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भारतीय भूवैज्ञानिक सर्वेक्षण
Geological Survey of India

कर्नाटक राज्य के चिकमंगलुरु, शिमोगा, दक्षिण कन्नड़ जिले के भूआकृति संख्या 48O/2, O/6 के कुछ हिस्सों में वृहद पैमाने पर (1:50,000) भूस्खलन संवेदनशीलता का मानचित्रण

Macro-scale (1:50,000) Landslide Susceptibility Mapping in parts of Toposheets nos. 48O/2, O/6 Chikmangaluru, Shimoga, Dakshin Kannada districts, Karnataka.

टोपोशीट सं./ Toposheet Nos.: 48O/2, 48O/6

मद संख्या: M4LSSM/एनसी/एस आर/SU-KG/2019/25183

Item no.: M4LSSM/NC/SR/SU-KG/2019/25183

कार्य सत्र 2019-20 का अंतिम प्रतिवेदन
Final Report for Field Season 2019-20

नेहा कुमारी, भू-वैज्ञानिक एवं शोवेश दुलाल मुदुली, भू-वैज्ञानिक
Neha Kumari, Geologist And Sovesh Dulal Muduli, Geologist

मिशन-IV
MISSION-IV

PROJECT: NLSM / परियोजना: एनएलएसएम

STATE UNIT: KARNATAKA & GOA/ राज्य इकाई: कर्नाटक एवं गोवा

नवम्बर, 2020
November, 2020

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भारतीय भूवैज्ञानिक सर्वेक्षण
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(FSP Code: M4LSSM/NC/SR/SU-KG/2019/25183)

Field Season: 2019-20

By

**Neha Kumari, Geologist
and
Sovesh Dulal Muduli, Geologist**

CONTENTS

Page no.

सारांश	i-iii
Abstract	iv-vi
I. INTRODUCTION	
1.1 Background Information	1-2
1.2 Present Work	2
1.3 Description of Study Area	3
1.4 Physiography and Drainage	3-4
1.5 Climate and Rainfall	4
1.6 General Gemorphology and Soil Types	5
1.7 General Geology	5-8
1.8 Methodology	8-10
1.9 Acknowledgements	10
II. PREVIOUS WORK ON LANDSLIDE STUDIES	11-13
2.1 Review of Literature	
2.2 Spatial distribution of Historic Landslide Incidences	
2.2.1 History of Landslides	
III. LANDSLIDE INCIDENCES IN PRESENT SCENARIO	14-20
3.1 Spatial distribution of Landslides	
3.1.1. Description of Major landslide incidences in the study area	
IV. LANDSLIDE SUSCEPTIBILITY ANALYSIS	21-37
4.1 Background	
4.2 Geo-factor Themes	
4.2.1 Slope Morphometry	
4.2.2 Landuse and Landcover	

4.2.3 Geomorphology	
4.2.4 Slope Forming Material (SFM)	
4.2.5 Regolith Thickness	
4.2.6 Structure and Drainage	
4.3 Methodology	32
4.4 Selection of mapping units	33
4.5 Methods of Susceptibility Analysis	33-37

V. LANDSLIDE SUSCEPTIBILITY MAP 39-45

5.1 Interpretation of Landslide Susceptibility Map
5.2 Spatial correlation of landslide distribution with geofactor classes
5.3 Quantitative statistical analysis
5.4 Landslide Susceptible Zones
5.5 Anthropogenic Causes of Slope failures
5.6 Natural causes of slope failures
5.7 Remedial Measures
5.8 Output Landslide Susceptibility Map

VI. CONCLUSIONS AND RECOMMENDATIONS 46-47

REFERENCES

LOCALITY INDEX

SYNOPSIS OF WORK DONE

FIVE POINT PROFORMA

DATASHEET ON MOVEMENT OF REPORT

CERTIFICATE OF QUALITY OF REPORT

LIST OF TABLES

Table 1: Details of nature of work, quantum and achievements.

Table 2: Chrono-stratigraphic Succession of Litho-units of the study area.

Table 3: Details of location of historic/past landslide incidences in the study area.

Table 4: The Percentage distribution of Classified Slope Gradient Map of T.S Nos. 48O/2, O/6 with their LOFS and Rank.

Table 5: The Percentage distribution of Classified Slope Curvature Map of T.S Nos. 48O/2, O/6 with their LOFS and Rank.

Table 6: The Percentage distribution of Classified Slope Aspect Map of T.S Nos. 48O/2, O/6 with their LOFS and Rank.

Table 7: The Percentage distribution of Classified Landuse/Landcover Map of T.S Nos. 48O/2, 48O/6 with their LOFS and Rank.

Table 8: The Percentage distribution of Classified Geomorphology classes of T.S Nos. 48O/2, O/6 with their LOFS and Rank.

Table 9: The Percentage distribution of Classified Slope Forming Material Map of T.S Nos. 48O/2, 48O/6 with their LOFS and Rank.

Table 10: The Percentage distribution of Classified Regolith Thickness Map of T.S Nos. 48O/2, 48O/6 with their LOFS and Rank.

LIST OF GRAPHS

Graph 1: Graph showing frequency distribution of different type of landslide incidences in the study area.

Graph 2: Graph showing percentage distribution of Slope Angle Class in the study area.

Graph 3: Graph showing percentage distribution of different Slope Curvature Class in the study area.

Graph 4: Graph showing percentage distribution of different Slope Aspect Class in the study area.

Graph 5: Graph showing percentage distribution of different LU/LC Classes in the study area.

Graph 6: Graph showing percentage distribution of different Geomorphology Classes in the study area.

Graph 7: Graph showing percentage distribution of landslides in different Slope Forming Material classes in the study area.

Graph 9: Graph showing percentage distribution of different Regolith Thickness classes in the study area.

Graph 10: Graph showing frequency of landslides distribution/occurrences in different LU/LC Classes.

Graph 11: Graph showing frequency of landslides distribution/occurrences in different geomorphology Classes.

Graph 12: Graph showing frequency of landslides distribution/occurrences in different Slope Angle Classes.

Graph 13: Graph showing frequency of landslides distribution/occurrences in different Regolith Thickness Classes.

Graph 14: Graph showing frequency of landslides distribution /occurrences in different Slope Aspect Classes.

Graph 15: Graph showing frequency of landslides in different Landslide Susceptible Zones.

LIST OF DIAGRAMS

Diagram 1: Flow diagram showing methodology adopted for Landslide Susceptibility Mapping.

LIST OF ANNEXURES

Annexure I: Geo-parametric landslide inventory database.

Annexure II: 42-point Geo-parametric landslide Inventory.

Annexure III: Tabular matrices for LOFS and consistency ratio calculations for six factor maps.

Annexure IV: Rainfall data (10 yrs) collected from different rain gauge stations of the study area.

LIST OF FIELD PHOTOGRAPHS

Photo 1: Field Photograph of Debris slide on lowly dissected hillslope East of Suranakodagi village.

Photo 2: Field Photograph of Debris slide on lowly dissected hillslope on Hulikal road section.

Photo 3: Field Photograph of Debris slide on lowly dissected hillslope on Koppa-Hariharpur road.

Photo 4: Field Photograph of Debris Slide South of Kalgudge Village/Koppa road.

Photo 5: Field Photograph of Debris Flow on lowly dissected hillslope at Kanave Village area.

Photo 6: Field Photograph of Debris slide on lowly dissected hillslope at Urumakki Village.

Photo 7: Field Photograph of Extensive Cut Slope failure on lowly dissected hillslope in Ganapatikatte Village of T.S. no. 48O/6.

Photo 8: Field Photograph of Settlement on Modified Slope Madagere village of T.S. no. 48O/6.

Photo 9: Field Photograph of Settlement on Modified Slope Nagalapur village of T.S. no. 48O/6.

Photo 10: Field Photograph of Escarpment of Highly Dissected Hillslope of Agumbe hill ranges.

Photo 11: Field Photograph of Cultivation on Pediment-Pediplain Complex adjacent to lowly dissected hillslope.

Photo 12: Field Photograph of Lowly Dissected Hillslope in and around Thirthahalli.

Photo 13: Field Photograph of Soil profile section of Vertical Slope Cut in the study area.

LIST OF PLATES

Plate-1: Location map of the study area in parts of Toposheets nos. 48O/2, O/6 Chikmangaluru, Shimoga, Dakshin Kannada districts, Karnataka.

Plate-2: Geological map of Toposheets nos. 48O/2, 48O/6 in parts of Chikmangaluru, Shimoga, Dakshin Kannada districts, Karnataka.

Plate-3: Landuse/Landcover map of Toposheets nos. 48O/2, 48O/6 in parts of Chikmangaluru, Shimoga, Dakshin Kannada districts, Karnataka.

Plate-4: Geomorphology map of Toposheet nos. 48O/2, 48O/6 in parts of Chikmangaluru, Shimoga, Dakshin Kannada districts, Karnataka.

Plate-5: Slope Forming Material map of Toposheets nos. 48O/2, 48O/6 in parts of Chikmangaluru, Shimoga, Dakshin Kannada districts, Karnataka.

Plate-6: Regolith Thickness map of Toposheets nos. 48O/2, 48O/6 in parts of Chikmangaluru, Shimoga, Dakshin Kannada districts, Karnataka.

Plate-7: Slope angle/gradient map of Toposheets nos. 48O/2, 48O/6 in parts of Chikmangaluru, Shimoga, Dakshin Kannada districts, Karnataka.

Plate-8: Slope Aspect map of Toposheets nos. 48O/2, 48O/6 in parts of Chikmangaluru, Shimoga, Dakshin Kannada districts, Karnataka.

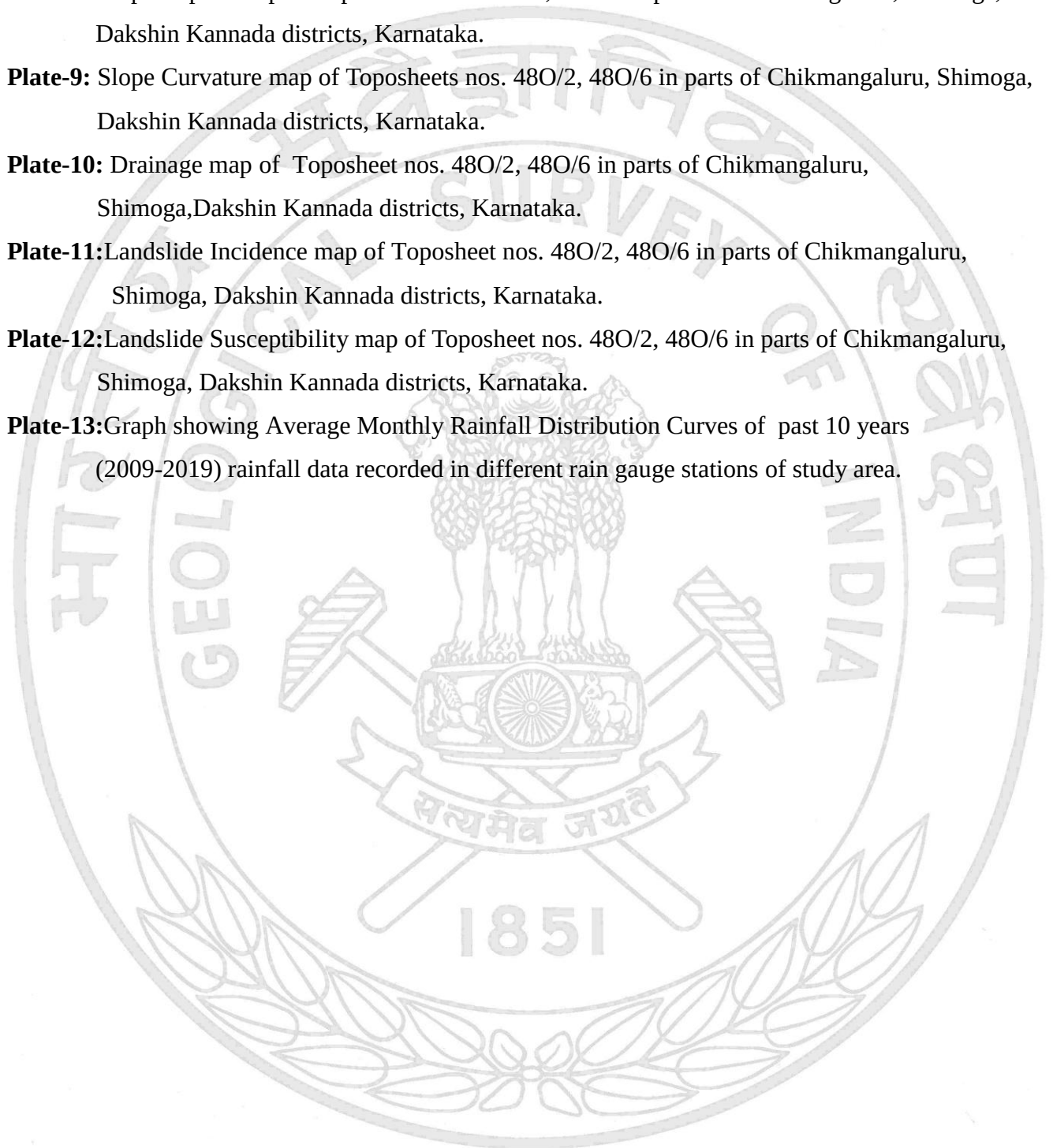
Plate-9: Slope Curvature map of Toposheets nos. 48O/2, 48O/6 in parts of Chikmangaluru, Shimoga, Dakshin Kannada districts, Karnataka.

Plate-10: Drainage map of Toposheet nos. 48O/2, 48O/6 in parts of Chikmangaluru, Shimoga, Dakshin Kannada districts, Karnataka.

Plate-11: Landslide Incidence map of Toposheet nos. 48O/2, 48O/6 in parts of Chikmangaluru, Shimoga, Dakshin Kannada districts, Karnataka.

Plate-12: Landslide Susceptibility map of Toposheet nos. 48O/2, 48O/6 in parts of Chikmangaluru, Shimoga, Dakshin Kannada districts, Karnataka.

Plate-13: Graph showing Average Monthly Rainfall Distribution Curves of past 10 years (2009-2019) rainfall data recorded in different rain gauge stations of study area.



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(मद संख्या: /LSSM4Mएनसी/एस आर-SU/KG/2019/25183)

(FS:2019-20)

द्वारा

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एवं

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सारांश

कर्नाटक राज्य के चिकमंगलुरु, शिमोगा, दक्षिण कन्नड़ (उडुपी) जिले के भू-आकृति संख्या 48O/02, और 48O/06 के कुछ हिस्सों में वृहद पैमाने 1:50,000 पर कुल 1495 वर्ग किलोमीटर के क्षेत्र का भूस्खलन संवेदनशीलता का मानचित्रण किया गया। अध्ययन क्षेत्र पश्चिमी-घाट पर्वत श्रृंखला के मलनाड पठार के कुछ हिस्सों का गठन करते हैं। कुछ इलाकों में ऊंची नीची एवं खड़ी घाटियों के साथ कई रैखिक और वक्र श्रृंखला वाले क्षेत्र हैं। अगुम्बे घाट की अत्यधिक विच्छेदित पर्वत श्रृंखलाएँ पश्चिमी भाग में NNW-SSE दिशा में और मध्यम रूप से विच्छेदित पर्वत श्रृंखलाएँ अध्ययन क्षेत्र के पूर्व-मध्य भागों में विद्यमान हैं। प्रमुख स्थलाकृतिक विशेषता यानी निम्न विच्छेदित पहाड़ी और अध्ययन क्षेत्र के पूर्वी हिस्सों में पिडमांट पहाड़ी श्रृंखलाओं का निर्माण पूर्वी घाट के NNW-SSE दिशा में अवतरित खड़ी पहाड़ियों से हुई है। अध्ययन क्षेत्र के प्रमुख हिस्से में निम्न विच्छेदित पहाड़ियों एवं ऊंची नीची स्थलाकृति के साथ आनिरंतरित छोटी पहाड़ी और पेडिमेट-पेडिप्लीन कॉम्प्लेक्स उपस्थित हैं। सुपारी की बागान विच्छेदित पेडिमेट-पेडिप्लीन क्षेत्रों में प्रमुख रूप से उत्पादित की जाती है। सिल्वर ओक, कॉफी और चाय कोप्पा और उसके आसपास की पहाड़ियों पर प्रमुख रूप से उत्पादित हैं, और काजू के बागान (एच एच पी) लेटेराइट की निम्न ऊंचाई वाली पहाड़ियों पर पाये जाते हैं। बबूल, सिल्वर ओक, नीलगिरी और सागौन के बागान भी व्यावसायिक उद्देश्यों के लिए अलग-अलग स्थानों पर उगाए जाते हैं। धान मुख्य क्षेत्रों में खेती की जाने वाली मुख्य फसल है। सामान्य ढलान में कोण 15-25° और <15° के बीच पहाड़ियों की निचली पहुंच और पहाड़ियों के ऊपरी छोर पर 25-35° के बीच भिन्न होता है। अध्ययन क्षेत्र में मृदा की उपरिभार 0.5-5मी., 5-10मी. और >10मी. पहाड़ियों के निचली ढलान और पेडिमेट-पेडिप्लीन कॉम्प्लेक्स के भिन्न भिन्न स्थानों में पाये जाते हैं तथा चट्टान का उपरिभार <0.5मी. पहाड़ के ऊर्ध्वाधर भाग, विच्छेदित पर्वत श्रृंखला के शीर्ष और चट्टान की खदान पर अनावृत हैं।

भूवैज्ञानिक रूप से, अध्ययन क्षेत्र का 80% भाग "प्रायद्वीपीय नाइस " आर्कियन युग के ग्रेनाइट नाइस/ग्रेनाइट की चट्टानें उपस्थित हैं जो विखंडित चट्टानी सामग्री और मिट्टी का मिश्रण की मोटी परत से आवृत हैं। भू-आकृति संख्या 48O/2 के दक्षिण-पश्चिमी भाग में

बाबाबुदन समूह के कुद्रेमुख के गठन के एम्फिबोलिटिस की चट्टानें उपस्थित हैं। शिमोगा शिस्ट बेल्ट के उत्तरी भाग में मेटासेंडीमेंट्री और रासायनिक रूप से अवक्षेपित चट्टानों को मेटाबेसाल्ट, बीआईएफ और अल्ट्रापैसिक, दक्षिण-पश्चिमी भाग में कोपा बैंड (धारवाड़ सुपरग्रुप के सरगुर समूह) के चट्टानें उपस्थित हैं। प्रायद्वीपीय गनीस की चट्टानें में अभिबोलईटिस के एन्क्लेव विद्वान हैं। इस क्षेत्र में तीव्र अपक्षय और क्षरण की गतिविधियाँ देखी गई हैं।

कुल 111 भूस्खलन की घटनाओं को दर्ज किया गया। भूस्खलन की अधिकांश घटना मलबे की स्लाइड एवं कुछ रॉक स्लाइड के रूप में रूप वर्गीकृत किए गए हैं। जो प्रकृति में प्रतिगामी, चौड़ी और बढ़ रही हैं। अध्ययन का मानना है कि ढलान के विफलता के प्राकृतिक और मानवजनित कारण हैं। भू-आकृतिक वर्गों के साथ भूस्खलन की घटनाओं का स्थानिक सहसंबंध इंगित करता है कि ढलान कोण $>15^\circ$ या $15-25^\circ$ जहां वृक्षारोपण (विशेष रूप से सुपारी की बागान और कॉफी) और कृषि मुख्य रूप से अनुकूल भूस्खलन अतिसंवेदनशील क्षेत्र हैं। इस क्षेत्र में मिट्टी के मोटी आवरण ने ज्यादातर कृषि और वृक्षारोपण को मुख्य भूमि-उपयोग प्रथाओं के रूप में प्रोत्साहित किया है। क्षेत्र में भू-उपयोग परिवर्तन और कृषि के तरीका ने उपरि मृदा को ढीला कर दिया है और अधिक वर्षा क्षेत्र में भूस्खलन के सक्रिय कारण हैं। अध्ययन से पता चलता है कि भूस्खलन और भूस्खलन के अतिसंवेदनशील क्षेत्रों का अधिकतम स्थान निम्न ऊंचाई वाली पहाड़ियों के गहरे विच्छेदन में देखा गया है। इनके अलावा, मुख्य ढलान विफलता ढीले पदार्थ (मिट्टी) के साथ विस्तृत कटे हुए पहाड़ी ढलान जो नई सड़क निर्माण और मौजूदा सड़क के चौड़ीकरण के लिए किये गए ढलान कोण $70^\circ-85^\circ$ पर सीमित हैं। भूस्खलन की घटनाये मुख्य रूप से ढीले सामग्री (मिट्टी), अत्यधिक अपक्षय, खंडित और जोइंटेड शैल के कमजोर तल के समानंतर हो रहे हैं, जिनकी उपरिभार मोटाई >10 मीटर और 5-10 मीटर पायी गयी है।

ढलान विफलताओं, अतिक्रमण और भूस्खलन/भू-अवतलन के भूवैज्ञानिक कारण अप्रभावी जल निकासी प्रणाली के परिणामस्वरूप वर्षा के दौरान अत्यधिक जल संतृप्ति के कारण ढाल पर पानी का दबाव बढ़ना है। मानसून के मौसम के दौरान भारी बारिश भूस्खलन के प्रमुख कारक है जो पानी से ढलान संतृप्ति जो आंतरिक संसंजन शक्ति को कम करते हैं है और मिट्टी की प्रोफाइल में हाइड्रोस्टैटिक दबाव उत्पन्न करता है। पहाड़ियों की अस्थिरता के मानवजनित कारण बागान एवं खेती के लिए कृषि भूमि के चौड़ीकरण की पद्धति और पहाड़ी क्षेत्रों में मिट्टी की खुदाई प्राकृतिक पहाड़ियों के संशोधन का अवैज्ञानिक तरीका है। कुल 36% भूस्खलन प्राकृतिक रूप से बहने वाली नदियां/नाला या कृत्रिम रूप से कृषि योग्य भूमि में सिंचाई उद्देश्य के लिए कृत्रिम रूप से निर्मित जल निकासी पहाड़ियों के कटाव स्थिर क्षेत्रों में भी ढलान की अस्थिरता के कारण हैं। वर्तमान अध्ययन में भूस्खलन या ढलान विफलताओं के लिए जिम्मेदार भू-घटक कारक लिथोलॉजी, संरचना, ढलान आकारिकी, भू-आकृति, भूमि उपयोग/भूमि आवरण, जल निकासी घनत्व, रेखांकन, वर्षा और मिट्टी के प्रकार के गुणात्मक और मात्रात्मक सांख्यिकीय विश्लेषण किया गया है। भूस्खलन संवेदनशीलता मानचित्र अलग-अलग विषयगत मानचित्रों को व्यवस्थित करके और इसी भूस्खलन घटना अनुकूलता स्कोर मानचित्र एल. ओ. एफ. एस. रेटिंग्स और भू-घटक वर्गों के भार का उपयोग करके ए एच पी आधारित गणितीय प्रतिरूपण डेटा मॉडलिंग पद्धति एवं मल्टी-क्लास इंडेक्स ओवरले विधि के माध्यम से तैयार किया गया।

अध्ययन क्षेत्र में भूस्खलन की घटनाओं का स्थानिक वितरण इंगित करते हैं कि कुल 91 भूस्खलन की घटनाएं कम भूस्खलन संवेदनशील क्षेत्र, 18 भूस्खलन मध्यम संवेदनशील और 2 में अतिसंवेदनशील क्षेत्र में पाए गए हैं। वर्गीकृत भूस्खलन संवेदनशीलता मानचित्र से संकेत मिलते हैं कि 7% क्षेत्र अतिसंवेदनशील हैं, 10.5% क्षेत्र मध्यम रूप से अतिसंवेदनशील हैं और 88.8% क्षेत्र कम अतिसंवेदनशील क्षेत्रों में आते हैं। भूस्खलन संवेदनशीलता विश्लेषण के आधार पर यह क्षेत्रों का प्रमुख हिस्सा भू-आकृति अनुमान लगाया जाता है कि भूस्खलन के अतिसंवेदनशील परिवर्तन जो भूमि उपयोग पद्धति के प्रभाव के कारण निम्न ढलान के विफलताओं के कारक हैं। जोखिम को कम करने के लिए शमन उपाय प्रभावी जल निकासी प्रणाली प्रदान करना आवश्यक है यानी ढलान वाले संतृप्ति और क्षरण को रोकने के लिए पहाड़ी इलाकों में सड़क के किनारों और पहाड़ी ढलान के दो भाग में पंक्तिदार प्रवाह तंत्र के साथ वीप जल निकासी तथा अपरदन को रोकने के लिये समर्थन प्रदान किया जाना चाहिए। कमजोर भूस्खलन अतिसंवेदनशील व्यापक कट ढलान पर ढलान स्थिरीकरण तकनीकों एवं जलनिस्रावक छिद्र से युक्त धारक भित्ति जैसे संरचनाओं के निर्माण प्राथमिकता के आधार पर किया जाना चाहिए यदि किसी भी सड़क, नागरिक संरचनाओं को नुकसान पहुंचा रहे हैं या आवास क्षेत्रों को प्रतिकूल रूप से प्रभावित कर रहे हैं।



Macro-scale (1:50,000) Landslide Susceptibility Mapping in parts of Toposheets nos. 48O/2, O/6

Chikmagalur, Shimoga, Dakshin Kannada districts, Karnataka.

(FSP Code: M4LSSM/NC/SR/SU-KG/2019/25183)

(FS:2019-20)

By

Neha Kumari, Geologist

&

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ABSTRACT

Pursuant to the annual programme of GSI for FS:2019-20, a total of 1495 sq. km. of the geographical area was mapped for landslide susceptibility mapping on 1:50,000 scale in parts of Chikmagalur, Shimoga, Dakshin Kannada districts of Karnataka state covering SOI T.S. nos. 48O/2 and 48O/6 vide FSP code no.: M4LSSM/NC/SR/SU-KG/2019/25183. The western part of study area is bordered by Udupi district which was formerly a part of Dakshin Kannada district. The study area constitutes parts of malnad plateau of Western Ghat hill ranges. The terrain is rugged with several linear and arcuate hill ranges with steep valleys. The prominent geomorphic features are highly dissected mountain ranges of agumbe ghat is trending NNW-SSE direction in the western part and major parts of the elevated areas in eastern parts of study area are lowly dissected hillocks with adjoining piedmont hill ranges. Major parts of the elevated areas are lowly dissected hillslope and pediment-pediplain complex characterized by gently sloping undulatory topography. The arecanut plantation is the major landuse practices in dissected pediment and peneplains areas. The silver oak, coffee & tea plantation are practised on hillslope in and around Koppa, whereas acacia, eucalyptus and teak plantation are also grown in isolated places for commercial purposes. Paddy is the main staple food crop cultivated in the peneplain areas. In general slope angle varies between 15-25° and <15° in lower reaches of hills and between 25-35° on upslope. The area has overburden thickness of 0.5-5m, 5-10m and >10m due to thick piles of soil and highly weathered rock. The rocks <0.5m are exposed on escarpment, deeply dissected mountain ranges, ridges, top of hills and rock quarries.

Geologically, 80% of the study area exposes rocks of “Peninsular Gneiss” represented by gneiss/granite of Archean age and these rocks are covered with a thick weathered mantle. The amphibolites of Kudremukh Formation of Bababudan Group were exposed in south-western part of TS no. 48O/2. The Shimoga Schist belt is occurring in northern part of (T.S no. 48O/6), exposes meta-volcanosedimentary and chemically precipitated rocks in the form of metabasalt, BIF, together with basic and ultrabasic rocks. The area consists of an irregular shaped schist belt in southwestern part which is known as Koppa band (Sargur Group of Dharwar Supergroup).

The Peninsular Gneiss forms the basement of schist belt with enclaves of amphibolite. The area has witnessed intense weathering and erosional activities.

Total of 111 nos. of landslides incidences were recorded. Majority of the landslide are shallow translational debris slides of retrogressive, widening and enlarging in nature and few are rock slides. The study owes that causative factor for frequent slope failures are both natural as well as anthropogenic. The spatial correlation of landslide incidences with geofactor classes indicates that slope angle $>15^\circ$ and $15-25^\circ$ are favourable landslide susceptible zones commonly used for arecanut plantations and agricultural purposes. The thick soil cover in the region has mostly encouraged agricultural & plantation practices. The landuse change and agricultural pattern in the area have loosened the topsoil and in turn has resulted in more landslides being triggered due increase in pore water pressure after excessive incessant rainfall events. The study reveals majority of the landslide incidences are observed in deep dissection of lowly elevated hillslope demarcated as landslide susceptible zones. Apart from these, major slope failures are confined on “Extensive Slope Cut” with steep slope angle varying between $70^\circ-85^\circ$ made for road construction and widening of existing road demarcated as vulnerable landslide prone zones.

The geo-scientific causes of slope failures, mass movement and landslips are due to ineffective drainage system, pronounced weathering phenomenon due to heavy rains during monsoon season and change in landuse pattern. The pronounced weathering phenomena, heavy rains during monsoon season are the triggering factors responsible for increase in pore water pressure due to excessive infiltration and water saturation on hillslopes. The decrease in the effective cohesion and increase in hydrostatic pressures in the soil profile causes slope failures. The anthropogenic causes of hillslope instability are unscientific way of modification of natural hillslope adjoining to cultivation land for widening of agricultural land and excavation of soil for arecanut plantations. Total 36% of landslides occurred due to removal of toe support by erosion and undercutting of hillslope by naturally flowing perennial streams/nala or artificially created drainage network for irrigation purpose in agriculture land causing slope instability even in stable areas.

In present study the geofactor causative factors responsible for the landslides or slope failures are mainly lithology, structure, slope morphometry, geomorphology, landuse/land cover, drainage density, lineaments, rainfall and soil types. The seamless Landslide susceptibility map prepared using AHP based knowledge driven data modelling method. The thematic maps are integrated using multi-class index overlay method and corresponding Landslide Occurrence Favorability Score maps (LOFS) are generated using LOFS ratings/weights of geofactor classes to generate landslide susceptibility map.

The spatial distribution of landslide incidences in the area indicates that total 91 landslide incidences falls in low landslide susceptible zones, 18 nos. of landslides occur in moderate and 2

for slope failures. The Western Ghats vulnerability to landslides is largely attributed to the deposits of overburden material on the steep hill slopes. The mitigation measures to reduce the risk is to provide effective drainage system i.e., lined drainage with weep holes all along the road sections in hilly terrain with thick overburden mass to prevent slope saturation & toe erosion. The construction of retaining structures with weep holes should be constructed on priority basis at vulnerable landslide susceptible extensive slope cut if damaging any road, civil structures or adversely affecting habitation areas.

Macro-scale (1:50,000) Landslide Susceptibility Mapping in parts of Toposheets nos. 48O/2, O/6

Chikmangaluru, Shimoga, Dakshin Kannada districts, Karnataka.

(FSP Code: M4LSSM/NC/SR/SU-KG/2019/25183)

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By

Neha Kumari, Geologist

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I. INTRODUCTION

1.1. Background Information

Landslides are the major natural hazard in hilly terrain of Himalayas of extra-Peninsular India and Western Ghat region of Indian Peninsula, which accounts for considerable loss of life and damage to communication routes, human settlements, agricultural fields and forest lands in recent past. Geological Survey of India, being the Nodal Agency for Landslides in India since 2004, vigorously and swiftly implemented the NLSM programme 2014 in hilly terrain. The landslide inventory was carried out along SH and NH roads and main district roads 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 during FS 2012-13. Landslide Susceptibility Maps spatially depict the areas where future slope failures are likely to occur due to specific environmental & terrain conditions. The weathering phenomenon and heavy rainfall during peak rainy season is the major triggering factor for landslides leading to the displacement of rocks and soils causing widespread damage to infrastructure such as railway, roads as well as casualties leading to loss of life and property.

In view of the ever increasing developmental pressure, the mean of communication network like roads, railways and other construction works are progressing rapidly in hilly terrain of Western Ghats. The Landuse/Landcover changes, whether of natural origin or anthropogenic activities has influenced the susceptibility of natural slopes to landslides all along NH and SH Ghat road sections of hilly terrains of Western Ghat. Accordingly, the hillside collapse is the most commonly occurring phenomena due to human interference, heavy rainfall, ineffective drainage and intense weathering & erosional phenomenon in Western Ghats. The specter of climatic change necessitates greater focus on slope failures, identification of hillsides prone to slope failures, study of causative and triggering factors, depiction of vulnerable areas for future management. Taking into account all these parameters “Macro-scale (1:50,000) Landslide Susceptibility Mapping” in parts of Toposheet nos. 48O/2 & 48O/6 Chikmangaluru, Shimoga,

Dakshin Kannada districts, Karnataka vide FSP code: M4LSSM/NC/SR/SU-KG/2019/25183 was carried out in Western Ghat region.

The Landslide Susceptibility Map is generated on priority basis using Analytical Heirarchial Process i.e. knowledge-driven mathematical data modeling method and multi-class index overlay data integration techniques in Arc GIS platform. GIS based data analysis are carried out based on the weightage assigned to causative geofactors to delineate the probability of spatial occurrence of landslides and categorise landslide susceptible zones as high, moderate and low landslide susceptible zones for the sustainable development.

1.2 Present Work

The aim of the present work was to carry out Macro-scale (1:50,000) Landslide Susceptibility Mapping in parts of Toposheets nos. 48O/2, O/6 Chikmangaluru, Shimoga, Dakshin Kannada districts, Karnataka to classify the area as High, Moderate, & Low landslide susceptible zones. The details of nature of work, quantum & achievements are furnished in (Table 1). The present study incorporates the following objectives:

- (i). Categorization of the hill slope in terms of landslide susceptibility.
- (ii). Preparation of landslide inventory database using high resolution remote sensing data, archival information and field inputs.
- (iii). Preparation of spatial database for geo-factors of landslides.

Table 1: Details of Nature & Quantum of work and Achievements.

Nature of Work	Target in (sq. km.)	Achievements in (sq. km.)
1. Pre field map preparation		
i) Preparation of Thematic maps (in GIS on scale 1:50000)		
a)Slope forming material map	1495 sq. km.	1495 sq. km.
b) Geomorphology and lineament map	1495 sq. km..	1495 sq. km.
c) Slope morphometry (slope, aspect & curvature) map	1495 sq. km.	1495 sq. km.
d) Landuse / Landcover map	1495 sq. km.	1495 sq. km.
e) Drainage map	1495 sq. km.	1495 sq. km.
f) Regolith Thickness map	1495 sq. km.	1495 sq. km.
ii) Preparation of landslide inventory map	1495 sq. km.	1495 sq. km.
2. Field based studies		
i)Field checking of all thematic maps	1495 sq. km.	1495 sq. km.
ii)Field checking and collection of landslide inventory attributes (41 point geo -parametric sheet)	1495 sq. km.	1495 sq. km. (111 nos. of Landslides)
3. Post field studies and modelling		
i) Updation of thematic and landslide inventory maps	1495 sq. km.	1495 sq. km.
ii) Landslide susceptibility modelling and finalization of landslide susceptibility map in GIS	1495 sq. km.	1495 sq. km.
4.Collection of rainfall data from available rain stations	10 years rainfall data obtained from different rain gauge stations of the study area.	

1.3 Description of Study Area

The study area covers 1495 sq. km of the geographical area that lies in Toposheet nos. 48O/2 and 48O/6 Chikmagalur, Shimoga, Udupi district formerly a part of Dakshin Kannada districts of Karnataka state. The study area is bounded by 13°30'00"N-13°45'00"N latitudes and 75°00'00.00"E-74°30'00.00"E longitudes (**Plate-1**) and forms the part of malnad plateau of Western Ghats. The study area is bordered by Shimoga district in the northern part, Udupi district in west, south, south-western part and Chikmagalur district in south and south-eastern part. Thirthahalli, Koppa and Udupi are the important taluks located in study area. Geomorphologically, the terrain is rugged with several linear and arcuate hill ranges with steep valleys. The mountain range of Agumbe ghat is occurring in the south-western part of the T.S. no. 48O/2. The inaccessible high hillocks are covered with thick forest and dense mixed jungle. Physiographically, the major part of the study area is low lying with gently undulating topography. The prominent geomorphic features are low elevated, lowly dissected hillslope with deeply dissected pediment and peneplains. Arecanut, Coffee, Tea, Silver Oak and Teak plantations are grown for commercial purposes in deeply dissected pediment-pediplain and lowly dissected hillslope. Paddy is the main staple food crop cultivated in the peneplain areas.

The important places are Agumbe, Koppa, Thirthahalli which are well connected by National Highway and State Highway from Bangalore to Mangalore. The entire study area is well connected by NH-169 (Thirthahalli-Koppa), NH-13 (Thirthahalli-Shimoga) and SH-01 (Thirthahalli-Agumbe) and SH-65 (Agumbe-Koppa-Narsimharajpura). The area is drained by Tunga river and its tributaries. The important localities are Thirthahalli, Agumbe, Koppa, Hariharpur, Kaimara, Devangi and Kaimara. The other important villages are Bobbi, Guddekere, Mastikatte and Yadur. All the villages are connected to taluk headquarter by State highways, National highways and metalled roads. The interior parts are well connected by fairly good metalled, all weather roads, cart and foot tracks. The nearest railway station is Anandpura (55Km) and Shimoga town (62km). The nearest airport is Mangalore situated at 133km away from taluk headquarter Thirthahalli.

1.4 Physiography and Drainage

The area forms the part of Western Ghat region. The terrain is highly rugged with several linear and arcuate hill ranges with gently undulatory topography. The highly dissected mountain ranges of Agumbe ghat comprises of ridges and steep valleys in the southwestern part of the area. The prominent topographic feature in the eastern parts of the area is formed by lowly dissected hillslope with adjoining piedmont hills. The Agume hill range has an average relief of 1000m and forms the water divide between Udupi and Shimoga districts. The area forms a part

of the walnad tract with deeply dissected hilly terrain ranging in elevation from 150m to 500m. However, the occurrence of flat topped hills indicates that the deeply dissected peneplains have suffered emergence at more than one period. The western region consists of valleys and hill ranges sloping west to east with a maximum altitude of 640 and 529m amsl. The important hills are .910 Ganikallu, .971 Kundadrigudda, .927 Kavaledurga, .903 Karbailugudda, Kovedurga-969m and Kabranagara-1031m msl.

The area is drained by Tunga river and its tributaries. The river systems form a dendritic to sub-dendritic pattern. The courses of the river Tunga and its tributaries are structurally controlled and show alignment along major lineament. The study area in general exhibits dendritic drainage in gneissic rock and sub-parallel drainage in schistose rock. The radial drainage is common in Thirthahalli-Agumbe ghat sections. The low drainage density and the ground slope indicate the flat terrain in Tunga sub-basins with a minimum surface runoff and moderate to good rate of water infiltration. In the rest of the area infiltration is low due to steep land, denser drainage pattern and maximum runoff. The catchment and river basin are the important sites for determining the water saturation in the adjacent areas.

1.5 Climate and Rainfall

The area enjoys tropical climate throughout the year with active southwest monsoon between July and September months. The location of the study area on the Arabian seaboard effectively controls the climate of the area with no extreme diurnal variations in temperature. The relative humidity ranges from 27 to 88%. The evapo-transpiration is normally high in ghat section. Summer prevails between March to early June, the wet months start from early June to September experiences maximum rainfall by southwest monsoons, October and November months experience scanty rain by Northeast monsoon (**Plate-13**). The winter commences in mid-November and ends in the middle of February.

In Tirthahalli taluk a place named Agumbe, which records highest rainfall, an average annual rainfall of 2671.90mm known as “Cherapunji of the south” in the Western Ghats. The variation in the precipitation between the driest and wettest months is 1095 mm. The least amount of rainfall occurs in January with an average of 1 mm. The greatest amount of precipitation occurs in July, with an average of 1096 mm. Most months of the year are marked by significant rainfall. The variation in temperatures throughout the year is 4.9°C. The short dry season has little impact. In Koppa taluk, the average annual temperature is 23.2°C and average annual rainfall is 2850 mm.

1.6 General Gemorphology and Soil Types

The district forms the part of Western Ghat areas (Sahayadri hill ranges), which can be demarcated into two zones viz; the densely forested hilly Malnad in the west and sparsely forested tablelands: semi-malnad in the east. The study area constitutes parts of malnad plateau in Western Ghats. The Malnad region is characterized by mountains with heavy rainfall covering Thirthahalli, Sagar, Sorab and Hosanagara taluks. The terrain is rugged with several linear, arcuate hill ranges and steep valleys in western part of T.S. no. 48O/2 and east-central part of T.S no. 48O/6. Physiographically, the terrain has gently undulating topography. The major parts of the elevated areas are characterized by gently sloping lowly dissected hillocks and pediment-piedplain complex with slope angle varies between 15-25° and <15°. The area is moderately to lowly dissected hillslopes with piedmont slope whereas the southwestern parts comprises of highly dissected mountain ranges of Agumbe ghat trending NNW-SSE direction.

The soils that occur in the study area are reddish to brownish clayey loam to lateritic in nature. In general these soils are acidic in nature. The rate of water infiltration through these soils is recorded as 4.3 to 40.11cm/hr. The sandy soil is also identified in the areas where the Archaean gneissic complex occurs. It is coarse grained highly porous and permeable in nature. The thickness of this soil varies from few cms to 5.00 m. The rate of water infiltration in this soil is remarkably higher than the clayey loam. Red soil as noticed at the contacts of granites and schistose rocks, is medium grained, highly permeable and having neutral pH value. The thickness of the soil varies from less than one metre (<1m) to 9.00 m and is having an average rate of water infiltration capacity about 2.4 cm/hr. The mixed soil occurs in the areas where the schistose rock is predominant. It is of medium to fine-grained and permeable with higher moisture content. The thickness of this type of soil ranges from 0.5 m to 29 m and is having the water infiltration capacity of about 0.60 cm/hour. (Source: Central Ground Water Board, Shimoga Brochure)

1.7 General Geology

1.7.1 Regional Geology

The region is a part of Western Dharwar Craton (WDC) which is characterized by meta-volcanic and meta-sedimentary rocks of the archean Dharwar Supergroup. Major schist belts viz. Western Ghats, Bababudan, Shimoga, Chitradurga and numerous minor schist belts such as Nuggihalli, Holenarsipur, JC Pura, Kalyadi-Nagamangala, Ghattihosahalli, Kunigal, Sigegudda are present in WDC. Shimoga schist belt is the largest of them which comprises the rocks of Bababudan and Chitradurga Groups. Bababudan Group is dominated by mafic volcanic rocks followed by shallow marine sedimentary rocks while the Chitradurga Group is dominated by

greywackes, pillowed basalts and deep marine sedimentary rocks with felsic volcanics. The Chitradurga Group in Shimoga belt can be subdivided into four formations viz. Jhandimatti, Joldal, Medur, and Ranibennur Formations. The Shimoga schist belt is exposed in southern part of the study area. It exposes volcano-sedimentary sequence in the form of metabasalt and banded hematite/ magnetite quartzite together with basic and ultrabasic bodies. The Kudremukh formation of Bababudan Group comprises of amygdular meta-volcanics with associated ultramafics. The peninsular gneissic complex forms the floor of the schist belt with various enclaves.

1.7.2 Geology Of the Study Area

Geologically, the area has rock types belonging to Sargur Group, PG-I, Chitradurga Group and Bababudan Group intruded by Closepet Granite, basic and acid intrusives, Laterite . The Sargur Group of rocks occur as thin tabular bands /enclave within PG-I and comprises of quartzite, kyanite-muscovite schist, quartz-muscovite schist, calc-silicate rock, pyribolite, amphibolite, BIF and meta-ultramafic rocks. occurs. The Bababudan Group comprises rocks belonging to Walkunji and Kudremukh Formation in this segment appears equivalent to Herambhapur Formation. Walkunji Formation consists of only quartzite band exposed at the base of the Kudremukh Formation in the southwestern corner of the area. Kudremukh Formation comprises of amphibolite, metabasalt, quartz-sericite schist, ultramafics, garnet granulite schist, banded haematite quartzite and banded magnetite quartzite.

The area forms southern part of Shimoga schist belt. It exposes metavolcanosedimentary sequence and chemically precipitated rocks in the form of metabasalt, BIF, together with basic and ultrabasic rocks. The Peninsular Gneisses form the basement of the schists, kyanite schists, ultramafics that belong to Sargur Group and occurs mostly in the southern part of the Herambhapur area. The area consists of an irregular shaped schist belt in the southwestern part which is known as Koppa band (Sargur Group of Dharwar Supergroup). The Chitradurga Group comprises of Jhandimatti and Joldal Formations. Jhandimatti Formation consists of polymict conglomerate, amphibolites, quartz sericite and quartz chlorite schist units belong to this formation in the peripheries of the schist belt. Joldal Formation consists of interbedded phyllite and Fe-Mn cherts in the core of the schist belts. Acid intrusive is represented by tourmaline-quartz rock and quartz vein. Basic intrusives represented by gabbro and dolerite are confined to western and south-western part of the area (**Table 2**).

The high-grade rocks of the area form two prominent bands viz. 'Herambapura arm' and 'Koppa band' (Ghosh Roy A.K., 1984). The Herambapura arm forms a V-shaped closure near Herambapura whereas the Koppa band is exposed at north of Koppa village.

The supracrustals of rocks of Koppa band are correlated with the Sargur Group whereas the rocks of Herambapura arm with that of Bababudan Group. Koppa band is wider in the southern part and tapers down towards NE near Sedgaru. Herambapura arm is exposed to the NW of the Koppa band.

Table 2: Chrono-lithostratigraphic succession of the study area (SOI T.S nos. 48O/2 &O/6)
Source: Ashish K. Ghosh (FS: 1980-81), Shafeeq Ahmed and Debashish Roy (FS: 1981-82), T.R. Anantharamu and Manjunatha (FS:1982-83) and Mines and Geology Department, Karnataka)

Lithology	Formation	Group	Supergroup	Age
Laterite				Cenozoic
Quartz Vein	Acid Intrusives	Younger Intrusives		Palaeoproterozoic
Gabbro	Basic Intrusives			
Dolerite				
Granite	Intrusive Granites			Archaean
Manganiferous Iron Quartzite	Joldal	Chitradurga (Shimoga)	Dharwar	
Ferruginous Phyllite				
Sericite Schist	Jhandimatti			
Quartz-chlorite Schist				
Amphibolite				
Conglomerate				
Quartzite	Herambhapur	Bababudan (Shimoga)		
Banded Haematite Quartzite				
Quartz-chlorite Schist				
Sericite Schist				
Amphibolite				
Ultramafite	Kudremukh	Bababudan (Western Ghat)		
Garnet-Grunerite Schist				
Banded Magnetite Quartzite				
Quartzite				
Metabasalt				
Amphibolite				
Granitoid (Karwar)	Granitoids	Peninsular Gneiss-I	Peninsular Gneissic Complex	
Granite Gneiss	Gneisses			
Kyanite-Muscovite Schist, Quartz-Muscovite Schist, Quartzite, Calc-silicate rock, Amphibolite, Pyribole, Banded Iron Formation, Ultramafite.		Sargur		

1.7.3 Structure

The trend of foliation in rocks of Bababudan Group varies from N-S to NW-SE with steep easterly dip. Gneisses show NW-SE foliation trend with low easterly dips. In the Herambapura arm, foliation (S_1) is prominent which trends NW-SE in the western limb of the 'V' shaped arm, becomes ENE-WSW around Herambapura and swings to NE-SW in the eastern limb. Bedding (S_0) is primarily parallel to the foliation. The altitude of foliation in the closure region of this fold indicates synformal nature of the fold. Since the foliation (S_1) is folded around the hinge of the fold, the Herambapura synform is possibly a second generation fold. The effect of this folding episode is manifested in the adjoining peninsular gneisses, which have concordant fabrics with the associated supracrustals (Ghosh Roy A.K., 1984). The axial trace of this fold is approximately N-S. The fold is as broad open fold with interlimb angle of 75° - 80° .

The contact of the Herambapura arm with the Solleball band of Shimoga schist belt appears to be either tectonic or an overlap. There is striking dissimilarity between the two are in structure, lithology and metamorphism. The Herambapura arm exhibit NNE-SSW foliation and consists of slightly higher grade of metamorphic rocks when compared to NNW-SSE trending Solleball band (Ghosh Roy A. K., 1984).

1.7.4 Metamorphism

In general the rocks in the study area have undergone greenschist to upper amphibolite facies of metamorphism. The supracrustals of Koppa band represent middle to upper amphibolite facies of metamorphism. The mineralogical assemblage in the Herambapura arm indicates lower to middle amphibolite facies. The rocks Jhandimatti and Joldal Formations represent green schist facies of metamorphism (Ghosh Roy A.K., 1984).

1.7.5 Economic Geology

Granite gneisses with well developed joints and foliations are quarried at many places as construction material. Clay pockets of small dimensions occur in weathered granites and gneisses of the area. Occurrences of kyanite, steatite, and tourmaline have been reported by previous workers but not of economic significance.

1.8 Methodology

Landslide susceptibility maps are prepared using AHP based modelling. In present study both probabilistic and heuristic-based method are used where the weightage is assigned to the causative factors/parameter based on weightage to landslide causal factors and where weightage is given by expert in particular domain.

In the present study causative geofactors thematic maps i.e. landuse/landcover, geomorphology, lithology, slope forming material, regolith thickness, slope morphometry were considered for landslide susceptibility mapping. Though rainfall is the important triggering factor for landslides, these are not considered in this study due to non-availability of sufficient and uniform data. The factors considered here are essentially the preparatory factors, which can be collected easily from the field and available informations. The thematic data layers for each of the factors were prepared in GIS based on topographic sheet, remote sensing and field data.

In the present study the categories of the selected factors were assigned the numerical weights following information value method, which is a statistical approach based on the frequency distribution of landslides in different factor classes. The landslide susceptibility map was finally prepared by integrating the data in GIS using AHP based data modelling method and multi-class index overlay technique for classifying the integrated values into different classes of landslide susceptibility. The landslide susceptibility map was then validated with the landslide distribution of the terrain. The outline of the methodology of landslide susceptibility mapping is shown in the **Flow Diagram 1**.

The Analytical Hierarchy Process is a multi-criteria decision making process of measurement through pair wise comparisons and relies on the judgements of the experts to derive priority scales (Saaty, 2008). The Analytical Hierarchy Process operates at four levels viz. defining problems, construction of pair wise comparison matrix, determining weights and obtaining overall priority. In Landslide Susceptibility Mapping different landslide causative factors are considered as alternatives. Absolute numbers (from 1 to 9) are assigned to each landslide related parameters based on its relative importance and comparison matrices are constructed to Compute Consistency Ratio (CR), Consistency Index (CI).

Methodology adopted for generating landslide susceptibility map is mentioned below:

I. Pre-field thematic/geofactor map preparations (in GIS on 1:50000 scale)

Various geofactor thematic maps i.e. Landuse and Landcover Map, Geomorphology Map, Slope Forming Material Map, Regolith Thickness Map, Slope Morphometry (Slope, Aspect, and Curvature) Map, Drainage Map, Landslide inventory Map are prepared in Arc GIS platform.

- i) Landuse/Landcover maps and Geomorphology maps are prepared with the help of topographic sheets and multi temporal high resolution satellite imagery of Google Earth.
- ii) Slope forming material maps and Regolith Thickness maps are generated with the aid of Geomorphology, Lithology (from GSI legacy map: Geology map) and Landuse and Landcover map as proxy thematic maps.

- iii) Drainage maps and Slope Morphometry (Aspect, Curvature and Slope) maps are DEM derivative map prepared from Carto DEM data of 30m resolution.
- iv) Landslide inventory database is prepared with the help of multi-temporal high resolution satellite imagery on Google Earth, historical and event based data are collected from GSI reports and other relevant papers/articles.

II. Field based studies/Ground truthing

- i) Ground truthing/ field checks of all geofactor thematic maps.
- ii) Field validation of landslide inventory and collection of recent and historic landslides.
- iii) Collection of landslide inventory and damage data as per 42-point geo-parametric sheet.
- iv) Validation of landslide incidences at important locations.

III. Post field studies and modelling

- i) Updation of thematic geofactor mas and landslide inventory maps in GIS platform.
- ii) Pair wise correlation matrix calculation, determination of LOFS and Rank as per weightage/rating assigned to different thematic (causative factors) variables.
- iii) AHP based modeling and multi-class index overlay analysis of different thematic maps for the preparation of Landslide susceptibility map on 1:50,000 scale on GIS platform.

All the Pre-field thematic layers were updated and compiled after field validation. The thematic maps are rasterised for data modelling and analysis. To perform GIS analysis all the thematic layers were projected in UTM (Zone 43N) taking WGS84 as spheroid and datum.

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II. PREVIOUS WORK ON LANDSLIDE STUDIES

2.1 Previous work:

In order to implement the proposed action plan of NDMA on Landslide Hazard Risk Mitigation it is proposed to take up landslide inventory of Karnataka state as a precursor to the landslide hazard zonation and risk evaluation of the hilly terrains of Western Ghats. The landslide inventory along National Highway & State Highway of Ghat roads in Coorg, Dakshina Kannada, Udupi, Shimoga and Chikmagalur districts, Karnataka carried out by GSI during FS: 10-12 and FS: 12-13 respectively by K. V. Maruthi e. al. Total 5 nos. of Landslides recorded along Shimoga-Tirthahalli road section (NH-13), 2 landslides are recorded along Tirthahalli-Koppa (NH-13), 2 landslides are recorded along Koppa-Narsimharajpura road section (SH-65), 10 landslides are recorded along Koppa-Sringeri road section in T.S. no: 48O/6. Total 9 nos. of landslides recorded along Tirthahalli-Someshwar road section (SH-01) in T.S. no: 48O/2 and in its adjacent areas.

The landslides 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. It is also found that the majority of the slides are restricted to the cut slopes having more than 10m height and quite a steep slope angle varying between 70° and 90°. The effect of human interference in the form of slope cutting for construction of road coupled with high rainfall and ineffective drainage at toe part are the causative factors for slope instability and failure.

2.2 Spatial distribution of historic landslide incidences:

During Field Season: 2012-13, landslide inventory was carried out along Ghat roads (NH & SH roads and main district roads) of Western Ghat in parts of Toposheet nos. 48 P/6, 10, 11, 15 & 16; 48 O/2, 3 & 6 of Coorg, Dakshina Kannada, Udupi, Shimoga and Chikmagalur districts of

Karnataka Western Ghat (*Maruthi et. al. 2013*). Details of location of historic/past landslide incidences in the study area are listed below in (**Table 3**).

The landslide incidences recorded along Ghat sections (NH & SH roads and main district roads) are mentioned below:

- (i) Landslides recorded along Shimoga-Tirthahalli road section (NH-13): 5 nos. of landslides are recorded in this ghat section in between nearly 30 km stretch.
- (ii) Landslides recorded along Tirthahalli-Koppa (NH-13): 2 nos. of landslides are recorded in this ghat section in between nearly 30 km stretch.
- (iii) Landslides recorded along Koppa-Narsimharajpura road section (SH-65): 2 nos. of landslides are recorded in this ghat section in between nearly 20 km stretch.

Description of past landslide incidences recorded in the study area:

- i. **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.
- ii. **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.
- iii. **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. **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 due to tampering of the natural slope for making road.

Table 3: Details of location of historic/past landslide incidences in the study area (SOI T.S nos. 4O/2, O/6) (Source:GSI report, K.V Maruthi et. al., 2013)

Shimoga-Tirthahalli Road Section (NH-13)					
Slide No.	T.S no.	Lat (in decimal degree)	Long (in decimal degree)	History	Type of Slide
KA-620	48O/6	13.715	75.398	Old	Debris Slide
KA-621	48O/6	13.708	75.276	Old	Earth Slump
KA-622	48O/6	13.697	75.273	Old & Reactivated	Debris Slump
KA-623	48O/6	13.700	75.269	Old & Reactivated	Debris Slide
KA-624	48O/6	13.700	75.263	Old & Reactivated	Debris Slide
Tirthahalli-Someshwar-Agumbe Ghat (SH-1)					
KA-625	48O/2	13.581	75.133	Old	Debris Slide
KA-626	48O/2	13.575	75.131	Old & Reactivated	Debris Slide
KA-627	48O/2	13.539	75.111	Old & Reactivated	Debris Slide
Tirthahalli-Koppa section (NH-13)					
KA-634	48O/6	13.579	75.328	Old	Debris Slump
KA-635	48O/6	13.609	75.303	Old	Debris Slump
Tirthahalli-Narsimharajpura road section (SH-65)					
KA-636	48O/6	13.535	75.387	Old & Reactivated	Earth Slump
KA-637	48O/6	13.535	75.426	Old	Debris Slump

III. LANDSLIDE INCIDENCES IN PRESENT SCENARIO

3.1 Spatial distribution of Landslides

Total 111 no. of landslides are recorded in the study area. Majority of the slides are debris and earth slide and few are rock slides which are retrogressive, enlarging and widening in nature occurring on lowly dissected hillslope. Majority of the slope failures are confined on vertical road cut and toe cutting of lowly dissected hill slope adjoining to cultivation and plantation areas. These areas are delineated as vulnerable zones and landslides are likely to get triggered during incessant rainfall due to overwater saturation and increased pore water pressure.

