1.2 Quantity of Work and Time Schedule

(1) Mode of Project

The general locations of each unit project are shown in Fig. - 1.1 and the summary of work quantities are shown in Table - 1.1.

The locations and descriptions of works in details are to be referred to the supporting report-3 respectively.

(2) Time Schedule

The construction period for Mt. Galunggung Disaster Prevention Project are scheduled to be started in 1988 and be completed in 1997; ten (10) years in total priod.

The general time schedule of Mt. Galunggung Disaster Prevention Project are shown in Fig. - 1.2. The detailed schedule is to be referred to the supporting report-3 respectively.

1.3 Price Level

The cost estimate shall be made at the price level of fiscal year 1987/1988. The unit prices for material, labour, equipment, etc. are based on the prices as of October, 1987.
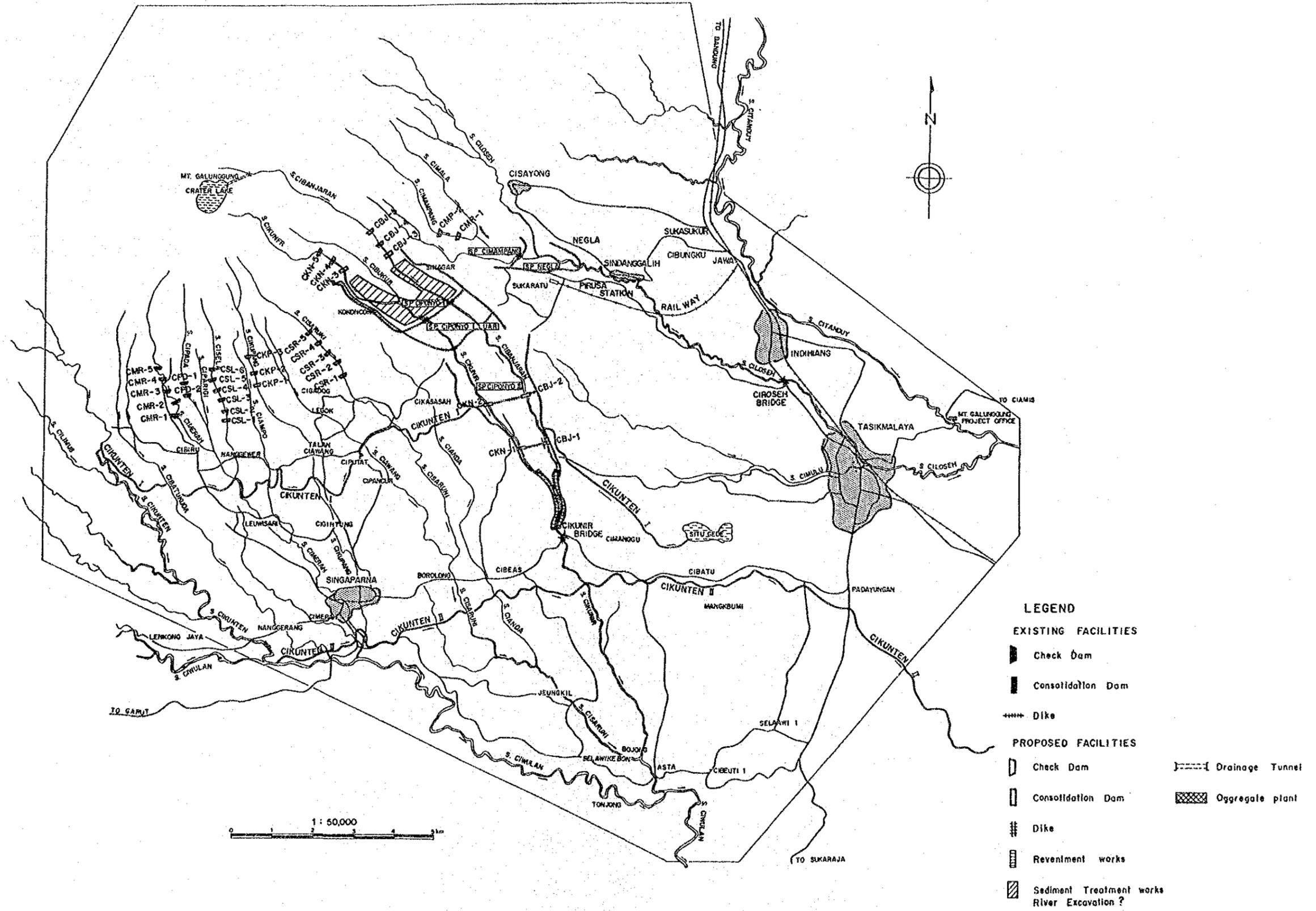
Fig. - 1.1   Location Map of Proposed Facilities of The Disaster Prevention Project

Table - 1.1   Quantity of Construction Works for each Project Area

Description	Unit	S.Ciloseh Area	S.Cikunir Area *1	Southern Slope Area	Crater Lake	Total
(1) Dike Improvement & Raising Lenth	m	3,801	11,631	–	–	15,432
Embankment Volume	m³	19,956	256,110	–	–	276,066
(2) Riverbed Leveling						
Leveling Volume	m³	–	1,370,000	–	–	1,370,000
(3) Riverbed Aggragation						
Aggradation Volume	m³	–	3,932,000	–	–	3,932,000
(4) Excavation & Hauling						
Hauling Volume	m³	394,000	630,000	–	–	1,024,000
(5) Aggregate Plant Number	site	–	1	–	–	1
(Manufacture Capacity)	ton/h	–	(140)	–	–	(140)
(6) Diversion Channel Length	m	–	1,500	–	–	1,500
Embankment Volume	m³	–	147,705	–	–	147,705
Masonry Volume	m³	–	19,125	–	–	19,125
(7) Check Dam Number	site	2	4	20	–	26
Excavation Volume	m³	2,640	5,370	43,530	–	51,540
Masonry Volume	m³	8,800	17,900	135,100	–	161,800
(8) Consolidation Dam Number	site	–	6	–	–	6
Dike Length	m	–	1,400	–	–	1,400
Embankment Volume	m³	–	34,320	–	–	34,320
Excavation Volume	m³	–	4,620	–	–	4,620
Masonry Volume	m³	–	15,400	–	–	15,400
(9) Revetment Length	m	–	1,700	–	–	1,700
Excavation Volume	m³	–	10,817	–	–	10,817
Masonry Volume	m³	–	9,615	–	–	9,615
(10) Drainage Tunnel Length	m	–	–	–	655	655

Note)

*1   Alternative D for the sediment management works in Ciponyo I Dalam

– 4 –

Work Item	1st STAGE					2nd STAGE				
	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th	9 th	10 th
I Preparatory works										
II Sand pocket maintenance works										
II-1 Improvement Dike										
II-2 Sediment management works										
Leveing riverbed										
Excavation and Houling										
Aggradation riverbed										
Aggregate plant										
Diversion Tunnel										
II-3 Check dam										
III River course stabilization works										
III-1 Consolidation dams										
III-2 Revetment works										
IV Check dam works										
IV-1 S.Cikunir Area										
IV-2 S.Cikupang Area										
IV-3 S.Cimerah Area										
V Crater Lake										

Fig. - 1.2   Construction Plan

1.4 Constitution of Cost Estimate

The constitution of the project cost is as shown below:

(1) Cost of Construction

    1) Main Construction Works Cost
      (A) Direct Cost
          a. Depreciation Cost
          b. Labor Cost
          c. Material Cost
          d. Fuel and Lubricant Cost
      (B) Indirect Cost
          Site Expense = 10% of (A)
          Profit   = 15% of (A)
    2) Preparatory Works Cost = 7% of (1)
    3) Tax (Value Added Tax: PPN = 10% of [1) + 2)]

(2) Land Acquisition Cost

(3) Government Administration Cost = 5% of [(1) + (2)].

(4) Contingency of Construction
    1) physical contingency
    2) price escalation

(5) Engineering Service Cost

(6) Contingency of Engineering Service
    1) physical contingency
    2) price escalation

1.5 Construction Cost

The construction works are divided into the following works.

1) Preparatory Works
2) Main Construction Works

These costs are estimated on the basic of the unit cost and work quantities.

The cost of construction works is composed of the following items.

1) Labour cost
2) Material cost
3) Equipment cost
4) Indirect cost

1.5.1 Labour Cost

The unit cost of Labour based on i) official standard prepared by the government ii) actual examples of contracts for similar works and iii) other relevant data, is as shown in Table - 1.2.

The unit cost of Labour in Mt. Galunggung Project Office at change in past 5 years is shown in Annex 1.

Table - 1.2   Unit Cost of Labour (1987/1988)

(Rp/man,day)

Description	Unit cost	Project SEMERU	Project MERAPI
Foreman	5,000	5,000	5,500
Labour (skilled)	3,500	3,500	3,500
Labour (common)	2,000	2,000	2,000
Operator	7,000	6,000	9,000
Assistant operator	4,500	4,500	5,000
Driver	5,000	5,000	5,000
Mechanic	6,500	6,000	7,000
Assistant mechanic	4,500	4,000	5,000
Electrician	5,000	5,000	5,000
Chief mason	4,000		4,000
Mason	3,500	3,500	3,500
Surveyor	6,000	5,000	5,000
Assistant surveyor	5,000	3,500	3,500
	3,500		
Chief carpenter	3,000		
Carpenter	3,500	3,500	3,500
Plasterer	3,500	3,500	3,500
Chief steel bar worker	3,500		
Steel bar worker	3,500	3,500	3,500
Gabion net maker	3,000		

Note: SEMERU Project; Mt. SEMERU urgent improvement project
   MERAPI Project; Mt. MERAPI Volcanic debris control project.

1.5.2 Material Cost

The material cost used in this project are divided into 3 types as shown below.

1) Materials produced in Indonesia
   i)   Fuel and lubricant (gasoline, diesel oil, gear oil, grease, etc.)
   ii) Concrete materials (Port-land cement, etc.)
   iii) Steel materials (reinforced bar, nail, wire, etc.)
2) Materials not produced in Indonesia
   i)   Steel materials (Corrugated Pipe, H Beam, etc.)
3) Materials obtained from the borrow area
   i)   Earth materials for embankment
   ii) Sand and gravel for concrete production
   iii) Boulder for masonry work

The unit cost of materials based on i) official standard prepared by the government, ii) maker's price, iii) other relevant data is as shown in Table – 1.3.

Table - 1.3   Unit Cost of Materials

(Rp)

Description	Unit	Unit Price	SEMERU	MERAPI
Gasoline	1	385	385	385
Diesel Oil	1	200	200	200
Mobil Oil	1	2,500	2,500	2,500
Gear Oil	1	2,500	2,500	2,500
Hydraulic Oil	1	3,500	3,500	3,500
Grease	kg	3,000	2,500	3,500
Engine Oil (Diesel)	1	2,000	2,000	2,000
Sand for concrete	m^3	5,000	3,500	7,500
Sand for other	m^3	5,000	3,000	7,500
Gravel for concrete	m^3	6,500	6,500	
Gravel for backfill	m^3	5,500	5,500	
Stone for masonry	m^3	5,000	4,500	
Stone for gabion	m^3	5,000	4,500	
Brick	PC	35		
Reinforced bar	kg	900	700	700
Nail	kg	1,000	1,000	1,000
Wire for rebar	kg	600		
Shape steel	kg	1,250		
Gabion wire	kg	950		
Timber plate for form	m^3	75,000		
Portland cement	bag (40 kg)	4,400	110,000/t	110,000/t
Corrugated pipe* (ϕ2000)	m	1,332,800		
H-ring*	m	374,800		
Corrugated pipe* (ϕ4000)	m	3,452,000		
H-Beam*	kg	2,133		

Notes: 1) ϕ2000^{mm} t = 4.5 mm - 118,00 (¥/m)
   2) H ring - H 100   - 50,000 (¥/1.5 m)
   3) ϕ3000^{mm} t = 3.2 mm - 267,000 (¥/m)
   4) H-Beam H125x125x6.5x9   - 23.8 kg/m

1.5.3 Equipment Cost

(1) Estimation Method

The equipment cost is determined by means of following calculation which is based on "p 5 EDIST I" used in Directorate River, DGWRD, DPU of Indonesia.

Equipment

a	Economic life	year
b	Operation time/year	hour/year
c	Basic price	Rp
d	Tire cost	Rp
e	Residual value, $0.1 \times (c-d)$	Rp
f	Depreciation cost, $\dfrac{c-d-e}{ab}$	Rp
g	owner ship cost, $\dfrac{0.2 \times (a+1) \times c}{2ab}$	Rp/hr
h	Operation cost, $i+j+k+l$	Rp/hr
i	Fuel l/hr ps x Rp/l	Rp/hr
j	Lubricant, $i \times 20\%$	Rp/hr
k	Tire cost	Rp/hr
l	Operator	Rp/hr
m	Repair and maintenance cost, $\dfrac{(c-d) \times n}{ab}$	Rp/hr
n	Ratio of repair and maintenance cost	%
o	Equipment cost $f+g+h+m$	Rp/hr

(2) Economic life, operation time/year, and repair and maintenance cost ratio.

Table - 1.4 is applied.

(3)   Basic Price of Equipment

The basic price of equipment are taken from the cost estimate of Mt. Semeru Urgent Improvement Project (Oct. 1986).

For the equipment un-given in this cost estimate, Japanese standard (1987) is applied.

The basic price of the equipment are as shown in Table - 1.5.

(4)   Estimation of fuel and lubricant cost

The fuel cost is estimated as given below:

- Fuel cost (Rp/hr): consumption rate (1/ps-hr)xHorse power
                     x fuel price (Rp/1)
- Lubricant cost (Rp/hr): Lumpsum, 20% of fuel cost

The fuel consumption rate of each equipment are show in Table - 1.6 which are obtained from the standard used by Ministry of Construction in Japan.

(5)   Equipments owed by Mt. Galunggung Project Office.

The equipments listed in Table - 1.7 are owned by Mt. Galunggung Project Office. These are considered to be leased to the contractor at his own expense for operation and repair cost.

(6)   Equipment Cost

The hourly equipment cost which consists of operating cost and owning cost is summerized as shown in Table - 1.8 as for the detailed equipment cost, refer to Annex - 2.

Table - 1.4 Standard of Equipment Lifetime and
Repair and Maintenance ratio (1/2)

Equipment	Economic life		Repair and Maintenance Cost
	Year	Hour	Ratio (%)
(1)	(2)	(3)	(4)
Bulldozer	5	10,000	90
Grader	5	10,000	90
Loader	5	10,000	90
Excavator	5	10,000	90
Towed scraper	6	12,000	65
Self propelled scraper	5	10,000	90
Crawler tractor	5	10,000	90
Wheel tractor	5	10,000	90
Crane	5	10,000	65
Non Vibrating Rollers			
- Self propelled	5	10,000	65
- Towed (excl. tractor)	6	12,000	65
Vibrating Rollers			
- Self propelled	3	6,000	90
under 2 ton			
- Self propelled	4	8,000	90
over 2 ton			
- Towed (excl. tractor)	4	8,000	90
Tamper:			
- Mechanical/pneumatic	4	4,000	65
- Vibrating plate tamper	4	4,000	65
Dump truck under 8 ton	5	10,000	90
Dump truck over 8 till	8	16,000	90
20 ton			
Tank truck	5	10,000	90
Batching Mixing Plant	10	15,000	90
Stone Crusher	5	10,000	90
Compressor	5	10,000	90
Concrete Mixer	2	4,000	65
under 250 liter			

Table - 1.4 Standard of Equipment Lifetime and
Repair and Maintenance Ratio (2/2)

(1)	(2)	(3)	(4)
Water pump until 4"	2	4,000	65
Water pump over 4"	3	6,000	65
Generator Set over 30 KVA	5	10,000	65

Source : PEDOMAN TATA CARA PENGGUNAAN PERALATAN
DI LINKGKUNGAN DEPARTEMEN PEKERJAAN UMUM

Departemen Pekerjaan Umum
October 1984.

