

BEIP

JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)
BANGKOK METROPOLITAN ADMINISTRATION(BMA)
THE GOVERNMENT OF THE KINGDOM OF THAILAND

**THE STUDY
ON
URBAN ENVIRONMENTAL IMPROVEMENT PROGRAM
IN
BANGKOK METROPOLITAN AREA**

FINAL REPORT

VOLUME 3: SECTOR PLANS AND TECHNICAL STUDIES

JICA LIBRARY



J1135556(7)

February 1997

PACIFIC CONSULTANTS INTERNATIONAL
SUURI-KEIKAKU

SSS

JR

97-043



JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)
BANGKOK METROPOLITAN ADMINISTRATION(BMA)
THE GOVERNMENT OF THE KINGDOM OF THAILAND

**THE STUDY
ON
URBAN ENVIRONMENTAL IMPROVEMENT PROGRAM
IN
BANGKOK METROPOLITAN AREA**

FINAL REPORT

VOLUME 3: SECTOR PLANS AND TECHNICAL STUDIES

February 1997

**PACIFIC CONSULTANTS INTERNATIONAL
SUURI-KEIKAKU CO.,LTD.**



1135556 (7)

The exchange rates applied in this Study are:

US\$ 1.00 = Baht 25.42

US\$ 1.00 = Japanese Yen 110.65

Baht 1.00 = Japanese Yen 4.35

(as of September 1996)

Preface

In response to a request from the Government of the Kingdom of Thailand, the Government of Japan decided to conduct "The Study on Urban Environmental Improvement Program in Bangkok Metropolitan Area" and entrusted the Study to the Japan International Cooperation Agency (JICA).

JICA sent to the Kingdom of Thailand a study team headed by Dr. Katsuhide NAGAYAMA, Pacific Consultants International, and composed of members of Pacific Consultants International, and Suuri-Keikaku Co.,Ltd., four times between August 1995 and December 1996.

The team held discussions with the officials concerned of the Government of the Kingdom of Thailand and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Kingdom of Thailand for their close cooperation extended to the team.

February 1997



Kimio Fujita
President

Japan International Cooperation Agency

February 1997

Mr. Kimio FUJITA

President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

Dear Sir,

We are pleased to formally submit herewith the final report of "The Study on Urban Environmental Improvement Program in Bangkok Metropolitan Area".

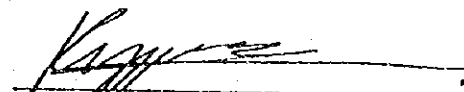
This report compiles the results of the Study which was undertaken in the Kingdom of Thailand from August 1995 through December 1996 by the Study Team, organized jointly by Pacific Consultants International and Suuri-Keikaku Co., Ltd.

We owed a lot to many people for the accomplishment of the Study. First, we would like to express our sincere gratitude and appreciation to all those extended their kind assistance and cooperation to the Study Team, in particular, relevant officials of Bangkok Metropolitan Administration, the Thai counterpart agency.

We acknowledge all the officials of your agency, the JICA Advisory Committee, Embassy of Japan in Thailand and Ministry of Foreign Affairs.

We wish the report would be able to contribute really to appropriate policies and measures for the Bangkok environmental improvement to be formed by the Thai Government.

Very truly yours,


Dr. Katsuhide NAGAYAMA

Team Leader,
The Study Team for the Study on
Urban Environmental Improvement
Program in Bangkok Metropolitan
Area

**THE STUDY ON URBAN ENVIRONMENTAL IMPROVEMENT PROGRAM
IN BANGKOK METROPOLITAN AREA
FINAL REPORT**

VOL. 3: SECTOR PLANS AND TECHNICAL STUDIES

TABLE OF CONTENTS

CHAPTER 1:	URBAN LAND USE	
	1.1 General.....	1-1
	1.2 Existing Conditions.....	1-1
	1.3 Urbanization Potentiality by Open Space vs. Built-up Ratio.....	1-5
	1.4 Policy Directions and Planning Issues.....	1-6
CHAPTER 2:	ENVIRONMENT-INITIATIVE TRANSPORT SYSTEM	
	2.1 Transport Planning Issue: Escape From A Vicious Circle in Car Oriented Society.....	2-1
	2.2 Vision of Transport for the Next Two Decades : Realization of A Traffic Calmed City.....	2-4
	2.3 Goals Reflecting the Transport Vision : Environment - Initiative Transportation System in 2011.....	2-5
	2.4 How do we get there ? : Concepts of Strategic Projects / Actions towards the Goal.....	2-7
	2.5 Bangkok Urban Transport Structure Plan : BEIP Proposal.....	2-9
CHAPTER 3:	AIR QUALITY AND POLLUTION MITIGATION	
	3.1 General.....	3-1
	3.2 Assessment of Present Conditions.....	3-1
	3.3 Policy Directions and Planning Issues.....	3-28
	3.4 Planning Targets and Proposed Measures.....	3-47
CHAPTER 4:	WATER SUPPLY SYSTEM	
	4.1 General.....	4-1
	4.2 Assessment on Present Conditions.....	4-1
	4.3 On-going and Future Development Plans.....	4-6
	4.4 Policy Directions and Planning Issues.....	4-10
CHAPTER 5:	FLOOD PROTECTION AND DRAINAGE SYSTEM	
	5.1 General.....	5-1
	5.2 Assessment on Present Condition.....	5-1
	5.3 Policy Direction and Planning Issues.....	5-11
	5.4 Planning Targets and Framework.....	5-14
CHAPTER 6:	WATER QUALITY	
	6.1 General.....	6-1
	6.2 Water Quality Survey in the Major Khlong in BMA Area.....	6-1
	6.3 Investigation for Prediction of Water Pollution Loads in BMA Area....	6-4

CHAPTER 7:	SEWAGE SYSTEM	
	7.1 General.....	7-1
	7.2 Assessment on Present Condition.....	7-1
	7.3 Policy Direction and Planning Issues.....	7-2
	7.4 Planning Targets and Framework.....	7-11
CHAPTER 8:	SOLID WASTE MANAGEMENT SYSTEM	
	8.1 General.....	8-1
	8.2 Assessment on Present Condition.....	8-2
	8.3 Policy Direction and Planning Issues.....	8-10
	8.4 Planning Targets and Framework.....	8-16
CHAPTER 9:	HOUSING AND HUMAN SETTLEMENT	
	9.1 General.....	9-1
	9.2 Salient Features of Housing in Bangkok.....	9-1
	9.3 Current Housing Supply Market in Bangkok.....	9-5
	9.4 Policy Directions and Planning Issues.....	9-5
CHAPTER 10:	NOISE AND VIBRATION	
	10.1 General.....	10-1
	10.2 Assessment on Present Conditions.....	10-2
	10.3 Policy Directions and Planning Issues.....	10-6
	10.4 Planning Targets and Proposed Measures.....	10-7
CHAPTER 11:	MICRO STUDY	
	11.1 Objective and Scope of the Micro Study.....	11-1
	11.2 A Physical Model of Subcenter Zone Development.....	11-3
	11.3 Major Planning Considerations on Six Model Areas.....	11-6
	11.4 Urban Environmental Quality Up-grading from Urban Design.....	11-6
CHAPTER 12:	APPLICATION OF GIS TECHNIQUE FOR PLANNING	
	12.1 Introduction to GIS.....	12-1
	12.2 Concept of the Urban Environmental Information System.....	12-2
	12.3 System Configuration.....	12-4
	12.4 Data/Information Filed in GIS.....	12-4
CHAPTER 13:	GIS DATA PROCESSING	
	13.1 Hierarchical Structure of GIS Data Processing.....	13-1
	13.2 Primary Data Analysis.....	13-1
	13.3 Secondary Data Analysis.....	13-6
	13.4 Tertiary Data Analysis.....	13-7
CHAPTER 14:	RECOMMENDATIONS OF INFORMATION SYSTEM DEVELOPMENT	
	14.1 Development of Mapping System.....	14-1
	14.2 Utilization of GIS for Administrative Purposes.....	14-2

APPENDICES

APPENDIX 1: THE BEIP TRANSPORT SIMULATION MODEL

APPENDIX 2: THE BEIP SIMULATION MODEL FOR AIR POLLUTION

List of Tables

Table 1.1	Land and Use Statistics	1-3
Table 1.2	Subsidence Statistics by District	1-4
Table 2.1	BEIP Proposal for Secondary Roads inside The Central Area	2-13
Table 2.2	Major Component of Strategic Projects (1: Short Term)	2-19
Table 2.2	Major Component of Strategic Projects (2 : Medium Term)	2-20
Table 2.2	Major Component of Strategic Projects (3 : Long Term)	2-21
Table 3.1	Air Pollutants Emission in BMR, by Sector, 1992 1000 Ton/year	3-3
Table 3.2	Review of Present Situation of Atmosphere, 1994	3-5
Table 3.3	Emission Factors	3-14
Table 3.4	Total Amount of Trip Volume	3-14
Table 3.5	Estimated Results of Pollutants' Load Amount	3-15
Table 3.6	Fuel Consumption and Pollutants' Load of Power Plants	3-15
Table 3.7	Emission Factors for LPG Burning	3-16
Table 3.8	Total Emission from Household in BMA	3-16
Table 3.9	Seasons and Time-Zones	3-17
Table 3.10	Pollutant Source Model	3-17
Table 3.11	Ranking of Annual Arithmetic Average of Air Pollutant Concentration, Compared to The Ambient Air Standards	3-19
Table 3.12	Unit Pollutant Emission (G/Km/Person), Average of BMR	3-19
Table 3.13	Area of each Ranking (Km ²)	3-20
Table 3.14	Revised Items of Ambient Air Quality Standard, 1995	3-26
Table 3.15	Monitoring Stations by PCD, Jan. to Dec. 1994	3-26
Table 3.16	Network Examples of Environmental Administration	3-27
Table 3.17	Simulated Cases	3-29
Table 3.18	Emission from Vehicle and Area of Each Ranking by Cases	3-31
Table 3.19	Case Settings of Case 1 to Case 4	3-36
Table 3.20	Case Setting of Case 1 and Case 5 to Case 7	3-37
Table 3.21	Case Settings of Case 1 and Case 7 to Case 9	3-38
Table 3.22	Number of Buses, in Sep. 1995	3-40
Table 3.23	Number of Daily Passengers for Fiscal Years 1991 - 1995	3-40
Table 3.24	Existing Maintenance Program for Air Pollution	3-41
Table 3.25	Profit and Loss of BMTA (Baht)	3-42
Table 3.26	Fare Levels sufficient to Cover Operating Costs for Fiscal Year 1995	3-42
Table 3.27	Unit Pollutant Emission (G/Km/Person), Average of BMR	3-43
Table 3.28	Pollutants from Bus (Case 1) Ton / year	3-43

