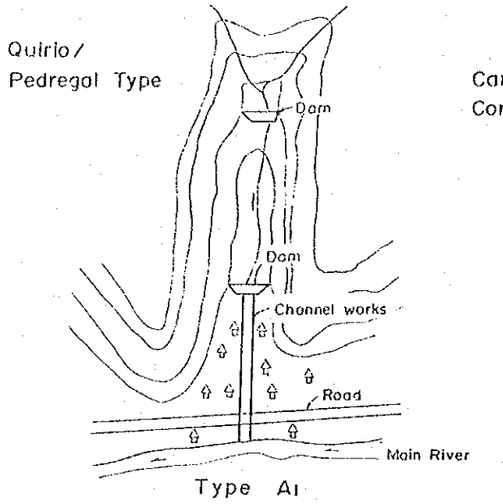
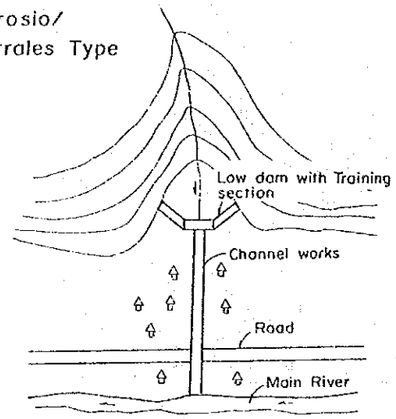
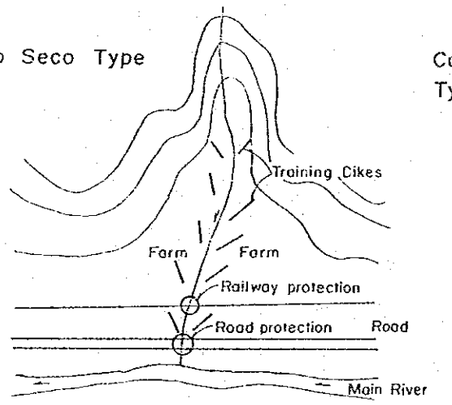


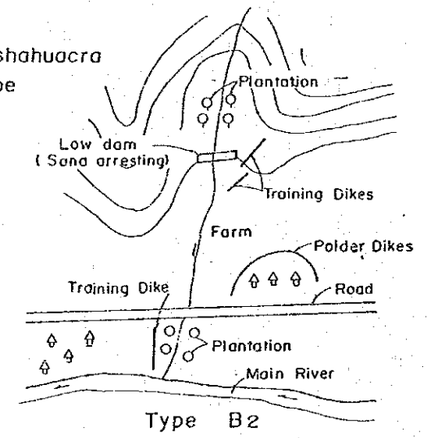
Type A1



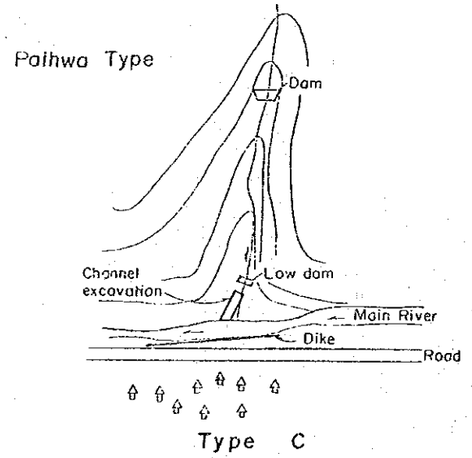
Type A2



Type B1

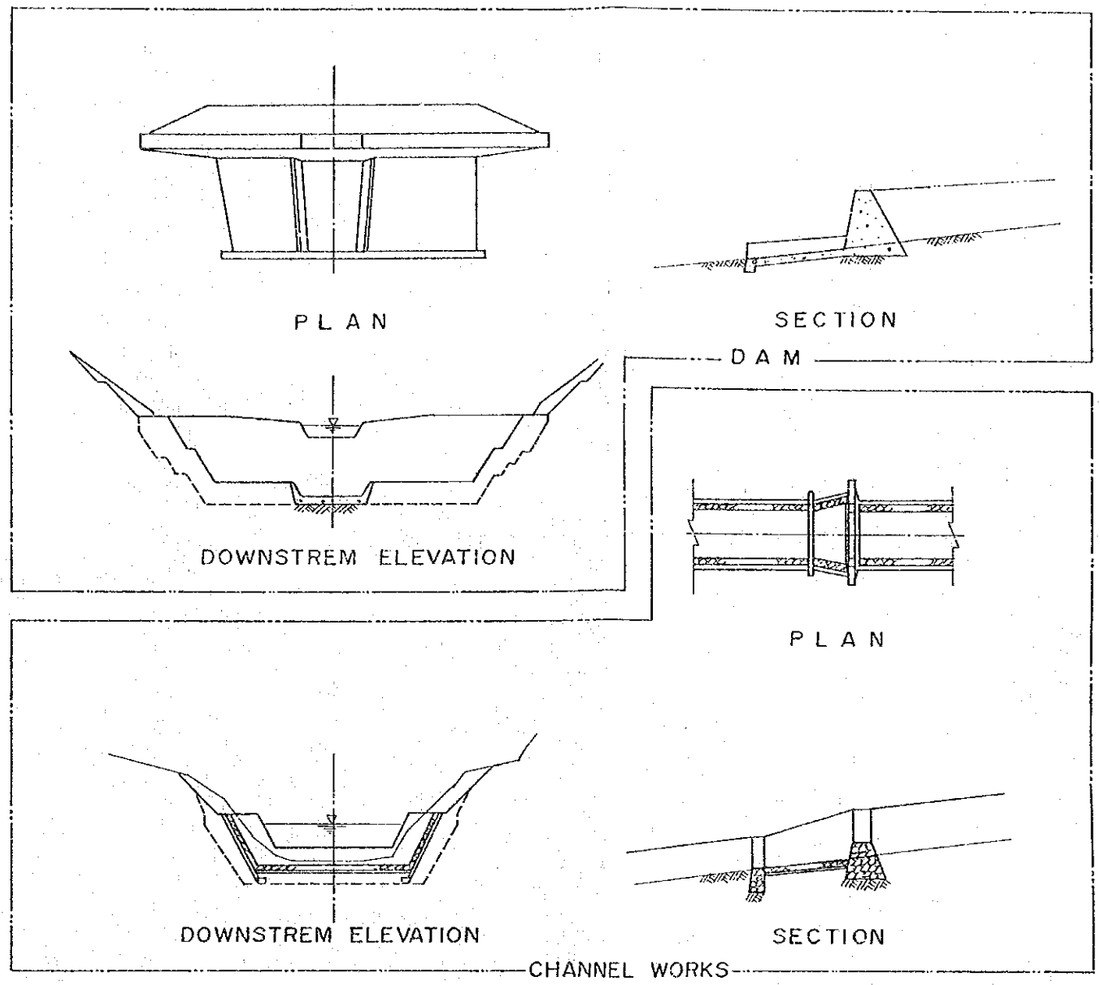


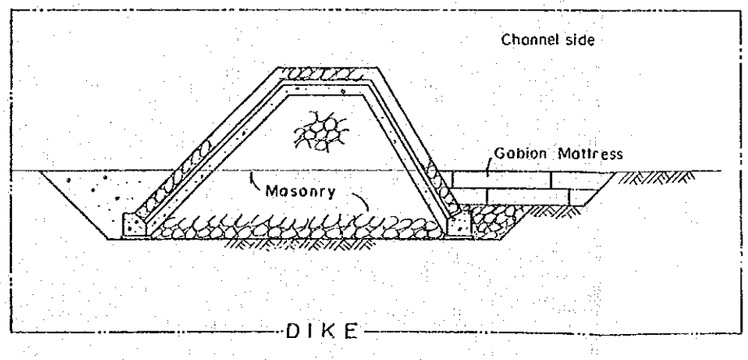
Type B2



Type C

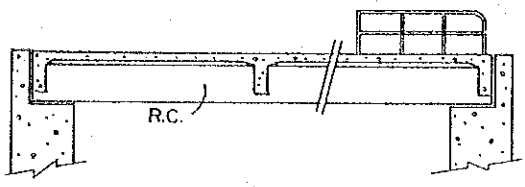
(1) Schematical Feature of 5 Types of Structural plan in Quebrada



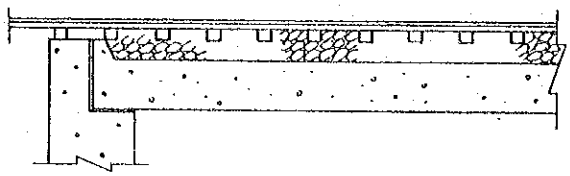


(2) Rough Schetch of Main Structures used in Qda Areas

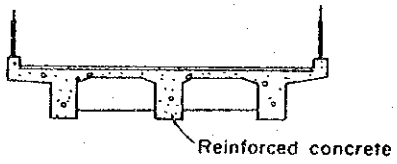
Fig. VII-1-2 Proposed Structural Plans for Quebrada Areas



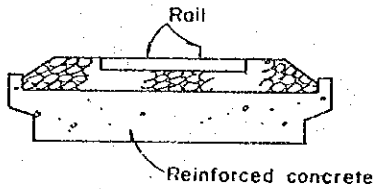
Profile



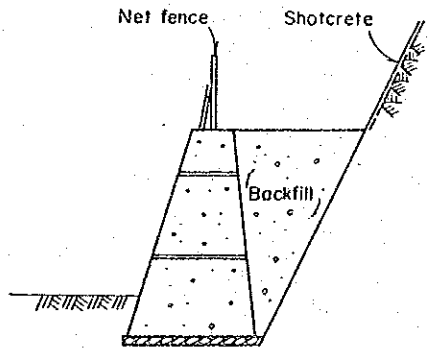
Profile



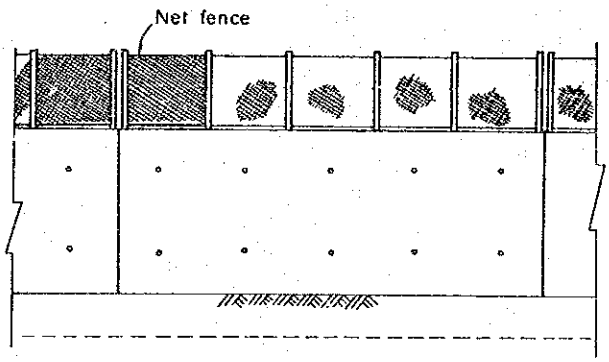
Section
Bridge (Road)



Section
Bridge (Railway)

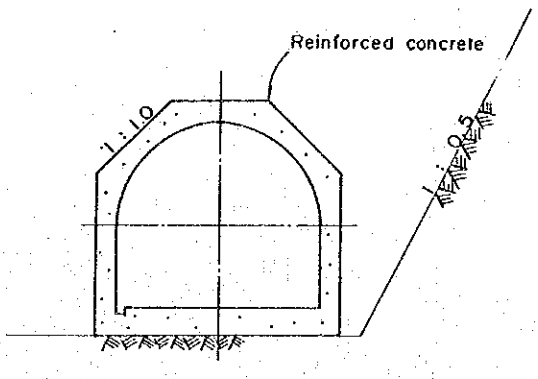


Section



Elevation

Retaining wall



Rockshed Tunnel

Fig. VII-1-3 Proposed Structure for Spe Areas

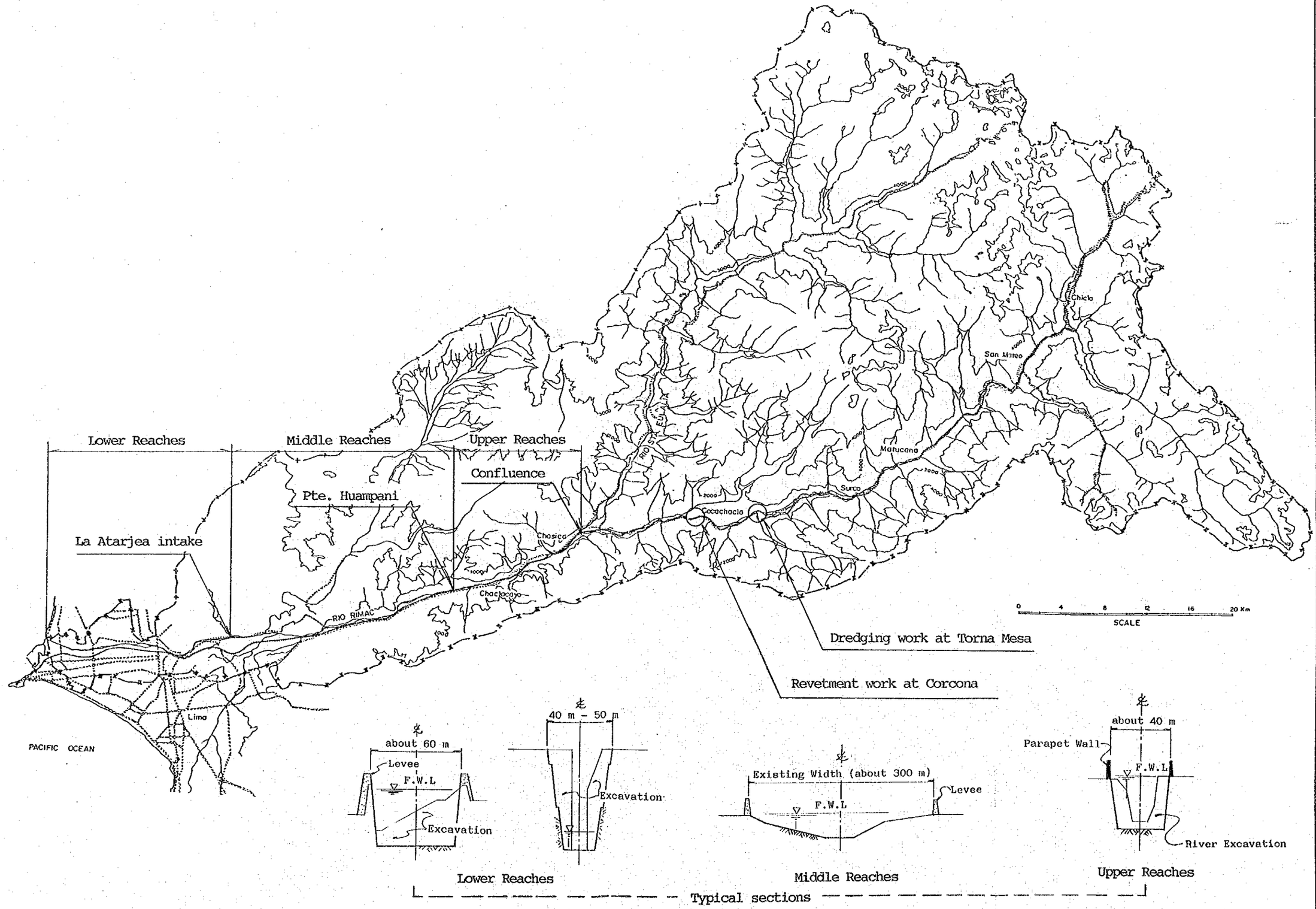
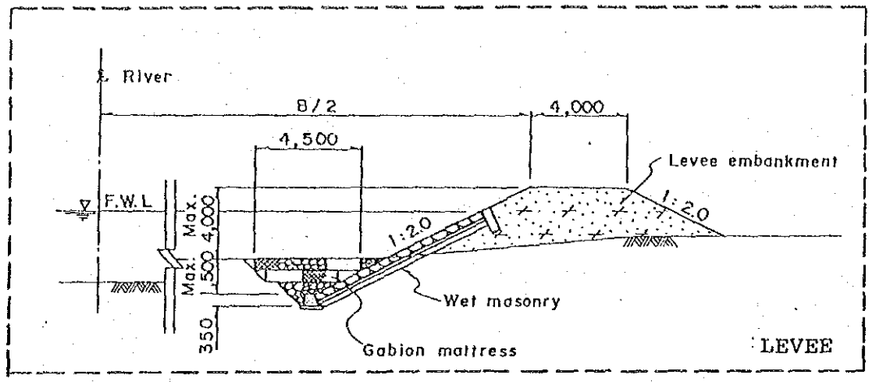
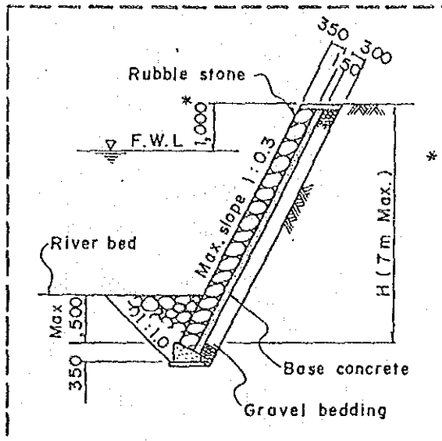


