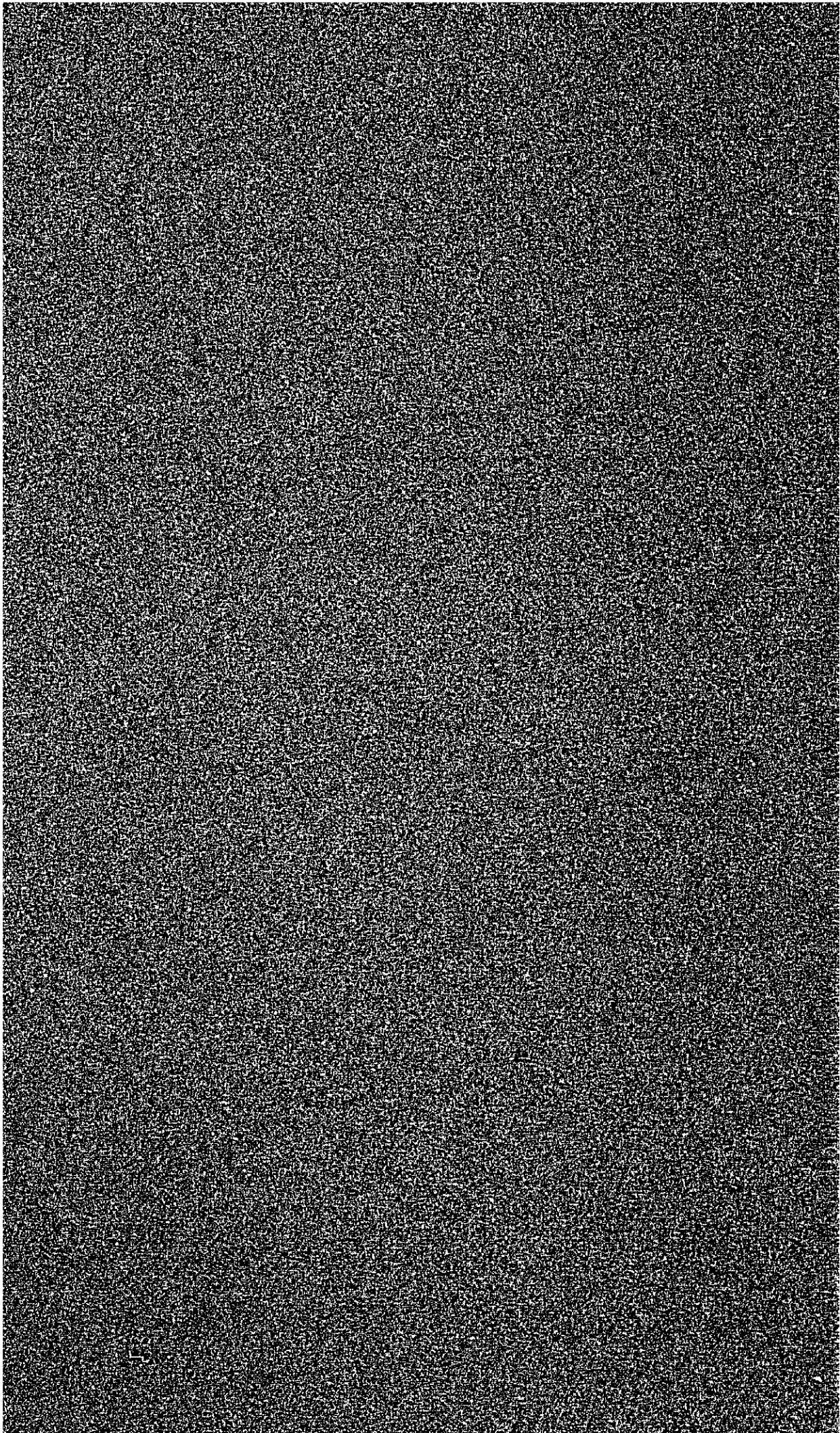


## **Chapter 3**

# **LAND USE AND POPULATION**

3.1	Urban Development	3-1
3.2	Population and Employment	3-8
3.3	Characteristics in Population and Employment Changes: 1982-2000	3-10



## CHAPTER 3 LAND USE AND POPULATION

### 3.1 Urban Development

#### (1) Existing Land Use

##### a) Existing Land Use

A map showing the existing land use of 1980 at a scale of 1:50,000 in Bangkok and its vicinity was provided by TCP. Fig. 3-1 is its reduced plan.

The classified land use areas by Tambon in 1980 were also provided by TCP. The land use areas are grouped into the traffic zones of this study as shown in Appendix Table 3-1. It is summarized into Table 3-1. It is found in the table that 16% of the GBA or 513 km<sup>2</sup> is urbanized. Agricultural uses still occupy 80% of the GBA. In the urbanized area, residential area occupies 50%, commercial area 6%, and industrial area 5%.

**TABLE 3-1 LAND USE IN THE GBA, 1980**

(In ha and percent)

	High Density Residen- tial Area	Residen- tial Area 1)	Commer- cial Area	Indus- trial Area	Government Insti- tution Utility Facility	Religi- ous Area	Agricul- tural Area 2)	Others 3)	Total
Bangkok Metropolis	1,809 (1.1)	18,591 (11.9)	2,578 (1.6)	1,317 (0.8)	4,660 (3.0)	425 (0.3)	106,797 (68.1)	20,665 (13.2)	156,842 (100.0)
Samut Prakan	115 (0.1)	2,678 (3.0)	189 (0.2)	1,210 (1.3)	667 (0.7)	169 (0.2)	78,624 (86.3)	7,442 (8.2)	91,094 (100.0)
Nonthaburi	1 (0.0)	2,105 (3.2)	65 (0.1)	96 (0.2)	315 (0.5)	65 (0.1)	62,520 (95.5)	294 (0.4)	65,461 (100.0)
Total Areas	1,925 (0.6)	23,374 (7.5)	2,832 (0.9)	2,623 (0.8)	5,642 (1.8)	659 (0.2)	247,941 (79.1)	28,401 (9.1)	313,397 (100.0)

Source : TCP, 1982

Note : 1) Medium and low density areas

2) Agricultural and rural areas

3) Park, open space, etc.

Remarks: The urbanized area is the area excluding agricultural area of 247,941 and half of others 14,201, resulting 51,255 ha.

##### b) Existing Land Use Pattern

The past development in the Bangkok area is classified as the monocentric type from a view point that the central district (the core area which is a densely mixed land use area) is surrounded by various types of residential area with some locations of industrial zones. Fig. 3-2 is a conceptual picture indicating the existing land use pattern.

The central business district (CBD) is defined as an area covering the districts

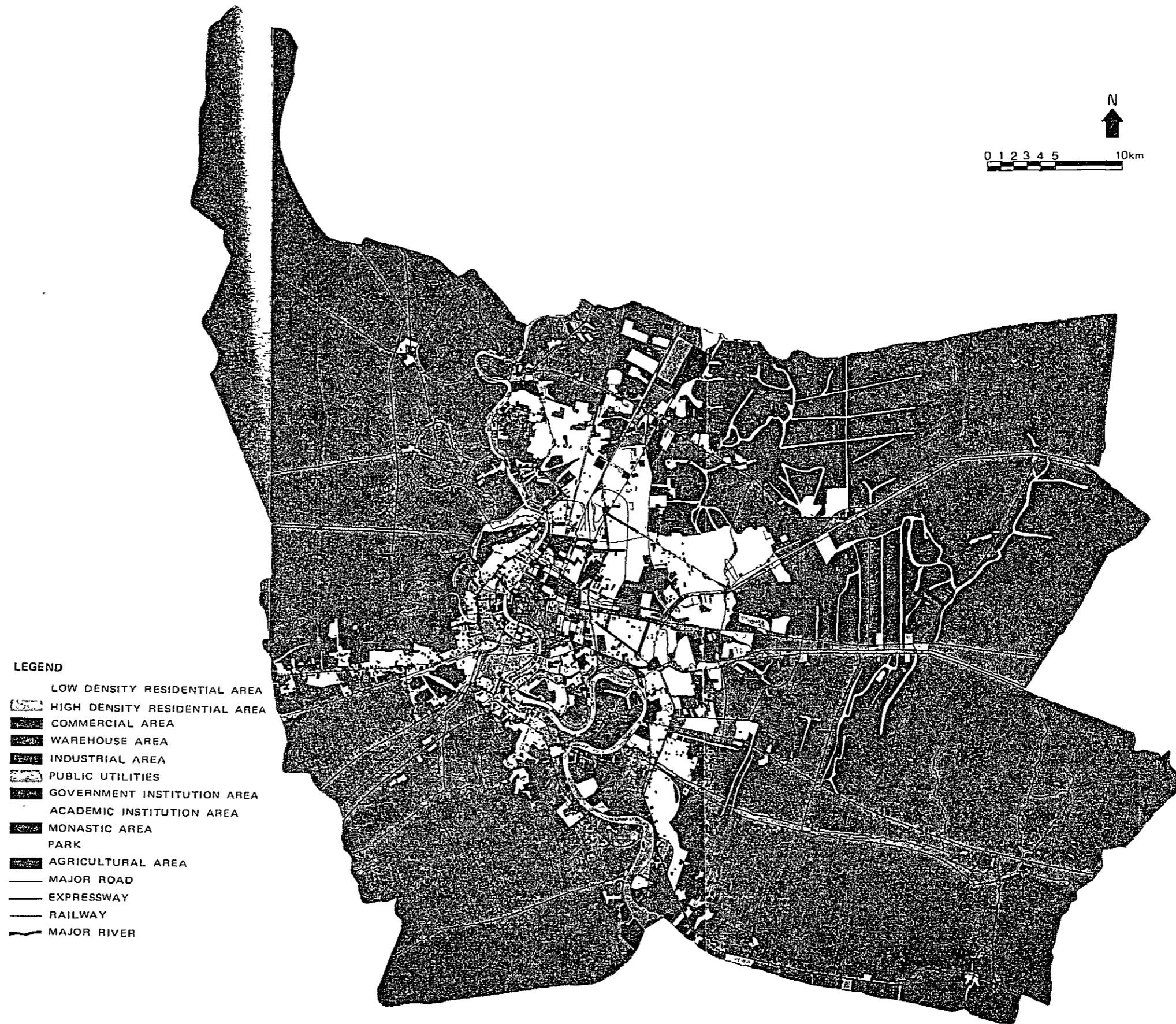


FIG. 3-1 EXISTING LAND USE MAP FOR GBA, 1982



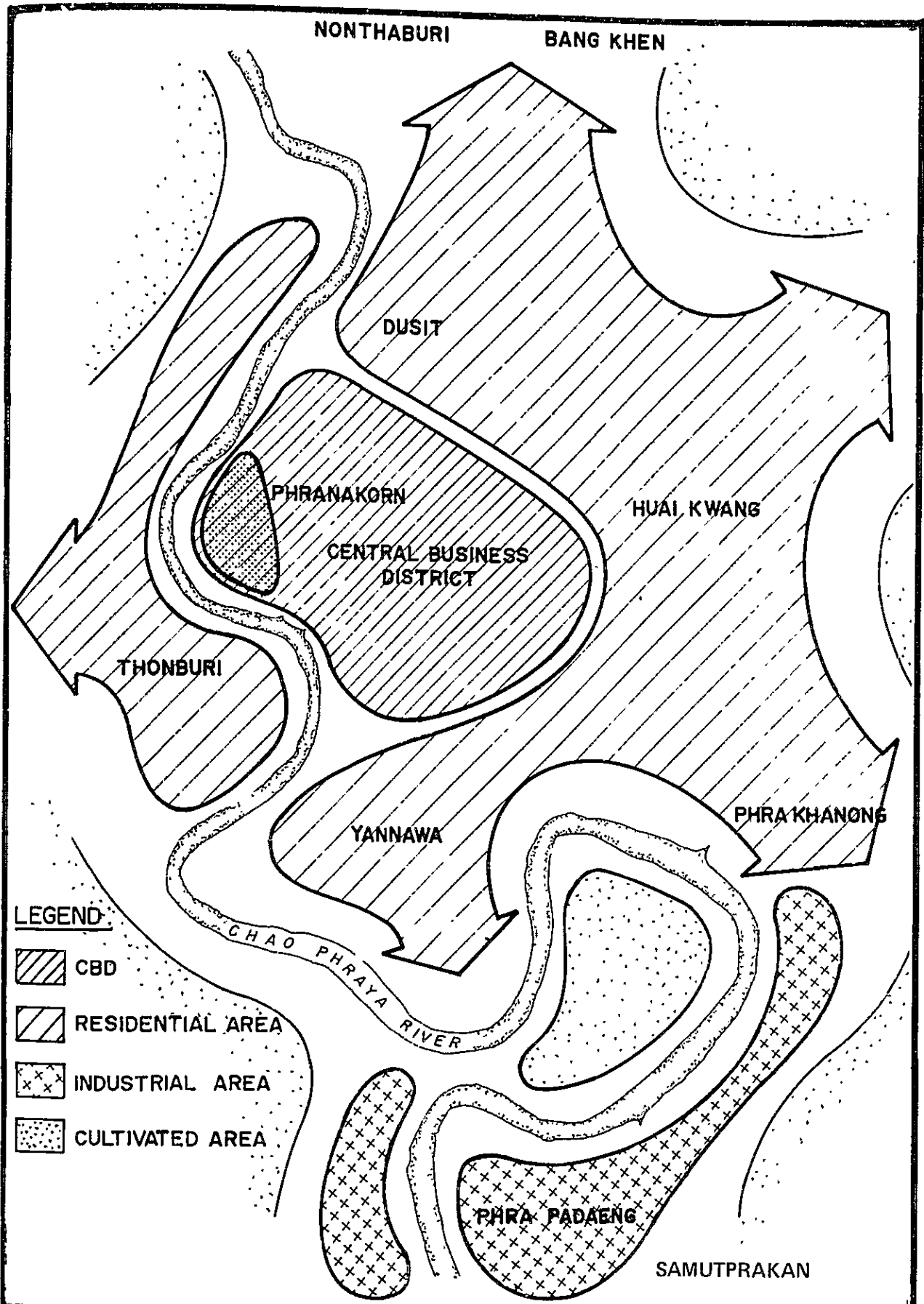


FIG. 3-2

EXISTING LAND USE PATTERN

THE SECOND STAGE EXPRESSWAY SYSTEM IN THE GREATER BANGKOK

of Pranakorn, Pomprab, Sampantawong, Pratumwan and Phya Thai which includes 50 percent of all the business establishments in the Bangkok Metropolis. Furthermore, Pranakorn is the center of government agencies which includes 48% of governmental employees. Most of the residential areas in the Thonburi side or in the west bank, especially in Khlongsan, Thonburi and Bangkok Noi, consist of high density districts.

On the east bank or the Pranakorn side, residential areas which surround CBD are Dusit, Huey Kwang, Bang Kapi, Bang Khen and Phra Khanong. The outer zones of Bangkok Metropolis are Minburi, Nongjog, Lad Krabang, Nongkaem, Pasrijaruen, Bang Khuntien, Taling Chun and Rajburana, which have plenty of cultivated land<sup>1</sup>).

The rapid growth of the Metropolis has caused the following problems which could be seen in other cities in the world :

- Over-populated area which usually tends to develop into a slum area with poverty and crime;
- Heavy traffic on roads;
- Underdevelopment of water supply, sewerage, garbage disposal, power supply, telephone system and fire force;
- Police faced with mounting crime statistic;
- Pollution;
- Flood; and
- Uncontrolled urbanization in the surburban agricultural areas.

Continuous and intense efforts are required to solve these problems. Simultaneously, a restraint policy against urban growth and expansion of the Metropolis is considered necessary. In these situations the Structural Plan of Bangkok Metropolis and its Vicinity, 2000 is drafted which is expected to guide the development of the Metropolis towards better and improved circumstances.

## (2) Future Land Use

There are two development plans the study can refer to at present. They are "The 5th 5-year Development Plan" and "The Structural Plan for Bangkok Metropolis and its Vicinity".

### a) The Fifth 5-Year Development Plan<sup>2</sup> )

The 5th national development plan covers the period from October 1981 to September 1986 proclaiming the policy targets for the development of various sectors of the Kingdom. Major targets of the plan were stated in Chapter 2.

Associated with the transportation system in the GBA, several major projects are shown to be prepared and/or implemented; i.e. the construction of mass rail transit lines, expressways and three bridges over the Chaophraya River, the expansion of Don Muang International Airport and the planning of a new international airport.

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1) TCP, the Structural Plan of Bangkok Metropolis and its Vicinity 2000, (Draft 1982 : translated by the Study Team).

