APPENDICES

Appendix-1 Construction Cost of Master Plan

Table-A.1.1 Construction Cost of River Improvement Works (5 year return period)

Rp		Unit Cost	River-bed Formation		Rehabilitation		Concrete Channel		Flood Wall Heightening		River Widening		Other Facility 35%		Total Cost
			Quantity	Construction Cost	Quantity	Construction Cost	Quantity	Construction Cost	Quantity	Construction Cost	Quantity	Construction Cost	Quantity	Construction Cost	
(1) Ruhu	Excavation	16,200 (Rp/m³)	53,800	872		0		0		0	4,800	78		0	
	Concrete	670,000 (Rp/m³)		0	4,284	2,870		0	195	131	1,590	1,065		0	
	Stream Diversion	1,000,000 (Rp/m)		0		0		0		0		0		0	
	Anchor-work	6,300,000 (Rp/m)		0		0		0		0	300	1,890		0	
	Total Cost			872		2,870		0		131		3,033		2,417	9,323
(2) Batu Merah	Excavation	16,200 (Rp/m³)	23,400	379		0		0		0	1,113	18		0	
	Concrete	670,000 (Rp/m³)		0	4,440	2,975	2,850	1,910	312	209	371	249		0	
	Stream Diversion	1,000,000 (Rp/m)		0		0	1,200	1,200		0		0		0	
	Anchor-work	6,300,000 (Rp/m)		0		0		0		0	70	441		0	
	Total Cost			379		2,975		3,110		209		708		2,583	9,964
(3) Tomu	Excavation	16,200 (Rp/m³)	26,500	429		0		0		0		0		0	
	Concrete	670,000 (Rp/m³)		0	417	279		0	411	275		0		0	
	Stream Diversion	1,000,000 (Rp/m)		0		0		0		0		0		0	
	Anchor-work	6,300,000 (Rp/m)		0		0		0		0		0		0	
	Total Cost			429		279		0		275		0		344	1,327
(4) Batu Gajah	Excavation	16,200 (Rp/m³)	49,500	802		0		0		0		0		0	
	Concrete	670,000 (Rp/m³)		0	6,012	4,028		0	116	78		0		0	
	Stream Diversion	1,000,000 (Rp/m)		0		0		0		0		0		0	
	Anchor-work	6,300,000 (Rp/m)		0		0		0		0		0		0	
	Total Cost			802		4,028		0		78		0		1,718	6,626
(5) Batu Gantung	Excavation	16,200 (Rp/m³)	21,300	345		0		0		0		0		0	
	Concrete	670,000 (Rp/m³)		0	4,350	2,915	570	382	100	67		0		0	
	Stream Diversion	1,000,000 (Rp/m)		0		0	250	250		0		0		0	
	Anchor-work	6,300,000 (Rp/m)		0		0		0		0		0		0	
	Total Cost			345		2,915		632		67		0		1,386	5,345

Table-A.1.2 Construction Cost of River Improvement Works (10 year return period)

Rp		Unit Cost	River-bed Formation		Rehabilitation		Concrete Channel		Flood Wall Heightening		River Widening		Other Facility 35%		Total Cost
			Quantity	Construction Cost	Quantity	Construction Cost	Quantity	Construction Cost	Quantity	Construction Cost	Quantity	Construction Cost	Quantity	Construction Cost	
(1)	Excavation	16,200 (Rp/m³)	64,000	1,037		0		0		0	17,600	285		0	
Ruhu	Concrete	670,000 (Rp/m³)		0	4,800	3,216		0	195	131	5,830	3,906		0	
	Stream Diversion	1,000,000 (Rp/m)		0		0		0		0		0		0	
	Anchor-work	6,300,000 (Rp/m)		0		0		0		0	1,100	6,930		0	
	Total Cost			1,037		3,216		0		131		11,121		5,427	20,932
(2)	Excavation	16,200 (Rp/m³)	26,200	424		0		0		0	15,105	245		0	
Batu	Concrete	670,000 (Rp/m³)		0	4,800	3,216	3,510	2,352	708	474	5,035	3,373		0	
Merah	Stream Diversion	1,000,000 (Rp/m)		0		0	1,200	1,200		0		0		0	
	Anchor-work	6,300,000 (Rp/m)		0		0		0		0	950	5,985		0	
	Total Cost			424		3,216		3,552		474		9,603		6,044	23,313
(3)	Excavation	16,200 (Rp/m³)	46,000	745		0		0		0		0		0	
Tomu	Concrete	670,000 (Rp/m³)		0	5,669	3,798		0	40	27		0		0	
	Stream Diversion	1,000,000 (Rp/m)		0		0		0		0		0		0	
	Anchor-work	6,300,000 (Rp/m)		0		0		0		0		0		0	
	Total Cost			745		3,798		0		27		0		1,600	6,170
(4)	Excavation	16,200 (Rp/m³)	49,500	802		0		0		0		0		0	
Baru	Concrete	670,000 (Rp/m³)		0	5,824	3,902	1,680	1,126	304	204		0		0	
Gajah	Stream Diversion	1,000,000 (Rp/m)		0		0	700	700		0		0		0	
	Anchor-work	6,300,000 (Rp/m)		0		0		0		0		0		0	
	Total Cost			802		3,902		1,826		204		0		2,357	9,091
(5)	Excavation	16,200 (Rp/m³)	21,300	345		0		0		0		0		0	
Batu	Concrete	670,000 (Rp/m³)		0	4,233	2,836	2,200	1,474	100	67		0		0	
Gantung	Stream Diversion	1,000,000 (Rp/m)		0		0	900	900		0		0		0	
	Anchor-work	6,300,000 (Rp/m)		0		0		0		0		0		0	
	Total Cost			345		2,836		2,374		67		0		1,968	7,590

Table-A.1.3 Construction Cost of River Improvement Works (30 year return period)

	Rp	River-bed Formation		Rehabilitation		Concrete Channel		Flood Wall Heightening		River Widening		Other Facility 35%		Total Cost
	Unit Cost	Quantity	Construction Cost	Quantity	Construction Cost	Quantity	Construction Cost	Quantity	Construction Cost	Quantity	Construction Cost	Quantity	Construction Cost	
(1) Ruhu														
Excavation	16,200 (Rp/m³)	75,900	1,230		0		0		0	26,400	428		0	
Concrete	670,000 (Rp/m³)	4,800	3,216	2,000	1,340		0	368	247	5,830	3,906		0	
Stream Diversion	1,000,000 (Rp/m)		0		0		0		0		0		0	
Anchor-work	6,300,000 (Rp/m)		0		0		0		0	1,100	6,930		0	
Total Cost			4,446		1,340		0		247		11,264	17,297	6,054	23,351
(2) Ruhu (2)														
Excavation	16,200 (Rp/m³)	65,100	1,055		0		0		0	32,400	525		0	
Concrete	670,000 (Rp/m³)	4,800	3,216	2,800	1,876		0	392	263	4,770	3,196		0	
Stream Diversion	1,000,000 (Rp/m)		0		0		0		0		0		0	
Anchor-work	6,300,000 (Rp/m)		0		0		0		0	900	5,670		0	
Total Cost			4,271		1,876		0		263		9,391	15,801	5,530	21,331
(3) Ruhu (3)														
Excavation	16,200 (Rp/m³)	70,100	1,136		0		0		0	37,400	606		0	
Concrete	670,000 (Rp/m³)	4,800	3,216	2,000	1,340		0	368	247	5,830	3,906		0	
Stream Diversion	1,000,000 (Rp/m)		0		0		0		0		0		0	
Anchor-work	6,300,000 (Rp/m)		0		0		0		0	1,100	6,930		0	
Total Cost			4,352		1,340		0		247		11,442	17,381	6,083	23,464
(4) Batu Merah														
Excavation	16,200 (Rp/m³)	30,400	492		0		0		0	19,200	311		0	
Concrete	670,000 (Rp/m³)	4,800	3,216	800	536	5,220	3,497	708	474	6,360	4,261		0	
Stream Diversion	1,000,000 (Rp/m)		0		0	1,400	1,400		0		0		0	
Anchor-work	6,300,000 (Rp/m)		0		0		0		0	1,200	7,560		0	
Total Cost			3,708		536		4,897		474		12,132	21,747	7,611	29,358
(5) Tomu														
Excavation	16,200 (Rp/m³)	46,000	745		0		0		0		0		0	
Concrete	670,000 (Rp/m³)	5,040	3,377	5,617	3,763	5,790	3,879	40	27		0		0	
Stream Diversion	1,000,000 (Rp/m)		0		0	2,100	2,100		0		0		0	
Anchor-work	6,300,000 (Rp/m)		0		0		0		0		0		0	
Total Cost			4,122		3,763		5,979		27		0	13,891	4,862	18,753
(6) Batu Gajah														
Excavation	16,200 (Rp/m³)	54,900	889		0		0		0	7,500	122		0	
Concrete	670,000 (Rp/m³)	6,300	4,221	6,000	4,020	5,400	3,618	200	134	5,830	3,906		0	
Stream Diversion	1,000,000 (Rp/m)		0		0	1,900	1,900		0		0		0	
Anchor-work	6,300,000 (Rp/m)		0		0		0		0	1,100	6,930		0	
Total Cost			5,110		4,020		5,518		134		10,958	25,740	9,009	34,749
(7) Bata Gantung														
Excavation	16,200 (Rp/m³)	26,300	426		0		0		0	5,400	87		0	
Concrete	670,000 (Rp/m³)	4,350	2,915	3,600	2,412	3,780	2,533		0	2,915	1,953		0	
Stream Diversion	1,000,000 (Rp/m)		0		0	1,300	1,300		0		0		0	
Anchor-work	6,300,000 (Rp/m)		0		0		0		0	550	3,465		0	
Total Cost			3,341		2,412		3,833		0		5,505	15,091	5,282	20,373

Table-A.1.4 Construction Cost of River Diversion

	Rp		Fixed Weir		Tunnel		Open Channel		Other Facility 35%		Total Cost
		Unit Cost	Quantity	Construction Cost	Quantity	Construction Cost	Quantity	Construction Cost	Quantity	Construction Cost	
(1) Ruhu	Excavation	16.200 (Rp/m^3)		0			12.180	198		0	
	Concrete	670.000 (Rp/m^3)	190	128		0	2.645	1.773		0	
	Tunnel	640.000 (Rp/m^3)		0		0		0		0	
	Total Cost			128		0		1.971	2.099	0	2.834
(2) Ruhu (2)	Excavation	16.200 (Rp/m^3)		0			9.454	154		0	
	Concrete	670.000 (Rp/m^3)	170	114		0	2.367	1.586		0	
	Tunnel	640.000 (Rp/m^3)		0		0		0		0	
	Total Cost			114		0		1.740	1.854	0	2.503
(3) Batu Merah (1)	Excavation	16.200 (Rp/m^3)		0		0		0		0	
	Concrete	670.000 (Rp/m^3)	140	94		0		0		0	
	Tunnel	640.000 (Rp/m^3)		0	33.480	21.428		0		0	
	Total Cost			94		21.428		0	21.522	0	29.055
(4) Batu Merah (2)	Excavation	16.200 (Rp/m^3)		0		0		0		0	
	Concrete	670.000 (Rp/m^3)	120	81		0		0		0	
	Tunnel	640.000 (Rp/m^3)		0	25.920	16.589		0		0	
	Total Cost			81		16.589		0	16.670	0	22.505
(5) Tomu (1)	Excavation	16.200 (Rp/m^3)		0		0	4.420	72		0	
	Concrete	670.000 (Rp/m^3)	130	88		0	1.560	1.046		0	
	Tunnel	640.000 (Rp/m^3)		0	13.140	8.410		0		0	
	Total Cost			88		8.410		1.118	9.616	0	12.982
(6) Tomu (2)	Excavation	16.200 (Rp/m^3)		0		0	3.273	54		0	
	Concrete	670.000 (Rp/m^3)	110	74		0	1.365	915		0	
	Tunnel	640.000 (Rp/m^3)		0	9.180	5.876		0		0	
	Total Cost			74		5.876		969	6.919	0	9.341

