5.2.2 Basic Policies for Flood Control Plan

Basic policies for flood control plan shall be summarized as shown in bellow:

<Basic Policy>

To achieve the purposes mentioned above, the following hard and soft countermeasures are to be applied on the basis of the policy of "*STAY HARMONY WITH WATER*":

- Hard Measures: Direct Measures to River Course
  - ✓ River course improvement by dikes, revetment, excavation, consolidation etc.
  - ✓ Flood peak discharge regulation by reservoir, retarding basin, diversion channel etc.
- Soft Measures: Indirect Measures to River Course
  - ✓ Flood forecast and evacuation system
  - ✓ To minimize the increased discharge by urban development based on the policy "Zero Delta Q Policy"
  - ✓ To enhance (or maintain) the flood control function of current basin through conservation of forest and/or reforestation, and conservation of firm lands such as rice fields

<Target Areas>

The target area to be protected against flood should cover the whole Bali Province, referring to "Bali Flood Mapping" as shown in Table-II-5.4. In the Master Plan, however, priority is put on urban areas such as Denpasar and Kuta areas, Singaraja and Negara.

- Singaraja(Beleleng River, Banumala River in Buleleng)
- Denpasar City(Badung River, Mati River)
- Negara(Sowan River, Bilikpoh River in Jemburana)

Table-II-5.4 Problems and Issues in Rivers of Bali

Zone	District/City	River Name	Problem/Issues	Countermeasures
East Bali	KARANGASEM KLUNGKUNG	Karobelahan, Daya, Nusu, Sakta, Batuniti, Kates, Kerkuk, Janga, Buhu, Unda (Telagawaja,Yeh Sah, Langon, Barak), Jinah, Lombang	1. Annual rainfall: 2,200 - 3,000 mm 2. Influenced by erupted material of Mt. Agung 3. Erosion is relatively active in the upstream, and causes sedimentation in the downstream.	1. Check dam, 2. Sand Pocket, 3. Groundsill, 4. Revetment, 5. Normalization, 6. Dike
	GIANYAR BANGLI	Melangit, Sungasang, Pakerisan, Petanu, Oos, Buhu		
Central Bali	BULELENG	Canging, Banyumala, Buleleng	1. Annual rainfall: 2,000 - 2,800 mm 2. "Bottle necks" 3. Sedimentation 4. Some rivers are influenced by tide.	1. Revetment, 2. Normalization, 3. Dike 4. Upstream Lands Conservation
	BADUNG DENPASAR	Badung, Mati, Teba		
	TABANAN	Yeh Ho, Balian, Bakung		
West Bali	BULELENG	Banyupoh, Grokgak, Tinga-Tinga, Sumaga, Gemgem, Saba, Medaum	1. Annual rainfall: 1,400 - 2,200 mm 2. Erosion is relatively active in the upstream, and causes sedimentation and river meandering in downstream. 3. Some rivers are influenced by tide.	1. Revetment, 2. Normalization, 3. Dike 4. Shortcut
	JEMBRANA	Sumbul, Bilukpoh, Sowan (Tukad Jogading, Tukad Pergung, Tukad daya Timur)		

Source: Pekerjaan Pembuatan Peta Banjir di Propinsi Bali, Proyek Pengelolaan Sumber Air dan Pengendalian Banjir Bali, 1996

<Design Scale>

The design scale of 10 to 30 years is adopted for the flood control plan depending on river basin areas and urbanized conditions, referring to the following consideration:

"Flood Control Manual Volume II", which was prepared in the middle of 1990's by a CIDA aid project, provides a summary of return period criteria which have been used in the design of various flood control projects in Indonesia. In an area of urban/industrial development, the design flood return period varies 10 to 25 years in the short term, and 25 to 50 years in the long term. Also in this manual, recommended minimum design flood standard are presented in Table-II-5.5. For new projects, minimum design flood return periods of more than 10 years in the initial phase and more than 25 years in the final phase are recommended.

Table-II-5.5 Recommended Minimum Return Period of Design Flood

Flood System	Project Type(for River Flood Control Project) and Total Population (for Drainage System)	Initial Phase	Final Phase
River System	Emergency Project	5-year	10-Year
	New Project	10	25
	Updating Project for rural and/or urban with P < 2,000,000	25	50
	Updating Project for urban with P > 2,000,000	25	100
Primary Drainage System (Catchment area> 500 ha)	Rural	2-year	5-year
	Urban P < 500,000	5	10
	Urban 500,000 < P < 2,000,000	5	15
	Urban P > 2,000,000	10	25

Notes: 1) Higher design flood standard should be applied if an economic analysis indicates that it is desirable or if flooding is a significant risk to human life.
2) P = Total Urban Population
3) Emergency Projects are developed without preliminary engineering and economic feasibility studies at sites where flooding is excessive and flooding problems present a significant risk to human life.
4) New Project include flood control projects where no previous flood projects have been developed or where Emergency Projects have been developed.
5) Updating Projects include rehabilitation projects and improvements to exiting project. Most River Basin Development Projects are considered to be updating projects.
6) Initial Phase is recommended for immediate use.
7) Final Phase is recommended for use in upgrading existing facility when the necessary funds become available.

5.2.3 Alternatives of Flood Control Plan

The alternatives for flood control plan for each targeted area are summarized as shown in Table-II-5.6.