Table – 1.5   Basic Price of Equipment

$(Rp \times 10^3)$

No.	Description	Unit Cost		Remarks
	Equipment	Class	CIF	
I.	Main Construction			
1.	Bulldozer	16 t	182,336	
2.	Tractor shovel	1.8 m^3	211,728	
3.	Back-hoe	1.4 m^3	483,392	
4.	Dump truck	11 t	107,314	
5.	Vibration Roller	8 t	107,440	
II.	Aggregate Plant			
1.	Vibrating grizzly feeder	22 kw	113,715	
2.	Jaw crusher	45 kw	258,745	
3.	Cut gate	1.7 (t)	30,607	
4.	Vibrating feeder	7.5 kw	46,871	
5.	Vibrating screen	30 kw	108,657	
6.	Crassifier	5.5 kw	93,663	
7.	Pump	55 kw	53,772	
8.	Belt conveyor	600 m	1,272,065	
III.	General Use			
1.	Compressor	3.5 m^3	1,620	
2.	Compressor	10.5 m^3/min	4,144	
3.	Diesel generator	30 KVA	2,321	
4.	Pick hammer	8 kg	33	
5.	Hand hammer	15 kg	140	
6.	Trolley	0.5 m^3	460	
7.	Fan	1.5 KW	1,390	
IV	Cooling Plant	7,000 Kcal	300,659	

Table - 1.6   Fuel Consumption Rate

Machinery	Type	Rate (1/ps-hr)	Remarks
Bulldozer	–	0.122	
Tractor shovel	Crawler	0.119	Incl. loader
	Wheel	0.104	
Shovel excavator	–	0.129	Back hoe etc.
Bulldozer with ripper	–	0.138	
Dump truck	Common	0.039	
	Construction	0.057	
Motor grader	–	0.071	
Road roller	–	0.075	
Tire roller	–	0.072	
Vibration roller	–	0.109	
Vibration compactor	–	G 0.211	
Tamper/Rammer	–	G 0.211	
Crawler crane	–	0.066	
Truck crane	Mechanic	0.030	
	Oil pressure	0.034	
Wheel crane	–	0.076	
Truck mixer	–	0.039	
Concrete		G 0.256	
		E 0.577 kwh/kw	
Truck	–	0.036	Incl. truck with crane
Trailer	–	0.049	
Pump	–	0.210	
Submergible pump	–	E 0.600 kwh/kw	
Generator	–	0.117, G 0.308	
Belt conveyor	–	0.190, G 0.333	
Winch	–	0.077	
		E 0.305 kwh/kw	
Air compressor	–	0.139	

Note: G : Gasoline
       E : Electric power
       No mark : Diesel oil

Table - 1.7   Equipment Owned by Mt. Galunggung Project Office

No.	Equipment	Type/No. Code	Condition			Remarks
			B	RR	RB	
1.	Bulldozer	(16 ton) Komatsu D 65 A : B1	o			Condition
		(16 ton) Komatsu D 65 A : B2			o	RR: Slight Damage
		(16 ton) Komatsu D 65 A : B3	o			RB: Damage
		(16 ton) Komatsu D 65 A : B4	o			B: Good
		(23 ton) Komatsu D 85 A : B. 006	o			
		(23 ton) Komatsu D 85 A : B. 007		o		
		(23 ton) Komatsu D 80 A :			o	
		(13 ton) Komatsu D 53 A :			o	
		(15 ton) Caterpilar D 6 D	o			
2.	Exe. Back Hoe ($0.75 \ m^3$)	Poclain TCS : 01			o	
		Poclain TCS : 02			o	
3.	Fork Lift (3 ton)	Casse : FK 1	o			
4.	Dump Truck (8 ton)	Saviem SM. 8: AD 900 BB		o		
		Saviem SM. 8: AD 923 BB	o			
		Saviem SM. 8: AD 934 BB	o			
		Saviem SM. 8: AD 935 BB	o			
		Saviem SM. 8: AD 939 BB		o		
		Saviem SM. 8: AD 942 BB	o			
		Saviem SM. 8: AD 943 BB	o			
		Saviem SM. 8: AD 944 BB		o		
		Saviem SM. 8: AD 945 BB	o			
		Saviem SM. 8: AD 946 BB		o		
5.	Water Tanker (3 ton)	Toyota : D 13 S	o			
6.	Welder (100A)	Yammer : TS 566	o			
7.	Generator	Perkin Ohatsu: KS 20 TN (20 KVA)	o			
		Perkin Ohatsu: KS 20 TN (20 KVA)	o			
		Honda : EM 200 (2 KVA)	o			
8.	Compressor	Fuseng : VA 521 CJ	o			

1.5.4 Indirect Cost

The indirect cost is to be as follows considering the actual examples of the contracts for similar works with some scale.

1) Site expenses: 10% of the total direct cost
2) Contractor's overhead and profit: 15% of the total direct cost

1.6 Government Cost

1.6.1 Land Acquisition Cost

The land acquisition cost shall be estimated on the basic of unit cost for the area.

The unit price for the land acquisition is given in Table - 1.8.

The land acquisition cost is calculated based on the mean unit price of the Kokoncong and the Sukaratu as these locations are expected to have similar condition as the proposed project area.

Table - 1.8   Unit price of Land Acquisition

Classification of Land Use		Location		
		Kokoncong	Sukaratu	Indihiang
- Plantation	(Rp/m^2)	1,400	1,500	2,000
- Dry land	(Rp/m^2)	700	750	1,000
- Fish pond	(Rp/m^2)	1,450	1,500	7,000
- Coconut tree	(Rp/stick)	6,000	7,000	10,000
- Rice	(Rp/m^2)	145	150	200
- Bamboo house	(Rp/pc)	100,000	100,000	100,000
- Semi permanent house	(Rp/pc)	1,000,000	1,000,000	1,000,000
- Permanent house	(Rp/m^2)	90,000	90,000	100,000

Source: Mt. Galunggung Project Office

1.6.2 Government Administration Cost

It is assumed that the government administration cost is 5% of the total construction cost excluding the Government Tax.

1.6.3 Engineering Service Cost

It is assumed that the Engineering Service cost is 18% of the total construction cost excluding the Government Tax.

1.6.4 Contingency

Two kinds of the contingency are to be considered in the cost estimate, they are the so-called physical contingency and the price escalation contingency.

The physical contingency for the unexpected change or addition of works is assumed at 10% of the total construction cost excluding the Government Tax. The price escalation shall be estimated on the construction cost. The annual price escalation of the Foreign Currency is 5%. The annual price escalation of the Local Currency is 12%.

1.6.5 Government Tax

The Government Tax is imposed on all civil work construction. The percentage of the Government Tax is 10% at the construction amount.

1.7 Exchange Rate

The following currency exchange rate (as of Oct., 1987) is to be used in the cost estimate.

Table - 1.9   Proposed Exchange Rate

US$	Yen¥	Rp
1	145	1,630
0.0069	1	11.24

1.8 Ratio of Foreign Currency Portion

The foreign currency portion in the cost is estimated in accordance with the ratio given in the Table - 1.10 below.

Table - 1.10   Ratio of Foreign Currency Portion

Cost	Ratio of foreign currency portion (%)
(I) Material	
Steel	100
Cement	65
Fuel, oil	50
(II) Equipment cost	
Depreciation cost	100
Repair & maintenance cost	60

2. Unit Cost

2.1 Allotment of Unit Cost

The unit cost of works is generally consist of the cost items
i) labour, ii) material, iii) equipment and iv) indirect cost, while for the man power works, the equipment cost is excluded from the above cost items.

The labour and the material allotment is determined on the basis of;

- Dasar Penyusunan Anggaran Biaya Bangunan which Mt. Galunggung Project Office uses.
- Actual result of past similar works and budgetary design in Mt. Galunggung Project Office.

The allotments are shown in Table - 2.1 -- 2.3.

Table - 2.1 Labour and Material Allotment
for Manpower Work (1/3)

Work item	Labour or material	Unit	Allotment
Excavation/1 m³			
1) Common soil			
Excavation	Common labour	man.day	0.75
Depth H$\leq$1 m [a]	Foreman	"	0.025
Transportation	Common labour	"	0.33
Distance L$\leq$30 m [b]	Foreman	"	0.01
2) Hard soil			
Excavation	Common labour	"	1.0
Depth H$\leq$1 m [a]	Foreman	"	0.033
Transportation	Common labour	"	0.33
Distance L$\leq$30 m [b]	Foreman	"	0.01
Gabion work 1/m³			
1) Plait	Wire	kg	9.6 [c]
	Gabion net maker	man.day	0.833
	Common labour	"	0.667
	Foreman	"	0.267
2) Stone filling	Stone	m³	1.0
	Common labour	man.day	1.5
	Foreman	"	0.025
3) Transportation		LS	818 Rp
4) Filter		LS	785 Rp
Riprap/1 m²	Stone	m³	0.275
25 cm thickness	Cement	bag	0.119
	Sand	m³	0.008
	Mason	man.day	0.08
	Chief mason	"	0.008
	Common labour	"	0.615
	Foreman	"	0.031

a) In case H$>$1 m, additional rate of each meter, common labour 0.0515
foreman 0.0075

b) In case L$>$30 m, use K = $\dfrac{a}{275}$ (L+75)   K: Cost of transportation (Rp/m³)
a: Cost of labour/day (Rp)
L: distance (m)

c) Frame ϕ 4 mm ... 20%, net ϕ 3 mm ... 80%, $\dfrac{45 \times 0.2 + 25 \times 0.8}{3}$ = 9.6 kg/m³

Table - 2.2   Labour and Material Allotment
for Manpower Work (2/3)

Work item	Labour or material	Unit	Allotment
Stone masonry/1 m^3 C:S=1;4			
	Stone	m^3	1.2
	Cement	bag	4.07
	Sand	m^3	0.522
	Mason	man.day	1.2
	Chief mason	"	0.12
	Common labour	"	3.6
	Foreman	"	0.18
Plain concrete/1 m^3 C:S:G=1:2:3			
1) Concrete material	Gravel	m^3	0.82
	Sand	"	0.54
	Cement	bag	6.8
2) Labour for mixing and placing	Common labour	man.day	6
	Foreman	"	0.3
	Mason	"	1
	Chief mason	"	0.1
3) Form work material	Wood	m^3	0.4
	Nail	kg	4
4) Labour for form making and removal	Chief carpenter	man.day	0.5
	Foreman	"	0.1
	Carpenter	"	5
	Common labour	"	2
	Common labour (removal)	"	4
5) Equipment cost		LS	8515 Rp
6) Fuel cost		LS	1363 Rp

Table – 2.3   Labour and Material Allotment

for Manpower Work (3/3)

Work item	Labour or material	Unit	Allotment
Reinforced concrete/1 mm^3 C:S:G=1:2:3			
1) Concrete material			
2) Labour for mixing and placing			
3) Form work material			
4) Labour for form making and removal		Same as plain concrete	
5) Equipment cost			
6) Fuel cost			
7) Rebar material	Reinforcing bar	kg	100
	Wire	"	2
8) Labour for steel fabrication and fixing	Steel bar worker	man.day	6.75
	Chief steel bar worker	"	2.25
	Common labour	"	6.75

2.2 Estimation of Unit Cost

The calculated unit cost for each work item is shown in Table - 2.4 - 2.6.

As for the details, refer to Annex-2.

The unit cost of aggregate for transportation to Jakarta is shown in Table - 2.5.

The unit cost of transportation for aggregate is present unit cost in Tasikmaraya.

Table - 2.4   Unit Cost of Construction Work (I) (Financial Cost)

Item No.	Work Description		Unit Cost			Rupiah Evaluation of Foreign (Rp)
			Total (Rp)	Foreign (¥)	Local (Rp)	
1-01	Open-cut excavation of sand with gravel by machinery Back-hoe (1.4 m³) including loading	(m³)	1,875	98	773	1,097
1-02	Open-cut excavation by man-power for foundation dam other structures	(m³)	3,296	-	3,296	-
1-03	Tunnel excavation of sand with gravel by man-power	(m³)	36,637	1,793	16,485	20,152
1-04	Tunnel excavation of rock by man-power	(m³)	38,304	1,875	17,229	21,075
1-05	Shaft execavation of sand with gravel by man-power	(m³)	53,419	2,272	27,886	25,533
1-06	Shaft excavation of rock by man-power	(m³)	80,883	3,618	40,217	40,666
2-01	Embankment, Fuenishing, Spreading and Compacing main board of dike Bulldozer 16 (t)	(m³)	2,562	129	1,109	1,453
2-02	Height of Dike <5.0 m Bulldozer 16 (t)	(m³)	3,424	173	1,482	1,942
3-01	Gabion work, Furnishing and placing wire net mattres and filling boulders in the wire net mattress	(m³)	27,974	1,026	16,437	11,537
4-01	Furnishing and placing wet masinry for dam	(m³)	49,712	1,310	34,987	14,725
4-02	Furnishing and placing plain concret	(m³)	153,581	2,941	120,523	33,058

Table - 2.5   Unit Cost of Construction Work (II) (Financial Cost)

Item No.	Work Description	Unit Cost			Rupiah Evaluation of Foreign (Rp)
		Total (Rp)	Foreign (¥)	Local (Rp)	
5-01	Transportation of river bed material from Sandpocket to aggregate plant L=5.0 km (m³)	2,360	102	1,209	1,151
5-02	Transportation of river bed material from Sandpocket to aggregate plant L=500 m (m³)	853	37	436	417
5-03	Transportation of river bed material from Sandpocket to aggregate plant L=1.0 km (m³)	1,052	46	538	514
5-04	Transportation of river bed material from Sandpocket to aggregate plant L=2.0 km (m³)	1,284	56	658	626
6-01	Aggregate plant equipment (m³)	2,836	114	1,553	1,283
7-01	Corrugated pipe 2,000 mm Furnishing and placing Corrugated pipe (m³)	2,217,039	194,880	26,588	2,190,451
7-02	Corrugated pipe 4,000 mm Furnishing and placing Corrugated pipe (m³)	4,366,780	388,504	–	4,366,780
8-01	H-Beam 2,000 mm Furnishing and placing H-Beam	575,789	38,929	138,227	437,562
8-02	H-Beam 4,000 mm Furnishing and placing H-Beam	890,379	78,979	2,655	887,724
9-01	Transportation of aggregate by train (m³)	5,875	418	1,175	4,700
10-01	loading (unloading)	1,022	54	411	744

3. Project Cost (Financial Cost)

3.1 Construction Cost

The construction cost consists of cost of preparatory works and cost of main construction work.

(1) Cost of Main Construction Works

The unit cost of each item is obtained from Section 2 and the quantity of each item is obtained Table - 1.1.

The cost of main construction works is shown in Table - 3.1, Table - 3.2, Table - 3.3, Table - 3.4. The breakdown construction cost refer to Annex-3.

Table - 3.1   Cost of Main Construction Works at 1st Stage

Unit x 10^6 Rp

Work items	Amount	Foreign	Local
(1) Crater lake tunnel works	3,791.0	268.1	777.6
(2) Dike improvement work			
2.1 Embankment	1,546.8	63.5	833.1
2.2 Excavation	785.6	37.1	368.7
(3) Sand pocket maintenance work			
3.1 Excavation (1)	3,737.4	185.0	1,658.0
3.2 Excavation (2)	7,792.0	368.0	3,655.7
3.3 Check dams	1,870.9	48.3	1,328.0
(4) River course stabilization work			
4.1 Embankment	528.2	18.3	322.5
4.2 Consolidation dam	263.6	6.8	187.2
4.3 Revetment work	981.9	23.6	716.6
(5) Check dams	968.4	25.0	687.4
(6) Aggregate plant	2,526.8	115.2	1,232.0
(7) Operation cost	0	412.2	412.2
T o t a l	25,204.8	1,158.9	12,179.0

Table - 3.2   Cost of Main Construction Works at 2nd Stage

Work items	$(Rpx10^6)$ Amount	$(¥x10^6)$ Foreign	$(Rpx10^6)$ Local
(1) Sand pocket maintenance works			
1.1 Excavation	12,988.7	613.4	6,094.1
1.2 Operation cost	687.0	–	687.0
(2) Check dams	5,891.2	152.0	4,182.7
T o t a l	19,566.9	765.0	10,963.8

Table - 3.3   Cost of Construction Equipment and Spare Parts

Items	$(Rpx10^6)$ Amount	$(¥x10^3)$
(1) Construction Equipment		
1.1 Aggregate plant	3,056.4	271,921
(2) Spare parts for Construction Equipment		
2.1 Aggregate plant	611.3	54,386
2.2 Construction Equipment	1,473.9	131,130
2.3 Spare tire	1,180.5	105,027
T o t a l	6,322.1	562,464

The cost for spare parts is estimated to be 15% of the CIF amount of equipment.

The cost for spare tire is estimated to be 20% of the amount of pump truck 11 ton.

Table - 3.4 Cost of Main Construction Equipment

$(\text{Rp} \times 10^3)$

Item	Class	Unit	Unit cost	Total
(1) Bulldozer	16 T	11	182,336	3,005,696
(2) Tractor shovel	1.8 m^3	7	211,728	1,482,096
(3) Back-hoe	1.4 m^3	12	483,392	5,800,704
(4) Dump-truck	11 t	55	107,314	5,902,270
(5) Vibration-Roller	8 t	5	107,440	537,200
T o t a l				15,727,966

$(9,825,696)$

The cost of preparatory works is estimated to be 7% of the amount of main construction.

(2)   Construction Cost

The summary of construction cost of each construction period is shown in Table - 3.5.

Table - 3.5 Construction Cost of Construction Period

Unit x 10^6 Rp)

Description	1st stage	2nd stage	Total
(1) Preparatory works	1,764.0	1,370.0	3,134.0
(2) Main construction works	25,204.8	19,566.9	44,771.7
(3) Construction Equipment and spare parts	6,322.1	0	6,322.1
(4) Total (1) + (2) + (3)	33,290.9	20,936.9	54,227.8
(5) Tax = (4) x 10%	3,329.1	2,093.7	5,422.8
Construction cost = (4) + (5)	36,620.0	23,030.6	59,650.6

3.2 Government Cost

(1) Land Acquisition Cost

The cost for the Land acquisition is as shown in Table - 3.6.

Table - 3.6   Quantity and Cost for Land Acquisition

Description	Quantity (m^2)	Unit Price	Amount (10^6 Rp)
1) Dike improvement			
2) Sand pocket			
3) Check dams			
4) Aggregate plant			
Total	319,400	3,000*	958.2

* Average unit price of 4) categories of Land

The amount of Land acquisition cost of 1st stage is Rp 514.6 x 10^6

The amount of Land acquisition cost of 2nd stage is Rp 443.6 x 10^6

(2) Government Administration Cost

The required Government administration cost is assumed as 5.0% of the total construction amount excluding the Government Tax.

The Government administration cost is calculated as follows:

	Foreign (10^6 ¥)	Local (10^6 Rp)	Amount (10^6 Rp)	Government Administration Cost (10^6 Rp)
1st stage	1,240	13,031.5	26,969.1	1,348.5
2nd stage	819.0	11,731.3	20,936.9	1,046.8
Total	2,059.0	24,762.8	47,906.0	2,395.3

(3)   Engineering Service Cost

The required Government administration cost is assumed as 15% of the total construction amount excluding the Government Tax.

Engineering Service cost = 47,906 x 15% = 7,186 x 10^6 Rp.

	1st stage	2nd stage	Total
. Foreign amount (Rp x 10^6)	4,664.6	1,798.4	6,463
. Local amount (Rp x 10^6)	447	276	723
. Foreign amount (¥ x 10^6) YEN Evaluation	415	160	575

(4)   Price Escalation

The Annual Price Escalation for Local currency portion is assumed 12%. The Annual Price Escalation for Foreign currency portion is assumed 5%.