The sub-surface weathering and erosion leads to reduction in cohesive and shear strength slope forming material. The unstable extensive slope cut, landslides, land subsidences and slope failures were recorded at road cut along Thirthahalli-Hulikal, Thirthahalli-Bejavalli-Tuduru-Mandegadde (NH-169) and Thirthahalli-Agumbe (NH-169A) road sections. The slope angle varying between 15° - 25° and 25° - 35° with cut slopes >10m height are more susceptible to failure due to unscientific way of slope modification. The slope failures recorded along Hulikal ghat road section are mainly confined at the intrusive contact of different litho-unit that provides the weaker plane for water seepage and hillslope saturation during incessant rainfall events.

The lowly dissected hillslope associated with deeply dissected pediment and peneplains in vicinity of paddy and arecanut plantation encounters slope failure in Heggarkoppa, Kumbarakoppa, Suranakodagi, Maddalkoppa, Urumakki village area (T.S. no. 48O/6) and Annavalli, Karunepura village area near Megaravalli in (T.S. no. 48O/2). The land use practice for agricultural purposes resulted in slope failure in adjoining hillslope where toe erosion by natural drainage/nala or artificially diverted nala and unscientific way of removal of soil by pediment/toe cutting of the hillslope adopted for widening the agricultural land and excavation of soil for Arecanut plantation contributed in slope degradation and removal of toe support. (Plate 7).

The landslide incidences recorded along Ghat sections (NH & SH roads and main district roads) and interior places are mentioned below:

1. Tirthahalli-Kaveldurga-Mastikatti-Hulikal road section (T.S: 48O/2) : 11nos. of debris slides and 2 nos. of rock slides.
2. Tirthahalli-Yadur-Addagudda road section and in and around areas (T.S: 48O/2): 08 nos. of debris slides.
3. Megaravalli-Dinda-Hansa road section and in and around areas (T.S: 48O/2): 06 nos. of debris slides.
4. Tirthahalli-Devangi-Koppa road section and in and around areas (T.S no: 48O/6): 09 nos. of debris slides.
5. Koppa-Hariharpur-Agumbe road sections (T.S no: 48O/2 & O/6): 13 nos. of debris slides.
6. Hariharpur-Surali road section (T.S no: 48O/6): 09 nos. of debris slides.
7. Thirthahalli-Agumbe road section (T.S no: 48O/2): 02 nos. of debris slides.
8. Thirthahalli-Shimoga road section (T.S no: 48O/6): 07 nos. of debris slides.
9. Koppa-NR Pura road section (T.S no: 48O/6): 02 nos. of debris slides.
10. Gadikallu-Herambapur-Koppa & surrounding areas (T.S no: 48O/6): 07 nos. of debris slides.

11. Ganpatikatte-Kanave-Muthinakoppa road section & surrounding areas (T.S no: 48O/6): 02 nos. of debris slides.
12. Thirthahalli-Mukthihariharpur road section (T.S no: 48O/2): 03 nos. of debris slides.

3.2 Description of Major landslide incidences in the study area:

I. Tirthahalli-Kaveldurga-Mastikatti-Hulikal road section

Slide no: KAR/SHM/2019/111: The shallow translational debris slide observed on lowly dissected slope in downslope direction at convex turn of the road beside arecanut plantation in Kestur village area at (*Lat:13°41'00.4"N: Long:75°10'45.1"E*). The unscientific way of removal of soil and weathered granite of >10m thickness destabilized the slope. The practice of getting soil for arecanut planation from adjoining hillslope has disturbed the slope. The exposed cut section provided new pathway for water seepage and saturation during rainfall. The flowing stream further contributes in slope saturation and reduces the cohesive strength of slope forming material. In active landslide zone construction of ~75m wide and 4m high retaining wall and weep holes at 3ft interval were provided and the work is in progress to stabilize and restrict the road subsidence.

Remedial Measures: Taking into consideration the risk factor, the lined drainage with weep holes should be provided at toe part of hillslope at road bench level in order to minimize the affect of water seepage and saturation in downslope.

Slide no: KAR/SHM/2019/14: The shallow translational rock slide observed at convex curvature of on road in 660m south-west of Kavaledurga village area at (*Lat: 13°42'40"N: Long: 75°7'53.6"E*) on lowly dissected slope. The slope failure is ~130 m wide occurred on fractured and jointed granite gneiss. The prolonged seepage, saturation and increased infiltration along the fracture plane resulted in rock failure. The flowing stream eroded the toe part of the hill slope; the subsequent failure in downslope direction induced road subsidence at road bench level. For effective drainage lined drainage should be made at toe of the hill slope so, that water should be channelized through culvert at suitable location to avoid toe erosion and subsequent slope failure in downslope direction. The retaining wall of 12m high was constructed at road bench in downslope direction at bank of flowing stream for toe support and to prevent bank erosion.

Remedial Measures: Taking into consideration the risk factor, the lined drainage should be provided at toe part at road bench level in upslope to prevent water seepage and saturation. The precarious rock boulders should be removed as precautionary measure.

Slide no: KAR/SHM/2019/23: The shallow translational debris slide occurred on lowly dissected slope with sparse vegetation cover along road section North of Ulakoppa village (*Lat: 13°42'44.28"N, Long:75°3'15.16"E*). In present scenario ~65m wide landslide zone is active, retrogressive, widening and enlarging in nature. The slope disturbance resulted due to unscientific way of removal of soil by toe cutting of the hillslope for road construction and communication network. The water seepage and infiltration along the weaker plane i.e. closely jointed and fractured granite gneiss resulted in intense weathering and slope saturation. The differential weathering at contact of two-different litho-units was also observed.

Remedial Measures: The effective drainage at road bench level i.e. lined drainage should be provided at toe part to avoid toe erosion road subsidence due to sub-surface weathering and erosion. The water should be diverted through proper culvert to drain excess water to safe location to reduce the vulnerability of the slope.

Slide no: KAR/SHM/2019/24: The shallow translational rock slide observed along Thirthahalli-Kaveldurga road section on extensive road cut (*Lat:13°42'55.34"N, Long:75°3'16.06"E*) on lowly dissected slope with moderate vegetation cover. The landslide zone is active, retrogressive, widening and enlarging in nature. The landslide zone is ~35m wide. The slope disturbance resulted due to unscientific way of removal of soil by toe cutting of the hillslope for road construction and communication network. The seepage and infiltration is along the weaker plane along joints and fractures. Thus increased water infiltration destabilizes the slope due to over water saturation that reduces the shear strength of slope forming material during heavy rainfall. The differential weathering on slope was also observed.

Remedial Measures: The lined drainage and weep holes should be provided at toe part to drain excess water through existing culvert in order to avoid road subsidence, toe erosion and effective drainage at road bench level to minimize the sub-surface weathering and erosion. The precarious rock boulders should be removed.

Slide no: KAR/SHM/2019/48: The shallow translational debris slide observed along Hulikal road section, South of Mastikatte village (*Lat:13°43'57.63"N, Long:75°1'24.87"E*) on lowly dissected slope with moderate vegetation cover. In present scenario the landslide zone is active, retrogressive, widening and enlarging in nature. The landslide zone is ~75m wide on vertical slope cut of ~14m. The slope failure in downslope direction may results in road subsidences at road bench level. The multiple slope failures on disturbed slope at road bench level in downslope direction are also influenced by flowing stream the contributes to lateral toe erosion and water saturation that increased the pore water pressure and reduced the cohesive strength of the soil.

Remedial Measures: The retaining wall with weep holes should be constructed for toe support in downslope. Slope gradation and plantation should be done on degraded slope as biotechnical protective measures. The lined drainage at toe part is required to avoid toe erosion.

II. Thirthahalli-Devangi-Koppa road section and in and around areas (T.S no: 48O/6):

Slide no: KAR/SHM/2019/102: The shallow translational debris slide on lowly dissected slope on Koppa road (NH-169A), North of Hilikere Village area (*Lat:13°37'33.56"N: Long:75°17'18.37"E*). In present scenario the landslide zone is active, widening and enlarging in nature. The slope forming material consists of in-situ soil and weathered rock having overburden thickness of >10m. The dimension of the landslide is ~16m length and ~110m wide in downslope direction at road bench level. The water seepage and saturation at road bench level on upslope initiated the slope failure and further aggravated by toe erosion by higher order (2nd order) stream channel flowing at footslope. The removal of soil for arecanut plantation further contributes to slope instability. The area is demarcated as unstable zone susceptible to slope failure during rainfall.

Remedial Measures: Taking into consideration the risk factor the lined drainage should be constructed at road bench level to avoid water seepage and slope saturation. The culvert of suitable dimension should be designed at suitable location to drain the excess water downslope. In current scenario retaining wall with weep holes should be constructed in downslope to provide toe support in order to avoid road subsidences during heavy rainfall.

Slide no: KAR/SHM/2019/100: The shallow translational debris slide observed South of Kalgudge Village area (*Lat:13°35'48.4"N: Long:75°18'16.7"E*) on lowly dissected slope with sparse vegetation/open scrub land in vicinity of Agriculture land. In present scenario the landslide zone is active, widening and enlarging in nature. The landslide zone is ~95m wide with overburden thickness of soil ~16m. The crown cracks were visible. The toe erosion by meandering concave curves of 2nd order perennial stream resulted in slope failure.

Remedial Measures: Taking into consideration the risk factor low height retaining wall and lined drainage with weep holes are required at footslope to avoid toe cutting and erosion by flowing stream.

Slide no: KAR/CHK/2019/108: The shallow translational debris slide observed on Koppa road NH-169A, Hire Kodagi Village area (*Lat:13°35'10.8"N: Long:75°19'16.7"E*) at road bench level on lowly dissected slope at convex curves of road. In present scenario the landslide zone is active, widening and enlarging in nature. The dimension of the landslide is vertical height: ~18m

and ~35 wide in downslope direction. The water seepage and saturation at road bench level on upslope initiated the slope failure. The removal of soil for arecanut plantation further contributes in slope instability. The area is demarcated as unstable zone susceptible to slope failure during rainfall. The slope forming material consists of in-situ soil and weathered rock having overburden thickness of >10m.

Remedial Measures: Taking into consideration the risk factor the lined drainage with weep holes should be constructed at road bench level to avoid water seepage and saturation on slope. And culvert should be designed at suitable location to drain the excess water downslope. In current scenario retaining wall with weep holes should be constructed at footslope for toe support in order to avoid road subsidences during heavy rainfall.

Slide no: KAR/CHK/2019/109: At Kumbarakoppa village area in T.S. no. 48O/6 (13°34'19.59"N:75°19'57.18"E & 13°34'19.16"N/75°19'59.73"E) multiple active debris landslides are recorded on lowly dissected hillslope. The slope forming material is in-situ soil with overburden thickness of >10m. The settlements on top of the hillslope are at risk. The heavy rainfall during monsoon is likely to reactivate and trigger the landslide. The increased infiltration by household discharge and nala erosion at toe part destabilizes the slope due to over water saturation triggered during heavy rainfall. The settlements at top slope add additional mass on the hillslope. Toe erosion by 3rd order nala/stream at toe part causes toe erosion.

Remedial Measures: The lined drainage at toe part of the slope should be provided to avoid water seepage & slope saturation. The plantation should be done on degraded slope. The waste water discharge directly on the slope should be avoided.

III. Koppa-Hariharpur-Agumbe road sections (T.S nos: 48O/2 & O/6):

Slide no.: KAR/CHK/2019/85: The shallow translational debris flow observed at Mathevani village area at (Lat:13°31'19.202"N: Long:75°16'44.4"E) on lowly dissected slope with Moderate vegetation. In present scenario the landslide zone is active, retrogressive, widening and enlarging in nature. The landslide zone is ~75m wide with overburden thickness of ~14m. The slope disturbance is observed due to unscientific way of modification of slope & removal of soil for settlement purposes. The vertical cut and toe cutting of hillslope lead to slope transformation that opened up new way of water seepage & slope saturation. Thus increased infiltration destabilized the slope due to over water saturation during heavy rainfall. The quartz vein and enclaves of quartz sericite schist within highly weathered granite gneiss at failure zone were observed. The differential weathering and kaolinization of rock were also observed. The area is

demarcated as unstable zone susceptible to slope failure during rainfall. Taking into consideration the risk factor the settlement in flow direction of debris is at high risk.

Remedial Measures: Easing of slope is required and retaining wall with weep holes should be constructed to provide toe support. The slope should be monitored during heavy rainfall in monsoon.

Slide no: KAR/CHK/2019/52: The shallow translational debris slide observed on extensive road cut on Koppa-Agumbe Road (*Lat:13°30'34.8"N: Long:75°6'21.4"E*) on lowly dissected slope with Moderate vegetation cover. In present scenario the landslide zone is active, retrogressive, widening and enlarging in nature. The landslide zone is ~22m wide on convex curves of the road section. The slope forming material consists of in-situ soil and weathered rock with average overburden thickness of ~10m. The rock is highly weathered and fractured.

Remedial Measures: Taking into consideration the risk factor, the lined drainage should be provided at toe part at road bench level to prevent water seepage and slope saturation.

Slide no: KAR/SHM/2019/50: The shallow translational debris slide observed extensive road cut on Koppa-Agumbe road, 1km from Mavinkatte village (*Lat:13°31'8.6"N: Long:75°9'47.2"E*) on lowly dissected slope with Moderate vegetation cover. In present scenario the landslide zone is active, retrogressive, widening and enlarging in nature. The landslide zone is ~90m wide and slope failure is observed in downslope slope direction at road bench level. The slope forming material consists of in-situ soil and weathered rock with average overburden thickness of ~8m. The rock exposed is granite gneiss and is highly weathered.

Remedial Measures: The lined drainage should be made at toe part and culvert should be designed at suitable locations to drain excess water. In current scenario retaining wall with weep holes should be constructed at footslope for toe support in order to avoid road subsidences during heavy rainfall.

IV. Gadikallu-Herambapur-Koppa and in and around areas (T.S no: 48O/6):

Slide no: KAR/CHK/2019/56: The shallow translational debris slide occurred on lowly dissected slope with moderate to sparse vegetation (*Lat: 13°35'23.94"N: Long: 75°21'48.31"E*) in Urumakki village area 2 km north of Gunavanti village In present scenario the landslide is active & retrogressive in nature. The vertical cut provides new pathway for water seepage and saturation during intense rainfall. The flowing stream at toe part contributes to toe erosion and removal of toe support. The debris flow may result in loss of crop (Paddy) & Agriculture land. The construction lined drainage and retaining wall with weep holes should be provided at foot of

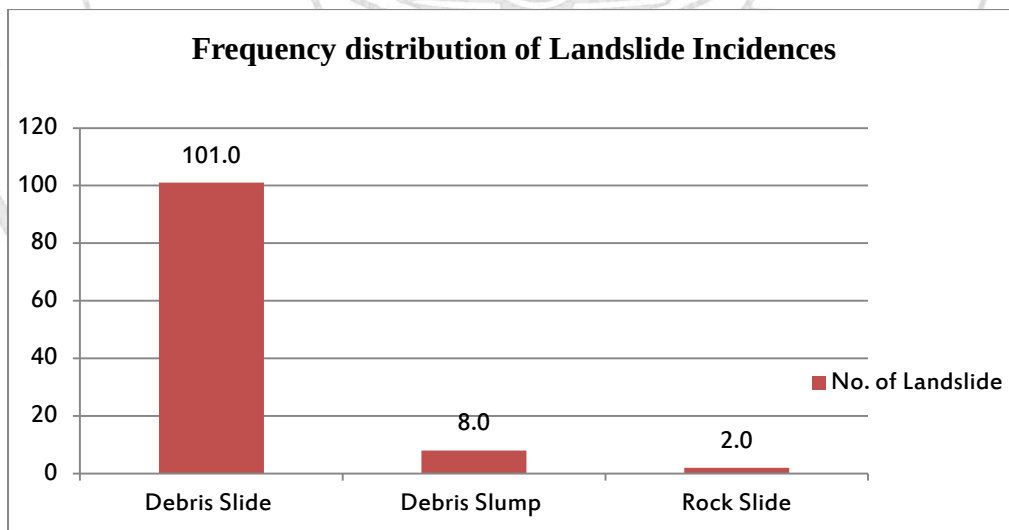
hill slope as protective remedial measures. The area is demarcated as unstable zone. The settlements constructed on top of slope are at risk.

Remedial Measures: Slope gradation and plantation should be done on slope. Construction of lined drainage and protective retaining wall with weep holes should be constructed for toe support.

V. Ganpatikatte-Kanave-Makikoppa road section and surrounding areas (T.S no: 48O/6):

Slide no: KAR/SHM/2019/59: The large dimension debris flow of ~100m run out recorded in Kanave village area at (Lat:13°41'58.63"N/Long: 75°24'12.24"E) on lowly dissected hillslope which has failed during heavy rainfall in August 2019. The water accumulated in trench made on top of hill under forest area by modification of upslope resulted in water seepage and slope saturation. The over saturated slope failed during intense rainfall due to reduction in shear and cohesive strength of the slope forming material. The area is demarcated as unstable zone susceptible to slope failure during rainfall. The contact plane of ferruginous phyllite and quartz chlorite schist are prone to mass failure. The slope forming material consists of in-situ soil and weathered rock with overburden thickness is >10m. The settlements in downslope direction are in high risk zone during rainfall.

Remedial Measures: Slope gradation should be done. The protective retaining wall with weep holes should be constructed for toe support.



Graph 1: Graph showing frequency distribution of different type of landslide incidences in the study area.

IV. LANDSLIDE SUSCEPTIBILITY ANALYSIS

4.1 Background

The Landslide Susceptibility Map is generated on priority basis using knowledge-driven mathematical method and data integration technique i.e. multi-class index overlay method for geofactors thematic maps integration in Arc GIS platform. The hillslopes are categorised as high, moderate and low susceptible zones based on weightage assigned to causative geofactors incorporating AHP based mathematical data modelling method for delineating the probability of spatial occurrence of landslides and landslide susceptible zones. Landslide susceptibility is a qualitative estimate of the spatial distribution of landslides, which exists or potentially may occur in an area. Although it is expected that landslide will occur more frequently in the most susceptible areas, however, in the susceptibility analysis, no time frame and magnitude of event are explicitly taken into account. The susceptibility map therefore gives only the qualitative estimation that the mapping unit (e.g., a pixel, slope unit or facet) will be affected by a future landslide. “Landslide Susceptibility Analysis” is carried out on the basis of AHP method for spatial prediction of landslide-prone areas and the final susceptible map of the area is classified as low, moderate and highly susceptible areas where likelihood of landslide occurrences in near future is expected.

Landslide occurrences in any terrain is governed by various factors, which are site/terrain specific so; multivariate analysis is required to serve the purpose. Different geofactor themes are taken into consideration which includes i) Physical state of slope/slope morphometric parameters such as slope gradient, slope aspect, and slope curvature, ii) Lithology or physical characteristics of slope forming material iii) spatial variation in thickness of slope forming material/regolith, iv) Geomorphic features, v) Geology and rock structure: orientation of planar/linear discontinuities in the rock mass in relation to topography, vi) Drainage and, vii) Landuse/Landcover including road and other physical features mappable on 1:50,000 scale. Based on the estimation of above pre-disposing geofactors, the following preparatory factors and its possible factor classes are considered for preparation of geofactor databases for the GIS-based analysis of susceptibility of hillslope to landsliding. Thematic data layers corresponding to the six factors were prepared in GIS. The data used to prepare these maps were collected from the topographic maps (1:50,000 scale), remote sensing data published literatures and field investigation. A brief description of these layers is given below.

4.2 Geofactor Themes: As per data model, some of the geofactor themes are categorical (e.g., geomorphology, LU/LC etc.) and others represent continuous data (e.g., slope, elevation etc.)

These different spatial geo-factor maps are prepared using various source data and employing different mapping techniques. The geofactor thematic maps are prepared for landslide susceptibility analysis are mentioned below:

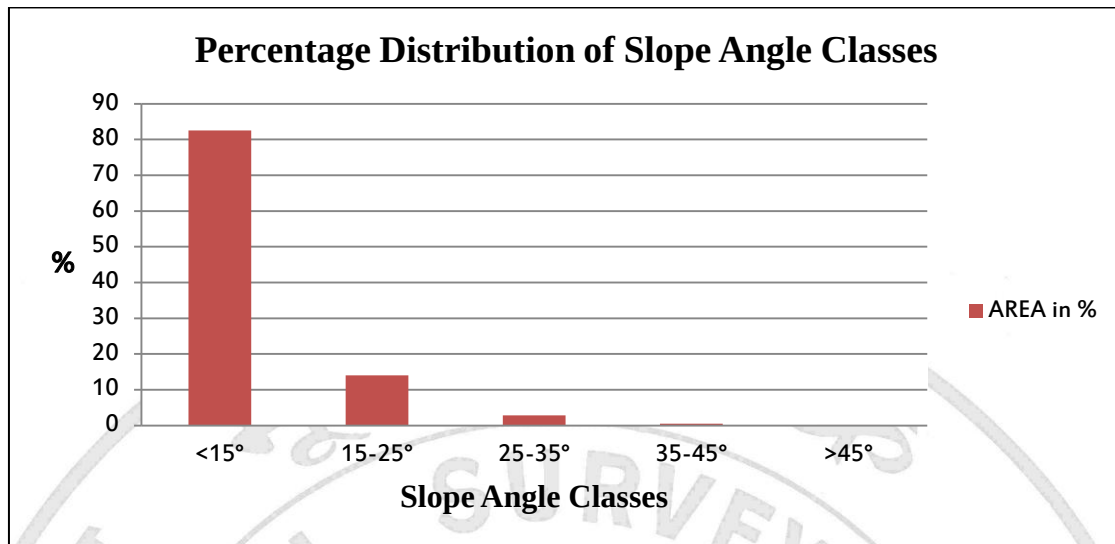
4.2.1 Slope Morphometry (Slope, Aspect, Curvature) Maps:

Raster maps of Slope (**Plate-5**), Aspect (**Plate-6**), and Curvature (**Plate-7**) are DEM derivative geofactor maps generated from Carto DEM of 30m resolution using Spatial Analyst/3D Analyst Module of Arc GIS software.

(a) Slope Angle Map (Plate-5) is classified into 5 classes; $<15^\circ$, $15^\circ-25^\circ$, $25^\circ-35^\circ$, $35^\circ-45^\circ$, $>45^\circ$ based on slope gradient, slope is deterministic geofactor class governing the failure plane. The slope class that has maximum LOFS is $25^\circ-35^\circ$ followed by $15^\circ-25^\circ$ slope, where the vertical cut has modified the slope with $70-90^\circ$ angle. According to the frequency distribution of landslide incidences, the slope varying from $\leq 15^\circ$ to 25° are more susceptible for landsliding and slope failure. According to the slope map 82.54% of the total study area has slope angle $<15^\circ$, 14% is under $15-25^\circ$, 2.84% is under $25-35^\circ$ slope angle, whereas .50% of the area has $35-45^\circ$ slope angle and remaining .11% has $>45^\circ$ slope angle. The slope map indicates that the lowly dissected hill slope and Pediment-Pediplain complex have slope angle $<15^\circ$ and $15-25^\circ$ that covers the most part of the study area, whereas the steep slopes of mountain ranges in west trending NW-SE and east trending NNW-SSE ranges from $35^\circ-45^\circ$ and $>45^\circ$ on scarp faces. The percentage distribution of different slope gradient classes are listed in (**Table 7**) based on classified slope map.

Table 4: The Percentage distribution of Classified Slope Gradient/Angle Map for T.S Nos. 480/2 & O/6 with their LOFS and Rank.

CLASS	Rank	LOFS	Area in (sq. km.)	Area in (%)
$<15^\circ$	2	0.1631	1244.56	82.54188
$15^\circ-25^\circ$	4	0.4597	200.58	14.00327
$25^\circ-35^\circ$	8	1.0000	41.18	2.839363
$35^\circ-45^\circ$	6	0.2817	7.38	0.502808
$>45^\circ$	2	0.1631	1.63	0.112679

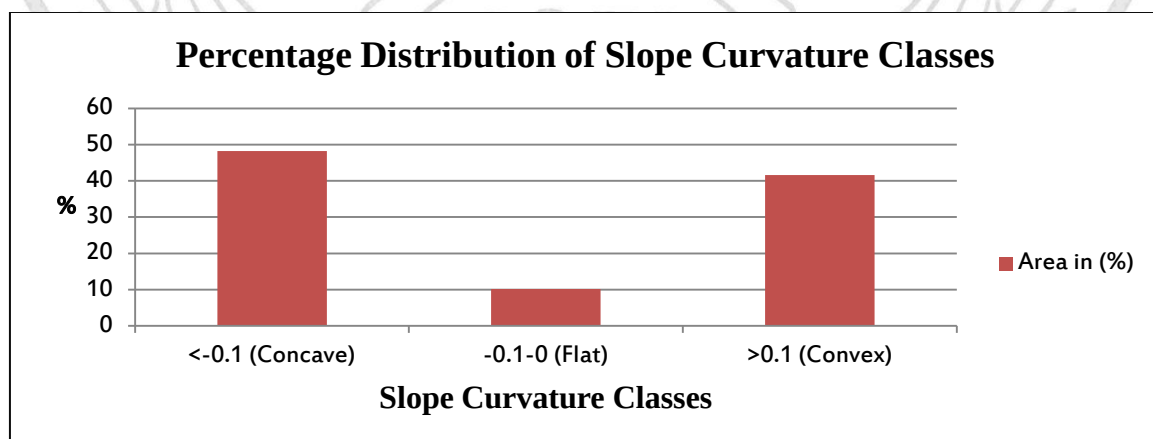


Graph 2: Graph showing percentage distribution of Slope Angle Class in the study area.

(b) **Slope Curvature Map (Plate-7)** shows negative and positive curvature values that represent concave and convex upward slopes respectively which are believed to have strong spatial correlation with landslides mapped and zero curvature shows flat surface. The percentage distribution of different slope curvature classes are listed in **(Table 8)**. Statistical analysis of on classified Curvature of the slope indicates that the probability of landslides increases as the hillsides become more concave or convex.

Table 5: The Percentage distribution of Classified Slope Curvature Map for T.S Nos. 480/2 & O/6 with their LOFS and Rank.

CLASS	Rank	LOFS	Area in (sq. km.)	Area in (%)
Concave	4	0.4113	674.97	48.27
Flat	2	0.1676	175.83	10.15
Convex	6	1.0000	639.87	41.58

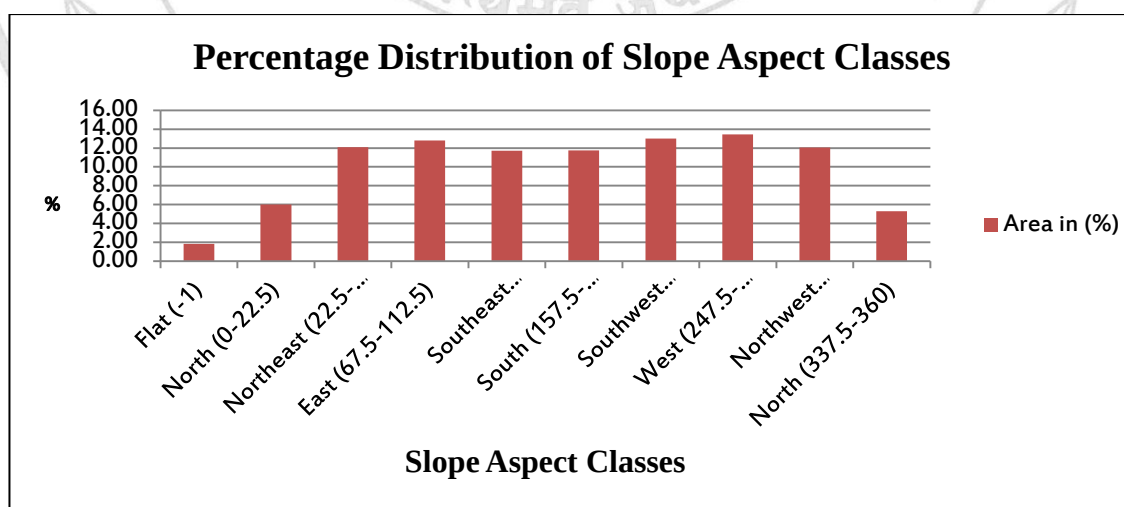


Graph 3: Graph showing percentage distribution of different Slope Curvature Class in the study area.

(c) **Slope Aspect Map:** Geofactor theme aspect is categorised into 10 classes namely N, NE, E, SE, S, SW, W, NW, NW & NNW (**Plate-6**). Raster map of Aspect are generated for analysing the Slope Morphometry. The computed aspect values are a categorical data, discretized into 10 classes extracted from Carto DEM of 30m resolution. Aspect parameter is not taken into consideration in the analysis as it has very less influence or of no affect on final Landslide Susceptibility Map. Aspect describes the maximum rate of change in the elevations or the slope direction. It is measured in positive integer degrees from 0 to 360 clockwise from North. Aspects of cells (pixels) of zero slope (flat areas) are assigned value of -1. Statistical analysis of on Aspect indicates that the South and South west facing hill facets the probability of landslides increases. Hence the South west monsoon play key role in slope saturation and weathering phenomenon.

Table 6: The Percentage distribution of Classified Slope Aspect Map for T.S Nos. 48O/2& O/6 with their LOFS and Rank.

CLASS	Area in (sq. km.)	Area in (%)
Flat (-1)	75.17	5.15
North (0-22.5)	88.80	6.09
Northeast (22.5-67.5)	164.66	11.29
East (67.5-112.5)	164.75	11.29
Southeast (112.5-157.5)	166.83	11.44
South (157.5-202.5)	183.07	12.55
Southwest (202.5-247.5)	190.31	13.05
West (247.5-292.5)	181.50	12.44
Northwest (292.5-337.5)	166.82	11.44
North (337.5-360)	76.83	5.27



Graph 4: Graph showing percentage distribution of different Slope Aspect Class in the study area.

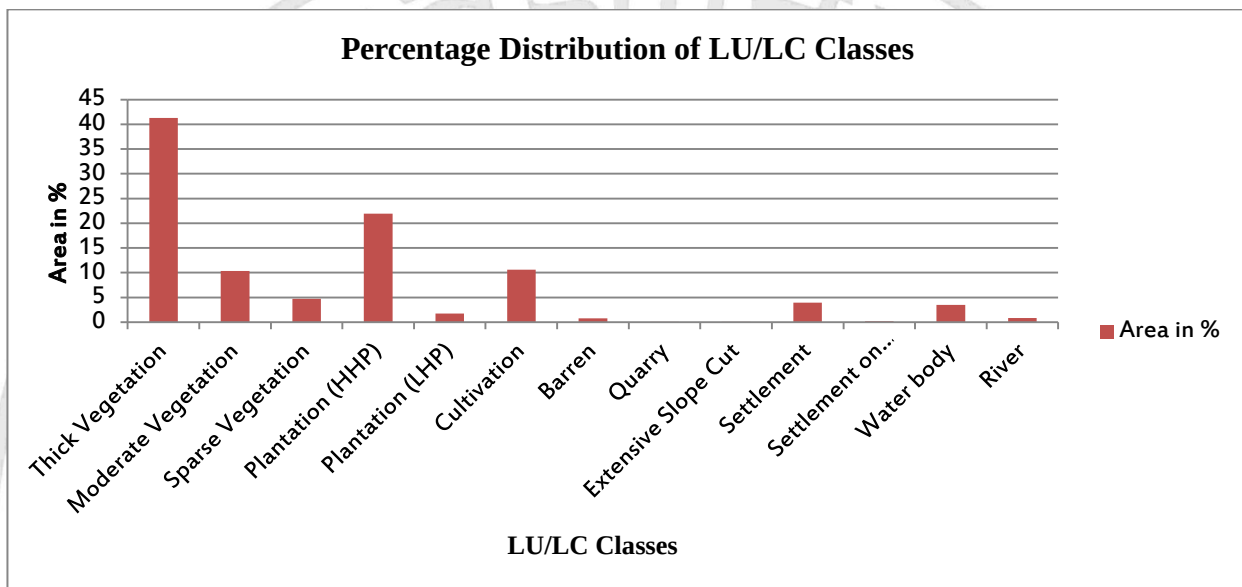
4.2.2 Landuse/Landcover Map:

The landuse/landcover map of the area was prepared from the remote sensing data. Ground truth data were collected from the field and also perceived from the topographical maps. Pre-field landuse and landcover map is prepared through visual interpretation of Google Earth Imagery (multi-temporal real time datasets) and validated during field traverses. Major part of the study area is reserve forest area covered with densely mixed jungle on inaccessible high hillocks. The Coffee, Eucalyptus plantation is practised on lower reaches of lowly dissected hill slope. The different LU/LC categories delineated are Thick vegetation, Moderate vegetation, Sparse vegetation, Plantation, Cultivated land, Rock Quarry, Barren, Fallow land and Extensive slope Cut. The thematic map is classified into some standard landuse/landcover classes (**Plate-4**). The landuse and landcover categories classified and their geographical distribution in percentage is illustrated in (**Table 10**). Based on geographical distribution around 21.95% and 10.35% of the study area is covered with thick vegetation and moderate dense mixed jungle whereas .66% of the area is covered with teak, eucalyptus and acacia plantation (HHP) in the fringe of the forest area, .11% of the area has cashew plantation (LHP) practised on low lateritic hills. The agro-climatic condition is conducive for cultivation of paddy and other plantation crops practised on 34.34 % of the study area. Total .04% of the extensive cut slope are made along the vertical road cut section. The study area is densely populated so, the settlement and settlement on modified slope covers 3.94% and .18% of the study area. Statistical analysis of Landuse/Landcover indicates that lowly dissected hillslope with thick and sparse vegetation along the ghat road and in the vicinity of streams and water catchment area are more prone to failure. The extensive cut slope provides new path way for water infiltration and slope saturation during rainfall that triggers landslides on the vertical cut slope. The thick soil covers encourages cultivation and planation of arecanut in disscetd hillslope so, widening of agricultural land & plantaion purposes leads to removal of toe support and toe ersion by perennial streams.

Table 7: The Percentage distribution of different Landuse/Landcover classes for T.S Nos. 48O/2 &O/6 with their LOFS and Rank.

Class	Rank	LOFS	Area in (sq. km.)	Area in (%)
Thick Vegetation	4	0.1988	617.64	41.31
Moderate Vegetation	5	0.2912	154.66	10.35
Sparse Vegetation	7	0.5631	70.58	4.72
Plantation (HHP)	4	0.1988	328.14	21.95
Plantation (LHP)	3	0.1366	26.43	1.77
Cultivation	2	0.0937	158.77	10.62

Barren	1	0.0626	11.8	0.79
Quarry	5	0.2912	0.81	0.05
Extensive Slope Cut	1	0.0626	0.66	0.04
Settlement	5	0.2912	58.92	3.94
Settlement on modified slope	1	0.0683	2.73	0.18
Water body	7	0.5631	52.03	3.48
River	0	0	12.11	0.81



Graph 5: Graph showing percentage distribution of different LU/LC Classes in the study area.

4.2.3 Geomorphology Map:

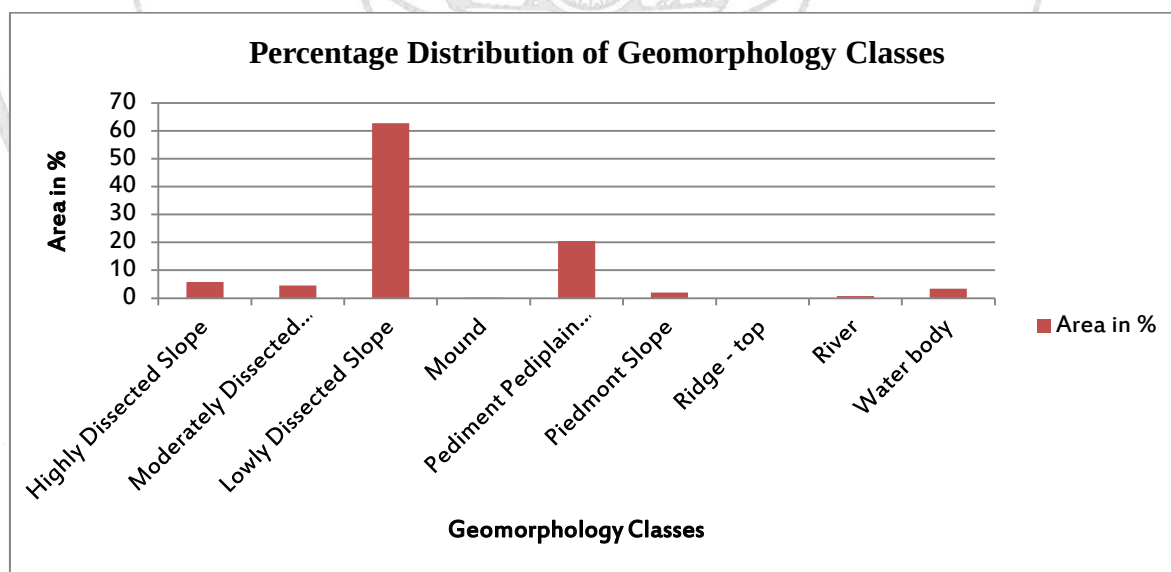
National Geomorphological and Lineament Map (NGLM) of GSI used as source map for geomorphology theme for use in landslide susceptibility map. It is one of the categorical geofactor thematic databases. The geomorphic features are mapped mostly through visual interpretation of Satellite imagery with limited field checks. The NGLM data is substantiated by reclassifying the existing geomorphic features making it more useful as an evidential layer for landslide susceptibility.

Geomorphologically, the area forms a part of Western Ghats and is characterised by a highly undulating rugged topography with steep ridges and lowly dissected hill slope with intermittent narrow valley fills and Pediment-Pediplain Complex having rolling topography. The lower reaches of hill slope are categorised as Pediment-Pediplain Complex and Piedmont slope of slope angle $<15^\circ$ and $15-25^\circ$ covering 20.53% and 1.99% of the study area respectively. The hillslope trending N-S direction are moderately dissected hillslope occupying 4.52% of the study area. The shimoga schist belt in north and southern extension of schist belt known as Koppa band controls the geomorphological features of the area (**Plate-4**). The

different geomorphic features and categories identified in the area and their geographical distribution (**Table 12**) indicates geomorphologically, 5.75% of the geographical area is highly dissected hills comprise of ridges and steep valleys in western part trending NNW-SSE agume ghat hill ranges, whereas 62.73% of the elevated area in the central and eastern part are lowly dissected hillslope with gently undulatory topography with lowly disscetd hillocks and Pediment-Pediplain Complex. Statistical analysis of Geomorphology indicates lowly dissected hillslope with deep dissection in the vicinity of streams and water catchment area are more prone to slope failure.

Table 8: The Percentage distribution of different Geomorphology classes for T.S Nos. 480/2 & O/6 with their LOFS and Rank.

Class	Rank	LOFS	Area covered in sq. km	Area covered (%)
Highly Dissected Slope	8	.7279	86.01	5.75
Moderately Dissected Slope	6	.4020	67.55	4.52
Lowly Dissected Slope	4	.1947	937.84	62.73
Mound	2	0.0819	2.58	0.17
Pediment Pediplain Complex	0	0	306.88	20.53
Piedmont Slope	4	0.1947	20.69	1.99
Ridge - top	0	0	1.04	0.07
River	0	0	12.11	0.81
Water body	0	0	51.58	3.45



Graph 6: Graph showing percentage distribution of different Geomorphology Classes in the study area.

4.2.4 Slope Forming Material Map:

Another important categorical data is geofactor theme of slope forming material which categorizes areas into discerning types of material occurring on slope which include different litho-units and overburden material. The primary source maps used for the preparation of such slope forming material map are Geology Map, Geomorphology map, Landuse/Landcover and Slope maps on 1:50,000 scale. The field-based knowledge/inputs on characteristics of exposed rock masses, their weathering details, types of overburden material, and thickness etc., are then combined with the above source maps and subsequently, slope forming material map can be derived as an important geofactor thematic map for use in the landslide susceptibility analysis.

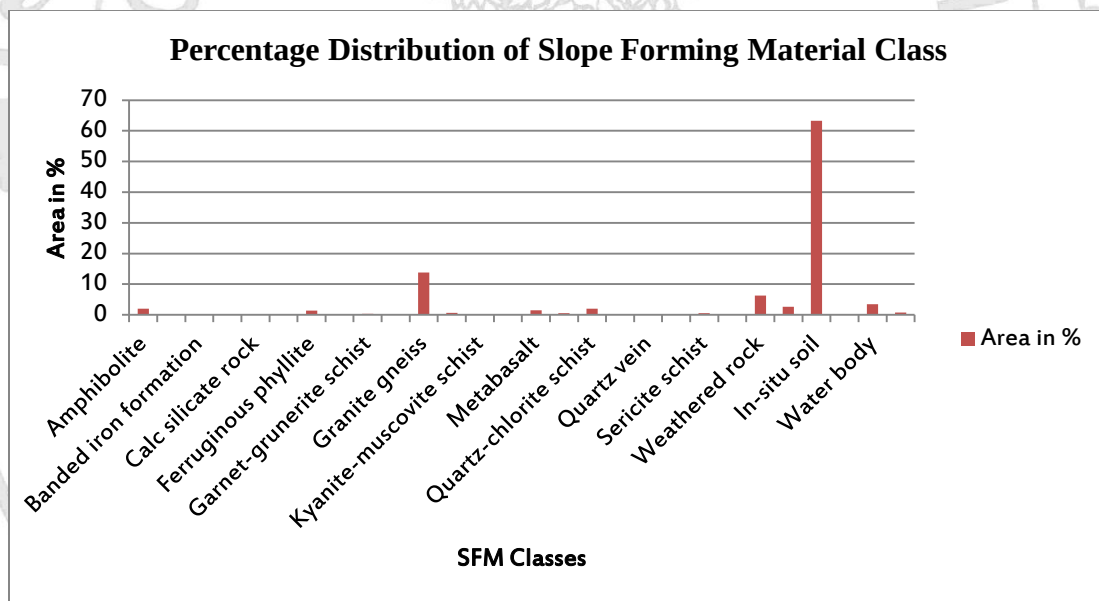
Since, on macro scale (1:50,000) it is generally difficult to classify susceptibility maps solely based on landslide types (e.g. debris and rock slides) so, the preparation of such a detailed and classified slope forming material map and using the same as an input thematic map in the landslide susceptibility modelling instead of general geology map would always be highly relevant. Statistical analysis of slope forming material indicates that the probability of landslides increases on weathered, fractured, jointed rock and loose material (soil) also at the intrusive contact of different litho-units that provides the weaker plane for water seepage and saturation on hillslope. In the study area phyllitic and schistose rock i.e. quartz chlorite schist, sericite schist, ferruginous phyllite, kaolinised weathered granite gneiss and amphibolite patches are susceptible to failure. Along the major part of the ghat road, the hillslope has weathered and lateritised granite and granite gneiss that encounter number of landslide and slope failure incidences during rainy season.

Majority of the landslides are occurring on the weathered rock and soil. In the study area the slope forming material classes (**Plate-9**) are identified as rock, weathered rock, in-situ soil & transported soil and accordingly Rank was given to all identified 25 classes. The percentage distribution are given below in (**Table 13**).

Table 9: The Percentage distribution of different Slope Forming Material classes for T.S Nos. 48O/2, O/6 with their LOFS and Rank.

CLASS	Rank	LOFS	Area in sq. km.	Area in %
In-situ soil	4	0.2409	946.47	80.00
Banded magnetite quartzite	1	0.0682	0.12	0.008
Granite	1	0.0682	2.61	0.175
Granite gneiss	1	0.0682	207.12	13.85
Quartzite	1	0.0682	0.22	0.015
Quartz vein	1	0.0682	0.03	0.002
Ultramafite	1	0.0682	0.33	0.022

Dolerite	1	0.0682	0.34	0.023
Granitoid	1	0.0682	9.45	0.632
Gabbro	1	0.0682	0.09	0.006
Transported Soil	3	0.1506	39.9	2.669
Weathered Rock	6	0.5437	94.44	6.317
Water body	0	0	51.41	3.439
River	0	0	11.41	0.763
Amphibolite	4	0.2409	29.49	1.973
Ferruginous phyllite	4	0.2409	20.77	1.389
Quartz-chlorite schist	4	0.2409	30.35	2.05
Manganiferous iron quartzite	4	0.2409	2.96	0.198
Pyribolite	2	0.2409	8.25	0.552
Quartz-muscovite schist	4	0.2409	2.32	0.155
Sericite schist	4	0.2409	7.44	0.497
Banded iron formation	2	0.2409	0.07	0.005
Calc silicate rock	4	0.2409	0.79	0.053
Garnet-grunerite schist	4	0.2409	4.77	0.319
Kyanite-muscovite schist	4	0.2409	0.01	0
Metabasalt	1	0.0682	21.79	1.458



Graph 7: Graph showing percentage distribution of landslides in different slope forming material in the study area.

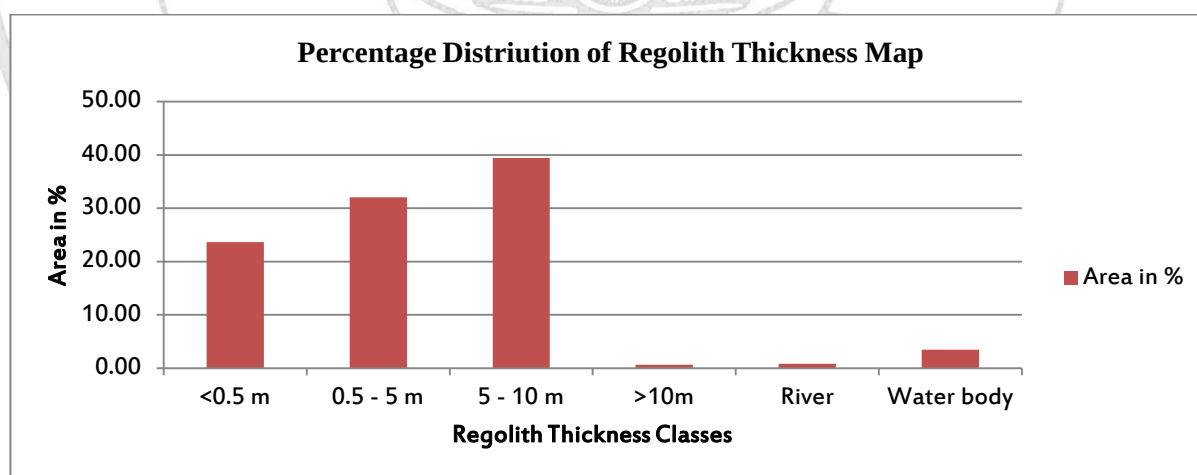
4.2.5 Regolith Thickness map:

The Regolith Thickness map is prepared on the basis of field observation in the study area. The variation in the thickness of soil/regolith was observed to be very erratic. Regolith means material i.e. in-situ or transported soil and weathered rock mass, lying over the fresh country rock. The thickness depends on different factors, one important factor being the local variation

in terrain morphology; therefore prediction of the thickness of regolith over a large area is extremely difficult. Ideally, for thickness modelling, a large number of observations (such as drill holes, outcrops or geophysical data) are required. However, at a catchment scale, this approach is difficult to implement. Given the above limitations, Regolith thickness map is prepared based on field observations. Assessment of depth of regolith at different sites was made by studying the exposures or cut sections along the road, streams, landslide scars and from open wells. The overburden thickness varies from <0.5m, 0-5m, 5-10m, 10-15m and their area and percentage distribution with LOFS and rank are illustrated in **Table 14**. Statistical analysis of regolith thickness indicates that the probability of landslides increases with increase of the overburden thickness of loose material (soil) on modified slope. The rock failure is occurring on weathered and jointed rock during prolonged weathering and water saturation along weaker plane. The overburden thickness of slope forming in-situ soil and transported soil the study area varies from 0.5-5m, 5-10m and >10m (**Plate-10**).

Table 10: The Percentage distribution of different Regolith Thickness classes for T.S Nos. 48I/5, I/6 & I/7 with their LOFS and Rank.

CLASS	Rank	LOFS	Area in (sq. km.)	Area covered (in %)
< 0.5 m	0	0	527.07	35.36
0.5 - 5 m	7	1	147.45	9.89
5 - 10 m	4	0.3230	502.82	33.73
>10m	2	0.1363	261.94	17.57
Water body	0	0	51.36	3.45



Graph 8: Graph showing percentage distribution of different Regolith Thickness Class in the study area.

4.2.6. Structure and Drainage

Structures were particularly joint and fracture play an important role in defining distribution of landslides. The presence of joints and their orientation with respect to the slope has large influence in causing landslides particularly the rock failures during rainfall. The seepage along weaker planes builds pore pressure resulting in shattering of rocks and such sliding surfaces are highly prone to failure.

Considering geo-hydrological parameters, the different order of streams are extracted and classified as first order, second order and higher order streams from Carto DEM data of 30m using Strahler's (1957) ordering system. It is observed that 1st order streams cause only limited erosion including shallow landslides. So, drainage is not considered as significant parameter for landslide susceptibility mapping. Prepared Drainage map from Carto DEM (30m resolution) on 1:50,000 scale. The area has Mani reservoir in the Northwest and the area is well drained by Tunga river and its tributaries. The river systems form a dendritic to sub-dendritic pattern. The area exhibits dendritic drainage pattern in gneissic rock and sub-parallel drainage pattern in schistose rock. The radial drainage pattern is occurring along Thirthahalli-Agumbe ghat section. Drainage map are extracted from Carto DEM data (30m resolution) and were classified based on stream orders i.e. 1st Order, 2nd Order, 3rd Order, 4th Order and 5th Order streams in GIS platform using spatial analyst tool (**Plate-8**). The landslides in this area are associated with 1st and 2nd order stream and higher order streams channels flowing at footslope adjoining to agricultural land because of toe erosion and scouring by streams during heavy water discharge in rainy season. The buffer of 0–50m, 50–100 are demarcated as site unsuitable for habitation.

4.3 Methodology

Due to the certain limitations/constraints in present ground condition and lack of sufficient landslide datasets for data driven modelling in such a situation empirically derived terrain-specific ratings and weights can pose problems. Hence, Analytical Hierarchy Processes is considered for the preparation and generation of landslide susceptibility map.

Different methods of predictive mapping of landslide susceptibility are adopted because landsliding is a complex interactions with several geo-environmental factors. The cardinal aim of landslide susceptibility mapping is to identify locations where future landslides are likely to occur, based on the fundamental assumption that spatial factors that caused present and past landslides are likely to cause similar landslides in the future. Several knowledge-driven (heuristic) and data-driven or empirical methods of mapping landslide susceptibility are

available in the literature which make use of indirect or direct spatial relations between landsliding of a certain type and relevant spatial factors.

Knowledge-driven/Heuristic methods of landslide susceptibility can either be direct or indirect. In indirect heuristic methods, individual factors are assigned specified weight values or ratings that are solely based on subjective criteria (Hansen, 1984; BIS, 1998). In the latter method, specified factor weights are considered regardless of the existing landslide inventory maps and variations in terrain conditions and to use unique weight values for the factor in different geomorphological/geological environments. However, the most important aspect of any predictive mapping is the validation. Validating the landslide susceptibility maps by mere overlapping the landslide incidence map over landslide susceptibility map is only trivial and cannot quantitatively assess the actual performance of any predictive model. Predictive modelling of susceptibility to sliding aims to make an estimate at every location in a study area of the future occurrence of such landslides based on known occurrence of landslides. The analysis thus assumes that the relations between spatial factors and past landslides are relevant to the occurrence of future landslides. Therefore, to effectively model the landsliding phenomenon, landslide incidences, controlling geofactors, their mutual importance in influencing landslides is taken into account.

Methodology of landslide susceptibility mapping is divided into the following main themes:

- **Identification and preparation of its landslide inventory database and maps in GIS:** Landslides, its types and failure mechanisms are the basic and fundamental parameters required by any analyst for carrying out landslide susceptibility analysis. For this, availability of a complete landslide inventory of an area is a prime pre-requisite. To accomplish this task, landslide inventory mapping using all sorts of available and past source information such as archival data, old maps/ reports, very high-resolution remote sensing data and adequate fieldwork are carried out and landslide inventory database is generated and landslide inventory map is prepared.
- Role of geofactors in landsliding and preparation of its related GIS-based database.
- Empirical selection or spatial association analysis between various geofactors and landslides for determining both ratings of factor classes and weights of the geofactor themes: Several empirical techniques are available in the literature for selection and weighting of geofactors using landslide inventory data through which spatial association analyses between prevalent landslides and different types of geofactor maps are carried out in a GIS. The purpose of accomplishing such quantitative spatial association analyses in

any predictive modeling of landslide susceptibility is to select and use only the good predictors, which are the spatial geofactors that exhibit positive spatial associations with existing landslides. After selection of such predictors, the next step is to objectively determine their inter-predictor weights and then combine the selected predictors with their weights in a suitable susceptibility model like Weighted Multiclass Index Overlay. GIS-based modeling for integration of selected and weighted geofactor maps for preparation of landslide susceptibility scores, validation and classification of landslide susceptibility score maps into qualitative maps showing varying degree of landslide susceptibility.

4.4. Selection of mapping unit

After the selection of appropriate preparatory factors, the next step was the selection of mapping units for the GIS based susceptibility analysis. Total 1495 sq. km. study area was converted into an equal-area grid by rasterizing the geofactor vector map using a $50\text{m} \times 50\text{m}$ pixel size. The DEM derivative maps are extracted from Carto DEM of 30m resolution for the overlay analysis of different thematic maps. Therefore, in this work, a pixel was selected as the basic mapping unit for the susceptibility modelling so, that the smallest landslide can be represented by a single pixel of $50\text{m} \times 50\text{m}$ resolution.

4.5. Methods of Susceptibility Analysis:

GIS analysis for landslide susceptibility mapping Techniques:

Landslide Occurrences Frequency Score (LOFS) are determined based on Pair wise correlation matrix and Rank as per the weightage/rating assigned to different thematic (causative factors) variables, different thematic maps are generated in GIS platform and corresponding LOFS maps are generated using LOFS ratings/weights of geofactor classes. The thematic geofactor maps are integrated in the GIS platform and overlay analysis is carried out. The six thematic data layers and the landslide distribution map were the input data layers for spatial analysis in GIS. The cell size selected for the analysis was $50\text{m} \times 50\text{m}$. Hence it may be inferred that the lithology, slope and land use seem to be the major controlling factors for landslide incidence. Assigning the information values as weights to the factor categories prepares the numerical data layers for further analysis. Now to obtain the total information value for a grid cell as given in equation (2), the numerical data layers were integrated using Spatial Analyst Model of ARC View GIS. The data integration performs arithmetic overlay of the numerical data layers in raster mode. The output landslide susceptibility map is generated

using rasterised datasets using Weighted Multiclass Index Overlay method of data integration and the AHP based knowledge driven mathematical data modelling. In the present study for calculation of factor class ratings and inter-predictor weights of factor maps using pairwise comparison matrix developed by Saaty, 1977.

1. Analysis for selection and weightage of geofactors (heuristic/ knowledge-driven AHP method)

- a. Empirical landslide-dependent analysis for determining terrain-specific ratings and weights of geofactors.
- b. Analysis and discussion about spatial association between each geofactor and observed landslides in the study area.

2. Data integration and landslide susceptibility mapping

- a. Data integration procedure-e.g., Weighted Multi-class Index Overlay.
- b. Data validation.
- c. Classification and preparation of qualitative landslide susceptibility map.
- d. Utility of landslide susceptibility maps and information with specific recommendations.

3. Data Modelling using Analytic Hierarchy Process (AHP):

The Analytic Hierarchy Process (AHP) is a multi-criteria decision-making approach which was originally developed by Prof. Thomas L. Saaty (1977). It is an effective tool for dealing with complex decisions and may aid the decision maker to set priorities and make the best decision. By reducing complex decisions to a series of pair wise comparisons, and then synthesizing the results, the AHP helps to capture both subjective and objective aspects of a decision. In addition, the AHP incorporates a useful technique for checking the consistency of the decision maker's evaluations, thus reducing the bias in the decision making process. The Analytical Hierarchy Process-AHP provides measures of consistency, derives priorities among criteria and alternatives, and simplifies preference ratings among decision criteria using pair wise comparisons to establish priorities among the elements to obtain the set of overall weights for achieving, evaluating and checking the consistency of judgements.

4. Classification of the Landslide Susceptibility Map into High, Moderate and Low Susceptible zones.

The basic procedures followed are described below:

1. Develop the ratings for each decision alternative for each criterion by • developing a pair wise comparison matrix for each criterion • normalizing the resulting matrix • averaging

the values in each row to get the corresponding rating • calculating and checking the consistency ratio.

2. Calculate the weighted average rating for each decision alternative and choose the one with the highest score.

Step 1: Pair wise comparison matrix

The criteria in the row are being compared to the criteria in the column.

