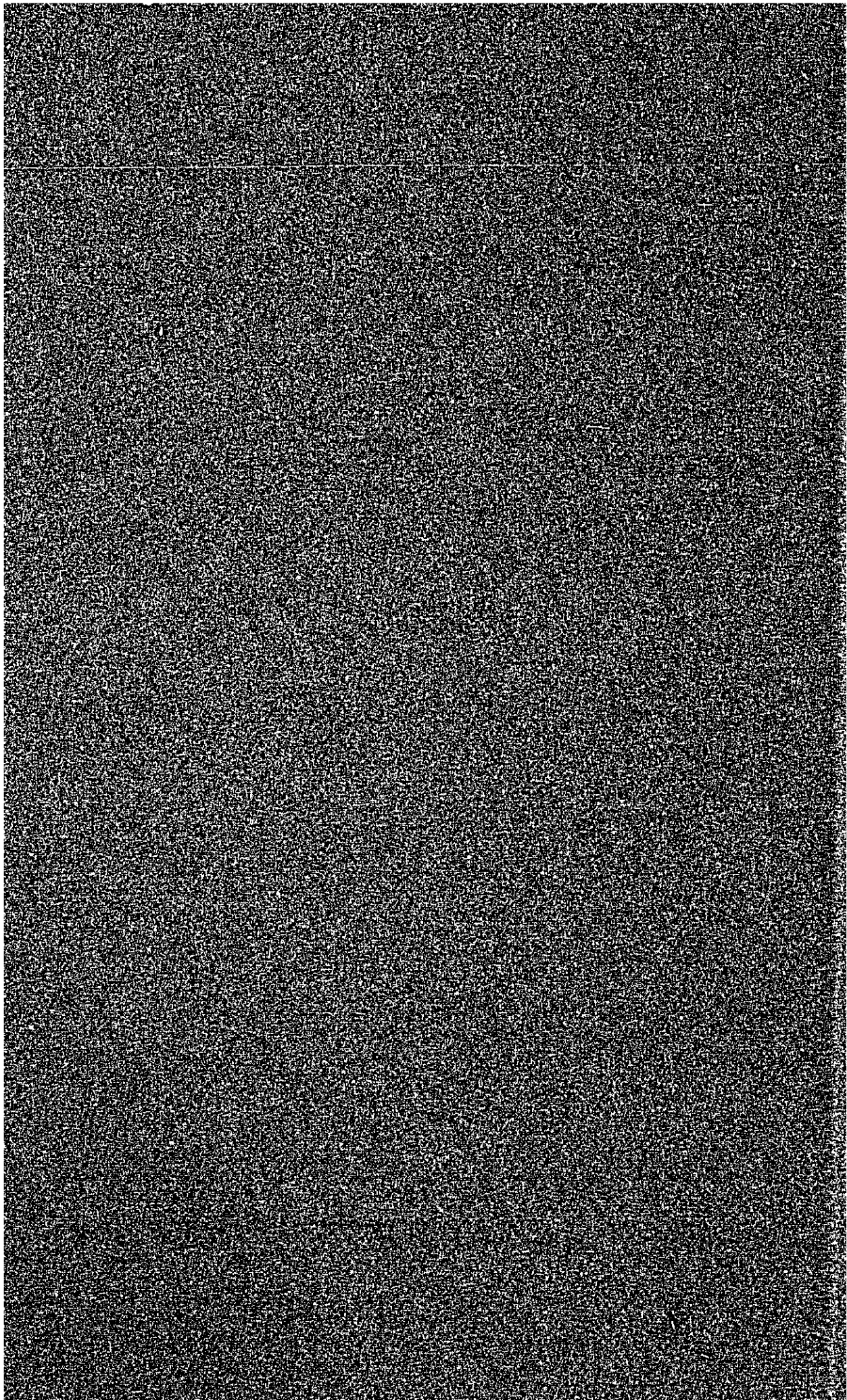


**LIST OF TABLES AND FIGURES**





## LIST OF TABLES AND FIGURES

### CHAPTER 1 INTRODUCTION

Fig.	1-1	General Flow Chart of the Study .....	1-4
------	-----	---------------------------------------	-----

### CHAPTER 2 SOCIO-ECONOMIC CHARACTERISTICS

Table	2-1	Gross Domestic Product and Gross National Product of the Kingdom : 1977-1981 .....	2-2
Table	2-2	Land Utilization of the Built-up Area of the GBA .....	2-4
Fig.	2-1	Zone Map of the GBA .....	2-7

### CHAPTER 3 LAND USE AND POPULATION

Table	3-1	Land Use in the GBA, 1980 .....	3-1
Table	3-2	Land Use in the GBA, 2000 .....	3-6
Table	3-3	Population in the GBA and its Vicinity .....	3-9
Table	3-4	Changes in Population and Employment .....	3-14
Fig.	3-1	Existing Land Use Map for GBA, 1982 .....	3-2
Fig.	3-2	Existing Land Use Pattern .....	3-3
Fig.	3-3	Future Land Use Map for GBA, 2000 .....	3-7
Fig.	3-4	Population Density by Zone, 1982 .....	3-11
Fig.	3-5	Population Density by Zone, 2000 .....	3-12
Fig.	3-6	Changes in Population and Employment .....	3-14
Fig.	3-7	Population Growth Ratio by Zone (1982-2000) .....	3-15
Fig.	3-8	Employed Persons at Work Places Growth Ratio by Zone (1982-2000) .....	3-16
Fig.	3-9	Growth of Urban Activities by Zone (1982-2000) .....	3-17

### CHAPTER 4 ROAD TRANSPORT SYSTEM AND TRAFFIC CHARACTERISTICS

Table	4-1	Expenditures on Highway Construction and Improvement in GBA .....	4-3
Table	4-2	Heavy Vehicle Ratio, Peak Hour Ratio and Rate of Direction .....	4-7
Table	4-3	PT/PVT Rate, 1982 .....	4-22
Table	4-4	Passenger Car/Motorcycle Rate .....	4-22
Table	4-5	Trip Volumes in 1972 and 1982 .....	4-22
Table	4-6	Check Figures on the Cordon Screen Lines, 1982 .....	4-25
Fig.	4-1	Road Network in the GBA, 1983 .....	4-2
Fig.	4-2	Traffic Volume : 1981 & 1982 .....	4-5
Fig.	4-3	The Expressway Traffic Volume (ADT 1982) .....	4-6
Fig.	4-4	Hourly Traffic Variation: The Din Daeng-Port Section .....	4-8
Fig.	4-5	Travel Speed Survey Results, 1982 .....	4-10

Fig.	4-6	Traffic Volume and Road Capacity, 1982	4-11
Fig.	4-7	Flow Chart of Zonal Distribution of Private Cars	4-14
Fig.	4-8	Flow Chart of the Establishment of Passenger Vehicle OD Matrices	4-16
Fig.	4-9	Flow Chart of the Establishment of Truck OD Tables, 1982	4-18
Fig.	4-10	Passenger Car Ownersip	4-20
Fig.	4-11	Motorization (MOT) and PVT Use	4-21

## CHAPTER 5 FUTURE ORIGIN – DESTINATION MATRICES

Table	5-1	Number of Registered Cars (1982)	5-1
Table	5-2	GPP, per capita GPP in the GBA	5-2
Table	5-3	Motorization by Year	5-3
Table	5-4	Future Number of Passenger Cars in GBA	5-3
Table	5-5	Passenger Car in each Changwat, 2000	5-3
Table	5-6	Generated (Attracted) Traffic from Eastern Seaboard to the Bangkok Area After the Completion of Deep Sea-Port	5-8
Table	5-7	Person Trips and Vehicle Trips in the GBA	5-13
Table	5-8	Increase Rate per annum of the Trips in the GBA.	5-14
Fig.	5-1	Forecast of Future Passenger Vehicle Fleet	5-4
Fig.	5-2	Proposed Transportation Facilities	5-6
Fig.	5-3	Number of Trips per Person in Various Cities	5-10
Fig.	5-4	Mtorization VS. Motorcycle Use Person Trips Relationship	5-12

## CHAPTER 6 EXPRESSWAY NETWORK PLANNING AND TRAFFIC FORECAST

Table	6-1	Parameters of the Diversion Model	6-29
Table	6-2	Coefficients of the Time-Balance Model	6-30
Table	6-3	Traffic Assignment Cases in Phase I Study	6-31
Table	6-4	Traffic Assignment Cases in Phase II Study	6-32
Table	6-5	Traffic Assignment Result – 1	6-39
Table	6-6	Comparison of Assigned Traffic Volume on the Ordinary Roads, 2000	6-42
Table	6-7	Total Average Traffic Volume per Kilometer	6-44
Table	6-8	Traffic Assignment Result – 2	6-46
Table	6-9	Percentage of Vehicle-Kms and Vehicle-Hours on the Expressway	6-46
Table	6-10	Estiamted Travel Speed	6-46
Table	6-11	Traffic Assignment Result by SES Development Alternatives	6-51
Fig.	6-1	Location of Traffic Congested Roads and Areas in CUA	6-3
Fig.	6-2	Zones Short of Road Area	6-4
Fig.	6-3	Function of Expressways	6-8
Fig.	6-4	CUA and Traffic Corridors	6-9