Considering the time schedule of construction, the price escalation amount is estimated for each category of construction stage as shown in Table - 3.7.

	1st stage	2nd stage	Total
Price escalation for Foreign (¥ x 10^6)	210.4	386.2	596.6
Price escalation for Local (Rp x 10^6)	5,909.7	17,280.8	21,190.5

(5)   Physical Contingency

The physical contingency for the unexpected change or addition of works is assumed 10% of the total construction cost excluding the Government Tax and the contingency cost itself.

	1st stage	2nd stage	Total
Physical contingency for Foreign (¥ x 10^6)	124.0	81.9	205.9
Physical contingency for Local (Rp x 10^6)	1,303.2	1,173.1	2,476.3

Foreign

	1	2	3	4	5	Grand Total
(1) Crater lake tunnel		67.0	67.0	67.0	67.1	268.1
(2) Dike improvement (Cikunir)		30.4	30.4	30.5		91.3
(3) Dike improvement (Ciloseh)					9.3	9.3
(4) Excavation (I) (Cikunir)	61.7	61.7	61.6			185.0
(5) Excavation (I) (Cikunir)			122.7	122.7	122.6	368.0
(6) Aggregate plant		115.2				115.2
(7) Check dam (Cikunir)		9.2	9.2	9.2	9.2	36.8
(8) Check dam (Cimampang)				5.8	5.7	11.5
(9) Revetment work		12.2	12.2	12.2	12.1	48.7
(10) Check dam		6.3	6.3	6.2	6.2	25.0
(11) Preparatory work		81.1				81.1
Total	61.7	383.1	309.4	253.6	232.6	1,240.0
	(0.05)	0.103	0.158	0.216	0.276	
	3.1	39.5	48.9	54.8	64.1	210.4

Foreign

	6	7	8	9	10	Grand Total
(1) Excavation	122.7	122.7	122.7	122.7	122.6	613.4
(2) Operation cost						-
(3) Check dam	30.4	30.4	30.4	30.4	30.4	152.0
Total	153.1	153.1	153.1	153.1	153.0	765.4
(4) Preparatory work	53.6					
Total	206.7	153.1	153.1	153.1	153.0	819.0
	0.340	0.407	0.477	0.551	0.692	
Total	70.3	62.3	73.0	84.4	96.2	386.2

Local (Rp)

	1	2	3	4	5	Grand Total
(1) Crater lake tunnel		194.4	194.4	194.4	194.4	777.6
(2) Dike improvement (Cikunir)		365.5	565.5	365.6		1,096.6
(3) Dike improvement (Ciloseh)					105.2	105.2
(4) Excavation (I) (Cikunir)	55.27	552.7	552.6			1,658.0
(5) Excavation (I) (Cikunir)			1,218.6	1,218.6	1,218.5	3,655.7
(6) Aggregate plant		1,232.0				1,232.0
(7) Check dam (Cikunir)		252.8	252.8	252.8	252.7	1,011.1
(8) Check dam (Cimampang)				158.5	158.4	316.9
(9) Revetment work		306.6	306.6	306.6	306.5	1,226.3
(10) Check dam		171.9	171.9	171.8	171.8	687.4
(11) Operation cost			137.4	137.4	137.4	412.2
(12) Preparatory works		852.5				852.5
Total	552.7	3,928.4	3,199.8	2,805.7	2,544.9	13,031.5
Price escalation	0.12	0.254	0.405	0.574	0.762	
	66.3	997.8	1,295.9	1,610.5	1,939.2	5,909.7

Local (Rp)

		6	7	8	9	10	Grand Total
(1)	Excavation	1,218.8	1,218.8	1,218.8	1,218.8	1,218.9	6,094.1
(2)	Operation	137.4	137.4	137.4	137.4	137.4	687.0
(3)	Check dam	836.5	836.5	836.5	836.6	836.6	4,182.7
	Total	2,192.7	2,192.7	2,192.7	2,192.8	2,192.9	10,963.8
(4)	Preparatory work	767.5					767.5
	Total	2,960.2	2,192.7	2,192.7	2,192.8	2,192.9	11,731.3
		0.974	1.211	1.476	1.773	2.106	
	Total	2,883	2,655.4	3,236.4	3,887.8	4,618.2	17,280.8

3.3 Project Cost

The project cost for each alternative plans are shown in Table - 3.7.

The project cost (financial cost) for alternative D is shown in Table - 3.8

The project cost (financial cost) of the urgent project to the exclusion south slope of Mt. Galunggung is shown in Table - 3.9.

Table - 3.7   Project Cost for each Alternative Plans

	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
1. Construction Equipment					
1-1 Aggregate Plant	3,056.2	2,412.4	1,975.7	1,475.0	0
2. Spare Parts Consumable Materials for construction equipment					
2-1 Aggregate Plant	611.3	482.5	395.1	295.0	0
2-2 Spare parts	1,473.9	1,473.9	1,473.9	1,473.9	1,473.9
2-3 Spare tire	1,180.5	1,180.5	1,180.5	1,180.5	1,180.5
Sub total	6,321.9	5,549.3	5,025.2	4,424.4	2,654.4
3. Civil Works					
3-1 Crater lake drainage works	3,791.0	3,791.0	3,791.0	3,791.0	3,791.0
3-2 Dike improvement works					
3-2.1 Embankment	1,820.0	1,820.0	1,820.0	1,820.0	1,820.0
3-3 Sand pocket maintenance work					
3-3.1 Excavation (1)	5,406.0	5,406.0	5,406.0	5,406.0	5,406.0
3-3.2 Excavation (2)	14,256.6	10,127.8	6,817.1	1,990.1	0
3-3.3 Excavation (3)	-	3,309.4	6,256.2	10,607.4	12,603.7
3-3.4 Raising dike	1,744.6	1,951.2	2,223.6	2,830.1	4,872.1
3-3.5 Diversion Cannel	-	1,321.7	1,505.3	1,954.6	3,250.5
3-5.6 Check dam	1,870.9	1,870.9	1,870.9	1,870.9	1,870.9
3-4 River course stabilization works					
3-4.1 Consolidation dam	792.7	792.7	792.7	792.7	792.7
3-4.2 Revetment works	981.0	981.0	981.0	981.0	981.0
3-5 Check dams works	6,859.6	6,859.6	6,859.6	6,859.6	6,859.6
3-6 Aggregate plant	2,139.0	1,711.1	1,254.0	941.4	0
3-7 Plant operation cost	1,010.9	718.1	483.4	141.1	0
3-8 Preparatory works	2,847.1	2,846.2	2,804.3	2,799.0	2,957.3
Sub total	43,519.4	43,506.7	42,865.1	42,784.9	45,204.8
Construction Cost	49,841.3	49,056.0	47,890.3	47,209.3	47,859.2
Project Cost	102,315.3	99,750.9	98,310.2	97,828.7	98,246.4

Note: Project cost is estimated (Co: Construction Cost) as follows;
Project cost = Co x 2.0528

Table - 3.8   Project Cost for Alternative D

Item	Project Cost (Rp×10^6)	Foreign Currency ¥(×10^6)	Local Currency (Rp×10^6)	Yen Evaluation ¥(×10^6)
1. Construction Equipment	1,475.0	131.2	–	
1-1 Aggregate Plant	1,475.0	131.2	–	
2. Spare Parts Consumable Materials for Construction Equipment	2,949.4	262.4	–	
2-1 Aggregate plant	295.0	26.2	–	
2-2 Spare parts	1,473.9	131.1	–	
2-3 Spare tire	1,180.5	105.1	–	
3. Civil Works	47,505.2	1,756.2	27,766.2	
3-1 Crater lake drainage works	3,791.0	268.2	777.6	
3-2 Dike improvement works				
3-2.1 Embankment	1,820.0	78.4	938.9	
3-3 Sandpocket maintenance work	24,659.1	1,134.1	11,911.6	
3-3.1 Excavation (1)	5,406.0	263.3	2,446.0	
3-3.2 Excavation (2)	10,607.4	553.6	4,384.9	
3-3.3 Excavation (3)	1,990.1	96.6	904.6	
3-3.4 Raising dike	2,830.1	98.6	1,722.2	
3-3.5 Diversion works	1,954.6	73.7	1,126.4	
3-3.6 Check dam	1,870.9	48.3	1,327.5	
3-4 River course stabilization work	1,773.4	48.6	1,226.7	
3-4.1 Consolidation dam	792.7	25.0	511.4	
3-4.2 Revetment works	981.0	23.6	715.3	
3-5 Check dams works	6,859.6	177.0	4,870.1	
3-6 Aggregate plant	941.1	49.9	380.4	
3-7 Plant operation cost	141.1	–	141.1	
3-8 Preparatory works	2,799.0	–	2,799.0	
3-9 Government tax	4,720.9	–	4,720.9	
4. Land Acquisition Cost	3,763.0	–	3,763.0	
5. Government Administration Cost	2,360.5	–	2,360.5	
Sub Total	58,053.7	2,149.8	33,889.8	
6. Contingency of Item 1 to 6	27,706.6	569.0	20,300.0	
6-1 Price escalation	22,474.5	444.0	17,484.0	
6-2 Physical contingency	5,232.1	215.0	2,816.0	
7. Engineering Service	8,497.7	604.8	1,699.8	
8. Contingency of Item 8	3,570.7	198.4	1,339.7	
8-1 Price escalation	2,720.9	138.0	1,169.7	
8-2 Physical contingency	849.8	60.4	170.0	
Total	97,828.7	3,612.0	57,229.3	

Notes: (1) Price level is as of Oct. 1987.
(2) Exchange rate is as follows: US=145=Rp.1,630 (10 Oct. 1987).
(3) Annual Price Escalation: Foreign Currency=5%, Local Currency=12%.
(4) Physical Contingency of Foreign and Local Currency=10%.
(5) (1.0/0.7-1.0)% Ceiling of Local Currency.

Table - 3.9   Project Cost for Urgent Project (Alternative D)

I t e m	Project Cost (Rpx10^6)	Local Currency (Rpx10^6)	Foreign Currency (x10^6)
1. Construction Equipment	1,475.0	–	1,475.0
1-1 Aggregate Plant	1,475.0	–	1,475.0
2. Spare Parts Consumable Materials for Construction Equipment	2,949.4	–	2,949.4
2-1 Aggregate plant	295.0	–	295.0
2-2 Spare parts	1,473.9	–	1,473.9
2-3 Spare tire	1,180.5	–	1,180.5
3. Civil Works	39,772.4	22,022.7	17,749.7
3-1 Crater lake drainage works	3,791.0	777.6	3,013.4
3-2 Dike improvement works			
3-2.1 Embankment	1,820.0	938.9	881.1
3-3 Sandpocket maintenance work	24,659.1	11,911.6	12,747.5
3-3.1 Excavation (1)	5,406.0	2,446.0	2,960.0
3-3.2 Excavation (2)	10,607.4	4,384.9	6,222.5
3-3.3 Excavation (3)	1,990.1	904.6	1,085.5
3-3.4 Raising dike	2,830.1	1,722.2	1,107.9
3-3.5 Diversion works	1,954.6	1,126.4	828.2
3-3.6 Check dam	1,870.9	1,327.5	543.4
3-4 River course stabilization work	1,773.7	1,226.7	547.0
3-4.1 Consolidation dam	792.7	511.4	281.3
3-4.2 Revetment works	981.0	715.3	265.7
3-5 Aggregate plant	941.1	380.4	560.7
3-6 Plant operation cost	141.1	141.1	0
3-7 Preparatory works	2,628.5	2,628.5	0
3-8 Government tax	4,017.9	4,017.9	0
4. Land Acquisition Cost	3,763.0	3,763.0	0
5. Government Administration Cost	2,398.0	2,398.0	0
Sub Total	50,357.8	28,183.7	22,174.1
6. Contingency of Item 1 to 6	32,410.9	14,336.1	18,074.8
6-1 Price escalation	26,391.7	12,358.7	14,033.0
6-2 Physical contingency	6,019.2	1,977.4	4,041.8
7. Engineering Service	9,723.3	1,153.5	8,569.8
8. Contingency of Item 8	4,167.0	988.7	3,178.3
8-1 Price escalation	3,241.0	823.9	2,417.1
8-2 Physical contingency	926.0	164.8	761.2
Total	96,659.0	44,662.0	51,997.0

Notes: (1) Price level is as of Oct. 1987.
   (2) Exchange rate is as follows: US=145=Rp.1,630 (10 Oct. 1987).
   (3) Annual Price Escalation: Foreign Currency=5%,
       Local Currency=12%.
   (4) Physical Contingency of Foreign and Local Currency=10%.
   (5) (1.0/0.7-1.0)% Ceiling of Local Currency.

4.   Economic Cost

4.1 General Condition

The project cost was estimated by using the price of Kab. Tasikmalaya in Province of West Java in September, 1987. The project cost by each project area is shown in Table - 4.2.

The specification of calculation for the project cost is as follows.

a)   The exchange rate from Rupiah to U.S.$1 = Rp.1,630.

b)   The price for machine parts which cannot be provided in Indonesia would apply the CIF price (Cost Insurance Freight) at Jakarta Port as the border price.

c)   The investigation cost is the one from the planning for the drawing of the personal expenses and the construction supervision. The rate of this cost to the constructive expenses should be 18%.

d)   The administrative cost of the government is the expense is paid directly to the site office from the Indonesian Government. The rate of this cost to the construction expenses is to be 5% by reference to the past results of Mt. Galunggung Project Office or the results of Mr. Sumer Project Office and Mr. Merapi Project Office which have the similar sabo projects.

e)   The physical contingency for the unexpected change or the additional works is assumed 10% of the construction cost.

The economic cost of the project should be consisted of the same items expenditure as its financial cost. The wages for ordinary (unskilled) laborers in the economic cost was supposed to be 50% of their norminal wages, and the annual economic cost was estimated excepting the income tax from the economic cost.

Shadow wage of unskilled labour is assumed 50% of their nominal wages, that is based on the followings.

1) There was no official statistic data about the unemployment rate in Kab. Tasikmalaya. Therefore, the results of hearing toward government offices show that the rate or perfect unemployment is about 25-27%.

2) There are 1,417 thousand households among the total 3,551 thousand households in Western Java that have one or more agricultural hired labors. The share of such households indicate 40%. Moreover, there are 80 thousand households that have one or more hired Manager in Western Java.

   In Kab. Tasikmalaya, the ratio of households which have one or more hired labors shows a little bit lawer, that is 35%.
   There are 89 thousand households which have one or more hired labor among totally 253 thousand households.

3) Therefore, it can be assumed that the shadow-wage of unskilled labor is 50% of their nominal wages, taking into consideration of perfect unemployment rate (25%) and the number of households which have hired labors (35%).

Table - 4.1   Number of Households Engaged in Agricultural Sector

Propinsi/Kab.	Area	Farm Households	Hired Labour	Hired Manager
Jawa Barat	Rural	3,345,949	1,364,637	70,985
	Urban	205,305	51,907	8,824
	Total	3,551,254	1,416,544	79,809
	(%)	(100%)	(39.9%)	
Tasikmalaya	Rural	240,725	84,449	3,714
	Urban	12,562	3,398	992
	Total	253,287	88,847	4,706
	(%)	(100%)	(35.1%)	

Source: Sensus Pertanian (Agricultural Census) 1983
(Biro Pusat Statistik)

Table - 4.2 Number of Households

Kabupaten.	Physical Building	Number of Households	Farm Households	Households did not engaged in Agricultural Sector
Tasikmalaya				
Rural	345,333	326,952	240,752	67,913 (20.8%)
Urban	48,677	51,110	12,562	37,108 (72.6%)
Total	398,010	378,062	252,287	105,021 (27.8%)

Source: Sensus Pertain 1983 (Biro Pusat Statistic)

The maintenance cost for new facilities is considered to occur from the following year of the completion of the facilities construction.

4.2 Unit Cost

The calculated unit cost of economic project cost is shown in Table - 4.3 - Table - 4.4. (As for the details, refer to Annex-4)

4.3 Economic Project Cost

The economic project cost for each alternative plans are shown in Table - 4.5. (as for the details, refer to Annex-5)

Considering the time schedule of construction, the disbursement schedule of each alternative plans is estimated as shown in Table - 4.5. (as the details, refer to Annex-6).