Fig. VII-1-4 Overall River Improvement Plan

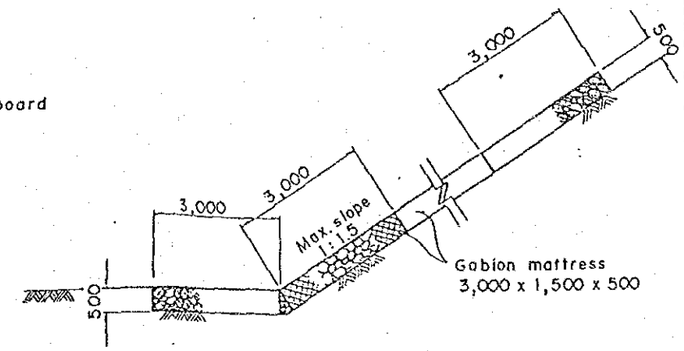


LEVEE

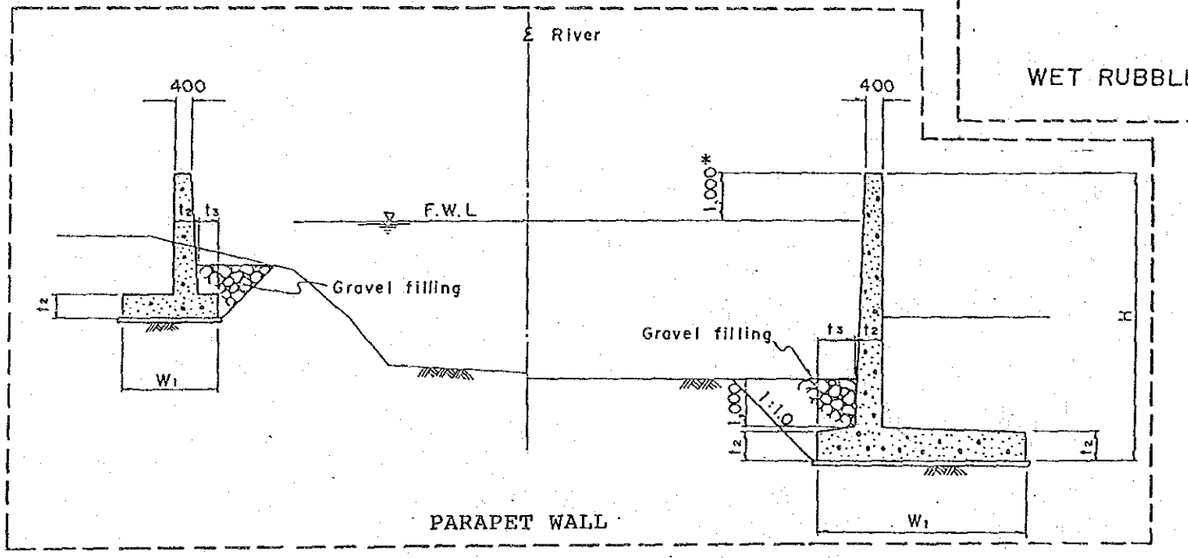


* Freeboard

WET RUBBLE MASONRY

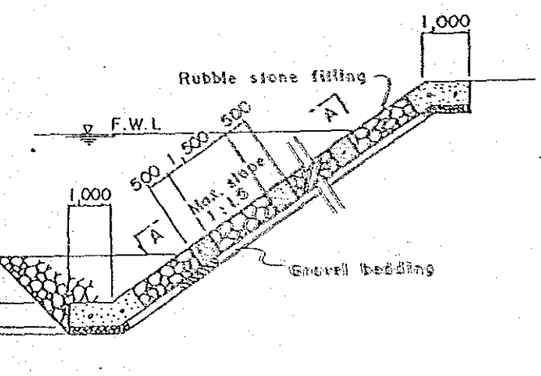


GABION WORK

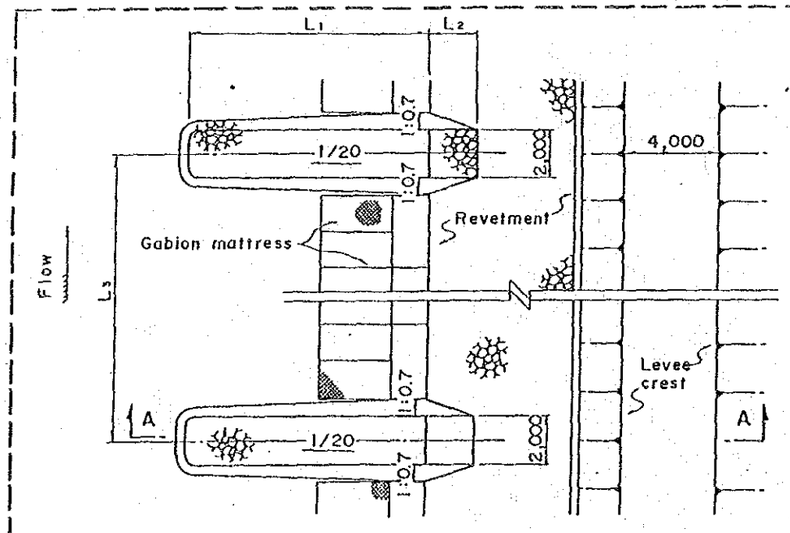


PARAPET WALL

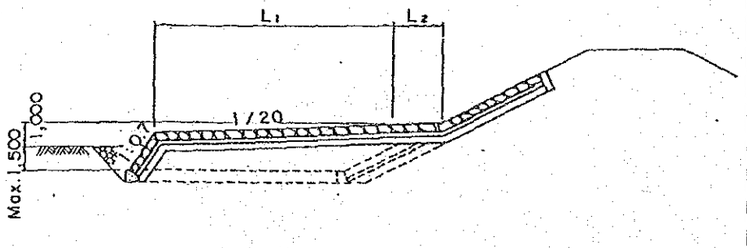
REVETMENT



PROFILE



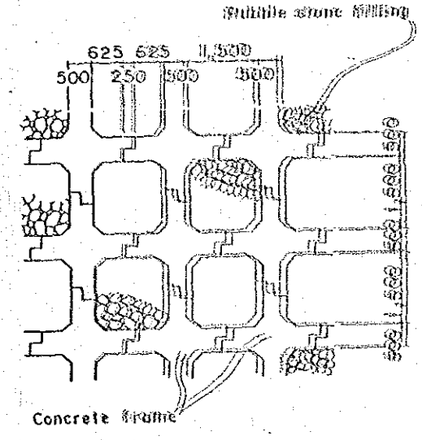
PLAN



SECTION A - A

GROYNE

Fig. VII-1-5 Proposed Structures of River Improvement Plan



SECTION A - A

FRAME WORK

Chapter VIII

VIII. IMPLEMENTATION PROGRAM

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CHAPTER VIII IMPLEMENTATION PROGRAM

1. GENERAL

Subsequent to the formulation of the master plan for disaster prevention, its desirable implementation program is examined. The examination is made through a comparative study on the conceivable alternative implementation programs.

The study reveals that the disaster prevention measures should be implemented as early as possible. The following details the above study.

2. ALTERNATIVE IMPLEMENTATION PROGRAMS

2.1 Debris and Slope Failure Disaster Prevention Plan

As mentioned, the implementation program is examined on the conceivable alternative implementation programs.

The alternative implementation programs for examination are prepared with the following consideration;

(i) The areas with the higher degree of danger and urgency should be implemented earlier.

(ii) The safety should be heightened equivalently in all the areas; that is, the implementation is not made one by one for each quebrada but should be made simultaneously for all the quebradas in a block area.

Two (2) alternative implementation programs prepared with the above-mentioned considerations are shown in Fig.VIII-2-1 (CASE-1) and VIII-2-2 (CASE-2).

CASE-1 considers the case that the implementation will be made in a normal schedule. On the other hand, CASE-2 considers the case that the implementation may be considerably delayed by some reasons such as the financing problem.

2.2 Inundation Disaster Prevention Plan

The alternative implementation programs for the inundation disaster prevention plan are prepared with the following considerations;

(i) In principle, the river improvement should be made from the lower reaches to the upper reaches in consideration that the increase of flow capacity

in the upper reaches may cause the inundation in the lower reaches.

(ii) The matters with a high urgency such as the improvement of defects in the existing dike, removal of garbage in the river channel and excavation of the remarkable riverbed deposits, etc. should be put into execution at the earliest without an adherence to the principle mentioned in (i) above.

(iii) The land acquisition will take a long time, requiring the earliest commencement of the necessary procedure for acquisition.

Three (3) alternative implementation programs for examination are prepared with the above considerations. The three (3) cases are as shown in Fig. VIII-2-3 (CASE-1), VIII-2-4 (CASE-2) and VIII-2-5 (CASE-3).

CASE-1 is considered to be of a normal schedule. CASE-2 considers the case that the implementation is accelerated with a particularly favourable arrangement for the execution. On the other hand, CASE-3 considers the case that the implementation is forced to be mitigated due to a delay of the necessary procedures.

3. EXAMINATION AND SELECTION OF IMPLEMENTATION PROGRAM

Based on the implementation programs illustrated in Figs.VIII-2-1 to VIII-2-5, project cost and benefit are tabulated in each program to carry out economic analysis. Tables VIII-3-1 to VIII-3-4 show the disbursed cost and benefit tables for two cases of implementation programs of structural plan of debris flow and slope failure disaster. Tables VIII-3-5 to VIII-3-7 presents same kind of tables for three cases of implementation program for inundation disaster.

Economic analysis on the alternative implementation programs was carried out and the result is summarized below.

Alternative Implementation Program	EIRR(%)
- Debris/Slope Failure Disaster Prevention Plan:	
CASE-1 (Normal)	5.4
CASE-2 (Mitigated)	5.2
- Inundation Disaster Prevention Plan:	
CASE-1 (Normal)	14.9
CASE-2 (Accelerated)	15.5
CASE-3 (Mitigated)	10.5

As seen above, the economic analysis indicates that the earlier implementation would be more advantageous economically in both plans for debris/slope failure and inundation disasters. It is needless to say that the earliest implementation is essential from the social aspects such as the prevention of loss of lives and stabilization of public welfare.

As such, the examination recommends the selection of the earlier implementation schedule, i.e. the selection of CASE-1 for the debris/slope failure disaster prevention plan and CASE-2 for the inundation disaster prevention plan.

The recommended implementation program is shown in Fig. VIII-2-1 and VIII-2-4. It is, however, noted that this implementation program is just prepared preliminarily at this master plan study stage, requiring the rearrangements based on more detailed investigations and studies in the subsequent study stage.

