

# GEOTECHNICAL AND GEOLOGICAL CHARACTERIZATION OF KAHAGALLA LANDSLIDE FOR MITIGATION PURPOSES

**Present by**

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- ❑ OBJECTIVES**
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# INTRODUCTION.....

- ❑ The Kahagalla earth slip which is one of the sixteen mitigation sites under LDPP, is located between Haputale and Bandarawela along Beragala-Hali-Ela highway A16, in the central hills of Sri Lanka, at an elevation of 1,430 m above MSL.
- ❑ The slide which has an areal extent of 3.5 ha is on the western slope of the mountain range running northeast from Haputale.
- ❑ The Kahagalla earthslip occurred in 1957.



# INTRODUCTION

□ National Building Research Organization (NBRO) executed the main investigations of Kahagolla earth slip including drilling, laboratory tests, geophysical explorations (seismic exploration and high density electric sounding), installation of monitoring instruments (extensometers, pipe strain gauges, borehole inclinometers and groundwater level gauges) and conducted the monitoring program as well.



# GEOLOGICAL FIELD SURVEY MAP OF THE KAHAGALLA LANDSLIDE

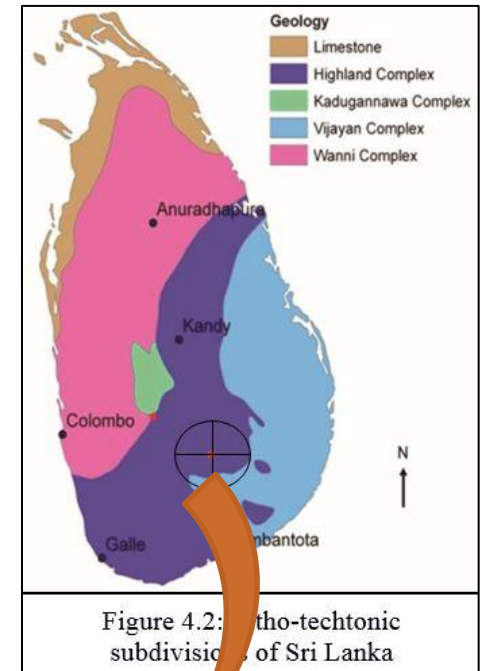
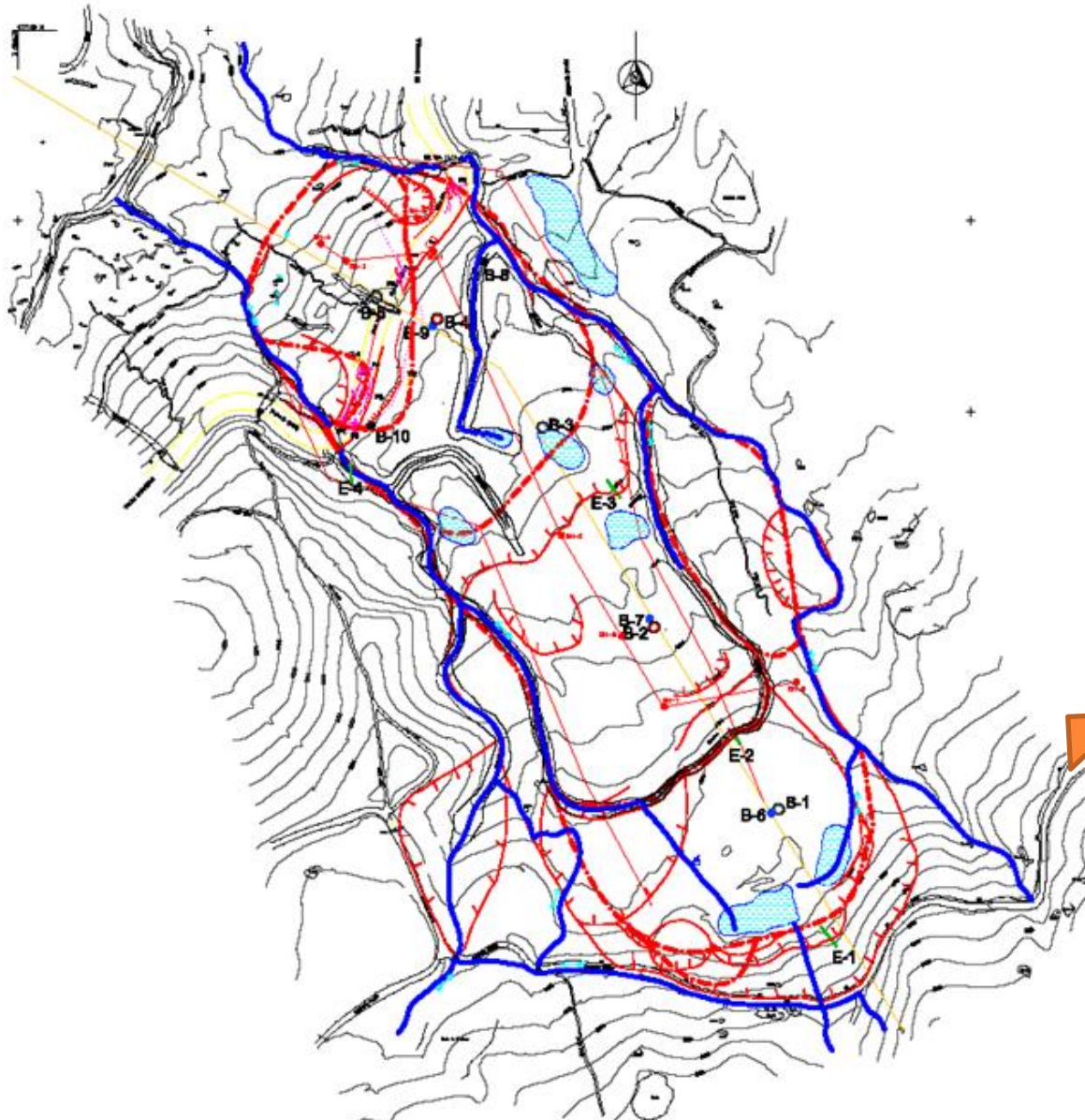


