5.3 Discussion and Decision

Discussion for JICA's proposal between JICA Team and Indonesian Government was made in March, 1991 and some changes were made as follows.

(1) Central Java

4 (four) among 16 IKKs proposed by JICA team were deleted and another 2 (two) IKKs were additioned instead.
Main reasons were the balance of numbers of High Priority IKKs among Kabupaten and Provinces and the difficulty to get the water.

(2) East Java

3 (three) IKKs among 10 IKKs proposed by JICA team were deleted and 5 (five) IKKs were additioned instead by the same reasons as in Central Java.

(3) Bali

4 (four) IKKs proposed by JICA team were accepted without change.

Selection of High Priority IKKs, including identification and discussion results, is summarized in Table 5.2.

High Priority IKKs finally decided (14 IKKs in Central Java, 12 IKKs in East Java and 4 IKKs in Bali) are shown in Table 5.3 and Fig. 5.3.

Table 5.2 Summary of Identification of High Priority IKKs

Province		Kabupaten	IKK	Type of Water Supply System	Installation Cost (Rp/Man)	Factor ①	②	③	④	Step 1.	2.	3. (①-a, ②-b)	4. (Addition to Step 3)	5.	High Priority IKKs
Central Java	1	BREBES	Bantarkawung	B-b	64,000	a	a	a	a	O	O	O		X	
	2		Bulakamba	D-b	76,700	a	a	a	c	O	O			O	O
	3		Paguyangan	A-a	51,300	a	b	a	c	O					
	4		Salem	B-b	59,200	a	a	a	c	O	O				
	5		Losari	C-b	72,200	a	a	a	c	O	O				
	6	CILACAP	Dayeuhluhur	A-a	65,000	a	b	b	b	O					
	7		Gandrungmangu	E	71,200	a	a	a	c	O	O				
	8		Jeruklegi	F	52,400	a	a	a	b	O	O	O			O
	9		Kesugihan	F	42,000	a	b	b	c	O					
	10		Nusawungu	F	162,200	b	a	a	b						
	11	PURWOREJO	Butuh	D-b	85,700	b	b	b	b						
	12		Banyuurip	B-b	81,000	a	b	a	b	O					
	13		Grabag	C-b	88,700	b	b	a	c						
	14		Kaligesing	B-a	83,300	b	b	a	a						
	15		Kemiri	C-b	77,300	a	a	a	c	O	O			O	O
	16		Purwodadi	C-b	73,400	a	a	a	c	O	O				
	17		Bayan	F	45,000	a	b	b	b	O					
	18		Ngombol	C-b	76,300	a	b	a	c	O					
	19	BANJAR NEGARA	Banjarmangu	A-a	76,500	a	b	b	b	O					
	20		Karangu Kobar	A-a	85,600	b	b	b	a						
	21		Madukara	B-b	74,200	a	a	b	b	O	O	O			O
	22		Pagentan	A-a	63,800	a	b	b	b	O					
	23		Punggelan	B-a	70,200	a	a	a	b	O	O	O			O
	24		Purwonegoro	B-b	93,000	b	a	a	a						
	25		Purworejo Klampok	B-a	60,000	a	b	a	a	O					
	26	KEBUMEN	Karangsambung	C-b	73,100	a	a	a	c	O	O				
	27		Ambalresmi	C-b	88,700	b	b	a	b						
	28		Demangsari	B-b	94,900	b	a	a	b						
	29		Setrojenar	C-b	111,700	b	a	a	b						
	30		Karanggayam	F	75,500	a	a	a	b	O	O	O			O
	31		Klegenwonosari	C-b	76,600	a	a	a	c	O	O				
	32		Mirit	C-b	101,000	b	b	a	b						
	33		Petanahan	C-b	81,800	a	a	a	b	O	O	O			O
	34		Prembun	C-b	104,300	b	b	a	b						
	35	KENDAL	Gemuh	B-b	87,900	b	a	a	b						
	36		Sukorejo	A-a	56,400	a	a	a	b	O	O	O			O
	37		Singorojo	E	105,500	b	a	a	b						
	38	BLORA	Banjarrejo	D-b	106,400	b	a	a	b						
	39		Jepon	D-a	79,700	a	a	b	a	O	O	O			O
	40		Mendenrejo	D-b	87,100	b	b	a	b						
	41	KUDUS	Dawe	B-a	67,300	a	b	b	c	O					
	42	PATI	Batangan	F	49,600	a	a	a	b	O	O	O			O
	43		Tayu	D-b	71,400	a	b	a	b	O					
	44	REMBANG	Kaliori	B-b	96,000	b	a	a	b						
	45		Sale	B-b	79,600	a	b	a	c	O					
	46	SRAGEN	Tangan	D-b	91,500	b	a	a	a						
	47		Miri	D-a	62,200	a	a	b	b	O	O	O		X	
	48		Gondang	D-b	78,600	a	a	a	b	O	O	O			O
	49		Jenar	D-b	69,700	a	a	a	b	O	O	O			O
	50		Plupuh	D-b	71,500	a	b	a	b	O					
	51		Sambirejo	D-b	72,000	a	a	b	b	O	O	O		X	
	52	WONOGIRI	Jatiroto	D-b	97,600	b	b	b	b						
	53		Nguntoronadi	D-b	88,700	b	b	a	b						
	54		Giriwoyo	B-b	70,100	a	a	b	b	O	O	O			O
	55		Jatipurno	B-b	83,600	b	b	b	b						
	56		Bulukerto	A-a	59,500	a	b	b	b	O					
	57		Manyaran	B-b	67,300	a	b	b	b	O					
	58	SEMARANG	Bawen	B-b	77,800	a	a	a	b	O	O	O			O
	59		Suruh	B-b	76,300	a	a	b	b	O	O	O		X	
	60	KLATEN	Bayat	C-b	75,700	a	b	a	b	O					
	61		Karangnongko	C-b	91,800	b	b	a	b						
	1	BOJONEGORO	Balen	D-b	89,700	b	a	a	b					O	O
	2		Baureno	D-b	87,700	b	a	a	a					O	O
	3		Kapas	D-b	110,200	b	b	a	b						
	4		Sumberrejo	D-b	101,200	b	a	a	b						
	5	TUBAN	Bangilan	D-b	81,200	a	b	b	a	O					
	6		Bulu	D-b	85,000	b	a	b	b						
	7		Parengan	B-b	99,700	b	a	b	b						
	8		Jenu	C-b	74,300	a	a	a	b	O	O	O			O
	9		Kerek	F	66,100	a	b	b	b	O					
	10	LAMONGAN	Karanggeneng	D-b	90,000	b	a	a	b						
	11		Kembangbahu	D-b	107,600	b	a	a	b					O	O
	12		Tikung	F	74,700	a	b	b	b	O					
	13		Ngimbang	B-b	135,000	b	a	a	b						
	14		Brondong	C-b	72,400	a	a	a	b	O	O	O		X	
	15	JOMBANG	Diwek	D-b	78,400	a	a	a	b	O	O	O			O

	2		Baureno	D-b	87,700	b	a	a	a						○	○
	3		Kapas	D-b	110,200	b	b	a	b							
	4		Sumberrejo	D-b	101,200	b	a	a	b							
	5	TUBAN	Bangilan	D-b	81,200	a	b	b	a	○						
	6		Bulu	D-b	85,000	b	a	b	b							
	7		Parengan	B-b	99,700	b	a	b	b							
	8		Jenu	C-b	74,300	a	a	a	b	○		○				○
	9		Kerek	F	66,100	a	b	b	b	○						
	10	LAMONGAN	Karanggeneng	D-b	90,000	b	a	a	b							
	11		Kembangbahu	D-b	107,600	b	a	a	b						○	○
	12		Tikung	F	74,700	a	b	b	b	○						
	13		Ngimbang	B-b	135,000	b	a	a	b							
	14		Brondong	C-b	72,400	a	a	a	b	○		○			X	
	15	JOMBANG	Diwek	D-b	78,400	a	a	a	b	○		○				○
	16		Gudo	D-b	85,400	b	b	a	c							
	17		Kudu	D-b	98,500	b	a	a	c							
	18		Megaluh	D-b	82,400	a	b	a	c	○						
	19		Mojowarno	D-b	90,400	b	b	a	a							
East	20		Ngoro	D-b	66,300	a	b	a	b	○						
Java	21	MADIUN	Jiwan	D-b	84,700	b	b	a	b						○	○
	22		Mejayan	F	56,100	a	b	b	a	○						
	23	MOJOKERTO	Dlanggu	F	382,700	b	b	b	b							
	24		Gedeg	D-b	99,600	b	b	a	b							
	25		Jatirejo	B-a	109,900	b	b	b	c							
	26		Kutorejo	D-b	91,000	b	a	b	b				○			○
	27		Pacet	F	68,900	a	b	b	b	○						
	28	LUMAJANG	Candipuro	A-a	61,500	a	a	a	b	○		○			X	
	29		Gucialit	A-a	66,600	a	b	b	b	○						
	30		Tempeh	A-a	81,400	a	a	a	c	○		○				○
	31		Kunir	D-b	81,100	a	a	a	b	○		○				○
	32		Randuagung	B-b	80,700	a	a	b	c	○		○			X	
	33		Ranuyoso	B-b	88,100	b	a	b	c							
	34		Senduro	B-a	94,800	b	a	a	b							
	35		Tempursari	B-b	84,300	b	a	a	b							
	36	PROBOLINGO	Banyuanyar	D-b	90,400	b	a	a	b						○	○
	37		Besuk	D-b	106,200	b	a	a	c							
	38		Gending	B-b	158,500	b	a	a	b							
	39		Maron	A-a	109,100	b	b	b	b							
	40		Sumberasih	B-b	75,900	a	a	a	b	○		○				○
	1	BADUNG	Blahkiuh	A-a	115,100	b	b	b	b							
	2	BULELENG	Munduk	B-b	125,600	b	b	b	b							
	3		Tista	D-b	111,100	b	a	a	a							
	4		Sangsit	F	102,500	b	b	b	b							
	5		Panji	A-a	140,000	b	a	b	b							
	6	GIANYAR	Singakerta	F	150,100	b	a	b	b							
	7		Tampak Siring	B-b	72,600	a	a	b	c	○		○		○		○
	8		Tegalalang	A-a	171,600	b	b	b	a							
	9		Ketewel	F	78,100	a	a	b	b	○		○	○			○
Bali	10	JEMBRANA	Asahduren	B-b	186,100	b	b	b	a							
	11	KARANG ASEM	Abang	A-a	94,100	b	a	a	c							
	12		Bebandem	B-b	94,600	b	a	b	b							
	13		Menanga	A-a	93,600	b	a	a	b					○		○
	14		Sibetan	A-a	79,500	a	a	b	b	○		○	○			○
	15	KLUNGKUNG	Sakti	B-b	94,600	b	a	a	b							
	16	TABANAN	Marga	A-a	82,700	a	b	b	c	○						
	17		Pupuan	A-a	103,600	b	b	b	b							
	18		Antap	B-b	117,800	b	a	a	c							
	19	BANGLI	Bangbang	A-a	99,400	b	a	b	c							
	20		Tiga	B-b	110,000	b	a	b	b							
No. of IKKs			121							60	35	24	6			30

(Note)

(1) Factor ① ___ Installation cost (a < 82,700$^{Rp/Man}$, b > 82,700$^{Rp/Man}$)
② ___ Difficulty to get the water (a: Difficult, B: Not so difficult)
③ ___ Existence of water supply facilities (a: No, b: Yes)
④ ___ Income level (a > 135,000$^{Rp/M}$, 135,000 > b > 75,000$^{Rp/M}$, C < 75,000$^{Rp/M}$)

(2) Step 1 ___ Nominate ①-a.
2 ___ Nominate ②-a out of Step 1.
3 ___ Nominate ④-a and ④-b out of step 2
4 ___ Review and Revision of Step 1 ~ step 3
5 ---- Discussion with GOI

(3) x..... Deleted in Step 5.

(4) In Factor ②, IKKs classified to "a" are as follows.

1) There are not enough water sources and the residents feel inconvenience because of lack of water.
2) Fairly long time and much labour, are required for the people to get the water for daily use.
3) The residents are forced to buy drinking water.
4) The rain water reservoirs are installed.

Table 5.3

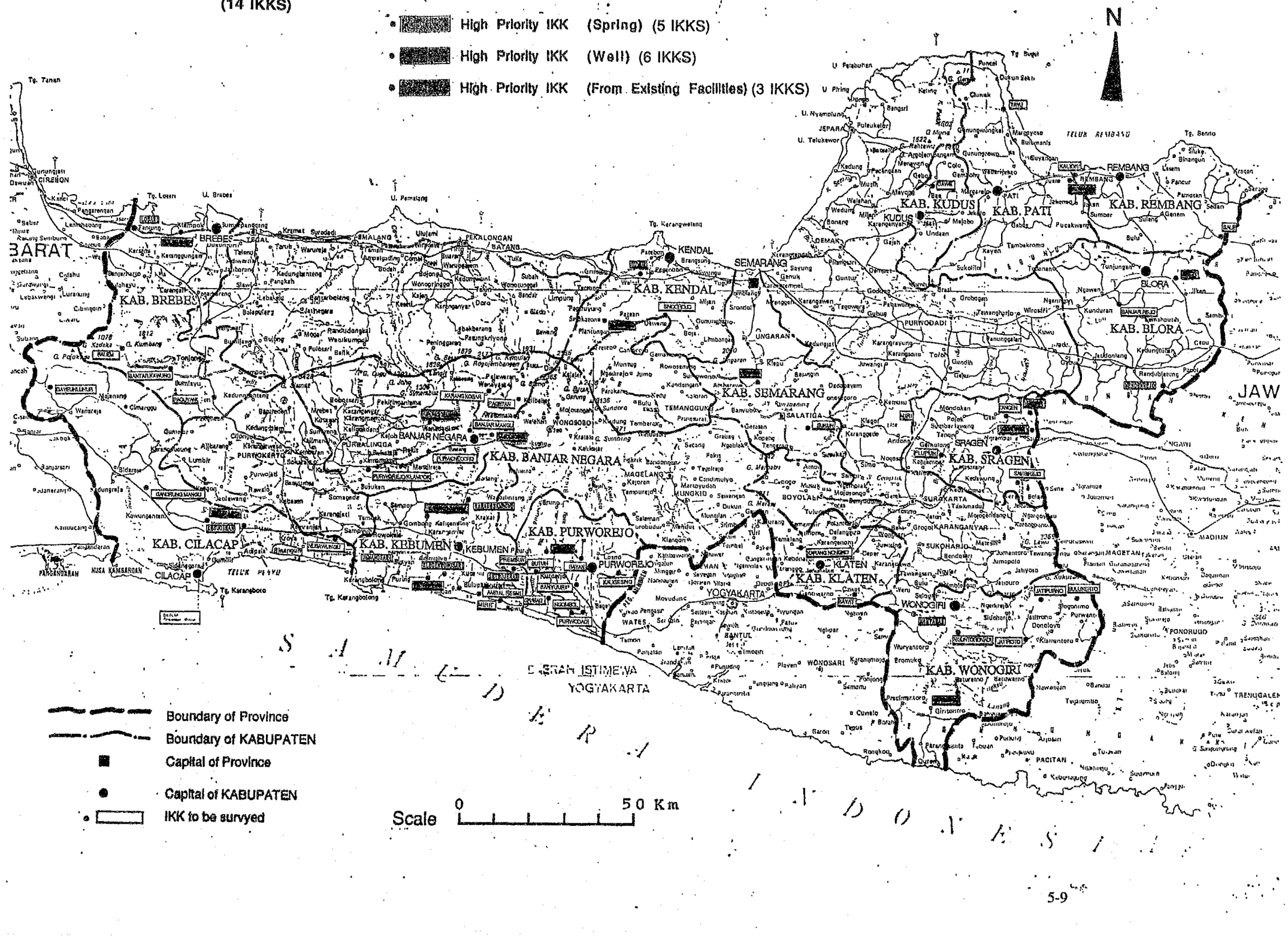
High Priority IKKs

No.	Province	Kabupaten	IKK
1	Central Java	BREBES	Bulakamba
2	"	CILACAP	Jeruklegi
3	"	PURWOREJO	Kemiri
4	"	BANJAR NEGARA	Madukara
5	"	"	Punggelan
6	"	KEBUMEN	Karanggayam
7	"	"	Petanahan
8	"	KENDAL	Sukorejo
9	"	BLORA	Jepon
10	"	PATI	Batangan
11	"	SRAGEN	Gondang
12	"	"	Jenar
13	"	WONOGIRI	Giriwoyo
14	"	SEMARANG	Bawen
15	East Java	BOJONEGORO	Balen
16	"	"	Baureno
17	"	TUBAN	Jenu
18	"	MADIUN	Jiwan
19	"	LAMONGAN	Kembangbahu
20	"	JOMBANG	Diwek
21	"	MOJOKERTO	Kutorejo

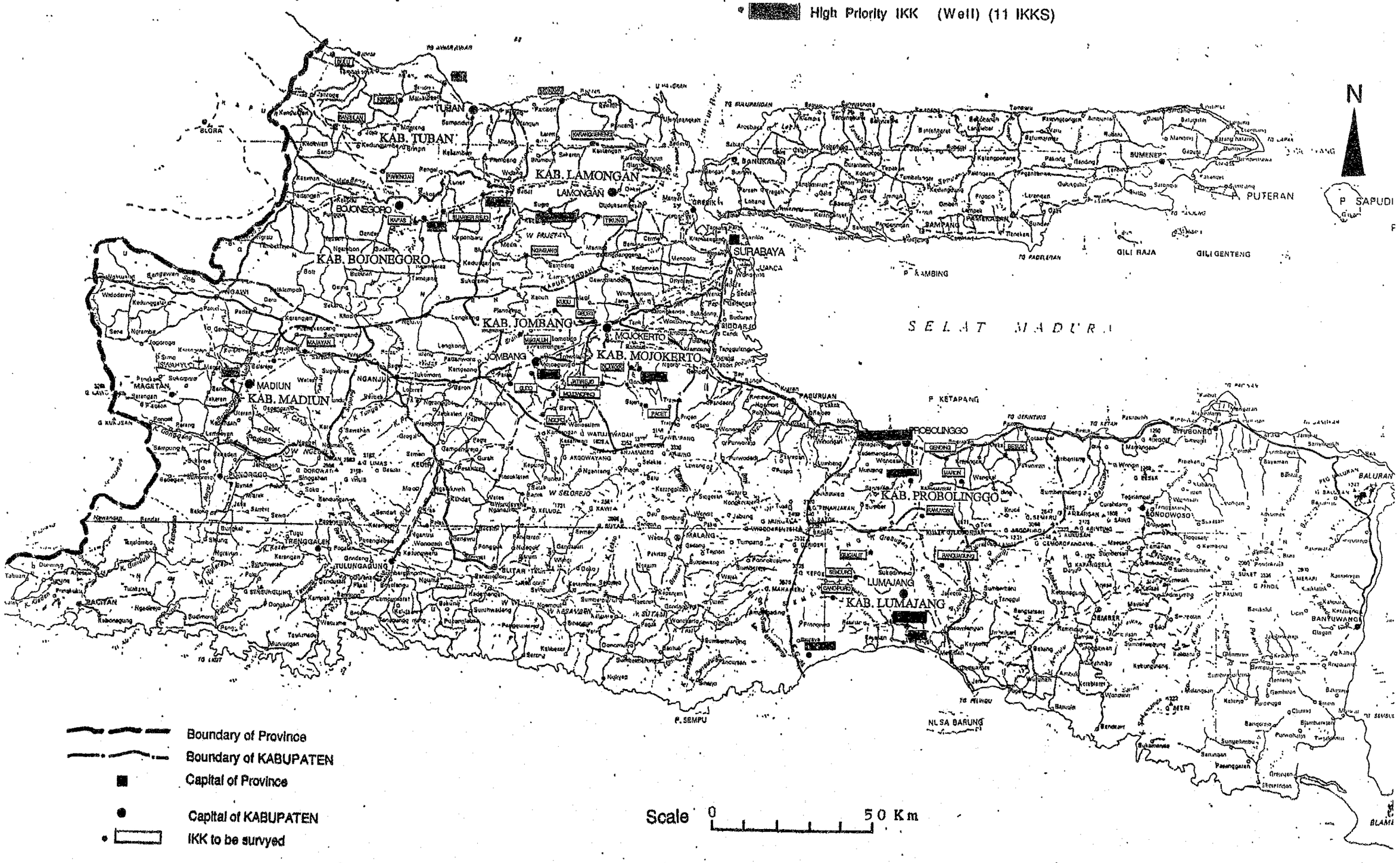
No.	Province	Kabupaten	IKK
22	East Java	LUMAJANG	Tempeh
23	"	"	Kunir
24	"	"	Tempursari
25	"	PROBOLINGGO	Banyuanyar
26	"	"	Sumberasih
27	B a l i	GIANYAR	Tampak Siring
28	"	"	Ketewel
29	"	KARANG ASEM	Menanga
30	"	"	Sibetan

