REPUBLIC OF INDONESIA
MINISTRY OF PUBLIC WORKS
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT

FINAL REPORT
FOR
THE STUDY
OF
WIDAS FLOOD CONTROL AND DRAINAGE PROJECT
PART-I STUDY

EXECUTIVE SAMMARY

JULY 1985

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO, JAPAN

EXECUTIVE SUMMARY

This EXECUTIVE SUMMARY is prepared in response to the request of the Government of Republic of Indonesia. It aims to present the summary for the Study of Widas Flood Control and Drainage Project, Part-I Study.

EXECUTIVE SUMMARY has the same contents as those of the Summary of the Main Report with the following contents:

- Basin and Background of Study
- Conclusion of Sector Study
- Overall Implementation Programmes

July, 1985

PREFACE

It is with great pleasure that I present this report on a study of the Widas Flood Control and Drainage Project, Part-I Study to the Government of the Republic of Indonesia.

This report embodies the result of a multidisciplinary survey which was carried out in the Brantas river basin area, East Java of Indonesia from June 1984 to March 1985 by a study team commissioned by the Japan International Cooperation Agency following the request of the Government of the Republic of Indonesia to the Government of Japan.

The survey team, headed by Mr. Hideki Sato, had a series of close discussions on the Project with the officials concerned of the Government of the Republic of Indonesia and conducted a wide scope of field survey and data analyses.

After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will be useful as a basic reference for development of the Brantas river basin and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Republic of Indonesia for their close cooperation extended to the survey team.

July, 1985

Keisuke Arita
President
Japan International Cooperation Agency

THE STUDY

OF

WIDAS FLOOD CONTROL AND DRAINAGE PROJECT

PART-I STUDY

July, 1985

Mr. Keisuke Arita
President
Japan International
Cooperation Agency
Tokyo

Dear Sir,

LETTER OF TRANSMITTAL

We are pleased to submit to you the Final Report for the Study of Widas Flood Control and Drainage Project, Part-I Study, prepared for consideration by the Government of Indonesia in implementing water resources development and management in the Brantas river basin in line with nation's socio-economic development objective.

The Report consists of the Main Report and Supporting Report. The Main Report contains review of the previous master plan prepared by the OTCA in 1973, analysis of the present conditions and future prospects, water resources development projects proposed for implementation upto the year 2000, and action plan. Action plan deals with recommendations on activities to be needed for realization of integrated development and management of water resources in the Brantas river basin. Supporting Report contains supporting data and technical details.

All members of Study Team wish to express grateful acknowledgement to the personnel of your Agency, Advisory Committee, Ministry of Foreign Affairs, Ministry of Construction, Ministry of Agriculture, Forestry and Fisheries, and Embassy of Japan in Indonesia as well as officials and individuals of Indonesia for their assistance extended to the Study Team. The Study Team sincerely hopes that the study results would contribute to the future water resources development in the Brantas river basin in particular and to her socio-economic development and well-being in general.

Yours sincerely,

Hideki Sato
Team Leader

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TO TUBAN

K. SURABAYA RIVER IMPROVEMENT 2ND STAGE

SURABAYA

WONOKROMO

BRACKISH FISHERY

KARANGPILANG TREATMENT WORKS

BENG IRRIGATION AREA 3300 HA

GOTAN LOJARI IRRIGATION AREA 4200 HA

BENG DAM

KEDUNGARAS DAM

WIDAS EXTENSION AREA 2250 HA

SEMANTOK DAM

TURI-TUNGGORONO IRRIGATION AREA

MOJOKERTO

KRIAN

WONOKROMO IRRIGATION AREA

MOJOSARI

DORONG

TO SOLO

WIDAS FLOOD CONTROL

JOMBANG

MOJOAGUNG

PAPAR-PETERONGAN IRRIGATION AREA

NGANJUK

MADURA STRAIT

BANGIL

KUNCIR DAM

WARUJAYENG

WARUJAYENG IRRIGATION AREA

WIDAS SOUTH IRRIGATION AREA 5500 HA

PADAAN

UNBULAN SPRING PIPE LINE

MADIUN RESIDENCE

PREJEG

TO PROBOLINGGO

MRICAN BARRAGE

PARE

KANCANGAN

PURWOSARI

KEDIRI

BABADAN DAM

PUJON

KROMO II DAM

LAWANG

BATU

SPECOSARI

TO PONOROGO

MALANG

TUMPANG

WONOREJO DAM

TUGU DAM

ULUNGAGUNG

UPPER BRANTAS WATERSHED MANAGEMENT

BLITAR

NGANJI

TRENGGALEK IRRIGATION AREA

WONOREJO IRRIGATION AREA

LUMBANGSARI DAM

KEPANJEN

KEPANJEN DAM

CAMPURDARAT

LODOYO

UPPER LESTI WATERSHED MANAGEMENT

LESTI DAM

DAMPIT

TO LUMAJANG

FLOOD DIVERSION

LESTI LEFT IRRIGATION AREA 2300 HA

CENTENG DAM

INDONESIAN OCEAN

KALIMANTAN

SUMATERA

JAVA SEA

JAKARTA

JAVA

SURABAYA

BALI

KALI BRANTAS PROJECT

INDONESIA OCEAN

LOCATION MAP

LEGEND :

BONDARY OF CATCHMENT AREA FOR BRANTAS BASIN

UNBULAN SPRING PIPE LINE

DAM SITE

TULUNGAGUNG GATE

Completed Project

Under-Construction Project

Boundary of Existing Irrigation Project

Prospective Project on this Study

Project identified on This Study or Project studied by other agency

BASIN - WIDE PROJECT

WATER MANAGEMENT SYSTEM

EAST JAVA GROUND WATER

WATER SHED MANAGEMENT

SUMMARY

BASIN AND BACKGROUND OF STUDY

1. The Brantas river basin in the East Java, Indonesia has a catchment area of about 12,000 km^2, which is the second largest river in Java island. The Brantas, originating from the southwestern slope of the Arjuno Mountain Complex, flows southward through the Malang plateau, then goes around the Arjuno Mountain Complex clockwise through major cities of Blitar, Tulungagung, Kediri and Kertosono. Reaching near Mojokerto, it branches into the Porong river debouching to the Strait of Madura, and the Surabaya river debouching to the same at north of Surabaya city. The total length of the Brantas is about 320 km. The major tributaries are the Lesti (625 km^2), Ngrowo (1,600 km^2), Konto (687 km^2) and Widas rivers (1,538 km^2).

2. The Brantas basin consists administratively of five Kotamadyas and ten Kabupatens. The total basin population has grown from 10.2 million in 1971 to 12.0 million in 1980 with the annual increase rate of 1.8%. Major economic activity in the basin is the agriculture sector, both in production and employment. This sector produced one third of the gross regional domestic products, and employed a half of the economically active population. Production of major crops in 1983 is paddy (2,300,000 t), maize (550,000 t), cassava (1,300,000 t) and sugar cane (467,000 t).

