

***TABLES***

**Table R.1 Schedule of Training Activities**

**GIS Training**

Period	Training Session
Apr-94	Basic notions of Cartography
May-94	ArcCAD - Introduction, Basic System, Database concepts, commands.
Jun-94	Introduction to line coverages, polygon coverages, property tables.

**Computer Systems Training**

Period	Training Session
25 Jan. - 7 Apr.	Hardware Concepts
21 Apr. - 2 Jun.	Foxbase
9 Jun. - 19 Jun.	System Design
22 Jun. - 5 Jul.	Database File Conversion
7 Jul. - 2 Aug.	BASIC Programming
4 Aug. - 11 Aug.	Clipper Programming
23 Aug. - 30 Aug.	Local Area Networks

**TABLE R.2 List of Data Transferred from the MPR-PMO**

Digital Files	Contents
<p><b>Map Data</b></p> <p>BASIN</p> <p>BASINBDY</p> <p>GISMF_1</p> <p>ISOPACHC</p> <p>LAHAR92</p> <p>LANDUSE</p> <p>LRIVERS</p> <p>LROADS</p> <p>NEWBRGY</p> <p>NEWTOWN</p> <p>PFD</p> <p>PRONE</p> <p>RDUTM</p> <p>RESETL</p> <p>RRIVERS</p> <p>RROADS</p> <p>SABODAM</p> <p>SLUTM</p>	<p>Major river systems</p> <p>Sub-basin boundary</p> <p>Mudflow hazard delineation</p> <p>Isopach lines for airborne ash deposits</p> <p>Area affected by the 91 and 92 lahar flows.</p> <p>Land use categories</p> <p>Rivers/shoreline in the upper left corner</p> <p>Roads in the upper left corner</p> <p>Delineation of barangay boundaries</p> <p>Provincial and town boundaries</p> <p>Pyroclastic flow deposit delineation</p> <p>Prone to future lahar events.</p> <p>Roads</p> <p>Resettlement/evacuation sites.</p> <p>Rivers/shoreline in the upper left corner</p> <p>Roads in the upper right corner</p> <p>Sabo dams</p> <p>Shoreline and rivers</p>
<p><b>Tabular Data</b></p> <p>BRGYDATA</p> <p>CENSUS</p> <p>DISTREG</p> <p>ECO_DATA</p> <p>HOSPITAL</p> <p>SCHOOL1</p> <p>SCHOOL2</p>	<p>NSO's barangay infrastructure survey</p> <p>Barangay population, number of households and average household size</p> <p>No. of Industrial establishments by type</p> <p>Economic data by province</p> <p>Public and private medical facilities</p> <p>Public elementary schools</p> <p>Other educational institutions</p>

Data as of Date: Oct 1994

Table R.3 Contents of the Digital Database

LAYER	DATA	DESCRIPTION	TYPE
Contour	c91_01 ~ 32	Before Eruption (1991)	Line
	c92_01 ~ 32	After Eruption (1992)	Line
	c94_01 ~ 32	2 Years After Eruption (1994)	Line
Rivers	RL91_01 ~ 32	River Data (1991)	Line
	RL91_ALL	River Data (1991)	Line
	RP91_01 ~ 32	River Data (1991)	Polygon
	RL91_ALL	River Data (1991)	Polygon
	RL92_01 ~ 32	River Data (1992)	Line
	RL92_ALL	River Data (1992)	Line
	RP92_01 ~ 32	River Data (1992)	Polygon
	RL92_ALL	River Data (1992)	Polygon
	RL94_01 ~ 32	River Data (1994)	Line
	RL94_ALL	River Data (1994)	Line
Houses	HPT_01 ~ 15	House Datas Before Eruption (1991) and After Eruption (1994) (Both Affected and Unaffected areas)	Point
	HPT_ALL		Point
	HPL_01 ~ 15		Polygon
	HPL_ALL		Polygon
Roads	ROL_01 ~ 32	Before Eruption (1991)	Line
	ROL_ALL		Line
	ROP_01 ~ 32		Polygon
	ROP_ALL		Polygon
River Elevation	KAS_91 KAS_94	Grid datas before Eruption	Point Point

Table R.4 Geomorphological Changes Estimated using GIS Techniques

Area	Catchment Area in sq.km	Pyroclastic Deposit 1, (2), (x M.cu.m)									
		(Remaining Ratio %)									
		1991 June	1991 October		1992 October		1994 March		1994 October		
		Erosion									
		1991		1992		1993		1994		Total	
Total Pyroclastic Deposit	63	1398	1148	82%	1028	74%	908	65%	770	55%	
		250	120		120		138		628		
Sacobia-Abacan		968	768	79%	688	71%	303	31%	295	30%	
		200	80		65		8		353		
Sacobia-Abacan Down stream	18	550	400	73%	347	63%	303	55%	295	54%	
		(496)	(374)	75%	(335)	67%		61%		59%	
Upstream	22	418	368	88%	341	82%	320	77%	252	60%	
		50	(394)	84%	(353)	75%		68%		53%	
Pasig Down stream	23	430	380	88%	340	79%	285	66%	223	52%	
		50	40		55		62		207		
Pasig		430	380	88%	340	79%	605	141%	475	110%	
		50	40		55		130		275		
Total Erosion		250		120		120		138		628	
Lahar Deposits											
Sacobia		150		80		65		8		303	
Abacan		50		0		0		0		50	
Pasig		50		40		55		130		275	

Comments: The Pyroclastic Deposit volume for 1994 March was estimated using the GIS database created from the DTM for 1991, 1992, 1994 with a contour interval of 5m mapped to a scale of 1:10000 from Aerial Photographs.

There was a piracy at the Upstream in 1993 October and the river basin areas changed.

Legend for estimates: 1. Assuming that erosion occurred more on the Sacobia-Abacan owing to Secondary explosion.  
 (2). Assuming that uniform erosion occurred at the Upstream and Sacobia-Abacan areas.

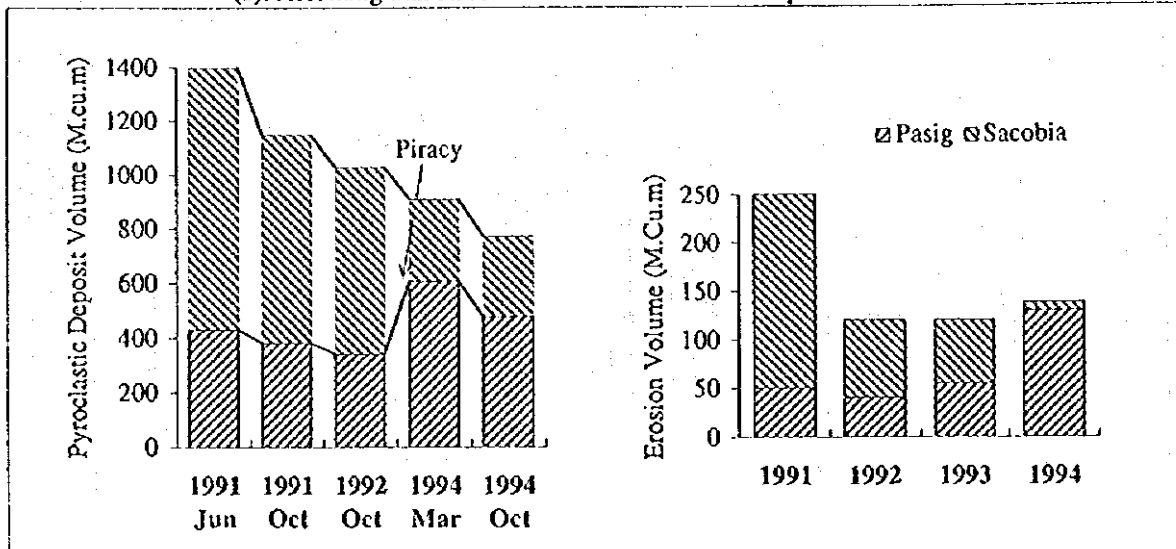


Table R.5 Lahar Deposit along Sacobla-Bamban River Estimated using GIS Techniques (1/3)

Sediment Deposit in Section 1-55 (Mactan-Bamban reach)

Section	distance (m)	92-91 deposit			94-92 deposit			94-91 deposit		
		area (m <sup>2</sup> )	volume (1000m <sup>3</sup> )	Accum. (1000m <sup>3</sup> )	area (m <sup>2</sup> )	volume (1000m <sup>3</sup> )	Accum. (1000m <sup>3</sup> )	area (m <sup>2</sup> )	volume (1000m <sup>3</sup> )	Accum. (1000m <sup>3</sup> )
1	0	408	0	0	545	0	0	953	0	0
2	200	485	89	89	1,292	184	184	1,777	273	273
3	400	1,098	158	248	679	197	381	1,777	355	629
4	600	1,070	217	464	748	143	524	1,818	359	988
5	800	1,703	277	742	1,659	241	764	3,362	518	1,506
6	1000	1,197	290	1,032	827	249	1,013	2,024	539	2,044
7	1200	1,625	282	1,314	991	182	1,195	2,616	464	2,508
8	1400	1,563	319	1,633	1,342	233	1,428	2,905	552	3,061
9	1600	2,002	356	1,989	953	230	1,657	2,955	586	3,646
10	1800	1,965	397	2,386	1,834	279	1,936	3,799	675	4,322
11	2000	4,564	653	3,039	960	279	2,216	5,524	932	5,254
12	2200	4,422	899	3,937	1,192	215	2,431	5,614	1,114	6,368
13	2400	7,268	1,169	5,106	512	170	2,601	7,780	1,339	7,707
14	2600	9,371	1,664	6,770	559	107	2,708	9,930	1,771	9,478
15	2800	6,551	1,592	8,362	1,101	166	2,874	7,652	1,758	11,236
16	3000	6,562	1,311	9,674	759	186	3,060	7,321	1,497	12,734
17	3200	5,722	1,228	10,902	1,052	181	3,241	6,774	1,410	14,143
18	3400	7,082	1,280	12,182	1,484	254	3,495	8,566	1,534	15,677
19	3600	7,836	1,492	13,674	1,890	337	3,832	9,726	1,829	17,506
20	3800	7,139	1,497	15,171	1,460	335	4,167	8,599	1,832	19,339
21	4000	6,911	1,405	16,576	3,405	487	4,654	10,316	1,892	21,230
22	4200	6,613	1,352	17,929	3,065	647	5,301	9,678	1,999	23,230
23	4400	7,478	1,409	19,338	6,262	933	6,234	13,740	2,342	25,572
24	4600	7,427	1,491	20,829	6,188	1,245	7,479	13,615	2,736	28,307
25	4800	6,616	1,404	22,233	6,299	1,249	8,727	12,915	2,653	30,960
26	5000	6,711	1,333	23,566	7,000	1,330	10,057	13,711	2,663	33,623
27	5200	6,531	1,324	24,890	7,239	1,424	11,481	13,770	2,748	36,371
28	5400	5,640	1,217	26,107	6,778	1,402	12,883	12,418	2,619	38,990
29	5600	5,968	1,161	27,268	6,232	1,301	14,184	12,200	2,462	41,451
30	5800	6,459	1,243	28,510	5,824	1,206	15,389	12,283	2,448	43,900
31	6000	7,837	1,430	29,940	5,753	1,158	16,547	13,590	2,587	46,487
32	6200	7,081	1,492	31,432	4,982	1,074	17,621	12,063	2,565	49,052
33	6400	7,763	1,484	32,916	3,985	897	18,517	11,748	2,381	51,433
34	6600	10,055	1,782	34,698	4,062	805	19,322	14,117	2,586	54,020
35	6800	12,985	2,304	37,002	5,163	923	20,244	18,148	3,227	57,246
36	7000	13,447	2,643	39,645	4,226	939	21,183	17,673	3,582	60,828
37	7200	11,983	2,543	42,188	4,797	902	22,086	16,780	3,445	64,274
38	7400	11,650	2,363	44,551	4,885	968	23,054	16,535	3,331	67,605
39	7600	10,685	2,234	46,785	5,346	1,023	24,077	16,031	3,257	70,862
40	7800	6,954	1,764	48,549	4,210	956	25,033	11,164	2,720	73,581
41	8000	5,560	1,251	49,800	3,229	744	25,776	8,789	1,995	75,576
42	8200	5,592	1,115	50,915	2,761	599	26,375	8,353	1,714	77,291
43	8400	6,076	1,167	52,082	2,786	555	26,930	8,862	1,722	79,012
44	8600	5,232	1,131	53,213	2,381	517	27,447	7,613	1,648	80,660
45	8800	4,472	970	54,183	2,471	485	27,932	6,943	1,456	82,115
46	9000	4,823	930	55,113	1,870	434	28,366	6,693	1,364	83,479
47	9200	3,084	791	55,903	2,428	430	28,796	5,512	1,221	84,699
48	9400	4,194	728	56,631	2,267	470	29,265	6,461	1,197	85,897
49	9600	11,452	1,565	58,196	4,601	687	29,952	16,053	2,251	88,148
50	9800	20,378	3,183	61,379	3,634	824	30,776	24,012	4,007	92,155
51	10000	19,388	3,977	65,355	2,237	587	31,363	21,625	4,564	96,718
52	10200	15,467	3,486	68,841	1,777	401	31,764	17,244	3,887	100,605
53	10400	12,971	2,844	71,685	1,834	361	32,125	14,805	3,205	103,810
54	10600	24,971	3,794	75,479	2,283	412	32,537	27,254	4,206	108,016
55	10800	17,175	4,215	79,694	2,940	522	33,059	20,115	4,737	112,753

1: Mactan

46: Masukup

55: Bambam highway

Table R.5 Lahar Deposit along Sacobia-Bamban River Estimated using GIS Techniques (2/3)  
Sediment Deposit in Section (56-101) Bamban river

Section	distance (m)	Total Deposit				Channel Deposit			
		91-92 volume (1000m <sup>3</sup> )	94-92 volume (1000m <sup>3</sup> )	91-94 volume (1000m <sup>3</sup> )	91-94 Accumula- (1000m <sup>3</sup> )	91-92 volume (1000m <sup>3</sup> )	94-92 volume (1000m <sup>3</sup> )	91-94 volume (1000m <sup>3</sup> )	91-94 Accumula- (1000m <sup>3</sup> )
56	0	2,655	502	3,157	3,157	500	100	600	600
57	200	2,124	324	2,448	5,605	1,026	145	1,171	1,771
58	400	2,238	201	2,439	8,044	1,012	75	1,087	2,858
59	600	2,341	180	2,521	10,565	1,129	92	1,221	4,078
60	800	2,303	399	2,702	13,266	1,222	141	1,363	5,441
61	1000	2,090	679	2,768	16,035	1,243	199	1,442	6,883
62	1200	2,156	791	2,947	18,982	1,147	222	1,369	8,252
63	1400	2,515	733	3,248	22,229	1,000	255	1,255	9,507
64	1600	3,277	727	4,004	26,233	913	266	1,179	10,686
65	1800	3,725	724	4,448	30,681	578	238	816	11,502
66	2000	3,536	624	4,160	34,842	285	212	496	11,998
67	2200	3,375	591	3,966	38,808	342	215	557	12,555
68	2400	3,220	902	4,122	42,930	412	172	583	13,138
69	2600	2,745	1,533	4,278	47,208	324	166	490	13,628
70	2800	2,321	1,934	4,255	51,463	291	280	571	14,198
71	3000	2,305	1,857	4,162	55,624	323	249	572	14,770
72	3200	2,387	1,565	3,951	59,576	285	184	469	15,239
73	3400	2,130	1,471	3,601	63,177	183	283	465	15,705
74	3600	2,195	1,228	3,422	66,599	157	356	513	16,218
75	3800	2,371	939	3,310	69,909	240	400	640	16,858
76	4000	2,057	1,332	3,389	73,298	351	524	875	17,733
77	4200	1,574	1,867	3,441	76,738	380	638	1,018	18,751
78	4400	1,723	1,594	3,317	80,055	388	528	915	19,666
79	4600	1,887	1,354	3,241	83,296	402	359	761	20,427
80	4800	1,567	1,527	3,094	86,390	321	313	635	21,062
81	5000	1,935	1,184	3,119	89,509	326	193	518	21,580
82	5200	2,314	797	3,111	92,620	280	170	451	22,031
83	5400	2,307	628	2,934	95,554	224	175	399	22,429
84	5600	2,288	557	2,845	98,399	208	121	330	22,759
85	5800	2,042	473	2,515	100,914	323	201	523	23,282
86	6000	2,076	249	2,324	103,238	283	157	440	23,722
87	6200	2,218	143	2,361	105,598	65	69	134	23,855
88	6400	2,097	93	2,190	107,789	34	47	80	23,936
89	6600	2,163	120	2,283	110,072	23	75	97	24,033
90	6800	2,199	100	2,299	112,370	53	74	127	24,160
91	7000	2,157	43	2,201	114,571	83	12	95	24,255
92	7200	2,335	38	2,373	116,944	89	7	96	24,351
93	7400	2,440	24	2,463	119,407	66	0	66	24,417
94	7600	2,435	31	2,465	121,872	27	20	47	24,464
95	7800	2,378	70	2,448	124,320	15	57	72	24,536
96	8000	2,292	104	2,396	126,716	21	38	59	24,595
97	8200	1,841	299	2,140	128,855	28	22	50	24,644
98	8400	1,381	454	1,835	130,690	24	80	104	24,748
99	8600	1,271	691	1,961	132,652	6	100	107	24,854
100	8800	1,150	936	2,086	134,738	71	83	154	25,008
101	9000	1,186	850	2,037	136,774	139	56	194	25,203
Total		103,318	33,456	136,774		16,840	8,363	25,203	

Table R.5 Lahar Deposit along Sacobia-Bamban River Estimated Using GIS Techniques (3a/3)

Sediment Deposit downstream of San Francisco Bridge (Sections 102-140)