Table 3.29	Primary Energy Consumption per GDP of Thailand	3-43
Table 3.30	Final Energy Consumption in Thailand	3-44
Table 3.31	Petroleum Products consumption in Transportation Sector, Bangkok	3-44
Table 3.32	Thailand Ambient Air Standard, 1995 (2538), compared with WHO's Guideline and Japanese Standard	34-3
Table 4.1	Existing Water Supply System Capacity	4-3
Table 4.2	Water Production in Main and Separate Systems in 1995	4-4
Table 4.3	Summary of Water Consumption in 1991 - 1995	4-5
Table 4.4	Block-wise Water Production and Consumption (1991 - 1995)	4-5
Table 4.5	Water Consumption by Type of Water Users(1991 - 1995)	4-6
Table 4.6	List of Water Supply Development Projects	4-8
Table 5.1	Frequent Inundation Roads in BMA Area	5-6
Table 6.1	Summary of BOD Loading for Different Wastewater Sources	6.4
Table 6.2	Calculation of BOD Loading for Different Wastewater Sources	6-5
Table 6.3	Water Pollution Trend along The Chao Phraya River	6-11
Table 7.1	On-Going Sewage Projects in BMA Area	7-2
Table 7.2	Stage Development in Sewage Master Plan	7-3
Table 7.3	Plant Site Area per Treatment Capacity	7-4
Table 7.4	Prediction of Wastewater Amount in Sewage Zones (2011)	7-9
Table 7.5	Prediction of BOD Loading in Sewage Zones (2011)	7-10
Table 7.6	Sewered Area Coverage Ratio under Proposed Stage Development	7-12
Table 8.1	Trend of Solid Waste Generation Amount in BMA 1990-1995	7-10
Table 8.2	Solid Waste Amount and Unit Generation Rate in 1995	8-6
Table 8.3	Operation Condition of Solid Waste Collection Vehicles (1995)	8-7
Table 8.4	List of Collection Boats	8-9
Table 8.5	Prediction of Solid Waste Amount (2011)	8-15
Table 9.1	Number of Houses by Type in Bangkok	9-1
Table 9.2	Size of Houses in Bangkok 1990	9-2
Table 9.3	Tenure of Living Quarters in Bangkok in 1990	9-3
Table 9.4	Slums in Bangkok in 1990 and 1993	9-3
Table 9.5	Parks and Urban Amenities in Bangkok in 1993	9-4
Table 9.6	Housing Prices at Current Housing Supply Market in Bangkok	9-6
Table 10.1	Roadside Noise Level (LAeq, dB)	10-2
Table 10.2	Factory Related Noise Level (LAeq, dB)	10-2
Table 10.3	Railway Side Noise Level (LAeq, dB)	10-4
Table 10.4	Considerations on Standards and Regulations	10-5
Table 10.5	Roadside Vibration Level (90 Percentile, dB)	10-5
Table 10.6	Factory Boundary Vibration Level (90 Percentile, dB)	10-6

Table 10.7	Planning Targets and Proposed Measures	10-7
Table 12.1	List of Map Date Used for The EIS Development	12-6
Table 13.1	Land Use Statistics by District	13-3
Table 13.2	Sub-District Statistics Produced by GIS Data Manipulation (1)	13-4
Table 13.3	Sub-District Statistics Produced by GIS Data Manipulation (2)	13-5
Table 13.4	Criteria and Weighted Score for Urban Development Potential Evaluation	13-6

List of Figures

Fig. 2.1	Vicious Circle of Car-oriented Society	2-3
Fig. 2.2	BEIP Proposal for Bangkok Urban Transport Structure	2-10
Fig. 2.3	Public Transport and Green & Waterway Structure	2-11
Fig. 2.4	Future Secondary Arterial System and Mass Transit System in The Central Area	2-15
Fig. 2.5	Images of Cross Section of Secondary Road with Eco-Street	2-16
Fig. 2.6	Environment Initiative Transport Development Scenario	2-18
Fig. 3.1	Appearance Frequency of Atmospheric Stability 1988(2531)	3-2
Fig. 3.2	Air Pollutants Emissions Ratio by Sector, BMR, 1992	3-3
Fig. 3.3	Location of Monitoring Stations	3-4
Fig. 3.4	TSP, One Year Average 1994, General Stations	3-5
Fig. 3.5	PM-10, Max. of 24 HR AVE. 1994 Roadside Stations	3-5
Fig. 3.6	Variations of Air Quality Concentration, 1994(2537), General Stations	3-7
Fig. 3.7	Variations of Air Quality Concentration, 1994(2537), Roadside Stations	3-8
Fig. 3.8	Flow Chart of Simulation	3-12
Fig. 3.9	Flow Chart of Estimate Emission from Vehicles	3-13
Fig. 3.10	Flow Chart of Diffusion Simulation	3-16
Fig. 3.11	Scatter Diagram Comparing The Simulation Result (Estimate) and The Monitoring Result in 1994 (Actual), (CO, PPB)	3-18
Fig. 3.12	Ratio of Unit Pollutant Emission (Bus Emission per Passenger =1.0)	3-19
Fig. 3.13	Air Pollution Distribution (Present)	3-21
Fig. 3.14	Area of each Ranking (Km ²)	3-20
Fig. 3.15	Air Pollutant Simulation High Concentration Area (Top 5 Km ²) Case 1	3-23
Fig. 3.16	Estimated Ratio of Vehicles by The First Registered Year as of Dec. 31, 1995, BMA	3-29
Fig. 3.17	Emission from Vehicle, Compared with Case 1	3-32
Fig. 3.18	Area of Higher Than The Standards (Rank 5 + Rank 6)	3-32

Fig. 3.19	Air Pollutant Distribution (Case 5)	3-33
Fig. 3.20	Air Pollutant Distribution (Case 6)	3-34
Fig. 3.21	Air Pollutant Distribution (Case 7)	3-35
Fig. 3.22	Area of "Higher Than The Standards" and "Extremely Higher Than The Standard of Case 1 to Case 4 (Km2)	3-36
Fig. 3.23	Area of "Higher Than The Standards" and "Extremely Higher Than The Standard of Case 1 and Case 5 to Case 7 (Km2)	3-38
Fig. 3.24	Area of "Higher Than The Standards" and "Extremely Higher Than The Standard of Case 1 and Case 7 to Case 9 (Km2)	3-39
Fig. 4.1	Water Service Area Expansion Plan	4-9
Fig. 5.1	Existing Flood Protection Facilities	5-3
Fig. 5.2	Inundated Area in 1983	5-3
Fig. 5.3	Inundated Area in 1995	5-4
Fig. 5.4	Inundation - Prone Roads in BMA Area (1993-1995)	5-5
Fig. 6.1(1/2)	Water Quality Test Result in Major Khlongs and The Chao Phraya River (Wet Season)	6-3
Fig. 6.1(2/2)	Water Quality Test Result in Major Khlongs and The Chao Phraya River (Dry Season)	6-3
Fig. 6.2	Trend of Water Quality in The Major Khlongs of BMA Areas during 1990-95	6-7
Fig. 6.3	Water Quality Changes in Major Khlong in East and West Banks	6-8
Fig. 6.4	Trend of Water Quality in Wet Season & Dry Season in The Major Khlong of BMA Areas during 1990-1995	6-9
Fig. 6.5(1/2)	Annual Average BOD/DO in Major Khlongs (Wet Season-1995)	6-10
Fig. 6.5(2/2)	Annual Average BOD/DO in Major Khlongs (Dry Season-1995)	6-10
Fig. 6.6(1/2)	Annual Changes of DO in The Chao Phraya River	6-12
Fig. 6.6(2/2)	Annual Changes of BOD in The Chao Phraya River	6-12
Fig. 7.1	Sewage Development Zones in Sewage Master Plan	7-3
Fig. 7.2	Water Quality of The SUMIDA River and Sewage Construction	7-11

Fig. 7.3	On-Going Sewage Projects and Planned Sewage Zones	7-13
Fig. 8.1	Location of Solid Waste Treatment and Disposal Facilities	8-3
Fig. 8.2	Disparities between Solid Waste Collection and Generation	8-8
Fig. 8.3	Proposed Solid Waste Treatment and Disposal System in 2001	8-19
Fig. 8.4	Conceptual Design of Bang Khun Thian Off-Shore Disposal Site	8-21
Fig. 10.1	Locations of Monitoring Points	10-3
Fig. 10.2	Noise in Bangkok and Tokyo	10-4
Fig. 11.1	Locations of Micro Study Model Areas	11-2
Fig. 11.2	A Conceptual Urban Model of Subcenter Zone Development with 500 Thousands Population	11-5
Fig. 11.3	A Proposal for Design of "Eco-Boulevard" as an Axis of Subcenter Zone	11-4
Fig. 11.4	Lat Krabang Subcenter Zone Development	11-7
Fig. 11.5	Taling Chan Subcenter Zone development	11-8
Fig. 11.6	Khlong Toey Build-up Area Improvement	11-11
Fig. 11.7	Din Daeng Renewal Project	11-12
Fig. 11.8	Chao Phraya River-front Redevelopment	11-13
Fig. 11.9	Rattanakosin Conservation	11-15
Fig. 12.1	Concept of Urban Environmental Information System	12-3
Fig. 12.2	System Configuration	12-5
Fig. 13.1	GIS Analysis Procedure	13-2