Table - 4.3   Unit Cost of Construction Work (I) (Economic Cost)

Item No.	Work Description		Unit Cost			Rupiah Evaluation of Foreign (Rp)
			Total (Rp)	Foreign (¥)	Local (Rp)	
1-01	Open-cut excavation of sand with gravel by machinery Back-hoe (1.4 m³) including loading	(m³)	1,435	98	333	1,102
1-02	Open-cut excavation by man-power for foundation of dam and other structure	(m³)	1,954	-	1,954	-
1-03	Tunnel excavation of sand with gravel by man-power	(m³)	37,370	1,793	16,218	20,152
1-04	Tunnel excavation of rock by man-power	(m³)	38,037	1,875	16,962	21,075
1-05	Shaft excavation of sand with gravel by man-power	(m³)	53,336	2,272	27,799	25,537
1-06	Shaft excavation of rock by man-power	(m³)	80,645	3,618	39,978	40,667
2-01	Embankment, Furnishing, Spreading and Compacting of main board of dike Bulldozer 16 (t)	(m³)	2,003	130	542	1,461
3-01	Gabion work, Furnishing and placing wire net mattress and filling boulders in the net mattress	(m³)	25,386	1,030	13,809	11,577
4-01	Furnishing and placing wet masonry for dam	(m³)	45,190	1,310	30,465	14,725
4-02	Furnishing and placing plain concrete	(m³)	138,401	2,941	105,343	33,058
5-01	Transportation of riverbed material from Sand Pocket to aggregate plant	(m³)	1,726	102	580	1,146
5-01	Transportation of riverbed material from Sand Pocket to aggregate plant	(m³)	624	37	207	417
6-01	Aggregate plant equipment	(m³)	1,316	114	1,553	1,283

Table – 4.4　Unit Cost of Construction Work (I) (Economic Cost)

Item No.	Work Description		Unit Cost			Rupiah Evaluation of Foreign (Rp)
			Total (Rp)	Foreign (¥)	Local (Rp)	
	Corrugated pipe 2,000 mm Furnishing and placing Corrugated pipe	(m)	2,216,571	194,880	26,120	2,190,451
7-02	Corrugated pipe 4,000 mm Furnishing and placing Corrugated pipe	(m)	4,366,780	388,504	–	4,366,780
8-01	H-Beem 2,000 mm Furnishing and placing H-Beem		575,460	38,929	137,898	437,562
8-01	H-Beem 4,000 mm Furnishing and placing H-Beem		575,460	38,929	137,898	437,562
8-02	H-Beem 4,000 mm Furnishing and placing H-Beem		890,379	78,979	2,655	887,723
9-01	Transportation of aggregate	(m³)	5,875	418	1,175	4,700
10-01	Loading (unloading)		1,022	54	411	744

Table - 4.5　Economic Project Cost and Disbursement Schedule for each Project Area

(x 10^6 Rp)

		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	Total
Cikunir area	A	2,066.9	6,430.7	6,286.3	4,520.4	4,507.7	4,709.0	3,390.6	3,390.6	3,390.7	3,390.7	42,083.5
	B	2,057.1	7,803.1	6,786.1	4,334.0	2,723.2	4,147.8	2,989.0	2,989.0	2,988.8	2,988.5	39,806.6
	C	2,345.5	8,335.1	7,815.6	5,398.9	4,082.2	2,514.9	1,801.3	1,801.3	1,801.3	1,801.0	37,697.0
	D	2,304.8	9,766.9	9,117.6	4,682.5	3,687.0	1,670.4	1,197.8	1,197.8	1,197.8	1,198.0	36,020.6
	E	2,566.0	10,212.4	10,212.1	5,364.7	5,363.9	886.7	886.7	886.7	886.7	886.5	38,152.4
Ciloseh area		523.3	-	-	252.4	2,845.2	-	-	-	-	-	3,620.9
Cisaruni area		44.6	263.9	-	-	-	536.8	536.8	536.8	537.0	536.9	2,992.8
Cikupang area		46.5	-	275.2	-	-	-	-	-	226.2	226.3	774.2
Cimerah area		73.3	-	-	278.0	278.1	979.3	979.3	979.3	979.4	979.7	5,526.4
Crater lake		466.3	1,228.1	1,228.1	1,228.1	1,228.3	-	-	-	-	-	5,378.9

Annex-1

Table - 1.1   Labour Wage (1/2)

Change in past 5 years

Budgetary standard for design
Mt. Galunggung Project Office

Description	Unit Cost (Rp/man.day)					
	1983	1984	1985	1986	1987	Overtime (1987) Rp/hr
Foreman	2,000	2,000	2,000	2,500	2,500	500
Labour (skilled)	2,000	2,000	2,000	2,000	2,000	500
Labour (common)	1,500	1,500	1,500	1,500	1,500	500
Operator	3,500	3,500	3,500	4,000	4,000	1,000
Assistant Operator	2,000	2,000	2,000	2,000	2,500	500
Driver	2,750	2,750	2,750	2,750	2,750	500
Mechanic	3,500	3,500	3,500	4,000	4,000	1,000
Assistant Mechanic	2,000	2,000	2,000	2,000	2,000	500
Electrician	3,500	3,500	3,500	4,000	4,000	1,000
Chief mason	2,500	2,500	2,500	3,500	3,500	1,000
Mason	2,000	2,000	2,000	3,000	3,000	750
Surveyor	5,000	5,000	5,000	6,000	6,000	1,000
Assistant Surveyor	4,000	4,000	4,000	5,000	5,000	750
Chief carpenter	2,500	2,500	2,500	3,500	3,500	1,000
Carpenter	2,000	2,000	2,000	3,000	3,000	750

Table - 1.2   Labour Wage (2/2)

Change in past 5 years

Budgetary standard for design
Mt. Galunggung Project Office

Description	Unit Cost (Rp/man.day)					
	1983	1984	1985	1986	1987	Overtime (1987) Rp/hr
Plasterer	2,000	2,000	2,000	3,000	3,000	750
Chief steel bar worker	2,500	2,000	2,500	3,500	3,500	1,000
Steel bar worker	2,000	2,000	2,000	3,000	3,000	750
Gabion net maker	2,000	2,000	2,000	3,000	3,000	750

Note: Wage for the work from 7:00 until 16:00
        Actual working hour :   8 hours

Table - 1.3 Unit Price of Construction Materials (1/2)

Change in past 5 years

Budgetary standard for design
Mt. Galunggung Project Office

Material	Unit	Unit Price (Rp)				
		1983	1984	1985	1986	1987
Gasoline	1	320	320	385	385	385
Diesel Oil	1	240	240	200	200	200
Mobil Oil	1	1,400	1,400	1,500	2,000	2,000
Gear Oil	1	1,400	1,400	1,500	2,000	2,000
Hydraulic Oil	1	1,400	1,400	1,750	2,000	2,000
Grease	kg	1,500	1,500	1,750	2,000	2,000
Engine Oil (Diesel)	1	1,400	1,400	1,500	2,000	2,000
Sand for concrete	m^3	750	750	750	2,000	2,000
Sand for other	m^3	750	750	750	2,000	2,000
Gravel for concrete	m^3	5,500	7,000	8,000	8,000	8,000
Gravel for backfill	m^3	3,500	4,000	5,000	5,000	5,000
Stone for masonry	m^3	4,000	5,000	5,000	5,000	5,000
Stone for gabion	m^3	4,000	5,000	5,000	5,000	5,000
Brick	pc	25	25	25	35	35

Table - 1.4 Unit Price of Construction Materials (2/2)

Change in past 5 years

Budgetary standard for design
Mt. Galunggung Project Office

Material	Unit	Unit Price (Rp)				
		1983	1984	1985	1986	1987
Reinforced bar	kg	500	500	500	900	900
Nail	kg	725	725	725	750	800
Wire for rebar	kg	450	500	600	600	600
Shape steel	kg	600	600	1,250	1,250	1,250
Gabion wire	kg	800	800	800	825	950
Timber plate for form	m^3	45,000	45,000	60,000	60,000	75,000
Portland cement	bag (40 kg)	3,000	3,250	3,500	3,500	3,800

Table - 1.5   Labour Wage (1/2)

Contrast to the cost of similar   Budgetary standard for design
project in other Project Offices   1987   (RP./man.day)

Description	Source				
	1	2	3	4	5
Foreman	2,500	3,000	5,000	3,750	
Labour (skilled)	2,000	2,250	3,500	3,250	
Labour (common)	1,500	2,000	2,000	2,750	
Operator	4,000	7,000	6,000	3,250	
Assistant Operator	2,500	5,000	4,500	1,750	
Driver	2,750	5,000	5,000	3,250	
Mechanic	4,000	7,000	6,000	3,250	
Assistant Mechanic	2,000	5,000	4,000	1,750	
Electrician	4,000	5,000	5,000	3,250	
Chief mason	3,500	4,000	–	3,750	
Mason	3,000	3,000	3,500	3,250	
Surveyor	6,000	5,000	5,000	3,200	
Assistant Surveyor	5,000	3,500	3,500	2,500	
Chief carpenter	3,500	5,000	–	3,750	
Carpenter	3,000	3,500	3,500	3,250	

Table - 1.6   Labour Wage (2/2)

Contrast to the cost of similar   Budgetary standard for design
project in other Project Offices   1987

Description	Source				
	1	2	3	4	5
Plasterer	3,000	3,000	3,500	2,200	
Chief steel bar worker	3,500	5,000	–	3,750	
Steel bar worker	3,000	3,000	3,500	3,250	
Gabion net maker	3,000	3,000	2,500	3,250	

Source: 1.   Mt. Galunggung Project Office

         2.   Mt. Merapi Project Office.

         3.   Mt. Semeru Project Office

         4.   Mt. Kelud Project Office.

Table - 1.7 Unit Price of Construction Materials (1/2)

Contrast to the cost of similar
project in other Project Offices

Budgetary standard for design
1987

Item	Unit	Source				
		1	2	3	4	5
Gasoline	l	385	385	385	385	
Diesel Oil	l	200	200	200	200	
Mobil Oil	l	2,000	2,200	2,500	-	
Gear Oil	l	2,000	2,000	2,500	-	
Hydraulic Oil	l	2,000	3,500	3,500	-	
Grease	kg	2,000	3,500	2,500	-	
Engine Oil (Diesel)	l	2,000	2,000	2,000	-	
Sand for concrete	m^3	2,000	2,000	3,500	3,500	
Sand for other	m^3	2,000	1,500	3,000	2,800	
Gravel for concrete	m^3	8,000	5,000	6,500	3,600	
Gravel for backfill	m^3	5,000	4,000	5,500	6,000 -7,000	
Stone for masonry	m^3	5,000	3,500	4,500	7,250	
Stone for gabion	m^3	5,000	3,500	4,500	7,250	
Brick	pc	35	20	20	18	

Table - 1.8   Unit Price of Construction Materials (2/2)

Contrast to the cost of similar   Budgetary standard for design
project in other Project Office   1987

Item	Unit	Source				
		1	2	3	4	5
Reinforced bar	kg	900	700	700	700	
Nail	kg	800	1,000	1,000	1,350	
Wire for rebar	kg	600	1,000	1,000	1,000 -1,250	
Shape steel	kg	1,250	700	700	—	
Gabion wire	kg	950	1,000	1,000	1,150	
Timber plate for form	m^3	75,000	70,000	200,000	160,000 -250,000	
Portland cement	bag (40 kg)	3,800	4,400	4,400	4,100	

Source : 1. Mt. Galunggung Project Office

         2. Mt. Merapi Project Office.

         3. Mt. Semeru Project Office

         4. Mt. Kelud Project Office.

Table - 1.9   Labour Wage (1/2)

Contrast to the cost of other project   Budgetary standard for design
in the vicinity of Tasikmalaya   1987   (RP./man.day)

Description	Source			
	1	2	3	4
Foreman	2,500	3,500	2,500	2,500
Labour (skilled)	2,000	4,000	3,000	2,000
Labour (common)	1,500	3,000	2,000	1,400
Chief of Operator				
Operator	4,000	--	3,500	4,000
Assistant Operator	2,500	-	-	2,500
Driver	2,750	-	-	2,500
Mechanic	4,000	-	3,500	4,000
Assistant Mechanic	2,000	-	-	2,500
Electrician	4,000	-	-	4,000
Chief mason	3,500	4,000	3,500	3,500
Mason	3,000	3,500	3,000	3,000
Surveyor	6,000	-	-	4,000
Assistant Surveyor	5,000	-	-	3,000
Chief carpenter	3,500	4,000	3,500	3,500
Carpenter	3,000	3,750	3,000	3,000
Assistant carpenter	-	2,500	--	--

Table - 1.10   Labour Wage (2/2)

Contrast to the cost of other project   Budgetary standard for design
in the vicinity of Tasikmalaya   1987   (RP./man.day)

Description	Source			
	1	2	3	4
Plasterer	3,000	–	3,000	3,000
Chief steel bar worker	3,500	4,000	3,500	3,500
Steel bar worker	3,000	3,000	3,000	3,000
Gabion net maker	3,000	–	–	3,000
Assistant steel bar worker	–	2,000	–	–

Source: 1. Mt. Galunggung Project Office 1987

2. Daftar Harga Satuan Bahan Bangunan dan Upah Pekerjaan Dwi
    Wulan II 1987 - 1988
    Deparetmen PU Direktorat Jenderal Cipta Karya.
    Departemen PU Propinsi Jawa Barat.
    Proyek Penyuluhan Pembangunan Perumahan Rakyat, Pusat
    Informasi Teknik Bangunan, Bandung

3. Daftar Harga Satuan Upah dan Bahan dalam Wilayah Kabupaten
    Daerah Tingkat II Tasikmalaya untuk Bahan Rencana - PROYEK
    INPRES TAHUN ANGGARAN 1986/1987

4. Citanduy Project Office 1987

Table - 1.11   Unit Price of Construction Materials (1/2)

Contrast to the cost of other project   Budgetary standard for design
in the vicinity of Tasikmalaya   1987   (Rp)

I t e m	Unit	Source			
		1	2	3	4
Gasoline	l	385	–	385	385
Diesel Oil	l	200	–	245	200
Mobil Oil	l	2,000	–	2,000 –12,500	2,000
Gear Oil	l	2,000	–	–	2,000
Hydraulic Oil	l	2,000	–	3,850	2,000
Grease	kg	2,000	–	2,000	2,000
Engine Oil (Diesel)	l	2,000	–	–	2,000
Sand for concrete	m^3	2,000	3,500	8,500	15,000 *
Sand for other	m^3	2,000	3,000	5,500	16,000 *
Gravel for concrete	m^3	8,000	7,500– 10,000	12,500– 11,000	15,000 *
Gravel for road	m^3	–	7,500– 10,000	11,000	–
Gravel for backfill	m^3	5,000	5,000	10,000	16,000 *
Stone for masonry	m^3	5,000	5,000	7,000	16,000 *
Stone for gabion	m^3	5,000	5,000	7,000	16,000 *
Brick	pc	35	30	–	30

Table - 1.12   Unit Price of Construction Materials (2/2)

Contrast to the cost of other project   Budgetary standard for design
in the vicinity of Tasikmalaya   1987   (Rp)

Item	Unit	Source			
		1	2	3	4
Reinforced bar	kg	900	440	900	850
Nail	kg	800	700	850	1,100
Wire	kg	600	850	975	1,000
Shape steel	kg	1,250	–	900	850
Timber plate for form	m^3	75,000	54,000	100,000	60,000
Gabion Wire	kg	950	–	–	900
Portand cement	t	95,000	85,000	100,000	95,000

Source: 1. Mt. Galunggung Project Office 1987

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Wulan II 1987 - 1988
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Departemen PU Propinsi Jawa Barat.
Proyek Penyuluhan Pembangunan Perumahan Rakyat, Pusat
Informasi Teknik Bangunan, Bandung

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INPRES TAHUN ANGGARAN 1986/1987

4. Citanduy Project Office 1987

* Source is far from the Project location.

Annex-2

Breakdown of Unit Cost (Financial Cost)

(I)   Unit Cost of Construction Works

(II)   Breakdown of Unit Cost

        1. Excavation by Machine (1-01)

        2. Excavation by Manpowr (1-02)

        3. Excavation of Crater Lake Tunnel (1-03 - 1-06)

            3.1 Drainage Tunnel

            3.2 Shaft

        4. Embankment by machine

            4.1 Height of Dike <5.0 m (2-01)

            4.2 Height of Dike ≦5.0 m (2-02)

        5. Gabion Work (3-01)

        6. Stone Masonry (4-01)

        7. Plain Concrete (4-02)

        8. Transportation of Riverbed Material

        9. Loading

Table - 2.1   Unit Cost of Construction Work (I) (Financial Cost)

Item No.	Work Description	Unit Cost			Rupiah Evaluation of Foreign (Rp)
		Total (Rp)	Foreign (¥)	Local (Rp)	
1-01	Open-cut excavation of sand with gravel by machinery Back-hoe (1.4 m³) including loading (m³)	1,875	98	773	1,097
1-02	Open-cut excavation by man-power for foundation dam other structures (m³)	3,296	-	3,296	-
1-03	Tunnel excavation of sand with gravel by man-power (m³)	36,637	1,793	16,485	20,152
1-04	Tunnel excavation of rock by man-power (m³)	38,304	1,875	17,229	21,075
1-05	Shaft exzacavation of sand with gravel by man-power (m³)	53,419	2,272	27,886	25,533
1-06	Shaft excavation of rock by man-power (m³)	80,883	3,618	40,217	40,666
2-01	Embankment, Fuenishing, Spreading and Compacing main board of dike Bulldozer 16 (t) (m³)	2,562	129	1,109	1,453
2-02	Height of Dike <5.0 m Bulldozer 16 (t) (m³)	3,424	173	1,482	1,942
3-01	Gabion work, Furnishing and placing wire net mattres and filling boulders in the wire net mattress (m³)	27,974	1,026	16,437	11,537
4-01	Furnishing and placing wet masinry for dam (m³)	49,712	1,310	34,987	14,725
4-02	Furnishing and placing plain concret (m³)	153,581	2,941	120,523	33,058

Table - 2.2   Unit Cost of Construction Work (II) (Financial Cost)

Item No.	Work Description		Unit Cost			Rupiah Evaluation of Foreign (Rp)
			Total (Rp)	Foreign (¥)	Local (Rp)	
5-01	Transportation of river bed material from Sand Pocket to aggregate plant L=5.0km	(m³)	2,360	102	1,209	1,151
5-02	Transportation of river bed material from Sand Pocket to aggregate plant L=500 m	(m³)	853	37	436	417
5-03	Transportation of river bed material from Sand Pocket to aggregate plant L=1.0km	(m³)	1,052	46	538	514
5-04	Transportation of river bed material from Sand Pocket to aggregate plant L=2.0km	(m³)	1,284	56	658	626
6-01	Aggregate plant equipment	(m³)	2,836	114	1,553	1,283
7-01	Corrugated pipe 2,000 mm Furnishing and placing Corrugated pipe	(m³)	2,217,039	194,880	26,588	2,190,451
7-02	Corrugated pipe 4,000 mm Furnishing and placing Corrugated pipe	(m³)	4,366,780	388,504	-	4,366,780
8-01	H-Beam 2,000 mm Furnishing and placing H-Beam	(m)	575,789	38,929	138,227	437,562
8-02	H-Beam 4,000 mm Furnishing and placing H-Beam	(m)	890,379	78,979	2,655	887,724
9-01	Transportation of aggregate by train	(m³)	5,875	418	1,175	4,700
10-01	loading (unloading)	(m³)	1,022	54	411	744

