CHAPTER 4

POPULATION

Population are affected directly to the project of drainage system. Forecast for population growth would be reliable and being approximate to the exact number of population as posible. If the small number are presented the capacity of units of system is not adequate, such following problems will be encountered as over load nuisance, damage properties, and being not safe to public health etc. On the other hand the more capacity of system. The more budget have to spend for this works. Besides the areal distribution of the population are affected to the extent of drainage and sewage collection systems, as well as the location and size of principal trunk and intercepting sewers, pumping stations, treatment works and moreover contributary population are related to sewage characteristics, both as to quality and strength.

FACTORS AFFECTING POPULATION GROWTH

Factors involved in projecting population growth of a metropolitan area include:-

[1]1. General population trends.

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[1]Wid H. Chilanan and Chalerm Keokangwal, Report of the Second National Seminar on Population of Thailand in Increase Population and Expansion in Metropolitan Area (Department of Town and Country Planning), pp. 4-5.

Table 5   POPULATION IN METROPOLITAN AREA
BANGKOK — THONBURI   MUNICIPALITY
1943 — 1965

A.D.	BANGKOK	THONBURI	METROPOLITAN AREA
1943	696,097	147,334	843,431
1944	735,373	153,415	860,788
1945	734,208	163,678	897,886
1946	565,642	168,357	733,999
1947	604,520	177,132	781,652
1948	675,929	184,778	860,707
1949	713,641	194,207	907,848
1950	757,636	205,990	963,626
1951	803,046	217,245	1,020,291
1952	845,374	227,590	1,072,964
1953	924,990	224,564	1,171,654
1954	971,870	259,869	1,231,439
1955	1,024,502	289,457	1,313,959
1956	1,127,923	302,732	1,430,655
1957	1,204,894	321,821	1,526,715
1958	1,286,422	336,039	1,622,461
1959	1,369,036	356,530	1,725,566
1960	1,419,492	381,185	1,800,678
1961	1,492,593	405,641	1,898,234
1962	1,548,047	435,351	1,983,398
1963	1,632,127	474,754	2,106,881
1964	1,669,246	504,478	2,173,724
1965	1,858,645	521,568	2,380,213

SOURCE: RESEARCH DIVISION, DEPARTMENT OF TOWN AND COUNTRY PLANNING,
MINISTRY OF INTERIOR.

[2]2. Birth and Death rates.

[3]3. Age and Sex Composition.

[4]4. Natural Increase and Migration.

5. Population Distribution.

6. Future Growth.

7. Industrial and commercial oportunities.

GENERAL POPULATION TRENDS

Rate of population growth in the capital of some country which are characterized the same as Bangkok in the peroid of 1950-1960 are following:-

Tokyo	4.42 %	Seul	5.22 %
Singapore	8.6 %	Manila	1.17 %
Rangoon	1.63 %	Columbo	2.25 %
Karaji	7.6 %	Delhi	7.3 %

The general population trends can be calculated by the [5]formula:-

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[2]ibid pp. 5-6.

[3]ibid pp. 6-8.

[4]ibid pp. 8-9.

[5]W.A. Hardenbergh, Water Supply and purification (3rd. edition; Ponnsylvania: International Textbood Company, 1950), p. 17.

$$r = \sqrt[n]{\frac{p_n}{p_0}} - 1$$

p_n = probable population after interval of n years

p_0 = population at any time.

r = rate of increase in population per year.

n = number of year being considered.

Population in metropolitan area 1960 = 1,800,678 persons

Population in metropolitan area 1950 = 963,626 persons

$$r = \sqrt[10]{\frac{1,800,678}{963,626}} - 1$$

$$= 6.45$$

It is evident that the rate of population growth in Bangkok-Thonburi is rather high but less than other capitals as Delhi, Singapore, Karachi.

