc	Routine

Guidelines for Hazard types & Groups

	Hazard Groups		
Hazard Type	**High I**	**Medium II**	**Low III**
Slope Instability	**Large failures or area of instability, likelyhood of continuing recurring problem**	**Moderate slip or slides, indication of larger potential problems**	**Minor slip or some instability indications, isolated rock fall or soil slip**
Erosion	**Serious erosion problems having current and ongoing impact on road**	**Significant erosion impacting on road**	**Minor erosion not directly impacting on road**
Pavement	**Complete failure**	**Partial failure of carriageway**	**Minor failures not impacting or likely to impact on traffic**
Structure	**Complete failure impacting on road**	**Failure impacting small structures**	**Sign of distress in structure**

Guidelines for Consequences

	Consequences		
Categories	Major a	Medium b	Slight c
Conditions	The road formation may fail at a significant length creating a condition of total road blockage without major interventions. Major investment likely to reinstate road formation.	A part of road formation may fail creating difficulty in vehicular flow. One way operation with adequate traffic safety may reinstate services	Debris deposited on road or failure of shoulder. Two way traffic can be promptly managed after debris clearances.

Table 1.7: Slope Related Database

Description of Database		Responsible Organization
Slope Inspection Record	General Slope Inspection	DRO and Maintenance Branch, DOR
	Regular Inspection Record	Once a month in general; Relevant Standard Forms can be used.(DRO)
	Bi-annual Inspection Record	Two times in a year; before & after Monsoon (DRO)
	Emergency Slope Inspection Record	At the time of emergency Relevant Standard Forms shall be used (DRO)
Monitoring Record	Rainfall data	Annual Rainfall data, Rainfall data related with big scale disasters, (DRO)
	Instrument measurement data of mass movement	Any kind of monitoring records for slope (DRO)
Relevant Slope Management Records	Topographical Maps Soil Investigation Report Countermeasure Works	(DRO)

Table 18: Standard Formats

Description of Standard Formats		Note
Recording Sheet	Slope Inspection Record	Distinct findings thatlikely to lead slope instability shall be recorded.
	Slope Disaster Record	Slope failures affecting road/ traffic operation shall be recorded.
	Slope Countermeasure Record	All types of countermeasures that applied in slopes shall be recorded.
Summary Sheet	Slope Inspection Summary	Lists of all inspected slopes shall be recorded.
	Slope Disaster Summary	List of Slope disasters shall be recorded.
	Slope Countermeasure Summary	List of all slope countermeasures shall be recorded.

Format 5,02

ROAD CLOSURE REPORT FORM

LOCATION

Division Road Office

Highway ☐ Feeder Road ☐ Urban Road ☐

Name of the Road

Chainge (or any description allowing the closure to be located along the road or, location in available topographical map (1: 125,000)

DATE AND DURATION

Road closed on (date) / / at : hrs.

Road reopened to trucks/buses on / / at : hrs.