Figure 4.2: Geothectonic subdivisions of Sri Lanka



# OBJECTIVES

- ❑ To study the general geological background and the sub-soil material with a view to understand the overall subsurface conditions to identify, assess and ascertain the engineering geological and geotechnical aspects of the subsurface.
- ❑ To identify slip surfaces, weak zones or any other geotechnical criteria leading for mass movement process.
- ❑ To install instruments to monitor movements of landslide and to assess fluctuation of groundwater level before and after adaptation of mitigation measures.



# OBJECTIVES

- ❑ To perform laboratory testing and geophysical exploration and to obtain information on landslide movement and features of the site needed for the consultant to execute landslide analysis and detailed design for mitigation of landslide.



# METHODOLOGY

- ❑ The detailed geotechnical investigations performed in this study include field investigation, field instrumentation and laboratory tests.
- ❑ Field investigation and instrumentation consisted of advancing of boreholes, performing the standard penetration test (SPT), collection of disturbed and undisturbed samples for laboratory tests, and the installation of piezometers, inclinometers, and Pipe strain gauges.





# METHODOLOGY

- ❑ Standard penetration tests (SPT) and undisturbed sampling were performed alternatively at 1.00 m depth intervals.
- ❑ The disturbed soil samples, collected from the SPT split-spoon sampler, were used for laboratory soil classification tests and for the determination of natural moisture content.
- ❑ Inclinerometers were installed in a few selected bore holes. Standpipe-type water level meters were installed at different depths in the other boreholes.



