V.10 River Environment

V.10.1 Results of the Biodiversity Survey

During the biodiversity survey, it had been found that between 1970 and 1997 there had been a loss of more than 70 species of fish, these may have been due the following factors, (1) change of fish habitat naturally or by other factors; (2) the indigenous fish fail in competition with non indigenous species which come from other habitat; (3) uncontrolled fish catchment. A total of 51 fish were caught and recorded during the dry and rainy season, among these only 16 were identified as indigenous to Brantas river.

Details are provided in section III.8 and Supporting Report.

Out of a total of 51 fish caught the table below provides two types of indicator species for clean water, and polluted water species. The clean water indicator fish only thrive in clean environment, wheras the polluted water indicator fish are tolerant to pollution loads

water and were generally located in the lower Brantas.

Indicator Species of Fish

No	Type of Indicator	Name
1	Clean Water Indicator	Cyprinus carpio Nemachilus fasciatus Osteochilus spilurus Bekepek (only local name known)
2	Polluted Water Indicator	Suckermouth Macrones mirocanthus Panchax panchax Poecilia reticulata Tilapia mossambica Lenger (only local name known)

V.10.1.1 Conservation Framework

The goal of conservation is to the extent possible, preserve the natural state of the river and ëstrike the optimal balance between conserving the diversity of nature and advancing human sustainable livingí. A conservation framework could help to integrate different methods and sectors involving components as varied as protected areas, technical measures in forestry, seed banks, aquaculture, botanical gardens (PJT-Arboretum) on-farm conservation areas,

settlements where river passes. It may also include regulations, social, economic and political factors.

There is complexity and uncertainty associated with biodiversity, use of strategic planning and modern adaptive management techniques would have be utilized for specific conservation activities.

The most effective way to conserve biodiversity is foremost to prevent the conversion or degradation of Brantas river habitat. Biodiversity is an important part of Brantas basin's forestry, fisheries, and tourism. Its conservation is affected by many other sectors.

Biodiversity conservation would require higher levels of cooperation and coordination than is required in traditional sectoral approaches to water resources management at PJT.

Baseline ecological, biodiversity, social and economic conditions must be characterized, monitored and evaluated overtime.

Economic incentives for conservation should be designed with special attention paid to who benefits, how and by how much.

In fish related conservation, better monitoring of fish stocks and more selective fish capture methods offer considerable scope for increasing the sustainability of harvest and the conservation of biodiversity.

V.10.1.2 Setting Priorities

The most effective actions to conserve biodiversity will take place at specific locations along the Brantas basin, and PJT capacities at present are going to be limited. Given this constraint setting priorities will have a big effect as they are likely to:

- focus on specific conservation objective;
- specify species or sites;
- reflect local values and needs;
- provide opportunity for participation by local regency/agencies (BAPPADALDA, PROKASIH, Min. of Forestryís PHDA, etc.) community and NGOs.

More specifically, resettlement of illegal occupants around Kediri, Malang, Mojokerto, and Surabaya river area should be carried out.. Sumber Brantas, Junggo, and Kademangan should be zoned for biological preservation and restoration.

V.10.2 Initial Environment Evaluation

The principal objective of an Initial Environmental Examination (IEE) is to reach a decision on whether a full-scale examination of environmental impacts, i.e., an Environmental Impact Assessment (EIA) will be required or not. The purpose of conducting the IEE for the Study on Comprehensive Management Plan for the Water Resources of the Brantas River Basin is to

identify the many environmental parameters affected by water resources development program.

The preparation of an IEE is generally an iterative assessment process that begins at the outset of the project. In this comprehensive management plan the key issues in the River Environment are (1) Watershed Management (2) Flood Control (3) Water Resources and Water Supply and (4) Water Quality, some of these issues have been analyzed in previous Study team reports.

Brantas riverís middle channel has been degrading considerably due to rampant sand mining, specially during the dry season. A lot of illegal sand mining is carried out. The mining should be prohibted.

River pollution, mainly from human and industrial wastes is serious in the Brantas river and reduces usable waste.

For the lower reaches of the Brantas, at Surabaya River, which is the most polluted among all of Brantas river areas, there is a Pollution Control Action Plan Study on-going.

In addition to the above, the IEE will focus on the conservation of biodiversity by proposing concrete measures for conservation (See Conservation Framework above). Furthermore, IEE will define parameters of allowable environmental capacity for maximum utilization of recreation and tourism business development.

The IEE should be regarded as an iterative assessment process that retains its importance

within the comprehensive management plan, but could also become a central tool for: (1) For monitoring and managing predicted impacts for many issues impacting the River Environment. (2) Refining management plan on discovery of impacts previously overlooked or changes in projects related to conservation of biodiversity, water resources, water supply, and recreational potential development among others.

The objective of the project is to formulate a comprehensive water resources management plan of the Brantas river basin including a structural development plan for appropriate, sustainable development, and management of the Brantas river basin. The major items including the above mentioned, brought to attention by the IEE will be categorized as follows:

1. Overall Impacts of the River Environment

A. Watershed Management (provided in the appropriate Chapter)

B. Flood Control (provided in the appropriate Chapter)

C. Water Resources and Water Supply (provided in the appropriate Chapter)

D. Water Quality

In the Brantas river basin industial and domestic wastes introduce large numbers and large quantities of chemicals into the environment. As reported earlier, total pollution loads

produced in 2020 compared with 1994 will be 2.8 times for industry 1.6 times for domestic. Also, it has been found that BOD and SS are lower in the dry season (May to November) and relatively higher during the wet season (December to April).

In the opinion of the study team the river quality can be maintained at a level of 6 mg/l of BOD by means of introducing introducing river maintenance water of 20 m3/s together with the appropriately sized development of waste-water treatment systems.

(1) The Problem of Eutrophication in the Reservoirs and Fish Production

The reservoirs in Brantas river basin (Selorejo, Karangkates, Lahor, and Widas reservoirs) are annual reservoirs which are already 20 years old in 1997. These reservoirs are all in the upstream area, while most of the industrial activity is located downstream. Because of this reason, the quality of water in the reservoirs tends to be good around the year. However, the nutrient content in the reservoirs tends to be high and it has been the main cause of eutrophication. The reasons for eutrophication, in addition to the external factors, such as the agricultural water run-off, is also due to the cultivation of fish in floating nets in some of these reservoirs.

The land management surrounding the reservoirs within the Brantas river basin, specially Selorejo is used as agricultural land, where chemical and organic fertilizer is used intensively. Due to this activity the impact of organic and chemical run-off has been speeding up the eutrophication process in the reservoir waters which has become a problem. Overall, the quality of Selorejo reservoir waters has been stable since its construction. It has been assumed that the proportional food chain has at present, become un-balanced. The nutrients contained in the waters are utilized by micro-organisms (phyto-planktons) then the planktons are eaten by the fish. The balance between the primary producers, the secondary producers, and the tertiary producers results in the stability of water environment.

As a result, fishery production in Selorejo reservoir has tended to decrease. To begin with, monitoring of the nutrient levels will be required. Stocking the reservoir with Oreochromis mossambica will also have to be carried out. The significance of Oreochromis mossambica in the waters is for biological control of phyto-planktons which in turn helps to avoid the ëbloomingí problem. This step is also intended for an increase in the fish production, as well as, for biological control of phyto-plankton population. The net benefit of these organisms is to provide a balance for better fish production. In Selorejo and other reservoirs, fish spreading is carried out when the water level are rising in the reservoirs. As a control measure, the floating net fish cultivation will not be carried out for the reduction of organic material load generated by fish feeding and droppings.

(2) The Problem of Water Hyacinth Control

Water Hyacinth (Enceng Gondek) is one of the factors that is speeding up the choking of the reservoirs and is also shortening their useful lives. The Enceng Gondek multiplies very quickly if the water is rich in nutrients. These can be controlled by mechanically removing Enceng Gondek or biologically by using grass carp (Ctenopharyngodon) and an insect (Neochitina sp.) in combination with mechanical removal of excessive growth. Another

suggested idea has been presented in an Australian consultant's report to the Southeast Asian Regional Center for Tropical Biology. This involves the physical control of Enceng Gondek by sinking them to 1 meter and covering them with black plastic sheet of 10 x 10 meters to cut off the sunlight so that it could decay. Subsequently, the waste is not necessarily lifted out to land but it is removed by flushing the waste downstream.

E. Conservation of Biodiversity (discussed in detail in section III.8)

F. Recreation Potential Development (discussed in detail in section III.8)

Given the scope of this study an EIA is not recommended.

Summary of Initial Environmental Examination

Impact Areas/Problems	Further Study
Brantas Watershed Management	Reconfirmation of Development Plans
Flood Control	Reconfirmation of Control Plan
Water Resources and Supply	Maximum Availability of Water
Water Quality	Emphasis on Malang and Surabaya
Conservation of Biodiversity	Upper, Middle and Delta
Recreation Development	Economic Feasibility

V.10.3 Project Implementation Program

V.10.3.1 Preliminary Proposed & Existing Project Cost

Proposed:

R&D /Laboratory/Water Quality Monitoring	:	Rp.	4500 million
O&M	:	Rp.	625 million
Biological Diversity Monitoring /Laboratory	:	Rp.	480 million
O&M	:	Rp.	9 million
Create Wetland /Fishponds	:	Rp.	44 million
Recreation Development Program	:	Rp.	648 million

Existing:

The PROKASIH program for Brantas river had a cost in 1996	:	Rp. 199 million.
The cost of environmental audits in 1996	:	Rp. 200 million
Business costs for tourism in 1996	:	Rp. 225 million

V.10.3.2Project Benefit

The income generated by tourism activities in 1996	: Rp. 476.3 million
The income from land use in the Brantas river area in 1996	: Rp. 103.7 million
The income from various sand mining operations in 1996	: Rp. 32. 7 million
Clean water sales in 1996	: Rp. 16.2 million

The above are benefits accrued for 1996, the proposed project benefits would have higher rates of returns.

V.10.4 Action Plan

Pollution control and river biodiversity conservation have to be on a convergent path in the Brantas basin for a sustainable water resources management plan. The PROKASIH 2005 Vision reiterates this as ìthe problem of water supply in broad outline includes the problem of quality and quantityî. For the PJT management to succeed, ìone river, one plan, and one coordination managementî must become the road map.

The preservation of maximum extent of the natural state of the river will be a key futre goal. The realistic target for the year 2020 will include the reclaimation of the lost indigenous species (there were 87 species in 1962 only 10 out of total 50 have been present in 1997).

The indigenous species with an economic potential, for example the good tasting Pangasius macronema (Wakal) and Ucheng, and Panchas panchas as an aquarium fish should be promoted.

The biodiversity survey has provided valuable data including 174 species of plant vegetation and 50 species of fish, efforts to harness their economic potential be included in any future plan.

The conservation framework above allows for a step by step plan to be developed and refined for specific Brantas basin requirements.

At PJT, river environment is now considered to be a key problem. An Environment Unit will be set up next year. Meanwhile, the PJT would need to show institutional capability to the newly constituted BAPEDALDA which is going to have the Vice-Chairmanís position in PROKASIH. These actions will go quite some distance in correcting the present status.

Land zoning should be applied to preserve the relatively pristine river areas like, Sumber Brantas, Junggo, and Kademangan.

Table V.1 Watershed Conservation Works for Critical Land of Erosion

Class	Definition and Characteristics of Critical Lands	Watershed Conservation Works Land Use near Critical Land			Remarks
		Upland field	Plantation	Forest	
C1	Critical land due to combination of presence of very shallow soils, very high inherent relative erodibility, localized occurrence of rock outcrops, stoniness and marginalty critical agrocrimate. Non critical land is confined only to valley bottoms with deep soils. On the farm erosion causes a major hazard.	TE	-	TE	Reforestation: not implementation due to shallow soils, rock outcrops, stony. Terracing: to be controlled erosion at erodible area.
C2	Critical land due to combination of presence of very shallow soils, very high inherent relative erodibility, localized occurrence of rock outcrops, stoniness. Non critical land is confined only to valley bottoms with deep soils. On the farm erosion causes a major hazard. On recent volcanic terrain includes land with high occurrence of boulders (>60%by volume) and shallow soils.	TE	-	TE	ditto
C3	Critical land due to combination of presence of very shallow soils, very high inherent relative erodibility, localized occurrence of rock outcrops, stoniness and steep slopes. Non critical land is confined only to valley bottoms with deep soils. On the farm erosion causes a major hazard.	TE	-	TE	ditto
C4	Critical land due to presence of coarse texture soils with low water holding capacity restricting land use, very high inherent erodivility and low stability. On the farm, stream bank and river bank erosion cause a major hazard.	RF	-	TE	Reforestation: to be implemented at future forest area. Terracing: to be controlled erosion from present forest area.
C5	Critical land due to presence of cinders, ashes, gravel, rocks and sandy soils associated with volcanic craters and very recent lava flows.	-	-	-	No measures: due to volcanic crater area.
C6	Critical land due to very high stream bank erosion hazard and occurrence of flush floods during peak rainfall events of rainy season. Effects generally only land adjacent to streams and rivers only.	TE	-	TE	Reforestation: not suitable due to field condition. Terracing: to be controlled erosion at stream and river bank.
C7	Critical land due to permanent flooding or inundation and very poor drainage, swamp or marsh.	-	-	-	No measures: not erodible area and carried out flood control works.
P	Potentially critical land consisting of C1 to C3 class conditions but under the present land utilization is not being degraded, damaged or misused. Generally forested, agroforestry, tree crops or soil conservation measures effective.	RF	-	TE	Reforestation: to be implemented as same as near the critical area. Terracing: to be controlled erosion from present forest area.
P1	Potentially critical land consisting of C4 class conditions but under the present land utilization is not being degraded, damaged or misused. Generally forested, agroforestry, tree crops cover or Soil Conservation measures generally effective.	RF	TE	TE	Reforestation: to be implemented at future forest area. Terracing: to be controlled at future plantation and forest area.
P2	Potentially critical land consisting of C5 class conditions but under the present land utilization is not being degraded, damaged or misused. Use for recreation and as a national reserve.	-	-	-	No measures: not erodible area.
SC	Seasonally critical land due to regular annual flooding and poor drainage restricting growing season and or causing crop damage during high water flows.	-	-	-	No measures: not erodible area.
SC1	Seasonally critical land due to regular annual flooding and poor drainage restricting land utilization and or causing crop damage during high water flows. In dry season subject to salt water intrusion and effects of high salinity and alkalinity.	-	-	-	No measures: not erodible area.

Note ; TE : Terracing RF : Reforestation

Source ; Class, Definition and characteristics : Screening Study Brantas Watershed, Volume III, Konto River Project, Phase III, 1988, DGRLR

Table V.2 Demarcation of Responsibilities on Water Quality Management in the Brantas River Basin

Management activities	Actions required		Responsible agencies	Implementation agencies
Overall plan, program and coordination	Establishment of "Water Quality Management Plan"	planning, programming	BWMC (PJT)	PJT/BBLH
	Coordination and instruction to related agencies	Coordinating	BWMC (PJT)	PJT/BBLH
Water quality monitoring	Monitoring of river water	O&M of WQMPCS	PJT	PJT
		O&M of automatic water quality monitoring systems	PJT	PJT
	Monitoring of river bed sediment	Sampling and analysis of river bed sediment	PJT	PJT
	Pollution sources inspection	Monitoring of domestic waste water (Business activities)	PJT	PJT/DKES
		Monitoring of domestic waste water (Dwellings)	PJT	PJT/DPU Cipta Karya
		Monitoring of industrial waste water	PJT	PJT/DPRIND
		Monitoring of agricultural waste water (livestock houses)	PJT	PJT/DPERTA
		Monitoring of other sources	PJT	PJT/DKES
	Preparation of inventory	Inventory survey	PJT	PJT
Domestic pollution control	On-site treatment facility (including semi-off-site treatment facility)	Combined type private sewage treatment facility	DPU Cipta Karya	Local government, etc.
		Sanitation facility (Septic tank, etc.)	DPU Cipta Karya	Local government
		Other methods (soil trench, etc.)	DPU Cipta Karya	Local government
	Off-site treatment facility	Sewerage systems (conventional, small-bore or shallow systems)	DPU Cipta Karya	Local government, etc.
Industrial pollution control	On-site treatment facility	Physical, chemical or biological treatment facilities	DPRIND	DPRIND
	Off-site treatment facility	Centralized treatment facility for industrial zone	DPRIND	DPRIND
		Centralized treatment facility for small scale industries	DPRIND	DPRIND
		Centralized treatment facility for densely industrialized zone	DPRIND	DPRIND
Agricultural pollution control	Waste water treatment (livestock houses)	Physical, chemical or biological treatment system	DPERTA	DPETEMA
	Agricultural chemicals uses control	Fertilizer and pesticides control	DPERTA	DPERTA
	Improvement of farming practices	Terracing, contouring, buffer strip cropping and mulching, etc.	DPERTA	DPEKEBU
Other pollution control	Sludge and septage management	Collection, treatment and disposal systems	DKES	Local government, etc.
	Solid waste (garbage) management	Collection, treatment and disposal systems	DKES	Local government, etc.
	Watershed management	Soil erosion control (afforestation, sediment control dam, etc.)	BRLKT	BRLKT
Direct purification	River maintenance flow	Optimum water allocation	PJT	PJT
		Water resource development	PJT	PJT
	Dredging or clearing	Dredging of rivers, clearing of ditches	PJT	PJT
	Utilization of Self-purification function	Soil treatment, plant treatment, etc.	PJT	PJT
Supporting activities	Assistance systems	Management of subsidy, loan and bounty	PJT	PJT/DPRIND
	License system	Issue or suspension of license for waste water discharge	PJT as a secretary	PJT/DPRIND
	Encouragement of environmental engineering industries	Technology development, financial assistance	MIT, DPRIND	BPPT, BPPI
	Human resource development	Analysts, environmental planner or engineer	BAPEDAL	EMC, BBLH
	Community participation	Promotion of campaign, financial assistance	PJT, BBLH	PJT, BBLH
	Environmental education	Promotion of campaign	BBLH	BBLH
Research and development	Pollution load identification	Simulation methods, magnitude of each pollution sources	PJT	PJT
	Domestic waste water treatment methods	Adequate treatment methods	DPU Cipta Karya	DPU Cipta Karya
	Industrial waste water treatment methods	Adequate treatment methods, cleaner production technology	MIT, DPRIND	BBPT, BPPI
	Direct purification methods	Soil treatment, plant treatment and other adequate methods	PJT	PJT
	Monitoring methods	Monitoring by aquatic life in the rivers	BBLH	BBLH
Legislation and/or Regulation	Enactment of related law and/or regulation	Water quality management, sewerage, etc.	BBLH as a secretary	BBLH
		Stringent of regulation or standards	BBLH as a secretary	BBLH

Table V.3 Required Projects on Water Quality Management in the Brantas River Basin

Management activities	Actions (projects) required		Priority	Remarks
Overall plan, program and coordination	Establishment of Water Quality Management system		Urgent	
	Institutional development of PJT	Establishment of Water Quality Management Department in PJT	Urgent	
		Enhancement of existing laboratory	Urgent	Partly commencement
		Foundation of new laboratory in Malang	Medium	
Water quality monitoring	Monitoring of river water	Establishment new system of river water	Urgent	
		Sampling and analysis of harmful components	High	
		Installation of automatic water quality monitoring system	High	
	Monitoring of river bed sediment	Sampling and analysis of river bed sediment	Medium	
	Pollution sources inspection (monitoring)	Domestic waste water (Business activities)	High	
		Domestic waste water (Dwellings)	Medium	Partly commencement
		Industrial waste water (major producers)	Urgent	Already commencement
		Industrial waste water (remaining industries)	High	
		Industrial waste water (small scale industries)	High	
		Industrial waste water (harmful components)	High	
		Agricultural waste water (livestock houses)	Urgent	Partly commencement
		Other sources	Low	Partly commencement
	Preparation of inventory	Inventory survey	High	
Domestic pollution control	On-site treatment facilities	CTPSTS (Surabaya)	Urgent	As a model project
		CTPSTS (Malang)	Urgent	ditto
		CTPSTS (Crucial facilities in other cities)	Urgent	ditto
		CTPSTS (Others)	High-low	
	Sanitation facilities	Sanitation facilities (Septic tank, imhoff tank), Surabaya	High	Partly commencement
		Sanitation facilities (Septic tank, imhoff tank), Malang	High	ditto
		Sanitation facilities (Septic tank, imhoff tank), Others	Medium-low	ditto
	Off-site treatment facilities	Sewerage system (Surabaya, SSDP)	Urgent	Partly commencement
		Sewerage system (Malang)	Urgent	
		Sewerage systems (Other cities)	Medium-low	
Industrial pollution control	On-site treatment facilities	Waste water treatment facilities for major producers	Urgent	Partly commencement
		Waste water treatment facilities for remaining large and medium scale industrie	High	
		Waste water treatment facilities for small scale industries	Medium-low	
	Off-site treatment facility	Centralized treatment facility for hot zone	Urgent	
		Centralized treatment facilities for small scale industries	Medium	
		Centralized treatment facilities for industrial parks	-	Already commencement
Agricultural pollution control	Waste water treatment (livestock houses)	Waste water treatment facilities for major producers	Urgent	Partly commencement
		Waste water treatment facilities for remaining livestock houses	High-low	
	Agricultural chemicals uses control	Preparation of guidelines	High	
	Improvement of farming practices	Technical approaches	Medium-low	As a watershed management
		Vegetative approaches	Medium-low	ditto
Other pollution control	Solid waste (garbage) management	Domestic solid waste collection, treatment and disposal systems	High	Partly commencement
		Industrial solid waste collection, treatment and disposal systems	High	
	Septage and sludge management	Septage collection, treatment and disposal systems	High	Partly commencement
		Sludge collection and disposal systems	High	
	Watershed management	Soil erosion control (afforestation, sediment control dam, etc.)	High-low	As a watershed management
Direct purification	River maintenance flow	Optimum water allocation	High	
		Water resource development	-	Already commencement
	Dredging or clearing	Dredging of rivers, clearing of ditches	High-low	As a river facilities management
	Utilization of Self-purification function	Soil treatment, plant treatment, etc.	Low	
Supporting activities	Assistance systems	Establishment of subsidy, low-interest loan and bounty	High	
	License system	Issue or suspension of license for waste water discharge	-	Already commencement
	Encouragement of environmental engineering indust	Technology development, financial assistance, tax privilege	High-low	Partly commencement
	Human resource development	Analysis, environmental planner or engineer	Urgent	
	Community participation	Promotion of campaign, financial assistance	High-low	Partly commencement
	Environmental education	Promotion of campaign	High	ditto
Research and development	Pollution load identification	Simulation methods, magnitude of each pollution sources	High	Already commencement
	Domestic waste water treatment methods	Adequate treatment methods	High	ditto
	Industrial waste water treatment methods	Adequate treatment methods, cleaner production technology	High	ditto
	Direct purification methods	Soil treatment, plant treatment and other adequate methods	High	Partly commencement
	Monitoring methods	Monitoring by aquatic life in the rivers	Low	
Legislation and/or Regulation	Enactment of related law and/or regulation	Water quality management, sewerage, etc.	Urgent	Partly commencement
		Stringent of regulation or standards	High	Partly commencement

Table V.4 Annual Potential Flow at New Lengkong Dam Site and Water Levels in Sutami Dam

(period : 1977 - 1996)

Year	Potential Flow (million m3)			Water Level in Sutami Reservoir (El.,m)		
	Annual	Drought Season	Rank in 20 years	1 June (Daily average)	30 November (Daily average)	Minimun Water Level in a Drought Season
1977	5,808.4	818.9	2	269.61	248.90	247.81
1978	10,429.5	3,928.0	20	273.05	261.21	260.84
1979	9,941.7	1,736.7	12	272.82	261.25	260.59
1980	6,640.1	992.2	4	271.92	N.A.	(257.54)
1981	8,549.5	2,316.8	19	271.13	262.96	257.87
1982	6,542.8	741.1	1	272.34	250.01	249.89
1983	7,952.0	1,846.5	13	272.21	258.82	256.66
1984	8,987.3	1,891.8	14	272.41	261.10	260.00
1985	7,217.5	1,656.4	11	272.44	260.90	260.62
1986	7,880.2	2,063.9	16	272.44	261.56	261.81
1987	6,702.5	891.3	3	270.84	264.03	259.29
1988	6,266.5	1,382.4	8	272.34	261.78	257.86
1989	7,085.1	2,254.4	18	272.80	N.A	(262.81)
1990	6,351.3	1,211.6	7	272.23	259.91	259.83
1991	6,188.1	1,053.8	6	272.36	261.58	261.03
1992	8,752.9	2,135.9	17	272.34	262.74	260.73
1993	7,274.2	1,492.7	9	272.43	260.51	256.60
1994	6,750.5	1,033.8	5	272.50	259.18	257.86
1995	8,256.4	2,008.2	15	272.40	266.12	263.23
1996	6,664.9	1,597.6	10	272.42	259.64	259.42

Source : Potential flow is calculated by the Study Team. Water level is from PJT.