Section No.	Period Distance (m)	1992.10-Pre-eruption			1994.3-1992.10			1994.3-Pre-eruption		
		Left Bank Area (1000 m <sup>3</sup> )	River channel (1000 m <sup>3</sup> )	Total (1000 m <sup>3</sup> )	Left Bank Area (1000 m <sup>3</sup> )	River channel (1000 m <sup>3</sup> )	Total (1000 m <sup>3</sup> )	Left Bank Area (1000 m <sup>3</sup> )	River channel (1000 m <sup>3</sup> )	Total (1000 m <sup>3</sup> )
102	200	830	169	998	0	4	4	830	172	1,002
103	400	867	83	950	0	2	2	867	84	951
104	600	858	114	972	0	5	5	858	119	977
105	800	911	126	1,037	0	22	22	911	148	1,059
106	1000	1,034	137	1,171	0	26	26	1,034	163	1,197
107	1200	1,142	138	1,281	0	15	15	1,142	154	1,296
108	1400	1,159	136	1,295	0	7	7	1,159	143	1,302
109	1600	1,146	128	1,274	0	7	7	1,146	136	1,281
110	1800	995	140	1,135	0	6	6	995	147	1,141
111	2000	511	86	597	0	19	19	511	106	617
112	2200	70	110	180	0	27	27	70	136	206
113	2400	161	112	273	0	10	10	161	122	283
114	2600	298	122	419	0	26	26	298	148	446
115	2800	321	169	490	0	32	32	321	201	522
116	3000	390	141	531	0	8	8	390	149	539
117	3200	452	134	586	0	0	0	452	134	586
118	3400	399	95	494	0	55	55	399	150	549
119	3600	366	54	420	0	88	88	366	142	507
120	3800	325	169	494	0	46	46	325	215	540
121	4000	412	80	492	0	44	44	412	124	536
122	4200	208	53	260	0	72	72	208	124	332
123	4400	403	25	428	0	42	42	403	67	470
124	4600	697	89	787	0	10	10	697	99	797
125	4800	794	65	859	0	46	46	794	111	905
126	5000	957	91	1,048	0	46	46	957	137	1,094
127	5200	776	0	776	0	75	75	776	75	851
128	5400	262	68	330	0	98	98	262	167	428
129	5600	282	0	282	0	54	54	282	54	336
130	5800	270	0	270	0	79	79	270	79	348
131	6000	357	10	366	0	119	119	357	129	486
132	6200	492	42	534	0	89	89	492	130	622
133	6400	520	0	520	0	101	101	520	101	621
134	6600	377	3	380	0	108	108	377	111	488
135	6800	376	0	376	0	67	67	376	67	442
136	7000	369	0	369	0	32	32	369	32	402
137	7200	253	0	253	0	36	36	253	36	290
138	7400	264	0	264	0	38	38	264	38	302
139	7600	199	39	238	0	1	1	199	41	240
140	7800	97	25	122	0	1	1	97	26	123



Table R.5 Lahar Deposit along Sacobia-Bamban River Estimated Using GIS Techniques (3b/3)  
Sediment Deposit downstream of San Francisco Bridge (Sections 141-181)

Section No.	Period	1992.10-Pre-eruption			1994.3-1992.10			1994.3-Pre-eruption		
	Distance (m)	Left Bank Area (1000 m <sup>3</sup> )	River channel (1000 m <sup>3</sup> )	Total (1000 m <sup>3</sup> )	Left Bank Area (1000 m <sup>3</sup> )	River channel (1000 m <sup>3</sup> )	Total (1000 m <sup>3</sup> )	Left Bank Area (1000 m <sup>3</sup> )	River channel (1000 m <sup>3</sup> )	Total (1000 m <sup>3</sup> )
141	8000	92	0	92	0	1	1	92	1	93
142	8200	46	3	49	0	3	3	46	6	52
143	8400	9	24	33	0	3	3	9	27	36
144	8600	23	0	23	0	1	1	23	1	24
145	8800	0	0	0	0	19	19	0	19	19
146	9000	6	0	6	0	17	17	6	17	23
147	9200	4	11	14	0	4	4	4	14	18
148	9400	32	0	32	0	4	4	32	4	36
149	9600	66	28	94	0	1	1	66	29	95
150	9800	56	55	111	0	0	0	56	55	111
151	10000	70	27	98	0	19	19	70	46	116
152	10200	83	21	103	0	50	50	83	70	153
153	10400	60	7	67	0	73	73	60	80	140
154	10600	4	57	61	0	59	59	4	116	120
155	10800	44	0	44	0	55	55	44	55	100
156	11000	18	0	18	0	83	83	18	83	101
157	11200	49	0	49	0	96	96	49	96	145
158	11400	38	0	38	0	90	90	38	90	128
159	11600	13	0	13	0	38	38	13	38	51
160	11800	30	7	37	0	8	8	30	14	44
161	12000	31	8	38	0	8	8	31	16	46
162	12200	46	15	60	0	0	0	46	15	60
163	12400	90	0	90	0	0	0	90	0	90
164	12600	106	0	106	0	0	0	106	0	106
165	12800	124	0	124	0	33	33	124	33	157
166	13000	112	18	130	0	43	43	112	61	173
167	13200	38	96	134	0	10	10	38	106	144
168	13400	-5	88	84	0	0	0	-5	88	84
169	13600	9	50	59	0	0	0	9	50	59
170	13800	45	40	85	0	12	12	45	52	97
171	14000	68	60	128	0	22	22	68	81	150
172	14200	82	76	158	0	20	20	82	96	178
173	14400	169	84	253	0	20	20	169	104	273
174	14600	263	0	263	0	20	20	263	20	283
175	14800	193	0	193	0	19	19	193	19	212
176	15000	294	0	294	0	17	17	294	17	310
177	15200	350	25	376	0	16	16	350	41	392
178	15400	303	57	360	0	16	16	303	73	376
179	15600	320	56	376	0	16	16	320	72	392
180	15800	418	45	463	0	8	8	418	53	471
181	16000	492	21	513	0	1	1	492	22	514
Total		24,891	3,930	28,820	0	2,466	2,466	24,891	6,396	31,286

**Table R.6 Inundation and Mud flow Area for each Return Period  
Estimated Using Simulation And GIS Techniques**

(sq.km.)

Flood Return Period (years)	Sacobia- Bamban River Basin		Abacan River Basin	
	Flood	Mudflow	Flood	Mudflow
2	42.2	2.3	29.4	2.92
5	44.1	2.45	30.6	3.33
10	48.1	3.24	32.6	5.54
20	59.4	3.26	38.7	7.01
50	77.5	3.98	48.5	10.97
100	142.4	5.08	76.8	11.52

Note: Inundation areas with water depth more than 20 cm.  
Mudflow areas with depth more than 50 cm.

**Table R.7 Value of Assets Estimated using GIS Techniques**

**Total Area / Count of Assets**

Category	Item	Total Count / Area in sq.km	Unit Value
Buildings	Residential	133,208	51,000 P/building
	Non Residential	5,744	265,000 P/building
Land	Irrigated Paddy	151.8	12,650 P/ha
	Non - Irrigated Paddy	251.8	9,440 P/ha
	Corn	0	9,810 P/ha
	Commercial Crops	0	20,930 P/ha
Infrastructure	National Roads	0.77	1,750 P/m
	Major Roads	0.02	1,750 P/m
	Other Roads	2.91	1,400 P/m
	Irrigation Schemes	80.48	71,680 P/m
	Bridges	0.020	55,000 P/m

Note: Lahar Damaged Area until 1994 140.93 sq.km.

**Estimated Value in each Municipality (x 1000 Pesos)**

Municipality	Buildings	Land	Infrastructure
<b>Abacan River System</b>			
ANGELES CITY	2,307,410	18	963,748
ARAYAT	637,651	82,899	58,319
MEXICO	427,615	26,695	137,531
SANTA ANA	359,369	32,698	34,845
Sub total	3,732,045	142,309	1,194,444
<b>Sacobia River system</b>			
MABALACAT	1,157,713	20,416	295,985
MAGALANG	398,490	60,266	231,004
CAPAS	220,737	22,535	8,162
CONCEPCION	752,032	110,227	142,188
BAMBAN	118,565	5,173	63,580
Sub total	2,647,537	218,617	740,918
<b>Study Area</b>	<b>6,379,582</b>	<b>360,927</b>	<b>1,935,362</b>

**Table R.8 Probable Annual Average Damage from Flood for each Return Period  
Estimated using GIS Techniques**

(x 1000 pesos)

<b>Flood Return Period</b>	<b>Buildings</b>	<b>Land</b>	<b>Infrastructure</b>	<b>Total</b>
2	123,413	16,483	17,779	157,675
5	129,907	16,875	18,803	165,585
10	136,744	17,779	21,421	175,944
20	151,423	19,259	25,235	195,916
50	188,088	21,298	33,675	243,061
100	195,774	24,268	32,357	252,398

<b>Flood Return Period</b>	<b>Buildings</b>	<b>Land</b>	<b>Infrastructure</b>	<b>Total</b>
2	49,247	21,733	19,334	90,313
5	51,764	21,996	19,759	93,519
10	55,106	22,676	19,284	97,067
20	57,989	23,474	19,893	101,355
50	59,064	27,676	21,047	107,787
100	68,900	36,662	21,803	127,366

<b>Flood Return Period</b>	<b>Buildings</b>	<b>Land</b>	<b>Infrastructure</b>	<b>Total</b>
2	172,660	38,216	37,113	247,989
5	181,671	38,871	38,562	259,104
10	191,850	40,455	40,706	273,011
20	209,412	42,733	45,127	297,271
50	247,152	48,974	54,722	350,849
100	264,674	60,930	54,160	379,764

Table R.9 Traffic Detour Costs due to Inaccessibility of Bridges estimated Using GIS Techniques

(x 1000 Pesos)

Original Route			Bridges		Traffic Conditions			Indirect cost for Inaccessibility
Route No.	Origin	Destination	Bam-ban	San Fran-cisco	Total No. of Vehicles	Distance (km)	Duration of Access	
1	MNL	Tarlac	x	-	1000	86.5	all year	30,777
2	S.Fernando	Tarlac	x	-	5000	57.5	all year	67,388
3	Angeles	Tarlac	x	-	5000	39.7	all year	85,576
4	S.Fernando	Bamban	x	-	500	27.9	all year	11,168
5	Angeles	Bamban	x	-	500	10.1	all year	12,987
<b>Sub Total</b>					<b>12000</b>			<b>207,897</b>
6	S.Fernando	Concepcion	-	x	500	44.3	all year	5,349
7	Angeles	Concepcion	-	x	500	26.5	all year	7,168
<b>Sub Total</b>					<b>1000</b>			<b>12,517</b>
<b>Total</b>					<b>13000</b>			<b>220,414</b>

Detour Routes for each Season

R.No.	Detour Routes		Bridges			Traffic Conditions			Detour Cost Analysis		
	Season	Route	Bam-ban	San Fran-cisco	Friend ship	Total No. of Vehicles	Distance (km)	Duration	Days of Detour	Detour Distance (km)	Cost* (x 1000 Pesos)
1	Dry Season	MNL-Tarlac	-	-	x	1000	111.6	6 months	180	25.1	15,388
	R. Season	MNL-Tarlac	-	-	x	1000	111.6	5 months	150	25.1	12,824
	R. Season	MNL-Tarlac	-	-	x	1000	111.6	30 days	30	25.1	2,565
<b>Sub total</b>											<b>30,777</b>
2	Dry Season	S.Fernando-Tarlac	-	x	-	5000	62.3	6 months	180	4.8	14,714
	R. Season	S.Fernando-Tarlac	-	x	-	5000	62.3	5 months	150	4.8	12,262
	R. Season	S.Fernando-Tarlac	-	-	x	5000	136.6	30 days	30	79.1	40,412
<b>Sub total</b>											<b>67,388</b>
3	Dry Season	Angeles-Tarlac	-	x	-	5000	44.5	6 months	180	4.8	14,714
	R. Season	Angeles-Tarlac	-	x	-	5000	44.5	6 months	150	4.8	12,262
	R. Season	Angeles-Tarlac	-	-	x	5000	154.4	30 days	30	114.7	58,601
<b>Sub total</b>											<b>85,576</b>
4	R. Season	S.Fernando-Bamban	-	x	-	500	50.5	5 months	150	22.6	5,773
	R. Season	S.Fernando-Bamban	-	-	x	500	133.5	30 days	30	105.6	5,395
<b>Sub total</b>											<b>11,168</b>
5	R. Season	Angeles-Bamban	-	x	-	500	32.7	5 months	150	22.6	5,773
	R. Season	Angeles-Bamban	-	-	x	500	151.3	30 days	30	141.2	7,214
<b>Sub total</b>											<b>12,987</b>
6	R. Season	S.Fernando-Concepcion	-	-	x	500	149	30 days	30	104.7	5,349
7	R. Season	S.Fernando-Concepcion	-	-	x	500	166.8	30 days	30	140.3	7,168

Note: \* See Vehicle Operating Cost Computation for details

Vehicle Operating Cost computation (VOC)

Data	Car/van	Jeepney	Bus	Truck
Running Cost(P/km)	2.29	1.61	3.65	4.93
Fixed Cost(P/min.)	0.12	0.59	0.84	0.94
Average Speed (km/hr)	40.00	40.00	40.00	40.00
Total cost	2.47	2.50	4.90	6.34
Vehicle Mix	0.47	0.24	0.16	0.14
VOC (P/km):	<b>3.41</b>			

Source: DPWH PMO, FS In Quezon, November 1994.

**Table R.10 Evacuation and Clean up Costs from Flood for each Return Period Estimated using GIS Techniques**

**Abacan River System** (x 1000 pesos)

Flood Return Period	Building Evacuation Cost	Building Cleanup Cost
2	5,024	2,093
5	5,288	2,203
10	5,566	2,319
20	6,164	2,568
50	7,656	3,190
100	7,969	3,321

**Sacobia River System**

Flood Return Period	Building Evacuation Cost	Building Cleanup Cost
2	2,005	835
5	2,107	878
10	2,243	935
20	2,361	984
50	2,404	1,002
100	2,805	1,169

**Study Area**

Flood Return Period	Building Evacuation Cost	Building Cleanup Cost
2	7,028	2,928
5	7,395	3,081
10	7,810	3,254
20	8,524	3,552
50	10,061	4,192
100	10,774	4,489

**Table R.11 Total Affected Population and Land  
for Maximum Possible Damage in 20 years**

	<b>Affected Area (ha)</b>	<b>Affected Household 1994</b>	<b>Affected Population 1994</b>	<b>Affected Cultivable land (ha)</b>
<b>Abacan River Basin</b>				
ANGELES CITY	185	1,021	5,146	0
ARAYAT	5	3	18	3
MEXICO	1,739	3,276	17,955	701
SANTA ANA	992	1,018	5,794	836
<b>Sub Total</b>	<b>2,921</b>	<b>5,318</b>	<b>28,913</b>	<b>1,540</b>
<b>Bamban River Basin</b>				
MABALACAT	201	31	153	3
MAGALANG	461	69	412	389
CAPAS	0	0	0	0
CONCEPCION	4,828	3,874	21,077	2,401
BAMBAN	326	580	2,939	15
<b>Sub Total</b>	<b>5,816</b>	<b>4,554</b>	<b>24,581</b>	<b>2,807</b>
<b>Total</b>	<b>8,737</b>	<b>9,872</b>	<b>53,495</b>	<b>4,347</b>

***FIGURES***



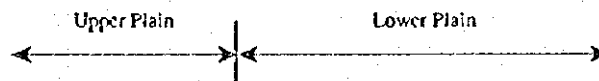
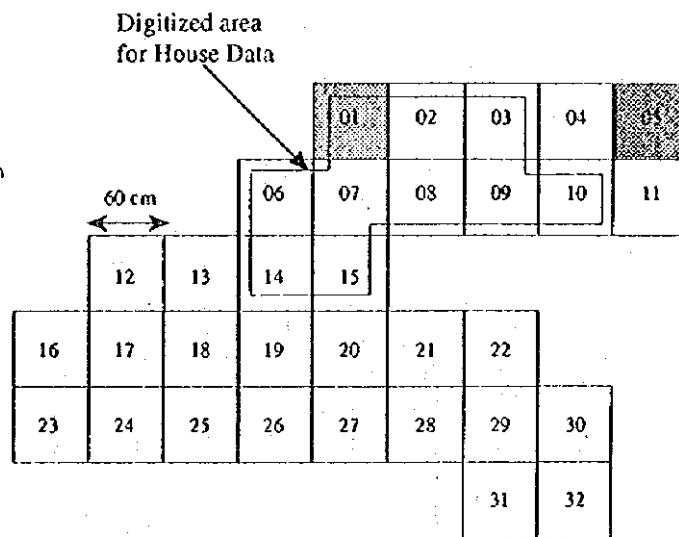


Contour Interval

Upper Plain	5m
Lower Plain	2m

Scale :

1:10000 = 6 Km



01 - 32 Map sheet Numbers



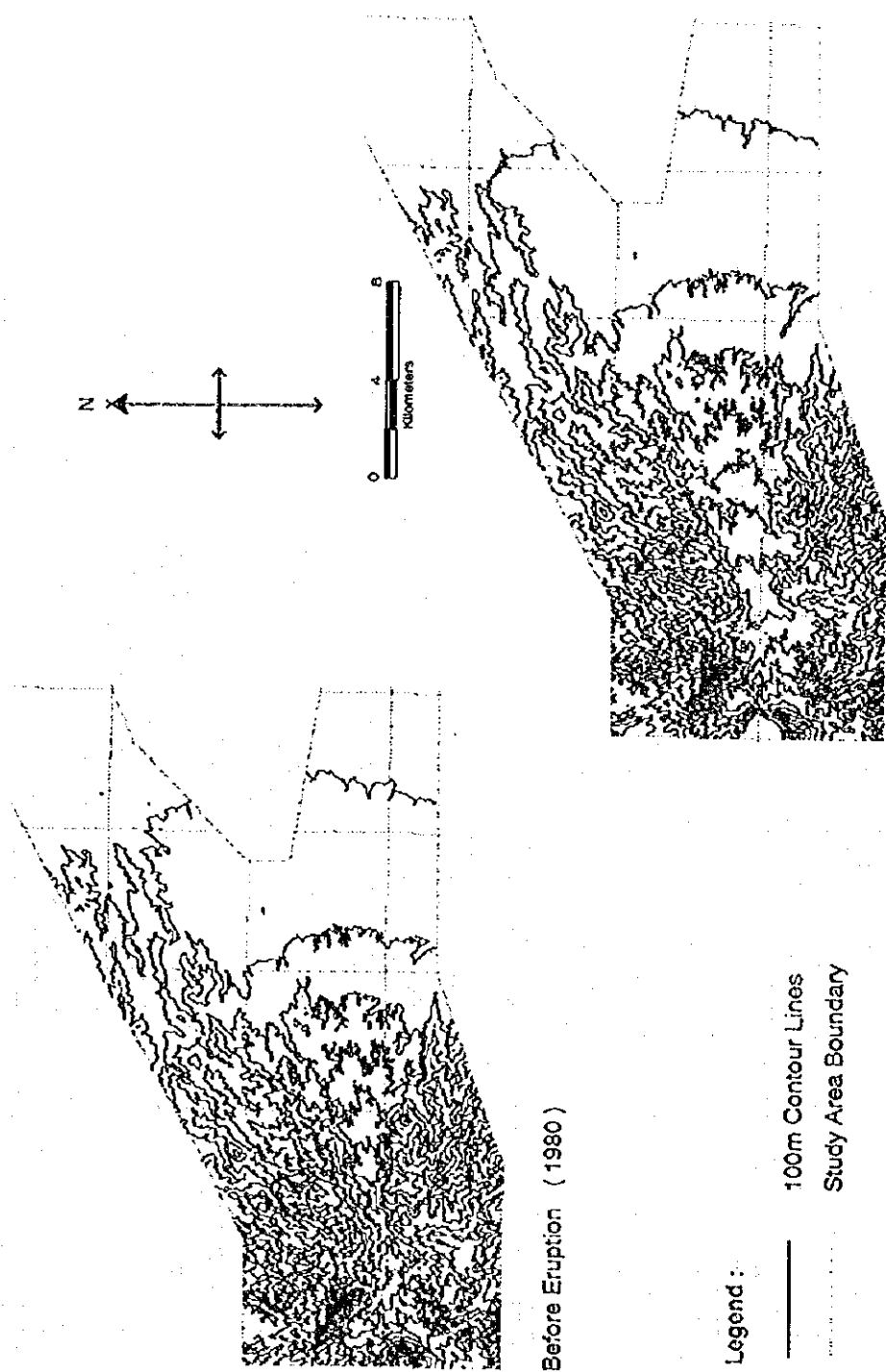
River Data not available for 1991



River Data not available for 1994

Figure R.1 Topographic Information from Aerial Surveys

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After Eruption ( 1994 )