Fig. 6-5	Working Flow of Selection of the most Appropriate Expressway Pattern in the GBA .....	6-11
Fig. 6-6	Future Land Use and Estimated Traffic Flow, 2000 (Without the Second Stage Expressway System).....	6-13
Fig. 6-7	Forecasted Future Traffic Volume, Capacity and Congestion Ratio on Traffic Corridors, 2000 .....	6-14
Fig. 6-8	Future Traffic Corridors and Major Control Points.....	6-16
Fig. 6-9	Conceptual Linkages of Expressway and Trunk Road: (In Hybrid Pattern) .....	6-18
Fig. 6-10	Proposed Master Plan of Expressway Network .....	6-19
Fig. 6-11	Conceptual Working Flow for Traffic Assignment (Person Trips) .....	6-21
Fig. 6-12	The Future Road Network .....	6-22
Fig. 6-13	Link Speed/Flow Curve .....	6-23
Fig. 6-14	Mass Rapid Transit System Considered for this Traffic Assignment .....	6-25
Fig. 6-15	Modal Split : Buses VS Existing Railways, and MTS .....	6-26
Fig. 6-16	Conceptual Working Flow for Establishment of Traffic Diversion Model to the Expressway.....	6-28
Fig. 6-17	Expressway Diversion Formula Time – Balance Approach .....	6-30
Fig. 6-18	Concept of Shifting Coefficient .....	6-30
Fig. 6-19	Typical Traffic Assignment Cases (1) .....	6-33
Fig. 6-20	Typical Traffic Assignment Cases (2) .....	6-32
Fig. 6-21	The Flow Chart of the Whole of Screening Process .....	6-34
Fig. 6-22	Estimated Average Traffic Volume Per Kilometer on Each Route Section, 2000 .....	6-36
Fig. 6-23	The Provisional Second Stage Expressway Network .....	6-37
Fig. 6-24	Estimated Traffic Volume, 2000 Case No. ST-2 (a) .....	6-40
Fig. 6-25	Estimated Traffic Volume on the Ordinary Roads, 2000 Case No. 4-1 .....	6-41
Fig. 6-26	Congestion Ratio on Traffic Corridors, 2000 .....	6-43
Fig. 6-27	Estimated Traffic Volume (ST-2(a)) .....	6-45
Fig. 6-28	Estimated Traffic Flow at Interchange, 2000 Case No. ST-2 (a) .....	6-48
Fig. 6-29	Ramp-Zone Desired Lines, 2000 Case No. R-1.....	6-49
Fig. 6-30	Ramp Block Desired Lines, 2000 Case No. R-1 .....	6-50
Fig. 6-31	Construction Priority of SES .....	6-54

## CHAPTER 7 BUS SERVICE THROUGH THE EXPRESSWAY

Table 7-1	BMTA Bus Operation in December 1982 : Summary .....	7-10
Table 7-2	Selected Bus Routes in the Corridors .....	7-11
Table 7-3	Bus Trips Subject for Diversion in the Corridors of SES .....	7-13
Table 7-4	Estimated Total Bus Trips (1982).....	7-23
Table 7-5	Estimated Total Bus Trips (2000).....	7-23

Table	7-6	Design Standards of Bus Bay .....	7-25
Table	7-7	Summary of Bus Bay Cost .....	7-28
Table	7-8	Economic Cost and Benefit of Normal Bus Service on the SES, 2000 .....	7-29
Fig.	7-1	Air Conditioned Bus Routes: Passengers Interviewed .....	7-3
Fig.	7-2	Normal Buses: Passenger Interviewing and Bus Counting Locations .....	7-4
Fig.	7-3	Additional Payment for Normal Bus Service through the Expressway .....	7-6
Fig.	7-4	A Typical Passengers Flow from Outer Areas .....	7-8
Fig.	7-5	Flow Chart of Bus Service through the Expressway .....	7-9
Fig.	7-6	Location of the Screen Sections .....	7-12
Fig.	7-7	The Bus Bay and the Serviceability .....	7-15
Fig.	7-8	Bus Bay Alternatives .....	7-15
Fig.	7-9	Location of Bus Bays on the SES .....	7-18
Fig.	7-10	Diverted Bus Routes and Trips : N-S Route; 2000 .....	7-20
Fig.	7-11	Diverted Bus Routes and TRips : East Route; 2000 .....	7-21
Fig.	7-12	Diverted Bus Routes and Trips : FES Routes; 2000 .....	7-22
Fig.	7-13	Diverted Bus Trips at each Rampway and at Screen Section : 2000 .....	7-24
Fig.	7-14	Bus Bay A-Type (Ground Level) .....	7-26
Fig.	7-15	Bus Bay B-Type (Elevated Level) .....	7-27

## CHAPTER 8 FINALIZATION OF THE ROUTE LOCATION

Table	8-1	Comparison of Alternative Routes (North-South Route) .....	8-15
Table	8-2	Comparison of Alternative Routes (East Route) .....	8-16
Fig.	8-1	Alternative Routes (North-South Route) .....	8-5
Fig.	8-2	Alternative Routes (East Route) .....	8-6
Fig.	8-3	Turbine Type Interchange between Alternative B-1-E and FES .....	8-10

## CHAPTER 9 ENGINEERING STUDY

Table	9-1	Adopted Design Speed .....	9-3
Table	9-2	Minimum ROW Width .....	9-4
Table	9-3	Maximum Hourly Rainfall Intensity and Crossfall of Paved Carriageway .....	9-8
Table	9-4	Expressway Geometric Design Standard (Design Speed 80 km/h for Throughway) .....	9-10
Table	9-5	Expressway Geometric Design Standard (Design Speed 50 km/h for Interchange Ramps and On/Off Ramps) .....	9-11
Table	9-6	Expressway Geometric Design Standard (Design Speed 40 km/h for Loop Type On/Off Ramps) .....	9-12
Table	9-7	Traffic Volume and Number of Lanes .....	9-15
Table	9-8	Traffic Capacity Analysis for Study Roads .....	9-17

Table	9-9	Summary of Number of Traffic Lanes . . . . .	9-18
Table	9-10	Traffic Volume and Number of Ramp Lanes and Booths . . . . .	9-29
Table	9-11	Number of Toll Booths . . . . .	9-28
Table	9-12	Appraisal of Overcrossing and Undercrossing Schemes . . . . .	9-36
Table	9-13	Appraisal of Viaduct and Embankment Schemes . . . . .	9-39
Table	9-14	Design Features of the Proposed Bridges and Viaduct on N-S Route . . . . .	9-52
Table	9-15	Design Features of the Proposed Bridges and Viaduct on East Route . . . . .	9-53
Table	9-16	Average Daily Traffic Volumes for Pavement Design. . . . .	9-54
Table	9-17	Summary of Items of Soils Survey . . . . .	9-57
Table	9-18	Typical Properties of Sub-surface Soils . . . . .	9-60
Table	9-19	Typical Properties of Materials . . . . .	9-61
Table	9-20	Main Rock Sources . . . . .	9-62
Table	9-21	Main Sources of Sand . . . . .	9-62
Table	9-22	Main Sources of Laterite . . . . .	9-63
Table	9-23	Record of the Recent Flood in GBA . . . . .	9-69
Table	9-24	Rainfall Probability . . . . .	9-70
Table	9-25	Surveyed Flood Stages at Embankment Sites . . . . .	9-75
Table	9-26	Design Flood Stages at Embankment Sites . . . . .	9-75
Table	9-27	Finished Grade of At-Grade Expressway . . . . .	9-75
Table	9-28	Recommended Type of Lighting Column . . . . .	9-79
Table	9-29	Outline of the Recommended Traffic Control Operation . . . . .	9-87
Table	9-30	Class of Vehicle and Toll Rate . . . . .	9-89
Table	9-31	Recommended Sign System . . . . .	9-95
Fig.	9-1	Typical Cross Sections of the Expressway (1) . . . . .	9-5
Fig.	9-2	Typical Cross Sections of the Expressway (2) . . . . .	9-6
Fig.	9-3	Typical Cross Sections of Interchange Ramps and On-Off Ramps . . . . .	9-9
Fig.	9-4	Flow Diagram to Calculate Design Traffic Capacity of the Expressway . . . . .	9-16
Fig.	9-5	Types & Varieties of Interchanges . . . . .	9-23
Fig.	9-6	Interchange Traffic Volume and its Number of Lanes . . . . .	9-25
Fig.	9-7	The Locations of On & Off Ramps . . . . .	9-27
Fig.	9-8	Types of Ramp Terminal . . . . .	9-26
Fig.	9-9	Typical Arrangement of Diagonal and Loop Ramps . . . . .	9-30
Fig.	9-10	(1) Traffic Analysis of Intersection (1) . . . . .	9-32
Fig.	9-10	(2) Traffic Analysis of Intersection (2) . . . . .	9-33
Fig.	9-11	Alternative of Overcrossing VS. Under-crossing Scheme near the Victory Monument . . . . .	9-35
Fig.	9-12	Concept of Pack Drain Method . . . . .	9-38
Fig.	9-13	Joint Development Plan (Type I) of the Expressway and BMA Street within the ROW . . . . .	9-41
Fig.	9-14	Joint Development Plans (Type II, III, IV & V) of Expressway and Street within ROW . . . . .	9-42