Remarks : Minimum water level in 1980 and 1989 are the lowest water level within the available data.

Table V.5 Water Balance at the New Lengkong Dam (1 / 3)

DEMAND = 1996 (present condition)
NATURAL FLOW : 10 YEAR DROUGHT YEAR ; 1977

Unit : m^3/s

		Irrigation Water Demand	Return Flow from Irrigation Area Upstream of Mojokerto	Water Demand in the Fishpond	Brantas Delta Irrigation Water Return Flow	Net Water Demand in the Fishpond	Total Domestic Water Demand	Return Flow from Domestic Water Upstream of Mojokerto	Industrial Water Demand	Return Flow from Industrial Water	Total Demand without Maintenance Flow	Total Available Return Flow except for Fishpond	Net Total Demand without Maintenance Flow	Available Water at the N.L. Dam	Surplus / Deficit	Required Maintenance Flow	Net Deficit	Total Demand including Maintenance Flow
		a	b	c	d	e If e>d e=e-d Else if d>e e=0	f	g	h	i =h*0.8	j =a+e+f+h	k =b+g+i	l =j-k	m	n =m-l	o	p If n>=0 p=0 Else if n<0 p=n	q =l+o
January	1st	48.70	7.89	1.29	3.90	0.00	3.42	0.00	1.48	1.19	53.60	9.08	44.52	258.34	213.82	20.00	0.00	64.52
	2nd	70.90	13.01	1.29	4.98	0.00	3.42	0.00	1.48	1.19	75.80	14.20	61.60	248.04	186.44	20.00	0.00	81.60
	3rd	72.20	10.14	1.29	7.59	0.00	3.42	0.00	1.48	1.19	77.10	11.32	65.77	458.07	392.29	20.00	0.00	85.77
February	1st	48.70	6.23	1.29	4.86	0.00	3.42	0.00	1.47	1.17	53.58	7.40	46.18	397.80	351.62	20.00	0.00	66.18
	2nd	51.30	9.46	1.29	2.64	0.00	3.42	0.00	1.47	1.17	56.18	10.63	45.55	388.23	342.68	20.00	0.00	65.55
	3rd	42.90	7.97	1.29	1.50	0.00	3.42	0.00	1.47	1.17	47.78	9.15	38.64	404.65	366.01	20.00	0.00	58.64
March	1st	40.40	7.84	1.29	1.59	0.00	3.42	0.00	1.49	1.19	45.30	9.03	36.28	461.41	425.14	20.00	0.00	56.28
	2nd	43.90	7.13	1.29	3.03	0.00	3.42	0.00	1.49	1.19	48.80	8.32	40.48	550.96	510.48	20.00	0.00	60.48
	3rd	46.10	8.35	1.29	1.83	0.00	3.42	0.00	1.49	1.19	51.00	9.54	41.46	592.30	550.84	20.00	0.00	61.46
April	1st	60.00	10.05	1.29	4.80	0.00	3.42	0.00	1.49	1.19	64.90	11.24	53.66	477.03	423.37	20.00	0.00	73.66
	2nd	35.30	6.48	1.29	0.90	0.39	3.42	0.00	1.49	1.19	40.59	7.67	32.92	306.98	274.06	20.00	0.00	52.92
	3rd	48.50	9.98	1.29	1.65	0.00	3.42	0.00	1.49	1.19	53.40	11.17	42.24	259.72	217.48	20.00	0.00	62.24
May	1st	64.20	11.69	1.29	2.97	0.00	3.42	0.00	2.01	1.61	69.62	13.29	56.33	137.36	81.03	20.00	0.00	76.33
	2nd	80.70	14.69	1.29	5.79	0.00	3.42	0.00	2.01	1.61	86.12	16.30	69.82	101.26	31.43	20.00	0.00	89.82
	3rd	86.60	14.56	1.29	7.32	0.00	3.42	0.00	2.01	1.61	92.02	16.17	75.86	84.81	8.95	20.00	-11.05	95.86
June	1st	76.20	13.34	1.29	6.42	0.00	3.42	0.00	5.08	4.07	84.70	17.41	67.29	128.55	61.26	20.00	0.00	87.29
	2nd	80.30	12.13	1.29	9.72	0.00	3.42	0.00	5.08	4.07	88.80	16.20	72.60	139.28	66.68	20.00	0.00	92.60
	3rd	86.60	11.98	1.29	10.56	0.00	3.42	0.00	5.08	4.07	95.10	16.05	79.05	130.58	51.53	20.00	0.00	99.05
July	1st	83.20	12.09	1.29	9.66	0.00	3.42	0.00	5.37	4.29	91.98	16.38	75.60	60.98	-14.63	20.00	-34.63	95.60
	2nd	74.50	10.43	1.29	9.00	0.00	3.42	0.00	5.37	4.29	83.28	14.72	68.56	42.10	-26.46	20.00	-46.46	88.56
	3rd	71.90	9.46	1.29	9.63	0.00	3.42	0.00	5.37	4.29	80.68	13.76	66.93	50.06	-16.87	20.00	-36.87	86.93
August	1st	71.50	9.34	1.29	9.45	0.00	3.42	0.00	5.36	4.29	80.28	13.63	66.65	40.92	-25.73	20.00	-45.73	86.65
	2nd	65.90	7.92	1.29	9.84	0.00	3.42	0.00	5.36	4.29	74.68	12.21	62.46	35.53	-26.93	20.00	-46.93	82.46
	3rd	59.80	7.98	1.29	7.89	0.00	3.42	0.00	5.36	4.29	68.58	12.27	56.31	34.08	-22.23	20.00	-42.23	76.31
September	1st	59.40	7.06	1.29	8.64	0.00	3.42	0.00	5.23	4.19	68.05	11.24	56.80	34.08	-22.73	20.00	-42.73	76.80
	2nd	60.00	7.52	1.29	8.25	0.00	3.42	0.00	5.23	4.19	68.65	11.71	56.94	30.84	-26.10	20.00	-46.10	76.94
	3rd	59.00	7.20	1.29	7.26	0.00	3.42	0.00	5.23	4.19	67.65	11.38	56.27	23.71	-32.56	20.00	-52.56	76.27
October	1st	60.80	8.61	1.29	6.21	0.00	3.42	0.00	5.35	4.28	69.57	12.89	56.68	21.03	-35.65	20.00	-55.65	76.68
	2nd	42.40	4.49	1.29	5.04	0.00	3.42	0.00	5.35	4.28	51.17	8.78	42.39	17.67	-24.73	20.00	-44.73	62.39
	3rd	52.90	4.67	1.29	7.89	0.00	3.42	0.00	5.35	4.28	61.67	8.95	52.72	25.24	-27.48	20.00	-47.48	72.72
November	1st	55.10	5.18	1.29	7.23	0.00	3.42	0.00	3.47	2.77	61.98	7.95	54.03	23.37	-30.67	20.00	-50.67	74.03
	2nd	55.90	7.62	1.29	5.70	0.00	3.42	0.00	3.47	2.77	62.78	10.40	52.38	36.00	-16.39	20.00	-36.39	72.38
	3rd	64.20	13.55	1.29	2.19	0.00	3.42	0.00	3.47	2.77	71.08	16.32	54.76	62.87	8.11	20.00	-11.89	74.76
December	1st	65.40	16.97	1.29	0.48	0.81	3.42	0.00	1.61	1.29	71.24	18.27	52.97	120.35	67.38	20.00	0.00	72.97
	2nd	68.00	13.17	1.29	3.06	0.00	3.42	0.00	1.61	1.29	73.03	14.46	58.57	136.94	78.37	20.00	0.00	78.57
	3rd	55.70	10.72	1.29	2.64	0.00	3.42	0.00	1.61	1.29	60.73	12.01	48.72	288.78	240.06	20.00	0.00	68.72
Total (million m3)		1,943.4	304.7	40.8	178.4	1.0	108.0	0.0	104.0	83.2	2,156.5	387.9	1,768.5	5,808.4	4,039.9	632.4	-575.3	2,401.0
Total in the drought season (million m3)		1,035.1	140.6	20.4	123.7	0.0	54.0	0.0	78.8	63.0	1,167.9	203.7	964.2	818.9	-145.3	316.2	-564.8	1,280.5
												Total for July to November (million m^3) :		474.7			-564.8	1,039.5

: Drought season

Table V.5 Water Balance at the New Lengkong Dam (2 / 3)

DEMAND = 2020 (WITHOUT SAVING MEASURE)
NATURAL FLOW : 10 YEAR DROUGHT YEAR ; 1977

Unit : m^3/s

		Irrigation Water Demand a	Return Flow from Irrigation Area Upstream of Mojokerto b	Water Demand in the Fishpond c	Brantas Delta Irrigation Water Return Flow d	Net Water Demand in the Fishpond e If c>d e=c-d Else if d>c	Total Domestic Water Demand f	Return Flow from Domestic Water Upstream of Mojokerto g	Industrial Water Demand h	Return Flow form Industrial Water i =h*0.8	Total Demand without Maintenance Flow j =a+e+f+h	Total Utilizable Return Flow except for Fishpond k =b+g+i	Net Total Demand without Maintenance Flow l =j-k	Natural Flow at the N.L. Dam m	Surplus /Deficit without Maintenance Flow n =m-l	Required Maintenance Flow o	Net Deficit p If n>o p=0 Else if p=n-o	Total Demand Including Maintenance Flow q =l+o
January	1st	57.30	9.57	8.50	4.80	3.70	29.41	7.08	9.59	7.67	99.99	24.32	75.67	258.34	182.66	20.00	0.00	95.67
	2nd	64.70	11.12	8.50	5.70	2.80	29.41	7.08	9.59	7.67	106.49	25.87	80.62	248.04	167.42	20.00	0.00	100.62
	3rd	56.80	8.80	8.50	5.67	2.83	29.41	7.08	9.59	7.67	98.62	23.56	75.07	458.07	383.00	20.00	0.00	95.07
February	1st	45.30	7.20	8.50	3.93	4.57	29.41	7.08	9.57	7.65	88.84	21.94	66.90	397.80	330.90	20.00	0.00	86.90
	2nd	42.20	7.59	8.50	3.03	5.47	29.41	7.08	9.57	7.65	85.64	22.33	64.32	388.23	323.91	20.00	0.00	84.32
	3rd	25.70	4.03	8.50	2.07	6.43	29.41	7.08	9.57	7.65	71.10	18.77	52.34	404.65	352.31	20.00	0.00	72.34
March	1st	17.80	3.51	8.50	1.17	7.33	29.41	7.08	9.60	7.68	64.13	18.28	45.86	461.41	415.56	20.00	0.00	65.86
	2nd	16.40	2.11	8.50	1.74	6.76	29.41	7.08	9.60	7.68	62.16	16.87	45.29	550.96	505.66	20.00	0.00	65.29
	3rd	17.70	3.08	8.50	0.84	7.66	29.41	7.08	9.60	7.68	64.36	17.84	46.52	592.30	545.78	20.00	0.00	66.52
April	1st	37.20	6.65	8.50	3.06	5.44	29.41	7.08	9.60	7.68	81.64	21.41	60.24	477.03	416.79	20.00	0.00	80.24
	2nd	31.20	4.95	8.50	2.43	6.07	29.41	7.08	9.60	7.68	76.27	19.71	56.56	306.98	250.42	20.00	0.00	76.56
	3rd	48.80	9.26	8.50	3.33	5.17	29.41	7.08	9.60	7.68	92.97	24.02	68.95	259.72	190.77	20.00	0.00	88.95
May	1st	58.40	9.94	8.50	4.95	3.55	29.41	7.08	10.37	8.29	101.72	25.32	76.40	137.36	60.96	20.00	0.00	96.40
	2nd	66.00	10.59	8.50	7.11	1.39	29.41	7.08	10.37	8.29	107.16	25.96	81.20	101.26	20.06	20.00	0.00	101.20
	3rd	62.20	9.95	8.50	6.42	2.08	29.41	7.08	10.37	8.29	104.05	25.33	78.72	84.81	6.08	20.00	-13.92	98.72
June	1st	56.40	10.21	8.50	4.92	3.58	29.41	7.08	14.93	11.95	104.32	29.23	75.08	128.55	53.47	20.00	0.00	95.08
	2nd	59.80	10.09	8.50	6.60	1.90	29.41	7.08	14.93	11.95	106.04	29.12	76.92	139.28	62.36	20.00	0.00	96.92
	3rd	63.40	10.23	8.50	6.69	1.81	29.41	7.08	14.93	11.95	109.55	29.26	80.29	130.58	50.29	20.00	0.00	100.29
July	1st	59.00	10.30	8.50	5.61	2.89	29.41	7.08	15.36	12.29	106.65	29.67	76.98	60.98	-16.01	20.00	-36.01	96.98
	2nd	53.00	9.21	8.50	5.16	3.34	29.41	7.08	15.36	12.29	101.10	28.58	72.52	42.10	-30.42	20.00	-50.42	92.52
	3rd	47.00	8.00	8.50	4.92	3.58	29.41	7.08	15.36	12.29	95.34	27.37	67.97	50.06	-17.91	20.00	-37.91	87.97
August	1st	41.60	7.72	8.50	3.45	5.05	29.41	7.08	15.35	12.28	91.40	27.08	64.32	40.92	-23.40	20.00	-43.40	84.32
	2nd	37.10	6.57	8.50	3.36	5.14	29.41	7.08	15.35	12.28	86.99	25.93	61.07	35.53	-25.54	20.00	-45.54	81.07
	3rd	38.00	7.61	8.50	2.25	6.25	29.41	7.08	15.35	12.28	89.00	26.97	62.03	34.08	-27.96	20.00	-47.96	82.03
September	1st	42.70	7.91	8.50	2.94	5.56	29.41	7.08	15.16	12.12	92.82	27.12	65.70	34.08	-31.63	20.00	-51.63	85.70
	2nd	46.80	8.95	8.50	3.15	5.35	29.41	7.08	15.16	12.12	96.71	28.16	68.55	30.84	-37.71	20.00	-57.71	88.55
	3rd	43.90	8.03	8.50	3.18	5.32	29.41	7.08	15.16	12.12	93.78	27.24	66.54	23.71	-42.84	20.00	-62.84	86.54
October	1st	42.70	8.17	8.50	2.97	5.53	29.41	7.08	15.34	12.27	92.97	27.52	65.45	21.03	-44.42	20.00	-64.42	85.45
	2nd	26.60	4.17	8.50	2.37	6.13	29.41	7.08	15.34	12.27	77.47	23.52	53.95	17.67	-36.28	20.00	-56.28	73.95
	3rd	26.50	3.86	8.50	3.12	5.38	29.41	7.08	15.34	12.27	76.62	23.21	53.41	25.24	-28.17	20.00	-48.17	73.41
November	1st	29.00	3.92	8.50	2.82	5.68	29.41	7.08	12.54	10.03	76.62	21.03	55.59	23.37	-32.22	20.00	-52.22	75.59
	2nd	28.40	4.51	8.50	2.10	6.40	29.41	7.08	12.54	10.03	76.74	21.63	55.11	36.00	-19.12	20.00	-39.12	75.11
	3rd	38.00	8.03	8.50	1.02	7.48	29.41	7.08	12.54	10.03	87.42	25.15	62.27	62.87	0.60	20.00	-19.40	82.27
December	1st	44.50	10.17	8.50	1.68	6.82	29.41	7.08	9.78	7.83	90.51	25.08	65.42	120.35	54.93	20.00	0.00	85.42
	2nd	62.90	10.56	8.50	4.65	3.85	29.41	7.08	9.78	7.83	105.94	25.47	80.47	136.94	56.47	20.00	0.00	100.47
	3rd	67.20	11.92	8.50	4.83	3.67	29.41	7.08	9.78	7.83	110.06	26.83	83.23	288.78	205.55	20.00	0.00	103.23
Total (million m3)		1,409.3	244.8	268.6	118.1	150.6	930.0	224.0	388.0	310.4	2,877.9	779.3	2,098.7	5,808.4	3,709.8	632.4	-640.9	2,731.1
Total in the drought season (million m3)		683.5	120.5	134.3	58.5	75.9	465.0	112.0	233.8	187.0	1,458.1	419.5	1,038.6	818.9	-219.7	316.2	-627.6	1,354.8
													Total from July to November (million m3) :	474.7			-627.6	1,102.3

Annual total deficit : -640.863 **million m3**

: Drought season

Table V.5 Water Balance at the New Lengkong Dam (3 / 3)

DEMAND = 2020 (SAVING MEASURE)
NATURAL FLOW : 10 YEAR DROUGHT YEAR ; 1977

Unit : m^3/s

		Irrigation Water Demand a	Return Flow from Irrigation Area Upstream of Mojokerto b	Water Demand in the Fishpond c	Brantas Delta Irrigation Water Return Flow d	Net Water Demand in the Fishpond e If c>d e=c-d Else if d>c e=0	Total Domestic Water Demand f	Return Flow from Domestic Water Upstream of Mojokerto g	Industrial Water Demand h	Return Flow form Industrial Water i =h*0.8	Total Demand without Maintenance Flow j =a+e+f+h	Total Utilizable Return Flow except for Fishpond k =b+g+i	Net Total Demand without Maintenance Flow l =j-k	Natural Flow at the N.L. Dam m	Surplus / Deficit without Maintenance Flow n =m-l	Required Maintenance Flow o	Net Deficit p If n>=o p=0 Else if p<=o	Total Demand including Maintenance Flow q =l+o
January	1st	52.26	8.69	8.50	4.49	4.01	29.41	7.08	3.52	2.82	89.20	18.59	70.61	258.34	187.72	20.00	0.00	90.61
	2nd	59.09	10.10	8.50	5.33	3.17	29.41	7.08	3.52	2.82	95.19	20.00	75.19	248.04	172.85	20.00	0.00	95.19
	3rd	51.91	7.99	8.50	5.30	3.20	29.41	7.08	3.52	2.82	88.03	17.89	70.14	458.07	387.93	20.00	0.00	90.14
February	1st	41.31	6.54	8.50	3.67	4.82	29.41	7.08	3.51	2.81	79.05	16.43	62.62	397.80	335.18	20.00	0.00	82.62
	2nd	38.45	6.89	8.50	2.83	5.66	29.41	7.08	3.51	2.81	77.04	16.79	60.25	388.23	327.97	20.00	0.00	80.25
	3rd	23.40	3.66	8.50	1.93	6.56	29.41	7.08	3.51	2.81	62.89	13.55	49.34	404.65	355.31	20.00	0.00	69.34
March	1st	16.22	3.19	8.50	1.09	7.40	29.41	7.08	3.52	2.82	56.56	13.09	43.46	461.41	417.95	20.00	0.00	63.46
	2nd	14.96	1.91	8.50	1.63	6.87	29.41	7.08	3.52	2.82	54.76	11.81	42.95	550.96	508.01	20.00	0.00	62.95
	3rd	16.04	2.79	8.50	0.79	7.71	29.41	7.08	3.52	2.82	56.68	12.70	43.99	592.30	548.31	20.00	0.00	63.99
April	1st	33.96	6.04	8.50	2.86	5.64	29.41	7.08	3.52	2.82	72.53	15.94	56.59	477.03	420.44	20.00	0.00	76.59
	2nd	28.40	4.50	8.50	2.27	6.22	29.41	7.08	3.52	2.82	67.56	14.40	53.16	306.98	253.82	20.00	0.00	73.16
	3rd	44.47	8.41	8.50	3.11	5.38	29.41	7.08	3.52	2.82	82.78	18.31	64.47	259.72	195.25	20.00	0.00	84.47
May	1st	53.28	9.03	8.50	4.63	3.87	29.41	7.08	3.84	3.07	90.40	19.19	71.21	137.36	66.15	20.00	0.00	91.21
	2nd	60.42	9.62	8.50	6.64	1.85	29.41	7.08	3.84	3.07	95.52	19.77	75.75	101.26	25.51	20.00	0.00	95.75
	3rd	56.89	9.04	8.50	6.00	2.50	29.41	7.08	3.84	3.07	92.64	19.19	73.44	84.81	11.36	20.00	-8.64	93.44
June	1st	51.54	9.27	8.50	4.60	3.90	29.41	7.08	5.71	4.56	90.55	20.92	69.63	128.55	58.92	20.00	0.00	89.63
	2nd	54.83	9.17	8.50	6.17	2.33	29.41	7.08	5.71	4.56	92.27	20.82	71.45	139.28	67.83	20.00	0.00	91.45
	3rd	58.02	9.29	8.50	6.25	2.24	29.41	7.08	5.71	4.56	95.38	20.94	74.44	130.58	56.14	20.00	0.00	94.44
July	1st	53.96	9.36	8.50	5.24	3.25	29.41	7.08	5.88	4.70	92.50	21.14	71.36	60.98	-10.38	20.00	-30.38	91.36
	2nd	48.49	8.37	8.50	4.82	3.67	29.41	7.08	5.88	4.70	87.45	20.16	67.29	42.10	-25.19	20.00	-45.19	87.29
	3rd	43.04	7.27	8.50	4.60	3.90	29.41	7.08	5.88	4.70	82.23	19.05	63.17	50.06	-13.11	20.00	-33.11	83.17
August	1st	38.00	7.01	8.50	3.22	5.27	29.41	7.08	5.88	4.70	78.55	18.80	59.76	40.92	-18.84	20.00	-38.84	79.76
	2nd	33.90	5.96	8.50	3.14	5.36	29.41	7.08	5.88	4.70	74.55	17.75	56.80	35.53	-21.27	20.00	-41.27	76.80
	3rd	34.60	6.91	8.50	2.10	6.39	29.41	7.08	5.88	4.70	76.28	18.69	57.58	34.08	-23.50	20.00	-43.50	77.58
September	1st	38.89	7.18	8.50	2.75	5.75	29.41	7.08	5.80	4.64	79.84	18.90	60.94	34.08	-26.86	20.00	-46.86	80.94
	2nd	42.64	8.13	8.50	2.94	5.55	29.41	7.08	5.80	4.64	83.40	19.86	63.54	30.84	-32.70	20.00	-52.70	83.54
	3rd	40.00	7.29	8.50	2.97	5.52	29.41	7.08	5.80	4.64	80.73	19.01	61.72	23.71	-38.01	20.00	-58.01	81.72
October	1st	38.92	7.42	8.50	2.78	5.72	29.41	7.08	5.87	4.70	79.92	19.20	60.72	21.03	-39.69	20.00	-59.69	80.72
	2nd	24.25	3.79	8.50	2.21	6.28	29.41	7.08	5.87	4.70	65.81	15.57	50.25	17.67	-32.58	20.00	-52.58	70.25
	3rd	24.27	3.51	8.50	2.92	5.58	29.41	7.08	5.87	4.70	65.13	15.29	49.84	25.24	-24.61	20.00	-44.61	69.84
November	1st	26.42	3.56	8.50	2.64	5.86	29.41	7.08	4.73	3.78	66.42	14.42	52.00	23.37	-28.63	20.00	-48.63	72.00
	2nd	25.82	4.10	8.50	1.96	6.53	29.41	7.08	4.73	3.78	66.49	14.96	51.53	36.00	-15.53	20.00	-35.53	71.53
	3rd	34.43	7.30	8.50	0.95	7.54	29.41	7.08	4.73	3.78	76.11	18.16	57.95	62.87	4.92	20.00	-15.08	77.95
December	1st	40.48	9.24	8.50	1.57	6.93	29.41	7.08	3.60	2.88	80.42	19.21	61.21	120.35	59.14	20.00	0.00	81.21
	2nd	57.28	9.59	8.50	4.35	4.15	29.41	7.08	3.60	2.88	94.44	19.55	74.89	136.94	62.05	20.00	0.00	94.89
	3rd	61.22	10.82	8.50	4.51	3.98	29.41	7.08	3.60	2.88	98.21	20.79	77.42	288.78	211.36	20.00	0.00	97.42
Total (million m3)		1,286.1	222.4	268.6	110.3	158.3	930.0	224.0	146.0	116.8	2,520.4	563.2	1,957.2	5,808.4	3,851.2	632.4	-576.8	2,589.6
Total in the drought season (million m3)		624.0	109.4	134.3	54.6	79.7	465.0	112.0	89.3	71.4	1,258.0	292.8	965.1	818.9	-146.2	316.2	-568.6	1,281.3
												Total from July to November (million m3) :		474.7			-568.6	1,043.3

