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GOVERNMENT OF INDIA
GEOLOGICAL SURVEY OF INDIA

LANDSLIDE INVENTORY ALONG NATIONAL HIGHWAY &STATE HIGHWAY OF GHAT ROADS IN COORG, DAKSHINA KANNADA, UDUPI, SHIMOGA AND CHIKMAGALUR DISTRICTS, KARNATAKA.

(Progress Report for the Field Season 2012-13)
Code No.: LHZ/ SR/ KG/2012/119

By
K.V.Maruthi, Senior Geologist
K.V.Chandran, Senior Geologist

Project: ENGINEERING GEOLOGY
State Unit: Karnataka and Goa
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SUMMARY

In order to implement the proposed action plan 2006 of the National Disaster Management Authority (NDMA) on landslide hazard and risk mitigation and to prepare a landslide database for future landslide studies, landslide inventory of the Ghat section of Western Ghat in parts of Karnataka state has been taken up since F.S. 2007-08. To update the database, an item pertaining to the landslide inventory along National highway (NH) and State highway (SH) roads in Ghat sections was taken up in Mission-IV under 'Engineering geology and Geotechnical investigation programme of GSI: Landslide Hazard Evaluation'. The landslide inventory was carried out along the road-sections of the Western Ghat in Coorg, Dakshina Kannada, Udupi, Shimoga and Chikmagalur districts covering parts of Toposheet nos. 48 P/6, 10, 11, 15& 16; 48 O/2, 3 & 6. The following Ghat road sections (SH and NH roads and main district roads) were covered during the FS 2012-13.

a) Murnad-Virajpet road section (SH-27): 4 landslides
b) Virajpet- Kerala boundary road section (SH-91): 18 landslides
c) Virajpet-Siddapur road section (SH-90): 2 landslides
d) Ammati-Polibetta-Siddapur road section (district road) and Murnad-Napoklu-Baghmandala road section (SH-90): 6 landslides
e) Sulya-Subramanya road section (district road): 7 landslides
f) Madikeri-Sulya road section (SH-88): 6 landslides
g) Shimoga-Tirthahalli road section (NH-13): 5 landslides
h) Tirthahalli -Someshwar road section (SH-01): 9 landslides
i) Tirthahalli-Koppa (NH-13): 2 landslides
j) Koppa-Narsimharajpura road section (SH-65): 2 landslides

The present study reveals that most of the landslides are shallow (<2m depth) debris slides/slumps with the height of the cut-slope as well as the inclination playing a major role in triggering the slides as the slides are confined to cut-slopes. The study also reveals that majority of the slides are restricted to the cut slopes having more than 10m height and quite a steep slope angle varying between 70^0 and 90^0. The relative relief from the cut-slope has also been low to moderate varying between 5m to 20m at all sections with overburden varying from 0.5-4.0 m. The main causes of landsliding in the Western Ghat are toe-cutting of hill slopes for the construction of road and slope modification for human settlements. In addition, the presence of highly weathered rock mass and the impact of heavy rainfall may be the aiding factors. Intense action of water is known to favour weathering of rocks that would in turn cause drop in the shearing resistance. The heavy rainfall in the Western Ghats during monsoon is in general known to trigger most of landslides in the area. Slide specific recommendations for each slide are provided. The generalized recommendations for the study area are as follows: i) Vertical cut slopes should be avoided in future as it does not

give stability in such terrain. ii) The geometrical modification of the slope by grading or bench to be provided. iii) Bio geotechnical measures of slope protection like plantation of Vetiver grass along the slope will reinforce most of the slides. iv) Proper surface drainage, drainage at toe and horizontal drainage are also recommended.

कर्नाटक राज्य के कूर्ग, दक्षिण कन्नड, उडुपी, शिमोगा व चिकमगलूर जिलों में राष्ट्रीय मार्गों व राज्य मार्गों के घाट प्रखंडों के किनारे भूस्खलन का सूचीकरण

(कार्य सत्र 2012-2013 का प्रगति प्रतिवेदन)

क्रमांक भू आ अ व/द क्षे/क गो/2012/119

द्वारा

के.वी.मारुति, वरिष्ठ भूविज्ञानी

के.वी.चंद्रन, वरिष्ठ भूविज्ञानी

सारांश

भूस्खलन आपदा व जोखि**म** न्यूनीकरण पर राष्ट्रीय महाविपदा प्रबंधन प्राधीकरण (एन एम डी ए) द्वारा प्रस्तावित कार्यवाही योजना 2006 को कार्यान्वयित करने के लिए व भविष्य में भूस्खलन अध्ययन के लिए भूस्खलन संबंधी डाटाबेस को तैयार करने के लिए कर्नाटक राज्य के पश्चिमी घाट के घाट प्रखंडों में भूस्खलन सूचीकरण का कार्य 2007-08 से आरंभ किया गया. डाटाबेस के नवीकरण के लिए, मिशन-**IV**: 'भारतीय भूवैज्ञानिक सर्वेक्षण के अभियान्त्रिकी भूविज्ञान व भूतकनीकी अन्वेषण कार्यक्रम: भूस्खलन आपदा आकलन' के अन्तर्गत घाट प्रखण्डों में राष्ट्रीय मार्ग (एन एच) व राज्य मार्ग (एस एच) के किनारे भूस्खलन सूचीकरण से संबंधित यह कार्य किया गया. भूस्खलन सूचीकरण का कार्य कूर्ग, दक्षिण कन्नडा, उडुपी, शिमोगा व चिकमगलूर जिलों में पश्चिमी घाट के प्रखण्डों में किया गया जो स्थलाकृतिक सं. 48 पी**/6,** 10**,** 11**,** 15 व 16**;** 48 ओ/2**,** 3**,** व 6 में आते हैं. 2012-13 कार्य सत्र के दौरान निम्नलिखित घाट प्रखंडों (राज्य मार्ग व राष्ट्रीय मार्ग व मुख्य जिला मार्ग) में कार्य किया गया:

अ) मर्नाड-विराजपेट मार्ग (राज्य मार्ग-27): 4 भूस्खलन

आ) विराजपेट- केरल सीमा मार्ग (राज्य मार्ग-91**)**: 18 भूस्खलन

इ) विराजपेट-सिद्दापुर मार्ग (राज्य मार्ग-90): 2 भूस्खलन

ई) अम्मटी-पोलिबेट्टा-सिद्दापुर मार्ग (जिला मार्ग) व मर्नाड-नपोक्लु-बघमण्डला मार्ग (राज्य मार्ग-90)**:** 6 भूस्खलन

उ) सुल्या-सुब्रमण्या मार्ग (जिला मार्ग) : 7 भूस्खलन

ऊ) मडिकेरी-सुल्या मार्ग (राज्य मार्ग-88): 6 भूस्खलन

ऋ) शिमोगा-तिरथहल्ली मार्ग (राष्ट्रीय मार्ग-13): 5 भूस्खलन

ऌ) तिरथहल्ली-सोमेश्वर मार्ग (राज्य मार्ग-01): 9 भूस्खलन

ऍ) तिरथहली-कोप्पा (राष्ट्रीय मार्ग-13): 2 भूस्खलन

ऎ) कोप्पा-नरसिंहराजपुरा मार्ग (राज्य मार्ग-65): 2 भूस्खलन

वर्तमान अध्ययन से यह ज्ञात होता है कि अधिकतर भूस्खलन (**<2** मीटर गहरे) उथले मलबे**,** स्खलन/अवसर्पण है. खडी ऊँची ढाल व झुकाव फिसलन को प्रवर्तित करने में मुख्य भूमिका अदा करती हैं चूंकि फिसलन खडी ढाल तक ही सीमित है. अध्ययन से यह भी ज्ञात होता है कि अधिकतर फिसलन 10 मीटर ऊँचाई व 70° व 90° के बीच में परिवर्तित अतिप्रवर ढाल तक सीमित हैं. खडी ढाल की सापेक्ष ऊँचाई निम्न से सामान्य भी है**,** जो सभी प्रखण्डों पर 5 मीटर से 20 मीटर के बीच में परिवर्तित है व उपरिभार 0.5-4.0 मीटर के बीच में परिवर्तित है. पश्चिमी घाट में भूस्खलन के मुख्य कारण मार्ग निर्माण के लिए गिरि ढाल के निचले स्तर पर कटाव व मानवीय बसाहट के लिए ढाल परिवर्तन हैं. इसके अलावा अति अपक्षयित चट्टान पिण्ड की उपस्थिति व भारी वर्षा को सहायक घटक माना जा सकता है. भारी वर्षा से चट्टानों के अपक्षय में वृद्धि होती है जो अपरूपण प्रतिरोध में कमी का कारण हो सकता है. मानसून के दौरान पश्चिमी घाट में भारी वर्षा सामान्यत: क्षेत्र में भूस्खलन को प्रवर्तित करने का कारण माना जाता है. हर एक फिसलन के लिए फिसलन विशेष अनुशंसा दी गई है. अध्ययन क्षेत्र के लिए दी जा रही व्यापीकृत अनुशंसा इस प्रकार है **i)** भविष्य में ऊर्ध्वाधर खडी ढालों से बचना चाहिए चूंकि ऐसे भूभाग में इसके स्थायित्व न के बराबर है. **ii)** संतुलन या कगार निर्माण द्वारा ढाल का ज्यामितीय परिवर्तन किया जाना. **iii)** ढाल संरक्षण के जैव भूतकनीकी उपाय जैसे ढाल के किनारे वेटिवेर घास का रोपण द्वारा अधिकतर ढालों को प्रबल बनाना. **iv)** उचित सतही अपवाह तंत्र**,** ढाल के निचले स्तर पर अपवाह तंत्र व क्षैतिज अपवाह तंत्र की भी अनुशंसा की जाती है.

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I. INTRODUCTION

Geological Survey of India, being the Nodal Agency for Landslides in India since 2004, vigorously and swiftly started integrated approach towards landslide hazard studies which included site specific landslide studies, landslide hazard zonation along road corridors and townships and preparation of landslide inventory. As far as State unit: Karnataka and Goa of Geological Survey of India is concerned Landslide inventory was first carried out during FS 2007-08 in the states of Karnataka and Goa separately.

In order to implement the proposed action plan 2006 of the National Disaster Management Authority (NDMA) on landslide hazard as well as risk mitigation and also to prepare a landslide database, preparation of an inventory on landslides at various stretches under the Western Ghat in parts of Karnataka state has been taken up. The Engineering Geology Division under the State unit of Karnataka and Goa has been preparing systematically, the landslide database of Karnataka since 2007-08. To update the landslide database, a field season item pertaining to landslide inventory along National Highways(NH) as well as State Highways (SH) at the Ghat sections was taken up under the annual programme (Code: LHZ/SR/KG/2012/119) of Mission IV related to Engineering geology and Geotechnical investigation programme of Landslide Hazard Evaluation.

During 2012-13, the landslide inventory was carried out along the road-sections of the Western Ghat in Coorg, Dakshina Kannada, Udupi, Shimoga and Chikmagalur districts covering parts of Toposheet nos. 48 P/6, 10, 11, 15& 16; 48 O/2, 3 & 6

I.1 LOCATION

Karnataka is bound by the Arabian Sea in the west, Goa and Maharashtra in the northwest and north respectively and Tamilnadu and Kerala to the south. During the FS 2012-13, landslide inventory was carried out along the ghat roads in the Western Ghat belt covering districts of Coorg, Dakshina Kannada, Udupi, Shimoga and Chikmagalur (Plate-1). The Western Ghat belt, known for its thickly vegetated forests and mineralization, is an irregularly elongated NW-SE trending belt. In Karnataka, the Western Ghats extend from Coorg district in the south to Uttar Kannada district in the north.

I.2. NATURE AND QUANTUM OF WORK

Nature of Work	Total work envisaged	Work proposed for FS: 2012-13	Work completed
Aerial photo / Image interpretation	500 sq.km	500 sq.km	500 sq.km
Inventory in 1:50,000 scale	250 L km (At least 1 km on either side of the road)	250 L km (At least 1 km on either side of the road)	279 L. Km (61 Landslide incidences)

I.3. PRESENT WORK

During the FS 2012-13, landslide inventory was carried out along ghat roads in the Western Ghat belt. A total of 279 line km was covered and 61 incidences of landslides were recorded.

The following Ghat sections (NH & SH roads and main district roads) were covered.

A) Landslides recorded along Murnad-Virajpet road section (SH-27): 4 landslides are recorded in this ghat section for nearly 16 km stretch *(Plate 3).*

B) Landslides recorded along Virajpet- Kerala boundary road section (SH-91): 18 landslides are recorded in this ghat section for nearly 30 km stretch. 5 debris slides 10 slumps including debris and earth, 2 rock falls and 1 composite slide noticed in the area. Some slides are provided with remedial measures in the form of retaining wall & stone pitching *(Plate 3).*

C) Landslides recorded along Virajpet-Siddapur road section (SH-90): 2 landslides are recorded in this ghat section for nearly 10 km stretch *(Plate 3).*

D) Landslides recorded along Ammati-Polibetta-Siddapur road section (district road) and Murnad-Napoklu-Baghmandala road section (SH-90): 6 landslides are recorded along 26 km stretch of this ghat section *(Plate 3).*

E) Landslides recorded along Sulya-Subramanya road section (district road): 7 landslides are recorded along 41 km stretch of this ghat section *(Plate 4).*

F) Landslides recorded along Madikeri-Sulya road section (SH-88): This section was already completed during earlier field seasons (FS 2007-08 &2008-09) but due to widening of road (SH-88) 6 new landslides were recorded in this ghat section for nearly 36 km stretch *(Plate 5).*

G) Landslides recorded along Shimoga-Tirthahalli road section (NH-13): 5 landslides are recorded in this ghat section in between nearly 30 km stretch *(Plate 6).*

H) Landslides recorded along Tirthahalli -Someshwar road section (SH-01): 9 landslides were recorded in this ghat section in between nearly 40 km stretch *(Plate 7).*

I) Landslides recorded along Tirthahalli-Koppa (NH-13): 2 landslides are recorded in this ghat section in between nearly 30 km stretch *(Plate 6).*

J) Landslides recorded along Koppa-Narsimharajpura road section (SH-65): 2 landslides are recorded in this ghat section in between nearly 20 km stretch *(Plate 6).*

I.4. METHODOLOGY ADOPTED FOR PREPARATION OF LANDSLIDE INVENTORY

1. The data on the earlier landslides were collected wherever available from the offices of the District Commissioners, PWDs and other district authorities.
2. Prioritization of the landslides for inventory: i.e., the road sections, where relatively more number of landslide incidences reported, were taken up on priority basis.
3. As relatively a large number of landslides were reported in Coorg district (Mishra, 2007), important district roads were given priority.
4. Only insufficient data could be obtained from aerial photographic study as the magnitude of landslides are relatively small and no temporal data was available. However, the details of the Aerial photographs studied are given separately in section I.6.
5. The data sheet including different PARAMETERSs on the landslides for Landslide inventory studies was used.(Appendix 1)
6. The check list table was prepared i.e., which road section to be carried out first, whether any data of reported landslides are available, consultation of aerial photos etc.,
7. Individual sites were meticulously studied and discrete measurements of various components were made.
8. During the field season 2007-08, the system of giving a unique ID number to individual landslides to enable storage in an appropriate landslide inventory database (Mishra & Pradhan, 2010) was started. For the landslides in Karnataka, the numbers were given as KA-01, KA-02 etc. Accordingly, during 2008-09, the landslides were numbered between KA-65 and KA-278 (Maruthi & Mishra, 2011). The sequence was continued in the subsequent years (Maruthi et.al, 2011, Maruthi & Chandran, 2012) and the first slide studied during the current study is assigned the number KA-577.
9. As many of the landslides lack data on the exact date of occurrence, the date on which landslide data was collected was taken as a criteria for assigning the ID numbers.
10. The numbers of images captured on a particular landslide is shown in parenthesis as KA-388 (1), KA-388 (2)… etc and the images are stored in the inventory database in 'jpeg' format.
11. The data is entered and stored in an Excel format as per the check-list. A copy lies with the Dy.DG, SU: Karnataka and Goa and the Director EG would be holding safe custody of the data.

I.5. MORPHOMETRIC DEFINITIONS

A list of commonly used 'Landslide morphometric terminology' (after Brunsden 1973) and its definition is furnished below. Also a diagrammatic representation is also presented in Plate-2.

Crown: Top most part of a landslide.
Head: The upper part of the landslide.
Toe: Bottom most part of a landslide
Length of a slide: Maximum length of the failed mass from crown to toe (in meters).

Width of a slide: Maximum width of failed mass from the left flank to the right flank boundary (in meters).
Depth of a slide: Maximum depth of the failed mass from the surface of the slide to the failure surface (in meters).
Volume of a slide: Volume of the failed mass above the failure surface (in meters).
Horizontal equivalent (HE): Plan distance from the crown of scarp to the foot of the failed mass (in meters).
Vertical interval (VI): Vertical height between the crown and foot of the failed mass (in meters).
Failure angle: slope angle at which failure takes place (in degrees).
Repose angle: Slope at which failed mass comes to rest (in degrees).
Slope angle - pre failure: Angle of slope before the failure (in degrees).
Slope angle - post failure: Angle of slope after the failure (in degrees).
General slope gradient: General slope angle from divide to stream (in degrees).
Direction of slide: Direction of slide taken at the centre of the slide.
Scarp width: Width of the scarp at the head of the failed mass (in meters).
Scarp depth: Length of the line which bisects the scarp width and measured from the scar width position to scarp head.
Scarp radius: Radius of the circle which 'best fits' the scarp shape.

I.6. AERIAL PHOTO STUDIES:

Following aerial photographs were studied for the purpose of preparing the Landslide inventory.

Toposheet	Task	Run Nos.	Photo nos	Toposheet	Task Nos.	Run Nos.	Photo nos
48O/2	570A	6	7-19	48P/10	570A	71	18-23
		44	10-16			72	16-21
		48	10-16			73	17-23
		7	1-6	48P/11	570A	31	5-11
48O/3	570A	61	10-15			32	3-8
		59	10-15			74	15-20
		53	10-15			75	13-18
48O/6	570A	6	20-30	48P/12	570A	80	19-23
		7	7-13			80	14-18
		44	17-22			82	1-5
		48	16-21			83	18-21
		10	14-16	48P/15	790A	12	11-21
48P/6	570A	71	12-17			13	11-19
		72	10-15			14	13-22
		73	12-16			15	11-19

I.7. CONSTRAINTS, LIMITATIONS & ASSUMPTIONS

1. Collection of complete data on many of the landslides might not have been possible in many places due to inaccessibility to the Crown/ Head portions of landslides and hence some measurements like scarp depth/width were visually estimated and inferred.
2. The radius of scarp is visually estimated

3. The angle of repose and angle of failure were taken based on the presently existing slope although the actual affected surface might be different.
4. The vertical interval and horizontal extensions were calculated from slide length and failure angle.
5. The task of studying the landslides with the help of either satellite imagery or the aerial photograph is difficult and time consuming as the magnitude of the slides in the Western Ghats is relatively small. Due to extensive developmental activity in the area that has resulted in modification of slopes in recent times, many of the earlier landslides could not be spotted in the aerial photographs. Besides, recent aerial photographs and temporal imageries were not always available.
6. Weathering is deciphered either at the site or at a nearby *nala* sections.

I.8. ACKNOWLEDGEMENTS

The authors are sincerely thankful to Dy.Director General, SU: Karnataka and Goa for support and guidance. They are thankful to Shafeeq Ahamed, Director for supervising the work and scrutiny of the report. Without the data provided by the district authorities, locating slides would have been a difficult task. In this regard authors are grateful to the District Commissioners, officials from PWD and officials from Revenue Department Govt. of Karnataka.

II. REGIONAL GEOLOGY

The landslide inventory study forms a part of Western Ghats that grade into a plateau towards east. The area exposes Late Archaean rocks (<3000 ma) viz., Peninsular Gneiss-I of Tonalite-Trondjhemite-Granodiorite composition as well as Middle Archaean (>3000 ma) Sargur Group, with ultramafic-mafic intrusive complex, serpentinised komatiitic and thoeliitic amphibolites, etc. in addition to lower to middle Archaean (≈ 3400 ma) older Gneisses. The Sargur Group is represented by a number of enclaves within gneisses and granites and the enclaves are quartzite, amphibolite, iron formation, garnetiferous mica schist, kyanite-staurolite schist, silimanite-garnet schist, calc-silicate rock and ultramafics. The Charnockite Group forms a major rock unit in the SW part of Coorg district and comprises hornblende diopside granulite, calc granulite and charnockite and pyroxene granulite. The Peninsular Gneiss of this region is a complex of migmatitic gneiss and granitoids and includes biotite gneiss, hornblende-biotite gneiss and hornblende gneiss. The peninsular gneiss is unconformably overlain by the Dharwar Supergroup (Bababudan Group). Bababudan Group is represented by four formations, namely (a) Walkunje Formation (b) Kudremukh Formation (c) Kodchadri Formation and d) Narasiparvata Formation. The Walkunje Formation represents the lower arenaceous and argillaceous member of the Bababudan Group. Other rock members associated with it are quartzites, quartz-sericite schist, greywacke, arkose and quartz-biotite-chlorite schist. Kudremukh Formation comprises amygdular metavolcanics, amphibolite, actinolite-chlorite schist, Meta gabbro and ultramafics with interbeds of quartzite, quartz-sericite schist and chlorite schist. Kodchadri Formation comprises of banded magnetite quartzite and quartz-chlorite-sericite schist. The Narasiparvata Formation comprises of acid porphyries, chlorite quartz schist and iron stones. Stratigraphically, the area exposes rocks belonging to Sargur Group, Peninsular Gneisses-I, Charnockite Group, Migmatite Complex, Bababudan Group and Chitradurga Group of rocks. Acid and basic intrusives are common. The majority of the rock sequences are lateritised that occur as extensive cappings in the Western Ghats and in coastal plains. (Anantharamu et.al, 1984; Awasthi, 1981; Balasubramanyan, 1969; Harendranath & Reddy, 1994; Pazhamalainathan et.al, 1982; Pazhamalainathan et.al, 1982[1]; Shafeeq Ahamed & Balachandran, 1983; Shafeeq Ahamed et.al, 1986; Venkatraman, 1968; Venkatraman, 1969).