2) NESDB, the Fifth 5-Year National Social and Economic Development Plan (1982-1986).

Pointing out the problem of excessive concentration of economic activities and population on the metropolitan area, the plan emphasizes a strategy to stimulate economic activities in other regions outside the Bangkok area.

b) The Structural Plan for Bangkok Metropolis and its Vicinity, 2000<sup>3</sup>)

This plan is already drafted and coordinating efforts are being made to be announced officially in 1983. The following are excerpts from the plan :

— Past Performances

The first “Greater Bangkok Plan” had been set out in 1960 (2503) by the Ministry of Interior with the support from the U.S. Government through USOM. The Greater Bangkok Plan included Nonthaburi Province and Samut Prakan Province. The plan was prepared to the year 1990 (2533) with the projected population of 4.5 million within the metropolitan area of 450 square kilometers. (Two years afterward, in 1962 the Office of Town and Country Planning was recognized as the Department of Town and Country Planning in the Ministry of Interior).

In 1972 there was the first revision for the Greater Bangkok Plan to incorporate in the new development plan of the city. This revised plan was also planned to the year 1990, but the projected population was 6.5 million within the larger area of 750 square kilometers. The revised plan was not enforceable by law because there was no city planning law at that time. However, it was used as basic guidelines for the government agencies in the metropolitan development.

In 1975, there was City Planning ACT 1975. In 1976, the Cabinet gave an assent to the Department of Town and Country Planning to accomplish a structural plan of the Bangkok Metropolis. This plan was called “The Structural Plan of Bangkok Metropolis and Suburbs”. The projection date of this structural plan was in the year 2000. It covered 6 provinces as follows : Bangkok Metropolis, Nonthaburi, Phatum Thani, Samut Prakan, Nakorn Prathom, and Samut Sakorn. The Department of Town and Country Planning expected to upgrade this project as ministry rules and enforce it as city planning law<sup>4</sup>).

— The Fifth 5-Year Development Plan

The improvement of the infrastructure of the Bangkok Metropolis and the Suburbs will follow policies and guidelines of the Fifth National Economic and Social Development Plan. Population growth of the Bangkok Metropolitan Area will be limited to a moderate growth rate by using the following guide line :

1. Develop cities throughout the countryside to act as social and economic centers which will reduce the excessive rural migration to GBA.
2. Develop the nearby cities in order to accept the roles of business, industrial and residential expansion from the Bangkok Metropolis.

— The New Structural Plan<sup>5</sup>)

To make the Structural Plan conform with the policy of the Fifth National Devel-

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3) TCP, op-cit.

4) TCP, op-cit.

5) TCP, op-cit.



opment Plan, the Plan has to cover not only the city area of the Bangkok Metropolis and its suburbs but also the whole region of the six provinces or so called "The Bangkok Metropolis and its Vicinity". This whole region is divided into 3 parts.

1. Inner Area : The inner area will be the city area of the Bangkok Metropolis and its vicinity. In the future it will have the radius of 20 to 25 kilometers from the center. It is planned to be surrounded by the outer ring road.
2. Green Belt Area : The green belt area is the area between the inner area and the outer area, being proposed to stop uncontrolled growth of the city area. The green belt area is the area planned for agriculture, recreation, landscape, rural dwelling and plenty of channels, within the radius of 30 kilometers from the center of the Bangkok Metropolis.
3. Outer Area : The outer area is the outside area of the green belt to the surrounding provincial boundaries. This area is encouraged for the use of agriculture and locations of residential and industrial complexes. Industrial parks should be in this zone.

Major targets of the plan are 1) redevelopment of the inner area, 2) encouragement of "self-contained urban clusters in the outer area and 3) no town development except existing village centers in the green belt area. Population is expected at 7.4 million in the Metropolis and 2.9 million in the five provinces, totalling 10.3 million in 2000.

The land use map for the year 2000 at a scale of 1:50,000 is shown to the Study Team from which the classified areas of the GBA are summarized in Fig. 3-3 and Table 3-2. It is planned, according to the table, that the urbanized area comprises 780 square kilometers, the residential area including satellite clusters composes 51%, the commercial area 5% and the industrial area 3%. The classified land use areas by Tambon in 2000 were provided by TCP in August 1982. These areas are regrouped into the traffic zones of the study as shown in Appendix Table 3-2.

TABLE 3-2 LAND USE IN THE GBA, 2000

Designation	(In ha and percent)											
	High Density Residential Area	Medium Density Residential Area	Low Density Residential Area	Commercial Area	Industrial Area	Government Institution Utility Facility	Religious Area	Park Open Space	Agricultural Belt	Rural Area	Satellite Town	Total
Bangkok Metropolis	3,360 (2.1)	5,565 (3.5)	17,502 (11.2)	3,523 (2.2)	1,527 (1.0)	4,141 (2.6)	582 (0.4)	25,958 (16.6)	62,739 (40.0)	28,333 (18.1)	1,652 (2.3)	156,842 (100.0)
Samutprakan	-	1,401 (1.5)	3,455 (3.8)	294 (0.3)	804 (0.3)	4,119 (4.5)	189 (0.2)	9,641 (10.6)	40,276 (44.2)	29,311 (32.2)	1,564 (1.7)	91,094 (100.0)
Nonthaburi	-	-	3,483 (5.3)	253 (0.4)	-	430 (0.7)	90 (0.1)	8,776 (13.4)	30,174 (46.1)	22,015 (33.6)	198 (0.3)	65,461 (100.0)
Total Areas	3,360 (1.1)	6,966 (2.2)	22,482 (7.8)	4,110 (1.3)	2,331 (0.7)	8,690 (2.8)	861 (0.3)	44,375 (14.2)	132,189 (42.5)	79,659 (52.4)	5,414 (1.7)	313,399 (100.0)

Source : TCP, The Structural Plan in The Bangkok Metropolis and the Vicinity, 2000 (Draft 1982)  
 Note : The urbanized area is defined to cover the columns from the residential areas to the religious area and 66% of the park open space, in the total of 78,048 ha.

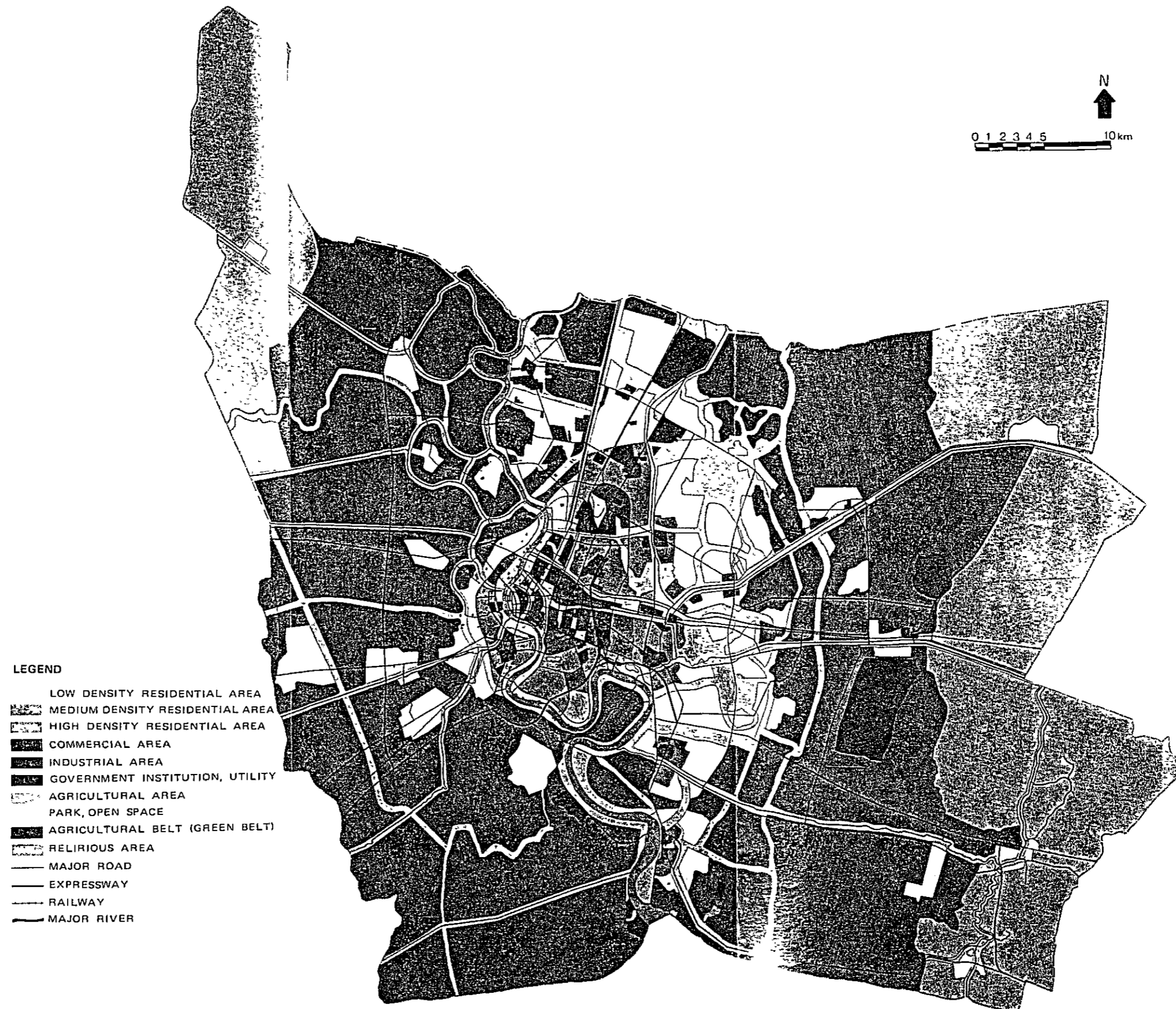


FIG. 3-3 FUTURE LAND USE MAP FOR GBA, 2000



## 3.2 Population and Employment

### 3.2.1 Population

#### (1) The Kingdom

The population of the Kingdom had grown at an average rate of 2.8% p.a. in the ten years reaching 46.5 million in 1980. It is widely recognized that a high growth rate of population is a burden for economic and social development of the country. The Government again emphasizes the importance of reducing the growth rate in its 5th 5-Year Plan (1982–1986), which aims at an annual growth rate of 1.5% at the end of 1986.

Associated with the plan, NSO prepared a working paper which forecasted a long-range regional population<sup>6)</sup>. Recently, TCP revised it slightly to forecast 63 million people in 2000<sup>7)</sup>.

Simultaneously, TCP has prepared the regionwise population forecast for future years based on which Appendix Tables 3–3 and Appendix Figs. 3–1 and 3–2 are prepared.

#### (2) The Greater Bangkok Area (GBA)

After the BTS of 1975, a number of roads and bridges studies used the population forecast referring to the previous Greater Bangkok Plan 2000 issued in 1976. It estimated 10 million inhabitants in the GBA in 2000. The current TCP draft plan assumes 8.7 million inhabitants to live in the GBA for the year 2000.

These figures indicate that the population estimate is associated with a policy to lessen the excessive concentration in the metropolitan area. The target becomes severer than the previous one. This study uses the new target figure as the overall population in the study area. Table 3–3 presents the population forecast upto 2000 together with the past statistics from 1965. It projects an average growth rate of 1.8% p.a. from 1980 to 2000 in the GBA. Appendix Table 3–4 indicates the changes in households and household size in the past several years. While the number of households increased at an average of 5.7% p.a. from 1976 to 1981, the household size decreased from 7.0 to 6.3 persons per household in the same period.

### 3.2.2 Employed Persons

#### (1) The Kingdom

Statistical data of employed persons in the kingdom are shown in Appendix Table 3–5. They indicate 12 million (excluding unpaid family workers) in 1980, which corresponds to 22.5% of the population. The percentages of the population employed registered an increasing but tapering-off tendency.

The number of the employed persons in the primary sector, mostly engaged in agricultural production, had increased in these years, but its percent share to the total had decreased. It became 53% in 1980, while it was 60% in 1960. On the other hand, the employed persons in the secondary and tertiary sectors had increased the percent

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6) Working Group on Population Projection NSO, Population Projection for Thailand : whole Kingdom and Regions 1970–2005 (1981).

7) TCP, op-cit.

TABLE 3-3 POPULATION IN THE GBA AND ITS VICINITY

(In thousand)

A. POPULATION

DESCRIPTION	1965	1970	1975	1980	1985	1990	1995	2000
Bangkok Metropolis (A)	2,896	3,517	4,349	5,154	5,805	6,458	6,991	7,365
Nonthaburi (B)	235	272	344	387	412	432	437	427
Samut Prakan (C)	285	331	430	536	602	700	811	935
The GBA (A) + (B) + (C)	3,416	4,120	5,123	6,077	6,818	7,590	8,239	8,726
Pratumtani (D)	218	250	294	324	351	372	386	391
Nakornpratom (E)	420	464	508	561	618	681	751	827
Samut Sakorn (F)	189	212	243	265	290	313	333	350
Bangkok and Vicinity (A)+(B)+(C)+(D)+(E)+(F)	4,244	5,047	6,168	7,228	8,077	8,956	9,709	10,294

Source : TCP, 1982

(In thousand)

B. GROWTH RATE

DESCRIPTION	1965-1970	1970-1975	1975-1980	1980-1985	1985-1990	1990-1995	1995-2000
Bangkok Metropolis	3.96	4.34	3.45	2.41	2.16	1.60	1.05
Nonthaburi	3.00	4.76	2.39	1.28	0.97	0.22	0.48
Samut Prakan	3.03	5.34	4.51	2.34	3.08	2.99	2.90
The GBA	3.82	4.45	3.47	2.33	2.17	1.65	1.16
Pratumtani	2.74	3.30	1.99	1.57	1.20	0.72	0.24
Nakornpratom	2.00	1.81	2.02	1.95	1.96	1.96	1.97
Samut Sakorn	2.31	2.79	1.78	1.78	1.52	1.26	1.00
Bangkok and Vicinity	3.52	4.09	3.22	2.25	2.09	1.63	1.18

Source : TCP, 1982

shares from 40% in 1976 to 47% of the total in 1980.

The figures of employed persons in the Central Region and the Bangkok Metropolis are shown in Appendix Tables 3-6 and 3-7, respectively. In the Central Region the percent share of those in the primary sector was 55% in 1976 but decreased to 46% in 1980, while it was 5.5% in 1976 and 4% in 1980 in the Metropolis. The percent reduction was resulted not from actual decreases in employment but from relatively high growth in other sectors.

Employed persons in the secondary and tertiary sectors in the Central Region registered a gradual increase in the percentage during the four years from 1976 to 1980, while the increase was larger in the Metropolis : 1,182,000 in 1976 to 1,918,400 in 1980. In 1980, the percent figures of employed persons (excluding unpaid family workers) to the population were 25% in the Central Region and 39% in the Metropolis, respectively.

## (2) GBA

Employment data by Changwat were not available for these years, 1976–1980. The figures of the GBA for 1982 were determined by the Study Team as in Appendix Table 3–8.

Employed persons at residential places and work places for the year 2000 were estimated by the process stated in Appendix 3–1. The employed persons at residential places are estimated at 2.40 million in 1982 and 3.46 million in 2000. The percent share to the population is 37.3% in 1982 and 39.7% in 2000.

The employed persons at work places in the GBA are estimated to be slightly higher than those in the residential places since there are workers coming into the GBA from the peripheral areas. The forecasts are 2.41 million in 1982 and 3.48 million in 2000, being shown in Appendix Tables 3–8 and 3–9.

### 3.2.3 Zonal Population and Employment

#### (1) Population

Population distribution among the zones in 1982 and 2000 is discussed in Appendix 3.1 and the result is shown in Appendix Table 3–10. Zonal population is related to the forecast of traffic demand (trip generation and attraction) as discussed in Chapter 5. Main features of the forecast are stated in the following section 3.3 of this chapter.

#### (2) Employed Persons at Work Places

Employed persons at work places by zone are estimated since they are also necessary as a variable input in the trip generation and attraction model formulas (referring to Chapter 5). The work process is discussed in Appendix 3.1 and the result is shown in Appendix Table 3–10. The following section describes some characteristic features of the forecast result.