Fig. 5.3 Location Map of High Priority IKKS

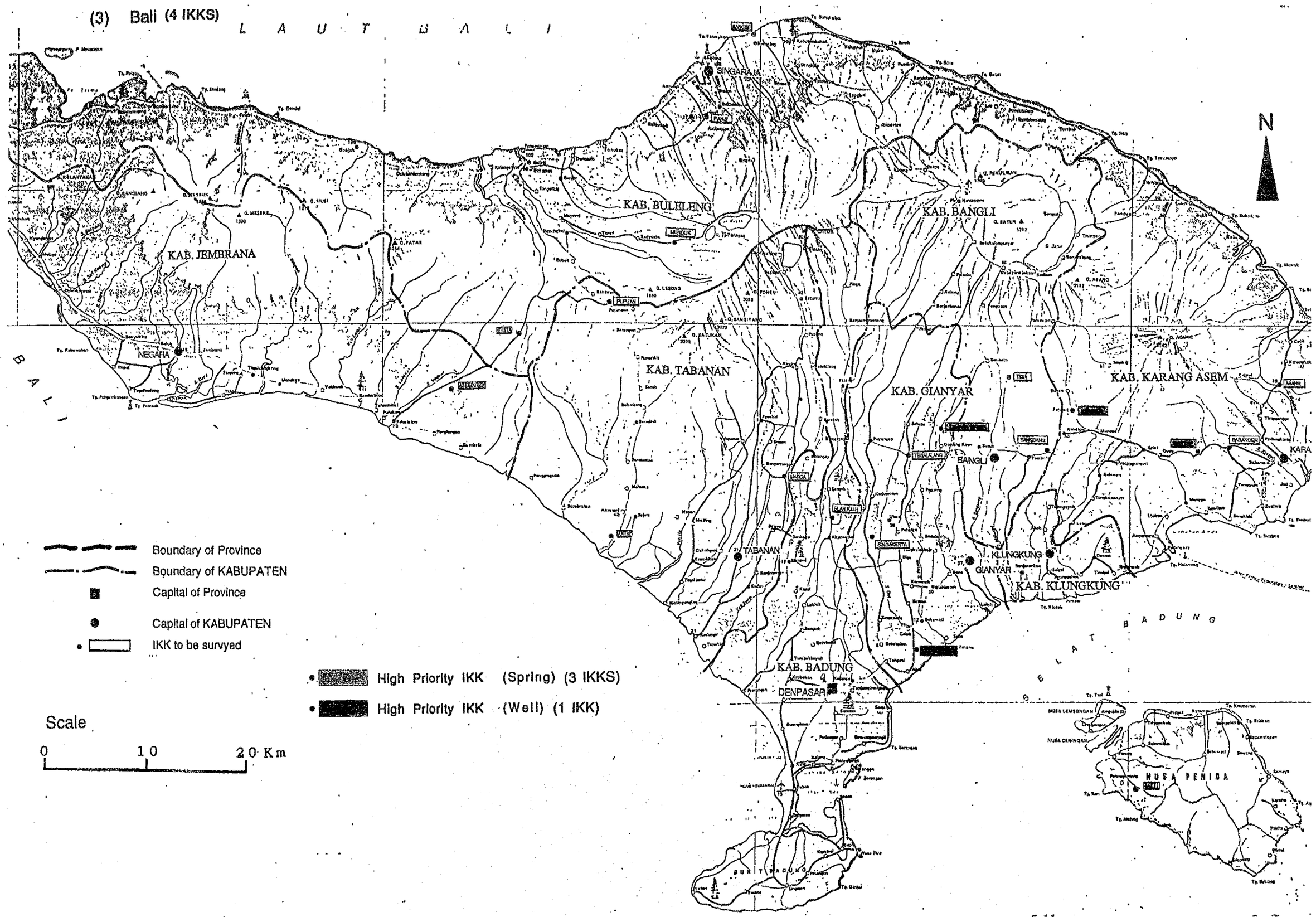
(1) Central Jawa
(14 IKKS)



(2) East Jawa (12 IKKS)



(3) Bali (4 IKKS)


L A U T B A L I
SINGARAJA
KAB. BULELENG
KAB. JEMBRANA
NEGARA
KAB. TABANAN
KAB. BANGLI
KAB. GIANYAR
KAB. KARANG ASEM
KAB. KLUNGKUNG
KAB. BADUNG
DENPASAR
TABANAN
BANGLI
GIANYAR
SELAT BADUNG
NUSA PENIDA
N
Boundary of Province
Boundary of KABUPATEN
Capital of Province
Capital of KABUPATEN
IKK to be survyed
High Priority IKK (Spring) (3 IKKS)
High Priority IKK (Well) (1 IKK)
Scale
0 10 20 Km

CHAPTER 6 FEASIBILITY STUDY FOR 30 IKKs

CHAPTER 6 FEASIBILITY STUDY FOR 30 IKKS

6.1 Plan of Water Supply Facilities

6.1.1 In-depth Field Surveys

Detailed field surveys for High Priority IKKs were conducted to determine the conditions for feasibility study from May to August 1991. In the surveys, the following surveys and investigations were included.

(1) Field Survey for Additional Data Collection

JICA Study Team visited 30 High Priority IKKs and conducted the field reconnaissance to receive and confirm the Answers to the Additional Questionnaires.

The following items in the Basic Plan were reviewed and revised in this survey.

1) Water Supply Area

Based on the Answers to the Additional Questionnaires and field reconnaissance together with the officials of Kecamatan/Desa office, water supply area, including the piping route, for each IKK was reviewed and confirmed.
This results were reflected to the Topographical Survey and finally to the design of water supply facilities.

2) Water Surved Population

Population of each IKK in year 2,000 was also reviewed and revised based on the Field Surveys and Statistic data published in 1991 (Census results in 1990).

3) Income Level

Income level of house-holds was revised based on the Answers to the Additional Questionnaires.
Comparison of income level on Basic Plan and Feasibility Study is shown in Table 6.1.1.
This results were reflected to the ratio of population served by public taps and house connections.

4) Water Sources

Water source for each IKK was reviewed through this survey also.
Details are shown in Chapter 3 and 6.1.2 in Chapter 6.

Table 6.1.1 Comparison of Income Level on Basic Plan and Feasibility Study

Province	I K K	Basic Plan		Additional Questionnaire Da			Monthly Income will be used for easibility study (Rp.)
		Monthly Income (Rp.)	Monthly xpenditure (Rp	Monthly Income (Rp.) Low	Medium	High	
Central Java	Bulakamba	54,312	47,872	75,000	137,500	187,500	137,500
	Jeruklegi	109,167	94,167	51,567	107,166	174,569	107,166
	Kemiri	60,934	58,744	75,000	150,000	300,000	150,000
	Madukara	116,667	91,667	30,000	100,000	200,000	100,000
	Punggelan	112,917	87,917	40,000	60,000	80,000	112,917 *
	Karanggayam	79,167	79,167	37,500	52,500	262,500	79,167 *
	Petanahan	109,167	109,167	45,500	80,000	105,000	109,167 *
	Sukorejo	97,917	97,917	70,000	-	200,000	97,917 *
	Jepon	139,167	119,167	70,000	160,000	310,000	160,000
	Batangan	97,917	82,917	50,000	200,000	300,000	200,000
	Gondang	86,667	71,667	-	37,500	147,000	86,667 *
	Jenar	78,042	74,542	45,000	67,000	104,000	78,042 *
	Girlwoyo	94,167	84,167	60,000	143,000	187,500	143,000
	Bawen	79,167	74,167	96,000	155,000	300,000	155,000
East Java	Balen	131,728	-	87,250	125,500	160,770	131,728 *
	Baureno	135,812	-	105,000	120,000	145,000	135,812 *
	Jenu	110,526	100,526	60,000	81,000	105,000	110,526 *
	Kembangbahu	110,526	105,526	49,775	107,245	159,715	110,526 *
	Diwek	82,895	-	35,000	175,000	325,000	175,000
	Jiwan	118,421	-	84,250	168,500	337,000	168,500
	Kutorejo	102,632	-	80,000	105,000	128,000	105,000
	Tempeh	63,158	55,658	60,000	80,000	120,000	80,000
	Kunir	94,737	74,737	40,000	50,000	195,000	94,737 *
	Tempursari	120,789	117,789	104,750	150,750	199,000	150,750
	Banyuanyar	86,842	86,842	132,600	145,560	174,820	145,560
	Sumberasih	98,684	-	119,200	147,650	170,250	147,650
Bali	Tampaksiring	59,831	-	75,000	115,000	200,000	115,000
	Ketewel	113,263	98,263	135,000	180,000	270,000	180,000
	Menanga	77,221	-	105,000	140,500	225,000	140,500
	Sibetan	99,748	84,748	53,000	145,000	241,000	145,000

Note : - Income for feasibility study took from medium monthly income base on additional questionnaire data, except several IKK (with * mark), still used monthly income for basic plan, because the incomes was decreased if compare with basic plan.

(2) Socio-Economic Survey

Socio-Economic Survey regarding the institutional and organizational aspects was conducted.
In this survey, the following items were included.

1) Laws and Regulations related to domestic water supply.
2) Establishment, Organization and Function of BPAM and PDAM
3) Financial Aspects of BPAM and PDAM

Results of this survey are shown in Chapter 2 and Supporting Report A.

(3) Topographical Survey

Topographical survey for 30 IKKs was conducted by a local survey company from May, 1991 to August, 1991.
The survey area and route for pipeline were decided previously by the Field Survey for Additional Data Collection.
Survey results were submitted to JICA Team as Survey Drawings ; total 684 drawings of A1 size consisting of location plan of pipe line, plan of water source, longitudinal section and cross section.

(4) Geological Observations

Supplemental geological investigations were carried out to determine the most suitable water source for each IKK of 30 high priority IKKs and to allocate the well locations including the test wells for IKKs where groundwater shall be used as the water source. In order to accomplish this purpose, outcrop investigation, topographic feature observation, existing deep well survey, land-use condition observation, river condition observation, existing data collection on deep wells, investigation about area inundated during the rain season, and so forth were carried out by visiting the sites.

(5) Hydrological Observations

Study confirmation of availability and discharge of springs as water source for proposed IKKs, and collecting data of existing deep wells nearby those IKks which are proposed to get water from deep wells were conducted.

(6) Water Quality Analyses

Water quality analyses were conducted on samples collected from springs which are proposed as water sources for High Priority IKKs and on samples collected from test wells.

1) Analysis at Site

Using the portable test kit provided by JICA, analyses were conducted on some items for samples collected from spring sources.

2) Analysis at Laboratories

Samples collected from springs and test wells were sent to the authorized laboratories and analyzed.

3) Bacterial Test

Bacterial tests were conducted to measure the numbers of coliform and bacteria at site using two kinds of simplified detection papers provided by JICA team.

Analysis results are described in 3.5 in Chapter 3.

6.1.2 Water Sources

(1) Selected Water Sources

Based on hydrogeological information obtained and compiled in the Phase I, the test well drilling and pumping test, water quality analysis, and a supplemental field survey and reconnaissance were carried out in the Phase II in order to confirm and determine the most suitable water supply source source for each IKK of 30 high priority IKKs. Results of the investigations in Phases I and II are described in Chapter 3, and related data are provided in Supporting Report B.

In the last analysis for selecting the water source, Table 6.1.2 - Summary of Selected Water Sources for High Priority IKKs - was constructed.

Table 6.1.2 consists of two tables; one for the IKKs of Central Java and the other for the IKKs of East Java and Bali. Table 6.1.2 is the last product that was prepared at the conclusion of the field investigations on water resources. It aims to be used for the feasibility study. Table 6.1.2 summarizes the selected water source and its condition in each IKK of 30, together with recommendations on water collecting facilities.

More detailed data and information related to hydrogeological condition and water resources are provided in Table B-2.7 and Section 2.2.2 of Supporting Report B.

(2) Water Sources Changed for New Ones

As is mentioned in Paragraph (2) of Section 3.2.4, water sources that had been proposed for the Basic Plan were inevitably changed for new ones. Their reasons are as explained hereinafter.

1) Madukara, Central Java

For the Basic Plan, Jurang Jero spring - the biggest spring in Madukara kecamatan - was proposed as the water source; however, according to a field survey in Phase II, the discharge rate of the spring was much lower than that (10 1/s) estimated in Phase I, and it was obliged to discard the use of the spring. It was thought that the spring discharge decrease is due to its specific nature of physical environment; Jurang Jero spring is located on a valley consisting of talus deposits; and the ground slope and the waterway are at instable condition.

Subsequently, the necessity of searching for an alternative water source occurred.

Available springs being around this IKK are Siton spring (13 l/s) in Pagentan kecamatan and Mudal spring (30 l/s, of which 10 l/s is available) in Banjarmangu kecamatan. Both springs are located at a good distance, so a collector well installed by the Serayu river on the south boundary of Madukara was also studied.

After the study on these alternative sources, a scheme of the collector well was renounced because the thickness of a riverbed gravel layer was estimated to be about 2m, and a conclusion was drawn to use the Mudal spring. In case of Mudal spring, existing water supply facilities for Banjarnegara City can partly be used.

2) Tempeh, East Java

Takir spring was proposed for the Basic Plan. It is far from the IKK area; about 9m along road. It has been disclosed by the site survey in Phase II that to take water from this spring is practically difficult because of its water right for irrigation.

In conclusion, the water source was changed from spring to groundwater, since this IKK area is underlain by a highly productive aquifers consisting of young Quaternary pyroclastics.

3) Tempursari, East Java

Sidomukti spring was used as the water source for Basic Plan. In the site survey of Phase I, only this spring was recommended by the local official. It is located on a mountain area of difficult accessibility. But, as a result of detailed site survey, Umbulsari I spring (600 l/s capacity) was discovered at a location nearer than Sidomukti. There is no problem to take the water from Umbulsari I spring. Thus, source spring was changed from Sidomukti to Umbulsari I from economical point of view.

4) Sumberasih, East Java

For the Basic Plan, Sumberbendo spring (15 l/s capacity) was proposed as the water source. However, it was disclosed by a site survey in Phase II that taking water from this spring is practically difficult because it has been used for irrigation. Thus, the supply source was changed to groundwater

from Sumberbendo spring. There are two operating P2AT wells in this kecamatan, and a groundwater potential map indicates that this IKK area belongs to one of the most productive aquifer zones with the potential of more than 40 l/s yield.

5) Ketewel, Bali

The use of existing Singakerta waterworks was proposed for the Basic Plan, but after that the extension of this waterworks has been proposed by other project for areas excluding Ketewel and it is in process. Therefore, the scheme for using existing Singakerta waterworks was obliged to be abandoned. Fortunately, it was recommended by PPSAB Denpasar that existing test well (50 l/s in normal capacity) at desa Batubulan is usable for Ketewel. Thus, the supply source was changed to groundwater abstracted from an existing test well.

6) Menanga, Bali

Here, spring was changed from Arca (500 l/s) to Gerubug (280 l/s) by a simple reason that the former is used for irrigation but the latter is not used for it and has enough surplus capacity; besides, these two springs are located near each other.

(3) Supplementary Remarks on Groundwater Investigation

Eighteen (18) IKKs among 30 high priority IKKs are scheduled to use groundwater as the water source, of which 10 IKKs need plural wells. In or near some IKKs highly productive deep wells are in operation and in some IKKs there are some test well data. In addition, not only new test well drilling and pumping tests but also pumping tests of existing dug wells were carried out at some several IKKs in the Phase II. However, confirmation of aquifer potential and water quality is important in case of groundwater development by means of wells. Therefore, it is recommended to perform supplementary aquifer investigations in some IKKs to make certain the said characteristics before the implementation, even though there was some kind of available information. The necessity of confirmatory groundwater exploration will depend on usefulness of available information and design requirements. The following factors are considered to be of importance in the site selection of confirmatory exploration.

1) More than two wells are required since the groundwater potential is not high.
2) There is some degree of anxiety about water quality since the site is near to sea or to saline groundwater zone.
3) Available information infers that the site is underlain by highly productive aquifers, but there is neither drill well in operation nor test well in the IKK area.

When these factors are taken into consideration, it appears that at least the following 9 IKKs need a confirmatory investigation.

1) Bulakamba, 2) Kemiri, 3) Petanahan, 4) Jepon, 5) Gondang, 6) Balen, 7) Baureno, 8) Kunir, and 9) Banyuanyar

The confirmatory exploration shall consist of test well drilling and pumping tests including borehole logging and water quality analysis. It is better to carry out geoelectrical survey for the determination of the well location. Re-examination of water quality is also recommended for IKKs where groundwater has been analyzed to be out of the norm in some items.

