

Chapter 7

Conclusion and Recommendation

CHAPTER 7 CONCLUSION AND RECOMMENDATION

7.1 CONCLUSION

“The Study on Flood Control and Landslide Prevention in the Tegucigalpa Metropolitan Area of the Republic of Honduras” has been completed. There are three purposes of the Study, namely, the establishment of the Master Plan, the Feasibility Study of the Priority Projects and the technology transfer.

The disaster prevention master plan including the flood damage mitigation plan and the landslide damage mitigation plan by structural and non-structural measures was made targeting a storm with a scale of Hurricane Mitch. Implementation of the proposed Master Plan will enable the Municipality of Tegucigalpa to create a safe city in terms of flood and landslide.

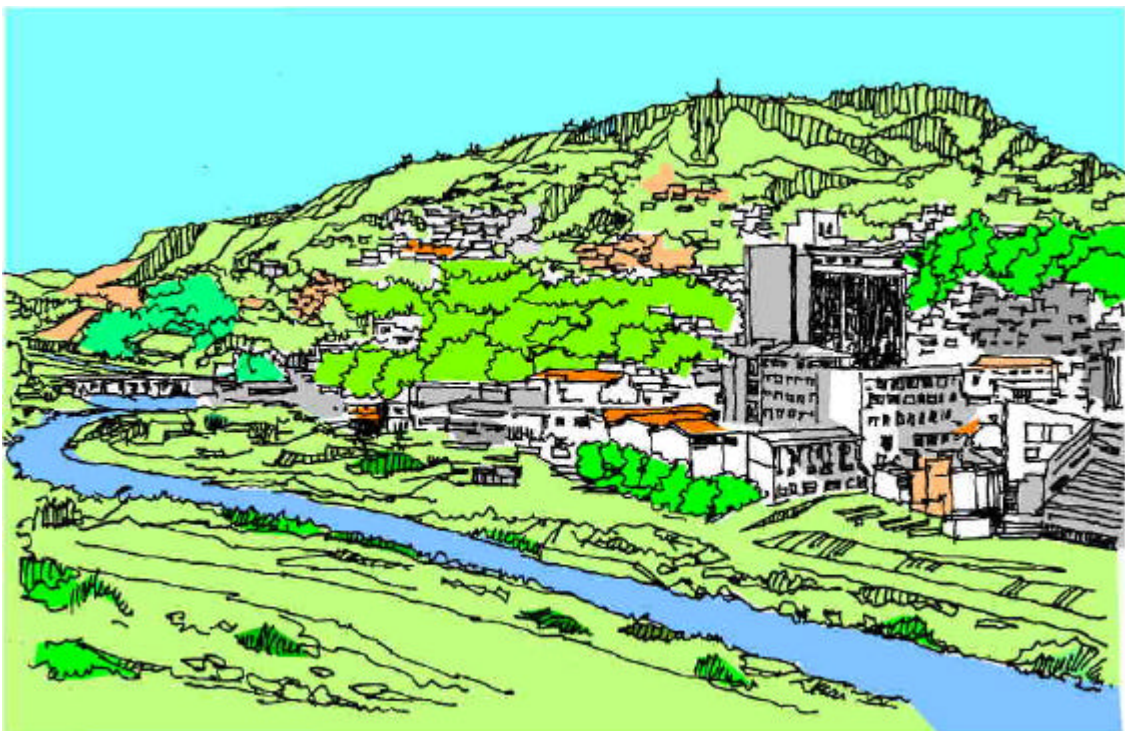
The Feasibility Study of the Priority Projects showed that those projects are feasible from economic aspect, financial aspect, environmental aspect and social aspect. It was concluded that implementation of the Priority Projects will give great benefit to the city.

Technology transfer was made through the Study. On-the-job training was made through the discussion on various problems in the projects, the field trip of the counterpart team members together with the Study Team members and through the participatory workshop among the counterpart team members.

7.2 RECOMMENDATIONS

It is recommended that:

- (1) The Master Plan proposed in this Study should be designated as the official disaster mitigation master plan for the city of Tegucigalpa by the central as well as the local government of Honduras,
- (2) In order to create a safe capital against storms, this disaster prevention master plan should be implemented according to the proposed schedule,
- (3) The Priority Projects should be implemented urgently to bring about immediate consequence of the plan,
- (4) It is necessary to update this Master Plan with the development of the city to cope with the change of natural and social background of the plan, and
- (5) All parties concerned should cooperate in order to make Tegucigalpa City a safe capital.



Tables

Table 2.1 Stratigraphic Table in Target Area

Era	Period	Epoch	Symbols	Features	
Cenozoic	Quaternary	alluvial	dt	Detritus sediment (based on a landslide, a slope failure, etc.). It consists of debris and earth and sand.	
			Qa1	The latest alluvial sediment. It consists of clay, sand and boulders.	
			Qe3	Lower terrace sediment : Fan of Sands and cobbles	
		pleistocene	Qe2b	Terrace sediment of middle rank : It consists of sand and stones. A matrix is not solid. An old fan or the sediment on the bottom of a river. It mainly consists of volcanic rock after the Tertiary. The color is from dark gray to gray.	
			Qe2a	Terrace sediment of middle rank : It consists of sand, stones, and silt. Tightness is good although a matrix is not solid. An old fan or bottom of river, and the sediment of a lake. It mainly consists of rock of Valle de Angeles group, and volcanic rock after the Tertiary. The color is from dark brown to blackish brown.	
			Qe1	Higher terrace sediment : It mainly consists of sand and stones, and tuff layer is inserted. By oldest terrace deposits, the matrix is consolidated weakly.	
			Qb	Lava of basalt (olivine slanting feldspar and scoria)	
			Qan2	It is distributed on the hill of Cerro Grande. It consists of andesite lava. Although the rock itself is precise hard, joint progresses and it is easy to dissociate massively. In the border part of a range, this stratum serves as cap rock and tends to cause a landslide.	
			Qan1	It is distributed over the low rank of Qan2. It consists of andesitic and rhyolitic tuff. Banded structure progresses. It is weak in weathering and easy to deteriorate in it. It becomes the cause of a landslide rarely.	
			Odt	It is mainly distributed near a Villa Nueva area. It consists of debris of the stones which made the subject rhyolite with a diameter of 20cm – 3m, and has a Vallu de Angeles Group origin. Half a matrix is solid, tightness is good.	
			Tertiary	miocene(Padre Miguel Group)	Tpm3
		Tep			It consists of rhyolitic tuff and conglomerate, sandstone, and siltstone. It deposits in underwater environments, such as a river. Stratified structure progresses almost horizontally. It is easy to dissociate from a stratum side, and may become the cause of a landslide in the part where the stratum inclines.
		Tcg			Cerro Grande member: Ignimbrite and rhyolite lava equipped with the matrix of crystals of the glassy quartz and crystal feldspar of a violet color. The rock itself is very hard, it is strong in weathering, and tends to form a steep cliff. Logic progresses and it is easy to dissociate. When this rock is distributed on a layer with weak intensity, this rock serves as cap rock and it is easy to generate a landslide. The deterioration action is received locally, and in the portion, intensity is falling remarkably and it is easy to generate a slope failure.
		Tpm2			Ignimbritic sequence middle member: Tuff by which quartz andesite nature was divided by class by style rhyolite. Banded structure progresses and it becomes the cause of a layer slide.
	Tpm1	Member of an Ignimbritic sequence low rank: Tuff of rhyolite of many colors. Some sedimentary rocks equipped with volcanic debris, tuff of quartz andesite nature, and andesitic tuff.			
	Tpm1	Lahars (debris flow tuff) with clast of tertiary volcanic rocks and cretaceous sediments. It consists of debris and consolidated sandstone. It is hardly the cause of a landslide by massive and hard ones.			
		oligocene (Matagalpa F)	Ti	Rhyolitic intrusive rock which is intrusive in Vallu de Angeles Group: Generally along with a dislocation, it is distributed, deterioration is given to Vallu de Angeles Group, and it is easy to become the cause of a slope failure.	
			Tm	Matagalpa formation: It consists of tuff, tuff breccia, and the andesite lava which presents a green color as it's base. It is easy to weather and changes in the shape of clay easily near the surface of the earth. For this reason, it is easy to become the cause of a landslide.	
	Mesozoic	Cretaceous (Valle de Angeles Group)		Krc	Rio Chiquito formation: It consists of mudstone, siltstone, sandstone, thin conglomerate layer, and thin limestone layer. Stratified structure is made. It's colors are blackish brown. It is easy to weather and changes simply to earth and sand. It is the stratum which is easy to generate a landslide and a slope failure.
Kvn				Villa Nueva formation: Conglomeratic siliciclastic layers (with clast of metamorphic and volcanic rock and limestone). Brown to light red sandstone and some volcanic tuff. Stratified structure progresses partially. It's colors are thin red to dark purple. Although it is strong compared with Krc, the landslide is generated locally.	