Breakdown of Unit Cost

1. Excavation by Machine (1-01)

    - Sand with gravel, Production: 84 m^3/hr

    - Back hoe 1.4 m^3

    - Allotment: 1/84 = 0.0119

Work Item	Allotment	Unit	Unit Cost (Rp)	Total	Amount Foreign	Local (Rp)
Depreciation cost	0.0119	hr/m^3	43,505	518	518	–
Owner ship cost	0.0119		29,004	345	–	345
Fuel oil cost	0.0119		6,456	77	38	39
Operator & labour	0.0119		2,038	24	–	24
Repair & maintenance	0.0119		43,505	518	311	207
Sub Total (Rp/m^3)				1,482	867	615
Total (Sub Total x 1.265)				1,875	1,097	778

Breakdown of Equipment Cost

Equipment   <u>Back hoe   1.4 m^3</u>

a	Economic life		5 year
b	Operation time per year		2,000 hour/year
c	Basic price		483,392,000 Rp
d	Tire cost		- Rp
e	Residual value, 0.1 x (c-d)		48,339,200 Rp
f	Depreciation cost, $\dfrac{c-d-e}{ab}$		43,505 Rp
g	Ownership cost, $\dfrac{0.2 \times (a+1) \times c}{2ab}$		29,004 Rp/hr
h	Operation cost, i+j+k+l		7,670 Rp/hr
i	Fuel 0.129 l/hr 209 ps x 200 Rp/l		5,380 Rp/hr
j	Lubricant, i x 20%		1,076 Rp/hr
k	Tire cost		- Rp/hr
l	Operator		2,038 Rp/hr
	Operator	0.143 x 7,000	Rp/hr
	Assistant operator	0.143 x 1/2 x 4,500	Rp/hr
	Foreman	0.143 x 1/5 x 5,000	Rp/hr
	Common labour	0.143 x 2 x 2,000	Rp/hr
m	Repair and maintenance cost, $\dfrac{(c-d) \times n}{ab}$		43,505 Rp/hr
n	Ratio of repair and maintenance cost		90%
o	Direct cost, f+g+h+m		123,684 Rp/hr
p	Indirect cost, 15% of direct cost		18,553 Rp/hr
q	Equipment cost, o+p		142,237 Rp/hr

Production/hour

$$Q = \frac{3,600 \times q \times E}{cm}$$

q = 1.37 m^3, E = 0.6, cm = 35 sec (swing angle = 180°)

$$Q = \frac{3,600 \times 1.37 \times 0.6}{35} = 84 \text{ m}^3/\text{hr}$$

2. Excavation by Manpower (1-02)

Excavation depth H ≤ 1 m

Transportation Distance L ≤ 30 m

	Work Item	Allotment	Unit	Unit Cost (Rp)	Total	Amount Foreign	Local (Rp)
Common soil	Excavation						
	Common labour	0.75	man.day	2,000	1,500	–	1,500
	Foreman	0.025	man.day	5,000	125	–	125
	Transportation						
	Common labour	0.33	man.day	2,000	660	–	660
	Foreman	0.01	man.day	5,000	50	–	50
	Sub Total				2,335		2,335
	Total (Rp/m^3) x 1.265				2,954		2,954
Hard soil	Excavation						
	Common labour	1	man.day	2,000	2,000	–	2,000
	Foreman	0.033	man.day	5,000	165	–	165
	Transportation						
	Common labour	0.33	man.day	2,000	660	–	660
	Foreman	0.01	man.day	5,000	50	–	50
	Sub Total				2,875		2,875
	Total (Rp/m^3) (Sub Total x 1.265)				3,637		3,637

Excavation by manpower : $(2.954 + 3.637) \times \dfrac{1}{2} = 3.296$ Rp

3. Excavation of Crater Lake Tunnel (1-03 - 1-06)

3.1 Drainage Tunnel

3.1.1 Condition

1) Dimension   Diameter: 2.0 m

              Length   :   665 m

2) Soil condition   a: Soil with gravel

                     b: Rock

3) Lining
    - Shorting: H-sections will be used and it is erected at intervals
                  of 1.0 m.
    - Lining material:
        Prefabricated corrugated steel pipe will be used as it has
        features of;
        . Light weight
        . Simple execution
        . Easy transportation
        Divided units of pipe are assembled to complete tunnel section
        at the place.

4) Tunnel section
    Circular section will be applied.

5) Excavation
    - Labour formation
        The work will be executed with following formation.

	Labour	Man	Work
Inside the Tunnel	Skilled tunnel labour	2	Excavation
	Tunnel labour	2	Excavation, Loading, Transport
	Tunnel foreman	1	Planning, Safety Control
Outside the Tunnel	Skilled labour	1	Operation of machines
	Common labour	1	Miscellaneous works

- Working hour per 1 day

Work	Working hour
Preparation, go in and out of tunnel	30 min
Rest in tunnel	30 min
Excavation and lining	420 min

- Cycle time   (min/1 cycle time)

Work	Sand with gravel	Rock
Transportation of excavated soil	$t_2 = 205$	$t_2 = 228$
Placing of rail and ventilation pipe	15	15
Check, survey	3	3
Excavation work	$t_3 = 196$	$t_3 = 196$
Total (min/1 cycle)	T=419	T=442

- Time for transportation of excavated soil per 1 cycle (t_2)

Description	Unit	Sand with Gravel	Rock
Carrying volume per 1 cycle	m^3	7.13	7.13
Carrying volume per 3 trollies	m^3	1.2	1.08
Loading unloading time per 1 trip	min	30	30
No. of trip (n)	trip	7.13/1.2=5.94	7.13/1.08=6.60
$t_2 = n \times (t + 30)$	min	205	228

t : Trip time $t = 150/66.7 \times 2 = 4.5$ min

      Average transport distance   L = 150 m

      Trip speed   V = 4 Km/hr = 66.7 m/min

- Time for excavation work per 1 cycle

$$t_3 = A \times P \times \frac{60}{q \times N} - (t + 3)$$

    A: Excavation area   7.13 m^3

    P: Spacing of shoring   1 m

    q: Performance of 1 hammer   0.7 m^3/hr

    N: No. of hammer   N=3

$$t_3 = 7.13 \times 1 \times \frac{60}{0.7 \times 3} - (4.5 + 3) = 196 \text{ min}$$

- Machines to be employed

Machine		No.
Pick hammer	8 kg	3
Air compressor	3.5 m /min	1
Trolly	0.5 m	3
Fan	1.5 Kw	1
Diesel generator	30 kvA	1

- Operating time of machines

Operating time of machines per 1 day operation is settled
7 hours.

- Labour cost

The unit cost of labours exclusively employed in tunnel work
are estimated in reference of the standard in Japan.
The unit costs are listed in the table below.

Labour	Unit	Amount
Skilled tunnel labour	Rp/man.day	7,000
Tunnel labour	"	5,000
Skilled labour	"	3,500
Tunnel foremen	"	7,000

3.1.2 Unit Cost of Tunnel Excavation (1-03)

-- Sand with gravel

T=419 min

Work Item	Allotment		Unit	Unit Cost (Rp)	Total	Amount foreign	Local (Rp)
Skilled tunnel labour	3.0	1)	man.day	7,000	21,000	--	21,000
Tunnel labour	3.0	1)	"	5,000	15,000	--	15,000
Tunnel foreman	1.5	1)	"	7,000	10,500	--	10,500
Skilled labour	1.5	1)	"	3,500	5,250	--	5,250
Common labour	1.5	1)	"	2,000	3,000	--	3,000
Compressor (3.5 m^3/min)	4.43	2)	hr	5,566	24,657	14,043	10,614
Pick hammer 8 kg	1.5	3)	day	2,506	3,759	2,709	1,050
Fan 1.5 Kw	0.9	4)	day	23,632	21,269	21,269	--
Trolly 0.5 m^3	3.0	4)	day	13,664	40,992	40,992	--
Diesel generator 30 kvA	0.9		day	47,824	43,042	24,765	18,276
Temporary facilities	1.0		meter	18,028	18,028	9,805	8,223
Total (Rp/1 cycle 1 meter)					206,497	113,583	92,914
x 1.265					261,219	143,682	117,537
m/m^3 (7.13) m^3					36,637	20,152	16,485

-- Rock (1-04)

T=442 min

Work item	Allotment	Unit	Unit cost (Rp)	Total	Amount foreign	Local (Rp)
Skilled tunnel labour	3.156	man.day	7,000	22,092	--	22,092
Tunnel labour	3.156	"	5,000	15,780	--	15,780
Tunnel foreman	1.579	"	7,000	11,053	--	11,053
Skilled labour	1.579	"	3,500	5,526	--	5,526
Common labour	1.579	"	2,000	3,158	--	3,158
Compressor (3.5 m^3/min)	4.321	hr	5,566	24,657	14,043	10,614
Pick hammer 8 kg	1.5	day	2,506	2,405	1,734	672
Fan 1.5 Kw	0.95	day	23,632	22,450	22,452	--
Trolly 0.5 m^3	3.0	day	13,664	25,825	25,825	--
Diesel generator 30 kvA	0.95	day	47,824	45,443	26,141	19,292
Temporary facilities	1.0	meter	18,028	18,028	9,805	8,223
Total (Rp/1 cycle 1 meter)				160,603	101,431	58,632
Rp/m^3 (7.13 m^3/m)						
x 1.265				38,304	21,075	17,229

Note: 1) Labour formation x $\dfrac{T}{420}$ 2) $(64 + t_3)/60$

3) $2 \times t_3/420$ 4) No x T/420

3.1.3 Equipment Cost

Equipment   Compressor   3.5 m^3/min   33 PS

Basic Price   :   1,620 kY

Economic life   :   5 year

Operation time/year   :   2000 hour/year

Repair & maintenance cost ratio :   90%

	Total	Amount (Y/hr) Foreign	Local
Depreciation	146	146	–
Ownership	97	–	97
Fuel, oil	98	49	49
Repair & maintenance	146	88	58
Miscellaneous	10	0	10
Total Y/hr	497	283	214
Rp/hr	5,566	3,170	2,396

1\$ = 1,630 Rp = 145Y, 11.2 Rp = 1 Y

3.1.4 Unit Cost of Lining (7-01)

- Corrugated pipe 2,000 mm

- 1 cycle (1 meter) 155 mm

Work Item	Allot- ment	Unit	Unit Cost (Rp)	Total	Amount Foreign	Local (Rp)
Corrugated pipe 2,000 mm	1.0	meter	1,332,800	1,332,800	1,332,800	-
R-ring H-100 @ 1.5 m	1.0	"	374,800	374,800	374,800	-
Skilled tunnel labour	0.74	man.day	7,000	5,180	–	5,180
Tunnel labour	0.74	"	5,000	3,700	–	3,700
Tunnel foreman	0.37	"	7,000	2,590	–	2,590
Skilled labour	0.37	"	3,500	1,295	–	1,295
Common labour	0.37	"	2,000	740	–	740
Fan 1.5 Kw	0.37	day	23,632	8,744	8,744	-
Trolly 0.5 m^3	0.37	day	13,632	5,056	5,056	-
Generator 30 kvA	0.37	day	47,824	17,695	10,181	7,514
Total Rp/1 meter				1,752,600	1,731,581	21,019
x 1.265				2,217,039	2,190,450	26,588
					¥194,880	

Note: $\dfrac{\text{Erection time}}{\text{1 day work}}$ = $\dfrac{155 \text{ min}}{420 \text{ min}}$ = 0.37 day/m

3.1.5 Shoring H-beam for Corrugated Pipe 2,000 mm (8-01)

- H-1.25 x 1.25 x 6.5 x 9
- Spacing 1 m

Work Item	Allot-ment	Unit	Unit Cost (Rp)	Total	Amount Foreign	Local (Rp)
H-beam H-125x125x6.5x9-3.207	152.6	kg	2,133	325,496	325,496	–
Wood	0.26	m^3	75,000	19,500	–	19,500
Skilled tunnel labour	0.52	man.day	7,000	3,640	–	3,640
Tunnel labour	0.52	"	5,000	2,600	–	2,600
Tunnel foreman	0.26	"	7,000	1,820	–	1,820
Skilled labour	0.26	"	3,500	910	–	910
Common labour	0.26	"	2,000	520	–	520
Fan 1.5 Kw	0.26	day	23,632	6,144	6,144	–
Trolly 0.5 m^3	0.52	day	13,664	7,105	7,105	–
Generator 30 kvA	0.26	day	47,824	12,434	7,154	5,280
Fabrication of steel	100	kg	750	75,000	–	75,000
Sub Total Rp/1 meter				455,169	345,899	109,270
Total x 1.265				575,789	437,562	138,227

Note: $\dfrac{\text{Erection time for shoring}}{\text{1 day work}} = \dfrac{110 \text{ min}}{420 \text{ min}} = 0.26$ day

H-125 x 125 x 6.5 x 9 - 3.207 m x 2

3.207 x 23.8 kg/m

= 76.3 kg

66,000¥/t x 250% x 1.15 = ¥189,750 x 11.24Rp/¥ = 2,132,790 Rp/t

$\doteq$ 2,133 Rp/kg

3.2 Shaft

3.2.1 Condition

1) Dimension   Diameter: 4.0 m

                   Depth   :   90 m

2) Soil condition   a: Sand with gravel

                       b: Rock

3) Excavation

    - Labour formation

Labour	Man	Work
Skilled tunnel labour	4	Excavation, installation of lining material
Skilled labour	1	Winch operating
Common labour	1	Work outside of pit
Foreman	1	Instruction

    - Excavation progress per 1 day

      Sand with gravel: 0.50 m/day

      Rock   :   0.35 m/day

    - Equipment for excavation

Use	Name	Specifications	No.
Excavation of excavated Soil Hanging of lining material	Scaffolding	With 10 Kw motor, 1 ton winch	1
Ventilation	Fan	ϕ 200 mm, 0.75 Kw	1
Transportation of evacuated soil	Belt conveyor	7 m length with 1 Kw motor	1
Drainage	Submersible pump	ϕ 50 mm, 3.7 Kw	1
Excavation			
for sand with gravel	Pick hammer	8 kg	4
for rock	Pick hammer	8 kg	1
	Hand hammer	15 kg	3
	Air compressor	10 m^3/min	1
Power source	Diesel Generator	30 kvA	1

    - Disposal of excavated soil

    - Excavated soil is planned to be put at about 5 m distance from the side wall of the shaft.

3.2.2 Unit Cost of Shaft Excavation (1-05)

- Sand with gravel

Work Item	Allotment	Unit	Unit Cost (Rp)	Total	Amount Foreign	Local (Rp)
Skilled tunnel labour	4	man.day	7,000	28,000	–	28,000
Skilled labour	1	"	3,500	3,500	–	3,500
Common labour	1	"	2,000	2,000	–	2,000
Foreman	1	"	5,000	5,000	–	5,000
Pick hammer 8 kg	4	Unit	2,506	10,024	7,224	2,800
Compressor 10 m^3/min	1	"	104,818	104,818	58,877	45,941
Diesel generator 30 kvA	1	"	47,824	47,824	27,517	20,307
Temporary facilities	1	day	119,982	119,982	59,879	60,103
Total Rp/day				321,148	153,497	167,651
Unit cost for 1 meter excavation (0.5 m/day)				642,296	306,994	335,302
Unit cost for 1 m^3 excavation (15.21 m^3/m)				42,229	20,184	22,045
x 1.265				53,419	25,533	27,886

- Rock (1-06)

Work Item	Allotment	Unit	Unit Cost (Rp)	Total	Amount Foreign	Local (Rp)
Skilled tunnel labour	4	man.day	7,000	28,000	–	14,000
Skilled labour	1	"	3,500	3,500	–	3,000
Common labour	1	"	2,000	2,000	–	1,500
Foreman	1	"	5,000	5,000	–	2,500
Hand hammer 15 kg	3	Unit	10,661	31,983	23,058	8,925
Pick hammer 8 kg	1	"	2,506	2,506	1,806	700
Compressor 10 m^3/min	1	"	104,818	104,818	58,877	45,941
Diesel generator 30 kvA	1	"	47,824	47,824	27,517	20,307
Temporary facilities	1	day	114,749	114,749	59,879	54,870
Total Rp/day				340,380	171,137	169,243
Unit cost for 1 meter excavation (0.35 m/day) Rp/m				972,514	488,963	483,551
Unit cost for 1 m^3 excavation (15.21 m^3/m)				63,939	32,147	31,792
Rp/m^3 x 1.265				80,883	40,666	40,217

3.2.3 Equipment Cost of 1 Day Operation

Equipment	Pick Hammer 8 kg			Hand Hammer 15 kg		
Basic price	¥33,000			¥140,000		
Economic life	2 years			2 years		
Operation time	800 hrs			800 hrs		
Repair & Maintenance Cost ratio	35%			35%		
	Amount (¥/hr)			Amount (¥/hr)		
	Total	Foreign	Local	Total	Foreign	Local
Depreciation	19	19	-	79	79	-
Ownership	6	-	6	26	-	26
Repair & Maintenance	7	4	3	31	19	12
Total (¥/hr)	32	23	9	136	98	38
(Rp/day)	2,506	1,806	700	10,061	7,686	2,975