If the rate of growth is 6.45 % the probable population in 1990 would be

$$p_n = p_0 (1+r)^n$$
$$= 1,800,678 (1+.1645)^{30}$$
$$= 11,000,000 \qquad \text{persons}$$

BIRTH AND DEATH RATES

Between 1946 to 1957 the birth rate in metropolitan area from 36.4 to 50.3 per thousands. Thereafter the birth rate gradually decline to 40.1 per thousand by 1964. It can be expected that the people in metropolitan area beginning to adjust themselve in equilibrium state in the future at hand. Simultaneously the reported death rate fell from 23.0 to 5.9 per thousand. It indicated that the development in

Table 6 RATE OF LIVE BIRTHS AND DEATHS IN METROPOLITAN AREA
BANGKOK-THONBURI MUNICIPALITY
1946—1964

A . D.	RATE OF BIRTHS			RATE OF DEATHS		
	BANGKOK	THONBURI	METROPOLITAN AREA	BANGKOK	THONBURI	METROPOLITAN AREA
1946	35.7	38.7	36.4	22.7	23.6	23.0
1947	38.3	37.0	38.0	19.5	20.8	19.8
1948	41.2	45.0	42.0	10.8	16.5	12.0
1849	44.4	48.2	45.2	11.2	19.6	12.8
1950	45.1	48.9	45.9	9.9	19.5	11.2
1951	44.0	49.1	45.1	9.5	15.3	10.2
1952	41.7	48.8	43.2	8.0	10.9	8.6
1953	40.2	51.8	42.6	6.7	7.8	6.9
1954	44.0	52.8	45.9	6.6	7.2	6.7
1955	46.7	52.2	47.9	6.4	5.0	6.1
1956	45.4	51.1	46.6	5.4	7.1	5.8
1957	49.0	55.2	50.3	7.2	6.7	7.1
1958	44.4	53.0	46.2	6.4	7.2	6.6
1959	46.8	54.2	47.3	5.5	5.1	5.4
1960	45.0	54.2	47.0	5.4	5.2	5.3
1961	42.5	52.5	44.6	5.2	4.3	5.0
1962	43.6	51.3	45.3	4.6	4.7	4.7
1963	42.0	49.9	43.7	4.4	4.5	4.4
1964	40.1	46.5	41.6	3.6	4.6	3.9

SOURCE : RESEARCH DIVISION, DEPARTMENT OF TOWN AND COUNTRY PLANNING, MINISTRY OF INTERIOR.

public health would continue progressively. Table 6 showns rate of live births and deaths in metropolitan area.