Table 2.12 Bank Condition and Hinterland along the Choluteca River (1/3)

Section No.	Left Side			Right Side		
	Revetment	Bank Erosion	Hinterland	Revetment	Bank Erosion	Hinterland
0	no revetment		flood area	no revetment		factory
1	no revetment		flood area	no revetment		factory
2	no revetment		flood area	no revetment		factory
3	no revetment		flood area	no revetment		factory
4	no revetment		flood area	no revetment		factory
5	no revetment		flood area	no revetment		factory
6	no revetment		flood area	no revetment		factory
7	no revetment		flood area	no revetment		factory
8	no revetment		flood area	no revetment		factory
9	no revetment		flood area	no revetment		slope land
10	no revetment		flood area	no revetment		flood area
11	no revetment		flood area	no revetment		flood area
12	no revetment		slope land	no revetment		flood area
13	no revetment		slope land	no revetment		flood area
14	no revetment		slope land	no revetment		flood area
15	no revetment		cliff	no revetment		flood area
16	no revetment		cliff	no revetment		flood area
17	no revetment		cliff	no revetment		flood area
18	no revetment		cliff	no revetment		flood area
19	no revetment		cliff	no revetment		flood area
20	no revetment		cliff	no revetment		flood area
21	no revetment		cliff	no revetment		flood area
22	no revetment		cliff	no revetment		slope land
23	no revetment		cliff	no revetment		slope land
24	no revetment		cliff	no revetment		slope land
25	no revetment		slope land	no revetment		cliff
26	no revetment		slope land	no revetment		cliff
27	no revetment		slope land	no revetment		cliff
28	no revetment		flood area	no revetment		cliff
29	no revetment		flood area	no revetment		cliff
30	no revetment		flood area	no revetment		cliff
31	no revetment		cliff	no revetment		cliff
32	no revetment		slope land	no revetment		cliff
33	no revetment		slope land	no revetment		slope land
34	no revetment		cliff	no revetment		slope land
35	no revetment		cliff	no revetment		slope land
36	no revetment		cliff	no revetment		slope land
37	no revetment		slope land	no revetment		slope land
38	no revetment		slope land	no revetment		slope land
39	no revetment		flood area	no revetment		cliff
40	no revetment		flood area	no revetment		cliff
41	no revetment		flood area	no revetment	erosion	slope land
42	no revetment		flood area	no revetment	erosion	slope land
43	no revetment		flood area	no revetment	erosion	flood area
44	no revetment		flood area	no revetment	erosion	flood area
45	revetment		cliff	revetment		slope land
46	revetment		cliff	revetment		slope land
47	no revetment		cliff	revetment		slope land
48	no revetment		cliff	revetment		slope land
49	no revetment		cliff	revetment		slope land
50	no revetment		cliff	revetment		slope land
51	no revetment		commercial area	revetment		commercial area
52	revetment		commercial area	revetment		commercial area
53	revetment		commercial area	revetment		commercial area
54	revetment		commercial area	revetment		commercial area
55	revetment		commercial area	revetment		commercial area
56	revetment		commercial area	revetment		commercial area
57	revetment		commercial area	revetment		commercial area
58	no revetment		commercial area	revetment		playground
59	no revetment		commercial area	revetment		playground
60	no revetment		commercial area	no revetment		cliff
61	no revetment		commercial area	no revetment		cliff
62	no revetment		commercial area	no revetment		cliff
63	no revetment		commercial area	no revetment		cliff
64	no revetment		commercial area	no revetment		cliff
65	revetment		commercial area	revetment		cliff
66	no revetment		commercial area	no revetment		cliff
67	no revetment		commercial area	no revetment		cliff
68	no revetment		commercial area	no revetment		cliff
69	no revetment		commercial area	no revetment		cliff
70	no revetment		commercial area	no revetment		cliff
71	no revetment		commercial area	no revetment		cliff
72	revetment		commercial area	revetment		residential area
73	no revetment		commercial area	revetment		residential area

Table 2.12 Bank Condition and Hinterland along the Choluteca River (2/3)

Section No.	Left Side			Right Side		
	Revetment	Bank Erosion	Hinterland	Revetment	Bank Erosion	Hinterland
74	no revetment		commercial area	revetment		residential area
75	no revetment		commercial area	revetment		residential area
76	no revetment		commercial area	revetment		residential area
77	no revetment		commercial area	revetment		residential area
78	no revetment		commercial area	revetment		residential area
79	no revetment		commercial area	revetment		residential area
80	no revetment		open space	revetment		residential area
81	no revetment		open space	revetment		residential area
82	no revetment		open space	no revetment		road
83	no revetment		open space	no revetment		road
84	no revetment		open space	no revetment		road
85	no revetment		open space	no revetment		road
86	no revetment		open space	no revetment		road
87	no revetment		cliff	no revetment		road
88	no revetment		slope land	no revetment		road
89	no revetment		slope land	no revetment		cliff
90	no revetment		slope land	no revetment		cliff
91	no revetment		slope land	no revetment		cliff
92	no revetment		slope land	no revetment		cliff
93	no revetment		slope land	no revetment		cliff
94	no revetment		slope land	no revetment		cliff
95	no revetment		open space	no revetment		cliff
96	no revetment		open space	no revetment		residential area
97	no revetment		cliff	no revetment		residential area
98	no revetment		cliff	no revetment		residential area
99	no revetment		cliff	no revetment		residential area
100	no revetment		cliff	no revetment		residential area
101	no revetment		cliff	no revetment		residential area
102	no revetment		cliff	no revetment		road
103	no revetment		cliff	no revetment		residential area
104	no revetment		road	no revetment		residential area
105	no revetment		cliff, residential area	no revetment		residential area
106	no revetment		cliff, residential area	no revetment		residential area
107	no revetment		cliff, residential area	no revetment		cliff
108	no revetment		cliff, residential area	no revetment		slope land
109	no revetment		cliff, residential area	no revetment		slope land
110	no revetment		cliff, residential area	no revetment		slope land
111	no revetment		slope land	no revetment		cliff
112	no revetment		commercial area	no revetment		cliff
113	no revetment		commercial area	no revetment		cliff
114	no revetment		commercial area	no revetment		open space
115	no revetment		open space	no revetment		open space
116	no revetment		open space	no revetment		cliff
117	no revetment		factory	no revetment		residential area
118	no revetment		factory	no revetment		residential area
119	no revetment		factory	no revetment		residential area
120	no revetment		road	no revetment		road
121	no revetment		slope land	no revetment		residential area
122	no revetment		slope land	no revetment		residential area
123	no revetment		slope land	no revetment		residential area
124	no revetment		slope land	no revetment		residential area
125	no revetment		residential area	no revetment		residential area
126	no revetment		cliff	no revetment		cliff
127	no revetment		cliff	no revetment		cliff
128	no revetment		cliff	no revetment		slope land
129	no revetment		road	no revetment		road
130	no revetment		road	no revetment		road
131	no revetment		road	no revetment		road
132	no revetment		road	no revetment		road
133	no revetment		road	no revetment		road
134	no revetment		road	no revetment		road
135	no revetment		road	no revetment		road
136	no revetment		road	no revetment		road
137	no revetment		cliff	no revetment		road
138	no revetment		cliff	no revetment		cliff
139	no revetment		cliff	no revetment		cliff
140	no revetment		cliff	no revetment		slope land
141	no revetment		residential area	no revetment		slope land
142	no revetment		residential area	no revetment		cliff
143	revetment		residential area	no revetment		cliff
144	revetment		residential area	no revetment		cliff
145	revetment		residential area	no revetment		cliff
146	revetment		residential area	no revetment		cliff
147	revetment		residential area	no revetment		cliff

Table 2.12 Bank Condition and Hinterland along the Choluteca River (3/3)