Table-A.1.5 Dam Construction Cost

(1) Ruhu(1) EL.64.000

Work Item	Unit Cost (Rp)	Quantity	Construction Cost (Rp x 10⁶)
(1) Diversion	9,200,000 Rp/m	580	5,336
(2) Dam Body	52,000 Rp/m³	201,000	10,452
(3) Spillway	670,000 Rp/m³	7,020	4,703
(4) Intake	3,000 x 10⁶	1	3,000
(5) Foundation	300,000 Rp/m³	5,279	1,584
(6) Other Works (25%)			6,269
Construction Cost			31,344

(2) Ruhu (2) EL.64.640

Work Item	Unit Cost (Rp)	Quantity	Construction Cost (Rp x 10⁶)
(1) Diversion	9,200,000 Rp/m	543	4,996
(2) Dam Body	52,000 Rp/m³	172,000	8,944
(3) Spillway	670,000 Rp/m³	6,857	4,594
(4) Intake	3,000 x 10⁶	1	3,000
(5) Foundation	300,000 Rp/m³	4,729	1,419
(6) Other Works (25%)			5,738
Construction Cost			28,691

(3) Batu Merah (1) EL.31.000

Work Item	Unit Cost (Rp)	Quantity	Construction Cost (Rp x 10⁶)
(1) Diversion	9,200,000 Rp/m	357	3,284
(2) Dam Body	52,000 Rp/m³	115,000	5,980
(3) Spillway	670,000 Rp/m³	5,868	3,932
(4) Intake	3,000 x 10⁶	1	3,000
(5) Foundation	300,000 Rp/m³	4,188	1,256
(6) Other Works (25%)			4,363
Construction Cost			21,815

(4) Batu Merah (2) EL.29.10

Work Item	Unit Cost (Rp)	Quantity	Construction Cost (Rp x 10⁶)
(1) Diversion	9,200,000 Rp/m	330	3,036
(2) Dam Body	52,000 Rp/m³	94,000	4,888
(3) Spillway	670,000 Rp/m³	5,730	3,839
(4) Intake	3,000 x 10⁶	1	3,000
(5) Foundation	300,000 Rp/m³	3,638	1,091
(6) Other Works (25%)			3,964
Construction Cost			19,818

(5) Tomu (1) EL.68.2

Work Item	Unit Cost (Rp)	Quantity	Construction Cost (Rp x 10^6)
(1) Diversion	9,200,000 Rp/m	414	3,809
(2) Dam Body	52,000 Rp/m^3	271,000	14,092
(3) Spillway	670,000 Rp/m^3	6,173	4,136
(4) Intake	3,000 x 10^6	1	3,000
(5) Foundation	300,000 Rp/m^3	6,680	2,004
(6) Other Works (25%)			6,761
Construction Cost			33,802

(6) Tomu (2) EL.61.80

Work Item	Unit Cost (Rp)	Quantity	Construction Cost (Rp x 10^6)
(1) Diversion	9,200,000 Rp/m	326	2,999
(2) Dam Body	52,000 Rp/m^3	159,000	8,268
(3) Spillway	670,000 Rp/m^3	5,708	3,824
(4) Intake	3,000 x 10^6	1	3,000
(5) Foundation	300,000 Rp/m^3	4,674	1,402
(6) Other Works (25%)			4,873
Construction Cost			24,367

(7) Batu Gajah (1) EL.68.00

Work Item	Unit Cost (Rp)	Quantity	Construction Cost (Rp x 10^6)
(1) Diversion	9,200,000 Rp/m	480	4,416
(2) Dam Body	52,000 Rp/m^3	292,000	15,184
(3) Spillway	670,000 Rp/m^3	6,522	4,370
(4) Intake	3,000 x 10^6	1	3,000
(5) Foundation	300,000 Rp/m^3	9,350	2,805
(6) Other Works (25%)			7,444
Construction Cost			37,218

(8) Batu Gajah (2) EL.65.30

Work Item	Unit Cost (Rp)	Quantity	Construction Cost (Rp x 10^6)
(1) Diversion	9,200,000 Rp/m	443	4,076
(2) Dam Body	52,000 Rp/m^3	235,000	12,220
(3) Spillway	670,000 Rp/m^3	6,326	4,238
(4) Intake	3,000 x 10^6	1	3,000
(5) Foundation	300,000 Rp/m^3	8,177	2,453
(6) Other Works (25%)			6,497
Construction Cost			32,484

(9) Batu Gantung (1) EL.68.000

Work Item	Unit Cost (Rp)	Quantity	Construction Cost (Rp x 10^6)
(1) Diversion	9,200,000 Rp/m	528	4,858
(2) Dam Body	52,000 Rp/m^3	228,000	11,856
(3) Spillway	670,000 Rp/m^3	6,642	4,450
(4) Intake	3,000 x 10^6	1	3,000
(5) Foundation	300,000 Rp/m^3	6,800	2,040
(6) Other Works (25%)			6,551
Construction Cost			32,755

(10) Batu Gantung (2) EL.65.30

Work Item	Unit Cost (Rp)	Quantity	Construction Cost (Rp x 10^6)
(1) Diversion	9,200,000 Rp/m	480	4,416
(2) Dam Body	52,000 Rp/m^3	174,000	9,048
(3) Spillway	670,000 Rp/m^3	6,387	4,279
(4) Intake	3,000 x 10^6	1	3,000
(5) Foundation	300,000 Rp/m^3	5,610	1,683
(6) Other Works (25%)			5,607
Construction Cost			28,033

Table-A.2.1 Land Acquisition Cost and Resettlement Cost

River	Cost	Unit Cost	River Improvement						Dam				Diversion			
			5 year		10 year		30 year		Batu Gaiah		Batu Gantung		Ruhu River		Batu Merah	
			Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
(1) Ruhu	Land Acquisition (Down)	450,000	1,500	675	10,000	4,500	17,000	7,650		0		0	9,900	4,455	10,000	4,500
	Resettlement (Down)	35,000,000	40	1,400	147	5,145	147	5,145		0		0	120	4,200	147	5,145
	Land Acquisition (Up)	25,000		0		0		0	411,000	10,275	346,000	8,650	1,540	39	1,540	39
	Resettlement (Up)	35,000,000		0		0		0		0		0	30	1,050	30	1,050
	Total Cost			2,075		9,645		12,795		10,275		8,650		9,744		10,734
(2) Batu Merah	Land Acquisition (Down)	450,000	350	158	4,750	2,138	7,750	3,488		0		0		0		0
	Resettlement (Down)	35,000,000	10	350	127	4,445	160	5,600		0		0		0		0
	Land Acquisition (Up)	25,000		0		0		0	236,000	5,900	202,000	5,050		0		0
	Resettlement (Up)	35,000,000		0		0		0	150	5,250	150	5,250		0		0
	Total Cost			508		6,583		9,088		11,150		10,300		0		0
(3) Tomu	Land Acquisition (Down)	500,000		0		0	5,500	2,475		0		0	2,476	1,238	2,362	1,181
	Resettlement (Down)	35,000,000		0		0	147	5,145		0		0	34	1,190	34	1,190
	Land Acquisition (Up)	25,000		0		0		0	155,000	3,875	108,000	2,700		0		0
	Resettlement (Up)	35,000,000		0		0		0		0		0		0		0
	Total Cost			0		0		7,620		3,875		2,700		2,428		2,371
(4) Batu Gajah	Land Acquisition (Down)	450,000		0		0	5,500	2,475		0		0		0		0
	Resettlement (Down)	35,000,000		0		0	147	5,145		0		0		0		0
	Land Acquisition (Up)	25,000		0		0		0	108,000	2,700	93,000	2,325		0		0
	Resettlement (Up)	35,000,000		0		0		0	20	700	20	700		0		0
	Total Cost			0		0		7,620		3,400		3,025		0		0
(5) Batu Gantung	Land Acquisition (Down)	500,000		0	250	125	4,750	2,375		0		0		0		0
	Resettlement (Down)	35,000,000		0	7	245	130	4,550		0		0		0		0
	Land Acquisition (Up)	25,000		0		0		0	131,000	3,275	101,000	2,525		0		0
	Resettlement (Up)	35,000,000		0		0		0		0		0		0		0
	Total Cost			0		370		6,925		3,275		2,525		0		0

Appendix-3 Number of Working Days for Construction

Table-A.3.1 Number of Construction Work Days in AMBON (for Dam Earthwork and Boring)

Item		1	2	3	4	5	6	7	8	9	10	11	12	Total
	Month Days	31	28	31	30	31	30	31	31	30	31	30	31	365
Holiday, etc	(1) Holiday	4	4	5	4	4	5	4	4	4	4	5	4	51
	(2) National Holiday	1	2	1	2	2	1	1	1	1	1	1	1	12
	(3) Maintenance Days	1	1	1	1	1	1	1	1	1	1	1	1	12
	(4) = (1)+(2)+(3)	6	7	7	7	7	6	6	6	5	5	7	6	75
Weather Condition	(5) Rainfall/day >30mm	0.8	0.5	1.1	1.3	3.6	5.5	5.0	2.7	1.6	0.5	0.5	1.5	24.6
	(6)	0.8	0.5	1.1	1.3	3.6	5.5	5.0	2.7	1.6	0.5	0.5	1.5	24.6
Non Working days (5)+(6)		6.8	7.5	8.1	8.3	10.6	11.5	11.0	8.7	6.6	5.5	7.5	7.5	99.6
Construction Working Days		24.2	20.5	22.9	21.7	20.4	18.5	20	22.3	23.4	25.5	22.5	23.5	265.4
		(24)	(21)	(23)	(22)	(20)	(19)	(20)	(22)	(23)	(26)	(23)	(24)	(267)

Monthly Average 22.3 days

Table-A.3.2 Number of Construction Work Days in AMBON (for Dam Concrete)

Item		1	2	3	4	5	6	7	8	9	10	11	12	Total
	Month Days	31	28	31	30	31	30	31	31	30	31	30	31	365
Holiday, etc	(1) Holiday	4	4	5	4	4	5	4	4	4	4	5	4	51
	(2) National Holiday	1	2	1	2	2	1	1	1	1	1	1	1	12
	(3) Maintenance Days	1	1	1	1	1	1	1	1	1	1	1	1	12
	(4) = (1)+(2)+(3)	6	7	7	7	7	6	6	6	5	5	7	6	75
Weather Condition	(5) Rainfall/day >30mm	1.1	0.6	1.5	1.7	4.4	6.2	6.1	3.3	2.0	0.7	0.6	1.8	30.0
	(6)	1.1	0.6	1.5	1.7	4.4	6.2	6.1	3.3	2.0	0.7	0.6	1.8	30.0
Non Working days (5)+(6)		7.1	7.6	8.5	8.7	11.4	12.2	12.1	9.3	7.0	5.7	7.6	7.8	105.0
Construction Working Days		23.9	20.4	22.5	21.3	19.6	17.8	18.9	21.7	23	25.3	22.4	23.2	260
		(24)	(20)	(23)	(21)	(20)	(18)	(19)	(22)	(23)	(25)	(22)	(23)	(260)