Tables

Table VIII-3-1 COST STREAM OF IMPLEMENTATION PROGRAM OF STRUCTURAL PLAN FOR DEBRIS FLOW AND SLOPE FAILURE DISASTER (NORMAL SCHEDULE)

IDENT	River name	Dir.cost	Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	IDENT	River name
Group A																																																							Group A	
R6	Qda Quirio	11686	4	1725	3449	1747	1747	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	R6	Qda Quirio
R7	Qda Pedregal	15784	4	2330	4659	2359	2359	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	50	58	58	58	58	58	58	58	58	58	58	58	R7	Qda Pedregal
R8	Qda Carosio	1944	3	430	572	434	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	R8	Qda Carosio
R9	Qda Corrales	4146	3	916	1222	924	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	R9	Qda Corrales
R19	Qda Rio Seco	4271	3	944	1258	952	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	R19	Qda Rio Seco
R32	Qda Paihua	8728	4	1288	2577	1304	1304	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	R32	Qda Paihua
S1	Cashahuacra	4150	3	917	1223	925	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	S1	Cashahuacra
Group B																																																							Group B	
R1	Qda Chacracayo	12662	4				1890	3779	1914	1914	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	R1	Qda Chacracayo
R2	Qda Chacrasana	6077	4				907	1814	918	918	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	R2	Qda Chacrasana
R3	Qda California	10855	4				1620	3241	1640	1640	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	R3	Qda California
R4	Qda Santa Maria	5854	4								887	1774	898	898	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	R4	Qda Santa Maria
R5	Qda La Contuta	19084	4								2893	5786	2928	2929	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	R5	Qda La Contuta
R10	Qda La Ronda	11452	4								1735	3471	1757	1757	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	R10	Qda La Ronda
R11	Qda Santa Ana	2695	3												621	828	626	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	R11	Qda Santa Ana
R13	Qda Cupicha	1858	3												428	571	432	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	R13	Qda Cupicha
R15	Qda Canchacalla	35308	4												5432	10864	5500	5500	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	R15	Qda Canchacalla
R16	Qda Guayabo	1416	3															330	440	333	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	R16	Qda Guayabo
R17	Qda Agua Salada	2266	3															528	704	532	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	R17	Qda Agua Salada
R18	Qda Esperanza	1527	3															356	474	358	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	R18	Qda Esperanza
R23	Qda Huacra	742	3															173	230	174	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	R23	Qda Huacra
R24	Qda Matata	1460	3															340	454	343	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	R24	Qda Matata
R25	Qda Cuchimachay	3272	4															509	1019	515	515	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	R25	Qda Cuchimachay
R31	Qda Chucumayo	3585	3																		845	1127	852	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	R31	Qda Chucumayo
R33	Qda Chacahuaro	547	3																		129	172	130	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	R33	Qda Chacahuaro
R34	Qda Pancha	10130	4																		1595	3191	1615	1615	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	R34	Qda Pancha
R35	Qda Viso	3054	4																		481	962	487	487	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	R35	Qda Viso
R37	Qda Parac	18858	4																					3007	6013	3045	3045	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	R37	Qda Parac
S2	Qda Redonda	2455	3																						588	784	593	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	S2	Qda Redonda
S3	Qda Infiernilla	1286	3																						308	411	311	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	S3	Qda Infiernilla
S5	Qda Lucuma	1369	3																						328	437	331	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	S5	Qda Lucuma
Group B (slope Area)																																																							Group B (slope Area)	
R -/0	Estuary-Jicamarca	19559	4																					3117	6234	3156	3156	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	R -/0	Estuary-Jicamarca
R -/1	Estuary-Chacracayo	23845	4																						3815	7631	3863	3863	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	R -/1	Estuary-Chacracayo
R 0/2	Jicamarca-Chacrasana	3080	3																									736	981	742	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	R 0/2	Jicamarca-Chacrasana
R 1/3	Chacracayo-Carifornia	65	1																												52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R 1/3	Chacracayo-Carifornia
R 4/6	Santa Maria-Quirio	149	1																																																						R 4/6	Santa Maria-Quirio
R 5/10	Cantuta-La Ronda	2066	3																																																						R 5/10	Cantuta-La Ronda
R 7/8	Pedregal-Carosio	921	2																																																						R 7/8	Pedregal-Carosio
R 8/9	Carosio-Corrales	271	1																																																						R 8/9	Carosio-Corrales
R9/-S/1	Corrales-Cashahuacra	271	1																																																						R9/-S/1	Corrales-Cashahuacra
R 10/-	La Ronda-confruence	54	1																																																							R 10/-	La Ronda-confruence
R -/11	confluence-Santa Ana	432	2																																																							R -/11	confluence-Santa Ana
R -/12	confluence-Santa Juan	108	1																																																							R -/12	confluence-Santa Juan
R 11/13	Santa Ana-Chupicha	4291	3																																																							R 11/13	Santa Ana-Chupicha
R 13/16	Chupicha-Guayabo	5232	3																																																							R 13/16	Chupicha-Guayabo
R 16/17	Guayabo-Agua Salada	2788	3																																																							R 16/17	Guayabo-Agua Salada
R 19/20	Rio Seco-Esperanza	7368	3																																																							R 19/20	Rio Seco-Esperanza
R 20/21	Esperanza-Verrugas	8205	3																																																							R 20/21	Esperanza-Verrugas
R 21/23	Verrugas-Huacra	6212	3																																																							R 21/23	Verrugas-Huacra
R 22/27	Lindey-Yamajume	6486	3																																																							R 22/27	Lindey-Yamajume
R 26/29	Chacamarca-Barranco	612	1																																																							R 26/29	Chacamarca-Barranco
R 31/33	Chucumayo-Chacahuaro	1435	3																																																							R 31/33	Chucumayo-Chacahuaro
R 37/40	Parac-R.Blanco	2976	3																																																							R 37/40	Parac-R.Blanco
S -/4	confluence-Alcula	145	1																																																							S -/4	confluence-Alcula
S 1/2	Cashahuacra-Redonda	549	1																																																							S 1/2	Cashahuacra-Redonda
S 2/3	Redonda-Infiernilla	440	1																																																							S 2/3	Redonda-Infiernilla
Total Cost		306085		8550	14960	8544	9880	9021	4650	4659	5812	11328	5881	5881	8273	13978	10554	15543	11696	9888	9864	10838	5202	9071	18183	17085	13175	5727	1178	1178	1178	1178	1178	1178	1178	1178	1178	1178	1178	1178	1178	1178	1178	1178	1178	1178	1178	1178	1178	1178	1178	1178	1178		

Note : The caluclation results from the 50th year are omitted to show here.

Table VIII-3-2 BENEFIT STREAM OF IMPLEMENTATION PROGRAM OF STRUCTURAL PLAN FOR DEBRIS FLOW AND SLOPE FAILURE DISASTER (NORMAL SCHEDULE)

IDENT	River name	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Group A																																																					
R6	Qda Quirio	34124			175	175	350	360	371	382	394	406	418	430	443	457	470	484	499	514	529	545	562	578	595	614	632	651	671	691	711	733	755	777	801	825	850	875	901	928	955	985	1014	1045	1076	1108	1142	1176	1211	1248	1285	1323
R7	Qda Pedregal	49821			255	255	509	524	540	556	573	590	608	626	645	664	684	704	726	747	770	793	817	841	866	892	919	947	975	1004	1035	1066	1098	1130	1164	1199	1235	1272	1311	1350	1390	1432	1475	1518	1565	1612	1660	1710	1761	1814	1868	1925
R8	Qda Carosio	11592			57	115	118	122	126	129	133	137	141	146	150	154	159	164	169	174	179	184	190	196	201	208	214	220	227	234	241	248	255	263	271	279	287	296	305	314	323	333	343	353	364	375	386	398	410	422	434	448
R9	Qda Corrales	14015			68	139	143	147	152	156	161	166	171	176	181	187	192	198	204	210	216	223	230	236	244	251	258	266	274	282	291	300	309	318	327	337	347	358	368	379	391	403	415	427	440	453	467	481	495	510	525	541
R10	Qda Rio Seco	26303			130	261	269	277	285	293	302	311	321	330	340	350	361	372	383	394	406	418	431	444	457	471	485	500	515	530	546	562	579	596	614	633	652	671	691	712	734	756	778	802	826	850	876	902	928	957	986	1015
R32	Qda Paihua	24754			127	127	254	262	269	277	286	294	303	312	322	331	341	351	362	373	384	396	407	420	432	445	459	472	486	501	516	532	548	564	581	598	616	635	654	673	694	714	736	758	781	804	828	853	879	905	932	960
S1	Cashahuacra	9880			49	98	101	104	107	110	114	117	120	124	128	132	136	140	144	148	153	157	162	167	172	177	182	188	193	199	205	211	218	224	231	238	245	252	260	268	276	284	292	301	310	319	329	339	349	360	370	381
Group B																																																						
R1	Qda Chacracayo	73953						379	391	758	781	805	829	854	879	906	933	961	989	1019	1050	1081	1114	1147	1182	1217	1253	1291	1330	1370	1411	1453	1497	1542	1588	1635	1685	1735	1787	1841	1896	1953	2011	2072	2134	2198	2264	2332	2402	2474	2548	2624
R2	Qda Chacrasana	12972						67	69	133	137	141	145	150	154	159	164	169	174	179	184	190	195	201	207	213	220	226	233	240	247	255	263	270	279	287	295	304	313	323	333	343	353	363	374	386	397	409	421	434	447	460
R3	Qda California	32125						165	170	329	339	349	360	371	382	393	405	417	430	443	456	470	484	498	513	529	545	561	578	595	613	631	650	670	690	710	732	754	776	800	824	848	874	900	927	955	983	1013	1043	1075	1107	1140
R4	Qda Santa Maria	14922										76	78	153	158	162	167	172	177	183	188	194	200	206	212	218	225	231	238	245	253	261	268	276	285	293	302	311	320	330	340	350	361	371	383	394	406	418	431	444	457	471	485	499	514
R5	Qda La Contuta	20659										108	109	212	218	225	231	238	246	253	261	268	276	285	293	302	311	320	330	340	350	361	371	383	394	406	418	431	444	457	471	485	499	514	530	546	562	579	596	614	632	651
R10	Qda La Ronda	22984										118	121	236	243	250	259	265	273	281	290	299	308	317	326	336	346	357	367	378	390	401	413	426	438	452	465	479	493	508	524	539	555	572	589	607	625	644	663	683	704	725
R11	Qda Santa Ana	28263														140	289	289	297	306	315	325	334	345	355	365	376	388	399	411	424	436	450	463	477	491	506	521	537	553	569	587	604	622	641	660	680	700	721	743	765	788
R13	Qda Cupiche	22165														110	220	226	233	240	247	255	262	270	278	287	295	304	313	323	332	342	353	363	374	385	397	409	421	434	447	460	474	488	503	518	533	549	566	583	600	618
R15	Qda Canchacalla	27250														140	144	279	288	296	305	315	324	334	344	354	365	376	387	398	410	423	435	448	462	476	490	505	520	535	551	568	585	603	621	639	659	678	699	720	741	763
R16	Qda Guayabo	22583																	112	225	232	239	246	253	261	268	276	285	293	302	311	321	330	340	350	361	372	383	394	406	418	431	444	457	471	485	499	514	530	546	562	579
R17	Qda Agua Salada	24433																	121	242	249	257	265	273	281	289	298	307	316	325	335	345	356	366	377	389	400	412	425	437	450	464	478	492	507	522	538	554	571	588	605	624
R18	Qda del Pato	23070																	77	229	236	243	250	258	265	273	282	290	299	308	317	327	336	346	357	368	379	390	402	414	426	439	452	466	480	494	509	524	540	556	573	590
R23	Qda Buacre	2583																	13	26	26	27	28	29	30	31	31	32	33	34	35	36	38	39	40	41	42	44	45	46	48	49	51	52	54	55	57	59	60	62	64	66
R24	Qda Hatata	5072																	25	50	52	53	55	57	58	60	62	64	65	68	70	72	74	76	78	81	83	86	88	91	94	96	99	102	105	108	112	115	118	122	126	129
R25	Qda Cuchimachay	8477																	49	50	97	100	103	106	109	113	116	120	123	127	131	135	139	143	147	151	156	161	165	170	176	181	186	192	198	203	210	216	222	229	236	243
R31	Qda Chucumayo	31366																				160	311	320	330	340	350	360	371	382	394	406	418	430	443	456	470	484	499	514	529	545	561	578	596	613	632	651	670	690	711	733
R33	Qda Chacabuaro	12090																				62	120	123	127	131	135	139	143	147	152	156	161	166	171	176	181	187	192	198	204	210	216	223	230	236	244	251	258	266	274	282
R34	Qda Pancha	24455																				125	129	251	258	266	274	282	291	299	308	318	327	337	347	358	368	379	391	402	414	427	440	453	467	481	495	510	525	541	557	574
R35	Qda Viso	12224																				63	65	125	129	133	137	141	145	150	154	159	164	168	174	179	184	190	195	201	207	213	220	226	233	240	247	255	262	270	278	287
R37	Qda Parac	28722																							137	141	274	282	291	299	308	318	327	337	347	358	368	379	391	402	414	427	440	453	467	481	495	510	525	541	557	574
S2	Qda Redonda	11685																								60	116	119	123	127	130	134	138	142	147	151	156	160	165	170	175	180	186	191	197	203	209	215	222	229	235	242
S3	Qda Infiernilla	7377																								36	73	75	78	80	82	85	87	90	93	95	98	101	104	107	111	114	117	121	124	128	132	136	140	144	149	153
S5	Qda Lucuma	7372																								36	73	75	78	80	82	85	87	90	93	95	98	101	104	107	111	114	117	121	124	128	132	136	140	144	149	153
Group B (slope Area)																																																				
R -/0	Estuary-Jicamarca	41148																							211	217	422	435	448	461	475	489	504	519	535	551	567	584	602	620	638	657	677	697	718	740	762	785	809	833	858	883
R -/1	Estuary-Chacracayo	38678																								223	229	406	429	431	444	458	471	485	500	515	530	546	563	580	597	615	633	652	672	692	713	734	756	779	802	826
R 0/2	Jicamarca-Chacrasana	628																										3	6	6	7	7	7	7	7	8	8	8	8	9	9	9	9	10	10	10	11	11	11	12	12	12	13
R 1/3	Chacracayo-Carifornia	1274																											12	12	12	13	13	14	14	14	15	15	16	16	17	17	18	18	19	19	20	21	21	22	22	23	24
R 4/5	Santa Maria-Quirio	108	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3
R 5/10	Cantuta-La Ronda	1016																																																		
R 7/8	Pedregal-Carosio	1265																																																		
R 8/9	Carosio-Corrales	624																																																		
R9/-S/1	Corrales-Cashahuacra	395																																																	
R 10/-	La Ronda-confruence	113																																																	
R -/11	confluence-Santa Ana	2288																																																	
R -/12	confluence-Santa Juan	1064																																																	
R 11/13	Santa Ana-Chupiche	19366																																																	
R 13/16	Chupiche-Guayabo	17299																																																	
R 16/17	Guayabo-Agua Salada	8856																																																	
R 19/20	Rio seco-Esperanza	29281																																																	
R 20/21	Esperanza-Verrugas	33391																																																	
R 21/23	Verrugas-Buacre	28435																																																	
R 22/27	Linday-Yamajuno	28057																																																	
R 26/29	Chacamara-Barranco	1368																																																	
R 31/33	Chucumayo-Chacahuaro	5098																																																	
R 37/40	Parac-R.Blanco	27730																																																	
S -/4	confluence-Alcula	1522																																																	
S 1/2	Cashahuacra-Redonda	1830																																																	
S 2/3	Redonda-Infiernilla	1457																																																	
	Total	939482	0	0	863	1169	1744	2406	2478	3126	3220	3617	3725	4119	4253	4798	5211	5724	6822	7741	8341	9447	10094	10573	11238	11933	12746	13311	13710	14122	14545	14982	15431	15894	16371	16862	17368	17889	18426	18978	19548	20134	20738	21360	22001	22661	23341	24041	24763	25505	26271	27059

IDENT	River name
Group A	
R6	Qda Quirio
R7	Qda Pedregal
R8	Qda Carosio
R9	Qda Corrales
R10	Qda Rio Seco
R32	Qda Paihua
S1	Cashahuacra
Group B	
R1	Qda Chacracayo
R2	Qda Chacrasana
R3	Qda California
R4	Qda Santa Maria
R5	Qda La Contuta
R10	Qda La Ronda
R11	Qda Santa Ana
R13	Qda Cupiche
R15	Qda Canchacalla
R16	Qda Guayabo
R17	Qda Agua Salada
R18	Qda del Pato
R23	Qda Buacre
R24	Qda Matata
R25	Qda Cuchimachay
R31	Qda Chucumayo
R33	Qda Chacabuaro
R34	Qda Pancha
R35	Qda Viso
R37	Qda Parac
S2	Qda Redonda
S3	Qda Infiernilla
S5	Qda Lucuma
Group B (slope Area)	
R -/0	Estuary-Jicamarca
R -/1	Estuary-Chacracayo
R 0/2	Jicamarca-Chacrasana
R 1/3	Chacracayo-Carifornia
R 4/5	Santa Maria-Quirio
R 5/10	Cantuta-La Ronda
R 7/8	Pedregal-Carosio
R 8/9	Carosio-Corrales
R9/-S/1	Corrales-Cashahuacra
R 10/-	La Ronda-confruence
R -/11	confluence-Santa Ana
R -/12	confluence-Santa Juan
R 11/13	Santa Ana-Chupiche
R 13/16	Chupiche-Guayabo
R 16/17	Guayabo-Agua Salada
R 19/20	Rio seco-Esperanza
R 20/21	Esperanza-Verrugas
R 21/23	Verrugas-Buacre
R 22/27	Linday-Yamajuno
R 26/29	Chacamara-Barranco
R 31/33	Chucumayo-Chacahuaro
R 37/40	Parac-R.Blanco
S -/4	confluence-Alcula
S 1/2	Cashahuacra-Redonda
S 2/3	Redonda-Infiernilla

Note : The caluclation results from the 50th year are omitted to show here.