Fig.	9-15	Concept Plan of Parking Lot and Shopping Center . . . . .	9-44
Fig.	9-16	Longitudinal Soil Profile . . . . .	9-55
Fig.	9-17	Location Map of Exploratory Bore Hole and Test Pit . . . . .	9-58
Fig.	9-18	Longitudinal Soil Profile along North-South Route . . . . .	9-59
Fig.	9-19	Longitudinal Soil Profile along East Route . . . . .	9-59
Fig.	9-20	Embankment Height and Factor of Safety . . . . .	9-65
Fig.	9-21	Settlement due to Consolidation . . . . .	9-66
Fig.	9-22	Existing Situation of the Project Area . . . . .	9-68
Fig.	9-23	Intensity-Duration-Frequency Curve in Bangkok Metropolis. . . . .	9-71
Fig.	9-24	Probable Flood Stages between Pak Nam and Bang Sai. . . . .	9-74
Fig.	9-25	Outline Plan of Pump Station . . . . .	9-77
Fig.	9-26	Schematic Diagram of Existing Traffic Control System . . . . .	9-82
Fig.	9-27	Proposed Layout Plan of C.C.T.V. Camera . . . . .	9-84
Fig.	9-28	Proposed Layout Plan of the Traffic Detector . . . . .	9-85
Fig.	9-29	Schematic Diagram of Recommended Traffic Control System . . . . .	9-86
Fig.	9-30	Flow Diagram of Toll Collection System . . . . .	9-89
Fig.	9-31	Schematic Diagram of Recommended Toll Data Processing System . . . . .	9-92
Fig.	9-32	Typical Layout of Signs in the Vicinity of On/Off-Ramp . . . . .	9-94

## CHAPTER 11 ESTIMATED CONSTRUCTION AND MAINTENANCE COST

Table	11-1	Land Acquisition and Compensation Costs . . . . .	11-2
Table	11-2	Summary of Project Costs in 1983 Prices N-S Route (1) Sta. 0+770 – Sta. 10+830. . . . .	11-5
Table	11-3	Summary of Project Costs in 1983 Prices N-S Route (2) Sta. 10+830 – Sta. 19+940 . . . . .	11-6
Table	11-4	Summary of Project Costs in 1983 Prices East Route (1) Sta. 0+780 – Sta. 9+500 . . . . .	11-7
Table	11-5	Summary of Project Costs in 1983 Prices East Route (2) Sta. 9+500 – Sta. 14+340 . . . . .	11-8
Fig.	11-1	Construction Segments for the Study . . . . .	11-3

## CHAPTER 12 ECONOMIC ANALYSIS

Table	12-1	Alternative Plans for Economic Evaluation . . . . .	12-3
Table	12-2	Basic Vehicle Operating Cost and Economic Cost at Basic Running Conditions . . . . .	12-3
Table	12-3	Time Value of Vehicles . . . . .	12-5
Table	12-4	Investment Cost . . . . .	12-8
Table	12-5	Economic Evaluation . . . . .	12-9
Table	12-6	Overall Traffic Cost . . . . .	12-12
Table	12-7	Project Cost of the SES Alternatives . . . . .	12-12
Table	12-8	Economic Assessment . . . . .	12-13
Fig.	12-1	Alternative Plans in the Phase I Study of SES . . . . .	12-4
Fig.	12-2	Flow Chart : Traffic Assignment and Traffic Cost, a SES Alternative . . . . .	12-6



Fig.	12-3	The SES Alternatives .....	12-11
Fig.	12-4	Toll Fare and Rate of Return : R-1 .....	12-14

CHAPTER 13 TOLL REVENUE AND FINANCIAL ANALYSIS

Table	13-1	Toll Fare Level .....	13-4
Table	13-2	Financial Analysis .....	13-6

CHAPTER 14 IMPLEMENTATION PLAN

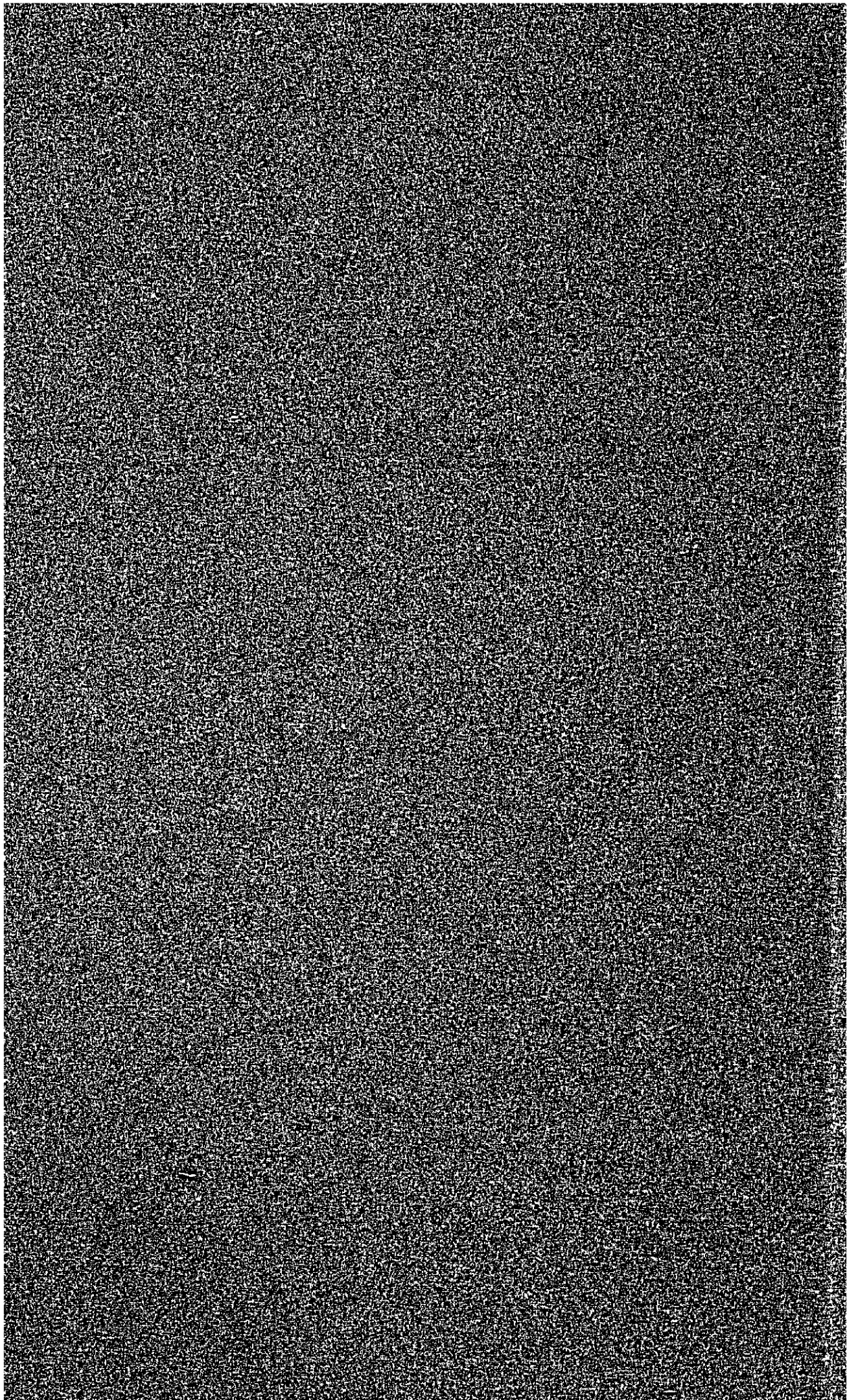
Table	14-1	Estimated Project Cost .....	14-1
Fig.	14-1	Construction Segments .....	14-2
Fig.	14-2	Overall Implementation Schedule of 2nd Stage Expressway System .....	14-4



# Chapter 1

## INTRODUCTION

1.1	Project Background	1-1
1.2	Study Objectives	1-2
1.3	Scope of Work	1-2
1.4	Study Approach and Execution of Study	1-2
1.5	Conduct of the Study	1-6
1.6	Organization of the Project Team	1-7
1.7	Report Procedure	1-9
1.8	Abbreviations	1-9



## CHAPTER 1 INTRODUCTION

### 1.1 Project Background

The Government of Japan, in compliance with the request of the Government of the Kingdom of Thailand (hereinafter called the "Government") has agreed to extend technical cooperation to the Government for the Feasibility Study on the Second Stage Expressway System Project (hereinafter called the "Study") in the Greater Bangkok Area (GBA).