Annual total deficit : -576.81 million m3

Drought season

Table V.6 Summary of Water Deficit at the New Lengkong Dam(1/2)
(No Water Saving Measure)

DEMAND = 2020

Unit : m^3/s

	Year	1982	1977	1987	1980	1994	1991	1988	1996	1979	1995	1981	1978	Min. Deficit	Max. Deficit
January	1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
February	1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
March	1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
April	1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May	1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2nd	-1.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.99
	3rd	-11.06	-13.65	-10.63	-5.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-13.65
June	1st	-13.69	0.00	0.00	-9.24	0.00	-5.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-13.69
	2nd	-24.67	0.00	-17.64	-34.02	0.00	-9.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-34.02
	3rd	-36.28	0.00	-27.64	-38.12	-9.09	-23.35	-9.84	-13.03	0.00	0.00	0.00	0.00	0.00	-38.12
July	1st	-37.69	-35.73	-36.02	-47.86	-20.12	-21.10	-27.49	-12.14	0.00	0.00	0.00	0.00	0.00	-47.86
	2nd	-37.69	-50.14	-25.79	-47.22	-21.71	-21.35	-21.32	-17.55	0.00	0.00	0.00	0.00	0.00	-50.14
	3rd	-37.42	-37.64	-35.84	-52.54	-20.18	-21.00	-24.93	-21.11	-12.40	0.00	0.00	0.00	0.00	-52.54
August	1st	-31.13	-43.13	-25.52	-14.34	-16.99	-19.62	0.00	-11.86	0.00	-7.23	-8.98	0.00	0.00	-43.13
	2nd	-39.97	-45.27	-36.22	-33.56	-22.40	-21.68	-28.75	0.00	-1.58	-17.20	-20.50	0.00	0.00	-45.27
	3rd	-38.28	-47.68	-27.52	-51.21	-25.72	-28.02	-36.63	-13.98	-17.70	-19.37	-9.92	0.00	0.00	-51.21
September	1st	-45.17	-51.35	-46.09	-50.68	-35.41	-33.91	-43.24	-20.86	-38.90	-27.73	-34.54	0.00	0.00	-51.35
	2nd	-49.32	-57.44	-52.15	-60.01	-40.91	-33.58	-50.34	-34.00	-41.84	-41.50	-53.12	0.00	0.00	-60.01
	3rd	-51.66	-62.56	-46.99	-60.65	-34.86	-36.18	-52.07	-29.52	-46.15	-38.04	0.00	0.00	0.00	-62.56
October	1st	-47.10	-64.15	-55.47	-54.41	-43.84	-15.03	-52.09	-9.91	-41.60	-42.46	0.00	0.00	0.00	-64.15
	2nd	-40.65	-56.01	-36.93	-24.77	-19.64	-31.05	-16.61	-7.34	-28.99	-7.67	0.00	0.00	0.00	-56.01
	3rd	-37.70	-47.90	-39.25	-29.11	-23.45	-33.21	-11.07	0.00	-11.79	0.00	0.00	0.00	0.00	-47.90
November	1st	-45.48	-51.95	-51.90	-31.02	-20.29	-30.48	-3.57	0.00	-0.40	0.00	-4.08	0.00	0.00	-51.95
	2nd	-37.41	-38.84	-44.77	0.00	-12.66	-1.42	0.00	0.00	-3.44	0.00	0.00	0.00	0.00	-44.77
	3rd	-42.78	-19.13	0.00	0.00	-4.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-42.78
December	1st	-8.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-8.73
	2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3rd	0.00	0.00	0.00	0.00	-34.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-34.13
Total (million m^3)		-629.26	-637.0	-542.3	-568.7	-359.9	-341.3	-332.8	-168.3	-215.1	-175.5	-114.2	0.0	0.0	-637.0
Total in the drought season (million m^3)		-609.48	-624.0	-532.2	-563.4	-327.5	-341.3	-332.8	-168.3	-215.1	-175.5	-114.2	0.0	0.0	-624.0

: Drought season

Table V.6 Summary of Water Deficit at the New Lengkong Dam (2/2)
(With Saving Water Measure)

DEMAND = 2020

Unit : m^3/s

	Year	1982	1977	1987	1980	1994	1991	1988	1996	1979	1995	1981	1978	Min. Deficit	Max. Deficit
January	1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
February	1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
March	1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
April	1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May	1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3rd	-5.78	-8.37	-5.35	-0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-8.37
June	1st	-8.24	0.00	0.00	-3.79	0.00	-0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-8.24
	2nd	-19.20	0.00	-12.17	-28.55	0.00	-4.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-28.55
	3rd	-30.43	0.00	-21.79	-32.27	-3.24	-17.50	-3.99	-7.18	0.00	0.00	0.00	0.00	0.00	-32.27
July	1st	-32.06	-30.11	-30.39	-42.23	-14.50	-15.47	-21.86	-6.51	0.00	0.00	0.00	0.00	0.00	-42.23
	2nd	-32.46	-44.92	-20.56	-41.99	-16.49	-16.12	-16.09	-12.32	0.00	0.00	0.00	0.00	0.00	-44.92
	3rd	-32.62	-32.84	-31.04	-47.74	-15.37	-16.20	-20.13	-16.31	-7.60	0.00	0.00	0.00	0.00	-47.74
August	1st	-26.57	-38.56	-20.96	-9.77	-12.42	-15.05	0.00	-7.29	0.00	-2.66	-4.41	0.00	0.00	-38.56
	2nd	-35.70	-41.00	-31.95	-29.29	-18.13	-17.41	-24.48	0.00	0.00	-12.93	-16.23	0.00	0.00	-41.00
	3rd	-33.83	-43.23	-23.06	-46.76	-21.27	-23.57	-32.18	-9.53	-13.25	-14.92	-5.47	0.00	0.00	-46.76
September	1st	-40.40	-46.59	-41.33	-45.92	-30.65	-29.14	-38.47	-16.10	-34.14	-22.97	-29.78	0.00	0.00	-46.59
	2nd	-44.31	-52.43	-47.14	-55.00	-35.90	-28.57	-45.34	-28.99	-36.83	-36.49	-48.12	0.00	0.00	-55.00
	3rd	-46.83	-57.74	-42.16	-55.82	-30.04	-31.35	-47.24	-24.69	-41.32	-33.21	0.00	0.00	0.00	-57.74
October	1st	-42.37	-59.42	-50.74	-49.68	-39.11	-10.30	-47.36	-5.18	-36.87	-37.73	0.00	0.00	0.00	-59.42
	2nd	-36.94	-52.31	-33.23	-21.07	-15.94	-27.35	-12.91	-3.64	-25.29	-3.97	0.00	0.00	0.00	-52.31
	3rd	-34.13	-44.33	-35.69	-25.54	-19.88	-29.65	-7.51	0.00	-8.23	0.00	0.00	0.00	0.00	-44.33
November	1st	-41.89	-48.36	-48.32	-27.43	-16.70	-26.89	0.00	0.00	0.00	0.00	-0.49	0.00	0.00	-48.36
	2nd	-33.82	-35.26	-41.18	0.00	-9.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-41.18
	3rd	-38.46	-14.80	0.00	0.00	-0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-38.46
December	1st	-4.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-4.51
	2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3rd	0.00	0.00	0.00	0.00	-28.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-28.32
Total (million m^3)		-545.4	-572.9	-472.2	-497.0	-290.3	-273.3	-279.5	-121.2	-178.4	-143.7	-90.8	0.0	0.0	-572.9
Total in the drought season (million m^3)		-536.0	-565.0	-467.1	-496.7	-263.4	-273.3	-279.5	-121.2	-178.4	-143.7	-90.8	0.0	0.0	-565.0

: Drought season

Table V.7 Water Balance Analysis Incorporating Possible Development (1/3)

(unit : million m^3)

Demand : Present(1996)

Demand	Water Saving	Maintenance Flow	Water Resources	1982 1/20 20-yr-drought	1977 2/20 10-yr-drought	1987 3/20 6.7-yr-drought	1980 4/20 5-yr-drought	1994 5/20 4-yr-drought	1991 6/20 3.3-yr-drought	1988 8/20 2.5-yr-drought	1996 10/20 2-yr-drought	1979 12/20 1.7-yr-drought	1995 15/20 1.3-yr-drought	1981 19/20 1.05-yr-drought	1978 20/20 1-yr-drought
			Potential Flow(Annual)	6,542.8	5,808.4	6,702.5	6,640.1	6,750.5	6,188.1	6,266.5	6,664.9	9,941.7	8,256.4	8,549.5	10,429.5
			(Drought Season)	741.1	818.9	891.3	992.2	1,033.9	1,053.8	1,382.4	1,597.6	1,736.7	2,008.2	2,316.9	3,928.0
				Expected Water Deficit during Drought Season											
Present	**No-Saving**	**WITH M/F**	Natural Flow(N.F.)	539.4	564.8	474.9	501.7	269.5	279.7	278.9	120.1	164.8	134.2	94.3	0.0
			N.F+Sutami(WL:272.5-260)	424.1	449.5	359.6	386.4	154.2	164.4	163.6	4.8	49.5	18.9	0.0	0.0
			N.F+Sutami(WL:260-246)	366.3	391.7	301.8	328.5	96.4	106.6	105.8	0.0	0.0	0.0	0.0	0.0
		WITHOUT	Natural Flow(N.F.)	235.1	307.4	198.8	244.1	38.3	41.5	97.6	2.6	43.2	27.8	25.8	0.0
			N.F+Sutami(WL:272.5-260)	119.8	192.1	83.5	128.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			N.F+Sutami(WL:260-246)	62.0	134.3	25.6	70.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note : Figure in the above table shows water deficit against water demand for 1996 to be expected during 6 months of drought season by available water resources including natural flow of each year, reservoir storage and water savings.
Zero (0) in a shaded column means no deficit .
Sutami means total capacity of Sutami and Lahor

Table V.7 Water Balance Analysis Incorporating Possible Development (2/3)

Demand : 2010

(unit : million m³)

Demand	Water Saving		Water Resources	1982 1/20 20-yr-drought	1977 2/20 10-yr-drought	1987 3/20 6.7-yr-drought	1980 4/20 5-yr-drought	1994 5/20 4-yr-drought	1991 6/20 3.3-yr-drought	1988 8/20 2.5-yr-drought	1996 10/20 2-yr-drought	1979 12/20 1.7-yr-drought	1995 15/20 1.3-yr-drought	1981 19/20 1.05-yr-drought	1978 20/20 1-yr-drought
			Potential Flow(Annual)	6,542.8	5,808.4	6,702.5	6,640.1	6,750.5	6,188.1	6,266.5	6,664.9	9,941.7	8,256.4	8,549.5	10,429.5
			(Drought Season)	741.1	818.9	891.3	992.2	1,033.9	1,053.8	1,382.4	1,597.6	1,736.7	2,008.2	2,316.9	3,928.0
				Expected Water Deficit during Drought Season											
2010	No-Saving w/ Mainte Flow		Natural Flow(N.F.)	541.8	565.3	472.5	501.6	267.2	278.3	280.5	122.4	170.7	136.9	89.2	0.0
		(1)	N.F+Sutami(St, WL:272.5-260)	437.7	461.2	368.4	397.5	163.1	174.2	176.4	18.3	66.6	32.8	0.0	0.0
		(2)	N.F+Sutami(St, WL:260-246)	390.6	414.1	321.3	350.4	116.0	127.1	129.3	0.0	19.5	0.0	0.0	0.0
		(3)	N.F+St(260)+Wonorejo(Wj: Dam+Push-back Scheme)	313.0	336.5	243.7	272.8	38.4	49.5	51.7	0.0	0.0	0.0	0.0	0.0
		(4)	N.F+St(246)+Wonorejo(Wj: Dam+Push-back Scheme)	265.9	289.4	196.6	225.7	0.0	2.4	4.6	0.0	0.0	0.0	0.0	0.0
		(5)	N.F+St(260)+Wj + Umbulan	252.3	275.8	183.0	212.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(6)	N.F+St(246)+Wj + Umbulan	205.2	228.7	135.9	165.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(7)	N.F+St(260)+Wj + Umbulan + Beng	105.3	128.8	36.0	65.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(8)	N.F+St(246)+Wj + Umbulan + Beng	58.2	81.7	0.0	18.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(9)	N.F+St(260)+Wj + Umbulan + Beng + Genteng I	35.3	58.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(10)	N.F+St(260)+Wj + Umbulan + Beng + Kedundgwarak	51.3	74.8	0.0	11.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(11)	N.F+St(260)+Wj + Umbulan + Beng + Genteng I + Kedundgwarak	0.0	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(12)	N.F+St(246)+Wj + Umbulan + Beng + Genteng I	0.0	11.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(13)	N.F+St(246)+Wj + Umbulan + Beng + Kedundgwarak	4.2	27.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(14)	N.F+St(246)+Wj + Umbulan + Beng + Genteng I + Kedundgwarak	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Saving w/ Mainte Flow		Natural Flow(N.F.)	480.5	516.5	418.5	447.0	216.4	226.5	239.1	85.3	145.0	112.8	72.0	0.0
		(1)	N.F+Sutami(St, WL:272.5-260)	376.4	412.4	314.4	342.9	112.3	122.4	135.0	0.0	40.9	8.7	0.0	0.0
		(2)	N.F+Sutami(St, WL:260-246)	329.3	365.3	267.3	295.8	65.2	75.3	87.9	0.0	0.0	0.0	0.0	0.0
		(3)	N.F+St(260)+Wonorejo(Wj: Dam+Push-back Scheme)	251.7	287.7	189.7	218.2	0.0	0.0	10.3	0.0	0.0	0.0	0.0	0.0
		(4)	N.F+St(246)+Wonorejo(Wj: Dam+Push-back Scheme)	204.6	240.6	142.6	171.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(5)	N.F+St(260)+Wj + Umbulan	191.0	227.0	129.0	157.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(6)	N.F+St(246)+Wj + Umbulan	143.9	179.9	81.9	110.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(7)	N.F+St(260)+Wj + Umbulan + Beng	44.0	80.0	0.0	10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(8)	N.F+St(246)+Wj + Umbulan + Beng	0.0	32.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(9)	N.F+St(260)+Wj + Umbulan + Beng + Genteng I	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(10)	N.F+St(260)+Wj + Umbulan + Beng + Kedundgwarak	0.0	26.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(11)	N.F+St(260)+Wj + Umbulan + Beng + Genteng I + Kedundgwarak	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(12)	N.F+St(246)+Wj + Umbulan + Beng + Genteng I	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(13)	N.F+St(246)+Wj + Umbulan + Beng + Kedundgwarak	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(14)	N.F+St(246)+Wj + Umbulan + Beng + Genteng I + Kedundgwarak	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note : Figure in the above table shows water deficit against water demand for 2010 to be expected during 6 months of drought season by available water resources including natural flow of each year, reservoir storage and water savings.

Zero (0) in a shaded column means no deficit .

Sutami means total capacity of Sutami and Lahor

Table V.7 Water Balance Analysis Incorporating Possible Development (3/3)

(unit : million m³)

Demand : 2020

Demand	Water Saving		Water Resources	1982 1/20 20-yr-drought	1977 2/20 10-yr-drought	1987 3/20 6.7-yr-drought	1980 4/20 5-yr-drought	1994 5/20 4-yr-drought	1991 6/20 3.3-yr-drought	1988 8/20 2.5-yr-drought	1996 10/20 2-yr-drought	1979 12/20 1.7-yr-drought	1995 15/20 1.3-yr-drought	1981 19/20 1.05-yr-drought	1978 20/20 1-yr-drought
			Potential Flow(Annual)	6,542.8	5,808.4	6,702.5	6,640.1	6,750.5	6,188.1	6,266.5	6,664.9	9,941.7	8,256.4	8,549.5	10,429.5
			(Drought Season)	741.1	818.9	891.3	992.2	1,033.9	1,053.8	1,382.4	1,597.6	1,736.7	2,008.2	2,316.9	3,928.0
				Expected Water Deficit during Drought Season											
2020	No-Saving w/ Mainte Flow		Natural Flow(N.F.)	609.5	624.0	532.2	563.4	327.5	341.3	332.8	168.3	215.1	175.5	114.2	0.0
		(1)	N.F+Sutami(St, WL:272.5-260)	513.3	527.8	436.0	467.2	231.3	245.1	236.6	72.1	118.9	79.3	18.0	0.0
		(2)	N.F+Sutami(St, WL:260-246)	473.9	488.4	396.6	427.8	191.9	205.7	197.2	32.7	79.5	39.9	0.0	0.0
		(3)	N.F+St(260)+Wonorejo(Wj: Dam+Push-back Scheme)	388.6	403.1	311.3	342.5	106.6	120.4	111.9	0.0	0.0	0.0	0.0	0.0
		(4)	N.F+St(246)+Wonorejo(Wj: Dam+Push-back Scheme)	349.2	363.7	271.9	303.1	67.2	81.0	72.5	0.0	0.0	0.0	0.0	0.0
		(5)	N.F+St(260)+Wj + Umbulan	327.9	342.4	250.6	281.8	45.9	59.7	51.2	0.0	0.0	0.0	0.0	0.0
		(6)	N.F+St(246)+Wj + Umbulan	288.5	303.0	211.2	242.4	6.5	20.3	11.8	0.0	0.0	0.0	0.0	0.0
		(7)	N.F+St(260)+Wj + Umbulan + Beng	180.9	195.4	103.6	134.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(8)	N.F+St(246)+Wj + Umbulan + Beng	141.5	156.0	64.2	95.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(9)	N.F+St(260)+Wj + Umbulan + Beng + Genteng I	110.9	125.4	33.6	64.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(10)	N.F+St(260)+Wj + Umbulan + Beng + Kedundgwarak	126.9	141.4	49.6	80.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(11)	N.F+St(260)+Wj + Umbulan + Beng + Genteng I + Kedundgwarak	56.9	71.4	0.0	10.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(12)	N.F+St(246)+Wj + Umbulan + Beng + Genteng I	71.5	86.0	0.0	25.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(13)	N.F+St(246)+Wj + Umbulan + Beng + Kedundgwarak	87.5	102.0	10.2	41.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(14)	N.F+St(246)+Wj + Umbulan + Beng + Genteng I + Kedundgwarak	17.5	32.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Saving w/ Mainte Flow		Natural Flow(N.F.)	536.0	565.0	467.1	496.7	263.4	273.3	279.5	121.2	178.4	143.7	90.8	0.0
		(1)	N.F+Sutami(260)	439.8	468.8	370.9	400.5	167.2	177.1	183.3	25.0	82.2	47.5	0.0	0.0
		(2)	N.F+Sutami(246)	400.4	429.4	331.5	361.1	127.8	137.7	143.9	0.0	42.8	8.1	0.0	0.0
		(3)	N.F+St(260)+Wonorejo(Wj: Dam+Push-back Scheme)	315.1	344.1	246.2	275.8	42.5	52.4	58.6	0.0	0.0	0.0	0.0	0.0
		(4)	N.F+St(246)+Wonorejo(Wj: Dam+Push-back Scheme)	275.7	304.7	206.8	236.4	3.1	13.0	19.2	0.0	0.0	0.0	0.0	0.0
		(5)	N.F+St(260)+Wj + Umbulan	254.4	283.4	185.5	215.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(6)	N.F+St(246)+Wj + Umbulan	215.0	244.0	146.1	175.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(7)	N.F+St(260)+Wj + Umbulan + Beng	107.4	136.4	38.5	68.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(8)	N.F+St(246)+Wj + Umbulan + Beng	68.0	97.0	0.0	28.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(9)	N.F+St(260)+Wj + Umbulan + Beng + Genteng I	37.4	66.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(10)	N.F+St(260)+Wj + Umbulan + Beng + Kedundgwarak	53.4	82.4	0.0	14.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(11)	N.F+St(260)+Wj + Umbulan + Beng + Genteng I+ Kedundgwarak	0.0	12.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(12)	N.F+St(246)+Wj + Umbulan + Beng + Genteng I	0.0	27.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(13)	N.F+St(246)+Wj + Umbulan + Beng + Kedundgwarak	14.0	43.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(14)	N.F+St(246)+Wj + Umbulan + Beng + Genteng I + Kedundgwarak	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note : Figure in the above table shows water deficit against water demand for 2020 to be expected during 6 months of drought season by available water resources including natural flow of each year, reservoir storage and water savings,

Zero (0) in a shaded column means no deficit .

