FIGURES

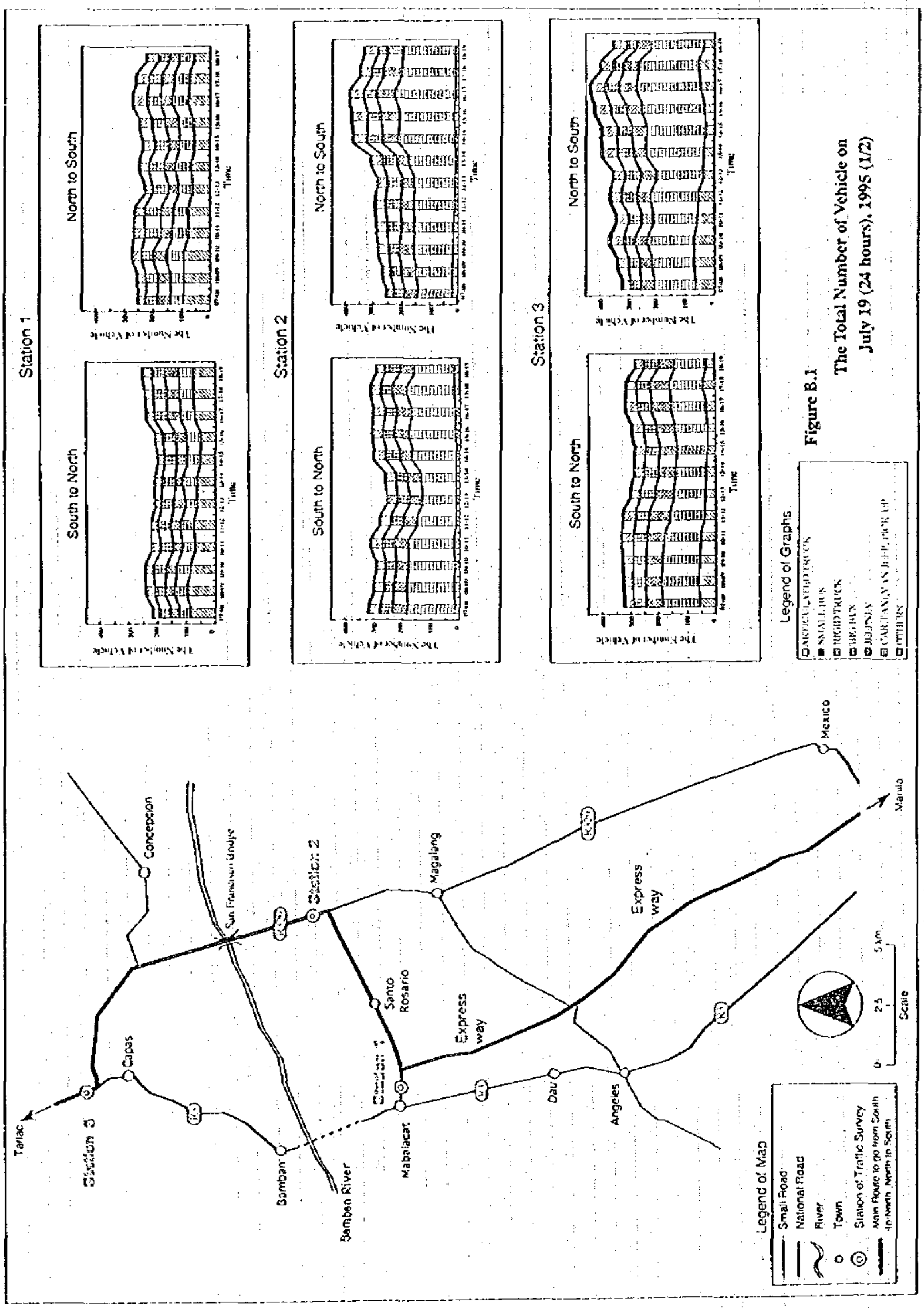
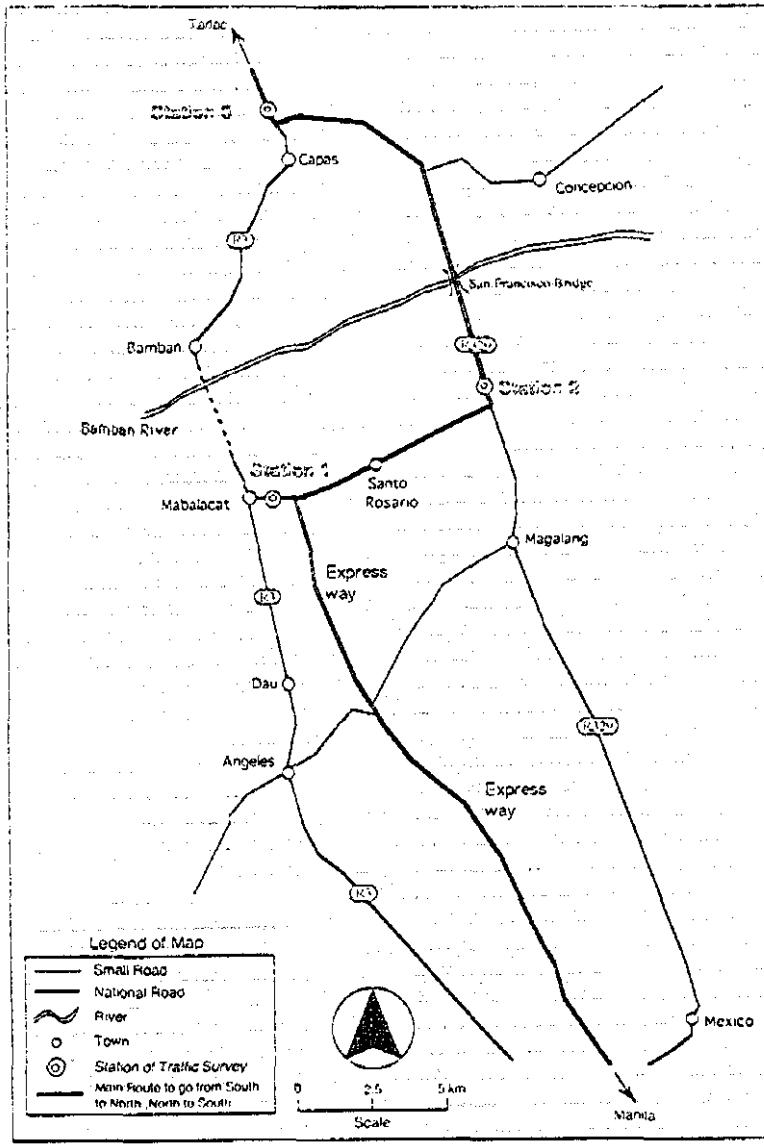


Figure B.1

The Total Number of Vehicle on July 19 (24 hours), 1995 (1/2)

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



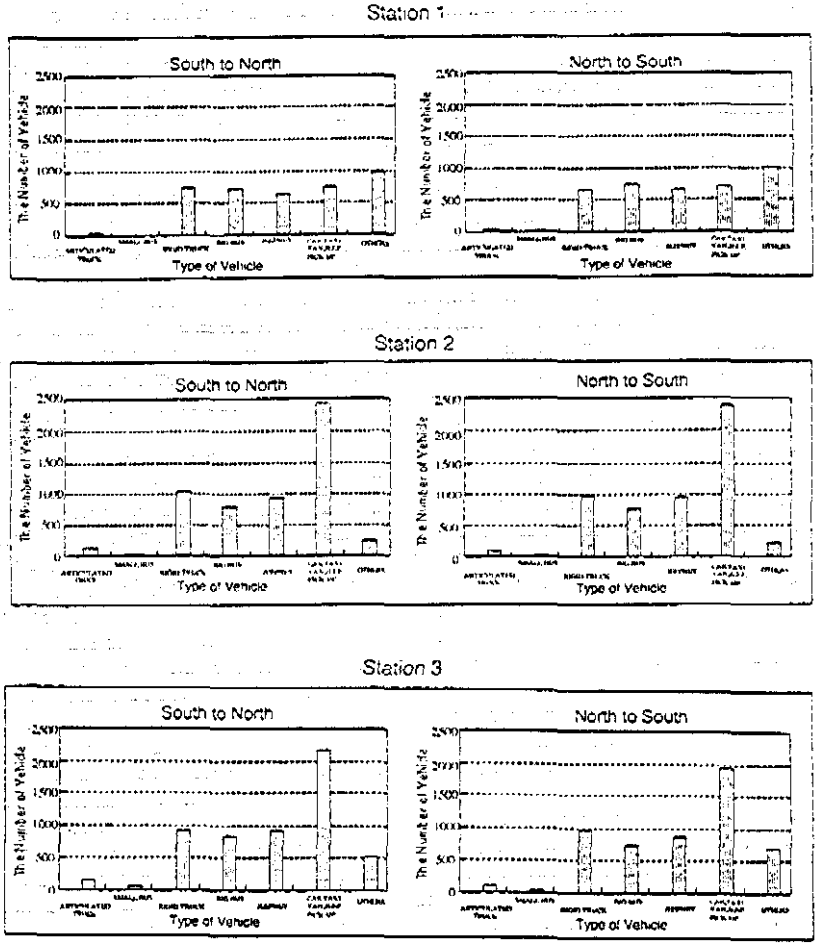


Figure B.2 The Total Number of Vehicle on July 19 (24 hours), 1995 (2/2)

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

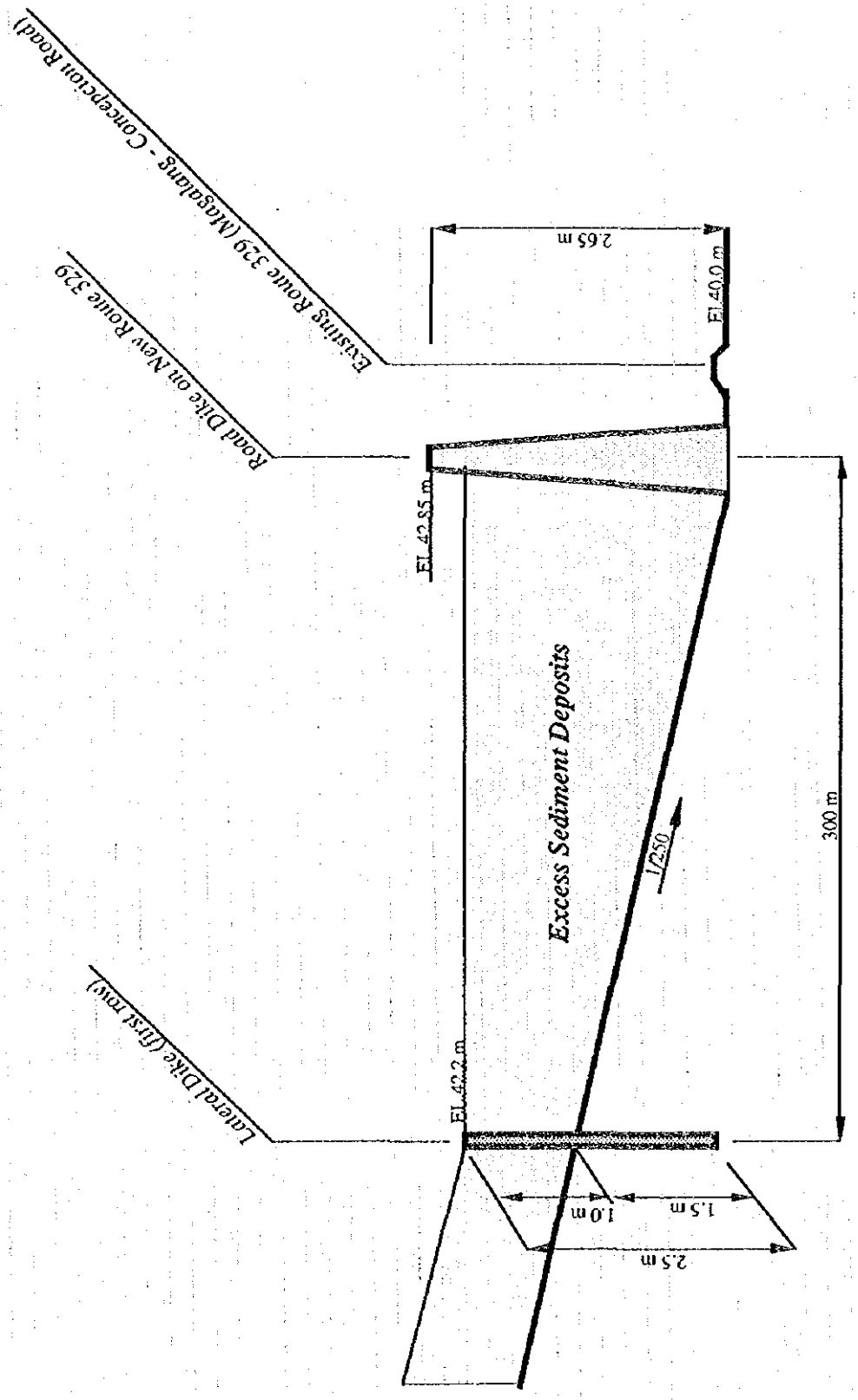
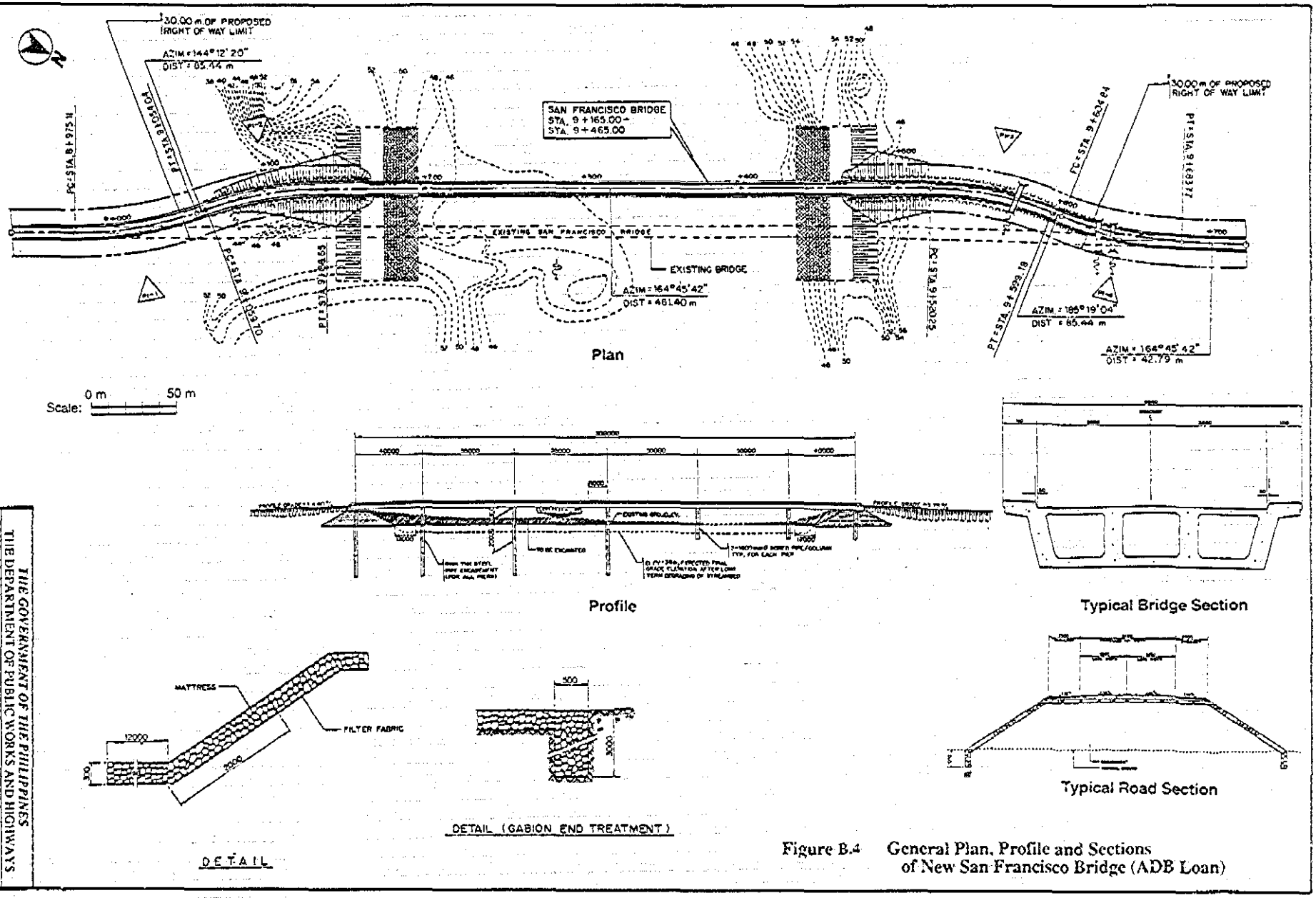


Figure B.3 Schematic Diagram of Elevating Route 329

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



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

Figure B.4 General Plan, Profile and Sections of New San Francisco Bridge (ADB Loan)

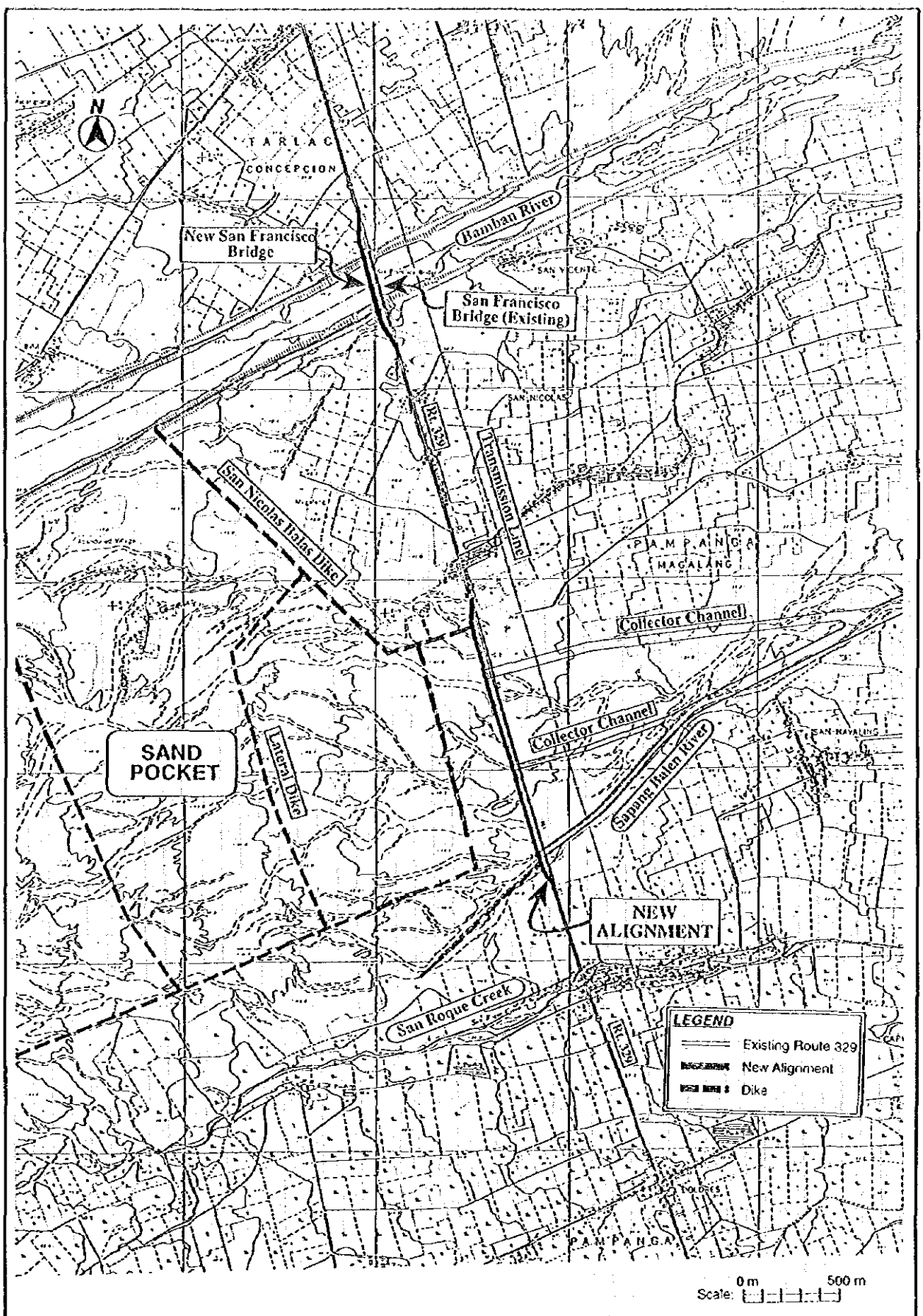
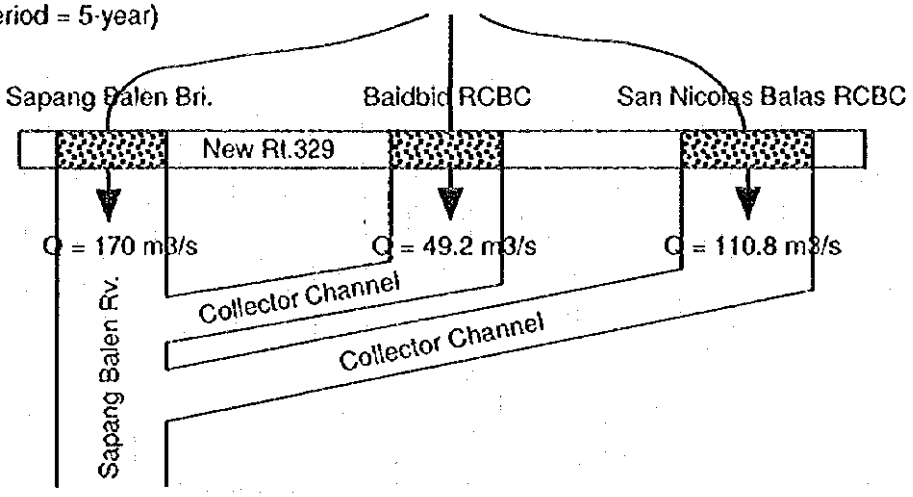


Figure B.5 Location Map of Route 329

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

Case - 1 : Before the training works for the Sacobia River

(Return period = 5-year)



Case - 2 : After the training works for the Sacobia River

(Return period = 50-year for bridge and 25-year for RCBC)

