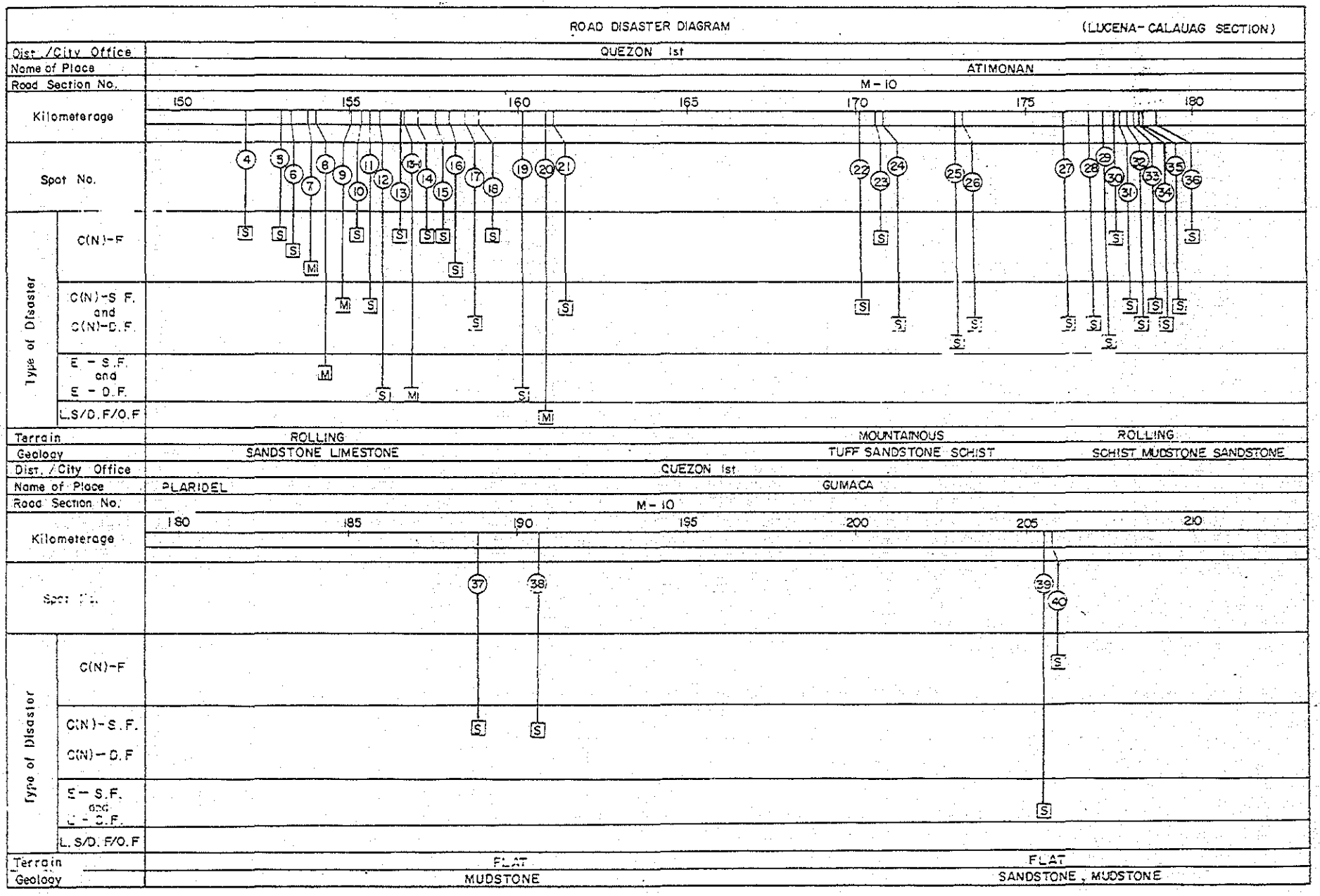
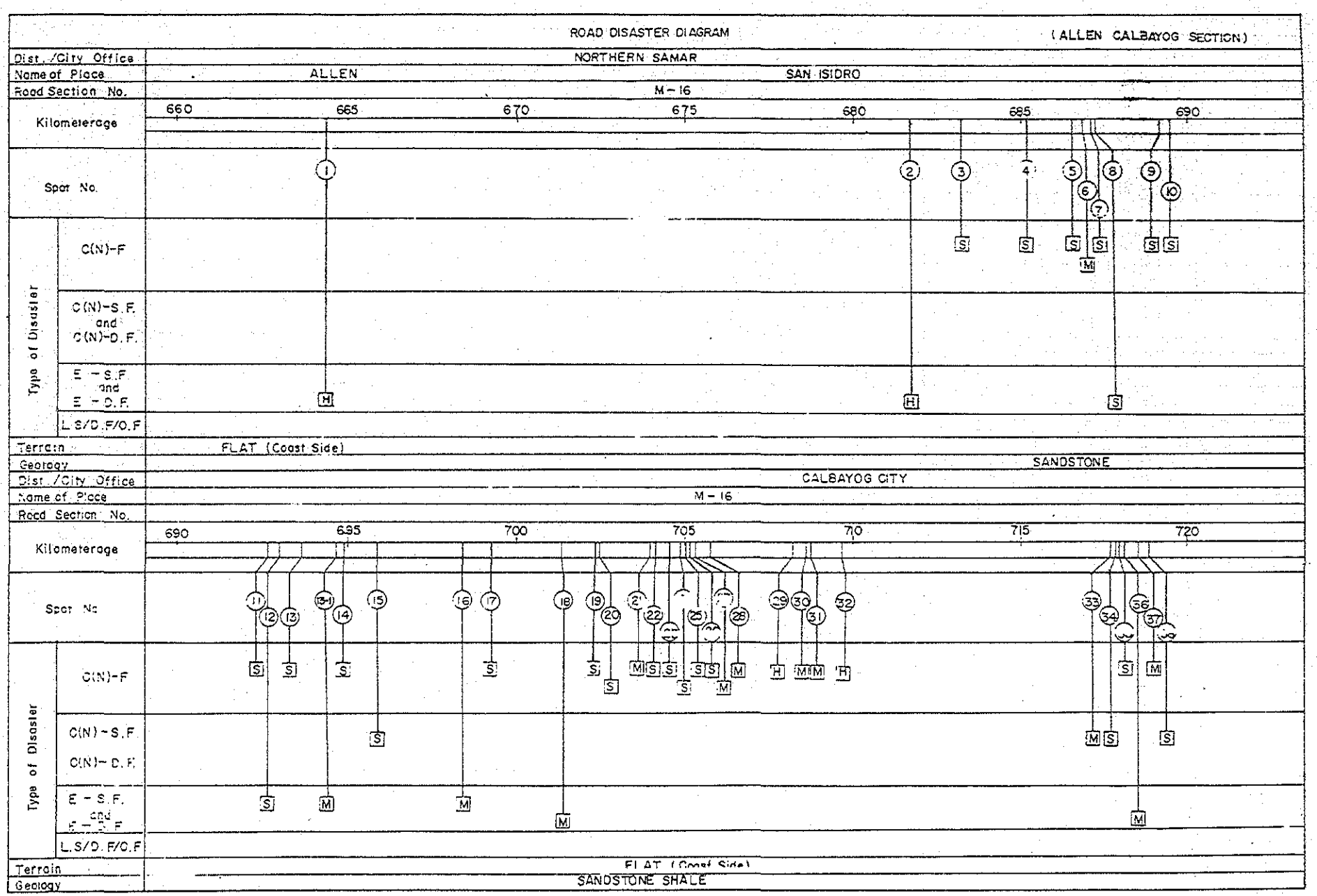
APPENDIX 5.3-2 ROAD DISASTER DIAGRAM

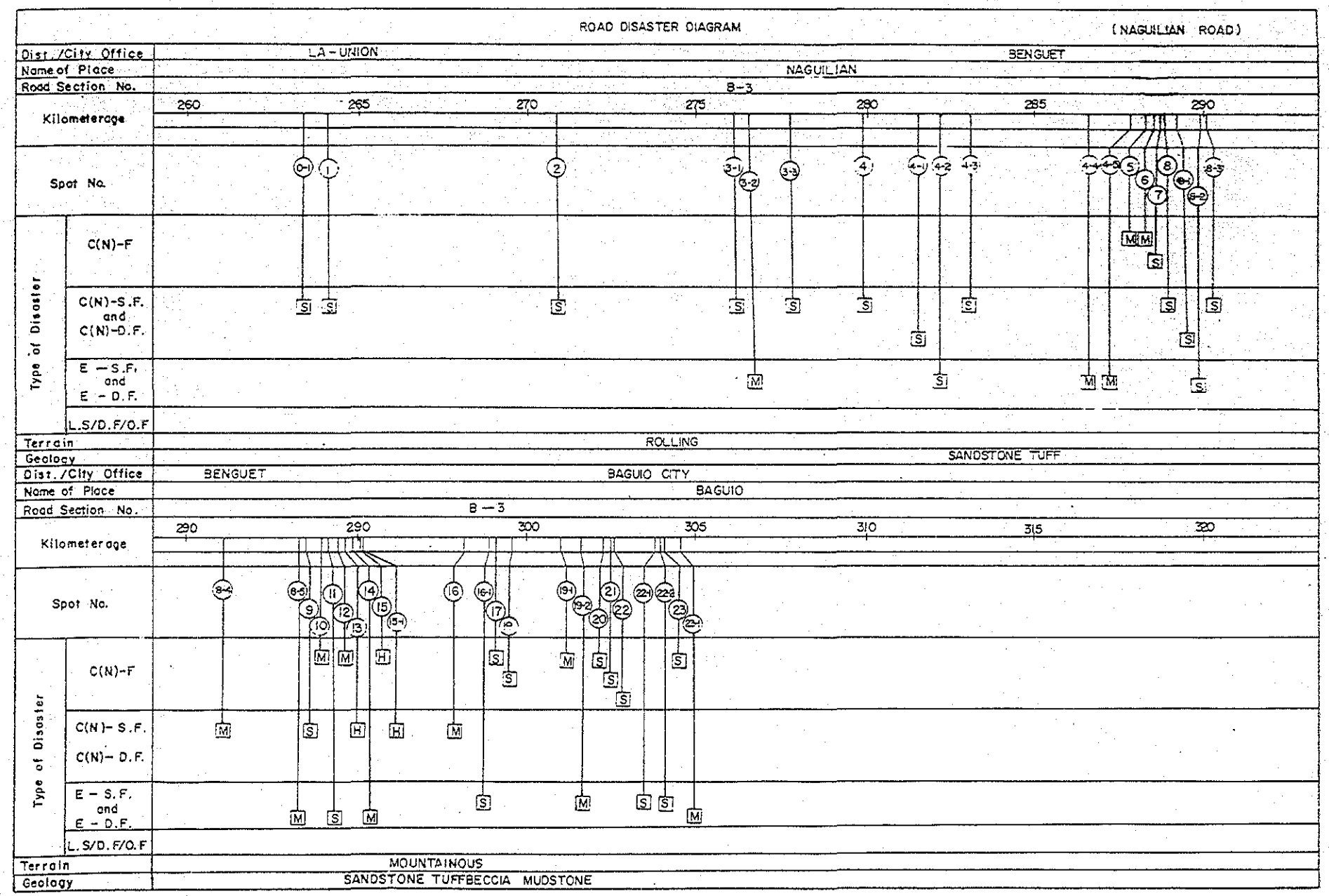
ROAD DISASTER DIAGRAM (LUCENA-CALAUAG SECTION)




ROAD DISASTER DIAGRAM
(ALLEN CALBAYOG SECTION)
Dist. /City Office
NORTHERN SAMAR
Name of Place
ALLEN
SAN ISIDRO
Road Section No.
M-16
Kilometerage
660
665
670
675
680
685
690
Spot No.
Type of Disaster
C(N)-F
C(N)-S.F. and C(N)-D.F.
E-S.F. and E-D.F.
L.S/D.F/O.F
Terrain
FLAT (Coast Side)
Geology
SANDSTONE
Dist. /City Office
CALBAYOG CITY
Name of Place
M-16
Road Section No.
Kilometerage
690
695
700
705
710
715
720
Spot No.
Type of Disaster
C(N)-F
C(N)-S.F.
C(N)-D.F.
E-S.F. and E-D.F.
L.S/D.F/O.F
Terrain
FLAT (Coast Side)
Geology
SANDSTONE SHALE

ROAD DISASTER DIAGRAM (ALLEN CALBAYOG SECTION)

Dist. / City Office		CALBAYOG CITY
Name of Place		
Road Section No.		M-16
Kilometerage		720 725
Spot No.		39 38
Type of Disaster	C(N)-F	S
	C(N)-S.F. C(N)-D.F.	
	E-S.F. and E-D.F.	W
	L.S/D.F/O.F.	
Terrain		
Geology		
Dist. /City Office		
Name of Place		
Road Section		
Kilometerage		
Spot No.		
Type of Disaster	C(N)-F	
	C(N)-S.F. C(N)-D.F.	
	E-S.F. and E-D.F.	
	L.S/D.F/O.F.	
Terrain		
Geology		


ROAD DISASTER DIAGRAM
(NAGUILIAN ROAD)
Dist./City Office
LA-UNION
BENGUET
Name of Place
NAGUILIAN
Road Section No.
B-3
Kilometerage
260
265
270
275
280
285
290
Spot No.
Type of Disaster
C(N)-F
C(N)-S.F. and C(N)-D.F.
E-S.F. and E-D.F.
L.S/D.F/O.F
Terrain
ROLLING
Geology
SANDSTONE TUFF
Dist./City Office
BENGUET
BAGUIO CITY
Name of Place
BAGUIO
Road Section No.
B-3
Kilometerage
290
295
300
305
310
315
320
Spot No.
Type of Disaster
C(N)-F
C(N)-S.F.
C(N)-D.F.
E-S.F. and E-D.F.
L.S/D.F/O.F
Terrain
MOUNTAINOUS
Geology
SANDSTONE TUFFBECCIA MUDSTONE

APPENDIX 5.5-1 24-HOUR RAINFALL AT SELECTED WEATHER STATIONS

APPENDIX 5.5-1 (1) 24-HOUR RAINFALL AT SELECTED WEATHER STATIONS (mm)
- 1980 -

Weather Station	T.S. BIRING								T. DITANG								
	3/20	21	22	23	24	25	26	27	5/10	11	12	13	14	15	16	17	18
Baguio	0.0	0.0	0.0	0.0	0	0	2.6	3.0	16.6	0.0	8.2	1.2	81.6	730.3	22.3	5.1	39.2
Dagupan	0.0	0.0	0.0	0.0	0.0	1.3	14.7	0.0	0.0	0.0	0.0	0	1.8	77.8	0.0	20.9	0.0
Ambulong	0.0	0.0	0.0	4.2	60.6	5.0	0.5	1.0	0.0	10.0	0.0	9.0	0.0	0.0	0.0	0.0	0.0
Lucena	0.0	0.0	0.5	44.5	138.7	40.9	0.0	0.5	0.0	0.5	0.0	4.1	0.0	0.0	0.0	0.0	18.1
Daet	0.0	0	6.1	34.0	316.9	2.3	17.7	1.8	0	0.0	11.7	0.5	0.0	0.0	0.0	0.0	0.0
Catarman	0	4.6	78.8	63.1	19.9	0	1.0	0.0	36.6	2.4	0	0.0	0.0	0.0	0.0	0.0	0.0
Catbalogan	2.8	3.6	9.1	303.3	7.1	5.6	0.5	0.0	0	3.1	0.0	0.0	0.0	0.0	0.0	0.0	35.1

Weather Station				T.S. GLORING					T.S. HUANING				T.D. ISANG				
	19	20	21	5/22	23	24	25	26	6/22	23	24	25	6/30	7/1	2		
Baguio	0.7	29.3	0.2	5.7	0.0	0.0	78.9	0.2	0	0.2	0.6	5.2	1.1	16.8	7.4		
Dagupan	1.3	8.6	0.0	0.0	0.0	0.0	85.0	0.0	0.0	0.0	0	3.3	0.0	26.6	4.4		
Ambulong	2.0	0	7.1	0.0	0.0	0.0	5.0	0.0	6.0	17.2	0	8.8	57.9	19.0	0.0		
Lucena	18.0	1.0	0.5	0.0	0.0	14.0	8.4	0.0	21.9	23.9	12.2	2.8	57.9	16.5	0.5		
Daet	0	1.8	0.0	0.0	0.0	138.0	1.8	0.5	6.1	57.1	0.0	0.0	6.1	2.3	0.0		
Catarman	0.0	4.2	0	0.0	14.2	27.0	0.0	0.0	16.0	20.2	4.0	9.8	28.0	0.4	0.0		
Catbalogan	0.0	0.0	0	0	1.8	8.4	0.0	0.0	113.9	7.4	5.1	3.1	19.6	0.0	0.0		

Weather Station	T.D. MARING		T. Nitang				T. Osang					T.D. PARING					
	7/16	17	7/19	20	21	22	7/23	24	25	26	27	8/15	16	17			
Baguio	6.0	0.4	50.8	153.7	165.3	0.0	T	35.0	536.3	22.9	0.0	2.6	7.0	5.4			
Dagupan	24.6	0.2	3.5	65.0	117.7	0.0	T	19.8	167.4	15.2	0.0	1.4	0.4	13.8			
Ambulong	91.2	0.8	41.6	38.0	20.0	0.0	0.6	59.6	122.2	0.0	0.0	34.0	10.4	3.4			
Lucena	36.3	17.0	7.1	9.4	15.0	T	0.5	2.0	39.3	1.0	3.0	24.7	2.0	0.5			
Daet	0.0	0.0	10.4	11.7	2.8	20.4	0.5	166.0	31.8	0.0	0.0	0	10.7	0.0			
Catarman	1.4	0	6.4	T	0.0	9.2	82.2	81.0	0.0	12.8	3.4	53.0	0.0	0.4			
Catbalogan	7.6	24.9	25.9	T	2.5	T	43.1	9.2	5.1	0.5	2.5	44.2	0	0			

APPENDIX 5.5-1 (1) (Cont'd.)

Weather Station	T.D. SENIANG						T.S. YONING			T. Aring							
	8/30	31	9/1	2	3	4	10/28	29	30	11/1	2	3	4	5	6	7	
Baguio	0	9.6	1.2	0	3.4	17.6	12.4	35.8	7.9	3.2	3.6	2.0	64.8	698.7	99.5	0.0	
Dagupan	0.0	2.0	14.3	5.8	0.0	1.6	7.0	25.4	0.8	16.8	1.0	0.0	24.2	103.0	0.0	0.0	
Ambulong	1.4	3.3	4.8	11.2	0	8.0	135.2	55.4	0.0	T	13.0	1.2	64.8	50.0	0.0	0.0	
Lucena	0	29.7	4.8	35.5	1.0	0.5	225.7	23.1	0.0	20.2	14.5	4.0	138.9	17.3	0.0	0.0	
Daet	0.0	15.0	26.2	26.2	0.5	17.6	170.3	3.8	0.0	0.8	15.7	74.0	129.4	0.0	0.0	1.0	
Catarman	2.0	31.8	3.4	61.2	31.4	8.2	108.2	0.0	0.0	0.0	21.0	108.0	23.2	0.0	0.0	0.0	
Catbalogan	44.7	1.5	9.9	21.4	0	0	76.2	1.3	0.0	7.1	75.3	72.6	6.3	T	0.0	0.0	

APPENDIX 5.5-1 (2) 24-HOUR RAINFALL AT SELECTED WEATHER STATIONS (mm)
- 1981 -

Weather Station	T.S. Daling				T.S. Elang				T. RUBING								
	6/28	29	30	7/1	2	7/3	4	5	9/15	16	17	18	19	20	21		
Baguio	0.2	0.0	8.1	1.5	0.0	3.6	110.2	41.4	5.5	0.0	28.4	35.1	181.4	228.0	4.4		
Dagupan	0.0	1.8	0.0	0.0	0.0	0.0	110.6	71.4	0.0	0.2	0.0	2.0	55.1	22.4	11.9		
Ambulong	48.6	0.0	26.8	14.0	0.0	18.8	82.2	0.0	0.0	0.0	2.5	0.0	8.6	165.6	0.0		
Lucena	0.0	0.0	55.5	19.8	0.0	22.8	66.0	0.5	23.5	10.7	18.5	21.5	10.6	4.5	1.0		
Daet	0.0	8.4	25.3	3.8	21.5	236.9	47.2	0.3	22.1	39.2	14.3	12.5	0.5	0.5	0.0		
Catarman	0.0	39.2	95.4	7.0	6.3	61.6	0.0	21.2	2.6	8.4	29.0	7.2	3.0	3.2	0.4		
Catbalogan	0.4	2.7	2.1	11.4	9.5	24.7	0.1	0.0	11.7	18.3	14.7	9.1	0.1	0.2	0.0		

Weather Station	T.D. SALING			T.S. UNSING			T. Yeyeng					T. Anding					
	9/24	25	26	10/12	13	14	11/17	18	19	20	21	11/22	23	24	25	26	27
Baguio	0.0	12.2	6.2	0.6	4.8	0.0	0.0	0.0	0.0	3.7	0.0	2.6	0.0	145.4	50.4	0.0	0.0
Dagupan	0.0	20.0	8.1	1.3	0.0	2.6	0.0	0.0	0.0	5.8	0.0	39.1	0.0	149.4	11.3	0.0	0.0
Ambulong	0.0	85.0	0.0	20.4	1.0	1.6	1.8	1.0	30.0	15.6	10.0	6.0	0.0	17.0	0.0	0.0	0.0
Lucena	8.1	107.5	0.0	13.3	22.3	18.3	16.2	2.0	46.2	3.0	1.5	10.6	5.1	100.6	0.0	0.0	2.5
Daet	6.0	62.8	0.0	6.8	40.1	19.0	5.6	10.3	29.5	11.4	1.3	5.6	130.5	134.0	0.0	0.0	0.0
Catarman	65.2	2.0	0.0	4.0	26.0	23.8	0.4	16.6	3.4	0.4	3.0	1.4	71.6	0.0	0.0	0.0	3.2
Catbalogan	48.4	0.1	0.2	1.4	28.9	9.0	0.0	14.4	1.8	0.0	7.0	10.2	16.6	0.0	0.0	0.0	28.0

Weather Station	T. DINANG					
	12/23	24	25	26	12/27	12/28
Baguio	0.0	0.0	0.0	0.0	0.0	0.0
Dagupan	0.0	0.0	0.0	0.2	0.0	0.0
Ambulong	4.0	1.2	7.2	64.0	0.0	0.0
Lucena	10.1	20.3	60.9	112.7	0.0	0.0
Daet	56.6	2.3	27.7	3.1	1.5	3.6
Catarman	4.6	0.6	133.0	0.0	0.0	3.0
Catbalogan	6.0	1.3	88.2	0.0	0.0	0.0

APPENDIX 5.5-1 (3) 24-HOUR RAINFALL AT SELECTED WEATHER STATIONS (mm)
- 1982 -

Weather Station	T. Bising								T. Klaring							
	3/22	23	24	25	26	27	28	29	5/15	16	17	18	19	20	21	22
Baguio	-	0	3.9	5.0	0	0	-	0	0	7.2	7.8	10.0	26.6	22.2	0	-
Dagupan	-	0	0	-	0	0	1.1	0	-	0	-	0	69.6	2.8	-	0
Ambulong	-	0	0	0	-	-	-	2.0	0	0	0	0	9.0	0	0	-
Lucena	-	16.5	0	0	2.5	7.8	0.5	3.0	2.0	4.0	-	0.5	12.4	0	2.0	6.1
Daet	0	11.3	0	0	20.1	9.9	6.1	5.4	11.4	10.0	0	85.8	63.2	0	0	0.5
Catarman	7.0	14.0	2.0	74.0	176.4	38.3	0	0	6.0	-	11.6	130.8	4.2	0	0	4.0
Catbalogan	5.0	4.2	5.3	40.8	92.2	25.2	0.6	18.2	8.4	33.0	61.4	99.6	1.6	0	0	3.4

Weather Station	T.S. DELING		T.S. Emang					T.D. Heling			T. ILIANG						
	7/2	3	7/12	13	14	15	16	7/21	22	23	7/26	27	28	29			
Baguio	164.4	116.0	3.7	-	10.2	49.9	10.4	1.9	18.9	6.0	17.5	49.4	237.3	111.6			
Dagupan	088.8	095.8	0	2.2	8.3	61.9	0.4	1.8	31.6	32.8	0.8	036.8	011.2	025.4		-	
Ambulong	47.0	0	1.5	1.0	23.6	61.1	0	3.8	29.6	-	10.8	7.6	24.2	11.6			
Lucena	.5	0	0	0	27.6	56.6	1.0	3.6	25.9	0	0	0	16.3	2.5			
Daet	04.3	0.0	-	11.7	306.7	15.7	-	9.4	15.2	10.0	0.0	0.0	06.1	01.3			
Catarman	3.4	0	0	13.6	45.8	-	0	12.3	4.0	17.6	0	0	1.8	0			
Catbalogan	0	0	-	56.8	74.4	0	0	1.0	25.4	55.0	3.4	0	0.2	0			

Weather Station	T. Loleng					T. Norming											
	8/5	6	7	8	9	8/19	20	21	22	23	24	25	26	27	28	29	30
Baguio	106.8	142.5	9.39	42.3	7.2	-	3.8	1.0	0	-	87.6	68.7	9.1	28.8	25.4	68.8	30.3
Dagupan	15.2	31.0	135.0	15.8	4.0	0	-	7.0	19.0	0	62.8	12.6	0	26.8	11.8	7.2	12.6
Ambulong	6.4	53.0	43.8	-	0	34.0	12.8	14.8	3.0	6.8	23.8	0	4.8	1.6	0	-	8.8
Lucena	3.6	4.3	0.5	-	0	51.3	13.2	3.3	34.8	72.1	4.3	-	0	8.6	0	0	5.1
Daet	-	8.4	2.1	0	99.0	32.3	99.0	11.6	13.7	3.1	2.8	0.5	0	1.3	0	15.7	0
Catarman	0.1	0	0	0.6	8.5	106.8	-	-	-	0	-	0	0	0	0	0	0
Catbalogan	0	0	0	-	0.4	8.8	0.6	-	0.4	9.2	0	0	2.0	0	0	0	0

APPENDIX 5.5-1 (3) (Cont'd.)