Table-II-5.6 Alternatives for Flood Control Plan for Each Targeted Area

Area	Rivers	River Characteristics and Land use	Adopted Alternatives	Another Alternatives
Denpsar City, Badung Regency	Badung	Urbanization in progress, Densely built-up area, River flows below inland elevation level	Manly riverbed excavation due to difficulty of river widening	Diversion to adjacent rivers
	Mati	No improvement from Ulun Tanjung Weir to Umadui Weir.(paddy field except near Kuta area)	River improvement and retarding basin(securing or natural retarding function)	Diversion to asea, 2 locations retarding basin
Singaraja Area	Buleleng	Inland low-lying area in downstream, Densely built-up area, Revetment fracturing	Riverbed excavation, revetment improvement	-
	Banumala	No improvement in downstream section	Banking, Revetment	-
Negara Area	Sowan(Kaliakah, Ijogading, Aya Timur,etc)	River improvement in progress after 1998 flooding	Normalizationm Revetment, Grandsill,et	Continuance of river improvement

5.3 Flood Control Plan for Badung River and Mati River

Outlines of flood control plan for Badung River and Mati River are shown in and Figure-II-5.12. Schemes of flood control for each river are shown in Figure-II-5.13 and Figure-II-5.14.

Considering the conditions of river basin such as land use, applied flood control systems are enlargement of flow area by riverbed excavation for Badung River, and combination of enlargement of flow area by riverbed excavation and retarding basin for Mati River.

Of course, there are some subjects to be solved in design or implementation stages. Among them, land acquisition or compensation for retarding basin of Mati River basin might be the most critical subject since land price of this area has been rise according to rapid urbanization.

Table-II-5.7 Flood Control Plan for Badung River and Mati River

River	Badung River	Mati River
Design Scale	25 years	25 years
Flood Processing System	Riverbed Excavation	Riverbed Excavation & Maintenance of Retarding Basins
Content	◆ Enlargement of flow area between Buagan weir and JL.Gajamada with removing Buagan weir to improve flow capability. ◆ Irrigation channel is connecting to Tebe River.	◆ Enlargement of flow area between JL. Gunung Soputan and JL. Bypass to improve flow capability. ◆ Regulate present land use of existing retarding basin to keep its function. (area of 15ha)
Major Works	【Riverbed Excavation】 ◆ Length：4.5km ◆ Depth：1.5m ◆ Width ：10m ◆ Volume：70,000m^3 【Comprehensive countermeasures】 ◆ River management including flood deifence activity ◆ Land use restriction ◆ Preparation of Hazard map	【Riverbed Excavation】 ◆ Length：6.5km ◆ Depth：1.5m ◆ Width ：10m ◆ Volume：100,000m^3 【Comprehensive countermeasures】 ◆ River management including flood deifence activity ◆ Land use restriction ◆ Preparation of Hazard map
Subjects to be Solved	◆ Consensus with farmers ◆ Disposal of excavated soil.	◆ Land acquisition/compensation ◆ Land use/spatial planning
The examined alternative	◆ Embankment improvement ◆ Drainage channel to Ayung River	◆ Embankment improvement ◆ Drainage canal to Kuta beach using with improvement of existing irrigation canals. ◆ Pumping facilities