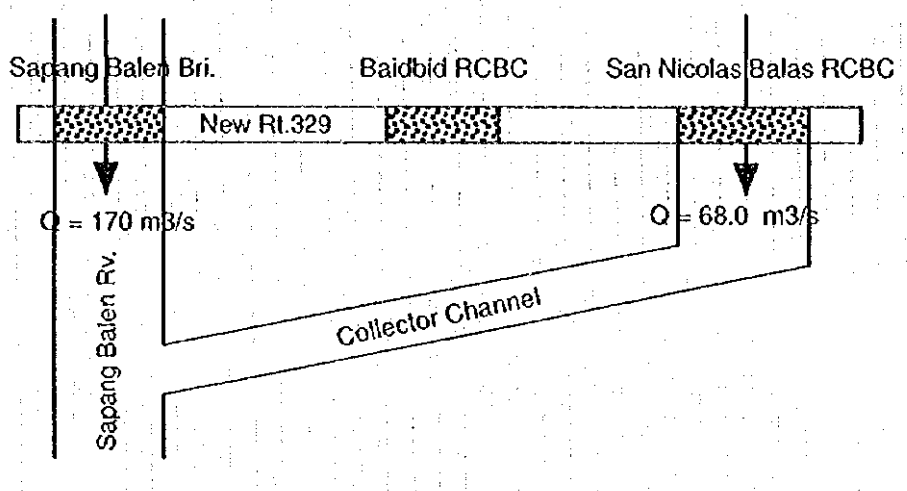


Figure B.6 Flood Control Condition

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

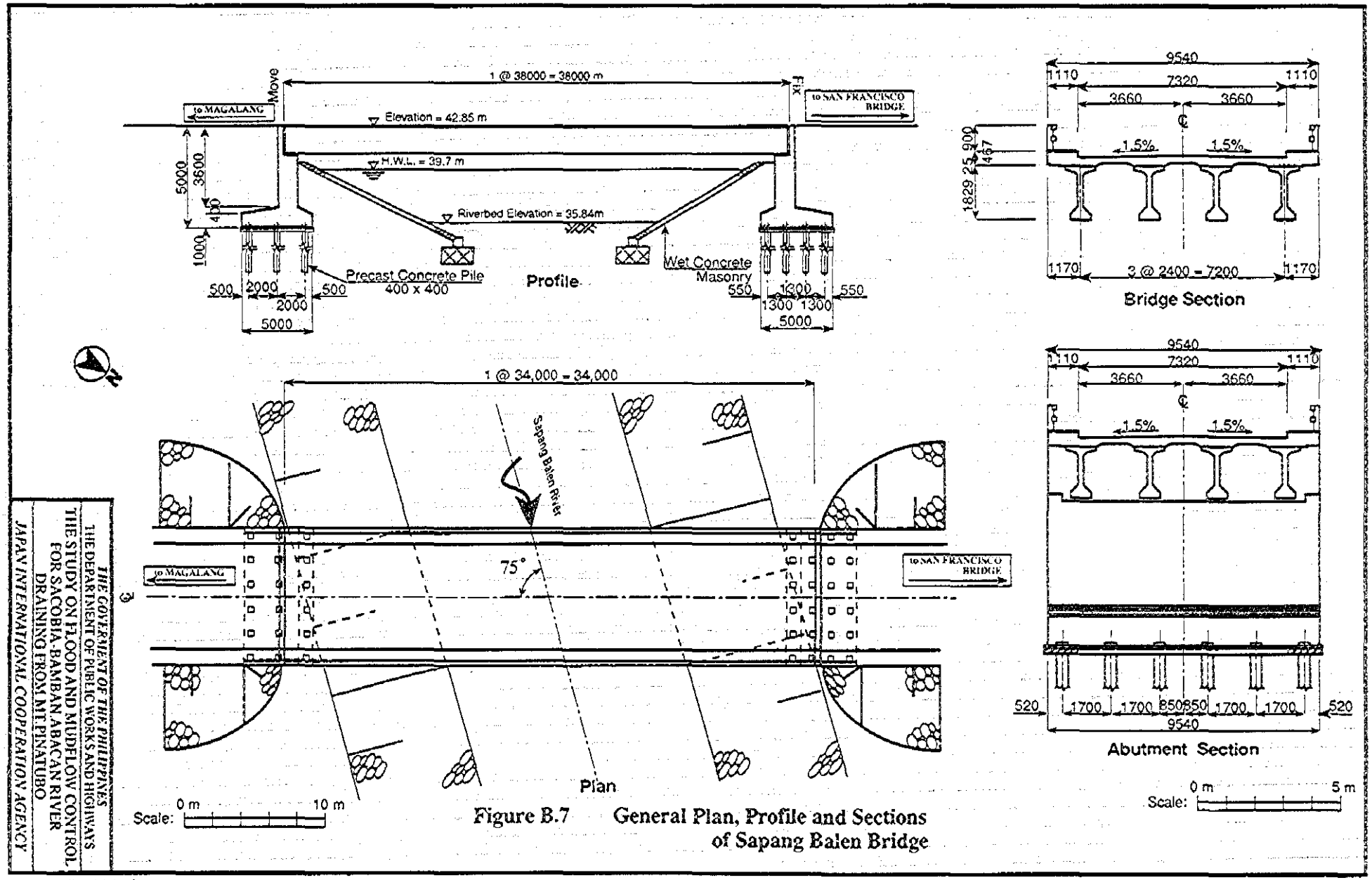
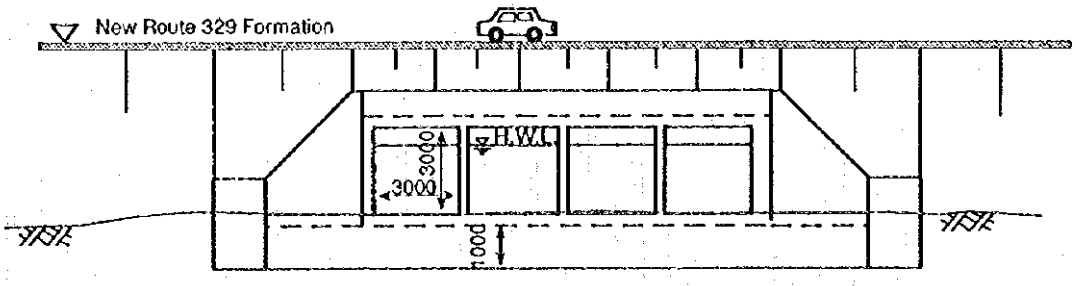
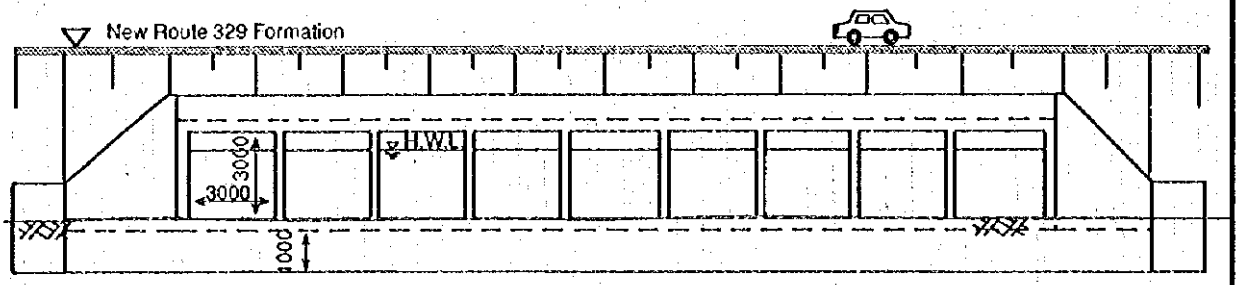


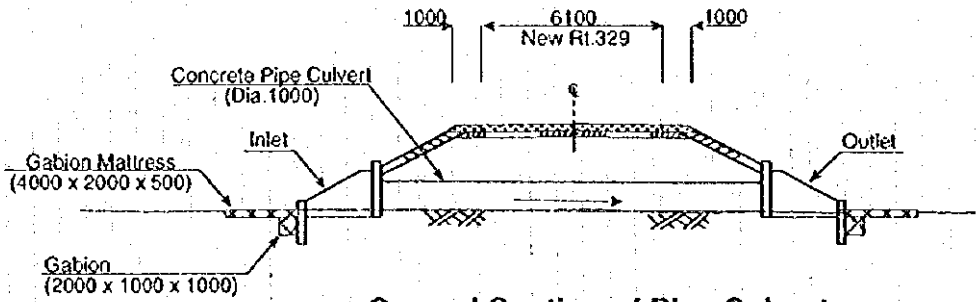
Figure B.7 General Plan, Profile and Sections of Sapang Balen Bridge



General Section of Baidbid Box Culvert



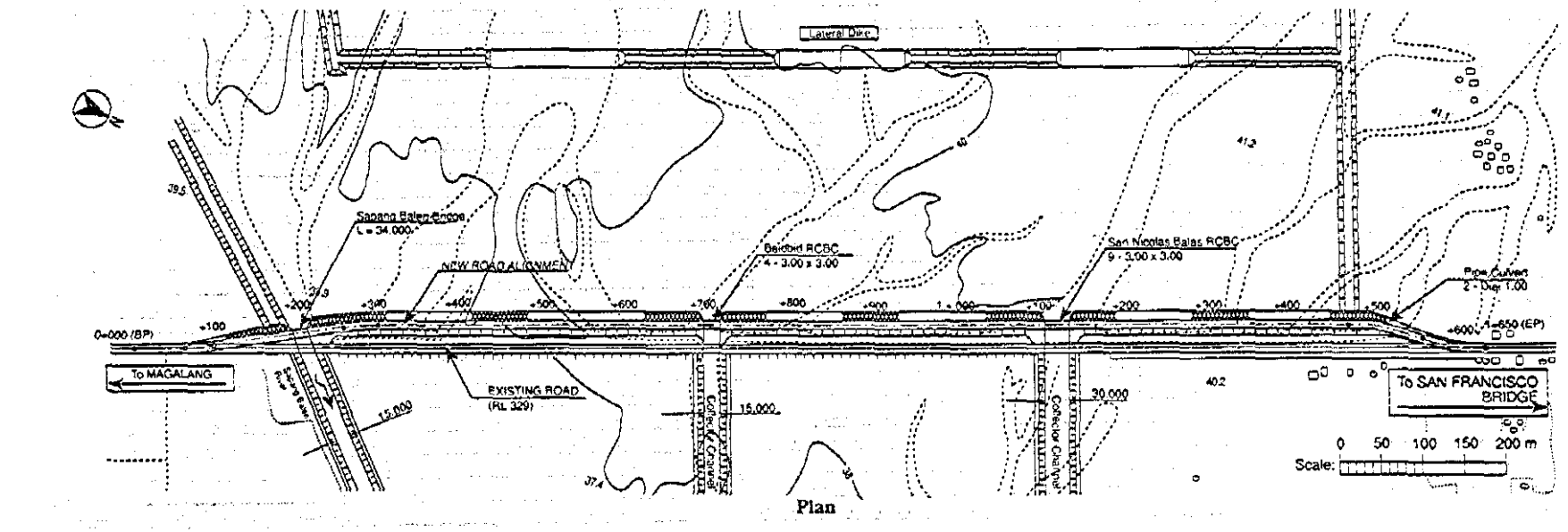
General Section of San Nicolas Balas Box Culvert



General Section of Pipe Culvert

Figure B.8 General Sections of Box Culvert and Pipe Culvert

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



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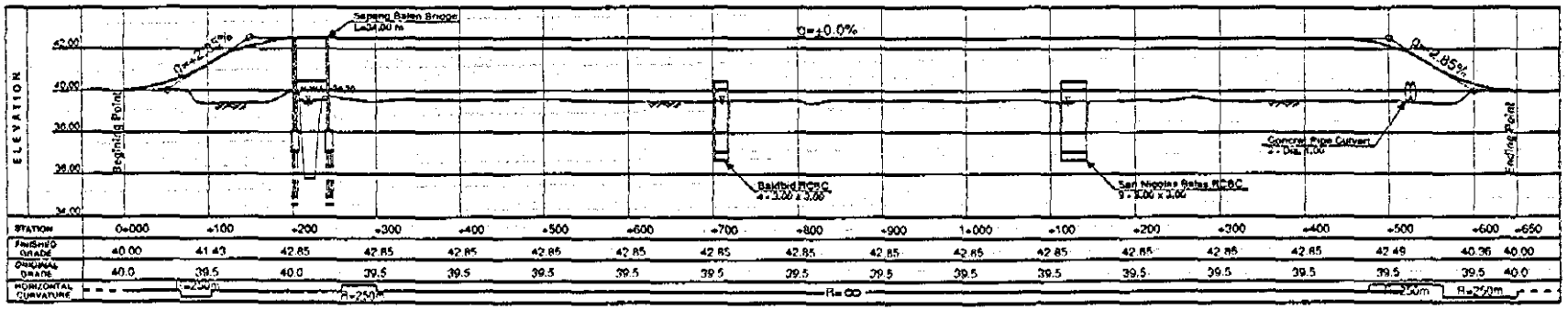
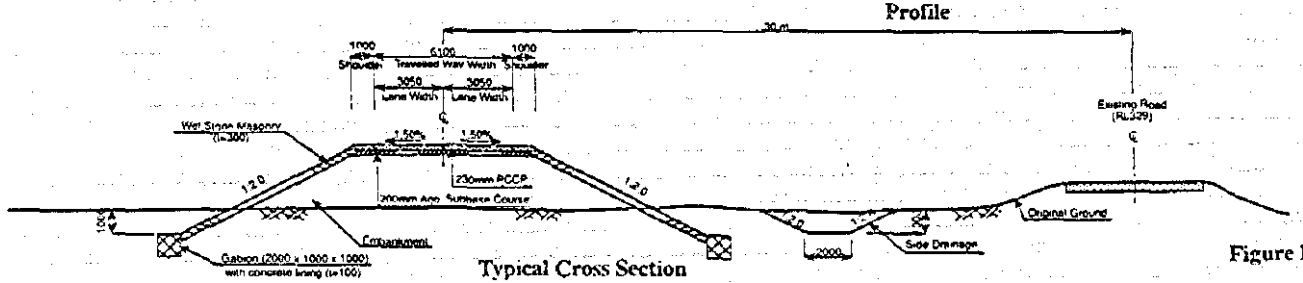


Profile



Typical Cross Section

Figure B.9 Plan, Profile and Section of Route 329

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

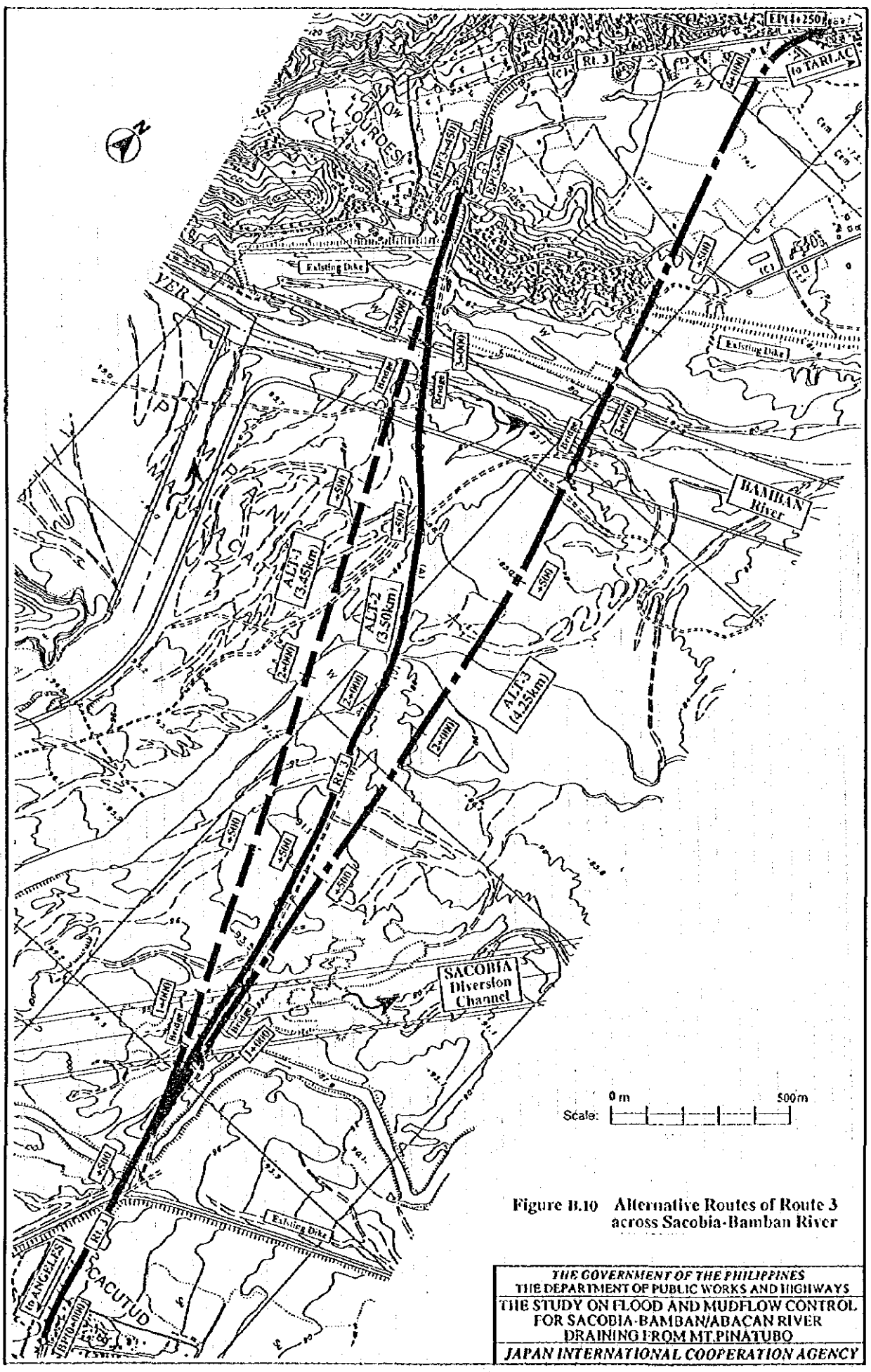


Figure B.10 Alternative Routes of Route 3 across Sacobia-Bamban River

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

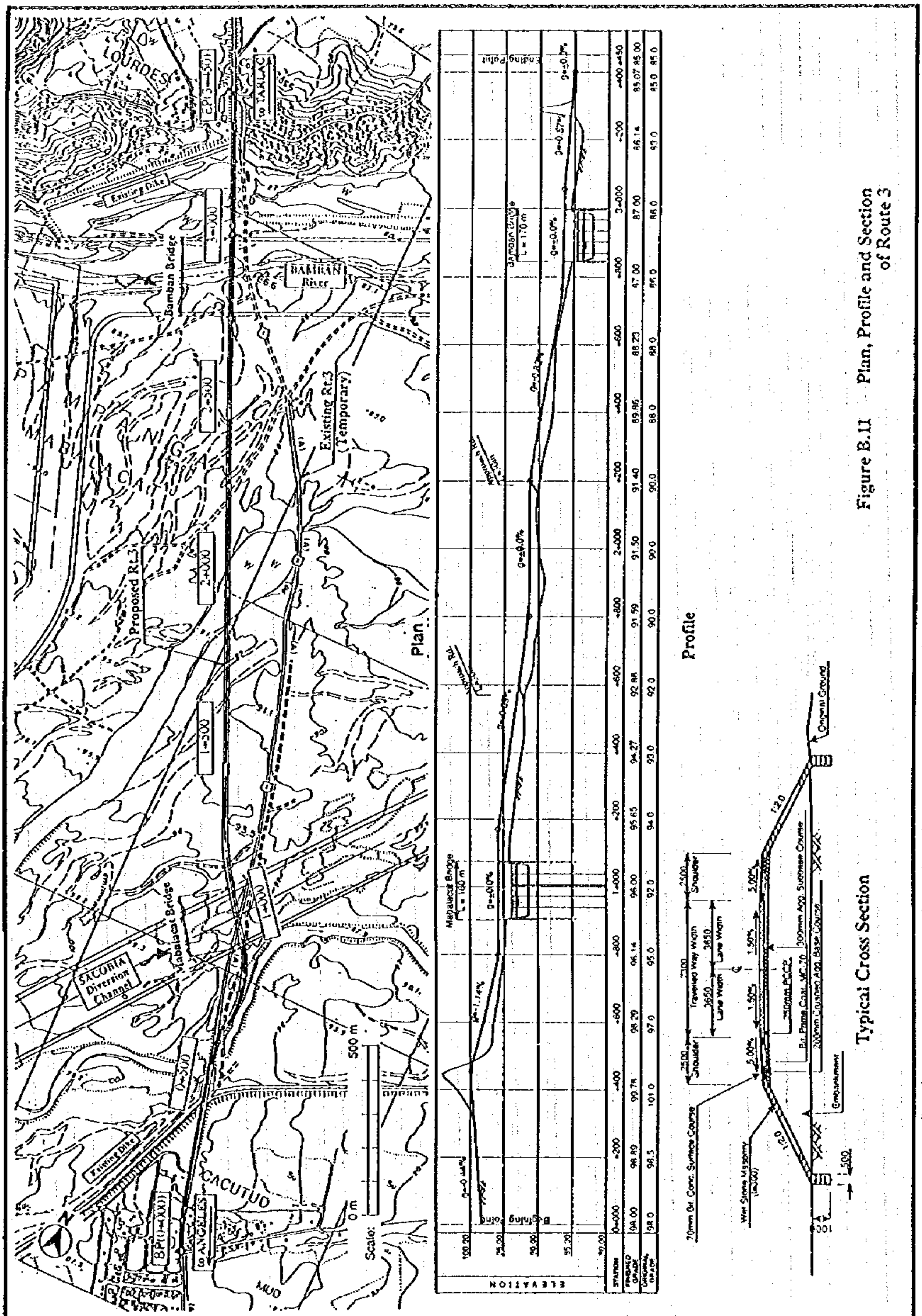


Figure B.11 Plan, Profile and Section of Route 3

THE GOVERMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN.ABACAN RIVER DRAINING FROM MT.PINATUBO

JAPAN INTERNATIONAL COOPERATION AGENCY

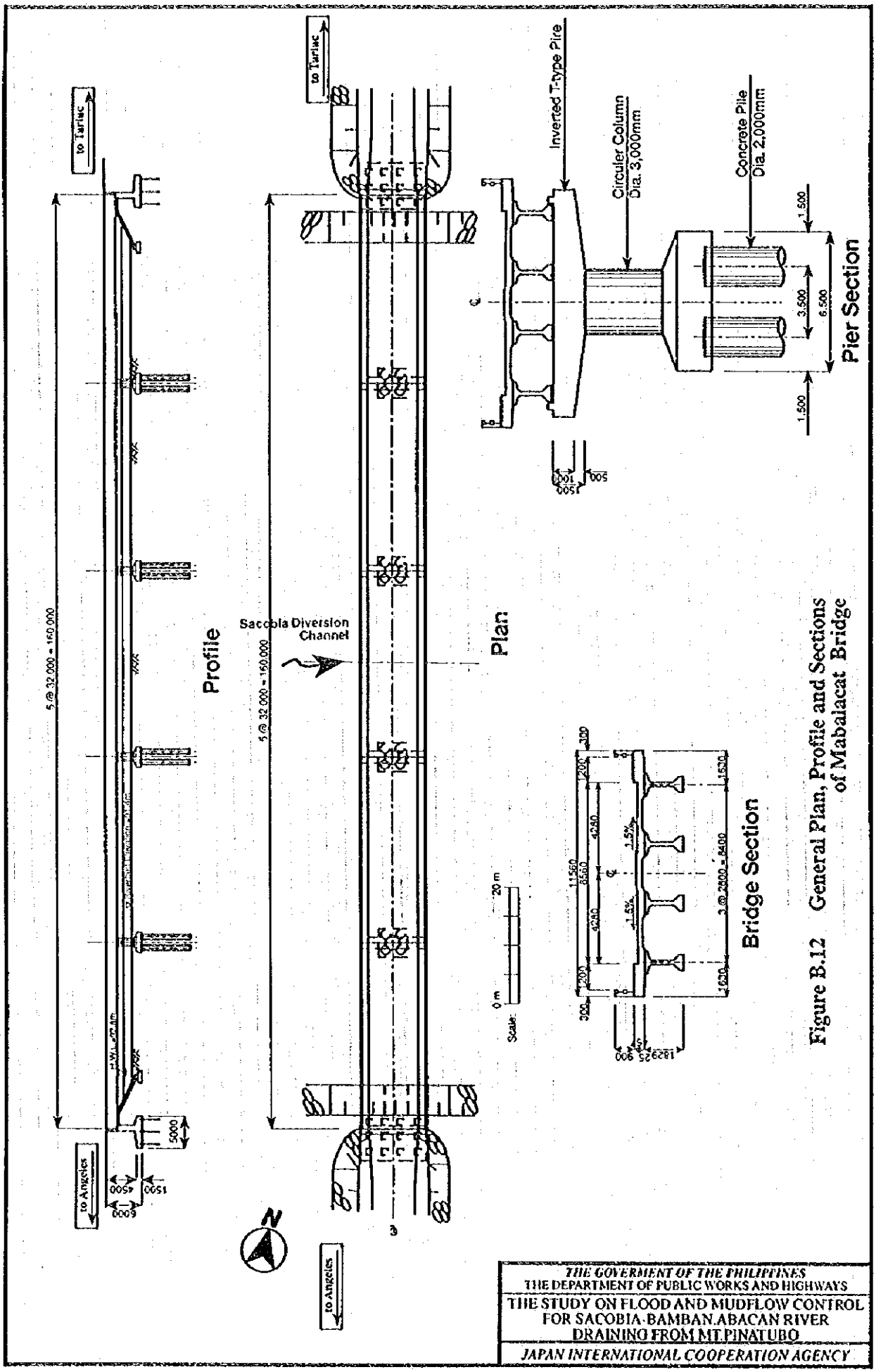
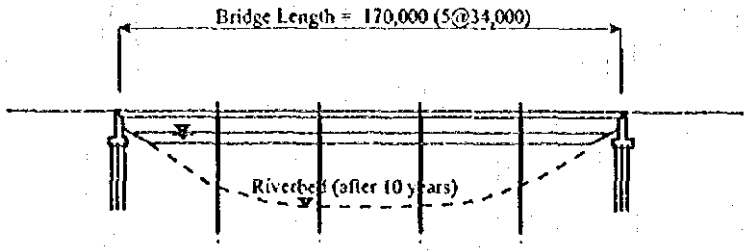
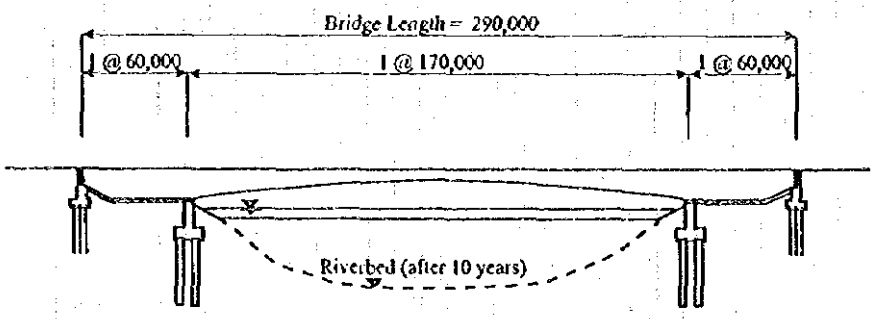