3. The manufacturing industry sector has grown with high growth rate, but its contribution to the basin economy is still as low as less than 20%. Industrialization is going on in and around Surabaya city which is the second largest city in Indonesia, and the economic center of the eastern half of Indonesia. Majors are industries producing foods, drinks, and tobacco.

4. The present land use in the basin consists of paddy field of 3,450 km^2, upland field of 2,005 km^2, plantation of 332 km^2, forest of 2,608 km^2, homestead/settlement of 2,396 km^2 and others of 1,009 km^2.

5. Land and water resources development had been implemented for long years. In 1961, an overall development plan was formulated. Based on the plan, completed are Selorejo multipurpose dam, Karangkates multipurpose dam, New Lengkong dam and Porong river improvement, and Lahor dam. In 1972-73, the overall plan was reviewed with technical assistance from the then OTCA, and a Master Plan identifying a number of Projects was formulated. Of the formulated projects, completed are Wlingi multipurpose dam, Brantas Delta irrigation rehabilitation, Lodoyo dam and power station, Surabaya river improvement, and Bening dam and Irrigation. On-going are Brantas middle reaches river improvement, Lodoyo-Tulungagung irrigation, Tulungagung drainage and Sengguruh hydropower projects.

6. According to the progress in the land and water resources development and the socio-economic development in the basin, the natural, social and economic environments have changed remarkably from the settings in the 1973 Master Plan. Almost all the dry season flow in the Brantas river is now utilized. Drought in 1982 hit the Surabaya city, resulting in bad quality of piped water supplied intermittently. On the other hand, demand for the domestic and industrial water are increasing.

7. Realizing the necessity of review of the said Master Plan, GOI requested to GOJ to provide a technical aid for carrying out the review of the 1973 Master Plan. In response to the request, GOJ decided to extend the technical services for the Study through Japan International Cooperation Agency (JICA). Accordingly, JICA organized a Study Team. The Study Team conducted field works from June to Decemeber in 1984, and plan formulation in January to March in 1985. The following are summaries of results of the Study which consist of sector studies and overall implementation program.

CONCLUSION OF SECTOR STUDY

AGRICULTURE AND IRRIGATION

8. Of the paddy field of 345,000 ha in the basin, the irrigation area is 316,500 ha. The main Brantas river feeds 81,600 ha.

The rest is irrigated by tributary flow, groundwater and spring water. The area fed by the main Brantas consists of Molek 3,991 ha, Lodoyo 15,228 ha, Warujayeng-Kertoyoso 12,827 ha, Besuk 539 ha, Jatimolek-Bunder 1,076 ha, Turi-Tenggorono 9,373 ha, Gottan to Losari 4,238 ha, Jatikulon 618 ha, Magetan 18,203 ha, Porong 12,339 ha, Wonokromo 2,989 ha and others 179 ha.

9. In the field of irrigation development, four projects are under construction; Waru-Turi Irrigation (23,400 ha, ADB finance), East Java Irrigation Rehabilitation (180,000 ha, IBRD finance), Lodoyo-Tulungagung Irrigation (15,200 ha, ADB finance), and East Java Groundwater Irrigation (30,000 ha, IBRD finance). These projects are to be implemented as scheduled. The projects for which detailed design is completed or under way are Wonorejo Dam and Irrigation (7,500 ha) and Paper-Petorongan Irrigation (Waru-Turi II, 14,600 ha).

10. Irrigation development is studied from the viewpoint of regional equity. Since paddy is the main crop in the basin, cropping intensity of paddy is taken as an indicator of status of regional development. The basin average paddy cropping intensity is measured as around 130%. The areas with the cropping intensity as low as 100% or so is the Lesti-Left area, Trenggalek area, Widas-North area, and Beng-Gottan-Losari area. For the Trenggalek area, Tugu dam and irrigation project has been proposed by BRBDEO, and a feasibility study is completed. For the remaining areas, irrigation development is studied. The results are as summarized below;

Area	Water Sources	Command Area (ha)	Construction Cost (Rp.10^9)	EIRR (%)
Lesti-Left	Main Brantas	2,300	4.21	18
Widas-North	Kedungwarak dam	950	6.39	11
	Semantok dam	1,300	46.76	0.5
Beng	Beng dam	3,200	10.26	23
Gottan-Losari	Main Brantas	4,180	5.68	12
Widas-South	Kuncir dam	6,270	78.05	4

The scale of Kedungwarak, Semantok and Kuncir dams in the above is only for irrigation water supply.

11. According to the water balance in future, very tight supply condition is foreseen. Therefore, it is recommended that implementation of new irrigation projects and rehabilitation projects will be started only after the necessary water for the project is secured without affecting the presently available water.

12. Projects included in the Master Plan are as follows;

	Action Program/Project	Reference	Present Status	Estimated Cost Rp.10^6 /1
AI-1	Warujayeng-Turi-Tunggorono	R/IV	D/D	41,289
AI-2	East Java Irrigation Rehabilitation	R/IV	U/C	271,330
AI-3	Lodoyo-Tulungagung Irrigation	R/IV	U/C	6,408
AI-4	P2AT Kediri-Nganjuk	R/IV	U/C	8,789
AI-5	East Java Groundwater	R/IV	D/D	75,395
AI-6	Mrican Barrage	R/IV	D/D	21,900
AI-7	Papar-Peterongan	R/IV	F/S	22,262
AI-8	Wonorejo	P/R	D/D	16,218
AI-9	Tugu	P/R	pre F/S	8,323
AI-10	Widas Extension	M/S	M/S	3,045
AI-11	Beng	M/S	M/S	5,175
AI-12	Lesti-Left	M/S	M/S	4,215
AI-13	Gottan-Losari	M/S	M/S	5,683

Reference : P/R; Project Report, R/IV; Repelita IV. MS; Master Plan Study

Present Status; Pre F/S; Pre feasibility study, F/S: Feasibility Study, D/D; Detailed Design, U/C; Under implementation.

Note /1 Construction cost of dam is not included.

DOMESTIC AND INDUSTRIAL WATER

13. In the basin, only 17% of the basin population is supplied with piped drinking water. The present water supply capacity is 4,339 l/sec in total consisting of 3,200 l/s in Surabaya, 763 l/s in Malang, 100 l/s in Kediri and system less than 100 l/s in Mojokerto, Blitar, Sidoarjo, Jombang and Nganjuk. Water supply projects are on-going. They are the Karangpilang Treatment Work Project (1,000 l/s), and Umbulan Spring development (2,200 l/s) for the Surabaya Metropolitan area (SMA) Basic Needs Aproach project (BNA) for 12 towns (520 l/s in total) and Ibu Kota Kecamatan project (IKK) for 50 locations (203 l/s in total).