Table VIII-3-3 COST STREAM OF IMPLEMENTATION PROGRAM OF STRUCTURAL PLAN FOR DEBRIS FLOW AND SLOPE FAILURE DISASTER (MITIGATED SCHEDULE)

IDENT	River name	Dir.cost	Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Group A																																																					
R5	Qda Quirio	8624	8	862	1294	1294	1294	1294	862	884	884	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43
R7	Qda Padregal	11649	8	1165	1747	1747	1747	1747	1165	1194	1194	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
R8	Qda Carosio	1432	6	215	358	358	215	143	147	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
R9	Qda Corrales	3054	6	458	764	764	458	305	313	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
R19	Qda Rio Seco	3146	6	472	787	787	472	315	322	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
R32	Qda Palhua	6441	8	644	966	966	966	966	644	660	660	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
S1	Cashahuacra	3057	6	459	764	764	459	306	313	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Group B																																																						
R1	Qda Chacracayo	9449	8							945	1417	1417	1417	1417	945	969	969	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47
R2	Qda Chacrasana	4535	8							454	680	680	680	680	454	455	455	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
R3	Qda California	8101	8							810	1215	1215	1215	1215	810	830	830	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41
R4	Qda Santa Maria	4435	8							444	665	665	665	665	444	455	455	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
R5	Qda La Contuta	14455	8							1447	2170	2170	2170	2170	1447	1483	1483	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72
R10	Qda La Ronda	8676	8							868	1301	1301	1301	1301	868	889	889	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43
R11	Qda Santa Ana	2070	6															311	518	518	311	207	212	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
R13	Qda Cupiche	1427	5															214	357	357	214	143	146	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
R15	Qda Canchacalla	27160	8															2716	4074	4074	4074	4074	2716	2784	2784	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136
R16	Qda Guayabo	1100	6															165	275	275	165	110	113	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
R17	Qda Agua Salada	1760	6															264	440	440	264	176	180	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
R18	Qda del Pato	1185	5															178	297	297	178	119	122	8	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
R23	Qda Huacra	576	6																					86	144	144	86	58	58	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
R24	Qda Matata	1134	6																					170	284	284	170	113	116	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
R25	Qda Cuchimachay	2546	8																					255	382	382	382	382	255	261	261	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
R31	Qda Chucumayo	2817	6																					423	704	704	423	282	289	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
R33	Qda Chacahuaro	430	6																					65	108	108	65	43	44	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
R34	Qda Pancha	7976	8																					798	1196	1196	1196	1196	798	818	818	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
R35	Qda Viso	2405	8																					241	361	361	361	361	241	247	247	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
R37	Qda Parac	15034	8																											1503	2255	2255	2255	2255	1503	1541	1541	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
S2	Qda Redonda	1950	6																											294	490	490	294	196	201	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
S3	Qda Infiernilla	1027	6																											154	257	257	154	103	105	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
S5	Qda Lucuma	1093	6																											184	273	273	184	109	112	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Group B (slope Area)																																																					
R -/0	Estuary-Jicamarca	15585	8																													1550	2338	2338	2338	2338	1559	1597	1597	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78
R -/1	Estuary-Chacracayo	19076	8																													1908	2861	2861	2861	2861	1908	1955	1955	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
R 0/2	Jicamarca-Chacrasana	2453	6																													368	613	613	368	245	251	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
R 1/3	Chacracayo-California	52	2																													25	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R 4/6	Santa Maria-Quirio	114	2																																																					
R 5/10	Cantuta-La Ronda	1586	6																																																				
R 7/8	Padregal-Carosio	706	4																																																			
R 8/9	Carosio-Corrales	207	2																																																		
R9/-S/1	Corrales-Cashahuacra	207	2																																																		
R 10/-	La Ronda-confruence	41	2																																																		
R -/11	confluence-Santa Ana	332	4																																																		
R -/12	confluence-Santa Juan	83	2																																																		
R 11/13	Santa Ana-Chupiche	3320	6																																																		
R 13/16	Chupiche-Guayabo	4048	6																																																		
R 16/17	Guayabo-Agua Salada	2157	6																																																		
R 18/20	Rio Seco-Esperanza	5723	6																																																		
R 20/21	Esperanza-Verrugas	6373	6																																																		
R 21/23	Verrugas-Huacra	4863	6																																																		
R 22/27	Linday-Yamajuma	5077	6																																																	
R 26/29	Chacamaza-Barranco	482	2																																																	
R 31/33	Chucumayo-Chacahuaro	1124	6																																																	
R 37/40	Parac-R.Blanco	2340	6																																																	
S -/4	confluence-Alcula	114	2																																																	
S 1/2	Cashahuacra-Redonda	429	2																																																
S 2/3	Redonda-Infiernilla	345	2																																																
Total Cost		270310		4275	6679	6679	5610	5076	3767	7758	10241	7636	7636	7636	5817	6241	7354	7220	9008	10603	10849	10496	8054	9429	10375	5683	4741	4075	2608	4272	5432	8032	9502	9372	8385	7903	6176	4557	4557	1178	1178	1178	1178	1178	1178	1178	1178	1178	1178	1178	1178	1178	1178

IDENT	River name	
Group A		
R6	Qda Quirio	.11858
R7	Qda Padregal	.16017
R8	Qda Carosio	1980
R9	Qda Corrales	4222
R19	Qda Rio Seco	4349
R32	Qda Palhua	8856
S1	Cashahuacra	4226
Group B		
R1	Qda Chacracayo	12709
R2	Qda Chacrasana	6100
R3	Qda California	10896
R4	Qda Santa Maria	5865
R5	Qda La Contuta	.19455
R10	Qda La Ronda	11669
R11	Qda Santa Ana	2717
R13	Qda Cupiche	1873
R15	Qda Canchacalla	.35444
R16	Qda Guayabo	1444
R17	Qda Agua Salada	.2310
R18	Qda del Pato	1557
R23	Qda Huacra	739
R24	Qda Matata	.1454
R25	Qda Cuchimachay	.3246
R31	Qda Chucumayo	3613
R33	Qda Chacahuaro	551
R34	Qda Pancha	.10169
R35	Qda Viso	3066
R37	Qda Parac	.18717
S2	Qda Redonda	2455
S3	Qda Infiernilla	1288
S5	Qda Lucuma	1369
Group B (slope Area)		
R -/0	Estuary-Jicamarca	19247
R -/1	Estuary-Chacracayo	23558
R 0/2	Jicamarca-Chacrasana	3048
R 1/3	Chacracayo-California	66
R 4/6	Santa Maria-Quirio	153
R 5/10	Cantuta-La Ronda	2105
R 7/8	Padregal-Carosio	943
R 8/9	Carosio-Corrales	278
R9/-S/1	Corrales-Cashahuacra	278
R 10/-	La Ronda-confruence	55
R -/11	confluence-Santa Ana	440
R -/12	confluence-Santa Juan	111
R 11/13	Santa Ana-Chupiche	4374
R 13/16	Chupiche-Guayabo	5333
R 16/17	Guaybo-Agua Salada	2842
R 19/20	Rio Seco-Esperanza	7454
R 20/21	Esperanza-Verrugas	8301
R 21/23	Verrugas-Huacra	6334
R 22/27	Linday-Yamajuma	6537
R 26/29	Chacamaza-Barranco	629
R 31/33	Chucumayo-Chacahuaro	1447
R 37/40	Parac-R.Blanco	2013
S -/4	confluence-Alcula	147
S 1/2	Cashahuacra-Redonda	553
S 2/3	Redonda-Infiernilla	445
		308007

Note : The caluclation results from the 50th year are omitted to show here.

Table VIII-3-4 BENEFIT STREAM OF IMPLEMENTATION PROGRAM OF STRUCTURAL PLAN FOR DEBRIS FLOW AND SLOPE FAILURE DISASTER (MITIGATED SCHEDULE)

IDENT	River name	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Group A																																																					
R6	Qda Quirio	38413							197	203	384	406	418	430	443	457	470	484	499	514	529	545	562	578	596	614	632	651	671	691	711	733	755	777	801	825	850	875	901	928	956	985	1014	1045	1076	1108	1142	1176	1211	1248	1285	1323
R7	Qda Pedregal	55859							287	296	573	590	608	626	645	664	684	704	726	747	770	793	817	841	866	892	919	947	975	1004	1035	1066	1098	1130	1164	1199	1235	1272	1311	1350	1390	1432	1475	1519	1565	1612	1660	1710	1761	1814	1868	1925
R8	Qda Carosio	12667						62	126	129	133	137	141	146	150	154	159	164	169	174	179	184	190	196	201	208	214	220	227	234	241	248	255	263	271	279	287	296	305	314	323	333	343	353	364	375	386	398	410	422	434	448
R9	Qda Corrales	15316						78	152	156	161	166	171	176	181	187	192	198	204	210	216	223	230	236	244	251	258	266	274	282	291	300	309	318	327	337	347	358	368	379	391	403	415	427	440	453	467	481	495	510	525	541
R10	Qda Rio Seco	28742						142	285	293	302	311	321	330	340	350	361	372	383	394	406	418	431	444	457	471	485	500	515	530	546	562	579	596	614	633	652	671	691	712	734	756	778	802	826	850	876	902	929	957	986	1015
R32	Qda Paihua	27855							143	147	286	294	303	312	322	331	341	351	362	373	384	396	407	420	432	445	459	472	486	501	516	532	548	564	581	598	616	635	654	673	694	714	736	758	781	804	828	853	879	905	932	960
S1	Cashahuacra	10786						54	107	110	114	117	120	124	128	132	136	140	144	148	153	157	162	167	172	177	182	188	193	199	205	211	218	224	231	238	245	252	260	268	276	284	292	301	310	319	329	339	349	360	370	381
Group B																																																						
R1	Qda Chacracayo	91501													736	758	933	961	989	1019	1050	1081	1114	1147	1182	1217	1253	1291	1330	1370	1411	1453	1497	1542	1588	1635	1685	1735	1787	1841	1898	1953	2011	2072	2134	2198	2264	2332	2402	2474	2548	2624
R2	Qda Chacrasana	15954													82	84	104	169	174	179	184	190	195	201	207	213	220	226	233	240	247	255	263	270	279	287	295	304	313	323	333	343	353	363	374	386	397	409	421	434	447	460
R3	Qda California	39510													203	209	405	417	430	443	456	470	484	498	513	529	545	561	578	595	613	631	650	670	690	710	732	754	776	800	824	848	874	900	927	955	983	1013	1043	1075	1107	1140
R4	Qda Santa Maria	16306													84	86	167	172	177	183	188	194	200	206	212	218	225	231	238	245	253	261	269	276	285	293	302	311	320	330	340	350	361	371	383	394	406	418	431	444	457	471
R5	Qda La Contuta	22575													116	119	231	238	246	253	261	268	276	285	293	302	311	320	330	340	350	361	371	383	394	406	418	431	444	457	471	485	499	514	530	546	562	579	595	614	632	651
R10	Qda La Ronda	25115													129	133	258	265	273	281	290	299	308	317	326	336	346	357	367	378	390	401	413	426	438	452	465	479	493	508	524	539	555	572	589	607	625	644	663	683	704	725
R11	Qda Santa Ana	33747																				167	334	345	355	365	376	388	399	411	424	436	450	463	477	491	506	521	537	553	569	587	604	622	641	660	680	700	721	743	765	788
R13	Qda Cupiche	26466																				131	262	270	278	287	295	304	313	323	332	342	353	363	374	385	397	409	421	434	447	460	474	488	503	518	533	549	566	583	600	618
R15	Qda Canchacalla	33514																					172	177	344	354	365	376	387	398	410	423	435	448	462	476	490	505	520	535	551	568	585	603	621	639	659	678	698	720	741	763
R16	Qda Guayabo	24787																				123	246	253	261	268	276	285	293	302	311	321	330	340	350	361	372	383	394	406	418	431	444	457	471	485	499	514	530	546	562	579
R17	Qda Agua Salada	28698																				132	265	273	281	289	298	307	316	325	335	345	355	366	377	389	400	412	425	437	450	464	478	492	507	522	538	554	571	588	605	624
R18	Qda del Pato	25209																				84	250	258	265	273	282	290	299	308	317	327	336	346	357	368	379	390	402	414	426	439	452	466	480	494	509	524	540	556	573	590
R23	Qda Huacra	3370																										17	33	34	35	36	38	39	40	41	42	44	45	46	48	49	51	52	54	55	57	59	60	62	64	66
R24	Qda Matata	6617																										33	66	68	70	72	74	76	78	81	83	86	88	91	94	96	99	102	105	108	112	115	118	122	126	129
R25	Qda Cuchimachay	12740																											67	69	131	135	139	143	147	151	156	161	165	170	176	181	186	192	198	203	210	216	222	229	236	243
R31	Qda Chucumayo	37453																										191	371	382	394	406	418	430	443	456	470	484	499	514	529	545	561	578	596	613	632	651	670	690	711	733
R33	Qda Chacahuaro	14437																										74	143	147	152	156	161	166	171	176	181	187	192	198	204	210	216	223	230	236	244	251	258	265	274	282
R34	Qda Pancha	15245																											78	80	156	161	165	171	176	181	187	192	198	204	210	216	223	230	236	244	251	258	266	274	282	291
R35	Qda Viso	15034																											77	79	154	159	164	168	174	179	184	190	195	201	207	213	220	226	233	240	247	255	262	270	278	287
R37	Qda Parac	35012																																	184	190	368	378	391	402	414	427	440	453	467	481	495	510	525	541	557	574
S2	Qda Redonda	14802																																75	147	151	156	160	165	170	175	180	186	191	197	203	209	215	222	229	235	242
S3	Qda Infiernilla	9345																																48	93	95	98	101	104	107	111	114	117	121	124	128	132	136	140	144	149	153
S5	Qda Lucuma	9338																																48	93	95	98	101	104	107	111	114	117	121	124	128	132	136	140	144	149	153
Group B (slope Area)																																																					
R -/0	Estuary-Jicamarca	58568																																																		
R -/1	Estuary-Chacracayo	54924																																																		
R 0/2	Jicamarca-Chacrasana	818																																																	
R 1/3	Chacracayo-Carifornia	1477																																																	
R 4/6	Santa Maria-Quirio	111																																																	
R 5/10	Cantuta-La Ronda	1068													1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	14	14	14	15	15	16	16	17	17	18	19	19	20	21	21	22	22	23	24
R 7/8	Pedregal-Carosio	1342																	5	11	11	11	12	12	12	13	13	13	14	14	15	15	16	16	17	18	19	19	20	20	21	22	22	23	24	24	25	26	26	27
R 8/9	Carosio-Corrales	642																12	13	14	14	14	15	15	16	16	17	17	18	18	19	19	20	21	21	22	23	23	24	25	25	26	27	28	29	29	30	31	32	33	34	35
R9/-S/1	Corrales-Cashahuacra	407													6	6	6	6	7	7	7	7	7	8	8	8	8	8	9	9	9	9	9	10	10	10	11	11	11	12	12	12	13	13	14	14	14	15	15	16	16	17	17
R 10/-	La Ronda-confruence	113													4	4	4	4	4	4	4	5	5	5	5	5	5	6	6	6	6	6	6	7	7	7	7	8	8	8	8	9	9	9	9	10	10	10	11	11
R -/11	confluence-Santa Ana	2500													1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3
R -/12	confluence-Santa Juan	1129																		24	25	25	26	27	28	29	29	30	31	32	33	34	35	36	37	38	40	41	42	43	45	46	47	49	50	52	53	55	56	58	60	62
R 11/13	Santa Ana-Chupiche	21161																			10	11	11	11	12	12	12	13	13	14	14	14	15	15	16	16	17	17	18	18	19	19	20	21	21	22	22	23	24	25	25	26	27	28	28
R 13/16	Chupiche-Guayabo	18903																										105	210	216	223	229	236	243	250	258	266	274	282	290	299	308	317	326	335	345	355	365	376	387	398	410	422
R 16/17	Guayabo-Agua Salada	9678																										94	187	193	199	205	211	217	224	230	237	244	252	259	267	275	283	292	301	310	319	329	338	348	359	370	381	392
R 19/20	Rio seco-Esperanza	33945																										48	96	99	102	105	108	111	115	118	122	125	129	133	137	141	145	149	154	159	163	168	173	178	184	189	195	201
R 20/21	Esperanza-Verrugas	38710																																																			
R 21/23	Verrugas-Huacra	31072																																																		
R 22/27	Linday-Yanajume	33502																																																		
R 26/29	Chacamarca-Barranco	1409																																																		
R 31/33	Chucumayo-Chacahuaro	6087																																																		
R 37/40	Parac-R.Blanco	32146																																																		
S -/4	confluence-Alcula	1713																																																		
S 1/2	Cashahuacra-Redonda	2185																																																	
S 2/3	Redonda-Infiernilla	1688																																																	
	Total	1100732	0	0	0	0	0	336	1286	1335	1962	2021	2082	2144	3557	3676	4513	4672	4817	4981	5387	6425	7491	8242	9149	9424	10113	11076	11920	12277	12851	13237	13648	14228	14995	15449	16698	17199	18233	18780	19343	19924	20521	21137	21771	22424	23097	23790	24504	25239	25996	26776