III. DESCRIPTION OF INDIVIDUAL LANDSLIDES

III.1.Landslides recorded along SH-27 between Murnad-Virajpet road section

SLIDE NO: KA-577

LOCATION: The slide is located at latitude 12° 16′ 53.8″ N and longitude 75° 45′ 15.9″ E in Survey of India toposheet No 48 P/15 along SH-27 between Murnad-Virajpet road section, Virajpet Taluk, Coorg district (Near bridge on SH-27 from Murnad towards Virajpet).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated debris slide (first occurred during July 2010). The debris consists of highly weathered rock particles consisting of gneiss with size ranging from boulders to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 2.0 m. The depth of weathering is > 10.0 m. SH-27 is the "element at risk", which constitutes the sole landuse of the area. Weathered gneiss is the exposed rock type in the area. The head and crown parts of the slide are stable where as toe part is unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 12.0 m (Photo 1).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	10.6 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	30.7 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	81.4 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	30°
h.	Run out distance / up to	:	12.0 m/ SH-27
i.	Cut slope Height	:	12.0 m
j.	Direction of slide	:	Towards east

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall with ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: SH-27 road was affected as fallen debris has blocked the road.

RECOMMENDATION: Removal of fallen debris from toe, Slope easing in the form of benches and proper lined drainage at toe are recommended.

SLIDE NO: KA-578

LOCATION: The slide is located at latitude 12° 13′ 13.1″ N and longitude 75° 46′ 59.8″ E in Survey of India toposheet No 48 P/15 along SH-27 between Murnad-Virajpet road section, Virajpet Taluk, Coorg district (After Kadnur on SH-27 from Murnad towards Virajpet).

SLIDE DESCRIPTION: The slide is classified as an old debris slide. The debris consists of highly weathered rock particles consisting of gneiss with size ranging from boulders to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 2.0 m. The depth of weathering is > 10.0 m. SH-27 is the "element at risk", which constitutes the sole landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are stable. The slide has a horizontal extent of 1.0 m and vertical interval of 12.0 m (Photo 2).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	10.9 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	32.0 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	87.2 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	30°
h.	Run out distance / up to	:	12.0 m/ SH-27
i.	Cut slope Height	:	12.0 m
j.	Direction of slide	:	N35°E

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall with ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE*:* SH-27 road was affected as fallen debris has blocked the road.

RECOMMENDATION: Old slide almost stabilized. Road widening in the left flank may reactivate the slide. Removal of heaped debris from toe and proper lined drainage at toe may arrest reactivation.

SLIDE NO: KA-579

LOCATION: The slide is located at latitude 12° 13′ 1.1″ N and longitude 75° 47′ 8.6″ E in Survey of India toposheet No 48 P/16 along SH-27 between Murnad-Virajpet road section, Virajpet Taluk, Coorg district (200 m from slide no KA-578 on SH-27 from Murnad towards Virajpet).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated debris slump. The debris consists of highly weathered rock particles consisting of gneiss with size ranging from boulders to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 2.0 m. The depth of weathering is > 10.0 m. Coffee curing factory just below the slide is the "element at risk". Weathered gneiss is the exposed rock type in the area. The head and crown parts of the slide are stable where as toe part is unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 18.0 m (Photo 3 & 4).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	15.9 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	79.7 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	316.8 m^3
e.	Slope angle - post failure	:	85°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	25°
h.	Run out distance / up to	:	18.0 m/ Up to Coffee curing factory
i.	Cut slope Height	:	12.0 m
j.	Direction of slide	:	N15°E

CAUSES: Effect of human interference in the form of slope cutting for construction of Coffee curing factory coupled with high rainfall with ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE: SH-27 road was affected as fallen debris has blocked the road.

RECOMMENDATION: Slide may reactivate with advent of monsoon and may damage the factory. Slope easing and proper drainage at toe are recommended.

SLIDE NO: KA-580

LOCATION: The slide is located at latitude 12° 12′ 56.5″ N and longitude 75° 47′ 19.5″ E in Survey of India toposheet No 48 P/16 along SH-27 between Murnad-Virajpet road section, Virajpet Taluk, Coorg district (200 m from slide no KA-579 on SH-27 from Murnad towards Virajpet).

SLIDE DESCRIPTION: The slide is classified as a new debris slump. The debris consists of highly weathered rock particles consisting of gneiss with size ranging from boulders to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 2.0 m. The depth of weathering is > 7.0 m. SH-27 is the "element at risk", which constitutes the sole landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 0.5 m and vertical interval of 8.5 m (Photo 5).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	7.6 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	9.3 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	17.7 m^3
e.	Slope angle - post failure	:	85°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	9.0 m/ SH-27
i.	Cut slope Height	:	8.0 m
j.	Direction of slide	:	N45°E(Variable as slide is on road bend)

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall with ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE: SH-27 road was affected as fallen debris has blocked the road.

RECOMMENDATION: Removal of fallen debris from toe, Slope easing in the form of benches and proper lined drainage at toe are recommended. Old tree precariously hanging on right flank has to be removed or else fallen will block the road.

III.2.Landslides recorded along SH-91 between Virajpet-Kerala boundary road section

SLIDE NO: KA-581

LOCATION: The slide is located at latitude 12° 8′ 16.8″ N and longitude 75° 47′ 36.9″ E in Survey of India toposheet No 48 P/16 along SH-91 between Virajpet-Kerala State Boundary(Makutta) road section, Virajpet Taluk, Coorg district (1 km from forest check post towards Makutta from Virajpet).

SLIDE DESCRIPTION: The slide is classified as a new debris slump. The debris consists of highly weathered rock particles consisting of charnockite with size ranging from boulders to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.0 m. The depth of weathering is > 6.0 m. SH-91 is the "element at risk", which constitutes the sole landuse of the area. Charnockite is the exposed rock type in the area. The head and crown parts of the slide are stable and toe part is unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 10.0 m (Photo 6).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	8.0 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	9.0 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	18.0 m^3
e.	Slope angle - post failure	:	85°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	25°
h.	Run out distance / up to	:	10.0 m/ SH-91
i.	Cut slope Height	:	7.0 m
j.	Direction of slide	:	N15°E

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall with ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE: SH-91 road was affected as fallen debris has blocked the road.

RECOMMENDATION: Removal of debris from the slope, removal of fallen tree and proper lined drainage at toe are recommended. Trees precariously hanging in crown portion should be removed.

SLIDE NO: KA-582

LOCATION: The slide is located at latitude 12° 7′ 49.5″ N and longitude 75° 47′ 55.0″ E in Survey of India toposheet No 48 P/16 along SH-91 between Virajpet-Kerala State Boundary(Makutta) road section, Virajpet Taluk, Coorg district (1 km from slide no KA-581 towards Makutta from Virajpet).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated debris slide (first occurred during July 2010).The slide has occurred in filled slope down to the valley. The debris consists of highly weathered rock particles consisting of charnockite with size ranging from boulders to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 6.0 m. SH-91 is the "element at risk", which constitutes the sole landuse of the area. Charnockite is the exposed rock type in the area. The head and crown parts of the slide are stable and toe part is unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 20.0 m (Photo 7 & 8).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	15.0 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	12.0 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.5 m
d.	Volume of failed mass above the failure surface	:	90.0 m^3
e.	Slope angle - post failure	:	65°
f.	Slope angle - pre failure	:	70°
g.	General slope gradient	:	25°
h.	Run out distance / up to	:	18.0 m/ SH-91
i.	Cut slope Height	:	10.0 m
j.	Direction of slide	:	N15°E

CAUSES: Effect of human interference in the form of filled slope for construction of road coupled with high rainfall with ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: SH-91 road was affected as part of the road was washed away.

RECOMMENDATION: Earlier remedial measures like wall breached, fresh wall and stone pitching done. Regular maintenance of remedial measures required with proper drainage on both sides of the road, a nala is flowing nearby and proper drainage outlet for this nala is must.

SLIDE NO: KA-583

LOCATION: The slide is located at latitude 12° 7′ 40.5″ N and longitude 75° 47′ 39.7″ E in Survey of India toposheet No 48 P/16 along SH-91 between Virajpet-Kerala State Boundary(Makutta) road section, Virajpet Taluk, Coorg district (0.5 km from slide no KA-582 towards Makutta from Virajpet).

SLIDE DESCRIPTION: The slide is classified as a new rock fall. The debris consists of weathered charnockite rock particles. The slided area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 7.0 m. Three sets of Joints are noticed J1- $N50^0W/78^0NE$ with 15.0-20.0 cm spacing with opening of 0.5 cm filled with soil, J2-$N65^0E/ 59^0NW$ with 10.0-15.0 cm spacing with opening of 0.5 cm filled with soil and J3- $N15^0E/ 70^0NW$ with 10.0-20.0 cm spacing and is tight. SH-91 is the "element at risk", which constitutes the sole landuse of the area. Charnockite is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 7.0 m (Photo 9).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	6.0 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	9.0 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.0 m
d.	Volume of failed mass above the failure surface	:	27.0 m^3
e.	Slope angle - post failure	:	85°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	25°
h.	Run out distance / up to	:	7.0 m/ SH-91
i.	Cut slope Height	:	8.0 m
j.	Direction of slide	:	N25°W

CAUSES: Weathering and dip/strike of rocks exposed in the area unfavorable.

NATURE OF FAILURE: The slide both Planar (along J1) failure and wedge failure (between J1 and J2).

NATURE OF DAMAGE: SH-91 road was affected.

RECOMMENDATION: Removal of fallen boulders from the slope surface. Trimming of rock surface is recommended.

SLIDE NO: KA-584

LOCATION: The slide is located at latitude 12° 7′ 31.1″ N and longitude 75° 47′ 9.5″ E in Survey of India toposheet No 48 P/16 along SH-91 between Virajpet-Kerala State Boundary(Makutta) road section, Virajpet Taluk, Coorg district (1 km from Natikalli Bridge towards Makutta from Virajpet).

SLIDE DESCRIPTION: The slide is classified as an old rock fall. The debris consists of weathered charnockite rock particles. The slided area has an overburden thickness of nearly 1.0 m. The depth of weathering is > 4.0 m. Two sets of Joints are noticed J1- $N58^0W/81^0NE$ with 10.0-15.0 cm spacing and is tight and J2-$N65^0E/ 84^0NW$ with 10.0-15.0 cm spacing and is tight. SH-91 is the "element at risk", which constitutes the sole landuse of the area. Charnockite is the exposed rock type in the area. The head, crown and toe parts of the slide are stable. The slide has a horizontal extent of 1.0 m and vertical interval of 19.0 m (Photo 10).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	18.0 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	22.0 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.0 m
d.	Volume of failed mass above the failure surface	:	198.0 m^3
e.	Slope angle - post failure	:	70°
f.	Slope angle - pre failure	:	85°
g.	General slope gradient	:	25°
h.	Run out distance / up to	:	19.0 m/ SH-91
i.	Cut slope Height	:	18.0 m
j.	Direction of slide	:	N80°W(Variable as slide is on road bend)

CAUSES: Effect of human interference and high rainfall with ineffective drainage and highly weathered slope material.

NATURE OF FAILURE: The slide both Planar (along J1) failure and wedge failure (between J1 and J2).

NATURE OF DAMAGE: SH-91 road was affected as fallen debris has blocked the road.

RECOMMENDATION: Old rock fall stabilized. Plant growth seen on slope material. Small boulders fallen from left flank has to be removed.

SLIDE NO: KA-585

LOCATION: The slide is located at latitude 12° 7′ 13.8″ N and longitude 75° 47′ 12.1″ E in Survey of India toposheet No 48 P/16 along SH-91 between Virajpet-Kerala State Boundary(Makutta) road section, Virajpet Taluk, Coorg district (1.5 km from slide no KA-584 towards Makutta from Virajpet).

SLIDE DESCRIPTION: The slide is classified as a new debris slump. The debris consists of highly weathered rock particles consisting of Charnockite with size ranging from boulders to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 5.0 m. SH-91 is the "element at risk", which constitutes the sole landuse of the area. Charnockite is the exposed rock type in the area. The head and crown parts of the slide are stable and toe part is unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 9.0 m (Photo 11).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	7.0 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	11.0 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	19.3 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	30°
h.	Run out distance / up to	:	9.0 m/ SH-91
i.	Cut slope Height	:	9.0 m
j.	Direction of slide	:	N15°W

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall with ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE: SH-91 road was affected.

RECOMMENDATION: Proper drainage at toe, removal of debris from toe is recommended. Slide almost stabilized, small plant growth seen on debris. Nala flowing nearby is well channeled and cemented.

SLIDE NO: KA-586

LOCATION: The slide is located at latitude 12° 7′ 1.6″ N and longitude 75° 47′ 27.1″ E in Survey of India toposheet No 48 P/16 along SH-91 between Virajpet-Kerala State Boundary(Makutta) road section, Virajpet Taluk, Coorg district (1.0 km from slide no KA-585 towards Makutta from Virajpet).

SLIDE DESCRIPTION: The slide is classified as a new debris slump. The debris consists of highly weathered rock particles consisting of charnockite with size ranging from boulders to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 5.0 m. SH-91 is the "element at risk", which constitutes the sole landuse of the area. Charnockite is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 9.0 m (Photo 12).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	8.0 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	12.5 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	25.0 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	25°
h.	Run out distance / up to	:	9.0 m/ SH-91
i.	Cut slope Height	:	9.0 m
j.	Direction of slide	:	Towards East

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall with ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE: SH-91 road was affected.

RECOMMENDATION: Removal of debris from slope, precariously hanging tree from the crown should be removed or else if fallen may block SH and provide proper drainage at toe.

SLIDE NO: KA-587

LOCATION: The slide is located at latitude 12° 7′ 0.1″ N and longitude 75° 47′ 29.9″ E in Survey of India toposheet No 48 P/16 along SH-91 between Virajpet-Kerala State Boundary(Makutta) road section, Virajpet Taluk, Coorg district (300-400 m from slide no KA-586 towards Makutta from Virajpet).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated composite slide (right flank Rock slide left flank debris). Big slide; down below the road also extended. The weathered portion has failed and intact massive portion still exists. The debris consists of highly weathered rock particles consisting of charnockite with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 2.0 m. The depth of weathering is > 4.0 m. Three sets of Joints are noticed J1-N50^{0}W/78^{0}NE with 30.0-40.0 cm spacing with opening of 0.5 cm filled with soil, J2-N72^{0}E/ 59^{0}NW with 20.0-30.0 cm spacing with opening of 0.5 cm filled with soil and J3- N35^{0}E/ 60^{0}NW with 10.0-20.0 cm spacing and is tight. SH-91 is the "element at risk", which constitutes the sole landuse of the area. Charnockite is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.5 m and vertical interval of 30.0 m (Photo 13 & 14).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	28.0 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	18.0 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.5 m
d.	Volume of failed mass above the failure surface	:	252.0 m^3
e.	Slope angle - post failure	:	70°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	25°
h.	Run out distance / up to	:	28.0 m/ SH-91and below
i.	Cut slope Height	:	18.0 m
j.	Direction of slide	:	N38°W

CAUSES: Weathering and joint pattern and disposition in the area are unfavorable.

NATURE OF FAILURE: The slide both Planar (along J3) failure and wedge failure (between J1 and J2).

NATURE OF DAMAGE: SH-91 road was affected.

RECOMMENDATION: Removal of fallen boulders /weathered material from slope. Proper lined drainage as drainage at toe is clogged. Precariously hanging tree from the crown should be removed. Erecting of sign board, netting of rock surface, slope grading are also recommended.

SLIDE NO: KA-588

LOCATION: The slide is located at latitude 12° 6′ 32″ N and longitude 75° 47′ 0.1″ E in Survey of India toposheet No 48 P/16 along SH-91 between Virajpet-Kerala State Boundary(Makutta) road section, Virajpet Taluk, Coorg district (1 km from slide no KA-587 towards Makutta from Virajpet).

SLIDE DESCRIPTION: The slide is classified as an old earth slump. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 4.0 m. SH-91 is the "element at risk", which constitutes the sole landuse of the area. Charnockite is the exposed rock type in the area. The head, crown and toe parts of the slide are stable. The slide has a horizontal extent of 1.0 m and vertical interval of 11.0 m (Photo 15).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	9.6 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	11.2 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	26.9 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	12.0 m/ SH-91
i.	Cut slope Height	:	12.0 m
j.	Direction of slide	:	N30°W

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall with ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE: SH-91 road was affected.

RECOMMENDATION: Removal of debris and proper drainage at toe to avoid reactivation.

SLIDE NO: KA-589

LOCATION: The slide is located at latitude 12° 6′ 21.1″ N and longitude 75° 46′ 50″ E in Survey of India toposheet No 48 P/16 along SH-91 between Virajpet-Kerala State Boundary(Makutta) road section, Virajpet Taluk, Coorg district (2 km from slide no KA-588 towards Makutta from Virajpet).

SLIDE DESCRIPTION: The slide is classified as a new earth slump. The debris consists of clay derived from weathering and soil. The slide area has an overburden thickness of nearly 2.0 m. The depth of weathering is > 5.0 m. SH-91 is the "element at risk", which constitutes the sole landuse of the area. Charnockite is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 9.0 m (Photo 16).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	8.0 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	18.5 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	37.0 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	25°
h.	Run out distance / up to	:	9.0 m/ SH-91
i.	Cut slope Height	:	9.0 m
j.	Direction of slide	:	Towards West (variable as slide is on road bend)

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall with ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE: SH-91 road was affected.

RECOMMENDATION: Removal of debris from toe, proper drainage at toe is recommended or else slide may prograde. Drainage is clogged at toe.

SLIDE NO: KA-590

LOCATION: The slide is located at latitude 12° 6′ 14.3″ N and longitude 75° 46′ 50.8″ E in Survey of India toposheet No 48 P/16 along SH-91 between Virajpet-Kerala State Boundary(Makutta) road section, Virajpet Taluk, Coorg district (1 km from slide no KA-589 towards Makutta from Virajpet).

SLIDE DESCRIPTION: The slide is classified as an old debris slide (Below the road towards valley). The debris consists of highly weathered rock particles consisting of charnockite with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 4.0 m. SH-91 is the "element at risk", which constitutes the sole landuse of the area. Charnockite is the exposed rock type in the area. The head, crown and toe parts of the slide are stable. The slide has a horizontal extent of 1.0 m and vertical interval of 13.0 m (Photo 17).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	12.0 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	8.0 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.5 m
d.	Volume of failed mass above the failure surface	:	48.0 m^3
e.	Slope angle - post failure	:	65°
f.	Slope angle - pre failure	:	70°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	15.0 m/ SH-91 and below the road
i.	Cut slope Height	:	9.0 m
j.	Direction of slide	:	N40°W (variable as slide is on road bend)

CAUSES: Effect of human interference and high rainfall with ineffective drainage and highly weathered slope material.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE*:* SH-91 road was affected.

RECOMMENDATION: Slide below the road in to the nala. Protective measures in the form of wall (retaining) at head/ crown constructed. Proper maintenance of protective measures and proper drainage at head is recommended as drainage is clogged.

SLIDE NO: KA-591

LOCATION: The slide is located at latitude 12° 6′ 7.7″ N and longitude 75° 46′ 32″ E in Survey of India toposheet No 48 P/16 along SH-91 between Virajpet-Kerala State Boundary(Makutta) road section, Virajpet Taluk, Coorg district (500 m from slide no KA-590 towards Makutta from Virajpet).

SLIDE DESCRIPTION: The slide is classified as an old earth slump. The debris consists of clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.0 m. The depth of weathering is > 4.0 m. SH-91 is the "element at risk", which constitutes the sole landuse of the area. Charnockite is the exposed rock type in the area. The head, crown and toe parts of the slide are stable. The slide has a horizontal extent of 1.0 m and vertical interval of 11.0 m (Photo 18).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	10.2 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	9.0 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	23.0 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	11.0 m/ SH-91
i.	Cut slope Height	:	9.0 m
j.	Direction of slide	:	N40°W

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall with ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE*:* SH-91 road was affected.

RECOMMENDATION: Old slide almost stabilized. Removal of debris from toe, proper drainage at toe is recommended or else slide may prograde as drainage is clogged at toe.

SLIDE NO: KA-592

LOCATION: The slide is located at latitude 12° 6′ 9.7″ N and longitude 75° 46′ 33.9″ E in Survey of India toposheet No 48 P/16 along SH-91 between Virajpet-Kerala State Boundary(Makutta) road section, Virajpet Taluk, Coorg district (Near 85 KM stone towards Makutta from Virajpet).

SLIDE DESCRIPTION: The slide is classified as a new earth slump. The debris consists of clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 4.0 m. SH-91 is the "element at risk", which constitutes the sole landuse of the area. Charnockite is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.5 m and vertical interval of 12.0 m (Photo 19).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	10.3 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	15.7 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	40.4 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	25°
h.	Run out distance / up to	:	11.0 m/ SH-91
i.	Cut slope Height	:	14.0 m
j.	Direction of slide	:	N30°W

CAUSES: Effect of human interference and high rainfall with ineffective drainage at toe and highly weathered slope material.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE*:* SH-91 road was affected.

RECOMMENDATION: Removal of debris from toe, slope grading and improvement of drainage at toe are recommended.

SLIDE NO: KA-593

LOCATION: The slide is located at latitude 12° 6′ 9.0″ N and longitude 75° 46′ 33.1″ E in Survey of India toposheet No 48 P/16 along SH-91 between Virajpet-Kerala State Boundary(Makutta) road section, Virajpet Taluk, Coorg district (15 from slide no KA-592 towards Makutta from Virajpet).

SLIDE DESCRIPTION: The slide is classified as a new debris slump. The debris consists of highly weathered rock particles consisting of Charnockite with size ranging from boulders to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 4.0 m. SH-91 is the "element at risk", which constitutes the sole landuse of the area. Charnockite is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.5 m and vertical interval of 12.0 m (Photo 20).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	10.0 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	14.0 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	35.0 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	25°
h.	Run out distance / up to	:	11.0 m/ SH-91
i.	Cut slope Height	:	14.0 m
j.	Direction of slide	:	Towards West

CAUSES: Effect of human interference and high rainfall with ineffective drainage at toe and highly weathered slope material.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE: SH-91 road was affected.

RECOMMENDATION: Removal of debris from toe, slope grading and improvement of drainage at toe are recommended. Slide prograding laterally, adjacent to slide no KA-592 may be treated simultaneously.

SLIDE NO: KA-594

LOCATION: The slide is located at latitude 12° 6′ 7.6″ N and longitude 75° 46′ 32.4″ E in Survey of India toposheet No 48 P/16 along SH-91 between Virajpet-Kerala State Boundary(Makutta) road section, Virajpet Taluk, Coorg district (20 from slide no KA-593 towards Makutta from Virajpet).