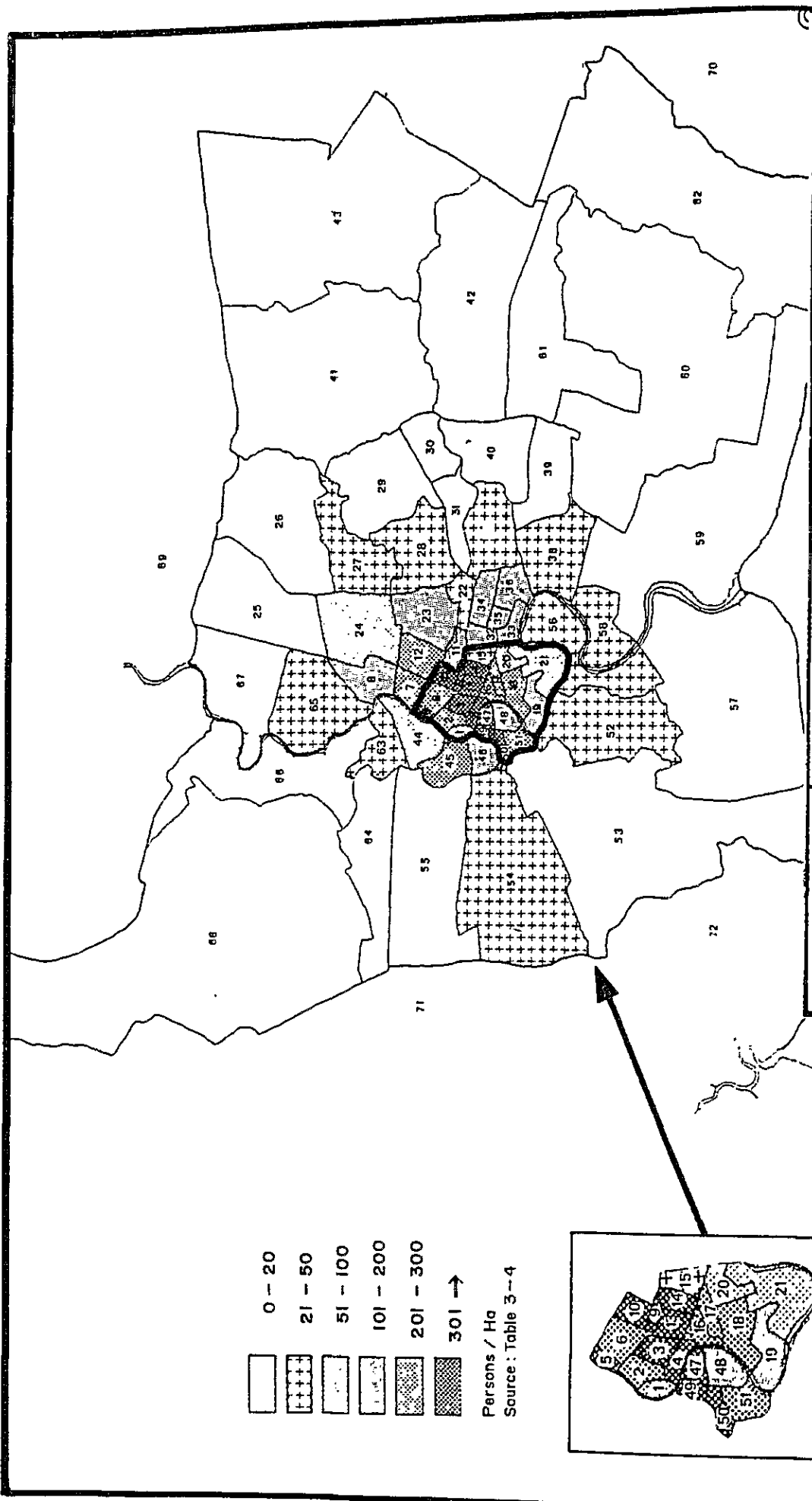
### 3.3 Characteristics in Population and Employment Changes : 1982–2000

#### 3.3.1 Overall Characteristics

The population in the GBA has changed from 5,123,000 in 1975 to 6,432,000 in 1982 and the job opportunities in Bangkok from 1.25 million in 1976 to 2.41 million in 1982. The average growth rate was 3.3% p.a. for 1975–82 and 9.5% p.a. for 1976–82, respectively.

The population forecast of the study, which refers to the TCP plan, is from 6.43 million in 1982 through 7.59 million in 1990 to 8.72 million in 2000. It indicates the growth rates of 2.1% p.a. from 1982 to 1990 and 1.4% p.a. from 1990 to 2000. Figs. 3–4 and 3–5 present the population density by zone for 1982 and 2000, respectively. It is found that the growth of the density is much expected in the suburban areas, particularly in the eastern side of Chaophraya River.

The job opportunities in the Area is from 2.41 million in 1982 to 3.48 million in 2000, indicating an average growth rate of 2.1% p.a.



- 0 - 20
- 21 - 50
- 51 - 100
- 101 - 200
- 201 - 300
- 301 +

Persons / Ha  
Source : Table 3-4

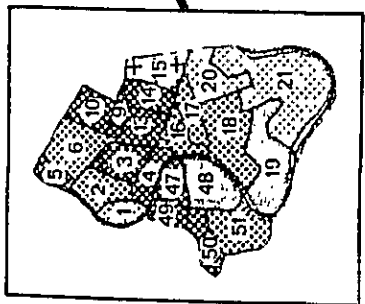
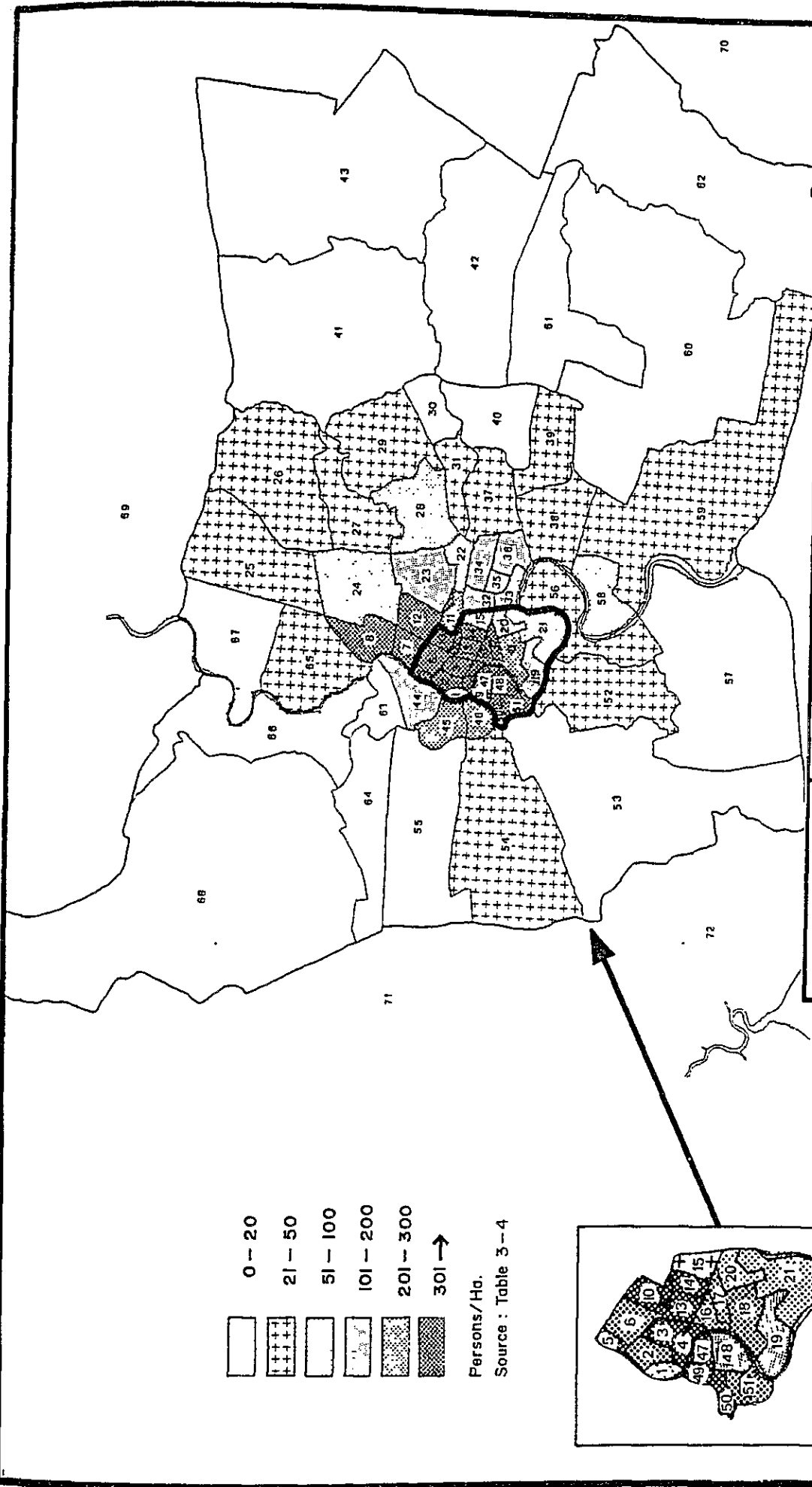


FIG. 3 - 4

POPULATION DENSITY BY ZONE , 1982

THE SECOND STAGE EXPRESSWAY SYSTEM IN THE GREATER BANGKOK



0 - 20  
 21 - 50  
 51 - 100  
 101 - 200  
 201 - 300  
 301 →

Persons/Ha.  
 Source : Table 3-4

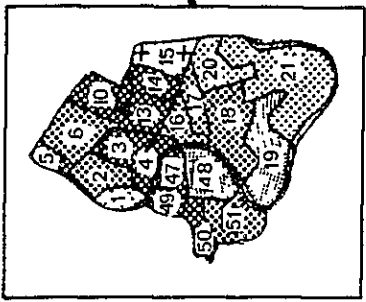


FIG. 3-5

POPULATION DENSITY BY ZONE, 2000

THE SECOND STAGE EXPRESSWAY SYSTEM IN THE GREATER BANGKOK



Compared with the past growth of population and employment, the forecast implies a strong tapering-off trend in the coming decades. It is understood that this is the Government plan intending to restrain uncontrolled growth of the GBA.

District-wise changes are summarized in Fig. 3-6 and Table 3-4 where the zones are categorized into three groups by using the classification in Appendix Fig. 3-4. Population and employment in the inner district in 1982 are already approaching to a saturating point. They increase modestly upto 2000. On the other side, population and jobs will increase in urban and suburban districts as well.

### 3.3.2 Population and Employment

#### (1) Population

Population growth ratios by zone are categorized and shown in Fig. 3-7. Of these zones, a group is identified in terms of high ratios of increase in population from 1982 to 2000. They are numbers 8, 23, 25, 27, 29, 39, 48, 51, 52, 56, 58, 59, and 66. These are the recently developing areas encompassing the traditionally built-up city area.

#### (2) Employment

Fig. 3-8 indicates the different growth ratios of job opportunities among the zones. Job opportunities are expected to increase at higher ratios in the zone of 23, 24, 25, 27, 29 and 41. They are located at the north (Bang Khen-Don Muang) and the north-eastern (Bang Kapi-Minburi) areas. The zones 58-61 in Samut Prakan Province will also have many job opportunities generated by new industrial locations in these zones.

Similar high growths are forecasted in the zones of 37, 39, 40 and 42. The zones 44-51 in the Thonburi side are expected to be redeveloped simultaneously.

#### (3) Growth Index of Urban Activities

If the population growth is accompanied by an increase of employment, the economic activities are aggregated to have larger potentiality in its zone. An index is computed by multiplying the growth ratio of population by that of employment. The zonal index indicates an relative magnitude of urban development for the period of 1982-2000 in terms of the combination of the growth of population and employment.

Zones 20, 21, 23, 25, 27, 28, 29, 39 and 59 register indexes of high development. They are in the north, the north-east and the south suburban areas. Fig. 3-9 presents the classified indexes among the zones.

It is found in summary that the overall growth activities thus enumerated in terms of population, job opportunities, and urban growth index will be prominent on the eastern side of Chaophraya River at the periphery of the built-up area.

FIG. 3-6 CHANGES IN POPULATION AND EMPLOYMENT

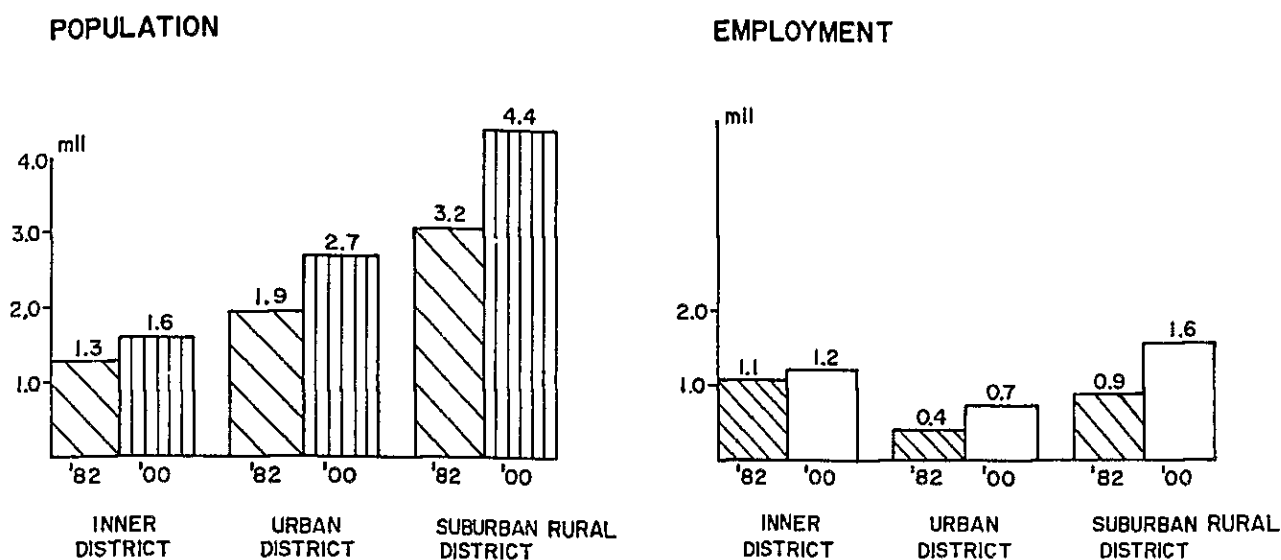
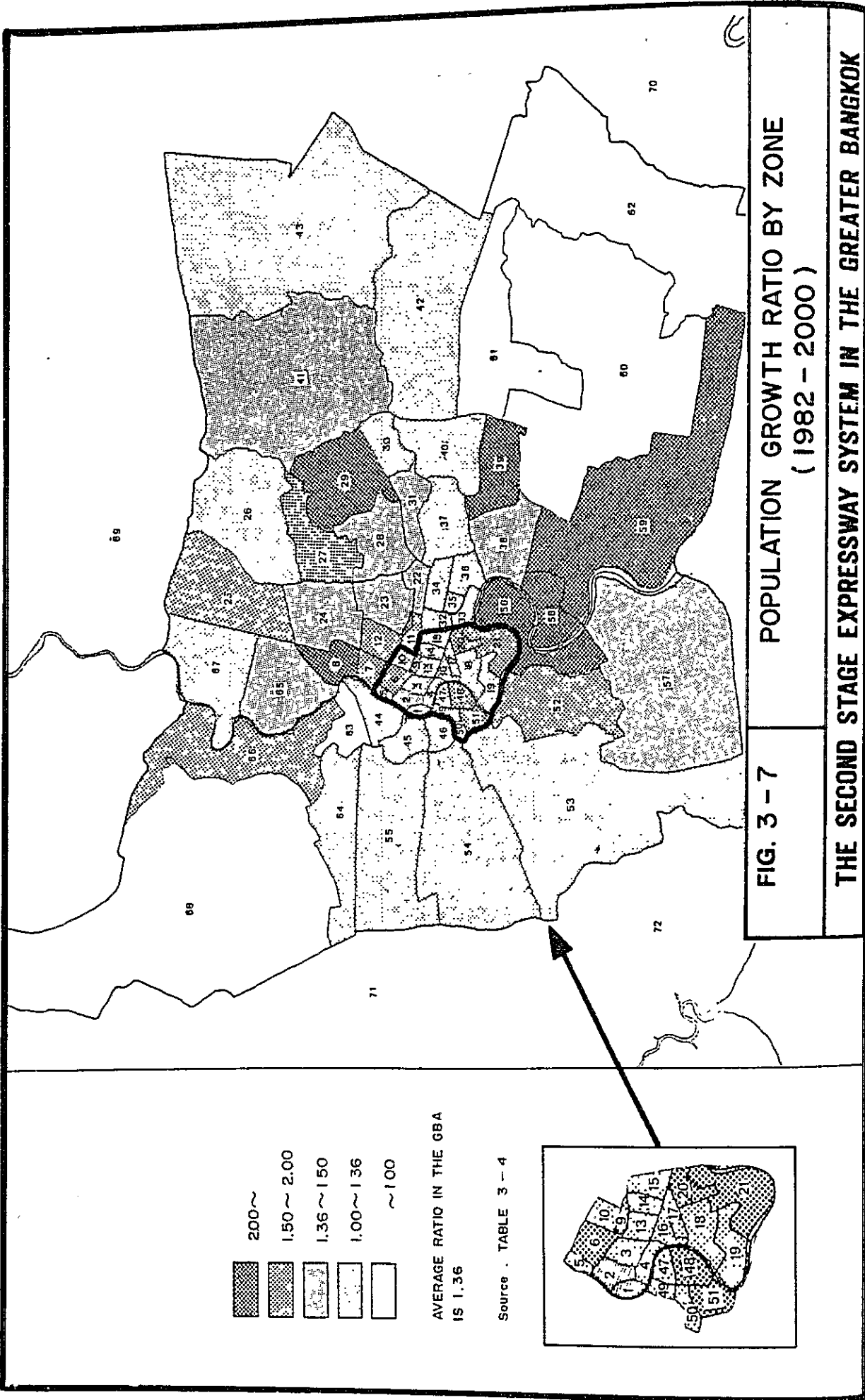