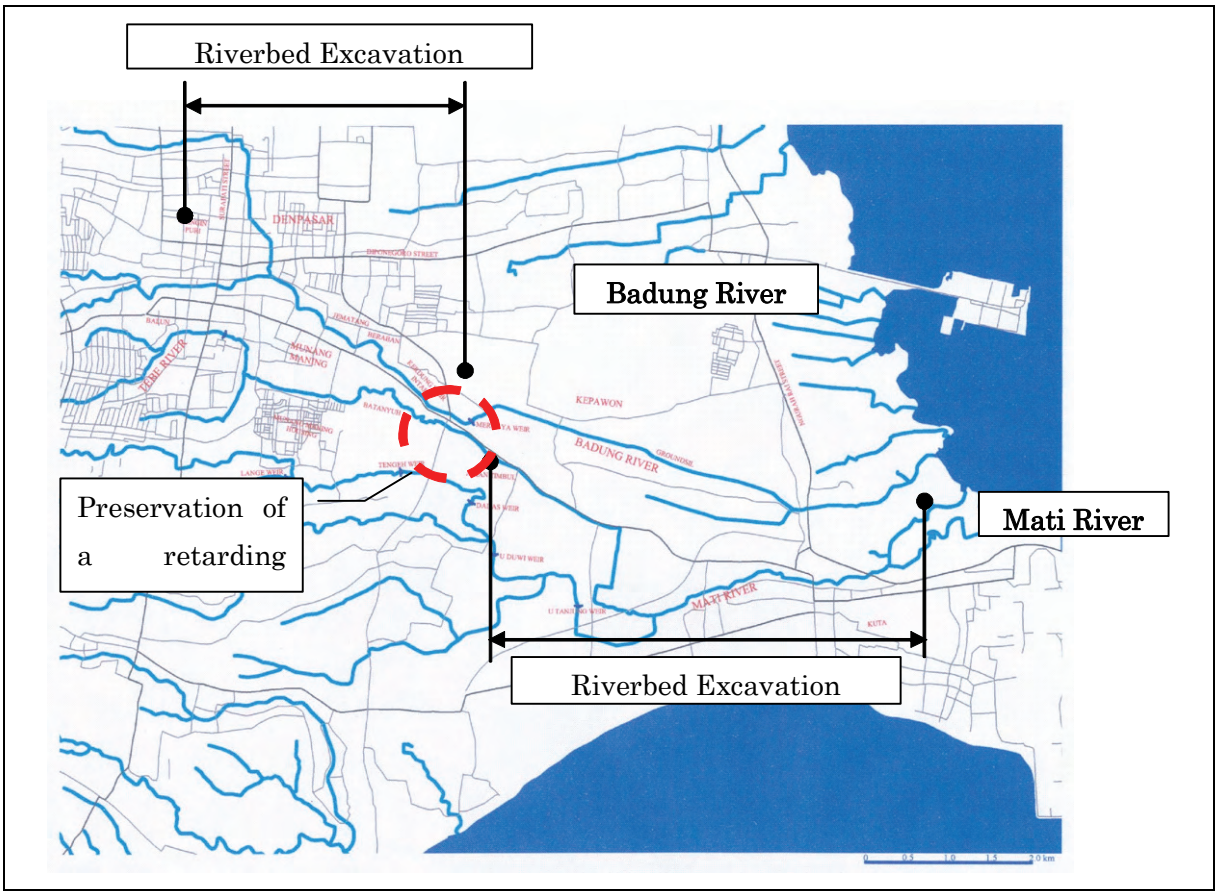


Figure-II-5.12 Flood Control Plan for Badung River And Mati River

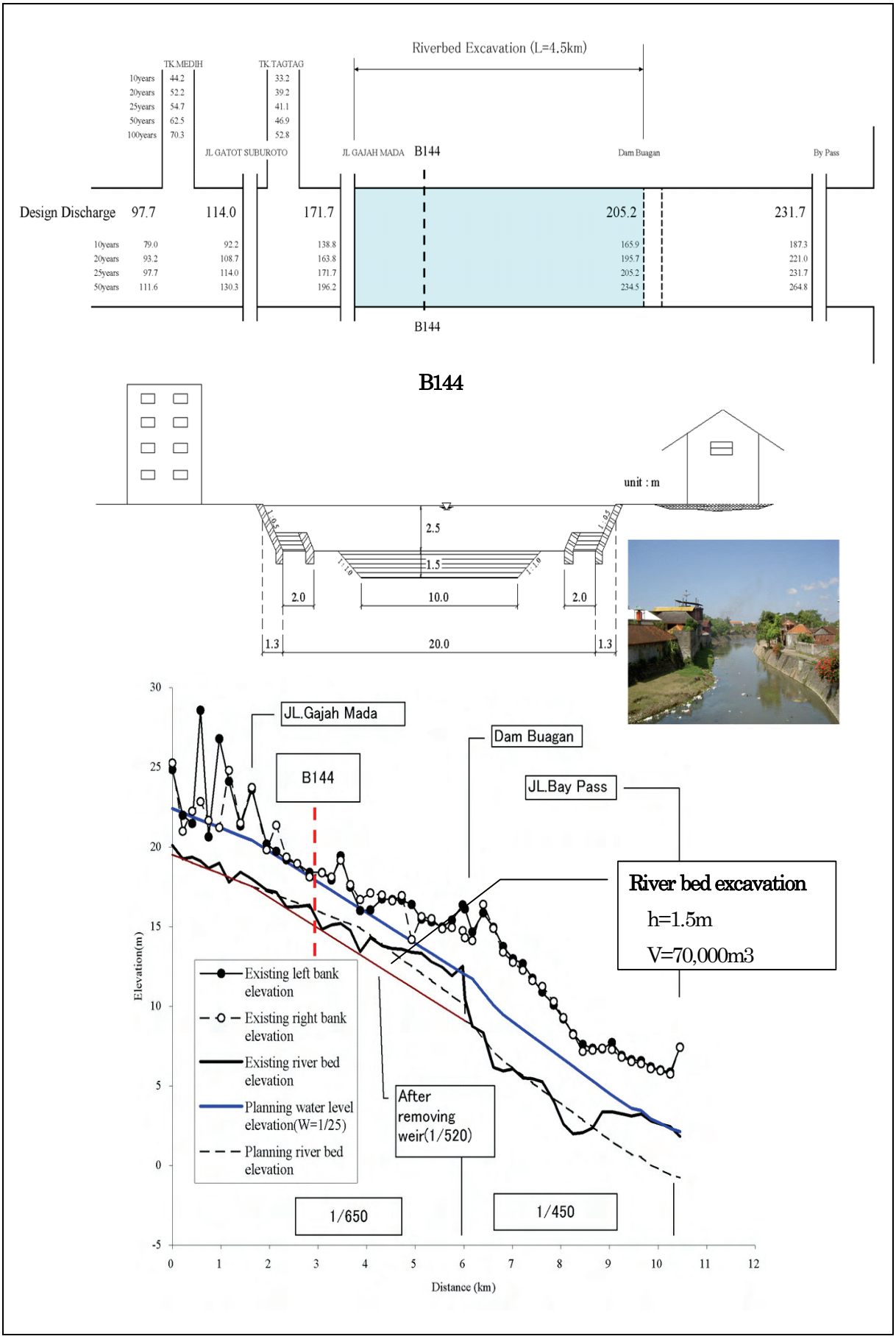


Figure-II-5.13 Flood Control Plan for Badung River (Riverbed Excavation)