SLIDE DESCRIPTION: The slide is classified as a new earth slump. Debris consists of clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 4.0 m. SH-91 is the "element at risk", which constitutes the sole landuse of the area. Charnockite is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 17.0 m (Photo 21).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	14.6 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	15.1 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	55.1 m^3
e.	Slope angle - post failure	:	70°
f.	Slope angle - pre failure	:	80°
g.	General slope gradient	:	25°
h.	Run out distance / up to	:	15.0 m/ SH-91
i.	Cut slope Height	:	13.0 m
j.	Direction of slide	:	N30°W

CAUSES: Effect of human interference and high rainfall with ineffective drainage at toe and highly weathered slope material.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE*:* SH-91 road was affected.

RECOMMENDATION: Fallen debris (still lying on road side), fallen tree should be removed, drainage clogged at toe. Proper drainage at toe, debris removal from slope and slope grading are recommended.

SLIDE NO: KA-595

LOCATION: The slide is located at latitude 12° 6′ 7.0″ N and longitude 75° 46′ 28.4″ E in Survey of India toposheet No 48 P/16 along SH-91 between Virajpet-Kerala State Boundary(Makutta) road section, Virajpet Taluk, Coorg district (150 from slide no KA-594 towards Makutta from Virajpet).

SLIDE DESCRIPTION: The slide is classified as a new earth slump. Debris consists of clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 4.0 m. SH-91 is the "element at risk", which constitutes the sole landuse of the area. Charnockite is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 10.0 m (Photo 22).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	8.0 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	24.0 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	48.0 m^3
e.	Slope angle - post failure	:	85°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	25°
h.	Run out distance / up to	:	10.0 m/ SH-91
i.	Cut slope Height	:	11.0 m
j.	Direction of slide	:	N60°E (variable as slide is on road bend)

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall with ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE*:* SH-91 road was affected.

RECOMMENDATION: Removal of debris from toe, proper drainage at toe as drainage is clogged. Slide on road bend prograding laterally.

SLIDE NO: KA-596

LOCATION: The slide is located at latitude 12° 5′ 27.0″ N and longitude 75° 45′ 24″ E in Survey of India toposheet No 48 P/16 along SH-91 between Virajpet-Kerala State Boundary(Makutta) road section, Virajpet Taluk, Coorg district (3 km from slide no KA-595towards Makutta from Virajpet).

SLIDE DESCRIPTION: The slide is classified as a new debris slide. Filled slope failure, nala flowing at toe, and toe cutting are seen. Remedial measures in the form of stone pitching are provided. The debris consists of highly weathered rock particles consisting of charnockite with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 4.0 m. SH-91 is the "element at risk", which constitutes the sole landuse of the area. Charnockite is the exposed rock type in the area. The head and crown parts of the slide are stable and toe part is unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 19.0 m (Photo 23).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	15.9 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	20.3 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.0 m
d.	Volume of failed mass above the failure surface	:	161.4 m^3
e.	Slope angle - post failure	:	50°
f.	Slope angle - pre failure	:	60°
g.	General slope gradient	:	25°
h.	Run out distance / up to	:	10.0 m/ SH-91
i.	Cut slope Height	:	11.0 m
j.	Direction of slide	:	N30°W

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall and ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: SH-91 road was affected.

RECOMMENDATION: Strengthen toe, proper maintenance of remedial measures and sign board recommended.

SLIDE NO: KA-597

LOCATION: The slide is located at latitude 12° 4′ 49.6″ N and longitude 75° 44′ 11.2″ E in Survey of India toposheet No 48 P/12 along SH-91 between Virajpet-Kerala State Boundary(Makutta) road section, Virajpet Taluk, Coorg district (1 Km after forest check post towards Makutta from Virajpet).

SLIDE DESCRIPTION: The slide is classified as a new debris slide. The debris consists of highly weathered rock particles consisting of charnockite with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 4.0 m. SH-91 is the "element at risk", which constitutes the sole landuse of the area. Charnockite is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 21.0 m (Photo 24).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	19.8 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	23.0 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.0 m
d.	Volume of failed mass above the failure surface	:	227.7 m^3
e.	Slope angle - post failure	:	75°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	30°
h.	Run out distance / up to	:	20.0 m/ SH-91
i.	Cut slope Height	:	18.0 m
j.	Direction of slide	:	S55°E

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall and ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: SH-91 road was affected.

RECOMMENDATION: Removal of fallen debris from toe & slope, proper drainage at toe as drainage is clogged and slope grading is recommended.

SLIDE NO: KA-598

LOCATION: The slide is located at latitude 12° 4′ 49.6″ N and longitude 75° 44′ 11.2″ E in Survey of India toposheet No 48 P/12 along SH-91 between Virajpet-Kerala State Boundary(Makutta) road section, Virajpet Taluk, Coorg district (30 m from slide no Ka-597 towards Makutta from Virajpet).

SLIDE DESCRIPTION: The slide is classified as a new debris slide. The debris consists of highly weathered rock particles consisting of charnockite with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 4.0 m. SH-91 is the "element at risk", which constitutes the sole landuse of the area. Charnockite is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 17.0 m (Photo 25).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	15.8 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	22.0 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.0 m
d.	Volume of failed mass above the failure surface	:	173.8 m^3
e.	Slope angle - post failure	:	70°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	30°
h.	Run out distance / up to	:	18.0 m/ SH-91
i.	Cut slope Height	:	12.0 m
j.	Direction of slide	:	S40°E

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall and ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: SH-91 road was affected.

RECOMMENDATION: Fallen debris from toe & slope and precariously hanging tree from the crown should be removed. Proper drainage at toe as drainage is clogged and slope grading is recommended.

III.3.Landslides recorded along SH-90 between Virajpet-Siddapur road section

SLIDE NO: KA-599

LOCATION: The slide is located at latitude 12° 12′ 0″ N and longitude 75° 48′ 45.6″ E in Survey of India toposheet No 48 P/15 along SH-90 between Virajpet-Siddapur road section, Virajpet Taluk, Coorg district (Near Muggal road cross).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated debris slide. Old scar is seen. The debris consists of highly weathered rock particles consisting of weathered gneiss with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 2.0 m. The depth of weathering is > 8.0 m. Muggal village road is the "element at risk", which constitutes the sole landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 28.0 m (Photo 26).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	26.1 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	16.8 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.0 m
d.	Volume of failed mass above the failure surface	:	219.2 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	25°
h.	Run out distance / up to	:	28.0 m/ Muggal road
i.	Cut slope Height	:	15.0 m
j.	Direction of slide	:	Towards North

CAUSES: Effect of human interference in the form of slope cutting for construction of road and plantations coupled with high rainfall and ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: Muggal road was affected.

RECOMMENDATION: Old slide caused due to human interference has been reactivated by toe removal for plantations in the form of benches. Proper drainage, slope easing, removal of debris from slope and toe are recommended.

SLIDE NO: KA-600

LOCATION: The slide is located at latitude 12° 12′ 0.1″ N and longitude 75° 48′ 45.1″ E in Survey of India toposheet No 48 P/15 along SH-90 between Virajpet-Siddapur road section, Virajpet Taluk, Coorg district (10 m from slide no KA-599 on Muggal road).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated debris slide. Old scar is seen. The debris consists of highly weathered rock particles consisting of weathered gneiss with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 2.0 m. The depth of weathering is > 7.0 m. Muggal village road is the "element at risk", which constitutes the sole landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.5 m and vertical interval of 40.0 m (Photo 27).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	38.2 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	15.3 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.0 m
d.	Volume of failed mass above the failure surface	:	292.2 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	25°
h.	Run out distance / up to	:	40.0 m/ Muggal road
i.	Cut slope Height	:	16.0 m
j.	Direction of slide	:	N15°E

CAUSES: Effect of human interference in the form of slope cutting for construction of road and plantations coupled with high rainfall and ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: Muggal road was affected.

RECOMMENDATION: Old slide, benching slope easing done should be properly remade. Proper drainage and removal of debris from slope is recommended.

III.4.Landslides recorded along Ammati-Polibetta-Siddapur road section

SLIDE NO: KA-601

LOCATION: The slide is located at latitude 12° 14′ 32.2″ N and longitude 75° 53′ 16.6″ E in Survey of India toposheet No 48 P/16 between Ammati-Polibetta road section, Virajpet Taluk, Coorg district (2 km from Ammati towards Polibetta).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated earth slump. Old slide towards valley has been reactivated by toe removal and construction of house. The debris consists of clay derived from weathering and soil. The slide area has an overburden thickness of nearly 2.0 m. The depth of weathering is > 7.0 m. Newly constructing house is the "element at risk", which constitutes the sole landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 13.0 m (Photo 28).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	11.0 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	13.0 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	35.8 m^3
e.	Slope angle - post failure	:	85°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	13.0 m/ House
i.	Cut slope Height	:	10.0 m
j.	Direction of slide	:	Towards North

CAUSES: Effect of human interference in the form of slope cutting for construction of house coupled with high rainfall and ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE: The house under construction is affected.

RECOMMENDATION: Old slide towards valley has been reactivated by toe removal and construction of house. Proper drainage and slope treatment in the form of retaining wall may prevent damage to house if reactivated.

SLIDE NO: KA-602

LOCATION: The slide is located at latitude 12° 14′ 32.6″ N and longitude 75° 53′ 19.2″ E in Survey of India toposheet No 48 P/16 between Ammati-Polibetta road section, Virajpet Taluk, Coorg district (400 m from slide no KA-601 towards Polibetta).

SLIDE DESCRIPTION: The slide is classified as an old debris slump. The debris consists of highly weathered rock particles consisting of weathered gneiss with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 2.0 m. The depth of weathering is > 4.0 m. Ammati-Polibetta road is "element at risk", which constitutes the sole landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are stable. The slide has a horizontal extent of 1.0 m and vertical interval of 13.0 m (Photo 29).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	9.0 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	12.2 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	27.5 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	10.0m/ Ammati-Polibetta road
i.	Cut slope Height	:	10.0 m
j.	Direction of slide	:	Towards South

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall and ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE: Ammati-Polibetta road is affected.

RECOMMENDATION: Old slide almost stabilized. Proper drainage at toe and removal of debris from toe are recommended.

SLIDE NO: KA-603

LOCATION: The slide is located at latitude 12° 15′ 14.1″ N and longitude 75° 54′ 24.8″ E in Survey of India toposheet No 48 P/15 between Polibetta-Siddapur road section, Virajpet Taluk, Coorg district (2 km after Polibetta, just below Yemingadi estate).

SLIDE DESCRIPTION: The slide is classified as an old debris slump. The debris consists of highly weathered rock particles consisting of weathered gneiss with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 5.0 m. Polibetta-Siddapur road is "element at risk", which along with coffee plantation constitutes the landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are stable. The slide has a horizontal extent of 1.0 m and vertical interval of 13.0 m (Photo 30).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	12.8 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	14.9 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	47.7 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	14.0m/ Polibetta-Siddapur road
i.	Cut slope Height	:	10.0 m
j.	Direction of slide	:	N25°W

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall and ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE: Polibetta-Siddapur road is affected.

RECOMMENDATION: Old slide is almost stabilized. Proper drainage at toe and removal of debris from toe are recommended.

SLIDE NO: KA-604

LOCATION: The slide is located at latitude 12° 16′ 39.9″ N and longitude 75° 53′ 43.9″ E in Survey of India toposheet No 48 P/15 between Polibetta-Siddapur road section, Virajpet Taluk, Coorg district (1.5 km after slide no KA-603 towards Siddapur).

SLIDE DESCRIPTION: The slide is classified as an old debris slide. The debris consists of highly weathered rock particles consisting of weathered gneiss with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 5.0 m. Polibetta-Siddapur road is "element at risk", which along with coffee plantation constitutes the landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are stable. The slide has a horizontal extent of 1.0 m and vertical interval of 20.0 m (Photo 31).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	19.2 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	18.2 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.0 m
d.	Volume of failed mass above the failure surface	:	174.7 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	21.0m/ Polibetta-Siddapur road
i.	Cut slope Height	:	12.0 m
j.	Direction of slide	:	N55°W

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall and ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: Polibetta-Siddapur road is affected.

RECOMMENDATION: Old slide is almost stabilized. Proper drainage at toe and removal of debris from toe are recommended.

III.5.Landslides recorded along Murnad-Napoklu-Bhagamandala road section

SLIDE NO: KA-605

LOCATION: The slide is located at latitude 12° 19′ 1.5″ N and longitude 75° 43′ 12.6″ E in Survey of India toposheet No 48 P/11 between Murnad-Napoklu road section, Madikeri Taluk, Coorg district (5 km from Murnad towards Napoklu).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated debris slump. The debris consists of highly weathered rock particles consisting of weathered gneiss with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 4.0 m. Murnad-Napoklu road is "element at risk", which along with coffee plantation constitutes the landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are stable. The slide has a horizontal extent of 1.0 m and vertical interval of 14.0 m (Photo 32).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	12.9 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	14.3 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	46.1 m^3
e.	Slope angle - post failure	:	70°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	14.0m/ Murnad-Napoklu road
i.	Cut slope Height	:	12.0 m
j.	Direction of slide	:	N80°W

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall and ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE*:* Murnad-Napoklu road is affected.

RECOMMENDATION: Cutting the slope for cart track has caused the slide. Removal of debris from slope, proper drainage at toe& crown and gradation of slope are recommended.

SLIDE NO: KA-606

LOCATION: The slide is located at latitude 12° 19′ 1.3″ N and longitude 75° 43′ 12.1″ E in Survey of India toposheet No 48 P/11 between Murnad-Napoklu road section, Madikeri Taluk, Coorg district (Other side of the road opposite to slide no KA-605).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated debris slump. The debris consists of highly weathered rock particles consisting of weathered gneiss with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 4.0 m. Murnad-Napoklu road is "element at risk", which along with coffee plantation constitutes the landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 13.0 m (Photo 33).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	12.2 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	10.1 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	30.8 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	13.0m/ Murnad-Napoklu road
i.	Cut slope Height	:	12.0 m
j.	Direction of slide	:	Towards South

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall and ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE: Murnad-Napoklu road is affected.

RECOMMENDATION: Drainage is clogged at toe. Removal of debris from slope& toe with proper drainage at toe and slope easing are recommended.

III.6.Landslides recorded along Sulya-Subramanya road section

SLIDE NO: KA-607

LOCATION: The slide is located at latitude 12° 35′ 32.6″ N and longitude 75° 24′ 5.2″ E in Survey of India toposheet No 48 P/6 between Sulya-Subramanya road section, Sulya Taluk, Dakshina Kannada district (1 km after Kanadka towards Subramanya from Sulya).

SLIDE DESCRIPTION: The slide is classified as a new earth slump. The debris consists of clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 5.0 m. Sulya-Subramanya road is "element at risk", which constitutes the sole landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 13.0 m (Photo 34).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	12.9 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	22.8 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	73.5 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	25°
h.	Run out distance / up to	:	13.0m / Sulya-Subramanya road
i.	Cut slope Height	:	13.0 m
j.	Direction of slide	:	Towards South

CAUSES: Effect of human interference and high rainfall with ineffective drainage and highly weathered slope material.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE: Sulya-Subramanya road is affected.

RECOMMENDATION: Proper drainage at toe, slope grading (already started) removal of hanging trees from the crown part are recommended.

SLIDE NO: KA-608

LOCATION: The slide is located at latitude 12° 35′ 25.9″ N and longitude 75° 24′ 58.1″ E in Survey of India toposheet No 48 P/6 between Sulya-Subramanya road section, Sulya Taluk, Dakshina Kannada district (1 km after Slide no KA-607 towards Subramanya from Sulya).

SLIDE DESCRIPTION: The slide is classified as an old debris slide. The debris consists of highly weathered rock particles consisting of weathered gneiss with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 3.0 m. Two sets of Joints are noticed J1-N80^{0}W/ Horizontal (foliation plane) with 30.0-60.0 cm spacing and is tight; J2- N40^{0}W/ Vertical with 10.0-30.0 cm spacing and is tight. Sulya-Subramanya road is "element at risk", which along with coffee plantation constitutes the landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are stable. The slide has a horizontal extent of 1.0 m and vertical interval of 40.0 m (Photo 35).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	38.0 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	42.0 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.5 m
d.	Volume of failed mass above the failure surface	:	1197.0 m^3
e.	Slope angle - post failure	:	65°
f.	Slope angle - pre failure	:	70°
g.	General slope gradient	:	25°
h.	Run out distance / up to	:	40.0m / Sulya-Subramanya road
i.	Cut slope Height	:	13.0 m
j.	Direction of slide	:	N10°W

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall and ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: Sulya-Subramanya road is affected.

RECOMMENDATION: Old slide is almost stabilized. Proper drainage at toe may be provided to avoid any reactivation. Hanging tree near right flank should be removed.

SLIDE NO: KA-609

LOCATION: The slide is located at latitude 12° 35′ 27.3″ N and longitude 75° 25′ 5.8″ E in Survey of India toposheet No 48 P/6 between Sulya-Subramanya road section, Sulya Taluk, Dakshina Kannada district (80-100 m from slide no KA-608 towards Subramanya from Sulya).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated earth slump. The debris consists of clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 3.0 m. Sulya-Subramanya road is "element at risk", which along with coffee plantation constitutes the landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are stable. The slide has a horizontal extent of 1.0 m and vertical interval of 11.0 m (Photo 36).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	10.1 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	12.6 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	31.8 m^3
e.	Slope angle - post failure	:	85°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	25°
h.	Run out distance / up to	:	11.0m / Sulya-Subramanya road
i.	Cut slope Height	:	11.0 m
j.	Direction of slide	:	N10°W

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall and ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a Translational failure.

NATURE OF DAMAGE: Sulya-Subramanya road is affected.

RECOMMENDATION: Old slide reactivated due to road widening. The slope cut material dumped on another side of the road and filled slope may give rise to another slide. Removal of debris and proper drainage should be provided at the base to avoid reactivation.

SLIDE NO: KA-610

LOCATION: The slide is located at latitude 12° 35′ 28″ N and longitude 75° 25′ 9.5″ E in Survey of India toposheet No 48 P/6 between Sulya-Subramanya road section, Sulya Taluk, Dakshina Kannada district (80-100 m from slide no KA-609 towards Subramanya from Sulya).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated debris slide. The debris consists of highly weathered rock particles consisting of weathered gneiss with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 3.0 m. Sulya-Subramanya road is "element at risk", which along with rubber plantation constitutes the landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown parts of the slide are stable and toe part is unstable. The slide has a horizontal extent of 2.0 m and vertical interval of 21.0 m (Photo 37 & 38).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	19.6 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	69.8 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.0 m
d.	Volume of failed mass above the failure surface	:	684.0m^3
e.	Slope angle - post failure	:	70°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	20.0m / Sulya-Subramanya road
i.	Cut slope Height	:	15.0 m
j.	Direction of slide	:	Towards North

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall and ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: Sulya-Subramanya road is affected.

RECOMMENDATION: Old slide was reactivated due to road widening. Debris should be removed and proper drainage at toe part should be provided to avoid reactivation.

SLIDE NO: KA-611

LOCATION: The slide is located at latitude 12° 35′ 51″ N and longitude 75° 27′ 26.3″ E in Survey of India toposheet No 48 P/6 between Sulya-Subramanya road section, Sulya Taluk, Dakshina Kannada district (3 km from Dodtotta towards Subramanya from Sulya).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated debris slide. The debris consists of highly weathered rock particles consisting of weathered gneiss with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 7.0 m. Sulya-Subramanya road is "element at risk", which along with rubber plantation constitutes the landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown parts of the slide are stable and toe part is unstable. The slide has a horizontal extent of 1.5 m and vertical interval of 16.0 m (Photo 39).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	14.6 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	44.2 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.0 m
d.	Volume of failed mass above the failure surface	:	322.7 m^3
e.	Slope angle - post failure	:	70°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	15.0m / Sulya-Subramanya road
i.	Cut slope Height	:	13.0 m
j.	Direction of slide	:	Towards North

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall and ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: Sulya-Subramanya road is affected.

RECOMMENDATION: Old slide was reactivated on right flank. Removal of fallen debris, removal of precariously hanging tree and proper drainage at toe are recommended.

SLIDE NO: KA-612

LOCATION: The slide is located at latitude 12° 37′ 49.6″ N and longitude 75° 32′ 38.9″ E in Survey of India toposheet No 48 P/10 between Sulya-Subramanya road section, Sulya Taluk, Dakshina Kannada district (2 km after Guttigar towards Subramanya from Sulya).

SLIDE DESCRIPTION: The slide is classified as an old debris slump. The debris consists of highly weathered rock particles consisting of weathered gneiss with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 10.0 m. Sulya-Subramanya road is "element at risk", which constitutes the sole landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are stable. The slide has a horizontal extent of 1.5 m and vertical interval of 14.0 m (Photo 40).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	12.7 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	20.1 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.0 m
d.	Volume of failed mass above the failure surface	:	127.6 m^3
e.	Slope angle - post failure	:	70°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	13.0m / Sulya-Subramanya road
i.	Cut slope Height	:	12.0 m
j.	Direction of slide	:	S60°W

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall and ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE: Sulya-Subramanya road is affected.

RECOMMENDATION: Old slide stabilized. Proper drainage at toe recommended avoiding any reactivation.

SLIDE NO: KA-613

LOCATION: The slide is located at latitude 12° 38′ 40.8″ N and longitude 75° 34′ 8.7″ E in Survey of India toposheet No 48 P/10 between Sulya-Subramanya road section, Sulya Taluk, Dakshina Kannada district (2 km after slide no KA-612 towards Subramanya from Sulya).

SLIDE DESCRIPTION: The slide is classified as an old debris slide. The debris consists of highly weathered rock particles consisting of weathered gneiss with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 7.0 m. Sulya-Subramanya road is "element at risk", which constitutes the sole landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are stable. The slide has a horizontal extent of 1.0 m and vertical interval of 13.0 m (Photo 41).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	12.1 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	21.0 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	63.5 m^3
e.	Slope angle - post failure	:	70°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	13.0m / Sulya-Subramanya road
i.	Cut slope Height	:	11.0 m
j.	Direction of slide	:	N80°E

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall and ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: Sulya-Subramanya road is affected.

RECOMMENDATION: Old slide stabilized. Proper drainage at toe is recommended for avoiding any reactivation.

III.7.Landslides recorded along SH-88 Madikeri-Sulya road section

SLIDE NO: KA-614

LOCATION: The slide is located at latitude 12° 25′ 24.4″ N and longitude 75° 40′ 55.6″ E in Survey of India toposheet No 48 P/11 along SH-88 between Madikeri-Sulya road section, Madikeri Taluk, Coorg district (1 km after Medenadu from Madikeri towards Sulya).

