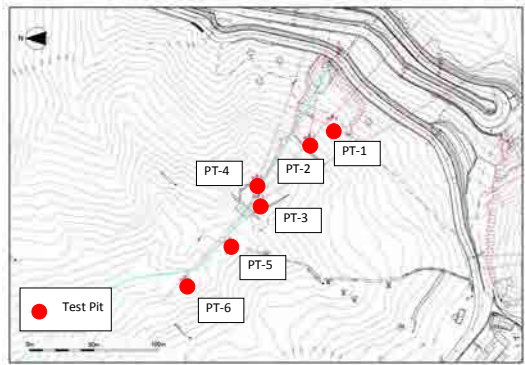


Appendix-5.5
Soil Test Result

Soil Test Result for Pit1-Pit6										
Item	Pit1	Pit2	Pit3	Pit4	Pit5	Pit6	Remarks			
Specific Gravity of Soil ρ_s	2.681	2.668	2.617	2.510	2.771	2.518	Avg. 2.661			
Specific Gravity in oven dried condition	2.655	2.560	2.585	2.549	2.559	2.577	Avg. 2.561			
Combined Specific Gravity $D_{50} = 1/2[(\rho_s/\rho_w) + (\rho_s/\rho_w)]$ (g/cm^3)	2.500	2.507	2.572	2.545	2.544	2.571	Avg. 2.537			
	2.615	2.610	2.620	2.635	2.676	2.614	Avg. 2.626			
Coefficient of Water Absorption q (%)	1.30	1.22	1.00	0.95	0.86	0.84	Avg. 1.03			
	0.58	0.83	0.72	0.49	0.23	0.94	Avg. 0.63			
Natural Water Content w (%)	1.38	1.42	1.38	1.22	1.43	0.93	Avg. 1.27			
	0.58	1.14	1.13	1.11	1.4	0.9	Avg. 0.83			
Coefficient of Water Absorption $q = \frac{w}{2} \times \frac{D_{50}}{100}$	1.1	1.0	1.0	0.7	1.1	0.9	Avg. 0.93			
	0.58	1.14	1.13	1.11	1.4	0.9	Avg. 0.83			
Natural Water Content w (%)	8.87	9.39	7.03	10.84	8.18	6.33	The average of Field density test material and Filed sieve test material			
	3.08	2.40	2.37	4.46	2.26	2.56	Site			
Combined Water Content $w = \frac{w}{2} \times \frac{D_{50}}{100}$	1.76	1.42	1.38	1.22	1.43	1.50	By field density test			
	7.1	7.5	6.5	8.7	7.0	5.0	Avg. 7.0			
Maximum Grain Size D_{max} (mm)	300	350	300	350	310	300	Classification of grain size is according to ASTM D633			
	3.0	24	0	17	2	0	Pit4 contained a boulder of 10kg in fact. the rate of more than 20mm is expected smaller than test result.			
Grain Size Distribution (%)	25.0	37	9	52	18	14	Pit4 relatively contains the boulder as grain size 200mm or more.			
	20.7	9.8	11.1	10.5	15.4	30.7				
Passing Diameter D_p (mm)	34	110	95	110	22	32				
	9.9	38	1	73	4.75	10				
Uniformity Coefficient $U_c = \frac{D_{60}}{D_{30}}$	318.8	89.5	100.0	31.9	177.8	190.5	JGS Uc-2: 10 Well-graded			
	12.0	4.5	0.4	7.6	3.9	11.9	ASTM Uc-2: 4 and 1 S; Uc S-3 Well-graded Gravel			
Minimum Density ρ_{min} (g/cm^3)	1.755	1.621	1.765	1.679	1.759	1.735	Calculated by Dry density and Water content			
	1.640	1.508	1.656	1.545	1.644	1.653	Calculated by the wet density test result of less than grain size 75mm			
Maximum Void Ratio e_{max}	0.583	0.719	0.615	0.641	0.601	0.547	Calculated from correction of gravel content method defined by Walker-Holtz			
	0.421	0.282	0.359	0.204	0.463	0.472	Pit4 is beyond the limits of Walker-Holtz method, because the content of more than grain size 75mm is 30% or more.			
Maximum Density ρ_{max} (g/cm^3)	2.376	2.432	2.392	2.530	2.408	2.287	Calculated by Dry density and Water content			
	2.139	2.027	2.223	2.132	2.196	2.138	Calculated by correction of gravel content method defined by Walker-Holtz			
Relative Density $D_r = \frac{\rho - \rho_{min}}{\rho_{max} - \rho_{min}} \times 100$	2.251	2.343	2.257	2.436	2.273	2.189	Calculated from correction of gravel content method defined by Walker-Holtz			
	0.156	0.111	0.166	0.189	0.188	0.196				
Wet Density ρ_w (g/cm^3)	2.138	2.226	2.144	2.314	2.159	2.079	Estimated by ρ_{max}			
	0.216	0.169	0.247	0.125	0.223	0.203	Pit1: 3.5.6 Avg. 0.230			
Dry Density ρ_d (g/cm^3)	2.139	2.189	2.153	2.277	2.187	2.058	Calculated by Dry density and Water content			
	21.0	21.5	21.1	22.3	21.3	20.2	Pit1: 3.5.6 Avg. 20.9			
Void Ratio $e = \frac{\rho_w - \rho_d}{\rho_d}$	0.284	0.234	0.316	0.187	0.291	0.302	Pit1: 3.5.6 Avg. 0.286			
	51.6	27.7	64.9	12.3	59.6	56.6	Pit1: 3.5.6 Avg. 58.2			
Maximum Grain Size of test pit (mm)	300	350	300	350	310	300				
	1.1 to 2.0	1.1 to 2.0	1.1 to 2.0	1.1 to 2.0	1.1 to 2.0	1.1 to 2.0				
Wet Density ρ_w (g/cm^3)	20.2	18.9	20.1	20.4	25.0	20.9	Pit1: 2.3.4.6 Avg. 20.1			
	1.949	1.856	1.931	1.999	2.404	2.037	Calculated by the wet density test result			
Void Ratio $e = \frac{\rho_w - \rho_d}{\rho_d}$	0.334	0.403	0.385	0.302	0.098	0.299	Pit1: 2.3.4.6 Avg. 0.337			
	32.6	70.3	46.5	-72.6	118.7	70.8	Pit1: 3.6 Avg. 50.0			



Sta.17+600 Location of Investigation



Pit1,2 : set up the Gabion2 where cobbles of Dmax300mm or more are distributed on slope ground surface
Pit3,4 : set between Gabion2 and Gabion 3
Pit5,6 : set at toe-of slope of counterweight fill

Photo 1: Location

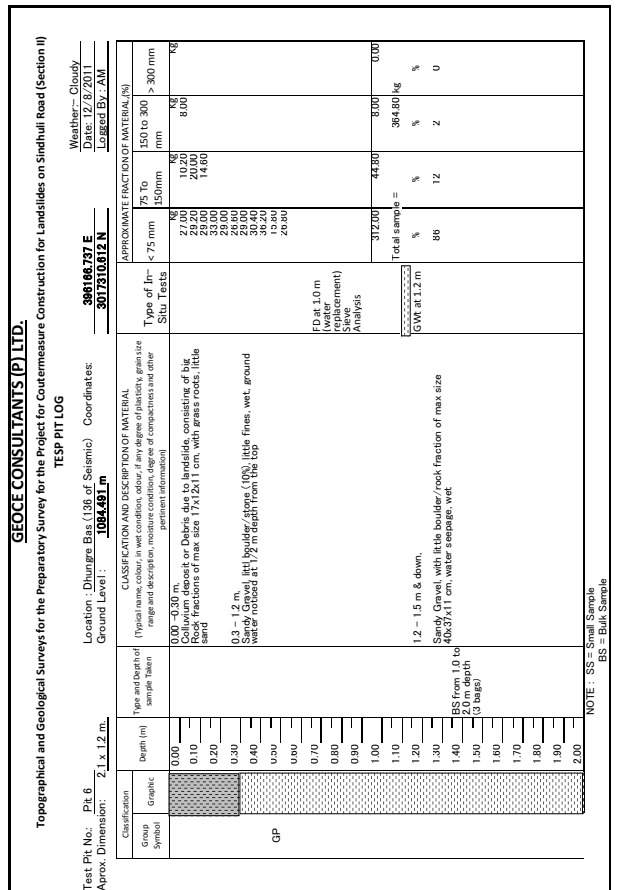
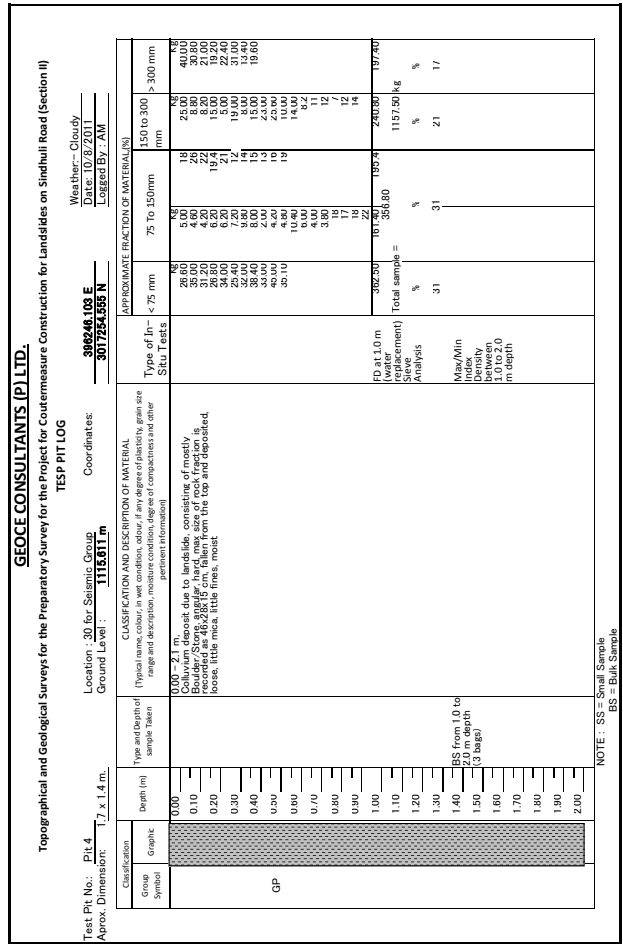
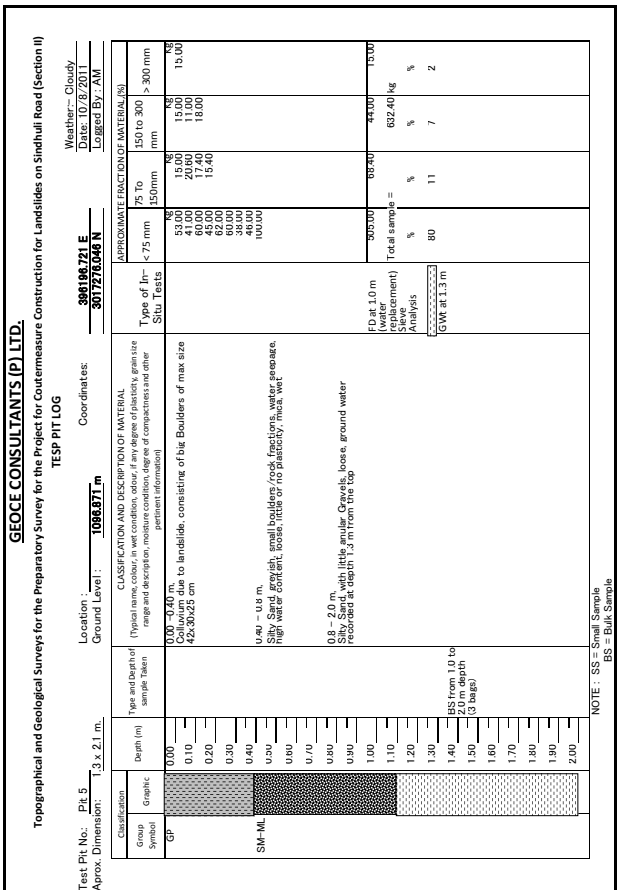
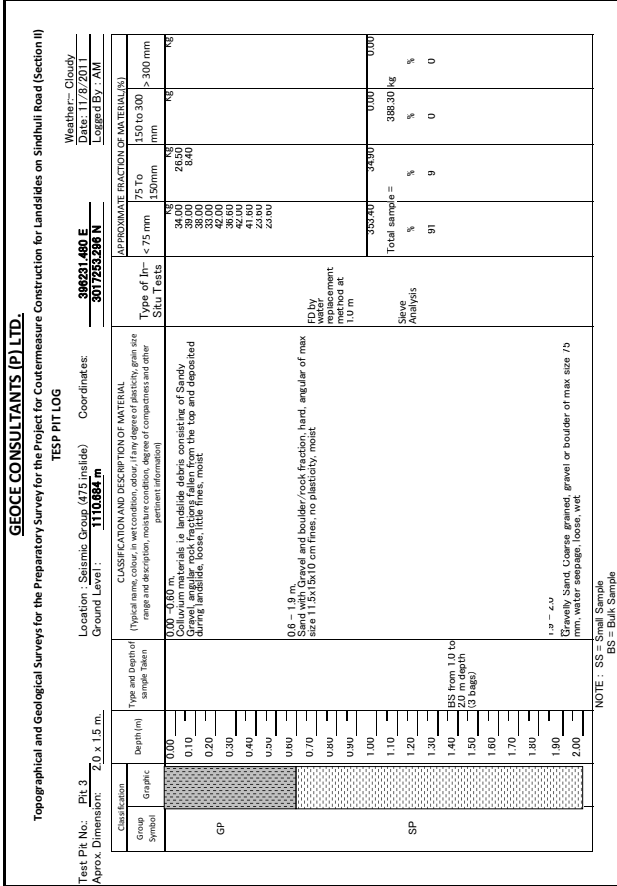
Photo 2: Location