Abbreviation

BEIP	The Study on Urban Environmental Improvement Program in Bangkok Metropolitan Area
BMA	Bangkok Metropolitan Administration
BMR	Bangkok Metropolitan Region
BMTA	Bangkok Mass Transit Authority
BOD	Biological Oxygen Demand
CBD	Central Business District
CO	Carbon Monoxide
DO	Dissolved Oxygen
DOH	Department of Highways, Ministry of Transport and Communications
DTCP	Department of Town and Country Planning
EEC	European Economic Community
ERTC	Environmental Research and Training Center
ETA	Express Transit Authority of Thailand
FAR	Floor Area Ratio
FIRR	Financial Internal Rate of Return
GDP	Gross Domestic Product
GIS	Geographic Information System
GPP	Gross Provincial Product
HBE	Home Based Education Trip
HBO	Home Based Others Trip
HBW	Home Based Work Trip
IDE	Institute of Developing Economies
IPCC	Intergovernmental Panel on Climate Change
JEA	Japan Environmental Agency
JICA	Japan International Cooperation Agency
LTD	Land Transport Department
MOF	Ministry of Finance
MOH	Ministry of Health
MOI	Ministry of Interior
MOID	Ministry of Industry
MOSTE	Ministry of Science, Technology and Environment
MOTC	Ministry of Transport and Communications
MRR	Middle Ring Road

MRTA	Metropolitan Rapid Transit Authority of Thailand
MSL	Mean Sea Level
MWA	Metropolitan Waterworks Authority of Thailand
NEPO	National Energy Policy Office
NESDB	National Economic and Social Development Board
NHA	National Housing Authority
NIIB	Non-Home Base Trip
NO	Nitrogen Monoxide
NO ₂	Nitrogen Dioxide
NO _x	Nitrogen Oxides
NPV	Net Present Value
OCMRT	Office for Commission of Management for Road Transport
OEPP	Office of Environmental Policy and Planning
ORR	Outer Ring Road
PCD	Pollution Control Department
PCU	Passenger Car Unit
PM	Particulate Matter
PM-10	Particulate Matter Smaller than 10 μ
PPP	Polluter-Pay-Principle
PWD	Public Works Department, Ministry of Interior
RID	Royal Irrigation Department
SO ₂	Sulfur Dioxides
SO _x	Sulfur Oxides
SPM	Suspended Particulate Matter
TDRI	Thailand Development Research Institute
TOE	Ton Oil Equivalent
TSP	Total Suspended Particulate
UNEP	United Nation for Environmental Program
UTDM	Urban Transport Database Management Project
VAT	Value Added Tax
WHO	World Health Organization
WMA	Wastewater Management Authority

CHAPTER 1: URBAN LAND USE

1.1 General

Bangkok Metropolitan Area is located on the deltaic lowland which is formed by the Chao Phraya River. Topographically, elevation of this lowland is showing from 1 to 2 m above sea level and the climatic condition of this area is belonging to the tropical monsoon which has clear rainy and dry season. These physical background of the Bangkok city greatly affects on the urban development and management.

Urbanized area of Bangkok city has been greatly changed and extended in these ten years because of the remarkable growth of Thai economy. Construction rush of many high-rise buildings and new highway networks and housing development have taken place. Growth of the urban area is still continuing year by year towards suburbs of Bangkok and potentially high productive agricultural land has been changed to housing, industrial estate and urban infrastructure development.

Urban environmental problems such as air pollution derived mainly from traffic jam, degradation of water quality of river and canals, ground subsidence and flooding in the urbanized area and so on, have become important subjects to be solved. These environmental problems are taking place in Bangkok within relatively short time and each phenomena is thought to be originated from the huge concentration of population and economic activities.

Urban and related environmental problems are usually caused as an overlapped manner by each other. Degradation process of the environmental quality needs a long time for the accumulation of pollutants, however, the phenomena appears suddenly and critically. These urban environmental problems sometimes take a form of disaster and affect even on the human life directly.

Therefore, well coordinated and organized preparation for the urban land use planning for Bangkok city should be discussed to protect and improve the existing urban environmental conditions. In this chapter, specifically, characteristics of urban land use in BMA are described.

1.2 Existing Conditions

(1) Extension of Urbanized Area in Bangkok

Thai Government has prepared many regulations for the proper development, building and land use control for the BMA in these 20 years to direct and manage the urban development. According to the historical data, urbanized area of Bangkok was less than 100 km² only at the end of 1950s. At the beginning of the 1970s, urban area extended to about 200 km² and it became 345 km² in 1980.

Existing land use map of the whole BMA area was compiled by Mapping Division of City Planning Department in 1995 based on interpretation of aerophotography which was taken in 1993. This map which was classified into thirteen(13) land use items was digitized and stored into the BEIP-GIS as one of the digital files. After the completion of data input, area of each land use categories are measured and listed by district in

table format (see Table 1.1). According to this data, total built-up area (or urbanized area) of BMA in 1993 is calculated at 541 km². This means that 34 % area of total BMA is covered by urban land use. On the contrary, BMA still has a sizable area of natural type land use. Agricultural area is occupied totally 1,038 km² (66 %) of BMA.

(2) Intensification of Urban Land use of Bangkok

Intensification of urban land use in Bangkok city has been taking place mainly since 1990s according to the building permission data prepared by City Planning Division and Building Control Division of BMA.

Building data of 1980-1987 is showing that number of buildings of 8-12 floors are 257, 13-20 floors are 135, 21-30 floors are 36 and over 31 floors are 6. Total number of high-rise buildings at 1987 was 434 sites. On the other hand, building permission data during 1990-1995 provided by Building Control Division is showing that number of high-rise building permission of 8-12 floors are 2092, 13-20 floors are 541, 21-30 floors are 543, and over 31 floors are 333 sites. Total number of permissions are 3509. It is very clear that these high-rise buildings having more than 31 floors have been constructed or being constructing within these 5 or 6 years. The main type of use of these buildings are condominium, office use, and hotel and so on. Construction of the large size building in the central area of Bangkok city is one of the factors of congestion.

(3) Road and Soi Ratio

Existing road network data based on 1:20,000 and 1:50,000 topographical map is also digitized and stored into BEIP-GIS and district boundary data is overlaid on this road network map. Total length and density of the existing road by district are calculated and listed in Table.

Total length of the road in BMA measured by BEIP-GIS is 7,770 km including every type of road such as expressway, secondary or tertiary road and soi. In Bangkok, soi network which is connected with major road is densely developed in the urbanized area and total length of soi is calculated at 6,180 km. This figure means that approximately 80 % of the total length of the existing road is occupied by soi.

Road density is calculated by each district and sub-district dividing total length of road by area of district or sub-district. In general, Din Daeng has the highest value of road density at 158 m/ha, and Pom Prap Sattruphai has the next high value at 137 m/ha and so on. On the contrary, the lowest value of road density is seen in Nong Chok at 9 m/ha and the second lowest is seen in Ratburana.

Mean value of the road density in Bangkok is 49.2 m/ha and these data are shown in the last column of the Table

(4) Distribution of Natural Constraints

Flooding and land subsidence are the main natural constraints for urbanization in BMA. In BEIP-GIS, flooded area by 1983 flood and simulated land subsidence map are digitized respectively as a basic data. Administrative boundary data is overlaid on these maps and flooded area and simulated land subsidence area by depth are calculated by each district. Results of calculation are listed in Table 1.2.

- Total flooded area by 1983 flood in BMA is calculated at 424 km² and those districts such as Phra Khanong, Lat Phrao, Suan Luang, and Bang Kapi are inundated more than 80 % area of the district. Khlong Toei, Huai Khwang, Jomtong and Prawet district were inundated 54%-68% area of their district.