SLIDE DESCRIPTION: The slide is classified as a new debris slide. The debris consists of highly weathered rock particles consisting of weathered gneiss with size ranging from boulder to pebble, clay derived from weathering and soil. Scarp with width of 12.0 m, radius of 10.0 m and height of 12.0m at an angle of 85° is observed. The slide area has an overburden thickness of nearly 2.0 m. The depth of weathering is > 7.0 m. SH-88 road is "element at risk", which constitutes the sole landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.5 m and vertical interval of 40.0 m (Photo 42).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	38.1 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	36.6 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.5 m
d.	Volume of failed mass above the failure surface	:	1045.8 m^3
e.	Slope angle - post failure	:	70°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	25°
h.	Run out distance / up to	:	40.0m / SH-88
i.	Cut slope Height	:	14.0 m
j.	Direction of slide	:	N80°E

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall, ineffective drainage at toe part and highly weathered slope material.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: SH-88 road was affected as debris blocked the road.

RECOMMENDATION: Slope grading, removal of debris from slope, proper drainage at toe with retaining wall for 50 m, 1 m height & width are recommended.

SLIDE NO: KA-615

LOCATION: The slide is located at latitude 12° 26′ 7.2″ N and longitude 75° 40′ 15.5″ E in Survey of India toposheet No 48 P/11 along SH-88 between Madikeri-Sulya road section, Madikeri Taluk, Coorg district.

SLIDE DESCRIPTION: The slide is classified as a new debris slump. The debris consists of highly weathered rock particles consisting of weathered gneiss with size ranging from boulder to pebble, clay derived from weathering and soil. Scarp with width of 8.0 m, radius of 7.0 m and height of 8.0m at an angle of 90° is observed. The slide area has an overburden thickness of nearly 2.0 m. The depth of weathering is > 7.0 m. SH-88 road is "element at risk", which constitutes the sole landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 20.0 m (Photo 43).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	17.8 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	22.6 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	100.6 m^3
e.	Slope angle - post failure	:	75°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	25°
h.	Run out distance / up to	:	22.0m / SH-88
i.	Cut slope Height	:	12.0 m
j.	Direction of slide	:	N75°E

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall, ineffective drainage at toe part and highly weathered slope material.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: SH-88 road was affected as debris blocked the road.

RECOMMENDATION: Removal of loose debris from slope, removal of debris from clogged drainage and slope grading are recommended.

SLIDE NO: KA-616

LOCATION: The slide is located at latitude 12° 26′ 17.6″ N and longitude 75° 40′ 7.3″ E in Survey of India toposheet No 48 P/11 along SH-88 between Madikeri-Sulya road section, Madikeri Taluk, Coorg district(2 km after slide no KA-615 towards Sulya from Madikeri).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated debris slump. The debris consists of highly weathered rock particles consisting of weathered gneiss with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 2.0 m. The depth of weathering is > 7.0 m. SH-88 road is "element at risk", which constitutes the sole landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 16.0 m (Photo 44).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	14.1 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	15.8 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	55.7 m^3
e.	Slope angle - post failure	:	75°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	16.0m / SH-88
i.	Cut slope Height	:	11.0 m
j.	Direction of slide	:	N45°E

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall, ineffective drainage at toe part and highly weathered slope material.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: SH-88 road was affected as debris blocked the road.

RECOMMENDATION: Proper drainage at toe, removal of debris from slope and slope easing are recommended.

SLIDE NO: KA-617

LOCATION: The slide is located at latitude 12° 26′ 20.3″ N and longitude 75° 40′ 7.3″ E in Survey of India toposheet No 48 P/11 along SH-88 between Madikeri-Sulya road section, Madikeri Taluk, Coorg district(300 m after slide no KA-616 towards Sulya from Madikeri).

SLIDE DESCRIPTION: The slide is classified as a new debris slide. The debris consists of highly weathered rock particles consisting of weathered gneiss with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 2.0 m. The depth of weathering is > 7.0 m. SH-88 road is "element at risk", which constitutes the sole landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 16.0 m (Photo 45).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	14.9 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	16.1 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	60.0 m^3
e.	Slope angle - post failure	:	75°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	16.0m / SH-88
i.	Cut slope Height	:	10.0 m
j.	Direction of slide	:	N10°E

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall, ineffective drainage at toe part and highly weathered slope material.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: SH-88 road was affected as debris blocked the road.

RECOMMENDATION: Proper drainage at toe, removal of debris from slope and slope easing are recommended.

SLIDE NO: KA-618

LOCATION: The slide is located at latitude 12° 26′ 17.8″ N and longitude 75° 39′ 30.9″ E in Survey of India toposheet No 48 P/11 along SH-88 between Madikeri-Sulya road section, Madikeri Taluk, Coorg district(800 m after Jodpal towards Sulya from Madikeri).

SLIDE DESCRIPTION: The slide is classified as a new debris slide. The debris consists of highly weathered rock particles consisting of weathered gneiss with size ranging from boulder to pebble, clay derived from weathering and soil. Scarp with width of 7.0 m, radius of 5.0 m and height of 7.0m at an angle of 90° is observed. The slide area has an overburden thickness of nearly 2.0 m. The depth of weathering is > 7.0 m. SH-88 road is "element at risk", which constitutes the sole landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 27.0 m (Photo 46).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	25.9 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	28.2 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.0 m
d.	Volume of failed mass above the failure surface	:	365.2 m^3
e.	Slope angle - post failure	:	70°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	25°
h.	Run out distance / up to	:	30.0m / SH-88
i.	Cut slope Height	:	13.0 m
j.	Direction of slide	:	N40°W

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall, ineffective drainage at toe part and highly weathered slope material.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: SH-88 road was affected as debris blocked the road.

RECOMMENDATION: Removal of loose debris from slope, removal of debris from clogged drainage at toe and slope grading are recommended.

SLIDE NO: KA-619

LOCATION: The slide is located at latitude 12° 26′ 17.8″ N and longitude 75° 39′ 17″ E in Survey of India toposheet No 48 P/11 along SH-88 between Madikeri-Sulya road section, Madikeri Taluk, Coorg district(300 m after slide no KA-618 towards Sulya from Madikeri).

SLIDE DESCRIPTION: The slide is classified as a new rock fall. The debris consists of highly weathered rock particles consisting of weathered gneiss with size ranging from boulder to pebble, clay derived from weathering and soil. Two sets of Joints are noticed J1-S60^{0}W/Vertical with 5.0-10.0 cm spacing and is tight; J2-N40^{0}W/ Vertical with 5.0-10.0 cm spacing and is tight. The slide area has an overburden thickness of nearly 2.0 m. The depth of weathering is > 7.0 m. SH-88 road is "element at risk", which constitutes the sole landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 12.0 m (Photo 47).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	10.1 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	12.8 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	32.3 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	25°
h.	Run out distance / up to	:	12.0m / SH-88
i.	Cut slope Height	:	10.0 m
j.	Direction of slide	:	N30°E

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall, ineffective drainage at toe part and highly weathered slope material.

NATURE OF FAILURE: The slide is a planar failure along J1.

NATURE OF DAMAGE: SH-88 road was affected as debris blocked the road.

RECOMMENDATION: Proper drainage at toe, removal of debris from slope and slope easing are recommended.

III.8.Landslides recorded along NH-13 between Shimoga-Tirthahalli road section

SLIDE NO: KA-620

LOCATION: The slide is located at latitude 13° 42′ 55″ N and longitude 75° 23′ 51.5″ E in Survey of India toposheet No 48 O/6 along NH-13 between Shimoga-Tirthahalli road section, Tirthahalli Taluk, Shimoga district(Near Begavali on NH-13 from Shimoga towards Tirthahalli).

SLIDE DESCRIPTION: The slide is classified as an old debris slide. The debris consists of highly weathered rock particles consisting of weathered phyllite with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.0 m. The depth of weathering is > 5.0 m. NH-13 road is "element at risk", which along with coconut plantations constitutes the sole landuse of the area. Weathered phyllite is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 11.0 m (Photo 48).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	10.0 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	15.0 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.0 m
d.	Volume of failed mass above the failure surface	:	75.0 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	12.0m / NH-13
i.	Cut slope Height	:	10.0 m
j.	Direction of slide	:	N30°W

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall and ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: NH-13 road was affected.

RECOMMENDATION: Proper drainage at toe, removal of debris from slope and slope easing are recommended.

SLIDE NO: KA-621

LOCATION: The slide is located at latitude 13° 42′ 27″ N and longitude 75° 16′ 32.4″ E in Survey of India toposheet No 48 O/6 along NH-13 between Shimoga-Tirthahalli road section, Tirthahalli Taluk, Shimoga district(Near Balagarmath on NH-13 from Shimoga towards Tirthahalli).

SLIDE DESCRIPTION: The slide is classified as an old earth slump. The debris consists of clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.0 m. The depth of weathering is > 5.0 m. NH-13 road is "element at risk", which constitutes the sole landuse of the area. Quartz-chlorite-schist is the exposed rock type in the area. The head and crown parts of the slide are stable and toe part is unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 10.0 m (Photo 49).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	9.0 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	11.0 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	24.8 m^3
e.	Slope angle - post failure	:	85°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	11.0m / NH-13
i.	Cut slope Height	:	10.0 m
j.	Direction of slide	:	S60°E

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall and ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a Translational failure.

NATURE OF DAMAGE: NH-13 road was affected.

RECOMMENDATION: Proper drainage at toe, removal of debris from slope and slope easing are recommended.

SLIDE NO: KA-622

LOCATION: The slide is located at latitude 13° 41′ 50″ N and longitude 75° 16′ 23.7″ E in Survey of India toposheet No 48 O/6 along NH-13 between Shimoga-Tirthahalli road section, Tirthahalli Taluk, Shimoga district(1 km after slide no KA-621 on NH-13 from Shimoga towards Tirthahalli).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated debris slump. The debris consists of highly weathered rock particles consisting of weathered gneiss with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.0 m. The depth of weathering is > 5.0 m. NH-13 road is "element at risk", which constitutes the sole landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 13.0 m (Photo 50).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	12.3 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	14.6 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	44.9 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	13.0m / NH-13
i.	Cut slope Height	:	10.0 m
j.	Direction of slide	:	N10°W

CAUSES: Effect of human interference in the form of slope cutting for construction of road coupled with high rainfall and ineffective drainage at toe part.

NATURE OF FAILURE: The slide is a Translational failure.

NATURE OF DAMAGE*:* NH-13 road was affected.

RECOMMENDATION: Proper drainage at toe, removal of debris from slope and slope easing are recommended.

SLIDE NO: KA-623

LOCATION: The slide is located at latitude 13° 41′ 58.4″ N and longitude 75° 16′ 6.6″ E in Survey of India toposheet No 48 O/6 along NH-13 between Shimoga-Tirthahalli road section, Tirthahalli Taluk, Shimoga district(600 m after slide no KA-622 on NH-13 from Shimoga towards Tirthahalli).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated debris slide. The debris consists of highly weathered rock particles consisting of weathered gneiss with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 6.0 m. NH-13 road is "element at risk", which constitutes the sole landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 16.0 m (Photo 51).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	15.1 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	30.0 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.0 m
d.	Volume of failed mass above the failure surface	:	226.5 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	16.0m / NH-13
i.	Cut slope Height	:	12.0 m
j.	Direction of slide	:	N20°E

CAUSES: Effect of human interference and high rainfall, ineffective drainage at toe and highly weathered slope material.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE*:* NH-13 road was affected.

RECOMMENDATION: Removal of loose debris from slope, drainage removal of debris from clogged drainage at toe and slope grading are recommended.

SLIDE NO: KA-624

LOCATION: The slide is located at latitude 13° 41′ 59.1″ N and longitude 75° 15′ 48.5″ E in Survey of India toposheet No 48 O/6 along NH-13 between Shimoga-Tirthahalli road section, Tirthahalli Taluk, Shimoga district(600 m after slide no KA-623 on NH-13 from Shimoga towards Tirthahalli).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated debris slide. The debris consists of highly weathered rock particles consisting of weathered gneiss with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.0 m. The depth of weathering is > 6.0 m. NH-13 road is "element at risk", which constitutes the sole landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 16.0 m (Photo 52).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	15.2 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	32.6 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.0 m
d.	Volume of failed mass above the failure surface	:	247.8 m^3
e.	Slope angle - post failure	:	85°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	17.0m / Inside of NH-13
i.	Cut slope Height	:	10.0 m
j.	Direction of slide	:	N10°E

CAUSES: Effect of human interference and high rainfall with ineffective drainage at toe and highly weathered slope material.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: Adjacent portionNH-13 road was affected.

RECOMMENDATION: Proper drainage at crown, removal of debris from slope and slope easing are recommended.

III.9.Landslides recorded along SH-1 between Tirthahalli-Someshwar road section

SLIDE NO: KA-625

LOCATION: The slide is located at latitude 13° 34′ 52.6″ N and longitude 75° 7′ 58″ E in Survey of India toposheet No 48 O/2 along SH-1 between Tirthahalli-Someshwar road section, Tirthahalli Taluk, Shimoga district(After Nalluru 1 km towards Someshwar from Tirthahalli).

SLIDE DESCRIPTION: The slide is classified as an old debris slide. The debris consists of highly weathered rock particles consisting of weathered metabasalt with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.0 m. The depth of weathering is > 5.0 m. SH-1 road is "element at risk", which constitutes the sole landuse of the area. Metabasalt is the exposed rock type in the area. The head, crown and toe parts of the slide are stable. The slide has a horizontal extent of 1.0 m and vertical interval of 24.0 m (Photo 53).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	23.5 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	30.2 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	177.4 m^3
e.	Slope angle - post failure	:	85°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	24.0m / SH-1
i.	Cut slope Height	:	10.0 m
j.	Direction of slide	:	N20°E

CAUSES: Effect of human interference and high rainfall, ineffective drainage at toe and highly weathered slope material.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: SH-1 road was affected.

RECOMMENDATION: Old slide stabilized; drainage at is toe clogged and there is a chance of reactivation. Proper maintenance of drainage to arrest reactivation and removal of debris from toe are recommended.

SLIDE NO: KA-626

LOCATION: The slide is located at latitude 13° 34′ 31.5″ N and longitude 75° 7′ 52″ E in Survey of India toposheet No 48 O/2 along SH-1 between Tirthahalli-Someshwar road section, Tirthahalli Taluk, Shimoga district(1 km from slide no KA-625 towards Someshwar from Tirthahalli).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated debris slide. The debris consists of highly weathered rock particles consisting of weathered metabasalt with size ranging from boulder to pebble, clay derived from weathering and soil. . Scarp with width of 23.0 m, radius of 20.0 m and height of 6.0m at an angle of 85° is observed. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 5.0 m. SH-1 road is "element at risk", which constitutes the sole landuse of the area. Metabasalt is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 25.0 m (Photo 54).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	24.0 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	29.6 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	177.6 m^3
e.	Slope angle - post failure	:	70°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	25.0m / SH-1
i.	Cut slope Height	:	10.0 m
j.	Direction of slide	:	N20°E

CAUSES: Effect of human interference and high rainfall, ineffective drainage at toe and highly weathered slope material.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: SH-1 road was affected.

RECOMMENDATION: Proper drainage at crown and toe as drainage at toe is clogged. Removal of fallen trees from the slope and fallen debris, slope easing is recommended.

SLIDE NO: KA-627

LOCATION: The slide is located at latitude 13° 32′ 20.1″ N and longitude 75° 6′ 38.5″ E in Survey of India toposheet No 48 O/2 along SH-1 between Tirthahalli-Someshwar road section, Tirthahalli Taluk, Shimoga district(Near Kavurehakkalu towards Someshwar from Tirthahalli).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated debris slide. The debris consists of highly weathered rock particles consisting of weathered metabasalt with size ranging from boulder to pebble, clay derived from weathering and soil. Scarp with width of 25.0 m, radius of 21.0 m and height of 7.0m at an angle of 85° is observed. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 6.0 m. SH-1 road is "element at risk", which constitutes the sole landuse of the area. Metabasalt is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 25.0 m (Photo 55).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	23.2 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	31.2 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.0 m
d.	Volume of failed mass above the failure surface	:	361.9 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	25.0m / SH-1
i.	Cut slope Height	:	10.0 m
j.	Direction of slide	:	N80°E

CAUSES: Effect of human interference and high rainfall with ineffective drainage at toe and highly weathered slope material.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: SH-1 road was affected.

RECOMMENDATION: Proper drainage at crown and toe as drainage at toe is clogged. Removal of fallen debris from slope and toe, slope easing is recommended.

SLIDE NO: KA-628

LOCATION: The slide is located at latitude 13° 29′ 46.3″ N and longitude 75° 4′ 50.6″ E in Survey of India toposheet No 48 O/3 along SH-1 between Tirthahalli-Someshwar road section, Tirthahalli Taluk, Shimoga district(Near Agumbe sunset view point towards Someshwar from Tirthahalli).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated debris slump. The debris consists of highly weathered rock particles consisting of weathered metabasalt with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.0 m. The depth of weathering is > 6.0 m. SH-1 road is "element at risk", which constitutes the sole landuse of the area. Metabasalt is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 14.0 m (Photo 56).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	12.6 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	21.0 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	66.2 m^3
e.	Slope angle - post failure	:	85°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	14.0m / SH-1
i.	Cut slope Height	:	9.0 m
j.	Direction of slide	:	N80°W

CAUSES: Effect of human interference and high rainfall with ineffective drainage at toe and highly weathered slope material.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE*:* SH-1 road was affected.

RECOMMENDATION: Slope easing and proper drainage at toe are recommended.

SLIDE NO: KA-629

LOCATION: The slide is located at latitude 13° 29′ 51.3″ N and longitude 75° 4′ 49.9″ E in Survey of India toposheet No 48 O/3 along SH-1 between Tirthahalli-Someshwar road section, Tirthahalli Taluk, Shimoga district(200-300 m from slide no KA-628 towards Someshwar from Tirthahalli).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated debris slide. The debris consists of highly weathered rock particles consisting of weathered metabasalt with size ranging from boulder to pebble, clay derived from weathering and soil. Scarp with width of 13.0 m, radius of 14.0 m and height of 5.0m at an angle of 85° is observed. The slide area has an overburden thickness of nearly 1.0 m. The depth of weathering is > 6.0 m. SH-1 road is "element at risk", which constitutes the sole landuse of the area. Metabasalt is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 19.0 m (Photo 57).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	18.0 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	22.3 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	100.4 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	19.0m / SH-1
i.	Cut slope Height	:	10.0 m
j.	Direction of slide	:	N60°E

CAUSES: Effect of human interference and high rainfall with ineffective drainage at toe and highly weathered slope material.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE: SH-1 road was affected.

RECOMMENDATION: Slope easing, removal of debris from the slope and proper drainage at toe are recommended.

SLIDE NO: KA-630

LOCATION: The slide is located at latitude 13° 29′ 37.5″ N and longitude 75° 4′ 37.7″ E in Survey of India toposheet No 48 O/3 along SH-1 between Tirthahalli-Someshwar road section, Tirthahalli Taluk, Shimoga district(400-500 m from slide no KA-629 towards Someshwar from Tirthahalli).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated debris slide. The debris consists of highly weathered rock particles consisting of weathered metabasalt with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.5 m. The depth of weathering is > 6.0 m. SH-1 road is "element at risk", which constitutes the sole landuse of the area. Metabasalt is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 25.0 m (Photo 58).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	23.5 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	26.0 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.0 m
d.	Volume of failed mass above the failure surface	:	305.5 m^3
e.	Slope angle - post failure	:	75°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	25.0m / SH-1
i.	Cut slope Height	:	12.0 m
j.	Direction of slide	:	N15°E

CAUSES: Effect of human interference and high rainfall with ineffective drainage at toe and highly weathered slope material.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: SH-1 road was affected.

RECOMMENDATION: Slope easing, removal of fallen trees and debris from the slope, proper drainage at toe and crown are recommended.

SLIDE NO: KA-631

LOCATION: The slide is located at latitude 13° 29′ 36″ N and longitude 75° 4′ 31.2″ E in Survey of India toposheet No 48 O/3 along SH-1 between Tirthahalli-Someshwar road section, Karkala Taluk, Udupi district (300-400 m from slide no KA-630 towards Someshwar from Tirthahalli).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated debris slide. The debris consists of highly weathered rock particles consisting of weathered metabasalt with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.0 m. The depth of weathering is > 6.0 m. SH-1 road is "element at risk", which constitutes the sole landuse of the area. Metabasalt is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 20.0 m (Photo 59).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	16.1 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	18.0 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.0 m
d.	Volume of failed mass above the failure surface	:	144.9 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	20.0m / SH-1
i.	Cut slope Height	:	10.0 m
j.	Direction of slide	:	N45°E

CAUSES: Effect of human interference and high rainfall with ineffective drainage at toe and highly weathered slope material.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE: SH-1 road was affected.

RECOMMENDATION: Slope easing, removal of fallen trees and debris from the slope, proper drainage at toe and crown are recommended.

SLIDE NO: KA-632

LOCATION: The slide is located at latitude 13° 29′ 18.6″ N and longitude 75° 4′ 40.2″ E in Survey of India toposheet No 48 O/3 along SH-1 between Tirthahalli-Someshwar road section, Karkala Taluk, Udupi district (1.5 km m from slide no KA-631 towards Someshwar from Tirthahalli).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated debris slide. The debris consists of highly weathered rock particles consisting of weathered metabasalt with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.0 m. The depth of weathering is > 6.0 m. SH-1 road is "element at risk", which constitutes the sole landuse of the area. Metabasalt is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 20.0 m (Photo 60).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	18.6 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	19.4 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		1.0 m
d.	Volume of failed mass above the failure surface	:	180.4 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	20.0m / SH-1
i.	Cut slope Height	:	11.0 m
j.	Direction of slide	:	N80°W

CAUSES: Effect of human interference and high rainfall with ineffective drainage at toe and highly weathered slope material.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE*:* SH-1 road was affected.

RECOMMENDATION: Slope easing, removal of fallen trees and debris from the slope, proper drainage at toe and crown are recommended.