TABLE 3-4 CHANGES IN POPULATION AND EMPLOYMENT

(In thousand)

	Zones	Population			Employment		
		1982	2000	00/82	1982	2000	00/82
Inner District	1-4 and 9-17	1289 (20)	1636 (18)	1.27	1088 (45)	1212 (35)	1.11
Urban District	5-8, 22-23, 32-36, and 44-51	1938 (30)	2650 (30)	1.37	434 (18)	716 (21)	1.65
Suburban and Rural	Other zones up to 68	3205 (50)	4440 (52)	1.39	889 (37)	1548 (45)	1.74
<b>TOTAL</b>		6432 (100)	8276 (100)	1.36	2411 (100)	3476 (100)	1.44

Source : From Appendix Table 3-10



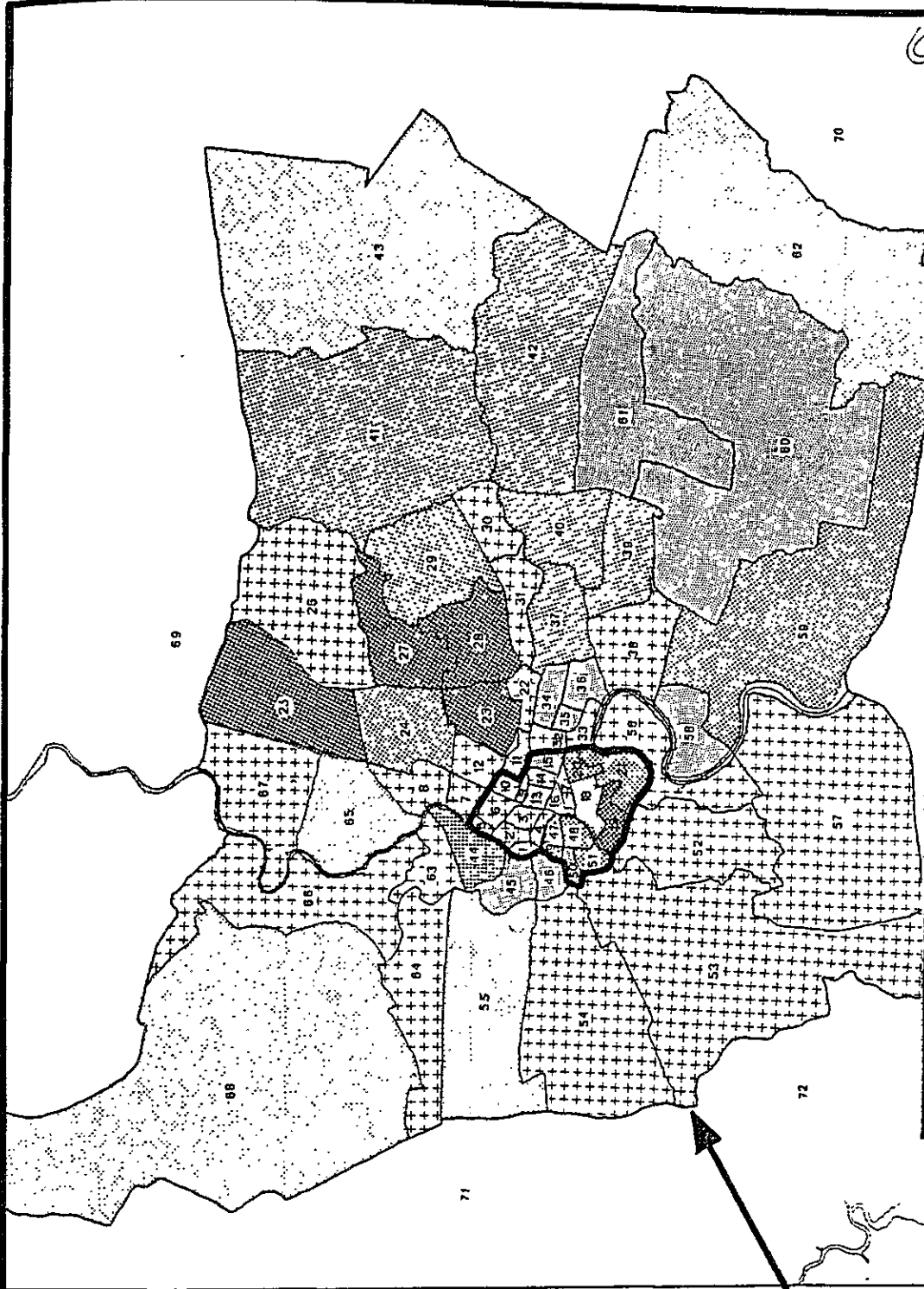
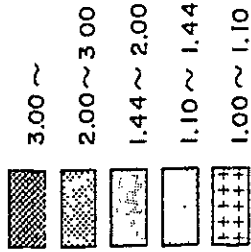


FIG. 3 - 8

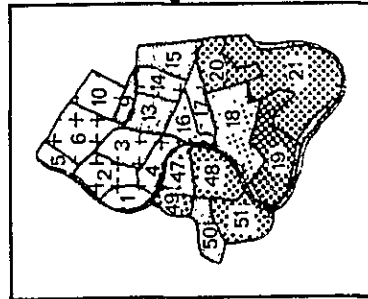
EMPLOYED PERSONS AT WORK PLACES  
GROWTH RATIO BY ZONE (1982 - 2000)

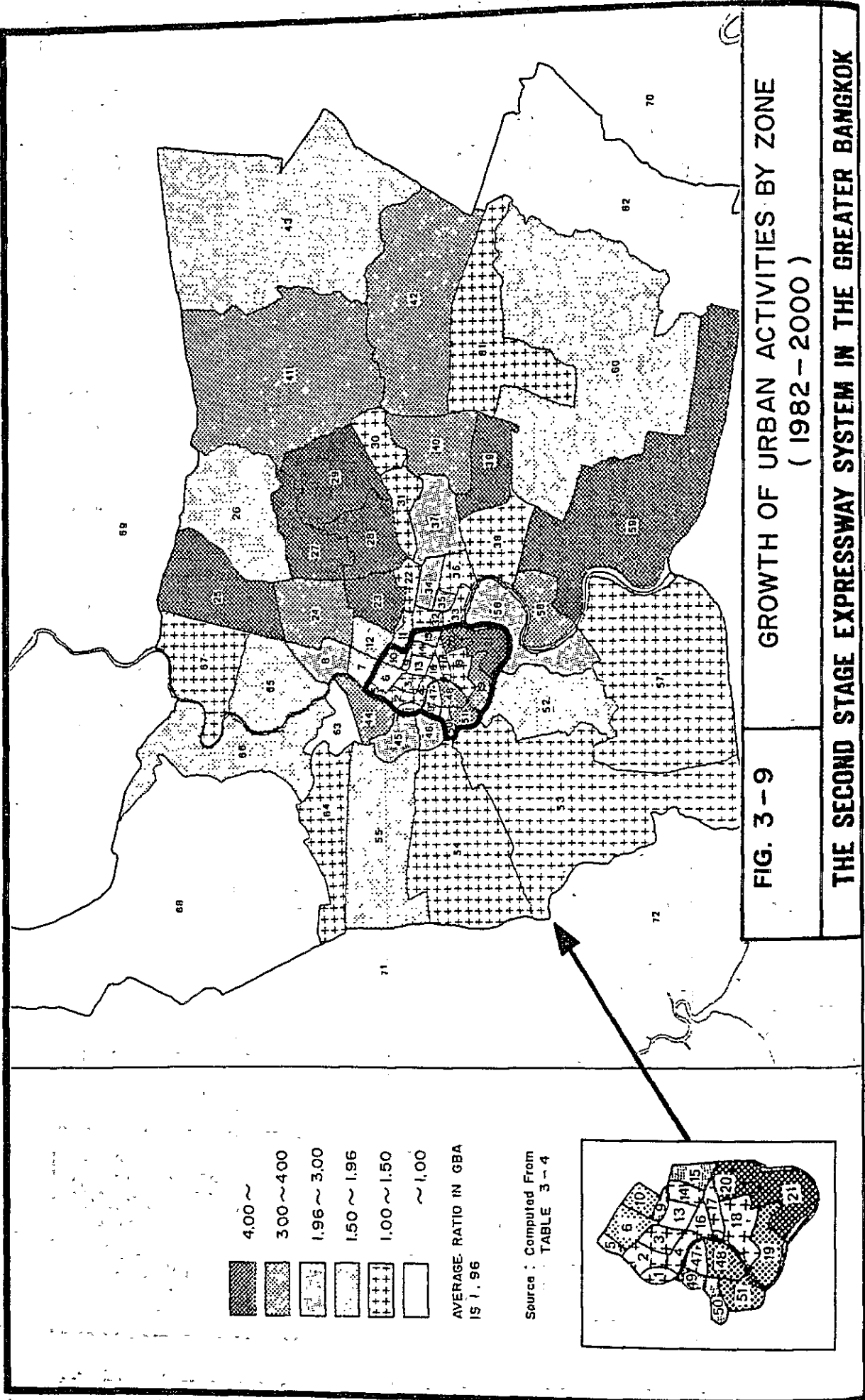
THE SECOND STAGE EXPRESSWAY SYSTEM IN THE GREATER BANGKOK



AVERAGE RATE IN THE GBA  
IS 1.44

Source : TABLE 3 - 4

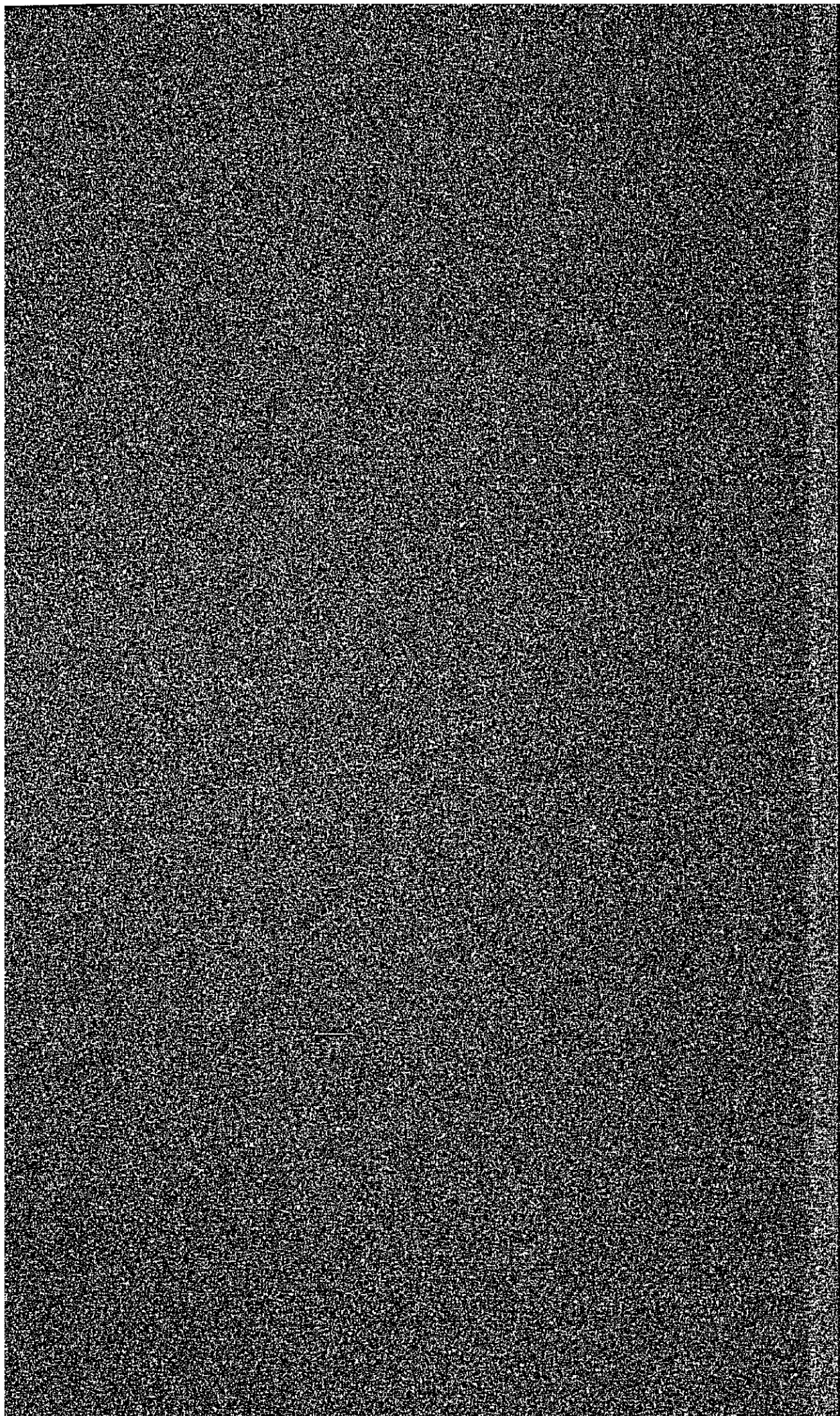




# Chapter 4

## ROAD TRANSPORT SYSTEM AND TRAFFIC CHARACTERISTICS

4.1	General	4-1
4.2	Roads and Traffic	4-1
4.3	Traffic Survey	4-9
4.4	Registered Vehicles	4-13
4.5	Origin and Destination Tables in 1982	4-15



## CHAPTER 4 ROAD TRANSPORT SYSTEM AND TRAFFIC CHARACTERISTICS

### 4.1 General

There are three major transport facilities in the GBA: railways, roads and rivers. The railway system is served by State Railway of Thailand. The major function of it is for inter-regional movement and this has done a little in providing service for intra-urban transport demand. The rivers and channels once served as the major transport network, but the relative share of their services has drastically decreased.

Nowadays the road network covers the entire GBA, and serves the majority of traffic demand, both of passengers and goods. The network is mostly composed of "tanon" (roads) to which "soi" (town streets) serve as branch streets between the main road and nearby communities. It is commonly recognized the roads in the urban area are far less developed resulting in heavy traffic congestion and waste of time and resource. This chapter discusses main features of the existing road system together with traffic characteristics.

### 4.2 Roads and Traffic

#### 4.2.1 Road Network

##### (1) Administration

The roads in GBA are mostly administered by BMA. However, the roads in suburban areas and some trunk lines extending to the other regions are under the jurisdiction of DOH. While DPW is in charge of the construction of large scale bridges, as well as maintenance and operation after the completion of the bridges. Toll expressways are constructed and operated by ETA.

##### (2) Roads

###### a) Ordinary Road Network

The main road network covering the GBA is shown in Fig. 4-1. Several radial trunk roads start at the core district and extend to outer areas, with associated grid pattern normal roads in the built-up area. The Middle Ring Road, being yet constructed its northern sections, serves for traffic as a circumferential road in the urbanized area. The Outer Ring Road plan was studied for its economic and technical viability in 1978. Construction of the northwestern part of it (Bangbouthong to Taling Chan section) was completed in 1982. Since this part is located in the western suburban areas, it would help little in mitigating the traffic congestion in the central built-up area.

Major trunk roads have capacities with more than six lanes mostly divided by median. Appendix Fig. 4-1 shows the roads by lane-number. Traffic signal is installed at major intersections, and particularly in the inner area the signal system has capability to coordinate the traffic operation systematically to let traffic flow efficiently. However, the traffic volume is much more than the signal can handle. Congestion of traffic on roads is quite common in the Metropolis.