Table 1.1 Land Use Statistics

DISTRICT NAME	HIGH DENSITY	MID DENSITY	LOW DENSITY	COMMERCIAL	INDUSTRIAL	WAREHOUSE	GOVERNMENTAL	AGRICULTURE	CONSERVATION	PARK	SCHOOL	RELIGION	WATER BODY	TOTAL
Bang Kapi	1.354	14.175	10.415	2.905	0.398	0	0.610	13.434	0	1.584	0.199	0	0	45.074
Bang Khen	0	7.300	8.077	0.836	0	0	8.399	53.256	0	0	0.037	0.438	0	78.343
Bang Kho Luem	0	5.434	0.151	0.552	0.090	0.388	0.115	0.312	0	0.130	0.033	0.100	1.153	8.458
Bang Khun Thian	0	9.663	10.963	0.187	0.910	0.040	0.018	134.339	0	0.011	0.116	0.103	0.203	156.553
Bang Phlat	0	4.089	4.222	0.959	0.038	0	0.016	1.454	0	0	0.085	0.048	0.947	11.858
Bang Rak	0	0.036	0	3.372	0	0	0.274	0	0	0.014	0.205	0.017	0.126	4.044
Bang Sue	7.415	1.289	0.851	0.746	0.693	0	0.161	1.211	0	0	0.091	0.012	0.596	13.085
Bangkok Noi	0.615	3.315	3.379	1.179	0	0	0.882	1.983	0	0	0.168	0.210	0.566	12.297
Bangkok Yai	0.085	3.680	0.157	0.864	0.128	0	0.137	0.653	0	0	0.173	0.175	0.189	6.241
Bung Kum	0.985	18.177	7.535	0.389	0.849	0	0.051	33.332	0	1.736	0.065	0	0	63.119
Chatu Chak	3.519	16.606	2.219	1.368	0.212	0	4.720	0.732	0	2.678	0.419	0	0.005	32.478
Din Daeng	0	6.493	0	1.025	0	0	0.483	0	0	0.128	0.349	0	0	8.478
Don Muang	0.035	15.245	6.451	0.525	0	0	15.586	20.284	0	0	0.447	0	0	58.573
Dusit	0.138	2.674	0.018	0.272	0.144	0	5.185	0	0.897	0.824	0.280	0.119	0.749	11.300
Huai Khwang	0	5.693	3.397	1.227	0	0	0.060	5.925	0	0	0.018	0	0	16.350
Jomtong	0.011	7.869	3.347	0.906	0.393	0	0.050	10.359	0	0	0.097	0.283	0.439	23.754
Khlong San	0	3.900	0	0.984	0.171	0.047	0.138	0.016	0	0	0.124	0.056	0.579	6.015
Khlong Toei	2.309	16.533	0.285	3.147	0.058	0.872	2.590	0.544	0	0.319	0.348	0	0.949	27.954
Lat Phrao	0.521	10.175	5.936	0.620	0.066	0	0.050	11.114	0	0	0.062	0	0	28.544
Lakrabang	0.153	2.314	7.012	0	2.088	0	0	116.979	0	0	0.027	0.020	0	128.593
Minburi	0.052	3.323	7.202	0.529	1.907	0	0.107	163.895	0	0	0.254	0	0	177.269
Nong Chok	0	0.452	5.656	0	0	0	0	234.948	0	0	0.000	0	0	241.056
Nong Khaem	0	5.071	9.530	0.143	0.746	0.012	0.490	30.622	0	0	0.138	0.203	0	46.955
Pathumwan	0.120	0.375	0.024	3.093	0	0	1.709	0.073	0	1.265	1.355	0	0.066	8.080
Phasi Charoen	0.006	16.748	3.523	1.467	0.436	0.196	0.101	33.286	0	0	0.430	0.254	0.175	56.622
Phaya Thai	0	7.989	0	0.289	0	0	0.529	0	0	0.112	0.061	0	0.093	9.073
Phra Khanong	1.424	23.853	0.767	0.789	0.239	1.356	0.332	3.738	0	0	0.520	0	0.924	33.942
Phra Nakhon	0.196	0.244	0.066	2.065	0.017	0	0.778	0	0.294	0.360	0.333	0.442	0.601	5.396
Pom Prap Sattrophajit	0.181	0.054	0	1.569	0	0	0.240	0.017	0	0	0.154	0.171	0.058	2.444
Prawet	0	13.125	11.399	0.921	0.814	0	0	38.497	0	0.579	0.024	0	0.117	65.476
Ratburana	0.387	10.048	2.129	0.993	0.546	0.464	0.279	30.235	0	0.083	0.248	0.187	1.126	46.725
Ratchathewi	0.495	1.375	0.466	1.467	0	0	2.605	0.167	0	0.140	0.453	0	0.057	7.225
Samphanthawong	0	0	0	1.033	0	0	0.055	0	0	0	0.026	0.123	0.172	1.409
Sathon	0.003	5.020	0	0.814	0.140	0.098	0.594	0.096	0	0.018	0.298	0.039	0.131	7.251
Suan Luang	0	9.272	4.201	0.492	0.025	0	0.017	6.090	0	0.121	0.247	0	0.276	20.741
Taling Chan	0	5.435	15.712	0	0	0	0.026	65.153	0	0	0.221	0.300	0.755	87.602
Thonburi	0.143	5.202	0.107	1.348	0.072	0.114	0.140	0.200	0	0	0.136	0.194	0.477	8.133
Yan Nawa	1.166	6.957	0.229	0.595	0.087	0.879	0.214	0.526	0	0.025	0.099	0.054	1.574	12.405
Total	21.333	269.203	135.426	39.670	11.267	4.466	47.741	1013.470	1.191	10.127	8.370	3.548	13.103	1578.915

Unit : km

Table 1.2 Subsidence Statistics by District

District	< -50 (cm)	-50 to -75 (cm)	-75 to -100 (cm)	-100 to -125 (cm)	-125 to -150 (cm)	-150 < (cm)	Total
Bang Kapi	0	13.084	20.942	11.051	0	0	45.076
Bang Khen	0	47.539	30.802	0	0	0	78.341
Bang Kho Laem	0	0	8.459	0	0	0	8.459
Bang Khun Thian	0	72.876	27.185	14.735	36.267	5.490	156.552
Bang Phlat	0	0	8.652	3.205	0	0	11.857
Bang Rak	0	0	2.197	1.846	0	0	4.043
Bang Sue	0	1.140	11.947	0	0	0	13.087
Bangkok Noi	0	0	0.743	11.555	0	0	12.299
Bangkok Yai	0	0	0	6.241	0	0	6.241
Bung Kum	0	62.773	0.346	0	0	0	63.119
Chatu Chak	0	1.438	31.040	0	0	0	32.478
Din Daeng	0	0	3.499	4.979	0	0	8.478
Don Muang	0	31.659	26.911	0	0	0	58.571
Dusit	0	0	9.305	1.998	0	0	11.303
Huai Khwang	0	0	1.833	14.517	0	0	16.350
Jomtong	0	0.984	15.992	6.776	0	0	23.752
Khlong San	0	0	0.325	5.691	0	0	6.015
Khlong Toei	0	0	9.832	18.122	0	0	27.954
Lat Phrao	0	13.643	14.901	0	0	0	28.543
Latkrabang	0	13.660	36.739	77.555	0.637	0	128.593
Minburi	14.862	119.990	21.023	19.414	1.979	0	177.268
Nong Chok	133.243	62.370	39.318	6.126	0	0	241.056
Nong Khaem	0	0.462	6.414	11.996	28.087	0	46.959
Pathumwan	0	0	5.996	2.084	0	0	8.079
Phasi Charoen	0	0	3.175	15.076	38.370	0	56.621
Phaya Thai	0	0	9.009	0.064	0	0	9.074
Phra Khanong	0	0	21.272	7.417	5.253	0	33.941
Phra Nakhon	0	0	0	5.394	0	0	5.394
Pom Prap Sattruphai	0	0	0	2.445	0	0	2.445
Prawet	0	28.534	20.413	12.430	4.098	0	65.476
Ratburana	0	0	19.247	16.766	8.073	2.636	46.722
Ratchathewi	0	0	4.496	2.727	0	0	7.223
Samphanthawong	0	0	0	1.409	0	0	1.409
Sathon	0	0	-7.106	0.142	0	0	7.249
Suan Luang	0	3.629	14.321	2.792	0	0	20.742
Taling Chan	0	0	25.294	48.262	14.047	0	87.603
Thonburi	0	0	1.322	6.812	0	0	8.133
Yan Nawa	0	0	12.263	0.142	0	0	12.405
Total	148.105	473.780	472.318	339.769	136.811	8.126	1578.910

- According to the simulated land subsidence data by the year 2017, area of less than 50 cm is calculated at 148 km² (9.3%), and this area is located in the north-eastern part of BMA such as Minburi and Nong Chok. Area of 50 cm-100 cm subsidence is calculated at 946 km² (60%) and area of more than 100 cm subsidence is 485 km² (31%) of BMA. More than 85% district area of the Bangkok Yai, Khlong San, Bangkok Noi, Phasi Charoen, Huai Khwang and Nong Khaem is covered by over 100 cm contour line of subsidence.
- IN BEIP-GIS, these flood and subsidence data map are overlaid again and compiled as a natural constraints map. Based on this map, it is pointed out that Huai Khwang, Khlong Toei, Bangkok Noi and Phra Khanong districts are the area of both higher potentiality of land subsidence and flooding.

1.3 Urbanization Potentiality by Open Space vs Built-up Ratio

Area of existing land use type by district and sub-district is calculated and compiled into table format. Open space ratio is calculated from the existing land use map and listed in Table 12.2 and 3 of Chapter 12. Population data, transportation data such as bus service or accessibility to road network and so on that are showing the existing conditions of the urban facilities in BMA are also input into BEIP-GIS. Based on these basic data, especially on open space/vs built-up ratio and population density by sub-district, future urbanization potentiality is described rather qualitatively.

(1) Sub-district group of more than 90 % built-up ratio with limited open space

This group of sub-districts are mainly distributed in old urbanized area in Bangkok. In these area, accessibility to the main road network or commercial center is excellent and basic services of urban facilities are also excellent.

Average population density in this group is 352 person/ha and this value is almost equal to the density of built-up area such as 365 person/ha.

In extremely populated area is showing the density more than 900 person/ha. Another characteristics of this group is that the sub-district area is relatively narrow. For the instance, area of Si Phraya is 0.76 km², Maha Phuttharam is 0.65 km², and Thung Phaya Thai is 2.51 km² and so on. Because of the high density of population and limited open space ratio, urbanization potentiality seems to be limited. In these area, future direction of urbanization should be a combination of intensification of land use and improvement of urban environment by redevelopment.

(2) Sub-district group of 76-89 % built-up ratio

This sub-district group are distributed almost the same district mentioned above and the basic characteristics of the population density, accessibility to the urban facility services and road network are almost the same level. Area of these sub-districts are also very narrow and the potentiality of future urbanization is also limited.