Before Eruption ( 1980 )

Legend :  
 ——— 100m Contour Lines  
 - - - - Study Area Boundary

Figure R.2 Details of Data Layers in the Digital Database (1/5)

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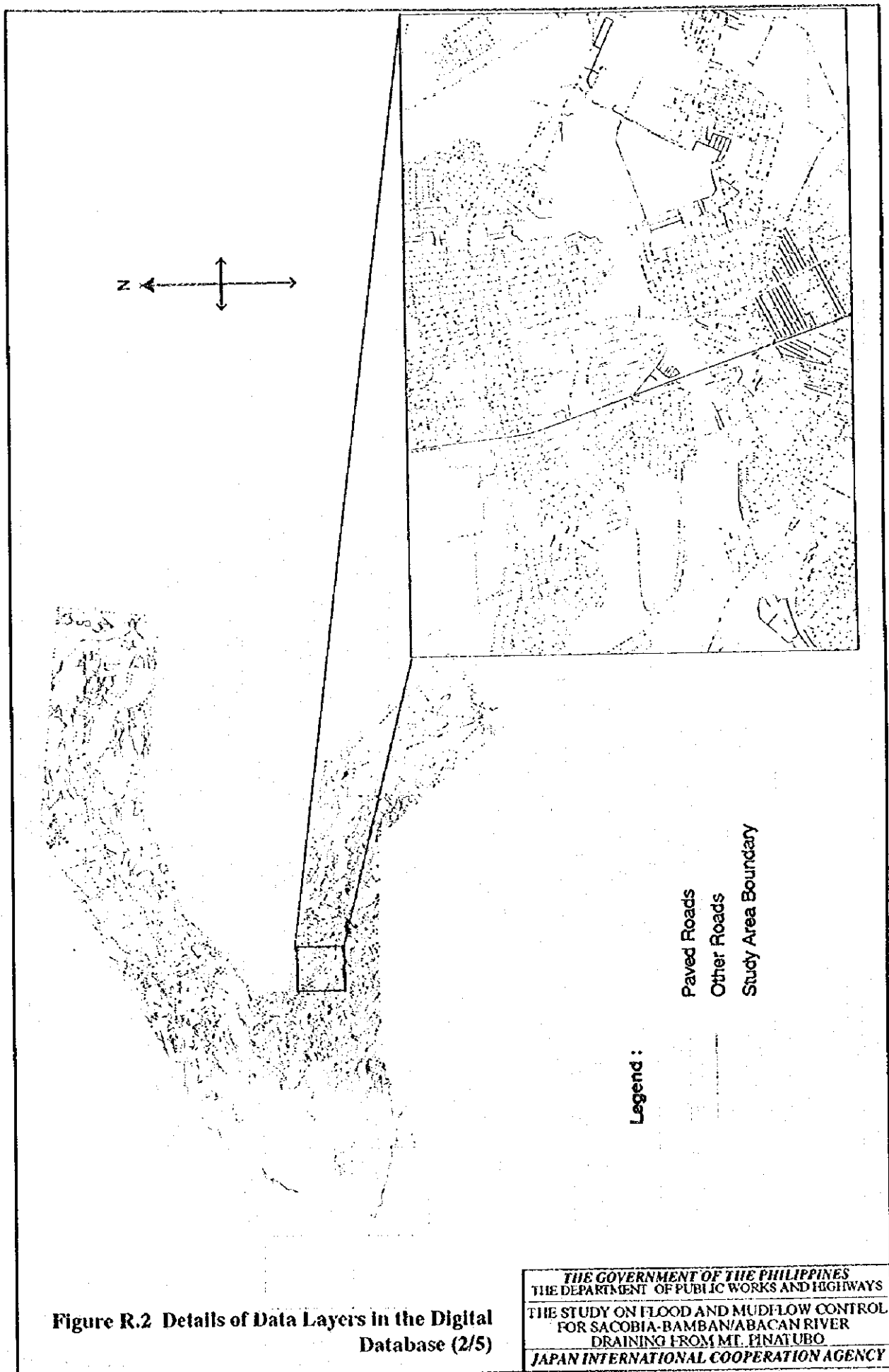


Figure R.2 Details of Data Layers in the Digital Database (2/5)

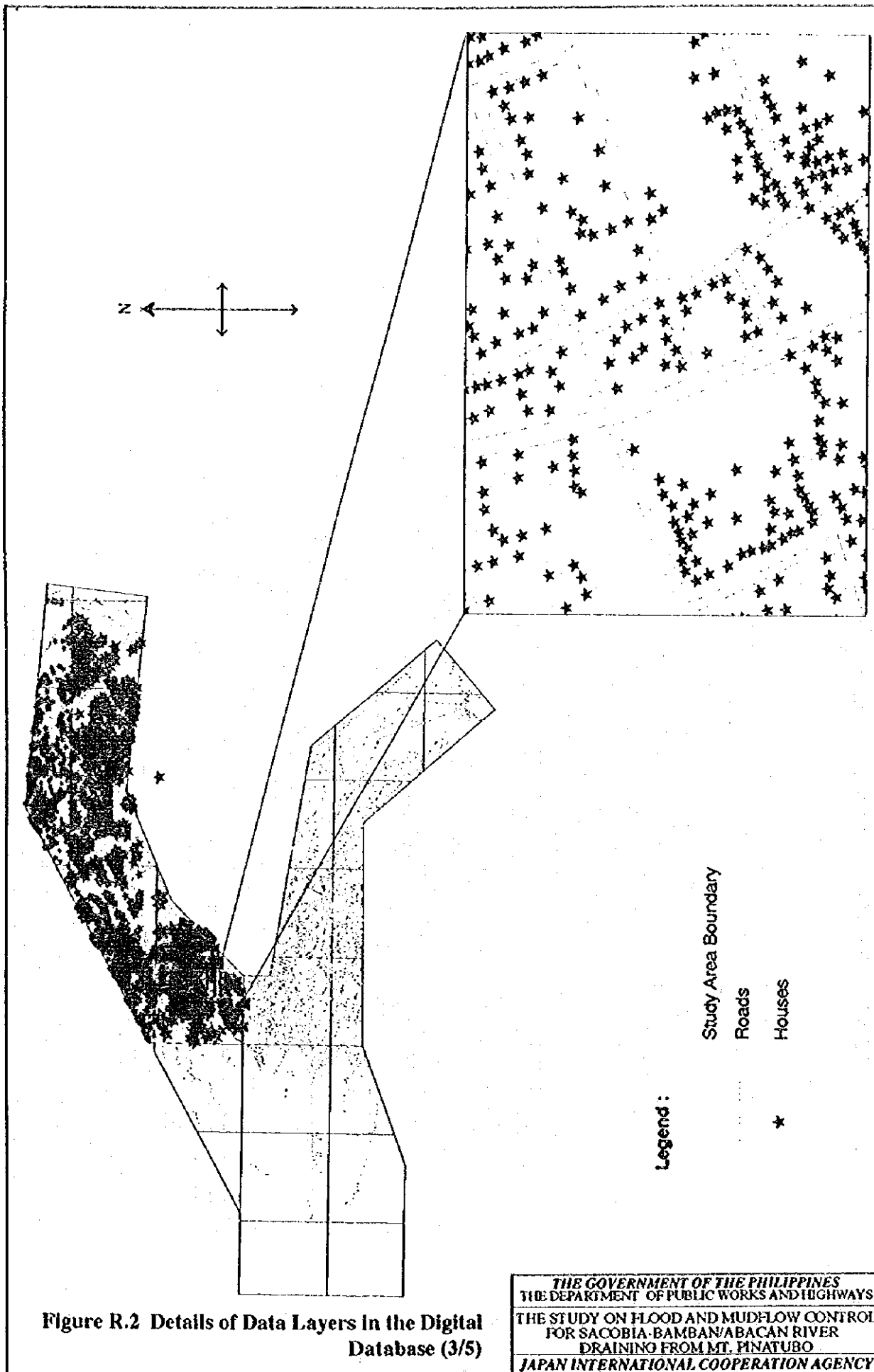
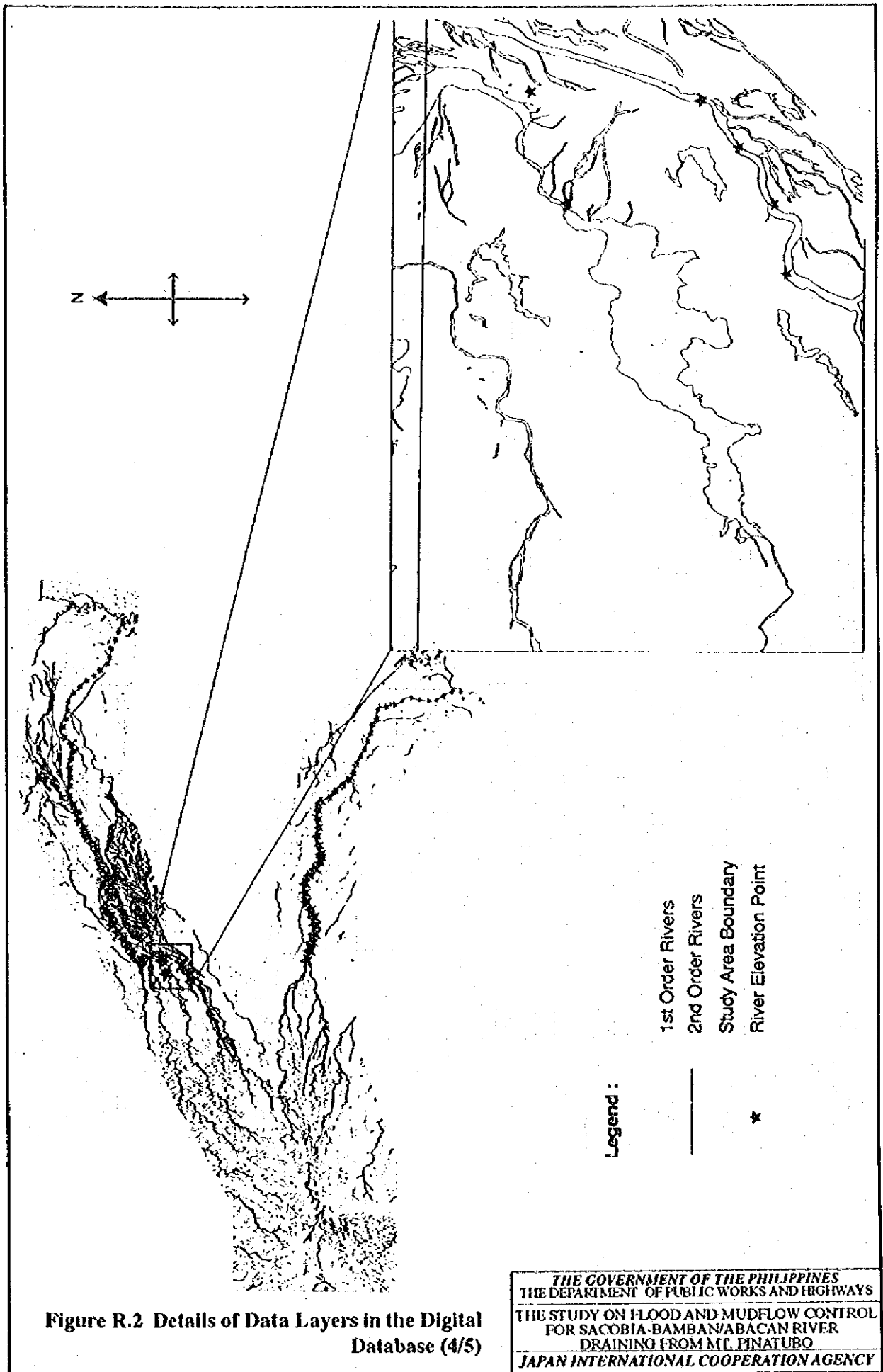
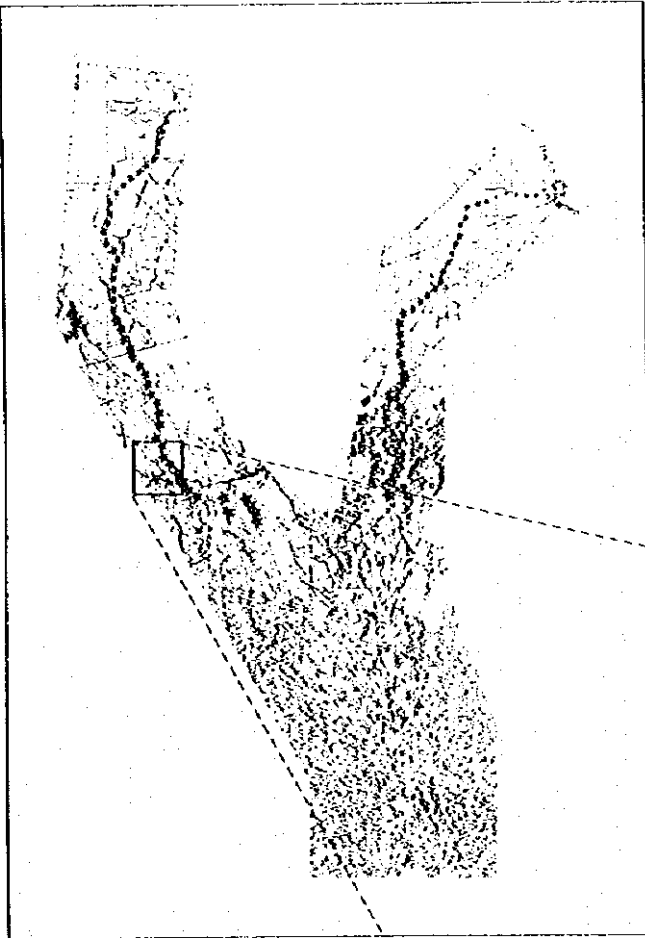


Figure R.2 Details of Data Layers in the Digital Database (3/5)

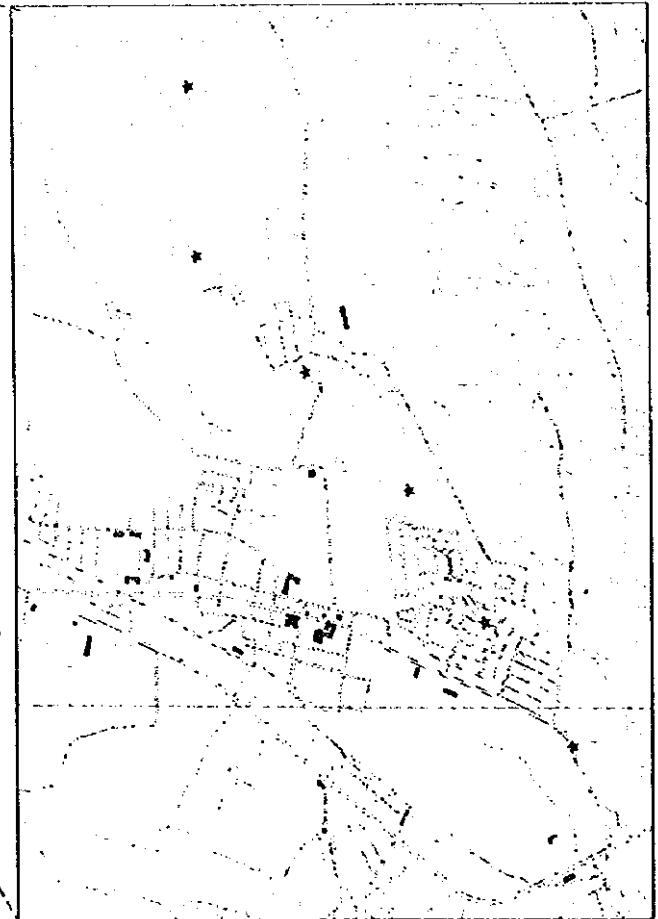


LEGEND :

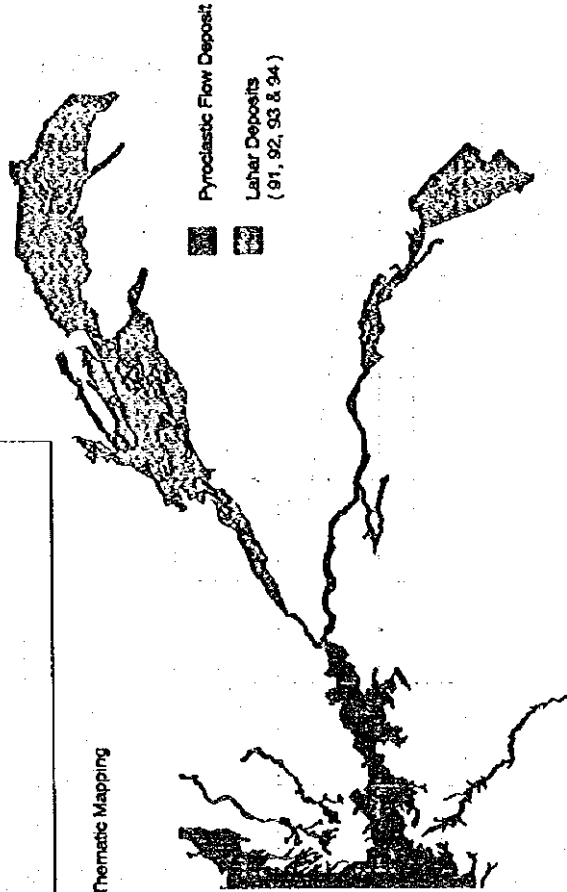
Study Area Boundary	—
100m Contour lines	—
Rivers	—
Roads	—
River Elevation	★
Buildings	■