Weather Station	T. Norming					T.S. Ruping							T. Weling				
	31	9/1	2	3	4	9/5	6	7	8	9/9	10	11	10/11	12	13	14	15
Baguio	28.2	56.8	28.0	3.6	4.6	2.0	0.9	3.0	-	4.6	5.0	0	3.8	9.2	4.4	103.4	49.2
Dagupan	9.0	17.4	6.0	6.6	11.2	6.8	19.6	0.6	0.3	2.8	5.2	13.2	0	0	0	5.2	22.0
Ambulong	4.4	0.8	7.4	18.8	50.4	4.0	1.0	38.6	37.8	204.0	4.0	0	0	0	-	3.4	0
Lucena	-	-	-	5.3	3.0	2.3	0.5	5.6	114.2	201.0	4.1	0.5	2.0	13.7	2.3	0	6.1
Daet	0	0	3.3	0	8.9	8.6	2.1	74.4	48.6	21.1	0.5	0	16.0	78.3	35.6	0	0
Catarman	1.4	0	0	0	-	12.2	27.4	215.4	46.6	0	0	0	2.4	12.8	0	-	0
Catbalogan	0	2.0	0	0	26.6	34.0	30.8	133.6	51.4	2.2	0	0	6.2	12.7	4.4	0.4	-

Weather Station	T.Aning							T.S. Bidang					
	12/2	3	4	5	6	7	8	12/7	7	8	9	10	11
Baguio	5.8	0	0	0	-	0	1.8	0	1.8	-	-	0	0
Dagupan	0.4	0	0	0	0	0	0	0	0	0	0	0	0
Ambulong	0	0	0	-	0	-	8.4	-	8.4	0	0	0	0
Lucena	0	5.1	0.5	-	11.5	8.1	30.8	8.1	30.8	0	0	0	0
Daet	6.8	31.2	4.6	12.7	0.5	35.6	98.9	35.6	98.9	0	0	0	0
Catarman	17.4	6.5	0	2.6	8.6	36.6	24.0	36.6	24.0	22.6	0	-	-
Catbalogan	2.0	0	4.0	0.6	4.2	21.8	4.4	21.8	4.4	1.8	0	0	0

APPENDIX 5.5-1 (4) 24-HOUR RAINFALL AT SELECTED WEATHER STATIONS (mm)
- 1983 -

Weather Station	T. Auring					T. Bebeng					T. DIDING						
	7/7	8	9	10	11	7/12	13	14	15	16	8/7	8	9	10	11	12	13
Baguio	11.0	-	-	4.6	4.1	0	14.2	26.0	21.4	2.0	47.6	14.7	3.6	4.0	60.6	135.4	103.9
Dagupan	1.0	0	0	0.4	0	1.6	4.0	6.0	17.4	1.0	055.4	0	0	00.3	029.8	070.6	053.6
Ambulong	0	0.6	37.8	57.0	0	0	-	61.0	196.0	0	23.2	0	0	3.0	5.2	14.4	14.7
Lucena	-	-	40.4	74.2	-	-	3.8	254.0	116.3	2.0	25.4	5.8	1.0	0	.5	.5	1.0
Daet	8.4	0	57.9	1.8	0	19.6	15.2	70.9	6.9	0	0	0	02.8	19.3	0	00.5	0
Catarman	0	4.0	58.6	-	0	14.8	165.8	127.8	6.4	34.0	14.2	0	0	0	0.2	0	0
Catbalogan	0	24.0	120.9	0.1	0	0	113.6	109.8	20.2	1.6	14.4	0	5.4	2.1	4.1	0	0

Weather Station	T.S. Etang			T. Herming				T.S. Luding			T.D. Mameng			T.S. Pepang		
	8/13	14	15	9/3	4	5	6	9/27	9/28	29	9/29	30	10/1	10/10	11	12
Baguio	103.9	217.8	83.6	7.2	7.6	35.8	7.8	6.0	1.0	-	-	9.2	3.4	24.0	19.2	-
Dagupan	53.6	141.0	62.0	61.9	3.6	3.1	19.8	0.8	0	0	0	3.1	4.1	17.8	25.4	-
Ambulong	14.7	25.8	8.6	30.0	0	9.1	0	0	0	-	-	26.2	14.6	36.2	-	0
Lucena	1.0	-	.5	20.6	6.3	-	2.0	-	-	1.0	1.0	41.1	48.8	50.8	4.6	62.5
Daet	0	0	0	24.3	35.0	19.3	0	0	0	15.7	15.7	35.4	13.0	102.1	0	0
Catarman	0	0	0	0	13.2	0	0	0	0	81.8	81.8	42.6	16.2	5.6	-	7.4
Catbalogan	0	0	0	77.4	0.2	0	0	0	0	105.5	105.5	9.0	4.2	2.8	0	2.1

Weather Station	T.S. Sisang			T. Warling											T.S. Yayang		
	10/20	21	22	11/17	18	19	20	21	22	23	24	25	26	27	11/23	24	25
Baguio	18.6	28.6	-	0	-	0	0	0	0	0	5.0	1.0	-	0	0	5.0	1.0
Dagupan	12.4	8.8	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ambulong	7.0	24.0	0	0	3.8	0	0	0	0	0	0	0	0	-	0	0	0
Lucena	26.9	72.7	-	2.0	59.9	-	-	.5	-	.5	-	-	-	9.1	.5	-	-
Daet	31.2	6.4	0.5	23.9	14.5	9.9	49.8	221.8	15.5	1.8	1.3	0	8.4	8.7	1.8	1.3	0
Catarman	5.8	1.4	0	0	72.8	131.4	189.4	83.0	-	-	5.2	14.2	26.6	0	-	5.2	14.2
Catbalogan	3.6	-	-	0.8	51.9	155.3	217.9	15.8	0	-	3.4	44.2	0.2	0	-	3.4	44.2

APPENDIX 5.5-1 (5) 24-HOUR RAINFALL AT SELECTED WEATHER STATIONS (mm)
- 1984 -

Weather Station	T.S. ASIANG						T. BIRING			T.S. KONSING			T.D. EDENG				
	6/19	20	21	22	23	24	7/1	2	3	7/5	6	7	8/11	12	13		
Baguio	6.4	0.2	20.4	59.2	79.4	18.2	5.2	68.2	1.0	13.0	52.9	8.4	13.8	2.4	36.4		
Dagupan	044.6	001.2	065.4	027.4	030.4	020.3	19.0	0.0	0.0	42.2	4.8	7.8	016.2	003.8	057.1		
Ambulong	1.0	9.1	25.2	34.8	8.6	11.8	013.8	009.6	005.8	026.4	032.4	0					
Lucena																	
Daet	06.1	00.5	01.0	9999	06.1	02.3											
Catarman	0	0	0	19.8	13.0	0.0											
Catbalogan	0	2.2	0	10.4	16.6	0	0.6	0.2	0	17.5	7.6	3.0					

Weather Station	T. ISANG				T.S. MARING				T. NITANG					T.D. PARING			
	8/16	17	18	19	8/27	28	29	30	8/31	9/1	2	3	4	10/19	20		
Baguio	134.2	66.2	61.6	9.4	35.3	381.3	276.7	131.9	9.3	1.2	20.2	.5	.5	10.4	1.6		
Dagupan	129.8	028.0	012.0	000.8	008.0	232.2	127.4	079.2	020.4	0	016.6	000.4	000.4				
Ambulong																	
Lucena																	
Daet																	
Catarman										2.4	68.4	0	13.0				
Catbalogan										35.6	1.0	0	17.0				

APPENDIX 5.5-2 ROAD DISASTER OCCURRENCE AND 24-HOUR RAINFALL

SECTION / WEATHER STA.		LUCENA - CALAUAG				ALLEN - CALBAYOG				NAGUILIAN	
		LUCENA		DAET		CATARMAN		CATBALOGAN		BAGUIO	
Year	Name of Cyclone	Disaster Occured	No Disaster	Disaster Occured	No Disaster	Disaster Occured	No Disaster	Disaster Occured	No Disaster	Disaster Occured	No Disaster
1980	Ditang	-	18	-	12	-	37	-	35	730	-
	Gloring	-	14	-	138	-	27	-	8	-	79
	Huaning	-	24	-	57	-	20	-	114	-	5
	Maring	-	36	-	0	-	1	-	25	-	6
	Nitang	-	15	-	20	-	9	-	26	165	-
	Osang	-	39	-	166	-	82	-	43	536	-
	Paring	-	25	-	11	-	53	-	44	-	7
	Seniang	-	36	-	26	-	61	-	45	-	18
	Aring	139	-	129	-	-	108	-	75	699	-
1981	Daling	66	-	237	-	-	95	-	11	-	8
	Saling	-	107	-	63	-	65	-	48	-	12
	Unsing	-	20	-	22	-	40	-	29	-	5
	Yeyeng	-	46	-	30	-	17	-	14	-	4
	Anding	101	-	134	-	72	-	96	-	145	-
	Dinang	-	113	-	57	133	-	88	-	-	0
1982	Bising	-	17	-	20	-	176	-	92	-	5
	Klaring	-	12	-	86	-	131	-	100	-	27
	Deling	-	1	-	4	-	3	-	0	164	-
	Heling	-	26	-	15	-	18	-	55	-	19
	Iliang	-	16	-	6	-	2	-	3	237	-
	Norming	-	72	-	16	-	1	-	27	88	-
	Rupiang	201	-	74	-	-	215	-	134	-	3
	Weling	-	14	-	78	-	13	-	13	-	103
	Aning	-	31	-	100	-	37	-	22	-	6
	Bidang	-	31	-	99	-	37	-	22	-	2
1983	Auring	-	74	-	58	-	59	-	121	-	11
	Bebeng	254	-	71	-	166	-	114	-	-	26
	Diding	-	25	-	19	-	14	-	14	135	-
	Etang	-	1	-	0	-	0	-	0	218	-
	Herming	-	21	-	35	-	13	-	77	-	36
	Luding	-	1	-	16	-	82	-	106	-	6
	Mameng	-	49	-	35	-	82	-	106	-	9
	Pepang	-	63	-	102	-	7	-	3	-	24
	Sisang	-	73	-	31	-	6	-	4	-	29
	Warling	-	60	-	222	189	-	218	-	-	5
	Yayang	-	1	-	2	-	14	-	44	-	5
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max
		66	113	71	222	72	215	88	134	88	103

APPENDIX 5.7-1 FREQUENCY OF TROPICAL CYCLONE

NO. OF TROPICAL CYCLONES PASSED
THROUGH OR APPROACHED TO RESPECTIVE ZONES

Year	LUCENA - CALAUAG ZONE	
	Typhoon	T. Storm T. Depression
1965	Bining Miling	T.S. Ibiang
1966	Klaring Loleng Aning	T.S. Gading T.D. Heling T.S. Uding
1967	Welming	
1968	Toyang	
1970	Atang Sening Pitang Yoling	T.S. Heling T.S. Wening
1971	Herming Mameng Neneng Pepang Barang	T.S. Dadang
1972	Konsing Toyang	T.S. Nitang T.S. Osang T.D. Seniang
1973	Narsing	
1974	Bising Iliang Bidang	T.S. Yaning T.D. Kading
1975	Herming	T.S. Pepang T.S. Neneng T.D. Sisang
1976	Huaning	T.S. Aring
1977	Unding	T.S. Elang T.S. Luming
1978	Atang Weling Yaning Kading	T.D. Deling T.D. Tering T.D. Bidang T.D. Delang
1979	Bebeng Pepang Yayang	T.S. Karing T.D. Sisang T.S. Krising
1980	Aring	T.S. Biring T.S. Gloring T.D. Isang T.D. Maring T.D. Seniang T.S. Yoning
1981	Yeyeng Anding Dinang	T.S. Daling T.S. Elang T.S. Saling
1982	Aning	T.S. Emang T.D. Heling T.S. Ruping T.S. Bidang
1983	Auring Bebeng	T.D. Mameng T.S. Pepang T.S. Yayang
Total	39	41
Average per year	2.1	2.2

NO. OF TROPICAL CYCLONES PASSED
THROUGH OR APPROACHED TO RESPECTIVE ZONES

Year	ALLEN - CALBAYOG ZONE	
	Typhoon	T. Storm T. Depression
1965	Elang Miling Rubing	T.S. Daling
1966	Klaring Loleng Aning	T.S. Uding T.D. Yoling
1967	Welming	
1968	Reming Seniang	
1969		T.D. Kuring
1970	Atang Sening Yoling	T.S. Klaring T.S. Emang T.S. Uding T.S. Wening
1971	Herming Mameng Neneng Pepang Berang	T.S. Diding T.S. Etang T.D. Oniang
1972	Asiang Konsing Toyang	T.S. Nitang
1973		T.S. Openg
1974	Tering	T.S. Yaning T.D. Kading T.D. Delang
1975	Auring	T.D. Sisang
1976	Huaning	T.S. Aring
1977		T.D. Atring T.S. Elang T.D. Tasing T.S. Yeyeng
1978	Atang Weling Kading	T.D. Deling T.D. Subang T.D. Delang T.D. Garding
1979	Bebeng Pepang Yayang	T.S. Krising
1980		T.S. Biring T.S. Gloring T.S. Huaning T.D. Maring T.D. Seniang T.S. Yoning
1981	Anding Dinang	T.S. Elang T.D. Saling T.S. Unsing
1982	Bising Klaring Norming Aming	T.D. Heling T.S. Ruping T.S. Bidang
1983	Auring Bebeng Warling	T.D. Mameng T.S. Pepang T.S. Yayang
Total	38	42
Average per year	2.0	2.2

NO. OF TROPICAL CYCLONES PASSED
THROUGH OR APPROACHED TO RESPECTIVE ZONES

Year	NAGUILIAN ROAD	
	Typhoon	T. Storm T. Depression
1965	Miling Unding	
1966	Klaring Loleng	T.D. Heling T.S. Gading T.S. Titang T.S. Uding
1967	Karing Gening Rosing Trining Welming	T.D. Oniang T.S. Pepang
1968	Huaning Nitang Toyang	T.S. Gloring
1969	Elang	
1970	Pitang Sening Yoling	T.S. Emang T.S. Heling
1971	Luding Uring	T.D. Oniang T.S. Ading T.S. Krising T.S. Dadang
1972	Konsing Edeng Gloring	T.S. Nitang T.D. Seniang
1973	Luming Narsing	T.D. Atring T.S. Ibiang
1974	Bising Iliang Susang Tering Wening Aning Bidang	
1975	Herming	T.S. Neneng T.S. Pepang
1976	Didang Huaning	T.S. Paring
1977	Openg Unding	T.S. Elang T.S. Luming
1978	Kading Yaning	T.S. Miding T.D. Subang
1979	Mameng Yayang	T.D. Karing T.S. Pepang T.D. Sisang T.S. Krising
1980	Ditang Nitang Osang Aring	T.S. Gloring T.D. Isang T.D. Maring T.D. Paring T.S. Yoning
1981	Anding Rubing	T.S. Elang
1982	Norming Weling	T.S. Emang T.S. Ruping T.S. Bidang
1983	Bebeng Herming	T.S. Etang T.S. Luding T.S. Pepang T.S. Sisang
Total	49	41
Average per year	2.6	2.2

APPENDIX 5.7-2 CLASSIFICATION OF TYPHOON SCALE

CLASSIFICATION OF TYPHOON SCALE
LUCENA - CALAUAG ZONE

Year	T. Cyclone	Max. 24-Hour Rainfall (mm)		Damages (Million ₱)	Casualties Dead + Missing	Classification
1965	T. Bining	44	Catarman	-	-	S
	T. Miling	368	Baguio	₱ 20 M	46	L
1966	T. Klaring	287	Baguio	₱ 4 M	77	M
	T. Loleng	133	Legaspi	-	-	S
	T. Aning	264	Borongan	₱ 2 M	20	M
1967	T. Welming	227	Virac	₱ 8 M	13	M
1968	T. Toyang	273	Baler	Considerable	Undetermined	M
1970	T. Atang	204	Virac	₱ 6 M	-	M
	T. Sening	235	Catbalogan	₱ 460 M	768	M
	T. Pitang	138	Casiguran	₱ 9.0 M	95	S
	T. Yoling	205	Virac	₱ 116 M	611	M
1971	T. Herming	121	Legaspi	₱ 3.8 M	27	S
	T. Mameng	190	Borongan	₱ 7.5 M	1	M
	T. Neneng	139	Roxas	₱ 0.1 M	1	S
	T. Pepang	180	Catbalogan	Considerable	Considerable	M
	T. Barang	106	Virac	Considerable	Undetermined	S
1972	T. Konsing	237	Legaspi	₱ 100 M	131	M
	T. Toyang	234	Itbayat	₱ 5 M	9	M
1973	T. Narsing	312	Cabanatuan	₱ 204 M	97	L
1974	T. Bising	494	Virac	₱ 35 M	105	L
	T. Iliang	142	Baguio	₱ 39 M	67	S
	T. Bidang	301	Virac	₱ 43 M	1	L
1975	T. Herming	174	Baler	-	-	M
1976	T. Huaning	334	Baguio	₱ 28 M	16	L
1977	T. Unding	321	Daet	₱ 457 M	40	L
1978	T. Atang	222	Masbate	₱ 245 M	113	M
	T. Weling	276	Catarman	₱ 64 M	57	M
	T. Yaning	275	Manila	₱ 88 M	53	M
	T. Kading	304	Infanta	₱1,021 M	724	L
1979	T. Bebeng	291	Virac	₱ 267	93	M
		95	Daet			
	T. Pepang	161	Legaspi	₱ 72 M	10	M
		121	Romblon			
	T. Yayang	235	Virac	₱ 4.6 M	6	M

CLASSIFICATION OF TYPHOON SCALE
LUCENA - CALAUAG ZONE
(Cont'd.)

Year	T. Cyclone	Max. 24-Hour Rainfall (mm)	Damages (Million ₱)	Casualties Dead + Missing	Classification
1980	T. Aring	699 Baguio 129 Daet	₱1,355 M	128	L
1981	T. Yeyeng	68 Calapan	₱ 1.3 M	4	S
	T. Anding	287 Baler 226 Legaspi	₱ 576 M	375	M
	T. Dinang	179 Masbate	₱ 593 M	342	M
1982	T. Aning	121 Virac	₱ 109 M	-	S
1983	T. Auring	675 Tayabas 111 Calapan	₱ 1.7 M	-	L
	T. Bebeng	254 Tayabas 240 Legaspi	₱ 467 M	142	M

SUMMARY OF TYPHOON SCALE

Classification	Max. 24-Hour Rainfall (mm)	No. of Typhoon
Small (S)	Less than 150	9 (0.47)
Medium (M)	150 - 300	21 (1.11)
Large (L)	more than 300	9 (0.47)
T o t a l		39 (2.1)

CLASSIFICATION OF TYPHOON SCALE
ALLEN - CALBAYOG ZONE

Year	T. Cyclone	Max. 24-Hour Rainfall (mm)		Damages (Million ₱)	Casualties Dead + Missing	Classification
1965	T. Elang	85	Virac	-	-	S
	T. Miling	368	Baguio	₱ 20 M	46	L
	T. Rubing	23	Manila	-	-	S
1966	T. Klaring	287	Baguio	₱ 4 M	77	M
	T. Loleng	133	Legaspi	-	-	S
	T. Aning	264	Borongan	₱ 2 M	20	M
1967	T. Welming	227	Virac	₱ 8 M	13	M
1968	T. Reming	565	Surigao	₱ 39 M	45	L
	T. Seniang	378	Borongan	₱ 55 M	365	L
1970	T. Atang	204	Virac	₱ 6 M	-	M
	T. Sening	235	Catbalogan	₱460 M	768	M
	T. Yoling	205	Virac	₱116 M	611	M
1971	T. Herming	121	Legaspi	₱3.8 M	27	S
	T. Mameng	190	Borongan	₱7.5 M	1	M
	T. Neneng	139	Rixas	₱0.1 M	1	S
	T. Pepang	180	Catbalogan	Considerable	Considerable	M
	T. Barang	106	Virac	"	"	S
1972	T. Asiang	189	Roxas	₱145 M	209	M
	T. Konsing	237	Legaspi	₱100 M	131	M
	T. Toyang	234	Itbayat	₱ 5 M	9	M
1974	T. Tering	186	Baguio	₱ 68 M	13	M
1975	T. Auring	102	Baler	₱16.2 M	47	S
1976	T. Huaning	334	Baguio	₱ 28 M	16	L
1978	T. Atang	222	Masbate	₱245 M	113	M
	T. Weling	276	Catarman	₱ 64 M	57	M
	T. Kading	304	Infanta	₱1,021 M	724	L
1979	T. Bebeng	291	Romblon	₱267 M	93	M
		95	Daet			
	T. Pepang	161	Legaspi	₱ 72 M	10	M
		121	Romblon			
	T. Yayang	235	Virac	₱4.6 M	6	M
1981	T. Anding	287	Baler	₱576 M	375	M
		226	Legaspi			
	T. Dinang	179	Masbate	₱593 M	342	M

CLASSIFICATION OF TYPHOON SCALE
ALLEN - CALBAYOG ZONE
(Cont'd.)

Year	T. Cyclone	Max. 24-Hour Rainfall (mm)		Damages (Million ₱)	Casualties Dead + Missing	Classification
1982	T. Bising	141	Cebu	₱587 M	203	M
		176	Catarman			
	T. Klaring	131	Catarman	?	?	S
	T. Norming	147	San Jose Mindoro	₱ 82 M	52	S
	T. Aning	121	Virac	₱109 M	-	S
1983	T. Auring	675	Tayabas	₱1.7 M	-	L
		111	Calapan			
	T. Bebeng	254	Tayabas	₱467 M	142	M
		240	Legaspi			
	T. Warling	222	Daet	₱522 M	154	M
		175	Legaspi			

SUMMARY OF TYPHOON SCALE

Classification	Max. 24-Hour Rainfall (mm)	No. of Typhoon
Small (S)	Less than 150	10 (0.53)
Medium (M)	150 - 300	22 (1.16)
Large (L)	more than 300	6 (0.31)
T o t a l		38 (2.0)

CLASSIFICATION OF TYPHOON SCALE
NAGUILIAN ROAD ZONE

Year	Typhoon	Max. 24-Hour Rainfall (mm)	Damages (Million P)	Casualties Dead + Missing	Classification
1965	Miling	368 Baguio	20	46	M
	Unding	212 Aparri	-	0	M
1966	Klaring	286 Baguio	4	77	M
	Loleng	133 Legaspi		0	S
1967	Karing	157 Tuguegarao	-	3	S
	Gening	510 Laoag	1	8	L
	Rosing	266 Baguio	-	0	M
	Trining	979 Baguio	17	244	Super-L
	Welming	227 Virac	8	13	M
1968	Huaning	364 Baguio	3	0	M
	Nitang	650 Baguio	2	2	Super-L
	Toyang	273 Baler	-	0	M
1969	Elang	512 Baguio	5	20	L
1970	Pitang	138 Casiguran	9	95	S
	Sening	235 Catbalogan	460	768	M
	Yoling	205 Virac	116	611	M
1971	Luding	207 Baguio	-	5	M
	Uring	145 Baguio	-	0	S
1972	Konsing	237 Legaspi	100	131	M
	Edeng	131 Baguio	-	214	S
	Gloring	480 Baguio		-	L
1973	Luming	380 Baguio	39	1	M
	Narsing	311 Cabanatuan	204	162	M
1974	Bising	494 Virac	34	105	L
	Iliang	142 Baguio	39	67	S
	Susang	781 Baguio	55	29	Super-L
	Tering	228 Baguio	68	13	M
	Wening	679 Baguio	126	23	Super-L
	Aning	410 Baguio	29	3	L
	Bidang	301 Virac	42	1	M
1975	Herming	174 Baler	-	0	S
1976	Didang	605 Baguio	625	347	Super-L
	Huaning	334 Baguio	28	16	M
1977	Openg	359 Baguio	21	65	M
	Unding	321 Daet	457	40	M

CLASSIFICATION OF TYPHOON SCALE
NAGUILIAN ROAD ZONE
(Cont'd.)

Year	Typhoon	Max. 24-Hour Rainfall (mm)	Damages (Million ₱)	Casualties Dead + Missing	Classification
1978	Kading	304 Infanta	1,000	724	M
	Yaning	275 Manila	88	53	M
1979	Mameng	398 Iba	48	27	M
	Yayang	235 Virac	5	6	M
1980	Ditang	730 Baguio	2	0	Super-L
	Nitang	165 Baguio	-	-	S
	Osang	536 Baguio	101	91	L
	Aring	699 Baguio	1,300	128	Super-L
1981	Rubing	467 Calayan	106	5	L
	Anding	287 Baler	576	375	M
1982	Norming	147 San Jose	82	52	S
	Weling	123 Baguio	625	126	S
1983	Bebeng	254 Tayabas	467	142	M
	Herming	229 Calayan	9	-	M

SUMMARY OF TYPHOON SCALE

Classification	Max. 24-Hour Rainfall (mm)	No. of Typhoon
Small (S)	less than 200	10 (0.53)
Medium (M)	200 - 400	25 (1.32)
Large (L)	400 - 600	7 (0.37)
Super-large (Super-L)	more than 600	7 (0.37)
T o t a l		49 (2.6)

APPENCICES FOR CHAPTER 6

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APPENDIX 6.3-1 LANDSLIDE ANALYSIS

APPENDIX 6.3-1 LANDSLIDE ANALYSIS

It was observed that landslide is likely to occur at Spot No. IVA-20 in the Lucena - Calauag Section.