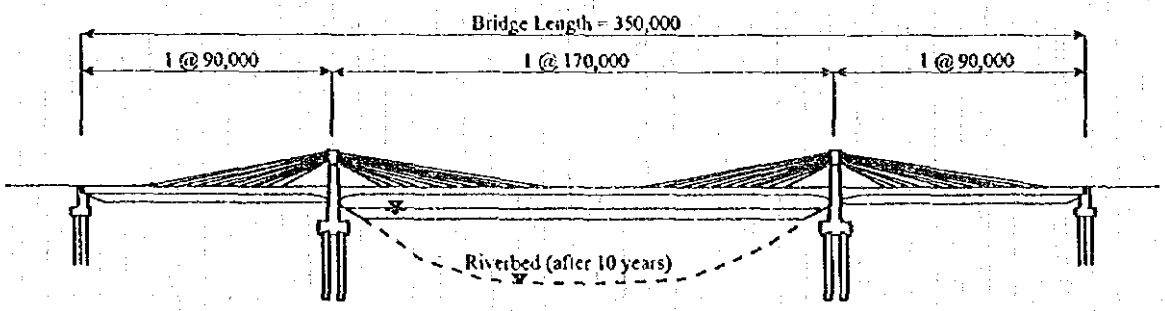
Figure B.12 General Plan, Profile and Sections of Mabalacat Bridge



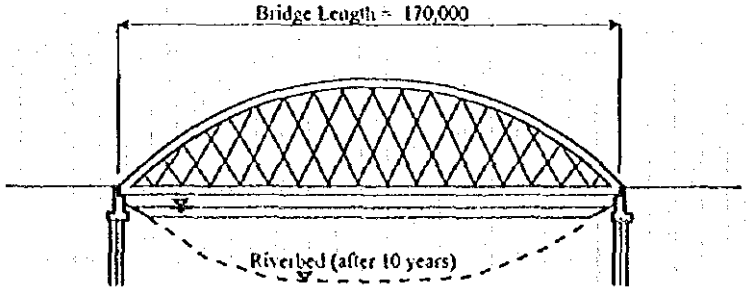
PC I-Girder Bridge



PC Box Girder Bridge



Extra-Dosed Bridge



Nielsen Bridge

Figure B.13 **Altenative Bridge Types of Bamban Bridge**

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

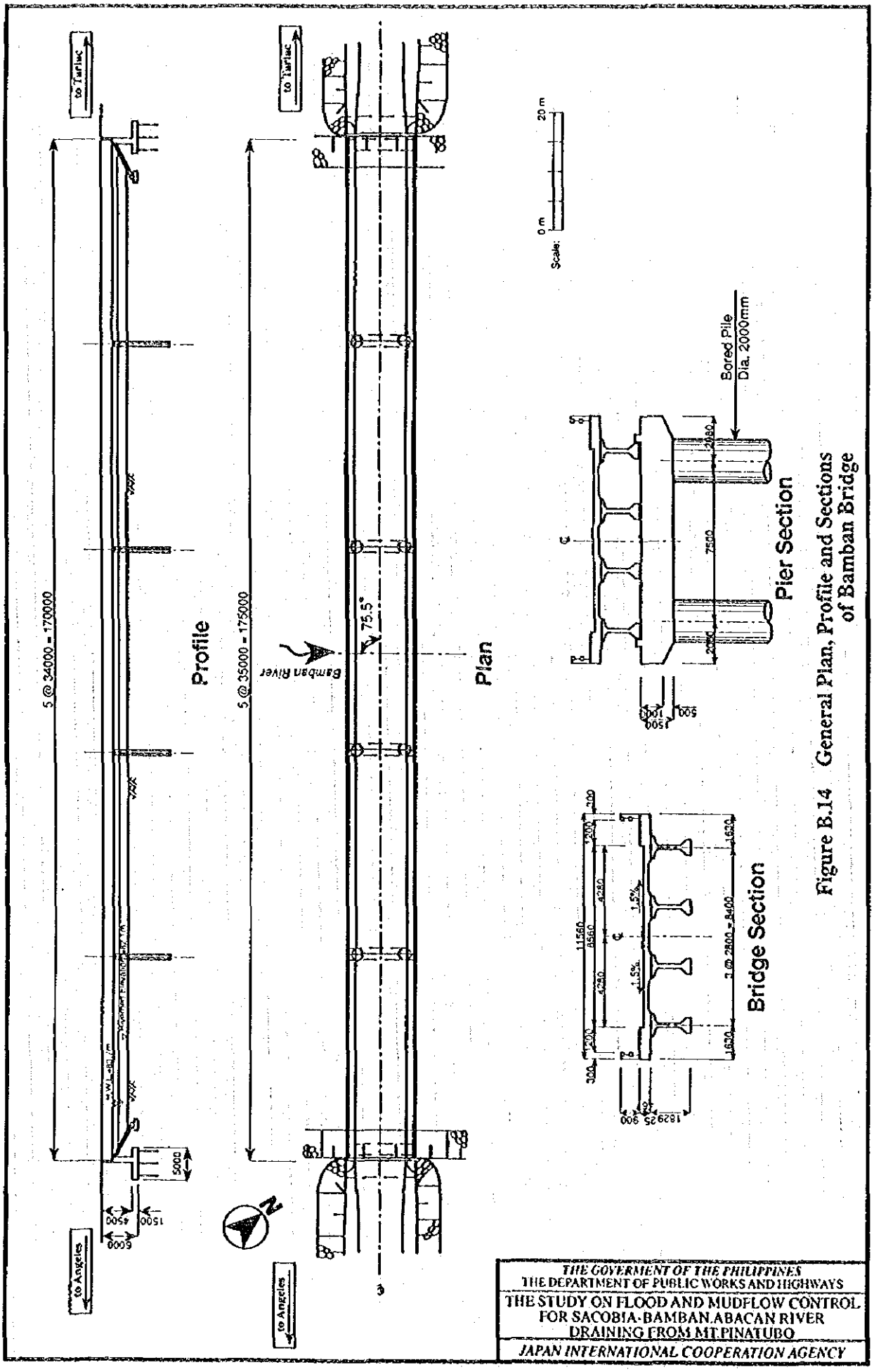


Figure B.14 General Plan, Profile and Sections of Bamban Bridge

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

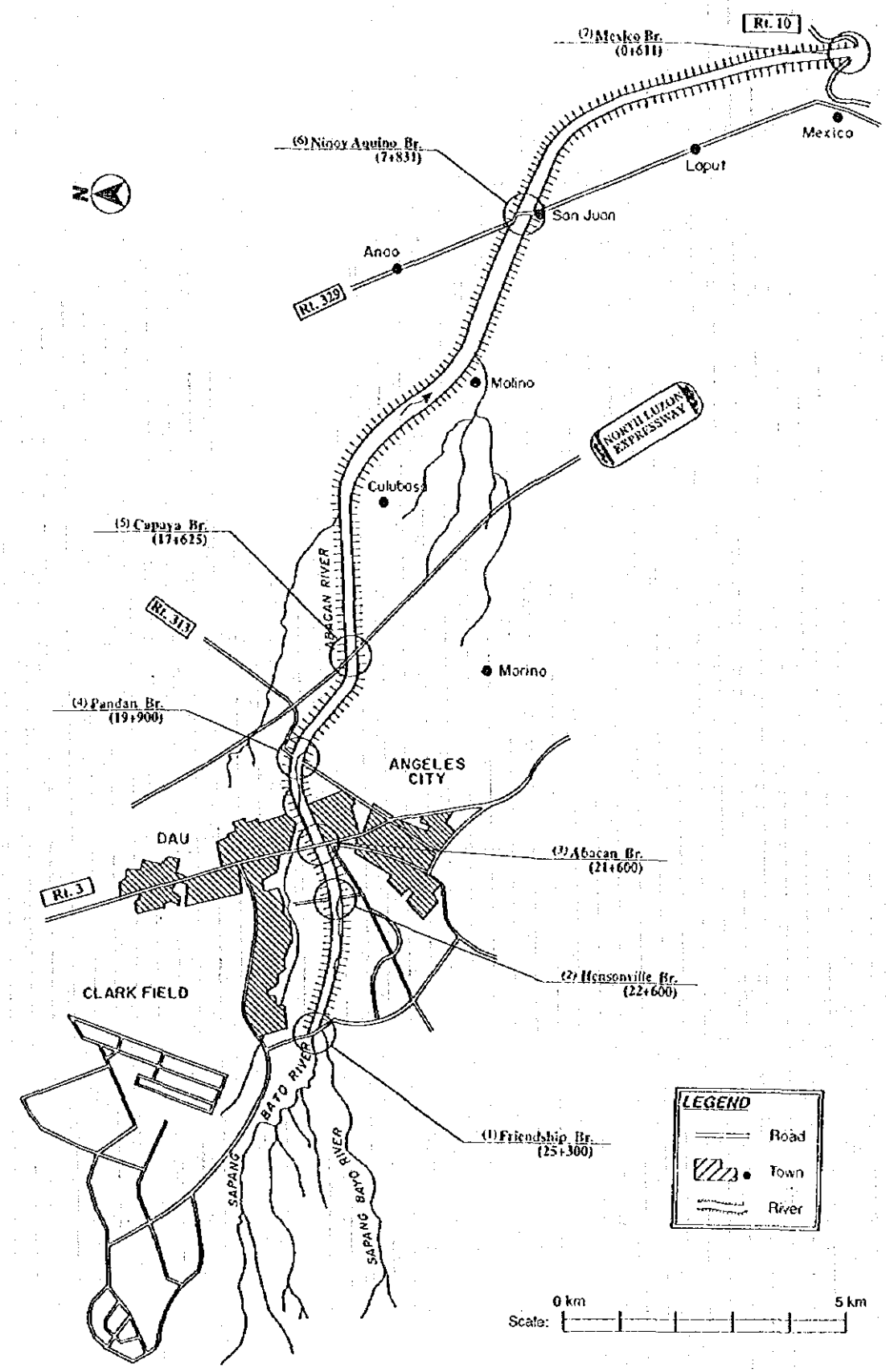
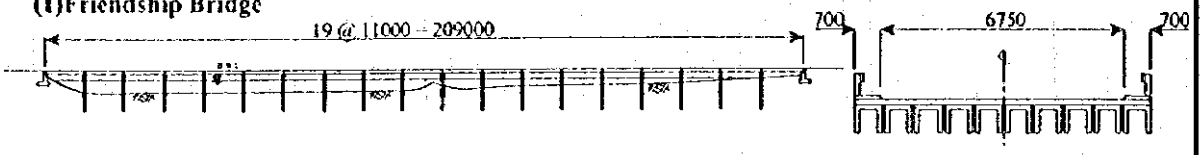


Figure B.15 Bridge Location across Abacan River

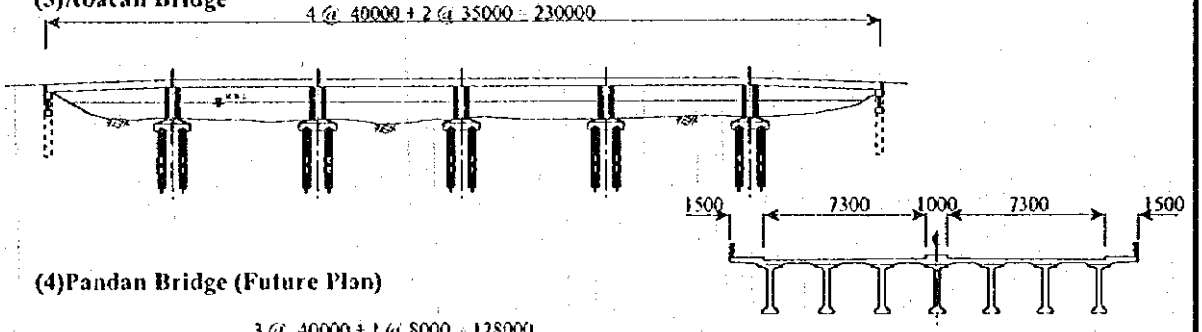
THE GOVERNMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT PINATUBO
JAPAN INTERNATIONAL COOPERATION AGENCY

(1)Friendship Bridge

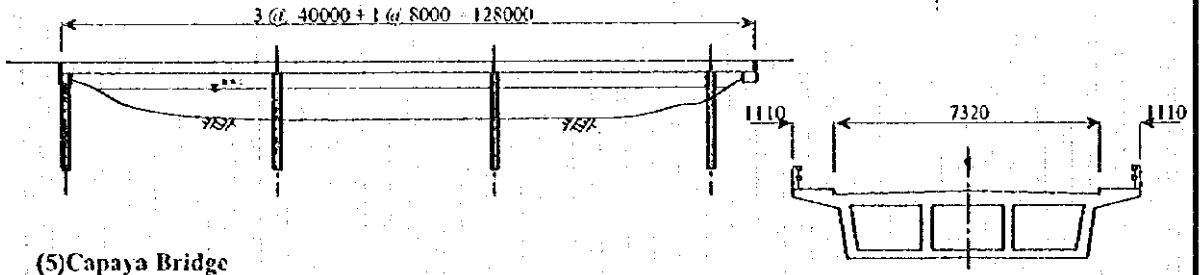


(2)Hensonville Bridge(No Bridge and No restoration Plan)

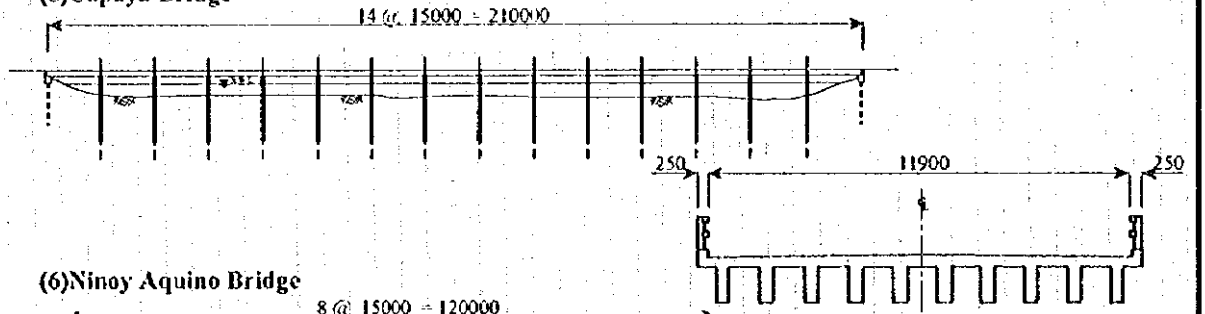
(3)Abacan Bridge



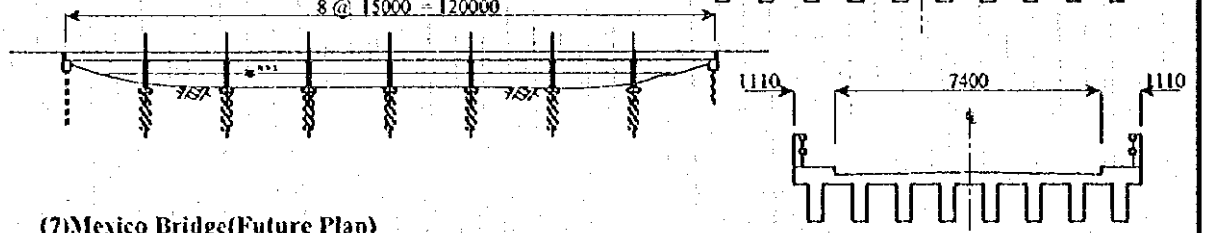
(4)Pandan Bridge (Future Plan)



(5)Capaya Bridge



(6)Ninoy Aquino Bridge



(7)Mexico Bridge(Future Plan)

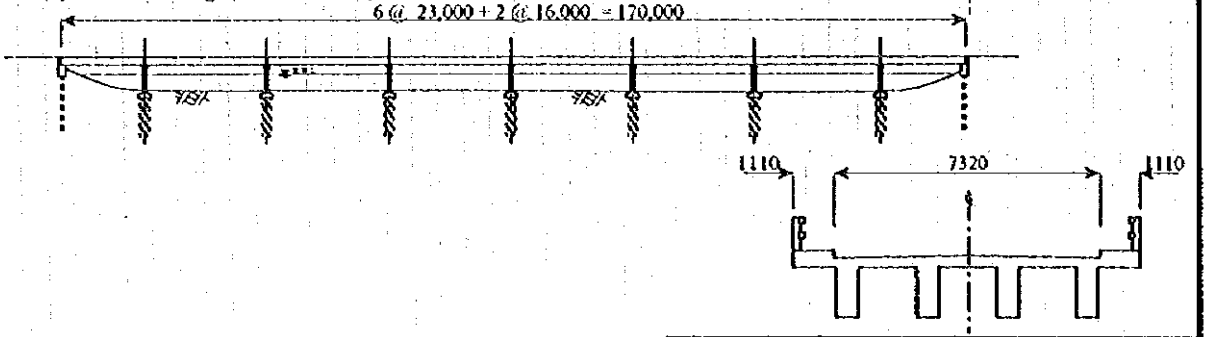


Figure B.16

Present Condition and Future Plan of Bridges in the Abacan River Basin

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

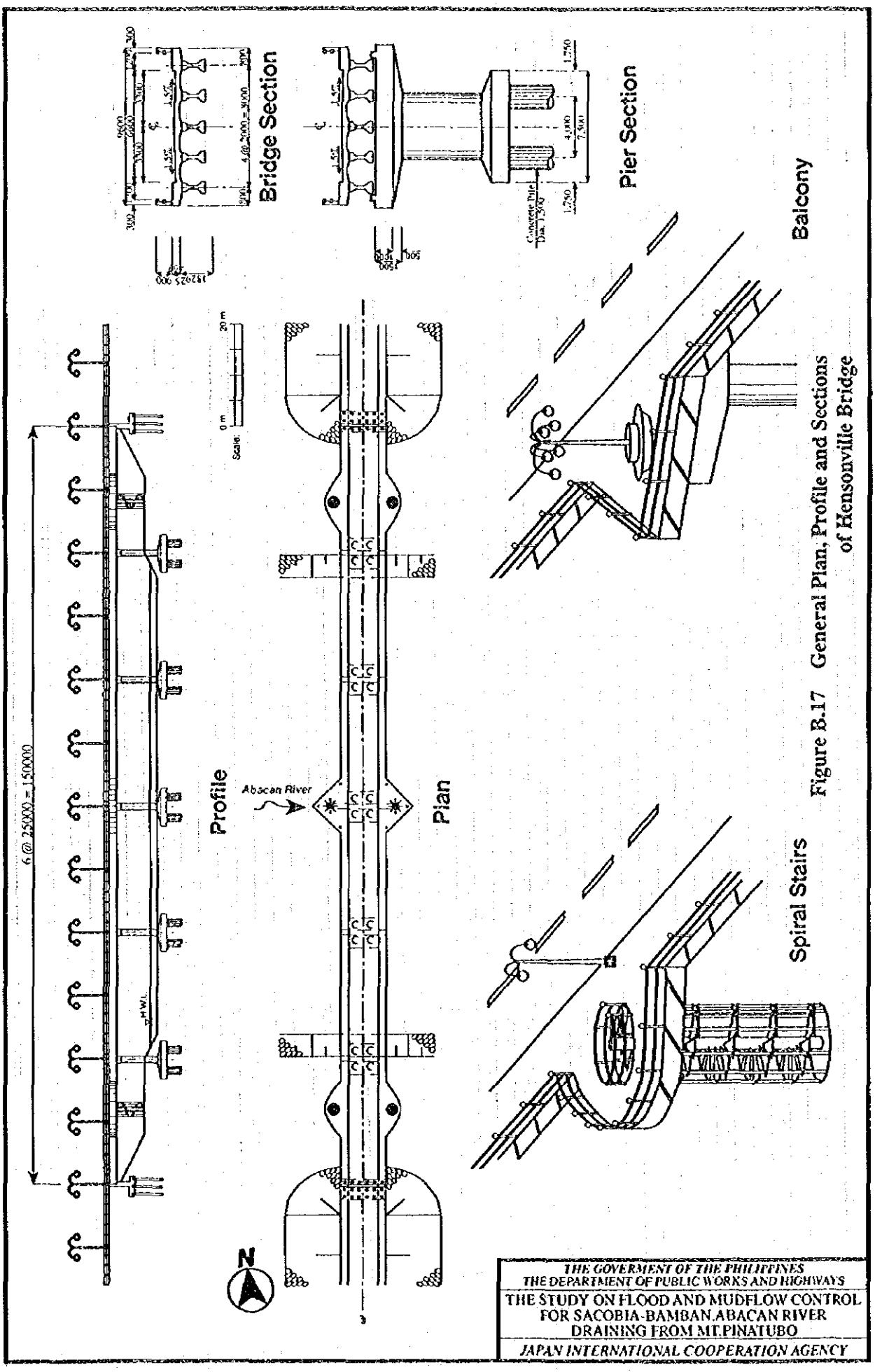


Figure B.17 General Plan, Profile and Sections of Hensonville Bridge

APPENDIX C

CONSTRUCTION PLAN / COST ESTIMATE

APPENDIX C

CONSTRUCTION PLAN / COST ESTIMATE

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C 1 CONSTRUCTION PLAN

1.1 BASIC CONDITIONS FOR CONSTRUCTION PLAN

The following conditions are basically applied to prepare the construction plan for projects of Sacobia-Bamban River basin and Abacan River basin.