14. From the viewpoint that safe water is vital need of all the inhabitants in the basin, the potential domestic water demand in future is estimated taking into account the population growth, urbanization, increase in the unit water demand per capita according to increase in per capita income. The basin population is forecasted to be 14,250,000 in 1990 and 17,552,500 in 2000. The potential domestic water demand in the year 2000 thus estimated is 914,000 m^3/day in SMA, 159,000 m^3/day in other Kotamadya, 128,000 m^3/day in the urban areas in Kabupatens and 396,000 m^3/day in the rural area.

15. Presently, industrial water of 6 m^3/sec is taken from the main Brantas and its distributaries with licences issued by the Irrigation Services, Surabaya. The Irrigation Services has no schedule to allocate more water to industries than now, since there is no surplus dry season flow in the rivers in drought years. Since the economic infrastructures are well developed in the Surabaya area, the industrialization in the area will proceed if the industrial water is secured. The national development plan accords high priority to industrialization, and the Surabaya area is one of the important candidates for industrial development.

16. The potential domestic and industrial water demand including all losses is estimated at 22 m^3/sec in SMA, 5.0 m^3/sec in other urban

areas and 5.5 m^3/sec in rural area in the year 2000. Even if water supply facilities are not constructed to meet the potential water demands, water allocation in the basin should take into consideration the potential water demand.

17. Projects included in the Master Plan are as follows;

	Action Program/Project	Reference	Present Status	Construction Cost (Rp.10^6)
MW-1	Push Back from Ngrowo River Basin	P/R	pre F/S	8,798
MW-2	Karangpilang Treatment Works Stage 1 (1 m^3/sec)	P/R	F/S	16,191
MW-3	Karangpilang Treatment Works Stage 2 (4 m^3/sec)	M/S	M/S	57,360
MW-4	Umbulan Spring Development	M/S	F/S	110,000
MW-5	Urban	M/S	M/S	62,695
MW-6	SMA	M/S	M/S	261,637
MW-7	Rural	M/S	M/S	27,060

FLOOD CONTROL

18. BRBDEO has carried out river improvement works in the middle reaches upstream of the New Lengkong dam. The first stage of the project aims to attain the discharge capacity of the main Brantas equivalent to the 10-year probable flood, and the second stage to the 50-year probable flood.

19. Design flood for the middle reaches river improvement has been estimated based on the hydrological data up to 1978. In 1981 and 1984, large floods equivalent to almost the design flood occurred in the main Brantas. Flood flow analysis is made including the recent flood record under the following conditions which are the same as assumptions taken by the Middle Reaches Project;

- Outflow from the tributaries is the same as that under the present development conditions in the tributaries.
- The existing retarding basins in the main Brantas and tributaries keep the existing retarding effects.

Fifty-year probable flood thus estimated newly is 1,050 m^3/s in the Kediri section, 1,250 m^3/s in the Konto-Widas section, 1,500 m^3/s in the Ploso section and 1,600 m^3/s in the New Lengkong dam and Porong river. The present design floods for the second stage are assessed to be 20 - 40 years probable floods in the newly estimated probable flood series.

20. In addition to the middle reaches river improvement, some counter-measures to cope with the excess discharge beyond the present design floods are required. The following two alternative cases are examined.

- re-improvement of the entire stretches of the main Brantas and Porong river
- flood diversion from the Lodoyo reservoir to the Indonesian Ocean through an open channel of 3 km long and a tunnel of 5 km long with the diversion capacity of 100 m^3/s.

The construction cost of the former is estimated at Rp. 28.4 billion and the latter at Rp. 12.9 billion. Then, the flood diversion plan is recommended. However, it would be premature to start construction of the diversion system immediately, since the discharge capacities equivalent to 20 - 40 years probable floods after completion of the second stage works are still in the high level in comparison with the discharge capacities of other rivers in Indonesia. Therefore, continuation of the second stage works as designed is recommended.

21. When Mt. Kelud erupts, occurrence of the following phenomena would be inevitable, even if necessary sabo works are carried out;

- large sediment inflow exceeding the sediment discharge capacity of the main Brantas for several years after eruption.
- transitional rise of 1 to 2 m of the riverbed in the main Brantas and gradual degradation after them.

Such riverbed rise will result in decrease of the discharge capacity by about 400 m^3/s and the discharge capacity will become below the capacity equivalent to the present 10-year probable flood. The safety against flood will become very low. For dischaging the newly estimated 50-year probable flood even after the eruption of the Mt. Kelud , same alternatives as presented in the previous paragraph are conceived. The required capacity of the diversion system is estimated at 600 m^3/s. The estimated costs are as follows;

- Improvement of main Brantas ; Rp. 78.5 billion
- Flood diversion from Lodoyo ; Rp. 61.6 billion

The former will not only need large construction cost, but also bring social problems in the riparian areas. In this context, the flood diversion plan to the Indonesian Ocean is recommended as a countermeasure when Mt. Kelud erupts. The total construction cost including engineering, administratation and physical contingency is estimated at Rp. 85.0 billion and EIRR is estimated at 7.9% at the present development level.

22. In the Widas basin, there are three natural retarding basins of about 30 km^2 in total, which control the flood outflows from the Widas basin to the main Brantas. From the 50-year probable flood distribution in the main Brantas, the outflow from the Widas basin with the retarding basins is estimated at 270 m^3/s. If all the retarding effects are removed (confinement), the outflow without the retarding basin is estimated at 850 m^3/s. Confinement will increase the flood discharge in the lower reaches of the main Brantas. The incremental cost due to confinement shall be borne by the Widas basin. Cost-benefit analysis shows that the confinement in the Widas basin will not be economical, even if the land enhancement benefit from the present retarding basins is taken into account. Further, in case of the confinement plan, the flood control works in the Widas basin are obliged to wait for completion of the improvement works in the main Brantas, although the inhabitants in the Widas basin desire urgent improvement.

23. From the above, the flood control plan in the Widas basin is conceived in such that it will not bring about increase of outflow to the main Brantas. Accordingly, the outflow should be 270 m^3/s as estimated for the present conditions. The total construction cost in the master plan level is estimated at Rp. 76.2 billion covering the costs for river cahnnel improvement and modification of the retarding basins. EIRR is estimated at 8.4% for the present development level. In the coming feasibility study, the following flood control works will be planned against the 25-year probable flood in the Widas basin.

- river channel improvement in Widas, Kedungsoko, Kuncir, Ulo rivers
- modification of the present natural retarding basins into controllable retarding basins
- construction of the new flood way
- combination of the above

24. At present, Mt. Kelud project carries out river improvement works in the lower reaches of the tributaries originating from Mt. Kelud. Basic criteria for planning of flood control works in the area is not to increase flood inflow into the main Brantas beyond the flood inflow with the retarding effects in the present wide riverbeds. The retarding effects are assessed by applying the regime theory. In case there is a sand pocket with retarding effect in the upstream area of the tributary, the river width in the lower reach of such tribuatry can be reduced by a width equivalent to the retarding effect in the sand pocket. Otherwise, the riverbed width shall be kept as the width determined by the regime theory.

