12. Soil Test and Water Quality

UNIVERSITE DES MASCAREIGNES

Avenue de la Concorde, Camp Levieux, Rose Hill

GEOTECHNICAL LABORATORY

CIVIL ENGINEERING DEPARTMENT

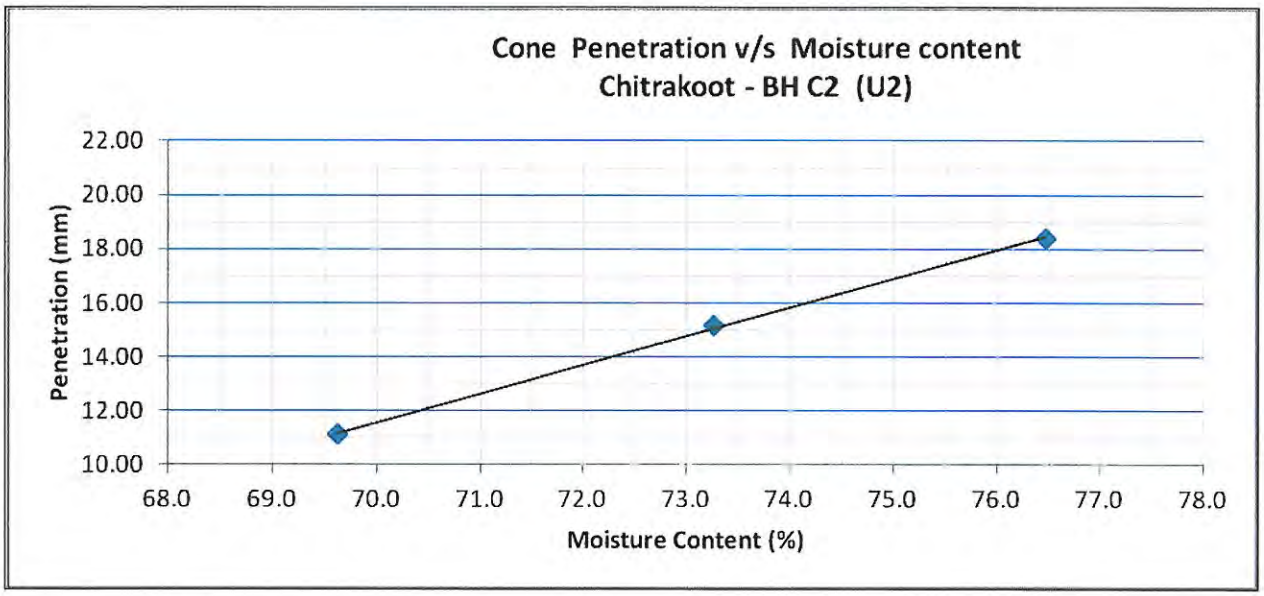
ATTERBERG LIMITS

(Methodology : BS 1377, Part 2, 1990)

Client: Sotravic Ltée **Project:** Chitrakoot **Location:** BH C2 (U2)

Date: 02.05.2013

Material type: Soil **Depth:** 4.8 – 5.25m



Liquid limit	**78** %
Plastic limit	**42.9** %
Plasticity index	**35.1** %

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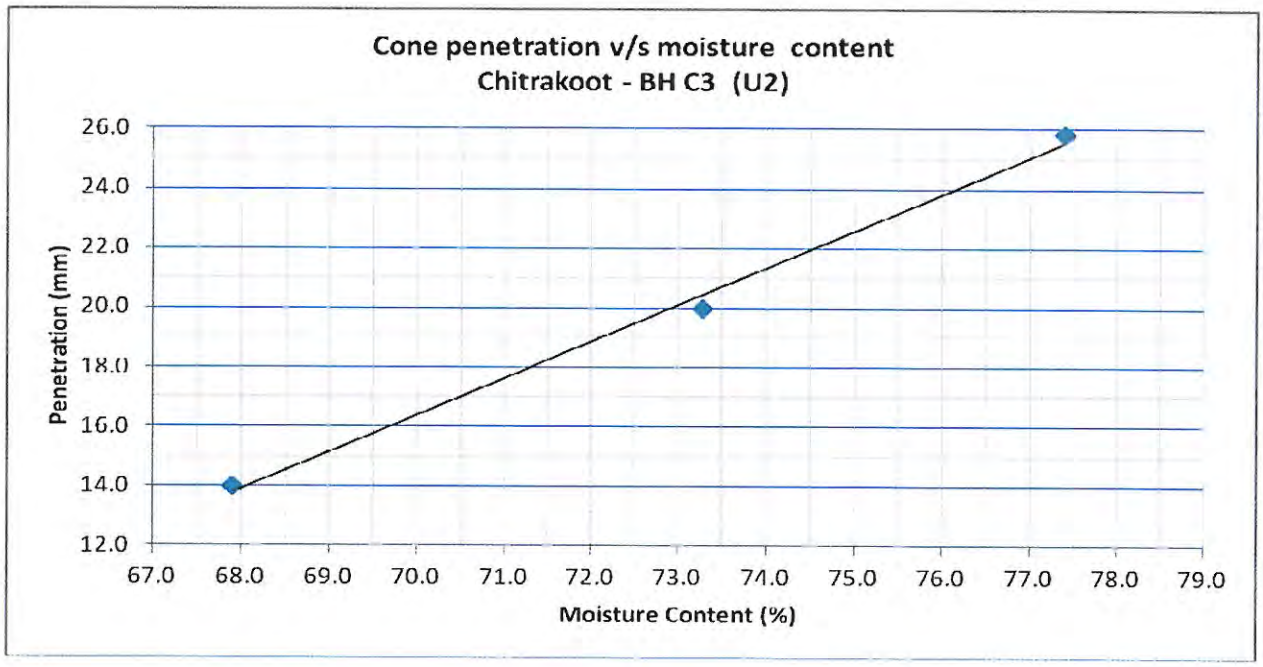
CIVIL ENGINEERING DEPARTMENT

ATTERBERG LIMITS

(Methodology : BS 1377, Part 2, 1990)

Client: Sotravic Ltée
Project: Chitrakoot
Location: BH C3 (U2)
Date: 02.05.2013
Material type: Soil
Depth: 6.60 – 7.05m



Liquid limit	**73**	%
Plastic limit	**45.1**	%
Plasticity index	**27.9**	%

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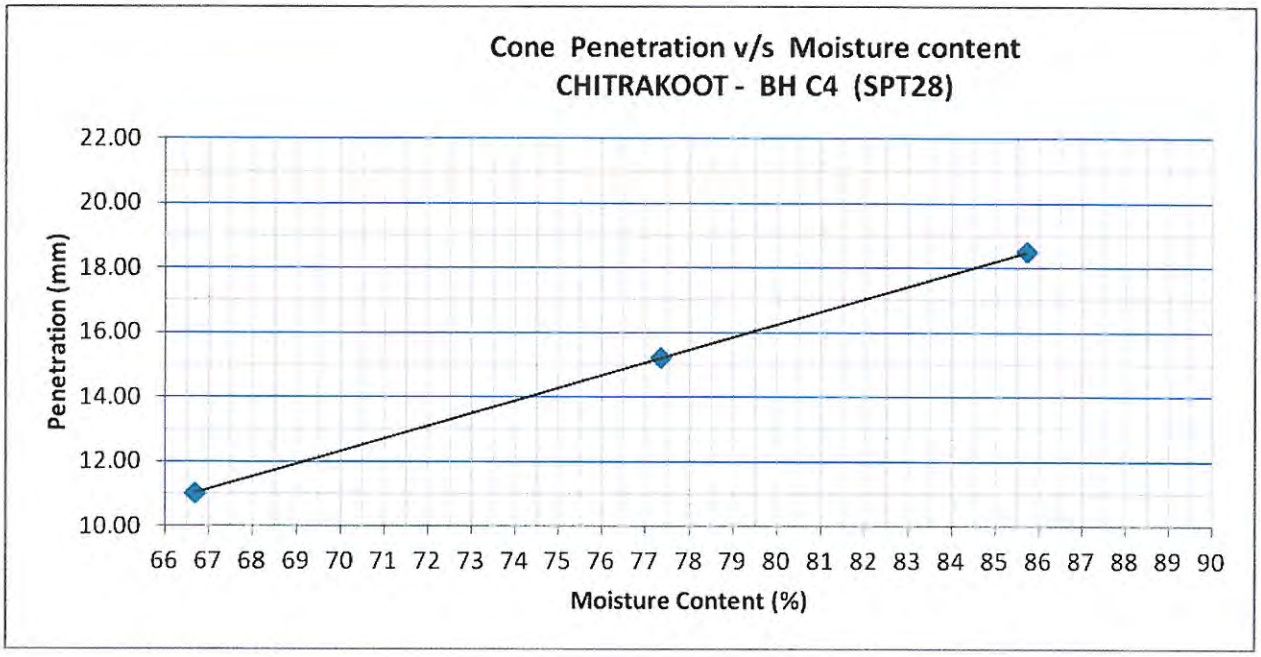
GEOTECHNICAL LABORATORY

CIVIL ENGINEERING DEPARTMENT

ATTERBERG LIMITS

(Methodology : BS 1377, Part 2, 1990)

Client: Sotravic Ltée
Project: Chitrakoot
Location: BH C4(SPT28)
Date : 26.04.13
Material type : Soil
Depth: 6.35 – 6.80m



Liquid limit	**89.5**	%
Plastic limit	**45**	%
Plasticity index	**44.5**	%

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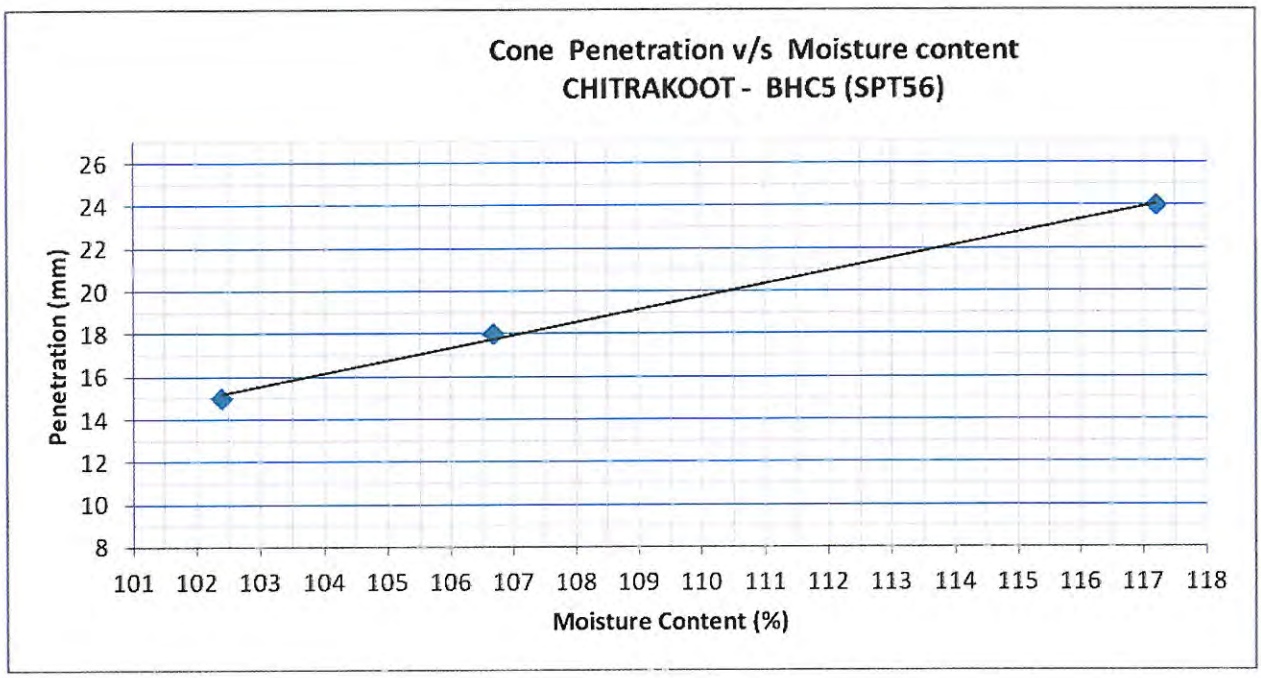
GEOTECHNICAL LABORATORY

CIVIL ENGINEERING DEPARTMENT

ATTERBERG LIMITS

(Methodology : BS 1377, Part 2, 1990)

Client: Sotravic Ltée
Project: Chitrakoot
Location: BH C5(SPT56)
Date : 26.04.13
Material type : Soil
Depth: 4.25 – 4.70m



Liquid limit	**110.5** %
Plastic limit	**41.7** %
Plasticity index	**68.8** %

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BULK DENSITY

(Methodology: BS 1377: 1990)

Client: Sotravic Ltée

Site : Chitrakoot

Date : 26.04.2013

Borehole	Date	Depth (m)	Material type	Bulk Density(g/cm^3)
BH-C2(U2)	16.04.13	4.80 – 5.25	Soil	1.80
BH-C3(U2)	18.04.13	6.60 – 7.05	Soil	1.60

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MOISTURE CONTENT

(Methodology: BS 1377: 1990)

Client: Sotravic Ltée

Site : Chitrakoot

Date : 22.04.13.03.13

Sample	Date	Depth (m)	Material type	Moisture content, %
BH-C1(SPT20)	27.03.13	3.00-3.45	Soil	50.0
BH-C2(U2)	16.04.13	4.80 – 5.25	Soil	51.2
BH-C3(U2)	18.04.13	6.60 – 7.05	Soil	43.8
BH-C4(SPT28)	20.03.13	6.35 – 6.80	Soil	61.8
BH-C5(SPT56)	19.03.13	4.25 – 4.70	Soil	47.7
BH-C6 (SPT25)	03.04.13	5.30 – 5.75	Soil	41.3

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CIVIL ENGINEERING DEPARTMENT

GEOTECHNICAL LABORATORY

SPECIFIC GRAVITY

(Methodology: BS 1377: 1990)

Client: Sotravic Ltée

Site : Chitrakoot

Date : 02.05.2013

Borehole	Date	Depth (m)	Material type	Specific Gravity, G_s
BH-C1(SPT20)	27.03.13	3.00-3.45	Soil	1.94
BH-C2(U2)	02.05.13	4.80 – 5.25	Soil	2.98
BH-C3(U2)	02.05.13	6.60 – 7.05	Soil	2.57
BH-C4(SPT28)	20.03.13	6.35 – 6.80	Soil	2.98
BH-C5(SPT56)	19.03.13	4.25 – 4.70	Soil	2.67
BH-C6 (SPT25)	03.04.13	5.30 – 5.75	Soil	2.10

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Avenue de la Concorde, Camp Levieux, Rose Hill

GEOTECHNICAL LABORATORY

CIVIL ENGINEERING DEPARTMENT

PARTICLE SIZE DISTRIBUTION

(Methodology : BS 1377, Part 2, 1990)

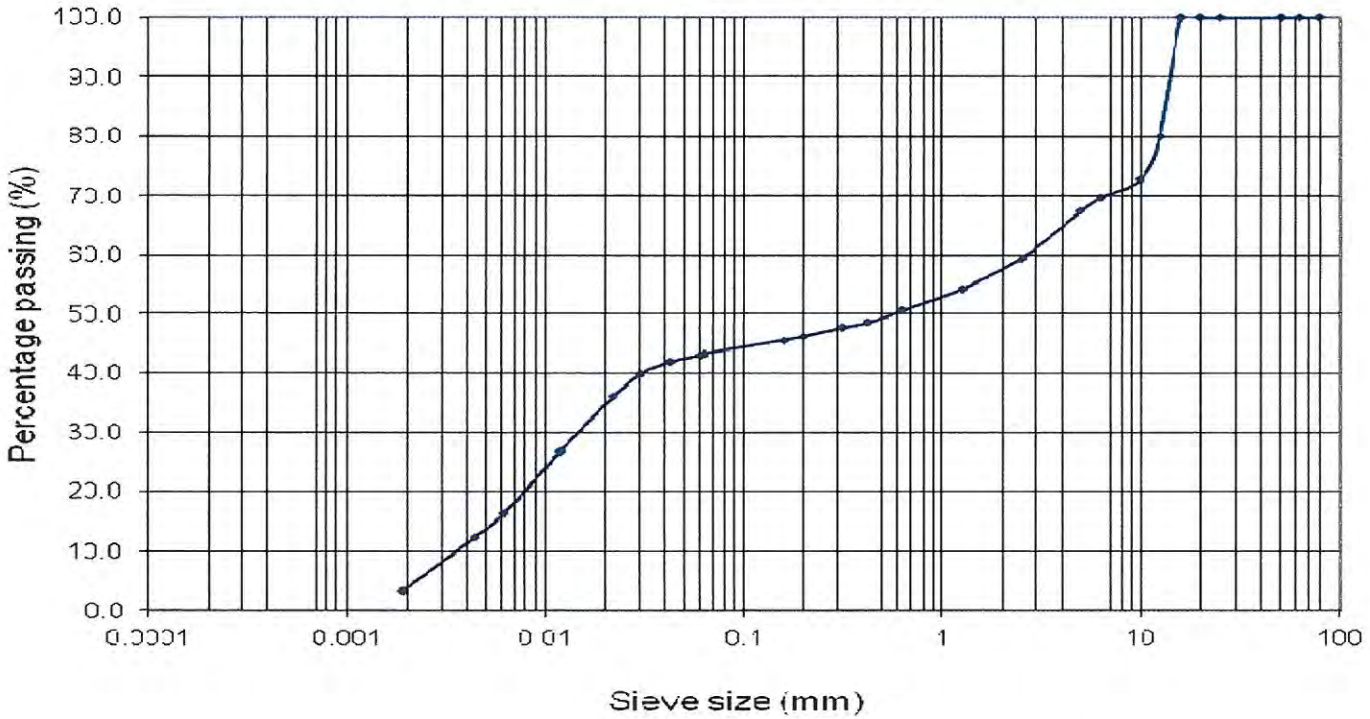
Client: Sotravic Ltée **Project:** Chitrakoot **Location:** BH C1(SPT20)

Date : 27.03.13

Material type : Soil **Depth:** 3.00 – 3.45 m

SIEVE SIZE	MASS RETAINED (g)	CUMMULATIVE RETAINED (g)	CUM PERCENTAGE RETAINED (%)	GRADING LIMIT % PASSING
80	0	0		100.0
63	0	0		100.0
50	0	0		100.0
25	0	0	0.0	100.0
20	0	0	0.0	100.0
16	0	0	0.0	100.0
12.5	59.8	59.8	19.9	80.1
10	21.6	81.4	27.1	72.9
6.3	9.2	90.6	30.2	69.8
5	7	97.6	32.5	67.5
2.5	24	121.6	40.5	59.5
1.25	15.5	137.1	45.7	54.3
0.63	11.2	148.3	49.4	50.6
0.425	6	154.3	51.4	48.6
0.315	2.7	157	52.3	47.7
0.2	4.3	161.3	53.8	46.2
0.16	1.9	163.2	54.4	45.6
0.063	6.8	170	56.7	43.3

PARTICLE SIZE DISTRIBUTION
Sample: Chitrakoot BH-C1(SPT 20)



Clay: 0-0.002mm Silt: 0.002-0.063mm Sand: 0.063-2.0mm Gravel: 2.0-60.0mm Cobbles: >60mm

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Avenue de la Concorde, Camp Levieux, Rose Hill

GEOTECHNICAL LABORATORY

CIVIL ENGINEERING DEPARTMENT

PARTICLE SIZE DISTRIBUTION

(Methodology : BS 1377, Part 2, 1990)

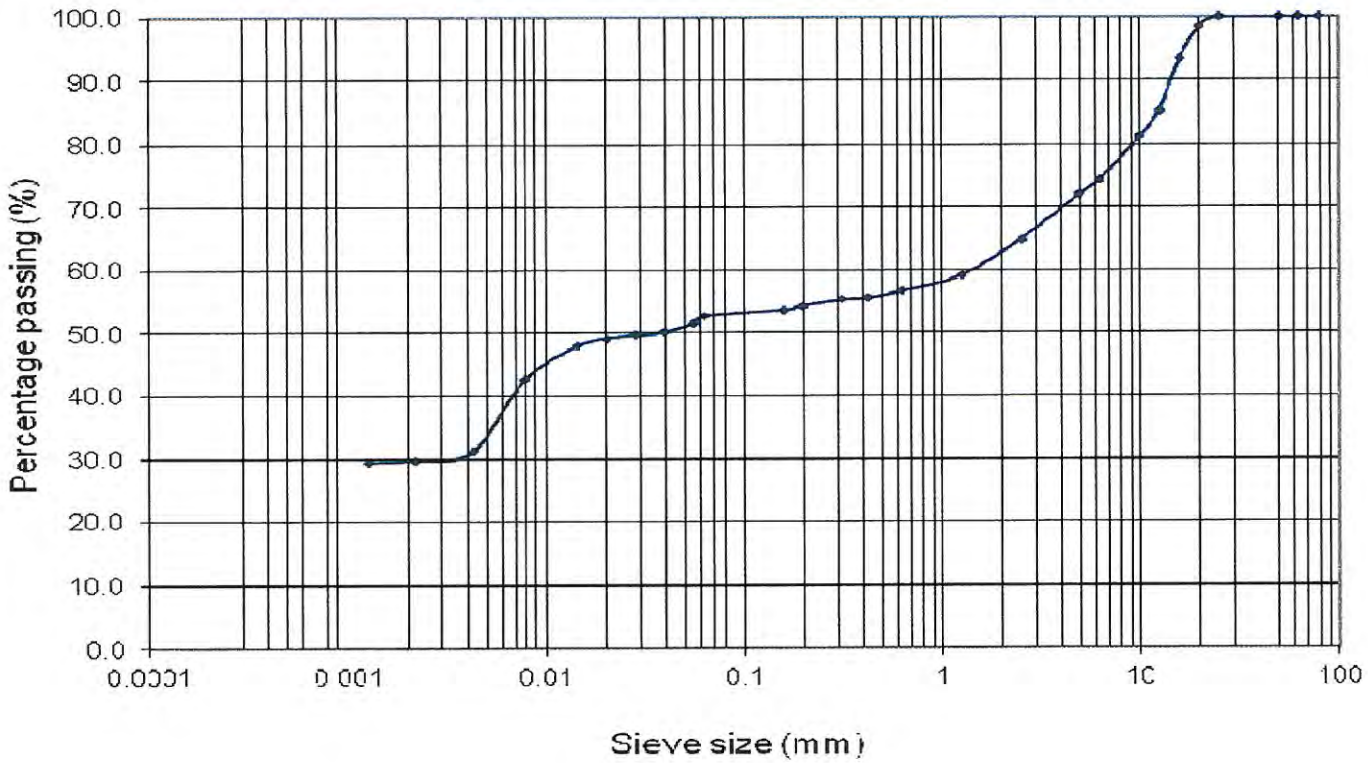
Client: Sotravic Ltée **Project:** Chitrakoot **Location:** BH C2 (U2)

Date : 23.05.2013

Material type : Soil **Depth:** 4.80 – 5.25 m

SIEVE SIZE	MASS RETAINED (g)	CUMMULATIVE RETAINED (g)	CUM PERCENTAGE RETAINED (%)	GRADING LIMIT % PASSING
80	0	0		100.0
63	0	0		100.0
50	0	0		100.0
25	0	0	0.0	100.0
20	14	14	1.5	98.5
16	46.6	60.6	6.5	93.5
12.5	77.1	137.7	14.7	85.3
10	37.9	175.6	18.8	81.2
6.3	63.5	239.1	25.6	74.4
5	20.5	259.6	27.8	72.2
2.5	68.8	328.4	35.1	64.9
1.25	53.9	382.3	40.9	59.1
0.63	22.9	405.2	43.3	56.7
0.425	10.6	415.8	44.5	55.5
0.315	2.4	418.2	44.7	55.3
0.2	8.9	427.1	45.7	54.3
0.16	6.1	433.2	46.3	53.7
0.063	8.9	442.1	47.3	52.7

PARTICLE SIZE DISTRIBUTION
Sample: Chitrakoot BH-C2 (U2: 4.80-5.25m)



Clay: 0-0.002mm Silt: 0.002-0.063mm Sand: 0.063-2.0mm Gravel: 2.0-60.0mm Cobbles: >60mm

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Avenue de la Concorde, Camp Levieux, Rose Hill

GEOTECHNICAL LABORATORY

CIVIL ENGINEERING DEPARTMENT

PARTICLE SIZE DISTRIBUTION

(Methodology : BS 1377, Part 2, 1990)

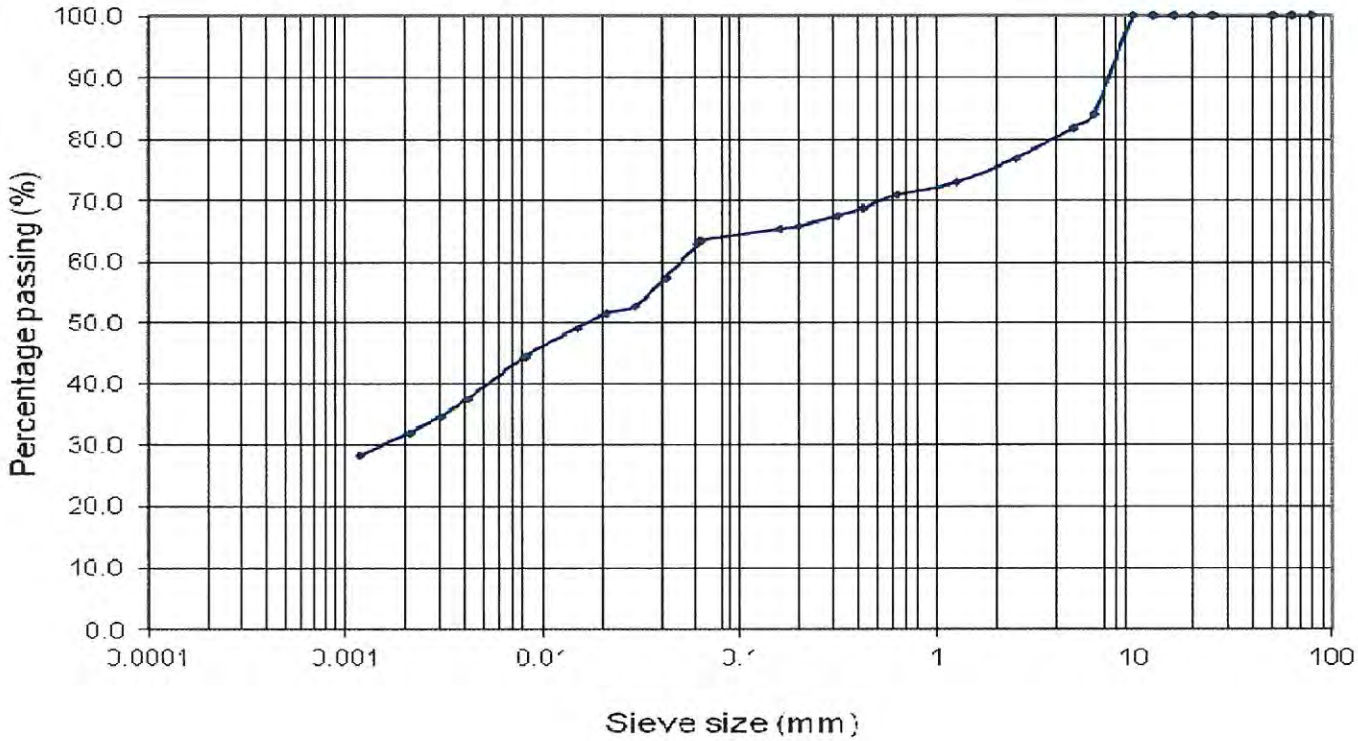
Client: Sotravic Ltée **Project:** Chitrakoot **Location:** BH C4(SPT28)

Date : 20.03.13

Material type : Soil **Depth:** 6.35 – 6.80 m

SIEVE SIZE	MASS RETAINED (g)	CUMMULATIVE RETAINED (g)	CUM PERCENTAGE RETAINED (%)	GRADING LIMIT % PASSING
80	0	0		100.0
63	0	0		100.0
50	0	0		100.0
25	0	0	0.0	100.0
20	0	0	0.0	100.0
16	0	0	0.0	100.0
12.5	0	0	0.0	100.0
10	0	0	0.0	100.0
6.3	57.8	57.8	15.8	84.2
5	8	65.8	18.0	82.0
2.5	18.3	84.1	23.0	77.0
1.25	14.4	98.5	27.0	73.0
0.63	7.4	105.9	29.0	71.0
0.425	7.9	113.8	31.2	68.8
0.315	4.8	118.6	32.5	67.5
0.2	5.9	124.5	34.1	65.9
0.16	1.8	126.3	34.6	65.4
0.063	7	133.3	36.5	63.5

PARTICLE SIZE DISTRIBUTION
Sample: Chitrakoot BH-C4(SPT 28)



Clay: 0-0.002mm Silt: 0.002-0.053mm Sand: 0.063-2.0mm Gravel: 2.0-60.0mm Cobbles: >60mm

UNIVERSITE DES MASCAREIGNES

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GEOTECHNICAL LABORATORY

CIVIL ENGINEERING DEPARTMENT

PARTICLE SIZE DISTRIBUTION

(Methodology : BS 1377, Part 2, 1990)

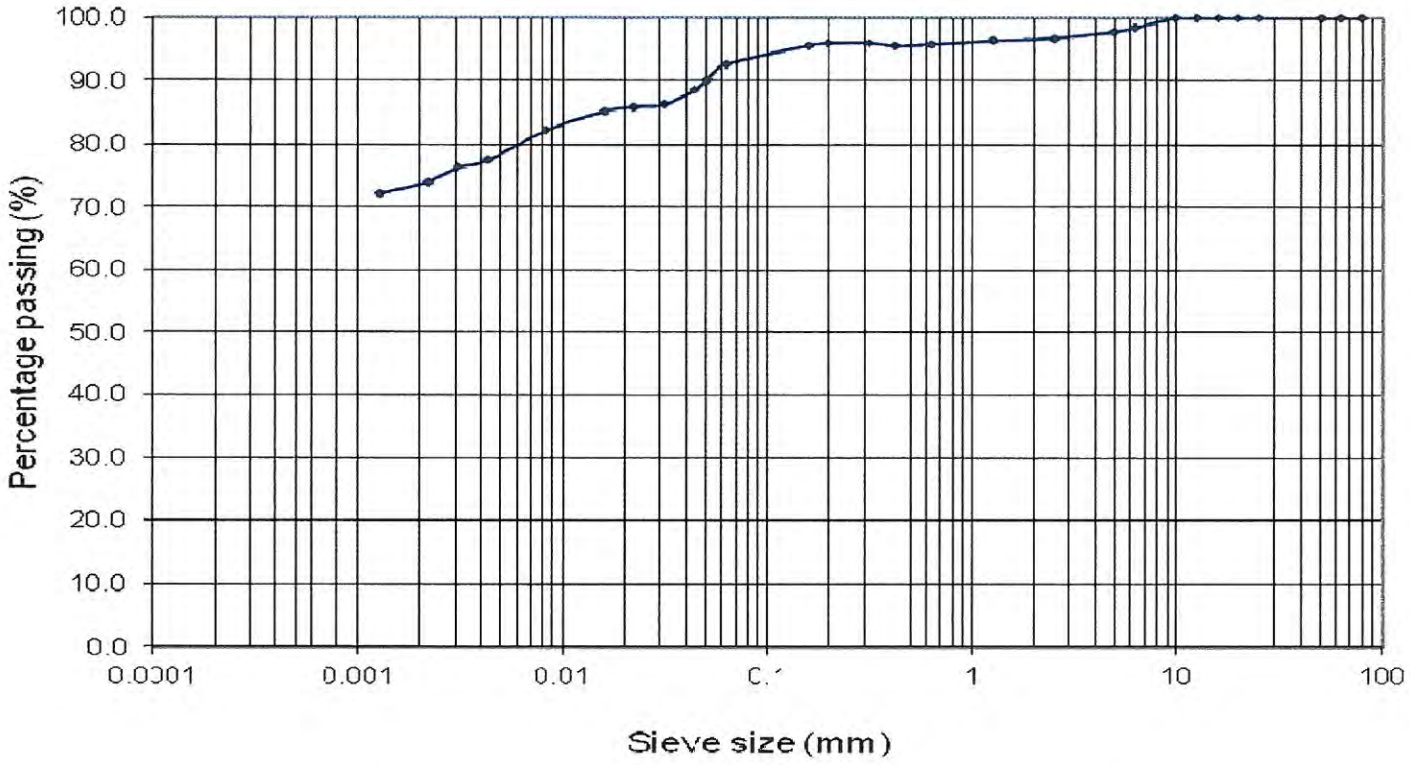
Client: Sotravic Ltée **Project:** Chitrakoot **Location:** BH C5(SPT56)

Date : 19.03.13

Material type : Soil **Depth:** 4.25 – 4.70 m

SIEVE SIZE	MASS RETAINED (g)	CUMMULATIVE RETAINED (g)	CUM PERCENTAGE RETAINED (%)	GRADING LIMIT % PASSING
80	0	0		100.0
63	0	0		100.0
50	0	0		100.0
25	0	0	0.0	100.0
20	0	0	0.0	100.0
16	0	0	0.0	100.0
12.5	0	0	0.0	100.0
10	0	0	0.0	100.0
6.3	4.2	4.2	1.5	98.5
5	1.9	6.1	2.2	97.8
2.5	2.9	9	3.2	96.8
1.25	1.2	10.2	3.6	96.4
0.63	1.6	11.8	4.2	95.8
0.425	0.7	12.5	4.5	95.5
0.315	-1.4	11.1	4.0	96.0
0.2	0.1	11.2	4.0	96.0
0.16	1.1	12.3	4.4	95.6
0.063	8.4	20.7	7.4	92.6

PARTICLE SIZE DISTRIBUTION
Sample: Chitrakoot BH-C5(SPT 56)



Clay: 0-0.002mm Silt: 0.002-0.063mm Sand: 0.063-2.0mm Gravel: 2.0-60.0mm Cobbles: >60mm

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GEOTECHNICAL LABORATORY

CIVIL ENGINEERING DEPARTMENT

PARTICLE SIZE DISTRIBUTION

(Methodology : BS 1377, Part 2, 1990)

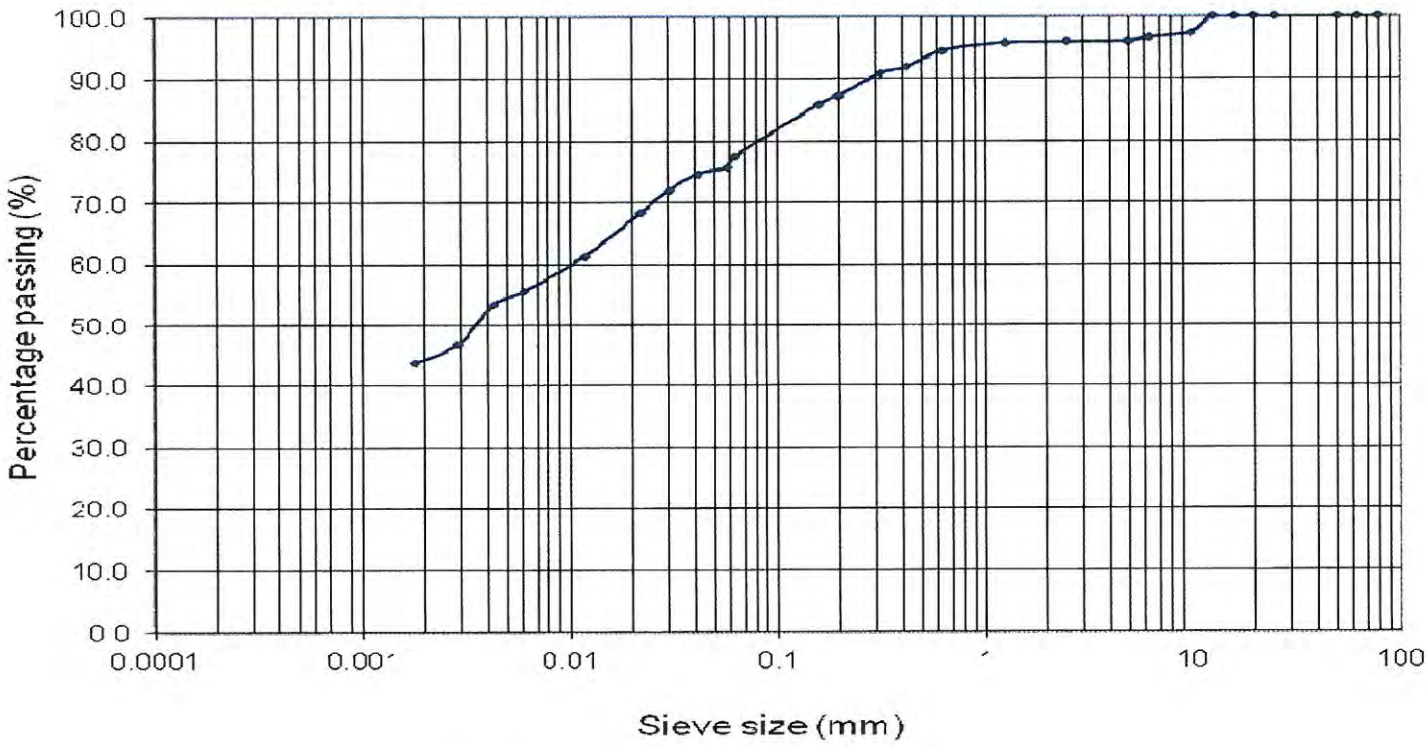
Client: Sotravic Ltée **Project:** Chitrakoot **Location:** BH C6(SPT25)

Date : 03.04.13

Material type : Soil **Depth:** 5.30 – 5.75 m

SIEVE SIZE	MASS RETAINED (g)	CUMMULATIVE RETAINED (g)	CUM PERCENTAGE RETAINED (%)	GRADING LIMIT % PASSING
80	0	0		100.0
63	0	0		100.0
50	0	0		100.0
25	0	0	0.0	100.0
20	0	0	0.0	100.0
16	0	0	0.0	100.0
12.5	0	0	0.0	100.0
10	10.7	10.7	2.5	97.5
6.3	3.4	14.1	3.4	96.6
5	2.4	16.5	3.9	96.1
2.5	0.6	17.1	4.1	95.9
1.25	0.6	17.7	4.2	95.8
0.63	5.3	23	5.5	94.5
0.425	11.1	34.1	8.1	91.9
0.315	4.5	38.6	9.2	90.8
0.2	14.5	53.1	12.6	87.4
0.16	5.8	58.9	14.0	86.0
0.063	35.3	94.2	22.4	77.6

PARTICLE SIZE DISTRIBUTION
Sample: Chitrakoot BH-C6(SPT 25)



C ay: 0-0.002mm Silt: 0.002-0.063mm Sand: 0.063-2.0mm Gravel: 2.0-60.0mm Cobbles: >60mm

Cernol
Water Solutions Ltd

PERSONAL SERVICE REPORT

Company: Sotravic Ltd

Address : Royal Road Coromandel

Attention: Mr. Jean Francois Ko Hoy Chong

Date of sample: 05/04/13

Date of Test: 05/04/13

Reference: W 060-065/D/13

Dear Sir,

We are pleased to submit hereunder results of analysis performed on your borehole water sample.

PARAMETERS	UNITS	BPP (6)	BPP (11)	BPP (13)	BH-C1	BH-C3	R-C2210
Total Hardness	mg/L, $CaCO_3$	210	190	150	154	326	116
Calcium Hardness	mg/L,$CaCO_3$	84	106	76	68	144	56
Magnesium Hardness	mg/L, $CaCO_3$	126	84	74	86	182	60
P. Alkalinity	mg/L, $CaCO_3$	NIL	NIL	NIL	NIL	NIL	NIL
M. Alkalinity	mg/L, $CaCO_3$	300	180	160	180	280	120
Chloride	mg/L, Cl^-	40.2	76.4	33.5	37.5	258.6	35.5
Sulphate	mg/L, SO_4^{2-}	31	19	12	2	43	8
Silica	mg/L, SiO_2	47.0	46.3	53.9	94.1	90.5	44.6
Sodium	mg/L, Na	72.6	31.4	25.0	30.7	45.3	104.1
Potassium	mg/L, K	20.0	3.4	0.5	1.3	1.5	4.6

Assuring you of our best services at all times.

Yours faithfully
For and on behalf of
CERNOL WATER SOLUTIONS LTD

MICHAEL CARVER
ADMINISTRATIVE MANAGER

Cernol
Water Solutions Ltd

PERSONAL SERVICE REPORT

Company: Sotravic Ltd

Address : Royal Road Coromandel

Attention: Mr. Jean Francois Ko Hoy Chong

Date of sample: 28/03/13

Date of Test: 05/04/13

Reference: W 226-229/C/13

Dear Sir,

We are pleased to submit hereunder results of analysis performed on your borehole water sample.

PARAMETERS	UNITS	PC1	RC1	CH-C4	BH-C5
Total Hardness	mg/L, $CaCO_3$	170	108	340	304
Calcium Hardness	mg/L,$CaCO_3$	100	50	98	126
Magnesium Hardness	mg/L, $CaCO_3$	70	58	242	178
P. Alkalinity	mg/L, $CaCO_3$	NIL	NIL	NIL	NIL
M. Alkalinity	mg/L, $CaCO_3$	180	110	390	260
Chloride	mg/L, Cl^-	50.0	29.5	126.0	144.7
Sulphate	mg/L, SO_4^{2-}	17	9	38	26
Silica	mg/L, SiO_2	36.2	40.2	119.4	107.7
Sodium	mg/L, Na	51.4	27.9	71.5	78.5
Potassium	mg/L, K	6.8	0.9	1.4	2.5

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Yours faithfully
For and on behalf of
CERNOL WATER SOLUTIONS LTD

MICHAEL CARVER
ADMINISTRATIVE MANAGER

05 APR 2013

PERSONAL SERVICE REPORT

Cernol
Water Solutions Ltd

Company: Sotravic Ltd

Address : Royal Road Coromandel

Attention: Mr. Jean-Francois Ko Hoy Chong

Date of sample: 19/02/13

Date of Test: 19/02/13

Reference: W 112-117/B/13

Dear Sir,

We are pleased to submit hereunder results of analysis performed on your borehole water sample.

PARAMETERS	UNITS	BH R-Q1	BH-Q1	BH-Q2	BH-2	BH-4	BH-5
Total Hardness	mg/L, $CaCO_3$	98	68	190	102	188	292
Calcium Hardness	mg/L,$CaCO_3$	40	30	108	58	132	178
Magnesium Hardness	mg/L, $CaCO_3$	58	38	82	44	56	114
P. Alkalinity	mg/L, $CaCO_3$	NIL	NIL	NIL	NIL	NIL	NIL
M. Alkalinity	mg/L, $CaCO_3$	100	50	340	130	390	330
Chloride	mg/L, Cl^-	59.6	44.9	118.6	42.9	556.1	100.5
Sulphate	mg/L, SO_4^{2-}	25	54	52	16	98	53
Silica	mg/L, SiO_2	47.6	75.8	77.1	80.4	52.0	76.1
Sodium	mg/L, Na	48.6	40.3	112.6	50.4	414	96.4
Potassium	mg/L, K	6.3	3.0	4.5	1.0	25.5	41

DISTRIBUTION	ACTION
C.C: PAS/FILE	
EA ←	
AM	✓
JK	
MG	✓
PE	
[illegible]	✓
CD	
JMP	
VP	✓
ACC.	
PROC.	
KL	
SV	
MH	
AB	
J-francois KO (original)	✓

Assuring you of our best services at all times.