At first, to examine the stability of the slope, landslide analysis was made assuming the slide are of 60 meters and 80 meters of radius. The result of computation shows;

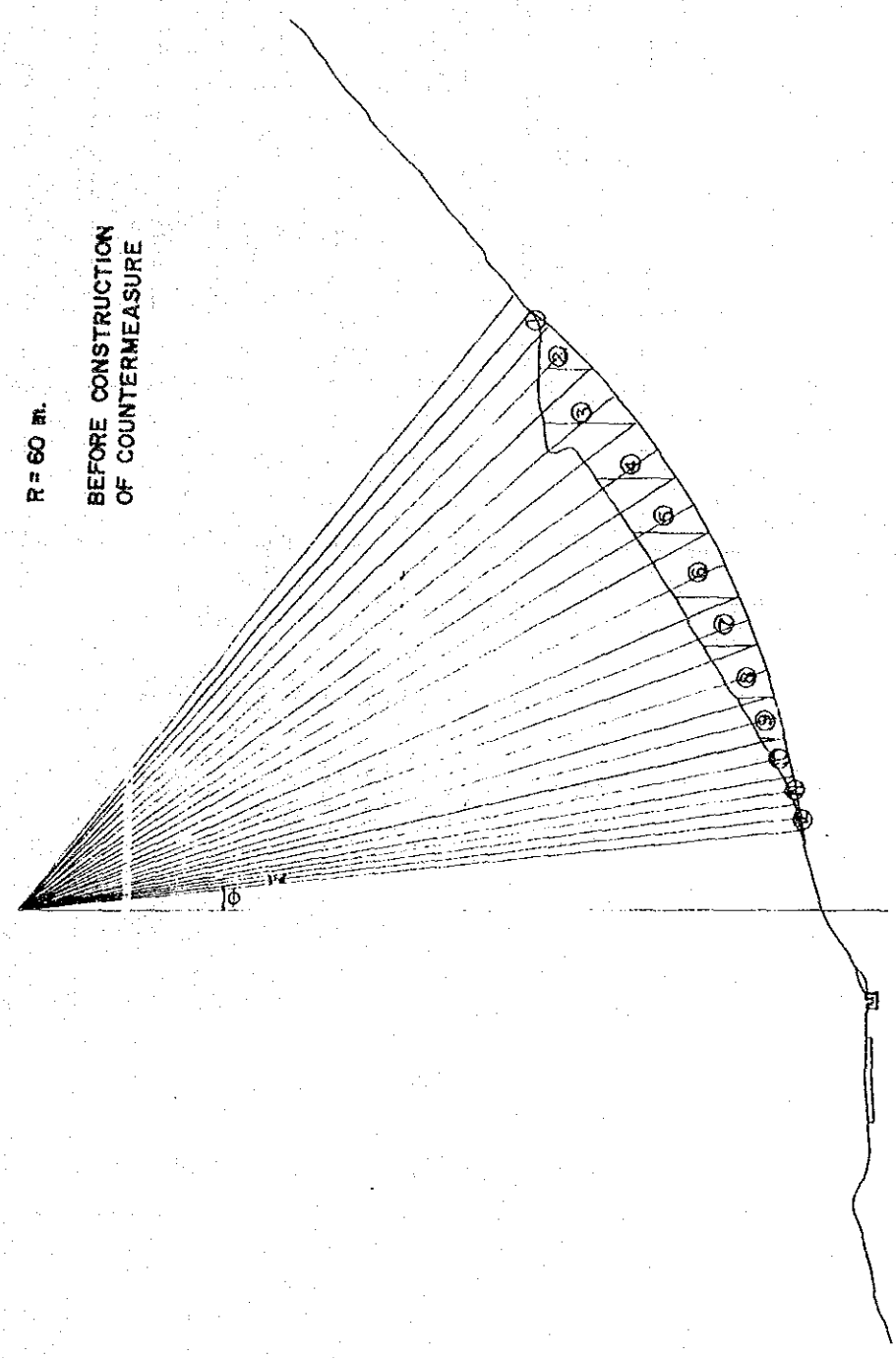
Radius = 60 m - - - - - Safety Factor = 1.071

Radius = 80 m - - - - - Safety Factor = 1.011

It means that landslide may occur with 80 meters of radius. Thus, earth removal work was proposed as countermeasures. The result of analysis in case of earth removal indicates;

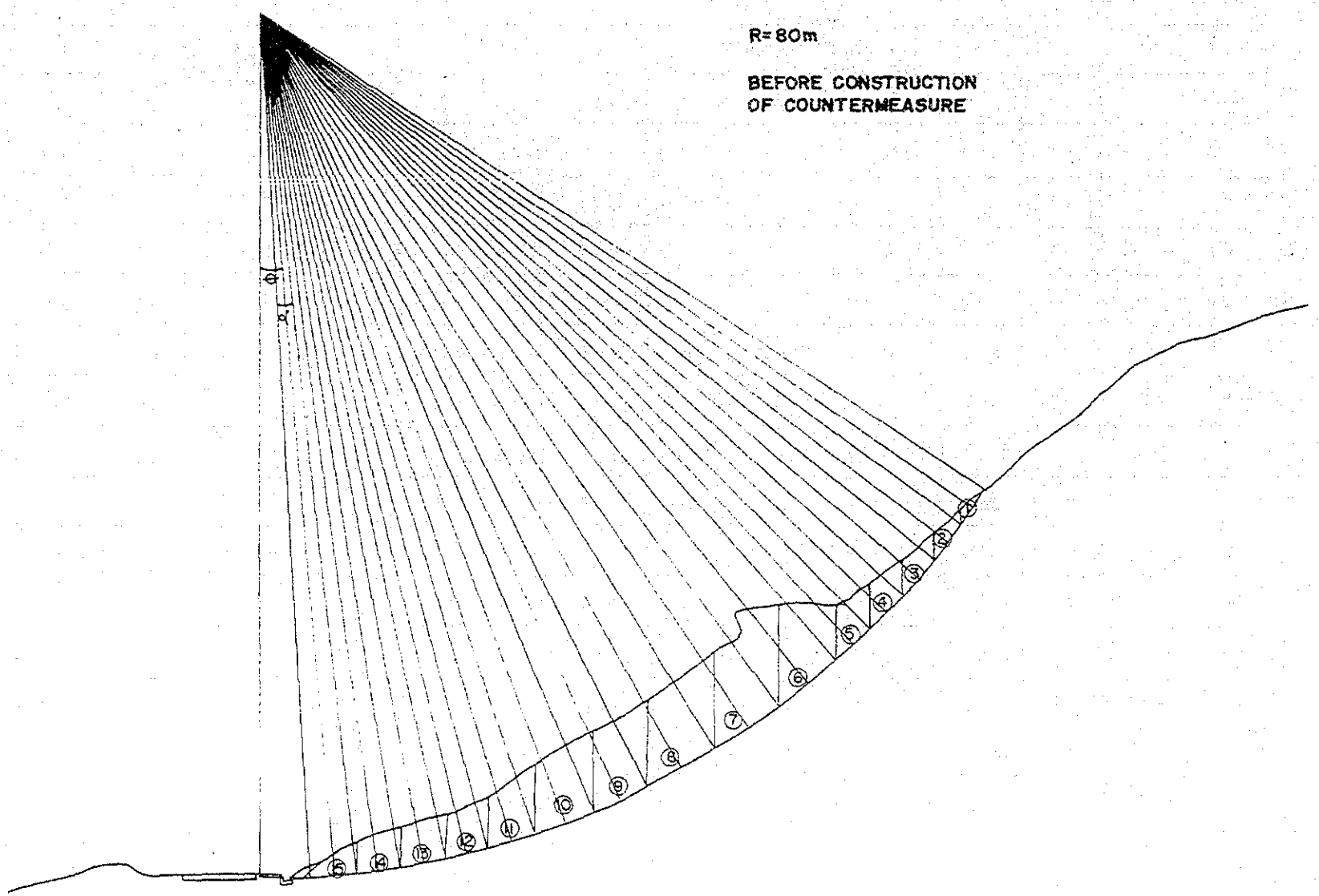
Radius = 80 m - - - - - Safety Factor = 1.375

It is assumed that landslide may not occur when earth removal will be applied.


R = 60 m.
BEFORE CONSTRUCTION
OF COUNTERMEASURE
φ

R = 60 m γ = 1.8 t/m^3 ϕ = 18° C = 1.5 t/m^2 (BEFORE COUNTERMEASURE)

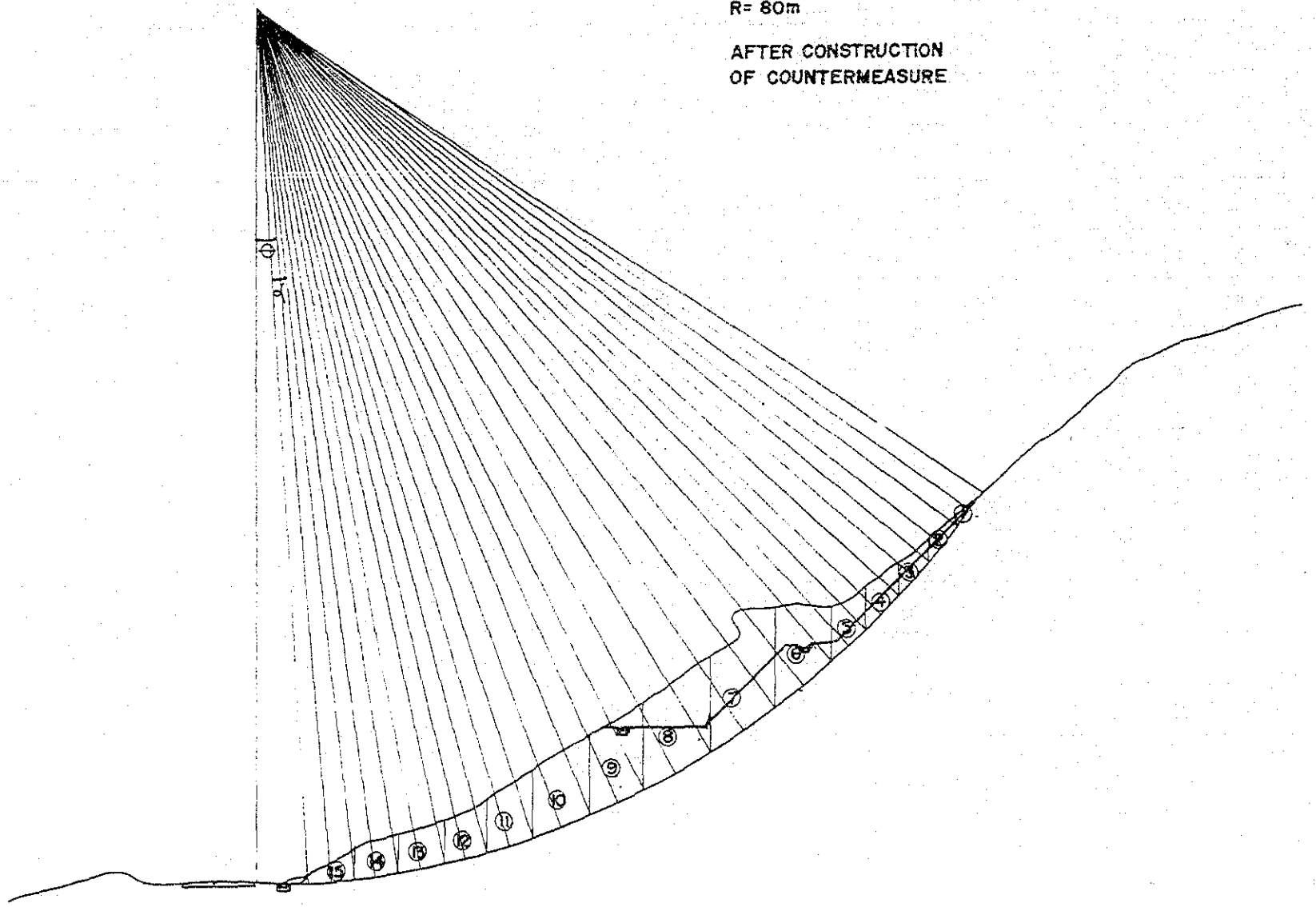
Slice No.	(1) Area of Trapezium A (m^2)	(2) Unit Weight of Soil (t/m^3)	(3) Weight of Slices W = γ . A (t/m)	(4) θ (degrees)	(5) cos θ	(6) sin θ	(7) W cos θ	(8) tan ϕ	(9) W·cosθ·tanϕ	(10) W sin θ	(11) α	(12) $\ell = \frac{\alpha}{360°} 2\pi r$	(13) C.ℓ (t/m)
1	$\frac{1}{2}$ x (2.3 x 0.9) = 1.04	1.8	1.87	49.5	.6494	.7604	1.214	.3249	0.394	1.422	3.0	3.14	4.710
2	$\frac{0.9 + 4.0}{2}$ x 3.2 = 7.84	1.8	14.11	46.0	.6947	.7193	9.802	.3249	3.185	10.149	4.0	4.19	6.285
3	$\frac{4.0 + 7.3}{2}$ x 4.0 = 22.60	1.8	40.68	41.5	.7490	.6626	30.469	.3249	9.899	26.954	5.0	5.24	7.860
4	$\frac{7.3 + 6.4}{2}$ x 4.0 = 27.40	1.8	49.32	36.5	.8039	.5948	39.648	.3249	12.882	29.336	5.0	5.24	7.860
5	$\frac{6.4 + 6.2}{2}$ x 4.0 = 25.20	1.8	45.36	31.5	.8526	.5225	38.674	.3249	12.565	23.701	5.0	5.24	7.860
6	$\frac{6.2 + 5.3}{2}$ x 5.0 = 28.75	1.8	51.75	26.5	.8949	.4462	46.311	.3249	15.046	23.091	5.0	5.24	7.860
7	$\frac{5.3 + 4.5}{2}$ x 3.8 = 18.62	1.8	33.52	22.0	.9272	.3746	31.079	.3249	10.098	12.556	4.0	4.19	6.285
8	$\frac{4.5 + 3.3}{2}$ x 3.8 = 14.82	1.8	26.68	18.0	.9511	.3090	25.375	.3249	8.244	8.244	4.0	4.19	6.285
9	$\frac{3.3 + 2.2}{2}$ x 3.0 = 8.25	1.8	14.84	14.5	.9681	.2504	14.376	.3249	4.671	3.718	3.0	3.14	4.710
10	$\frac{2.2 + 1.0}{2}$ x 2.8 = 4.48	1.8	8.06	11.5	.9799	.1994	7.898	.3249	2.566	1.607	3.0	3.14	4.710
11	$\frac{1.0 + 0.5}{2}$ x 2.0 = 1.5	1.8	2.70	9.0	.9877	.1564	2.667	.3249	.866	0.422	2.0	2.09	3.135
12	$\frac{1}{2}$ x (2.0 x 0.5) = .5	1.8	0.90	7.0	.9925	.1219	0.893	.3249	.290	0.110	2.0	2.09	3.135
13													
14													
15													
	$F_s = \frac{70.695 + 80.706}{141.31} = 1.071$								80.706	141.31			70.695


R=80m
BEFORE CONSTRUCTION
OF COUNTERMEASURE
φ
α
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

R = 80 m γ = 1.8 t/m^3 ϕ = 18° c = 1.5 t/m^2 (BEFORE COUNTERMEASURE)

Slice No.	(1) Area of Trapezium A (m^2)	(2) Unit Weight of Soil (t/m^3)	(3) Weight of Slices W = γ . A (t/m)	(4) θ (degrees)	(5) cos θ	(6) sin θ	(7) W cos θ	(8) tan ϕ	(9) W·cosθ·tan ϕ	(10) W sin θ	(11) α	(12) $l = \frac{\alpha}{360°} 2\pi r$	(13) C.ℓ (t/m)
1	$\frac{1}{2}$ x (1.2 x 3.0) = 1.80	1.8	3.24	55	0.5736	0.8192	1.858	.3249	0.604	2.554	3.0	4.19	6.285
2	$\frac{1.2 + 2.4}{2}$ x 3.0 = 5.40	1.8	9.72	52	0.6156	0.7880	5.984	.3249	1.944	7.659	3.0	4.19	6.285
3	$\frac{2.4 + 3.2}{2}$ x 3.0 = 8.40	1.8	15.12	49	0.6560	0.7547	9.919	.3249	3.222	11.411	3.0	4.19	6.285
4	$\frac{3.2 + 4.0}{2}$ x 3.0 = 10.80	1.8	19.44	46	0.6946	0.7193	13.503	.3249	4.387	13.983	3.0	4.19	6.285
5	$\frac{4.0 + 5.0}{2}$ x 3.0 = 13.50	1.8	24.30	43	0.7314	0.6820	17.773	.3249	5.774	16.573	3.0	4.19	6.285
6	$\frac{5.0 + 9.3}{2}$ x 5.5 = 39.32	1.8	70.78	39	0.7771	0.6293	55.003	.3249	17.871	44.542	5.0	6.98	10.470
7	$\frac{9.3 + 8.8}{2}$ x 6.0 = 54.30	1.8	97.74	34	0.8292	0.5592	81.026	.3249	26.325	54.556	5.0	6.98	10.470
8	$\frac{8.8 + 8.0}{2}$ x 6.0 = 50.40	1.8	90.72	29	0.8746	0.4848	79.344	.3249	25.779	43.981	5.0	6.98	10.470
9	$\frac{8.0 + 7.4}{2}$ x 5.0 = 38.50	1.8	69.30	24.5	0.9100	0.4147	63.063	.3249	20.489	28.738	4.0	5.58	8.370
10	$\frac{7.4 + 6.2}{2}$ x 5.0 = 34.00	1.8	61.20	20.5	0.9367	0.3502	57.326	.3249	18.625	21.432	4.0	5.58	8.370
11	$\frac{6.2 + 4.7}{2}$ x 4.5 = 24.52	1.8	44.15	17	0.9563	0.2934	42.221	.3249	13.717	12.954	3.0	4.19	6.285
12	$\frac{4.7 + 3.8}{2}$ x 3.0 = 12.75	1.8	22.95	14	0.9703	0.2419	22.268	.3249	7.235	5.552	3.0	4.19	6.285
13	$\frac{3.8 + 3.4}{2}$ x 4.0 = 14.40	1.8	25.96	11	0.9816	0.1908	25.482	.3249	8.279	4.953	3.0	4.19	6.285
14	$\frac{3.4 + 2.8}{2}$ x 4.0 = 12.40	1.8	22.32	8	0.9903	0.1392	22.103	.3249	7.181	3.107	3.0	4.19	6.285
15	$\frac{1}{2}$ x (2.8 x 4.5) = 6.30	1.8	11.34	5	0.9962	0.0872	11.297	.3249	3.670	.989	3.0	4.19	6.285
									165.102	273.184			111.050

$$F_s = \frac{111.050 + 165.102}{273.184} = 1.011$$


R= 80m
AFTER CONSTRUCTION
OF COUNTERMEASURE

R = 80 m γ = 1.8 t/m^3 ϕ = 18° C = 1.5 t/m^2 (AFTER COUNTERMEASURE)

Slice No.	(1) Area of Trapezium A (m^2)	(2) Unit Weight of Soil (t/m^3)	(3) Weight of Slices W = γ . A (t/m)	(4) θ (degrees)	(5) cos θ	(6) sin θ	(7) W cos θ	(8) tan ϕ	(9) W·cosθ·tanϕ	(10) W sin θ	(11) α	(12) $l = \frac{\alpha}{360°} 2\pi r$	(13) C.l (t/m)
1	$\frac{1}{2}$ x (0.6 x 3.0) = 0.90	1.8	1.62	55	0.5736	0.8192	0.929	.3249	0.302	1.327	3.0	4.19	6.285
2	$\frac{0.6 + 1.2}{2}$ x 3.0 = 2.70	1.8	4.86	52	0.6156	0.7880	2.992	.3249	0.972	3.830	3.0	4.19	6.285
3	$\frac{1.2 + 1.6}{2}$ x 3.0 = 4.20	1.8	7.56	49	0.6560	0.7547	4.959	.3249	1.611	5.706	3.0	4.19	6.285
4	$\frac{1.6 + 1.6}{2}$ x 3.0 = 4.80	1.8	8.64	46	0.6946	0.7193	6.001	.3249	1.950	6.215	3.0	4.19	6.285
5	$\frac{1.6 + 2.0}{2}$ x 3.0 = 5.40	1.8	9.72	43	0.7314	0.6820	7.109	.3249	2.310	6.629	3.0	4.19	6.285
6	$\frac{2.0 + 5.0}{2}$ x 5.5 = 19.25	1.8	34.65	39	0.7771	0.6293	26.926	.3249	8.748	21.805	5.0	6.98	10.470
7	$\frac{5.0 + 2.8}{2}$ x 6.0 = 23.40	1.8	42.12	34	0.8292	0.5592	34.926	.3249	11.347	23.554	5.0	6.98	10.470
8	$\frac{2.8 + 6.0}{2}$ x 6.0 = 26.40	1.8	47.52	29	0.8746	0.4848	41.561	.3249	13.503	23.038	5.0	6.98	10.470
9	$\frac{6.0 + 7.4}{2}$ x 5.0 = 33.50	1.8	60.30	24.5	0.9100	0.4147	54.873	.3249	17.828	25.006	4.0	5.58	8.370
10	$\frac{7.4 + 6.2}{2}$ x 5.0 = 34.00	1.8	61.20	20.5	0.9367	0.3502	57.326	.3249	18.625	21.432	4.0	5.58	8.370
11	$\frac{6.2 + 4.7}{2}$ x 4.5 = 24.52	1.8	44.15	17	0.9563	0.2934	42.221	.3249	13.717	12.954	3.0	4.19	6.285
12	$\frac{4.7 + 3.8}{2}$ x 3.0 = 12.75	1.8	22.95	14	0.9703	0.2419	22.268	.3249	7.235	5.552	3.0	4.19	6.285
13	$\frac{3.8 + 3.4}{2}$ x 4.0 = 14.40	1.8	25.96	11	0.9816	0.1908	25.482	.3249	8.279	4.953	3.0	4.19	6.285
14	$\frac{3.4 + 2.8}{2}$ x 4.0 = 12.40	1.8	22.32	8	0.9903	0.1392	22.103	.3249	7.181	3.107	3.0	4.19	6.285
15	$\frac{1}{2}$ x (2.8 x 4.5) = 6.30	1.8	11.34	5	0.9962	0.0872	11.297	.3249	3.670	.989	3.0	4.19	6.285
									117.278	166.097			111.050

$$F_s = \frac{111.050 + 117.278}{166.097} = 1.375$$

APPENDIX 6.4-1 COMPARATIVE STUDY OF RE-ALIGNMENT METHOD WITH THE COUNTERMEASURE

APPENDIX 6.4-1 COMPARATIVE STUDY OF RE-ALIGNMENT METHOD WITH THE COUNTERMEASURE

In general, re-alignment method with catch wall is economical may as avoiding disaster measure, especially where terrain is flat and there is wide space enough to construct catch wall and provide deposite space for fallen materials.

In this Study, re-alignment method was adopted at 8 spots. For 2 spots, detailed comparative studies were carried out to compare construction cost of re-alignment with alternative slope protection works, as reported in this Appendix. While, for 6 spots, rough comparative cost analysis were made.

2 Spots for Detailed Comparative Analysis
(Reported in this Appendix)

- IV-A-15 in the Lucena - Calauag Section
- VIII-27 in the Allen - Calbayog Section

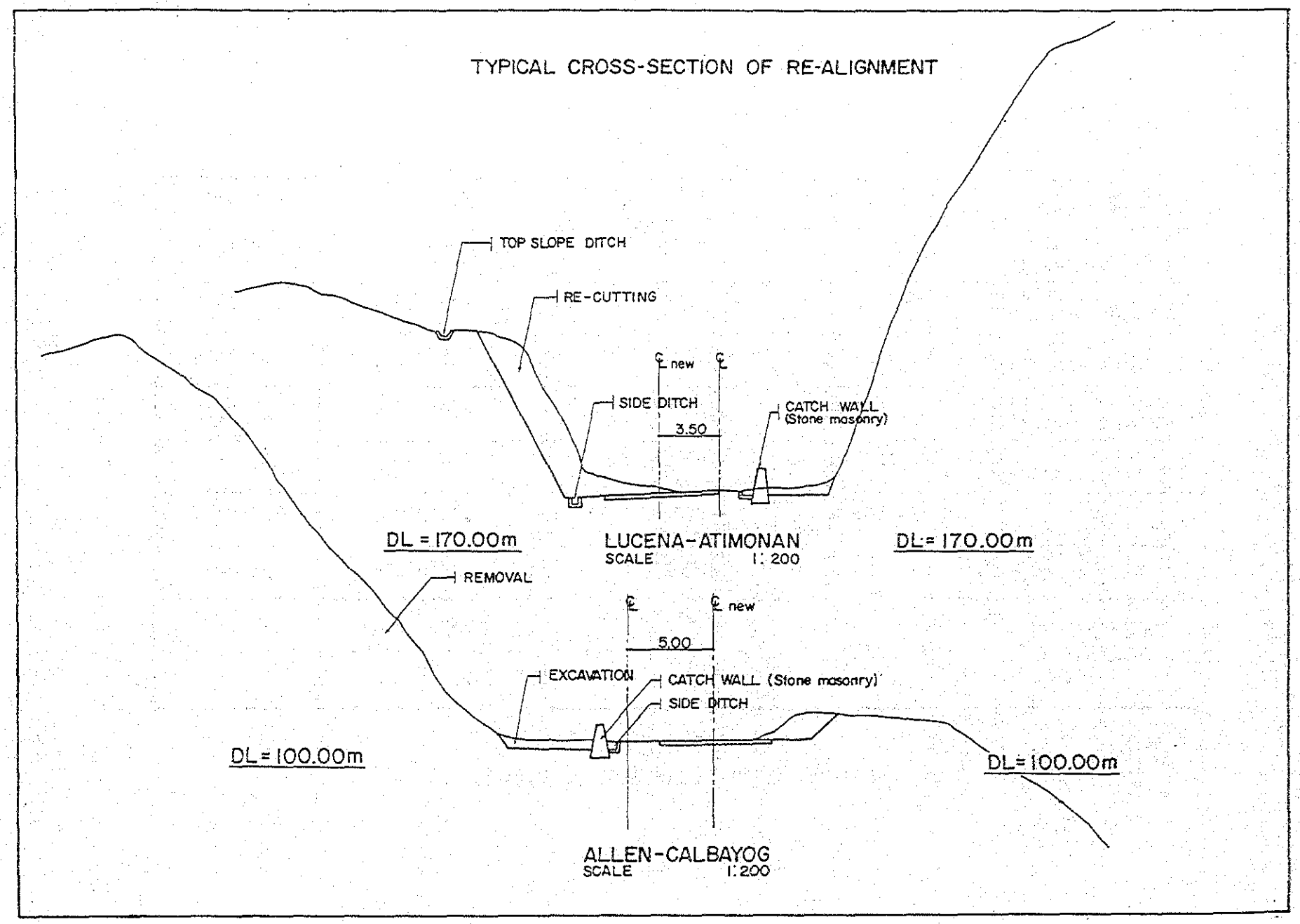
6 Spots for Rough Comparative Cost Analysis

- IV-A-17 in the Lucena - Calauag Section
- IV-A-18 "
- VIII-28 in the Allen - Calbayog Section
- VIII-29 "
- VIII-32 "
- VIII-37 "

SUMMARY OF COMPARATIVE COST ANALYSIS

UNIT: PESOS

SPOT NO.	CONSTRUCTION COST		DIFFERENCE COST	TYPES OF ALTERNATIVE COUNTERMEASURE
	RE-ALIGNMENT	ALTERNATIVE COUNTERMEASURE		
IV-A-15	4,260,776	8,355,841	4,095,065	Concrete Spraying t = 15 cm.
IV-A-17	2,005,774	6,504,405	4,498,631	Concrete Spraying t = 15 cm.
IV-A-18	9,556,938	13,727,244	4,170,306	Concrete Spraying t = 15 cm.
VIII-27	3,108,079	32,173,077	29,064,998	Sprayed concrete crib with conc.wall
VIII-28	1,606,075	7,381,027	5,774,952	Concrete spraying t = 10 cm.
VIII-29	1,542,444	9,326,440	7,783,996	Concrete spraying t = 10 cm.
VIII-32	720,529	11,400,757	10,680,228	Concrete spraying t = 15 cm.
VIII-37	1,722,925	12,462,345	10,739,420	Sprayed concrete crib with conc.wall


TYPICAL CROSS-SECTION OF RE-ALIGNMENT
TOP SLOPE DITCH
RE-CUTTING
℄ new
℄
SIDE DITCH
3.50
CATCH WALL (Stone masonry)
DL = 170.00m
LUCENA-ATIMONAN
SCALE 1: 200
DL= 170.00m
REMOVAL
℄
℄ new
5.00
EXCAVATION
CATCH WALL (Stone masonry)
SIDE DITCH
DL= 100.00m
DL= 100.00m
ALLEN-CALBAYOG
SCALE 1:200

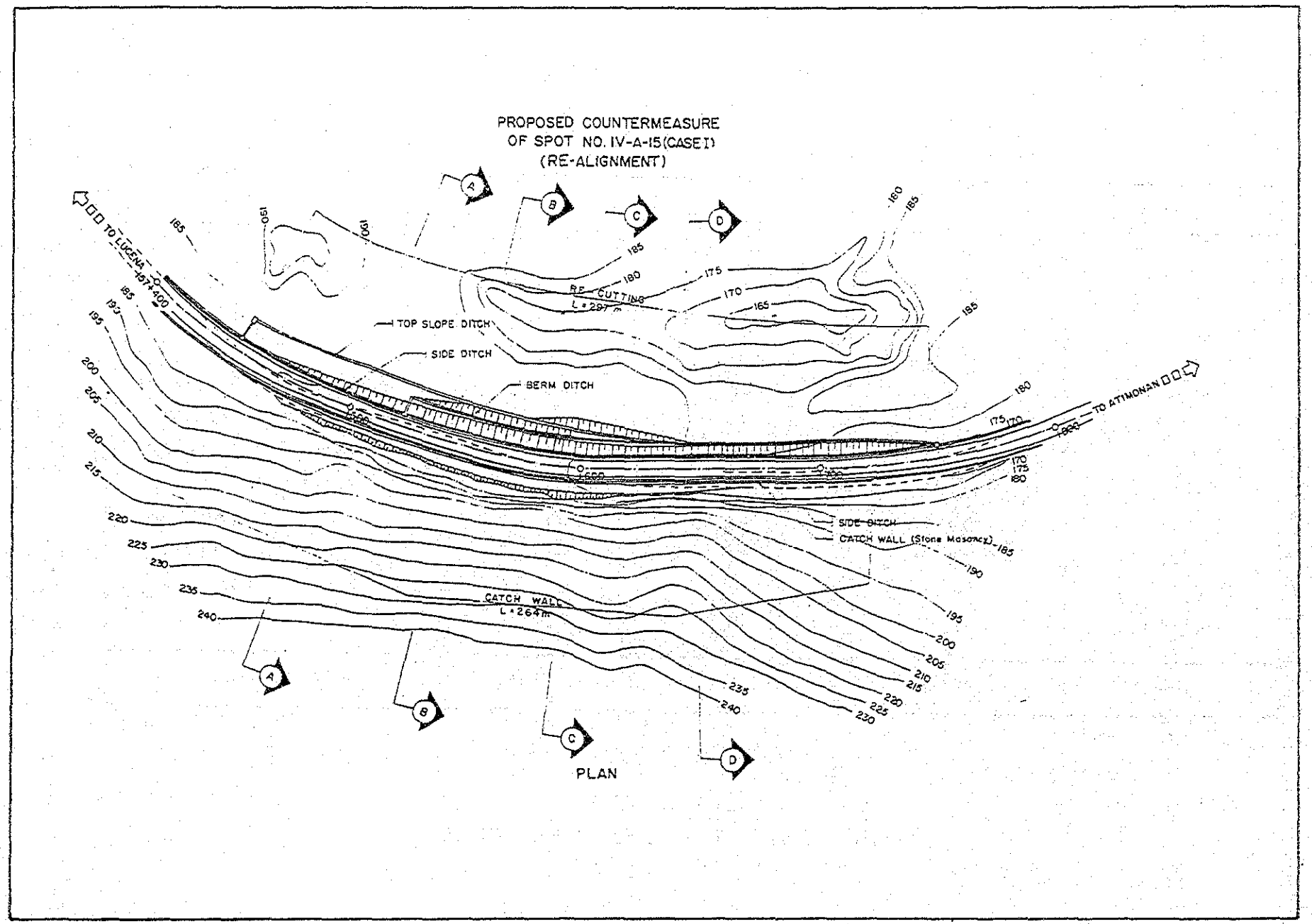
ESTIMATED COST OF PROPOSED COUNTERMEASURE
(RE-ALIGNMENT)