Topographical and Geological Surveys for the Preparatory Survey for the Project for Countermeasure Construction for Landslides on Sindhuli Road (Section II)												
GEOCONSULTANTS (P) LTD.												
TSP PIT LOG												
Location : Dhunge Bhanjyang, Sta. 17+600												
Ground Level : 1150.029 m												
Weather: Cloudy, Date: 11/8/2011, Logged By: AM												
Coordinates: 30.7198, 100.160 N												
Approx. Dimension: 1.7 x 1.7 m												
Classification	Group Symbol	Depth (m)	CLASSIFICATION AND DESCRIPTION OF MATERIAL (Type and description, moisture condition, degree of compactness and other pertinent information)								Type of In-Situ Tests	
			11 to 2.0 Silt Sand, with angular rock fraction of max size 25 mm.									
GP	GP	0.00	0.00 ~ 1.0 m. Type and description, moisture condition, degree of compactness and other pertinent information								FD at 1.0 m	
		0.10	11 to 2.0 Silt Sand, with angular rock fraction of max size 25 mm.									
SP	SP	0.10	11 to 2.0 Silt Sand, with angular rock fraction of max size 25 mm.								FD at 1.0 m	
		0.20	11 to 2.0 Silt Sand, with angular rock fraction of max size 25 mm.									
SP	SP	0.30	11 to 2.0 Silt Sand, with angular rock fraction of max size 25 mm.								FD at 1.0 m	
		0.40	11 to 2.0 Silt Sand, with angular rock fraction of max size 25 mm.									
SP	SP	0.50	11 to 2.0 Silt Sand, with angular rock fraction of max size 25 mm.								FD at 1.0 m	
		0.60	11 to 2.0 Silt Sand, with angular rock fraction of max size 25 mm.									
SP	SP	0.70	11 to 2.0 Silt Sand, with angular rock fraction of max size 25 mm.								FD at 1.0 m	
		0.80	11 to 2.0 Silt Sand, with angular rock fraction of max size 25 mm.									
SP	SP	0.90	11 to 2.0 Silt Sand, with angular rock fraction of max size 25 mm.								FD at 1.0 m	
		1.00	11 to 2.0 Silt Sand, with angular rock fraction of max size 25 mm.									
SP	SP	1.10	11 to 2.0 Silt Sand, with angular rock fraction of max size 25 mm.								FD at 1.0 m	
		1.20	11 to 2.0 Silt Sand, with angular rock fraction of max size 25 mm.									
SP	SP	1.30	11 to 2.0 Silt Sand, with angular rock fraction of max size 25 mm.								FD at 1.0 m	
		1.40	11 to 2.0 Silt Sand, with angular rock fraction of max size 25 mm.									
SP	SP	1.50	11 to 2.0 Silt Sand, with angular rock fraction of max size 25 mm.								FD at 1.0 m	
		1.60	11 to 2.0 Silt Sand, with angular rock fraction of max size 25 mm.									
SP	SP	1.70	11 to 2.0 Silt Sand, with angular rock fraction of max size 25 mm.								FD at 1.0 m	
		1.80	11 to 2.0 Silt Sand, with angular rock fraction of max size 25 mm.									
SP	SP	1.90	11 to 2.0 Silt Sand, with angular rock fraction of max size 25 mm.								FD at 1.0 m	
		2.00	11 to 2.0 Silt Sand, with angular rock fraction of max size 25 mm.									
		0.00	APPROXIMATE FRACTION OF MATERIALS (%)									
		0.10	75 To 150 To 300 To 300 mm									
		0.20	75 To 150 To 300 To 300 mm									
		0.30	75 To 150 To 300 To 300 mm									
		0.40	75 To 150 To 300 To 300 mm									
		0.50	75 To 150 To 300 To 300 mm									
		0.60	75 To 150 To 300 To 300 mm									
		0.70	75 To 150 To 300 To 300 mm									
		0.80	75 To 150 To 300 To 300 mm									
		0.90	75 To 150 To 300 To 300 mm									
		1.00	75 To 150 To 300 To 300 mm									
		1.10	75 To 150 To 300 To 300 mm									
		1.20	75 To 150 To 300 To 300 mm									
		1.30	75 To 150 To 300 To 300 mm									
		1.40	75 To 150 To 300 To 300 mm									
		1.50	75 To 150 To 300 To 300 mm									
		1.60	75 To 150 To 300 To 300 mm									
		1.70	75 To 150 To 300 To 300 mm									
		1.80	75 To 150 To 300 To 300 mm									
		1.90	75 To 150 To 300 To 300 mm									
		2.00	75 To 150 To 300 To 300 mm									

NOTE: SS = Small Sample, BS = Bulk Sample

Topographical and Geological Surveys for the Preparatory Survey for the Project for Countermeasure Construction for Landslides on Sindhuli Road (Section II)												
GEOCONSULTANTS (P) LTD.												
TSP PIT LOG												
Location : Dhunge Bhanjyang, Sta. 17+600												
Ground Level : 1142.765 m												
Weather: Cloudy, Date: 11/8/2011, Logged By: AM												
Coordinates: 30.7198, 100.160 N												
Approx. Dimension: 1.7 x 1.3 m												
Classification	Group Symbol	Depth (m)	CLASSIFICATION AND DESCRIPTION OF MATERIAL (Type and description, moisture condition, degree of compactness and other pertinent information)								Type of In-Situ Tests	
			0.00 ~ 0.40 m. Dark grey to black, silty clay to siltstone, consisting of thin, platy, sandy gravel fragments of max 10 cm, fallen from the top and deposited; fine, little fines, moist.									
GP	GP	0.00	0.00 ~ 0.40 m. Dark grey to black, silty clay to siltstone, consisting of thin, platy, sandy gravel fragments of max 10 cm, fallen from the top and deposited; fine, little fines, moist.								FD at 1.0 m	
		0.10	0.00 ~ 0.40 m. Dark grey to black, silty clay to siltstone, consisting of thin, platy, sandy gravel fragments of max 10 cm, fallen from the top and deposited; fine, little fines, moist.									
SP	SP	0.40	0.00 ~ 0.40 m. Dark grey to black, silty clay to siltstone, consisting of thin, platy, sandy gravel fragments of max 10 cm, fallen from the top and deposited; fine, little fines, moist.								FD at 1.0 m	
		0.50	0.00 ~ 0.40 m. Dark grey to black, silty clay to siltstone, consisting of thin, platy, sandy gravel fragments of max 10 cm, fallen from the top and deposited; fine, little fines, moist.									
SP	SP	0.60	0.00 ~ 0.40 m. Dark grey to black, silty clay to siltstone, consisting of thin, platy, sandy gravel fragments of max 10 cm, fallen from the top and deposited; fine, little fines, moist.								FD at 1.0 m	
		0.70	0.00 ~ 0.40 m. Dark grey to black, silty clay to siltstone, consisting of thin, platy, sandy gravel fragments of max 10 cm, fallen from the top and deposited; fine, little fines, moist.									
SP	SP	0.80	0.00 ~ 0.40 m. Dark grey to black, silty clay to siltstone, consisting of thin, platy, sandy gravel fragments of max 10 cm, fallen from the top and deposited; fine, little fines, moist.								FD at 1.0 m	
		0.90	0.00 ~ 0.40 m. Dark grey to black, silty clay to siltstone, consisting of thin, platy, sandy gravel fragments of max 10 cm, fallen from the top and deposited; fine, little fines, moist.									
SP	SP	1.00	0.00 ~ 0.40 m. Dark grey to black, silty clay to siltstone, consisting of thin, platy, sandy gravel fragments of max 10 cm, fallen from the top and deposited; fine, little fines, moist.								FD at 1.0 m	
		1.10	0.00 ~ 0.40 m. Dark grey to black, silty clay to siltstone, consisting of thin, platy, sandy gravel fragments of max 10 cm, fallen from the top and deposited; fine, little fines, moist.									
SP	SP	1.20	0.00 ~ 0.40 m. Dark grey to black, silty clay to siltstone, consisting of thin, platy, sandy gravel fragments of max 10 cm, fallen from the top and deposited; fine, little fines, moist.								FD at 1.0 m	
		1.30	0.00 ~ 0.40 m. Dark grey to black, silty clay to siltstone, consisting of thin, platy, sandy gravel fragments of max 10 cm, fallen from the top and deposited; fine, little fines, moist.									
SP	SP	1.40	0.00 ~ 0.40 m. Dark grey to black, silty clay to siltstone, consisting of thin, platy, sandy gravel fragments of max 10 cm, fallen from the top and deposited; fine, little fines, moist.								FD at 1.0 m	
		1.50	0.00 ~ 0.40 m. Dark grey to black, silty clay to siltstone, consisting of thin, platy, sandy gravel fragments of max 10 cm, fallen from the top and deposited; fine, little fines, moist.									
SP	SP	1.60	0.00 ~ 0.40 m. Dark grey to black, silty clay to siltstone, consisting of thin, platy, sandy gravel fragments of max 10 cm, fallen from the top and deposited; fine, little fines, moist.								FD at 1.0 m	
		1.70	0.00 ~ 0.40 m. Dark grey to black, silty clay to siltstone, consisting of thin, platy, sandy gravel fragments of max 10 cm, fallen from the top and deposited; fine, little fines, moist.									
SP	SP	1.80	0.00 ~ 0.40 m. Dark grey to black, silty clay to siltstone, consisting of thin, platy, sandy gravel fragments of max 10 cm, fallen from the top and deposited; fine, little fines, moist.								FD at 1.0 m	
		1.90	0.00 ~ 0.40 m. Dark grey to black, silty clay to siltstone, consisting of thin, platy, sandy gravel fragments of max 10 cm, fallen from the top and deposited; fine, little fines, moist.									
SP	SP	2.00	0.00 ~ 0.40 m. Dark grey to black, silty clay to siltstone, consisting of thin, platy, sandy gravel fragments of max 10 cm, fallen from the top and deposited; fine, little fines, moist.								FD at 1.0 m	
			0.00 ~ 0.40 m. Dark grey to black, silty clay to siltstone, consisting of thin, platy, sandy gravel fragments of max 10 cm, fallen from the top and deposited; fine, little fines, moist.									
		0.00	APPROXIMATE FRACTION OF MATERIALS (%)									
		0.10	75 To 150 To 300 To 300 mm									
		0.20	75 To 150 To 300 To 300 mm									
		0.30	75 To 150 To 300 To 300 mm									
		0.40	75 To 150 To 300 To 300 mm									
		0.50	75 To 150 To 300 To 300 mm									
		0.60	75 To 150 To 300 To 300 mm									
		0.70	75 To 150 To 300 To 300 mm									
		0.80	75 To 150 To 300 To 300 mm									
		0.90	75 To 150 To 300 To 300 mm									
		1.00	75 To 150 To 300 To 300 mm									
		1.10	75 To 150 To 300 To 300 mm									
		1.20	75 To 150 To 300 To 300 mm									
		1.30	75 To 150 To 300 To 300 mm									
		1.40	75 To 150 To 300 To 300 mm									
		1.50	75 To 150 To 300 To 300 mm									
		1.60	75 To 150 To 300 To 300 mm									
		1.70	75 To 150 To 300 To 300 mm									
		1.80	75 To 150 To 300 To 300 mm									
		1.90	75 To 150 To 300 To 300 mm									
		2.00	75 To 150 To 300 To 300 mm									

NOTE: SS = Small Sample, BS = Bulk Sample



Field Minimum and Maximum Index Density Tests
 2 Compaction by Monkey Jumper/Hammer

1 Details of Mould/Drum	
Diameter, d=	0.57 m
Area, A =	0.255176 m ²

Location:- TP - 1	
Minimum Index Density	Maximum Index Density
Total Weight of sample, W	314.9 Kg
Height of sample, h	0.702778 m
Volume of Mould, V	0.179832 m ³
Minimum Index Density, ρ_{min}	1755.404 kg/m ³
Maximum Index Density, ρ_{dmax}	2289.905 kg/m ³