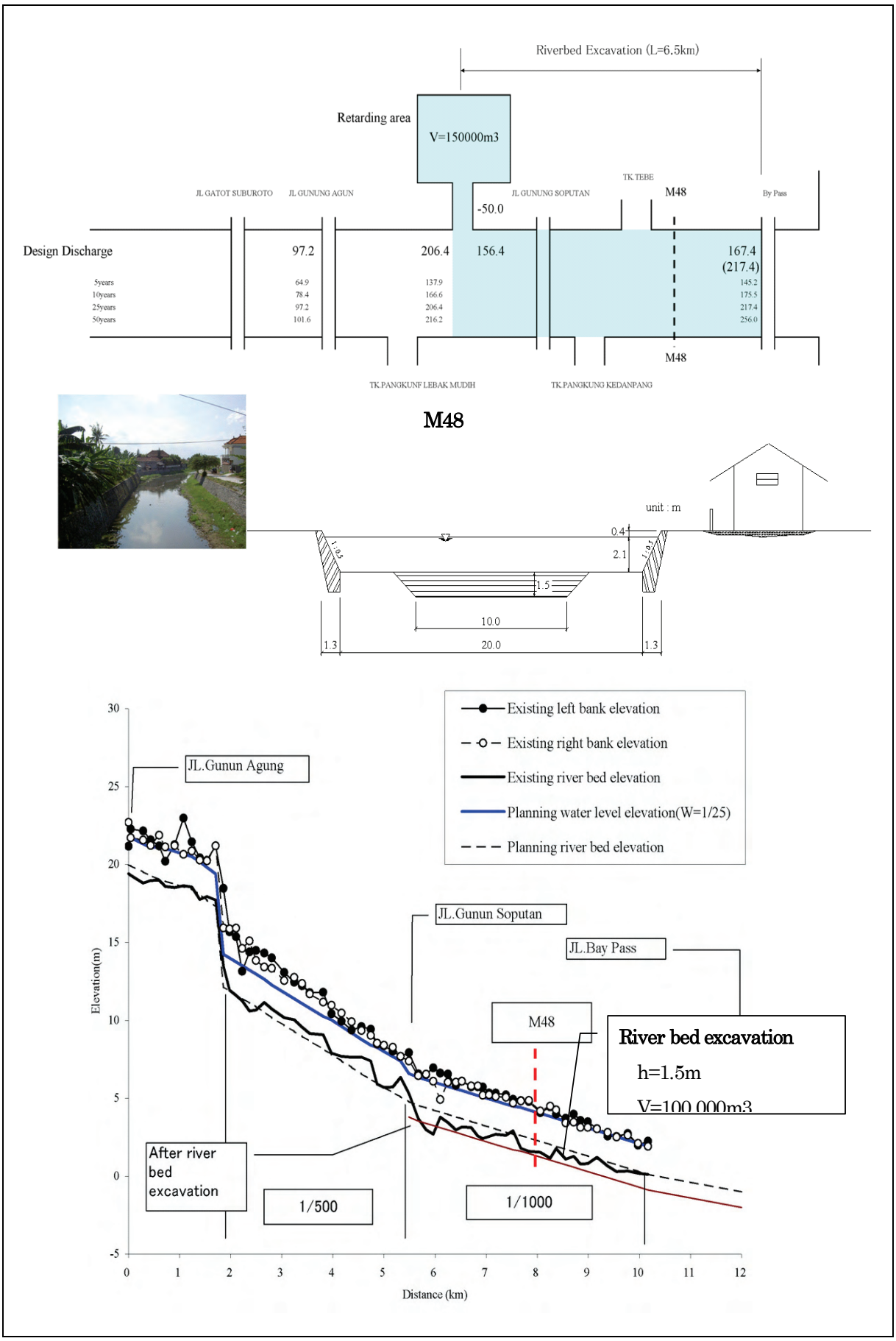


Figure-II-5.14 Flood Control Plan for Mati River

5.4 Flood Control Plan for Banyumala River and Buleleng River in Singaraja

5.4.1 Current Issues

Banyumala River flows west side and Buleleng River flows east side of Singaraja City. Catchment areas of Banyumala River and Buleleng River are 35.6km^2 and 30.6km^2, respectively. Both basin forms narrow shape with north and south long, and river gradients are steep.

Big floods occurred on January 9th in 2002, March 3rd in 2004 and so on. Inundation areas ranged from riverside to parts of city center of Singaraja. Based on the result of site reconnaissance and interview survey, it is found that there is a section in which height of right bank is low in Banyumala River, and flood is overflowed at this point. As for Buleleng River, insufficient flow area due to riverbed aggradation might be a cause of floods.