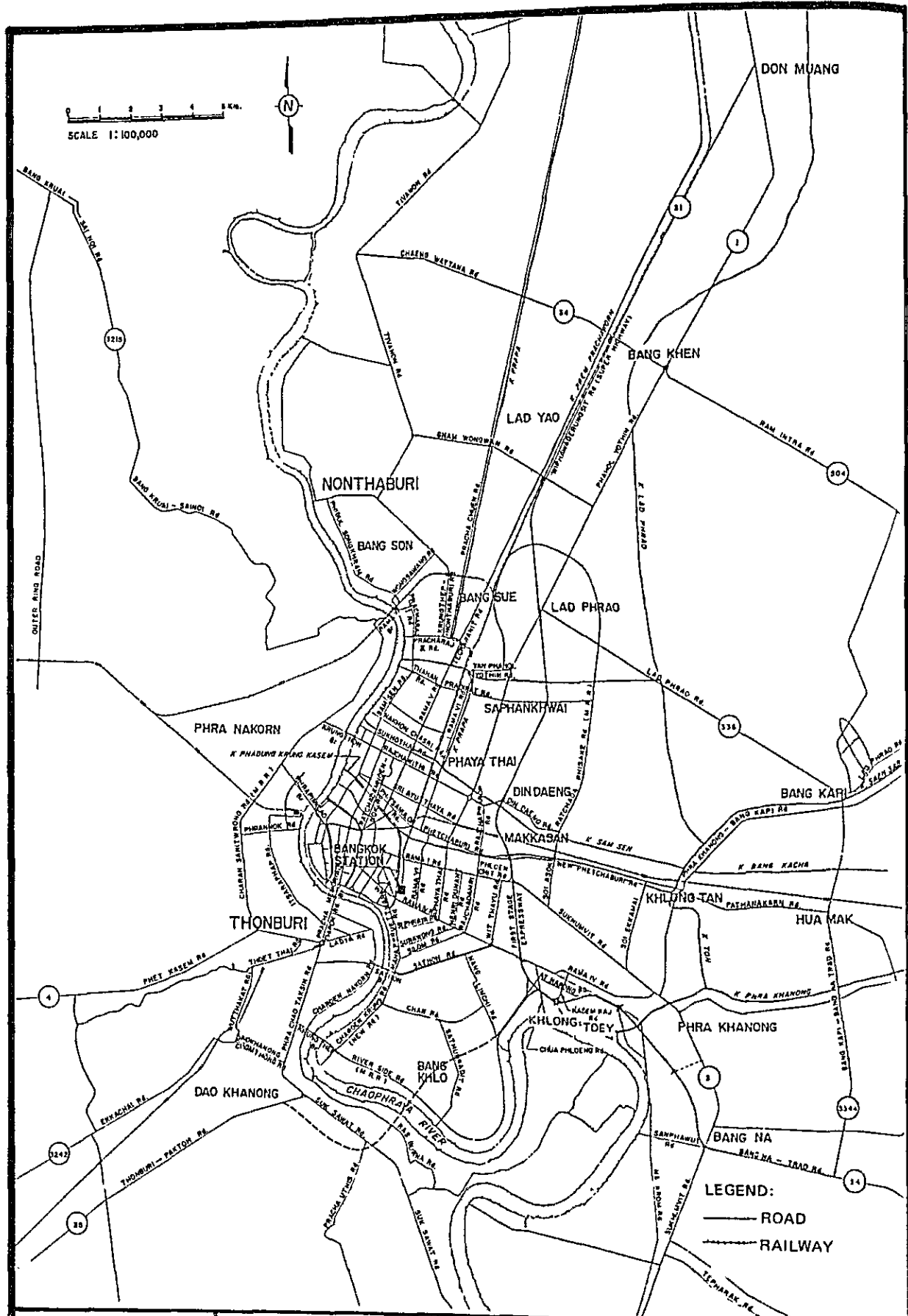


FIG. 4-1

ROAD NETWORK IN THE GBA, 1983

THE SECOND STAGE EXPRESSWAY SYSTEM IN THE GREATER BANGKOK

b) Expressway Network

The expressway system in the GBA is operated by the Expressway and Rapid Transit Authority of Thailand (ETA). They are consisting of three sections and the total length is approximately 27.1 kms (see Fig. 4-1), namely:

Din Daeng	– Port section	8.9 kms
Bang Na	– Port Section	7.9 kms
Dao Khanong	– Port section	10.3 kms
Total length		27.1 kms

The first section (Din Daeng-Port) was opened to traffic in October 1981, the second section (Bang Na-Port) was opened in January 1983 and the last section (Dao Khanong-Port) will be constructed by the beginning of 1988. The expressway is now operating as a toll road and it charges 10 and 20 Baht for small and large vehicles, respectively.

c) Roads under Planning and Construction

The Study Team have updated the road improvement and construction plans through BMA, DOH and PWD. It is likely that these plans will be realized within the coming ten years. The road sections covered by the plans are shown in Fig. 6-12 in Chapter 6.

(3) Expenditures for Improvement of Road Network

Expenditures on road construction and improvement by DOH, BMA, PWD and ETA are shown in Table 4-1. It is hard to find an average increasing or decreasing rate of the expenditures over these years because the figures varied considerably. However, it is found that annual expenditure on roads increased by 16% in the GBA for the past years of 1980-1982 reading at 2.7 billion Baht in 1982.

TABLE 4-1 EXPENDITURES ON HIGHWAY CONSTRUCTION AND IMPROVEMENT IN GBA

(In million baht of current prices)

Agency	Designation	1979	1980	1981	1982*
DOH <sup>1)</sup>	Bangkok	354.30	772.92	1,075.09	461.20
	Samut Prakan	21.60	35.92	3.00	55.60
	Nonthaburi	77.36	199.17	246.75	159.32
BMA <sup>2)</sup>	Bangkok	N.A.	55.17	82.05	N.A.
ETA <sup>3)</sup>		494.96	774.35	840.88	1,558.45
PWD <sup>4)</sup>		84.01	197.85	249.22	500.75
	TOTAL	1,032.23	2,035.38	2,496.99	2,735.32

Sources: 1) Planning Division, DOH – September 1982  
 2) Policy and Planning Division 1, Department of Policy and Planning, BMA – November 1982  
 3) ETA, Actual expenditures 1979-1981  
 4) PWD, Actual expenditures 1979-1982  
 Note: \* Budget figures, except for PWD

## 4.2.2 Traffic Characteristics

### (1) Traffic Volumes

Traffic volumes on major road sections were studied using the following sources:

#### a) Traffic Counting Data of OCMRT

OCMRT has conducted traffic counting surveys at major intersections and roads in preparing the installation of signals and road improvement. Counting stations were not fixed for a certain period of years. Annual changes over the several years on the same road section could not be found by the OCMRT data. Accordingly, the volumes were adjusted to 1981 by using the data since 1977 with a growth rate determined by time serial data on some locations of the file. The 1981 traffic volumes are shown in Fig. 4-2 in which the CUA<sup>1)</sup> is delineated.

#### b) Traffic Counting Data of DOH

The DOH file of traffic counting data presents annual changes on some roads in the GBA. The counting stations since 1976 are presented in Appendix Fig. 4-2. They were edited into the traffic volume on cordon lines as determined in Appendix Fig. 4-3. The volumes on these cordon lines since 1976 are shown in Appendix Table 4-1. The figures in the table indicate a traffic growth rate of 5.7% p.a. over the years from 1976 to 1981.

#### c) Traffic Counting by the Study Team

Traffic counting survey was conducted on some road sections in July 1982. The locations are shown in Appendix Fig. 4-4 and the result is shown in Appendix Table 4-2. The result and supplementary data are incorporated into the volume on the three cordon screen lines as shown in Appendix Fig. 4-5. The volumes in ADT on the cordon lines are shown in Appendix Table 4-3.

The survey also presents the traffic volume on the sections of Expressways as shown in Fig. 4-3. Daily traffic volume on the Din Daeng-Sukhumvit section is 27,000 and that on the Sukhumvit-Rama IV section is 21,000. The classified counts are shown in Appendix Table 4-2.

For the purpose of establishing the traffic diversion model to the Expressway, an additional traffic counting survey was conducted in February 1983 both ordinary roads and the Expressway. The survey results are discussed in the following Chapter 6.

#### d) Traffic Volumes on the Road Network

The above informations were put together to indicate ADT in 1981 and 1982 on selected road sections. They are presented in Fig. 4-2. The figure indicates high volumes on the roads such as Super Highway, Phahol Yothin, New Phetchaburi, Sukhumvit and Rama IV. Most of them had 100,000-120,000 vehicles/day on the sections in the inner urbanized area.

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1) CUA means the central urbanized area covering the central business district (CBD), built-up area and the area in which the mixed land use development with high-medium densities of population is expected. Traffic congestion on roads are quite common in this area. It covers zones 1 to 21 and 47 to 51.

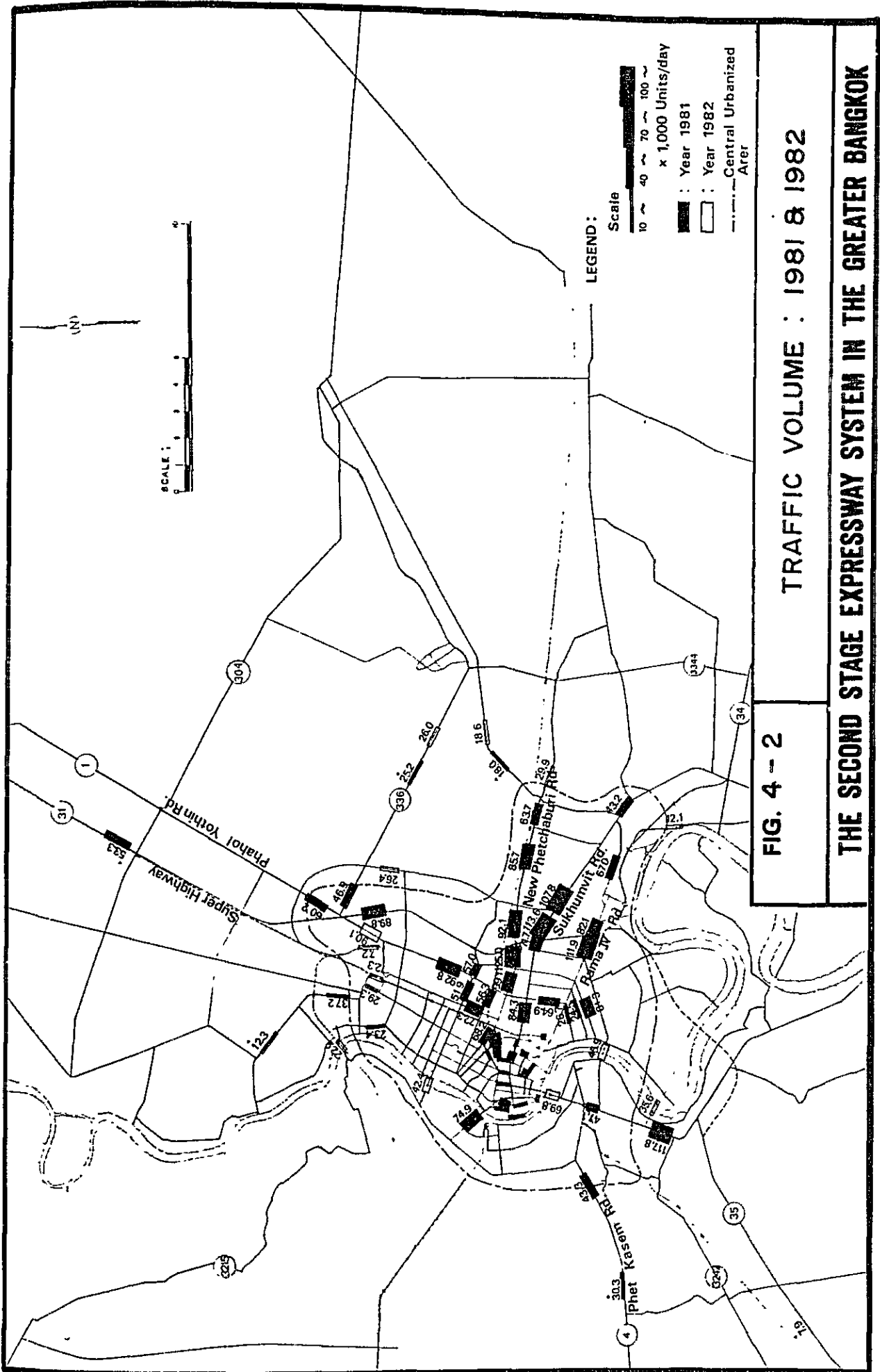


FIG. 4 - 2

TRAFFIC VOLUME : 1981 & 1982

THE SECOND STAGE EXPRESSWAY SYSTEM IN THE GREATER BANGKOK

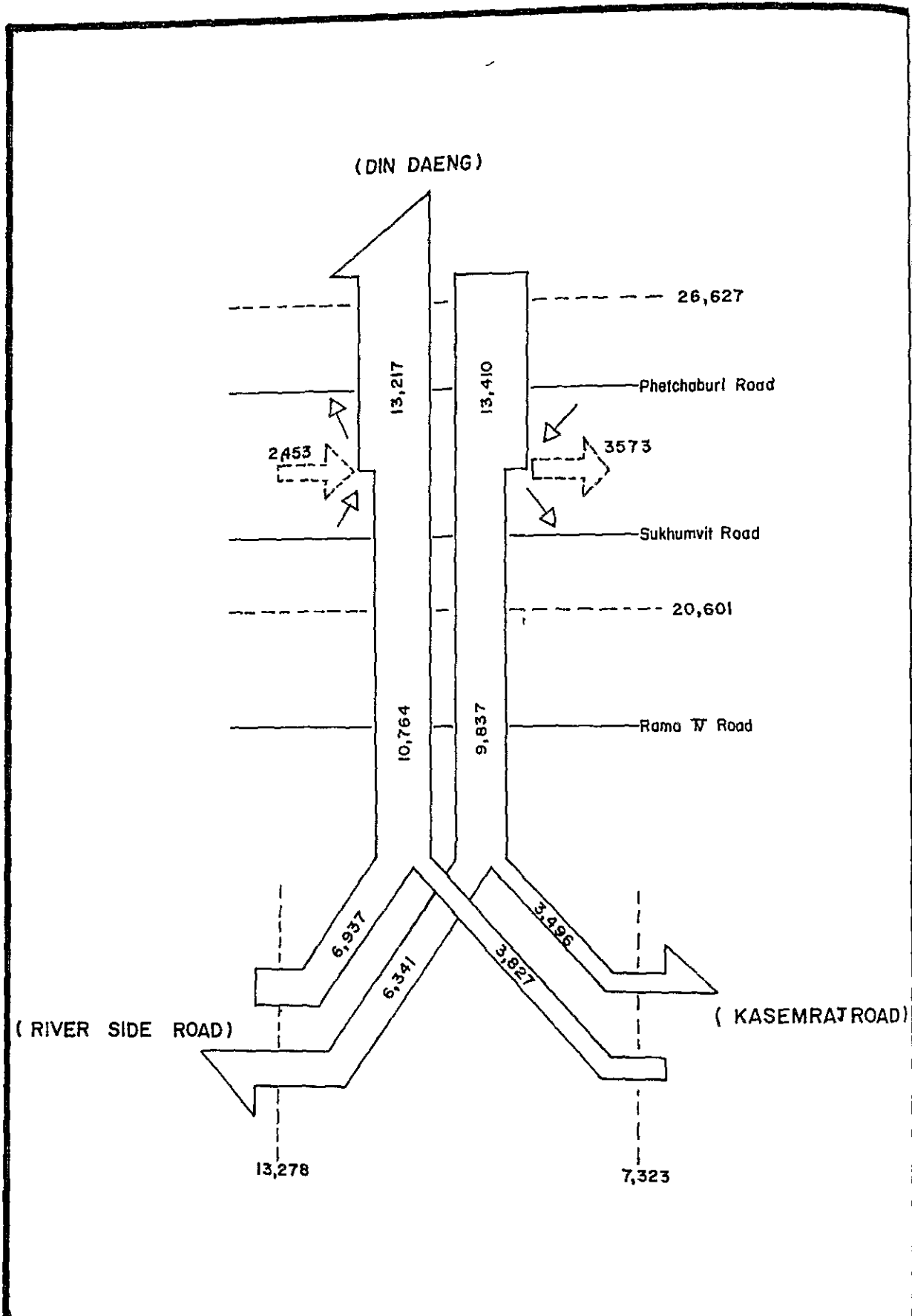


FIG. 4-3

THE EXPRESSWAY TRAFFIC VOLUME (ADT 1982)

THE SECOND STAGE EXPRESSWAY SYSTEM IN THE GREATER BANGKOK

(2) Peak Hour Ratios

The peak hour ratios of traffic volume obtained from the result of the traffic counting on July 1982 are summarized in Table 4-2. The roads had two peak hours: 7.00-9.00 and 16.00-18.00. The peak hour ratios were between 6 and 13% of ADT.