# STANDARD PENETRATION TEST (SPT)





# LABORATORY TESTING

# METHODOLOGY

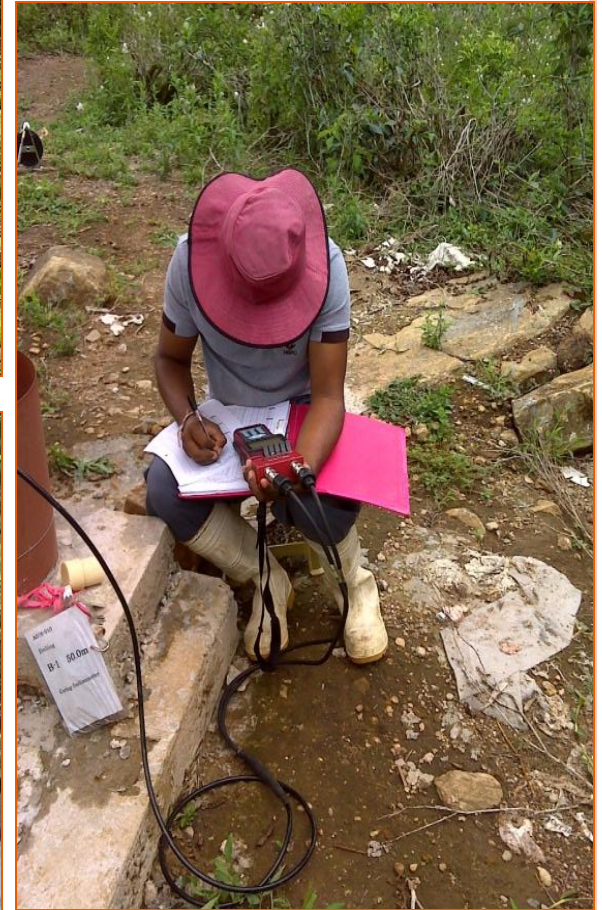
- Geophysical survey as seismic survey and resistivity survey was carried out to identify subsurface conditions.
  
- Monitoring works were carried out nearly one year time period and using analyzed monitoring data slip surface, strain of due to load of moving mass and rate of movement were identified.




# GEOPHYSICAL SURVEY



# INSTRUMENT SETTING



# RESULTS AND DISCUSSION

	NATIONAL BUILDING RESEARCH ORGANISATION GEOTECHNICAL ENGINEERING DIVISION											TABLE 1 - SUMMARY OF TEST RESULTS									
	PROJECT : LANDSLIDE DISASTER PROTECTION PROJECT OF THE NATIONAL ROAD NETWORK LOCATION : KAHAGALLA (A016-10)											Sheet No. 1 of 1		Job Ref. 30/24697							
Borehole No.	Depth of Sample Collection m	Soil classification	Natural Moisture Content %	Specific Gravity	Wet Density g/cm <sup>3</sup>	Grain Size Distribution				Atterberg Limits			Triaxial test/ Consolidated Undrained		Consolidation test			Direct shear			
						Gravel %	Sand %	Silt %	Clay %	LL %	PL %	PI %	C kPa	φ Deg.	C <sub>v</sub>	P <sub>v</sub> kPa	Cc / (1+e <sub>0</sub> )	C kPa	φ Deg.		
A016-10-1	9.00-9.45	GM	34	2.65		36	20	14	30	56	40	16									
	14.00-14.45	SM	32	2.79			62	28	10	Non plastic											
A016-10-2	9.00-9.45	SM	55	2.51			52	44	4	62	44	18									
	15.00-15.45	SM	24	2.46		1	75	16	8	Non plastic											
	18.00-18.45	SM	24	2.60		30	52	15	3	Non plastic											
A016-10-3	10.00-10.45	MH	52	2.26			41	29	30	72	38	34									
	16.00-16.45	SM	49	2.52			63	29	8	39	31	8									
	20.00-20.45	SM	23	2.60		1	69	23	7	32	23	9									
A016-10-4	17.00-17.45	SM	53	2.55			52	27	21	74	49	25									
	24.00-24.45	SM	62	2.75			65	15	20	94	48	46									
	28.00-28.45	SM	39	2.36		1	87	8	4	41	29	12									
A016-10-5	10.00-10.45	SM	18	2.62			70	25	5	Non plastic											
Box Sample B		MH	32	2.61	1.51		26	36	38	60	45	16	20	32						10	32