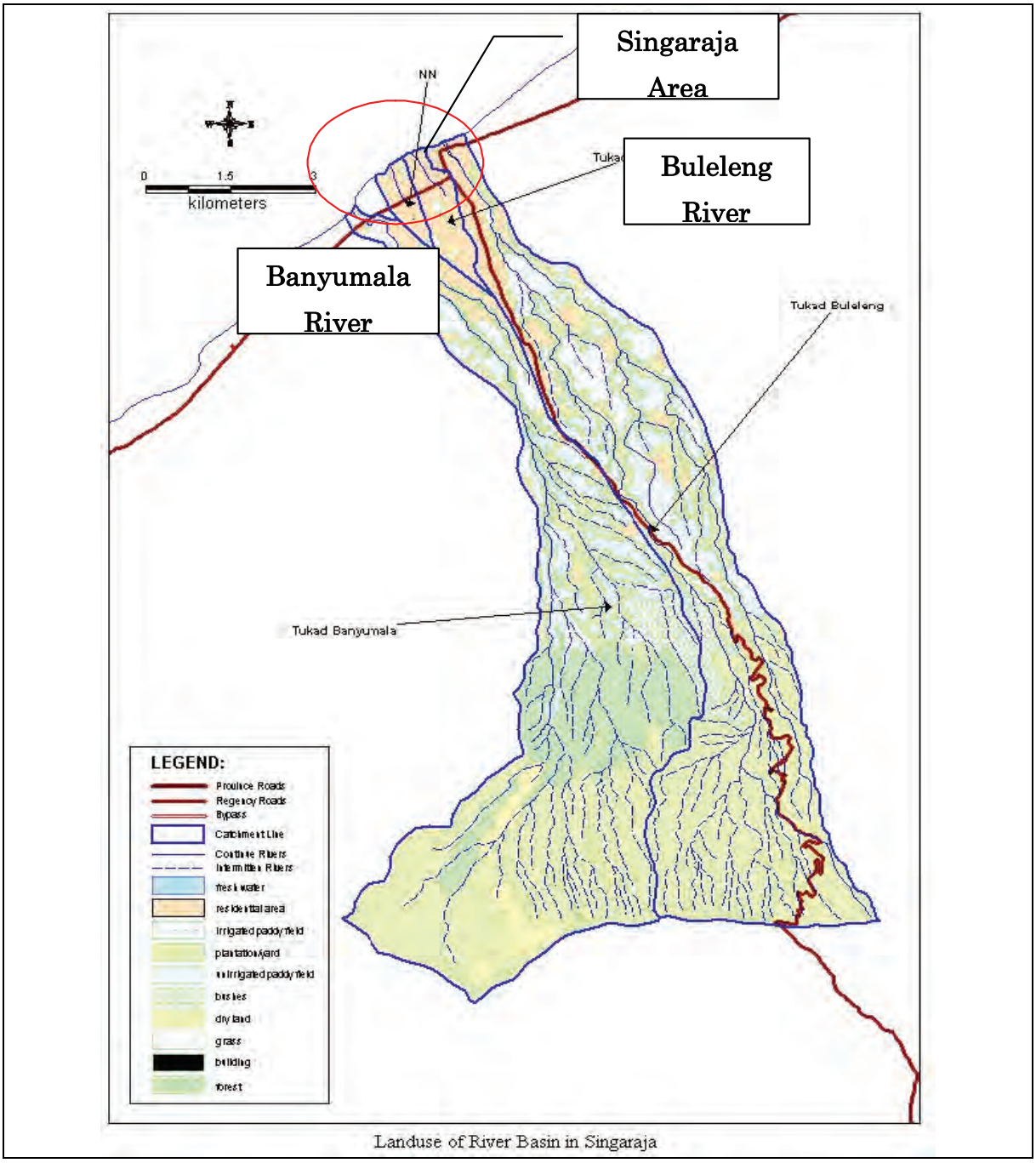


Figure-II-5.15 Banyumala and Buleleng River Basins

Current river conditions for both rivers are summarized as follows:

- Due to overflowing results from no banking or low banking in right side of downstream section of Banumala River, river water flows to center of Sigaraja.
- Poor drainage caused to low-lying area inland of Buleleng River, flows centered to right side inland area and inundation occurred.

No topographic survey results such as longitudinal section and cross sections for these area are available for river improvement plan.

5.4.2 Flood control Plan

Flood control of Banyumala River and Buleleng River is urgently needed since Singaraja City has suffering from frequent flood. Basic concepts for flood control plan are shown in follows:

- Considering the importance of the area and experiences in Indonesia, it is judged as proper design scale of 10 year-return period as initial phase.
- Although it is impossible to draw detailed plans of flood control for these rivers due to lack of basic data such as river profile and survey map, it is considered that riverbed stabilization works such as check dam and groundsill are prioritized work items as well as embankment improvement, bank protection and channel normalization.

Based on the second concept, urgent works as shown in Table-II-5.8 are recommended. Furthermore, further study based on basic data such as survey drawings, investigation of actual conditions is significantly necessary in order to draw detailed plan.

Table-II-5.8 Flood Control Plan for Banyumala River and Buleleng River

River	Length	Major Work Items
Banyumala River	1,350 m	◆ Channel Normalization: 30 m width x 0.5 m depth ◆ Embankment: 4 m width x 2.0 m height Bank Protection: 2.5 m height
Buleleng River	1,650 m	◆ Riverbed Excavation: 20 m width x 2.0 m depth Bank Protection: 2.0 m height

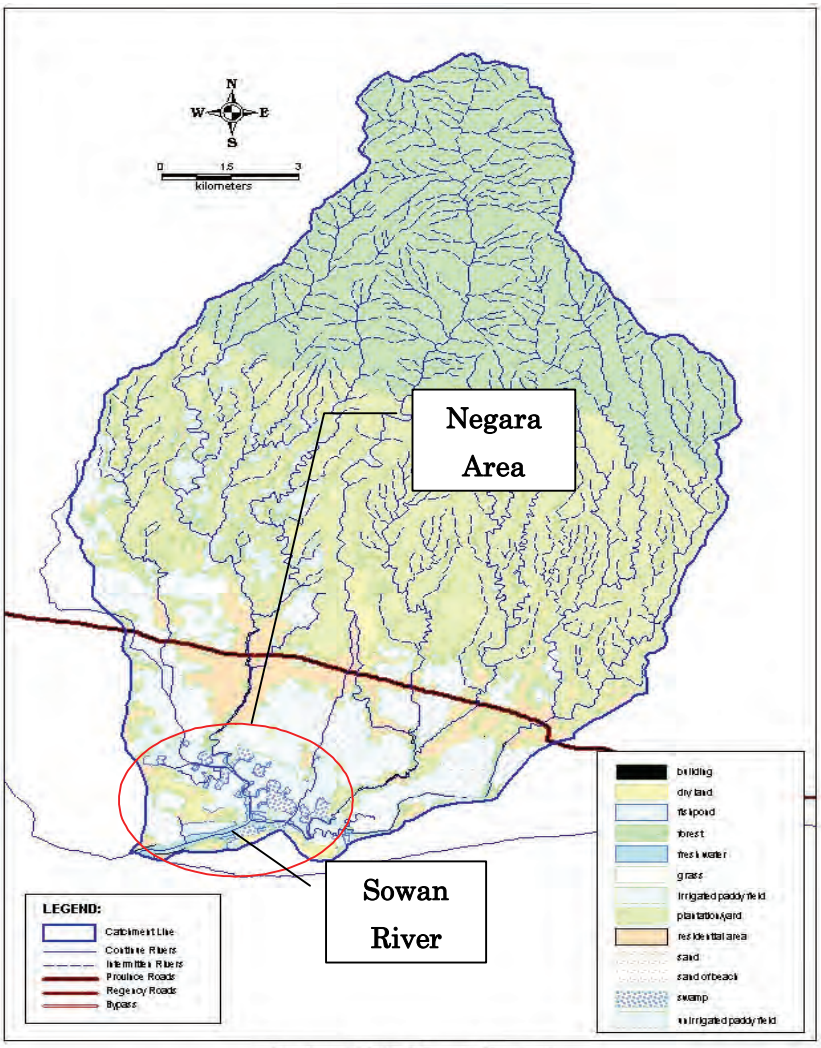
5.5 Flood Control Plan for Sowan River in Negara