AGE AND SEX OF POSITION

In 1965 the report stated by Municipality of Bangkok and Phonburi that the ratio of man equal 106 persons to every 100 woman figure 7 prepared during the year 1960 population census show that the different between age goup 0 - 5 year and 5 - 9 year group is relatively compared with the age group 5 - 9 year and 10 - 14 year is very low. Consequently it assumed that the birth rate declines gradually the age group between 20 - 29 year is rather high because there are many young people that migrated from the up-country to get the job. From the figure 7 showed that not only man to search for job but a large number of woman migrated to the metropolitan to find job too.
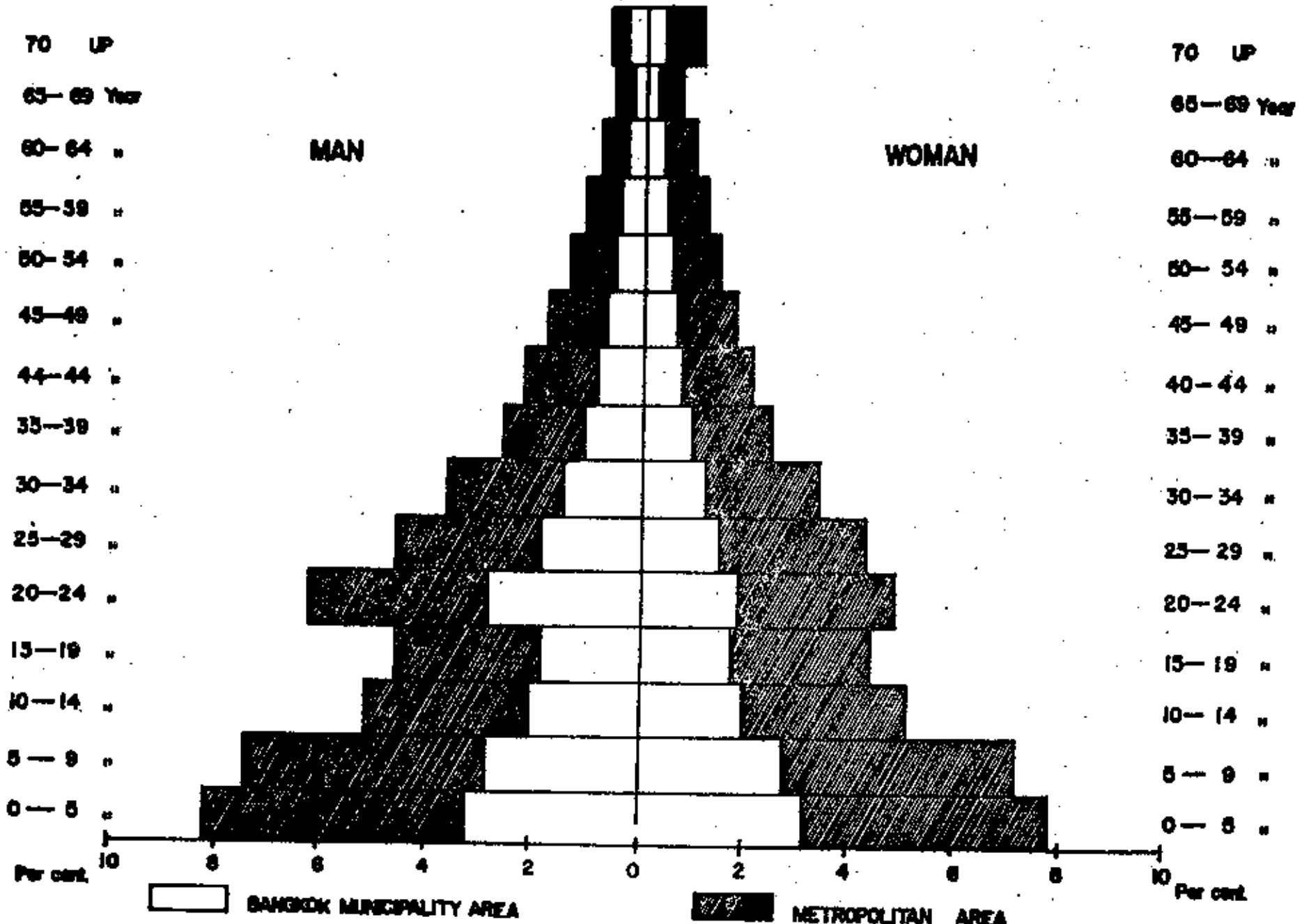
NATURE Between MIGRATION.

Most of people transfer from one section of the country to the another for they wish to shift their occupational interest. But the migration shown in Table 7 are rather confused changing to high and low to meet economic & socials condition as it can not be analyzed, however.

PUBLIC WORKS

If the population growth increases readily the big problem concerning with the utilities is to construct the sewerage and drainage works. The expert planner of Litch-field Whiting Bowno Associates called the characteristics

FIGURE 7

AGE AND SEX COMPOSITION
IN METROPOLITAN AREA
1960

MAN   WOMAN

| Per cent. | 10 | 8 | 6 | 4 | 2 | 0 | 2 | 4 | 6 | 8 | 10 Per cent. |

BANGKOK MUNICIPALITY AREA   METROPOLITAN AREA

SOURCE: RESEARCH DIVISION, DEPARTMENT OF TOWN AND COUNTRY PLANNING MINISTRY OF INTERIOR.