25. Projects included in the Master Plan are as follows;

Action program/Project		Reference	Present Status	Construction Cost (Rp. 10^6)
FC-1	Middle Reach River Improvement (2nd Stage)	P/R	U/C	37,617
FC-2	Tulungagung Drainage	P/R	U/C	10,350
FC-3	K.Surabaya (2nd Stage)	R/IV	D/D	62,538
FC-4	Widas Flood Control & Drainage	M/S	M/S	76,200
FC-5	Lodoyo Diversion Scheme	M/S	M/S	85,000

WATERSHED MANAGEMENT

26. Lesti river/Upper Brantas : In this area, there are highly erodible areas of 237 km^2 in total. High concentration sediment flow is observed in the Lesti river. Such sediment flow enters into the Karangkates reservoir at present, and will enter into the Sengguruh reservoir in the upstream of the Karangkates dam after 1987 when the Sengguruh dam is completed. The annual sediment discharge at the Sengguruh site is estimated at 2.26 million m^3 and the average sediment trapping efficiency of the Sengguruh reservoir is estimated at 45%. As the sediment space of the Sengguruh reservoir is designed as 29 million m^3, the sediment will fill up the reservoir in 20 years, and the daily regulating capacity of the reservoir will be decreased much. The Karangkates reservoir is a master reservoir in the Brantas basin, and it is desired to elongate the reservoir life time as long as possible. In view of the above, watershed management works in this area are recommended. The works involve 9 sabo dams and reforestation with terracing in the erodible areas. The construction cost of the sabo dams is estimated at Rp. 35.3 billion.

27. Upstream of Selorejo reservoir/Upper Konto river : The sediment deposit rate in the Selorejo reservoir is estimated at 0.23 million m^3 per annum. If this rate can be kept, the reservoir life time will be more than 50 years and there is no immediate problem so far. From the general view of the watershed conservation, reforestation in the erodible areas is recommended.

28. Mt. Kelud : Mt. Kelud is an active volcano locating in the center of the Brantas basin, and erupted 10 times in the period from 1811 up to 1966. The erupted materials amounting 100 to 300 million m^3 caused serious damages to the basin. Mt. Kelud project has continued debris control works in the southern and western slopes of Mt. Kelud based on the distribution plan of the erupted materials, and completed 67 sabo facilities up to now. The total storage capacity of these facilities is 19.4 million m^3, and the present deposit of sand is 14.5 million m^3.

29. The erupted materials distribution plan which has been currently adopted by the G. Kelud Project is given below;

- one cycle of eruption	15 years
- amount of eruption materials by one eruption	200 million m^3
- falling materials in unaffected area	70 million m^3
- allowable sediment of the main Brantas	64 million m^3
- amount to be retained by sabo facilities	66 million m^3

The above distribution plan was established aiming at retaining erupted materials as much as possible in the mountainous area, thus eliminating debris damages in the lower plain area. This plan is considered appropriate in conservertive view from Sabo planning, thus it is recommended to carry out the debris control works as scheduled by the G. Kelud Project.

30. Areal distribution of eruption materials varies by eruption and involves unforseen factors. In 1966 eruption, the river bed of the main Brantas rose up by 1 to 2 m due to excess sediment inflow during several years after the eruption. Even though the G. Kelud project is implemented, it would be almost impossible to arrest completely such excess sediment inflows into the Brantas. From the viewpoint of maintaining the main Brantas in kinematic equilibrium condition during 15 years of one eruption cycle allowing temporary river bed fluctuation, alternative distribution plan is examined. The results are given below;

- one cycle of eruption — 15 years
- amount of eruption materials by one eruption — 200 million m^3
- amount retained in the falling place — 65 million m^3
- allowable sediment of the main Brantas — 93 million m^3
- amount to be retained by Sabo facilities — 42 million m^3

As seen above, sabo facilities with dead storage capacity of at least 42 million m^3 are needed in order to maintain the main Brantas.

The above distribution plan suggests that eruption materials flowing into sabo area is in excess of the remaining storage capacity of the existing sabo facilities (dead storage plus control space). For this, it is recommended that additional sabo facilities with 6.4 million m^3 storage capacity be constructed urgently. The construction of such additional sabo facilities can be covered by the appropriated budget of the G. Kelud Project.

31. Projects included in the Master Plan are as follows;

	Action program/Project	Reference	Present Status	Construction Cost (Rp. 10^6)
WS-1	G. Kelud	R/IV	U/C	94,019
WS-2	Upstream of K. Brantas	M/S	M/S	35,270
WS-3	Reforestration (K. Brantas/ K. Konto/K. Ngrowo)	M/S	M/S	19,500

ELECTRIC POWER

32. According to the power demand forecast by PLN, rapid and large increase in both capacity and energy requirement is forecasted for the East Java system as well as the entire Java system; 2,735 GWh and 446 MW in 1983/84 to 27,256 GWh and 4,446 MW in 2003/2004. PLN plans to cope with such demands mainly by large scale thermal plants and by hydropower in the Central and West Java. However, the EHV interconnection will remain as single line until the period of REPELITA VII, and it will be risky for peak power supply in the East Java to rely on the hydropower in the Central and West Java through the single line connection. There-

fore, at least 10% of the total installed capacity in the East Java system shall be shared by the hydropower plants with East Java in order to cope with peak power demand and to keep the reliability level of the East Java system.

32. Hydropower development is examined in conjunction with dam development and preliminary results are as follows;

	Installed Capacity (MW)	Annual Energy (GWh)
Genteng I	18.6	54.9
K. Konto II	62.0	207.4
Babadan	9.4	28.1
Kuncir	4.3	28.3
Kedungwarak	0.7	3.0
Beng	12.0	10.4
Lumbangsari	10.8	46.9
Kepanjen	6.0	32.5

Implementation of the hydropower development will be according to the schedule of the the dam development.

34. Projects included in the Master Plan are as follows;

Action program/Project	Reference	Present Status	Costruction Cost (Rp. 10^6)
EP-1 Sengguruh	P/R	U/C	79,186
EP-2 Lesti III	P/R	F/S	12,749
EP-3 South Tulungagung	P/R	D/D	41,164
EP-4 Wonorejo	P/K	D/D	12,724
EP-5 Tugu	P/R	D/D	1,572
EP-6 Beng	M/S	M/S	14,063
EP-7 K. Konto II	M/S	M/S	38,488
EP-8 Genteng I	M/S	M/S	14,420
EP-9 Lumbangsari	M/S	M/S	14,030
EP-10 Kepanjen	M/S	M/S	10,077

DAM DEVELOPMENT

35. Relating to the existing dams, the following are recommended;

- revision of reservoir operaton rule of the Karangkates-Lahor reservoir
- examination of heightening of HWL of the Karangkates reservoir by 2 m or so
- examination of spillway capacity of the existing dams (Karangkates, Lahor, Wlingi, and Selorejo) based on the current design standard of spillway and recent hydrological data.

