No. 69

REPUBLIC OF INDONESIA
MINISTRY OF PUBLIC WORKS (DPU)
DIRECTORATE GENERAL OF
HUMAN SETTLEMENT (CIPTA KARYA)

UJUNG PANDANG

WATER SUPPLY DEVELOPMENT PROJECT

VOLUME III

SUPPORTING REPORTS FOR MASTER PLAN

NOVEMBER 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

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FOREWORD

Each of the Supporting Reports prepared by individual specialists constitutes the base for, corresponding major study field, the planning and strategy described in the Master Plan and Feasibility Study for the Water Supply Development Project of Ujung Pandang.

The Reports deal with following studies and surveys:

I. Population Projection

Population projection by zone and age up to the year of 2005.

II. Water Requirements

Future water requirements projected in a five year increament up to the year of 2005 based on the National Guidelines, and Team's forecast thereon.

III. Study on Water Sources

Study on the availability of the existing and proposed water sources located at the administrative area of Kotamadya Ujung Pandang and its surrounding area.

IV. Study on Water Quality

Study on the quality of water at the existing facilities, distribution system and the proposed and existing water sources including shallow wells.

V. Comparison of Alternatives

Selection of the optimal and cost-effective water supply plan up to 2005.

VI. Surveys on Water Usage, etc.

Household survey for selected 530 samples, public standpipe survey, and surveys on water losses at the existing transmission canal, daily variation of water consumption water pressure in the distribution network and survey on accounted-for water.

I. POPULATION PROJECTION

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1. GENERAL

This study intends to estimate the total population of Kotamadya Ujung Pandang up to the year of 2005, the design year, and population distribution into the zones, which are to be utilized for projection of water demand.

To the above end, the procedures to be taken are firstly to estimate the total population in Section 2, and then based on this, to distribute it to the zones (kecamatan/kelurahan) in Section 3.

Population growth up to the present will be summarized as follows: the population increase from early 1970's to 1976 was rather small which would be attributed to natural growth, whereas the population increase after 1976 has been sizeable, due to migration. The number of migrants in 1980 is estimated at 20,000 to 30,000 persons/year, and the larger portion of this increase is considered to have taken place in kecamatan Tamalate and Panakkukang in the suburbs where housing estates are rapidly being developed.

Under the circumstances, projection of total population will possibly be made with a certain quantitative accuracy, but distribution of population may not be made so accurately because of scarcity of available information. For, the population increase in the suburbs has been caused by housing estates, but the projects of housing estates are not planned on long terms.

However, the design and construction of distribution networks to be made based on the distribution of population do not require a long period, except the case of trunk mains. Therefore, possible deviations, if any, in population or water demand projection may give no serious effects to the project. Considering the above, the method of projection to be taken is determined as such that enables the design of trunk mains over a long term and gives the total demand in each zone.

Basic Processes to project population are summarized as follows:

1) To analyze characteristics of the past population growth based on data and information.

2) To build models for projection which are consistent with the characteristics of population growth and able to consider government policies and other factors.

3) To simulate future population growth, taking into account housing estate plans and others.

2. PROJECTION OF TOTAL POPULATION

2.1 Characteristics of Past Population and Growth

In projecting future population, the characteristics of population growth is to be primarily made clear. The characteristics thus clarified are to be used to construct population projection models suited for population growth in Ujung Pandang.

Past population statistics are presented on Figure 2.1. This shows that the increases in 1975-76 and 1979-80 were remarkable, and those in other years very small. Ordinarily, such phenomena do not occur. When it is taken into consideration that the above two remarkable increases were on two particular cases (1976: Election Enumeration and 1980: Population Census), the statistics of the other years do not probably show true figures. Therefore, for the population projection in the following, the above two cases and other population censuses (1961 and 1971) will be used as basic data.

Population statistics on Figure 2.1 will again be reviewed here. According to the above, growth rates in 1961 to 1971 and 1971 to 1976 were 1.70% and 1.29% respectively, while that in 1976 to 1980 was 4.27%, remarkably large. In the latter period, a sizable migration might have taken place, if the ordinary birth rate and mortality are considered.

Further, characteristics of population growth will be considered with regard to age group, as briefed below. Age groups in 1971 and 1980 are presented on Figure 2.2.

1) Comparison of age groups in 1971 and 1980 shows that there is a significant difference in age group of 15 - 24 years. This indicates that migration of population of this age group is large.

2) Percentage of 15 - 24 year age group in South Sulawesi excluding Ujung Pandang is not large. From this, it is supposed that there are many emigrants from that area to Ujung Pandang and other provinces.

Conclusively from the above analyses, people, mostly younger generation, have been migrating into Ujung Pandang since around the end of 1970, resulting in the significant increase of population in Ujung Pandang.

This tendency will accelerate the water shortage in Ujung Pandang, which the people have been chronically suffering from.

2.2 Projection Method

To project future population in Ujung Pandang, a model suitable for the characteristics as analyzed above is developed, which is briefed below.

There are three factors for population growth, namely, mortality, fertility and migration. The analysis in 2.1 indicates that the major factor for population growth in the recent years is migration. The assumption of the amount of migration, therefore, will largely affect the results of population projection.

As it is hardly possible to grasp the real state of migration during a short period of investigation, projection of long term future population based on such investigation will not necessarily be reliable. For, the migration is apt to be influenced by the government policy. Considering all the above, future population will be projected with migration as an exogenous factor.

As regards mortality and fertility, projection will be made as follows. Roughly speaking, births depend on the number of fertile women. In the case of Ujung Pandang, the percentage of 15 - 24 year age group is significantly large (both men and women share half of the group population each). As migration of the present tendency is supposed to continue, projection by crude birth ratio may not be suitable. Similarly, regarding mortality, projection by crude death ratio may not be appropriate, considering mortality is different by age, and the composition of age groups is rather not normal. From the above discussions, the concept of "Cohort projection" will be best suited, which in projection of births and deaths can take in fertility and mortality by age group.

In the following, a method to project future population which is devised based on Cohort projection is briefly described. The basic idea of this method is, as shown on Figure 2.3, to classify the population by age, estimate numbers of birth, death classified by age and migrants classified, and then estimate the population in the following year. This is repetitive method. The migration will be put in in total number. Slight problems in applying this method are how to assume the reproduction rates, mortality rates (both by age) and composition ratio of migrants by age.

Detailed procedures will be described later. In Ujung Pandang, reliable data of births and deaths are not available. Therefore, for this study, one parameter will be used for one age group, not considering each age in the group.

First, for mortality, the following age groups will be employed, considering the classifications of census data.

AGE GROUP (j)	I	II	III	IV	V	VI	VII
AGE	0 ~ 4	5~14	15 ~ 24	25~34	35~44	45~54	55~

Then, population capable of reproduction is assumed to be represented by the population of age 15 to 34 years, taking into consideration the classification of deaths by age group. Reproduction rate is assumed to be same with all ages in the range mentioned above.

Regarding migration, the following procedures are taken, that is, 1) population from 1976 to 1980 is estimated on the assumption that there are no migrants, and 2) from the difference between the estimated population and the real population in 1980, the migration population is distributed to each age group classified by 5 years bracket. The distribution ratio within one age group is assumed same regardless of age.

2.3 Estimation of Model Parameters and Migration Magnitude

Regarding the projection model described in 2,2, method of deciding various parameters, verification of the application thereof, and migration magnitude will be described below.

First, about formulation of the parameters. The parameters to be adopted are fertility rate (F^T), mortality rate (M_j^T), and migration allocation rate (R_j), where T denotes year and j age group. Parameters, F^T and M_j^T are hard to be quantified, but their tendency can be known, as briefed below.

M_j^T: It will decrease along with development and spread of medicine. Is is low with young population, high with middle and advance age population, and comparatively low with infants.

F^T: It will become smaller due to spread of family planning among the public.

Considering the above, the following formula will be used as a general formula which can express the above mentioned tendencies.

$$Y^T = K + A \cdot B^{T-T_o}$$

where,

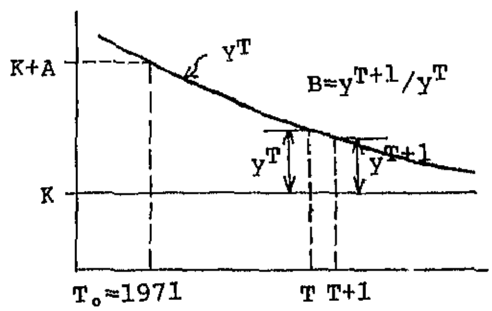
Y^T: F^T or M_j^T at the year T

K : Constant value (F^T or M_j^T at the year $T = \infty$)

A : Constant value (Difference between values of F^T of M_j^T at the year $T = T_o$ and $T = \infty$)

B : Constant value (< 1, $= Y^{T+1}/Y^T$, refer to the figure below)

T_o : Basic year (= 1971 in this case)



Further, concerning the difference of mortality among ages, the following curves of K, A and B will be assumed from the above consideration

Schematic Curves of Parameters

(Assumption for the above. Over present and future, the age group of 15-24 years has the lowest mortality)

(Assumption for the above. Medical advance gives better effects on age groups of higher mortality, i.e., $B = Y^{T+1}/Y^{T}$ is smaller)

After the above preparation, utilizing the population by age group of 1971 and 1980, namely, the population capable of reproduction and population of age less than one year with regard to reproduction; and the sharp pointed shape of the population pyramid with regard to mortality, M_J^T and F^T are estimated. Further, in estimating the above, it is assumed that migration during 1971 to 1976 was zero because of the very low population growth, and after 1976, migration contributed to the population increase.

The results of estimation of parameters and simulation of population growth (Migration = 0) are presented in Table 2.1, and Figures 2.4 and 2.5. As seen on the figures, the estimated curves accord well with the actual one in 1976, and also the shape of pyramid in 1980, at the middle- and higher-age groups, is similar to the actual one. From the above, it will be concluded that the estimation is well acceptable with sufficient accuracy.

As regards migrants as a component of the population, the following is assumed considering the difference between the estimated population and the actual population by age group in 1980, and reproduction by migrants.

AGE GROUP	0 ~ 4	5 ~ 9	10 ~ 14	15 ~ 19	20 ~ 24	25 ~ 29 30 ~ 34 35 ~ 39 40 ~ 44
PERCENT	0	0	20	50	26	1 x 4

By applying the parameters so far described, migration from 1976 to 1980 will be estimated, and further applying this estimation the population up to 1980 can be calculated, and also this can be compared with the actual population in 1980. It is almost impossible to estimate correctly the number of migrants, but if migrants were zero, the difference between the calculated population and the actual population is 77,000 persons. Assuming that the number of migrants per year were about same, it is 15,000 to 20,000 persons per year. On the other hand, the estimated population of non-census, which is not considered very correct and reliable, may possibly indicate the tendency, if not correct figures.

As examples of population calculation using the above assumption, two cases as shown below are calculated, and its results are presented on Figures 2.6 and 2.7, and Table 2.2.

	1976~1977	1977~1978	1978~1979	1979~1980
Sudden Increase Case(1)	5,000	5,000	32,000	32,000 (SUM:74,000)
Gradual Increase Case(2)	15,500	17,000	18,500	20,000 (SUM:71,000)

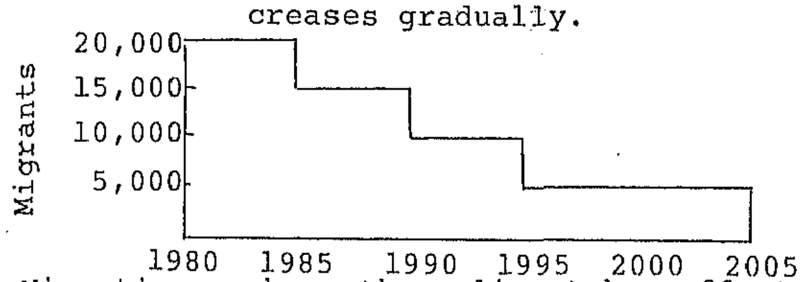
The figures indicate that the calculated population pyramid accord well with the actual one, especially with Case 1 (Sudden Increase). This verifies that the assumed parameters and number of migrants (71,000 to 74,000 persons in 4 years) are appropriate.

2.4 Population Projection and Population for Planning

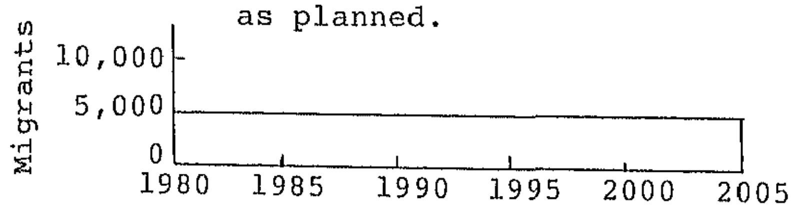
By applying the models so far described, population projection with the characteristics of population growth considered can be made when the number of future migrants is assumed. As the number of migrants is roughly known as analyzed in 2.3, a scenario (simulation case) will be prepared. Further, as BAPPEDA has a population policy to suppress gradually migration, the scenario will set so as to lower the level of migration in the future.

Based on the above consideration, the folowing scenarios with two cases of migration are provided.

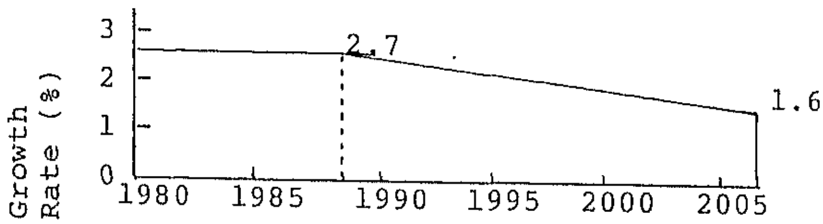
Case 1 Higher Migration: where it takes time to efectuate the BAPPEDA policy, and migration decreases gradually.



Case 2 Lower Migration : where the policy takes effect in a short period, and migration decreases as planned.

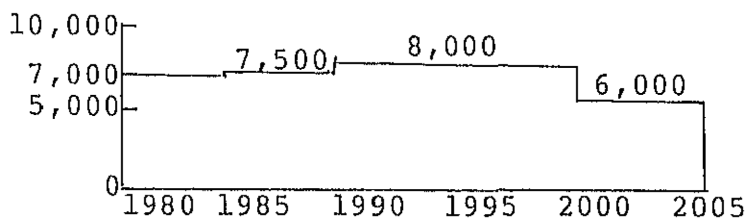


In addition, a case of crude growth rates was prepared from the information of BAPPEDA, for comparison.



The results of projection of the above three cases are shown on Figure 2.8. As is seen on the figure, Crude Growth Case lies between the two curves of Cases 1 and 2, rather close to the Case 2 curve. For the Master Plan of the future water supply system, Crude Growth Case is recommended considering the political implication thereof.

Migration corresponding to the BAPPEDA case projection can be calculated as shown below.



1/ For projection, 1980 is employed as the starting point, considering reliability of population data.

Further, the population by age group in 1980, 1995 and 2005 is shown on Figure 2.9, as calculated using the above migration.

3. Areawise Population Projection

In this section, total population will be distributed to kecamatan/kelurahan for the following purposes:

1) To distribute water demand to areas.
2) To determine the capacities of the distribution system.

This section consist of 3.1 Analysis of Local Characteristics of Population Growth, 3.2 Projection Method, and 3.3 Areawise Population Projection.

3.1 Analysis of Local Characteristics of Population Growth

The results of study in the preceding Section 2 show that the population growth in Ujung Pandang largely depends on migration of population. Therefore, in forecasting and distributing population areawise, the following must be considered:

1) Where transmigrants to settle from other municipalities and provinces.
2) Regarding movements within the city, from where to where, how many and for what reason.

Following analyses are made from the above view points.

A) Grouping of Kecamatan

Based on the data of population (1971, 1980 census and 1976 enumeration), all kecamatans will be plotted as shown on Figure 3.1 according to the following two parameters:

1) Population density (1976 and 1980)
2) Population growth rate (1971-1976 and 1976-1980)

Further on this figure, kecamatans are marked with 〰 those housing estate as shown on the figure. From this figure, it is apparent that the 11 kecamatans can be grouped into the following two areas: area with and area without housing estates (refer to Figure 3.2 and Table 3.1).

1) Urban Area : kecamatans Mariso, Mamajang, Ujung Pandang, Makassar, Wajo, Bontoala, Tallo and Ujung Tanah.

2) Suburban Area : kecamatans Panakkukang, Tamalate and Biringkanaya

Urban Area corresponds to the old city area before the expansion of the city in 1972, and Suburban Area does to the mergered area. Population pyramids in 1980 are shown on Figure 3.3. From these figures and table, characteristics of the two Areas are as follows:

1) Urban area : Population density is comparatively high. Age brackets of 15 to 24 years account for higher percentage. Possibly, younger migrants from other provinces and towns may have settled in this Area.

2) Suburban Area : This is, so to speak, the suburbs to the old city, and population density is still rather low in spite of rapid population growth. The Area has housing estate plans, and migrants seem to have settled as typical families.

B) Characteristics of Population Growth in Urban Area

Based on the 1971 and 1980 censusses, trends of population density variation and population growth in Urban Area are shown on Figure 3.4 in contrast to the distance from Mayor Office (this method is adopted customarily by the city). The figures indicate that:

1) Residents in the central area are decreasing. It is considered due to the reason that administrative offices are concentrated and large-scale stores are established, leading to seperation of work place and residence, along with the development of the city and commerce.

2) The further from the central area, the higher the growth rate of population. The peripheral areas of the city are having concentration of population

3) From the above 1) and 2), Urban Area is now undergoing "sprawling".

C) Characteristics of Population Growth in Suburban Area

In accordance with the same procedure of the above, Figure 3.5 is prepared. The figure shows that:

1) The closer to the central area, population density is higher, and the growth rate of population is also higher.

2) Due to the sprawling of Urban Area, concentration of population seems to have started from the boundary of Urban Area.

D) Comparison of Population Growth Between Two Areas

(a) Comparison of Population Pyramids in Urban Area and Suburban Area

The population pyramids in Urban and Suburban Areas (as shown on Figure 3.5) indicate that the age group of 15 - 24 years old of Urban Area projects more extensively than that of Suburban Area.

(b) Comparison of Population Increase Ratios

The increase ratios obtained from the data of population censusses in 1971 and 1980 indicate that the rate of Suburban Area is 6 times larger than that of Urban Area.

Area	a.1971 Census	b.1980 Census	c. Increase Ratio (b/a-1)
Urban Area	441,365	509,286	15%
Suburban Area	113,457	199,179	75%

(c) Housing Estate

The housing estates is a key factor to forecast the future areawise population projection because it plays a vital role in population migration in the city.

The present housing estates are as follows.

1) Most of the housing estates are being constructed or programmed to be constructed in Suburban Area as shown in the table below.

KECAMATAN	Actual 1980	1981	1982	1983	1984	Average 1981-'84	Plan 1985	1986
Panakkukang	650	420	420	480	1,680	750	950	850
Tamalate	2,420	1,260	1,260	1,550	980	1,270	880	1,000
Biringkanaya	110	160	40	40	70	80	2,100	1,790
Sub total (Suburban Area)	3,180	1,840	1,720	2,070	2,730	2,100	3,930	3,840
Mamajang	40	30	30	0	0	20	0	0
T o t a l	3,220	1,870	1,750	2,070	2,730	2,120	3,930	3,840

2) The demands for such houses are extreemly high and exceeding the supplies and therefore there are no vacant houses.

3) There are two conditions to qualify the applicants to reside in the house.

Condition 1 PERUMNAS (housing corporation)

i) living in Ujung Pandang

ii) having permanent job (regardless to job categories)

iii) family without own house

Condition 2 BTN (Bank Tabungan Negara) and housing company authorized by the Municipality

i) living in South Sulawesi

ii) government employee and qualified employee of the private company. The merchant and handy workers are not qualified.

iii) famili without own house

Those who are qualified by above are considered average famili constituent.

3.2 Projection Method

The process of population projection by zone (kecamatan/ kelurahan) is composed of 3 steps. The first step is projection for 2 Areas, as defined in 3.1. The second is allocation of each Area's population to kecamatans. As for Suburban Area, there is a third step to distribute population of kecamatans to each kelurahan similarly to the second step. This is because the three kecamatans in the suburbs are too large to provide effective information for distribution network planning.

The basic approach is mentioned below taking into account the above 3.1 D). The conception of this approach is shown on Figure 3.6.

1) Families living in Urban Area and South Sulawesi are likely to migrate to housing estate in Suburban Area.

2) The remaining migrants (major parts of the migrants with age group of 15 - 24 years old) from other cities and provinces to Urban Area.

3) The housing estates will be constructed in Suburban Area continuously and accommodate the migrants from Urban Area and other towns in South Sulawesi.

4) The natural increase of the population gives rise in both Areas derived from the birth and mortality.

The areawise population projection model has been developed as shown on Figure 3.7 by the basic approach mentioned above. Each model is described below.

1) Sub-model for increase by migration in Suburban Area.
   The construction of the housing eatate motivates the migration from Urban Area and other towns in South Sulawesi to Suburban Area.
   The number of migrants is calculated in proportion to newly constructed houses.
   The average number of person in the family who live in above houses is assumed to be 6. The age constituent of the average family is considered proportionate to the age constituent of population in Suburban Area in 1980 (as shown on

Figure 3.3).
Above means that the construction of housing estate gives decrease of population in Aurban Area and increase in Suburban Area.

2) Sub-model for increase by migration in Urban Area.
In the previous city's total population projection, the population of migration from other towns and provinces was obtained as shown on Figures in page 1-23.
These migrants partly enter the housing estates in Suburban Area as mentioned in 1). From the above, remainings of the migrants (major part of migrants with age group 15 - 24 years old) enter this Area.

4) Sub-model for calculation of total population growth in Areas.
The following calculations have been made in accordance with above 1) - 3).

Population Growth in Urban Area	:	natural increase + increase by migration - decrease by housing estate
Population Growth in Suburban Area	:	natural increase + increase by housing estate

5) Sub-model for population distribution to kecamatans in Urban Area.
The phenomenon of the sprawl is noticeable in this area as mentioned in 3.1. In Urban Area the increased population is distributed to 8 kecamatans utilizing the contribution ratio1/ supposing that the sprawling (population increase pattern) will continue similarly after the year 1981.

6) Sub-model for distribution of population growth by migration to kecamatans in Suburban Area.
Based on housing estate plan by kecamatan, population growth in this area is distributed to 3 kecamatans. This means the same process as 1) is adopted.

7) Sub-model for distribution of natural population growth to kecamatans in Suburban Area.
The population by natural growth in this area is distributed to 3 kecamatans in proportion to population in previous year.

1/ This ratio is defined as follows : $CR(j) = \frac{\text{Population Growth in Kecamatan } j}{\text{City's Total Population Growth}}$

3.3 Areawise Population Projection

Population from 1981 to 2005 is kecamatan/kelurahan are projected using the above method. The result of projection are described below along with the procedures.

A) Presuming Housing Estate Plan

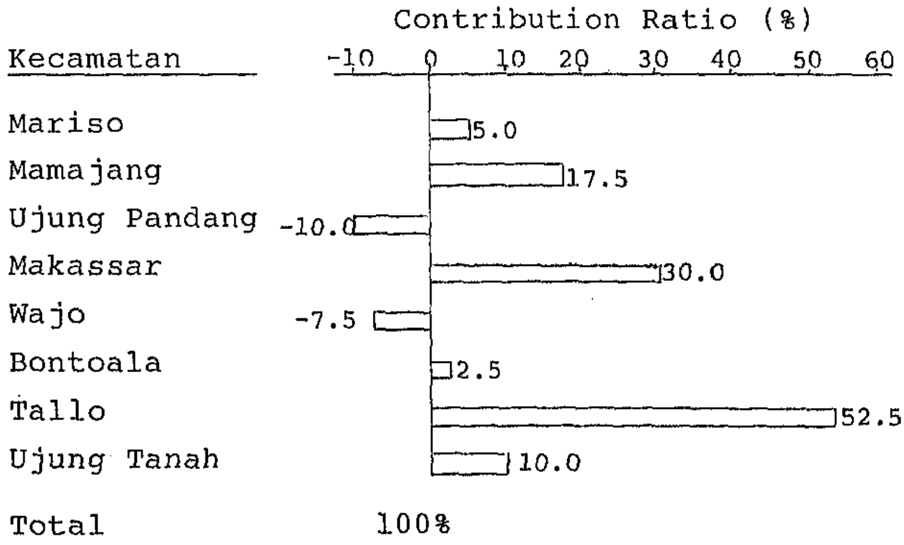
Based on the annual average housing constructions through 1981-1984 (2,100 houses) and population growth characteristics as mentioned in 3.1, the housing estate's housing construction constituents after the year 1985 are presumed as follows.

Panakkukang	750	houses/year	(35%)
Tamalate	1,150	houses/year	(55%)
Biringkanaya	200	houses/year	(10%)

Based on above plan, population increase in Suburban Area is distributed to 3 kecamatans.
As to kelurahan level, the estate's area was decided in consideration of space for housing development. The results are shown in Table 3.4.

B) Calculation of Contribution Ratio to Population Growth

As previously mentioned, contribution ratios of kecamatan in Urban Area is utilized for population distribution. The ratios were assumed as shown on figure below based on the census data of 1971 and 1980.



C) Population Distribution

The results of distribution are summarized in Tables 3.5 (kecamatan level) and 3.6 (kelurahan level). They show two distinct growths, that is, small growth of 90,000 in Urban Area and explosive growth of 430,000 in Suburban Area. In 2005, the population of Suburban Area exceeds that of Urban Area owing to urbanization in kecamatan Tamalate and Panakkukang.

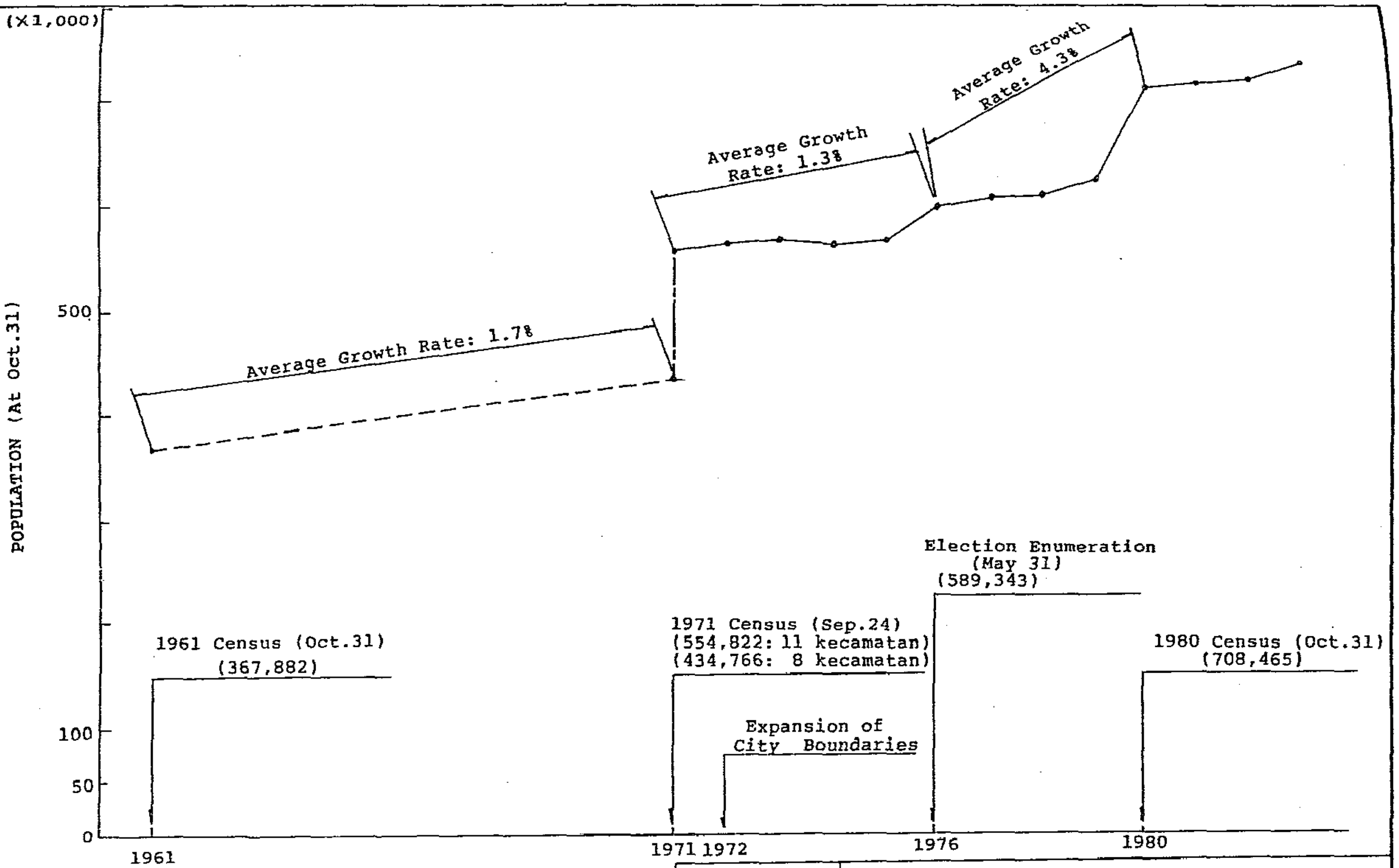


FIGURE	POPULATION TREND
2.1	

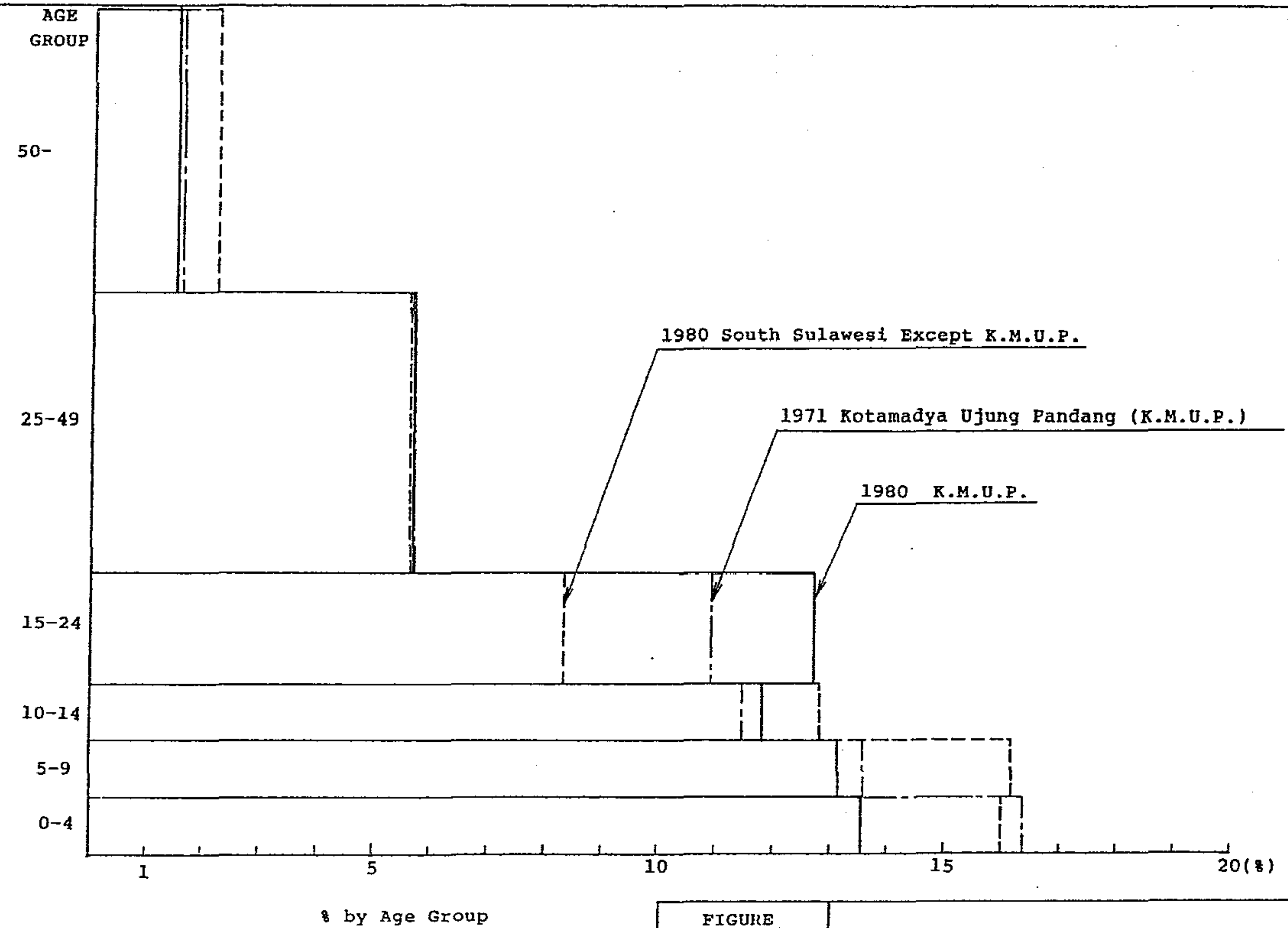


FIGURE 2.2 POPULATION PYRAMIDS

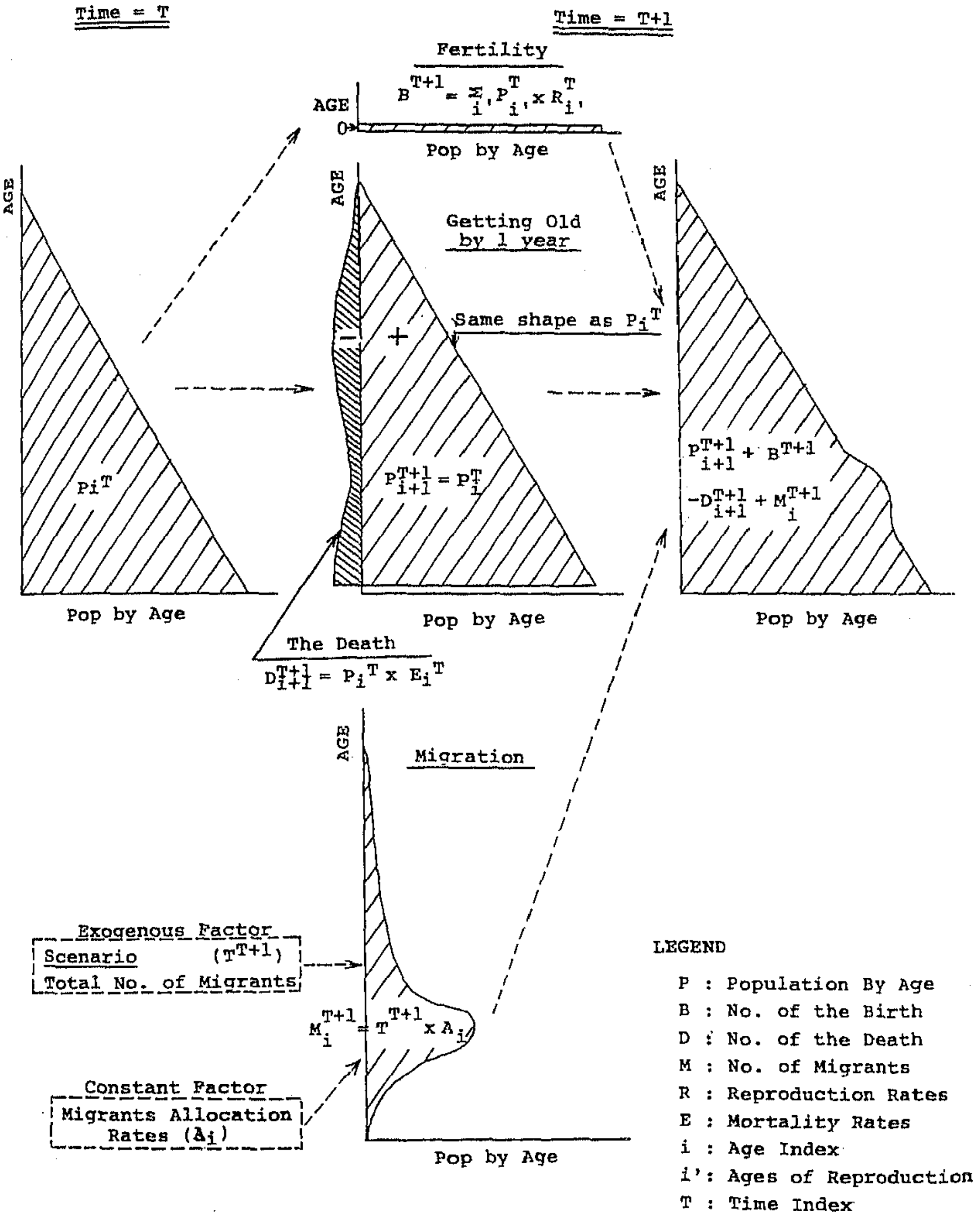


FIGURE	POPULATION PROJECTION METHOD
2.3	

TABLE 2.1 SIMULATION OF PAST POPULATION GROWTH
(Subject to Migrants = 0)

YEAR	EST.	OBSERVED	ERROR
1971	555,700	555,700	0
1972	564,000	561,697	2,303
1973	572,300	564,374	7,926
1974	580,800	558,680	22,120
1975	588,900	564,501	24,399
1976	597,300	596,876	424
1977	605,900	602,422	3,478
1978	614,500	602,916	11,584
1979	623,000	623,925	-925
1980	631,500	708,465	-76,965

BIRTH AND MORTALITY RATES

Items	Estimated figure		Coefficient of formula			Esti-mated
	1971	1980	K	A	B	2000
	‰	‰	‰	‰		‰
Reproduction Rate 1/	100	82	63	37	0.93	66
Mortality Rate 2/ for Age Group						
1) 0 - 4	20	15	10	10	0.92	11
2) 5 - 14	15	11	6	9	0.93	7
3) 15 - 24	13	10	5	8	0.95	6
4) 25 - 34	14	11	6	8	0.95	7
5) 35 - 44	15	12	7	8	0.94	8
6) 45 - 54	60	43	25	35	0.93	28
7) 55 -	81	57	35	46	0.92	38