Step 2: Normalization

This step is to normalize the matrix by totalling the numbers in each column. Each entry in the column is then divided by the column sum to yield its normalized score.

The sum of each column is 1.

Step 3: Consistency analysis

Now, calculate the consistency ratio is calculated and value is checked. The purpose for doing this is to make sure that the original preference ratings were consistent.

There are 3 steps to arrive at the consistency ratio:

1. Calculate the consistency measure
2. Calculate the consistency index (CI).
3. Calculate the consistency ratio (CI/RI where RI is a random index).

$$CI = \lambda_{\max} - n / n - 1$$

$$CR = CI / RI$$

To calculate the consistency measure, we can take advantage of Excel's matrix multiplication function = MMULT()

Approximation of the Consistency Index

1. Multiply each column of the pair wise comparison matrix by the corresponding weight.
2. Divide of sum of the row entries by the corresponding weight.
3. Compute the average of the values from step 2, denote it by $\lambda_{\max}$.
4. The approximate $CI = \lambda_{\max} - n / n - 1$

Consistency Ratio (CR)

$$CR = CI / RI$$

Random Index (RI)

The CI of a randomly-generated pair wise comparison matrix

n	1	2	3	4	5	6	7	8	9
RI	0.00	0.00	0.58	0.9	1.12	1.24	1.32	1.41	1.46

Notes: n = order of matrix, Random inconsistency indices for n = 10 (Saaty, 1980)

In the AHP method, the scale range 1–9 is assumed. The standard preference scale was used by Miller is as follows:

Preference Level	Numerical Value
Equally Preferred	1
Equally to Moderately Preferred	2
Moderately Preferred	3
Moderately to Strongly Preferred	4
Strongly Preferred	5
Strongly to Very Strongly Preferred	6
Very Strongly Preferred	7
Very Strongly to Extremely Preferred	8
Extremely Preferred	9

1. The calculation of the ratings for each factor classes and weights of each factor maps was performed in excel. Based on pair wise matrix comparison of each factor class for all geo-factor thematic maps, calculation of Eigen values, fraction rate values and Landslide Occurrence Favourability Score (LOFS) rating was obtained.
2. Annexure III provides the calculated LOFS ratings of all classes of six geo-factor thematic maps. The excel table is joined with the factor maps using “Table Join & Relate” function in Arc GIS.
3. Using the “Lookup” function in Reclassify tool of Arc GIS, LOFS rating map was generated for each thematic geo-factor maps, showing the spatial distribution of LOFS values.
4. Using “Map Algebra” function of Spatial Analyst Tool in Arc GIS rating maps were combined together to obtain landslide susceptibility score maps.

For generation of “Raw Landslide Susceptibility Score Map” in Arc GIS, “raster calculation” command under map algebra is used. For “Raw Landslide Susceptibility Score Map” the following formula is used.

$$\text{Susc Score} = (\text{LOFS_Factor1} * \text{weight of Factor1} + \text{LOFS_Factor2} * \text{weight of Factor2} + \text{LOFS_Factor3} * \text{weight of Factor3} + \dots + \text{LOFS_Factor}_n * \text{weight of Factor}_n) / \text{Sum of inter-predictor weight}$$

5. Classification break values were determined on the basis of logic of providing mutual comparison expert-driven ranking to sub-divide the score map. Considering rank value of ‘5’ in a scale of ‘0 to 9’ has higher likelihood in influencing landslides which comes after 50% of absolute difference values, similarly rank value of ‘≤3’ has least likelihood in influencing landslides comes after 30% of absolute difference value. Hence, 50% cut-off margin or

weightage was used to determine the break raster value between “Moderate” and “High” susceptibility classes, while 30% cut-off margin or weightage was used between “Low” and “Moderate” susceptibility classes

In AHP based knowledge-driven models, classification break values can be determined on the basis of the logic applied while giving mutual comparison expert driven ranking. It is always thought by any expert that rank value for any factor class is ≥ 5 , and it is considered that the particular factor class has higher likelihood in influencing the landslides. This rank value of “5” in a scale of “0” to “9” comes after 50% of the absolute difference values ($9-0 = 9$; 50% of 9 is 4.5). That is why this 50% cut-off margin or weightage can be used to determine the break raster value between “Moderate” and “High” susceptibility classes (*BrMH*). Similarly, when rank value for any factor class is ≤ 3 (lower than 30% of the absolute difference value of 9), and it is considered that the particular geofactor class has lesser likelihood in influencing any landslides. Accordingly, 30% cut-off margin or weightage can be used to determine the break values between “Low” and “Moderate” susceptibility classes (*BrLM*).

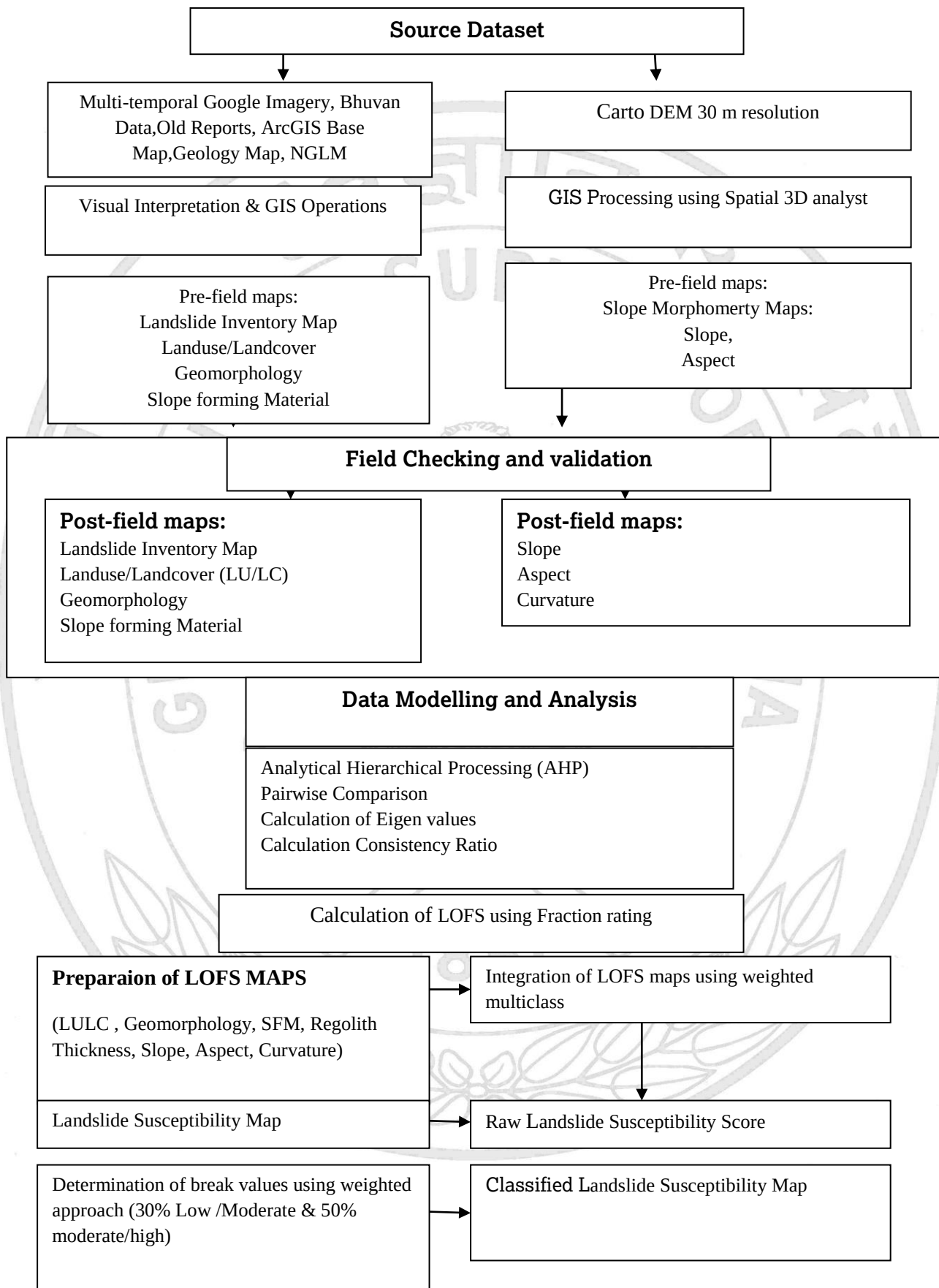
Using the above logic the required break values can be determined by using the following formula:

$$\mathbf{BrMH} = [(Abs\ Diff\ LOFS\ Factor1*50)*weight\ of\ Fcator1 + (Abs\ Diff\ LOFS\ Factor2*50)*weight\ of\ Fcator2 + (Abs\ Diff\ LOFS\ Factor3*50)*weight\ of\ Fcator3 + + (Abs\ Diff\ LOFS\ Factor_n*50)*weight\ of\ Fcator_n] / Sum\ of\ inter - predictor\ weight$$

$$\mathbf{BrLM} = [(Abs\ Diff\ LOFS\ Factor1*30)*weight\ of\ Fcator1 + (Abs\ Diff\ LOFS\ Factor2*30)*weight\ of\ Fcator2 + (Abs\ Diff\ LOFS\ Factor3*30)*weight\ of\ Fcator3 + + (Abs\ Diff\ LOFS\ Factor_n*30)*weight\ of\ Fcator_n] / Sum\ of\ inter - predictor\ weight$$

Once break values (*BrMH* and *BrLM*) are calculated, Classified Landslide Susceptibility Map is prepared by reclassifying the Raw Landslide Susceptibility Score Map using reclassify command in Arc GIS. In reclassification window, three classes is chosen and in break values, 2nd topmost value given as the first value (Class 1), 1st topmost value is given as the second value (Class 2) and third value (Class 3) is given as one. Now the Raw Landslide Susceptibility Score Map is classified into the following categories: Class 1 stands for “Low Susceptibility”, Class 2 stands for “Moderate Susceptibility” and Class 3 stands for “High Susceptibility”.

Figure-1: Flow diagram showing methodology for Landslide Susceptibility Mapping



V. LANDSLIDE SUSCEPTIBILITY MAP

5.1 Interpretation of Landslide Susceptibility Map

General: The prominent geomorphic feature of the study area is low elevated, lowly dissected hillslope with deeply dissected pediment and peneplains. The area is low lying with gently undulatory topography. The major part of study area has slope gradient that varies between 15-25° and <15°. The Arecanut plantation is the major landuse practice in deeply dissected pediment and peneplain grown for commercial purposes. The paddy is the major staple food crop cultivated in the peneplain areas. The area is covered with moderate to thick vegetation. The rocks of “Peninsular Gneiss” represented by granite gneiss/granite of Archean age are exposed in major part of the study area. The area has witnessed various degree of weathering and erosional activities. The overburden thickness of in-situ and transported soil in general varies between 0.5-5m, 5-10m and >10m.

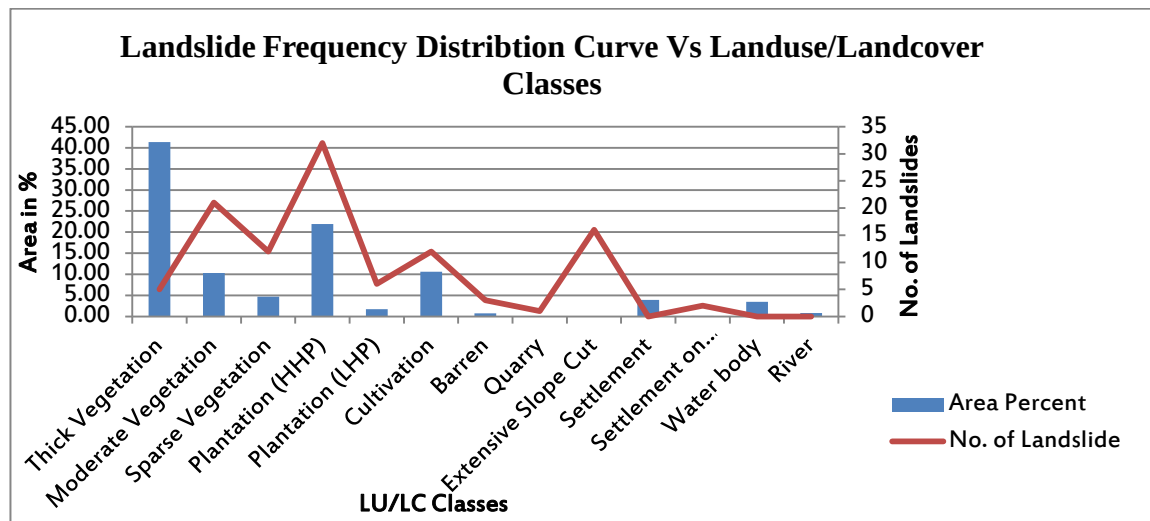
The topography of the region is sensitive and any change in the landuse causes landslide or slope failures affecting agricultural land and settlements. Infrastructural development in the form of construction of new roads and widening of the existing roads involved the modification of slopes thus the equilibrium attained by the nature has been deteriorated.

GIS based spatial data analysis was carried for landslide susceptibility mapping in Toposheet nos. 48O/2, 48O/6 in parts of Chikmangaluru, Shimoga, Dakshin Kannada districts, Karnataka. The important causative factors generally responsible for landslides incidences/occurrences were studied and corresponding thematic data layers were prepared in GIS. Numerical weights for different categories of these factors were determined based on a statistical approach and then integrated in GIS environment to arrive at landslide susceptibility map of the area as high, moderate, and low landslide susceptible zones.

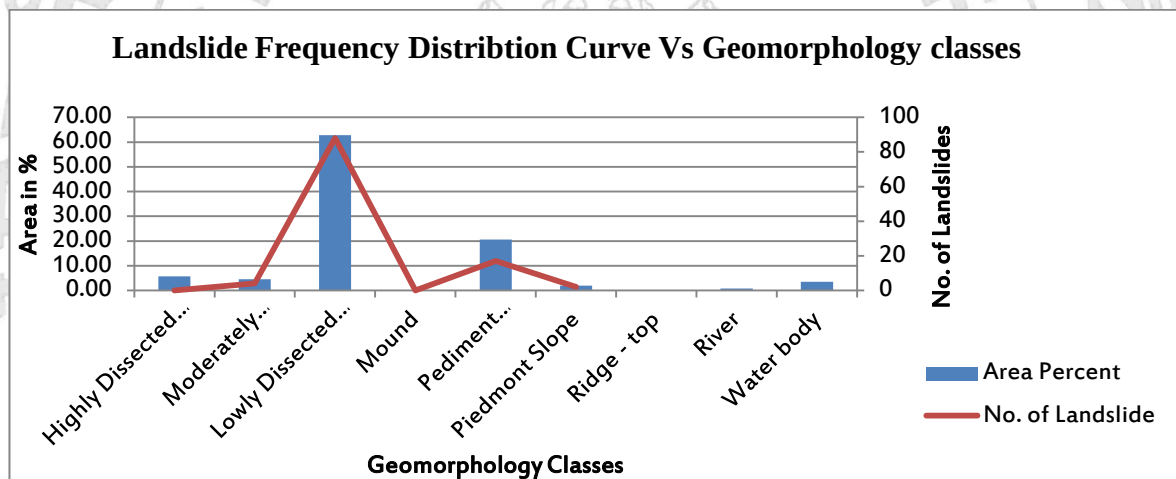
5.2 Spatial correlation of landslide distribution with geofactor classes:

The causative factors generally responsible for the landslides or slope failures viz., lithology, structure, regolith thickness, slope forming material, slope morphometry (slope, aspect, curvature), geomorphology, landuse/landcover, drainage density, lineaments. The corresponding thematic data layers are correlated with landslide incidences to understand the probability of occurrences of landslides and influencing geofactors.

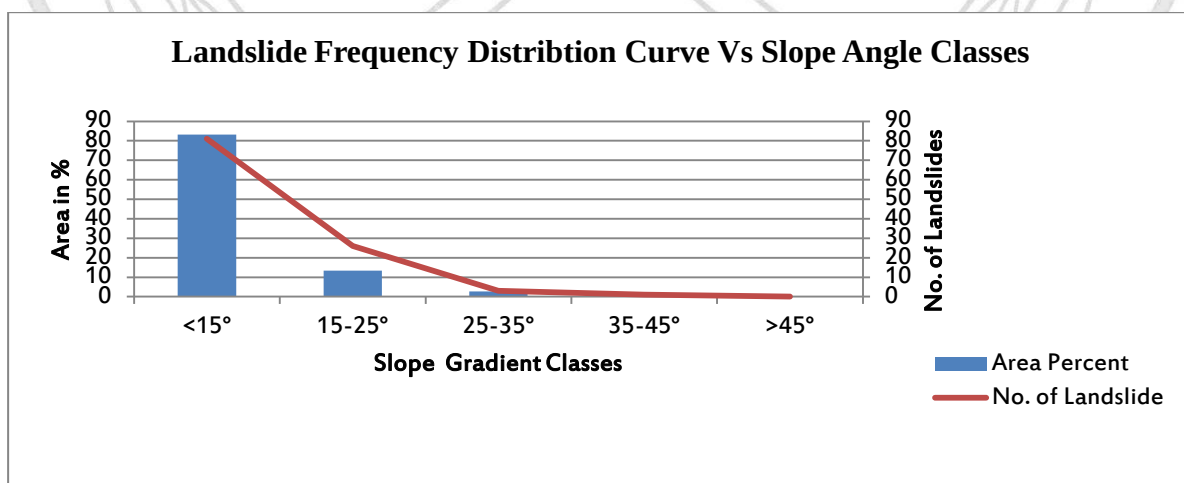
Graphs showing Spatial correlation of landslide distribution with geofactor classes:



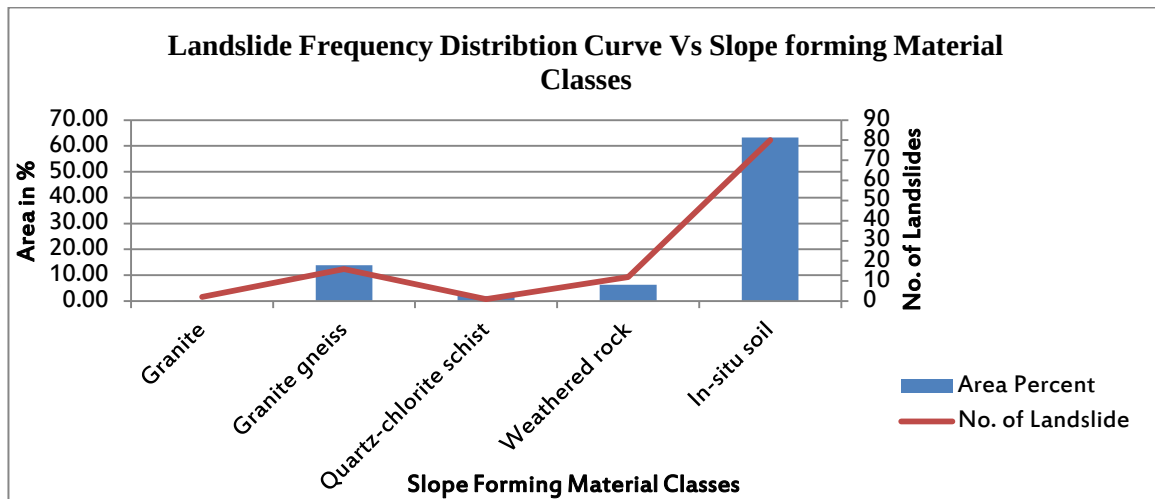
Graph 9: Graph showing frequency of landslides distribution/occurrences in different LU/LC Classes.



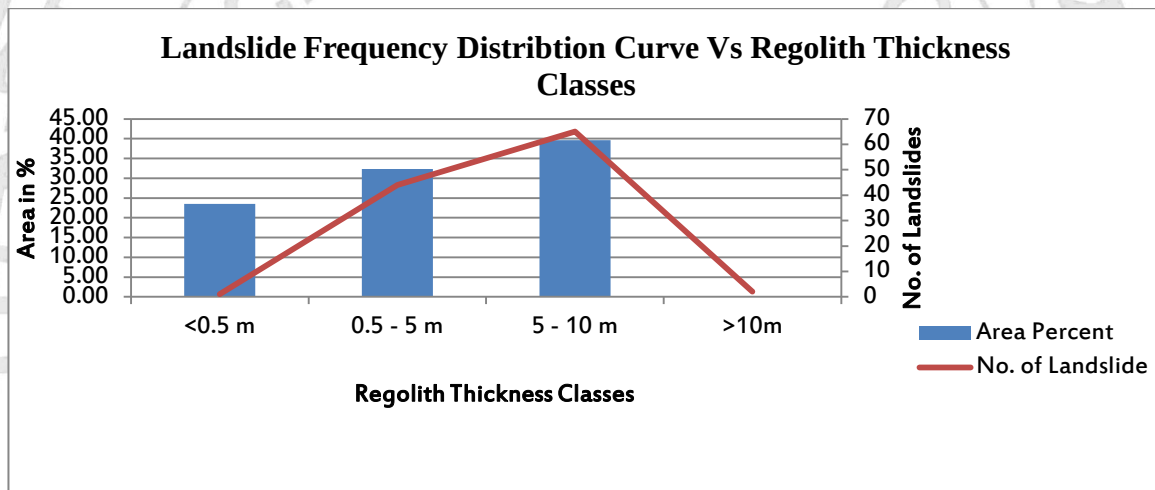
Graph 10: Graph showing frequency of landslides distribution/occurrences in different Geomorphology Classes.



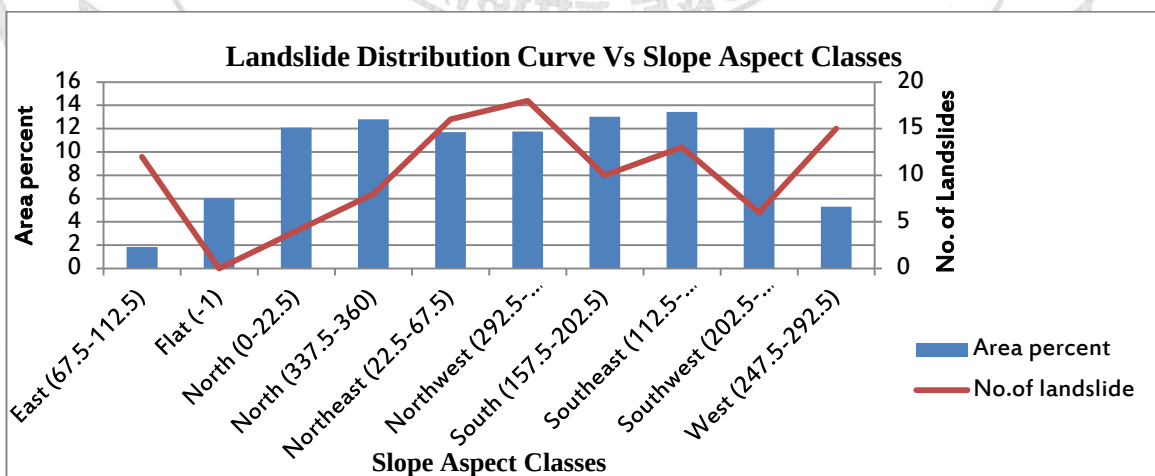
Graph 11: Graph showing frequency of landslides distribution/occurrences in different Slope Angle Classes



Graph 12: Graph showing frequency of landslides distribution /occurrences in different Slope forming material Classes



Graph 13: Graph showing frequency of landslides distribution/occurrences in different Regolith Thickness Classes



Graph 14: Graph showing frequency of landslides distribution /occurrences in different Slope Aspect Classes.

5.3 Quantitative statistical analysis of geofactors and geofactor classes

Quantitative statistical analysis of geofactors and geofactor classes influencing landslide incidences indicates that slope gradient, landuse-landcover change, extensive cut slope, geomorphology, type of overburden material and overburden thickness are considered to be the deterministic geofactors governing the slope failures in hilly terrain of Western Ghat region. The spatial correlation of landslide incidences with geofactor classes (**Graph 10 to Graph 15**) indicates that majority of the landslide are shallow translational debris slides of retrogressive, widening and enlarging in nature. It may be inferred that the lithology, slope and land use is the major controlling factors for landslide incidence.

5.4 Landslide Susceptible Zones

The unstable extensive cut slope, landslides, land subsidences and slope failures were recorded along the road cutting confined to slope varying between 15° - 25° and 25° - 35° and modified steep slope of $>45^{\circ}$ on lowly dissected hillslope with cut slopes >10 m height all along Thirthahalli-Hulikal, Thirthahalli-Bejavalli-Tuduru-Mandegadde(NH-169), Thirthahalli-Hulikal, Thirthahalli-Agumbe(SH-1), Koppa-Kaimara(SH-65), Hariharpur-Mavinkatte(SH-65), Hariharpur-Surali road sections are demarcated as moderate landslide susceptible zones. The slope failures were recorded along Hulikal ghat road section are at intrusive contact zone of different litho-units that provides the weaker plane for water seepage and slope saturation. The multiple slope failures were observed in Bhartipura village area (T.S.no: 48O/6) on extensive cut slope on highly weathered quartz sericite schist excavated for settlement purposes are at high landslide susceptible zones. Such vulnerable slopes should be monitored during heavy rainfall. The Agumbe hill ranges are highly rugged, comprises of steep escarpments, ridges and steep valleys. Along Agumbe road section road cut failures were recorded on vertical cut section of 8-10m height.

The unstable area are demarcated in and around Herambapur, where disposition of bands of Amphibolite, Quartz sericite schist and Quartz chlorite schist indicates folding and contact plane of litho-units were demarcated as the vulnerable zone for landslips. The multiple slope failures observed on the convex curvature of the road cut in Kankod Village area (T.S.no:48O/2) and old slides are recorded on concave curvature of Koppa-Hariharpur (T.S. no. 48O/6) road cut on lowly dissected hill slope. The slope forming material consists of weathered rock and soil. These areas are demarcated as unstable zone susceptible to slope failure during heavy precipitation. The multiple slope failures were observed in Bhartipura village area

(T.S.no:48O/6) on extensive cut slope on highly weathered quartz sericite schist excavated for settlement purposes. The hillslope is demarcated as unstable and prone to slope failure. The slope should be monitored during heavy rainfall.

The lowly dissected hillslope associated with deeply dissected pediment and peneplains in vicinity of paddy and arecanut plantation encounters slope failure in Heggarkoppa, Kumbarakoppa, Suranakodagi, Maddalkoppa, Urumakki village area (T.S. no.48O/6) and Annavalli, Karunepura village area near Megaravalli (T.S. no. 48O/2) on lowly dissected hillslope. The land use practice for agricultural purposes resulted in slope failure in adjoining hillslope where toe erosion by drainage/nala and unscientific way of removal of soil by pediment/toe cutting of the hillslope adopted for widening the agricultural land and excavation of soil for arecanut plantation contributes to slope degradation and removal of toe support. The artificial drainage network created for irrigation purpose at toe part of hillslope and palaeo-stream channels in deeply dissected pediment and pediplain channelizes water and provides new pathway for water seepage, slope saturation and toe erosion. The reduction in shear and cohesive strength of the slope forming material resulted in slope failure leading to loss of crop (Paddy) & Agriculture land. In such places construction of gabion wall with wire mesh should be provided at foot of hill slope as protective remedial measures. In such places construction of gabion wall with wire mesh should be provided at foot of hill slope as protective remedial measures.

The large dimension debris flow of ~100m run out recorded in Kanave village (T.S no: 48O/6) on lowly dissected hillslope failed during heavy rainfall in August 19. The area is demarcated as unstable zone susceptible to slope failure during rainfall. The contact plane of ferruginous phyllite and quartz chlorite schist are prone to mass failure. The settlements in downslope direction are in high risk zone during rainfall. Similarly, In Urumakki village area 2 km north of Gunavanti village (T.S.no:48O/6) landslide of large dimension on lowly dissected hillslope are recorded. The drainage/nala course at footslope causes shear failure of weathered and loose soil due to toe erosion and slope saturation during rainfall. The settlement at top slope is at risk. In and around Komane village area settlements on modified slope are at risk as the slope is identified as vulnerable zones for landslip incidence in future.

5.5 Anthropogenic Causes of Slope failures

The landuse change has resulted in slope failure even in stable areas of $>15^\circ$ slope angle. The thick mantle of soil encourages agriculture and plantations in dissected pediment-pediplain areas. The practice of widening of agricultural land, removal of soil for arecanut plantation from adjoining hillslope may impact the stability of hillslope. The vulnerability of slope

failures are more pronounced during intense rain. Such practices may lead to loss of crop and agricultural land if slope fails and debris inundate the surrounding land. The slope failure due to toe erosion by naturally flowing stream or man-made diverted stream channels results in toe erosion and toe support. At many places unlined open wells on top of slope saturates and pave the pathway for sub-surface weathering and erosion by water infiltration. The slope saturation and pore water pressure during heavy rainfall reduces the cohesion and shear strength failure in long run.

The extensive slope cut at road bench level along major National highway and State highway traversing the study area are unstable zones and are likely to fail. So, lined drainage at upslope and proper toe support measures at toe part of hillslope, breast or retaining wall should be constructed at road bench level on priority considering the site condition to avoid any casualties. Timely monitoring of hillslope during rainy season should be done by responsible authority to safe guard man and material. Settlement on vulnerable slope are observed in Komane and Bubbli village area. In such places effective drainage measures should be taken to avoid water saturation and shear strength failure of unconsolidated material due to pore water pressure on slope. The cracks on upslope should be monitored and should be reported to concern district authority in order to take appropriate measures on time.

5.6 Natural causes of slope failure

The removal of toe support by toe erosion and undercutting of hillslope by naturally flowing streams/nala or artificially created drainage network for irrigation purpose in agriculture land are naturally induced slope failures in gentle slopes. Most of the failure surface at exposed sections along highway displays deeply decomposed peninsular gneiss. The pronounced weathering phenomenon, heavy rains during monsoon season is the major landslide triggering factors that leads to slope saturation by water infiltration, decreases the effective cohesion and generates hydrostatic pressures in the soil profile propagated the slope failures. The slope failures were recorded at the intrusive contacts of different litho-unit that provides new pathway for water seepage and hillslope saturation. At many places kaolinised zone/clay zone behaves as driving force for shear strength failure of hillslope.

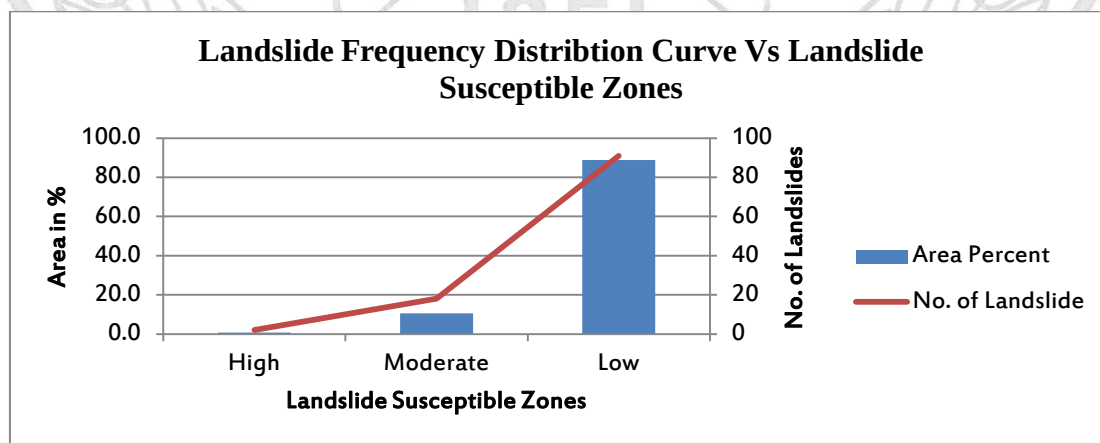
5.7 Remedial Measures

The provision of effective drainage system i.e. lined drainage and culvert of suitable dimension should be constructed for discharge of excess water downslope at suitable sites. Such provisions will prevent toe erosion and slope saturation to avoid subsidences and slope

failure due to increase pore water pressure and loss in cohesion of slope forming material. Most of the exposed sections along highway and the failure surfaces display deeply decomposed peninsular gneiss due to pronounced weathering phenomenon and heavy rains during monsoon season is the major landslide triggering factors that leads to slope saturation by water, decreases the effective cohesion and generates hydrostatic pressures in the soil profile allowing slope failures. The mitigation measures to reduce the risk is to construct retaining structures at unstable landslide prone or vulnerable areas and gabion wall with wire mesh should be made at hillslope adjoining to agriculture land to provide toe support and to prevent toe erosion by flowing nala/streams.

5.8.Output Landslide Susceptibility Maps

The overlay analysis and validation of susceptibility map with respect to Landslide Distribution Map (**Graph 16**) indicates that total 91 nos. of Landslide incidences falls in low landslide susceptible zones, 18 nos. of landslides occur in moderate and 2 nos. falls on high landslide susceptible zones. According to the classified landslide susceptibility map, 7% of the area is highly susceptible, 10.5% of the area is moderately susceptible and 88.8% of the area is low susceptible zones. Thus, the study owes the frequent slope failure in the study area caused by combined affect of both natural and anthropogenic activities. The knowledge driven modeling indicates that hillslope with deeply dissected pediment-pediplain complex are more prone to failure. It may be inferred that majority of the landslide occurrences are on low landslide susceptibility zone indicates anthropogenic influence i.e. land use change has adverse affect on slope stability. The pronounced weathering phenomenon, heavy rains during monsoon season is the major landslide triggering factors that leads to slope saturation by water, decreases the effective cohesion and generates hydrostatic pressures in the soil profile allowing slope failures.



Graph 15: Graph showing frequency of landslides in different Landslide Susceptible Zones.

VI. CONCLUSIONS AND RECOMMENDATIONS

1. Geologically, the area has rock types belonging to Sargur Group, PG-I, Chitradurga Group and Bababudan Group intruded by Closepet Granite, basic and acid intrusives. The major part of the study area consists of granitoid and granite gneiss of Archean age. The Shimoga schist belt exposes meta-volcanosedimentary, metabasalt, BIF, together with basic and ultrabasic rocks. An irregular shaped schist belt in the southwestern part known as Koppa band (Sargur Group of Dharwar Supergroup).
2. Slope gradient, landuse change, type of overburden material and overburden thickness are considered to be the deterministic geofactors governing the slope failure. The spatial distribution of landslides with respect to slope gradient indicates that nearly 23.68 % of slides are occurring on slope $<15^\circ$, 52.63% on $15-25^\circ$ slope, 15.79% on $25-35^\circ$ slope and rest 7.89% on $35-45^\circ$ slope. Major slope failure are restricted to “Extensive Slope Cut” with steep slope angle.
3. The spatial correlation of landslide incidences with different geofactor classes indicates that majority of the landslide are shallow translational debris slides widening, enlarging and retrogressive in nature and few are rock slides associated with hillslope having Moderate vegetation, Sparse vegetation and High Height Plantation areas of $>15^\circ$ and $15-25^\circ$ slope angle on lowly dissected hillslope.
4. The study owes the frequent slope failure in the study area that is influenced by natural as well as anthropogenic causes mentioned below:
 - (i) Slope modification due to unscientific way of removal/excavation of soil by toe cutting of hillslope for cultivation purposes.
 - (ii) The removal of toe support by erosion and undercutting of hillslope by naturally flowing streams/nala or artificially created drainage network for irrigation purpose in agriculture land.
 - (iii) The pronounced weathering phenomenon and heavy rains during monsoon are the major landslide triggering factors that lead to slope saturation by water, decreases the effective cohesion and generates hydrostatic pressures in the soil profile paving the way for slope failures.
 - (iv) The slope failures were recorded at the intrusive contact of different litho-units that provide the weaker plane provides new pathway for water seepage and hillslope saturation.

5. The thick soil cover in the region has mostly encouraged plantation and agricultural practises that loosen the top soil. The heavy rain in monsoon increases pore water pressure and reduce the cohesive strength of soil that in turn has resulted in more number of landslide incidences.
6. Maximum landslide occurrences are observed on lowly dissected hillslope gently of $<15^\circ$ to $15-25^\circ$ in low landslide susceptible zones that indicates the influence of landuse/landcover change and pronounced weathering. The slope failure is triggered by excessive incessant rainfall.
7. The seamless landslide susceptibility map prepared using AHP based data modelling method indicates that 0.7% of the area is highly susceptible, 10.5% of the area is moderately susceptible and 88.8% of the area falls in low susceptible zones.

Recommendations:

1. It is suggested that protective slope stability measures should be taken up for development activities in high landslide susceptible zones and moderate susceptible zones to avoid loss of life and property due to landslips/landslides incidences.
2. The unscientific way of removal of toe support by excavation of soil at road bench level for construction and widening of roads, widening of agriculture and plantation area should not be practised. The lined drainage should be provided at footslope and upslope at road bench level to avoid toe erosion by flowing stream.
3. The biotechnical slope protection measures that utilize mechanical elements (structures) in combination with biological elements i.e., plant should be practiced to prevent slope failure and erosion where the material has been removed or excavated for construction purposes.
4. The proper scientific way of slope treatment should be adopted for long term stability of disturbed slopes. During the cutting/modifications of the slope geologists from nearby Engineering Geology Division may be consulted to acquire proper guidance so as to derive suitable slope protective measures.
5. The concrete retaining wall with weep holes and lined drainage at the toe portion of hill slope, stone pitching, gabion wall, and slope re-gradation as per the site conditions are suggested as remedial measures required to stabilize the disturbed zones.
6. Vertical cut slopes should be modified to stabilize the slope by providing benching on slope at specific interval to reduce the risk of sliding in future.
7. Indiscriminate slope cuttings have to be strictly regulated and engineering solutions such as protective walls/embankments to be made where ever required.

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LOCALITY INDEX

Locality Name	Latitude	Latitude	T.S No.
Agumbe	13° 30' 34.199" N	75° 05' 47.589" E	48O/2
Araga	13° 44' 55.580" N	75° 12' 05.264" E	48O/2
Babbi	13° 42' 32.062" N	75° 12' 47.294" E	48O/2
Balebailu	13° 41' 06.142" N	75° 13' 48.468" E	48O/2
Basavani	13° 35' 42.903" N	75° 16' 21.360" E	48O/6
Basti Math	13° 36' 17.986" N	75° 29' 49.521" E	48O/6
Begar	13° 30' 02.372" N	75° 12' 05.750" E	48O/2
Bejjavalli	13° 44' 07.675" N	75° 19' 43.688" E	48O/6
Bellur	13° 36' 57.757" N	75° 24' 59.930" E	48O/6
Bharatipura	13° 42' 06.608" N	75° 16' 07.368" E	48O/6
Devangi	13° 37' 48.822" N	75° 16' 57.843" E	48O/6
Dinda	13° 39' 35.942" N	75° 08' 22.065" E	48O/2
Edtal	13° 32' 19.582" N	75° 15' 59.827" E	48O/6
Ganapatikatte	13° 34' 58.384" N	75° 18' 29.721" E	48O/6
Gaurigadde	13° 31' 15.979" N	75° 15' 36.056" E	48O/6
Guddekeri	13° 33' 59.721" N	75° 07' 43.643" E	48O/2
Guddekoppa	13° 39' 29.025" N	75° 11' 54.248" E	48O/2
Gunavanti	13° 34' 18.489" N	75° 21' 36.805" E	48O/6
Hansa	13° 38' 14.950" N	75° 7' 53.527" E	48O/2
Hariharapura	13° 31' 13.097" N	75° 18' 06.076" E	48O/6
Heggaru	13° 31' 42.505" N	75° 14' 30.896" E	48O/2
Hosahalli	13° 39' 32.459" N	75° 10' 18.285" E	48O/2
Hosuru	13° 33' 19.064" N	75° 14' 39.827" E	48O/2
Hulikal	13° 43' 50.326" N	75° 0' 39.951" E	48O/2
Imbrakodu	13° 42' 27.871" N	75° 15' 49.495" E	48O/6
Jogimakki	13° 30' 28.839" N	75° 25' 45.307" E	48O/6
Kaimara	13° 35' 38.040" N	75° 28' 59.380" E	48O/6
Kammaradi	13° 35' 03.246" N	75° 12' 44.658" E	48O/2
Kanave	13° 42' 06.066" N	75° 23' 46.695" E	48O/6
Kavaledurga	13° 42' 58.217" N	75° 08' 02.395" E	48O/2
Kavuruehakkalu	13° 32' 35.489" N	75° 06' 34.964" E	48O/2
Kesave	13° 34' 51.563" N	75° 23' 24.575" E	48O/6
Kestur	13° 41' 16.782" N	75° 10' 58.985" E	48O/2
Komane	13° 39' 29.390" N	75° 12' 55.262" E	48O/2
Koppa	13° 32' 16.740" N	75° 22' 18.073" E	48O/6
Kottebail	13° 38' 01.538" N	75° 27' 59.760" E	48O/6
Kudregundi	13° 33' 09.849" N	75° 25' 18.097" E	48O/6
Kugi	13° 30' 48.164" N	75° 24' 44.454" E	48O/6
Kumberakoppa	13° 34' 09.557" N	75° 20' 02.834" E	48O/6
Kunchur	13° 30' 29.867" N	75° 20' 02.185" E	48O/6

Locality Name	Latitude	Latitude	T.S No.
Kundari Estate	13° 33' 01.384" N	75° 09' 51.802" E	48O/2
Kuppalli	13° 36' 15.712" N	75° 18' 51.915" E	48O/6
Kuruvalli	13° 40' 54.278" N	75° 14' 42.808" E	48O/2
Madamakki	13° 30' 24.107" N	75° 01' 09.652" E	48O/2
Madapur	13° 35' 42.718" N	75° 25' 16.548" E	48O/6
Makkikoppa	13° 41' 48.489" N	75° 25' 26.142" E	48O/6
Malandur	13° 39' 41.712" N	75° 25' 48.243" E	48O/6
Mandagadde	13° 44' 33.187" N	75° 27' 21.219" E	48O/6
Masarur	13° 36' 37.853" N	75° 15' 27.564" E	48O/6
Matvani	13° 31' 15.507" N	75° 16' 43.590" E	48O/6
Megaravalli	13° 37' 32.397" N	75° 09' 12.253" E	48O/2
Mekerri	13° 42' 47.013" N	75° 05' 53.706" E	48O/2
Mel Koppa	13° 34' 22.406" N	75° 17' 36.097" E	48O/6
Melinakuruvalli	13° 40' 27.033" N	75° 15' 09.671" E	48O/6
Mrugavadhe	13° 39' 06.980" N	75° 23' 22.318" E	48O/6
Muduba	13° 43' 01.128" N	75° 25' 47.253" E	48O/6
Muktihariharapur	13° 43' 18.279" N	75° 11' 13.434" E	48O/2
Muttinakoppa	13° 43' 18.360" N	75° 27' 56.911" E	48O/6
Nagalapur	13° 35' 22.004" N	75° 29' 32.274" E	48O/6
Nagaramakki	13° 34' 08.510" N	75° 24' 59.732" E	48O/6
Nalur	13° 35' 39.042" N	75° 08' 1.294" E	48O/2
Nirulli	13° 39' 26.159" N	75° 15' 31.718" E	48O/6
Surali	13° 30' 16.046" N	75° 17' 58.950" E	48O/6
Talamakki	13° 32' 49.222" N	75° 23' 25.299" E	48O/6
Tenginakoppa	13° 44' 33.091" N	75° 07' 53.309" E	48O/2
Tirthahalli	13° 41' 24.717" N	75° 14' 46.932" E	48O/2
Tirthamutturu	13° 37' 05.740" N	75° 13' 39.063" E	48O/2
Tuduki	13° 41' 54.036" N	75° 15' 41.185" E	48O/6
Tuduru	13° 42' 50.532" N	75° 22' 41.706" E	48O/6
Ulakoppa	13° 42' 33.093" N	75° 03' 06.668" E	48O/2
Yadur	13° 41' 40.399" N	75° 04' 44.075" E	48O/2

SYNOPSIS OF WORK DONE

1.	Title of the report	Macro-scale (1:50,000) Landslide Susceptibility Mapping in parts of Toposheets nos. 480/2 & O/6, Chikmangalur, Shimoga & Dakshin Kannada districts, Karnataka.	
2.	FSP Code No	M4LSSM/NC/SR/SU-KG/2019/25183	
3.	Field Season	2019 – 2020	
4.	Date of Commencement	21 th September 2020	
5.	Date of Completion	31 st March 2020	
6.	Officers associated with the investigation and no. of days spent in the field	Ms. Neha Kumari, Geologist (90 days) & Mr. Sovesh Dulal Muduli, Geologist (91 days)	
7.	Quantum of work done		
	1.Pre field map preparation		
	Preparation of Thematic maps (in GIS on scale 1:50000)		
	(a) Slope Forming Material map		1495 sq. km
	(b) Geomorphology & Lineament map		1495 sq. km
	(c) Slope Morphometry (slope, aspect & curvature) map		1495 sq. km
	(d) Landuse / Landcover map		1495 sq. km
	(e) Drainage map		1495 sq. km
	(f) Regolith thickness map		1495 sq. km
	(ii) Preparation of Landslide Inventory Map		1495 sq. km
	2. Field-based studies		
	(i) Field-checking of all thematic maps		1495 sq. km
	(ii)Field checking and collection of landslide inventory attributes (41 point geo -parametric sheet)		1495 sq. km (111 nos. Landslides)
	3. Post-field studies and modelling		
	i)Updation of thematic and landslide inventory maps		1495 sq. km
	ii)Landslide susceptibility modelling and finalization of landslide susceptibility map in GIS		1495 sq. km
	4. Collection of rainfall data from available rain stations	1495 sq. km (Taluk wise 10 years Monthly rainfall data obtained from different rain gauge stations.)	
8.	Expenditure in Rs.	Wages (Rs.)	71,394/-
		OC (Rs.)	89,116/-
		Total (Rs.)	1,60,510/-

FIVE POINT PROFORMA

Title of the report	Macro-scale (1:50,000) Landslide Susceptibility Mapping in parts of Toposheets nos. 48O/2 & O/6, Chikmangalur, Shimoga & Dakshin Kannada districts, Karnataka.
Names of the Authors	Ms. Neha Kumari, Geologist & Mr. Sovesh Dulal Muduli, Geologist
1. Background of the investigation at whose instance or with what particular objective in view the investigation was undertaken.	The item was taken up as per the annual programme of GSI vide FSP Code No: M4LSSM/NC/SR/SU-KG/2019/25183 with an objective to prepare seamless Landslide Susceptibility Map on 1:50,000 scale.
2. Whether the item of investigation was included in the approved programme for the year concerned. If so, particulars, such as item No. page reference etc. may be given.	Yes M4LSSM/NC/SR/SU-KG/2019/25183
3. Date of commencement of the investigation with month and year, and exact number of days spent by the officers in the field in connection with the investigation.	21 st September 2019 1. Neha Kumari - 90 days 2. Mr. Sovesh Dulal Muduli- 91 days
4. Brief comments by Director/ Supervisory officer on the conclusion and recommendation by the author(s) with suggestion for implementing the same.	I fully agree with the conclusions drawn and recommendations made by the authors.
5. Please state specifically how the results of the investigation were achieved compared with the objective for which it was undertaken	The objective of the investigation is fully achieved.
Date: Place: Bengaluru Project/Division: NLSM/Engineering and Landslide Division Operation/Region: SU:K&G/Southern Region	Signature: Name: Shri J. Srihari Designation: Director



Geological Survey of India
Data sheet on report movement in connection with its scrutiny

Project / Division: NLSM/ENGG & Landslide Division.	FSP Code.: M4LSSM/NC/SR/SU-KG/2019/25183	Mission:- IVA
Title of the Project	Macro-scale (1:50,000) Landslide Susceptibility Mapping in part of Toposheets nos.480/2, 480/6 Chikmangaluru, Shimoga, Dakshin Kannada districts, Karnataka.	

Name of author(s) 1. Neha Kumari, Geologist 2. Sovesh Dulal Muduli, Geologist	Date of submission of report to the Supervisory Officer 28-06-2020 Signature of the author Neha Kumari 28/06/2020 (Signature of the senior most author) NEHA KUMARI.
Name of Supervisory Officer K.V. MARUTHI DIRECTOR	Date of receipt of report 29-07-2020 Date of completion of scrutiny 22-07-2020 Date of handing over report to the author after scrutiny 22-07-2020 Signature M. Srinivas K.V.
Name of author(s) To whom the report has been handed over by the Supervisory Officer NEHA KUMARI GEOLOGIST	Date of receipt after scrutiny 29-07-2020 Signature Neha Kumari 29/07/2020 Date of resubmission 29-07-2020 Signature Neha Kumari 29/07/2020
Supervisory Officer K.V. MARUTHI DIRECTOR.	Date of receipt 2nd draft after modification 29-07-2020 Date of handing over report to the RMH 30-07-2020 Signature M. Srinivas K.V.