Section No.	Left Side			Right Side		
	Revetment	Bank Erosion	Hinterland	Revetment	Bank Erosion	Hinterland
148	no revetment		residential area	no revetment		residential area
149	no revetment		residential area	no revetment		residential area
150	no revetment	erosion	residential area	no revetment	erosion	residential area
151	no revetment		residential area	no revetment		residential area
152	no revetment		residential area	no revetment		residential area
153	no revetment		residential area	no revetment		residential area
154	no revetment		residential area	no revetment		residential area
155	no revetment		residential area	no revetment		residential area
156	no revetment		residential area	no revetment		residential area
157	no revetment		residential area	no revetment		residential area
158	no revetment		cliff	no revetment		residential area
159	no revetment		cliff	no revetment		residential area
160	no revetment		cliff	no revetment		residential area
161	no revetment		cliff	no revetment		residential area
162	no revetment		factory	no revetment		residential area
163	no revetment		factory	no revetment		residential area
164	no revetment		factory	no revetment		slope land
165	no revetment		road	no revetment		slope land
166	no revetment		road	no revetment		slope land
167	no revetment		road	no revetment		slope land
168	no revetment		road	no revetment		slope land
169	no revetment		slope land	no revetment		cliff
170	no revetment		slope land	no revetment		cliff
171	no revetment		slope land	no revetment		slope land
172	no revetment		cliff	no revetment		slope land
173	no revetment		cliff	no revetment		slope land
174	no revetment		cliff	no revetment		slope land
175	no revetment		cliff	no revetment		slope land
176	no revetment		slope land	no revetment		slope land
177	no revetment		slope land	no revetment		slope land
178	no revetment		slope land	no revetment		slope land
179	no revetment		slope land	no revetment		slope land
180	no revetment		slope land	no revetment		road
181	no revetment		slope land	no revetment		road
182	no revetment		cliff	no revetment		residential area
183	no revetment		cliff	no revetment		residential area
184	no revetment		cliff	no revetment		residential area
185	no revetment		cliff	no revetment		slope land
186	no revetment		cliff	no revetment		slope land
187	no revetment		slope land	no revetment		cliff
188	no revetment		slope land	no revetment		road
189	no revetment		cliff	no revetment		road
190	no revetment		cliff	no revetment		road
191	no revetment		road	no revetment		road
192	no revetment		slope land	no revetment		road
193	no revetment		slope land	no revetment		road
194	no revetment		flood area	no revetment		cliff
195	no revetment		flood area	no revetment		cliff
196	no revetment		flood area	no revetment		cliff
197	no revetment		flood area	no revetment		cliff
198	no revetment		flood area	no revetment		cliff
199	no revetment		flood area	no revetment		cliff
200	no revetment		flood area	no revetment		slope land

Table 2.17 Degree of Danger of Landslides

Rank of danger degree	Topographic Characteristics and Observation
A	There are evidences of present or recent movement of the landslide mass. The landslide blocks which moved during Hurricane Mitch or those which are judged as having moved in these ten years. The slip scarp is not covered by any vegetation and where outcrop reveals. Cracks are observed at the boundaries and misalignment of artificial structures are observed. The bottom part of the landmass is swelling out or small slope failure of tongue shape is observed.
B	Although the typical landslide topographic features are observed, it is judged that there are no movement in recent years. (slip scarp or side cracks are covered by vegetation). Without any typical landslide topographic features, following observations are made; there are examples of recent landslides with a similar geological formation in the neighborhood the structure of the land mass is composed of clay or colluvial deposit and it is weak
C	Although the landslide topographic feature is observed, the age of the slide occurrence is old and the block is stable at present. The slip scarp forms a terrace but is covered by debris and surface soil without revealing the original shape. There observed a swelling shape at the bottom but no new collapse or deformation of structures around. There is no symptom of landslide from the hearing of the residents.

Table 2.18 Geographical and Geological Feature Data List of the Slope Failure Ground

No	bed rock	slope angle (degree)	failure height (m)	Deposition distance (m)
1	Tm	18	20	10
2	Tcg	25	28	58
3	Tcg	44	70	30
4	Tcg	37	40	18
5	Qan 2	34	15	
6	Tcg	47	52	
7	Qan 1	27	15	
8	Tm	35	23	
9	Tcg	35	32	
10	Tcg	51	63	20
11	Tcg	29	75	
12	Tcg	43	95	
13	Tcg	32	65	
14	Tcg	32	65	
15	Tcg	43	35	
16	Tcg	40	48	
17	Tcg	48	56	20
18	Tcg	47	51	
19	Tcg	54	20	
20	Tcg	48	111	
21	Tcg	30	42	
22	Tcg	49	55	
23	Tcg	55	65	10
24	Krc	29	17	
25	Krc	35	8	15
26	Tcg	49	75	
27	Tcg	45	40	
28	Tcg	36	20	
29	Tpm 3	19	35	
30	Krc	45	13	7
31	Krc	38	13	10
32	Krc	44	15	8
33	Krc	23	75	
34	Krc	29	40	
35	Krc	35	12	15
36	Krc	46	22	13
37	Krc	37	6	4
38	Krc	53	17	7
39	Tpm 1	32	33	
40	Tcg	41	24	
41	Tcg	44	20	
42	Tcg	50	20	17
43	Tcg	55	22	28
44	Tm	20	32	
45	Tcg	30	28	
46	Tcg	40	20	20
47	Tcg	45	16	13
48	Tcg	34	17	
49	Tcg	62	24	
50	Tcg	62	20	5
51	Tcg	44	23	
52	Tcg	53	20	
53	Tcg	44	48	
54	Tcg	60	50	17
55	Tcg	34	65	
56	Tcg	37	37	47
57	Tcg	62	14	15
58	Tcg	62	27	
59	Tcg	37	17	24
60	Tcg	42	40	22
61	Tcg	44	28	7
62	Tcg	41	40	21
63	Tcg	60	22	
64	Tcg	38	40	
65	Tcg	50	36	10
66	Tcg	52	65	
67	Tpm 1	35	31	40
68	Tpm 1	34	14	
69	Krc	41	15	
70	Krc	56	22	
71	Krc	30	17	
72	Krc	38	32	
73	Tpm 1	42	15	
74	Tpm 1	44	17	
75	Tpm 1	28	12	
76	Tpm 1	33	13	
77	Tpm 1	47	45	
78	Tpm 1	30	15	
79	Tpm 1	44	25	
80	Tpm 1	33	15	8
81	Krc	18	12	
82	Krc	20	11	
83	Krc	20	9	
84	Tpm 1	46	45	
85	Kvn	41	22	
86	Kvn	41	38	
87	Krc	39	11	15
88	Krc	23	20	
89	Krc	28	7	
90	Tpm 1	39	42	32
91	Tpm 1	40	24	13
92	Tpm 1	40	33	
93	Tpm 1	52	36	7
94	Tpm 1	36	37	
95	Tpm 1	32	35	
96	Tpm 1	49	15	10
97	Tpm 1	42	34	7
98	Tpm 1	38	38	
99	Tpm 1	32	27	
100	Tpm 1	33	23	7
101	Tcg	35	48	
102	Tcg	47	44	
103	Tpm 1	28	17	15
104	Tpm 1	55	36	
105	Tpm 1	62	29	13
106	Tpm 1	45	25	23
107	Tep	42	45	18
108	Tep	35	43	20
109	Kvn	34	19	18
110	Kvn	35	20	8
111	Kvn	39	14	
112	Tep	30	15	20
113	Kvn	38	23	
114	Tep	43	50	
115	Tep	37	7	9
116	Tpm 1	37	54	
117	Kvn	34	45	
118	Tpm 1	50	36	14
119	Tep	38	38	
120	Tep	45	19	
121	Qb	50	20	
122	Tpm 1	67	45	
123	Tm	25	18	
124	Tm	30	15	
125	Tm	33	35	
126	Qan 1	28	20	
127	Qan 2	32	20	
128	Is	34	22	
129	Tm	44	18	
130	Tm	27	15	
131	Qan 1	30	15	
132	dt	32	8	
133	dt	31	5	
134	Qan 1	41	15	
135	Tm	27	15	
136	Tm	37	10	
137	dt	30	15	
138	Is	29	18	
139	dt	32	13	
140	dt	25	50	
141	dt	38	10	
142	Is	22	8	
143	Is	33	20	
144	Is	40	18	
145	Qe	36	10	
146	dt	36	33	
147	Is	32	18	
148	dt	36	15	
149	dt	20	23	
150	Is	26	30	
151	dt	34	5	
152	Qe	34	18	
153	Qe	48	12	
154	Qe	30	10	
155	Qe	36	13	
156	Qe	20	15	
157	Qe	24	14	
158	Qe	20	15	
159	Qb	43	23	
160	Qb	28	23	
161	Qb	39	18	
162	Qe	34	13	
163	Qe	59	14	
164	Tep	37	7	
165	Tep	49	6	
166	Is	32	6	
167	Tep	41	15	
168	Is	32	10	
169	Is	20	10	
170	Is	34	22	
171	Kvn	28	13	
172	Kvn	30	18	
173	Kvn	38	7	