Note: 1/ ; Population of 0 year age per 1,000 people of 15-34 year age

2/ ; Number of the death per 1,000 people for age group

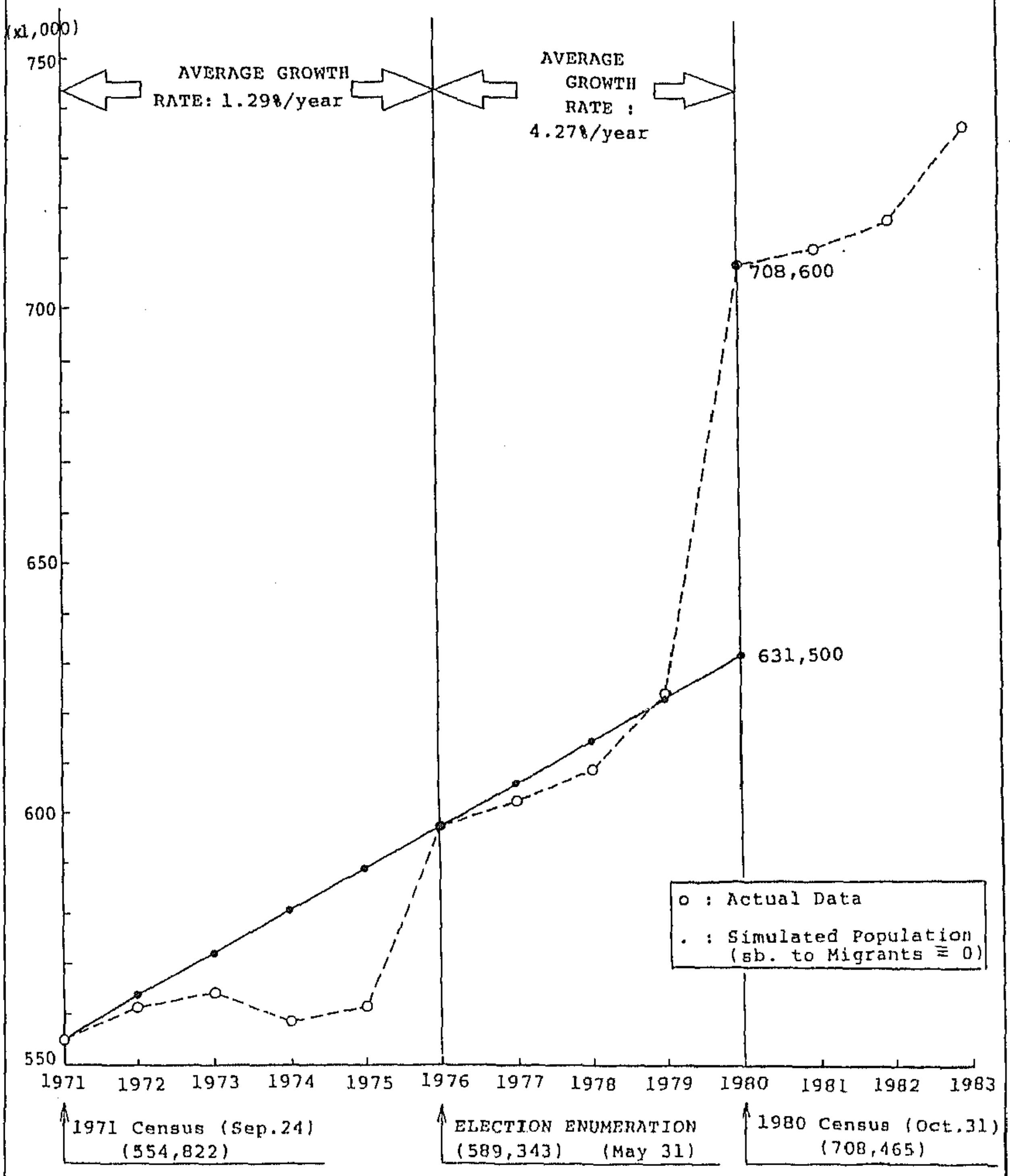


FIGURE	SIMULATION OF PAST POPULATION GROWTH WITHOUT MIGRANTS
2.4	

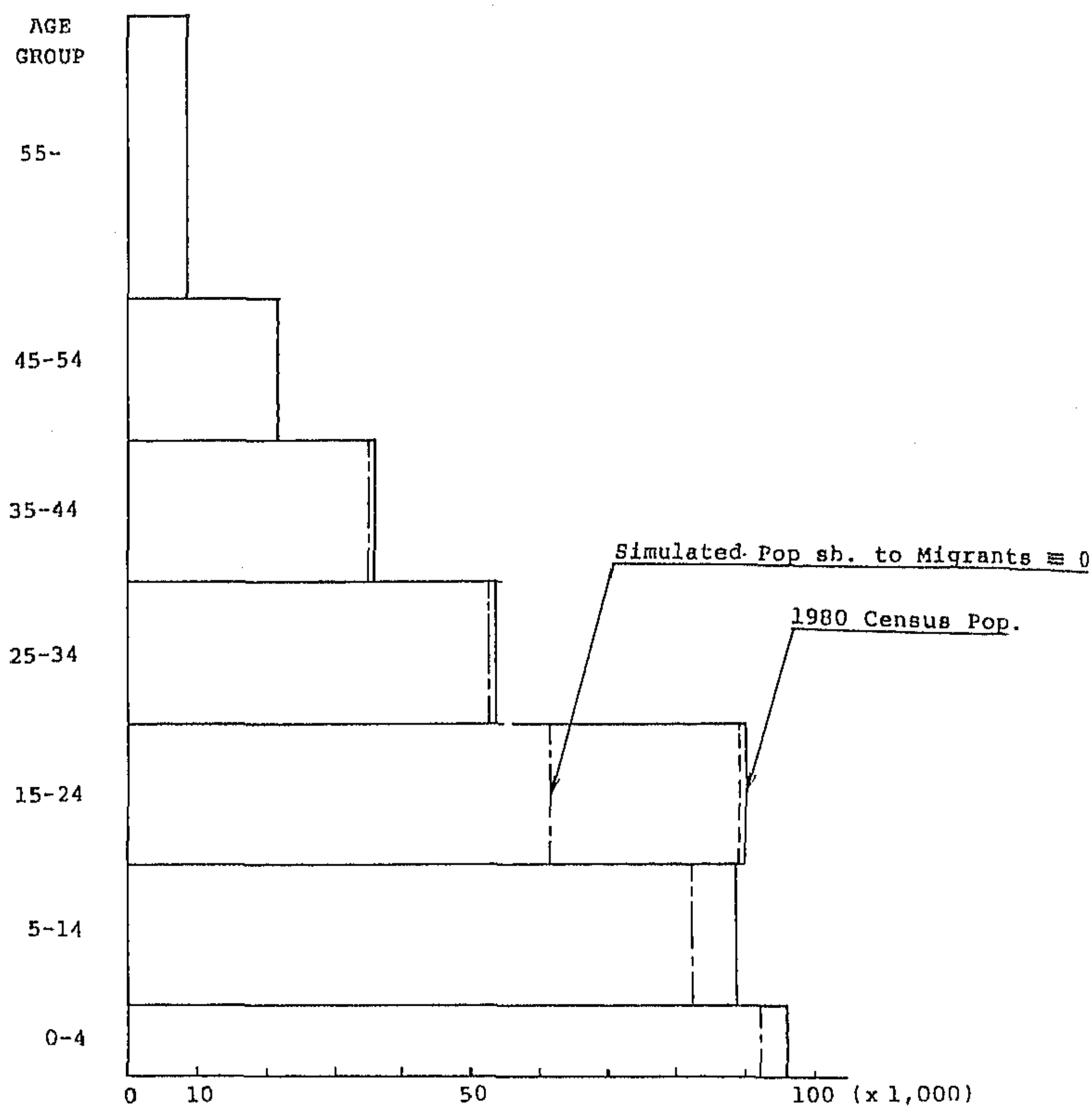


FIGURE	COMPARISON OF POPULATION PYRAMIDS
2.5	

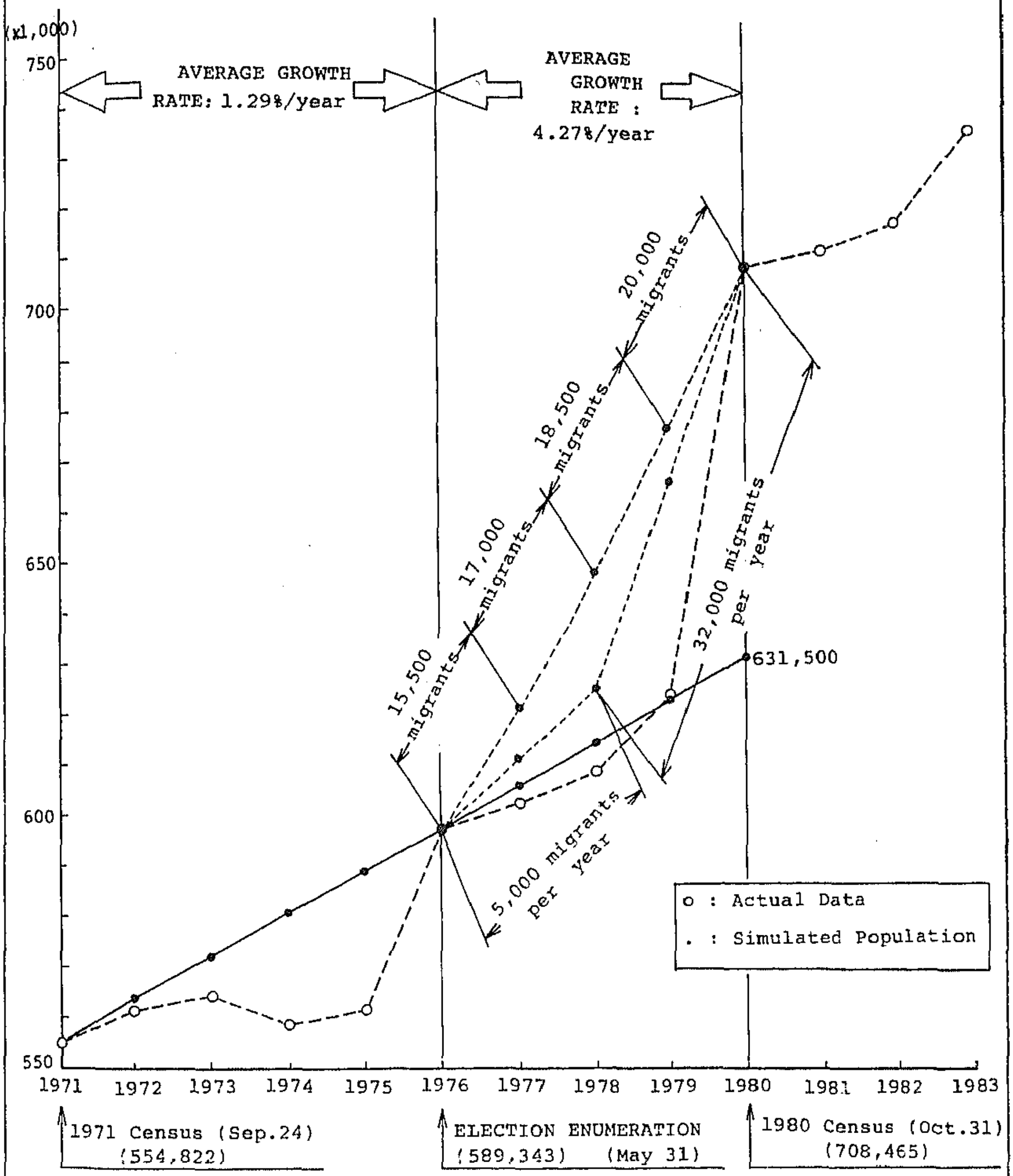


FIGURE	SIMULATION OF PAST POPULATION GROWTH
2.6	

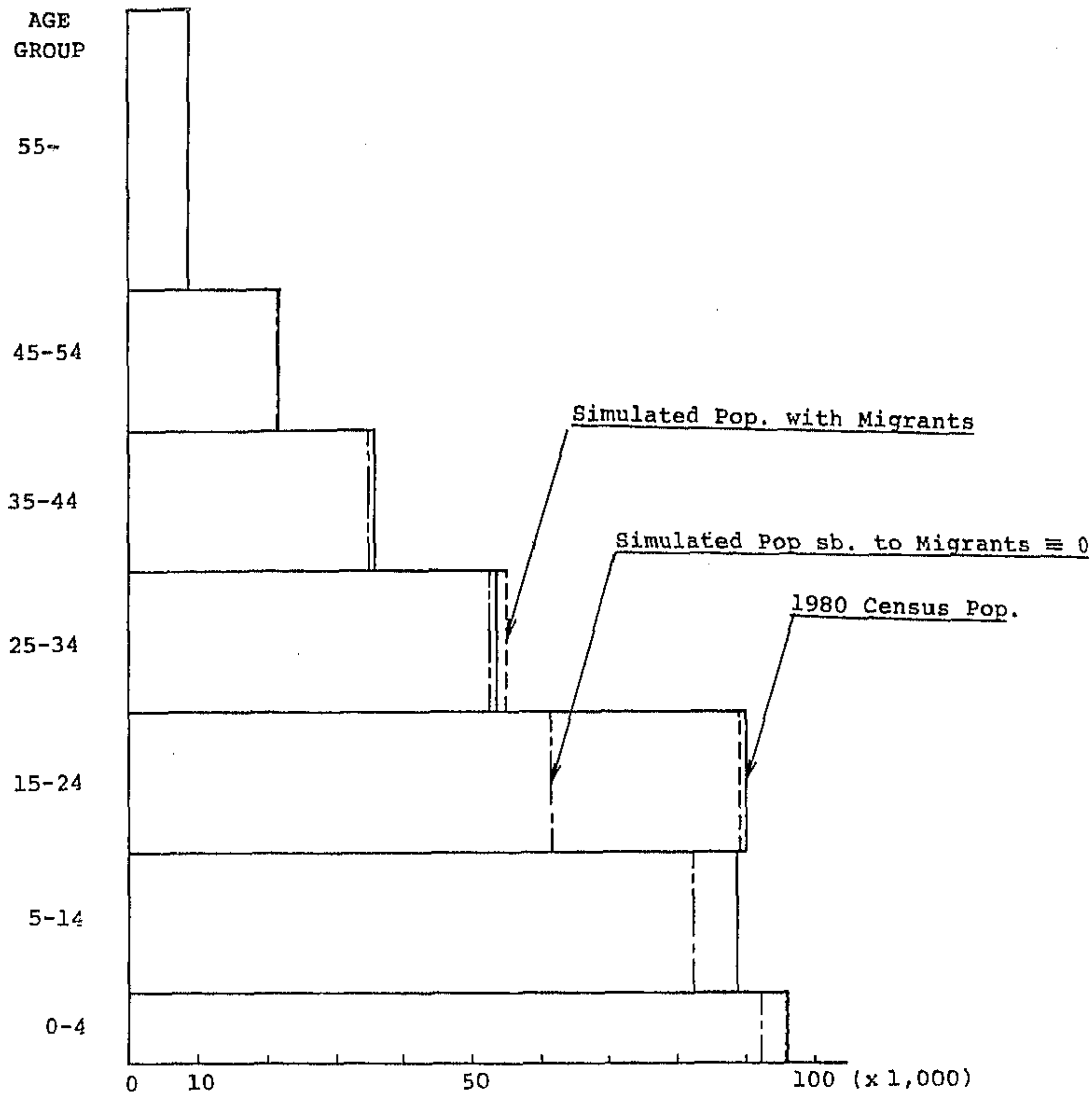


FIGURE 2.7 COMPARISON OF POPULATION PYRAMIDS

TABLE 2.2 SIMULATION OF PAST POPULATION GROWTH

a) Migrants from 1976 to 1980 are:

1976 1977 : 5,000
1977 1978 : 5,000
1978 1979 : 32,000
1979 1980 : 32,000

YEAR	EST.	OBSERVED	ERROR
1971	555,700	555,700	0
1972	564,000	561,697	2,303
1973	572,300	564,374	7,926
1974	580,800	558,680	22,120
1975	588,900	564,501	24,399
1976	597,300	596,876	424
1977	610,900	602,422	8,478
1978	624,800	602,916	21,884
1979	665,700	623,925	41,775
1980	708,600	708,465	135

b) Migrants from 1976 to 1980 are:

1976 1977 : 15,500
1977 1978 : 17,000
1978 1979 : 18,500
1979 1980 : 20,000

YEAR	EST.	OBSERVED	ERROR
1971	555,700	555,700	0
1972	564,000	561,697	2,303
1973	572,300	564,374	7,926
1974	580,800	558,680	22,120
1975	588,900	564,501	24,399
1976	597,300	596,876	424
1977	621,500	602,422	19,078
1978	647,800	602,916	44,884
1979	676,700	623,925	52,775
1980	708,100	708,465	-365

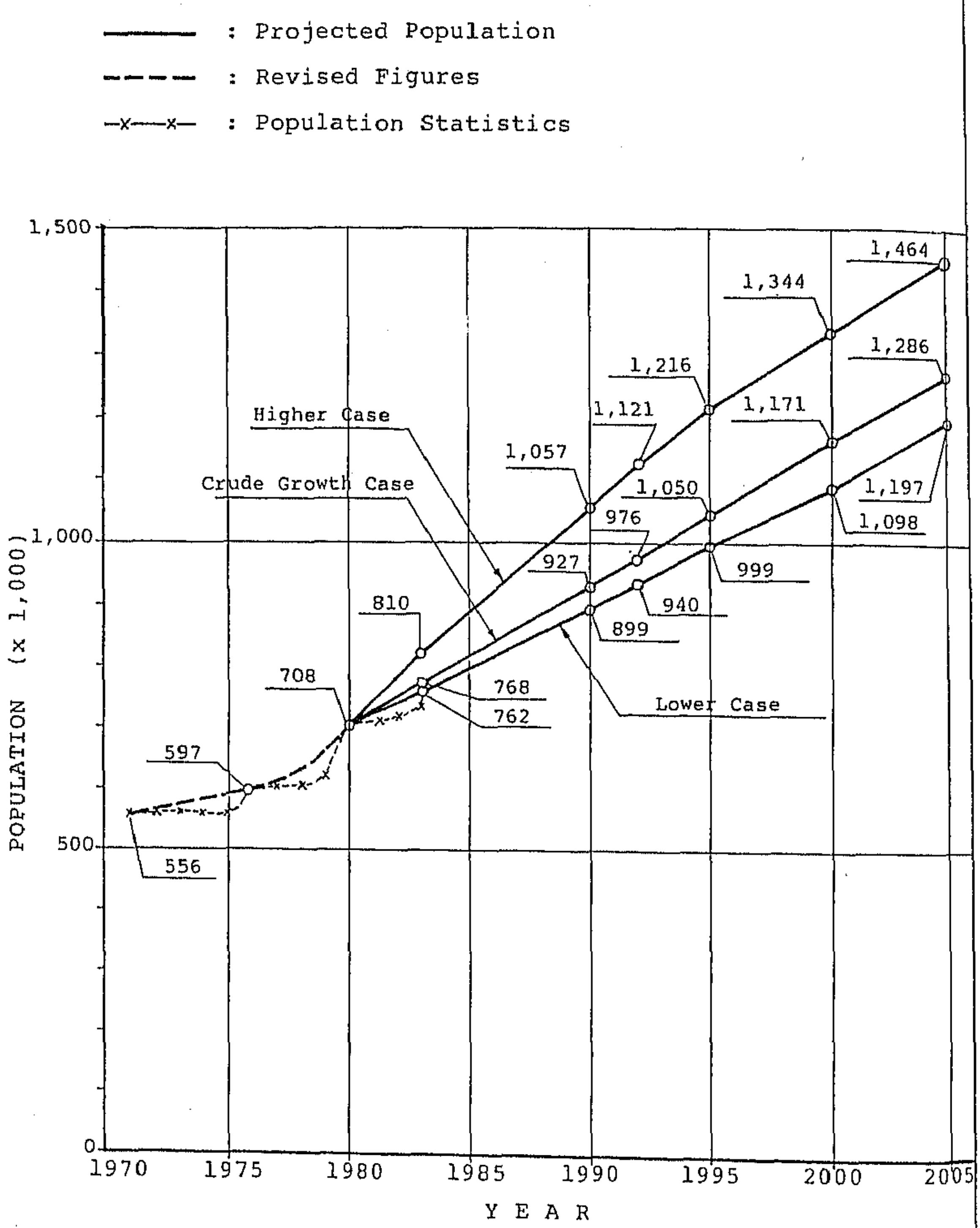


FIGURE	PROJECTED POPULATION
2.8	

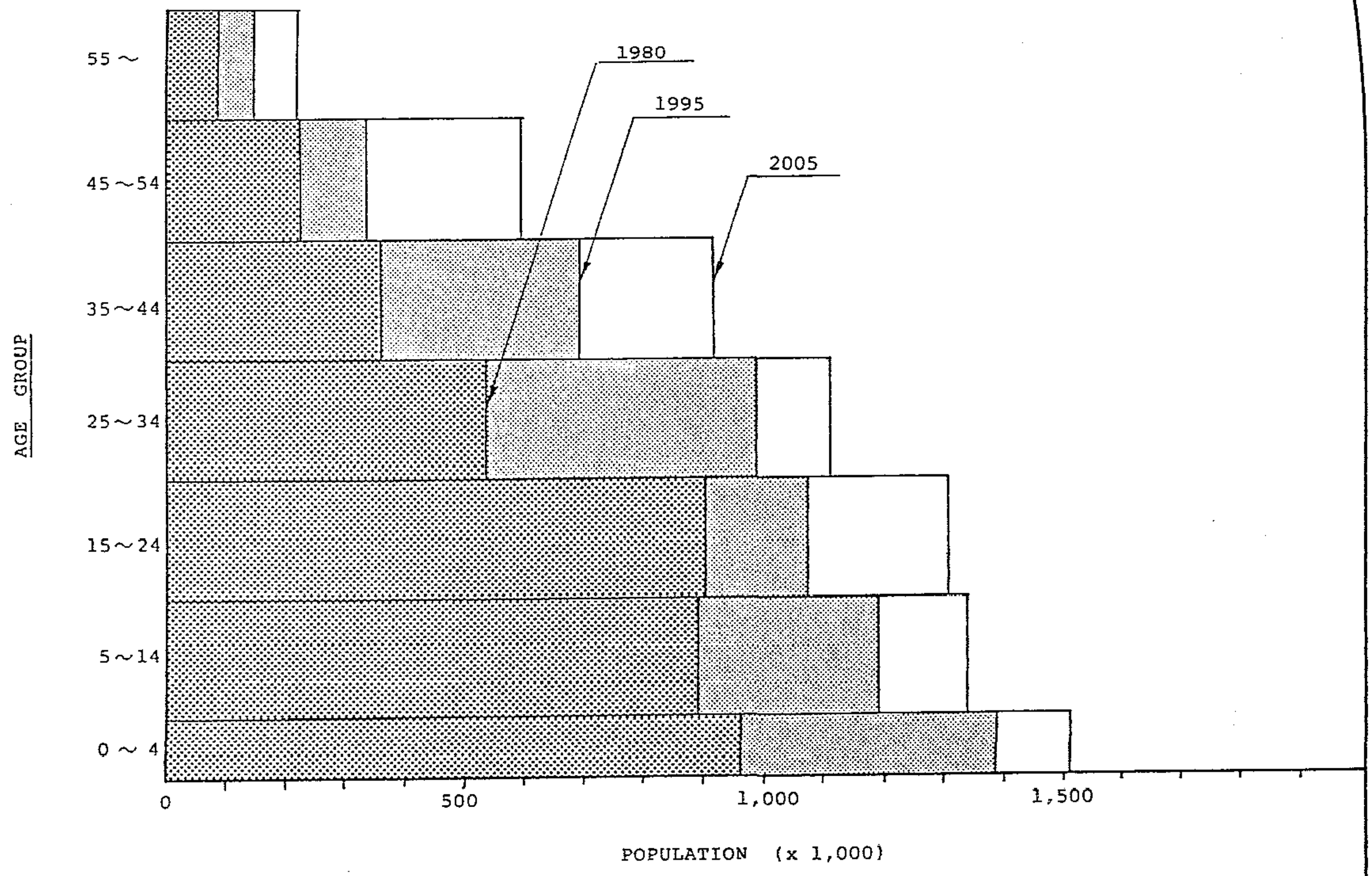


FIGURE	FUTURE POPULATIONS BY AGE GROUP
2.9	

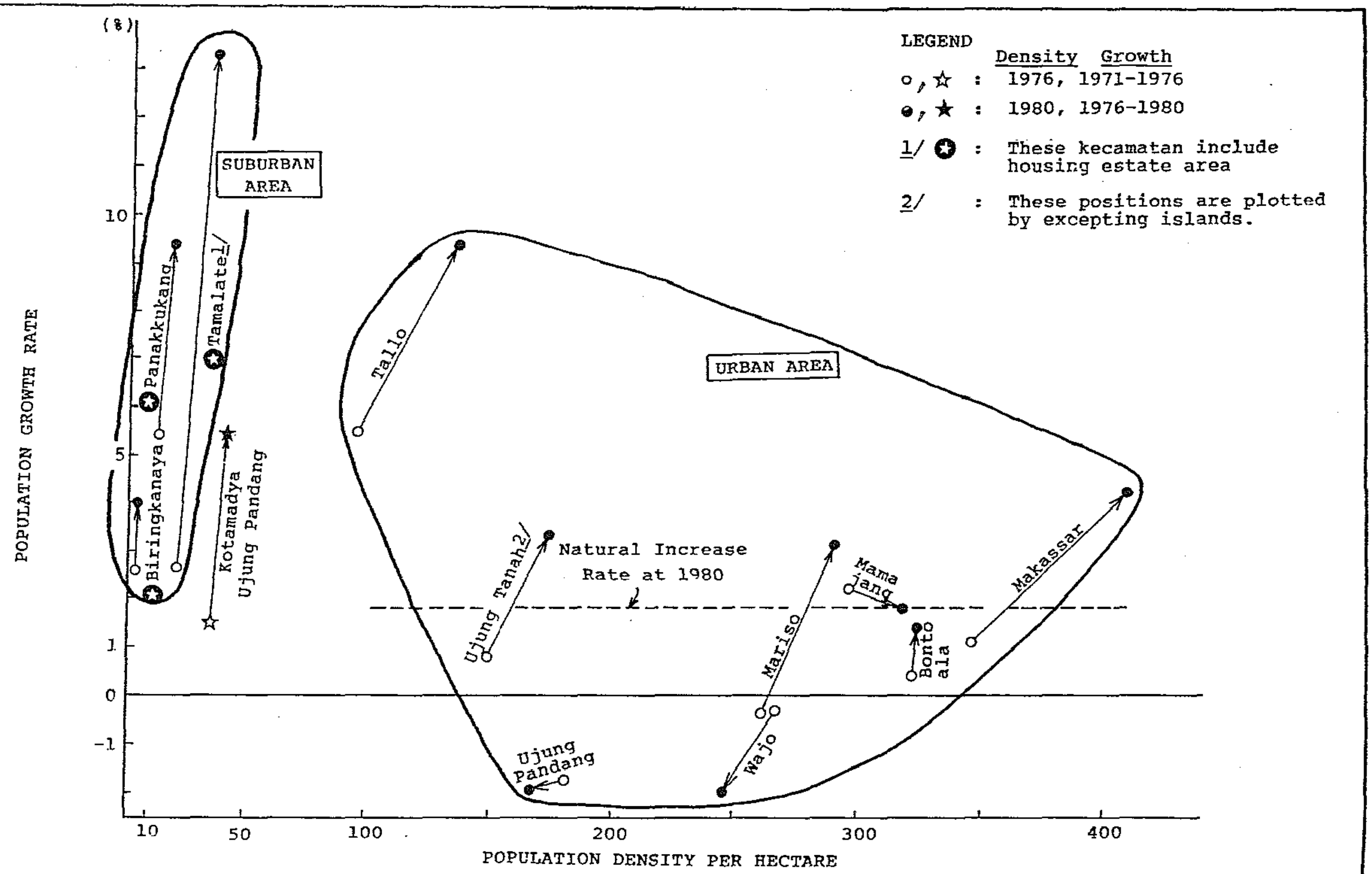


FIGURE	CHARACTERISTICS OF POPULATION
3.1	GROWTHS BY KECAMATAN

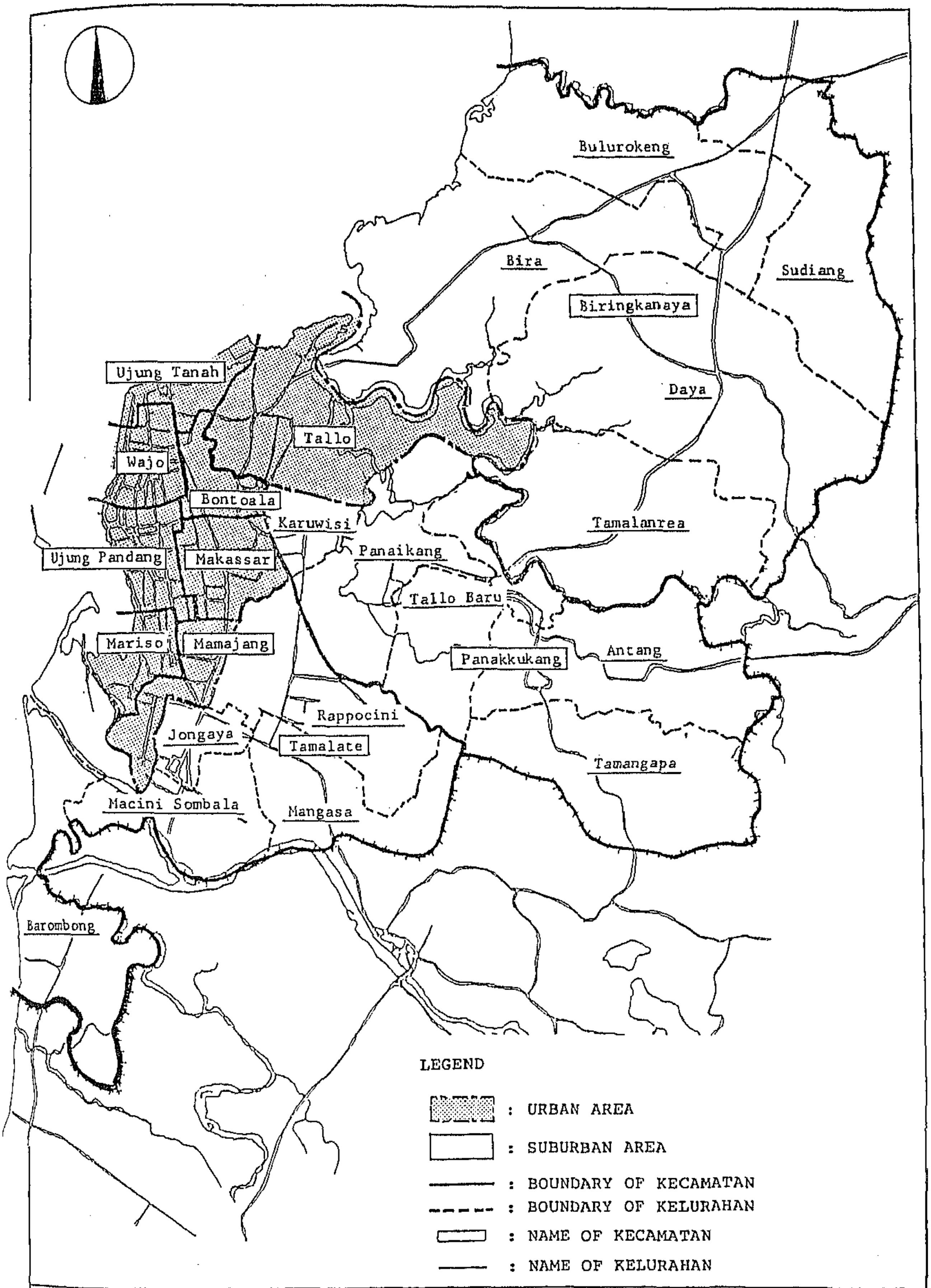


FIGURE	URBAN AND SUBURBAN AREA
3.2	

TABLE 3.1 CHARACTERISTICS OF AREAS AND KECAMATANS

AREA/KECAMATAN	AREA 1983 (ha)	POPULATIN 1980	FAMILLES 1980	POPULATION DENSITY 1980 (per ha)	FAMILY SIZE 1980	POPULATION GROWTH RATIO (%/YEAR) 1971-1976	1976-1980
1. Mariso	182	52,685	8,329	290	6.3	-0.38	3.13
2. Mamajang	225	71,560	11,211	318	6.4	2.19	1.79
3. Ujung Pandang	263	44,102	6,869	168	6.4	-1.73	-1.88
4. Makassar	252	102,973	17,628	409	5.8	1.11	4.26
5. Wajo	199	49,186	7,555	247	6.5	-0.33	-1.93
6. Bontoala	210	68,073	10,518	324	6.5	0.41	1.39
7. Tallo	583	78,193	14,262	134	5.5	5.51	9.38
8. Ujung Tanah	594	42,514	7,513	72	5.7	0.79	3.36
SUB TOTAL (Urban Area)	2,508	509,286	83,885	203	6.1	0.91	2.48
9. Panakkukang	4119	68,022	11,750	17	5.8	5.42	9.33
10. Tamalate	2944	99,502	16,253	34	6.1	2.63	13.27
11. Biringkanaya	8006	31,655	6,396	4	4.9	2.60	4.02
SUB TOTAL (Suburban Area)	15,069	199,179	34,399	13	5.8	3.56	10.19
TOTAL	17,577	708,465	118,284	40	6.0	1,47	4,38

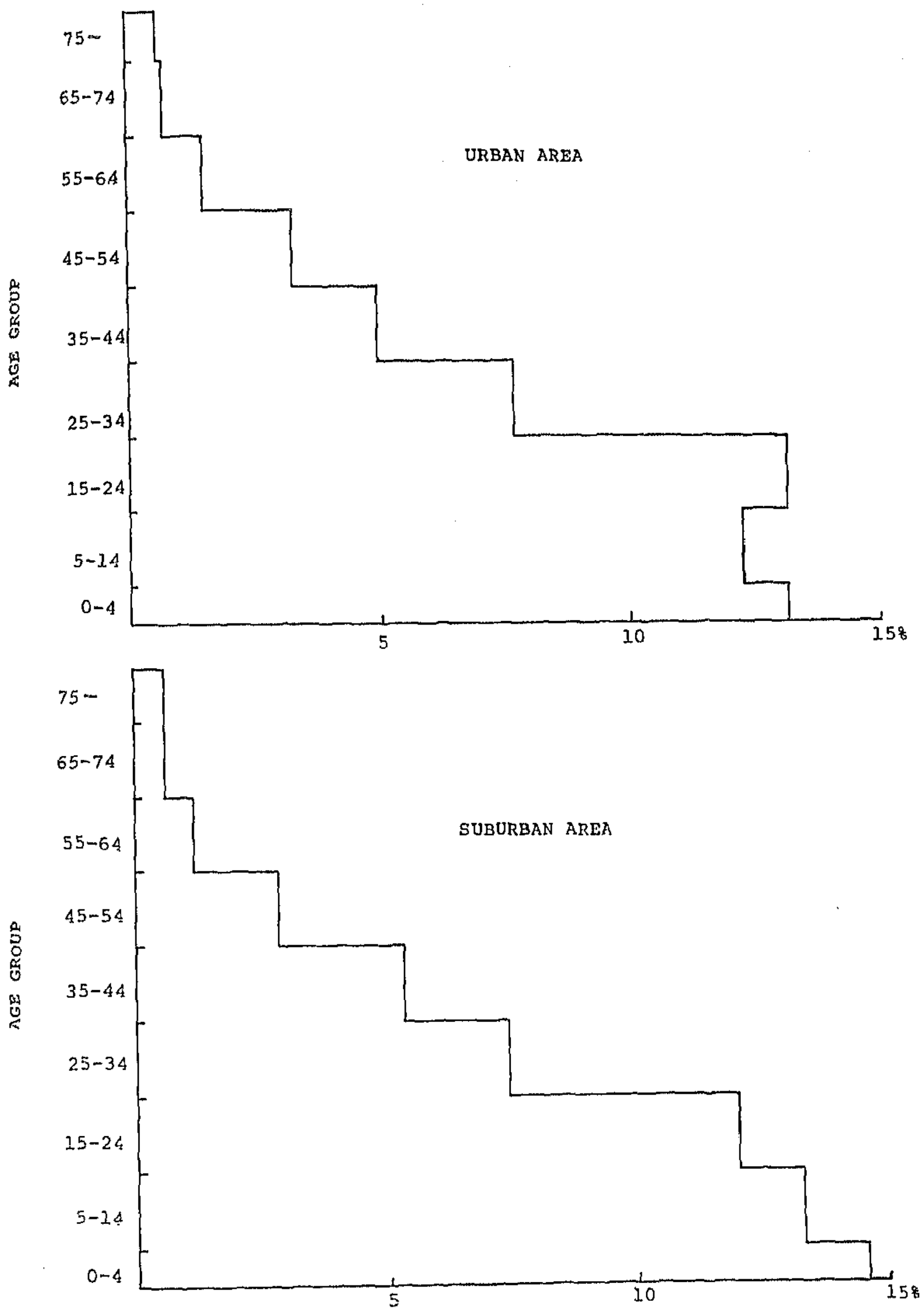


FIGURE	COMPARISON OF TWO POPULATION PYRAMIDS
3.3	

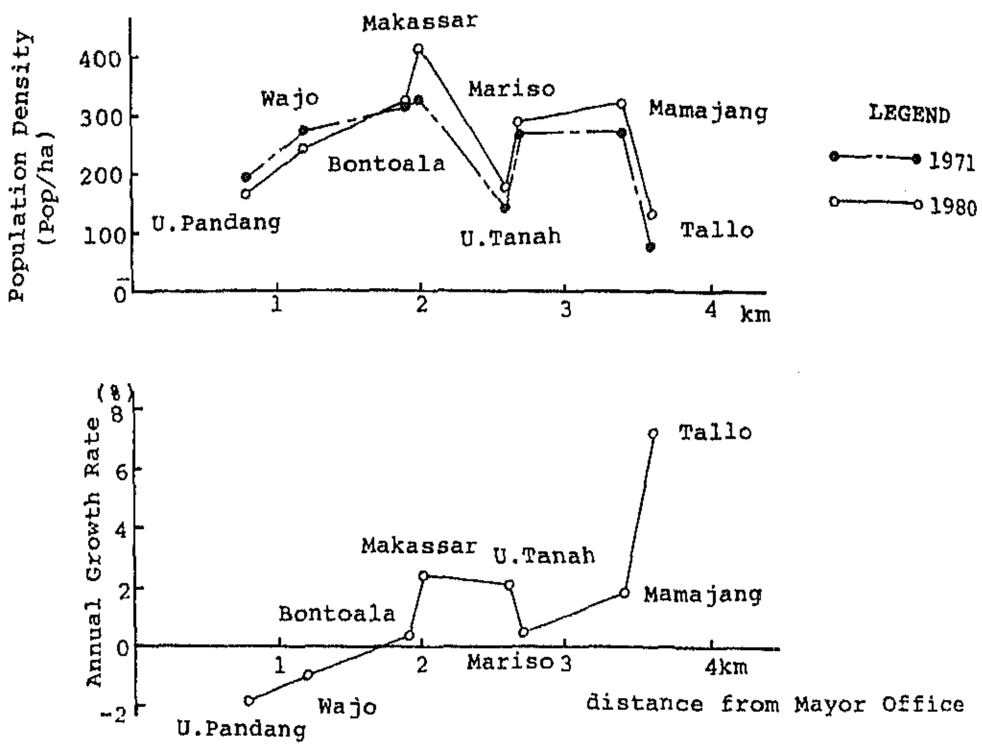


FIGURE	ANALYSIS OF POPULATION GROWTHS
3.4	BY KECAMATAN IN SUBURBAN AREA

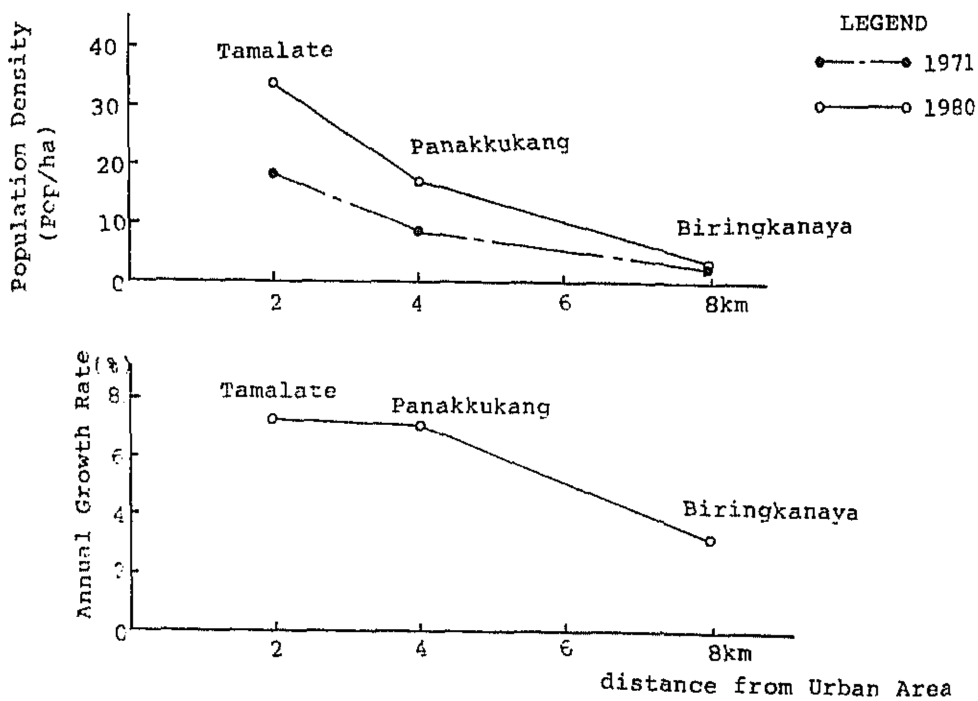


FIGURE	ANALYSIS OF POPULATION GROWTHS
3.5	BY KECAMATAN IN URBAN AREA

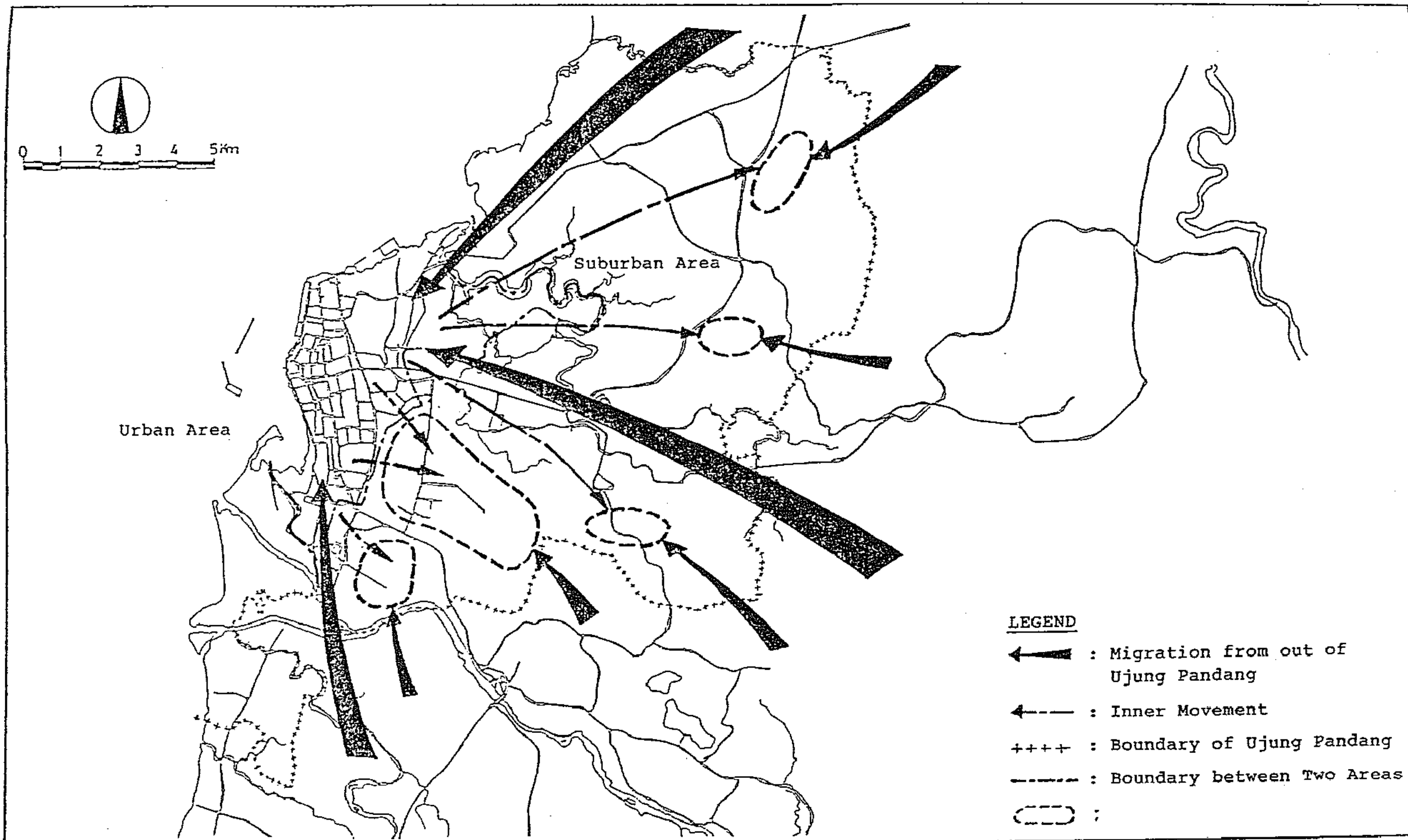


FIGURE	CONCEPTION OF POPULATION ALLOCATION BETWEEN TWO AREAS
3.6	

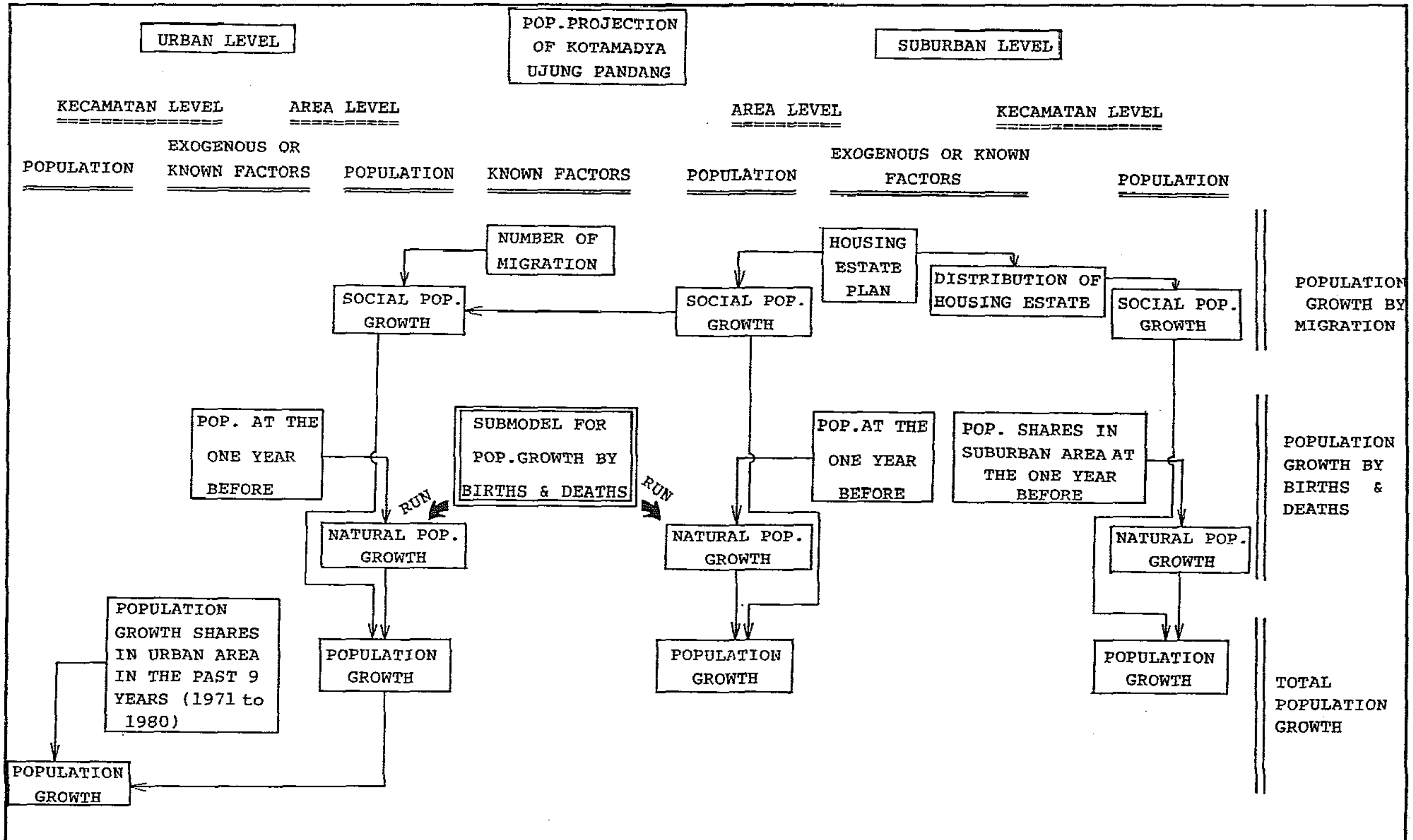


FIGURE 3.7 PROCESS OF POPULATION PROJECTION BY KECAMATAN

TABLE 3.4 PRESUMPTION OF HOUSING ESTATE PLAN

KECAMATAN	KELURAHAN AND	AREA (ha)	Housing Area at 1980 (ha)	Housing Estate During 1981 1984		Housing Estate During 1985 1990		Housing Estate During 1991 1995		Housing Estate During 1996 2000		Housing Estate During 2001 2005		Tot. Housing Area at 2005 (ha)
				House	Area (ha)	House	Area (ha)	House	Area (ha)	House	Area (ha)	House	Area (ha)	
PANAKKUKANG	1. Karuwisi	119	0	0	0.0	800	16.0	0	0.0	0	0.0	0	0.0	16.0
	2. Panaikang	1.338	654	1.120	78.5	1.900	38.0	1,000	20.0	0	0.0	0	0.0	136.5
	3. Tallo Baru	554	0	60	1.2	200	4.0	1,000	20.0	3,000	60.0	1,000	20.0	105.2
	4. Antang	1,053	0	0	0.0	600	12.0	0	0.0	0	0.0	0	0.0	12.0
	5. Tamangapa	1,056	0	1,820	37.0	1,000	20.0	1,750	35.0	750	15.0	2,750	55.0	162.0
	Sub Total	4,119	(650)	3,000	116.7	4,500	90.0	3,750	75.0	3,750	75.0	3,750	75.0	431.7
TAMALATE	1. Mangasa	636	0	0	0.0	3,500	70.0	1,500	30.0	1,750	35.0	2,250	45.0	180.0
	2. Rappocini	722	2,320	4,180	195.6	1,350	27.0	2,250	45.0	2,500	50.0	3,500	70.0	387.6
	3. Jongaya	202	0	0	0.0	750	15.0	1,000	20.0	0	0.0	0	0.0	35.0
	4. Macini Sombala	323	100	870	15.4	1,300	26.0	1,000	20.0	1,500	30.0	0	0.0	91.4
	5. Barombong	1,062	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0.0
	Sub Total	2,944	(2,420)	5,050	211.0	6,700	138.0	5,750	115.0	5,750	115.0	5,750	115.0	694.0
BIRINGKANAYA	1. Daya	2,285	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0.0
	2. Sudiang	1,378	0	0	0.0	170	3.4	1,000	20.0	1,000	20.0	1,000	20.0	63.4
	3. Bira	1,861	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0.0
	4. Tamalanrea	1,216	110	310	5.6	830	16.6	0	0.0	0	0.0	0	0.0	22.2
	5. Bulurokeng	1,266	0	0	0.0	200	4.0	0	0.0	0	0.0	0	0.0	4.0
	Sub Total	8,006	(110)	310	5.6	1,200	24.0	1,000	20.0	1,000	20.0	1,000	20.0	89.6