Table 6.1.2(1) Summary of Selected Water Sources for High Priority IKKs -- Central Java

IKKs			Selected Water Sources					Recommendable Water Collecting Facilities	Remarks
No	Name of IKK	Water Demand(l/s)	Source Type	Source Name or Aquifer Type	Source Location and Distance	Min. Spring Yield or Test Well Data	Water Quality		
1	Bulakamba	22.8	G.W.	Confined aquifers of sand layers in sedimentary facies	Desa Jubang, 5km south of the Kec. office	Bulakamba Ⅱ ;D=51m, T=190-357m²/d for Q=3-7 l/s	Within norm	2 drilled wells; 75m depth and 12 l/s yield each	
2	Jeruklegi	20.2	Exist.	Cilacap City water supply system	Tapping point is near the southern boundary of Kec.	———	——	Tapping to existing pipeline	
3	Kemiri	17.7	G.W.	Unconfined type aquifer of alluvial sands	Desa Kerep, 1km west of the Kec. office	A 30m deep test well infers that the well capacity is 5-10 l/s	E.C.=334, but Fe and Mn exceed the norm	3 drilled wells; 40m depth and 6 l/s yield each	Deep aquifers are not productive
4	Madukara	8.1	SPR.	Mudal spring	In another Kecamatan (Banjarmanggu)	30 l/s, of which 10 l/s is available	Within norm	Spring-fed reservoir	Existing Banjarnegara supply system is partly used.
5	Punggelan	7.1	SPR.	Trabawulan spring	Desa Petugulan, 7.5km from the Kec. office	40 l/s in total	Within norm	Creek-fed reservoir, with protection cover against falling stones	
6	Karanggayam	5.4	Exist.	Kebumen City water supply system	Tapping point is at the south boundary of the Kecamatan	———	——	Tapping to existing Kebumen waterpipe	
7	Petanahan	9.3	G.W.	Confined aquifers of sand layers in alluvium	Desa Karangduwur, Northern edge of the IKK area	P2AT EW99 in Desa Petanahan: S.W.L = 1.2m, S.C.=1.7 l/s/m	E.C.=1700 for EW99 of 50m depth	1 drilled well of 60m depth and 10 l/s yield	Groundwater of the south area is brackish
8	Sukorejo	16.5	SPR.	Tlogomili spring in a riverhead pond	Desa Tlogopayung in Kec. Plantungan, 15km from the IKK	800 l/s in total	Within norm	Collector caisson or Embedded perforated conduits	Several springs in the riverhead pond
9	Jepon	17.5	G.W.	Fissure water in a limestone formation	Desa Soko, 9km north of IKK in the same Kecamatan	P2AT TW 77 & TW81; TW77 Q = 2 l/s TW81 Q = 5 l/s +	Within norm except Fe =1.4	4 drilled wells; 150m depth and 5 l/s yield each	Pumping test of exist. P2AT TW81 was run in Nov.-Dec, 1991
10	Batangan	12.1	Exist.	Sani river flown out from Genbong dam	Desa Karangdowo of Kec. Pati	———	Muddy	Upgrade the pump capacity of existing intake for Juwana syst	Existing Juwana water supply line is partly used
11	Gondang	22.4	G.W.	Highly productive aquifer of young volcanic products	Desa Tunggul, 5km south of the Kec. office	Q> 15 l/s from exist deep wells in the same geological zone	E.C.=300-750	2 drilled wells; 150m depth and 12 l/s yield each	
12	Jenar	8.7	G.W.	Unconfined type of aquifer of alluvial sand	Dusun Prayunan in Desa Dawung in the IKK area	K=0.01cm/s from the tests on existing shallow wells	Within norm	2 drilled wells; 30m depth and 5 l/s yield each	Deep aquifers are not productive
13	Giriwoyo	7.2	SPR.	Kakap spring, from underground stream (cave)	Desa Giriwoyo, within the IKK	33 l/s in Oct. 1990 (52 l/s in Aug. '91)	Within norm	Spring-fed reservoir or Intake weir	
14	Bawen	21.3	SPR.	Umbul spring	Desa Keban Dalem in Kec. Jambu, 15km south of IKK	130 l/s in total	Within norm	Tapping to outlets of existing spring-fed reservoir	Spring intake has been constructed by DINAS Cipta Karya

Notes on source type symbols: G.W.= Groundwater
SPR.= Spring
Exist.=Existing water supply system

Table 6.1.2(2) Summary of Selected Water Sources for High Priority IKKs — East Java and Bali

IKKs			Selected Water Sources					Recommendable Water Collecting Facilities	Remarks
No	Name of IKK	Water Demand(l/s)	Source Type	Source Name or Aquifer Type	Source Location and Distance	Min. Spring Yield or Test Well Data	Water Quality		
15	Balen	16.4	G.W.	Confined aquifers of sand layers in alluvium	Desa Kedungdowo, 4km north of the IKK center	Existing test wells in Desa Kedungdowo; D=60-100m, capacity=10-20 l/s	Below a depth of 80m is saline	2 drilled wells; 70m depth and 10 l/s yield each	3 test wells by Solo River Authority exist in Desa Kedungdowo
16	Baureno	14.8	G.W.	Confined aquifers of sand layers in alluvium	Desa Sumbung Lor, 5km west of the IKK center	EJWR-5 in Desa Tambakrame; D=24m, well capacity=7.5 l/s	Within norm	2 drilled wells; 70m depth and 10 l/s yield each	
17	Jenu	11.8	G.W.	Fissures in a limestone formation	Desa suwalen, 3km south of the Kec. office	Many deep wells in the vicinity yield more than 40 l/s/well	Within norm	1 drilled well of 100m depth and 20 l/s yiels	
18	Jiwan	22.8	G.W.	Highly productive aquifers of fluvial sand and gravel of volcanic origin	Eastern part of Desa Jiwan, within the IKK area	Existing deep wells in Kota Madiun at 5km SE produce 40+ l/s/well	Within norm	1 drilled well of 100m depth and 25 l/s yield	
19	Kembangbahu	7.1	G.W.	Confined sand seams in sedimentary facies	Desa Mangkujajar and Desa Kedung Megarih	4.5 l/s from a new test well at Desa Mangkujajar	TDS = 1634 Chloride = 666.5	2 drilled wells; 125m depth and 4.0 l/s yield each	The test well can be used as one of production wells
20	Diwek	17.1	G.W.	Highly productive aquifers of alluvial sands and gravels	Desa Cukir in the IKK area	Existing deep wells within 3km from IKK have capacity of more than 40 l/s	Within norm	1 drilled well of 100m depth and 25 l/s yield	
21	Kutorejo	17.8	G.W.	Highly productive fluvial deposits of volcanic products	Desa Karangdieng, within the IKK area	P2AT well No.97 in Desa Karangdieng yields 40 l/s plus	Within norm	1 drilled well of 100m depth and 25 l/s yield	
22	Tempeh	15.6	G.W.	Pyroclastics of young Quaternary volcanic products	Desa Tempeh Lor in the IKK area	20-40 l/s for a deep well, from Groundwater Potential Map	Within norm	1 drilled well of 80m depth and 20 l/s yield	
23	Kunir	21.2	G.W.	Alluvial deposits of sand and gravel, and Tertiary pyroclastics	Desa Kunir Lor in the IKK area	20-40 l/s for a deep well, from Groundwater Potential Map	Within norm	1 drilled well of 100m depth and 25 l/s yield	Geoelectric survey was conducted in this IKK last year (1990)
24	Tempursari	13.7	SPR.	Umbulsari 1 spring	About 3km from IKK	600 l/s in total	Within norm	Intake tower or spring-fed reservoir	
25	Banyuanyar	19.5	G.W.	Unconfined aquifer of volcanic sand and breccia	About 250m north of main road in Desa Liprak Kulon	5.0 l/s for a 40m deep well, by a theoretical analysis	Within norm	3 drilled wells; 50m depth and 8.0 l/s yield each in average	A new test well indicates that the lava below 37m has no aquifer potential
26	Sumberasih	11.8	G.W.	High potential aquifer of young volcanic products	Southernmost corner of the IKK in Desa Muneng Kidul	P2AT TW012: D=102m 32 l/s capacity 24 l/s in operation	Within norm	1 drilled well of 80m depth and 15 l/s yield	
27	Tampak Siring	9.7	SPR.	Tirta Empul spring	Near the north-east boundary of the IKK area	400 l/s in total	Within norm	Outflow-fed reservoir or reconstruction of spring-fed reservoir	The spring is in the temple yard
28	Ketewel	11.1	G.W.	High potential aquifer of volcanic products	Desa Batubulan, 3km west of the IKK	TPW2: Depth 200m Capacity 50 l/s	Within norm	Existing TPW2 well. Submersible pump of 20 l/s capacity	
29	Menanga	6.9	SPR.	Gerubug spring	1.2km from the Desa Menanga 50 l/s	280 l/s in total	Within norm	Spring-fed reservoir	
30	Sibetan	11.6	SPR.	Dukuh Muding spring	Banjar Dukuh, 2km southwest of Desa Sibetan office	27 l/s in total	Within norm	Reconstruct spring-fed reservoir	

6.1.3 Design Conditions

(1) Review of Design Criteria

After the In-Depth Field Surveys for 30 IKKs which resulted in the revision of design conditions such as income level and population served, JICA team conducted a review of design criteria based on the comparison with another projects shown in the Table 6.1.3.
Main items revised from the Basic Plan, through discussions with Cipta Karya, are reservoir capacity and module system of water supply capacity per population.

1) Reservoir Capacity

Reservoir capacity of each water supply system was studied theoretically as shown in Fig. 6.1.1.
After discussions between JICA Team and Cipta Karya, the capacity of reservoir, including a capacity of elevated tank if required, was decided to have a two (2) hours of retention time for the maximum day demand, taking the capacity of Public Taps and some numbers of the existing Bak Mandi into account.
In this decision, actual water usage of the people and economization of the facilities were also considered.

2) Module System

Modular system of water supply capacity per population was adopted considering existing and under going another IKK system water supply facilities.
Pump capacity and reservoir capacity are modulated.

Design Criteria finally decided are shown in Table 6.1.4.

Table 6.1.3 Comparison List of Design Standard

Sep, '91 Revised on Sep, 23
JICA Team

(No.)	Agency, Project / Year / Criteria	Repelita IV (Modification)	Repelita V (ADB)	IKK Sulawesi (IBRD)	IKK Sulawesi (JICA)	IKK in Central Java, East Java and Bali (Proposed) (JICA)	Reason for Proposal
		1986	1990	1985	1991	1991	
1	Supply Level at House Connection (H.C.) (l/c/d)	60	90	60	90	90	Considering the recent Actual Water usage — (a)
2	Supply Level at Public Tap (P.T.) (l/c/d)	30	30	30	30	30	(i) (a) (ii) So as not to stand out of another project — (b)
3	Population Served (%)	50-100	50-100	50-100	50-100	50-100	(i) (a) (ii) Economical point of view — (c)
4	Water Supply Capacity per Population	(Source Cap) (Population) 5 l/s 3,000 - 6,000 10 l/s 6,001 - 12,000 20 l/s 12,001 - 20,000	(Source Cap) (Population) 2.5 l/s 1,000 - 3,000 5.0 l/s 3,001 - 5,000 10 l/s 5,001 - 10,000	(Gravity Spring) (Other) 2.5 l/s 3,000- 6,000 5.0 l/s 3,000 - 6,000 5.0 l/s 6,001-12,000 10.0 l/s 6,001-12,000 10.0 l/s 12,001-20,000 20.0 l/s 12,001-20,000	(Supply Level) X Population (l/c/d)	(Supply Level) X Population (l/c/d)	(i) (a) (ii) (c)
5	Ratio of Population Served by H.C./P.T.	50/50 - 80/20	60/40 - 80/20	50/50 - 80/20	50/50	60/40 - 80/20	(i) (b) (ii) (c)
6	Number of People per H.C.	10	10	10	10	10	ditto
7	Number of People per P.T.	100	50-100	100 (P.H.)	100	100	ditto
8	Water Allocation for Non-Domestic Demand (%)	5	5	5	5	5	ditto
9	Water Allocation for Leakage and Losses (%)	Nb	20	15	15	15	ditto
10	Factor for Maximum Day	1.1	1.1	1.1	1.1	1.1	ditto
11	Factor for Peak Hour	1.1	1.4	1.1	2.4	1.4	(c)
12	Target Year (in Future) (Years)	10	10	10	10	10	(b)
13	Operation Hours (Hours)	Gravity System : 24 Pumping System : 12	24	Gravity System : 24 Pumping System : 12	24	24	(a)
14	Flow Restrictor	(Pumping) 50l/hr for H.C. 250l/hr for P.T. (Gravity) 25l/hr for H.C. 125l/hr for P.T.	Nb	(Pumping) 0.83 l/min for H.C. 4.2 l/min for P.H. (Gravity) 0.42 l/min for H.C. 2.1 l/min for P.H.	Nb	Nb	(a)
15	Capacity of Reservoir	Nb	Modul 2.5 :20m3(2.2hr) Modul 5.0 : 30m3(1.7hr) Modul 10.0: 40m3(1.1hr)	Decentralized 2.0 m3/P.H. 8ak mandi/H.C.	(Population) (hr) 1,000 - 2,000 12 2,000 - 3,000 10 3,000 - 5,000 9 More than 5,000 8	Refer to Study for Reservoir Capacity	(i) (a) (ii) (c)

Fig. 6.1.1 Study for Reservoir Capacity

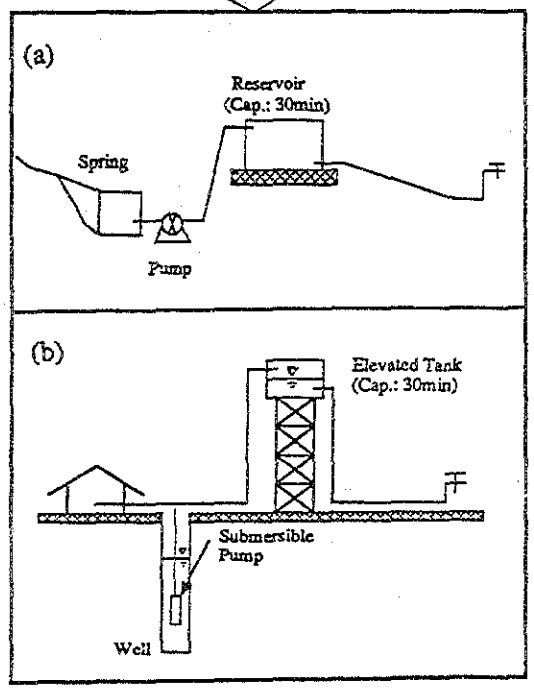
Start

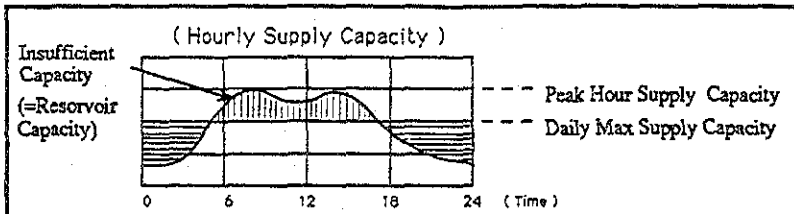
Do water source and Pump have enough capacity to cater the Peak hour demand ?

No

Yes

① Only Reservoir for pressure adjustment (Peak hour demand X 30 min) is required





Theoretical Max. Reservoir Capacity.

- Peak hour ratio : α (Peak hour demand/max. day demand)
- Max. day demand (per hour) : qo (m3/hr)
- Peak hour demand : $\alpha \cdot qo$ (m3/hr)
- Max day demand (per day) : Qo (24 qo m3/day)
- Max. Reservoir Capacity : Vmax. (m3)
- Duration time of Peak hour demand : t (hr)

$$t = \frac{Qo}{\alpha \cdot qo} = \frac{24 \cdot qo}{\alpha \cdot qo} = \frac{24}{\alpha} \quad (hr)$$

$$Vmax = \alpha \cdot qo \cdot t - qo \cdot t = (\alpha - 1) \cdot qo \cdot \frac{24}{\alpha} = 24 \cdot (1 - \frac{1}{\alpha}) \cdot qo$$

Can the capacity of Bak mandi and Public Tap be taken into account?

Yes

② Only Reservoir for pressure adjustment is required (30min) same as ①

Attachement 1

Considering that not all house holds have Bak Mandi in the existing IKKs, this case will not be at variance wirh reality.

No

③ Alternative (A)
Theoretical Max. Reservoir Capacity : Vmax

$$\alpha = \frac{1.4}{1.1} = 1.27$$

$$Vmax = 24 \cdot (1 - \frac{1}{1.27}) \cdot qo = 5.1 \cdot qo \quad (5.1 \text{ hrs})$$

④ Alternative (B)
Reservoir capacity considering the actual water usage and capacity of Public Taps

Attachement 2

Table 6.1.4 Design Criteria

No.	Criteria \ Phase / Stage	1	2
		Basic Plan	Feasibility Study
1	Supply Level at House Connection (H.C.) (l/c/d)	90	90
2	Supply Level at Public Tap (P.T.) (l/c/d)	30	30
3	Population Served (%)	50 - 100	50 - 100
4	Water Supply Capacity per Population	(Supply Level) x Population (l/c/d)	(Source Cap)(Population) 10.0 4,900 - 8,800 15.0 9,200 - 11,500 20.0 14,100 - 16,400 25.0 17,800 - 20,400
5	Ratio of Population Surved by H.C./P.T.	60/40 - 80/20	70/30 - 80/20
6	Number of People per H.C.	5	10
7	Number of People per P.T.	100	100
8	Water Allocation for Non-Domestic Demand (%)	5	5
9	Water Allocation for Leakage and Losses (%)	15	15
10	Factor for Maximum Day	1.1	1.1
11	Factor for Peak Hour	1.5	1.4
12	Target Year (in Future) (Years)	10	10
13	Operation Hours (Hours)	24	24
14	Flow Restrictor	No	No
15	Capacity of Reservoir	(Population) (hr) Less than 5,000 9 More than 5,000 8	Module (l/s) Cap (m3) (hr) 10.0 80 (2.0) 15.0 120 (2.0) 20.0 160 (2.0) 25.0 200 (2.0)

6.1.4 Water Supply Facilities

Based on the design condition shown in 6.1.3 and the topographical survey drawings, water supply facilities for 30 IKKs have been designed.

(1) System Design

According to the water sources and the ground elevations, water supply systems for 30 IKKs have been studied from the economical point of view and finally they are divided into 10 types of supply systems shown in Fig. 6.1.2.

Design methodology of these systems is shown in Supporting Report C.

(2) Summary of Water Supply Facilities

1) Summary of Water Supply Facilities for 30 IKKs is shown in Table 6.1.5.
Design drawings are included in Supporting Report C.

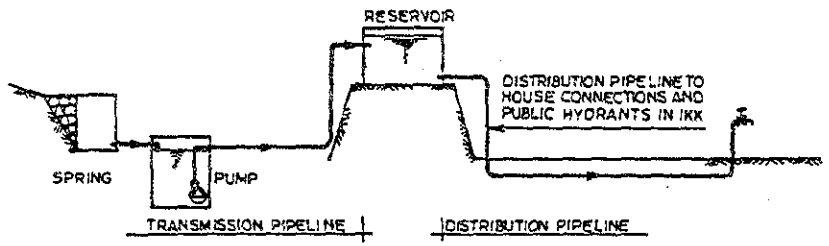
2) Design methodology of the facilities is also described in Supporting Report C.

3) Ca $(OCl)_2$ injection facilities are provided in all IKKs except Jeruklegi and Karanggayam (Type E-b).

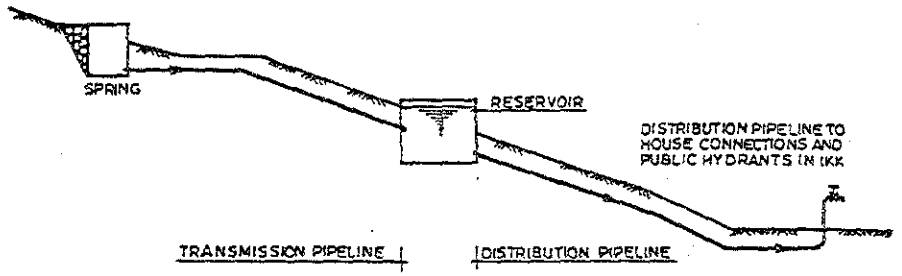
4) Lead (Pb) treatment facilities in Madukara and Iron (Fe) treatment facilities in Kemiri and Jepon are finally proposed to be installed.