Location:- TP - 2	
Minimum Index Density	Maximum Index Density
Total Weight of sample, W	297.9 Kg
Height of sample, h	0.702778 m
Volume of Mould, V	0.179832 m ³
Minimum Index Density, ρ_{min}	1621.043 kg/m ³
Maximum Index Density, ρ_{dmax}	2178.885 kg/m ³

Location:- TP - 4	
Minimum Index Density	Maximum Index Density
Total Weight of sample, W	299.9 Kg
Height of sample, h	0.7 m
Volume of Mould, V	0.179823 m ³
Minimum Index Density, ρ_{min}	1678.854 kg/m ³
Maximum Index Density, ρ_{dmax}	2316.817 kg/m ³

GEOCE CONSULTANTS (P) LTD				
Topographical and Geological Surveys for the Preparatory Survey for the Project for Countermeasure Construction for Landslides on Sindhuili Road (Section II)				
SPECIFIC GRAVITY & WATER ABSORPTION TEST				
Location	Dhungre Bhanjyang	Tested by	KB	
Test Pit:	Pit 1	Date	September 2011	
Sample Size:	1 >75 mm 2 75 - 37.5 mm 3 37.5 - 4.75 mm			
Sample No.	Description	>75 mm 1 Weight (gm)	75-37.5 mm 2 Weight (gm)	37.5-4.75 mm 3
	Mass of submerged density basket and saturated sample, M1	3,970.00	3,441.00	4,055.00
	Mass of submerged empty density basket, M2	1,320.00	1,320.00	1,320.00
	Mass of saturated surface dried test sample in air, B	4,275.00	3,460.00	4,457.00
	Mass of oven dried test sample, A	4,250.00	3,415.00	4,400.00
	Mass of saturated test sample in water, C (M1 - M2)	2,650.00	2,121.00	2,735.00
CALCULATIONS		1	2	3
Specific Gravity:				
a)	Bulk Sp. Gr = A/(B-C)	2.615	2.550	2.555
b)	Bulk Sp Gr (saturated surface dry) = B/(B-C)	2.631	2.584	2.588
c)	Apparent Sp Gr = A/(A-C)	2.656	2.639	2.643
d)	(d) Water Absorption = (B-A)/A*100	0.58	1.30	1.28

GEOCE CONSULTANTS (P) LTD				
Topographical and Geological Surveys for the Preparatory Survey for the Project for Countermeasure Construction for Landslides on Sindhuili Road (Section II)				
SPECIFIC GRAVITY & WATER ABSORPTION TEST				
Location	Dhungre Bhanjyang	Tested by	KB	
Test Pit:	Pit 2	Date	September 2011	
Sample Size:	1 >75 mm 2 75 - 37.5 mm 3 37.5 - 4.75 mm			
Sample No.	Description	>75 mm 1 Weight (gm)	75-37.5 mm 2 Weight (gm)	37.5-4.75 mm 3
	Mass of submerged density basket and saturated sample, M1	4,690.00	3,830.00	5,075.00
	Mass of submerged empty density basket, M2	1,320.00	1,320.00	1,320.00
	Mass of saturated surface dried test sample in air, B	5,435.00	4,090.00	6,107.00
	Mass of oven dried test sample, A	5,390.00	4,040.00	6,020.00
	Mass of saturated test sample in water, C (M1 - M2)	3,370.00	2,510.00	3,755.00
CALCULATIONS		1	2	3
Specific Gravity:				
a)	Bulk Sp. Gr = A/(B-C)	2.610	2.557	2.560
b)	Bulk Sp Gr (saturated surface dry) = B/(B-C)	2.632	2.589	2.597
c)	Apparent Sp Gr = A/(A-C)	2.668	2.641	2.658
d)	(d) Water Absorption = (B-A)/A*100	0.83	1.22	1.42

GEOCE CONSULTANTS (P) LTD				
Topographical and Geological Surveys for the Preparatory Survey for the Project for Countermeasure Construction for Landslides on Sindhuili Road (Section II)				
SPECIFIC GRAVITY & WATER ABSORPTION TEST				
Location	Dhungre Bhanjyang	Tested by	KB	
Test Pit:	Pit 3	Date	September 2011	
Sample Size:	1 >75 mm 2 75 - 37.5 mm 3 37.5 - 4.75 mm			
Sample No.	Description	>75 mm 1 Weight (gm)	75-37.5 mm 2 Weight (gm)	37.5-4.75 mm 3
	Mass of submerged density basket and saturated sample, M1	3,910.00	2,855.00	5,020.00
	Mass of submerged empty density basket, M2	1,320.00	1,320.00	1,320.00
	Mass of saturated surface dried test sample in air, B	4,170.00	2,495.00	6,012.00
	Mass of oven dried test sample, A	4,140.00	2,470.00	5,930.00
	Mass of saturated test sample in water, C (M1 - M2)	2,590.00	1,535.00	3,700.00
CALCULATIONS		1	2	3
Specific Gravity:				
a)	Bulk Sp. Gr = A/(B-C)	2.620	2.573	2.565
b)	Bulk Sp Gr (saturated surface dry) = B/(B-C)	2.639	2.599	2.600
c)	Apparent Sp Gr = A/(A-C)	2.671	2.642	2.659
d)	(d) Water Absorption = (B-A)/A*100	0.72	1.00	1.36

GEOCE CONSULTANTS (P) LTD				
Topographical and Geological Surveys for the Preparatory Survey for the Project for Countermeasure Construction for Landslides on Sindhuli Road (Section II)				
SPECIFIC GRAVITY & WATER ABSORPTION TEST				
Location	Dhungre Bhanjyang	Tested by	KB	
Test Pit:	Pit 4	Date	September 2011	
Sample Size:	1 >75 mm 2 75 - 37.5 mm 3 37.5 - 4.75 mm			
Sample No.	Description	>75 mm 1 Weight (gm)	75-37.5 mm 2 Weight (gm)	37.5-4.75 mm 3
	Mass of submerged density basket and saturated sample, M1	2,960.00	2,800.00	3,825.00
	Mass of submerged empty density basket, M2	1,320.00	1,320.00	1,320.00
	Mass of saturated surface dried test sample in air, B	2,635.00	2,423.00	4,090.00
	Mass of oven dried test sample, A	2,622.00	2,400.00	4,040.00
	Mass of saturated test sample in water, C (M1 - M2)	1,640.00	1,480.00	2,505.00
CALCULATIONS				
Specific Gravity:		1	2	3
a)	Bulk Sp. Gr = A/(B-C)	2.635	2.545	2.549
b)	Bulk Sp Gr (saturated surface dry) = B/(B-C)	2.648	2.569	2.580
c)	Apparent Sp Gr = A/(A-C)	2.670	2.609	2.632
d)	(d) Water Absorption = (B-A)/A*100	0.49	0.95	1.22

GEOCE CONSULTANTS (P) LTD				
Topographical and Geological Surveys for the Preparatory Survey for the Project for Countermeasure Construction for Landslides on Sindhuli Road (Section II)				
SPECIFIC GRAVITY & WATER ABSORPTION TEST				
Location	Dhungre Bhanjyang	Tested by	KB	
Test Pit:	Pit 5	Date	September 2011	
Sample Size:	1 >75 mm 2 75 - 37.5 mm 3 37.5 - 4.75 mm			
Sample No.	Description	>75 mm 1 Weight (gm)	75-37.5 mm 2 Weight (gm)	37.5-4.75 mm 3
	Mass of submerged density basket and saturated sample, M1	4,020.00	2,812.00	4,020.00
	Mass of submerged empty density basket, M2	1,320.00	1,320.00	1,320.00
	Mass of saturated surface dried test sample in air, B	4,305.00	2,445.00	4,390.00
	Mass of oven dried test sample, A	4,295.00	2,424.00	4,325.00
	Mass of saturated test sample in water, C (M1 - M2)	2,700.00	1,492.00	2,700.00
CALCULATIONS				
Specific Gravity:		1	2	3
a)	Bulk Sp. Gr = A/(B-C)	2.676	2.544	2.559
b)	Bulk Sp Gr (saturated surface dry) = B/(B-C)	2.682	2.566	2.598
c)	Apparent Sp Gr = A/(A-C)	2.693	2.601	2.662
d)	(d) Water Absorption = (B-A)/A*100	0.23	0.86	1.48

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Topographical and Geological Surveys for the Preparatory Survey for the Project for Countermeasure Construction for Landslides on Sindhuli Road (Section II)				
SPECIFIC GRAVITY & WATER ABSORPTION TEST				
Location	Dhungre Bhanjyang	Tested by	KB	
Test Pit:	Pit 6	Date	September 2011	
Sample Size:	1 >75 mm 2 75 - 37.5 mm 3 37.5 - 4.75 mm			
Sample No.	Description	>75 mm 1 Weight (gm)	75-37.5 mm 2 Weight (gm)	37.5-4.75 mm 3
	Mass of submerged density basket and saturated sample, M1	3,433.00	3,077.00	4,055.00
	Mass of submerged empty density basket, M2	1,320.00	1,320.00	1,320.00
	Mass of saturated surface dried test sample in air, B	3,402.00	2,860.00	4,445.00
	Mass of oven dried test sample, A	3,370.00	2,836.00	4,406.00
	Mass of saturated test sample in water, C (M1 - M2)	2,113.00	1,757.00	2,735.00
CALCULATIONS				
Specific Gravity:		1	2	3
a)	Bulk Sp. Gr = A/(B-C)	2.614	2.571	2.577
b)	Bulk Sp Gr (saturated surface dry) = B/(B-C)	2.639	2.593	2.599
c)	Apparent Sp Gr = A/(A-C)	2.681	2.628	2.637
d)	(d) Water Absorption = (B-A)/A*100	0.94	0.84	0.88

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Natural Moisture Content Tests

TP No: Pit 1

Water Content Determination					
		<37.5 mm		37.5 - 75 mm	>75 mm
F1	Wt of wet soil + Pan, gm	1705	1405	1140	895
F2	Wt of dry soil + Pan, gm	1560	1300	1107	865
F3	Wt of can, gm	95.5	110.2	69.4	92.5
F4	wt of water (F1-F2), gm	145.00	105.00	33.00	30.00
F5	wt. of dry soil (F2-F3), gm	1461.50	1189.80	1037.60	772.50
F6	Water content (F4/F5*100), %	9.92	8.83	3.18	3.88
	Average water content (%)	9.37		3.53	0.00

TP No: Pit 2

Water Content Determination					
		<37.5 mm		37.5 - 75 mm	>75 mm
F1	Wt of wet soil + Pan, gm	1075	1170	1402	1516
F2	Wt of dry soil + Pan, gm	981	1090	1375	1500
F3	Wt of can, gm	74.3	80	82.1	74.4
F4	wt of water (F1-F2), gm	94.00	80.00	27.00	16.00
F5	wt. of dry soil (F2-F3), gm	906.70	1010.00	1292.90	1425.60
F6	Water content (F4/F5*100), %	10.37	7.92	2.09	1.12
	Average water content (%)	9.14		1.61	0.00

TP No: Pit 3

Water Content Determination					
		<37.5 mm		37.5 - 75 mm	>75 mm
F1	Wt of wet soil + Pan, gm	1780	1770	1160	985
F2	Wt of dry soil + Pan, gm	1660	1670	1149	960
F3	Wt of can, gm	135	158.1	84.9	90.7
F4	wt of water (F1-F2), gm	120.00	100.00	11.00	25.00
F5	wt. of dry soil (F2-F3), gm	1525.00	1511.90	1064.10	869.30
F6	Water content (F4/F5*100), %	7.87	6.61	1.03	2.88
	Average water content (%)	7.24		1.95	0.00

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Natural Moisture Content Tests

TP No: Pit 4

Water Content Determination		<37.5 mm	37.5 - 75 mm	>75 mm
F1	Wt of wet soil + Pan, gm	1140	1055	905
F2	Wt of dry soil + Pan, gm	1035	973	875
F3	Wt of can, gm	99.9	74	70
F4	Wt of water (F1-F2), gm	105.00	82.00	30.00
F5	Wt. of dry soil (F2-F3), gm	935.10	899.00	805.00
F6	Water content (F4/F5*100), %	11.23	9.12	3.73
Average water content (%)		10.17	3.18	0.00