CAUSE

Slide ☐ Wash-out ☐ Flood ☐ Others

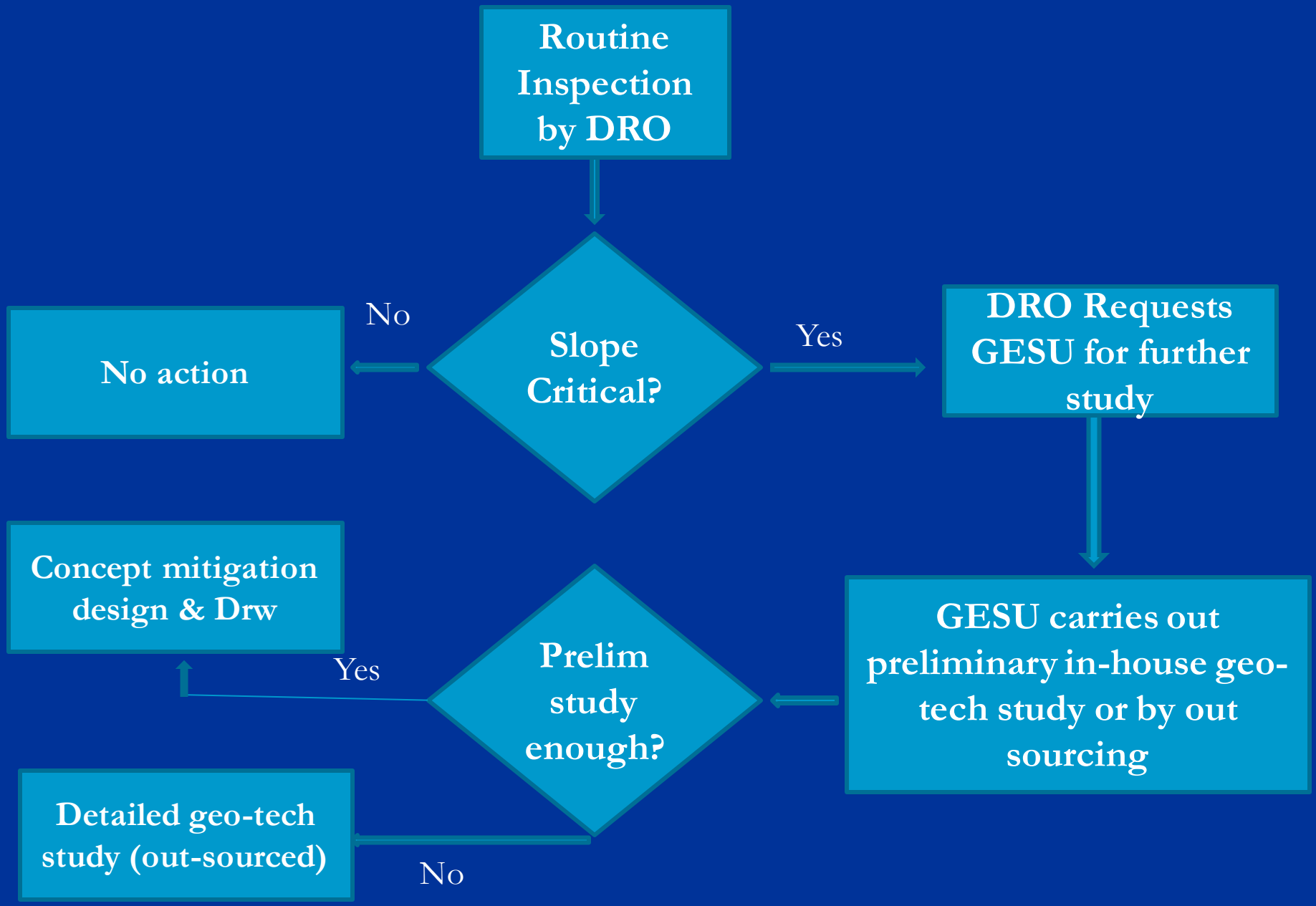
RESOURCES USED FOR REOPENING

Approximate cost (mapower, fuel,materials,etc.) NRs.

Equipment used	Equipment Available on-site (in days)	Equipment Working Hours
1. Tipper		
2. Loader (Make, capacity)		
3. Dozer (Make, capacity)		
4. Backhoe (Make, capacity)		
5. Others (Specify)		