SLIDE NO: KA-633

LOCATION: The slide is located at latitude 13° 28′ 28″ N and longitude 75° 2′ 2.4″ E in Survey of India toposheet No 48 O/3 along SH-1 between Tirthahalli-Someshwar road section, Karkala Taluk, Udupi district(2.0 km m after Bandimatha towards Someshwar from Tirthahalli).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated debris slide. The debris consists of highly weathered rock particles consisting of weathered metabasalt with size ranging from boulder to pebble, clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.0 m. The depth of weathering is > 6.0 m. SH-1 road is "element at risk", which constitutes the sole landuse of the area. Metabasalt is the exposed rock type in the area. The head, crown and toe parts of the slide are unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 15.0 m (Photo 61).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	13.9 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	18.2 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	63.2 m^3
e.	Slope angle - post failure	:	85°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	15.0m / SH-1
i.	Cut slope Height	:	10.0 m
j.	Direction of slide	:	N55°E

CAUSES: Effect of human interference and high rainfall with ineffective drainage at toe and highly weathered slope material.

NATURE OF FAILURE: The slide is a rotational failure.

NATURE OF DAMAGE*:* SH-1 road was affected.

RECOMMENDATION: Retaining structure given at toe breached. Extension of toe wall with proper drainage at toe and crown and slope easing and removal of fallen debris from slope and toe are recommended.

III.10.Landslides recorded along NH-13 between Tirthahalli-Koppa road section

SLIDE NO: KA-634

LOCATION: The slide is located at latitude 13° 34′ 28″ N and longitude 75° 2′ 2.4″ E in Survey of India toposheet No 48 O/6 along NH-13 between Tirthahalli-Koppa road section, Koppa Taluk, Chikmagalur district(Near Jitanmakki towards Tirthahalli from Koppa).

SLIDE DESCRIPTION: The slide is classified as an old debris slump. The debris consists of clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.0 m. The depth of weathering is > 5.0 m. NH-13 road is "element at risk", which constitutes the sole landuse of the area. Weathered gneiss is the exposed rock type in the area. The head and crown parts of the slide are stable and toe part is unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 12.0 m (Photo 62).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	10.1 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	18.2 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	46.0 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	12.0m / NH-13
i.	Cut slope Height	:	8.0 m
j.	Direction of slide	:	N20°E

CAUSES: Effect of human interference and high rainfall with ineffective drainage at toe.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE: NH-13 road was affected.

RECOMMENDATION: Old slide stabilized. Proper drainage at toe, removal of debris from slope and slope easing are recommended to arrest any reactivation.

SLIDE NO: KA-635

LOCATION: The slide is located at latitude 13° 36′ 31″ N and longitude 75° 18′ 10.3″ E in Survey of India toposheet No 48 O/6 along NH-13 between Tirthahalli-Koppa road section, Tirthahalli Taluk, Shimoga district(2 km after Kambarkoppa towards Tirthahalli from Koppa).

SLIDE DESCRIPTION: The slide is classified as an old debris slump. The debris consists of clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.0 m. The depth of weathering is > 5.0 m. NH-13 road is "element at risk", which constitutes the sole landuse of the area. Weathered gneiss is the exposed rock type in the area. The head and crown parts of the slide are stable and toe part is unstable. The slide has a horizontal extent of 1.0 m and vertical interval of 13.0 m (Photo 63).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	10.5 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	21.3 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	55.9 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	13.0m / NH-13
i.	Cut slope Height	:	9.0 m
j.	Direction of slide	:	N70°E

CAUSES: Effect of human interference and high rainfall with ineffective drainage at toe.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE: NH-13 road was affected.

RECOMMENDATION: Old slide stabilized. Proper drainage at toe, removal of debris from slope and slope easing are recommended to arrest any reactivation.

III.11.Landslides recorded along SH-65 between Koppa- Narsimharajpura road section

SLIDE NO: KA-636

LOCATION: The slide is located at latitude 13° 32′ 6.7″ N and longitude 75° 23′ 12.0″ E in Survey of India toposheet No 48 O/6 along SH-65 between Koppa-Narsimharajpura road section, Koppa Taluk, Chikmagalur district(2 km after Koppa towards NR pura).

SLIDE DESCRIPTION: The slide is classified as an old and reactivated earth slump. The debris consists of clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.0 m. The depth of weathering is > 5.0 m. SH-65 road is "element at risk", which constitutes the sole landuse of the area. Weathered gneiss is the exposed rock type in the area. The head, crown and toe parts of the slide are stable. The slide has a horizontal extent of 1.0 m and vertical interval of 10.0 m (Photo 64).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	8.7 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	82.0m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	178.4 m^3
e.	Slope angle - post failure	:	85°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	10.0m / SH-65
i.	Cut slope Height	:	9.0 m
j.	Direction of slide	:	N40°W

CAUSES: Effect of human interference and high rainfall with ineffective drainage at toe.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE: SH-65 road was affected.

RECOMMENDATION: Old slide slightly reactivated at right flank due to road widening. Proper drainage at toe and removal of fallen debris and slope easing are recommended.

SLIDE NO: KA-637

LOCATION: The slide is located at latitude 13° 32′ 6.9″ N and longitude 75° 25′ 35.1″ E in Survey of India toposheet No 48 O/6 along SH-65 between Koppa-Narsimharajpura road section, Koppa Taluk, Chikmagalur district (after Kuderegundi towards NR pura from Koppa).

SLIDE DESCRIPTION: The slide is classified as an old debris slump. The debris consists of clay derived from weathering and soil. The slide area has an overburden thickness of nearly 1.0 m. The depth of weathering is > 5.0 m. SH-65 road is "element at risk", which constitutes the sole landuse of the area. Quartz-chlorite-schist is the exposed rock type in the area. The head, crown and toe parts of the slide are stable. The slide has a horizontal extent of 1.0 m and vertical interval of 20.0 m (Photo 65 & 66).

MORPHOLOGICAL PARAMETERS OF SLIDE:

a.	Length of failed mass from crown to foot	:	18.3 m
b.	Maximum width of failed mass from the left flank to the right flank boundary	:	42.6 m
c.	Maximum depth of the failed mass from the surface of the slide to the failure surface		0.5 m
d.	Volume of failed mass above the failure surface	:	194.9 m^3
e.	Slope angle - post failure	:	80°
f.	Slope angle - pre failure	:	90°
g.	General slope gradient	:	20°
h.	Run out distance / up to	:	10.0m / SH-65
i.	Cut slope Height	:	12.0 m
j.	Direction of slide	:	N30°W

CAUSES: Effect of human interference and high rainfall with ineffective drainage at toe.

NATURE OF FAILURE: The slide is a translational failure.

NATURE OF DAMAGE: SH-65 road was affected.

RECOMMENDATION: Old slide is stabilized as plant growth seen on debris, if reactivated electric pole is in grave danger. Proper drainage at toe and crown, slope easing is recommended to arrest reactivation.

IV.GENERAL DESCRIPTION OF LANDSLIDES STUDIED IN 2012-13

IV.1. Landslides recorded along Murnad-Virajpet road section (SH-27): A total of 4 landslides (KA-577 to KA-580) were recorded along a 16 km stretch of the ghat section. The slides are shallow with less than 1 m depth. The general slope angle is 20°. The overburden thickness is around 2 m and consists of soil and weathered rock. The cut slope angle is 90° with height varying from 8-12 m. Lithologically, the area comprises weathered gneiss. Two debris slide and two debris slumps were noticed caused mainly due to tampering of the natural slope for making road and settlements. The cut slopes have failed due to heavy rain in the Ghat section during monsoon.

IV.2. Landslides recorded along Virajpet-Kerala Boundary road section (SH-91): A total of 18 landslides (KA-581 to KA-598) were recorded along a 30 km stretch of the ghat section. The slides are shallow with less than 2m depth. The general slope angle varies from 20° to 30° .The slopes are thickly vegetated. The overburden thickness varies from 1-4 m and consists of soil and weathered rock. The cut slope angle is 60° to 90° with height varying from 7-18m. Lithologically, the area comprises charnockite/ weathered charnockite. The slides are mainly slumps both earth and debris. Two rock fall and one composite slide are also observed. Landslides are caused mainly due to tampering of the natural slope for making road. Road construction has increased the instability of the hill slopes. The loose and non-cohesive weathered material present on the slope might have failed due to increase in pore water pressure during heavy rains in the monsoon period. Some slides are provided with remedial measures in the form of retaining wall & stone pitching.

IV.3.Landslides recorded along Virajpet-Siddapur road section (SH-90): A total of 2 landslides (KA-599 to KA-600) were recorded along a 10 km stretch of the ghat section. The slides are shallow with less than 2m depth. The general slope angle is 25°.The slopes are moderately vegetated and main land use is coffee plantations. The overburden thickness is around 4-5m and consists of soil and weathered rock. The cut slope angle is around 90° with height varying from 15-16m. Lithogically the area comprises of weathered gneiss. Landslides are mainly debris slides caused mainly due to tampering of the natural slope for plantations.

IV.4.Landslides recorded along Ammati-Polibetta-Siddapur road section (district road) and Murnad-Napoklu-Baghmandala road section (SH-90): A total of 6 landslides (KA-601 to KA-606) were recorded along a 26 km stretch of the ghat section. The slides are shallow with less than 2m depth. The general slope angle is around 20° .The slopes are moderately vegetated and main land use is coffee plantations. The overburden thickness varies from 1.5-3m and consists of soil

and weathered rock. The cut slope angle is around 90° with height varying from 10-12m. Lithologically the area comprises of weathered gneiss. Landslides are mainly slumps both debris and earth are caused mainly due to tampering of the natural slope for plantations and making road.

IV.5.Landslides recorded along Sulya-Subramanya road section (district road): A total of 7 landslides (KA-607 to KA-613) were recorded along a 41 km stretch of the ghat section. The slides are shallow with less than 2m depth. The general slope angle varies from 20° to 25°. The slopes are moderately vegetated and main land use is Rubber/ areca nut/ coconut plantations. The overburden thickness varies from 1.5-5m and consists of soil and weathered rock. The cut slope angle is 80° to 90° with height varying from 11-15m. Road construction has increased the instability of the hill slopes. The loose and non-cohesive weathered material present on the slope might have failed due to increase in pore water pressure during heavy rains in the monsoon period. Lithologically the area comprises of weathered Gneiss.

IV.6.Landslides recorded along Madikeri-Sulya road section (SH-88): This section was already completed during earlier field seasons (FS 2007-08 &2008-09) but due to widening of road (SH-88) 6 new landslides (KA-614 to KA-619) were recorded in this ghat section for nearly 36 km stretch of the ghat section. The slides are shallow with less than 2m depth. The general slope angle varies from 20° to 25°. The slopes are moderately vegetated and main land use is Rubber/ areca nut/ coconut plantations. The overburden thickness varies from 2-5m and consists of soil and weathered rock. The cut slope angle is 90° with height varying from 10-14m. Lithologically the area comprises of weathered gneiss. Slope failure may be chiefly due to toe cuts/slope modification triggered by heavy rainfall and road construction has increased the instability of the hill slopes.

IV.7.Landslides recorded along Shimoga-Tirthahalli road section (NH-13): A total of 5 landslides (KA-620 to KA-624) were recorded along a 30 km stretch of the ghat section. The slides are shallow with less than 2m depth. The general slope angle is around 20°. The overburden thickness varies from 1-3m and consists of soil and weathered rock. The cut slope angle is 90° with height varying from 10-12m. Lithologically the area comprises of weathered Gneiss. Landslides are mainly caused mainly due to tampering of the natural slope for making road.

IV.8.Landslides recorded along Tirthahalli -Someshwar road section (SH-01): A total of 9 landslides (KA-625 to KA-633) were recorded along a 40 km stretch of the ghat section. The slides are shallow with less than 2m depth. The general slope angle around 20°. The overburden thickness varies from 1-3m and consists of soil and weathered rock. The cut slope angle is 90° with height varying from 9-12m. Lithologically the area comprises of weathered gneiss. Landslides are mainly caused mainly due to tampering of the natural slope for making road.

IV.9.Landslides recorded along Tirthahalli-Koppa (NH-13): A total of 2 landslides (KA-634 to KA-635) were recorded along a 30 km stretch of the ghat section. The slides are shallow with less than 2m depth. The general slope angle is around 20° .The slopes are moderately vegetated and main land use is coffee plantations. The overburden thickness is around 2m and consists of soil and weathered rock. The cut slope angle is around 90° with height varying from 8-9m. Geologically the area comprises of weathered gneiss. Landslides are mainly caused mainly due to tampering of the natural slope for making road.

IV.10. Landslides recorded along Koppa-Narsimharajpura road section (SH-65): A total of 2 landslides (KA-636 to KA-637) were recorded along a 20 km stretch of the ghat section. The slides are shallow with less than 2m depth. The general slope angle is around 20° .The slopes are moderately vegetated and main land use is coffee plantations. The overburden thickness is around 2m and consists of soil and weathered rock. The cut slope angle is around 90° with height varying from 9-12m. Geologically the area comprises of weathered gneiss. Landslides are mainly caused mainly due to tampering of the natural slope for making road.

V. GENERAL CHARACTERISTICS OF LANDSLIDES STUDIED DURING 2012-13

V.1. Type of slides: A total of 61 landslide sites (KA-577 to KA-637) have been studied during F.S.2012-13. Out of 61 landslides, 28 slides are categorized under 'Debris slides', 29 under 'Debris' and 'Earth' slumps, 3 as 'Rock-falls' and the rest one as Composite slide. Accordingly, the percentage distribution is depicted in Table 1 and graphically represented in Fig. 1.

Table 1: Type of landslides observed during 2012-13.

Type of slides	No of slide	%
Debris slide	28	45.90
Debris slump	18	29.51
Earth slump	11	18.03
Rock fall	3	4.92
Composite Slide	1	1.64
Total	61	100

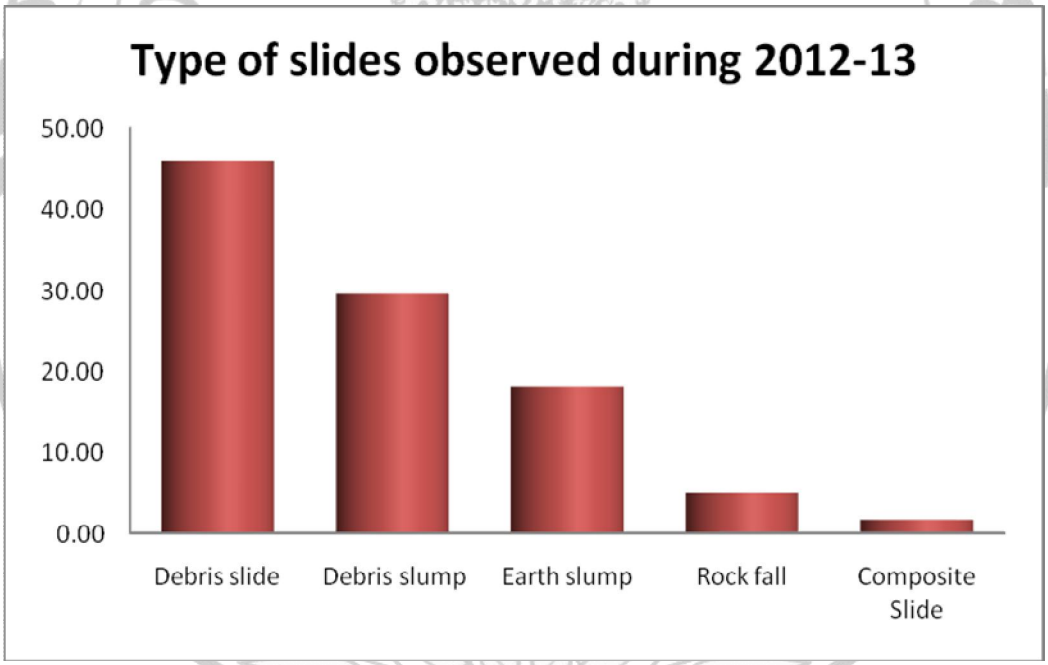

Fig 1: Type of landslides observed during 2012-13

Section-wise analysis of landslides reveals that Tirthahalli-Someshwar section is having maximum number of debris slides (8 nos), closely followed by Virajpet-Kerala boundary section (5 nos). The Virajpet-Kerala boundary section also has a maximum number of Earth slumps (6 nos) rock fall (2 no) and one Composite slide. Madikeri-Sulya section has one rock fall. Debris slumps were recorded in almost all the sections with maximum (4 nos) recorded in Virajpet-Kerala boundary section (Table 2 & 3).

Table 2: Type of landslides observed in each section

	Murnad-Virajpet road section (SH-27	Virajpet-Kerala Boundary road section (SH-91)	Virajpet-Siddapur road section (SH-90)	Ammati-Polibetta-Siddapur road section (District road)	Murnad-Napoklu-Baghmandala road section (SH-90)	Sulya-Subramanya road section (District road)	Madikeri-Sulya road section (SH-88)	Shimoga-Tirthahalli road section (NH-13)	Tirthahalli-Someshwar road section (SH-1)	Tirthahalli-Koppa road section (NH-13)	Koppa-Narsimharajpura road section (SH-65)
Debris slide	2	5	2	1	0	4	3	3	8	0	0
Debris slump	2	4	0	2	2	1	2	1	1	2	1
Earth slump	0	6	0	1	0	2	0	1	0	0	1
Rock fall	0	2	0	0	0	0	1	0	0	0	0
Composite Slide	0	1	0	0	0	0	0	0	0	0	0
Total	4	18	2	4	2	7	6	5	9	2	2

Table 3: Percentage distribution of type of slides observed in each section

	Murnad-Virajpet road section (SH-27	Virajpet-Kerala Boundary road section (SH-91)	Virajpet-Siddapur road section (SH-90)	Ammati-Polibetta-Siddapur road section (District road)	Murnad-Napoklu-Baghmandala road section (SH-90)	Sulya-Subramanya road section (District road)	Madikeri-Sulya road section (SH-88)	Shimoga-Tirthahalli road section (NH-13)	Tirthahalli-Someshwar road section (SH-1)	Tirthahalli-Koppa road section (NH-13)	Koppa-Narsimharajpura road section (SH-65)
Debris slide	50.00	27.78	100.0	25.00	0.00	57.14	50.00	60.00	88.89	0.00	0.00
Debris slump	50.00	22.22	0.00	50.00	100.0	14.29	33.33	20.00	11.11	100.0	50.00
Earth slump	0.00	33.33	0.00	25.00	0.00	28.57	0.00	20.00	0.00	0.00	50.00
Rock fall	0.00	11.11	0.00	0.00	0.00	0.00	16.67	0.00	0.00	0.00	0.00
Composite Slide	0.00	5.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

V. 2. Dimensions of landslides: The dimensions in terms of length, width and depth of individual landslides and the percentages are presented in Table 4, 5 and graphically represented in Fig 2a, 2b and 2c. It can be noted from the table that 83.61 % of the slides are < 20.0 m in length and 54.1 % of the slides are < 20.0 m in width. With regard to depth, 93.44% of the slides are shallow with ≤1.0m depth. The dimensions of slides in each road sections are also presented in Table 6, 7, 8, 9, 10 and 11 with corresponding percentage distribution.

The Standard deviation of the dimensions of the observed landslides reveals that all the slides are shallow slides and the depth of failure varies between 0.5m and 2m.The Width of the slides varies over a wide range because of the fact that the multiple source/event slides are juxtaposed and difficult to delimit. The base length variation is mainly dependant on the cut slope height and lateral progradation of the slides. Also the length of the slides is restricted by road cuttings and cut slope height considering very few slides which have extended below the roads (Fig 2d).