36. Total surface water in the basin is quite a lot as 120 billion m^3 on the yearly basis, but the seasonal variation is very large. The existing storage capacity in the basin is only 3% of the total surface runoff in the basin. In order to cope with the future water demands, dam and reservoir development is of vital necessity. However, there are very few site suitable for large storage reservoir by conventional development method due to the topographic conditions. Therefore, it becomes necessary to consider development of inter-basin transfer of water, inter-seasonal reservoir with pumped storage and inter-yearly reservoir.

37. Based on the topographic maps so far available, 7 damsites which are suitable for large storage are examined. Results are as follows;

Name of Dam	Effective Storage Capacity	Dam Volume	Construction Cost	EIRR
Genteng I	70 MCM	3.0 MCM	Rp. 91.1 x 10^9	12.4%
K. Konto II	63	9.3	202.7	12.7
Babadan	85	8.3	140.1	6.6
Kuncir	22.5	6.9	75.1	5.8
Semantok	40	5.3	73.2	2.9
Kedungwarak	54	0.2	41.5	5.3
Beng	150	0.5	56.1	16.6

The Kudungwarak and Beng dams are planned as inter-seasonal pumped storage reservoir, and the Genteng I, K. Konto II and Babadan dams are planned to include inter-basin transfer. Taking into account the economic feasibility

and the location of the damsite (preference to location near to Surabaya), the Beng dam and K.Konto II dams are recommended as for water resources development by the year 2000.

38. Projects included in the Master Plan are as follows;

Action program/Project		Reference	Present Status	Construction Cost (Rp. 10^6)
MP-1	Wonorejo dam	P/R	D/D	76,658
MP-2	Tugu dam	P/R pre	F/S	40,029
MP-3	Kedungwarak	M/S	M/S	5,894
MP-4	Beng	M/S	M/S	42,066
MP-5	K. Konto II	M/S	M/S	211,926
MP-6	Genteng I	M/S	M/S	68,596

AQUA CULTURE

39. The coastal area of the Brantas has a large potential of brackish water fishery, and presently milk fish and shrimp are cultured. But the unit yields are not so high. The GOI intends to promote the shrimp culture as exporting industry widely over the nation, and the Sidoarjo area is one of the candicates. Locating near the transportation and marketing facilities, the Sidoarjo area is comparatively advantageous to other areas.

40. According to the report on the brackish water culture in the Sadoarjo area with a net area of 13,000 ha, prepared by staff of GOI, the minimum fishery water requirement for this area is estimated at 13.5 m^3/s. However, from the river water balance in the basin, there is no dry season runoff allocatable to brackish water fishery development. As a trial case, one cropping in rainy season in the improved fish ponds is examined, and found economically viable. Further study on this sector is recommended.

41. The following projects are included in the Master Plan.

Action program/Project		Reference	Present Status	Construction Cost (Rp.10^6)
AQ-1	Brackish Water Fish Pond	M/S	M/S	66,640

WATER ALLOCATION STUDY

42. Available water in the basin: Since runoff downstream of Jabon on the K.Brantas and Perning on the K.Surabaya, if once taken from the river course, will have no chance to be used again, the runoff passing the Jabon-Perning is considered as the lastly available water in the basin. By removing the influences of intakes along the main stream and control by reservoirs, the naturalized flow is estimated at the Jabon-Perning Site, and the total available amount of water in dry season from June to November is estimated as follows;

Drought year	
- twice in 20 years	; 833.5 MCM
- 4 times in 20 years	; 867.1 MCM
- 10 times in 20 years	;1,251.7 MCM

43. Future water demand: By accumulating the water demands estimated by each sector, the total water demand at the Jabon-Perning site is estimated for the year 2000 as follows;

		Sectar Demand	Accumulated Total
(1)	Domestic water	345.5 MCM	345.5 MCM
(2)	City water	237.2 MCM	582.7 MCM
(3)	Irrigation (Authorized)	636.5 MCM	1,219.2 MCM
(4)	Industry (Presently licenced)	80.0 MCM	1,299.2 MCM
(5)	Future Irrigation	271.1 MCM	1,570.3 MCM
(6)	Future industry	74.3 MCM	1,644.6 MCM
(7)	Unauthorized dry season paddy	47.4 MCM	1,692.0 MCM
(8)	Fishery	179.0 MCM	1,871.0 MCM

44. Water balance : Including the storage capacity of the Karangaktes reservoir, push-back water from the K.Ngrowo, water in the Wonorejo reservoir to be allocated to the main Brantas, water from the Umbulan Spring, and the storage capacity of the Beng reservoir, the total supply capacity in the drought condition with reccurence of twice in 20 years is 1,569.6 MCM. Then, the water demand upto the presently licenced

industrial water can be satisfied, and there remains water of 270.4 MCM useful for future industry or irrigation or combination of them.

45. Water Allocation : There are possible alternatives of water allocation such as irrigation oriented, industry oriented, or others. Since decision on the allocation belongs to the national policy, the study presents only possible menu.

WATER MANAGEMENT SYSTEM

46. In order to make efficient and effective use of the limited water in dry season, and to secure safely against floods in rainy season, introduction of extensive water management system to be supported by the on-line real-time systems is recommended. The system will consist of computer syatem, communication system and telemetering system and will cover the entire basin when all the system is completed. The system proposed is well in line with the flood forecasting and warnming system to be constructed by the Middle Reaches project, and will integrate the FF system into the management system. Data and records to be collected by the FF system will be the important basis of the water management system. Stagewise implementation of the system (three stages) is recommended.

47. For opeartion of the water management system and management of the water resources in the basin, establishment of organizational and institutional arrangement is needed by the time of introducing the hardware of the management system.

48. Projects included in the Master Plan are as follows;

Action program/Project		Reference	Present Status	Construction Cost (Rp.10^6)
WM-1	Flood Forecasting System	P/R	U/S	5,266
WM-2	Water Managment System, Stage 1	M/S	M/S	11,706
WM-3	-do- Stage 2	M/S	M/S	6,502
WM-4	-do- Stage 3	M/S	M/S	5,670

OVERALL IMPLEMENTATION PROGRAMMES

49. Based on the conclusions of the Sector Study, overall implementation programmes are formulated subsequently. Priority of projects formulation is shown in the following way:

(1) Priority will be given to on-going projects all of which are considered of urgent necessity for completion and economically and technically viable.

(2) Projects concerning water resource development are given high priority in order to alleviate the problem of water deficiency in dry season.

(3) Since the Widas river basin is the under-developed area in the Brantas river basin, the development of this area must be taken into account from the viewpoint of regional equity.

(4) Projects of agriculture and irrigation are selected as priority ones in terms of the view not so as to affect the overall water balance of the Brantas basin.

(5) The selection of projects relating to hydropower development ought to be in conjunction with water resource and dam development. Priority given to projects of hydropower is put in the low level.