Yours faithfully
For and on behalf of
CERNOL WATER SOLUTIONS LTD

MICHAEL CARVER
ADMINISTRATIVE MANAGER

Reg. Office & Factory • Black River Road, Petite Rivière, Mauritius
PO Box 619, Port Louis, Mauritius • Telephone: (230) 206-1818 • Facsimile: (230) 233-1739 • cws@cernol.com
Website: www.cernolgroup.com
BRN No.: C07026219

13. Review and Recommendation for the Disaster Scheme

C. LANDSLIDE EMERGENCY SCHEME

C.1 Monitoring of Landslides

C.1.1 The Ministry of Public Infrastructure, National Development Unit, Land Transport and Shipping (MPI) is responsible for the monitoring[1] of landslides ~~*all over the Island*~~ *in the Landslide-Prone Regions.*

The LANDSLIDE EMERGENCY SCHEME applies to the List of Landslide-Prone Regions provided in Annex A and any other area where landslide may occur in the future.

C.1.1.1 *General* ~~*Preparedness*~~

C.1.1.2 With the increase in development and the pressure on land requirements, new and existing constructions have considerably changed the configuration and physical properties of some areas which, as a result, have become prone to landslide.

C.1.1.3 There is a need to warn the public and more particularly the inhabitants of these sensitive areas of the need for precautionary measures in case of likelihood of landslides.

~~*C.1.1.4 In the absence of objective (measured) data, the MPI will coordinate with Local Authorities for collection of on-site visual data.*~~

C.2 Action by Local Authorities

C.2.1 Local Authorities shall, ahead of the convening of the Cyclone and Other Natural Disasters Committee, *undertake a fresh survey and provide such information to MPI and any other ministry/agency and* update the list of landslide-prone regions in Mauritius.

C.2.2 *Government Information Service*

In collaboration with Local Authorities, the Government Information Service and the MBC will prepare illustrated posters and film strips to remind the public of the dangers of landslide.

C.2.3 *Police*

The Police, in collaboration with the Meteorological Services and the MBC shall arrange to give talks on TV and Radio on dangers to transportation in landslide conditions.

C.3 Responsibility of the Central Cyclone and Other Natural Disasters Committee

C.3.1 The Central Cyclone and Other Natural Disasters Committee will become operational in case of natural disasters such as landslide conditions.

C.3.2 *Role of NDOCC/DOCR 's*

A National Disaster and Operations Coordination Centre (NDOCC) has been set up at the Police Headquarters, Line Barracks and is operational for the purpose of taking charge of the management of disasters in Mauritius. In cases of national emergency/crisis such as, cyclones, torrential rains, landslides, tsunamis, high waves, oil spills on large scale inland or at sea, aircraft crashes, major road accidents, and so on, the NDOCC is activated and initiates all necessary actions to deal with the situation. Where such incidents have occurred on a national scale, Police Divisional Operations Rooms and Branch Operations Rooms (where applicable) will likewise be converted into Local Disaster and Operations Coordination Rooms (DOCR) to coordinate efforts of concerned Government services and Parastatal Bodies at ground level. However, in case of a local incident/occurrence, the Police Divisional/Branch Operations Rooms are automatically transformed into a local DOCR and the Divisional Commander/Branch Officer concerned immediately takes charge of his respective DOCR.

C.4 Landslide Conditions

The following criteria for the issue of warnings to the inhabitants of landslide areas will henceforth apply:

(i) geomorphology;
(ii) identification of landslide areas;
(iii) rainfall recording; and

[1] *Landslide monitoring includes regular measurement of ground displacement and on-site visual check. These will be conducted under the instruction of a Landslide Expert Team.*

(iv) ground displacement.

C.5 The warning/evacuation system shall consist of three stages as follows:

Stage 1 Warning Stage
Stage 2 Evacuation Stage
Stage 3 Termination

- *The warning/evacuation system flow chart is shown in the Annex B for landslide areas which are identified as subject to high risk of landslide. When the warning system is activated, the relative ministries/agencies will follow procedures.*

C.5.1 *Stage 1 – Warning Stage*

C.5.1.1 The Stage 1 Warning will be triggered by one of the following conditions:

- *(i) The MMS observed rainfall R_{m1} mm/hour, or*
- *(ii) the MPI confirmed measurement of displacement E_1 mm/day, or*
- *(iii) Inhabitants confirmed the anomalies (cracks, subsidence, etc.), R_{i1} mm/hour rainfall*

C.5.1.2 The MMS will constantly monitor the amount of rainfall and will inform the NDOCC as soon as the R_{m1} mm/hour rainfall is recorded. The LP/SMF will give warning to all inhabitants based on the information from NDOCC.

C.5.1.3 The MPI will monitor constantly ground movement and will inform it to the NDOCC as soon as a displacement of E_1 mm/day is recorded or if visual displacement of ground is noted. *The LP/SMF will react according to C.5.1.7.*

However, *under the situation of Cyclone/Torrential Rain which is described in the disaster scheme,* the Special Mobile Force will take readings of extensometers on hills and will communicate the information to the Ministry of Public Infrastructure, National Development Unit, Land Transport and Shipping (Public Infrastructure Division) and the Meteorological Services.

C.5.1.4 The inhabitants will inform the LP/SMF about anomalies/rainfall. The LP/SMF will check the situation and inform the NDOCC. The LP/SMF, in collaboration with Local Authorities, will give warning to the inhabitants.

C.5.1.5 Once *the above warning* is communicated by the Chairperson of the Coordinating Committee (PMO), to the MPI, the latter will communicate same to the NDOCC and MMS. The NDOCC will then inform the residents of the affected areas. The warning will also be communicated by the NDOCC to the following Ministries and Organizations which make up the Coordinating Committee:-

- Prime Minister's Office (Chairperson)
- Ministry of Energy and Public Utilities
- Ministry of Social Integration and Economic Empowerment
- Ministry of Local Government and Outer Islands
- Ministry of Public Infrastructure, National Development Unit, Land Transport and Shipping (Public Infrastructure Division)
- Ministry of Public Infrastructure, National Development Unit, Land Transport and Shipping (Land Transport & Shipping Division)
- Ministry of Public Infrastructure, National Development Unit, Land Transport and Shipping (NDU Division)
- Ministry of Social Ministry of Social Security, National Solidarity and Reform Institutions
- Ministry of Education and Human Resources
- Ministry of Environment and Sustainable Development
- Ministry of Tertiary Education, Science, Research and Technology
- Ministry of Health and Quality of Life
- Ministry of Gender Equality, Child Development and Family Welfare
- Meteorological Services
- Government Fire Services
- Central Water Authority

- Central Electricity Board
- Local Authorities
- University of Mauritius

C.5.1.6 The NDOCC will inform the Chairperson of the Coordinating Committee who will convene a meeting for the issue of the Stage 1 Warning. The warning will be broadcast by the MBC and Private Radios. Communication to the affected residents will be done by the *LP/SMF* by loudspeakers or other means.

C.5.1.7 The *LP/SMF* shall, when issuing Stage ~~2~~ 1 Warning advice the residents to complete all preparations for an eventual evacuation and stand ready to vacate their houses once the order is issued. Arrangements should be made by the Ministry of Health and Quality of Life and the *LP/SMF* for the transfer to hospitals of disabled people who elect to do so. First Aid Service providers may be invited to extend their assistance.

C.5.1.8 The NDOCC will take appropriate measures to muster all available resources and equipment in order to assist in an eventual evacuation exercise and any salvage operation.

C.5.1.9 The Stage ~~2~~ 1 Warning will also be communicated by the NDOCC to the following Ministries/Departments/Organizations and which will be responsible for the following:

(a) *Ministry of Health and Quality of Life*:

(i) to prepare special ward for any casualty that may arise out of an eventual evacuation;

(ii) to provide an adequate number of medical and para-medical personnel intended to receive casualties; and

(iii)to be ready to despatch Ambulances adequately staffed and equipped.

(b) *Ministry of Social Security, National Solidarity and Reform Institutions, Ministry of Gender Equality, Child Development and Family Welfare*

The Ministry of Social Security, National Solidarity and Reform Institutions and the Ministry of Gender Equality, Child Development and Family Welfare will ensure that all Refugee Centres under their respective control are opened and made ready for use.

(c) *The Central Water Authority* will stand ready to close the shut-off valves on the pipes going through the region as soon as the evacuation order is issued.

(d) *The Central Electricity Board* will be ready to switch off electricity supply in the affected area as and when instructed by the Crisis Committee or the most senior gazetted Police Officer. The Central Electricity Board will ensure as far as possible that power cuts are restricted to the affected areas only so as to avoid unnecessary deprivation of electricity to unaffected areas.

(e) *The Fire Services and the Non-Governmental Organizations (Red Cross Society, St. John Ambulance etc.)* will be informed by the NDOCC of the possibility of an evacuation order being issued and to enlist their assistance.

C.5.2 *Stage 2 – Evacuation Stage*

C.5.2.1 Stage ~~3~~ 2 is reached when ~~ground displacement is equal to or is greater than 2mm in an hour~~ *one of the following conditions prevails*.

- *(i) the MMS has observed continuous rainfall R_{m2} mm/hour or*
- *(ii) the MPI has confirmed measurement of displacement E_{2d} mm/day or E_{2h},mm/hour or*
- *(iii) Inhabitants have confirmed heavy damage to their buildings, R_{i2} mm/hour rainfall.*

C.5.2.2 The MMS will monitor constantly amount of rainfall and will inform the NDOCC as soon as continuous rainfall of R_{m2} mm/hour is recorded. The LP/SMF will give warning to all inhabitants based on the information from NDOCC.

C.5.2.3 The MPI will monitor constantly ground movement and will inform the NDOCC as soon as a displacement E_{2d} mm/day or E_{2h} mm/hour is recorded or if visual displacement of ground is noted. This task will be performed by the LP/SMF in the situation of Cyclone/Torrential Rain which is described in the disaster scheme. The LP/SMF will give warning to the inhabitants based on the information from NDOCC.

C.5.2.4 The inhabitants will evacuate by themselves (voluntary evacuation) and will inform the LP/SMF when they notice heavy damage to their buildings or R_{i2} mm/hour rainfall. The LP/SMF will check the situation and inform the NDOCC. The LP/SMF will give warning to

all inhabitants.

C.5.2.5 The NDOCC will also contact the Secretary to Cabinet and Head of the Civil Service or, in his absence, the Senior Chief Executive, Home Affairs, with a view to convening, at the earliest, a meeting of the Crisis Committee consisting of representatives of:

(i) Prime Minister's Office
(ii) Ministry of Energy and Public Utilities
(iii) Ministry of Social Integration and Economic Empowerment
(iv) Ministry of Public Infrastructure, National Development Unit, Land Transport and Shipping (Public Infrastructure Division)
(v) Ministry of Local Government and Outer Islands
(vi) Police Department
(vii) Meteorological Services
(viii) Local Authorities

The Crisis Committee will review the situation in the light of all available information pertaining to rainfall recording and ground displacement.

C.5.2.6 As in the case of the ~~*two*~~ previous stage~~*s*~~, the recording will be continually monitored by the *MMS and* the MPI and the data communicated to the NDOCC and the MMS. The NDOCC will then pass on the information to the Crisis Committee which will meet to approve the evacuation order. The evacuation order will be broadcast and/or communicated to the appropriate residents in the same manner as in Stage ~~*2*~~ 1.

C.5.2.7 If, on information being obtained from the MPI and the MMS, the NDOCC considers that an urgent and immediate evacuation is required and that there might not be enough time to convene the Crisis Committee, then the most senior gazetted officer present in Line Barracks will give the order for evacuation after consultation with the Chairperson of the Crisis Committee, if possible.

C.5.2.8 As Stage ~~3~~ 2 is reached and evacuation is in progress, the various Ministries/Departments/Organizations involved should actively set in motion arrangements for which they are responsible. In particular, the following measures should be implemented:

(i) *Ministry of Education and Human Resources and Ministry of Tertiary Education, Science, Research and Technology*: Educational Institutions in affected areas should be closed.
(ii) *Ministry of Social Security, National Solidarity and Reform Institutions, Ministry of Gender Equality, Child Development and Family Welfare:* The Ministry of Social Security, National Solidarity and Reform Institutions and the Ministry of Gender Equality, Child Development and Family Welfare will ensure that all Refugee Centres under their respective control are opened and made ready for use.
(iii) *Ministry of Health and Quality of Life*: Ambulances should be dispatched on site for the conveyance of handicapped, old and sick people, and any casualty cases to hospital. Arrangements will also be made for Health Inspectors to visit regularly the refugee centres to ensure acceptable sanitary conditions there.
(iv) *Central Water Authority*: The Central Water Authority will close the valves on the pipelines within the affected area and will arrange for water to be supplied regularly to the refugee centres.
(v) *Central Electricity Board*: The Central Electricity Board will proceed with the interruption of the power supply in the affected areas.
(vi) *Police Department* will cordon off the affected area and ensure the protection of property of the residents. An Incident Officer will be responsible and will have full authority for the control and coordination of the operation on site. Access to the cordoned off area will only be permitted by the Incident Officer.

C.5.3 *Stage 3 – Termination*

C.5.3.1. A close monitoring and stocktaking exercise will be undertaken by relevant authorities after stabilization of ground movement has been noted. *As in the case of the previous stages, the recording will be continually monitored by the MMS and the MPI and the data communicated to the NDOCC. The NDOCC will then pass on the information to the Crisis Committee*. The all-clear signal will be given after a meeting of the Crisis

Committee when the following conditions have been reached.

- *(i) Inhabitants have confirmed no new anomalies, or*
- *(ii) the MMS has observed no rainfall for three days or*

(iii) the MPI has confirmed measurement of displacement 0 mm a day

The Local Authority/Police will inform the inhabitants of the termination of the evacuation stage.

C.5.4 *In Case of Sudden Landslide*

C.5.4.1 When there is sudden landslide and the Crisis Committee cannot for practical reasons be convened, the Emergency Warning is issued by the NDOCC after consultation with the Chairperson of the Crisis Committee, if possible. Action will be triggered off as provided for under Stage 2.

C.5.4.2 Special Arrangements during Cyclone Warning/Torrential Rains Warning

The prevalence of cyclonic conditions over and around Mauritius will entail the adoption of special arrangements with regard to the inhabitants of landslide-prone areas. The issue of a Cyclone Warning Class II or a Torrential Rain Warning may constitute for the inhabitants a Landslide Stage 1 Warning. Given that the issue of a Cyclone Warning Class III entails the cessation of all normal activities, the inhabitants of the landslide-prone areas may be evacuated if there exists a strong likelihood of a Cyclone Warning Class III being issued and the possibility of landslide occurring.

As soon as a Cyclone Warning II or a Torrential Rain Warning is issued by the MMS, the Crisis Committee will, in consultation with the Chairperson of the Coordinating Committee, convene a meeting to consider the advisability of issuing an evacuation order. Action as provided for in Stage 2 will be triggered off.

It will be followed by the warning/evacuation system flow chart of the Landslide Stage 1/2 when the trigger reaches the designated threshold even though the Cyclone Warning I.

C.6 **Landslide Bulletins**

C.6.1 Bulletins giving the intensity and estimated duration of the rain event will be issued at regular intervals by the Meteorological Services.

C.7 **Distribution of Landslide Bulletins**

C.7.1 Landslide information and warning stages are distributed through the MBC, the Press, the Private Radios, the telephone system including Mauritius Telecom Call Centre and the NDOCC.

C.7.2 The Meteorological Services is responsible for distribution of bulletins to:
The Secretary to Cabinet and Head of the Civil Service The Senior Chief Executive, Home Affairs
The Ministry of Energy and Public Utilities
The Ministry of Public Infrastructure, National Development Unit, Land Transport and Shipping (Public Infrastructure Division)
The Ministry of Education and Human Resources
The Ministry of Tertiary Education, Science, Research and Technology The Ministry of Local Government and Outer Islands
The NDOCC
The Government Information Service The Department of Civil Aviation
The Government Fire Services The Water Resources Unit The MBC
The Mauritius Telecom Call Centre (Telmet) The Mauritius Ports Authority
The Airports of Mauritius Ltd The Central Electricity Board The Central Water Authority
The Waste Water Management Authority Airport of Rodrigues Ltd
Private Radios

C.7.3 *MBC*

The MBC will, on receipt of the warning, arrange for immediate broadcast and for its rebroadcast at half hourly intervals.

C.7.4 *Ministry of Information and Communication Technology and Mauritius Telecom*

The Ministry of Information and Communication Technology will explore the

possibility with Mauritius Telecom and other Mobile Operators of informing the public in general through an SMS-based system of cyclone warnings/emergency measures to be taken in case of natural disasters or to target specifically parents of students through the e-Register system, in case of natural calamities.

C. 7.4.1 The Mauritius Telecom will arrange for the operation of the Telmet Service by which any telephone enquirer may listen to the recorded version of latest bulletin. The Mauritius Telecom will arrange with the Government Information Service to give wide publicity to the above facilities through the Radio, TV and Press.

C.7.5 *Police*

The NDOCC is responsible for informing the following that a warning is in force:

(a) The President
(b) The Prime Minister
(c) The Deputy Prime Minister, Minister of Energy and Public Utilities
(d) The Vice-Prime Minister, Minister of Finance and Economic Development
(e) The Vice-Prime Minister of Public Infrastructure, National Development Unit, Land Transport and Shipping
(f) The Minister of Social Integration and Economic Empowerment
(g) The Permanent Secretary and the Director (Civil Engineering), Ministry of Public Infrastructure, National Development Unit, Land Transport and Shipping (Public Infrastructure Division)
(h) The Permanent Secretary, Ministry of Public Infrastructure, National Development Unit, Land Transport and Shipping (Land Transport & Shipping Division)
(i) The Permanent Secretary, Ministry of Public Infrastructure, National Development Unit, Land Transport and Shipping (NDU Division)
(j) The Senior Chief Executive, Ministry of Education and Human Resources
(k) The Permanent Secretary, Ministry of Tertiary Education, Science, Research and Technology
(l) The Permanent Secretary, Ministry of Local Government and Outer Islands
(m) The Commanding Officer, Special Mobile Force
(n) The Divisional Police Headquarters which will inform Local Cyclone Commissioners, Chief Executive Officers of Municipalities and District Councils
(o) The General Manager, Road Development Authority

C.7.6 *Ministry of Housing and Lands and Ministry of Social Integration and Economic Empowerment*

The Ministry of Housing and Lands will intervene immediately to identify sites in the affected areas for putting up temporary shelters for victims.

The Ministry of Social Integration and Economic Empowerment will assist in the provision of temporary shelters to accommodate victims who have lost their houses during the landslides.

C.7.7 *Mauritius Revenue Authority, Customs Department*

The MRA, Customs Department, will take necessary measures for the rapid release of relief consignments and any goods needed during a disaster.

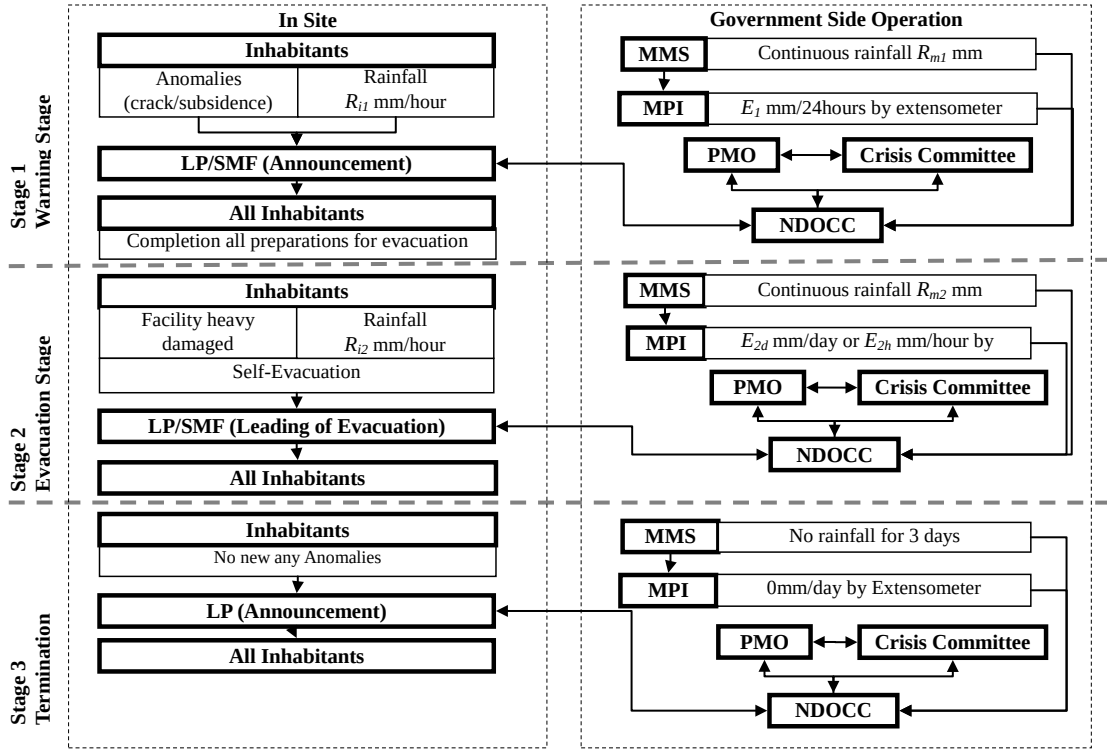
Annex A

LIST OF LANDSLIDE-PRONE REGIONS IN MAURITIUS

No.	Area Name
Pamplemousses District Council	
1	Temple Road, Creve Coeur
2	Congomah Village Council (Ramlakhan)
3	Congomah Village Council (Leekraj)
4	Congomah Village Council (Frederick)
5	Congomah Village Council (Blackburn Lane)
6	Les Mariannes Community Centre (Road area)
7	Les Mariannes Community Centre (Resident area)
8	L'Eau Bouillie
Municipality of Port Louis	
9	Chitrakoot, Vallée des Prêtres
10	Vallée Pitot (near Eidgah)
11	Le Pouce Street
12	Justice Street (near Kalimata Mandir)
13	Mgr. Leen Street and nearby vicinity, La Butte
14	Pouce Stream
15	Old Moka Road, Camp Chapelon
16	Boulevard Victoria, Montagne Coupe
17	Pailles: (i) access road to Les Guibies and along motorway, near flyover bridge
18	Pailles: (ii) access road Morcellement des Aloes from Avenue M. Leal (on hillside)
19	Pailles: (iii) Soreze region
20	Montée S, GRNW
Black River District Council	
21	Plaine Champagne Road, opposie « Musee Touche Dubois »
22	Chamarel: (i) near Restaurant Le Chamarel
23	Chamarel: (ii) Roadside
24	Grande Rivière Noire Village Hall
Savanne District Council	
25	Baie du Cap: (i) Near St Francois d'Assise Church
26	Baie du Cap: (ii) Maconde Region
27	Riviere des Anguilles, near the bridge
Grand Port District Council	
28	Quatre Soeurs, Marie Jeanne, Jhummah Street, Old Grand Port
29	Bambous Virieux, Rajiv Gandhi Street (near Bhowany House), Impasse Bholoa
30	Cave in at Union Park, Rose Belle
Municipality of Curepipe	
31	Trou-aux-Cerfs
32	River Bank at Cite l'Oiseau
33	Louis de Rochecouste (Riviere Seche)
34	Piper Morcellement Piat
Municipality of Quatre Bornes	
35	Candos Hill at Lall Bahadoor Shastri and Mahatma Gandhi Avenues
36	Cavernous Area at Mgr. Leen Avenue and Bassin
Municipality of Beau Bassin/Rose Hill	
37	Morcellement Hermitage, Coromandel

Annex B

(Draft) Flow Chart of the warning/evacuation system



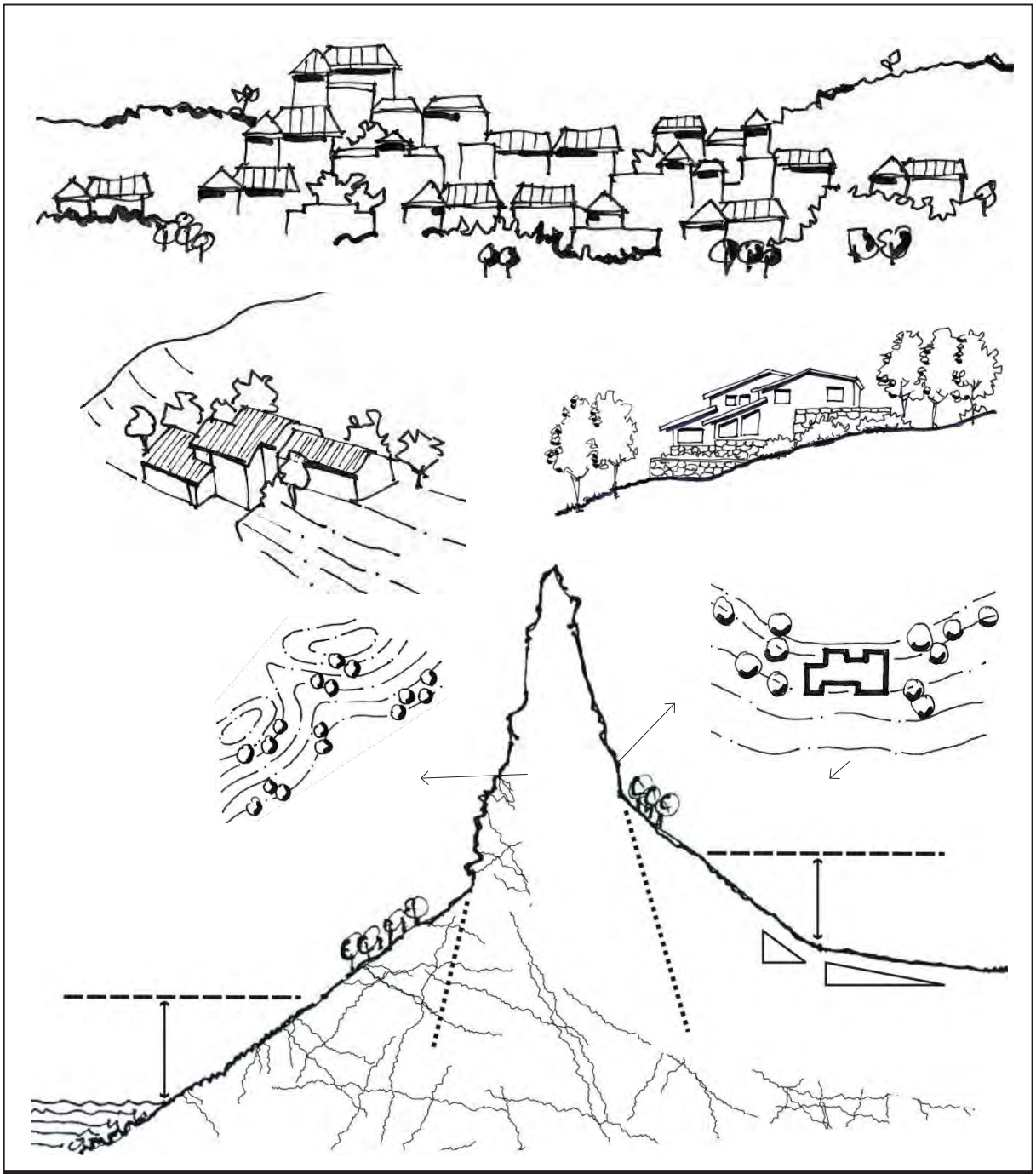
Area Name	Stage 1: Warning Stage			Stage 2: Evacuation Stage			
	R_{i1} (Rainfall [mm/hour] observed by inhabitants)	R_{m1} (Rainfall [mm/hour] observed by MMS)	E_1 (Displacement of ground [mm/day] observed by MPI)	R_{i2} (Rainfall [mm/hour] observed by inhabitants)	R_{m2} (Rainfall [mm/hour] observed by MMS)	E_{2d} (Displacement of ground [mm/day] observed by MPI)	E_{2h} (Displacement of ground [mm/hour] observed by MPI)
Chitrakoot	75			100			
Quatre Soeurs							
Vallée Pitot	75			100			

MMS: Mauritius Meteorological Services
MPI: Ministry of Public Infrastructure, National Development Unit, Land Transport and Shipping
NDOCC: National Disaster and Operations Coordination Centre
PMO: Prime Minister's Office
LP: Local Police
SMF: Special Mobile Force

14. Review and Recommendation for the Planning Policy Guidance

Mauritius

Design Sheet



Design For Sloping Sites

November 2004
Incorporating Revision 1
_____, 20xx

Ministry of Housing and Lands

Ministry of Housing and Lands

PPG 1 Design Guidance Revision x? _____ 20xx?
UPDATE to PPG 1 First Issued in November 2004

1. BACKGROUND

In September 2006 the PPG 1, issued in November 2004, was revised and the following amendment, among others, was brought to "Design Sheet − Design for Sloping Sites" :

Residential land development is expanding onto slopes that are at risk of slope disasters. This is a growing issue. To safely rectify this situation, namely through structural countermeasure works for the entire area, would entail a huge expense and time. Therefore, it is important to clarify the potential danger area and restrict development in such areas to protect citizens' lives and property.

2. OBJECTIVE

Given the shortage of land use control in a risk area of slope disasters, the development restriction is being added in the area. This will help to mitigate slope disasters.

3. EFFECTIVE DATE

With effect from ____th _____20xx?

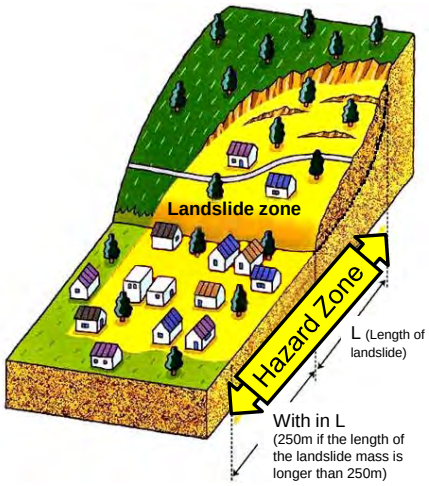
Design For Sloping Sites

Residential land development is expanding onto slopes that are at risk of slope disasters. To safely rectify this situation, it is important to clarify the potential danger areas and restrict development in such areas to protect citizens' lives and property.
The following contents are criteria for development control in the designated areas of the Landslide Hazard Zone and Slope Failure Hazard Zone.

＜Risk Management for Landslide Disaster＞

- Landslide Hazard Zones will be designated by a committee which will consist of landslide experts in collaborative coordination with the Ministry of Public Infrastructure, Local Authorities and related ministries/agencies, and the Ministry of Housing and Lands will earmark the designated zones on the plan of the Outline Planning Scheme, as areas prone to damage to buildings and life-threatening injuries to residents in case of landslides. A Hazard Zone is designated by the following criteria.
  - Landslide area (area which is currently prone to landslides or possibly vulnerable to landslides in future)
  - Area within a distance equivalent to the length of the landslide mass from the bottom end of the landslide area (250m if the length of the landslide mass is longer than 250m)
  - Authorized research/study achievements by ministries and agencies (Example: Areas evaluated as more than a Medium rank of Landslide Hazard in the "Disaster Risk Reduction Strategic Framework and Action Plan, Ministry of Environment and Sustainable Development, 2012")

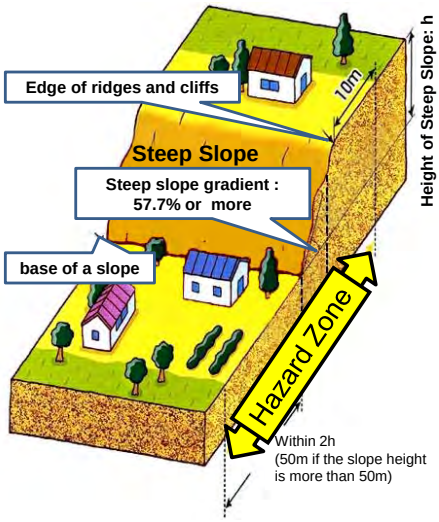
- Development will not normally be permitted in a Hazard Zone.
- When designating a Hazard Zone, it should be publicized in advance, as well as finding out the opinions of ministries/agencies/local authorities.
- When it is recognized that there is no longer any reason for Hazard Zone designation because countermeasures for the landslides have been undertaken, the Hazard Zone shall be rescinded in whole or partially through the same procedure of public notification and enquiry of opinions on the designation.



＜Risk Management for Slope Failure>

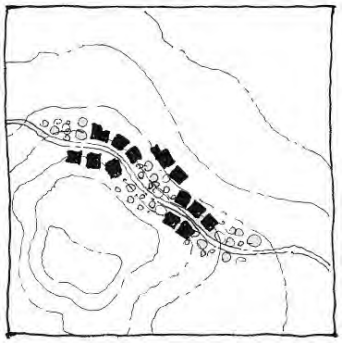
- Slope Failure Hazard Zones will be designated by a committee which will consist of landslide experts in collaborative coordination with Ministry of Public Infrastructure, Local Authorities and related ministries/agencies, and Ministry of Housing and Lands will earmark the designated zones on the plan of the Outline Planning Scheme, as areas prone to damage to buildings and life-threatening injuries to residents in case of slope failure. The Hazard Zone is designated by the following criteria.
  - Area having a slope gradient of 30 degrees (57.7% or 1 in 1.7) or more and slope height of 5m or more
  - Area within a 10m horizontal distance from the edge of ridges and cliffs
  - Area within a distance twice the slope height from the base of a slope (50m if the slope height is more than 50m)
  - A slope failure hazard area identified by authorized research/study achievements of ministries and agencies

- Development will not normally be permitted in the Hazard Zone.
- When designating a Hazard Zone, it should be publicized in advance, as well as finding out the opinions of ministries/agencies/local authorities.
- When it is recognized that there is no longer any reason for the Hazard Zone designation because countermeasures for the slope failure have been undertaken, the Hazard Zone shall be rescinded in whole or partially through the same procedure of public notification and enquiry of opinions on the designation.



The development control will be required not only the above landslide/slope failure criteria, but also the following slope stability criteria

Design For Sloping Sites



Development on sloping sites

This Design Guidance should be applied to proposals for development on the slopes of the Mountain Ranges as listed in the First Schedule of the Forest and Reserves Act 1983 or as subsequently amended and other locations where steep (>10%) slopes exist.

Port Louis and Calebasses Ranges
Mont Piton Montagne
Blanche Petit Malabar
Grand Malabar Corps de
Garde Candos Hill Rempart
Tamarin and Terre Rouge Ranges
Riviere Noire and Morne Brabant Range
Savanne Range Perruche
Bambou and Creole Ranges
Lagrave and Chevillard or d'Auvillard Ranges
Montagne Chaumant
Montagne Pauline
Montagne Dalais Montagne
Maurice Mountain Vernon

Development on steep slopes will also require the submission of a Preliminary Environmental Report and/or Environmental Impact Assessment. You should discuss the need for these with the Ministry of Environment

Pressure to develop mountain slopes in Mauritius has recently intensified. The pressure is particularly intense on those slopes that offer a view out to sea.

The development of criteria for the sloping sites is required, which can consider not only safety/security but also comfort, aspect/landscape, etc.

The following criteria apply to plot layouts on sloping sites:

Slope Stability

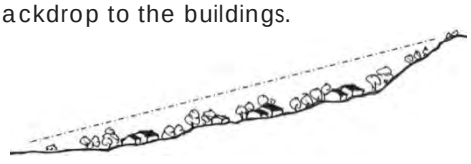
- Development will not normally be permitted on slopes steeper than 1:5 (20%).
- Above slopes of 1:10 (10%), and in areas of poor bearing capacity, the ground conditions should be checked and proposed structures certified by a qualified engineer. A Site Constraint Analysis and written statement detailing all proposed mitigation measures should be submitted to and approved by the Permit Authority prior to the commencement of any on-site works.

SITE CONSTRAINT ANALYSIS Typical Information
• Topography, with emphasis on slopes over 10%
• Vegetation such as individual trees, groupings of trees and shrubs, habitat types
• Drainage courses and riparian corridors
• Sewage disposal systems
• Geologic constraints including landslides and active fault lines
• Visibility from off-site
• Areas of fire danger
• Solar orientation and prevailing wind patterns
• Significant ridgelines

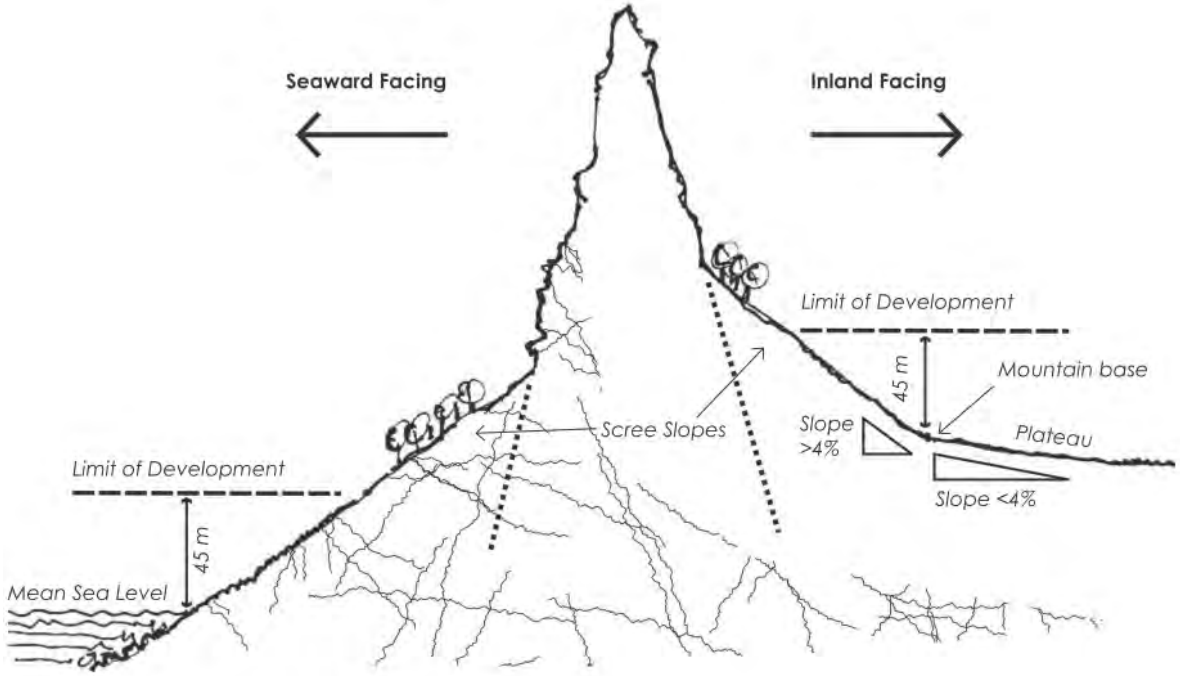
Site Location and Visual Impact

- As a general guide development should not be any higher than 45 metres above the mountain base, or in the case of slopes facing the sea, 45 metres above Mean Sea Level.
- Building profiles should not visually break the ridge line of the slope, especially when seen from important vantage points and buildings should not be built on the crest of slopes. The hillside should act as a backdrop to the buildings.

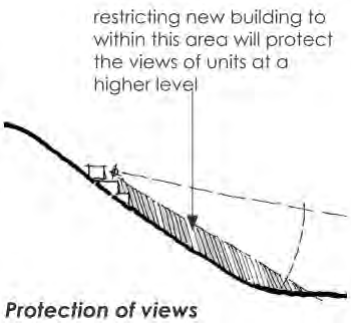
Development should not project above significant ridgelines



Design For Sloping Sites



Height limitation of development on mountain slopes



Protection of views

- Care should be taken to protect the view of dwellings both above and below any new development, and unit spacing should be such that views of the natural landscape are retained
- The mountain or slope should act as the backdrop to the building. This is far more preferable to having the building project into a blue sky background. If the building or structure does break the plane of the natural backdrop, it should be designed to mimic the natural lines of the mountains and hillsides

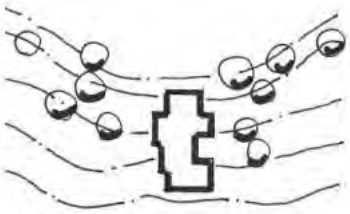
  Existing and new vegetation should be placed to soften the mass of building as viewed from off site

Avoid long unbroken building forms

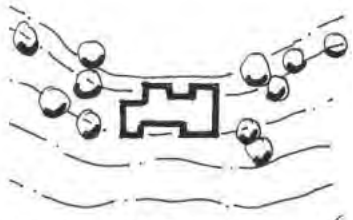
- Buildings should be placed far enough apart to reveal views of the mountain and the natural landscaped backdrop from other buildings and downslope

Design For Sloping Sites

Avoid the cumulative impact of buildings dominating slopes



Building is perpendicular to contours ✗



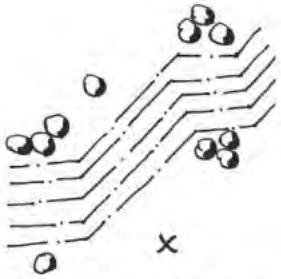
Building is parallel with the contours ✓

- Buildings sited to maximise views at the expense of natural vegetation should be resisted

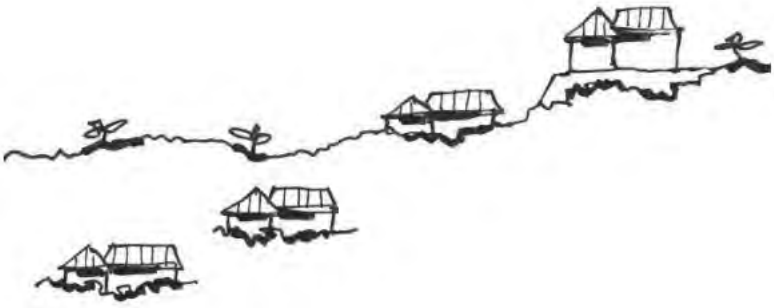
  Buildings should not appear overly prominent or obtrusive

- Buildings should be planned to enhance a site's natural features. The form, mass, profile and architectural features should be designed to blend with the natural terrain and preserve the undulating profile of the slopes. Multi storey buildings on or close to ridge lines should be avoided and on all sites lower profile buildings should be encouraged

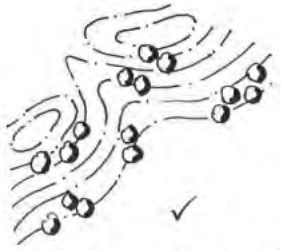
- In areas of varying topography, buildings higher than their surroundings are particularly prominent and due consideration must be given to distant views and important skylines. The same dwelling sited at different heights and locations can have very different impacts on the hillside and skyline. Permit applications for development on slopes must include sufficient information for judgements to be made regarding the acceptability of the development; for instance photo montages, elevations over a wide area showing the setting of the building as well as sections and contours.