Equipment	Air Compressor 10.5 m^3/min			Diesel Generator 30 kvA		
Basic price	¥4,144 k			¥2,321 k		
Economic life	5 years			5 years		
Operation	2,000 hrs			2,000 hrs		
R & M cost ratio	90 %			65 %		
	Amount (¥/hr)			Amount (¥/hr)		
	Total	Foreign	Local	Total	Foreign	Local
Depreciation	370	370	-	209	209	-
Ownership	249	-	249	139	-	139
Fuel	263	132	131	84	42	42
Oil	53	27	26	17	9	8
R & M	370	222	148	151	91	60
Miscellaneous	32	-	32	10	-	10
Total (¥/hr)	1337	751	586	610	351	259
(Rp/day)	104,818	58,877	45,941	47,824	27,517	20,307

Operating time of machine = 7 hours/day

Equipment Cost for a day Operation

Equipment		Trolly (0.5 m^3)	Fan (1.5 kw)
a) Initial Cost (¥)		460,000	1,390,000
b) Economic Life (year)		5	6
c) Operation Day (day/year)		140	170
d) Depreciation Ratio (%)		90	90
f) Yearly Management Cost Ratio (%)		5	5
g) Depreciation Cost (¥/day)	$\dfrac{a \times d}{b \times c}$	593	1,226
h) Repair & Maintenance Cost (¥/day)	$\dfrac{a \times e}{b \times c}$	462	476
i) Yearly Management Cost (¥/day)	$\dfrac{a \times f}{c}$	165	408
j) Hire Cost (¥/day)	g+h+i	1,220	2,110
(Rp/day)		13,664	23,632

3.2.4 Unit Cost of Lining (7-02)

- Coruggated pipe 4,000 mm

Work Item	Allotment	Unit	Unit Cost (Rp)	Total	Amount Foreign	Local (Rp)
Liner plate φ 4,000 mm, t=3.2 mm	1	meter	3,452,000	3,452,000	3,452,000	-
Total Rp/1 meter				3,452,000	3,452,000	-
x 1.265				4,366,780	4,366,780	

3.2.5 Unit Cost of Reinforcing H-beam (8-02)

- H 125 x 125 x 6.5 x 9

- 311 kg/1 ring @ 1.0 m

Work Item	Allotment	Unit	Unit Cost	Total	Amount Foreign	Local (Rp)
Skilled tunnel labour	0.4	man.day	3,500	1,400	-	1,400
Skilled labour	0.1	"	3,000	300	-	300
Common labour	0.1	"	1,500	150	-	150
Foreman	0.1	"	2,500	250	-	250
H-beam H-125 x 125 x 6.5 x 9	329	kg	2,133	701,757	701,757	-
Total Rp/1 ring				703,857	701,757	2,100
Unit cost for 1 meter excavation (Rp/m) (1.0 m/1 ring)				890,379	887,723 ¥78,979	2,655

φ 4,000 mm   t=3.2

¥161,000 + 106,000 = ¥267,000/m x 1.15 = ¥307,050/m

= 3,451,242

= 3,452,000

H-125 x 125 x 6.5 x 9 - 13.82 m x 23.8 kg/m = 328.9 kg

4. Embankment by machine

- Bulldozer 16 ton
- Production: Excavation 71 m³/hr

Spreading & compaction 38 m³/hr

4.1 Height of Dike <5.0 m (2-01)

Work Item	Allotment	Unit	Unit Cost (Rp)	Total	Amount Foreign	Local (Rp)
Depreciation cost	0.0404	hr/m³	16,410	663	663	–
Ownership cost	0.0404		10,960	443	–	443
Fuel oil cost	0.0404		4,320	175	88	87
Operator & labour	0.0404		2,038	82	–	82
Repair & Maintenance	0.0404		16,410	663	398	265
Total (Rp/m³)				2,026	1,149	877
x 1.265				2,562	1,453	1,109

Production/hour

Excavation $Q = \dfrac{60 \times q \times E}{Cm}$, Cm = 0.038L + 0.2 (min), L=20 m, Cm=0.96 min

$$Q = \frac{60 \times 1.75 \times 0.65}{0.96} = 71 \text{ m}^3/\text{hr}$$

Spreading Q_1 = 10E (11D+8) = 10 x 0.6 x (11 x 0.3+8) = 68 m³/hr

E : Work efficiency   0.6

D : Height after compaction   0.3 m

Compaction $Q = \dfrac{V\ W\ D\ E}{N} = \dfrac{3,500 \times 0.7 \times 0.3 \times 0.6}{5} = 88 \text{ m}^3/\text{hr}$

V=3,500 m/hr, W=0.7 m, D=0.3 m, E=0.6, N=5

Spreading and compaction

$$Q = \frac{Q_1 \times Q_2}{Q_1 + Q_2} = \frac{68 \times 88}{68 + 88} = 38 \text{ m}^3/\text{hr}$$

Allotment $\dfrac{1}{38} + \dfrac{1}{71} = 0.0404$

4.2 Height of dike ≥ 5.0 m (2-02)

- Bulldozer 16 ton
- Production : Excavation 71 m^3/hr
  Spreading & compaction 25 m^3/hr

Work Item	Allotment	Unit	Unit Cost (Rp)	Total	Amount Foreign	Local (Rp)
Depreciation cost	0.054	hr/m^3	16,410	886	886	-
Ownership cost	0.054		10,960	592	-	592
Fuel oil cost	0.054		4,320	233	117	116
Operator & labour	0.054		2,038	110	-	110
Repair & Maintenance	0.054		16,410	886	532	354
Total (Rp/m^3)				2,707	1,535	1,128
x 1.265				3,424	1,942	1,482

Production/hour

Excavation $Q = \dfrac{60 \times q \times E}{Cm}$ Cm = 0.038L + 0.2 (min), L=20 m, Cm=0.96 min

$$Q = \frac{60 \times 1.75 \times 0.65}{0.96} = 71 \text{ m}^3/\text{hr}$$

Spreading $Q_1 = 10E (10D+8) = 10 \times 0.6 \times (11 \times 0.15+8) = 58 \text{ m}^3/\text{hr}$

E : Work efficiency   0.6

D : Height after compaction   0.15 m

Compaction $Q = \dfrac{V\,W\,D\,E}{N} = \dfrac{3,500 \times 0.7 \times 0.15 \times 0.6}{5} = 44 \text{ m}^3/\text{hr}$

V=3,500 m/hr, W=0.7 m, D=0.15 m, E=0.6, N=5

Spreading and compaction

$$Q = \frac{Q_1 \times Q_2}{Q_1 + Q_2} = \frac{58 \times 44}{58 + 44} = 25 \text{ m}^3/\text{hr}$$

Allotment

$$A = \frac{1}{25} + \frac{1}{71} = 0.054$$

Breakdown of Equipment Cost

Equipment Bulldozer 16 ton

a	Economic life	5	year
b	Operation time/year	2,000	hour/year
c	Basic price	182,336,000	Rp
d	Tire cost	–	Rp
e	Residual value, 0.1 x (c-d)	18,233,600	Rp
f	Depreciation cost, $\dfrac{c-d-e}{ab}$	16,410	Rp
g	Ownership cost, $\dfrac{0.2 \times (a+1) \times c}{2ab}$	10,960	Rp/hr
h	Operation cost, i+j+k+l	5,534	Rp/hr
i	Fuel 18.3 1/hr 150 ps x 200 Rp/1	3,600	Rp/hr
j	Lubricant, i x 20%	720	Rp/hr
k	Tire cost		Rp/hr
l	Operator	2,038	Rp/hr
	Operator	7,000	Rp/hr
	Assistant operator	4,500	Rp/hr
	Foreman	5,000	Rp/hr
	Common labour	2,000	Rp/hr
m	Repair and maintenance cost, $\dfrac{(c-d) \times n}{ab}$	16,410	Rp/hr
n	Ratio of repair and maintenance cost	90	%
o	Direct cost, f+g+h+m	49,314	Rp/hr
p	Indirect cost, 15% of direct cost	7,397	Rp/hr
q	Equipment cost, o+p	56,711	Rp/hr

5. Gabion Work (3-01)

- 1 m^3 gabion mattres
- 4 mm wire for frame 20%
- 3 mm wire for net 80%

Work Item	Allotment	Unit	Unit Cost (Rp)	Total	Amount Foreign	Local (Rp)
Plait						
Wire	9.6	kg	950	9,120	9,120	.
Gabion net maker	0.68	man.day	3,000	2,040	–	2,040
Common labour	0.546	"	2,000	1,092	–	1,092
Foreman	0.0267	"	5,000	134	–	134
Stone filling						
Stone	1	m^3	5,000	5,000	–	5,000
Common labour	1.5	man.day	2,000	3,000	–	3,000
Foreman	0.025	"	5,000	125	–	125
Transportation of stone L$\leq$75 m	1	LS	818	818	–	818
Filter	1	LS	785	785	–	785
Total (Rp/m^3)				22,114	9,120	12,794
x 1.265				27,974	11,537	16,437

6. Stone Masonry (4-01)

- 1 m^3 stone masonry, C:S=1:4

Work Item	Allotment	Unit	Unit Cost (Rp)	Total	Amount Foreign	Local (Rp)
Stone	1.2	m^3	5,000	6,000	–	6,000
Cement	4.07	bag	4,400	17,908	11,640	6,268
Sand	0.522	m^3	5,000	2,610	–	2,610
Mason	1.2	man.day	3,500	4,200	–	4,200
Chief mason	0.12	"	4,000	480	–	480
Common labour	3.6	"	2,000	7,200	–	7,200
Foreman	0.18	"	5,000	900	–	900
Total (Rp/m^3)				39,298	11,640	27,658
x 1.265				49,712	14,725	34,987

7. Plain Concrete (4-02)

- 1 m³ Plain concrete, C:S:G=1:2:3

Work Item	Allotment	Unit	Unit Cost (Rp)	Total	Amount Foreign	Local (Rp)
1) Concrete material						
Gravel	0.82	m³	8,000	6,560	--	6,560
Sand	0.54	"	5,000	2,700	0	2,700
Cement	6.8	bag	4,400	29,920	19,448	10,472
Sub Total (Rp/m³)				39,180	19,448	19,732
2) Labour for mixing and placing						
Common labour	6	man.day	2,000	12,000	--	12,000
Foreman	0.3	"	5,000	1,500	-	1,500
Mason	1	"	3,500	3,500	-	3,500
Chief mason	0.1	"	4,000	400	-	400
Sub Total (Rp/m³)				6,600	-	6,600
3) Form work material						
Wood	0.4	m³	75,000	30,000	-	30,000
Nail	4	kg	1,000	4,000	-	4,000
Sub Total (Rp/m³)				34,000	-	34,000
4) Labour for form making and removal						
Chief carpenter	0.5	man.day	3,500	1,750	--	1,750
Foreman	0.1	"	5,000	500	-	500
Carpenter	5	"	3,500	17,500	-	17,500
Common labour	2	"	2,000	4,000	-	4,000
Common labour (removal)	4	"	2,000	8,000	-	8,000
Sub Total (Rp/m³)				31,750	--	31,750
5) Equipment						
Mixer (250 lt)		LS	1,885	1,885	1,313	572
Vibrator		LS	458	458	303	155
Belt conveyor		LS	6,172	6,172	4,387	1,785
Sub Total (Rp/m³)				8,515	6,003	2,512
6) Fuel, Oil		LS		1,363	682	681
Total (Rp/m³)				121,408	26,133	95,275
x 1.265				153,581	33,058	120,523

8. Transportation of Riverbed Material

Long distance 5 km (5-01)

$Q=12.0 \text{ m}^3/\text{hr}$

Work Item	Allotment	Unit	Unit Cost (Rp)	Total	Amount Foreign	Local (Rp)
Dump truck 11 ton, production 9.4 m³/ hr=0.106 hr/m³						
Depreciation cost	0.083	hr/m³	5,944	493	493	–
Ownership cost	0.083		6,036	501	–	501
Fuel, oil	0.083		2,904	241	121	120
Tire cost	0.083		1,100	91	–	91
Driver	0.083		571	47	–	47
Repair & Maintenance	0.083		5,944	493	296	197
Indirect cost	–				–	
Total (Rp/m³)				1,866	910	956
x 1.265				2,360	1,151	1,209

Production/hour

$$Q = \frac{60 \times q \times E}{cm} \qquad q=6.1 \text{ m}^3, \ E=0.9$$

$$Cm = \frac{n \times Cms}{60 \times Es} + \frac{1}{v_1} + \frac{1}{v_2} + t_1 + t_2$$

$$\frac{n \times Cms}{60 \times Es} \doteq 5 \text{ min.,} \quad l=5 \text{ Km}, \ v_1 = 30 \text{ Km/hr} = 500 \text{ m/min}$$

$$v_2 = 40 \text{ Km/hr} = 666 \text{ m/min}, \ t_1 = 3 \text{ min}, \ t_2 = 2 \text{ min}$$

$$Cm = 5 + \frac{5000}{666} + \frac{5000}{500} + 3 + 2 = 27.5 \text{ min}$$

$$Q = \frac{60 \times 6.1 \times 0.9}{27.5} = 12.0 \text{ m}^3/\text{hr}$$

Near distance 500 m (5-02)

Work Item	Allotment	Unit	Unit Cost (Rp)	Total	Amount Foreign	Local (Rp)
Dump truck 11 ton, production 7.0 m³/ hr=0.106 hr/m³						
Depreciation cost	0.03	hr/m³	5,944	178	178	--
Ownership cost	0.03		6,036	181	--	181
Fuel, oil	0.03		2,904	87	44	43
Tire cost	0.03		1,100	33	--	33
Driver	0.03		571	17	--	17
Repair & Maintenance	0.03		5,944	178	107	71
Indirect cost	--				--	
Total (Rp/m³)				674	329	345
x 1.265				853	37	436

Production/hour

$$Q = \frac{60 \times q \times E}{cm} \qquad q=6.1 \ m^3, \ E=0.9$$

$$Cm = \frac{n \times Cms}{60 \times Es} + \frac{1}{v_1} + \frac{1}{v_2} + t_1 + t_2$$

$$\frac{n \times Cms}{60 \times Es} \doteqdot 5 \ min., \ l=0.5 \ Km, \ v_1 = 30 \ Km/hr = 500 \ m/min$$

$$v_2 = 40 \ Km/hr = 666 \ m/min, \ t_1 = 3 \ min, \ t_2 = 2 \ min$$

$$Cm = 5 + \frac{500}{666} + \frac{500}{500} + 3 + 2 = 11.8 \ min$$

$$Q = \frac{60 \times 6.1 \times 0.9}{11.8} = 28.0 \ m^3/hr$$

Near distance 1,000 m (5-03)

Work Item	Allotment	Unit	Unit Cost (Rp)	Total	Amount Foreign	Local (Rp)
Dump truck 11 ton, production 7.0 m³/ hr=0.106 hr/m³						
Depreciation cost	0.037	hr/m³	5,944	220	220	-
Ownership cost	0.037		6,036	223	-	223
Fuel, oil	0.037		2,904	107	54	53
Tire cost	0.037		1,100	41	-	41
Driver	0.037		571	21	-	21
Repair & Maintenance	0.037		5,944	220	132	48
Indirect cost	-				-	
Total (Rp/m³)				832	406	426
x 1.265				1,052	514	538

Production/hour

$$Q = \frac{60 \times q \times E}{cm} \quad q=6.1 \text{ m}^3, \; E=0.9$$

$$Cm = \frac{n \times Cms}{60 \times Es} + \frac{1}{v_1} + \frac{1}{v_2} + t_1 + t_2$$

$$\frac{n \times Cms}{60 \times Es} \doteq 5 \text{ min., } 1=1.0 \text{ Km, } v_1 = 30 \text{ Km/hr} = 500 \text{ m/min}$$

$$v_2 = 40 \text{ Km/hr} = 666 \text{ m/min, } t_1 = 3 \text{ min, } t_2 = 2 \text{ min}$$

$$Cm = 5 + \frac{1000}{666} + \frac{1000}{500} + 2 + 2 = 12.5 \text{ min}$$

$$Q = \frac{60 \times 6.1 \times 0.9}{12.5} = 26.4 \text{ m}^3/\text{hr}$$

Near distance 2,000 m (5-04)

Work Item	Allotment	Unit	Unit Cost (Rp)	Total	Amount Foreign	Local (Rp)
Dump truck 11 ton, production 7.0 m³/ hr=0.106 hr/m³						
Depreciation cost	0.045	hr/m³	5,944	268	268	--
Ownership cost	0.045		6,036	272	--	272
Fuel, oil	0.045		2,904	131	66	65
Tire cost	0.045		1,100	50	--	50
Driver	0.045		571	26	--	26
Repair & Maintenance	0.045		5,944	268	161	107
Indirect cost	--			--		
Total (Rp/m³)				1,015	495	520
x 1.265				1,284	626	658

Production/hour

$$Q = \frac{60 \times q \times E}{cm} \qquad q=6.1 \ m^3, \ E=0.9$$

$$Cm = \frac{n \times Cms}{60 \times Es} + \frac{1}{v_1} + \frac{1}{v_2} + t_1 + t_2$$

$$\frac{n \times Cms}{60 \times Es} \doteqdot 5 \ min., \ 1=0.5 \ Km, \ v_1 = 30 \ Km/hr = 500 \ m/min$$

$$v_2 = 40 \ Km/hr = 666 \ m/min, \ t_1 = 3 \ min, \ t_2 = 2 \ min$$

$$Cm = 5 + \frac{2000}{666} + \frac{2000}{500} + 1 + 2 = 15.0 \ min$$

$$Q = \frac{60 \times 6.1 \times 0.9}{15.0} = 22.0 \ m^3/hr$$

Breakdown of Equipment Cost

Equipment   Dump truck 11 ton

a	Economic life	8 year
b	Operation time per year	2,000 hour/year
c	Basic price	107,314,000 Rp
d	Tire cost	1,650,000 Rp
e	Residual value, 0.1 x (c-d)	10,566,400 Rp
f	Depreciation cost, $\dfrac{c-d-e}{ab}$	5,944 Rp
g	Ownership cost, $\dfrac{0.2 \times (a+1) \times c}{2ab}$	6,036 Rp/hr
h	Operation cost, i+j+k+l	4,575 Rp/hr
i	Fuel 0.039 l/hr x 310 ps x 200 Rp/l	2,420 Rp/hr
j	Lubricant, i x 20%	484 Rp/hr
k	Tire cost	1,100 Rp/hr
l	Operator	1,001 Rp/hr
	Operator	0.143 x 7,000 Rp/hr
	Assistant operator	4,500 Rp/hr
	Foreman	5,000 Rp/hr
	Common labour	2,000 Rp/hr
m	Repair and maintenance cost, $\dfrac{(c-d) \times n}{ab}$	5,944 Rp/hr
n	Ratio of repair and maintenance cost	90 %
o	Direct cost, f+g+h+m	22,499 Rp/hr
p	Indirect cost, 15% of direct cost	3,375 Rp/hr
q	Equipment cost, o+p	25,874 Rp/hr