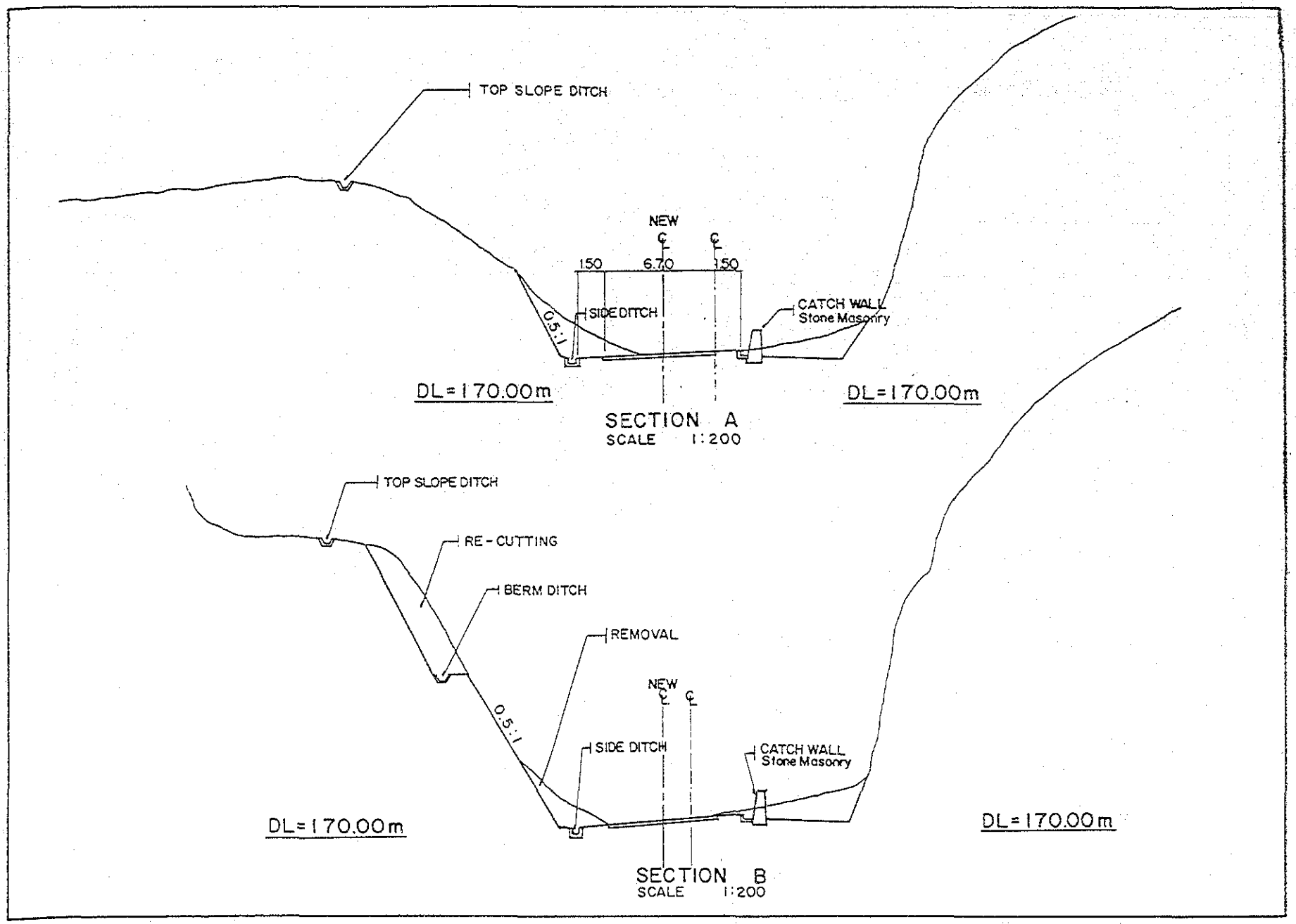
LOCATION: LUCENA - CALAUAG SECTION

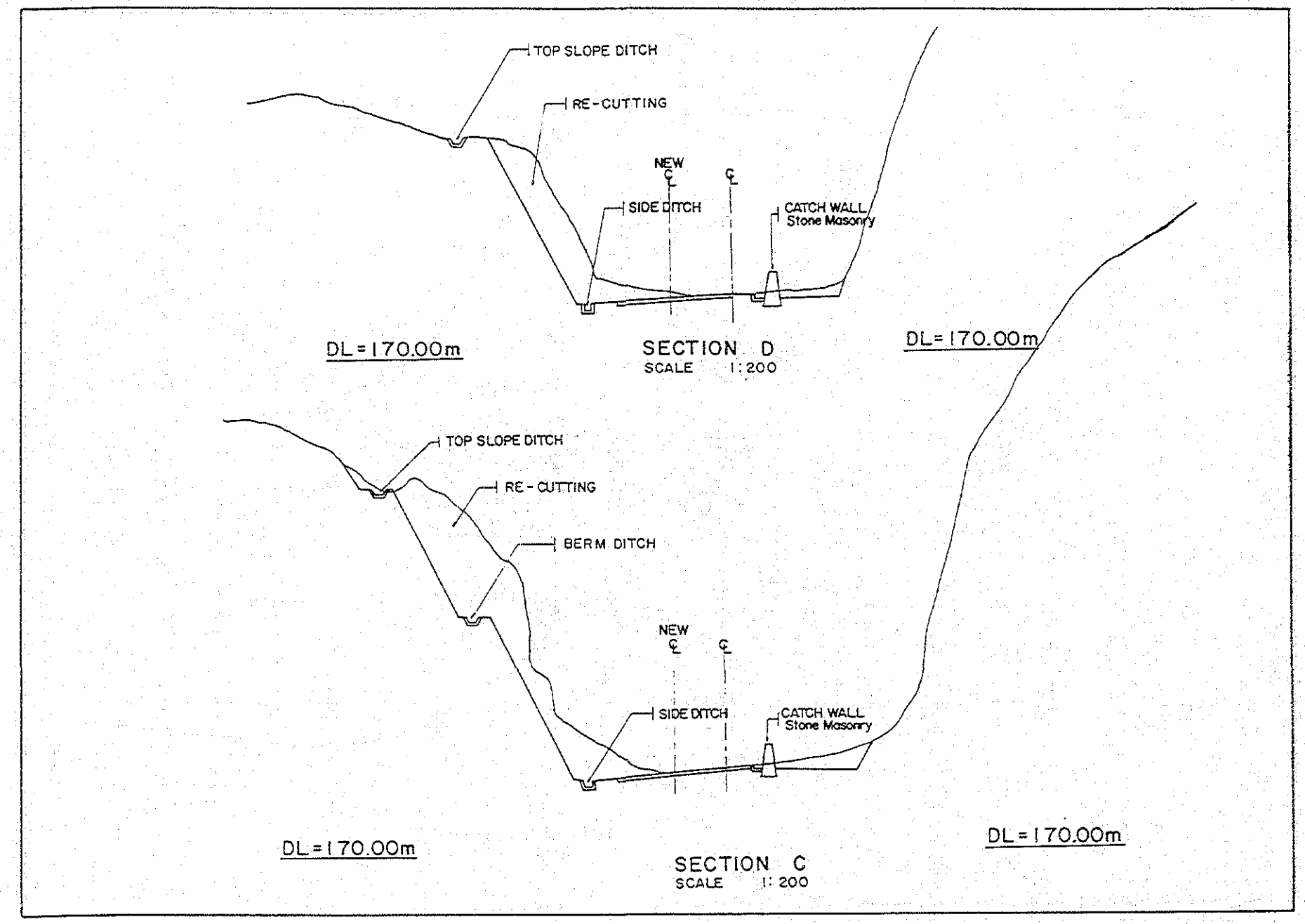
SPOT NO. IV-A-15

UNIT PESOS

ITEM OF WORK	U N I T	QUANTITY	UNIT PRICE	A M O U N T
Side Ditch	Lm	598	768	459,264
Berm Ditch	Lm	374	175	65,450
Top Slope Ditch	Lm	418	305	127,490
Catch Wall	Lm	1,215	308	374,220
Concrete Pavement	m^2	350	1,480	518,000
Removal (Soft Rock)	m^3	240.31	1,870	448,800
Excavation (Soft Rock)	m^3	261	240	62,640
Re-cutting (Soft Rock)	m^3	356	6,202	2,207,912
T o t a l				4,260,776


PROPOSED COUNTERMEASURE
OF SPOT NO. IV-A-15(CASE I)
(RE-ALIGNMENT)
TO LUCENA
TO ATIMONAN
TOP SLOPE DITCH
SIDE DITCH
BERM DITCH
RE-CUTTING
L = 297 m
CATCH WALL
L = 264m
CATCH WALL (Stone Masonry)
A
B
C
D
PLAN


TOP SLOPE DITCH
NEW
150
6.70
150
SIDE DITCH
0.5:1
CATCH WALL
Stone Masonry
DL=170.00m
DL=170.00m
SECTION A
SCALE 1:200
TOP SLOPE DITCH
RE-CUTTING
BERM DITCH
REMOVAL
NEW
0.5:1
SIDE DITCH
CATCH WALL
Stone Masonry
DL=170.00m
DL=170.00m
SECTION B
SCALE 1:200


TOP SLOPE DITCH
RE-CUTTING
NEW
SIDE DITCH
CATCH WALL
Stone Masonry
DL=170.00m
SECTION D
SCALE 1:200
DL=170.00m
TOP SLOPE DITCH
RE-CUTTING
BERM DITCH
NEW
SIDE DITCH
CATCH WALL
Stone Masonry
DL=170.00m
DL=170.00m
SECTION C
SCALE 1:200

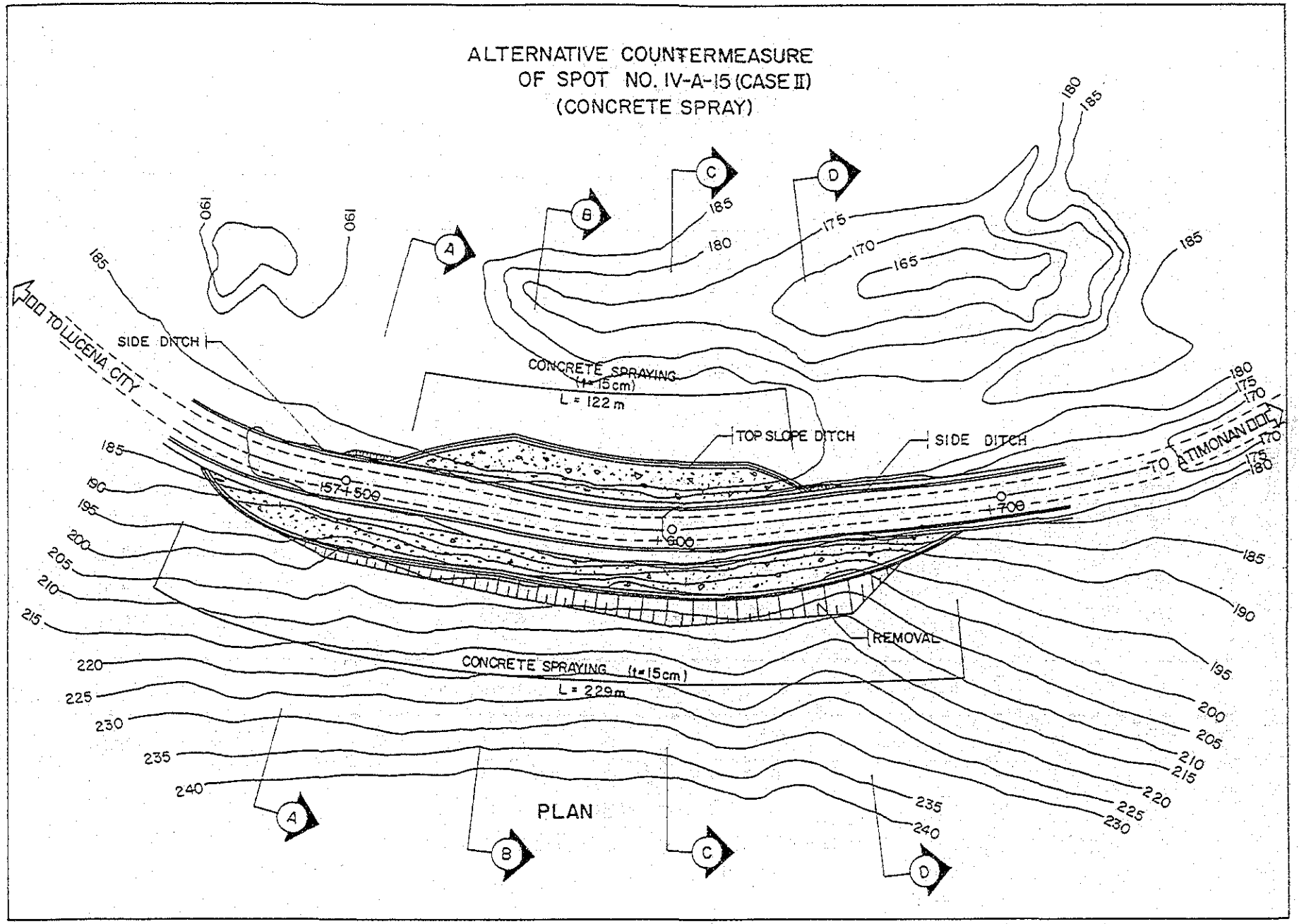
ESTIMATED COST OF ALTERNATIVE COUNTERMEASURE
(CONCRETE SPRAY)

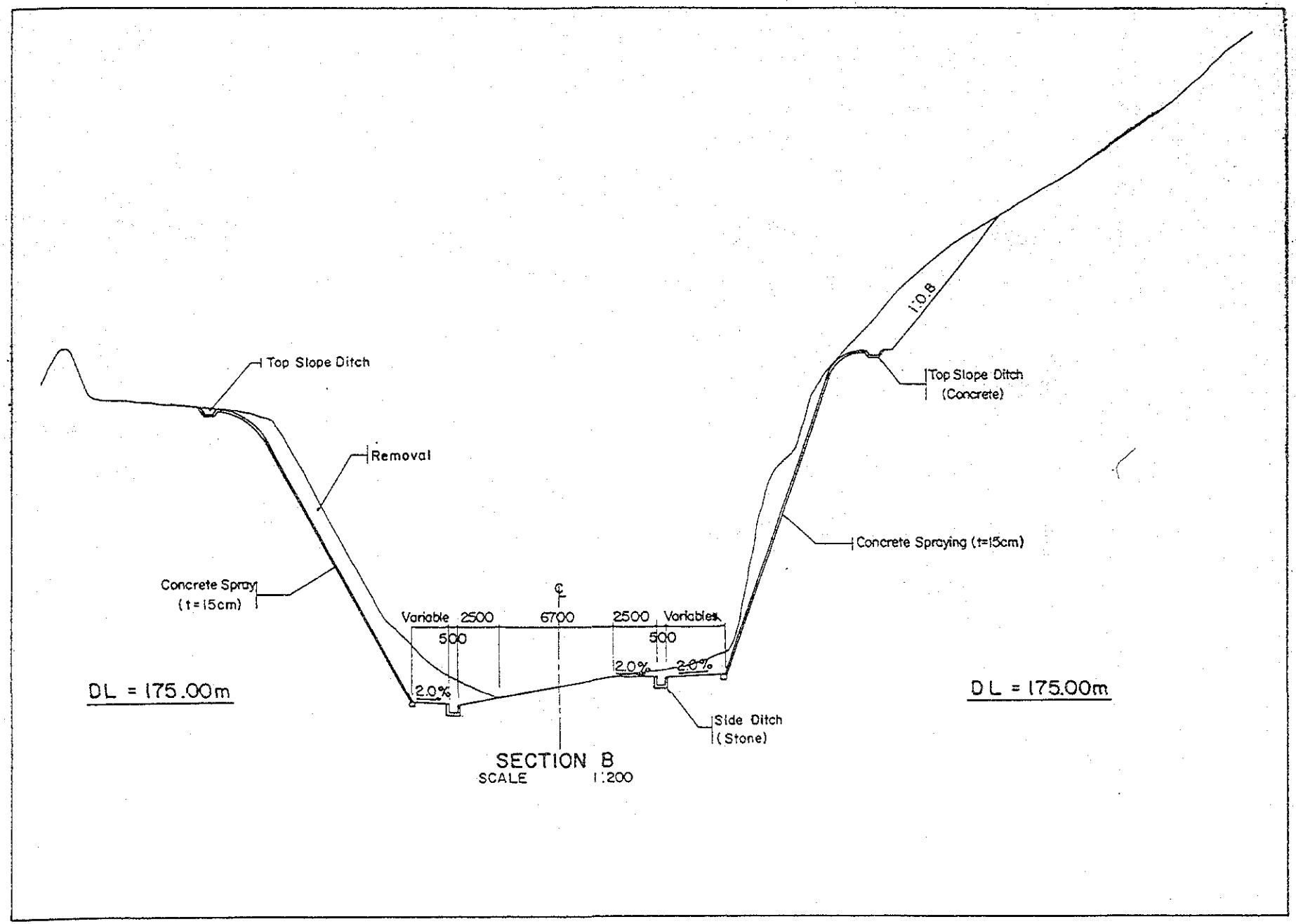
LOCATION: LUCENA - CALAUAG

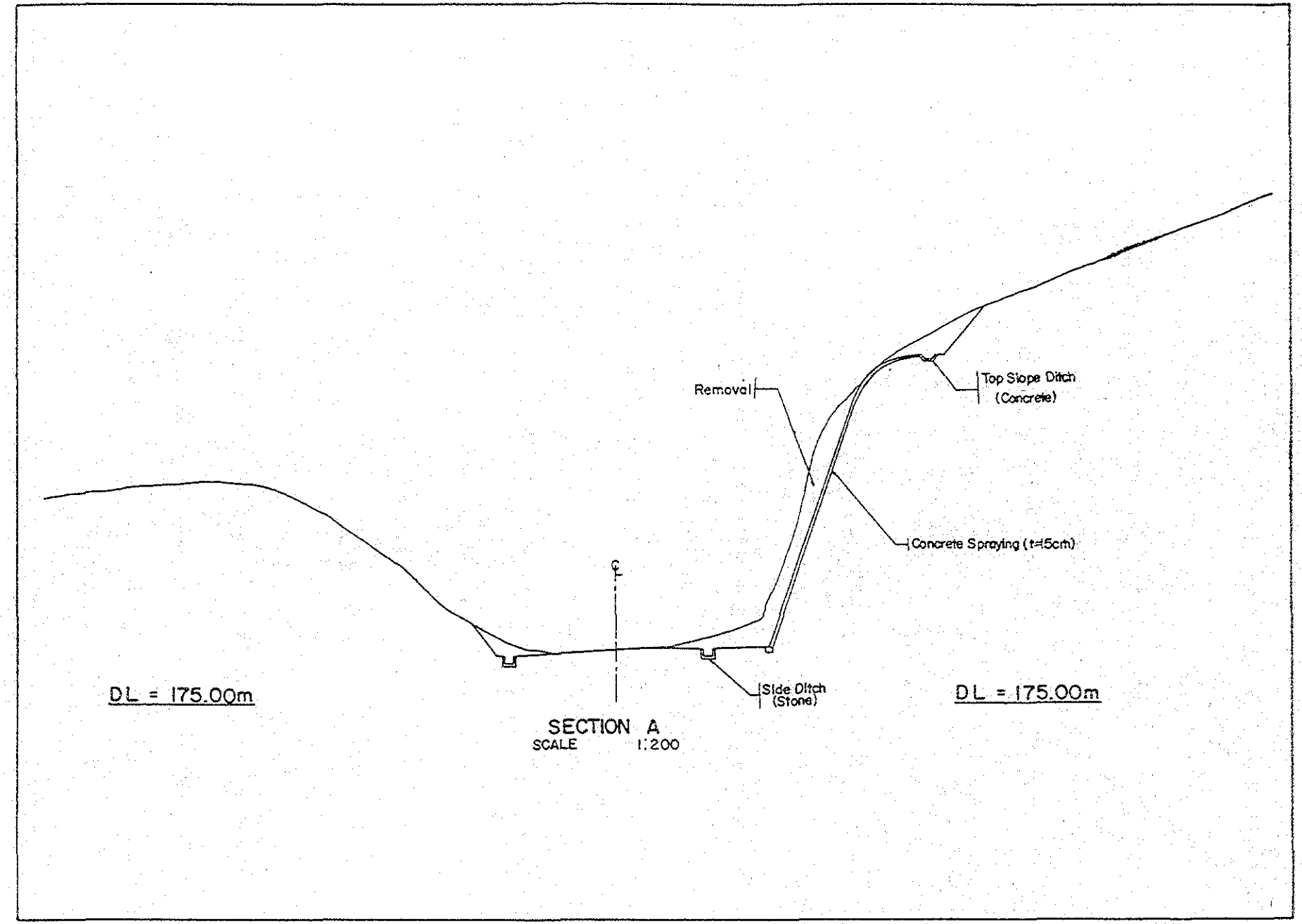
SPOT NO. IV-A-15

UNIT : PESOS

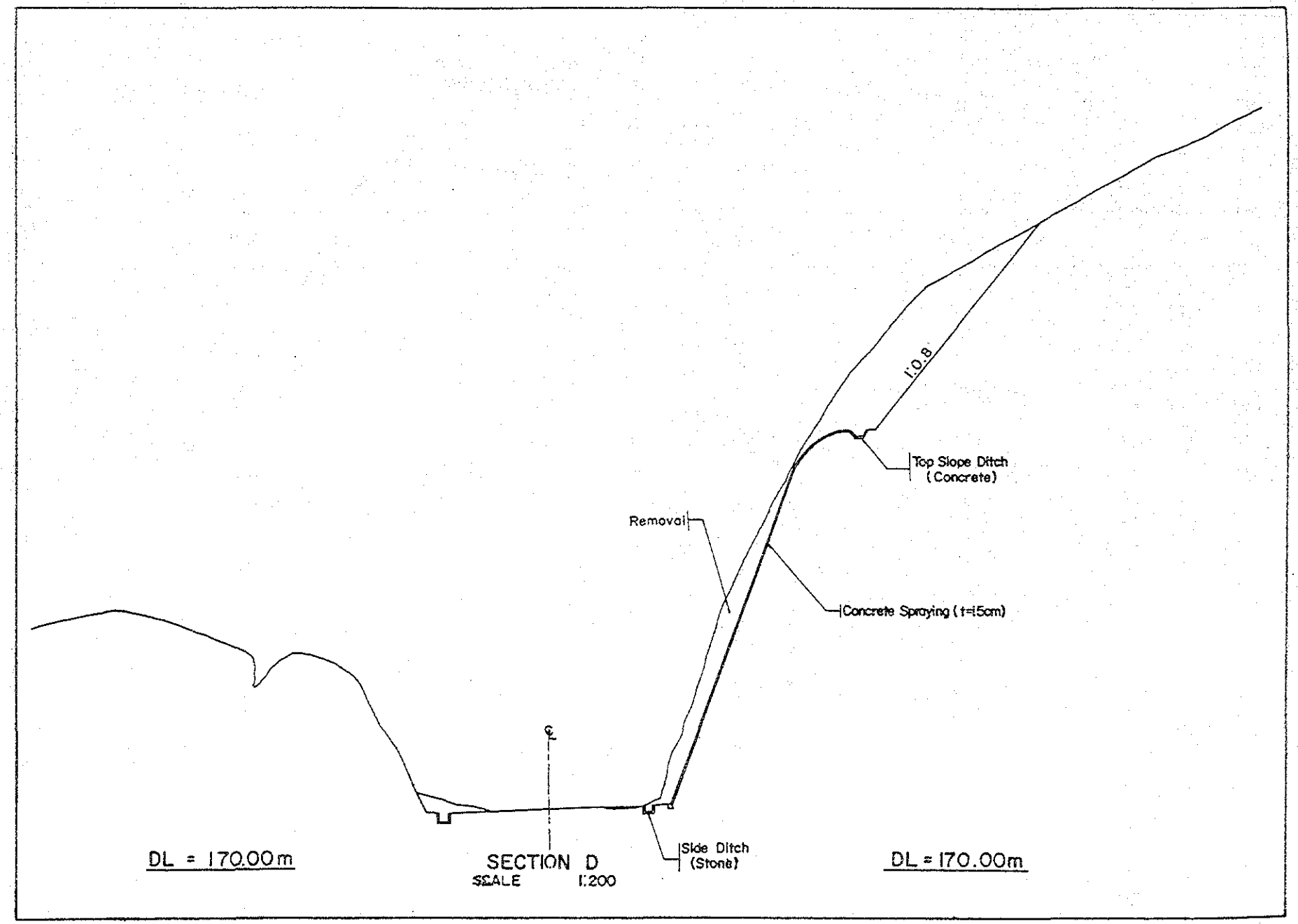
ITEM OF WORK	U N I T	QUANTITY	UNIT PRICE	A M O U N T
Top Slope Ditch	Lm	418	315	131,670
Vertical Ditch	Lm	523	55	28,765
Side Ditch	Lm	598	550	328,900
Concrete Spray (t = 15 cm)	m^2	822	6,405	5,264,910
Removal (Soft Rock)	m^3	240.31	10,826	2,601,596
T o t a l				8,355,841