Name of Regional Mission Head <u>S.K. Tripathi</u> (Through internal peer review committee)	Date of receipt of report Date of handing over the report after peer review to the Project Director Signature
Name of Supervisory Officer <u>K.V. MARUTHI</u>	Date of receipt of report from the RMH after peer review <u>25-11-2020</u> Date of handing over to author(s) <u>25-11-2020</u> Signature <u>M. V. K.V.</u>
Name of author(s) <u>Ms. NEHA KUMARI</u> <u>GEOLOGIST</u>	Date of receipt of report from Supervisory Officer <u>25-11-2020</u> Date of handing over report after Modification to Supervisory Officer <u>26-11-2020</u> Signature <u>Neha Kumari</u>
Name Supervisory Officer <u>K.V. MARUTHI</u>	Date of receipt of report after modification from author (s) <u>26-11-2020</u> Date of handing over report to RMH <u>26-11-2020</u> Signature <u>M. V. K.V.</u>
Name of Regional Mission Head (RMH) <u>S.K. Tripathi</u> <u>DDG, RMH-IV,</u>	Date of receipt after modification from the Project Director Date of handing over report to the HoD of the Region for approval Signature <u>S.K. Tripathi</u>
Name of the HOD of the Region <u>एस.के. त्रिपाठी/S.K. TRIPATHI</u> <u>उप-निदेशक/Dy. Director General, HOD,</u> <u>क्षेत्रीय मिशन प्रमुख/Regional Mission Head-IV</u> <u>भारतीय भूगर्भात्मिक सर्वेक्षण/Geological Survey of India</u> <u>पश्चिमी क्षेत्र, उदयपुर/Southern Region, Udaipur</u>	Date of receipt of report for approval Date of approval Date of sending back report to the Project Director Signature of the HoD <u>S.K. Tripathi</u>
Name of the Project Director <u>K.V. MARUTHI</u>	Date of receipt of report after approval of HOD <u>27-11-2020</u> Date of circulation of report <u>27-11-2020</u> Signature <u>M. V. K.V.</u>



GEOLOGICAL SURVEY OF INDIA

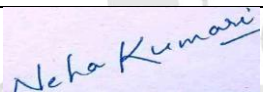
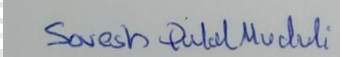
Certificate of Quality of the Report

Project/ Division:NLSM **FSP Code No.:** M4LSSM/NC/SR/SU-KG/2019/25183 **Mission:** IVA

Title of the Report: Macro-scale (1:50,000) Landslide Susceptibility Mapping in parts of Toposheets nos. 48O/2, O/6 Chikmangaluru, Shimoga, Dakshin Kannada 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. Ms. Neha Kumari, Geologist	90 days	
2.Mr. Sovesh Dulal Muduli, Geologist	91 days	

Part-B:

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

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

Part-C

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

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

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

Name of the Director in charge of the Laboratory	Date of receipt of samples from the Field Officer/ party	Date of providing complete analytical results to 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
Shri J. Srihari, Director	02	06	

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	Signature with date

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

GEO-PARAMETRIC LANDSLIDE INVENTORY DATABASE

ANNEXURE I

Slide No.	State	TS No.	NH/SH/Locality	Lat	Long	Length	Width	Height	Type of Slide	Activity	Distribution	Style	Failure mechanism	History	Geomorphology	Lithology	Landuse/Landcover	Geo-scientific Causes	Remedial measures
KAR/SHM/2019/01	Karnataka	48O/2	Thirthahalli-Mukthihariharapur road	13.704	75.221	~8 m	~55m	~6m	Debris slump	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Acacia Plantation	vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope
KAR/SHM//2019/02	Karnataka	48O/2	Talabi Village	13.664	75.222	~10 m	~ 50 m	~9m	Debris slump	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Moderate vegetation	vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope
KAR/SHM//2019/03	Karnataka	48O/2	Babbli Village	13.715	75.15	~8 m	~65 m	~1m	Debris slide	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Moderate vegetation /Extensive cut slope	vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope
KAR/SHM//2019/04	Karnataka	48O/2	Tirthahalli town	13.694	75.234	~8 m	~7 m	~1m	Debris slide	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Old, reactivated	Lowly Dissected Hillslope	Weathered Granite gneiss	Moderate vegetation	Toe cutting of slope	Slope gradation and retaining wall with weep holes should be constructed
KAR/SHM/48O2/2019/05	Karnataka	48O/2	East of Heggarkoppa village	13.717	75.247	~78m	~110 m	~18m	Earth slide	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Old, reactivated	Lowly Dissected Hillslope	Weathered Granite gneiss	Moderate vegetation	Toe or piedmont cutting of the hillslope, nala erosion	Easing of slope required, construction of gabion wall with wire mesh is required. Plantation should be done to hold the loose soil
KAR/SHM//2019/06	Karnataka	48O/2	800m south of Kankod Village	13.689	75.148	~8 m	~80m	~7m	Debris slide	Active	Confined	Multiple	Shallow translational failure	Old, Reactivated	Lowly Dissected Hillslope	Granite gneiss	Moderate vegetation	vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope
KAR/SHM//2019/07	Karnataka	48O/2	745m south of Kankod Village	13.691	75.148	~12 m	~75m	VH~8m, Crown Height~1.8 m	Debris slide	Active	Widening and Enlarging	Single	Shallow translational failure	Old, Reactivated	Lowly Dissected Hillslope	Granite gneiss	Moderate vegetation on upslope	Toe cutting of slope for road construction	Slope gradation is require, low height lined drainage with weep holes should be constructed
KAR/SHM//2019/08	Karnataka	48O/2	West of Kankod Village	13.697	75.144	~12 m	~90m	VH~9m, Crown Height~1.5 m	Debris slide	Active	Retrogressive , Widening and Enlarging	Single	Shallow translational failure	Old, Reactivated	Lowly Dissected Hillslope	Granite gneiss	Moderate vegetation	Toe or piedmont cutting of the hillslope for widening the agricultural land	Easing of slope required, construction of gabion wall with wire mesh is required. Plantation should be done to hold the loose soil
KAR/SHM/2019/09	Karnataka	48O/2	West of Kankod Village	13.702	75.137	~12 m	~90m	VH~9m, Crown Height~1.5 m	Debris slide	Active	Retrogressive , Widening and Enlarging	Single	Shallow translational failure	Old, Reactivated	Lowly Dissected Hillslope	Granite gneiss	Moderate vegetation	vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope
KAR/SHM/2019/10	Karnataka	48O/6	Bhartipura/Tudike village	13.701	75.264	~8 m	~55m	~6m	Debris slump	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Quartz Chlorite Schist and Quartz Sericite Schist	Acacia Plantation	vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope
KAR/SHM//2019/11	Karnataka	48O/6	Bhartipura village	13.7	75.263	~8 m	~95m	VH~12m	Debris slide	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	Initiated	Lowly Dissected Hillslope	Quartz Sericite Schist	Acacia Plantation /Extensive Cut slope	Extensive cut slope failure for settlement purposes	Easing of slope required,construction of retaining wall with weep holes are suggested
KAR/SHM//2019/12	Karnataka	48O/6	Bhartipura/Tudike village (NH-13)	13.7	75.264	~8 m	~95m	VH~12m	Debris slide	Active	Advancing,Widening & Enlarging	Single	Shallow translational failure	Initiated	Lowly Dissected Hillslope	Quartz Sericite Schist	Acacia Plantation /Extensive Cut slope	Extensive cut slope failure for settlement purposes	Easing of slope required,construction of retaining wall with weep holes are suggested
KAR/SHM//2019/13	Karnataka	48O/6	1.6 km Northwest of Bilve Hariharapur village	13.742	75.274	~11m	~65m	VH~7m	Debris slump	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Lowly Dissected Hillslope	Lowly Dissected Hillslope	Ambhibolite	Acacia Plantation and Moderate Vegetation	vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope
KAR/SHM//2019/14	Karnataka	48O/2	660m SW of Kavaledurga village	13.712	75.131	~60m	~130m	VH~22m	Rock slide	Active	Progressive	Multiple, successive	Shallow translational failure	Old, Suspended	Lowly Dissected Hillslope	Granite Gneiss	Sparse Vegetation/ECS	Increased infiltration along fractured granite increases the pore water pressure leading to Shear strength failure	Lined drainage and culvert is required to discharge excess water downslope. Retaining wall constructed in downslope direction at road bench level
KAR/SHM//2019/15	Karnataka	48O/2	Mekkeri village	13.709	75.094	~22m	~65m	VH~11m	Debris slide	Active	Retrogressive	Multiple	Shallow translational failure	Old, Suspended	Moderately Dissected Hillslope	Granite Gneiss	Moderate vegetation	Toe cutting and toe erosion by stream	Easing of slope required, construction of gabion wall with wire mesh is required to prevent toe erosion and toe support.
KAR/SHM//2019/16	Karnataka	48O/2	North west of Nidagodu village	13.689	75.102	~15m	~65m	VH~12m	Debris slide	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiated	Lowly Dissected Hillslope	Weathered Granite gneiss	Sparse vegetation	Toe cutting and toe erosion by stream	Easing of slope required
KAR/SHM/2019/17	Karnataka	48O/2	Addagudda	13.68	75.051	~12m	~35m	VH~8m	Debris slide	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Old, Suspended	Lowly Dissected Hillslope	Weathered Granite gneiss	Sparse vegetation	Weathering and Erosion	Lined drainage is required.
KAR/SHM//2019/18	Karnataka	48O/2	Addagudda	13.678	75.049	~9m	~25m	VH~8m	Debris slump	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Suspended	Lowly Dissected Hillslope	Weathered Granite gneiss	Moderate vegetation	Weathering and Erosion	Lined drainage is required.
KAR/SHM//2019/19	Karnataka	48O/2	Addagudda	13.68	75.053	~9m	~55m	VH~12m	Debris slide	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Suspended	Lowly Dissected Hillslope	Weathered Granite gneiss	Sparse vegetation/Extensive cut slope/SMS	Extensive cut slope failure for settlement purposes	Easing of slope required,construction of retaining wall with weep holes are suggested
KAR/SHM//2019/20	Karnataka	48O/2	Addagudda	13.67	75.065	~9m	~55m	VH~12m	Debris slump	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Suspended	Lowly Dissected Hillslope	Weathered Granite gneiss	Moderate vegetation	Weathering and Erosion	Lined drainage is required.
KAR/SHM//2019/21	Karnataka	48O/2	Yadur village	13.704	75.063	~15m	~65m	VH~12m	Debris slide	Active	Retrogressive ,Widening & Enlarging	Multiple	Shallow translational failure	Suspended	Lowly Dissected Hillslope	Weathered Granite	Moderate or Sparse vegetation	vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope

GEO-PARAMETRIC LANDSLIDE INVENTORY DATABASE

ANNEXURE I

Slide No.	State	TS No.	NH/SH/Locality	Lat	Long	Length	Width	Height	Type of Slide	Activity	Distribution	Style	Failure mechanism	History	Geomorphology	Lithology	Landuse/ Landcover	Geo-scientific Causes	Remedial measures
KAR/SHM//2019/22	Karnataka	48O/2	Yadur village	13.705	75.062	~12m	~65m	VH~8m	Debris slide	Active	Retrogressive , Widening & Enlarging	Multiple	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Weathered Granite	Moderate vegetation	vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope
KAR/SHM/2019/23	Karnataka	48O/2	Ulakoppa road section	13.712	75.054	~12m	~65m	VH~8m	Debris slide	Active	Retrogressive , Widening & Enlarging	Multiple	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Weathered Granite gneiss	Moderate vegetation on upslope and SMS downslope	vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope
KAR/SHM/2019/24	Karnataka	48O/2	Ulakoppa village	13.715	75.054	~22m	~35m	VH~17m	Rock slide	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Weathered Granite gneiss	Moderate vegetation	vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope. Precarious rock boulders should be removed
KAR/SHM/2019/25	Karnataka	48O/2	Halagunda village	13.721	75.041	~60m	~120m	VH~17m	Debris slide	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Old, Suspended	Lowly Dissected Hillslope	Weathered Granite gneiss	Moderate vegetation	vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope
KAR/SHM/2019/26	Karnataka	48O/2	Suranakodagi village	13.641	75.302	~28m	~165m	VH~14m	Debris slide	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Pediment-pediplain complex	Weathered Quartz sericite schist and Quartz Chlorite schist	Moderate vegetation	Toe cutting and toe erosion by stream	Easing of slope required, construction of retaining wall with weep holes are required to prevent toe erosion and toe support.
KAR/SHM/2019/27	Karnataka	48O/2	Lakshmipur village	13.662	75.284	~18m	~75m	VH~12m	Debris slide	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Weathered Granite gneiss	Moderate vegetation /Extensive Cut slope	Extensive cut slope failure for settlement purposes	Slope gradation is required
KAR/SHM/2019/28	Karnataka	48O/2	North-West of Solugodu village	13.672	75.263	~10m	~65m	VH~8m	Debris slide	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Weathered Granite gneiss	Acacia plantation	vertical road cut failure	Lined drainage and culvert is required to discharge excess water and breast wall should be constructed in downslope direction
KAR/SHM/2019/29	Karnataka	48O/2	North of Kottekoppa village	13.7	75.324	--	--	--	Debris slide	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure in downslope	Initiation	Lowly Dissected Hillslope	Weathered Granite gneiss	Moderate vegetation	ineffective drainage system	Lined drainage and culvert is required to discharge excess water downslope
KAR/SHM/2019/30	Karnataka	48O/2	Doddamane village	13.7186	75.38723	~14m	~65m	~8m	Debris slide	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Weathered Granite gneiss	Moderate vegetation	increased pore pressure	Slope gradation is required
KAR/SHM/2019/31	Karnataka	48O/2	South of Kavurehakhalu village	13.539	75.109	~18 m	~35m	~6m	Debris slide	Active	Progressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Lateritised Metabasalt	Acacia Plantation	vertical road cut failure	Easing of slope, lined drainage and low height retaining wall with weep holes are required.
KAR/SHM/2019/32	Karnataka	48O/2	Tirthahalli Town	13.693	75.243	~30 m	~110m	--	Debris slide	Active	Progressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Sparse Vegetation	vertical toe cutting of hillslope	Easing of slope, lined drainage and low height retaining wall with weep holes are required.
KAR/SHM/2019/33	Karnataka	48O/2	Tirthahalli-Kuruvali road	13.679	75.245	~25 m	~70m	--	Rock slide	Active	Progressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Sparse Vegetation	Extensive cut slope failure for settlement purposes	Retaining wall with weep holes are required.
KAR/SHM/2019/34	Karnataka	48O/6	Devangi road	13.626	75.281	~25 m	~35m	VH~7m	Debris slide	Active	Progressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Acacia plantation on Top	vertical road cut failure	Lined drainage is required.
KAR/SHM/2019/35	Karnataka	48O/6	Devangi-Ganapatikatte road	13.582	75.305	~20 m	~35m	VH~13m	Debris slide	Active	Progressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Moderate Vegetation	vertical road cut failure	Lined drainage is required.
KAR/SHM/2019/36	Karnataka	48O/6	Ganapatikatte	13.582	75.305	~25 m	~35m	VH~7m	Debris slide	Active	Progressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Acacia plantation	unscientific way of removal of soil for plantation	Easing of slope is required.
KAR/CHK/2019/37	Karnataka	48O/6	Ganapatikatte	13.581	75.305	~20 m	~85m	VH~13m	Debris slide	Active	Progressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Ambhibolite	Moderate vegetation/Extensive cut slope	Extensive cut slope failure for settlement purposes	Slope gradation is required
KAR/SHM/2019/38	Karnataka	48O/6	Gadikallu-Nagaravalli	13.598	75.326	~20 m	~675m	VH~14m	Debris slide	Active	Progressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Moderate vegetation	vertical road cut failure	Lined drainage is required.
KAR/SHM/2019/39	Karnataka	48O/6	Gadikallu-Nagaravalli	13.607	75.332	~15 m	~35m	VH~10m	Debris slide	Active	Progressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	PPC	Granite gneiss	Acacia Plantation/Moderate Vegetation	vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope. Precarious rock boulders should be removed
KAR/SHM/2019/40	Karnataka	48O/6	Ganapatikatte-Gadikallu road section	13.615	75.331	~15 m	~35m	VH~8m	Debris slide	Active	Retrogressive , Widening & Enlarging	Multiple	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Quartz Chlorite schist	Sparse Vegetation/ Plantation	vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope. Precarious rock boulders should be removed
KAR/SHM/2019/41	Karnataka	48O/6	West of Kalgudge	13.6	75.297	~15 m	~35m	VH~12m	Debris slide	Active	Retrogressiv , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Moderate vegetation	Toe cutting and toe erosion by stream	Easing of slope required, construction of gabion wall with wire mesh is required to prevent toe erosion and toe support.
KAR/SHM/2019/42	Karnataka	48O/6	Kalgudge-Basavani road section	13.597	75.283	~22m	~30m	VH~12m	Debris slide	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Acacia	vertical road cut failure	Lined drainage is required.
KAR/SHM/2019/43	Karnataka	48O/6	Madagere village	13.619	75.26	~22m	~40m	VH~8m	Debris slide	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Acacia	Extensive cut slope failure for settlement purposes	Slope gradation is required and retaining wall should be constructed
KAR/SHM/2019/44	Karnataka	48O/6	West of Madagere village	13.621	75.256	~30m	~35m	VH~8m	Debris cum rock slide	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Old/Abandoned	Lowly Dissected Hillslope	Granite gneiss	Moderate Vegetation	weathering & erosion	Lined drainage is required.

GEO-PARAMETRIC LANDSLIDE INVENTORY DATABASE

ANNEXURE I

Slide No.	State	TS No.	NH/SH/Locality	Lat	Long	Length	Width	Height	Type of Slide	Activity	Distribution	Style	Failure mechanism	History	Geomorphology	Lithology	Landuse/ Landcover	Geo-scientific Causes	Remedial measures
KAR/SHM/2019/45	Karnataka	48O/6	West of Madagere village	13.621	75.256	~14m	~55m	VH~12m	Debris slide	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Moderate Vegetation	weathering & erosion	Lined drainage is required.
KAR/SHM/2019/46	Karnataka	48O/6	South of Andagere village	13.624	75.27	~22m	~45m	VH~12m	Debris slide	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Moderate Vegetation	Toe cutting and toe erosion by stream	construction of gabion wall with wire mesh is required to prevent toe erosion and toe support.
KAR/SHM/2019/47	Karnataka	48O/2	Hulikal road section	13.733	75.025	~16m	~85m	VH~11m	Debris slide	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Moderate vegetation	Vertical road cut failure	Easing of slope required. Lined drainage and culvert is required . Breast wall in downslope direction is required.
KAR/SHM/2019/48	Karnataka	48O/2	Hulikal road section	13.733	75.024	~22m	~75m	VH~14m	Debris slide	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Acacia plantation	Toe cutting and toe erosion by stream	Easing of slope & Lined drainage is required . Breast wall in downslope direction is required.
KAR/SHM/2019/49	Karnataka	48O/2	Hulikal road section	13.719	75.003	~12m	~110m	VH~14m	Debris slide	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Old	Lowly Dissected Hillslope	Granite gneiss	Thick vegetation	weathering & erosion	Lined drainage is required.
KAR/SHM/2019/50	Karnataka	48O/2	Hulikal road section	13.724	75.009	~18m	~25m	VH~14m	Debris slide	Suspended	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Old	PPC	Granite gneiss	Thick vegetation	weathering & erosion	Lined drainage is required.
KAR/CHK//2019/51	Karnataka	48O/6	Mel koppa	13.573	75.299	~18m	~110m	VH~6m	Debris slide	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	New	Lowly Dissected Hillslope	Granite gneiss	Acacia Plantation/Sparse vegetation	Vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope
KAR/CHK//2019/52	Karnataka	48O/6	Mel koppa- Angadimane	13.569	75.287	~18m	~155m	VH~8m	Debris	Active	Retrogressive , Widening & Enlarging	Multiple	Shallow translational failure	New	Lowly Dissected Hillslope	Granite gneiss	Moderate Vegetation	Vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope
KAR/CHK//2019/53	Karnataka	48O/6	Koppa-Hariharpur road (NH-13)	13.522	75.33	~12m	~27m	VH~8m	Debris	Active	Retrogressive , Widening & Enlarging	Multiple	Shallow translational failure	New	Lowly Dissected Hillslope	Granite gneiss	Moderate Vegetation	Vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope
KAR/CHK//2019/54	Karnataka	48O/6	Koppa road	13.525	75.332	~12m	~65m	VH~8m	Debris	Active	Retrogressive , Widening & Enlarging	single	Shallow translational failure	Old	Lowly Dissected Hillslope	Granite gneiss	Thick Vegetation	Vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope
KAR/CHK//2019/55	Karnataka	48O/6	Gunavanti	13.587	75.369	~22m	~70m	VH~18m	Debris	Active	Retrogressive , Widening & Enlarging	Multiple	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	ThickVegetation	unscientific way of removal of soil for widening of agricultural land	Plantation on slope should be encouraged.
KAR/CHK/2019/56	Karnataka	48O/6	Gunavati- Golikoppa road section	13.59	75.363	~26m	~138m	VH~22m	Debris	Active	Retrogressive , Widening & Enlarging	Multiple	Shallow translational failure	Old and reactivated	Lowly Dissected Hillslope	Quartz muscovite schist and Granite gneiss	Extensive Cut Slope/Sparse Vegetation	Toe cutting and toe erosion by stream	Easing of slope & Lined drainage is required . Retaining wall with weep holes are required.
KAR/CHK/6/2019/57	Karnataka	48O/6	Urumakki village	13.588	75.363	~30m	~110m	VH~28m	Debris	Active	Retrogressive , Widening & Enlarging	Multiple	Shallow translational failure	Old	Lowly Dissected Hillslope	Granite gneiss	Moderate Vegetation	Toe cutting and toe erosion by stream	Easing of slope & Lined drainage is required . gabion wall with wire mesh are required.
KAR/CHK/2019/58	Karnataka	48O/6	South of Golikoppa	13.594	75.363	~30m	~100m	VH~25m	Debris	Active	Retrogressive , Widening & Enlarging	Multiple	Shallow translational failure	Old	Lowly Dissected Hillslope	Granite gneiss	Moderate Vegetation	Toe cutting and toe erosion by stream	Easing of slope & Lined drainage is required . gabion wall with wire mesh are required.
KAR/SHM/2019/59	Karnataka	48O/6	Kanave road	13.7	75.403	~40m	~42m	VH~8m	Debris	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Quartz cholitre schist	Sparse Vegetation	Trench on top of slope saturates and increased the pore water pressure & shear strength failure	Easing of slope required.
KAR/SHM/2019/60	Karnataka	48O/6	Mudaba road	13.711	75.435	~18m	~45m	VH~7m	Debris	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Quartz chlorite schist	Thick Vegetation	Vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope
KAR/SHM/2019/61	Karnataka	48O/2	Annavalli village	13.633	75.154	~13m	~40m	VH~12m	Debris	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	PPC	Granite and Amphibolites contact	Acacia plantation	Toe cutting and toe erosion by stream	Easing of slope and lined drainage with weep holes are required.
KAR/SHM/2019/62	Karnataka	48O/2	South of Annavalli village	13.631	75.154	~18m	~45m	VH~7m	Debris	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Amphibolite/l aterite	Acacia plantation	increase pore water pressure, weathering and erosion	Easing of slope is required. Plantation on slope should be done.
KAR/SHM/2019/63	Karnataka	48O/2	Karunepura village	13.635	75.144	~18m	~100m	VH~7m	Debris	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Old, reactivated	PPC	Amphibolite	Acacia plantation	Toe cutting and toe erosion by stream	Easing of slope and lined drainage and retaining wall with weep holes are required at road bench level in downslope direction.
KAR/SHM/2019/64	Karnataka	48O/2	Dinda village	13.661	75.141	~20m	~30m	VH~18m	Debris	Suspended	Retrogressive , Widening & Enlarging	Multiple	Shallow translational failure	Old, reactivated/ suspended	Lowly Dissected Hillslope	Granite gneiss	Moderate vegetation	vertical road cut failure	Easing of slope and lined drainage and retaining wall with weep holes are required at road bench level in downslope direction.
KAR/SHM/2019/65	Karnataka	48O/2	North of Dinda village	13.663	75.138	~12m	~35m	VH~8m	Debris	Active	Retrogressive , Widening & Enlarging	Multiple	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Moderate vegetation	Toe cutting and toe erosion by stream	Plantation on slope should be encouraged.
KAR/SHM/2019/66	Karnataka	48O/2	Hansa village	13.64	75.133	~30m	~455m	VH~22m	Debris	Active	Retrogressive ,Widening & Enlarging	Single	Shallow translational failure	Old, reactivated	Lowly Dissected Hillslope	Granite gneiss	Acacia plantation	vertical road cut failure & nala erosion in footslope	Easing of slope and lined drainage and retaining wall with weep holes are required at road bench level in downslope direction.

GEO-PARAMETRIC LANDSLIDE INVENTORY DATABASE

ANNEXURE I

Slide No.	State	TS No.	NH/SH/Locality	Lat	Long	Length	Width	Height	Type of Slide	Activity	Distribution	Style	Failure mechanism	History	Geomorphology	Lithology	Landuse/ Landcover	Geo-scientific Causes	Remedial measures
KAR/CHK/2019/67	Karnataka	48O/2	Gadikallu-Koppa road	13.573	75.332	~50m	~100m	VH~22m	Debris	Active	Retrogressive , Widening & Enlarging	Multiple	Shallow translational failure	Old, reactivated	PPC	Quartz muscovite schist, pyribolite, granite gneiss	Acacia plantation	Toe cutting and toe erosion by stream	Gabion wall with wire mesh are required.
KAR/CHK/2019/68	Karnataka	48O/6	Thirthahalli-Koppa road (NH-169)	13.552	75.345	~14m	~35m	VH~6m	Debris	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Pyribolite	Coffee plantation, silver oak plantation	vertical road cut failure	Lined drainage at toe part is required
KAR/CHK/2019/69	Karnataka	48O/6	Baru Kodagi	13.507	75.39	~15m	~25m	VH~12m	Debris	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Quartz chlorite schist, Ferruginous phyllite	Coffee and silver oak plantation	vertical road cut failure	Lined drainage at toe part is required
KAR/CHK/2019/70	Karnataka	48O/6	West of Badigi village	13.503	75.391	~12m	~15m	VH~10m	Debris	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Quartz chlorite schist	Coffee plantation, silver oak plantation	vertical road cut failure	Easing of slope and lined drainage are required.
KAR/CHK/2019/71	Karnataka	48O/6	Kugi village	13.51	75.413	~14m	~35m	VH~12m	Debris	Suspended	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Old, suspended	Lowly Dissected Hillslope	Ferruginous phyllite	Moderate vegetation, coffee plantation	vertical road cut failure	Easing of slope and lined drainage are required.
KAR/CHK/2019/72	Karnataka	48O/6	Ajaravalli village	13.574	75.408	~12m	~35m	VH~8m	Debris	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	PS	Granitoid	Moderate vegetation	unscientific way of removal of soil for plantation	Easing of slope & gabion wall with wire mesh are required.
KAR/SHM/2019/73	Karnataka	48O/6	Kargese village	13.62	75.375	~15m	~45m	VH~13m	Debris	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	PPC	Granite gneiss	Sparse vegetation	Toe cutting and toe erosion by stream	Retaining wall with weep holes are required at road bench level.
KAR/CHK/2019/74	Karnataka	48O/6	Kargese village	13.622	75.374	~12m	~35m	VH~8m	Debris	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Pyribolite	Plantation	Toe cutting and toe erosion by stream	Gabion wall with wire mesh are required.
KAR/SHM/2019/75	Karnataka	48O/2	Nabala village	13.546	75.164	~8m	~28m	VH~5m	Debris	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Moderate vegetation	vertical road cut failure	Easing of slope and lined drainage are required.
KAR/SHM/2019/76	Karnataka	48O/2	Hosakere road section	13.529	75.161	~9m	~26m	VH~6m	Debris	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Acacia plantation	vertical road cut failure	Easing of slope and lined drainage are required.
KAR/SHM/2019/77	Karnataka	48O/2	Agumbe-Mavinkatte road section	13.513	75.171	~12m	~26m	VH~8m	Debris	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	PPC	Granite gneiss	Moderate vegetation	Toe cutting and toe erosion by stream	lined draiange and easing of slope is required.
KAR/CHK/2019/78	Karnataka	48O/2	Agumbe-Hariharpur road	13.503	75.212	~9m	~90m	VH~7m	Debris	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Moderate vegetation	vertical road cut failure	lined draiange and easing of slope is required. Retaining wall with weep holes are required at road bench level.
KAR/SHM/2019/79	Karnataka	48O/2	Agumbe-Guddekere road	13.552	75.12	~13 m	~18m	VH~7m	Debris	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Metabasalt	Acacia on upslope	vertical road cut failure	lined draiange and easing of slope is required. Retaining wall with weep holes are required at road bench level.
KAR/SHM/2019/80	Karnataka	48O/2	Agumbe-Koppa road	13.51	75.106	~16 m	~22m	VH~9m, crown height:~2.5 m	Debris	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Moderately Dissected Hillslope	Metabasalt	Acacia on upslope	Vertical road cut failure	esing of slope and Lined drainage is required .
KAR/CHK/2019/81	Karnataka	48O/6	Hariharpur Village	13.518	75.308	~12m	~30m	VH~8m	Debris	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	Old, reactivated	Lowly Dissected Hillslope	Granite gneiss	Sparse Vegetation	Extensive cut slope failure	Easing or slope gradation is required.
KAR/SHM/2019/82	Karnataka	48O/6	Near Hariharpur	13.518	75.31	~18 m	~85m	VH~12m, crown height: 3m	Debris	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	PPC	Granite gneiss	Sparse Vegetation /Extensive slope cut	Vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope
KAR/CHK/2019/83	Karnataka	48O/6	Koppa-Agumbe road	13.518	75.269	~16 m	~35m	VH~15m, crown height: 2m	Debris	Active	Retrogressive , Widening & Enlarging	Multiple	Shallow translational failure	Old	Lowly Dissected Hillslope	Granite gneiss	Moderate vegetation	Vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope
KAR/CHK/2019/84	Karnataka	48O/6	Koppa-Agumbe road	13.518	75.307	~18 m	~28m	VH~9m, crown height: 1m	Debris	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Sparse Vegetation	Vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope
KAR/CHK/2019/85	Karnataka	48O/6	Mathevani village	13.522	75.279	~30 m	~75m	VH~14m, crown height: 3.8m	Debris	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss/quartz vein and quartz sericite schist	Sparse Vegetation	Extensive cut slope failure for settlement purposes	Easing of slope & Retaining wall with weep holes are required.
KAR/CHK/2019/86	Karnataka	48O/6	South west of Heggara village	13.525	75.241	~18 m	~65m	VH~15m, crown height: 2m	Debris	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Sparse Vegetation	Vertical road cut failure in downslope direction	Easing of slope & Lined drainage is required . Retaining wall with weep holes are required.
KAR/SHM/2019/87	Karnataka	48O/6	NH-13 (Tirthahalli-Shimoga)	13.725	75.443	~18 m	~65m	VH~15m, crown height: 2m	Debris	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	Initiation	PPC	Granite gneiss	Sparse Vegetation /Plantation	Toe cutting and toe erosion by stream	Easing of slope & Lined drainage is required . Retaining wall with weep holes are required.

GEO-PARAMETRIC LANDSLIDE INVENTORY DATABASE

ANNEXURE I

Slide No.	State	TS No.	NH/SH/Locality	Lat	Long	Length	Width	Height	Type of Slide	Activity	Distribution	Style	Failure mechanism	History	Geomorphology	Lithology	Landuse/ Landcover	Geo-scientific Causes	Remedial measures
KAR/SHM/2019/88	Karnataka	48O/6	Shimoga road	13.716	75.426	~18 m	~28m	VH~8m, crown height: 2m	Debris	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	Initiation	MDS	Ferrugeneous phyllite	Sparse Vegetation	Toe cutting and toe erosion by stream	Easing of slope & Lined drainage is required . Retaining wall with weep holes are required.
KAR/CHK/2019/89	Karnataka	48O/6	West of Banagi village	13.655	75.468	~18 m	~28m	VH~7m	Debris	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	Initiation	PPC	Granite gneiss	Sparse Vegetation	Vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope
KAR/CHK/2019/90	Karnataka	48O/6	Kudregundi	13.552	75.426	~18 m	~65m	VH~14m, crown height: ~2m	Debris	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	Initiation	PPC	Granite gneiss	Moderate Vegetation/coffee plantation	Vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope
KAR/CHK/2019/91	Karnataka	48O/6	Koppa road	13.535	75.386	~18m	~35m	VH~12m	Debris	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Ferruginous Phyllite	Sparse Vegetation	Vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope
KAR/CHK/2019/92	Karnataka	48O/6	South of Kela Harandur	13.532	75.383	~18 m	~25m	VH~7m	Debris	Active	Retrogressive , Widening & Enlarging	Single	Shallow translational failure	Initiation	PS	Quartz chlorite schist	Sparse Vegetation/plantation on upslope	Vertical road cut failure	Lined drainage and culvert is required to discharge excess water downslope
KAR/CHK/2019/93	Karnataka	48O/6	Nagalapur Village	13.511	75.312	~13 m	~25m	VH~9m	Debris	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Sparse Vegetation on upslope	Extensive cut slope failure for settlement purposes	Slope gradation is required
KAR/CHK/2019/94	Karnataka	48O/6	Edtal Village	13.537	75.269	~18 m	~65m	VH~15m, crown height: 2m	Debris	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Plantation/Sparse Vegetation on upslope	unscientific way of removal of soil for widening of road	Slope gradation is required
KAR/CHK/2019/95	Karnataka	48O/6	Kodtal Village	13.528	75.265	~16 m	~100m	VH~12m, crown height: 2m	Debris	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	Initiation	PPC	Granite gneiss, Quartz Sericite Schist	Acacia Plantation on upslope	Toe cutting and toe erosion by stream	Lined drainage is required
KAR/CHK/2019/96	Karnataka	48O/6	Gaurigadde Village	13.523	75.262	~16 m	~65m	VH~12m, crown height: 2m	Debris	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Thick vegetation	Toe cutting and toe erosion by stream	Lined drainage is required
KAR/CHK/2019/97	Karnataka	48O/6	Gaurigadde Village	13.525	75.258	~15 m	~65m	VH~12m, crown height: 2m	Debris	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	Initiation	PPC	Granite gneiss	Moderate vegetation on upslope, Betel nut plantation and cultivation downslope	Toe cutting for widening agricultural land and toe erosion by stream	Lined drainage and low height retaining wall with weep holes are required
KAR/CHK/2019/98	Karnataka	48O/6	Gaurigadde Village	13.509	75.269	~12 m	~45m	VH~12m, crown height: 2m	Debris	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Thick vegetation	Toe cutting and toe erosion by stream	Lined drainage is required
KAR/CHK/2019/99	Karnataka	48O/6	Suralli Village	13.504	75.297	~18 m	~45m	VH~12m, crown height: 2m	Debris	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Thick vegetation	Vertical road cut failure	Lined drainage and low height retaining wall with weep holes are required
KAR/SHM/2019/100	Karnataka	48O/6	South of Kalgudge Village	13.597	75.305	~25 m	~95m	VH~16m	Debris	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	Initiation	PPC	Granite gneiss	Sparse vegetation	Toe cutting and toe erosion by stream	Lined drainage and low height retaining wall with weep holes are required
KAR/SHM/2019/101	Karnataka	48O/6	North of Hilikere Village	13.624	75.288	~16 m	~110m	VH~14m, Crown Height; 2.5m	Debris	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	Old	Lowly Dissected Hillslope	Granite gneiss	Sparse vegetation	Toe cutting and toe erosion by stream	Lined drainage and retaining wall with weep holes are required
KAR/SHM/2019/102	Karnataka	48O/6	North of Hilikere Village	13.626	75.288	~12 m	~55m	VH~9m, Crown Height; 2.5m	Debris	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	Initiation	PPC	Granite gneiss	Sparse vegetation	unscientific way of removal of soil for plantation	Retaining wall with weep holes are required at road bench level
KAR/SHM/2019/103	Karnataka	48O/6	1.8km from Ganapatikatte village	13.646	75.322	~30 m	~100m	VH~15m, Crown Height; 2.7m	Debris	Active	Advancing , Widening & Enlarging	Mutiple	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Sparse vegetation	Toe cutting and toe erosion by stream	Easing of slope, lined drainage and breast wall with weep holes are required
KAR/CHK/2019/104	Karnataka	48O/6	Arkilli village	13.589	75.446	~10 m	~55m	VH~8m	Debris	Active	Widening and Enlarging	Single	Shallow translational failure	Initiation	Moderately Dissected Hillslope	Granite gneiss	Sparse vegetation/Plantation on upslope	Toe erosion	Easing of slope, lined drainage are required
KAR/CHK/2019/105	Karnataka	48O/6	Edigere village	13.592	75.408	~22 m	~155m	VH~8m	Debris	Active	Widening	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Coffee and Silver Oak Plantation	unscientific way of removal of soil for plantation	Easing of slope is required.
KAR/SHM/2019/106	Karnataka	48O/2	South of Hukkalbailu village	13.644	75.216	~18 m	~83m	VH~12m	Debris	Active	Widening	Single	Shallow translational failure	Initiation	Lowly Dissected Hillslope	Granite gneiss	Moderate vegetation	Toe cutting and toe erosion by stream	Easing of slope and lined drainage with weep holes are required
KAR/SHM/2019/107	Karnataka	48O/2	Kundadi Gudda	13.559	75.169	~22m	~30m	VH~12m	Rock	Suspended	Widening	Single	Shallow translational failure	Old	Lowly Dissected Hillslope	Granite gneiss	Moderate vegetation	weathering & erosion	Lined drainage and culvert is required to discharge excess water downslope
KAR/CHK/2019/108	Karnataka	48O/2	Hire Kodagi	13.586	75.321	~18 m	~35m	VH~16m	Debris	Active	Widening and Enlarging	Single	Shallow Translational failure	Old, Suspended	Lowly Dissected Hillslope	Granite gneiss	Moderate vegetation	unscientific way of removal of soil for plantation	Easing of slope, lined drainage and breast wall with weep holes are required
KAR/CHK/2019/109	Karnataka	48O/2	NH-169, Koppa Road	13.572	75.333	~18 m	~35m	VH~16m	Debris	Active	Widening	Single	Shallow translational failure	Old, suspended	Lowly Dissected Hillslope	Granite gneiss	Moderate vegetation	Toe cutting and toe erosion by stream	Lined drainage and retaining wall with weep holes are required

GEO-PARAMETRIC LANDSLIDE INVENTORY DATABASE

ANNEXURE I

Slide No.	State	TS No.	NH/SH/Locality	Lat	Long	Length	Width	Height	Type of Slide	Activity	Distribution	Style	Failure mechanism	History	Geomorphology	Lithology	Landuse/Landcover	Geo-scientific Causes	Remedial measures
KAR/SHM/2019/110	Karnataka	48O/2	500 East of Tudike village (NH-13)	13.699	75.269	~18 m	~45m	VH~16m	Debris	Active	Widening	Single	Shallow translational failure	Old	Lowly Dissected Hillslope	Granite gneiss	Plantation upslope	Vertical road cut failure	Reinforced retaining wall with weep holes are required
KAR/SHM/2019/111	Karnataka	48O/2	South west of Kestur village area	13.694	75.179	~14 m	~95m	VH~12m	Debris	Active	Advancing , Widening & Enlarging	Single	Shallow translational failure	New	Lowly Dissected Hillslope	Granite gneiss	Thick vegetation	unscientific way of removal of soil at road bench level for plantation	Lined drainage and retaining wall with weep holes are required and construction on progress.



No	Field		Description
1	Slide No.	:	KAR/SHM/2019/01
2	State	:	Karnataka
3	District		Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	600m West of Niratur Village on Thirthahalli-Mukthihariharapur road section
6	NH/SH/Locality	:	600m West of Niratur Village
7	Latitude	:	13°42'12.7" N
8	Longitude	:	75°13'15.46" E
9	Length	:	~8 m
10	Width	:	~55m
11	Height	:	~6m
12	Area	:	--
13	Depth	:	~.5 m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slump
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Acacia Plantation on upslope and thick vegetation on downslope of lowly dissected hills
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No causalities
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The vertical road cut leads to slope transformation that opens up new way for water seepage & slope saturation that destabilize the slope during intense incessant rainfall.
37	Remedial measures	:	The lined drainage and culvert should be designed at road bench level to channelize or discharge excess water downslope at suitable location. The debris should be removed to unclog the drainage.
38	Remarks, if any		The area is identified as slumping zone and is demarcated as meta-stable zone susceptible to slope failure during rainfall. The electric power line nearby is at risk.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The small dimension debris slide observed on lowly dissected hillslope at road bench level due to unscientific way of removal of soil by toe cutting of hillslope for road development. The vertical cut leads to slope transformation that opens up new way for water seepage & slope saturation that destabilize the slope. The slope is susceptible to failure during monsoon rainfall. So, the lined drainage with properly designed culvert is the remedial measures suggested for effective drainage and to minimize toe erosion.
41	Date of Reporting	:	15/10/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/02
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Kuruvalli- Komane road section
6	NH/SH/Locality	:	Talabi Village
7	Latitude	:	13°39'50.7" N
8	Longitude	:	75°13'20.2" E
9	Length	:	~10 m
10	Width	:	~ 50 m
11	Height	:	~9m
12	Area	:	--
13	Depth	:	~1m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slump
18	Rate of movement	:	Slow
19	Activity	:	Active

20	Distribution	:	widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock/in-situ soil
27	Landuse/ Landcover	:	Moderate vegetation on upslope and Arecanut plantation in downslope
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense Rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The vertical road cut leads to slope transformation that opens up new way for water seepage & slope saturation that destabilized the slope during intense incessant rainfall.
37	Remedial measures	:	The lined drainage and culvert should be designed at road bench level to channelize or discharge excess water downslope at suitable location.
38	Remarks, if any	:	The area is demarcated as meta-stable zone.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The small dimension debris slide observed on lowly dissected hillslope at road bench level due to unscientific way of removal of soil by toe cutting of hillslope for road development. The vertical cut leads to slope transformation that opens up new way for water seepage & slope saturation that destabilize the slope. The slope is susceptible to failure during monsoon rainfall. So, the lined drainage with properly designed culvert is the remedial measures suggested for effective drainage and to minimize toe erosion.
41	Date of Reporting	:	15/10/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/03
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Kavaldurga road section
6	NH/SH/Locality	:	Babbli Village
7	Latitude	:	13°42'53.2"N
8	Longitude	:	75°09'1.2"E
9	Length	:	~8 m
10	Width	:	~65 m
11	Height	:	~1m
12	Area	:	--
13	Depth	:	~15m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Advancing , Widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock and in-situ soil
27	Landuse/ Landcover	:	Moderate vegetation in upslope /extensive slope cut
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of natural slope for road construction. The slope transformation opened up new pathway for water infiltration & slope saturation. The increased pore water pressure and pronounced weathering reduced the shear strength of the slope forming material during heavy rainfall.
37	Remedial measures	:	The lined drainage and culvert should be designed at road bench level to channelize or discharge excess water downslope at suitable location in order to minimise slope saturation, toe erosion and subsequent slope failure.
38	Remarks, if any	:	The area is demarcated as meta-stable zone.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The small dimension debris slide occurred on extensive cut slope observed on lowly dissected hillslope at road bench level. The slope disturbance is observed due to unscientific way of modification of natural slope for road construction. The slope transformation opened up new pathway for water infiltration & slope saturation. The increased pore water pressure and pronounced weathering reduced the shear strength of the slope forming material during heavy rainfall. The lined drainage and culvert should be designed at road bench level to channelize or discharge excess water downslope at suitable location in order to minimise slope saturation, toe erosion and subsequent slope failure.
41	Date of Reporting	:	16/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/04
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Tirthahalli Court road
6	NH/SH/Locality	:	Tirthahalli town
7	Latitude	:	13°41'39.84"N
8	Longitude	:	75°14'02.96"E
9	Length	:	~8 m
10	Width	:	~7 m
11	Height	:	~1m
12	Area	:	--
13	Depth	:	~15m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide

18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive ,Widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old, reactivated
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Weathered Granite gneiss
26	Structure	:	Moderately weathered rock/in-situ soil
27	Landuse/ Landcover	:	Sparse or moderate vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope & removal of soil for settlement and other construction purposes modified the natural slope angle. The toe cutting of hillslope leads to slope transformation that opened up new way of erosion, water seepage & slope saturation. Thus increased pore water pressure reduced the shear strength of the slope forming material during heavy rainfall.
37	Remedial measures	:	Easing of hillslope and retaining wall with weep holes should be constructed. Monitoring of hillslope during rainy season should be done on priority.
38	Remarks, if any	:	The area is demarcated as unstable zone. The houses in vicinity are constructed on vulnerable location.
39	Photos. Sketch of Plan & section of the slide	:	

40	Summary/Abstract	:	Debris slide was recorded along the court road near Tirthahalli town. The old slide scars and reactivation of old slide are observed on disturbed hillslope. The weathered granite gneiss constitutes the slope forming material. The toe cutting of hillslope lead to slope transformation that opened up new way of erosion, water seepage & slope saturation. Thus increased water infiltration destabilized the slope due to increased pore water pressure that reduces the shear strength of the slope forming material during heavy rainfall. Easing of slope and construction of retaining wall is suggested as remedial measure to avoid loss to life and property.
41	Date of Reporting	:	15/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/05
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Heggarkoppa village
6	NH/SH/Locality	:	East of Heggarkoppa village
7	Latitude	:	13°42'59.78"N
8	Longitude	:	75°14'50.13"E
9	Length	:	~78m
10	Width	:	~110 m
11	Height	:	~18m
12	Area	:	--
13	Depth	:	~2.8m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Earth
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, Widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old, reactivated
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Weathered Granite gneiss
26	Structure	:	In-situ soil
27	Landuse/ Landcover	:	Moderate vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded

33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance resulted due to unscientific way of removal of soil by toe or piedmont cutting of the hillslope for widening the agricultural land and excavation of soil for arecanut plantation. In an addition the natural or man-made drainage network for irrigation purpose in adjoining paddy field further exaggerated toe erosion and removal of toe support. The water saturation due to water infiltration on exposed cut section during rainfall provided new pathway for extensive weathering that reduced shear strength of slope forming material due to over saturation of hill slope further the natural or man-made drainage network for irrigation purpose in adjoining paddy field resulted in toe erosion and removal of toe support.
37	Remedial measures	:	Easing of slope should be done. Construction of gabion wall with wire mesh should be provided at foot of hill slope adjoining paddy field as protective remedial measures .The plantation should be done on failed mass to stabilize the slope.
38	Remarks, if any	:	The area is demarcated as unstable zone. The debris flow may lead to loss of crop (Paddy) & Agriculture land in monsoon.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	Earth Slide occurred on lowly dissected slope with moderate to sparse vegetation. In present scenario the landslide is active & retrogressive in nature. The slope disturbance resulted due to unscientific way of removal of soil by toe or piedmont cutting of the hillslope for widening the agricultural land and excavation of soil for arecanut plantation. In an addition the natural or man-made drainage network for irrigation purpose in adjoining paddy field further exaggerated toe erosion and removal of toe support. The water saturation due to water infiltration on exposed cut section during rainfall provides new pathway for extensive weathering that reduced shear strength of slope forming material due to over saturation of hill slope further the natural or man-made drainage network for

			irrigation purpose in adjoining paddy field resulted in toe erosion and removal of toe support. The flowing stream at toe part contributes to toe erosion and removal of toe support. The debris flow may results in loss of crop (Paddy) & agriculture land. The construction of gabion wall with wire mesh should be provided at foot of hill slope as protective remedial measures.
41	Date of Reporting	:	15/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/06
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Kankod road section
6	NH/SH/Locality	:	800m south of Kankod village
7	Latitude	:	13°41'19.98"N
8	Longitude	:	75°08'54.30"E
9	Length	:	~8 m
10	Width	:	~80m
11	Height	:	~7m
12	Area	:	--
13	Depth	:	~1.5 m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Confined
21	Style	:	Multiple
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old, Reactivated
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Moderately weathered rock
27	Landuse/ Landcover	:	Sparse and moderate vegetation on upslope
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way

			of modification of natural slope for road construction. The slope transformation opened up new pathway for water infiltration & slope saturation. The increased pore water pressure and pronounced weathering reduced the shear strength of the slope forming material during heavy rainfall.
37	Remedial measures	:	The low height lined drainage and culvert should be designed at road bench level to channelize or discharge excess water downslope at suitable location.
38	Remarks, if any		The modified hill slope is demarcated as meta-stable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The debris slide with multiple slope failures and slumps were observed on the concave curvature of the road cut on lowly dissected hill slope. The slope forming material consists of weathered rock and loose soil that failed during rainfall. The increased pore water pressure and pronounced weathering reduced the shear strength of the slope forming material during heavy rainfall. The low height lined drainage and culvert should be designed at road bench level to channelize or discharge excess water downslope at suitable location. The loose debris may block the road communication during heavy rainfall.
41	Date of Reporting	:	16/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/07
2	State	:	Karnataka
3	District		Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Kankod road section
6	NH/SH/Locality	:	745m south of Kankod village
7	Latitude	:	13°41'28.8"N

8	Longitude	:	75°08'52.6"E
9	Length	:	~12 m
10	Width	:	~75m
11	Height	:	VH~8m, Crown Height~1.8m
12	Area	:	--
13	Depth	:	~1.5 m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Widening and Enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old, Reactivated
24	Geomorphology	:	Lowly dissected hillslope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Moderately weathered rock
27	Landuse/ Landcover	:	Sparse and moderate vegetation on upslope
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense Rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded, electric pole nearby
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of natural slope for road construction. The slope transformation opened up new pathway for water infiltration & slope saturation. The increased pore water pressure and pronounced weathering reduced the shear strength of the slope forming material during heavy rainfall.
37	Remedial measures	:	The low height lined drainage should be made at toe of the hill slope and culvert should be designed at proper site suitable for discharge of excess water on upslope to minimize pore water pressure and seepage down the slope. The effective drainage is necessary to avoid slope saturation, toe erosion and subsequent landslips. At places slope gradation can be done.
38	Remarks, if any	:	The modified hill slope is demarcated as meta-stable zone susceptible to slope failure during rainfall.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The debris slide with multiple slope failures and slumps were observed on the convex curvature of the road cut on lowly dissected hillslope. The slope forming material consists of weathered rock and loose soil that failed during rainfall. The increased pore water pressure and pronounced weathering reduced the shear strength of the slope forming material during heavy rainfall. The low height lined drainage and culvert should be designed at road bench level to channelize or discharge excess water downslope at suitable location. The loose debris may block the road communication during heavy rainfall. The slope forming material consists of weathered rock and loose soil that failed during rainfall. The loose debris may block the road communication during heavy rainfall.
41	Date of Reporting	:	16/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/08
2	State	:	Karnataka
3	District		Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Kankod Village area
6	NH/SH/Locality	:	West of Kankod village
7	Latitude	:	13° 41'49.50"N
8	Longitude	:	75° 08'38.7"E
9	Length	:	~12 m
10	Width	:	~90m
11	Height	:	VH~9m, Crown Height~1.5m
12	Area	:	--
13	Depth	:	~1.5 m
14	Volume	:	--
15	Run out distance	:	~65m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, Widening and enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old, Reactivated
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Moderate vegetation on upslope, agricultural land at downslope
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss to livestock, loss to agricultural land
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance resulted due to unscientific way of removal of soil by toe or piedmont cutting of the hillslope for widening of the agricultural land and excavation of soil for arecanut plantation. In an addition the natural or man-made drainage network for irrigation purpose in adjoining paddy field further exaggerated toe erosion and removal of toe support. The water saturation due to water infiltration on exposed cut section during rainfall provided pathway for extensive weathering that reduced shear strength of slope forming material due to over saturation of hill slope further the natural or man-made drainage network for irrigation purpose in adjoining paddy field resulted in toe erosion and removal of toe support.

37	Remedial measures	:	Easing of slope should be done. Construction of gabion wall with wire mesh should be provided at foot of hill slope adjoining paddy field as protective remedial measures for toe support. Plantation should be done on failed mass to stabilize the slope.
38	Remarks, if any		The area is demarcated as unstable zone.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	Debris landslide occurred on lowly dissected slope with moderate vegetation. In present scenario the landslide is active & retrogressive in nature. The slope disturbance resulted due to unscientific way of removal of soil by toe or piedmont cutting of the hillslope for widening the agricultural land. The natural 3 rd order stream flowing at foot slope beside agriculture land resulted in toe erosion and removal of toe support. The water seepage and water saturation at toe part reduced shear strength of slope forming material and removal of toe support by scouring by flowing stream failed the hillslope. The debris flow resulted in loss of crop (Paddy) & agriculture land. The construction of gabion wall with wire mesh should be provided all along flowing stream channel at foot of hill slope as protective remedial measures.
41	Date of Reporting	:	16/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/09
2	State	:	Karnataka
3	District		Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	West of Kankod Village
6	NH/SH/Locality	:	West of Kankod Village
7	Latitude	:	13°42'8.44"N
8	Longitude	:	75°8'11.44"E

9	Length	:	~12 m
10	Width	:	~90m
11	Height	:	VH~9m, Crown Height~1.5m
12	Area	:	--
13	Depth	:	~1.5 m
14	Volume	:	--
15	Run out distance	:	~65m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, Widening and enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old, Reactivated
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock , in-situ soil
27	Landuse/ Landcover	:	Moderate vegetation on upslope, agricultural land at downslope
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance resulted due to unscientific way of removal of soil by toe or piedmont cutting of the hillslope for widening of the agricultural land and excavation of soil for arecanut plantation. In an addition the natural or man-made drainage network for irrigation purpose in adjoining paddy field further exaggerated toe erosion and removal of toe support. The water saturation due to water infiltration on exposed cut section during rainfall provided new pathway for extensive weathering that reduces shear strength of slope forming material due to over saturation of hill slope further the natural or man-made drainage network for irrigation purpose in adjoining paddy field resulted in toe erosion and removal of toe support.
37	Remedial measures	:	Easing of slope should be done. Construction of gabion wall with wire mesh should be provided at foot of hill slope adjoining paddy field as protective remedial for toe support and to prevent mass movement. Plantation should be done on failed mass to stabilize the slope.
38	Remarks, if any	:	The area is demarcated as unstable zone.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	Debris landslide occurred on lowly dissected slope with moderate vegetation. In present scenario the landslide is active & retrogressive in nature. The slope disturbance resulted due to unscientific way of removal of soil by toe or piedmont cutting of the hillslope for widening of the agricultural land. The natural 3 rd order stream flowing at foot slope beside agriculture land resulted in toe erosion and removal of toe support. The extensive seepage and water saturation at toe part reduced shear strength of slope forming material and removal of toe support by scouring by flowing stream failed the hillslope. The mass failure resulted in loss of crop (Paddy) & agriculture land. Easing of slope should be done. Construction of gabion wall with wire mesh should be provided at foot of hill slope adjoining paddy field as protective remedial measures for toe support and to prevent mass movement. Plantation should be done on failed mass to stabilize the slope.
41	Date of Reporting	:	16/11/19
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/10
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Bhartipura village
6	NH/SH/Locality	:	Bhartipura/Tudike village
7	Latitude	:	13°42'04.96"N
8	Longitude	:	75°15'49.56"E
9	Length	:	~8 m
10	Width	:	~55m
11	Height	:	~6m
12	Area	:	--

13	Depth	:	~.5 m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slump
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Quartz chlorite schist and Quartz sericite schist
26	Structure	:	Highly weathered rock and in-situ soil
27	Landuse/ Landcover	:	Acacia plantation on upslope
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No causalities
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope & removal of soil for road construction. & settlement purposes. The vertical cut and toe cutting of hillslope made for road development leads to slope transformation that opened up new way of water seepage & slope saturation. Thus increased water infiltration saturated and increased the pore water pressure that destabilized the slope during heavy rainfall. The failure plane is governed by the contact plane of Quartz chlorite schist and Quartz sericite schist.
37	Remedial measures	:	The lined drainage should be made at toe of the hill slope and culvert should be designed at proper site suitable for discharge of excess water on upslope to minimize pore water pressure and seepage down the slope. The effective drainage is necessary to avoid slope saturation, toe erosion and subsequent landslips.
38	Remarks, if any	:	The area is identified as slumping zone and is demarcated as meta-stable zone susceptible to slope failure during rainfall. Electric Power line nearby is at risk.
39	Photos. Sketch of Plan & section of the slide	:	

			
40	Summary/Abstract	:	The debris slump resulted due to unscientific way of modification of natural slope for road construction & settlement purposes. The vertical cut and toe cutting of hillslope made for road development leads to slope transformation that opened up new way of water seepage & slope saturation. Thus increased infiltration destabilized the slope due to over water saturation during heavy rainfall. The failure plane is governed by the contact plane of Quartz chlorite schist and Quartz sericite schist. The slope forming material consists of in-situ soil with overburden thickness varies between 5-10m and >10m. The area is identified as slumping zone and is demarcated as meta-stable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	16/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/11
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Bhartipura village
6	NH/SH/Locality	:	Bhartipura village
7	Latitude	:	13°42'01.6"N
8	Longitude	:	75°15'47.2"E
9	Length	:	~8 m
10	Width	:	~95m
11	Height	:	VH~12m
12	Area	:	--
13	Depth	:	~1.2 m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide

18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Advancing , Widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiated
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Quartz sericite schist
26	Structure	:	Highly weathered rock and in-situ soil
27	Landuse/ Landcover	:	Acacia plantation on upslope/extensive slope cut
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The unscientific way of modification of natural slope & removal of soil for settlement purposes. The vertical cut made on slopes leads to slope transformation that opened up new way of water seepage & slope saturation. Thus water infiltration increases the pore water pressure that destabilized the hillslope during heavy rainfall. The slope failure was more pronounced due to highly weathered Quartz sericite schist.
37	Remedial measures	:	Turfing of slope face and slope gradation is recommended as cost effective measures, further retaining wall with weep holes must be provided to prevent slope failure.
38	Remarks, if any	:	The hillslope is demarcated as meta-stable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The multiple slope failures were recorded on extensive cut slope made for settlement purposes. The unscientific way of modification of natural slope & removal of soil for settlement purposes. The vertical cut made on slopes leads to slope transformation that opened up new way of water seepage & slope saturation. Thus water infiltration increased the pore

			water pressure that destabilizes the hillslope during heavy rainfall. The slope failure more pronounced due to highly weathered Quartz Sericite Schist. The slope forming material consists of in-situ soil having overburden thickness of 5-10m and >10m. Turfing of slope face and slope gradation is recommended as cost effective measures, further retaining wall with weep holes must be provided to prevent slope failure. The slope should be monitored during heavy rainfall. The slope failure is prone during heavy rainfall and the hillslope is demarcated as meta-stable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	16/11/2019
42	Landslide Category	:	II

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/12
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Bhartipura village area
6	NH/SH/Locality	:	Thirthahalli-Shimoga road (NH-13)
7	Latitude	:	13°41'58.4"N
8	Longitude	:	75°15'50.5"E
9	Length	:	~8 m
10	Width	:	~95m
11	Height	:	VH~12m
12	Area	:	--
13	Depth	:	~1.2 m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Advancing, Widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiated
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Quartz sericite schist
26	Structure	:	Highly weathered rock and in-situ soil
27	Landuse/ Landcover	:	Acacia plantation on upslope/extensive slope cut
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded

33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The unscientific way of modification of natural slope & removal of soil for settlement purposes. The extensive vertical cut made on slopes leads to slope transformation that opened up new way of water seepage & slope saturation. Thus increased infiltration and pore water pressure destabilizes the slope during heavy rainfall. The slope failure is pronounced at highly weathered Quartz Sericite Schist.
37	Remedial measures	:	Slope gradation is recommended as cost effective measures and retaining wall with weep holes must be provided to prevent slope failure. The vertical slope cut of 7m height is also present at road bench level. So, breast wall with weep holes is suggested as a preventive measure to avoid landslips
38	Remarks, if any	:	The hillslope is demarcated as unstable zone susceptible to slope failure during rainfall. The settlements built up on modified slope in Tudige village are at risk.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The slope failures were recorded on vertical extensive cut slope made for settlement purposes. The slope forming material consists of in-situ soil having overburden thickness of >10m. Slope gradation is recommended as cost effective measures and retaining wall with weep holes must be provided to prevent slope failure. Slope should be monitored during heavy rainfall.
41	Date of Reporting	:	14/11/2019
42	Landslide Category	:	II

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/13
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Bilve Hariharpur/ Hudala road section
6	NH/SH/Locality	:	1.6 km Northwest of Bilve Hariharpur village
7	Latitude	:	13°44'32.5"N

8	Longitude	:	75°16'27.3"E
9	Length	:	~11m
10	Width	:	~65m
11	Height	:	VH~7m
12	Area	:	--
13	Depth	:	~1.2 m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slump
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, Widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old, Suspended
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Ambhibolite
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Acacia plantation on upslope and moderate vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	Electric pole nearby
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope & removal of soil for road construction. & settlement purposes. The vertical cut and toe cutting of hillslope made for road development leads to slope transformation that opened up new way of water seepage & slope saturation. Thus increased water infiltration saturated and increased the pore water pressure that destabilized the slope during heavy rainfall.
37	Remedial measures	:	The lined drainage should be made at toe of the hill slope and culvert should be designed at proper site suitable for discharge of excess water on upslope to minimize pore water pressure and seepage down the slope. The effective drainage is necessary to avoid slope saturation, toe erosion and subsequent landslips.
38	Remarks, if any	:	The area is identified as slumping zone and is demarcated as meta-stable zone susceptible to slope failure during rainfall.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The small dimension debris slump occurred on lowly dissected hillslope at road bench level. The slope disturbance is observed due to unscientific way of modification of slope & removal of soil for road construction & settlement purposes. The vertical cut and toe cutting of hillslope made for road development leads to slope transformation that opened up new way of water seepage & slope saturation. Thus increased water infiltration saturates and increased the pore water pressure that destabilized the slope during heavy rainfall. The slope is susceptible to failure during monsoon rainfall. So, lined drainage and culvert should be made at suitable location is the remedial measure for effective drainage during rainy season.
41	Date of Reporting	:	17/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/14
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Kavaledurga road section
6	NH/SH/Locality	:	660m SW of Kavaledurga village
7	Latitude	:	13° 42'43.66"N
8	Longitude	:	75° 7'52.14"E
9	Length	:	~60m
10	Width	:	~130m
11	Height	:	VH~22m
12	Area	:	--
13	Depth	:	~1.6 m
14	Volume	:	--
15	Run out distance	:	~70m
16	Type of Material	:	Rock

17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Progressive
21	Style	:	Multiple, successive
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old, Suspended
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite Gneiss
26	Structure	:	fractured
27	Landuse/ Landcover	:	Sparse Vegetation/extensive slope cut
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	Electric pole nearby
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The closely fractured granite gneiss provided the weaker plane that facilitates infiltration of water. The prolonged infiltration along the fracture plane resulted in increased stress and pore water pressure. The higher order stream channel in downslope eroded the toe part of the hill slope subsequently resulted in slope failure and road subsidence in downslope direction.
37	Remedial measures	:	The lined drainage should be made at toe of the hill slope so, that water can be channelized through culvert designed/constructed at suitable location is suggested as remedial measure for effective drainage to avoid toe erosion and subsequent slope failure and subsidences in downslope direction. The precarious rock boulders should be removed for safety purpose as precautionary measure.
38	Remarks, if any	:	Taking into consideration the risk factor, the lined should be provided at toe part at road bench level in upslope to prevent water seepage and saturation. The precarious rock boulders should be removed for safety purpose as precautionary measure. The area is demarcated as unstable zone.
39	Photos. Sketch of Plan & section of the slide	:	

			
40	Summary/Abstract	:	The shallow translational debris slide observed at convex curvature of on road in 660 m SW of Kavaledurga village area on lowly dissected slope. The slope failure is ~130m wide occurred on fractured and jointed granite gneiss along road. The closely fractured granite gneiss provides the weaker plane that facilitates infiltration of water. The prolonged infiltration along the fracture plane resulted in increased stress and pore water pressure. The higher order stream channel in downslope eroded the toe part of the hill slope sub subsequently resulted in slope failure and road subsidence in downslope direction. The lined drainage should be made at toe of the hill slope so, that water can be channelized through culvert designed/constructed at suitable location is suggested as remedial measure for effective drainage to avoid toe erosion and subsequent slope failure and subsidences in downslope direction. The precarious rock boulders should be removed for safety purpose as precautionary measure. The high retaining wall of 12m constructed in downslope for toe support and has reduced the chances of abrupt slope failure.
41	Date of Reporting	:	18/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/15
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	480/2
5	Name of the slide	:	South of Mekkeri village
6	NH/SH/Locality	:	Mekkeri village
7	Latitude	:	13°42'31.8"N
8	Longitude	:	75°5'37.08"E
9	Length	:	~22m
10	Width	:	~65m
11	Height	:	VH~11m

12	Area	:	--
13	Depth	:	~1.2 m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive
21	Style	:	Multiple
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old, Suspended
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Weathered rock
27	Landuse/ Landcover	:	Moderate vegetation on upslope and HHP in downslope direction.
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The unscientific way modification and removal of soil for arecanut plantation resulted in removal of toe support. The toe erosion by flowing stream at toe part saturated and reduced the cohesive and shear strength of the slope forming material.
37	Remedial measures	:	The gabion wall with wire mesh at toe part of hillslope should be made to prevent soil slips and scouring of hillslope during heavy discharge of water during heavy rainfall. The slope gradation is required.
38	Remarks, if any	:	The area is demarcated as unstable zone.
39	Photos. Sketch of Plan & section of the slide	:	

			
40	Summary/Abstract	:	The shallow multiple translational debris slide observed in south of Mekkeri village on lowly dissected slope with moderate vegetation cover in vicinity of arecanut plantation. In present scenario the landslide zone is active, widening and enlarging in nature. The landslide zone is ~65m wide with overburden thickness of ~11m. The crown cracks were visible. The causative factors for slope failure are removal of toe support by removal of soil from hillslope for arecanut plantation as well as toe cutting and erosion by drainage at foot slope. The gabion wall with wire mesh at toe part of hillslope should be made as preventive measures to avoid soil slips during rainfall. Easing of slope and afforestation on degraded slope should be done.
41	Date of Reporting	:	18/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/16
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Nidagodu village area
6	NH/SH/Locality	:	North west of Nidagodu village
7	Latitude	:	13°41'19.1"N
8	Longitude	:	75°06'6.5"E
9	Length	:	~15m
10	Width	:	~65m
11	Height	:	VH~12m
12	Area	:	--
13	Depth	:	~1.2 m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris

17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, Widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiated
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Weathered Granite gneiss
26	Structure	:	Highly weathered rock/in-situ soil
27	Landuse/ Landcover	:	Sparse or moderate vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The scouring and under cutting by higher 2 nd order stream during heavy water discharge in monsoon at toe part of lowly dissected hillslope got destabilized due to toe erosion and subsequent removal of toe support. The slope failure resulted due to increased pore water pressure and decrease in shear and cohesive strength of the slope forming material during heavy rainfall.
37	Remedial measures	:	Easing of slope/ slope gradation is required.
38	Remarks, if any	:	The area is demarcated as unstable zone.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The shallow translation debris slide occurred on lowly dissected hillslope beside agricultural land where toe part of hillslope is saturated by naturally flowing stream. The scouring and under cutting by higher 2 nd order stream during heavy water discharge in monsoon at toe part of lowly dissected hillslope got destabilized due to toe erosion and subsequent removal of toe

			support. The slope failure resulted due to increased pore water pressure and decrease in shear and cohesive strength of the slope forming material during heavy rainfall. Easing of slope/ slope gradation is required. The area is demarcated as unstable zone.
41	Date of Reporting	:	18/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/17
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Addagudda
6	NH/SH/Locality	:	Addagudda
7	Latitude	:	13°40'46.8"N
8	Longitude	:	75°03'4.4"E
9	Length	:	~12m
10	Width	:	~35m
11	Height	:	VH~8m
12	Area	:	--
13	Depth	:	~1 m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive , Widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old, Suspended
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Weathered Granite gneiss
26	Structure	:	Highly weathered rock & in-situ soil
27	Landuse/ Landcover	:	Moderate vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The Debris slide occurred on hillslope due to intense weathering and erosional activities.