(1) Workable Times

Projected annual workable months are assumed at 8 months in dry season from November to June. Workable days are estimated at 26 days per month.

(2) Labor

Skilled and unskilled laborers can be recruited from the surrounding areas of sites and from Metro Manila.

(3) Construction Materials

Major construction materials required are gravel, boulder, mountain clayey soils, cement, reinforcing bars, and structural steel materials including steel sheet piles. Since construction sites are located in/around Angeles City or near to Metro Manila, products can be easily obtained commercially. Mountain soils are available in/around construction sites. Boulders are transported from some borrow pits in Tarlac Province (one of them is located at Mayantoc along Camiling River, about 2 hours from Bamban River) or Zambales Province. Ready mixed concrete is available in Angeles City. However, some special structural steel materials may be imported because they are not locally produced.

(4) Construction Equipment

Major construction equipment needed such as bulldozers, loaders, cranes, dump trucks etc., are available in Metro Manila or the vicinity of construction sites on the rental basis.

(5) Spoil Banks

Excavated earth material of the Bamban river channel will be disposed at the spoil bank area. Swampy left bank downstreammost area of the Bamban River is proposed for spoils. On the other hand, area on the left bank of most downstream reach near the Mexico Bridge is proposed as spoil bank for the Abacan River.

(6) Preparatory Works and Temporary Facilities

Water for construction works can be obtained from shallow wells at sites and river water may be used. Commercial electric power is available at sites. As access roads to the sites, a national expressway (North Super Highway), national highways (route No. 3, 10 and 329), and many provincial and municipal roads are available. Also, river channels play a role of access road in dry season.

(7) Executive Body

Construction works will be executed by contract system and administrated by MPR-PMO with assistance of engineering consultants.

1.2 SACOBIA-BAMBAN RIVER BASIN

1.2.1 Project Components

Flood control and mudflow control works for the Sacobia-Bamban River basin include the following construction components and they are shown in Figure C.1.

(1) Sand Pocket Reinforcement Works

a) Route 329 Road Dike (1.65 km long)
b) Lateral Dikes (5.96 km long)
c) Reinforcement of Dike (Closing of open dikes, mountain soil cover, sodding etc., 12.5 km long)

(2) Sacobia River Sediment Control Works

a) Maskup Consolidation Dam (Steel sheet pile double wall)
b) Groundsill Works (Steel sheet pile double wall, 6 sets)
c) Training Works (2.8 million m3 of channel excavation and 10.36 km long of rubble concrete bank protection)

(3) Bamban River Improvement Works

a) Slope Protection Works (Rubble concrete, 29.15 km long)
b) Spur Dike Works (Concrete pile type, 12 sets)
c) Channel Excavation Works including Maintenance Works (15.5 million m3)
d) Dike Raising Works (6.0 km long)
e) Dike Reinforcement Works (Mountain soil cover, sodding and maintenance road, 12.5 km long)

(4) Sapang Balen River Improvement Works

a) Straightening of Channel (2.0 km long)
b) Rubble Slope Protection (1.2 km long)
c) Existing Bartolome Bridge Extension Works (30 m long)

(5) Sapang Cauayan River Training Works (Rubble concrete revetted channel, 2.65 km long)

(6) Highway Route 3 Restoration Works
a) Bamban Bridge
b) Mabalacat Bridge
c) Embankment and Concrete Pavement

1.2.2 Implementation Schedule

At present, rehabilitation and protection works of the Short Term Plan is ongoing. Continuously, Medium Term Plan will start in 1996 and targets the "Philippines 2000" as the completion year. Medium term plan including detailed design, pre-construction and construction will, therefore, be implemented for 4 years from 1996 to 1999.

From the end of 1995, required fund for the project will be arranged and detailed design will be done for one year from the middle of 1996.

Project construction works will be executed in two stages:

(1) From the end of 1996 to the middle of 1998

Construction of Highway Route 329 road dike and reinforcement of sand pocket which should be urgently implemented.

(2) From the middle of 1997 to end of 1999

Sacobia sediment control works including construction of a consolidation dam and training works, Bamban River Improvement Works, and Sapang Cauayan River Training Works.

Figure C.2 shows the proposed implementation schedule of the project for the Sacobia-Bamban River basin.

1.2.3 Standard Construction Methods of Major Works

The following are standard construction methods of major works.

(1) Steel wall type sabo dams and groundsills

Sabo/consolidation dams are designed as steel double wall filled with lahar material or boulders and with concrete top cover. Double wall is made of steel sheet piling. Steel sheet piling works will be executed by a combination of a 35-ton class crawler crane equipped with a vibrating hammer (30 kW) and a 20-ton truck crane.

(2) Earthworks of dike/road embankment and channel excavation

Embankment work including spreading and compacting for dike/road using lahar material is done mainly by heavy equipment such as 32-ton class bulldozers, 8 to 20-ton class tire rollers and 1.0-ton class vibrating rollers.

Excavation of sandy channels will be carried out by a combination of a 32-ton class bulldozer for collecting/spreading , a 2-m3 wheel loader for loading, and 11-ton class dump trucks for hauling to specific sites.

(3) Gabion works and bank/slope protection works

Gabion works are included in the construction of sabo dams, groundsills, lateral dikes, bank/slope protection works. They are to be carried out manually with assistance of equipment such as 10-ton class truck cranes.

Rubble concrete slope protection works will be constructed manually using equipment such as 0.2 m3 portable type concrete mixers, 10-ton truck cranes, and 0.6 m3 class backhoes.

(4) Spur dike

Spur dike made of reinforced concrete (RC) piles can be constructed by using a drop hammer operated by a winch.

(5) Bridge

Mabalacat Bridge crossing the Bamban River and Bamban Bridge crossing the Sacobia River will be constructed of I-beam girder for superstructure and bored cast-in-place concrete pile (C.C.P.) for substructure. The bridge slab will be constructed of reinforced concrete.

The bored cast-in-place concrete pile will be constructed by using rotary drilling rig on a 35-ton class crawler crane for drilling hole and concrete tremie pipes and concrete pump for concrete placement. The borehole will always be under bentonite suspension and steel casting will be used for almost all of the upper half of the hole. Bentonite mixer, pump and desanding equipment will be provided at site.

1.2.4 Necessary Heavy Construction Equipment

Number of main heavy equipment needed for major works is estimated like as below in accordance with the implementation schedule. They are listed in Table C.1.

(1) Steel Sheet Piling Works

In case of Maskup Dam and Groundsills

Work volume	:	102,140 m (14,300 sheets) in 1998
Workable days	:	8 months x 26 day = 208 days
Necessary equipment	:	a combination of a 35-ton crawler crane with 30 kW hammer and a 20-ton truck crane.
Necessary number of group	:	14,300 sheets/208 day/20 sheets per day = 4 groups

(2) Channel Excavation Work

In case of channel excavation in Sacobia Training Works;

Work volume	:	2,800,000 m3 , 1 km hauling
Workable days	:	8 months x 26 days = 208 days
Necessary equipment	:	a combination of a 32-ton bulldozer, a 2-m3 wheel loaders and 22 dumptruck (11-ton).
Necessary number of group	:	2,800,,000 m3/208 days/ 2, 750 m3 per day = 5 groups

1.3 ABACAN RIVER BASIN

1.3.1 Project Components

The flood control and mudflow control works for the Abacan River Basin include the following construction components and they are shown in Figure C.3.

(1) Reconstruction of Sabo Dam No. 6 (Steelbar mesh double wall type)
(2) Reconstruction of Sabo Dam No. 9 (Steel Sheet pile double wall type)
(3) Reconstruction of Sabo Dam TM-1 (Steel Sheet pile double wall type)
(4) Bank Protection Works in Upper Reach (Gabion type, 3.0 km long)
(5) Bank Protection Works in Upper Reach (Rubble concrete type, 1.51 km long)
(6) Training Works in Middle Reach (Rubble concrete revetted channel, 7.9 km long)
(7) Hensonville Bridge Work
(8) Slope Protection Works in Lower Reach (Rubble concrete type, 12.6 km long)
(9) Dike Reinforcement Works (Mountain soil cover, sodding and maintenance road, 18.4 km long)
(10) Channel Excavation Work including Maintenance Works (2.0 million m3)

1.3.2 Implementation Schedule

At present, rehabilitation and protection works of the Short Term Plan is ongoing. Continuously, the Medium Term Plan will start in 1996 and targets the "Philippines 2000" as the completion year. Medium term plan including detailed design,

pre-construction and construction will, therefore, be implemented for 4 years from 1996 to 1999. Implementation schedule is shown in Figure C.4.

1.3.3 Standard Construction Methods of Major Works

Construction methods of the Project for Abacan River basin including slope protection works, training works, sabo dam works, etc., are the same as those mentioned in 1.2.3 of Sacobia-Bamban River basin.

1.3.4 Necessary Heavy Equipment

Number of main heavy equipment needed for major works is estimated like as below in accordance with the implementation schedule. They are listed in Table C.2.

(1) Steel Sheet Piling Works

In case of Sabo Dam No.9;

Work volume	:	28,000 m (3,500 sheets) in 1997
Workable days	:	4 months x 26 day = 104 days
Necessary equipment	:	a combination of a 35-ton crawler crane with 30 kW hammer and a 20-ton truck crane.
Necessary number of group	:	3,500 sheets/104 days/20 sheets per day = 2 groups

(2) Channel Excavation Work

Work volume	:	500,000 m3 per year (4 years), 1 km hauling
Workable days	:	7 months x 26 days = 182 days
Necessary equipment	:	a combination of a 32-ton bulldozer, a 2-m3 wheel loaders and 22 dumptruck (11-ton).
Necessary number of group	:	500,000 m3/182 days/ 2, 750 m3 per day = 1 group

C.2 COST ESTIMATE

2.1 CONDITIONS FOR COST ESTIMATE

Project cost is estimated on the following criteria.

(1) Construction works are to be executed on the contract basis.

(2) Basic prices are based on the price level as of November, 1995.

(3) Exchange rates used to convert foreign currencies into local currency are US$1.00 = 25.00 Pesos = 100 Yen (1.00 Peso = 4.0 Yen).

(4) Estimated cost is divided into two portions, namely foreign currency (FC) and local currency (LC), because foreign financial assistance is expected for the implementation of projects.

(5) Cost of main civil works is estimated by multiplying work quantities by the respective unit costs.

(6) Some components of project cost are estimated as a certain percentage of major components.

2.2 *COMPONENTS OF PROJECT COST*

Project cost consists of costs for main construction works, compensation, government administration, engineering services, physical contingency and price contingency.

(1) Unit Price

Unit prices of items such as labor cost, material cost and equipment cost are the basis of the main construction work cost. Labor costs which include all fringe benefits and material costs are based on data collected by MPR-PMO, DPWH. Equipment cost is given on the basis of rental rates authorized by the Associated Construction Equipment Lessor, Inc. of the Philippines (ACEL). Labor cost and construction material cost are listed in Table C.3 and C.4.

(2) Unit Cost

Unit costs consist of direct unit cost comprising material costs, labor costs, equipment cost and indirect costs including contractor's expenses, overhead, profit, insurance, bond, field supervision and administration, security and safety control, Value Added Tax (VAT), etc. Indirect costs excluding VAT are estimated as a percentage of direct unit cost, i.e., 20%. VAT is 10% of costs of labor and equipment.

(3) Main Construction Cost

Main construction cost consists of costs for preparatory works, main works, and miscellaneous works.

Cost of preparatory works covers the establishment of contractor's site offices; water, power supply and communication systems; topographic survey and soil investigation; transportation of construction equipment; preparation of drawings, and so on. This is estimated as 5% of cost of main works.

Cost of main works covers costs required for major civil work items in the projects such as excavation, sabo dams, channeling, slope protection works, groundsills, bridges, road embankment and pavement, and so on.

Cost of miscellaneous works covers minor civil work items compared with the above-mentioned main works, including drainage ditch, demolition of existing structures, temporary roads and bridges, maintenance of roads, and so on. Cost of miscellaneous works is estimated as 10% of cost of main works.

(4) Compensation Cost

Compensation cost covers land acquisition and house evacuation required for construction works.

(5) Government Administration Cost

Administration cost, among others, is defined as the necessary cost for government staff, office equipment, and so on. Administration expense is estimated as 5% of main construction cost and compensation cost.

(6) Cost of Engineering Services

Cost for engineering services covers the detailed design and construction supervision of the projects made by consulting engineering firms or consultants employed by the Government. Cost of engineering services is estimated as about 10% of main construction cost.

(7) Physical Contingency

Physical contingency which is prepared for unknown construction works is assumed as 10% of main construction cost, administration expense, and compensation cost.

(8) Price Contingency

Price contingency is provided to cope with price escalation during project implementation. The following rates of price escalation are adopted:

- 2.5% for foreign currency portion
- 8.7% for local currency portion

(9) Foreign and Local Currency Portions

Foreign currency portion mostly covers costs of equipment and engineering services, and a part of materials.

Local currency portion covers mainly all costs of labor, VAT, compensation, and administration, and a part of material cost and engineering service cost.

The following proportion of foreign/local currency portion is adopted:

Items	Foreign Currency	Local Currency
1. Materials		
Cement	0.7	0.3
Re-bar	0.8	0.2
Structural Steel	0.9	0.1
Stone Materials	0.4	0.6
Lumber	0.4	0.6
Bituminous Materials	0.6	0.4
Fuel, Lubricant	0.8	0.2
2. Construction Equipment	0.7	0.3
3. Labor	0.0	1.0
4. Compensation Cost	0.0	1.0
5. Administration Cost	0.0	1.0
6. Engineering Cost	0.9	0.1

2.3 ESTIMATED PROJECT COST FOR SACOBIA-BAMBAN RIVER BASIN

2.3.1 Project Cost

Project cost for the Project of Sacobia-Bamban river basin is estimated at 2,834 million pesos in total including physical and price contingencies. The following is a summary of estimated cost. Detailed breakdown of cost is shown in Tables C.5 and C.6.

Unit: million pesos

	Item	Foreign Currency Portion	Local Currency Portion	Total
1.	Main Construction Cost	1,184	747	1,931
1.1	Preparatory Works	52	32	84
1.2	Main Works	1,030	649	1,679
1.3	Miscellaneous Works	103	65	168
2.	Land Acquisition	0	34	34
3.	Administration Cost	0	98	98
3.	Engineering Service Cost	174	19	193
4.	Physical Contingency	134	80	216
	Total	1,494	978	2,472
4.	Price Contingency	113	249	362
	Grand Total	1,607	1,227	2,834

2.3.2 Disbursement Schedule

The following is the annual disbursement schedule of Project Cost from 1996 to 1999 based on the implementation schedule indicated in Figure C.2.

Unit: million pesos

Year	Foreign Currency Portion	Local Currency Portion	Total
1996	196	130	326
1997	241	170	411
1998	608	464	1,072
1999	562	463	1,025
Total	1,607	1,227	2,834

Detailed Annual Disbursement Schedule is shown in Table C.7.

2.3.3 Cost of Operation and Maintenance

Annual cost of operation and maintenance (O/M), from the year of 2000 following completion of project works, is estimated at 9.7 million pesos assuming it to be 0.5% of main construction cost.

Aside from the O/M cost above, maintenance works (desilting work of channel) should be continued for 9 years from 1996 to 2004. Annual maintenance cost for desilting work is estimated at 90 million pesos.

2.4 ESTIMATED PROJECT COST FOR ABACAN RIVER BASIN

2.4.1 Project Cost

Project cost for the Project of Abacan river basin is estimated at 1,005 million pesos in total including physical and price contingencies. The following is a summary of estimated cost, and breakdown of cost is shown in Tables C.8 and C.9.

Unit: million pesos

	Item	Foreign Currency Portion	Local Currency Portion	Total
1.	Main Construction Cost	407	273	680
1.1	Preparatory Works	18	12	30
1.2	Main Works	354	237	591
1.3	Miscellaneous Works	35	24	59
2.	Land Acquisition	0	8	8
3.	Administration Cost	0	34	34
4.	Engineering Service Cost	61	7	68
5.	Physical Contingency	47	29	76
	Total	515	350	865
6.	Price Contingency	39	100	140
	Grand Total	555	450	1,005

2.4.2 Disbursement Schedule

The following is a summary of the annual disbursement schedule from 1996 to 1999 based on the Implementation Schedule given in Figure C.4.

Unit: million pesos

Year	Foreign Portion	Local Portion	Total
1996	55	37	92
1997	83	60	143
1998	238	191	429
1999	178	162	340
Total	555	450	1,005

Table C.10 shows the Annual Disbursement Schedule in detail.

2.4.3 Cost of Operation and Maintenance

Annual cost of operation and maintenance (O/M) is estimated at 3.4 million pesos assuming it to be 0.5% of main construction cost from the year of 2000 following completion of project works.

Aside from the O/M cost above, maintenance works (desilting work of channel) should be continued for 4 years from 1996 to 1999. Annual maintenance cost for desilting work is estimated at 30 million pesos.

TABLES

Table C.1 Necessary Heavy Construction Equipment for Sacobia-Bamban River Basin

Equipment	Capacity	Required Number
Bulldozer	32-ton	8
Bulldozer	21-ton	4
Wheel Loader	2.0-m^3	8
Dump Truck	11-ton	180
Tire Roller	8 to 20-ton	4
Vibrating Roller	1-ton	4
Crawler Crane	35-ton	4
Truck Crane	20-ton	4
Truck Crane	11-ton	12
Vibrating Hammer	30-kW	4
Backhoe	0.6-m^3	7
Motor Grader	3.1-m	4

Table C.2 Necessary Heavy Construction Equipment for Abacan River Basin

Equipment	Capacity	Required Number
Bulldozer	32-ton	2
Bulldozer	21-ton	3
Wheel Loader	2.0-m^3	2
Dump Truck	11-ton	33
Tire Roller	8 to 20-ton	1
Vibrating Roller	1-ton	3
Crawler Crane	35-ton	1
Truck Crane	20-ton	1
Truck Crane	11-ton	4
Vibrating Hammer	30-kW	1
Backhoe	0.6-m^3	4

Table C.3 Labor Cost

Unit : Peso/Day

Item	Unit	Unit Cost
Foreman	day	230
Mason	day	180
Steelman	day	180
Carpenter	day	180
Skilled Laborer	day	180
Laborer	day	150
Equip. Operator	day	220
Driver	day	170

Table C.4 Construction Material Cost

Unit : Peso

Material	Unit	Unit Cost	F.C	L.C
Portland Cement (40kg)	bag	125	88	37
Reinforced Bar	kg	12	10	2
Steel Sheet Pile	kg	23	21	2
Structural Steel	kg	25	23	2
Crushed Gravel	m3	300	120	180
Boulder	m3	400	160	240
Sand	m3	150	60	90
Mix Sand Gravel	m3	200	80	120
Aggregate	m3	450	180	270
Sand Bag	piece	5	0	5
Plywood	sheet	520	52	468
Concrete (175 kg/cm2)	m3	1,700	1020	680
Concrete (210 kg/cm2)	m3	1,900	1140	760
Concrete (240 kg/cm2)	m3	2,000	1200	800
Concrete (280 kg/cm2)	m3	2,300	1380	920
Galvanized Gabion Wire	m3	1,000	800	200
Grass for Sodding	m2	2		2
Gasoline (Premium)	litre	9.17	7	2.17
Gasoline (Regular)	litre	9.00	7	2
Diesel Oil	litre	7.17	6	1.17

F.C. = Foreign Currency Portion
L.C. = Local Currency Portion

Table C.5 Project Cost for Sacobia-Bamban River Basin

Unit : Pesos

Work Items	Unit	Quantity	F.C. Portion		L.C. Portion		Total	
			Unit Cost	Amount	Unit Cost	Amount	Unit Cost	Amount
I. MAIN CONSTRUCTION COST				3,184,362,734		746,816,292		3,930,879,027
1.1 Preparatory Works	L.s.			51,454,932		32,451,578		83,955,610
1.2 Main Works				3,029,880,638		649,231,559		3,679,112,197
1.2.1 Sand Pocket				157,719,682		96,735,358		254,455,040
(1) Road Dike	m	1,650		57,413,982		30,932,008		88,345,990
1) Sapan Balen Bridge	m2	363	15,000	5,445,000	10,600	3,847,800	25,600	9,292,800
2) Box Culverts	m3	969	8,735	8,463,885	2,969	2,858,147	5,704	5,492,952
3) Embankment & Concrete Pavement	m	1,612	4,348	7,006,220	5,393	8,701,366	9,744	15,707,586
4) Rubble Concrete type Slope Protection	m	1,612	9,873	15,915,517	5,637	9,086,195	15,510	25,001,712
5) Others	L.s.			6,413,440		6,437,563		12,851,000
(2) Lateral Dike	m	5,950		72,816,000		36,129,600		108,745,600
1) 1st-Row Lateral Dike	m	1,110	12,156	13,493,000	6,048	6,713,400	18,204	20,206,400
2) 2nd-Row Lateral Dike	m	2,130	12,084	25,761,000	6,018	12,817,800	18,312	38,578,800
3) 3rd-Row Lateral Dike	m	2,720	12,265	33,362,000	6,102	16,598,400	18,368	49,960,400
(3) Raising & Clothing of Open Dikes	m	3,050		23,804,750		14,378,280		38,183,030
1) Embankment, Mountain Soil and Gravel Pvt.	m	3,050	758	2,310,850	590	1,798,180	1,347	4,109,030
2) Rubble Concrete type Slope Protection	m	3,050	7,647	21,493,900	4,125	12,580,100	11,772	34,074,000
(4) Raising/Slope Prot. of San Nicolas Balas Dike	m	2,100		12,884,500		8,140,500		20,805,000
1) Embankment, Mountain Soil and Gravel Pvt.	m	2,100	2,468	5,182,500	1,785	3,747,900	4,253	8,930,400
2) Rubble Concrete type Slope Protection	m	2,100	3,563	7,482,000	2,092	4,392,600	5,655	11,874,600
(5) Raising/Slope Prot. of Parua R. Dike	m	2,090		11,220,450		7,154,970		18,375,420
1) Embankment, Mountain Soil and Gravel Pvt	m	2,090	1,354	2,830,300	999	2,088,200	2,353	4,918,500
2) Rubble Concrete type Slope Protection	m	2,090	4,014	8,390,150	2,424	5,066,770	6,438	13,456,920
1.2.2 Masiap Consolidation Dam				86,189,591		39,055,093		125,244,624
(1) Steel Sheet Piling	m	36,915	1,260	46,512,900	144	5,315,760	1,404	51,828,660
(2) Reinforced Concrete	m3	2,366	2,735	6,471,010	2,969	7,024,654	5,704	13,495,664
(3) Plain Concrete	m3	6,806	1,620	11,025,720	2,482	16,892,492	4,102	27,918,212
(4) Gabion Mattress	m3	5,937	1,210	7,183,770	597	3,544,389	1,807	10,728,159
(5) Ring Dike Embankment	m	542	922	562,454	745	404,332	1,673	906,786
(6) Ring Dike Rubble Conc. Slope Protection	m3	3,333	1,515	5,052,828	836	3,119,688	2,452	8,172,516
(7) Others	L.s.			8,440,869		2,753,778		12,194,647
1.2.3 Sacobia River Training Work				325,935,801		177,930,870		503,865,871
(1) Groundsills	set	6		152,424,990		78,599,730		227,724,720
1) Steel Sheet Piling	m	65,200	1,260	82,152,000	144	9,388,800	1,404	91,540,800
2) Reinforced Concrete	m3	5,410	2,735	14,796,350	2,969	16,062,290	5,704	30,858,640
3) Plain Concrete	m3	11,920	1,620	19,310,400	2,482	29,585,440	4,102	48,895,840
4) Gabion Work	m3	28,020	1,210	24,924,200	597	11,951,940	1,807	36,876,140
5) Others	L.s.			10,842,040		5,611,260		20,253,300
(2) Channel Excavation	m3	2,800,000	40	112,000,000	24	67,200,000	64	179,200,000
(3) Rubble Concrete type Slope Protection	m	10,356	5,486	56,810,811	3,875	40,131,340	9,361	96,941,151
1.2.4 Bamban River Improvement				279,839,875		195,845,597		475,885,272
(1) Channel Excavation (Upper Reach)	m3	2,000,000	40	80,000,000	24	48,000,000	64	128,000,000
(2) Raising Dikes (Embank., Mount. Soil & Pvt)	m	7,200	3,544	25,516,490	2,594	18,678,926	6,138	44,195,320
(3) Rubble Concrete type Slope Protection	m	29,150	5,344	155,786,000	3,868	112,697,200	9,210	268,484,100
(4) Spur Dike	set	12	158,240	1,898,875	242,748	2,912,977	400,988	4,811,852
(5) Dike Reinforcement Work	m	12,500	1,187	14,837,500	1,085	13,556,500	2,272	28,394,000
1.2.5 Sapang Calayan River Training Works	m	2,650	3,862	10,233,435	2,765	7,326,668	6,626	17,559,503
1.2.6 Sapang Balen River Improvement Works				29,015,069		18,933,120		47,949,189
(1) Channel Straightening	m	2,000	5,580	11,160,000	3,390	6,780,000	8,970	17,940,000
(2) Rubble Concrete type Slope Protection	m	1,200	11,505	13,806,069	7,743	9,291,120	19,248	23,097,180
(3) Additional Span for Bartolece Bridge	m2	270	15,000	4,050,000	10,800	2,862,000	25,800	6,912,000
1.2.7 Restoration of Highway Route 3	m	3,400		148,743,255		113,405,452		256,152,707
(1) Bamban Bridge	m2	2,041	21,000	42,861,000	14,840	30,288,440	35,840	73,149,440
(2) Mabalacat Bridge	m2	2,751	21,000	57,771,000	14,840	40,824,840	35,840	98,595,840
(3) Embankment & Concrete Pavement	m	3,023	13,932	42,115,255	13,990	42,292,172	27,922	84,407,427
1.3 Miscellaneous Works	L.s.			102,338,044		64,923,156		167,811,220
2. LAND ACQUISITION	ha	456		0		34,200,000		34,200,000
(1) Route 329 Road Dike	ha	5	0	0	75,000	375,000	75,000	375,000
(2) Dikes in Sand Pocket	ha	10	0	0	75,000	750,000	75,000	750,000
(3) Sacobia River Sediment Control Works	ha	90	0	0	75,000	6,750,000	75,000	6,750,000
(4) Highway Route 3	ha	1	0	0	75,000	75,000	75,000	75,000
(5) Spoil Bank	ha	350	0	0	75,000	26,250,000	75,000	26,250,000
3. ADMINISTRATION COST				0		98,258,951		98,258,951
4. ENGINEERING SERVICE COST				173,788,112		19,309,790		193,097,903
5. PHYSICAL CONTINGENCY				135,815,085		80,012,608		215,827,693
Total				1,493,965,831		978,397,642		2,472,363,574
6. PRICE CONTINGENCY				112,546,000		249,181,000		361,727,000
Grand Total				1,606,511,831		1,227,578,642		2,834,120,574
7. MAINTENANCE WORKS (Desilting Work, 1998-2004) (Excluding price escalation)	m3	13,500,000				80 819,000,000	80	819,000,000