Monthly Average 21.7 days

Table-A.3.3 Number of Construction Work Days in AMBON (for Dam Embankment Core and Filter)

Item		1	2	3	4	5	6	7	8	9	10	11	12	Total
	Month Days	31	28	31	30	31	30	31	31	30	31	30	31	365
Holiday, etc	(1) Holiday	4	4	5	4	4	5	4	4	4	4	5	4	51
	(2) National Holiday	1	2	1	2	2	1	1	1	1	1	1	1	12
	(3) Maintenance Days	1	1	1	1	1	1	1	1	1	1	1	1	12
	(4) = (1)+(2)+(3)	6	7	7	7	7	6	6	6	5	5	7	6	75
Weather Condition	(5) Rainfall/day 5-25mm	4.7	4.0	5.4	5.7	7.3	8.6	8.1	6.2	4.8	3.4	1.4	4.6	64.2
	(6) Rainfall/day 25-50mm	0.8	0.5	1.2	1.3	2.1	2.8	3.4	1.8	1.2	0.3	0.5	1.3	17.2
	(7) = (6) x 2	1.6	1	2.4	2.6	4.2	5.6	6.8	3.6	2.4	0.6	1	2.6	34.4
	(8) Rainfall/day > 50mm	0.3	0.1	0.4	0.5	2.3	3.5	2.8	1.5	0.8	0.5	0.1	0.5	13.3
	(9) = (8) x 3.5	1.05	0.35	1.4	1.75	8.05	12.25	9.8	5.25	2.8	1.75	0.35	1.75	46.6
	(10) = (5)+(7)+(9)	7.4	5.4	9.2	10.1	19.6	26.5	24.7	15.1	10.0	5.8	2.8	9.0	145.2
Non Working days (4)+(10)		13.4	12.4	16.2	17.1	26.6	32.5	30.7	21.1	15.0	10.8	9.8	15.0	220.2
Construction Working Days		17.65	15.65	14.80	12.95	4.45	-2.45	0.30	9.95	15.00	20.25	20.25	16.05	144.85
		(18)	(16)	(15)	(13)	(4)	(-2)	(0)	(10)	(15)	(20)	(20)	(16)	(145)

Monthly Average 12.1 days

Working Period of Embankment Core and Filter is set from September to April (Month Average)

Appendix-4 Unit Cost of Bridge Reconstruction

Table-A.4.1 Unit Cost of Bridge Reconstruction in AMBON

Name	Item	Unit	Quantity	Unit Price	Cost	Remark
Temporary Bridge	21m etc		1		122,000,000	Lo 5 % 5 Used
Dismantle Bridge		m3	200	410,000	82,000,000	Lo 80 %
Foundation Work	Precast Pile	Pc	12	1,900,000	22,800,000	Lo 50 %
Precast Beam	21m x 0.8m	Pc	11	24,400,000	268,400,000	Lo 80 %
Construction of Beam	Construction		1		12,200,000	Lo 45 % 120t Crane
	Structure		1		122,000,000	With Concrete 100m^3
	Support		1		250,000	Lo 20 %
Others					350,000	Lo 50 %
Total					630,000,000	

Lo 57 %
Fo 43 %

Table-A.4.2 Unit Cost of Bridge Rehabilitation in AMBON

Name	Item	Unit	Quantity	Unit Price	Cost	Remark
Temporary Support			1		7,320,000	Lo 75 % 5 Used
Ground Anchor Work		Pc	4	39,400,000	157,600,000	Lo 18 %
Concrete Work		m3	300	770,000	231,000,000	Lo 90 %
Others					4,080,000	Lo 50 %
Total					400,000,000	

Lo 61 %
Fo 39 %

Note: Bridge beam is left in situ

Table-A.4.3 Unit Cost of Foot Bridge Reconstruction (W = 2m)

Name	Item	Unit	Quantity	Unit Price	Cost	Remark
Beam	Span 11m		1		12,200,000	Lo 10 % H400x200-2Pc
Fitting Work			1		1,220,000	Lo 20 %
Blacktop		m3	2.5	550,000	1,375,000	Lo 75 %
Others					1,205,000	Lo 25 % Handrail etc
Total					16,000,000	

Lo 17 %
Fo 83 %

Appendix-5 Unit Cost of Drainage Gate

Table-A5.1 Construction Cost of Drainage Gate (Typical Type A)

Name	Item	Material	Unit	Quantity	Unit Cost	Cost (Rp)	Remark
Gate	1.5x1.5m	Steel	kg	500	7,300	3,650,000	Lo 5%
Spindle	50mm dia	Stainless Steel	kg	100	73,000	7,300,000	Lo 2%
Gear-Box		Steel	kg	100	24,000	2,400,000	Lo 5%
Frame		Steel	kg	150	7,300	1,095,000	Lo 5%
Other						1,445,000	Lo 50%
Fitting			ton	0.8	1,220,000	976,000	Lo 50%
Total						16,866,000	

16,900,000 Rp
Lo 10%
Fo 90%

Table-A5.2 Construction Cost of Drainage Gate (Typical Type B)

Name	Item	Material	Unit	Quantity	Unit Cost	Cost (Rp)	Remark
Gate	0.75x0.75m	Wood (with Angle Steel)	kg	40	2,400	96,000	Lo 95%
Spindle	50mm dia		kg	100	73,000	7,300,000	Lo 45%
Handle	500mm	Steel	kg	10	12,200	122,000	Lo 70%
Frame		Steel	kg	38	7,300	277,400	Lo 50%
Other						779,500	Lo 75%
Fitting			ton	0.3	1,220,000	366,000	Lo 90%
Total						8,940,900	

8,940,000 Rp
Lo 50%
Fo 50%

Table-A6.1 Unit Cost of River Excavation

Equipment ; Back Hoe 0.6m3 (Heaped Bucket 0.8m3) (R-1)

a.	Economic life				5	year	
b.	Operation time per year				2,000	hr/year	
c.	Basic price				361,120,000	Rp	
d.	Tire cost				0	Rp	
e.	Residual value, 0.1 x (c-d)				36,112,000	Rp	
f.	Depreciation cost, (c-d-e)/(axb)				32,501	Rp/hr	32,501
g.	Ownership cost, (0.2x(a+1)xc/(2axb))				21,667	Rp/hr	21,667
h.	Operation cost, i+j+k+l				12,657	Rp/hr	12,657
i.	Fuel 0.129 l/h.ps	126ps		413	6,713	Rp/hr	
j.	Lubricant, i x 20%				1,343	Rp/hr	
k.	Tire cost				0	Rp/hr	
l.	Operator				4,601	Rp/hr	
	Operator	0.143	1	13,750	1,966	Rp/hr	
	Assistant Operator	0.143	0.5	7,150	511	Rp/hr	
	Foreman	0.143	0.2	8,250	236	Rp/hr	
	Common Labor	0.143	2	6,600	1,888	Rp/hr	
m.	Repair and maintenance cost, ((c-d)xn)/(axb)				32,501	Rp/hr	32,501
n.	Ratio of repair and maintenance cost				90	%	
o.	Direct cost, f+g+h+m				99,325	Rp/hr	99,325
p.	Indirect cost, 15% of direct cost				14,899	Rp/hr	
q.	Equipment cost, o+p				114,224	Rp/hr	114,224

$$Q = ((q \times 0.75) \times 3,600 \times E)/cm$$
$$= ((0.8 \times 0.75) \times 3,600 \times 0.65)/38$$
$$= 37 \ m3/h$$

Lo 13%
Fo 87%

3,087 Rp/m3
(R-2) 11,780 Rp/m3 (R-2)
Others 133 Rp/m3
Total 15,000 Rp/m3

Equipment ; Dump Truck 8t (Transportation of Bed Excavation Material) (R-2)

a.	Economic life				5	year	
b.	Operation time per year				2,000	hr/year	
c.	Basic price				170,100,000	Rp	
d.	Tire cost				530,000	Rp	
e.	Residual value, 0.1x(c-d)				16,857,000	Rp	
f.	Depreciation cost, (c-d-e)/(axb)				15,261	Rp/hr	15,261
g.	Ownership cost, (0.2x(a+1)xc/(2axb))				10,206	Rp/hr	10,206
h.	Operation cost, i+j+k+l				6,390	Rp/hr	6,390
i.	Fuel 0.040 l/h.ps	244ps		413	4,031	Rp/hr	
j.	Lubricant, i x 20%				806	Rp/hr	
k.	Tire cost				295	Rp/hr	
l.	Operator				1,258	Rp/hr	
	Operator	0.143	1	7,150	1,022	Rp/hr	
	Assistant Operator	0.143			0	Rp/hr	
	Foreman	0.143	0.2	8,250	236	Rp/hr	
	Common Labor	0.143			0	Rp/hr	
m.	Repair and maintenance cost, ((c-d)xn)/(axb)				1,521	Rp/hr	15,261
n.	Ratio of repair and maintenance cost				90	%	
o.	Direct cost, f+g+h+m				47,119	Rp/hr	47,119
p.	Indirect cost, 15% of direct cost				7,068	Rp/hr	
q.	Equipment cost, o+p				54,187	Rp/hr	54,187

Lo 13%
Fo 87%

$$Q = (C \times 60 \times E)/Cm$$
$$= (4 \times 60 \times 0.75)/39$$
$$= 4.6 \ m3/h$$
11,780 Rp/m3

$$C = (8t/(1.8t/m3)) \times 0.9$$
$$= 4.00 \ m3$$
$$Cm = 8.4km \; ; \; ((8.4/30 \times 0.95) \times 60) \times 2 + 2 + 1.5$$
$$= 39 \ min$$

Table-A6.2 Unit Cost of Sheet Pile Construction (10 piece) L = 7m

(Rp)

Name	Item	Unit	Quantity	Unit Price	Cost	Remark	
Foreman		man	0.22	8,250	1,793	46 piece/day	Lo
Labor (skilled)		man	0.43	7,700	3,348		Lo
Assistant operator		man	0.22	7,150	1,554		Lo
Labor		man	0.22	6,600	1,435		Lo
Crawler Crane	40t	day	0.22	1,499,000	325,870	c-1	Lo 5.3%
Vibro Hammer	220ps	day	0.22	2,804,000	609,565		Lo 10%
Truck Crane	20t	day	0.22	265,667	57,754	(c-2)x1/3	Lo 8.9%
Sheet Pile Material		t	3.36	2,074,000	6,968,640		Lo 20%
Other					10,041		Lo 50%
Total					7,980,000		

Width of Pile Construction (10 Piece)   1,995,000 Rp/m
= 0.4m/piece x 10   Lo   20%
= 4.0 m   Fo   80%

Table-A6.3 Unit Cost of Ground Anchor Construction (Depth 18m/Piece)

(Rp)

Name	Item	Unit	Quantity	Unit Price	Cost	Remark	
Boring Work		man	18.00	149,000	2,681,999		Lo
Anchor Composition		piece	0.10	29,150	2,915	1day/10piece	Lo
Grouting Work		m3	0.17	80,000	13,600		Lo
Tension and Fix		piece	1.00	7,000	7,000		Lo
Anchor Material		piece	1.00	1,220,000	1,220,000		Lo 5.3%
Other					24,486		Lo 50%
Total					3,950,000		

3,950,000 Rp-Pc(18m)
219,400 Rp-m
Lo   20%
Fo   80%

Table-A6.4 Unit Cost of Boring (10m)

(Rp)