Details of Data Layers



Thematic Mapping



Pyroclastic Flow Deposit  
 Lahar Deposits  
 (91, 92, 93 & 94)

Figure R.2 Details of Data Layers in the Digital Database (S/S)

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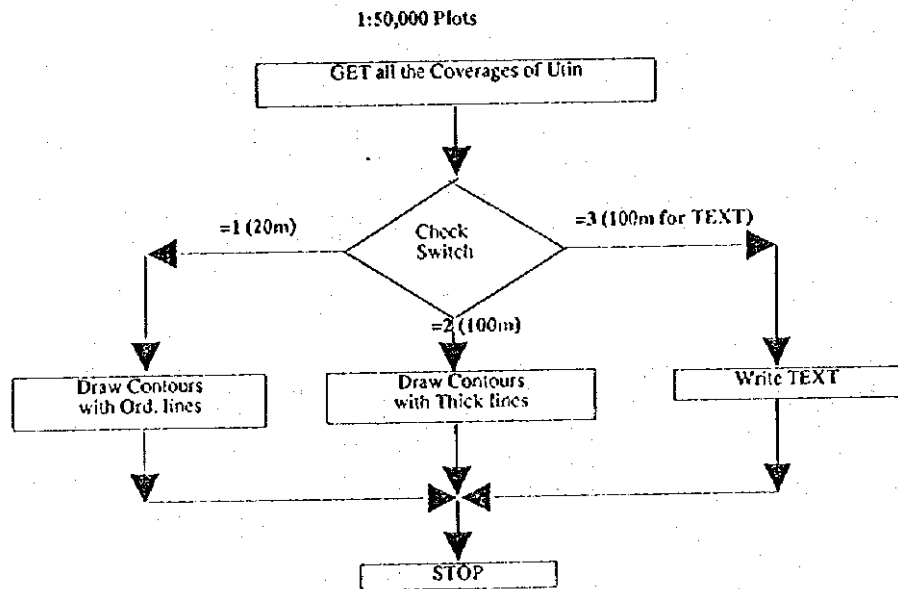
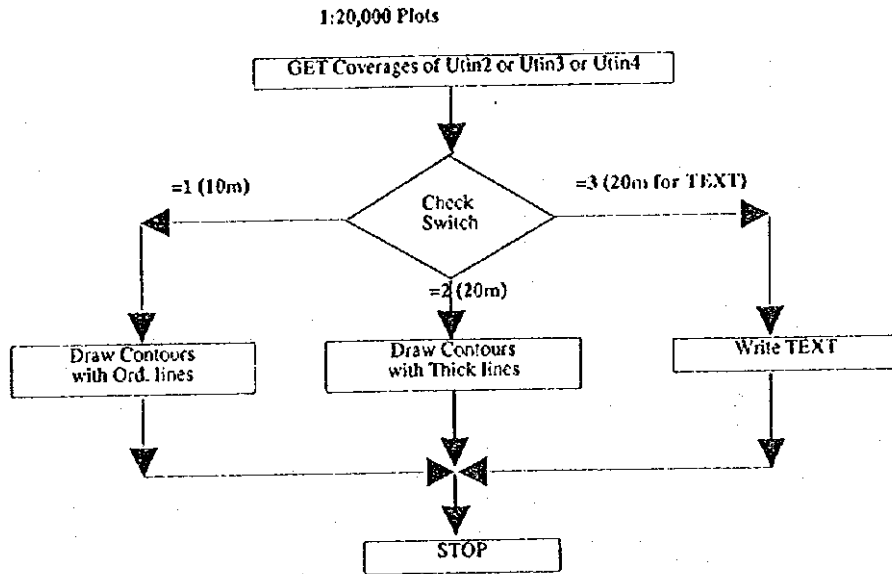
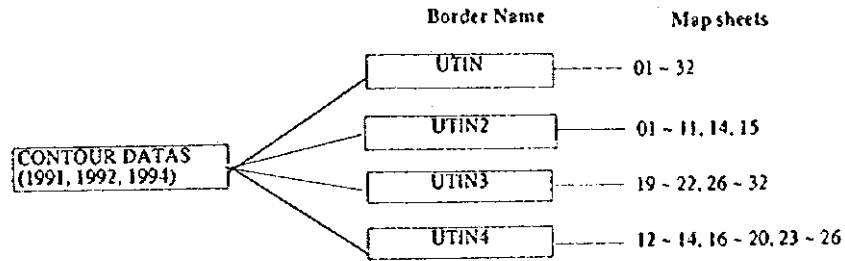
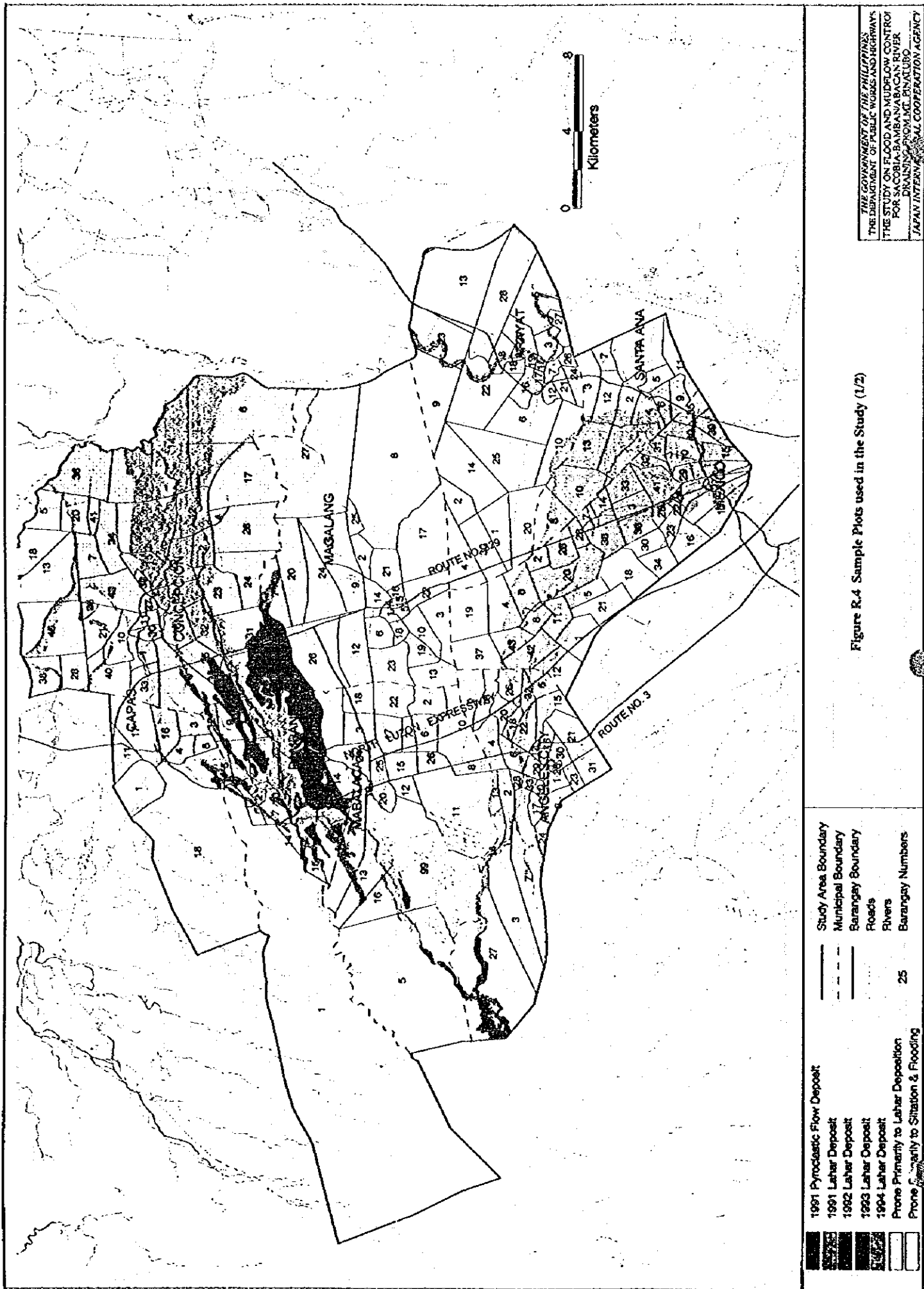


Figure R.3 Flow Chart for Developing Plotting Routines

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 DRAINING FROM MT. PINATUBO  
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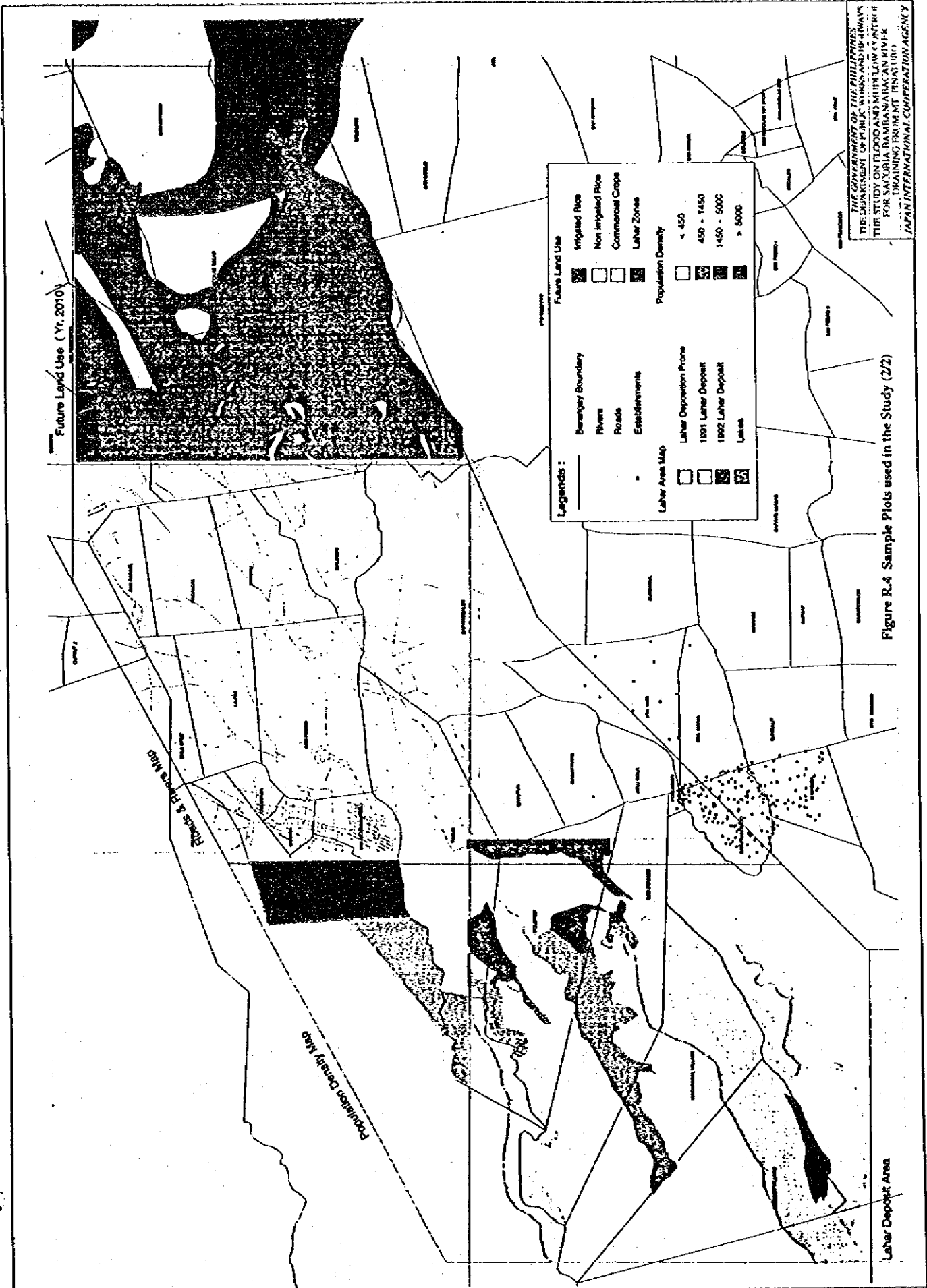
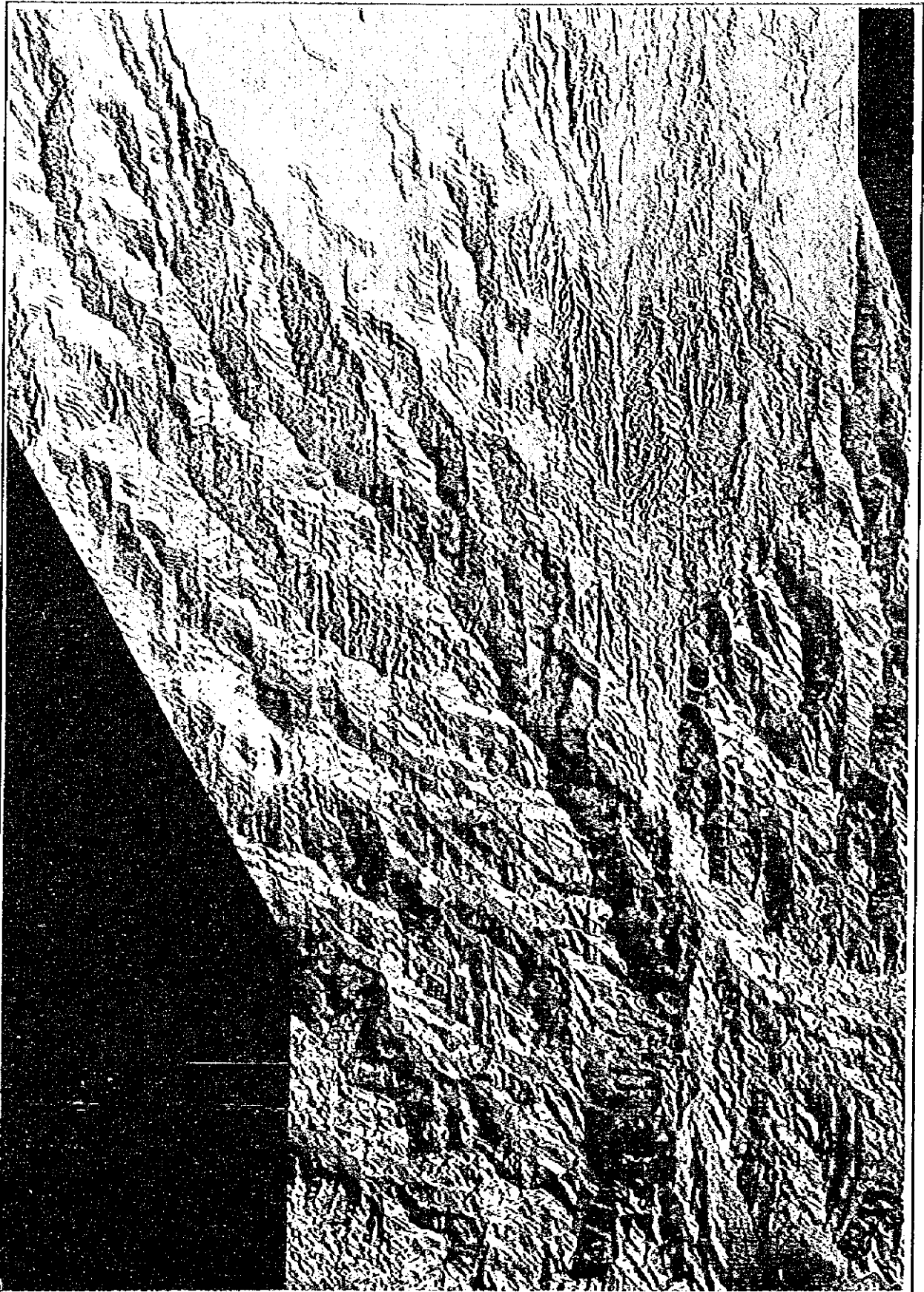


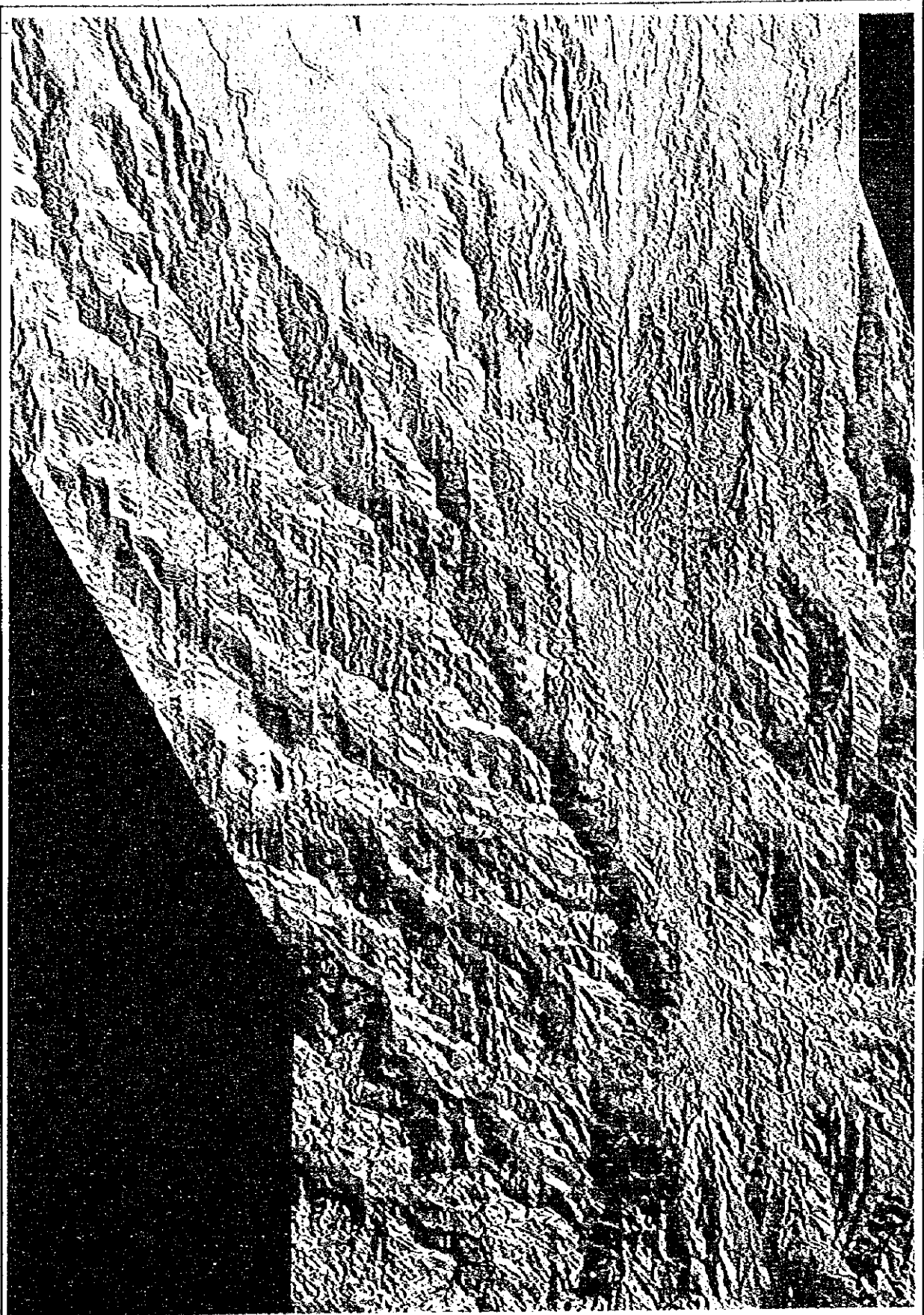
Figure R.4 Sample Plots used in the Study (2/2)