Note:
(1) Preparatory Works = 5% of Main Works of 1.
(2) Miscellaneous Works = 10% of Main Works of 1.
(3) Administration Cost = 5% of 1. and 2.
(4) Engineering Service Cost = 10% of 1.
(5) Physical Contingency = 10% of 1., 2., and 4.
(6) Price Contingency = 2.5% for F.C. and 8.7% for L.C. from 1. to 5.
(7) Exchange Rate : US$ 1.00 = 100 Yen = 25 Pesos

Table C.6 Breakdown of Project Cost for Sacobia-Bamban River Basin (1/2)

Unit : Pesos

Work Items	Unit	Quantity	F.C.		L.C.		Total	
			Unit Cost	Amount	Unit Cost	Amount	Unit Cost	Amount
I MAIN CONSTRUCTION COST				1,184,362,735		746,616,292		1,930,979,027
I.1 Preparatory Works	L.s.			51,494,032		32,461,578		83,955,610
I.2 Main Works				1,029,880,639		649,231,558		1,679,112,197
I.2.1 Sand Pocket				157,719,682		99,735,358		254,455,040
(1) Road Dike	m	1,650		37,413,982		30,932,008		68,345,990
1) Sapang Balen Bridge	m2	383	15,000	5,445,000	10,600	3,847,800	25,600	9,292,800
2) Box Culverts	m3	983	2,735	2,633,805	2,969	2,859,147	5,704	5,492,952
3) Pipe Culvert(1000 dia.)	m	44	680	29,920	1,045	45,980	1,725	75,900
4) Embankment	m3	76,500	26	1,989,000	17	1,300,500	43	3,289,500
5) Rubble Concrete	m3	8,073	765	6,175,845	472	3,810,456	1,237	9,986,301
6) Filter Mat	m2	26,911	72	1,937,592	53	1,426,283	125	3,363,875
6) Gabion Mattress	m3	6,448	1,210	7,802,080	597	3,849,456	1,807	11,651,536
7) Base Course	m3	1,290	110	141,900	151	194,790	261	336,690
8) Subbase Course	m3	3,580	155	554,900	226	809,080	381	1,363,980
9) Concrete Pavement	m3	2,262	1,910	4,320,420	2,828	6,396,936	4,738	10,717,356
10) Surface Course for Sidewalk	m2	8,060	792	6,383,520	793	6,391,580	1,585	12,775,100
(2) Lateral Dike	m	5,960		79,616,000		36,129,600		108,745,600
1) Structural Excavation (1st-Row)	m3	6,100	30	183,000	24	146,400	54	329,400
2) Gabion Work(1std-Row)	m3	11,000	1,210	13,310,000	597	6,567,000	1,807	19,877,000
3) Structural Excavation (2nd-Row)	m3	11,700	30	351,000	24	280,800	54	631,800
4) Gabion Work(2nd-Row)	m3	21,000	1,210	25,410,000	597	12,537,000	1,807	37,947,000
5) Structural Excavation (3rd-Row)	m3	15,000	30	450,000	24	360,000	54	810,000
6) Gabion Work(3rd-Row)	m3	27,200	1,210	32,912,000	597	16,238,400	1,807	49,150,400
(3) Raisig & Clothing of Open Dikes	m	3,050		23,804,750		14,378,280		38,183,030
1) Embankment	m3	47,000	26	1,222,000	17	799,000	43	2,021,000
2) Mountain Soil	m3	9,150	90	823,500	73	667,950	163	1,491,450
3) Gravel Pavement	m3	1,830	145	265,350	181	331,230	326	596,580
4) Gabion Mattress	m3	6,100	1,210	7,381,000	597	3,641,700	1,807	11,022,700
5) Rubble Concrete	m3	16,300	765	12,469,500	472	7,693,600	1,237	20,163,100
6) Filter Mat	m2	15,200	72	1,094,400	53	805,600	125	1,900,000
7) Structural Excavation	m3	18,300	30	549,000	24	439,200	54	988,200
(4) Raisig/ Slope Prot. of San Nicolas Balas Dike	m	2,100		12,664,500		8,140,500		20,805,000
1) Embankment	m3	144,000	26	3,744,000	17	2,448,000	43	6,192,000
2) Mountain Soil	m3	12,600	90	1,134,000	73	919,800	163	2,053,800
3) Gravel Pavement	m3	2,100	145	304,500	181	380,100	326	684,600
4) Gabion Mattress	m3	2,100	1,210	2,541,000	597	1,253,700	1,807	3,794,700
5) Rubble Concrete	m3	5,600	765	4,284,000	472	2,643,200	1,237	6,927,200
6) Filter Mat	m2	6,500	72	468,000	53	344,500	125	812,500
7) Structural Excavation	m3	6,300	30	189,000	24	151,200	54	340,200
(5) Raising/Slope Prot. of Parua River Dike	m	2,090		11,220,450		7,154,970		18,375,420
1) Embankment	m3	83,300	26	2,165,800	17	1,416,100	43	3,581,900
2) Mountain Soil	m3	4,000	90	360,000	73	292,000	163	652,000
3) Gravel Pavement	m3	2,100	145	304,500	181	380,100	326	684,600
4) Gabion Mattress	m3	2,090	1,210	2,528,900	597	1,247,730	1,807	3,776,630
5) Rubble Concrete	m3	5,570	765	4,261,050	472	2,629,040	1,237	6,890,090
6) Filter Mat	m2	19,600	72	1,411,200	53	1,038,800	125	2,450,000
7) Structural Excavation	m3	6,300	30	189,000	24	151,200	54	340,200
I.2.2 Maskup Consolidation Dam				86,189,531		39,055,093		125,244,624
(1) Driving Steel Sheet Piles(Type-II)	m	36,915	1,260	46,512,900	144	5,315,760	1,404	51,828,660
(2) Supply & Install of Tie Rods (8m)	pcs	573	6,325	3,624,225	885	507,105	7,210	4,131,330
(3) Supply & Install of Steel Webs	ton	125	31,000	3,906,000	6,040	761,040	37,040	4,667,040
(4) Reinforced Concrete	m3	2,366	2,735	6,471,010	2,969	7,024,654	5,704	13,495,664
(5) Plain Concrete	m3	6,806	1,620	11,025,720	2,492	16,892,492	4,102	27,918,212
(6) Gabion Work	m3	5,937	1,210	7,183,770	597	3,544,389	1,807	10,728,159
(7) Filter Mat	m2	5,937	72	427,464	53	314,661	125	742,125
(8) Structural Excavation	m3	41,844	30	1,255,320	24	1,004,256	54	2,259,576
(9) Soil Filling in Dam	m3	9,183	25	229,500	18	165,240	43	394,740
(10) Wing Dam				5,553,622		3,525,496		9,079,118
1) Embankment	m3	10,400	25	260,000	18	187,200	43	447,200
2) Structural Excavation	m3	13,000	30	390,000	24	312,000	54	702,000
3) Gabion Mattress	m3	1,084	1,210	1,311,640	597	647,148	1,807	1,958,788
4) Filter Mat	m2	11,911	72	799,992	53	588,883	125	1,388,875
5) Rubble Concrete	m3	3,333	765	2,549,745	472	1,573,176	1,237	4,122,921
6) Mountain Soil Cover	m3	2,188	90	195,120	73	158,264	163	353,384
7) Gravel Pavement for Inspection Road	m3	325	145	47,125	181	58,825	326	105,950
I.2.3 Sacobia River Training Work				325,935,091		177,930,870		503,865,871
(1) Groundsills	set	6		157,124,990		70,599,730		227,724,720
1) Driving Steel Sheet Piles	m	65,200	1,260	82,152,000	144	9,388,800	1,404	91,540,800
2) Supply & Install of Tie Rods (5.5m)	pcs	1,320	4,705	6,210,600	605	798,600	5,310	7,009,200
3) Supply & Install of Steel Web	ton	290	31,000	8,990,000	6,040	1,751,600	37,040	10,741,600
4) Reinforced Concrete	m3	5,410	2,735	14,796,350	2,969	16,062,290	5,704	30,858,640
5) Plain Concrete	m3	11,920	1,620	19,310,400	2,492	29,585,440	4,102	48,895,840
6) Gabion Work	m3	20,020	1,210	24,224,200	597	11,951,940	1,807	36,176,140
7) Filter Mat	m2	20,020	72	1,441,440	53	1,061,060	125	2,502,500
(2) Channel Excavation	m3	2,800,000	40	112,000,000	24	67,200,000	64	179,200,000
(3) Slope Protection	m	10,356		56,810,011		40,131,140		96,941,151
1) Structural Excavation	m3	150,400	30	4,512,000	24	3,609,600	54	8,121,600
2) Footing Concrete	m3	2,796	2,736	7,649,856	2,968	8,299,528	5,704	15,949,384
3) Gabion Mattress	m3	6,214	1,210	7,518,940	597	3,709,758	1,807	11,228,698
4) Filter Mat	m2	120,130	72	8,649,360	53	6,366,890	125	15,016,250
5) Rubble Concrete	m3	36,039	765	27,569,835	472	17,010,408	1,237	44,580,243
6) Gravel Pavement for Inspection Road	m3	6,276	145	910,020	181	1,135,956	326	2,045,976

Table C.6 Breakdown of Project Cost for Sacobia-Bamban River Basin (2/2)

1.2.4 Bamban River Improvement				278,039,675		195,845,597		473,885,272
(1) Channel Excavation (Upper Reach)	m3	2,000,000	40	80,000,000	24	48,000,000	64	128,000,000
(2) Raising Dikes	m	7,200		25,516,400		18,678,920		44,195,320
1) Embankment	m3	700,000	26	18,200,000	17	11,900,000	43	30,100,000
2) Mountain Soil	m3	69,000	90	6,210,000	73	5,037,000	163	11,247,000
3) Gravel Pavement for Inspection Road	m3	4,320	145	626,400	181	781,920	326	1,408,320
4) Sodding	m2	120,000	4	480,000	8	960,000	12	1,440,000
(3) Rubble Concrete Type Slope Protection	m	29,150		155,786,900		112,697,200		268,484,100
1) Structural Excavation	m3	350,000	30	10,500,000	24	8,400,000	54	18,900,000
2) Footing Concrete	m3	7,900	2,736	21,614,400	2,968	23,447,200	5,704	45,061,600
3) Gabion Mattress	m3	17,500	1,210	21,175,000	597	10,447,500	1,807	31,622,500
4) Filter Mat	m2	300,000	72	21,600,000	53	15,900,000	125	37,500,000
5) Rubble Concrete	m3	90,000	765	68,850,000	472	42,480,000	1,237	111,330,000
6) Mountain Soil	m3	95,000	90	8,550,000	73	6,935,000	163	15,485,000
7) Gravel Pavement for Inspection	m2	17,500	145	2,537,500	181	3,167,500	326	5,705,000
8) Sodding	m2	240,000	4	960,000	8	1,920,000	12	2,880,000
(4) Spur Dike	set	12		1,898,875		2,912,977		4,811,852
1) Driving of R.C. Piles	m	3,780	464	1,753,920	729	2,755,620	1,193	4,509,540
2) Reinforced Concrete Beams	m3	53	2,735	144,955	2,969	157,357	5,704	302,312
(5) Dike Reinforcement Works	m	12,500		14,837,500		13,556,500		28,394,000
1) Gravel Pavement for Inspection Road	m3	7,500	145	1,087,500	181	1,357,500	326	2,445,000
2) Mountain Soil	m3	143,000	90	12,870,000	73	10,439,000	163	23,309,000
3) Sodding	m2	220,000	4	880,000	8	1,760,000	12	2,640,000
1.2.5 Sapang Cauayan River Training Works	m	2,650		10,233,435		7,326,068		17,559,503
(1) Structural Excavation	m3	32,966	30	988,980	24	791,184	54	1,780,164
(2) Footing Concrete	m3	716	2,736	1,958,976	2,968	2,125,088	5,704	4,084,064
(3) Gabion Mattress	m3	1,590	1,210	1,923,900	597	949,230	1,807	2,873,130
(4) Filter Mat	m2	17,782	72	1,280,304	53	942,446	125	2,222,750
(5) Rubble Concrete	m3	5,335	765	4,081,275	472	2,518,120	1,237	6,599,395
1.2.6 Sapang Balen River Improvement Works				29,016,060		18,933,120		47,949,180
(1) Straightening of Channel	m	2,000		11,160,000		6,780,000		17,940,000
1) Excavation of Channel	m3	240,000	40	9,600,000	24	5,760,000	64	15,360,000
2) Embankment	m3	60,000	26	1,560,000	17	1,020,000	43	2,580,000
(2) Rubble Concrete Type Slope Protection	m	1,200		13,806,060		9,291,120		23,097,180
1) Structural Excavation	m3	20,000	30	600,900	24	480,000	54	1,080,000
2) Footing Concrete	m3	330	2,736	902,880	2,968	979,440	5,704	1,882,320
3) Gabion Mattress	m3	720	1,210	871,200	597	429,840	1,837	1,301,040
4) Filter Mat	m2	5,640	72	406,080	53	298,920	125	705,000
5) Rubble Concrete	m3	12,700	765	9,715,500	472	5,994,400	1,237	15,709,900
6) Mountain Soil	m3	13,400	90	1,206,000	73	978,200	163	2,184,200
7) Gravel Pavement for Inspection	m2	720	145	104,400	181	130,320	326	234,720
(3) *Additional Span for Bartolose Bridge*	m2	270	15,000	4,050,000	10,600	2,862,000	25,600	6,912,000
1.2.7 Restoration of Highway Route 3	m	3,400		142,747,255		113,405,452		256,152,707
(1) Bamban Bridge	m2	2,041	21,000	42,861,000	14,840	30,288,440	35,840	73,149,440
(2) Mabalacat Bridge	m2	2,751	21,000	57,771,000	14,840	40,824,840	35,840	98,595,840
(3) Concrete Pavement	m	3,023		42,115,255		42,292,172		84,407,427
1) Embankment	m3	206,000	26	5,356,000	17	3,502,000	43	8,858,000
2) Pipe Culvert(1000 dia.)	m	782	680	531,760	1,045	817,190	1,725	1,348,950
3) Rubble Concrete	m3	14,635	765	11,195,775	472	6,907,720	1,237	18,103,495
4) Base Course	m3	2,345	110	257,950	151	354,095	261	612,045
5) Sub-base Course	m3	9,618	155	1,490,480	226	2,173,216	381	3,663,696
6) Concrete Pavement	m3	5,701	1,910	10,900,370	2,828	16,138,396	4,738	27,039,766
7) Surface Course for Sidewalk	m2	15,635	792	12,382,920	793	12,398,555	1,585	24,781,475
1.3 Miscellaneous Works	l.s.			102,988,064		64,923,156		167,911,220
2. LAND ACQUISITION	ha	456		0		34,200,000		34,200,000
(1) Route 329 Road Dike	ha	5	0	0	75,000	375,000	75,000	375,000
(2) Dikes in Sand Pocket	ha	10	0	0	75,000	750,000	75,000	750,000
(3) Sacobia River Sediment Control Works	ha	90	0	0	75,000	6,750,000	75,000	6,750,000
(4) Highway Route 3	ha	1	0	0	75,000	75,000	75,000	75,000
(5) Spoil Bank	ha	350	0	0	75,000	26,250,000	75,000	26,250,000
3. ADMINISTRATION COST				0		98,258,951		98,258,951
4. ENGINEERING SERVICE COST				173,786,112		19,309,790		193,997,903
5. PHYSICAL CONTINGENCY				135,815,085		80,012,608		215,827,693
Total				1,493,965,932		978,397,641		2,472,363,573
6. PRICE CONTINGENCY				112,646,000		249,111,000		361,757,000
Ground Total				1,606,611,932		1,227,508,641		2,834,120,573
7. MAINTENANCE WORK (Desilting Works from 1998 to 2004) (Excluding price escalation)	m3	13,500,000			60	810,000,000	60	810,000,000

Note:
(1) Preparatory Works = 5% of Main Works
(2) Miscellaneous Works = 10% of Main Works
(3) Administration Cost = 5% of 1. and 2.
(4) Engineering Service Cost = 10% of 1.
(5) Physical Contingency = 10% of 1., 2., and 4.
(6) Price Contingency = 2.5% for F.C and 8.7% for L.C of sum from 1. to 5.
(7) Exchange Rate : US$ 1.00 = 100 Yen = 25 Peso

Table C.7 Annual Disbursement Schedule for Sacobia-Bamban River Basin

Unit : 1,000 Pesos

Work Items	Total			1996			1997			1998			1999		
	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
1. MAIN CONSTRUCTION COST	1,184,363	746,616	1,930,980	112,651	76,570	189,221	156,346	97,301	253,648	483,177	297,684	780,861	432,189	275,062	707,251
1.1 Preparatory Works	51,494	32,462	83,956	4,898	3,329	8,227	6,798	4,230	11,028	21,008	12,943	33,950	18,791	11,959	30,750
1.2 Main Works	1,029,881	649,232	1,679,113	97,957	66,582	164,540	135,953	84,610	220,563	420,154	258,855	679,009	375,816	239,184	615,001
1.2.1 Sand Pocket	157,720	96,736	254,456	37,638	21,833	59,472	59,556	37,451	97,007	60,525	37,452	97,977	0	0	0
1) Road Dike	37,414	30,932	68,346	0	0	0	18,707	15,466	34,173	18,707	15,466	34,173	0	0	0
2) Lateral Dike	72,616	36,130	108,746	13,071	6,503	19,574	26,142	13,007	39,149	33,403	16,620	50,023	0	0	0
3) Raising/Closing of Open Dikes	23,805	14,378	38,183	11,903	7,189	19,092	11,903	7,189	19,092	0	0	0	0	0	0
4) Raising of San Nicolas Dike	12,665	8,141	20,806	12,665	8,141	20,806	0	0	0	0	0	0	0	0	0
5) Raising of Parua Dike	11,220	7,155	18,375	0	0	0	2,805	1,789	4,594	8,415	5,366	13,781	0	0	0
1.2.2 Maskup Consolidation Dam	86,190	39,055	125,245	0	0	0	8,619	3,906	12,525	43,095	19,528	62,623	34,476	15,622	50,098
1.2.3 Sacobia River Training Works	325,935	177,931	503,866	0	0	0	21,394	11,073	32,467	134,968	72,166	207,133	169,574	94,692	264,266
(1) Grounsills	157,125	70,600	227,725	0	0	0	15,713	7,060	22,773	78,563	35,300	113,863	62,350	28,240	91,090
(2) Channel Excavation	112,000	67,200	179,200	0	0	0	0	0	0	28,000	16,800	44,800	84,000	50,400	134,400
(3) Slope Protection	56,810	40,131	96,941	0	0	0	5,681	4,013	9,694	28,405	20,066	48,471	22,724	16,052	38,776
1.2.4 Bamban River Improvement Works	278,040	195,846	473,886	38,206	30,462	68,668	35,195	24,506	59,702	125,902	87,869	213,771	78,736	53,009	131,745
(1) Channel Excavation	80,000	48,000	128,000	0	0	0	8,000	4,800	12,800	40,000	24,000	64,000	32,000	19,200	51,200
(2) Raising Dikes	25,516	18,679	44,195	0	0	0	3,827	2,802	6,629	21,689	15,877	37,566	0	0	0
(3) Slope Protection	155,787	112,697	268,484	22,368	16,905	40,273	22,368	16,905	40,273	62,315	45,079	107,394	46,736	33,809	80,545
(4) Spur Dikes	1,899	2,913	4,812	0	0	0	0	0	0	1,899	2,913	4,812	0	0	0
(5) Dike Reinforcement Works	14,838	13,557	28,395	14,838	13,557	28,395	0	0	0	0	0	0	0	0	0
1.2.5 S. Cavayan River Training Works	10,233	7,326	17,559	0	0	0	0	0	0	0	0	0	10,233	7,326	17,559
1.2.6 S. Balen River Improvement Works	29,016	18,933	47,949	22,113	14,288	36,401	6,903	4,645	11,549	0	0	0	0	0	0
(1) Straightening of Channel	11,160	6,780	17,940	11,160	6,780	17,940	0	0	0	0	0	0	0	0	0
(2) Slope Protection	13,806	9,291	23,097	6,903	4,646	11,549	6,903	4,646	11,549	0	0	0	0	0	0
(3) Expansion of Bartolome Bridge	4,050	2,862	6,912	4,050	2,862	6,912	0	0	0	0	0	0	0	0	0
1.2.7 Restoration of Highway Route 3	142,747	113,405	256,152	0	0	0	4,286	3,029	7,315	55,664	41,841	97,505	82,797	68,535	151,332
(1) Bamban Bridge	42,861	30,288	73,149	0	0	0	4,286	3,029	7,315	38,575	27,259	65,834	0	0	0
(2) Mabalacat Bridge	57,771	40,825	98,596	0	0	0	0	0	0	8,666	6,124	14,789	49,105	34,701	83,807
(3) Embankment & Concrete Pavement	42,115	42,292	84,407	0	0	0	0	0	0	8,423	8,458	16,881	33,692	33,834	67,526
1.3 Miscellaneous Works	102,988	64,923	167,911	9,796	6,658	16,454	13,595	8,461	22,056	42,015	25,886	67,901	37,582	23,918	61,500
2. LAND ACQUISITION	0	34,200	34,200	0	17,100	17,100	0	17,100	17,100	0	0	0	0	0	0
3. ADMINISTRATION COST	0	98,259	98,259	0	10,316	10,316	0	13,537	13,537	0	39,043	39,043	0	35,363	35,363
4. ENGINEERING SERVICE COST	173,788	19,310	193,098	60,826	6,758	67,584	52,136	5,793	57,929	30,413	3,379	33,792	30,413	3,379	33,792
5. PHYSICAL CONTINGENCY	135,815	80,013	215,828	17,348	10,043	27,391	20,848	12,019	32,868	51,359	30,106	81,465	46,260	27,844	74,104
Total	1,493,966	978,397	2,472,365	190,825	120,787	311,612	229,331	145,751	375,082	564,949	370,212	935,161	508,862	341,648	850,510
6. PRICE CONTINGENCY	112,646	249,111	361,757	4,771	9,611	14,382	11,610	24,006	35,616	43,439	94,173	137,612	52,926	121,321	174,148
Ground Total	1,606,613	1,227,508	2,834,122	195,595	130,398	325,993	240,941	169,757	410,698	608,388	464,385	1,072,773	561,688	462,969	1,024,658
7. MAINTENANCE WORKS (Desilting Works) (Excluding price escalation)	60 pesos x 1,500,000 m3 /year = 90 million peso/year (1996 - 2004)														