TP No: Pit 5

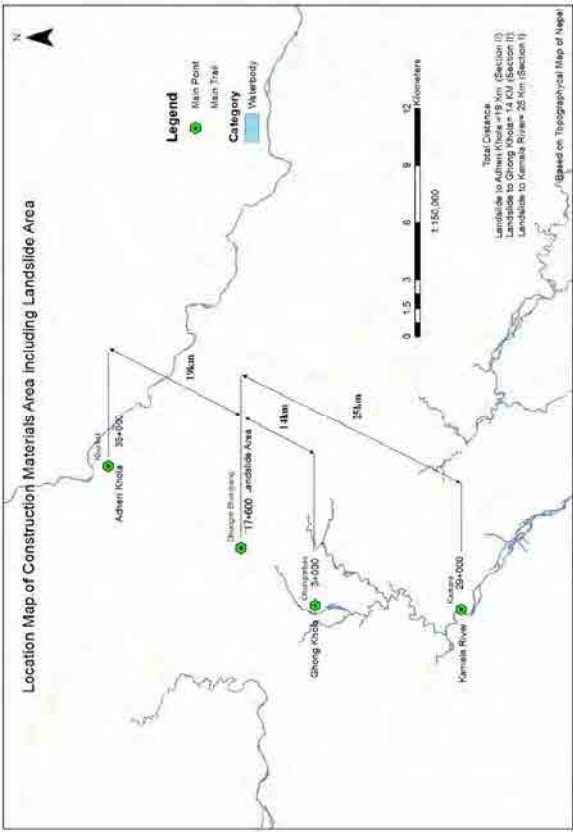
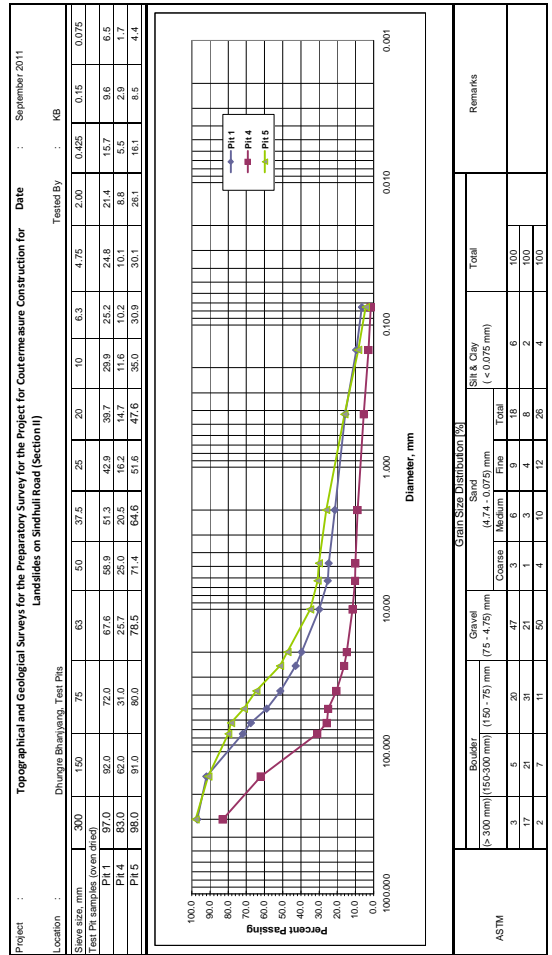
Water Content Determination		<37.5 mm	37.5 - 75 mm	>75 mm
F1	Wt of wet soil + Pan, gm	2000	2000	1465
F2	Wt of dry soil + Pan, gm	1860	1855	1440
F3	Wt of can, gm	154.7	137	136.3
F4	Wt of water (F1-F2), gm	140.00	145.00	25.00
F5	Wt. of dry soil (F2-F3), gm	1705.30	1718.00	1303.70
F6	Water content (F4/F5*100), %	8.21	8.44	1.92
Average water content (%)		8.32	1.92	0.00

TP No: Pit 6

Water Content Determination		<37.5 mm	37.5 - 75 mm	>75 mm
F1	Wt of wet soil + Pan, gm	915	837	965
F2	Wt of dry soil + Pan, gm	872	790	843
F3	Wt of can, gm	79.5	67	57.8
F4	Wt of water (F1-F2), gm	43.00	47.00	22.00
F5	Wt. of dry soil (F2-F3), gm	792.50	723.00	885.20
F6	Water content (F4/F5*100), %	5.43	6.50	2.49
Average water content (%)		5.96	2.64	0.00

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Topographical and Geological Surveys for the Preparatory Survey for the Project for Countermeasure Construction for Landslides on Sindhuil Road (Section II)



Soil Test Result of Riverbed (Adheri Kholi: A1~A3, Ghong Kholi: G1~G3, Kamala River: K1~K3)

Item	A1	A2	A3	G1	G2	G3	K1	K2	K3	Remarks	
Specific Gravity of Soil (G _s) (g/cm ³)	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	The sample picked up from Spits of each river was mixed and tested.	
Specific Gravity in oven dried condition (G _s) (g/cm ³)	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65		
Combined Specific Gravity (G _s) (g/cm ³)	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65		
Coefficient of Water Absorption (Q _w) (%)	0.71	0.71	0.71	1.10	1.10	1.10	0.52	0.52	0.52	data	
Combined Water Absorption (Q _w) (%)	0.71	0.71	0.71	1.10	1.10	1.10	0.52	0.52	0.52	data	
Natural Water Content (W _n) (%)	1.15	2.24	2.31	3.17	3.88	4.36	2.26	2.67	2.41	The average of Field density test, natural and Field oven-dry test.	
Combined Water Content (W _c) (%)	1.15	2.24	2.31	3.17	3.88	4.36	2.26	2.67	2.41	data	
Maximum Grain Size (mm)	300	300	300	150	150	300	300	300	300	Classification of grain size is according to ASTM663	
Grain Size Distribution (%)	Gravel Part (75mm-4.75mm)	0	0	0	0	0	0	0	0	The average of Field density test, natural and Field oven-dry test.	
	Sand Part (4.75mm-0.075mm)	0	0	0	0	0	0	0	0		
	Fine Sand Part (0.075mm-0.0075mm)	0	0	0	0	0	0	0	0		
	Silt & Clay Part (<0.075mm)	100	100	100	100	100	100	100	100		
	75mm	0	0	0	0	0	0	0	0		
	4.75mm	0	0	0	0	0	0	0	0		
	0.075mm	0	0	0	0	0	0	0	0		
	0.0075mm	0	0	0	0	0	0	0	0		
	0.00075mm	0	0	0	0	0	0	0	0		
	0.000075mm	0	0	0	0	0	0	0	0		
Compressive Characteristics	Minimum Density (g/cm ³)	1.974	1.918	1.889	1.817	1.918	1.798	1.805	1.850	1.870	Calculated by Dry density and Water content
	Maximum Density (g/cm ³)	2.041	2.041	2.002	1.898	1.938	1.822	1.844	1.941	1.981	
	Optimum Moisture Content (%)	1.854	1.882	1.852	1.784	1.851	1.729	1.788	1.812	1.832	
	Shrinkage Ratio (%)	2.023	2.008	1.970	1.808	1.873	1.765	1.910	1.906	1.941	
	Maximum Void Ratio (e _{max})	0.355	0.328	0.421	0.460	0.330	0.437	0.464	0.375	0.462	
	Minimum Void Ratio (e _{min})	0.309	0.257	0.340	0.448	0.317	0.430	0.359	0.318	0.368	
	Relative Density (D _r)	2.224	2.227	2.225	2.247	2.262	2.225	2.224	2.124	2.238	
	Relative Density (D _r)	2.272	2.288	2.298	2.271	2.271	2.242	2.202	2.175	2.210	
	Relative Density (D _r)	2.202	2.185	2.183	2.182	2.184	2.146	2.179	2.080	2.188	
	Relative Density (D _r)	2.251	2.252	2.261	2.268	2.194	2.140	2.280	2.199	2.280	
Relative Density (D _r)	0.980	0.942	0.929	0.919	0.917	0.917	0.918	0.919	0.929		
Stiffness	Modulus (E _s) (kg/cm ²)	0.176	0.217	0.167	0.162	0.162	0.168	0.147	0.174	0.176	Estimated by (D _r)
	Dry Density (ρ _d) (kg/cm ³)	1.109	1.173	1.161	1.112	1.112	1.108	1.102	1.209	1.191	
	Void Ratio (e)	1.139	1.139	1.144	1.207	1.204	1.202	1.146	1.202	1.191	
	Relative Density (D _r) (ρ _d × 100 / (ρ _d × e _{max} × 100))	0.230	0.180	0.229	0.245	0.174	0.230	0.207	0.230	0.229	
	Relative Density (D _r) (ρ _d × 100 / (ρ _d × e _{min} × 100))	0.15	0.15	0.14	0.15	0.15	0.14	0.14	0.15	0.15	
	Relative Density (D _r) (ρ _d × 100 / (ρ _d × e _{max} × 100))	0.240	0.209	0.268	0.244	0.244	0.238	0.272	0.191	0.278	
	Relative Density (D _r) (ρ _d × 100 / (ρ _d × e _{min} × 100))	0.208	0.227	0.235	0.197	0.194	0.194	0.209	0.195	0.242	
	Void Ratio (e)	0.307	0.248	0.297	0.314	0.250	0.299	0.274	0.204	0.204	
	Relative Density (D _r) (ρ _d × 100 / (ρ _d × e _{max} × 100))	1.8	8.1	24.8	30.1	35.1	50.3	39.7	9.3	32.3	
	Relative Density (D _r) (ρ _d × 100 / (ρ _d × e _{min} × 100))	2.295	2.412	2.412	2.242	2.242	2.242	2.242	2.242	2.242	
Stiffness	Modulus (E _s) (kg/cm ²)	2.295	2.412	2.412	2.242	2.242	2.242	2.242	2.242	2.242	
	Relative Density (D _r) (ρ _d × 100 / (ρ _d × e _{min} × 100))	2.295	2.412	2.412	2.242	2.242	2.242	2.242	2.242	2.242	
	Relative Density (D _r) (ρ _d × 100 / (ρ _d × e _{min} × 100))	2.295	2.412	2.412	2.242	2.242	2.242	2.242	2.242	2.242	
	Relative Density (D _r) (ρ _d × 100 / (ρ _d × e _{min} × 100))	2.295	2.412	2.412	2.242	2.242	2.242	2.242	2.242	2.242	

Borrow Pit Name/ Comparison Item	I Adheri Khola	II Ghong Khola	III Kamala River	Notes (basis etc.)
Distance from Embankment Area	19km	14km	25km	
Land Owners	Private Land 1 points	Public Land Private Land if not enough 2 points	Public Land 3 points	By field inspection
Approach Road	Existing Road	Existing Road	Existing Road	
Influence on Farm Facility	There is uncultivated land	nothing	nothing	
Influence on Riverbed Lowering	Since the riverbed (public land) is lower than the surrounding land not less than 2m, excavation is difficult. 1 points	Since the riverbed (public land) is narrow (about 20-m width) and sandbank is not large and thin, the digging of large area is necessary for avoid riverbed lowering 2 points	Since sandbank accumulate large area and thick, the influence of riverbed lowering is low. 3 points	
Others	Under collecting from private land by Hazama	Under collecting from public land by local company	Under collecting from public land by public works, etc.	
Quality of Riverbed Material	Sand and Gravel contain Cobbles (particle size 75-300 mm) and Boulders (particle size 300 mm or more) 2 points	Sand and Gravel contain Cobbles 3 points	Sand and Gravel contain Cobbles 3 points	By soil investigation
Quantity	Medium 2 points	Small 1 point	Large 3 points	By field inspection
Cost	Material Cost (DOR)	Several times of 167NR 1 points	About 167NR 3 points	
	Transport Cost (JAPAN)	Middle 2 points	Short 3 points	
Sum	A little High	Low	Low	
Comprehensive Evaluation	9Points	12 points	16points	

I Adheri Khola

Location : Sta.37+000 Existing borrow pit



II Ghong Khola

Existing digging point



III Kamala River

Upper side of Kamala Bridge

Sandbank Width 100m or more Length 500m or more

Tributary stream



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TESP PIT LOG

Project: Sindhuil Road (Section II) Test Pit No.: G-3 Coordinates: **N 27° 19.439' E 85° 54.884'** Date: 13/8/2011
 Aprox. Dimension: 1.0 x 1.0 m. Location: Chong Khola Ground Level: **1651.0 m** Logged By: AM

Classification Group Symbol	Depth (m) Graphic	Type and Depth of sample Taken	CLASSIFICATION AND DESCRIPTION OF MATERIAL (Typical name, colour, in wet condition, odour, if any degree of plasticity, grain size range and description, moisture condition, degree of compactness and other pertinent information)	APPROXIMATE FRACTION OF MATERIAL (%)		
				< 75 mm	75 To 150mm	150 to 300 mm
GP	0.00		Riverbed materials consisting of Alluvium with rounded hard and strong big Boulders of max size 25x18x13 cm, little Sand	29.00	12.60	11.2
	0.10		No FD	30.40	10.00	
	0.20			28.40	11.2	
	0.30			38.60	13.00	
	0.40			39.00	13.00	
	0.50			46.00	15.00	
	0.60			52.00	18.00	
	0.70			39.40	15.00	
	0.80			48.00	15.00	
	0.90			15.00		
1.00			407.40	12.60	11.20	
			94.00	3.00	3.00	
					0.00	
					0.00	