37	Remedial measures	:	The lined drainage should be provided at toe part to avoid toe erosion. The effective drainage measures at road bench level will avoid the probability of road subsidence due to sub-surface weathering and erosion.
38	Remarks, if any	:	The area is meta-stable zone.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The shallow debris slide occurred on highly weathered and loose soil on hillslope. The wet condition resulted in decrease in cohesive strength of slope forming material. The slumping zone ~75m on either side is observed.
41	Date of Reporting	:	19/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/18
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Addagudda
6	NH/SH/Locality	:	Addagudda
7	Latitude	:	13°40'39.9"N
8	Longitude	:	75°02'57.4"E
9	Length	:	~9m
10	Width	:	~25m
11	Height	:	VH~8m
12	Area	:	--
13	Depth	:	~1 m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slump
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive , widening & enlarging

21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Suspended
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Weathered Granite gneiss
26	Structure	:	Highly weathered rock/in-situ soil
27	Landuse/ Landcover	:	Sparse or Moderate vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The Debris slump occurred on hillslope due to intense weathering and erosional activities.
37	Remedial measures	:	The lined drainage should be provided at toe part to avoid toe erosion. The culvert of suitable dimension should be constructed for discharge of excess water downslope as effective drainage measures at road bench level which will avoid the probability of road subsidence due to sub-surface seepage, weathering and erosion.
38	Remarks, if any	:	The area is demarcated as slumping and unstable zone.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The Debris slump occurred on hillslope at road bench level due to intense weathering and erosional activities. The slope saturation can be minimized by effective drainage provisions.
41	Date of Reporting	:	19/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/19
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Addagudda
6	NH/SH/Locality	:	Addagudda
7	Latitude	:	13°40'47.42"N
8	Longitude	:	75°03'09.97"E
9	Length	:	~9m
10	Width	:	~55m
11	Height	:	VH~12m
12	Area	:	--
13	Depth	:	~1.2 m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive , widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Suspended
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Weathered Granite gneiss
26	Structure	:	Highly weathered rock and in-situ soil
27	Landuse/ Landcover	:	Sparse vegetation/extensive slope cut
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The unscientific way of modification of natural slope & removal of soil for settlement purposes. The vertical cut made on slopes leads to slope transformation that opened up new way of water seepage & slope saturation. Thus increased infiltration and pore water pressure destabilized the slope during heavy rainfall. The slope failure is pronounced at highly weathered Quartz sericite schist.
37	Remedial measures	:	Turfing of slope face and slope gradation is recommended as cost effective measures and retaining wall with weep holes must be provided to prevent slope failure.
38	Remarks, if any	:	The hillslope is demarcated as meta-stable zone susceptible to slope failure during rainfall.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The multiple slope failures were recorded on extensive cut slope made for settlement purposes. The slope should be monitored during heavy rainfall. The slope failure is prone during heavy rainfall and the hillslope is demarcated as meta-stable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	18/11/2019
42	Landslide Category	:	III

No	Field	:	Description
1	Slide No.	:	KAR/SHM/2019/20
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Addagudda
6	NH/SH/Locality	:	Addagudda
7	Latitude	:	13° 40'10.9"N
8	Longitude	:	75° 03'52.4"E
9	Length	:	~9m
10	Width	:	~55m
11	Height	:	VH~12m
12	Area	:	--
13	Depth	:	~1.2 m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slump
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive , Widening & Enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure

23	History	:	Suspended
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Weathered Granite gneiss
26	Structure	:	Highly weathered rock/in-situ soil
27	Landuse/ Landcover	:	Moderate vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense Rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barr en	:	Forest
36	Geo-scientific Causes	:	The Debris slump occurred on hillslope due to intense weathering and erosional activities.
37	Remedial measures	:	The lined drainage should be provided at toe part to avoid toe erosion. The culvert of suitable dimension should be constructed for discharge of excess water downslope as effective drainage measures at road bench level which will avoid the probability of road subsidence due to sub-surface seepage, weathering and erosion.
38	Remarks, if any	:	The area is slumping zone and are quite unstable zone.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The Debris slump occurred on hillslope at road bench level due to intense weathering and erosional activities. The slope saturation can be minimized by effective drainage provisions.
41	Date of Reporting	:	19/11/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/SHM/2019/21
2	State	: Karnataka
3	District	: Shimoga
4	Toposheet No.	: 48O/2
5	Name of the slide	: North west of Yadur village
6	NH/SH/Locality	: Yadur village
7	Latitude	: 13°42'13.4"N
8	Longitude	: 75°03'48"E
9	Length	: ~15m
10	Width	: ~65m
11	Height	: VH~12m
12	Area	: --
13	Depth	: ~1.4 m
14	Volume	: --
15	Run out distance	: --
16	Type of Material	: Debris
17	Type of movement	: Slide
18	Rate of movement	: Slow
19	Activity	: Active
20	Distribution	: Retrogressive, widening & enlarging
21	Style	: Multiple
22	Failure mechanism	: Shallow translational failure
23	History	: Suspended
24	Geomorphology	: Lowly dissected slope
25	Geology/Lithology	: Weathered Granite
26	Structure	: Highly weathered rock/in-situ soil
27	Landuse/ Landcover	: Moderate or sparse vegetation
28	Hydrological condition	: Damp
29	Triggering Factor	: Prolonged and intense rainfall
30	Death of persons	: No casualties
31	People affected	: Nil
32	Livestock Loss	: No loss recorded
33	Communication	: No damage recorded
34	Infrastructure	: No damage recorded
35	Agriculture/forest/Barren	: Forest
36	Geo-scientific Causes	: The slope disturbance resulted due to unscientific way of removal of soil by toe cutting of the hillslope for road construction and communication network. The weaker plane is at contact of the intrusive granite within granite gneiss and vertical road cut opened up new way of erosion, water seepage & slope saturation. Thus increased water infiltration increased pore water pressure that reduced the shear strength of the slope forming material during heavy rainfall.
37	Remedial measures	: The lined drainage should be provided at toe part to minimize toe erosion and culvert should be designed for effective drainage at road bench level to avoid road subsidence due to sub-surface weathering and erosion.
38	Remarks, if any	: The area is slump zone and is quite unstable zone. The slumping

			zone is extending upto ~110m.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The debris slide observed on lowly dissected hillslope at road bench level. The road cut is susceptible to failure during monsoon rainfall. The slope disturbance resulted due to unscientific way of removal of soil by toe cutting of the hillslope for road construction and communication network. The weaker plane is at contact of the intrusive granite within granite gneiss and vertical road cut opened up new pathway of water seepage & slope saturation. Thus increased water infiltration increases pore water pressure that reduced the shear strength of the slope forming material during heavy rainfall. The lined drainage should be provided at toe part to minimize toe erosion and culvert should be designed for effective drainage at road bench level to avoid road subsidence due to sub-surface weathering and erosion. The area is slump zone and is quite unstable zone. The slumping zone is extending upto ~110m
41	Date of Reporting	:	19/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/22
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	North west of Yadur village
6	NH/SH/Locality	:	Yadur village
7	Latitude	:	13°42'18.72"N
8	Longitude	:	75°03'44.4"E
9	Length	:	~12m
10	Width	:	~65m
11	Height	:	VH~8m
12	Area	:	--
13	Depth	:	~1.5 m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive , Widening & Enlarging
21	Style	:	Multiple
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Weathered Granite
26	Structure	:	Highly weathered rock/in-situ soil
27	Landuse/ Landcover	:	Moderate vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense Rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barr en	:	Forest
36	Geo-scientific Causes	:	The slope disturbance resulted due to unscientific way of removal of soil by toe cutting of the hillslope for road construction and communication network. The slope transformation due to vertical cut of dimension ~65m width and weaker plane at contact of the intrusive granite within granite gneiss and vertical road cut opened up new pathway of erosion, water seepage & slope saturation. Thus increased water infiltration increased pore water pressure that reduced the shear strength of the slope forming material during heavy rainfall.
37	Remedial measures	:	The lined drainage should be provided at toe part to minimize toe erosion and culvert should be designed for effective drainage at road bench level to avoid road subsidence due to sub-surface weathering and erosion.

38	Remarks, if any		The area is demarcated as unstable zone.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The debris slide observed on lowly dissected hillslope at road bench level. The slope disturbance resulted due to unscientific way of removal of soil by toe cutting of the hillslope for road construction and communication network. The slope transformation due to vertical cut of dimension ~65m width and weaker plane at contact of the intrusive granite within granite gneiss opened up new pathway of erosion, water seepage & slope saturation. Thus increased water infiltration increased pore water pressure that reduced the shear strength of the slope forming material during heavy rainfall. The road cut is susceptible to failure during monsoon rainfall. So, lined drainage with suitable dimension culvert should be designed and constructed at suitable location for effective drainage.
41	Date of Reporting	:	19/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/23
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Ulakoppa village area
6	NH/SH/Locality	:	Ulakoppa road section
7	Latitude	:	13°42'44.28"N
8	Longitude	:	75°3'15.16"E
9	Length	:	~12m
10	Width	:	~65m

11	Height	:	VH~8m
12	Area	:	--
13	Depth	:	~1.4 m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Multiple
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Weathered Granite gneiss
26	Structure	:	Highly weathered and fractured rock
27	Landuse/ Landcover	:	Moderate vegetation on upslope and Settlement on modified slope
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance resulted due to unscientific way of removal of soil by toe cutting of the hillslope for road construction and communication network. The seepage and infiltration along the weaker plane i.e. closely jointed and fractured granite gneiss resulted in intense weathering and slope saturation.
37	Remedial measures	:	The lined drainage should be provided at toe part to avoid toe erosion and effective drainage at road bench level to avoid road subsidence due to sub-surface weathering and erosion. The water should be diverted through proper culvert to drain excess water for the safety of settlements build in downslope direction in long run.
38	Remarks, if any	:	The area is unstable zone.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The shallow translational debris slide observed along road section North of Ulakoppa village on lowly dissected slope with sparse vegetation cover. In present scenario the landslide zone is active, retrogressive, widening and enlarging in nature. The landslide zone is ~65m wide. The slope disturbance resulted due to unscientific way of removal of soil by toe cutting of the hillslope for road construction and communication network. The seepage and infiltration along the weaker plane i.e. closely jointed and fractured granite gneiss resulted in intense weathering and slope saturation. The differential weathering at contact of two-different litho-units was observed.
41	Date of Reporting	:	19/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/24
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	North of Ulakoppa village
6	NH/SH/Locality	:	Ulakoppa-Mastikatte road section
7	Latitude	:	13°42'55.34"N
8	Longitude	:	75°03'16.06"E
9	Length	:	~22m
10	Width	:	~35m
11	Height	:	VH~17m
12	Area	:	--
13	Depth	:	~2.5 m
14	Volume	:	--
15	Run out distance	:	~30m
16	Type of Material	:	Rock slide

17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive , widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Weathered Granite gneiss
26	Structure	:	Highly weathered and fractured rock
27	Landuse/ Landcover	:	Moderate vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance resulted due to unscientific way of removal of soil by toe cutting of the hillslope for road construction and communication network. The seepage and infiltration is along the weaker plane along joints and fractures. Thus increased water infiltration and slope saturation increases the pore water pressure that reduced the shear strength of slope forming material during heavy rainfall. The differential weathering on slope was also observed.
37	Remedial measures	:	The provision of lined drainage with weep holes should be provided at toe part to drain excess water through existing culvert to avoid subsidence, toe erosion. The effective drainage at road bench level is required to avoid road subsidence due to sub-surface weathering and erosion. The precarious rock boulders should be removed.
38	Remarks, if any	:	The area is unstable zone.
39	Photos. Sketch of Plan & section of the slide	:	

40	Summary/Abstract	:	The shallow translational rock slide observed along road section on extensive road cut on lowly dissected slope with moderate vegetation cover. The landslide zone is active, retrogressive, widening and enlarging in nature. The landslide zone is ~35m wide. The slope disturbance resulted due to unscientific way of removal of soil by toe cutting of the hillslope for road construction and communication network. The seepage and infiltration is along the weaker plane along joint and fracture. Thus increased water infiltration and slope saturation increases the pore water pressure that reduced the shear strength of slope forming material during heavy rainfall. The differential weathering on slope was also observed. The provision of lined drainage with weep holes should be provided at toe part to drain excess water through existing culvert to avoid subsidence, toe erosion. The effective drainage at road bench level is required to avoid road subsidence due to sub-surface weathering and erosion. The precarious rock boulders should be removed.
41	Date of Reporting	:	18/11/2019
42	Landslide Category	:	III

No	Field	:	Description
1	Slide No.	:	KAR/SHM/2019/25
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	South of Halagunda village
6	NH/SH/Locality	:	Halagunda village
7	Latitude	:	13°43'16"N
8	Longitude	:	75°02'26.3"E
9	Length	:	~60m
10	Width	:	~120m
11	Height	:	VH~17m
12	Area	:	--
13	Depth	:	~2.5 m
14	Volume	:	--
15	Run out distance	:	~30m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Creep
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old, Suspended (10-12 yrs old)
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Weathered Granite gneiss

26	Structure	:	Highly weathered rock/in-situ soil
27	Landuse/ Landcover	:	Moderate vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance resulted due to unscientific way of removal of soil by toe cutting of the hillslope for road construction and communication network. Thus increased water infiltration increased the pore water pressure and reduced the shear strength of the slope forming material during heavy rainfall.
37	Remedial measures	:	The lined drainage should be provided at toe part to minimize toe erosion and culvert should be designed for effective drainage at road bench level to avoid road subsidence due to sub-surface weathering and erosion.
38	Remarks, if any	:	The area is unstable slumping zone.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The old scars of shallow translational debris slide observed on lowly dissected hillslope. The slide is suspended in present scenario; afforestation on slope has stabilized the slope. The slope disturbance resulted due to unscientific way of removal of soil by toe cutting of the hillslope for road construction and communication network. Thus increased water infiltration increased pore water pressure and reduced the shear strength of the slope forming material during heavy rainfall. In long term lined drainage should be provided at toe part to minimize toe erosion and culvert should be designed for effective drainage at road bench level to avoid road subsidence due to sub-surface weathering and erosion.
41	Date of Reporting	:	18/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/26
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	East of Suranakodagi village
6	NH/SH/Locality	:	Suranakodagi village
7	Latitude	:	13°38'27.6"N
8	Longitude	:	7°18'5.5"E
9	Length	:	~28m
10	Width	:	~165m
11	Height	:	VH~14m
12	Area	:	--
13	Depth	:	~1.8 m
14	Volume	:	--
15	Run out distance	:	~30m
16	Type of Material	:	Debris slide
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Weathered Quartz sericite schist and Quartz chlorite schist
26	Structure	:	Highly weathered rock/in-situ soil
27	Landuse/ Landcover	:	Moderate vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance resulted due to unscientific way of removal of soil by piedmont/toe cutting of the hillslope for widening the agricultural land and getting soil for arecanut plantation. The vertical cut made for removal of soil opened up new way of erosion, water seepage & slope saturation. Thus increased water infiltration destabilized hillslope due to increased pore water pressure that reduces shear and cohesive strength of slope forming material during heavy rainfall. The open well on upslope saturated the hillslope and drainage at toe part for supplying water in paddy field for irrigation purpose resulted in toe erosion and removal of toe support.

37	Remedial measures	:	The open well at upslope should be lined and protective wall should be constructed at failed soil mass for preventing loss of crop and agriculture land during monsoon.
38	Remarks, if any	:	The area is demarcated as unstable zone.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The shallow debris slide occurred on hill slope in vicinity of agricultural land. The slope got failed along kaolinised highly weathered Quartz sericite schist and Quartz chlorite schist. The slope is unstable and likely to fail during intense rainfall. The excavation of soil destabilizes the hillslope. The slope disturbance resulted due to unscientific way of removal of soil by piedmont/toe cutting of the hillslope for widening the agricultural land and getting soil for arecanut plantation. The vertical cut made for removal of soil opened up new way of erosion, water seepage & slope saturation. Thus increased water infiltration destabilized hillslope due to increased pore water pressure that reduced shear and cohesive strength of slope forming material during heavy rainfall. The open well on upslope saturated the hillslope and drainage at toe part for supplying water in paddy field for irrigation purpose resulted in toe erosion and removal of toe support.
41	Date of Reporting	:	18/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/27
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Lakshmipur village
6	NH/SH/Locality	:	Lakshmipur village

7	Latitude	:	13°39'42.2"N
8	Longitude	:	7°17'2.4"E
9	Length	:	~18m
10	Width	:	~75m
11	Height	:	VH~12m
12	Area	:	--
13	Depth	:	~1m
14	Volume	:	--
15	Run out distance	:	~30m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Weathered Granite gneiss
26	Structure	:	Highly weathered rock and in-situ soil
27	Landuse/ Landcover	:	Sparse vegetation/extensive slope cut
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance resulted due to unscientific way of removal of soil from hillslope for settlement purpose. The vertical cut with overburden thickness of 5-10m transformation and opened up new way of erosion, water seepage & slope saturation. Thus increased water infiltration reduced the shear strength of the slope forming material during heavy rainfall.
37	Remedial measures	:	Slope gradation is required.
38	Remarks, if any	:	The area is unstable zone and settlement at nearby at risk.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The slope failure occurred on extensive cut slope made on lowly dissected hill slope. The slope got failed on kaolinized weathered granite gneiss. Thus increased water infiltration reduced the shear strength of the slope forming material during heavy rainfall. The slope gradation should be done on modified hillslope.
41	Date of Reporting	:	18/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/28
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	North-West of Solugodu village
6	NH/SH/Locality	:	North-West of Solugodu village
7	Latitude	:	13°40'19.8"N
8	Longitude	:	75°15'46.8"E
9	Length	:	~10m
10	Width	:	~65m
11	Height	:	VH~8m
12	Area	:	--
13	Depth	:	~1m
14	Volume	:	--
15	Run out distance	:	~30m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single

22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Weathered Granite gneiss
26	Structure	:	Highly weathered rock/in-situ soil
27	Landuse/ Landcover	:	Acacia plantation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance resulted due to unscientific way of removal of soil that lead to slope transformation that opened up new way of erosion, water seepage & slope saturation that increased the pore water pressure and reduced the shear strength of the slope forming material during heavy rainfall.
37	Remedial measures	:	Easing of slope is required. Lined drainage at toe part should be made to prevent toe erosion and excess water should be drained out through culvert designed at suitable sites to avoid subsidence at road bench level.
38	Remarks, if any	:	The area is meta-stable zone.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The slope failure occurred on extensive cut slope made on lowly dissected hill slope. The water infiltration and saturation of weathered granite gneiss resulted in increased pore water pressure and reduction in the shear and cohesive strength of the slope forming material during heavy rainfall. The modified natural slope should be eased.
41	Date of Reporting	:	18/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/29
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Kottekoppa road section
6	NH/SH/Locality	:	North of Kottekoppa village
7	Latitude	:	13°41'58.06"N
8	Longitude	:	75°19'27.04"E
9	Length	:	--
10	Width	:	~45m
11	Height	:	--
12	Area	:	--
13	Depth	:	--
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Soil
17	Type of movement	:	Subsidence
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Advancing , widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure in downslope
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Weathered Granite gneiss
26	Structure	:	Highly weathered rock/in-situ soil
27	Landuse/ Landcover	:	Moderate vegetation or sparse vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The road subsidence evident on road bench level. Due to lack of ineffective drainage system in upslope which saturated the slope downslope direction that resulted in decreased cohesive strength of the soil.
37	Remedial measures	:	The provision of lined drainage and culvert should be designed on upslope for effective discharge of water to avoid slope saturation. The protective supporting breast wall with weep holes should be constructed in downslope direction to control the soil slip.
38	Remarks, if any	:	The area is unstable zone and settlement at downslope is at risk.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The cracks developed on road indicate ground subsidence due to slope saturation. The lack of effective drainage system on upslope has made the slope vulnerable. The provision of lined drainage and culvert should be designed on upslope for effective discharge of water to avoid slope saturation. The protective supporting breast wall with weep holes should be constructed in downslope direction to control the soil slip. The area is unstable zone and settlement at downslope is at risk.
41	Date of Reporting	:	18/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/30
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Doddammane village
6	NH/SH/Locality	:	Doddammane village
7	Latitude	:	13°43'07.11"N
8	Longitude	:	75°23'14.03"E
9	Length	:	~14m
10	Width	:	~65m
11	Height	:	~8m
12	Area	:	--
13	Depth	:	--
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide

18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Advancing , widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Weathered Granite gneiss
26	Structure	:	Highly weathered rock/in-situ soil
27	Landuse/ Landcover	:	Moderate vegetation or sparse vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No loss recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope failure occurred due to increased pore pressure which has reduced the shear and cohesive strength of the soil due to over saturation of weathered rock and soil during heavy rainfall.
37	Remedial measures	:	Slope gradation is required.
38	Remarks, if any	:	The area is meta-stable.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The debris slide occurred on lowly dissected hillslope due to increased pore pressure and reduction in shear and cohesive strength of the soil due to over saturation of weathered rock and soil during heavy rainfall. The slope gradation is required.
41	Date of Reporting	:	18/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/31
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Agumbe road section (NH-169A)
6	NH/SH/Locality	:	South of Kavurehakhalu village
7	Latitude	:	13°32'20.5"N
8	Longitude	:	75°06'32.76"E
9	Length	:	~18 m
10	Width	:	~35m
11	Height	:	~6m
12	Area	:	--
13	Depth	:	~2m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Progressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Lateritised Metabasalt
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Acacia Plantation on upslope and thick vegetation on downslope
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barr en	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope & removal of soil for road construction. The vertical cut transformed the slope and opened up new way of erosion, water seepage & slope saturation that increased the pore water pressure and reduced the shear strength of the slope forming material during heavy rainfall.
37	Remedial measures	:	Easing of slope required. The lined drainage and retaining wall with weep holes is recommended to be constructed at the site to avoid toe erosion and landslips on kaolinized, lateritic and highly weathered rock.
38	Remarks, if any	:	The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The debris slide initiated during heavy rainfall on lowly dissected hill slope with moderate vegetation cover. The slope disturbance is observed due to unscientific way of modification of slope & removal of soil for construction of road. The vertical cut made leads to slope transformation that opened up new way of water seepage & runoff pattern. The concrete retaining wall with weep holes at the toe of the slide with proper lined drainage is required.
41	Date of Reporting	:	15/11/2019
42	Landslide Category	:	III

No	Field	:	Description
1	Slide No.	:	KAR/SHM/2019/32
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Tirthahalli Town
6	NH/SH/Locality	:	Tirthahalli Town
7	Latitude	:	13°41'36.03"N
8	Longitude	:	75°14'36.03"E
9	Length	:	~30 m
10	Width	:	~110m
11	Height	:	--
12	Area	:	--
13	Depth	:	~1.8m
14	Volume	:	--
15	Run out distance	:	~25m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active

20	Distribution	:	Progressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered and fractured rock
27	Landuse/ Landcover	:	Sparse Vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Sparse vegetation
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope & removal of soil for construction purposes. The vertical toe cutting of hillslope lead to slope transformation that opened up new way of water seepage & slope saturation. Thus increased infiltration and sub surface seepage through household discharge saturates upslope. Intense rainfall increased the pore water pressure and reduced the shear strength of slope forming material.
37	Remedial measures	:	Easing of slope is required. The lined drainage should be made at toe of the hill slope at road bench level for effective drainage in order to avoid toe erosion and landslips on highly weathered rock. The retaining wall with weep holes is recommended to be constructed at the site as protective measure.
38	Remarks, if any	:	The area is demarcated as unstable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The debris slide occurred on lowly dissected hillslope due to unscientific way of modification of slope & removal of soil for construction. The vertical cut made for settlement purpose

			transformed the slope that opened up new way of water seepage & runoff pattern. Thus increased infiltration destabilized the slope due to over water saturation during heavy rainfall. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness varies between 5-10m. The concrete retaining wall with weep holes at the toe of the slide with proper lined drainage is required.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/33
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Kuruvalli Village area
6	NH/SH/Locality	:	Tirthahalli-Kuruvalli road
7	Latitude	:	13°40'45.88"N
8	Longitude	:	75°14'41.52"E
9	Length	:	~25 m
10	Width	:	~70m
11	Height	:	--
12	Area	:	--
13	Depth	:	~1.8m
14	Volume	:	--
15	Run out distance	:	25m
16	Type of Material	:	Rock cum debris slide
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Progressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered and fractured rock
27	Landuse/ Landcover	:	Sparse vegetation/quarry
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Barren
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of

			modification of slope & removal of soil for construction purposes on other side of quarry section on the same hillslope. The vertical toe cutting of hill slope leads to slope transformation that opened up new pathway of water seepage & slope saturation in fractured granite. The adjacent rock quarries further widened up the crevices and provided the way for increased infiltration on slope.
37	Remedial measures	:	The retaining wall with weep holes should be constructed for effective drainage at road bench level and to avoid toe erosion and subsequent slope failure.
38	Remarks, if any		The area is demarcated as un-stable zone susceptible to slope failure during rainfall. The house in vicinity should be shifted permanently to safer location.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The shallow rock failure occurred on lowly dissected hill slope with sparse vegetation cover. The slope disturbance is observed due to unscientific way of modification of slope & removal of soil for construction. The vertical cut made for settlement purpose lead to slope transformation that opened up new pathway for water seepage & runoff pattern. Thus increased infiltration destabilized the slope due to over water saturation during heavy rainfall. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness varies between 5-10m. The concrete retaining wall with weep holes at the toe of the slide with proper lined drainage is required.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/34
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Kampanakodagi
6	NH/SH/Locality	:	Devangi road
7	Latitude	:	13°37'32.2"N
8	Longitude	:	75°16'50.4"E
9	Length	:	~25 m
10	Width	:	~35m
11	Height	:	VH~7m
12	Area	:	--
13	Depth	:	~1.8m
14	Volume	:	--
15	Run out distance	:	~25m
16	Type of Material	:	Debris
17	Type of movement	:	Slump
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Progressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered and fractured rock
27	Landuse/ Landcover	:	Acacia plantation on Top
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope for road construction purposes. The vertical cut lead to slope transformation that open up new pathway for water seepage & slope saturation in fractured granite. The increased pore water pressure reduced the shear and cohesive strength of slope forming material during heavy rainfall.
37	Remedial measures	:	The lined drainage and culvert at road bench level should be provided for effective drainage and to avoid toe erosion and slope failure.
38	Remarks, if any	:	The area is demarcated as meta-stable zone susceptible to slope failure during rainfall. The slumping zone is extending upto ~65m.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The Debris slump occurred on lowly dissected hill slope with sparse vegetation cover at concave turn of the road. The slope disturbance is observed due to unscientific way of modification of slope & removal of soil for construction. The slope transformation due to vertical opened up new way of water seepage & runoff pattern during heavy rainfall. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness varies between 5-10m. The lined drainage and culvert at road bench level should be provided for effective drainage. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall. The slumping zone is extending upto ~65m
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/35
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Ganapatikatte
6	NH/SH/Locality	:	Devangi- Ganapatikatte road
7	Latitude	:	13°34'55.6"N
8	Longitude	:	75°18'17.2"E
9	Length	:	~20 m
10	Width	:	~35m
11	Height	:	VH~13m
12	Area	:	--
13	Depth	:	~1m
14	Volume	:	--
15	Run out distance	:	~25m
16	Type of Material	:	Debris

17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Progressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered fractured rock
27	Landuse/ Landcover	:	Moderate vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope for road construction purposes. The vertical cut lead to slope transformation that opened up new pathway for water seepage & slope saturation in fractured granite. The increased pore water pressure and reduced shear and cohesive strength lead to slope failure during heavy rainfall.
37	Remedial measures	:	The lined drainage and culvert at road bench level should be provided for effective drainage to avoid toe erosion and slope failure.
38	Remarks, if any	:	The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	

			
40	Summary/Abstract	:	The vertical cut made for road construction leads to slope transformation that opened up new pathway for water seepage & slope saturation in fractured granite. The increased pore water pressure reduced the shear and cohesive strength of slope forming material that lead to slope failure during heavy rainfall. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness varies between 5-10m. The slumping zone is extending upto 65m. The lined drainage and culvert at road bench level should be provided for effective drainage to avoid toe erosion and slope failure.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/36
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Ganapatikatte
6	NH/SH/Locality	:	Ganapatikatte
7	Latitude	:	13°34'55.60"N
8	Longitude	:	75°18'17.20"E
9	Length	:	~25 m
10	Width	:	~35m
11	Height	:	VH~7m
12	Area	:	--
13	Depth	:	~1.8m
14	Volume	:	--
15	Run out distance	:	~28m
16	Type of Material	:	Debris

17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Progressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered and fractured rock
27	Landuse/ Landcover	:	Acacia plantation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance resulted due to unscientific way of removal of soil for plantation that lead to slope transformation that opened up new pathway for water seepage & slope saturation that increased the pore water pressure and reduced the shear & cohesive strength of the slope forming material during heavy rainfall.
37	Remedial measures	:	Easing of slope is required.
38	Remarks, if any	:	The area is meta-stable zone.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The slope failure occurred on lowly dissected hill slope due to unscientific way of removal of soil for plantation that lead to slope transformation that opened up new pathway for water seepage & slope saturation. The increase in pore water pressure reduced the shear & cohesive strength of the slope forming material during heavy rainfall. Easing of slope is required. The area is meta-stable zone.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/37
2	State	:	Karnataka
3	District		Chikmangalur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Ganapatikatte
6	NH/SH/Locality	:	Ganapatikatte
7	Latitude	:	13°34'52.70"N
8	Longitude	:	75°18'17.20"E
9	Length	:	~20 m
10	Width	:	~85m
11	Height	:	VH~13m
12	Area	:	--
13	Depth	:	--
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Progressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Ambhibolite
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Moderate vegetation/extensive slope cut
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope for settlement purposes. The extensive vertical cut made for settlement lead to slope transformation that opened up new pathway for water seepage & slope saturation that increased the pore water pressure and reduced shear strength of the slope forming material during heavy rainfall.
37	Remedial measures	:	Slope gradation is required.
38	Remarks, if any		The area is demarcated as meta-stable zone susceptible to slope failure during rainfall. The slumping zone extending upto 65m.

39	Photos. Sketch of Plan & section of the slide	:	 
40	Summary/Abstract	:	The debris slide occurred on lowly dissected hillslope on extensive slope cut made for settlement purpose lead to slope transformation that opened up new pathway for water seepage & runoff pattern. Thus increased infiltration rises pore water pressure that reduced the shear strength of the slope forming material during heavy rainfall. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness varies between 5-10m.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/38
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Nagaravalli
6	NH/SH/Locality	:	Gadikallu-Nagaravalli
7	Latitude	:	13°35'54.5"N
8	Longitude	:	75°19'34.4"E
9	Length	:	~20 m
10	Width	:	~675m
11	Height	:	VH~14m
12	Area	:	--
13	Depth	:	--
14	Volume	:	--
15	Run out distance	:	~25m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Progressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Moderate vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance resulted due to unscientific way of removal of soil for plantation that lead to slope transformation that opened up new pathway water seepage & slope saturation that increased the pore water pressure and reduced the shear strength of the slope forming material during heavy rainfall.
37	Remedial measures	:	The lined drainage and culvert at road bench level should be provided for effective drainage and to avoid toe erosion and slope failure.
38	Remarks, if any	:	The area is demarcated as meta-stable zone susceptible to slope failure during rainfall. The slumping zone is upto 25m on either side.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The debris slide occurred on vertical road cut made for road construction that lead to slope transformation that opened up new pathway for water seepage & slope saturation in fractured granite. The increased pore water pressure and reduced shear and cohesive strength lead to slope failure during heavy rainfall. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness varies between 5-10m. The slumping zone is extending upto 25m. The lined drainage and culvert at road bench level should be provided for effective drainage and to avoid toe erosion and slope failure.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/39
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/6
5	Name of the slide	:	2 km North of Nagaravalli
6	NH/SH/Locality	:	Gadikallu-Nagaravalli
7	Latitude	:	13°36'26.5"N
8	Longitude	:	75°19'53.7"E
9	Length	:	~15 m
10	Width	:	~35m
11	Height	:	VH~10m
12	Area	:	--
13	Depth	:	--
14	Volume	:	--
15	Run out distance	:	~25m

16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Progressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Acacia plantation/Moderate vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No causalities
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	Electric powerline pole nearby
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope for settlement purposes. The vertical cut and toe cutting of hillslope lead to slope transformation that opened up new pathway for water seepage & slope saturation in weathered rock.
37	Remedial measures	:	Lined drainage at toe part should be made to control toe erosion and culvert of suitable dimension should be constructed at suitable location to drain excess water down the slope in order to avoid water seepage and slope saturation.
38	Remarks, if any	:	The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The debris slide occurred on convex curvature on vertical road cut made for road construction leads to slope transformation that opened up new way of water seepage & slope saturation. The increased pore water pressure lead to reduced shear and cohesive strength of slope

			failure during heavy rainfall. Lined drainage at toe part should be made to control toe erosion and culvert of suitable dimension should be constructed at suitable location for draining excess water downslope in order to avoid water seepage and slope saturation. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/40
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/6
5	Name of the slide	:	2 km South of Herambapur
6	NH/SH/Locality	:	Ganapatikatte-Gadikallu road section
7	Latitude	:	13°36'55.6"N
8	Longitude	:	75°19'53.1"E
9	Length	:	~15 m
10	Width	:	~35m
11	Height	:	VH~8m
12	Area	:	--
13	Depth	:	~1.2m
14	Volume	:	--
15	Run out distance	:	~25m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Multiple
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Quartz Chlorite schist
26	Structure	:	Highly weathered rock, folded
27	Landuse/ Landcover	:	Sparse vegetation/ plantation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No causalities
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope for settlement purposes. The vertical cut and

			toe cutting of hillslope lead to slope transformation that opened up new pathway for water seepage & slope saturation in weathered rock.
37	Remedial measures	:	Lined drainage at toe part should be made to control toe erosion and culvert of suitable dimension should be constructed at suitable location for draining excess water down the slope in order to avoid water seepage and slope saturation.
38	Remarks, if any		The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The debris slide occurred on lowly dissected hill slope with sparse vegetation cover. The vertical road cut lead to slope transformation that opens up new way of water seepage & slope saturation. The increased pore water pressure reduced the shear and cohesive strength leads to slope failure during heavy rainfall. Lined drainage at toe part should be made to control toe erosion and culvert of suitable dimension should be constructed at suitable location for draining excess water down the slope in order to avoid water seepage and slope saturation. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/SHM/2019/41
2	State	: Karnataka
3	District	: Shimoga
4	Toposheet No.	: 48O/6
5	Name of the slide	: West of Kalgudge village
6	NH/SH/Locality	: West of Kalgudge
7	Latitude	: 13°35'59.34"N
8	Longitude	: 75°17'49.01"E
9	Length	: ~15 m
10	Width	: ~35m
11	Height	: VH~12m
12	Area	: --
13	Depth	: ~1.2m
14	Volume	: --
15	Run out distance	: ~25m
16	Type of Material	: Debris
17	Type of movement	: Slide
18	Rate of movement	: Slow
19	Activity	: Active
20	Distribution	: Retrogressiv, widening & enlarging
21	Style	: Single
22	Failure mechanism	: Shallow translational failure
23	History	: Initiation
24	Geomorphology	: Lowly dissected slope
25	Geology/Lithology	: Granite gneiss
26	Structure	: Highly weathered rock, 2 sets widely spaced joints
27	Landuse/ Landcover	: Moderate vegetation
28	Hydrological condition	: Damp
29	Triggering Factor	: Prolonged and intense rainfall
30	Death of persons	: No casualties
31	People affected	: Nil
32	Livestock Loss	: No loss recorded
33	Communication	: No damage recorded
34	Infrastructure	: No damage recorded
35	Agriculture/forest/Barren	: Forest
36	Geo-scientific Causes	: The joints opened up new pathway of water seepage & slope saturation in weathered rock and soil. Artificial drainage at toe part of hillslope adjoining to cultivation for irrigation purposes induced scouring and toe erosion during heavy discharge in rainy season.
37	Remedial measures	: Easing of slope is required. Gabion wall with wire mesh should be constructed for toe support.
38	Remarks, if any	: The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The shallow debris slide on lowly dissected hill slope with moderate vegetation cover. The joints opened up new pathway for water seepage & slope saturation in weathered rock and soil. Drainage at toe part of hillslope adjoining to cultivation for irrigation purposes induced scouring and toe erosion during heavy discharge in rainy season. Easing of slope required. Gabion wall with wire mesh should be constructed for toe support and erosion by flowing streams at toe part.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/SHM/2019/42
2	State	: Karnataka
3	District	: Shimoga
4	Toposheet No.	: 48O/6
5	Name of the slide	: Chakkodi
6	NH/SH/Locality	: Kalgudge-Basavani road section
7	Latitude	: 13°35'47.45"N
8	Longitude	: 75°16'57.92"E
9	Length	: ~22m
10	Width	: ~30m
11	Height	: VH~12m
12	Area	: --
13	Depth	: ~1.2m
14	Volume	: --
15	Run out distance	: ~18m
16	Type of Material	: Debris

17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock and in-soil
27	Landuse/ Landcover	:	Acacia Plantation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The vertical road cut at convex curvature of road opened up new pathway for water seepage & slope saturation in weathered rock. Drainage at toe part saturates the slope and induced toe erosion during heavy precipitation.
37	Remedial measures	:	The lined drainage at toe part and culvert should be designed at suitable location at road bench level to channelize or discharge excess water downslope for effective drainage to avoid toe erosion and subsequent slope failure.
38	Remarks, if any	:	The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The shallow debris slide occurred on lowly dissected hill slope with Moderate vegetation cover. The vertical road cut opened up new pathway for water seepage & slope saturation in weathered rock. Drainage at toe part saturates the slope and induced toe erosion during heavy precipitation. The lined drainage at toe part and culvert should

			be designed at suitable location at road bench level to channelize or discharge excess water downslope as remedial measure for effective drainage and to avoid toe erosion and subsequent slope failure. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness varies between 5-10m. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/43
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Madagere village
6	NH/SH/Locality	:	Madagere village
7	Latitude	:	13°37'9.7"N
8	Longitude	:	75°15'35.9"E
9	Length	:	~22m
10	Width	:	~40m
11	Height	:	VH~8m
12	Area	:	--
13	Depth	:	~1.2m
14	Volume	:	--
15	Run out distance	:	~18m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock and in-soil
27	Landuse/ Landcover	:	Acacia
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The unscientific way of removal of soil by making vertical cut for

			settlement purposes opened up new pathway for water seepage & slope saturation in weathered rock and soil. Water infiltration increased pore water pressure and reduced the cohesive and shear strength of the slope forming material resulted in slope failure during intense incessant rainfall.
37	Remedial measures	:	Retaining wall with weep holes should be constructed. Slope gradation or easing of slope is required. The slope should be monitored during heavy rainfall.
38	Remarks, if any		The area is demarcated as unstable zone susceptible to slope failure during rainfall. The settlement nearby is at high risk.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The debris slide occurred on lowly dissected hill slope due to made for settlement purposes that opened up new pathway for water seepage & slope saturation in weathered rock and soil. Water infiltration increased the pore water pressure and reduced the cohesive and shear strength of the slope forming material resulted in slope failure during intense incessant rainfall. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness >10m. The settlement nearby is at high risk. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/44
2	State	:	Karnataka
3	District		Shimoga
4	Toposheet No.	:	48O/6
5	Name of the slide	:	West of Madagere village
6	NH/SH/Locality	:	West of Madagere village

7	Latitude	:	13°37'15.43"N
8	Longitude	:	75°15'21.7"E
9	Length	:	~30m
10	Width	:	~35m
11	Height	:	VH~8m
12	Area	:	--
13	Depth	:	~1.2m
14	Volume	:	--
15	Run out distance	:	~22m
16	Type of Material	:	Debris cum rock slide
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock and in-soil
27	Landuse/ Landcover	:	Moderate Vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No causalities
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope failure occurred due to intense weathering & erosion. The toe erosion and water saturation increased the pore water pressure and induced shear strength failure.
37	Remedial measures	:	The lined drainage with suitable dimension culvert should be designed and constructed at suitable location for effective drainage.
38	Remarks, if any	:	The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The Debris slide observed on lowly dissected hillslope. The slope failure occurred due to intense weathering and erosion. The water saturation increased pore water pressure and resulted in shear strength failure. The area is susceptible to failure during monsoon rainfall. The slumping zone is either side 50m prone to failure. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness >10m. So, the lined drainage with suitable dimension culvert should be designed and constructed at suitable location for effective drainage. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/45
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/6
5	Name of the slide	:	West of Madagere village
6	NH/SH/Locality	:	West of Madagere village
7	Latitude	:	13°37'15.8"N
8	Longitude	:	75°15'20.0"E
9	Length	:	~14m
10	Width	:	~55m
11	Height	:	VH~12m
12	Area	:	--
13	Depth	:	~1m
14	Volume	:	--
15	Run out distance	:	~55m
16	Type of Material	:	Debris

17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock and in-soil
27	Landuse/ Landcover	:	Moderate Vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope failure occurred due to intense weathering & erosion. The toe erosion and water saturation increased the pore water pressure and induced shear strength failure.
37	Remedial measures	:	The lined drainage with suitable dimension culvert should be designed and constructed at suitable location for effective drainage.
38	Remarks, if any	:	The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The Debris slide observed on lowly dissected hillslope. The slope failure occurred due to intense weathering & erosion. The toe erosion and water saturation increased the pore water pressure and induced shear strength failure. The area is susceptible to failure during monsoon rainfall. The slumping zone is either side 50m prone to failure. The slope forming material consists of in-situ soil and

			weathered rock. So, the lined drainage with suitable dimension culvert should be designed and constructed at suitable location for effective drainage. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/46
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/6
5	Name of the slide	:	South of Andagere village
6	NH/SH/Locality	:	South of Andagere village
7	Latitude	:	13°37'27.9"N
8	Longitude	:	75°16'11.6"E
9	Length	:	~22m
10	Width	:	~45m
11	Height	:	VH~12m
12	Area	:	--
13	Depth	:	~1m
14	Volume	:	--
15	Run out distance	:	~55m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive , widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock and in-situ soil
27	Landuse/ Landcover	:	Moderate vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance resulted due to unscientific way of removal of soil by piedmont/toe cutting of the hillslope for widening the agricultural land and getting soil for arecanut plantation. The vertical cut made for removal of soil opened up new pathway for

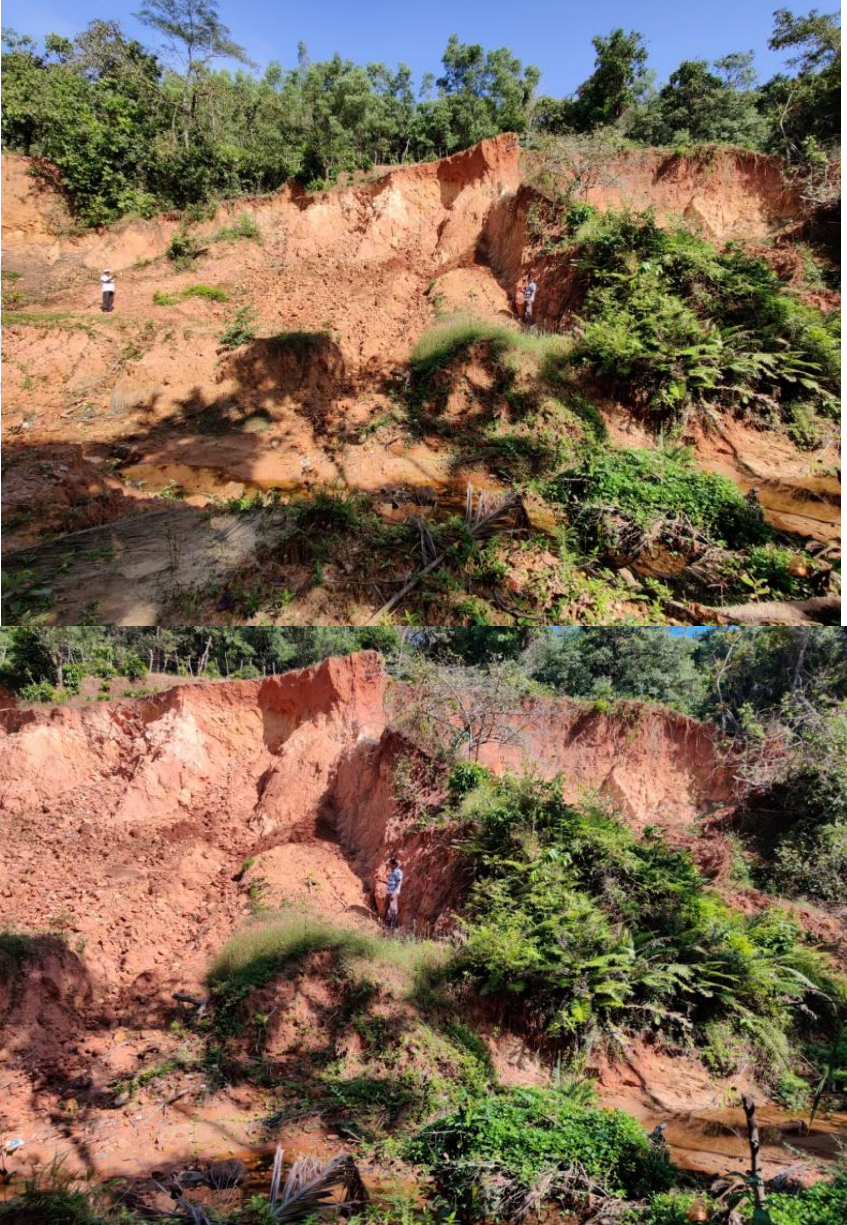
			erosion, water seepage & slope saturation. Thus increased water infiltration destabilized the slope due to increased pore water pressure that reduces shear and cohesive strength of slope forming material during heavy rainfall. Drainage at toe part for paddy field for irrigation purpose results in toe erosion and removal of toe support. The unplanned open water well on upslope further saturates the hillslope.
37	Remedial measures	:	The gabion wall with wire mesh as protective wall should be constructed at failed soil mass for preventing loss of crop and agriculture land during monsoon.
38	Remarks, if any		The area is demarcated as unstable zone.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The shallow debris slide occurred on hillslope in vicinity of agricultural land. The slope is unstable and likely to fail during intense rainfall. The excavation of soil destabilized the hillslope. The toe erosion by flowing nala saturated the hillslope during rainy season. The increased pore water pressure reduced the shear and cohesive strength of slope forming material during intense rainfall. The gabion wall with wire mesh as protective wall should be constructed at failed soil mass for toe support and further arresting the movement of debris during rainfall to prevent loss of crop and agriculture land during monsoon.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/47
2	State	:	Karnataka
3	District		Shimoga
4	Toposheet No.	:	48O/2

5	Name of the slide	:	Hulikal road section
6	NH/SH/Locality	:	Hulikal road section
7	Latitude	:	13°43'58.88"N
8	Longitude	:	75°01'30.15"E
9	Length	:	~16m
10	Width	:	~85m
11	Height	:	VH~11m
12	Area	:	--
13	Depth	:	~1m
14	Volume	:	--
15	Run out distance	:	~
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock and in-situ soil
27	Landuse/ Landcover	:	Moderate vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The extensive cut slope made for road widening lead to slope transformation that opened up new pathway for water seepage and slope saturation in weathered rock and soil. Thus increased water infiltration increased the pore water pressure that reduced the shear and cohesive strength of slope forming material during heavy rainfall.
37	Remedial measures	:	Lined drainage and retaining wall with weep holes should be constructed for toe support and avoid toe erosion. Slope gradation is required on upslope on vertical road cut.
38	Remarks, if any	:	The area is demarcated as unstable zone susceptible to slope failure during rainfall.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The extensive slope cut made for road widening leads to slope transformation that opens up new pathway of water seepage and saturation in weathered rock and soil. Thus increased water infiltration destabilizes the slope due to increased pore water pressure that reduces shear and cohesive strength of slope forming material during heavy rainfall. The slope forming material consist of in-situ soil and weathered rock. The overburden thickness is >10m. In downslope direction at road bench level multiple failures occurred having vertical height of ~15m from road bench and width ~115m. The drainage/nala at footslope causes toe erosion and water saturation that makes the slope vulnerable for mass movement. The area is demarcated as unstable zone susceptible to slope failure during rainfall. The slumping zone is either side 50m prone to failure.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/SHM/2019/48
2	State	: Karnataka
3	District	: Shimoga
4	Toposheet No.	: 48O/2
5	Name of the slide	: Hulikal road section
6	NH/SH/Locality	: Hulikal road section
7	Latitude	: 13°43'57.63"N
8	Longitude	: 75°01'24.87"E
9	Length	: ~22m
10	Width	: ~75m
11	Height	: VH~14m
12	Area	: --
13	Depth	: ~3m
14	Volume	: --
15	Run out distance	: ~
16	Type of Material	: Debris
17	Type of movement	: Slide
18	Rate of movement	: Slow
19	Activity	: Active
20	Distribution	: Retrogressive, widening & enlarging
21	Style	: Single
22	Failure mechanism	: Shallow translational failure
23	History	: Initiation
24	Geomorphology	: Lowly dissected slope
25	Geology/Lithology	: Granite gneiss
26	Structure	: Highly weathered rock and in-situ soil
27	Landuse/ Landcover	: Acacia plantation
28	Hydrological condition	: Damp
29	Triggering Factor	: Prolonged and intense rainfall
30	Death of persons	: No casualties
31	People affected	: Nil
32	Livestock Loss	: No loss recorded
33	Communication	: No damage recorded
34	Infrastructure	: No damage recorded
35	Agriculture/forest/Barren	: Forest
36	Geo-scientific Causes	: The slope failure in downslope direction at road bench level in may resulted in road subsidences and communication failure. The multiple failures occurred at hillslope by stream/nala flowing in downslope direction causing toe erosion and slope saturation. The stream at footslope further saturated the slope and destabilises the hillslope.
37	Remedial measures	: Retaining wall with weep holes should be constructed for toe support at downslope. Slope gradation is required. The lined drainage at toe part is required to avoid toe erosion.
38	Remarks, if any	: The area is demarcated as unstable zone susceptible to slope failure during rainfall. The road is likely to subside during rainy season so, monitoring of slope is required during monsoon.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The shallow translational debris slide observed along road section, South of Mastikatte village on lowly dissected slope with moderate vegetation cover. In present scenario the landslide zone is active, retrogressive, widening and enlarging in nature. The landslide zone is ~75m wide and vertical height of ~14m. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness is >10m. The slope failure in downslope direction resulted in road subsidences at road bench level. The multiple failures occurred at hillslope and stream/nala flowing in downslope direction lead to toe erosion and toe saturation causing slope failure. The retaining wall with weep holes should be constructed for toe support at downslope. Slope gradation or easing of slope is required. The lined drainage at toe part is required to avoid toe erosion.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/SHM/2019/49
2	State	: Karnataka
3	District	: Shimoga
4	Toposheet No.	: 48O/2
5	Name of the slide	: Hulikal road section
6	NH/SH/Locality	: Hulikal road section
7	Latitude	: 13°43'8.88"N
8	Longitude	: 75°00'11.02"E
9	Length	: ~12m
10	Width	: ~110m
11	Height	: VH~14m
12	Area	: --
13	Depth	: ~2m
14	Volume	: --
15	Run out distance	: ~
16	Type of Material	: Debris
17	Type of movement	: Slump
18	Rate of movement	: Slow
19	Activity	: Active
20	Distribution	: Retrogressive, widening & enlarging
21	Style	: Single
22	Failure mechanism	: Shallow translational failure
23	History	: Old
24	Geomorphology	: Lowly dissected slope
25	Geology/Lithology	: Granite gneiss
26	Structure	: Highly weathered rock and in-situ soil
27	Landuse/ Landcover	: Thick vegetation
28	Hydrological condition	: Damp
29	Triggering Factor	: Prolonged and intense rainfall
30	Death of persons	: No casualties
31	People affected	: Nil
32	Livestock Loss	: No loss recorded
33	Communication	: No damage recorded
34	Infrastructure	: No damage recorded
35	Agriculture/forest/Barren	: Forest
36	Geo-scientific Causes	: The extensive cut slope lead to slope transformation that opened up new pathway for water seepage and saturation in weathered rock and soil. Thus increased water infiltration increased the pore water pressure that reduced the shear and cohesive strength of slope forming material during heavy rainfall.
37	Remedial measures	: The lined drainage at toe part is required to avoid toe erosion.
38	Remarks, if any	: The area is demarcated as unstable zone susceptible to slope failure during rainfall.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The road cut failure at road bench level is because of reduced cohesion and shears strength of slope forming material and caused due to intense weathering and erosional activity. The lined drainage at toe part is required to avoid toe erosion. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness is 5-10m. The area is slumping zone. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/SHM/2019/50
2	State	: Karnataka
3	District	: Shimoga
4	Toposheet No.	: 48O/2
5	Name of the slide	: Hulikal road section
6	NH/SH/Locality	: Hulikal road section
7	Latitude	: 13°43'27.6"N
8	Longitude	: 75°00'32.3"E
9	Length	: ~18m
10	Width	: ~25m
11	Height	: VH~14m
12	Area	: --
13	Depth	: ~2.5m
14	Volume	: --
15	Run out distance	: ~
16	Type of Material	: Debris
17	Type of movement	: Slide
18	Rate of movement	: Slow