Name	Item	Unit	Quantity	Unit Price	Cost	Remark	
Foreman		man	0.65	8,250	5,363	0.65day/10m	Lo
Labor (skilled)		man	0.65	7,700	5,005		Lo
Labor		man	1.30	6,600	8,580		Lo
Boring Machine	55kw	day	0.65	1,954,000	1,270,100		Lo
Other Machine		day	0.65	300,000	195,000		Lo 5.3%
Other					5,952		Lo 50%
Total					1,490,000		

149,000 Rp-m
Lo   19.1%
Fo   80.9%

Table-A6.5 Equipment ; Crawler Crane 40t (Sheet Pile)

<div align="right">(C-1)</div>

a.	Economic life				6	year	
b.	Operation time per year				2,000	hr/year	
c.	Basic price				846,700,000	Rp	
d.	Tire cost				0	Rp	
e.	Residual value, 0.1x(c-d)				84,670,000	Rp	
f.	Depreciation cost, (c-d-e)/(axb)				63,503	Rp/hr	32,501
g.	Ownership cost, (0.2x(a+1)xc)/(2xaxb)				49,391	Rp/hr	21,667
h.	Operation cost, i+j+k+l				9,874	Rp/hr	12,657
i.	Fuel 0.070 l/h.ps	152ps		413	4,394	Rp/hr	
j.	Lubricant, ix20%				879	Rp/hr	
k.	Tire cost				0	Rp/hr	
l.	Operator				4,601	Rp/hr	
	Operator	0.143	1	13,750	1,966	Rp/hr	
	Assistant Operator	0.143	0.5	7,150	511	Rp/hr	
	Foreman	0.143	0.2	8,250	236	Rp/hr	
	Common Labor	0.143	2	6,600	1,888	Rp/hr	
m.	Repair and maintenance cost, ((c-d)xn)/(axb)				63,503	Rp/hr	32,501
n.	Ratio of repair and maintenance cost				90	%	
o.	Direct cost, f+g+h+m				186,270	Rp/hr	99,325
p.	Indirect cost, 15% of direct cost				27,941	Rp/hr	
q.	Equipment cost, o+p				214,211	Rp/hr	114,224

1day (7hr) = 1,499,000 Rp/hr

Lo 5.3%

Fo 94.7%

Table-A6.6 Equipment ; Truck Crane 20t (Sheet Pile)

<div align="right">(C-2)</div>

a.	Economic life				8	year	
b.	Operation time per year				2,000	hr/year	
c.	Basic price				534,400,000	Rp	
d.	Tire cost				0	Rp	
e.	Residual value, 0.1x(c-d)				53,440,000	Rp	
f.	Depreciation cost, (c-d-e)/(axb)				30,060	Rp/hr	15,261
g.	Ownership cost, (0.2x(a+1)xc)/(2xaxb)				30,060	Rp/hr	10,206
h.	Operation cost, i+j+k+l				8,819	Rp/hr	6,390
i.	Fuel 0.037 l/h.ps	230ps		413	3,515	Rp/hr	
j.	Lubricant, ix20%				703	Rp/hr	
k.	Tire cost				0	Rp/hr	
l.	Operator				4,601	Rp/hr	
	Operator	0.143	1	7,150	1,966	Rp/hr	
	Assistant Operator	0.143	0.5		511	Rp/hr	
	Foreman	0.143	0.2	8,250	236	Rp/hr	
	Common Labor	0.143	2		1,888	Rp/hr	
m.	Repair and maintenance cost, ((c-d)xn)/(axb)				30,060	Rp/hr	15,261
n.	Ratio of repair and maintenance cost				90	%	
o.	Direct cost, f+g+h+m				98,999	Rp/hr	47,119
p.	Indirect cost, 15% of direct cost				14,850	Rp/hr	
q.	Equipment cost, o+p				113,848	Rp/hr	54,187

1day (7hr) = 797,000 Rp/hr

Lo 8.9%

Fo 91.1%

Table-A7.1 Unit Cost of Tunnel Excavation (1 cycle (54m3))

		Cycle Time	396 min
		Excavation Length	1.2 min
		Section Area	45 m2

Name	Item	Unit	Quantity	Unit Price	Cost		Remark
Foreman	Tunnel Work	Man	0.93	9,900	9,188	Ordinary x 1.2	Lo
Labor (skilled)	Tunnel Work	Man	4.64	9,240	42,879	Ordinary x 1.2	Lo
Labor	Tunnel Work	Man	2.78	8,580	23,890	Ordinary x 1.3	Lo
Explosive		kg	37.80	26,800	1,013,040	0.7kg/m3	Lo
Temporary Support	H 125 x 125	kg	350.00	3,000	1,050,000		Lo 20%
Pick Hammer	40kg	day	2.06	41,000	84,563	5+2	Lo 50%
Loader	1.8m3	h	2.27	124,613	282,456	Ts=136min	Lo 11.9%
Dump Track	2t	h	10.3	24,075	247,972	Tt=619min	Lo 30.5%
Other					137,699	5%	Lo 50%
Total					2,891,699		

	53,500 Rp/m3	Lo 52.5 %
Loading Outside	2,020 Rp/m3	Lo 13.9 %
Transportation Outside	6,670 Rp/m3	Lo 10.2 %
Others	110 Rp/m3	
Total	62,300 Rp/m3	Lo 46.7 %
		Fo 53.3 %

Table-A7.2 Equipment ; Loader 1.8m3 (Heaped Bucket)

a.	Economic life				5	year	
b.	Operation time per year				2,000	hr/year	
c.	Basic price				397,720,000	Rp	
d.	Tire cost				0	Rp	
e.	Residual value, 0.1x(c-d)				39,772,000	Rp	
f.	Depreciation cost, (c-d-c)/(axb)				35,795	Rp/hr	35,795
g.	Ownership cost, (0.2x(a+1)xc)/(2xaxb)				23,863	Rp/hr	23,863
h.	Operation cost, i+j+k+l				12,906	Rp/hr	12,906
i.	Fuel 0.133 l/h.ps 126ps			413	6,921	Rp/hr	
j.	Lubricant, ix20%				1,384	Rp/hr	
k.	Tire cost				0	Rp/hr	
l.	Operator				4,601	Rp/hr	
	Operator	0.143	1	13,750	1,966	Rp/hr	
	Assistant Operator	0.143	0.5	7,150	511	Rp/hr	
	Foreman	0.143	0.2	8,250	236	Rp/hr	
	Common Labor	0.143	2	6,600	1,888	Rp/hr	
m.	Repair and maintenance cost, ((c-d)xn)/(axb)				35,795	Rp/hr	35,795
n.	Ratio of repair and maintenance cost				90	%	
o.	Direct cost, f+g+h+m				108,359	Rp/hr	108,359
p.	Indirect cost, 15% of direct cost				16,254	Rp/hr	
q.	Equipment cost, o+p				124,613	Rp/hr	124,613
						Lo	11.9%
						Fo	88.1%

Table-A7.3 Equipment ; Dump Truck 2t (With Air Cleaner)

a.	Economic life				5	year	
b.	Operation time per year				2,000	hr/year	
c.	Basic price				61,000,000	Rp	
d.	Tire cost				5,300,000	Rp	
e.	Residual value, 0.1x(c-d)				6,047,000	Rp	
f.	Depreciation cost, (c-d-c)/(axb)				5,442	Rp/hr	5,442
g.	Ownership cost, (0.2x(a+1)xc)/(2xaxb)				3,660	Rp/hr	3,660
h.	Operation cost, i+j+k+l				6,390	Rp/hr	6,390
i.	Fuel 0.040 l/h.ps 244ps			413	4,031	Rp/hr	
j.	Lubricant, ix20%				806	Rp/hr	
k.	Tire cost				25	Rp/hr	
l.	Operator				1,258	Rp/hr	
	Operator	0.143	1	7,150	1,022	Rp/hr	
	Assistant Operator	0.143			0	Rp/hr	
	Foreman	0.143	0.2	8,250	236	Rp/hr	
	Common Labor	0.143			0	Rp/hr	
m.	Repair and maintenance cost, ((c-d)xn)/(axb)				5,442	Rp/hr	5,442
n.	Ratio of repair and maintenance cost				90	%	
o.	Direct cost, f+g+h+m				20,935	Rp/hr	20,935
p.	Indirect cost, 15% of direct cost				3,140	Rp/hr	
q.	Equipment cost, o+p				24,075	Rp/hr	24,075
						Lo	30.5%
						Fo	69.5%

Table-A7.4 Equipment ; Dump Truck 8t   (Batu Merah Diversion Tunnel to Disposal Site)

a.	Economic life					5	year	
b.	Operation time per year					2,000	hr/year	
c.	Basic price					139,400,000	Rp	
d.	Tire cost					530,000	Rp	
e.	Residual value, 0.1x(c-d)					13,887,000	Rp	
f.	Depreciation cost, (c-d-e)/(axb)					12,498	Rp/hr	12,498
g.	Ownership cost, (0.2x(a+1)xc)/(2axb)					8,364	Rp/hr	8,364
h.	Operation cost, i+j+k+l					3,781	Rp/hr	3,781
i.	Fuel 0.404 l/h.ps	244ps		200	Rp/l	1,952	Rp/hr	
j.	Lubricant, ix20%					390	Rp/hr	
k.	Tire cost					295	Rp/hr	
l.	Operator					1,144	Rp/hr	
	Operator	0.143		1	6,500	930	Rp/hr	
	Assistant Operator	0.143				0	Rp/hr	
	Foreman	0.143		0.2	7,500	215	Rp/hr	
	Common Labor	0.143				0	Rp/hr	
m.	Repair and maintenance cost, ((c-d)xn)/(axb)					12,498	Rp/hr	12,498
n.	Ratio of repair and maintenance cost					90	%	
o.	Direct cost, f+g+h+m					37,142	Rp/hr	37,142
p.	Indirect cost, 15% of direct cost					5,571	Rp/hr	
q.	Equipment cost, o+p					42,713	Rp/hr	42,713

Transportation/Working Hours

$Q = (Cx60xE)/Cm$

   $= (4x60x0.75)/39$

   $=$ 6.4 m3/h

     6,670 Rp/m3

$C = (8t/(1.8T/m3))x0.9$

   $= 4.00m3$

$Cm = 5.9km ; ((5.9/(30*0.95)x60)x2+2+1.5$

   $= 28 min$

Lo   10.2%
Fo   89.8%

Table-A7.5 Equipment ; Back Hoe 0.6m3   (Outside Batu Merah Tunnel)

a.	Economic life					5	year	
b.	Operation time per year					2,000	hr/year	
c.	Basic price					296,000,000	Rp	
d.	Tire cost					0	Rp	
e.	Residual value, 0.1x(c-d)					29,600,000	Rp	
f.	Depreciation cost, (c-d-e)/(axb)					26,640	Rp/hr	26,640
g.	Ownership cost, (0.2x(a+1)xc/(2axb))					17,760	Rp/hr	17,760
h.	Operation cost, i+j+k+l					11,497	Rp/hr	11,497
i.	Fuel 0.129 l/h.ps	126ps			375	6,095	Rp/hr	
j.	Lubricant, ix20%					1,219	Rp/hr	
k.	Tire cost					0	Rp/hr	
l.	Operator					4,183	Rp/hr	
	Operator	0.143		1	12,500	1,788	Rp/hr	
	Assistant Operator	0.143		0.5	6,500	465	Rp/hr	
	Foreman	0.143		0.2	7,500	215	Rp/hr	
	Common Labor	0.143		2	6,000	1,716	Rp/hr	
m.	Repair and maintenance cost, ((c-d)xn)/(axb)					26,640	Rp/hr	26,640
n.	Ratio of repair and maintenance cost					90	%	
o.	Direct cost, f+g+h+m					82,537	Rp/hr	82,537
p.	Indirect cost, 15% of direct cost					12,381	Rp/hr	
q.	Equipment cost, o+p					94,918	Rp/hr	94,918