TESTED BY: WKS

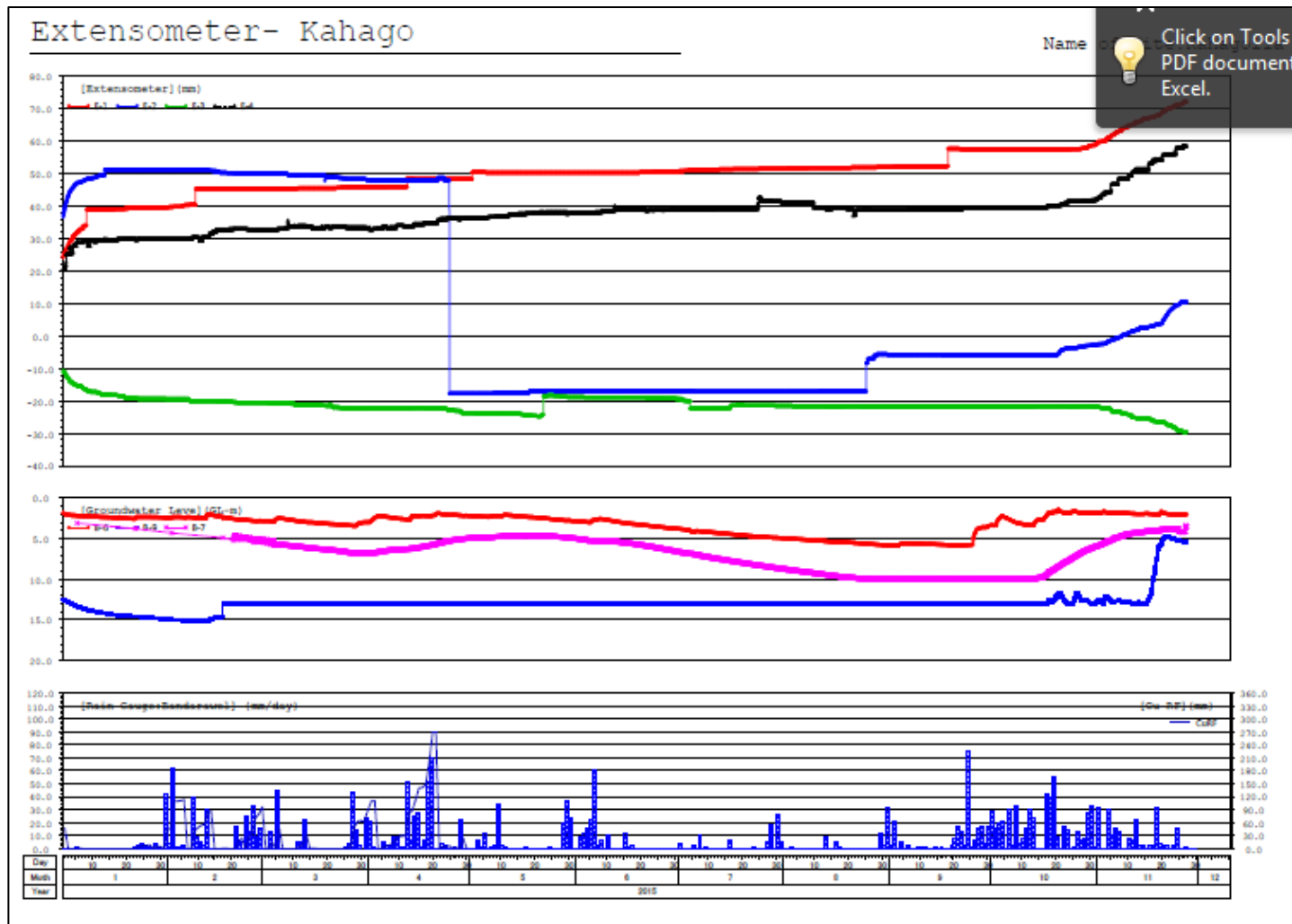
ANALYZED BY: DGA

CHECKED BY: CB/CJ/LK