Sharp angles and uniform slope banks appear unnatural



- Existing vegetation should be used to soften structural mass and blend buildings into natural settings

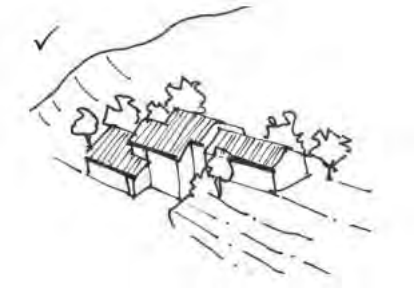


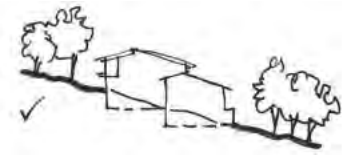
Use varied slopes and berms to resemble natural features

Design For Sloping Sites

Building form reflects hillside form and setting:

- *Stepped into the slope*
- *Use of natural materials*
- *Small roof areas*

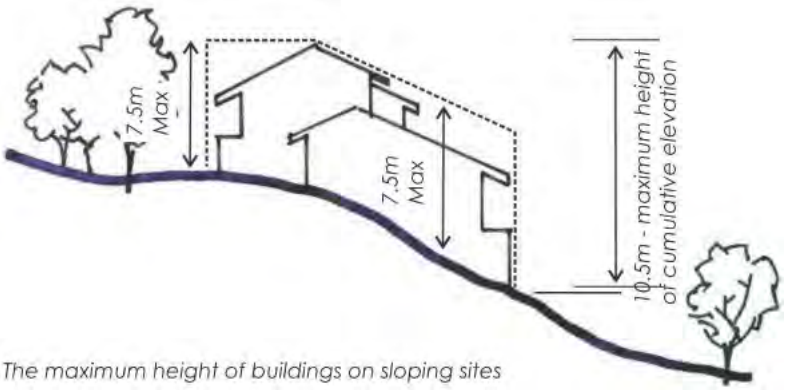




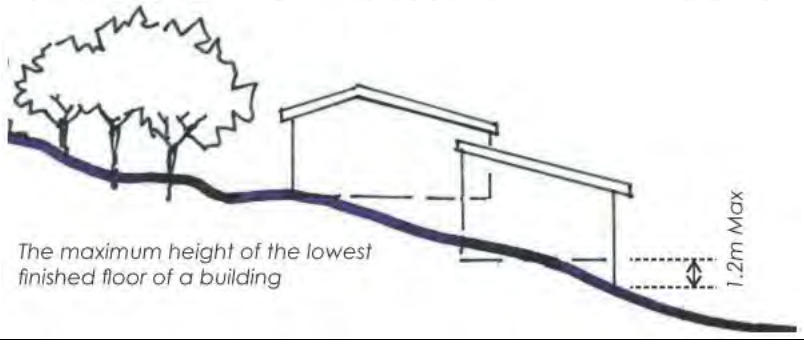
- Careful consideration should be given to the potential cumulative impacts of development within the hillside setting and upon existing ridgelines. Ensure sufficient space is retained between buildings to reveal appropriate views of ridges and the natural landscaped backdrop.

Architectural Form

- The form, massing and architectural features of buildings should be designed to blend with the natural terrain and preserve the undulations of the slopes. Roofs should be orientated in the direction of the slope and large gable ends should be avoided
- Contrasting and varied horizontal and vertical building planes should be used to create various light, shade, and shadow patterns to reduce perceived bulk.
  Large expanses of wall in a single plane on downhill elevations should be avoided
- The maximum height of buildings should not normally exceed 7.5m. The maximum height of a building's combined elevation should not normally exceed 10.5m measured from the lowest part of the building to the highest
- The height of the lowest finished floor(s) of a structure, excluding basements, should not be more than 1.2m above existing grade to ensure buildings follow slopes

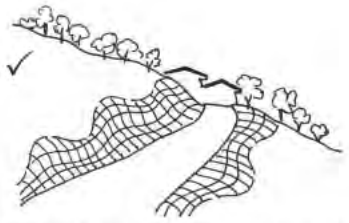


The maximum height of buildings on sloping sites

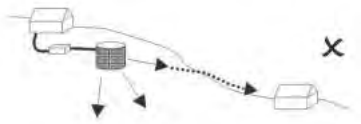


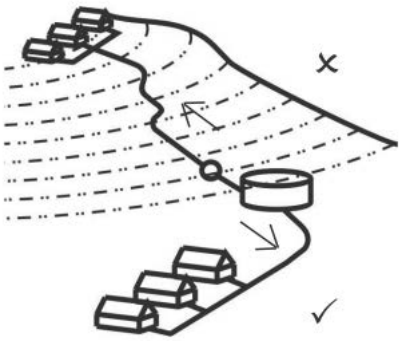
The maximum height of the lowest finished floor of a building

Design For Sloping Sites



Slope changes should appear as natural as possible





- Retaining walls and structures should be planned in a curvilinear manner that reflects the natural contours of the landscape, and materials and finishes should harmonise both with the terrain and the buildings on the site
- Long unbroken rooflines should be avoided. Instead, roofs should be broken into smaller components to reflect the irregular natural hillside patterns. The roof should be orientated in the same direction of the slope contour and large gable ends on downhill elevations should be avoided
- Dark or earthtone colours should be used to make the building less conspicuous as seen from off site. White or light colours should be avoided. The colours used for buildings should harmonise with the natural colours of the hillside.

Infrastructure

Highways and utility infrastructure services should be of a high standard for developments on steep slopes:

- Roads should be laid out to avoid steep grades and should normally not exceed 1:8 (12.5%))
- The consideration of the following is required for road design.
  - Enough stability against external effects such as traffic load and rain
  - Design for easy/simple maintenance
  - In a part of cut slope, groundwater drainage and gradient should be considered to avoid landslide, rock fall and slope disaster
  - In a part of embankment, design and pavement to support the traffic load is required. The material strength, height, shape of the embankment should be considered to avoid deformation/subsidence by traffic load or the embankment. Also, enough stability against destructive cause such rain and percolating water is required.
  - Road planning should be avoided in high risk areas such as landslides/slopes
  - Drainage facilities will be required to keep the stability for the slope and avoid erosion.
  - The gradient of slope should be designed by the geology/bedrock/height of the embankment/cut slope.
- Stormwater should be disposed of within the plot boundary or to a centralised stormwater soakaway system and should not be allowed to flow to adjacent plots or into road reserves
- Ground water drainage (open ditch, underground drain, or other facility) is required to drain off the surface water which can be the cause of landslides from the landslide/slope failure risk area to another area.

- Special care is needed to control surface water drainage and engineering studies should be provided to show the effect that drainage might have on other properties. Inadequate drainage may trigger land slips
- On-site sewage and waste water disposal systems must take account of soil characteristics. The use of septic tanks may not be possible, or special designs might be required, because of the risk of effluent appearing at the surface in land/properties below the site being developed
- Underground utility services and poles should not be placed in made-up ground
- Water pressure from Central Water Authority facilities should be adequate to reach the upper limits of development on a high slope. A minimum residual pressure of 10 metres at property boundary is recommended
- The provision of water to properties above the level of existing water storage reservoirs, or remote from the existing supply network may be difficult and/or costly to achieve. Early discussion should be held with the Central Water Authority.

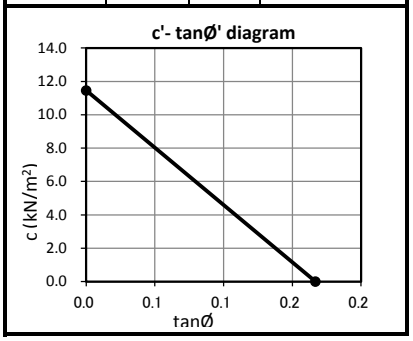
15. Result of Stability Analysis

A block landslide in Chittrakoot area

Modified Fellenius method

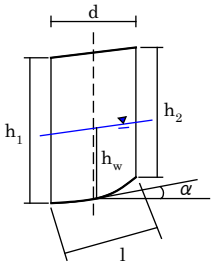
$$Fs = \frac{S}{T} = \frac{\sum\{c \cdot l + (W - U \cdot d)\cos\alpha \cdot \tan\phi\}}{\sum W \cdot \sin\alpha} = \underline{1.130}$$

F_0	c (kN/m2)	ϕ (°)	tan ϕ (°)
0.980	11.450	0.000	0.0000
	0.000	9.470	0.1668



Soil Constants

No.	Strata	Geological Material	Unit Weight		Cohesion	Internal Friction Angle	
			γ_t (kN/m^3)	γ_{sat} (kN/m^3)	c (kN/m^2)	φ (°)	tanφ (°)
1	Landslide block	sand	18.00		5.0	15.0000	0.2679
2	Landslide block	Clay	18.00		5.0	13.7663	0.2450
3	Landslide block	Gravel	18.00		5.0	13.7663	0.2450
4	Bedrock	Basalt	18.00		5.0	14.7500	0.2633
5	QS-test	QS-test	18.00		5.0	5.3700	0.0940



Slice No.	Strata	Geological Material	Height (L) h_1 (m)	Height (R) h_2 (m)	Wide d (m)	Area A (m^2)	Unit Weight γ_t (kN/m^3)	Weight W (kN/m)	Length l (m)	Angle α (°)	W.L. Height h_w (m)	Pore Water P U (kN/m^2)	Cohesion c (kN/m^2)	tanφ (°)	S	T
1	Landslide block	QS-test	0.00	3.64	10.13	18.45	18.00	332.05	10.19	-6.432	0.04	0.40	5.00	0.094	81.612	-37.197
2	Landslide block	QS-test	3.64	6.07	16.46	79.99	18.00	1439.80	16.51	-4.082	1.43	14.04	5.00	0.094	195.850	-102.491
3	Landslide block	QS-test	6.07	8.15	13.06	92.88	18.00	1671.80	13.06	-1.474	3.56	34.95	5.00	0.094	179.519	-43.010
4	Landslide block	QS-test	8.15	8.79	18.62	157.73	18.00	2839.22	18.63	1.320	5.05	49.51	5.00	0.094	273.310	65.380
5	Landslide block	QS-test	8.79	8.72	22.29	195.05	18.00	3510.86	22.38	5.148	5.85	57.33	5.00	0.094	320.954	315.003
6	Landslide block	QS-test	8.72	8.13	17.56	147.97	18.00	2663.40	17.63	5.147	6.01	58.98	5.00	0.094	240.538	238.943
7	Landslide block	QS-test	8.13	8.26	20.75	170.17	18.00	3063.06	20.84	5.146	6.18	60.58	5.00	0.094	273.257	274.736
8	Landslide block	QS-test	8.26	8.80	19.87	169.47	18.00	3050.53	19.95	5.148	6.53	64.04	5.00	0.094	266.213	273.741
9	Landslide block	QS-test	8.80	8.60	15.92	138.47	18.00	2492.44	16.03	6.730	6.41	62.89	5.00	0.094	219.351	292.087
10	Landslide block	QS-test	8.60	8.07	19.77	164.71	18.00	2964.77	19.93	7.283	5.46	53.54	5.00	0.094	277.399	375.828
11	Landslide block	QS-test	8.07	7.23	11.69	89.44	18.00	1609.84	11.84	8.957	4.38	42.91	5.00	0.094	162.078	250.637
12	Landslide block	QS-test	7.23	6.94	9.01	63.79	18.00	1148.27	9.04	4.988	3.79	37.12	5.00	0.094	121.420	99.845
13	Landslide block	QS-test	6.94	6.55	6.37	42.98	18.00	773.57	6.38	3.495	3.74	36.64	5.00	0.094	82.592	47.151
14	Landslide block	QS-test	6.55	7.13	6.88	47.07	18.00	847.19	6.89	3.494	3.79	37.22	5.00	0.094	89.926	51.629
15	Landslide block	QS-test	7.13	6.76	6.09	42.31	18.00	761.57	6.10	3.495	3.85	37.79	5.00	0.094	80.372	46.424
16	Landslide block	QS-test	6.76	4.90	15.29	89.13	18.00	1604.32	15.41	6.949	3.39	33.22	5.00	0.094	179.318	194.105
17	Landslide block	QS-test	4.90	7.74	5.38	34.00	18.00	612.06	5.42	6.949	2.82	27.64	5.00	0.094	70.340	74.055
18	Landslide block	QS-test	7.74	7.07	13.67	101.24	18.00	1822.33	13.77	6.949	2.54	24.94	5.00	0.094	207.075	220.489
19	Landslide block	QS-test	7.07	6.73	10.19	70.31	18.00	1265.55	10.27	7.506	2.15	21.07	5.00	0.094	149.304	165.320
20	Landslide block	QS-test	6.73	6.67	9.87	66.11	18.00	1190.00	9.94	6.676	1.83	17.98	5.00	0.094	144.213	138.334
21	Landslide block	QS-test	6.67	5.71	3.32	20.52	18.00	369.40	3.57	21.761	1.21	11.84	5.00	0.094	46.678	136.953
22	Landslide block	QS-test	5.71	3.07	3.32	14.56	18.00	261.99	4.48	42.186	0.35	3.43	5.00	0.094	39.837	175.939
23	Landslide block	QS-test	3.07	0.00	1.62	2.49	18.00	44.77	3.63	63.469	0.00	0.00	5.00	0.094	20.026	40.052
														Σ	3721.18	3293.95

A block Landslide in Chitrakoot area

Coordinates

No.	Slice No.	Topography		Landslide Plane	Groundwater Level	Horizontal Drainage
		X (m)	Y (m)	Y (m)	Y (m)	Y (m)
1		19.851	188.000		188.000	186.000
2		25.427	189.000	189.000	189.000	187.000
3	1	29.589	189.500	189.500	189.500	189.500
4	2	39.719	192.000	188.358	190.439	188.439
5	3	56.183	193.257	187.183	191.966	189.966
6	4	69.239	195.000	186.847	193.192	191.192
7	5	87.864	196.061	187.276	195.028	193.028
8	6	110.154	198.000	189.284	197.224	195.224
9	7	127.717	199.000	190.866	198.955	196.955
10	8	148.471	201.000	192.735	201.000	199.000
11	9	168.338	203.321	194.525	203.321	201.321
12	10	184.261	205.000	196.404	204.435	202.435
13	11	204.027	207.000	198.930	205.818	203.818
14	12	215.720	208.000	200.773	206.636	204.636
15	13	224.725	208.500	201.559	207.267	205.267
16	14	231.095	208.500	201.948	207.712	205.712
18	15	237.974	209.500	202.368	208.194	206.194
19	16	244.065	209.500	202.740	208.620	206.620
20	17	259.359	209.500	204.604	209.500	207.500
21	18	264.741	213.000	205.260	210.001	208.001
22	19	278.409	214.000	206.926	211.272	209.272
23	20	288.594	215.000	208.268	212.220	210.220
24	21	298.462	216.090	209.423	213.138	211.138
25	22	301.779	216.455	210.747	213.446	211.446
26	23	305.096	216.821	213.753	213.905	213.753
27		306.717	217.000	217.000	217.000	217.000
28		314.181	218.000			
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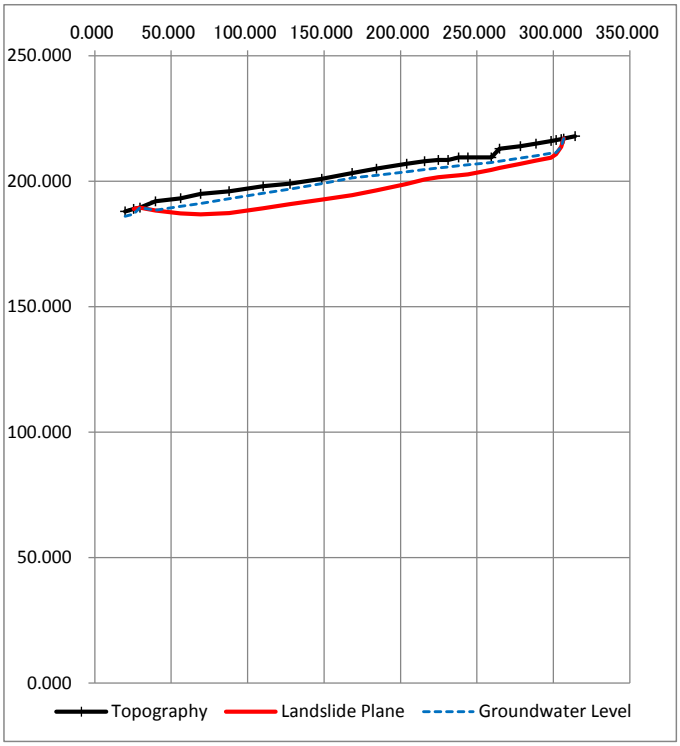
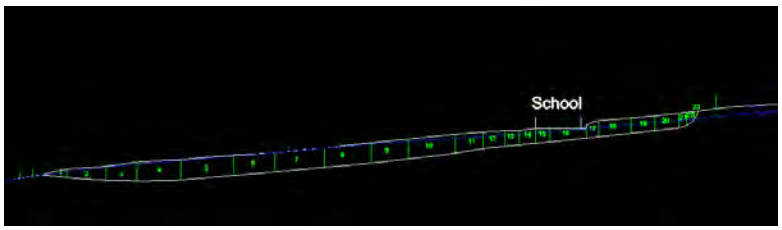


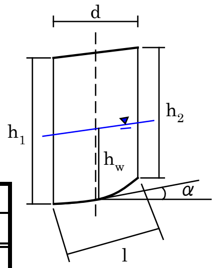


WL= HWL [14th, Feb, 2013]

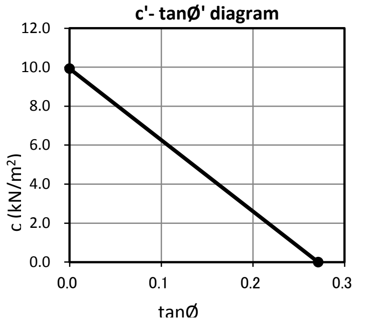
B block Landslide in Chitrakoot area

Modified Fellenius method

$$Fs=\frac{S}{T}=\frac{\sum\{c\cdot l+(W-U\cdot d)\cos\alpha\cdot\tan\phi\}}{\sum W\cdot\sin\alpha}=\underline{1.175}$$



F_0	c (kN/m2)	φ (°)	tanφ (°)
0.980	9.930	0.000	0.0000
	0.000	15.170	0.2711



Soil Constants

No.	Strata	Geological Material	Unit Weight γ_t (kN/m³)	Unit Weight γ_{sat} (kN/m³)	Cohesion c (kN/m²)	Internal Friction Angle φ (°)	Internal Friction Angle tanφ (°)
1							
2							
3							
4							
5	Chitrakoot	cullvium	18.00		5.0	7.6700	0.1347

Slice No.	Strata	Geological Material	Height (L) h_1 (m)	Height (R) h_2 (m)	Wide d (m)	Area A (m²)	Unit Weight γ_t (kN/m³)	Weight W (kN/m)	Length l (m)	Angle α (°)	W.L. Height h_w (m)	Pore Water P U (kN/m²)	Cohesion c (kN/m²)	tanφ (°)	S	T
1	Landslide block	cullvium	0.00	1.29	6.18	4.00	18.00	71.97	6.18	-0.102		0.00	5.00	0.135	40.593	-0.128
2	Landslide block	cullvium	1.29	2.45	6.24	11.70	18.00	210.61	6.24	1.239		0.00	5.00	0.135	59.574	4.554
3	Landslide block	cullvium	2.45	3.70	7.81	24.02	18.00	432.41	7.82	2.758		0.00	5.00	0.135	97.242	20.804
4	Landslide block	cullvium	3.70	4.48	13.70	56.02	18.00	1008.42	13.76	5.097	0.97	9.46	5.00	0.135	186.654	89.586
5	Landslide block	cullvium	4.48	5.43	8.00	39.63	18.00	713.27	8.07	7.458	1.95	19.15	5.00	0.135	115.127	92.583
6	Landslide block	cullvium	5.43	4.91	9.25	47.81	18.00	860.62	9.37	9.346	1.88	18.40	5.00	0.135	138.610	139.757
7	Landslide block	cullvium	4.91	3.32	12.44	51.20	18.00	921.66	12.70	11.737	0.82	8.08	5.00	0.135	171.796	187.486
8	Landslide block	cullvium	3.32	3.65	6.77	23.62	18.00	425.23	6.97	13.865	0.17	1.66	5.00	0.135	88.997	101.899
9	Landslide block	cullvium	3.65	3.11	9.08	30.72	18.00	553.04	9.43	15.637	0.17	1.66	5.00	0.135	116.920	149.064
10	Landslide block	cullvium	3.11	2.74	10.48	30.65	18.00	551.64	11.01	17.854		0.00	5.00	0.135	125.769	169.128
11	Landslide block	cullvium	2.74	1.02	7.78	14.62	18.00	263.17	8.28	19.941		0.00	5.00	0.135	74.703	89.755
12	Landslide block	cullvium	1.02	0.00	4.31	2.20	18.00	39.64	4.63	21.330		0.00	5.00	0.135	28.108	14.420
																Σ 1244.09 / 1058.91

Σ 1244.09 1058.91

B block Landslide in Chitrakoot area

Coordinates

No.	Slice No.	Topography		Landslide Plane	Groundwater Level	Groundwater Level
		X (m)	Y (m)	Y (m)	Y (m)	Y (m)
1		4.403	143.000			
2		9.126	145.000			
3	1	26.351	148.800	148.800		
4	2	32.531	150.083	148.789	148.789	146.789
5	3	38.773	151.379	148.924	150.009	148.009
6	4	46.579	153.000	149.300	151.536	149.536
7	5	60.280	155.000	150.522	154.216	152.216
8	6	68.278	157.000	151.569	155.780	153.780
9	7	77.526	158.000	153.091	156.633	154.633
10	8	89.963	159.000	155.675	157.780	155.780
11	9	96.733	161.000	157.346	159.579	157.579
12	10	105.815	163.000	159.888	161.994	159.994
13	11	116.296	166.000	163.264	164.780	162.780
14	12	124.077	167.109	166.087	166.087	164.087
15	13	128.387	167.770	167.770		
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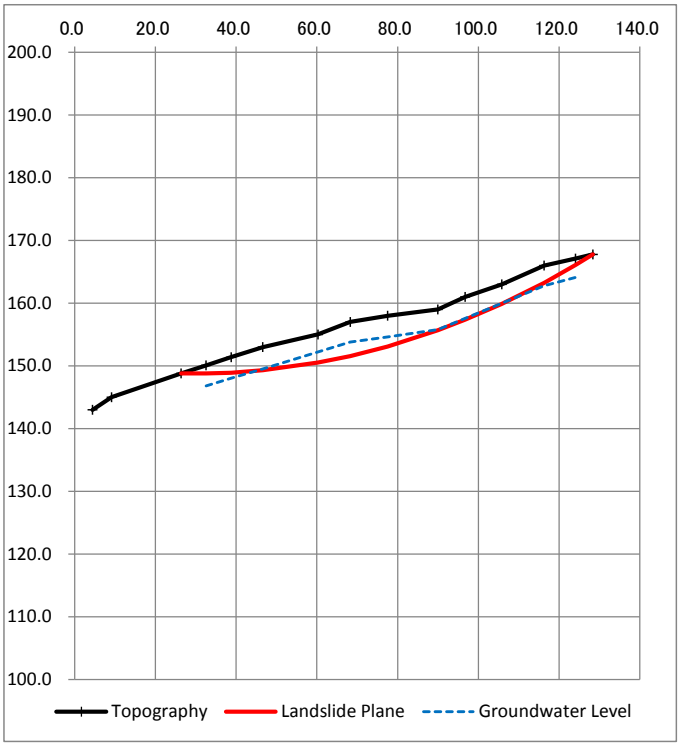
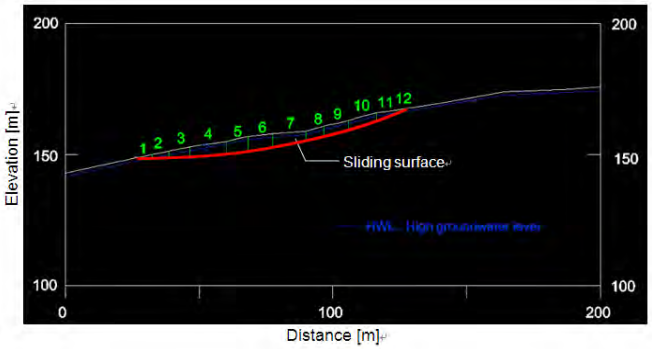




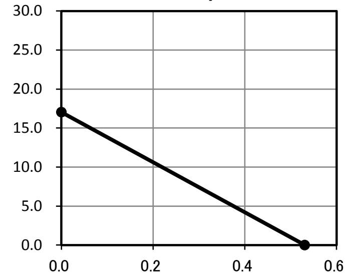
A block Landslide in Quatre Soeurs area

Fellenius method

$$Fs=\frac{S}{T}=\frac{\sum\{c\cdot l+(W-U\cdot d)\cos\alpha\cdot\tan\phi\}}{\sum W\cdot\sin\alpha}=\underline{1.407}$$

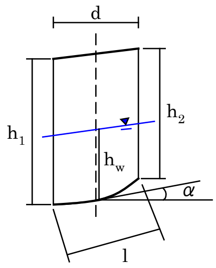
F_0	c (kN/m2)	ϕ (°)	tanϕ (°)
1.000	17.040	0.000	0.0000
	0.000	27.950	0.5306

Back analysis



Soil Constants

No.	Strata	Geological Material	Unit Weight γ_t (kN/m^3)	Unit Weight γ_{sat} (kN/m^3)	Cohesion c (kN/m^2)	Internal Friction Angle φ (°)	Internal Friction Angle tanφ (°)
5	Quatre Soeurs	1	16.00		8.0	16.0800	0.2883



Slice No.	Strata	Geological Material	Height (L) h_1 (m)	Height (R) h_2 (m)	Wide d (m)	Area A (m^2)	Unit Weight γ_t (kN/m^3)	Weight W (kN/m)	Length l (m)	Angle α (°)	W.L. Height h_w (m)	Pore Water P U (kN/m^2)	Cohesion c (kN/m^2)	tanφ (°)	S	T
1	Landslide block	1	1.00	1.02	0.61	0.61	16.00	9.77	0.61	-1.418		0.00	8.00	0.288	7.665	-0.242
2	Landslide block	1	1.02	2.04	1.89	2.89	16.00	46.17	1.89	-0.819		0.00	8.00	0.288	28.414	-0.660
3	Landslide block	1	2.04	1.89	6.47	12.73	16.00	203.66	6.47	1.328		0.00	8.00	0.288	110.471	4.720
4	Landslide block	1	1.89	1.37	6.47	10.55	16.00	168.79	6.49	4.621		0.00	8.00	0.288	100.425	13.600
5	Landslide block	1	1.37	3.07	2.49	5.51	16.00	88.21	2.50	6.906		0.00	8.00	0.288	45.267	10.607
6	Landslide block	1	3.07	4.75	2.20	8.61	16.00	137.73	2.22	8.119	0.99	9.70	8.00	0.288	50.998	19.452
7	Landslide block	1	4.75	5.45	1.87	9.55	16.00	152.76	1.90	9.169	1.86	18.25	8.00	0.288	48.917	24.343
8	Landslide block	1	5.45	5.99	2.57	14.69	16.00	234.96	2.61	10.307	2.56	25.14	8.00	0.288	69.208	42.039
9	Landslide block	1	5.99	6.55	2.12	13.31	16.00	213.03	2.17	11.522	3.11	30.49	8.00	0.288	59.220	42.553
10	Landslide block	1	6.55	7.02	2.38	16.12	16.00	257.90	2.44	12.713	3.58	35.10	8.00	0.288	68.552	56.753
11	Landslide block	1	7.02	7.38	2.55	18.32	16.00	293.14	2.62	13.989	3.87	38.00	8.00	0.288	75.929	70.861
12	Landslide block	1	7.38	7.18	1.81	13.18	16.00	210.92	1.88	15.140	3.95	38.78	8.00	0.288	54.155	55.087
13	Landslide block	1	7.18	6.51	4.56	31.22	16.00	499.48	4.76	16.822	3.57	34.97	8.00	0.288	131.928	144.554
14	Landslide block	1	6.51	6.75	2.26	15.01	16.00	240.20	2.39	18.647	2.91	28.56	8.00	0.288	67.059	76.802
15	Landslide block	1	6.75	5.16	4.26	25.39	16.00	406.25	4.55	20.407	2.14	20.96	8.00	0.288	122.000	141.654
16	Landslide block	1	5.16	4.19	2.37	11.10	16.00	177.56	2.56	22.221	1.27	12.42	8.00	0.288	60.018	67.148
17	Landslide block	1	4.19	1.14	6.63	17.69	16.00	282.97	7.31	24.737		0.00	8.00	0.288	132.526	118.411
18	Landslide block	1	1.14	1.24	1.76	2.08	16.00	33.36	1.97	27.098		0.00	8.00	0.288	24.332	15.195
19	Landslide block	1	1.24	0.00	2.76	1.71	16.00	27.31	3.13	28.406		0.00	8.00	0.288	31.981	12.991
														Σ	1289.07	915.87

A block Landslide in Quatre Soeurs area

Coordinates

No.	Slice No.	Topography		Landslide Plane	Groundwater Level	Groundwater Level
		X (m)	Y (m)	Y (m)	Y (m)	Y (m)
1		457.018	-53.751			
2		457.018	-53.251			
3	1	457.018	-52.251	-53.251	-53.251	-55.251
4	2	457.624	-52.251	-53.266	-53.172	-55.172
5	3	459.512	-51.251	-53.293	-52.928	-54.928
6	4	465.983	-51.251	-53.143	-52.089	-54.089
7	5	472.453	-51.251	-52.62	-51.251	-53.251
8	6	474.938	-49.251	-52.319	-49.811	-51.811
9	7	477.139	-47.251	-52.005	-48.535	-50.535
10	8	479.01	-46.251	-51.703	-47.451	-49.451
11	9	481.578	-45.251	-51.236	-46.361	-48.361
12	10	483.702	-44.251	-50.803	-45.46	-47.46
13	11	486.078	-43.251	-50.267	-44.451	-46.451
14	12	488.623	-42.251	-49.633	-43.7	-45.7
15	13	490.434	-41.967	-49.143	-43.167	-45.167
16	14	494.995	-41.251	-47.764	-42.608	-44.608
18	15	497.259	-40.251	-47	-42.331	-44.331
19	16	501.522	-40.251	-45.414	-41.808	-43.808
20	17	503.894	-40.251	-44.445	-41.518	-43.518
21	18	510.529	-40.251	-41.388	-40.705	-42.705
22	19	512.284	-39.251	-40.49	-40.49	-42.49
23	20	515.039	-39	-39		
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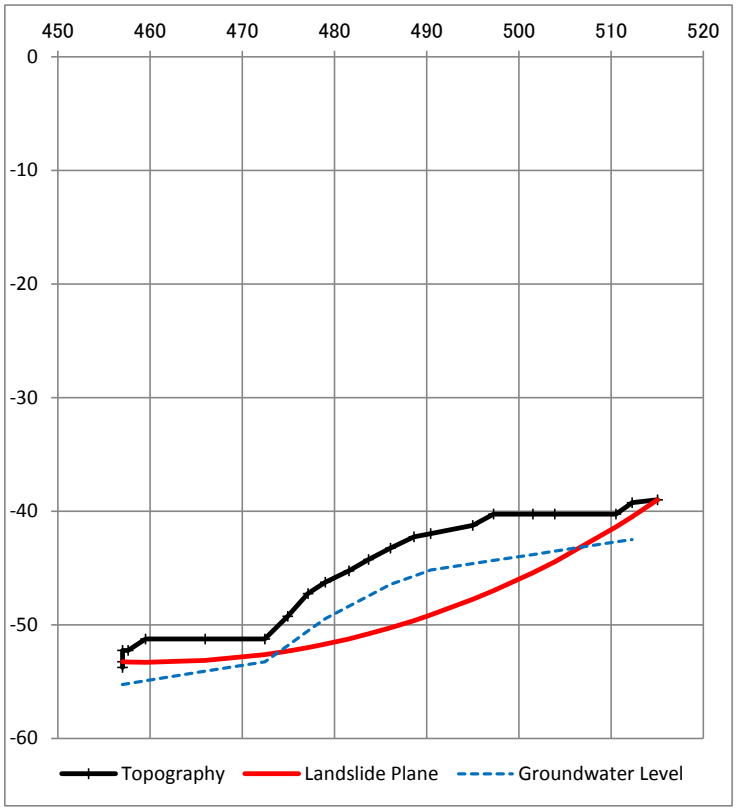
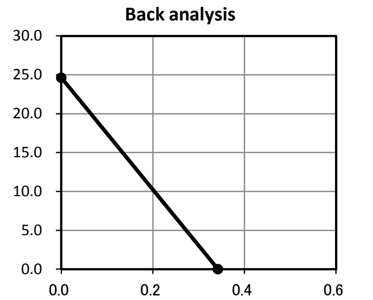


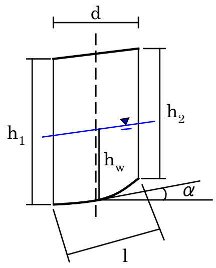
B block Landslide in Quatre Soeurs area

Fellenius method

$$Fs = \frac{S}{T} = \frac{\sum\{c \cdot l + (W - U \cdot d)\cos\alpha \cdot \tan\phi\}}{\sum W \cdot \sin\alpha} = \underline{1.129}$$

F_0	c (kN/m2)	ϕ (°)	tanϕ (°)
1.000	24.620	0.000	0.0000
	0.000	18.880	0.3420





Soil Constants

No.	Strata	Geological Material	Unit Weight		Cohesion	Internal Friction Angle	
			γ_t (kN/m^3)	γ_{sat} (kN/m^3)	c (kN/m^2)	φ (°)	tanφ (°)
5	Quatre Soeurs	1	18.00		8.0	13.0000	0.2309

Slice No.	Strata	Geological Material	Height (L) h_1 (m)	Height (R) h_2 (m)	Wide d (m)	Area A (m^2)	Unit Weight γ_t (kN/m^3)	Weight W (kN/m)	Length l (m)	Angle α (°)	W.L. Height h_w (m)	Pore Water P U (kN/m^2)	Cohesion c (kN/m^2)	tanφ (°)	S	T
1	Landslide block	1	0.00	1.92	8.05	7.71	18.00	138.74	8.10	-6.485		0.00	8.00	0.231	96.641	-15.669
2	Landslide block	1	1.92	3.45	8.72	23.38	18.00	420.89	8.74	-3.498		0.00	8.00	0.231	166.879	-25.678
3	Landslide block	1	3.45	4.64	5.24	21.18	18.00	381.31	5.24	-1.017		0.00	8.00	0.231	129.937	-6.768
4	Landslide block	1	4.64	5.46	5.53	27.92	18.00	502.52	5.53	0.880		0.00	8.00	0.231	160.255	7.722
5	Landslide block	1	5.46	6.04	7.43	42.72	18.00	768.87	7.44	3.189		0.00	8.00	0.231	236.765	42.775
6	Landslide block	1	6.04	6.88	9.58	61.89	18.00	1113.93	9.64	6.208	0.09	0.85	8.00	0.231	330.872	120.463
7	Landslide block	1	6.88	6.60	8.20	55.29	18.00	995.17	8.32	9.660	1.11	10.85	8.00	0.231	272.793	166.998
8	Landslide block	1	6.60	6.50	6.49	42.52	18.00	765.35	6.58	9.663	1.71	16.72	8.00	0.231	202.157	128.461
9	Landslide block	1	6.50	6.97	8.98	60.48	18.00	1088.56	9.11	9.663	2.34	22.90	8.00	0.231	273.824	182.717
10	Landslide block	1	6.97	7.70	6.70	49.13	18.00	884.36	6.82	10.766	2.91	28.51	8.00	0.231	211.809	165.200
11	Landslide block	1	7.70	8.26	2.28	18.19	18.00	327.36	2.32	10.899	3.18	31.20	8.00	0.231	76.661	61.893
12	Landslide block	1	8.26	7.77	7.11	56.97	18.00	1025.38	7.26	11.836	3.47	34.02	8.00	0.231	235.147	210.313
13	Landslide block	1	7.77	7.94	7.36	57.81	18.00	1040.56	7.58	13.926	3.92	38.41	8.00	0.231	230.491	250.436
14	Landslide block	1	7.94	8.59	5.45	45.05	18.00	810.94	5.61	13.922	4.31	42.28	8.00	0.231	175.010	195.119
15	Landslide block	1	8.59	9.53	4.26	38.60	18.00	694.87	4.39	13.948	4.61	45.21	8.00	0.231	147.658	167.489
16	Landslide block	1	9.53	9.56	2.85	27.20	18.00	489.61	3.01	18.940	4.69	46.01	8.00	0.231	102.384	158.916
17	Landslide block	1	9.56	8.04	7.30	64.23	18.00	1156.12	7.72	18.996	4.52	44.29	8.00	0.231	243.566	376.318
18	Landslide block	1	8.04	9.04	2.90	24.77	18.00	445.94	3.07	18.990	4.34	42.55	8.00	0.231	94.951	145.114
19	Landslide block	1	9.04	7.72	6.76	56.65	18.00	1019.74	7.15	18.995	4.17	40.90	8.00	0.231	219.439	331.911
20	Landslide block	1	7.72	7.54	3.41	26.02	18.00	468.33	3.61	18.998	3.99	39.17	8.00	0.231	101.925	152.455
21	Landslide block	1	7.54	7.14	5.84	42.88	18.00	771.92	6.18	18.992	3.83	37.59	8.00	0.231	169.995	251.213
22	Landslide block	1	7.14	7.09	3.61	25.66	18.00	461.88	3.88	21.763	3.57	35.01	8.00	0.231	103.028	171.252
23	Landslide block	1	7.09	5.42	4.21	26.34	18.00	474.16	5.59	41.080	2.22	21.81	8.00	0.231	111.214	311.572
24	Landslide block	1	5.42	2.49	2.03	8.02	18.00	144.36	4.19	61.087	-0.48	0.00	8.00	0.231	49.653	126.364
25	Landslide block	1	2.49	0.00	0.72	0.90	18.00	16.21	2.85	75.280	-3.27	0.00	8.00	0.231	23.714	15.677
														Σ	4166.77	3692.26

B block Landslide in Quatre Soeurs area

Coordinates

No.	Slice No.	Topography		Landslide Plane	Groundwater Level	Groundwater Level
		X (m)	Y (m)	Y (m)	Y (m)	Y (m)
1		586.118	-65.251			
2		602.658	-63.251	-63.251		
3	1	602.658	-63.251	-63.251	-67.89	-69.89
4	2	610.708	-62.251	-64.166	-66.757	-68.757
5	3	619.428	-61.251	-64.699	-65.53	-67.53
6	4	624.667	-60.153	-64.792	-64.792	-66.792
7	5	630.198	-59.251	-64.707	-63.979	-65.979
8	6	637.628	-58.251	-64.293	-62.891	-64.891
9	7	647.207	-56.372	-63.251	-60.479	-62.479
10	8	655.408	-55.251	-61.855	-58.414	-60.414
11	9	661.898	-54.251	-60.75	-56.781	-58.781
12	10	670.878	-52.251	-59.221	-54.52	-56.52
13	11	677.578	-50.251	-57.947	-52.833	-54.833
14	12	679.858	-49.251	-57.508	-52.259	-54.259
15	13	686.968	-48.251	-56.018	-50.328	-52.328
16	14	694.328	-46.251	-54.193	-48.05	-50.05
18	15	699.778	-44.251	-52.842	-46.363	-48.363
19	16	704.038	-42.251	-51.784	-45.043	-47.043
20	17	706.888	-41.251	-50.806	-44.163	-46.163
21	18	714.188	-40.251	-48.293	-41.904	-43.904
22	19	717.088	-38.251	-47.295	-41.007	-43.007
23	20	723.848	-37.251	-44.968	-38.914	-40.914
24	21	727.258	-36.251	-43.794	-37.859	-39.859
25	22	733.101	-34.647	-41.783	-36.051	-38.051
26	23	736.708	-33.251	-40.343	-34.935	-36.935
27	24	740.918	-31.251	-36.673	-33.632	-35.632
28	25	742.945	-30.512	-33.003	-33.003	-35.003
29		743.668	-30.251	-30.251	-32.781	-34.781
30		748.028	-29.251			
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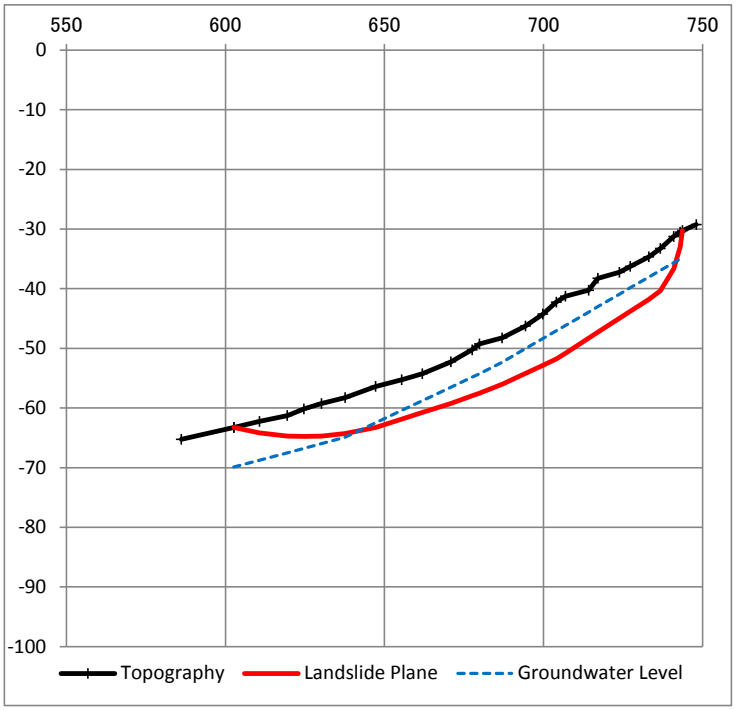

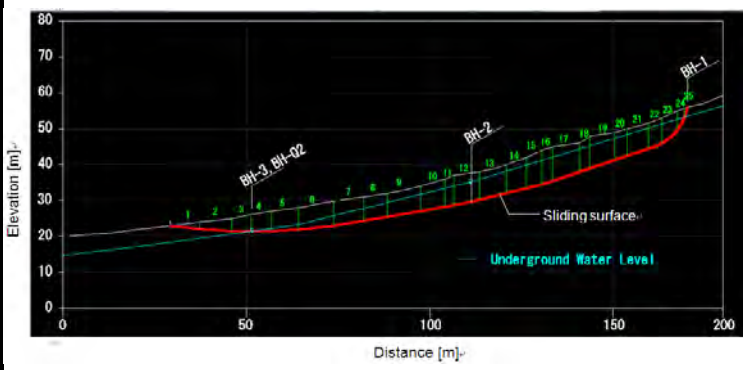

安定計算ValleePitot_A2-Block_HWL.xls

Coordinates

No.	Slice No.	Topography		Landslide Plane	Groundwater Level
		X (m)	Y (m)	Y (m)	Y (m)
1					
2		34.762	32.871	32.871	32.248
3	1	34.762	32.871	32.871	32.248
4	2	36.428	33.536	32.822	32.822
5	3	37.587	34.000	32.868	33.306
6	4	39.203	34.507	33.043	33.912
7	5	40.774	35.000	33.340	34.500
8	6	42.679	35.358	33.806	34.845
9	7	44.635	35.726	34.284	35.200
10	8	46.094	36.000	34.641	35.465
11	9	46.782	36.107	34.994	35.589
12	10	47.320	36.191	35.687	35.687
13		47.475	36.215	36.215	35.715
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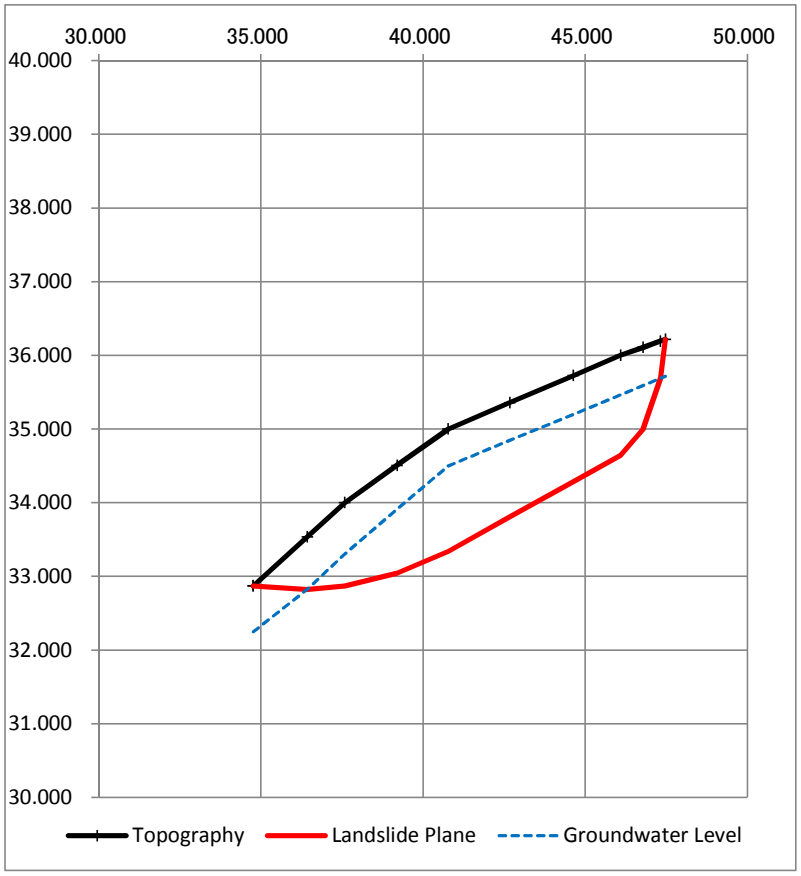
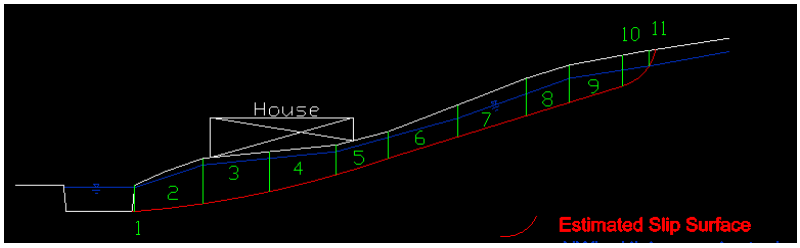