Sutami means total capacity of Sutami and Lahor

Table V.8 Comparison of Alternatives for Sengguruh and Sutami Reservoirs

	Present condition	Alt. 1	Alt. 2	Alt. 3
Countermeasure		- Construction of 17 sabo dams Storage capacity 15.1 mil cu.m - Sengguruh Dredging in rainy season 1.75 mil cum/yr Total (22yr) 38.5 mil cu.m - Sutami Dredging in rainy season 0.7 mil cum/yr Total (22yr) 15.4 mil cu.m - Construction of tunnel for sediment disposal D= 2.3 m L= 21.45 km	- Construction of 17 sabo dams Storage capacity 15.1 mil cu.m - Sengguruh Dredging in rainy season 1.75 mil cu.m/yr Total (22yr) 38.5 mil cu.m - Construction of tunnel for sediment disposal D= 2.1 m L= 21.45 km	- Construction of 17 sabo dams Storage capacity 15.1 mil cu.m - Sengguruh Dredging around intake 0.04 mil cu.m/yr Total (22yr) 0.88 mil cu.m
Cost (million Rp.) - Sengguruh - Sutami - Tunnel - Sabo dam - Other (admi etc) - Total		586,198 443,345 78,624 87,594 132,841 1,328,602	586,198 - 71,058 87,594 106,966 851,816	11,063 - - 87,594 43,474 142,131
Storage Capacity	unit: mil cu.m 2020 1997 - Sengguruh Gross 0 3.4 Effective 0 1.2 - Sutami Gross 119.6 183.4 Effective 102.4 146.6	unit: mil cu.m 2020 2020-1997 - Sengguruh Gross 2.5 -0.9 Effective 1.2 0.0 - Sutami Gross 182.5 -0.9 Effective 146.0 -0.6	unit: mil cu.m 2020 2020-1997 - Sengguruh Gross 2.5 -0.9 Effective 1.2 0.0 - Sutami Gross 167.1 -16.3 Effective 135.3 -11.3	unit: mil cu.m 2020 2020-1997 - Sengguruh Gross 0.0 -3.4 Effective 0.0 -1.2 - Sutami Gross 134.9 -48.5 Effective 113.0 -33.6
Required water for dredging & disposal (unusable water in rainy season)		- Sengguruh Dredging 7.4 mil cu.m/yr Tunnel 34.6 mil cu.m/yr Sub-total 41.9 mil cu.m/yr - Sutami Dredging 2.9 mil cu.m/yr Total 44.9 mil cu.m/yr	- Sengguruh Dredging 7.4 mil cu.m/yr Tunnel 26.4 mil cu.m/yr Sub-total 33.7 mil cu.m/yr - Sutami Dredging 0.0 mil cu.m/yr Total 33.7 mil cu.m/yr	
Energy production	unit: MWh/year 2020 1997 - Sengguruh 0 80,820 - Sutami 456,659 465,302	unit: MWh/year 2020 2020-Present - Sengguruh 78,750 -2,070 - Sutami 456,400 -8,902	unit: MWh/year 2020 2020-Present - Sengguruh 79,155 -1,665 - Sutami 456,502 -8,800	unit: MWh/year 2020 2020-Present - Sengguru 80,785 -35 * Run-of-river type - Sutami 458,697 -6,605
Benefit (mil. Rp.) - Effective storage capacity in Sutami - Energy production Sengguruh Sutami - total of Benefit		532,290 526,491 -15,668 1,043,113	390,170 528,123 -12,040 906,253	138,590 468,186 5,277 612,053
Benefit - Cost (mil. Rp.)		-285,489	54,437	469,922

Table V.9 Comparison of Alternatives for Wlingi and Lodoyo Reservoirs

	Alt.1	Alt.2	Alt.3
Countermeasure	- Dredging in Wlingi 1st - 5th yr : 1.19 mil cu.m/yr 6th - 22nd yr : 0.43 mil cu.m/yr - Dredging in Lodoyo 1st - 5th yr : 0.76 mil cu.m/yr 6th - 22nd yr : 0.73 mil cu.m/yr	- Dredging in Wlingi 1st - 5th yr : 1.19 mil cu.m/yr 6th - 22nd yr : 0.27 mil cu.m/yr - Dredging in Lodoyo 1st - 5th yr : 0.76 mil cu.m/yr 6th - 22nd yr : 0.46 mil cu.m/yr - Extension of Bypass Channel L=8.7km	- Dredging in Wlingi 1st - 5th yr : 1.19 mil cu.m/yr 6th - 22nd yr : 0.27 mil cu.m/yr - Dredging in Lodoyo 1st - 5th yr : 0.30 mil cu.m/yr 6th - 22nd yr : 0.04 mil cu.m/yr - Extension of Bypass Channel L=8.7km
Cost (mil. Rp.)			
- Wlingi	231,924	167,857	167,857
- Lodoyo	239,075	164,763	23,437
- Bypass channel	0	38,856	38,856
- Dam	0	0	0
- Other (admi etc)	23,549	33,160	26,095
- Total	494,548	404,636	256,245
Benefit (mil. Rp.)			
- Wlingi	1,099,199	1,099,709	935,778
- Lodoyo	218,060	218,196	218,470
- Kesamben	0	0	0
- Total	1,317,259	1,317,905	1,154,248
B-C	822,711	913,269	898,003

summary.xls/Summary

Table V.10 Implementation Program and Disbursement Schedule for Maintenace and Rehabilitation Works for River Facilities (without VAT)

(Unit: Million Rp.)

Project	Total Cost	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Extension of Bypass Channel																							
Construction	44,684		11,171	11,171	11,171	11,171																	
Engineering Services	3,810	762	762	762	762	762																	
Administration	2,235	447	447	447	447	447																	
O/M	6,477						381	381	381	381	381	381	381	381	381	381	381	381	381	381	381	381	381
Total	57,206	1,209	12,380	12,380	12,380	12,380	381	381	381	381	381	381	381	381	381	381	381	381	381	381	381	381	381
Dredging in Wlingi Reservoir																							
Construction	193,026	13,741	13,741	13,741	13,741	13,741	7,313	7,313	7,313	7,313	7,313	7,313	7,313	7,313	7,313	7,313	7,313	7,313	7,313	7,313	7,313	7,313	7,313
Engineering Services																							
Administration	9,657	687	687	687	687	687	366	366	366	366	366	366	366	366	366	366	366	366	366	366	366	366	366
O/M																							
Total	202,683	14,428	14,428	14,428	14,428	14,428	7,679	7,679	7,679	7,679	7,679	7,679	7,679	7,679	7,679	7,679	7,679	7,679	7,679	7,679	7,679	7,679	7,679
Dredging in Lodoyo Reservoir																							
Construction	189,485	8,776	8,776	8,776	8,776	8,776	8,565	8,565	8,565	8,565	8,565	8,565	8,565	8,565	8,565	8,565	8,565	8,565	8,565	8,565	8,565	8,565	8,565
Engineering Services																							
Administration	9,471	439	439	439	439	439	428	428	428	428	428	428	428	428	428	428	428	428	428	428	428	428	428
O/M																							
Total	198,956	9,215	9,215	9,215	9,215	9,215	8,993	8,993	8,993	8,993	8,993	8,993	8,993	8,993	8,993	8,993	8,993	8,993	8,993	8,993	8,993	8,993	8,993
Dredging in Sengguruh																							
Construction	13,596	618	618	618	618	618	618	618	618	618	618	618	618	618	618	618	618	618	618	618	618	618	618
Engineering Services																							
Administration	682	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
O/M																							
Total	14,278	649	649	649	649	649	649	649	649	649	649	649	649	649	649	649	649	649	649	649	649	649	649
Grand Total	473,123	25,501	36,672	36,672	36,672	36,672	17,702	17,702	17,702	17,702	17,702	17,702	17,702	17,702	17,702	17,702	17,702	17,702	17,702	17,702	17,702	17,702	17,702

Note: Physical contingency (15% of the total cost) is disbursed to the respective cost items.

Construction

Engineering Services

Table V.11 Annual OM Cost for River facilities

I. Operation Cost

I.1 Patrol/Inspection of river and sabo facilities.	Rp.	49.1	million
I.2 Monitoring of river-bed materials	Rp.	7.0	million
I.3 Monitoring on storage capacities and sediment material in Sabo dams in Mt. Kelud area.	Rp.	105.9	million

II. Maintenance cost for river facilities.

River channel and facilities excluding dams and weir: Rp. 12,807.6 million

(29 rivers)

Brantas	3,616.5	Song	81.1
Amprong	74.0	Badak	196.6
Lesti	329.9	Konto	2,205.9
Lahor	9.3	Widas	398.8
Lekso	63.6	Kedungsoko	100.5
Semut	0.0	Ulo	52.9
Jari	63.7	Kuncir	199.0
Putih	35.0	Bening	0.0
Parit Agung	914.1	Beng	39.3
Parit Raya	569.5	Watudakon	66.1
Ngrowo	756.8	Porong	999.0
Ngasinan	38.9	Surabaya	278.8
Tawing	101.1	Wonokromo	168.9
Tugu	17.2	Mas	630.2
Bodeng	47.6	Sumber Brantas	737.1
Meteo-hydrological observation in downstream basin			16.2

III. Operation and Maintenance cost of dam and weirs Rp. 5,352.0 million

(Dredging costs of Sengguruh, Wlingi and Lodoyo reservoirs are not included in the above cost.)

Sengguruh	689.3	Menturus	104.6
Sutami	802.6	New Lengkong	285.7
Lahor	234.7	Jagir	228.3
Selorejo	341.2	Gunungsari	138.7
Bening	228.1	Mlirip	17.1
Wlingi	694.9	Gubeng	32.6
Lodoyo	269.5	Wonokromo	34.3
Mrican	237.9	Wonorejo	945.7
Jatimlerek	66.8		

IV. Maintenance cost of Mt. Kelud sabo works	Rp.	1,970.0	million
V. Sub-total of I. - IV.	Rp.	20,291.6	million
VI. Contingency (15% of V)	Rp.	3,043.7	million
V. Grand-total	Rp.	23,335.3	million

Table V.12 Summary of Water Balance on Integrated Operation of Sutami and Wonorejo Dams

Unit: Million m^3

Discharge Condition / Water Allocation	1996 Water Demand without River Maintenance water							1996 Water Demand with River Maintenance water						
	Deficit	Water Supply				Minimum Storage		Deficit	Water Supply				Minimum Storage	
		Stami	Wonorejo	Push-back	Total	Sutami	Wonorejo		Stami	Wonorejo	Push-back	Total	Sutami	Wonorejo
1977: 2/20 Drought														
Priority to Sutami dam	46.8	173.2	72.0	14.6	259.8	0.0	34.0	270.0	173.2	106.0	15.6	294.8	0.0	0.0
Priority to Wonorejo dam	13.6	173.2	106.0	14.6	293.8	0.0	0.0	270.0	173.2	106.0	15.6	294.8	0.0	0.0
Storage capacity Basis	13.6	173.2	106.0	14.6	294.0	0.0	0.0	270.0	173.2	106.0	15.6	294.8	0.0	0.0
1980: 4/20 Drought														
Priority to Sutami dam	14.2	181.5	34.8	13.6	229.9	0.0	71.2	205.8	173.2	106.0	16.6	295.8	0.0	0.0
Priority to Wonorejo dam	0.0	124.5	106.0	13.6	244.1	48.7	0.0	205.8	173.2	106.0	16.6	295.8	0.0	0.0
Storage capacity Basis	0.0	142.9	87.6	13.6	244.1	38.6	18.4	205.8	173.2	106.0	16.6	295.8	0.0	0.0
1988: 8/20 Drought														
Priority to Sutami dam	0.0	89.2	0.0	8.4	97.6	91.3	106.0	46.0	173.4	45.9	13.6	232.8	0.0	60.1
Priority to Wonorejo dam	0.0	13.9	75.3	8.4	97.6	159.3	30.7	0.0	159.3	106.0	13.6	278.9	14.1	0.0
Storage capacity Basis	0.0	55.3	33.9	8.4	97.6	122.4	72.1	0.0	163.9	99.4	13.6	278.9	7.5	6.6
1986: 16/20 Drought														
Priority to Sutami dam	No deficit under the condition of potential flow.							0.0	41.4	0.0	5.1	46.1	135.7	106.0
Priority to Wonorejo dam								0.0	0.0	41.0	5.1	46.1	173.2	65.0
Storage capacity Basis								0.0	25.4	15.6	5.1	46.1	151.3	90.4

Table V.13 Information to be Collected

Kind of Information		Watershed Management	Flood Control Management	Water Quantity Management/ Water Resources Development	Water Quality Management	River Environment Management
Accumulated Data	General Information	Text of laws, regulations, and standards				
		Contents of operation manual				
		Outline of existing reports				
	Basic Data of River Basins	Socio-economic situation (population, households, and production of the basin)				
		Land information Land use map Maps on land slide and erosion Geologic map Topographic map	Information on flood fighting system			
	Information on Projects and Plans	Information on plans River basin conservation plan Land slide control plan Sabo plan	Information on plans Flood control plan River improvement plan	Water resources development plan Facility rehabilitation, extension plan	Pollution control plan	Environmental management plan Development of recreation facilities, rehabilitation plan
				(Outline of the Plan and its Progress)		
				POLA Water supply plan domestic, irrigation brackish, industrial hydro-electric power		
	Observed Information		Observation results precipitation, river water level, river discharge volume, water level of reservoir, and total discharge volume	Water supply records domestic, irrigation brackish, industrial hydro-electric power	Results of water quality observation	
			Records of gate operations			
	Information on River Basins	Results of investigations Riverbed material investigation Sand sampling investigation Investigation of land slide and erosion	Survey results Survey results of rivers and reservoirs Flood damage assessment			Environmental assessment
		Survey on present condition of erosion control barriers	Survey on conditions of flood control facilities and observation facilities	Survey results on facilities Low water observation facilities Intake facilities Irrigation facilities Fishpond		
	Information of Calculation Results, etc.			Water demand forecasting domestic, irrigation brackish, industrial hydro-electric power	Simulation results of Water Quality Monitoring Pollution Control System	
Real-time Information	Observed Information		Observation precipitation, river water level, river discharge volume, water level of reservoir, and total discharge volume	Actual situation of water supply	Actual condition of water quality	
			Actual situation of gate operations			
			Results of flood forecasting Flood warning			

Table V.14 Information to be Managed in Inter-agency Information System (1/5)

Organization	Member of BWMC	Observe river information	Observe water quality data	Information to be managed	Form of Information	Data processing to be required for common use of data and information	Method of data management
PJT head office	O	O		Text of laws	Text	Collection and obtain permission of use Manual input	Electronic data files
				Statistical data (socio-economic situation)	Table	Collection and obtain permission of use Preparation of tables	Electronic data files
				Topographic map	Image	Electronic filing by scanning	Original drawings, Electronic data files
				Basic data (inventory of structures, flood fighting system)	Text, table, and image	Preparation of documents (or use existing documents) Electronic filing by scanning	Documents, original drawings, Electronic data files
				Survey results (including topographic survey)	Outline (image, table, picture, etc.) Table Topographic survey data	Preparation of outline Electronic filing by scanning Result data processing	Original reports, Electronic data files
				Hydrological data	Table	Data collection from FFWS Data input and processing (data other than FFWS) Preparation of table	Electronic data files
				Water quality data	Table	Data collection from FFWS (2 stations) Data processing and input at Malang Laboratory Preparation of tables	Electronic data files
				Survey results (for delivery) Flood damage assessment Monthly report on rivers Water quality	Reports (for delivery) Electronic mail for acknowledgement of the delivery	Preparation of reports Preparation of electronic mails	Original reports Electronic data files of the electronic mails
				Progress of projects	Outline (progress)	Preparation of outline (fixed format)	Original progress reports, Electronic data files of outlines
				Information on existing reports	List	Preparation of list	Original reports Electronic data files
				Present condition of rivers (water volume, water quality)	Information by image of real-time condition of rivers	Collection of real-time data from FFWS Process the data into image data	Electronic data files
PJT(SURABAYA)		O		Progress of projects	Outline (progress)	Preparation of outline (fixed format)	Original progress reports, Electronic data files of outlines
				Information on existing reports	List	Preparation of list	Original reports, Electronic data files
Sutami		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files

Table V.14 Information to be Managed in Inter-agency Information System (2/5)

Organization	Member of BWMC	Observe river information	Observe water quality data	Information to be managed	Form of Information	Data processing to be required for common use of data and information	Method of data management
Wlingi		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Lodoyo		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Selorejo		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Tulungagung inlet gate		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Tulungagung pump station		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Wonorejo		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Segawe		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Tiudan		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Mrican		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Bening		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Jatimlerek		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Menturus		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
New Lengkong		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Mlirip		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files

Table V.14 Information to be Managed in Inter-agency Information System (3/5)

Organization	Member of BWMC	Observe river information	Observe water quality data	Information to be managed	Form of Information	Data processing to be required for common use of data and information	Method of data management
Gunungsari		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
WQ Laboratory (Mojokerto)				Observation, test, and water quality data	Table	Manual input	Original recording sheets, Electronic data files
BRLKT	O			Information of drawings	Image	Electronic filing by scanning	Original drawings, Electronic data files
				Survey results	Outline Table	Preparation of outline Processing of survey results	Original reports, Electronic data files
				Precipitation data	Table	Manual input	Original recording sheets, Electronic data files
				Progress of projects	Outline (progress)	Preparation of outline (electronic mail)	Original progress reports, Electronic data file of electronic mails
				Information on existing reports	List	Preparation of list	Original reports, Electronic data files
PDAM	O	O		Water use plan (water demand)	Outline Table	Preparation of outline of the plan	Original recording sheets, Electronic data files
				Water use forecasting	Table	Preparation of outline of the forecasting	Original recording sheets, Electronic data files
				Actual water use records	Outline of activities Table (Consumption volume)	Preparation of table of water consumption records (consumption items and volume)	Original recording sheets, Electronic data files
				Progress of projects	Outline (progress)	Preparation of outline (electronic mail)	Original progress reports, Electronic data file of electronic mails
				Information on existing reports	List	Preparation of list	Original reports, Electronic data files
Dinas Pengairan	O	O		Precipitation data	Table	Manual input	Original recording sheets, Electronic data files
				Water use plan (water demand)	Outline Table	Preparation of outline of the plan	Original recording sheets, Electronic data files

Table V.14 Information to be Managed in Inter-agency Information System (4/5)

Organization	Member of BWMC	Observe river information	Observe water quality data	Information to be managed	Form of Information	Data processing to be required for common use of data and information	Method of data management
(Dinas Pengairan)				Water use forecasting	Table	Preparation of outline of the forecasting	Original recording sheets. Electronic data files
				Progress of projects	Outline (progress)	Preparation of outline (electronic mail)	Original progress reports. Electronic data file of electronic mails
				Information on existing reports	List	Preparation of list	Original reports. Electronic data files
DPRIKAN	O	O		Water use plan (water demand)	Outline Table	Preparation of outline of the plan	Original recording sheets. Electronic data files
				Water use forecasting	Table	Preparation of outline of the forecasting	Original recording sheets. Electronic data files
				Actual water use records	Outline of activities Table (Consumption volume)	Preparation of table of water consumption records (consumption items and volume)	Original recording sheets. Electronic data files
				Progress of projects	Outline (progress)	Preparation of outline (electronic mail)	Original progress reports. Electronic data file of electronic mails
				Information on existing reports	List	Preparation of list	Original reports. Electronic data files
DPRIND	O	O		Water use plan (water demand)	Outline Table	Preparation of outline of the plan	Original recording sheets. Electronic data files
				Water use forecasting	Table	Preparation of outline of the forecasting	Original recording sheets. Electronic data files
				Actual water use records	Outline of activities Table (Consumption volume)	Preparation of table of water consumption records (consumption items and volume)	Original recording sheets. Electronic data files
				Results of treatment of industrial waste water Data on water quality	Outline Table (water quality data)	Preparation of outline of the results Manual data input	Original recording sheets. Electronic data files (documents and numeric data)
				Progress of projects	Outline (progress)	Preparation of outline (electronic mail)	Original progress reports. Electronic data file of electronic mails
				Information on existing reports	List	Preparation of list	Original reports. Electronic data files

Table V.14 Information to be Managed in Inter-agency Information System (5/5)

Organization	Member of BWMC	Observe river information	Observe water quality data	Information to be managed	Form of information	Data processing to be required for common use of data and information	Method of data management
PT.PLN	O	O		Water use plan (water demand)	Outline Table	Preparation of outline of the plan	Original recording sheets, Electronic data files
				Water use forecasting	Table	Preparation of outline of the forecasting	Original recording sheets, Electronic data files
				Actual water use records	Outline of activities Table (Consumption volume)	Preparation of table of water consumption records (consumption items and volume)	Original recording sheets, Electronic data files
				Progress of projects	Outline (progress)	Preparation of outline (electronic mail)	Original progress reports, Electronic data file of electronic mails
				Information on existing reports	List	Preparation of list	Original reports, Electronic data files
BAPEDALDA	O	O	O	Results of environmental assessment on rivers	Outline	Preparation of outline of the plan	Original recording sheets, Electronic data files
				River environmental management (including water quality) Periodical reports	Outline	Preparation of outline (electronic mail)	Electronic data file of electronic mails
				Progress of projects	Outline (progress)	Preparation of outline (electronic mail)	Original progress reports, Electronic data file of electronic mails
				Information on existing reports	List	Preparation of list	Original reports, Electronic data files
DPU Cipta Karya			O	Results of treatment of urban waste water Water quality data	Outline Table (water quality data)	Preparation of outline of the results Manual data input	Original recording sheets, Electronic data files (documents and numeric data)
DPERTA			O	Water quality data	Table (water quality data)	Manual data input	Original recording sheets, Electronic data files
DKES			O	Water quality data	Table (water quality data)	Manual data input	Original recording sheets, Electronic data files