NOTE: SS = Small Sample
BS = Bulk Sample

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TESP PIT LOG

Project: Sindhuil Road (Section II) Test Pit No.: G-1 Coordinates: **N 27° 19.570' E 85° 54.760'** Date: 13/8/2011
 Aprox. Dimension: 1.0 x 1.0 m. Location: Chong Khola Ground Level: **1669.0 m** Logged By: AM

Classification Group Symbol	Depth (m) Graphic	Type and Depth of sample Taken	CLASSIFICATION AND DESCRIPTION OF MATERIAL (Typical name, colour, in wet condition, odour, if any degree of plasticity, grain size range and description, moisture condition, degree of compactness and other pertinent information)	APPROXIMATE FRACTION OF MATERIAL (%)		
				< 75 mm	75 To 150mm	150 to 300 mm
GP	0.00		Riverbed materials consisting of Alluvium with rounded hard and strong big Boulders, little Sand	43.40	24.00	
	0.10		No FD	24.20	24.00	
	0.20			28.40	24.00	
	0.30			26.00	24.00	
	0.40			22.20	24.00	
	0.50			22.00	24.00	
	0.60			22.60	24.00	
	0.70			21.30	24.00	
	0.80			7.00		
	0.90				314.90	24.00
1.00			93.00	7.00	0.00	

NOTE: SS = Small Sample
BS = Bulk Sample

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TESP PIT LOG

Project: Sindhuil Road (Section II) Test Pit No.: A-1 Coordinates: **N 27° 19.984' E 85° 59.689'** Date: 14/8/2011
 Aprox. Dimension: 0.9 x 0.9 m. Location: Ardhen Khola Ground Level: **980.0 m** Logged By: AM

Classification Group Symbol	Depth (m) Graphic	Type and Depth of sample Taken	CLASSIFICATION AND DESCRIPTION OF MATERIAL (Typical name, colour, in wet condition, odour, if any degree of plasticity, grain size range and description, moisture condition, degree of compactness and other pertinent information)	APPROXIMATE FRACTION OF MATERIAL (%)		
				< 75 mm	75 To 150mm	150 to 300 mm
GP	0.00		Riverbed materials consisting of Alluvium with rounded hard and strong big Boulders of max size 16x16x26 cm, little Sand	92	10	17.2
	0.10		No FD	24.40	16.00	
	0.20			23.00	13.00	
	0.30			31.80	20.60	
	0.40			33.00	20.40	
	0.50			26.20	13.00	
	0.60			37.80	20.40	
	0.70			32.60	13.00	
	0.80			34.60	13.00	
	0.90			32.40	13.00	
1.00			508.00	80.00	17.20	
			84.00	13.00	3.00	
					0.00	
					0.00	

NOTE: SS = Small Sample
BS = Bulk Sample

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TESP PIT LOG

Project: Sindhuil Road (Section II) Test Pit No.: G-2 Coordinates: **N 27° 19.476' E 85° 54.922'** Date: 13/8/2011
 Aprox. Dimension: 1.2 x 1.0 m. Location: Chong Khola Ground Level: **1647.0 m** Logged By: AM

Classification Group Symbol	Depth (m) Graphic	Type and Depth of sample Taken	CLASSIFICATION AND DESCRIPTION OF MATERIAL (Typical name, colour, in wet condition, odour, if any degree of plasticity, grain size range and description, moisture condition, degree of compactness and other pertinent information)	APPROXIMATE FRACTION OF MATERIAL (%)		
				< 75 mm	75 To 150mm	150 to 300 mm
GP	0.00		Riverbed materials consisting of Alluvium with rounded hard and strong big Boulders of max size 15x12x8 cm, little Sand, wet	21	23.40	
	0.10		No FD	20.00	23.40	
	0.20			40.50	23.40	
	0.30			41.80	23.40	
	0.40			37.80	23.40	
	0.50			49.40	23.40	
	0.60			36.60	23.40	
	0.70			47.00	23.40	
	0.80			48.40	23.40	
	0.90			46.00	23.40	
1.00			538.30	23.40	0.00	
			96.00	4.00	0.00	
					0.00	
					0.00	

NOTE: SS = Small Sample
BS = Bulk Sample

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Topographical and Geological Surveys for the Preparatory Survey for the Project for Countermeasure Construction for Landslides on Sindhuil Road (Section II)

Project: Sindhuil Road (Section II) _____ Date: 15/08/2011
 Aprox. Dimension: 1.2 x 0.9 m. _____ Logged By: AM

Test Pit No.: K - 1 _____ Coordinates: N 27° 09.966' E 85° 53.842'
 Location: Kamla River _____ Ground Level: 440.0 m

TESP PIT LOG

Classification Group Symbol	depth (m)	Type and Depth of sample taken	CLASSIFICATION AND DESCRIPTION OF MATERIAL (Typical name, colour, in wet condition, odour, if any degree of plasticity, grain size range and description, moisture condition, degree of compactness and other pertinent information)	APPROXIMATE FRACTION OF MATERIAL (%)		
				< 75 mm	75 To 150mm	150 to 300 mm
GP	0.00		Riverbed materials consisting of Alluvium, reddish, with rounded hard and strong big Boulders of max size 25x20x15 cm, little Sand	22.20	33.20	28
	0.10	FD at 0.1m		24.20	15.20	15
	0.20		0-0.1 m, Fine Sand with Gravel, loose, dry	45.00	25.00	5.2
	0.30		0.1 - 0.6 m, Coarse Sand with few Boulder	33.00	26.40	
	0.40		0.6 - 1.1 m, Coarse Sand with big Boulders, loose and dry	38.80	28.80	
	0.50			39.00		
	0.60			39.40		
	0.70			39.00		
	0.80			33.80		
	0.90			28.60		
1.00			32.20	110.60	78.20	
			889.20	128.80	14.00	
			699.80		9.00	
			77.00		0.00	

NOTE: SS = Small Sample
BS = Bulk Sample

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Topographical and Geological Surveys for the Preparatory Survey for the Project for Countermeasure Construction for Landslides on Sindhuil Road (Section II)

Project: Sindhuil Road (Section II) _____ Date: 14/8/2011
 Aprox. Dimension: 1.2 x 0.85 m. _____ Logged By: AM

Test Pit No.: A - 2 _____ Coordinates: N 27° 19.054' E 85° 59.700'
 Location: Andheri Khola _____ Ground Level: 822.0 m

TESP PIT LOG

Classification Group Symbol	depth (m)	Type and Depth of sample taken	CLASSIFICATION AND DESCRIPTION OF MATERIAL (Typical name, colour, in wet condition, odour, if any degree of plasticity, grain size range and description, moisture condition, degree of compactness and other pertinent information)	APPROXIMATE FRACTION OF MATERIAL (%)		
				< 75 mm	75 To 150mm	150 to 300 mm
GP	0.00		Riverbed materials consisting of Alluvium with rounded hard and strong big Boulders of max size 18x23x30 cm, little Sand	37.00	56.40	23
	0.10			31.00	17.00	20.2
	0.20	BS		55.40		1.9
	0.30			54.00		3.1
	0.40			50.80		
	0.50			39.00		
	0.60			48.40		
	0.70			19.00		
	0.80			22.40		
	0.90			26.40		
1.00			32.40	73.40	93.80	
			584.30	10.00	12.00	
			78.00		0.00	

NOTE: SS = Small Sample
BS = Bulk Sample

GEOCE CONSULTANTS (P) LTD.

Topographical and Geological Surveys for the Preparatory Survey for the Project for Countermeasure Construction for Landslides on Sindhuil Road (Section II)

Project: Sindhuil Road (Section II) _____ Date: 15/08/2011
 Aprox. Dimension: 1.3 x 1.0 m. _____ Logged By: AM

Test Pit No.: K - 2 _____ Coordinates: N 27° 09.974' E 85° 53.898'
 Location: Kamla River _____ Ground Level: 434.460 m

TESP PIT LOG

Classification Group Symbol	depth (m)	Type and Depth of sample taken	CLASSIFICATION AND DESCRIPTION OF MATERIAL (Typical name, colour, in wet condition, odour, if any degree of plasticity, grain size range and description, moisture condition, degree of compactness and other pertinent information)	APPROXIMATE FRACTION OF MATERIAL (%)		
				< 75 mm	75 To 150mm	150 to 300 mm
GP	0.00		Riverbed materials consisting of Alluvium, reddish, with rounded hard and strong big Boulders of max size 20x25x8 cm, little Sand	29.10	43.00	22
	0.10	FD at 0.1m		27.00	20.80	
	0.20		0-0.6 m, Fine Sand with Gravel, loose, dry and water seepage at 0.9 m	21.00	20.40	
	0.30		0.6 - 0.9 m, Coarse Sand with Gravels, loose and dry	39.00	37.00	
	0.40			42.00	28.00	
	0.50			38.00	19.60	
	0.60			35.20		
	0.70			38.20		
	0.80			43.60		
	0.90			33.00		
1.00			41.00	127.80	22.00	
			603.60	82.40	2.00	
			780.00	14.00	0.00	
			84.20		0.00	

NOTE: SS = Small Sample
BS = Bulk Sample

GEOCE CONSULTANTS (P) LTD.

Topographical and Geological Surveys for the Preparatory Survey for the Project for Countermeasure Construction for Landslides on Sindhuil Road (Section II)

Project: Sindhuil Road (Section II) _____ Date: 14/8/2011
 Aprox. Dimension: 1.2 x 1.0 m. _____ Logged By: AM

Test Pit No.: A - 3 _____ Coordinates: N 27° 19.216' E 85° 59.879'
 Location: Andheri Khola _____ Ground Level: 819.0 m

TESP PIT LOG

Classification Group Symbol	depth (m)	Type and Depth of sample taken	CLASSIFICATION AND DESCRIPTION OF MATERIAL (Typical name, colour, in wet condition, odour, if any degree of plasticity, grain size range and description, moisture condition, degree of compactness and other pertinent information)	APPROXIMATE FRACTION OF MATERIAL (%)		
				< 75 mm	75 To 150mm	150 to 300 mm
GP	0.00		Riverbed materials consisting of Alluvium with rounded hard and strong big Boulders of max size 20x25x8 cm, little Sand	29.10	43.00	22
	0.10			27.00	20.80	
	0.20		0-0.5 m, Gravel mixed with Fine Sand, loose, dry	23.40	17.00	
	0.30		0.5 - 1.0 m, Fine Sand with big boulder at depth 0.9 m	37.40	18.00	
	0.40			40.80		
	0.50			35.20		
	0.60			38.00		
	0.70			33.00		
	0.80			28.00		
	0.90			28.00		
1.00			444.50	93.20	16.00	
			80.00	17.00	3.00	
					0.00	

NOTE: SS = Small Sample
BS = Bulk Sample

GEOTECHNICAL AND GEOLOGICAL SURVEYS FOR THE PREPARATORY SURVEY FOR THE PROJECT FOR COUNTERMEASURE CONSTRUCTION FOR LANDSLIDES ON SINDHU ROAD (SECTION II)

FIELD DENSITY TEST
Water Replacement Method

Location: **Andheri Khola** Test Pit: **A-1** Test Depth: **0.1 m** Date: **14-Sep-11**

Project: **Sindhuli Road (Section II)** Test Pit No.: **K-3** Coordinates: **N 27° 08' 39.0" E 85° 54' 10.7"** Date: **15/8/2011**
Approx. Dimension: **1.3 x 1.0 m.** Location: **Kamala River** Ground Level: **445.0 m** Logged By: **AM**

Classification	Group Symbol	Depth (m)	Type and depth of sample taken	CLASSIFICATION AND DESCRIPTION OF MATERIAL (Typical name, colour, in wet condition, odour, if any degree of plasticity, grain size range and moisture content, moisture reduction, degree of compaction, etc.)	APPROXIMATE FRACTION OF MATERIAL (%)		
					< 75 mm	75 To 150 mm	150 to 300 > 300 mm
GP		0.00		Riverbed materials consisting of alluvium, reddish, with rounded hard and strong big boulders of max size 27.24x19 cm, little sand	100	0	0
		0.10			25.00	16.00	59.00
		0.20			24.20	16.80	59.00
		0.30			42.00	15.80	42.20
		0.40			34.20	13.00	52.80
		0.50			44.80	15.00	40.20
		0.60			43.80	16.00	40.20
		0.70			30.80	16.00	53.20
		0.80			46.00	16.00	38.00
		0.90			33.00	16.00	51.00
		1.00			33.00	16.00	51.00

NOTE : SS = Small Sample
BS = Bulk Sample

GEOTECHNICAL AND GEOLOGICAL SURVEYS FOR THE PREPARATORY SURVEY FOR THE PROJECT FOR COUNTERMEASURE CONSTRUCTION FOR LANDSLIDES ON SINDHU ROAD (SECTION II)