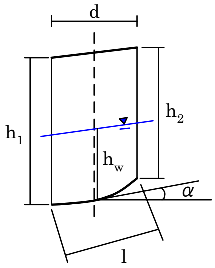
Modified Fellenius method

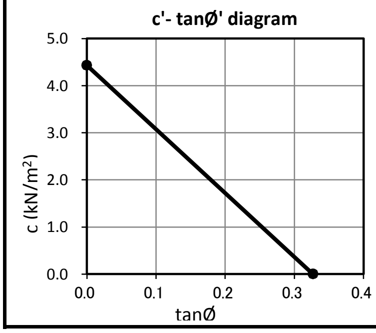
$$Fs=\frac{S}{T}=\frac{\sum\{c\cdot l+(W-U\cdot d)\cos\alpha\cdot\tan\phi\}}{\sum W\cdot\sin\alpha}=\underline{1.000}$$

F_0	c (kN/m2)	ϕ (°)	tanϕ (°)
0.980	4.435	0.000	0.0000
	0.000	18.100	0.3269

Soil Constants

No.	Strata	Geological Material	Unit Weight		Cohesion	Internal Friction Angle	
			γ_t (kN/m³)	γ_{sat} (kN/m³)	c (kN/m²)	φ (°)	tanφ (°)
1							
2							
3							
4							
5	Vallee Pitot	1	18.00		1.5	12.2100	0.2164





Slice No.	Strata	Geological Material	Height (L) h_1 (m)	Height (R) h_2 (m)	Wide d (m)	Area A (m²)	Unit Weight γ_t (kN/m³)	Weight W (kN/m)	Length l (m)	Angle α (°)	W.L. Height h_w (m)	Pore Water P U (kN/m²)	Cohesion c (kN/m²)	tanφ (°)	S	T
1	Vallee Pitot	1	0.00	0.71	1.67	0.59	18.00	10.69	1.67	-1.689	-0.31	0.00	1.50	0.216	4.812	-0.315
2	Vallee Pitot	1	0.71	1.13	1.16	1.07	18.00	19.23	1.16	2.273	0.22	2.15	1.50	0.216	5.361	0.763
3	Vallee Pitot	1	1.13	1.46	1.62	2.10	18.00	37.77	1.63	6.179	0.65	6.40	1.50	0.216	8.338	4.066
4	Vallee Pitot	1	1.46	1.66	1.57	2.45	18.00	44.16	1.60	10.702	1.01	9.94	1.50	0.216	8.466	8.200
5	Vallee Pitot	1	1.66	1.55	1.90	3.06	18.00	55.05	1.96	13.735	1.10	10.78	1.50	0.216	10.196	13.072
6	Vallee Pitot	1	1.55	1.44	1.96	2.93	18.00	52.70	2.01	13.735	0.98	9.59	1.50	0.216	10.156	12.514
7	Vallee Pitot	1	1.44	1.36	1.46	2.04	18.00	36.80	1.50	13.735	0.87	8.53	1.50	0.216	7.370	8.737
8	Vallee Pitot	1	1.36	1.11	0.69	0.85	18.00	15.29	0.77	27.237	0.71	6.96	1.50	0.216	3.182	6.999
9	Vallee Pitot	1	1.11	0.50	0.54	0.44	18.00	7.84	0.88	52.123	0.30	2.92	1.50	0.216	2.149	6.187
10	Vallee Pitot	1	0.50	0.00	0.16	0.04	18.00	0.70	0.55	73.627	-0.25	0.00	1.50	0.216	0.869	0.675
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Coordinates

No.	Slice No.	Topography		Landslide Plane	Groundwater Level
		X (m)	Y (m)	Y (m)	Y (m)
1		2.472	27.089		
2		3.623	26.859		26.859
3	1	5.878	25.359	25.359	26.859
4	2	9.272	26.859	25.428	26.859
5	3	11.796	28.000	25.500	27.366
6	4	15.943	29.000	25.655	28.199
7	5	22.569	30.000	26.000	29.530
8	6	29.888	32.000	26.520	31.000
9	7	35.918	33.000	27.060	32.000
10	8	47.951	34.000	29.176	33.209
11	9	55.830	35.000	30.561	34.000
12	10	64.711	37.000	32.122	35.938
13	11	73.468	39.081	33.667	37.905
14	12	76.777	40.000	35.148	38.675
15	13	79.225	40.494	39.245	39.245
16	14	79.352	40.520	40.520	39.245
18					
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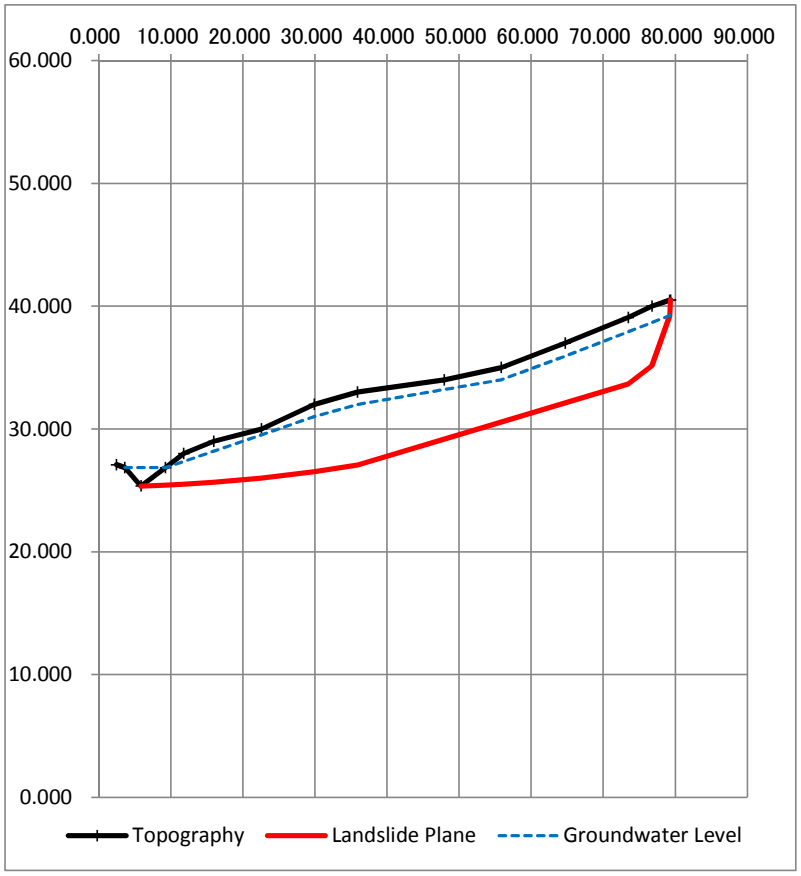
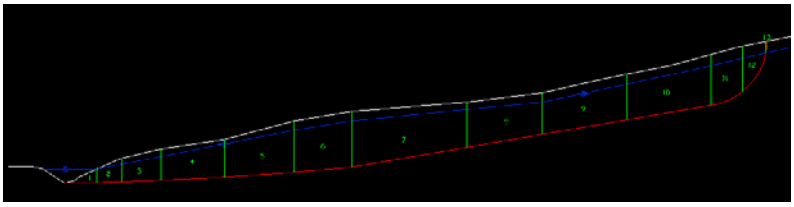
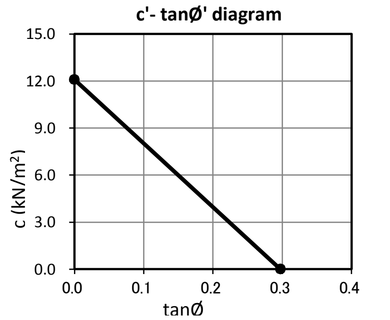


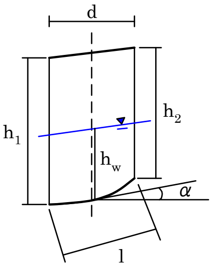


Modified Fellenius method

$$Fs=\frac{S}{T}=\frac{\sum\{c\cdot l+(W-U\cdot d)\cos\alpha\cdot\tan\phi\}}{\sum W\cdot\sin\alpha}=\underline{0.980}$$

F_0	c (kN/m2)	ϕ (°)	tanϕ (°)
0.980	12.090	0.000	0.0000
	0.000	16.550	0.2972





Soil Constants

No.	Strata	Geological Material	Unit Weight		Cohesion	Internal Friction Angle	
			γ_t (kN/m^3)	γ_{sat} (kN/m^3)	c (kN/m^2)	φ (°)	tanφ (°)
1							
2							
3							
4							
5	Vallee Pitot	2	18.00		5.0	9.8800	0.1742

Slice No.	Strata	Geological Material	Height (L) h_1 (m)	Height (R) h_2 (m)	Wide d (m)	Area A (m^2)	Unit Weight γ_t (kN/m^3)	Weight W (kN/m)	Length l (m)	Angle α (°)	W.L. Height h_w (m)	Pore Water P U (kN/m^2)	Cohesion c (kN/m^2)	tanφ (°)	S	T
1	Vallee Pitot	2	0.00	1.43	3.39	2.43	18.00	43.71	3.39	1.165	1.47	14.37	5.00	0.174	16.090	0.888
2	Vallee Pitot	2	1.43	2.50	2.52	4.96	18.00	89.30	2.53	1.634	1.65	16.17	5.00	0.174	21.068	2.546
3	Vallee Pitot	2	2.50	3.35	4.15	12.12	18.00	218.15	4.15	2.141	2.21	21.62	5.00	0.174	43.111	8.148
4	Vallee Pitot	2	3.35	4.00	6.63	24.33	18.00	438.01	6.63	2.981	3.04	29.78	5.00	0.174	75.035	22.775
5	Vallee Pitot	2	4.00	5.48	7.32	34.69	18.00	624.46	7.34	4.064	4.01	39.28	5.00	0.174	95.234	44.255
6	Vallee Pitot	2	5.48	5.94	6.03	34.43	18.00	619.76	6.05	5.117	4.71	46.19	5.00	0.174	89.467	55.280
7	Vallee Pitot	2	5.94	4.82	12.03	64.76	18.00	1165.71	12.22	9.973	4.49	44.00	5.00	0.174	170.234	201.892
8	Vallee Pitot	2	4.82	4.44	7.88	36.49	18.00	656.85	8.00	9.970	3.74	36.64	5.00	0.174	103.156	113.720
9	Vallee Pitot	2	4.44	4.88	8.88	41.37	18.00	744.70	9.02	9.969	3.63	35.57	5.00	0.174	118.636	128.918
10	Vallee Pitot	2	4.88	5.41	8.76	45.06	18.00	811.14	8.89	10.006	4.03	39.49	5.00	0.174	124.272	140.934
11	Vallee Pitot	2	5.41	4.85	3.31	16.99	18.00	305.73	3.63	24.112	3.88	38.07	5.00	0.174	46.701	124.897
12	Vallee Pitot	2	4.85	1.25	2.45	7.47	18.00	134.42	4.77	59.141	1.76	17.29	5.00	0.174	32.089	115.388
13	Vallee Pitot	2	1.25	0.00	0.13	0.08	18.00	1.43	1.28	84.312	-0.64	0.00	5.00	0.174	6.431	1.421
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															Σ	941.53	961.06

Data Sheet for Stability Analysis (Channel for Flood)

Analysis Settings

SLOPE/W Analysis

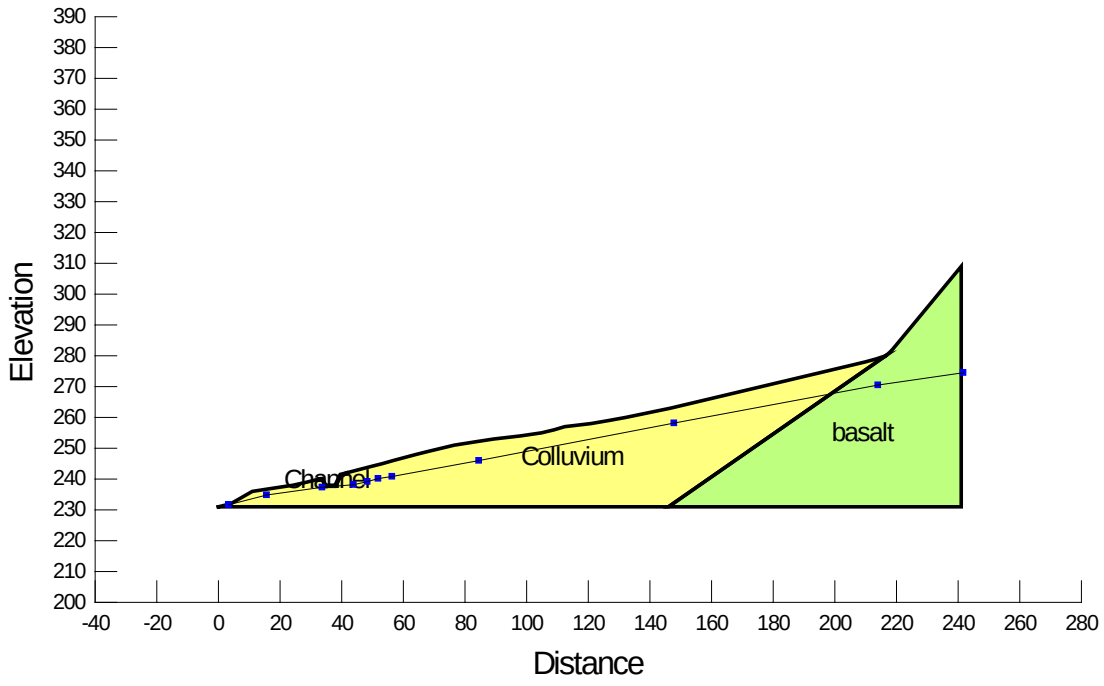
Kind: SLOPE/W
Method: Bishop, Ordinary and Janbu
Settings
Apply Phreatic Correction: No
PWP Conditions Source: Piezometric Line
Use Staged *R*apid Drawdown: No
SlipSurface
Direction of movement: Right to Left
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant

Materials

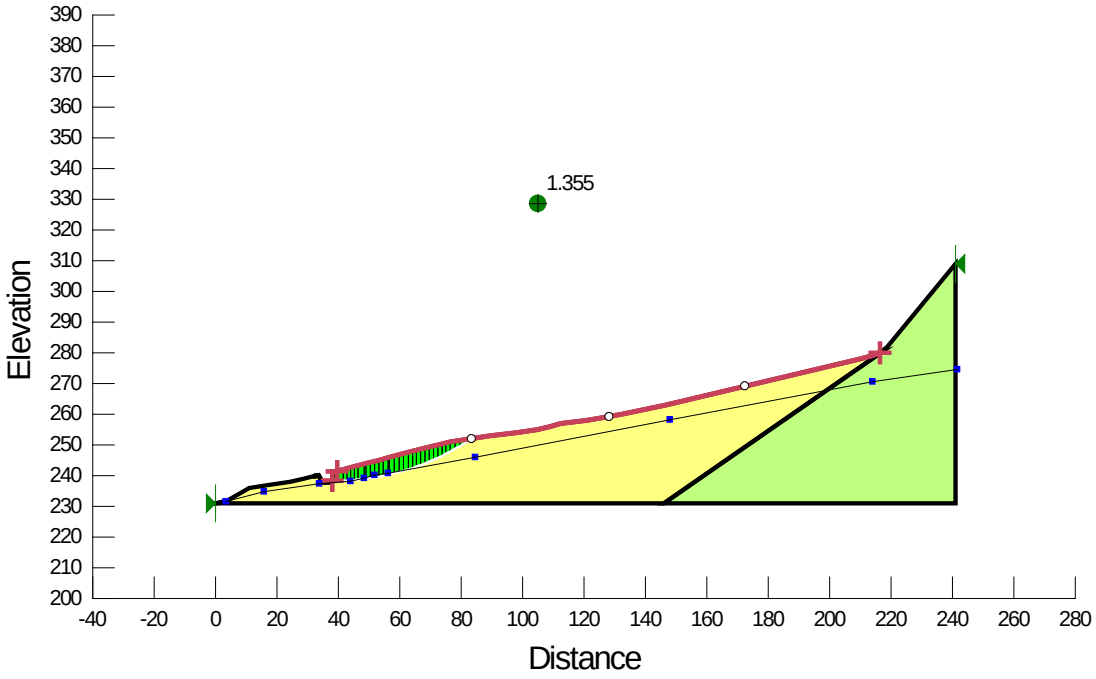
Colluvium
Model: Mohr-Coulomb
Unit Weight: 18 kN/m³
Cohesion: 10 kPa
Phi: 10 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

basalt
Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

Channel
Model: Mohr-Coulomb
Unit Weight: 23 kN/m³
Cohesion: 500 kPa
Phi: 80 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1



Model for Analysis



Result of Analysis

Critical Slip Surfaces

	Number	FOS	Center (m)	Radius (m)	Entry (m)	Exit (m)
1	12	1.355	(38.78, 317.918)	79.572	(83.485, 252.093)	(38.0535, 238.35)

Slices of Slip Surface: 12

	No.	X (m)	Y (m)	PWP (kPa)	Base Normal Stress (kPa)	Frictional Strength (kPa)	Cohesive Strength (kPa)
1	12	38.174915	238.3491	-6.0805673	9.0911937	51.558721	500
2	12	38.91315	238.3492	-5.5494718	35.571771	6.2722629	10
3	12	40.5155	238.3717	-4.6149851	62.085683	10.947381	10
4	12	42.10075	238.41825	-3.9284625	66.663835	11.754633	10
5	12	43.30025	238.47745	-3.6438773	71.050573	12.528133	10
6	12	44.5855	238.56175	-2.5099952	75.356596	13.287401	10
7	12	45.81346	238.66005	-0.7369730	79.109609	13.949159	10

8	12	47.32796	238.8132	1.136445	83.113599	14.454784	10
9	12	48.694	238.9677	2.821622	86.430352	14.742475	10
10	12	49.7785	239.11355	4.2374923	88.48339	14.854825	10
11	12	51.1595	239.31865	5.8501142	90.620762	14.947352	10
12	12	52.4825	239.538	6.5686797	92.245276	15.107096	10
13	12	53.89875	239.8003	6.3642006	93.906564	15.436081	10
14	12	55.46625	240.1201	5.8483023	95.586873	15.823331	10
15	12	56.47	240.33835	5.4150965	96.418321	16.046324	10
16	12	57.45087	240.57215	4.8924622	96.719855	16.191647	10
17	12	58.97261	240.95545	3.8804509	96.755432	16.376365	10
18	12	60.49435	241.37095	2.5530051	96.214209	16.514997	10
19	12	62.01609	241.8191	0.9049102	95.079056	16.605443	10
20	12	63.44698	242.2699	-0.9331094	93.516692	16.489516	10
21	12	64.803835	242.7261	-2.957598	91.262318	16.092009	10
22	12	66.1775	243.2157	-5.2794747	88.20084	15.552188	10
23	12	67.551165	243.734	-7.8826681	84.656896	14.927295	10
24	12	68.915665	244.2777	-10.751631	80.686739	14.227249	10
25	12	70.271	244.84705	-13.888371	76.295585	13.45297	10
26	12	71.626335	245.44625	-17.318083	71.409371	12.591399	10
27	12	73.002165	246.086	-21.108771	65.856212	11.612227	10
28	12	74.3985	246.7681	-25.277772	59.596678	10.508502	10
29	12	75.794835	247.4845	-29.78298	52.789666	9.3082424	10
30	12	77.291875	248.2933	-35.012082	43.739909	7.7125261	10
31	12	78.889625	249.2015	-41.034328	32.357628	5.7055228	10
32	12	80.487375	250.15955	-47.545899	20.216228	3.5646665	10
33	12	82.085125	251.16955	-54.569292	7.2941076	1.286148	10
34	12	83.1849	251.8902	-59.649565	-1.9805972	-0.3492327	10

16. Project Leaflet (Project of Landslide Management in the Republic of Mauritius)

Table of Contents

1. Background

1.1 What is Landslide?


Landslide

Landslide is the phenomenon in which the wide range and gentle slope moves down slowly under the influence of groundwater. Since landslides occur over a massive area, and a large amount of soil mass is moved in general, it can cause serious damages. In most case, rainfall and condition of groundwater level cause landslide occurrence.

1.2 Landslide in Mauritius

In Mauritius which is vulnerable to climate change, particularly landslide issues are becoming more serious due to recent natural disasters resulting from environmental changes and the increase of structures because of tourism and land development on steep slopes.


Landslide in Vall *Photo*

Landslide disaster in Mauritius

Year	Location	Landslide disaster in the past
1986	La Butte	1500 houses were damaged, 4 main water pipes and high voltage power lines were broken.
2005	Chitrakoot	54 houses were damaged.
	Quatre Soeurs	11 houses were affected
2006	Chitrakoot	14 houses were damaged
2008	Chitrakoot /Quatre Soeurs	Landslides re-occurred.

1.3 What Mauritius government had done to tackle the issues as countermeasure so far?

Meanwhile, various climate change adaptation programs are undertaken in Mauritius mainly by the Japanese Government (La Butte in Port Louis City was targeted), the United Nations Development Programme (UNDP) and the Indian Ocean Commission (IOC).

The Landslide Emergency Scheme was added to the "*Cyclone and Other Natural Disasters Scheme"* in 2008. The Scheme clarifies necessary actions, the role and responsibility of each organization and stakeholder in cases of five natural disasters which includes Cyclone, Torrential Rain, Landslide, Tsunami and High Waves. Also, the Landslide Management Unit (LMU) was established in Ministry of Public Infrastructure, National Development Unit. Land Transport and Shipping, and is responsible for the monitoring of landslides all over the Island.

1.4 Why the Landslide Management Project?

The Mauritius government already understands risks of landslide disaster, and implements some measures on scientific and technical grounds in consideration of environmental burden and safety management. However, it has not yet found a fundamental solution due to the lack of experts and engineers, and the lack of publicity of climate change adaption measures and disaster prevention administration to local communities. Therefore, the government of Mauritius requested technical assistance in landslide management to the government of Japan. After a series of consultation, the Landslide Management Project was launched in May 2012.


R/D Signing


Photo with Vice-prime Minister and MPI Minister

Message from Minister of Public Infrastructure

In the face of a worldwide phenomenon caused by climate change and other natural upheavals, we are witnessing more and more disturbances in our settlement. Landslides have become a major concern today and serious measures have to be applied to manage the situations.

Mauritius is not spared. As a matter of fact, quite a number of landslide problems have been inventoried and Government has tapped assistance from JICA to devise ways and means to mitigate the extent of the problem and its associated devastating consequences. JICA is presently embarked on a major project in Mauritius aimed at promoting site management and ensuring safety and security of people.

2 Outline of the Project

2.1 Overall Goal

The Project has set long-term goals as the Overall Goa l as "To mitigate landslide disasters in Mauritius".

2.2 Outcomes of the Project

The Project focuses in achieving the following three (3) specific outputs.

Expected Outputs	
Output 1	A landslide management plan is formulated to establish a landslide monitoring system.
Output 2	The Feasibility Study and pilot project are implemented to examine, carry out and learn specific approaches.
Output 3	Landslide management skills at the Repair and Rehabilitation Unit (RRU), Landslide Management Unit (LMU) and other related Institutions are improved.

2.3 Schedule

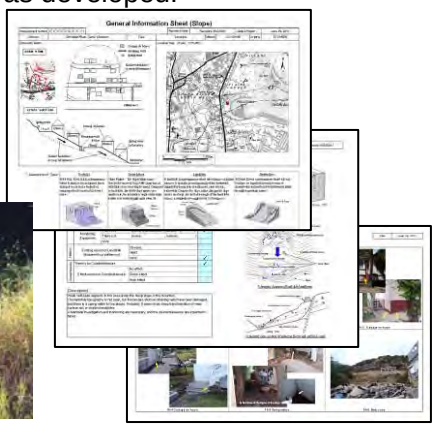
The Project duration is **from May 2012 to September 2014 for two and half years.** The schedule to implement the Project is shown in the figure below.

3 Progress of the Project (as of Sep. 2012)

3.1 Landslide inventory survey

The survey team with MPI staff conducted site observation and various surveys to understand current status and identified 37 disaster areas caused by landslide, slope failure, stream erosion, cave and others. Based on the site investigation and various surveys, a landslide inventory was developed.

Site observation



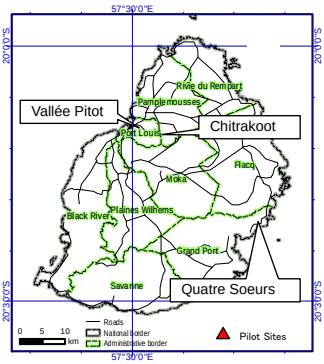
Landslide inventory

3.2 Landslide hazard areas (Priority areas)

The Project has identified

① **Chitrakoot,**
② **Quatre Soeurs** and
③ **Vallée Pitot**

as the highest priority areas according to current landslide activity, its hazard risk potential, the scale of landslide.



Map

3.3 Social survey

The survey aims to grasp residents' awareness level and views on government policy and plans related to the landslide disaster. The survey team consisting of students of University of Mauritius and University of Technologies, has conducted questionnaire survey by visiting sample households in Aug.-Sep. 2012. The landslide management plan will be made that reflects the results of survey.

3.4 Monitoring analysis of landslide

The Project is now conducting measurement at each priority area to understand the landslide mechanism and create maps of micro-landform units and cross-sections of landslides. Also, the geotechnical surveys is also scheduled after receiving approvals from landowners at designed points in order to understand the status of underground. Monitoring Plan will be finalized based on the above survey results.

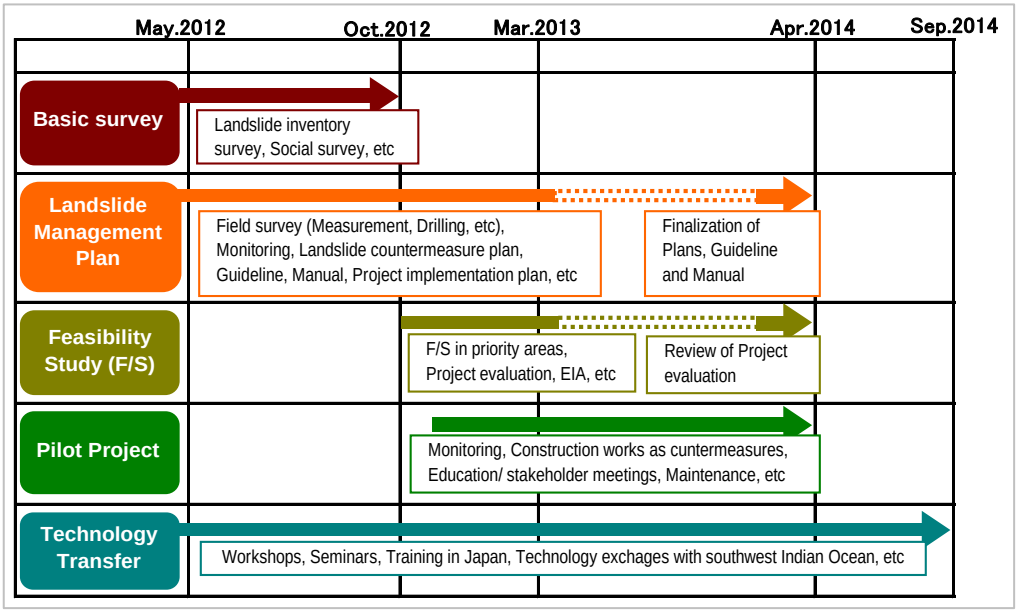
Social survey

Measurement

For residents living at priority areas

We might indirectly cause you some troubles during the field survey and monitoring works. We would like to be informed if you face any problems. Your understanding and cooperation would be really appreciated.

Implementation Schedule



For more information, please contact us.

Project Office

JICA Expert Room
Technical Division
Ministry of Public Infrastructure, National Development Unit, Land Transport & Shipping
Phoenix, Mauritius
Phone:601-1600
Fax: 686-4506

Table des matières

1. Introduction

1.1 Qu'est-ce qu'un glissement de terrain ?


Glissement de terrain

Le glissement de terrain se définit comme le détachement de masses de roches et de terres. Les glissements de terrains sont fréquemment causés par des fortes précipitations, mais aussi par des secousses. L'éboulement se définit comme l'affaissement d'éléments la plupart du temps assez grands d'un flanc de montagne, dû à des instabilités géologiques.

1.2 Le glissement de terrain à Maurice

L'île Maurice est très vulnérable aux changements climatiques et les problèmes de glissements de terrain deviennent de plus en plus graves en raison des catastrophes naturelles causées par les changements climatiques, l'augmentation des structures et de l'aménagement du territoire sur des pentes raides.


Glissement de terrain Landslide à Vallée Pitot

Les catastrophes causes par le glissement de terrain

L'annee	Lieu	le glissement de terrain
1986	La Butte	1500 maisons ont été endommagées, 4 conduites d'eau principales et des lignes à haute tension ont été brisées.
2005	Chitrakoot	54 maisons ont été endommagées
	Quatre Soeurs	11 maisons ont été touchées
2006	Chitrakoot	14 maisons ont été endommagées
2008	Chitrakoot /Quatre Soeurs	Les glissements de terrain ont refait surface.

1.3 Quel sont les mesures prise par le gouvernement de Maurice pour résoudre le problème ?

Divers programmes d'adaptation aux changements climatiques ont été entrepris à Maurice principalement par le gouvernement japonais, Par exemple (La Butte à Port Louis a été la cible principale), suivi de l'Organisation des Nations Unies pour le développement (PNUD) et la Commission de l'Océan Indien. Le système d'urgence (plan d'évacuation) de glissement de terrain a été ajouté au programme de "Cyclone et autres Catastrophes naturelles" en 2008. Le programme précise les mesures nécessaires, le rôle et les responsabilités de chaque organisation et des parties prenantes dans les cas de cinq catastrophes naturelles qui comprennent Cyclone, Pluie diluvienne, les glissements de terrain, tsunamis et les hautes montées de vagues.

En outre, l'Unité de Gestion des glissements de terrain (LMU) a été créé au sein du *Ministère des Infrastructures Publiques, National Development Unit, Land Transport et Shipping*, qui est responsable de la surveillance des glissements de terrain partout dans l'île.

1.4 Pourquoi la mise en place du projet de gestion des glissements de terrain?

Le Gouvernement de Maurice prend en considération les risques lies aux glissements de terrain, et met en œuvre des mesures sur des bases scientifiques et techniques en contrepartie de la charge environnementale et pour la gestion de sécurité de la population. Cependant, il n'a pas encore trouvé une solution fondamentale à cause du manque d'experts et d'ingénieurs, et de l'absence de publicité des mesures d'adaptation au changement climatique et à la prévention des catastrophes pour la population Mauricienne.

Par conséquent, le gouvernement de Maurice a demandé une assistance technique en matière de gestion des glissements de terrain au gouvernement du Japon. Après une série de consultations, le projet de gestion de glissement de terrain a été lancé en mai 2012.


Signature/Discussion


Une photo Prise avec le vice Premier Ministére

Message du Ministé Publique et Infrastructure

Face à un phénomène mondial causé par le changement climatique et autres catastrophes naturels, nous vivons des perturbations inquiétantes dans notre système de planification des logements. Les glissements de terrain sont devenus une préoccupation majeure aujourd'hui, et les grands moyens doivent être déployés afin de gérer ces situations.

Maurice ne fait pas l'exception à la règle. En fait, un certain nombre de problèmes de glissements de terrain a été répertorié et le gouvernement a sollicité l'assistance technique de l'Agence de Coopération Internationale du Japon (le JICA) afin de concevoir des moyens d'atténuer l'ampleur du problème et ses conséquences dévastatrices associés. JICA travaille actuellement sur un projet majeur à l'île Maurice, visant à promouvoir la gestion des sites affectés par les glissements de terrain et assurer la sécurité des habitants.

Aperçu du projet

2.1 L'objectif principal du projet

Pour atténuer les catastrophes glissements de terrain à l'île Maurice".

2.2 Résultats du projet

Le projet se concentre sur la réalisation des trois (3) rendements spécifiques au cours de la période du projet.

2.3 Plan

La durée du projet est de **mai 2012 à Septembre 2014 pour deux ans et demi.** Le calendrier de mise en œuvre du projet est illustré dans la figure ci-dessous.

Résultats attendus	
étape 1	Un plan de gestion de glissement de terrain sera conçu pour mettre en place un système de surveillance des glissements de terrain.
étape 2	Le F / S et le projet pilote seront mises en œuvre afin d'examiner, de réaliser et apprendre des approches spécifiques.
étape 3	Compétences en gestion de glissements de terrain à l'Unité de réparation et de réhabilitation (RRU), Unité de gestion des glissements de terrain (LMU) et d'autres institutions concernées seront améliorées.

2 Les progrès du projet (en septembre 2012)

3.1 Sondage des glissements de terrain

L'équipe, avec le personnel de MPI, a entrepris des visites sur les sites d'observations et diverses études pour comprendre la situation actuelle et a identifié 37 zones sinistrées causés par des glissements de terrain, la pente échec, l'érosion des cours d'eau, cave et autres. Sur la base de l'enquête sur place et enquêtes diverses, un inventaire des glissements de terrain a été développé.

Observation du lieu

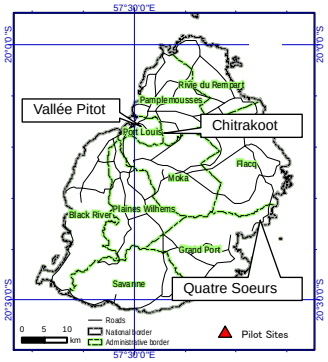
Base de données sur le glissement de terrain

3.2 Zones à risque de glissement de terrain (zones prioritaires)

Le projet a identifié

① **Chitrakoot,**
② **Quatre Soeurs** et
③ **Vallée Pitot**

comme les sites prioritaires selon des glissement de terrain actuel et du risque potentiel sur l'echelle du glissement de terrain.



Zones prioritaires

3.3 Enquête sociale

L'enquête vise à sensibiliser les habitants sur les glissement de terrain, sur la politique gouvernementale et les plans liés au catastrophe due au glissement de terrain. L'équipe des enquêteurs composé des étudiants du l'université de Maurice et l'université de Technologies ont menés une enquête par questionnaire en visitant une partie representative des foyers en aout et septembre 2012. Le plan de gestion du glissement de terrain se basera sur le résultats des enquêtes.

3.4 Analyse de surveillance des glissements de terrain

Afin de comprendre le mécanisme de glissement de terrain et de créer des cartes de micro-reliefs unités et sections de glissements de terrain, le projet procède actuellement à des mesures sur chaque site prioritaire. Afin de comprendre le statut des souterrains, des sondages géotechniques sont également prévus après avoir reçu les approbations des propriétaires fonciers aux points repères. Plan de suivi sera finalisé sur la base des résultats de l'enquête ci-dessus.

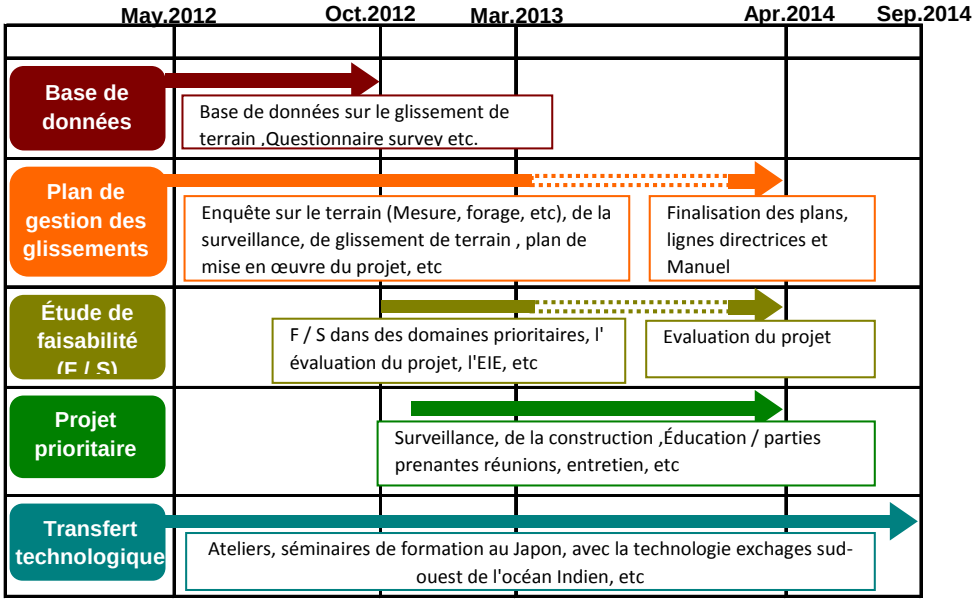
Enquéte Sociale

Mesures

Les résidents qui vivent dans des zones prioritaires

Nous pouvons indirectement causer quelques ennuis en cours de cette enquete, suivi des travaux par rapport au glissement de terrain. Nous voulons être informé si vous rencontrez des problèmes suite a cela.Votre compréhension et coopération serait vraiment apprécié.

Enquéte mise en oeuvre



Pour plus d'informations, veuillez nous contacter síl vous plait..

Project Office

JICA Expert Room
Technical Division
Ministry of Public Infrastructure,
National Development Unit,
Land Transport & Shipping
Phoenix, Mauritius
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Vol.2 April 2013

2nd Project Newsletter was issued!!

The Landslide Management Project is ongoing. We are happy to share our progress made from July 2012 in this paper. We might indirectly cause you some troubles during the field survey and monitoring works, but these works are essential to protect our lives, livelihoods and assets of communities and individuals from the impacts of landslide hazards. We look forward to your continued support and cooperation. Enjoy reading!

Progress of Project Activity (Jul. 2012 – Mar. 2013)

1. The 1st Stakeholder meeting *(Sep. 2012)*

The Project has identified Chitrakoot, Quatre Soeurs and Vallée Pitot as the highest priority areas considering current landslide activity, potential hazard risk and the scale of the landslide.

In order to understand the mechanism of landslide occurrence at these three areas and examine practical countermeasures, the Project planned to conduct various surveys and monitoring works like topographic survey, drilling works and installation of monitoring devices. These surveys and works might indirectly cause some troubles for the resident's daily life.

Therefore, the Project conducted the first Stakeholder Meetings for residents in September 2012. Staff of Ministry of Public Infrastructure, National Development Unit, Land Transport & Shipping (hereinafter referred to as "MPI"), with Japanese Experts, visited each priority site and explained residents about the background and the objective of the Project, the outline of each survey and the monitoring methods. Various constructive comments and suggestions were given by the residents. The Project was requested by the residents for informing of the progress and the outcomes of project activity on a regular basis. Residents showed their full commitments for the Project at the end.

Stakeholder meetings will be regularly organized to share the results of surveys and monitoring, and ensure community's involvement in the project activities.


1st Stakeholder meeting in Quatre Soeurs (21 Sep, 2012)


1st Stakeholder meeting in Chitrakoot (22 Sep, 2012)


House-to-house visit for residents of Vallée Pitot (6 Oct, 2012)

2. Technical Transfer Seminar *(Oct, 2012)*


Technical Transfer Seminar

The 1st technical transfer seminar was held on 10 October 2012 at Swami Vivekananda International Convention Centre (SVICC). The Seminar aimed to inform relevant stakeholders of the contents, policy and procedure of the Project and the results of the basic survey. The Seminar was initiated by Mr. V. Lutchmeeparsad, Permanent Secretary of MPI.

3. Training in Japan *(end Nov. – Dec. 2012)*

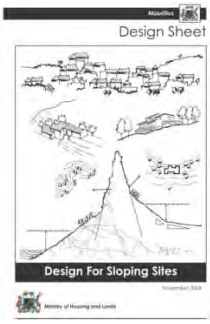
The training was conducted in Japan from 24 November to 15 December 2012 for 22 days. It aimed to understand the actual landslide occurrences and the importance and the method of landslide countermeasure works. Five MPI staff visited actual landslide sites, and learned techniques of landslide mitigations and its risk controlling in Japan.


Lecture


Field visit to landslide area

4. Review of Planning Policy Guidance (PPG) *(Jul. 2012-)*

The Planning Policy Guidance (PPG) is a scheme which has legal binding force for building/development permit. It has a few contents of development restriction in landslide risk area. In order to ensure proper landslide disaster risk management in Mauritius from a legal perspective, PPG is now under review by discussion/consideration with Local Authorities and related Ministries /Departments /Organizations.



PPG

5. Landslide Site Investigation *(Jul. 2012 - ongoing)*

In order to examine countermeasures against landslide disaster, the Project needs to understand the following matters needs;

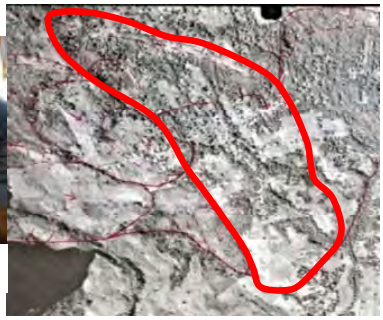
(1) Geological setting of the underground
(2) Mechanism of landslide occurrence

Therefore, the Project conducted the following surveys and works:

① Aerial photographic interpretation

The landslide areas were identified by using the aerial photographs.

Reading aerial photographs

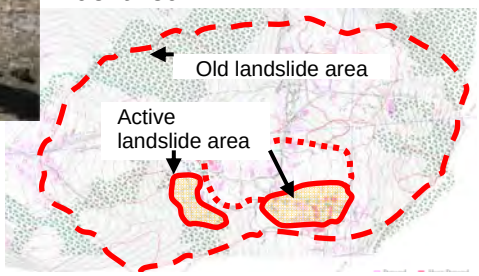


Identified rough landslide area in Chitrakoot

② Topographic Survey

Surveying

The topographical map was developed based on the results of measurements. The cross section of a detailed scale for a landslide area was also identified.



Landslide area in Chitrakoot

③ Site reconnaissance (Field Survey)

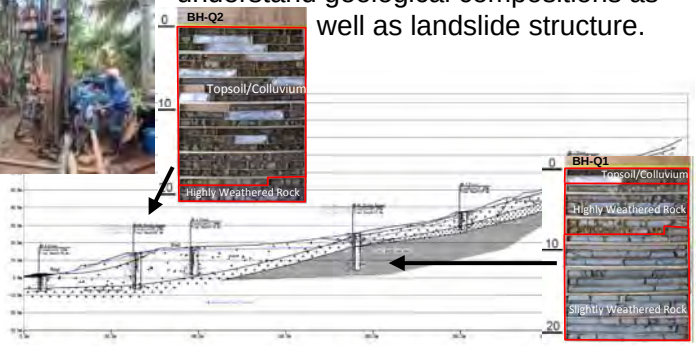
The site reconnaissance was carried out to investigate the detailed landslide condition at the areas. The actual damaged houses were also identified.