**Figure R.5 3-D Stereo Image of the Upper  
Plains (1/3)**

Data from 1:10000 DTM based aerial survey between 1981-1991

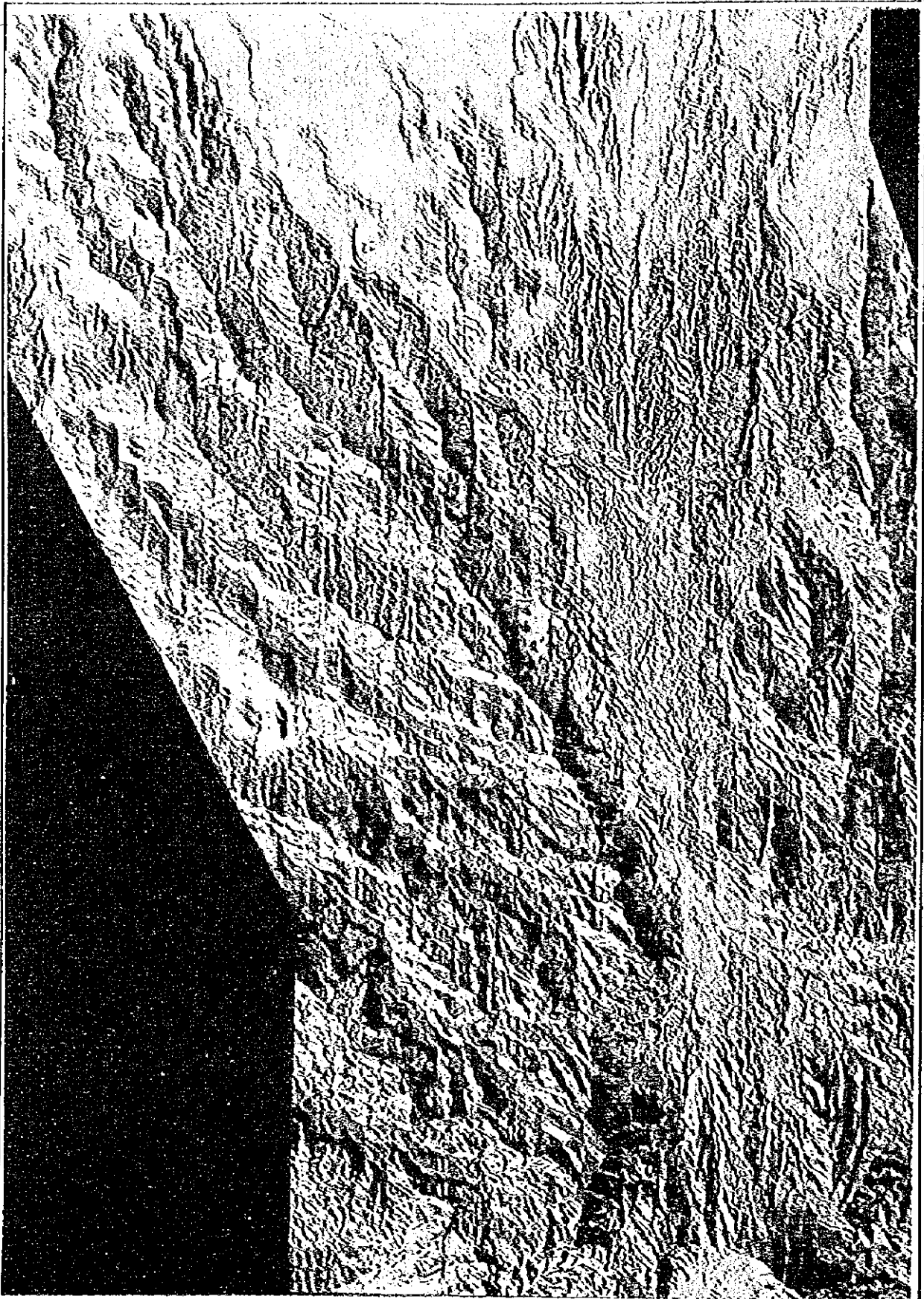
THE GOVERNMENT OF THE PHILIPPINES  
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**Figure R.5 3-D Stereo Image of the Upper  
Plains (2/3)**

Data from 1:10000 DTM based aerial survey in October 1992

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*FOR SACOBIA-BAMBAN/ABACAN RIVER*  
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**Figure R.5 3-D Stereo Image of the Upper  
Plains (3/3)**

Data from 1:10000 DTM based aerial survey in March 1994

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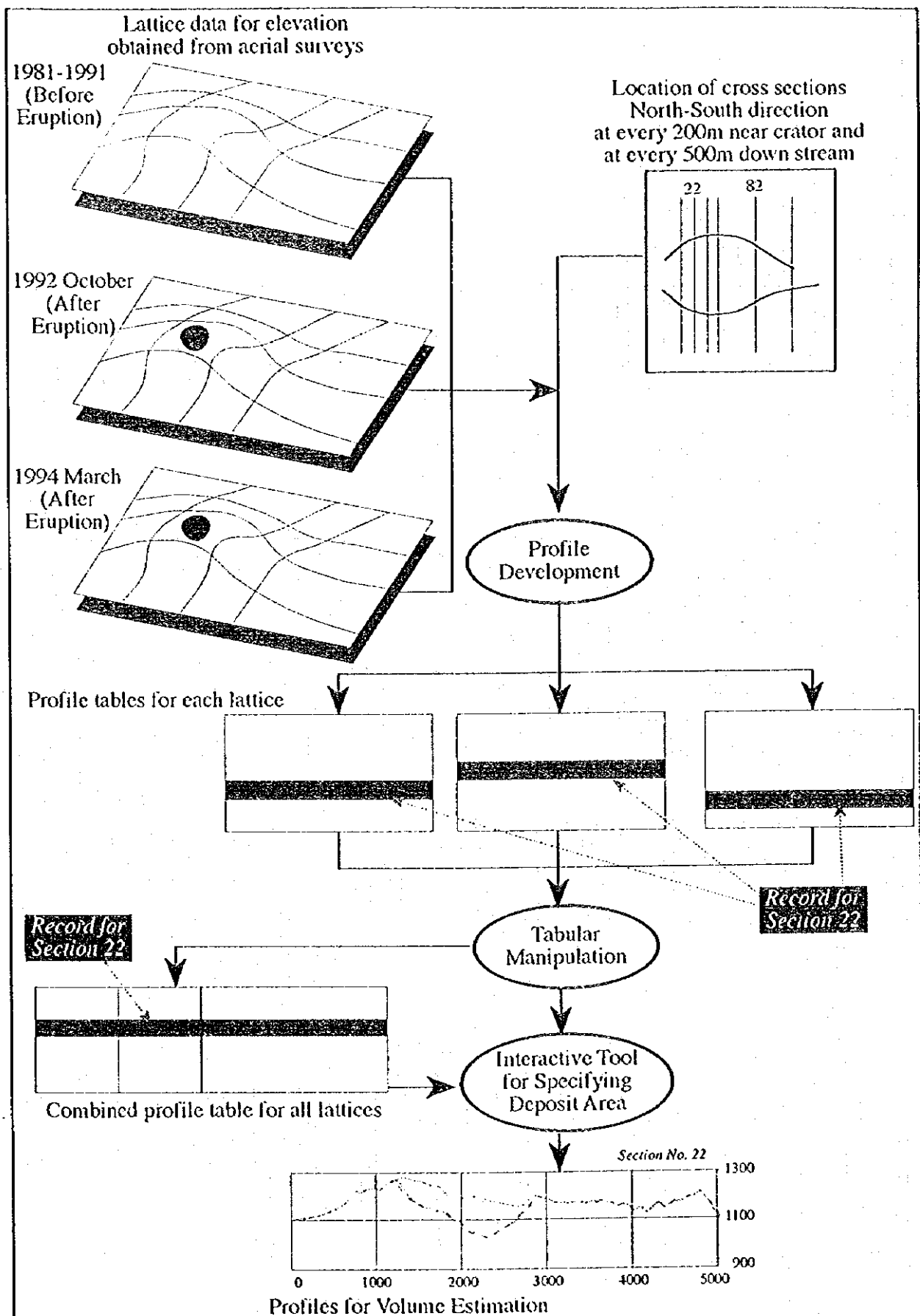
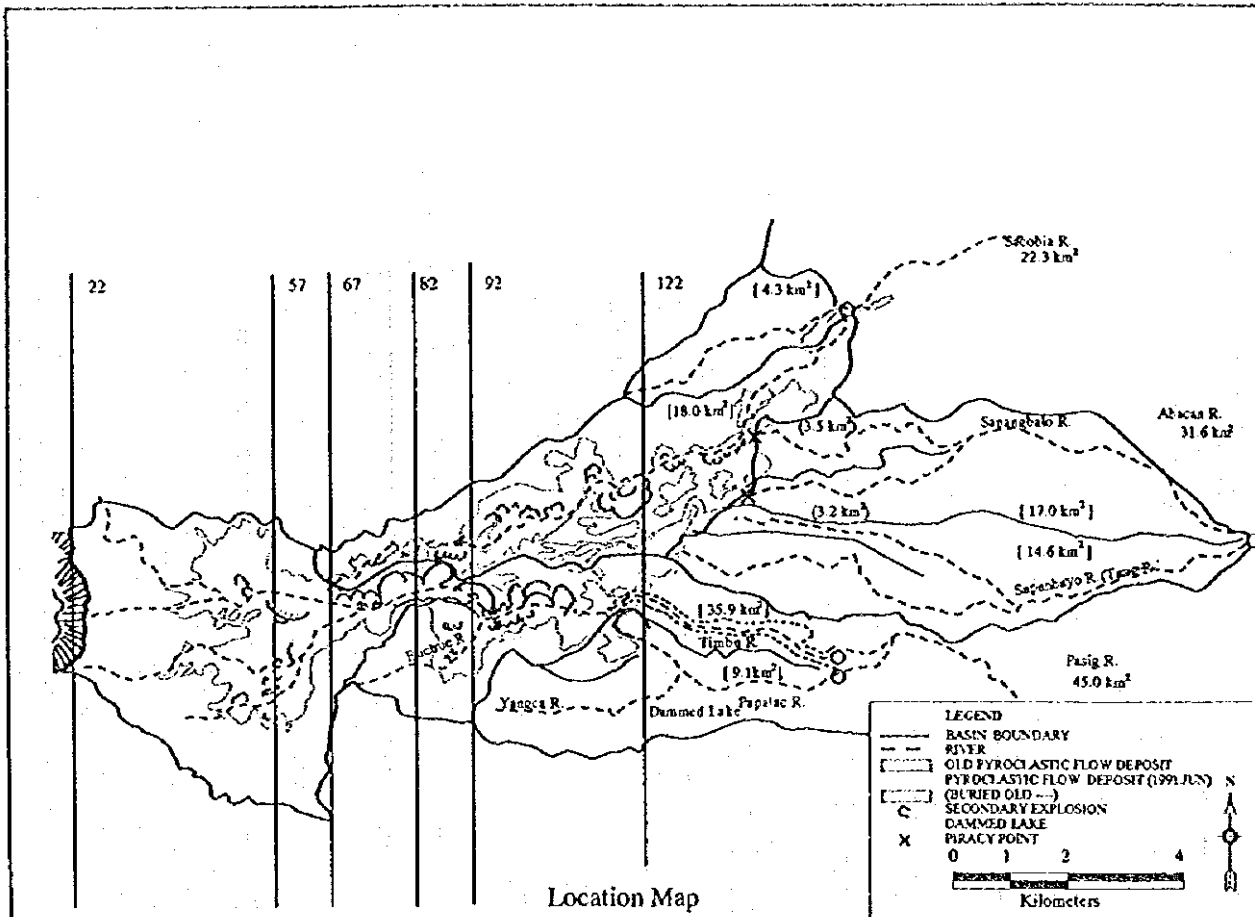
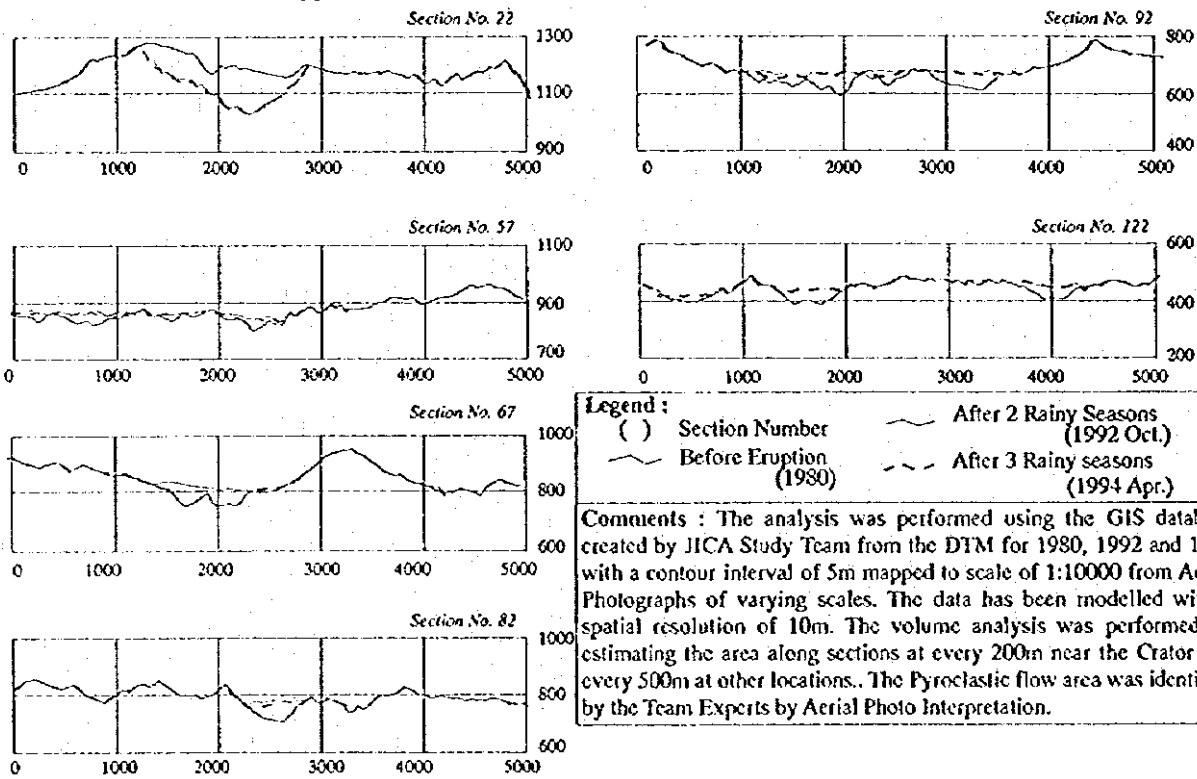


Figure R.6 Procedure for Pyroclastic Flow Deposit Analysis

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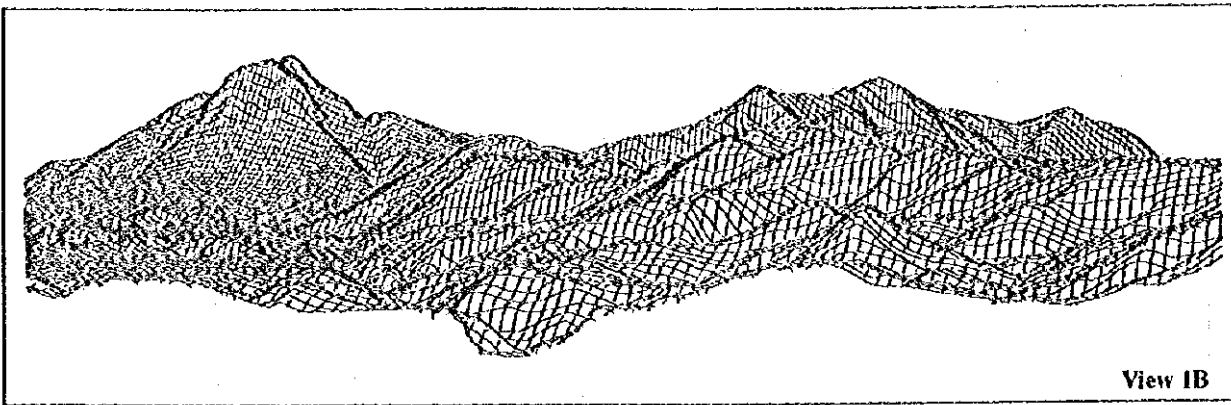