REMARKS

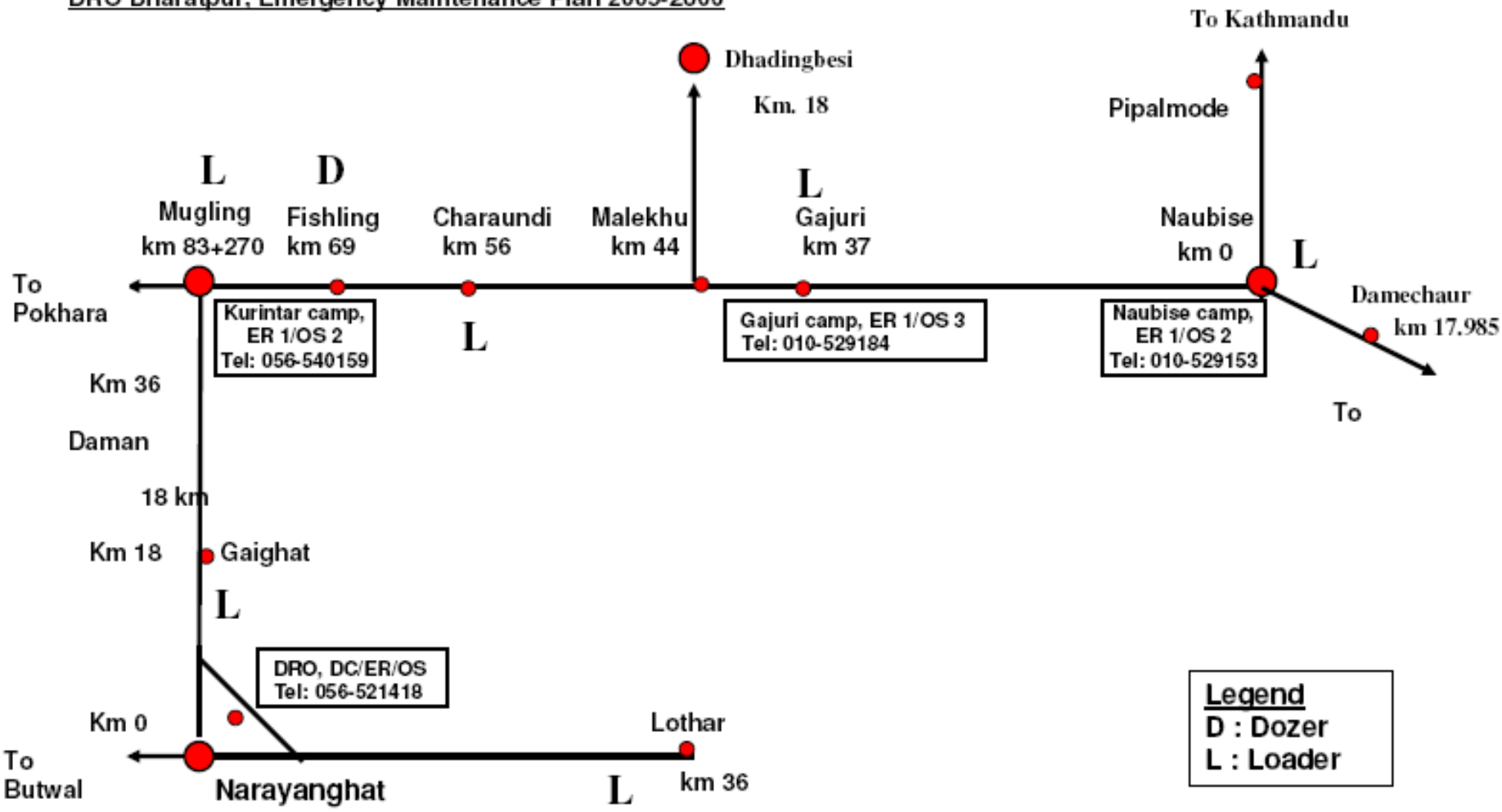
Current DoR Practice


Routine Inspection by DRO
Slope Critical?
No
No action
Yes
DRO Requests GESU for further study
GESU carries out preliminary in-house geo-tech study or by out sourcing
Prelim study enough?
Yes
Concept mitigation design & Drw
No
Detailed geo-tech study (out-sourced)