The above red line is indicating main cliff

Checking of the damaged houses at site

④ Drilling Survey

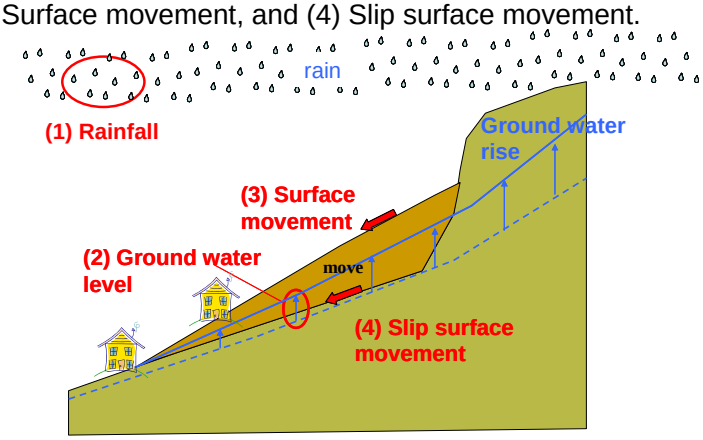
The drilling survey was carried out to understand geological compositions as well as landslide structure.



Geological Cross Section of the landslide block in Quatre Soeurs

6. Monitoring of Landslide movement *(Dec. 2012-ongoing)*

In order to know the actual movement of landslide at sites, we need to monitor four parameters at least, which are (1) Rainfall, (2) Ground water level, (3) Surface movement, and (4) Slip surface movement.



Parameters to be monitored

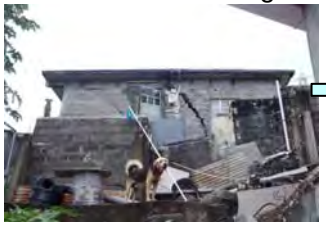
The Project installed various monitoring equipment, and has started collecting monitoring data on a regular basis. The results of monitoring will be reported to the residents living at site and other relevant organizations.

Monitoring of surface land movement (by extensometer)

Monitoring of slip surface movement (by borehole inclinometer)

7. Landslide disaster occurred in Vallée Pitot *(Feb. 2013)*

The continuous heavy rainfalls resulted in a landslide re-activity occurred at one of the priority area, Vallée Pitot in February 2013. One house was completely damaged, but fortunately all family members were safe. According to the instruction given by MPI, they already moved from their home before the incident happened. The main cause of this landslide occurrence is assumed that the amount of groundwater was increased by the supply of a large quantity of surface water flowing from the mountain. Countermeasures to control the future landslide are now being examined.



Before the disaster (22 Feb 2013)

After the disaster (26 Feb 2013)

For more information, please contact us.

Project Office/JICA Expert Room

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Le Projet de glissement de terrain a L'Ile Maurice

Vol.2 April 2013

Nous sommes heureux de partager notre progrès réalisés depuis Juillet 2012 dans ce pamphlet. On pourrait indirectement causer quelques ennuis lors de l'enquête et pendant les travaux des terrains, mais ces travaux sont essentiels pour protéger vos vies, les moyens de subsistance et les biens des communautés et des individus contre les effets des risques de glissements de terrain. Nous nous réjouissons de votre soutien et de votre coopération. Bonne lecture!

Les progrès de l'activité du projet (Juillet 2012-Mars 2013)

1. La 1ère réunion des parties prenantes *(Sept. 2012)*
Le projet a identifié Chitrakoot, Quatre Soeurs et Vallée Pitot comme les endroits prioritaires compte tenu des glissements de terrain en cours, le risque de danger potentiel et l'ampleur de glissement de terrain.
Afin de comprendre le mécanisme de glissement de terrain qui s'est produit dans ces trois endroit et d'examiner les contre-mesures pratiques, le projet prévoit de mener des enquêtes et divers travaux de surveillance comme des relevés topographiques, les travaux de forage et l'installation de dispositifs de surveillance. Ces études et les travaux pourraient causer indirectement des problèmes de la vie quotidienne des résidents.

Par conséquent, le projet a organisé des réunions avec les résidents de c'est localités en Septembre 2012. Le personnel du ministère des Infrastructures publiques, la National Développement Unit, le transport extérieur et de la marine (ci-après dénommer "MPI"), en collaboration avec des experts japonais, a visité chaque site prioritaire et a expliqué aux résidents sur l'arrière-plan, l'objectif du projet, et les méthodes de surveillance. Pendant ces précédentes réunions diverses remarques et suggestions constructives ont été faites par les résidents. Ces Réunions ont été organisées suite à la demande des résidents pour informer sur l'état d'avancement et les résultats des activités du projet sur une base régulière. Suite à cela Les résidents ont montré leurs engagements complets.
Des réunions seront organisées régulièrement afin de partager les résultats des enquêtes et de la surveillance, et d'assurer la participation des communautés dans les activités du projet.


Première réunion des parties prenantes à Quatre Soeurs a eu lieu (21 sep 2012)


Premiere Reunion à Chitrakoot (22 Sep, 2012)


Visite à domicile à Vallée Pitot (6 Oct, 2012)

2. Séminaire sur le transfert technique *(Oct, 2012)*


Séminaire

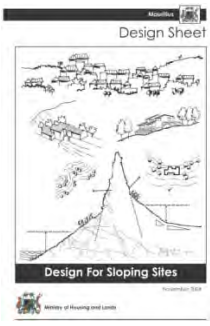
Le 1er séminaire a eu lieu le 10 Octobre 2012 à Swami Vivekananda International Convention Centre (SVICC). Le séminaire visait à informer les parties prenantes du contenu, de la politique et de la procédure du projet et les résultats de l'enquête de base. Le séminaire a été par M. V. Lutchmeeparsad, Secrétaire permanent du MPI.

3. **Formation au Japon** *(fin novembre-décembre 2012)*
La formation a été menée au Japon le 24 Novembre au 15 Décembre 2012 pour 22 jours. Il vise à comprendre les causes de glissements de terrain réelles et l'importance et la méthode des travaux pour empêcher le glissement de terrain de contre œuvrent. Cinq membres du personnel MPI ont visité des sites de glissements de terrains réels, et une formation sur les techniques de mesures d'atténuation des glissements de terrain et son contrôle des risques au Japon.


Lecture


Visite des lieux susceptibles d'être une zone de glissement de terrain.

4. **Examen du document d'orientation de la planification (PPG)** *(juillet 2012 -)*



PPG

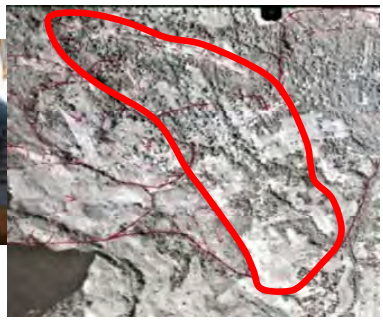
PPG Le document d'orientation de la planification (PPG) est un régime juridique qui a force obligatoire pour la construction / développement permis. Il a peu de contenu de restriction développement dans endroit à risques de glissement de terrain. Afin d'assurer une bonne gestion des risques de glissement de terrain en cas de catastrophe à l'île Maurice à partir d'un point de vue juridique, PPG est en cours d'examen par la discussion / étude avec les autorités locales et les ministères concernes / Services / Organisations.

5. Enquête sur l'emplacement des glissements de terrain *(juillet 2012 - en cours)*
Afin d'examiner les contre-mesures contre les catastrophes glissement de terrain, Nous avons besoin de comprendre ;
(1) Le cadre géologique du sous-sol
(2) Mécanisme de survenue de glissements de terrain.
Par conséquent, le projet à mener des enquêtes et les travaux suivant;

①Photo-interprétation aérienne

Les zones de glissements de terrain ont été identifiées à l'aide des photographies aériennes

La lecture des photographies aériennes

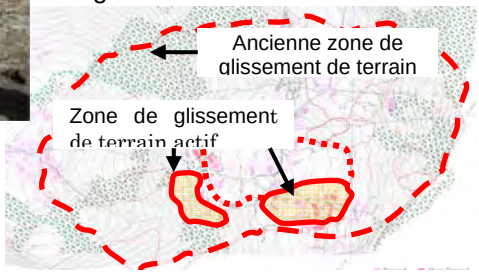


Identification de zone de glissement de terrain à chitrakoot.

② Des relevés topographiques

Investigation

La carte topographique a été développée sur la base des données des mesures. La coupe transversale d'une échelle détaillée d'une zone de glissement de terrain a également été identifiée.



Landslide area in Chitrakoot

③ Site de reconnaissance (sur le terrain)

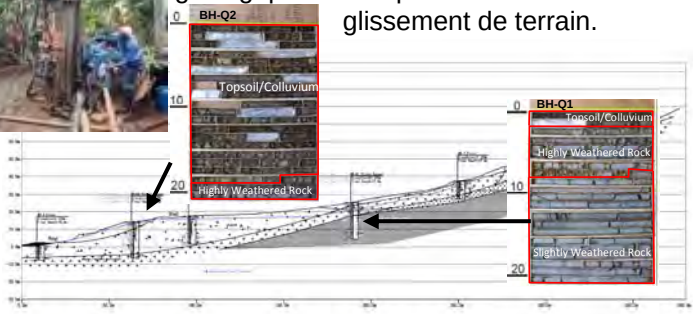
La reconnaissance du site a été réalisée pour étudier l'état de glissement de terrains détaillés sur les domaines. Les maisons endommagées réelles ont également été identifiés.

La ligne rouge au-dessus indique une falaise principale

Vérification des maisons endommagées sur les lieu

④ Enquête de forage

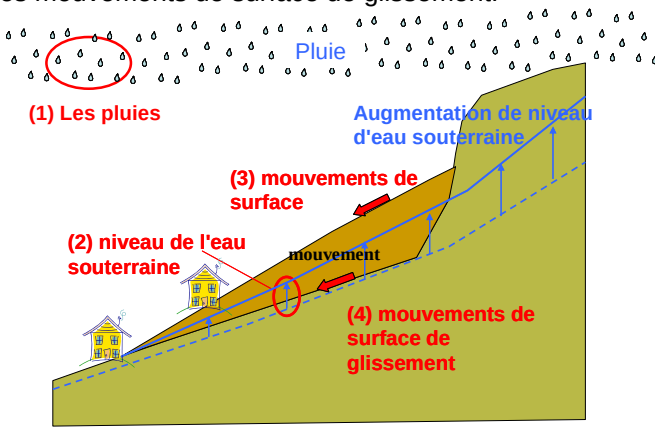
L'enquête forages ont été réalisés pour comprendre les compositions géologiques ainsi qu'au structure de glissement de terrain.



Coupe Géologique transversale du bloc de glissement de terrain à Quatre Soeurs

6. La surveillance du mouvement des glissements de terrain *(décembre 2012 - en cours)*

Afin de connaître le mouvement réel de glissement de terrain sur les sites, nous avons besoin de surveiller quatre paramètres au moins, qui sont (1) Les pluies, (2) le niveau de l'eau souterraine, (3) les mouvements de surface, et (4) des mouvements de surface de glissement.



les paramètres à surveiller

Le projet d'installation de différents Equipment de surveillance, et la recuperation des données de surveillance sur une base régulière. Les résultats du suivi seront communiqués aux résidents sur le site et d'autres organisations compétentes.

Suivi des mouvements de terrain de surface (par extensomètre)

Suivi des mouvements à la surface de glissement (par inclinomètre de forage)

7. Catastrophe du au glissement de terrain qui s'est produit à la Vallée Pitot en *(février 2013)*

Les pluies continues résultent en un glissement de terrain réactivité a eu lieu à l'un des domaines prioritaires, Vallée Pitot en Février 2013, Une maison a été complètement endommagée, et la famille a été forcée de quitter leur maison après l'incident. La principale cause de cet événement est due au glissement de terrain suite à une augmentation d'eau souterraine par rapport à une grande quantité d'eau de surface qui provient de la montagne. Les contre-mesures pour contrôler le glissement de terrain futur sont actuellement à l'étude.

Avant la catastrophe (22 février 2013)

Après la catastrophe (26 février 2013)

Pour plus d'informations, Veuillez nous contacte.

JICA Expert Office

Division Technique, Ministère des Infrastructures publiques, la National Development Unit Transport Extérieur, et marine
Phoenix, Maurice
Téléphone : 601-1600, Fax: 686-4506

Vol.3 November 2013

3rd Project Newsletter was issued!!

The second year of the Landslide Management Project has started. In this 3rd Project newsletter, we would like to share our achievements and progress until October 2013. We also would like to convey our appreciation to all stakeholders, for making the Project proceed. The project is about to get to the important part such as implementation of the pilot project. We would appreciate your continued support and cooperation.
In the meantime, happy reading!

Progress of Project Activity (Apr. 2013 – Oct. 2013)

1. Selection of priority site for the pilot project

After investigating of thirty-seven (37) landslide-prone sites in Mauritius, the Project has identified three landslide hazard areas; ①Chitrakoot, ②Quatre Soeurs and ③Vallée Pitot. The Project has carried out field surveys, and collected monitoring data from these areas since August 2012.

1-1. Selection of pilot project site

The Project has considered necessary countermeasures to be implemented at three priority areas. Various aspects like the risk assessments, the monitoring results, the size of landslide, the disaster scale, the countermeasure workload were taken into consideration in the planning process (as shown in the table below). Each aspect was examined and given a degree of the priority (high, middle, low), and the site with the highest total degree was selected as the priority site for the pilot project.

Chitrakoot: this is one of the largest and most active landslides in Mauritius. It also scored higher than the other sites in regard to degree of risk, disaster scale, and landslide size. With the strong request from the Mauritian government and its inhabitants, Chitrakoot received the highest overall score.

Vallée Pitot: MPI is going to start a detailed landslide investigation and monitoring in the area after November 2013, with the technical assistance of the Project.

Priority areas	Chitrakoot	Vallée Pitot	Quatre Soeurs
Monitoring results gained by the Project (in 2013)	Some landslide blocks are active	Still intensely active	No apparent landslide activity after the year 2008.
Degree of risk	**High**	**High**	**Middle**
Size of landslide	**Large**	**Small**	**Middle**
Disaster Scale	**High**	**Middle**	**Middle**
Countermeasures to be implemented by the project and MPI			
Construction work	○ (by Project fund)	○ (by MPI budget)	△ (depends on the progress of relocation)
Early warning and evacuation system	Early warning and evacuation system to be established by the Project		Relocation of inhabitants by MPI made progress

Quatre Soeurs: there was no apparent landslide activity since the year 2008. MPI has already made some progress on the relocation of inhabitants. Therefore, the Project will not implement countermeasures in the area.

1-2. Feasibility study (F/S) *(May – Jul. 2013)*

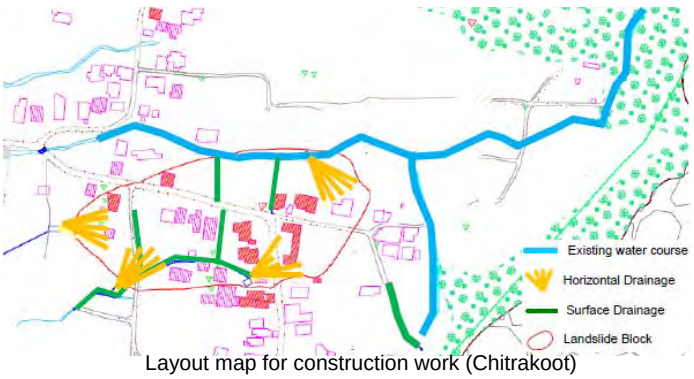
The project carried out a feasibility study (F/S) for Chitrakoot, the area chosen as the priority site. The pilot project on landslide countermeasures was evaluated before/during/after the implementation from technical, economic and social perspectives. The results of the F/S concluded that Chitrakoot area was evaluated to be the most suitable as the pilot project site.

2. Proposed countermeasures

2-1. Construction work (Chitrakoot)

Landslide occurs after continuous heavy rains as the large amount of water is accumulated on the surface and under the ground. Therefore, as countermeasures, it needs to reduce the amount of surface water and groundwater by artificial drainage system. The following construction works will be undertaken in Chitrakoot. The detailed design is under preparation by the Project.

Construction work	Expected function
(1) Horizontal drainage	- To stop groundwater level rise artificially
(2) Ditch	- To reduce the amount of groundwater and surface stream water - To connect the water collected by horizontal drainages to the existing water channels
(3) Channel for flood	- To drain surface water which is flowed from the mountain side



Layout map for construction work (Chitrakoot)

Horizontal drainage *(image)*

Channel for flood *(image)*

2-2. Early warning and evacuation system

In order to take necessary actions, it is important to predict when and which landslides have reached a

dangerous level. The Project has proposed the following three main methods of predicting the risk of landslides.

① To install and monitor the landslide monitoring devices such as extensometers
② To monitor the accumulated rainfall
③ To observe cracks, deformations or other abnormal phenomena on the ground surface or structures

MPI is responsible for the monitoring of landslides all over the Islands, however, it is not always possible for MPI to visit the site to check the site condition and monitoring data during heavy rains due to the difficulties of access to the site such as water-covered and/or closure of the road. Therefore, the Project has proposed to establish an early warning and evacuation system, which make inhabitants know when it reach to the alert level using the following system;

① Alert system (which is connected to the installed extensometer)
② Simple rain gauge system (will be installed at one of the houses in the are)

The above system will be useful for inhabitants to know when landslides reach to the alert level on site, and contact relevant organizations such as police to take necessary actions.


Simple rain gauge system


Alarm system

2-3. Disaster drill *(Vallée Pitot, Jun. 2013)*

At end of February 2013, landslide occurred after continuous heavy rains, and some residents in Vallée Pitot were forced to evacuate as their houses were heavily damaged. The fatal disaster triggered public concern over how to prevent such disasters, and worries about the future of the inhabitants living in the disaster-prone areas. Therefore, Police Department with relevant stakeholders conducted a disaster drill on 30th June in Vallée Pitot. Inhabitants living in Vallée Pitot participated in the exercise to practice responses to the landslide disaster.


Confirmation of the safety of residents

3. 3rd Stakeholder meeting *(Apr. 2013)*

The Project conducted the second stakeholder meeting for residents at priority areas in April 2013 to shared and discuss on the following matters;

① Result of landslide site investigation
② Results of monitoring
③ Basic policy for countermeasures (construction works, early warning and evacuation system)

The comments given by inhabitants and stakeholders were taken into consideration in the planning of detailed designs of countermeasures.


Demonstration of simple rain gage (Quatre Soeurs, 12 Apr. 2013)


Relevant organization (Min.of Housing, SMF, Local Police, Council Officer) also attended


Inhabitants checking the location of landslide (Chitrakoot, 13 Apr. 2013)


Discussion with inhabitants (Vallee Pitot, 14 Apr. 2013)

4. Capacity development of Landslide Management Unit (LMU)

The Project has examined the role and responsibility of LMU for landslide management. The LMU's staff of technical capacity as well as organizational capabilities has been also enhanced through the technical transfer made by the Project. For the purpose of capacity development, the 2nd training in Japan for five MPI staff was conducted in August 2013 for two weeks. Through the training, the trainees learned about a wide range of countermeasures, government organizations and systems, etc, which are useful for application in Mauritius. They also gained strong motivation to improve the disaster management system in Mauritius.


Learning of latest landslide research in Japan

5. Work schedule

The implementation of Pilot Project for Chitrakoot is scheduled as shown below.

	2013		2014	
	Nov	Jan	Apr.	Dec
Construction work	Finalization of detailed design /cost estimation	rainy seasons Tender, etc	Implementation of pilot project	
Early warning and evacuation sytem	Installation	Trial operation	Operation	

Stakeholder meeting

For more information, please contact us.

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Vol.3 Nov 2013

La Deuxième année du Projet de gestion du glissement de terrain a commencé, suite à cela nous sommes heureux de partager notre Progrès réalisés depuis Octobre 2013 dans la publication de ce troisième pamphlet.

Nous tenons également à exprimer notre reconnaissance à toutes les parties prenantes, pour nous avoir offert leur aide à mettre ce projet sur pieds. Nous sommes arrivés à la partie la plus importante qui est la mise en œuvre de ce projet. Nous nous réjouissions D'avance de votre soutien et de votre coopération. Bonne lecture!

Les progrès de l'activité du projet *(Apr. 2013 – Oct. 2013)*

1. Sélection de sites prioritaires pour le projet pilote

Le projet a identifié Chitrakoot, Quatre Soeurs et Vallée Pitot comme les endroits prioritaires compte tenu des glissements de terrain en cours. Le projet a mené plusieurs enquête et à recueilli des données depuis Août 2012.

1-1. Choix du site du projet pilote

Le projet a examiné les contre-mesures nécessaires à mettre en œuvre dans les trois domaines prioritaires. Différents aspects tels que les évaluations des risques, les résultats de surveillance, la taille de glissement de terrain, l'ampleur des catastrophes, les contre-mesures pratiques ont été prises en considération dans le processus de planification (comme indiqué dans le tableau ci-dessous). Chaque aspect a été examiné et a été différentié en terme de (haute, moyenne ou faible), et l'endroit avec le degré la plus élevé a été choisi comme site prioritaire pour le projet pilote.

Chitrakoot: c'est l'une des endroits où le glissement de terrain est considéré comme le plus grand et le plus actif à l'île Maurice. Il a également été considéré comme le plus élevé parmi les autres endroits en ce qui concerne le degré de risque, l'ampleur des catastrophes, et la taille des glissements de terrain en relation avec cela, nous avons reçu une demande du gouvernement de l'île Maurice et des résidents de prendre des mesures necessaire dans cette région car il a été détecté comme un endroit à risque. Chitrakoot a reçu la note globale la plus élevée en termes de glissement de terrain.

Vallée Pitot: Le personnel du ministère des Infrastructures publiques, la National Développement Unit, le transport extérieur et de la marine (ci-après dénommer "MPI"), en collaboration avec des experts japonais vont commencer une enquête détaillée de glissements de terrain et vont recueillir des données après Novembre 2013.

Quatre Soeurs: Depuis l'année 2008 aucune activité de glissements de terrain apparente a été examiné la MPI a déjà fait quelques progrès sur la relocalisation des habitants a Quatre Sœurs Par conséquent, il n'y aura pas de contre-mesures prise dans cette région.

Les endroits prioritaires	**Chitrakoot**	**Vallée Pitot**	**Quatre Soeurs**
Les résultats des donnés en 2013	Certains blocs de glissements de terrain sont actifs	Active	Aucune activité de glissements de terrain apparent depuis l'an 2008.
Degrée de risque	**Haute**	**Haute**	**Moyen**
Size of landslide	**Grande**	**Moyen**	**Moyen**
Disaster Scale	**Haute**	**Moyen**	**Moyen**
Countermeasures to be implemented by the project and MPI			
Travaux de construction	○ (par le fonds de projet)	○ (Par rapport au fonds du ministere des infrastructure)	Δ (mise sur place du relocalisation)
Système d'alerte et d'évacuation	Système d'alerte et d'évacuation a été etablie à l'ile Maurice.		Mise sur place du relocalisation en cours

1-2 Etude d'opérabilité *(May – Jul. 2013)*

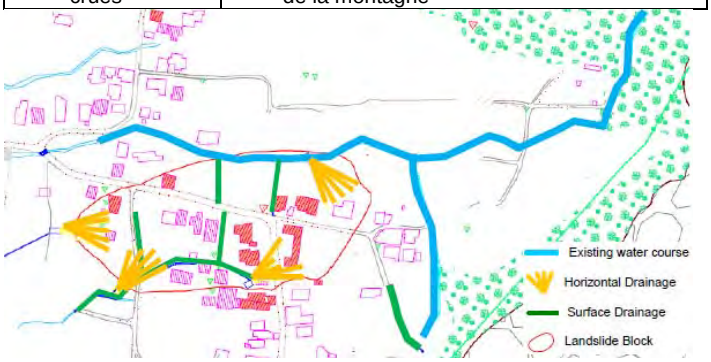
Chitrakoot, a été choisi comme site de priorité. Le projet pilote relatif aux mesures de glissements de terrain a été évalué avant / pendant / après la mise en œuvre du point de vue technique, économique et social.

2. Suggestion de certains contre

2-1. mesures des travaux de construction (Chitrakoot)

Le Glissement de terrain survient après de fortes pluies continues qui donnent suite à une grande quantité d'eau accumulée sur la surface et sous la terre. Par conséquent, des contre-mesures comme le système de drainage artificiel est nécessaire pour réduire la quantité des eaux de surface et des eaux souterraines. Les travaux de construction suivants seront entrepris dans Chitrakoot. La conception détaillée est en cours d'examen par le projet.

Travaux de construction	Fonction prévue
(1) drainages horizontaux	- Pour arrêter la montée du niveau des eaux souterraines artificiellement
(2) Fossé	- Pour réduire la quantité des eaux souterraines et d'eau de surface - Pour raccorder l'eau recueillie par les drainages horizontaux pour les voies d'eau existantes
(3) Channel en crues	- pour drainer l'eau de surface qui provient de la montagne



Map de Travaux de construction (Chitrakoot)

Drainages horizontaux *(image)*

Channel en crues *(image)*

2-2 Système d'alerte et d'évacuation

Afin de prendre les mesures nécessaires, il est important de prévoir quand les glissements de terrain ont atteint un niveau dangereux. Le projet a proposé trois méthodes de prédiction

du risque de glissements de terrain.
Pour les dispositifs de surveillance des glissements de terrain;

① Un Equipment tels que l'extensomètre
② Pour contrôler les précipitations cumulées
③ Afin d'observer des fissures, déformations ou d'autres phénomènes anormaux à la surface ou structures sol

MPI est responsable de la surveillance des glissements de terrain partout dans l'île, cependant, il n'est pas toujours possible pour eux de visiter le site pour vérifier l'état du site et des données de surveillance lors de fortes pluies en raison des difficultés d'accès au site, telles que en cas d'inondation et / ou de fermeture de la route. Par conséquent, le projet a proposé d'établir un système d'alerte et d'évacuation, qui font que habitants seront prévenu quand il atteint le niveau d'alerte en utilisant le système suivant;

① Système d'alerte (qui est relié l'extensomètre installé)
② Système de pluviomètre simple (sera installé dans l'une des maisons.)

Le système ci-dessus sera utile enfin que les habitants sont prévenu en cas de glissements de terrain, les démarchent à suivre est de contacter les organisations compétentes telles que la police enfin qu'ils puissent prendre les mesures nécessaires.


Système de pluviomètre


Système d'alerte

2-3. *(Vallée Pitot, Jun. 2013)*
Les pluies continues résultent en un glissement de terrain réactivité a eu lieu à l'un des domaines prioritaires, Vallée Pitot en Février 2013, Une maison a été complètement endommagée, et la famille a été forcée de quitter leur maison après l'incident. La principale cause de cet événement est due au glissement de terrain suite à une augmentation d'eau souterraine par rapport à une grande quantité d'eau de surface qui provient de la montagne Les contre-mesures pour contrôler le glissement de terrain futur sont actuellement à l'étude.
Cette catastrophe fatale a déclenché l'inquiétude du public sur la façon de prévenir de telles catastrophes, et les inquiétudes quant à l'avenir des habitants vivant dans cette endroit a risqué .Par conséquent, la force de police avec d'autre organisations concernés ont mené un exercice d'évacuation de sauvetage en cas de catastrophe de glissement de terrain le 30 Juin à Vallée Pitot. Les habitants de cette endroit ont été nombreux a participé à l'exercice '


Verification de securité des habitants.

3. 3eme réunions avec les résidents de c'est localités *(Apr. 2013)*
Le Projet a mené la deuxième réunion des parties prenantes pour les résidents dans les zones prioritaires en Avril 2013 ou ils ont partagés et discuter sur les questions suivantes;

① Résultat des surveillances et l'investigations de l'endroit à risque.
② Les bases prioritaires pour les contre-mesures (travaux de construction, d'alerte et d'évacuation)

Les commentaires soumis par les habitants et les parties prenantes ont été prises en considération dans la planification des plans détaillés des contre-mesures.


Démonstration de Système de pluviomètre (Quatre Soeurs, 12 avril 2013)


La présence Organisation concernée (Min.of logement, SMF, la police locale, agent du Conseil.

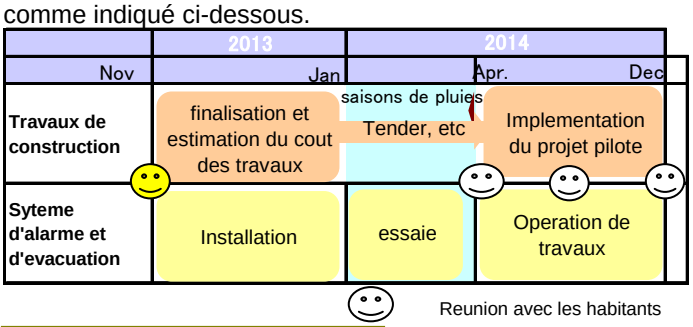

Observation par les habitants.


Discussion (Vallee Pitot, 14 Apr. 2013)

4. Le développement des capacités de glissement de terrain Unité de gestion (LMU)
Le projet est porté sur le rôle et la responsabilité du LMU pour la gestion des glissements de terrain. Le personnel du LMU de la capacité technique ainsi que des capacités de l'organisation a été également renforcé par le transfert technique fait par le projet. Une deuxième formation au Japon pour cinq personnes formant parti du MPI a été réalisée en Août 2013 pour deux semaines. Grâce à la formation, les stagiaires en ont appris d'avantage sur le glissement de terrain, qui s'avère utiles et peut être aussi applique à l'île Maurice. Ils ont également acquis une forte motivation pour améliorer le système de gestion des catastrophes à l'île Maurice.


Les personnels du MPI au Japon

5.Plan de travail
La mise en œuvre d'un projet pilote pour Chitrakoot est prévu comme indiqué ci-dessous.



Pour Plus d'information, Veuillez nous contacter

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Project of Landslide Management in the Republic of Mauritius

Vol.4 July 2014

Our 4th Newsletter!!

Bonjour! We are glad to issue our 4th project newsletter. Realizing a society where citizens can live safely in peace is a wish for all the citizens and an important responsibility of the government. In order to mitigate landslide disaster, we will finally start implementation of countermeasure work in the pilot project site, Chitrakoot. In order to take necessary actions when you face the risk of landslide disaster, the Project has also proposed to establish the early warning and evacuation system. In order to make the system more effective, your understanding and cooperation are crucial. Let's work together!

Progress of Project Activity (Nov. 2013 – Jul. 2014)

1. 3rd Stakeholder meeting *(Nov. 2013)*

The Project conducted the third stakeholder meeting at three (3) priority areas, Chitrakoot, Vallée Pitot and Quatre Soeurs in Nov. 2013.

(1) Chitrakoot

: Chitrakoot has been chosen as the pilot project site for landslide countermeasures. In Chitrakoot, two meetings were organized for the relevant Ministries/ Departments and inhabitants separately.

For the meeting for the relevant Ministries/Departments, 13 organizations including Ministry of Agriculture, Ministry of Housing and Land, Water Resources Unit of Ministry of Energy and Public Utilities, National Parks and Conservation Service, Central Water Authority, SMF/Local Police, Ministry of Environment and Sustainable Development. In the meeting, the role and responsibility of each organization for implementation of countermeasure were defined, and the Project requested for their cooperation.

During the meeting with inhabitants, evacuation center was determined in the surrounding areas. Also, some contact persons who will check the alert system and simple rain gauge, and call to the Police when it reaches to the warning level, were selected and appointed among inhabitants.

After the meeting, the site tour was organized to enable even inhabitants who cannot read a map to confirm the actual site where the countermeasure works would be implemented.

(2) Quatre Soeurs and Vallée Pitot

In the above two areas, although the Project will not implement countermeasure works, the early warning and evacuation system has been established. In the meeting, the outline of the system was explained using illustrated leaflet. In preparation for the time of evacuation, the evacuee list for each area was developed in cooperation with Local Police.

Evacuee list was made with Local Police (Quatre Soeurs)

Explanation and demonstration by MPI CP (Quatre Soeurs)

Demonstration of simple rain gauge (Vallée Pitot)

Explanation on site (Vallée Pitot)

Meeting with relevant organizations (Chitrakoot)

Meeting with inhabitants (Chitrakoot)

Demonstration of simple rain gauge (Chitrakoot)

Site tour with inhabitants (Chitrakoot)

2. Trial early warning and evacuation system has been installed *(Jan. 2014)*

In three priority areas, Chitrakoot, Vallée Pitot, Quatre Soeurs, the alert system and the simple rain gauges were installed as supplement devices to enable inhabitants to know the timing of warning and evacuation stages on site. This trial system had become effective since Jan. 2014, and will be reviewed and evaluated its effectiveness through the interview survey, which will be conducted in Jul. 2014. The early warning and evacuation system will be finalized by Dec. 2014.

Alert system

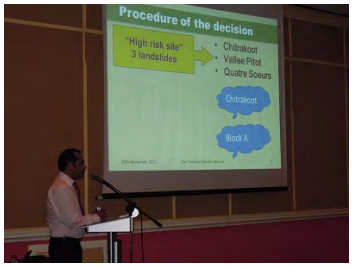
Alert system

Simple rain gauge

3. 2nd Technical Transfer Seminar *(Nov. 2013)*

The 2nd Technical Transfer Seminar was held on 20 November 2013 at Sugar Beach Hotel in Flic en Flac, organized by Ministry of Public Infrastructure (MPI), National Development Unit, Land Transport and Shipping (Civil Engineering Division) and JICA Expert Team. The seminar was officially opened by Mr Lutchmeeparsad Vidianand, Permanent Secretary of MPI. Then, JICA Expert Team and MPI staff made presentations on the progress of the project, recommendations for existing legislations related to landslide and landslide management methods. Lessons Learned from Case Studies in Japan, like Tohoku Earthquake [Earthquake & Tsunami] (occurred in Mar. 2011) and Izu-Ooshima [Landslide] (occurred in Oct. 2013), were also shared with participants.

2nd Technical Transfer Seminar



Presentation by MPI staff

4. Landslide countermeasure works will start very soon in Chitrakoot! *(Jul. 2014)*

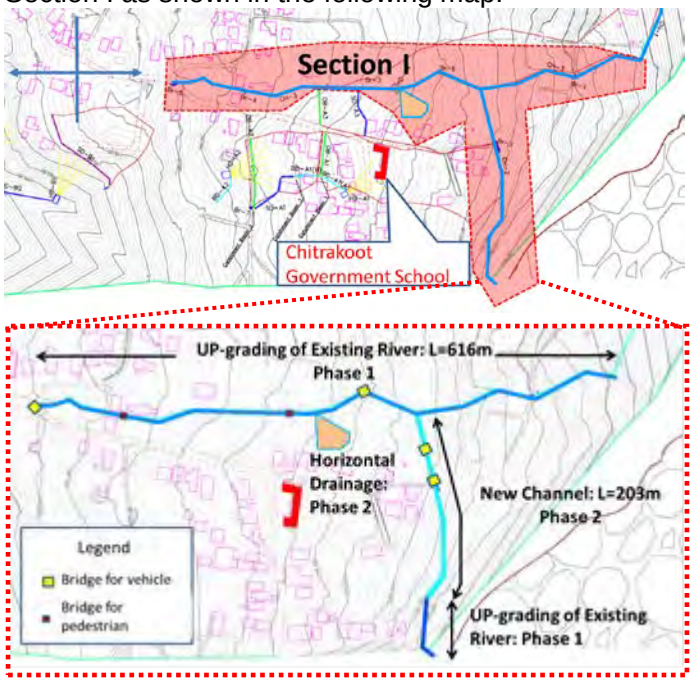
4-1. Outline of the countermeasure works

According to the result of investigations and monitoring conducted by the Project, it proved that landslide occurs after continuous heavy rains as the large amount of water is accumulated on the surface and under the ground during rainy season.

In order to avoid landslide occurrence, it needs to drain these waters by installation of drainage system that will contribute to the creation of the similar condition of dry season even during rainy season.

4-2. Location of construction work

The Project will implement construction works for Section I as shown in the following map.



4-3. Work Schedule

Section I is divided into two Phases, a Phase 1 where is government land, and a Phase 2 where land acquisition procedure is required as the area is privately-owned lands. The Project will implement the work for Phase 1 first, and the work for Phase 2 accordingly after the completion of land acquisition process.

4-4. 4th Stakeholder meeting *(Jul. 2014)*

The Project conducted the 4th stakeholder meeting in Chitrakoot in Jul. 2014 before the start of landslide countermeasure works. Two meetings were organized for the relevant Ministries/ Departments and inhabitants separately.

Municipality of Port Louis, SMF, Local Police, Ministry of Housing and Lands, Forestry Department and Service, Ministry of Environment and Sustainable Development, NDU of MPI and NDRRMC attended for the meeting for the relevant Ministries/Departments. Almost 25 inhabitants also attended for the meeting for inhabitants.

The outline of the landslide countermeasures and the above work schedule were confirmed during the meeting.

Meeting with relevant organizations (Chitrakoot)

Meeting with inhabitants (Chitrakoot)

The construction work will be started on Friday 18 July 2014, and will continue till end of Dec. 2014.

For inhabitants living in Chitrakoot

We might indirectly cause you some troubles during the construction works. We would like to be informed if you face any problems. Your understanding and cooperation would be really appreciated.

For more information, please contact us.

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Vol.4 Juillet 2014

Voici notre 4ème brochure!!

Bonjour! Nous sommes heureux de publier notre 4ème brochure. Visualisé une société où les citoyens peuvent vivre en sécurité dans la paix est un souhait pour tous les citoyens et un devoir importante du gouvernement. Afin d'atténuer le glissement de terrain, nous allons enfin commencer la mise en œuvre du travail de contre-mesure sur le site du projet pilote, Chitrakoot. Afin de prendre les mesures nécessaires lorsque vous faites face au risque de glissement de terrain, le projet a également proposé de mettre en place le système d'alerte et d'évacuation. Afin de rendre le système plus efficace, votre compréhension et la coopération sont essentielles.

Les progrès de l'activité du projet

(novembre 2013-juillet 2014)

1. Réunion 3 ème intervenants *(Nov. 2013)*

Le projet a mené trois réunions des parties prenantes dans les (3) domaines prioritaires, Chitrakoot, Vallée Pitot et Quatre Soeurs en novembre 2013.

(1) Chitrakoot

: Chitrakoot a été choisi comme site du projet pilote de lutte contre les glissements de terrain. A Chitrakoot, deux réunions ont été organisées pour les ministères / départements et des habitants concernés séparément.

Pour la réunion concernant les ministères / départements appliqués, 13 organisations, y compris le Ministère de l'Agriculture, Ministère du logement et de la terre, les ressources en eau de l'unité ministère de l'Énergie et des Services publics, les parcs nationaux et Service de la conservation, la Central Water Autorité, SMF / police locale, ministère de l'Environnement et du développement durable. Lors de la réunion, le rôle et la responsabilité de chaque organisation pour la mise en œuvre de contre-mesures ont été définies, et les experts ont demandé leur entière coopération.

Lors de la réunion avec les habitants, certains centre d'évacuation ont été choisis dans les lieux voisinage, et aussi une personne a été designer pour vérifier le système d'alerte et le pluviomètre installes chez trois habitants, et d'il est nécessaire d' appeler la police quand il atteint le niveau d'alerte.

Après la réunion, la visite du site a été organisée pour permettre aux habitants qui ne savent pas lire une carte pour confirmer le site où les travaux de contre-mesures seraient mises en œuvre.

(2) Quatre Soeurs et Vallée Pitot

Dans les deux endroits ci-dessus, bien que le projet ne sera pas mis en œuvre en ce qui concerne les travaux de contre-mesures, le système d'alerte et d'évacuation a été mis en place. Lors de la réunion, les grandes lignes du système a été expliquée à l'aide d'une illustration d'image. Durant la préparation concernant le temps de l'évacuation, la liste des personnes a évacuées pour chaque secteur a été développée en coopération avec la police locale.

List devaluation a été faite par la police (Quatre Soeurs)

Explication et démonstration par la MPI CP (Quatre Soeurs)

Démonstration du pluviomètre gauge (Vallée Pitot)

Explication du site (Vallée Pitot)

Reunion avec les organisations concernées (Chitrakoot)

Reunion avec les habitants (Chitrakoot)

Demonstration du pluviomètre (Chitrakoot)

Visite des lieu avec les habitants (Chitrakoot)

2. Première instance d'alerte et d'évacuation a été installé en *(Jan. 2014)*

Système d'alerte a (Chitrakoot) et (Vallée Pitot) des pluviomètre ont été installés dans les trois (3) domaines prioritaires, Chitrakoot, Vallée Pitot, Quatre Soeurs, le système d'alerte et les pluviomètres simples ont été installés en tant que dispositifs de supplément pour permettre aux habitants de connaître le déroulement des étapes d'alerte et d'évacuation sur place. Ce système d'essai a pris effet depuis janv. 2014, et sera examiné et évalué son efficacité grâce à l'enquête de l'entrevue, qui aura lieu en juillet 2014. L'alerte précoce et d'évacuation seront finalisés Dec. 2014.

Système d'alerte (Chitrakoot, Vallée Pitot)

Simple pluviomètre

3. 2ème Séminaire sur le transfert technique *(Nov. 2013)*
Le Séminaire sur le transfert technique a eu lieu le 20 Novembre 2013 au Sugar Beach Hôtel à Flic en Flac, organisé par le Ministère des Infrastructures Publiques (MPI), la National Développement Unit, Land Transport et expédition (Division génie civil) et de l'équipe d'experts de JICA. Le séminaire a été officiellement débute par l'honorable M. Lutchmeeparsad Vidianand, Secrétaire permanent du MPI. Ensuite, l'Equipe d'experts (JICA) et Les ingénieurs de la MPI ont présenté des exposés sur les progrès du projet, des recommandations pour les législations existantes relatives aux glissements de terrain et les méthodes de gestion des glissements de terrain. Leçons tirées des études de cas au Japon, comme Tohoku Earthquake [Tremblement de terre et tsunami] (survenus en mars 2011) et Izu-Ooshima [Glissement de terrain] (survenue en octobre 2013), ont également été partagés avec les participants.


Le Séminaire

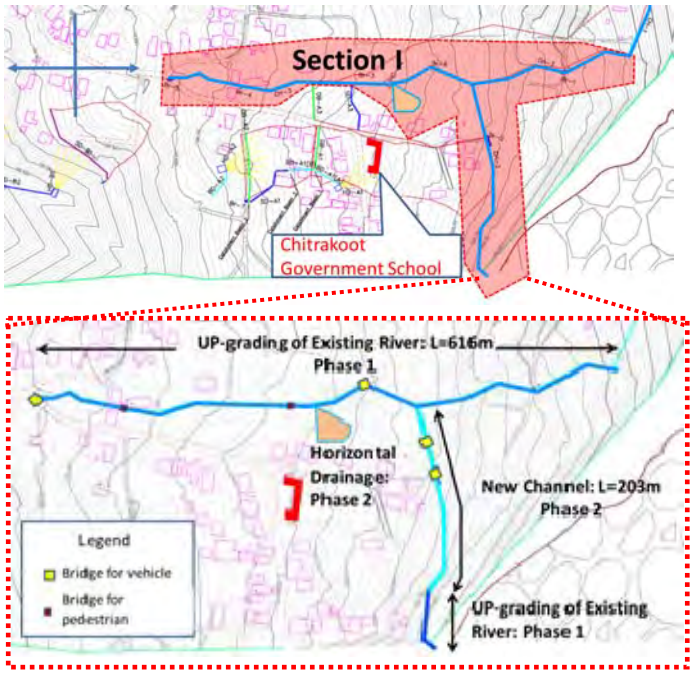
Presentation par MPI

4. Les travaux de glissement de terrain vont commencer très bientôt à Chitrakoot! *(Jul. 2014)*

4-1. Aperçu des travaux de contre-mesures
Selon le résultat des enquêtes et de surveillance menée par le projet, il s'est avéré que des glissements de terrain se produit après de fortes pluies continues comme étant considérées que la grande quantité d'eau s'accumule sur la surface et dans le sol pendant la saison des pluies.