TABLE 3.5 PROJECTED KECAMATAN POPULATIONS

KECAMATAN	Year 1980	1983	1990	1992	1995	2000	2005
1. Mariso	52,685	53,000	55,000	56,000	56,000	57,000	58,000
2. Mamajang	71,560	74,000	79,000	81,000	84,000	88,000	90,000
3. Ujung Pandang	44,102	43,000	40,000	39,000	37,000	35,000	34,000
4. Makassar	102,973	107,000	116,000	120,000	124,000	131,000	134,000
5. Wajo	49,186	48,000	46,000	45,000	44,000	42,000	41,000
6. Bontoala	68,073	68,000	69,000	69,000	70,000	70,000	71,000
7. Tallo	78,193	86,000	102,000	107,000	116,000	129,000	133,000
8. Ujung Tanah 1)	42,514	44,000	47,000	48,000	50,000	52,000	53,000
SUB TOTAL (Urban Area)	509,286	523,000	554,000	565,000	581,000	602,000	614,000
9. Panakkukang	68,022	80,000	130,000	143,000	164,000	199,000	235,000
10. Tamalate	99,502	130,000	196,000	217,000	248,000	302,000	358,000
11. Biringkanaya	31,655	35,000	47,000	51,000	57,000	68,000	79,000
SUB TOTAL (Suburban Area)	199,179	245,000	373,000	411,000	469,000	569,000	672,000
TOTAL	708,465	768,000	927,000	976,000	1.050,000	1.171.000	1.286.000

1) These figures include populations in islands, projected by assuming no migrant during the period of projection. Present and future populations are as follows :

Population in islands	7,340	8,000	9,000	9,000	9,000	10,000	10,000

TABLE 3.6 PROJECTED KELURAHAN POPULATIONS IN SUB URBAN AREA

KECAMATAN/ KELURAHAN	Year 1980	1983	1990	1992	1995	2000	2005
1. KEC. PANAKKUKANG	68,022	80,000	130,000	143,000	164,000	199,000	235,000
1-1 Karuwisi	21,836	23,000	31,000	32,000	34,000	36,000	39,000
1-2 Panaikang	26,883	35,000	51,000	56,000	62,000	67,000	71,000
1-3 Tallo Baru	10,407	11,000	15,000	17,000	22,000	42,000	51,000
1-4 Antang	4,926	5,000	10,000	10,000	10,000	11,000	12,000
1-5 Tamangapa	3,970	6,000	23,000	28,000	36,000	43,000	62,000
2. KEC. TAMALATE	99,502	130,000	196,000	217,000	248,000	302,000	358,000
2-1 Mangasa	14,076	15,000	39,000	44,000	51,000	66,000	84,000
2-2 Rappocini	34,341	57,000	77,000	86,000	99,000	121,000	150,000
2-3 Jongaya	30,878	33,000	41,000	45,000	51,000	55,000	59,000
2-4 Macini Sombala	12,187	17,000	29,000	32,000	37,000	49,000	53,000
2-5 Barombong	8,020	8,000	10,000	10,000	10,000	11,000	12,000
3. KEC. BIRINGKANAYA	31,655	35,000	47,000	51,000	57,000	68,000	79,000
3-1 Daya	9,936	11,000	12,000	12,000	13,000	14,000	15,000
3-2 Sudiang	6,074	6,000	8,000	11,000	15.000	22,000	30,000
3-3 Bira	5,017	5,000	6,000	6,000	6,000	7,000	7,000
3-4 Tamalanrea	5,138	7,000	13,000	14,000	15,000	16,000	17,000
3-5 Bulurokeng	5,490	6,000	8,000	8,000	8,000	9,000	10,000
TOTAL (Suburban Area)	199,179	245,000	373,000	411,000	469,000	569,000	672,000

II. WATER REQUIREMENTS

TABLE OF CONTENTS

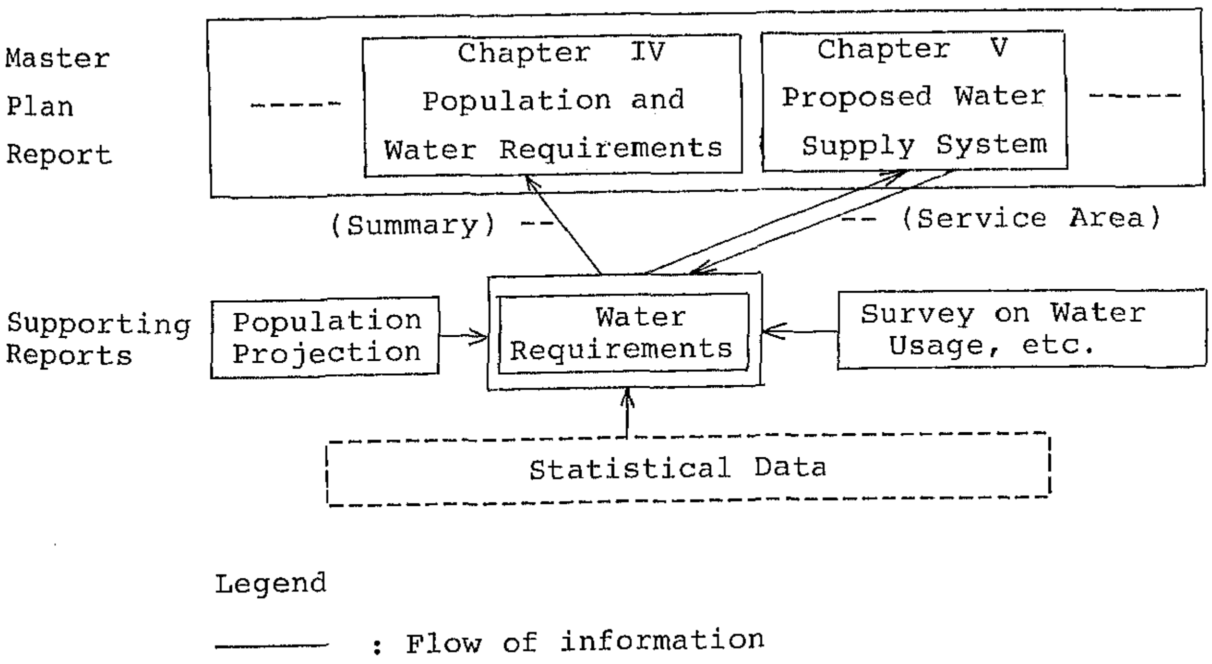
WATER REQUIREMENTS

1. GENERAL

This study provides a future water requirement, one of basic information for planning water supply system. Projection is made in two classifications: One is a requirement for the whole city; the other, distribution of the requirement. The information provided from the former result is mainly utilized for designing sizes of facilities for water sources, intake, transmission and treatment. The latter provides a piece of information for drafting future distribution network.

The contents of this study are orderly described below. First, in Section 2, recent situation of water consumption and actual states of residents' water usage are explained. Next, in Section 3, water requirement for domestic usage is forecasted, followed by projection of non-domestic water requirement in Section 4. Finally, the above future requirements are distributed in Section 5.

This report is related to other reports as shown on the figure below:



Regarding information derived from other reports, the details should be referred to those reports, if necessary.

2. PAST AND PRESENT WATER CONSUMPTION

Data available on water consumption are not necessarily sufficient. Using those data, trend of water consumption over the past years has been analyzed, and all the results are described hereinafter.

2.1 Analysis of Yearly Trend by Monthly Records

Monthly records of consumption are presented on Figure 2.1. From this figure, the following will be pointed out:

1) Water consumption in the past four years is roughly on the rising trend.
2) Monthly consumptions are nearly constant in each year, indicating no cyclic or seasonal fluctuations.
3) In 1982, a dry year, occuring once in a decade, the consumption during the period from July to December was unusually smaller. It may have been due to the drought. If water had been available, the consumption during that period might have been 8.8 to 9.1 million m^3/month, or 24 to 25 thousand m^3/day.
4) Table 2.1 shows that the increase of domestic use connections is very rapid (19% per annum in average). Normally, increase in water consumption would be in parallel, but actually, the estimated consumption in 1982 is almost same as that in 1983 and 1984 (both are not droughty). When the existing water facilities (the system capacity 56,000 m^3/day; accounted-for water, 50%) are considered, the capacity of the facilities is insufficient to meet the demand of the consumers. In other words, the water supply is in chronic shortage, in terms of accounted-for water. This is also verified by the questionnaire survey.

2.2 Water Consumption by Usage

From Table 2.1, characteristics of water consumption by usage are as follows:

1) Percentages of domestic use in connection and consumption are very high as shown on Figure 2.2, especially that of house connections. In non-domestic use, ABRI has a high share, about 60% of the total non-domestic use.

2) Domestic use accounts for large portion of the increase in water consumption, as seen on Figure 2.3. From the trend of rapid increase of house connection, and also from the fact that the supply to the housing projects will depend on house connection, domestic use has a vital importance in planning.

3) Results of analysis of per capita consumption of house connections are shown in Table 2.3, which has been clarified to play an important role in planning of the water supply system. As seen on the table, the consumption increased normally from 1980 through 1982, but then the increasing trend has been stopped due to restraints in water sources and facilities. This tallies with what has been described in 2.1 4). Without such restraints, the present per capita consumption might be 130 l/c/d.

4) Results of survey of public standpipes are as follows, which will be used for planning.

Consumption per standpipe	:	1.81 m^3 (average in January to September 1984)
Number of users per hydrant	:	60 persons (10 households x 6 persons)
Per capita consumption	:	30 l/c/d

2.3 Population Served

As there are no records of population served, estimation thereof is made based on the results of household survey, and public standpipe survey. Population served by category of usage, thus estimated, is shown in Table 2.3.

As shown thereon, house connections account for about 60% of the total connections, and the share of public standpipes is gradually increasing.

Further, served population by kecamatan is estimated as shown in Table 2.4. This table indicates the coverage in kecamatan Wajo and Ujung Pandang is more than half.

2.4 Present Water Usage of Inhabitants

In this sub-section, the present water usage including the use of groundwater will be estimated, as there are no reliable data concerning such usage, and clarifying present states of major part of total consumption is the first step to demand projection.

The objects of clarifying the present usage are 1) per capita consumption in directly-connected household, 2) that in indirectly- connected household as public standpipe, and 3) that in household supplied by neighbors. The first and the third are analyzed in first step on the basis of household survey and statistical data. The second is done based on the results of public standpipe survey and first step analysis.

(A) 1st Step: Analysis of Water Usage Supplied by House Connection

The processes for analysis are as follows:

1) To classify present domestic water use into 6 categories purposes: drinking, cooking, washing hands, etc., bathing, laundering and cleaning, etc.; furthermore assume average composition of these catagory uses including groundwater on house-connected user as the table below.

	Drinking	Cooking	Washing hands, etc.	Bathing	Laun- dering	Cleaning etc.
Average Compo- sition on House- Connected User	2.5%	15.0%	12.5%	40.0%	27.5%	2.5%

2) To assume ratios of neighbors-supplied user's demand to house-connected user's demand as follows:

	Drinking	Cooking	Washing hands, etc.	Bathing	Laun-dering	Cleaning etc.
% of neighbors supplied user's composition	100%	40%	40%	40%	40%	40%

3) To estimate the average portion to depend on piped-water out of whole demand on each purpose as follows based on the result of household survey and at the request of the water quality for its purpose:

Average % of Piped Water out of Whole Demand

User Category	Drinking	Cooking	Washing hands, etc.	Bathing	Laun-dering	Cleaning etc.
House Connection	100%	90%	80%	60%	40%	20%
Neighbors Supply	100%	90%	10%	10%	5%	3%

4) To calculate present per capita demands for each purpose utilizing the information:

i) The results of the household survey shows that the ratio of house connection to neighbors supply is 2:1.

ii) Accounted-for water per house connection is 600 l/day, and the average family size is 6 persons according to the 1980 census.

Conclusively from all the above discussions, Table 2.5 is obtained, which shows composition of per capita consumption. This table indicates that the household with house connection takes 63 liters, 60% of its whole water requirement from the piped water system, while household of neighbors supply relies on the water supply system by 16 liter for $^{1}/4$ of its water needs.

(B) 2nd Step: Estimation of Water Usage Supplied by Public Standpipe

As mentioned at 2.2 4), per capita consumption at public standpipe is considered to be 30 liter, which is about two times larger than that of neighbors supply case. This difference is assumed to come from the difference of dependent ratios on piped water out of whole demand. Taking into consideration the water quality required for each water use, these dependent ratios are fixed so as to meet the total at 30 l/c/d, which results in as shown in Table 2.6. This kind of households, on average, rely on the water supply system for 1/2 of total water demands.

3. PROJECTION OF REQUIREMENTS FOR DOMESTIC USE

In this section, requirements for domestic use will be given through financial evaluation. Prior to explanation of this result, matters considered and procedures employed are described below. That is:

1) Regarding the target of water supply, there exists the National Guideline, which is to be attained within REPELITA IV (1990). For this reason, the target figures will be observed in planning the system in 1990.

2) Beyond REPELITA IV, the target figures are not available. So, two sets of the figures up to 2005, are presumed and used for planning alternatives of water supply system (refer to 3.1).

3) Meanwhile, a projection by another approach which is considered applicable to Ujung Pandang is made so as to know the appropriateness of application of the Guideline (refer to 3.2). Because, the Guideline specifies factors basicaly unrelated to the characteristics and present situation of a city.

4) The appropriateness of the three plans were roughly evaluated and compared through economical and financial study. Conclusively, a more suitable plan for the master planning is adopted (refer to 3.3).

3.1 Projection based on National Guideline

In the Republic of Indonesia, 'The Directorate For Composition Of Clean Water Supply And Sanitary Environment Program For The Regional Level', published in 1983, provides national targets for water supply and sanitation in REPELITA IV (1990). The guideline sets forth such factors as population coverage,per capita demand, etc. as summarized in Table 3.1. Regarding future plan in 1990, this guideline is adopted as mentioned above. Meanwhile, future plans beyond REPELITA IV were proposed under two different presumptions: One is a case where the quantity of water supply trends upward rapidly (hereinafter called Case A), the other a case where it trends toward a little lower (Case B).

The procedures to calculate production volume are as follows:

$$\text{Production} = \text{Population Served} \times \text{Average Per Capita Demand} \qquad (3.1)$$

$$\text{Population Served} = \text{Population} \times \text{Population Coverage} \qquad (3.2)$$

$$\begin{aligned}\text{Average Per Capita Demand} = {} & \text{Demand Per Capita Served by a House Connection} \times \text{\% of Population Served by House Connection} \\ & + \text{Demand Per Capita Served by a Public Standpipe} \times \text{\% of Population Served by Public Standpipe}\end{aligned} \qquad (3.3)$$

A time series of population is given from Supporting Reports "Population Projection". So, the next three factors are defined for computing future production.

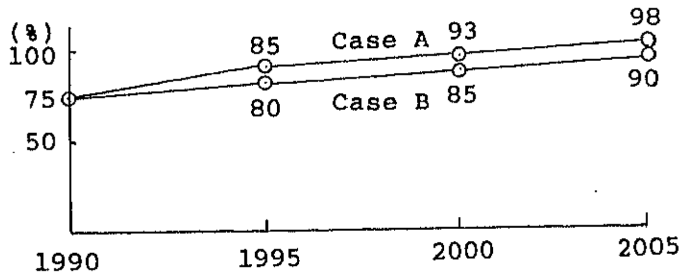
1) Population Coverage (refer Eq.(3.2))

2) Per Capita Demand by Service Type (refer Eq.(3.3))
   [House Connection and Public Standpipe]

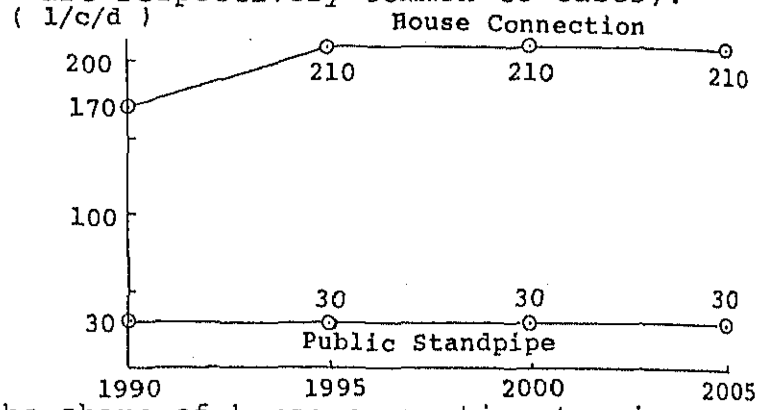
3) Composition of Service Types (refer Eq.(3.3))
   [House Connection and Public Standpipe]

Two cases of parameter set up to 2005 were assumed as follows respectively:

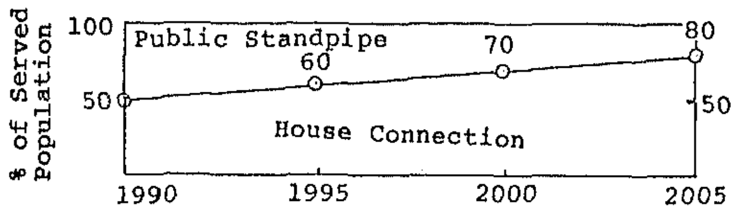
1) Population Coverage; to increase gradually in future



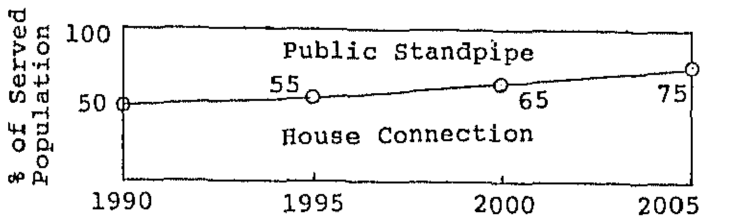
2) Per Capita Demand; to be applied the figures by town cate-
by Service Type gory in the Guideline. (These figures are respectively common to Cases).



3) Composition of; the share of house connection to rise gradual-
Service Type ly: that of public standpipe to fall gradually



Case A



Case B

Future requirements in these Cases are calculated in Table 3.2, indicating the requirements in Case A is larger than that of Case B by about 15%.

3.2 Projection Based on Present Situation

As previously mentioned, demand projection by a different approach from the Guideline is carried out in this study. This approach can be divided into two major processes: one is the process where per capita demand including well water, etc. if forecasted, and the other is one where fundamentals of water supply plan is designed based on the present system.

These processes are explained as follows respectively:

A) Projection of per capita demand

1) To presume maximum demand*) per capita for each purpose such as drinking, cooking, bathing, etc. [MD(j), j: purpose], based on the records of unit consumption in the city of high standards of living.

   *) This value is assumed to be constant up to the design year.

2) To calculate demand*) for each purpose in the future [TD(j, t,l); t:year, l: demand level] by multiplying maximum demand by realization ratio**) [RR(j,t,l)] which is valued based on present situation.

   *) There exist two kind of this demand: one is higher demand level, the other is lower demand level.

   **) In other words, definition of realization ratio of demand j at year = T is as follows:

$$RR(j,t,l) = TD(j,t,l)/MD(j)$$

3) To divide unit demand into two categories: one is demand satisfied by piped water*), [PC(j,t,s); s: service type] the other is demand done by other sources.

   *) PC is computed by multiplying TD by dependency ratio [RD(j,t,s)], to piped water. And there are four service types:house connection, public standpipe, water wagon, and neighbors supply.

4) To total all PCs, which account for per capita requirement of piped water PR(t,s).

   This process is expressed by following formulas:

$$PR(t,s) = \sum_j PC(j,t,s) \qquad (3.4)$$

$$PC(j,t,s) = TD(j,t,l) \times RD(j,t,s)^{*)} \qquad (3.5)$$

$$TD(j,t,l) = MD(j) \times RR(j,t,l)^{*)} \qquad (3.6)$$

*) These values are assumed to rise along with the progress of standards of living.

B) Fundamentals of water supply plan

In forming future water supply, the followings are taken into consideration:

(a) Situation of present system
- Service area/population coverage
- Composition of service type
- Transmission and distribution losses

(b) Future situation
- Population distribution
- Distribution of house type
- Construction schedule
- Ability of raising investment
- Availability of water sources
- Standards of living and income level.

Concrete items of water supply information, i.e.,(1) Population coverage, (2) Composition of service types, were projected in consideration of the above factors.

The result of projection of per capita demand and water requirements (hereinafter called Case C) are shown in Tables 3.3 and 3.4, and Figures 3.1 and 3.2. Figure 3.2 illustrates comparison of this projection with ones described at 3.1, indicating this case is the lowest.

3.3 Evaluation of Projection

In this sub-section, water supply plans made in 3.1 and 3.2 are compared with each other, through financial evaluation.

In evaluating water requirements, the following consideration was taken:
Water supply eneterprise employs the independent profit system. Major revenue of this system is water sales for domestic and non-domestic use. Regarding non-domestic use, user can cope with water tariff by some means, for example, price rise. But as regards domestic use, households pay water charge out of their income. If they can not afford the money, they do not connect with house

connection. This means PDAM would consequently suffer from shortage of revenue to repay the loan. From this, evaluation is focused on whether water charge for average use is permissible or not.

Further, another evaluation viewpoint of annual investment is supplemented. This viewpoint is to examine whether the construction cost is too enormous to be financed or not.

Prior to evaluation as described above, the following processes of preparation is needed:

i) To calculate total water requirements by summing up domestic and non-domestic requirements (Projection of non-domestic requirements will be described in Section 4).

ii) To assume ratio of unaccounted-for water to be constant after the target of 20% being attained.

iii) To compute the capacity of water supply system.

iv) To estimate construction cost as well as operation and maintenance costs.

v) To calculate depreciation for construction cost by assuming expected depreciable life of 40 years.

vi) To set up three cases of composition of the capital as follows:

Capital	Case (1)	Case (2)	Case (3)
Loan *)	100 %	80	70
Equity	0 %	20	30
Ave. Interest Rate	11.0%	8.8	7.7

*) Interest rate is assumed to be 11%

vii) To calculate ineterset payment by multiplying the construction cost by average interest rates in each case.

viii) To compute annual operation expenses by totaling operation and maintenance cost, depreciation, and interest payment.

ix) To divide annual expense by annual accounted-for water, which makes total average water tariff.

x) To calculate average tariff for house connection using the following equation.

$$\text{Total Ave. Tariff} = \frac{\text{Requirements by House Connection} \times T^{h} + \text{Requirements by Public Standpipe} \times T^{p} + \text{Non-Domestic Requirements} \times T^{n}}{\text{Daily Ave. Requirements}}$$

where;

T^{h} : Tariff for house connection

T^{p} : Tariff for public standpipe (assumed: $T^{p} = 0.5 \times T^{h}$)

T^{n} : Tariff for non-domestic requirements (assumed: $T^{n} = 4.0 \times T^{h}$)

xi) To estimate residents' permissible expenditure for water by utilizing the data of household survey and by assuming income increase ratio and maximal share of water charge.

After the preparation above, evaluation and examination are carried out in viewpoints as previously mentioned.

The results of preparation processes are shown in Tables 3.5 and 3.6, and Figure 3.3. Table 3.5 drew the conclusion that average water tariff and tariff for house connection (T^{h}) of Case A are the highest, and those of Case C are the cheapest respectively for all the three interest case. Table 3.6 shows permissible water rate of house connection for each case, which was calculated based on the result of household survey and some assumption (refer to Figure 3.3).

Based on the results above, the three water supply plan were evaluated as shown on Figure 3.4. What is evident from this figure is that all T^{h}s excluding interest Case 3 in 1995 of Case A (higher case of the Guideline) exceed permissible rates. Regarding Case B (lower case of the Guideline), most of T^{h}s do not exceed the rates, which suggests the existence of financial feasibility.

Regarding investment for construction of water supply system, annual average amounts are calculated assuming construction periods of six years for Stage I and eight years for Stage II as follows:

	Stage I			Stage II		
	Total Cost (million per year)	Annual Average (million per year)	Cost per Capita*) (thousand per year)	Total Cost (million per year)	Annual Average (million per year)	Cost per Capita*) (thousand per year)
Case A	64,620	10,770	10,3	92,300	11,538	9,0
Case B	52,095	8,683	8,3	87,355	10,919	8,5
Case C	24,540	4,090	3,9	92,450	11,556	9,0

*) For calculation, the population in the target year of each Stage, namely 1995 for Stage I and 2005 for Stage II is employed.

This table indicates the construction costs for Stage I range widely from 4 billion Rp. to 11 billion Rp. while those for Stage II are much the same at 11 billion Rp. The amounts of investment of Case B are smaller than that of Case A in both stages and are proportional to the population. These feature suggest Case B is more favorable than Case A in viewpoints of finance and public economy.

Conclusively, Case B is adopted as the water requirements for water supply planning taking into consideration the national target. Requirements of this case is recapitulated as shown in Table 3.7 and Figure 3.5.

4. PROJECTION OF REQUIREMENTS FOR NON-DOMESTIC USE

In this section, non-domestic water requirements are projected in two components: One is the requirement in the newly planned industrial estate at keluarahan Daya, and the other is that in other places.

4.1 Requirement in Industrial Estate

In estimating future water requirement in industrial estate located at kelurahan Daya, the program shown in Table 4.1, is taken into planning with a slight modification in timing of the requirement. This is because there are no factories in operation although they were expected to be so by 1985. Regarding the period beyond the program, a similar estate with similar requirement is assumed to be constructed near the present.

The results of projection of requirement which is planned to be supplied by piped water system is shown in Table 4.2.

4.2 Requirement in Other Area

In projecting requirement except industrial estate, the following considerations and procedures were employed, which was made taking account of limited availability of data:

1) Water quality for non-domestic use ranges from very clean water such as distilled water to not so clean water such as cooling water.

2) The latter kind of water tends to be taken in not from piped water but from, for example, well, river and the sea, if available.

3) From the above, piped water requirements can be calculated by multiplying total water demands including well water, etc., by dependency ratio ti piped water (hereinafter called demand coverage ratio).

4) Total demand can be computed by multiplying employee in secondary and tertiary industry by demand per employee.

5) Demand coverage ratio can be divided into two factors: one is regional coverage ratio which can be expressed by percentage of served employees to total employees, and the other is qualitative ratio which means percentage of piped water consumption to the total in directly connected building.

The procedures above can be summarized and expressed as the formulas below:

$$\text{(Piped) Water Requirement} = \text{Total Demand} \times \text{Demand Coverage Ratio of Piped Water} \quad (4.1)$$

$$\text{Total Demand} = \text{Employee in secondary and tertiary industry} \times \text{Demand per Employee} \quad (4.2)$$

$$\text{Demand Coverage Ratio} = \text{Regional Coverage Ratio} \times \text{Qualitative Coverage Ratio} \quad (4.3)$$

$$[\text{\% of employee served}] \quad [\text{\% of piped water requirement to total unit}]$$

The results of projection are shown in Table 4.3 including present situation and other factors concerned. Further, future water requirements of domestic and non-domestic are summarized in Table 4.4 and Figure 4.1.

5. DISTRIBUTION OF WATER REQUIREMENTS

In this section,requirements projected in Sections 3 (domestic use) and 4 (non-domestic use) in the whole city is distributed to zones (kecamatan/keluarahan) in respective ways.

5.1 Method of Distribution for Domestic Use

In distributing domestic requirements, main considerations to be taken are summarized as follows:

1) Requirements by zone in service area are roughly proportional to populations.

2) As per capita requirement differs from type to type of service, distribution of the types influences that of requirement greatly.

The result of areawise population projection provides an effective information on considering the matter of 1). Regarding 2), after examining all available data synthetically, distribution is conducted utilizing the relationship between structure type of house and service type.

The relation is that people supplied by house connection live mainly in houses of permanent structure. On the other hand, that people in wooden houses depend on standpipes or their neighbors for treated water. Further, the following facts give reasons for selecting a method.

- The data of house types by kecamatan/kelurahan are available.
- Houses planned at housing estate is of permanent structure and also designed to be served by direct connection.

The procedures of the method are:

1) To divide population of zone into house types taking account of the information mentioned above.

2) To project served populations by zone in service area (refer to Section 2 in Chapter 5 of Master Plan Report) taking into consideration present population coverage, conditions of groundwater, standards of living, etc.

3) To classify the served populations into two service types taking advantage of the results of 1) and 2) and the following relationship among the types:

House Type		Service Type
Permanent	100% →	House Connection
Semi-permanent	gradually increase → (to House Connection) / gradually decrease → (to Public Hydrant)	
Temporary	100% →	Public Hydrant

4) To total the values obtained by multiplying population as calculated in 3), by per capita demand of each type.

5.2 Population Projection by House Type

First, the present distribution of population by house structure type was estimated by utilizing the data in 1979. The result of estimation (refer to Table 5.1) indicates that more than half of the inhabitants in kecamatan Ujung Pandang live in permanent structured house, on the other hand, three fourth of those in Biringkanaya live in wooden house.

Population projection by house type was carried out taking account of housing development, natural population growth, etc. The result as shown in Table 5.1 indicates that the percentage increase of permanent structure is remarkable in kecamatan Panakkukang and Tamalate.

5.3 Distribution of Domestic Requirements

Future population served by zone is counted based on population in service area and a presumption of willingness to connect. The willingness in the future was assumed on the basis of present coverage, qualitative and quantitative condition of well water, and standards of living. Then, population served was divided into two service types in consideration of population by house type. The result of this process is shown in Table 5.2 with percentage of house connection. After the procedures of preparation conducted above, domestic water requirements were distributed among kecamatans/kelurahans. Table 5.3 , the result of distribution, indicates the distinct increase of requirements in kecamatan Tamalate and Panakkukang, i.e. the rising share of the two areas by 20%.

5.4 Distribution of Non-domestic Requirements

As mentioned previously, non-domestic requirements are divided into two components: one is the requirement in the industrial estate, and the other is that of other places.

As the estate is located at kelurahan Daya, the former requirement needs no distribution. The problem is to distribute the latter demand among kecamatan/kelurahan.

For the purpose of that, following consideration and assumption is made:

Consideration: non-domestic water requirements except industrial requirement can be classified into the following two categories, namely:

1) Requirements which are in proportion to the growth of population, such as, of shops, supermarkets, mosques, etc.

2) Requirements which are inversely proportionate to, or unrelated with the population growth, such as, of industries, universities, etc.

Assumption : there will arise a great increase of requirements of the above two categories in kecamatans of Tamalate, Panaikang and Biringkanaya, because of expected rapid population growth and socio-economical development.

Distribution of non-domestic water requirements is made by the following processes, based on the above consideration and assumption.

1) To allocate total requirements between categories, i.e.
   a) demands to be divided among all kecamatans and
   b) those divided among those three kecamatans in consideration of future population share of each area.

2) To distribute two kinds of requirements among kecamatans/kelurahans, namely:
   - Requirement (a): To divide in proportion to present consumption.
   - Requirement (b): To divide in proportion to future population.

Along with the processes above, calculation was conducted as desribed below. The result of process 1) is shown in following table.

	1983	1990	1995	2000	2005
1) Total Population (x 1,000)	768	927	1,050	1,171	1,286
Population Increase (x 1,000)					
2) Urban Area	0	31	58	79	91
3) Suburban Area	0	128	224	324	427
4) 3) - 2)	0	97	166	245	336
5) 1)/4) (%)	0	10.5	15.8	20.9	26.1
		= 10	= 15	= 20	= 25
6) Non-domestic Requirements (m^3/day)	9,900	16,100	23,000	33,300	45,400
7) Requirement to be Distributed Among All Kecamatans	9,900	14,500	19,500	26,600	34,000
8) Requirement to be Distributed Among The Three Kecamatans	0	1,600	3,500	6,700	11,400

Process 2) was conducted using the Total consumption of the following table and other information.

KECAMATAN	Armed Force	Large Enterprise	Others	Total
1. Mariso	10,885	1,296	8,362	20,543
2. Mamajang	19,770	-	8,432	28,202
3. Ujung Pandang	5,926	1,788	9,953	17,667
4. Makassar	4,592	2,474	13,664	20,730
5. Wajo	-	15,216	16,806	32,022
6. Bontoala	-	-	11,791	11,791
7. Tallo	-	-	5,072	5,072
8. Ujung Tanah	-	-	6,464	6,464
9. Panakkukang	17,326	-	7,545	24,871
10. Tamalate	39,600	-	14,600	54,200
11. Biringkanaya	-	-	39,600	39,600
T O T A L	98,099	20,774	142,290	221,563

(M^3/month)

The result of distribution including requirement in industrial estate is shown in Table 5.3, indicating remarkable increase in kecamatan Biringkanaya, i.e., the rising share by 30%.

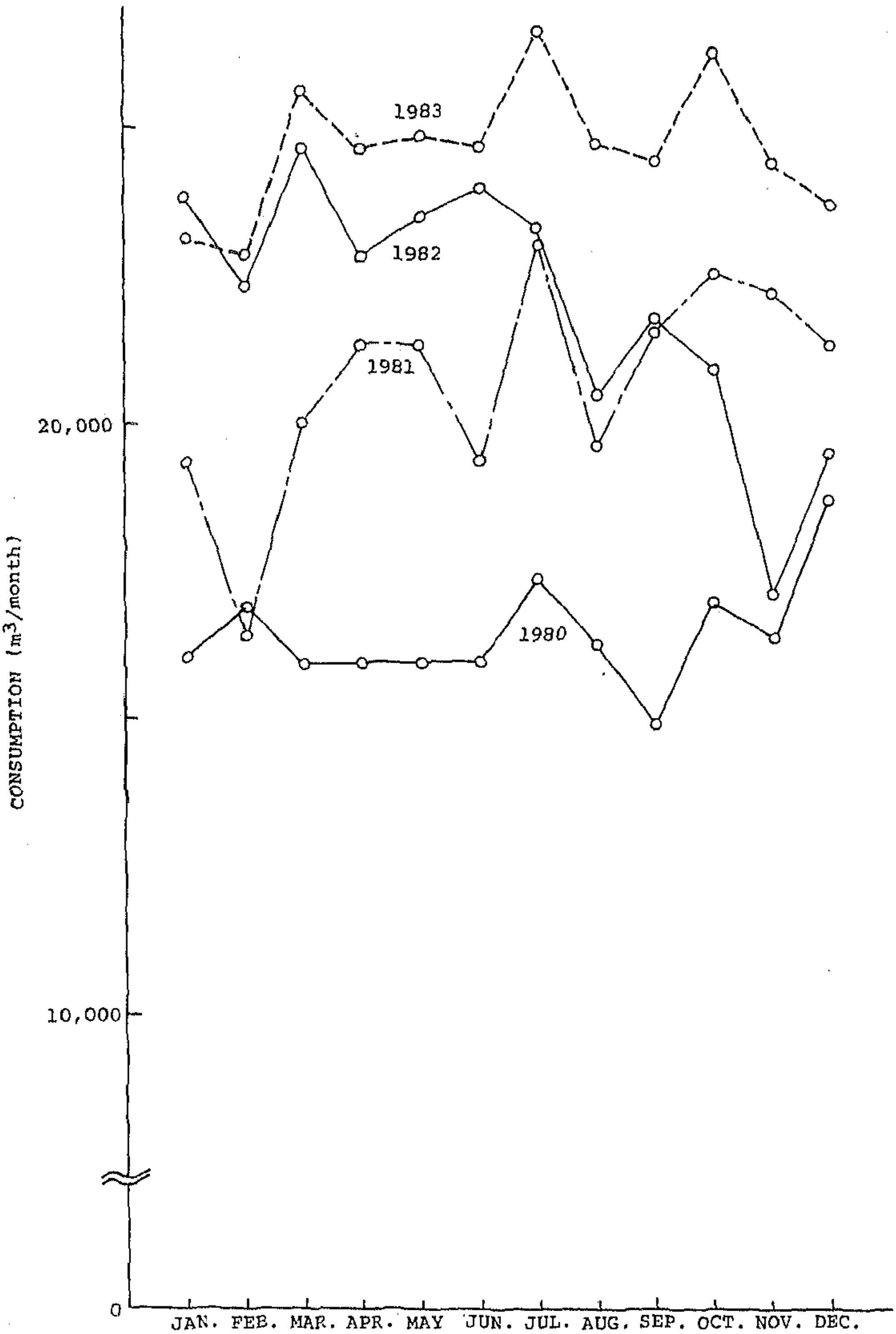


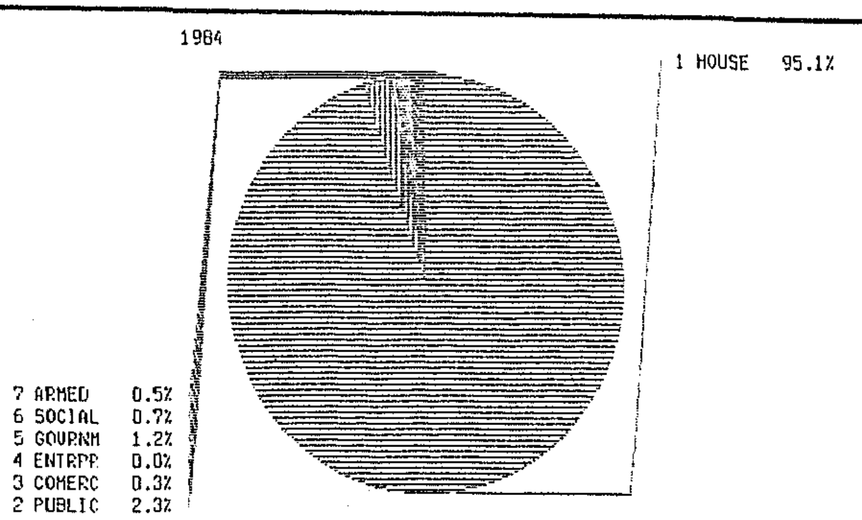
FIGURE 2.1	MONTHLY WATER CONSUMPTION

TABLE 2.1.

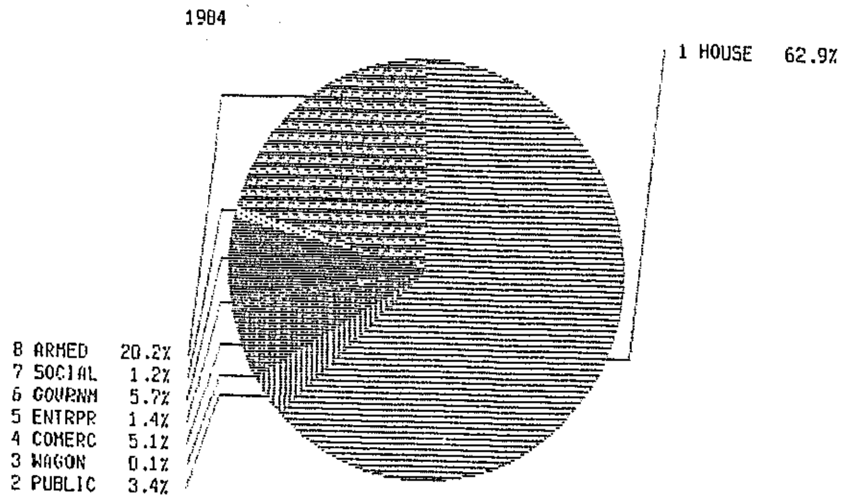
NUMBER OF CONNECTIONS AND WATER CONSUMPTION

Item	Usage	Category Of Custmers	YEAR 1980 DEC.	1981 DEC.	1982 DEC.	1983 DEC.	1984 JUN.
Connec-tions (units)	Domestic	**HOUSE CONNECTION**	14910	18600	21715	25013	25356
		PUBLIC STANDPIPE	134	259	358	555	605
		WATER WAGON	0	0	0	0	0
	Non-domestic	Comerce & Industry	67	67	72	76	78
		Large Enterprise	0	2	2	2	2
		Goverment	240	274	300	323	323
		Social Institution	73	141	154	170	175
		Armed Force	118	120	123	136	137
	Total		15542	19463	22724	26275	26676
	Ratio of Domestic (%)		96.8	96.9	97.1	97.3	97.3
Consump-tion (CMD)	Domestic	**HOUSE CONNECTION**	9400	12403	13770	*) 15554	15779
		PUBLIC STANDPIPE	147	301	395	601	865
		WATER WAGON	3	5	5	5	6
	Non-domestic	Comerce & Industry	1180	1249	1276	1321	1281
		Large Enterprise	0	310	295	290	345
		Goverment	1136	1372	1429	1508	1426
		Social Institution	112	229	238	258	310
		Armed Force	4434	4769	4649	5040	5077
		Water Wagon	7	9	9	10	11
	Total		16420	20647	22065	24586	25101
	Ratio of Domestic (%)		58.2	61.6	64.2	65.7	65.3

*) **These figures are estimated based on 1983 data.**



CONNECTION

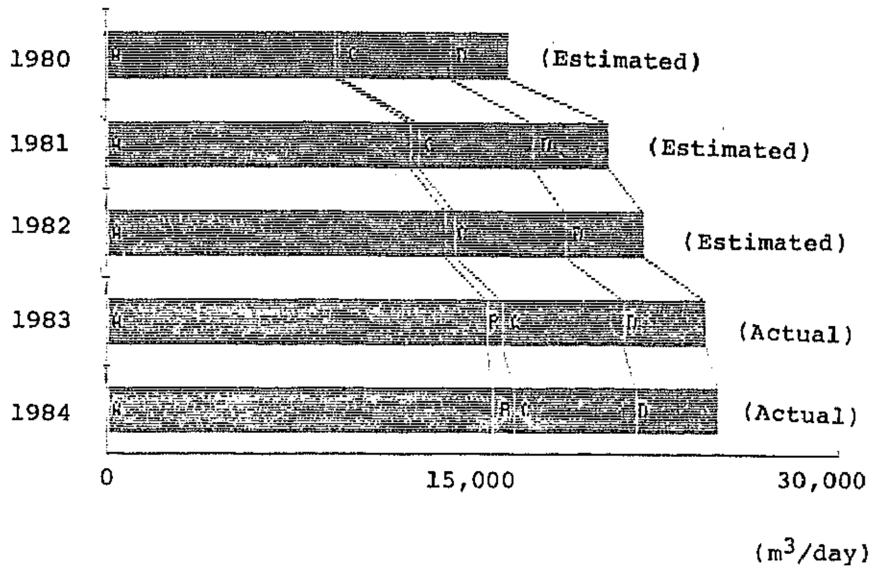


CONSUMPTION

DEFINITION OF CATEGORY

CATEGORY	CONSUMPTION DATA (Year:1983)	CATEGORY	DEFINITION
RUMAH TANGGA / USAHA KECIL	63.3%	House Connection	DOMESTIC (65.7%)
BAK UMUM	2.4%	Public Standpipe	DOMESTIC (65.7%)
OTO TANGKI (0.1%)	0.0%	Water Wagon	DOMESTIC (65.7%)
OTO TANGKI (0.1%)	0.1%	Water Wagon	NON-DOMESTIC (34.3%)
USAHA BESAR	1.2%	Large Enterprise	NON-DOMESTIC (34.3%)
USAHA SEDANG	5.4%	Commerce & Industry	NON-DOMESTIC (34.3%)
INSTANSI	6.1%	Government	NON-DOMESTIC (34.3%)
LEMSOS	1.0%	Social Institution	NON-DOMESTIC (34.3%)
A.B.R.I	20.5%	Armed Force	NON-DOMESTIC (34.3%)

FIGURE	
2.2	CONNECTION AND CONSUMPTION SHARE



A : House Connection

B : Public Standpipe and Water Wagon

C : Armed Force

D : Other Non-domestic

FIGURE	CONSUMPTION TRENDS BY USE
2.3	

TABLE 2.2

Per Capita Consumption (House Connection)

Year	Period	Average Daily Consump. (CMD)		Connec-tions		Family Size			Per Capita Consump. (LCD)
1980	JAN.~DEC.	9400	/ (	14910	*	5.99	) =		105.3
1981	JAN.~DEC.	12403	/ (	18600	*	6.03	) =		110.6
1982	JAN.~DEC.	13770	/ (	21715	*	6.06	) =		104.6
	JAN.~JUN.	14848	/ (	20158	*	6.05	) =		121.7
	JUL.~DEC.	12710	/ (	21715	*	6.06	) =		96.6
1983	JAN.~DEC	15554	/ (	25013	*	6.10	) =		101.9
1984	JAN.~JUL.	15779	/ (	25356	*	6.12	) =		101.7

TABLE 2.3

POPULATION SERVED

Category		YEAR 1980 DEC.	1981 DEC.	1982 DEC.	1983 DEC.	1984 JUN.
Population		708465	727735	747530	767862	788748
Population Served		142213	184071	219163	262481	269424
Served Ratio (%)		20.1	25.3	29.3	34.2	34.2
House Connection *1	(person)	89311	112158	131593	152579	155179
	(%)	62.8	60.9	60.0	58.1	57.6
Public Hydrant *2	(person)	8040	15540	21480	33300	36300
	(%)	5.7	8.4	9.8	12.7	13.5
Water Wagon *3	(person)	206	294	294	313	356
	(%)	0.1	0.2	0.1	0.1	0.1
Neighbors Supply *4	(person)	44655	56079	65796	76290	77589
	(%)	31.4	30.5	30.0	29.1	28.8
Population Not-Served		566252	543664	528367	505381	519324

*1~*4:These figures are estimated employing followig formula :

*1 : NC x F
*2 : NC x PT
*3 : Q / UT
*4 : NP x F

Whereas. NC : Number of Connections
F : Family Size
PT : Average Number of Served People per Public Tap
= 60 person (<== 10 Families x 6 Person) 1/
Q : Quantity of Water Sold by Wagon (M3)
UT : Percapita Consumption of Wagon Water = 16 liter
(= That of Household provided by Neighbors)
NP : Number of Households provided by Neighbors
= Number of House-Connected People x 0.5

1/ These figures are fixed based on population statistics and field survey. (refer to Supporting Reports "SURVEYS ON WATER USAGE,ETC.")