Based on this decision, the Japan International Cooperation Agency (hereinafter called the "JICA"), an official agency responsible for the execution of the technical cooperation program of the Japanese Government, carried out the Study in close cooperation with the Expressway and Rapid Transit Authority of Thailand (hereinafter called the "ETA") and the agencies concerned of the Government.

GBA is, by far, the largest urban area in Thailand with a population of approximately six (6) million. It produces nearly 40 percent of the nation's Gross Domestic Product. Being the center of activities in the country, it offers the best opportunities in the kingdom for both higher educational and cultural activities. GBA has been and will continue to be the main focus of human activities, generating social and economic benefits that have important multiplier effects over the rest of the country.

The greater opportunities for social and economic advancement tend to attract rural people to migrate to Bangkok, which has consequently increased its population. The population increase of Bangkok leads to continuing expansion of the urban area and an intensified land use in the built-up area.

The rapid urban expansion in GBA inevitably has entailed various urban problems and this has become increasingly serious especially in the central business district and its fringe areas.

Inadequacy of basic infrastructures, inappropriate land use and housing shortage and the great need to improve the transportation network in these areas are the main problems.

The necessity to strengthen the road network in GBA by providing an expressway network is primarily due to the recent increase in vehicle traffic demand accompanying the development of the area.

The First Stage Expressway System (FES) was thus planned to link the major highways from the north, the south and the east to relieve the traffic congestion in Bangkok. More in detail, the FES consists of three sections, namely, the 8.9 km Din Daeng-Port section, the 7.9 km Bang Na-Port section, and the 10.3 km Dao Khanong-Port section.

In the above FES, the Din Daeng-Port section was opened to traffic in October 1981 and the Bang Na-Port section was opened to traffic in January 1983 as a toll expressway system.

Under such circumstances, it is believed that there is a pressing requirement for expansion of the expressway network in the Greater Bangkok Area since the road traffic demand in the area is expected to continue the current trend of rapid increase as the economy grows further in the future.

The Second Stage Expressway System will not only make up the vital portion of the expressway network of the Metropolis and distribute traffic in the area to avoid serious traffic



congestion which would otherwise occur in certain radial and circumferential roads but will also allow the land use pattern for the area to be greatly improved.

## **1.2 Study Objectives**

The overall objective of the Study above-mentioned is to determine the technical, economic and financial feasibility of, and to prepare an optimum program for, the construction of the Second Stage Expressway System.

## **1.3 Scope of Work**

The Study area covers the Greater Bangkok Area including its satellite cities. The works required have been divided into Phase I and Phase II to meet the requirement of the work and time schedule. In general, the work comprises:

Phase I: Identify the existing situation of the transport system, forecast the transport demand and review other relevant studies.

Screening of the alternatives to identify high priority routes which are to be included in the Second Stage Expressway System.

Phase II: Feasibility study on the identified routes complete with forecast of future traffic volume, preliminary engineering and economic and financial studies.

## **1.4 Study Approach and Execution of the Study**

### **1.4.1 General**

A multi-disciplinary team approach was employed to the Study. With the team approach, adequate attention to all the various components of the Study was ensured and an opportunity for resolving the various complex study issues in a broader manner was provided.

Although the Study Team concentrated their effort on the execution of the Study, special attention was also given to specific objectives, such as the preparation of various reports and attendance at inter-agency Coordination Subcommittee meetings. Throughout the period of the Study, the Study Team kept close contact with the Government and care was exercised to secure concurrence at all the stipulated stages.

In the preparation of reports an attempt was made to present the Study completely and as clearly as possible, including not only results and conclusions, but also steps leading to the final results and the basic assumptions used. This was done to make it possible for those in charge of the implementation to have at their disposal all possible variations which actual development might require.

### **1.4.2 Basic Policies of the Study**

The Study Team designed their Study approach to meet the following basic policies:

#### **(1) Recommended Implementation Program**

The implementation plans will be recommended for the construction of the Second



Stage Expressway System in the orders of the period of 10 or 15 years. If it includes a staged construction plan, an optimum staging schedule will be determined based on comparative studies.

(2) Viability of the Second Stage Expressway System

Since the Second Stage Expressway System will constitute the part of the trunk road network in GBA, its economic viability should be identified within the framework of the overall road network development in the area. In addition, the financial viability of the Expressway will also be studied.

### 1.4.3 Execution of the Study

(1) General

The Study Team despatched by the JICA spent 403 days (from 6 June to 15 December, 1982 and from 24 January to 21 August, 1983) in Bangkok and its vicinity for fact finding, data collection, topographic, soils and materials and traffic surveys, and various studies as well as for discussions with the officials of various relevant ministries and agencies of the Government.

In planning the efficient execution of the Study, the Study was carried out in two phases under the headings of Phase I and Phase II. These phases were further subdivided into logical functions as briefly shown in Fig. 1-1.

(2) Phase I Study

Phase I Study essentially consisted of studies on the present transport system and its prospect in the future and screening of the Second Stage Expressway System components, and comprised the following works:—

a) Collection and Analysis of Data

- Socio-economic and land use data;
- Development plans;
- Road transport system and traffic characteristics;
- Inventory of existing transport facilities;
- Geotechnical and hydrological data;
- Aerial photographs and topographical maps; and
- Various design standards.

b) Traffic Study

- Traffic survey and analysis; and
- Inception study for the forecast of future traffic demand.

c) Expressway Network Planning and Inception Traffic Assignment

- Necessity of expressway network;
- Policies for expressway network planning;