(3) Sub-district Group of 51-75 % built-up ratio

In this group, population density is showing the average level of total BMA. Population density of the thirteen(13) sub-district in this group is 148 person/ha.

Average density of those sub-district which have enough space such as Thong Song Hong and Hua Mak are 103 and 143 persons/ha respectively in built-up area. Accessibility to the urban facilities in this group is showing less low level and future urbanization potentiality seems to be high in several sub-districts like Hua Mak and Thong Song Hong.

(4) Sub-district group of less than 50 % built-up ratio with enough open space

This group of sub-districts are distributed in the fringe area of existing urbanized area. Area of each sub-district is relatively large and the average population density is 146 person/ha in built-up area and 49 person/ha in total. Accessibility to the urban facilities is also relatively low level in general, however, those sub-district such as Chim Phli, Khlong Thanon, Khanna Yao, Saphan Sung, Bang Khae Nua, Minburi and Nong Khang Phlu are not only having enough space but also higher potentiality of urbanization. In these area, detail urban infrastructure development plan should be prepared as a guideline to keep the higher standard of future urbanization.

1.4 Policy Directions and Planning Issues

(1) Necessity of Basic Data Preparation

It is, first to point out that the accessibility and availability of the most up to dated map data and information for land use analysis in the study area were relatively difficult. Especially the availability of the large scale topographical map is quite limited. For this study, 1:4,000 scale map was provided to Study Team by PWD, however, the contents of this map series were already out of date because of this maps were compiled in 1987 by JICA technical assistance Program. For the detail planning, management and control of urban land use, basic information on building construction and use, floor area ratio and coverage ratio, land titles, and location of urban facilities such as pipeline network of water supply and so on, should be prepared based on the most up to dated large topographical map as the baseline data. In addition to those data, another thematic maps on the latest land use, infrastructure distribution and natural condition etc., should be prepared by relevant agencies in most appropriate map scale. Basic data survey and preparation of the urban development planning of BMA should be carried out in well coordinated manner, and accessibility to those data should be guaranteed for comprehensive understandings of the urban conditions among relevant agencies.

(2) Measures for Water Management

Treatment of both surface and ground water in BMA area is a key issue to keep the higher environmental quality for living. From the land use planning point of view, it must be necessary to fully consider how to take a harmony with water.

As the concentration of large population and rapid expansion of urbanized area in Bangkok, deltaic lowland that is basically utilized for agriculture and fish ponds have been altered to artificial land use such as buildings, roads, housings and industrial estate. These land uses always cover the land surface by pavement. This alteration of natural condition directly effects on the run-off ratio of the surface water. As a result of these change of environmental condition, heavy rainfalls in rainy season are sometimes causing flood in the relative lowland area and flood water takes the form of stagnation.

Construction of flood protection dike, watergate and pumping station for drainage of flood water was the major issues of metropolitan area of Bangkok in past years and sizable investment have been made for the development of those infrastructures. Extensive flooding has not caused in Bangkok since 1983 due to the effects of flood protection facilities. But in 1995, Thonburi area and outside area of flood protection dike in eastern part of Bangkok were suffered from severe flood disaster. Because of the limitation of available financial resource for the flood mitigation facilities, priority area to be protected or limitation area of urbanization should be discussed. At present, 17,000 ha of non-urbanized area or open space area is distributed between the Kings Dike and Inner Dike. If this area is developed by 147 person/ha which is an average density in eastern part of Bangkok, another 2,500,000 persons can be accepted. In the western bank area of Chao Phraya River, 30,800 ha of open space is measured based

on existing land use map of BMA. BMA still has an enough land resource at this moment, therefore, urbanization area should be controlled within flood free area. Enough space should be designated for the development of urban road network, park, drainage canal and so on.

(3) Land Subsidence and Affection by Global Change in Environment

Attention should be also paid on changes of environment in the long term point of view. The "Green House Effect" caused by increase of CO₂ will raise the sea level at the rate of 0.5 to 1.0 cm annually. It is forecasted that the present sea level will raise 0.5 to 1.0 m globally. The raise of sea level will make serious damages in the deltaic area of lower Chao Phraya River.

Another important factor related with the change of sea level is land subsidence. The area and volume of subsidence are already mentioned in previous section. These land subsidence and sea level raise will intensify the flood disaster. In Bangkok, 320 ha of 0 m area in elevation had already recognized in 1987 and these low lying area must be extended due to the land subsidence in these ten years.

These inter-related phenomena should be well considered to seek necessary and effective measures for future urbanization of Bangkok.

(4) Preparation and Up-dating of Regulations for Land Use Control

Existing regulations for land use control should be improved and updated to regulate the urban development. The land use zoning system is the basic guideline for land use, however, methodology for zoning system should be improved based on the detail data analysis which is supported by modern information technique such as GIS.

Chapter 2 : ENVIRONMENT-INITIATIVE TRANSPORT SYSTEM

2.1 Transport Planning Issue: Escape From A Vicious Circle in Car Oriented Society

In 1996, one of the critical environmental problems in Bangkok is poor air quality, especially that along the major roadsides. The air pollutant emission at roadsides is dependent on volume and speed of the vehicular traffic. Emission factors of vehicle become significantly increase due to decrease of speeds. Rapidly increasing vehicular traffic, with their low speeds, is contributing to a massive increase of total amount of pollutant air. Accordingly, the people in Bangkok would have a common understanding that the heavy traffic jam on roads is the main cause of the environmental problem.

It is true that road transport is a major contributor to poor air quality in Bangkok, however, it was found in the BEIP study that traffic congestion itself is not a root cause of the environmental problem. We should address more fundamental issues forming the present society towards the next transport plan. The policy of "environment initiative transport system" discussed in Chapter 10.4 of Volume 2 should be a guideline for our future planning activities.

First, it should be recognized that we have been enjoying urban economic growth and urban life of Bangkok based on a "Car-Oriented Society" for these two decades. In the car-oriented society, mobility of cars is given the highest priority rather than mobility of the people. Due to this principle (car first), development of urban and road infrastructure have been proceeded. That is, where road traffic congestion is identified, more road spaces have been provided to accommodate vehicular traffic demand. But, this is a too simplistic approach. It needs to be recognized that we will no longer able to enjoy them based on the car-oriented society.

It is recognized that there is a vicious circle in the car-oriented society of Bangkok as described in figure 2.1. Given more road space, people will be encouraged to own their private cars and motorcycles along with up-lifting of their income levels (this phenomenon is clearly shown in the transport simulation of case 2 and 8). Therefore, another traffic congestion will be added to the road segments. This eventually causes negative impacts on traffic flow of public transport (especially on buses) as well. For example, high occupancy vehicles (HOV) have been allowed to enter the bus lanes recently in peak hours. This type of policy is depriving an advantage of public transport. Then, again people are encouraged to have their private vehicles.

This vicious circle has been further worsened by some sub-social system shown in Figure 2.1. Among the sub-social systems, there are government subsidy to the bus operator, infrastructure development in the past (for example, high standard motorway of radial type such as FES and Dong Muang tollway), and several technical problems such as signal controlling.

For example, urban growth in the past has been led by transport infrastructure development e.g. the urban development at the end of the second stage expressway or the ribbon development along major road corridors, which have been adding longer vehicular trips on the major corridor.

In summary, there exists a unorganized energy-consuming cycle in the car-oriented society of Bangkok. In this context, planning issues should be found in "How to escape from this vicious circle" and/or "How to change the "Car-oriented Society" into a deferent system.