TABLE 2.4 POPULATIONS SERVED BY KECAMATAN

KECAMATAN	Pop. in 1983 *)	No. of House Connections	No. of Public Hydrants	Population Coverage (%)				Population Served
				House Connect.	Public Hydrant	Neighbors Supply	Total	
1. Mariso	53,000	1,970	18	22.3	2.0	11.2	35.5	19,000
2. Mamajang	74,000	1,145	1	9.3	0.1	4.7	14.1	10,000
3. Ujung Pandang	43,000	2,284	2	37.2	0.3	18.6	56.1	24,000
4. Makassar	107,000	2,676	196	15.0	11.0	7.5	33.5	36,000
5. Wajo	48,000	3,027	2	37.8	0.3	18.9	57.0	27,000
6. Botoala	68,000	2,769	142	24.4	12.5	12.2	49.1	33,000
7. Tallo	86,000	1,891	41	13.2	2.9	6.6	22.7	20,000
8. Ujung Tanah	44,000	1,092	141	14.9	19.2	7.5	41.6	18,000
9. Panakkukang	80,000	2,472	8	18.5	0.6	9.3	28.4	23,000
10. Tamalate	130,000	5,077	0	23.4	0.0	11.7	35.1	46,000
11. Biringkanaya	35,000	610	4	10.5	0.7	5.3	16.5	6,000
TOTAL	768,000	25,013	555	19.4	4.3	9.7	34.1	262,000

*) : These figures in 1983, taken from statistics, are revised by the Team.

TABLE 2.5 PRESENT WATER USAGE (No.1)

User Category	Item	Total	Drinking	Cooking	Washing hand etc.	Bathing	Laundering	Cleaning etc.
	Present (l/c/d)	157	4	23	20	63	43	4
House	Demand (%)	100	2.5	14.6	12.7	40.0	27.4	2.5
Connection	PDAM (l/c/d)	97	4	21	16	38	17	1
	Consump. (%)	100	4.1	21.6	16.5	39.2	17.5	1.0
	Present (l/c/d)	65	4	9	8	25	17	2
Neighbors	Demand (%)	100	6.2	13.8	12.3	38.5	26.2	3.1
Supply	PDAM (l/c/d)	17	4	8	1	3	1	0
	Consump. (%)	100	23.5	47.1	5.9	17.6	5.9	0.0

TABLE 2.6 PRESENT WATER USAGE (No.2)

User Category	Item	Total	Drinking	Cooking	Washing hand etc.	Bathing	Laundering	Cleaning etc.
	Present (l/c/d)	65	4	9	8	25	17	2
Public	Demand (%)	100	6.2	13.8	12.3	38.5	26.2	3.1
Standpipe	PDAM (l/c/d)	30	4	8	6	8	4	0
	Consump. (%)	100	13.3	26.7	20.0	26.7	13.3	0.0

TABLE 3.1 SUMMARY OF NATIONAL GUIDELINE

GOI PELITA IV POLICY - WATER SUPPLY LEVELS OF SERVICE

Town Category	1 Metro	2 Large City	3 Medium Town	4 Small Town	5 IKK
Population (1,000's)	over 1,000	500 to 1,000	100 to 500	20 to 100	3 to 20
Percent of 1990 population to be served (1)	75	75	75	75	75
	B.N.A Program				IKK Program
DOMESTIC DEMAND (Liters/cap/day)					
Direct House or Yard Connections (2)	210	170	150	90	60 (3)
Public Standpipe (2)	30	30	30	30	30
TOTAL AVERAGE DOMESTIC DEMAND (liters/cap/day)	120	100	90	60	45
NON-DOMESTIC DEMAND	Based on Survey of Requirements				
(% of domestic demand)	60%	40%	30%	20%	5%
	(For budgeting purposes only)				
ALLOWANCE FOR UNACCOUNTED-FOR WATER					
(% of Total Production) (4)	20%	20%	20%	20%	15%

Notes:

(1) Represent National target. Percentage population served by individual schemes may vary in accordance with density of development, alternative water supplies, boundary of town and service area, etc.

(2) The ratio of population served by House/Yard connections to the population served by Public Standpipes should reflect the national target of 50 : 50. This ratio may vary for individual schemes (based on Socio-economic survey) in which case the domestic demand for the house/yard connections should be varied so that the Total Average Domestic Demand target is achieved.

(3) Yard connections only. Domestic demand for yard connections should not be reduced but the ratio of yard connections to public standpipes may be varied, based upon a socio-economic survey, between the limits 80 : 20 and 20 : 80, utilizing the full capacity of the module.

(4) Minimum allowance. For existing systems this may be increased on the basis of a survey of actual losses and estimated trend.

TABLE 3.2 FUTURE REQUIREMENTS OF GUIDELINED CASE

ITEM	1983	Case A YEAR 1990	Case A 1995	Case A 2000	Case A 2005	Case B YEAR 1990	Case B 1995	Case B 2000	Case B 2005
Population (x1.000)	768	927	1.050	1.171	1.286	927	1.050	1.171	1.286
Served Ratio (%)	34.1	75.0	85.0	93.0	98.0	75.0	80.0	85.0	90.0
Served Populatin (x1.000)	262	695	893	1089	1260	695	840	995	1157
Domestic Demand Per Capita (LCD)	65	100	138	156	174	100	129	147	165
Domestic Water Demand (M3/D)	17,000	70.000	123.000	170.000	219.000	70.000	108.000	146.000	191.000
Non-domestic Water Demand (M3/D)	10,000	27.000	40.000	56.000	73.000	27.000	40.000	56.000	73.000
TOTAL DEMAND (Piped Water) (M3/D)	27,000	97.000	163.000	226.000	292.000	97.000	148.000	202.000	264.000
TOTAL DEMAND PER CAPITA (LCD)	103	140	183	208	232	140	176	203	228
Accounted-for Water to Production (%)	50.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0
Total Water Production (Daily Max..M3/D)	54,000	121.000	204.000	283.000	365.000	121.000	185.000	253.000	330.000
Total Water Production (Daily Max..L/S)	630	1.400	2.360	3.270	4.220	1.400	2.140	2.920	3.820
Water Production Per Capita (LCD)	206	174	223	260	290	174	220	254	285

TABLE 3.3 PER CAPITA DEMAND & PER CAPITA CONSUMPTION IN DOMESTIC USAGE

(YEAR : 1990) / (YEAR : 1995)

Quality	Usage	Total Demand *1 (LCD)	1990 Maxmum House Connect. Present Demand (%) (LCD)	1990 Maxmum House Connect. Consump. (%) (LCD)	1990 Others Present Demand (%) (LCD)	1990 Others CONSUMP. Public Hydrant (%) (LCD)	1990 Others CONSUMP. Water Wagon (%) (LCD)	1990 Others CONSUMP. From Neighbors (%) (LCD)	1995 House Connect. Present Demand (%) (LCD)	1995 House Connect. Consump. (%) (LCD)	1995 Others Present Demand (%) (LCD)	1995 Others CONSUMP. Public Hydrant (%) (LCD)	1995 Others CONSUMP. Water Wagon (%) (LCD)	1995 Others CONSUMP. From Neighbors (%) (LCD)
Clean	Drinking	4	100	100	100	100	100	100	100	100	100	100	100	100
			4	4	4	4	4	4	4	4	4	4	4	4
	Cooking	30	85	95	30	95	95	95	90	100	30	95	95	95
			26	24	9	9	9	9	27	27	9	9	9	9
	Washing Hands.etc.	26	80	85	29	90	70	70	90	90	29	90	90	90
			21	18	8	7	5	5	23	21	8	7	7	7
	Bathing	70	90	65	34	30	10	10	95	70	34	30	30	30
			63	41	24	7	2	2	67	47	24	7	7	7
	Laundering	70	70	45	24	20	5	5	80	50	24	20	20	20
			49	22	17	3	1	1	56	28	17	3	3	3
Not Clean	Cleaning. etc.	20	30	30	8	5	3	3	40	40	8	5	5	5
			6	2	2	0	0	0	8	3	2	0	0	0
	Toilet Flushing	30	5	100	0	0	0	0	10	100	0	0	0	0
			2	2	0	0	0	0	3	3	0	0	0	0
	Total	250	68	66	25	48	34	34	75	71	25	48	48	48
			170	112	63	30	21	21	188	133	63	30	30	30

*1 : The maximum total demands inply all kinds of possible and actual water demands for each purpose.

TABLE 3.3 (Continued Table)

PER CAPITA DEMAND & PER CAPITA CONSUMPTION IN DOMESTIC USAGE

Quality	Usage	Maxmum Total Demand *1 (LCD)	YEAR : 2000 House Connect. Present Demand (%) (LCD)	YEAR : 2000 House Connect. Consump. (%) (LCD)	YEAR : 2000 Others Present Demand (%) (LCD)	YEAR : 2000 Others CONSUMP. Public Hydrant (%) (LCD)	YEAR : 2000 Others CONSUMP. Water Wagon (%) (LCD)	YEAR : 2000 Others CONSUMP. From Neighbors (%) (LCD)	YEAR : 2005 House Connect. Present Demand (%) (LCD)	YEAR : 2005 House Connect. Consump. (%) (LCD)	YEAR : 2005 Others Present Demand (%) (LCD)	YEAR : 2005 Others CONSUMP. Public Hydrant (%) (LCD)	YEAR : 2005 Others CONSUMP. Water Wagon (%) (LCD)	YEAR : 2005 Others CONSUMP. From Neighbors (%) (LCD)
Clean	Drinking	4	100	100	100	100	100	100	100	100	100	100	100	100
			4	4	4	4	4	4	4	4	4	4	4	4
	Cooking	30	95	100	35	100	100	100	98	100	40	100	100	100
			29	29	11	11	11	11	29	29	12	12	12	12
	Washing Hands.etc.	26	95	95	35	90	90	90	98	100	40	95	95	95
			25	24	9	8	8	8	25	25	10	10	10	10
	Bathing	70	98	80	40	30	30	30	100	100	45	30	30	30
			69	55	28	8	8	8	70	70	32	9	9	9
	Laundering	70	90	60	30	20	20	20	95	70	35	20	20	20
			63	38	21	4	4	4	67	47	25	5	5	5
Not Clean	Cleaning. etc.	20	50	50	15	5	5	5	60	60	20	5	5	5
			10	5	3	0	0	0	12	7	4	0	0	0
	Toilet Flushing	30	15	100	0	0	0	0	25	100	0	0	0	0
			5	5	0	0	0	0	8	8	0	0	0	0
	Total	250	82	78	30	47	47	47	86	88	35	47	47	47
			204	160	76	35	35	35	215	190	86	40	40	40

*1 : The maximum total demands inply all kinds of possible and, actual water demands for each purpose.

TABLE 3.4 WATER REQUIREMENTS BASED ON PRESENT SITUATION

ITEM		1983	1990	YEAR 1995	2000	2005
Population (x1.000)		768	927	1.050	1.171	1,286
Population Coverage (%)		34.1	60.0	75.0	85.0	93.0
Served Populatin (x1.000)		262	556	788	995	1,196
Ratio Among Serice Type	House Connection (%)	58.1	40.0	50.0	60.0	65.0
	Public Hydrant (%)	12.7	49.5	47.0	39.8	34.9
	Neighbors Supply.etc. (%)	29.2	10.5	3.0	0.2	0.1
Served Populations By Type	House Connection	153	223	394	597	778
	Public Hydrant	33	275	370	396	417
	Neighbors Supply.etc.	76	58	24	2	1
Domestic Demand Per Capita (LCD)		65	62	82	110	138
Per Capita Demands By Serice Type	House Connection (LCD)	97	112	133	160	190
	Public Hydrant (LCD)	30	30	30	35	40
	Neighbors Supply.etc. (LCD)	17	21	30	35	40
Domestic Piped Water Demand (M3/D)		17,000	34.000	64.000	109.000	164.000
Piped Water Demands By Serice Type	House Connection (M3/D)	15,000	25,000	52.000	95.000	147.000
	Public Hydrant (M3/D)	1,000	8.000	11.000	14.000	17.000
	Neighbors Supply.etc.(M3/D)	1,000	1.000	1.000	0	0
Non-domestic Piped Water Demand (M3/D)		10,000	27.000	40,000	56.000	73.000
TOTAL DEMAND (Piped Water) (M3/D)		27,000	61.000	104.000	165.000	237.000
TOTAL DEMAND PER CAPITA (LCD)		103	110	132	166	198
Accounted-for Water to Production (%)		50.0	65.0	75.0	80.0	80.0
Total Water Production (Daily Max..M3/D)		54,000	94,000	139,000	206.000	296,000
Total Water Production (Daily Max..L/S)		630	1.090	1.600	2.390	3.430
Water Production Per Capita (LCD)		206	169	176	207	247

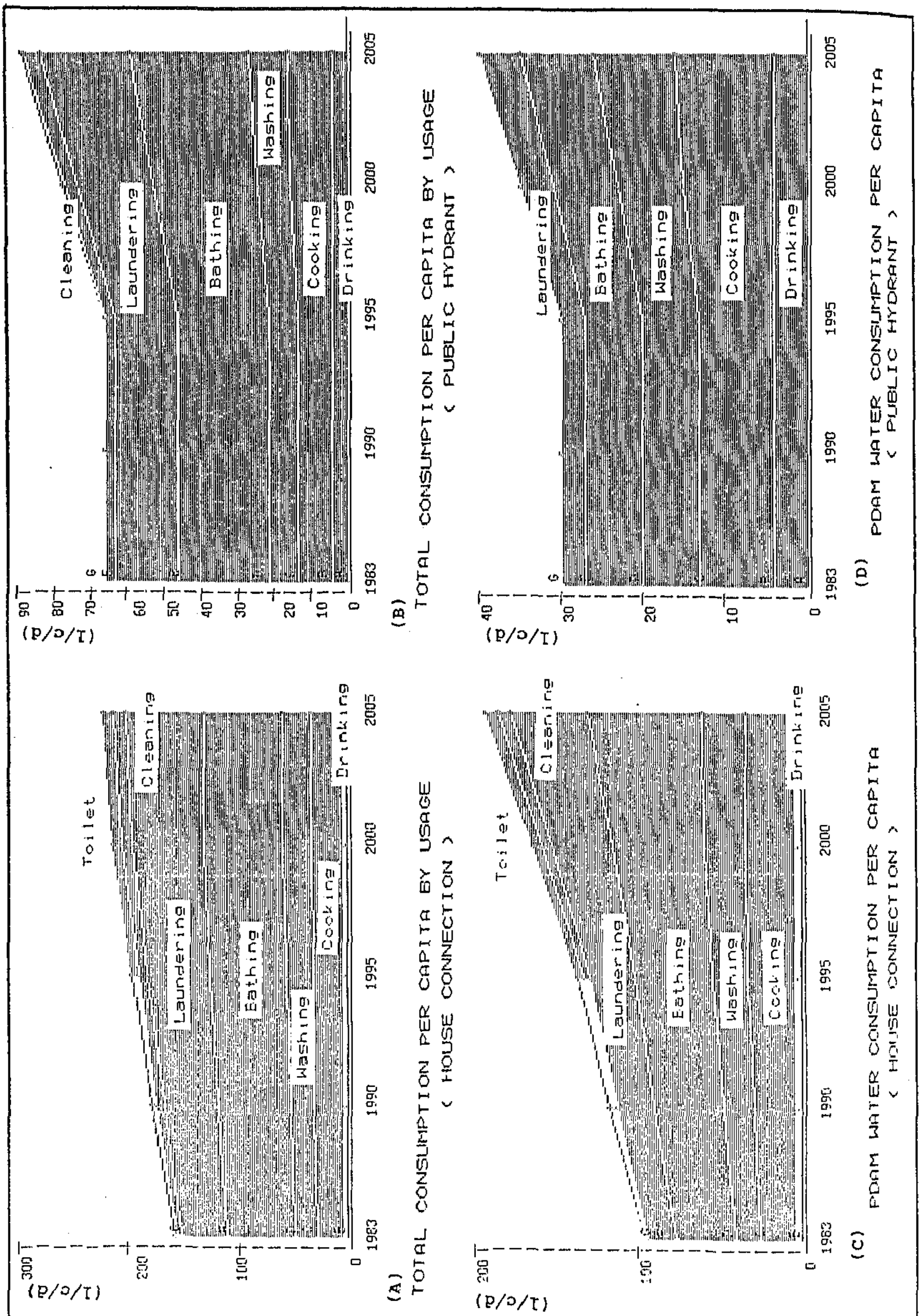
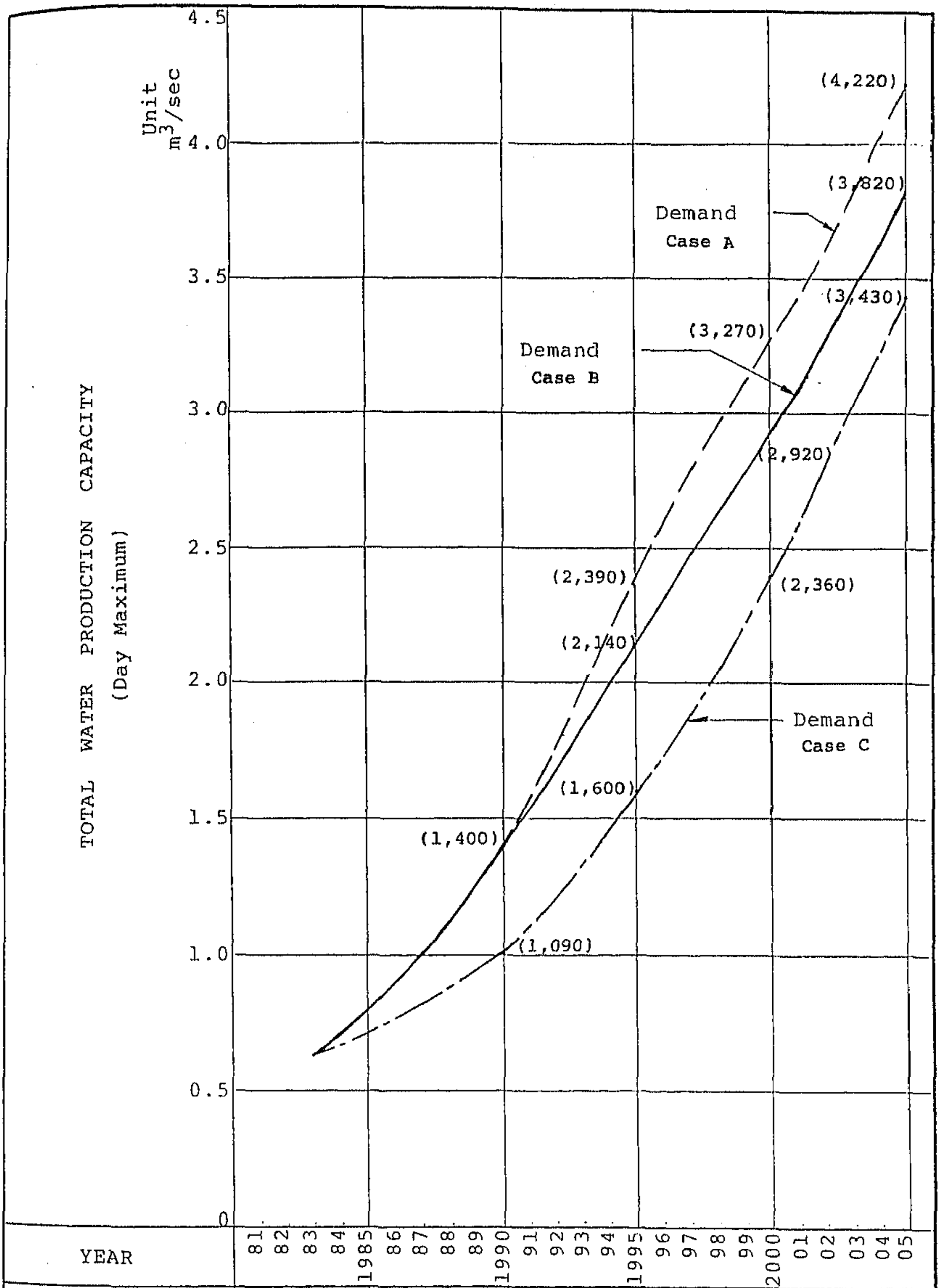


FIGURE	FUTURE REQUIREMENTS PER CAPITA
3.1	



STAGING		STAGE I	STAGE II

FIGURE 3.2	COMPARISON OF WATER REQUIREMENTS

TABLE 3.5 COMPARISON OF WATER REQUIREMENTS

Item		STAGE I (1995)			STAGE II (2005)		
		Case A	Case B	Case C	Case A	Case B	Case C
<<Water Requirements>>							
- Accounted-for Water	($\times 10^6$ m^3/year)	59.50	54.02	37.96	106.58	96.36	86.51
1) House Connection	($\times$ 1,000 m^3/day)	112	97	53	211	182	147
2) Public Standpipe	($\times$ 1,000 m^3/day)	11	11	11	8	9	17
3) Non-domestic	($\times$ 1,000 m^3/day)	40	40	40	73	73	73
Total	($\times$ 1,000 m^3/day)	163	148	104	292	264	237
- Annual Production	(m^3/sec)	2.36	2.14	1.60	4.22	3.82	3.43
<<Annual Cost>> (in million Rp.)							
- Operation Cost		2,777	2,452	2,038	4,493	4,002	3,726
- Administration Cost		1,071	971	726	1,916	1,734	1,557
Sub-total		3,848	3,423	2,764	6,409	5,736	5,283
- Construction Cost		64,620	52,095	24,540	156,920	139,450	116,990
- Depreciation (2.5%)		1,842	1,528	840	4,149	3,712	3,151
- Interest Payment	(Case 1) 1/	7,108	5,730	2,699	17,261	15,340	12,869
	(Case 2)	5,687	4,584	2,160	13,809	12,272	10,295
	(Case 3)	4,976	4,011	1,890	12,083	10,738	9,008
Total Annual Cost	(Case 1)	12,798	10,681	6,303	27,819	24,788	21,303
	(Case 2)	11,377	9,535	5,764	24,367	21,720	18,729
	(Case 3)	10,666	8,962	5,494	22,641	20,186	17,442
<<Water Tariff>> (Rp./m^3)							
- Average Water Tariff	(Case 1)	215	198	166	261	257	246
	(Case 2)	191	177	152	229	225	216
	(Case 3)	179	166	145	212	209	202
- Tariff for House Connection	(Case 1)	126	112	79	150	142	130
	(Case 2)	112	100	72	132	124	114
	(Case 3)	105	94	69	122	115	107

1/ Interest Case 1, 2 and 3 correspond 100% loan; equity 0%, 80%, 20%, 70%, and 30% respectively.

TABLE 3.6 CUSTOMERS' CAPABILITY FOR WATER PAYMENT

STAGE	Require-ments Case	Served Ratio (%) (A)	Percentage of House Connection (B)	Coverage by House Connection (A) x (B)	Monthly Income of Customer by House Connection	Permissible Water Payment (Rp.)	Permissible Water Rate (Rp./m^3)
I (1995)	A	85	60	51.0 = 50	68,000 1/ x 1.05^{11} 2/ = 116,000	116,000 x 3.5 3/ % = 4,100	$4{,}100 \times \frac{1}{30} \times \frac{1}{6} \times \frac{1}{0.210}$ = 108
	B	80	55	44.0 = 45	75,000 x 1.05^{11} = 128,000	128,000 x 3.5 % = 4,500	$4{,}500 \times \frac{1}{30} \times \frac{1}{6} \times \frac{1}{0.210}$ = 119
	C	75	50	37.5	86,000 x 1.05^{11} = 147,000	147,000 x 3.5 % = 5,100	$5{,}100 \times \frac{1}{30} \times \frac{1}{6} \times \frac{1}{0.133}$ = 213
II (2005)	A	98	80	78.4 = 77.5	37,000 x 1.05^{21} = 103,000	103,000 x 3.5 % = 3,600	$3{,}600 \times \frac{1}{30} \times \frac{1}{6} \times \frac{1}{0.210}$ = 95
	B	90	75	67.5	48,000 x 1.05^{21} = 134,000	134,000 x 3.5 % = 4,700	$4{,}700 \times \frac{1}{30} \times \frac{1}{6} \times \frac{1}{0.210}$ = 124
	C	93	65	60.5 = 60	56,000 x 1.05^{21} = 156,000	156,000 x 3.5 % = 5,500	$5{,}500 \times \frac{1}{30} \times \frac{1}{6} \times \frac{1}{0.190}$ = 161

1/ This income corresponds to the lowest level at present distribution (refer to Figure 3.3)

2/ Annual increase rate of income is assumed at 5%

3/ Permissible share of expenditure for water is fixed at 3.5% based on the results of household survey.

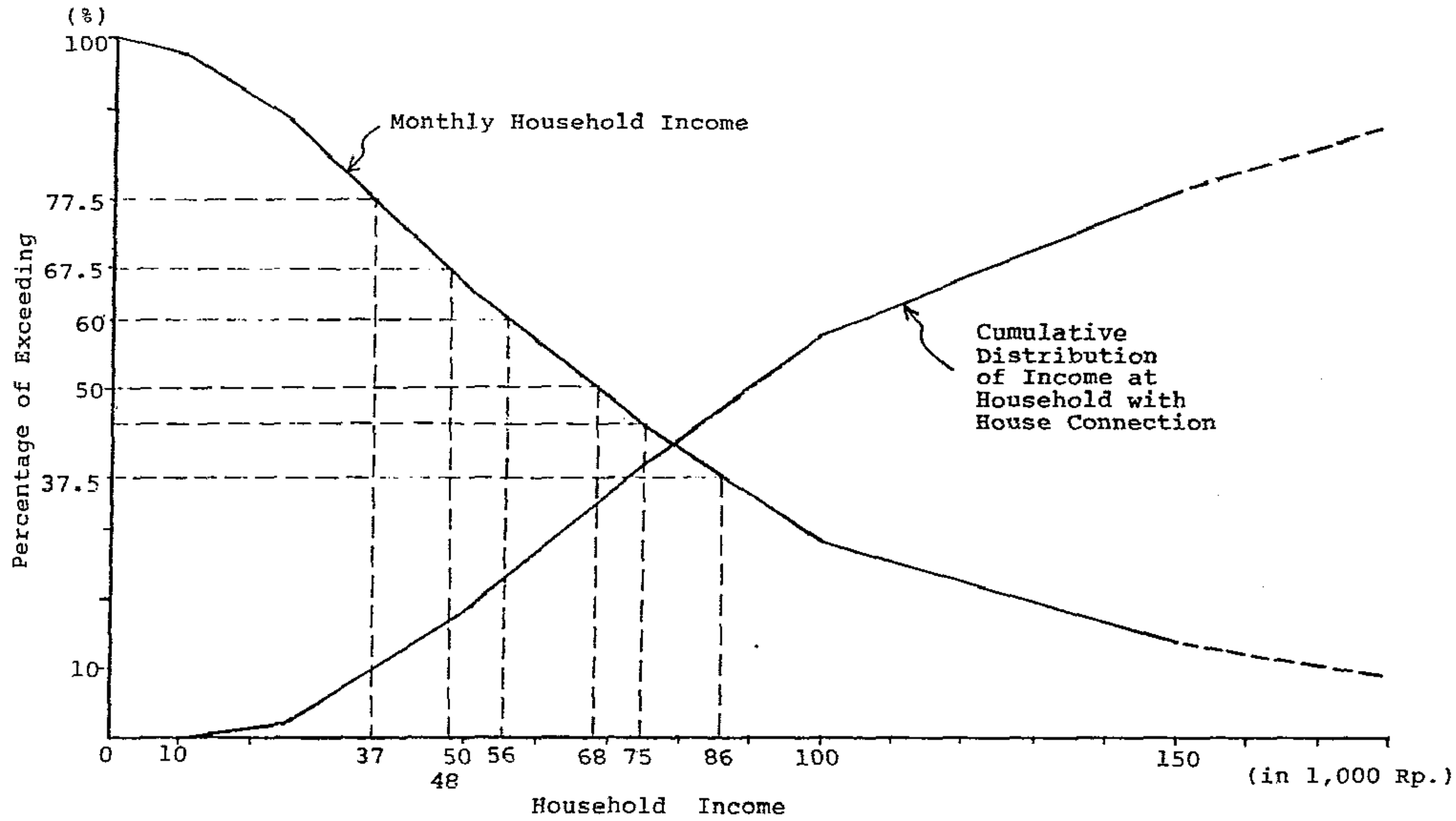


FIGURE	RELATIVE CUMULATIVE FREQUENCY CURVE OF HOUSEHOLD INCOME AND HOUSE CONNECTION
3.3	

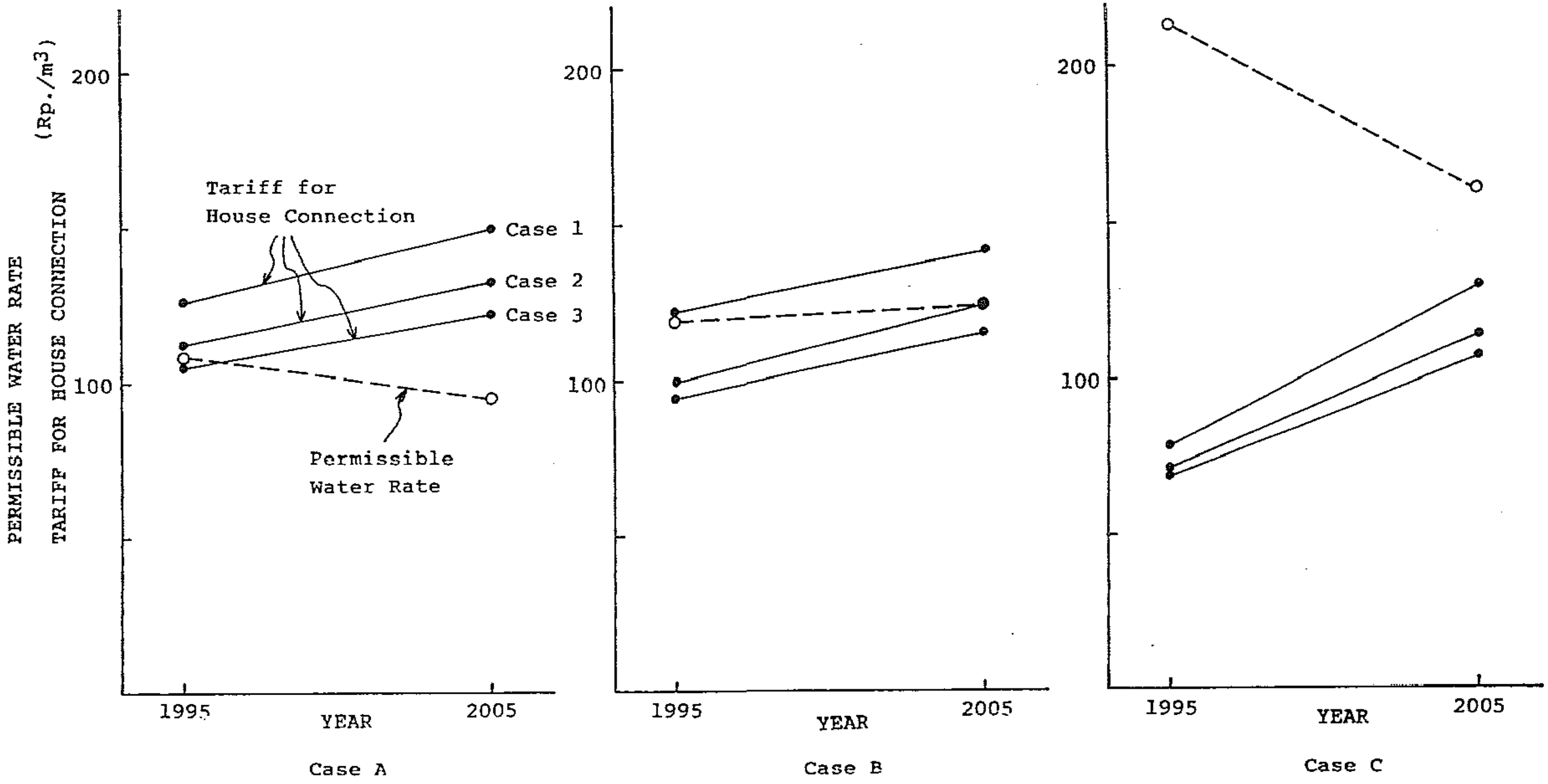


FIGURE 3.4	EVALUATION OF SUPPLY PLAN

TABLE 3.7 WATER REQUIREMENTS FOR DOMESTIC USAGE

Description	1983 1/	1990	1992	1995	2000	2005
Population (x 1,000)	768	927	976	1,050	1,171	1,286
Population Coverage (%)	34.1	75.0	77.0	80.0	85.0	90.0
Served Population (x 1,000)	262	695	752	840	995	1,157
Served by House Connection	153	487	542	630	775	927
Served by Public Standpipe	33	208	210	210	220	230
Ratio Between Service Type (%) — House Connection	58.4	70.0	72.0	75.0	78.0	80.0
Ratio Between Service Type (%) — Public Standpipe	12.6	30.0	28.0	25.0	22.0	20.0
Average Demand Per Capita (l/c/d)	65	100	113	127	147	162
House Connection	97	130	145	160	180	195
Public Standpipe	30	30	30	30	30	30
Water Requirements (m^3/day)	17,000	70,000	85,000	107,000	146,000	188,000
House Connection	15,000	64,000	79,000	101,000	139,000	181,000
Public Standpipe	1,000	6,000	6,000	6,000	7,000	7,000

1/ In 1983, there exists the third kind of served population: 76,000 population served from neighbors with per capita demand of 17 liter (about one thousand requirement).

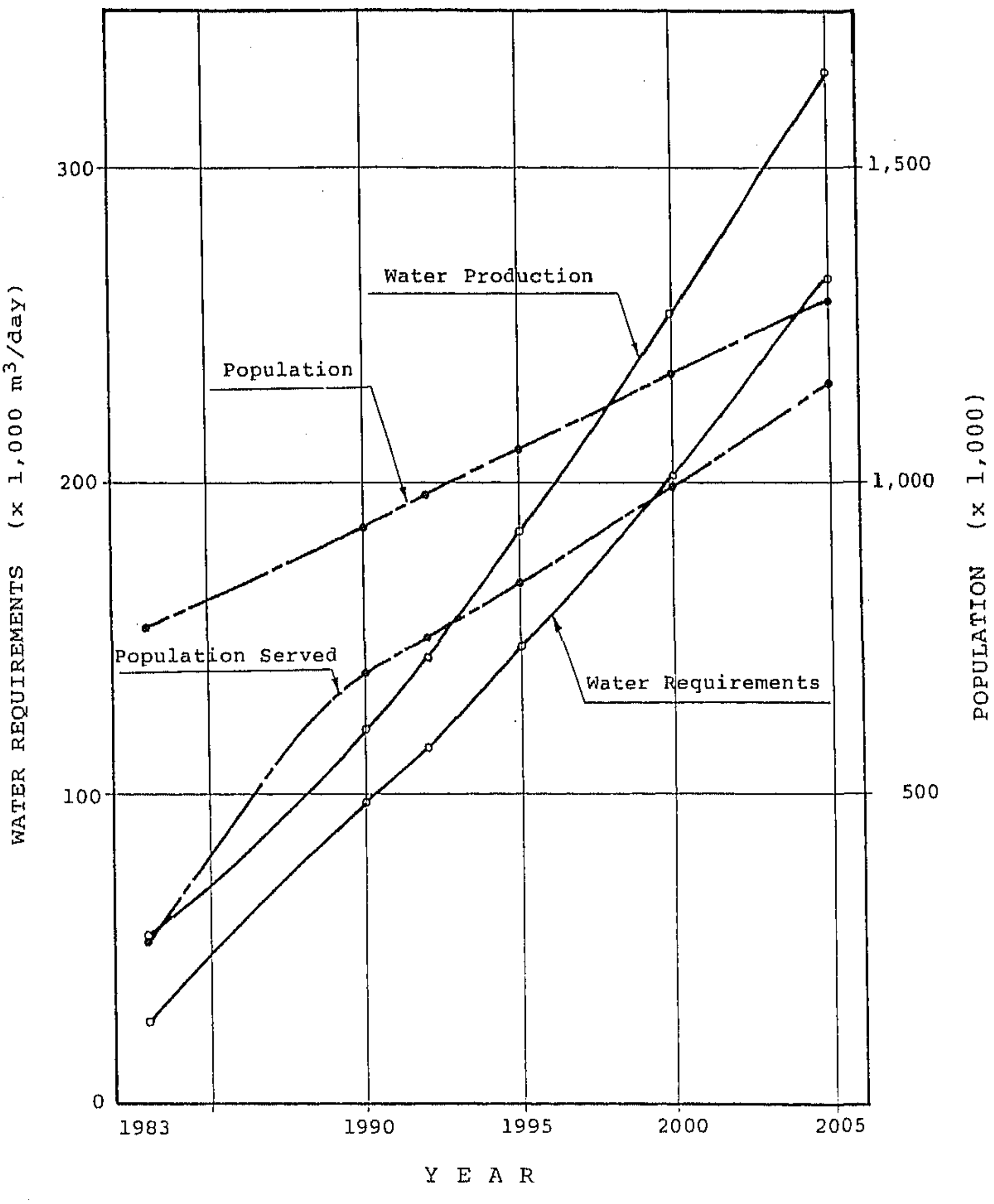


FIGURE	WATER REQUIREMENTS AND POPULATION (CASE B)
3.5	

TABLE 4.1 INDUSTRIAL ESTATE PLAN

Stage Construction	Site Area (ha)	Factory Area (ha)	Employee	Water Requirement (m^3/day)	Electric Power (Kw/day)	Water Requirement Per Employee (1/day)
STAGE I (1982-1985)	86,0	61,0	11,700	4,460	13,230	381
STAGE II (1985-1988)	80,0	61,0	8,370	6,480	13,190	774
STAGE III	58,3	43,0	6,930	3,250	7,620	469
TOTAL	224,3	165,0	27,000	14,190	34,040	526

TABLE 4.2 WATER REQUIREMENTS FOR INDUSTRIAL ESTATE

Description	1983	1990	1992	1995	2000	2005
Employee in Industrial Estate (x 1,000)	0	20	25	32	43	55
Demand Per Employee (l/c/d)	-	550	524	516	519	509
Water Requirements in Industrial Estate (m^3/day)	0	11,000	13,100	16,500	22,300	28,000

TABEL 4.3 WATER REQUIREMENTS FOR NON-DOMESTIC USAGE

Description	1983	1990	1992	1995	2000	2005
Population of 15 - 54 Age (x 1,000)	440	545	573	616	700	782
Ratio of Employment (%)	30	35	37	40	45	50
Employee (x 1,000)	132	191	212	246	315	391
Employee in Industrial Estate (x 1,000)	0	20	25	32	43	55
Regional Coverage Ratio in Other Area (%)	75	85	87	90	95	98
Other Employee in Service	99	145	163	193	258	329
<Industrial Estate>						
Water Requirements in Industrial Estate (m^3/day)	0	11,000	13,100	16,500	22,300	28,000
Demand Per Employee (l/c/d)	125	130	132	135	143	150
Qualitative Coverage Ratio (%)	80	85	86	88	90	92
Unit Demand for Piped Water (l/c/d)	100	111	114	119	129	138
Water Requirements in Other Area (m^3/day)	9,900	16,100	18,600	23,000	33,300	45,400
Total Water Requirements (m^3/day)	9,900	27,100	31,700	39,500	55,600	73,400
Average Demand Per Employee (l/c/d)	100	164	169	176	185	191

TABLE 4.4 WATER REQUIREMENTS (SUMMARY)

Description	1983	1990	1992	1995	2000	2005
Population (x 1,000)	768	927	976	1,050	1,171	1,286
Population Coverage (%)	34.1	75.0	77.0	80.0	85.0	90.0
Served Population (x 1,000)	262	695	752	840	995	1,157
Water Demand Per Capita (l/c/d)	65	100	113	127	147	162
Domestic Water Requirements (m^3/day)	17,000	70,000	85,000	107,000	146,000	188,000
Non-domestic Water Requirements (m^3/day)	10,000	27,000	32,000	40,000	56,000	73,000
Total Water Requirements (m^3/day)	27,000	97,000	117,000	147,000	202,000	261,000
Domestic Demand to Total (%)	63.0	72.2	72.6	72.8	72.3	72.0
Total Water Requirements Per Capita (l/c/d)	103	140	156	175	203	226
Accounted-for Water to Production (%)	50.0	80.0	80.0	80.0	80.0	80.0
Water Production (m^3/day)	54,000	121,000	146,000	184,000	253,000	326,000
Water Production (m^3/sec)	0.63	1.40	1.69	2.13	2.92	3.78
Water Production Per Capita (l/c/d)	206	174	194	219	254	282