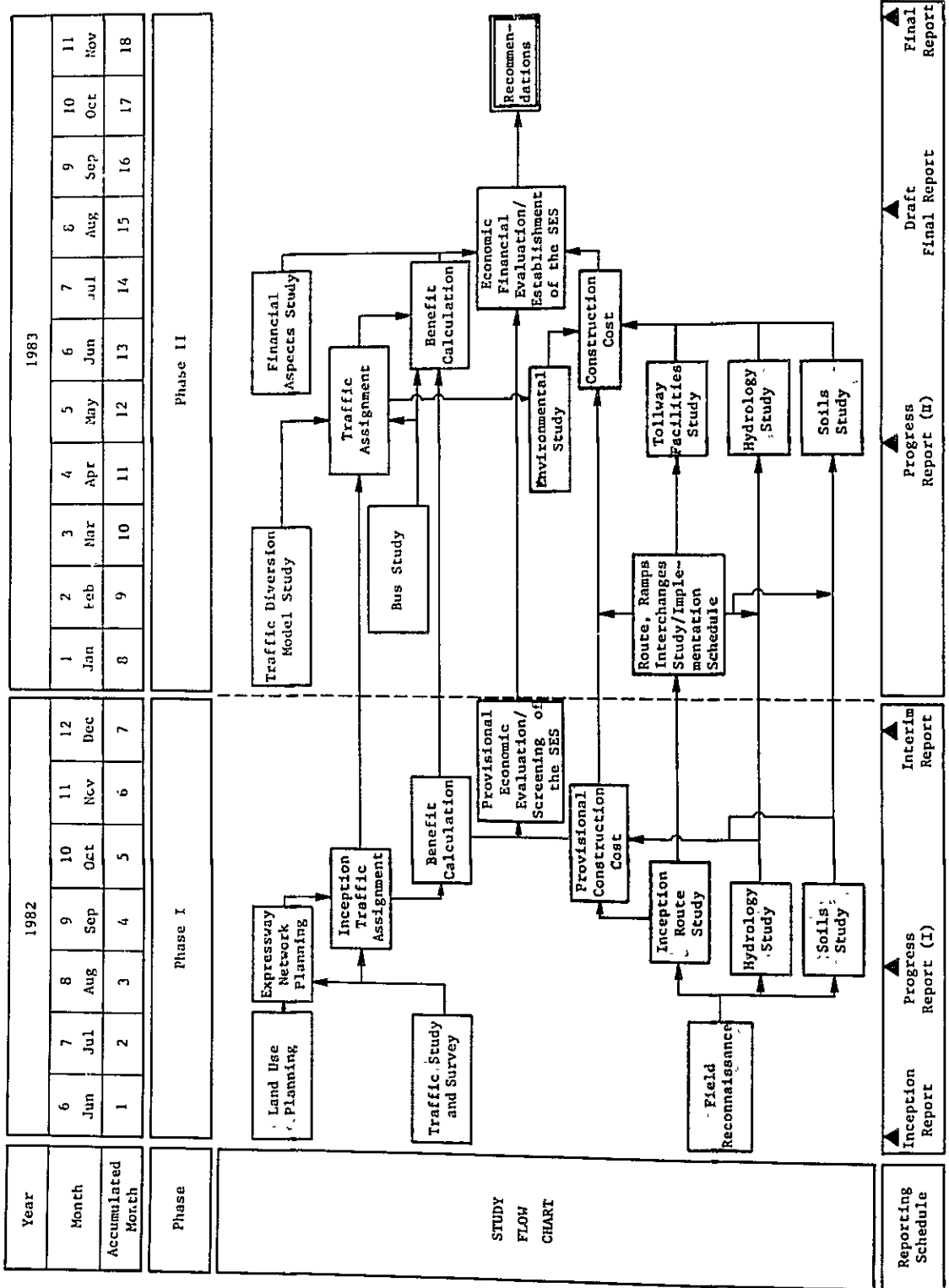


FIG. 1-1 GENERAL FLOW CHART OF THE STUDY

- Identification of present urban traffic problems;
  - Future urbanization and function of expressway;
  - Selection of the optimum expressway network pattern; and
  - Establishment of the future expressway network.
- d) Inception Engineering Studies for the Established Second Stage Expressway Network
- Study of the expressway geometric design standard;
  - Analysis of traffic capacities;
  - Route studies;
  - Study of the concept of interchanges and on/off-ramps; and
  - Structural design concepts.
- e) Provisional Cost Estimates
- f) Provisional Economic Evaluations
- g) Identification of the High Priority Routes of the Expressway Project
- Ranking of the expressway alternatives; and
  - Selection of high priority routes of the Second Stage Expressway System.

(3) Phase II Study

Two routes, namely the North-South Route (hereinafter called the “N–S Route”) and the East Route were selected for the feasibility study as a result of Phase I Study.

Briefly, the Phase II Study comprises the following tasks:

- a) Collection and Analysis of Additional Data
- b) Traffic Surveys and Studies
- Vehicle OD survey; and
  - Bus operation survey.
- c) Traffic Assignment
- Setting of traffic diversion model;
  - Examination of toll fares;
  - Analysis of bus operation;
  - Final traffic assignment.
- d) Finalization of the Route Locations
- Identification of alternative routes; and
  - Selection of optimum route locations for each subcorridor.
- e) Preliminary Engineering Design
- Route survey (i.e. traverse line setting and leveling);

- Production of aerial photo mosaics;
  - Soils and materials survey;
  - Determination of geometric and bridge design standards;
  - Expressway capacity analysis;
  - Preliminary expressway geometric designs;
  - Preliminary designs of interchanges and on/off-ramps;
  - Study of viaducts and other structures;
  - Preliminary design of pavement;
  - Soils and materials study;
  - Hydrological study;
  - Studies of toll collection system and other facilities; and
  - Environmental impact study.
- f) Cost Estimates
- Right-of-way acquisition cost;
  - Construction cost; and
  - Maintenance and expressway operation cost.
- g) Economic Evaluation
- Estimation of economic benefits; and
  - Economic evaluation with sensitivity analysis.
- h) Financial Study
- Investment cost;
  - Financial expenditure and cost;
  - Toll revenue calculation and study of repayment program; and
  - Sensitivity analysis.
- i) Foreseeable Economic and Social Impact Studies
- j) Formulation of Implementation Program
- Execution agency;
  - Construction segments;
  - Stage construction; and
  - Implementation time schedule.

## 1.5 Conduct of the Study

The Study was carried out by the Study Team which was composed of the Japanese Consultant Staff and the ETA Counterpart Staff.

The ETA and Supervisory Committee of JICA have acted as advisors to the Study Team. The ETA Board of Directors has set a 16-member Coordination Subcommittee to give assistance

and coordination for the execution of the Study.

The Supervisory Committee (members of the Japanese Government) held meetings in Tokyo as the need arose, observing the Team's progress and providing necessary advice. The representatives of the Supervisory Committee made separate visits to Bangkok during the period of the works in Thailand to discuss directly with the Team matters that would support the Team, confirming the essential points of decision with the Government.

## 1.6 Organization of the Project Team

The complete staff who directly participated in the Study are as follows:

### (1) Supervisory Committee Members of the Japanese Government

Mr. Shigeomi Samukawa (Chairman)	Hanshin Expressway Public Corporation
Mr. Shoichiro Numata	Tokyo Metropolitan Expressway Public Corporation
Mr. Nobuo Shinoda	Ministry of Construction, Japan
Mr. Motoyuki Kidokoro	Ministry of Construction, Japan
Mr. Asao Yamakawa	Ministry of Construction, Japan
Mr. Tetsuharu Banba	Ministry of Construction, Japan
Mr. Nobuyoshi Iwasaki (Coordinator)	JICA

### (2) Coordination Subcommittee Members of the Government

Mr. Charan Burapharat (Chairman)	ETA
Mr. Siva Charoenpong	ETA
Mr. Bumpen Chaturapruk	Bangkok Metropolitan Administration (Ministry of Interior)
Mr. Monthien Weerothai	Bangkok Mass Transit Authority (Ministry of Communication)
Mr. Bancha Wattanasindhu	Department of Highways (Ministry of Communication)
Mr. Pallop Ongcharoen	Department of Town and Country Planning (Ministry of Interior)
Mr. Thawal Polpuech	Department of Technical and Economic Cooperation (Ministry of Foreign Affairs)
Mr. Yutasak Stihirun	ETA
Mr. Srisuk Chantarangsu	Ministry of Communication
Mr. Nopadol Pangrawee	Ministry of Finance
Mr. Pichai Pamanikabhutr	National Environment Board

Mr. Visnu Bhulsuk	National Economic and Social Development Board (Office of the Prime Minister)
Mr. Prapon Vongvichien	Office of the Committee for the Management of Road Traffic
Mr. Vanich Pansuwan	State Railway of Thailand
Mr. Vichitr Vatcharindr	ETA, Secretary
Mr. Pachearn Pirotesak	ETA, Assistant Secretary
(3) JICA Study Team	
Mr. Akira Shikichi	Team Leader (PCI)
Mr. Kunio Teshima	Team Leader (PCI)
Mr. Teruhiko Horie	Transport Planner/Economist (PCI)
Mr. Tomoyuki Matsumura	Traffic Specialist (PCI)
Mr. Masaru Mizukami	System/Traffic Engineer (PCI)
Mr. Kazuaki Kato	Traffic Engineer (PCI)
Mr. Tsuneyoshi Jitsuhara	Traffic Engineer (PCI)
Mr. Tatsuyuki Negishi	Urban Planner (PCI)
Mr. Kazuhiro Suwa	Bus Traffic Planner (PCI)
Mr. Masaaki Goto	Bus Facilities Planner (PCI)
Mr. Haruo Sakashita	Highway Engineer (PCI)
Mr. Hiroyuki Endo	Structural/Cost Estimates Engineer (PCI)
Mr. Yoshiya Niinomi	Toll Collection System Facilities Specialist (PCI)
Mr. Takashi Hattori	Environment Specialist (PCI)
Mr. Hikoroku Otsuka	Hydrologist (PCI)
Mr. Sakae Takada	Soils & Materials Engineer (PCI)
(4) Counterpart Staff	
Mr. Siva Charoenpong	Project Director (ETA)
Mr. Vichitr Vatcharindr	Deputy Project Director (ETA)
Mr. Pachearn Pirotesak	Technical Assistant in Traffic Engineering (ETA)
Mr. Chotisak Visetsuranun	Technical Assistant in Civil Engineering (ETA)
Mr. Somchai Jongkittipong	Technical Assistant in Civil Engineering (ETA)
Mr. Sittichai Jullasing	Technical Assistant in Civil Engineering (ETA)
Mr. Sombat Suraprasit	Technical Assistant in Civil Engineering (ETA)
Mrs. Aisavaraporn Thongtem	Technical Assistant in Economics (ETA)
Mrs. Uravadee Choosri	Technical Assistant in Economics (ETA)
Mrs. Suthathip Tamtai	Technical Assistant in Economics (ETA)
Miss Walee Pipatkulsawat	Secretary (ETA)



## 1.7 Report Procedure

This Final Report on the Feasibility Study on the Second Stage Expressway System in the Greater Bangkok consists of the following volumes:

EXECUTIVE SUMMARY  
VOLUME I : TEXT  
VOLUME II : APPENDIX  
VOLUME III : DRAWINGS

At the various stages of the Study, the following reports had been presented by JICA to the ETA:

- Inception Report, June 1982, to discuss with the ETA the study approaches and requirements, way of the execution of works and the Government undertakings;
- Progress Report (1), August 1982, containing the study results thereof;
- Interim Report, December 1982, containing all results of the Phase I Study; and
- Progress Report (2), April 1983, to present the interim outcome of the Phase II Study
- Draft Final Report, August 1983, containing all results of Phase I and II Studies

## 1.8 Abbreviations

### (1) Agencies and Authorities

BMA	Bangkok Metropolitan Administration (Ministry of Interior)
BMTA	Bangkok Mass Transit Authority (Ministry of Communication)
DLT	Department of Land Transport (Ministry of Communication)
DOH	Department of Highways (Ministry of Communication)
DPW, PWD	Department of Public Works (Ministry of Interior)
DTCP, TCP	Department of Town and Country Planning (Ministry of Interior)
DTEC	Department of Technical and Economic Cooperation (Ministry of Foreign Affairs)
ETA	Expressway and Rapid Transit Authority of Thailand (Ministry of Interior)
JICA	Japan International Cooperation Agency
MOC	Ministry of Communication
MOI	Ministry of Interior
MOF	Ministry of Finance
MWWA	Metropolitan Water Works Authority (Ministry of Interior)
NEB	National Environment Board
NESDB	National Economic and Social Development Board (Office of the Prime Minister)
NHA	National Housing Authority of Thailand (Ministry of Interior)
NSO	National Statistics Office (Office of the Prime Minister)

OCMRT	Office of the Committee for the Management of Road Traffic
PD	Police Department
RID	Royal Irrigation Department
SRT	State Railway of Thailand

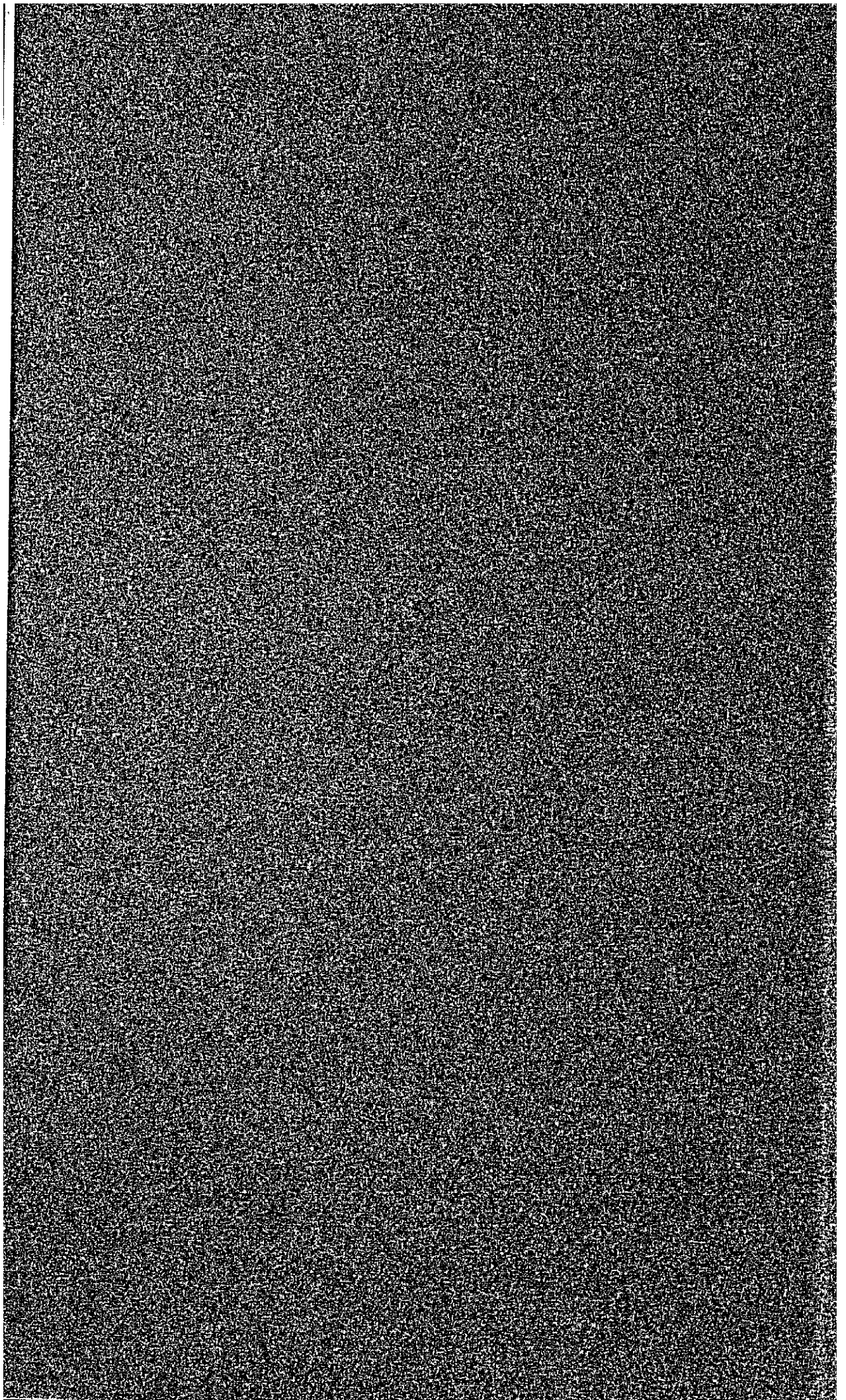
(2) Other Abbreviations

AASHTO	Americal Association of State Highway and Transportation Officials
ADT	Average daily traffic
AADT	Annual average daily traffic
B/C	Benefit cost ratio
BTS	Bangkok transportation study
CKD	Complete knock down
CBD	Central business district
CIF	Cost with insurance and freight
CRF	Capital recovery factor
CUA	Central urbanized area
FES	The First Stage Expressway System
GBA	Greater Bangkok Area
GDP	Gross domestic product
GPP	Gross provincial product
GRP	Gross regional product
IRR	Internal rate of return
MC	Motorcycle
MSL	Mean sea level
MTS	Mass transit system
OD	Origin and destination
PT	Public transport
PVT	Private transport
PW	Present worth
ROW	Right-of-way
SES	The Second Stage Expressway System
TOR	Terms of reference
VOC	Vehicle operating cost

## **Chapter 2**

# **SOCIO-ECONOMIC CHARACTERISTICS**

2.1	General	2-1
2.2	The Country	2-2
2.3	The Greater Bangkok Area	2-3
2.4	Zones	2-6





## CHAPTER 2 SOCIO-ECONOMIC CHARACTERISTICS

### 2.1 General

Socio-economic characteristics of the country and the Greater Bangkok Area (GBA) in past decades are summarized by referring to available statistic data. Economic development plan of the country and urban development plan of Greater Bangkok Area are also reviewed.

The influence area of the project is delineated by traffic zones. The zones are used to break down the forecasted economic indexes and traffic volumes.

### 2.2 The Country

The Kingdom of Thailand occupies the area of 514,000 km<sup>2</sup> in the Indo-Chinese Peninsula; lying between longitude 97°E and 106°E and between latitude 5°N and 21°N. The countries bordering the Kingdom are the Lao People's Democratic Republic, Democratic Kampuchea, Malaysia and The Socialist Republic of the Union of Burma. The Kingdom consists of five regions: Central, North, North-east, East and South. The capital is Bangkok located in the central region which covers the area of 104,000 km<sup>2</sup> along Chaophraya River.

#### 2.2.1 Development in the Past

The population was 26.3 million in 1960, 35.5 million in 1970, 46.9 million in 1980 and 48.5 million in 1982. The average population growth rate per annum decreased from 3.0% during the 1960's to 2.1% p.a. for the five years of 1976–1981.

In the 1980's statistics, the total employed persons (11 years old and over) were 21.2 million which were divided into 3 sectors : 15.0 million employees or 70% of the whole labour forces were in the primary sector, i.e. agriculture, forestry, and fishing, while 2.1 million employees were in the secondary sector, including construction and public utility, and 4.1 million employees were in the commerce and service sectors.

Gross domestic product (GDP) in 1981 was estimated at 803.2 billion Baht in current prices, of which agriculture contributed 26%, manufacturing and construction 26%, transport and communication 8% and trade, commerce and administration 40%. As shown in Table 2-1, GDP in terms of constant prices had increased at the rate of 7.4% p.a. during the period from 1977 to 1981, while per capita GDP in constant prices had grown at 5.3% p.a. in the same period.

The financial position of the national government in the past several years is shown in Appendix Table 2-1. It registered deficits although the amount was around 15–20% of the Government expenditure. International balance of payment, on the other hand, indicated a favorable change into surplus in the overall balance in 1980 and 1981 mainly caused by capital inflows from foreign countries (Appendix Table 2-2).