9. Loading

$77 \text{ m}^3/\text{h}$

Work Item	Allotment	Unit	Unit Cost (Rp)	Total	Amount Foreign	Local (Rp)
Depreciation cost	0.013	hr/m^3	21,173	275	275	–
Ownership cost	0.013		12,704	165	–	165
Fuel, oil cost	0.013		6,625	86	43	43
Operator & labour	0.013		572	7	–	7
Repair & Maintenance	0.013		21,173	275	165	110
Total (Rp/m^3)				808	483	325
				1,022	–	–

Breakdown of Equipment Cost

Equipment Tractor Shovel $1.8\ m^3$

a	Economic life	5 year
b	Operation time per year	2,000 hour/year
c	Basic price	211,728,000 Rp
d	Tire cost	Rp
e	Residual value, 0.1 x (c-d)	21,172,800 Rp
f	Depreciation cost, $\dfrac{c-d-e}{ab}$	21,173 Rp
g	Ownership cost, $\dfrac{0.2 \times (a+1) \times c}{2ab}$	12,704 Rp/hr
h	Operation cost, i+j+k+l	7,839 Rp/hr
i	Fuel 0.129 l/hr x 214 ps x 200 Rp/l	5,521 Rp/hr
j	Lubricant, i x 20%	1,104 Rp/hr
k	Tire cost	– Rp/hr
l	Operator	Rp/hr
	Operator	0.143 x 4,000 Rp/hr
	Assistant operator	Rp/hr
	Foreman	Rp/hr
	Common labour	Rp/hr
m	Repair and maintenance cost, $\dfrac{(c-d) \times n}{ab}$	21,173 Rp/hr
n	Ratio of repair and maintenance cost	90 %
o	Direct cost, f+g+h+m	22,499 Rp/hr
p	Indirect cost, 15% of direct cost	3,375 Rp/hr
q	Equipment cost, o+p	25,874 Rp/hr

Breakdown of Construction Cost (Financial Cost)

Alternative - A Cikunir Area

B Cikunir Area

C Cikunir Area

D Cikunir Area

E Cikunir Area

Financial Cost of Construction

		A	B	C	D	E
1-01	Crater Lake	3,791.0	3,791.0	3,791.0	3,791.0	3,791.0
2-01	Improvement dike	209.6	209.6	209.6	209.6	209.6
2-02	Check dam	446.2	446.2	446.2	446.2	446.2
2-03	Excavation	1,668.6	1,668.6	1,668.6	1,668.6	1,668.6
2-04	Aggregate plant	88.3	88.3	88.3	88.3	88.3
3-01	Improvement	1,610.4	1,610.4	1,610.4	1,610.4	1,610.4
3-02	Check dam	1,424.7	1,424.7	1,424.7	1,424.7	1,424.7
3-03	Excavation (1)	3,737.4	3,737.4	3,737.4	3,737.4	3,737.4
3-04	Excavation (3) 1st	–	1,314.2	6,459.9	8,365.4	8,459.1
3-04'	Excavation (3) 2nd	–	2,195.3	0	2,291.8	4,135.9
3-05	Excavation (2) 1st	4,568.0	3,020.0	1,778.5	–	–
3-05'	Excavation (2) 2nd	9,688.6	7,107.8	5,038.6	1,990.1	–
3-06	Aggregate plant	2,139.0	1,711.1	1,254.0	941.4	–
3-07	Operation 1st	323.9	214.1	126.1	–	–
3-07'	Operation 2nd	687.0	504.0	357.3	141.1	–
3-08	Rising dike	1,584.6	1,951.2	2,223.6	2,888.1	5,148.1
3-09	Diversion cannel	–	1,321.7	1,505.3	1,954.6	3,250.5
3-10	Consolidation dam	792.8	792.8	792.8	792.8	792.8
3-11	Revetment works	981.0	981.0	981.0	981.0	981.0
4-01	Check dam	233.2	233.2	233.2	233.2	233.2
4-01'	Check dam	2,134.5	2,134.5	2,134.5	2,134.5	2,134.5
4-02	Check dam	243.3	243.3	243.3	243.3	243.3
4-02'	Check dam	360.0	360.0	360.0	360.0	360.0
4-03	Check dam	492.2	492.2	492.2	492.2	492.2
4-03'	Check dam	3,893.8	3,893.8	3,893.8	3,893.8	3,893.8
5-01	Aggregate equipment	3,056.2	2,412.4	1,975.7	1,475.0	0
5-02	Spare parts	611.3	482.5	395.1	295.0	0

Note) Excavation (1) for riverbed
     Excavation (2) for aggregate
     Excavation (3)   2nd stage

1. Breakdown of Construction Cost for Alternative-A

(1) Breakdown of Construction Cost (Crater Lake Tunnel)

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp×10^6)	Foreign (¥×10^6)	Local (Rp×10^6)
1. Civil Work						
(1) Main Work						
1-03	m^3	1,069	36,637	39.2	1.9	17.8
1-04	m^3	3,672	38,304	140.7	6.9	63.1
1-05	m^3	228	53,419	12.2	0.4	7.7
1-06	m^3	1,141	80,883	92.3	4.1	46.2
4-02	m^3	1,260	153,581	193.5	3.7	151.9
7-01	m	665	2,217,039	1,474.3	129.6	17.6
7-02	m	665	575,789	382.9	25.9	91.8
8-01	m	90	4,366,780	393.0	35.0	0
8-02	m	90	890,379	80.1	7.1	0
15-01	hour	6,600	5,800	38.3	-	38.3
16-01	m	3,120	110,000	343.2	-	343.2
Cooling plant				601.3	53.5	0
Total				3,791.0	268.1	777.6

(2) Breakdown of Construction Cost (Ciloseh Area)

(2-1) Dike Improvement

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Excavation						
1-01	m^3	19,956	1,875	37.4	2.0	15.5
5-01	m^3	19,956	2,360	47.1	2.0	24.1
(2) Embankment						
2-01	m^3	19,956	2,562	51.1	2.6	22.1
3-01	m^3	2,646	27,974	74.0	2.7	43.5
Total				209.6	9.3	105.2

(2-2) Check Dams of Cimampang Area

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-02	m^3	2,640	3,296	8.7	–	8.7
4-01	m^3	8,800	49,712	437.5	11.5	308.2
Total				446.2	11.5	316.9

(2-3) Plant operation

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
Plant operation cost	m^3	394,000	224	88.3	0	88.3
Total				88.3	0	88.3

(2-4) Excavation (2)
(1st stage)

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-01	m^3	394,000	1,875	738.8	38.6	306.5
5-01	m^3	394,000	2,360	929.8	40.2	476.3
Total				1,668.6	78.8	782.8

Note: Excavation 2;

(3) Breakdown of Construction Cost (Cikunir Area)

Dike Improvement (without Ciponyo I Dalam)

	Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1.	Civil Work						
	(1) Excavation						
	1-01	m^3	125,238	1,875	234.8	12.3	97.4
	5-01	m^3	125,238	2,360	295.6	12.8	151.4
	(2) Embankment						
	2-01	m^3	125,238	2,562	320.9	16.2	138.9
	3-01	m^3	27,136	27,974	759.1	27.8	446.0
	Total				1,610.4	69.1	833.7

(4) Breakdown of Construction Cost (Cikunir Area)

Rising Dike (Ciponyo I Dalam)

	Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1.	Civil Work						
	(1) Excavation						
	1-01	m^3	40,306	1,875	75.6	6.3	49.7
	5-01	m^3	40,306	2,360	95.1	6.5	77.2
	(2) Embankment						
	2-01	m^3	40,306	2,562	103.3	8.2	70.8
	4-01	m^3	24,994	49,712	1,242.5	32.7	874.5
	3-01	m^3	2,436	27,974	68.1	2.5	40.0
	Total				1,584.6	56.2	1,112.2

(5) Breakdown of Construction Cost (Cikunir Area)

(5-1) Aggregate plant

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-02	m^3	6,648	3,296	21.9	0	21.9
4-02	m^3	3,708	153,581	569.5	10.9	446.9
(2) Material						
Metal	(t)	200	5,620,000	1,124.0	100.0	-
(3) Placing	(t)	335	1,264,500	423.6	-	423.6
Total				2,139.0	110.9	892.4

(5-2) Plant Operation Cost
1st stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
Plant operation cost	m^3	1,446,000	224	323.9	-	323.9
Total				323.9	-	323.9

(5-3) Excavation (2)
1st stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-01	m^3	1,446,000	1,875	2,711.3	141.7	1,125.0
5-04	m^3	1,446,000	1,284	1,856.7	80.5	951.5
Total				4,568.0	222.2	2,076.5

(5-4) Plant Operation Cost

2nd stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp×10⁶)	Foreign (¥×10⁶)	Local (Rp×10⁶)
Plant operation cost	m³	3,067,000	224	687.0	0	687.0
Total				687.0	0	687.0

(5-5) Excavation (2)

2nd stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp×10⁶)	Foreign (¥×10⁶)	Local (Rp×10⁶)
1. Civil Work						
(1) Main Work						
1-01	m³	3,067,000	1,875	5,750.6	300.6	2,386.1
5-04	m³	3,067,000	1,284	3,938.0	170.8	2,018.1
Total				9,688.6	471.4	4,404.2

(6) Breakdown of Construction Cost (Cikunir Area)

(6-1) Excavation (1)

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-01	m^3	1,370,000	1,875	2,568.8	133.7	1,065.9
5-02	m^3	1,370,000	853	1,168.6	50.8	597.3
Total				3,737.4	184.5	1,663.2

(6-2) Excavation (3)

1st stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-01	m^3	0	1,875	0	0	0
5-03	m^3	0	1,052	0	0	0
Total				0	0	0

(6-3) Excavation (3)

2nd stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-01	m^3	0	1,875	0	0	0
5-03	m^3	0	1,052	0	0	0
Total				0	0	0

(7) Breakdown of Construction Cost (Cikunir Area)

Diversion cannel

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Excavation						
1-01	m^3	0	1,875	0	0	0
5-01	m^3	0	2,360	0	0	0
(2) Embankment						
2-01	m^3	0	2,562	0	0	0
4-01	m^3	0	49,712	0	0	0
Total				0	0	0

(8) Breakdown of Construction Cost (Cikunir Area)

(8-1) Consolidation dams

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Dike						
1-01	m^3	34,320	1,875	64.4	3.4	26.7
2-01	m^3	34,320	2,562	88.0	4.4	38.1
4-01	m^3	6,990	49,712	347.5	9.2	244.6
5-02	m^3	34,320	853	29.3	1.3	15.0
(2) Consolidation dams						
1-02	m^3	1,560	3,296	5.1	0	5.1
4-01	m^3	5,200	49,712	258.5	6.8	181.9
Total				792.8	25.1	511.4

(8-2) Revetment works

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-01	m^3	10,817	1,875	20.3	1.1	8.4
2-01	m^3	6,490	2,562	16.6	0.8	7.2
4-01	m^3	9,615	49,712	478.0	12.6	336.4
4-02	m^3	2,975	153,581	456.9	8.7	358.6
5-02	m^3	10,817	853	9.2	0.4	4.7
Total				981.0	23.6	715.3

(9) Breakdown of Construction Cost (Cikunir Area)

Check dam

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-02	m^3	8,430	3,296	27.8	–	27.8
4-01	m^3	28,100	49,712	1,396.9	36.8	983.1
Total				1,424.7	36.8	1,010.9

(10) Breakdown of Construction Cost (Cisaruni Area)

(10-1) Check dams 1st stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-02	m^3	1,380	3,296	4.5	–	4.5
4-01	m^3	4,600	49,712	228.7	6.0	160.9
Total				233.2	6.0	165.4

(10-2) Check dams 2nd stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-02	m^3	12,630	3,296	41.6	–	41.6
5-02	m^3	42,100	49,712	2,092.9	55.2	1,473.0
Total				2,134.5	55.2	1,514.6

(11) Breakdown of Construction Cost (Cikupang Area)

(11-1) Check dams 1st stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-02	m^3	1,440	3,296	4.7	--	4.7
4-01	m^3	4,800	49,712	238.6	6.1	167.9
Total				243.3	6.1	172.6

(11-2) Check dams 2nd stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-02	m^3	2,130	3,296	7.0	-	7.0
4-01	m^3	7,100	49,712	353.0	9.3	248.4
Total				360.0	9.3	255.4

(12) Breakdown of Construction Cost (Cimerah Area)

(12-1) Check dams 1st stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-02	m^3	2,910	3,296	10.0	0	10.2
4-01	m^3	9,700	49,712	482.2	12.7	339.4
Total				492.2	12.7	349.4

(12-2) Check dams 2nd stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-02	m^3	23,040	3,296	75.9	0	75.9
5-02	m^3	76,800	49,712	3,817.9	100.6	2,687.0
Total				3,893.8	100.6	2,762.9

2. Breakdown of Construction Cost for Alternative-B

(1) Breakdown of Construction Cost (Crater Lake Tunnel)

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-03	m^3	1,069	36,637	39.2	1.9	17.8
1-04	m^3	3,672	38,304	140.7	6.9	63.1
1-05	m^3	228	53,419	12.2	0.4	7.7
1-06	m^3	1,141	80,883	92.3	4.1	46.2
4-02	m^3	1,260	153,581	193.5	3.7	151.9
7-01	m	665	2,217,039	1,474.3	129.6	17.6
7-02	m	665	575,789	382.9	25.9	91.8
8-01	m	90	4,366,780	393.0	35.0	0
8-02	m	90	890,379	80.1	7.1	0
15-01	hour	6,600	5,800	38.3	–	38.3
16-01	m	3,120	110,000	343.2	–	343.2
Cooling plant				601.3	53.5	0
Total				3,791.0	268.1	777.6

(2) Breakdown of Construction Cost (Ciloseh Area)

(2-1) Dike Improvement

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp$\times 10^6$)	Foreign (¥$\times 10^6$)	Local (Rp$\times 10^6$)
1. Civil Work						
(1) Excavation						
1-01	m^3	19,956	1,875	37.4	2.0	15.5
5-01	m^3	19,956	2,360	47.1	2.0	24.1
(2) Embankment						
2-01	m^3	19,956	2,562	51.1	2.6	22.1
3-01	m^3	2,646	27,974	74.0	2.7	43.5
Total				209.6	9.3	105.2

(2-2) Check Dams of Cimampang Area

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp$\times 10^6$)	Foreign (¥$\times 10^6$)	Local (Rp$\times 10^6$)
1. Civil Work						
(1) Main Work						
1-02	m^3	2,640	3,296	8.7	–	8.7
4-01	m^3	8,800	49,712	437.5	11.5	308.2
Total				446.2	11.5	316.9

(2-3) Plant operation

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp$\times 10^6$)	Foreign (¥$\times 10^6$)	Local (Rp$\times 10^6$)
Plant operation cost	m^3	394,000	224	88.3	0	88.3
Total				88.3	0	88.3

(2-4) Excavation (2)

(1st stage)

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp$\times 10^6$)	Foreign (¥$\times 10^6$)	Local (Rp$\times 10^6$)
1. Civil Work						
(1) Main Work						
1-01	m^3	394,000	1,875	738.8	38.6	306.5
5-01	m^3	394,000	2,360	929.8	40.2	476.3
Total				1,668.6	78.8	782.8

Note: Excavation 2;

(3) Breakdown of Construction Cost (Cikunir Area)

Dike Improvement (without Ciponyo I Dalam)

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Excavation						
1-01	m³	125,238	1,875	234.8	12.3	97.4
5-01	m³	125,238	2,360	295.6	12.8	151.4
(2) Embankment						
2-01	m³	125,238	2,562	320.9	16.2	138.9
3-01	m³	27,136	27,974	759.1	27.8	446.0
Total				1,610.4	69.1	833.7

(4) Breakdown of Construction Cost (Cikunir Area)

Rising Dike (Ciponyo I Dalam)

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Excavation						
1-01	m³	63,862	1,875	119.7	6.3	49.7
5-01	m³	63,862	2,360	150.7	6.5	77.2
(2) Embankment						
2-01	m³	63,862	2,562	163.6	8.2	70.8
4-01	m³	27,436	49,712	1,363.9	35.9	960.0
3-01	m³	5,481	27,974	153.3	5.6	90.1
Total				1,951.2	62.5	1,247.8

(5) Breakdown of Construction Cost (Cikunir Area)

(5-1) Aggregate plant

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp×10⁶)	Foreign (¥×10⁶)	Local (Rp×10⁶)
1. Civil Work						
(1) Main Work						
1-02	m^3	5,318	3,296	17.5	0	17.5
4-02	m^3	2,966	153,581	455.5	8.7	357.5
(2) Material						
Metal	(t)	160	5,620,000	899.2	80.0	0
(3) Placing	(t)	268	1,264,500	338.9	0	338.9
Total				1,711.1	88.7	713.9