Table 7 NATURAL INCREASE AND MIGRATION IN METROPOLITAN AREA
BANGKOK-THONBURI MONICIPALITY
1947 — 1964

A.D.	NATURAL INCREASE			MIGRATION			POPULATION
	BANGKOK	THONBURI	METROPO-LITAN AREA	BANGKOK	THONBURI	METROPO-LITAN AREA	INCREASED
1947	11,352	2,867	14,219	27,536	5,908	33,444	47,663
1948	20,571	5,244	25,815	50,828	2,402	53,230	79,045
1949	23,698	5,757	29,455	14,014	3,672	17,686	47,141
1950	26,660	6,059	32,719	17,335	5,724	28,059	55,778
1951	27,721	7,343	35,064	17,689	3,912	21,601	56,665
1952	28,461	8,616	37,077	13,867	1,729	15,596	52,673
1953	30,964	10,849	41,803	48,652	8,229	56,881	98,690
1954	36,368	11,847	48,215	10,212	1,358	11,570	59,785
1955	41,494	13,652	54,946	11,638	15,936	27,574	82,520
1956	45,101	13,313	58,414	58,320	-38	58,282	116,696
1957	50,419	15,625	66,044	26,552	3,464	30,016	96,060
1958	48,888	15,383	64,271	32,640	-1,165	31,475	95,744
1959	56,537	17,423	73,960	26,077	3,067	29,190	103,150
1960	56,433	18,633	75,066	-5,977	6,023	46	75,112
1961	55,471	19,528	74,999	16,900	4,928	21,828	96,827
1962	60,263	20,215	80,478	-4,809	7,495	2,686	83,164
1963	61,496	21,481	82,977	22,584	17,923	40,507	123,484
1964	60,760	21,082	81,842	-23,641	8,642	-14,999	66,843

SOURCE : RESEARCH DIVISION, DEPARTMENT OF TOWN AND COUNTRY PLANNING, MINISTRY OF INTERIOR.

of Bangkok-Thonburi area that "Multiple Nuder Concept". It
is a theory originated by R.D. Mckenzie said that there is
no only one nuclear but consisting of many centres such as
the centre of industry, the centre of university, the centre
of retail shops etc. The existing centres, Bang Rag, Bang
Lampu, Wang Burapa are not enough to service so that the new
are as settled at Raj Prasonk, Pratonam, Pat Ponge centre.

Distributed population and extended Land in Metropo-
litan area collected from maps and protographs are include:-

Bangkok originated in B.E. 2325 and completed in B.E.
2328 the total area is 2163 rais.

B.E. 2443 extended 8,330 rai, the population 600,000 persons
" 2479 " 26,970 " " " " 650,000 "
" 2496 " 41,735 " " " " 964,000 "
" 2501 " 60,230 " " " " 1,622,000 "

POPULATION DISTRIBUTION

At present population distributed mixing together.
Comercial area is combined with residential building, the
frontage streets are commercial buildings and the inside of
blocks are residential houses. The institutions are scattered
everywhere. The government try to distribute schools, re-
creation areas, institutions, industrial firms and residen-
tials to the outskirt of the city because of requiring to
raise the standard of living in the central part of city.
The outskirt area is not crowded so that the drainage of waste
water can be drained by septic tank and cesspool.

INDUSTRIAL AND COMMERCIAL OPPORTUNTIES

For industries the government tries to encourage domestic and foreign enterprises to undertake more industrial activities in the country. In the central part of city is forbidden to build the new industrial firms for causing nuisance and being a menace to public health but the existing firms have to dispose of waste water by primary treatment. At this time some agencies followed the Land Use provided by city planning moving to the outdkirt of the city.

Commercial activities are not much changable but the centre of commerce have to alter to another place which now Pratonam and Raj Prasonk being the centres. The area selected for commerce by L.W.B.A. are most reliable owing to at present shown the commercial area is exactly the same place that was selected by city planning.

POPULATION IN 1990 BY CALCULATION

Various ways can be calculated to find out population. From preceeding data showed that the population in Bangkok--Thonburi trends to decrease into saturated state. It is expected that if [6]Least Square Method is applied the result would be satisfactory for the characteristics of the city in this manner. The reason used arithmatic trend due to the

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[6]Gordon H Fair and John C Geyer, Water Supply and Wastewater Disposal (New York: John Wiley & Sons, Inc., 1954), pp. 125-126.

government policy to encourage the development in the up-
-country consequently the population would gradually increase
by this way more than was trended by gemetric projection.