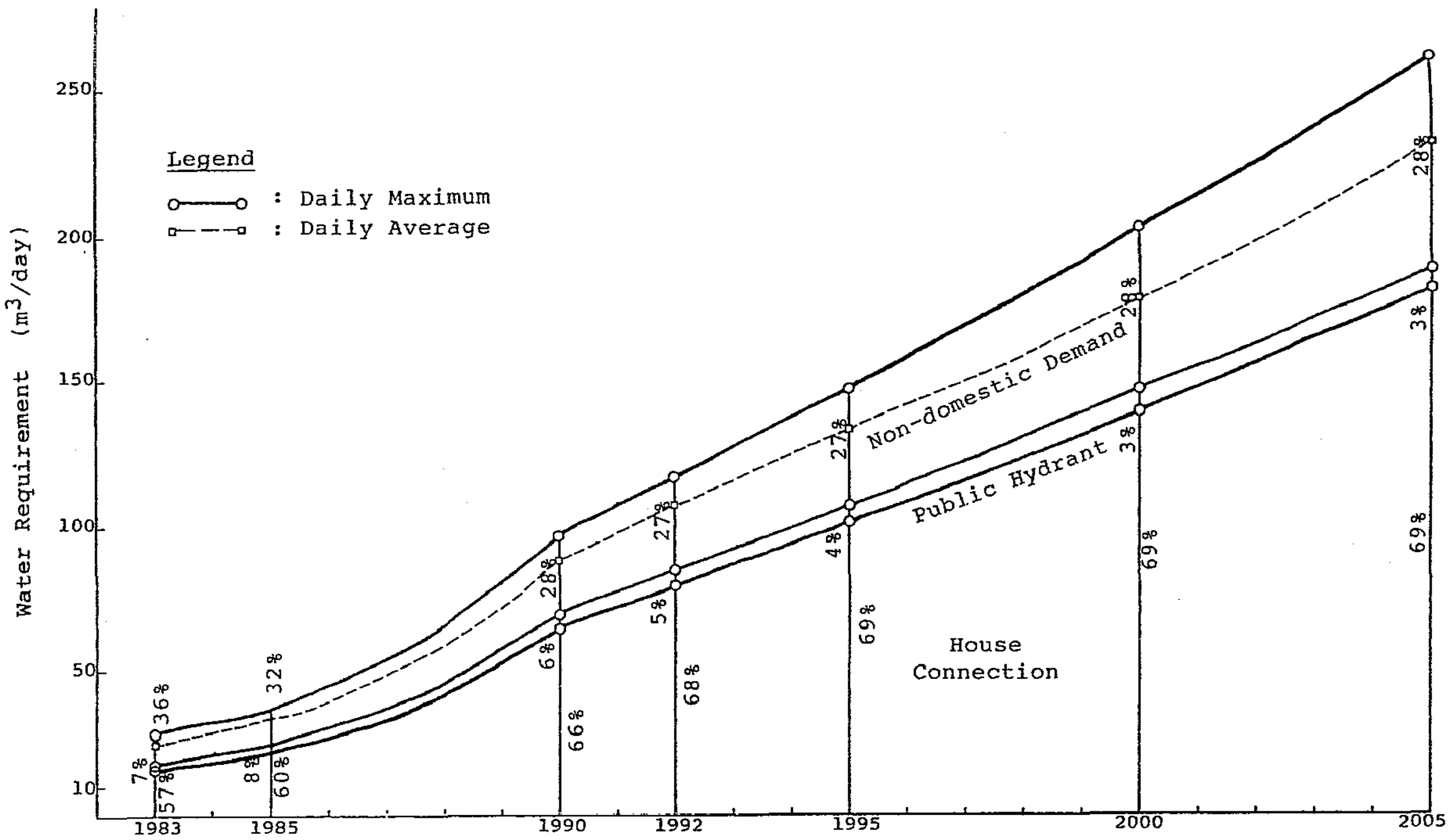


FIGURE 4.1 WATER REQUIREMENT BY USE

TABLE 5.1 POPULATIONS BY HOUSE TYPE

KECAMATAN/KELURAHAN	1983	1990	1992	1995	2000	2005
1.Mariso	53,000	55,000	56,000	56,000	57,000	58,000
	20,000	22,000	23,000	25,000	28,000	31,000
	13,000	15,000	15,000	14,000	14,000	14,000
	20,000	18,000	18,000	17,000	15,000	13,000
2.Hamajang	74,000	79,000	81,000	84,000	88,000	90,000
	29,000	32,000	33,000	35,000	38,000	42,000
	12,000	15,000	16,000	17,000	19,000	20,000
	33,000	32,000	32,000	32,000	31,000	28,000
3.Ujung Pandang	43,000	40,000	39,000	37,000	35,000	34,000
	25,000	26,000	26,000	27,000	28,000	29,000
	14,000	12,000	11,000	9,000	7,000	5,000
	4,000	2,000	2,000	1,000	0	0
4.Makassar	107,000	116,000	120,000	124,000	131,000	134,000
	16,000	21,000	24,000	28,000	35,000	40,000
	39,000	44,000	45,000	47,000	51,000	56,000
	52,000	51,000	51,000	49,000	45,000	38,000
5.Wajo	48,000	46,000	45,000	44,000	42,000	41,000
	20,000	21,000	21,000	22,000	23,000	25,000
	18,000	17,000	17,000	16,000	15,000	15,000
	10,000	8,000	7,000	6,000	4,000	1,000
6.Bontoala	68,000	69,000	69,000	70,000	70,000	71,000
	15,000	17,000	18,000	20,000	22,000	26,000
	21,000	23,000	24,000	25,000	28,000	32,000
	32,000	29,000	27,000	25,000	20,000	13,000
7.Tallo	86,000	102,000	107,000	116,000	127,000	133,000
	8,000	11,000	13,000	18,000	26,000	36,000
	9,000	16,000	20,000	25,000	33,000	39,000
	69,000	75,000	74,000	73,000	68,000	58,000
8.Ujung Tanah	44,000	47,000	48,000	50,000	52,000	53,000
	5,000	6,000	7,000	8,000	11,000	13,000
	7,000	9,000	10,000	12,000	16,000	22,000
	32,000	32,000	31,000	30,000	25,000	18,000
9.Panakkukang	80,000	130,000	143,000	164,000	199,000	235,000
	8,000	35,000	46,000	63,000	90,000	140,000
	16,000	38,000	40,000	45,000	56,000	49,000
	56,000	57,000	57,000	56,000	53,000	46,000
a/Karuwisi	23,000	31,000	32,000	34,000	36,000	39,000
	2,000	6,000	6,000	7,000	8,000	15,000
	5,000	9,000	10,000	11,000	13,000	11,000
	16,000	16,000	16,000	16,000	15,000	13,000
b/Panaikang	35,000	51,000	56,000	62,000	67,000	71,000
	3,000	12,000	16,000	21,000	23,000	33,000
	3,000	10,000	11,000	13,000	17,000	14,000
	29,000	29,000	29,000	28,000	27,000	24,000
c/Tallo Baru	11,000	15,000	17,000	22,000	42,000	51,000
	2,000	3,000	5,000	9,000	27,000	38,000
	7,000	10,000	10,000	11,000	13,000	11,000
	2,000	2,000	2,000	2,000	2,000	2,000
d/Antang	5,000	10,000	10,000	10,000	11,000	12,000
	500	2,000	2,000	2,000	2,000	3,000
	500	3,000	3,000	3,000	4,000	5,000
	4,000	5,000	5,000	5,000	5,000	4,000
e/Tamangapa	6,000	23,000	28,000	36,000	43,000	62,000
	500	12,000	17,000	24,000	30,000	51,000
	500	6,000	6,000	7,000	9,000	8,000
	5,000	5,000	5,000	5,000	4,000	3,000
10.Tamalate	130,000	196,000	217,000	248,000	302,000	358,000
	28,000	68,000	83,000	105,000	165,000	225,000
	53,000	80,000	88,000	100,000	102,000	105,000
	49,000	48,000	46,000	43,000	35,000	28,000
a/Mangngasa	15,000	39,000	44,000	51,000	66,000	84,000
	3,000	17,000	20,000	25,000	40,000	58,000
	8,000	18,000	20,000	23,000	24,000	25,000
	4,000	4,000	4,000	3,000	2,000	1,000
b/Rappocini	57,000	77,000	86,000	99,000	121,000	150,000
	16,000	30,000	38,000	48,000	72,000	103,000
	28,000	34,000	36,000	40,000	40,000	40,000
	13,000	13,000	12,000	11,000	9,000	7,000
c/Jongaya	33,000	41,000	45,000	51,000	55,000	59,000
	7,000	11,000	13,000	17,000	23,000	28,000
	14,000	18,000	20,000	23,000	23,000	23,000
	12,000	12,000	12,000	11,000	9,000	8,000
d/Macini Sombala	17,000	29,000	32,000	37,000	49,000	53,000
	1,500	9,000	11,000	14,000	28,000	33,000
	2,500	8,000	10,000	12,000	12,000	13,000
	13,000	12,000	11,000	11,000	9,000	7,000
e/Barombong	8,000	10,000	10,000	10,000	11,000	12,000
	500	1,000	1,000	1,000	2,000	3,000
	500	2,000	2,000	2,000	3,000	4,000
	7,000	7,000	7,000	7,000	6,000	5,000
11.Biringkanaya	35,000	47,000	51,000	57,000	68,000	79,000
	3,000	10,000	13,000	17,000	26,000	36,000
	5,000	9,000	11,000	15,000	22,000	29,000
	27,000	28,000	27,000	25,000	20,000	14,000
a/Daya	11,000	12,000	12,000	13,000	14,000	15,000
	1,000	2,000	2,000	2,500	3,500	4,000
	4,000	4,000	4,500	5,000	6,000	8,000
	6,000	6,000	5,500	5,500	4,500	3,000
b/Sudiang	6,000	8,000	11,000	15,000	22,000	30,000
	500	2,000	4,500	7,500	13,000	20,000
	500	1,000	2,000	3,500	6,000	8,000
	5,000	5,000	4,500	4,000	3,000	2,000
c/Bira	5,000	6,000	6,000	6,000	7,000	7,000
	0	500	500	500	1,500	2,000
	0	500	500	1,000	2,000	3,000
	5,000	5,000	5,000	4,500	3,500	2,000
d/Tamalanrea	7,000	13,000	14,000	15,000	16,000	17,000
	1,000	4,000	4,500	5,000	6,000	7,500
	500	3,000	3,500	4,500	5,500	6,500
	5,500	6,000	6,000	5,500	4,500	3,000
e/Bulurokeng	6,000	8,000	8,000	8,000	9,000	10,000
	500	1,500	1,500	1,500	2,000	2,500
	0	500	500	1,000	2,500	3,500
	5,500	6,000	6,000	5,500	4,500	4,000
TOTAL	768,000	927,000	976,000	1,050,000	1,171,000	1,286,000
	177,000	269,000	307,000	368,000	492,000	643,000
	207,000	278,000	297,000	325,000	363,000	386,000
	384,000	380,000	372,000	357,000	316,000	257,000
% of Permanent	23.0%	29.0%	31.5%	35.0%	42.0%	50.0%
% of Semi-permanent	27.0%	30.0%	30.4%	31.0%	31.0%	30.0%
% of Temporary	50.0%	41.0%	38.1%	34.0%	27.0%	20.0%

Note:

From top to bottom

1) Population

2) Population of Permanent Structured House

3) Population of Semi-permanent Structured House

4) Population of Temporary Structured House

TABLE 5.2 POPULATION SERVED BY CONNECTION TYPE

KECAMATAN/KELURAHAN	1983	1990	1992	1995	2000	2005
1. Mariso	20,000	43,000	45,000	47,000	51,000	54,000
	13,000	32,000	33,000	35,000	37,000	42,000
	1,000	11,000	12,000	12,000	12,000	12,000
	65%	74%	73%	74%	73%	78%
2. Mamajang	11,000	60,000	64,000	71,000	80,000	85,000
	7,000	40,000	43,000	49,000	55,000	57,000
	0	20,000	21,000	22,000	25,000	28,000
	64%	67%	67%	69%	69%	67%
3. Ujung Pandang	19,000	35,000	35,000	36,000	35,000	34,000
	13,000	33,000	34,000	35,000	35,000	34,000
	0	2,000	1,000	1,000	0	0
	68%	94%	97%	97%	100%	100%
4. Makassar	37,000	98,000	104,000	111,000	124,000	130,000
	17,000	63,000	68,000	74,000	86,000	93,000
	11,000	35,000	36,000	37,000	38,000	37,000
	46%	64%	65%	67%	69%	72%
5. Wajo	27,000	42,000	43,000	43,000	42,000	41,000
	17,000	36,000	37,000	38,000	38,000	40,000
	1,000	6,000	6,000	5,000	4,000	1,000
	63%	86%	86%	88%	90%	98%
6. Bontoala	34,000	57,000	59,000	62,000	65,000	69,000
	17,000	36,000	39,000	43,000	47,000	52,000
	9,000	21,000	20,000	19,000	18,000	17,000
	50%	63%	66%	69%	72%	75%
7. Tallo	20,000	80,000	87,000	97,000	113,000	123,000
	12,000	23,000	31,000	42,000	59,000	71,000
	2,000	57,000	56,000	55,000	54,000	52,000
	60%	29%	36%	43%	52%	58%
8. Ujung Tanah	18,000	35,000	37,000	39,000	42,000	43,000
	7,000	13,000	16,000	20,000	27,000	33,000
	8,000	22,000	21,000	19,000	15,000	10,000
	39%	37%	43%	51%	64%	77%
9. Panakkukang	24,000	75,000	88,000	113,000	157,000	198,000
	15,000	65,000	77,000	101,000	138,000	173,000
	1,000	10,000	11,000	12,000	19,000	25,000
	63%	87%	88%	89%	88%	87%
a/Karuwisi	8,000	26,000	27,000	30,000	33,000	37,000
	5,000	24,000	25,000	29,000	32,000	36,000
	1,000	2,000	2,000	1,000	1,000	1,000
	63%	92%	93%	97%	97%	97%
b/Panaikang	11,000	40,000	45,000	52,000	60,000	66,000
	7,000	34,000	39,000	47,000	55,000	62,000
	0	6,000	6,000	5,000	5,000	4,000
	64%	85%	87%	90%	92%	94%
c/Tallo Baru	5,000	9,000	11,000	14,000	29,000	38,000
	3,000	7,000	9,000	11,000	25,000	33,000
	0	2,000	2,000	3,000	4,000	5,000
	60%	78%	82%	79%	86%	87%
d/Antang	0	0	1,000	3,000	7,000	9,000
	0	0	1,000	2,000	5,000	6,000
	0	0	0	1,000	2,000	3,000
	-	-	100%	67%	71%	67%
e/Tamangapa	0	0	4,000	14,000	28,000	48,000
	0	0	3,000	12,000	21,000	36,000
	0	0	1,000	2,000	7,000	12,000
	-	-	75%	86%	75%	75%

KECAMATAN/KELURAHAN	1983	1990	1992	1995	2000	2005
10. Tamalate	46,000	155,000	174,000	203,000	260,000	330,000
	31,000	135,000	152,000	179,000	231,000	293,000
	0	20,000	22,000	24,000	29,000	37,000
	67%	87%	87%	88%	89%	89%
a/Mangngasa	1,000	30,000	34,000	40,000	56,000	78,000
	1,000	28,000	32,000	38,000	53,000	74,000
	0	2,000	2,000	2,000	3,000	4,000
	100%	93%	94%	95%	95%	95%
b/Rappocini	35,000	69,000	77,000	90,000	113,000	146,000
	23,000	62,000	70,000	83,000	105,000	137,000
	0	7,000	7,000	7,000	8,000	9,000
	66%	90%	91%	92%	93%	94%
c/Jongaya	10,000	34,000	38,000	43,000	48,000	55,000
	7,000	29,000	32,000	37,000	41,000	46,000
	0	5,000	6,000	6,000	7,000	9,000
	70%	85%	84%	86%	85%	84%
d/Macini Sombala	0	21,000	24,000	28,000	40,000	47,000
	0	16,000	18,000	21,000	31,000	35,000
	0	5,000	6,000	7,000	9,000	12,000
	-	76%	75%	75%	78%	74%
e/Barombong	0	1,000	1,000	2,000	3,000	4,000
	0	0	0	0	1,000	1,000
	0	1,000	1,000	2,000	2,000	3,000
	-	-	-	-	33%	25%
11. Biringkanaya	6,000	15,000	16,000	18,000	26,000	50,000
	4,000	11,000	12,000	14,000	20,000	39,000
	0	4,000	4,000	4,000	6,000	11,000
	67%	73%	75%	78%	77%	78%
a/Daya	4,000	8,000	8,000	9,000	11,000	13,000
	3,000	7,000	7,000	8,000	10,000	11,000
	0	1,000	1,000	1,000	1,000	2,000
	75%	86%	86%	89%	91%	85%
b/Sudiang	0	0	0	0	0	12,000
	0	0	0	0	0	10,000
	0	0	0	0	0	2,000
	-	-	-	-	-	83%
c/Bira	0	0	0	0	3,000	5,000
	0	0	0	0	2,000	3,000
	0	0	0	0	1,000	2,000
	-	-	-	-	67%	60%
d/Tamalanrea	2,000	6,000	7,000	8,000	10,000	13,000
	1,000	4,000	5,000	6,000	7,000	10,000
	0	2,000	2,000	2,000	3,000	3,000
	50%	67%	71%	75%	70%	77%
e/Bulurokeng	0	1,000	1,000	1,000	3,000	7,000
	0	0	0	0	2,000	5,000
	0	1,000	1,000	1,000	1,000	2,000
	-	0%	0%	0%	67%	71%
TOTAL	262,000	695,000	752,000	840,000	995,000	1,157,000
	153,000	487,000	542,000	630,000	775,000	927,000
	33,000	208,000	210,000	210,000	220,000	230,000
	58%	70%	72%	75%	78%	80%

Note:
From top to bottom
1) Served Population
2) Population Served by House Connection
3) Population Served by Public Stand-pipe
4) % of Population Served by House Connection

TABLE 5.3 SERVED POPULATION & WATER REQUIREMENT

KECAMATAN/KELURAHAN	1983	1990	1992	1995	2000	2005
1. Mariso	20,000	43,000	45,000	47,000	51,000	54,000
	1,400	4,500	5,100	6,000	7,400	8,600
	900	1,300	1,500	1,800	2,400	3,100
	2,300	5,800	6,600	7,800	9,800	11,700
2. Mamajang	11,000	60,000	64,000	71,000	80,000	85,000
	700	5,800	6,900	8,500	10,600	12,000
	1,300	1,900	2,100	2,600	3,500	4,500
	2,000	7,700	9,000	11,100	14,100	16,500
3. Ujung Pandang	19,000	35,000	35,000	36,000	35,000	34,000
	1,400	4,400	5,000	5,600	6,300	6,600
	800	1,200	1,300	1,600	2,100	2,700
	2,200	5,600	6,300	7,200	8,400	9,300
4. Makassar	37,000	98,000	104,000	111,000	124,000	130,000
	2,100	9,300	10,900	12,900	16,600	19,300
	900	1,300	1,500	1,800	2,400	3,100
	3,000	10,600	12,400	14,700	19,000	22,400
5. Wajo	27,000	42,000	43,000	43,000	42,000	41,000
	1,800	4,900	5,500	6,200	7,000	7,800
	1,400	2,100	2,300	2,800	3,800	4,800
	3,200	7,000	7,800	9,000	10,800	12,600
6. Bontoala	34,000	57,000	59,000	62,000	65,000	69,000
	2,100	5,400	6,300	7,400	9,000	10,700
	500	700	900	1,000	1,300	1,700
	2,600	6,100	7,200	8,400	10,300	12,400
7. Tallo	20,000	80,000	87,000	97,000	113,000	123,000
	1,300	4,700	6,200	8,400	12,200	15,400
	200	300	400	400	500	700
	1,500	5,000	6,600	8,800	12,700	16,100
8. Ujung Tanah	18,000	35,000	37,000	39,000	42,000	43,000
	1,000	2,400	3,000	3,800	5,300	6,800
	300	400	500	600	800	1,000
	1,300	2,800	3,500	4,400	6,100	7,800
9. Panakkukang	24,000	75,000	88,000	113,000	157,000	198,000
	1,600	8,800	11,500	16,500	25,400	34,500
	1,100	2,200	2,600	3,400	5,300	7,800
	2,700	11,000	14,100	19,900	30,700	42,300
a/Karuwisi	8,000	26,000	27,000	30,000	33,000	37,000
	550	3,200	3,700	4,650	5,800	7,050
	350	750	800	900	1,100	1,450
	900	3,950	4,500	5,550	6,900	8,500
b/Panaikang	11,000	40,000	45,000	52,000	60,000	66,000
	750	4,600	5,850	7,650	10,050	12,200
	500	1,150	1,300	1,550	2,050	2,600
	1,250	5,750	7,150	9,200	12,100	14,800
c/Tallo Baru	5,000	9,000	11,000	14,000	29,000	38,000
	300	1,000	1,350	1,850	4,600	6,600
	250	300	350	400	950	1,500
	550	1,300	1,700	2,250	5,550	8,100
d/Antang	0	0	1,000	3,000	7,000	9,000
	0	0	150	350	950	1,250
	0	0	50	150	250	350
	0	0	200	500	1,200	1,600
e/Tamangapa	0	0	4,000	14,000	28,000	48,000
	0	0	450	2,000	4,000	7,400
	0	0	100	400	950	1,900
	0	0	550	2,400	4,950	9,300
10. Tamalate	46,000	155,000	174,000	203,000	260,000	330,000
	3,300	18,200	22,700	29,300	42,400	58,300
	700	1,900	2,300	3,200	5,400	8,500
	4,000	20,100	25,000	32,500	47,800	66,800
a/Mangngasa	1,000	30,000	34,000	40,000	56,000	78,000
	100	3,700	4,700	6,100	9,600	14,550
	0	350	450	600	1,100	1,950
	100	4,050	5,150	6,700	10,700	16,500
b/Rappocini	35,000	69,000	77,000	90,000	113,000	146,000
	2,450	8,300	10,350	13,500	19,100	27,000
	550	850	1,050	1,400	2,350	3,700
	3,000	9,150	11,400	14,900	21,450	30,700
c/Jongaya	10,000	34,000	38,000	43,000	48,000	55,000
	750	3,900	4,800	6,100	7,600	9,250
	150	350	450	600	900	1,300
	900	4,250	5,250	6,700	8,500	10,550
d/Macini Sombala	0	21,000	24,000	28,000	40,000	47,000
	0	2,250	2,800	3,550	5,850	7,200
	0	300	300	500	900	1,350
	0	2,550	3,100	4,050	6,750	8,550
e/Barombong	0	1,000	1,000	2,000	3,000	4,000
	0	50	50	50	250	300
	0	50	50	100	150	200
	0	100	100	150	400	500
11. Biringkanaya	6,000	15,000	16,000	18,000	26,000	50,000
	400	1,600	1,900	2,400	3,800	8,000
	1,800	13,800	16,300	20,300	28,100	35,500
	2,200	15,400	18,200	22,700	31,900	43,500
a/Daya	4,000	8,000	8,000	9,000	11,000	13,000
	300	950	1,050	1,300	1,800	2,200
	1,200	12,450	14,800	18,350	24,950	30,050
	1,500	13,400	15,850	19,650	26,750	32,250
b/Sudiang	0	0	0	0	0	12,000
	0	0	0	0	0	2,050
	0	0	0	0	0	1,350
	0	0	0	0	0	3,400
c/Bira	0	0	0	0	3,000	5,000
	0	0	0	0	350	650
	0	50	50	50	100	100
	0	50	50	50	450	750
d/Tamalanrea	2,000	6,000	7,000	8,000	10,000	13,000
	100	600	800	1,050	1,300	2,050
	600	1,100	1,250	1,700	2,850	3,500
	700	1,700	2,050	2,750	4,150	5,550
e/Bulurokeng	0	1,000	1,000	1,000	3,000	7,000
	0	50	50	50	350	1,050
	0	200	200	200	200	500
	0	250	250	250	550	1,550
TOTAL	262,000	695,000	752,000	840,000	995,000	1,157,000
	17,100	70,000	85,000	107,000	146,000	188,000
	9,900	27,100	31,700	39,500	55,600	73,400
	27,000	97,100	116,700	146,500	201,600	261,400

NOTE:

From top to bottom

1) Served Population
2) Domestic Water Requirement (m^3/day)
3) Non-domestic Water Requirement (m^3/day)
4) Total (m^3/day)

TABLE 5.4 POPULATION SERVED

KECAMATAN/KELURAHAN	1983	1990	1992	1995	2000	2005
1.Mariso	53,000	55,000	56,000	56,000	57,000	58,000
	53,000	55,000	56,000	56,000	57,000	58,000
	20,000	43,000	45,000	47,000	51,000	54,000
	37%	78%	80%	84%	89%	93%
2.Mamajang	74,000	79,000	81,000	84,000	88,000	90,000
	74,000	79,000	81,000	84,000	88,000	90,000
	11,000	60,000	64,000	71,000	80,000	85,000
	15%	76%	79%	85%	91%	94%
3.Ujung Pandang	43,000	40,000	39,000	37,000	35,000	34,000
	43,000	40,000	39,000	37,000	35,000	34,000
	19,000	35,000	35,000	36,000	35,000	34,000
	45%	88%	90%	97%	100%	100%
4.Makassar	107,000	116,000	120,000	124,000	131,000	134,000
	107,000	116,000	120,000	124,000	131,000	134,000
	37,000	98,000	104,000	111,000	124,000	130,000
	35%	84%	87%	90%	95%	97%
5.Wajo	48,000	46,000	45,000	44,000	42,000	41,000
	48,000	46,000	45,000	44,000	42,000	41,000
	27,000	42,000	43,000	43,000	42,000	41,000
	57%	91%	96%	98%	100%	100%
6.Bontoala	68,000	69,000	69,000	70,000	70,000	71,000
	68,000	69,000	69,000	70,000	70,000	71,000
	34,000	57,000	59,000	62,000	65,000	69,000
	50%	83%	86%	89%	93%	97%
7.Tallo	86,000	102,000	107,000	116,000	127,000	133,000
	65,000	102,000	107,000	116,000	127,000	133,000
	20,000	80,000	87,000	97,000	113,000	123,000
	23%	78%	81%	84%	89%	92%
8.Ujung Tanah	44,000	47,000	48,000	50,000	52,000	53,000
	36,000	38,000	39,000	41,000	42,000	43,000
	18,000	35,000	37,000	39,000	42,000	43,000
	42%	74%	77%	78%	81%	81%
9.Panakkukang	80,000	130,000	143,000	164,000	199,000	235,000
	53,000	93,000	120,000	155,000	195,000	233,000
	24,000	75,000	88,000	113,000	157,000	198,000
	30%	58%	62%	69%	79%	84%
a/Karuwisi	23,000	31,000	32,000	34,000	36,000	39,000
	18,000	31,000	32,000	34,000	36,000	39,000
	8,000	26,000	27,000	30,000	33,000	37,000
	35%	84%	84%	88%	92%	95%
b/Panaikang	35,000	51,000	56,000	62,000	67,000	71,000
	25,000	51,000	56,000	62,000	67,000	71,000
	11,000	40,000	45,000	52,000	60,000	66,000
	31%	78%	80%	84%	90%	93%
c/Tallo Baru	11,000	15,000	17,000	22,000	42,000	51,000
	10,000	11,000	16,000	22,000	42,000	51,000
	5,000	9,000	11,000	14,000	29,000	38,000
	45%	60%	65%	64%	69%	75%
d/Antang	5,000	10,000	10,000	10,000	11,000	12,000
	0	0	2,000	8,000	9,000	11,000
	0	0	1,000	3,000	7,000	9,000
	0%	0%	10%	30%	64%	75%
e/Tamangapa	6,000	23,000	28,000	36,000	43,000	62,000
	0	0	14,000	29,000	41,000	61,000
	0	0	4,000	14,000	28,000	48,000
	0%	0%	14%	39%	65%	77%

KECAMATAN/KELURAHAN	1983	1990	1992	1995	2000	2005
10.Tamalate	130,000	196,000	217,000	248,000	302,000	358,000
	83,000	188,000	209,000	240,000	294,000	350,000
	46,000	155,000	174,000	203,000	260,000	330,000
	35%	79%	80%	82%	86%	92%
a/Mangngasa	15,000	39,000	44,000	51,000	66,000	84,000
	2,000	39,000	44,000	51,000	66,000	84,000
	1,000	30,000	34,000	40,000	56,000	78,000
	7%	77%	77%	78%	85%	93%
b/Rappocini	57,000	77,000	86,000	99,000	121,000	150,000
	53,000	77,000	86,000	99,000	121,000	150,000
	35,000	69,000	77,000	90,000	113,000	146,000
	61%	90%	90%	91%	93%	97%
c/Jongaya	33,000	41,000	45,000	51,000	55,000	59,000
	26,000	41,000	45,000	51,000	55,000	59,000
	10,000	34,000	38,000	43,000	48,000	55,000
	30%	83%	84%	84%	87%	93%
d/Macini Sombala	17,000	29,000	32,000	37,000	49,000	53,000
	0	29,000	32,000	37,000	49,000	53,000
	0	21,000	24,000	28,000	40,000	47,000
	0%	72%	75%	76%	82%	89%
e/Barombong	8,000	10,000	10,000	10,000	11,000	12,000
	0	2,000	2,000	2,000	3,000	4,000
	0	1,000	1,000	2,000	3,000	4,000
	0%	10%	10%	20%	27%	33%
11.Biringkanaya	35,000	47,000	51,000	57,000	68,000	79,000
	14,000	24,000	25,000	27,000	41,000	78,000
	6,000	15,000	16,000	18,000	26,000	50,000
	17%	32%	31%	32%	38%	63%
a/Daya	11,000	12,000	12,000	13,000	14,000	15,000
	7,000	11,000	11,000	12,000	13,000	15,000
	4,000	8,000	8,000	9,000	11,000	13,000
	36%	67%	67%	69%	79%	87%
b/Sudiang	6,000	8,000	11,000	15,000	22,000	30,000
	0	0	0	0	0	30,000
	0	0	0	0	0	12,000
	0%	0%	0%	0%	0%	40%
c/Bira	5,000	6,000	6,000	6,000	7,000	7,000
	0	0	0	0	6,000	6,000
	0	0	0	0	3,000	5,000
	0%	0%	0%	0%	43%	71%
d/Tamalanrea	7,000	13,000	14,000	15,000	16,000	17,000
	6,000	11,000	12,000	13,000	16,000	17,000
	2,000	6,000	7,000	8,000	10,000	13,000
	29%	46%	50%	53%	63%	76%
e/Bulurokeng	6,000	8,000	8,000	8,000	9,000	10,000
	1,000	2,000	2,000	2,000	6,000	10,000
	0	1,000	1,000	1,000	3,000	7,000
	0%	13%	13%	13%	33%	70%
TOTAL	768,000	927,000	976,000	1,050,000	1,171,000	1,286,000
	642,000	827,000	909,000	995,000	1,117,000	1,267,000
	262,000	695,000	752,000	840,000	995,000	1,157,000
	34%	75%	77%	80%	85%	90%

Note:

From top to bottom

1) Population

2) Population in Service Area

3) Served Population

4) Population Coverage [3)/ 1)]

III. WATER SOURCES STUDY

TABLE OF CONTENTS

1. INTRODUCTION

The objective of this study is to clarify the present condition of water sources for the water supply system in Kotamadya Ujung Pandang and to project a water source development plan until the target year of 2005, all based on review of the data prepared in previous studies and the collection and compilation of additional data.

The water source study, especially on surface water, was undertaken throughout Kotamadya Ujung Pandang and the surrounding area. The area (latitude 4°50' to 5°25' S and longitude 119°30' to 120 E) comprises the Maros, the Tallo and the Jeneberang river basins, and administratively covers Kotamadya Ujung Pandang and a part of Kabupatens Maros and Gowa in South Sulawesi Province (refer to Figure 1.1). The review of data on groundwater was done chiefly in Kotamadya Ujung Pandang due to limited data.

For the study on surface water, the JENEBERANG RIVER FLOOD CONTROL PROJECT (PHASE II) of March 1982 by JICA[1] and the DESIGN UNIT SOUTH SULAWESI of July 1982 by DHV[2] have provided the related information. As for the groundwater study, the LAPORAN KEMAJUAN KERJA, SURVEY GEOHIDROLOGY DAN PENDUGAAN GEOFISIKA AIR TANAH, KOTAMADYA UJUNG PANDANG of December 1983 by DPMA[3] and the KWALITAS AIR TANAH DI KOTAMADYA UJUNG PANDANG 1983 by LPGN[4] have supplied available data on existing shallow wells.

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1) Japan International Cooperation Agency

2) DHV Consulting Engineers

3) Direktorat Penyelidikan Masalah Air, Direktorat Jendral Pengairan

4) Lembaga Geologi dan Pertambangan Nasional, Lembaga Ilmu Pengetahuan Indonesia

2. NATURAL ENVIRONMENT

2.1 Topography

The area for the water sources survey is nearly 2,000 km^2, consisting of the Maros, the Tallo and the Jeneberang river basins. Most of the area covers the the flat land with elevations below 50 m and the rest which have relatively high elevations of 2,000 m to 3,000 m forms a part of the watershed of South Sulawesi Province dividing it into the east side and the west side.

The study area is situated in the west side and faces the Makassar Strait. The flat land that mainly comprises alluvial plains at an altitude of 1.0 m to 5.0 m above mean sea level spreads from the west coast to the east by some 20 km in width.

The Tallo River originates in a little hilly land in the eastern part and flows westward. The Maros and the Jeneberang rivers arise in the watershed which has high and steep mountain ranges, and also flow down to the west joining many tributaries.

2.2 Geology

Geology of the area is mainly classified into three groups; namely, i) neocene tertiary sedimentary rocks, ii) Lompobattang volcanic products of quaternary, and iii) alluvial deposits (refer to FIGURE 2-1).

Neocene tertiary sedimentary rocks, which are distributed in the middle reaches of the three rivers consist of pyroclastic rocks such as tuff, lapilli tuff and volcanic breccia, and some sedimentary rocks such as mudstone, silt and limestone. Lompobattang volcanic products are distributed in the upper reaches of the Jeneberang River and consist of andesite lava, tuff breccia and mud flows. Alluvial deposits are distributed on the plain lying in the flat land. These consolidated deposits consist of clay, sand and gravel.

Concerning the geological structure of the bedrock, pyroclastic rocks and marine sedimentary rocks were firstly deposited. After then, volcanic products appeared and alluvial deposits such as river gravel and sand covered these bedrocks.

The groundwater level in the urban area of Kotamadya Ujung Pandang is between 0 m to 2.0 m above the mean sea level and its adjacent area. In the northeastern part of Kotamadya Ujung Pandang, it is relatively high with 4.0 m to 5.0 m above the mean sea level. During dry season, groundwater level falls by as much as 1.0 m to 3.0 m from that of the rainy season. The decline of the water table in the hilly land is bigger than that in the urban area.

2.3 Climate

Climatic conditions in the area are dominated by tropical monsoons, having distinct dry and rainy seasons. Climate in the area is affected by two different climatic patterns; namely, the northeast monsoon which blows from north to east between November to March, and the southwest monsoon blowing from the east on the Sulawesi Island between May and August.

In the west coastal area where kotamadya Ujung Pandang is located, the northeast monsoon brings much rainfall during its dominant season; hence, this period is defined as the rainy season. On the other hand, the southwest monsoon brings less rainfall than the northeast monsoon and the corresponding period consists of the dry season.

Rainfall data are available at 12 gauging stations in and around the study area. (Refer to FIGURE 2-2.)

Other meteorological data observations were carried out in the 5 stations of Maros, Hasanuddin, Panakkukang, Bontobili and Bontosunggu. FIGURE 2-2 shows the location of these stations and TABLE 2-2 presents their meteorological observation items.

<u>Rainfall</u>

The isohyetal map was drawn based on the mean annual rainfall at the 12 gauging stations mentioned above, as shown in FIGURE 2-2 (refer to TABLE 2-1). The mean annual rainfall is estimated at 4,000 mm in the mountainous area and 3,000 mm in the coastal area. The rainfall is distributed into two distinct seasons; a rainy season with 75% of the annual rainfall from November to April, and a dry season, from May to October. Monthly rainfall distribution at 6 major stations are presented in FIGURE 2-3.

Relatively long rainfall records are available at Salojirang, Batu Bassi, Ujung Pandang, Sungguminasa and Kampili stations. Their mean monthly rainfalls from 1971 to 1983 are presented in TABLE 2-3. From their past rainfall records during the dry season, it is inferred that the droughtiest year in recent years occurred in 1972 or 1982 and the next was in the year of 1976 or 1980, in and around the study area.

Temperature

The temperature fluctuates minimally through the year and the mean monthly figures of average daily data ranges between 24°C and 28°C. These figures are compiled in TABLE 2-4.

Relative Humidity

The mean monthly relative humidity is about 85% in the rainy season and about 75% in the dry season, with minimal seasonal change. The figures are presented in TABLE 2-5.

Wind

Wind velocity is measured at the three stations of Hasanuddin, Bontobili and Bontosunggu, as shown in TABLE 2-6. From the records available, it is known that Bontosunggu Station receives extremely stronger wind than both Hasanuddin and Bontobili stations.

Sunshine

TABLE 2-7 shows the longest sunshine hour of about 9 hours in August and September and the shortest of about 4 hours in Jaunuary and February. The mean annual sunshine hour is about 7 hours.

Pan-evaporation

The annual pan-evaporation ranges from 1,800 mm/year to 2,200 mm/year. The highest pan-evaporation of about 7 mm/day occurs in September to October, and the lowest is about 4 mm/day in February to March. These figures are shown in TABLE 2-8.

3. PRESENT CONDITION

3.1 Surface Water

Surface water sources for the Kotamadya Ujung Pandang water supply system currently consist of two different origins. One is the Maros river water, which is taken by the weir at Leko Pancing about 30 km northeast of Ujung Pandang, and the other is the Jeneberang river water, which is pumped up at the intake tower immediately below the Sungguminasa bridge. At present, the Maros River supplies more than 90% of all surface water sources.

The surface water survey of this study was conducted in the area covering the Maros, the Tallo and the Jeneberang river basins, mainly at the existing two intake sites. FIGURE 3-1 shows the area covered by the surface water survey.

3.1.1 Maros River

Features

The Maros River with a catchment basin of approximately 650 km^2 and a length of approximately 80 km originates in the Lawekang Mountain (1,361 m). In its upper reaches, the river runs down from east to west through a feather-shaped mountainous region having limestones and porous rocks. In the middle reaches, the main stream joins many tributaries and changes its course towards the northeast. Then it joins one of the tributaries, which is the Bantimurung River with a catchment basin of approximately 150 km^2, at a distance of approximately 20 km from the river mouth. Meandering through Maros City in the flat land, it finally pours into the Makassar Strait. Its alignment and longitudinal profile are shown in FIGURES 3-1 and 3-2, respectively.

Discharge

Two stream stage gauges are installed in the Maros river basin, as shown in FIGURE 3-3. One is located at Tompo Bulu about 1.0 km upstream of the Leko Pancing Weir and the other is in the upper reaches of the Bantimurung River.

As for the Bantimurung Gauge, stream stage records are not available because a lot of individual discharge measurements deviate from the mean stage-discharge relation due to backwater effect by the Batu Bassi Weir which is situated about 2.0 km downstream of the gauge.

The discharge measurement at Tompo Bulu has been conducted 75 times since 1977. The result shows that the riverbed is stable, and the gauging range has been limited to not so low stage of the river water. The estimated rating curve is shown in Equation (3.1); however, it should be noted that the rating curve has low accurary for estimating the discharge at very low stream stage and high stream stage.

Equation	Range	Applicable Period	
$Q = 4.55\ (H+0.21)^2$	$H \leq 0.44$ m	1976 to 1983)	..(3.1)
$Q = 51.18\ (H-0.24)^2$	$H > 0.44$ m	1976 to 1983)	

where,

Q : discharge at Tompo Bulu in m^3/sec

H : gauge reading in m

By means of this rating curve, the continuously measured water levels were converted into discharge values, and the results are tabulated in the form of monthly mean discharge in TABLE 3-1.

The rainy season flow appears from December to April or May. The drought flow appears from July to November, and the minimum value, which normally sets a limit to water supply potential, occurs in the end of October.

River Utilization

The river water in the upper reaches of the Maros is utilized for the said water supply in Ujung Pandang and irrigation by the weir at Leko Pancing. At Samanggi and Batu Bassi in the Bantimurung River, the water is taken for irrigation. Along the whole river course, the river plays an effective role in the transportation system, especially for bamboos.

3.1.2 Jeneberang River

Features

The Jeneberang River arises in the Bawakaraeng Mountain (2,833 m), and has a catchment basin of 727 km^2 and a length of 75 km. In its upper reaches, the river runs down through a feather-shaped mountainous region with a natural vegetation of some tall trees. In its upper reaches, there remains a collapse whose scar has been kept unhealed for an unknown period of time. The collapse had produced sediments which have mostly caused the rise of the riverbed level of the Jeneberang.

Gathering many small tributaries and changing its course towards the southwest, the river joins the

Jenelata River at about 1.0 km downstream of the Bili-Bili gauging station. Then, the river enters its lower reaches which is spreading an alluvial fan on both the right and the left banks. On its right bank, Kotamadya Ujung Pandang came to shape itself in the vicinity of the sea and an agricultural land extends towards the mountainous area. The left bank consists of an extension of a fertile agricultural land. The river's alignment and longitudinal profile are shown in FIGURES 3-1 and 3-2, respectively.

Discharge

Four stream stage gauges have been provided along the Jeneberang River in the lower reaches from Bili-Bili. The location of these gauging stations are shown in FIGURE 3-3.

Stream stage records are available for conversion to discharge values at the three gauges; namely, Bili-Bili and Jenelata automatic gauges, as well as the Jenelata manual gauge. Those of Sungguminasa gauges are not available especially at low flows, because the stage-discharge relations are not reliable due to severe riverbed fluctuation by sand excavation and poor operation.

Discharge measurement has been carried out at Bili-Bili 40 times since 1981. The rating curve at this site was estimated on the basis of the discharge measurement results and is given in Equation (3.2). This curve has low accuracy, same as the Tompo Bulu's, for estimating the discharge at very low stream stage and high stream stage.

Equation	Range	Applicable Period	
$Q = 7.08\ (H+0.64)^2$	$H \leq 0.06$ m	1981 to 1983)	..(3.2)
$Q = 57.49\ (H-0.17)^2$	$H > 0.06$ m	1981 to 1983)	

where,

Q : discharge at Bili-Bili in m^3/sec

H : gauge reading in m

TABLE 3-2 presents the mean monthly discharge converted from stream stage records.

At the Jenelata manual gauge, discharge measurement had been made 20 times from 1979 to 1980, and the gauge was abandoned in 1981. The automatic gauge of Jenelata was built at almost the same place as the manual gauge in 1980 and discharge measurement has been conducted 33 times since 1981. Each rating curve was estimated on the basis of each discharge measurement results, as shown in Equation (3.3) and (3.4), respectively. These curves have low accuracy at very low stream stage and high stream stage as in the abovementioned curves.

For Manual Gauge:

Equation	Range	Applicable Period	
$Q = 6.88\ (H+0.27)^2$	$H \leq 0.48$ m	1978 to 1980)	..(3.3)
$Q = 20.58\ (H-0.04)^2$	$H > 0.48$ m	1978 to 1980)	

For Automatic Gauge:

Equation	Range	Applicable Period	
$Q = 5.94\ (H-0.03)^2$	$H \leq 0.86$ m	1981 to 1983)	..(3.4)
$Q = 19.94\ (H-0.41)^2$	$H > 0.86$ m	1981 to 1983)	

where,

Q : discharge of the Jenelata in m^3/sec
H : gauge reading in m

The mean monthly discharge values at the Jenelata gauges are presented in TABLE 3-3.