DATE: 17/7/2015

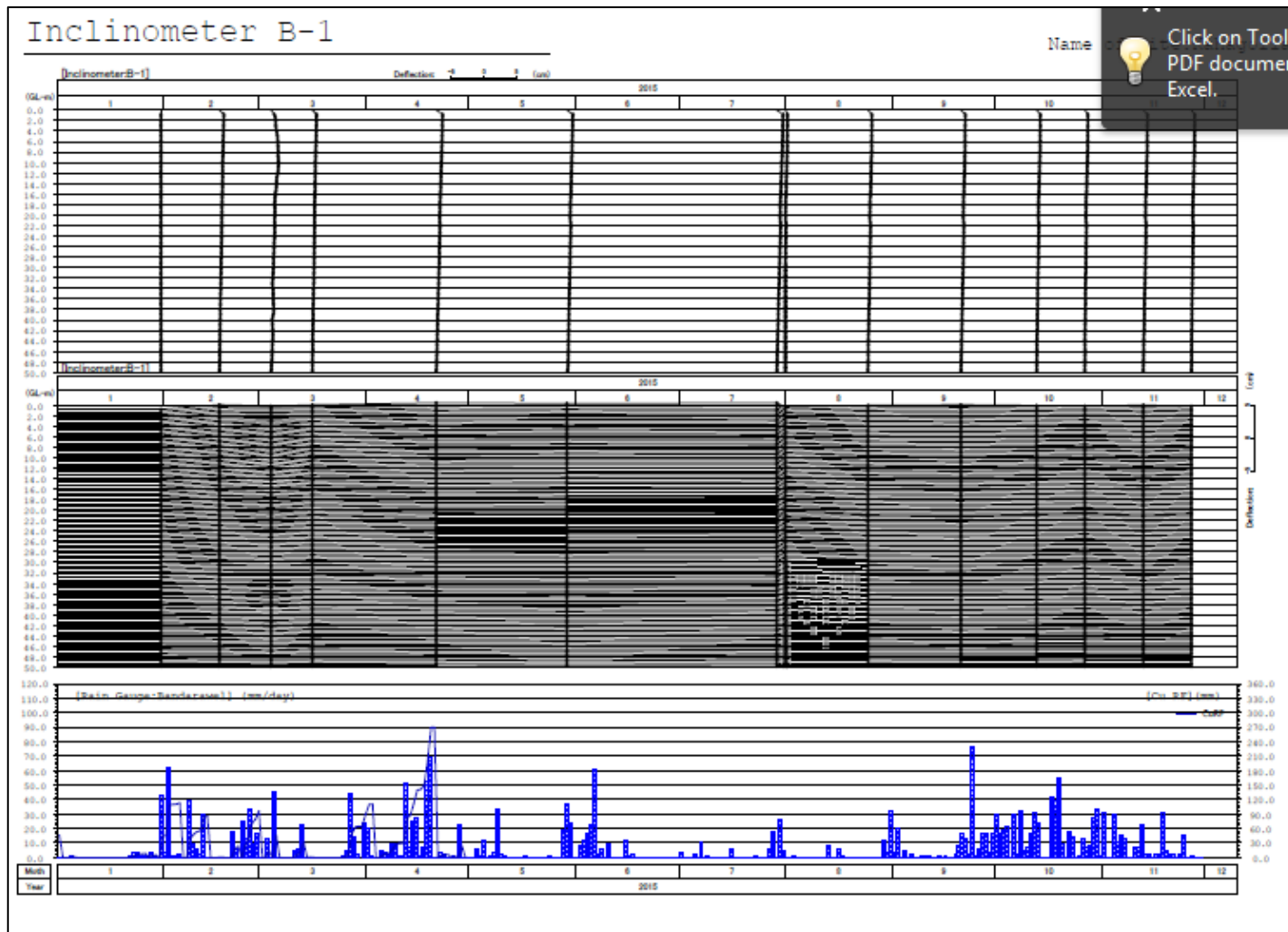
**Table No:1-Summary of Laboratory Test Results**