Afin d'éviter le glissement de terrain, un système de drainage a été mise en place afin de réduire l'eau par l'installation d'un système de drainage qui contribuera à la création de l'état semblable de saison sèche, même pendant la saison des pluies.

4-2. Lieu des travaux de construction
Le projet mettra en œuvre les travaux de construction de la section I comme le montre la carte ci-dessous.



4-3. L'itinéraires de travail
Section I est divisé en deux phases, une phase 1 où concernant la terre parvenant au gouvernement, et une étude de phase 2 pour lequel la procédure d'acquisition des terres est nécessaire car certain zone sont considérés comme des terres privées. Le projet mettra en œuvre les travaux de la phase 1 en premier lieux, et les travaux de la phase 2 en conséquence après l'achèvement du processus d'acquisition des terres.

4-4. 4ème réunion des parties prenantes *(Jul. 2014)*
Le projet a mené la 4ème réunion des parties prenantes à Chitrakoot en juillet 2014 avant le début des travaux glissement de terrain de contre-mesures. Deux réunions ont été organisées pour les ministères / départements et des habitants concernés séparément.

La Municipalité de Port-Louis, SMF, la police locale, le ministère du Logement et des Terres, Département et le Service des forêts, Ministère de l'Environnement et du Développement Durable, NDU de MPI et NDRRMC a assisté à la réunion pour les ministères / départements concernés. Près de 25 habitants ont également assisté à la réunion pour les habitants. Les travaux des contre-mesures de glissements de terrain et l'horaire de travail ci-dessus ont été confirmés lors de la réunion.


Reunion avec les organisations concernées (Chitrakoot)


Reunion avec les habitants (Chitrakoot)

Les travaux de construction débuteront le vendredi 18 Juillet 2014, et se poursuivra jusqu'à la fin Déc. 2014.

Pour les habitants vivant à Chitrakoot
Nous pourrions indirectement vous causer quelques ennuis pendant les travaux de construction. Nous tenons à être informées si vous rencontrez des problèmes. Votre compréhension et coopération serait vraiment apprécié.

Pour plus d'informations, s'il vous plaît contactez-nous.

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Vol.5 December 2014

Final Newsletter!!

Bonjour to all! The Project of Landslide Management in the Republic of Mauritius was commenced in May 2012 and is in its final stages. We are pleased to inform that the Project has been successfully implemented. The project team wishes to say a big Merci beaucoup to each and everyone who has given any sort of cooperation and support to the project….

Progress of Project Activity (Jul. 2014 – Dec. 2014)

1. Landslide countermeasure works in Chitrakoot were completed! *(Jul.2014 - Dec. 2014)*

In Chitrakoot, the construction work for landslide countermeasures started on 22nd July 2014 and completed in early December 2014.

In this area, landslide occurs after continuous heavy rains as the large amount of water is accumulated on the surface and under the ground, especially during rainy season. In order to avoid landslide occurrence, the Project conducted countermeasure works to drain waters by installation of drainage system *(Please see the back page of this Newsletter for more details!)*. These works are expected to mitigate the risk of landslide occurrence and to ensure the safety and security of people's lives in Chitrakoot.

We indirectly caused you some troubles during the construction works. The Project probably wouldn't have been able to achieve this without your understanding and cooperation. We would like to express our appreciations to all the stakeholders, especially inhabitants in Chitrakoot. Merci beaucoup.


Construction work
(left: new channel, right: horizontal drainage

2. Regular site meetings in Chitrakoot *(Jul. 2014 – Nov. 2014)*

The meetings with relevant stakeholders were organized on a fortnightly basis at project site to share the progress of the works and issues encountered during the construction works. Various stakeholders like Forestry Department, Municipality of Port Louis, Ministry of Housing and Lands (MHL), Water Resources Unit (WRU) and Mauritius Police Force (MPF) attended the meetings. We would like to express our sincere gratitude to those people that showed their commitments to the Project. Thanks to your cooperation, the Project could proceed with things efficiently.

Site meeting

3. Questionnaire survey to review a trial early warning and evacuation system *(Jul. 2014)*

In three priority landslide areas, namely Chitrakoot, Vallée Pitot, Quatre Soeurs, the alert system and the simple rain gauges were installed and become effective since Jan. 2014. The system aimed to enable inhabitants to know the timing of warning and evacuation stages on site in a simple and easy way.

In order to review the effectiveness of the system, the Project conducted an interview survey targeting inhabitants who lives in three priority areas at the end of Jul. 2014. Local Police of Vallée Pitot also accompanied the survey team and assisted to identify target households.

As a result of the survey, various outcomes and lessons learnt of the project activities were identified. The Project will propose the revised system in Jan. 2015.

Interview survey

4. Landslide Disaster Prevention Handbook is now available! *(Jul. 2014 -)*

The Project developed the Landslide Disaster Prevention Handbook and published it under joint authorship with MPI and National Disaster Risk Reduction and Management Centre (NDRRMC).

The handbook outlines necessary information people should know about landslide disasters, and emphasizes the importance of "Disaster Prevention", which is a key concept to cope with landslides.

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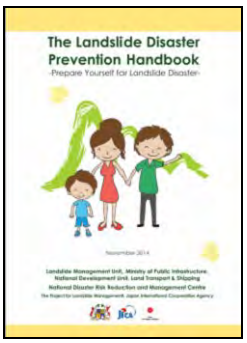


Landslide handbook

5. Discussion on future landslide management system *(Jul. 2014 -)*

The Project is now considering the expected mission and tasks regarding landslide management of relevant organization, especially LMU, through dialogue and discussions with MPI counterparts and stakeholders, in order to ensure landslide management system after the Project ends in January 2015.

Map and Photos of our Landslide Countermeasure Works

Bridge on new channel

New channel

Upgrade of bridge

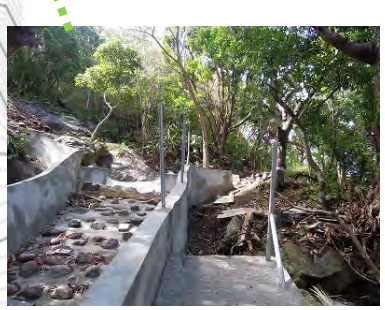
New Channel: L=203m
Phase 2

UP-grading of Existing River: Phase 1

UP-grading of Existing River: Phase 1

Horizontal Drainage: Phase 2

School



Upgrade of water stream

Horizontal drainage

Upgrade of river

Legend

- Bridge for vehicle
- Bridge for pedestrian

50m

to Port Louis

Message from JICA Expert Team

It has been a memorable journey with full of challenges since May. 2012. We all hope that the Project could establish a platform for better landslide management in Mauritius. It is indispensable that national government, local governments, private sectors, communities, among others, are working together to prevent landslide disasters. Your challenge has just begun, but we believe you can do it! We are always under the same sky supporting you. Merci beaucoup to all!!

JICA Expert Office *(*to be closed in late Jan. 2015)*

Technical Division, Ministry of Public Infrastructure, National Development Unit, Land Transport & Shipping
Phoenix, Mauritius
Phone:601-1600, Fax: 686-4506

Vol.5 Décembre 2014

La dernière brochure !!

Bonjour à tous! Le projet de gestion des glissements de terrain à l'île Maurice a débuté en mai 2012 et est actuellement en phase finale. Nous sommes heureux de vous informer que le projet a été mis en œuvre avec succès. L'équipe du projet tient à dire un grand Merci à tous ceux qui y ont participé et collaboré à soutenir le projet..

Les progrès de l'activité du projet (Juillet. 2014 – Décembre. 2014)

1. Les travaux de glissements de terrain de contre-mesure à Chitrakoot ont été achevés! *(Juillet. 2014 – Décembre. 2014)*

À Chitrakoot, les travaux de construction de contre-mesures du glissement de terrain a débuté le 22 Juillet 2014 et sera achevée au début de Décembre 2014.

Dans cette zone, le glissement de terrain se produit après de fortes pluies continuelles provoquant une grande quantité d'eau qui s'accumule sur la surface et sous la terre, en particulier pendant la saison des pluies. Afin d'éviter un glissement de terrain, les travaux de contre-mesures ont été réalisés pour drainer les eaux d'un terrain humide grâce à l'installation d'un système de drainage (A voir à la dernière page les travaux de contre-mesures) Ces travaux devraient atténuer le risque de glissements de terrain et d'assurer la sécurité de la vie des gens à Chitrakoot. Nous avons indirectement causé quelques problèmes au cours des travaux de construction. Le projet n'aurait probablement pas pu y parvenir sans votre compréhension et votre coopération. Nous tenons à exprimer notre remerciement à toutes les parties prenantes, en particulier habitants à Chitrakoot. Merci beaucoup.


Les travaux de construction
(à gauche: nouvelle chaîne, à droite: horizontale drainage)

2. Des réunions régulières ont été organisées à Chitrakoot *(depuis juillet 2014 et jusqu'à présent Novembre 2014)*

Des réunions avec les diffèrent ministères prenantes ont été organisées sur le site du projet à enfin de partager l'avancement des travaux et les problèmes rencontrés au cours des travaux de construction.

Divers intervenants comme le ministère des Infrastructures publiques (MPI), le Département des forêts, la municipalité de Port-Louis, le ministère du Logement et des Terres (MHL), l'Unité des ressources en eau (WRU) et la Force policière (MPF) ont tous participé aux réunions. Nous tenons à exprimer notre sincère gratitude à ceux qui ont montré leur engagement pour ce projet. Merci pour votre coopération, le projet a été en mesure de procéder à toutes choses efficacement.

Réunion du site à Chitrakoot

3. Un questionnaire a été confectionné visant à réaliser et d'examiner le fonctionnement du système d'alerte et le système d'évacuation *(Juiletl 2014)*

Dans les trois zones de glissement de priorité, à savoir Chitrakoot, Vallée Pitot, Quatre Soeurs, le système d'alerte et les pluviomètres qui ont été installés en Janvier 2014..

Ce système visait à permettre aux habitants de connaître le déroulement des étapes d'alerte et d'évacuation sur le site d'une manière simple et facile. Afin de vérifier l'efficacité du système en 2014 le projet a mené une enquête interview ciblant les habitants qui vit dans les trois endroits prioritaire. La police locale de Vallée Pitot a également accompagne l'équipe d'enquête et ils étaient d'une grand aide.

Suite à l'enquête, divers résultats et leçons ont été tirées des activités du projet et ont été identifiés. Le projet proposera un système d'alerte et d'évacuation plus efficace en janvier 2015.

Interview survey

4. Le Guide de prévention des catastrophes de glissement de terrain maintenant disponible. *(Juillet. 2014 -)*

Le projet a développé le manuel de prévention des catastrophes du glissement de terrain et l'a publié en partenariat du MPI et du centre national de réduction des risques de catastrophe et Centre de gestion (NDRRMC).

Le manuel décrit les informations nécessaires que les gens doivent connaître sur le glissement de terrain catastrophiques, et ce manuel met l'accent sur l'importance de la "prévention des catastrophes", qui est un concept clé pour faire face aux glissements de terrain.
Le manuel a été distribué aux organisations et aux habitants concernés qui vivent dans les endroits de risque de glissements de terrain. Si vous voulez en savoir plus sur les glissements de terrain, Veuillez contacter le L'Unité de gestion de glissement de terrain (LMU) de la MPI et obtenir un manuel!

Manuel de glissement de terrain

5. Discussion sur le système de gestion de glissement de terrain *(juil 2014 -).*

Le projet envisage maintenant d'attribuer les responsabilités et les tâches de gestion de glissement de terrain suite aux discussions et réunions avec leurs homologues notamment – LMU/MPI aux différentes organisations / ministères, afin d'assurer que le système de gestion de glissement de terrain est bien menée à la fin du projet en Janvier 2015.

Photos des travaux de contre-mesures pour le glissement de terrain

Pont pour un nouveau canal

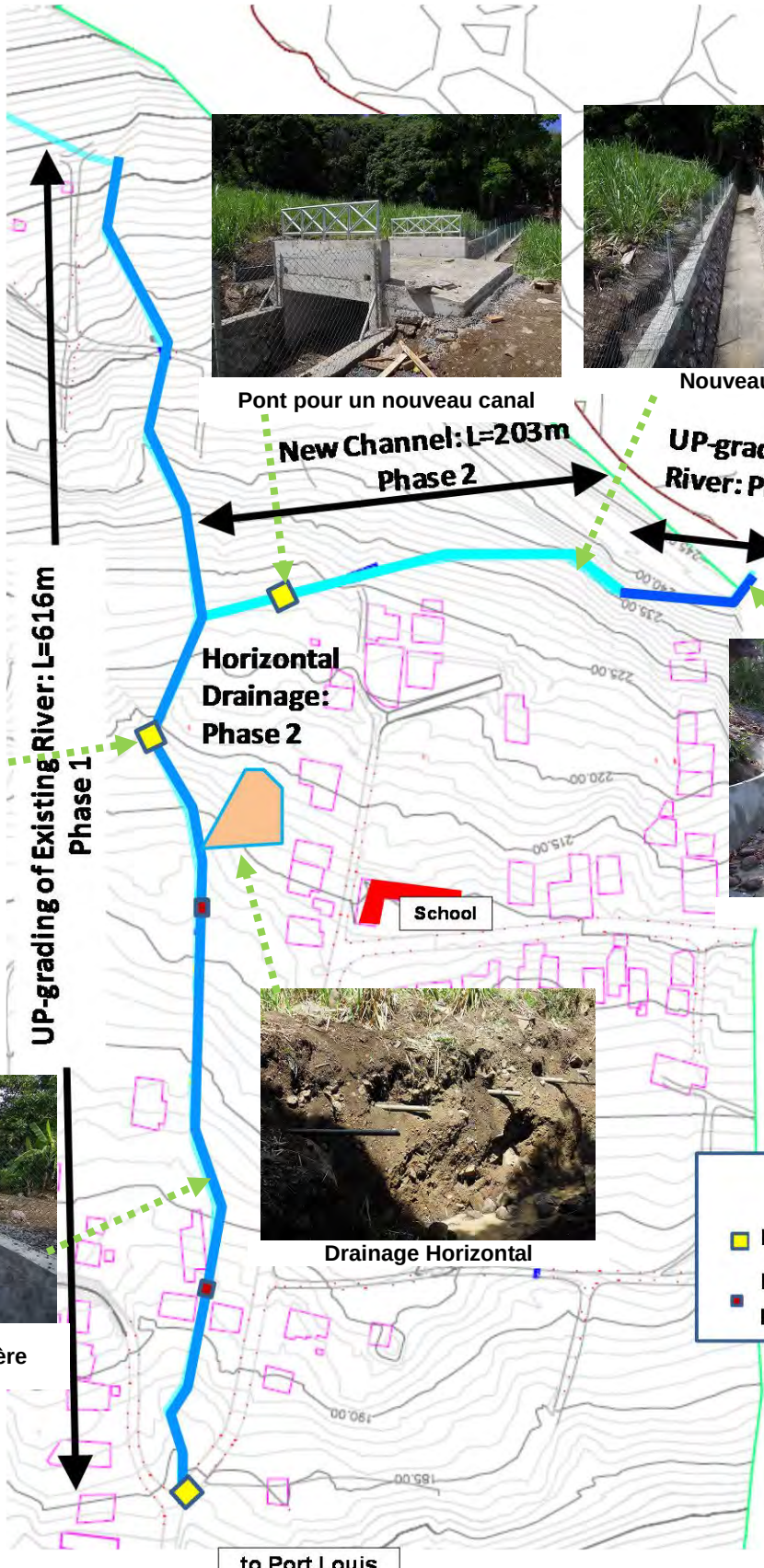
Nouveau Canal

Mise à niveau du pont

Mise à niveau du jet d'eau

Drainage Horizontal

Mise à niveau de la rivière



Message des Expert Japonais (JICA)

Ce projet a été un voyage inoubliable avec plein de défis depuis mai. 2012. Nous espérons tous que le projet pourrait établir une plate-forme pour une meilleure gestion de glissement de terrain à l'île Maurice. Il est nécessaire que le gouvernement national, les gouvernements locaux, le secteur privé, les communautés, entre autres, travaillent ensemble pour se protéger des phénomènes des catastrophes de glissement de terrain. Votre défi vient de commencer, mais nous pensons que vous pouvez le faire! Nous vivons sous le même ciel et nous serons toujours là pour vous soutenir. Merci à tous !!

JICA Expert Office
(Fin du projet Jan. 2015)
Division Technique, Ministère des infrastructure publiques , la national développement unit Transport Extérieur et marine, Phoenix, Mauritius
Phone:601-1600, Fax: 686-450

Vol.5 December 2014

Final Newsletter!!

Good Afternoon. The Project of Landslide Management in the Republic of Mauritius was commenced in May 2012 and is in its final stages. We are pleased to inform that the Project has been successfully implemented. The project team wishes to say a big Merci beaucoup to each and everyone who has given any sort of cooperation and support to the project….

Progress of Project Activity (Jul. 2014 – Dec. 2014)

1. Landslide countermeasure works in Chitrakoot were completed! *(Jul.2014 - Dec. 2014)*

In Chitrakoot, the construction work for landslide countermeasures started on 22nd July 2014 and will be completed in early December 2014.

In this area, landslide occurs after continuous heavy rains as the large amount of water is accumulated on the surface and under the ground, especially during rainy season. In order to avoid landslide occurrence, the Project conducted countermeasure works to drain waters by installation of the drainage system *(Please see the back page of this Newsletter for more details!)*. These works are expected to mitigate the risk of landslide occurrence and to ensure the safety and security of people in Chitrakoot.

We indirectly caused you some troubles during the construction works. The Project probably wouldn't have been completed without your understanding and cooperation. We would like to express our appreciation to all the stakeholders, especially inhabitants of Chitrakoot. Thank you very much.


Construction work
(left: new channel, right: horizontal drainage

2. Regular site meetings in Chitrakoot *(Jul. 2014 – Nov. 2014)*

The meetings with relevant stakeholders were organized on a fortnightly basis at the project site to discuss the progress of the works and issues encountered during the construction works. Various stakeholders like Forestry Department, The Municipal Council of Port Louis, Ministry of Housing and Lands (MHL), Water Resources Unit (WRU) and the Mauritius Police Force (MPF) attended the meetings. We would like to express our sincere gratitude to those people who showed their commitments to the Project. Thanks to your cooperation, the Project could proceed with things efficiently.

Site meeting

3. Questionnaire survey to review a trial early warning and evacuation system *(Jul. 2014)*

In three priority landslide areas, namely Chitrakoot, Vallée Pitot, Quatre Soeurs, the alert system and the simple rain gauges were installed and become effective since Jan. 2014. The system aimed to enable inhabitants to know the timing of warning and evacuation stages on site in a simple and easy way.

In order to review the effectiveness of the system, the Project conducted a survey targeting inhabitants who live in three priority areas at the end of Jul. 2014. Local Police of Vallée Pitot also accompanied the survey team and assisted to identify target households.

As a result of the survey, various outcomes and lessons learnt of the project activities were identified. The Project will propose the revised system in Jan. 2015.

Interview survey

4. Landslide Disaster Prevention Handbook is now available! *(Jul. 2014 -)*

The Project developed the Landslide Disaster Prevention Handbook and published it under joint authorship with MPI and National Disaster Risk Reduction and Management Centre (NDRRMC).

The handbook outlines necessary information people should know about landslide disasters, and emphasizes the importance of "Disaster Prevention", which is a key concept to cope with landslides.

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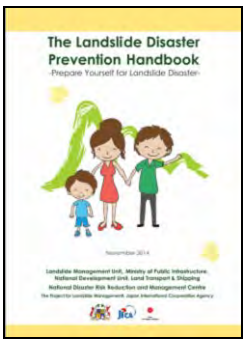

Landslide handbook

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The Project is now considering the expected mission and tasks regarding landslide management of relevant organizations, especially LMU, through dialogue and discussions with MPI counterparts and stakeholders, in order to ensure an appropriate landslide management system after the Project ends in January 2015.

Map and Photos of our Landslide Countermeasure Works

Upgrade of bridge

Bridge on new channel

New channel

Upgrade of water stream

Upgrade of river

Horizontal drainage

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It has been a memorable journey full of challenges since May. 2012. We all hope that the Project could establish a platform for better landslide management in Mauritius. It is indispensable that government, local authorities, the private sector, communities, amongst others, work together to prevent landslide disasters. Your challenge has just begun, but we believe you can do it! We are always under the same sky supporting you. Thank you very much and Arigato gozai mashita!!!

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Technical Division, Ministry of Public Infrastructure, National Development Unit, Land Transport & Shipping
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Vol.5 Décembre 2014

La Version finale !!

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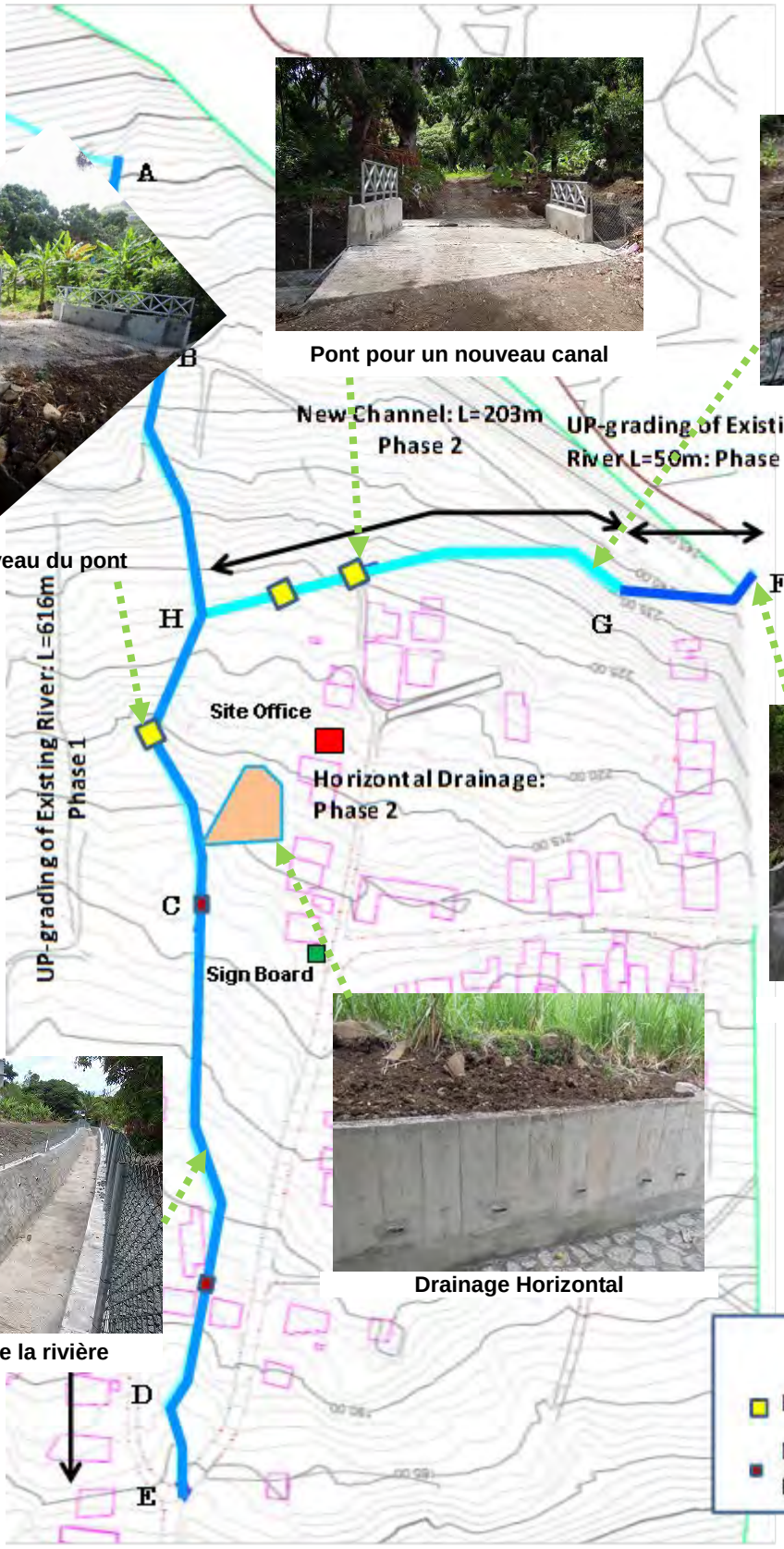

Mise à niveau du jet d'eau

Mise à niveau de la rivière

Drainage Horizontal

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(Fin du projet Jan. 2015)
Division Technique, Ministère des infrastructure publiques , la national développement unit Transport Extérieur et marine, Phoenix, Mauritius
Phone:601-1600, Fax: 686-450

17. Presentation Material for 1st Stakeholder Meeting

1st Stakeholder Meeting for the Landslide Project Management

21-22 September 2012

Ministry of Public Infrastructure (MPI)

Japan International Cooperation Agency (JICA)

Today's Topics

1. Landslide disasters in Mauritius
2. Why Landslide Management Project?
3. Outline of the Project

1. Landslide disasters in Mauritius

What is Landslide?

"Landslide" means a wide variety of processes that result in the downward and outward movement of slope-forming materials including rock, soil, artificial fill, or a combination of these.

The materials may move by falling, toppling, sliding, spreading, or flowing.

(source: United States Geological Survey)

1. Landslide disasters in Mauritius

Actual cases in Mauritius

Chitrakoot

Vallée Pitot

Quatre Soeurs

Still small disasters at this time, but in future… (show movie)

1. Landslide disasters in Mauritius

Year	Location	Landslide disaster in the past
1986	La Butte	1500 houses were damaged, 4 main water pipes and high voltage power lines were broken.
2005	Chitrakoot	54 houses were damaged.
	Quatre Soeurs	11 houses were affected
2006	Chitrakoot	14 houses were damaged
2008	Chitrakoot Quatre Soeurs	Landslides re-occurred

2. Why Landslide Management Project?

Landslide have become a major concern in Mauritius, especially for citizens in high-risk areas.

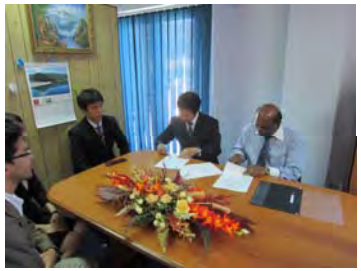
Landslide disaster needs to be **mitigated** to

✓ reduce the risk of landslides by stabilizing slopes,
✓ protect your lives, livelihoods and assets of communities and individuals from the impacts of landslide hazards

2. Why Landslide Management Project?

Therefore, the government of Mauritius through Ministry of Public Infrastructure, embarked the **Landslide Management Project** since May 2012 in cooperation with relevant stakeholders and Japan International Cooperation Agency (JICA).

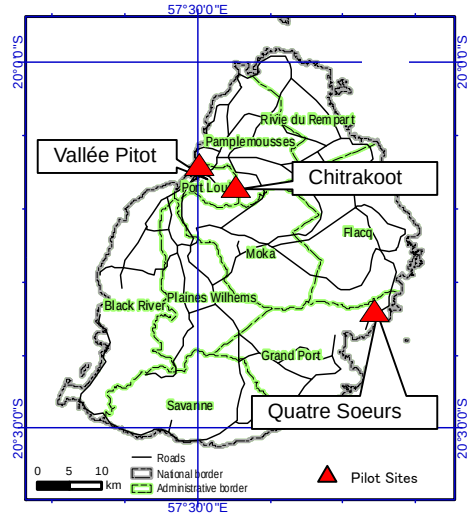
Photo with Vice-prime Minister and MPI Minister



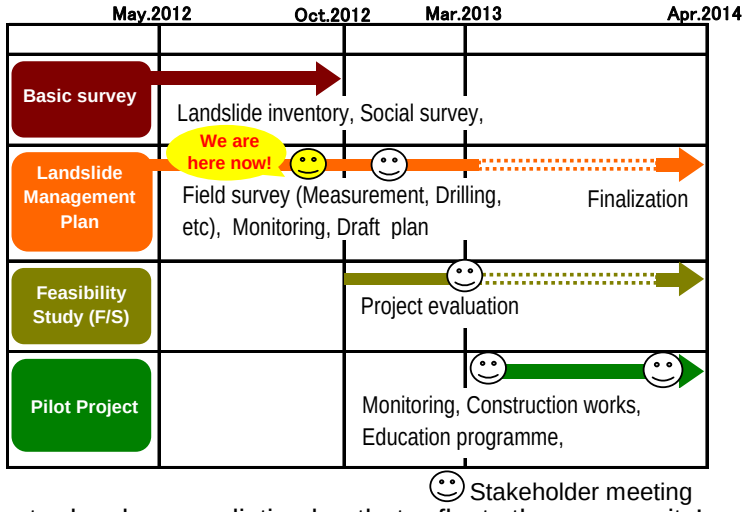
R/D Signing

3. Outline of the Project

The Project has identified three (3) priority areas as the most critical high-risk area for landslide disasters.



3. Outline of the Project/Schedule



In order to develop a realistic plan that reflects the community's real needs, the Landslide Management Plan will be developed using consultative and participatory approach through stakeholder meetings.

3. Outline of the Project

In order to examine countermeasures, we need to understand;

(1) Current landslide mechanism, and

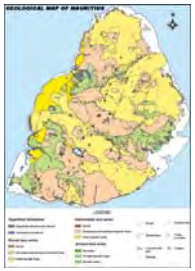
(2) Status of the underground

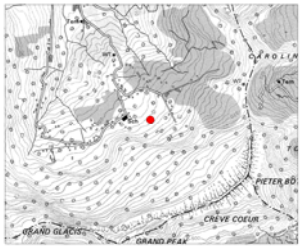
The following surveys and works need to be done;

1. Data collection	5. Measurement
2. Analysis of Aerial Photos	6. Geophysical Exploration
3. Field Survey	7. Drilling
4. Land surface status analysis	8. Monitoring

Countermeasures

3. Outline of the Project





(1) Data collection

(2) Analysis of aerial photos

(3) Field survey

(4) Land surface status survey

3. Outline of the Project

(5) Measurement

[Aim] : to identify the spatial location of existing natural and artificial objects (such as trees, houses, etc)

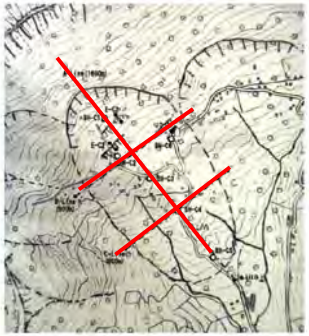
	Implementation period
Chitrakoot	October 2012 (for 2 weeks)
Quatre Soeurs	Done (6 -14 September 2012)
Vallee Pitot	Sep. – Oct. (for 1 week)

** There are some possibility to clear the bush area if needed.*

3. Outline of the Project

(6) Geophysical Exploration

[Aim] : to measure the physical properties of the subsurface land



(Location: See the distributed map)

	Implementation period
Chitrakoot	1 month (in November 2012)

3. Outline of the Project

(7) Drilling

[Aim] : to understand the soil profile of the land by using a drill bit

Drilling work

	Number of drilling points	Implementation period
Chitrakoot	6	Oct. – Nov. 2012
Quatre Soeurs	2	

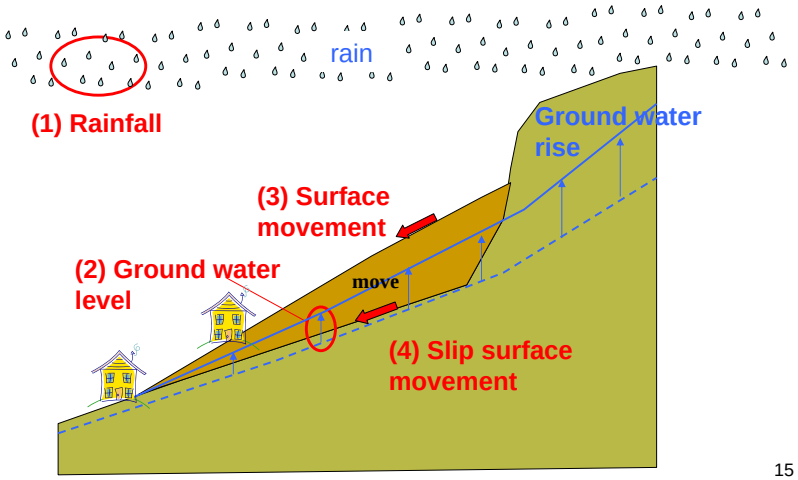
(Location: See the distributed map)

** There are some possibility to clear the bush area if needed.*

3. Outline of the Project

(8) Monitoring

We need to monitor 4 parameters;



The processes when the landslide occurs

3. Outline of the Project

(8) Monitoring

(1) Rain gauge

[Aim] : to gather and measure the amount of rain water over a set period of time.

Site	Number/Device	Frequency of monitoring
Chitrakoot	1	Once a month at least
Quatre Soeurs	1	

Monitoring will continue for 10 years at least

3. Outline of the Project
(8) Monitoring

(2) Ground water level meter

[Aim] : to measure the level of groundwater

	Number of points
Chitrakoot	2
Quatre Soeurs	2

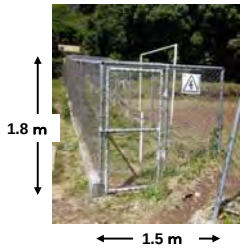
(Location: same as drilling points)

***Monitoring will continue for 10 years at least**

3. Outline of the Project
(8) Monitoring

(3) Extensometer

[Aim] : to monitor the movement of surface land



Site	Number	Timing of Installation
Chitrakoot	2	Oct. – Nov. 2012
Quatre Soeurs	1	
Vallée Pitot	2	

(Location: See the distributed map)

***Monitoring will continue for 10 years at least**

3. Outline of the Project
(8) Monitoring

(4) Borehole inclinometer / Pipe strain gauge

[Aim] : to monitor the movement of the underground

	Number of drilling points
Chitrakoot	4
Quatre Soeurs	2

(Location: same as drilling points)

***Monitoring will continue for 10 years at least**

Request for residents living at priority areas

We might indirectly cause you some troubles during the field survey and monitoring works.

We would like to be informed if you face any problems.

For any queries;

Technical Division
Ministry of Public Infrastructure, National Development Unit, Land Transport & Shipping
Phoenix, Mauritius
Phone:601-1600
Fax: 686-4506

Your understanding and cooperation would be really appreciated.

18. Presentation Material for 2nd Stakeholder Meeting

2nd Stakeholder Meeting for the Landslide Management Project

Chitrakoot, Sat 13 April 2013

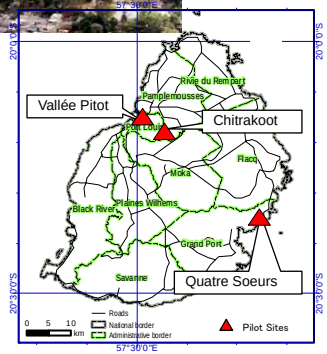
Ministry of Public Infrastructure (MPI)

Japan International Cooperation Agency (JICA)

Today's Topics

1. **Review of the 1st Stakeholder Meetings**
2. **The results of field survey**
3. **The results of monitoring data** (gained from the installed equipment)
4. **The basic policy for countermeasures** (construction works, early warning and evacuation system)
5. **Schedule** (future Plan)

1. Review of 1st Stakeholder meeting



We explained:

1. What is Landslide?
2. Landslide disasters in Mauritius
   - Priority area
3. Why Landslide Management Project?
   - Background and the Need of the Project
4. Outline of the Project
   - Implementation schedule
   - Methods of landslide monitoring analysis (Measurement, Drilling, Geophysical exploration)

1. Review of 1st Stakeholder meeting (Chitrakoot)

Date: Sat 22 Sep. 2012, Participants: 46

Summary of comments given by residents	Matters to be considered by the Project
•Mauritius government conducted some surveys and installed similar monitoring devices in 2005, however, the monitoring result has never been informed to residents. •Any development activities are prohibited in Chitrakoot due to the high-risk area of landslide disasters, so residents requested the Project not only for the survey and monitoring works but also for concrete construction works as countermeasures.	− The results of previous survey were already reviewed, but these data is too old to examine appropriate countermeasures. It was also highlighted that JICA Project needs to install equipments to the right locations to understand the mechanism of landslide occurrence properly. −The Project agreed to organize Stakeholder Meetings on a regular basis in order to share the results of survey and monitoring. −Residents seem to have high expectations toward construction works as countermeasures, so there is a need to highlight the importance of soft components such as early warning and evacuation system.

2. Result of Landslide Site Investigation

Chitrakoot

Method of Landslide Site Investigation

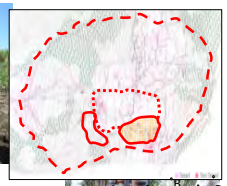
Step 1 **Aerial photographic interpretation**

The landslide area and its characteristics is identified by using the aerial photos.

Step 2 **Site reconnaissance (Field survey)**

The field survey is carried out to investigate the detailed landslide condition at sites and the damaged houses.

Step 3 **Topographic Survey**



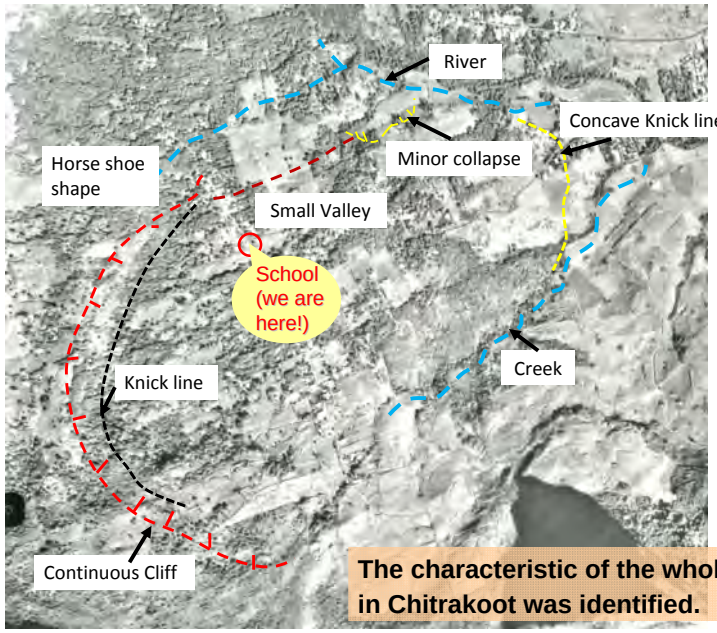
The topographical map is developed.

Step 4 **Drilling Survey**

The drilling survey is carried out to understand geological compositions as well as landslide structure.

Step 1

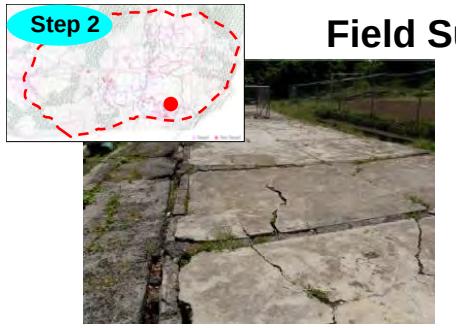
Aerial Photographic Interpretation



The characteristic of the whole land in Chitrakoot was identified.

Step 2

Field Survey (1)



Crack (behind the school)

Step (behind the school)

Damage of the school

Crack on the wall (near the school)

Step 2

Field Survey (2)

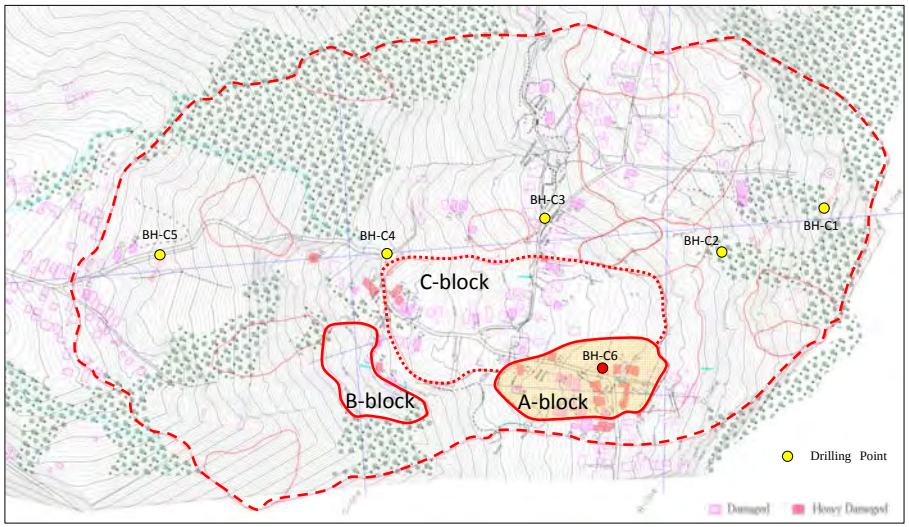
House6

House4

Damaged Houses

Step 3

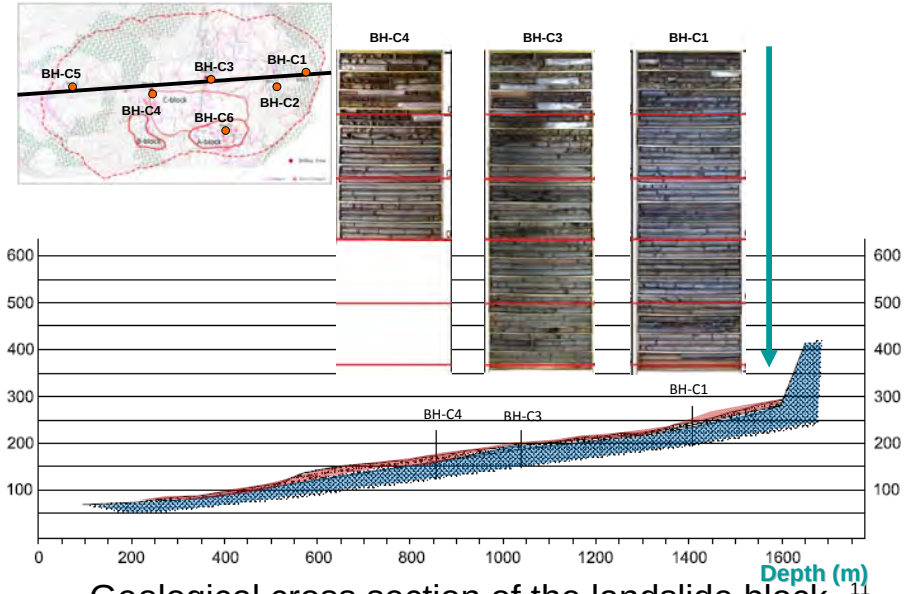
The Results of Field Survey



Active landslide areas were identified.