River Utilization

The Jeneberang river water is utilized for irrigation at the Bili-Bili and Kampili intakes, water supply for Katamadya Ujung Pandang and Kota Sungguminasa, industrial water for the Gowa Paper Factory, and storage for fishponds in the vicinity of the estuary.

At a few points, people are ferried across the river. Quarrying and sand collection is briskly carried on along the river course mainly during the dry season.

3.1.3 Tallo River

Features

The Tallo River, flowing from east to west between the Maros and the Jeneberang rivers, has a catchment basin of 432 km^2 and a length of approximately

70 km. The river originates in Leran-Leran Mountain (612 m) and gathers many small streams in the middle reaches.

The Tallo River with a sluggish riverbed gradient is a tidal river. The stretch under tidal influence extends nearly 20 km from the estuary. The river meanders through the swampland and flows down into the Makassar Strait.

Its alignment and longitudinal profile are shown in FIGURES 3-1 and 3-2, respectively.

Discharge

A staff gauge is installed beside the PLTU Thermal Power Plant at Tello, as shown in FIGURE 3-3. However, stream stage observation has never been conducted.

River Utilization

The Tallo River, as a whole, is being utilized as a drain. In the middle reaches, the waste water from the Gowa Paper Factory pours into one of the tributaries and in the lower reaches a great deal of industrial and domestic waste water are discharged into the river.

Although the Tallo River is contaminated and saline, a part of the river water is utilized for the thermal power plant as cooling water and storage for fishponds in the vicinity of the river mouth. As described before, Tallo River has a sluggish gradient and is used for boat and bamboo transportation.

3.1.4 Lakes and Fishponds

Lakes

There are two lakes which have relatively large storage capacities in the southeast of Kota Sungguminasa and on the right bank of the Jeneberang River. They are the Mawang and the Tonjong lakes and their locations are shown in FIGURE 3-1. Their water mostly depend on rainfall and there is no conspicuous stream that pours into them.

According to the information received from inhabitants near the lakes, these lakes practically dried up during the past severe drought periods in 1972 and 1982.

The principal features of these lakes are presented below.

	Mawang	Tonjong
Location/Administration	Desa Tamarunang/ Kabupaten Gowa	Desa Tamarunang/ Kabupaten Gowa
Surface Area[1)]	70,000 m^2	300,000 m^2
Maximum Depth[2)]	1.75 m	1.5 m
Storage Capacity[3)]	1,000,000 m^3	300,000 m^3
Usage	Fishery, recreation and boat transportation	Fishery

1) Surface areas were estimated from the topographic map prepared by JICA in 1981.

2) Maximum depths were obtained from the field survey by the Study Team.

3) Storage capacities were estimated by the Study Team.

Fishponds

There are many fishponds in the surrounding area of Kotamadya Ujung Pandang, especially in the lower reaches of the Maros and the Tallo rivers and around the river mouth of the Jeneberang. In Kotamadya Ujung Pandang, the area of fishponds extends to about 10% of all the administration area.

At fishponds, generally salty river water is utilized for shrimp and fish propagation. Most of the fishponds are surrounded by dikes of 1.0 m to 2.0 m in height. From the topographic map prepared by JICA in 1981, the surface area of a typical fishpond was presumed to be some 10,000 m^2. The principal features of fishponds by river basin were estimated based on the statistics of the Directorate General of Agriculture in South Sulawesi, as follows:

	River Basin		
	Maros	Tallo	Jeneberang
Total Surface Area	6,400 ha	1,100 ha	400 ha
Average Depth	1.0 m	1.0 m	0.5 m
Total Storage Capacity	$64 \times 10^6 m^3$	$11 \times 10^6 m^3$	$2 \times 10^6 m^3$

3.2 Groundwater

For the people in Kotamadya Ujung Pandang, groundwater is considered to be an indispensable water source in the present circumstance of low diffusion rate of piped water supply system. It is utilized as a private water source through dug shallow wells, drilled deep wells and springs.

3.2.1 Shallow Well

Shallow wells, which depend on unconfined groundwater and which have depths of under 15 m, are found all over the whole area of Kotamadya Ujung Pandang. The Study Team presumed that there are approximately 50,000 shallow wells in the area covering more than 95% of the number of wells.

The people in this area have used shallow wells as an important water source for their daily needs since olden times, and now, even the inhabitants who live in the district served by piped water have shallow wells as a dependable water source. A typical shallow well for domestic use in the urban area has some 1.0 m in diameter with 3.0 m to 5.0 m in depth.

In the densely populated area and the suburbs of Kotamadya Ujung Pandang, shallow wells are utilized as a common well. The yield of one domestic well ranges from about 0.2 l/sec to over 2.0 l/sec. A typical shape of shallow well with some 2.0 m in diameter and 5.0 m to 10.0 m in depth is shown in FIGURE 3-4.

3.2.2 Deep Well

Deep wells, which are drilled by machines, are costly so that most of them are installed only at the public utilities; namely, hospitals, schools and factories. These wells, with 30 m to 90 m in depth, are distributed on the relatively high lands such as the Daya and the Mandai districts of Kec. Biringkanaya and a part of Kec. Panakkukang, where yields of shallow wells often decrease to a critical volume during the dry season.

Until now, artesian groundwater has not been detected in and around Kotamadya Ujung Pandang. Accordingly, there is no artesian well, and people in general use groundwater which is pumped up from deep wells and stored in tanks for their daily needs (refer to FIGURE 3-4).

A general description of the major deep wells in an around Koamadya Ujung Pandang is presented in TABLE 3-4. This table shows that the average pumpage of a deep well ranges from 1.0 l/sec to 3.0 l/sec, which is not so much when compared with the yield of a shallow well.

3.2.3 Spring

There are a few springs at Sudiang, a district in Kec. Biringkanaya, but they are not artesian springs and generally, they are used in the same manner as a shallow well (refer to FIGURE 4-8).

According to the information received from the inhabitants, the springs did not dry up even in the past severe drought year of 1972 and 1982, so that some people at Daya District, where shallow wells tend to dry up during the dry season, came to Sudiang to take water for their daily necessities. However, utilizable water volume of springs will not be expected so much, judging from the existing scale of springs and their seepage conditions.

3.3 Water Utilization System

A schematic diagram of the water utilization system in and around the project area is shown in

FIGURE 3-5. In the diagram, figures of river discharge present the minimum values during the dry season in 1976. Available raw water for water supply are values of a 5-year probability, which were estimated in the following chapter, and nearly correspond to the estimated minimum quantity of water intake in 1976.

Along the Bantimurung River in the Maros basin, paddy fields of approximately 7,000 ha in total is being irrigated by the Samanggi and the Batu Bassi irrigation systems. The Leko Pancing Weir is the only regular intake facility located in the upper reaches of the Maros River, so that it can draw natural river flow by as much as its intake capacity. The water taken at the weir is conveyed to the Panaekang Treatment Plant by the transmission channel. Although there are two irrigation offtakes along the channel, the water is only diverted for irrigation when there is a surplus to the water supply requirement. The irrigation area that depends on the channel accounts for approximately 4,000 ha.

In the case of the Tallo River, the Tello Thermal Plant of PLTU uses the river water of 2,400 m^3/hour (0.67 m^3/sec) for cooling the generator throughout the year.

Water utilization of the Jeneberang River is done in the main river after it joins the Jenelata River. TABLE 3-5 presents the mean monthly discharge at the confluence.

The Bili-Bili Intake is located immediately below the confluence point. The intake is not provided with any weir except a makeshift barrage of piled cobblestones on the riverbed. About 5,000 ha of paddy fields are being irrigated by the existing Bili-Bili system.

The Kampili Weir is situated at about 7.5 km downstream of the above-mentioned Bili-Bili intake structure. It has a fixed weir on the foundation rock which is outcropped from the riverbed. The Kampili system is irrigating about 19,000 ha of paddy fields.

The Jeneberang river water decrease so much during the dry season that irrigation water demand for paddy cultivation is available only for about 10% of all paddy fields. The average water requirement for the paddy fields from May to September was estimated to be 1.375 l/sec/ha (refer to the report, JENEBERANG FLOOD CONTROL PROJECT, PHASE II, March 1982, JICA). Consequently, the average quantity of water intake at Bili-Bili and Kampili from May to September were estimated at 0.69 m^3/sec and 2.61 m^3/sec, respectively.

The Gowa Paper Factory Intake, which is equipped with an intake gate, is located at about 5.0 km downstream of the Kampili Weir, and the Kota Sungguminasa municipal intake tower is installed at about 6.5 km downstream of the paper factory structure. According to the information received from the persons concerned, although both intakes can secure the quantity of water by as much as the demand in the rainy season of 0.25 m^3/sec and 0.004 m^3/sec, respectively, their actual intake rates during the dry season decreases to some 70% of each demand due to the decrease in the river discharge.

At the Sungguminasa intake point of PDAM, the river discharge was estimated by deducting the sum of the quantities of water intake mentioned above from the river discharge at the confluence point of the Jeneberang and Jenelata rivers. During the dry season, the available water that can be taken at Sungguminasa is only a part of the river flow, because the river spreads out widely and some of the water infiltrates into a great deal of sediment as riverbed water.

As for groundwater usage, there is much difference between areas served with piped water and those without it. Groundwater use in the piped water served area is limited to miscellaneous purposes aside from drinking and cooking, while in the other area, it is utilized for all purposes of daily life. Based on the field survey results conducted by the Study Team, the total daily usage volume of groundwater in Kotamadya Ujung Pandang is estimated to be ranging from 60,000 m^3/day to 90,000 m^3/day (refer to the study report, HOUSEHOLD SURVEY).

3.4 Water Management

3.4.1 Management System

Water management in Indonesia is undertaken by the Ministry of Public Works and also provincially by the regional governments in accordance with the GOI regulation concerning water management system.

In and around the project area, the Directorate General of Water Resources Development of South Sulawesi (DGWRDSS), Ministry of Public Works, practically deals with the various affairs on water and water resources such as irrigation, flood prevention, water utilization right, and so on. This agency also conducts operation and maintenance for existing irrigation facilities through sub-agencies; namely, the Seksi Pengairan Maros in Kab. Maros and the Seksi Pengairan Gowa Takalar in Kab. Gowa. Hydrological observation and data analysis are carried out by the Penyelidikan Masalah Air (PMA), which is a section under DGWRDSS.

With regard to groundwater, there is no specific agency in Kotamadya Ujung Pandang being responsible for well installation and administration, though groundwater investigations in Kotamadya Ujung Pandang have been done by the Direktorat Penyelidikan Masalah Air (DPMA) and other agencies of the central government. However, permission for drilled deep well installations, which are small in number, is secured from the Kantor Wilayah Departemen Pertambangan dan Energi Propinsi Sulawesi Selatan.

3.4.2 Actual Condition of Water Usage

Although river water is mostly taken by means of irrigation intake facilities, it is not necessarily used only for agriculture. Part of the water taken through the irrigation system is generally used as domestic water by the inhabitants along the existing irrigation channels. Occasionally, control gates at irrigation systems are operated with a request besides irrigation water requirements. This situation was ascertained from not only the information received from the persons concerned but also from the discharge observation records at the irrigation channels, where water requirements for irrigation do not appear from September to October in an ordinary dry season based on the present cropping schedule of paddy fields around the project area.

Needless to bring forward a case of the Sungguminasa Intake in the Jeneberang River, the quantity of water intake at the lower reaches is generally dominated by the upper's water intake rates. According to circumstances, the lower intake pumps are obliged to stop operation due to critically low river flow during the dry season.

To settle these situations, it is necessary to define water rights based on each legal quantity of water intake and to use limited river water effectively and orderly among the authorities concerned.

4. WATER SUPPLY POTENTIAL

4.1 Surface Water

In this section, the water supply potential of surface water will be studied on the Maros and the Jeneberang rivers, chiefly at existing intake sites, on the basis of river discharge data and field survey results.

4.1.1 Maros River

The water supply potential of the Maros River was examined from three viewpoints, as follows:

1) Existing water supply capacity at Leko Pancing

2) River water development in the Bantimurung River

3) River water development in the downstream after joining the Maros and the Bantimurung rivers

Judging from the study results mentioned below, there is no possibility of new water source development in the Maros River.

1) To define the critical river discharge of the Maros at Tompo Bulu during dry periods, the frequency curve was set by plotting the annual minimum discharge on the normal probability paper. The flow regime and the flow duration curve at Tompo Bulu is presented in FIGURES 4-1 and 4-2, respectively. FIGURE 4-3 shows the probable minimum discharge at Tompo Bulu. From the discharges at Tompo Bulu and at

the starting point of the transmission channel for the Panaikang Treatment Plant in the dry season of 1982, it was estimated that the available water at Leko Pancing is approximately 70% of the river discharge at Tompo Bulu. Each probable minimum discharge by return period was estimated based on the relation of both points, as shown below.

Return Period (Year)	River Discharge at Tompo Bulu (l/sec)	Raw Water Available for Water Supply at Leko Pancing Weir (l/sec)
20	600	420
10	850	600
5	1,280	900
2.5	1,700	1,190
2	1,940	1,360

In this study, it was judged appropriate to adopt a 5-year probability as the basic year for the Master Plan Study taking similar planning of other cities in Indonesia, Bili-Bili Dam planning, and economical project scale into consideration. Consequently, the discharge of 900 l/sec, which corresponds to the value of a 5-year probability, was determined as the available raw water of the basic year at Leko Pancing.

2) As described in the previous chapter, the Maros joins the Bantimurung River in the lower reaches. Along the Bantimurung River, there are vast irrigation areas depending on the existing two intake systems so that there is little hope of getting water from the river water after taking irrigation water, especially during dry periods. According to the information received from the people concerned in irrigation, the irrigation area along the Bantimurung River suffered

from water shortage during the dry periods of 1982. Only half of the area of paddy fields was irrigated, as compared with the area irrigated in ordinary dry seasons.

3) As for the downstream part of the confluence of the Maros and the Bantimurung rivers, the river water is not available for water supply due to sea water intrusion.

4.1.2 Jeneberang River

The water supply potential of the Jeneberang River was studied from the following three points:

1) Existing water supply capacity at Sungguminasa

2) On-going water resources development plan (Bili-Bili Dam)

3) River water development in the Jenelata River

Judging from the study results mentioned below, there is no possibility of a new water source development except the Bili-Bili Dam.

1) To clarify the critical low flow at Sungguminasa during dry periods, the frequency curve was drawn on the log-normal probability paper by the plotting position formula. The river discharge at Sungguminasa was estimated taking into account the water utilization system mentioned in the previous chapter, as presented in TABLE 4-1 and FIGURE 4-4. The probable minimum discharge at Sungguminasa is shown in FIGURE 4-5. From the relation between the pumps'

operation records at Sungguminasa and the river discharge, it was presumed that raw water available for water supply from the Jeneberang is approximately 30% of the river discharge. Probable minimum discharges by return period were estimated based on the relation of two points as presented below.

Return Period (Year)	River Discharge at Sungguminasa (l/sec)	Raw Water Available for Water Supply at Sungguminasa (l/sec)
20	90	25
10	140	40
5	250	75
2.5	500	150
2	660	200

Through the same approach of the Maros to the basic year, the discharge of 75 l/sec corresponding to a 5-year probability was determined as the available raw water at the Sungguminasa Intake.

2) Water utilization of the Jeneberang during the dry season reaches the limit of river water capacity, so that the Bili-Bili Dam Project in the middle reaches of the Jeneberang has been considered as a water resources development plan. In 1982, the feasibility study of Bili-Bili Dam was carried out as a multipurpose project by JICA. The proposed Bili-Bili Dam was planned at the 31 km point away from the Jeneberang river mouth to achieve the desired objectives such as flood control function, municipal and industrial water supply and increment of rice production and power generation. The dam was planned to contain water amounting to 258 x 10^6 m^3, with available discharge quantity for multipurpose use totaling

31.6 m^3/sec, of which 2.3 m^3/sec was allocated for water supply, based on the raw water demand in 2000.

3) With regard to the Jenelata River, it is impossible to use natural river flow because the Bili-Bili Dam Project was studied by taking into account the Jenelata river flow.

4.2 Groundwater

Until now, in Kotamadya Ujung Pandang some hydro-geological investigations such as the existing well survey, electrical resistivity survey, drilling test and pumping test have been conducted by authorities concerned; namely, DPMA, LGPN and KANTOR WILAYAH DEPARTEMEN PERTAMBANGAN DAN ENERGI. In this section, the availability of groundwater for public water source will be studied based on the said previous survey results.

4.2.1 Groundwater Investigations

From the survey results of existing shallow wells by DPMA, the Study Team plotted the electrical conductivity distribution map and the water table contour map. They are shown in FIGURES 4-6 and 4-7, respectively. The area with high electrical conductivities (more than 1,000   /cm) is mostly situated in the area where water tables of wells are below the mean sea level. This shows that sea water intrusion are distributed widely to the inland area of Kotamadya Ujung Pandang through the Tallo and the Jeneberang rivers.

Electrical resistivity survey and sampling of boring core were done in the relatively wide range of Kotamadya Ujung Pandang. According to the survey results, tertiary bedrock consisting of calcareous and sandstone are distributed as foundation of Kotamadya Ujung Pandang. Its electrical specific resistivity is 10 ohm-m to 70 ohm-m. Alluvial deposits with 10 m to 30 m in thickness lie on the bedrock. The deposits are composed of 4 layers such as topsoil, sand, silt and clay. The electrical specific resistivity of topsoil is below 10 ohm-m and it implies seawater intrusion. Although the sand layer with not so small electrical specific resistivity is considered as an aquifer without salinity, it has little possibility to extract a large quantity of groundwater due to its relatively thin layer of 5.0 m to 10 m in the project area.

Based on the hydro-geological conditions mentioned above and the results of the field survey by the Study Team, the area where groundwater was not available for domestic use was identified, as shown in FIGURE 4-8.

4.2.2 Well Capacity Estimate

Yield of a Shallow Well

Generally, the yield of a shallow well, depending on unconfined groundwater and lying on impervious layer, will be roughly estimated by the following Thiem formula.

$$Q = \frac{\pi \cdot K (H^2 - h^2)}{\log (R/r)} \qquad \text{..............(4.1)}$$

where,

Q : yield (m^3/sec)
K : coefficient of permeability (m/sec)

H : thickness of aquifer (m)

h : depth from water table to impervious layer (m)

R : radius of influence (m)

r : radius of well (m)

The value of yield that can be calculated by this formula is mostly dominated by the coefficient of permeability of aquifer. In this case, a typical shallow well was assumed based on the data on hand (refer to TABLE 4-2) and field survey results, and the following values were applied:

$$K = 1 \times 10^{-4} \; - \; 1 \times 10^{-3}$$
$$H = 5$$
$$h = 4$$
$$R = 50$$
$$r = 0.5$$

Consequently, the yield of a shallow well will be;

$$Q = 0.0006 \ m^3/sec \; - \; 0.006 \ m^3/sec$$
$$= 0.6 \ l/sec \; - \; 6.0 \ l/sec$$

Pumping Test

In the well survey by DPMA in 1983, pumping tests of shallow wells were executed from various soil conditions. According to the results, as shown in TABLE 4-2, a constant water discharge from a well was measured ranging from 0.25 l/sec to 5.0 l/sec. Consequently, DPMA concluded that the average water production of a shallow well was about 0.5 l/sec.

Judging from the results mentioned above, the yield of a shallow well is very poor, so that a lot of well installations will be required if groundwater is utilized for public water supply system to meet water requirements in the future.

4.3 Available Water Sources

According to the study results up to this section, available surface water sources for water supply are 900 l/sec from the Maros River and 75 l/sec from the Jeneberang River. The available discharge quantity will be allocated from the Bili-Bili Dam.

To develop a water source to more than the natural river flow, dam construction with a reservoir will be considered. In the Maros river basin, this plan is technically impossible because topographic and geological conditions are not suitable for dam construction; i.e., the flat land spread out, and porous and weak limestones are distributed as foundation rocks. As for the Jeneberang river basin, although a damsite will be considered in the Jenelata River at just upstream of the confluence of the Jeneberang and the Jenelata, dam construction at this site is so costly that this plan is financially unfeasible at present.

On the other hand, groundwater is not advisable to be adopted as a water source for the PDMA water supply system, because it is impossible to secure a great deal of water quantity in the Kotamadya Ujung Pandang area due to thin aquifer and relatively low permeability. Therefore, only surface water should be considered as an available water source for the future water supply system in Kotamadya Ujung Pandang.

4.4 Tentative Water Sources

Tentative water sources will supply part of the water shortage during severe dry periods as supplementary or emergency water sources, though they cannot continue as water supply throughout the year or for a long term. In and around the project area, the following six (6) plans will be considered as tentative water sources. Among these plans, it is only the riverbed water of the Maros that appears to have a possibility, because it is not so costly and requires a relatively easier method to take in the water.

1) Riverbed water of the Maros River;
2) A storage basin construction beside the transmission channel;
3) Well installations along the transmission channel;
4) Riverbed water of the Jeneberang River;
5) Upper tributaries of the Tallo River; and
6) Storage water of Mawang and Tonjong lakes.

The locations of these plans are shown in FIGURE 4-9 and the principal characteristics of each plan are described as follows:

1) Riverbed Water of the Maros River

This plan is to take the riverbed water through an infiltration gallery, which will be installed at just upstream of the Leko Pancing Weir, and to discharge the water into the transmission channel by pumps. As for maintenance after construction, it is necessary to conduct periodical inspections for the prevention of clogging in the gallery. Although this plan is possible, its implementation should be considered based on geological and hydrological investigation results.

2) A Storage Basin Construction Beside the Transmission Channel

This plan consists of a storage basin construction to store the surplus water to water supply requirements through the transmission channel in the rainy season. During severe dry periods, the basin will discharge the stored water into the transmission channel by pumps. This plan is the surest method to supply water shortage, but it is so costly.

3) Well Installation Along the Transmission Channel

This plan is to dig many shallow wells along the transmission channel. During dry season, groundwater will be drawn by pumps and released into the channel. This plan requires the systematic operation and maintenance of many shallow wells, causing depletion of the yield of the existing shallow wells.

4) Riverbed Water of the Jeneberang River

This plan is to install an infiltration gallery in the vicinity of the Sungguminasa Intake and to increase the quantity of water intake from the Jeneberang River. Around Sungguminasa, a great deal of sediment deposits exist so that clogging of the infiltration gallery will easily occur. The structure will be required to be stable against large river flow in the rainy season.

5) Upper Tributaries of the Tallo River

The transmission channel from the Leko Pancing Weir crosses two tributaries of the Tallo River by means of an inverted siphon. During dry season, the river water will be taken by pumps and discharged into the transmission channel. Due to non-availability of flow data on the Tallo River, the real conditions of the two streams in the dry season has not been clarified. Water quality is undesirable because industrial waste water flows into one of the Tallo tributaries. Hydrological and water quality investigations will be required before implementation of this plan.

6) Storage Water of Mawang and Tonjong Lakes

This plan is to pump up storage water of the two lakes and to send it to the transmission channel. Since storage water of these two lakes mostly depend on rainfall, they decrease to a small quantity during the severe dry periods and the water contains a lot of phytoplankton and turbidity, so that extra water treatment processes will be required to use the storage water for water supply.

Comparison of the tentative water sources mentioned above, including rough construction costs, are summarized in TABLE 4-3.

4.5 Water Sharing Arrangement

In consideration of the remoteness of a new water source for water supply, the utilization of the currently limited water resources deserves preferential consideration for development in the form of water sharing arrangement.

In Indonesia, Government Regulation No. 22-1982 requires that drinking water will be secured in preference to any other utilization purposes. Accordingly, the most practical solution to secure a water source for a steady water supply is the installation of new intake facilities upstream of the existing intake structures on the Maros and the Jeneberang rivers. In this case, a part of the irrigation water, etc., may be diverted for drinking water supply purposes according to the condition of the available river water, though this procedure of river water utilization is only a provisional measure until a dependable water source for drinking water supply is secured.

When the above-mentioned procedure is adopted, two sites are considered as suitable; one is the upstream of the Batu Bassi Weir on the Bantimurung River and the other is the upstream of the Kampili Weir on the Jeneberang River. Although data on the river flow of the Bantimurung are not sufficient, the minimum flow at Batu Bassi has been roughly estimated to have ranged from about 0.5 m^3/sec to 1.0 m^3/sec during the dry periods of 1982, the droughtiest year in the past 10 years, taking into account its catchment area of about 150 km^2 compared with the catchment area of 276.6 km^2 at Tompo Bulu on the same river system of the Maros (refer to TABLE 3-1). On the other hand, at the Kampili weir site with the catchment area of 623.7 km^2, the minimum flow has been estimated to have ranged from about 2.0 m^3/sec to 3.0 m^3/sec during the same periods of the Batu Bassi, according to the survey results of this water sources study (refer to TABLE 3-5.).

In carrying out the water sharing arrangement with regard to the available source for water supply from the flow regime of the two rivers, water resources management on water sharing for multiple purposes requires to be reviewed and discussed with the authorities concerned.

5. WATER SOURCES DEVELOPMENT PLAN

5.1 Raw Water Demand and Supply Planning

As described in the study report on WATER DEMAND, the future water requirements were estimated in a 5-year increment up to the target year of 2005. Raw water demand was also estimated through the same way taking account of transmission and distribution losses. FIGURE 5-1 shows raw water demand and available water source for the 1983-2005 periods.

There is no certain water source for a future water supply system in Kotamadya Ujung Pandang except the Bili-Bili Dam Reservoir to be constructed in the middle reaches of the Jeneberang River. Judging from the present state of the Bili-Bili Dam Project, the water will be supplied from the Bili-Bili Dam Reservoir at the beginning of 1996. At this point in time, the existing Sungguminasa intake facility in the Jeneberang River will be abandoned due to aged equipment, with the operation of the new water distribution system. FIGURE 5-1 also shows the Bili-Bili Dam construction schedule proposed in the Feasibility Study Report on THE JENEBERANG RIVER FLOOD CONTROL PROJECT.

The available water sources up to 1995 are the surface waters of the Maros and the Jeneberang rivers of 975 l/sec in total. Out of this capacity, 900 l/sec from the Maros River will be available in the future irrespective of the Bili-Bili dam construction. To meet the total raw water demand of 4,173 l/sec in the target year of 2005, approximately 3,273 l/sec of the deficit requires to be supplied from the reservoir storage of Bili-Bili Dam as a new water source.

5.2 Recommended Water Supply Planning Before Bili-Bili Dam Construction

According to the relation between raw water demand and supply capacity before the Bili-Bili dam construction, the maximum deficit appears to be approximately 1,200 l/sec at the end of 1995.

To avoid water shortage anticipated up to 1995, some countermeasures need to be executed, though they will probably fall into disuse after completion of Bili-Bili Dam. In the present condition of water sources in and around the project area, two kinds of countermeasures will be considered. One is to carry out several tentative water sources development plans mentioned in the previous chapter and the other is to extract raw water upstream of existing irrigation diversion works of the Bantimurung or the Jeneberang rivers through water sharing arrangement based on the GOI Regulation No. 22 of 1982.

Judging from the reasons mentioned below, to take river water upstream of existing irrigation intake facilities of the Jeneberang River through water sharing arrangement is recommended as a provisional water supply method until Bili-Bili Dam will be able to fulfill its function.

1) Tentative water source development plans appear to have a lot of insecurity toward water supply capacity and require various investigations into geological and hydrological matters for their implementation. Consequently, it will take much time before they come into effect.

2) On the basis of the entire water supply plan of this project taking into account the conveyance route from Bili-Bili Dam, the utilization of the Jeneberang river water is more economical than the utilization of the Bantimurung river water due to short access to the nearest treatment plant.

3) Although discharges of the Bantimurung River are obscure, it is presumed that river flow of the Jeneberang River is a bit more abundant than that of the Bantimurung River comparing these two river's catchment area upstream of the existing irrigation diversions.

The schematic diagrams of water source development plans up to 1995 and for the 1996-2005 periods are presented in FIGURES 5-2 and 5-3, respectively.

In the meantime, the withdrawal of irrigation water for water supply, especially in severe dry seasons, may give some effects to the livelihood of households who rely on the raw water of the irrigation canal. These conditions, although suspected to take place during few weeks of 5 years, should be mitigated by conducting campaign on reduction of wasteful water use and by suppling piped water to those people.

TABLE 2-1. MEAN MONTHLY RAINFALL IN AND AROUND STUDY AREA

Ref. No.	Station	Adminis-tration	Calculation Period	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1	Salojirang	PMA	1974-1983	783	729	540	234	165	107	86	25	68	166	330	653	3886
2	Batu Bassi	PMA	1974-1983	628	450	393	275	156	114	71	18	60	127	422	628	3342
3	Ujung Pandang (Makassar)	PMA (BMG)	1974-1983	750	588	444	181	90	60	47	7	20	74	246	579	3086
4	Senre	PMA	1975-1983	627	592	345	244	168	70	33	14	40	132	304	535	3104
5	Sungguminasa	BMG E.P.	1974-1983	635	594	324	146	104	57	53	8	22	57	224	544	2768
6	Borongloe	E.P.	1975-1983	672	600	321	239	134	60	18	16	42	99	216	520	2937
7	Kampili	PMA	1974-1983	530	382	247	162	88	55	39	6	33	77	228	470	2327
8	Intake Bili-Bili	PMA	1975-1983	675	636	346	258	136	67	66	20	46	74	301	610	3235
9	Malino	PMA	1975-1983	675	669	461	464	267	176	77	32	57	132	289	679	3978
10	Julu Bori	E.P.	1975-1983	577	510	349	163	100	39	22	6	27	39	191	410	2433
11	Mandalle	E.P.	1975-1983	715	616	287	89	101	47	31	8	14	34	267	695	2904
12	Macini Baji	E.P.	1975-1983	776	653	373	164	106	66	55	14	49	57	208	484	3005

PMA : Penyelidikan Masalah Air

BMG : Badan Meteorologi & Geofisika

E.P.: Exploitasi & Pemeliharaan

TABLE 2-2. METEOROLOGICAL DATA IN AND AROUND STUDY AREA

Station	Start of Observation	Item of observation					Administration
		Temper-ature	Sunshine	Relative Humidity	Wind	Pan-Evaporation	
Maros	1975	0	0	0	-	0	LPPM
Hasanuddin	1971	0	0	0	0	-	BMG
Panakukkang	1971	0	0	0	-	-	BMG
Bontobili	1980	0	0	0	0	0	PMA
Bonto Sunggu	1977	0	0	0	0	0	PMA

LPPM - Lembaga Penelitian Pertanian Maros
BMG - Badan Meteorologi & Geofisika
PMA - Penyelidikan Masalah Air

0 : Data available
- : No observation

TABLE 2-3. MONTHLY RAINFALL (1)

Station: Salojirang   River Basin: Maros   Unit: mm

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1971	476	580	632	157	111	297	49	25	66	507	162	609	3671
1972	1136	524	339	67	28	0	0	12	0	9	98	361	2574
1973	837	129	446	395	155	81	102	59	208	55	858	628	3953
1974	458	806	581	123	134	35	123	79	158	285	493	603	3878
1975	518	313	532	516	110	97	145	48	230	351	527	726	4113
1976	922	602	460	11	61	156	3	0	0	293	427	704	3639
1977	1606	1873	605	413	260	213	0	44	0	0	139	601	5754
1978	837	870	749	280	349	231	374	43	229	216	422	920	5520
1979	1286	770	1120	313	340	144	2	0	1	59	184	665	4884
1980	595	664	474	162	37	6	1	11	0	145	158	761	3014
1981	660	647	257	197	121	53	205	0	53	-	496	886	3572
1982	636	577	523	127	67	3	0	0	0	0	0	251	2184
1983	310	166	98	198	161	128	5	-	8	149	457	408	-

- : No data available

TABLE 2-3. MONTHLY RAINFALL (2)

Station: Batu Bassi   River Basin: Maros   Unit: mm

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1971	383	551	602	125	168	292	108	3	79	617	250	452	3630
1972	1051	324	812	214	0	0	0	0	0	10	122	313	2846
1973	495	122	241	427	943	50	118	65	208	91	651	465	3876
1974	446	659	369	138	3	36	129	36	83	356	348	318	2921
1975	455	264	374	401	113	170	133	10	115	255	611	617	3526
1976	827	418	503	36	40	92	2	0	0	206	472	548	3144
1977	802	129	468	611	187	241	30	25	0	0	330	641	3469
1978	681	427	282	275	335	277	106	60	258	32	490	792	4103
1979	730	418	480	208	265	49	4	0	1	59	435	622	3271
1980	670	731	409	268	132	3	0	40	17	109	380	792	3472
1981	649	507	328	339	171	93	218	0	123	64	671	623	3786
1982	584	586	490	235	52	0	0	0	0	0	12	448	2407
1983	439	365	224	235	266	166	5	0	7	185	552	882	3326

TABLE 2-3. MONTHLY RAINFALL (3)

Station: Sungguminasa | River Basin: Jeneberang | Unit: mm

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1971	615	663	1319	-	-	11	12	2	85	-	-	-	-
1972	-	-	-	-	-	-	-	-	-	-	-	-	-
1973	581	40	272	146	80	4	28	1	78	21	573	-	-
1974	218	-	548	42	68	27	172	25	95	147	189	547	-
1975	513	306	403	168	72	31	76	32	95	252	382	517	2847
1976	834	524	382	5	46	45	0	0	0	87	328	445	2696
1977	1395	1473	195	268	21	55	0	0	0	0	114	510	4031
1978	499	595	252	225	356	209	174	18	23	25	113	559	3048
1979	695	728	430	103	144	143	0	0	0	14	112	668	3057
1980	708	513	330	254	117	13	0	0	0	34	74	948	2997
1981	719	515	196	51	95	18	108	0	11	9	-	591	-
1982	581	583	416	164	21	0	0	0	0	0	0	290	2055
1983	191	109	85	176	97	26	0	0	0	0	701	364	1749

- : No data available

TABLE 2-3. MONTHLY RAINFALL (4)

Station: Kampili | River Basin: Jeneberang | Unit: mm

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1971	-	-	-	134	72	141	63	-	-	-	-	385	-
1972	935	494	383	69	15	-	-	-	-	-	-	-	-
1973	-	-	-	-	-	-	-	-	-	-	-	-	-
1974	-	-	-	-	-	-	-	-	94	203	327	452	-
1975	362	345	310	381	99	24	82	13	69	154	326	513	2678
1976	658	379	341	26	37	14	8	0	0	98	255	309	2125
1977	976	618	128	107	12	82	0	41	0	0	84	393	2441
1978	470	388	209	212	232	170	140	41	109	44	333	558	2906
1979	647	627	305	84	135	120	0	28	13	34	69	507	2657
1980	674	417	330	86	50	0	0	11	14	58	175	614	2429
1981	408	200	157	198	85	33	70	13	32	62	199	366	1823
1982	304	241	242	56	28	3	0	0	0	0	26	427	1327
1983	272	222	120	304	118	51	49	0	3	112	482	557	2290

- : No data available

TABLE 2-3. MONTHLY RAINFALL (5)

Station: Ujung Pandang　　River Basin: Tallo　　Unit: mm

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1971	1379	1444	1493	-	202	154	26	0	29	152	506	1367	-
1972	1809	1842	1247	102	20	0	0	7	0	0	25	-	-
1973	797	-	1201	311	200	111	71	84	58	20	743	2040	-
1974	1210	1219	1149	72	88	33	101	0	72	155	353	997	5449
1975	713	374	686	546	156	112	124	33	59	326	371	738	4238
1976	812	398	556	27	78	21	13	0	0	99	278	546	2828
1977	1167	1368	246	351	17	105	2	5	0	0	0	298	3559
1978	534	535	257	217	239	161	143	25	67	89	183	652	3102
1979	727	537	297	109	107	106	1	0	0	9	176	574	2643
1980	688	488	471	110	26	16	0	4	0	0	97	706	2606
1981	639	365	282	139	64	45	85	0	4	10	495	692	2820
1982	724	458	466	70	24	0	0	0	0	0	0	234	1976
1983	287	140	28	168	104	3	2	0	0	56	506	352	1646

- : No data available

TABLE 2-4. MEAN MONTHLY TEMPERATURE (AVERAGE DAILY)

Unit : ^{o}C

Station	Calculation Period	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
Maros	1976-1983	26.7	26.7	26.9	27.2	27.6	27.4	27.2	27.3	27.4	27.9	27.3	26.7	27.2
Hasanuddin	1974-1983	25.6	25.7	26.0	26.3	26.5	26.1	25.7	26.2	26.8	26.5	26.6	25.9	26.2
Panakukkang	1974-1983	25.7	25.5	25.9	26.2	26.4	25.7	25.2	25.6	26.7	27.2	26.3	25.9	26.1
Bontobili	1980-1983	25.7	25.5	26.2	26.6	26.8	25.7	24.7	24.0	24.3	25.7	25.8	25.0	25.5
Bonto Sunggu	1977-1983	26.6	26.4	26.7	27.3	27.3	27.1	26.2	26.2	26.9	27.4	27.5	26.3	26.8

TABLE 2-5. MEAN MONTHLY RELATIVE HUMIDITY

Unit : %

Station	Calculation Period	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
Maros	1975-1983	86.3	87.1	88.0	85.9	83.1	80.2	76.6	73.6	75.1	78.6	83.8	87.4	82.1
Hasanuddin	1974-1983	85.7	86.5	84.6	82.8	81.0	78.4	74.9	69.1	67.8	73.1	79.8	85.8	79.1
Panakukkang	1974-1983	86.6	87.8	85.8	83.4	82.8	81.8	76.4	69.2	66.1	70.8	77.9	86.3	79.5
Bontobili	1980-1983	90.7	91.0	90.3	88.3	88.0	84.8	80.0	75.5	71.5	71.3	79.3	86.8	83.1
Bonto Sunggu	1977-1983	91.7	92.7	91.7	89.5	88.5	88.7	86.9	86.9	82.6	82.0	87.1	91.3	88.3

TABLE 2-6. MEAN MONTHLY WIND VELOCITY

Unit : km/day

Station	Calculation Period	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
Hasanuddin	1974-1983	6.8	6.8	6.1	5.2	4.7	5.2	5.9	7.6	7.4	7.2	6.8	5.9	6.3
Bontobili	1980-1983	11.0	9.4	8.6	7.8	6.8	7.8	8.1	9.2	10.9	12.0	11.6	11.2	9.5
Bonto Sunggu	1977-1983	104.9	75.7	59.0	54.4	61.0	58.9	54.8	61.5	79.1	91.3	79.0	80.6	71.7

TABLE 2-7. MEAN MONTHLY SUNSHINE HOURS

Unit : hour

Station	Calculation Period	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
Maros	1976-1979	4.1	3.4	4.3	7.0	6.8	6.1	7.6	9.8	9.6	8.7	6.9	4.3	6.6
Hasanuddin	1974-1983	3.8	3.7	4.5	5.9	6.0	6.0	6.6	7.3	7.1	6.6	5.6	3.8	5.6
Panakukkang	1974-1983	4.1	3.3	4.9	6.9	7.0	6.7	7.8	9.0	8.6	7.8	6.2	3.3	6.3
Bontobili	1980-1983	4.2	4.6	5.7	6.6	6.9	7.1	8.2	9.3	9.0	8.8	6.8	4.9	6.8
Bonto Sunggu	1977-1983	4.3	4.6	5.9	7.1	7.1	6.3	8.3	8.9	9.0	8.7	6.1	4.8	6.8

TABLE 2-8. MEAN MONTHLY PAN-EVAPORATION

Unit : mm/day

Station	Calculation Period	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
Maros	1975-1983	4.4	4.2	4.3	4.5	4.5	4.4	5.2	6.0	6.4	6.2	5.1	4.3	5.0
Bontobili	1980-1983	4.7	4.3	5.2	5.7	4.7	5.0	5.4	7.0	8.0	8.1	6.9	6.4	6.0
Bonto Sunggu	1977-1983	4.9	4.3	4.6	5.0	4.8	4.8	5.4	6.6	7.2	7.2	5.9	5.2	5.5

TABLE 3-1. MEAN MONTHLY DISCHARGE AT TOMPO BULU

Unit: m^3/sec

YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1976	61.82	57.14	55.70	13.44	6.92	1.88	1.58	-	-	-	5.01	28.25
1977	-	103.20	46.66	36.10	19.06	21.99	7.08	3.98	2.15	1.69	5.06	33.23
1978	59.45	39.76	35.06	27.27	16.83	15.39	14.86	7.47	6.58	6.08	9.70	48.93
1979	65.54	40.29	44.86	25.62	21.17	10.99	4.60	2.88	2.02	1.83	3.61	40.15
1980	68.85	71.38	40.36	32.94	13.05	7.51	4.49	2.13	1.81	2.44	10.83	51.43
1981	67.77	58.88	29.85	34.98	18.88	7.41	8.57	4.09	3.55	3.57	26.25	62.07
1982	66.34	66.05	35.17	34.00	15.14	5.63	2.71	1.68	1.54	1.34	0.83	4.36
1983	15.95	42.57	17.76	29.79	20.68	13.04	6.05	2.37	1.81	2.83	20.36	38.99

TABLE 3-2. MEAN MONTHLY DISCHARGE AT BILI-BILI

Unit: m^3/sec

YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1975	54.07	57.46	51.20	53.60	28.77	10.76	4.66	3.55	2.58	3.99	41.77	68.19
1976	94.82	68.68	68.79	16.59	13.75	2.89	2.75	2.58	2.33	7.69	17.48	24.10
1977	112.57	176.41	60.02	53.13	11.67	20.33	2.72	2.60	2.40	2.23	17.05	64.13
1978	67.54	64.73	35.34	21.05	22.27	16.09	27.54	6.69	4.34	4.44	20.57	76.11
1979	98.67	58.41	61.18	25.55	22.31	10.72	2.67	2.54	2.38	2.44	7.07	70.75
1980	85.65	106.25	73.56	49.32	20.75	5.33	2.57	2.44	2.29	6.79	21.53	85.84
1981	97.13	77.63	43.06	54.46	45.09	16.81	23.89	7.94	9.03	10.01	43.43	88.50
1982	81.82	72.53	38.90	46.90	16.08	5.56	2.55	2.15	2.23	2.30	2.47	7.58
1983	12.67	26.56	14.26	27.50	21.02	10.67	4.35	2.78	2.42	3.09	16.89	48.82

Note: Discharges from 1975 to 1980 were estimated by the JENEBERANG FLOOD CONTROL PROJECT (PHASE II), 1982, JICA.

TABLE 3-3. MEAN MONTHLY DISCHARGE OF THE JENELATA RIVER

Unit: m^3/sec

YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1978	77.46	44.25	29.58	13.69	16.53	18.04	13.15	6.52	2.76	4.53	6.63	43.88
1979	59.17	26.31	27.0	18.51	14.19	7.64	3.10	2.24	1.41	1.55	2.77	21.36
1980	63.09	53.82	20.51	29.21	14.31	4.15	2.79	1.96	1.36	1.55	5.97	34.66
1981	32.73	23.45	19.13	15.40	14.07	3.79	10.45	3.68	2.95	3.65	19.08	34.51
1982	22.82	78.63	12.19	29.59	7.56	3.56	2.19	1.55	1.36	0.95	1.20	7.24
1983	11.90	16.91	8.42	23.27	14.39	8.36	4.87	2.27	1.66	3.44	13.93	19.12

Note: Discharges from 1978 to 1980 were estimated based on rating curves by the manual guage; while, discharges from 1981 to 1983 were estimated based on rating curves by the automatic gauge.

TABLE 3-4. GENERALIZED DESCRIPTION OF MAJOR DEEP WELLS

Ref. No.	Year Installed	Proprietor/Location	Depth (m)	Pumpage (l/min)	Water Table of Well (M.S.L.)	Remarks
D1.	1980	Tidung/Monumen Emmy Saelan, Ujung Pandang	102	180	- 5.0	-
D2.	1980	Km. 17, Ujung Pandang	102	80	- 2.5	-
D3.	1980	PLTU/Tello, Ujung Pandang	150	-	-	Abandoned (salty groundwater)
D4.	1980	PLTU/Tello, Ujung Pandang	67	100	- 4.0	-
D5.	1979	Mandai/Hanggar Merpati, Ujung Pandang	80	80	- 5.0	-
D6.	1979	Mandai/Hanggar Merpati, Ujung Pandang	60	80	- 6.0	-

Note : Locations of these wells are shown in FIGURE 4-6.