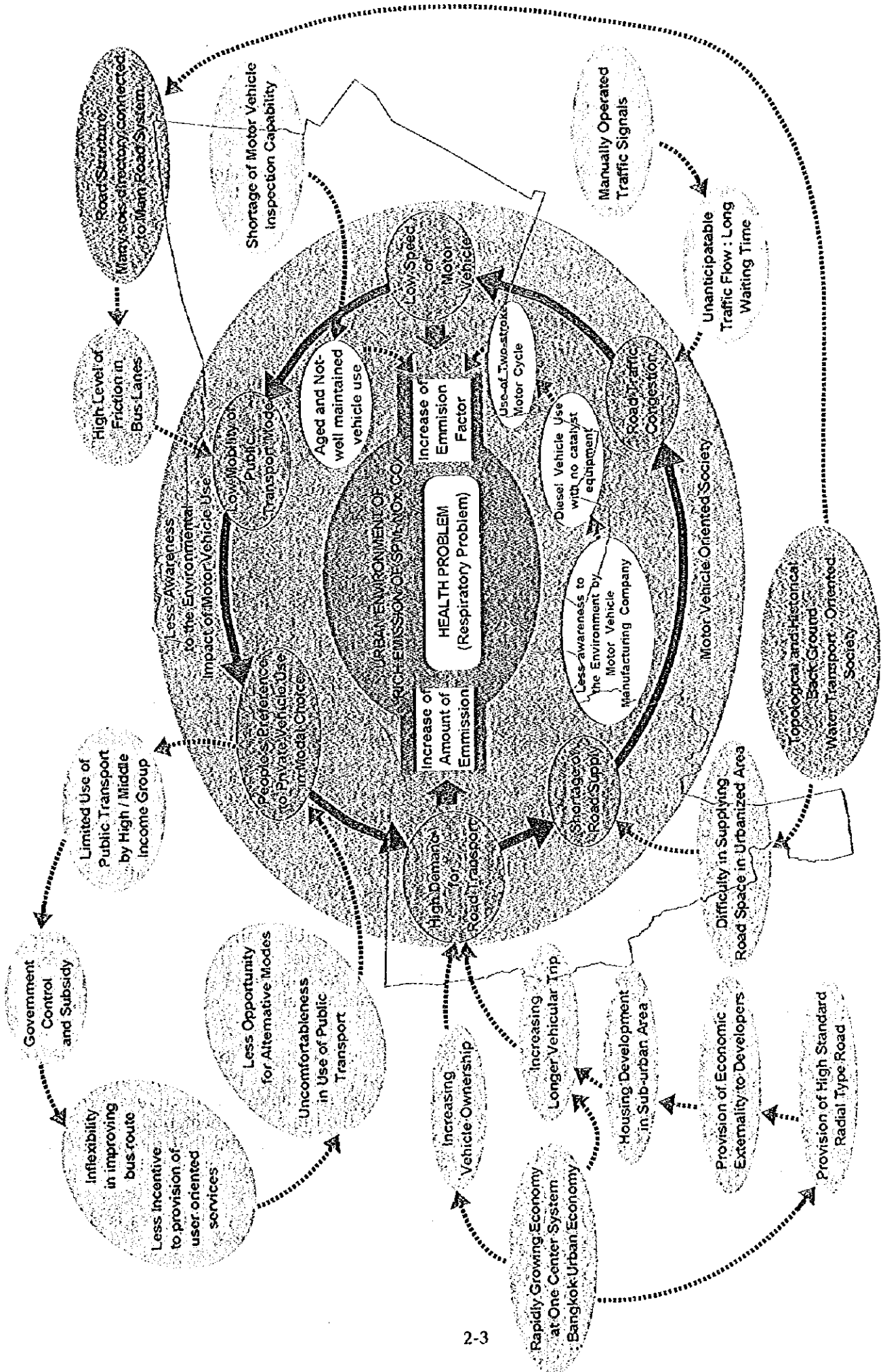


Figure 2.1 Vicious Circle of Car-Oriented Society

2.2 Vision of Transport for the Next Two Decades : Realization of A Traffic Calmed City

A challenge is now to re-direct such the unorganized energy-consuming system in a vicious circle into a new transport vision presented here, where people and transport infrastructure driven urban development can coexist for betterment of the whole community.

This vision is also consistent with the city development philosophy, that is currently being pursued in other major cities, represented by "Eco-City" Development.

Vision of Transport towards the Next Two Decades

1. A "Traffic Calmed City" based on safe and friendly environment for non-motorized transport would be created;
2. A transport system supportive enough of "Eco-city" development would be developed; and
3. Bangkok would be inhabited by the people having improved awareness to the environment in modal choice.

The urban structure and transport infrastructure need to be developed in an integrated manner to achieve an environmental / ecological balance. This implies that the planning of transport infrastructure should be aimed at improving the mobility and accessibility of people rather than those of motor vehicles, which is termed "Traffic Calming".

In this context, it is necessary to change from a motorized-private-vehicle-advantageous society to a public-transport-orientated society at first. Public transport systems which have less impact on urban ecology should be given a higher priority under the limited resources available to spend on transport infrastructure.

The less road space in Bangkok in comparison to other major cities is often quoted as a reason of the severe traffic congestion. This is partially the case, however, if public transport adequately plays a larger role in movement of people, the traffic congestion problem may not worsen even under such a condition.

The less road space in Bangkok might be recognized as a rather favorable situation for the urban ecological system simply because paved spaces are limited and thereby cars on the roads are limited by the limited space. At the same time, it is recognized that this situation has been providing a good chance to develop and promote public transport system including exclusive bus operation and mass rapid transit system, because there is a disadvantage for vehicle users, that is traffic congestion. On the contrary, advantage of public transport can be much more emphasized through improving inter-modal facilities and giving priority to public transport in use of road space.

The traffic calmed city, at the same time, calls for people in Bangkok to become more aware of their environment and their way of living. This is an education process to support the improvement of public transport, so that public transport becomes an effective alternative to the private vehicles. People will need to be aware of the impact of their modal choice on the environment when there are alternatives. We should always remind that motor vehicles have the largest negative impact on the environment among the currently available forms of land transport.

Finally, in order to re-direct our energy to the above vision, a set of key initiatives is derived as follows:

Key Strategic Initiatives towards the Transport Vision of Bangkok in 2011

<i>For Vehicle Owners:</i>	
1	Reduce need and use of private vehicles in urban life
2	Promote ridership of public transport systems including buses and MRTs and non-motorized modes
<i>For Commuters:</i>	
3	Improve or develop Inter-modal facilities among those systems;
4	Restrict private vehicle use in CBD where public transport modes are readily available
<i>For All Residents</i>	
5	Create a safe environment for non-motorized mode users, pedestrians and residents

2.3 Goals Reflecting The Transport Vision : Environment - Initiative Transportation System in 2011

(1) Modal Share of Public Transport

Applying a mixed-policy suggested by the simulation analyses (Case 7, 9, 10), approximately 70% of all peak hour person travel will be able to be made by public transport mode. This is the most ideal situation to be the planning target. At present, about 40 % of daily person trips are made by public transport mode and 45% of those are made by private modes (car and motorcycle). Assuming the target figure of 70% is realized today, more than 60 % (4.6 million person trips a day within BMA) of private-vehicle-trip must be shifted to public transport mode. If these 4.6 million trips are accommodated by only bus transport services, the target seems to be very difficult to achieve. A simple calculation : "40 person x 10 times operation a day x 11,500 buses = 4.6 million person trips" indicates that at least the number of buses needs to be doubled now. In this context, the Mass Rapid Transit Master Plan system should be promised in the year 2011.

(2) Multi Modal Corridor

Through developing the sub-centers, a "Multi Nucleus" System will be created in Bangkok. In order to efficiently induce the multi nucleus system, the "Multi Modal Corridor" System, consisting of multiple transportation facilities such as major arterial roads, medium / mass transportation, and expressways, is required. The Multi Modal Corridor should have important functions as follows;

- The system gives the outlying activity centers (sub-centers and major local activity centers) direct and reliable accessibility to the central area
- The system gives alternatives to the people in modal choice
- The system gives higher priority to public transport users

(3) Integrated Public Transport System and Quality Pedestrian Environment

Special emphasis needs to place on the integrated improvement of public transport system, being consist of MRTs, public and private buses, waterways and taxis. Development of inter-modal facilities is a key for encouraging the people to use public transport modes.

Recently the new Mor Chit bus terminal project has been proceeded by a private company, where three deferent public transport systems come across : BERTS, BTSC, and Buses. Even there exist deference among the implementation schedule of each transport system, this type of facility should be designed in an integrated manner to have functions as follows;

- The facility should have enough capacity for future transfer demand and should provide high and quality access between deferent systems;
- The facility itself can be an attraction center such as a shopping center, an aquarium, and a theater to ensure vital financial performance for private sectors. These attractions are important initiators to generate trips on holidays, contributing financial performance of public transport system.

(4) Road System

A simple "More Roads" policy should, of course, be explored. However, there is an important planning view, that is "How the new road construction will improve or contribute to better public transport system in Bangkok"

Necessity of "secondary road" has been discussed in the context of solution for so-called "Super Block" problem. In BEIP, however, new road construction addition to the 8th plan project will be allowed only when those are beneficial to promotion of public transport modes and development of the sub-center. Necessary spaces should be reserved for these type of road construction.

Besides, of the 8th Plan Project, the Outer Ring Road will be effective to make the movement of freight in and around Bangkok more efficient and more rational. And, a new arterial ring road to be formed with the ETA expressway should be facilitated to provide a structural backbone of future urbanization and land use policies in Bangkok.

(5) Traffic Management

Recently introduced Area Traffic Control (ATC) system should be fully operated as soon as possible. The system has been working in night-time when the traffic congestion is not severe, but not be allowed to operate in day-time. By this time, the most of capability of the ATC has not been made. Instead of the ATC, many policemen are allocated at the intersections to control the traffic. This is simply meaning a double investment. Enacting the ATC, policemen should be re-allocated to other function such as watching vehicles on exclusive bus lanes.

In summary, target for transport sector in the year 2011 is established as follows:

Bangkok Transport Target in 2011

- 70% of all peak hour person travel by public transport in the year 2011
- Much Development of Quality Pedestrian Facilities
- Completion of Mass Transit Master Plan
- Development of Multi Modal Corridor
- Development of Integrated Public Transport System
- Development of Hierarchical Road System which is supportive of Sub Center development and use of the MRTs
- Implementation of the full ATC and Area Restraint

2.4 How do we get there ? : Concepts of Strategic Projects / Actions towards the Goal

In order to achieve the target, eight (8) key strategic projects / actions are proposed in addition to the 8th Plan Projects. Integrated efforts should be made to implement them in coordination with relevant agencies.

Strategic Project 1: Roads for Pedestrians

Access to public transport

The "soi" is an unique resource for re-organizing Bangkok as a pedestrianized city. As they are connected to major arterial roads, they can be developed as good access roads when public transport systems are facilitated along the major roads.

Exclusive space for pedestrians

There are many examples in cities where several roads be closed to create open space exclusively for pedestrians and revitalize the areas. This policy may be applied for the areas Silom Rd. between Soi Convent for example and the new road along Khlongs.

These pedestrian roads projects should be beneficial for public transport users and residents, thereby creating favorable circumstances for a "public transport - oriented society".

Strategic Project 2: Improvement of Mobility in Urban Activity Centers

Once people enter centers by public transport, they need to also use public transport again or walk for the next trip within the center. Without such convenient modal facilities in the central busy areas, it will fail to attract people to use public transport. Both of "Accessibility to the central busy areas" and "Mobility in the central busy area" should be realized at the same time.

Additional secondary roads are necessary to create public transport priority area where buses and MRTs are to be given advantages. Improvement of major- and minor-secondary roads is very important to encourage people to use public transport through providing convenient access to MRT stations, job places, among others.