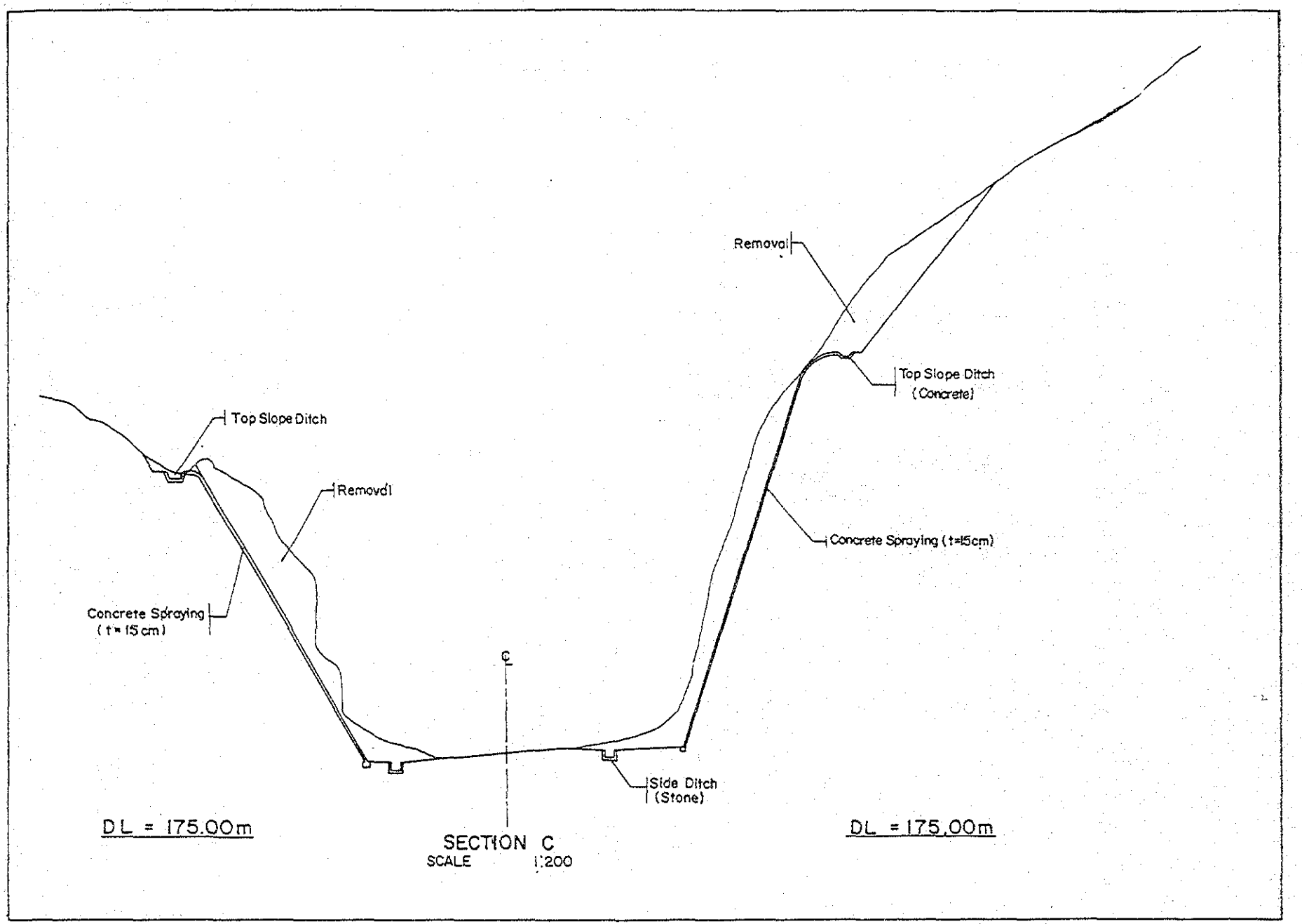

ALTERNATIVE COUNTERMEASURE
OF SPOT NO. IV-A-15 (CASE II)
(CONCRETE SPRAY)
TO LUCENA CITY
SIDE DITCH
CONCRETE SPRAYING
(t=15cm)
L = 122 m
TOP SLOPE DITCH
SIDE DITCH
TO ATIMONAN
REMOVAL
CONCRETE SPRAYING (t=15cm)
L = 229m
PLAN
A
B
C
D
160
185
190
175
170
165
180
195
200
205
210
215
220
225
230
235
240


Top Slope Ditch
Removal
Concrete Spray
(t=15cm)
DL = 175.00m
Variable
2500
6700
2500
Variable
500
500
2.0%
2.0%
2.0%
1:0.8
Top Slope Ditch
(Concrete)
Concrete Spraying (t=15cm)
DL = 175.00m
Side Ditch
(Stone)
SECTION B
SCALE 1:200



SECTION A
SCALE 1:200


1:0.8
Top Slope Ditch
(Concrete)
Removal
Concrete Spraying (t=15cm)
℄
Side Ditch
(Stone)
DL = 170.00m
SECTION D
SCALE 1:200
DL = 170.00m



SECTION C
SCALE 1:200

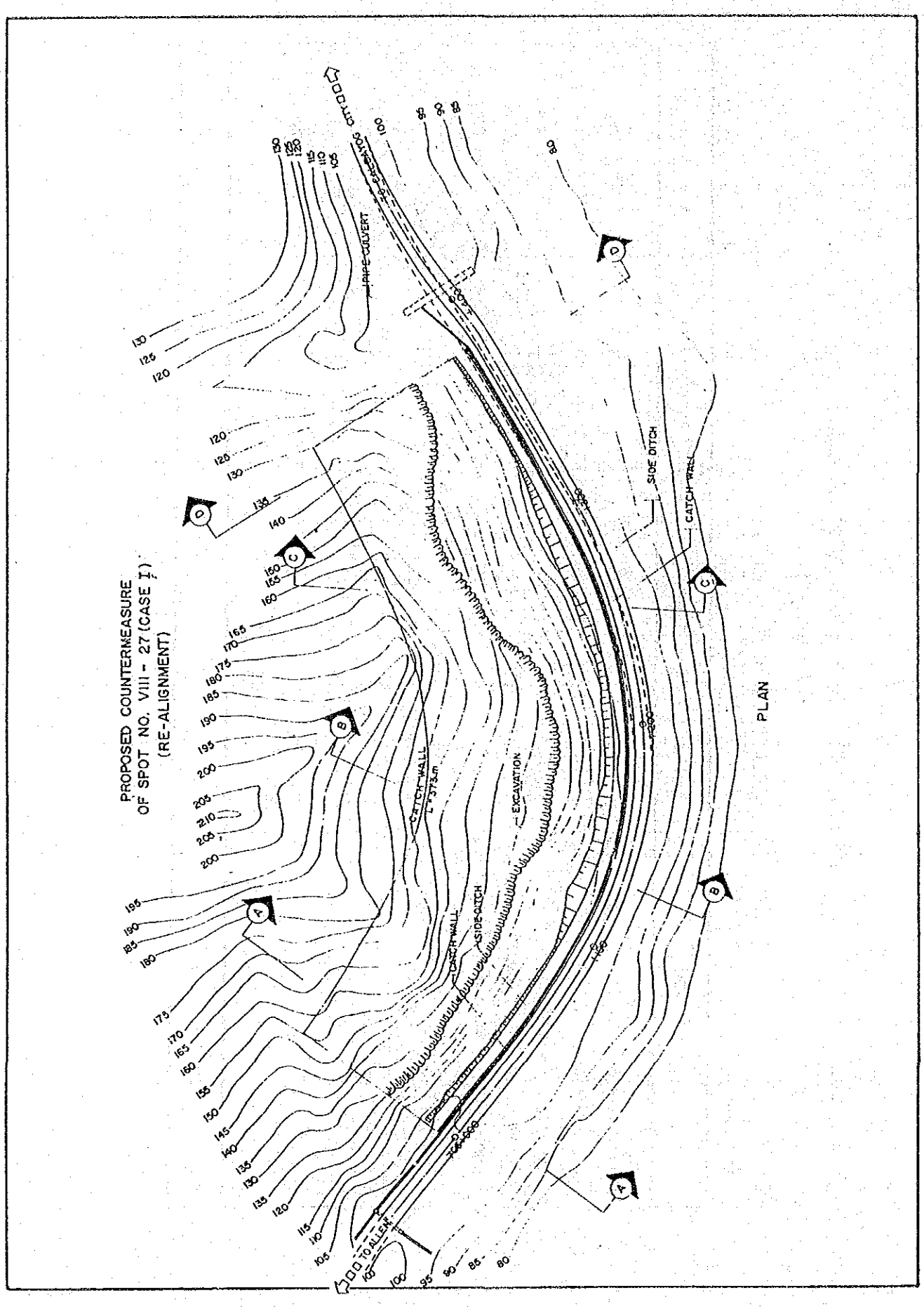
ESTIMATED COST OF PROPOSED COUNTERMEASURE
(RE-ALIGNMENT)

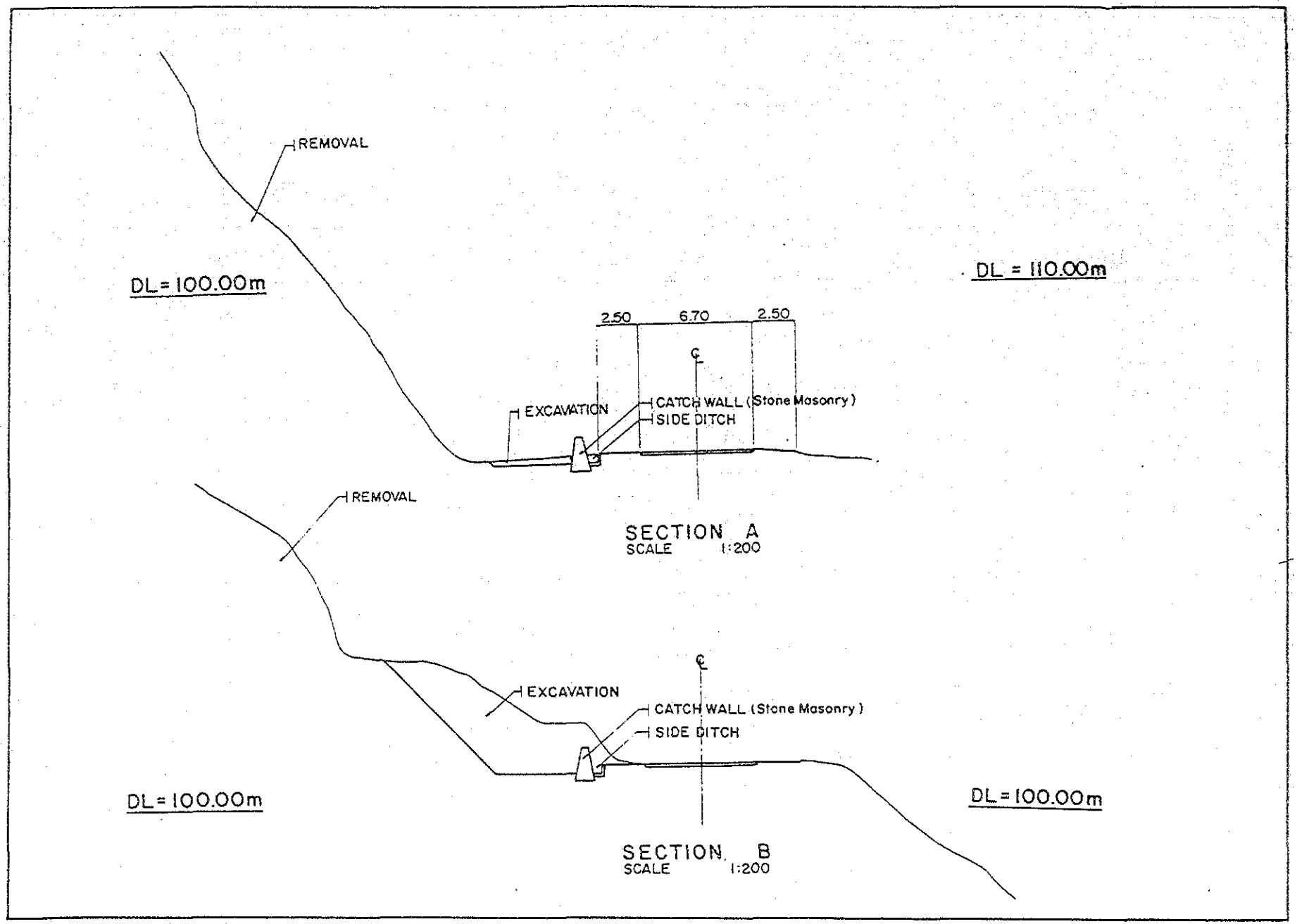
LOCATION: ALLEN - CALBAYOG

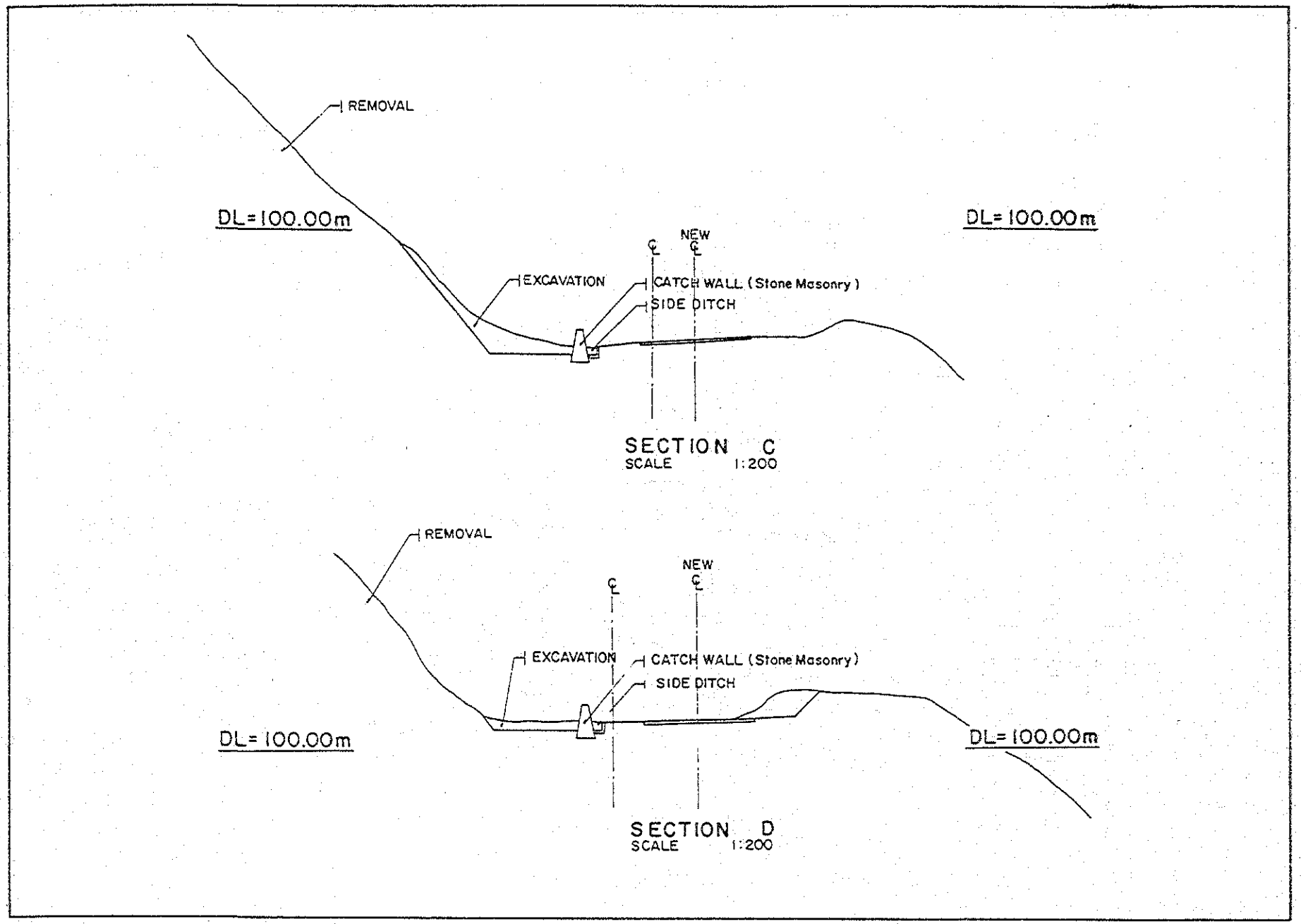
SPOT NO. VIII-27

UNIT : PESOS

ITEM OF WORK	U N I T	QUANTITY	UNIT PRICE	A M O U N T
Side Ditch	Lm	598	460	275,080
Catch Wall	Lm	1,215	373	453,195
Concrete Pavement	m^2	350	750	262,500
Excavation (Soft Rock)	m^3	261	7,384	1,927,224
Removal (Soft Rock)	m^3	240	792	190,080
T o t a l				3,108,079


PROPOSED COUNTERMEASURE
OF SPOT NO. VIII - 27 (CASE I)
(RE-ALIGNMENT)
PLAN
CATCH WALL
L=373m
EXCAVATION
SIDE DITCH
PIPE CULVERT
TO ALLER
A
B
C
D


REMOVAL
DL = 100.00m
DL = 110.00m
2.50
6.70
2.50
EXCAVATION
CATCH WALL (Stone Masonry)
SIDE DITCH
SECTION A
SCALE 1:200
REMOVAL
EXCAVATION
CATCH WALL (Stone Masonry)
SIDE DITCH
DL = 100.00m
DL = 100.00m
SECTION B
SCALE 1:200


REMOVAL
DL=100.00m
DL=100.00m
NEW
EXCAVATION
CATCH WALL (Stone Masonry)
SIDE DITCH
SECTION C
SCALE 1:200
REMOVAL
NEW
EXCAVATION
CATCH WALL (Stone Masonry)
SIDE DITCH
DL=100.00m
DL=100.00m
SECTION D
SCALE 1:200

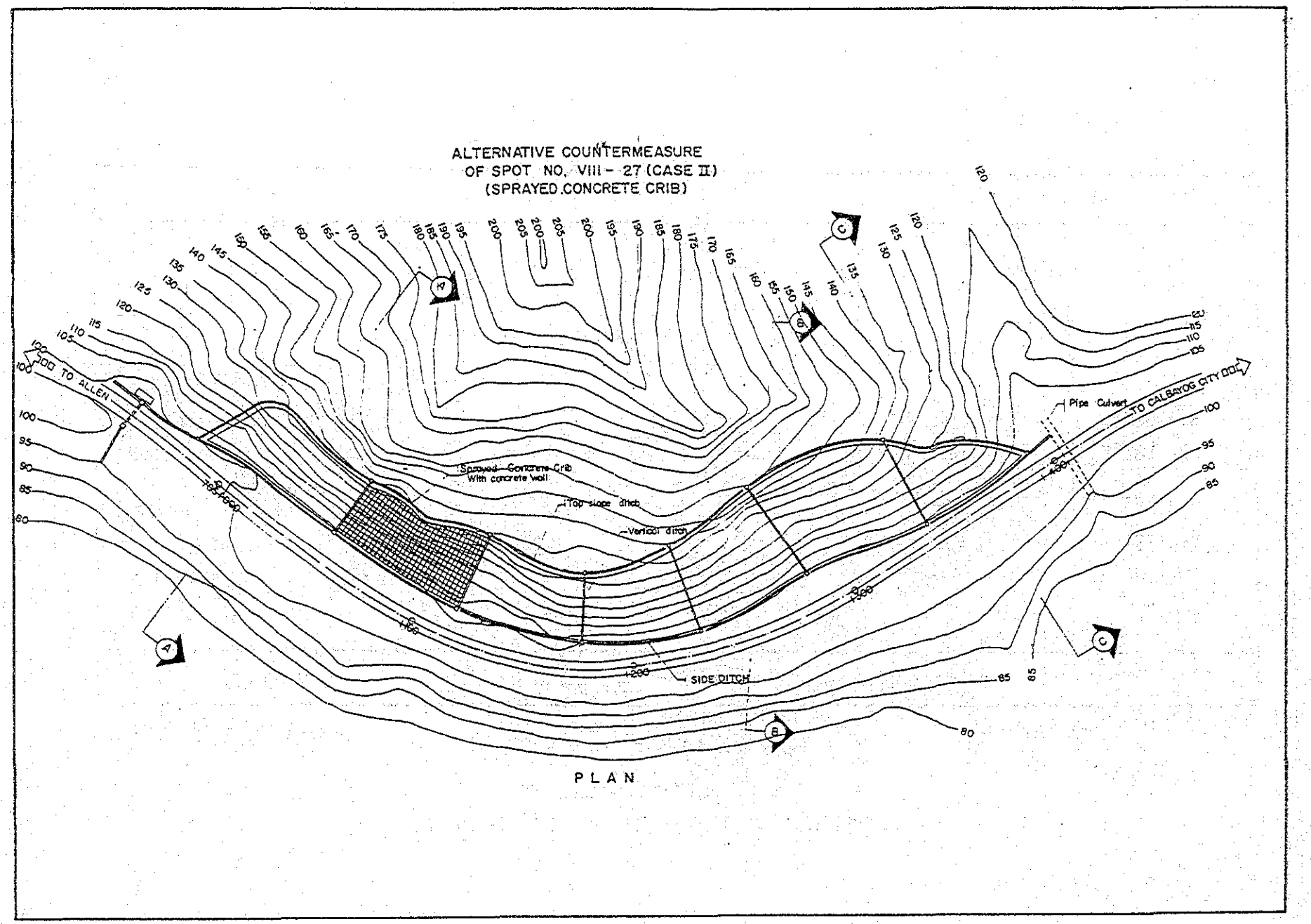
ESTIMATED COST OF ALTERNATIVE COUNTERMEASURE
(SPRAYED CONCRETE CRIB)