Source : BIDANG GEOLOGI KANTOR WILAYAH DEPARTEMEN PERTAMBANGAN DAN ENERGI PROPINSI SULAWESI SELATAN

TABLE 3-5. MEAN MONTHLY DISCHARGE AT THE CONFLUENCE OF THE JENEBERANG AND THE JENELATA

Unit: m^3/sec

YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1975	85.92	91.30	81.36	85.17	45.27	17.10	7.40	5.64	4.10	6.34	66.37	108.35
1976	150.67	109.13	109.31	26.36	21.85	4.59	4.37	4.10	3.70	12.22	27.78	38.29
1977	178.87	280.32	95.37	84.42	18.54	32.30	4.32	4.13	3.81	3.54	27.09	101.90
1978	145.00	108.98	64.92	34.74	38.80	34.13	40.69	13.21	7.10	8.97	27.20	119.99
1979	157.84	84.72	88.18	44.06	36.50	18.36	5.77	4.78	3.79	3.99	13.83	92.11
1980	148.74	160.07	94.07	78.53	35.06	9.48	5.36	4.40	3.65	8.34	27.50	120.50
1981	129.86	101.08	62.19	69.86	59.16	20.60	34.34	11.62	11.98	13.66	62.51	123.01
1982	104.64	151.16	51.09	76.49	23.64	9.12	4.74	3.70	3.59	3.25	3.67	14.82
1983	24.57	43.47	22.68	50.77	35.41	19.03	9.22	5.05	4.08	6.53	30.82	67.94

Note: The discharges at the confluence from 1975 to 1977 were estimated by means of multiplying the Jeneberang discharges by the catchment basin ratio value of 1.589; while, those from 1978 to 1983 were estimated by adding the discharges at Bili-Bili to the discharges at Jenelata.

TABLE 4-1. MEAN MONTHLY DISCHARGE AT SUNGGUMINASA

Unit: m^3/sec

YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1975	85.67	91.05	81.11	84.92	42.24	13.62	3.92	2.16	0.62	6.09	66.12	108.10
1976	150.42	108.88	109.06	26.11	18.37	1.11	0.89	0.62	0.22	11.97	27.53	38.04
1977	178.62	280.07	95.12	84.17	15.06	28.82	0.84	0.65	0.33	3.29	26.84	101.65
1978	144.75	108.73	64.67	34.49	35.32	30.65	37.21	9.73	3.62	8.72	26.95	119.94
1979	157.59	84.47	87.93	43.81	33.02	14.88	2.29	1.30	0.31	3.74	13.58	91.86
1980	148.49	159.82	93.82	78.28	31.58	6.00	1.88	0.92	0.17	8.09	27.25	120.25
1981	129.61	100.83	61.94	69.61	55.68	17.12	30.86	8.14	8.50	13.41	62.26	122.76
1982	104.39	150.91	50.84	76.24	20.16	5.64	1.26	0.22	0.11	3.00	3.42	14.57
1983	24.32	43.22	22.43	50.52	31.93	15.55	5.74	1.57	0.60	6.28	30.51	67.69

Note : The discharges at Sungguminasa were estimated considering the capacity of intake facilities for the irrigation, the paper factory, etc.

TABLE 4-2. PUMPING TEST RESULTS BY DPMA (NOVEMBER, 1983)

Ref. No.	Location	Ground Height (M.S.L.)	Diameter (m)	Well Depth (m)	Water Table of Well (M.S.L.)	Pumping Depression (m)	Pumpage (l/sec)	Electrical Conductivity (m)	Soil Condition	Estimated Coefficient of Permeability (m/sec)
P1.	Santongan /Daya	12.0	5.3	3.40	10.60	- 1.4	5.30	250	River sediment /gravel	1.4×10^{-3}
P2.	Bulu Rokeng /Biringkanaya	22.0	1.47	7.05	18.57	- 1.15	2.10	150	Volcanic sediment/sand	4.0×10^{-4}
P3.	Pannara /Antang	2.5	0.85	2.59	1.21	- 0.88	0.72	200	Alluvium /clay	7.2×10^{-4}
P4.	Kasi-Kasi /Rappocini	2.0	0.5	2.15	1.80	0	0.60	400	River sediment /sand	-
P5.	Samata /Samata	6.0	0.83	3.39	5.65	- 2.54	0.83	430	River sediment /sand	1.4×10^{-4}
P6.	Bontotanga /Macini Sombala	2.5	0.85	4.10	1.05	- 0.75	0.85	1630	River sediment /sand	3.8×10^{-4}
P7.	Parangloe /Bira	3.0	2.5	7.20	- 2.85	- 0.5	2.50	8150	Volcanic sediment/sand	2.7×10^{-3}

Note: - The coefficient of permeability was estimated based on the Thiem formula assuming H = water depth, h = H - (Pumping depression) and R = 50 m (refer to the equation (4.2)).

- Location of these wells are shown in FIGURE 4-6.

TABLE 4-3. COMPARISON OF TENTATIVE WATER SOURCES

Water Source	Intake Method (Source Condition)	Probable Intake Rate	Water Quality	Facilities Required	Construction Cost million US $	Investigation Required	Description
Maros River	Pumping up (River bed water) at Leko Pancing	0.1 m^3/sec	No Problem	. Infiltration Gallery Ø 1,000. L=100m . Pumps	0.08 0.04 } 0.12	. Geological Invenstigation . Permeability Test	P o s s i b l e
	B a s i n (Storage)	0.5 m^3/sec x 86,400 x 30 days = 1,300,000 m^3	No Problem	. Basin: 3m(H)x700m(W) x700(L) . Pumps	12.3 0.2 } 12.5	. Geological Investigation . Soil Test	Costly. It is possible to expand storage capacity
Groundwater	Pumping up (Shallow well)	0. 1 m^3/sec (0.5 l/sec/well)	No Problem	. Well: Ø 2,000 x 5m (depth) x 200 wells . Pumps	0.5 0.4 } 0.9	. Hydrogeological Investigation . Pumping up test	It is impossible to operate and maintain many wells systematically
Tallo River (Tributaries)	Pumping up (River flow)	0.1 m^3/sec	Salinity Contamination	. Pumps . Pipeline: Ø 300 L=200m	0.1 0.5 } 0.15	. River discharge observation . Water quality analysis during severe dry periods	Water quality is undesirable
Jeneberang River	Pumping up (River bed water) at Sungguminasa	0.1 m^3/sec	No Problem	. Infiltration gallery Ø 1.000.L=200m	0.16	. Geological Investigation . Permeability Test	The structures will be required to be stable against flood.
Mawang & Tonjong Lakes	Pumping up (Existing Storage)	0.5 m^3/sec x 86,400 x 30 days = 1,300,000 m^3	Phytoplankton Turbidity	. Pumps . Pipeline: Ø800,6 km . Purification device	0.2 4.0 0.4 } 4.6	. Reservoir storage observation . Water quality analysis during severe dry periods	Water quality is undesirable and existing storage is not so abundant.

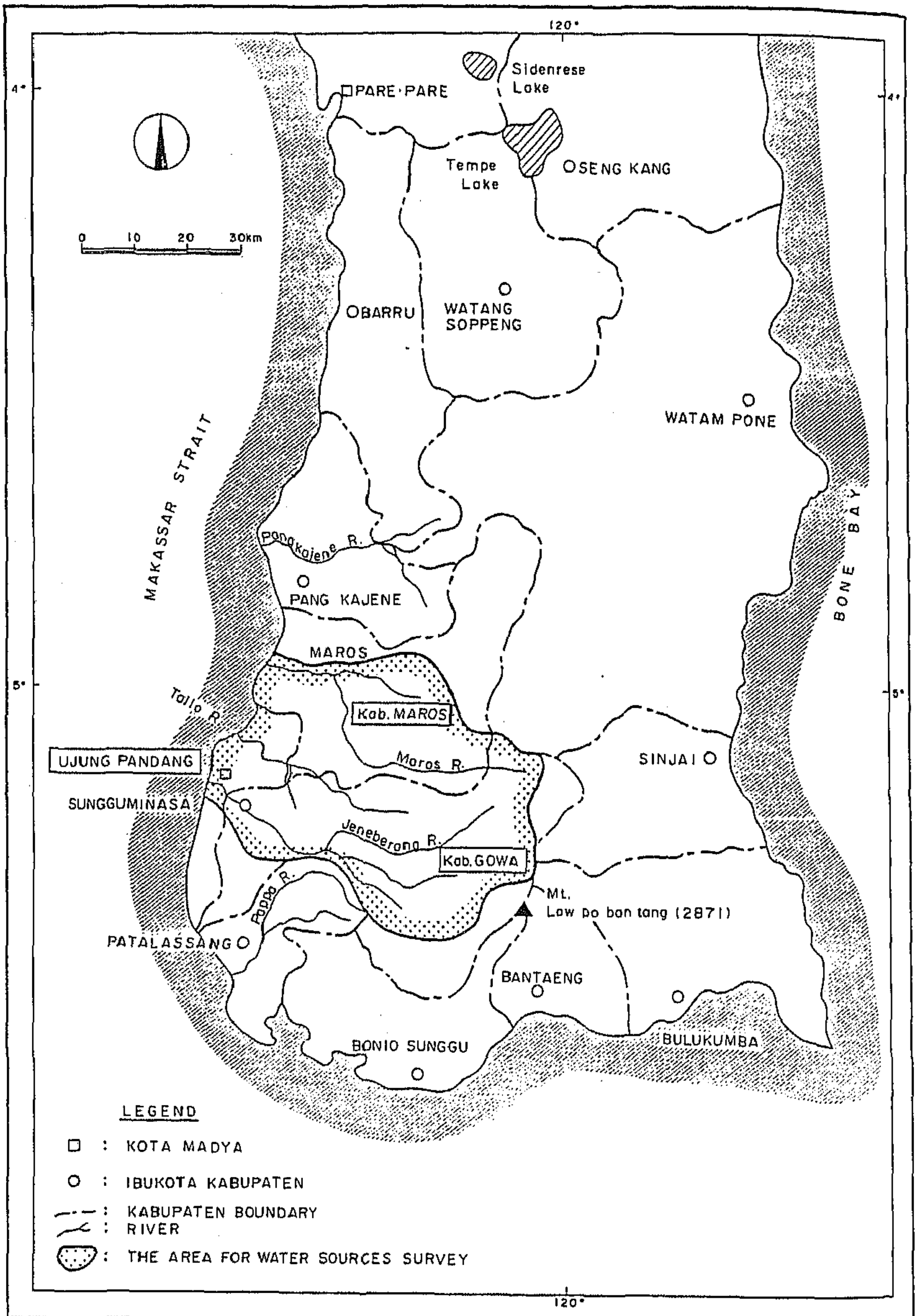


FIGURE I - 1	LOCATION MAP OF THE AREA FOR WATER SOURCES SURVEY

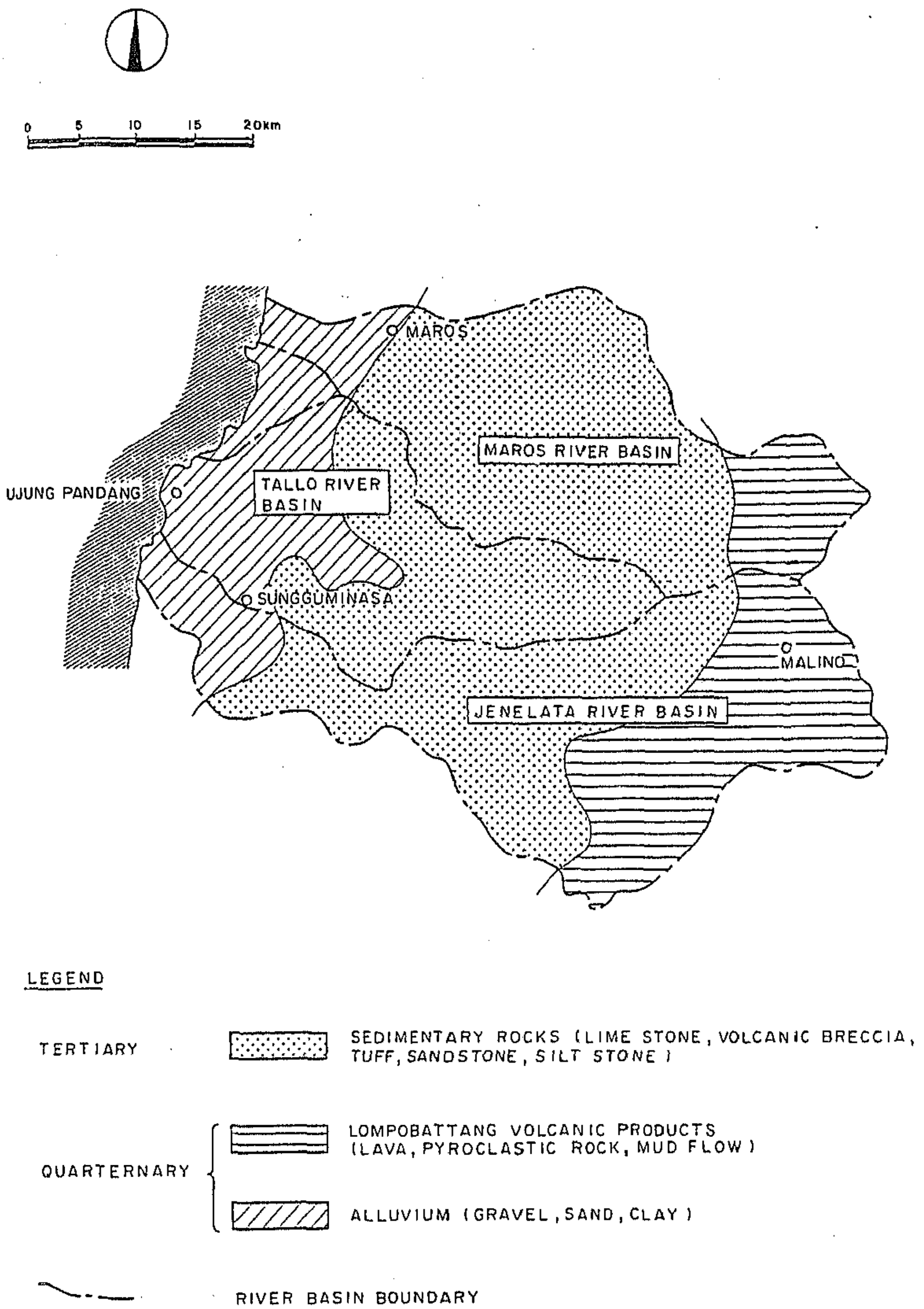
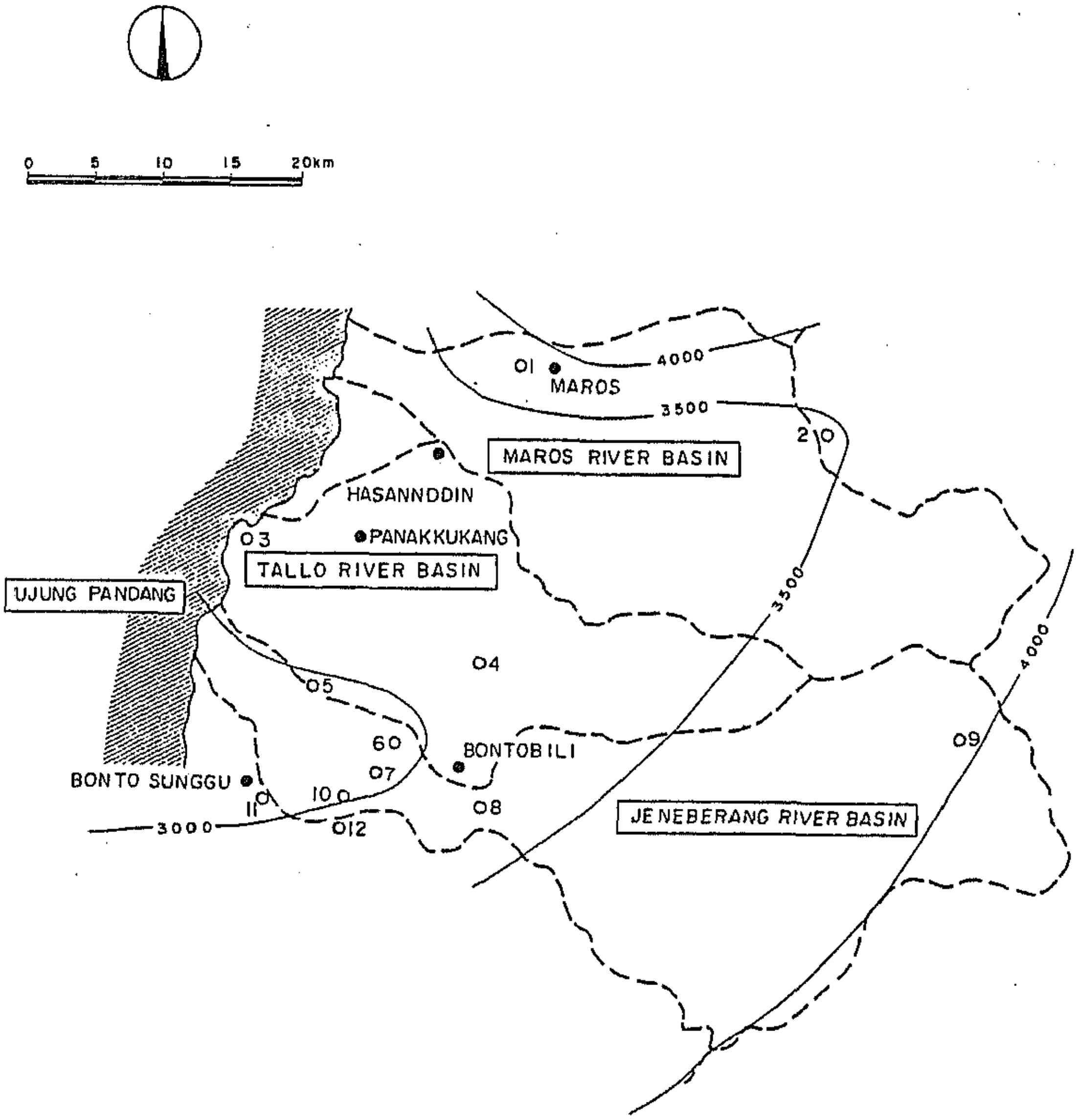


FIGURE 2-1	GEOLOGICAL MAP



NO	STATION	MEAN ANNUAL RAINFALL (mm)
1	SALOJI RANG	3886
2	BATU BASSI	3342
3	UJUNG PANDANG	3086
4	SENRE	3104
5	SUNGGUMINASA	2768
6	BORONGLOE	2937
7	KAMPILI	2327
8	INTAKE BILI-BILI	3235
9	MALINO	3978
10	JULU BORI	2433
11	MANDALLE	2904
12	MACCINI BAJI	3005

LEGEND

- ― ― : BASIN BOUNDARY
- O : RAINFALL STATION
- 3500 : ISOHYETAL LINE
- • : METEOROLOGICAL STATION

FIGURE 2-2 LOCATION MAP OF RAINFALL STATIONS & METEOROLOGICAL STATIONS (ISOHYETAL MAP)

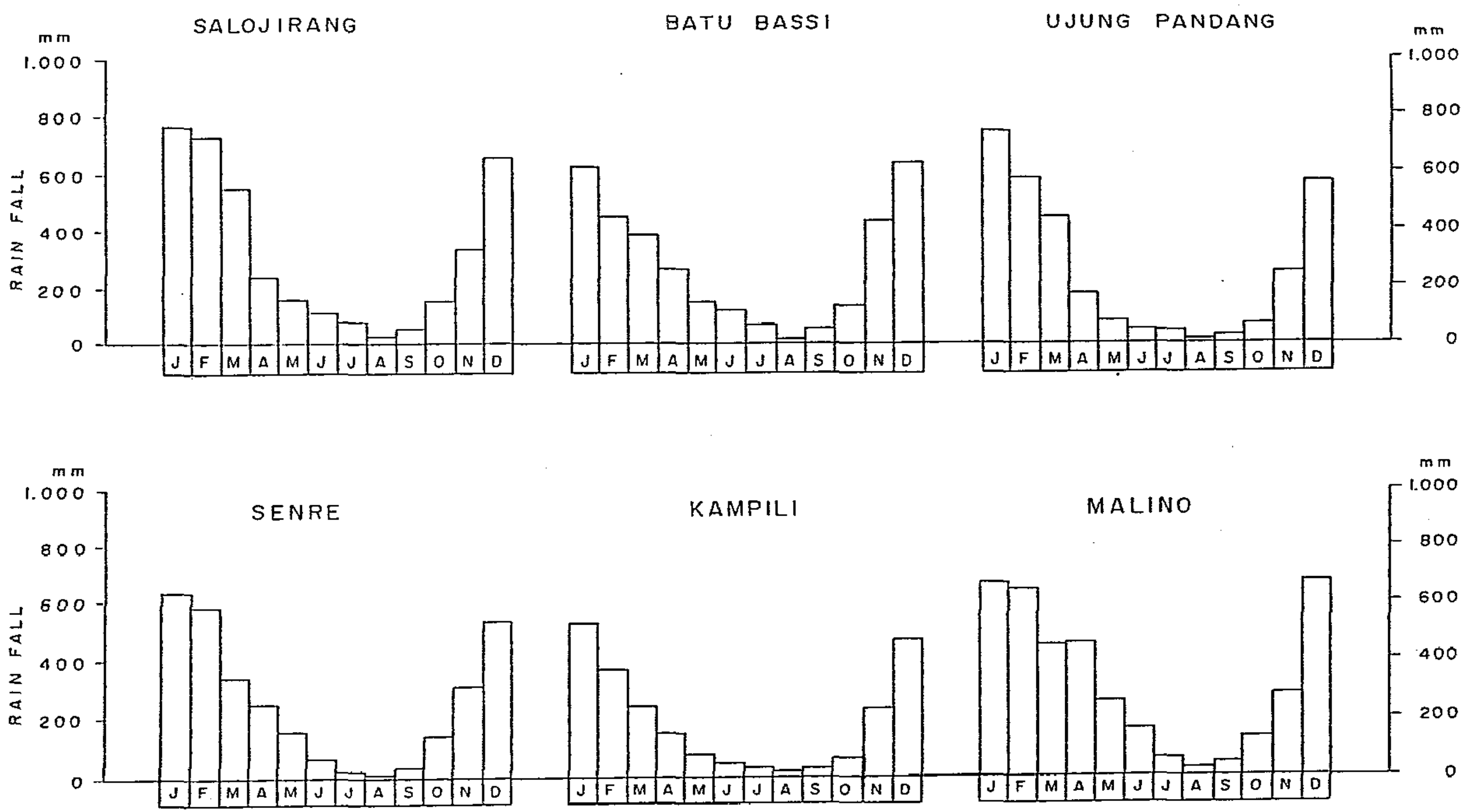


FIGURE 2-3 MONTHLY RAINFALL DISTRIBUTION

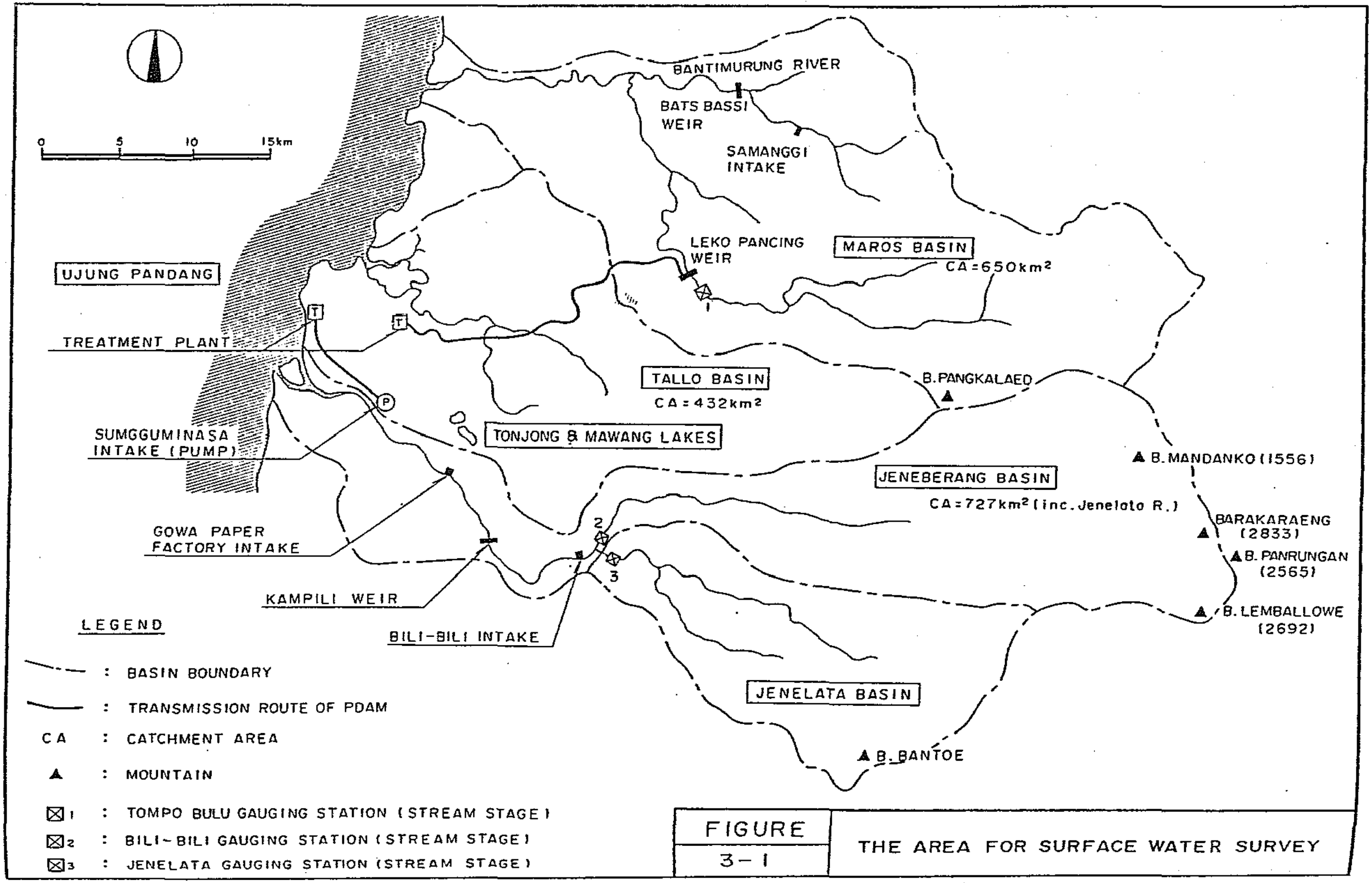


FIGURE 3-1 THE AREA FOR SURFACE WATER SURVEY

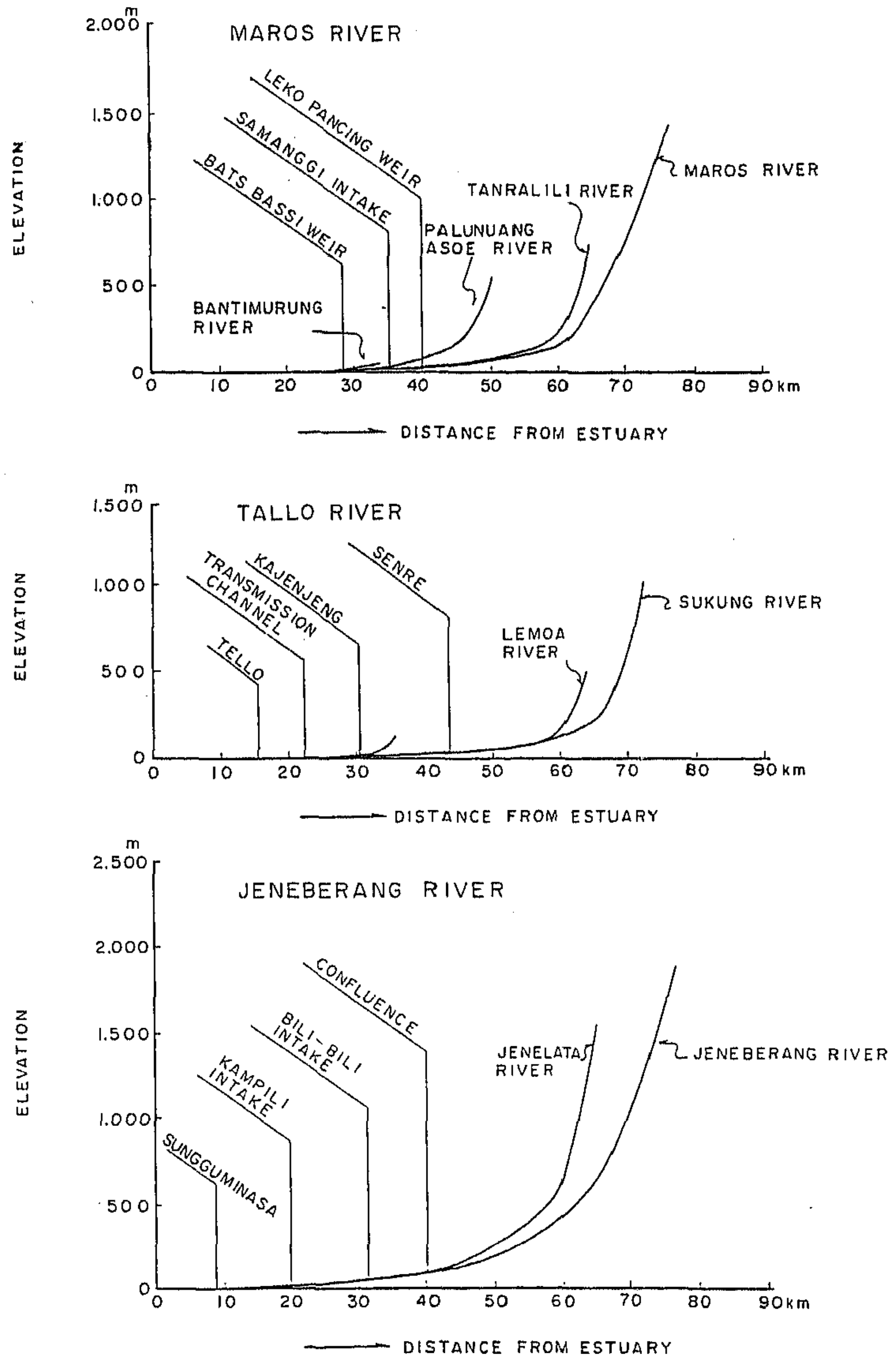
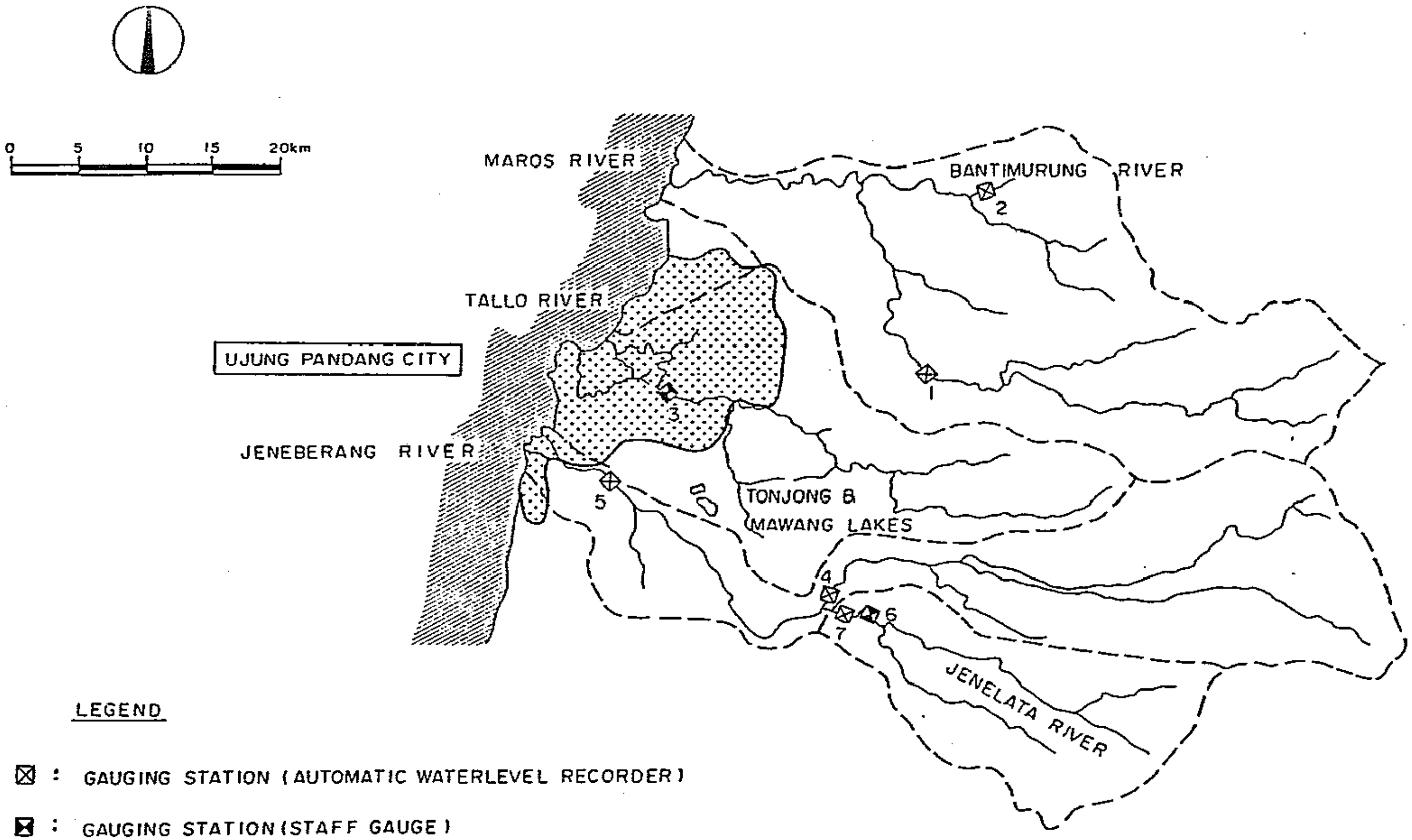


FIGURE 3 - 2 LONGITUDINAL PROFILE OF THE RIVERS



LEGEND

⊠ : GAUGING STATION (AUTOMATIC WATERLEVEL RECORDER)

◪ : GAUGING STATION (STAFF GAUGE)

1. TOMPO BULU (CA: $276.6 km^2$)
2. BANTIMURUNG (CA: $17.6 km^2$)
3. Tallo (CA: $417.3 km^2$)
4. BILI-BILI (CA: $384.4 km^2$)
5. SUNGGMINASA (CA: $673.6 km^2$)
6. JENELATA (CA: $226.3 km^2$)
7. JENELATA (CA: $226.3 km^2$)

FIGURE 3-3 LOCATION MAP OF GAUGING STATIONS

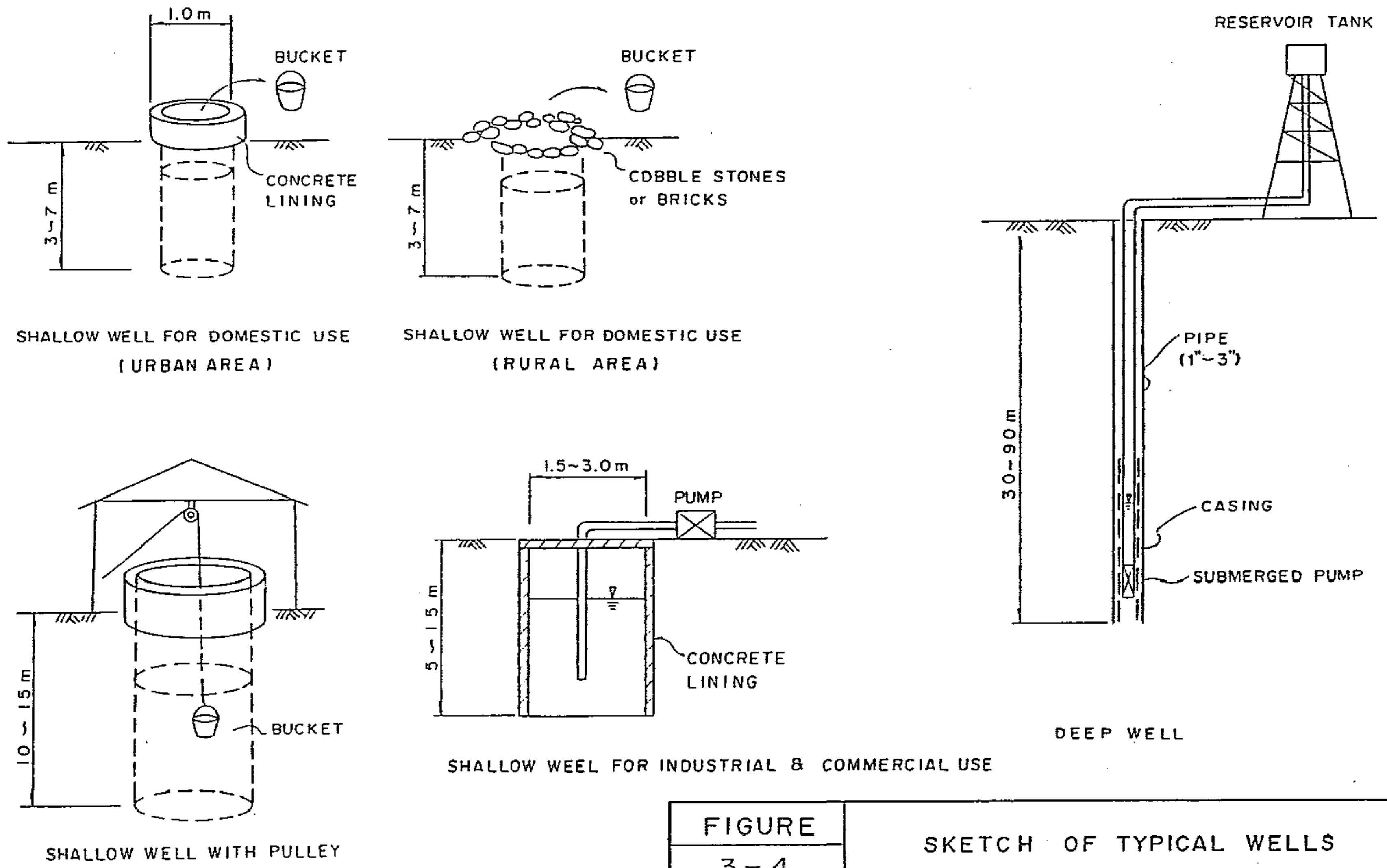


FIGURE 3-4 SKETCH OF TYPICAL WELLS

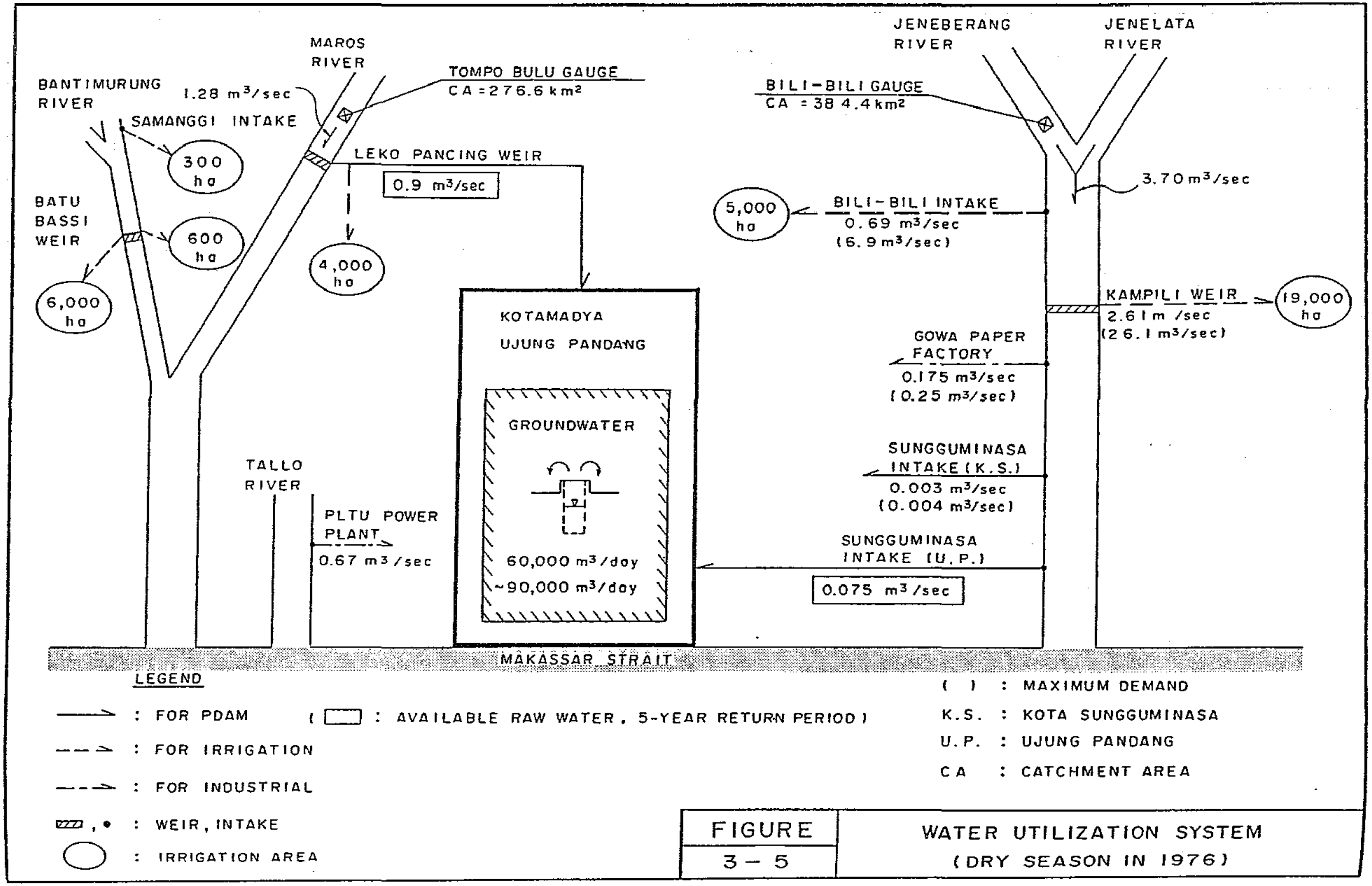


FIGURE 3 – 5 WATER UTILIZATION SYSTEM (DRY SEASON IN 1976)