IDENT	River name
Group A	
R6	Qda Quirio
R7	Qda Pedregal
R8	Qda Carosio
R9	Qda Corrales
R10	Qda Rio Seco
R32	Qda Paihua
S1	Cashahuacra
Group B	
R1	Qda Chacracayo
R2	Qda Chacrasana
R3	Qda California
R4	Qda Santa Maria
R5	Qda La Contuta
R10	Qda La Ronda
R11	Qda Santa Ana
R13	Qda Cupiche
R15	Qda Canchacalla
R16	Qda Guayabo
R17	Qda Agua Salada
R18	Qda del Pato
R23	Qda Huacra
R24	Qda Matata
R25	Qda Cuchimachay
R31	Qda Chucumayo
R33	Qda Chacahuaro
R34	Qda Pancha
R35	Qda Viso
R37	Qda Parac
S2	Qda Redonda
S3	Qda Infiernilla
S5	Qda Lucuma
Group B (slope Area)	
R -/0	Estuary-Jicamarca
R -/1	Estuary-Chacracayo
R 0/2	Jicamarca-Chacrasana
R 1/3	Chacracayo-Carifornia
R 4/6	Santa Maria-Quirio
R 5/10	Cantuta-La Ronda
R 7/8	Pedregal-Carosio
R 8/9	Carosio-Corrales
R9/-S/1	Corrales-Cashahuacra
R 10/-	La Ronda-confruence
R -/11	confluence-Santa Ana
R -/12	confluence-Santa Juan
R 11/13	Santa Ana-Chupiche
R 13/16	Chupiche-Guayabo
R 16/17	Guayabo-Agua Salada
R 19/20	Rio seco-Esperanza
R 20/21	Esperanza-Verrugas
R 21/23	Verrugas-Huacra
R 22/27	Linday-Yanajume
R 26/29	Chacamarca-Barranco
R 31/33	Chucumayo-Chacahuaro
R 37/40	Parac-R.Blanco
S -/4	confluence-Alcula
S 1/2	Cashahuacra-Redonda
S 2/3	Redonda-Infiernilla

Note : The caluclation results from the 50th year are omitted to show here.

Table VIII-3-5 COST AND BENEFIT STREAM OF IMPLEMENTATION PROGRAM OF STRUCTURAL PLAN FOR INUNDATION DISASTER (NORMAL SCHEDULE)

Unit : US $ 10^3

WORK ITEMS / NORMAL SCHEDULE	YEAR 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Total Cost	Investm Cost
I.GROUP (A)																																																				
I.1 MAIN STREAM (Confulence to River Mouth)																																																			
(a) Lower Reaches (Atarjea Weir to River Mouth)																																																			17166	
- Riverbed excavation & removal of garbage (Downstream of the narrow gorge)	3500																																																		3500	
- Land acquisition for the narrow gorge	387	193																																																	580	
- Riverbed excavation & removal of garbage (Upstream of the narrow gorge)	56																																																		56	
- Dike or parapet wall	1333	2667																																																	4000	
- Widening of the nallow gorge		1867	3733																																																5600	
- Revetment, etc.	686	1372	1372																																																3430	
O & M		43	43	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	12547	
(b) Middle Reaches (Huampani Bridge to Atarjea Weir)																																																					
- Repair of defects in the existing dike	40																																																			40	
- Removal of garbage				7																																																7	
- Dike or parapet wall				7000	3500																																															10500	
- Revetment, etc.				1000	1000																																															2000	
O & M					32	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	16920	
(c) Upper Reaches (Confluence to Huampani Bridge)																																																				
- Land acquisition	55.5	55.5	55.5	55.5	28																																																250	
- Widening of river channel					500	1000	500																																													2000	
- Dike or parapet wall						7533	3767																																													11300	
- Revetment, etc.						1685	1685																																													3370	
O & M							43	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	16920	
I.2 JICAMARCA RIVER																																																				
- Increase of flow capacity of culvert at confluence with Rimac river				599																																															599	
O & M				1.5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3		
II.GROUP (B)																																																				
II.1 RIMAC RIVER (Matucana to Confluence)																																																			
(a) Lower Reaches							307.5	615	307.5																																													1230	
O & M									3	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6		
(b) Upper Reaches									212.5	425	212.5																																											850	
O & M											2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4		
Total	6057.5	6197.5	5203.5	8749	5149	10370	6454.5	852	760	668	457.5	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247		

Remark : O & M cost is estimated to be 0.5% of total project cost

Unit : US $ 10^3

WORK ITEMS / NORMAL SCHEDULE	YEAR 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
I.GROUP (A)																																																		
I.1 MAIN STREAM (Confulence to River Mouth)																																																		
(a) Lower Reaches (Atarjea Weir to River Mouth)			2030	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060
- Riverbed excavation & removal of garbage (Downstream of the narrow gorge)																																																		
- Land acquisition for the narrow gorge																																																		
- Riverbed excavation & removal of garbage (Upstream of the narrow gorge)																																																		
- Dike or parapet wall																																																			
- Widening of the nallow gorge																																																		
- Revetment, etc.																																																		
O & M					920	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840
(b) Middle Reaches (Huampani Bridge to Atarjea Weir)																																																		
- Repair of defects in the existing dike																																																		
- Removal of garbage																																																		
- Dike or parapet wall																																																		
- Revetment, etc.																																																		
O & M							1897	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793
(c) Upper Reaches (Confluence to Huampani Bridge)																																																		
- Land acquisition																																																		
- Widening of river channel																																																		
- Dike or parapet wall																																																		
- Revetment, etc.																																																		
O & M																																																		
I.2 JICAMARCA RIVER																																																		
- Increase of flow capacity of culvert at confluence with Rimac river					640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640
O & M																																																		
II.GROUP (B)																																																		
II.1 RIMAC RIVER (Matucana to Confluence)																																																		
(a) Lower Reaches																																																		
O & M																																																		
(b) Upper Reaches																																																		
O & M																																																		
Total	0	0	2030	4060	5620	8540	8437	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10332	10333	10333	10333	10333

Table VIII-3-6 COST AND BENEFIT STREAM OF IMPLEMENTATION PROGRAM OF STRUCTURAL PLAN FOR INUNDATION DISASTER (ACCELERATED SCHEDULE)

Unit : US $ 10^3

WORK ITEMS / ACCELERATED SCHEDULE	YEAR 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Total Investm Cost
I.GROUP (A)																																																			
1.1 MAIN STREAM (Confulence to River Mouth)																																																		
(a) Lower Reaches (Atarjea Weir to River Mouth)																																																		
- Riverbed excavation & removal of garbage (Downstream of the narrow gorge)	3500																																																	17166 3500
- Land acquisition for the narrow gorge	387	193																																															580
- Riverbed excavation & removal of garbage (Upstream of the narrow gorge)	56																																																56
- Dike or parapet wall	1333	2667																																															4000
- Widening of the nallow gorge		1867	3733																																														5600
- Revetment, etc.	686	1372	1372																																														3430
O & M		43	43	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	
(b) Middle Reaches (Huampani Bridge to Atarjea Weir)																																																		
- Repair of defects in the existing dike	40																																																	12547
- Removal of garbage			7																																															40
- Dike or parapet wall			7000	3500																																														7
- Revetment, etc.			1000	1000																																														10500
O & M				32	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	2000
(c) Upper Reaches (Confluence to Huampani Bridge)																																																	
- Land acquisition	84	83	83																																																16920
- Widening of river channel				1000	1000																																														250
- Dike or parapet wall				3767	7533																																														2000
- Revetment, etc.					3370																																														11300
O & M					43	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	3370
1.2 JICAMARCA RIVER																																																	
- Increase of flow capacity of culvert at confluence with Rimac river				599																																													599
O & M				1.5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
II.GROUP (B)																																																	
II.1 RIMAC RIVER (Matucana to Confluence)																																																	
(a) Lower Reaches						615	615																																												
O & M							3	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	1230
(b) Upper Reaches								425	425																																									
O & M									2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	850
Total	6086	6225	13238	9985.5	12098	852	855	668	670	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	

Remark : O & M cost is estimated to be 0.5% of total project cost

Unit : US $ 10^3

WORK ITEMS / ACCELERATED SCHEDULE	YEAR 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
I.GROUP (A)																																																	
1.1 MAIN STREAM (Confulence to River Mouth)																																																	
(a) Lower Reaches (Atarjea Weir to River Mouth)			2030	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060
- Riverbed excavation & removal of garbage (Downstream of the narrow gorge)																																																	
- Land acquisition for the narrow gorge																																																	
- Riverbed excavation & removal of garbege (Upstream of the narrow gorge)																																																	
- Dike or parapet wall																																																	
- Widening of the nallow gorge																																																	
- Revetment, etc.																																																	
O & M																																																	
(b) Middle Reaches (Huampani Bridge to Atarjea Weir)			920	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840
- Repair of defects in the existing dike																																																	
- Removal of garbage																																																	
- Dike or parapet wall																																																	
- Revetment, etc.																																																	
O & M																																																	
(c) Upper Reaches (Confluence to Huampani Bridge)					1897	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793
- Land acquisition																																																	
- Widening of river channel																																																	
- Dike or parapet wall																																																	
- Revetment, etc.																																																	
O & M																																																	
I.2 JICAMARCA RIVER																																																	
- Increase of flow capacity of culvert at confluence with Rimac river					640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640
O & M																																																	
II.GROUP (B)																																																	
II.1 RIMAC RIVER (Matucana to Confluence)																																																	
(a) Lower Reaches																																																	
O & M																																																	
(b) Upper Reaches																																																	
O & M																																																	
Total	0	0	2030	4060	8437	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333

Table VIII-3-7 COST AND BENEFIT STREAM OF IMPLEMENTATION PROGRAM OF STRUCTURAL PLAN FOR INUNDATION DISASTER (MITIGATED SCHEDULE)