On the expressway sections, the peak hour volume came out in the hours of 7.00-9.00 and 16.00-18.00 with the ratios of 10-14%. Hourly traffic volumes were also shown in Fig. 4-4 in which it was found that hourly ratios during the day time except peak hours were in the range of 4-7%.

(3) Composition of Heavy Vehicles

The percent shares of the heavy vehicles (large buses and heavy trucks) in ADT on roads are shown in Table 4-2.

TABLE 4-2 HEAVY VEHICLE RATIO, PEAK HOUR RATIO AND RATE OF DIRECTION

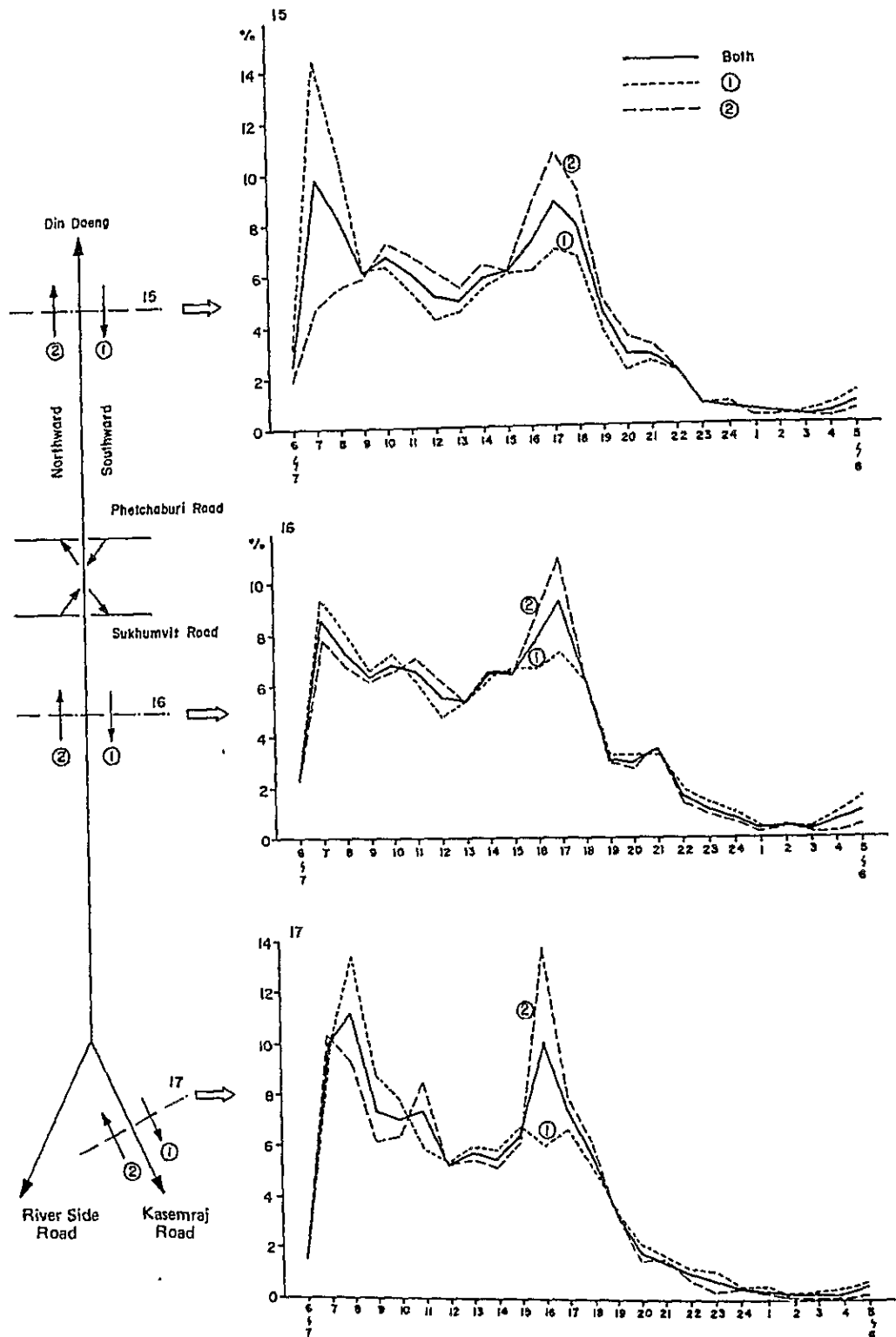
Location No.		Total Except Motorcycle (1)	Heavy Vehicle (Bus & Truck) (2)	Heavy Vehicle Ratio (%) (3) = (2)/(1)	Peak Volume (4)	Peak Ratio (%) (5) = (4)/(1)	Rate of Direction (%)
Total 1-14	Inbound	309,101	40,281	13.0	28,158	9.1	62.3
	Outbound	303,664	40,111	13.2	17,027	5.6	37.7
	Total	612,765	80,392	13.1	45,185	7.4	100.0
Total 15-17	Inbound	28,890	4,389	15.2	3,750	13.0	68.0
	Outbound	28,066	4,344	15.5	1,766	6.3	32.0
	Total	56,956	8,733	15.3	5,516	9.7	100.0
Total 1-17	Inbound	337,991	44,670	13.2	31,908	9.4	62.9
	Outbound	331,730	44,455	13.4	18,793	5.6	37.1
	Total	669,721	89,125	13.3	50,701	7.6	100.0

Sources: Using the result of traffic counting survey in July 1982. Details are in Appendix Table 4-5.

Large percentages of heavy vehicles are found on the roads which connect directly with the inter-regional trunk roads and on the roads adjacent to cargo handling centers and industrial areas. The percent share of large vehicles on the Din Daeng-Port Expressway was 15.3% which did not include normal public buses. The expressway connects directly to the Bangkok port and the national trunk roads towards the north (No. 1 and No. 31) and east (No. 34).

(4) Directional Share

Directional share on roads is also summarized in Table 4-2. Since the land use pattern in the central urbanized area shows a typical mixed location of residence, commercial enterprises, industries, etc., the traffic movement on both directions was commonly found at the same level. Most of the counting data including on the expressways had



**FIG: 4-4**

HOURLY TRAFFIC VARIATION ( % OF ADT )  
 THE DIN DAENG - PORT SECTION

**THE SECOND STAGE EXPRESSWAY SYSTEM IN THE GREATER BANGKOK**

directional shares of 40–60%.

(5) Average Occupants

Average occupants per small vehicles were counted on Phetchaburi Road in September 1982 in the direction towards the central area for selected hours. The result is in Appendix Table 4–4. The number of average occupants per car (private car including the driver and taxi excluding the driver) was 1.65 and per motorcycle 1.24.

(6) Travel Speed

A travelling speed was surveyed by using a common passenger car, Toyota Corolla 5 seats, 1,300 cc, on the following selected roads. The test was conducted in the morning peak hours and in the morning off-peak hours:

- Northward: Phahol Yothin Road;
- Eastward: Phetchaburi Road;
- Southward: Sukhumvit Road; and
- Westward: Pracha Tipok-Phet Kasem Road

The result is shown in Fig. 4–5 and Appendix Table 4–6. Fig. 4–5 indicates that the ten minutes travelling distance under a free flow condition is equal to the distance of 40 minutes under the peak hour traffic flow. Average travelling speed in the morning peak hour congestion towards the central core area is 12 km/hour. However, on some road sections in the inner urban area, the speed is as low as 6 km/hour.

(7) Traffic Congestion

The degree of traffic congestion is presented usually by the ratio: traffic volume/road capacity. The congestion degrees on some cordon screens were examined in terms of ADT and peak hour volume, respectively, being shown in Fig. 4–6.

### 4.3 Traffic Survey

#### 4.3.1 Person Trip Home Interview

(1) Objectives

There are more than one million households in the GBA. Their overall trip survey was once studied in 1972 by BTS. There would be substantial changes in the movement of persons and vehicles during the ten years since, because of spatial and economic development in the GBA.

The expressway study could not conduct the extensive survey as above, but conducted a modest survey (2,250 were visited out of one million households) to get some basic parameters which could be applied to the estimate of traffic volume and economic evaluation.

It is to be noticed that a normal sampling methodology was not applicable because the household file in Amphoe Office was not allowed to use for the survey. However, some results as stated in this report were considered useful because they were not deviated to large extent from the forecasts in the previous studies including the BTS. The detailed home interview survey method and its data sheets are presented in Appendix 4.1.



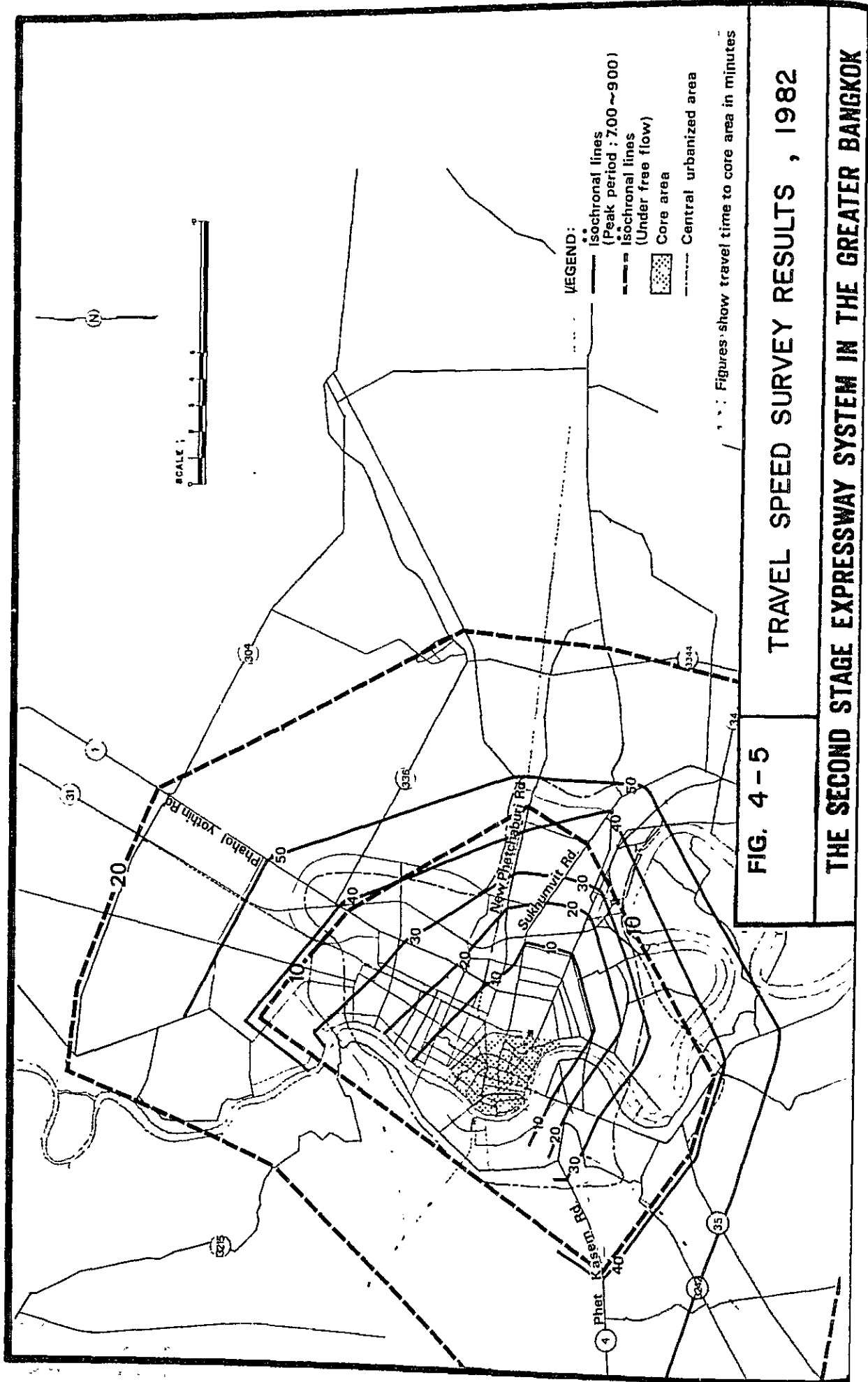


FIG. 4-5

TRAVEL SPEED SURVEY RESULTS , 1982

THE SECOND STAGE EXPRESSWAY SYSTEM IN THE GREATER BANGKOK



(2) Results

The detailed results are shown in Appendix Tables 4-12 through 4-17 and some findings are as follows:

- Overall trip rate per person was 1.33;
- Trips using the public transport were 69% and those using private means were 31%;
- Trip purpose distribution was: home to work 22%, home to school 18%, business 6%, private matters 12% and go home 42%;
- Car owning families were 37%, motorcycles 14% and none 49%; and
- Income earners per family was 2.9 persons including part time workers.

#### 4.3.2 Bus and Rail Passenger Interview

(1) Objectives

A mass transit system (MTS) by rail lines are under preparation in the Metropolis to serve for increasing traffic demand. If this MTS is constructed, specifically a number of public transport users may divert to MTS from the conventional bus services. This modal split estimate is to be taken into account when traffic simulation in future road network in GBA is conducted. A diversion to MTS will assist in reducing the number of buses and the traffic congestion on roads. The interview on passengers on selected railway stations together with those at adjacent bus stops were conducted to find a tendency of user split between buses and SRT services. 378 railway passengers (23.5%) were interviewed among 1,606 and 1,016 buses passenger (11.1%) were interviewed among 9,187.

(2) Survey

a) Locations

Four railways stations were selected as shown in Appendix Fig. 4-7. Simultaneously, adjacent bus stops (two stops at Don Muang, Lak Si and Bang Khen, and one stop at Wat Sing) were selected.

b) Interview

Passengers going toward the inner Bangkok were interviewed for such items as origin-destination, trip purpose, means to come to the bus stop and rail station, ticket classification, vehicle ownership, etc. Interview was conducted from 6.00-12.00 hours in the morning.

Total passengers on each stop and station were counted for the same period. They were used to get expansion factors by hours. The summarized numbers are shown in Appendix Table 4-18.

c) Results

The results are shown in Appendix Table 4-19. Some characteristics to be noted are:

- Majority of rail users (74%) came to the station by buses and those by walk were 18%; while bus users on these stops, 59% of them came by buses (they change the bus routes) and 38% by walk;
- Rail users of 45% buy discounted monthly ticket (discounted rate by 60% for common passengers and by 80% for students), while most bus users buy ordinary ticket; and
- Trip purpose distribution was enumerated only for the morning time. If the interview continued in the afternoon the percent share of “go home” would increase substantially.

Analysis of modal split of passengers between the existing rails and buses was discussed in Section 6–4, Chapter 6.

#### 4.4 Registered Vehicles

##### 4.4.1 Classification

Small vehicles such as cars, motorcycles, small trucks are registered in Police Department, while large trucks and buses are registered in Land Transport Department. Classified vehicles in the GBA since 1978 to 1981 are shown in Appendix Table 4–20.

The number of cars increased at a rate of 9.5% p.a. during the years from 1978 to 1981, and motorcycles at a lower rate of 7.7% p.a. from 1978 to 1980. The registration in 1981 is said under review by the officers. Trucks also increased at a higher rate of 14.5% p.a. from 1978 to 1981. Among the three provinces of GBA, the registration in Bangkok was the highest with more than 90% of the registration.

By using this increasing trend it was estimated that the registration of the GBA in 1982 was 380,300 for private cars, 218,000 for motorcycles, approximately 115,000 for trucks and 20,000 buses including private, government and school buses.