Table 2.19 Threshold Values for Slope Failure Danger for Each Geology

Bed rock	Dangerous Slope		notes
	Slope Gradient (degree)	Area (m ²)	
Kvn	30	645,300	
Krc	20	3,183,500	
Tm	20	1,110,300	
Ti	32	200	The value of "Tcg" is adopted.
Tpml	32	18,900	The value of "Tcg" is adopted.
Tpm1	28	1,192,700	Tpm1, Tpm2, and Tpm3 are united and examined.
Tpm2	28	140,500	Tpm1, Tpm2, and Tpm4 are united and examined.
Tcg	32	1,897,300	
Tep	35	299,800	
Tpm3	28	1,958,600	Tpm1, Tpm2, and Tpm4 are united and examined.
Odt	28	14,300	Odt, Qan1, Qan2, and Qb are united and examined.
Qan1	28	265,400	Odt, Qan1, Qan3, and Qb are united and examined.
Qan2	28	272,200	Odt, Qan1, Qan4, and Qb are united and examined.
Qb	28	217,700	Odt, Qan1, Qan5, and Qb are united and examined.
Qe1	20	115,700	Qe1, Qe2a, Qe2b, and Qe3 are united and examined.
Qe2a	20	320,200	Qe1, Qe2a, Qe2b, and Qe4 are united and examined.
Qe2b	20	79,200	Qe1, Qe2a, Qe2b, and Qe5 are united and examined.
Qe3	20	89,100	Qe1, Qe2a, Qe2b, and Qe6 are united and examined.
dt	25	187,900	
ls	22	707,300	
total area(m ²)		12,715,100	-
The rate to whole area		12.1%	-

Table 2.20 Number of Households in Rank A Landslide Masses and Their Affected Areas

No.	Block Name	Address	Area (block area + affected area) (m2)	Numbers of influence houses
1	Canaan	COL.CANAAN	147,467	113
2	Reparto	BARRIO EL REPARTO	276,929	452
3	Bambu	BARRIO LA CABANA ,BARRIO EL EDEN No.1, BARRIO LA RONDA, COL.ALTOS de LA CABANA	46,801	42
4	Bosque	BARRIO ALTOS DEL BOSQUE o 13 de FEBRERO, BARRIO LA ESTRELLA	49,709	196
5	Buena Vista	BARRIO.BUENA VISTA	10,220	7
6	Berrinche	COL.SOTO	382,494	361
7	Campo Cielo	COL.CAMPO CIELO	6,460	25
8	San Martin	COL.AYESTAS	25,717	74
9	Flor 1	COL.LA FLOR No.1	16,112	21
10	Zapote Centro	CO.ZAPOTE CENTRO , CO.BRISAS DE OLANCHO	29,902	126
11	Zapote Norte	CO.ZAPOTE NORTE	5,355	4
12	Villa Union	CO. VILLAUNION	6,067	5
13	Brasilia	CO. BRASILLA CO. SAN JUAN DEL NORTE No.2	43,768	61
14	Centro America	RE. CENTRO AMERICA CO. 1DE DICIEMBRE	6,930	6
15	Nueva Esperanza	CO. NUEVA ESPERANZA	30,907	16
16	Las Torres Este	CO. LAS TORRES	6,881	19
17	Las Torres Oeste	CO. LAS TORRES	5,580	15
<i>Add</i>			<i>1,097,299</i>	<i>1,543</i>

Table 2.26 Related Disaster Prevention Projects

Field	Project name	Honduran Organization	Donor Organization	Content	Output	Target area	Term	Category
Flood	Inundation survey	SOPTRAVI		Map preparation by field survey	Inundation map	Tegucigalpa urban area	1998	Emergency Rehabilitation
Flood	Inundation survey	SERNA		Map preparation by field survey	Inundation map	Tegucigalpa urban area	1998	Emergency Rehabilitation
Flood	Inundation survey	AMDC		Map preparation by field survey	Inundation map	Tegucigalpa urban area	1998	Emergency Rehabilitation
Landslide	Landslide block identification	SOPTRAVI	Japan	Map preparation by photo analysis	Landslide block map	Tegucigalpa urban area	1998	Emergency Rehabilitation
	Rehabilitation of bridges	SOPTRAVI	Japan	Reconstruction of two bridges	Bridge	Tegucigalpa urban area	2000 - 2003	Emergency Rehabilitation
Road	Bridge construction	SOPTRAVI	Sweden	Construction of a bridge	Bridge	Tegucigalpa urban area	2002 -	Emergency Rehabilitation
Road	Bus terminal construction	SMDC		Construction of a new bus terminal along the Choluteca River	Bus terminal	Tegucigalpa urban area		
Landslide	Berrinche landslide mechanism/countermeasures	SERNA	WB	Investigation on landslide mechanism and proposal of counter measures	Landslide prevention measures	Tegucigalpa urban area	1999 - 2001	Rehabilitation
Watershed management	Concepcion watershed rehabilitation	IHPEJ (NGO)	Catholic Relief Service	Planting of trees, construction of micro sabo dams	Reforestation Micro sabo dams	Watershed of Concepcion dam	1999 - 2002	Watershed management
Watershed management	Bambu reforestation	Eco Bambu (NGO)		Planting of trees	Reforestation	Bambu landslide	1999 -	Watershed management
Water supply	Water supply facilities rehabilitation	SANAA	BID	Reconstruction of Picacho water pipe	Water pipe	Tegucigalpa urban area	1999 - 2001	Rehabilitation
Water supply	Water supply facilities rehabilitation	SANAA	Japan	Reconstruction of water distribution system	Water pipes and tanks	Tegucigalpa urban area	1999 - 2001	Rehabilitation
Institution	Emergency Act Preparation	COPECO	USAID/ UNDP	Preparation of institution for national emergency system	National Emergency Act	Whole country	2001.3 - 2001.8	Preparation Emergency Rehabilitation
Education	Primary education for disaster prevention	COPECO/ Education Ministry/ Red Cross	Red Cross	Education for primary school students		Whole country	Ongoing	
Forecasting/warning Structural code	Forecasting/Warning System Preparation	SERNA/SMN/ ENEE/ SANAA	USGS	Establishment of flood and landslide warning system	Forecasting/warning system		2000.1 - 2001.12	Preparation Emergency
	Revision of Structural Code	COPECO	World Bank	Revision of structural code to take into account natural disaster	New structural code	Whole country	2000.10 - 2001.9	Preparation
Land use	Preparation of new land use act	SERNA/Justice Ministry		Preparation of new land use act	New land use act	Whole country		
Hazard map	Hazard map preparation	SERNA	USAID	Preparation of hazard map of 40 municipalities including Tegucigalpa	Hazard map	40 municipalities	1999.3 - 2001.11	Preparation
Disaster Prevention	Natural Disaster Vulnerability Reduction	SERNA/COPECO	World Bank	Monitoring/warning, strengthening of local organization	Monitoring system	Whole country	200.11 - 2005.4	Preparation Emergency

Table 4.1 Proposed Master Plan Projects

	Flood Damage Mitigation	Landslide Damage Mitigation	Common
Structural Measures	Choluteca River Improvement Pescado Lake Outlet Improvement	Berrinche Reparto Bambu	-
Non-structural Measures	Watershed Management Land Use Plan/Land Use Regulation Structural Code Application	Land Use Plan/Land Use Regulation	Education/Enlightenment/Training