Table 4: Dimensions of landslides (length and widthwise) with percentage distribution observed during 2012-13

Length/ Width	No of Landslides	% distribution	No of Landslides	% distribution
≤10m	13	21.31	5	8.20
>10m≤20m	38	62.30	28	45.90
>20m≤30m	7	11.48	16	26.23
>30m≤40m	3	4.92	6	9.84
>40m≤50m	0	0.00	3	4.92
>50m	0	0.00	3	4.92
Total	61	100.00	61	100.00

Table 5: Dimensions of landslides (Depth wise) with percentage distribution observed during 2012-13

Depth	No of Landslides	% distribution
≤1.0m	57	93.44
>1.0m≤2.0m	4	6.56
>2.0m≤5.0m	0	0.00
>5.0m	0	0.00
Total	61	100

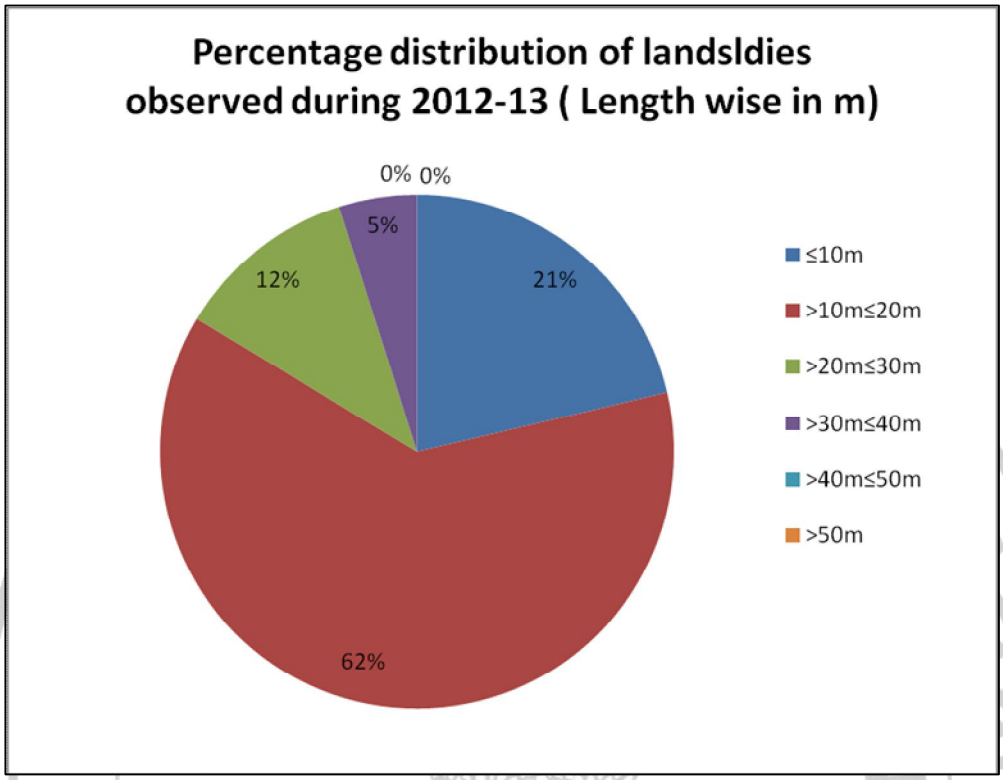

Fig 2a: Percentage distribution of landslides with respect to their length

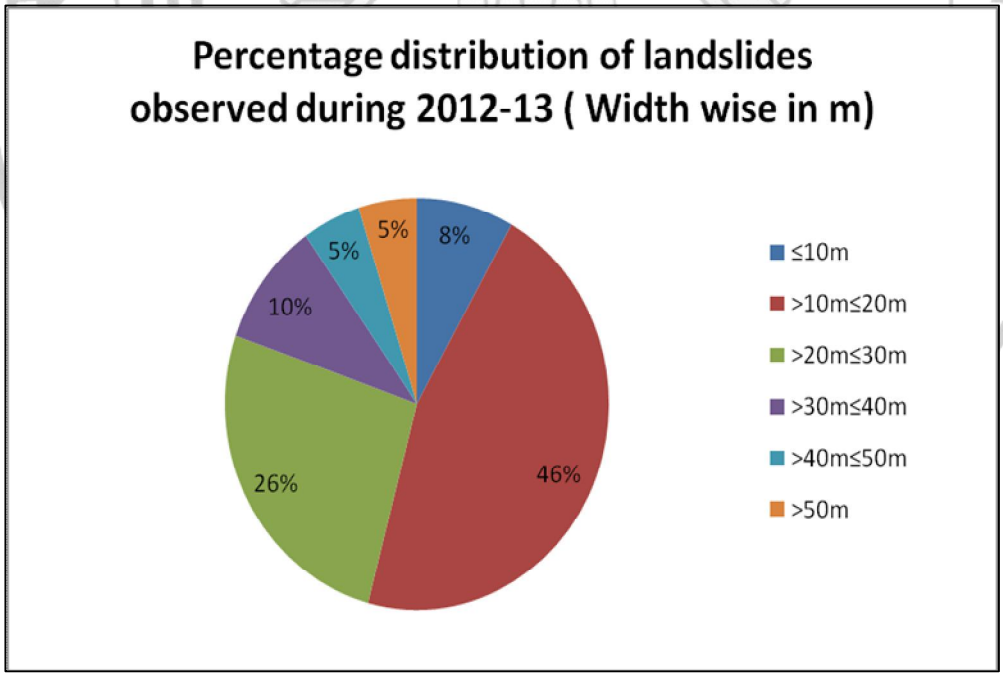

Fig 2b: Percentage distribution of landslides with respect to their width

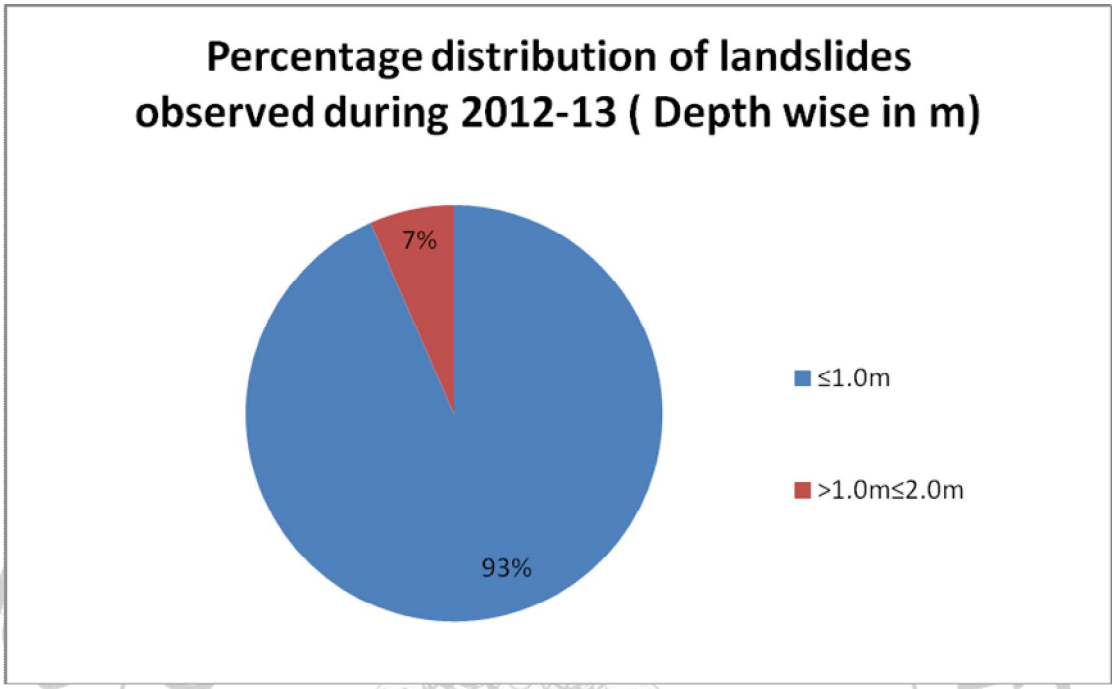

Fig 2c: Percentage distribution of landslides with respect to their depth

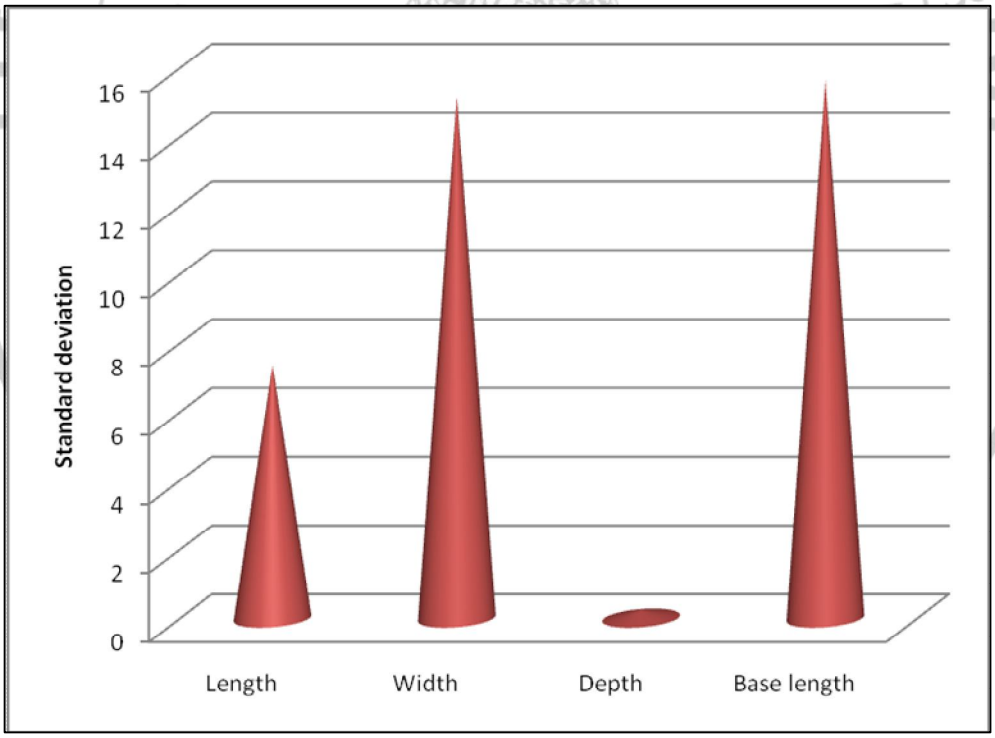

Fig 2d: Standard deviation of the basic dimensions of the landslides observed during 2012-13

Table 6: Dimension of slides in each section (length in m)

	Murnad-Virajpet road section (SH-27	Virajpet-Kerala Boundary road section (SH-91)	Virajpet-Siddapur road section (SH-90)	Ammati-Polibetta-Siddapur road section (District road)	Murnad-Napoklu-Baghmandala road section (SH-90)	Sulya-Subramanya road section (District road)	Madikeri-Sulya road section (SH-88)	Shimoga-Tirthahalli road section (NH-13)	Tirthahalli-Someshwar road section (SH-1)	Tirthahalli-Koppa road section (NH-13)	Koppa-Narsimharajpura road section (SH-65)
≤10m	1	8	0	1	0	0	0	2	0	0	1
>10m≤20m	3	9	0	3	2	6	4	3	5	2	1
>20m≤30m	0	1	1	0	0	0	1	0	4	0	0
>30m≤40m	0	0	1	0	0	1	1	0	0	0	0
>40m≤50m	0	0	0	0	0	0	0	0	0	0	0
>50m	0	0	0	0	0	0	0	0	0	0	0
Total	4	18	2	4	2	7	6	5	9	2	2

Table 7: Percentage distribution of dimension of slides in each section (length in m)

	Murnad-Virajpet road section (SH-27	Virajpet-Kerala Boundary road section (SH-91)	Virajpet-Siddapur road section (SH-90)	Ammati-Polibetta-Siddapur road section (District road)	Murnad-Napoklu-Baghmandala road section (SH-90)	Sulya-Subramanya road section (District road)	Madikeri-Sulya road section (SH-88)	Shimoga-Tirthahalli road section (NH-13)	Tirthahalli-Someshwar road section (SH-1)	Tirthahalli-Koppa road section (NH-13)	Koppa-Narsimharajpura road section (SH-65)
≤10m	25.00	44.44	0.00	25.00	0.00	0.00	0.00	40.00	0.00	0.00	50.00
>10m≤20m	75.00	50.00	0.00	75.00	100.00	85.71	66.67	60.00	55.56	100.00	50.00
>20m≤30m	0.00	5.56	50.00	0.00	0.00	0.00	16.67	0.00	44.44	0.00	0.00
>30m≤40m	0.00	0.00	50.00	0.00	0.00	14.29	16.67	0.00	0.00	0.00	0.00
>40m≤50m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
>50m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 8: Dimension of slides in each section (width in m)

	Murnad-Virajpet road section (SH-27	Virajpet-Kerala Boundary road section (SH-91)	Virajpet-Siddapur road section (SH-90)	Ammati-Polibetta-Siddapur road section (District road)	Murnad-Napoklu-Baghmandala road section (SH-90)	Sulya-Subramanya road section (District road)	Madikeri-Sulya road section (SH-88)	Shimoga-Tirthahalli road section (NH-13)	Tirthahalli-Someshwar road section (SH-1)	Tirthahalli-Koppa road section (NH-13)	Koppa-Narsimharajpura road section (SH-65)
≤10m	1	4	0	0	0	0	0	0	0	0	0
>10m≤20m	0	9	2	4	2	1	3	3	3	1	0
>20m≤30m	0	5	0	0	0	3	2	1	4	1	0
>30m≤40m	2	0	0	0	0	0	1	1	2	0	0
>40m≤50m	0	0	0	0	0	2	0	0	0	0	1
>50m	1	0	0	0	0	1	0	0	0	0	1
Total	4	18	2	4	2	7	6	5	9	2	2

Table 9: Percentage distribution of dimension of slides in each section (width in m)

	Murnad-Virajpet road section (SH-27	Virajpet-Kerala Boundary road section (SH-91)	Virajpet-Siddapur road section (SH-90)	Ammati-Polibetta-Siddapur road section (District road)	Murnad-Napoklu-Baghmandala road section (SH-90)	Sulya-Subramanya road section (District road)	Madikeri-Sulya road section (SH-88)	Shimoga-Tirthahalli road section (NH-13)	Tirthahalli-Someshwar road section (SH-1)	Tirthahalli-Koppa road section (NH-13)	Koppa-Narsimharajpura road section (SH-65)
≤10m	25.00	22.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
>10m≤20m	0.00	50.00	100.00	100.00	100.00	14.29	50.00	60.00	33.33	50.00	0.00
>20m≤30m	0.00	27.78	0.00	0.00	0.00	42.86	33.33	20.00	44.44	50.00	0.00
>30m≤40m	50.00	0.00	0.00	0.00	0.00	0.00	16.67	20.00	22.22	0.00	0.00
>40m≤50m	0.00	0.00	0.00	0.00	0.00	28.57	0.00	0.00	0.00	0.00	50.00
>50m	25.00	0.00	0.00	0.00	0.00	14.29	0.00	0.00	0.00	0.00	50.00
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 10: Dimension of slides in each section (depth in m)

	Murnad-Virajpet road section (SH-27	Virajpet-Kerala Boundary road section (SH-91)	Virajpet-Siddapur road section (SH-90)	Ammati-Polibetta-Siddapur road section (District road)	Murnad-Napoklu-Baghmandala road section (SH-90)	Sulya-Subramanya road section (District road)	Madikeri-Sulya road section (SH-88)	Shimoga-Tirthahalli road section (NH-13)	Tirthahalli-Someshwar road section (SH-1)	Tirthahalli-Koppa road section (NH-13)	Koppa-Narsimharajpura road section (SH-65)
≤1.0m	4	16	2	4	2	6	5	5	9	2	2
>1.0m≤2.0m	0	2	0	0	0	1	1	0	0	0	0
>2.0m≤5.0m	0	0	0	0	0	0	0	0	0	0	0
>5.0m	0	0	0	0	0	0	0	0	0	0	0
Total	4	18	2	4	2	7	6	5	9	2	2

Table 11: Percentage distribution of dimension of slides in each section (depth in m)

	Murnad-Virajpet road section (SH-27	Virajpet-Kerala Boundary road section (SH-91)	Virajpet-Siddapur road section (SH-90)	Ammati-Polibetta-Siddapur road section (District road)	Murnad-Napoklu-Baghmandala road section (SH-90)	Sulya-Subramanya road section (District road)	Madikeri-Sulya road section (SH-88)	Shimoga-Tirthahalli road section (NH-13)	Tirthahalli-Someshwar road section (SH-1)	Tirthahalli-Koppa road section (NH-13)	Koppa-Narsimharajpura road section (SH-65)
≤1.0m	100.00	88.89	100.00	100.00	100.00	85.71	83.33	100.00	100.00	100.00	100.00
>1.0m≤2.0m	0.00	11.11	0.00	0.00	0.00	14.29	16.67	0.00	0.00	0.00	0.00
>2.0m≤5.0m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
>5.0m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

V.3.Bedrock Geology: A large majority of the landslides have occurred where bedrock is weathered gneiss amounting to a total of 31 slides, forming 50.82 % of the total slides. This is followed by charnockite, mainly seen along Virajpet-Kerala boundary section, totaling 18 slides that constitute around 29.51%. Metabasalt as bed rock was observed in Tirthahalli-Someshwar road section totaling 9 slides and constituting 14.75% of the total slides. Only 3 slides were seen where the bedrock is either quartz-chlorite-schist or weathered phyllite (Table 12).

Table 12: Bed rock Geology of slides observed during 2012-13

Bed rock geology	No of landslides	%
Weathered Gneiss	31	50.82
Charnockite	18	29.51
Metabasalt	9	14.75
Quartz-Chlorite-Schist	2	3.28
Weathered Phyllite	1	1.64
Total	61	100.00

V. 4. Depth/length (D/L) ratio: The depth to length ratio (D/L) for most of the slides fall in between 0.02 to 0.08indicating their 'shallow depth'. One slide in Virajpet-Kerala boundary falling in SH-91 is relatively deep landslide with D/L ratio exceeding 0.15 (Fig 3).

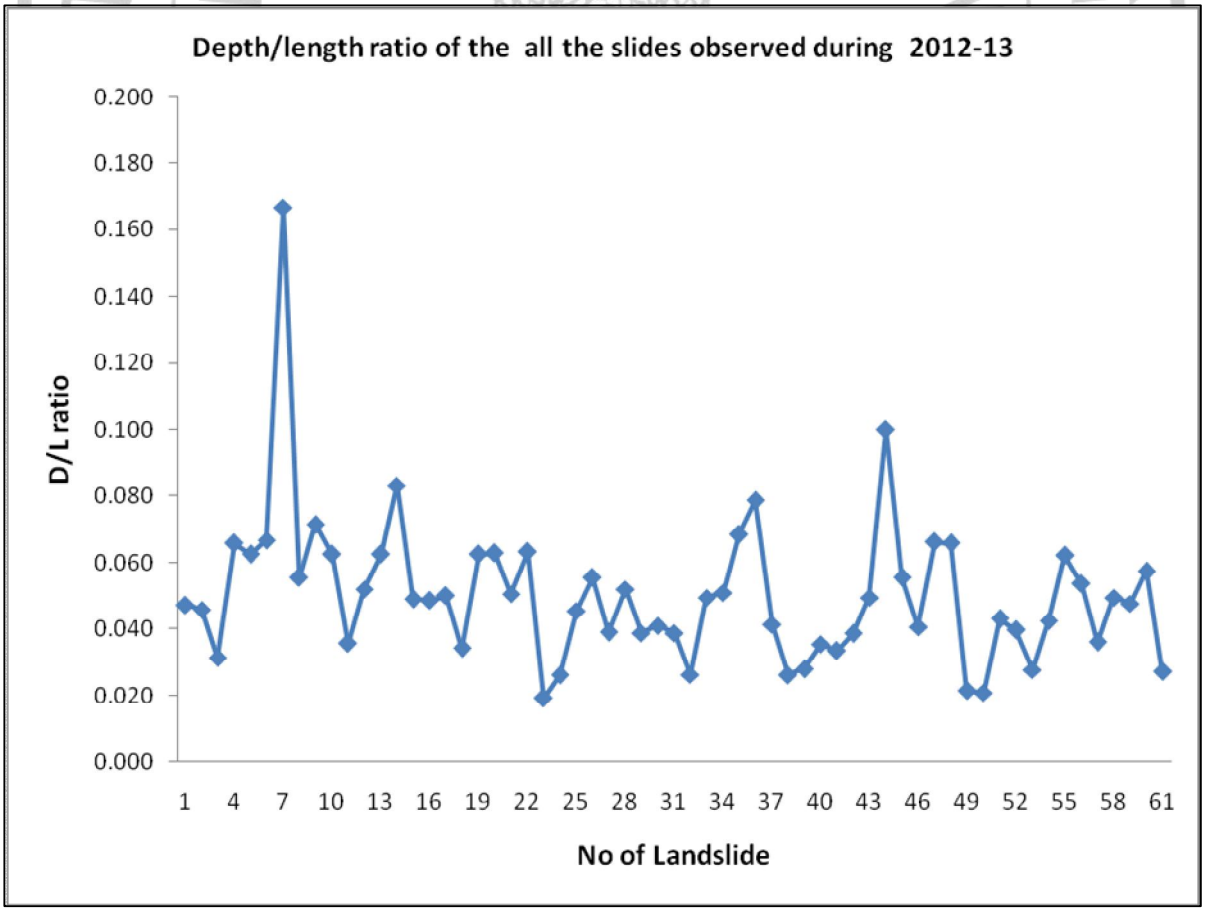

Fig 3: Depth/length ratio of all slides observed during 2012-13

V. 5. History of landslides: Due to the lack of data on the date of occurrence of landslides the age of landslide is difficult to arrive at; therefore history was taken on the morphological features observed on hill slopes. The landslides with fresh surface having less vegetation on debris was categorized as new slides and rest are grouped as old slides. As regard to reactivated ones, the old slides wherein new slides developed are considered along with the slides wherein authorities have provided some remedial measures but still then failed are also grouped under reactivated ones. Most of the landslides in the area are grouped as Old and reactivated slides totaling 25 constituting around 40.98% of the total slides. The fact that 40.98% slides are old and reactivated may suggest that the landslides are recurring problem pending treatment measures. The new slides are 19 in number constituting 31.15% of the total may suggest the slopes were at the threshold of instability in which failures started after a certain excedance of pore water pressure and 'drain' of strength of slope forming material. The old slides are 17 in number constituting around 27.87% of the total slides (Table 13).

Table 13: Number of landslides observed during 2012-13 according to their ages

History of slides	No of slide	%
New	19	31.15
Old	17	27.87
Old and reactivated	25	40.98
Total	61	100.00

Table 14: Number of landslides in each section observed during 2012-13 according to their ages

	Murnad-Virajpet road section (SH-27	Virajpet-Kerala Boundary road section (SH-91)	Virajpet-Siddapur road section (SH-90)	Ammati-Polibetta-Siddapur road section (District road)	Murnad-Napoklu-Baghmandala road section (SH-90)	Sulya-Subramanya road section (District road)	Madikeri-Sulya road section (SH-88)	Shimoga-Tirthahalli road section (NH-13)	Tirthahalli-Someshwar road section (SH-1)	Tirthahalli-Koppa road section (NH-13)	Koppa-Narsimharajpura road section (SH-65)
New	1	12	0	0	0	1	5	0	0	0	0
Old	1	4	0	3	0	3	0	2	1	2	1
Old and Reactivated	2	2	2	1	2	3	1	3	8	0	1
Total	4	18	2	4	2	7	6	5	9	2	2

Table 15: Percentage distribution of landslides according to their ages during each section observed during 2012-13

	Murnad-Virajpet road section (SH-27	Virajpet-Kerala Boundary road section (SH-91)	Virajpet-Siddapur road section (SH-90)	Ammati-Polibetta-Siddapur road section (District road)	Murnad-Napoklu-Baghmandala road section (SH-90)	Sulya-Subramanya road section (District road)	Madikeri-Sulya road section (SH-88)	Shimoga-Tirthahalli road section (NH-13)	Tirthahalli-Someshwar road section (SH-1)	Tirthahalli-Koppa road section (NH-13)	Koppa-Narsimharajpura road section (SH-65)
New	25.00	66.67	0.0	0.0	0.0	14.29	83.33	0.0	0.0	0.0	0.0
Old	25.00	22.22	0.0	75.0	0.0	42.86	0.00	40.00	11.11	100.0	50.0
Old and Reactivated	50.00	11.11	100.0	25.0	100.00	42.86	16.67	60.00	88.89	0.00	50.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

History of landslides in each road section reveals that majority of new slides have occurred in Virajpet-Kerala boundary and Madikeri-Sulya road sections (12 & 5 slides respectively) constituting around 66.67 & 83.3% respectively of the total slides in the sections. Old slides are seen in every section maximum being in Virajpet-Kerala boundary (4 slides) amounting to 22.22% of the total slides in that section. The old and reactivated slides are seen maximum in Tirthahalli-Someshwar road section where 8 such slides are recorded constituting around 88.89% of total slides in the road section (Table 14, 15).

V. 6. Cut slope heights: Majority of the slides totaling 56 observed during the study have cut slope heights ranging between 5 m and 15 m. Such slides constitute around 91.8 % of total slides. This is followed by >15m and ≤20m cut slopes accounting for 4 slides constituting around 6.56% of total slides. One slide is observed in Virajpet-Kerala boundary road sector where it has failed on valley side and no cut slope is involved. (Table 16, 17 and 18, Fig 4).