Fig. 6.1.2 TYPE OF WATER SUPPLY SYSTEMS (1/2)

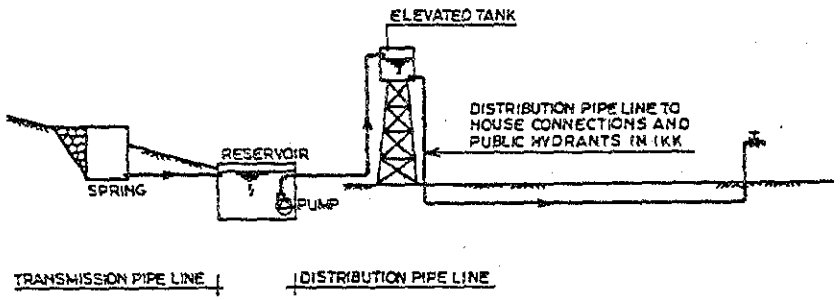
TYPE A-a | WATER SOURCE FROM SPRING BY PUMP SYSTEM



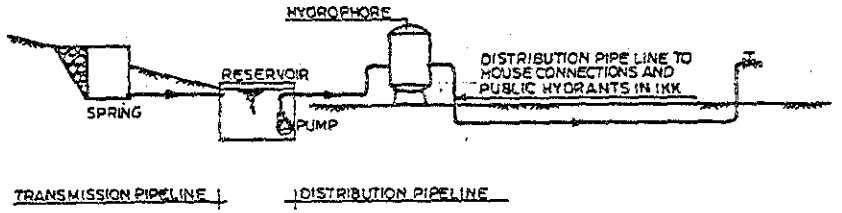
TYPE A-b | WATER SOURCE FROM SPRING BY GRAVITY SYSTEM



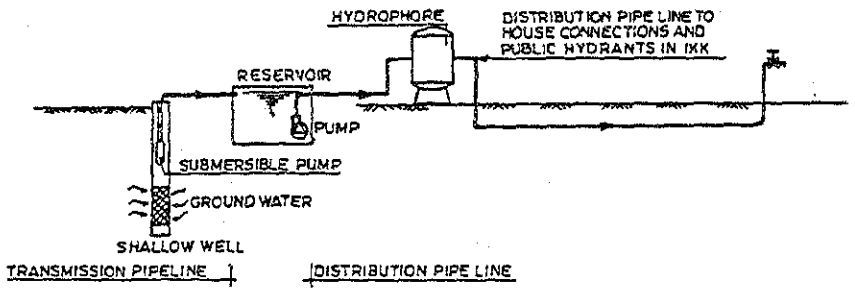
TYPE B-a | WATER SOURCE FROM SPRING WITH ELEVATED TANK



TYPE B-b | WATER SOURCE FROM SPRING WITH HYDROPHORE



TYPE C | WATER SOURCE FROM SHALLOW WELL WITH HYDROPHORE



TYPE D-a | WATER SOURCE FROM DEEP WELL WITH RESERVOIR ONLY

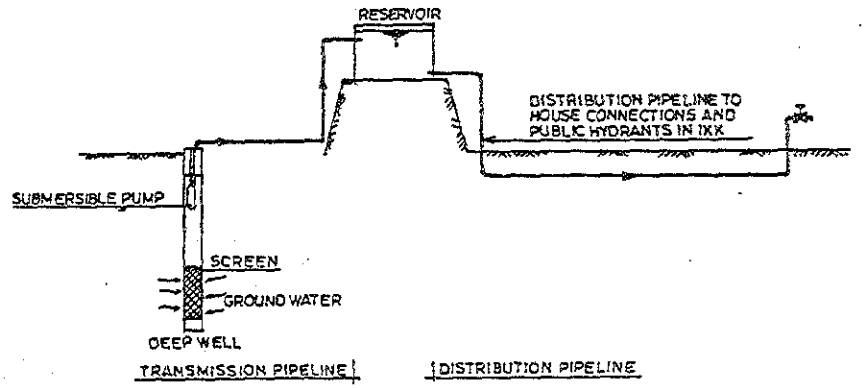
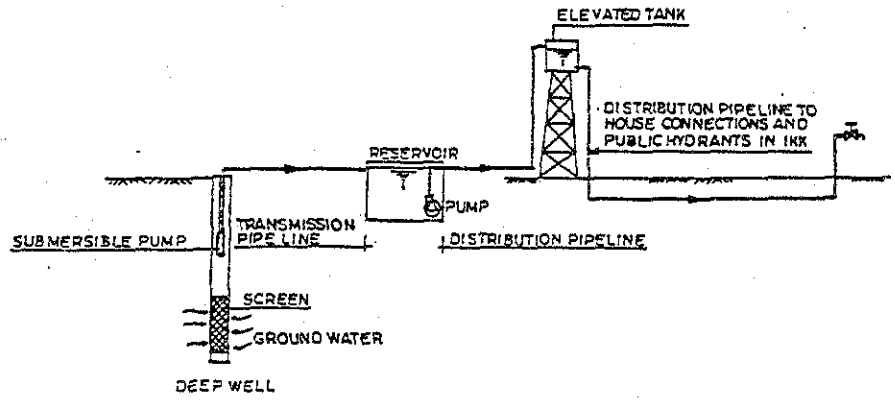
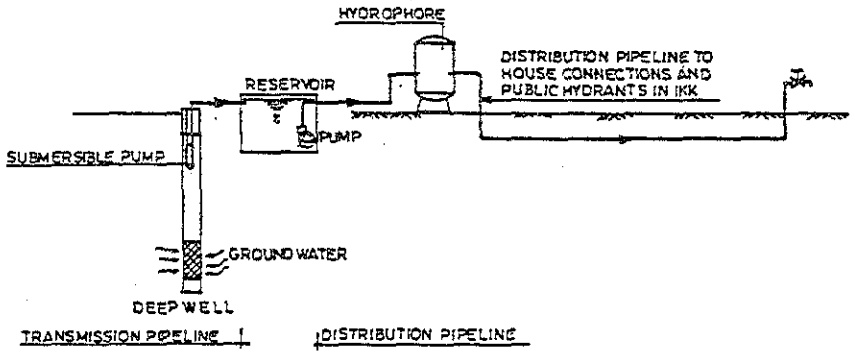


Fig. 6.1.2 TYPE OF WATER SUPPLY SYSTEMS (2/2)

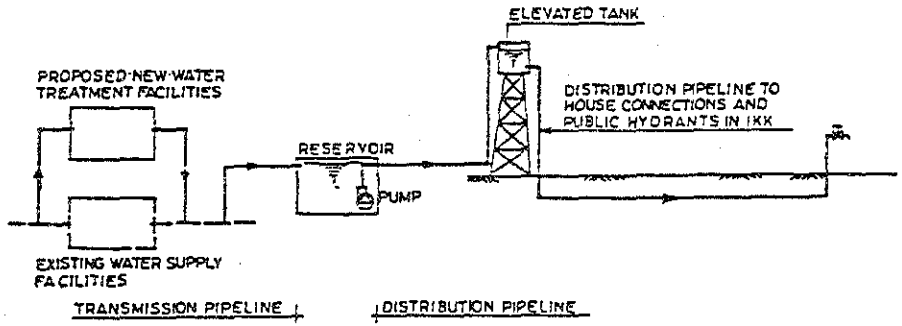
TYPE D-b WATER SOURCE FROM DEEP WELL WITH ELEVATED TANK



TYPE D-c WATER SOURCE FROM DEEP WELL WITH HYDROPHORE



TYPE E-a TAPPING FROM EXISTING WATER SUPPLY FACILITIES WITH ELEVATED TANK



TYPE E-b TAPPING FROM EXISTING WATER SUPPLY FACILITIES WITH HYDROPHORE

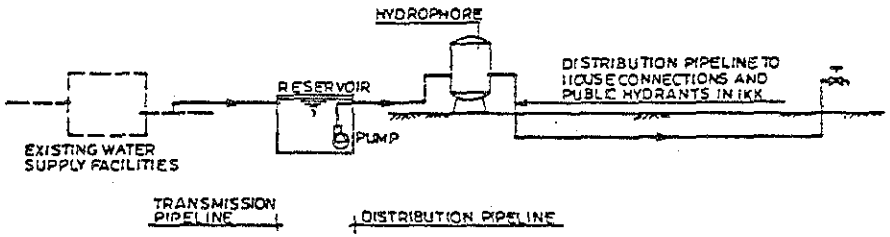


Table 6.1.5 SUMMARY LIST OF FEASIBILITY STUDY FOR 30 IKKS (1/3)

	Name Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Kabupaten	BREBES	CILACAP	PURWOREJO	BANJARNEGARA	BANJARNEGARA	KEBUMEN	KEBUMEN	KENDAL	BLORA	PATI	SRAGEN	SRAGEN	MONOGIRI	SEMARANG
2	Kecamatan	BULAKAMBA	JERUKLEGI	KEMIRI	MADUKARA	PUNGGELAN	KARANGGAYAM	PETANAHAN	SUKOREJO	JEPON	BATURSARI	GONDANG	JENAR	GIRIWOYO	HARJOSARI
3	I K K	BULAKAMBA	JERUKLEGI	KEMIRI	MADUKARA	PUNGGELAN	KARANGGAYAM	PETANAHAN	SUKOREJO	JEPON	BATANGAN	GONDANG	JENAR	GIRIWOYO	BAWEN
5	Total Population in the year 2000:														
	A. Project Area	19,100	18,370	14,860	7,320	11,730	8,200	9,570	15,010	14,650	10,100	22,100	12,540	6,720	17,880
	B. Served Area	19,100	18,370	14,860	7,320	6,450	4,920	8,420	15,010	14,650	10,100	20,330	7,900	6,050	17,880
6	Sarved Population	100 %	100 %	100 %	100 %	55 %	60 %	88 %	100 %	100 %	100 %	92 %	63 %	90 %	100 %
7	%-tage of Population served by House Connections (H.C.)	80	70	80	70	70	70	70	70	80	80	70	70	80	80
8	Water demand for H.C. (D = 90 l/cap/day)(l/day)	1375200	1157310	1069920	461160	406350	309960	530460	945630	1054800	727200	1280790	497700	435600	1287360
9	%-tage of Population served by Public Hydrants (P.H.)	20	30	20	30	30	30	30	30	20	20	30	30	20	20
10	Water demand for P.H. (D = 30 l/cap/day)(l/day)	114600	165330	89160	65880	58050	44280	75780	135090	87900	60600	182970	71100	36300	107280
11	Sub-total water demand (l/day)	1489800	1322640	1159080	527040	464400	354240	606240	1080720	1142700	787800	1463760	568800	471900	1394640
12	Water demand for non domestic (5 % x (11))(l/day)	74490	66132	57954	26352	23220	17712	30312	54036	57135	39390	73188	28440	23595	69732
13	Water demand for leakage and losses 15 % x (11)(l/day)	223470	198396	173862	79056	69660	53136	90936	162108	171405	118170	219564	85320	70785	209196
14	Total average demand (l/day)	1787760	1587168	1390896	632448	557280	425088	727488	1296864	1371240	945360	1756512	682560	566280	1673568
15	Total Average demand (l/sec)	20.69	18.37	16.10	7.32	6.45	4.92	8.42	15.01	15.87	10.94	20.33	7.90	6.55	19.37
16	Max day : 1.1 x (15)(l/sec)	22.76	20.21	17.71	8.05	7.10	5.41	9.26	16.51	17.46	12.04	22.36	8.69	7.21	21.31
17	Peak hour demand : 1.4 x (15)(l/sec)	28.97	25.72	22.54	10.25	9.03	6.89	11.79	21.01	22.22	15.32	28.46	11.06	9.18	27.12
18	Source capacity required for 24 hours operation/day (l/sec)	22.76	20.21	17.71	8.05	7.10	5.41	9.26	16.51	17.46	12.04	22.36	8.69	7.21	21.31
19	Potential source available	G.W.	EXT.	G.W.	SPR.	SPR.	EXT.	G.W.	SPR.	G.W.	EXT.	G.W.	G.W.	SPR.	SPR.
20	Water source capacity available	12 x 2		6 x 3	10	35		10	100	5 x 4		12 x 2	5 x 2	30	30
21	System	D-b	E-b	C	B-a	A-a	E-b	D-b	A-b	D-a	E-a	D-a	C	A-a	A-b
22	Source Pump (Submersible Pump)														
	A. Number of pump	2	-	3	-	-	-	1	-	4	-	2	2	-	-
	B. Capacity (l/sec)	15	-	10	-	-	-	10	-	5	-	15	5	-	-
	C. Head (m)	30	-	30	-	-	-	30	-	40	-	60	30	-	-
23	Main Distribution Pump (Submersible Pump)														
	A. Number of pump	3	3	3	3	3	3	3	-	-	4	-	3	3	-
	B. Capacity (l/sec)	15	15	10	5	5	5	5	-	-	5	-	5	5	-
	C. Head (m)	30	60	60	80	80	80	30	-	-	30	-	60	80	-
24	Booster Pump (Submersible Pump)														
	A. Number of pump	-	-	-	3	3	-	-	-	-	-	2	2	-	2 : 2
	B. Capacity (l/sec)	-	-	-	5	5	-	-	-	-	-	5	5	-	15 : 5
	C. Head (m)	-	-	-	60	60	-	-	-	-	-	60	30	-	80 : 40
25	Service Reservoir (m³)	150	200	160	60	20	80	60	40	160	90	200	80	20	200
26	Hydrophore														
	A. Capacity (m³)	-	9	9	-	-	5	-	-	-	-	3	5 : 3	-	3 : 6.5
	B. Working Pressure (kg/cm²)	-	6	6	-	-	8	-	-	-	-	6	6 : 6	-	6 : 8
27	Break Pressure Tank														
	A. Number	-	-	-	2	5	-	-	2	2	-	-	-	-	1
	B. Capacity (m³)	-	-	-	6	6	-	-	10	10	-	-	-	-	12
28	Booster Pump Pit														
	A. Number	-	-	-	1	1	-	-	-	-	-	1	1	-	2
	B. Capacity (m³)	-	-	-	6	6	-	-	-	-	-	3	1.5	-	1.5
29	Elevated tank														
	A. Capacity (m³)	50	-	-	20	-	-	20	-	-	30	-	-	-	-
	B. Height (m)	15	-	-	15	-	-	15	-	-	15	-	-	-	-
30	Generator Set														
	A. Number	2	2	2	2 : 2	2	2	2	-	2	2	2 : 2	2 : 2	2	2 : 2
	B. Power (KVA)	60	80	80	60 : 40	80	60	40	-	40	20	20 : 60	60 : 20	60	80 : 20
31	Water Treatment Facility (l/sec)	-	-	18	8	-	-	-	-	18	13	-	-	-	-
32	Chlorination Unit (l/hr)	2.7	-	2.7	2.7	2.7	-	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
33	Number of House Connections	1528	1286	1189	512	452	344	589	1051	1172	808	1423	553	484	1430
34	Number of Public Hydrants	38	55	30	22	19	15	25	45	29	20	61	24	12	36

Note : No:19 (Abrev. list): Spring = SPR.
Groundwater = G.W.
Extension = EXT.

No.20 : 12 x 2 : 12 = Capacity (l/sec)
2 = Number of Well

No.21 : D - b etc = Type of Water Supply System

Table 6.1.5 SUMMARY LIST OF FEASIBILITY STUDY FOR 30 IKKS (2/3)

1	Name Code	15	16	17	18	19	20	21	22	23	24	25	26
2	Kabupaten	BOJONEGORO	BOJONEGORO	TUBAN	MADIUN	LAMONGAN	JOMBANG	MOJOKERTO	LUMAJANG	LUMAJANG	LUMAJANG	PROBOLINGGO	PROBOLINGGO
3	Kecamatan	BALEN	BURENO	JENU	JIWAN	KEMBANGBAHU	DIWEK	KUTOREJO	TEMPEH	KUNIR	TEMPURSARI	BANYUANYAR	SUMBERASIH
4	I K K	BALEN	BURENO	JENU	JIWAN	KEMBANGBAHU	DIWEK	KUTOREJO	TEMPEH	KUNIR	TEMPURSARI	BANYUANYAR	SUMBERASIH
5	Total Population in the year 2000:												
	A. Project Area	18,860	12,660	10,740	21,190	7,550	20,800	22,750	22,460	24,030	17,130	21,770	10,720
	B. Served Area	14,900	12,410	10,740	19,070	6,420	14,350	16,150	14,150	19,220	11,480	16,330	9,860
6	Sarved Population	79 %	98 %	100 %	90 %	85 %	69 %	71 %	63 %	80 %	67 %	75 %	92 %
7	%-tage of Population served by House Connections (H.C.)	70	80	70	80	70	80	70	70	70	80	80	80
8	Water demand for H.C. (D = 90 l/cap/day)(l/day)	938700	893520	676620	1373040	404460	1033200	1017450	891450	1210860	826560	1175760	709920
9	%-tage of Population served by Public Hydrants (P.H.)	30	20	30	20	30	20	30	30	30	20	20	20
10	Water demand for P.H. (D = 30 l/cap/day)(l/day)	134100	74460	96660	114420	57780	86100	145350	127350	172980	68880	97980	59160
11	Sub-total water demand (l/day)	1072800	967980	773280	1487460	462240	1119300	1162800	1018800	1383840	895440	1273740	769080
12	Water demand for non domestic (5 % x (11))(l/day)	53640	48399	38664	74373	23112	55965	58140	50940	69192	44772	63687	38454
13	Water demand for leakage and losses 15 % x (11)(l/day)	160920	145197	115992	223119	69336	167895	174420	152820	207576	134316	191061	115362
14	Total average demand (l/day)	1287360	1161576	927936	1784952	554688	1343160	1395360	1222560	1660608	1074528	1528488	922896
15	Total Average demand (l/sec)	14.90	13.44	10.74	20.66	6.42	15.55	16.15	14.15	19.22	12.44	17.69	10.68
16	Max day : 1.1 x (15)(l/sec)	16.39	14.79	11.81	22.73	7.06	17.10	17.77	15.57	21.14	13.68	19.46	11.75
17	Peak hour demand : 1.4 x (15)(l/sec)	20.86	18.82	15.04	28.92	8.99	21.76	22.61	19.81	26.91	17.41	24.77	14.95
18	Source capacity required for 24 hours operation/day (l/sec)	16.39	14.79	11.81	22.73	7.06	17.10	17.77	15.57	21.14	13.68	19.46	11.75
19	Potential source available	G.W.	G.W.	G.W.	G.W.	G.W.	G.W.	G.W.	G.W.	G.W.	SPR.	G.W.	G.W.
20	Water source capacity available	10 x 2	10 x 2	20	25	4.5 x 2	25	25	20	25	50	8 x 3	15
21	System	D-b	D-c	D-c	D-c	D-c	D-b	D-c	D-c	D-b	B-b	D-c	D-b
22	Source Pump (Submersible Pump)												
	A. Number of pump	2	2	1	1	2	1	1	1	1	-	3	1
	B. Capacity (l/sec)	10	10	15	25	5	20	20	20	25	-	10	15
	C. Head (m)	40	30	40	40	40	40	40	40	40	-	40	40
23	Main Distribution Pump (Submersible Pump)												
	A. Number of pump	3	4	4	3	3	3	3	3	3	4	3	4
	B. Capacity (l/sec)	10	5	5	15	5	10	10	10	15	5	10	5
	C. Head (m)	30	80	60	60	60	30	60	30	30	60	40	30
24	Booster Pump (Submersible Pump)												
	A. Number of pump	-	-	-	-	-	-	-	-	-	-	-	-
	B. Capacity (l/sec)	-	-	-	-	-	-	-	-	-	-	-	-
	C. Head (m)	-	-	-	-	-	-	-	-	-	-	-	-
25	Service Reservoir (m³)	120	120	120	200	80	120	160	160	150	30	160	90
26	Hydrophore												
	A. Capacity (m³)	-	6.5	6.5	9	5	-	9	9	-	6.5	9	-
	B. Working Pressure (kg/cm²)	-	8	6	6	6	-	6	6	-	6	6	-
27	Break Pressure Tank												
	A. Number	-	-	-	-	-	-	-	-	-	-	-	-
	B. Capacity (m³)	-	-	-	-	-	-	-	-	-	-	-	-
28	Booster Pump Pit												
	A. Number	-	-	-	-	-	-	-	-	-	-	-	-
	B. Capacity (m³)	-	-	-	-	-	-	-	-	-	-	-	-
29	Elevated tank												
	A. Capacity (m³)	40	-	-	-	-	40	-	-	50	-	-	30
	B. Height (m)	15	-	-	-	-	15	-	-	15	-	-	15
30	Generator Set												
	A. Number	2	2	2	2	2 : 2	2	2	2	2	2	2	2
	B. Power (KVA)	60	80	80	100	20 : 40	60	80	60	80	60	60	60
31	Water Treatment Facility (l/sec)	-	-	-	-	-	-	-	-	-	-	-	-
32	Chlorination Unit (l/hr)	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
33	Number of House Connections	1043	993	752	1526	449	1148	1131	991	1345	918	1306	789
34	Number of Public Hydrants	45	25	32	38	19	29	48	42	58	23	33	20

Note : No:19 (Abrev. list): Spring = SPR.
Groundwater = G.W.
Extension = EXT.