50. Based on the implication of priority mentioned above, the following projects (excluding on-going projects) are recommended to be started these implementation by 1990/1991.

(1) Agriculture/Irrigation Project

- Wonorejo Dam Irrigation Project (D/D was completed)
- Tugu Dam/Irrigation Project (D/D was completed)
- Widas Extension Irrigation Project (Master plan)

(2) Water Supply Project

- Karangpilang Treatment Works Project (1st, 2nd, 3rd stage)
- Umbulan Spring Development Project (D/D was completed)
- Push Back from Ngrowo River Basin (Master plan)

(3) Flood Control Plan

- Surabaya River Improvement Project (2nd stage, F/S was completed)
- Widas Flood Control Plan (Master plan)

(4) Dam Development Plan (including electric development plan)

- Wonorejo Dam Project (D/D was completed)
- Beng Dam Project (Master plan)
- Kedungwarak Dam Project (Master plan)

(5) Watershed Management

- The Plan of Sabo and Reforestation in the Upper Brantas River
- Reforestation (overall area of the Brantas basin)

(6) Water Management System

- Water Management System (1st stage)

51. For implementation of projects mentioned above, the annual fund requirement will amount to Rp. 100 through 200 billion at 1984 constant price (Refer to the attached Table of Fund Requirement). These amount of fund is equal to or more than the fund allocated to the development of the Brantas river basin. If the annual fund is restricted to Rp. 100 billion, the implementation of some projects will be postponed. Even though the available fund is under such circumstances as mentioned above, projects recommended above are strongly advised to be implemented in order to promote the nation's socio-economic development. (Refer to the attached Table of Alternative Fund Requirement).

52. In order to evolve the proposed projects for implementation the feasibility study and detailed design of individual proposed projects are to be carried out according to the project status. The following actions are recommended to be taken as early as possible in order to promote these projects effectively (excluding projects whose present status is after the completion of D/D).

(1) Agriculture/Irrigation Project

- Widas Extension Plan:

  The F/S of this project was decided to be made in Part II of this Study. Action plan will be clarified in the stage of F/S.

(2) Water Supply Project

- Push Back from Ngrowo River Basin:

  Hydrological observation so as to get the more correct data on available return flow. The survey of available return water from Lodoyo irrigation area will be required.

(3) Flood Control Plan

- Surabaya River Improvement Plan:

  The detailed survey of present network of drainage channel.
  The survey of water quality.

- Widas Flood Control Plan:

  The F/S of this project was decided to be made in Part II of this Study. Action plan will be clarified in the stage of F/S.

(4) Dam Development Plan

- Beng Dam, Konto II Dam:

  Hydrological observation to get the more correct data on available water.
  The other survey concerning the geological investigation of dam site and the investigation of land use within the reservoir area.

(5) Watershed Management

- The survey of erodibility in the proposed basin area
- Hydrological observation including sediment and discharge at the proposed Sabo dam
- Monitoring of experimental terrace for the prevention of landslide

(6) Water Management System

- The detailed investigation of organization and institution relating to water management system

53. In parallel with action plan mentioned above, the following survey is recommended to be conducted thoroughly. The surveys which are regarded as incomplete ones in the formulation of Master Plan are compensated by surveys as shown below. They become the fundamental reference in the time when the future Master Plan is required to be reviewed.

(1) The survey of basin's water resource

- The more correct hydrological observation
- The survey of groundwater in the overall area of the basin

(2) The survey of irrigation water

- The more correct survey of present water use

(3) The survey of water quality

- The long-term survey of water quality in the downstream of the Brantas river, Surabaya river and their tributaries

(4) The survey of aqua-culture

- The survey of present aqua-culture industry in other areas
- The survey of seasonal fluctuation of salinity of brackish water in the area of Sidoarjo
- Based on the above two surveys, the possibility of aqua-culture planning must be clarified.

FUND REQUIREMENT OF K. BRANTAS BASIN DEVELOPMENT; MASTER PLAN UPTO YEAR 2000 (1/2)

Unit: x 10^6 Rp. 1984 constant price

SECTOR	ACTION	PROGRAM/PROJECT	REFERENCES	PRESENT STATUS	ESTIMATED COST	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
AGRICULTURE & IRRIGATION	AI-1	Warujayeng-Turi-Tunggrono	R/IV	D/D	41,289	7,273	12,184	12,342	6,240	3,250											
	AI-2	East Java Irrigation Rehabilitation	M/IV	U/C	271,330	19,691	19,143	17,850	16,646	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	
	AI-3	Ledoyo-Tulunggagung Irrigation	R/IV	U/C	6,408	3,224	2,271	913													
	AI-4	PIAT Kediri-Nganjuk	R/IV	U/C	8,789	2,373	2,692	1,812	1,912												
	AI-5	East Java Groundwater	R/IV	D/D	75,395	586	966	1,063	7,980	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200			
	AI-6	Mrican Barrage	R/IV	D/D	(21,900)	(1,500)	(2,250)	(2,625)	(1,125)	(1,200)	(1,200)	(1,200)	(1,200)	(1,200)	(1,200)	(1,200)	(1,200)	(1,200)	(1,200)	(1,200)	(1,200)
	AI-7	Papar-Pelerongan	R/IV	F/S	(22,262)	(3,916)	(6,560)	(6,645)	(3,391)	(1,750)											
	AI-8	Wonorejo	F/R	D/D	16,218					5,405	5,405	5,408									
	AI-9	Tugu	F/R	Pre F/S	8,325						1,665	2,497	2,497	1,664							
	AI-10	Widas Extension	M/S	M/S	3,045						1,015	1,015	1,015								
	AI-11	Bong	M/S	M/S	5,175								1,035	1,553	1,552	1,035					
	AI-12	Lesti-Left	M/S	M/S	(4,215)									(843)	(1,264)	(1,264)	(843)				
	AI-13	Gotlem-Lesti	M/S	M/S	(5,683)													(1,136)	(1,705)	(1,705)	(1,137)
DOMESTIC & INDUSTRIAL WATER	MW-1	Push Back from Ngrowo River Basin	F/R	Pre F/S	8,798			2,639	3,520	2,639											
	MW-2	Karangpilang Treatment Works Stage 1 (1 m^3/sec)	F/R	F/S	16,191	1,633	7,340	5,583	1,635												
	MW-3	Karangpilang Treatment Works Stage 2 & 3 (4 m^3/sec)	M/S	M/S	57,360				1,070	6,687	4,984	2,664	6,687	10,720	7,305	5,736	5,736	5,736			
	MW-4	Umbulan Spring Development	M/S	F/S	110,000					22,000	22,000	22,000	22,000	22,000							
	MW-5	Urban	M/S	M/S	62,695		2,471	2,471	2,471	2,471	2,471	4,633	4,633	4,633	4,633	4,633	5,435	5,435	5,435	5,435	5,435
	MW-6	SMA	M/S	M/S	261,637									19,688	19,688	19,688	31,337	31,337	37,073	37,073	37,073
	MW-7	Rural [1]	M/S	M/S	27,060		2,338	2,338	2,338	2,338	2,338	1,625	1,625	1,625	1,625	1,625	1,449	1,449	1,449	1,449	1,449
FLOOD CONTROL	FC-1	Middle Reach River Improvement (2nd Stage)	F/R	U/C	37,617	8,327	8,056	7,261	7,264	4,679	2,030										
	FC-2	Tulunggagung Drainage	F/R	U/C	10,350	6,900	3,450														
	FC-3	K. Surabaya (2nd Stage)	R/IV	D/D	62,538		6,254	12,508	12,502	12,507	12,507	6,254									
	FC-4	Widas Flood Control & Drainage	M/S	M/S	76,200						15,240	15,240	15,240	15,240	15,240						
	FC-5	Ledoyo Diversion Scheme	M/S	M/S	85,000											17,000	17,000	17,000	17,000	17,000	
WATERSHED MANAGEMENT	WS-1	G. Kelud	R/IV	U/C	94,019	4,525	5,115	6,210	6,169	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	WS-2	Upstream of K. Brantas	M/S	M/S	35,270		1,575	4,410	4,730	1,895	1,675	4,510	2,835	2,095	2,095	1,575	1,575	1,400	1,400	1,750	1,750
	WS-3	Reforestration (K.Brantas/K.Konto/K.Ngrowo)	M/S	M/S	19,500				1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500