**Typical Cross Section Data (distance in meters)**

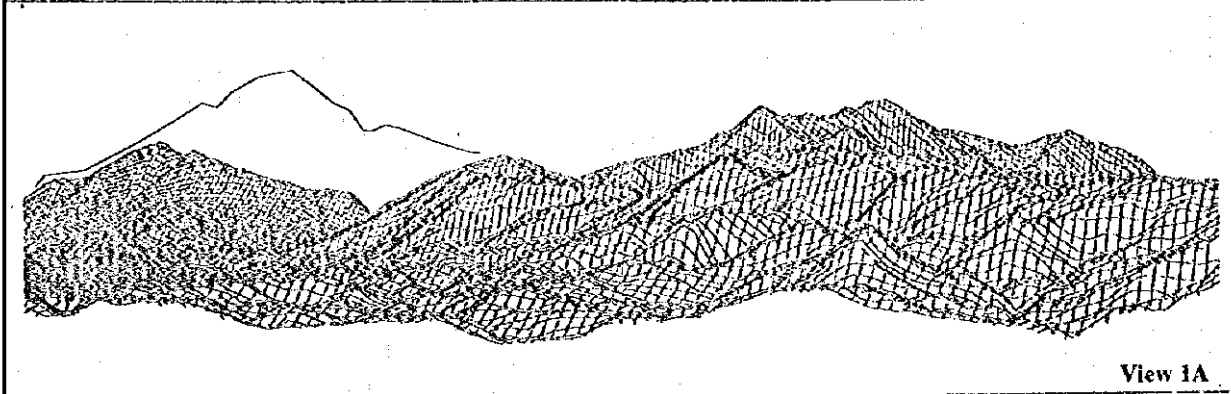


**Figure R.7 Location of Cross Sections for Pyroclastic Flow Deposit Analysis**

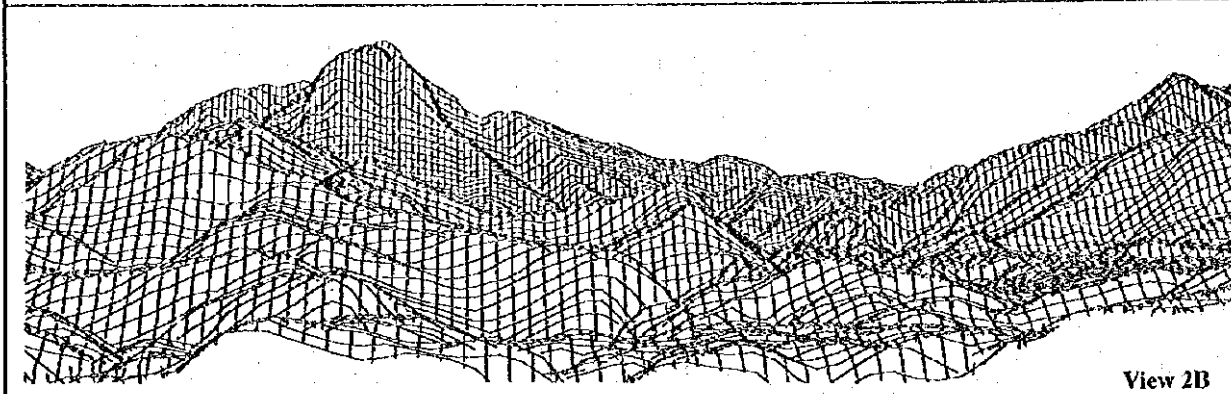
**THE GOVERNMENT OF THE PHILIPPINES**  
**THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS**  
**THE STUDY ON FLOOD AND MUDFLOW CONTROL**  
**FOR SACOBIA-BAMBAN/ABACAN RIVER**  
**DRAINING FROM MT. PINATUDO**  
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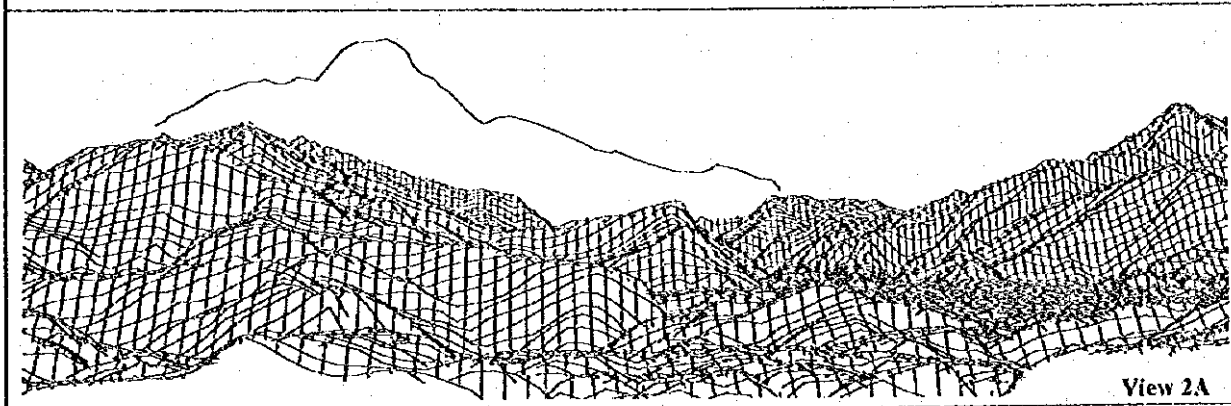
View 1B



View 1A



View 2B



View 2A

Legend:  
 View 1B - View from Clark Air Base using DTM for 1991  
 View 1A - View from Clark Air Base using DTM for 1994 (the crater in the Background)  
 View 2B - View from Watch Point 5 using DTM for 1991  
 View 2A - View from Watch Point 5 using DTM for 1994 (the crater in the Background)

**Figure R.8 Birds Eye View of Pyroclastic Flow Deposit Area**

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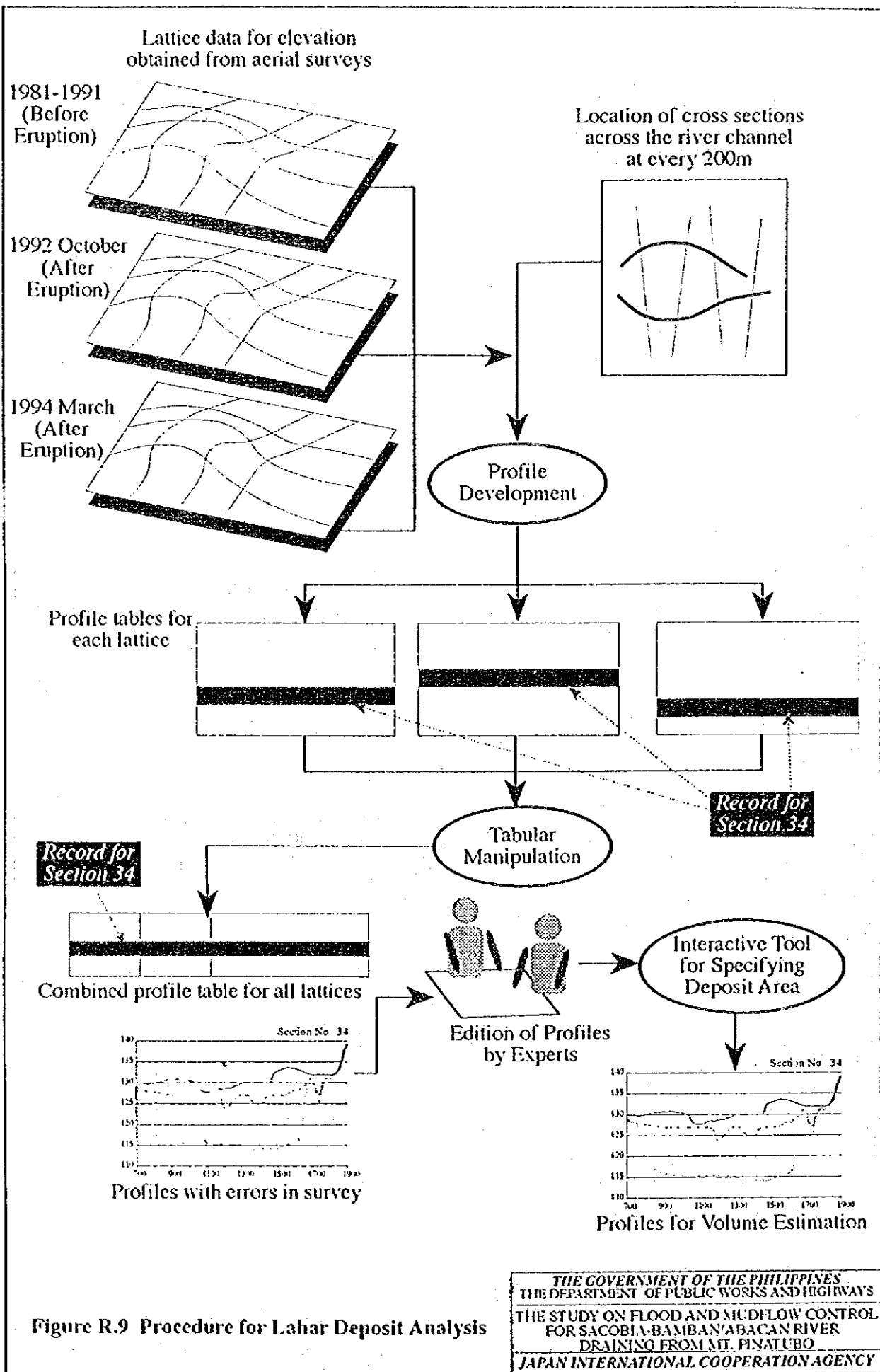


Figure R.9 Procedure for Lahar Deposit Analysis

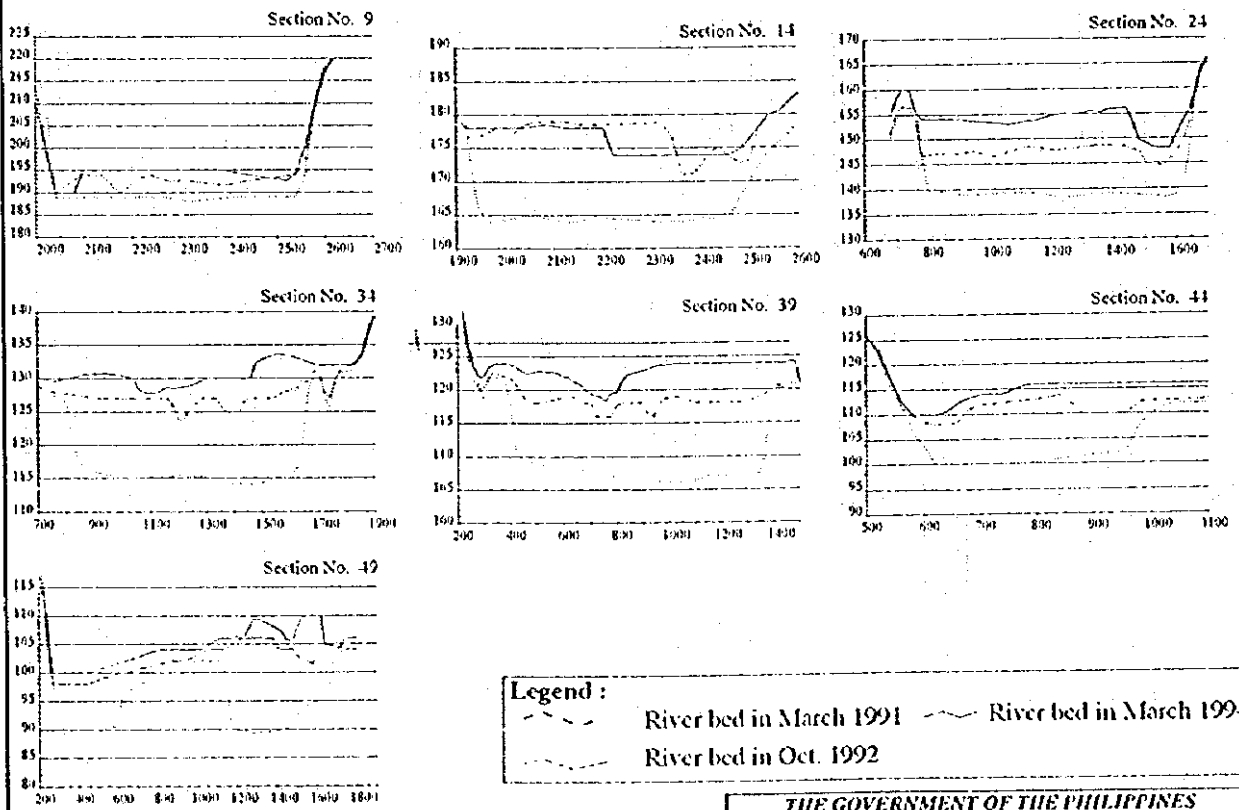
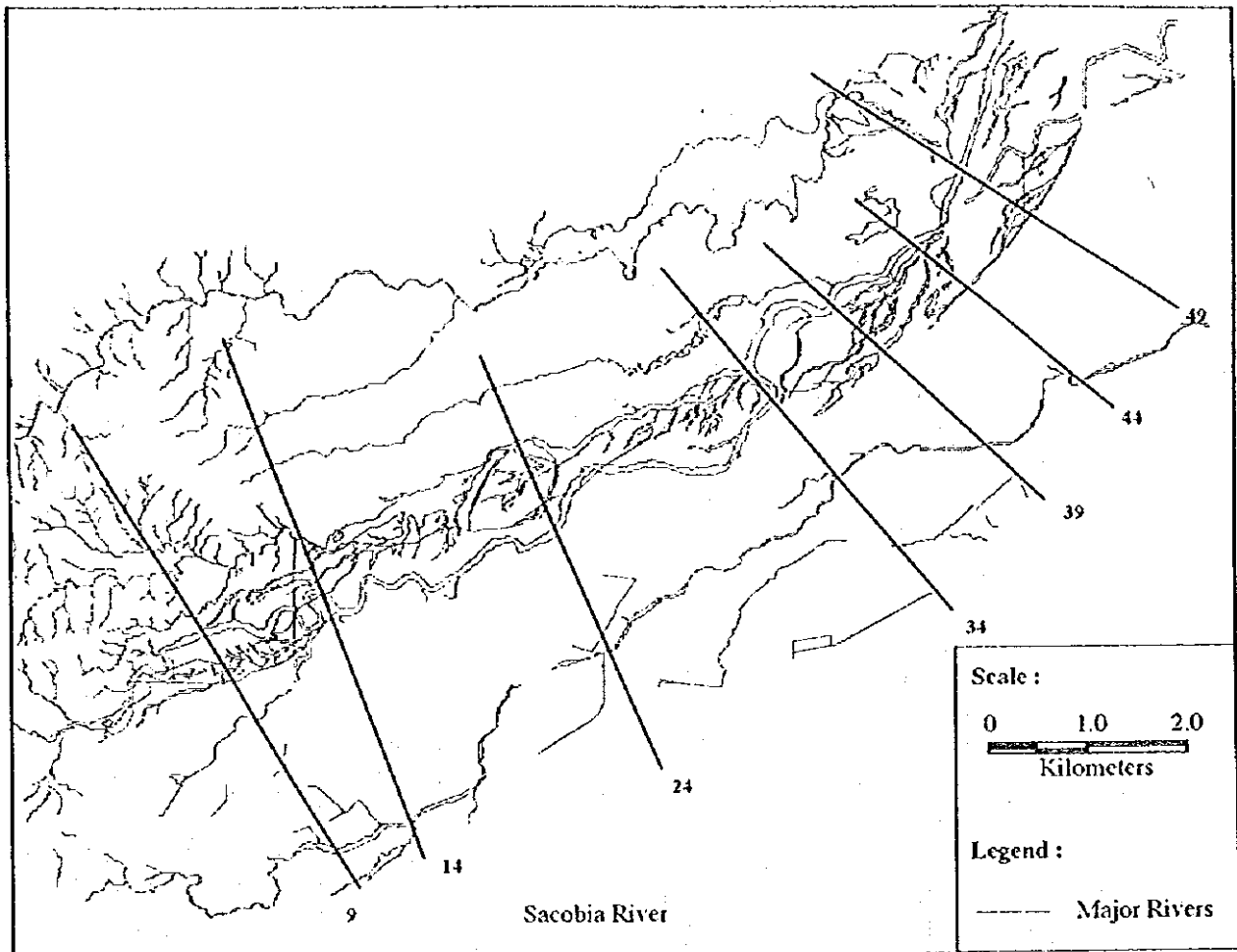
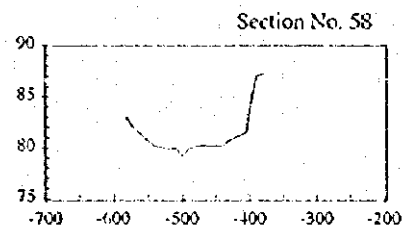
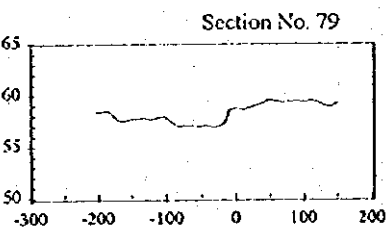
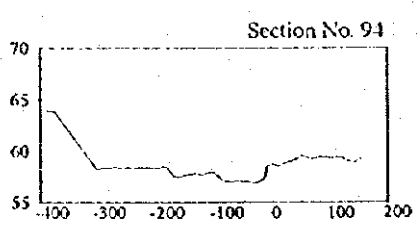
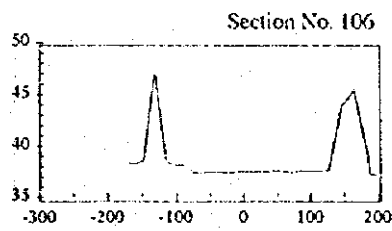
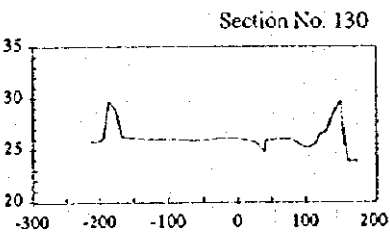
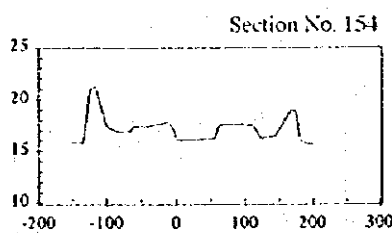
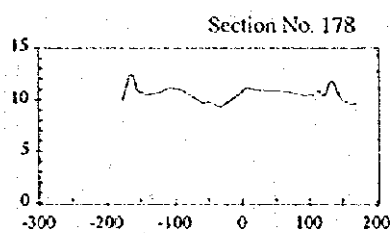
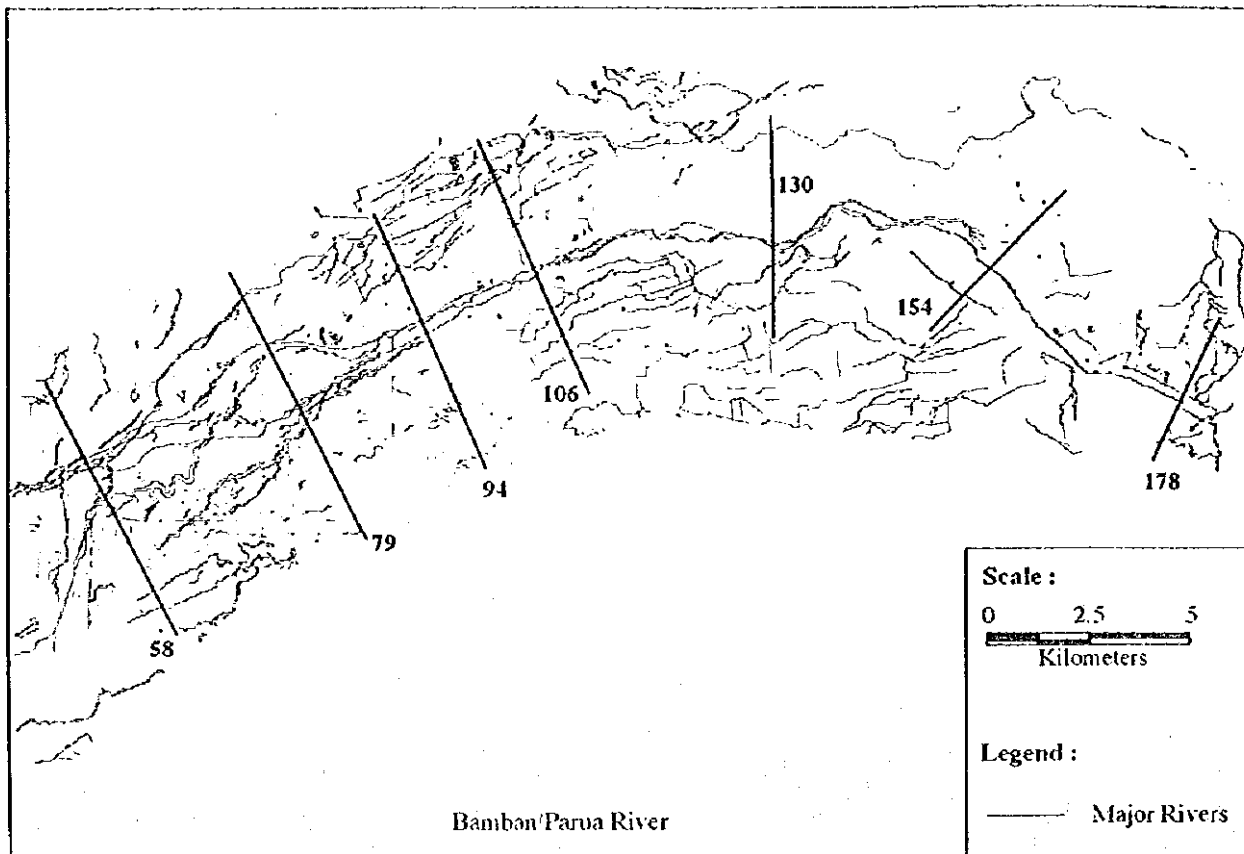