No.20 : 10 x 2 : 10 = Capacity (l/sec)
2 = Number of Well

No.21 : D - b etc = Type of Water Supply System

Table 6.1.5 SUMMARY LIST OF FEASIBILITY STUDY FOR 30 IKKS (3/3)

1	Name Code	27	28	29	30
2	Kabupaten	GIANYAR	GIANYAR	KARANGASEM	KARANGASEM
3	Kecamatan	TAMPAKSIRING	SUKAWATI	RENDANG	BEBANDEM
4	I K K	TAMPAKSIRING	KETEWEL	MENANGA	SIBETAN
5	Total Population in the year 2000:				
	A. Project Area	8,730	9,250	5,760	9,710
	B. Served Area	8,730	9,250	5,760	9,710
6	Sarved Population	100 %	100 %	100 %	100 %
7	%-tage of Population served by House Connections (H.C.)	70	80	80	80
8	Water demand for H.C. (D = 90 l/cap/day)(l/day)	549990	666000	414720	699120
9	%-tage of Population served by Public Hydrants (P.H.)	30	20	20	20
10	Water demand for P.H. (D = 30 l/cap/day)(l/day)	78570	55590	34560	58260
11	Sub-total water demand (l/day)	628560	721500	449280	757380
12	Water demand for non domestic (5 % x (11))(l/day)	31428	36075	22464	37869
13	Water demand for leakage and losses 15 % x (11)(l/day)	94284	108225	67392	113607
14	Total average demand (l/day)	754272	865800	539136	908856
15	Total Average demand (l/sec)	8.73	10.02	6.24	10.52
16	Max day : 1.1 x (15)(l/sec)	9.60	11.02	6.86	11.57
17	Peak hour demand : 1.4 x (15)(l/sec)	12.22	14.03	8.74	14.73
18	Source capacity required for 24 hours operation/day (l/sec)	9.60	11.02	6.86	11.57
19	Potential source available	SPR.	G.W.	SPR.	SPR.
20	Water source capacity available	300	20	50	12
21	System	B-a	D-b	B-b	B-a
22	Source Pump (Submersible Pump)				
	A. Number of pump	-	1		
	B. Capacity (l/sec)	-	15		
	C. Head (m)	-	40		
23	Main Distribution Pump (Submersible Pump)				
	A. Number of pump	3	4	3	4
	B. Capacity (l/sec)	5	5	5	5
	C. Head (m)	40	40	80	80
24	Booster Pump (Submersible Pump)				
	A. Number of pump	-	-	2 : 2 : 2 : 4	4
	B. Capacity (l/sec)	-	-	2.5 : 2.5 : 5.0 : 5.0	5
	C. Head (m)	-	-	60 : 80 : 60 : 80	80
25	Service Reservoir (m³)	20	90	20	90
26	Hydrophore				
	A. Capacity (m³)	-	-	2 : 3 : 3 : 3 : 2 : 5	-
	B. Working Pressure (kg/cm²)	-	-	6 : 6 : 8 : 8 : 8 : 8	-
27	Break Pressure Tank				
	A. Number	-	-	3	1 : 1
	B. Capacity (m³)	-	-	1.5	3 : 9
28	Booster Pump Pit				
	A. Number	-	-	3 : 2	1
	B. Capacity (m³)	-	-	3 : 1.5	9
29	Elevated tank				
	A. Capacity (m³)	20	30	-	30
	B. Height (m)	11.5	10.5	-	11
30	Generator Set				
	A. Number	2	2	4 : 6 : 2	2
	B. Power (KVA)	40	60	20 : 40 : 60	100
31	Water Treatment Facility (l/sec)	-	-	-	-
32	Chlorination Unit (l/hr)	2.7	2.7	2.7	2.7
33	Number of House Connections	611	740	461	777
34	Number of Public Hydrants	26	19	12	19

Note : No:19 (Abrev. list): Spring = SPR.
Groundwater = G.W.
Extension = EXT.

6.2 Management Plan

6.2.1 Construction Plan

Construction plan for 30 IKKs has been proposed as shown in Table 6.2.1, based on the following conditions.

(1) For the detailed design, field investigations including the followings should be conducted.

1) Topographical survey for detailed design
2) Soil investigation
3) Geophisical prospecting and test well drilling and pumping test for IKKs for which ground water will be proposed to be a water source and where they have not been conducted in this Feasibility Study.

(2) For tender packages, 30 IKKs were proposed to be devited into six (6) groups, that is three (3) groups in Central Java, two (2) in East Java and one (1) in Bali, as shown in Table 6.2.1, considering the followings.

1) Shortening of construction period.
2) Availability and capability of contractors
3) Efficiency of detailed design and tender works

Table 6.2.1 : CONSTRUCTION SCHEDULE FOR 30 IKKs

No.	Description	MONTH (1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36)
1	Loan Negotiation	
2	Field Investigation	
3	Detailed Design	
4	Land Acquisition	
5	Tender Document	
6	Tender and Award	A, B, C, F, D, E
7	Procurement Pipes, Machine and Electrical Equipment	A,B,F ; C,D,E
8	Construction	
8.1	Well Drilling	A, B, C, D, E
8.2	Civil Works	A,B,F ; C,D,E
8.3	Pipe Laying Works	A, B, C,D, E
8.4	Public Hydrants and House Connections	A, F, C, D, B, E
8.5	Installation of Machine and Electrical Equipment	A,B,F Test Run ; C,D,E Test Run

LEGEND

GROUP(A) (Central Java)
(1) BULAKAMBA
(4) MADUKARA
(5) PUNGGELAN
(8) SUKOREJO

GROUP(B) (Central Java)
(2) JERUKLEGI
(3) KEMIRI
(6) KARANGGAYAM
(7) PETANAHAN
(13) GIRIWOYO

GROUP(C) (Central Java)
(9) JEPON
(10) BATANGAN
(11) GONDANG
(12) JENAR

GROUP(D) (East Java)
(15) BALEN
(16) BAURENO
(17) JENU
(18) JIWAN
(19) KEMBANGBAHU
(20) DIWEK
(21) KUTOREJO

GROUP(E) (East Java)
(22) TEMPEH
(23) KUNIR
(24) TEMPURSARI
(25) BANYUANYAR
(26) SUMBERASIH

GROUP(F) (Bali)
(27) TAMPAKSIRING
(28) KETEWEL
(29) MENANGA
(30) SIBETAN

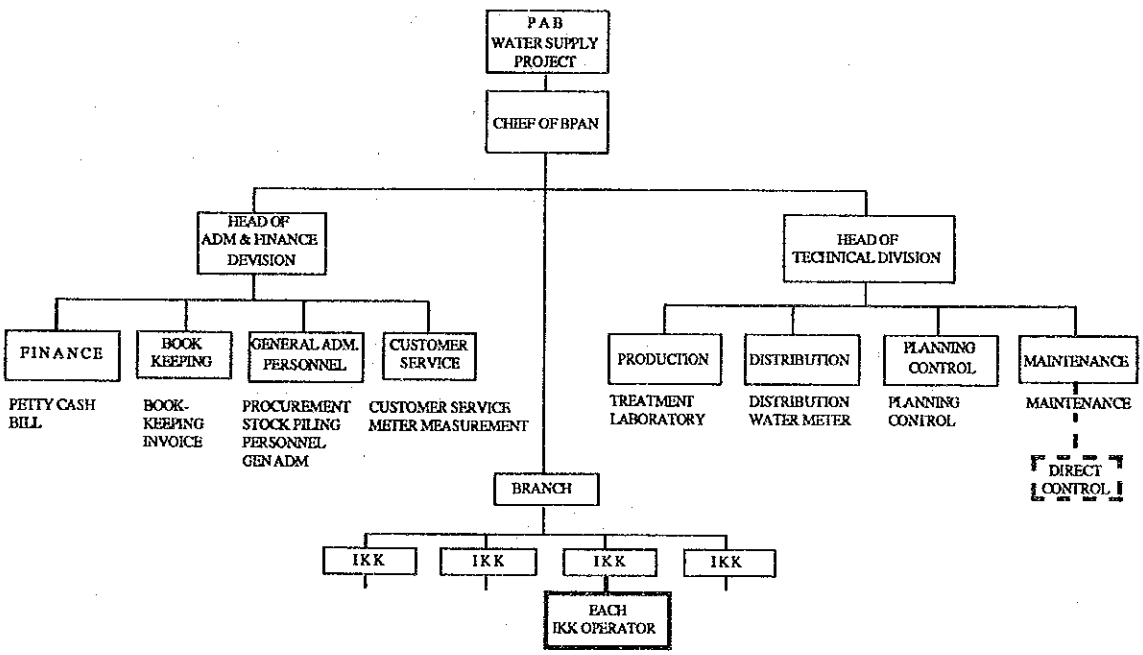
6.2.2 Operation and Maintenance Plan

(1) Organization

Water supply facilities in each IKK will belong to BPAM or PDAM in Kabupaten to which the IKK is belonging and BPAM or PDAM will manage the facilities.

As for organization and function of BPAM and PDAM, refer to Chapter 2 in this Main Report. For one sample, organization structure of BPAM including operation and maintenance is shown in Fig. 6.2.1.

Fig. 6.2.1 ORGANIZATION STRUCTURE OF BPAM, TYPE A



(2) Operation

1) Operators necessary for water supply facilities will belong to each BPAM or PDAM.

2) Arrangement of operators in each IKK is as follows.

(1) As a general rule, just like in existing IKK System water supply facilities, total three (3) operators should be assigned to each IKK. That is, two (2) operators (1 person x 2 shifts) for pump operation, pump inspection, Chlorine injection, etc., and one (1) operator (1

person x 1 shift, day time) for watching of water source, inspection of reservoir and pipeline, etc.

(ii) However, in those IKKs where more than three pump stations including booster pump stations are installed, following total five (5) operators should be assigned.
Four (4) operators (2 persons x 2 shifts) for pump operation, pump inspection, Chlorine injection, etc., and one (1) operator (1 person x 1 shift, day time) for watching of water source, inspection of reservoir and pipeline, etc.

3) Numbers of operators in each IKK are shown in Table 6.2.3.

(3) Maintenance

Maintenance of the facilities would be conducted by the Maintenance section of each BPAM or PDAM directly.
Repairs and replacements of the facilities should be done by the persons of Maintenance section or contractors based on the request from operators.

6.2.3 Cost Estimates

(1) Basis of Cost Estimation

The following basic prices have been used for the estimation of the Construction Cost for Water Supply Facilities in 30 IKKs.

1) Basic price from Pusat Informasi Teknik Bangunan Jawa Tengah. (Agustus - September 1991)
2) Basic price from Pusat Informasi Teknik Bangunan Jawa Timur. (Agustus - September 1991)
3) Basic price from Pusat Informasi Teknik Bangunan Bali (Agustus - September 1991)
4) Quotation from Suppliers.
5) Standard Unit Cost from Cipta Karya.

(2) Items of Cost Estimation

1) Direct Cost

The installation cost (material, labour and equipment cost) for the following facilities will be included.

(i) Intake facilities for spring
(ii) Well (Shallow well / Deep well)
(iii) Reservoir / elevated tank
(iv) Water treatment facilities
(v) Break pressure Tank
(vi) Chlorination Unit
(vii) Pumps
(viii) Generator
(ix) Hydrophore
(x) Piping (including valves, airvalves, wash out etc.)
(xi) Public Hydrants
(xii) House Connection
(xiii) Housing (Sub-Station, Pump House etc.)
(xiv) Others (main water meter and spare parts)
(xv) Internal transportation fee of imported materials.

2) Indirect Cost

The following indirect cost will be included in this Cost Estimation.

(i) Land acquisition 1.7 % of direct cost
(ii) Administration Fee 1.9 % of direct cost
(iii) Training 0.6 % of direct cost
(iv) Consultants Fee including the followings 13 % of direct cost.
  i) Topographical Survey
  ii) Soil investigation
  iii) Geophisical prospecting
  iv) Test well drilling and pumping test
  v) Detailed Design
  vi) Construction Supervision
  vii) Others
(v) Physical Contingency 10 % of direct cost
(vi) Price escalation
  i) 4.7 % of Foreign portion cost per year.
  ii) 8 % of local portion cost per year.

3) Operation and Maintenance Cost

The following cost will be included in Operation and Maintenance Cost.

(i) Operation Cost
  i) Man power fee for operators
  ii) Electric power and fuel
  iii) Chemical
    $Ca(OCl)_2$ injection fee

(ii) Maintenance Cost
    5 % of equipment cost, such as pumps, generators, chlorination unit etc., per year.

(3) Results of Cost Estimation

1) Summary of Construction Cost for 30 IKKs is shown in Table 6.2.2. Details of direct cost are shown in Supporting Report E.

2) Summary of Operation and Maintenance Cost for 30 IKKs is shown in Table 6.2.3.

TABEL 6.2.2 (1) SUMMARY LIST OF CONSTRUCTION COST

UNIT : 1,000 Rp.

	CODE	1	2	3	4	5	6	7	8	9	10
	NAME OF I K K	BULAKAMBA	JERUKLEGI	KEMIRI	MADUKARA	PUNGGELAN	KARANGGAYAM	PETANAHAN	SUKOREJO	JEPON	BATANGAN
	PROVINCE	CENTRAL JAVA	CENTRAL JAVA	CENTRAL JAVA	CENTRAL JAVA	CENTRAL JAVA	CENTRAL JAVA	CENTRAL JAVA	CENTRAL JAVA	CENTRAL JAVA	CENTRAL JAVA
	POPULATION	19,100	18,370	14,860	7,320	6,450	4,920	8,420	15,010	14,650	10,100
A.	DIRECT COST										
a.	Intake Facility for Spring	-	13,650	-	7,500	22,750	4,500	-	39,000	-	-
b.	Water Treatment Facility	-	-	184,100	110,700	-	-	-	-	184,100	226,277
c.	Well (Shallow / Deep)	65,170	-	74,970	-	-	-	36,660	-	203,916	-
d.	Pump + Generator	149,000	174,755	198,005	219,000	164,000	138,475	101,750	-	103,500	56,000
e.	Chorination Unit	2,460	-	2,460	2,460	2,460	-	2,460	2,460	2,460	-
f.	Reservoir / Elevated Tank	183,044	55,691	50,771	133,444	109,279	23,079	84,164	66,950	103,771	115,892
g.	Piping	622,648	599,410	235,167	610,193	230,898	274,399	153,646	1,007,179	871,848	982,169
h.	Public Taps	83,600	121,000	66,000	48,400	41,800	33,000	55,000	99,000	63,800	44,000
i.	House Connection	382,000	321,500	297,250	128,000	113,000	86,000	147,250	262,750	293,000	202,000
j.	Others	43,732	41,519	33,989	41,306	24,549	22,932	19,729	41,891	50,579	47,428
k.	Internal Transportation Fee of Imported Materials	6,540	4,515	5,895	3,563	4,892	4,477	3,752	4,500	4,588	658
	TOTAL DIRECT COST	1,538,194	1,332,041	1,148,607	1,304,566	713,628	586,862	604,411	1,523,730	1,881,562	1,674,424
B.	INDIRECT COST										
a.	Land Acquisition	26,149	22,645	19,526	22,178	12,132	9,977	10,275	25,903	31,987	28,465
b.	Administration	29,226	25,309	21,824	24,787	13,559	11,150	11,484	28,951	35,750	31,814
c.	Training	9,229	7,992	6,892	7,827	4,282	3,521	3,626	9,142	11,289	10,047
d.	Consultants	199,965	173,165	149,319	169,594	92,772	76,292	78,573	198,085	244,603	217,675
e.	Physical Contingency	153,819	133,204	114,861	130,457	71,363	58,686	60,441	152,373	188,156	167,442
	TOTAL INDIRECT COST	418,389	362,315	312,421	354,842	194,107	159,626	164,400	414,454	511,785	455,443
	TOTAL DIRECT AND INDIRECT COST (A + B)	1,956,582	1,694,356	1,461,028	1,659,408	907,735	746,489	768,811	1,938,184	2,393,346	2,129,867
C.	PRICE ESCALATION	266,429	221,865	190,046	208,237	108,881	87,140	99,465	278,906	336,469	300,665
	TOTAL COST (A + B + C)	2,223,012	1,916,220	1,651,075	1,867,645	1,016,617	833,628	868,276	2,217,090	2,729,816	2,430,532
	Construction Cost / Person (Rupiah/Person)	116,388	104,312	111,109	255,143	157,615	169,437	103,121	147,708	186,336	240,647

TABEL 6.2.2 (2) SUMMARY LIST OF CONSTRUCTION COST

UNIT : 1,000 Rp.