Table 4.2 Maximum Daily and Annual Rainfall at Toncontin Station

Year	Rainfall (mm)	
	Max. Daily	Annual
1951	76.20	786
1952	61.20	1,146
1953	47.80	823
1954	54.40	1,173
1955	49.80	1,274
1956	44.20	689
1957	63.20	779
1958	78.70	972
1959	109.00	944
1960	45.50	962
1961	53.10	774
1962	93.00	1,066
1963	47.80	883
1964	69.30	893
1965	77.20	766
1966	79.20	1,047
1967	46.20	641
1968	83.30	1,025
1969	45.00	1,199
1970	65.20	1,003
1971	46.70	750
1972	34.30	453
1973	60.50	1,078
1974	68.10	861
1975	86.00	995
1976	44.50	750
1977	74.50	776
1978	57.60	731
1979	78.10	1,180
1980	62.30	996
1981	54.40	1,113
1982	49.20	718
1983	49.40	719
1984	94.40	1,084
1985	39.90	610
1986	41.00	503
1987	66.10	693
1988	82.00	1,264
1989	36.90	878
1990	73.10	675
1991	38.30	595
1992	54.10	728
1993	43.10	949
1994	75.70	564
1995	56.60	1,146
1996	73.00	889
1997	94.80	835
1998	120.40	1,180
1999	53.00	870

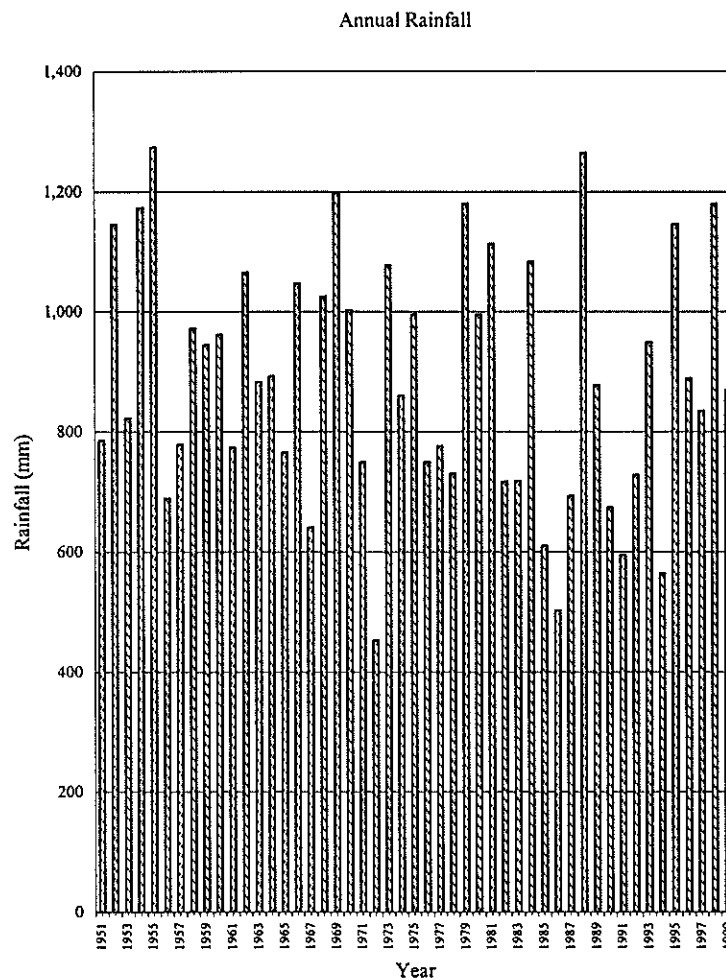


Table 4.11 Volume Estimation of Erosion/Sediment Control in the Pilot Project Area

Stream	Material	Height (m)	No. Dams	Section (m ²)*	Width (m)	Volume (m ³)
A) Micro SABO Dams						
Q.Santa Elena	Dry masonry	1	923	1.0	5.0	5.0
	Dry masonry	2	53	2.3	10.0	23.0
10	Gavion	3	162	5.0	15.0	75.0
	Gavion	4	14	7.8	20.0	156.0
Sub-total:			1,152			
Q.Jardinera	Dry Masonry	1	574	1.0	5.0	5.0
	Dry Masonry	2	236	2.3	10.0	23.0
	Gavion	3	87	5.0	15.0	75.0
	Gavion	4	-	7.8	20.0	156.0
Sub-total:			897			
Total:			2,049			
B) Vetiver Live Barriers						
				Length (m)	Width (m)	
Q.Santa Elena				6,400	100	
Q.Jardinera				5,550	100	
Total:				11,950		

* Includes energy dissipator

Table 4.12 Inundated Area and Evacuation Places(in case of Hurricane Mitch scale storm)

Inundated Area	Evacuation Place
Barrio El Chile	Colonia El Porvenir's high land
Barrio Abajo	Barrio Abajo, Barrio Los Dolores's high land, Barrio Buenos Aires
Barrio El Centavo	Barrio El Centavo's high land
Barrio La Bolsa	Barrio La Bolsa's high land
Colonia El Prado	Colonia Humuya
Colonia Maradiaga	Barrio La Granja
Campo de Balompie	Colonia Las Brisas's high land
Colonia San Jose De La Vega	Colonia San Jose De La Vega's high land
Colonia Jardines De Loarque	Colonia Jardines De Loarque's high land
Colonia Satellite	Colonia Stelite's high land

Table 4.13 List of Colonias with Large Number of Endangered Households

No.	Name of Colonia	Endangered Households	Endangered Population	Endangered Area (ha)
1	Col. Villanueva Sur	1,125	5,679	334,088
2	Bo. Reparto	863	4,357	58,019
3	Col. 3 de Mayo	747	3,771	64,019
4	Col. Villanueva Norte	695	3,510	180,951
5	Col. Villa Unión	656	3,313	111,936
6	Col. Los Pinos	644	3,253	167,657
7	Col. Las Mercedes	615	3,107	13,516
8	Col. Villa Cristina Etapa I, II, III	450	2,270	82,847
9	Col. Canaan	429	2,167	104,681
10	Bo. Bella Vista	421	2,128	51,778
11	Col. Ayestas	395	1,994	45,000
12	Bo. San Pablo	375	1,895	40,142
13	Col. 28 de Marzo	366	1,850	48,310
14	Bo. Las Crucitas No 1 y No 2	343	1,733	31,003
15	Col. La Esperanza	333	1,683	19,771
16	Col. Rodríguez	327	1,653	22,961
17	Col. La Obrera	326	1,647	21,039
18	Bo. El Manchen	324	1,587	47,368
19	Col. La Independencia	309	1,558	48,696
20	Col. La Flor No. 1	304	1,536	58,863
21	Bo. Centro de Comayagua	290	1,465	142,203
22	Col. El Rosario	274	1,383	6,003
23	Bo. Sipile	254	1,283	21,849
24	Col. 21 de Octubre	225	1,104	46,970
25	Col. San Miguel	215	1,052	32,457
26	Col. Nueva Santa Rosa	210	1,058	32,958
27	Col. Pilito José Angel Ulloa	206	1,040	23,219
28	Col. Jardín del Norte	197	993	46,198
29	Col. Campo Cielo	186	937	22,365
30	Bo. Abajo	186	938	68,482
31	Col. Zapote Centro	185	907	18,168
32	Col. Flor de Campo	183	922	27,841
33	Col. San Martín	182	917	19,516
34	Bo. Morazán	181	912	16,708
35	Col. San José de las Vegas I,II Etapa	180	883	14,220
36	Col. Las Torres	173	872	10,695
37	Col. Arturo Duarte Etapa I, II, III, IV	173	874	26,816
38	Col. Rafael Leonardo Callejas	172	867	32,847
39	Col. 1 de Diciembre	172	869	33,951
40	Col. Altos de San Francisco	168	850	34,118
41	Col. Francisco Morazán	166	836	19,540
42	Col. Modesto Rodas Alvarado	165	833	35,150
43	Col. Centro América Oeste	160	782	21,254
44	Col. Rosa Linda	155	785	26,993
45	Col. San Francisco	152	770	15,883
46	Col. Rivera de la Vega	150	737	14,741
47	Bo. El Pastel	150	757	22,731
48	Col. Izaguirre	143	721	30,961
49	Bo. El Chile	141	689	19,232
50	Bo. El Guanacaste	140	709	34,440

Table 4.15 House Relocation for Structural Measures

No.	Block Name	Numbers of influence houses by landslide	Numbers of houses to be relocated for structural measures	Structural Measures Planed
1	Canaan	113	60	Drainage
2	Reparto	452	10	Drainage, Excavation
3	Bambu	42	0	Drainage
4	Bosque	196	40	Drainage
5	Buena Vista	7	2	Drainage
6	Berrinche	361	0	Drainage, Excavation
7	Campo Cielo	25	15	Drainage
8	San Martin	74	60	Drainage, Counter fill
9	Flor 1	21	25	Counter fill
10	Zapote Centro	126	70	Drainage, Counter fill
11	Zapote Norte	4	6	Counter fill, Excavation
12	Villa Union	5	6	Counter fill
13	Brasilia	61	40	Counter fill
14	Centro America	6	2	Counter fill
15	Nueva Esperanza	16	60	Excavation
16	Las Torres Este	19	15	Excavation
17	Las Torres Oeste	15	10	Excavation
<i>Add</i>		<i>1,543</i>		