5.5.1 Current Issues

Sowan River basin with a catchment area of 171.5 km^2(total area of 6 catchments area) has 6 tributaries, namely Kaliakah River, Ijogading River, Aya Timur River, Subual River, Mendoyo River and Pergung River which meets each other in south Negara. Among them, Ijogading River flows through center of Negara City and has largest discharge. River length of Ijogading from river mouth of Sowan River is 29.9 km.

Floods occurred on October 14-16 in 1998, and inundation area ranged along the national road Denpasar-Glimanuk line to south part of Negara. Based on the interview survey conducted by the Study Team, it is estimated that inundation depth are 0.5-1.0 m and inundation period reached 48 hours.

After this flood, Flood Control and Coastal Protection Project Office of Bali Province *(PPDB-Bali)* drawn a river improvement plan in 2,000 and some river improvement works are being implemented under the plan.



Landuse of Tukad Sowan Perancak

Figure-II-5.16 Sowan River Basins

Flood Area in Negara (October 14-15 1998)

Bilok Poh Bridge and its upstream wing which dropped after flooded.

October 14-16,1998

Figure-II-5.17 Inundation Area

Current river conditions for rivers are summarized as follows:

- Due to sediment supply from upstream, narrowing of flow sections in progress.
- It is difficult to wide the river width for the reason of flowing in densely houses areas for Rivers such as Kakiakah River, Ijagadeng River and Aya Timur River near Negara
- There is influence from tidal level in the section of down-steam in Sowan River.

5.5.2 Flood Control Plan for Sowan River in Negara

Design scale of 25 year-return-period is adopted for existing river improvement plan. It is considered proper scale based on "Flood Control Manual Volume II". Besides, big flood event has never been occurred after 1998 in this area. It is recommended that river improvement works are advanced under the existing plan.

Design flood discharges of tributaries are summarized in Table-II-5.9. It is noted that nearer rivers to city center, larger specific discharges.

Table-II-5.9 Design Discharge

Rivers	Catchment Area (km^2)	Design Discharge (m^3/s)	Specific Discharge ($m^3/s/km^2$)	Remarks
1)Tk. Kaliakah				
-Atas	9.86	22.16	2.25	New Plan
-Bawah	22.24	59.75	2.69	New Plan
-Bayu Biru	8.25	26.49	3.21	New Plan
2)Tk. Ijogading				
-Atas	24.12	174.61	7.24	
-Bawah	32.99	214.50	6.50	
-Tk. Titis	9.93	76.87	7.74	New Plan
3)Tk. Aya Timur	32.73	173.03	5.28	
4) Tk. Subual	17.13	92.50	5.40	
5) Tk. Mendoyo	12.23	140.17	11.46	
6) Tk. Pergung				
-Atas	21.17	96.22	4.55	
-Bawah	35.99	96.22	2.67	

River improvement works under the plan are summarized as shown in Table-II-5.10. Major works are channel normalization, embankment, bank protection and groundsill.

Table-II-5.10 Summary of River Improvement Works

Rivers	Design Discharge (m^3/s)	Type of Works on Improvement Plan	Remarks
1)Tk. Kaliakah	59.75	Channel Normalization, Embankment, Bank Protection, Groundsill Section length L=11.0 km	New
Bayu Biru	26.49		
2)Tk. Ijogading	214.50	Channel Normalization Section length L=6.0 km	Tk.Titis (New)
Tk. Titis	76.87		
3)Tk. Aya Timur	173.03	Channel Normalization Section length L=7.0 km	
4)Tk. Subual	92.50	Channel Normalization, Bank Protection Section length L=3.0 km	
5)Tk. Mendoyo	140.17	Channel Normalization, Bank Protection Section length L=5.0 km	
6)Tk. Pergung	96.22	Channel Normalization, Bank Protection Section length L=5.0 km	

Source) ***Laporan Akhir*** *Detail Desain Sistem Pengendalian Banjir Tukad Sowan dan Anak-anak Sungainya di Kabupaten Jembrana Propinsi Bali (2000)*

5.6 Flood Control Plan for Other Flood Prone Areas

Except three basins mentioned previous sections, there are many rivers by which people suffer from floods or sediment disasters. Especially, in Karangasem Regency, there are many tributaries which need to be improved in order to prevent sediment problems such as debris flow, riverbed degradation and river bank erosion. In Bali Province, flood control works as well as Sabo works are executed

under control of *PPBD-Bali*. Proposed projects for flood control and sediments are summarized in Table-II-5.11.