	CODE	11	12	13	14	15	16	17	18	19	20
	NAME OF I K K	GONDANG	JENAR	GIRIWOYO	BAWEN	BALEN	BAURENO	JENU	JIWAN	KEMBANGBAHU	DIWEK
	PROVINCE	CENTRAL JAVA	CENTRAL JAVA	CENTRAL JAVA	CENTRAL JAVA	EAST JAVA	EAST JAVA	EAST JAVA	EAST JAVA	EAST JAVA	EAST JAVA
	POPULATION	20,330	7,900	6,050	17,880	14,900	12,410	10,740	19,070	6,420	14,350
A.	DIRECT COST										
a.	Intake Facility for Spring	-	-	19,500	19,500	-	-	-	-	-	-
b.	Water Treatment Facility	-	-	-	-	-	-	-	-	-	-
c.	Well (Shallow / Deep)	108,592	46,600	-	-	76,452	46,600	44,670	44,670	85,000	44,170
d.	Pump + Generator	171,613	194,475	125,000	204,630	144,750	183,518	174,018	219,005	149,475	140,000
e.	Chorination Unit	2,460	2,460	2,460	2,460	2,460	2,460	2,460	2,460	2,460	2,460
f.	Reservoir / Elevated Tank	77,391	30,329	11,699	100,191	160,549	39,948	39,948	65,971	27,257	160,549
g.	Piping	475,689	246,091	168,157	1,103,122	515,614	394,102	237,507	236,335	138,927	255,462
h.	Public Taps	134,200	52,800	26,400	79,200	108,000	60,000	76,800	91,200	45,600	69,600
i.	House Connection	355,750	138,250	121,000	357,500	281,610	268,110	203,040	412,020	121,230	309,960
j.	Others	40,224	27,703	19,509	59,400	37,936	33,631	27,563	34,193	20,230	29,188
k.	Internal Transportation Fee of Imported Materials	5,241	4,921	3,681	4,055	11,520	11,644	10,294	10,974	7,686	8,283
	TOTAL DIRECT COST	1,371,160	743,630	497,405	1,930,058	1,338,891	1,040,013	816,299	1,116,828	597,864	1,019,672
B.	INDIRECT COST										
a.	Land Acquisition	23,310	12,642	8,456	32,811	22,761	17,680	13,877	18,986	10,164	17,334
b.	Administration	26,052	14,129	9,451	36,671	25,439	19,760	15,510	21,220	11,359	19,374
c.	Training	8,227	4,462	2,984	11,580	8,033	6,240	4,898	6,701	3,587	6,118
d.	Consultants	178,251	96,672	64,663	250,908	174,056	135,202	106,119	145,188	77,722	132,557
e.	Physical Contingency	137,116	74,363	49,741	193,006	133,889	104,001	81,630	111,683	59,786	101,967
	TOTAL INDIRECT COST	372,955	202,267	135,294	524,976	364,178	282,884	222,033	303,777	162,619	277,351
	TOTAL DIRECT AND INDIRECT COST (A + B)	1,744,115	945,898	632,699	2,455,034	1,703,070	1,322,897	1,038,333	1,420,605	760,483	1,297,023
C.	PRICE ESCALATION	232,927	109,369	73,784	323,310	229,986	166,753	127,563	180,127	90,495	173,509
	TOTAL COST (A + B + C)	1,977,042	1,055,267	706,484	2,778,344	1,933,056	1,489,650	1,165,895	1,600,732	850,978	1,470,533
	Construction Cost / Person (Rupiah/Person)	97,248	133,578	116,774	155,388	129,735	120,036	108,556	83,949	132,551	102,476

TABEL 6.2.2 (3) SUMMARY LIST OF CONSTRUCTION COST

UNIT : 1,000 Rp.

	CODE	21	22	23	24	25	26	27	28	29	30
	NAME OF I K K	KUTOREJO	TEMPEH	KUNIR	TEMPURSARI	BANYUANYAR	SUMBERASIH	TAMPAKSIRING	KETEWEL	MENANGA	SIBETAN
	PROVINCE	EAST JAVA	EAST JAVA	EAST JAVA	EAST JAVA	EAST JAVA	EAST JAVA	BALI	BALI	BALI	BALI
	POPULATION	16,150	14,150	19,220	11,480	16,330	9,860	8,730	9,250	5,760	9,710
A.	DIRECT COST										
a.	Intake Facility for Spring	-	-	-	29,500	-	-	19,500	-	19,500	7,800
b.	Water Treatment Facility	-	-	-	-	-	-	-	-	-	-
c.	Well (Shallow / Deep)	44,170	33,910	44,670	-	91,455	33,910	-	-	-	-
d.	Pump + Generator	184,505	164,255	158,250	149,518	178,505	141,000	92,500	141,000	503,088	211,000
e.	Chorination Unit	2,460	2,460	2,460	2,460	2,460	2,460	2,460	2,460	2,460	2,460
f.	Reservoir / Elevated Tank	59,252	59,252	201,691	13,581	59,252	127,803	85,115	128,152	89,957	186,990
g.	Piping	275,200	186,935	339,120	341,261	190,247	178,378	186,789	366,227	228,761	291,133
h.	Public Taps	115,200	100,800	139,200	55,200	79,200	48,000	63,700	46,550	29,400	46,550
i.	House Connection	305,370	267,570	363,150	247,860	352,620	213,030	175,968	213,120	132,768	223,776
j.	Others	31,769	26,867	36,350	28,808	29,708	24,517	20,440	29,629	47,298	34,086
k.	Internal Transportation Fee of Imported Materials	11,004	10,140	9,519	8,854	9,671	8,313	11,124	16,806	61,759	28,260
	TOTAL DIRECT COST	1,028,930	852,189	1,294,410	877,042	993,117	777,412	657,596	943,939	1,114,990	1,032,054
B.	INDIRECT COST										
a.	Land Acquisition	17,492	14,487	22,005	14,910	16,883	13,216	11,179	16,047	18,955	17,545
b.	Administration	19,550	16,192	24,594	16,664	18,869	14,771	12,494	17,935	21,185	19,609
c.	Training	6,174	5,113	7,766	5,262	5,959	4,664	3,946	5,664	6,690	6,192
d.	Consultants	133,761	110,785	168,273	114,015	129,105	101,064	85,487	122,712	144,949	134,167
e.	Physical Contingency	102,893	85,219	129,441	87,704	99,312	77,741	65,760	94,394	111,499	103,205
	TOTAL INDIRECT COST	279,869	231,795	352,079	238,555	270,128	211,456	178,866	256,751	303,277	280,719
	TOTAL DIRECT AND INDIRECT COST (A + B)	1,308,799	1,083,984	1,646,489	1,115,597	1,263,245	988,868	836,462	1,200,690	1,418,267	1,312,773
C.	PRICE ESCALATION	167,372	137,660	223,273	141,215	163,364	126,835	110,822	155,398	132,139	163,136
	TOTAL COST (A + B + C)	1,476,171	1,221,645	1,869,762	1,256,813	1,426,610	1,115,703	947,283	1,356,088	1,550,406	1,475,909
	Construction Cost / Person (Rupiah/Person)	91,404	86,335	97,282	109,478	87,361	113,154	108,509	146,604	269,168	151,999

SUMMARY LIST OF CONSTRUCTION COST FOR EACH PROVINCE

UNIT : 1,000 Rp.

	CODE	1-14	15-26	27-30	1-30
	NAME OF I K K PROVINCE	ALL IN CENTRAL JAVA PROVINCE	ALL IN EAST JAVA PROVINCE	ALL IN BALI PROVINCE	ALL THREE PROVINCES
	POPULATION	171,360	165,080	33,450	369,890
A.	DIRECT COST				
a.	Intake Facility for Spring	126,400	29,500	46,800	202,700
b.	Water Treatment Facility	705,177	-	-	705,177
c.	Well (Shallow / Deep)	535,908	589,677	-	1,125,585
d.	Pump + Generator	2,000,203	1,986,798	947,588	4,934,588
e.	Chorination Unit	27,060	29,520	9,840	66,420
f.	Reservoir / Elevated Tank	1,145,696	1,015,052	490,214	2,650,961
g.	Piping	7,580,617	3,289,087	1,072,910	11,942,613
h.	Public Taps	948,200	988,800	186,200	2,123,200
i.	House Connection	3,205,250	3,345,570	745,632	7,296,452
j.	Others	514,490	360,762	131,453	1,006,705
k.	Internal Transportation Fee of Imported Materials	61,278	117,902	117,943	297,123
	TOTAL DIRECT COST	16,850,277	11,752,667	3,748,578	32,351,523
B.	INDIRECT COST				
a.	Land Acquisition	286,455	199,795	63,726	549,976
b.	Administration	320,155	223,301	71,223	614,679
c.	Training	101,102	70,516	22,491	194,109
d.	Consultants	2,190,536	1,527,847	487,315	4,205,698
e.	Physical Contingency	1,685,028	1,175,267	374,858	3,235,152
	TOTAL INDIRECT COST	4,583,275	3,196,726	1,019,613	8,799,614
	TOTAL DIRECT AND INDIRECT COST (A + B)	21,433,553	14,949,393	4,768,192	41,151,138
C.	PRICE ESCALATION	2,837,495	1,928,154	561,495	5,327,144
	TOTAL COST (A + B + C)	24,271,047	16,877,547	5,329,687	46,478,282
	Construction Cost / Person (Rupiah/Person)	141,638	102,239	159,333	125,654

Table 6.2.3 : SUMMARY LIST OF OPERATION AND MAINTENANCE COST FOR 30 IKK

UNIT : 1,000 Rp.

	CODE	1	2	3	4	5	6	7	8	9	10
	NAME OF I K K	BULAKAMBA	JERUKLEGI	KEMIRI	MADUKARA	PUNGGELAN	KARANGGAYAM	PETANAHAN	SUKOREJO	JEPON	BATANGAN
	PROVINCE	CENTRAL JAVA	CENTRAL JAVA	CENTRAL JAVA	CENTRAL JAVA	CENTRAL JAVA	CENTRAL JAVA	CENTRAL JAVA	CENTRAL JAVA	CENTRAL JAVA	CENTRAL JAVA
	POPULATION	19,100	18,370	14,860	7,320	6,450	4,920	8,420	15,010	14,650	10,100
	TYPE OF W.S.S	D—b	E—b	C	B—a	A—a	E—b	D—b	A—b	D—a	E—a
	No. OF OPERATOR	3	3	5	3	3	3	3	3	5	3
1.	Operation (per year)	4,284	4,284	7,140	4,284	4,284	4,284	4,284	4,284	7,140	4,284
2.	Power & Fuel (per year)	19,217	25,623	25,623	32,029	25,623	19,217	12,812	-	12,812	6,406
3.	Chemical (per year)	6,280	5,577	4,887	2,221	1,959	1,493	2,555	4,556	4,818	3,322
4.	Maintenance (per year)	7,573	8,738	10,023	11,073	8,323	6,924	5,211	123	5,298	2,800
	TOTAL COST OF OPERATION AND MAINTENANCE PER YEAR	37,355	44,221	47,673	49,607	40,189	31,918	24,861	8,963	30,067	16,812

	CODE	11	12	13	14	15	16	17	18	19	20
	NAME OF I K K	GONDANG	JENAR	GIRIWOYO	BAWEN	BALEN	BAURENO	JENU	JIWAN	KEMBANGBAHU	DIWEK
	PROVINCE	CENTRAL JAVA	CENTRAL JAVA	CENTRAL JAVA	CENTRAL JAVA	EAST JAVA	EAST JAVA	EAST JAVA	EAST JAVA	EAST JAVA	EAST JAVA
	POPULATION	20,330	7,900	6,050	17,880	14,900	12,410	10,740	19,070	6,420	14,350
	TYPE OF W.S.S	D—a	C	A—a	A—b	D—b	D—c	D—c	D—c	D—c	D—b
	No. OF OPERATOR	5	5	3	3	3	3	3	3	3	3
1.	Operation (per year)	7,140	7,140	4,284	4,284	4,284	4,284	4,284	4,284	4,284	4,284
2.	Power & Fuel (per year)	25,623	25,623	19,217	32,029	19,217	25,623	25,623	32,029	19,217	19,217
3.	Chemical (per year)	6,170	2,398	1,990	5,880	4,523	4,081	3,259	6,272	1,948	4,719
4.	Maintenance (per year)	8,704	9,847	6,373	10,355	7,361	9,299	8,824	11,073	7,597	7,123
	TOTAL COST OF OPERATION AND MAINTENANCE PER YEAR	47,637	45,008	31,864	52,548	35,384	43,287	41,990	53,658	33,046	35,343

	CODE	21	22	23	24	25	26	27	28	29	30
	NAME OF I K K	KUTOREJO	TEMPEH	KUNIR	TEMPURSARI	BANYUANYAR	SUMBERASIH	TAMPAKSIRING	KETEWEL	MENANGA	SIBETAN
	PROVINCE	EAST JAVA	EAST JAVA	EAST JAVA	EAST JAVA	EAST JAVA	EAST JAVA	BALI	BALI	BALI	BALI
	POPULATION	16,150	14,150	19,220	11,480	16,330	9,860	8,730	9,250	5,760	9,710
	TYPE OF W.S.S	D—c	D—c	D—b	B—b	D—c	D—b	B—a	D—b	B—b	B—a
	No. OF OPERATOR	3	3	3	3	5	3	3	3	5	3
1.	Operation (per year)	4,284	4,284	4,284	4,284	7,140	4,284	4,284	4,284	7,140	4,284
2.	Power & Fuel (per year)	25,623	19,217	25,623	19,217	19,217	19,217	12,812	19,217	70,463	32,029
3.	Chemical (per year)	4,903	4,296	5,833	3,775	5,370	3,242	2,649	3,041	1,893	3,193
4.	Maintenance (per year)	9,348	8,336	8,036	7,599	9,048	7,173	4,748	7,173	25,277	10,673
	TOTAL COST OF OPERATION AND MAINTENANCE PER YEAR	44,159	36,133	43,776	34,875	40,775	33,917	24,493	33,715	104,774	50,178

	CODE	1−14	15−26	27−30	1−30
	NAME OF I K K PROVINCE	ALL IN CENTRAL JAVA PROVINCE	ALL IN EAST JAVA PROVINCE	ALL IN BALI PROVINCE	ALL THREE PROVINCES
	POPULATION	171,360	165,080	33,450	369,890
OPERATION AND MAINTENANCE COST					
	TYPE OF W.S.S	-	-	-	-
	No. OF OPERATOR	50	38	14	102
1.	Operation (per year)	71,400	54,264	19,992	145,656
2.	Power & Fuel (per year)	281,853	269,042	134,521	685,415
3.	Chemical (per year)	54,106	52,222	10,775	117,103
4.	Maintenance (per year)	101,363	100,816	47,871	250,050
	TOTAL COST OF OPERATION AND MAINTENANCE PER YEAR	508,722	476,343	213,160	1,198,225

6.3 Project Evaluation

6.3.1 General

The project evaluation is conducted from the financial and economic points of view for each IKK and the whole 30-IKK.

The financial aspect is evaluated by means of a Financial Internal Rate of Return (FIRR), by providing two alternative revenue conditions of current tariff and affordability of customers to pay for water consumed. Where, the current tariff applies an average water tariff rate of BPAMs and PDAMs concerned, and the affordability is assumed to be a rate of 4% of the average household income (hereinafter referred to as the "4% -affordability"), in accordance with similar projects of Indonesia in recent years.

In addition to the FIRR analysis, a financial cash flow of the project would be examined for the 30 IKK as a whole, assuming that a foreign loan is applied to the initial investment cost. But, the financial analysis concerning operation of each BPAM and PDAM is not included in the present study.

On the other hand, the economic evaluation is carried out by means of an Economic Internal Rate of Return (EIRR), by using the estimated economic cost and benefit of the project.

In accordance with Section 6.2 Management Plan, construction works of the project would be completed within three years, including the period of preparation work and detail design, and the works are assumed to be commenced in 1993.

The project life is taken as 30 years after completion of the construction works. The project revenue (or benefit), together with operating and maintenance costs (OM cost), is assumed to occur every year during the period of project life. Other conditions and assumptions necessary for the financial and economic evaluations are given in Annex 1.

6.3.2 Financial Evaluation

Project Cost

Construction cost of the project is in detail given for each IKK in Table 6.2.2, and the total cost for the whole 30-IKK is estimated at Rp.46,478 million, taking account of the annual price escalation of 4.7% for foreign currency portion and 8% for local currency portion.

The OM cost for each IKK is indicated at the 1991 price level in Table 6.2.3. During the period of project life the OM cost would amount to Rp.199,474 million for the whole 30-IKK, taking the said price escalation into account. Cash flow of the OM cost together with the construction cost is given in Table 6.3.1.

Project Revenue

As mentioned in previous Section 6.3.1, two alternatives are prepared for estimating the project revenue, and the result is given in Table 6.3.2, under the conditions and assumptions described in Annex 1. The total revenue at the 1991 price level is estimated at Rp.1,469 million per annum and Rp.4,311 million per annum by applying the current tariff and the 4%-affordability, respectively. Annual flow of the revenue for the whole 30-IKK for the period of project life is shown in Table 6.3.1.

Cost-Revenue Analysis

The FIRR is estimated under the conditions and assumptions stated in Annex 1, and the result is summarized in Table 6.3.3. In case where the 4%-affordability is applied, the FIRR for the whole 30-IKK comes to 15.7%, which the project shows to be feasible financially. The FIRR for each IKK also shows the high figure comparatively as a water supply project of small scale, except the rate for Madukara and Menanga. The low FIRR for the said two IKKs would be due mainly to that construction, operation and maintenance of the project are costly relatively to the low number of population served.

In case where the current tariff is used for estimating the revenue, the FIRR comes to nearly zero percent for the whole 30-IKK and a negative for 16 IKKs (See Table 6.3.3).

From result of the foregoing financial analysis, it is estimated that the FIRR for the whole 30-IKK will attain to 10% and 5% by raising the average current tariff (Rp.150/m^3) to Rp.280/m^3 (85% up) and to Rp.200/m^3 (30% up), respectively.

Apart from the evaluation, a cash flow statement of cost and revenue for the whole 30-IKK is provided assuming a foreign loan for the construction cost. The loan condition is assumed as follows:

- Interest rate : 3.0% per annum
- Grace period : 10 years
- Repayment period : 30 years (including grace period)

In this statement, the 4%-affordability is adopted for the project revenue, and the result is given in Table 6.3.4. The statement shows that the project will be borne to repay the loan without any problem. In this case, the FIRR would come to 10.0%.

6.3.3 Economic Evaluation

Economic Cost

The economic cost of the project is converted from the financial cost under the conditions and assumptions described in Annex 1, and the result is given for each IKK as shown in Table 6.3.5. The total economic cost for the whole 30-IKK amounts to Rp.36,568 million for the construction cost and Rp.1,079 million for the annual OM cost. Annual flows of these costs are given in Table 6.3.7.

Economic Benefit

The economic benefit is mainly estimated based on a concept of time saving for fetching water from the water sources, and in addition the benefit of reduction in cost for purchasing water from water-vendors is estimated for a part of water consumption in IKKs of Baureno and Menanga. The benefit is given as a difference between both conditions of with and without the projects, under the conditions and assumptions stated in Annex 1. The economic annual benefit is estimated at Rp.5,408 million in total of the whole 30-IKK and the result for each IKK is given in Table 6.3.6. As shown in Table 6.3.7, the total economic benefit for the whole 30-IKK would amount to Rp.161,709 million during the period of project life.

Cost-Benefit Analysis

The EIRRs for the whole 30-IKK and each IKK are given in Table 6.3.3. The EIRR for the whole 30-IKK is estimated at 10.1%, which is a fairly high rate from a viewpoint of basic human needs project.

As seen in Table 6.3.3, the EIRR has a tendency to give a comparatively high figure for the IKK where is difficult to fetch water. Therefore, a priority for execution of the project should be given to such IKK with high EIRR, as well as the IKK with high FIRR.

Sensitivity Test of EIRR

Various conditions and assumptions have been set in the present study based on professional experience and appropriate judgment of experts, but there always remains the question as to the degree of reliability of inputs. Therefore, a test is carried out for sensitivity of the EIRR to variations in the economic cost and benefit which have been estimated for the whole 30-IKK.