FIELD DENSITY TEST
Water Replacement Method

Location: **Andheri Khola** Test Pit: **A-1** Test Depth: **0.1 m** Date: **14-Sep-11**

Project: **Sindhuli Road (Section II)** Test Pit No.: **K-3** Coordinates: **N 27° 08' 39.0" E 85° 54' 10.7"** Date: **15/8/2011**
Approx. Dimension: **1.3 x 1.0 m.** Location: **Kamala River** Ground Level: **445.0 m** Logged By: **AM**

Field Density test	Wt of wet soil (gm)	Wt of water (W _w) (gm)	Wt of dry soil (F ₁) (gm)	Wt of soil + Pan (F ₂) (gm)	Wt of water in hole (F ₃) (gm)	Wt of soil + Pan (F ₄) (gm)	Wt of water in hole (F ₅) (gm)	Wt of soil + Pan (F ₆) (gm)	Wt of water in hole (F ₇) (gm)	Water Content Determination		
										W _w (%)	F ₁ (%)	F ₂ (%)
F1	8100.00	1000.00	7100.00	8100.00	1000.00	7100.00	1000.00	8100.00	1000.00	12.54	89.46	12.54
F2	8100.00	1000.00	7100.00	8100.00	1000.00	7100.00	1000.00	8100.00	1000.00	12.54	89.46	12.54
F3	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F4	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F5	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F6	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F7	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F8	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F9	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F10	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00

NOTE : SS = Small Sample
BS = Bulk Sample

GEOTECHNICAL AND GEOLOGICAL SURVEYS FOR THE PREPARATORY SURVEY FOR THE PROJECT FOR COUNTERMEASURE CONSTRUCTION FOR LANDSLIDES ON SINDHU ROAD (SECTION II)

FIELD DENSITY TEST
Water Replacement Method

Location: **Andheri Khola** Test Pit: **A-3** Test Depth: **0.1 m** Date: **14-Sep-11**

Project: **Sindhuli Road (Section II)** Test Pit No.: **K-3** Coordinates: **N 27° 08' 39.0" E 85° 54' 10.7"** Date: **15/8/2011**
Approx. Dimension: **1.3 x 1.0 m.** Location: **Kamala River** Ground Level: **445.0 m** Logged By: **AM**

Field Density test	Wt of wet soil (gm)	Wt of water (W _w) (gm)	Wt of dry soil (F ₁) (gm)	Wt of soil + Pan (F ₂) (gm)	Wt of water in hole (F ₃) (gm)	Wt of soil + Pan (F ₄) (gm)	Wt of water in hole (F ₅) (gm)	Wt of soil + Pan (F ₆) (gm)	Wt of water in hole (F ₇) (gm)	Water Content Determination		
										W _w (%)	F ₁ (%)	F ₂ (%)
F1	9400.00	1000.00	8400.00	9400.00	1000.00	8400.00	1000.00	9400.00	1000.00	11.70	88.30	11.70
F2	9400.00	1000.00	8400.00	9400.00	1000.00	8400.00	1000.00	9400.00	1000.00	11.70	88.30	11.70
F3	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F4	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F5	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F6	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F7	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F8	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F9	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F10	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00

NOTE : SS = Small Sample
BS = Bulk Sample

GEOTECHNICAL AND GEOLOGICAL SURVEYS FOR THE PREPARATORY SURVEY FOR THE PROJECT FOR COUNTERMEASURE CONSTRUCTION FOR LANDSLIDES ON SINDHU ROAD (SECTION II)

FIELD DENSITY TEST
Water Replacement Method

Location: **Andheri Khola** Test Pit: **K-1** Test Depth: **0.1 m** Date: **15-Sep-11**

Project: **Sindhuli Road (Section II)** Test Pit No.: **K-3** Coordinates: **N 27° 08' 39.0" E 85° 54' 10.7"** Date: **15/8/2011**
Approx. Dimension: **1.3 x 1.0 m.** Location: **Kamala River** Ground Level: **445.0 m** Logged By: **AM**

Field Density test	Wt of wet soil (gm)	Wt of water (W _w) (gm)	Wt of dry soil (F ₁) (gm)	Wt of soil + Pan (F ₂) (gm)	Wt of water in hole (F ₃) (gm)	Wt of soil + Pan (F ₄) (gm)	Wt of water in hole (F ₅) (gm)	Wt of soil + Pan (F ₆) (gm)	Wt of water in hole (F ₇) (gm)	Water Content Determination		
										W _w (%)	F ₁ (%)	F ₂ (%)
F1	6140.00	1000.00	5140.00	6140.00	1000.00	5140.00	1000.00	6140.00	1000.00	16.27	83.73	16.27
F2	6140.00	1000.00	5140.00	6140.00	1000.00	5140.00	1000.00	6140.00	1000.00	16.27	83.73	16.27
F3	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F4	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F5	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F6	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F7	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F8	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F9	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F10	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00

NOTE : SS = Small Sample
BS = Bulk Sample

GEOTECHNICAL AND GEOLOGICAL SURVEYS FOR THE PREPARATORY SURVEY FOR THE PROJECT FOR COUNTERMEASURE CONSTRUCTION FOR LANDSLIDES ON SINDHU ROAD (SECTION II)

FIELD DENSITY TEST
Water Replacement Method

Location: **Andheri Khola** Test Pit: **K-2** Test Depth: **0.1 m** Date: **15-Sep-11**

Project: **Sindhuli Road (Section II)** Test Pit No.: **K-3** Coordinates: **N 27° 08' 39.0" E 85° 54' 10.7"** Date: **15/8/2011**
Approx. Dimension: **1.3 x 1.0 m.** Location: **Kamala River** Ground Level: **445.0 m** Logged By: **AM**

Field Density test	Wt of wet soil (gm)	Wt of water (W _w) (gm)	Wt of dry soil (F ₁) (gm)	Wt of soil + Pan (F ₂) (gm)	Wt of water in hole (F ₃) (gm)	Wt of soil + Pan (F ₄) (gm)	Wt of water in hole (F ₅) (gm)	Wt of soil + Pan (F ₆) (gm)	Wt of water in hole (F ₇) (gm)	Water Content Determination		
										W _w (%)	F ₁ (%)	F ₂ (%)
F1	7400.00	1000.00	6400.00	7400.00	1000.00	6400.00	1000.00	7400.00	1000.00	13.50	86.50	13.50
F2	7400.00	1000.00	6400.00	7400.00	1000.00	6400.00	1000.00	7400.00	1000.00	13.50	86.50	13.50
F3	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F4	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F5	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F6	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F7	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F8	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F9	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00
F10	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	90.00	10.00

NOTE : SS = Small Sample
BS = Bulk Sample

GEOTECHNICAL AND GEOLOGICAL SURVEYS FOR THE PREPARATORY SURVEY FOR THE PROJECT FOR COUNTERMEASURE CONSTRUCTION FOR LANDSLIDES ON SINDHU ROAD (SECTION II)

FIELD DENSITY TEST
Water Replacement Method

Location: **Andheri Khola** Test Pit: **K-3** Test Depth: **0.1 m** Date: **15-Sep-11**

Project: **Sindhuli Road (Section II)** Test Pit No.: **K-3** Coordinates: **N 27° 08' 39.0" E 85° 54' 10.7"** Date: **15/8/2011**
Approx. Dimension: **1.3 x 1.0 m.** Location: **Kamala River** Ground Level: **445.0 m** Logged By: **AM**

Field Density test	Wt of wet soil (gm)	Wt of water (W _w) (gm)	Wt of dry soil (F ₁) (gm)	Wt of soil + Pan (F ₂) (gm)	Wt of water in hole (F ₃) (gm)	Wt of soil + Pan (F ₄) (gm)	Wt of water in hole (F ₅) (gm)	Wt of soil + Pan (F ₆) (gm)	Wt of water in hole (F ₇) (gm)	Water Content Determination		
										W _w (%)	F ₁ (%)	F ₂ (%)
F1	8100.00	1000.00	7100.00	8100.00	1000.00	7100.00	1000.00	8100.00	1000.00	12.54	89.46	12.54
F2	8100.00	1000.00	7100.00	8100.00	1000.00	7100.00	1000.00	8100.00	1000.00	12.54	89.46	12.54
F3	3085.00	308.50	2776.50	3085.00	308.50	2776.50	308.50	3085.00	308.50	10.00	9	

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 Topographical and Geological Surveys for the Preparatory Survey for the Project for Countermeasure Construction for Landslides on Sindhuli Road (Section II)

SPECIFIC GRAVITY & WATER ABSORPTION TEST

Location Ghong Khola Tested by KB
 Test Pit: G 1, G 2 & G 3 Date September 2011
 Sample Size:
 1 >75 mm
 2 75 - 37.5 mm
 3 37.5 - 4.75 mm

Sample No.	Description	>75 mm	75-37.5 mm	37.5-4.75 mm
		1	2	3
		Weight (gm)	Weight (gm)	
	Mass of submerged density basket and saturated sample, M1	4,346.00	3,010.00	4,460.00
	Mass of submerged empty density basket, M2	1,320.00	1,320.00	1,320.00
	Mass of saturated surface dried test sample in air, B	4,851.00	2,689.00	5,004.00
	Mass of oven dried test sample, A	4,780.00	2,672.00	4,949.00
	Mass of saturated test sample in water, C (M1 - M2)	3,026.00	1,690.00	3,140.00

CALCULATIONS

		1	2	3
Specific Gravity:				
a)	Bulk Sp. Gr = A/(B-C)	2.619	2.675	2.655
b)	Bulk Sp Gr (saturated surface dry) = B/(B-C)	2.658	2.692	2.685
c)	Apparent Sp Gr = A/(A-C)	2.725	2.721	2.736
d)	(d) Water Absorption = (B-A)/A*100	1.46	0.63	1.10

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 Topographical and Geological Surveys for the Preparatory Survey for the Project for Countermeasure Construction for Landslides on Sindhuli Road (Section II)

SPECIFIC GRAVITY & WATER ABSORPTION TEST

Location Andheri Khola Tested by KB
 Test Pit: A 1, A 2 & A 3 Date September 2011
 Sample Size:
 1 >75 mm
 2 75 - 37.5 mm
 3 37.5 - 4.75 mm

Sample No.	Description	>75 mm	75-37.5 mm	37.5-4.75 mm
		1	2	3
		Weight (gm)	Weight (gm)	
	Mass of submerged density basket and saturated sample, M1	3,505.00	3,330.00	4,130.00
	Mass of submerged empty density basket, M2	1,320.00	1,320.00	1,320.00
	Mass of saturated surface dried test sample in air, B	3,505.00	3,227.00	4,495.00
	Mass of oven dried test sample, A	3,482.00	3,205.00	4,463.00
	Mass of saturated test sample in water, C (M1 - M2)	2,185.00	2,010.00	2,810.00

CALCULATIONS

		1	2	3
Specific Gravity:				
a)	Bulk Sp. Gr = A/(B-C)	2.638	2.634	2.649
b)	Bulk Sp Gr (saturated surface dry) = B/(B-C)	2.655	2.652	2.668
c)	Apparent Sp Gr = A/(A-C)	2.685	2.682	2.700
d)	(d) Water Absorption = (B-A)/A*100	0.66	0.68	0.71

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 Topographical and Geological Surveys for the Preparatory Survey for the Project for Countermeasure Construction for Landslides on Sindhuli Road (Section II)

SPECIFIC GRAVITY & WATER ABSORPTION TEST

Location Kamala River Tested by KB
 Test Pit: K 1, K 2 & K 3 Date September 2011
 Sample Size:
 1 >75 mm
 2 75 - 37.5 mm
 3 37.5 - 4.75 mm

Sample No.	Description	>75 mm	75-37.5 mm	37.5-4.75 mm
		1	2	3
		Weight (gm)	Weight (gm)	
	Mass of submerged density basket and saturated sample, M1	3,385.00	3,180.00	3,825.00
	Mass of submerged empty density basket, M2	1,320.00	1,320.00	1,320.00
	Mass of saturated surface dried test sample in air, B	3,342.00	3,020.00	4,062.00
	Mass of oven dried test sample, A	3,339.00	3,003.00	4,041.00
	Mass of saturated test sample in water, C (M1 - M2)	2,065.00	1,860.00	2,505.00

CALCULATIONS

		1	2	3
Specific Gravity:				
a)	Bulk Sp. Gr = A/(B-C)	2.615	2.589	2.595
b)	Bulk Sp Gr (saturated surface dry) = B/(B-C)	2.617	2.603	2.609
c)	Apparent Sp Gr = A/(A-C)	2.621	2.627	2.631
d)	(d) Water Absorption = (B-A)/A*100	0.09	0.56	0.52