(5-2) Plant Operation Cost

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp×10⁶)	Foreign (¥×10⁶)	Local (Rp×10⁶)
Plant operation cost	m^3	956,000	224	214.1	0	214.1
Total				214.1	0	214.1

(5-3) Excavation (2)

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp×10⁶)	Foreign (¥×10⁶)	Local (Rp×10⁶)
1. Civil Work						
(1) Main Work						
1-01	m^3	956,000	1,875	1,792.5	93.3	743.8
5-04	m^3	956,000	1,284	1,227.5	53.2	629.0
Total				3,020.0	146.5	1,372.8

(5-4) Plant Operation Cost

2nd stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
Plant operation cost	m^3	2,250,000	224	504.0	-	504.0
Total				504.0	-	504.0

(5-5) Excavation (2)

2nd stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-01	m^3	2,250,000	1,875	4,218.8	220.5	1,750.5
5-04	m^3	2,250,000	1,284	2,889.0	126.0	1,480.5
Total				7,107.8	346.5	3,231.0

(6) Breakdown of Construction Cost (Cikunir Area)

(6-1) Excavation (1)

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-01	m^3	1,370,000	1,875	2,568.8	133.7	1,065.9
5-02	m^3	1,370,000	853	1,168.6	50.8	597.3
Total				3,737.4	184.5	1,663.2

(6-2) Excavation (3)

1st stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-01	m^3	449,000	1,875	841.9	43.8	349.3
5-03	m^3	449,000	1,052	472.3	20.5	241.6
Total				1,314.2	64.3	590.9

(6-3) Excavation (3)

2nd stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-01	m^3	750,000	1,875	1,406.3	73.2	583.5
5-03	m^3	750,000	1,052	789.0	34.3	403.5
Total				2,195.3	107.5	987.0

(7) Breakdown of Construction Cost (Cikunir Area)

Diversion cannel

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp$\times 10^6$)	Foreign (¥$\times 10^6$)	Local (Rp$\times 10^6$)
1. Civil Work						
(1) Excavation						
1-01	m^3	85,500	1,875	160.3	8.4	66.5
5-01	m^3	85,500	2,360	201.8	8.7	103.4
(2) Embankment						
2-01	m^3	85,500	2,562	219.1	11.0	94.8
4-01	m^3	14,895	49,712	740.5	19.5	521.1
Total				1,321.7	47.6	785.8

(8) Breakdown of Construction Cost (Cikunir Area)

(8-1) Consolidation dams

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp$\times 10^6$)	Foreign (¥$\times 10^6$)	Local (Rp$\times 10^6$)
1. Civil Work						
(1) Dike						
1-01	m^3	34,320	1,875	64.4	3.4	26.7
2-01	m^3	34,320	2,562	88.0	4.4	38.1
4-01	m^3	6,990	49,712	347.5	9.2	244.6
5-02	m^3	34,320	853	29.3	1.3	15.0
(2) Consolidation dams						
1-02	m^3	1,560	3,296	5.1	0	5.1
4-01	m^3	5,200	49,712	258.5	6.8	181.9
Total				792.8	25.1	511.4

(8-2) Revetment works

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp$\times 10^6$)	Foreign (¥$\times 10^6$)	Local (Rp$\times 10^6$)
1. Civil Work						
(1) Main Work						
1-01	m^3	10,817	1,875	20.3	1.1	8.4
2-01	m^3	6,490	2,562	16.6	0.8	7.2
4-01	m^3	9,615	49,712	478.0	12.6	336.4
4-02	m^3	2,975	153,581	456.9	8.7	358.6
5-02	m^3	10,817	853	9.2	0.4	4.7
Total				981.0	23.6	715.3

(9) Breakdown of Construction Cost (Cikunir Area)

Check dam

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp$\times 10^6$)	Foreign (¥$\times 10^6$)	Local (Rp$\times 10^6$)
1. Civil Work						
(1) Main Work						
1-02	m^3	8,430	3,296	27.8	–	27.8
4-01	m^3	28,100	49,712	1,396.9	36.8	983.1
Total				1,424.7	36.8	1,010.9

(10) Breakdown of Construction Cost (Cisaruni Area)

(10-1) Check dams 1st stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp$\times 10^6$)	Foreign (¥$\times 10^6$)	Local (Rp$\times 10^6$)
1. Civil Work						
(1) Main Work						
1-02	m^3	1,380	3,296	4.5		
4-01	m^3	4,600	49,712	228.7		
Total				233.2		

(10-2) Check dams 2nd stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp$\times 10^6$)	Foreign (¥$\times 10^6$)	Local (Rp$\times 10^6$)
1. Civil Work						
(1) Main Work						
1-02	m^3	12,630	3,296	41.6		
5-02	m^3	42,100	49,712	2,092.9		
Total				2,134.5		

(11) Breakdown of Construction Cost (Cikupang Area)

(11-1) Check dams 1st stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-02	m^3	1,440	3,296	4.7		
4-01	m^3	4,800	49,712	238.6		
Total				243.3		

(11-2) Check dams 2nd stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-02	m^3	2,130	3,296	7.0		
4-01	m^3	7,100	49,712	353.0		
Total				360.0		

(12) Breakdown of Construction Cost (Cimerah Area)

(12-1) Check dams 1st stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-02	m^3	2,910	3,296	10.0		
4-01	m^3	9,700	49,712	482.2		
Total				492.2		

(12-2) Check dams 2nd stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-02	m^3	23,040	3,296	75.9		
5-02	m^3	76,800	49,712	3,817.9		
Total				3,893.8		

3. Breakdown of Construction Cost for Alternative-C

(1) Breakdown of Construction Cost (Crater Lake Tunnel)

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-03	m³	1,069	36,637	39.2	1.9	17.8
1-04	m³	3,672	38,304	140.7	6.9	63.1
1-05	m³	228	53,419	12.2	0.4	7.7
1-06	m³	1,141	80,883	92.3	4.1	46.2
4-02	m³	1,260	153,581	193.5	3.7	151.9
7-01	m	665	2,217,039	1,474.3	129.6	17.6
7-02	m	665	575,789	382.9	25.9	91.8
8-01	m	90	4,366,780	393.0	35.0	0
8-02	m	90	890,379	80.1	7.1	0
15-01	hour	6,600	5,800	38.3	–	38.3
16-01	m	3,120	110,000	343.2	–	343.2
Cooling plant				601.3	53.5	0
Total				3,791.0	268.1	777.6

(2) Breakdown of Construction Cost (Ciloseh Area)

(2-1) Dike Improvement

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Excavation						
1-01	m^3	19,956	1,875	37.4	2.0	15.5
5-01	m^3	19,956	2,360	47.1	2.0	24.1
(2) Embankment						
2-01	m^3	19,956	2,562	51.1	2.6	22.1
3-01	m^3	2,646	27,974	74.0	2.7	43.5
Total				209.6	9.3	105.2

(2-2) Check Dams of Cimampang Area

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-02	m^3	2,640	3,296	8.7	–	8.7
4-01	m^3	8,800	49,712	437.5	11.5	308.2
Total				446.2	11.5	316.9

(2-3) Plant operation

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
Plant operation cost	m^3	394,000	224	88.3	0	88.3
Total				88.3	0	88.3

(2-4) Excavation (2)
(1st stage)

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-01	m^3	394,000	1,875	738.8	38.6	306.5
5-01	m^3	394,000	2,360	929.8	40.2	476.3
Total				1,668.6	78.8	782.8

Note: Excavation 2;

(3) Breakdown of Construction Cost (Cikunir Area)

Dike Improvement (without Ciponyo I Dalam)

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Excavation						
1-01	m^3	125,238	1,875	234.8		
5-01	m^3	125,238	2,360	295.6		
(2) Embankment						
2-01	m^3	125,238	2,562	320.9		
3-01	m^3	27,136	27,974	759.1		
Total				1,610.4		

(4) Breakdown of Construction Cost (Cikunir Area)

Rising Dike (Ciponyo I Dalam)

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Excavation						
1-01	m^3	84,342	1,435	121.0		
5-01	m^3	84,342	1,726	145.6		
(2) Embankment						
2-01	m^3	84,342	2,003	168.9		
4-01	m^3	29,258	45,190	1,322.2		
3-01	m^3	7,004	25,386	177.8		
Total				1,935.5		

(5) Breakdown of Construction Cost (Cikunir Area)

(5-1) Aggregate plant

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp×10⁶)	Foreign (¥×10⁶)	Local (Rp×10⁶)
1. Civil Work						
(1) Main Work						
1-02	m^3	3,989	3,296	13.1	0	13.1
4-02	m^3	2,225	153,581	341.7	6.5	268.2
(2) Material						
Metal	(t)	115	5,620,000	646.3	57.5	
(3) Placing	(t)	200	1,264,500	252.9	–	252.9
Total				1,214.0	64.0	534.2

(5-2) Plant Operation Cost
1st stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp×10⁶)	Foreign (¥×10⁶)	Local (Rp×10⁶)
Plant operation cost	m^3	563,000	224	126.1	–	126.1
Total				126.1	–	126.1

(5-3) Excavation (2)
1st stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp×10⁶)	Foreign (¥×10⁶)	Local (Rp×10⁶)
1. Civil Work						
(1) Main Work						
1-01	m^3	563,000	1,875	1,055.6	55.2	438.0
5-04	m^3	563,000	1,284	722.9	31.5	370.5
Total				1,778.5	86.7	808.5

(5-4) Plant Operation Cost

2nd stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
Plant operation cost	m^3	1,595,000	224	357.3	–	357.3
Total				357.3	–	357.3

(5-5) Excavation (2)

2nd stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-01	m^3	1,595,000	1,875	2,990.6	156.3	1,240.9
5-04	m^3	1,595,000	1,284	2,048.0	89.3	1,049.5
Total				5,038.6	245.6	2,290.4

(6) Breakdown of Construction Cost (Cikunir Area)

(6-1) Excavation (1)

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-01	m^3	1,370,000	1,875	2,568.8	133.7	1,065.9
5-02	m^3	1,370,000	853	1,168.6	50.8	597.3
Total				3,737.4	184.5	1,663.2

(6-2) Excavation (3)

1st stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-01	m^3	2,207,000	1,875	4,138.1	215.4	1,717.0
5-03	m^3	2,207,000	1,052	2,321.8	100.9	1,187.4
Total				6,459.9	316.3	2,904.4

(6-3) Excavation (3)

2nd stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-01	m^3	0	1,875	0	0	0
5-03	m^3	0	1,052	0	0	0
Total				0	0	0

(7) Breakdown of Construction Cost (Cikunir Area)

Diversion cannel

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp×10⁶)	Foreign (¥×10⁶)	Local (Rp×10⁶)
1. Civil Work						
(1) Excavation						
1-01	m³	103,020	1,875	193.2	10.1	80.1
5-01	m³	103,020	2,360	243.1	10.5	124.6
(2) Embankment						
2-01	m³	103,020	2,562	263.9	13.3	114.3
4-01	m³	16,196	49,712	805.1	21.2	566.6
Total				1,505.3	55.1	885.6

(8) Breakdown of Construction Cost (Cikunir Area)

(8-1) Consolidation dams

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp×10⁶)	Foreign (¥×10⁶)	Local (Rp×10⁶)
1. Civil Work						
(1) Dike						
1-01	m³	34,320	1,875	64.4	3.4	26.7
2-01	m³	34,320	2,562	88.0	4.4	38.1
4-01	m³	6,990	49,712	347.5	9.2	244.6
5-02	m³	34,320	853	29.3	1.3	15.0
(2) Consolidation dams						
1-02	m³	1,560	3,296	5.1	0	5.1
4-01	m³	5,200	49,712	258.5	6.8	181.9
Total				792.8	25.1	511.4

(8-2) Revetment works

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp×10⁶)	Foreign (¥×10⁶)	Local (Rp×10⁶)
1. Civil Work						
(1) Main Work						
1-01	m³	10,817	1,875	20.3	1.1	8.4
2-01	m³	6,490	2,562	16.6	0.8	7.2
4-01	m³	9,615	49,712	478.0	12.6	336.4
4-02	m³	2,975	153,581	456.9	8.7	358.6
5-02	m³	10,817	853	9.2	0.4	4.7
Total				981.0	23.6	715.3

(9) Breakdown of Construction Cost (Cikunir Area)

Check dam

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10⁶)	Foreign (¥x10⁶)	Local (Rpx10⁶)
1. Civil Work						
(1) Main Work						
1-02	m³	8,430	3,296	27.8	–	27.8
4-01	m³	28,100	49,712	1,396.9	36.8	983.1
Total				1,424.7	36.8	1,010.9

(10) Breakdown of Construction Cost (Cisaruni Area)

(10-1) Check dams 1st stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10⁶)	Foreign (¥x10⁶)	Local (Rpx10⁶)
1. Civil Work						
(1) Main Work						
1-02	m³	1,380	3,296	4.5	–	4.5
4-01	m³	4,600	49,712	228.7	6.0	160.9
Total				233.2	6.0	165.4

(10-2) Check dams 2nd stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10⁶)	Foreign (¥x10⁶)	Local (Rpx10⁶)
1. Civil Work						
(1) Main Work						
1-02	m³	12,630	3,296	41.6	–	41.6
5-02	m³	42,100	49,712	2,092.9	55.2	1,473.0
Total				2,134.5	55.2	1,514.6

(11) Breakdown of Construction Cost (Cikupang Area)

(11-1) Check dams 1st stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-02	m^3	1,440	3,296	4.7	–	4.7
4-01	m^3	4,800	49,712	238.6	6.1	167.9
Total				243.3	6.1	172.6

(11-2) Check dams 2nd stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-02	m^3	2,130	3,296	7.0	–	7.0
4-01	m^3	7,100	49,712	353.0	9.3	248.4
Total				360.0	9.3	255.4

(12) Breakdown of Construction Cost (Cimerah Area)

(12-1) Check dams 1st stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-02	m^3	2,910	3,296	10.0	0	10.2
4-01	m^3	9,700	49,712	482.2	12.7	339.4
Total				492.2	12.7	349.4

(12-2) Check dams 2nd stage

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-02	m^3	23,040	3,296	75.9	0	75.9
5-02	m^3	76,800	49,712	3,817.9	100.6	2,687.0
Total				3,893.8	100.6	2,762.9

4. Breakdown of Construction Cost for Alternative-D

(1) Breakdown of Construction Cost (Crater Lake Tunnel)

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp×10^6)	Foreign (¥×10^6)	Local (Rp×10^6)
1. Civil Work						
(1) Main Work						
1-03	m³	1,069	36,637	39.2	1.9	17.8
1-04	m³	3,672	38,304	140.7	6.9	63.1
1-05	m³	228	53,419	12.2	0.4	7.7
1-06	m³	1,141	80,883	92.3	4.1	46.2
4-02	m³	1,260	153,581	193.5	3.7	151.9
7-01	m	665	2,217,039	1,474.3	129.6	17.6
7-02	m	665	575,789	382.9	25.9	91.8
8-01	m	90	4,366,780	393.0	35.0	0
8-02	m	90	890,379	80.1	7.1	0
15-01	hour	6,600	5,800	38.3	–	38.3
16-01	m	3,120	110,000	343.2	–	343.2
Cooling plant				601.3	53.5	0
Total				3,791.0	268.1	777.6

(2) Breakdown of Construction Cost (Ciloseh Area)

(2-1) Dike Improvement

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Excavation						
1-01	m^3	19,956	1,875	37.4	2.0	15.5
5-01	m^3	19,956	2,360	47.1	2.0	24.1
(2) Embankment						
2-01	m^3	19,956	2,562	51.1	2.6	22.1
3-01	m^3	2,646	27,974	74.0	2.7	43.5
Total				209.6	9.3	105.2

(2-2) Check Dams of Cimampang Area

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-02	m^3	2,640	3,296	8.7	–	8.7
4-01	m^3	8,800	49,712	437.5	11.5	308.2
Total				446.2	11.5	316.9

(2-3) Plant operation

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
Plant operation cost	m^3	394,000	224	88.3	0	88.3
Total				88.3	0	88.3

(2-4) Excavation (2)
(1st stage)

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rpx10^6)	Foreign (¥x10^6)	Local (Rpx10^6)
1. Civil Work						
(1) Main Work						
1-01	m^3	394,000	1,875	738.8	38.6	306.5
5-01	m^3	394,000	2,360	929.8	40.2	476.3
Total				1,668.6	78.8	782.8

Note: Excavation 2;

(3) Breakdown of Construction Cost (Cikunir Area)

Dike Improvement (without Ciponyo I Dalam)

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp×10⁶)	Foreign (¥×10⁶)	Local (Rp×10⁶)
1. Civil Work						
(1) Excavation						
1-01	m³	125,238	1,875	234.8	12.3	97.4
5-01	m³	125,238	2,360	295.6	12.8	151.4
(2) Embankment						
2-01	m³	125,238	2,562	320.9	16.2	138.9
3-01	m³	27,136	27,974	759.1	27.8	446.0
Total				1,610.4	69.1	833.7

(4) Breakdown of Construction Cost (Cikunir Area)

Rising Dike (Ciponyo I Dalam)

Item	Unit	Quantity	Unit Price (Rp)	Amount (Rp×10⁶)	Foreign (¥×10⁶)	Local (Rp×10⁶)
1. Civil Work						
(1) Excavation						
1-01	m³	130,872	1,875	245.4	12.8	10.8
5-01	m³	130,872	2,360	308.9	13.4	158.2
(2) Embankment						
2-02	m³	130,872	3,424	448.1	27.0	145.1
4-01	m³	32,277	49,712	1,604.6	42.3	1,129.3
3-01	m³	10,049	27,974	281.1	10.3	165.2
Total				2,888.1	105.8	1,699.6