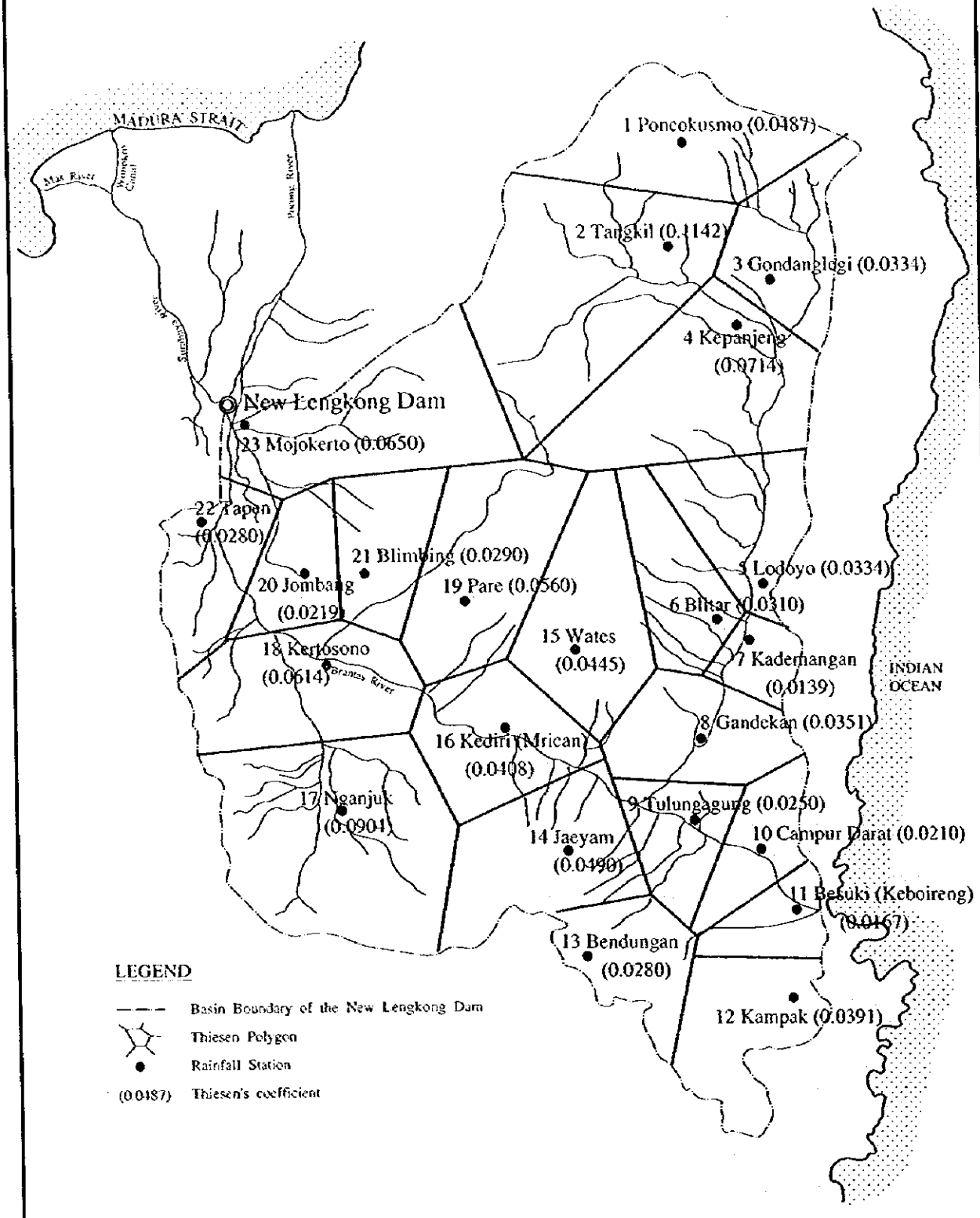


Figure V.1 Thiesen Polygon in the Catchment Area of the New Lengkong Dam

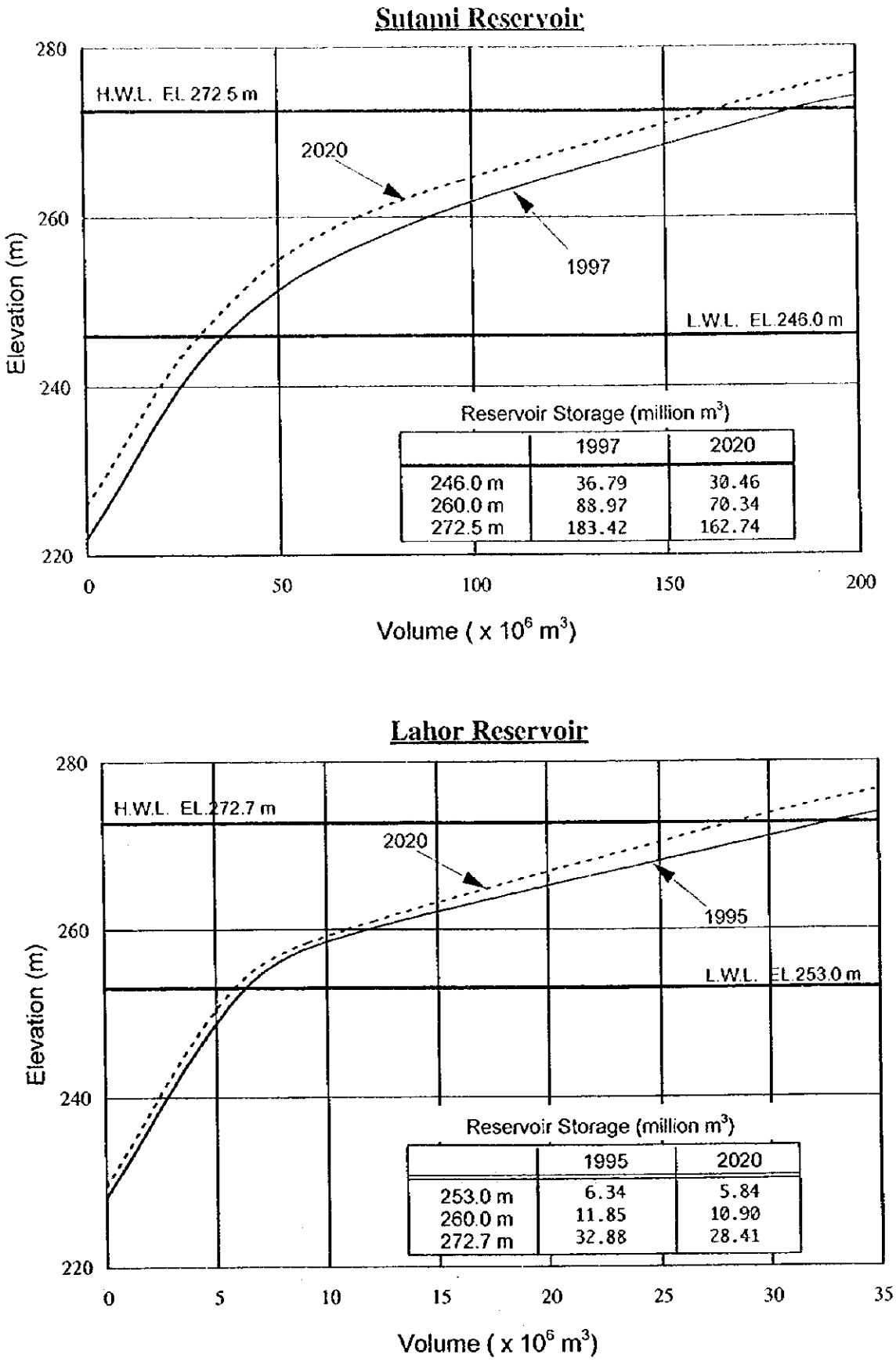


Figure V.2 H-V Curve of the Sutami and Lahor Reservoirs

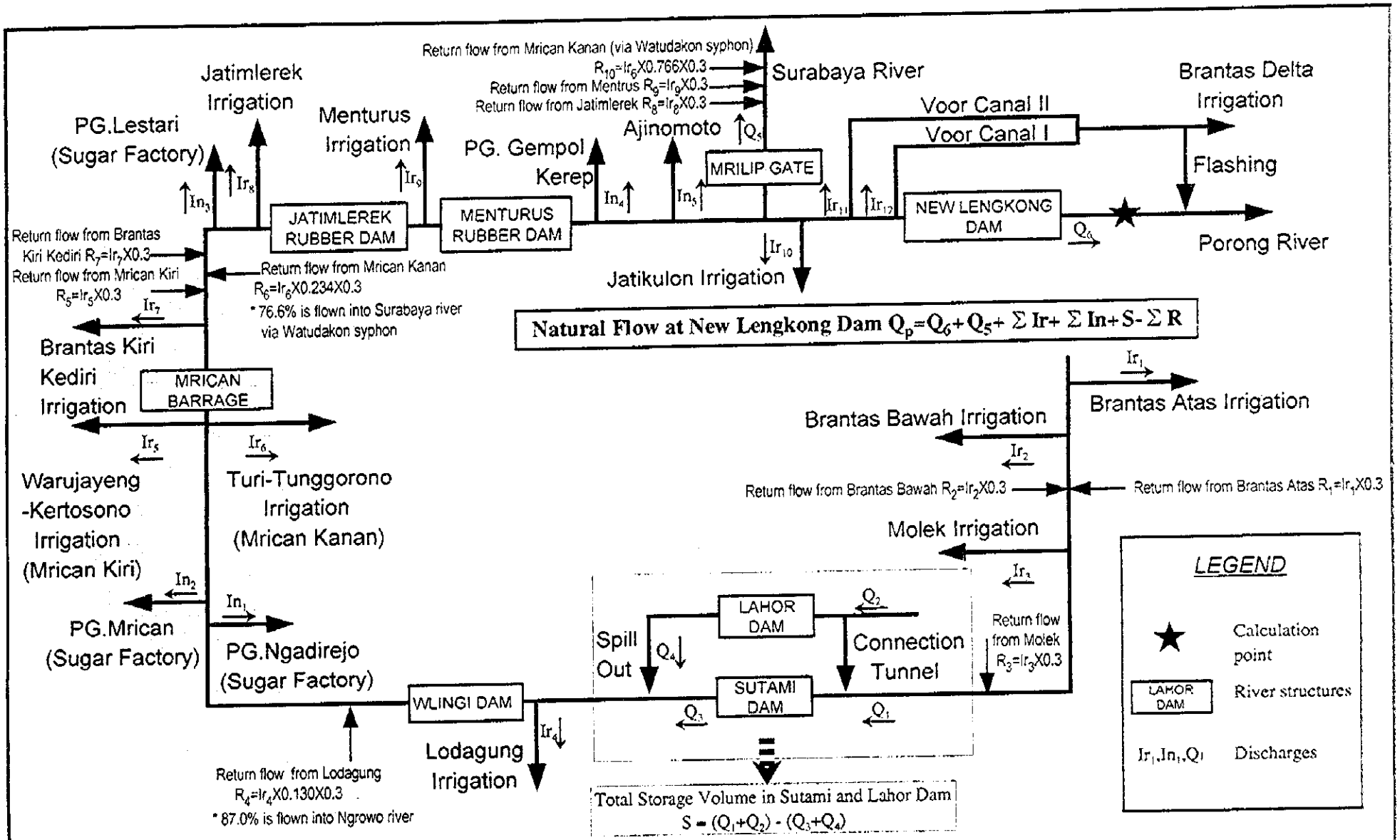


Figure V.3 Calculation Method of Natural Flow at the New Lengkong Dam

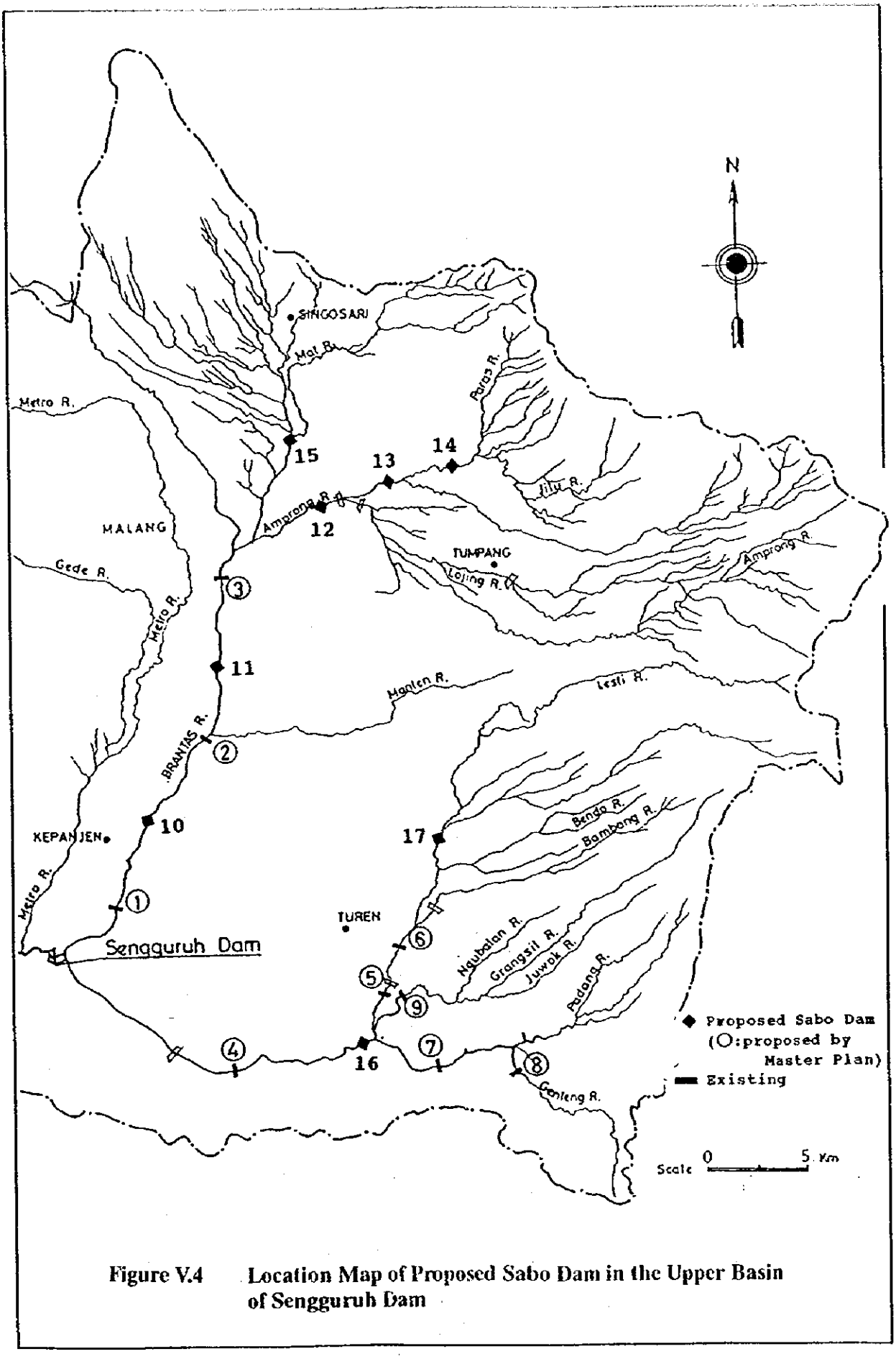


Figure V.4 **Location Map of Proposed Sabo Dam in the Upper Basin of Sengguruh Dam**

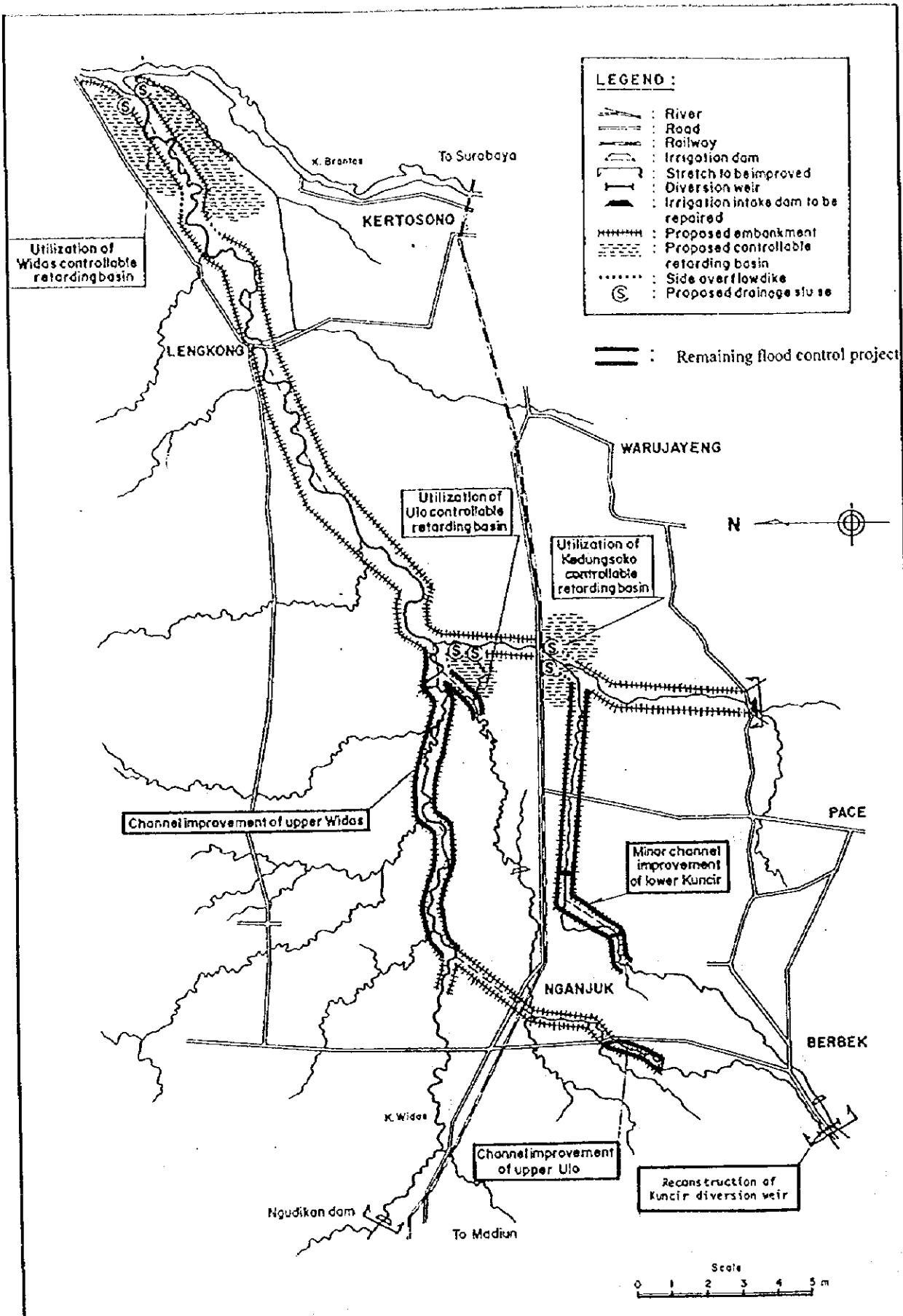
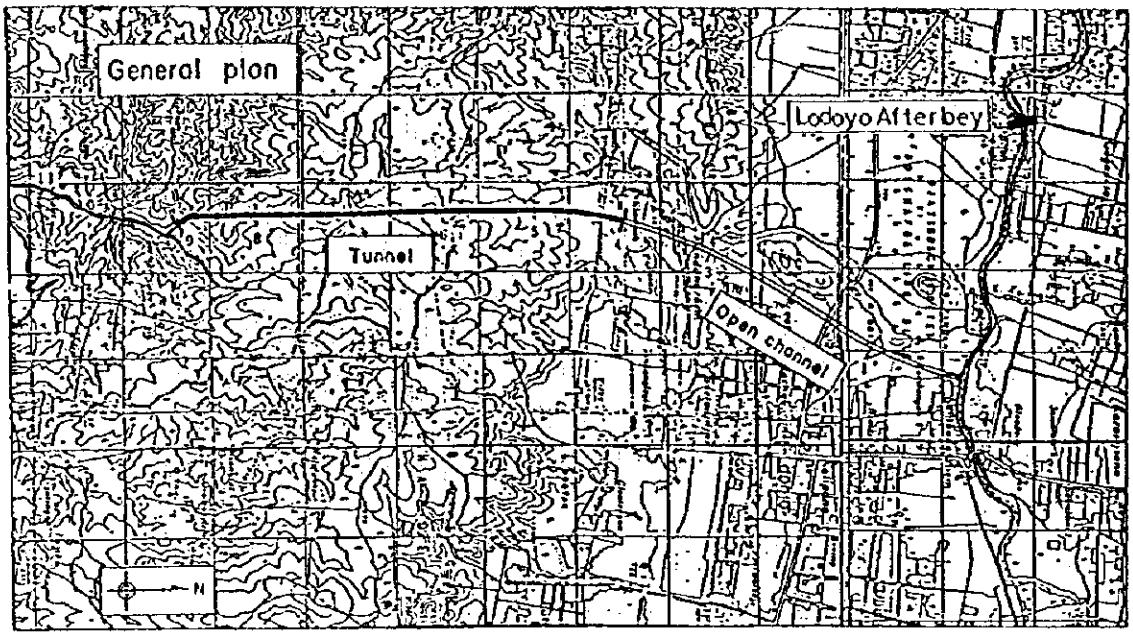
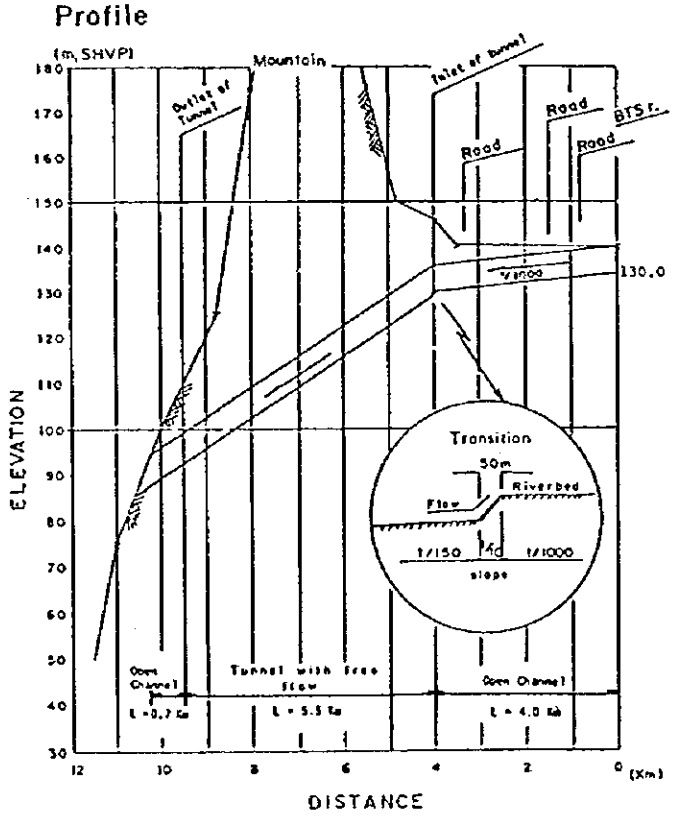
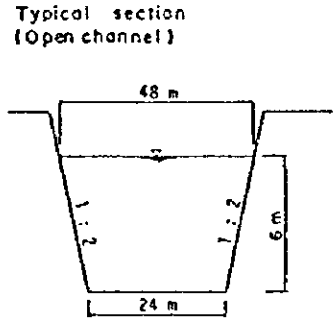