Table 4.16 Proposed Evacuation Site

No.	Name	Proposed Evacuation Site
1	Canaan	The top of the east spur side and the west spur side. COL.CANAAN
2	Reparto	A top of the spur on the east. COL. GUILLEN
3	Bambu	A Western and eastern top of the spur. Bo.EL EDEN No.1, Co.ALTOS de LA CABANA
4	Bosque	A south flat area. Bo. EL BOSQUE
5	Buena Vista	The flat area of the north side. Bo. BUENA VISTA
6	Berrinche	The left bank of the Choluteca River is dangerous. The hill in the downtown area, or Cerro Grande hill is appropriate. Bo.LA CHIVERA
7	Canpo Ciero	An evacuation area is restricted. The top of the north or west spurs or the Western are comparatively stable, and can be chosen as an evacuation area. Co.CAMPO CIELO, Co.SAN MARTIN
8	San Martin	Surrounding slopes are dangerous. The plateau on the north can be chosen as evacuation site. Co.SAN MARTIN
9	Flor 1	The gentle slope above a northeast side. Co.LA FLOR No.1
10	Zapote centro	Compared with the lower part, the northwest side upper part is safe. Co.FUERZAS ARMADAS
11	Zapote norte	It is better to avoid refuge along the streams. There is a safe place on a south slope. Co.3 de MAYO
12	Villa Union	Since almost all surrounding slopes are hazard areas, they need to choose a far place. The top of the spur 300m southeast is suitable. Co.FLOR No.1
13	Brasilia	The south downward slope has loose land, and can be chosen as an evacuation area. Co.EL CARRIZAL
14	Centro America	The neighborhood has many flat areas and they can be chosen as evacuation areas. Re.CENTRO AMERICA
15	Nueva Esperanza	The upper gentle slope is suitable as an evacuation area. Co.NUEVA ESPERANZA, Co.NUEVA ESPERANZA III ETAPA
16	Los Torres este	The plateau top 50m or more away from the cliff above a slope. Co.INESTROZA
17	Los Torres oeste	The plateau top above the south of slope. Co.INESTROZA

Table 4.17 Matrix of Assignment and Functions (Disaster Preparation)

		1	2	3	4	5	6	7	8	9	10
		PREVENTIVE MEASURES									
SUPPORTING COMMITTEE		GENERAL MANAGEMENT	INSTALLATION AND OBSERVATION OF METEOROLOGICAL EQUIP.	DRILL OF EVACUATION	PRESERVATION OF FOODS FOR EMERGENCY	COMMUNICATION SYSTEM FOR EMERGENCY	IMPROVEMENT OF RIVER, MOUNTAIN STREAM, CANAL	LANDSLIDE PROTECTION	MONITORING /REGULATION OF LAND USE	REGULATION OF HOUSE STRUCTURE	WATERSHED MANAGEMENT
1	FFAA			A	A	A	A	A			A
2	BONBEROS			A		A					A
3	CRUZ ROJA HONDURENA			A	A	A					
4	CRUZ VERDE			A	A	A					
5	BOY SCOUTS			A	A	A					A
6	SECRETARIA DE SALUD	A		A	A	A				A	A
7	IHSS										
8	COLEGIO MEDICO										
9	COLEGIO DE ENFERMERAS										
10	UNAH		A	A	A			A	A	A	
11	SOPTRAVI	A	A	A	A	A	A	A		A	
12	MUNICIPALIDAD DC	A		A	A	A	C	C	C	C	C
13	FHIS	A					A	A	A	A	A
14	SERNA	A	C	A			A	A	A	A	A
15	COHDEFOR	A				A	A	A	A		A
6	INA						A	A	A		A
17	SAG				A			A			A
18	SECRETARIA DE EDUCACION	A		A	A		A				A
19	ONGS/OPDS	A			A		A				A
20	CODEM-DC	C	A	C	C	A	A	A	A	A	A
21	ENEE	A	A	A		A					A
22	SECRETARIA DE GOBERNACION								A		
23	POLICIA NACIONAL			A	A	A					
24	SANAA	A	A	A	A	A	A	A	A	A	A
25	HONDUTEL			A	A	A					
26	CONATEL					C					
27	R/AFICIONADOS			A	A	A					
28	SERVICIO METEOROLOGICO NACIONAL		A	A							A
29	MINISTERIO PUBLICO			A	A		A	A	A		
30	INFOP	A		A	A						
31	SECRETARIA DE RR EE										
32	SETCO	A									
33	IHNFA										
34	IHMA			A	A						
35	BANASUPRO			A	A						
36	SECRETARIA DE TRABAJO										
37	SECRETARIA DE FINANZAS	A			A				A		A
38	CARE/CAMI				A						
39	COPECO	A	A	A	A	A		A	A	A	A
40	PMA				A						
41	COLEGIO DE INGENIEROS CIVILES DE HONDURENO									A	
42	COLEGIO DE ARQUITECTOS									A	

Table 4.18 Matrix of Assignment and Functions (Emergency Action)

		1	2	3	4	5	6	7	8	9	10	11
		EMERGENCY OPERATIONS										
SUPPORTING COMMITTEE		MONITORING AND ALERT	COMMUNICATIONS	SEARCHES, RESCUE AND EVACUATION	SECURITY	TRANSPORTATION AND MACHINE	TEMPORARY REFUGES AND FOODS	EVALUATION OF DAMAGES AND NECESSITY ANALYSIS	HEALTH	DANGEROUS MATERIALS	FOREST PROTECTION	MANAGEMENT OF INTERNATIONAL COOPERATION
1	FFAA	A	A	C	A	A	A	A	A	A	A	
2	BONBEROS		A	A					A	A	A	
3	CRUZ ROJA HONDURENA	A	A	A		A	A	A	A			A
4	CRUZ VERDE			A			A	A	A			
5	BOY SCOUTS			A	A		A					
6	SECRETARIA DE SALUD		A			A	A	A	C	A		A
7	IHSS								A			
8	COLEGIO MEDICO								A			
9	COLEGIO DE ENFERMERAS								A			
10	UNAH	A					A	A	A	A		
11	SOPTRAVI					C		A				
12	MUNICIPALIDAD DC	A			A	A	C	A			A	A
13	FHIS					A	A	A				
14	SERNA	A				A		A		C	A	
15	COHDEFOR	A	A			A		A			C	
16	INA					A						
17	SAG					A		A		A	A	
18	SECRETARIA DE EDUCACION						A				A	
19	ONGS/OPDS						A					A
20	CODEM	C	C			A	A	C			A	A
21	ENEE	A	A				A	A			A	
22	SECRETARIA DE GOBERNACION							A			A	
23	POLICIA NACIONAL	A	A	A	C					A	A	
24	SANAA	A	A				A	A			A	
25	HONDUTEL		C		A		A					
26	CONATEL	A	A									
27	R/AFICIONADOS	A	A									
28	SERVICIO METEOROLOGICO NACIONAL	A	A								A	
29	MINISTERIO PUBLICO				A					A	A	
30	INFOP						A					
31	SECRETARIA DE RR EE											
32	SETCO		A			A						C
33	IHNFA						A					A
34	IHMA						A					
35	BANASUPRO						A					
36	SECRETARIA DE TRABAJO						A					
37	SECRETARIA DE FINANZAS											A
38	CARE/CAMI											
39	COPECO	A	A	A		A	A	A				A

Table 4.19 Matrix of Assignment and Functions (Disaster Rehabilitation)