Figure R.10 Profiles of Cross Sections along Sacobia River

THE GOVERNMENT OF THE PHILIPPINES  
 THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS  
 THE STUDY ON FLOOD AND MUDFLOW CONTROL  
 FOR SACOBIA-BAMBAN/ABACAN RIVER  
 DRAINING FROM MT. PINATUBO  
 JAPAN INTERNATIONAL COOPERATION AGENCY



**Comments :**

Section No:	Distance from Confluence (km)
58	24.6
79	20.4
94	17.4
106	15.0
130	10.2
154	5.4
178	0.6

**Figure R.II Profiles of Cross Sections along Bamban River**

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 DRAINING FROM MT. PINATUBO  
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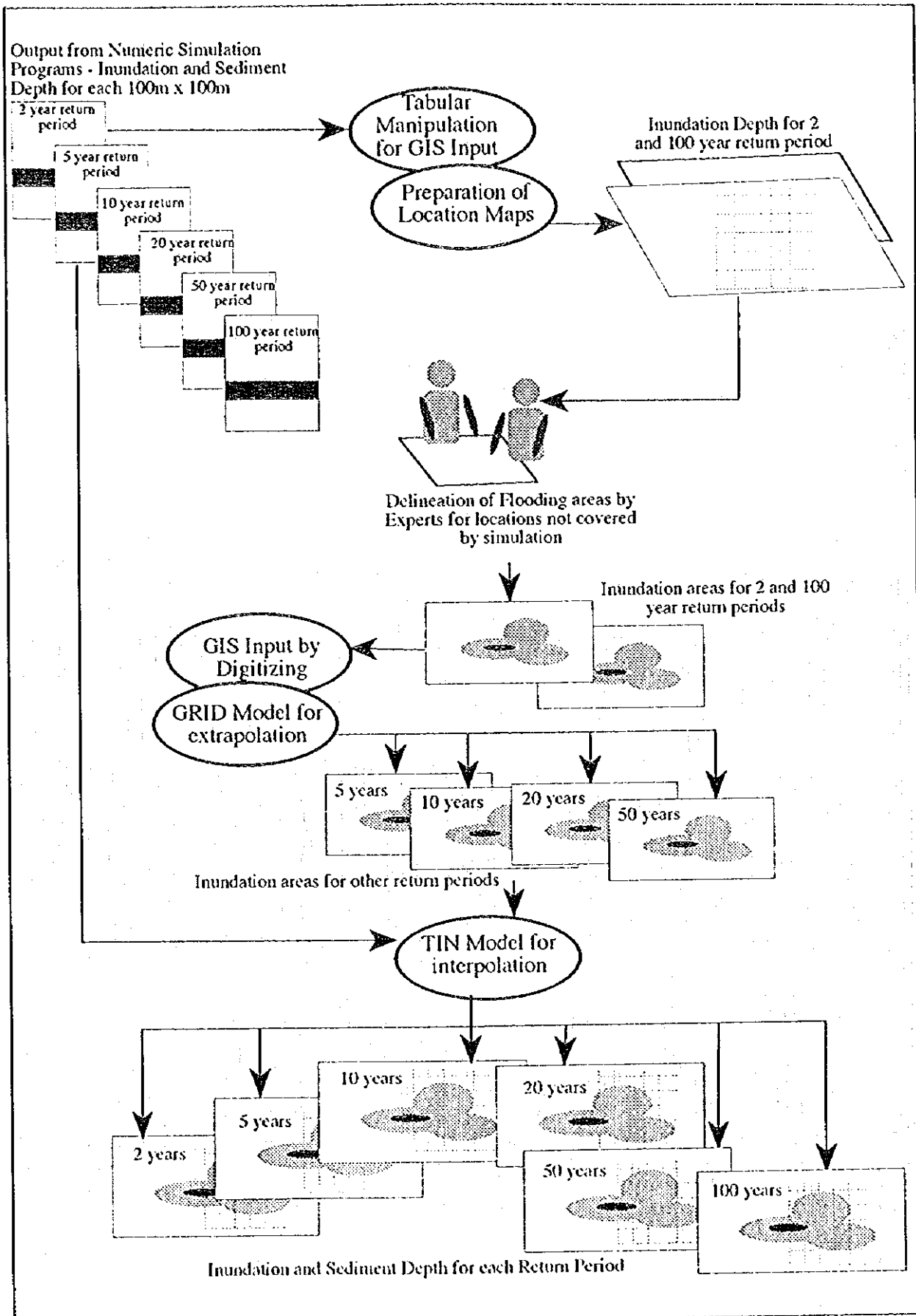
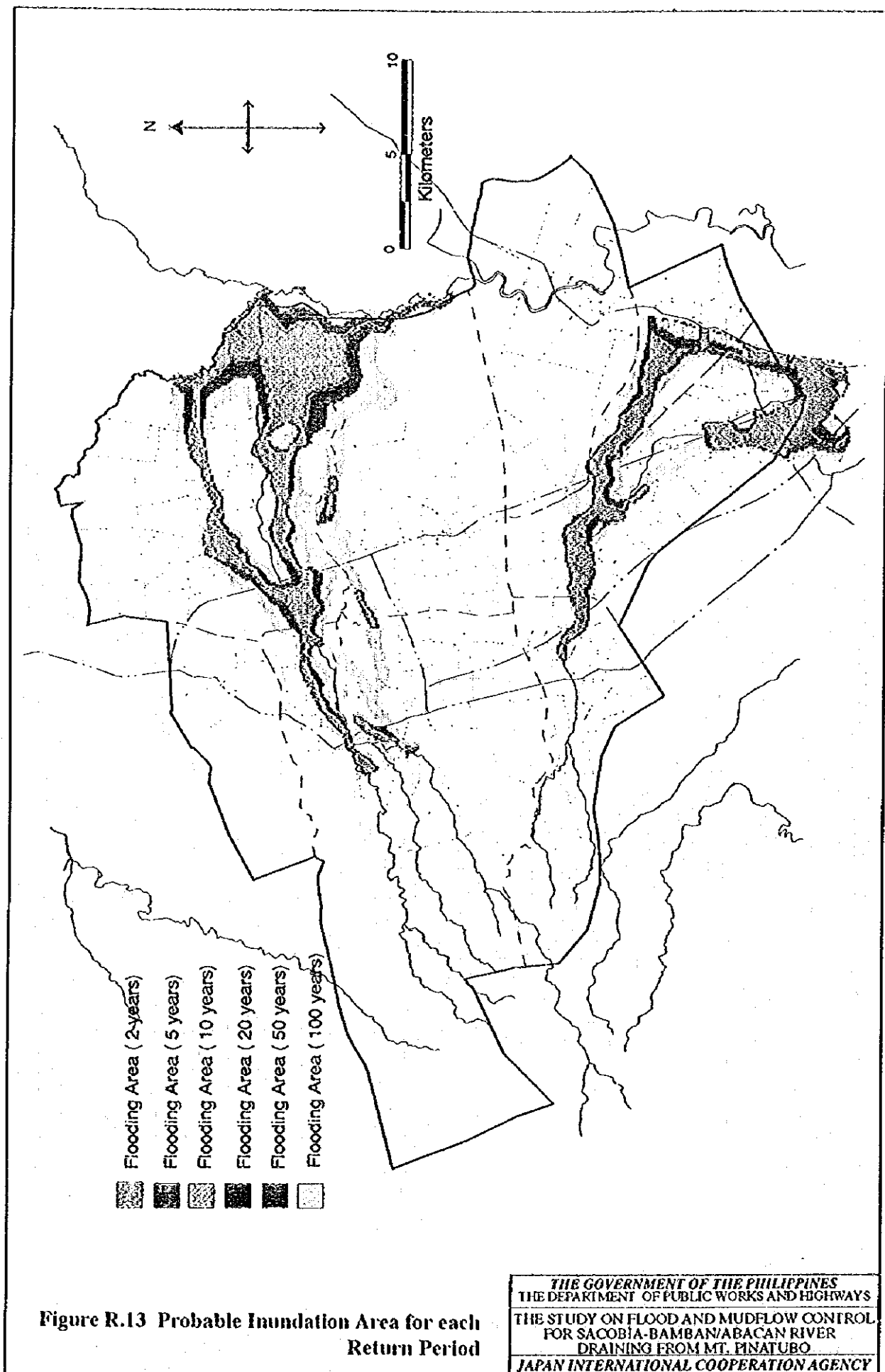


Figure R.12 Procedure for Mud Flow and Flood Analysis

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 FOR SACOBIA-BAMBAN-ABACAN RIVER  
 DRAINING FROM MT. PINATUBO  
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- Flooding Area ( 2-years)
- Flooding Area ( 5 years)
- Flooding Area ( 10 years)
- Flooding Area ( 20 years)
- Flooding Area ( 50 years)
- Flooding Area ( 100 years)

**Figure R.13 Probable Inundation Area for each Return Period**

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 FOR SACOBIA-BAMBAN/ABACAN RIVER  
 DRAINING FROM MT. PINATUBO  
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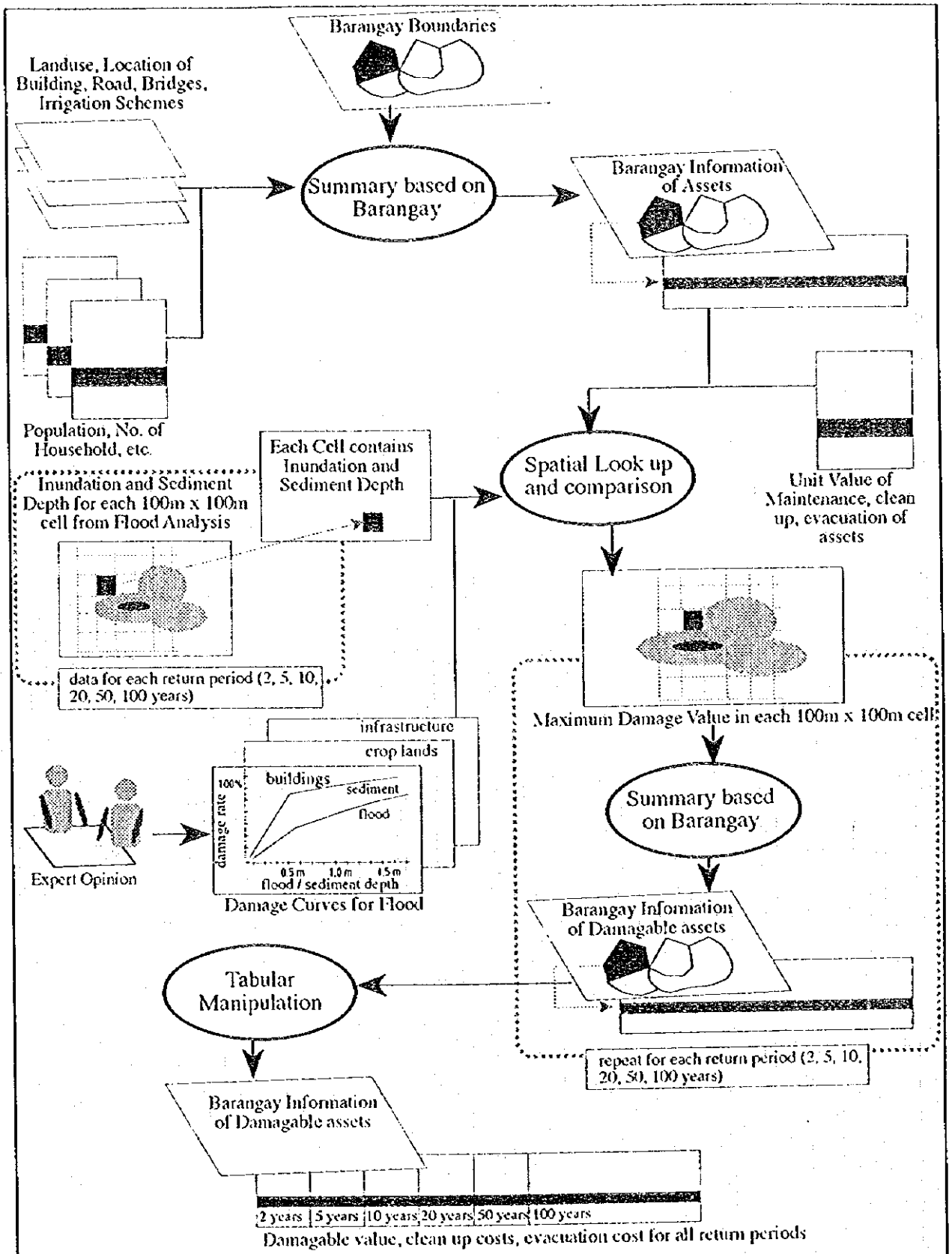