Figure V.5 Location of Proposed Widas River Flood Control Project







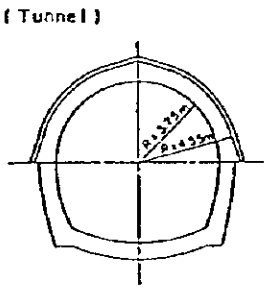


Figure V.6 Location of Proposed Diversion Channel Project

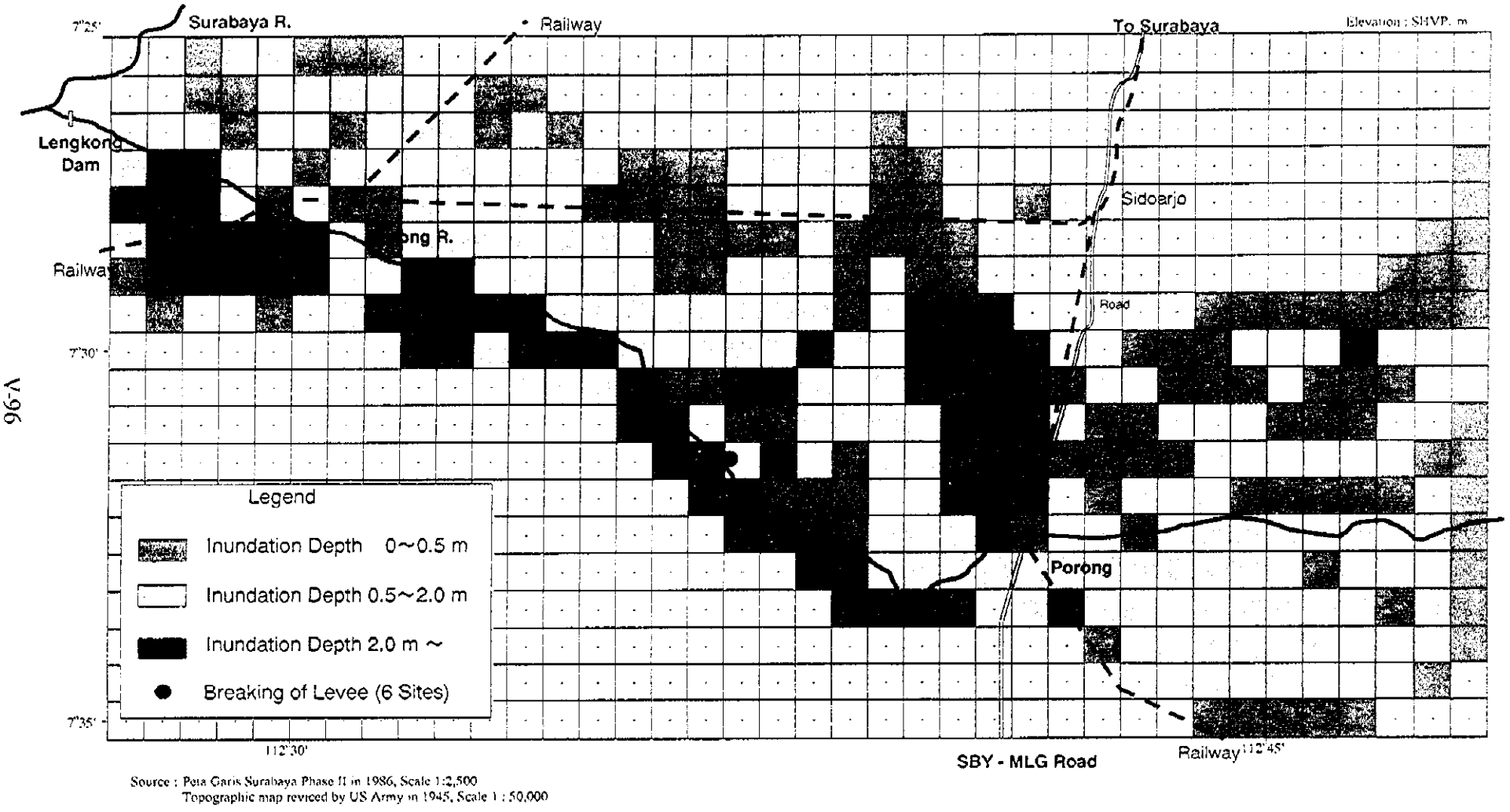


Figure V.7 Hazard Map

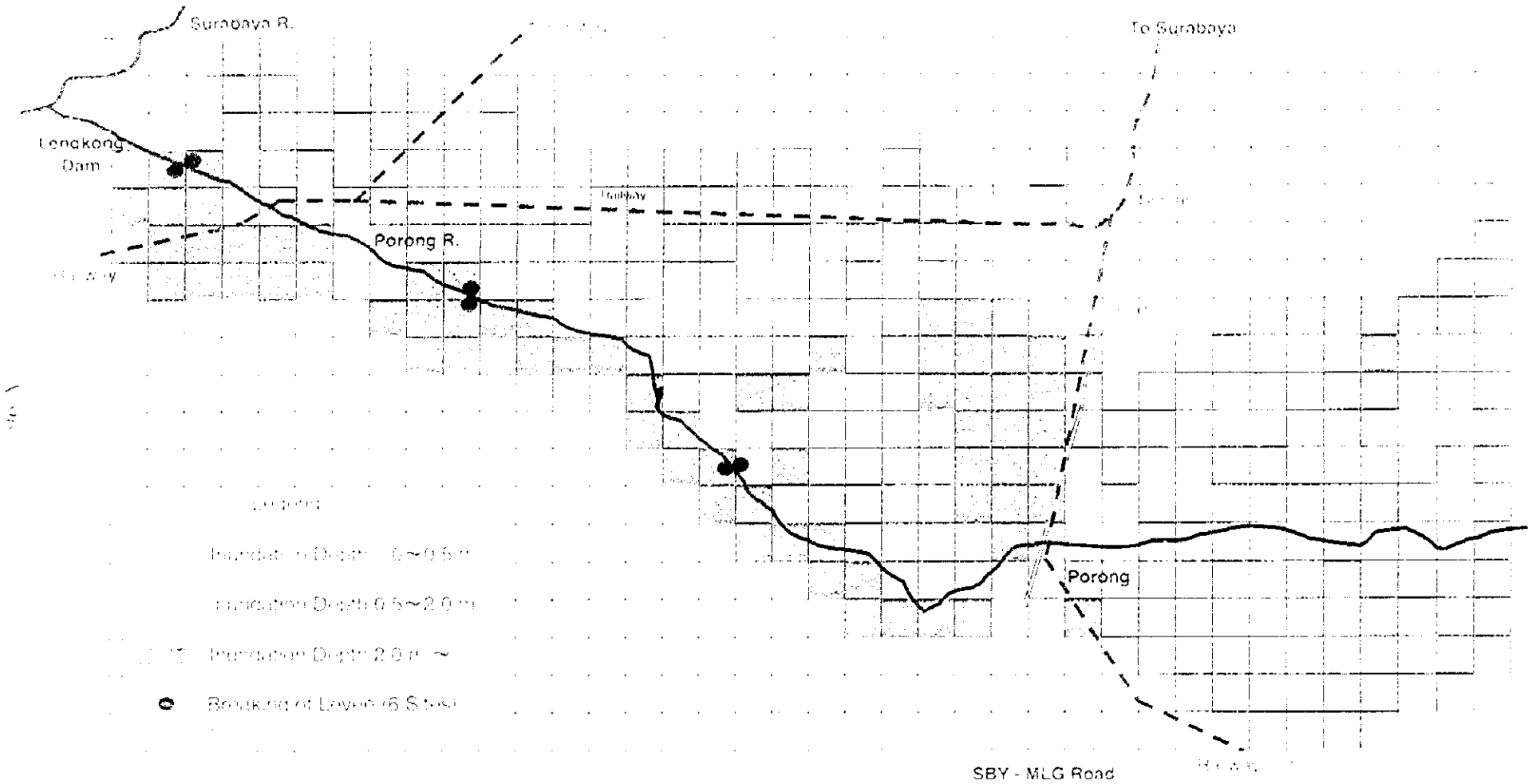


Figure V.7 Hazard Map

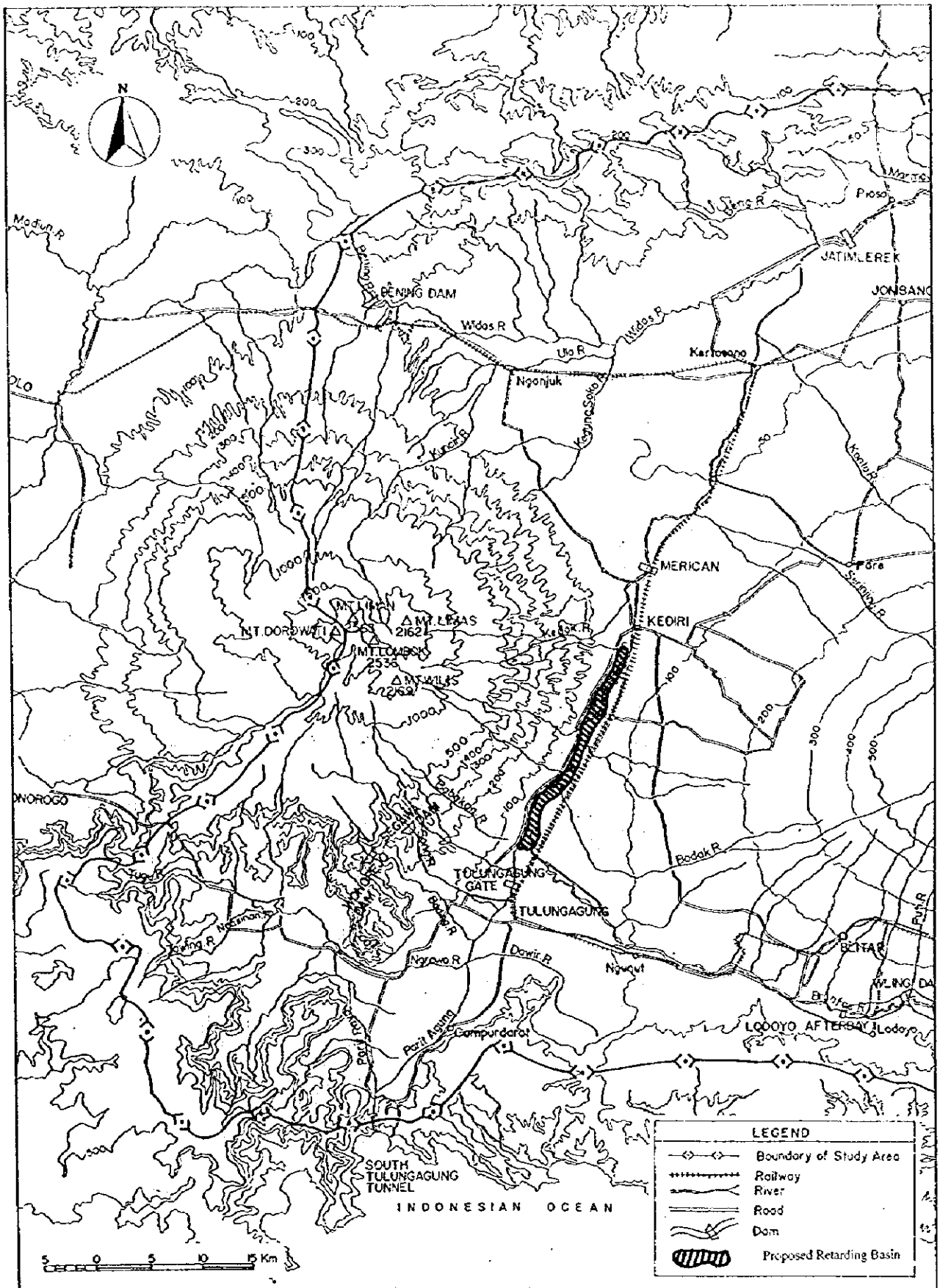


Figure V.8 **Location of Natural Retarding Basin of Brantas Middle Reach and Confluence of Ngrowo River**

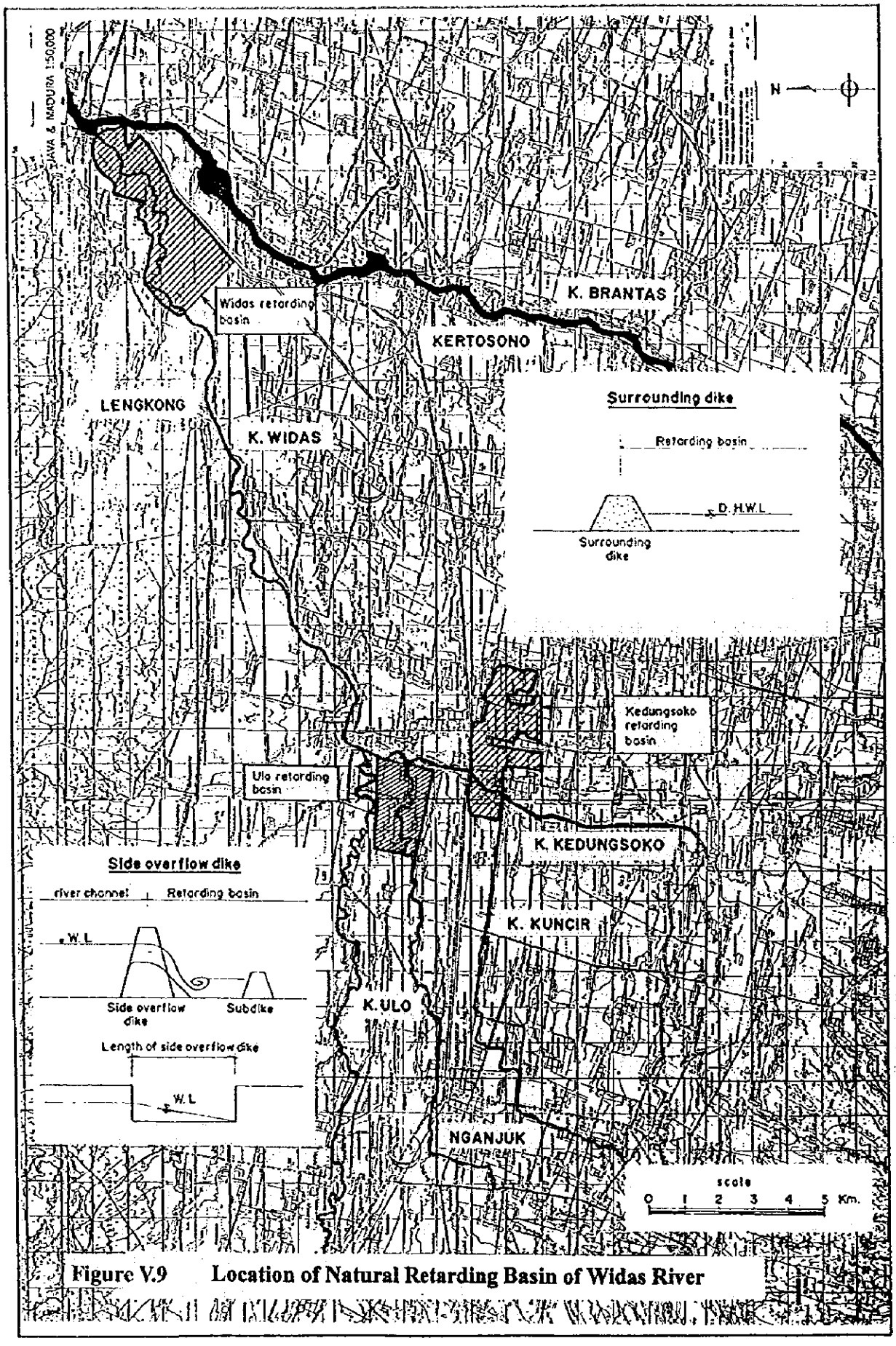


Figure V.9 Location of Natural Retarding Basin of Widas River

Project	Work Item	Amount (mil. Rp.)
1. Watershed Conservation	- Reforestation and terracing	(141,125)
1.1 Watershed Conservation by BRLKT	- Land compensation	-
	-Engineering	(14,113)
	-Administration	(7,056)
1.2 Experimental Research by PJT	-Installation/Running	2,078
	-Land compensation	1,304
	-Engineering	2,988
	-Administration/OM	614
2. Sabo	-Construction	380,980
(1) G. Kelud basin	-Land compensation	5,503
	-Engineering	38,098
	-Administration	19,324
	-Operation and maintenance	26,468
(2) Upper Brantas & Lesti basin	-Construction	100,940
	-Land compensation	-
	-Engineering	10,094
	-Administration	5,047
	-Operation and maintenance	17,154
3. Flood Control	Widas river + Lower Ulo river	
(1) Widas River	-Construction	38,532
	-Land compensation	13,766
	-Engineering	3,853
	-Administration	2,615
	-Operation and maintenance	6,545
	Kuncir	
	-Construction	23,906
	-Land compensation	9,833
	-Engineering	2,391
	-Administration	1,687
	-Operation and maintenance	3,585
	Upper Ulo river	
	-Construction	15,463
	-Land compensation	9,401
	-Engineering	1,546
	-Administration	1,243
	-Operation and maintenance	1,395
(2) Lodoyo diversion tunnel	-Construction	362,689
	-Land compensation	4,672
	-Engineering	36,269
	-Administration	18,368
	-Operation and maintenance	-

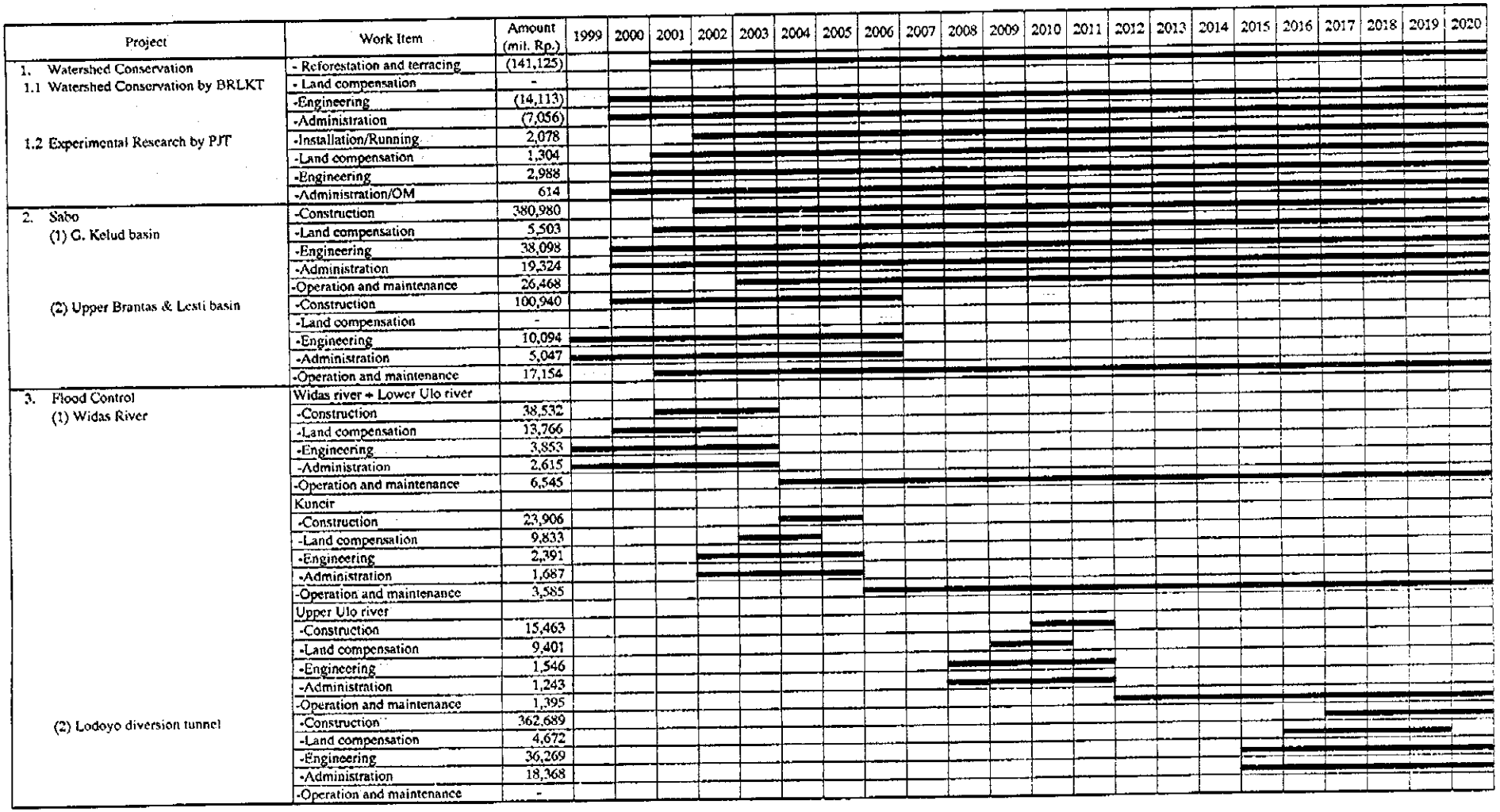


Figure V.10 Implementation Program for Watershed Conservation, Sabo and Flood Control

Action Plan	Amount (mil.Rp.)	PJT			New PJT		
		1999	2000	2001	2002	2003	2004
1999 - 2000							
(1) Preparation of land use map, which is drawn in detail erosion area and forestry zone, for the purpose of water resources management.	-						
(2) Review of master plan investigated in detail the debris run-off from the Mt. Kulud basin.	16,692						
(3) Review of master plan on water reosurces management considered the recent basin conditions.	16,692						
(4) Preparation of basin conservation plan and recommendation on its execution to administrator.	1,300						
(5) Investigation on actual conditions of the existing sabo facilities.	1,000						
(6) Preparation on quality improvement and transportation measures for product made from deposit materials in sand-pocket.	-						
(7) Preparation of basic data on objective tributaries (topographical data and profile investigation).	-						
(8) Survey and setting out the boundary stick of retarding basin which was recommended by the existing master plan.	500						
2002 - 2004							
(1) Continuous investigation on actual conditions of illegal sand mining on riverbed.	-						
(2) Investigation on actual conditions of flood damage (grasp of major damage area).	-						
(3) Preparation of proposed flood control manual.	-						
(4) Preparation and announcement of flood risk area map in the whole basin.	-						