Loading Outside Excavation Material

$Q = ((qx0.75)x3,600xE)/Cm$

   $= ((0.8x0.75)x3,600x0.65)/30$

   $=$ 4.7 m3/h

     2,020 Rp/m3

Lo   13.9%
Fo   86.1%

Appendix 8 Unit Cost of Dam Construction

Table-A8.1 Unit Cost of Excavation (Rp/100m3)

Name	Item	Unit	Quantity	Unit Cost	Cost	Remark	Remark
Excavation	Bulldozer 32t	m3	100	4,148	414,800	D-1	Lo 10.6%
Loading		m3	100	2,449	244,940	D-4	Lo 10.4%
Transportation		m3	102.5	7,564	755,339	D-5	Lo 20.0%
Final Excavation	0.6m3 Backhoe, Others	m2	2.5	10,000	25,000		Lo 50.0%
Others					9,920		Lo 50.0%
Total					1,449,999		

14,700 Rp/m3
Lo   16.5%
Fo   83.5%

Table-A8.2 Unit Cost of Dam Embankment (Core) (Rp/100m3)

Name	Item	Unit	Quantity	Unit Cost	Cost	Remark	Remark
Quarry	Bulldozer 32t	m3	170	2,909	494,573	D-6	Lo 10.0%
Excavation							
Transportation	Dump Truck 32t		100	4,258	425,850	D-8	Lo 17.4%
	Dump Truck 32t		100	6,787	678,698	D-8	Lo 17.4%
	Dump Truck 10t	m3	70	4,060	284,203	D-10	Lo 26.1%
Spreading	Bulldozer 21t	m3	100	1,607	160,700	D-11	Lo 11.8%
Compaction	Tamping Roller	m3	100	970	97,034	D-12	Lo 14.0%
Others					58,943		Lo 50.0%
Total					2,200,000		

22,000 Rp/m3
Lo   17.2%
Fo   82.8%

Table-A8.3 Unit Cost of Dam Embankment (Filter) (Rp/100m3)

Name	Item	Unit	Quantity	Unit Cost	Cost	Remark	Remark
Quarry			170				
Excavation	Bench-cut Method	m3	136	5,000	680,000		Lo 50.0%
	Bulldozer (With Ripper)	m3	34	1,628	55,344	D-1	Lo 10.6%
Assist Loading	Bulldozer 21t	m3	50	4,104	205,186	30%	Lo 10.7%
Loading	Loader 5.4m3	m3	100	2,291	229,068	D-7	Lo 8.3%
Transportation	Dump Truck 32t	m3	30	3,194	95,816	D-9	Lo 17.4%
	Dump Truck 32t	m3	30	5,051	151,523	D-9	Lo 17.4%
	Dump Truck 32t	m3	70	4,772	334,040	D-9	Lo 17.4%
	Dump Truck 10t	m3	70	4,060	284,203	D-10	Lo 26.1%
Spreading	Bulldozer 21t	m3	100	1,337	133,721	D-11	Lo 11.8%
Compaction	Vibratory Roller 12t	m3	100	447	44,693	D-12	Lo 14.0%
Others					16,407		Lo 50.0%
Total					2,230,000		

22,300 Rp/m3
Lo   26.6%
Fo   73.4%

Table-A8.4 Unit Cost of Dam Embankment (Rock) (Rp/100m3)

Name	Item	Unit	Quantity	Unit Cost	Cost	Remark	Remark
Quarry	Bench-cut Method	m3	170	5,000	850,000		Lo 50.0%
Loading	Loader 5.4m3	m3	170	2,291	389,415	D-7	Lo 8.3%
Assist Loading	Bulldozer 21t	m3	50	4,104	205,186	30%	Lo 10.7%
Transportation	Dump Truck 10t	m3	70	4,060	284,203	D-1	Lo 26.1%
	Dump Truck 32t	m3	100	4,772	477,200	D-9	Lo 17.4%
Spreading	Bulldozer 32t	m3	100	3,273	327,258	D-2	Lo 10.7%
Compaction	Vibratory Roller 12t	m3	100	197	19,680	D-13	Lo 12.4%
Others					47,058	Rip-Rap etc	Lo 20.0%
Total					2,600,000		

26,000 Rp/m3
Lo   26.3%
Fo   73.7%

Table-A8.5 Equipment ; Bulldozer 32t (with Ripper) (D-1)

a.	Economic life				5	year	
b.	Operation time per year				2,000	hr/year	
c.	Basic price				922,300,000	Rp	
d.	Tire cost				0	Rp	
e.	Residual value, 0.1x(c-d)				92,230,000	Rp	
f.	Depreciation cost, (c-d-e)/(axb)				83,007	Rp/hr	83,007
g.	Ownership cost, (0.2x(a+1)xc)/(2xaxb)				55,338	Rp/hr	55,338
h.	Operation cost, i+j+k+l				26,350	Rp/hr	26,350
i.	Fuel 0.138 l/h.ps	318ps		413	18,124	Rp/hr	
j.	Lubricant, ix20%				3,625	Rp/hr	
k.	Tire cost				0	Rp/hr	
l.	Operator				4,601	Rp/hr	
	Operator	0.143	1	13,750	1,966	Rp/hr	
	Assistant Operator	0.143	0.5	7,150	511	Rp/hr	
	Foreman	0.143	0.2	8,250	236	Rp/hr	
	Common Labor	0.143	2	6,600	1,888	Rp/hr	
m.	Repair and maintenance cost, ((c-d)xn)/(axb)				83,007	Rp/hr	83,007
n.	Ratio of repair and maintenance cost				90	%	
o.	Direct cost, f+g+h+m				247,702	Rp/hr	247,702
p.	Indirect cost, 15% of direct cost				37,155	Rp/hr	
q.	Equipment cost, o+p				284,857	Rp/hr	284,857

Dam Bed Excavation (Ripper Excavation)   Lo   10.6%

$Q = (60xaxlxE)/Cm$ $Cm = (1/24)x20m+0.25$ Fo   89.4%

$= (60x0.35x20x0.45)/1.08$ $= 1.08$ min

$=$ 175 m3/h

1,628 Rp/m3

Table-A8.6 Equipment ; Bulldozer 32t (Excavation and Push) (D-2)

a.	Economic life				5	year	
b.	Operation time per year				2,000	hr/year	
c.	Basic price				836,900,000	Rp	
d.	Tire cost				0	Rp	
e.	Residual value, 0.1x(c-d)				83,690,000	Rp	
f.	Depreciation cost, (c-d-e)/(axb)				75,321	Rp/hr	75,321
g.	Ownership cost, (0.2x(a+1)xc)/(2xaxb)				5,014	Rp/hr	50,214
h.	Operation cost, i+j+k+l				23,956	Rp/hr	23,956
i.	Fuel 0.138 l/h.ps	283ps		413	16,129	Rp/hr	
j.	Lubricant, ix20%				3,226	Rp/hr	
k.	Tire cost				0	Rp/hr	
l.	Operator				4,601	Rp/hr	
	Operator	0.143	1	13,750	1,996	Rp/hr	
	Assistant Operator	0.143	0.5	7,150	511	Rp/hr	
	Foreman	0.143	0.2	8,250	236	Rp/hr	
	Common Labor	0.143	2	6,600	1,888	Rp/hr	
m.	Repair and maintenance cost, ((c-d)xn)/(axb)				75,321	Rp/hr	75,321
n.	Ratio of repair and maintenance cost				90	%	
o.	Direct cost, f+g+h+m				224,812	Rp/hr	224,812
p.	Indirect cost, 15% of direct cost				33,722	Rp/hr	
q.	Equipment cost, o+p				258,534	Rp/hr	258,534

Dam Bed Excavation (Excavation and push)   Lo   10.7%

$Q = (60xaxfxE)/Cm$ $Cm = 0.027x20m+0.79$ Fo   89.3%

$= (60x4.68x1.0x05)/1.33$ $= 1.33$ min

$=$ 106 m3/h

2,439 Rp/m3

Rock Material Spreading $Cm = 0.027x20m+0.79$

$Q = (60xaxfxE)/Cm$ $= 1.33$ min

$= (60x4.681.0x0.5)/1.33$

$=$ 79 m3/h

3,273 Rp/m3

Table-A8.7 Equipment ; Bulldozer 21t (Excavation and Push)   (D-3)

a.	Economic life				5	year	
b.	Operation time per year				2,000	hr/year	
c.	Basic price				836,900,000	Rp	
d.	Tire cost				0	Rp	
e.	Residual value, 0.1x(c-d)				83,690,000	Rp	
f.	Depreciation cost, (c-d-e)/(axb)				75,321	Rp/hr	75,321
g.	Ownership cost, (0.2x(a+1)xc)/(2xaxb)				50,214	Rp/hr	50,214
h.	Operation cost, i+j+k+l				23,956	Rp/hr	23,956
i.	Fuel 0.138 l/h.ps	283ps		413	16,129	Rp/hr	
j.	Lubricant, ix20%				3,226	Rp/hr	
k.	Tire cost				0	Rp/hr	
l.	Operator				4,601	Rp/hr	
	Operator	0.143	1	13,750	1,966	Rp/hr	
	Assistant Operator	0.143	0.5	7,150	511	Rp/hr	
	Foreman	0.143	0.2	8,250	236	Rp/hr	
	Common Labor	0.143	2	6,600	1,888	Rp/hr	
m.	Repair and maintenance cost, ((c-d)xn)/(axb)				75,321	Rp/hr	75,321
n.	Ratio of repair and maintenance cost				90	%	
o.	Direct cost, f+g+h+m				224,812	Rp/hr	224,812
p.	Indirect cost, 15% of direct cost				33,722	Rp/hr	
q.	Equipment cost, o+p				258,534	Rp/hr	25,853

Dam Bed Excavation (Assist Loader) Lo 10.7%

$Q = (60xaxfxE)/Cm$ $Cm = 0.027x20m+0.79$ Fo 89.3%

$= (60x2.81x1.2x05)$ $= 1.33 \ min$

$= \quad 63 \ m3/h$

$4,104 \ Rp/m3$

Table-A8.8 Equipment ; Back Hoe 1.2m3   (D-4)

a.	Economic life				5	year	
b.	Operation time per year				2,000	hr/year	
c.	Basic price				675,900,000	Rp	
d.	Tire cost				0	Rp	
e.	Residual value, 0.1x(c-d)				67,590,000	Rp	
f.	Depreciation cost, (c-d-e)/(axb)				60,831	Rp/hr	60,831
g.	Ownership cost, (0.2x(a+1)xc)/(2xaxb)				40,554	Rp/hr	40,554
h.	Operation cost, i+j+k+l				18,827	Rp/hr	18,827
i.	Fuel 0.138 l/h.ps	208ps		413	11,855	Rp/hr	
j.	Lubricant, ix20%				2,371	Rp/hr	
k.	Tire cost				0	Rp/hr	
l.	Operator				4,601	Rp/hr	
	Operator	0.143	1	13,750	1,966	Rp/hr	
	Assistant Operator	0.143	0.5	7,150	511	Rp/hr	
	Foreman	0.143	0.2	8,250	236	Rp/hr	
	Common Labor	0.143	2	6,600	1,888	Rp/hr	
m.	Repair and maintenance cost, ((c-d)xn)/(axb)				60,831	Rp/hr	60,831
n.	Ratio of repair and maintenance cost				90	%	
o.	Direct cost, f+g+h+m				181,043	Rp/hr	181,043
p.	Indirect cost, 15% of direct cost				27,156	Rp/hr	
q.	Equipment cost, o+p				208,199	Rp/hr	208,199