Table-II-5.11 Description of Proposed Projects for Flood Control Plan

Regency	River	Estimated Cost (mil. Rp.)	Facilities, Works
Bangli	Tirta Payuk River	750	Groundsill: 1 unit
Badung/Denpasar	Ayung River	4,565	Channel Normalization: 550 m, Consolidation Dam: 1 unit Bank Protection: 1,100 m
Buleleng	Bengkala River	1,050	Channel Normalization: 500 m, Bank Protection: 500 m
	Saba River	6,352	Channel Normalization: 750 m Bank Protection: 1,500 m, Spur Dyke: 15 unit Check Dam/Groundsill: 3 unit
	Gemgem River	1,980	Channel Normalization: 500 m, Bank Protection: 500 m Check Dam: 1 unit, Spur Dyke: 5 unit
	Grokgak River	2,275	Channel Normalization: 500 m, Bank Protection: 1,000 m, Check Dam: 1 unit
Gianyar	Petanu River	1,561	Channel Normalization: 775 m, Bank Protection: 1,550 m
	Sangsang River	700	Bank Protection and Groundsill
	Oos River	2,212	Channel Normalization: 750 m, Bank Protection: 1,500 m, Check Dam: 1 unit
	Pakerisan River	975	Channel Normalization: 500m, Bank Protection: 1,000 m
	Sangsang River	1,240	Groundsill: 1 unit, Bank Protection: 400 m
Jembrana	Yeh Embang River	5,270	Channel Normalization: 1,700 m, Bank Protection: 2,400 m Check Dam: 1 unit, Spur Dyke: 15
	Melaya River	1,910	Channel Normalization: 800 m Bank Protection: 1,000 m, Check Dam: 1 unit
	Yeh Sumbul River	2,423	Channel Normalization: 650 m, Bank Protection: 900 m Check Dam: 1 unit, Spur Dyke: 12 unit
	Biluk Poh River	3,687	Channel Normalization: 950 m, Bank Protection: 1,900 m Groundsill: 1 unit, Spur Dyke: 20 unit
	Daya Barat River	850	Check Dam: 1unit
Karangasem	Buhu River	8,480	Channel Normalization: 3,200 m Check Dam: 1 unit, Consolidation Dam: 1 unit, Bank Protection: 6,400 m
	Krekuk River	4,387	Channel Normalization: 1,365 m Lahar Pocket Bank Improvement: 1,550m Check Dam: 1 unit, Bank Protection: 2,730 m
	Bahapi River	6,030	Channel Normalization: 600 m, Bank Protection: 1,200 m Check Dam: 2 unit, Consolidation Dam: 1 unit
	Jangga River	965	Channel Normalization: 300 m, Bank Protection: 600 m River Structure Improvement: 1 unit
	Kates River	4,032	Channel Normalization: 750 m, Bank Protection: 1,500 m Check Dam: 1 unit, Embankment: 1,500 m
	Peningsungan River	723	Channel Normalization: 300 m Bank Protection: 600 m, Spur Dyke: 3 unit
	Batu nini River	4,361	Embankment: 1,450m, Bank Protection: 1,500m Check Dam: 2 unit, Spur Dyke: 25 unit
	Daya River	6,890	Channel Normalization: 2,900 m, Bank Protection: 500 m Embankment: 4,500 m, Check Dam: 1 unit
	Karobelahan River	4,781	Channel Normalization: 650 m Embankment: 3,600 m, Check Dam: 2 unit
	Amed River	1,888	Channel Normalization: 1,250 m, Embankment: 2,500 m
Klungkung	Unda River	9,865	Bank Protection, Groundsill, Consolidation Dam
Tabanan	Yeh Bakung River	1,042	Channel Normalization: 200m, Groundsill: 1 unit Bank Protection: 400 m, Spur Dyke: 12 unit
	Sungi River	1,085	Channel Normalization: 700 m, Bank Protection: 1,400 m
	Yeh Ho River	968	Channel Normalization: 150 m Bank Protection: 300 m, Check Dam 1unit

CHAPTER 6 COST ESTIMATE

6.1 Conditions of Cost Estimate

Cost estimation for the Study is based on the costs and prices in Indonesian Rupiah (Rp.) at the time of June 2005, which exchange rate of 1 US$ = 9,260 Rp. = 106.97 yen (yen = 86.57 Rp) is applied for conversion of currencies. Unit prices used for cost estimation of projects in Master Plan Study are determined based on the "Degree of Governor of Bali No.17 year 2004 for Goods and Service Prices Standard for Government Needs of Bali Province" and "Journal for Construction Material and Interior Edition XXII July 2004". Unit prices not covered by the above information are obtained by quotations from manufactures, suppliers or distributors of products required for projects or estimation from the prices of the similar projects in the past in Indonesia. The project cost is composed of the following cost items shown in Table-II-6.1.

Table-II-6.1 Composition of Project Cost

Breakdown	Conditions/Components
(1) Construction Cost	Labor, material and equipment costs for construction
(2) Land Acquisition and Compensation	3% of construction cost for reservoir project, 2% of construction cost for other projects
(3) Government Administration Expense	5% of the construction cost
(4) Engineering Service	10% of the construction cost
(5) Contingency	10% of construction cost, land acquisition and compensation, administration expense and engineering services
(6) Government Tax	The government tax in Indonesia is the Value Added Tax (10%) which is not included for project cost estimation.

6.2 Main Facilities and Specifications for Priority Project

The main facilities and works for the priority projects are summarized in Table-II-6.2.

Table-II-6.2 Main Facilities and Works for Priority Project

Projects	Facilities, Works
1 Integrated Project	
● Multipurpose Ayung Dam	Concrete Gravity Dam, Power Generation Facility (7.6MW)
● Multipurpose Benel Dam	Rock-fill Dam, Intake Facility
2 Water Supply Project	
● Western Water Supply System	Water Treatment Plant (300 lit/s), Weir, Transmission Pipe(10.9km)
● Central Water Supply System	Water Treatment Plant (1,800 lit/s), Weir, Transmission Pipe (8.9km)
● Eastern Water Supply System	Water Treatment Plant (800 lit/s), Weir, Transmission Pipe (57.5km), Pumping Station ($6.0m^3$/min×33m)
● Water Treatment for Denpasar	Water Treatment Plant (150 lit/s) (Warribang-2)
● Water Treatment for Jembrana (Benel)	Water Treatment Plant (60/ lit/s)
● Water Supply – Well: Related regencies	Small-scale Well Development (for each Regency, 570 lit/s)
● Water Supply –Spring: Related regencies	Small-scale Spring Development (for each Regency, 1,315 lit/s)
3 Flood/Sediment control Project	
● Badung & Mati Rivers Flood Control	Riverbed Excavation (11km), Weir Improvement (Badung River), Retarding Basin (Mati River)
● Singaraja Area Flood Control	Riverbed Excavation, Channel Normalization, Revetment (Length: 3km)
● Negara and Other Areas	Channel Normalization, Banking, Revetment
● Coastal Protection	Serangan Aera :Revetment, Seawall Section length L=15.9km