Figure V.11 Required Cost for Action Plan

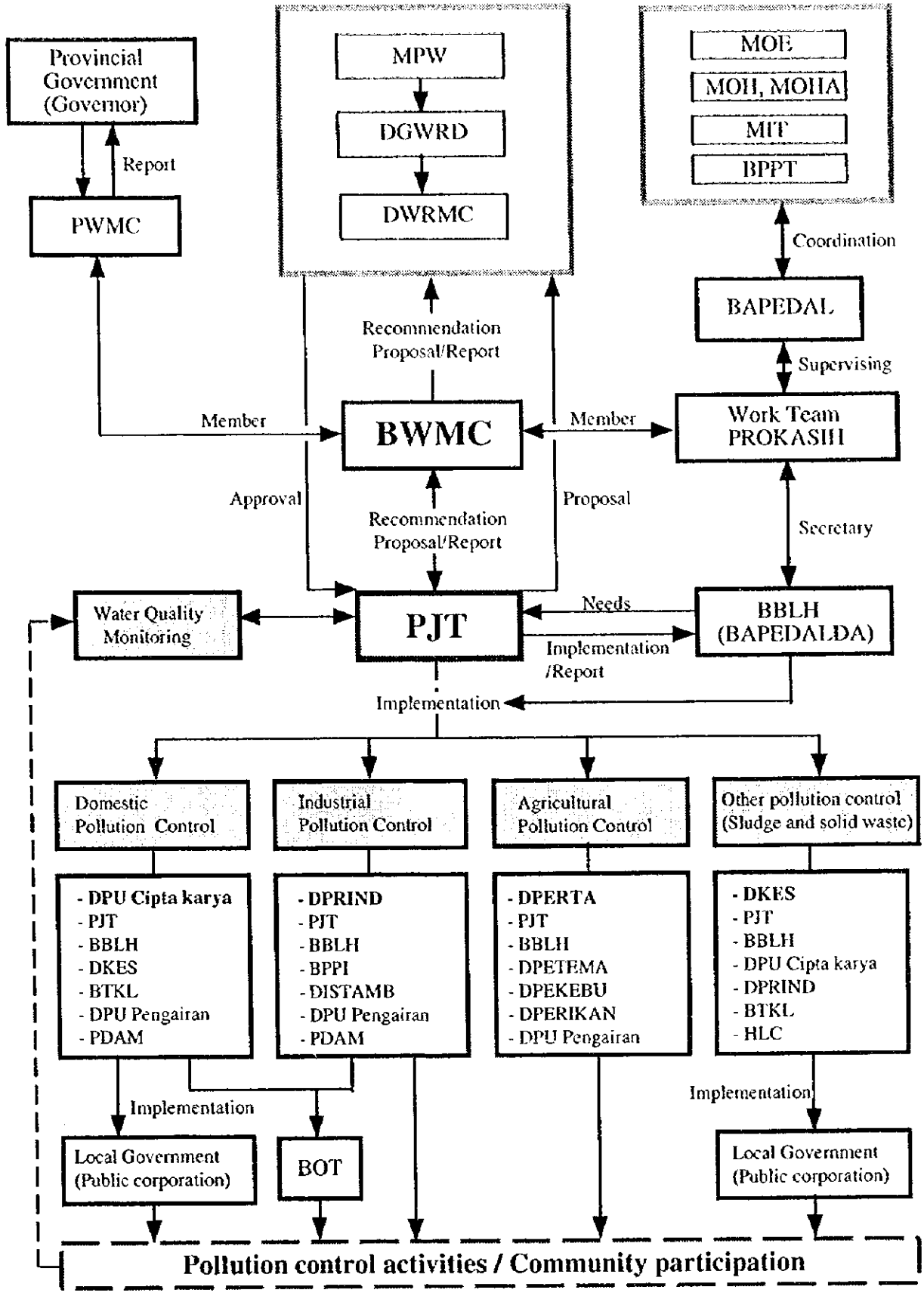


Figure V.12 Proposed Organization of Water Quality Management

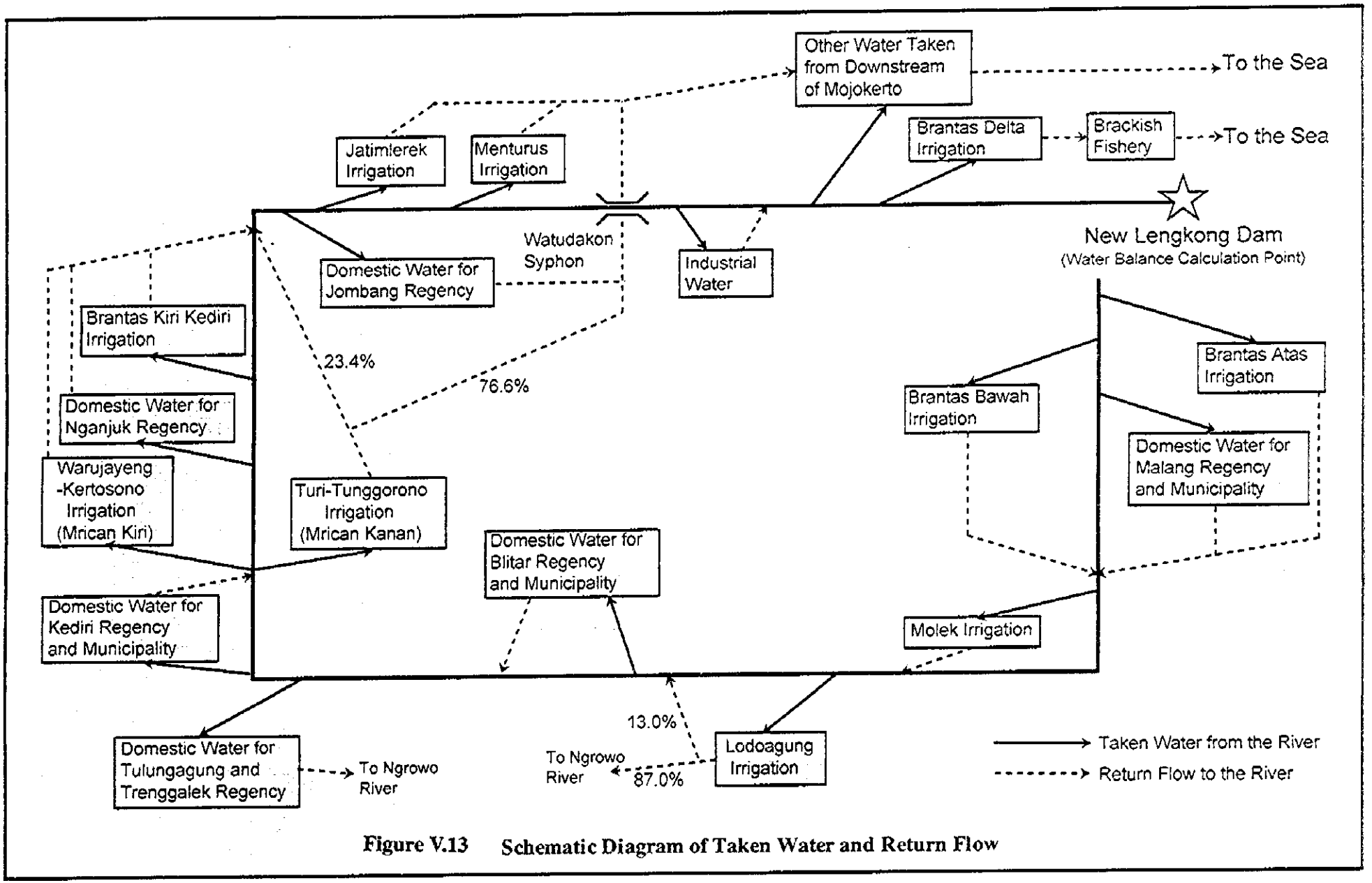


Figure V.13 Schematic Diagram of Taken Water and Return Flow

Project	Works	Cost (million Rp.)
Wonorejo Dam	Dam	
	Push-back Scheme	
Umbulan Balk Water Supply Project		
Beng Dam	Study and Construction	133,374
	Land Acquisition/Resettlement	132,000
	Operation and Maintenance	4,582
	Related Water Treatment Plant	269,410
Genteng I Dam	Study and Construction	271,542
	Land Acquisition/Resettlement	19,120
	Operation and Maintenance	1,379
	Related Water Treatment Plant	127,617
Kedungwarak Dam	Study and Construction	80,952
	Land Acquisition/Resettlement	62,900
	Operation and Maintenance	5,211
	Related Water Treatment Plant	99,257
Irrigation Canal Lining	Consrtruction	236,581
	Operation and Maintenance	2,366

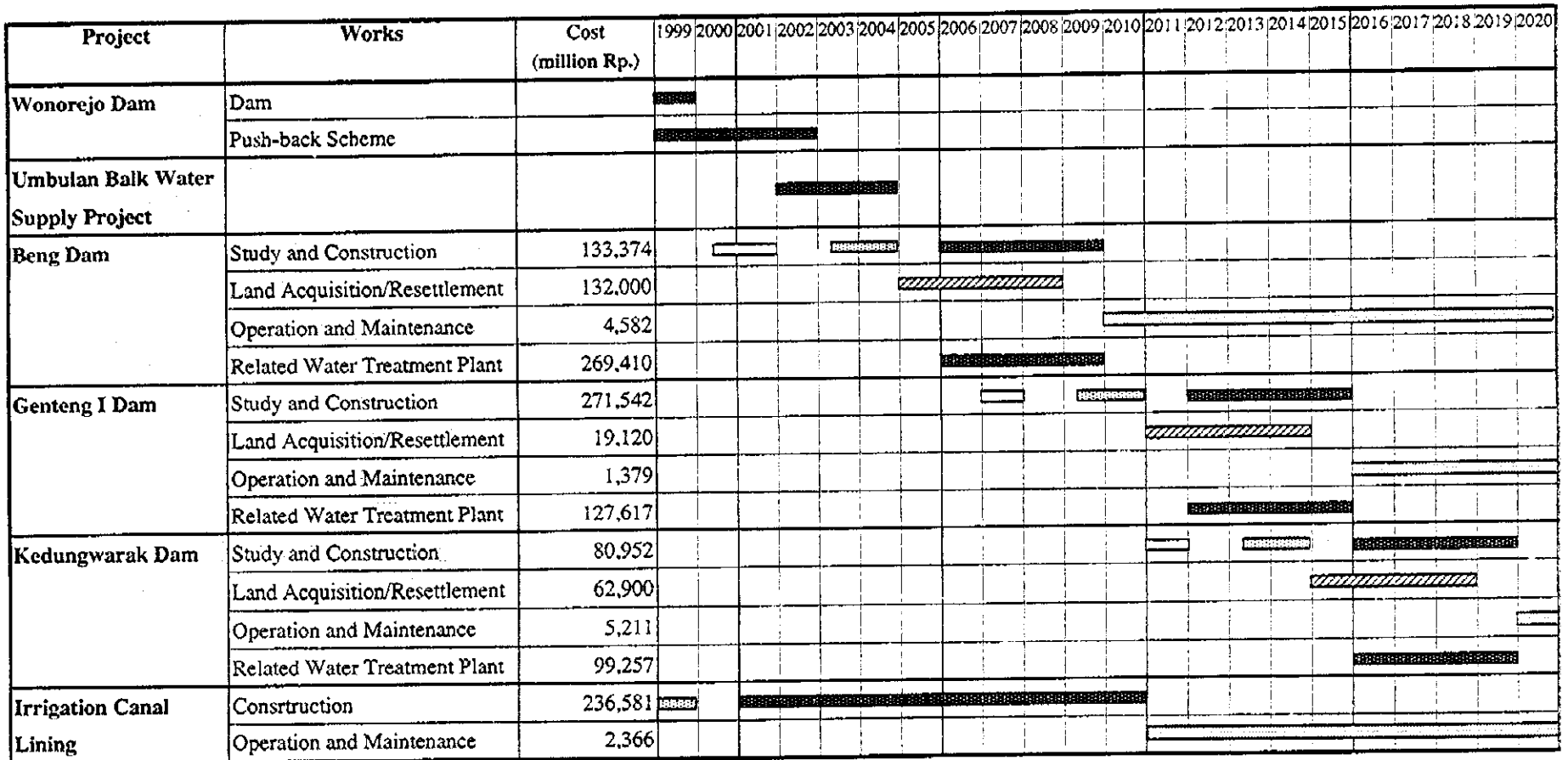


Figure V.14 Implementation Program for Water Resources Development Projects

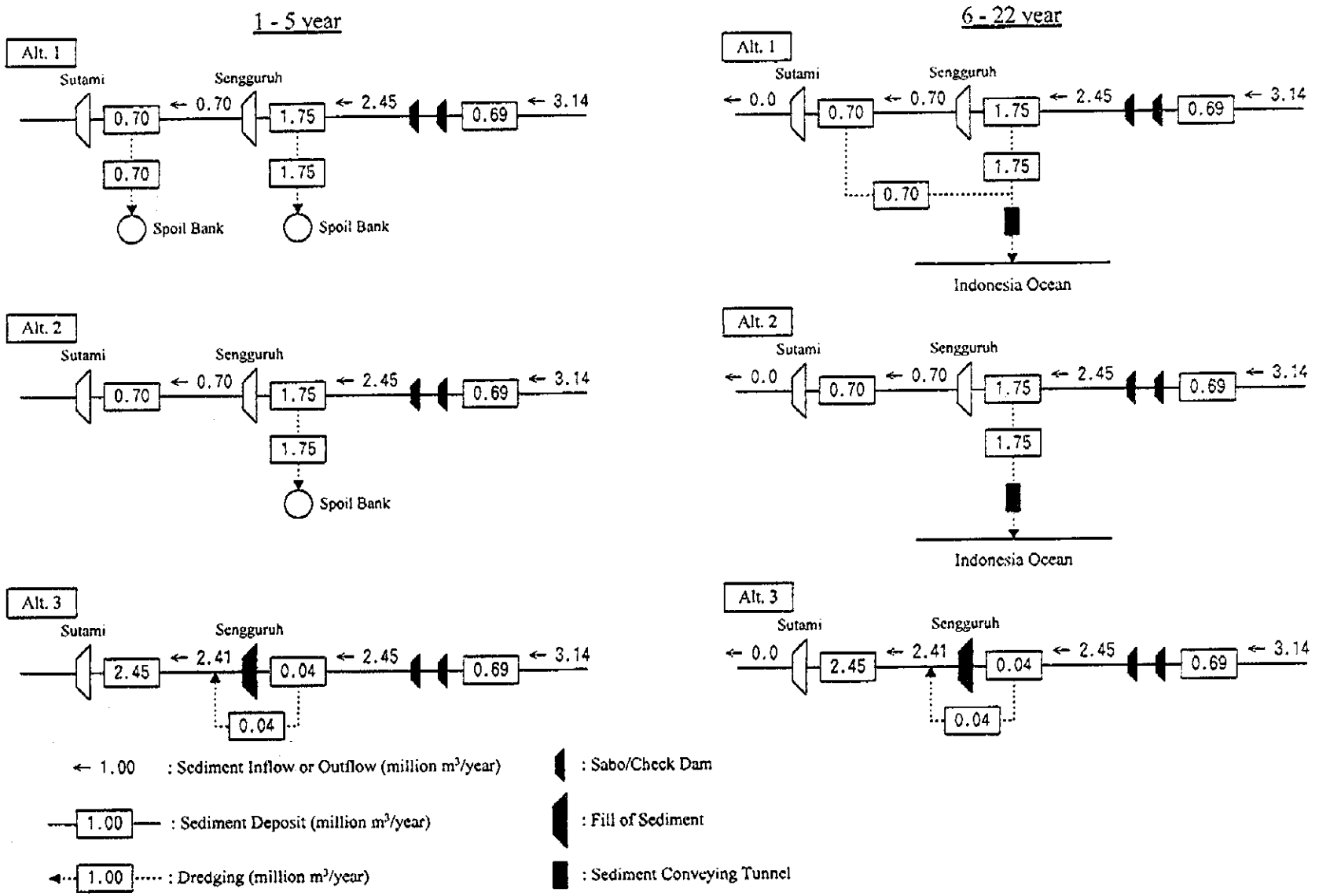


Figure V.15 Alternative of Countermeasure for Sengguruh and Sutami Reservoirs

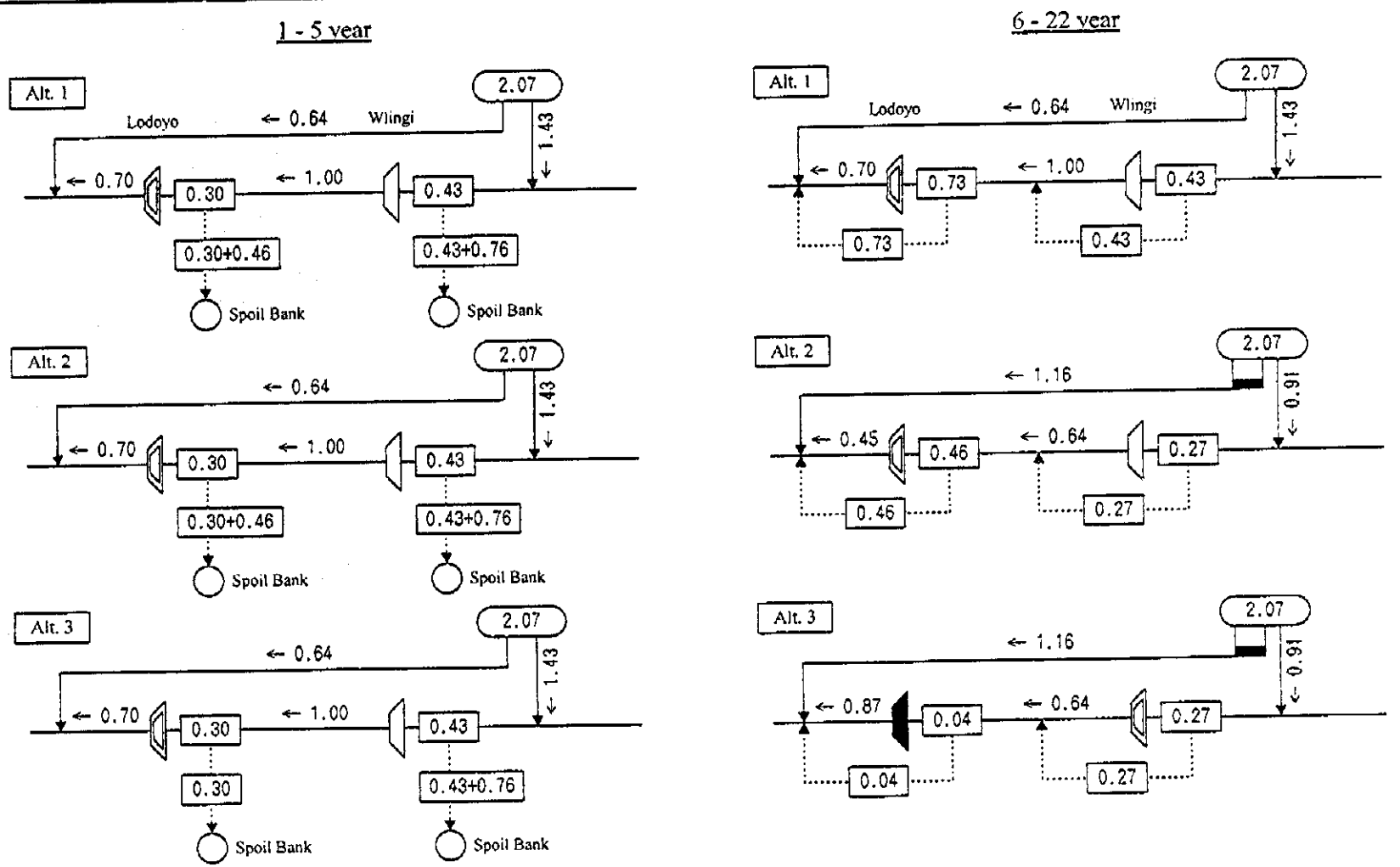


Figure V.16
Alternative of Countermeasure for Wlingi and Lodoyo Reservoirs

Source: The Brantas Rehabilitation Project,
Comprehensive Study of Sediment Bypass Channel,
Final Report, December 1996

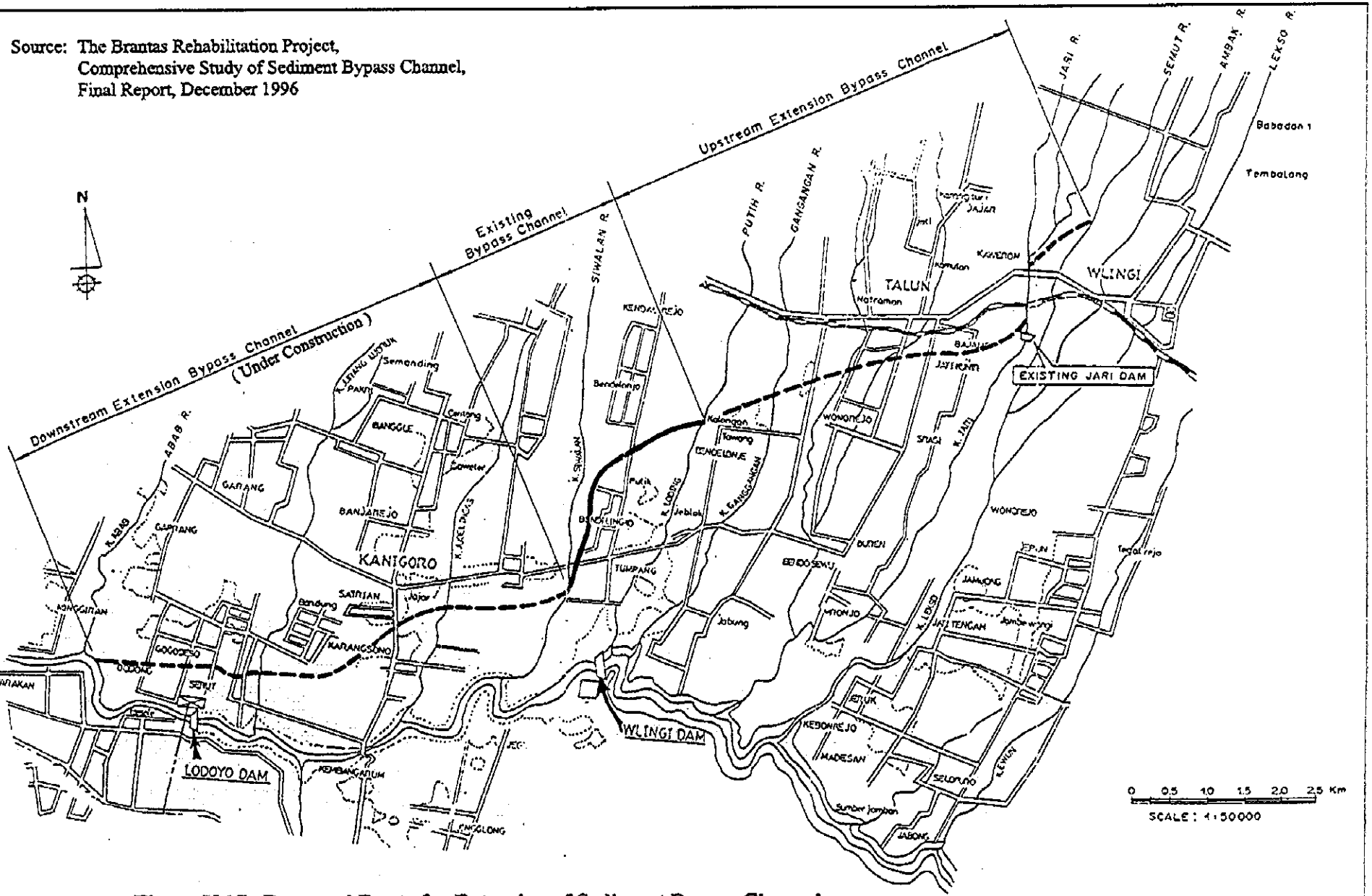
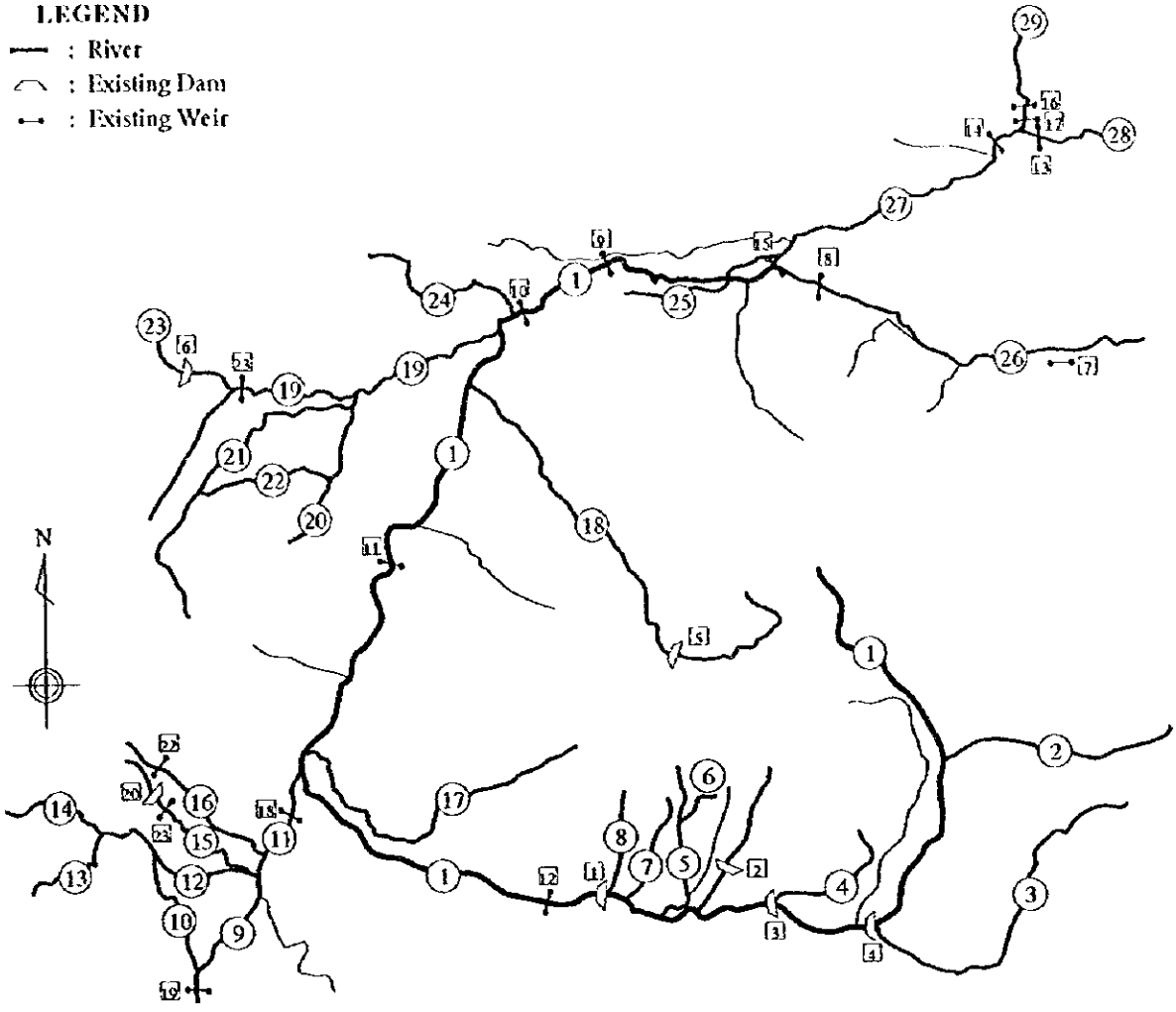