Resource Deployment Chart to tackle Emergencies

13 Emergency Maintenance Action Plan :

DRO Bharatpur, Emergency Maintenance Plan 2005-2006



Success stories

Km. 42+000 Prithvi Highway

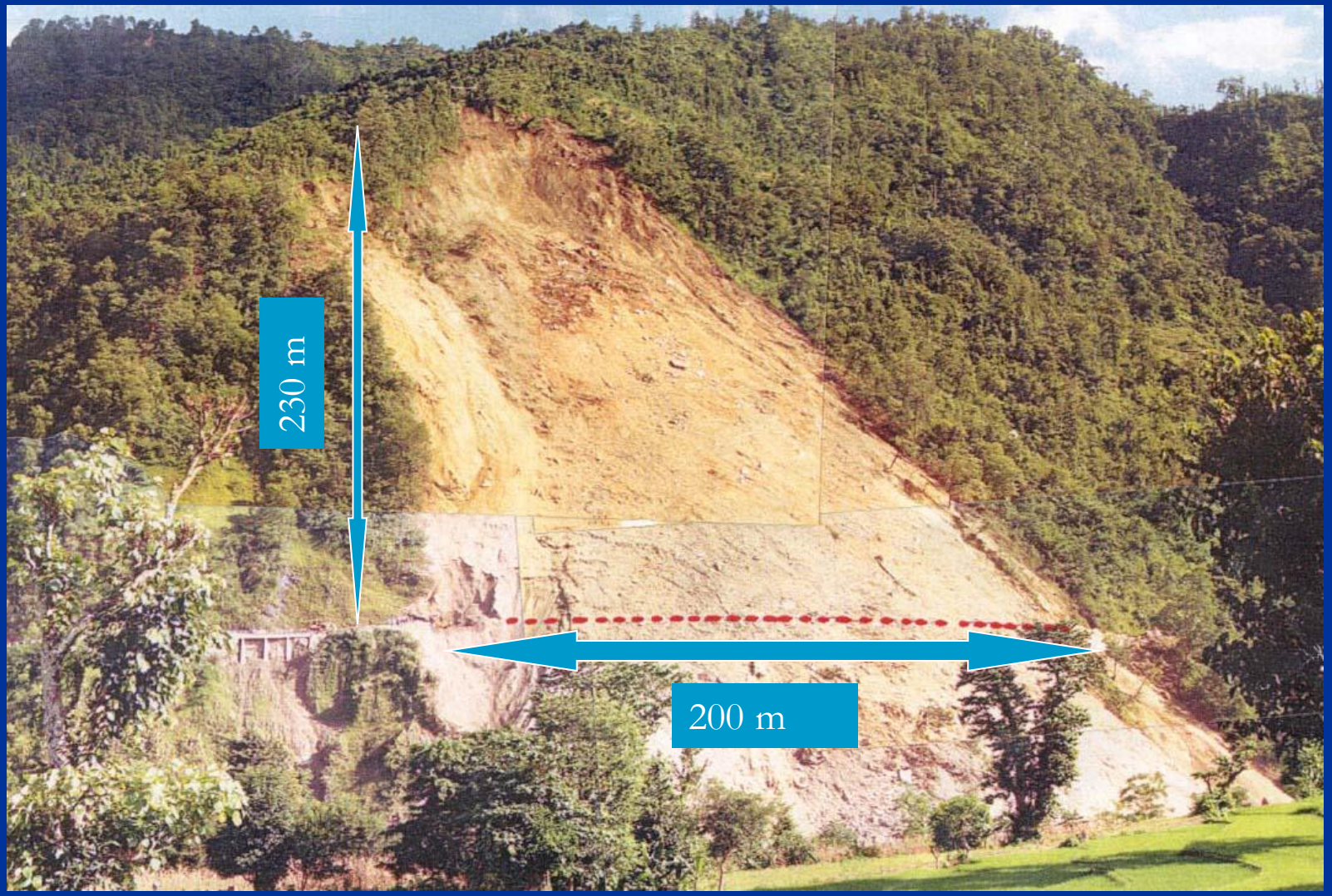
After completion of civil structure & trimming, 2004

After bio-engg, 2009

Krishnabhir Slope Rehabilitation

Prior to Failure of Aug 11, 2000 :

Failure Extent:



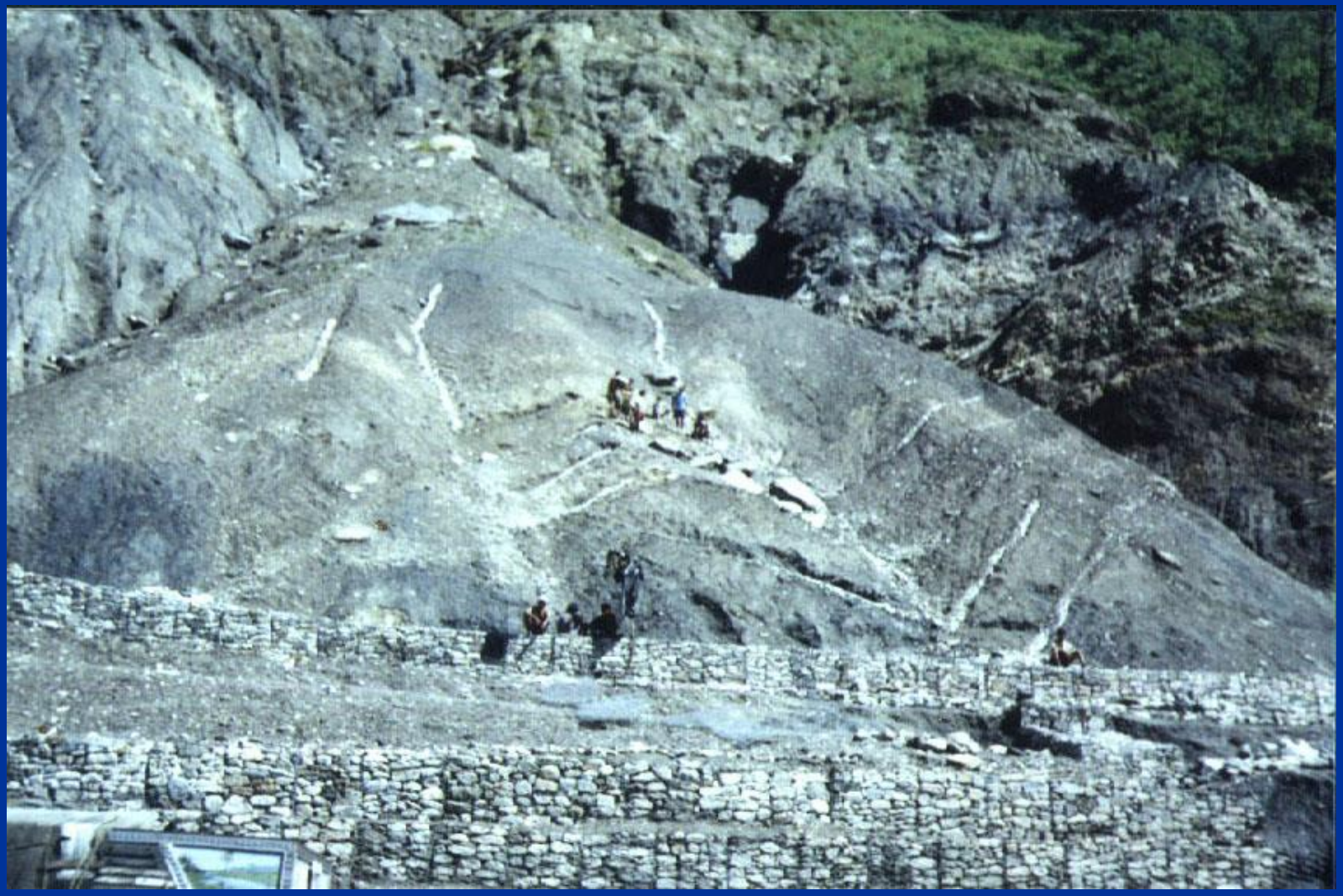
clearing debris

Feb, 2003

After Slope Trimming – July 2003

Underconstruction of Gabion Bolsters –

July 2003



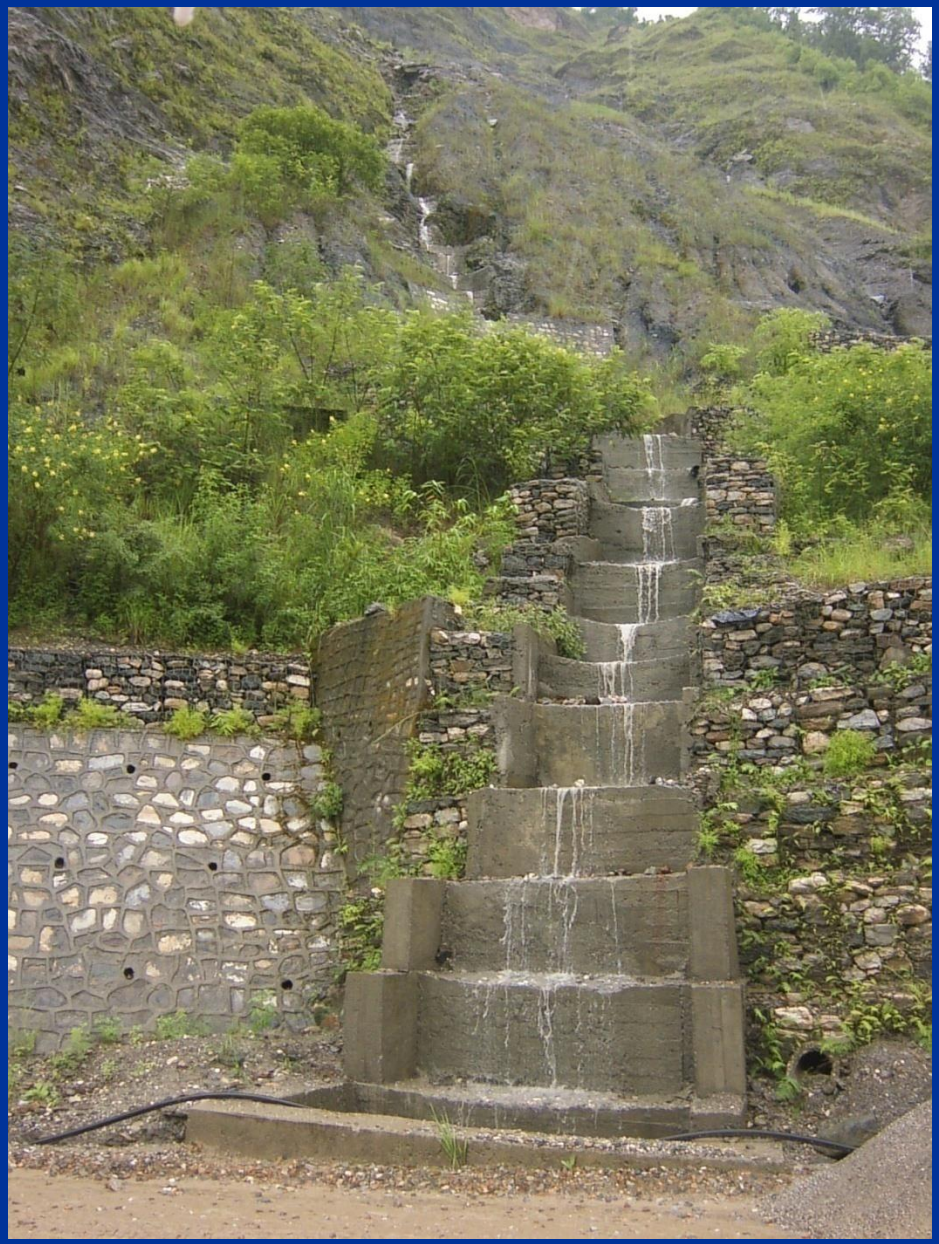
After Plantation August, 2003