Projects	Facilities, Works
4 Irrigation Project	
● Irrigation Improvement (from Ayung)	Irrigated Area (Approx. 9,500ha)
● Irrigation Improvement (from Benel)	Irrigated Area (Approx. 1,000ha)
● Irrigation Improvement: Related regencies	Intake/Channel Improvement

6.3 Project Cost

Total project cost for water resources development plan are estimated as Rp. 3,799 billion. Project costs for each component are shown as Table-II-6.3.

Table-II-6.3 Breakdown of Project Cost for Each Component

(Unit: Million Rp.)

Projects	(1)	(2)	(3)	(4)	Sub-Total (1)-(4)	(5)	Project Cost
◆ **Integrated Project**							**955,078**
1. Multipurpose Ayung Dam	692,648	13,853	34,632	69,265	810,398	81,040	891,438
(1) Dam & Reservoir	553,748						
(2) Power Facilities	138,900						
2. Multipurpose Benel Dam	49,448	989	2,472	4,945	57,854	5,785	63,640
◆ **Water Supply Project**							**828,337**
3. Western Water Supply System (W1)	51,329	1,027	2,566	5,133	60,055	6,005	66,060
4. Central Water Supply System (C1)	222,666	4,453	11,133	22,267	260,519	26,052	286,571
5. Eastern Water Supply System (E5)	248,668	4,973	12,433	24,867	290,942	29,094	320,036
6. Water Treatment for Denpasar	17,235	345	862	1,724	20,165	2,016	22,181
7. Water Treatment for Jemnrana (Benel)	8,044	161	402	804	9,411	941	10,353
8. Water Supply – Well: Related regencies	62,997	1,260	3,150	6,300	73,706	7,371	81,077
9. Water Supply – Spring: Related regencies	32,680	654	1,634	3,268	38,236	3,824	42,059
◆ **Flood/Sediment Control Project**							**1,267,234**
10 Badung &Mati Rivers Flood Control	91,135	1,823	4,557	9,114	106,628	10,663	117,291
11. Singaraja Area Flood Control	18,074	361	904	1,807	21,147	2,115	23,261
12. Flood/Sediment Control: Related regencies	478,632	9,573	23,932	47,863	560,000	56,000	616,000
13. Coastal Protection: Related regencies	396,800	7,936	19,840	39,680	464,256	46,426	510,682
◆ **Irrigation Project**							**748,514**
14. Irrigation Improvement (from Ayung)	71,250	1,425	3,563	7,125	83,363	8,336	91,699
15. Irrigation Improvement (from Benel)	7,500	150	375	750	8,775	878	9,653
16. Irrigation Improvement: Related regencies	502,845	10,057	25,142	50,285	588,329	58,833	647,162
◆ **Total**							**3,799,163**

Notes:
(1): Construction Cost (2): Land Acquisition and Compensation
(3): Government Administration Expense (4): Engineering Services (5): Contingency

6.4 Project Cost for Each Phase

The project costs for each phase is also estimated and summarized as shown in Table-II-6.4.

Table-II-6.4 Summary of Project Cost for Each Phase

(Unit: million Rp.)

Projects	Phase				Total
	2006-2010	2011-2015	2016-2020	2021-2025	
◆ **Integrated Project**	**249,753**	**644,041**	**61,284**	**0**	**955,078**
1. Multipurpose Ayung Dam	249,753	612,221	29,464	-	891,438
2. Multipurpose Benel Dam	-	31,820	31,820	-	63,640
◆ **Water Supply Project**	**41,604**	**386,230**	**253,132**	**147,371**	**828,337**
3. Western Water Supply System (W1)	-	43,532	11,264	11,264	66,060
4. Central Water Supply System (C1)	-	151,408	67,581	67,582	286,571
5. Eastern Water Supply System (E5)	-	155,293	134,693	30,050	320,036
6. Water Treatment for Denpasar	22,181	-	-	-	22,181
7.Water Treatment for Jemnrana (Benel)	-	-	10,353	-	10,353
8. Water Supply – Well: Related regencies	17,583	24,420	19,537	19,537	81,077
9. Water Supply – Spring: Related regencies	1,840	11,577	9,704	18,938	42,059
◆ **Flood/Sediment Control Project**	**337,892**	**366,002**	**281,670**	**281,670**	**1,267,234**
10. Badung & Mati Rivers Flood Control	46,917	70,374	-	-	117,291
11. Singaraja Area Flood Control	9,304	13,957	-	-	23,261
12. Flood/Sediment Control: Related regencies	154,000	154,000	154,000	154,000	616,000
13. Coastal Protection: Related Area	127,671	127,671	127,670	127,670	510,682
◆ **Irrigation Project**	**161,791**	**207,641**	**212,466**	**166,616**	**748,514**
14. Irrigation Improvement (from Ayung)	-	45,850	45,849	-	91,699
15. Irrigation Improvemet (from Benel)	-	-	4,827	4,826	9,653
16. Irrigation Improvement: Related regencies	161,791	161,791	161,790	161,790	647,162
◆ **Total**	**791,040**	**1,603,914**	**808,552**	**595,657**	**3,799,163**