Table 16: Number of landslides observed during 2012-13 with different cut slope height

Cut slope Heights	No of slides	%
≤5m	0	0.00
>5m≤10m	28	46.67
>10m≤15m	28	46.67
>15m≤20m	4	6.67
>20m≤25m	0	0.00
>25m	0	0.00
Total	60	100.00

Table 17: Number of landslides in each section observed during 2012-13 with different cut slope height

	Murnad-Virajpet road section (SH-27	Virajpet-Kerala Boundary road section (SH-91)	Virajpet-Siddapur road section (SH-90)	Ammati-Polibetta-Siddapur road section (District road)	Murnad-Napoklu-Baghmandala road section (SH-90)	Sulya-Subramanya road section (District road)	Madikeri-Sulya road section (SH-88)	Shimoga-Tirthahalli road section (NH-13)	Tirthahalli-Someshwar road section (SH-1)	Tirthahalli-Koppa road section (NH-13)	Koppa-Narsimharajpura road section (SH-65)
≤5m	0	0	0	0	0	0	0	0	0	0	0
>5m≤10m	1	8	0	3	0	0	2	4	7	2	1
>10m≤15m	3	6	1	1	2	7	4	1	2	0	1
>15m≤20m	0	3	1	0	0	0	0	0	0	0	0
>20m≤25m	0	0	0	0	0	0	0	0	0	0	0
>25m	0	0	0	0	0	0	0	0	0	0	0
Total	4	17	2	4	2	7	6	5	9	2	2

Table 18: Percentage distribution of cut slope heights of slides in each section observed during 2012-13

	Murnad-Virajpet road section (SH-27	Virajpet-Kerala Boundary road section (SH-91)	Virajpet-Siddapur road section (SH-90)	Siddapur road section (District road)	Murnad-Napoklu-Baghmandala road section (SH-90)	Sulya-Subramanya road section (District road)	Madikeri-Sulya road section (SH-88)	Shimoga-Tirthahalli road section (NH-13)	Tirthahalli-Someshwar road section (SH-1)	Tirthahalli-Koppa road section (NH-13)	Narsimharajpura road section (SH-65)
≤5m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
>5m≤10m	25.00	47.06	0.00	75.00	0.00	0.00	33.33	80.00	77.78	100.00	50.00
>10m≤15m	75.00	35.29	50.00	25.00	100.00	100.00	66.67	20.00	22.22	0.00	50.00
>15m≤20m	0.00	17.65	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
>20m≤25m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
>25m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

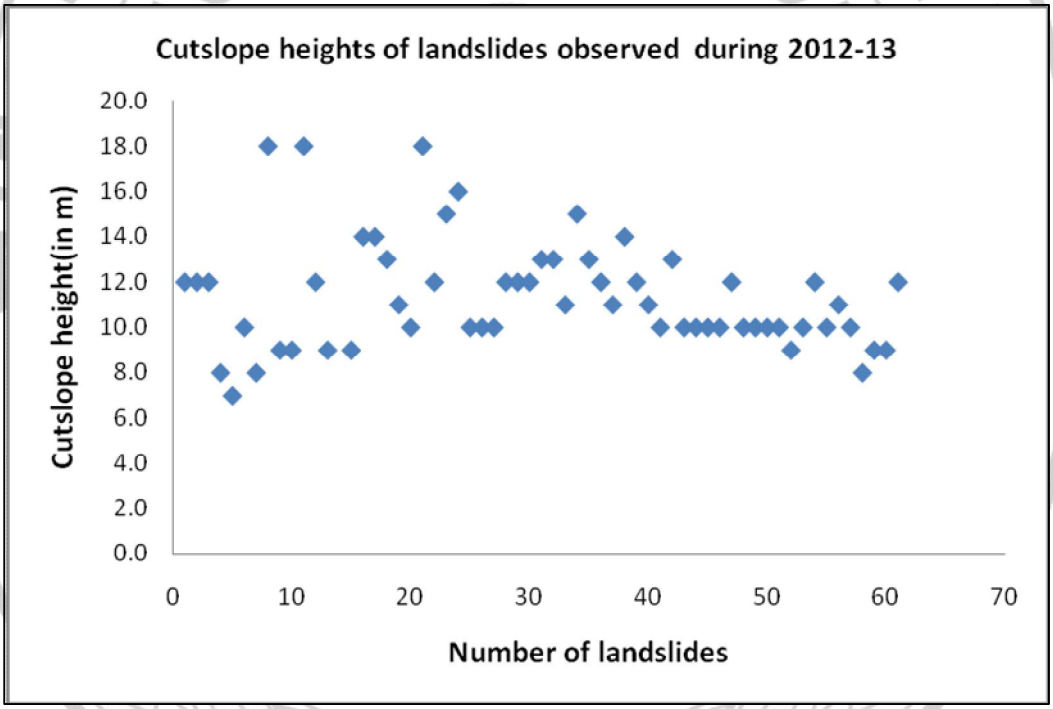

Fig 4: Cut slope heights of slides observed during 2012-13

VI. SUMMARY

1. Almost all landslides studied in the area appear to have caused due to the human interference in modifying the existing natural slopes. The specific causes of landslides in Western Ghat in general as well the study area in particular are 'toe cutting' of hill slopes for the construction of road, modification for human settlement, presence of weathered and loose rock mass, heavy and frequent rain etc.
2. All slides are triggered by heavy rainfall mainly in rainy seasons extending for 4 months from June to September. The ubiquitous presence of water is favorable for intense weathering of rocks causing appreciable drop in their shearing resistance. The heavy rainfall during monsoon is the major triggering factor for all the slides.
3. Majority of the slides observed during 2012-13 are 'debris slides' totaling to 28 slides constituting around 45.90% of the total landslides in the area. 'Slumps' - both debris as well as 'earth slumps' are 29 in number, constituting 47.54% of the total slides. Incidence of 'rock falls' is 3 landslides, constituting 4.92% of the total number of slides. Composite slides are only one in number (around 1.64%). The 'debris slides' were mainly noticed in Tirthahalli-Someshwar section (8 nos), closely followed by Virajpet-Kerala boundary section (5 nos). In general, there is a close correlation with the cut slope height and debris slides. Where cut slope height is relatively higher, the dominance of debris slides are noticed and small cut slope height and almost vertical to sub vertical slope angle may be attributed for the occurrence of debris slump and earth slumps.
4. Two 'rock falls' and one composite slide are noticed in Virajpet-Kerala boundary section. The rock falls are mainly planar/wedge failure types attributed to formation of wedge blocks due to intersecting joints.
5. Large majority of the slides are small in dimension, Around 80.33% of the slides observed are less than 30 m in length and all such slides are shallow with less than 2m depth. The width of the slides varies over a wide range probably related to multiple sources and lateral grading of slides. Such slides are juxtaposed and difficult to delimit.
6. Majority of the landslides are confined to weathered gneissic bedrock. About 31 such slides constituting around 50.82% of the total were seen. This is followed by charnockite bedrock seen in Virajpet-Kerala boundary section which has recorded 18 slides (29.51%). Metabasalt as bed rock was observed in Tirthahalli-Someshwar road section totaling 9 slides and constituting 14.75% of the total slides. Only 3 slides were seen where the bedrock is either quartz-chlorite-schist or weathered phyllite
7. Majority of the slides observed during 2012-13 have cut slope heights ranging between 5 m and 15 m (4 slides or 6.56 % of total slides) . One slide is observed in Virajpet-Kerala boundary road sector where it has failed on valley side and no cut slope is involved.
8. Due to lack of data on date of occurrence the landslides were grouped in to new, old and reactivated based on the morphological features observed on hill slopes, with fresh surface having less plant growth on debris categorized as new slides and rest are grouped as old slides. As regard to reactivated ones, the old slides wherein new slides are developed are considered along with the slides wherein authorities have provided some

remedial measures but still then failed are grouped under reactivated ones. Most of the landslides in the area are grouped as old and reactivated slides totaling 25 constituting around 40.98% of the total slides followed by 19 new slides constituting 31.15% of the total.

9. The depth to length ratio (D/L) for most of the slides fall in between 0.02 to 0.08indicating their 'shallow depth'. One slide in Virajpet-Kerala boundary falling in SH-91 is relatively deep landslide with D/L ratio exceeding 0.15 .The convex slopes were found to be more prone /susceptible to sliding than the concave and irregular slopes. Therefore cut slopes should be made as a plane or with a little concavity with the top edge a plane at an angle less than the angle of concavity.
10. Cut slope angle and height appear to have played a major role in slope failure.
11. The Overburden thickness is around 1-4 m consisting of mostly soil and weathered rock in most of the cases.

VII. RECOMMENDATIONS

In order to minimize the incidences of landslides, the following measures are recommended.

1. Proper drainage is required to be maintained. The drainage is seen blocked or absent in around 60% of the affected areas. The water from uphill slope needs to be diverted in the following ways in order to minimize sliding.
   i. Provision of contour drainage at the Crown part.
   ii. Insertion of horizontal perforated pipes into the slopes which will act as weep-holes in the vertical slopes, thereby reducing the pore water pressure by draining out the excess water. This has to be given at appropriate intervals as per the site condition.
   iii. Lined drainage at the toe.
2. Vertical cut slopes should be avoided in future as it does not give stability in such terrain.
3. Retaining structures like retaining wall, stone pitching are recommended as per the site condition.
4. Bio geotechnical measures of slope protection like plantation of Vetiver grass along the slope will reinforce most of the slides.

(K.V.Maruthi) **Senior Geologist**	**(K.V.Chandran)** **Senior Geologist**
SCRUTINIZED BY **(Shafeeq Ahamed)** **Director**	

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SYNOPSIS OF WORK DONE

1.	Title of the report	LANDSLIDE INVENTORY ALONG NATIONAL HIGHWAY &STATE HIGHWAY OF GHAT ROADS IN COORG, DAKSHINA KANNADA, UDUPI, SHIMOGA AND CHIKMAGALUR DISTRICTS, KARNATAKA.
2.	Item No.	LHZ/ SR/ KG/2012/119
3	Field Season	2012-13
4	Date of commencement	April 2012
5	Date of completion	March 2013
6	Officers Associated with investigation	K.V.Maruthi, Senior Geologist K.V.Chandran, Senior Geologist
7	Quantum of work done	

Nature of Work	**Total work envisaged**	**Work proposed for FS: 2012-13**	**Work completed**
Aerial photo / Image interpretation	500 sq.km	500 sq.km	500 sq.km
Inventory in 1:50,000 scale	250 L km (At least 1 km on either side of the road)	250 L km (At least 1 km on either side of the road)	279 L. Km (61 Landslide incidences)

8	Expenditure (1) POL (2) Wages (3) Misc./other charges	 Rs 11,180=00 Rs. 3114=95 Rs. 18,240=00(Including charges for hiring vehicle)
9	Other information if any	----

(K.V.Maruthi) **Senior Geologist**	**(K.V.Chandran)** **Senior Geologist**
(Shafeeq Ahamed) **Director**	

PLATE-1

LOCATION MAP OF KARNATAKA SHOWING LANDSLIDE INCIDENCES ALONG NH, SH & MAJOR DISTRICT ROADS DURING 2012-13

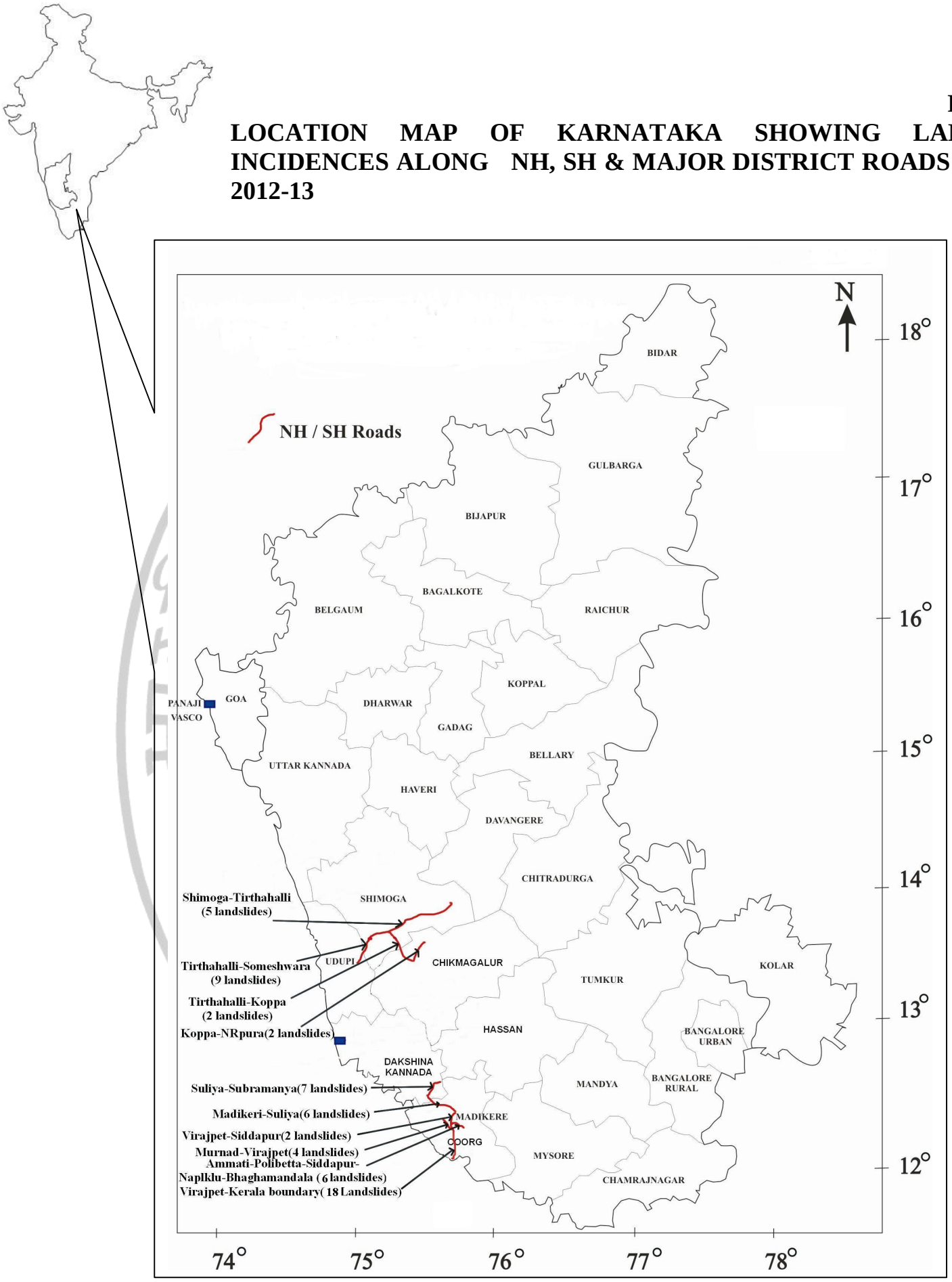
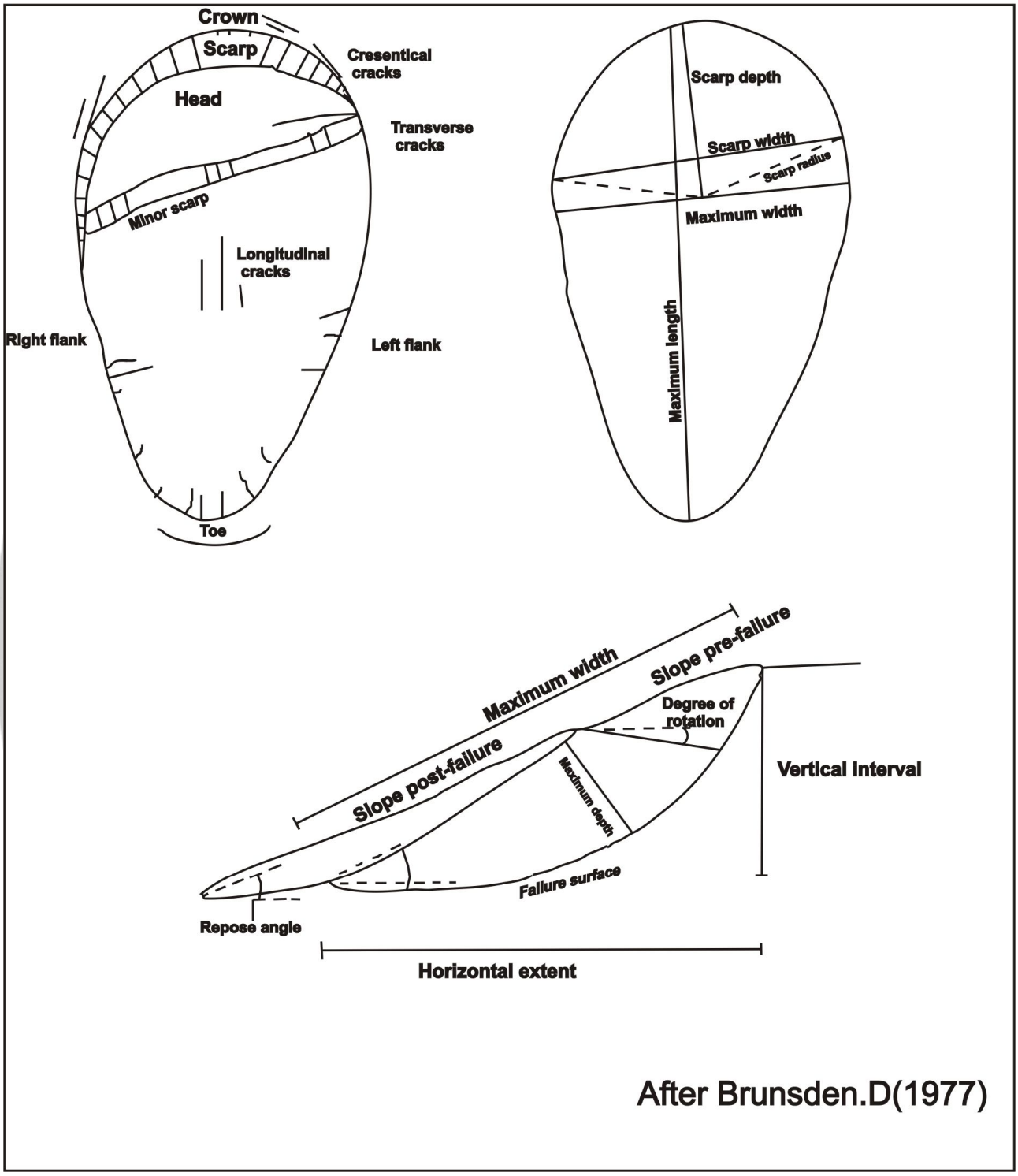


PLATE-2

MORPHOMETRIC TERMINOLOGY OF LANDSLIDES

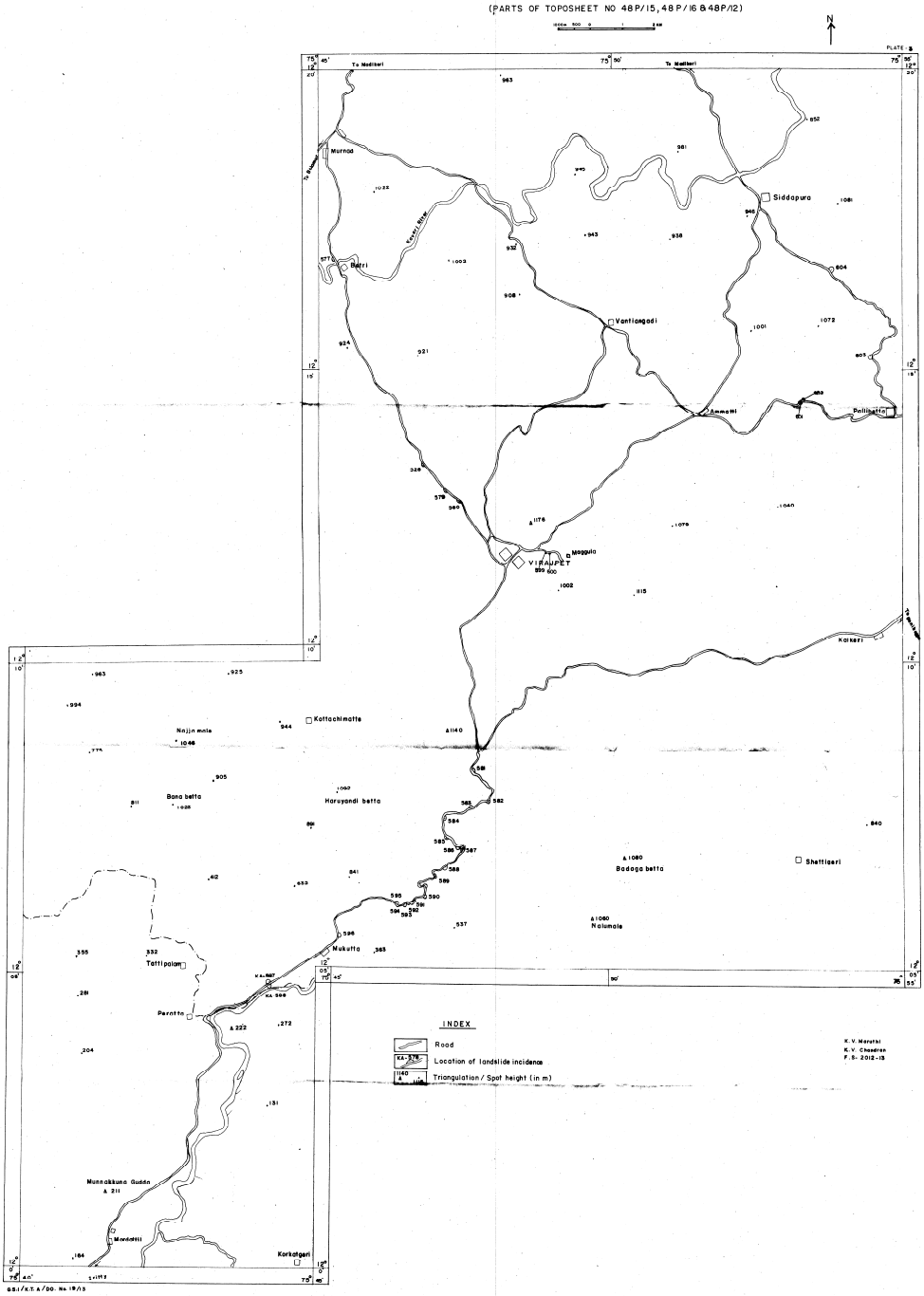


GEOLOGICAL SURVEY OF INDIA

LANDSLIDE INVENTORY MAP ALONG NH & SH GHAT ROADS OF KARNATAKA

(PARTS OF TOPOSHEET NO 48P/15, 48P/16 & 48P/12)