Dam Bed Excavation (Loading) Lo 10.4%

$Q = (3,600xaxfxE)/Cm$ $Cm = 30 \ sec$ Fo 89.6%

$= (3,600x1.18x1.0x0.6)/30$

$= \quad 85 \ m3/h$

$2,449 \ Rp/m3$

Table-A8.9 Equipment ; Dump Truck 10t   (D-5)

a.	Economic life				5	year	
b.	Operation time per year				2,000	hr/year	
c.	Basic price				224,000,000	Rp	
d.	Tire cost				9,200,000	Rp	
e.	Residual value, 0.1x(c-d)				21,480,000	Rp	
f.	Depreciation cost, (c-d-e)/(axb)				19,332	Rp/hr	19,332
g.	Ownership cost, (0.2x(a+1)xc)/(2xaxb)				13,440	Rp/hr	13,440
h.	Operation cost, i+j+k+l				13,015	Rp/hr	13,015
i.	Fuel 0.040 l/h.ps	335ps		413	5,534	Rp/hr	
j.	Lubricant, ix20%				1,107	Rp/hr	
k.	Tire cost				5,115	Rp/hr	
l.	Operator				1,258	Rp/hr	
	Operator	0.143	1	7,150	1,022	Rp/hr	
	Assistant Operator	0.143			0	Rp/hr	
	Foreman	0.143	0.2	8,250	236	Rp/hr	
	Common Labor	0.143			0	Rp/hr	
m.	Repair and maintenance cost, ((c-d)xn)/(axb)				19,332	Rp/hr	19,332
n.	Ratio of repair and maintenance cost				90	%	
o.	Direct cost, f+g+h+m				65,119	Rp/hr	65,119
p.	Indirect cost, 15% of direct cost				9,768	Rp/hr	
q.	Equipment cost, o+p				74,886	Rp/hr	74,886

$$Q = (60xqxfxE)/Cm$$
$$= (60x5.5x1.0x09)/30$$
$$= 9.9 \ m3/h$$
$$7,564 \ Rp/m3$$

C =	5.50 m3	Lo	20.0%
L =	3.60 km	Fo	80.0%
Cm = 3.9xL+16			
=	30.04 min		

Table-A8.10 Equipment ; Bulldozer 44t (Quarry Excavation) (Core)   (D-6)

a.	Economic life				5	year	
b.	Operation time per year				2,000	hr/year	
c.	Basic price				1,100,400,000	Rp	
d.	Tire cost				0	Rp	
e.	Residual value, 0.1x(c-d)				110,040,000	Rp	
f.	Depreciation cost, (c-d-e)/(axb)				99,036	Rp/hr	99,036
g.	Ownership cost, (0.2x(a+1)xc)/(2xaxb)				66,024	Rp/hr	66,024
h.	Operation cost, i+j+k+l				29,359	Rp/hr	29,359
i.	Fuel 0.138 l/h.ps	326ps		413	20,632	Rp/hr	
j.	Lubricant, ix20%				4,126	Rp/hr	
k.	Tire cost				0	Rp/hr	
l.	Operator				4,601	Rp/hr	
	Operator	0.143	1	13,750	166	Rp/hr	
	Assistant Operator	0.143	0.5	7,150	511	Rp/hr	
	Foreman	0.143	0.2	8,250	236	Rp/hr	
	Common Labor	0.143	2	6,600	1,888	Rp/hr	
m.	Repair and maintenance cost, ((c-d)xn)/(axb)				99,036	Rp/hr	99,036
n.	Ratio of repair and maintenance cost				90	%	
o.	Direct cost, f+g+h+m				293,455	Rp/hr	293,455
p.	Indirect cost, 15% of direct cost				44,018	Rp/hr	
q.	Equipment cost, o+p				337,474	Rp/hr	337,474

Quarry Excavation
$$Q = (60xaxfxE)/Cm$$
$$= (60x6.9x0.9x0.5)/8.9$$
$$= 116 \ m3/h$$
$$2,909 \ Rp/m3$$

	Lo	10.0%
Cm = 0.027x30m+0.79	Fo	90.0%
= 1.60 min		

Table-A8.11 Equipment ; Wheel Type Loader 5.4m³ (D-7)

a.	Economic life				5	year	
b.	Operation time per year				2,000	hr/year	
c.	Basic price				1,293,200,000	Rp	
d.	Tire cost				0	Rp	
e.	Residual value, 0.1x(c-d)				129,320,000	Rp	
f.	Depreciation cost, (c-d-e)/(axb)				116,388	Rp/hr	116,388
g.	Ownership cost, (0.2x(a+1)xc)/(2xaxb)				77,592	Rp/hr	77,592
h.	Operation cost, i+j+k+l				28,254	Rp/hr	28,254
i.	Fuel 0.115 l/h.ps 415ps			413	19,710	Rp/hr	
j.	Lubricant, ix20%				3,942	Rp/hr	
k.	Tire cost				0	Rp/hr	
l.	Operator				4,601	Rp/hr	
	Operator	0.143	1	13,750	1,966	Rp/hr	
	Assistant Operator	0.143	0.5	7,150	500	Rp/hr	
	Foreman	0.143	0.2	8,250	236	Rp/hr	
	Common Labor	0.143	2	6,600	1,888	Rp/hr	
m.	Repair and maintenance cost, ((c-d)xn)/(axb)				116,388	Rp/hr	116,388
n.	Ratio of repair and maintenance cost				90	%	
o.	Direct cost, f+g+h+m				338,622	Rp/hr	338,622
p.	Indirect cost, 15% of direct cost				50,793	Rp/hr	
q.	Equipment cost, o+p				389,415	Rp/hr	389,415

Quarry (Core Material Loading)   Lo   8.3%

$Q = (3600xqxfxE)/Cm$ Cm 40 sec   Fo   91.7%

$= (3600x4.51x0.9x05)/40$

$=$ 183 m3/h

2,128 Rp/m3

Quarry (Rock Material Loading)

$Q = (3600xqxfxE)/Cm$ Cm 40 sec

$= (3600x4.51x1.20x0.35)/40$

$=$ 170 m3/h

2,291 Rp/m3

Table-A8.12 Equipment ; Dump Truck 32t (Core Transportation) (D-8)

a.	Economic life				8	year	
b.	Operation time per year				2,000	hr/year	
c.	Basic price				958,900,000	Rp	
d.	Tire cost				52,220,000	Rp	
e.	Residual value, 0.1x(c-d)				90,668,000	Rp	
f.	Depreciation cost, (c-d-e)/(axb)				51,001	Rp/hr	51,001
g.	Ownership cost, (0.2x(a+1)xc)/(2xaxb)				53,938	Rp/hr	53,938
h.	Operation cost, i+j+k+l				32,915	Rp/hr	32,915
i.	Fuel 0.063 l/h.ps 472ps			413	12,281	Rp/hr	
j.	Lubricant, ix20%				2,456	Rp/hr	
k.	Tire cost				13,577	Rp/hr	
l.	Operator				4,601	Rp/hr	
	Operator	0.143	1	13,750	1,966	Rp/hr	
	Assistant Operator	0.143	0.5	7,150	511	Rp/hr	
	Foreman	0.143	0.2	8,250	236	Rp/hr	
	Common Labor	0.143	2	6,600	1,888	Rp/hr	
m.	Repair and maintenance cost, ((c-d)xn)/(axb)				51,001	Rp/hr	51,001
n.	Ratio of repair and maintenance cost				90	%	
o.	Direct cost, f+g+h+m				188,855	Rp/hr	188,855
p.	Indirect cost, 15% of direct cost				28,328	Rp/hr	
q.	Equipment cost, o+p				217,183	Rp/hr	217,183

Quarry (Core Material Transportation)   L = 0.2km (from Quarry to Temporary Stockpile to Dam)

$Q = (60xqxfxE)/Cm$ Cm = 4.6xL+16   Lo   17.4%

$= (60x17.7x0.9x0.9)/17$ Cm = 42.58 mm   Fo   82.9%

$=$ 51 m3/h   4,258 Rp/m3

Quarry (Core Material Transportation)   L =2.3km (from Quarry to Temporary Stockpile to Dam)

$Q = (60xqxfxE)/Cm$ Cm = 4.6xL+16

$= (60x17.7x0.9x0.9)/27$ Cm = 26.58 mm

$=$ 32 m3/h   6,787 Rp/m3

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Table-A8.13 Equipment ; Dump Truck 32t (Filter and Rock Transportation)   (D-9)

a.	Economic life				8	year	
b.	Operation time per year				2,000	hr/year	
c.	Basic price				958,900,000	Rp	
d.	Tire cost				52,220,000	Rp	
e.	Residual value, 0.1x(c-d)				90,668,000	Rp	
f.	Depreciation cost, (c-d-e)/(axb)				51,001	Rp/hr	51,001
g.	Ownership cost, (0.2x(a+1)xc)/(2axb)				53,938	Rp/hr	53,938
h.	Operation cost, i+j+k+l				32,915	Rp/hr	32,915
i.	Fuel 0.063 l/h.ps	472ps		413	12,281	Rp/hr	
j.	Lubricant, ix20%				2,456	Rp/hr	
k.	Tire cost				13,577	Rp/hr	
l.	Operator				4,601	Rp/hr	
	Operator	0.143	1	13,750	1,966	Rp/hr	
	Assistant Operator	0.143	0.5	7,150	511	Rp/hr	
	Foreman	0.143	0.2	8,250	236	Rp/hr	
	Common Labor	0.143	2	6,600	1,888	Rp/hr	
m.	Repair and maintenance cost, ((c-d)xn)/(axb)				51,001	Rp/hr	51,001
n.	Ratio of repair and maintenance cost				90	%	
o.	Direct cost, f+g+h+m				188,855	Rp/hr	188,855
p.	Indirect cost, 15% of direct cost				28,328	Rp/hr	
q.	Equipment cost, o+p				217,183	Rp/hr	217,183

Quarry (Filter Material Transportation)
$Q = (60xqxfxE)/Cm$
$= (60x17.7x1.2x0.9)/17$
$= 68$ m3/h
$3,194$ Rp/m3
Quarry (Filter Material Transportation)
$Q = (60xqxfxE)/Cm$
$= (60x17.7x1.2x0.9)/27$
$= 43$ m3/h
$5,051$ Rp/m3

$L = 0.2$km (from Quarry to Temporary Stockpile)
$Cm = 4.6xL+16$ Lo   17.4%
$Cm = 26.58$min   Fo   82.6%

$L = 2.3$km (from Temporary Stockpile to Dam)
$Cm = 4.6xL+16$
$Cm = 26.58$ min
$L = 2$km (from Quarry to Dam)
$Cm = 4.6xL+16$
$Cm = 25.20$ min