# RESULTS AND DISCUSSION





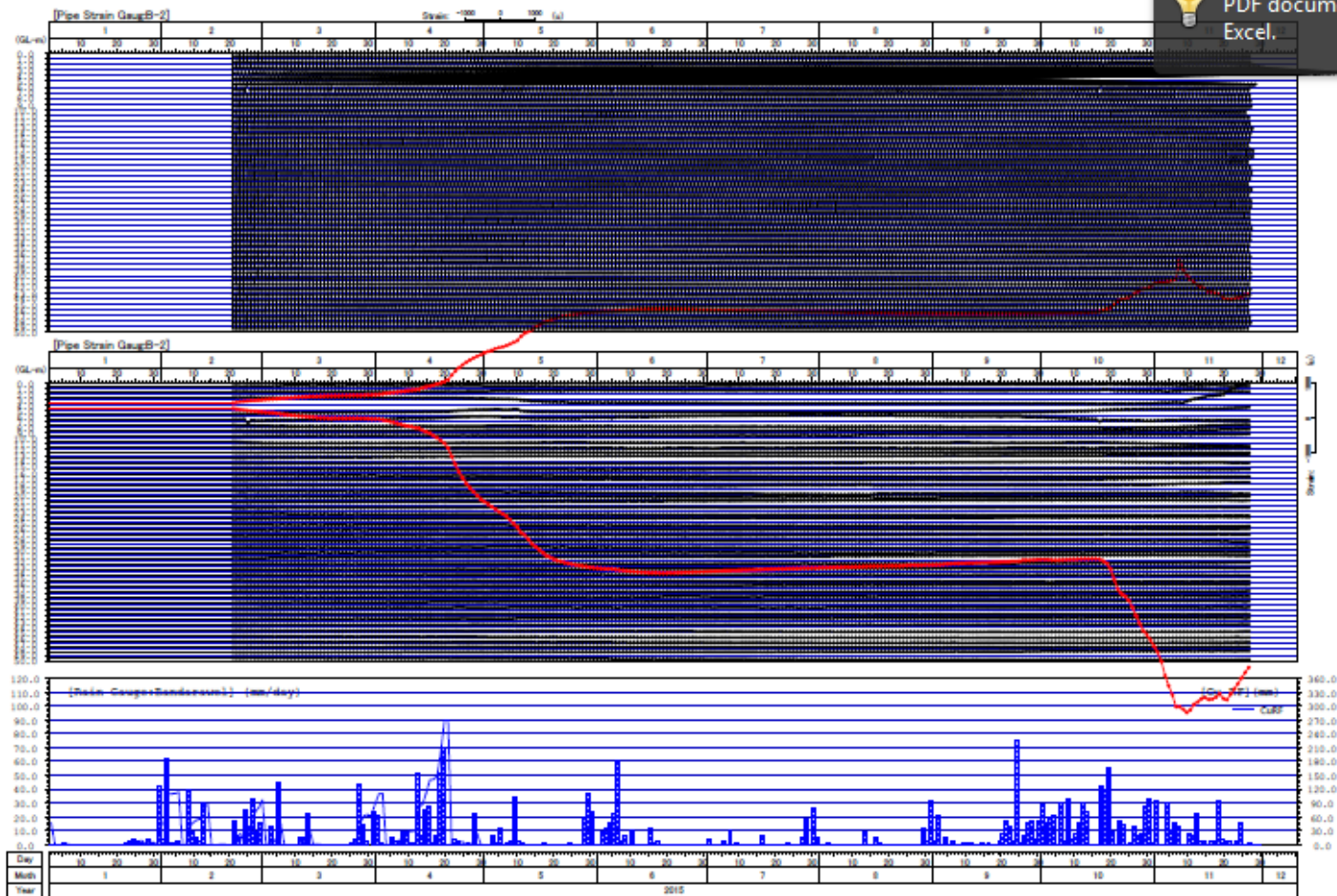
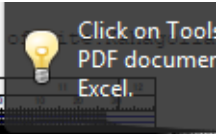
# RESULTS AND DISCUSSION