		1	2	3	4	5	6	7	8
		OPERATION OF RECONSTRUCTION							
SUPPORTING COMMITTEE		RECONSTRUCTION OF INFRASTRUCTURE	REHABILITATION OF INSTALLATIONS	STABILIZATION OF LANDSLIDE SITE	CONSTRUCTION OF REFUGEE'S HOUSE	PREVENTION OF EPIDEMIC	EDUCATION FOR REFUGED CHILDREN	SECURITY	INTERNATIONAL COOPERATION MANAGEMENT
1	FFAA	A			A	A		A	
2	BONBEROS					A			
3	CRUZ ROJA HONDURENA				A	A			A
4	CRUZ VERDE				A	A			A
5	BOY SCOUTS								
6	SECRETARIA DE SALUD				A	C	A		A
7	IHSS					A			
8	COLEGIO MEDICO					A			
9	COLEGIO DE ENFERMERAS					A	A		
10	UNAH		A			A	A		
11	SOPTRAVI	A	A	A	C				A
12	MUNICIPALIDAD DC	C	A	C	A	A	A	A	A
13	FHIS	A	A	A	A				A
14	SERNA	A	A	A	A				A
15	COHDEFOR		A	A	A				
16	INA				A				
17	SAG								
18	SECRETARIA DE EDUCACION						C		A
19	ONGS/OPDS	A	A	A	A	A	A		A
20	CODEM DC	A	C	A	A		A	A	A
21	ENEE		A		A				
22	SECRETARIA DE GOBERNACION							A	
23	POLICIA NACIONAL(Secretaria de Seguridad)				A			C	
24	SANAA	A	A	A	A	A			A
25	HONDUTEL		A		A			A	
26	CONATEL		A					A	
27	R/AFICIONADOS								
28	SERVICIO METEOROLOGICO NACIONAL(SOPTRAVI)		A						
29	MINISTERIO PUBLICO				A			A	
30	INFOP				A		A		
31	SECRETARIA DE RR EE								A
32	SETCO								C
33	IHNFA						A	A	
34	IHMA								
35	SUPLIDORA NACIONAL DE PRODUCTOS BASICOS BANASUPRO								
36	SECRETARIA DE TRABAJO								
37	SECRETARIA DE FINANZAS								A
38	CARE/CAMI								A
39	COPECO		A		A		A		A
40	PMA				A				A
41	COLEGIO DE INGENIEROS CIVILES DE HONDURENO	A			A				
42	COLEGIO DE ARQUITECTOS	A			A				
43	OIM				A				

Table 4.20 Project Cost

Items	Unit		Quantity	Master Plan Project		
	Unit	Cost(USD)		Amount(USD)		
				Total	L.C.	F.C.
1. Flood Damage Mitigation				33,124,336.0	25,275,380.1	7,848,955.8
1.1 Structural Measures				31,554,452.7	24,064,697.7	7,489,754.9
Earth excavation	m3	6.44	709,810	4,571,176.4	1,930,683.2	2,640,493.2
Rock excavation	m3	14.50	38,163	553,363.5	304,922.4	248,441.1
Revetment (A)	m	1,883.25	2,543	4,789,104.8	4,332,229.4	456,875.4
Revetment (B)	m	1,878.43	5,175	9,720,875.3	8,791,134.8	929,740.5
Parapet wall	m	296.57	2,451	726,893.1	670,936.7	55,956.3
Gabion	m	364.67	3,853	1,405,073.5	1,192,503.5	212,570.0
Shaft works	pieces	93,058.30	52	4,839,031.6	3,266,668.6	1,572,363.0
Counterweight fill	m3	0.79	42,631	33,678.5	14,068.2	19,610.3
Anchor works	ls.	370,220.89	1	370,220.9	205,597.5	164,623.4
Spoil Bank	m3	0.79	959,562	758,053.9	316,655.4	441,398.5
Gabion h=4m (Spoil Bank)	m	270.64	1,800	487,152.0	392,544.0	94,608.0
Revetment(Spoil Bank)	m	1,883.25	400	753,300.0	681,436.0	71,864.0
Parapet wall(Spoil Bank)	m	296.57	300	88,971.0	82,122.0	6,849.0
Mallol Bridge Reinforcement	ls.		1	322,445.6	293,487.9	28,957.7
Mallol Bridge Replacement	ls.	951,867.99	1	951,868.0	826,256.3	125,611.7
Demolition work (Bridge)	ls.	316,578.8	1	316,578.9	160,439.1	156,139.8
Pescado Lagoon	ls.	77,404.30	1	77,404.3	52,578.8	24,825.5
Replacement of Sewage Pipes	m	455.55	1,100	501,105.0	471,570.0	29,535.0
Replacement of Water Supply	ls.		1	288,156.4	78,863.9	209,292.5
1.2 NoN-Structural Measures				1,569,883.3	1,210,682.4	359,200.9
Watershed Management	ls.		1	1,518,883.3	1,210,682.4	308,200.9
Warning System (Transmitter)	ls.	17,000.00	3	51,000.0		51,000.0
2. Landslide Damage Mitigation				5,248,009.7	3,602,043.8	1,645,965.9
2.1 Structural Measures				4,363,009.7	2,902,043.8	1,460,965.9
Berrinche	ls.	3,090,747.03	1	3,090,747.0	1,973,840.9	1,116,906.1
Reparto	ls.	1,184,313.06	1	1,184,313.1	860,894.6	323,418.5
Bambu	ls.	87,949.58	1	87,949.6	67,308.3	20,641.3
2.2 NoN-Structural Measures				885,000.0	700,000.0	185,000.0
Resettlement	houses	3,500.00	200	700,000.0	700,000.0	
Warning System (Transmitter)	ls.	15,000.00	4	60,000.0		60,000.0
(Receiver)	ls.	125,000.00	1	125,000.0		125,000.0
3. Other				2,000,000.0	2,000,000.0	0.0
Education	ls.		1	1,000,000.0	1,000,000.0	
Disaster Mitigation System	ls.		1	1,000,000.0	1,000,000.0	
4. Direct Construction Cost				40,372,345.7	30,877,423.9	9,494,921.7
5. Administration	ls.	-		2,492,102.1	2,492,102.1	
Administration	ls.			2,018,617.3	2,018,617.3	
Land cost	houses	47,348.48	10	473,484.8	473,484.8	
6. Engineering service	ls.	-		6,789,595.3	1,701,795.3	5,087,800.0
7. Physical contingency	ls.	-		4,037,234.6	3,087,742.4	949,492.2
(Sub-total : 4+5+6+7)				53,691,277.7	38,159,063.7	15,532,213.9
8. Price contingency	ls.	-		10,220,000.0	7,710,000.0	2,510,000.0
Total				63,911,277.7	45,869,063.7	18,042,213.9

Table 4.21 Implementation Program

Items	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Detailed Design	█															
Tendering Procedure	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Construction																
1 Structural Measures																
Earth excavation																
Rock excavation																
Revetment (A)																
Revetment (B)																
Gabion																
Parapet wall																
Shaft works																
Counterweight fill																
Anchor works																
Spoil Bank																
Gabion (Spoil Bank)																
Revetment(Spoil Bank)																
Parapet wall (spoil Bank)																
Pescado Lagoon																
Mallol Bridge(Reinforcement)																
Mallol Bridge(Replacement)																
Demolition Work																
Replacement of Sewage Pipes																
Replacement of Water Supply																
NoN-Structural Measures																
Watershed Management																
Warning System																
2 Landslide Prevention																
Structural Measures																
Berrinche																
Reparto																
Bambu																
NoN-Structural Measures																
Resettlement																
Warning System																
3 Other																
Education																
Disaster Mitigation System																
Administration																
Construction Supervision																

Table 5.3 Screening (Flood Control and Landslide Prevention)

Environmental Item		Description	Evaluation	Remarks (reason)	
Social Environment	1	Resettlement	Resettlement due to land occupancy (transfer of rights of residence/land ownership)	Y	Reparto landslide prevention
	2	Economic Activities	Loss of base of economic activities, such as land, and change of economic structure	N	
	3	Traffic and Public Facilities	Impacts on schools, hospitals and present traffic conditions, such as the increase of traffic congestion and accidents	Y	Traffic for civil works
	4	Split of Communities	Community split due to interruption of area traffic	N	
	5	Cultural Properties	Damage to or loss of value of churches, temples, shrines, archeological remaining or other cultural assets	Y	Mallol Bridge
	6	Water Rights and Rights of Common	Obstruction of fishing rights, water rights, rights of common	N	
	7	Public Health Condition	Worsening of public health and sanitation conditions due to the generation of garbage and the increase of vermin	N	
	8	Waste	Generation of construction waste, debris and logs	Y	Civil works
	9	Hazard(risk)	Increase in danger from ground failures, caverns, etc.	N	
Natural environment	10	Topography and Geology	Changes of valuable topography and geology due to excavation or filling work	N	
	11	Soil Erosion	Topsoil erosion by rainfall after reclamation and deforestation	N	
	12	Groundwater	Lowering of the groundwater table due to over drafting and turbid water caused by construction work	Y	Drainage works
	13	Hydrological Situation	Changes of river discharge, flow velocity and riverbeds condition due to filling work and diversion channel	Y	Riverbed excavation
	14	Coastal Zone	Coastal erosion and change of vegetation due to coastal reclamation and coastal changes	N	
	15	Fauna and Flora	Obstruction of breeding and extinction of species due to change of habitat conditions	Not known	
	16	Meteorology	Changes of temperature, rainfall, wind, etc, due to large-scale reclamation and building construction	N	
	17	Landscape	Changes of topography and vegetation due to reclamation. Deterioration of aesthetic harmony by structures	N	
Pollution	18	Air Pollution	Pollution caused by exhaust gas or toxic gas from vehicles or factories	Y	Traffic of civil work
	19	Water Pollution	Pollution caused by the decrease of discharge or the inflow of sediment	Y	Riverbed excavation
	20	Soil Contamination	Contamination caused by discharge of diffusion of sewage or toxic substances	Not known	Riverbed excavation
	21	Noise and Vibration	Noise and vibrations generated by vehicles and pumping operations	Y	By civil works
	22	Land Subsidence	Deformation of the land and land subsidence due to lowering of groundwater table	N	
	23	Offensive Odor	Generation of exhaust gas and offensive odor by facility construction and operation	N	