Unit : US $ 10^3

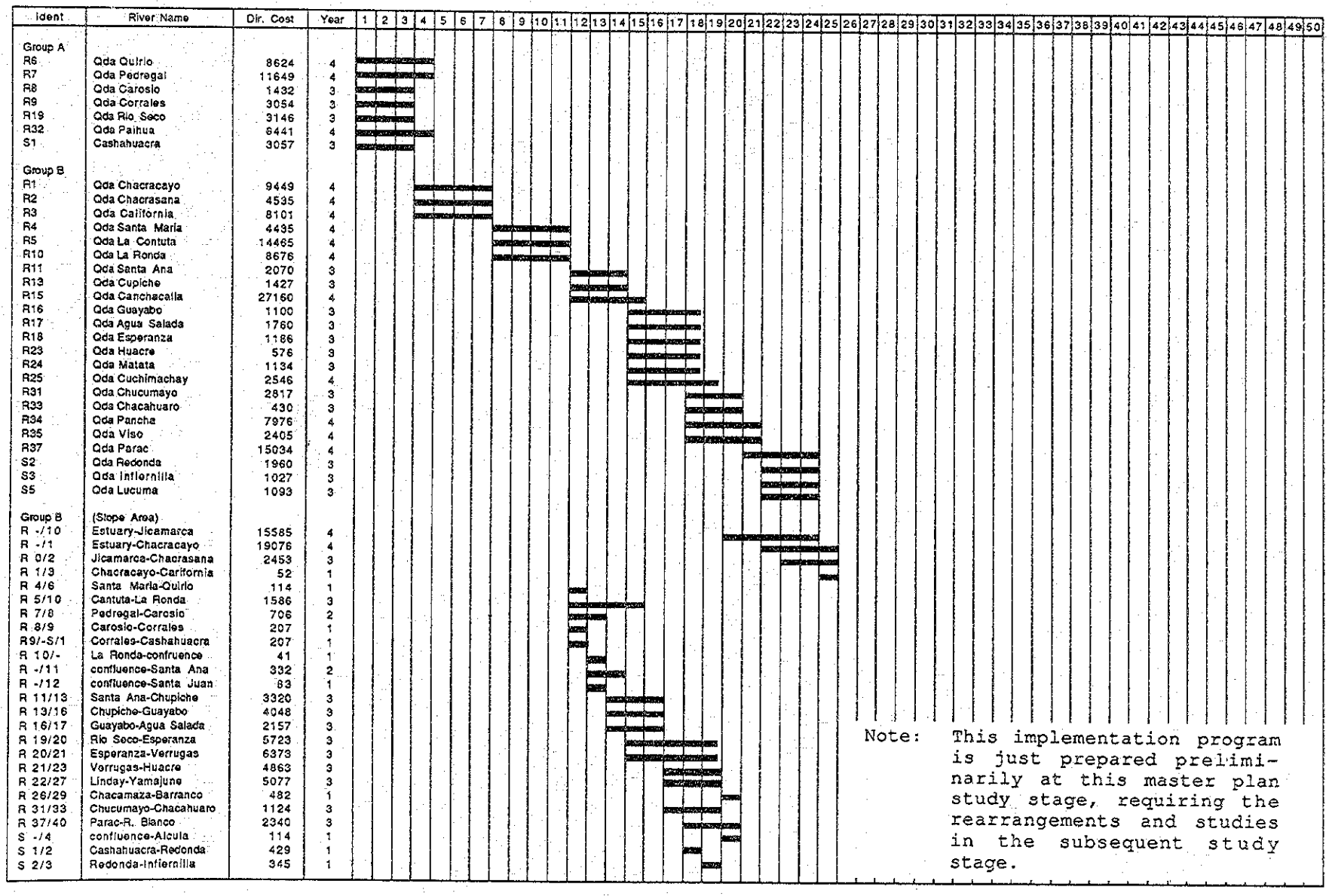
WORK ITEMS / MITIGATED SCHEDULE	YEAR 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Total	Investm Cost
I.GROUP (A)																																																				
I.1 MAIN STREAM (Confulence to River Mouth)																																																			
(a) Lower Reaches (Atarjea Weir to River Mouth)																																																		17166
- Riverbed excavation & removal of garbage (Downstream of the narrow gorge)	3500																																																	3500
- Land acquisition for the narrow gorge	194	193	193																																														580
- Riverbed excavation & removal of garbage (Upstream of the narrow gorge)		56																																															56
- Dike or parapet wall		2000	2000																																														4000
- Widening of the nallow gorge				2800	2800																																												5600
- Revetment, etc.		857.5	857.5	857.5	857.5																																													3430
O & M				43	43	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86		
(b) Middle Reaches (Huanpani Bridge to Atarjea Weir)																																																		12547
- Repair of defects in the existing dike	40																																																	40
- Removal of garbage						7																																													7
- Dike or parapet wall						5250	5250																																												10500
- Revetment, etc.						666	1334																																												2000
O & M							32	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63		
(c) Upper Reaches (Confluence to Huanpani Bridge)																																																		16920
- Land acquisition	35.8	35.7	35.7	35.7	35.7	35.7	35.7																																												250
- Widening of river channel								667	667	666																																									2000
- Dike or parapet wall									5650	5650																																									11300
- Revetment, etc.									1124	2246																																									3370
O & M										43	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85		
I.2 JICAMARCA RIVER																																																		
- Increase of flow capacity of culvert at confluence with Rimac river						599																																												599
O & M						1.5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3		
II.GROUP (B)																																																		
II.1 RIMAC RIVER (Matucana to Confluence)																																																		
(a) Lower Reaches											615	615																																							1230
O & M												3	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6		
(b) Upper Reaches													425	425																																					850
O & M														2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4		
Total	3769.8	3142.2	3086.2	3736.2	3736.2	6645.2	6740.7	819	7593	8757	852	855	668	670	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247	247		

Remark : O & M cost is estimated to be 0.5% of total project cost

Unit : US $ 10^3

WORK ITEMS / MITIGATED SCHEDULE	YEAR 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
I.GROUP (A)																																																		
I.1 MAIN STREAM (Confulence to River Mouth)																																																		
(a) Lower Reaches (Atarjea Weir to River Mouth)			2030	2030	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060	4060
- Riverbed excavation & removal of garbage (Downstream of the narrow gorge)																																																		
- Land acquisition for the narrow gorge																																																		
- Riverbed excavation & removal of garbage (Upstream of the narrow gorge)																																																		
- Dike or parapet wall																																																			
- Widening of the nallow gorge																																																		
- Revetment, etc.																																																		
O & M																																																		
(b) Middle Reaches (Huanpani Bridge to Atarjea Weir)							920	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840	1840
- Repair of defects in the existing dike																																																		
- Removal of garbage																																																		
- Dike or parapet wall																																																		
- Revetment, etc.																																																		
O & M										1897	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793	3793
(c) Upper Reaches (Confluence to Huanpani Bridge)																																																		
- Land acquisition																																																		
- Widening of river channel																																																		
- Dike or parapet wall																																																		
- Revetment, etc.																																																		
O & M																																																		
I.2 JICAMARCA RIVER																																																		
- Increase of flow capacity of culvert at confluence with Rimac river							640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640
O & M																																																		
II.GROUP (B)																																																		
II.1 RIMAC RIVER (Matucana to Confluence)																																																		
(a) Lower Reaches																																																		
O & M																																																		
(b) Upper Reaches																																																		
O & M																																																		
Total	0	0	0	2030	2030	4060	5620	6540	6540	8437	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333	10333

Figures



Ident	River Name	Dir. Cost	Year
Group A			
R6	Qda Quirlo	8624	4
R7	Qda Pedregal	11649	4
R8	Qda Carosio	1432	3
R9	Qda Corrales	3054	3
R19	Qda Rio Seco	3146	3
R32	Qda Paihua	6441	4
S1	Cashahuacra	3057	3
Group B			
R1	Qda Chacracayo	9449	4
R2	Qda Chacrasana	4535	4
R3	Qda California	8101	4
R4	Qda Santa Maria	4435	4
R5	Qda La Contuta	14465	4
R10	Qda La Ronda	8676	4
R11	Qda Santa Ana	2070	3
R13	Qda Cupiche	1427	3
R15	Qda Canchacalla	27160	4
R16	Qda Guayabo	1100	3
R17	Qda Agua Salada	1760	3
R18	Qda Esperanza	1186	3
R23	Qda Huacre	576	3
R24	Qda Matata	1134	3
R25	Qda Cuchimachay	2546	4
R31	Qda Chucumayo	2817	3
R33	Qda Chacahuaro	430	3
R34	Qda Pancha	7976	4
R35	Qda Viso	2405	4
R37	Qda Parac	15034	4
S2	Qda Redonda	1960	3
S3	Qda Infiernilla	1027	3
S5	Qda Lucuma	1093	3
Group B	(Slope Area)		
R -/10	Estuary-Jicamarca	15585	4
R -/1	Estuary-Chacracayo	19076	4
R 0/2	Jicamarca-Chacrasana	2453	3
R 1/3	Chacracayo-Carifornia	52	1
R 4/6	Santa Maria-Quirlo	114	1
R 5/10	Cantuta-La Ronda	1586	3
R 7/8	Pedregal-Carosio	706	2
R 8/9	Carosio-Corrales	207	1
R9/-S/1	Corrales-Cashahuacra	207	1
R 10/-	La Ronda-confruence	41	1
R -/11	confluence-Santa Ana	332	2
R -/12	confluence-Santa Juan	83	1
R 11/13	Santa Ana-Chupiche	3320	3
R 13/16	Chupiche-Guayabo	4048	3
R 16/17	Guayabo-Agua Salada	2157	3
R 19/20	Rio Seco-Esperanza	5723	3
R 20/21	Esperanza-Verrugas	6373	3
R 21/23	Verrugas-Huacre	4863	3
R 22/27	Linday-Yamajune	5077	3
R 26/29	Chacamaza-Barranco	482	1
R 31/33	Chucumayo-Chacahuaro	1124	3
R 37/40	Parac-R. Blanco	2340	3
S -/4	confluence-Alcula	114	1
S 1/2	Cashahuacra-Redonda	429	1
S 2/3	Redonda-Infiernilla	345	1

Note: This implementation program is just prepared preliminarily at this master plan study stage, requiring the rearrangements and studies in the subsequent study stage.

Fig. VIII-2-1 Alternative Implementation Schedule of Countermeasures for Debris Flow and Slope Failure Disaster (Accelerated schedule)

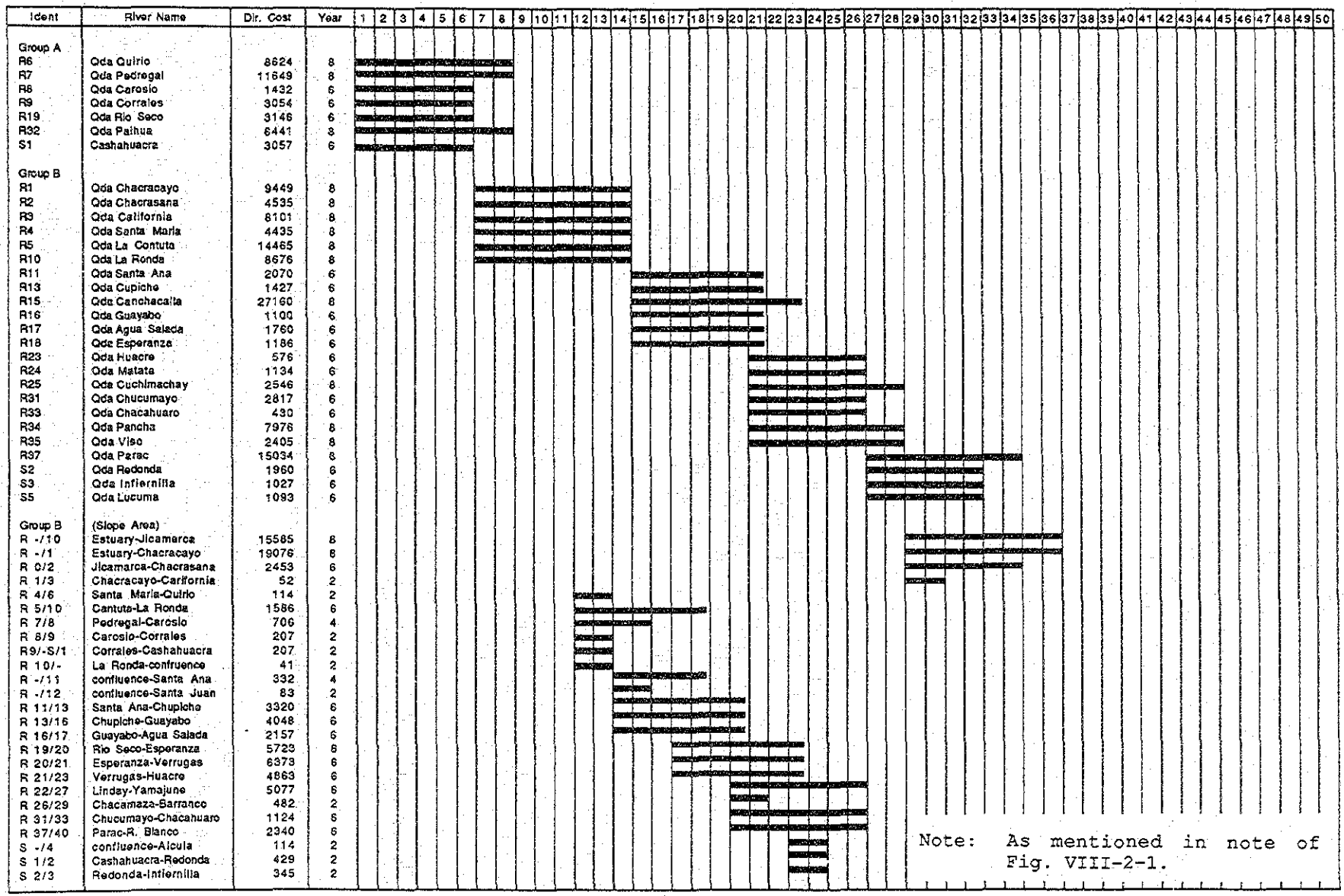


Fig. VIII-2-2 Alternative Implementation Schedule of Countermeasures for Debris Flow and Slope Failure Disaster (Mitigated schedule)