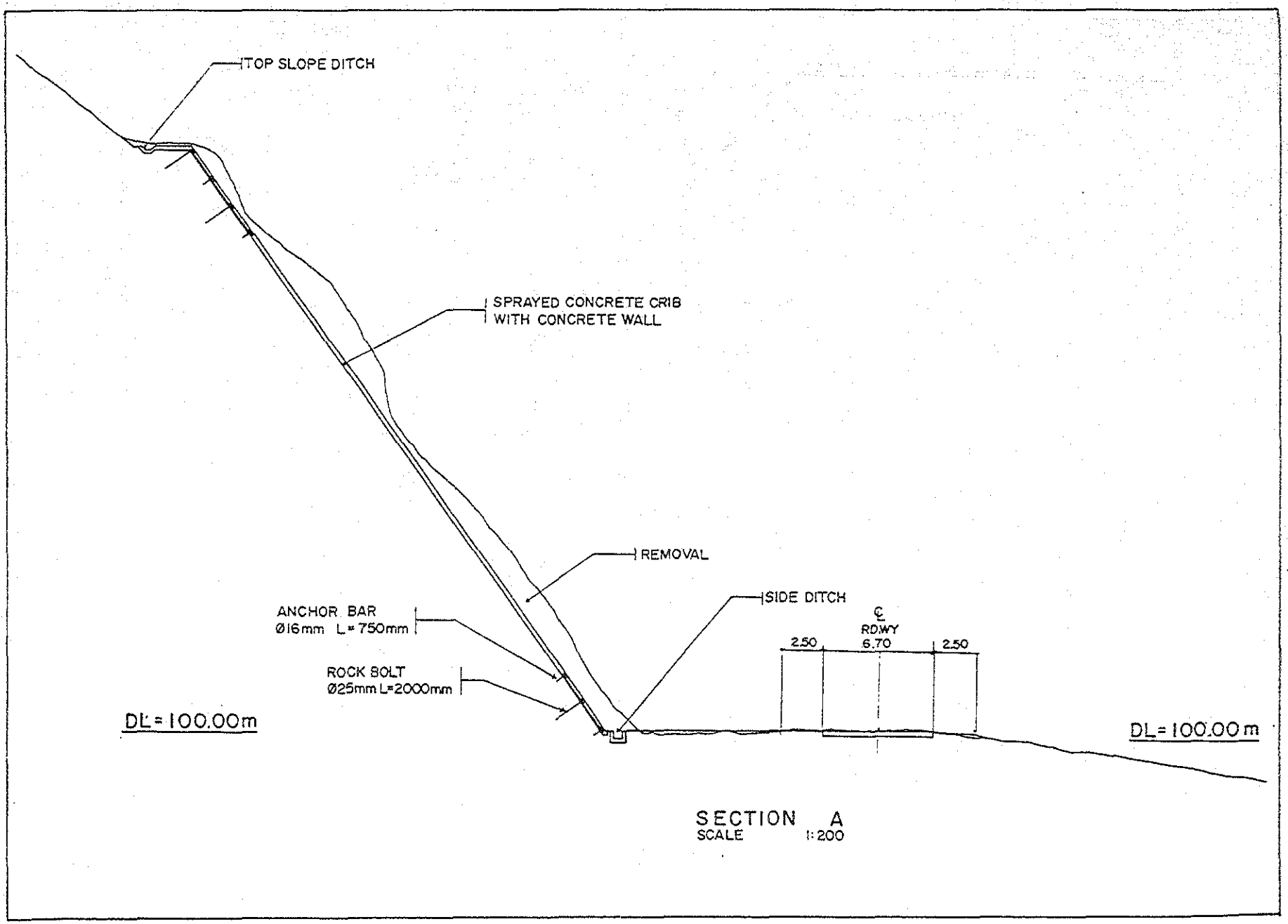
LOCATION: ALLEN - CALBAYOG

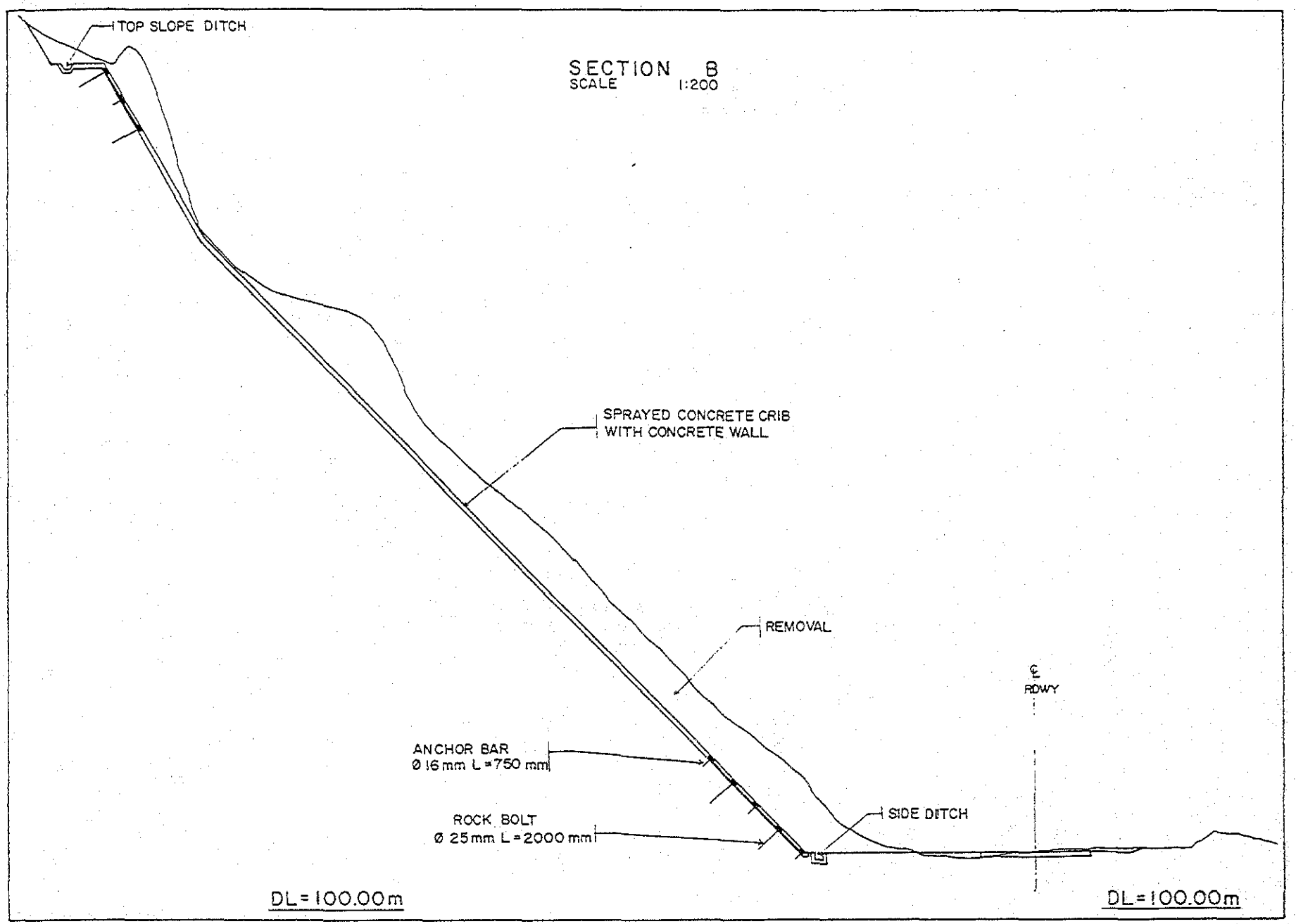
SPOT NO. VIII-27

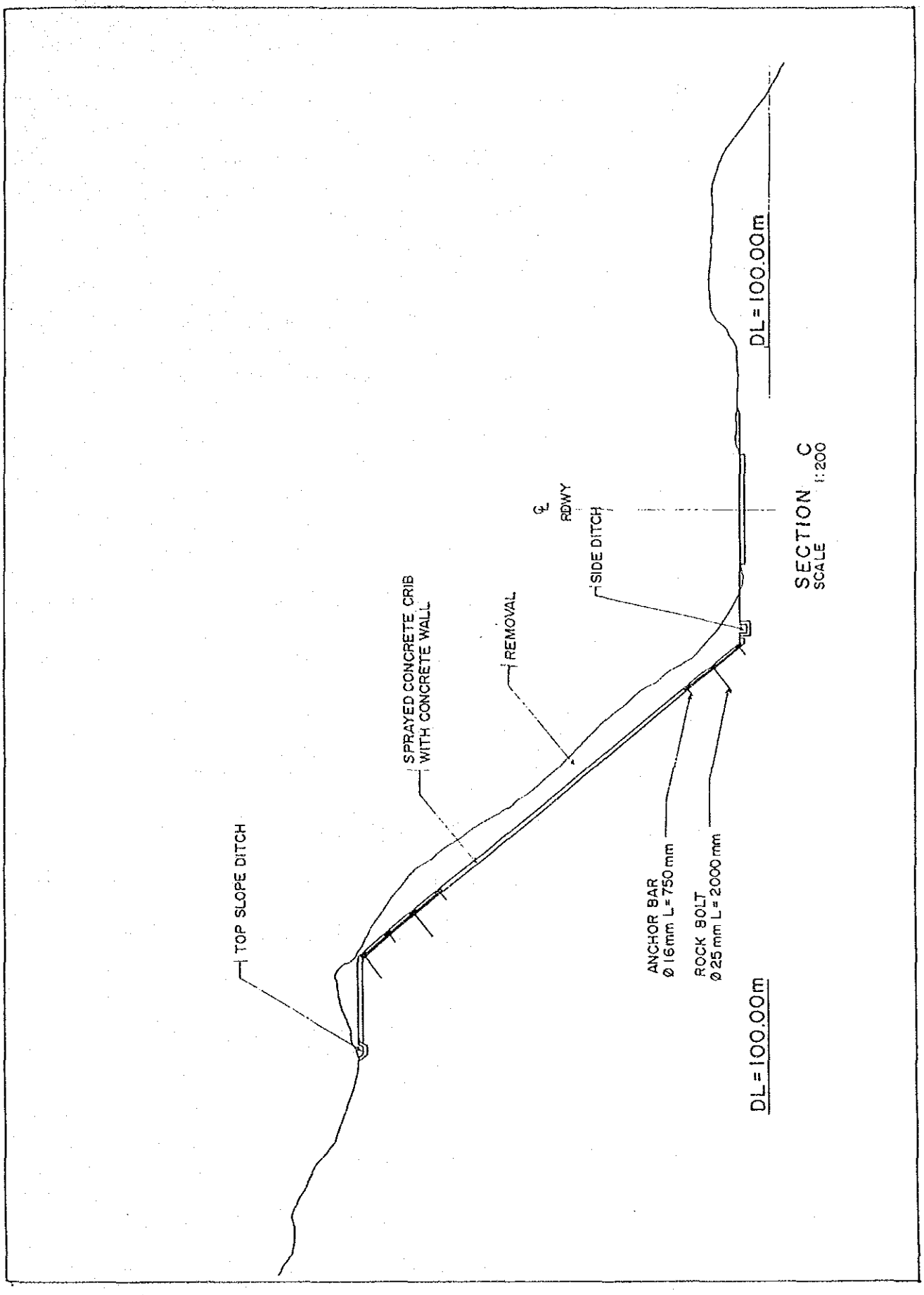
UNIT : PESOS

ITEM OF WORK	U N I T	QUANTITY	UNIT PRICE	A M O U N T
Side Ditch	Lm	598	398	238,004
Vertical Ditch	Lm	523	300	156,900
Top Slope Ditch	Lm	418	296	123,728
Sprayed Concrete Crib with Concrete Wall	m^2	1,300.47	13,930	18,115.547
Rock Bolt	Lm	2,566	2,020	5,183,320
Removal (Soft Rock)		240.31	34,770	8,355,578
T o t a l				32,173,077


ALTERNATIVE COUNTERMEASURE
OF SPOT NO. VIII - 27 (CASE II)
(SPRAYED CONCRETE CRIB)
TO ALLEN
TO CALBAYOG CITY
Pipe Culvert
Sprayed Concrete Crib
With concrete wall
Top slope ditch
Vertical ditch
SIDE DITCH
PLAN


TOP SLOPE DITCH
SPRAYED CONCRETE CRIB
WITH CONCRETE WALL
REMOVAL
SIDE DITCH
ANCHOR BAR
Ø16mm L=750mm
ROCK SOLT
Ø25mm L=2000mm
℄
RDWY
2.50
6.70
2.50
DL=100.00m
DL=100.00m
SECTION A
SCALE 1:200

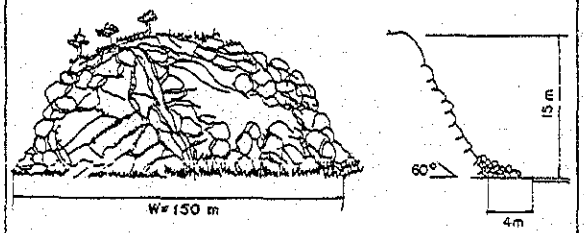
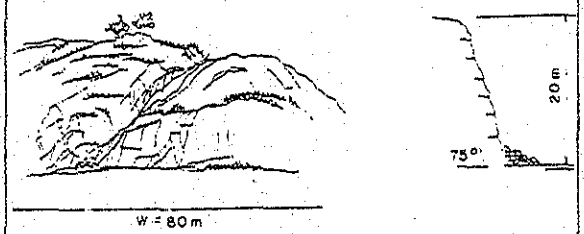
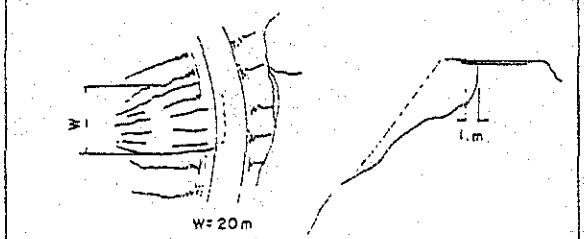
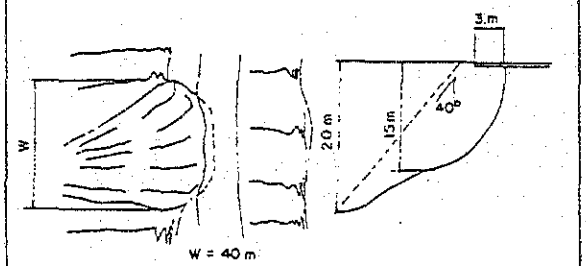

TOP SLOPE DITCH
SECTION B
SCALE 1:200
SPRAYED CONCRETE CRIB
WITH CONCRETE WALL
REMOVAL
℄
RDWY
ANCHOR BAR
Ø 16 mm L=750 mm
ROCK BOLT
Ø 25 mm L=2000 mm
SIDE DITCH
DL=100.00m
DL=100.00m


SECTION C
SCALE 1:200
DL=100.00m
DL=100.00m
℄
RDWY
SIDE DITCH
REMOVAL
SPRAYED CONCRETE CRIB
WITH CONCRETE WALL
TOP SLOPE DITCH
ANCHOR BAR
Ø 16mm L=750mm
ROCK BOLT
Ø 25 mm L= 2000 mm

APPENDIX 6.5-1 CONDITION OF DISASTER AND SELECTED COUNTERMEASURES

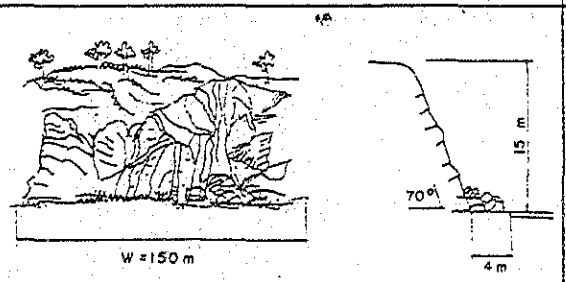
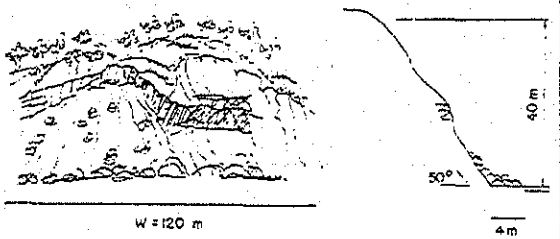
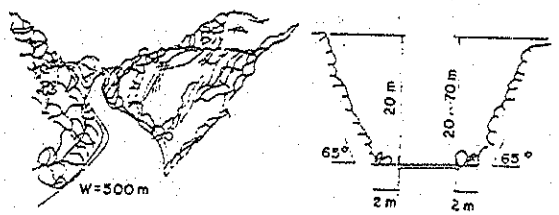
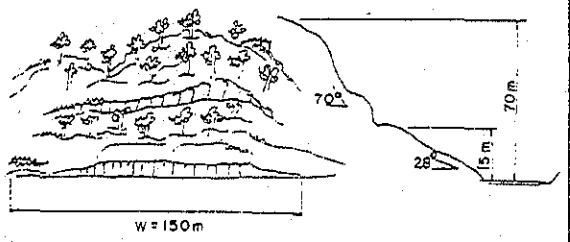
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES

LUCENA - CANDELARIA SECTION

No.	Spot No.	Km. Type of Disaster	Existing Slope Condition: Dimension of Slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for Selection of Countermeasures	Countermeasures
1	IVA-6	153 + 900 C-F		. Hard Rock. . Sandstone. . Slightly weathered and developed crack.	. Surface water flows on the slope.	. Slope is steeper than optimum and stable. . Progress of weathering may not be remarkable. . Detached rocks exist on the slope. . Fallen rock size: 30～57cm . Big cracks developed.	. Removal. . Anchor wire net.
2	IVA-7	154 + 100 C-F		. Hard Rock. . Sandstone. . Slightly weathered and developed crack. . Cracks slightly developed.	. A little concentration of slope surface water.	. Slope is steep but stable. . Progress of weathering may be remarkable. . Fallen rock size: 30～75cm . Small cracks, not so developed.	. Removal. . Concrete spraying, t = 10cm
3	IVA-8	155 + 100 E-D.F		. Embankment material	. Concentration of road surface water. . Road surface water also saturates into the embankment materials.	. Embankment slope is steep. . No existing slope protection. . Poor drainage facilities exist on the roadway.	. Re-filling. . Stone masonry retaining wall. . Side ditch. . Vertical ditch.
4	IVA-13 -1	156 + 700 E-D.F		. Embankment material. (Sandy Soil)	. Road surface water saturates into the embankment materials.	. Slope is not so steep. . Poor drainage facilities exists on the roadway. . Embankment materials were saturated by road surface water.	. Under construction.

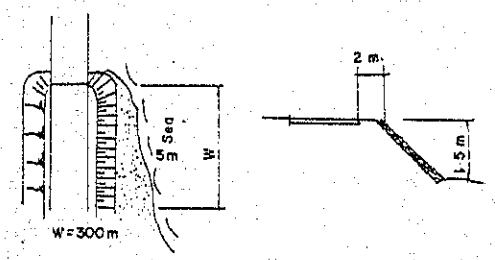
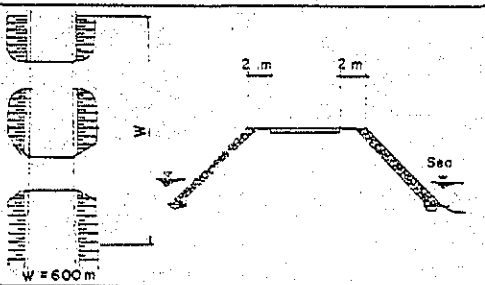
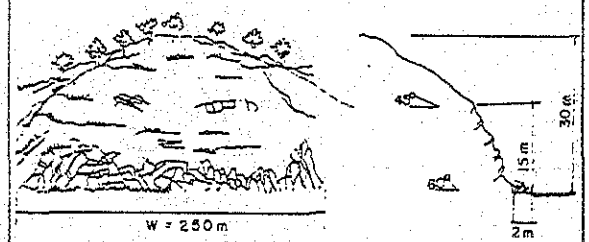
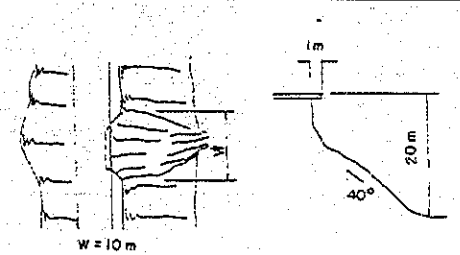
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES

LUCENA - CALAUAG SECTION

No.	Spot No.	Km. Type of Disaster	Existing Slope Condition			Factor for Selection of Countermeasures	Countermeasures
			Dimension of Slope	Geological Condition	Water Condition		
5	IVa-15	157 + 600 C-F		. Soft Rock. . Limestone. . Highly weathered and developed crack.	. Surface water flows on the slope and a little concentration of surface water from hinterland.	. Slope is steep but not so high. . Progress of weathering is anticipated on weak soft rock. . Fallen rock size: 0.50～1.00m	. Re-alignment. . Re-cutting (left portion). . Catch wall. . Top slope ditch. . Berm ditch. . Side ditch.
6	IVA-17	158 + 500 C-D.F		. Soft Rock. . Limestone. . Highly weathered and developed crack.	. Surface water flows on the slope.	. Slope is a little bit steep. . More progress of weathering occurs due to surface water. . Very weak soft rock. . Detached rock exist on the slope. . Fallen rock size: 30～75cm	. Re-alignment. . Re-cutting. . Removal. . Catch wall. . Side ditch.
7	IVA-18	158 + 900 C-F		. Soft Rock. . Limestone. . Highly weathered and developed crack.	. Slope surface water flows on the slope and a little concentration of surface water from hinterland.	. Slope is steep and high. . Progress of weathering is anticipated on weak soft rock. . Fallen rock.	. Re-alignment. . Concrete spraying (t = 15cm). . Re-cutting (left portion). . Removal (right portion). . Catch wall. . Top slope ditch (left portion). . Berm ditch (left portion) . Side ditch.
8	IVA-20	160 + 800 L.S.		. Cohesive soil.	. Surface and seepage water flows on the slopes.	. Top slope is steep. . Cliff is susceptible to slide. . Treatment of water.	. Removal (Cliff). . Re-cutting (lower portion). . Vegetation. . Stone pitching waterway. . Pipe culvert (1000 mm ø). . Berm ditch. . Side ditch. (Case Study)

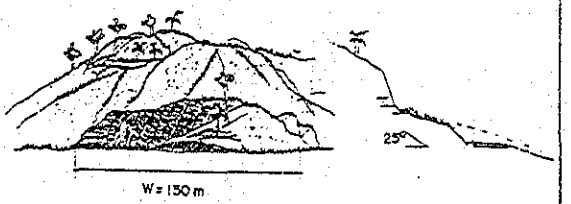
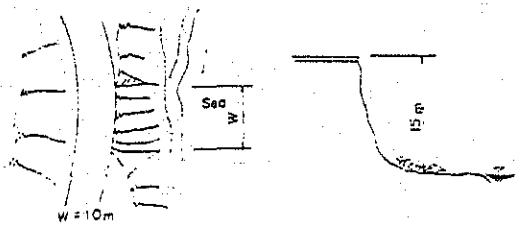
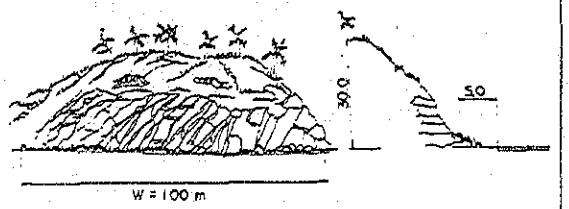
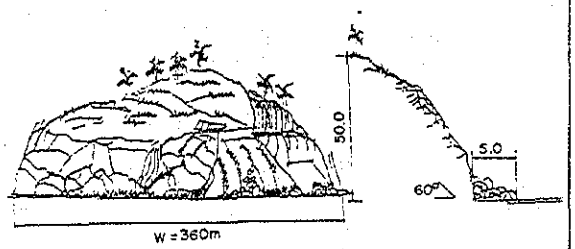
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES

ALLEN - CALBAYOG SECTION

No.	Spot No.	Km. Type of Disaster	Existing Slope Condition			Factor for Selection of Countermeasures	Countermeasures
			Dimension of Slope	Geological Condition	Water Condition		
1	VIII-1	664 + 400 E-D.F		. Ripraped embankmetn slope.	. Existing slope protection by riprap. . Scouring by sea waves during high tide.		. Spot is excluded from the study. . Overflow of sea water should be remedied as riparian project.
2	VIII-2	681 + 700 E-D.F		. Ripraped embankment slope.	. Existing slope, protection by riprap. . Scouring by sea waves.		. Spot is excluded from the study. . Overflow of sea water should be remedied as riparian project.
3	VIII-6	686 + 900 C-F		. Soft rock. . Sandstone. . Slightly weathered and developed crack.	. Surface water flows on the slope and a little concentrated.	. Slope is steep but not so high. . Progress of weathering may not be remarkable. . Detached rocks exist on the slope. . Fallen rock size: 30 75cm	. Removal. . Concrete spraying t = 15cm for lower portion of slope. . Anchor wire net for upper portion of slope. . Side ditch. . Top slope ditch. . Vertical ditch.
4	VIII-15-1	694 + 700 E-D.F		. Embankment materials. (Gravelly Soil)	. Concentration of road surface water. . Road surface water saturates into embankment materials.	. Slope is steep and high. . Poor drainage facilities exist on the raodway.	. Re-filling. . Stone masonry retaining wall. . Pipe culvert (1000 mm ϕ)

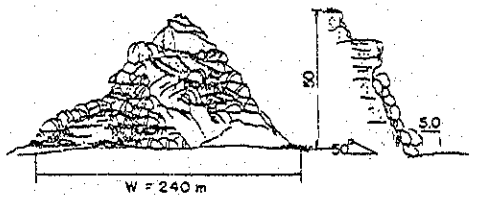
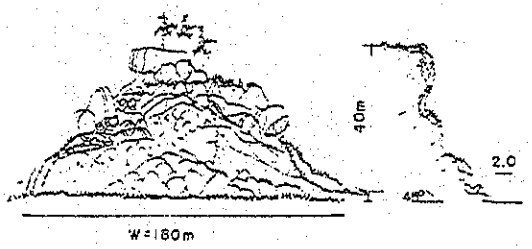
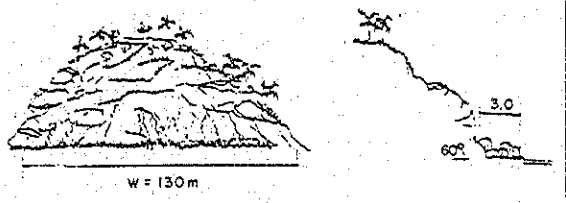
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES

ALLEN - CALBAYOG SECTION

No.	Spot No.	Km. Type of Disaster	Existing Slope Condition: Dimension of Slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for Selection of Countermeasures	Countermeasures
5	VIII-16	698 + 300 D.F			. Water from hinterland concentrates at this place. . Groundwater is high.	. Cliff is susceptible to slide. . Control of water flow. . High groundwater. . Slope is steep. . Vegetation can grow. (Case Study)	Debris Flow: . Re-cutting. . Vegetation. . Stone pitching waterway. . Close conduit with open ditch. . Horizontal drain hole (60 mm ø). Cut Slope: . Re-cutting. . Vegetation. (Case Study)
6	VIII-18	701 + 200 E-D.F		. Embankment materials. (Gravelly Soil)		. Slope gradient is steep and high. . No existing slope protection. . Scouring by sea waves. . Small scale riparian.	. Re-filling. . Stone masonry retaining wall. . Gravity type retaining wall. . Gabion foot protection.
7	VIII-21	703 + 800 C-F		. Hard rock. . Sandstone. . Slightly weathered and regular crack.	. Water from hinterland flows on the slope.	. Slope is not so steep but high. . Progress of weathering may be remarkable.	. Concrete spraying. (t = 10cm) . Re-cutting (spot portion). . Top slope ditch. . Side ditch. . Vertical ditch. (Case Study)
8	VIII-27	705 + 200 C-F		. Soft rock. . Sandstone. . Highly weathered and developed crack.	. Water from hinterland flows on the slope and a little concentrated.	. Slope is little bit steep and high. . Progress of weathering is anticipated. . weak earth pressure is expected because of soft rock.	. Re-alignment. . Removal. . Excavation. . Catch wall. . Side ditch.

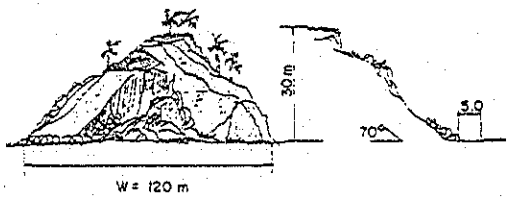
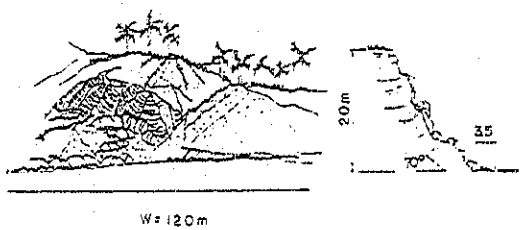
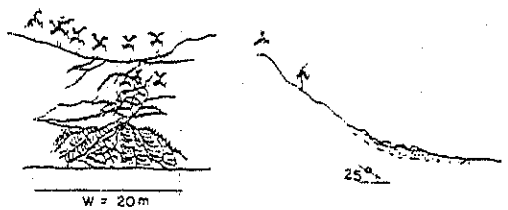
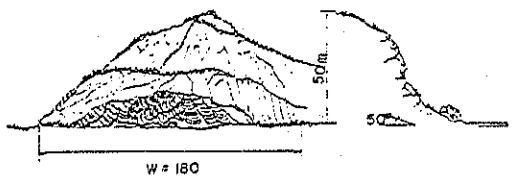
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES

ALLEN - CALBAYOG SECTION

No.	Spot No.	Km. Type of Disaster	Existing Slope Condition: Dimension of Slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for Selection of Countermeasures	Countermeasures
9	VIII-28	705 + 600 C-F		. Hard rock. . Sandstone. . Slightly weathered and regular crack.	. Water from hinterland flows on the slope.	. Slope is a little bit steep and high. . Progress of weathering may be remarkable. . Fallen rock size: 30 75cm	. Re-alignment. . Removal. . Catch wall. . Side ditch.
10	VIII-29	708 + 200 C-F		. Hard and soft rock. . Limestone and sandstone. . Highly weathered and developed crack.	. Surface water flows on the slope.	. Slope is almost optimum but high. . More progress of weathering occurs due to surface water. . Detached rock exist on the slope. . Weak earth pressure is expected.	. Re-alignment. . Removal. . Catch wall. . Side ditch.
11	VIII-30	708 + 600 C-F		. Hard rock. . Sandstone. . Slightly weathered and regular crack.	. Water from hinterland flows on the slope.	. Slope is a little bit steep but not so high. . Progress of weathering may be remarkable. . Detached rock exist on the slope.	. Concrete spraying. (t = 10cm) . Re-cutting. . Catch wall. . Top slope ditch. . Berm ditch. . Side ditch.
12	VIII-31	708 + 650 C-F		. Soft rock. . Sandstone, shale. . Slightly weathered and developed crack.	. Water from hinterland flows on the slope and a little concentrated.	. Slope is a little bit steep but not so high. . Progress of weathering may be remarkable.	. Re-cutting. . Berm ditch. . Top slope ditch. . Side ditch.

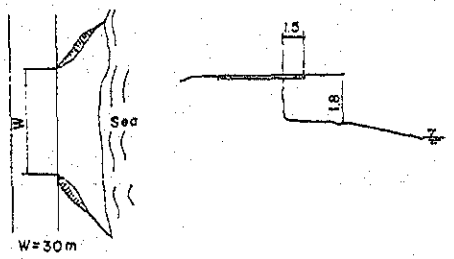
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES

ALLEN - CALBAYOG SECTION

No.	Spot No.	Km. Type of Disaster	Existing Slope Condition			Factor for Selection of Countermeasures	Countermeasures
			Dimension of Slope	Geological Condition	Water Condition		
13	VIII-32	709 + 600 C-F		. Soft rock. . Sandstone, shale. . Slightly weathered and developed crack. . Cracks inclined to road. . Weak portion exist in the slope between the strata.	. Water from hinterland flows on the slope.	. Slope is steep but not so high. . More progress of weathering occurs due to surface water. . Detached rock exist on the slope.	. Re-alignment. . Removal. . Re-cutting (spot portion). . Catch wall. . Side ditch. (Case Study)
14	VIII-33	717 + 700 C-S.F		. Hard and soft rock. . Sandstone, and shale. . Highly weathered and developed crack.	. Water from hinterland flows on the slope.	. Slope is steep but not so high. . Progress of weathering is anticipated. . Weak earth pressure is expected.	. Re-cutting. . Top slope ditch. . Berm ditch. . Side ditch.
15	VIII-36	718 + 100 D.F			. Concentration of slope surface water from hinterland.	. Slope is stable and covered by tree and grasses. . Protection of slope is not reasonable. . Wide shoulder. . Control of water flow.	. Re-cutting. . Catch wall. . Stone pitching waterway. . Berm ditch. . Side ditch.
16	VIII-37	718 + 500 C-F		. Hard rock. . Andesite. . Highly weathered and developed crack.	. Surface water flows on the slope.	. Slope is a little bit steep and high. . Progress of weathering is anticipated. . Weak earth pressure is expected.	. Re-alignment. . Removal. . Excavation. . Catch wall. . Side ditch.