Step 4

Drilling Survey (Boring Cores)



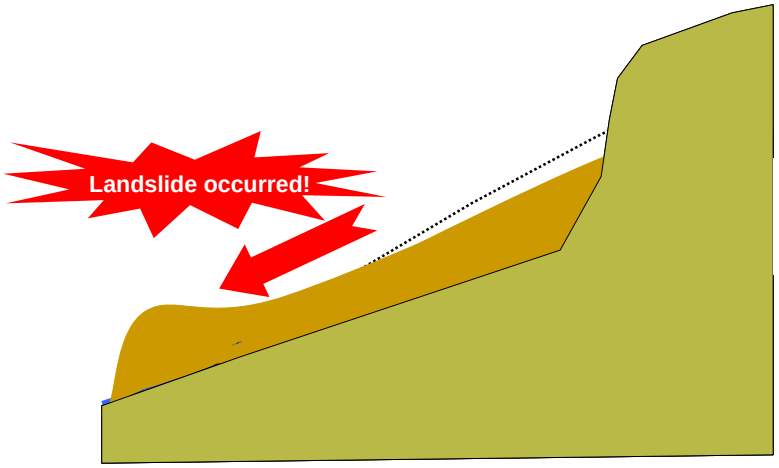
Geological cross section of the landslide block

3. Result of Monitoring

Chitrakoot

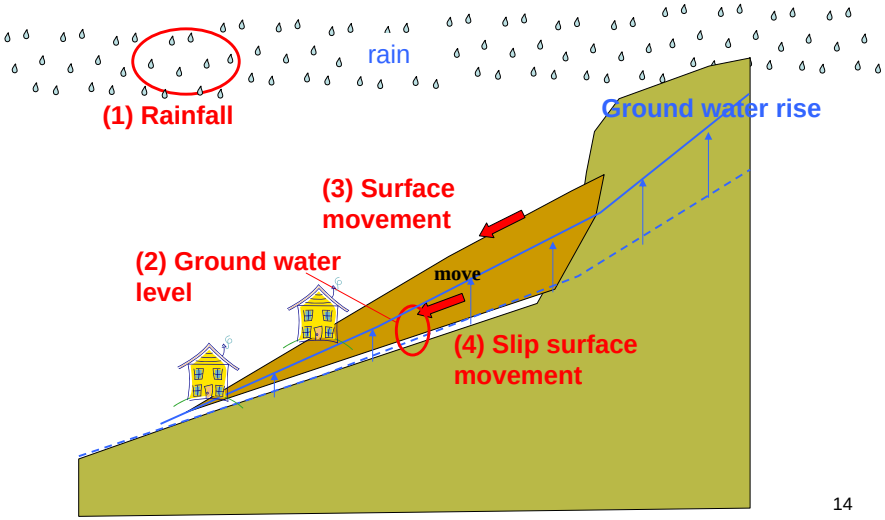
Mechanism of landslide occurrence

(general)



3. Result of Monitoring

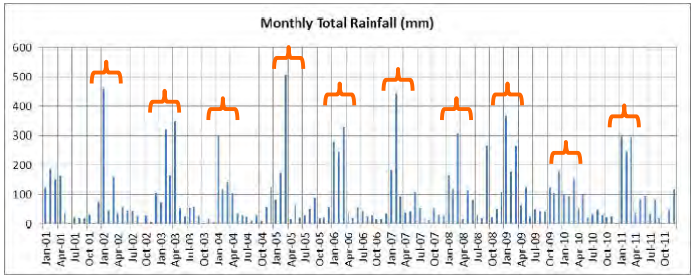
The following 4 parameters should be monitored:



The processes when the landslide occurs

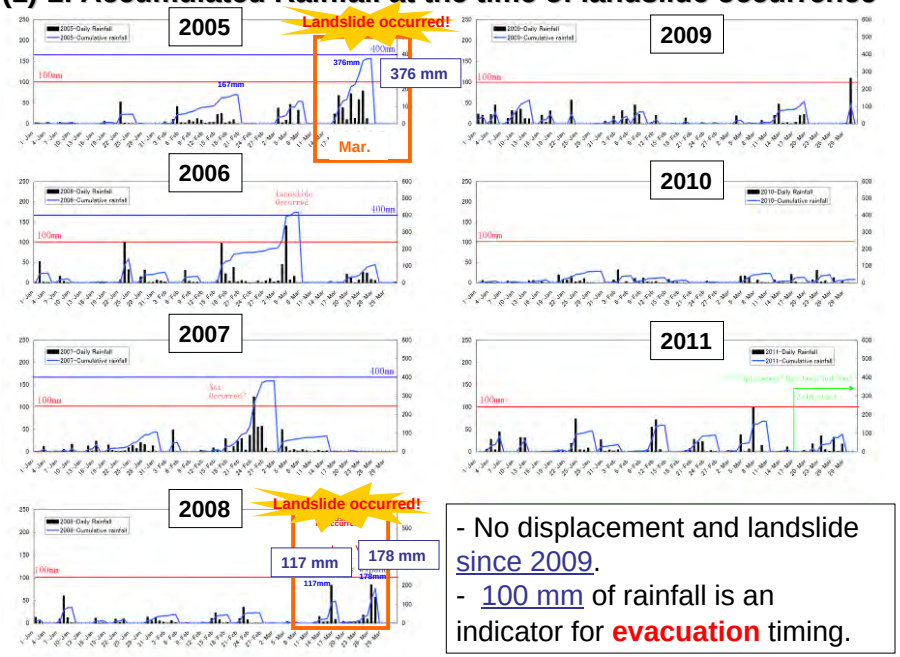
(1)-1. Rainfall around Chitrakoot

Year	Monthly Total Rainfall (mm)												Yearly Total Rainfall (mm)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2001	125.6	188.2	150.0	163.3	39.6	3.0	22.0	19.0	19.6	31.6	2.0	74.0	837.9
2002	461.3	46.0	158.7	37.2	58.7	45.4	45.2	27.4	4.4	29.4	6.4	105.2	1025.3
2003	72.8	320.8	165.2	348.8	55.1	25.0	55.6	58.0	27.2	3.8	16.2	6.4	1154.9
2004	299.2	117.6	143.6	105.4	35.5	30.1	24.9	9.7	29.7	8.4	57.6	127.3	989.0
2005	81.5	173.4	506.3	15.4	66.7	22.1	30.1	52.0	88.6	20.4	21.1	58.4	1136.0
2006	278.5	245.0	328.5	37.3	19.7	59.0	44.2	25.1	29.3	15.2	15.0	34.8	1131.6
2007	183.2	445.1	93.7	38.9	44.6	108.5	56.1	19.8	13.1	54.9	30.9	27.4	1116.2
2008	164.6	119.4	306.4	15.4	115.1	81.8	28.8	20.0	267.4	24.1	52.9	107.9	1303.8
2009	369.9	177.8	265.2	66.1	126.4	24.7	51.9	44.8	41.2	122.9	105.4	176.8	1573.1
2010	98.5	92.3	153.0	54.8	101.6	20.6	33.0	50.3	29.8	24.2	25.5	2.8	686.4
2011	298.0	244.6	295.6	39.2	83.0	96.0	35.3	79.9	20.3	2.3	48.5	118.6	1361.3
Average	221.2	197.3	233.3	83.8	67.8	46.9	38.8	36.9	51.9	30.7	34.7	76.3	1119.6



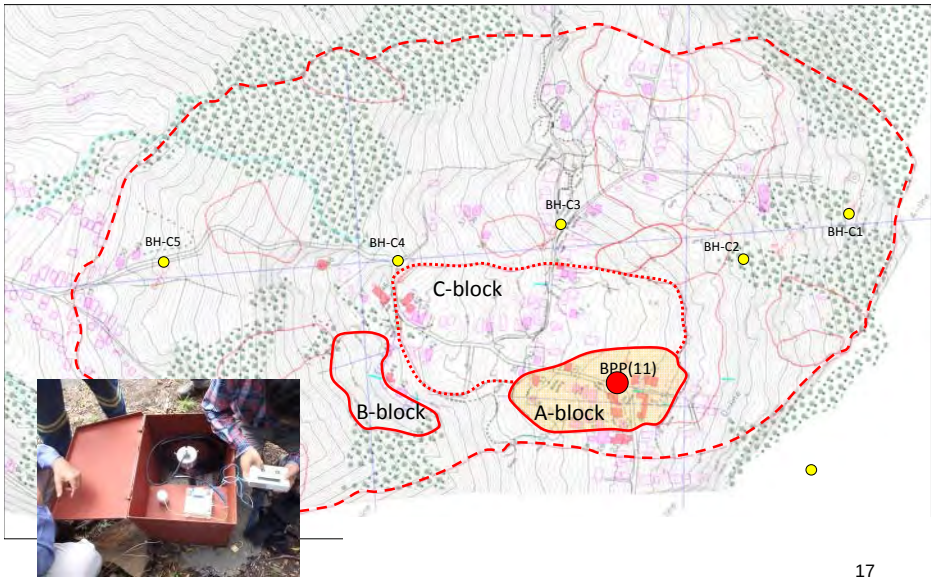
The amount of rainfall tends to increase during cyclone season (from Jan. to Mar. every year)

(1)-2. Accumulated Rainfall at the time of landslide occurrence



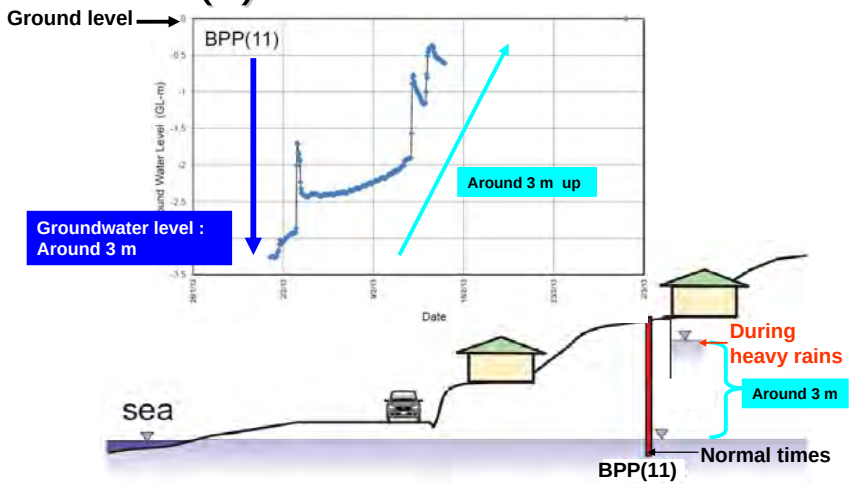
- No displacement and landslide since 2009.
- 100 mm of rainfall is an indicator for **evacuation** timing.

(3) Groundwater level



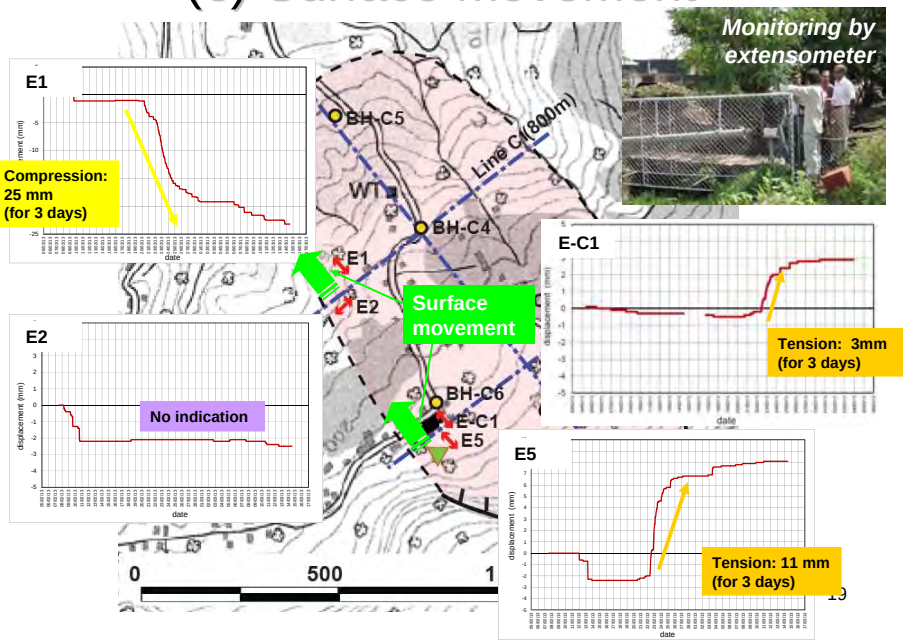
Monitoring of groundwater level

(2) Groundwater level

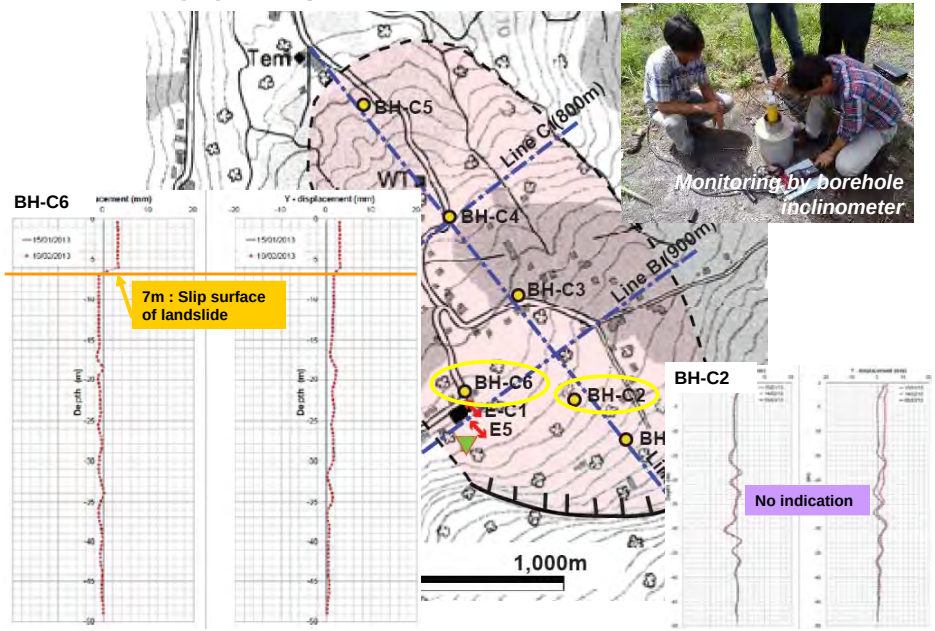


The groundwater level will
- change according to the rainfall.
- increase up to the ground level after heavy rains.

(3) Surface movement



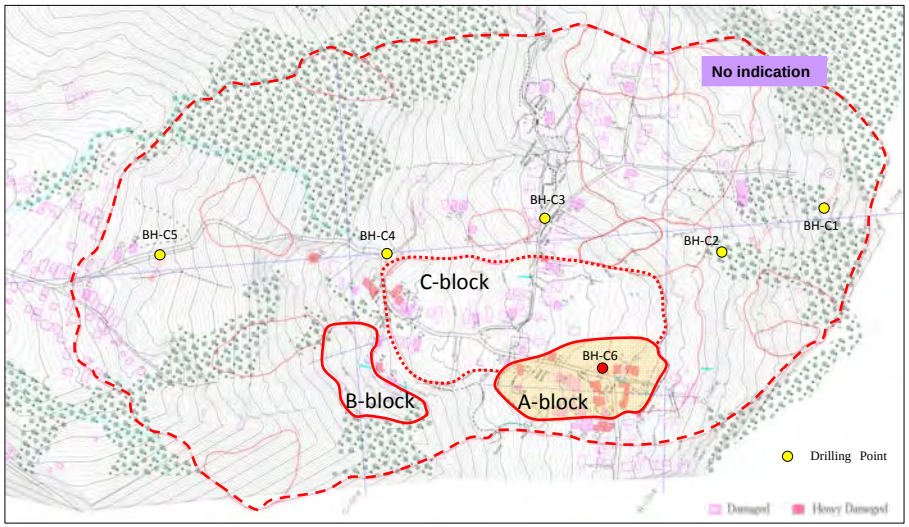
(4) Slip surface movement



4. Basic policy for countermeasures

Chitrakoot

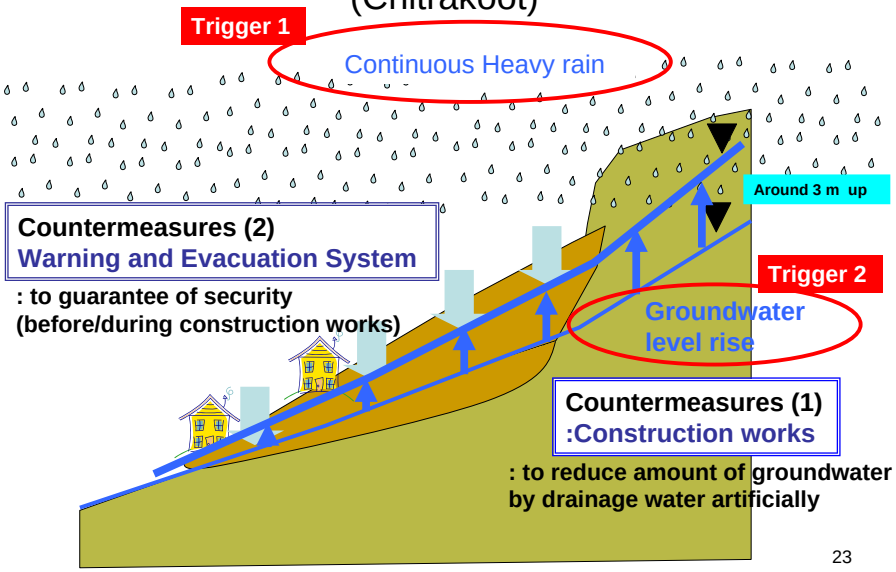
Target areas for implementation of countermeasures



Active landslide areas (A-block, B-block)

Causes of landslide occurrence

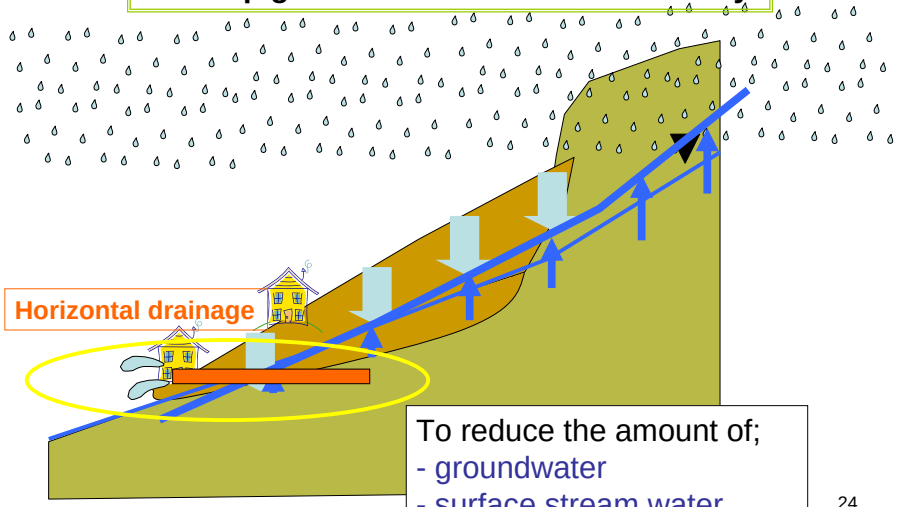
(Chitrakoot)



Countermeasures (1) Construction works

Horizontal Drainage (concept)

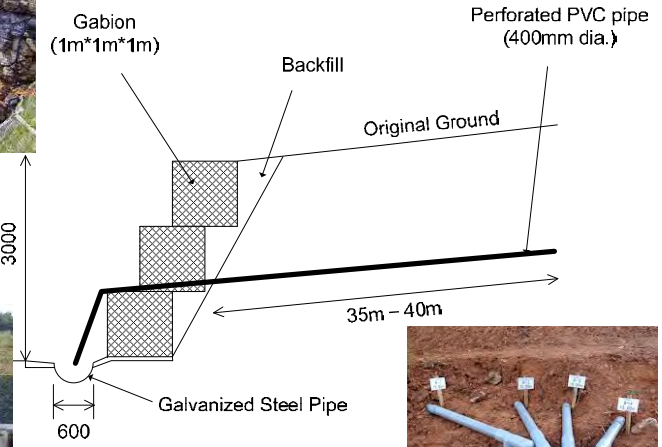
: to stop groundwater level rise artificially



Countermeasures (1) Construction works

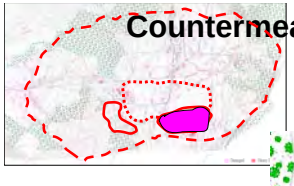
Horizontal Drainage

(General cross section)



Countermeasures (1) Construction works

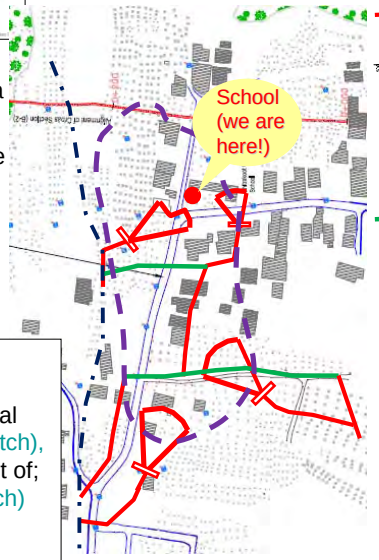
Location (A-block)



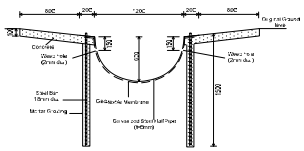
Active Landslide area

Horizontal Drainage

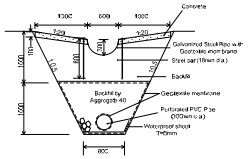
Existing channel



Opened Ditch



Opened and Blind Ditch

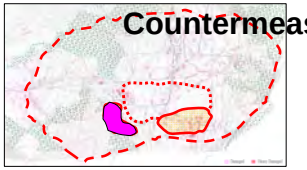


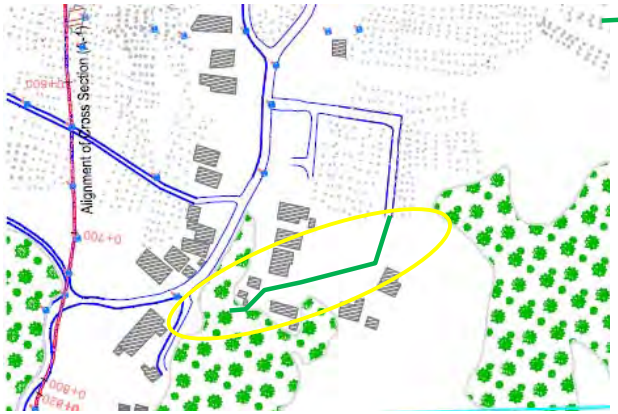
Role of Ditch

1) To connect the water collected by horizontal drainage (Opened ditch),
2) To reduce the amount of;
- groundwater (Blind ditch)
- surface stream water (Opened ditch)

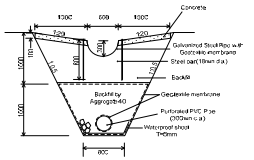
Countermeasures (1) Construction works

Location (B-block)





Opened and Blind Ditch

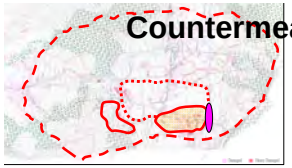


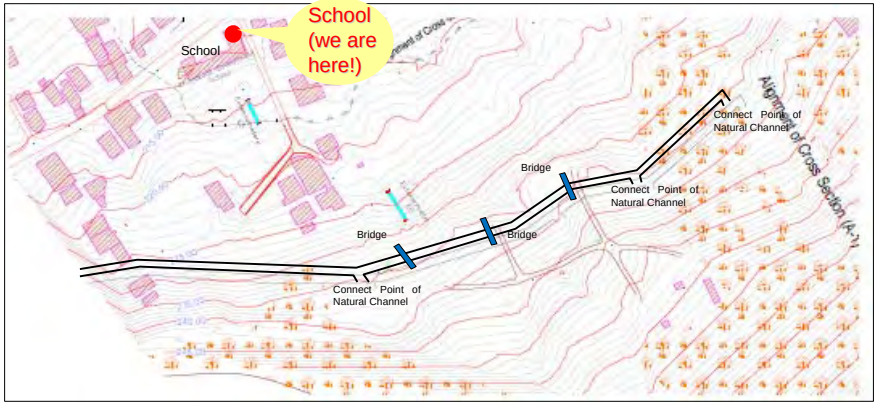
Role of Ditch

- To reduce the amount of; groundwater and surface stream water

Countermeasures (1) Construction works

Drainage system





To drain surface water which is flowed from the mountain side.

Countermeasures (2)

Warning and Evacuation System

- Construction works will start from Apr. 2014 for 9 months. There is some possibility that landslide occur before /during construction works.
- After construction work, we need to monitor three (3) years at least to make sure that land is surely stabilized.

How to protect our lives from landslide hazards?

Warning and Evacuation system is KNOW-HOW to protect you by yourself/community.

1) Alert System
2) Hand-made Rain Gauge System
3) Early Warning and Evacuation System

Countermeasures (1) Warning and Evacuation System

1) Alert System

[Problem] It is sometimes impossible for MPI to visit the site and check the site condition and monitoring data during heavy rains due to the difficulty of access to the site (water-covered road, closure of the road, etc)

Revolving light / Security Alarm

How to know when it reach to the alert level?

[Solution] Revolving light and alert system which is connected to the installed Extensometers

Revolving light and Alarm will work when the monitoring data reached to the alert level.
1) Warning Stage:
2) Evacuation Stage: + sound

Countermeasures (1) Warning and Evacuation System

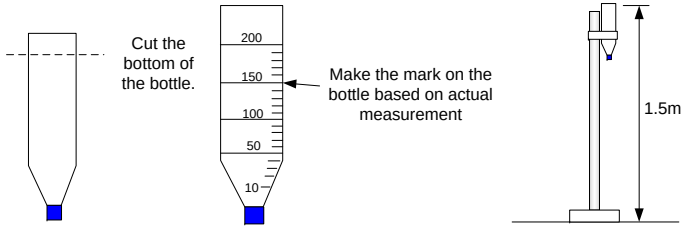
2) Hand-made rain gauge system

[Problems]

- Automatic rain gauge has been installed at area, however, it is difficult for residents to check the data as specific equipment is needed.
- Warning information given by Mauritius Metrological Service (MMS) sometimes delay to reach to the people.

How to know when it reach to the alert level?

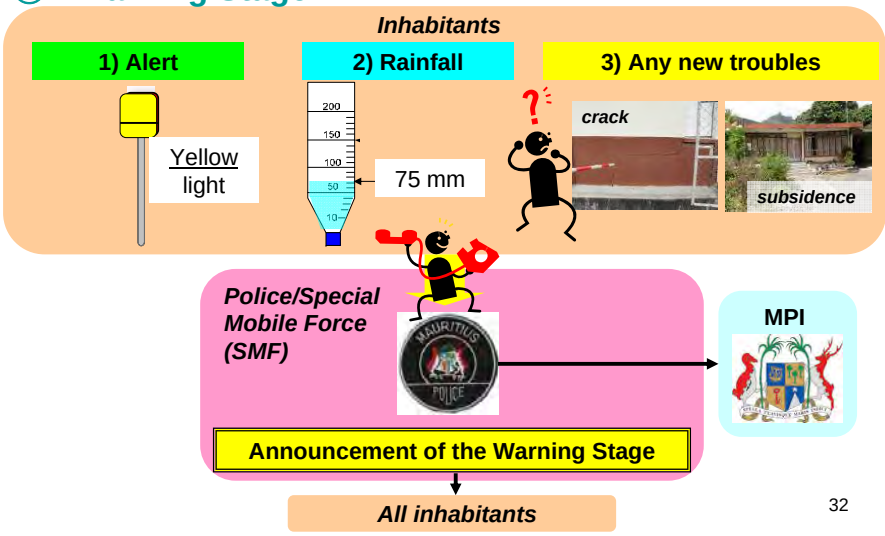
[Solution] Hand-made rain gauge system



Countermeasures (1) Warning and Evacuation System

2) Warning and Evacuation System

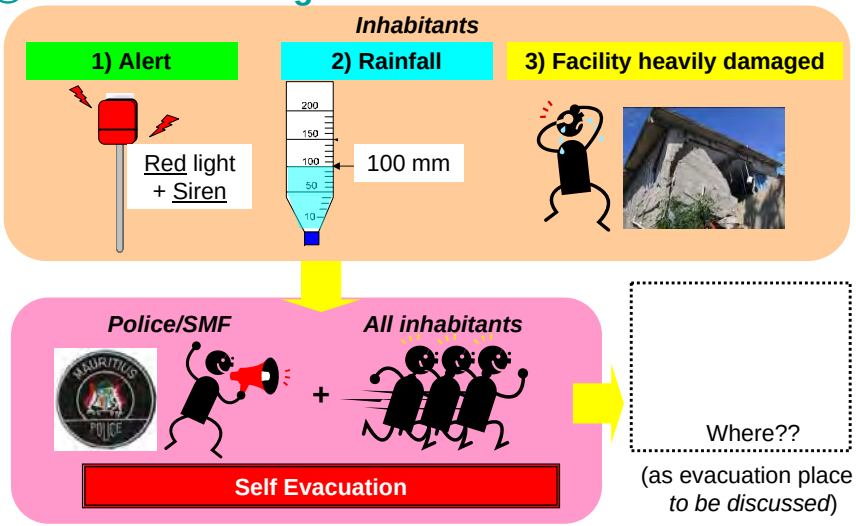
① Warning Stage



Countermeasures (1) Warning and Evacuation System

2) Warning and Evacuation System

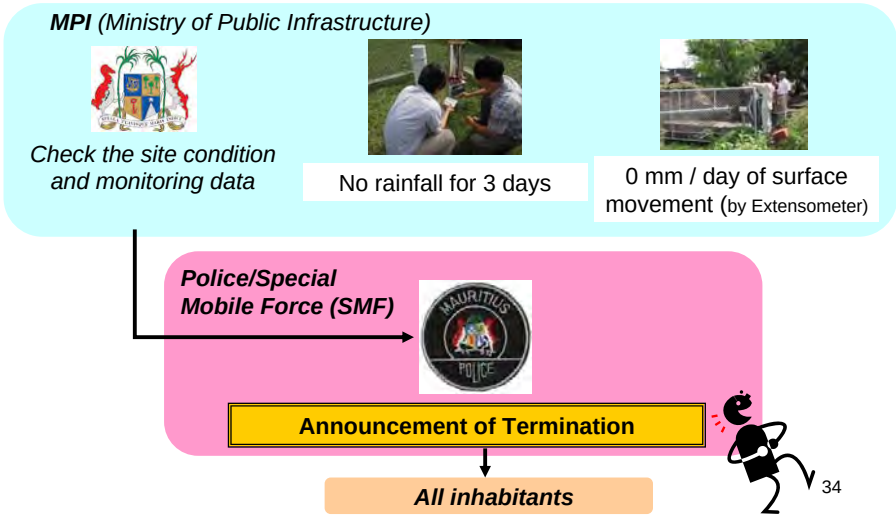
② Evacuation Stage



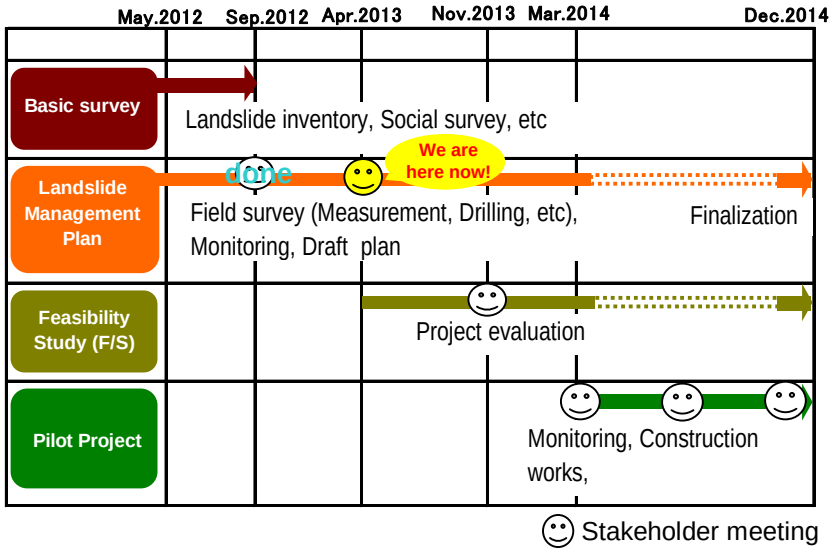
Countermeasures (1) Warning and Evacuation System

2) Warning and Evacuation System

③ Termination



5. Schedule (Future Plan)



See you at next meeting!

Countermeasures (2) 1) Early Warning System

③ Evacuation Stage:

Self Evacuation

Discussion

1) Any public facility in the area which is outside of active landslide area? *(as evacuation place)*

2) How to reach the above evacuation place? *(as evacuation route)*

Request for residents living at priority areas

We might indirectly cause you some troubles during the field survey and monitoring works.

We would like to be informed if you face any problems.

For any queries;

Technical Division
Ministry of Public Infrastructure, National Development Unit, Land Transport & Shipping
Phoenix, Mauritius
Phone:601-1600
Fax: 686-4506

Your understanding and cooperation would be really appreciated.

19. Minutes of 1st Technical Seminar

FOR THE 1ST TECHNICAL TRANSFER SEMINAR
MINUTES OF MEETING

Subject: 1st Technical Transfer Seminar
Organized by:
- Ministry of Public Infrastructure, National Development Unit, Land Transport and Shipping
- JICA Expert Team
Date: 10 October 2012
Time: 10:00-16:00
Location: Kestrel Meeting Room, Swami Vivekananda International Convention centre, Les Pailles.

1. Opening speech 10:00-10:10
Mr. Luchmeeparsad /Permanent Secretary, MPI

He recognised the support of JICA and thanks JICA for this valuable Technical Assistance in a field where Mauritius has no real experience and very scares expertise. Mauritius ministry is doing its level best to safeguard people and their property in landslide prone areas with the help of JICA Expert Team.

2. Keynote speech 10:10-10:20
Mr. Ichikawa/Chief adviser, JICA Expert Team
He introduced Japan situation related to landslide disasters. 'Donation of JICA is not only to teach Mauritians but it is a sharing of knowledge. He also explained framework of JICA's scheme about Climate Change Adaptation.

3. Outline of the Project 10:20-10:35
Mr. Kuwano/Vice chief adviser, JICA Expert Team
- Methods of the project
- 3 area prone to be very risky (Chitrakoot ,Vallee Pitot and Quatre - Soeur)
- JICA project schedule, and landslide management study/plan

4. What is a landslide? 10:35-11:05
Mr. Kuwano/Vice chief adviser, JICA Expert Team
- Definition of landslide, type of landslide movement,
- Outline of landslide investigation and analysis
- Introduction of landslide countermeasures

5. Landslide disaster in Mauritius 11:05-11:35
Mr. Jewon/Deputy director, CE, MPI
- Historical Involvement
- Current Involvement
- Case study
- Warning system/evacuation system

[Question and answers, comment]
UOM – Mr A.Chan Chin Yuk
Italian Team (AAP) has already identified these three sites. However the assessment for the period of 6 month done by Italian Team has not been submitted yet. Why is there a need for duplication of work?

Answer form Mr. Jewon: The assessment by Italian Team (AAP) has been implemented by only topographic feature of 1/50,000 scale map. The assessment is too rough to identify and to evaluate mechanism and risk of the three sites.

6. Basic survey and target landslides 11:35-12:00

Mr. Iwasaki/Landslide survey & analysis, JICA Expert Team

- Topography and geology
- Landslide inventory survey
- Selection of target landslide

[Question and answers, comment]

Mr N.Khedal from Ministry of Environment

He proposed establishments of drain system for the water preservation at the foot of the mountain in Chitrakoot.

Answer form Mr. Kuwano: It is true that landslide movement is highly connected to movement of the groundwater. Therefore the establishments of drain system lead to control landslide movement. Based on the result of investigation and monitoring, JET and MPI will consider countermeasure such as drain system.

Mr N.Khedal from Ministry of Environment

He also introduces a preparation of a refugee center (for tsunami) in Quatre Soeur.

7. Landslide analysis and interpretation 13:30-14:00

Mr. Yokoo/Landslide monitoring, JICA Expert Team

- Principle of stability analysis
- Application of stability analysis for hazard evaluation
- Factor of safety

8. Collaboration with other project (AAP etc.) 14:00-14:30

Mr. Ichikawa/Chief adviser, JICA Expert Team

- Basic project structure
- Activities of development partners
- Similarities and duplications
- The way of maximize the result

9. Survey plan and monitoring for landslide 14:45-15:05

Mr. Yokoo/Landslide monitoring, JICA Expert Team

- Monitoring device
- Utilization method of monitoring results
- Monitoring plan

10. Activity plan 15:05-15:20

Mr. Kuwano/Vice chief adviser, JICA Expert Team

- Evaluation of landslide
- Review of PPG
- Proposal of early warning and evacuation site
- Preparation of guideline/manual

[Question and answers, comment]

Mrs Suntah – Ministry of Housing and Land

MHL needs a proper zoning for landslide area in PPG and they think they should define high risk area on landslide. MHL think that they should rethink the measures (= regulation) for landslide in the PPG.

Mr K.Domah (Head of Works Dept), Moka/Flacq District council

What is methodology of definition of regulated area for landslide?
Answer form Mr. Kuwano: JET think there is 2 methods. One is for active landslide, the site shall be proposed by local authorities to MPI as current method, and MPI shall make a detail hazard investigation for the site, and then the site shall be proposed for "legal area" if necessary. Another is for potential landslide, landslide prone site by topographic condition and land-use condition shall be proposed for "warning area" if necessary.

Mr Ichikawa –JICA Expert Team
Review of early warning system in the "disaster scheme in Mauritius" is necessary for both active and potential landslide.

Mr O.C .Domah -(Head of Works Dept), Black River District Council
He thinks the "legal area" and "warning area" on landslide is important for local authorities. The map which describes the areas is preferable to be distributed to local authorities in the future.
Answer form Mr. Jewon: The map has to be prepared, refined and has to be distributed.

11. Closing speech 15:20-15:30
Mr Jewon /Deputy Director, CE, MPI
It is a great pleasure for MPI Members to work in collaboration with JICA Expert Team. He is happy and appreciates what has been done since JICA started to work with Mauritius.

List of Attendants

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Mr. TAKESHI KUWANO (Vice Chief Advisor / Landslide Management)
Mr. TOMOHARU IWASAKI (Landslide survey and analysis)
Mr FUMIHIKO YOKOO (Landslide Monitoring)
Ms. MARTINE CITON (Project Assistant of JICA Expert Team)
Ms.SOPHIE BUNDUN (Project Assistant of JICA Expert Team)

20. Minutes of 2nd Technical Seminar

FOR THE 2ND TECHNICAL TRANSFER SEMINAR
MINUTES OF MEETING

Subject: 2nd TECHNICAL TRANSFER SEMINAR
Date: 20TH NOVEMBER 2013
Time: 09:30-16:00
Venue: SUGAR BEACH HOTEL, FLIC EN FLAC
Organized by:

- MINISTRY OF PUBLIC INFRASTRUCUTRE, NATIONAL DEVELOPMENT UNIT, -LAND AND TRANSPORT AND SHIPPING (CIVIL ENGINEERING DIVISION)
- JICA EXPERT TEAM

1. Opening Speech by the Permanent Secretary Mr Lutchmeeparsad

He recognized the valuable support from JICA and thanks JICA for their Technical Assistance in a field where Mauritius has no real experience and very limited expertise. Mauritius ministry is doing its level best to safeguard people and their property in landslide prone areas with the help of JICA Expert Team, JICA is providing a technical transfer to the technical division, in accordance an LMU (Landslide disaster Management) is being implemented. JICA with the collaboration of MPI Engineer is working on 3 pilot sites, Chitrakoot, Vallee Pitot and Quatre Soeurs. The handover of the Interim Report will be submitted to the Permanent Secretary.

2. Opening Speech by Mr Ichikawa / Chief Advisor JICA Expert Team

He introduced an overview of Japan situations related to landslide disasters. 'Donation of JICA is not only to teach Mauritians but it is an implementation of the technical transfer and sharing of knowledge.

3. Outline on the progress of the Project by Mr Kuwano /Vice Chief Advisor JICA Expert Team

Explanation on:
Overall goal is to mitigate Landslide disaster in Mauritius
Objectives of the project
Out of 37 sites, 3 area prone to be very risky (Chitrakoot, Vallee Pitot and Quatre - Soeurs)
JICA project schedule and landslide management study/plan

4. Geological Interpretation by Mr Kuwano/Vice Chief Advisor JICA Expert Team

High risk site, landslide movement, surface abnormalities
He elaborated on the survey been made, and the Geological Interpretation followed by the countermeasures been taken in action.

5. Monitoring Results for three pilot sites by Mr Yokoo/Landslide Monitoring JICA Expert.

He elaborated on the measures for landslide disaster mitigation (structural and non-structural measures. He also gives a brief explanation on the different equipment been installed and their functioning and results.

6. Review and recommendation for the disaster scheme by Mr Gonai/Development and Land use JICA Expert.

He explained about the process for making recommendation for Disaster Scheme with the collaboration of relevant ministries and as such stakeholders meeting has been organised so as to collect opinions of the inhabitants.

He also elaborated on the improvement of the warning and evacuation system, MPI responsibilities and the simplification of the warning and evacuation system flow existing 5 stages has been modified to 3 stage followed with the procedures.

7. Review and recommendation for the Planning Policy Guidelines by Mr Gonai/Development and Land use JICA Expert.

Explanation on the process making recommendation for the PPG

Existing legal systems and plans (Overview of Japan landslide disaster) and the actual procedures for the PPG – review of the Legal system schemes for the landslide slope management.

8. Training in Japan by Mr Jewon /Deputy Director, CE, MPI

Elaboration on the training in Japan

Transfer of Knowledge form JICA expert team to the engineer division.

He explained about the amount of works been done in Landslide area while designing countermeasures will be taken on board

9. Priority site and pilot project site by Mr Bissessur/Senior engineer, CE MPI

He elaborated on the decision for selection of pilot site, he gives a brief explanation on the damaged houses, in accordance various countermeasures are being undertaken construction works design , need further investigation with the help of municipalities and EIA... , he takes some references from Japan.

10. Structural Countermeasures by Mr Anadachee /Senior engineer, CE MPI

He gives a brief explanation on the targeted area differentiated in block A and B these area are active area not allow for construction. He explained about the purpose of these countermeasures and the functioning of these equipment he also added that we need a maintenance section to follow up . Different construction of works will be started but there are different issues to be taken into consideration like land acquisition etc..

11. Early Warning and evacuation system by Mr Mosaheb/Senior engineer, CE MPI

He explained about the Hard and soft Countermeasures -warning system simple rain gauge, evacuation process and the zone of the affected area.

He also elaborated on a hand-made rain gauge to show the local organizations each level (75mm for warning, 100mm for evacuation).

He explained about the revolving light that would be installed at the place where extensometer has been installed at school so as to inform the public of the timing of warning and evacuation.

The Alarm System (Visual and sound system working) these have been installed in both Chitrakoot and Vallee Pitot.

12. IEC (Information, Education Communication)/Consensus building By Ms Kawabata and Mr Dabycharun

Ms Yurie explained about the importance of Information, Education Communication)

Brief case studies on Japan. She gives a brief explanation on how do they need to organise stakeholders meetings as sometime the meaning of landslide is unknown to the public. Mr Dabycharun

showed different meeting organised at the 3 pilot sites to inform about the progress of the outcomes of the project .There has been 3 newsletters which has been issued. Finally he showed the work schedule (Future Plan)

13. Pilot Project evaluation by Mr Ramdhan/Senior engineer, CE, MPI
Mr Ramdhan gives a brief explanation on the evaluation of the 3 pilot sites

14. Organizational Reinforcement plan by Ms Yoshida/Capacity Development JICA Team
She explained about the capacity development of the landslide management unit counterpart will form part of the LMU .she gives a brief description of all the component needed to set up the Landslide Management Unit.

15. Activity Plan by Mr Kuwano /Vice Chief Advisor JICA Expert Team
Mr Kuwano explained about the activities which will be undertaken such as the Feasibility Study, Pilot Project consensus building and reporting all these will end up in March 2015.