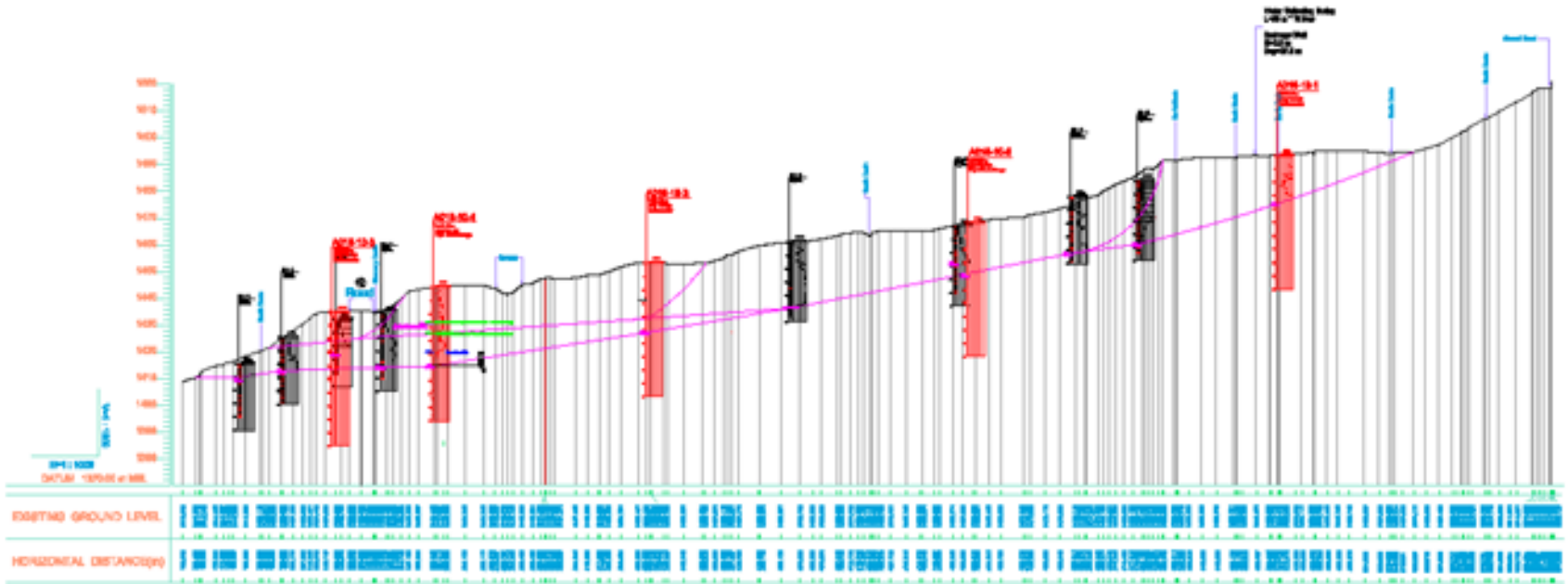
# RESULTS AND DISCUSSION

pipe strain gauge B2

Name



# RESULTS AND DISCUSSION



# RESULTS AND DISCUSSION

- ❑ The general geology of the study site is characterized by calc gneiss, charnockitic gneiss, garnet-biotite gneiss and khondolite. The material within the slip area consists of colluvial deposits and in-situ weathered residual materials.
- ❑ Since continues movement of the soil mass at the study site, the soil strength properties (SPT “N”) are drastically changed horizontally and vertically.
- ❑ However the site is dominated by sandy silt and silty sand while gravel and rock boulders are distributed in an irregular way.
- ❑ With this subsurface condition, the water table can be found at shallow levels varying from 2m to 6m but it was dropped to deep levels as 12m to 16 m at the appeared tension cracks.



## RESULTS AND DISCUSSION

- ❑ Thus the colluvial deposit consists of material that has come down from a scarp above, travelling a substantial distance, the material, varying from large boulders to clay-size particles, is thoroughly mixed, resulting in a well graded mix.
- ❑ Therefore, at a macro scale a certain homogeneity prevails. At the colluvial slopes of Kahagalla, failure had been a retrogressive failure.
- ❑ Therefore, a distinguishing feature between in-situ weathered residual soils and colluvial deposits is the presence of preferred shear planes of low strength, such as relict joints, in the former and their absence in the latter. Comparing the slip planes, in the cases of the Kahagalla earth slips the slip surface is within the soil.



# CONCLUSION

- ❑ Thus the colluvial deposit consists of material that has come down from a scarp above, travelling a substantial distance, the material, varying from large boulders to clay-size particles, is thoroughly mixed, resulting in a well graded mix.
- ❑ Therefore, at a macro scale a certain homogeneity prevails.
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**THANK YOU**