Note:
(1) Preparatory Works = 5% of Main Works of 1.
(2) Miscellaneous Works = 10% of Main Works of 1.
(3) Administration Cost = 5% of 1. and 2.
(4) Engineering Service Cost = 10% of 1.
(5) Physical Contingency = 10% of 1., 2., and 4.
(6) Price Contingency = 2.5% for F.C and 8.7% for L.C of sum from 1. to 5.
(7) Exchange Rate : US$ 1.00 = 100.0 Yen = 25.0 Pesos

Table C.8 Project Cost for Abacan River Basin

Unit : Pesos

Work Items	Unit	Quantity	F.C. Portion		L.C. Portion		Total	
			Unit Cost	Amount	Unit Cost	Amount	Unit Cost	Amount
1. MAIN CONSTRUCTION COST				407,480,335		272,516,835		679,997,170
1.1 Preparatory Works	l.s.			17,716,536		11,848,558		29,565,094
1.2 Main Works				354,330,726		236,971,161		591,301,887
1.2.1 Reconstruction of Sabo Dams				96,738,420		47,048,016		143,786,436
(1) Sabo Dam No.6				6,661,947		5,943,426		12,605,373
1) Steel Wall and Tie Roads	ton	61	31,000	1,891,000	6,040	368,440	37,040	2,259,440
2) Reinforced Concrete	m3	805	2,735	2,201,675	2,969	2,390,045	5,704	4,591,720
3) Plain Concrete	m3	756	1,620	1,224,720	2,482	1,876,392	4,102	3,101,112
4) Gabion Mattress	m3	432	1,210	522,720	597	257,904	1,807	780,624
5) Others	l.s.			821,832		1,050,645		1,872,477
(2) Sabo Dam No.9	l.s.			64,250,769		27,857,532		92,108,301
1) Steel Sheet piling	m	28,020	1,260	35,305,200	144	4,034,880	1,404	39,340,080
2) Reinforced Concrete	m3	4,426	2,735	12,105,110	2,969	13,140,794	5,704	25,245,904
3) Plain Concrete	m3	1,900	1,620	3,078,000	2,482	4,715,800	4,102	7,793,800
4) Gabion Mattress	m3	3,884	1,210	4,699,640	597	2,318,748	1,807	7,018,388
5) Rubble Concrete type Slope Protection	m3	685	2,559	1,752,915	1,968	1,348,080	4,527	3,100,995
6) Others	l.s.			7,309,904		2,299,230		9,609,134
(3) Sabo Dam TM-1	l.s.			25,825,704		13,247,058		39,072,762
1) Steel Sheet piling	m	11,212	1,260	14,127,120	144	1,614,528	1,404	15,741,648
2) Reinforced Concrete	m3	592	2,735	1,619,120	2,969	1,757,648	5,704	3,376,768
3) Plain Concrete	m3	3,213	1,620	5,205,060	2,482	7,974,666	4,102	13,179,726
4) Gabion Mattress	m3	2,150	432	928,800	597	1,283,550	1,029	2,212,350
5) Others	l.s.			3,945,604		616,666		4,562,270
1.2.2 Bank Erosion Protection Works in Upper Reaches				48,746,553		30,254,827		79,001,380
(1) Gabion Type Slope Protection	m	3,000	13,429	40,285,500	8,062	24,186,600	21,491	64,472,100
(2) Rubble Concrete Type Slope Protection	m	1,510	5,603	8,461,053	4,019	6,068,227	9,622	14,529,280
1.2.3 Training Works in Angeles City	m	7,900	13,512	106,741,184	10,111	79,878,352	23,623	186,619,536
1.2.4 Slope Protection in Lower/Middle Reach	m	12,600	5,258	66,251,700	3,861	48,642,900	9,119	114,894,600
1.2.5 Dike Reinforcement Works	m	18,400	935	17,201,000	905	16,660,800	1,840	33,861,800
1.2.6 Hensonville Bridge Works	m2	1,049	17,780	18,651,869	13,810	14,486,266	31,590	33,138,135
1.3 Miscellaneous Works	l.s.			35,433,073		23,697,116		59,130,189
2. LAND ACQUISITION (Spoil Bank)	ha	100	0	0	75,000	7,500,000	75,000	7,500,000
3. ADMINISTRATION COST				0		34,374,859		34,374,859
4. ENGINEERING SERVICE COST				61,199,745		6,799,972		67,999,717
5. PHYSICAL CONTINGENCY				46,868,008		28,681,681		75,549,689
Total				515,548,088		349,873,346		865,421,434
6. PRICE CONTINGENCY				39,138,000		100,495,000		139,633,000
Ground Total				554,686,088		450,368,346		1,005,054,434
7. MAINTENANCE WORKS (Desilting Works from 1996 to 1999) (Excluding price escalation)	m3	2,000,000			60	120,000,000	60	120,000,000

Note:
(1) Preparatory Works = 5% of Main Works
(2) Miscellaneous Works = 10% of Main Works
(3) Administration Cost = 5% of 1. and 2.
(4) Engineering service Cost = 10% of 1.
(5) Physical Contingency = 10% of 1., 2., and 4.
(6) Price Contingency = 2.5% for Foreign Portion and 8.7% for Local Portion
(7) Exchange Rate : US$ 1.00 = 100 Yen = 25 Pesos

Table C.9 Breakdown of Project Cost for Abacan River Basin (1/2)

Unit : Pesos

Work Items	Unit	Quantity	F.C.		L.C.		Total	
			Unit Cost	Amount	Unit Cost	Amount	Unit Cost	Amount
I. MAIN CONSTRUCTION COST				497,480,335		272,516,835		679,997,170
I.1 Preparatory Works	l.s.			17,716,536		11,848,558		29,565,094
I.2 Main Works				354,330,726		236,971,161		591,301,887
I.2.1 Reconstruction of Sabo Dams				96,738,420		47,048,016		143,786,436
(1) Sabo Dam No.6				6,661,947		5,943,426		12,605,373
1) Supply & Install of Steel Sheet Walls	ton	61	31,000	1,891,000	6,040	368,440	37,040	2,259,440
2) Reinforced Concrete(Top of Dam)	m3	805	2,735	2,201,675	2,969	2,390,045	5,704	4,591,720
3) Plain Concrete (Apron)	m3	756	1,620	1,224,720	2,482	1,876,392	4,102	3,101,112
4) Gabion Mattress	m3	432	1,210	522,720	597	257,904	1,807	780,624
5) Filter Mat	m2	936	72	67,392	53	49,608	125	117,000
6) Structual Excavation	m3	7,628	30	228,840	24	183,072	54	411,912
7) Boulder Filling in Dams	m3	3,285	160	525,600	249	817,965	409	1,343,565
(2) Sabo Dam No.9				64,250,769		27,857,592		92,108,361
1) Driving Steel Piles	m	28,020	1,260	35,305,200	144	4,034,880	1,404	39,340,080
2) Supply and Install of Tie Rods (7 m)	pcs	437	5,515	2,410,055	695	303,715	6,210	2,713,770
3) Supply and Install of Web Steel	ton	95	31,000	2,976,000	6,040	579,840	37,040	3,555,840
4) Reinforced Concrete(Top of Dam)	m3	4,426	2,735	12,105,110	2,969	13,140,794	5,704	25,245,904
5) Plain Concrete (Apron)	m3	1,900	1,620	3,078,000	2,482	4,715,800	4,102	7,793,800
6) Gabion Mattress	m3	3,884	1,210	4,699,640	597	2,318,748	1,807	7,018,388
7) Filter Mat	m2	26,717	72	1,923,624	53	1,416,001	125	3,339,625
8) Structural Excavation	m3	20,685	30	620,550	24	496,440	54	1,116,990
9) Soil Filling in Dats	m3	14,493	25	362,325	18	260,874	43	623,199
10) Footing of Rubble Concrete	m3	90	2,736	246,240	2,968	267,120	5,704	513,360
11) Rubble Concrete	m3	685	765	524,025	472	323,320	1,237	847,345
(3) Sabo Dam T8-1				25,825,704		13,247,658		39,072,762
1) Driving Steel Piles (Type-II)	m	11,212	1,260	14,127,120	144	1,614,528	1,404	15,741,648
2) Supply and Install of Tie Rods (7 m)	pcs	152	5,515	838,280	695	105,640	6,210	943,920
3) Supply and Install of Web Steel	ton	33	31,000	1,023,000	6,040	199,320	37,040	1,222,320
4) Reinforced Concrete(Top of Dam)	m3	592	2,735	1,619,120	2,969	1,757,648	5,704	3,376,768
5) Plain Concrete (Apron)	m3	3,213	1,620	5,205,060	2,482	7,974,666	4,102	13,179,726
6) Gabion Mattress	m3	2,150	1,210	2,601,500	597	1,283,550	1,807	3,885,050
7) Filter Mat	m2	2,142	72	154,224	53	113,526	125	267,750
8) Structural Excavation	m3	5,355	30	160,650	24	128,520	54	289,170
9) Soil Filling in Dats	m3	3,870	25	96,750	18	69,660	43	166,410
I.2.2 Bank Erosion Protection Works				48,746,553		30,254,827		79,001,380
(1) Gabion Type Slope Protection	m	3,000		40,285,500		24,186,600		64,472,100
1) Gabion Work	m3	27,000	1,210	32,670,000	597	16,119,000	1,807	48,789,000
2) Plain Concrete	m3	1,800	1,620	2,916,000	2,482	4,467,600	4,102	7,383,600
3) Filter Mat	m2	21,000	72	1,512,000	53	1,113,000	125	2,625,000
4) Backfill by Lahar Sand	m3	67,500	25	1,687,500	18	1,215,000	43	2,902,500
5) Structural Excavation	m3	48,000	30	1,440,000	24	1,152,000	54	2,592,000
6) Sodding	m3	15,000	4	60,000	8	120,000	12	180,000
(2) Rubble Concrete Type Slope Protection	m	1,510		8,461,053		6,068,227		14,529,280
1) Structural Excavation	m3	21,925	30	657,750	24	526,200	54	1,183,950
2) Earth Filling	m3	19,283	25	482,075	18	347,094	43	829,169
3) Footing Concrete	m3	543	2,736	1,485,648	2,968	1,611,624	5,704	3,097,272
4) Gabion Mattress	m3	1,087	1,210	1,315,270	597	648,939	1,807	1,964,209
5) Rubble Concrete	m3	5,052	765	3,864,780	472	2,384,544	1,237	6,249,324
6) Filter Mat	m2	7,280	72	524,160	53	385,840	125	910,000
6) Gravel Pavement for Inspection Road	m3	906	145	131,370	181	163,986	326	295,356
I.2.3 Training Works in Angeles City	m	7,500		106,741,184		79,878,352		186,619,536
(1) Structural Excavation	m3	189,600	30	5,688,000	24	4,550,400	54	10,238,400
(2) Footing Concrete	m3	5,214	2,736	14,265,504	2,968	15,475,152	5,704	29,740,656
(3) Rubble Concrete	m3	36,340	765	27,800,100	472	17,152,480	1,237	44,952,580
(4) Filter Mat	m2	131,140	72	9,442,080	53	6,950,420	125	16,392,500
(5) Gravel Pavement for Inspection Road	m3	7,900	145	1,145,500	181	1,429,900	326	2,575,400
(6) Channel Excavation	m3	880,000	55	48,400,000	39	34,320,000	94	82,720,000
I.2.4 Slope Protection in Lower/Middle Reach	m	12,600		66,251,760		48,642,900		114,894,600
(1) Structural Excavation	m3	151,200	30	4,536,000	24	3,628,800	54	8,164,800
(2) Footing Concrete	m3	3,400	2,736	9,302,400	2,968	10,091,200	5,704	19,393,600
(3) Gabion Mattress	m3	7,560	1,210	9,147,600	597	4,513,320	1,807	13,660,920
(4) Rubble Concrete	m3	35,660	765	27,279,900	472	16,831,520	1,237	44,111,420
(5) Filter Mat	m2	119,700	72	8,618,400	53	6,344,100	125	14,962,500
(6) Gravel Pavement for Inspection Road	m3	7,560	145	1,096,200	181	1,368,360	326	2,464,560
(7) Mountain Soil	m3	62,400	90	5,616,000	73	4,555,200	163	10,171,200
(8) Sodding	m2	163,800	4	655,200	8	1,310,400	12	1,965,600
I.2.5 Dike Reinforcement Works	m3	18,400		17,201,000		16,660,800		33,861,800
(1) Gravel Pavement for Inspection Road	m3	11,000	145	1,595,000	181	1,991,000	326	3,586,000
(2) Mountain Soil	m3	154,660	90	13,914,000	73	11,285,800	163	25,199,860
(3) Sodding	m2	423,000	4	1,692,000	8	3,384,000	12	5,076,000

Table C.9 Breakdown of Project Cost for Abacan River Basin (2/2)

1.2.6 Bensonville Bridge Works				18,551,869		14,486,266		33,138,135
1) Bridge	m2	1,049	15,000	15,735,000	10,600	11,119,400	25,600	26,854,400
2) Embankment of Approach Road	m3	7,884	26	204,984	17	134,028	43	339,012
3) Boxculvert	m3	350	2,735	957,250	2,969	1,039,150	5,704	1,996,400
4) Base Course	m3	250	110	27,500	151	37,750	261	65,250
5) Sub base Course	m3	645	155	99,975	226	145,770	381	245,745
6) Rubble Concrete	m3	604	765	462,000	472	285,088	1,237	747,148
7) Concrete Pavement	m3	610	1,910	1,165,100	2,828	1,725,080	4,738	2,890,180
1.3 Miscellaneous Works	l.s.			35,433,073		23,697,116		59,130,189
2. LAND ACQUISITION (Spoil Bank)	ha	100	0	0	75,000	7,500,000	75,000	7,500,000
3. ADMINISTRATION COST				0		34,374,859		34,374,859
4. ENGINEERING SERVICE COST				61,199,345		6,799,972		67,999,717
5. PHYSICAL CONTINGENCY				46,868,008		28,681,681		75,549,689
Total				515,549,088		349,873,346		865,421,434
6. PRICE CONTINGENCY				39,138,000		100,455,000		139,633,000
Ground Total				554,686,088		450,328,346		1,005,054,434
7. MAINTENANCE WORK (Desilting Works from 1995 to 1999) (Excluding price escalation)		₱2,000,000			60	120,000,000	60	120,000,000

Note:
(1) Preparatory Works = 5% of Main Works
(2) Miscellaneous Works = 10% of Main Works
(3) Administration Cost = 5% of 1. and 2.
(4) Engineering Service Cost = 10% of 1.
(5) Physical Contingency = 10% of 1., 2., and 4.
(6) Price Contingency = 2.5% for F.C and 8.7% for L.C of sum of 1. to 5.
(7) Exchange Rate : US$ 1.00 = 100 Yen = 25.0 Pesos

Table C.10 Annual Disbursement Schedule for Abacan River Basin

(Unit : 1,000 pesos)

Work Items	Total			1996			1997			1998			1999		
	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
1. MAIN CONSTRUCTION COST	407.481	272.516	679.996	23.993	18.775	42.768	59.954	39.932	99.886	188.379	119.975	308.854	134.655	93.834	228.488
1.1 Preparatory Works	17.717	11.849	29.565	1.043	816	1.859	2.607	1.736	4.343	8.212	5.216	13.428	5.855	4.080	9.934
1.2 Main Works	354.331	236.970	591.301	20.863	16.326	37.189	52.134	34.724	86.857	164.243	104.326	268.569	117.091	81.595	198.686
1.2.1 Reconstruction of Sabo Dams	96.739	47.047	143.786	0	0	0	16.063	6.964	23.027	56.310	25.690	82.001	24.366	14.393	38.759
(1) Sabo Dam No. 6	6.662	5.943	12.605	0	0	0	0	0	0	1.666	1.486	3.151	4.997	4.457	9.454
(2) Sabo Dam No. 9	64.251	27.857	92.108	0	0	0	16.063	6.964	23.027	48.188	20.893	69.081	0	0	0
(3) Sabo Dam TM-1	25.826	13.247	39.073	0	0	0	0	0	0	6.457	3.312	9.768	19.370	9.935	29.305
1.2.2 Bank Protection Works in Upper Reach	48.746	30.255	79.001	0	0	0	0	0	0	24.373	15.128	39.501	24.373	15.128	39.501
(1) Gabion type Slope Protection	40.285	24.187	64.472	0	0	0	0	0	0	20.143	12.094	32.236	20.143	12.094	32.236
(2) Rubble Conc. type Slope Prot.	8.461	6.068	14.529	0	0	0	0	0	0	4.231	3.034	7.265	4.231	3.034	7.265
1.2.3 Training Works in Angeles City	106.741	79.878	186.619	0	0	0	13.343	9.985	23.327	53.371	39.939	93.310	40.028	29.954	69.982
1.2.4 Slope Protection in Lower Reach	66.252	48.643	114.895	16.563	12.161	28.724	16.563	12.161	28.724	16.563	12.161	28.724	16.563	12.161	28.724
1.2.5 Dike Reinforcement Works	17.201	16.661	33.862	4.300	4.165	8.466	4.300	4.165	8.466	4.300	4.165	8.466	4.300	4.165	8.466
1.2.6 Hensonville Bridge Works	18.652	14.486	33.138	0	0	0	1.865	1.449	3.314	9.326	7.243	16.569	7.461	5.794	13.255
1.3 Miscellaneous Works	35.433	23.697	59.130	2.086	1.633	3.719	5.213	3.472	8.686	16.424	10.433	26.857	11.709	8.159	19.869
2. LAND ACQUISITION	0	7.500	7.500	0	7.500	7.500	0	0	0	0	0	0	0	0	0
3. ADMINISTRATION COST	0	34.375	34.375	0	2.513	2.513	0	4.994	4.994	0	15.443	15.443	0	11.424	11.424
4. ENGINEERING SERVICE COST	61.200	6.800	68.000	24.480	2.720	27.200	12.240	1.360	13.600	12.240	1.360	13.600	12.240	1.360	13.600
5. PHYSICAL CONTINGENCY	46.868	28.682	75.550	4.847	2.899	7.747	7.219	4.129	11.349	20.112	12.133	32.245	14.689	9.519	24.209
Total	515.549	349.872	865.421	53.320	34.408	87.728	79.413	50.416	129.829	221.231	148.911	370.142	161.584	116.138	277.722
6. PRICE CONTINGENCY	39.138	100.495	139.634	1.333	2.993	4.326	4.020	9.154	13.174	17.011	42.345	59.356	16.775	46.003	62.777
Ground Total	554.687	450.368	1.005.055	54.653	37.401	92.054	83.434	59.570	143.003	238.242	191.256	429.498	178.359	162.140	340.499
7. MAINTENANCE WORKS(Desilting Works) (Excluding price escalation)		120.000	120.000		30.000	30.000		30.000	30.000		30.000	30.000		30.000	30.000

Note:
(1) Preparatory Works = 5% of Main Works
(2) Miscellaneous Works = 10% of Main Works
(3) Administration Cost = 5% of 1. and 2.
(4) Engineering Service Cost = 10% of 1.
(5) Physical Contingency = 10% of 1., 2. and 4.
(6) Price Contingency = 2.5% for Foreign Portion and 8.7% for Local Portion
(7) Exchange Rate : US$ 1.00 = 100 Yen = 25 Pesos