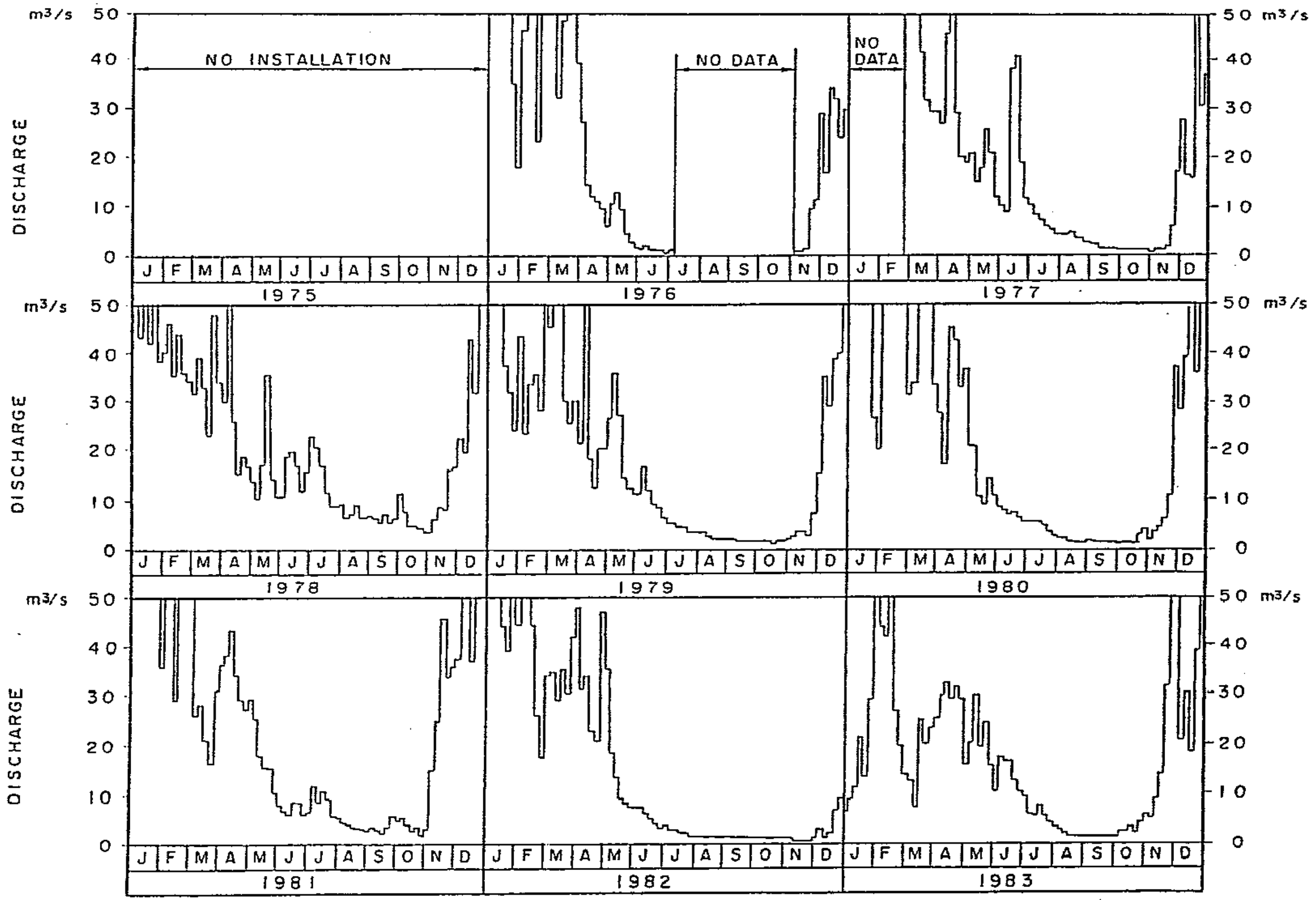
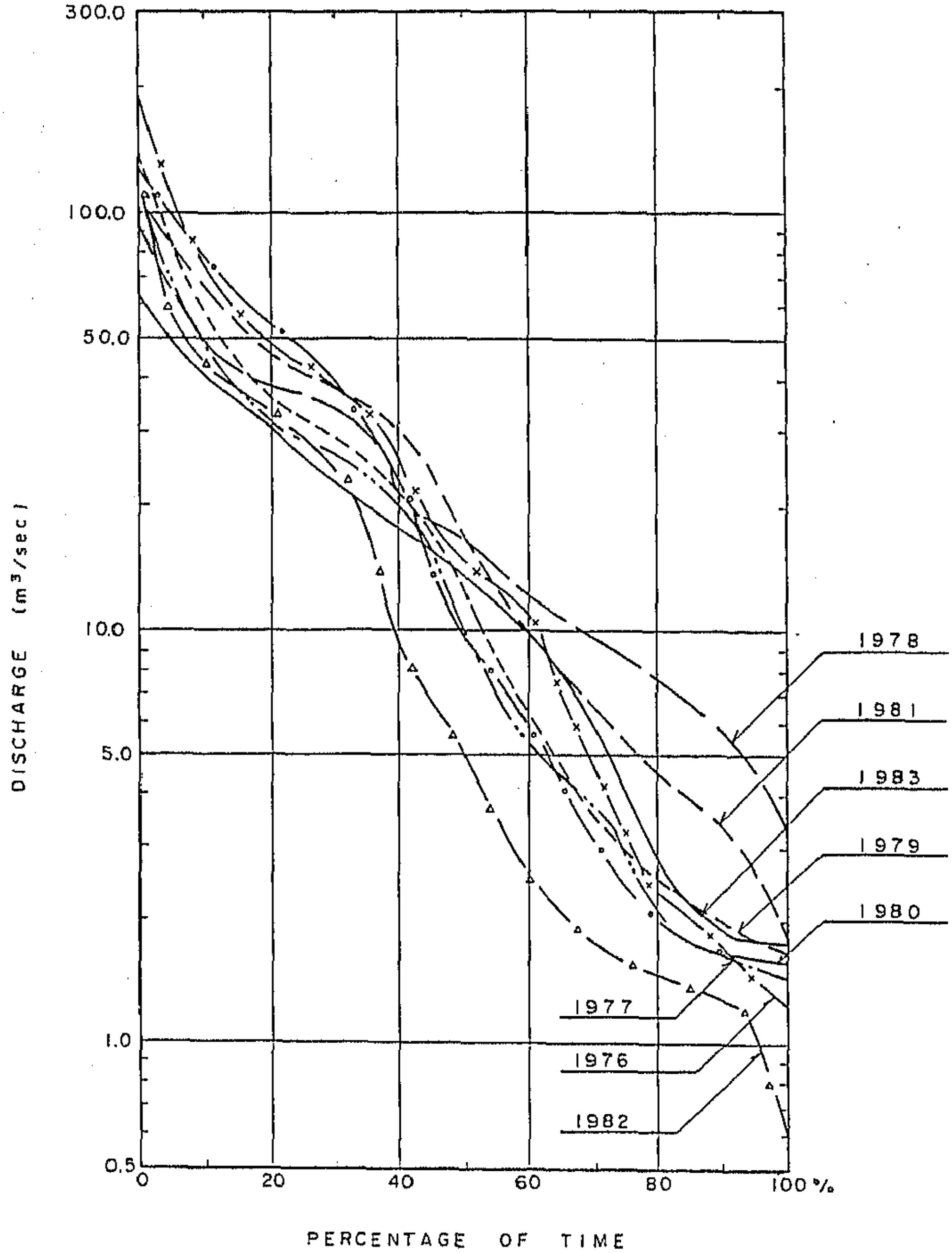


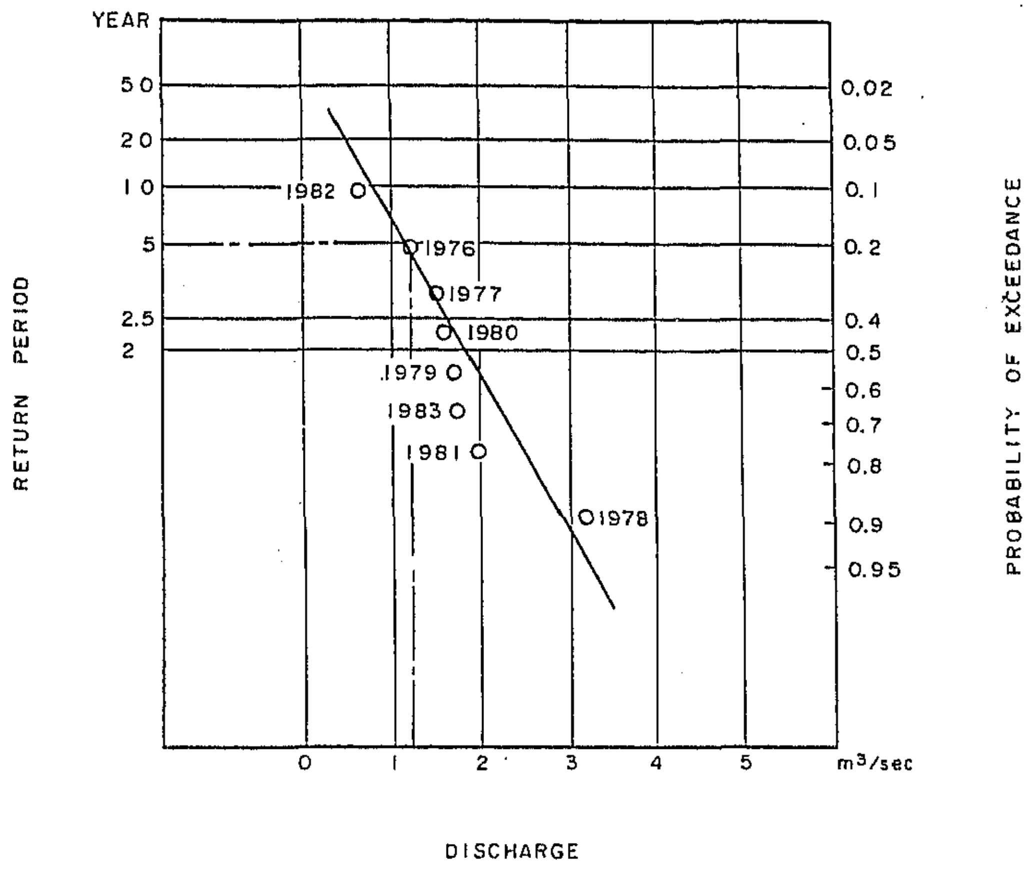
FIGURE 4 – 1

FLOW REGIME AT TOMPO BULU (THE MAROS RIVER)



NOTE : THIS CURVE WAS DRAWN BASED ON 5-DAYS MEAN DISCHARGE OBTAINED.

FIGURE 4 - 2	RIVER FLOW DURATION CURVE AT TOMPO BULU



NOTE: THE ABOVE FREQUENCY CURVE WAS DETERMINED BY PLOTTING THE ANNUAL MINIMUM DISCHARGE (AS THE 5-DAYS MEAN) AT TOMPO BULU.

FIGURE 4-3	PROBABLE MINIMUM DISCHARGE AT TOMPO BULU

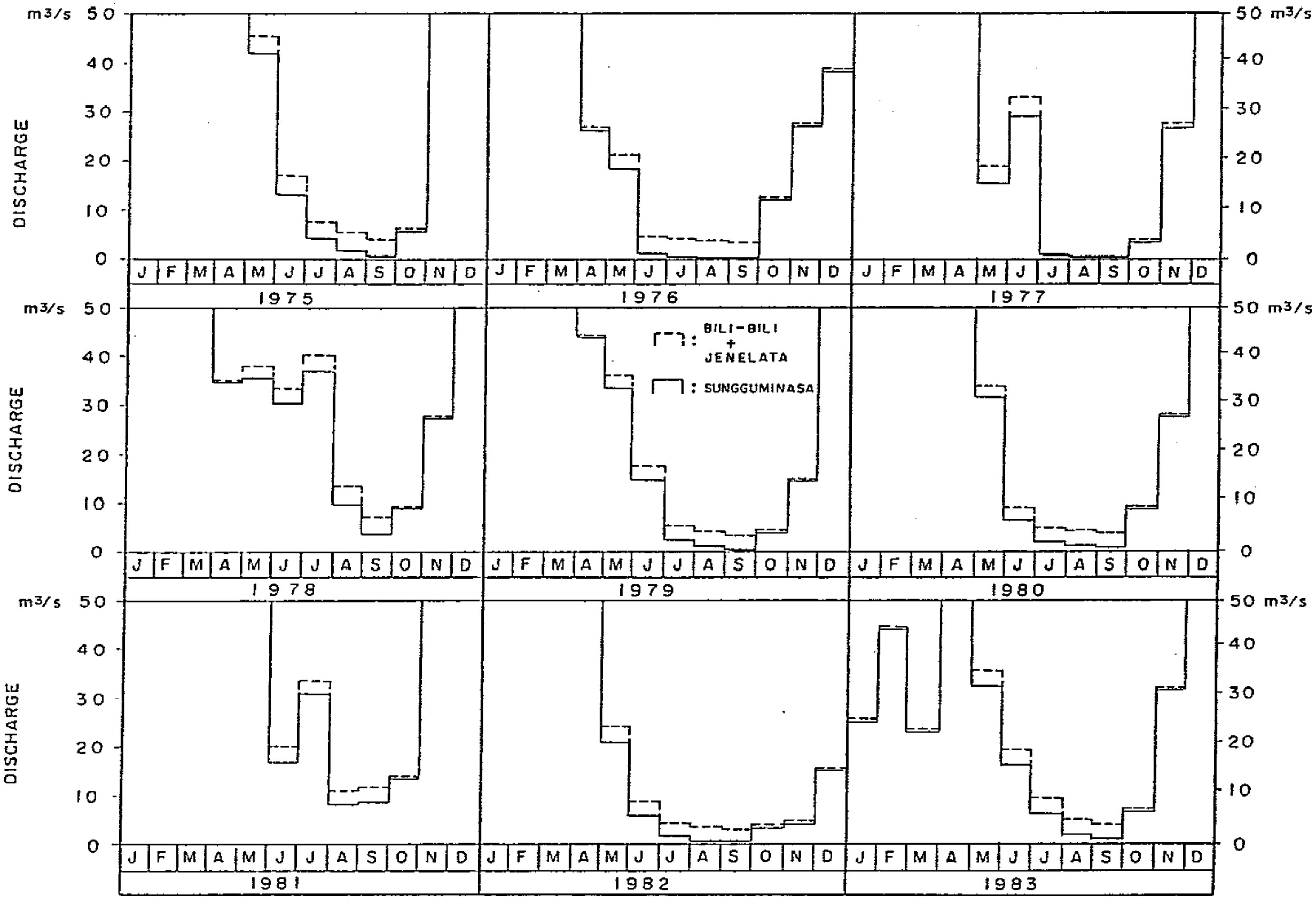
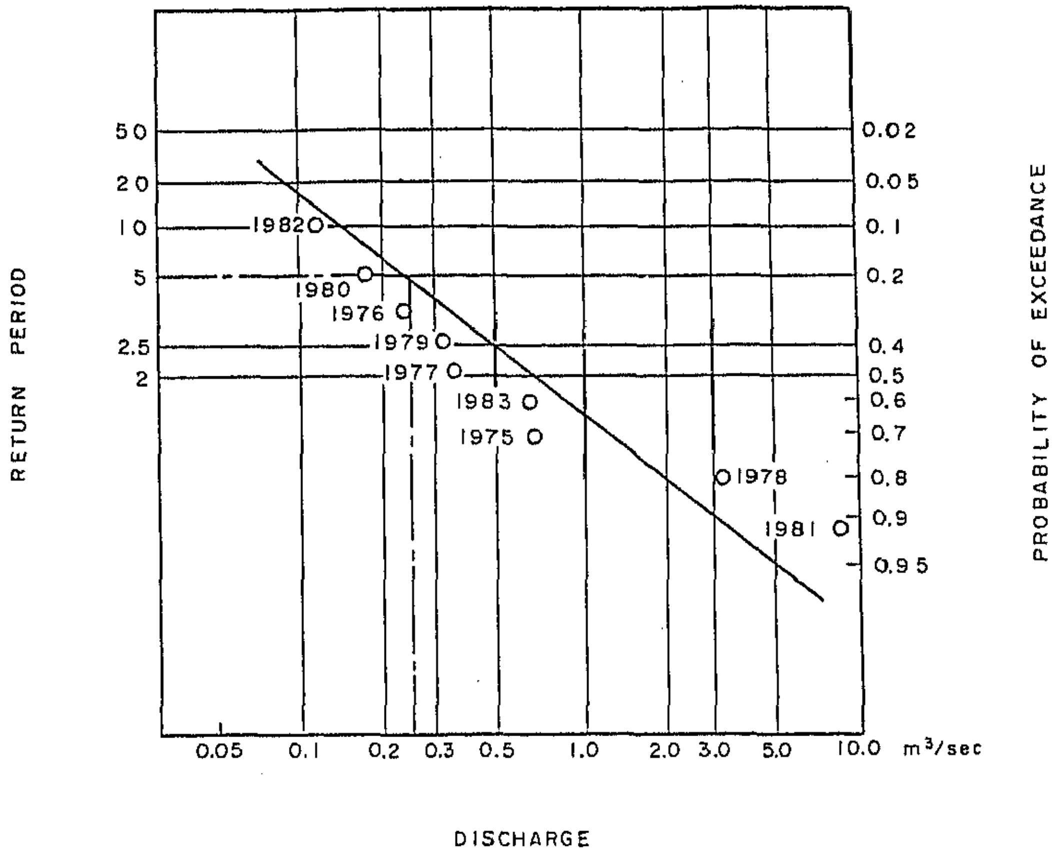


FIGURE 4 – 4	FLOW REGIME AT SUNGGUMINASA (THE JENEBERANG RIVER)



NOTE : THE ABOVE FREQUENCY CURVE WAS DETERMINED BY PLOTTING THE ANNUAL MINIMUM DISCHARGE (AS THE MONTHLY MEAN) AT SUNGGUMINASA.

FIGURE 4 – 5	PROBABLE MINIMUM DISCHARGE AT SUNGGUMINASA

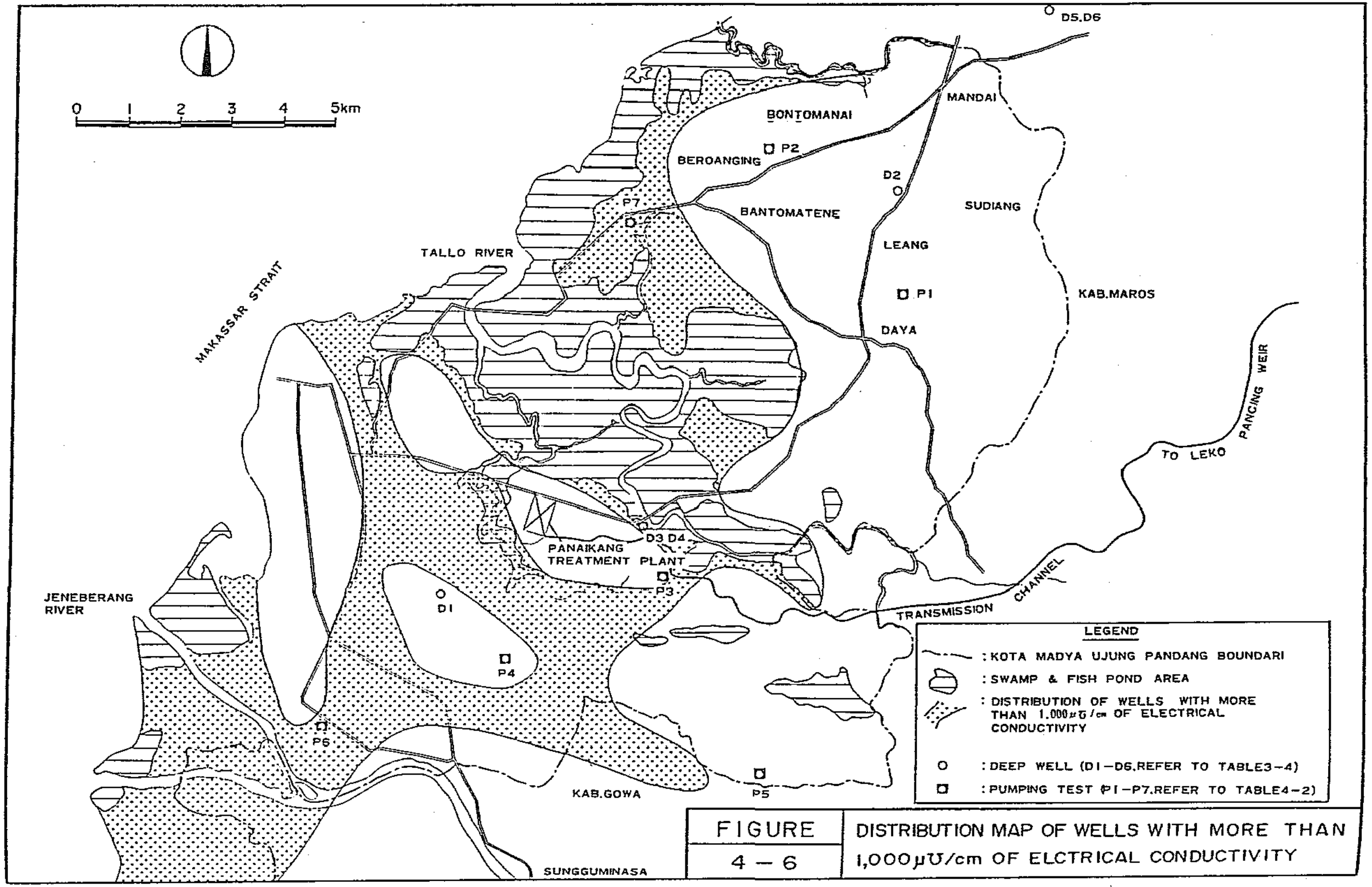


FIGURE 4-6 DISTRIBUTION MAP OF WELLS WITH MORE THAN 1,000μ℧/cm OF ELCTRICAL CONDUCTIVITY

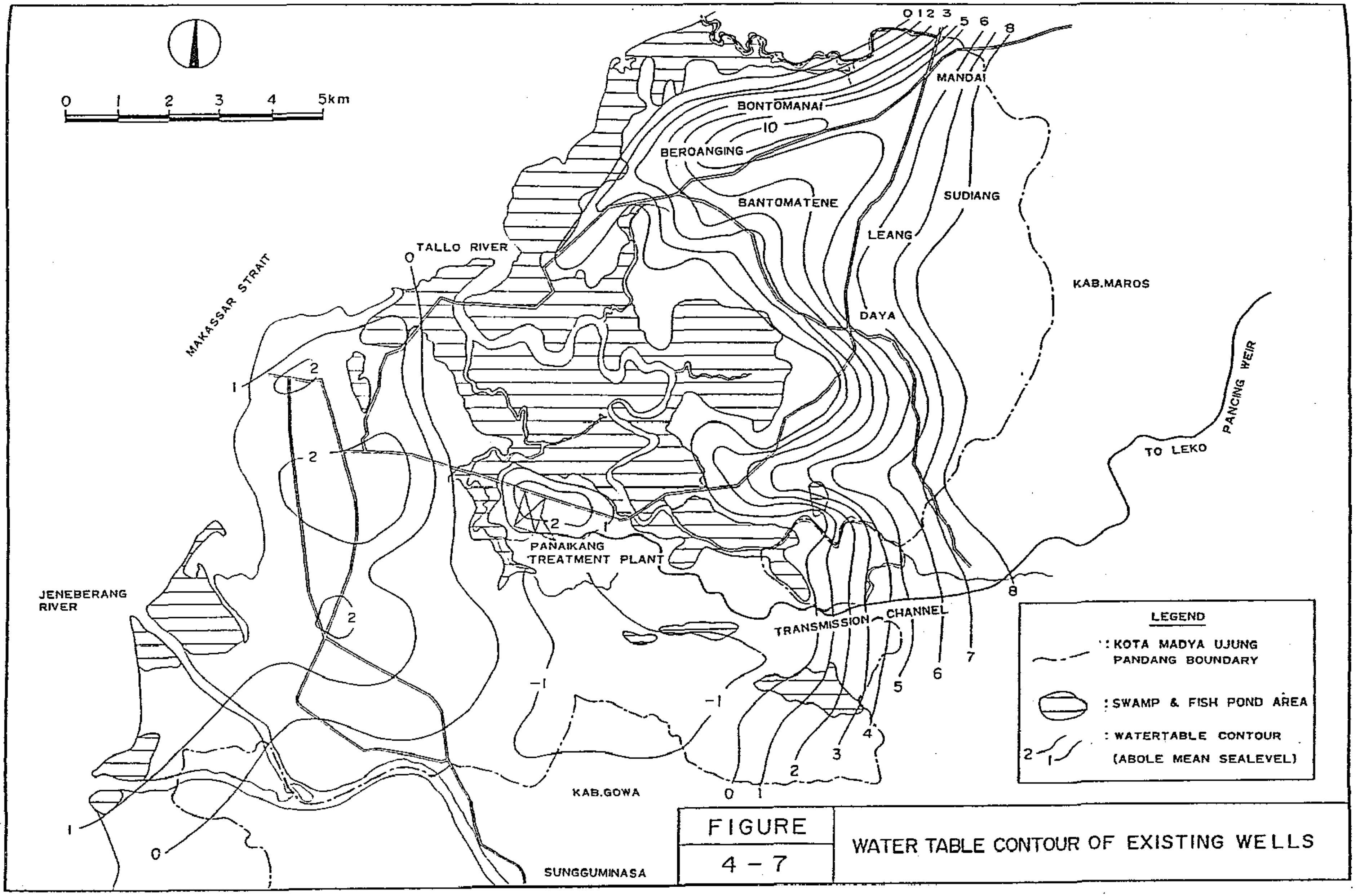


FIGURE 4 - 7 WATER TABLE CONTOUR OF EXISTING WELLS

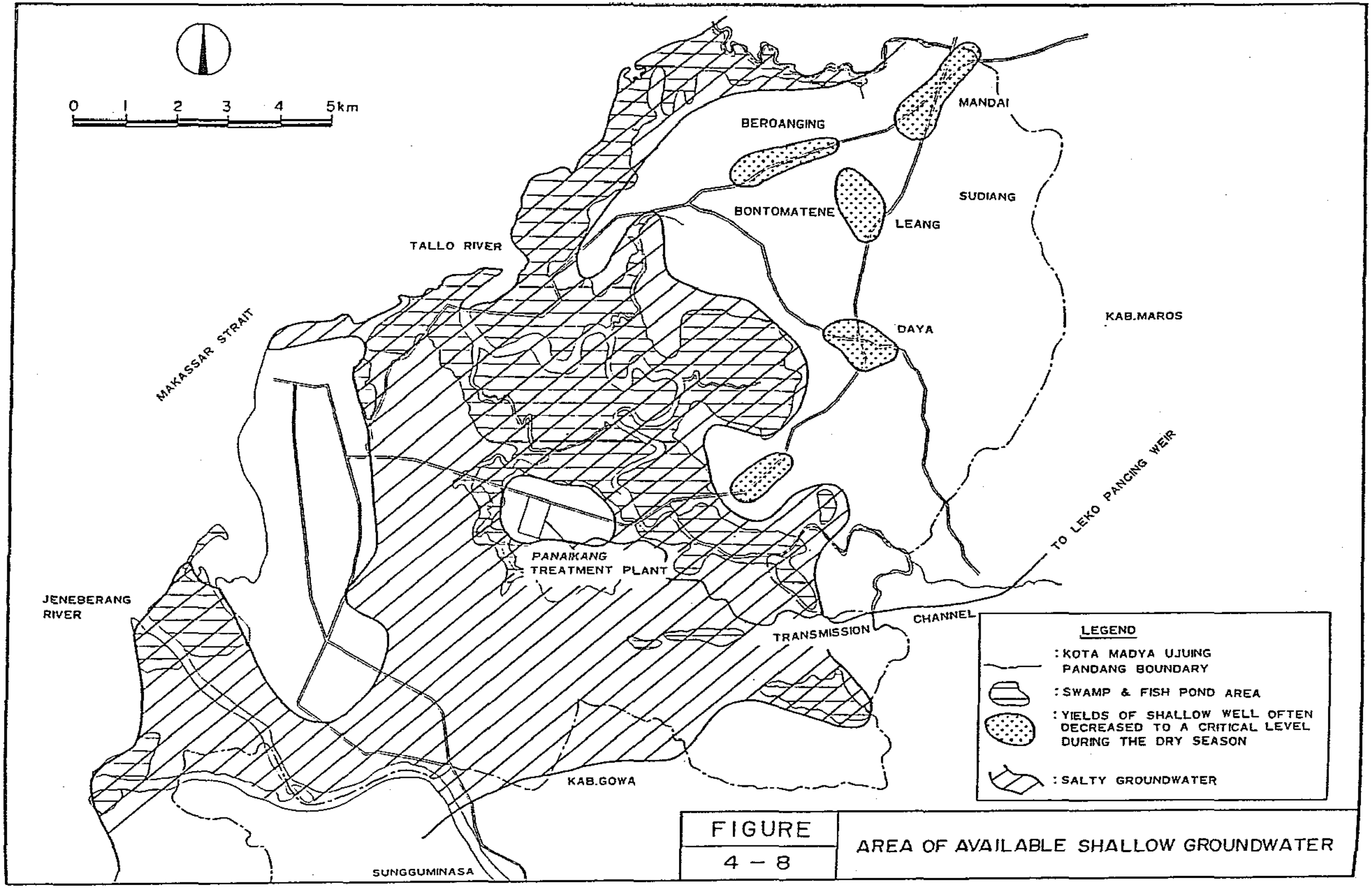


FIGURE 4 – 8 AREA OF AVAILABLE SHALLOW GROUNDWATER

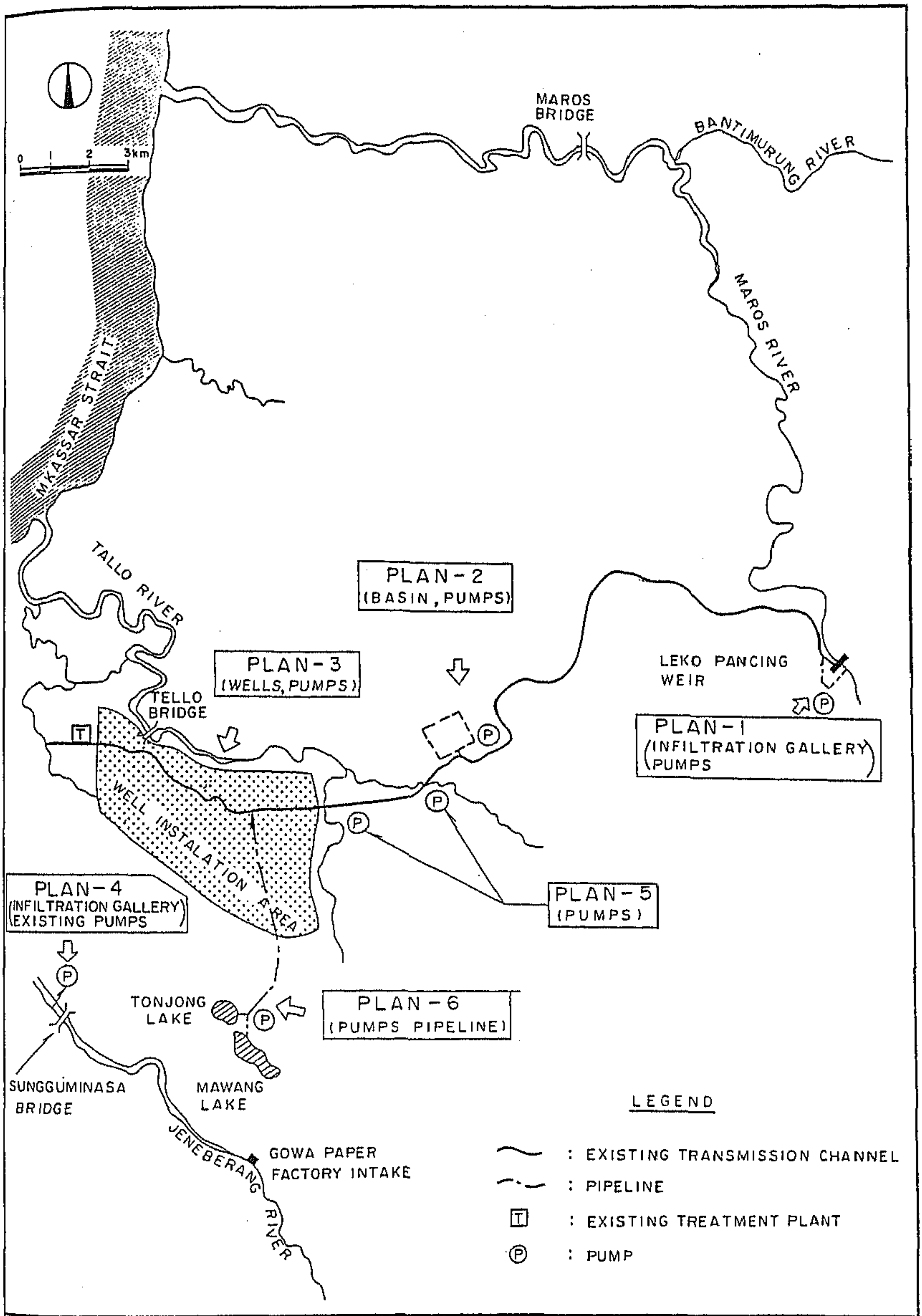


FIGURE 4-9 TENTATIVE WATER SOURCES DEVELOPMENT PLANS

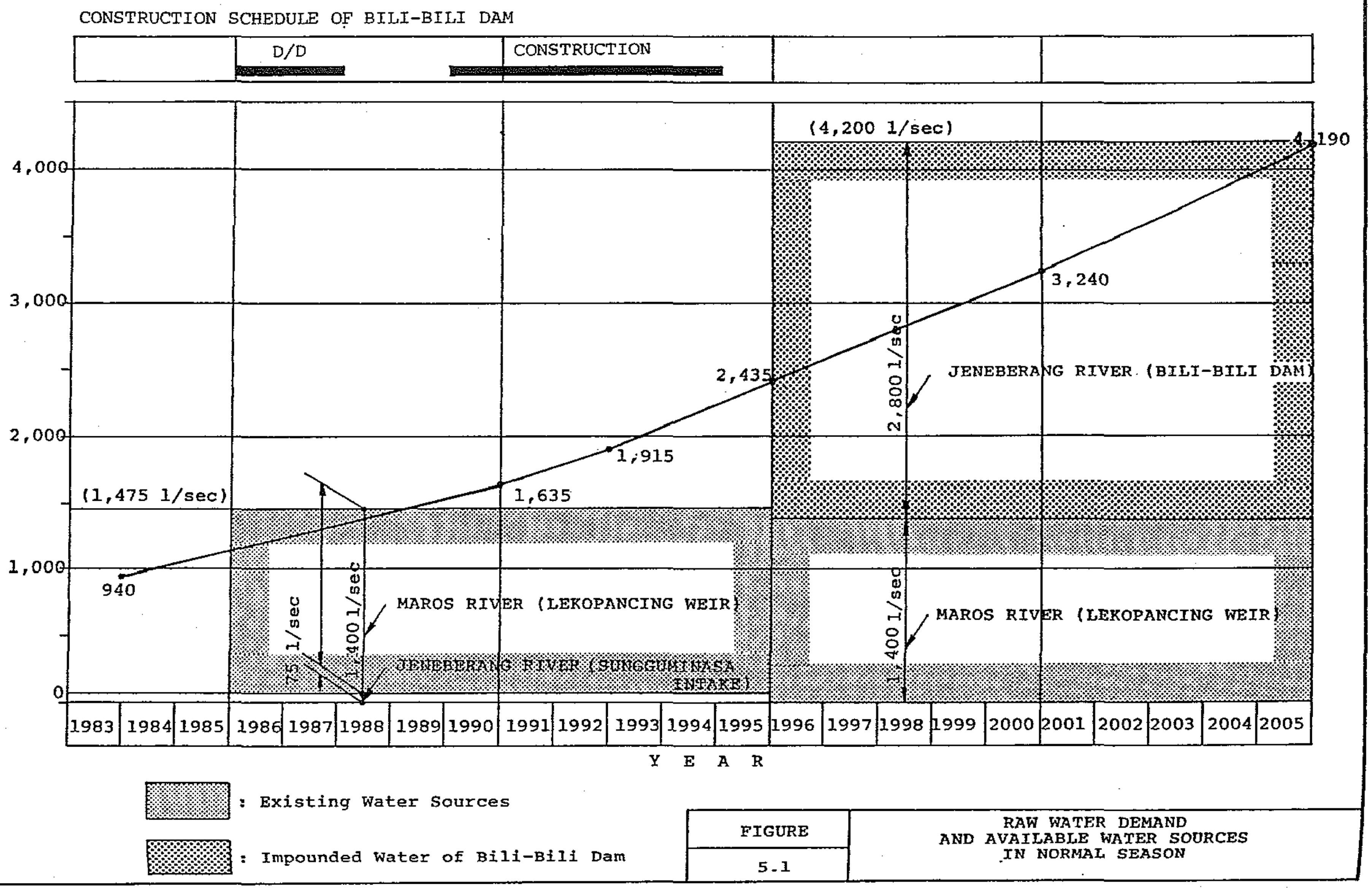


FIGURE 5.1

RAW WATER DEMAND AND AVAILABLE WATER SOURCES IN NORMAL SEASON

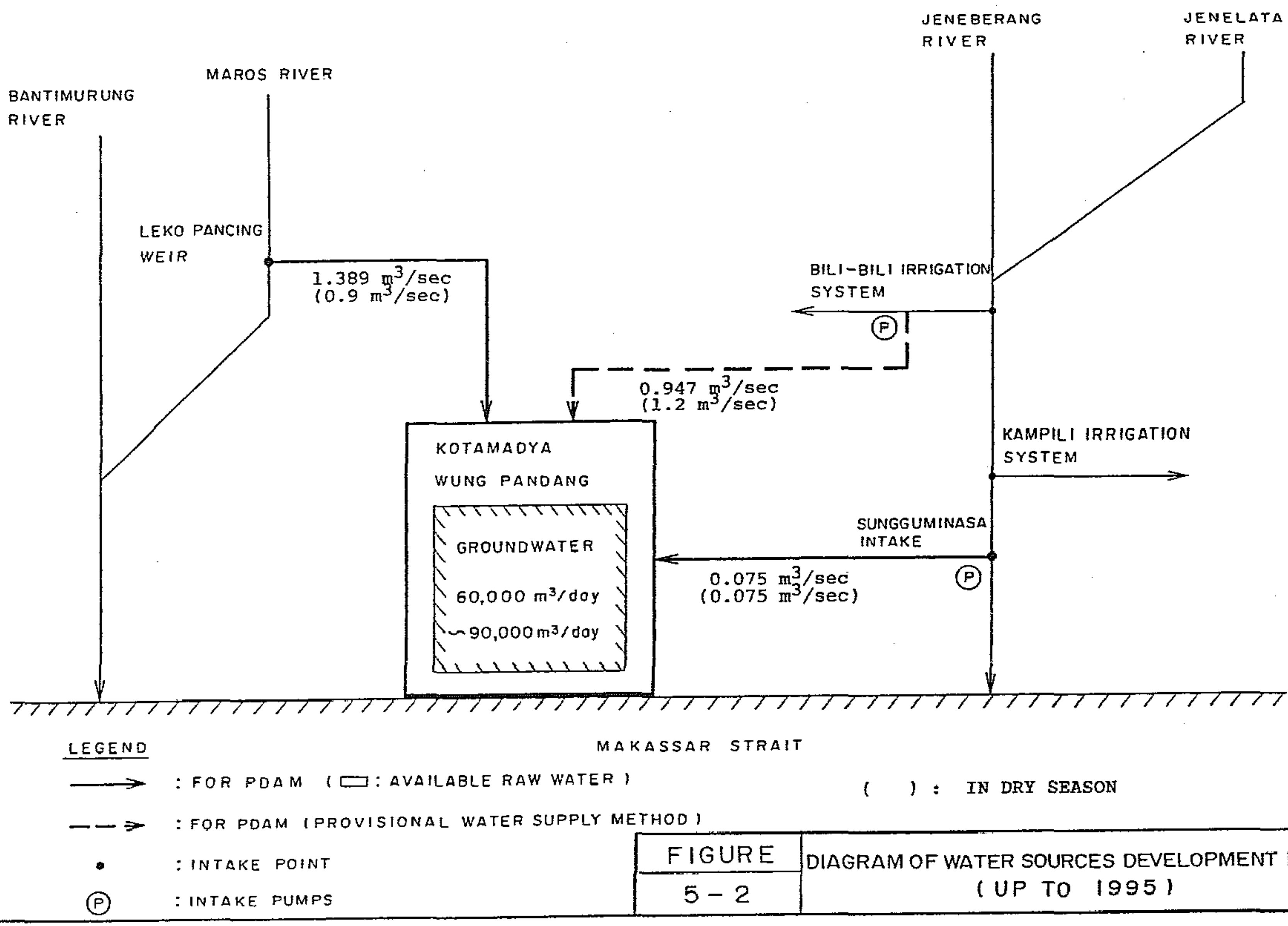
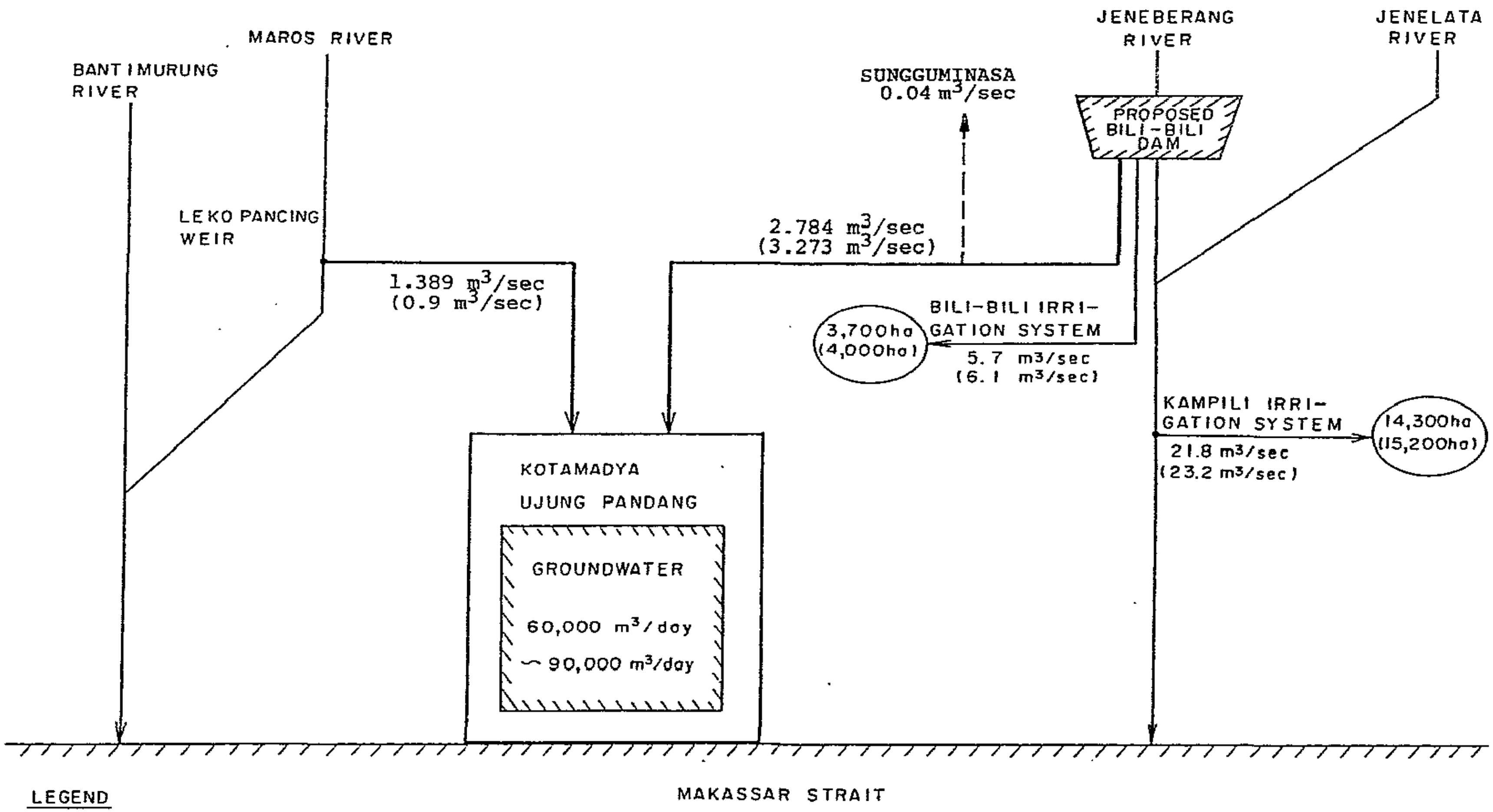


FIGURE 5-2 DIAGRAM OF WATER SOURCES DEVELOPMENT PLAN (UP TO 1995)



LEGEND

→ : FOR PDAM (▭ : AVAILABLE RAW WATER)

○ : THE AREA TO BE IRRIGATED BY BILI-BILI DAM (DRY SEASON)

• : INTAKE POINT

( ) : IN DRY SEASON

FIGURE 5-3 DIAGRAM OF WATER SOURCES DEVELOPMENT PLAN (1996 - 2005)