Figure R.14 Procedure for Flood Hazard Analysis

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 FOR SACOBIA-BAMBAN/ABACAN RIVER  
 DRAINING FROM MT. PINATUBO  
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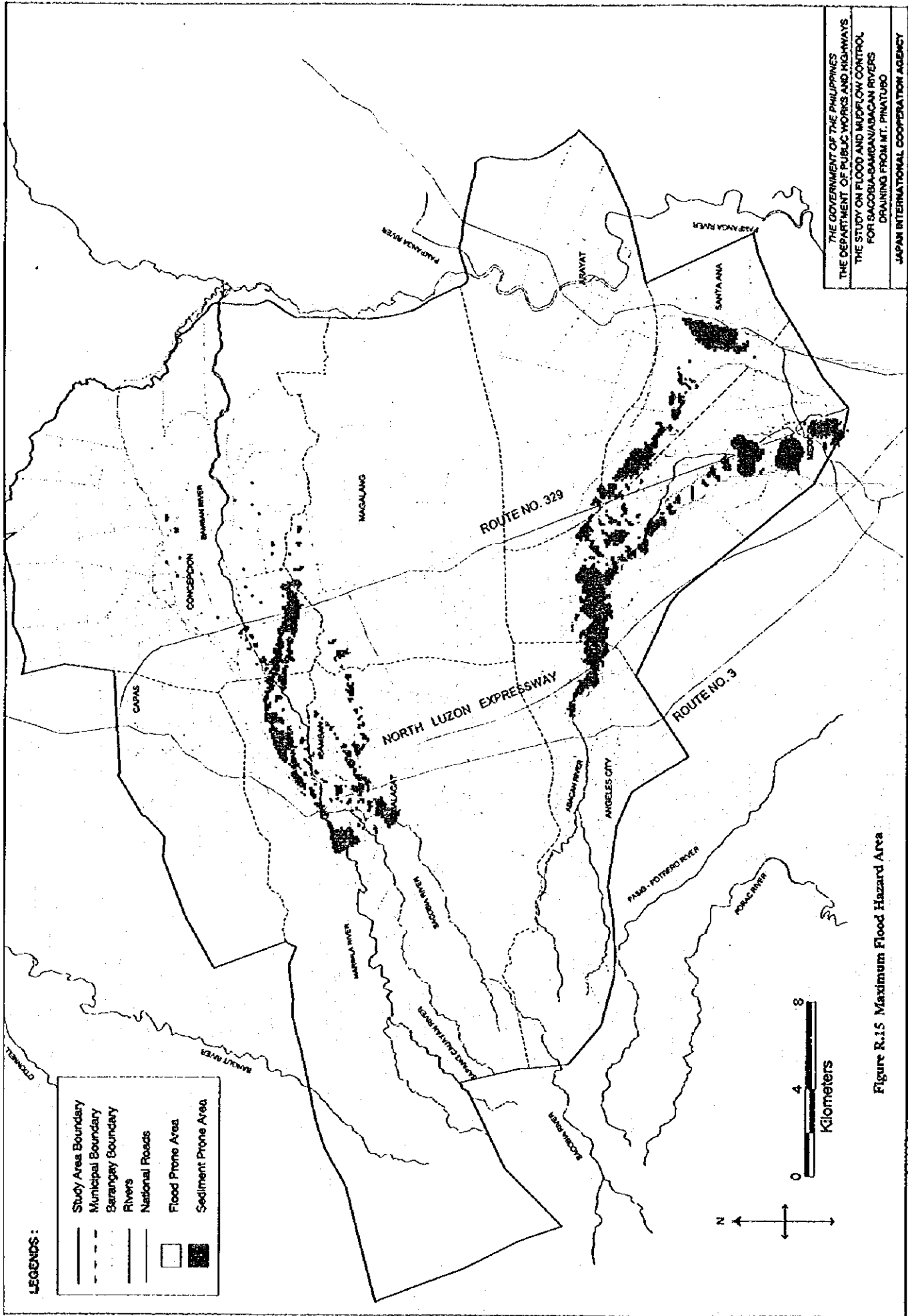
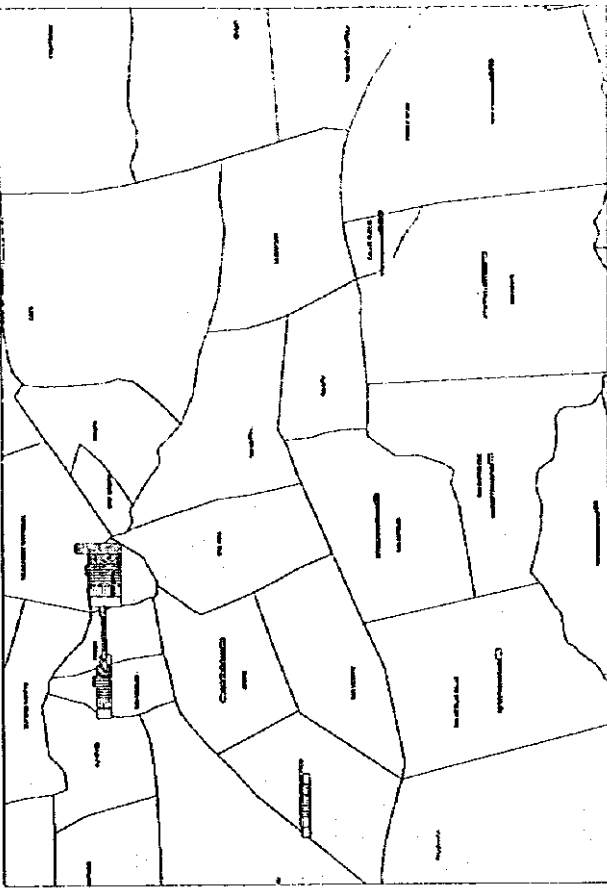
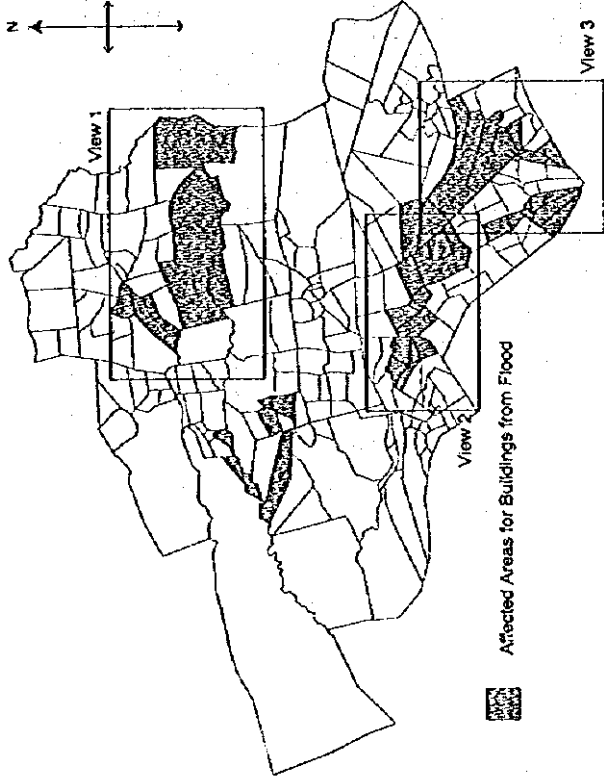
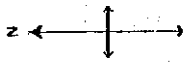
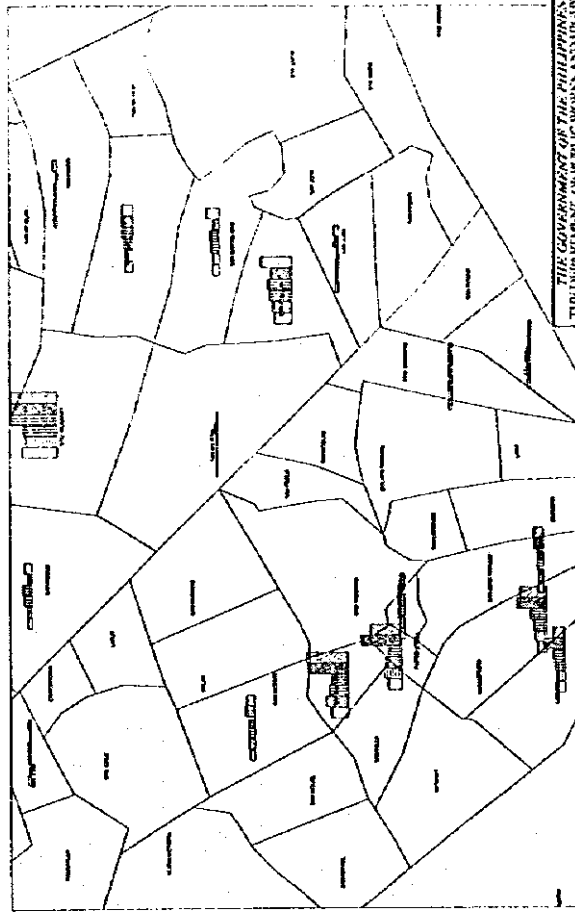


Figure R.15 Maximum Flood Hazard Area

View 1 (near CONCEPCION)



View 3 (near MEXICO)



Building Damage (x 1000 person)  
28000

[White Box]	2 Years
[Light Gray Box]	5 Years
[Medium Gray Box]	10 Years
[Dark Gray Box]	20 Years
[Black Box]	50 Years
[Cross-hatched Box]	100 Years

Affected Areas for Buildings from Flood

View 2 (near ANGELES CITY)

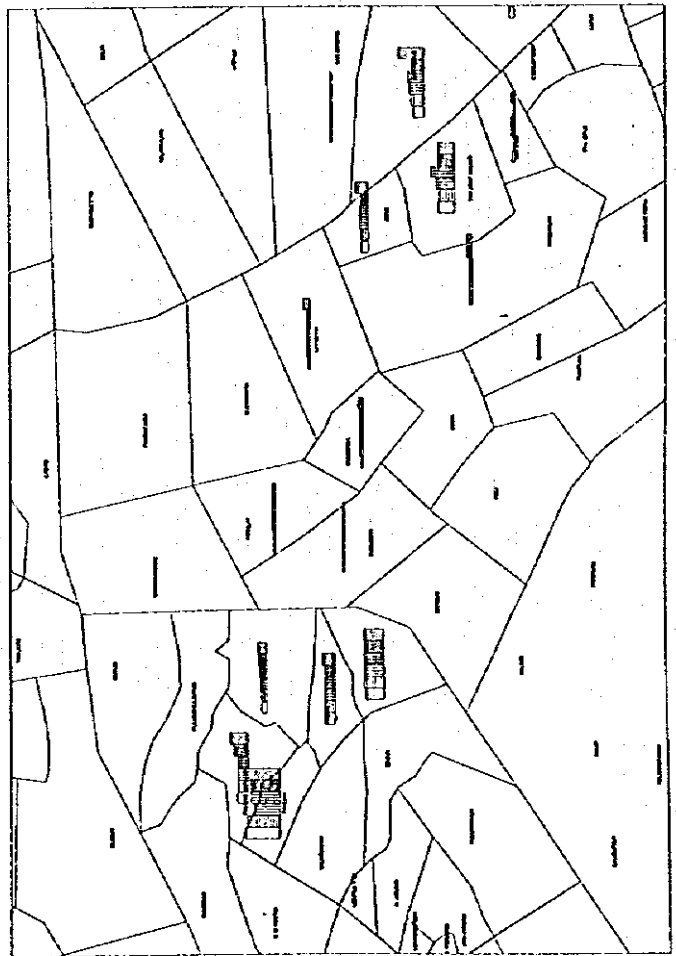
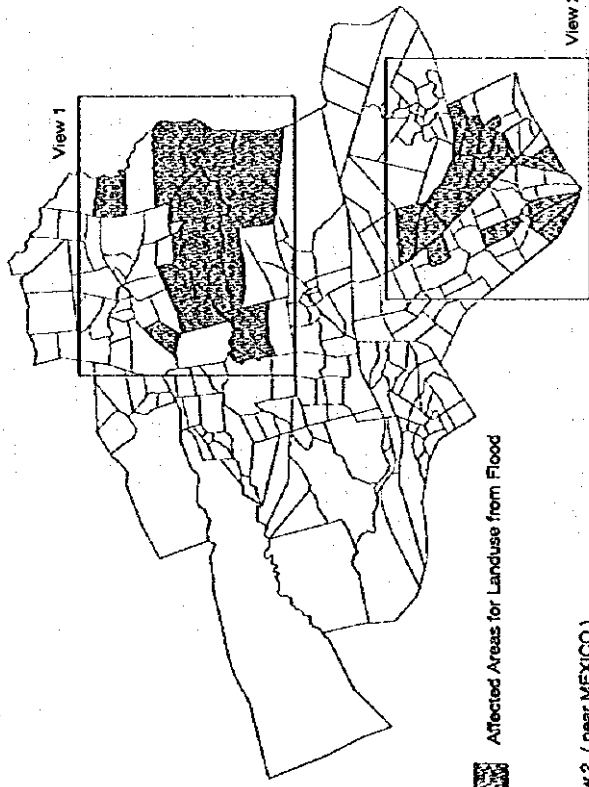
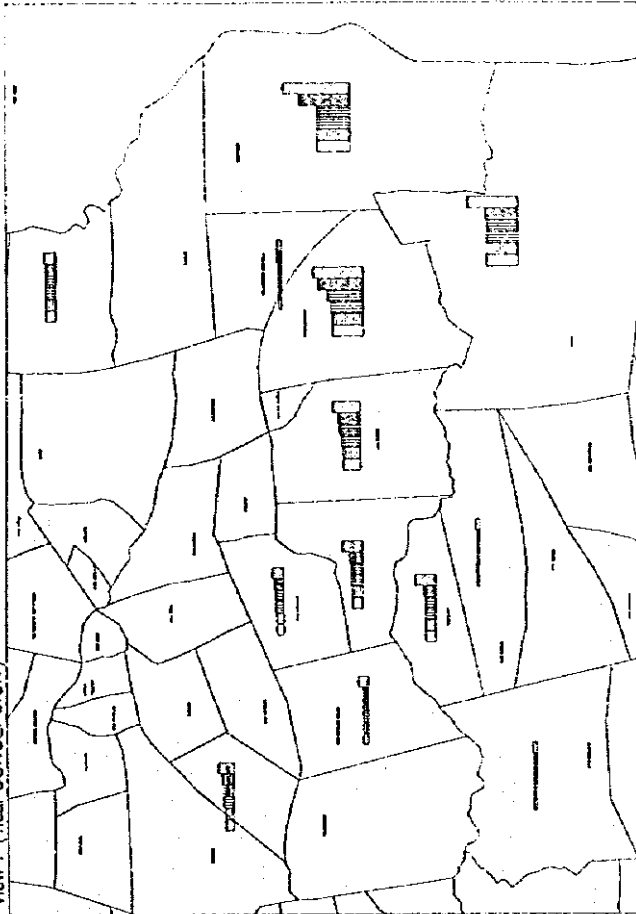


Figure R.16 Probable Damage to Buildings from Flood for each Return Period

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THIS STUDY ON FLOOD AND MUDFLOW CONTROL  
FOR SACUBIA-BANDANABACAN RIVER  
DRAINING FROM MT. TINSAYONG  
JAPAN INTERNATIONAL COOPERATION AGENCY



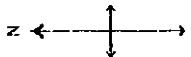
View 1 (near CONCEPCION)



Affected Areas for Landuse from Flood

View 2

View 2 (near MEXICO)



Land Use (x 1000 pesos)

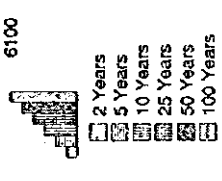
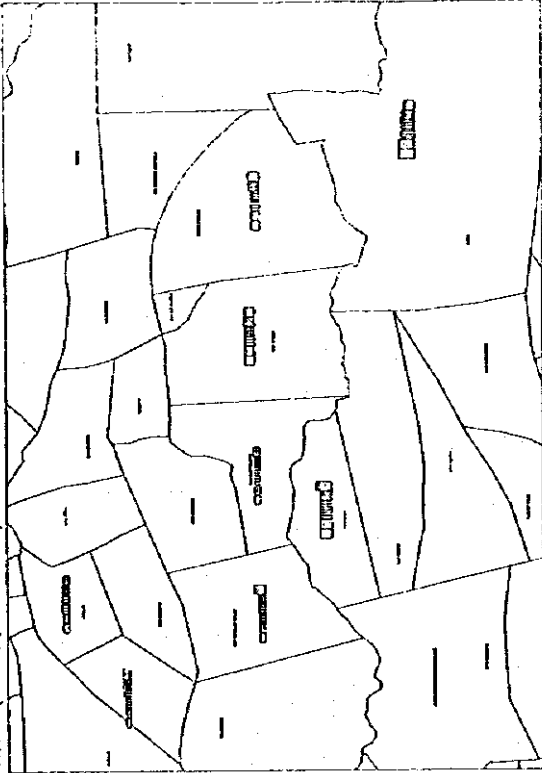


Figure R.17 Probable Damage to Cultivable Land from Flood for each Return Period

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 THE STUDY ON FLOOD AND MODELING CENTER  
 FOR SACORIA-HAMBANAN RIVER  
 DRAINAGE FROM THE TINSAY  
 JAPAN INTERNATIONAL COOPERATION AGENCY

View 1 (near CONCEPCION)

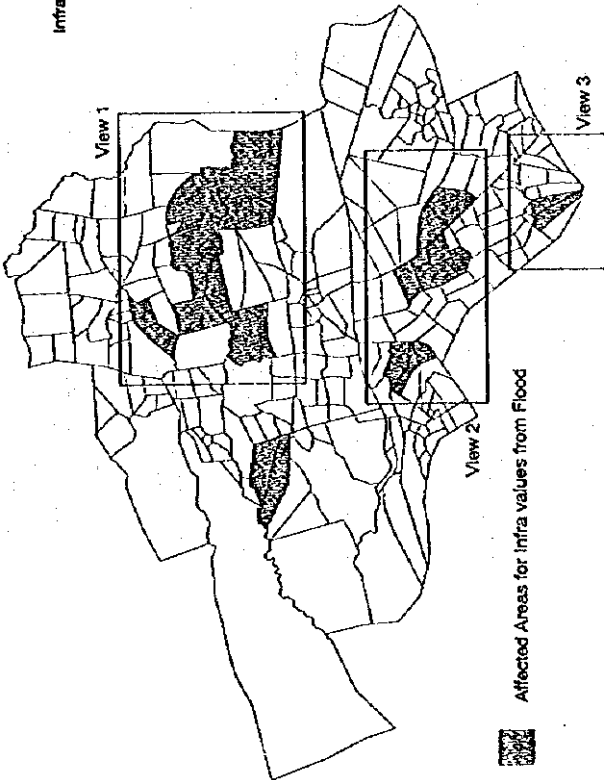
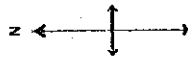


Infra Values (x 1000 pesos)

12000

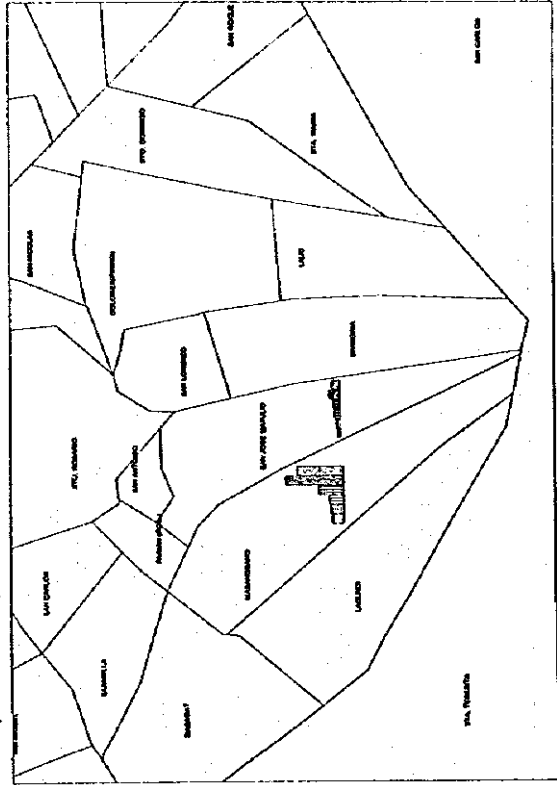


- 2 Years
- 5 Years
- 10 Years
- 25 Years
- 50 Years
- 100 Years



Affected Areas for Infra values from Flood

View 3 (near MEXICO)



View 2 (near ANGELES CITY)

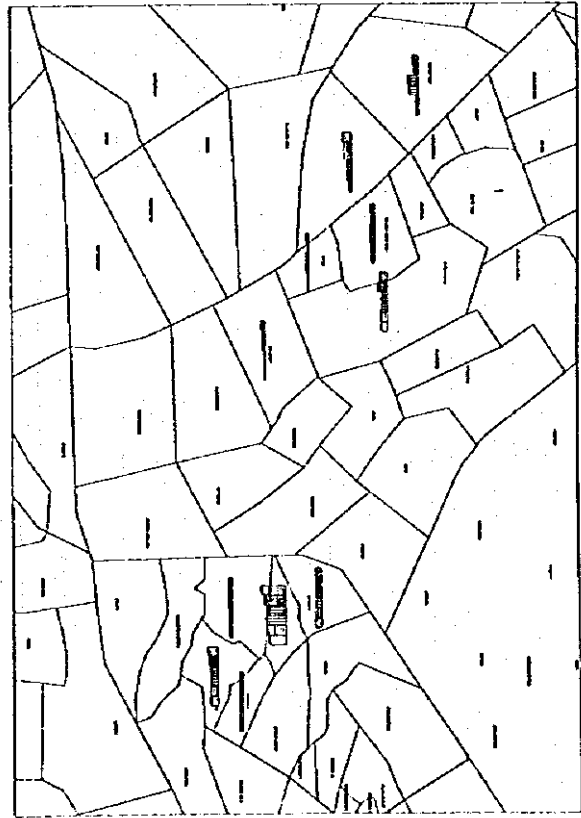


Figure R.18 Probable Damage to Infrastructure from Flood for each Return Period

THE GOVERNMENT OF THE PHILIPPINES  
 THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS  
 THE STUDY ON FLOOD AND WINDFLOW CONTROL  
 FOR ACCORDIA-DAMBANGALAN RIVER  
 DRAINAGE BASIN, IRRIGAL, ILOILO  
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