August, 2004

April 2007

East Slope : 2003

East Slope after civil & bio_engg : 2006



Managed water flow : 2005

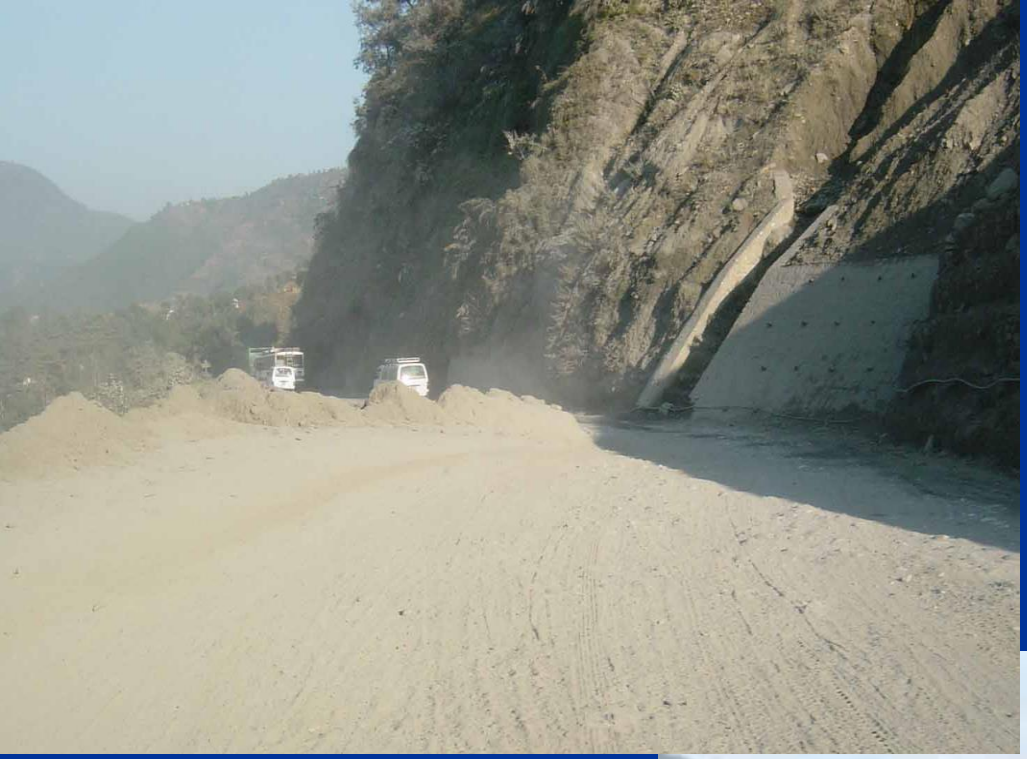
West Gully before Construction of Check Dams 2003