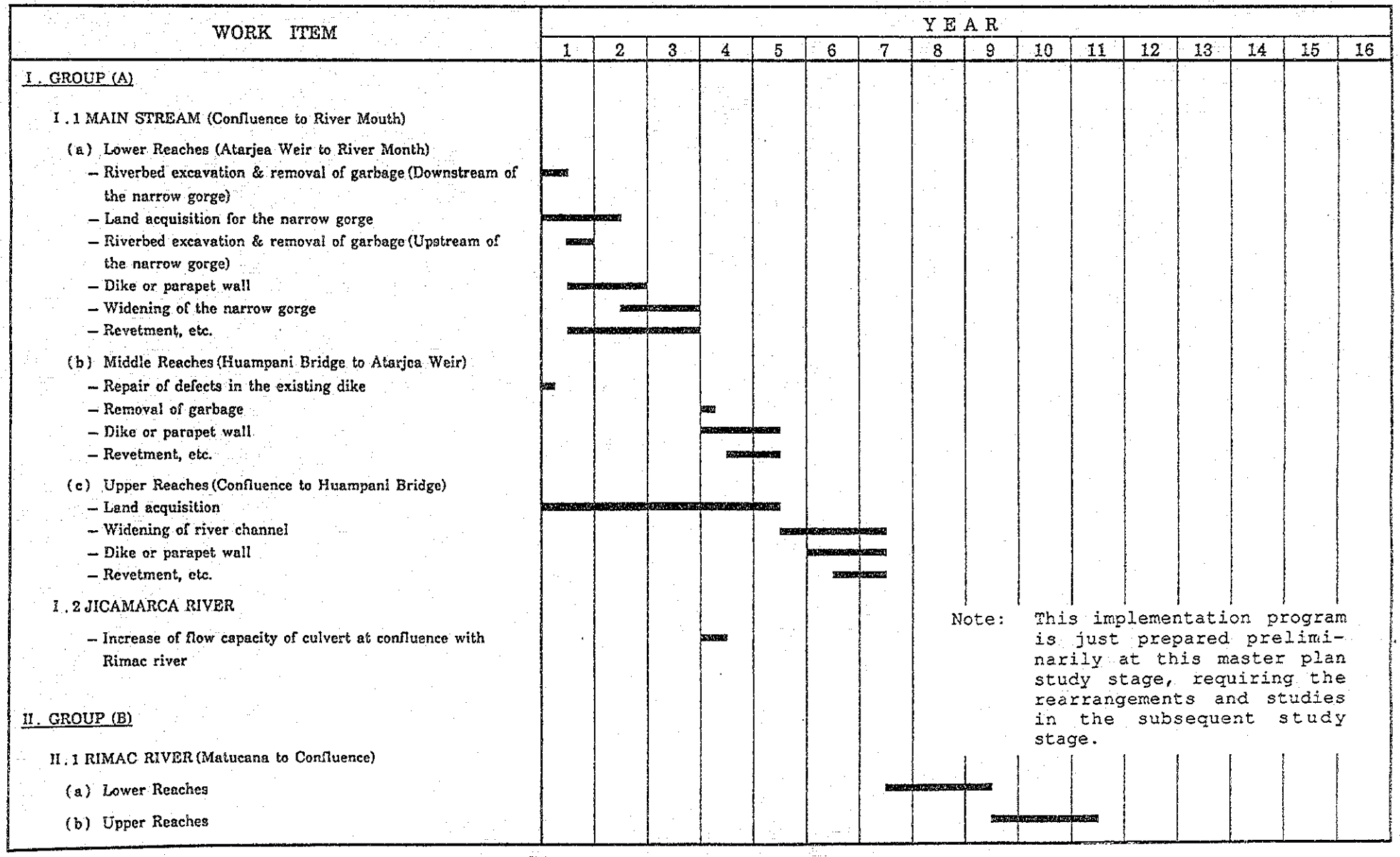


Fig. VIII-2-3 Alternative Implementation Schedule of Countermeasures for Inundation Disaster (Normal Schedule)

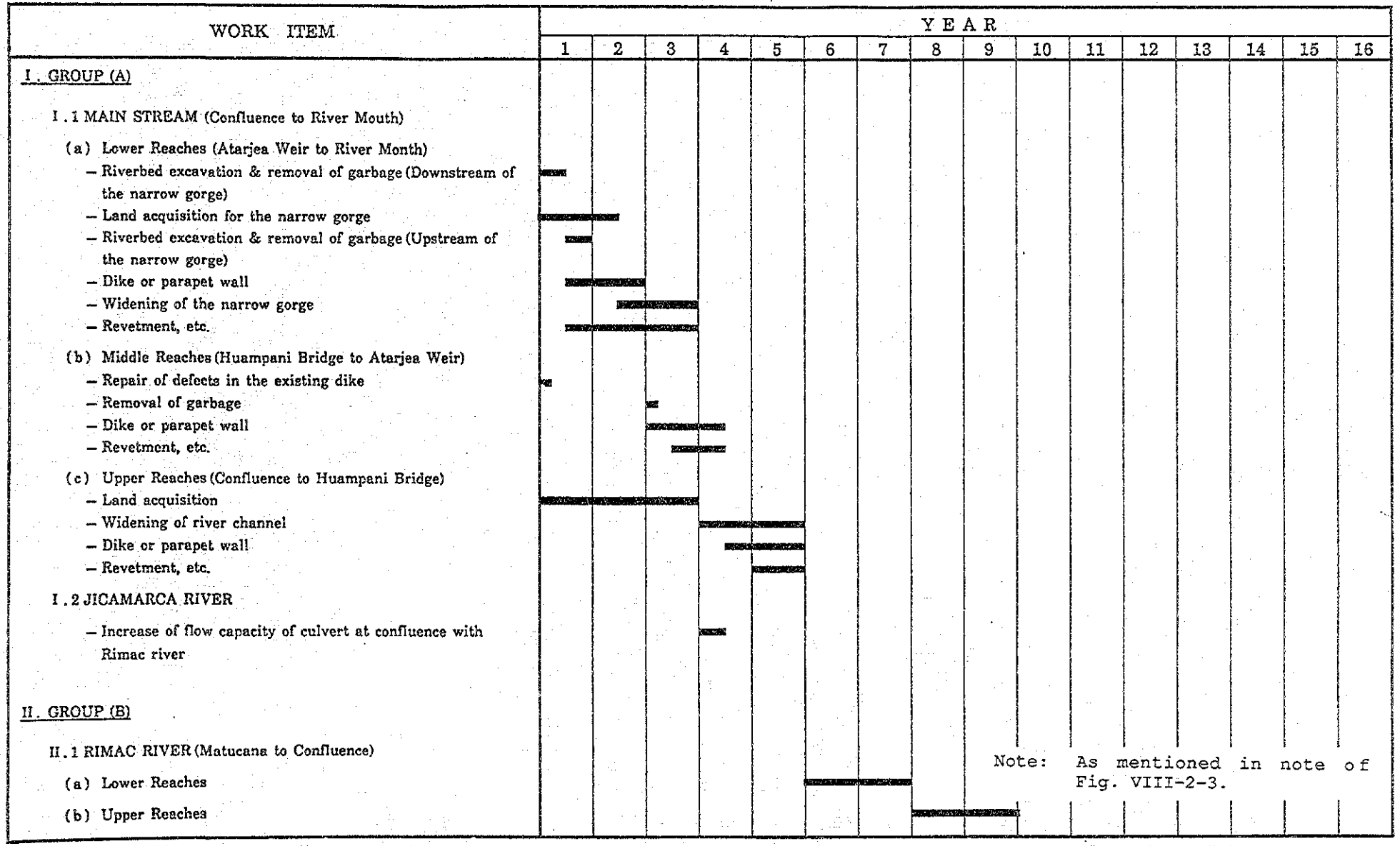


Fig. VIII-2-4 Alternative Implementation Schedule of Countermeasures for Inundation Disaster (Accelerated Schedule)

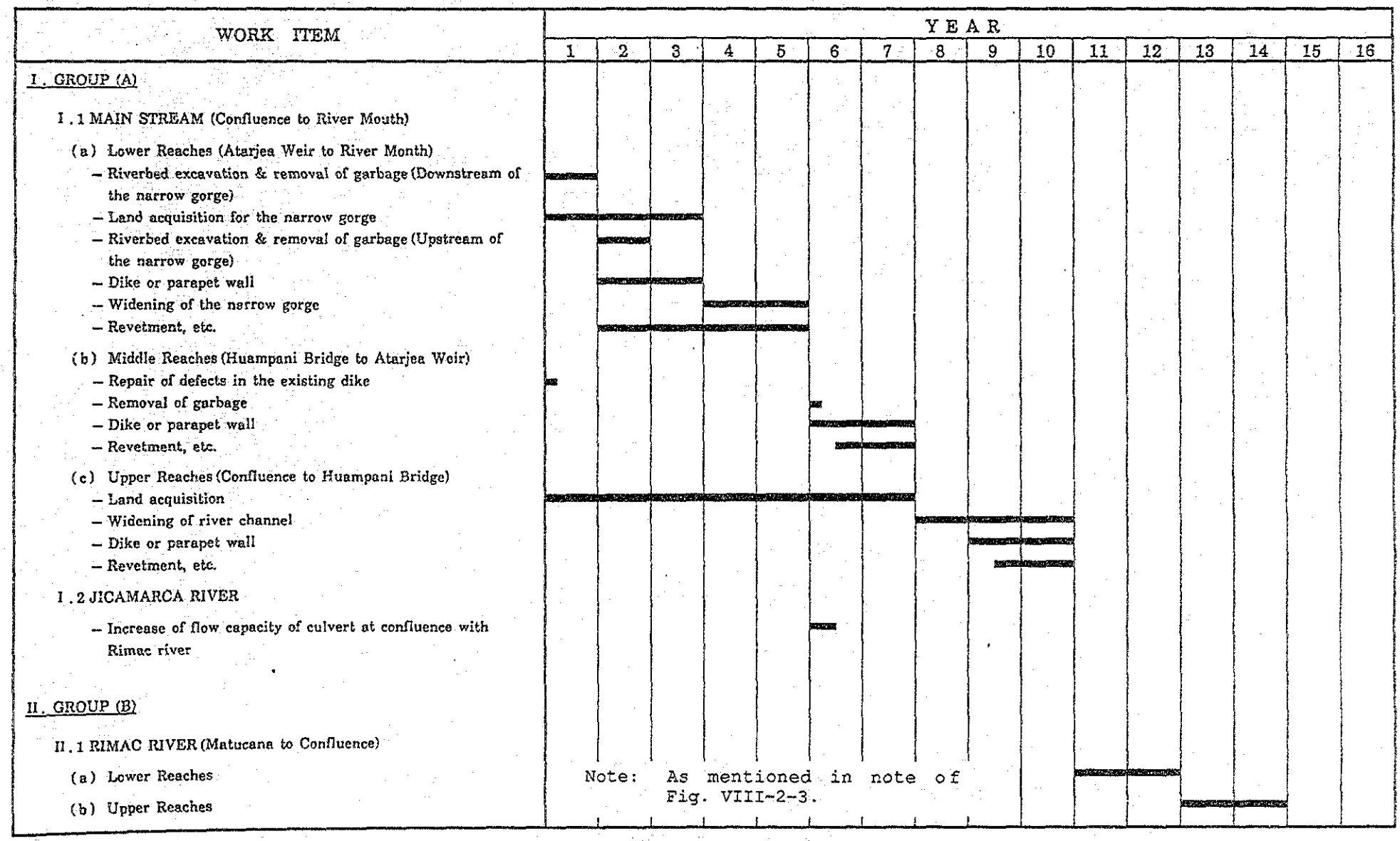


Fig. VIII-2-5 Alternative Implementation Schedule of Countermeasures for Inundation Disaster (Mitigated Schedule)

Chapter IX

IX. RECOMMENDATION FOR FUTURE ACTIONS

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CAHPTER IX RECOMMENDATION FOR FUTURE ACTIONS

1. GENERAL

The previous chapters have discussed the desirable master plan for disaster prevention in the Rimac river basin, including the structural measures for the debris flow and inundation disasters and various non-structural measures.

The master plan formulated through the examination is summarized in Chapter VII. Its desirable implementation program is given in Chapter VIII. A recommendation considered important in implementing this disaster prevention plan is given in this chapter.

Further, the realization of the overall plan will require a considerable long term. On the other hand, the plan involves some urgent matter for which the necessary actions should immediately be taken with a particularly high urgency. This chapter also discusses such urgent matters and necessary actions for them.

2. RECOMMENDATION

(A) The formulated master plan should be considered as the basic guideline for the disaster prevention plan in the basin. It is most important that the consistent and comprehensive disaster prevention plan for the whole basin be implemented systematically in accordance with the basic guideline. The above is, first of all, stressed as most important.

(B) The realization of the overall disaster prevention plan will require a considerably long time. On the other hand, the plan involves some urgent matters for which the actions should immediately be taken. The recommendations are made for such urgent matters as follows:

(1) The seven quebradas classified into Group A have a high urgency for implementation. On the other hand, the structural measures proposed for these quebradas require a more detailed confirmation of technical and economic feasibilities, investigating the topographic and geological conditions in detail.

Therefore, the necessary procedure for executing the feasibility study should be promoted with a high priority.

(2) In view that the urban area in the downstream reaches of Rimac river is exposed to an extreme danger of inundation disaster, some countermeasures should urgently be taken.

The necessary urgent measures are shown in order of priority as follows;

(a) River bed excavation and removal of garbage in the downstream of narrow gorge at 9 to 10 km from the river mouth, and revetment,

(b) River bed excavation and removal of garbage in the upstream of narrow gorge, and revetment,

(c) Widening the narrow gorge, and revetment.

In view that the land acquisition procedure takes a long time, it is also recommended to put into execution at the earliest the land acquisition necessary for widening the narrow gorge.

(3) There are some defects of the dike in the middle reaches. The repair for these defects also has the highest urgency, requiring the earliest implementation at the same time with the said measures for the lower reaches.

(4) The inundation disaster prevention plan proposed for the upper reaches (Huampani Bridge to the confluence) requires the land acquisition in a considerably large scale, which will take a long time. Thus, it is recommended to commence the acquisition at the earliest.

(5) Although all of the proposed non-structural measures are of the urgent necessity, the following two items have a particularly high urgency.

(a) Strict prohibition of disposal of garbage into the river, and

(b) Strict prohibition of new encroachment of inhabitants into the dangerous area.

The immediate and strict execution of the above two items is recommended.

(6) Prior to the implementation of the above items (2) to (4), more detailed investigation, survey and design works, etc. will become necessary. It is required to proceed with the procedures necessary for such works as mentioned.

(C) It is recommended to commence as early as possible the research for vegetation in the basin which is considered important from the aspect of disaster prevention as follows;

A remarkable devastation of the basin is recognized especially in the lower reaches of the basin without any vegetation, causing various disaster. Thus, the vegetation to stabilize the devastated basin is of the keen necessity.

Various findings for a successful vegetation in the devastated area are obtained through the researches in other countries as well as Japan. However, the Climate, geology and soil conditions, which dominantly effect on the vegetation, are different in the respective areas. This means that a suitable solution has to be found out in the respective area through the various examinations.