The following steps show the way to calculate:-

A.D.	METROPOLITAN AREA	REMARKS
1945	897,886	Omitted population in
1950	963,626	1945 due to nonuniform
1955	1,313,959	(very low) caused by the
1960	1,800,678	result of war.
1965	2,380,213	

POPULATION X, IN THOUSAND	5 -.year peroid rate of growth y %	x^2	xy
963.626	36.35	928,583	35,028
1313.959	37.04	1,729,596	48,669
1800.678	32.18	3,242,521	57,983
SUM 4078.263	105.57	5,897,700	141,680
MEANS 1359.42	35.19	1,965,900	47,227

$$a + b \frac{(\Sigma x)}{n} - \frac{(\Sigma y)}{n} = 0 \quad \dots\dots\dots\dots\dots(1)$$

$$a + b \frac{(\Sigma x^2)}{\Sigma x} - \frac{(\Sigma xy)}{\Sigma x} = 0 \quad \dots\dots\dots\dots\dots(2)$$

$$a + b\ 1359.42 - 35.19 = 0 \quad \dots\dots\dots\dots\dots(3)$$

$$a + b \frac{5,897,700}{4078.263} - \frac{141,680}{4078.263} = 0$$

$$a + b\ 1446.13 - 34.74 = \quad \dots\dots\dots\dots\dots(4)$$

(3) - (4) - 86.71 b-.45

$$b = - \frac{.45}{86.71} = - .005198$$

Substitute in (3)

a - 1359.42 x .005198 - 35.19 = 0

a - 7.066 - 35.19 = 0

a = 42.256

Arithmetic trend, Y = 42.256 - .005198 X

__1970__   Y = 42.256 - .005198 x 2380.2 = 29.534

Population = 2380.2 + 2380.2 x 295   = 308 3.07

__1975__   Y = 42.256 - 005198 x 3083.07 = 26.23

Population = 3083.07 + 3083.07 x .262   = 3890.08

__1980__   Y = 42.256 - .005198 x 3890.08 = 22.035

Population = 3890.08 + 3890.08 x .22135 = 4747.26

__1985__   Y = 4747.26 - .005198 x 4747.26= 17.58

Population = 4747.26 + 4747.26 x 17.58 = 5581.83

__1990__   Y = 42.256 - .005198 x 5581.83 = 13.242

Population = 5581.83 + 5581.83 x .1324 = 6320.864

The population would be 6,320,864 persons

PROPOSED POPULATION OF METROPOLITAN AREA IN FUTURE

In 1990, from calculation the population in the metro-
politan area would be estimated of 6,320,864 persons and the
method of graphical extension of past records the expected
total population is 6,100,000 persons. But for the consi-
deration in various ways it would follow the proposed popu-
lation which recommended by Litchfield Whiting Bowne and As-
sociates which lay out the comprehensive plan forthe metro-
politan area. It stated that in 1990 the population of the

metropolitan area have to hold to a total of 4.5 million
people. The reasons are subdivided as follows:-

1. If it cannot hold the population in the limit of
4.5 million people it cannot fulfil the utility service.
No budget to construct the sewerage and drainage works be-
cause of requiring a lot of money to serve a large community.

2. It indicated that the results get from foregoing
factors support the idea of Litchfield Whiting Bowne and
Associates. General population trends will give good results
when the population increases constantly, but 11 million peo-
ple would be impossible for the development city. From Ta-
ble of Rate of Live Births and Deaths and age Sex Composition
chart indicated that Birth Rate which mostly influenced po-
pulation growths gradually decline from 1957 to 1964. It
conforms the Litchfield concept which he forecasted before
1958.