Figure V.17 Proposed Route for Extension of Sediment Bypass Channel



Remarks:

River

1. Brantas
2. Amprong
3. Lesti
4. Lahor
5. Lekso
6. Semut
7. Jari
8. Putih
9. Parit Agung
10. Parit Raya
11. Ngrowo
12. Ngasinan
13. Tawing
14. Tugu
15. Boding
16. Song
17. Badak
18. Konto
19. Widas
20. Kedungsoko
21. Ulo
22. Kuncir
23. Bening
24. Beng
25. Watudakon
26. Porong
27. Surabaya
28. Wonokromo
29. Mas

Major facility

Dam

1. Wlingi
2. Lahor
3. Sutami
4. Sengguruh
5. Selorejo
6. Bening
20. Wonorejo

Weir

7. Bangil Tak
8. New Lengkong
9. Menturus
10. Jatimlerek
11. Mrican
12. Lodoyo
13. Jagir
14. Gunungsari
15. Mlirip
16. Gubeng
17. Wonokromo
18. Tulungagung
19. Tulungagung Tunnel
21. Glatik
22. Segawe Weir
23. Tiudan

Figure V.18 Rivers and Facilities Proposed To Be Managed By PJT

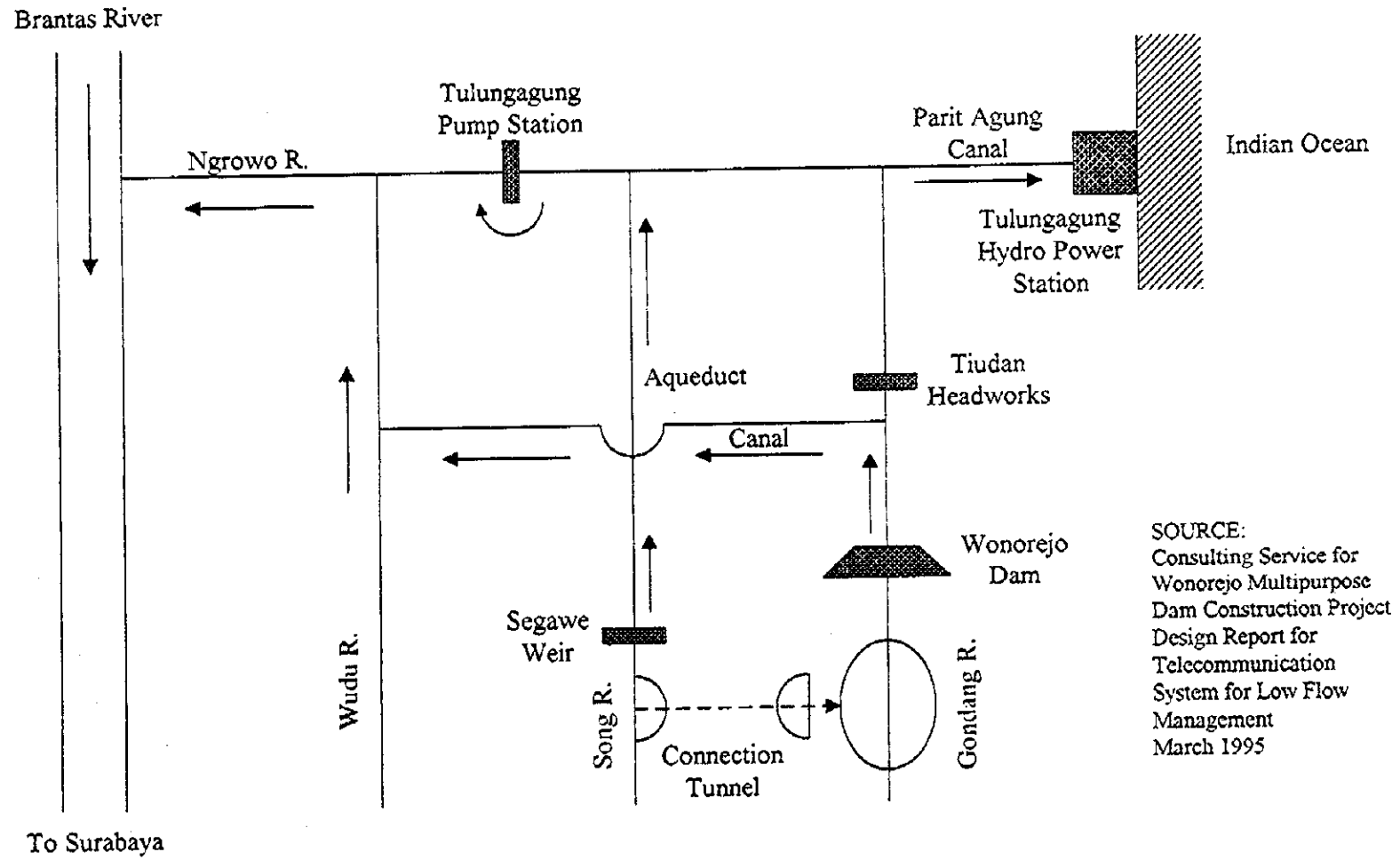


Figure V.19 Ngrowo River Water Conveyance System

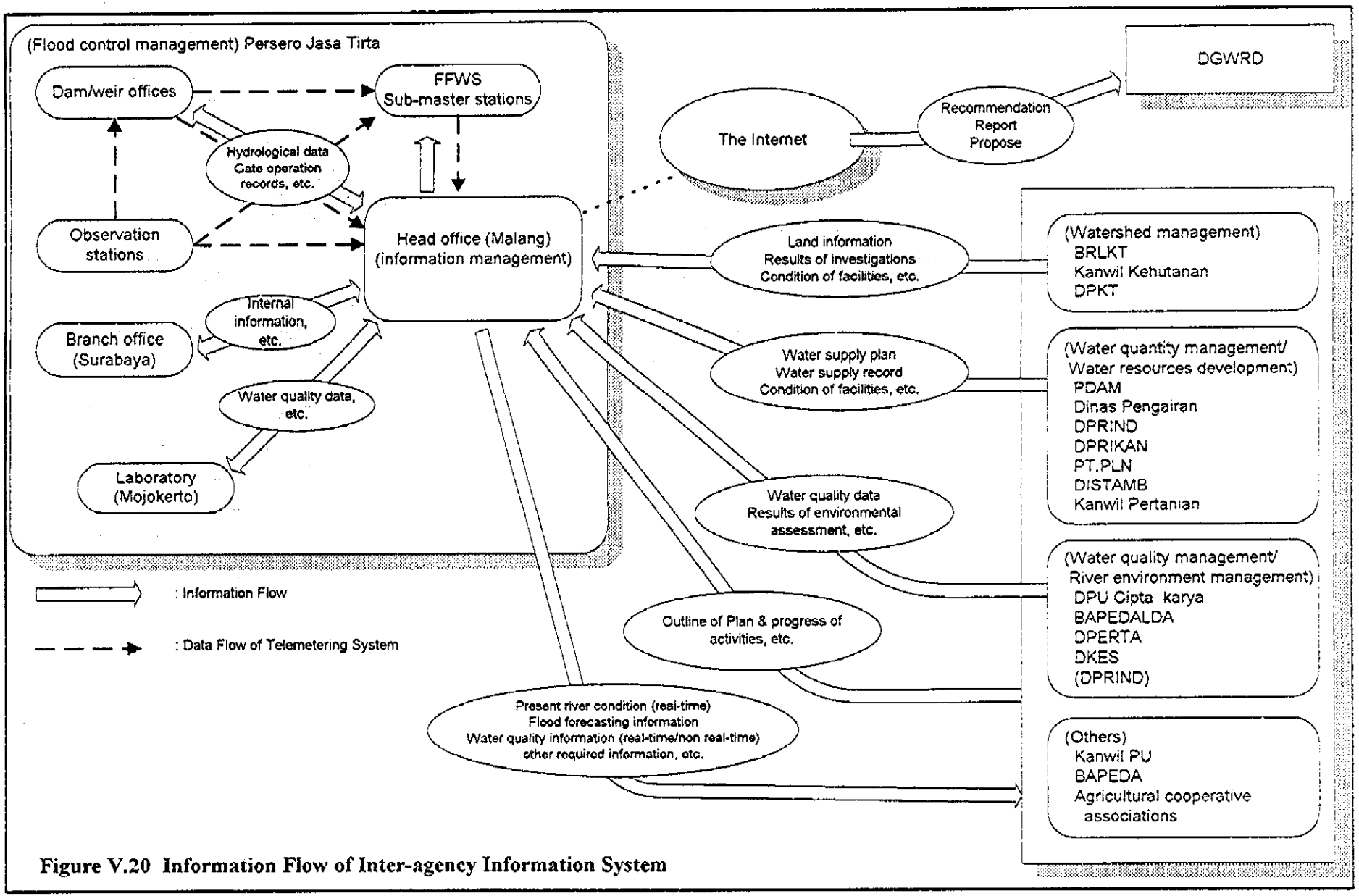


Figure V.20 Information Flow of Inter-agency Information System

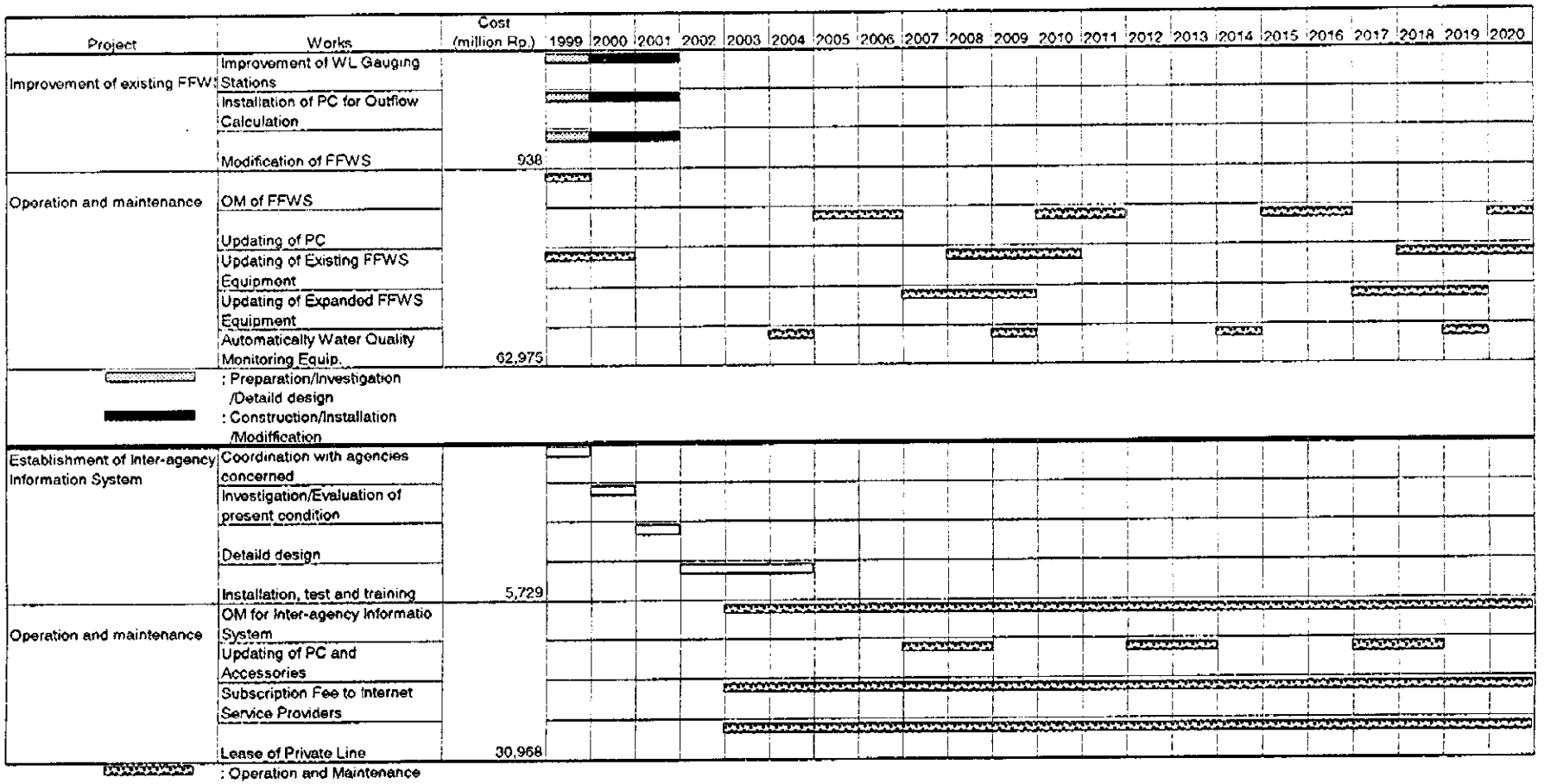


Figure V.21 Impremention Program for Improvement of FFWS and Establishment of Inter-agency Information System

VI STUDY ON MANAGERIAL ASPECTS OF WATER RESOURCES MANAGEMENT

VI.1 Organization for Overall Water Resources Management

VI.1.1 General

Based on the analysis of current conditions of the water resources management in the Brantas, the basic concept of "one river, one plan and one management" is proposed to be applied for the WRM system as explained in detail in chapter IV. This implies that the Brantas river basin should be comprehensively managed by a sole agency. Judging from the historical background and know-how of locality, PJT' is assumed to be the most appropriate management agency of the Brantas. All the tasks required for water resources management should be consistently unified under PJT, the sole responsible agency of the Brantas. For some sectors in which some agencies are more appropriate in WRM in the basin than PJT, then the responsibility to manage the sector shall be delivered from PJT to these agencies.

VI.1.2 Proposals on overall water resources management system

The following are proposed relating to the water resources management in the Brantas river basin on the basis of the basic concept of "one river, one plan and one management".

(1) Establishment of MPW administrative line

In the Brantas river basin, there are two administrative lines at present: one is the line of MPW and another is that of Provincial Government. At present, there are as many as 32 agencies involved in water resources management in the Brantas and no one can say who is the ultimately responsible agency in the Brantas. The obscurity for responsibility sometimes causes duplication of management activities and lack of necessary action.

In the Government Regulation No.22 of 1982, it is clearly stipulated that, within the total of 90 rivers in Indonesia, two rivers of the Brantas and the Citarum are to be managed by state corporation. This is inferred to be based on the fact that these two river basins are significantly important from the point of view of the socio-economy in the country. The Brantas has the largest population of 14.2 million in the Jawa Island in 1993 followed by the Bengawan Solo (12.8 million) and the Citarum (12.1 million). In terms of the population density, the Brantas and the Citarum river basins have the largest in the Java Island: 1,006 persons per km2 in the Citarum and 935 persons per km2 in the Brantas[1]. Regarding the Brantas river basin, the population accounts for 7 % of the whole country population and the GRDP accounts for 9 % of the whole GDP in 1996. This shows the socio-economic importance of the basin in the country.

In case of Japan, all the 2,800 river systems are classified into the "Grade A river systems" and the "Grade B river systems". The way of river management differs as shown in next page:

[1] Source : "Study for Formulation of Irrigation Development Program in Indonesia" JICA, 1993

	River systems	Total length of rivers (km)	Responsible agency	Construction fund source
Grade A Rivers	109	87,153	Minister of Construction	National budget
Grade B Rivers	2,691	35,717	Prefectural Governors	Subsidized budget

The Grade A river systems constitute the important rivers from the point of view of national economy and people's lives in the country and the Grade B river systems constitute other river systems than Grade A. The Ministry of Construction (MOC) is directly responsible for the management of Grade A rivers and the prefecture Government is responsible for Grade B rivers. The water right to utilize river water is licensed by the Minister of Construction for the Grade A rivers and by the Prefectural Governor for the Grade B rivers. The construction of river facilities like dams is carried out by Water Resources Development Corporation (WARDEC) with responsibility delegated from the MOC by national budget in the seven major river systems of Grade A rivers. The construction in the Grade B rivers is carried out by the prefectural governments which receive some funding from Central Government.

The unified management by one agency is desired from the following reasons:

a. Tasks and responsibility are clear and it can be clearly understood who should do what, when and how,

b. Consistency in planning can be maintained and

c. Coordination among the related agencies can be comprehensively systematized.

Referring to the example of Japan, it is proposed in this Study that the administrative line of MPW-PJT should be responsible for water resources management in the Brantas. The coordination between MPW-PJT line and the Provincial Government line will be maintained through the Basin Water Resources Management Committee (BWRMC) which is proposed later in this Section.

(2) Delegation of responsibility for implementation

When the MPW administrative line is confirmed, the MPW is assumed to be solely responsible for water resources management in the Brantas basin. For daily operation in WRM, the responsibility will be delegated from MPW to PJT. And in the areas where PJT is not appropriate to be responsible, it is proposed that the responsibility for implementation be delegated further from PJT to the responsible agencies.

In the watershed management sector, PJT will delegate the responsibility to BRLKT(Sub-division Brantas) and DPKT Dati II(Kabupaten level). The former is in charge of middle term planing and the latter is in charge of implementation of land rehabilitation and soil conservation works respectively.

While, in the water quality management sector, PJT will delegate the responsibility for implementation to BAPEDALDA(Provincial level) which was newly established by replacing the previous BBLH in November 1997.

In the areas other than the above, PJT will be the lead agency covering the areas of flood management, water supply management and river environment management. The delegation will extend to the field of planning, implementation and periodical reporting. In preparing the sector plan, the agency will obtain technical recommendation and/or datas related to the sector from PJT. After implementation by the agency, periodical reporting will be made to PJT by the agency.

(3) Basin Water Resources Management Committee (BWRMC)

As already acknowledged widely, the Brantas river basin is at the stage moving from "development" to "management". The development of water resources in the Brantas basin is approaching to the final stage and the cost for development is getting higher and higher. The management of water demand including saving measures and investment for raising water use efficiency is getting more and more important. Non-structural measures in stead of structural measures are to be pursued.

Under these situations, a "fine tuning" is required in water resources management. There exists the Provincial Water Management Committee (PWMC) in the East Java Province. The most peculiar function of this committee is to determine the water allocation in the Brantas for which the meeting is held twice a year i.e. once before the dry season begins and another before the rainy season begins. The interest of the committee extends provincial wide.

It is proposed that a Basin Water Resources Management Committee (BWRMC) be established in the Brantas basin. The framework of this committee will be as follows:

a. Purpose : To implement the water resources management efficiently and effectively through grasping the local (river basin) needs and/or local information as far as possible.

b. Main tasks :

- Preparing water allocation plan
- Preparing land utilization plan
- Preparing flood control operation plan
- Tackling natural disaster
- Conducting any activities related to soil and water conservation
- Improving the community awareness and participation in developing, utilizing, protecting and controlling water resources

c. Member agencies :

Watershed-related agencies and Bupatihs of Kabupaten in the Basin in addition to member agencies of PWMC

d. Chairman : Director of DWRUC

e. Secretary agency : PJT

All the substantial matters related to water resources management in the Brantas presented above will be discussed and determined in the committee including counter measures for drought occasion. The result will be implemented by each responsible agencies after getting approval of MPW(DWRUC). The coordination with PWMC is a must for BWRMC and periodical meeting will be held between these two basin committees.

(4) Consolidation of PKB, PGKS and PJT

At present, there are two government managed projects in the Brantas i.e. Brantas river Basin Development Project (PKB) and Volcanic Disaster Prevention Project of Mt. Kelud and Mt. Semeru (PGKS). The PKB is mainly responsible for construction and rehabilitation of river infrastructures and PGKS for Sabo works and land prevention works respectively. These two areas of tasks are those stipulated in the Minister (MPW) Regulation No. 56 in 1991 as tasks for which PJT is responsible. Therefore there exists duplication of tasks in this areas among PKB, PGKS and PJT.

One of the primary responsibilities of PJT is to supply water for utilization in various purposes in accordance with users' needs. In order to achieve this mission, PJT must have the capability to construct and/or rehabilitate river infrastructures and to control land slide in upper reaches in the Basin. The current manpower of PJT is not sufficient to do the tasks in these fields. Considering the situation, it is proposed in the Study to consolidate these three agencies into one organization.

Merits of the consolidation from the point of view of water resources management as a whole comprise :

a. to raise efficiency of activities related to construction, rehabilitation and operation and maintenance of river infrastructures through integration of techniques and manpower into one agency,

b. to save manpower committed to water resources management in the Basin,

c. to utilize machinery and equipment more efficiently,

d. to enhance the coordination among the agencies in doing their tasks and

e. to save overhead costs in implementing the tasks.

While merits to PJT from the point of view of an enterprise comprise:

a. to acquire and preserve the technologies of construction of river infrastructures including dams and reservoirs and so on which currently is not maintained sufficiently in PJT,

b. to save the training cost of manpower that would be required if an experienced staff were transferred from PKB/PGKS in stead of a non-skilled staff.

In consolidating three agencies, it is to be taken into consideration that PJT cannot afford to hold more manpower than that required for attaining its responsible tasks. This is required from the nature of PJT as a Perum organization which is expected to make profit to some extent besides doing its public service.

VI.1.3 Issues of "Balai"

In Indonesia, rights and roles of the central government have been transferred in these years to local governments aiming that local governments should be autonomous. Along with this policy, some rights and responsibility of a provincial government are being transferred to the lower level of regency governments.

Among others, the establishment of a new river basin water resources bureau (called as new "Balai" which means an institution in Indonesian language) will have a big influence to the water resources management of the Brantas river basin in the future.

Under the new system, existing Caban Dinas Pengairan (Water Resources Service at Kabupaten level) which is responsible for water resources management of a river basin as a whole will be reorganized into Dinas PU Pengairan Daerah Tingkat II and will be responsible only for irrigation in the Kabupaten.

Other function than irrigation will be transferred to the new Balai. In the East Java Province, the existing ten (10) KORWIL (Koodinatur Wilayah Pengairan) which is coordinating inter-Kabupaten irrigation matters will be reorganized into nine(9) Balais. In the Brantas river basin, three(3) Balais including Malang, Kediri and Surabaya will be established. This means that four water resources management bodies including PJT will be established in one river basin of the Brantas. The building of new Balais in the Brantas basin is the duplication of tasks and will bring confusions of management.

VI.1.4 Comparison of alternatives for overall WRM system

As a summary of the above proposals regarding the water resources management system in the Brantas, a comparison of alternatives for water resources management system is depicted in Table VI.1. The alternative A shows the current status of water resources management system in the Brantas. The alternative B is a hypothetical one with the administrative line of MHA-Governor-PJT in stead of MPW-PJT line. The alternative C is the system proposed by JICA Study Team. Three alternatives are depicted in schematics at the top of the table and major elements of each water resources management system are explained in the middle. Problems are presented and each alternative are finally evaluated at the bottom of the table.

As shown in the table, all the current problems regarding the water resources management now the Brantas encountered is expected to be solved by the alternative C. More details of the Alternative C for its realization are stated in chapter VII "Implementation Program and Action Plan" in this report.