19	Activity	:	Suspended
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Fractured, Highly weathered rock and in-situ soil
27	Landuse/ Landcover	:	Thick vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The road cut failure occurred due to intense weathering and erosional activity reduced the cohesion and shear strength of slope forming material.
37	Remedial measures	:	The lined drainage at toe part is required to avoid toe erosion and toe support.
38	Remarks, if any	:	The area is demarcated as unstable zone slumping zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The road cut failure occurred due to intense weathering and erosional activity reduced the cohesion and shear strength of slope forming material. The lined drainage at toe part is required to avoid toe erosion. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness is 5-10m. The area is slumping zone. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/CHK/2019/51
2	State	: Karnataka
3	District	: Chikmanglur
4	Toposheet No.	: 48O/6
5	Name of the slide	: Mel koppa
6	NH/SH/Locality	: Mel koppa
7	Latitude	: 13°34'22.96"N
8	Longitude	: 75°17'56.86"E
9	Length	: ~18m
10	Width	: ~110m
11	Height	: VH~6m
12	Area	: --
13	Depth	: ~2.5m
14	Volume	: --
15	Run out distance	: --
16	Type of Material	: Debris
17	Type of movement	: Slide
18	Rate of movement	: Slow
19	Activity	: Active
20	Distribution	: Retrogressive, widening & enlarging
21	Style	: Single
22	Failure mechanism	: Shallow translational failure
23	History	: New
24	Geomorphology	: Lowly dissected slope
25	Geology/Lithology	: Granite gneiss
26	Structure	: In-situ soil
27	Landuse/ Landcover	: Acacia plantation/Sparse vegetation
28	Hydrological condition	: Damp
29	Triggering Factor	: Prolonged and intense rainfall
30	Death of persons	: No causalities
31	People affected	: Nil
32	Livestock Loss	: No loss recorded
33	Communication	: No damage recorded
34	Infrastructure	: No damage recorded
35	Agriculture/forest/Barren	: Forest
36	Geo-scientific Causes	: The road cut failure at road bench level occurred due to intense weathering and erosion and loss of cohesive strength of the soil.
37	Remedial measures	: The lined drainage at toe part is required to avoid toe erosion and culvert should be constructed at suitable location to drain excess water downslope to minimize water seepage and saturation.
38	Remarks, if any	: The area is demarcated as unstable zone susceptible to slope failure during rainfall.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The road cut failure at road bench level occurred due to intense weathering and erosion and loss of cohesive strength of the soil. The area is slumping zone. The lined drainage at toe part is required to avoid toe erosion and culvert should be constructed at suitable location to drain excess water downslope to minimize water seepage and saturation. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness is 5-10m. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/CHK/2019/52
2	State	: Karnataka
3	District	: Chikmanglur
4	Toposheet No.	: 48O/6
5	Name of the slide	: Mel koppa
6	NH/SH/Locality	: Mel koppa- Angadimane
7	Latitude	: 13°34'8.71"N
8	Longitude	: 75°17'14.54"E
9	Length	: ~18m
10	Width	: ~155m
11	Height	: VH~8m
12	Area	: --
13	Depth	: ~2.5m
14	Volume	: --
15	Run out distance	: ~22
16	Type of Material	: Debris
17	Type of movement	: Slide

18	Rate of movement	:	creep
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Multiple
22	Failure mechanism	:	Shallow translational failure
23	History	:	New
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	In-situ soil
27	Landuse/ Landcover	:	Moderate vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	Electric pole nearby
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The road cut failure at road bench level occurred due to intense weathering and erosion and loss of cohesive strength of the soil.
37	Remedial measures	:	The lined drainage at toe part is required to avoid toe erosion and culvert should be constructed at suitable location to drain excess water downslope to minimize slope seepage and saturation.
38	Remarks, if any	:	The area is demarcated as unstable zone susceptible to slope failure during rainfall. And settlements at downslope are at risk during heavy precipitation.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The road cut failure at road bench level occurred due to intense weathering and erosion lead to loss of cohesive strength of the soil. The area is slumping zone upto ~155m. The lined drainage at toe part is required to avoid toe erosion and culvert should be constructed at suitable location to drain excess water downslope to minimize slope seepage and saturation. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness is 5-10m. The area is demarcated as unstable zone susceptible to

			slope failure during rainfall.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/53
2	State	:	Karnataka
3	District	:	Chikmanglur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	NH-13
6	NH/SH/Locality	:	Koppa-Hariharpur road (NH-13)
7	Latitude	:	13°31'20.9"N
8	Longitude	:	75°19'48.4"E
9	Length	:	~12m
10	Width	:	~27m
11	Height	:	VH~8m
12	Area	:	--
13	Depth	:	~2.5m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Multiple
22	Failure mechanism	:	Shallow translational failure
23	History	:	New
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	In-situ soil
27	Landuse/ Landcover	:	Moderate Vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The vertical road cut failure at concave curvature at road bench level due to intense weathering and erosion and loss of cohesive strength of the soil.
37	Remedial measures	:	The lined drainage at toe part is required to avoid toe erosion and culvert should be constructed at suitable location to drain excess water

			downslope to minimize slope seepage and saturation.
38	Remarks, if any		The area is demarcated as unstable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The vertical road cut failure occurred at concave curvature of road. The primary cause of slope failure is intense weathering and erosion and loss of cohesive strength of the soil. The area is slumping zone upto ~125m. The lined drainage at toe part is required to avoid toe erosion and culvert should be constructed at suitable location to drain excess water downslope to minimize slope seepage and saturation. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness is 5-10m. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/CHK/2019/54
2	State	: Karnataka
3	District	: Chikmanglur
4	Toposheet No.	: 48O/6
5	Name of the slide	: Koppa road
6	NH/SH/Locality	: Thirthahalli-Koppa road(NH-13)
7	Latitude	: 13°31'28.9"N
8	Longitude	: 75°19'55.2"E
9	Length	: ~12m
10	Width	: ~65m
11	Height	: VH~8m
12	Area	: --
13	Depth	: ~1.3m
14	Volume	: --
15	Run out distance	: ~12m
16	Type of Material	: Debris

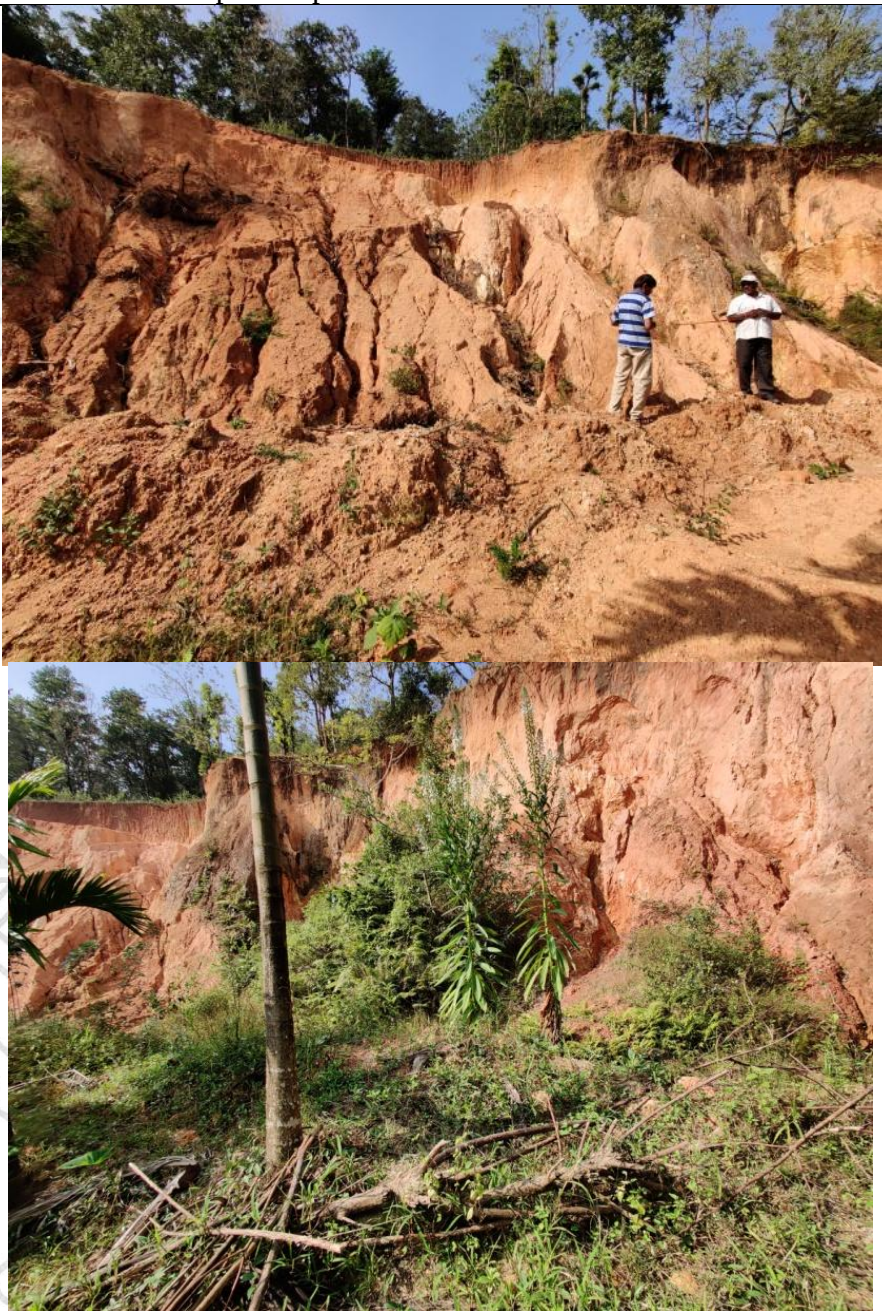
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	In-situ soil
27	Landuse/ Landcover	:	Thick Vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The vertical road cut failure at concave curvature at road bench level occurred due to intense weathering and erosion and loss of cohesive strength of the soil.
37	Remedial measures	:	The lined drainage at toe part is required to avoid toe erosion and culvert should be constructed at suitable location to drain excess water downslope to minimize slope seepage and saturation.
38	Remarks, if any	:	The area is demarcated as unstable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The vertical road cut failure is at concave curvature at road bench level. The primary cause of slope failure occurred due to intense weathering and erosion and loss of cohesive strength of the soil. The lined drainage at toe part is required to avoid toe erosion and culvert should be constructed at suitable location to drain excess water downslope to minimize slope seepage and saturation. The slope

			forming material consists of in-situ soil and weathered rock. The overburden thickness is 5-10m. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/55
2	State	:	Karnataka
3	District	:	Chikmanglur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Gunavanti village
6	NH/SH/Locality	:	Gunavanti village
7	Latitude	:	13°35'12.45"N
8	Longitude	:	75°22'7.15"E
9	Length	:	~22m
10	Width	:	~70m
11	Height	:	VH~18m
12	Area	:	--
13	Depth	:	~1.3m
14	Volume	:	--
15	Run out distance	:	~22m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Multiple
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	In-situ soil
27	Landuse/ Landcover	:	Thick vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance resulted due to unscientific way of removal of soil by toe or piedmont cutting of the hillslope for widening the agricultural land and getting soil for arecanut plantation. In an addition man-made drainage network for irrigation purpose in adjoining paddy field further exaggerated toe erosion and removal of

			toe support. The water saturation due to water infiltration on exposed cut section during rainfall provided new pathway for extensive weathering that reduced shear strength of slope forming material due to over saturation of hill slope further the natural or man-made drainage network for irrigation purpose in adjoining paddy field resulted in toe erosion and removal of toe support.
37	Remedial measures	:	The construction of gabion wall with wire mesh should be provided at foot of hill slope adjoining the paddy field as protective remedial measures for toe support and arrest the movement of debris and prevent toe erosion and slope saturation by flowing streams that will lead to mass movement. The plantation should be done on failed mass to stabilize the slope.
38	Remarks, if any		The area is demarcated as unstable zone.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	Debris slide occurred on lowly dissected slope with moderate to sparse vegetation. In present scenario the landslide is active & retrogressive in nature. The vertical cut provides new pathway for water seepage and saturation during intense rainfall. The flowing stream at toe part contributes to toe erosion and removal of toe support. The debris flow may results in loss of crop (Paddy) & agriculture land if get reactivated in monsoon. The construction of gabion wall with wire mesh should be provided at foot of hill slope adjoining the paddy field as protective remedial measures for toe support and arrest the movement of debris and prevent toe erosion and slope saturation by flowing streams that will lead to mass movement. The plantation should be done on failed mass to stabilize the slope.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/CHK/2019/56
2	State	: Karnataka
3	District	: Chikmagalur
4	Toposheet No.	: 48O/6
5	Name of the slide	: Urumakki village
6	NH/SH/Locality	: Gunavati-Golikoppa road section
7	Latitude	: 13°35'23.94"N
8	Longitude	: 75°21'48.31"E
9	Length	: ~26m
10	Width	: ~138m
11	Height	: VH~22m
12	Area	: --
13	Depth	: ~2.5m
14	Volume	: --
15	Run out distance	: ~12m
16	Type of Material	: Debris
17	Type of movement	: Slide
18	Rate of movement	: Slow
19	Activity	: Active
20	Distribution	: Retrogressive, widening & enlarging
21	Style	: Multiple
22	Failure mechanism	: Shallow translational failure
23	History	: Old and reactivated
24	Geomorphology	: Lowly dissected slope
25	Geology/Lithology	: Quartz muscovite schist and Granite gneiss
26	Structure	: In-situ soil
27	Landuse/ Landcover	: Extensive cut slope/Sparse vegetation
28	Hydrological condition	: Damp
29	Triggering Factor	: Prolonged and intense Rainfall
30	Death of persons	: No casualties
31	People affected	: Nil
32	Livestock Loss	: No loss recorded
33	Communication	: No damage recorded
34	Infrastructure	: No damage recorded
35	Agriculture/forest/Barren	: Forest
36	Geo-scientific Causes	: The slope disturbance resulted due to unscientific way of removal of soil by toe or piedmont cutting of the hillslope for widening the agricultural land and getting soil for arecanut plantation. The naturally flowing stream at toe part for irrigation purpose in adjoining paddy field has contributed in slope saturation, toe erosion and removal of toe support. The water saturation due to water infiltration on exposed cut section during rainfall provided new pathway for extensive weathering that reduced shear strength of slope forming material due to over saturation of hill slope further the natural or man-made drainage network for irrigation purpose in adjoining paddy field resulted in toe erosion and removal of toe support. The shear failure at contact of highly weathered and kaolinised Quartz muscovite schist and Granite gneiss were evident.
37	Remedial measures	: The high height retaining wall with weep holes should be constructed

			and easing of slope should be done.
38	Remarks, if any		The area is demarcated as unstable zone. The settlements constructed on top of slope are at risk.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	Debris slide occurred on lowly dissected slope with moderate to sparse vegetation. In present scenario the landslide is active & retrogressive in nature. The vertical cut provided new pathway for water seepage and saturation during intense rainfall. The flowing stream at toe part contributed to toe erosion and removal of toe support. The debris flow may results in loss of crop (Paddy) & agriculture land. The construction lined drainage and retaining wall with weep holes should be provided at foot of hill slope as protective remedial measures. The area is demarcated as unstable zone. The settlements constructed on top of slope are at risk.
41	Date of Reporting	:	05/12/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/CHK/2019/57
2	State	: Karnataka
3	District	: Chikmanglur
4	Toposheet No.	: 48O/6
5	Name of the slide	: Urumakki village
6	NH/SH/Locality	: Urumakki village
7	Latitude	: 13°35'17.01"N
8	Longitude	: 75°21'47.97"E
9	Length	: ~30m
10	Width	: ~110m
11	Height	: VH~28m
12	Area	: --
13	Depth	: ~2m
14	Volume	: --
15	Run out distance	: ~55m
16	Type of Material	: Debris
17	Type of movement	: Slide
18	Rate of movement	: Slow
19	Activity	: Active
20	Distribution	: Retrogressive, widening & enlarging
21	Style	: Multiple
22	Failure mechanism	: Shallow translational failure
23	History	: Old
24	Geomorphology	: Lowly dissected slope
25	Geology/Lithology	: Granite gneiss
26	Structure	: In-situ soil
27	Landuse/ Landcover	: Moderate vegetation
28	Hydrological condition	: Damp
29	Triggering Factor	: Prolonged and intense rainfall
30	Death of persons	: No casualties
31	People affected	: Nil
32	Livestock Loss	: No loss recorded
33	Communication	: No damage recorded
34	Infrastructure	: No damage recorded
35	Agriculture/forest/Barren	: Forest
36	Geo-scientific Causes	: The slope disturbance resulted due to unscientific way of removal of soil by toe or piedmont cutting of the hillslope for widening the agricultural land and getting soil for arecanut plantation. The naturally flowing stream at toe part for irrigation purpose in adjoining paddy field has contributed in slope saturation, toe erosion and removal of toe support. The diverted nala along toe part of hillslope for irrigation purpose in adjoining paddy field resulted in toe erosion and removal of toe support. The shear failure occurred due to decreased cohesive strength of slope forming material as a result of prolonged weathering and erosion.
37	Remedial measures	: The construction of gabion wall with wire mesh and lined drainage should be provided at foot of hill slope as protective remedial

			measures to prevent mass movement and reduce the chance of loss of agriculture land by debris flow.
38	Remarks, if any		The area is demarcated as unstable zone.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The slope disturbance resulted due to unscientific way of removal of soil by toe or piedmont cutting of the hillslope for widening the agricultural land and getting soil for arecanut plantation. The naturally flowing stream at toe part for irrigation purpose in adjoining paddy field has contributed in slope saturation, toe erosion and removal of toe support. The diverted nala along toe part of hillslope for irrigation purpose in adjoining paddy field resulted in toe erosion and removal of toe support. The shear failure occurred due to decreased cohesive strength of slope forming material as a result of prolonged weathering and erosion. The construction of gabion wall with wire mesh and lined drainage should be provided at foot of hill slope as protective remedial measures to arrest the movement of soil and reduce the chance of loss of agriculture land. The area is demarcated as unstable zone.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/CHK/2019/58
2	State	: Karnataka
3	District	: Chikmagalur
4	Toposheet No.	: 48O/6
5	Name of the slide	: North of Gunavanti village
6	NH/SH/Locality	: North of Gunavanti village
7	Latitude	: 13°35'38.9"N

8	Longitude	:	75°21'46.4"E
9	Length	:	~30m
10	Width	:	~100m
11	Height	:	VH~25m
12	Area	:	--
13	Depth	:	~1.5m
14	Volume	:	--
15	Run out distance	:	~50m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Multiple
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	In-situ soil
27	Landuse/ Landcover	:	Moderate vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance resulted due to unscientific way of removal of soil by toe or piedmont cutting of the hillslope for widening the agricultural land and getting soil for arecanut plantation. The naturally flowing stream at toe part for irrigation purpose in adjoining paddy field has contributed in slope saturation, toe erosion and removal of toe support. The diverted nala along toe part of hillslope for irrigation purpose in adjoining paddy field resulted in toe erosion and removal of toe support. The shear failure occurred due to decreased cohesive strength of slope forming material as a result of prolonged weathering and erosion.
37	Remedial measures	:	The construction of gabion wall with wire mesh and lined drainage should be provided at foot of hill slope as protective remedial measures to arrest the movement of soil and reduce the chance of loss of agriculture land.
38	Remarks, if any	:	The area is demarcated as unstable zone.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The slope disturbance resulted due to unscientific way of removal of soil by toe or piedmont cutting of the hillslope for widening the agricultural land and getting soil for arecanut plantation. The naturally flowing stream at toe part for irrigation purpose in adjoining paddy field has contributed in slope saturation, toe erosion and removal of toe support. The diverted nala along toe part of hillslope for irrigation purpose in adjoining paddy field resulted in toe erosion and removal of toe support. The shear failure occurred due to decreased cohesive strength of slope forming material as a result of prolonged weathering and erosion. The construction of gabion wall with wire mesh and lined drainage should be provided at foot of hill slope as protective remedial measures to arrest the movement of soil and reduce the chance of loss of agriculture land. The area is demarcated as unstable zone.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/SHM/2019/59
2	State	: Karnataka
3	District	: Shimoga
4	Toposheet No.	: 48O/6
5	Name of the slide	: Kanave village
6	NH/SH/Locality	: Kanave road
7	Latitude	: 13°41'58.63"N
8	Longitude	: 75°24'12.24"E
9	Length	: ~40m
10	Width	: ~42m
11	Height	: VH~8m
12	Area	: --
13	Depth	: ~1.3m
14	Volume	: --
15	Run out distance	: ~112m
16	Type of Material	: Debris
17	Type of movement	: Flow
18	Rate of movement	: Slow
19	Activity	: Active
20	Distribution	: Retrogressive, widening & enlarging
21	Style	: Single
22	Failure mechanism	: Shallow translational failure
23	History	: Initiation
24	Geomorphology	: Lowly dissected slope
25	Geology/Lithology	: Quartz cholitre schist
26	Structure	: In-situ soil
27	Landuse/ Landcover	: Sparse vegetation
28	Hydrological condition	: Wet
29	Triggering Factor	: Prolonged and intense rainfall
30	Death of persons	: No casualties
31	People affected	: No loss recorded
32	Livestock Loss	: Houses at down slope at risk
33	Communication	: No damage recorded
34	Infrastructure	: No damage recorded
35	Agriculture/forest/Barren	: Forest
36	Geo-scientific Causes	: Trench on top of slope saturated the top slope that resulted in reduction in shear and cohesive strength of the slope forming material.
37	Remedial measures	: Trench dug at top slope must not be practised. Removal of soil from upslope for trench destabilised the slope and provided new path way for slope seepage and slope saturation. Easing of slope is required.
38	Remarks, if any	: The area is demarcated as unstable zone susceptible to slope failure during rainfall.

39	Photos. Sketch of Plan & section of the slide	:	 
40	Summary/Abstract	:	The large dimension debris flow of ~100m run out distance recorded in Kanave village area on lowly dissected hillslope failed during heavy rainfall in August 2019. The water accumulated in trench made on top of hill under forest area resulted in water seepage and slope saturation. The over saturated slope failed during intense rainfall due to reduction in shear and cohesive strength of the slope forming material. The area is demarcated as unstable zone susceptible to slope failure during rainfall. The contact plane of ferruginous phyllite and quartz chlorite schist are prone to mass failure. The slope forming material consists of in-situ soil and highly weathered rock with overburden thickness is >10m. The settlements in downslope direction are at high risk zone during rainfall.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/SHM/2019/60
2	State	: Karnataka
3	District	: Shimoga
4	Toposheet No.	: 48O/6
5	Name of the slide	: Mudaba road
6	NH/SH/Locality	: Mudaba road
7	Latitude	: 13°42'39.88"N
8	Longitude	: 75°26'7.74"E
9	Length	: ~18m
10	Width	: ~45m
11	Height	: VH~7m
12	Area	: --
13	Depth	: ~1.3m
14	Volume	: --
15	Run out distance	: --
16	Type of Material	: Debris
17	Type of movement	: Slide
18	Rate of movement	: Slow
19	Activity	: Active
20	Distribution	: Retrogressive, widening & enlarging
21	Style	: Single
22	Failure mechanism	: Shallow translational failure
23	History	: Initiation
24	Geomorphology	: Lowly dissected slope
25	Geology/Lithology	: Quartz chlorite schist
26	Structure	: In-situ soil
27	Landuse/ Landcover	: Thick vegetation
28	Hydrological condition	: Wet
29	Triggering Factor	: Prolonged and intense rainfall
30	Death of persons	: No casualties
31	People affected	: No loss recorded
32	Livestock Loss	: No loss recorded
33	Communication	: No damage recorded
34	Infrastructure	: No damage recorded
35	Agriculture/forest/Barren	: Forest
36	Geo-scientific Causes	: The vertical road cut failure at concave curvature at road bench level occurred due to intense weathering and erosion, increased pore water pressure resulted in cohesive and shear strength failure of the slope forming material.
37	Remedial measures	: The lined drainage at toe part is required to avoid toe erosion and culvert should be constructed at suitable location to drain excess water downslope to minimize slope seepage and saturation.
38	Remarks, if any	: The area is demarcated as unstable zone susceptible to slope failure during rainfall. Houses constructed in down slope are at risk.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The vertical road cut failure is at concave curvature at road bench level. The vertical road cut failure at concave curvature at road bench level occurred due to intense weathering and erosion, increased pore water pressure resulted in cohesive and shear strength failure of the slope forming material. The lined drainage at toe part is required to avoid toe erosion and culvert should be constructed at suitable location to drain excess water downslope to minimize slope seepage and saturation. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness is 5-10m. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/SHM/2019/61
2	State	: Karnataka
3	District	: Shimoga
4	Toposheet No.	: 48O/2
5	Name of the slide	: Annavalli village
6	NH/SH/Locality	: Annavalli village
7	Latitude	: 13°37'57.01"N
8	Longitude	: 75° 9'15.06"E
9	Length	: ~13m
10	Width	: ~40m
11	Height	: VH~12m
12	Area	: --
13	Depth	: ~1.8 m

14	Volume	:	--
15	Run out distance	:	20m
16	Type of Material	:	Debris
17	Type of movement	:	slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite and Amphibolites
26	Structure	:	In-situ soil and highly weathered rock
27	Landuse/ Landcover	:	Acacia plantation on top slope
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The naturally flowing stream at toe part for irrigation purpose in adjoining paddy field has contributed in slope saturation, toe erosion and removal of toe support. The water saturation due to water infiltration on exposed cut section during rainfall provided new pathway for extensive weathering and reduced the shear strength of slope forming material due to over saturation of hill slope. Further the natural or man-made drainage network for irrigation purpose in adjoining paddy field resulted in toe erosion and removal of toe support. The shear failure occurred at contact of highly weathered and kaolinised granite and amphibolites.
37	Remedial measures	:	Lined drainage with weep holes should be constructed and easing of slope should be done. The construction of gabion wall with wire mesh should be provided at foot of hill slope as protective remedial measures to prevent mass movement and reduce the chance of loss of agriculture land.
38	Remarks, if any	:	The failed mass may results in loss of crop (Paddy) & agriculture land.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	Debris slide occurred on lowly dissected slope with moderate to sparse vegetation. In present scenario the landslide is active & retrogressive in nature. The flowing stream at toe part contributes to toe erosion and removal of toe support. The shear failure occurred at Contact of highly weathered and kaolinised granite and amphibolites. The inundation of debris in agricultural land may results in loss of crop (Paddy) & agriculture land. The lined drainage with weep holes should be constructed and easing of slope should be done. The construction of gabion wall with wire mesh should be provided at foot of hill slope as protective remedial measures to arrest the movement of soil and reduce the chance of loss of agriculture land.
41	Date of Reporting	:	9/12/2019
42	Landslide Category	:	III

No	Field	:	Description
1	Slide No.	:	KAR/SHM/2019/62
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	South of Annavalli village
6	NH/SH/Locality	:	South of Annavalli village
7	Latitude	:	13°37'51.6"N
8	Longitude	:	75°9'13.7"E
9	Length	:	~18m
10	Width	:	~45m
11	Height	:	VH~7m
12	Area	:	--
13	Depth	:	~1.3m

14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Amphibolite/laterite
26	Structure	:	indistinct
27	Landuse/ Landcover	:	Acacia on top slope and sparse vegetation downslope
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	No loss
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	Unscientific way of removal of soil and water infiltration from top surface paved new pathway for water seepage caused intense weathering and erosion . The increased pore water pressure resulted in reduced cohesive and shear strength failure of slope forming material.
37	Remedial measures	:	Easing of slope and plantation on loose soil mass in downslope is required.
38	Remarks, if any	:	Slope is demarcated as unstable area.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The debris slide occurred on hillslope due to unscientific way of removal of soil paved new pathway for water seepage that triggered

			intense weathering and erosion. The reduction in cohesive strength of the soil resulted in mass failure during intense weathering. Easing of slope is required. Slope is demarcated as unstable.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/63
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Karunepura village
6	NH/SH/Locality	:	Karunepura village
7	Latitude	:	13°38'6.4"N
8	Longitude	:	75°08'37.63"E
9	Length	:	~18m
10	Width	:	~100m
11	Height	:	VH~7m
12	Area	:	--
13	Depth	:	~1.3m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old, reactivated
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Amphibolite
26	Structure	:	In-situ soil, weathered rock
27	Landuse/ Landcover	:	Acacia plantation, downslope betel nut plantation
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss
33	Communication	:	No loss recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	Creep movement in top slope resulted in small dimension debris slide at road bench level in downslope direction. Multiple slope failure occurred due to nala erosion by flowing nala at footslope.
37	Remedial measures	:	The lined drainage and culvert of suitable dimension should be constructed at suitable location to drain excess water downslope to

			minimise the chances of slope saturation and slope failure. The retaining wall with weep holes should be constructed in downslope direction for toe support.
38	Remarks, if any		The slope is unstable and should be monitored during monsoon.
39	Photos. Sketch of Plan & section of the slide	:	 
40	Summary/Abstract	:	Creep movement in top slope resulted in small dimension debris slide at road bench level in downslope direction. Multiple slope failure occurred due to nala erosion by flowing nala at footslope. Cracks were observed on road are evidence of road subsidences. The lined drainage and culvert of suitable dimension should be constructed at suitable location to drain excess water downslope to minimise the chances of slope saturation and slope failure. The retaining wall with weep holes should be constructed in downslope direction for toe support. The slope is unstable and should be monitored during monsoon.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/SHM/2019/64
2	State	: Karnataka
3	District	: Shimoga
4	Toposheet No.	: 48O/2
5	Name of the slide	: Dinda village
6	NH/SH/Locality	: Dinda village
7	Latitude	: 13°39'41.3"N
8	Longitude	: 75°8'25.8"E
9	Length	: ~20m
10	Width	: ~30m
11	Height	: VH~18m
12	Area	: --
13	Depth	: ~1.3m
14	Volume	: --
15	Run out distance	: --
16	Type of Material	: Debris
17	Type of movement	: Slide
18	Rate of movement	: Slow
19	Activity	: Suspended
20	Distribution	: Retrogressive, widening & enlarging
21	Style	: Multiple
22	Failure mechanism	: Shallow translational failure
23	History	: Old, reactivated
24	Geomorphology	: Lowly dissected slope
25	Geology/Lithology	: Granite gneiss
26	Structure	: In-situ soil, weathered rock
27	Landuse/ Landcover	: Moderate vegetation on top, downslope betelnut plantaion
28	Hydrological condition	: Wet
29	Triggering Factor	: Prolonged and intense rainfall
30	Death of persons	: No casualties
31	People affected	: Nil
32	Livestock Loss	: No loss recorded
33	Communication	: No damage recorded
34	Infrastructure	: No damage recorded
35	Agriculture/forest/Barren	: Forest
36	Geo-scientific Causes	: The vertical road cut failure occurred at road bench level The primary cause of slope failure occurred due to intense weathering and erosion. The increased pore water pressure resulted in cohesive and shear strength failure of the soil.
37	Remedial measures	: The lined drainage should be made at toe part and culvert should be designed at suitable locations to drain excess water. In current scenario retaining wall with weep holes should be constructed at footslope for toe support in order to avoid road subsidences during heavy rainfall.
38	Remarks, if any	: The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.

39	Photos. Sketch of Plan & section of the slide	:	 
40	Summary/Abstract	:	The vertical road cut failure occurred at road bench level The primary cause of slope failure occurred due to intense weathering and erosion. The increased pore water pressure resulted in cohesive and shear strength failure of the soil. The lined drainage at toe part is required to avoid toe erosion and culvert should be constructed at suitable location to drain excess water downslope to minimize slope seepage and saturation. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness is 5-10m. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/SHM/2019/65
2	State	: Karnataka
3	District	: Shimoga
4	Toposheet No.	: 48O/2
5	Name of the slide	: North of Dinda village
6	NH/SH/Locality	: North of Dinda village
7	Latitude	: 13°39'47.9"N
8	Longitude	: 75°8'17.9"E
9	Length	: ~12m
10	Width	: ~35m
11	Height	: VH~8m
12	Area	: --
13	Depth	: ~1.3m
14	Volume	: --
15	Run out distance	: 55m
16	Type of Material	: Debris
17	Type of movement	: slide
18	Rate of movement	: Slow
19	Activity	: Active
20	Distribution	: Retrogressive, Widening & enlarging
21	Style	: Multiple
22	Failure mechanism	: Shallow translational failure
23	History	: Initiation
24	Geomorphology	: Lowly dissected slope
25	Geology/Lithology	: Granite gneiss
26	Structure	: In-situ soil, weathered rock
27	Landuse/ Landcover	: Moderate vegetation
28	Hydrological condition	: Wet
29	Triggering Factor	: Prolonged and intense rainfall
30	Death of persons	: No casualties
31	People affected	: Nil
32	Livestock Loss	: No loss recorded
33	Communication	: No damage recorded
34	Infrastructure	: No damage recorded
35	Agriculture/forest/Barren	: Forest
36	Geo-scientific Causes	: Toe cutting of hillslope for widening of agricultural land. The drainage at toe part caused toe erosion and removal of toe support. The prolonged seepage and saturation resulted in hillside collapse due reduced cohesive and shear strength of slope forming material.
37	Remedial measures	: Easing of slope is required. Gabion wall with wire mesh can be made to arrest the soil slip by toe erosion.
38	Remarks, if any	: The area is meta-stable.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The debris slide occurred due to toe cutting of hillslope for widening of agricultural land. The drainage at toe part caused due to toe erosion and removal of toe support. The prolonged seepage and saturation resulted in hillside collapse due to loss in cohesive strength of slope forming material. Easing of slope is required. Gabion wall with wire mesh can be made to arrest the soil slip by toe erosion. The area is meta-stable.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/SHM/2019/66
2	State	: Karnataka
3	District	: Shimoga
4	Toposheet No.	: 48O/2
5	Name of the slide	: Hansa village
6	NH/SH/Locality	: Hansa village
7	Latitude	: 13°38'24.15"N
8	Longitude	: 75°8'0.18"E
9	Length	: ~30m
10	Width	: ~455m
11	Height	: VH~22m
12	Area	: --
13	Depth	: ~1.3m
14	Volume	: --
15	Run out distance	: --
16	Type of Material	: Debris

17	Type of movement	:	slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old, reactivated
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	In-situ soil, weathered rock
27	Landuse/ Landcover	:	Acacia plantation, downslope betelnut plantaion
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No causalities
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	Creep movement in upslope and nala erosion at footslope resulted in multiple slope failure and road subsidences at road bench level.
37	Remedial measures	:	Effective drainage measures i.e. lined drainage and culvert of suitable dimension should be constructed at suitable location to drain excess water downslope to minimize slope saturation.
38	Remarks, if any	:	The area is unstable zone.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The multiple slope failures and road subsidences occurred at road bench level occurred due to creep movement in upslope and nala erosion at footslope. Effective drainage measures i.e. lined drainage and culvert of suitable dimension should be constructed at suitable location on upslope to drain excess water downslope to minimize slope saturation.
41	Date of Reporting	:	09/12/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/67
2	State	:	Karnataka
3	District		Chikmanglur
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Hasakere village area
6	NH/SH/Locality	:	Gadikallu-Koppa road
7	Latitude	:	13°34'21.32"N
8	Longitude	:	75°19'54.31"E
9	Length	:	~50m
10	Width	:	~100m
11	Height	:	VH~22m
12	Area	:	--
13	Depth	:	~1.3m
14	Volume	:	--
15	Run out distance	:	~65m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Multiple
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old, reactivated
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Quartz muscovite schist, pyribolite, granite gneiss
26	Structure	:	In-situ soil and weathered rock
27	Landuse/ Landcover	:	Acacia plantation, downslope betel nut plantaion
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope failure occurred due to nala erosion and increased pore water pressure resulted in decreased shear strength failure of soil mass.
37	Remedial measures	:	Gabion wall may be constructed for toe support and to minimize toe erosion.
38	Remarks, if any		The area is demarcated as meta-stable zone.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The slope failure occurred due to nala erosion and increased pore water pressure resulted in decreased shear strength failure of soil mass. Gabion wall may be constructed for toe support and to minimize toe erosion.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field	:	Description
1	Slide No.	:	KAR/CHK/2019/68
2	State	:	Karnataka
3	District	:	Chikmanglur
4	Toposheet No.	:	480/6
5	Name of the slide	:	Ammadi coffee estate
6	NH/SH/Locality	:	Thirthahalli-Koppa road (NH-169)
7	Latitude	:	13°33'8.69"N
8	Longitude	:	75°20'42.66"E
9	Length	:	~14m
10	Width	:	~35m
11	Height	:	VH~6m
12	Area	:	--
13	Depth	:	~1m
14	Volume	:	--
15	Run out distance	:	~55m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	New

24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Pyribolite
26	Structure	:	In-situ soil, weathered rock
27	Landuse/ Landcover	:	Coffee plantation, silver oak plantation
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The vertical road cut failure is at concave curvature at road bench level caused due to intense weathering and erosion and loss of cohesive and shear strength failure of the soil. Failure occurred along the contact of quartz chlorite schist and Ferruginous phyllite.
37	Remedial measures	:	The lined drainage at toe part is required to avoid toe erosion and culvert should be constructed at suitable location to drain excess water downslope to minimize slope seepage and saturation. Slope gradation required.
38	Remarks, if any	:	The cracks are developed and area is demarcated as unstable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The vertical road cut failure is at concave curvature at road bench level caused due to intense weathering and erosion and loss of cohesive strength of the soil. Failure occurred along the contact of Quartz chlorite schist and Ferruginous phyllite. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness is 5-10m. The lined drainage at toe part is required to avoid toe erosion and culvert should be constructed at suitable location to drain excess water downslope to minimize slope seepage and saturation. Slope gradation is required. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/CHK/2019/69
2	State	: Karnataka
3	District	: Chikmanglur
4	Toposheet No.	: 48O/6
5	Name of the slide	: Baru Kodagi
6	NH/SH/Locality	: Baru Kodagi
7	Latitude	: 13°30'25.7"N
8	Longitude	: 75°23'22.7"E
9	Length	: ~15m
10	Width	: ~25m
11	Height	: VH~12m
12	Area	: --
13	Depth	: ~.5m
14	Volume	: --
15	Run out distance	: ~22m
16	Type of Material	: Debris
17	Type of movement	: Slide
18	Rate of movement	: Slow
19	Activity	: Active
20	Distribution	: Retrogressive, widening & enlarging
21	Style	: Single
22	Failure mechanism	: Shallow translational failure
23	History	: Initiation
24	Geomorphology	: Lowly dissected slope
25	Geology/Lithology	: Quartz chlorite schist, Ferruginous phyllite
26	Structure	: In-situ soil, weathered rock
27	Landuse/ Landcover	: Coffee and silver oak plantation
28	Hydrological condition	: Wet
29	Triggering Factor	: Prolonged and intense rainfall
30	Death of persons	: No casualties
31	People affected	: Nil
32	Livestock Loss	: No loss recorded
33	Communication	: No damage recorded
34	Infrastructure	: No damage recorded
35	Agriculture/forest/Barren	: Forest
36	Geo-scientific Causes	: The vertical road cut failure is at concave curvature at road bench level caused due to intense weathering and erosion and loss of cohesive strength of the soil.
37	Remedial measures	: The lined drainage at toe part is required to avoid toe erosion and culvert should be constructed at suitable location to drain excess water downslope to minimize slope seepage and saturation. Slope gradation is required.
38	Remarks, if any	: The area is demarcated as unstable zone susceptible to slope failure during rainfall.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The vertical road cut failure is at concave curvature at road bench level caused due to intense weathering and erosion and loss of cohesive strength of the soil. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness is 5-10m. The lined drainage at toe part is required to avoid toe erosion and culvert should be constructed at suitable location to drain excess water downslope to minimize slope seepage and saturation. Slope gradation is required. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/70
2	State	:	Karnataka
3	District	:	Chikmanglur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	West of Badigi village
6	NH/SH/Locality	:	West of Badigi village
7	Latitude	:	13°30'12"N
8	Longitude	:	75°23'29"E
9	Length	:	~12m
10	Width	:	~15m
11	Height	:	VH~10m
12	Area	:	--
13	Depth	:	~.5m
14	Volume	:	--
15	Run out distance	:	~22m

16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Quartz chlorite schist
26	Structure	:	In-situ soil, weathered rock
27	Landuse/ Landcover	:	Coffee plantation, silver oak plantation
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense Rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The vertical road cut failure is at concave curvature at road bench level and caused due to intense weathering and erosion and loss of cohesive strength of the soil.
37	Remedial measures	:	The lined drainage at toe part is required to avoid toe erosion and culvert should be constructed at suitable location to drain excess water downslope to minimize slope seepage and saturation.
38	Remarks, if any	:	The cracks were developed and area is demarcated as unstable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The vertical road cut failure is at concave curvature at road bench level. The primary cause of slope failure is due to intense weathering and erosion and loss of cohesive strength of the soil. The lined drainage at toe part is required to avoid toe erosion and culvert should be constructed at suitable location to drain excess water downslope to

			minimize slope seepage and saturation. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness is 5-10m. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/71
2	State	:	Karnataka
3	District	:	Chikmanglur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Kugi village
6	NH/SH/Locality	:	Kugi village
7	Latitude	:	13°30'36.8"N
8	Longitude	:	75°24'46.6"E
9	Length	:	~14m
10	Width	:	~35m
11	Height	:	VH~12m
12	Area	:	--
13	Depth	:	~.5m
14	Volume	:	--
15	Run out distance	:	~12m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Suspended
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old, suspended
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Ferruginous phyllite
26	Structure	:	In-situ soil, weathered rock
27	Landuse/ Landcover	:	Moderate vegetation, coffee plantation
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The vertical cut opened up new way of water seepage & slope saturation in weathered rock. Drainage at toe part saturated the slope

			and induced toe erosion during heavy precipitation.
37	Remedial measures	:	The lined drainage at toe part should be provided and culvert should be designed at suitable location at road bench level to channelize or discharge excess water downslope are effective drainage measures to avoid toe erosion and slope failure.
38	Remarks, if any		The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The shallow debris slide on lowly dissected hill slope with moderate vegetation cover. The vertical road cut open up new pathway for water seepage & slope saturation in weathered rock. Drainage at toe part saturated the slope and induced the toe erosion during heavy precipitation. The lined drainage at toe part should be provided and culvert should be designed at suitable location at road bench level to channelize or discharge excess water downslope are the effective drainage measures to avoid toe erosion and slope failure. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness varies between 5-10m.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/72
2	State	:	Karnataka
3	District	:	Chikmanglur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Ajaravalli village
6	NH/SH/Locality	:	Ajaravalli village
7	Latitude	:	13°34'26.5"N
8	Longitude	:	75°24'28"E
9	Length	:	~12m
10	Width	:	~35m
11	Height	:	VH~8m
12	Area	:	--
13	Depth	:	~.5m
14	Volume	:	--
15	Run out distance	:	~12m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granitoid
26	Structure	:	In-situ soil, weathered rock
27	Landuse/ Landcover	:	Betelnut plantation downslope / moderate vegetation upslope
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance resulted due to unscientific way of removal of soil by toe or piedmont cutting of the hillslope for widening of the agricultural land and getting soil for arecanut plantation. In an addition man-made drainage network for irrigation purpose in adjoining paddy field further exaggerated toe erosion and removal of toe support. The water saturation due to water infiltration on exposed cut section during rainfall provided new pathway for extensive weathering that reduced shear strength of slope forming material due to over saturation of hill slope further the natural or man-made drainage network for irrigation purpose in adjoining paddy field resulted in toe erosion and removal of toe support.
37	Remedial measures	:	The construction of gabion wall with wire mesh should be provided at foot of hill slope adjoining the paddy field as protective remedial measures to minimize the chance of toe erosion and slope saturation

			leading to mass movement. The plantation should be done on failed mass to stabilize the slope.
38	Remarks, if any		The area is demarcated as unstable zone.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	Debris slide occurred on lowly dissected slope with moderate to sparse vegetation. In present scenario the landslide is active & retrogressive in nature. The vertical cut provides new pathway for water seepage and saturation during intense rainfall. The flowing stream at toe part contributes to toe erosion and removal of toe support. The debris flow may results in loss of crop (Paddy) & agriculture land. The construction of gabion wall with wire mesh should be provided at foot of hill slope as protective remedial measures to restrict the soil slip.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/73
2	State	:	Karnataka
3	District	:	Chikmanglur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Kargese village
6	NH/SH/Locality	:	Kargese village
7	Latitude	:	13°37'11.9"N
8	Longitude	:	75°22'30.1"E
9	Length	:	~15m
10	Width	:	~45m
11	Height	:	VH~13m
12	Area	:	--
13	Depth	:	~1m
14	Volume	:	--

15	Run out distance	:	~30m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	In-situ soil, weathered rock
27	Landuse/ Landcover	:	Agriculture land downslope, upslope sparse vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No loss recorded
34	Infrastructure	:	No loss recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance resulted due to unscientific way of removal of soil by toe or piedmont cutting of the hillslope for widening of the agricultural land and getting soil for arecanut plantation. In addition the natural or man-made drainage network for irrigation purpose in adjoining paddy field further exaggerates toe erosion and removal of toe support. The water saturation due to water infiltration on exposed cut section during rainfall provided new pathway for extensive weathering that reduced shear strength of slope forming material due to over saturation of hill slope further the natural or man-made drainage network for irrigation purpose in adjoining paddy field resulted in toe erosion and removal of toe support.
37	Remedial measures	:	The construction of gabion wall with wire mesh should be provided at foot of hill slope adjoining the paddy field as protective remedial measures to minimize the chance of toe erosion and slope saturation leading to mass movement. The plantation should be done on failed mass to stabilize the slope.
38	Remarks, if any	:	The area is demarcated as unstable zone.

39	Photos. Sketch of Plan & section of the slide	:	 
40	Summary/Abstract	:	Debris slide occurred on lowly dissected slope with moderate to sparse vegetation. In present scenario the landslide is active & retrogressive in nature. The stream channels get reactivated during intense rainfall that provides new pathway for water seepage and saturation. The flowing stream at toe part contributes to toe erosion and removal of toe support. The debris flow may results in loss of crop (Paddy) & Agriculture land. The construction of gabion wall with wire mesh should be provided at foot of hill slope as protective remedial measures.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/74
2	State	:	Karnataka
3	District	:	Chikmanglur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Kargese village
6	NH/SH/Locality	:	Kargese village
7	Latitude	:	13°37'17.59"N
8	Longitude	:	75°22'25.70"E
9	Length	:	~12m
10	Width	:	~35m
11	Height	:	VH~8m
12	Area	:	--
13	Depth	:	~2m
14	Volume	:	--
15	Run out distance	:	~12m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Pyribolite
26	Structure	:	In-situ soil, weathered rock
27	Landuse/ Landcover	:	Betelnut, coconut plantation and banana plantation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No loss recorded
34	Infrastructure	:	No loss recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance resulted due to unscientific way of removal of soil by toe or piedmont cutting of the hillslope for widening the agricultural land and getting soil for arecanut plantation. In addition natural or man-made drainage network for irrigation purpose in adjoining paddy field further exaggerated toe erosion and removal of toe support. The water saturation due to water infiltration on exposed cut section during rainfall provided new pathway for extensive weathering that reduced shear strength of slope forming material due to over saturation of hill slope further the natural or man-made drainage network for irrigation purpose in adjoining paddy field resulted in toe erosion and removal of toe support.
37	Remedial measures	:	The construction of gabion wall with wire mesh should be provided at

			foot of hill slope adjoining the paddy field as protective remedial measures to minimize the chance of toe erosion and slope saturation leading to mass movement. The plantation should be done on failed mass to stabilize the slope.
38	Remarks, if any		The area is demarcated as unstable zone.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	Debris slide occurred on lowly dissected slope with moderate to sparse vegetation. In present scenario the landslide is active & retrogressive in nature. The palaeo-stream channels get reactivated during intense rainfall that provides new pathway for water seepage and saturation. The flowing stream at toe part contributes to toe erosion and removal of toe support. The debris flow may result in loss of crop (Paddy) & Agriculture land if it get reactivated. The construction of gabion wall with wire mesh should be provided at foot of hill slope as protective remedial measures.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/SHM/2019/75
2	State	: Karnataka
3	District	: Shimoga
4	Toposheet No.	: 48O/2
5	Name of the slide	: Nabala village
6	NH/SH/Locality	: Nabala village
7	Latitude	: 13°32'44.306"N
8	Longitude	: 75°9'51.017"E
9	Length	: ~8m
10	Width	: ~28m

11	Height	:	VH~5m
12	Area	:	--
13	Depth	:	~.5m
14	Volume	:	--
15	Run out distance	:	~12m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	In-situ soil and weathered rock
27	Landuse/ Landcover	:	Moderate vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope and removal of soil for road development. The vertical road cut and toe cutting of hillslope leads to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall. Drainage at toe part saturates the slope and induces toe erosion during heavy precipitation.
37	Remedial measures	:	The lined drainage at toe part and culvert should be designed at suitable location at road bench level to channelize or discharge excess water downslope as remedial measure for effective drainage and to avoid toe erosion and subsequent slope failure.
38	Remarks, if any	:	The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The shallow debris slide is on lowly dissected hill slope with Moderate vegetation cover. The vertical cut opened up new way of water seepage & slope saturation in weathered rock. Drainage at toe part saturates the slope and induced toe erosion during heavy precipitation. The lined drainage at toe part and culvert should be designed at suitable location at road bench level to channelize or discharge excess water downslope as remedial measure for effective drainage and to avoid toe erosion and subsequent slope failure. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness varies between 5-10m.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/76
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	480/2
5	Name of the slide	:	North of Hosakere village
6	NH/SH/Locality	:	Hosakere road section
7	Latitude	:	13°31'44.6"N
8	Longitude	:	75°9'37.9"E
9	Length	:	~9m
10	Width	:	~26m
11	Height	:	VH~6m
12	Area	:	--
13	Depth	:	~.5m
14	Volume	:	--

15	Run out distance	:	~12m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	In-situ soil and weathered rock
27	Landuse/ Landcover	:	Acacia plantation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope and removal of soil for road development. The vertical road cut and toe cutting of hillslope lead to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall. Drainage at toe part saturated the slope and induced toe erosion during heavy precipitation.
37	Remedial measures	:	The lined drainage at toe part and culvert should be designed at suitable location at road bench level to channelize or discharge excess water downslope as remedial measure for effective drainage and to avoid toe erosion and slope failure.
38	Remarks, if any	:	The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The shallow debris slide on lowly dissected hill slope with moderate vegetation cover. The vertical cut opened up new way of water seepage & slope saturation in weathered rock. Drainage at toe part saturated the slope and induced toe erosion during heavy precipitation. The lined drainage at toe part and culvert should be designed at suitable location at road bench level to channelize or discharge excess water downslope is effective drainage measures to avoid toe erosion and slope failure. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness varies between 5-10m.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/77
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	1.5 km east of Hosagadde village
6	NH/SH/Locality	:	Agumbe-Mavinkatte road section
7	Latitude	:	13°30'45.161"N
8	Longitude	:	75°10'14.417"E
9	Length	:	~12m
10	Width	:	~26m
11	Height	:	VH~8m
12	Area	:	--
13	Depth	:	~.5m
14	Volume	:	--
15	Run out distance	:	~12m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	In-situ soil and weathered rock
27	Landuse/ Landcover	:	Moderate vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No causalities
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	Toe erosion by flowing nala, intense weathering and erosion reduced the cohesive and shear strength of the slope forming material.
37	Remedial measures	:	Gabion wall with wire mesh at toe part of hillslope should be provided.
38	Remarks, if any	:	The area is demarcated as unstable.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The shallow debris slide occurred on lowly dissected hillslope caused due to toe erosion by flowing nala adjoining agricultural land. Gabion wall with wire mesh at toe part of hillslope should be provided to minimize toe erosion.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/SHM/2019/78
2	State	: Karnataka
3	District	: Shimoga
4	Toposheet No.	: 48O/2
5	Name of the slide	: 1.2 km from Mavinkatte village
6	NH/SH/Locality	: Agumbe-Hariharpur road (SH-655)
7	Latitude	: 13°30'9.412"N
8	Longitude	: 75°12'44.04"E
9	Length	: ~9m
10	Width	: ~90m
11	Height	: VH~7m
12	Area	: --
13	Depth	: ~.5m
14	Volume	: --
15	Run out distance	: ~12m
16	Type of Material	: Debris
17	Type of movement	: Slide
18	Rate of movement	: Slow
19	Activity	: Active
20	Distribution	: Retrogressive, widening & enlarging
21	Style	: Single

22	Failure mechanism	:	Shallow translational failure
23	History	:	Old
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	In-situ soil, weathered rock
27	Landuse/ Landcover	:	Moderate vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope and removal of soil for road development. The vertical road cut and toe cutting of hillslope lead to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall. Drainage at toe part saturated the slope and induced toe erosion during heavy precipitation.
37	Remedial measures	:	The Lined drainage should be made at toe part and culvert should be designed at suitable locations to drain excess water. In current scenario retaining wall with weep holes should be constructed at footslope for toe support in order to avoid road subsidences during heavy rainfall.
38	Remarks, if any	:	The area is demarcated as unstable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	

			
40	Summary/Abstract	:	The shallow translational debris slide occurred on extensive road cut on lowly dissected slope with moderate vegetation cover. In present scenario the landslide zone is active, retrogressive, widening and enlarging in nature. The landslide zone is ~90m wide and slope failure is observed in downslope slope direction at road bench level. The slope forming material consists of in-situ soil and weathered rock with average overburden thickness of ~8m. The rock exposed is granite gneiss and is highly weathered. The lined drainage should be made at toe part and culvert should be designed at suitable locations to drain excess water. In current scenario retaining wall with weep holes should be constructed at footslope for toe support in order to avoid road subsidences during heavy rainfall. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	26/11/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/SHM/2019/79
2	State	: Karnataka
3	District	: Shimoga
4	Toposheet No.	: 48O/2
5	Name of the slide	: Agumbe road
6	NH/SH/Locality	: Agumbe-Guddekere road
7	Latitude	: 13°33'8.2"N
8	Longitude	: 75°7'12.6"E
9	Length	: ~13 m
10	Width	: ~18m
11	Height	: VH~7m
12	Area	: --
13	Depth	: ~.5 m

14	Volume	:	--
15	Run out distance	:	~10m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Advancing , widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old, reactivated
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Metabasalt
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Acacia on upslope
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope and removal of soil for road development. The vertical road cut and toe cutting of hillslope leads to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall. Drainage at toe part saturated the slope and induced toe erosion during heavy precipitation.
37	Remedial measures	:	The lined drainage should be provided at toe part and culvert should be designed at suitable location at road bench level to channelize or discharge excess water downslope as remedial measure for effective drainage to prevent toe erosion and slope failure.
38	Remarks, if any	:	The area is demarcated as unstable zone susceptible to slope failure during rainfall.

39.	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The shallow debris slide occurred on lowly dissected hill slope with moderate vegetation cover. The vertical cut opened up new way of water seepage & slope saturation in weathered rock. Drainage at toe part saturates the slope and induced toe erosion during heavy precipitation. The lined drainage should be made at toe part and culvert should be designed at suitable location at road bench level to channelize or discharge excess water downslope as effective drainage measures to avoid toe erosion and slope failure. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall. The slope forming material consists of in-situ soil and weathered rock. The overburden thickness varies between 5-10m.
41	Date of Reporting	:	14/12/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/80
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Agumbe-Koppa road
6	NH/SH/Locality	:	Agumbe-Koppa road
7	Latitude	:	13°30'34.8"N
8	Longitude	:	75°6'21.4"E
9	Length	:	~16 m
10	Width	:	~22m
11	Height	:	VH~9m, crown height;~2.5m
12	Area	:	--
13	Depth	:	~.5 m
14	Volume	:	--
15	Run out distance	:	~10m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Metabasalt
26	Structure	:	Highly weathered and fractured rock
27	Landuse/ Landcover	:	Acacia on upslope
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope and removal of soil for road development. The vertical road cut and toe cutting of hillslope leads to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall.
37	Remedial measures	:	Easing of slope is required and lined drainage is required so that excess water get drained through the existing culvert at road bench level.
38	Remarks, if any	:	The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.