FIGURES

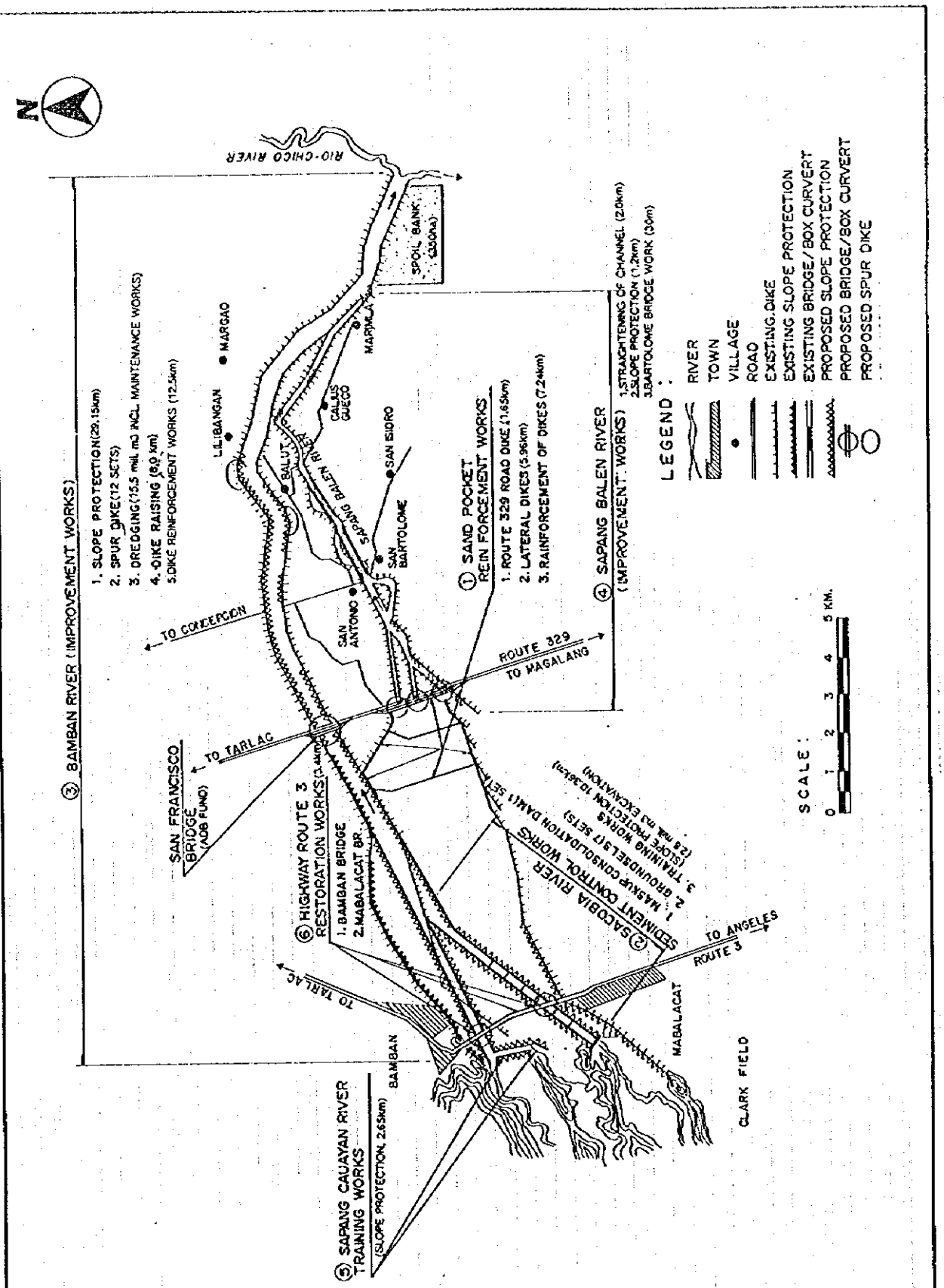

Figure C.1 General Plan for Sacobia-Bamban River Basin

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

Year / Work Item	Quantity	1995 S O N D	1996 J F M A M J J A S O N D	1997 J F M A M J J A S O N D	1998 J F M A M J J A S O N D	1999 J F M A M J J A S O N D
I. JICA M/P & F/S						
2. Financial Arrangement						
3. Selection of Consultant						
4. Detailed Design						
5. Selection of Contractors						
6. Construction						
I. Mobilization & Preparatory	1 s.					
II. Sacobia River Sediment Control Works						
II. 1 Sand Pocket						
(1) Heightening/Closing & Slope Protection of Dikes	7,240 m					
a) Mabalacat-Magalang S/F Bridge Dike	3,050 m					
b) San Nicolas Balas Dike	2,100 m					
c) Parua River Dike	2,090 m					
(2) Lateral Dikes	5,960 m					
a) 1st Row	1,110 m					
b) 2nd Row	2,130 m					
c) 3rd Row	2,720 m					
(3) Road Dike	1,650 m					
a) Sapang Balen Bridge	38 m					
b) Baidbid Box Culvert	15 m					
c) San Nicolas Balas Box Culvert	30 m					
d) Portland Cement Concrete Pavement	1,567 m					
II. 2 Sacobia River (Mashup Consolidation Dam and Training Work)						
(1) Driving Sheet Piles	102,149 m					
a) Mashup Consolidation Dam	36,920 m					
b) Groundsel No. 1	10,870 m					
c) Groundsel No. 2	10,870 m					
d) Groundsel No. 3	10,870 m					
e) Groundsel No. 4	10,870 m					
f) Groundsel No. 5	10,870 m					
g) Groundsel No. 6	10,870 m					
(2) Channel Excavation	2,800,000 m3					
(3) Slope Protection of Banks	10,360 m					
(4) Gabion Work	25,960 m3					
(5) Concrete Work	26,500 m3					
(6) Wing Dike	542 m					
III. Bamban River Improvement Works						
(1) Dike Reinforcement Work	12,500 m					
(2) Channel Excavation (Upper Reach)	2,000,000 m3					
(3) Heightening of Dikes (Lower Reaches)	6,000 m					
(4) Slope Protection of Dikes	29,150 m					
a) Left Dike (Middle Reaches)	8,250 m					
b) Left Dike (Upper Reaches)	6,850 m					
c) Right Dike (Middle Reaches)	3,350 m					
d) Right Dike (Upper Reaches)	10,700 m					
(5) Spur Dikes	12 sets					
(6) San Francisco Bridge	300 m					
IV. Sapang Balen River Improvement	14,000 m					
(1) Straightening	2,000 m					
(2) Slope Protection	1,200 m					
(3) Additional Span for San Antonio Br.	30 m					
V. Sapang Cawayan River Training Works	2,650 m					
a) Left Bank	950 m					
b) Right Bank	1,700 m					
VI. Restoration of Highway Route 3	3,400 m					
(1) Bamban Bridge	200 m					
(2) Mabalacat Bridge	240 m					
(3) Portland Cement Concrete Pavement	2,960 m					
VII. Maintenance Works (Desilting, up to 2004)	13,500,000 m3					

Figure C.2 Project Implementation Schedule for Sacobia-Bamban River Basin

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

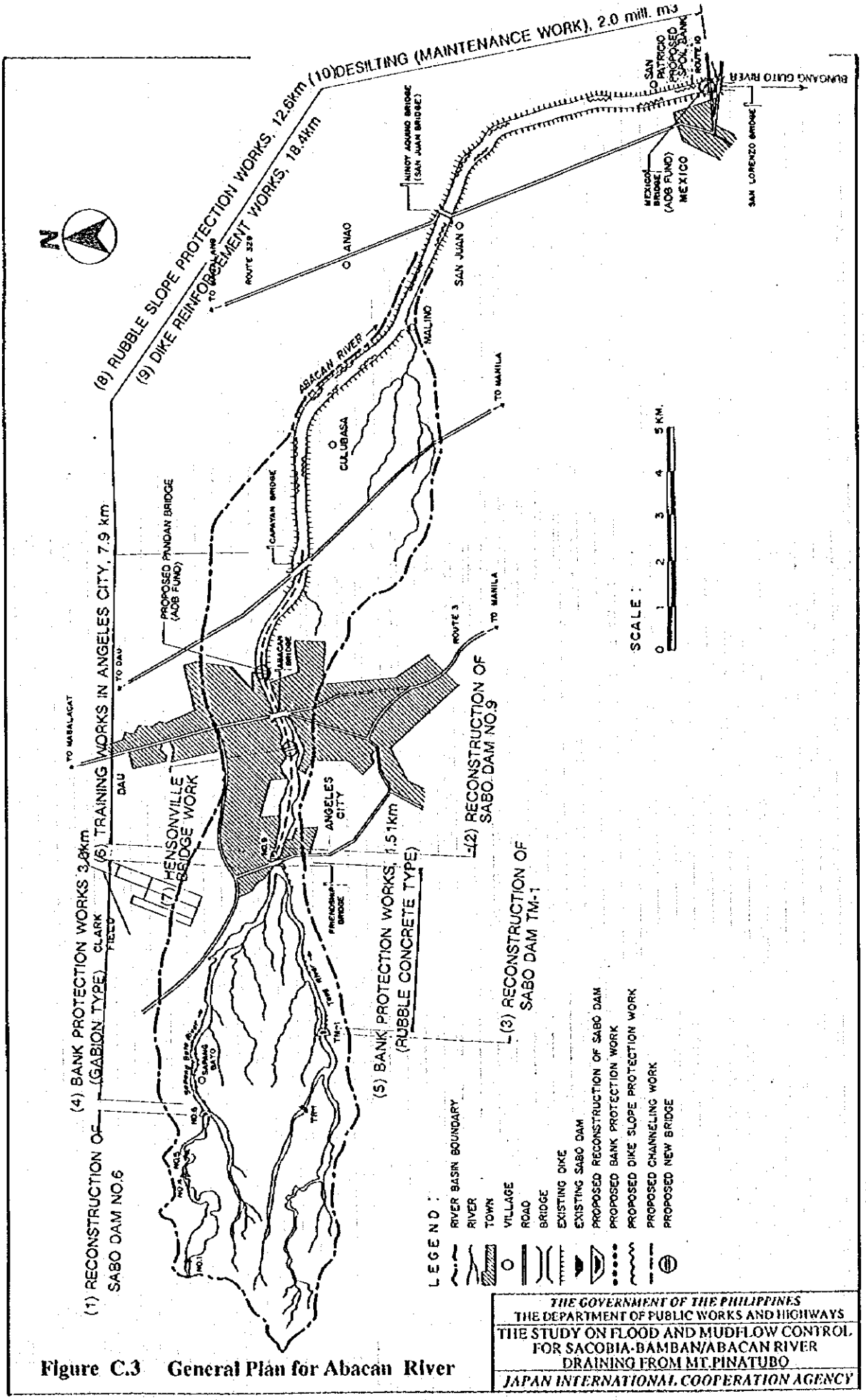

Figure C.3 General Plan for Abacan River

Work Item	Quantity
1. JICA M/P & F/S	
2. Financial Arrangement	
3. Selection of Consultant	
4. Detailed Design	
5. Selection of Contractors	
6. Construction	
I. Mobilization & Preparatory	L.S.
II. Upper Reaches Sediment Control Works	
II.1 Reconstruction of Sabo Dams	
(1) Sabo Dam No.6	
a) Assembling of Steel Sheet Wall	61 t
b) Excavation	7,630 m3
c) Gabion Work	440 m3
d) Concreting	1,570 m3
e) Boulder Filling	3,290 m3
(2) Sabo Dam No.9	
a) Driving Sheet Piles	28,020 m
b) Excavation	20,690 m3
c) Gabion Work	3,890 m3
d) Concreting	6,330 m3
e) Earth Filling	14,500 m3
(3) Sabo Dam TM-1	
a) Driving Sheet Piles	11,220 m
b) Excavation	5,360 m3
c) Gabion Work	2,150 m3
d) Concreting	3,810 m3
e) Earth Filling	3,870 m3
II.2 Bank Erosion Protection Works	4,510 m
III. Lower/Middle Reaches Flood Control Works	
(1) Slope Protection of Dikes	12,600 m
(2) Training Works in Angeles City	7,900 m
(3) Dike Reinforcement Works	18,400 m
IV. Bridge Works	
(1) Mexico Bridge	
(2) Hensonville Bridge	
(3) Pandan Bridge	
V. Maintenance Works (Desilting)	2 mill. m3

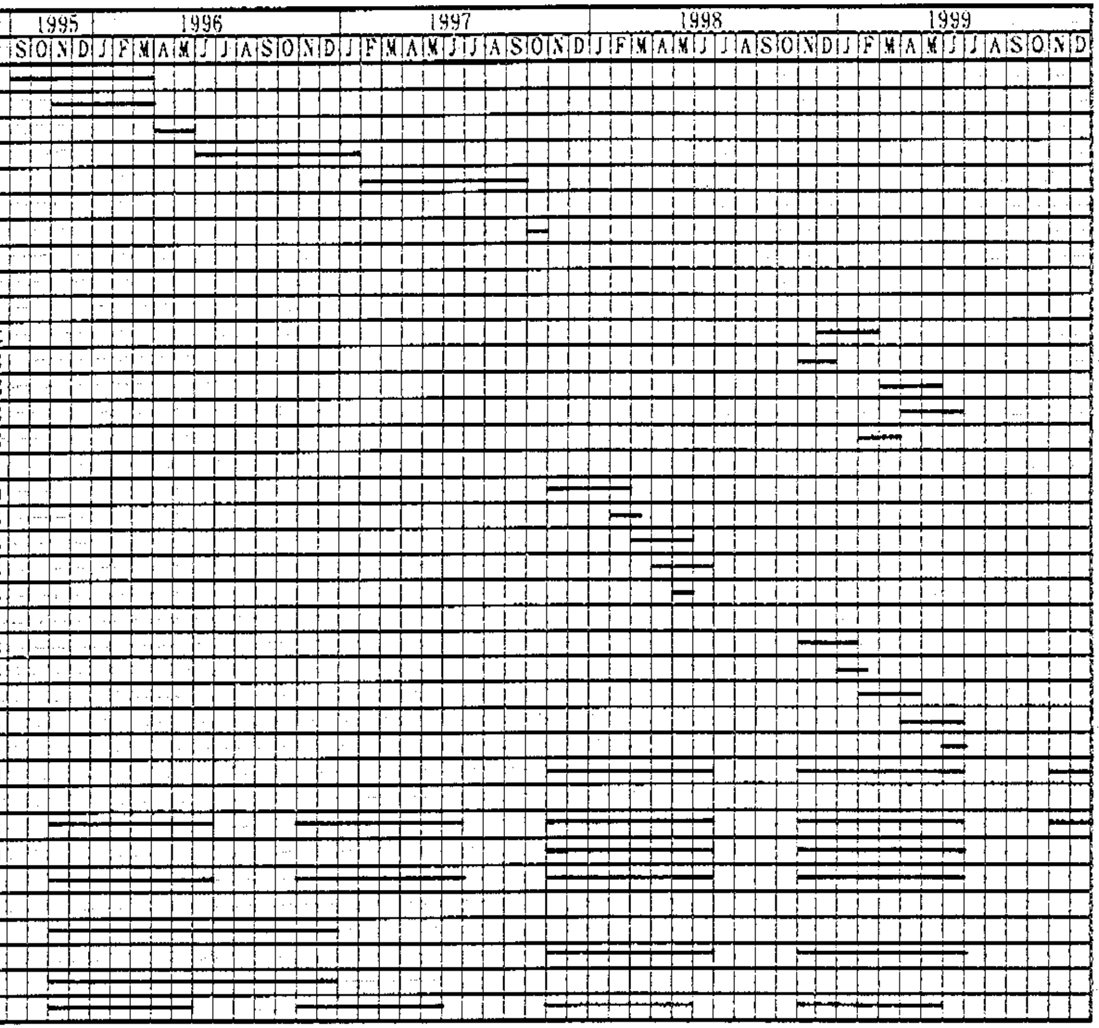

Figure C.4 Project Implementation Schedule for Abacan River Basin

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

APPENDIX D

ENVIRONMENTAL IMPACT ASSESSMENT

APPENDIX D

ENVIRONMENTAL IMPACT ASSESSMENT

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1.1 PHYSICO-CHEMICAL ENVIRONMENT

1.1.1 Morphological Changes of Sacobia/Bamban River

The construction works of major dikes on both side of Sapang Cauayan and Marimla River, as well as the channelization of the Sacobia/ Bamban River and the consolidation dam upstream expected to construct in the upstream of the National Highway Route 3 on the main stream of Sacobia River are the major components of the Project. As a result, a section of Sacobia/Bamban River between National Highway Route 3 and Route 329 goes under a major rehabilitation works during the next five years hence major morphological changes of the watershed regime is drastically changed in order to safeguard the general public and its economic activities.

Consolidation dam is effective in controlling in-channel deposition. It prevents excessive sediment deposition in the downstream section of the river. The dam would control 80 million cu.m of sediment presently stored in the valley between Mactan and Maskup. The impact of sediment retention on the geomorphological process of the river is that the dam structure will retard the vertical erosion of the river. The elevation of the river bed will remain as it is now so long as the dam structure remains stable.

The would-be fixed course of the river is slightly different from the original course of the river as it was before the Mt. Pinatubo eruption. The course is also different from the present course of the river made after the Mt. Pinatubo eruption. The new course of the river has been determined based on the engineering concept of river improving technology. It is also determined according to the present topography made by the volcanic materials transported by the river since the eruption. Upon completion of the river improvement works, morphological stabilization of the river is expected to take place and that the construction works should fix the course of the river permanently.

After the year 2,000, the river bed should be deepened to some extent, especially at the section downstream of the confluence of Sapang Cauayan, Marimla and Sacobia/Bamban River. However, the scouring action of these rivers and its subsequent changes on the river morphology would not cause any disadvantages on the surrounding natural and social environment as a whole.

1.1.2 Morphological Changes of Sapang Balen River

A section of Sapang Balen River to the east of Route 329 has been causing a number of floods to the agricultural and residential areas along its course since the Mt. Pinatubo eruption. This is partly due to the flow of Sacobia/Bamban River became as wide as the width of the area now termed as Sand Pocket area designed to hold up the lahar materials while flood water had to be released to Sapang Balen River in order to minimize the damages to the area east of the Route 329 as well as the road vital to link northern Luzon Island and Manila. As a result, the river water flowing beyond the capacity of Sapang Balen River breached its dikes.

Because of the urgent construction of the Sand Pocket area, a number of villages have experienced a number of flood events during the past few years despite the fact that they were protected from mud flow. In order to improve the situation, as a result of the recent engineering feasibility study, and partly due to the petition made from a group of local communities, realignment of the meandering course of Sapang Balen River to a straight channel with durable dikes have been determined to conduct. Thereby the area hitherto affected by flood events since the Mt. Pinatubo eruption would be improved. Further, for the drainage purpose, the exit of Sapang Balen River linking to Sacobia Bamban River has been created on the right bank of Sacobia/Bamban River near

Barangay Balutu. There was no clear exit of the river before but the river water formed swamp and eventually flown into Rio Chico River.

1.1.3 Flood Water Intrusion to Candaba Swamp

There was a speculative thinking during the early stage of the studies conducted for Mt. Pinatubo affected areas that the excessive flood water from Rio Chico River via Candaba Spillway off Pampanga River would overflow and find its way to Candaba Swamp. There was also a thinking that confining flood water into the straight river channel enclosed by dikes would make faster velocity of the flow of river. Thus, the river water would reach to the confluence of Rio Chico River and Sacobia/Bamban River with large scouring energy, or potential flood water. However, because of the swamp area around the confluence has more water retaining capacity, the lapsed time for the river water reaching to Candaba Swamp can be considerably long. The geographical conditions of the area, which is almost level, velocity of the flow of river would unlikely to contain destructive force unless there is extremely unusual amount of rainfall both in the upstream and the downstream areas.

The accumulated volcanic materials in the Sacobia/Bamban River basin has been stabilized to some extent during the past few years. Further, the catchment area of the river on the Mt. Pinatubo slope has been shifted to Pasig River as a result of a series of secondary explosions since the eruption. Thus amount of volcanic deposit has been reduced quite drastically. Thus factors to flood Candaba Swamp could be as follows:

(1) Unusual combination of rainfall in the upstream areas of Rio Chico River, Pampanga River and Sacobia/Bamban River and the downstream areas;

(2) Excessive amount of lahar materials accumulated in the river channel of Rio Chico River;

(3) Present river improvement works of straightening up of the meandering channel of Rio Chico River that would make faster flow of the river water.

Unless a combination of these factors occur all at the same time, Candaba Swamp should not be threatened by flood event.

1.1.4 Spoil Bank

Spoil banks for depositing dredging materials have been identified in the swampy area near the confluence of Bamban River and Rio Chico River. Filling of a portion of the wetland changes geographical configuration of the area. As a result, present natural watershed of the area is affected to some extent i.e. filling over a wide area will change the fluvial functions of the swamp area.

Among the impacts is the reduction of the effective storage capacity of the wetland during the period of peak flow. This may lead to the increase of land area susceptible to flooding. The disposal of spoils in the swamp of Rio Chico may also result to secondary erosion of the filling area. Although the amount is nominal, subsequent sedimentation should occur where there was none before as the spoils are exposed to intense rainfall and surface runoff.

1.1.5 Surface Water Quality

There is no factors causing changes on the surface water quality of the river upon implementation of the Project. Present water quality within the Study Area is shown in the Table D.4.

1.2 BIOLOGICAL ENVIRONMENT

1.2.1 Fauna

(1) Bird

The study period on wildlife observation in July 1995 was not the season to observe migratory bird species in the Study Area. However, early migratory bird species of White-Headed Stilt (*Himantopus*), Ruff (*Philomachus pugnax*), Cattle Egret (*Bubulcus ibis*) and Litter Egret (*Egretta garsetta*) have been observed. There are other species such as Gray Heron (*Ardea cinerea*), Purple Heron (*Ardea purpurea*), Pheasant-Tailed Jacana (*Hydrophasianus chirurgus*) have been observed although the number of each species is not as large as the regular season. These birds are insectivorous and considered that they are preying mainly on the locust abundantly breeding in the lahar affected areas. Tables D-6,-7 and -8 shows the tendency of bird species observed in the Study Area. The column for Evenness of the distribution of birds shown in the Table D-7 indicates "very high". It would mean that the very few birds are observed in wide areas. Dominance, or number of them in a unit of area is still very low.

(2) Mammals

Well before the Mt. Pinatubo eruption, almost all of the mammals are wiped out from the study area as a result of heavy agricultural development. Very few rodents, reptiles and amphibians remain in the Study Area at the moment. Rodents and reptiles do begin increasing in the sabo dam structure as its boulders provide shade, moist and safe habitat. However, it would not contribute to explode the population of these species. Planting trees and bamboo on the dikes would increase wildlife habitat, including birds and insects. Planting trees for slope protection should also provide habitat for wildlife. However, the process would take long period of time and the conditions of increasing wildlife population would not be as large as the conditions before the Mt. Pinatubo eruption.

(3) Locust

As was the case in 1994, extensive generation of locust population in the lahar affected area is likely to occur during the dry seasons in the future because of the vegetation in the lahar affected area as well as the local plantation crop of sugar cane would provide best breeding ground for them. The pioneer grass species that sprout in the lahar affected area is Talahib (*Saccharum spontaneum*) and it is a good food producer for locust as it is one of the favorite grass species for locust to breed on. Sugar cane widely planted in the Study Area is also a family of Talahib grass, which is good food producer for locust. The lack of insectivorous wildlife, such as snake, lizard, amphibians and bird species since the eruption of Mt. Pinatubo further enhances the explosion of locust population for the years to come. The lack of agricultural activities to spray insecticide should also a part contributing to breed locust in the Study Area. Explosion of the population of locust continues for several weeks before it drastically reduced. Resuming agricultural activities and enhancing agro-ecological conditions is the best solution to the locust explosion in general.

1.2.2 Flora

(1) Excessive Cutting of Trees on Mt.Arayat

The forested area on the lower half of Mt.Arayat slope, in the area west to northwest of the peak, has been heavily denuded during the past couple of years. The area below 450 m contour line within the Mt.Arayat National Park is designated as a part of country wide protection area of "National Integrated Protected Area (NIPAS)" of the Philippines. However, cutting trees on the slope of Mt.Arayat is taking place within the

NIPAS area of Mt.Arayat.

The demand on fuelwood and charcoal for cooking in the areas affected by lahar is one of the major reasons as trees are the most inexpensive source of fuel in the Study Area. Because of the income level of the local population affected by lahar has been drastically lowered, many would have to depend on the inexpensive fuel. Table D.2 a. shows the number of households using various sources of energy for cooking based on the population census before the Mt. Pinatubo eruption while the table b. shows the estimated fuel consumption after the Mt. Pinatubo eruption. The increase of demand on fuelwood and charcoal is approximately 12.5% higher than the period before the eruption of Mt. Pinatubo within the Study Area. This is due to the fact that the evacuees are using fuelwood/charcoal. Other people affected by the eruption and remained in the Study Area are also going into fuelwood consumption depending on the level of the standard of living.

There are a lot of other people demanding fuelwood in the areas outside of the Study Area who area affected by lahar since the eruption of Mt. Pinatubo and subsequent lahar and flood events. Such areas like Zambales and other municipalities in Pampanga outside the Study Area, especially the area along Pasig-Potrero River, also contain a large number of evacuees affected by lahar and flood events who are demanding fuelwood. Further, because of the transportation disruption, shrinking availability of gas and kerosene has made the small industry hitherto depending on gas and kerosene switched their energy over to locally available fuelwood. As the local supply of fuelwood is stable and inexpensive, estimated demand on fuelwood has gone up by about 20-25% comparing to the period before the Mt. Pinatubo eruption.

The resulted excessive cutting of trees in the forested area on Mt.Arayat will further go up as the population in the Study Area as well as the other areas on the east side of Mt. Pinatubo, such as the area along Pasig-Potrero River area, will continue to increase, or elsewhere as affected by lahar and flood events. Thus the pressure on the demand of trees on Mt.Arayat, the only source of fuelwood supply in the area east of Mt. Pinatubo, will not be lowered. This will continue until such time that the living conditions of the population affected by lahar and flood in the area east of Mt. Pinatubo are reinstated as before the Mt. Pinatubo eruption.