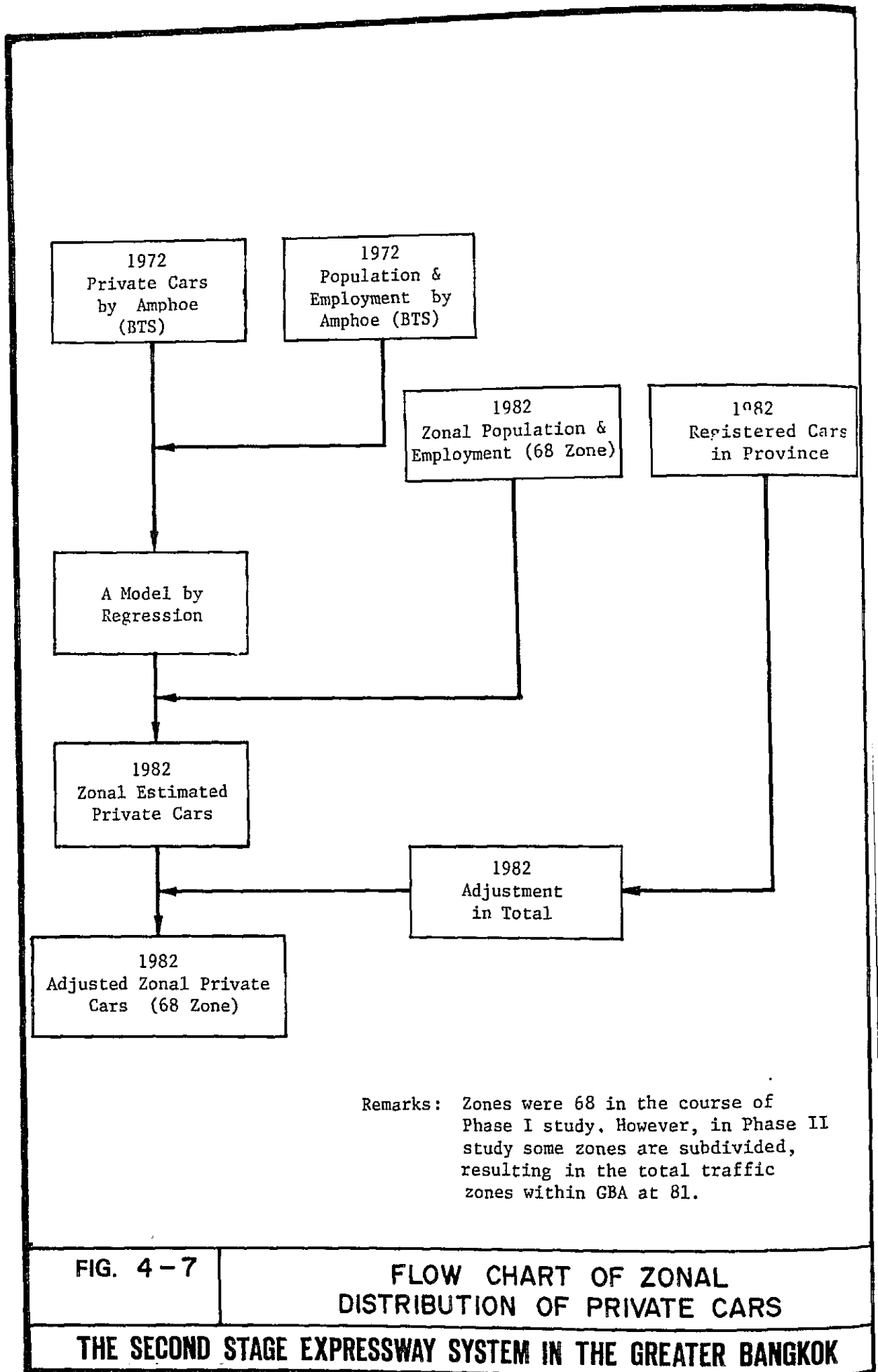
##### 4.4.2 Zonal Distribution of Private Cars

Zonal distribution of private cars was estimated in order to use in trip generation-attraction forecast. The process is shown in Fig. 4–7. Firstly, the vehicle number in Amphoe was determined by population and workers at work places in Amphoe of 1972 using the data of BTS. A regression analysis was applied and the parameters were found as:

$$Y = -1,675 + 0.026 X_1 + 0.147 X_2 \quad (r = 0.965)$$

where Y : car fleet in the zone  
 X<sub>1</sub> : population in the zone  
 X<sub>2</sub> : employed persons in the zone  
 r: a correlation coefficient

The model formula was used with population and workers at work places in the zones of 1982 as determined in Chapter 3 to estimate the zonal private passenger cars which in turn were adjusted to the total of three provinces provisionally set in subsection 4.4.1 above. The result is shown in Appendix Table 5–1 in Chapter 5.



Remarks: Zones were 68 in the course of Phase I study. However, in Phase II study some zones are subdivided, resulting in the total traffic zones within GBA at 81.

FIG. 4-7

FLOW CHART OF ZONAL DISTRIBUTION OF PRIVATE CARS

THE SECOND STAGE EXPRESSWAY SYSTEM IN THE GREATER BANGKOK

### 4.4.3 Number of Buses

The operational condition of buses which will affect a modal split rate between private transport (PVT) and public transport (PT) was studied. The detailed bus operation record is discussed in the latter Chapter 7. The Bangkok Mass Transit Authority (BMTA) is operating 118 normal and 17 air-conditioned bus routes in 1982. The shortest bus route among them is 10 km long, while the longest is 35 km long, and the average length of bus operation routes is about 20 km.

According to the result of the bus passenger OD survey conducted by BMTA in 1980, the distribution of bus passenger trip lengths can be summarized as follows:

Length of Trips	Rate
less than 12 km	70.1%
12 km – 24 km	24.6
24 km – 36 km	4.6
more than 36 km	0.7
Total	100.0%

The annual increase rate of the number of buses during the last 10 years is 7.1% and this increase rate is lower than that of passenger cars (8.1% per annum) during the same period.

## 4.5 Origin and Destination Tables in 1982

### 4.5.1 Methodology

#### (1) Passenger Vehicles

Three types of OD matrices, passenger car (including taxi and samlor), motorcycle (M/C) and bus, are considered as a basic type of passenger vehicles.

The OD matrices were established by using various sources including the information which were collected and analyzed from the home-interview survey conducted for the Study. The study results of BTS (Bangkok Transportation Study) were also incorporated where necessary. The conceptual working flow for the establishment of 1982 OD matrices is shown in Fig. 4-8, and the working steps are summarized as follows:

- Forecast of control total of person trip generation in GBA;
- Estimation of PVT (Private)/PT (Public) generation trip;
- Zonal person trip generation classified into PVT/PT;
- Establishment of PVT and PT person trip OD matrices;
- Conversion of the person trips to the vehicle trips by using passenger occupancy rate by vehicle type;
- Screen line check; and
- Establishment of vehicle OD matrices in 1982.

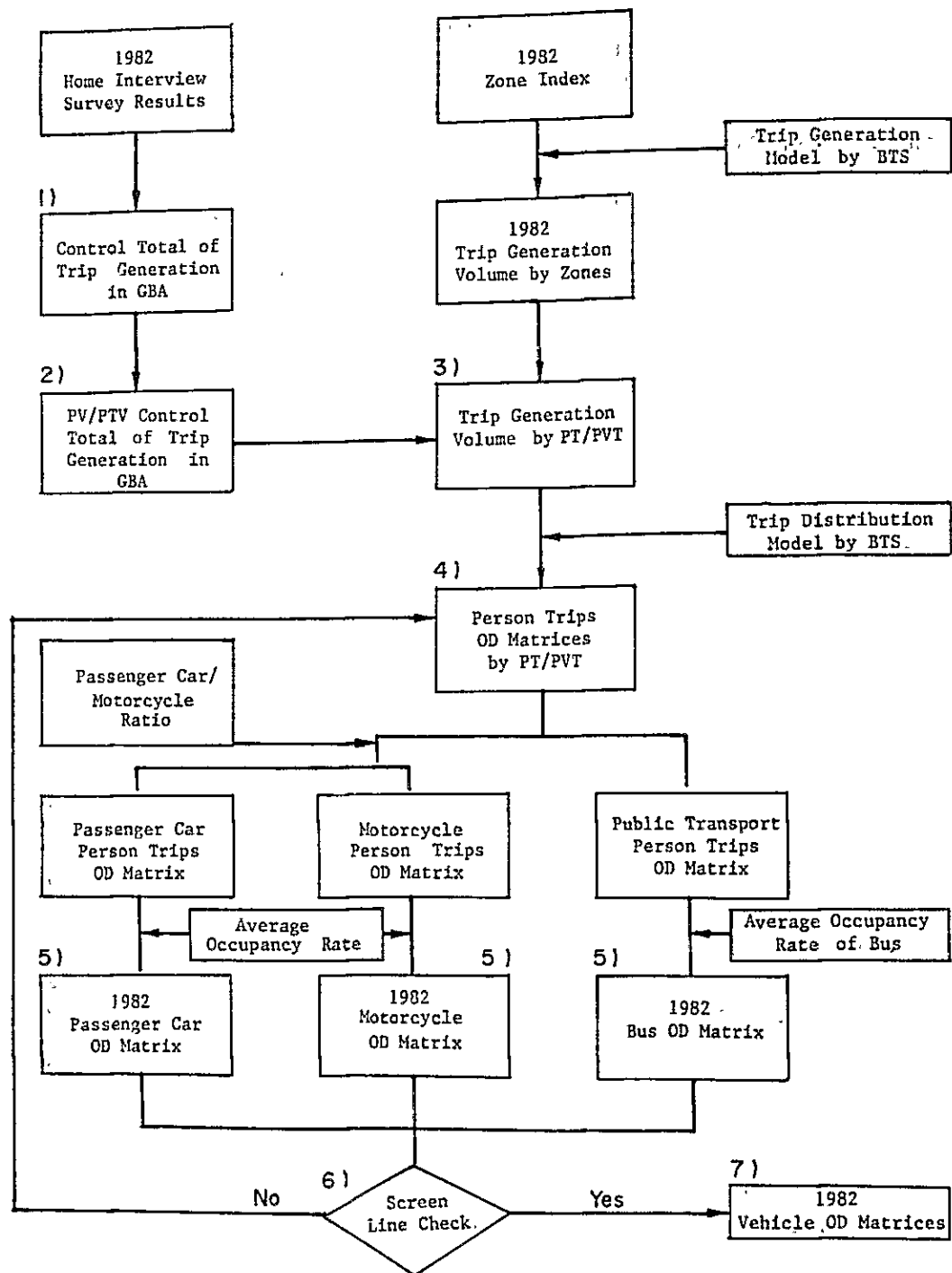


FIG. 4 - 8

FLOW CHART OF THE ESTABLISHMENT OF PASSENGER VEHICLE OD MATRICES

THE SECOND STAGE EXPRESSWAY SYSTEM IN THE GREATER BANGKOK

## (2) Trucks

Truck OD matrix was established in accordance with the 1977 Truck OD matrix which was established in the "Feasibility Study for the Bangkok Urban Truck Terminals". The conceptual working flow and each work item are shown in Fig. 4-9, and the working steps are summarized as follows:

- Estimation of 1982 truck trips generation volume in GBA as a control total;
- Estimation of zonal truck trips generation using truck trips generation model; and
- Establishment of 1982 Truck OD matrix.

Based on the Truck matrix in 1977, 1982 OD matrix was established and the result was checked on the screen line.

### 4.5.2 Establishment of the 1982 OD Tables

#### (1) Total Trip Volume of GBA in 1982

The total trip volume of GBA in 1982, as a control total, was estimated using the following formula:

$$T = P \times N$$

where

- T : number of total trips in GBA (trips)
- P : total population in GBA (persons)
- N : number of generated trips per person (trips/person)

It is known that the trip rate per person (N) increases as the economic activities develops. The average annual increasing rate of the trip rate in Tokyo Metropolitan Area during the past ten years (1968-1978) was 1.6 percent. On the other hand, the increase rate in the trip rate in GBA during the 18 years from 1972 to 1990 is forecasted at 1.5 percent per annum in the BTS study. According to this increase rate, the trip rate per person in 1982 is estimated at 1.3. Furthermore, the number of trips per person in 1982 is calculated at 1.47 by using the number of registered vehicles in 1982 under the assumption that the number of trips per vehicle reduced by 10% from 1972. (Refer to Appendix 4.2). Based on these considerations, the number of trips per person was determined at 1.33 which was estimated by the home interview survey result for the Study. The population of GBA in 1982 is 6,432 thousand persons. Therefore, the total person trips generated in GBA in 1982 are calculated as follows:

$$\begin{aligned} T &= P \times N \\ &= 6,432 \text{ (thousand)} \times 1.33 \text{ (trips/person)} \\ &= 8,555 \text{ (thousand trips)} \end{aligned}$$

Compared with the total trips in GBA in 1972, the annual increase rate of person trips was 6.7%.

#### (2) PT/PVT Rate

Since 1972 in which BTS was conducted, the number of passenger cars in GBA has increased by 8.1 percent per annum. However, the fuel price escalation after the first oil shock during the years 1973 to 1974 and the second oil shock during 1979 to 1980



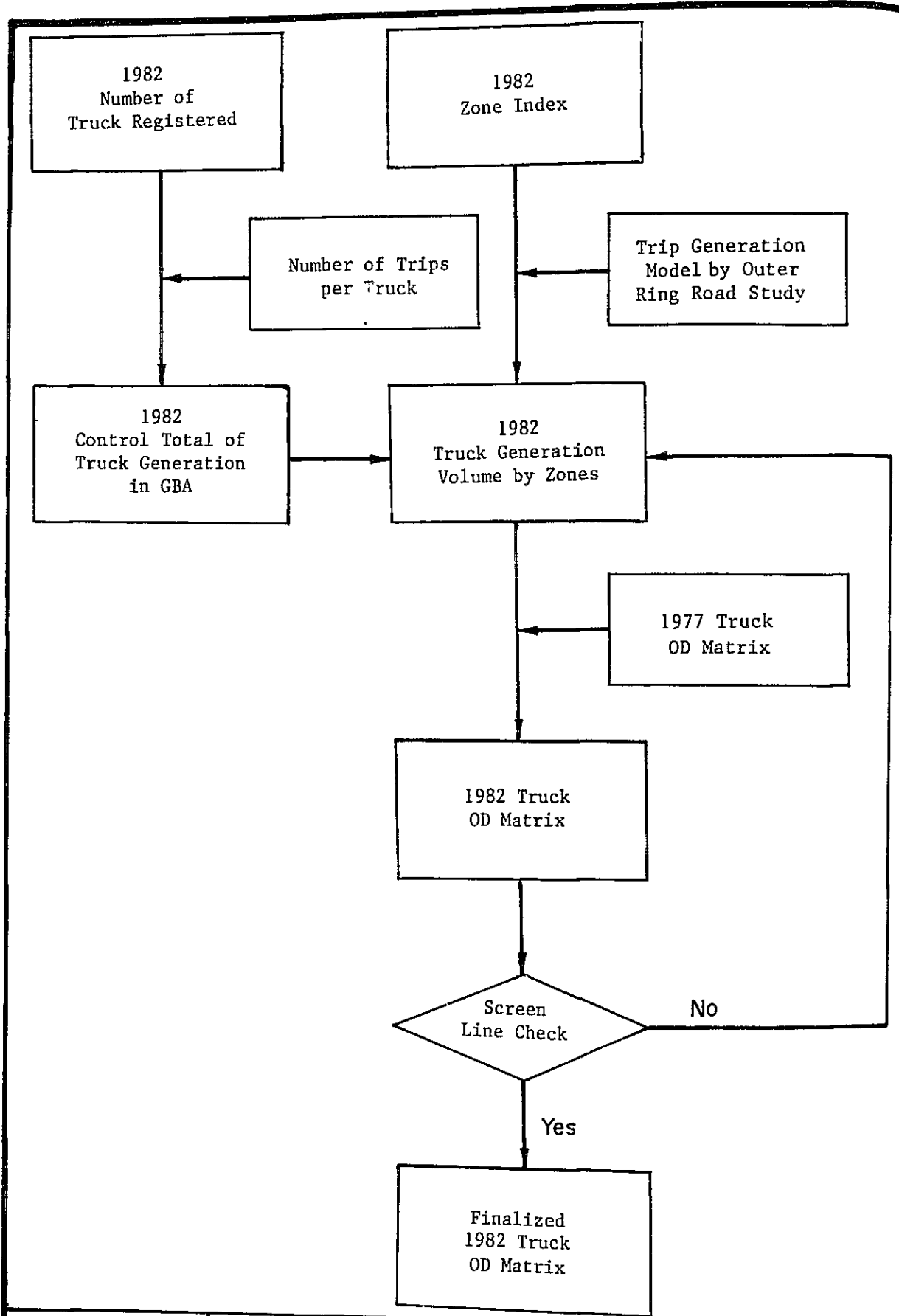


FIG. 4 - 9

FLOW CHART OF THE ESTABLISHMENT OF TRUCK OD TABLES ,1982

THE SECOND STAGE EXPRESSWAY SYSTEM IN THE GREATER BANGKOK

seems to have affected the use pattern of private vehicles in GBA. Incidentally, the price of regular gasoline in 1972 was 1.91 Baht per liter, and in 1982 it has increased to 11.4 Baht. This means the annual increase rate of the price of regular gasoline was almost 20% during the past ten years. Furthermore, the characteristics of the passenger car ownership identified during the home interview survey for this study indicated that almost 10% of the total households have more than two cars (Refer to Fig. 4-10).