Table-A8.14 Equipment ; Dump Truck 10t   (D-10)

a.	Economic life				8	year	
b.	Operation time per year				2,000	hr/year	
c.	Basic price				224,000,000	Rp	
d.	Tire cost				9,200,000	Rp	
e.	Residual value, 0.1x(c-d)				21,480,000	Rp	
f.	Depreciation cost, (c-d-e)/(axb)				12,083	Rp/hr	12,083
g.	Ownership cost, (0.2x(a+1)xc)/(2axb)				12,600	Rp/hr	12,600
h.	Operation cost, i+j+k+l				13,015	Rp/hr	13,015
i.	Fuel 0.040 l/h.ps	335ps		413	5,534	Rp/hr	
j.	Lubricant, ix20%				1,107	Rp/hr	
k.	Tire cost				5,115	Rp/hr	
l.	Operator				1,258	Rp/hr	
	Operator	0.143	1	7,150	1,022	Rp/hr	
	Assistant Operator	0.143			0	Rp/hr	
	Foreman	0.143	0.2	8,250	236	Rp/hr	
	Common Labor	0.143			0	Rp/hr	
m.	Repair and maintenance cost, ((c-d)xn)/(axb)				12,083	Rp/hr	12,083
n.	Ratio of repair and maintenance cost				90	%	
o.	Direct cost, f+g+h+m				49,780	Rp/hr	49,780
p.	Indirect cost, 15% of direct cost				7,467	Rp/hr	
q.	Equipment cost, o+p				57,247	Rp/hr	57,247

$Q = (60xqxfxE)/Cm$ Lo   17.4%
$= (60x6.1x0.9x0.9)/21$ Fo   82.9%
$= 14.1$ m3/h
$4,060$ Rp/m3

$L = 1.3$km (from Quarry to Disposal site)
$Cm = 3.9xL+16$
$= 21$ min

Table-A8.15　Equipment ; Bulldozer 21t (Core Spreading)　　　　　　(D-11)

a.	Economic life				5	year	
b.	Operation time per year				2,000	hr/year	
c.	Basic price				585,600,000	Rp	
d.	Tire cost				0	Rp	
e.	Residual value, 0.1x(c-d)				58,560,000	Rp	
f.	Depreciation cost, (c-d-e)/(axb)				52,704	Rp/hr	52,704
g.	Ownership cost, (0.2x(a+1)xc)/(2xaxb)				35,136	Rp/hr	35,136
h.	Operation cost, i+j+k+l				18,758	Rp/hr	18,758
i.	Fuel　0.138 l/h.ps	207s		413	11,798	Rp/hr	
j.	Lubricant, ix20%				2,360	Rp/hr	
k.	Tire cost				0	Rp/hr	
l.	Operator				4,601	Rp/hr	
	Operator	0.143	1	13,750	1,966	Rp/hr	
	Assistant Operator	0.143	0.5	7,150	511	Rp/hr	
	Foreman	0.143	0.2	8,250	236	Rp/hr	
	Common Labor	0.143	2	6,600	1,888	Rp/hr	
m.	Repair and maintenance cost, ((c-d)xn)/(axb)				52,704	Rp/hr	52,704
n.	Ratio of repair and maintenance cost				90	%	
o.	Direct cost, f+g+h+m				159,302	Rp/hr	159,302
p.	Indirect cost, 15% of direct cost				23,895	Rp/hr	
q.	Equipment cost, o+p				183,198	Rp/hr	183,198

```
Core Spreading                                               Lo    11.8%
    Q = 10xEx(18xD+13)                                       Fo    88.2%
      = 10x0.65x(18x0.25+13)              D = 0.25 m
      =        114 m3/h
             1,607 Rp/m3
Filter Spreading
    Q = 10xEx(18xD+13)                    D = 0.45 m
      = 10x0.65x(18x0.25+13)
      =        137 m3/h
             1,337 Rp/m3
```

Table-A8.16　Equipment ; Tamping Roller 31t (Core Compaction)　　　　(D-12)

a.	Economic life				5	year	
b.	Operation time per year				2,000	hr/year	
c.	Basic price				224,000,000	Rp	
d.	Tire cost				0	Rp	
e.	Residual value, 0.1x(c-d)				24,400,000	Rp	
f.	Depreciation cost, (c-d-e)/(axb)				21,960	Rp/hr	21,960
g.	Ownership cost, (0.2x(a+1)xc)/(2xaxb)				14,640	Rp/hr	14,640
h.	Operation cost, i+j+k+l				9,507	Rp/hr	9,507
i.	Fuel　0.090 l/h.ps	110ps		413	4,089	Rp/hr	
j.	Lubricant, ix20%				818	Rp/hr	
k.	Tire cost				0	Rp/hr	
l.	Operator				4,601	Rp/hr	
	Operator	0.143	1	13,750	1,966	Rp/hr	
	Assistant Operator	0.143	0.5	7,150	511	Rp/hr	
	Foreman	0.143	0.2	8,250	236	Rp/hr	
	Common Labor	0.143	2	6,600	1,888	Rp/hr	
m.	Repair and maintenance cost, ((c-d)xn)/(axb)				21,960	Rp/hr	21,960
n.	Ratio of repair and maintenance cost				90	%	
o.	Direct cost, f+g+h+m				68,067	Rp/hr	68,067
p.	Indirect cost, 15% of direct cost				10,210	Rp/hr	
q.	Equipment cost, o+p				78,278	Rp/hr	78,278

```
Core Compaction                                             Lo    14.0%
    Q = VxWxDxE/N                                            Fo    86.0%
      = 4000x2.2x0.2x0.55/12
      =       80.67 m3/h
              970 Rp/m3
```

Table-A8.17 Equipment ; Vibratory Roller 12t (Filter and Rock Compaction)   (D-13)

a.	Economic life				5	year	
b.	Operation time per year				2,000	hr/year	
c.	Basic price				356,200,000	Rp	
d.	Tire cost				0	Rp	
e.	Residual value, 0.1x(c-d)				35,620,000	Rp	
f.	Depreciation cost, (c-d-e)/(axb)				32,058	Rp/hr	32,058
g.	Ownership cost, (0.2x(a+1)xc)/(2xaxb)				21,372	Rp/hr	21,372
h.	Operation cost, i+j+k+l				12,059	Rp/hr	12,059
i.	Fuel 0.114 l/h.ps	132ps		413	6,215	Rp/hr	
j.	Lubricant, ix20%				1,243	Rp/hr	
k.	Tire cost				0	Rp/hr	
l.	Operator				4,601	Rp/hr	
	Operator	0.143	1	13,750	1,966	Rp/hr	
	Assistant Operator	0.143	0.5	7,150	511	Rp/hr	
	Foreman	0.143	0.2	8,250	236	Rp/hr	
	Common Labor	0.143	2	6,600	1,888	Rp/hr	
m.	Repair and maintenance cost, ((c-d)xn)/(axb)				32,058	Rp/hr	32,058
n.	Ratio of repair and maintenance cost				90	%	
o.	Direct cost, f+g+h+m				97,547	Rp/hr	97,547
p.	Indirect cost, 15% of direct cost				14,632	Rp/hr	
q.	Equipment cost, o+p				112,179	Rp/hr	112,179

Lo	12.4%
Fo	87.6%

(Filter)

$$Q = VxWxDxE/N$$
$$= 3000x1.9x0.4x0.55/5$$
$$=   251 \ m3/h$$
$$447 \ Rp/m3$$

(Rock)

$$Q = VxWxDxE/N$$
$$= 2500x1.9x1.0x0.6/5$$
$$=   570 \ m3/h$$
$$197 \ Rp/m3$$

Appendix 9 Construction Plan of River Diversion Tunnel

(1) Construction Condition

Working ; 24 day/month

Construction Quantity

Length(L)= 900m
Excavation Section (A)= 45m2
Excavation Quantity= 40,900m3
Excavation Classification; 1/4xB + 3/4xC

Excavation Month: 26 month   1,570 m3/month
                                              65m3/day

(2) Main Constoruction Method

Excavation ; Blasting Method
Transportation of Excavation Material;   Dump Truck(2t:With Air Clenner)
Loading;   Loader (1.5m3)

(3) Riquire Unit Quantity to Excavation(blasting)

Drilling Number= 3.4 Pi/m2
Blasting Length= 1.2 m
Drilling Speed (mean)= 35 cm/min   (Leg Hammer)
Number of Leg Hammer; 5
Driling Time = ((45/3.4/5)x1.2x100)/35
                      9.1min

Blasting Material= 0.8kgx(1/4)+0.7kgx(3/4)
            = 0.725 kg/m3

Loading (Loader)

$Qs = (3,600 \times q \times E)/Cm$
   = (3,600x0.7x0.5)/45
   = 28 m3/h

Loading Time of Blasting Length

$Ts = 60 \times Q_0/Q_s + t$
   = 60x(45m2x1.2m)/28+20
   = 136min   (2.27h)

(45m2x1.2m)/(28m3/hx2.27h)= 0.9   → 1 Ve

Excavation Sycle Time			
Excavation	Preparation	15	
	Drilling	10	
	Load and Blasting	75	With Ventilate
	Cut loose of rock	25	
	total	125	
Loading	Preparation	10	
of	Loading	136	
Excavation	Clearance	10	
Material	Surveying	10	
	total	166	
Supporting	Preparation	15	
Work	Structure	60	
	total	75	
Others		30	
	Total	396min	(6.60h)

Transportation of Excavation Material;(2t Dump Truck)

$Q = (60 \times q \times E)/Cm$ $Cm = Cm_1 + Cm_2$
   = (60x0.8x0.9)/7.9 $Cm_1 = 60 \times q_t/Qs =$ 1.7min
   =   5.5 m3/h $Cm_2 = 60 \times (L/v + L'/v' + t/60)$
                                 =60x(0.45km/10+0.1km/12+3/60)
                                 =6.2min

Transportation Time of Blasting Length

Tt=   45m2 x 1.2m x 60/5.5 +30
       619min   (10.32h)   → 1 Ve (at Over Time Work)