culvert for debris flow 2004

Slope around east cascade 2004

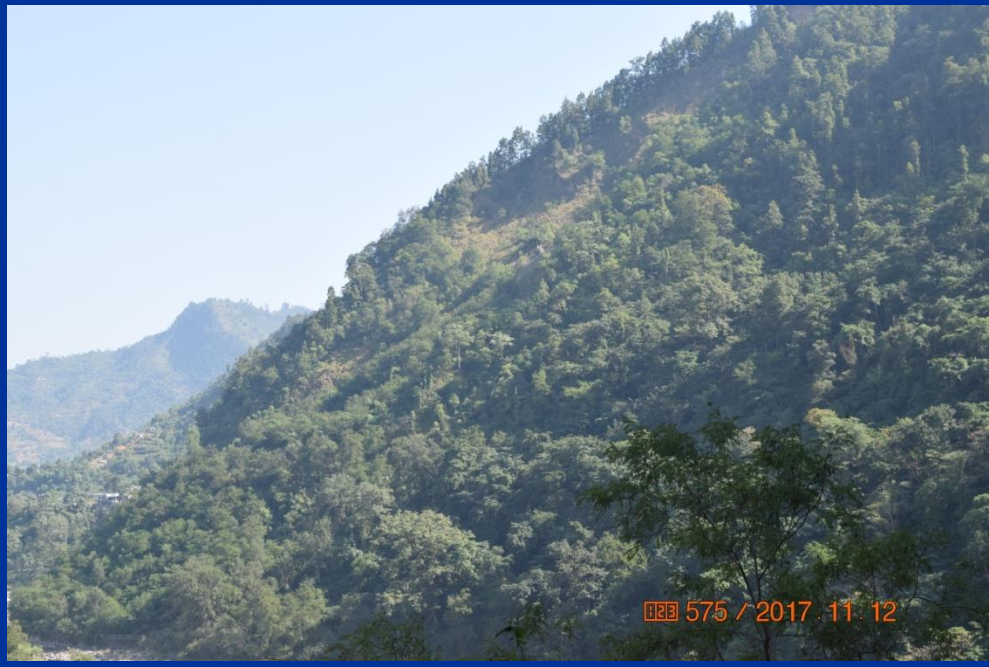
2004

2009



Dusty road surface in the dry season 2003

Road surface in 2005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Times 17 - 23 AUGUST 2007 #362

No news from Krishna Bhir is good news

Ever wondered why this notorious landslide is no more on the front pages?

BADRI PAUDYAL on the PRITHBI HIGHWAY

FIGHTING GRAVITY WITH BIOLOGY: While the vegetation holds the topsoil together, water and debris at Krishna Bhir are managed by check dams, sloping drains and culverts (above). "The great thing about plantsis that they make the slope stronger as they get older," says Naresh man Shakya (left).

Bio-engineering tames Krishna Bhir

कृष्णभीर रोकिने भो

कृष्णभीरको पहिरोमा रोफा

शान्त कृष्णभीर

Expenditures

Expenditure Summary

Fiscal Years	Mitigation Works	Expenditure (in million)
2000 – 2003	Stage 1 (Debris Removal)	15.805
2003 – to date	Stage 2 (Bio & civil Struc)	37.634
	Total	**53.439**

Probable Collaboration with HydroMet Agencies

- Sharing of Rain fall data;
- Providing information to Hydromet agencies the critical road sections

Thank you