Considering the above facts, there is a possibility of change in the private use pattern in the trend of increasing car ownership, that is, even though they own their cars, they do not want to use them at the same frequency as in the previous time.

Based on the home-interview survey result in 1982 together with the above considerations, the rate of PVT trips was determined to occupy 31% of the total trips, while the number of PT trips 69%.

The percent share of person trips between PT (bus) and PVT (passenger car, motorcycle, taxi and samlor), studied from various view points is shown in Table 4-3. And the relationship between motorization (passenger cars/1,000 persons) and the rate of PVT person trips which was analyzed from the home interview survey is shown in Fig. 4-11. Compared with the PVT rate of 48% in 1972, PVT rate in 1982 is estimated at 24% under the motorization of 59 vehicles per 1,000 persons. It indicates 50% lower than the figure in 1972.

Based on this examination and the fact that the number of persons per private car has been decreasing, while the number of persons per bus has been increasing (it seems that the bus fare influences the bus use since the fare of 1.5 Baht remained for the past years), the number of persons who seemed to use the PT was subtracted from the total number of person trips and thus the remaining portion of person trips was assumed to use private transport. Accordingly, the rate of person trips which use the PVT was settled as 35% and the remaining 65% was for PT users (See Fig. 4-11 \* mark). From these figures, the average trip rate of passenger cars in 1982 was estimated at 2.5 trips per day.

### (3) Passenger Car/Motorcycle Rate

The person trips which use private transport are divided into two modes of transport, that is, passenger car users (including taxi and samlor users) and motorcycle users. Based on the results of the screen line survey and the passenger occupancy rate survey both of which were conducted for the Study, the modal split between passenger car and motorcycle was examined. At the same time, the result of the Outer Bangkok Ring Road Study was referred to for the adjustment of the rate in the urban area. The result is shown in Table 4-4.

The modal split of passenger car and motorcycle was determined at 81% for the persons using the passenger car and 19% for those using the motorcycle. On the other hand for the modal split rate by vehicle trip, 76.5% of the vehicles is passenger cars and 23.5% for motorcycles.

Based on the above examinations, the control total in GBA in 1982 of person trips and vehicle trips were calculated as in Table 4-5.

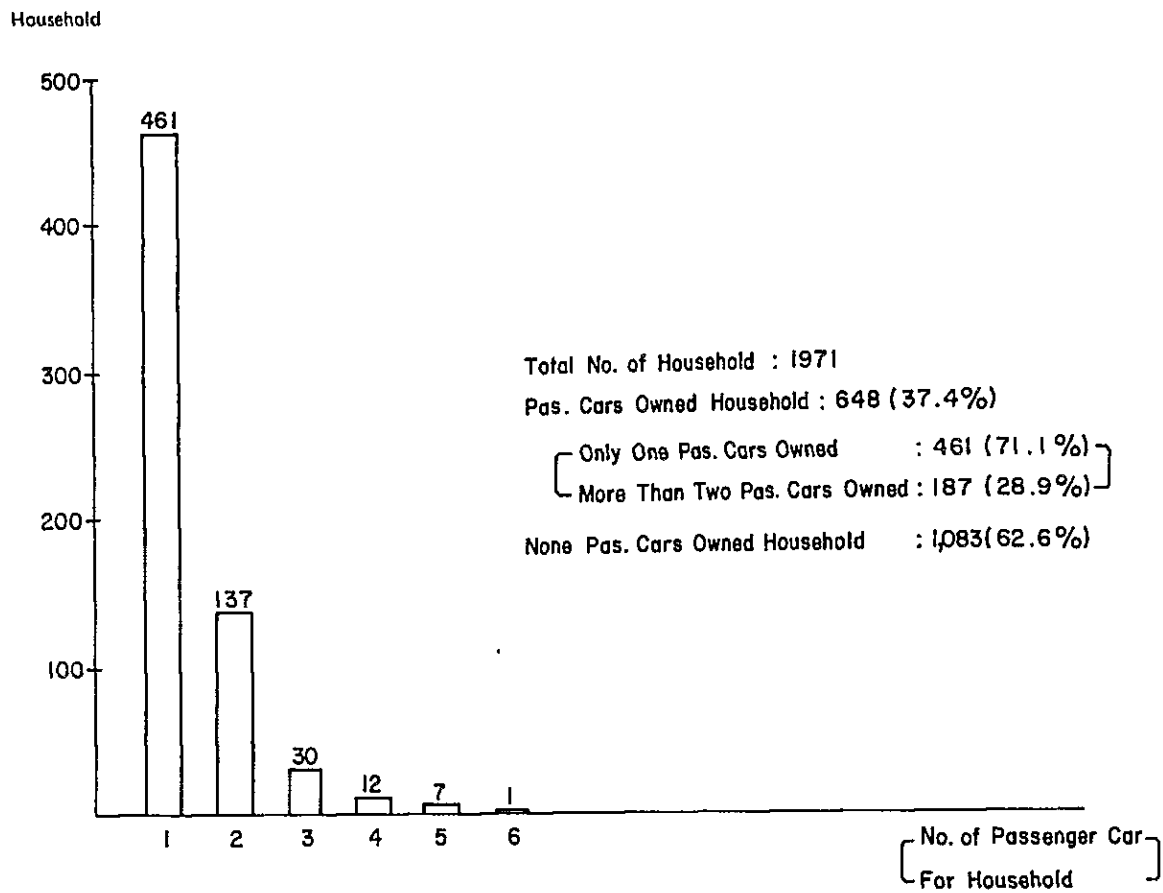
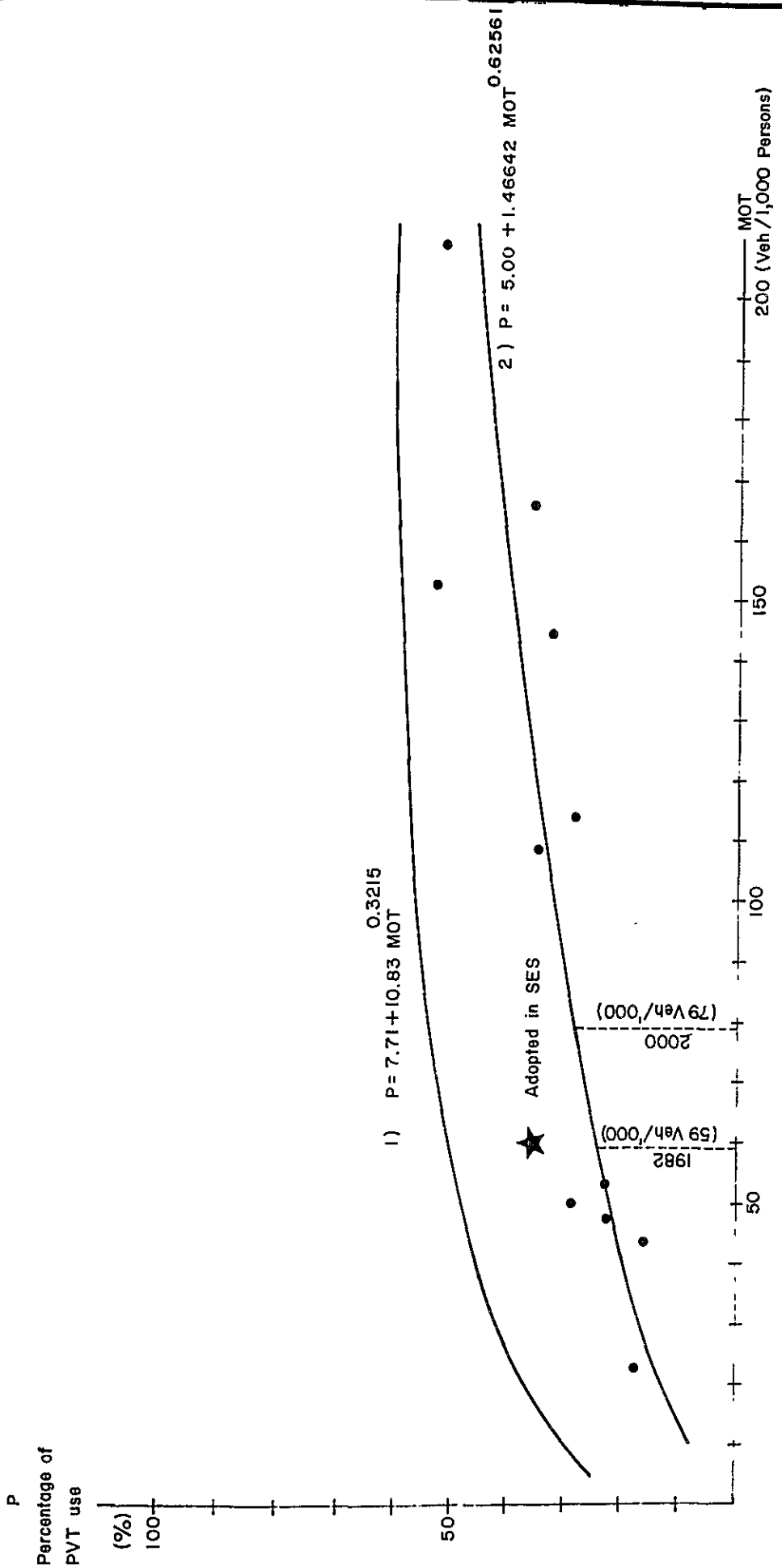


FIG. 4 - 10

PASSENGER CAR OWNERSHIP

THE SECOND STAGE EXPRESSWAY SYSTEM IN THE GREATER BANGKOK



NOTE :

- 1) Formulated in BTS, 1972
- 2) Formulated in SES 1982
- ★ SES (Second Stage Expressway System)

FIG. 4 - 11

MOTORIZATION (MOT) AND PVT USE

THE SECOND STAGE EXPRESSWAY SYSTEM IN THE GREATER BANGKOK

TABLE 4-3 PT/PVT RATE, 1982

(Unit: %)

Description	PVT	PT
1. BTS Model, 1972 $P = 7.7 + 10.83MOT^{0.3215}$	48	52
2. Estimated by forecasted number of vehicles, 1982 (Under the assumption that the trip rate remains at 1972 figures)	41	59
3. Screen line traffic count result by SES, 1982	23	77
4. Home interview survey result by SES, 1982	31	69
5. Cross section traffic counts result in the core area by Outer Ring Road Study, 1977	45	55

TABLE 4-4 PASSENGER CAR/MOTORCYCLE RATE

Description	A) Central area of GBA (This study) %	B) Screen line Result %	A) + B) Total %
1) Passenger Vehicles	272,159 81.9	507,004 73.8	779,163 76.5
persons	443,619 85.6	826,416 78.7	1,270,035 81.0
2) Motor-cycles	60,056 18.1	179,846 26.2	239,902 23.5
persons	74,469 14.4	223,009 21.3	297,478 19.0
3) = 1)+2) vehicles	332,215 100	686,850 100	1,019,065 100
persons	518,088 100	1,049,425 100	1,567,513 100

Note: Average passenger occupancy – Passenger Car : 1.65  
(1982 survey result) Motorcycle: 1.24

TABLE 4-5 TRIP VOLUMES (IN 1972 AND 1982)

(In thousand)

Designation	1972		1982		Annual Average increase of vehicles in %
	Persons	Vehicles	Persons	Vehicles	
Cars	1,700.0	976.0	2,382.2	1,443.8	4.0
PVT MCs	332.0	266.0	558.8	450.6	5.4
Total	2,032.0	1,242.0	2,941.0	1,894.4	4.3
PT	2,458.0	77.0	5,614.0	119.4	4.5
TOTAL	4,490.0	1,319.0	8,555.0	2,013.8	4.3

(4) Zonal Trip Generation-Attraction

Zonal potentiality of trip generation and attraction is shown by a model formula in BTS. The formula is as follows:

$$T_i = (A_0 \times N) + (A_1 \times P_i) + (A_2 \times J_i) + (A_3 \times C_i)$$

where  $N$  : number of traffic cells in the zone, which was fixed in BTS  
 $P_i$  : population in zone  $i$   
 $J_i$  : job opportunity in  $i$   
 $C_i$  : private cars in  $i$   
 $T_i$  : total person trip generation (equals to attraction) in  $i$

Parameters	A0	A1	A2	A3
Special	604	2,273	2,039	—
Core	3,763	—	1,537	8,803
Urban	2,820	0,442	1,341	6,426
Rural	866	0,279	0,915	10,261

Source: C30 Vol II, BTS

Given the zonal economic indexes of 1982, generated trips in terms of persons were calculated.

(5) OD Matrix Tables of Passenger Cars

The matrices of 1972 were used as the base of distribution pattern and the Fratar Method was used to iterate and aggregate all zone pair trips into the control total.

In order to determine the trips to and from the outside zones (No. 69 through No. 72) the 1979 traffic counting data were used. These traffic volumes were assumed to be distributed among the inside zones in proportion to the total trips in respective zones. After taking into account the estimated increase to 1982 using the DOH data, these trips were added to the inner-zonal trips of GBA.

(6) Truck OD Matrix

Truck trip OD tables were prepared in 1977 when the feasibility of truck terminal construction project was studied. The traffic zones used in the study were adjusted to those in this study. Total trips of truck vehicles in 1982 were determined by registered trucks (estimated at 114,000) and average trip rate per day per vehicle (4 trips). This volume of 456,000 trips is considered reasonable when compared with the Nonthaburi Study, relative magnitudes of other vehicle types in actual registered vehicles and cordon screen traffic data.

The zonal trip generation and attraction of truck trips were estimated by using the parameter of the Nonthaburi Study. They are shown below:

$$T_i = a \times J_i$$

where  $T_i$  : trip ends in the zone i  
 $J_i$  : job opportunity in zone i  
 $a$  : parameter of trip generation and attraction;

special	2.62
inner core	1.40
core	2.62
urban	1.57
semiurban	2.10
rural	1.71

The calculated trip ends in each zone were aggregated and adjusted to the total trips determined at 456,000 as above.

Trips to and from the outside zones (No. 69 through No. 72) were based on the summarized matrix of vehicle trips studied in 1979<sup>2)</sup> with a modification to the level of traffic volume in 1982. Their distribution among the inside zone depends on the magnitude of trips generated or attracted among the zones.

(7) Screen Line Check

When the OD trips crossing the cordon screen lines in 1982 were aggregated, they were compared with those obtained from traffic counting observation. The comparison is shown in Table 4-6 in which the differences were modified and adjusted closer to the observed volume. The trips after adjustment are considered acceptable. It is determined not to modify the OD table trips any more.

(8) OD Matrix Tables in 1982

Based on these examinations, the matrices for passenger cars, motorcycles, buses and trucks were established. The OD matrices established were compiled in a form of computer output in a separate file.

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2) DLT and JICA, Feasibility Study for the Bangkok Truck Terminals Construction Project in the Kingdom of Thailand (1980).

TABLE 4-6 CHECK FIGURES ON THE CORDON SCREEN LINES, 1982

Cordon Screen No. <sup>1)</sup>	Designation	Type of Vehicles			Total
		Cars and Motorcycle	Buses	Trucks	
1 (North- ern Screen)	(A) Observed	243,513	29,056	39,502	312,073
	(B) Estimated (OD Tables)	219,554	14,612	44,019	278,185
	(A)/(B)	1.11	1.99	0.90	1.12
	(C) Adjusted	233,479	28,095	38,645	300,219
	(C)/(A)	0.96	0.97	0.98	0.96
2 (East- ern Screen)	(A) Observed	131,188	21,528	30,502	183,218
	(B) Estimated (OD Tables)	153,574	13,748	34,280	201,602
	(A)/(B)	0.85	1.57	0.89	0.91
	(C) Adjusted	141,213	20,857	29,063	191,133
	(C)/(A)	1.08	0.97	0.95	1.04
3 (On the Chao Phraya River)	(A) Observed	312,147	27,286	52,648	392,081
	(B) Estimated (OD Tables)	252,698	28,860	60,031	341,589
	(A)/(B)	1.24	0.95	0.87	1.15
	(C) Adjusted	306,415	27,742	54,972	389,129
	(C)/(A)	0.98	0.96	1.04	0.99

Note : 1) Cordon screen lines are shown in Appendix  
Fig. 4-5 of Chapter 4