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Table 5.4 Scoping

Environmental item		Evaluation	Reason	
Social environment	1	Resettlement	B	Ten houses to be relocated by Reparto landslide prevention works
	2	Economic Activities	D	No effect
	3	Traffic and Public Facilities	D	No effect
	4	Split of Communities	D	No effect
	5	Cultural Properties	A	Historical structures in Centro and Comayaguela near the Choluteca River
	6	Water Rights and Rights of Common	D	No effect
	7	Public Health Condition	D	No effect
	8	Waste	B	Produced by civil works
	9	Hazard(risk)	D	No effect
Natural environment	10	Topography and Geology	D	No effect
	11	Soil Erosion	D	No effect
	12	Groundwater	D	Drainage work will lower the groundwater table
	13	Hydrological Situation	D	No effect
	14	Coastal Zone	D	No effect
	15	Fauna and Flora	C	To be checked in the field reconnaissance
	16	Meteorology	D	No effect
	17	Landscape	D	No effect
Pollution	18	Air Pollution	C	By civil works
	19	Water Pollution	B	By civil works
	20	Soil Contamination	C	To be checked in sampling and testing
	21	Noise and Vibration	B	By civil works
	22	Land Subsidence	D	No effect
	23	Offensive Odor	D	No effect

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Note 1; evaluation categories:

- A: serious impact is expected
- B: some impact is expected
- C: extent of impact is unknown(examination is needed. Impact may become clear as study progresses.)
- D: no impact is expected. IEE/EIA is not necessary

Note 2; evaluation should be made with reference to the "explanation of item"

Table 6.2 Boring Investigation

Borehole No.	Depth (m)	Borehole No.	Depth (m)
<i>El Berrinche</i>		C-1	15
B-1	40	C-2a	17
B-2	50	C-2b	8
B-3	35	C-3	20
B-4	25	C-4	15
B-5	25	<i>El Reparto</i>	
B-6	60	R-1	39
B-7	25	R-2	30
B-8	25	R-3	35
B-9	30	R-4	35
W-1	25	R-5	7
W-2	35	R-6	4
Total Linear Meters Cored		600 m	

Table 6.6 Project Cost

Items	Unit		Quantity	Priority Project		
	Unit	Cost(USD)		Amount(USD)		
				Total	L.C.	F.C.
1. Flood Damage Mitigation				19,971,478.3	13,693,742.9	6,277,735.3
1.1 Structural Measures				19,920,478.3	13,693,742.9	6,226,735.3
Earth excavation	m3	6.44	709,810	4,571,176.4	1,930,683.2	2,640,493.2
Rock excavation	m3	14.50	38,163	553,363.5	304,922.4	248,441.1
Revetment (A)	m	1,883.25	2,543	4,789,104.8	4,332,229.4	456,875.4
Revetment (B)	m	1,878.43	0			
Parapet wall	m	296.57	290	86,005.3	79,384.6	6,620.7
Gabion	m	364.67	3,853	1,405,073.5	1,192,503.5	212,570.0
Shaft works	pieces	93,058.30	52	4,839,031.6	3,266,668.6	1,572,363.0
Counterweight fill	m3	0.79	42,631	33,678.5	14,068.2	19,610.3
Anchor works	ls.	370,220.89	1	370,220.9	205,597.5	164,623.4
Spoil Bank	m3	0.79	954,797	754,289.5	315,082.9	439,206.5
Gabion h=4m (Spoil Bank)	m	270.64	1800	487,152.0	392,544.0	94,608.0
Revetment(Spoil Bank)	m	1,883.25	409	753,300.0	681,436.0	71,864.0
Parapet wall(Spoil Bank)	m	296.57	300	88,971.0	82,122.0	6,849.0
Mallol Bridge Reinforcement	ls.		1	322,445.6	293,487.9	28,957.7
Mallol Bridge Replacement	ls.	951,867.99				
Demolition work (Bridge)	ls.	316,578.8				
Pescado Lagoon	ls.	77,404.30	1	77,404.3	52,578.8	24,825.5
Replacement of Sewage Pipes	m	455.55	1,100	501,105.0	471,570.0	29,535.0
Replacement of Water Supply	ls.		1	288,156.4	78,863.9	209,292.5
1.2 NoN-Structural Measures				51,000.0	0.0	51,000.0
Watershed Management	ls.					
Warning System (Transmitter)	ls.	17,000.00	3	51,000.0		51,000.0
2. Landslide Damage Mitigation				4,548,009.7	2,902,043.8	1,645,965.9
2.1 Structural Measures				4,363,009.7	2,902,043.8	1,460,965.9
Berrinche	ls.	3,090,747.03	1	3,090,747.0	1,973,840.9	1,116,906.1
Reparto	ls.	1,184,313.06	1	1,184,313.1	860,894.6	323,418.5
Bambu	ls.	87,949.58	1	87,949.6	67,308.3	20,641.3
2.2 NoN-Structural Measures				185,000.0	0.0	185,000.0
Resettlement	houses	3,500.00				
Warning System (Transmitter)	ls.	15,000.00	4	60,000.0		60,000.0
(Receiver)	ls.	125,000.00	1	125,000.0		125,000.0
3. Other				500,000.0	500,000.0	0.0
Education	ls.		1	500,000.0	500,000.0	
Disaster Mitigation System	ls.					
4. Direct Construction Cost				25,019,488.0	17,095,786.7	7,923,701.2
5. Administration	ls.	-		1,724,459.2	1,724,459.2	
Administration	ls.			1,250,974.4	1,250,974.4	
Land cost	houses	47,348.48	10	473,484.8	473,484.8	
6. Engineering service	ls.	-		3,615,317.6	975,717.6	2,639,600.0
7. Physical contingency	ls.	-		2,501,948.8	1,709,578.7	792,370.1
(Sub-total : 4+5+6+7)				32,861,213.6	21,505,542.2	11,355,671.3
8. Price contingency	ls.	-		3,830,000.0	2,530,000.0	1,300,000.0
Total				36,691,213.6	24,035,542.2	12,655,671.3

Table 6.7 Implementation Program

Items	2002	2003	2004	2005	2006
Detailed Design	■				
Tendering Procedure		■			
Construction			■	■	■
1 Structural Measures					
Earth excavation			■	■	■
Rock excavation				■	■
Revetment (A)			■	■	■
Revetment (B)					
Gabion				■	■
Parapet wall					■
Shaft works			■	■	■
Counterweight fill				■	
Anchor works			■	■	
Spoil Bank			■	■	■
Gabion (Spoil Bank)			■	■	■
Revetment(Spoil Bank)			■	■	
Parapet wall (spoil Bank)				■	
Pescado Lagoon			■		
Mallol Bridge(Reinforcement)			■	■	
Mallol Bridge(Replacement)					
Demolition Work					
Replacement of Sewage Pipes			■	■	
Replacement of Water Supply			■	■	
NoN-Structural Measures					
Watershed Management					
Warning System			■		
2 Landslide Prevention					
Structural Measures					
Berrinche			■	■	■
Reparto			■	■	
Bambu			■		
NoN-Structural Measures					
Resettlement					
Warning System			■		
3 Other					
Education			■	■	■
Disaster Mitigation System			■	■	■
Administration			■	■	■
Construction Supervision			■	■	■