FUND REQUIREMENT OF K. BRANTAS BASIN DEVELOPMENT; MASTER PLAN UPTO YEAR 2000 (2/2)

Unit: x 10^6Rp. 1984 constant price

SECTOR	ACTION PROGRAM/PROJECT	REFERENCES	PRESENT STATUS	ESTIMATED COST	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
ELECTRIC POWER	EP-1 Sunggoruh	F/R	U/C	79,186	30,157	40,704	7,852	473												
	EP-2 Lesti III	F/R	F/S	12,749	1,275	2,550	2,550	3,825	2,549											
	EP-3 South Tulungagung	F/R	D/D	41,164		2,403	8,297	12,352	15,347	2,765										
	EP-4 Wonorejo	F/R	D/D	12,724					4,241	4,241	4,242									
	EP-5 Tugu	F/R	D/D	1,572								786	786							
	EP-6 Beng	M/S	M/S	14,063								4,219	5,625	4,219						
	EP-7 K.Konto II	M/S	M/S	38,488										7,698	11,546	11,546	7,698			
	EP-8 Genteng I	M/S	M/S	(14,420)														(4,326)	(5,768)	(4,326)
	EP-9 Lumbangsari	M/S	M/S	(14,030)														(4,209)	(5,612)	(4,209)
	EP-10 Kepanjeng	M/S	M/S	(10,077)														(3,023)	(4,031)	(3,023)
DAM DEVELOPMENT	MP-1 Wonorejo Dam	F/R	D/D	76,658	3,833	3,833	3,833	19,165	19,165	19,165	7,664									
	MP-2 Tugu Dam	F/R	Pre F/S	40,029					4,003	8,006	12,009	8,006	8,005							
	MP-3 Kedungwarak Dam	M/S	M/S	5,894						1,768	2,358	1,768								
	MP-4 Beng	M/S	M/S	42,066							8,413	12,620	12,620	8,413						
	MP-5 K.Konto II	M/S	M/S	211,926									21,193	42,385	42,385	42,385	42,385	21,193		
	MP-6 Genteng I	M/S	M/S	(68,596)													(13,719)	(20,579)	(20,579)	(13,719)
AQUA-CULTURE	AQ-1 Brackish Water Fish Pond Stage 1	M/S	M/S	(66,640)							(6,664)	(6,664)	(6,664)	(6,664)	(6,664)	(6,664)	(6,664)	(6,664)	(6,664)	(6,664)
WATER MANAGEMENT SYSTEM	WM-1 Flood Forecasting System	F/R	U/S	5,266	1,955	3,311														
	WM-2 Water Management System, Stage 1	M/S	M/S	11,706						685	1,166	1,113	3,878	4,864						
	WM-3 " , Stage 2	M/S	M/S	6,502										588	2,067	2,593	1,254			
	WM-4 " , Stage 3	M/S	M/S	5,670												59	3,597	1,405	609	
	TOTAL COST OF CERTAIN PROJECTS			2,005,870	91,752	126,656	99,932	111,798	141,876	140,660	134,403	118,779	164,025	153,035	139,990	151,815	149,991	110,455	88,717	53,207
	CONTINGENCY (15%)			300,881	13,763	18,998	14,990	16,770	21,281	20,909	20,160	17,817	24,603	22,955	20,999	22,772	22,499	16,568	13,308	7,981
	TOTAL			2,306,751	105,515	145,654	114,922	128,568	163,157	160,300	154,563	136,595	188,629	175,990	160,989	174,587	172,490	127,023	102,025	61,188
	TOTAL COST OF UNCERTAIN PROJECTS			227,821	5,416	8,810	9,270	4,516	2,950	1,200	7,864	7,864	8,707	9,128	9,128	8,706	22,719	41,706	45,559	34,278
	CONTINGENCY (15%)			34,175	812	1,322	1,391	677	443	180	1,180	1,180	1,306	1,369	1,369	1,306	3,408	6,256	6,834	5,142
	TOTAL			261,996	6,228	10,132	10,661	5,193	3,393	1,380	9,044	9,044	10,013	10,497	10,497	10,012	26,127	47,962	52,393	39,420
	GRAND TOTAL			2,568,747	111,743	155,786	125,583	133,761	166,550	161,680	162,148	144,181	198,642	186,487	171,486	184,599	198,116	174,985	154,417	100,608

Note: Project stated in parenthesis is of uncertainty of the implementation.

Legend: Column in references, P/R; Project Report, R/IV; Repelita-IV, M/S; Master Plan Study.
Column in present status, Pre F/S; Pre-feasibility Study Stage, F/S; Feasibility Study Stage, D/D; Detailed Design Stage, U/C; Under Implementation.

/1 : Fund allocated is 30% of the total cost estimated for potential water demand.