1.3 SOCIAL ENVIRONMENT

1.3.1 Sand Pocket Area

The total area of about 22 square km land is now abandoned and utilized as the Sand Pocket area as is shown in the Table D.1. Five barangays are affected and their population was about 8,676. The area is expected to receive direct benefit upon completion of the structural measures of the Project as the agricultural development described in the Section K Agricultural Development of the Master Plan of the Project is planned to take place in the area.

Acquisition of land in the areas where permanent structures are going to occupy has been in progress in the Sand Pocket Area. However, the Sand Pocket area of 2,200 ha temporarily used for in order to retard lahar material is not subject to land acquisition as retarding volcanic materials transported by Sacobia River to the area on the right bank of Bamban River between Route 3 and the San Francisco bridge on the Route 329 is considered temporary measure. It was also a countermeasure to stop the lahar from damaging the residential and agricultural area between Bamban and Sapang Balen River to the east of Route 329 i.e. urgent measures to safeguard the general public and its economic activities.

The land owners of the Sand Pocket area has been asked for lending the area as retarding coarse volcanic materials. The consent among them was made during the

public hearing that this is a temporary measure and that the area will be returned to them upon completion of the structural measures. The Sand Pocket area is converted to an irrigated agricultural area before it is released to the original land owners. Thus no part of the Sand Pocket area is agreed, both by the land owners and DPWH, that the area is not subject to land acquisition.

On the other hand, method of the acquisition of land within the Sand Pocket area for developing irrigation system is a separate issue involving Department of Agriculture, National Irrigation Administration, Department of Agrarian Reform, municipal government, and the present land owners who own their land in the Sand Pocket area. There is a possibility that the Land Bank of the Philippines would also be involved in for the financial arrangement. In general, any government owned land is not transferable from one department to the other according to the laws and regulations of the Philippines.

Purchasing the land in the Sand Pocket area for the right-of-way to conduct irrigation scheme may lead to an intricate issues, but not limited to, as follows:

1) There are a number of small land owners in heavy debt who cannot sell the land for agricultural development and re-purchase the land for their agricultural activities;

2) There are those who would rather hold it for speculative sale of land as there would be a townships and a new road is constructed in a part of the Sand Pocket Area;

3) Farmers returning to the Sand Pocket area simply do not want to sell their land if there is a plan to develop irrigation scheme;

4) Tremendous amount of paper works to clear the ownership of land is involved and therefore the small land owners do not want to get involved into it;

These factors would slow down the process of land acquisition for the irrigation development project.

In the mean time, the land owners in the Sand Pocket area are privileged exempt from the payment of land tax. However, there is no income generated from the land they own for a long period of time while some land owners would still have to pay the credit over the land they own. The period of payment varies from several years to more than twenty years depending on the installment arrangement made by the time of purchase of land. Further, the land owners involved in the agricultural development in the Sand Pocket area would have to wait for 14-18 years until their land is returned with irrigation system, counting from the time of Mt. Pinatubo eruption to the expected time of the completion of irrigation development. During this period, they will have no appropriate means to generate major income.

1.3.2 Spoil Bank

The excavation of 16.5 million cu.m. of material from the section of river between the San Francisco bridge and the confluence of Rio Chico for the 9 year period starting in the year 1996 would require a total area of 1,650 ha as the spoil bank is filled at 1 m thick. In reality, yearly excavation operation would produce 1.8 million cu.m of material. This would need to reclaim 180 ha of land, at 1 m thick, near the area of excavation operation.

Although the expected area for Spoil Bank is agricultural land, the area swamped during the rain season is available for disposing excavated material in the Municipality of Magalan. The nominated area is on the right bank of Rio Chico River near the Bamban

River. Method of disposal is as follows:

1) Remove top soil from the designated spoil bank during the dry season;
2) Dispose excavated material into the designated spoil bank;
3) Back-fill the spoil bank with the top soil as soon as the depth of spoil becomes 1 m;
4) Repeat the process.

In this way, the fertility of the swamp area designated for spoil bank, most of them are privately owned agricultural land, could be maintained as much as possible. In many cases, reclamation works would raise the ground level of the agriculture area. Thus the area would be made available for year round farming in place of swamped area during the rain season and that the area is not used during the dry season.

Land acquisition for Spoil Bank is necessary as a matter of course. At P7.5/m2, the total cost of land acquisition would be P6.75 million per year, or the total cost of P60.75 million for the 9 year period. Because of the operation would actually improve the swamp land into the productive year-round agricultural area, the cost of land acquisition can be negotiable.

1.3.3 Improvement on Sapang Balen River

Since the petition was sent to DPWH that the meandering course of Sapang Balen River should be straitened. The idea of the petition was agreed under the frame work of the Project. Thus there should not be any problem on the land acquisition. The work involves major reorganization of the farmland along the river. The riverside area would be sold to the farmers while the farmland would be purchased for dike construction area. Depending on the alignment of the dikes, some farming areas can be swapped.

1.3.4 Agricultural Development

Since the engineering design to stabilize the river morphology of Sacobia/Bamban River is conducted in the areas where local agriculture was the major economic activity, what is more important for the local residents in the lahar affected area is to formulate feasible livelihood program based on agriculture or any program that would support agricultural activities. Details of the agricultural development program associated with the Project is reported in the Section K of Master Plan.

As is shown in the Table D.3, 69.6 % of the farmers in Tarlac would receive benefit from the Agricultural Development Program of the Project. On the other hand, the farmers in Mabalacat and Angeles are not fully benefited from the program, mainly because their agricultural areas are reduced due to the major morphological changes and the shift of river channel caused by the lahar and the permanent structure measures planned to conduct in the lahar affected Area. As a result, only a fraction of the farmers in Mabalacat will return to agriculture under the Agricultural Development Program associated with the Project. Thus it is essential to generate other job opportunities for the farmers who would not receive direct benefit from it.

1.3.5 Reinstatement of National Highway Route 3

As soon as the conditions of the river and the surrounding areas affected by lahar along Sacobia/Bamban River between Mabalacat and Bamban is stabilized, the National Highway Route 3 linking Mabalacat and Bamban is planned to reinstate. Thereby the road traffic between Mabalacat and Bamban is resumed with relatively short haulage and that the flow of population and commodities should become more smooth than as it is now for generating economic activities.

The old alignment of the road is planned to straightening up in order to enhance effective flow of traffic. As a result, acquisition of land for the section of the road is involved. In turn, the area of the old road alignment can be sold for the use of the general public, or maintain it as it is now but release for the public housing area.

1.4 ENVIRONMENTAL MANAGEMENT PROGRAM

1.4.1 Land Acquisition for the Sand Pocket Area

Voluntary effort of the land owners being patients for offering their land to the Sand Pocket area during the past four years, although much of the area was a result of natural phenomenon and not useful for any purposes, has been the key issue of the land acquisition for the agricultural development project expected to take place in the Sand Pocket area. In return, there has already been an interim moratorium on the payment of land tax, interest and the principal payment for agrarian reform related to the land they own.

The perceived benefits from the improvements and developments in the local agrarians' land are considered enough compensation for making use of the area during the lahar and flood rehabilitation period at rent free. What counts most is that the project and its merits are clearly explained to the beneficiaries and that the relationships of trustworthy has already been established among those of the local residents and the local and the central government agencies concerned with the Project. Thus the following suggestions, but not limited to, would be sensible to implement as a part of new development scheme upon the Sand Pocket Area is made safe to conduct normal economic activities.

(1) Exclusively employ small land owners within the areas where the structural measures are to take place in the Sand Pocket Area. This would particularly effective in order to encourage maximum participation of the local residents to the Project;

(2) Guarantee that the remaining credit period of the agricultural area of the original landowner is maintained. This should be based on the thought that the area of the measurement of land whose right-of-way is given for a designated period of time to DPWH and it should be the same area as before the Mt. Pinatubo eruption. Conditions of the guarantee should be that the irrigation facilities are the same or compatible to that of the one existed before the Mt. Pinatubo eruption. Any purchase of land exceeding the area the land owner used to own before the Mt. Pinatubo eruption is subject to the general arrangement of the sale of land under the scheme set forth by the development agency or agencies of the irrigation facilities;

(3) Any payment not recoverable for the cost incurred by the irrigation facility development after the sales of land should be split among the municipality and provincial government as well as the central government agencies concerned with the irrigation facility development;

(4) Establish task force, involving the representatives of local residents, Barangay Council, Municipal Assessor, Department of Agriculture, Department of Agrarian Reform, Land Bank, Office of Mayor, DPWH and other agencies concerned with the Project. They should deal with the general management of land acquisition which would involve tremendous amount of paper works. The appointed task force or NGO should function as middleman agent that assist farmers to obtain certificate related to the land ownership, tax, debt, etc. They should also monitor the performance of the arrangement as suggested above until such time that the irrigation facility development project is completed. Their

task is also to monitor the speculative sales of land for other purposes such as commercial development.

There are, however, a few major operations would have to be conducted in order to implement the development project in the Sand Pocket Area. Since the survey references and boundary marks are all buried under volcanic debris, new survey references should be established for the entire area in order to delineate ownerships. This would involve a considerable amount of cost as well as time.

Land speculation would be very likely to hamper the agricultural development project in the Sand Pocket area. The price of land in the Sand Pocket Area close to the National Highway Route 3 has gone up to P12.20/m^2 - P30/m^2 in place of P7.5/m^2. In this respect, speculative sales of land should take place earlier if the agricultural development project is much delayed than originally intended. It would mean that the more the implementation of the agricultural development project delay, the more the land acquisition cost should become larger.

1.4.2 Agriculture Development Program as Major Livelihood Program

As is shown in the Table D.9, the most common means of making living in the study area is farming and livestock raising. Table D.10 to D.16 indicates the concern of the local residents over the agricultural development works. Major concern over the livelihood program of the Study Area is thus agricultural rehabilitation works. Detailed irrigation scheme development, soil rehabilitation program and pilot farming programs are discussed in the Agricultural Development Program, Appendix K of the Master Plan of this study. Most of the environmental management program related to agriculture is included in it.

The local barangay offices, municipality, and the central government agencies have all shown their interests on the agricultural development programs, especially in the Sand Pocket area.

1.4.3 Tree Cutting on Mt.Arayat

There is no way to reduce the pressure on the fuelwood supply within the Study Area where there are a lot of evacuation centers are filled up with evacuees. Thus there is no way to reduce pressure on cutting trees on Mt. Arayat. No aforestation measures would catch up the growth of demand on fuelwood immediately. The only way to reduce pressure on the demand of fuelwood is:

(1) to reinstate traffic conditions between Manila and Angeles City as soon as possible for LPG gas, kerosene, and other types of energy supply;

(2) increase job opportunities as much and as soon as possible; and

(3) generate the flow of LPG gas and kerosene for cooking for those affected by flood and lahar.

The overall performance of the resumption of the above conditions should depend much on the maintenance of the road between Manila and Angeles City as well as the road between Olongapo and Angeles City.

1.4.4 Slope Stabilization

The existing conditions in the lahar and ashfall-affected areas are as follows:

- deficient in nitrogen and potassium
- deficient in most micronutrient except for iron;
- general lack of soil nurturing microorganisms;
- absence of soil-fauna which aid in mineralization and decomposition of organic matter;
- processes of the growth and development of plants; and
- general changes in the microclimate due to the barrenness caused by the volcanic materials.

Thus rational approach is to select species with nitrogen-fixing plant such as leguminous species and mycorrhiza species. The first colonizers of biological environment in the degraded areas are those species tolerant to extremely barren conditions and are able to reproduce quickly with large number of easily dispersed seeds. Talahib (*Saccharum spontaneum*) possesses such capability of adaptation in addition to its association with nitrogen fixer, azosperillum.

As is shown in the Table D.5, several tree species have been selected for slope protection. Seedlings of these species are readily and locally available from the nurseries of the Department of Environment and Natural Resources. Planting these trees in the upstream area of Sacobia/Bamban River should become feasible within the next couple of years as the ground temperatures are lowered and the slopes on the mountain would become more stable, relatively high organic contents and more safe to work on.

The Sacobia River Basin Development Corporation, an organization for generating livelihood opportunities for the Aetas would be the nominated organization for executing the tree planting work. There has been a Presidential Order of the Philippines, No.263, July 19, 1995, for Community-Based Forest Management (CBFM), which declared to generate forest resources for the local communities across the nation. With the combination of the organization and the Presidential Order, a dual-purpose program of the community-based forest management and protecting the slope of the upstream area of Sacobia/Bamban River could be conducted as soon as practicable.

1.4.5 Use of Talahib Grass

Talahib (*Saccharum spontaneum*) is considered as a good organic fertilizer as it is cut, piled up, fermented and mixed with soil. As agricultural development programs are conducted in the lahar affected areas within the Study Area, a program to generate organic matter to enhance fertility of the lahar affected soil by using the abundantly growing Talahib grass should be formulated. As this practice is widely spread among the farmers, the irrigation system rehabilitation program would soon recreate agro-ecological environment and that it will provide ground cover with agricultural plants. In this respect, abundant growth of Talahib grass is essential in two respect:

- It contributes to prevent the locust population from exploding and subsequently damage agricultural crops in the adjacent area; and
- Organic material for enhancing soil fertility is readily available.

1.4.6 Planting Tree/Bamboo for Dike Protection

Planting bamboo on the dikes protecting residential and agricultural areas would be effective not only to increase the rigidness of the dike structure but would also enhance the growth of habitat for wildlife. Thereby bird and other insectivorous species would return to the lahar affected areas. This would also contribute to reduce the risk of locust population explosion to some extent.

1.4.7 Terrestrial Wildlife Management

(1) Suppression of Locust Population

As soon as agricultural development takes place and resumes the original agricultural activities in the lahar affected areas, agro-ecological conditions will provide ideal biological conditions for birds, reptiles, amphibians, rodents, and insect species that are natural enemies. Thus, resuming general agriculture, fruits tree growing, bamboo planting for dike slope protection will all be effective to invite wildlife species that will suppress locust population.

(2) Reintroduction of Wildlife

The animals that the Aetas usually hunt for food should be raised for the purpose of releasing them on the slope of Mt. Pinatubo. Sacobia River Basin Development Authority is in the position to conduct this program along with the tree planting program.

1.4.8 Soil Resources

Bio-engineering restoration for agro-ecology through a large amount of organic input would be the first prioritized action. Hastened ecological succession of grass species by making use of Talahib grass, chopping, fermenting and plowing them into soil as organic matter is the most inexpensive method to increase organic content of the soil in the lahar affected areas. The program should be implemented in association with the agricultural development program.

1.5 ENVIRONMENTAL MONITORING PROGRAM

1.5.1 Tree Cutting on Mt.Arayat

The rate of tree cutting on Mt.Arayat should be closely monitored in relation to the monitoring on the demand of fuelwood within the Study Area as well as the areas affected by lahar. Since the local DENR office has a program to plant trees assigning some local NGO groups, the program should be enforced with some budgetary assist.

1.5.2 Locust Breeding

Locust breeding should be monitored until such time that the breeding grounds are eliminated i.e. agro-ecological conditions are fully reinstated in the Study Area. Any sign of the explosion of locust population should be dealt well in advance. In relation to this, monitoring of wildlife should be conducted on a monthly basis starting from the time of construction works up to the time of project's completion. To be monitored are insectivorous birds that feed on locust and other types of wildlife such as skinks, shrews, and rodents. Type of feeding of the wildlife observed in the study area is shown in the Table D.8. The population of these wildlife should also be monitored in order to predict the level and timing of locust population explosion.

Wildlife species in Candaba and Matulakdan Swamps and Mt. Arayat National Park should also be monitored on a quarterly basis to determine whether changes in their population occur during the construction phase.

1.5.3 Establishing Task Force

A task force monitoring the agricultural development should be assigned in order to properly monitor the arrangement of developing the thoughts and idea to designate the Sand Pocket area. The task force should also monitor the performance of subsequent irrigation facility development programs. The task force can be formed by any

government agency such as Mt. Pinatubo Commission, or a local government agencies, representative(s) of the barangays concerned with agricultural development program, including NGO group(s) specifically formed for the purpose, or a combination of them.

D.2 Environmental Impact ASSESSMENT for ABACAN RIVER BASIN

2.1 PHYSICO-CHEMICAL ENVIRONMENT

2.1.1 Abacan River Extension Channel

Abacan river Extension channel, extending to the southeast of Mexico, is outside of our Study Area. It is under construction by DPWH. Since the area is outside of the frame work of the Project, no research works related to the engineering design has been conducted to date. On the other hand, because of the channelization work is conducted urgently in order to prevent the surrounding residential areas in Mexico from flooding since the Mt. Pinatubo eruption, it has been effective for the purpose originally it intended. However, the concept of engineering works and the way the channelization work has been conducted to date has not been made clear.

It appears that the channelization work is to cut through the swamp area to the southeast of Mexico in order to drain river water further to the swamp area, eventually linking to the main stream of Pampang river. This is a significant change on the morphology of the river and the swamp. Subsequently the biological conditions of the swamp and the agricultural activities taking place in the swamp are all significantly affected. In order to prevent the natural environment and the social environment from flooding by uncontrolled flow of the river, separate engineering scheme, including environmental impact assessment for the improvement of this portion of Abacan river should be established as soon as possible.

2.1.2 River Improvement Works

The river improvement works for the section of Abacan river between Friendship Bridge and Capaya Bridge, including sabo dam at the downstream of Friendship Bridge, all in Angeles City, would fix the natural course of river and that the morphology of the river is made unchanged when the works are completed. Permanent embankment on both side of the river is designed to safeguard the residential and business areas as much as possible. Thus provide positive impact to the social environment. Relatively shallow flow of water in the river made of sandy volcanic river bed does not support significant aquatic life at the moment as the river ecology has been renewed since the eruption of Mt. Pinatubo.

2.1.3 Channelization of Abacan river

A small section of the river, approximately 1.5 km upstream from Baily Bridge to the exit of the river in Mexico is planned to channelize under the frame work of the Project. Approximately 4 million cu.m. of material is planned to excavate from the section of the river in order to reinstate the flow condition of the river. Although this is the work that would change the morphology of the section of river, no adverse effect on the river ecology is expected to associate with the excavation. On the contrary, the work would straighten the river channel to make smooth flow of water. It is designed to reduce flooding damages to the surrounding areas.

2.1.4 Sabo Dams

A series of sabo dams planned to construct in the upstream area of the Abacan river are intended to stabilize and control the sediment discharge into the downstream area. The

present sabo dams have been deteriorated and will have to be improved upon implementation of the Project. The collapse of these sabo dams can trigger massive mud flow and tremendous bank erosion with disastrous effects. Thus rehabilitation of the existing sabo dams as well as constructing new one would contribute to safeguard the downstream area. These measures are an action of the permanent changes on the river morphology. With the measures, social environment in the downstream area is safeguarded. No significant negative impact against the renewed flow of the river since the Mt. Pinatubo eruption is expected to occur.

2.2 *BIOLOGICAL ENVIRONMENT*

2.2.1 Wildlife

Rehabilitation of sabo dam as well as building new one is believed to provide habitat for the ground dwelling wildlife such as rodents, reptiles and amphibians. However, sabo dams would provide very small fraction of wildlife habitat comparing to the entity of natural environment in the watershed area. Thus there would not be a very high expectation of creating wildlife habitat by this particular work. Table D.6 shows the wildlife species observed in the Study Area. In general no wildlife habitat in the Abacan river basin is negatively affected by the project implementation.

2.2.2 Planting Trees/Bamboo for Dike Protection

The catchment area of Abacan river has been very well developed during the past decades. Middle portion of the river flows through heavily populated area whereas the lower portion of the river goes through well developed agricultural area. The upstream portion has been covered with very thick volcanic materials i.e. there is no significant natural biological environment left in the Abacan river basin.

In some places in the downstream area of the river, naturally grown trees are observed on the dikes. Thereby bird and other insectivorous species would return to the lahar affected areas and eliminate unwanted insects such as locust. However, much of the downstream area is dominated by agro-ecology of rice growing area. Planting more trees and bamboo on the dikes for the purpose of protecting residential and agricultural areas would be effective not only to increase the rigidness of the dike structure but would also enhance the growth of habitat for wildlife.

2.3 *SOCIAL ENVIRONMENT*

2.3.1 Spoil Bank

An area of 200 ha is required for spoil bank in the area near the exit of Abacan river extension channel as 2 million cu.m of volcanic materials are excavated from the river between the year 1,996 and 2,000 if the Project is so implemented. The nominated spoil bank area can be in the swamp area accessible from Mexico. Alternative area could be the swamp area to the north of Ninoi Aquino Bridge. Method of disposing the spoil is as follows:

(1) Remove the top soil of the designated swamp area during the dry season;
(2) Dispose excavated materials into the designated area;
(3) Back-fill the top soil on the spoil;
(4) Move to the other area as soon as the depth of spoil reaches to 1 m;
(5) Repeat the process until excavation operation is completed.

In this way the fertility of the spoil bank, most of them are privately owned agricultural area, will be maintained as much as possible. Because of the operation would actually improve the swamp land into the productive year-round agricultural area, the cost of

compensation for the improvement can be negotiable. Instead of acquiring land, long term lease arrangement could be the most probable option.

2.3.2 Increasing Security on the Residential and Commercial Areas

The middle portion of Abacan river is subject to further river improvement works in order to stabilize the river channel and its embankment. This is the measure designed to safeguard the residential and commercial areas on both side of the river at the section between Friendship Bridge and Capaya Bridge in Angeles City. Excavation of the river channel, construction of the dikes on both side of the river, and reconstruction of the sabo dam No.9 in the downstream of Friendship Bridge as well as the renewal of Friendship Bridge will all function to safeguard the residential and commercial areas on both side of the river. Thus no significant impact on the social environment is expected to induce by these engineering measures.

2.4 ENVIRONMENTAL MANAGEMENT PROGRAM

2.4.1 Agriculture Development Program as Livelihood Program

As is indicated in the D.9 to D.16, major concern over the livelihood program of the local resident in the Study Area is agriculture rehabilitation works. They should be implemented as per irrigation scheme development, soil rehabilitation program and pilot farming programs discussed in the Agricultural Development Program, Appendix K, Master Plan.

2.4.2 Fuelwood Supply

There is no way to reduce the pressure on the fuelwood supply within the Study Area where there are a lot of evacuation centers are filled up with evacuees. Those who stay at home or conduct business as before have also limited access to LPG gas and kerosene as major energy for cooking. Thus there is no way to reduce pressure on cutting trees in the study area, especially in the area at the foot of Mt.Arayat. No aforestation measures would catch up the growth of demand on fuelwood immediately. Thus the only way to reduce pressure on the demand of fuelwood is to reinstate traffic conditions between Manila and Angeles City, increase job opportunities, and generate the flow of LPG gas and kerosene for cooking i.e. general recovery of economy is essential.

2.5 ENVIRONMENTAL MONITORING PROGRAM

2.5.1 Fuelwood Supply

The rate of tree cutting on Mt.Arayat should be closely monitored in relation to the monitoring on the demand of fuelwood within the Study Area as well as the areas affected by lahar.

2.5.2 Livelihood Program for the Aeta

There are relatively few Aeta families living in the area along Abacan river and they have no organization like Sacobia River Basin Development Authority. However, the demand of the Aetas living in the area along Abacan river is the same as those living in the Sacobia/Bamban river basin. Thus an organization dealing with enhancement of the life style of the Aeta who have been affected by the Mt. Pinatubo eruption should be considered. For the short term program, the organization should assist the Aetas to resume their agricultural practice. For long term program, reintroduction of a wide variety of wildlife that they hunt for food should be considered.