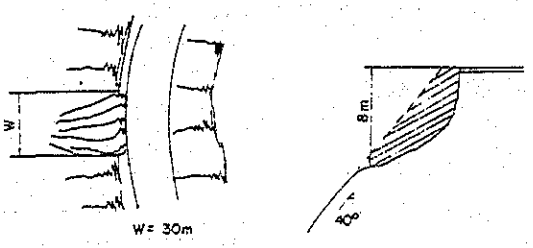
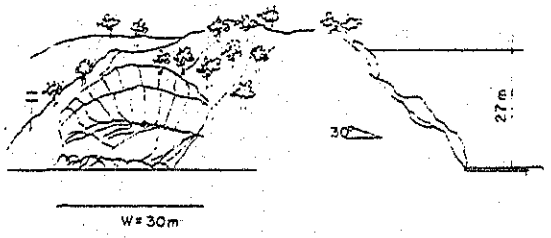
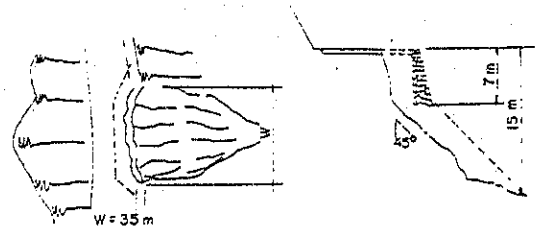
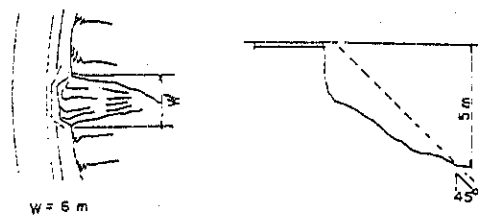
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES

ALLEN - CALBAYOG SECTION

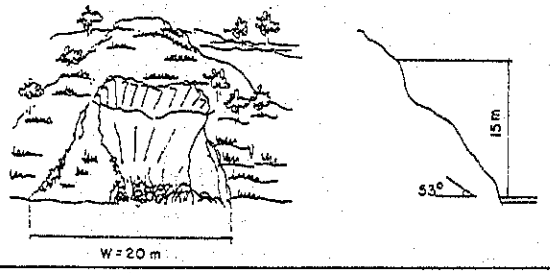
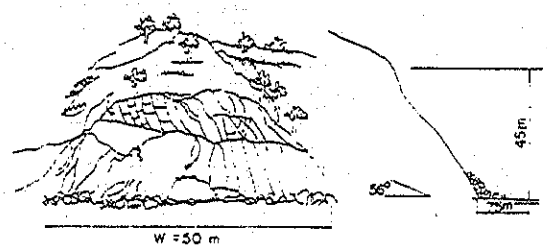
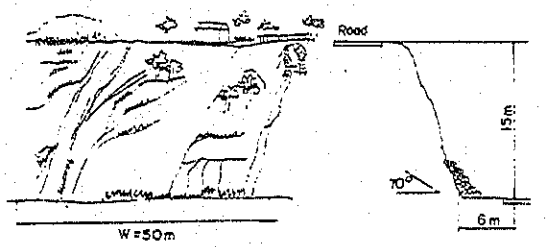
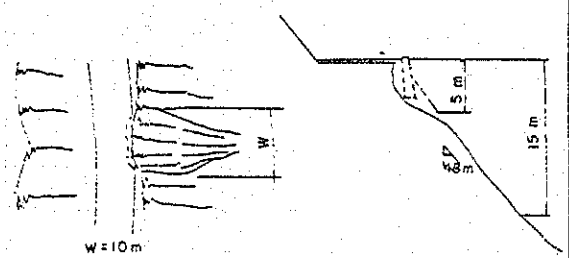
No.	Spot No.	Km. Type of Disaster	Existing Slope Condition			Factor for Selection of Countermeasures	Countermeasures
			Dimension of Slope	Geological Condition	Water Condition		
17	VIII-39 -1	721 + 800 E-D.F		. Embankment material. (Sand)	. No existing slope protection. . Scouring by the sea wave during high tide.		- Under construction.

CONDITION OF DISASTER AND SELECTED COUNTERMEASURES

NAGUILIAN ROAD

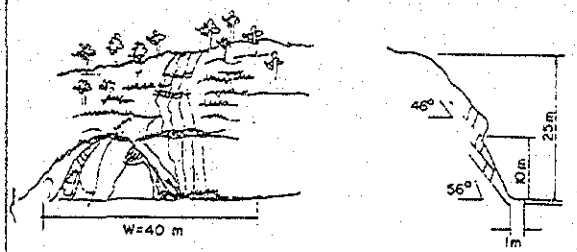
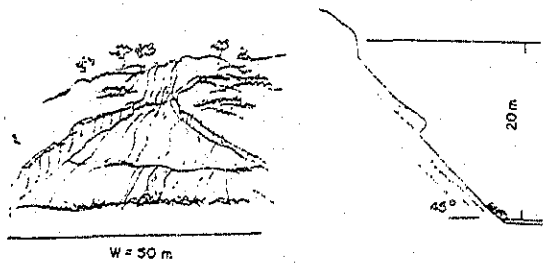
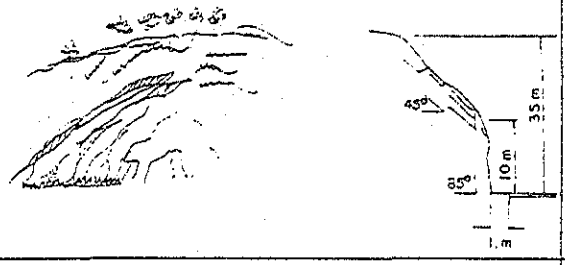
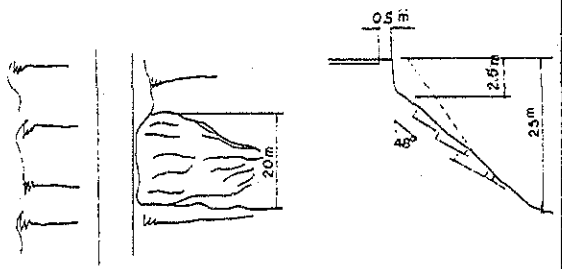
No.	Spot No.	Km. Type of Disaster	Existing Slope Condition: Dimension Slope Condition	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for Selection of Countermeasure	Countermeasures
1	IN-3-2	276 + 550 E-D.F		. Embankment material. (Cohesive Soil)	. Concentration of road surface water. . Road surface water saturates into embankment materials.	. Embankment slope is steep. . No existing slope protection. . Poor drainage facilities exist on the roadway.	. Re-filling. . Stone masonry R.W. . Side ditch.
2	IN-4-1	281 + 500 C-D.F		. Soft rock. . Sandstone. Gravelly Soil. . Highly weathered and developed crack.	. Concentration of slope surface water from hinterland. . A little seepage of water occurs.	. Treatment of water. . Vegetation can grow. . Slope is gentle.	. Removal. . Vegetation. . Stone pitching waterway. . Berm ditch. . Side ditch. . Pipe culvert. (1000 mm ø) (Case Study)
3	IN-4-4	286 + 600 E-D.F		. Embankment material. (Cohesive Soil)	. Concentration of road surface water. . Road surface water saturates into embankment materials.	. Embankment slope is steep. . Poor drainage facilities.	. Re-filling. . Stone masonry R.W. . Side ditch.
4	IN-4-5	287 + 800 E-D.F		. Embankment material. (Cohesive Soil)	. Concentration of road surface water. . Road surface water saturates into embankment materials.	. Embankment slope is steep. . No existing slope protection. . Poor drainage facilities.	. Re-filling. . Stone masonry R.W. . Side ditch.

CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — NAGUILIAN ROAD

No.	Spot No.	Km. Type of Disaster	Existing Slope Condition: Dimension of Slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for Selection of Countermeasures	Countermeasures
5	IN-5	288 + 300 C-F		. Soft rock. . Tuff. . Highly weathered and developed crack.	. Surface water flows on the slope.	. Slope gradient is a little bit steep but not so high. . More progress of weathering occurs due to surface water. . Rock has many cracks and joints. . Vegetation can not grow.	. Removal. . Concrete spraying. (t = 15cm) . Side ditch. . Vertical ditch. . Top slope ditch.
6	IN-7	288 + 700 C-F		. Hard rock. . Tuff. . Slightly weathered and developed crack.	. Surface water flows on the slope.	. Slope gradient is optimum but very steep above 20m thereafter. . Progress of weathering is may not be remarkable. . Wide shoulder. . Utilized as quarry.	. Re-cutting (above 20m) at top portion. . Stone masonry catch wall. . Side ditch.
7	IN-8-4	291 + 000 C-S.F		. Soft rock. . Tuff. . Highly weathered and developed crack.	. A little concentration of slope surface water.	. Slope gradient is steep, but not so high. . More progress of weathering occurs due to surface water. . There is a road at the top of slope.	. Re-filling. . Gravity type R.W. (lower portion) . Stone masonry R.W. (upper portion) . Berm ditch. . Side ditch.
8	IN-8-5	291 + 050 E-D.F		. Embankment material. (Cohesive Soil)	. Concentration of road surface water. . Road surface water also saturates into the embankment materials.	. Embankment slope is steep. . Poor drainage facilities.	. Re-filling. . Stone masonry retaining wall. . Side ditch. . Berm ditch. (Case Study)

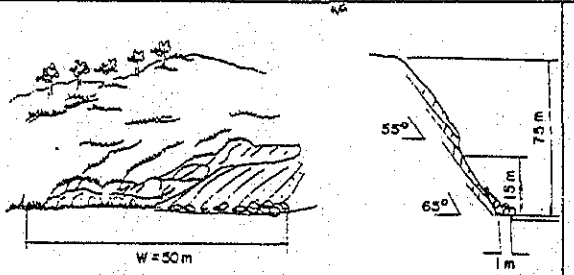
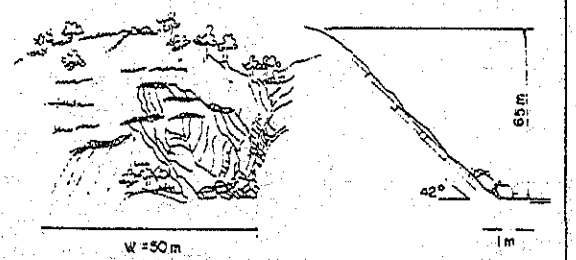
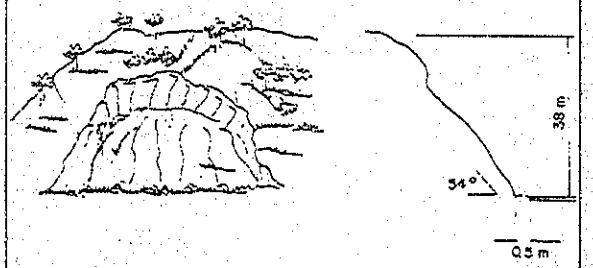
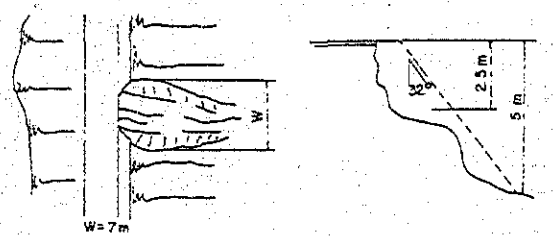
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES

NAGUILIAN ROAD

No.	Spot No.	Km. Type of Disaster	Existing Slope Condition			Factor for Selection of Countermeasure	Countermeasures
			Dimension of Slope	Geological Condition	Water Condition		
9	IN-10	293 + 500 C-F		. Hard rock. . Conglomerate. . Slightly weathered and regular crack. . Cracks inclined to road.	. Water from hinterland flows at a hollow on the slope.	. Slope is a little bit steep, but acceptable because of rock. . Progress of weathering may not be remarkable. . Weak portion exists in the slope between the strata. . Unstable rocks exists on slope.	. Removal. . Rock bolt. . Anchor wire net. . Side ditch.
10	IN-12	294 + 100 C-F		. Hard rock. . Sandstone and mudstone. . Slightly weathered and regular crack. . Cracks inclined to road.	. Water from hinterland flows on the slope and a little concentrated.	. Slope is optimum . Progress of weathering may not be remarkable. . Unstable rocks exists on slope.	. Removal. . Anchor wire net. . Side ditch.
11	IN-13	294 + 400 C(N)-S.F		. Hard rock. . Sandstone, shale and conglomerate. . Slightly weathered and regular crack.	. Water from hinterland flows on the slope.	. Slope is steep, but almost stable. . Progress of weathering may not be remarkable. . Unstable rocks exists on slope. . Big cracks developed.	. Removal. . Anchor wire net. . Side ditch.
12	IN-14	294 + 600 E-D.F		. Hard rock. . Tuffbrecciea. . Slightly weathered and regular crack.	. Concentrated of road surface water.	. Slope is steep and high. . Poor drainage facilities exist on the roadway. . Embankment materials were saturated by road surface water.	. Base concrete. . Gravity type R.W. (lower portion) . Stone masonry R.W. (upper portion) . Re-filling. . Berm ditch. . Side ditch.

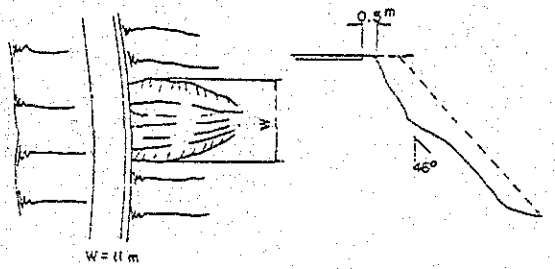
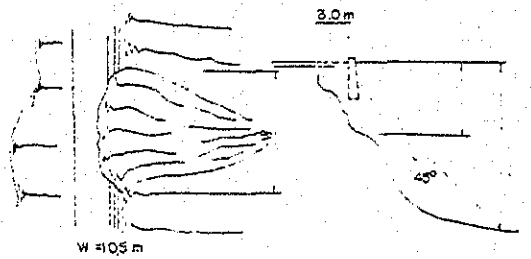
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES

NAGUILIAN ROAD

No.	Spot No.	Km. Type of Disaster	Existing Slope Condition: Dimension of Slope	Geological Condition	Water Condition	Factor for Selection of Countermeasure	Countermeasures
13	IN-15	204 + 600 C(N)-F		. Hard rock. . Tuff, tuffbrecciea. . Regular crack.	. Water from hinterland flows on the slope and a little concentrated.	. Slope is a little bit steep and high. . No progress of weathering is anticipated. . Falling rock size: 75cm . Big rocks are unstable. . Small rocks may fall.	. Removal. . Anchor wire net. . Side ditch.
14	IN-15-1	294 + 800 C(N)-S.F		. Hard rock. . Tuff, tuffbrecciea. . Regular crack.	. Water from hinterland flows on the slope and concentrated to depress area.	. Slope is optimum but high. . Weak portion exist in the slope between the strata. . No progress of weathering is anticipated. . Falling rock size: 75cm . Big rocks are unstable. . Small rock may fall.	. Removal. . Rock bolt. . Anchor wire net. . Catch fence.
15	IN-16	298 + 200 C-S.F		. Soft rock. . Conglomerate. . Highly weathered and developed crack.	. Water from hinterland flows on the slope and a little concentrated.	. Slope is a little bit steep but not so high. . Progress of weathering. . Poor drainage facilities exist on the roadway. . Slope is covered by trees and grasses.	. Re-cutting. . Vegetation. . Berm ditch. . Vertical ditch. . Side ditch. . Top slope ditch.
16	IN-19-1	301 + 000 E-D.F		. Embankment material. (Cohesive Soil)			. Under construction.

CONDITION OF DISASTER AND SELECTED COUNTERMEASURES

NAGUILIAN ROAD

No.	Spot No.	Km. Type of Disaster	Existing Slope Condition			Factor for Selection of Countermeasures	Countermeasures
			Dimension of Slope	Geological Condition	Water Condition		
17	IN-19-1	301 + 600 E-D.F		. Embankment material. (Gravelly Soil)	. Concentration of road surface water. . Road surface water saturates into embankment material.		. Under construction.
18	IN-23-1	301 + 500 E-D.F		Embankment material. (Gravelly Soil)	. Concentration of road surface water. . Road surface water saturates into embankment materials.		. Under construction.

APPENDICES FOR CHAPTER 7

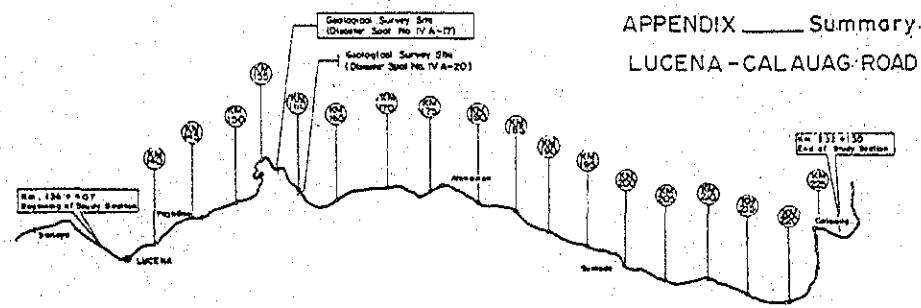
7.1-1	Geological Survey	163
7.1-2	Check Table	175

APPENDIX 7.1-1 GEOLOGICAL SURVEY

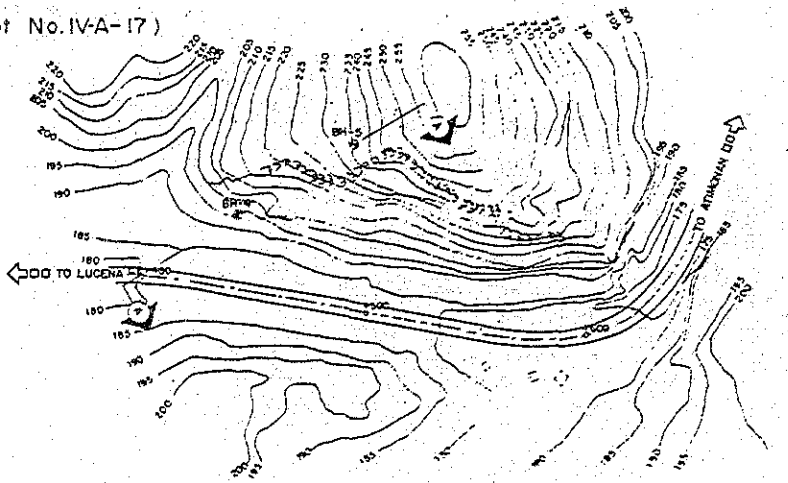
HALF REDUCED COPY

APPENDIX ____ Summary of Geological Survey

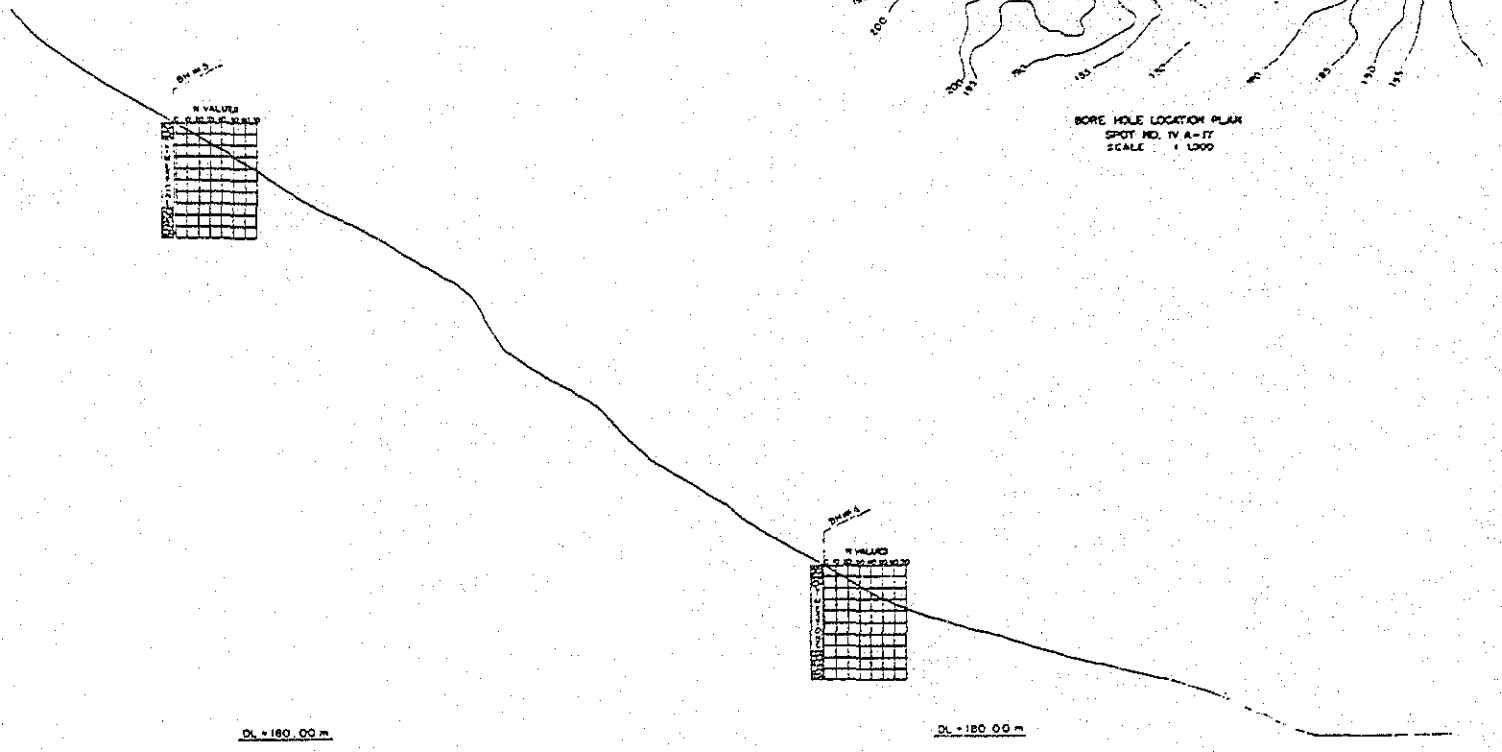
LUCENA - CALAUAG ROAD (Spot No. IV-A-17)



KEY MAP LUCENA - CALAUAG SECTION
SCALE 1 : 250,000

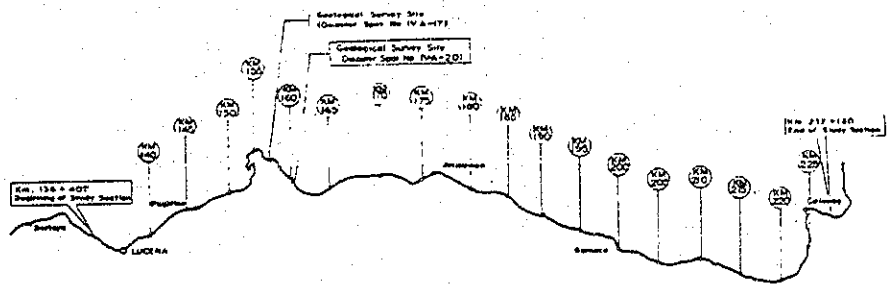


BORE HOLE LOCATION PLAN
SPOT NO. IV A-17
SCALE 1 : 1,000

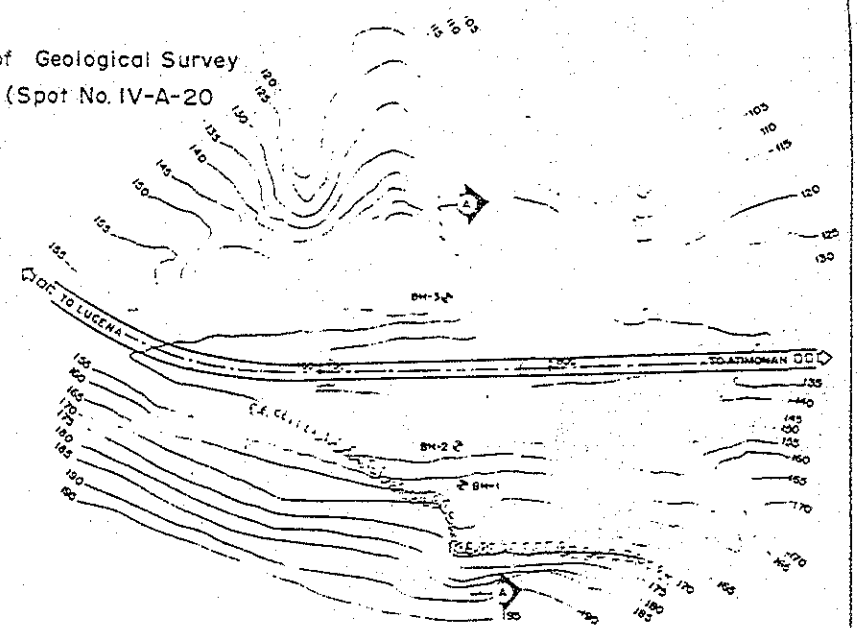


HALF REDUCED COPY

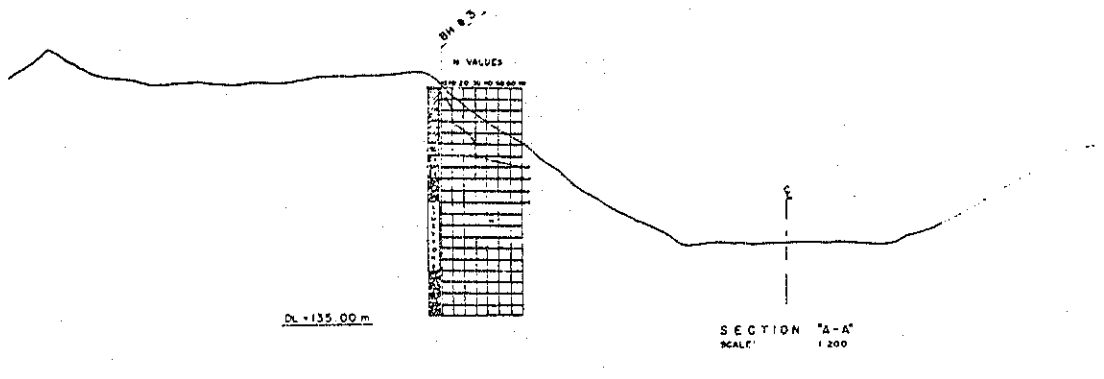
APPENDIX____ Summary of Geological Survey
LUCENA – CALAUAG ROAD (Spot No. IV-A-20



KEY MAP LUCENA – CALAUAG SECTION
SCALE 1" 250,000'



BORE HOLE LOCATION PLAN
SPOT NO IV-A-20
SCALE 1:1,000

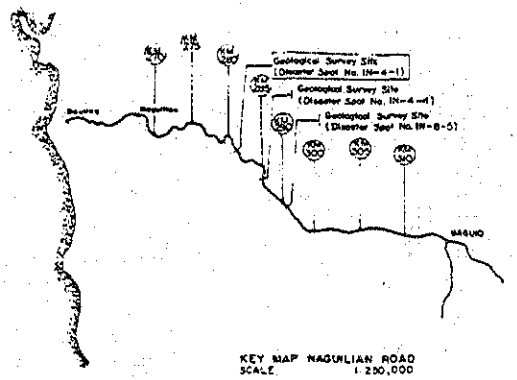


SECTION "A-A"
SCALE 1:200

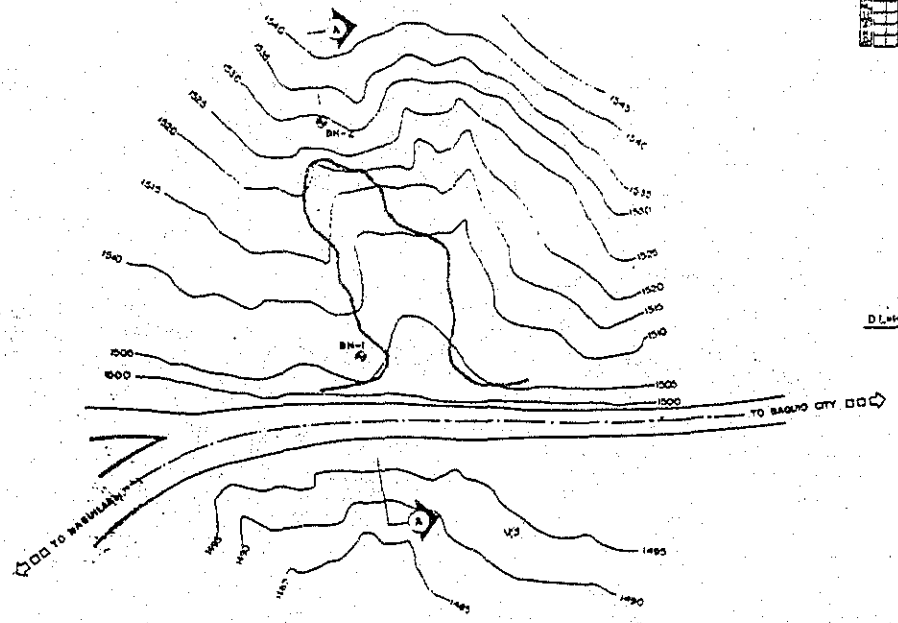
HALF REDUCED COPY

APPENDIX ____ Summary of Geological Survey

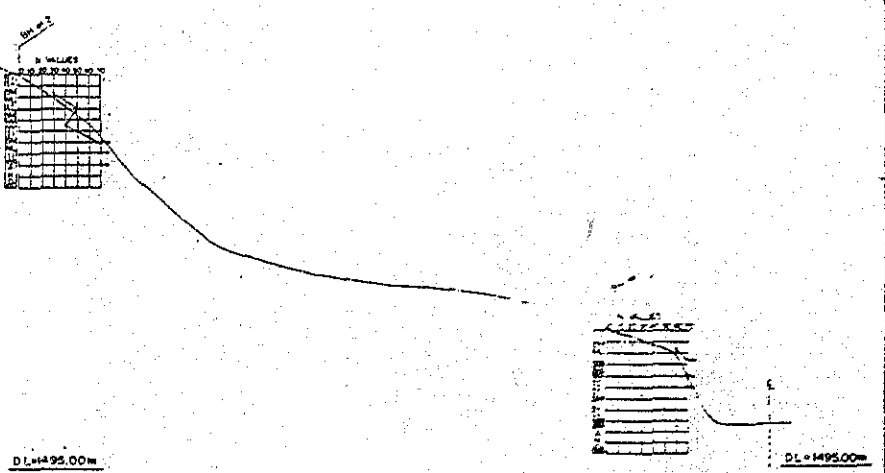
NAGUILIAN ROAD (Spot No. 4-1)