The steady economic development was accompanied by increases in the service of the transport sector. Changes in export and/or import are indicated by the number of vessels and tonnage using the Bangkok Port. The total number of vessels coming in and out increased from 6,000 to 7,200 and the gross freight tonnage from 23.0 million to 34.8 million from 1975 to 1980 (Appendix Table 2-3). The State Railway of Thailand (SRT) increased its

passengers from 62.6 million to 66.9 million and freight from 5.2 million to 6.5 million tons from 1975 to 1980 (Appendix Table 2-4).

In the case of road transportation, the number of registered vehicles including motorcycles increased from 551,000 to 960,000 in the period from 1975 to 1981, resulting in the growth rate of 10% p.a. (Appendix Table 2-6). Changes in the highway length, under the administration of Department of Highways (DOH) during the years of 1975 to 1980, indicate that the national highway network approaches 13,900 km in total length. National roads with paved surface are less likely to expand their total length more than 14,000 km. Of the total national and provincial roads, 80% was paved and 20% graveled surface in 1980 (Appendix Table 2-7).

Movements of aircrafts, passengers and freight cargo at Don Muang International Airport for the years from 1975 to 1981 reflect a highly developed feature of the economy and international air traffic growth. As shown in Appendix Table 2-8, the annual growth of international passengers in the period 1975 to 1981 was 11.2% p.a., and that of cargo in the same period was 14.1% p.a. Passengers on domestic lines had a higher growth rate of 16.3% simultaneously. The lower increase rate of air flights, 0.7% p.a. for the years of 1975 to 1981, indicates the increased use of larger size aircraft.

TABLE 2-1 GROSS DOMESTIC PRODUCT AND GROSS NATIONAL PRODUCT OF THE KINGDOM : 1977 - 1981

DESCRIPTION	1977	1978	1979	1980	1981	Average p.a. 77-81
<b>A. At Current Prices</b>						
1. GDP (million Baht)	393,030	469,952	556,240	684,930	803,161	(19.6%)
2. GNP (million Baht)	391,016	464,550	546,449	672,440	785,880	(19.1%)
3. Per Capita GNP (Baht)	8,832	10,273	11,850	14,319	16,415	(16.8%)
4. Per Capita GDP (Baht)	8,878	10,392	12,062	14,585	16,776	(17.2%)
<b>B. At Constant Prices In 1972</b>						
1. GDP (million Baht)	237,173	261,097	276,907	292,852	315,116	(7.4%)
2. GNP (million Baht)	235,598	257,043	269,897	284,573	304,951	(6.7%)
3. Per Capita GNP (Baht)	5,322	5,684	5,853	6,060	6,370	(4.6%)
4. Per Capita GDP (Baht)	5,357	5,774	6,005	6,236	6,582	(5.3%)
Population (in '000)	44,272.7	45,221.6	46,113.8	46,961.3	47,875.0	(2.0%)

Sources 1) Bank of Thailand Monthly Economic Report, April 1982.  
2) Population : from Population Registration Section, Administrative Department, Ministry of Interior.



## 2.2.2 Development in the Future

In order to maintain appropriate economic growth and to coordinate harmonious development in all sectors and regions of the Kingdom, the Government has proclaimed 5-Year plans several times in the past, in which strategies and policies are announced to achieve the goals and objectives of the plan.

Currently, the Fifth 5-Year Plan (1982–1986)<sup>1)</sup> is operating. This identifies such major problems as unstable external financial position, concentrated economic growth in the metropolis, poverty and wealth distribution, etc. among others. This plan sets the major development objectives as follows:

- RESTORE THE COUNTRY'S FINANCIAL STABILITY  
REDUCE/SLOW DOWN CONSUMPTION, CONSERVE ENERGY, AND ACCELERATE EXPORTS ;
- RESTRUCTURE AGRICULTURE, INDUSTRY, ENERGY, AND TRANSPORT SECTORS ;
- DISPERSE SOCIAL SERVICES TO THE RURAL AREAS AND REDUCE POPULATION GROWTH RATE ;
- ERADICATE ABSOLUTE POVERTY IN DEPRESSED RURAL AREAS ;
- COORDINATE ECONOMIC DEVELOPMENT WITH NATIONAL SECURITY MANAGEMENT ; and
- REFORM DEVELOPMENT ADMINISTRATION AND DECENTRALIZE ECONOMIC OWNERSHIP PATTERN.

Major targets of the plan are as follows:

- Export should be accelerated at 22% p.a. in order to sustain the economic growth and to reduce the trade deficit;
- Increase GDP at a rate of 6.6% p.a.;
- Population increase rate be lowered to a rate of 1.5% p.a. by the end of 1986;
- Slow down the expansion of the Bangkok Metropolitan Area to hold almost 6 million people by 1986; and
- Five zones are designated as specific development activating areas: new industrial complex of the Eastern Seaboard, Upper North, Lower Northeast, Four Southern Provinces and Western Region.

## 2.3 The Greater Bangkok Area

### 2.3.1 Development in the Past

#### (1) The Area, Population and Economy

In 1958, the Bangkok populated area covered 90 km<sup>2</sup> mostly within Bangkok and Thonburi districts. Rapid urbanization continued and expanded to annex Samut Prakan, Nonthaburi and Pathumthani resulting in the total urban area of 500 km<sup>2</sup> in 1980. Table 2–2 indicates changes in areas of classified land uses within the city area in 1968 and 1980.

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1) NESDB, The Fifth 5-Year National, Social and Economic Development Plan (1982–1986)

TABLE 2-2 LAND UTILIZATION OF THE BUILT-UP AREA OF THE GBA

Classification	(km <sup>2</sup> )		
	1968	1980	80/68
Government and Public Uses	51.5	44.6	0.87
Commercial	17.5	29.7	1.70
Industrial and Warehouses	18.6	35.5	1.91
High Density Residential	23.2	17.7	0.76
Medium-Low Density Residential	93.2	255.8	2.74
Education and Wats	18.7	20.1	1.07
Parks, etc.	5.6	19.3	3.45
<b>TOTAL</b>	<b>228.3</b>	<b>422.7</b>	<b>1.85</b>

Sources: TCP, the Structural Plan of Bangkok Metropolis and its vicinity 2000, (Draft 1982 -- translated by the Study Team)

According to the table, the land use classified as commercial and industrial warehouses increased 1.8 times from 1968 to 1980, the ratio is almost the same as that of the total built-up area. The land use pattern of high density residential area is reduced, probably, by changing into commercial and/or industrial warehouses categories. Medium-low density residential area increased by 2.7 times during the years of 1968 to 1980, indicating a typical spatial urban expansion.

Population in the Greater Bangkok Area (the GBA, covering Bangkok, Nonthaburi and Samut Prakan) was 3.4 million in 1965, which increased to 6.1 million in 1980. The average annual rate of increase was 4.0% p.a., while it was 2.8% for the whole country in the same period.

Rapid migration to the GBA was accelerated by the rapid growth in the economy of the district. However, the rapid growth has brought in a number of problems which were identified to be tackled in a series of development plans.

Concentrated activities, particularly in the economy, are indicated, for example, by the statistics of Gross Provincial Product (GPP), as shown in Appendix Tables 2-9 and 2-10. For the years from 1973 to 1980, the annual growth of GPP in GBA was 10.2%, while the country's GPP registered 7.3% in terms of constant prices. The GPP of the GBA as a percentage of that of the whole Kingdom was 40%, but the population of the GBA was only 13% of the total population of the country in 1980.

Per capita GPP in the GBA was 43,639 Baht in 1980 at current prices, according to the same Appendix Table. It was approximately 3.1 times larger than that of the whole country. The per capita figure in the GBA had increased at a rate of 18.0% p.a. in current prices and 6.2% p.a. at constant prices from 1976 to 1980. They were also higher than those of the whole country which registered 16.1% and 4.2%, respectively in the period.

## (2) Infrastructure

The inhabitants of the GBA consumed the fresh water of 3.3 million m<sup>3</sup> per day in 1980, of which 2.6 million m<sup>3</sup> was from the Metropolitan Water Works Authority

(MWWA) and the remaining 0.7 million m<sup>3</sup> from private wells. However, MWWA depends 2.1 million m<sup>3</sup> on the river water and 0.5 million m<sup>3</sup> on underground water. The well pumping by MWWA, private households, and factories has caused serious problems of ground settlement in the GBA, particularly in the eastern urbanized area<sup>2</sup>).

Flood is a big problem, especially in rainy season. The terrain is flat with an average elevation of 1.2 m from the mean sea level. The existing channels and storm water drainage system are under urgent necessity of improvement so as to maintain drainage efficiency and minimize flood damage. Sanitary sewerage system is also in necessity of improvement and development.

The traditional transport means were boats on channels and rivers crossing the plain around Chaophraya River. However, its share in the sector became smaller when many waterways were reclaimed to develop roads with vehicle transport. Requirement for vehicle transport services increased at a high rate as seen in changes in vehicle registration (Appendix Table 4-18), while road construction was lagging far behind the increase in traffic demand.