Strategic Project 3: Revitalization of Water Transport with Green -Water Network

Currently, the water transport in Bangkok has a small modal share in Bangkok. However, in the morning peak hour, "express river boats" are full. The limitation for increasing the service level is not the number of boats but rather the capacity of piers. Piers should be improved together with inter-modal facilities. At the same time, the landscape along Khlongs is a very unique resource of Bangkok. This should be restored to be more natural and friendly system.

Strategic Project 4: "Eco-Street" Development for Non Motorized Transport

Throughout Bangkok, there is a water system of small khlongs. Providing paths along the khlongs, they are capable of function as a network for bicycle paths and walkways. Bangkok is a very flat city, thereby it is ideal for the development of this system. A comfortable Non Motorized-transport System with beautiful scenes should be restored in the unique city and for the next generation.

Strategic Project 5: Give Priority to Buses : Enforcement of Exclusive Bus Lane

Contra bus lane and bus priority lane system, which is enacted in part of the central area, should be enhanced. At present, buses are obstructed by cars (HOV and cars coming from "soi") and motorcycles coming into the bus lane even on bus priority lanes. This situation should be improved urgently rather than making efforts on controlling traffic signals.

There are several corridors connecting between sub-urban areas and the central area, which are heavily used by commuters. These corridors should be focused on first. Even on the tollways, exclusive bus lanes can be introduced.

In the central busy area, minor modification such as bus bay will be effective to avoid inter-obstruction between buses. Besides, selected secondary roads are necessary to be created as better routes for public transport services (feeder service) where buses and MRTs are to be given traffic advantage.

Strategic Project 6: Area Road Pricing System : Create disadvantageous environment for private vehicle users in selected areas

The area inside Middle Ring Road would be studied for applying this policy after the completion of MRT Master Plan. There are some 20 interfaces (major roads) on the Ring Road. Appropriate measures to functionalize the area restraint system need to be explored.

Strategic Project 7: Support Metropolitan Sub-center Development

Transport system and urban development should be inter-related to economize and rationalize the investments. Well-coordination among all relevant agencies is necessary to link the transport development together with a view to the Sub-center Development.

Strategic Project 8: Environmental Education and Enlightenment

The majority of Bangkok people are already the environment-conscious. But, further educational and enlightening activities are necessary to improve awareness to the environment in their way of living. Some form of environmental education should be provided from the beginning of the formal education, or elementary school.

2.5 Bangkok Urban Transport Structure Plan : BEIP Proposal

In line with the concept of strategic plans discussed in the previous section, A Structure Plan of Bangkok Urban Transport System in 2011 and several specific plans / programs were prepared (BEIP proposal). The fundamental of the BEIP proposal is almost all the transport projects proposed for the 8th National Development Plan by each relevant agency (BMA, DO, PWD, and ETA). Thus, BEIP proposal should be understood as an additional idea towards achieving the goals set forth

(1) Assumptions : Urban Structure

As discussed in Chapter 9, the three sub-center development: Min Buri-Lad Krabang Sub-center, Talling Chan Sub-Center, and Bang Khunthian Sub-Center, are proposed in order to create a multi nucleus system in BMA. These three sub-centers should be accommodated by good transport system.

The area inside the Middle Ring Road plus part of Khlong Toey, Huay Khwang and Bang Kapi is defined as the core area. Within the core area, quite good mobility of people will be ensured by the mass transit system. Thus, the core area is recognized as a "public transport advantageous area" where a good feeder system by buses is provided and private vehicle use is limited.

(2) Future Primary Arterial System and Multi Modal Corridor System

Primary Arterial Road here is defined as a trunk road system for inter-urban and inter-regional transport. Heavy vehicles for freight transport are always allowed to use it. The Outer Ring Road by DOH, a new ring road system being formed by new roads beneath the ETA's expressway system and the fourteen national highways connected to the ring roads are proposed as primary arterial system in the year 2011.

The New Middle Ring Road is recognized as the fringe of extension of urbanization from the center of Bangkok. There is no primary system inside the NMRR, thereby heavy vehicles are restricted to enter the central area.

Eight "Multi Modal Corridors are designated as shown in Figure 2.2. These corridors are connecting the three sub-centers and the central area. Exclusive bus lanes should be introduced on the arterial roads.

In addition to the existing three inter-city bus terminals, two new inter-city bus terminals are proposed at Huay Khwang and nearby Taksin Monument. At these five bus terminals, special interchange terminals should be provided which are "controlled areas" to allow feeder bus passengers to make cross-platform interchange with express buses.

There are some 20 transfer locations between deferent MRT systems. These transfer locations are likely to be developed as attraction centers in the central area. A master plan should be prepared to ensure coordination between deferent systems and private sectors development.

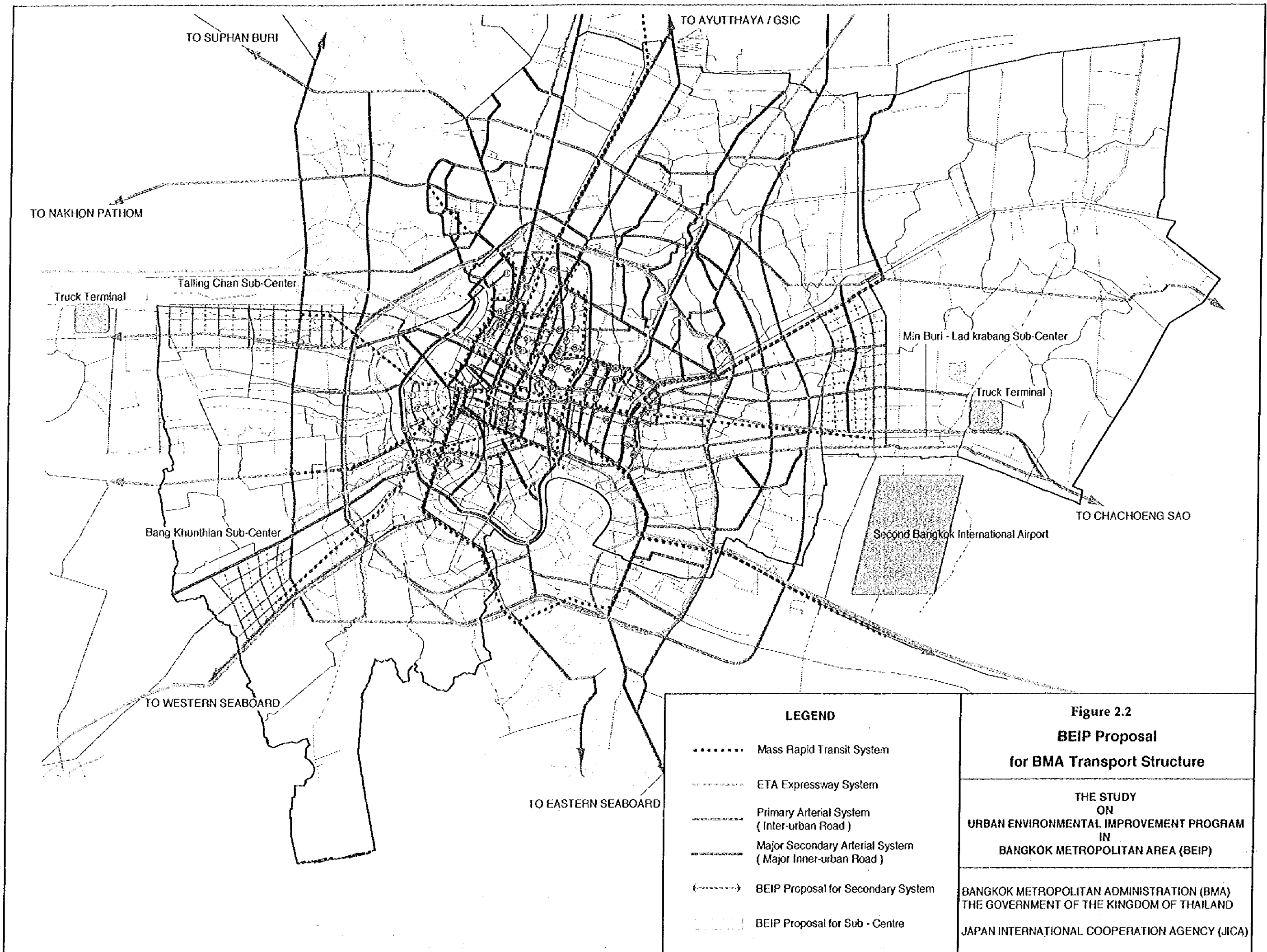
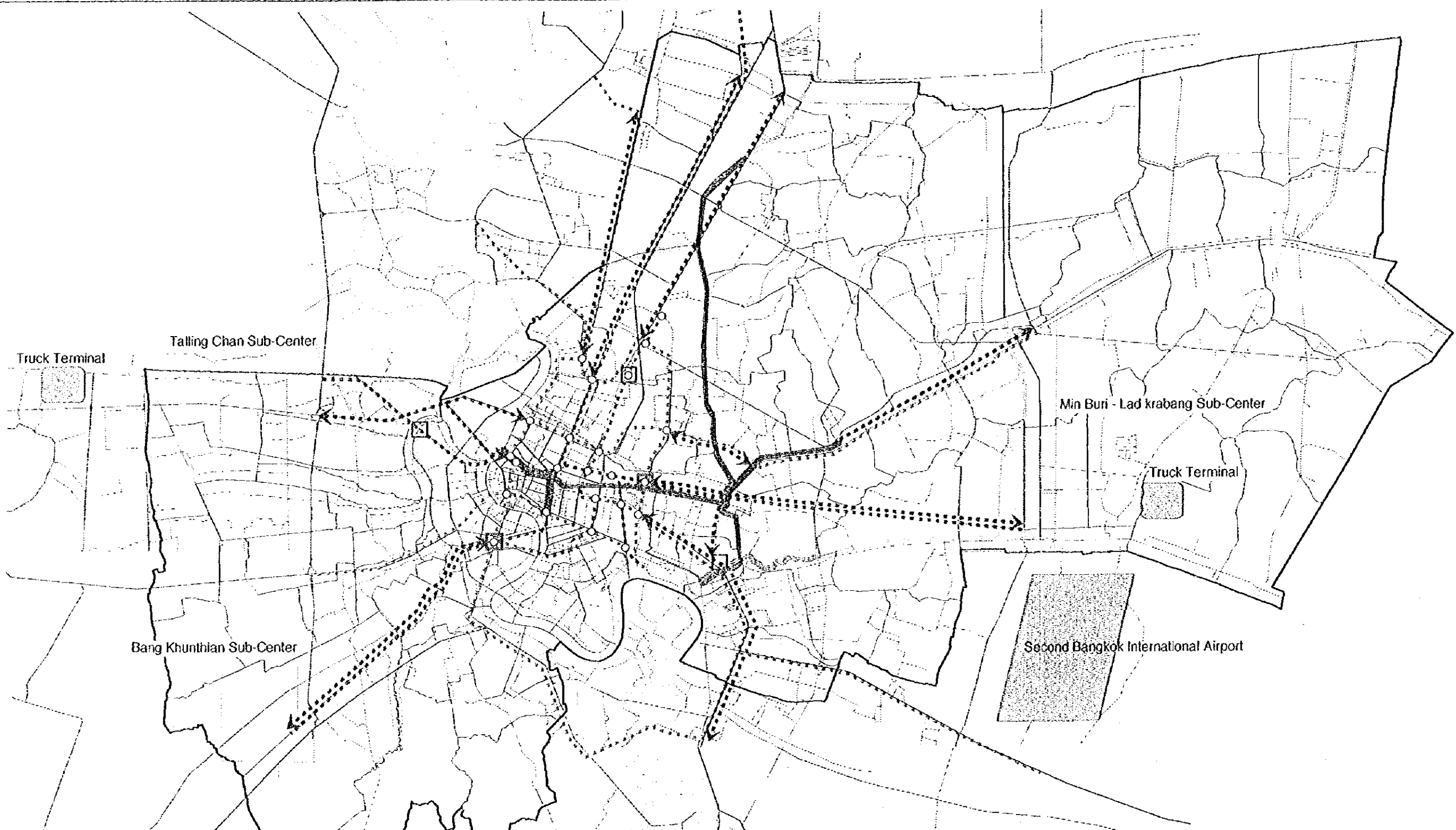