KEY MAP NAGUILIAN ROAD
SCALE 1:250,000



BORE HOLE LOCATION PLAN
SPOT NO. 4-1
SCALE 1:500

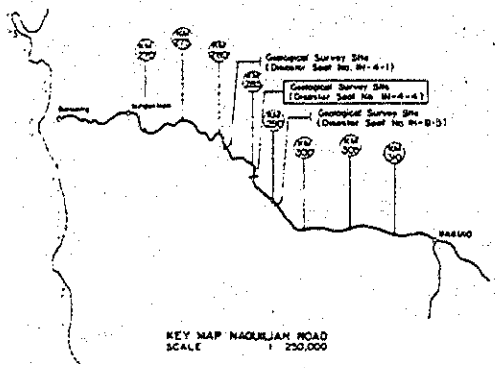


SECTION A-A
SCALE 1:200

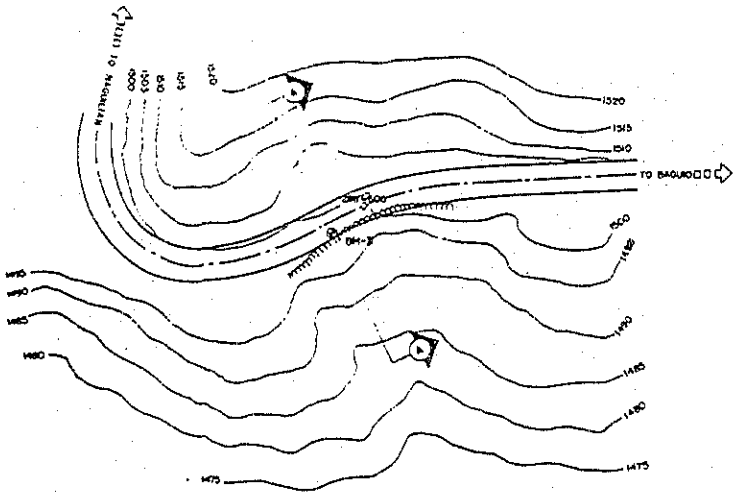
HALF REDUCED COPY

APPENDIX ____ Summary of Geological Survey

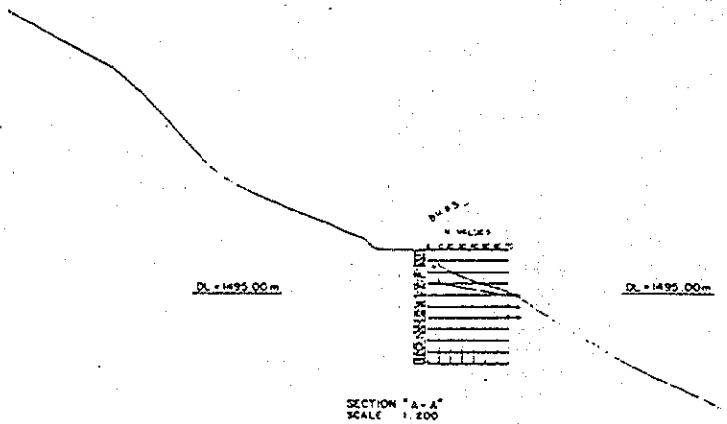
NAGUILIAN ROAD (Spot No. 4 -4)



KEY MAP NAGUILIAN ROAD
SCALE 1 : 250,000



BORE HOLE LOCATION PLAN
SPOT NO. IN-4-4
SCALE 1 : 500

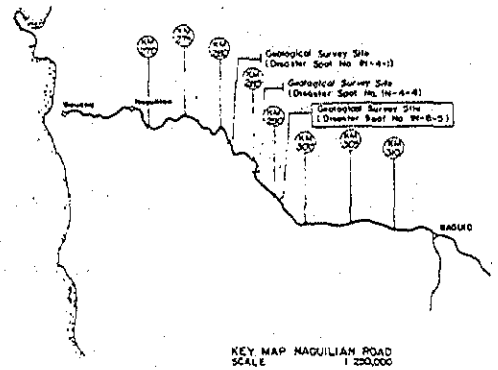


SECTION "A - A"
SCALE 1 : 200

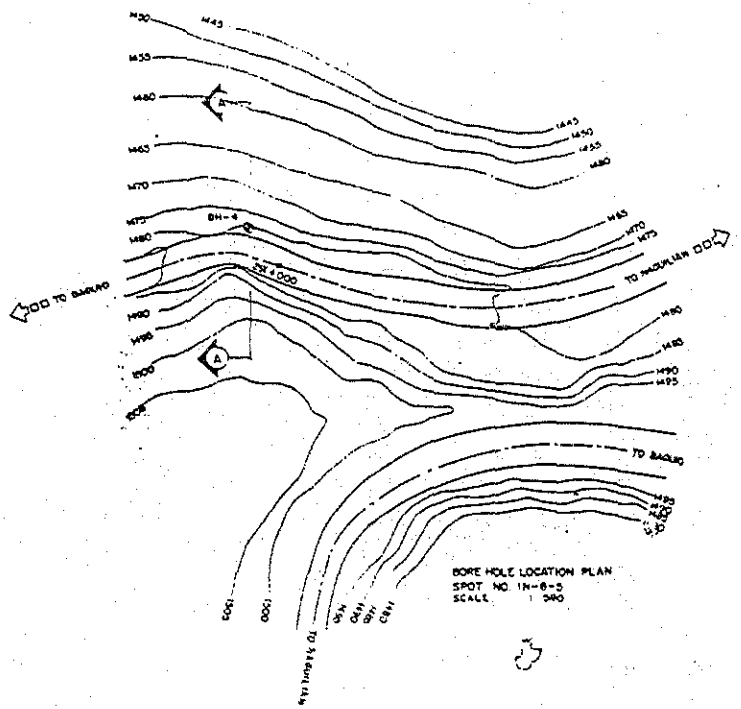
HALF REDUCED COPY

APPENDIX ____ Summary of Geological Survey

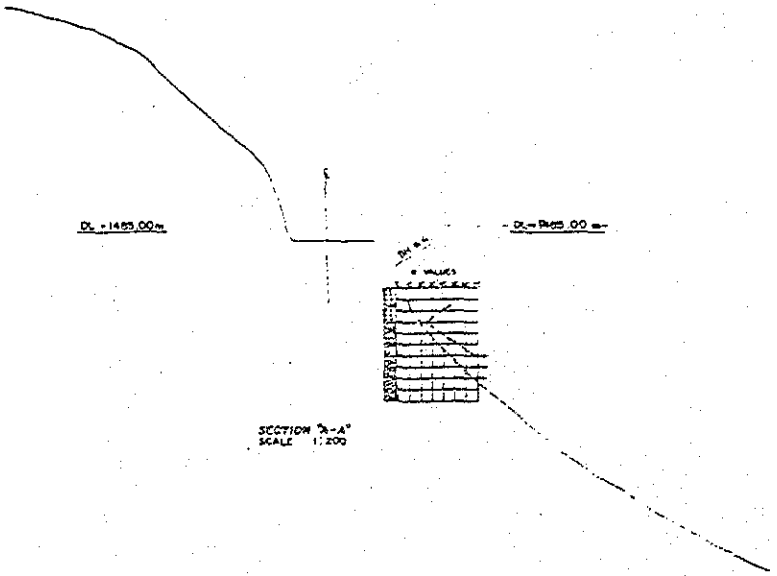
NAGUILIAN ROAD (Spot No. 8-5)



KEY MAP NAGUILIAN ROAD
SCALE 1:250,000



BORE HOLE LOCATION PLAN
SPOT NO. IN-8-5
SCALE 1:500



SECTION "A-A"
SCALE 1:200

BORING LOG

Km. 160.80

PROJECT ROAD DISASTER PREVENTION PROJ. JOB NO. 720 BORE HOLE NO. BH-1
LOCATION Bgy. Malinao Ilaya, Atimonan, Quezon DATE STARTED 11-17-84 DATE COMPLETED 11-18-84
GROUND WATER ELEV. 3.75 m GROUND SURFACE ELEV. 158.067 m
DRILLING METHOD washboring and coring SAMPLERS USED 5.0 cm OD-SS, NXL-CB
WT. OF HAMMER 63.6 kg HAMMER FALL 76.2 cm

DEPTH IN M	GRAPH	DESCRIPTION	CONSISTENCY	NMC PL—O—LL (20 40 60 80 100)	P.I.	O BLOW COUNT, N ● % RECOVERY (20 40 60 80 100)	OTHER TEST DATA
0	GM	Very moist yellowish brown sandy silty GRAVEL	FIRM				ROD %
5	LIMESTONE						
10		Dirty white highly weathered LIMESTONE with silt-clay matrix	VERY DENSE				
15							
20		END OF BORING AT 20.00 M.					

NOTE: BETWEEN 2.50 - 20.00m is Coring

BORING LOG

Km. 160.80

PROJECT ROAD DISASTER PREVENTION PROJ. JOB NO. 720 BORE HOLE NO. BH-2
LOCATION Bgy. Malinao Ilaya, Atimonan, Q. DATE STARTED 11-14-84 DATE COMPLETED 11-15-84
GROUND WATER ELEV. 6.15 m GROUND SURFACE ELEV. 151.351 m
DRILLING METHOD washboring and coring SAMPLERS USED 50 cm OD-SS, NXL-CB
WT. OF HAMMER 63.6 kg HAMMER FALL 76.2 cm

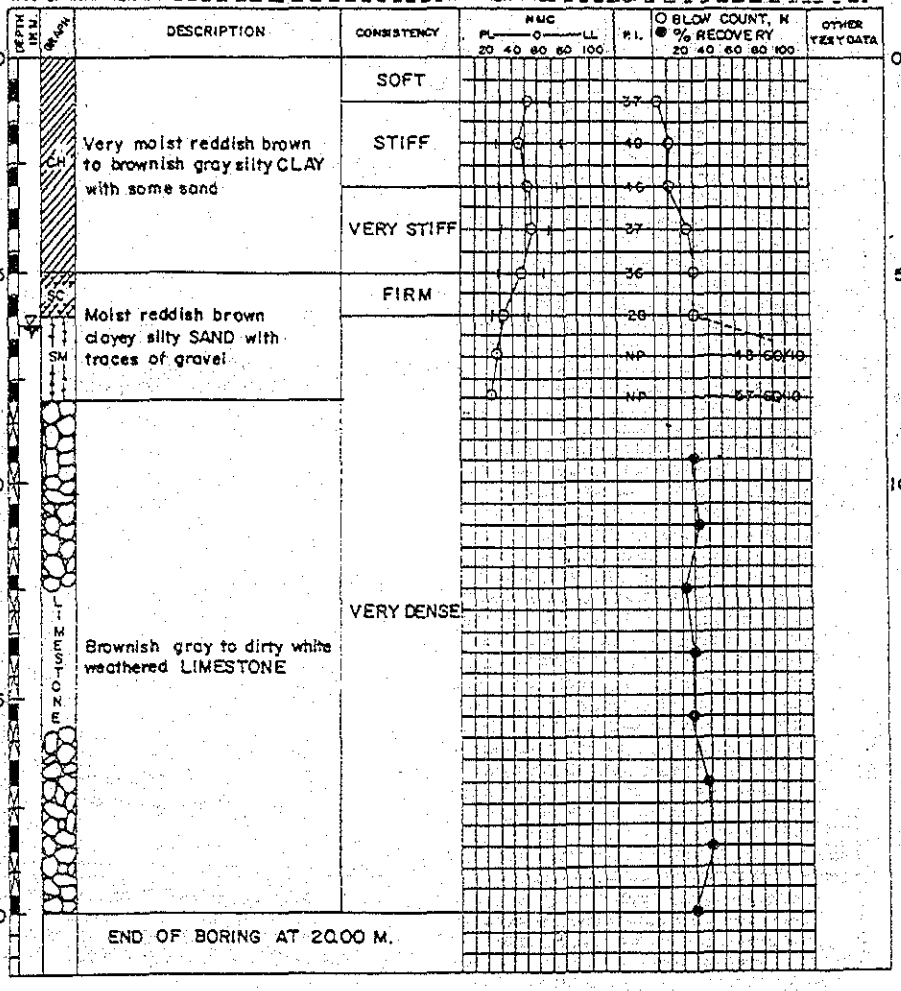
DEPTH IN M	GRAPH	DESCRIPTION	CONSISTENCY	NMC PL—O—LL (20 40 60 80 100)	P.I.	O BLOW COUNT, N ● % RECOVERY (20 40 60 80 100)	OTHER TEST DATA
0	GP	Moist yellowish brown sandy GRAVEL with traces of silt	DENSE		NP		
	SW	Dry yellowish brown gravelly SAND with traces of silt			NP		
5	LIMESTONE	Dirty white highly weathered LIMESTONE	VERY DENSE				
10	MH	Very moist dark gray clayey SILT	HARD		26		
			VERY STIFF		17		
					19		
15	CH	Very moist brownish gray silty CLAY	HARD		29		
					32		
					46		
	MH	Moist dark gray clayey SILT			40		
					43		
					27		
					24		
20		END OF BORING AT 20.00 M.			24		

NOTE: BETWEEN 2.50 - 9.00 m is Coring

B O R I N G L O G

Km 160.80

PROJECT _ ROAD DISASTER PREVENTION PROJ. JOB NO. 720 BORE HOLE NO. BH-3
LOCATION _ Bgy. Malinao Ilaya, Atimonan, Quezon DATE STARTED 11-19-84 DATE COMPLETED 11-21-84
GROUND WATER ELEV. 6.20 m GROUND SURFACE ELEV. 154.613 m
DRILLING METHOD washboring and coring SAMPLERS USED 5.0 cm OD-SS, NXL-CB
WT. OF HAMMER 63.6 kg HAMMER FALL 76.2 cm

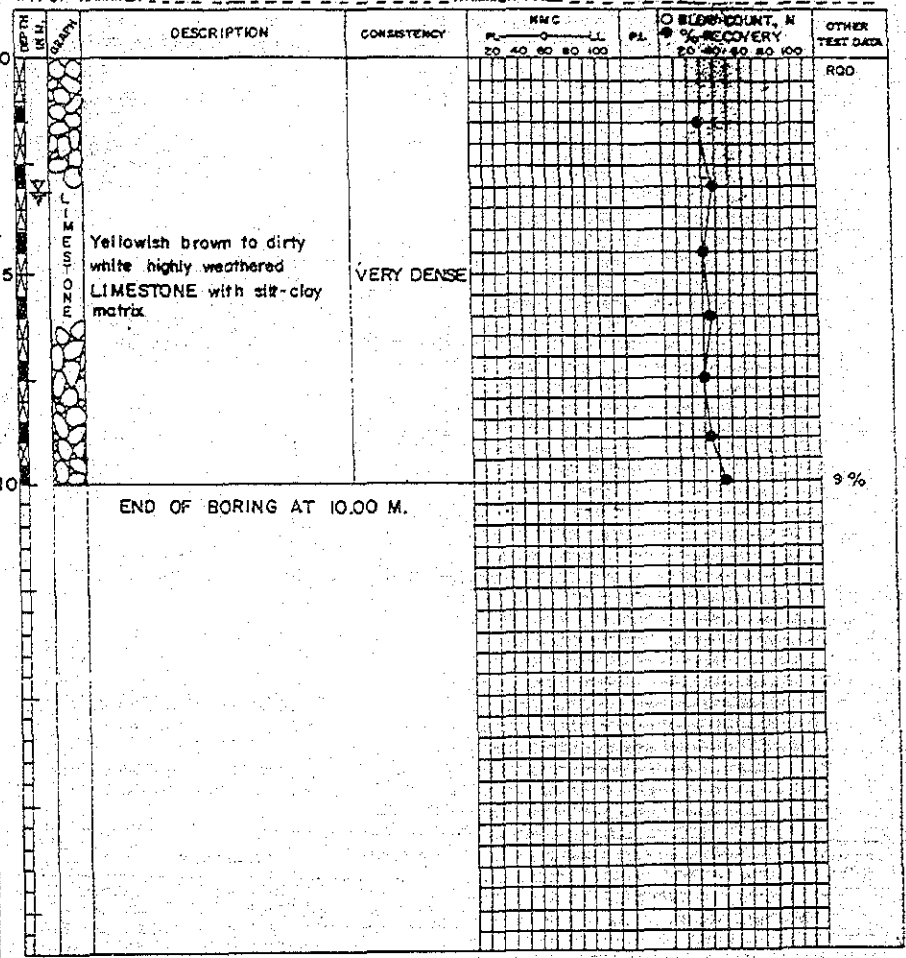


NOTE: BETWEEN 9.50 - 20.00 m is Coring

B O R I N G L O G

Km 158.50

PROJECT _ ROAD DISASTER PREVENTION PROJ. JOB NO. 720 BORE HOLE NO. BH-4
LOCATION _ Sta. Catalina, Atimonan, Quezon DATE STARTED 11-24-84 DATE COMPLETED 11-25-84
GROUND WATER ELEV. 3.05 m GROUND SURFACE ELEV. 230.00 m
DRILLING METHOD coring SAMPLERS USED NXL-CB
WT. OF HAMMER HAMMER FALL



NOTE: BETWEEN 1.50 - 10.00m is Coring

APPENDIX _____ BORING LOG (LUCENA-CALAUAG SECTION)(3)

B O R I N G L O G

Km. 158.80

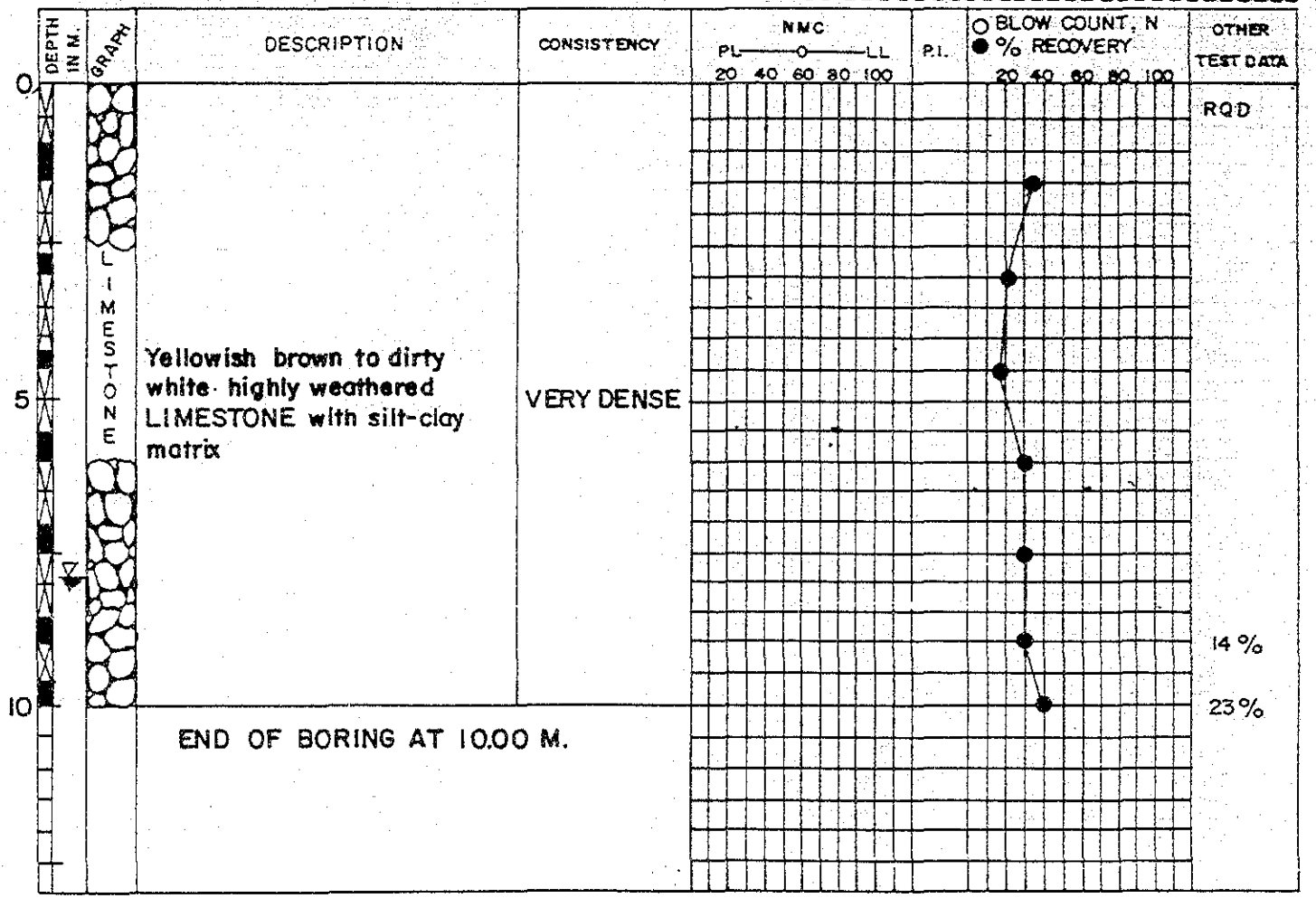
PROJECT ROAD DISASTER PREVENTION PROJ. JOB NO. 720 BORE HOLE NO. BH-5

LOCATION Sta Catalina, Atimonan, Quezon DATE STARTED 11-20-84 DATE COMPLETED 11-26-84

GROUND WATER ELEV. 7.80 M GROUND SURFACE ELEV. 235.253 m

DRILLING METHOD coring SAMPLERS USED NXL-CB

WT. OF HAMMER _____ HAMMER FALL _____



NOTE: BETWEEN 1.50 - 10.00m is Coring

BORING LOG

Ka. 282

PROJECT ROAD DISASTER PREVENTION PROJ. JOB NO. 720 BORE HOLE NO. BH-1
LOCATION Naguilian Road, Benguet DATE STARTED 11-30-84 DATE COMPLETED 12-1-84
GROUND WATER ELEV. 3.25 m GROUND SURFACE ELEV. 461.936 m
DRILLING METHOD washboring and coring SAMPLERS USED 5.0 cm OD-SS, NQ-CB
WT. OF HAMMER 63.6 Kg. HAMMER FALL 76.2 cm.

DEPTH IN M.	GRAPH	DESCRIPTION	CONSISTENCY	NMC PL—O—LL (20 40 60 80 100)	P.I.	BLOW COUNT, N / % RECOVERY (20 40 60 80 100)	OTHER TEST DATA
0	SM ML	Moist light brown clayey silty SAND	VERY DENSE		9	60/15	
		Brownish gray vesicular basalt GRAVEL to COBBLES with weakly cemented SILTSTONE			8	60/15	
5	SM	Moist brownish gray silty SAND with traces of weathered andesite fragments			NP	60/15	
					NP	60/15	
		Gray highly weathered ANDESITE				60/15	
10		END OF BORING AT 10.00 M.					

BORING LOG

Ka. 282

PROJECT ROAD DISASTER PREVENTION PROJ. JOB NO. 720 BORE HOLE NO. BH-2
LOCATION Naguilian Road, Benguet DATE STARTED 11-3-84 DATE COMPLETED 11-4-84
GROUND WATER ELEV. 3.50 m GROUND SURFACE ELEV. 483.536 m.
DRILLING METHOD washboring and coring SAMPLERS USED 5.0 cm OD-SS, NQ-CB
WT. OF HAMMER 63.6 Kg. HAMMER FALL 76.2 cm.

DEPTH IN M.	GRAPH	DESCRIPTION	CONSISTENCY	NMC PL—O—LL (20 40 60 80 100)	P.I.	BLOW COUNT, N / % RECOVERY (20 40 60 80 100)	OTHER TEST DATA
0	SM ML		DENSE			15	
	SM MH	Moist light brown clayey silty SAND				15	
5	SM ML					27	
			VERY DENSE			12	
		Light brown highly weathered ANDESITE				6 — 60/10	
10		END OF BORING AT 10.00 M.					

BORING LOG

Km. 286-287

PROJECT: ROAD DISASTER PREVENTION PROJ. JOB NO. 720 BORE HOLE NO. BH-3
LOCATION: Naguilian Road, Benguet DATE STARTED 11-28-84 DATE COMPLETED 11-29-84
GROUND WATER ELEV. 3.00 m. GROUND SURFACE ELEV. 643.765 m
DRILLING METHOD: washboring and coring SAMPLERS USED 5.0cm. OD-SS, NQ-CB
WT. OF HAMMER: 63.6 Kg. HAMMER FALL 76.2 cm

DEPTH IN M.	GRAPH	DESCRIPTION	CONSISTENCY	NMC PL—O—LL (20 40 60 80 100)	P.I.	BLOW COUNT, N ● % RECOVERY (20 40 60 80 100)	OTHER TEST DATA
0	CH	Very moist reddish brown sandy silty CLAY with traces of gravel	FIRM				
	SM	Moist reddish brown clayey silty SAND with traces of fine gravel					
5		Light gray fractured ANDESITE with traces of siltstone veinlets	VERY DENSE				
10		END OF BORING AT 10.00 M.					

BORING LOG

Km. 291

PROJECT ROAD DISASTER PREVENTION PROJ. JOB NO. 720 BORE HOLE NO. BH-4
LOCATION Naguilian Road, Benguet DATE STARTED 11-25-84 DATE COMPLETED 11-27-84
GROUND WATER ELEV. below 10.10 m GROUND SURFACE ELEV. 632.710 m
DRILLING METHOD washboring and coring SAMPLERS USED 5.0 cm. OD-SS, NQ-CB
WT. OF HAMMER 63.6 Kg. HAMMER FALL 76.2 cm

DEPTH IN M.	GRAPH	DESCRIPTION	CONSISTENCY	NMC PL—O—LL (20 40 60 80 100)	P.I.	BLOW COUNT, N ● % RECOVERY (20 40 60 80 100)	OTHER TEST DATA
0	SM	Moist reddish brown silty SAND with some gravel	DENSE		NP		
			FIRM		NP		
	CH	Very moist reddish brown silty CLAY with some sand	HARD		40		
5	SM ML	Moist reddish brow clayey silty SAND			5		
	SM	Moist reddish brown silty SAND with some gravel			NP	60/10	
		Reddish brown andesite GRAVEL to COBBLES	VERY DENSE				
10		END OF BORING AT 10.10 M.			NP	60/10	
15							