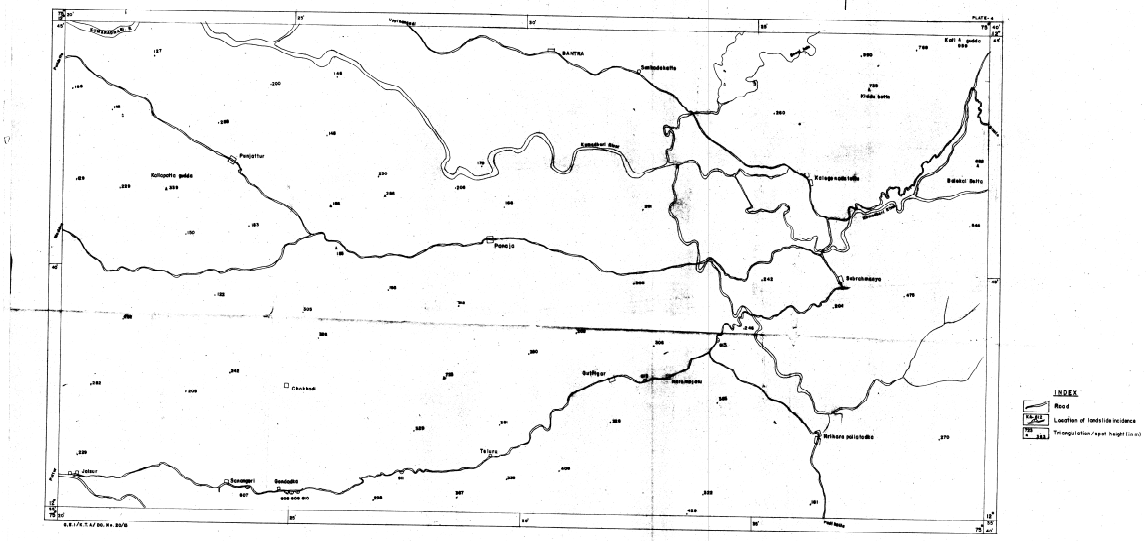
PLATE - 5



GEOLOGICAL SURVEY OF INDIA

LANDSLIDE INVENTORY MAP ALONG NH & SH GHAT ROADS OF KARNATAKA

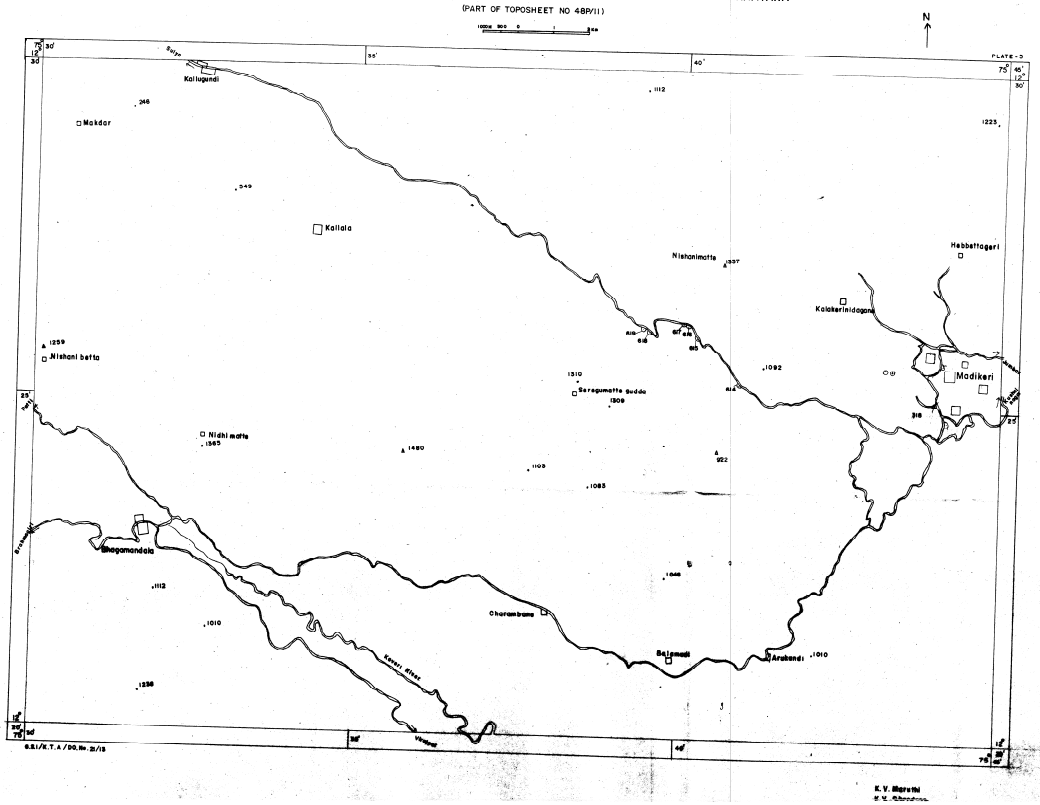
(PARTS OF TOPOSHEET NO 48P/8 48P/10)



GEOLOGICAL SURVEY OF INDIA

LANDSLIDE INVENTORY MAP ALONG NH & SH GHAT ROADS OF KARNATAKA

(PART OF TOPOSHEET NO 48P/11)



K.V. Maruthi

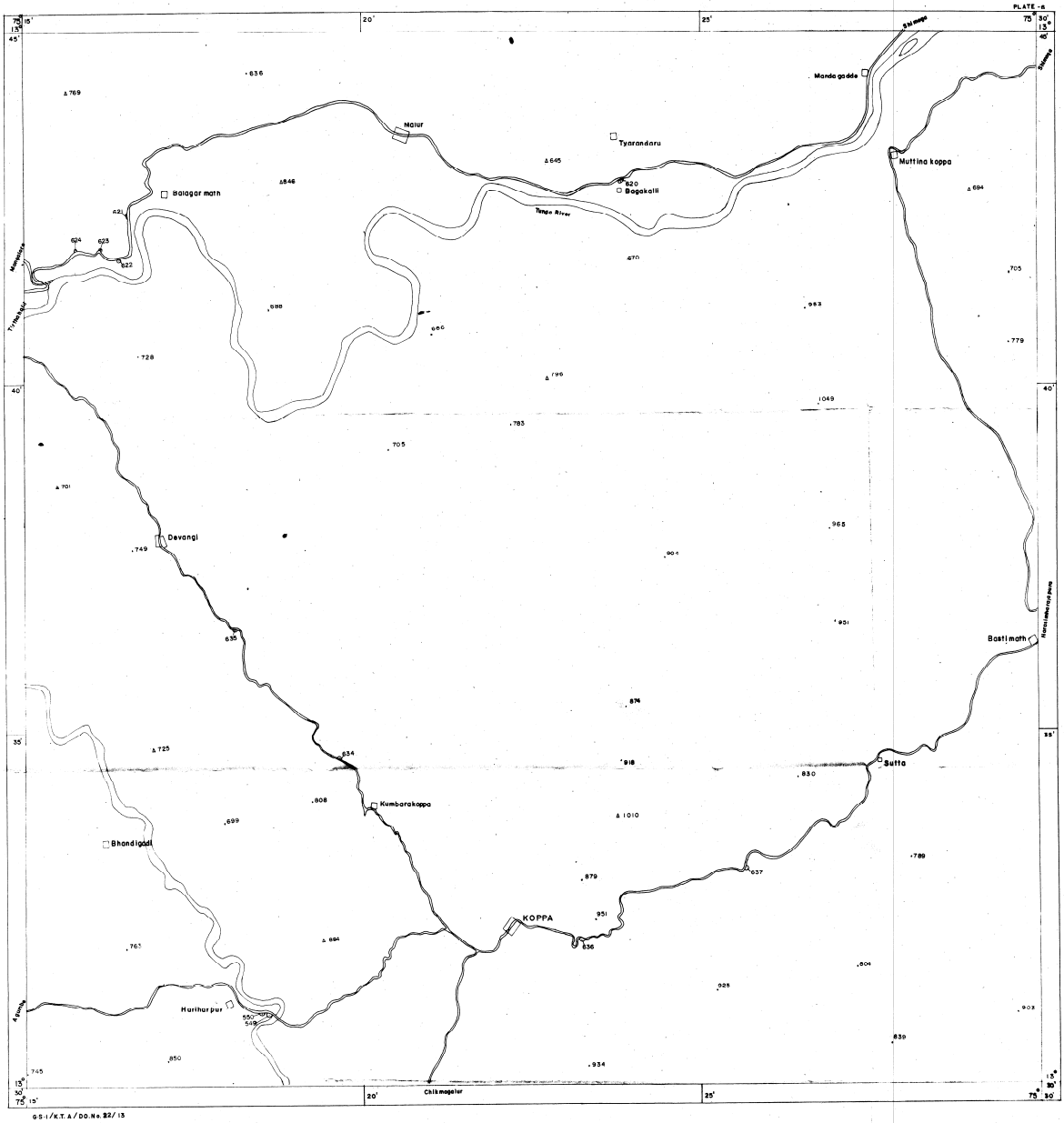
K.V. Shivakumar

GEOLOGICAL SURVEY OF INDIA

LANDSLIDE INVENTORY MAP ALONG NH & SH GHAT ROADS OF KARNATAKA

(PARTS OF TOPOSHEET NO 48 O/6)

PLATE - 6



GSI/K.T.A/DO.No 22/13

INDEX

- Road
- Location of landslide incidence
- Triangulation / Spot height (in m)

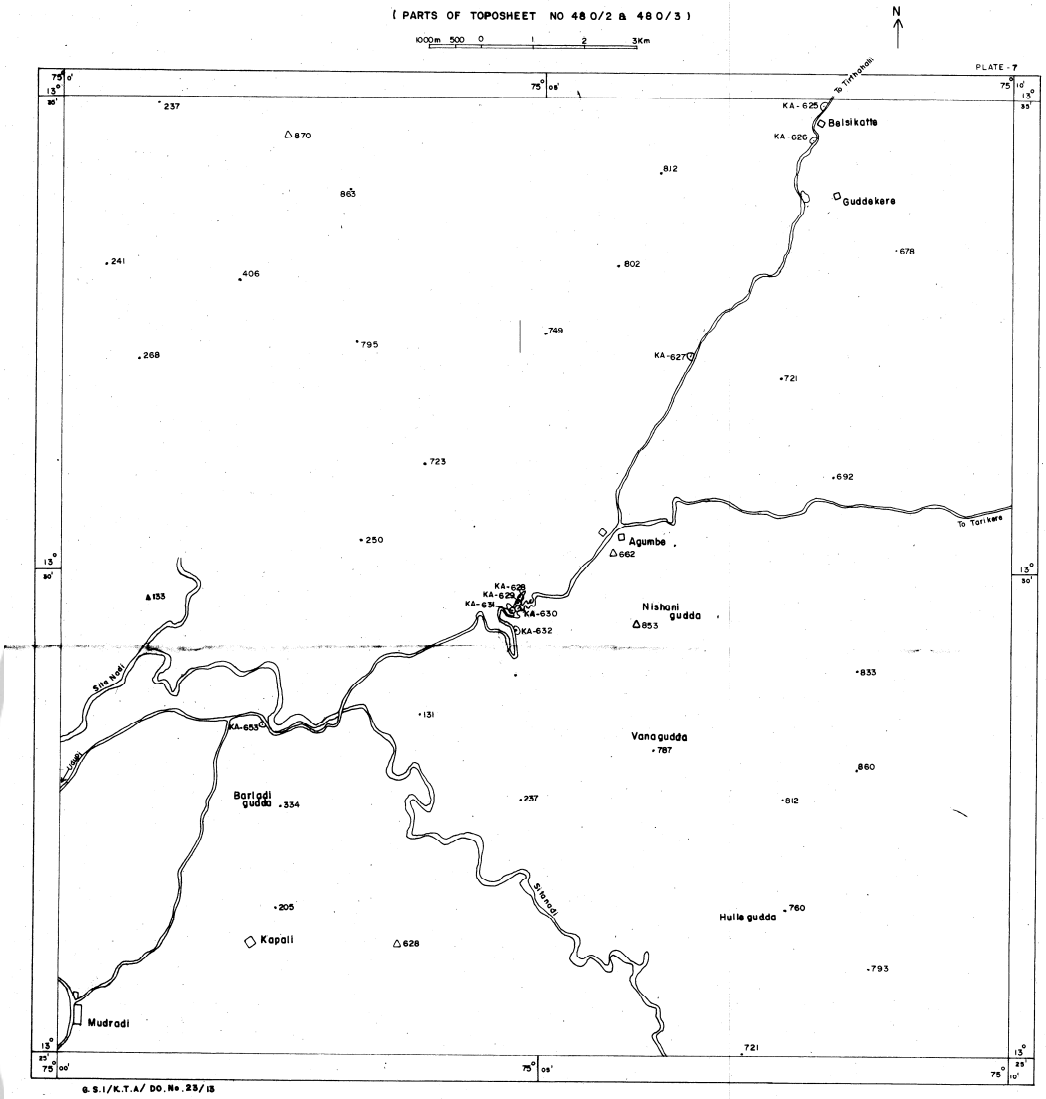
K.V. Marathi
K.V. Chandran
F.S.- 2012-13

GEOLOGICAL SURVEY OF INDIA

LANDSLIDE INVENTORY MAP ALONG NH & SH GHAT ROADS OF KARNATAKA

(PARTS OF TOPOSHEET NO 48 O/2 & 48 O/3)

PLATE - 7



INDEX

- Road
- KA-63C — Location of Landslide incidence
- 853 / 789 — Triangulation/Spot height (in m)

K.V. Maruthi
K.V. Chandran
F.S-2012-13

G.S.I/K.T.A/ DO. No. 23/13

APPENDIX-1

LANDSLIDE INVENTORY FORMAT

1.SLIDE NUMBER:	

2.LOCATION						Toposheet number					
TALUK:				DISTRICT:					STATE:		
Latitude				N	Longitude				E	Altitude	M.asl

3.SLIDE DATA: Length width Depth Base length approximate volume of material

3a. Morphometry In m In m

3b. Scarp morphometry Radius Height Angle

In m

3c.Crown condition: Stable/unstable

3d. Head condition: Stable/unstable

3e. Toe condition: Stable/unstable 3f. Whether: FRESH / REACTIVATED

Date of occurrence: D/ /M/ /Y/

3g.Whether: STABALISED/ACTIVE

3h.Rapidity of movement: SLOW/MODERATE/ABRUPT

3i.Type of slide:

i. Creep:

ii. Slump/subsidence followed by debri slide

iii. Debri slide

iv. Rock fall Strike Dip

Towards Spacing Opening Filling

v. Rock slide Planar: along

Wedge: JI

J2

J3

3j. Run out distance from toe of rupture: In m

Up to Location(Description)

3k. Slide direction: 3l.Repose angle:

3 m. Areas: 3n. Shape: 3o.

Perimeter:

3p. Horizontal extent: 3q. Vertical interval:

4. DAMAGES:

5. ELEMENTS AT RISK:

6. CONTRIBUTING FACTORS: Soil thickness in m Type of soil

Sandy	Silty	Clayey	Humus	Laterite

. B).Rock: Weathered / Fresh

6a. Slope forming material
6b. Saturation condition: Saturated/ Wet / Dry
6c. Ground water: Dry/ Flowing / Wet/ Damp
6d. Slope angle: Original: Cut slope/pre Post
6e. Cut slope height :
6f. Depth of weathering:
6g: Vegetation Cover: Barren/ Bushy / Tea/ Coffee
Forest: Sparsely/ Moderately/ Thickly
6h: Erosion by water Toe / Head ward / Lateral
6i. Human interference i**)** Cultivation: Tea/coffee/others ii**)** Deforestation **iii)** Quarrying
iv) Heavy vehicular movement **v)** Construction / settlement
vi) Road cutting **vii)** Railway cutting

7. **RAIN FALL**: On day of slide in mm. Date: D M Y
Data source:
8. **PROBABLE CAUSE**: 1. Weathering- decomposition/disintegration
2. Saturation
3. Toe cutting by river or nala.
4. Ineffective drainage
5. Effect of human interference
6. Less vegetation cover
7. Dip/ Strike unfavourable
8. Any other (specify)
9. **GEOLOGY**
10. **Cracks:** **Type** **position** **opening** **length** **angle**
11. **DATA SOURSE**: Self investigated/ Any other (specify)
12. **PHOTO NO**.:
13**. REMEDIAL MEASURES:**

14. REMARKS:

15. **SKETCH:**

DATED DATA COLLECTED BY

GEOLOGICAL SURVEY OF INDIA

Data sheet on report movement in connection with its scrutiny

Project / Division: **EG Division SU:K&G GSI Banglore**	FSP No: **LHZ/ SR/KG/2012/119**	Mission: **IV**
Title of the report: **LANDSLIDE INVENTORY ALONG NATIONAL HIGHWAY &STATE HIGHWAY OF GHAT ROADS IN COORG, DAKSHINA KANNDA, UDUPI, SHIMOGA AND CHIKMAGALUR DISTRICTS, KARNATAKA.**		
Names of author(s) 1. K.V. MARUTHI 2. K.V. CHANDRAN 3.	Date of submission to the Supervisory Officer 10.07.2013 Signature of the senior most author K.V.	
Name of the Supervisory Officer: SHAFEEQ AHAMED	Date of receipt of the report:	10.07.2013
	Date of completion of scrutiny:	18.07.2013
	Date of handing over the report to the author(s) after scrutiny:	18.07.2013
	Signature:	
Name of the author to whom the report has been handed over by the Supervisory Officer: K.V. MARUTHI	Date of receipt after scrutiny: 18.07.2013 Signature: K.V. Date of resubmission: 24.07.2013 Signature: K.V.	
Supervisory Officer SHAFEEQ AHAMED	Date of receipt after modification:	25.07.2013
	Date of handing over the report to the Regional Mission Head:	
	Signature:	25/07/13
Name of the Regional Mission Head - IV P.A.RAMESH BABU	Date of receipt of the report:	29.7.13
	Date of handing over the report to the Project Director after peer review:	24.9.13
	Signature:	

Supervisory Officer SHAFEEQ AHAMED	Date of receipt of the report from the Regional Mission Head after peer review:	24.09.2013
	Date of handing over to the author(s)	24.09.2013
	Signature:	
Name of the author(s) K.V. MARUTHI	Date of receipt of the report from the Supervisory Officer:	24.09.2013
	Date of resubmission to the Superisory Officer after modification:	26.09.2013
	Signature:	K.V.
Name of the Supervisory Officer SHAFEEQ AHAMED	Date of receipt of the report after modification:	26.09.2013
	Date of handing over the report to the Regional Mission Head:	26.09.2013
	Signature:	

Name of the Regional Mission Head: IV P.A.RAMESHBABU	Date of receipt of the report from the Project Director after modification:	27.09.2013
	Date of handing over the report to the HOD of the Region for approval:	27.09.2013
	Signature:	
Name of the HOD of the Region: S.BALAKRISHNAN	Date of receipt of the report for approval:	28.09.2013
	Date of approval:	29.09.2013
	Date of sending back report to Project Director:	29.09.2013
	Signature:	
Name of the Project Director:	Date of receipt of the report after approval of the HOD:	
	Date of circulation of the report	
	Signature:	

GEOLOGICAL SURVEY OF INDIA
Certificate of Quality of the report

Project/ Division: **EG Division SU:K&G GSI Banglore**
FSP No.: **LHZ/ SR/KG/2012/119** Mission: **IV**
Title of the report: **LANDSLIDE INVENTORY ALONG NATIONAL HIGHWAY &STATE HIGHWAY OF GHAT ROADS IN COORG, DAKSHINA KANNDA, UDUPI, SHIMOGA AND CHIKMAGALUR DISTRICTS, KARNATAKA.**

Part – A

This is to certify that the following Officer(s) have carried out the above mentioned FSP and are responsible for collection of field data, carrying out required laboratory analysis, compilation and synthesis of field data, collation of the data and writing of the report as per the approved guidelines. The duration of field stay of each Officer is as against his/ her name.

Name and designation of the Officer	Total field stay during the FSP (No. of days)	Signature with date
1. K.V. MARUTHI, Sr. Geologist	29	K.V. 19/7/12
2. K.V. CHANDRAN, Sr. Geologist	30	19/7/12
3.		

Part-B **-NA-**

This is to certify that drilling has been carried out and completed as per the table given below:

Drilling Unit No	Date of commencement of drilling	Date of completion of drilling	Name and signature of the Director Drilling
1.			
2.			

Part-C **-NA-**

This is to certify that geophysical component of the item has been carried out as per the table given below

Name(s) Designation of the geophysicist	Date of commencement of work	Date of completion of work	Signature of the Geophysicist with date
1.			
2.			
Name of the Director (Geophysics)			
Signature with date			

Part-D **-NA-**

This is to certify that the chemical analysis of the geological samples has been carried out as per the table given below

Name of the Director in charge of the Laboratory	Date of receipt of samples from the Field Officer/ party	Date of providing complete analytical resultsto the Field Officer/ party	Signature with date

Part –E

This is to certify that the Supervisory Officer(s) mentioned below have supervised the above item and have provided guidance to the Field Officer(s). The number of inspection visits and total duration of field visits is as per the table below. It is also certified that the work carried out under the project is of high standards, the norms of field work, lab work etc. have been followed. It is also certified that thorough scrutiny of the report for maintaining the scientific contents and its quality has been overseen

Name(s) and designation of the Supervisory Officers	No. of inspection visits	Total No. of days spent on inspection visit	Signature with date
Dr.B.R.Venkatesh, Director	**03**	**05**	**Retired**
Shafeeq Ahamed, Director	**02**	**03**	25/07/12

Part-F

This is to certify that the report has been thoroughly scrutinized at the Regional Mission Head level. The scientific contents and the quality of the report are certified. The report has been peer reviewed and the needful corrections have been attended to.

Name and designation of the Regional Mission Head - R	Signature with date
P.A. RAMESH BABU, Dy.D.G.	P.A.

Part-G

This is to certify that the report has been scrutinized at various levels and has also been peer reviewed. On being satisfied regarding the scientific content and quality of the report, the undersigned has accorded approval for its circulation.

Name and designation of the Regional HOD	Signature with date
S.BALAKRISHNAN	