[COMMENTS AND QUESTIONS FROM THE AUDIENCE DURING THE TECHNICAL TRANSFER SEMINAR]

Municipality of Beau Bassin/ Rose Hill– Mr Oodally
As MPI will improve their knowledge and ability regarding Landslide they can help in examining and determined countermeasures for the other 34 sites. Regarding the hazard map why can't JICA do for the whole of Port Louis .Mr Ichikawa said that the MPI will hand over the Hazard Map to MHL for these to site for the over sites MPI will take over this responsibility.

Mrs Suntah – Ministry of Housing and Land
They need a proper zoning and there is a need to apply and need to be more definite map (Hazard Map as the outline map and ppg work together. Mr Jewon said that a draft of the hazard map will be given for Valle Pitot and Chitrakoot. Can't do a hazard map for the whole of Port Louis City. Mr Ichikawa said that the MPI will hand over the Hazard Map to MHL for these two pilot sites.

Mr Bholah – NDU
His question was about the targeted site, if there has been a plan investigation which has been made. His question has been answered on the different presentation done by JICA Experts.

Final Speech –Mr Jewon /Deputy Director, CE, MPI
It is a great pleasure for MPI Members to work in collaboration with JICA Expert Team.

End of Minutes

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21. Minutes of 1st Advisory Committee in Japan

2012 年 8 月 31 日

議事録（案）

日時：２０１２年８月３１日（金曜日）１９：３０～２１：１５		
件名：モーリシャス国「地すべり対策プロジェクト」第一回国内支援委員会		
所属	役職	氏名
国内支援委員	京都大学防災研究所准教授	福岡　浩
	ＮＰＯ法人砂防広報センター理事長	保科　幸二
ＪＩＣＡ	マダカスカル事務所長	笹館　孝一
	国際協力専門員 アフガニスタン国水・エネルギー省長期専門家	永田　謙二
	アフリカ部アフリカ第三課主任調査役	野口　伸一
	地球環境部防災第二課長	米林　徳人
	地球環境部防災第二課	築添　恵
コンサルタント	総括（国際航業）	市川　建介
	地すべり調査・解析（国際航業）	岩崎　智治
	担当営業（国際航業）	菊池　幸祐
場所：ＪＩＣＡ本部、マダカスカル事務所、アフガニスタン事務所		

概　要：冒頭で、市川総括より、調査概要を説明し、詳細を岩崎団員の方から以下の通り説明があった。

① 【既存資料・情報収集、整理及び分析】現在入手した資料及び、未入手である雨量データの入手時期等の確認。
② 【地すべりインベントリー調査】別添資料１にて、地すべりインベントリー調査結果と対象６ヶ所の地すべり台帳の説明。
③ 【構造物・非構造物対策の実態調査】別添資料１にて調査結果を取りまとめた調査票について説明。
④ 【社会調査】別添資料２にて、社会調査概要の説明。
⑤ 【組織･制度に係る調査】現在調査中の組織･制度に関する情報収集の進捗状況を説明。
⑥ 【経済調査】「モ」国の経済状況、国家開発計画、国家予算、地すべり対策に関わる情報収集についての進捗状況説明。
⑦ 【地すべり危険地の特定】被害状況や地すべりの規模、C/P からの要望を踏まえて、「チトラクート」「カトルスール」「バリーピット」の 3 箇所を地すべり危険地に特定した

⑧ 【モニタリング計画】別添資料３にて、3 箇所の地すべり危険地で策定したモニタリング計画についての説明。
⑨ 【課題の抽出とその対応策】別添資料４にて、地すべり管理計画作成に向けた課題と対応策について説明。
⑩ 【Ｆ／Ｓ】別添資料５にて、現状で想定される対策工について説明。

討議事項：地すべり分野にかかる 6 月 1 日から 8 月末時点までの 3 ヶ月間の実施内容を踏まえ、主に以下のとおり討議が行われた。

【地すべり地の同定と対策】

支援委員・地すべり危険地に特定について、今回示された 3 箇所は妥当であり、この 3 箇所で良いと思う。お金のかからない地すべりモニタリングをＣ／Ｐ自ら提案させ、行政の意識改革をし、また、新聞等の切り抜きなどを利用しつつ、住民に地すべりについて理解してもらう事が重要。

支援委員：今回の地すべり対象ヶ所は、６ヶ所であるが、それ以外にも可能性があるか宅地規制の観点で調べて頂きたい。

コンサル：航空写真からその可能性を調べてみたい。

支援委員：道路計画の際に潜在的な地すべりの可能性などの情報が、災害予防になる。

JICA：チクラク―トでは、地すべり後、住民との話し合いで移転をしない事になったが、その辺をもう少し調べる必要がある。対策工の事業規模についてはどうか。

コンサル：チクラクートは、住民アンケートやＭＰＩへの取材等で、状況を把握したい。チクラクートとカトルスールは、再活動型の地すべりが原因であり、地下水と表面水による影響が大きく、雨のない時は、ほとんど動いていないと判断している。対策工については、地下水排除工や表面水の排水路を考えており、数千万円規模で考えている。場合によっては、アンカーなどの抑止工の実施についても検討したい。

JICA：開発調査では予算が限られているので、Ｃ／Ｐの予算も考慮して、考えてほしい。調査用機材だけでなく、施工用機材の供与も検討する必要がある。

支援委員：今回のプロジェクトの対象は「地すべり」だが、基礎調査で見つかった土石流はモニタリング方法もワーニング方法も違うので、土石流のモニタリング・ワーニングについても少し提案できないか

JICA：今回の対象ヶ所６ヶ所（地すべり箇所）以外の対策については、どう考えているか？

コンサル：６ヶ所は、地すべり対策として捉え、それ以外については、「モ」国に多く存在する土木技術者と対象ヶ所を回り、それぞれの対策方法を技術移転している。

【防災対策・土地規制】

支援委員：他国の事例では違法行為で２０年以上住み続けると土地を取得できるケースも

あり、地すべり地域からの強制移動は難しいケースもある。
コンサル：チクラクートエリアの地すべり地域の下流側に宅地を造成したが、地すべりの活動によってそのエリアは現在 MHL によって立ち入り規制がなされている。
支援委員：雨量によって自分たちで避難できるような災害対策計画を立てる必要がある為、Ｃ／Ｐ自身で、雨量計を使えるようにしなくてはならない。
コンサル：このプロジェクトは環境・気候変動・防災対応策として地すべり対策と海岸保全を実施するものである。「モ」国では、同様な切り口から様々なドナーが入ってきている。この地すべりプロジェクトで今後関連すると思われるプロジェクトに AAP のイタリアのコンサルによる災害リスクプロジェクトがある。このプロジェクトは本年 10 月に完了するが、最近の発表では首相府の災害対策指針である、「Cyclones and other Disasteres」との整合性が問われていた。本プロジェクトにおける地すべり 32 カ所の原点もこの指針を基に調査したものであるため、この指針の内容も踏まえた議論が活発になる可能性がある。
支援委員：学術機関と提携するとプロジェクト修了後の持続的活動も考えられるので、検討して頂きたい。億単位のお金を使えば、衛星画像解析による、地すべりモニタリングができ，地すべり地形判読技術を定着して頂きたい。また、行政だけでなく、民間のコンサルの育成も併せて考えて頂きたい。

【技術移転･住民教育】
支援委員：ワークショップやセミナーを取り入れた本プロジェクトの内容は有効だと考えられる。住民参加型のプロジェクトを推進して頂きたい。
支援委員：メディアの教育も重要で、日本の地すべり学会もそこに注目しており、一般人に対しての啓蒙活動が非常に重要と考えている。
コンサル：通常、他のプロジェクトなどで行われている住民啓蒙活動は、本プロジェクトではＩＥＣという専門分野になっている。この意図としてモーリシャスは国の民度が高いことや、テレビなどによる情報が伝達しやすいことがあげられ、情報伝達網を有効に活用することで効果が発現されると判断している。
支援委員：日本では、コミュ二ティーの消防団や住民組織があるが、モーリシャスではあるか。
コンサル：まだ組織体制の調査結果が出ていないが、少なくとも今までの調査から、防災は自治体が、管理していると理解している。
支援委員：添付資料にモニタリングについて、計測期間が不足との記述があるが、住民の記憶をもとに過去の災害状況を調べる事である程度の補完が可能かもしれないので、聞き取りして情報収集するのも良いと思う。社会調査の際に、2005 年豪雨の際のチトラクートやカトルスール地すべり災害発生時の自治体の対応とその結果（上手く避難ができたか、避難体制が機能したか等）について調査すれば、今後の警戒避難体制の検討に役立つだろう。雨のデータは、何年分か？

コンサル：10 年くらいのデータを想定しているが、他にあるか関係機関に問い合わせてみる。
JICA：10 年程度では少ないと思う。出来るだけ長期間のデータを入手して欲しい。
支援委員：現在現場に設置されている伸縮計はどこの製品か。仕様は。
コンサル：アメリカ製の伸縮計で、データを飛ばして集中管理できる仕組みだが、６台中 4 台壊れ、2 台だけしか使われていない。
支援委員：ウズベキスタン等で使われているアナログ式伸縮計なども有効だと考える。

【ガイドライン・政策への反映・防災組織】
支援委員：ガイドラインついて JICA は、どう考えているか？
JICA：国とプロジェクトによって違うが、日本のガイドラインを押しつけるようなやり方はしない。今後は、先方の状況を見て、決めていきたい。また、「モ」国は、住めるエリアが限られている為、今後、こういった意見が、20～30 年後に活きてくるかもしれない。貧しい人々が、地すべり危険地域に追いやられる時代が来る可能性もある。
JICA：将来のビジョンとして、「モ」国で一緒に調査した技術者より、貧しい人々がもう既に危険地域へ追いやられている状況の説明があった。降雨量のデータは、過去 10 年ではなく、できるだけ遡ってデータを入手し、その中で 2005 年頃の地すべり災害を引き起こした大雨について分析するのが良いと思う。「モ」国に地すべりユニットができないのは、国として、地すべりに対する意識が低いからでは無いか。
JICA：必要な人数と活動に対する TOR がない。資料に書いてある通り、７名がＣ／Ｐとして設定されている。
支援委員：ガイドラインを作るにあたり、「モ」国が自主的に作成し、自ら使えるものにして頂きたい。
JICA：「モ」国にて、以前 JBIC で行ったプロジェクトの C/P は全ていなくなっていたが、今回もそういった事が起こる可能性はないか？技術ガイドラインや PPG への提言は、日本のガイドラインや法令を押し付けるのではなく、モ国側が自主的に作成することが肝要であり、そのための叩き台となるようなものを作成しモ国側の自主的な作成作業を後押ししてほしい
JICA：持続的な組織として、地すべりユニットを残してもらうようにしてほしい。
JICA：調査団の９月、１０月の活動では、対象６ヶ所の政府承認取り付けまで行って欲しい。日本の専門家がいなくなったら、終わるようなプロジェクトではなく、政策まで繋がるような活動にし、今後の協力まで繋げるようにすべき。
JICA：20～30 年後を見据え、地すべり部としての組織を作るのが望ましい。
JICA：イタリアのコンサルの調査結果をよく確認し、本プロジェクトに影響ないか確認していく。
支援委員：日本では、地すべり地形分布図がだれでも見る事ができるようになっており、

「モ」国においても同様の情報提供がでるとこまでいくのが望ましい。また、多くいる土木技術者に地すべりに興味を持って頂き、地すべり専門家が育ってほしい。
JICA：TICAD-V も開催される中、今後、アフリカへの援助が注目されている為、本プロジェクトをしっかり成功させて頂きたい。

以上

22. Minutes of 2nd Advisory Committee in Japan

モーリシャス国
海岸保全・再生に関する能力向上プロジェクト及び地すべり対策プロジェクト

地すべり対策プロジェクト　第 2 回　国内支援委員会　打合せ協議議事録

日時	2013 年 5 月 28 日（火）19:30～21:00	
件名	モーリシャス国海岸保全・再生に関する能力向上プロジェクト及び地すべり対策プロジェクト（地すべり対策プロジェクト）第 2 回　国内支援委員会	
場所	JICA 本部 211 会議室	
出席者 敬称略	国内支援委員（砂防広報センター）	保科　幸二
	国内支援委員（京都大学防災研究所）	福岡　浩
	国内支援委員（JICA　国際協力専門員）	永田　譲二
	外務省国際協力局　国別開発協力第三課	栗山　泰
	JICA 地球環境部　参事役	宮坂　実
	JICA 地球環境部　防災第二課課長	米林　徳人
	JICA 地球環境部　防災第二課	築添　恵
	JICA アフリカ部　アフリカ第三課	飯山　聖基
	JICA マダカスカル事務所所長	笹舘　孝一
	JICA マダカスカル事務所	高橋　薫
	調査団（国際航業株式会社）	市川　建介
	調査団（国際航業株式会社）	桑野　健
	調査団（国際航業株式会社）	岩崎　智治
	調査団（国際航業株式会社）	郷内　吉瑞
資料	1.　次第 2.　説明スライド	

●対象地すべり 3 地区でのハザード評価（調査・解析）に関する協議事項

〔対象地域〕

- チトラクート、カトルスール、バリーピットの 3 地区でハザード評価を実施し、各地で活動的な地すべりブロックを特定し、今後の対策対象ブロックを決定した。例えば、チトラクートでは、当初は大規模な全体ブロックを対象と考えていたが、実際の対策対象は 2 か所の活動的な小ブロックだけとなっている。（調査団）
- 対象ブロック以外でも家屋の被害が認められるが、活動的なブロック以外の状況はどうなっているのか？（笹舘）

  ⇒チトラクートだけでなく、他の 2 地区でも、活動的な地すべりブロックの周辺も含めた範囲で家屋被害調査を実施し、その上で、今後の対策対象とする地すべりブロックを決定した。（調査団）

〔調査・解析手法〕

- 地すべり活動によって孔内傾斜計が機能しなくなった場合、日本独自の技術のひとつである縦型伸縮計など大移動量に対応可能な方法についても検討することが望ましい。国際的にも日本の技術力をアピールできる。（福岡）
- 自立発展性を考慮して、ブロック境界を判定する調査手法等そのものの移転が重要である。（福岡）

- 安定計算に対しては、逆算法だけでなく、一面せん断試験などを使って c とφの妥当性について示すことが望ましい。国際的にも標準となっている。（福岡）

〔地すべり評価〕

- 3 地区の地すべり評価結果および対策工の考え方は、妥当である。（支援委員）
- 累積雨量および連続雨量の違いについて、日本で用いられている降雨量と早期警戒の事例などを踏まえて「モ」国側に紹介することが望ましい。また、警戒にあたり、気象庁が開発した土壌雨量指数などの利用例についても紹介することが望ましい。（福岡）

●ハード対策に関する協議事項

（1）全般

- 排水された水については、地すべりに影響しないよう安全に流下させることが重要である。（永田）

  ⇒了解した。海水の濁度を上げないため、排水を直接海に流さない（一旦河川で土砂を堆積・希釈させる）などして、土砂流出を抑制する環境配慮を行いたい。（調査団）
- 対策工実施に関して、JICA プロジェクトと MPI に役割分担は？（笹舘）

  ⇒プロジェクトでは、チトラクートにおいて安全率 1.10 程度を目標として排水工までを実施する。安全率は 1.20 まで検討するかどうかについては、MPI の判断となるが、プロジェクトでは安全率は 1.20 までの構造物設計までを実施して「モ」国に提案する（対策工事は実施しない）。（調査団）
- 「モ」国側の対策工予算状況、スケジュール・タイミングを考慮する必要がある。（笹舘）

  ⇒　MPI は地すべり対策の予算化を考慮しており、予算確保することは可能。今後、工事の実施時期・内容・費用について精査し、MPI の予算確保を促す。（調査団）
- 対策検討の際、宅地化の需要、移転、対策工の関係をどのように考えているか？（保科）

  ⇒チトラクートは都市部に近く宅地化需要が高いため、構造物対策を実施してでも、宅地住居を確保することが望ましい。カトルスールは地方都市で代替土地も多く、移転とのバランスを考えた構造物対策が望ましい。（調査団）
- 対策実施後、対策工効果判定のため、地下水位などのモニタリングが重要である。特に国道などでの監視・警報システムに活用できると思われる。（福岡）
- チトラクート以外の地区の対策工図面に凡例を付記すること。（笹舘）

（2）チトラクート

- チトラクートでは、活動している A ブロック・B ブロックのみを対策対象とすることは妥当である。（保科）
- チトラクートの地下水位が降雨終了後も徐々に高くなるのは、集水地形の影響と考えられる。対策工設計にも反映できるか。また、地下水浸食が発生している可能性がある。（福岡）

  ⇒山地からの地下水が定常的に提供されており、その影響で地下水位が増加しているものと思われる。また、豪雨時には地表水が溢水しているため、大断面水路で地表水排水を実施することを提案している。（調査団）

- 暗渠工はコストがかかると考えられるが、採用した理由は？（福岡）

  ⇒「モ」国では暗渠工の実績があると同時に、既存の住宅地に影響が出ないよう提案している。（調査団）
- 暗渠工等は地下水排除で効果的であるが、維持管理のコストもかかる。その点についても「モ」国側に十分理解してもらうべきである。（福岡）
- 上部で大断面水路を建設する際、水路を下端として新規の地すべりが発生する可能性があるため、設計時・施工時に考慮する必要がある。（福岡）
- 保全対象、対策工実施の意義は？（米林）

  ⇒A・B ブロック内で住居（25～30 軒程度）、道路（公共バス路線）、再開が望まれている小学校の保全といった社会的意義がある。また、異なる規模の地すべりの調査、さまざま対策工法を学ぶといった観点から意義がある。（調査団）
- 対象地すべり（A・B ブロック）以外の被害状況および対策要望は？（笹舘）

  ⇒現地で住宅被害調査を実施した。結果は A・B ブロック以外でも被害があるが、この被害は地下水による基礎地盤浸食による被害であり（モニタリングから地すべりの活動も見られない）、大断面水路による地表面排水が効果的である。（調査団）
- 宅地化計画があったが、プロジェクトでの対策工実施の関係は？（笹舘）

  ⇒　B ブロック周辺に造成予定地があったが、現在は宅地化は進行していない。B ブロックの安定化が実現すれば、宅地化を進められる可能性がある（ただし、特に危険な地域については「地すべり防止区域」などを指定して開発禁止とする）。開発禁止区域は全体の 1 割を超えないくらいを予想している。（調査団）

  ⇒宅地化計画推進につながる配慮が必要である。（保科）

  ⇒宅地化した場合、住宅の自重により安定化していた地すべりが再度動き出す可能性があるため、配慮が必要。（福岡）

  ⇒検討中の区域指定のアプローチを対応方法のひとつに考えている。（調査団）

（3）カトルスール

- 移転の進捗状況は？（永田）

  ⇒住民に対する移転の交渉中である。移転先の用地・建物は確保されており、概算の移転費用も検討済であるなど、移転作業は順調に進捗している。（大部分の住民が合意しているが、漁師などは移転に反対している。調査団）
- 移転の進捗状況に応じて構造物対策は変更することを考えているのか？（永田）

  ⇒移転の状況により対策が変わる可能性がある。移転しない場合は構造物対策が重要となる。移転後も地すべり末端の国道についてもリスクが残るため、表面排水程度が必要である。移転・警戒（ソフト）と対策工（ハード）のバランスおよび、国道をどのように扱うかについて、MPI と協議のうえ進めていく。（調査団）
- 住居を撤去した場合、地すべりリスクが低くなるか？（永田）

  ⇒「モ」国の住居はブロック積構造物が多く重量が大きいため、地すべりは安定する方向に向かう可能性が高い。（調査団）

●ソフト対策に関する協議事項

〔早期警戒避難システム〕

- 早期警戒・避難については、住民参加が重要なポイントになる。(保科)
- 国民性や文化など「モ」国の事情を考慮した提言・アプローチ・法制度が求められる。(福岡)
- 日本の事例でも、住民がハザードマップにしたがい不適切な避難場所・避難経路を選択したことにより被害が出たケースがある。そのため、最悪のシナリオを想定して、住民教育を実施することが望ましい。また、避難ルートは個々の家屋ごとに避難途中の安全を検討し、慎重に決めてほしい。(福岡)
- システムの維持管理コスト負担は？(永田)

  ⇒MPI が予算化して維持管理を行う。(調査団)
- 早期警戒の住民によるモニタリングデータ確認について、豪雨時は外に出ることが危険と考えられるが、問題ないか？住民による自主的な警戒・避難が機能するか？(高橋)

  ⇒村長など信頼性の高い人間を連絡係とする。村長から SMF に固定電話で連絡することで携帯電話不通の事態に対応できる。避難には SMF の特殊車両など使用することが可能である。(調査団)

〔PPG〕

- 住民に対する防災教育について、日本の事例などを具体的に組み込む必要がある。(米林)
- 住民教育では、地すべりだけでなく、急傾斜地崩壊や土石流についても教示することが望ましい。(福岡)
- 各項目に対するバックデータ・課題を十分に整理したうえで、提言する。(米林)
- 提言に際しては、開発と安全保障のバランスについて配慮が求められる。(米林)
- JICA、「モ」国政府(MPI、住宅土地省など)、自治体、住民の役割分担を明確にした提案が望ましい。(保科)
- 提言には、建築規制(高さ規制など)や水処理について言及することを検討する。(福岡)
- 地すべり防止地区など土地利用規制については、住民や関係機関からの反対も予想されるため、「モ」国の状況を勘案したものとする。(福岡・米林)
- 土地利用規制に係る規制区域の判定法についても技術移転することが望ましい。(福岡)
- 各自治体の地域計画の改訂は、PPG 提言を考慮するべきである(高橋)

  ⇒PPG への提言が本プロジェクトの業務の範囲とされているが、現在進行中のポートルイスの地域計画改定作業に本プロジェクトの成果を提供することで、地域計画に斜面災害リスク管理の視点が組み込まれるよう働きかけている(調査団)

●LMU の組織強化計画に関する協議事項

- MPI(LMU)の緊急対応では、災害発生時点での対応と、被害が起きた後の復旧について明確に分けて整理するべきである。(永田)
- SMF、MPI、住民の役割分担を明確にした提案とする。(永田)

●総評

- 個別のハード・ソフト対策はそれを実施するエリアの社会的背景、行政面で対応策などを総合的に鑑みた上で説明されなければならない。対策の説明にはエリア毎の（ソフト・ハードの）課題に対して適切であるかどうかの判断材料を提供すべき。（米林）
- TICAD でも防災は重要視されているので、引き続き協力を望んでいる。（栗山）
- 早期警戒避難システムに対して、気象レーダを活用する案件の形成について検討していきたい。（栗山）
- 防災案件は、日本の強みを生かせる分野であり、今後も継続的に実施していきたい。（飯山）

以上

23. Minutes of 3rd Advisory Committee in Japan

モーリシャス国
海岸保全・再生に関する能力向上プロジェクト及び地すべり対策プロジェクト

地すべり対策プロジェクト　第３回　国内支援委員会　打合せ協議議事録

日時	2013 年 10 月 30 日（水）17:00～19:30	
件名	モーリシャス国海岸保全・再生に関する能力向上プロジェクト及び地すべり対策プロジェクト（地すべり対策プロジェクト）第３回　国内支援委員会	
場所	JICA 本部 229 会議室	
出席者 敬称略	国内支援委員（砂防広報センター）	保科　幸二
	国内支援委員（京都大学防災研究所）	福岡　浩
	国内支援委員（JICA　国際協力専門員）	永田　譲二
	JICA 地球環境部　防災第二課課長	米林　徳人
	JICA 地球環境部　防災第二課	平野　潤一
	JICA アフリカ部　アフリカ第三課	飯山　聖基
	JICA マダカスカル事務所	高橋　薫
	調査団（国際航業株式会社）	市川　建介
	調査団（国際航業株式会社）	桑野　健
	調査団（国際航業株式会社）	岩崎　智治
	調査団（国際航業株式会社）	郷内　吉瑞
資料	1.　次第 2.　説明スライド	

●はじめに：国際協力における防災の動向

- TICAD V では防災の主流化が明文化されるとともに、2015 年には仙台で世界防災会議が実施される。UNDP、フランス開発庁、UNICEF 等も防災案件に強く興味を示しており、今後も防災事業は重要な位置づけとなる。また、2015 年の MDGs に防災が取り入れられようとしているほか、COP19 に防災案件が組み込まれるなど、気候変動の観点からも注視されている。（米林）

●優先地域とパイロット地域の選定に関する質疑応答

- チトラクートは、大規模地すべりであり多種の対策工が可能であること、日本の対策事例を参考にして対策工法を検討できること、首都圏に近く地理的優位性もあることなどから、優先地域・パイロット地域として選定したことが妥当である。（福岡）
- 優先地域の選定過程（得点設定、現況安全率など）に関する客観的な説明が必要である。（福岡）
- 選定にあたっては「本事業が「モ」国のモデルケースとなり得る」という視点が必要であり、その点についても MPI に説明する必要がある。（保科）
- チトラクートで MPI からの要望が高いという点について、MPI から要望書を取り付ける。（米林）
- 選定にあたり、EIA を十分に実施して検討する必要がある。（米林）

●パイロット事業（チトラクート構造対策工）に関する質疑応答

- ラビュッテ地区で 1980 年代に実施された日本の対策工事との違いは？（福岡）

- ラビュッテでは日本の最先端技術を前面に出し、杭などの抑止工を主体としたが、「モ」国独自で実施できる対策工法ではなく再現性はなかった。チトラクートでは抑制工が主体であり「モ」国での普及発展を念頭において対策工法を選定している。（調査団）

- 洪水用大断面水路の水処理を十分に実施する必要がある。例えば山側から水は砕石などにより十分に水抜きを行い、谷側には水路の水が浸透しない工夫が必要である。また、建設後の維持管理をどのように実施するかを考慮する。施工後の効果判定のため、周辺水位のモニタリング等を実施するべきである。（福岡）
- 洪水用大断面水路の必要性について理由を明確にしておく。（保科）
  - 現在活動中の AB ブロックへの雨水進入を防ぐほか、AB ブロック以外の地すべり活動の緩和のためにも有効である。（調査団）
- 水平ボーリング工について、すべり面が確定してない段階で実施することについての見解を整理しておく。ただし、短期間プロジェクトで対策工法の技術移転をしなければならないという点で、やむを得ないということは理解できる。（福岡）
- 水平ボーリングは目詰まりが危惧される。維持管理について配慮が求められる（保科）
  - ブラッシングや高圧水により、「モ」国でも維持管理可能である。維持管理の重要性について MPI に説明済みで、今後ワークショップで説明を行っていく。（調査団）
- 明暗渠工について、「モ」国で頻繁に用いられている工法ということであれば、効果が期待できる。（福岡）
- 明暗渠工の流水量選定のための降雨強度 50 年確率について、その妥当性について説明する必要がある。（保科）
- 明暗渠工で表流水を渓流に流すことによって下流への影響（洪水など）を検討する必要がある（米林）
  - 既往河川で流下させるため問題はないが、既存河川の最大流量等を今後、「モ」国の河川関係当局に確認する予定である。（調査団）
- 本対策工をモデルケースとして、「モ」国で普及するための取り組みや技術移転が求められる。（保科）
- 全体地すべりと AB ブロックに対する対策工の関係（AB のみの対策工をすれば問題ないのか？）についての解説が求められる。（永田）
  - 全体地すべりは安定しており、AB ブロックの顕著な動きが観察されているため、AB に注力することとする。（調査団）
- 対策工の施工前後のモニタリング結果を比較するなどして、対策工の効果判定を実施する必要がある。（福岡）
- 各対策工が地すべりの何にどの程度寄与するのか（効果判定・評価）を技術移転することが望ましい。（永田）
  - 既存の水位観測孔などによる地下水位低下による効果を判定する。その解説を MPI に実施する。（調査団）
- チトラクートの地すべり特性を踏まえた上で、選定対策工法が適正技術であるかどうかを整理する。（米林）

- パイロット事業の対策工事費の税金は免除になるか？（米林）
  - 現地再委託費に係る VAT は返金される（調査団）
- 援助の妥当性を説明するため、パイロット事業における対策工選定のプロセスを理解させ、その技術移転を行い各対策工法のメリット・デメリットの比較表などを整理する。（米林）
- チトラクートの住民移転計画はあるか？（米林）
  - 現状では、ない。（調査団）

●早期警戒システムと避難に関する質疑応答

- 住民による「自主避難」は「モ」国では効果的であると思われる。（福岡）
- 住民への啓蒙活動にサイレンや回転灯を使用する（通常使われない機材に住民は関心を持たないため、警報機材が普段から機能していることを住民に周知するなど)。（福岡）
- 避難時に考えられ得る全てのシナリオ（地すべりと同時に洪水が発生するなど）を考慮して、住民への教育や避難経路の設定などを行う。（福岡）
- 自主避難について、誰が観察し、誰が自主避難の判断を行うのか？この点について検討が求められる。（保科）
- 自主避難に関する責任の所在を整理しておく（自主避難時に行政の責任はどうなるのか等）（永田）
- 自主避難は現在の「モ」国において実際に実施可能であるか？（永田）豪雨時にサイレンが聞こえないなどの問題があるため、工夫が必要である。（福岡）
  - 警戒・避難の基準値を複数（伸縮計、雨量計、目視）設けることにより、実施可能性を高めている。（調査団）
- 自主避難が機能するかどうかは地域差があることが多く、方法論について十分に検討する。（米林）
- 「モ」国で警察が主体となって実施している住民避難訓練の取り組みはすばらしい。住民だけでなく行政側も地すべり災害発生時の対応模擬訓練をすることを検討する。（福岡）
- 避難訓練を実施して、要援護者支援、避難所運営などなどの課題を整理して、改善案を提言するべきである。（平野）
- 住民教育の際、地すべりメカニズム・原理を理解させることにより災害時の適切な対応を独自で考慮できる可能性がある。（福岡）
- 地すべりを含めた防災一般の解説を、セミナーや住民説明会で実施することを検討する（保科）
- 小学生に対する防災教育（回転灯・サイレンの説明、避難経路のまちあるきなど）を検討する。（他プロジェクトでの資料提供可能）（平野）
- 警報の空振り率を考慮すべきである。空振りが続いた場合、自主避難への意識低下が懸念される。（永田）
  - 住民理解が重要であり、住民説明会で十分な理解を求める。基準値は仮であり、次回雨期を踏まえて随時見直を行うことで関係者に理解を得ている。（調査団）
- 警戒避難の基準値が変わり得ることについて MPI や住民に説明・技術移転が必要である。（平野）
- 基準値を検討する際、土壌雨量指数を活用することは有用である。「モ」国で時間雨量がない場

合は、TRMM（全球で 3 時間毎の雨量が 10 年分蓄積）を用いることによって検討可能である。（福岡）

- 今回は過去の気象庁の日雨量データを用いて解析を実施した（IT/R 記載）。プロジェクトで設置した雨量計を元に、次回雨期の計測結果から土壌雨量指数の活用について検討する。（調査団）

- サイレン・回転灯の盗難、バッテリー切れに対する配慮はどのように考えているか。また設置したポールはサイクロンで破損しないか。（米林）
  - 計器そのものは、伸縮計の保護フェンス内に設置している。チトラクートのサイレン・回転灯は学校敷地内の高所なので問題ないと考えている。バリーピットではサイレン・回転灯を防護柵で囲った。バッテリーについては、「モ」国で調達可能な機材構成とした。ポールは十分な強度を持っているため問題ない。（調査団）
- 警戒避難の基準値は誰が決定したかを明確にしておくべきである（基準以下で被害が出た場合への責任問題）。（米林）
  - 調査団の助言に基づいて、MPI が決定する。（調査団）

●災害スキームと PPG への提言に関する質疑応答

- 条文の英語表現を適正化する。（福岡）
- 開発可能区域の見直しのための基準は何か？（保科）
  - モ国では市街化調整区域の柔軟な見直しの動きがある（PPG 及び自治体の地域計画に記載されている）。しかし、見直しに係る検討されるべき点、留意点、基準などが示されていない。これについて補足の提言を行っている（調査団）
- 「モ」国に開発可能区域の見直しができる具体的な場所は存在するのか？あれば例示するべき。（永田）
- MPI の責任範囲を限定した場合、MPI と他省庁・自治体とのデマケを明確にし、ステークホルダー会議などで説明する必要がある。（保科）
- 行政職員の能力強化の具体的手順を明確にするべきである。（保科）
- 「モ」国の防災体制・法制度の変更が検討されており、十分に情報収集を行い、PPG や災害スキームに反映し、実際に機能する PPG や災害スキームとする。（高橋）

●プロジェクト全体に関するコメント

- 災害のシナリオに明確にするべきである。（福岡）
- サイレンが誤動作した場合の解除はどのようにするのかを検討しておく。（福岡）
- チトラクート全体地すべりのモニタリング、対策効果判定のため、水準測量等を実施することを MPI に提言する。（福岡）
- Wi-Fi データ転送可能な傾斜計・土壌水分計を導入して地すべり変位を観測できた事例もある。「モ」国でも検討してはどうか。（福岡）
- 地すべり面が浅い場合、高層建築物の基礎杭などでも抑止工の役割を果たす可能性がある。このような点について検討してはどうか。（福岡）

- 本プロジェクトの成果を国際学会で発表してはどうか。（福岡）
- 自主的にハード・ソフト、設計、施工、維持管理でき来るよう技術移転・プロジェクト運営をして欲しい。（保科）
- 本プロジェクトの成果を日本の地すべり学会で発表してはどうか。（保科）
- 今後の提言については C/P と協働で実施することとし、MPI の主体性を引き出すようにする。ただし、MPI だけでなく「モ」国全体を考慮する。（平野）
- 防災の主流化の中でバイアスがかからないよう留意する。（平野）
- 住民に対して十分なリスクコミュニケーションを行う（例えば、警報システムは地すべり用であり洪水には有効ではないことを住民に説明し、誤解を避ける）。（平野）
- 先方政府が主体的な活動を行うことを前提とする。リスクについて良くコミュニケーションを図り責任の所在を明らかにする。（米林）

- 本委員会での協議をもって、IT/R の内容は決定されたこととする。IT/R には根拠となる各種データを入れるとともに、今後実施する活動内容についても明記する。（米林）

以上

24. Minutes of 4th Advisory Committee in Japan

モーリシャス国
海岸保全・再生に関する能力向上プロジェクト及び地すべり対策プロジェクト

地すべり対策プロジェクト　第４回　国内支援委員会　打合せ協議議事録

日時	2014 年 12 月 24 日（水）16:00～17:50	
件名	モーリシャス国海岸保全・再生に関する能力向上プロジェクト及び地すべり対策プロジェクト（地すべり対策プロジェクト）第４回　国内支援委員会	
場所	JICA 本部 229 会議室	
出席者 敬称略	国内支援委員（砂防広報センター）	保科　幸二
	国内支援委員（新潟大学災害・復興科学研究所）	福岡　浩
	国内支援委員（JICA　国際協力専門員）	永田　譲二
	JICA 地球環境部　防災第二課課長	米林　徳人
	JICA 地球環境部　防災第二課	平野　潤一
	JICA マダカスカル事務所　所長	西本　玲
	JICA マダカスカル事務所	高橋　薫
	調査団（国際航業株式会社）	市川　建介
	調査団（国際航業株式会社）	桑野　健
	調査団（国際航業株式会社）	岩崎　智治
	調査団（国際航業株式会社）	吉田　悠
資料	1.　次第 2.　説明スライド	

●チトラクート地すべり構造物対策に関する質疑応答

- 大断面水路工の水路壁谷側には遮水シートを設置しているとのことであるが、水路壁山側において漏水対策を行っているか？地下水が水路工の下部を流れ出る恐れがあるのではないか？（福岡）
  - 水路壁山側には遮水シートは設置していないが、大断面水路工から取り逃した地下水をとるため、地すべり地内において暗渠工を設置した。（調査団）
- パイロット工事後の地すべり対策効果はどの程度か？（福岡）
  - 対策工完成直後であり、現在、雨季前であるため雨が少なく確認できていない。1 月以降モニタリングに注視するが、地下水位の上昇を抑えられることを期待している。（調査団）
- 本プロジェクトにおいて、地すべり調査・解析・設計・施工を網羅する多種多様な活動を実施したことは賞賛に値する。ただし、各活動の目的をやや曖昧であり、それぞれ活動が今後「モ」国においてどのように活用されるのか明確にする必要がある。（保科）
  - 技術移転の意味もあることから、なるべく多くの活動を網羅した。本プロジェクトを通して MPI 側が実施すべきタスクを理解し、地すべりのハード・ソフトに係る対策の新たな組織・体制を構築した。今後これらの組織により、「モ」国の地すべり対策が実施されていく。（調査団）
- 対策工法について、1990 年代に実施された JICA 案件の集水井を選定しなかった理由は何か？また、アンカー工を選定しなかった理由は？（永田）
  - 90 年代の対策工は日本の企業が実施したが、本プロジェクトでは、今後「モ」国側のみで実施できることを目的としている。「モ」国側のみで実施するためには、機材、技術、維持

管理等の観点から難しいと思われ、水路工や水平ボーリング工など持続可能な工法を選定した。（調査団）

- 対象地区が住宅地且つ緩斜面であるため施工が難しく、アンカー工を選定しなかった。（調査団）

- 発生機構からアースフローの可能性があり、アースフローではアンカー工や集水井の効果は低いと考えられる。集水井内部からの水平ボーリング等であれば効果を期待できる。（福岡）
  - 「モ」国側で将来的に実施可能な追加対策工事について報告書で言及する。（調査団）
- 地下水位がどの程度下がることを想定しているか？（永田）
  - 場所によって異なるが、全体的に地下水位が 2～3m下がることを想定している。当初 Fs=0.98 と想定しており、工事後は Fs=1.05 として計算を行っている。今後、Fs=1.20 程度まで上げる場合は、アンカー工等の追加工事が必要となる。（調査団）
- パイロット工事でのキャンセル区間について、次年度に MPI が引き継いで実施予定とのことであるが、実施されるまでの洪水の発生を懸念している。（米林）→MPI への引き継ぎ MOU に記載する。（調査団：事前打合せでの協議事項）
- 地すべり対策工事を MPI に引き継ぐ場合、水路工への立入り禁止の看板設置やゴミ捨て防止などの啓蒙活動を MPI が対応するようにする。（米林）→MPI への引き継ぎ MOU に記載する。（調査団：事前打合せでの協議事項）
- 附帯工の橋梁について、2013 年伊豆大島で発生した土砂災害では流木等が橋梁に詰まり土砂が氾濫して被害が発生している。本工事の橋梁は問題ないか？（福岡）
  - 集水面積および確率雨量から流水量を考慮した深さ・幅を十分にとっており問題ない。ただし流木については､同様の懸念があることから､日本での事例を MPI に伝え注意を促す。また、報告書にも留意点として記載する。（調査団）

●早期警報・避難システムに関する質疑応答

- チトラクート地区の地下水位モニタリングに関して、季節変動はあるが降雨量による日・時間変動はほとんどないとのことであるが、ボーリン掘削深度が 30m程度とすべり面より、かなり深い。掘削深度がすべり面程度（地すべり土塊内）であれば、日・時間変動が認められる可能性ある。早期警戒・避難の指標を設定する場合、地すべり土塊（深度 6m以浅）における地下水位の変動を考慮する必要がある。（福岡）
  - 地すべり土塊内であれば、日・時間変動が認められる可能性ある。ただし、モニタリングデータが少なく判断は難しい。地下水変動について再度検討し、基準値設定の技術的根拠を明確にする。（調査団）
- 地下水の季節変動、日・時間変動のメカニズムを整理したうえで、警戒基準案に示されている 5mm や 20mm の技術的根拠を示すべきである。また基準値は一律ではなく、対象 3 地区でも各地すべりに対して基準値を設定すべきである。（福岡）
  - 基準値設定の技術的根拠を明確にする。（調査団）
- 地下水位観測値等は、情報通信技術（ICT）を使って一般（地域住民）に情報公開している事例もある。（福岡）

- 近年、降雨量と地すべり活動が必ずしも高い相関を持たないということは一般的な考え方になっているので、降雨量を警戒・避難基準値に用いないということも現実的であるが、基準値設定の技術的根拠やデータの検証が必要である。（保科）
  - 基準値設定の技術的根拠を明確にする。（調査団）
- 早期警戒・避難システムは 3 地区のみであり、「モ」国でのシステムとしては完成していない。プロジェクト終了後も MPI が基準値の更新やシステム構築を進め、全国展開するべきである。（保科）
- 早期警戒・避難を検討する場合、地下水の変動がやはり重要である。ハード対策として実施した水路工や排水工の対策により、地下水位を低下させる効果は十分であるか？（永田）
  - 今後のモニタリングで検証する必要があるが、地下水位の低下が不十分の場合は追加の水平ボーリング等で対処する必要がある。（調査団）
- 警戒基準案において、家屋内の変状が基準の一つとなっているが、地すべりブロックが大きい地域においては家全体が動き、クラックが発生しない家もあるのではないか？（永田）
  - 地すべりが活動しても家屋にクラックが発生しないことはあり得る。基本的に家屋が崩壊しなければ、住民の生命は守られることになる。（調査団）
- 家屋内の変状を警戒基準案とすることは、判定が難しいが、現実的であり良いと思う。（保科）
- 中国では家屋のクラックに防犯センサー（変位があると警報を鳴らすもの）を設置して対応した例がある。クラックの発生・伸展を伝えるシステム作りが重要である。（福岡）
- 家屋内の変状を警戒・避難に活用する場合の情報伝達システムが難しいので、十分考慮する必要がある。（永田）
- 調査団提案の「住民の生命のみを守る」という表現はやや閉鎖的である。（保科）
  - 「のみ」を削り、「住民の生命を守る」という表現に変更する。（平野、調査団）

●プロジェクト全体に関するコメント

- プロジェクト成果の一つとして、技術能力強化が挙げられているが、技術移転が各項目において誰に行われたのか記載したほうが良いのではないか？（保科）
  - 調査・解析・施工監理の全ての課程において CP を巻き込んで業務を実施している。MPI の組織体制も強化されており、プロジェクト終了後 CP だけで地すべり対策を実施できるようにしている。（調査団）
  - 記載箇所・方法については調査団と今後相談する。報告書 7 章に技術移転項目があり、各項目の成果についてプロジェクト当初と終了時の比較があると良い。（平野）
  - CP の人事異動があるため個人名を記載することは難しいが、課を示すことは可能である。（米林）
- エチオピアでは CP の職員離職率が高いことが問題になっていたが「モ」国ではどうか？（福岡）
  - 2015 年夏に 1 人異動予定であるが、それ以外の CP は全員留まる予定であり、本プロジェクトの移転技術を今後も活用できる。（調査団）
- 現在、気象関係の技プロが実施されており、本プロジェクトと相乗効果を持つようにしたい。また斜面災害アドバイザーを要請しており、パイロット事業の成果が引き継がれるとともに定

着するよう、同アドバイザー派遣に向けて引き続き取り組んでいく。（高橋）

- 持続可能性という観点から、対策工・機材の維持管理能力が強化されることを望んでいる。また、モニタリング機材（伸縮計等）の自主制作の努力も必要である。（福岡）
- 対象地区の住民に対して、地すべりの機構や誘因等の理解を促すことが重要である。また、今後コミュニティ内においてデータを読める住民や機材の維持管理を行う住民の養成が望ましい。（福岡）

●報告書に関するコメント

- DFR に対するコメントは 1 月 9 日までに提出することとする。（平野）
- MPI への引き継ぎ事項、早期警戒・避難の基準値の技術的根拠等を報告書に記載する。（米林）
- 今後、報告書が CP のみならず関係機関にも活用されるよう、各関係機関の役割分担を明記する。（米林）
- セミナーやステアリング・コミッティで関係機関の役割分担を説明するべきである。（米林）
- 報告書が関係機関に配布されるよう CP に呼びかける。また、ステアリング・コミッティやセミナーでは関係機関を招聘し、特に地方自治体の参加に配慮する。（高橋）

以上