GEOCE CONSULTANTS (P) LTD.
 Topographical and Geological Surveys for the Preparatory Survey for the Project for Countermeasure Construction for Landslides on Sindhuli Road (Section II)

Natural Moisture Content Tests

TP No: G 1

		Water Content Determination			
		<37.5 mm		37.5 - 75 mm	>75 mm
F1	Wt of wet soil + Pan, gm	1300	1350	1500	835
F2	Wt of dry soil + Pan, gm	1265	1307	1460	827
F3	Wt of can, gm	114.9	99.9	82.4	57.8
F4	wt of water (F1-F2), gm	35.00	43.00	40.00	8.00
F5	wt. of dry soil (F2-F3), gm	1150.10	1207.10	1377.60	769.20
F6	Water content (F4/F5*100), %	3.04	3.56	2.90	1.04
Average water content (%)		3.17		2.21	0.00

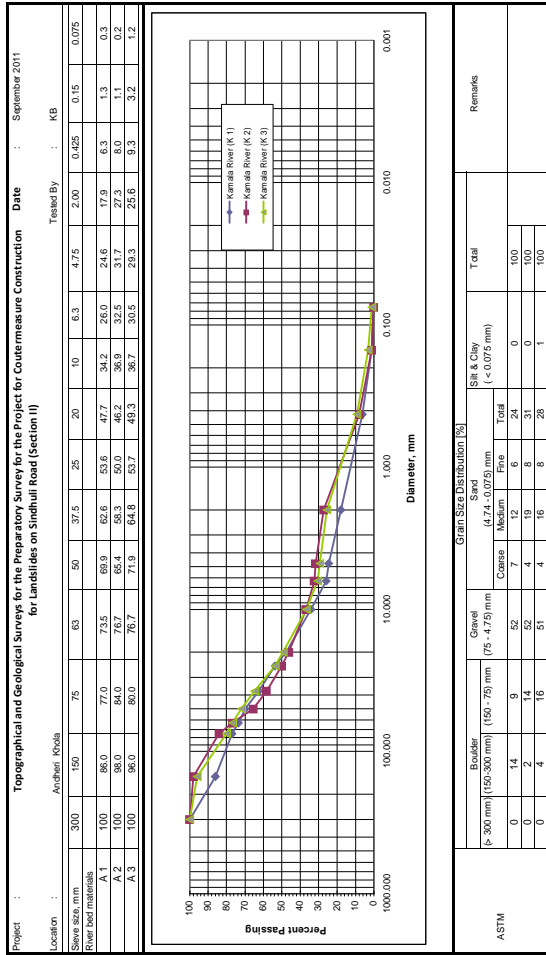
TP No: G 2

		Water Content Determination			
		<37.5 mm		37.5 - 75 mm	>75 mm
F1	Wt of wet soil + Pan, gm	1118	1530	1225	741
F2	Wt of dry soil + Pan, gm	1080	1490	1170	737
F3	Wt of can, gm	69.4	98.5	76.5	82.1
F4	wt of water (F1-F2), gm	38.00	40.00	55.00	4.00
F5	wt. of dry soil (F2-F3), gm	1010.60	1391.50	1093.50	654.90
F6	Water content (F4/F5*100), %	3.76	2.87	5.03	0.61
Average water content (%)		3.89		0.63	0.00

TP No: G 3

		Water Content Determination			
		<37.5 mm		37.5 - 75 mm	>75 mm
F1	Wt of wet soil + Pan, gm	1200	1200	1300	1430
F2	Wt of dry soil + Pan, gm	1137	1145	1255	1415
F3	Wt of can, gm	66	87.4	78	70.9
F4	wt of water (F1-F2), gm	63.00	55.00	45.00	15.00
F5	wt. of dry soil (F2-F3), gm	1071.00	1057.60	1177.00	1344.10
F6	Water content (F4/F5*100), %	5.88	5.20	3.82	1.12
Average water content (%)		4.97		1.12	0.00

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GRAIN SIZE DISTRIBUTION



Dmax ≈ 200mm, air void is smaller than other pits



Dmax ≈ 300mm, air void is large and loose
Photo 3: Test Pit 1



Gravels of Dmax ≈ 30~50mm are distributed on ground surface of depth 0.6m or less. Gravels get fewer in lower layer. All layer is loose.

Photo 5: Test Pit 3



Photo 4: Test Pit 2



Cobble of Dmax 200mm is distributed on surface as depth 0.1m. Gravels of Dmax 150mm in depth 0.1 or more.

Photo 7: Test Pit 5

Cobbles of Dmax 300mm are main. Air void is largest and loose.

Photo 6: Test Pit 4



Cobble of Dmax 300 is distributed in depth 0.0~0.3m. Depth 0.3~1.3m is gravels of Dmax 150mm. Depth 1.3 or more is sand and gravel, and springwater

Photo 8: Test Pit 6

IN-SITU INDEX DENSITY TESTS



Photo 9: Compaction Layers by Monkey Jumper



IN-SITU FILED DENSITY TESTS



Photo 10: In-situ Density by Sand Cone Method

Photo 11: IN-SITU DENSITY TESTS BY WATER REPLACEMENT METHOD



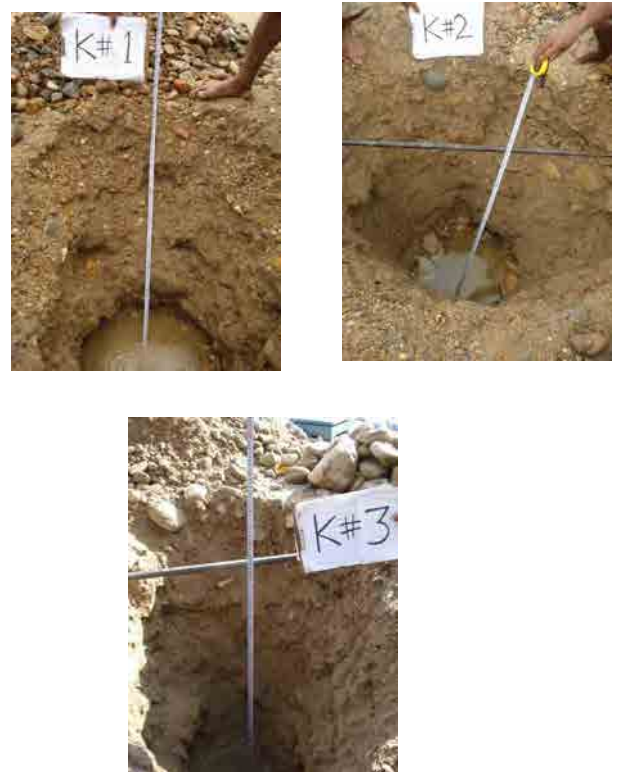
TEST PIT ON RIVER BED (Ghong Khola)



TEST PIT ON RIVER BED (Andheri Khola)



TEST PIT ON RIVER BED (Kamala River)



IN-SITU DENSITY TESTS BY WATER REPLACEMENT METHOD



In-situ Density at Ghong Khola (G3)

In-situ Density tests at Kamala River



In-situ Density tests at Andheri Khola



ROCK SAMPLE



FIELD SIEVE



Appendix-5.6
Review of Monitoring Data

1. Review of Monitoring Data

Monitoring devices set by the last project have been transferred to the Department of Roads (DOR). They are continuing the monitoring independently from October 2010. The JICA Study Team reviewed the monitoring data up to August 2011 given by DOR in this study. The team mainly examined the data recorded from the tiltmeter because the data were smoothly continued from the data of the last project. The data recorded from the inclinometer were not included in this review because the data were not continued from the data of the last monitoring.

1.1 Tiltmeter

Tiltmeters were set in and around each landslide area in order to evaluate the stability of each area. The study team confirmed the data of Sta. 17+400 for reference, where construction work is being done by DOR. The amount of tiltmeter is shown in Table 1.1.

Table 1.1 Amount of Tiltmeter

Location	Number	Quantity	Frequency of Monitoring
Sta. 17+400 (for reference)	AK-1-AK-3	3	1-2 times/week (July 2010-Sep. 2010) 1/month (Oct. 2010-Aug. 2011)
Sta. 18+200	AK-4-AK-5	2	1-2 times/week (July 2010-Sep. 2010) 1/month (Oct. 2010-Aug. 2011)
Sta. 17+600	BK-1-BK-8	8	2 times/week (Aug. 2010-Sep. 2011) 1/month (Oct. 2010-Aug. 2011)
Total		13	

The degree of tilting is based on Figure 1.2.

Table 1.2 Degree of Tilting (Japan Road Association)

Rank of tilting	Average tilting/day	Total tilting (seconds/month)	Cumulative tilting	Correlation between direction of tilting and topography	Activity
Rank A	More than 5 seconds	More than 100 seconds	Strong	Obvious	Strong
Rank B	1-5 seconds	30-100 seconds	Middle	Obvious	Weak
Rank C	Less than 1 second	Less than 30 seconds	Weak	Obvious	(more observation is needed)
Rank D	More than 3 seconds	None (intermittent)	None (intermittent)	None	Active in limited area

※ Considering both average tilting/day and cumulative tilting to decide the rank

The condition of each tiltmeter is as shown in Table 1.3.

Table 1.3 Observation of Tiltmeter (July 2010-Aug. 2011)

Location	Number	Average tilting/day (second)	Total tilting (seconds/month)	Cumulative tilting	Direction of tilting	Judgment
Sta. 17+400	AK-1	0.1	2.8	None	N83W	None
	AK-2	0.2	7.3	None	N26W	None
	AK-3	0.8	23.0	Weak	N57E	Rank C

				(diagonally upper)		
Sta. 18+200	AK-4	1.9	57.0	Very strong in rainy season (diagonally)	N17E	Rank B
	AK-5	2.0	59.7	Very strong in rainy season (upper)	S86W	Rank B
Sta. 17+600	BK-1	0.6	18.6	Middle (horizontally)	N11W	Rank C
	BK-2	0.2	5.4	None	N65W	None
	BK-3	0	1.3	None	N65W	None
	BK-4 (on the retaining wall)	0.5	14.4	None (recurring)	N1W	Rank C (diagonally)
	BK-5 (on the retaining wall)	0.7	21.6	Weak (diagonally)	S1W	Rank C
	BK-6 (on the retaining wall)	0.4	11.1	None (recurring)	N25W	Rank C (diagonally)
	BK-7 (on the retaining wall)	1.1	34.1	Weak (diagonally lower, recurring)	N62E	Rank B (diagonally)
	BK-8	0.3	7.6	None	N60W	None

Source: JICA Study Team, DOR

Tilting was not observed at all along AK-1 and AK-2 in Sta. 17+400 during the monitoring period. Very little cumulative tilting (Rank C) was observed in the upper diagonal direction at AK-3. It may be influenced by the collapse of shotcrete.

Very strong cumulative tilting at AK-4 and AK-5 during rainy season was observed in Sta. 18+200. Both were judged to have Rank B classification. The site slope is becoming unstable due to rainfall as observed by the collapse of shotcrete according to the data of the last project. Also, the monitoring data of tiltmeter is showing the same tendency.

Slight tilting along the direction oriented orthogonally to the contour line is observed during rainy season at BK-1 in Sta. 17+600 around the collapse area. It is judged to have Rank C. No tilting was observed at BK-2 and BK-3 in the upper zone except during the time just after setting work. There is no tilting at BK-8 in the upper area of the old landslide.

Recurring tilting was observed at BK-4 and BK-7, located on the top of the retaining wall, in the upper slope of the collapse. They were judged to have Rank C and Rank B (middle cumulative), respectively. Around BK-7, the collapse under the road is considered to influence the retaining wall gradually.

Recurring tilting is observed at BK-5 and BK-6 on the upper slope. They were judged to have Rank C and stable slope.