39.	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The shallow translational debris slide observed extensive road cut on Koppa-Agumbe road on lowly dissected slope with moderate vegetation cover. In present scenario the landslide zone is active, retrogressive, widening and enlarging in nature. The landslide zone is ~22m wide on convex curves of road section. The slope forming material consists of in-situ soil and weathered rock with average overburden thickness of 10m. The rock is highly weathered and fractured. Taking into consideration the risk factor, the lined drainage should be provided at toe part at road bench level to prevent water seepage and slope saturation.
41	Date of Reporting	:	14/12/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/81
2	State	:	Karnataka
3	District	:	Chikmangalur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Hariharpur Village
6	NH/SH/Locality	:	Hariharpur Village
7	Latitude	:	13°31'4.77"N
8	Longitude	:	75°18'29.09"E
9	Length	:	~12m
10	Width	:	~30m
11	Height	:	VH~8m
12	Area	:	--
13	Depth	:	~1m
14	Volume	:	--
15	Run out distance	:	--

16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Advancing , widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old, reactivated
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Sparse vegetation on upslope
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope and removal of soil for road development. The vertical road cut and toe cutting of hillslope lead to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall.
37	Remedial measures	:	Lined drainage at foot slope is required and excess water should be drained through culvert to minimize toe erosion and slope saturation.
38	Remarks, if any	:	The area is demarcated as meta-stable zone susceptible to slope failure during rainfall. The area is identified as slumping zone. The settlement at top slope at risk.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The slope disturbance is observed due to unscientific way of

			modification of slope and removal of soil for road development. The vertical road cut and toe cutting of hillslope leads to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall. Lined drainage at foot slope is required and excess water should be drained through culvert to minimize toe erosion and slope saturation. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall. The area is identified as slumping zone. The settlement at top slope is having risk.
41	Date of Reporting	:	20/12/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/82
2	State	:	Karnataka
3	District	:	Chikmangalur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Near Hariharpur
6	NH/SH/Locality	:	Near Hariharpur
7	Latitude	:	13°31'4.296"N
8	Longitude	:	75°18'35.557"E
9	Length	:	~18 m
10	Width	:	~85m
11	Height	:	VH~12m, crown height: 3m
12	Area	:	--
13	Depth	:	~2.5m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Sparse Vegetation on upslope/extensive slope cut
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense Rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil

32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope and removal of soil for road development. The vertical road cut and toe cutting of hillslope lead to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall. The rock is highly weathered and kaolinised.
37	Remedial measures	:	Slope gradation or easing of slope required.
38	Remarks, if any	:	The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The slope disturbance is observed due to unscientific way of modification of slope & removal of soil. The vertical cut and toe cutting of hillslope lead to slope transformation that opened up new way of water seepage & slope saturation. Thus increased infiltration destabilized the slope due to over water saturation and weathering during heavy rainfall. The rock is highly weathered and kaolinised. The slope gradation or easing of slope is required. The slope forming material consists of in-situ soil and weathered rock with average overburden thickness of >10m. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	23/12/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/CHK/2019/83
2	State	: Karnataka
3	District	: Chikmangalur
4	Toposheet No.	: 48O/6
5	Name of the slide	: Koppa-Agumbe road
6	NH/SH/Locality	: Koppa-Agumbe road
7	Latitude	: 13°31'5.376"N
8	Longitude	: 75°16'7.1"E
9	Length	: ~16 m
10	Width	: ~35m
11	Height	: VH~15m, crown height: 2m
12	Area	: --
13	Depth	: ~1 m
14	Volume	: --
15	Run out distance	: --
16	Type of Material	: Debris
17	Type of movement	: Slide
18	Rate of movement	: Slow
19	Activity	: Active
20	Distribution	: Retrogressive, widening & enlarging
21	Style	: Multiple
22	Failure mechanism	: Shallow translational failure
23	History	: Old
24	Geomorphology	: Lowly dissected slope
25	Geology/Lithology	: Granite gneiss
26	Structure	: Highly weathered rock
27	Landuse/ Landcover	: Sparse vegetation/moderate vegetation on upslope
28	Hydrological condition	: Damp
29	Triggering Factor	: Prolonged and intense Rainfall
30	Death of persons	: No casualties
31	People affected	: Nil
32	Livestock Loss	: No loss recorded
33	Communication	: No damage recorded
34	Infrastructure	: No damage recorded
35	Agriculture/forest/Barren	: Forest
36	Geo-scientific Causes	: The slope disturbance is observed due to unscientific way of modification of slope and removal of soil for road development. The vertical road cut and toe cutting of hillslope lead to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall.
37	Remedial measures	: Easing of slope and lined drainage is required.
38	Remarks, if any	: The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The slope disturbance is observed due to unscientific way of modification of slope and removal of soil for road development. The vertical road cut and toe cutting of hillslope lead to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall. Easing of slope and lined drainage is required. The slope forming material consists of in-situ soil with average overburden thickness of >10m. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	23/12/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/CHK/2019/84
2	State	: Karnataka
3	District	: Chikmangalur
4	Toposheet No.	: 48O/6
5	Name of the slide	: Koppa-Agumbe road
6	NH/SH/Locality	: Koppa-Agumbe road
7	Latitude	: 13°31'4.809"N
8	Longitude	: 75°18'25.202"E
9	Length	: ~18 m
10	Width	: ~28m
11	Height	: VH~9m, crown height:1m
12	Area	: --
13	Depth	: ~1 m
14	Volume	: --
15	Run out distance	: --
16	Type of Material	: Debris
17	Type of movement	: Slide
18	Rate of movement	: Slow
19	Activity	: Active
20	Distribution	: Advancing, widening & enlarging
21	Style	: Single
22	Failure mechanism	: Shallow translational failure
23	History	: Old
24	Geomorphology	: Lowly dissected slope
25	Geology/Lithology	: Granite gneiss
26	Structure	: Highly weathered rock
27	Landuse/ Landcover	: Sparse vegetation on upslope
28	Hydrological condition	: Damp
29	Triggering Factor	: Prolonged and intense rainfall
30	Death of persons	: No casualties
31	People affected	: Nil
32	Livestock Loss	: No loss recorded
33	Communication	: No damage recorded
34	Infrastructure	: No damage recorded
35	Agriculture/forest/Barren	: Forest
36	Geo-scientific Causes	: The slope disturbance is observed due to unscientific way of modification of slope and removal of soil for road development. The vertical road cut and toe cutting of hillslope leads to slope transformation that opens up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall.
37	Remedial measures	: Easing of slope and lined drainage is required.
38	Remarks, if any	: The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The slope disturbance is observed due to unscientific way of modification of slope and removal of soil for road development. The vertical road cut and toe cutting of hillslope leads to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall. Easing of slope and lined drainage is required. The slope forming material consists of in-situ soil with average overburden thickness of >10m. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	20/12/2019
42	Landslide Category	:	III

No	Field	Description
1	Slide No.	: KAR/CHK/2019/85
2	State	: Karnataka
3	District	: Chikmangalur
4	Toposheet No.	: 48O/6
5	Name of the slide	: Mathevani village
6	NH/SH/Locality	: Mathevani village
7	Latitude	: 13°31'19.202"N
8	Longitude	: 75°16'44.4"E
9	Length	: ~30 m
10	Width	: ~75m
11	Height	: VH~14m, crown height: 3.8m
12	Area	: --
13	Depth	: ~3 m
14	Volume	: --
15	Run out distance	: --

16	Type of Material	:	Debris
17	Type of movement	:	Flow
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss, quartz vein and Quartz sericite schist
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Moderate vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope & removal of soil for settlement purposes. The vertical cut and toe cutting of hillslope lead to slope transformation that opened up new pathway of water seepage & slope saturation. Thus increased infiltration and increased pore water pressure reduced the shear strength of slope forming material during heavy rainfall. The quartz vein and enclaves of quartz sericite schist within highly weathered Granite gneiss were observed on disturbed failed mass in landslide zone. The differential weathering and kaolinization of rock were also observed.
37	Remedial measures	:	Easing of slope is required and retaining wall with weep holes should be constructed to provide toe support. The slope should be monitored during heavy rainfall in monsoon.
38	Remarks, if any	:	The area is demarcated as unstable zone susceptible to slope failure during rainfall. Taking into consideration the risk factor the settlement in flow direction of debris is at high risk.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The shallow translational debris flow observed at Mathevani village area on lowly dissected slope with Moderate vegetation. In present scenario the landslide zone is active, retrogressive, widening and enlarging in nature. The landslide zone is ~75m wide with overburden thickness of ~14m. The slope disturbance is observed due to unscientific way of modification of slope & removal of soil for settlement purposes. The vertical cut and toe cutting of hillslope lead to slope transformation that opened up new way of water seepage & slope saturation. Thus increased infiltration destabilized the slope due to over water saturation during heavy rainfall. The quartz vein and enclaves of quartz sericite schist within highly weathered granite gneiss at failure zone were observed. The differential weathering and kaolinization of rock were also observed. Easing of slope is required and retaining wall with weep holes should be constructed to provide toe support. The slope should be monitored during heavy rainfall in monsoon. The area is demarcated as unstable zone susceptible to slope failure during rainfall. Taking into consideration the risk factor the settlement in flow direction of debris is at high risk.
41	Date of Reporting	:	20/12/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/86
2	State	:	Karnataka
3	District		Chikmangalur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	South west of Heggaru village
6	NH/SH/Locality	:	South west of Heggaru village

7	Latitude	:	13°31'30.036"N
8	Longitude	:	75°14'27.598"E
9	Length	:	~18 m
10	Width	:	~65m
11	Height	:	VH~15m, crown height: 2m
12	Area	:	--
13	Depth	:	~1 m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Sparse vegetation on upslope
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No causalities
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope & removal of soil for settlement purposes. The vertical cut and toe cutting of hillslope lead to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased water infiltration increased the pore water pressure and reduced the shear strength of slope forming material during heavy rainfall.
37	Remedial measures	:	Lined drainage and retaining wall with weep holes at footslope is required for toe support and to minimize toe erosion. The suitable designed culvert should be constructed at road bench level to drain excess water downslope at suitable location.
38	Remarks, if any	:	The area is demarcated as unstable zone susceptible to slope failure during rainfall. The road subsidence and slope failure is prone in downslope direction.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The slope disturbance is observed due to unscientific way of modification of slope & removal of soil for settlement purposes. The vertical cut and toe cutting of hillslope leads to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the shear strength of slope forming material during heavy rainfall. Lined drainage and retaining wall with weep holes at footslope is required for toe support and to minimize toe erosion. The culvert should be constructed at road bench level to drain excess water downslope at suitable location. The area is demarcated as unstable zone susceptible to slope failure during rainfall. The road subsidence and slope failure is prone in downslope direction.
41	Date of Reporting	:	20/12/2019
42	Landslide Category	:	III

No	Field	:	Description
1	Slide No.	:	KAR/SHM/2019/87
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/6
5	Name of the slide	:	750 m east of Nidagalale
6	NH/SH/Locality	:	NH-13 (Tirthahalli-Shimoga)
7	Latitude	:	13°43'29.83"N
8	Longitude	:	75°26'34.49"E
9	Length	:	~18 m
10	Width	:	~65m
11	Height	:	VH~15m, crown height: 2m
12	Area	:	--

13	Depth	:	~2 m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Sparse Vegetation /plantation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The scouring toe erosion by 1 st order drainage due to excess discharge of rainwater in stream channel that lead to slope failure. The exposed slope opened up new pathway for surface runoff, water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the shear strength of slope forming material during heavy rainfall.
37	Remedial measures	:	Easing of slope required. Lined drainage at foot slope is required to avoid toe erosion and slope saturation.
38	Remarks, if any	:	The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	

			
40	Summary/Abstract	:	The slope failure resulted due to toe erosion and undercutting or scouring of footslope by flowing stream that lead to slope transformation that opened up new way of water seepage & slope saturation. Thus increased infiltration destabilized the slope due to over water saturation during heavy rainfall. Lined drainage at footslope is required to avoid toe erosion and slope saturation. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	21/12/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/88
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Shimoga road (NH-13)
6	NH/SH/Locality	:	Shimoga road
7	Latitude	:	13°42'56.9"N
8	Longitude	:	75°25'33.3"E
9	Length	:	~18 m
10	Width	:	~28m
11	Height	:	VH~8m, crown height: 2m
12	Area	:	--
13	Depth	:	~1 m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris

17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Advancing , widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Ferruginous phyllite
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Sparse Vegetation on upslope
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope and removal of soil for road development. The vertical road cut and toe cutting of hillslope lead to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall.
37	Remedial measures	:	Lined drainage is required. The culvert should be designed at proper location to discharge excess water downslope to avoid toe erosion and slope saturation.
38	Remarks, if any	:	The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The slope disturbance is observed due to unscientific way of modification of slope and removal of soil for road development. The vertical road cut and toe cutting of hillslope lead to slope transformation that opened up new pathway for water seepage &

			slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall. Easing of slope and lined drainage is required. The culvert should be designed at proper location to discharge excess water downslope to avoid toe erosion and slope saturation. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	21/12/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/89
2	State	:	Karnataka
3	District	:	Chikmangalur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	West of Banagi village
6	NH/SH/Locality	:	West of Banagi village
7	Latitude	:	13°39'17.9"N
8	Longitude	:	75°28'5.2"E
9	Length	:	~18 m
10	Width	:	~28m
11	Height	:	VH~7m
12	Area	:	--
13	Depth	:	~1 m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Advancing , widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Sparse vegetation on upslope
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded

35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope and removal of soil for road development. The vertical road cut and toe cutting of hillslope lead to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall.
37	Remedial measures	:	Lined drainage is required. The culvert should be designed at proper location to discharge excess water downslope to avoid toe erosion and slope saturation.
38	Remarks, if any	:	The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The slope disturbance is observed due to unscientific way of modification of slope and removal of soil for road development. The vertical road cut and toe cutting of hillslope lead to slope transformation that opens up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall. Easing of slope and lined drainage is required. The culvert should be designed at proper location to discharge excess water downslope to avoid toe erosion and slope saturation. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	22/12/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/90
2	State	:	Karnataka
3	District		Chikmangalur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Koppa road near Kudregundi
6	NH/SH/Locality	:	Kudregundi
7	Latitude	:	13°33'8.208"N
8	Longitude	:	75°25'35.003"E
9	Length	:	~18 m
10	Width	:	~65m
11	Height	:	VH~14m, crown height: ~2m
12	Area	:	--
13	Depth	:	~1 m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Advancing, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Moderate vegetation/coffee state on upslope
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No causalities
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest/Coffee estate
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope and removal of soil for road development. The vertical road cut and toe cutting of hillslope lead to slope transformation that open up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall.
37	Remedial measures	:	Lined drainage is required. The culvert should be designed at proper location to discharge excess water downslope to avoid toe erosion and slope saturation.
38	Remarks, if any		The area is demarcated as unstable zone susceptible to slope failure during rainfall.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The slope disturbance is observed due to unscientific way of modification of slope and removal of soil for road development. The vertical road cut and toe cutting of hillslope lead to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall. Easing of slope and lined drainage is required. The culvert should be designed at proper location to discharge excess water downslope to avoid toe erosion and slope saturation. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	22/12/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/91
2	State	:	Karnataka
3	District	:	Chikmangalur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Kela Harandur
6	NH/SH/Locality	:	Koppa road
7	Latitude	:	13°32'5.8"N
8	Longitude	:	75°23'10.5"E
9	Length	:	~18m
10	Width	:	~35m
11	Height	:	VH~12m
12	Area	:	--
13	Depth	:	~1m

14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Ferruginous phyllite
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Sparse Vegetation on upslope
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope and removal of soil for road development. The vertical road cut and toe cutting of hillslope lead to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall.
37	Remedial measures	:	Lined drainage is required. The culvert should be designed at proper location to discharge excess water downslope to avoid toe erosion and slope saturation.
38	Remarks, if any	:	The area is demarcated as unstable zone susceptible to slope failure during rainfall.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The slope disturbance is observed due to unscientific way of modification of slope and removal of soil for road development. The vertical road cut and toe cutting of hillslope leads to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall. Easing of slope and lined drainage is required. The culvert should be designed at proper location to discharge excess water downslope to avoid toe erosion and slope saturation. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	22/12/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/92
2	State	:	Karnataka
3	District	:	Chikmangalur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	South of Kela Harandur
6	NH/SH/Locality	:	South of Kela Harandur
7	Latitude	:	13°31'55.4"N
8	Longitude	:	75°22'59.4"E
9	Length	:	~18 m
10	Width	:	~25m
11	Height	:	VH~7m
12	Area	:	--
13	Depth	:	~1 m

14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Retrogressive, widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Quartz chlorite schist
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Sparse vegetation/plantation on upslope
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense Rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	Electric pole uprooted damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope and removal of soil for road development. The vertical road cut and toe cutting of hillslope lead to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall.
37	Remedial measures	:	Lined drainage is required. The culvert should be designed at proper location to discharge excess water downslope to avoid toe erosion and slope saturation.
38	Remarks, if any	:	The area is demarcated as unstable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The slope disturbance is observed due to unscientific way of modification of slope and removal of soil for road development.

			The vertical road cut and toe cutting of hillslope leads to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall. Easing of slope and lined drainage is required. The culvert should be designed at proper location to discharge excess water downslope to avoid toe erosion and slope saturation. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	22/12/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/93
2	State	:	Karnataka
3	District	:	Chikmangalur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Nagalapur Village
6	NH/SH/Locality	:	Nagalapur Village
7	Latitude	:	13°30'37.9"N
8	Longitude	:	75°18'42.1"E
9	Length	:	~13 m
10	Width	:	~25m
11	Height	:	VH~9m
12	Area	:	--
13	Depth	:	~.5m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Advancing , widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Sparse vegetation /extensive cut slope
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded

34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope & removal of soil for settlement purposes. The vertical toe cutting of hillslope lead to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall.
37	Remedial measures	:	Easing and gradation of slope required.
38	Remarks, if any	:	The area is demarcated as meta-stable zone susceptible to slope failure during rainfall. The settlement in vicinity is at risk.
39.	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The slope disturbance is observed due to unscientific way of modification of slope & removal of soil for settlement purposes. The vertical toe cutting of hillslope leads to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall. The slope forming material consists of in-situ soil and weathered rock with average overburden thickness of 10m. The settlement in vicinity is at risk. Easing of slope is required. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall. The area is identified as slumping zone.
41	Date of Reporting	:	23/12/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/94
2	State	:	Karnataka
3	District	:	Chikmangalur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Edtal Village, Matina Math
6	NH/SH/Locality	:	Edtal Village
7	Latitude	:	13°32'14.2"N
8	Longitude	:	75°16'7.1"E
9	Length	:	~18 m
10	Width	:	~65m
11	Height	:	VH~15m, crown height: 2m
12	Area	:	--
13	Depth	:	~1 m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Advancing , widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Plantation/Sparse vegetation on upslope
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope disturbance is observed due to unscientific way of modification of slope & removal of soil for road development. The vertical cut and toe cutting of hillslope lead to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall.
37	Remedial measures	:	Lined drainage at footslope is required and provision of water diversion or discharge through culvert should be made to avoid toe erosion and slope saturation.
38	Remarks, if any	:	The area is demarcated as meta-stable zone susceptible to slope failure during rainfall. The area is identified as slumping zone.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The slope disturbance is observed due to unscientific way of modification of slope & removal of soil for road development. The vertical road cut and toe cutting of hillslope lead to slope transformation that opened up new pathway for water seepage & slope saturation. Thus increased infiltration increased the pore water pressure and reduced the cohesive strength of the slope forming material during heavy rainfall. The lined drainage at footslope is required and provision of water diversion or discharge through culvert should be made to avoid toe erosion and slope saturation. The area is demarcated as meta-stable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	22/12/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/95
2	State	:	Karnataka
3	District	:	Chikmangalur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Kodtal Village
6	NH/SH/Locality	:	Kodtal Village
7	Latitude	:	13°31'41.5"N
8	Longitude	:	75°15'55.6"E
9	Length	:	~16 m
10	Width	:	~100m
11	Height	:	VH~12m, crown height: 2m
12	Area	:	--
13	Depth	:	~2.5 m
14	Volume	:	--
15	Run out distance	:	--

16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Advancing , widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss, Quartz sericite schist
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Acacia Plantation on upslope
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The toe erosion by 1 st order drainage and undercutting of foot slope by flowing stream leads to slope transformation that opened up new way of water seepage & slope saturation. Thus increased discharge of rainwater in stream channel and infiltration destabilized the slope due to over water saturation during heavy rainfall.
37	Remedial measures	:	Lined drainage at footslope is required to avoid toe erosion and slope saturation.
38	Remarks, if any	:	The area is demarcated as unstable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	

40	Summary/Abstract	:	The debris slide that occurred due to unscientific way of removal of soil opened up new pathway for water seepage and saturation. The heavy discharge in flowing higher order stream during rainfall resulted in scouring and toe cutting of hillslope by nala erosion at toe part of hillslope that destabilized the slope due to over water saturation and reduced cohesive strength of the soil and highly weathered rock. The low height retaining wall with weep holes are required at footslope to minimise toe erosion by flowing nala. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	22/12/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/96
2	State	:	Karnataka
3	District	:	Chikmangalur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Gaurigadde Village
6	NH/SH/Locality	:	Gaurigadde Village
7	Latitude	:	13°31'23.97"N
8	Longitude	:	75°15'43.39"E
9	Length	:	~16 m
10	Width	:	~65m
11	Height	:	VH~12m, crown height:2m
12	Area	:	--
13	Depth	:	~2.5 m
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Advancing , widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	indistinct
27	Landuse/ Landcover	:	Thick vegetation
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No causalities
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded

33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope failure occurred due to increased infiltration and nala erosion at toe part that destabilized the slope during heavy rainfall.
37	Remedial measures	:	Lined drainage with weep holes are required at footslope to minimise toe erosion.
38	Remarks, if any	:	The area is demarcated as unstable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The debris slide occurred due to unscientific way of removal of soil opens up new pathway for water seepage and slope saturation. The heavy discharge in flowing higher order stream during rainfall resulted in scouring and toe cutting of hillslope by nala erosion at toe part of hillslope that destabilizes the slope due to over water saturation and reduction in cohesive strength of the soil and highly weathered rock. The slope forming material consists of in-situ soil and weathered rock with average overburden thickness of >10m. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	23/12/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/97
2	State	:	Karnataka
3	District		Chikmagalur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Gaurigadde Village
6	NH/SH/Locality	:	Gaurigadde Village
7	Latitude	:	13°31'28.8"N
8	Longitude	:	75°15'28.8"E
9	Length	:	~15 m
10	Width	:	~65m
11	Height	:	VH~12m, crown height: 2m
12	Area	:	--
13	Depth	:	~2.5 m
14	Volume	:	--
15	Run out distance	:	~20m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Advancing , widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Moderate vegetation on upslope, betelnut plantation and cultivation downslope
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The unscientific way of removal of soil for widening of agricultural land. The vertical cut opened up new pathway for water seepage and saturation. The heavy discharge in flowing higher order stream during rainfall resulted in scouring and toe cutting of hillslope by nala erosion at toe part of hillslope that destabilized the slope due to over water saturation and reduced cohesive strength of the soil and highly weathered rock.
37	Remedial measures	:	Lined drainage and low height retaining wall with weep holes are required at footslope to minimise toe erosion by flowing nala.
38	Remarks, if any		The area is demarcated as unstable zone susceptible to slope failure during rainfall.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The debris slide occurred due to removal of soil for widening of agricultural land. The vertical cut opened up new pathway for water seepage and saturation. The heavy discharge in flowing higher order stream during rainfall resulted in scouring and toe cutting of hillslope by nala erosion at toe part of hillslope that destabilized the slope due to over water saturation and reduced the cohesive strength of the soil and highly weathered rock. Lined drainage and low height retaining wall with weep holes are required at footslope to minimise toe erosion by flowing nala. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	23/12/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/98
2	State	:	Karnataka
3	District	:	Chikmangalur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Gaurigadde Village
6	NH/SH/Locality	:	Gaurigadde Village
7	Latitude	:	13°30'32.4"N
8	Longitude	:	75°16'9.8"E
9	Length	:	~12 m
10	Width	:	~45m
11	Height	:	VH~12m, crown height: 2m
12	Area	:	--
13	Depth	:	~2.5 m

14	Volume	:	--
15	Run out distance	:	~20m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Advancing , widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Thick vegetation
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The heavy discharge in flowing higher order stream during rainfall resulted in scouring and toe cutting of hillslope by nala erosion at toe part of hillslope that destabilized the slope due to over water saturation and reduced cohesive strength of the soil.
37	Remedial measures	:	Lined draiange are required at footslope to minimise toe erosion.
38	Remarks, if any	:	The area is demarcated as unstable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The debris slide occurred on lowly dissected hillslope with thick vegetation cover. The heavy discharge in flowing higher order stream during rainfall resulted in scouring and toe cutting of hillslope by nala erosion at toe part of hillslope that destabilized the slope due to over water saturation and reduction in cohesive strength of the soil. Lined drainage is required at footslope to

			minimise toe erosion. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	23/12/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/99
2	State	:	Karnataka
3	District		Chikmangalur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Suralli Village
6	NH/SH/Locality	:	Suralli Village
7	Latitude	:	13°30'15"N
8	Longitude	:	75°17'49.4"E
9	Length	:	~18 m
10	Width	:	~45m
11	Height	:	VH~12m, crown height: 2m
12	Area	:	--
13	Depth	:	~2 m
14	Volume	:	--
15	Run out distance	:	~20m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Advancing , widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Thick vegetation
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The vertical road cut transformed the hillslope that paved the new pathway for water infiltration and saturation in highly weathered rock and soil leading to reduced cohesive and shear strength of the slope forming material.

37	Remedial measures	:	The low height retaining wall with weep holes and lined drainage are required at foot slope to minimise toe erosion.
38	Remarks, if any	:	The area is demarcated as unstable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The vertical road cut transformed the hillslope that paved the new pathway for water infiltration and saturation in highly weathered rock and soil lead to reduced cohesive and shear strength of the slope forming material. The low height retaining wall with weep holes and lined drainage are required at foot slope to minimise toe erosion. The slope forming material consists of in-situ soil and weathered rock with average overburden thickness of >10m. The cracks on convex curvature of the road are observed. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	23/12/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/100
2	State	:	Karnataka
3	District	:	Chikmangalur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	South of Kalgudge Village/Koppa road
6	NH/SH/Locality	:	South of Kalgudge Village
7	Latitude	:	13°35'48.4"N
8	Longitude	:	75°18'16.7"E
9	Length	:	~25 m
10	Width	:	~95m
11	Height	:	VH~16m
12	Area	:	--

13	Depth	:	~2 m
14	Volume	:	--
15	Run out distance	:	~20m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Advancing , widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Sparse vegetation
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The stream/nala erosion and undercutting or scouring at toe part of hillslope destabilized the slope due to over water saturation that reduced the cohesive and shear strength of the slope forming material during heavy rainfall.
37	Remedial measures	:	The low height retaining wall and lined drainage with weep holes are required at footslope to minimise toe erosion. Easing of slope required.
38	Remarks, if any	:	The area is demarcated as unstable zone susceptible to slope failure during rainfall. Electric pole on upslope is at risk.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The shallow translational debris slide observed South of Kalgudge village area on lowly dissected slope with sparse vegetation/open scrub land in vicinity of agriculture land. In present scenario the landslide zone is active, widening and enlarging in nature. The

			landslide zone is ~95m wide with overburden thickness of ~16m. The crown cracks were also visible. The toe erosion by meandering concave curves of 2 nd order perennial stream resulted in slope failure due to increased pore water pressure and reduced cohesive and shear strength failure during heavy rainfall. Crown cracks are also visible. The low height retaining wall and lined drainage with weep holes are required at footslope to minimise toe erosion. The slope forming material consists of in-situ soil and weathered rock with average overburden thickness of >10m. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	23/12/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/101
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/6
5	Name of the slide	:	North of Hilikere Village
6	NH/SH/Locality	:	Koppa road NH-169
7	Latitude	:	13°37'25"N
8	Longitude	:	75°17'15.1"E
9	Length	:	~16 m
10	Width	:	~110m
11	Height	:	VH~14m, Crown Height; 2.5m
12	Area	:	--
13	Depth	:	~2 m
14	Volume	:	--
15	Run out distance	:	~22m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Advancing , widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock and soil
27	Landuse/ Landcover	:	Sparse vegetation
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil

32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded, electric pole on upslope.
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The water seepage and saturation at road bench level on upslope initiated the slope failure and further aggravated by toe erosion by higher order (2 nd order) stream channel flowing at footslope. The removal of soil for areacanut plantation further contributed in slope instability due to cohesive and shear strength failure during heavy rainfall.
37	Remedial measures	:	The lined drainage with weep holes should be constructed at road bench level to avoid water seepage and saturation on slope. And culvert should be designed at road bench level at suitable location to drain the excess water downslope. In current scenario retaining wall with weep holes should be constructed at footslope for toe support in order to avoid road subsidences during heavy rainfall.
38	Remarks, if any	:	The area is demarcated as unstable zone susceptible to slope failure during rainfall. Road is at high risk.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The debris slide occurred on lowly dissected hillslope at road bench level in downslope direction. The water seepage and saturation at road bench level on upslope initiated the slope failure and further aggravated by toe erosion by higher order (2 nd order) stream channel flowing at footslope. The removal of soil for areacanut plantation further contributed in slope instability. The lined drainage with weep holes should be constructed at road bench level to avoid water seepage and saturation on slope. Culvert should be designed at road bench level at suitable location to drain the excess water downslope. In current scenario retaining wall with weep holes should be constructed at footslope for toe support in order to avoid road subsidences during heavy rainfall.
41	Date of Reporting	:	23/12/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/102
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Koppa road NH-169
6	NH/SH/Locality	:	North of Hilikere Village
7	Latitude	:	13°37'33.56"N
8	Longitude	:	75°17'18.37"E
9	Length	:	~12 m
10	Width	:	~55m
11	Height	:	VH~9m, Crown Height:2.5m
12	Area	:	--
13	Depth	:	~1 m
14	Volume	:	--
15	Run out distance	:	~22m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Confined
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Sparse vegetation
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The unscientific way of removal of soil for widening of agricultural land loosen the top soil. During heavy rainfall the increased pore water pressure on slope reduced the cohesive strength of the slope forming material .
37	Remedial measures	:	Easing of slope is required.
38	Remarks, if any		The area is demarcated as unstable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The unscientific way of removal of soil provided new pathway

			for water seepage and saturation that lead to shear strength failure due to increased pore water pressure. Easing of slope required. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	23/12/2019
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/103
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Ganapatikatte village
6	NH/SH/Locality	:	1.8km from Ganapatikatte village
7	Latitude	:	13°38'45.3"N
8	Longitude	:	75°19'19.7"E
9	Length	:	~30 m
10	Width	:	~100m
11	Height	:	VH~15m, Crown Height; 2.7m
12	Area	:	--
13	Depth	:	~2 m
14	Volume	:	--
15	Run out distance	:	~22m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Advancing , widening & enlarging
21	Style	:	Mutiple
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Sparse vegetation
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Agriculture
36	Geo-scientific Causes	:	The increased infiltration and nala erosion at toe part that

			destabilized the slope due to over water saturation that resulted in cohesive and shear strength failure triggered during heavy rainfall.
37	Remedial measures	:	Easing of slope, lined drainage and breast wall with weep holes are required at footslope to minimise toe erosion and toe cutting by higher 3rd order stream.
38	Remarks, if any		The area is demarcated as unstable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The debris slide occurred on lowly dissected hillslope due to removal of soil for arecanut plantation that destabilised the slope. The stream/nala erosion and undercutting or scouring at toe part of hillslope further contributed in slope destabilization due to over water saturation resulted in cohesive and shear strength failure during heavy rainfall. The retaining wall and lined drainage with weep holes are required at footslope to minimise toe erosion. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	12/02/2020
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/104
2	State	:	Karnataka
3	District		Chikmangalur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Arkilli village
6	NH/SH/Locality	:	Arkilli village
7	Latitude	:	13°35'20.6"N
8	Longitude	:	75°26'45.7"E
9	Length	:	~10 m
10	Width	:	~55m
11	Height	:	VH~8m
12	Area	:	--
13	Depth	:	--
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Sparse vegetation/ rubber plantation
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Widening and enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Sparse vegetation/plantation on upslope
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	No casualties
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The stream/nala erosion and undercutting or scouring at toe part of hillslope destabilized the slope due to over water saturation that resulted in cohesive and shear strength failure during heavy rainfall.
37	Remedial measures	:	The low height retaining wall and lined drainage with weep holes are required at footslope to minimise toe erosion.
38	Remarks, if any		The area is demarcated as unstable zone susceptible to slope failure during rainfall.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The debris slide occurred on lowly dissected hillslope at road bench level in downslope direction where removal of soil for areca nut plantation destabilised the slope. The stream/nala

			erosion and undercutting or scouring at toe part of hillslope destabilized the slope due to over water saturation resulted in cohesive and shear strength failure of soil during heavy rainfall. The lined drainage and retaining wall with weep holes are required at footslope to minimise toe erosion and provide toe support. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	12/02/2020
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/CHK/2019/105
2	State	:	Karnataka
3	District	:	Chikmangalur
4	Toposheet No.	:	48O/6
5	Name of the slide	:	Edigere village
6	NH/SH/Locality	:	Edigere village
7	Latitude	:	13°35'29.7"N
8	Longitude	:	75°24'27.5"E
9	Length	:	~22 m
10	Width	:	~155m
11	Height	:	VH~8m
12	Area	:	--
13	Depth	:	--
14	Volume	:	--
15	Run out distance	:	~22m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Widening
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Coffee and silver oak plantation
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded

35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The unscientific way of slope modification for plantation purposes destabilized the slope gradient and provided new pathway for water seepage and saturation. The slope failure resulted due to reduced cohesive and shear strength of the slope forming material.
37	Remedial measures	:	Easing of slope is required.
38	Remarks, if any	:	The area is demarcated as unstable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The debris slide occurred on lowly dissected hillslope. The unscientific way of slope modification for plantation purposes destabilized the slope gradient and provided new pathway for water seepage and saturation. The slope failure resulted due to reduced cohesive and shear strength of the slope forming material. Easing of slope is required. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	12/02/2020
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/106
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	South of Hukkalbailu village
6	NH/SH/Locality	:	South of Hukkalbailu village
7	Latitude	:	13°38'38.86"N
8	Longitude	:	75°12'57.17"E
9	Length	:	~18 m
10	Width	:	~83m

11	Height	:	VH~12m
12	Area	:	--
13	Depth	:	--
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Widening and enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiation
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Moderate vegetation
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The increased infiltration and nala erosion at toe part destabilized the slope due to over water saturation and increased pore water pressure during intense rainfall.
37	Remedial measures	:	Easing of slope and lined drainage are required at footslope to minimise toe erosion and toe cutting by higher 3 rd order stream.
38	Remarks, if any	:	The area is demarcated as unstable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The slope failure occurred on lowly dissected hillslope adjoining agricultural land due to increased infiltration and nala erosion at toe part of hillslope due to over water saturation

			and increased pore water pressure during heavy rainfall. The slope forming material consists of in-situ soil and weathered rock with average overburden thickness of >10m. Toe erosion along 3 rd order nala/stream. Gabbion wall and lined drainage with weep holes are required at footslope to minimise toe erosion and toe cutting by higher 3 rd order stream.
41	Date of Reporting	:	12/02/2020
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/107
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Kundadi Gudda
6	NH/SH/Locality	:	Kundadi Gudda
7	Latitude	:	13°33'32.8"N
8	Longitude	:	75°10'7.1"E
9	Length	:	~22m
10	Width	:	~30m
11	Height	:	VH~12m
12	Area	:	--
13	Depth	:	--
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Rock
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Suspended
20	Distribution	:	Widening and enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Moderately weathered and fractured rock
27	Landuse/ Landcover	:	Moderate vegetation
28	Hydrological condition	:	Damp
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest

36	Geo-scientific Causes	:	The slope failure resulted due to weathering and erosion of rock and increased pore water pressure and slope saturation during heavy rainfall.
37	Remedial measures	:	Lined drainage should be provided at toe part and excess water should be diverted through properly designed culvert at suitable location at road bench level.
38	Remarks, if any	:	The area is demarcated as unstable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The slope failure resulted due to weathering and erosion of rocks and increased pore water pressure and slope saturation during heavy rainfall. Lined drainage should be provided at toe part and excess water should be diverted through properly designed culvert at suitable location at road bench level. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	12/02/2020
42	Landslide Category	:	III

No	Field	:	Description
1	Slide No.	:	KAR/CHK/2019/108
2	State	:	Karnataka
3	District	:	Chikmangalur
4	Toposheet No.	:	48O/2
5	Name of the slide	:	NH-169, Koppa Road
6	NH/SH/Locality	:	Hire Kodagi
7	Latitude	:	13°35'10.8"N
8	Longitude	:	75°19'16.7"E
9	Length	:	~18 m
10	Width	:	~35m
11	Height	:	VH~16m

12	Area	:	--
13	Depth	:	--
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Widening and enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old, Suspended
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/Landcover	:	Moderate vegetation
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	Modification of slope for plantation provided new pathway for water infiltration and erosion. During heavy rainfall pore water pressure got increased and nala erosion at toe part destabilized the slope during heavy rainfall.
37	Remedial measures	:	Lined drainage and culvert should be designed at proper location to drain excess rain water to minimize the slope saturation downslope. So, retaining wall with weep holes and lined drainage are required at foot slope to minimise toe erosion and toe cutting by higher 3 rd order stream and provide toe support to reduce the risk of road collapse.
38	Remarks, if any	:	The area is demarcated as unstable zone susceptible to slope failure during rainfall.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	Modification of slope for plantation provided new pathway for water infiltration and erosion. During heavy rainfall pore water pressure got increased and nala erosion at toe part destabilized the slope during heavy rainfall. Lined drainage and culvert should be designed at proper location to drain excess rain water to minimize the slope saturation downslope. So, retaining wall with weep holes and lined drainage are required at foot slope to minimise toe erosion and toe cutting by higher 3 rd order stream and provide toe support to reduce the risk of road collapse. The slope forming material consists of in-situ soil and weathered rock with average overburden thickness of >10m. The area is demarcated as unstable zone susceptible to slope failure during rainfall.
41	Date of Reporting	:	12/02/2020
42	Landslide Category	:	III

No	Field		Descripti
1	Slide No.	:	KAR/CHK/2019/109
2	State	:	Karnataka
3	District	:	Chikmangalur
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Kumberkoppa
6	NH/SH/Locality	:	NH-169, Koppa Road
7	Latitude	:	13°34'19.59"N
8	Longitude	:	75°19'57.18"E
9	Length	:	~18 m
10	Width	:	~35m
11	Height	:	VH~16m
12	Area	:	--
13	Depth	:	--
14	Volume	:	--

15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Widening
21	Style	:	Multiple
22	Failure mechanism	:	Shallow translational failure
23	History	:	Old, suspended
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Moderate vegetation
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	No damage recorded
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The increased infiltration by household discharge and nala erosion at toe part destabilized the slope due to over water saturation during heavy rainfall. The settlement at top slope add additional mass on the hillslope. Toe erosion along 3 rd order nala/stream further contributes in slope instability.
37	Remedial measures	:	Lined drainage and retaining wall with weep holes are required at footslope to minimise toe erosion and toe cutting by higher 3 rd order stream. Discharge of household waste water on the slope should not be done.
38	Remarks, if any	:	The area is demarcated as unstable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	At 13°34'19.16"N/75°19'59.73"E Kumbarakoppa village multiple active debris landslides with slope failures are recorded on lowly dissected hillslope. The slope forming material is in-situ soil with overburden thickness of >10m. The settlements on top of the hillslope are at risk. The landslides get triggered by

			heavy rainfall during monsoon. The drainage at toe part propagates the toe erosion. So, lined drainage at toe part of the slope should be provided to avoid seepage & slope saturation. The slope gradation should be done and appropriate drainage should be provided.
41	Date of Reporting	:	12/02/2020
42	Landslide Category	:	I

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/110
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Thirthahalli-Shimoga Road (NH-13)
6	NH/SH/Locality	:	500 East of Tudike village (NH-13)
7	Latitude	:	13°41'56.55"N
8	Longitude	:	75°16'8.29" E
9	Length	:	~18 m
10	Width	:	~45m
11	Height	:	VH~16m
12	Area	:	--
13	Depth	:	--
14	Volume	:	--
15	Run out distance	:	--
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Widening
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	Initiated
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock
27	Landuse/ Landcover	:	Moderate vegetation downslope/plantation upslope
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	Road subsidences
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The slope saturation leads to increased infiltration that reduced

			the shear and cohesive strength of the slope forming material leading to slope failure in downslope direction during heavy rainfall.
37	Remedial measures	:	Reinforced retaining wall with weep holes are required at road bench level at foot slope to avoid road subsidence and collapse. along important road corridor.
38	Remarks, if any		The area is demarcated as unstable zone susceptible to slope failure during rainfall.
39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	Subsidence of road was observed due to debris slide at downslope direction at due to improper and ineffective drainage on upslope. The slope stabilization at road bench level is provided using sand bags at successive benches in downslope direction to prevent landslips and ground subsidences as short term remedial measures. The area is demarcated as unstable zone susceptible to slope failure during rainfall. The slope forming material consists of in-situ soil with average overburden thickness of >10m.
41	Date of Reporting	:	12/02/2020
42	Landslide Category	:	III

No	Field		Description
1	Slide No.	:	KAR/SHM/2019/111
2	State	:	Karnataka
3	District	:	Shimoga
4	Toposheet No.	:	48O/2
5	Name of the slide	:	Kavaledurga road
6	NH/SH/Locality	:	South west of Kestur village area
7	Latitude	:	13°41'0.40"N
8	Longitude	:	75°10'45.1"E
9	Length	:	~14 m
10	Width	:	~95m
11	Height	:	VH~12m
12	Area	:	--
13	Depth	:	~2.5 m
14	Volume	:	--
15	Run out distance	:	~22m
16	Type of Material	:	Debris
17	Type of movement	:	Slide
18	Rate of movement	:	Slow
19	Activity	:	Active
20	Distribution	:	Advancing , widening & enlarging
21	Style	:	Single
22	Failure mechanism	:	Shallow translational failure
23	History	:	New
24	Geomorphology	:	Lowly dissected slope
25	Geology/Lithology	:	Granite gneiss
26	Structure	:	Highly weathered rock and soil
27	Landuse/ Landcover	:	Thick vegetation on upslope, plantation downslope
28	Hydrological condition	:	Wet
29	Triggering Factor	:	Prolonged and intense rainfall
30	Death of persons	:	No casualties
31	People affected	:	Nil
32	Livestock Loss	:	No loss recorded
33	Communication	:	Damage to road
34	Infrastructure	:	No damage recorded
35	Agriculture/forest/Barren	:	Forest
36	Geo-scientific Causes	:	The unscientific way of removal of soil for arecanut plantation destabilized the slope, exposed cut section provides new pathway for water seepage and saturation and 1 st order nala/streams further reduced the cohesive and shear strength of slope forming material during heavy rainfall.
37	Remedial measures	:	The lined drainage and retaining wall with weep holes are required at footslope to provide toe support.
38	Remarks, if any	:	The area is demarcated as unstable zone susceptible to slope failure during rainfall.

39	Photos. Sketch of Plan & section of the slide	:	
40	Summary/Abstract	:	The shallow translational debris slide observed on lowly dissected slope in downslope direction at convex turn of the road beside arecanut plantation in Kestur village area. The overburden thickness of in-situ soil and weathered granite is >10m. The unscientific way of removal of soil for arecanut plantation destabilized the slope, exposed cut section provided new pathway for water seepage and saturation and 1 st order nala/streams further contributed in reduction of cohesive strength of slope forming material. In active landslide zone construction of 75m wide and 4m high with retaining wall with weep holes provided at 3ft interval is on progress to stabilize and restrict road subsidences.
41	Date of Reporting	:	23/01/2020
42	Landslide Category	:	II

Tabular matrices for LOFS and consistency ratio calculations for six factor maps

Table 15: Slope angle classes with LOFS rating

I. Pair-wise comparison matrix of Slope Angle classes

Slope Angle	<15°	15-25°	25°-35°	35°-45°	>45°
<15°	1.00	0.33	0.14	0.20	1.00
15°-25°	3.00	1.00	0.20	0.33	3.00
25°-35°	7.00	5.00	1.00	3.00	7.00
35°-45°	5.00	3.00	0.33	1.00	5.00
>45°	1.00	0.33	0.14	0.20	1.00
Cumulative Sum	17.00	9.67	1.82	4.73	17.00

II. LOFS rating for Slope Angle class

Slope Angle	<15°	15-25°	25-35°	35-45°	>45°	Sum	Frac. Rate	LOFS rating
<15°	0.05882	0.034483	0.078534	0.042254	0.058824	0.272917	0.054583	0.1081
15-25°	0.17647	0.103448	0.109948	0.070423	0.176471	0.63676	0.127352	0.2523
25-35°	0.41176	0.517241	0.549738	0.633803	0.411765	2.524312	0.504862	1.0000
35-45°	0.29412	0.310345	0.183246	0.211268	0.294118	1.293094	0.258619	0.5123
>45°	0.05882	0.034483	0.078534	0.042254	0.058824	0.272917	0.054583	0.1081

Slope Angle class	Rank	LOFS Rating
<15°	2	0.1081
15-25°	4	0.2523
25-35°	8	1.0000
35-45°	6	0.5123
>45°	2	0.1081

Tabular matrices for LOFS and consistency ratio calculations for six factor maps

Table 16: Slope Curvature classes with LOFS rating

I. Pair-wise comparison matrix of Slope Curvature classes

Curvature	Concave	Flat	Convex
Concave	1.00	3.00	0.33
Flat	0.33	1.00	0.20
Convex	3.00	5.00	1.00
Cumulative Sum	4.33	9.00	1.53

II. LOFS rating for Slope Curvature classes

Curvature	Concave	Flat	Convex	Sum rows	Frac. rate	LOFS Rating
Concave	0.230769	0.333333	0.217391	0.781494	0.260498	0.4113
Flat	0.076923	0.111111	0.130435	0.318469	0.106156	0.1676
Convex	0.692308	0.555556	0.652174	1.900037	0.633346	1.0000

CLASS	Rank	LOFS Rating
Concave	4	0.4113
Flat	2	0.1676
Convex	6	1.0000

Tabular matrices for LOFS and consistency ratio calculations for six factor maps

Table 17: Landuse and Landcover classes with LOFS rating

I. Pair-wise comparison matrix of Landuse-Landcover classes

LULC	B	CL	ESC	FL	MV	HHP	LHP	QR	S	SM	TV	SV
B	1.00	0.50	0.11	1.00	0.20	0.25	0.33	0.20	1.00	0.14	0.25	0.14
CL	2.00	1.00	0.13	2.00	0.25	0.33	0.50	0.25	2.00	0.17	0.33	0.17
ESC	9.00	8.00	1.00	9.00	5.00	6.00	7.00	5.00	9.00	3.00	6.00	3.00
FL	1.00	0.50	0.11	1.00	0.20	0.25	0.33	0.20	1.00	0.14	0.25	0.14
MV	5.00	4.00	0.20	5.00	1.00	2.00	3.00	1.00	5.00	0.33	2.00	0.33
HHP	4.00	3.00	0.17	4.00	0.50	1.00	2.00	0.50	4.00	0.25	1.00	0.25
LHP	3.00	2.00	0.14	3.00	0.33	0.50	1.00	0.33	3.00	0.20	0.50	0.20
QR	5.00	4.00	0.20	5.00	1.00	2.00	3.00	1.00	5.00	0.33	2.00	0.33
S	1.00	0.50	0.11	1.00	0.20	0.25	0.33	0.50	1.00	0.14	0.25	0.14
SM	7.00	6.00	0.33	7.00	3.00	4.00	5.00	3.00	7.00	1.00	4.00	1.00
TV	4.00	3.00	0.17	4.00	0.50	1.00	2.00	0.50	4.00	0.25	1.00	0.25
SV	7.00	6.00	0.33	7.00	3.00	4.00	5.00	3.00	7.00	1.00	4.00	1.00
Cumulative Sum	49.00	38.50	3.00	49.00	15.18	21.58	29.50	15.48	49.00	6.96	21.58	6.96

II. LOFS rating for Landuse-Landcover classes

LU /LC	B	CL	ESC	FL	MV	HHP	LHP	QR	S	SM	TV	SV	Sum rows	Frac rate	LOFS
B	0.020408	0.012987	0.037022	0.020408	0.013172	0.011583	0.011299	0.012917	0.020408	0.02052	0.011583	0.02052	0.212828	0.017736	0.0626
CL	0.040816	0.025974	0.04165	0.040816	0.016465	0.015444	0.016949	0.016146	0.040816	0.02394	0.015444	0.02394	0.318402	0.026533	0.0937
ESC	0.183673	0.207792	0.333201	0.183673	0.329308	0.277992	0.237288	0.322928	0.183673	0.430917	0.277992	0.430917	3.399356	0.28328	1.0000
FL	0.020408	0.012987	0.037022	0.020408	0.013172	0.011583	0.011299	0.012917	0.020408	0.02052	0.011583	0.02052	0.212828	0.017736	0.0626
MV	0.102041	0.103896	0.06664	0.102041	0.065862	0.092664	0.101695	0.064586	0.102041	0.04788	0.092664	0.04788	0.989888	0.082491	0.2912

Tabular matrices for LOFS and consistency ratio calculations for six factor maps

LU /LC	B	CL	ESC	FL	MV	HHP	LHP	QR	S	SM	TV	SV	Sum rows	Frac rate	LOFS
HHP	0.081633	0.077922	0.055534	0.081633	0.032931	0.046332	0.067797	0.032293	0.081633	0.03591	0.046332	0.03591	0.675857	0.056321	0.1988
LHP	0.061224	0.051948	0.0476	0.061224	0.021954	0.023166	0.033898	0.021529	0.061224	0.028728	0.023166	0.028728	0.46439	0.038699	0.1366
QR	0.102041	0.103896	0.06664	0.102041	0.065862	0.092664	0.101695	0.064586	0.102041	0.04788	0.092664	0.04788	0.989888	0.082491	0.2912
S	0.020408	0.012987	0.037022	0.020408	0.013172	0.011583	0.011299	0.032293	0.020408	0.02052	0.011583	0.02052	0.232204	0.01935	0.0683
SM	0.142857	0.155844	0.111067	0.142857	0.197585	0.185328	0.169492	0.193757	0.142857	0.143639	0.185328	0.143639	1.91425	0.159521	0.5631
TV	0.081633	0.077922	0.055534	0.081633	0.032931	0.046332	0.067797	0.032293	0.081633	0.03591	0.046332	0.03591	0.675857	0.056321	0.1988
SV	0.142857	0.155844	0.111067	0.142857	0.197585	0.185328	0.169492	0.193757	0.142857	0.143639	0.185328	0.143639	1.91425	0.159521	0.5631

CLASS	Rank	LOFS Rating
Barren	1	0.0626
Barren Sand	0	0.0000
Cultivation	2	0.0937
Extensive Slope Cut	9	1.0000
Fallow Land	1	0.0626
Moderate Vegetation	5	0.2912
Plantation (HHP)	4	0.1988
Plantation (LHP)	3	0.1366
Quarry	5	0.2912
Settlement	1	0.0683
Settlement on modified slope	7	0.5631
Swamp	0	0.0000
Thick Vegetation	4	0.1988
Sparse Vegetation	7	0.5631
Water body	0	0.0000
Salt Pan	0	0.0000

Tabular matrices for LOFS and consistency ratio calculations for six factor maps

Table 18: Geomorphology classes with LOFS rating

I. Pair-wise comparison matrix of Landuse-Landcover classes

CLASS	DS	ESC	MOUND	CFS	LDS	MDS	HDS	PIED SLOPE
DS	1	8	8	7	6	4	2	6
ESC	0.125	1	1	0.5	0.333333333	0.2	0.142857143	0.333333333
MOUND	0.125	1	1	0.5	0.333333333	0.2	0.142857143	0.333333333
CFS	0.142857143	2	2	1	0.5	0.25	0.166666667	0.5
LDS	0.166666667	3	3	2	1	0.333333333	0.2	1
MDS	0.25	5	5	4	3	1	0.333333333	3
HDS	0.5	7	7	6	5	3	1	5
PIED SLOPE	0.166666667	3	3	2	1	0.333333333	0.2	1
Sum total	2.476190476	30	30	23	17.16666667	9.316666667	4.185714286	17.16666667

II. LOFS rating for Geomorphology classes

CLASS	DS	ESC	MOUND	CFS	LDS	MDS	HDS	PIED SLOPE	Sum Rows	Frac rate	LOFS
DS	0.403846154	0.266667	0.266666667	0.30435	0.349514563	0.429338104	0.4778157	0.34951456	2.8477102	0.35596	1
ESC	0.050480769	0.033333	0.033333333	0.02174	0.019417476	0.021466905	0.034129693	0.01941748	0.2333181	0.02916	0.08193
MOUND	0.050480769	0.033333	0.033333333	0.02174	0.019417476	0.021466905	0.034129693	0.01941748	0.2333181	0.02916	0.08193
CFS	0.057692308	0.066667	0.066666667	0.04348	0.029126214	0.026833631	0.039817975	0.02912621	0.3594079	0.04493	0.12621
LDS	0.067307692	0.1	0.1	0.08696	0.058252427	0.035778175	0.04778157	0.05825243	0.5543288	0.06929	0.19466
MDS	0.100961538	0.166667	0.166666667	0.17391	0.174757282	0.107334526	0.07963595	0.17475728	1.144693	0.14309	0.40197
HDS	0.201923077	0.233333	0.233333333	0.26087	0.291262136	0.322003578	0.23890785	0.29126214	2.072895	0.25911	0.72792
PIED SLOPE	0.067307692	0.1	0.1	0.08696	0.058252427	0.035778175	0.04778157	0.05825243	0.5543288	0.06929	0.19466

Tabular matrices for LOFS and consistency ratio calculations for six factor maps

GEOMORPHOLOGY CLASSES	Rank	LOFS Rating
Denudational Slope	9	1
Escarpment	2	0.0819
Mound	2	0.0819
Colluvial Footslope	3	0.1262
Lowly Dissected Slope	4	0.1947
Moderately Dissected Slope	6	0.402
Highly Dissected Slope	8	0.7279
Piedmont Slope	4	0.1947
Ridge-top	0	0
Tidal Flat	0	0
Water body	0	0
Plateau Top (Flat)	0	0
Rolling Plain	0	0
Valley Fill	0	0
Alluvial Plain	0	0
Beach	0	0
Coastal Plain	0	0
Pediment-Pediplain Complex	0	0
Hilltop	0	0

Tabular matrices for LOFS and consistency ratio calculations for six factor maps

Table 19: Slope Forming Material map with LOFS rating

I. Pair-wise comparison matrix of Slope Curvature classes

SFM CLASSES	CSD	INSITU	COL	LSD	R (Type-1)	R (Type-2)	R (Type-3)	TS	WR
CSD	1	0.5	0.333333	0.166667	3	2	0.5	1	0.25
INSITU	2	1	0.5	0.2	4	3	1	2	0.333333
COL	3	2	1	0.25	5	4	2	3	0.5
LSD	6	5	4	1	8	7	5	6	3
R(Type-1)	0.333333	0.25	0.2	0.125	1	0.5	0.25	0.333333333	0.166667
R(Type-2)	0.5	0.333333	0.25	0.142857	2	1	0.333333333	0.5	0.2
R(Type-3)	2	1	0.5	0.2	4	3	1	2	0.333333
TS	1	0.5	0.333333	0.166667	3	2	0.5	1	0.25
WR	4	3	2	0.333333	6	5	3	4	1
SUM	19.83333	13.58333	9.116667	2.584524	36	27.5	13.58333333	19.83333333	6.033333

II. LOFS rating for Slope Forming Material classes

SFM CLASSES	CSD	INSITU	COL	LSD	R(Type-1)	R(Type-2)	R(Type-3)	TS	WR	Sum Rows	Frac rate	LOFS
CSD	0.05042	0.03681	0.036563	0.064486	0.083333333	0.072727273	0.036809816	0.050420168	0.041436	0.473006521	0.052556	0.150594949
INSITU	0.10084	0.07362	0.054845	0.077384	0.111111111	0.109090909	0.073619632	0.100840336	0.055249	0.756598876	0.084067	0.240884562
COL	0.151261	0.147239	0.109689	0.09673	0.138888889	0.145454545	0.147239264	0.151260504	0.082873	1.17063473	0.130071	0.372704538
LSD	0.302521	0.368098	0.438757	0.386918	0.222222222	0.254545455	0.36809816	0.302521008	0.497238	3.140918908	0.348991	1
R(Type-1)	0.016807	0.018405	0.021938	0.048365	0.027777778	0.018181818	0.018404908	0.016806723	0.027624	0.214309818	0.023812	0.068231567
R(Type-2)	0.02521	0.02454	0.027422	0.055274	0.055555556	0.036363636	0.024539877	0.025210084	0.033149	0.307264657	0.034141	0.097826358
R(Type-3)	0.10084	0.07362	0.054845	0.077384	0.111111111	0.109090909	0.073619632	0.100840336	0.055249	0.756598876	0.084067	0.240884562
TS	0.05042	0.03681	0.036563	0.064486	0.083333333	0.072727273	0.036809816	0.050420168	0.041436	0.473006521	0.052556	0.150594949
WR	0.201681	0.220859	0.219378	0.128973	0.166666667	0.181818182	0.220858896	0.201680672	0.165746	1.707661092	0.18974	0.543682006

Tabular matrices for LOFS and consistency ratio calculations for six factor maps

CLASS	Rank	LOFS
In-situ soil	4	0.2409
Banded magnetite quartzite	1	0.0682
Granite	1	0.0682
Granite gneiss	1	0.0682
Quartzite	1	0.0682
Quartz vein	1	0.0682
Ultramafite	1	0.0682
Dolerite	1	0.0682
Granitoid	1	0.0682
Meta-dolerite	1	0.0682
Epidiorite	1	0.0682
Gabbro	1	0.0682
Metabasalt	1	0.0682
Metagabbro	1	0.2409
Quartz porphyry	1	0.2409
Calcrete	2	0.2409
Conglomerate	2	0.2409
Transported Soil	3	0.1506
Weathered Rock	6	0.5437
Water body	0	0.0000
River	0	0.0000
Laterite	4	0.2409
Amphibolite	4	0.2409
Metapyroxenite	4	0.2409
Pyroxene granulite	4	0.2409
Carbonaceous phyllite	4	0.2409
Ferruginous phyllite	4	0.2409
Quartz-chlorite schist	4	0.2409

Tabular matrices for LOFS and consistency ratio calculations for six factor maps

Table 20: Regolith Thickness classes with LOFS rating

I. Pair-wise comparison matrix of Regolith Thickness classes

Regolith Thickness	0.5 - 5 m	5 - 10 m	>10 m
0.5 - 5 m	1.00	4.00	6.00
5 - 10 m	0.25	1.00	3.00
>10 m	0.17	0.33	1.00
Sun Cumulative	1.42	5.33	10.00

II. LOFS rating for Regolith Thickness classes

Regolith Thickness	0.5 - 5 m	5 - 10 m	>10 m	Sum rows	Frac rate	LOFS
0.5 - 5 m	0.705882	0.75	0.6	2.055882	0.685294	1.0000
5 - 10 m	0.176471	0.1875	0.3	0.663971	0.221324	0.3230
>10 m	0.117647	0.0625	0.1	0.280147	0.093382	0.1363

Regolith Thickness classes (in mts)	Rank	LOFS Rating
<0.5m	0	0
0.5-5m	7	1
5-10m	4	0.322961
>10m	2	0.136266

Tabular matrices for LOFS and consistency ratio calculations for six factor maps

Table 21: Table showing Pair-wise comparison matrix of individual geofactor maps and weights.