3. At present the government is encouraging growth
and development of other cities throughout the country such
as the presence of project of North Region Development, to
do comprehensive plan for city planning in the up-country
and establishing new universities in Chiengmai and Konkhan.
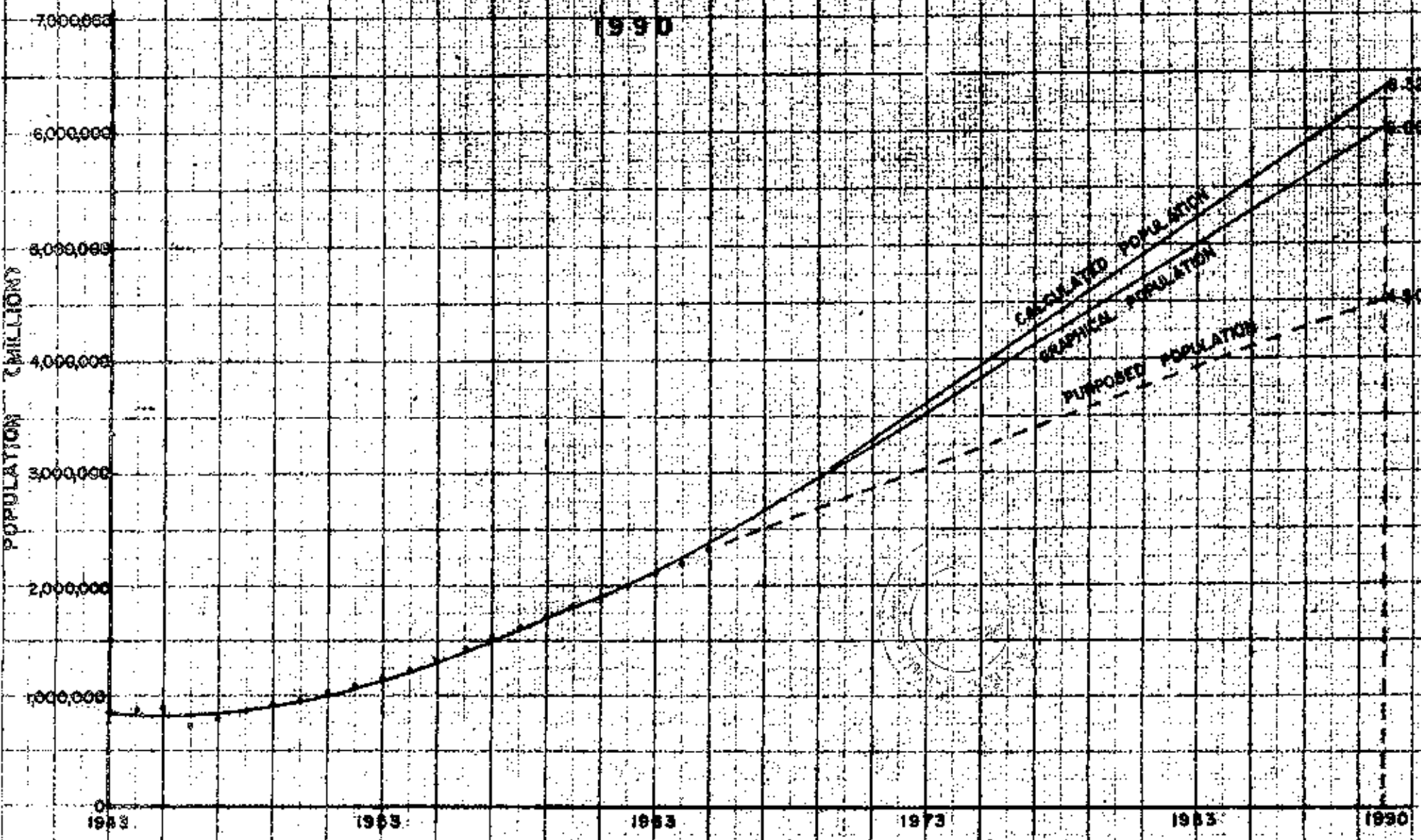
4. Some large organization, firms, institutions etc.
are in the program to extend from the metropolitan area to
another provinces. The new port for deep wharf plan to lo-
cate at Sriracha and large industrial area is selected at
Rangsit.

5. It is expected that the standard of living will be soon higher due to provided well utility services, more education, good transportation and facilitate recreation etc. These environment would force them be aware of the necessity to menage the birth control

If the population conform the Litchfields forecast that is about 4.5 million people, the calculation of sewerage and drainage systems have to base on Land Use prepared by Litchfield.

POPULATION IN METROPOLITAN AREA
1990

FIGURE 6