The sensitivity of the EIRR is tested for the 5% and 10% increases in the economic cost and the 5% and 10% decreases in the economic benefit. The result is given as follows:

Sensitivity Test of EIRR (%)

Increase in Cost	Decrease in Benefit		
	0%	-5%	-10%
0%	10.1	9.4	8.7
+5%	9.5	8.8	8.1
+10%	8.8	8.2	7.5

The EIRR would come to 7.5% in the most pessimistic condition which combines 10%-increase in the cost and 10%-decrease in the benefit. This percentage is in somewhat higher position than an average EIRR of the regional water supply projects. It seems therefore that the project still maintains the socio-economic feasibility, even if it comes to such a pessimistic condition.

Socio-Economic Impacts

Aside from the foregoing tangible benefit, the following effects would be expected by implementation and/or completion of the construction works:

(1) A stimulative effect for promotion of the socio-economic development in and around the study area.

(2) Reduction in cases of water-borne diseases in IKKs due to supply of clean water.

(3) Creation of employment opportunities for inhabitants in and around the study area.

6.3.4 Summary of Project Evaluation

Result of the project evaluation is summarized as follows:

(1) In case where the 4%-affordability is applied for the financial evaluation, the FIRR for individual IKKs shows a high figure comparatively as a water supply project of small scale, except the rate for Madukara and Menanga. As a result, the FIRR for whole 30-IKK indicates 15.7%, which the project is feasible financially.

(2) Whereas, in case where the current tariff is used, the FIRR comes to nearly zero percent for the whole 30-IKK. Accordingly, to get the FIRR of 10% which is close to an opportunity cost of capital in the study area, the average water rate for domestic use has to be raised from the current tariff of Rp.150/m^3 to Rp.280/m^3 (85% up). And also to get the FIRR of 5% taking account of the "Basic Human Needs", it would need to raise the tariff to Rp.200/m^3 (30% up).

(3) The EIRR for the whole 30-IKK shows 10.2% which is a fairly high rate as a basic human needs project, i.e. the project would be feasible socio-economically.

(4) As regards the individual IKKs, the EIRR has a tendency to give a comparatively high figure for the IKK where it is difficult to fetch water. For example, the IKK Menanga shows a the high EIRR of 19.4%, despite the FIRR is a negative. On the other hand, almost all of IKKs with the lower

EIRR than 5% indicate a high FIRR, under condition of the 4%-affordability.

(5) In conclusion, the project as a whole of 30-IKK is feasible financially (by raising the average current tariff by about 30%) and socio-economically. The sub-project for individual IKK also would be feasible, under a condition which the project should satisfy the feasibility of either financial or economic aspect.

ANNEX 1. Conditions and Assumptions used for the Project Evaluation

1. Financial Conditions and Assumptions

The following conditions and assumptions are set for financial evaluation of the project.

(1) The annual price escalation of commodities and services procured for the project is assumed to be a rate of 8% for the local currency portion and 4.7% for the foreign currency portion, during the periods of construction works and project life.

(2) In estimating the water supply revenue, two alternatives of water tariff rate are prepared; one is an average rate of current tariff of BPAMs and PDAMs concerned, the other is a rate which corresponds to 4% of an average household income (the 4%-affordability).

(3) The average tariff rate of BPAM/PDAM for household in 1991 is estimated at Rp.150/m^3 for house connection (H.C.) and Rp.100/m^3 for public hydrant (P.H.). On the other hand, the tariff rate which is estimated in accordance with the said 4%-affordability comes to Rp.440/m^3 for H.C. and Rp.293/m^3 for P.H. by applying an average household income of Rp.128,000 per month shown in Table 2.1.5 of Section 2.1.

(4) According to the design criteria shown in Paragraph 6.1.3, the ratio of house connection and public hydrant uses in the population served is defined to be 70 : 30 (or 80 : 20) by IKK. This ratio is also applied to non-domestic users which are presumed to be 5% of the total water demand.

(5) The water supply revenue is firstly estimated at the tariff rate in 1991, and after that year it is assumed to increase at the same rate (8% per annum) as the price escalation of local commodities and services.

(6) Calculation of the water supply revenue is based on the population served in the target year 2000 in accordance with the design criteria, and after that year this revenue would accrue every year during the period of project life. On the other hand, the revenue which will accrue in each year from 1996 to 1999 after completion of the construction works is estimated on the basis of the population served in each year.

(7) A bad debt is presumed to be 5% of the water supply revenue expected in each year.

(8) Opportunity cost of capital is assumed to be a rate of 10% in the study area.

(9) The construction cost of house connection facilities in the initial investment is assumed to be repaid in yearly installments for 4 years after completion of the construction works.

2. Economic Conditions and Assumptions

The following conditions and assumptions are set for economic evaluation of the project.

(1) Transfer payments such as taxes and duties are assumed to be 10% of market prices of commodities and services procured locally, and to be exempted from duties for those imported from abroad.

(2) Standard conversion rate to be applied for local commodities and services is assumed to be approximately 100%, based on export and import statistics in recent years.

(3) Economic wage of unskilled laborers to be employed for the construction works is assumed to be 90% of the actual market wage, taking account of the employment opportunity of laborers in the study area.

(4) Economic cost of land compensation is assumed to be 90% of the financial cost, taking account of the opportunity cost of land use.

(5) The economic cost and benefit of the project are given in the present value (PV) at the 1991 price level and are taken no account of the price escalation during the periods of construction works and project life.

(6) At present, the majority of inhabitants in IKKs concerned are using water of well, spring, canal, river or water-vendor for their daily lives (condition of without the project), and after completion of the project it is expected that they will get their domestic water from water supply facilities of house connection or public hydrant (condition of with the project). In the present study, economic benefit of

the project is given as an economic difference between both conditions of with and without the projects.

(7) For estimating the economic benefit, a saving of time for fetching water from the water sources is adopted, and in addition to the time saving, a reduction in cost for purchasing water from the water-vendors is applied to a part of water consumption of inhabitants in two IKKs of Baureno and Menanga.

(8) At the condition of without the project, the time necessary for fetching water was estimated based on the answer of questionnaire survey to officers of Kecamatans related to the 30-IKK. This time varies in distance between household and water source, seasons, topographic condition in IKKs, etc. Nevertheless, as an average the following relation between time spent per day and distance for fetching water was given from results of the survey:

Relation between Time spent per day
and Distance for fetching Water

Distance (m)	Time (hour)	Distance (m)	Time (hour)
5	0.5	500	1.8
10	0.6	1,000	2.0
20	0.8	2,000	3.0
50	1.0	3,000	4.0
100	1.5	4,000	5.0

The above-mentioned relations are used as a standard for estimating the saving time. However, of course the topographic and other special conditions in each IKK were separately taken into account, according to information from the Kecamatan officers.

(9) On the other hand, at the condition of with the project the time spent for fetching water is assumed to be zero hour for the house connection and 0.5 hours for the public hydrant.

(10) It is assumed that the time saved for fetching water will produce an increase in working time, and that the economic benefit will come to Rp.168.75 per hour in 1991, on the basis of a laborer wage of Rp.1,500/day, a work time of 8-hour/day and the employment opportunity rate of 90%.

(11) In estimating the reduction in cost for purchasing water from the vendors stated in (7) above, the economic water price in 1991 is assumed to be Rp.150 per 40 liters on average, based on information from the Kecamatan officers.

(12) The matters described in (4), (6) and (8) of the said financial conditions and assumptions are also applied to the economic conditions and assumptions.

Table 6.3.1 CASH FLOW OF FINANCIAL COST AND BENEFIT FOR THE WHOLE 30-IKK

Unit: Million Rps.

Year		Financial Cost			Financial Revenue	
		Const.	OMR	Total	Case (A)	Case (B)
1	1993	6,011	0	6,011	0	0
2	1994	28,903	0	28,903	0	0
3	1995	11,567	0	11,567	0	0
4	1996	0	1,761	1,761	2,724	6,745
5	1997	0	1,902	1,902	2,909	7,288
6	1998	0	2,054	2,054	3,117	7,897
7	1999	0	2,218	2,218	3,339	8,547
8	2000	0	2,396	2,396	2,937	8,618
9	2001	0	2,587	2,587	3,172	9,308
10	2002	0	2,794	2,794	3,426	10,052
11	2003	0	3,018	3,018	3,700	10,857
12	2004	0	3,259	3,259	3,996	11,725
13	2005	0	3,520	3,520	4,315	12,663
14	2006	0	3,802	3,802	4,661	13,676
15	2007	0	4,106	4,106	5,033	14,770
16	2008	0	4,434	4,434	5,436	15,952
17	2009	0	4,789	4,789	5,871	17,228
18	2010	0	5,172	5,172	6,341	18,606
19	2011	0	5,586	5,586	6,848	20,095
20	2012	0	6,033	6,033	7,396	21,702
21	2013	0	6,515	6,515	7,987	23,439
22	2014	0	7,036	7,036	8,626	25,314
23	2015	0	7,599	7,599	9,317	27,339
24	2016	0	8,207	8,207	10,062	29,526
25	2017	0	8,864	8,864	10,867	31,888
26	2018	0	9,573	9,573	11,736	34,439
27	2019	0	10,339	10,339	12,675	37,194
28	2020	0	11,166	11,166	13,689	40,169
29	2021	0	12,059	12,059	14,784	43,383
30	2022	0	13,024	13,024	15,967	46,854
31	2023	0	14,066	14,066	17,244	50,602
32	2024	0	15,191	15,191	18,624	54,650
33	2025	0	16,406	16,406	20,114	59,022
Total		46,481	199,474	245,955	246,914	719,548

Note: Case (A): Current Tariff Basis.
Case (B): 4 % Criterion of Household Income.

Table 6.3.2 VOLUME AND REVENUE OF SUPPLIED WATER AT THE 1991 PRICE LEVEL

NO.	IKK	Supplied Water (m3/year)		Revenue (Million Rps./Year)							
				(1) Average Current Tariff				(2) 4 %-Household Income Criterion			
		H.C. & Non-Domestic	P.H.	H.C. & Non-Domestic	P.H.	Total	Effective (95 %)	H.C. & Non-Domestic	P.H.	Total	Effective (95 %)
1	Bulakamba	529,137	41,829	79.37	4.18	83.55	79.38	232.82	12.34	245.16	232.90
2	Jeruklegi	446,556	60,345	66.98	6.03	73.02	69.37	196.48	17.80	214.29	203.57
3	Kemiri	411,674	32,543	61.75	3.25	65.01	61.76	181.14	9.60	190.74	181.20
4	Madukora	177,942	24,046	26.69	2.40	29.10	27.64	78.29	7.09	85.39	81.12
5	Punggelan	156,793	21,188	23.52	2.12	25.64	24.36	68.99	6.25	75.24	71.48
6	Karanggayam	119,600	16,162	17.94	1.62	19.56	18.58	52.62	4.77	57.39	54.52
7	Petanahan	204,682	27,660	30.70	2.77	33.47	31.79	90.06	8.16	98.22	93.31
8	Sukorejo	364,878	49,308	54.73	4.93	59.66	56.68	160.55	14.55	175.09	166.34
9	Jepon	405,856	32,084	60.88	3.21	64.09	60.88	178.58	9.46	188.04	178.64
10	Batangan	279,805	22,119	41.97	2.21	44.18	41.97	123.11	6.53	129.64	123.16
11	Gondang	494,202	66,784	74.13	6.68	80.81	76.77	217.45	19.70	237.15	225.29
12	Jenar	192,041	25,952	28.81	2.60	31.40	29.83	84.50	7.66	92.15	87.55
13	Giriwoyo	167,606	13,250	25.14	1.32	26.47	25.14	73.75	3.91	77.66	73.77
14	Bawen	495,339	39,157	74.30	3.92	78.22	74.31	217.95	11.55	229.50	218.03
15	Balen	362,204	48,947	54.33	4.89	59.23	56.26	159.37	14.44	173.81	165.12
16	Baureno	343,800	27,178	51.57	2.72	54.29	51.57	151.27	8.02	159.29	151.33
17	Jenu	261,079	35,281	39.16	3.53	42.69	40.56	114.87	10.41	125.28	119.02
18	Kembangbahu	156,064	21,090	23.41	2.11	25.52	24.24	68.67	6.22	74.89	71.15
19	Diewk	397,545	31,427	59.63	3.14	62.77	59.64	174.92	9.27	184.19	174.98
20	Jiwan	528,306	41,763	79.25	4.18	83.42	79.25	232.45	12.32	244.77	232.54
21	Kutorejo	392,590	53,053	58.89	5.31	64.19	60.98	172.74	15.65	188.39	178.97
22	Tempeh	343,972	46,483	51.60	4.65	56.24	53.43	151.35	13.71	165.06	156.81
23	Kunir	467,219	63,138	70.08	6.31	76.40	72.58	205.58	18.63	224.20	212.99
24	Tempursari	318,036	25,141	47.71	2.51	50.22	47.71	139.94	7.42	147.35	139.98
25	Banyuanyar	452,398	35,763	67.86	3.58	71.44	67.86	199.06	10.55	209.61	199.12
26	Sumberasih	273,157	21,593	40.97	2.16	43.13	40.98	120.19	6.37	126.56	120.23
27	Tampak Siring	212,218	28,678	31.83	2.87	34.70	32.97	93.38	8.46	101.84	96.74
28	Ketewel	256,257	20,258	38.44	2.03	40.46	38.44	112.75	5.98	118.73	112.79
29	Menanga	159,572	12,614	23.94	1.26	25.20	23.94	70.21	3.72	73.93	70.24
30	Sibetan	269,001	21,265	40.35	2.13	42.48	40.35	118.36	6.27	124.63	118.40
	Total	9,639,530	1,006,097	1,445.93	100.61	1,546.54	1,469.21	4,241.39	296.80	4,538.19	4,311.28

Table 6.3.3 RESULT OF PROJECT EVALUATION

IKK	FIRR (%)		EIRR (%)
	Current Tariff	4 % Affordability	
(1) BULAKAMBA	6.2	18.6	2.2
(2) JERUKLEGI	4.2	18.1	5.7
(3) KEMIRI	1.9	17.8	5.2
(4) MADUKARA	N	5.3	15.9
(5) PUNGGELAN	N	9.1	23.2
(6) KARANGGAYAM	N	8.4	1.1
(7) PETANAHAN	1.6	17.7	2.9
(8) SUKOREJO	6.9	16.1	11.6
(9) JEPON	3.3	13.9	4.1
(10) BATANGAN	2.8	12.0	11.4
(11) GONDANG	4.9	19.3	6.6
(12) JENAR	N	11.4	15.7
(13) GIRIWOYO	N	14.8	18.9
(14) BAWEN	1.4	14.4	10.8
(15) BALEN	3.1	15.6	7.3
(16) BAURENO	N	16.4	23.6
(17) JENU	N	15.5	0.7
(18) JIWAN	5.4	21.7	3.0
(19) KENBANGBAHU	N	12.0	22.8
(20) DIWEK	5.5	19.5	2.3
(21) KUTOREJO	3.4	19.0	3.9
(22) TEMPEH	4.7	20.4	7.3
(23) KUNIR	5.1	19.2	1.6
(24) TEMPURSARI	2.9	18.3	5.6
(25) BANYUANYAR	6.4	21.9	14.3
(26) SUMBERASIH	0.5	17.4	6.6
(27) TAMPAKSIRING	2.2	16.9	17.3
(28) KETEMEL	N	14.2	9.7
(29) MENANGA	N	N	19.4
(30) SIBETAN	N	12.2	13.6
WHOLE	0.1	15.7	10.1

Note : "N" means a negative FIRR.

Table 6.3.4 CASH FLOW STATEMENT

Unit: US$ 1,000

Year		Capital Cost			Loan Payment		OM Cost	Total Cost	Construction Fund	Revenue	Total Revenue	Surplus or Deficit	Accumulation
		F.C.	L.C.	Total	Interest	Capital							
	1991						608.32391			2188.467			0
1	1993	425	2,466	2,892	0	0	0	2,892	2,892	0	2,892	0	0
2	1994	4,126	9,607	13,733	87	0	0	13,819	13,733	0	13,733	(87)	(87)
3	1995	921	4,372	5,294	499	0	0	5,792	5,294	0	5,294	(499)	(585)
4	1996	0	0	0	658	0	765	1,423	0	2,932	2,932	1,509	923
5	1997	0	0	0	658	0	801	1,459	0	3,071	3,071	1,612	2,535
6	1998	0	0	0	658	0	839	1,497	0	3,226	3,226	1,729	4,265
7	1999	0	0	0	658	0	878	1,536	0	3,385	3,385	1,849	6,114
8	2000	0	0	0	658	0	920	1,577	0	3,309	3,309	1,731	7,845
9	2001	0	0	0	658	0	963	1,620	0	3,464	3,464	1,844	9,689
10	2002	0	0	0	658	0	1,008	1,666	0	3,627	3,627	1,961	11,650
11	2003	0	0	0	658	1,096	1,056	2,809	0	3,798	3,798	988	12,639
12	2004	0	0	0	625	1,096	1,105	2,826	0	3,976	3,976	1,150	13,789
13	2005	0	0	0	592	1,096	1,157	2,845	0	4,163	4,163	1,318	15,107
14	2006	0	0	0	559	1,096	1,212	2,866	0	4,359	4,359	1,492	16,599
15	2007	0	0	0	526	1,096	1,268	2,890	0	4,563	4,563	1,673	18,272
16	2008	0	0	0	493	1,096	1,328	2,917	0	4,778	4,778	1,861	20,133
17	2009	0	0	0	460	1,096	1,391	2,947	0	5,002	5,002	2,056	22,188
18	2010	0	0	0	427	1,096	1,456	2,979	0	5,238	5,238	2,258	24,447
19	2011	0	0	0	395	1,096	1,524	3,015	0	5,484	5,484	2,469	26,916
20	2012	0	0	0	362	1,096	1,596	3,053	0	5,741	5,741	2,688	29,604
21	2013	0	0	0	329	1,096	1,671	3,096	0	6,011	6,011	2,916	32,519
22	2014	0	0	0	296	1,096	1,749	3,141	0	6,294	6,294	3,153	35,672
23	2015	0	0	0	263	1,096	1,832	3,191	0	6,590	6,590	3,399	39,071
24	2016	0	0	0	230	1,096	1,918	3,244	0	6,899	6,899	3,655	42,726
25	2017	0	0	0	197	1,096	2,008	3,301	0	7,224	7,224	3,922	46,649
26	2018	0	0	0	164	1,096	2,102	3,363	0	7,563	7,563	4,201	50,849
27	2019	0	0	0	132	1,096	2,201	3,429	0	7,919	7,919	4,490	55,339
28	2020	0	0	0	99	1,096	2,305	3,499	0	8,291	8,291	4,792	60,131
29	2021	0	0	0	66	1,096	2,413	3,575	0	8,680	8,680	5,106	65,237
30	2022	0	0	0	33	1,096	2,526	3,655	0	9,088	9,088	5,433	70,670
31	2023	0	0	0	0	0	2,645	2,645	0	9,516	9,516	6,871	77,541
32	2024	0	0	0	0	0	2,769	2,769	0	9,963	9,963	7,193	84,734
33	2025	0	0	0	0	0	2,899	2,899	0	10,431	10,431	7,532	92,266
	Total	5,473	16,446	21,918	12,093	21,918	48,306	104,236	21,918	174,583	196,501	92,266	-

Table 6.3.5 ECONOMIC CONSTRUCTION COST AND OMR COST

Unit: Million Rps.