Factor	Slope	Curvature	SFM	LULC	Geom	RT	Factor Classes	Rank
Slope	1.00	6.00	0.33	2.00	5.00	3.00	Slope	7
Curvature	0.17	1.00	0.13	0.20	0.50	0.25	Curvature	2
SFM	3.00	8.00	1.00	4.00	7.00	5.00	SFM	9
LULC	0.50	5.00	0.25	1.00	4.00	2.00	LULC	6
Geom	0.20	2.00	0.14	0.25	1.00	0.33	Geomorphology	3
RT	0.33	4.00	0.20	0.50	3.00	1.00	Regolith Thickness	5
Sum Cumulative	5.20	26.00	2.05	7.95	20.50	11.58		

Factor	Slope	Curvature	SFM	LULC	Geom	RT	Sum rows	Frac rate	Weight	Weight WN
Slope	0.19231	0.23077	0.16098	0.25157	0.24390	0.25907	1.33859	0.2230991	6.5073541	7
Curvature	0.03269	0.03846	0.06341	0.02516	0.02439	0.02159	0.20570	0.0342842	1	1
SFM	0.57692	0.30769	0.48780	0.50314	0.34146	0.43178	2.64881	0.4414679	12.876734	13
LULC	0.09615	0.19231	0.12195	0.12579	0.19512	0.17271	0.90403	0.1506721	4.3948026	4
Geom	0.03846	0.07692	0.06829	0.03145	0.04878	0.02850	0.29240	0.0487336	1.4214622	1
RT	0.06346	0.15385	0.09756	0.06289	0.14634	0.08636	0.61046	0.1017432	2.9676444	3

Factor	Slope	Curvature	SFM	LULC	Geom	RT	Sum rows	CV
Slope	0.223099109	0.205704903	0.1456844	0.3013441	0.2436681	0.3052295	1.4247302	6.3860863
Curvature	0.037926849	0.034284151	0.0573908	0.0301344	0.0243668	0.0254358	0.2095388	6.1118283
SFM	0.669297328	0.274273204	0.4414679	0.6026883	0.3411354	0.5087158	2.8375779	6.4275977
LULC	0.111549555	0.171420753	0.110367	0.1506721	0.1949345	0.2034863	0.9424302	6.254843
Geom	0.044619822	0.068568301	0.0618055	0.037668	0.0487336	0.0335752	0.2949705	6.0527105
RT	0.073622706	0.137136602	0.0882936	0.075336	0.1462009	0.1017432	0.622333	6.1167052
							Sum CV	37.349771

TABULAR RAINFALL DATA OF RAIN GAUGE STATIONS FOR TEN YEARS.

ANNEXURE-IV

		Average Rainfall 2009-2017											
							2009						
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Taluk	Hobli												
Tirthahalli	TIRTHAHALLI HOBLI	0.0	0.0	3.4	0.0	3.9	5.6	58.8	12.9	15.0	5.2	3.7	0.5
Tirthahalli	AGRAHARA HOBLI	0.0	0.0	2.5	0.2	4.2	8.0	62.2	14.1	14.1	6.1	3.7	0.4
Tirthahalli	AGUMBE HOBLI	0.1	0.0	3.4	0.4	2.4	25.6	93.9	32.0	35.3	12.7	2.0	0.7
Tirthahalli	MANDAGADDE HOBLI	0.0	0.0	0.6	0.8	2.9	3.5	31.2	5.8	11.7	2.8	2.3	0.5
							2010						
Tirthahalli	TIRTHAHALLI HOBLI	0.5	0.0	0.2	0.8	3.6	5.9	10.1	7.8	9.0	2.8	2.8	0.1
Tirthahalli	AGRAHARA HOBLI	0.5	0.0	0.0	3.7	3.5	3.0	3.4	4.6	3.3	3.4	1.9	0.0
Tirthahalli	AGUMBE HOBLI	0.8	0.0	0.0	1.7	3.9	2.8	4.8	4.4	4.7	1.5	4.6	0.1
Tirthahalli	MANDAGADDE HOBLI	1.0	0.0	0.0	2.1	3.0	3.7	4.6	4.1	4.1	3.0	3.7	0.0
							2011						
Tirthahalli	TIRTHAHALLI HOBLI	0.0	0.1	0.0	1.0	0.7	28.9	31.9	24.3	20.3	4.7	1.5	0.0
Tirthahalli	AGRAHARA HOBLI	0.0	0.0	0.0	3.0	1.9	20.5	27.7	17.7	17.0	3.6	1.8	0.0
Tirthahalli	AGUMBE HOBLI	0.1	0.0	0.0	2.9	0.9	47.4	42.8	45.6	29.4	6.0	2.5	0.1
Tirthahalli	MANDAGADDE HOBLI	0.0	0.0	0.0	0.7	0.2	10.0	16.6	12.5	12.1	4.5	1.2	0.0
							2012						
Tirthahalli	TIRTHAHALLI HOBLI	0.0	0.0	0.0	1.9	0.7	13.6	20.7	25.4	4.5	1.2	3.8	0.0

TABULAR RAINFALL DATA OF RAIN GAUGE STATIONS FOR TEN YEARS.

ANNEXURE-IV

Tirthahalli	AGRAHARA HOBLI	0.0	0.0	0.0	2.6	1.4	9.0	14.6	25.0	9.1	1.4	3.9	0.0
Tirthahalli	AGUMBE HOBLI	0.0	0.0	0.0	3.4	0.7	34.3	40.3	38.4	27.4	1.3	3.2	0.1
Tirthahalli	MANDAGADDE HOBLI	0.0	0.0	0.0	1.6	2.1	4.9	7.7	12.9	4.3	0.8	1.7	0.0
							2013						
Tirthahalli	TIRTHAHALLI HOBLI	0.0	0.4	0.1	1.0	1.1	29.9	51.4	16.5	7.9	2.8	0.2	0.0
Tirthahalli	AGRAHARA HOBLI	0.0	0.8	0.1	2.2	1.9	24.7	49.0	18.7	7.2	3.1	0.3	0.0
Tirthahalli	AGUMBE HOBLI	0.1	0.5	0.3	1.0	6.2	45.5	88.9	29.7	15.9	13.0	2.2	0.4
Tirthahalli	MANDAGADDE HOBLI	0.0	0.2	0.2	0.7	2.1	11.8	30.9	10.1	5.7	1.4	0.7	0.0
							2014						
Tirthahalli	TIRTHAHALLI HOBLI	0.0	0.1	0.0	1.0	4.9	10.9	45.2	27.8	11.8	2.9	0.3	0.4
Tirthahalli	AGRAHARA HOBLI	0.0	0.2	0.1	1.7	5.5	10.4	35.6	19.3	10.2	3.2	0.1	0.3
Tirthahalli	AGUMBE HOBLI	0.0	0.0	0.2	2.6	4.4	16.5	64.9	50.8	18.7	5.3	1.3	0.4
Tirthahalli	MANDAGADDE HOBLI	0.0	0.0	0.6	1.9	4.0	4.6	15.0	12.2	7.6	3.9	0.2	0.4
							2015						
Tirthahalli	TIRTHAHALLI HOBLI	0.0	0.0	0.9	1.4	3.4	29.3	23.8	14.5	4.9	3.3	2.3	0.1
Tirthahalli	AGRAHARA HOBLI	0.0	0.0	1.8	1.9	4.7	23.1	13.5	9.1	5.1	4.3	3.2	0.1
Tirthahalli	AGUMBE HOBLI	0.1	0.0	0.6	1.5	3.0	30.2	42.3	21.9	9.2	6.3	3.1	0.1
Tirthahalli	MANDAGADDE HOBLI	0.0	0.0	1.3	2.2	3.4	15.2	9.8	6.7	3.8	3.4	2.7	0.1
							2016						
Tirthahalli	TIRTHAHALLI HOBLI	0.0	0.0	0.0	0.1	2.8	17.7	21.3	20.7	5.9	1.4	0.3	0.1
Tirthahalli	AGRAHARA HOBLI	0.0	0.0	0.0	0.0	2.8	13.4	21.3	12.1	4.0	1.6	0.6	0.2

TABULAR RAINFALL DATA OF RAIN GAUGE STATIONS FOR TEN YEARS.

ANNEXURE-IV

Tirthahalli	AGUMBE HOBLI	0.0	0.0	0.0	0.0	4.1	29.4	35.9	32.1	12.0	2.4	0.8	0.1
Tirthahalli	MANDAGADDE HOBLI	0.0	0.0	0.0	0.0	2.6	9.8	13.6	9.0	4.3	1.5	0.6	0.1
							2017						
Tirthahalli	TIRTHAHALLI HOBLI	0.0	0.0	0.0	0.4	2.9	24.4	27.0	23.5	8.8	2.2	0.6	0.0
Tirthahalli	AGRAHARA HOBLI	0.0	0.0	0.1	0.3	3.0	17.8	22.3	15.5	9.0	2.7	0.7	0.0
Tirthahalli	AGUMBE HOBLI	0.0	0.0	0.0	0.6	4.3	32.8	40.4	31.4	9.5	4.3	0.8	0.2
Tirthahalli	MANDAGADDE HOBLI	0.0	0.1	0.3	0.5	3.0	9.6	12.5	9.4	6.7	2.5	0.7	0.0
						2009-2017							
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tirthahalli	TIRTHAHALLI HOBLI	0.1	0.1	0.5	0.9	2.7	18.5	32.3	19.3	9.8	3.0	1.7	0.1
Tirthahalli	AGRAHARA HOBLI	0.1	0.1	0.5	1.7	3.2	14.4	27.7	15.1	8.8	3.3	1.8	0.1
Tirthahalli	AGUMBE HOBLI	0.1	0.1	0.5	1.6	3.3	29.4	50.5	31.8	18.0	5.9	2.3	0.2
Tirthahalli	MANDAGADDE HOBLI	0.1	0.0	0.3	1.2	2.6	8.1	15.8	9.2	6.7	2.6	1.5	0.1

				KOPPA 1997-2017								
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
KOPPA	1.0	6.0	31.0	58.3	96.9	493.6	912.4	673.8	232.6	123.9	59.6	10.5

FIELD PHOTOGRAPHS

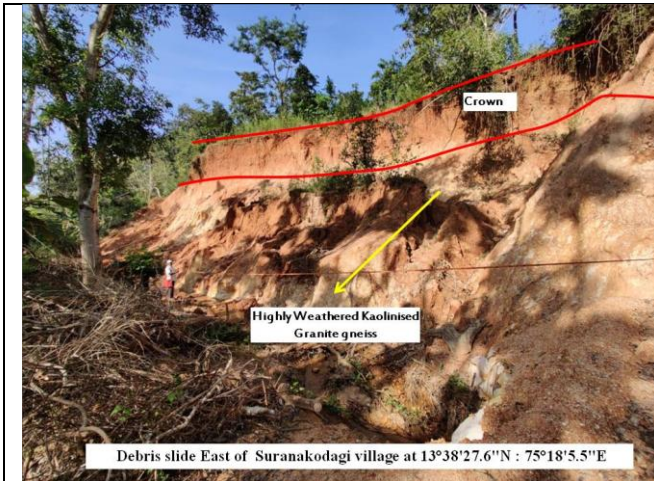


Photo 1: Debris slide East of Suranakodagi village at $13^{\circ}38'27.6''\text{N}$: $75^{\circ}18'5.5''\text{E}$



Photo 2: Debris slide at Hulikal road $13^{\circ}43'8.88''\text{N}$ / $75^{\circ}0'11.02''\text{E}$

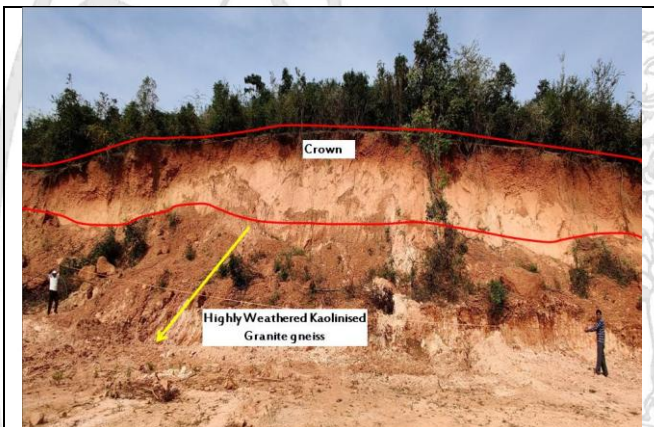


Photo 3: Hariharpur on NH-169; Debris Slide at $13^{\circ}41'58.1''\text{N}$: $75^{\circ}24'11.7''\text{E}$



Photo 4: Debris Slide South of Kalgudge Village/Koppa road at $13^{\circ}35'48.4''\text{N}$ / $13^{\circ}35'48.4''\text{N}$



Photo 5: Kanave Village: Debris Flow at $13^{\circ}41'58.1''\text{N}$: $75^{\circ}24'11.7''\text{E}$

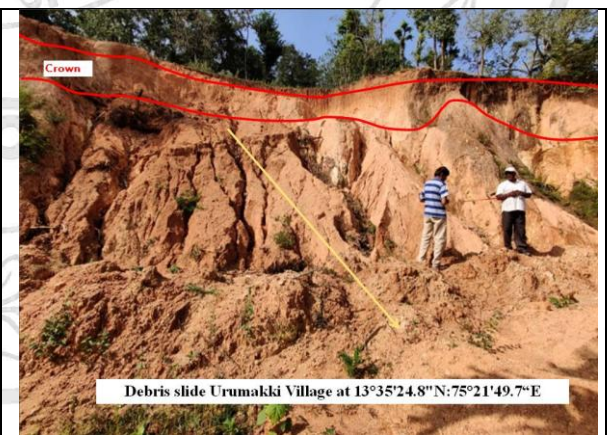


Photo 6: Debris slide Urumakki Village at $13^{\circ}35'24.8''\text{N}$: $75^{\circ}21'49.7''\text{E}$

FIELD PHOTOGRAPHS



Photo 7: Extensive Cut Slope failure on lowly dissected hillslope in Ganapatikatte Village of T.S. no. 480/6



Photo 8: Settlement on Modified Slope Madagere village of T.S. no. 480/6

Photo 9: Settlement on Modified Slope Nagalapur Village of T.S. no. 480/6

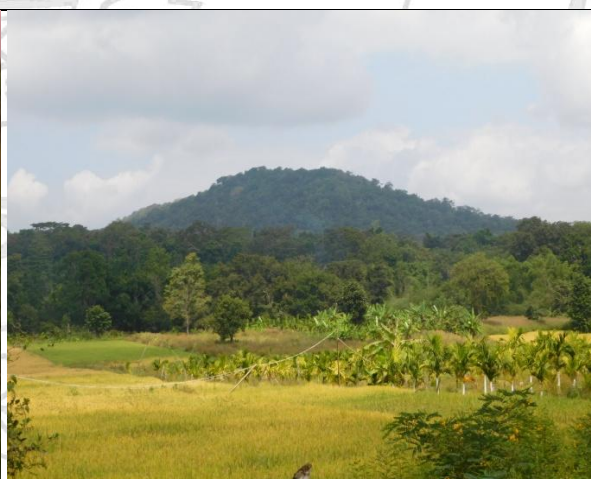


Photo 10: Escarpment of Highly Dissected Hillslope of Agumbe hill ranges.

Photo 11: Cultivation on Pediment-Pediplain Complex adjacent to lowly dissected hillslope.

FIELD PHOTOGRAPHS



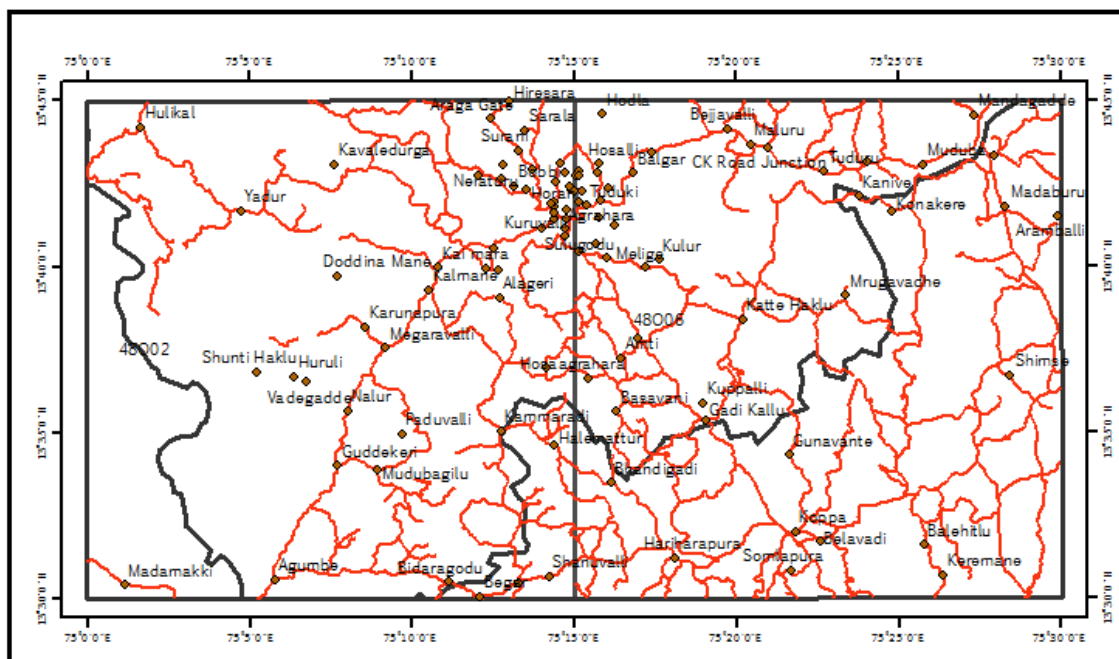
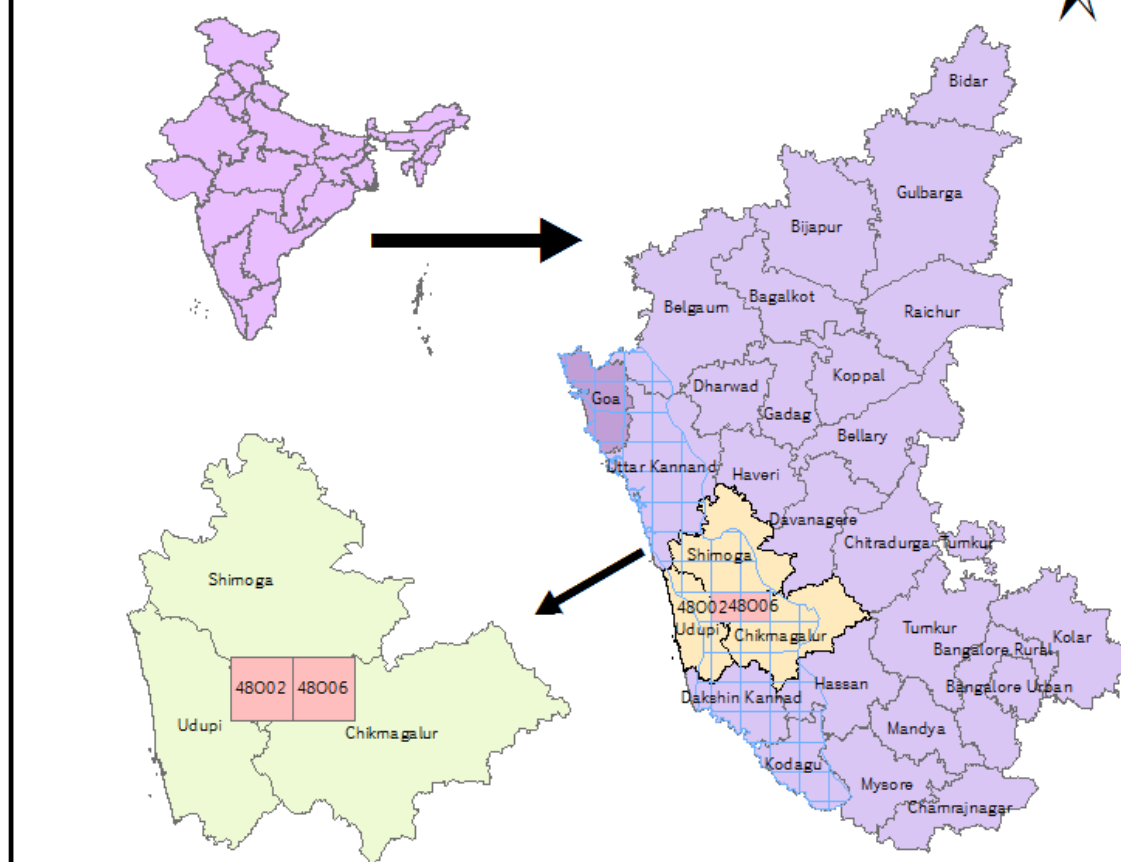
Photo 12: Lowly Dissected Hillslope in and around Thirthahalli.



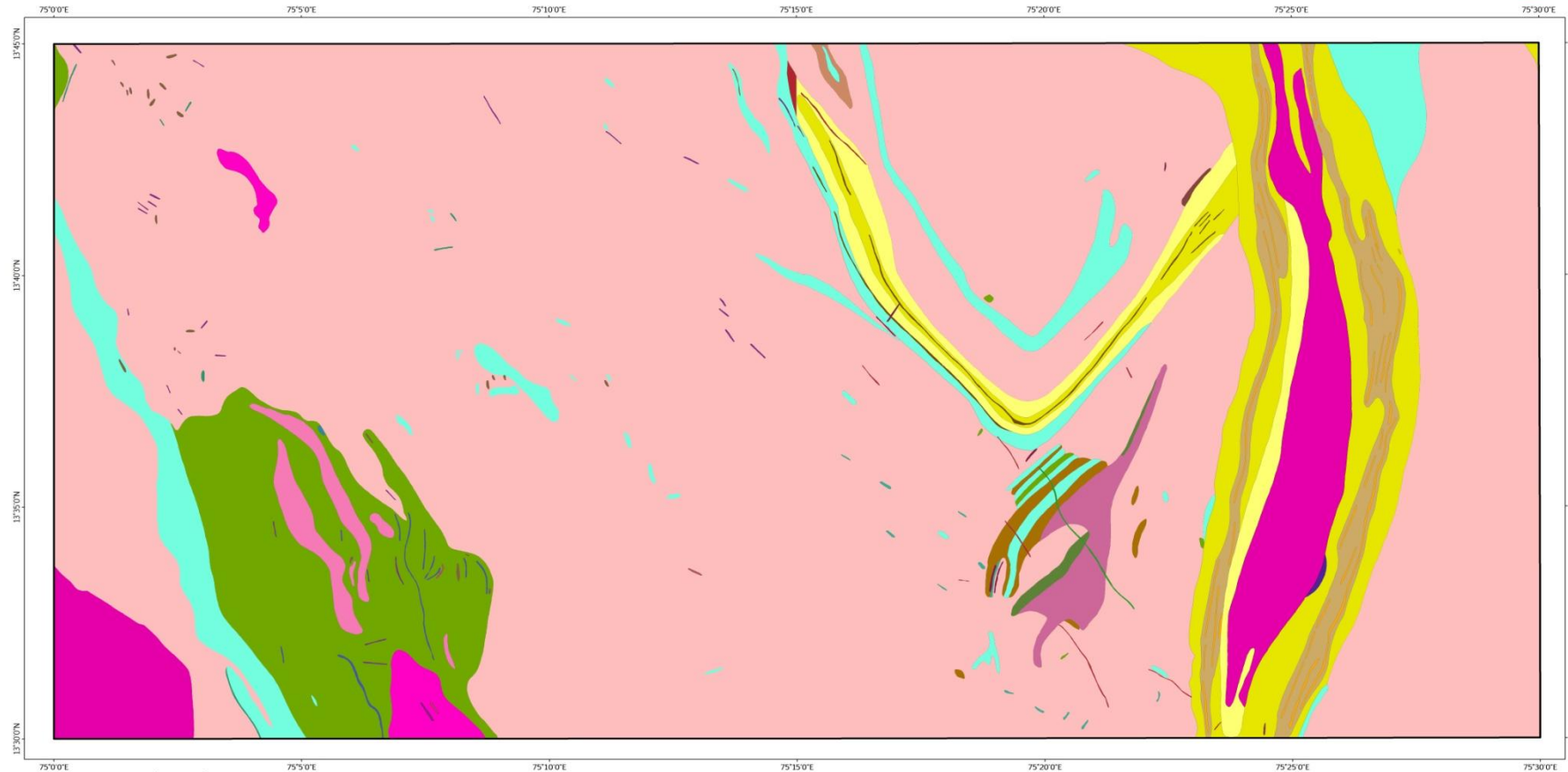
Photo 13: Soil profile section of Vertical Slope Cut in the study area.



LOCATION MAP OF THE STUDY AREA



Geological Map of SOI TS Nos. 480/2 & 480/6 of the Study Area



Legend

Lithology

Amphibolite	Granite	Quartz vein	Manganiferous iron quartzite	Laterite	Sericite schist
Banded haematite quartzite	Granite gneiss	Quartzite	Conglomerate	Pyribolite	Quartz-muscovite schist
Banded magnetite quartzite	Granitoid(Karwar)	Sericite schist	Ferruginous phyllite	Quartz vein	Ultramafite
Dolerite	Kyanite-muscovite schist	Ultramafite	Quartz-chlorite schist	Gabbro	
Garnet-grunerite schist	Metabasalt	Banded iron formation	Calc silicate rock	Quartzite	

Landuse/Landcover Map of T.S nos. 480/2 and 480/6 in parts of Chikmangalur, Shimoga & Udupi districts, Karnataka

0 1.5 3 6 9 12 Kms



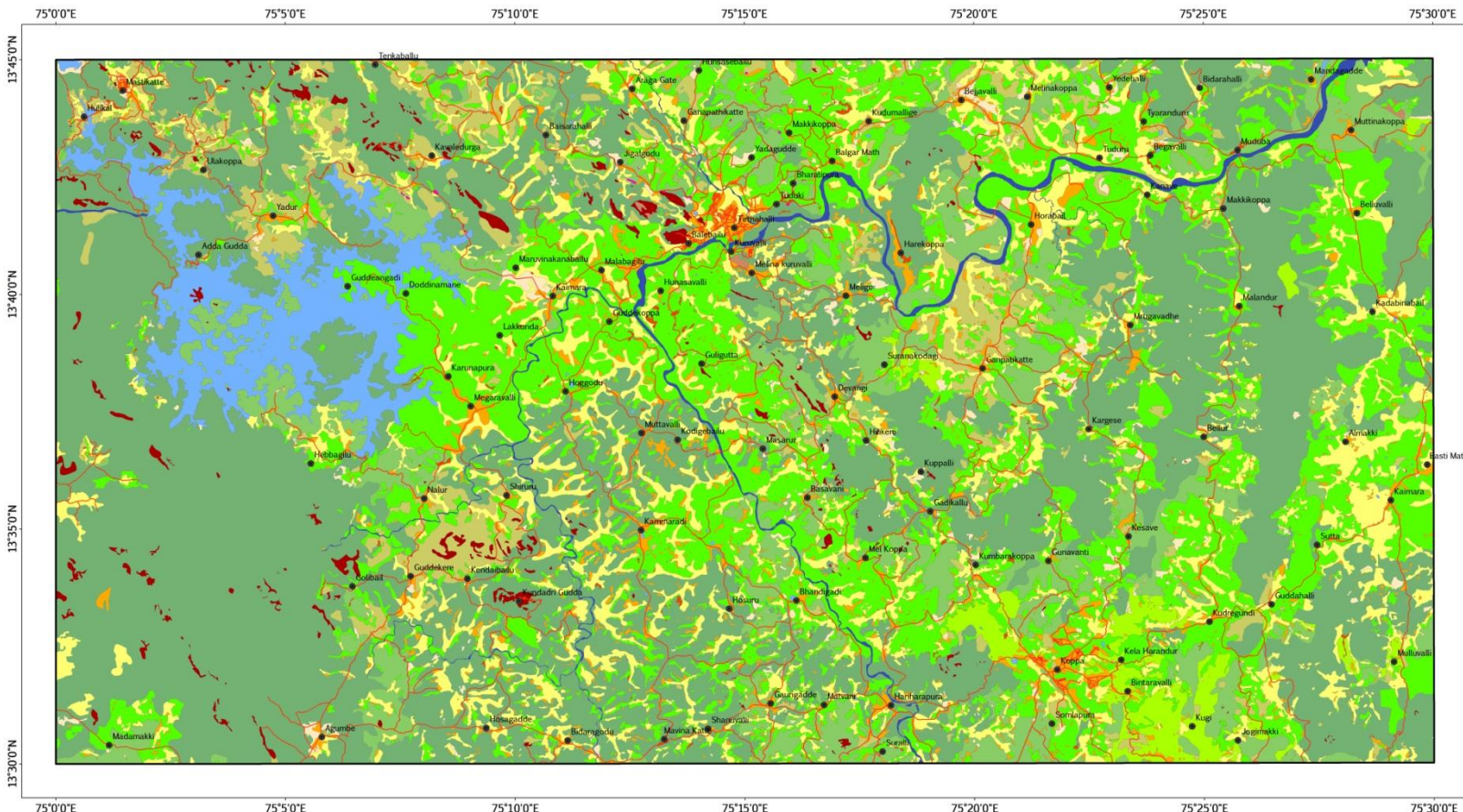
Index

Landuse_Landcover

CLASS

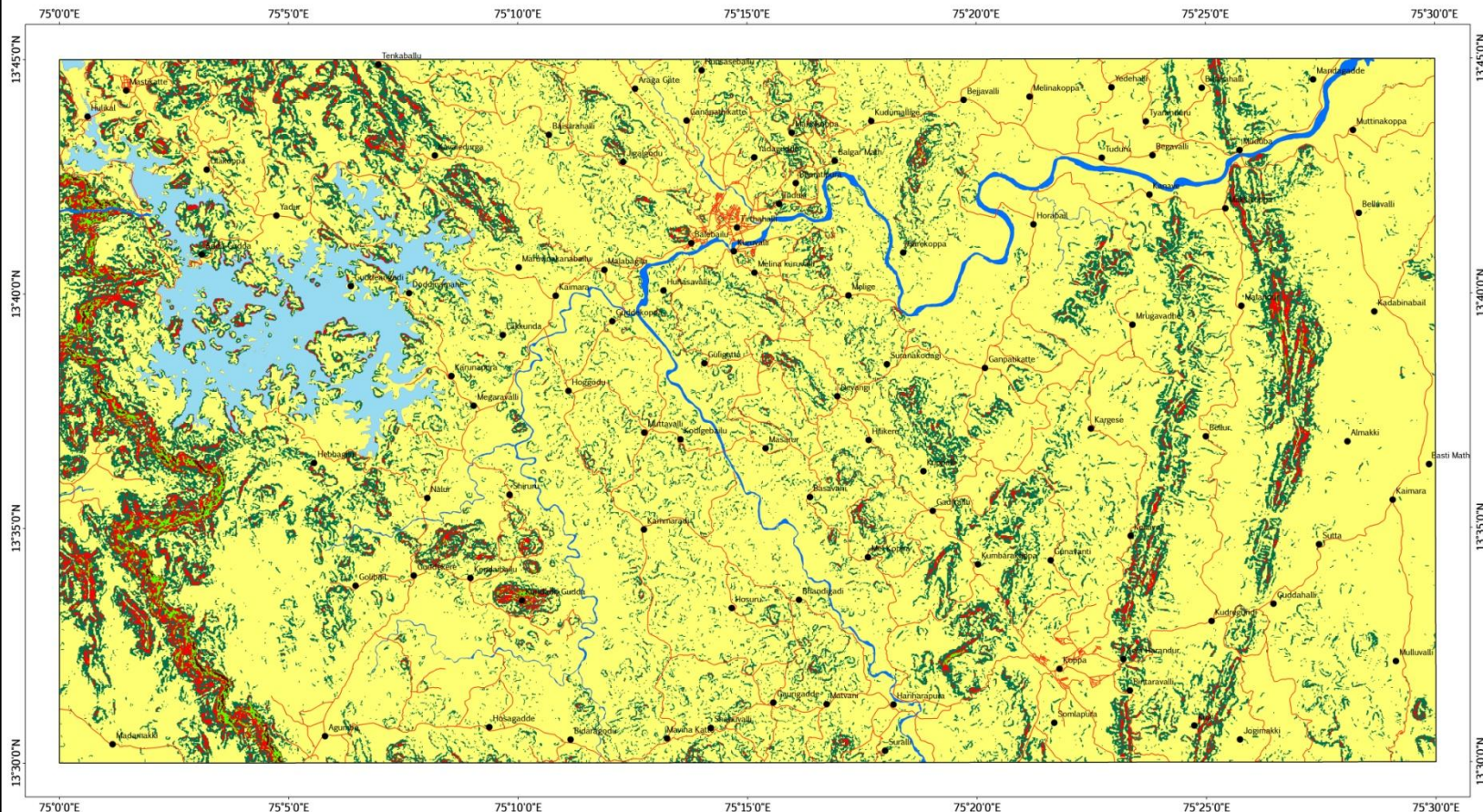
- Thick Vegetation
- Moderate Vegetation
- Sparse Vegetation
- Plantation (HHP)
- Plantation (LHP)
- Cultivation
- Barren
- Fallow Land
- Quarry
- Extensive Slope Cut
- Settlement on modified slope
- Settlement
- River
- Water body
- Location
- Road

Prepared By:
Neha Kumari, Geologist
Sovesh Dulal Muduli, Geologist



Slope Map of T.S nos. 480/2 and 480/6 in parts of Chikmangalur, Shimoga & Udupi districts, Karnataka

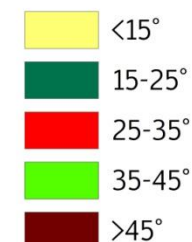
0 1.5 3 6 9 12 Kms



Index

Slope Angle

CLASS



• Location

— Road

Reservoir

River

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Sovesh Dulal Muduli, Geologist

Slope Aspect Map of T.S nos. 480/2 and 480/6 in parts of Chikmangalur, Shimoga & Udupi districts, Karnataka

0 1.5 3 6 9 12 Kms



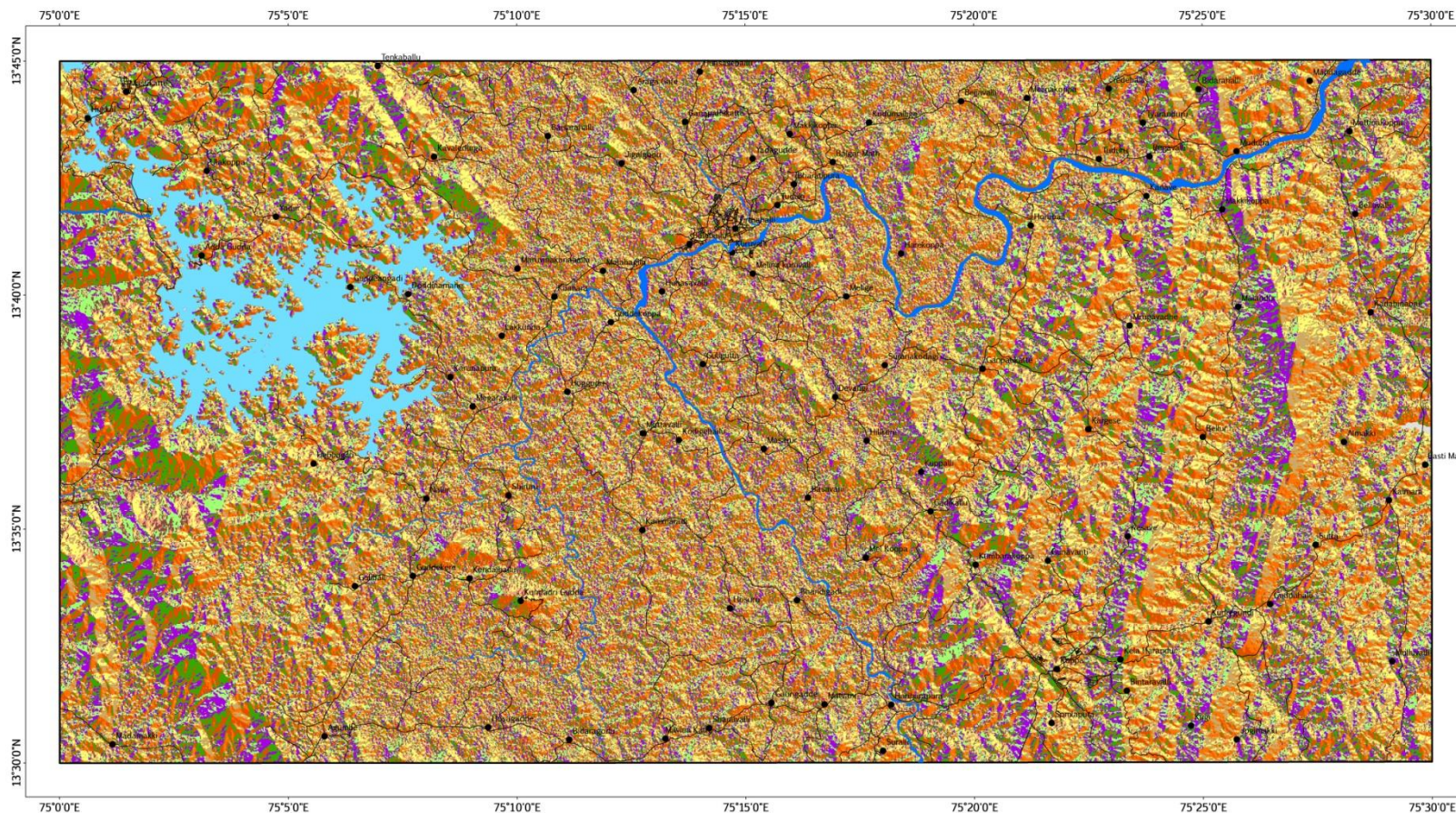
Index

Aspect CLASS

- East (67.5-112.5)
- Flat (-1)
- North (0-22.5)
- North (337.5-360)
- Northeast (22.5-67.5)
- Northwest (292.5-337.5)
- South (157.5-202.5)
- Southeast (112.5-157.5)
- Southwest (202.5-247.5)
- West (247.5-292.5)

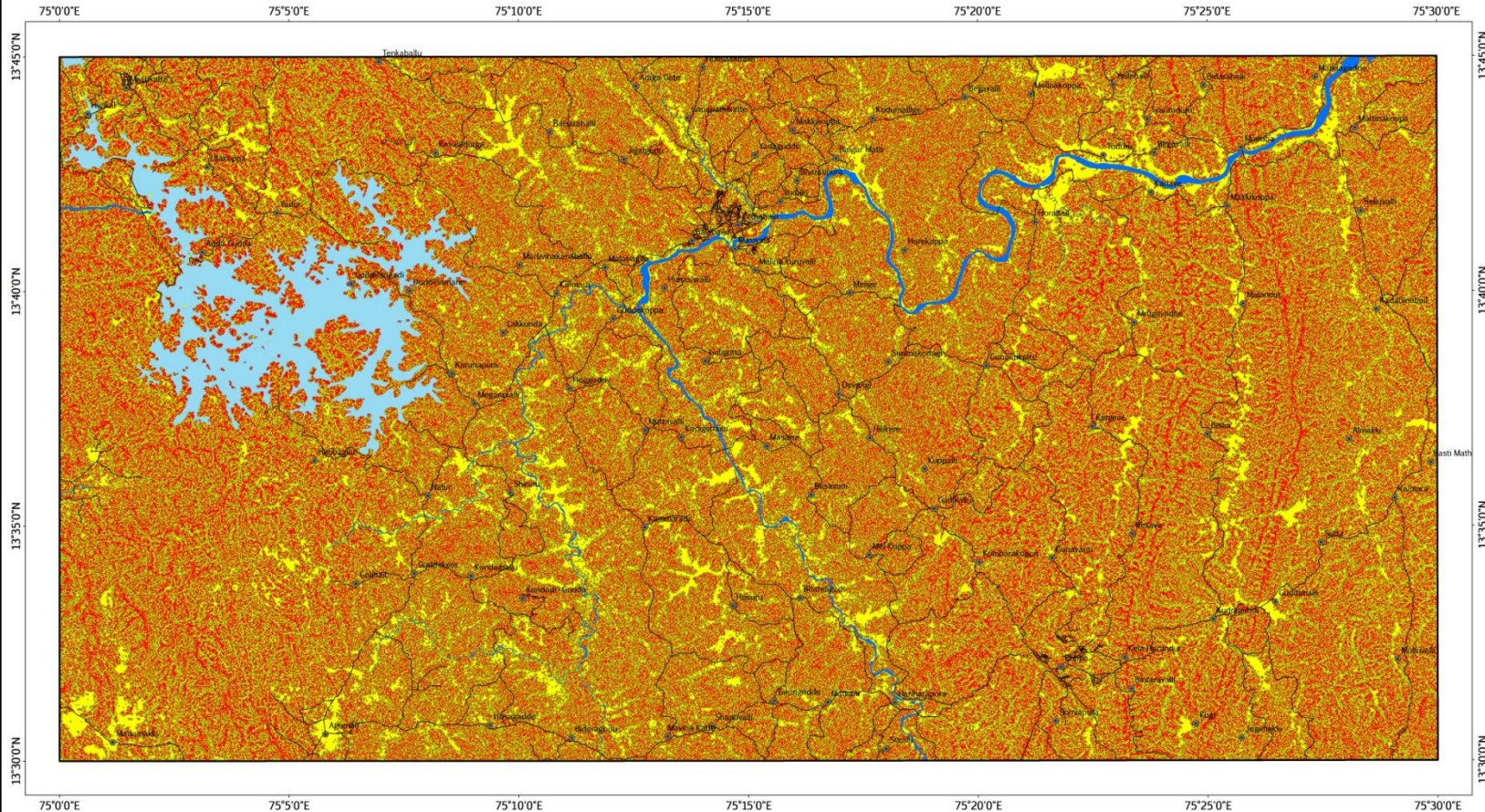
- Location
- Road
- Reservoir
- River

Prepared By:
Neha Kumari, Geologist
Sovesh Dulal Muduli, Geologist



Slope Curvature Map of T.S nos. 480/2 and 480/6 in parts of Chikmangalur, Shimoga & Udupi districts, Karnataka

0 1.5 3 6 9 12 Kms



Index

Curvature

CLASS

<-0.1 (Concave)

-0.1-0 (Flat)

>0.1 (Convex)

Location

Road

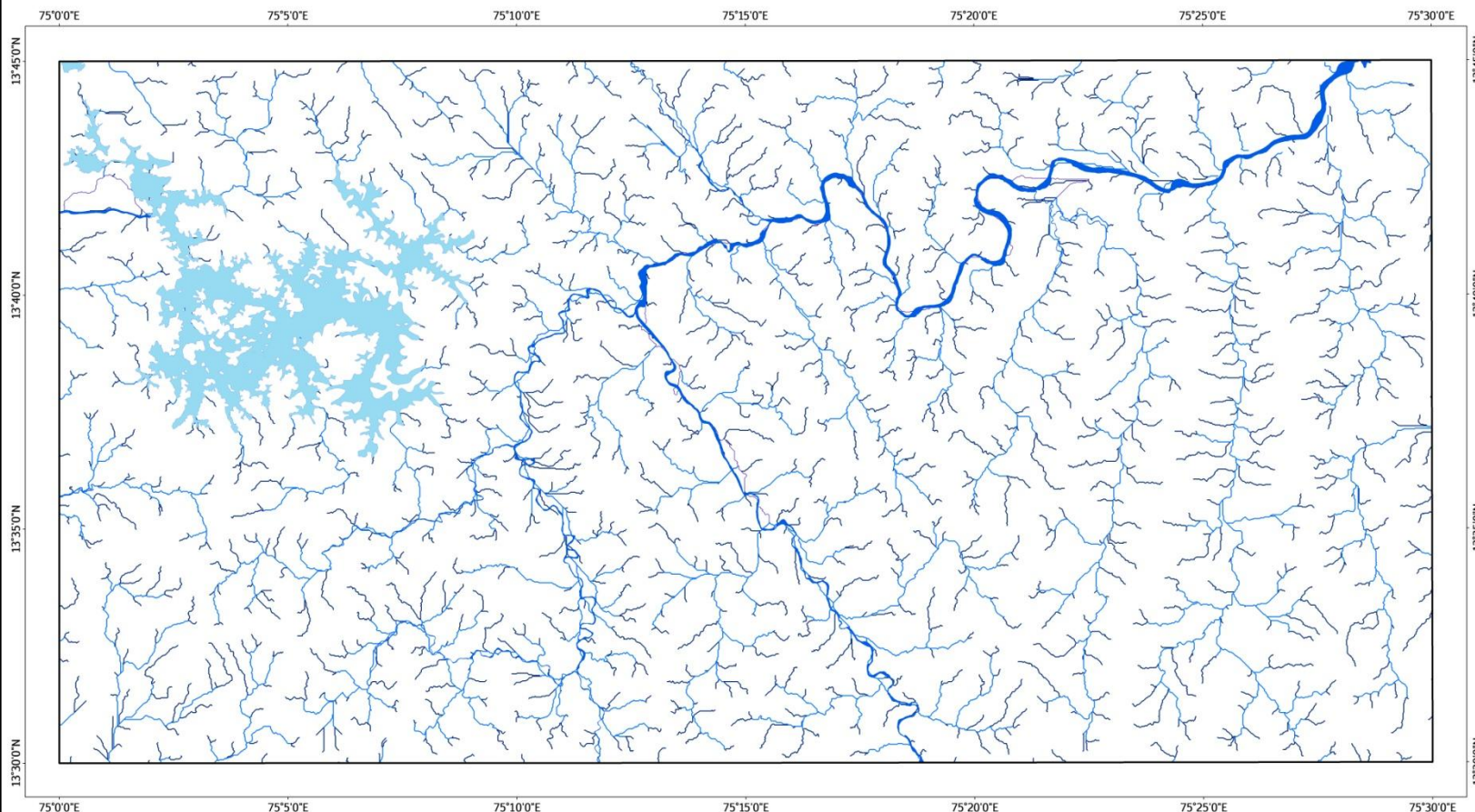
Reservoir

River

Prepared By:
Neha Kumari, Geologist
Sovesh Dulal Muduli, Geologist

Drainage Map of T.S nos 480/2 and 480/6 in parts of Chikmangalur, Shimoga & Udupi districts, Karnataka

0 1.5 3 6 9 12 Kms



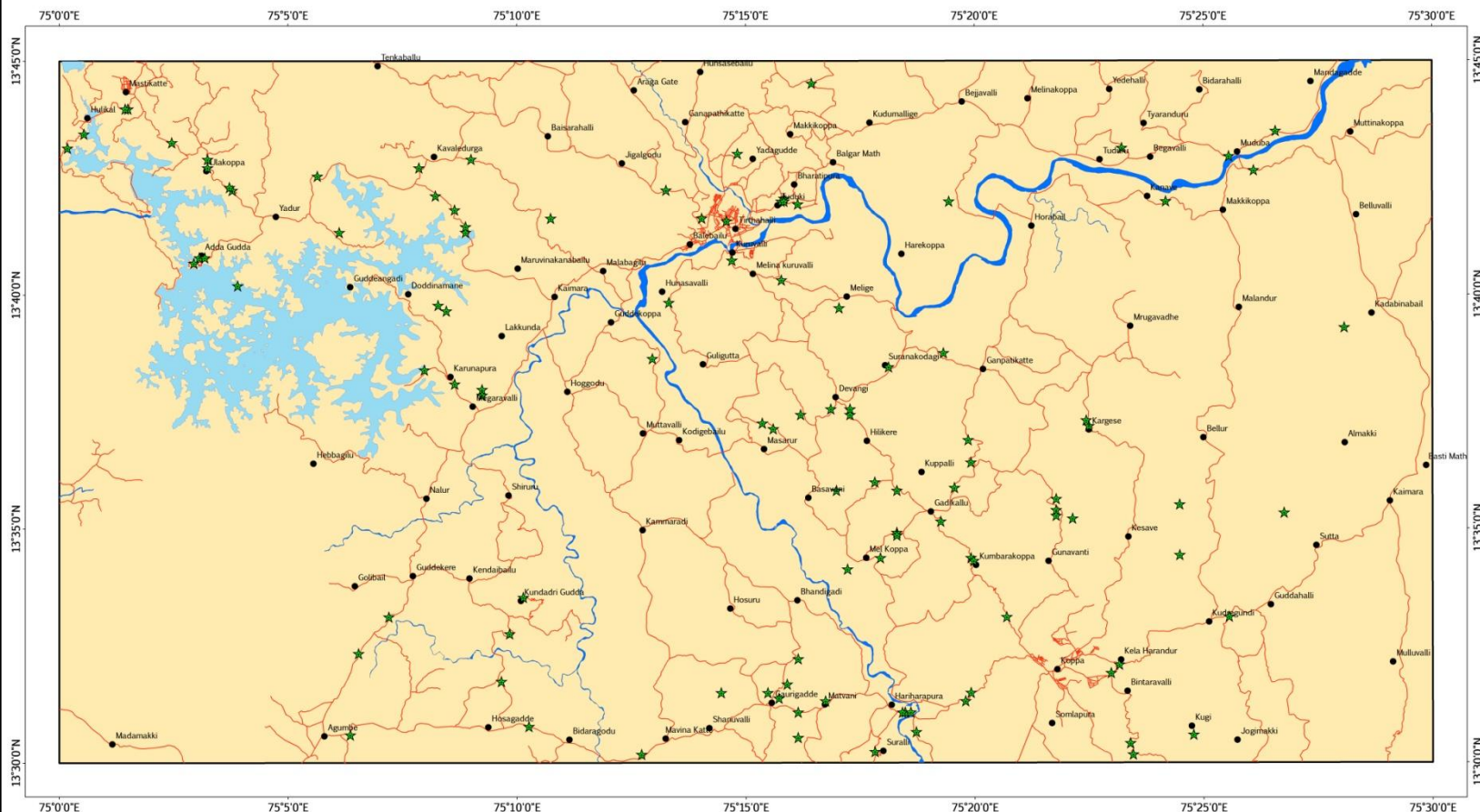
Index Drainage Stream_Order

- 1st Order Stream
- 2nd Order Stream
- 3rd Order Stream
- 4th Order Stream
- 5th Order Stream
- Reservoir
- River

Prepared By:
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Sovesh Dulal Muduli, Geologist

Landslide Incidence Map of T.S nos. 480/2 and 480/6 in parts of Chikmangalur, Shimoga & Udupi districts, Karnataka

0 1.5 3 6 9 12 Kms



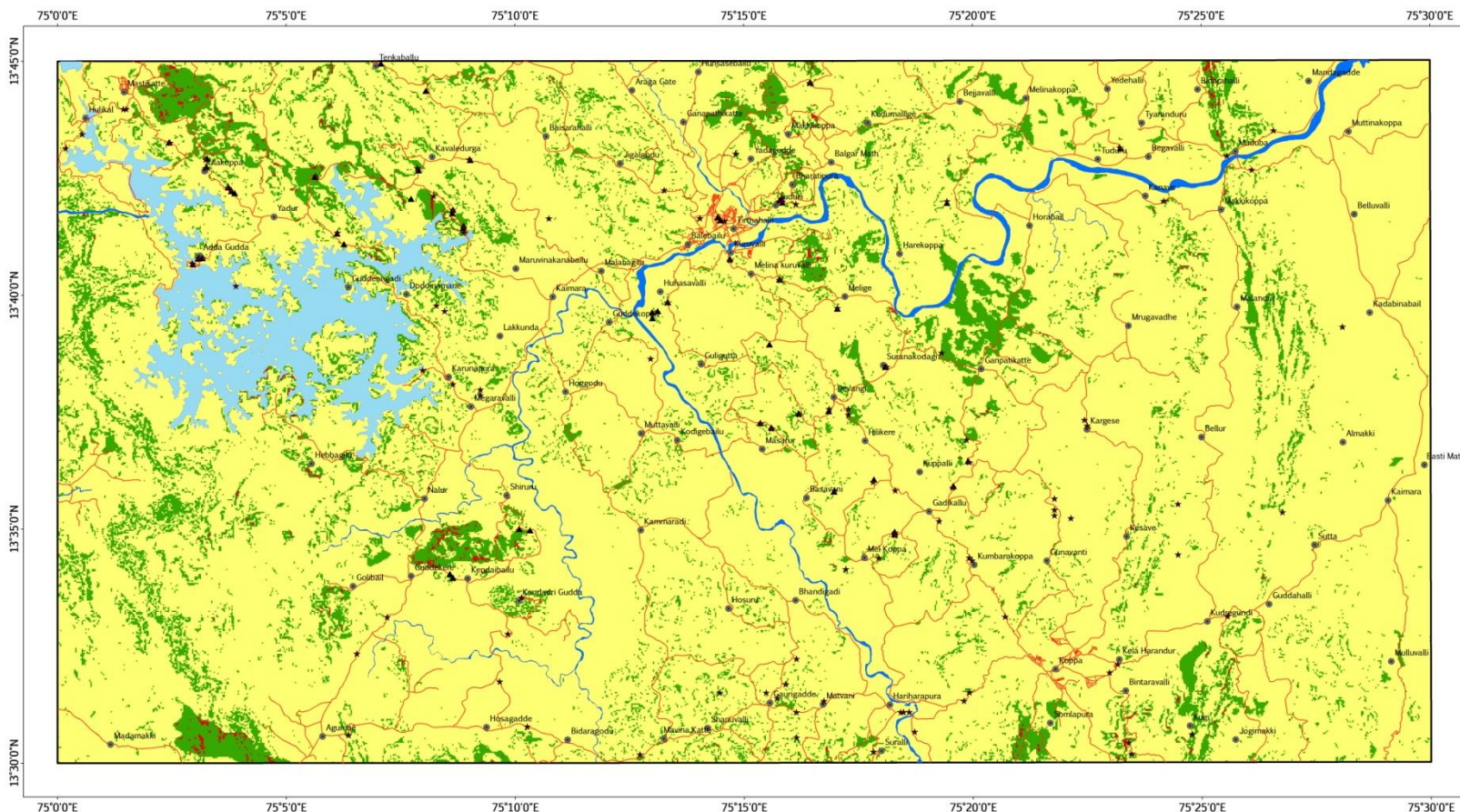
Index

- ★ Landslide Incidences
- Location
- Road
- Reservoir
- River

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Landslide Susceptibility Map of T.S nos. 480/2 and 480/6 in parts of Chikmangalur, Shimoga & Udupi districts, Karnataka

0 1.5 3 6 9 12 Kms



- Index**
- Landslide Susceptibility CLASS**
- High
 - Moderate
 - Low
 - Landslide Incidences
 - Unstable Zone
 - Location
 - Road
 - Reservoir
 - River

Prepared By:
Neha Kumari, Geologist
Sovesh Dulal Muduli, Geologist

Average Monthly Rainfall Distrubution for 10 years (2009-2019)