APPENDIX-10 DESIGN DRAWINGS

1.	River Improvement Works	Plan (Ruhu River)
2.	River Improvement Works	Plan (Batu Merah River)
3.	River Improvement Works	Plan (Tomu River)
4.	River Improvement Works	Plan (Batu Gajah River)
5.	River Improvement Works	Plan (Batu Gantung River)
6.	River Improvement Works	Longitudinal Profile (Ruhu River)
7.	River Improvement Works	Longitudinal Profile (Batu Merah River)
8.	River Improvement Works	Longitudinal Profile (Tomu River)
9.	River Improvement Works	Longitudinal Profile (Batu Gajah River)
10.	River Improvement Works	Longitudinal Profile (Batu Gantung River)
11.	River Improvement Works	Typical Cross Section I
12.	River Improvement Works	Typical Cross Section II
13.	River Improvement Works	Typical Cross Section III
14.	River Improvement Works	Typical Cross Section IV
15.	River Improvement Works	Drainage Back-flow Prevention Gate
16.	River Improvement Works	Reconstruction of Main Bridge
17.	River Diversion Works	Plan of Diversion Tunnel
18.	River Diversion Works	Longitudinal Profile of Diversion Tunnel
19.	River Diversion Works	Structural Layout Plan of Inlet Tunnel
20.	Construction of Dams	Location of Batu Gajah Dam Reservoirs
21.	Construction of Dams	General Plan of Batu Gajah Dam
22.	Construction of Dams	Structural Layout Plan of Batu Gajah Dam
23.	Construction of Dams	Location of Batu Gantung Dam Reservoirs
24.	Construction of Dams	General Plan of Batu Gantung Dam
25.	Construction of Dams	Structural Layout Plan of Batu Gantung Dam
26.	Construction of Dams	Location of Quarry-site and Access
27.	Check Dam Works	General Plan of Check Dams (Ruhu River, Tomu River)
28.	Check Dam Works	General Plan of Check Dams (Batu Gajah River, Batu Gantung River)
29.	Land Reclamation Works	Land Reclamation Plan of Nilu River
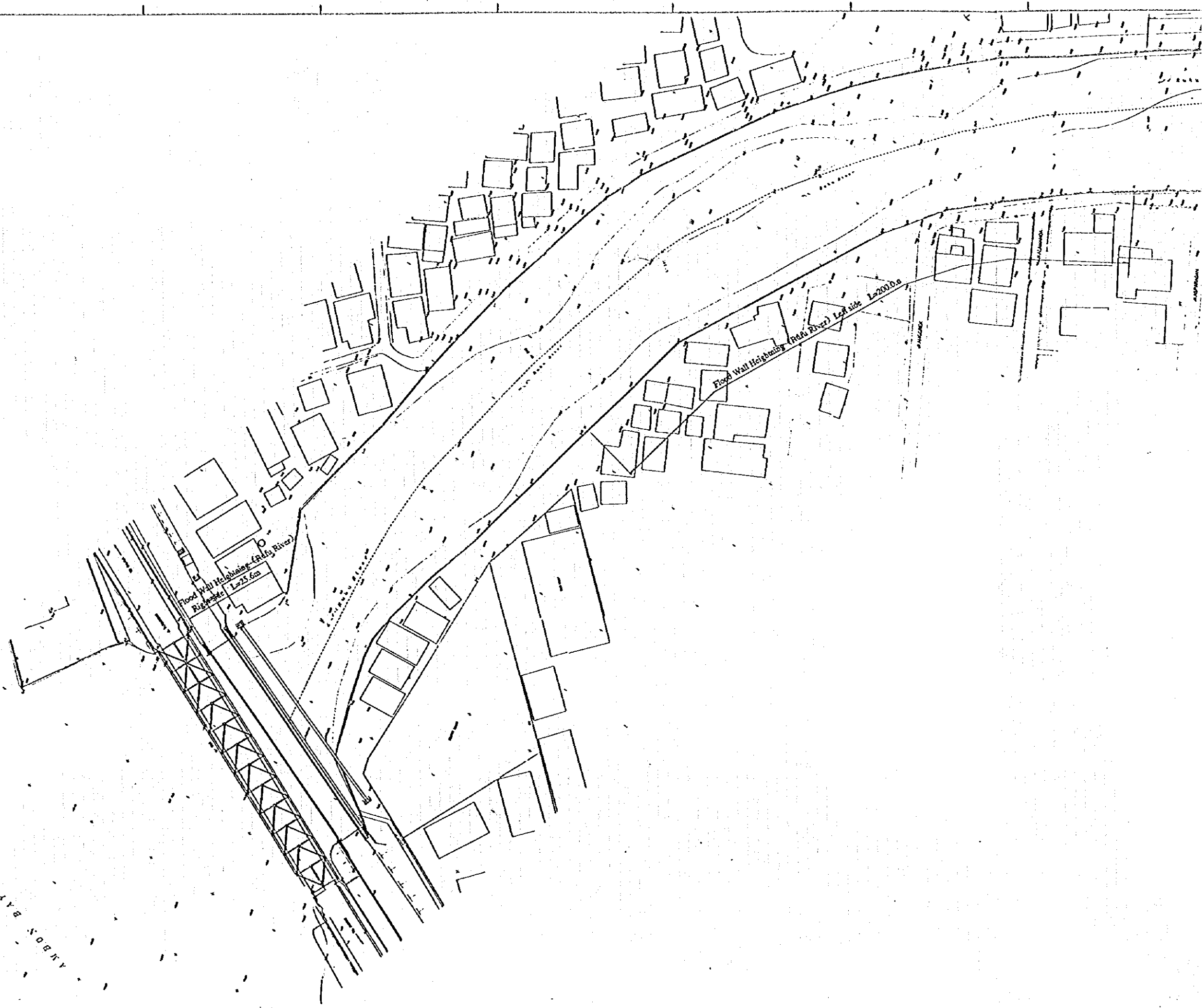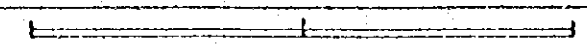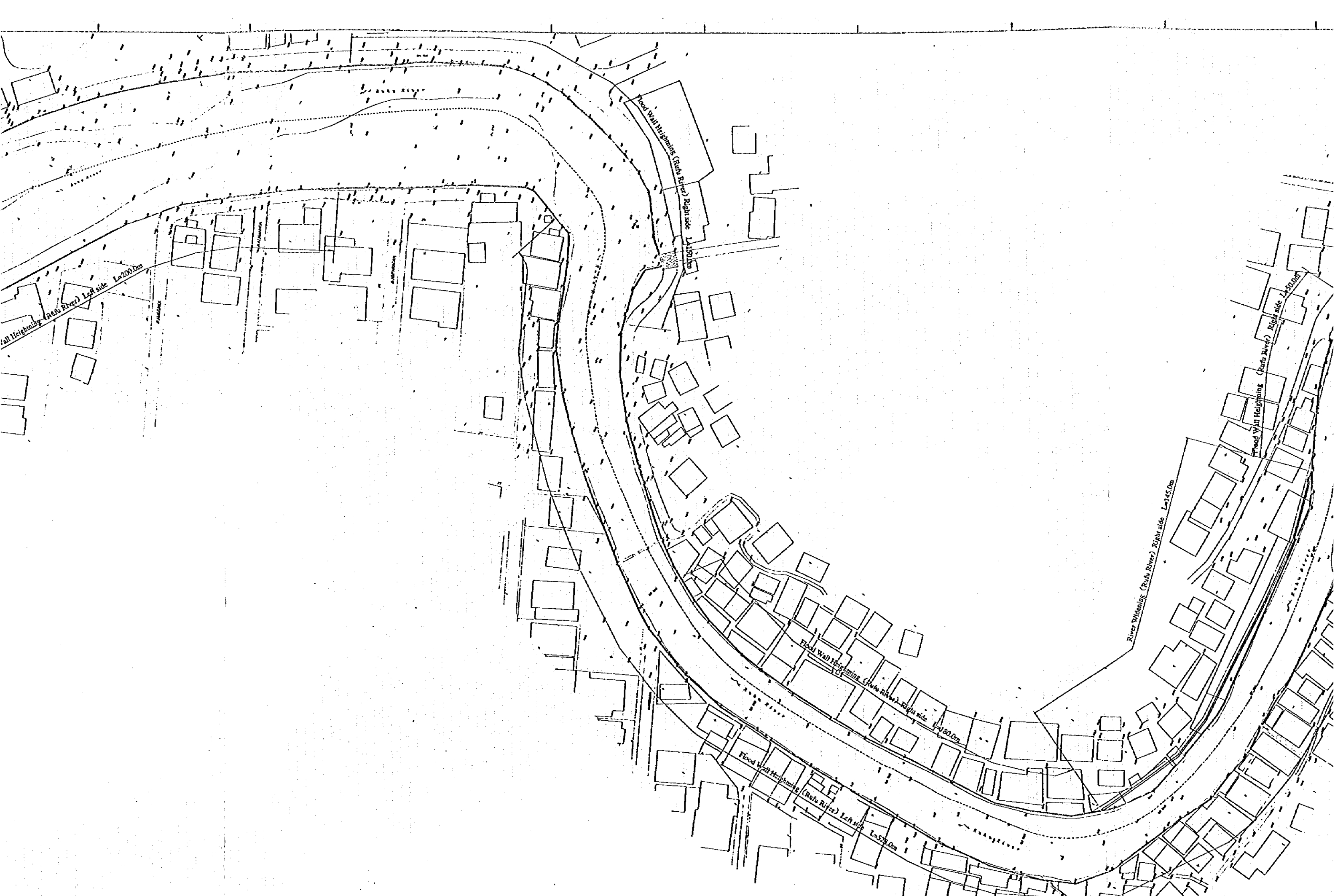
Flood Wall Heightening (Ridd River)
Right side   L=15.6m

Flood Wall Heightening (Ridd River)   Left side   L=200.0 m

AMBON BAY

Flood Wall Heightning (Rufu River) Right side L=150.0m

Flood Wall Heightning (Rufu River) Left side L=200.0m

Flood Wall Heightning (Rufu river) Right side L=150.0m

River Widening (Rufu River) Right side L=145.0m

Flood Wall Heightning (Rufu River) Right side L=180.0m

Flood Wall Heightning (Rufu River) Left side L=520.0m

Flood Wall Heightning (Rufu River) Right side L=50.0m

Flood Wall Heightning (Rufu River) Right side L=50.0m

River Widening (Rufu River) Right side L=145.0m

River Widening (Rufu River) Left side L=50.0m

Flood Wall Heightning

River Widening (Rufu River) Right side L=80.0m

Flood Wall Heightning (Rufu River) Left side L=272.0m

Flood Wall Heightning (Ruhu River), Left side L=272.0m

Flood Wall Heightning (Ruhu River), Right side L=50.0m

Flood Wall (Lightning) (Batu Merah River)

River

Flood Wall Heightning Batu Merah River 1 Right side L=191.0m

Flood

River Widening (Batu Merah River) Right side L=420.0m

Flood Wall Heightning (Batu Merah River) Left side L=525.0m

River Right side L=191.0m

Flood Wall Heightening (Batu Merah River) Right side L=63.0m

River Widening (Batu Merah River) Right side L=144.0m

Flood Wall Heightening (Batu Merah River) Right side L=88.0m

Flood Wall H

River Widening (Batu Merah River)

River Widening (Batu Merah River) Right side L=33.0m

Flood Wall Heightening (Batu Merah River) Right side L=40.0m

Flood Wall Heightening (Batu Merah River) Left side L=350.0m

Flood Wall Heightning (Batu Merah River) Right side

River Widening (Batu Merah River) Right side L=144.0m

River Widening (Batu Merah River) Right side

River Widening (Batu Merah River) Right side L=77.0m

River Widening (Batu Merah River) Right side L=105.0m

Flood Wall Heightning (Batu Merah River) Right side L=88.0m

Flood Wall Heightning (Batu Merah River) Right side

Flood Wall Heightning (Batu Merah River) Left side L=225.0m

River Widening (Batu Merah River) (Batu Merah River) Right side L=35.0m Right side L=40.0m

Flood Wall Heightning (Batu Merah River) Left side L=350.0m

River Widening (Batu Merah River) Right side L=105.0m

Batu Merah River) Right side L=77.0m

Flood Wall Heightning (Batu Merah River) Right side

Flood Wall Heightning (Batu Merah River) Left side L=225.0m

River Widening (Tone River)
Right side   L=34.0m

River Widening (Tone River)
Right side   L=77.0m

River Widening (Toms River)
Right side   L=77.0m

River Widening (Toms River) Right side   L=36.0m

Flood Wall Heightning (Tomu River) Right side L=100.0m

Flood Wall Heightning (Tomu River) Left side L=150.0m

River Widening (Toms River) Right side L=64.0m

Flood Wall Heightening (Toms River) Right side L=37m

River Widening (Toms River) Right side L=18.0m

Flood Wall Heightening (Toms River) Right side L=100.0m

River Widening Right side

Flood Wall Heightning (Toshu River) Right side L=300.0m

River Widening (Toshu River) Right side L=55.0m

L=100.0m

Flood Wall Heightning (Toshu River) Left side L=500.0m

River Widening (Toshu River) Right side L=18.0m

Flood Wall Heightning (Toshu River) Right side

Flood Wall Heightning (Tomb River) Right side L=50 m

Flood Wall Heightning (Tomb River) Left side L=150m

Flood Wall Heightning (Tomb River) Left side

Flood Wall Heightning (Tomb River) Left side

River) Right side L=200.0m

Flood Wall Heightning (Tomu River)
Right side L=50.0m

Flood Wall Heightning (Tomu River)
Left side L=125.0m

Flood Wall Heightning (Tomu River) Left side L=50.0m

Flood Wall Heightning (Tomu River)