IKK	Construction Cost												OM Cost at 1991 Price Level
	1st Year			2nd Year			3rd Year			Total			
	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	
1. BURALKAMBA	52	240	292	322	833	1,155	27	248	275	401	1,321	1,722	34
2. JERUKLEGI	45	193	238	266	446	712	100	453	553	411	1,092	1,503	40
3. KEMIRI	39	164	203	236	381	617	90	387	477	365	932	1,297	43
4. MADUKARA	44	189	233	389	637	1,026	34	188	222	467	1,014	1,481	45
5. PUNGGELAN	24	99	123	246	329	575	22	96	118	292	524	816	36
6. KARANGGAYAM	20	76	96	170	171	341	68	169	237	258	416	674	29
7. PETANAHAN	20	86	106	127	199	326	48	202	250	195	487	682	22
8. SUKOREJO	52	251	303	222	884	1,106	17	265	282	291	1,400	1,691	8
9. JEPON	18	182	200	334	870	1,204	63	630	693	415	1,682	2,097	27
10. BATANGAN	16	163	179	289	778	1,067	56	564	620	361	1,505	1,866	15
11. GONDANG	13	125	138	326	595	921	51	431	482	390	1,151	1,541	43
12. JENAR	7	57	64	292	269	561	34	195	229	333	521	854	41
13. GIRIWOYO	17	65	82	144	145	289	58	144	202	219	354	573	29
14. BAWEN	65	293	358	477	1,003	1,480	41	297	338	583	1,593	2,176	47
15. BALEN	45	204	249	293	724	1,017	25	212	237	363	1,140	1,503	32
16. BAURENO	35	149	184	306	514	820	27	149	176	368	812	1,180	39
17. JENU	28	114	142	261	391	652	23	113	136	312	618	930	38
18. JIWAN	38	161	199	322	557	879	28	161	189	388	879	1,267	48
19. KEMBANGBAHU	20	81	101	211	275	486	19	80	99	250	436	686	30
20. DIWEK	34	155	189	234	545	779	20	159	179	288	859	1,147	32
21. KUTOREJO	35	150	185	287	519	806	25	151	176	347	820	1,167	40
22. TEMPEH	9	94	103	136	436	572	148	142	290	293	672	965	32
23. KUNIR	13	157	170	160	720	880	170	231	401	343	1,108	1,451	39
24. TEMPURSARI	9	98	107	141	447	588	155	145	300	305	690	995	31
25. BANYUANYAR	10	114	124	149	520	669	162	167	329	321	801	1,122	37
26. SUMBERASIH	8	88	96	121	402	523	131	131	262	260	621	881	31
27. TAMPAKSIRING	21	136	157	159	309	468	14	102	116	194	547	741	22
28. KETEWEL	31	190	221	252	430	682	22	142	164	305	762	1,067	30
29. MENANGA	36	158	194	634	329	963	59	102	161	729	589	1,318	94
30. SIBETAN	34	200	234	320	447	767	28	146	174	382	793	1,175	45
TOTAL	838	4,432	5,270	7,826	15,105	22,931	1,765	6,602	8,367	10,429	26,139	36,568	1,079

Table 6.3.6 ESTIMATES OF ECONOMIC BENEFIT

NO.	IKK	Household Served		Saving Time (hr/hh/day)			Annual Benefit (Mil. Rps.)
		H.C.	P.H.	H.C.	P.H.	Total	
1	Bulakamba	3,553	888	1,777	0	1,777	115
2	Jeruklegi	2,990	1,282	2,093	256	2,350	152
3	Kemiri	2,765	691	1,935	138	2,073	134
4	Madukora	1,192	511	3,694	1,328	5,022	326
5	Punggelan	1,050	450	3,150	1,125	4,275	277
6	Karanggayam	801	343	721	137	858	56
7	Petanahan	1,371	587	822	59	881	57
8	Sukorejo	2,443	1,047	2,932	733	3,665	238
9	Jepon	2,726	681	2,180	204	2,385	155
10	Batangan	1,879	470	3,382	611	3,993	259
11	Gondang	3,310	1,418	2,317	284	2,600	169
12	Jenar	1,286	551	2,315	717	3,031	197
13	Giriwoyo	1,126	281	2,026	366	2,392	155
14	Bawen	3,327	832	4,324	665	4,990	324
15	Balen	2,426	1,040	2,183	416	2,599	168
16	Baureno	2,309	577	5,079	981	6,061	393
17	Jenu	1,748	749	1,049	75	1,124	73
18	Kembangbahu	1,045	448	2,613	896	3,509	227
19	Diewk	2,670	667	1,335	0	1,335	87
20	Jiwan	3,548	887	1,774	0	1,774	115
21	Kutorejo	2,629	1,127	1,577	113	1,690	110
22	Tempeh	2,303	987	1,612	197	1,810	117
23	Kunir	3,129	1,341	1,564	0	1,564	101
24	Tempursari	2,136	534	1,495	107	1,602	104
25	Banyuanyar	3,038	760	3,038	380	3,418	222
26	Sumberasih	1,834	459	1,468	138	1,605	104
27	Tampak Siring	1,421	609	2,132	609	2,741	178
28	Ketewel	1,721	430	2,065	301	2,366	153
29	Menanga	1,072	268	5,144	1,152	6,296	408
30	Sibetan	1,807	452	3,071	542	3,613	234
	Total	64,653	21,368	70,870	12,529	83,399	5,408

Table 6.3.7 FLOW OF ECONOMIC COST AND BENEFIT

Unit: Million Rps.

Year		Economic Cost			Economic Benefit
		Const.	OM	Total	
1	1993	5,270	0	5,270	0
2	1994	22,931	0	22,931	0
3	1995	8,367	0	8,367	0
4	1996	0	1,079	1,079	5,201
5	1997	0	1,079	1,079	5,244
6	1998	0	1,079	1,079	5,301
7	1999	0	1,079	1,079	5,354
8	2000	0	1,079	1,079	5,408
9	2001	0	1,079	1,079	5,408
10	2002	0	1,079	1,079	5,408
11	2003	0	1,079	1,079	5,408
12	2004	0	1,079	1,079	5,408
13	2005	0	1,079	1,079	5,408
14	2006	0	1,079	1,079	5,408
15	2007	0	1,079	1,079	5,408
16	2008	0	1,079	1,079	5,408
17	2009	0	1,079	1,079	5,408
18	2010	0	1,079	1,079	5,408
19	2011	0	1,079	1,079	5,408
20	2012	0	1,079	1,079	5,408
21	2013	0	1,079	1,079	5,408
22	2014	0	1,079	1,079	5,408
23	2015	0	1,079	1,079	5,408
24	2016	0	1,079	1,079	5,408
25	2017	0	1,079	1,079	5,408
26	2018	0	1,079	1,079	5,408
27	2019	0	1,079	1,079	5,408
28	2020	0	1,079	1,079	5,408
29	2021	0	1,079	1,079	5,408
30	2022	0	1,079	1,079	5,408
31	2023	0	1,079	1,079	5,408
32	2024	0	1,079	1,079	5,408
33	2025	0	1,079	1,079	5,408
	Total	36,568	32,370	68,938	161,709

6.4 Recommendations

(1) The proposed project for 30 High Priority IKKs is technically feasible and economically justified conditionally.
Immediate implementation of the project is recommended from the social and sanitary reasons.

(2) Because of the high costs required for the implementation, foreign financial assistance may be necessary.

(3) For another IKKs except 30 IKKs, feasibility studies are also required in the next stage.

(4) Before implementation of these 30 IKKs, a confirmatory investigation for ground water capacity in IKKs shown below, where test well drilling and pumping tests were not conducted at the proposed well points in this feasibility study, is recommended.

1) Bulakamba, 2) Kemiri, 3) Petanahan, 4) Jepon, 5) Gondang
6) Balen, 7) Baureno, 8) Kunir, and 9) Banyuanyar

Basides the test well drilling and pumping tests, geoelectrical survey for the determination of the well location and water quality analyses are also recommended.

(5) As for water quality of the following water sources, where some items of water quality showed somewhat higher than the Standard, recheckings (sampling and analyses) are recommended before implementation.

Name of IKK	Water Source	Check items
Madukara	Mudal Spring	Lead (Pb)
Batangan	Juwana System	Lead (Pb)
Kemiri	Shallow Well	Iron (Fe)
Jepon	Deep Well	Iron (Fe)
Kembangbahu	Deep Well	TDS and Chloride (Cl^-)

(6) Coliform and Bacteria showed high value at almost all existing water sources except deep wells in field surveys in Phase 1 and 2.

It is necessary to conduct a $Ca(OCl)_2$ injection to each supply water to keep a residual Chlorine at the Taps, for sanitary reasons. Education to the community is also required.

(7) Operation and Maintenance

1) Operation including the inspection of the facilities should be conducted faithfully based on the Operation Manual, to keep the people served safe and healthy and give them easiness of living.

2) During the construction period of the water supply facilities, Test Run for the facilities should be conducted before commencement of the operation.
Training of operators is also required.

3) Periodical Maintenance, based on the Maintenance Manual, is also important to prevent the facilities from accidents and deterioration.

(8) Education to the community, regarding the necessity of a clean water supply facilities and sanitation, is also required especially in rural areas.

(9) Community Participation

Community Participation for the following items will be required.

1) Cooperation to the land acquisition and construction works.

2) Cooperation and Assistance to BPAM or PDAM regarding the followings.

(i) Conservation of safety for water supply facilities, including the prevention of deterioration of the facilities and contamination of supply water.

(ii) Report to BPAM or PDAM office on accidents such as water leakage and illegal connection, etc.

(iii) Tariff payment

CHAPTER 7 SUPPLEMENTARY STUDY

Chapter 7 Supplementary Study

This study was conducted in response to the request from Indonesian Government. Details are described in this Chapter.

7.1 Study Condition

7.1.1 IKKs to be studied

The objects of this study are the 30 High Priority IKKs listed in Table 5.3.

7.1.2 Design Criteria

The design criteria proposed in the minutes of meetings on the Draft Final Report dated February 5, 1992 were applied to this study. They are shown in Table 7.1.1.

Table 7.1.1 Design Criteria

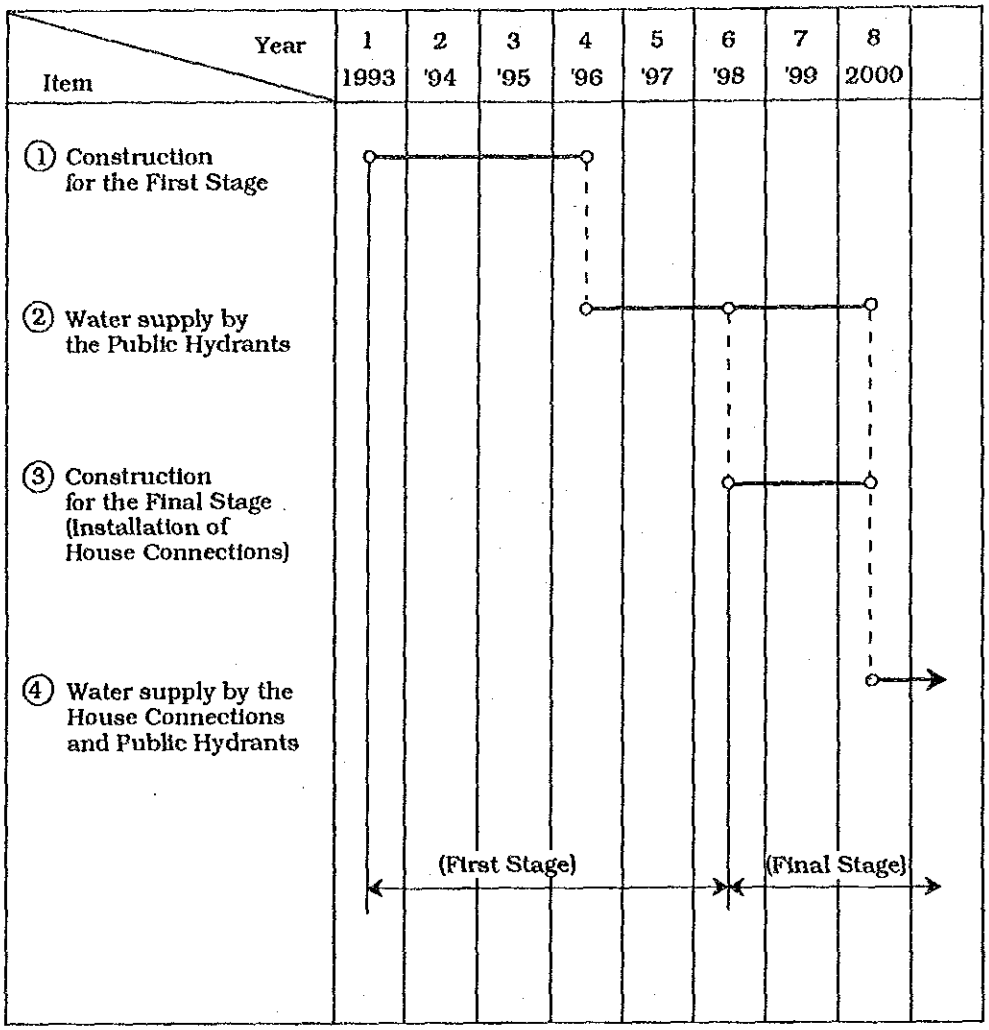
No.	DESIGN CRITERIA	FIRST STAGE *)	FINAL STAGE **)
1.	Supply Level at House Connection (H.C.) (l/c/d)	-	90
2.	Supply Level at Public Hydrant (P.H) (l/c/d)	30	30
3.	Population Served (%)	50 - 100	50 - 100
4.	Water supply capacity per population	Module system	Module system
5.	Ratio of Population served by H.C./P.H.	0/100	70/30 - 80/20
6.	Number of people per H.C.	-	10
7.	Number of people per P.H.	100	100
8.	Water allocation for non-domestic deman (%)	5	5
9.	Water allocation for leakage and losses (%)	15	15
10.	Factor for maximum day	1.1	1.1
11.	Factor for Peak Hour	1.4	1.4
12.	Target year (in future)	10 years	10 years
13.	Operation hours	24 hours	24 hours
14.	Flow restrictor	No	No
15.	Capacity of reservoir	(2 hrs)	(2 hrs)

Notes : (1) *) Means the first 2 (two) years

(2) **) Same as Table 6.1.4

7.1.3 Construction and Operation Schedule

The construction and operation schedule will be considered as follows with the condition that this project will be implemented from 1993.



7.1.4 Others

(1) The water supply systems for the final stage are the same as proposed in 6.1.4 in this Report.

(2) The water supply systems for the first stage are proposed with the following conditions.

(i) Ratio of population served by Public Hydrants

- In the first stage of the project, water supply shall be conducted only with Public Hydrants as proposed. The water demand reduced by this

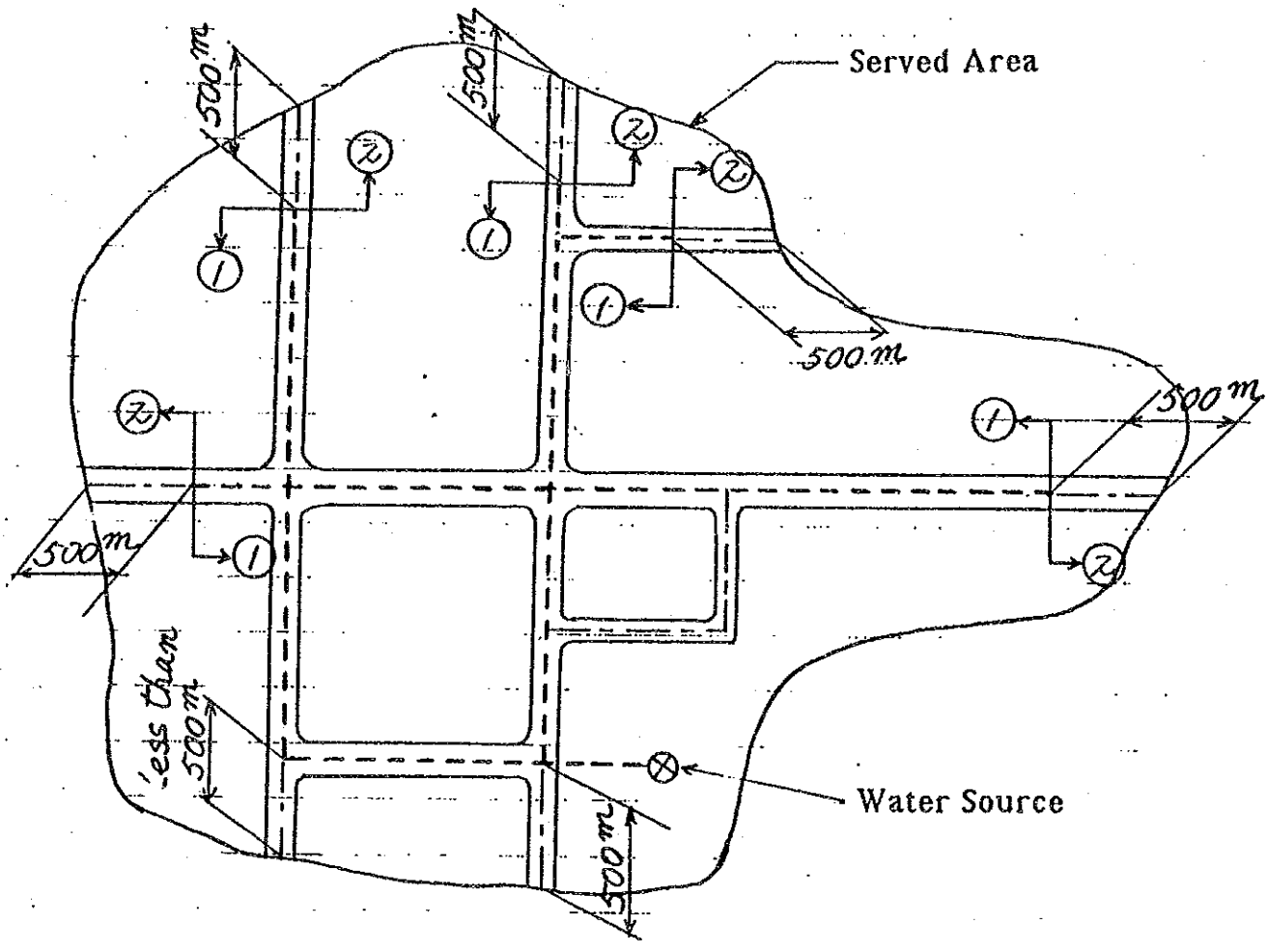
approach compared with that in the final stage shall be taken into consideration on well construction, well pump installation and so forth, to minimize the construction cost for the first stage implementation.

(ii) Pipe line

- The pipeline shall be designed taking into consideration of the water supply capacity in the final stage, even water supply in the first stage should be conducted with a smaller amount by the Public Hydrants.
- The maximum access to the nearest Public Hydrant in the first stage shall be 500 meters or less. Hence, pipelines in the edge of the planned area with a length of 500 meters shall not be constructed in the construction for the first stage, but in the construction for the final stage.

Refer to Fig. 7.1.1.

Fig. 7.1.1 Schematic Drawing of Pipeline in the First Stage and Final Stage



① ····· To be installed in the First Stage

② ····· To be installed in the Final Stage

– – – – – – Pipeline installed in the First Stage

– — – — – — Pipeline installed in the Final Stage