ALTERNATIVE OF FUND REQUIREMENT

Unit: Rp x 10^6 1984 constant price

		Action Program/Project	Total Cost	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
AGRICULTURE & IRRIGATION	AI-1	Warujayeng-Turi-Tenggorono	41,289	7,273	12,184	12,342	6,240	3,250											
	AI-2	East Java Irrigation Rehabilitation	144,665	9,846	9,571	8,925	8,323	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000
	AI-3	Ludoyo-Tulungagung Irrigation	6,408	3,224	2,271	913													
	AI-4	PIAT, Kediri-Nganjuk	8,789	2,373	2,692	1,812	1,912												
	AI-5	East Java Groundwater	49,805	586	966	1,063	3,990	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600
	AI-6	Wonorejo	16,214					5,405	5,405	5,404									
	AI-7	Widas Extension	3,045						1,015	1,015	1,015								
	AI-8	Beng	5,176								1,035	1,553	1,553	1,035					
	AI-9	Tugu	8,323											1,665	2,497	2,497	1,664		
DOMESTIC & INDUSTRIAL WATER	MW-1	Push Back From Ngrowo Basin	8,798			2,639	3,520	2,639											
	MW-2	Karangpilang Treatment Works 1	16,191	1,633	7,340	5,583	1,635												
	MW-3	" Works 2 & 3	57,360				1,070	6,687	4,984	2,669	6,687	4,984	7,335	5,736	5,736	5,736	5,736		
	MW-4	Umbulan Spring Development	110,000					22,000	22,000	22,000	22,000	22,000							
	MW-5	Urban water	45,665		1,853	1,853	1,853	1,853	1,853	3,475	3,475	3,475	3,475	3,475	3,805	3,805	3,805	3,805	3,805
	MW-6	SMA	202,110										17,146	17,146	17,146	17,146	17,146	33,366	33,366
	MW-7	Rural	27,060		2,338	2,338	2,338	2,338	2,338	1,625	1,625	1,625	1,625	1,625	1,449	1,449	1,449	1,449	1,449
FLOOD CONTROL	FC-1	Middle Reach River Improvement 2	38,317	8,327	8,056	7,961	7,264	4,679	2,030										
	FC-2	Tulungagung Drainage	10,350	6,900	3,450														
	FC-3	K. Surabaya (2nd Stage)	62,538		6,254	12,508	12,508	6,253	6,253	6,254	6,254	6,254							
	FC-4	Widas Flood Control & Drainage	76,200						7,620	7,620	7,620	7,620	7,620	7,620	7,620	7,620	7,620	7,620	
WATERSHED MANAGEMENT	WS-1	G. Kelud	94,019	4,525	5,115	6,210	6,169	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	WS-2	Upstream of K. Brantas	35,270		1,575	4,410	4,730	1,895	1,675	4,510	2,835	2,095	2,095	1,575	1,575	1,400	1,400	1,750	1,750
	WS-3	Reforestration (K. Brantas/ K. Konto/K. Ngrowo)	19,500				1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
HYDRO-POWER	EP-1	Sunggruh	79,186	30,157	40,704	7,852	473												
	EP-2	Lesti III	12,750	1,275	2,550	2,550	3,825	2,550											
	EP-3	South Tulungagung	41,164		2,403	8,297	12,352	15,347	2,765										
	EP-4	Wonorejo	12,724					4,241	4,241	4,242									
	EP-5	Beng	14,063									4,219	5,625	4,219					
	EP-6	Tugu	1,572													786	786		
DAM DEVELOPMENT	MP-1	Wonorejo Dam	76,658	3,833	3,833	3,833	19,165	19,165	19,165	7,664									
	MP-2	Kedungwarak Dam	5,894						1,768	2,358	1,768								
	MP-3	Beng Dam	42,066								8,413	12,620	12,620	8,413					
	MP-4	Tugu Dam	40,029										4,003	8,006	12,009	8,006	8,005		
	MP-5	K. Konto II Dam	63,578															21,193	42,385
WATER MANAGEMENT SYSTEM	WM-1	Flood Forcasting System	5,266	1,955	3,311														
	WM-2	Water Management System Stage 1	11,706						685	1,166	1,113	3,878	4,864						
	WM-3	" Stage 2	6,502										588	2,067	2,593	1,254			
	WM-4	" Stage 3	5,670													59	3,597	1,405	609
		TOTAL COST	1,505,600	81,907	116,466	91,089	98,867	118,402	103,897	90,102	83,941	90,424	88,649	82,682	74,531	80,343	81,792	90,689	103,464
		CONTINGENCY (15%)	225,840	12,286	17,470	13,663	14,830	17,760	15,585	13,515	12,591	13,561	13,297	12,402	11,180	12,051	12,269	13,603	15,464
		GRAND TOTAL	1,731,440	94,193	133,936	104,752	113,697	136,162	119,482	103,617	96,532	103,988	101,946	95,084	85,711	92,394	94,061	104,292	118,984

IMPLEMENTATION PROGRAM OF MASTER PLAN
FOR K. BRANTAS BASIN

SECTOR		PROJECT	'85 '86 '87 '88 '89 '90 '91 '92 '93 '94 '95 '96 '97 '98 '99 '00
IRRIGATION & AGRICULTURE	AI- 1	Waru-Turi	
	AI- 2	East Java I. Rehabili	
	AI- 3	Lodoyo-Tulungagung	
	AI- 4	P2AT. Kediri-Nganjuk	
	AI- 5	East Java Groundwater	
	AI- 6	Mrican Barrage	
	AI- 7	Paper-Peterongan	
	AI- 8	Wonorejo	
	AI- 9	Tugu	
	AI-10	Widas Extension	
	AI-11	Beng	
	AI-12	Lesti-Left	
	AI-13	Gottan-Lasari	
DOMESTIC & INDUSTRIAL WATER	MW- 1	Push Back from Ngrowo River Basin	
	MW- 2	Karangpilang Treatment Works Stage 1	
	MW- 3	Karangpilag Treatment Works Stage 2	
	MW- 4	Umbulen Spring Development	
	MW- 5	Urban	
	MW- 6	SMA	
	MW- 7	Rural	
FLOOD CONTROL	FC- 1	Middle Reach River Improvement	
	FC- 2	Tulungagung Drainage	
	FC- 3	K. Surabaya (Stage 2)	
	FC- 4	Widas Flood Control & Drainage	
	FC- 5	Lodoyo Diversion Scheme	
WATERSHED MANAGEMENT	WS- 1	G. Kelud	
	WS- 2	Upstream of K. Brantas	
	WS- 3	Reforestration (K. Brantas/ K. Konto/K. Ngrowo)	
HYDRO-ELECTRIC POWER	EP- 1	Sunggoruh	
	EP- 2	Lesti III	
	EP- 3	South Tulungagung	
	EP- 4	Wonorejo	
	EP- 5	Tugu	
	EP- 6	Beng	
	EP- 7	K. Konto II	
	EP- 8	Genteng I	
	EP- 9	Lumbangsari	
	EP-10	Kepanjeng	
DAM DEVELOPMENT	MP- 1	Wonorejo Dam	
	MP- 2	Tugu Dam	
	MP- 3	Kedungwarak Dam	
	MP- 4	Beng	
	MP- 5	K. Konto II	
	MP- 6	Genteng I	
AQUA-CULTURE	AQ- 1	Brackish Water Fish Pond (Stage 1)	
WATER MANAGEMENT SYSTEM	WM- 1	Flood Forcasting System	
	WM- 2	Water Management System Stage 1	
	WM- 3	Water Management System Stage 2	
	WM- 4	Water Management System Stage 3