Thus traffic congestion on roads in the built-up area becomes a bottleneck phenomenon which hampers the comfortable and efficient urban lives, as stated in detail in Chapter 4.

Meanwhile, the rail line services for mass transit, were regrettably neglected in the GBA. The State Railway of Thailand served for interregional movement rather than intra-urban movement. Passenger movement on the SRT lines within the GBA was quite small. According to the BTS in 1972, the person trips using the railways was 8,000 out of the total of 4,678,000 trips per day. Relative shares up to 1982 would have increased but not substantially since intra-urban service of SRT is quite small.

Appendix Table 2-5 presents the statistical data of passenger volumes on selected railway stations in GBA from 1976 to 1981. During these years SRT increased passengers on most of the stations in GBA. On the northern line, the ratio of increase was as high as 7.40 at Bang Khen and 6.34 at Lak Si but low as 0.71 at Khlong Rangsit. On the east line the ratio was 2.53 at Khlong Tan and 3.16 at Hua Mak. Passengers on the western line and the southern line were smaller in number than the northern and eastern lines. Bangkok (Hua Lumpong) Station increased by 74% while Thonburi decreased by 15% from 1975 to 1981.

Don Muang Station had 879,510 passengers in 1981. It had the third largest passengers following Bangkok and Bang Sue. It meant 2,410 passengers per day for departure. Assuming 70% of the passengers departed for the central district, it was 1,690 passengers. With 22 trains in operation, 76 passengers per train were carried on the average, the volume of which was relatively small compared with bus passengers.

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2) Summarized from TCP, *op.cit.* See the source of Table 2-2.

### 2.3.2 Development in the Future

#### (1) The Structural Plan of Bangkok and the Vicinity, 2000

Since the beginning of 1960, Bangkok Metropolitan Administration (BMA) and the Government proposed or drafted several urban plannings for the GBA. The current general conceptual plan for urbanization of the GBA which is called "The Structural Plan of Bangkok Metropolis and the Vicinity, 2000", is already drafted and being prepared to be proclaimed by the Ministry of Interior in 1983. The draft is summarized in Chapter 3 in which it provides the basic frame for traffic forecast of the Study.

#### (2) Strategies

It is to be noticed that the plan emphasizes guiding the population of the GBA so as not to increase as in the past and protecting the peripheral agricultural area from the spatial urban expansion. The Government plans to develop the economy in other regions rather than in the GBA in order to lessen unfavorable effects of the excessive economic concentration in the Metropolis.

The plan assumes that the BMA population is 6 million and gross regional product (GRP) at 120,000 million Baht in 1972 prices in 1986, referring to the Fifth 5-Year Plan. This trend is extrapolated to have 200,000 million Baht in 1972 prices with the population of 7.5 million in BMA in 2000. It means the population growth at 1.6% p.a. and GRP at 3.7% p.a. beyond 1986 up to 2000. These forecasts indicate that the country would not expect the economic growth of the metropolitan region as it has been in the past, since higher growth in other regions is more favorable and to be encouraged.

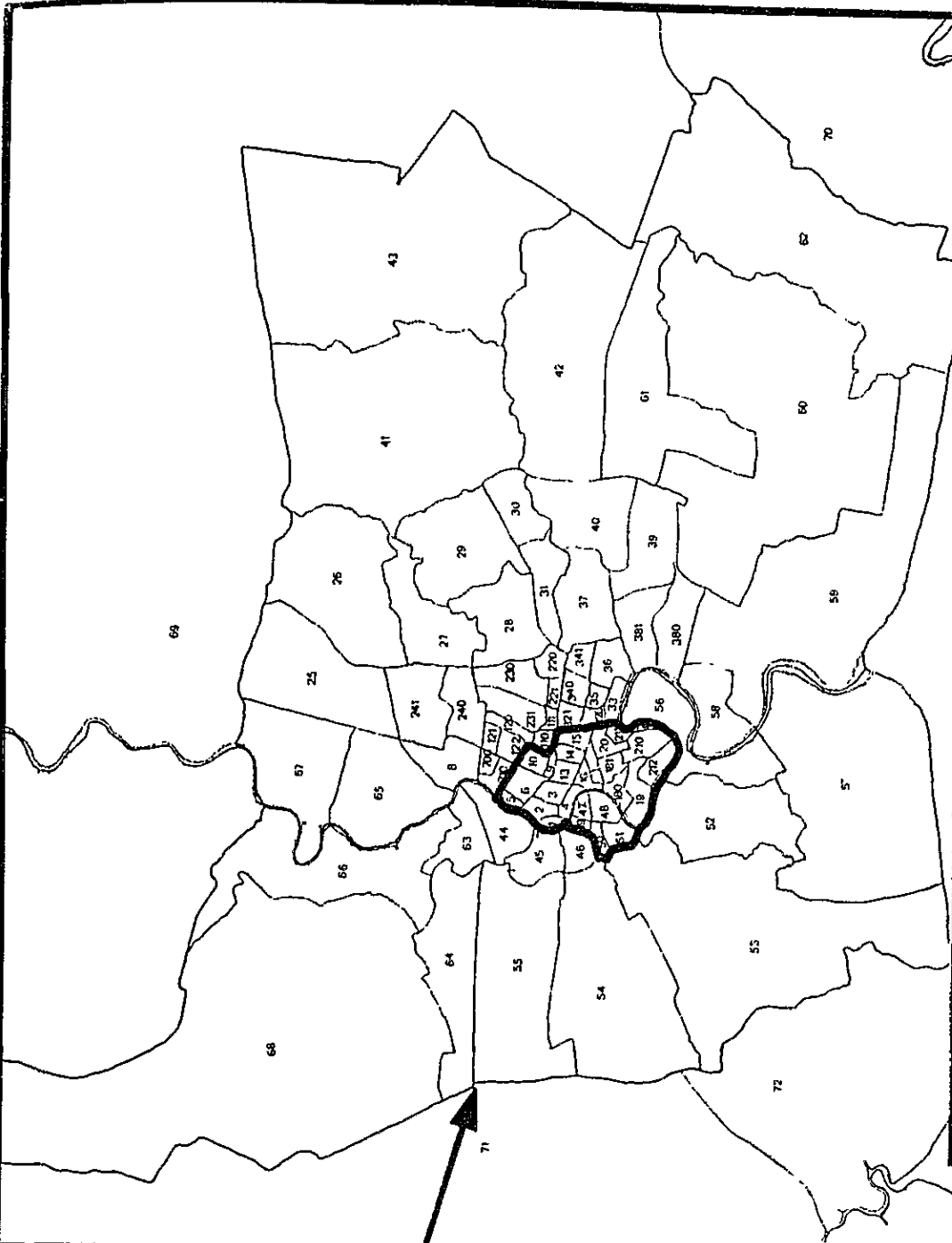
## 2.4 Zones

Zones are delineated as shown in the zone map of Fig. 2-1 and the zone code table, Appendix Table 2-11. The inner area is divided into smaller zones because urbanization and road network are densely developed, while the zones in the suburban area have larger zones because urbanization and road network are less developed. For the study of the expressways in the Metropolis, the regions outside the Greater Bangkok Area are less influential than the districts within the area. Accordingly, outside regions are delineated into large zones, each covering the area along the trunk national highway.

Administrative boundaries Amphoe and Tambon are used for the delineation. Relationship with the zoning in Bangkok Transport Study (BTS) are also shown in Appendix Table 2-11.

In the scope of work the study area is specified to cover the Greater Bangkok Area and its satellite cities (Pathum Thani, Nonthaburi, Samut Prakan and Chon Buri). These areas are delineated into 85 zones in total. Traffic forecast and economic assessment are always conducted with all traffic zones which include the aforementioned study area and the other regions of the country as well.

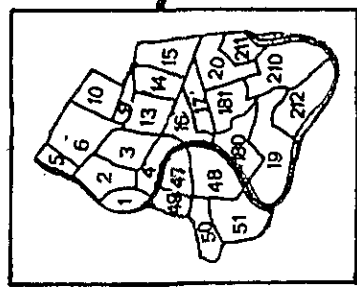
However, the study shall be concentrated in the Greater Bangkok Area consisting of Bangkok Metropolis, Nonthaburi and Samut Prakan, because the proposed Second Expressway System is located within the Metropolitan area. In this report hereafter, the Greater Bangkok Area is abbreviated as the GBA.



**FIG. 2-1**

**ZONE MAP OF THE GBA**

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



**Remarks :**

The zones with "two digits" from 1 to 72 were used as the basic zoning in Phase I study. When the SES routes were determined, it was considered better to sub-divide some zones adjacent to the routes. The sub-divided zones are shown in "three digits". The total number of the zones are 85, which are used in Phase II study.