Furthermore, the successful vegetation in the basin may require a persistent research and accumulation of data in a long term. Thus, it is recommended to start with the research to find out the most suitable measure for vegetation in the basin, referring to the various findings obtained under the similar conditions in other countries.
For reference, an examination and recommendation for vegetation in the basin is presented at the end of this chapter as an Annex "Examination and Recommendation for Vegetation", which also provides the present situation of research for vegetation in Japan.

(D) The study on necessity and possibility of installation of radar rain gauge system in the basin reveals:

(i) The basin keenly needs the installation of radar rain gauge which will make it possible to forecast the state of precipitation.

(ii) The installation of radar rain gauge in the basin will technically be possible as well as highly effective for the disaster prevention.

Then, it is recommended to proceed with the examination for installing radar rain gauge system in the basin. In installing the system, it is especially noted that a satisfactory arrangement of primal matters such as establishments of communication system, warning system and its organization, etc. is inevitable and extremely important for the sufficient fulfillment of its function.

(E) The training of engineers is essential as discussed in Chapter VI "Non-Structural Plan for Disaster". The engineers should be available in executing the

structural measures as proposed for disaster prevention.

On the one hand, a satisfactory training requires a considerably long time. Therefore, it is important to start with the training as soon as possible. Thus, it is recommended to proceed with the procedures necessary for establishing a training center for engineers.

Annex

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1. Examination and Recommendation for Vegetation

1.1 Necessity of Vegetation

A remarkable devastation of the basin is recognized especially in the lower reaches of the basin without any vegetation. A huge amount of sediments produced due to the above devastation causes various disasters in the life zone of basin.

Even if some structural measures for disaster, prevention are provided, production of sediments and its movement will remain unsolved, continuously threatening the occurrence of serious disaster. Thus, the vegetation to stabilize the ruined basin is of the keen necessity.

1.2 Cause of Devastation

The following is considered to be the main cause for the devastation of basin:

(1) The basin belongs to the so-called semiarid area. Especially, the lower reaches of basin has little rain which is essential for the vegetation.

(2) The geology consists of the granitic rocks. The surface is under the weathered condition of above rocks, which is very poor in preserving the water as well as impoverished to yield the vegetation.

(3) The steep mountain slope in the basin accelerates the movement of surface soil, which makes it difficult to settle the vegetation.

1.3 Requirements for Vegetation

The minimum requirement for vegetation will be;

(1) The water is available,
(2) The surface soil does not move, and
(3) The surface soil contains the necessary nourishment for plants.

Since it is considered unrealistic to artificially deliver the water in view of such a vast area for necessary vegetation and the serious shortage of municipal water in the basin, the following is expected as a way to make the vegetation possible in the basin.

(1) To improve the capability to keep the water in soil,
(2) To provide a measure to prevent the movement of soil,
(3) To give the fertilizer if required, and

(4) To introduce some strong plants against the arid climate and poor nourishment.

1.4 Research of Vegetation for the Devastated Area in Japan

There are some ruined areas in Japan which are situated under the conditions generally similar to those of the basin. The area has produced much sediment, causing various disasters in the developed downstream reaches.

As such, various attempts to recover the vegetation in the area have experimentally been executed for a long time more than a hundred year.

The above research had various findings for the recovery of vegetation in a desolate area as follows;

(1) The attempt to directly cover the whole slope with the vegetation frequently results in a failure, since the surface soil moves before a stable vegetation grows up there.

(2) Then, it is effective for the development of vegetation to create a primary base condition for vegetation where a stable vegetation can grow up. The above primary vegetation gradually changes the whole slope into much more favourable state for the development of vegetation.

(3) It is effective in the preparation of the primary base condition for vegetation to artificially create the place in the form of a line where the soil is unmovable.

(4) The soil materials originated from the weathering of granitic rocks are very poor in the preservability of water and nourishment. Then, in addition to the creation of the place where the soil is unmovable, it is necessary to look into a measure to improve the preservability of water and nourishment.

(5) It is found through various experimental trials that the terracing with sod would be the best way to create the mentioned primary base condition for vegetation. The terracing with sod, provided in the form of horizontal strips on the slope as shown in the attached figure, will effectively settle the soil in

position as well as improve the capability to keep the water.

(6) It is important to select the plants resistible against the dry and barren condition. The pine and eucalyptus, etc. are found to be strong against such dry and sterile condition by the following reason: that is, the pine and eucalyptus have the so-called mycorrhiza, and thereby, a fungus called as basidiomycete which makes the mushroom attaches to the roots of tree. The mushroom attached to the roots of tree remarkably improves the capability to absorb the nutrition from the sterile soil. It is essential to start with such plants durable for the severe condition. Then, the condition for vegetation is improved by the primary vegetation gradually increasing the kinds of plant and area of vegetation.

(7) Some follow-up cares are required to achieve a complete success of vegetation since the self-supporting vegetation requires the following cycle: that is, the nutrition in soil changes into the trunk and leaves of tree, i.e. into the organic matter. The organic matter returns to the soil and then, is again disintegrated into the nutrition for plants. The achievement of the cycle as mentioned takes a long time during which the plants frequently die due to the consumption of nutrition prior to the establishment of cycle. Therefore, the follow-up care such as the addition of fertile and cultivation of soil is important until the said cycle for self-supporting vegetation is established in the area.

(8) The achievement of vegetation in a devastated area takes a long time of 100 to 200 years or more. It also requires the persistent research to find out a suitable solution in the respective area.

1.5 Recommendation

The following recommendation is made for achieving the vegetation in the basin:

(1) The vegetation in the devastated area is an international subject with which many other countries as well as Japan are wrestling. Various findings for the vegetation are obtained as mentioned in the preceding section. However, the climate, geology and soil conditions, which dominantly effect on the vegetation, are different in the respective area. It means that a suitable solution has to be found out in the respective area through the trials and errors. Thus, it is recommended to start with the research to find out the most suitable measure for vegetation in the basin.

(2) The successful vegetation in the basin may require the persistent research and accumulation of data in a long term as mentioned. Then, it is important to establish a satisfactory research group which can continue the research in a long term.

(3) The research and accumulation of data are recommendable to be made in a typical test area, referring to the various findings obtained under the similar condition in other countries. The reference should also be made to the conditions for and kinds of tree and grass which already exist partially in the

(4) In view of the extreme dry condition in the basin, it is considered a special idea to upgrade the water preservability in soil will be required to be introduced. In relation to the matter, there is an idea which proposes to improve the water preservability in soil with some agents consisting of the super absorbability polymer, although its effect on vegetation or specification for its use, etc. are still under the research. It is also recommendable to try the measure applying such a special idea for the vegetation in the basin.

2. Examination on Necessity and Possibility of Installation of Radar Rain Gauge in the Basin

2.1 Necessity of the Installation of Radar Rain Gauge System in the Rimac River Basin

The pattern of heavy rainfall and disaster due to the rainfall in the basin is as follows:

(1) A mass of heavy rain cloud arises in the Amazon river basin adjacent to the Rimac river basin.

(2) The above rain cloud sometimes spreads over the Rimac river basin beyond the Andes mountain range.

(3) The rain cloud promptly spreads in several minutes, causing a heavy rainfall in the upstream reaches of the Rimac river basin.

(4) The basin is characterized with the very steep topography and little vegetation, and thus, the rainfall rapidly flows down without any retarding on the mountain slope. The destructive debris flow originating from the erosion of unconsolidated deposit by the rapid flow occurs in the quebrada. The destructive debris flow in the quebrada usually breaks out about 30 minutes after the spread of rain cloud in the basin.

out about 30 minutes after the spread of rain cloud in the basin.

(5) The Rimac river is also characterized by its steep riverbed gradient, and therefore, the flood arrives in the downstream reaches in a very short time of a few hours, making the counteraction against flood difficult.

Such being the situation of rainfall and disaster due to the rainfall in the basin, it will be paramountly useful for the necessary counteraction if the rain cloud in the Amazon river basin can be detected and its movement be forecast beforehand.

The radar rain gauge makes it possible to detect such rain cloud and forecast its movement. It can be said that the basin keenly needs the installation of radar rain gauge system which will make it possible to take an effective counteraction for avoiding the disaster.

2.2 Possibility of the Installation of Radar Rain Gauge System in the Rimac River Basin

2.2.1 Function of Radar Rain Gauge System

The function of radar rain gauge system is outlined as follows;

(1) The radio wave to be radiated from the radar detects rain drops. The radar rain gauge can cover a wide observation range up to 200 km from the radar site. The quantitative observation is possible within 120 km from the radar site where radio wave is capable of directly detecting rain drops, whereas the observation for the area from 120 km to 200 km is qualitatively covered.

(2) A ground rain gauge can not survey the precipitation area accurately since it detects rain only as one point. However, the radar rain gauge provides the size of precipitation area with ease, as it is able to gauge the spread of the precipitation area.

(3) The radar rain gauge can trace the movement of precipitation area such as the change of precipitation area, direction of movement, its velocity and intensity of precipitation, etc, making it possible to forecast the state of precipitation in a short term of two or three hours.

(4) The meteorological informations acquired at the radar site is transmitted via a multiplex radio link to a remote meteorological observatory. The radar relay

link is capable of transmitting the radar video and other meteorological data.

2.2.2 Possibility of the Installation

An examination on the possibility of installation of radar rain gauge system in the basin reveals that the installation would be possible and effective for avoiding the disaster in the basin as follows:

(1) The site for installing the radar rain gauge can be selected at Ticlio or Milloc which is situated in the uppermost reaches of the basin and a high altitude of about 4,800m. The accessibility to Ticlio or Milloc is also favourable with the national road passing through the basin.

(2) As mentioned, the radar rain gauge can cover the wide observation range up to 200 km from the radar rain gauge site. As for the area within 120 km from the radar rain gauge site, the radar is possible to quantitatively observe the precipitation. On the one hand, the basin has the catchment area of 3,300 km^2 with about 150 km in the longitudinal length and 20 km in width. Then, the radar rain gauge observation covers the whole basin. Besides that, the radar rain gauge site is located at the place where an extensive view of the Amazon river basin can be taken, making it possible to mostly detect the precipitation or rain cloud of the Amazon river basin, trace the movement of precipitation area and forecast the precipitation area or intensity of precipitation, etc. thereafter.

(3) The informations can be sent every moment to a remote meteorological observatory installed in the basin. The informations and necessary warning can also be transmitted to each area in the basin through the above meteorological observatory, although the satisfactory communication system should be equipped.

(4) A detailed state of precipitation after two to three hours can be forecast, and therefore, the necessary warning can be given two to three hours before the occurrence of debris flow or flooding.

(5) The installation of one set of radar rain gauge station will make a satisfactory observation system in the whole basin possible. Then, the expense necessary for installing the radar rain gauge system in the basin is approximately estimated at about US$ 10×10^6, including the installation of a radar rain gauge station, a processing system of radar data and other necessary facilities. The arrangement of budget for the above necessary expense seems not to be of an extreme difficulty.

Figures

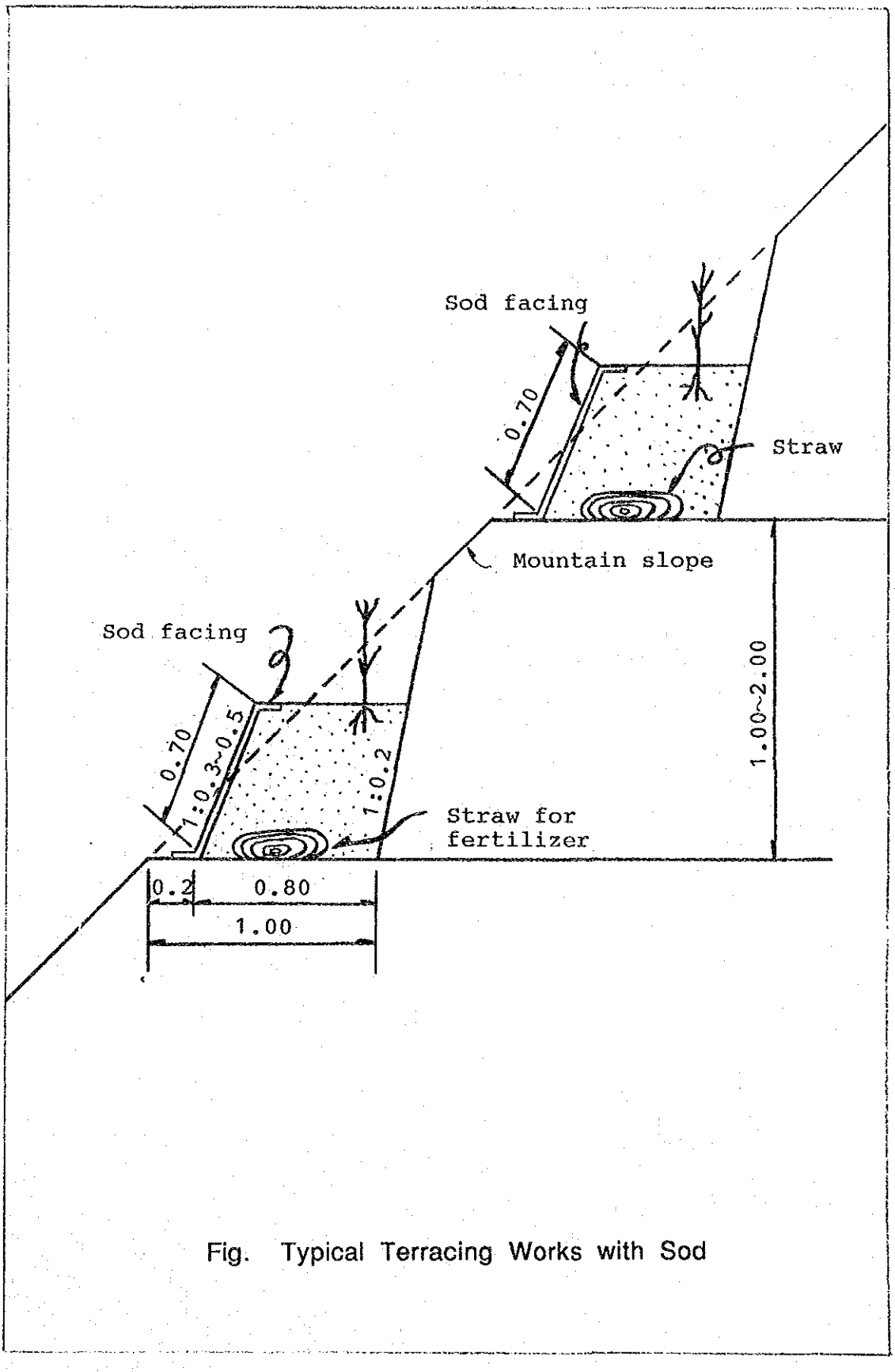

Fig. Typical Terracing Works with Sod