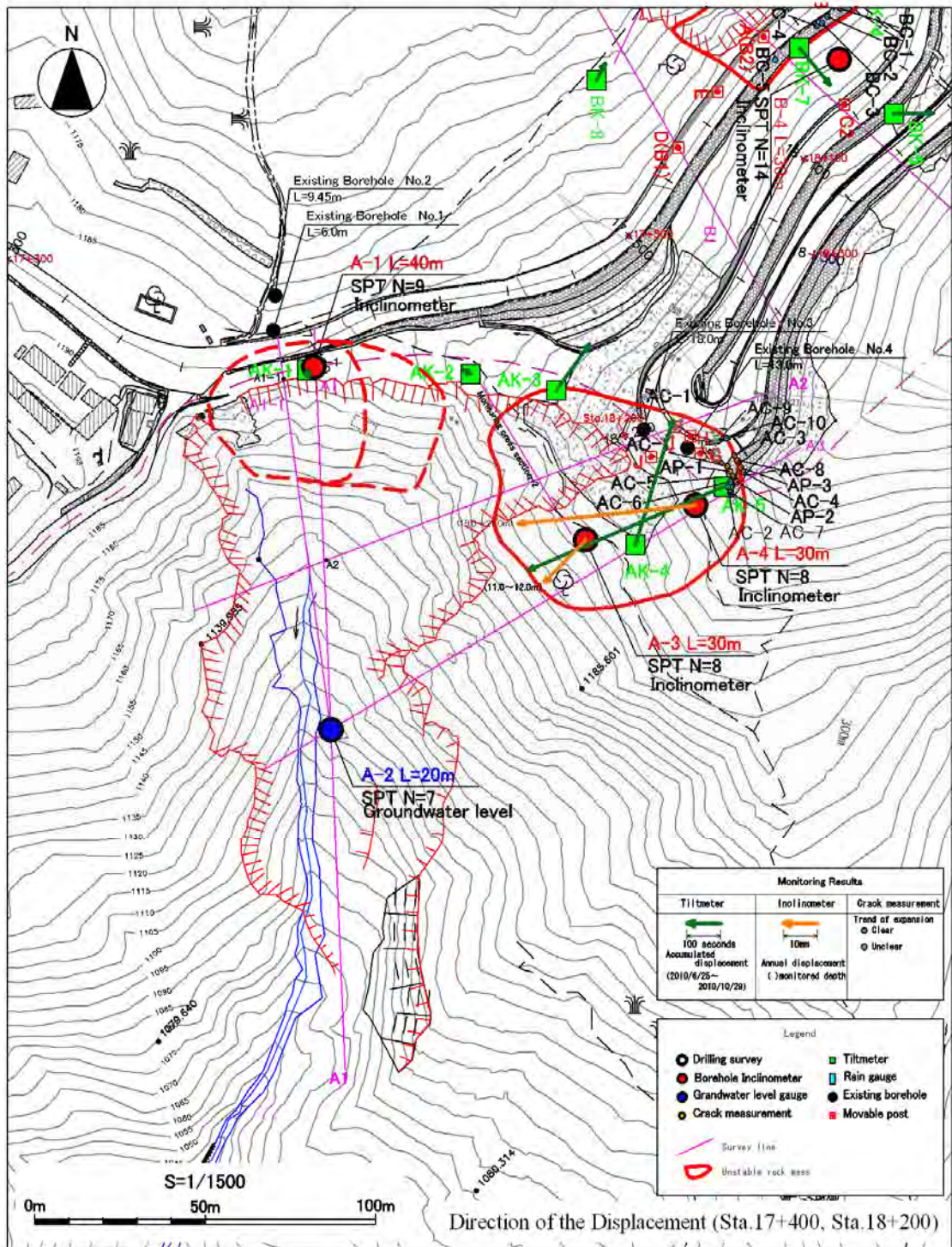


Figure 1.1 Horizontal Map Showing Tilting Direction (Source: JICA Study Team)

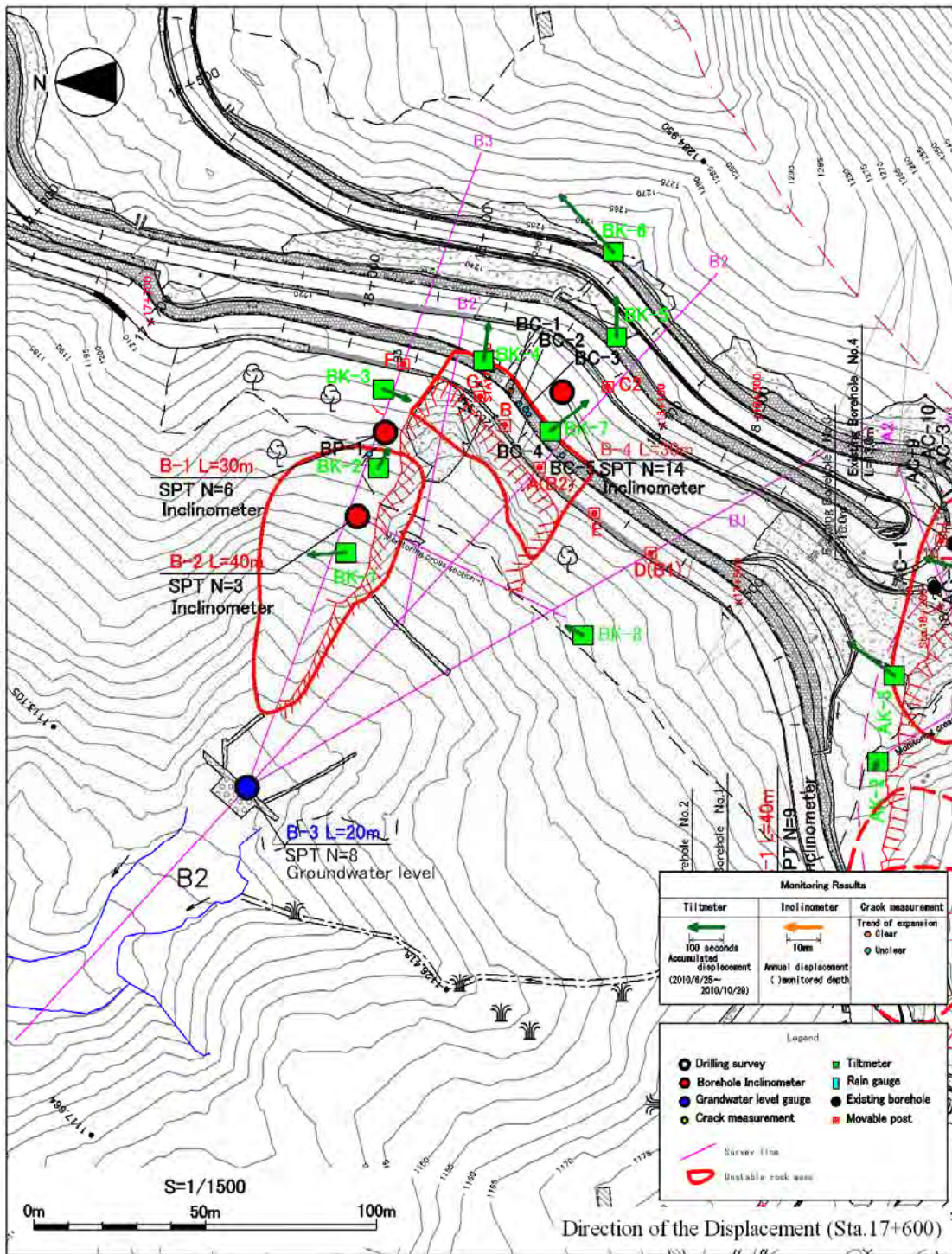


Figure 1.2 Horizontal Map Showing Tilting Direction (Source : JICA Study Team)

1.2 Crack Measurement

Crack measurement continues on the retaining wall on the upper part of the collapse at Sta. 17+600 and at the hairpin curve on the upper part at Sta. 18+200. These cracks occurred during the past and the condition of their progress is now observed by measurement.

Crack measurement is transferred to DOR in October 2010 and the data seem to have little change before and after the transfer. The JICA Study Team measured the cracks again and confirmed the difference between last time and this time.

The number of crack measurements is shown in Table 1.4.

Table 1.4 Number of Crack Measurements (By Hand)

Location	Position	Number of Measurement	Period of Measurement	Note
Sta. 18+200	Retaining wall on the upper area of collapse	14 cracks P-1-3, AC-1-11	Jun. 2010 - Sep. 2011	Measurement of the distance of crack and that of two pins at AP-1-3 and AC-5-8
Sta. 17+600	Retaining wall on the upper area of collapse	6 cracks BC-1~5, BP-1	Jun. 2010 - Sep. 2011	Measurement of outside and inside distance of crack at BP-1
Total	2	20 cracks		

The condition of each crack measurement is as shown in Table 1.5.

Table 1.5 Crack Measurement (Total Distance)

Location	Point	C: Crack Distance P: Pin Distance	Total Distance (mm)	Condition
Sta. 18+200	AP-1	C	12.0	Remarkable Increasing
		P	20.0	
	AP-2	C	41.0	Remarkable Increasing
		P	48.0	
	AP-3	C	1.0	
		P	-1.0	
	AC-1	C	14.5	Remarkable Increasing
	AC-2	C	(2.3)	
	AC-3	C	0.7	
	AC-4	C	(15.8)	(Remarkable Increasing)
	AC-5	C	30.0	Remarkable Increasing
		P	33.0	
	AC-6	C	0	
		P	1	
	AC-7	C	0.5	
		P	8.0	
	AC-8	C	4.0	
P		-2.0		
AC-9	C	3.1		
AC-10	C	-0.1		
AC-11	C	4.0		

Sta. 17+600	BC-1	C	1.2
		P	-5.0
	BC-2	C	-0.2
		P	0.1
	BC-3	C	0
		P	0.7
	BC-4	C	-0.2
		P	0.1
	BC-5	C	0
		P	4.0
BP-1	P (outside)	0	
	P (inside)	6	

Source: JICA Study Team

Tendency of increasing crack width is obvious at the right side of the retaining wall at Sta. 18+200. Maximum total width of AP-1, AP-2, AC-1, AC-4, and AC-5 points is 48 mm from June 2010 to September 2011. No obvious movement was observed during the time of crack measurement except very small movement at Sta. 17+600.

1.3 Rainfall Gauge

The amount of rainfall gauge measurement is as shown in Table 1.6.

Table 1.6 Amount of Rainfall Gauge Measurement

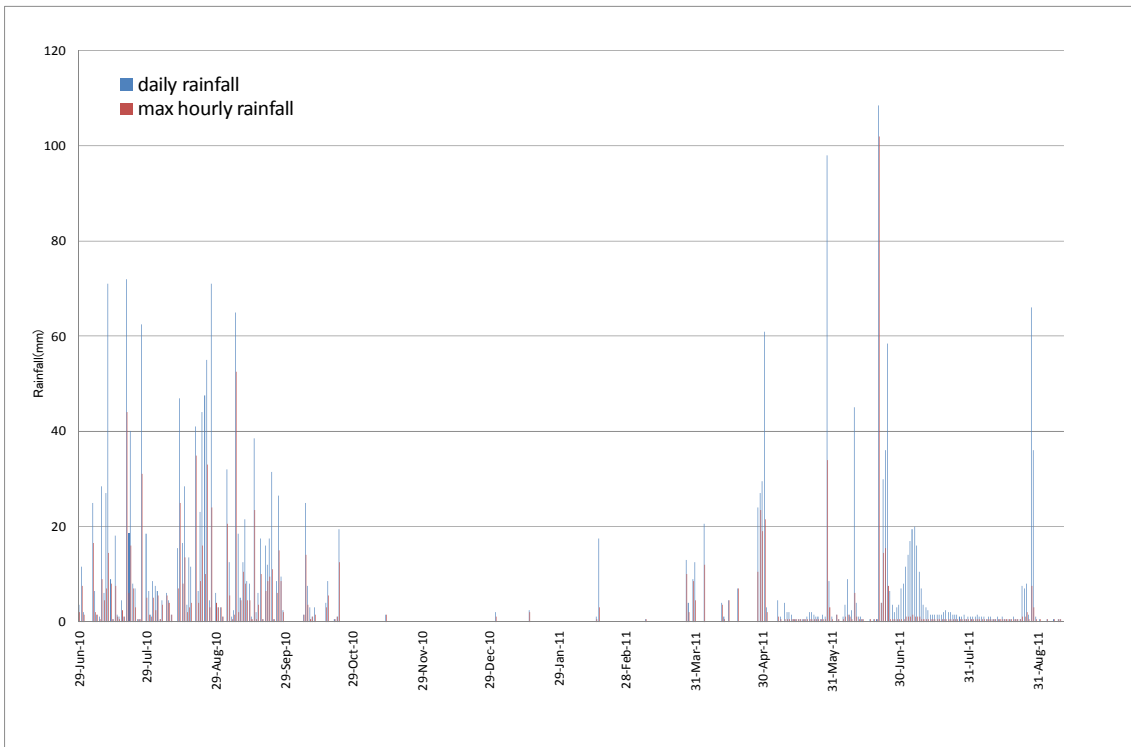
Location	Equipment	Period of Measurement	Note
Near Sta. 17+200 (on the roof)	Rainfall Gauge Data logger	June 2010 - Sep 2011	Replacement of JICA gauge with Hazama gauge

Max. daily rainfall, max. continuous rainfall and max. hourly rainfall are shown in Table 1.7.

Table 1.7 Rain Condition in 2011

Item	Date	Rainfall (mm)	Note
Max. daily rainfall	21 June	108.5	
Max. continuous rainfall	21 June - 26 July	417	Reset in the case of no rain in 24 hours (less than 1 mm/hour)
Max. hourly rainfall	21 June	102	
Date of over 20 mm/day	21 June	108.5	
	25 June	58.5	
	7 July	20	
	28 August	66	
	29 August	36	

Source: DOR



Source: DOR

Figure 1.3 Rainfall (2011)