Figure 2.2
BEIP Proposal
for BMA Transport Structure

THE STUDY
ON
URBAN ENVIRONMENTAL IMPROVEMENT PROGRAM
IN
BANGKOK METROPOLITAN AREA (BEIP)

BANGKOK METROPOLITAN ADMINISTRATION (BMA)
 THE GOVERNMENT OF THE KINGDOM OF THAILAND
 JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



LEGEND	
.....	BERTS (Hopewell)
.....	BTSC (Tanayon)
.....	MRTA BLUE
.....	MRTA ORANGE
.....	MRTA PURPLE
←.....→	Priority Commuting Bus Corridor (outside MRR)
.....	Khlong Padung Krong Kasem Line
.....	Khlong Lad Prao Line
.....	Khlong San Saeb Line
.....	Khlong Phrakhanong Line
○	Transfer Location of MRT (Activity Centre Bus Terminal)
□	Bus Terminal (Existing)
□	Bus Terminal (BEIP Proposal)
.....	Green & Waterway

Figure 2.3
Public Transport
and Green & Waterway Structure

THE STUDY
ON
URBAN ENVIRONMENTAL IMPROVEMENT PROGRAM
IN
BANGKOK METROPOLITAN AREA (BEIP)

BANGKOK METROPOLITAN ADMINISTRATION (BMA)
THE GOVERNMENT OF THE KINGDOM OF THAILAND

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

(3) Future Secondary Arterial System

Table 2.1 shows proposed secondary roads in addition to the BMA's 8th Plan projects. Every road should be developed with the common purpose of promotion of public transport. The proposed projects can be categorized into nine packages as follows;

1) Package 1: BEIP_01 - BEIP_10

These projects are very important for BERTS, MRTA Orange and MRTA Blue lines. By these secondary system, metro passengers can access to job places, education places, among others in Bangkok Noi, Bangkok Yai, Thonburi and Khlong San areas. The secondary roads to be place here will also contribute to creating a new large activity center west-side of the Chao Phraya River.

Package 2: BEIP_11 - BEIP_14

These projects are prepared to increase road capacity of the gate of the North Multi Modal Corridor : Phahon Yothin Rd, Wiphawadi Rangsit Rd. and New roads proposed by BMA (B 3.12) and DOH (DOH74).

Package 3: BEIP_15 - BEIP_19

These projects are necessary for BERTS, MRTA Orange and MRTA Purple systems, providing improved feeder routes in south of Bangsu area.

Package 4: BEIP_20 - BEIP_21

These projects are beneficial to BTSC and BERTS, providing better feeder routes in Phaya Thai area.

Package 5: BEIP_22 - BEIP_30

These projects are beneficial to BTSC, BERTS and MRTA Orange lines, providing better feeder routes in Phaya Thai and Huay Khwang areas.

Package 6: BEIP_31 - BEIP_32

These projects will be proceeded together with re-development of Makkasan area, providing better connection between Ploenchit Rd. and Petchaburi Rd.

Package 7: BEIP_33 - BEIP_35

These projects will be proceeded together with a re-location program of the Chulalongkorn University (assuming relocated to one the BEIP sub-centers). This is a very challenging project package.

Package 8: BEIP_36 - BEIP_37

These projects will be proceeded together with re-development of Thai Tobacco Monopoly.

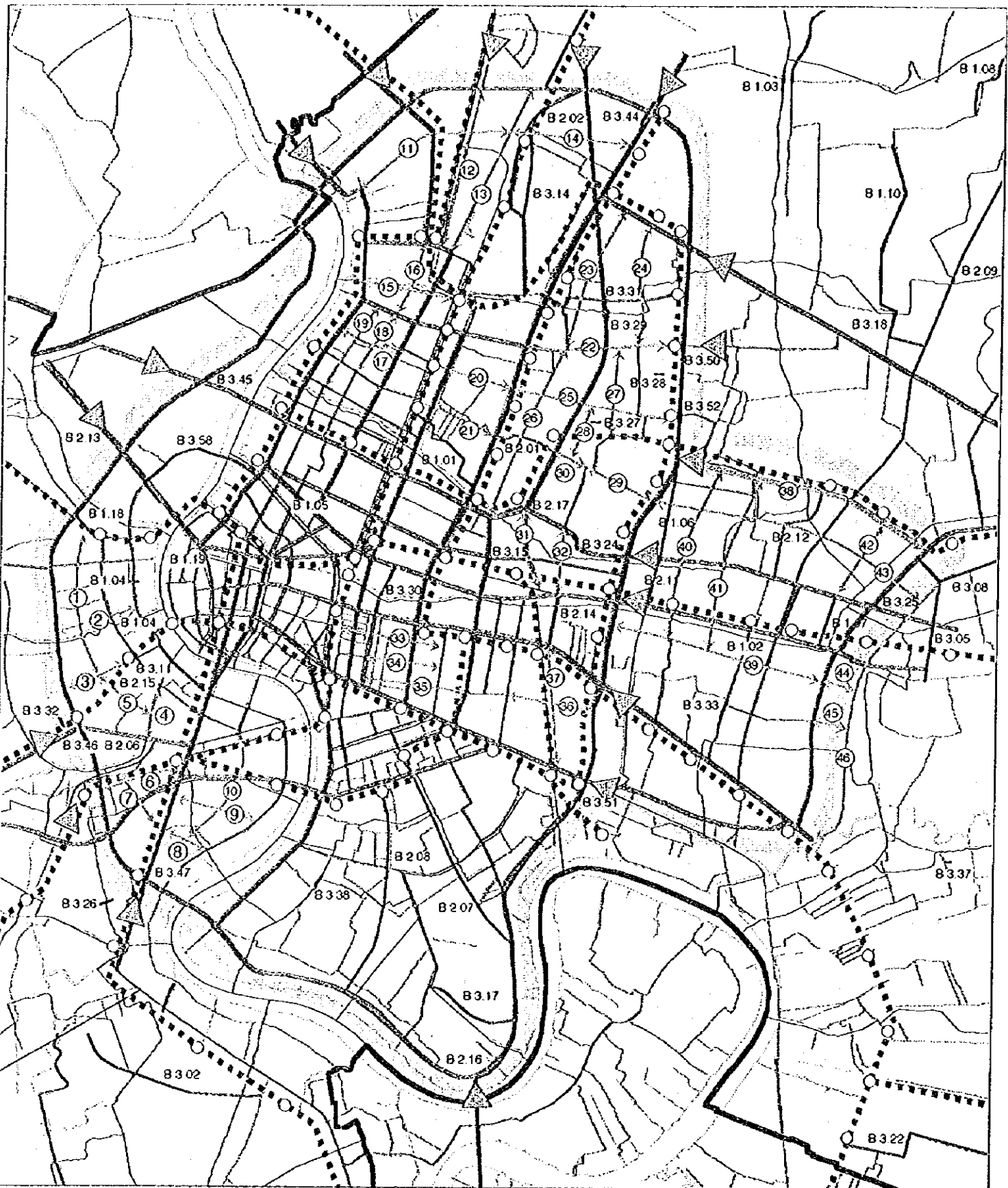
Package 9: BEIP_38 - BEIP_46

These projects will create a new large activity center such as Silom area outside the Middle Ring Road. Transport system for this are is consist of BERTS, MRTA Orange, MRTA Blue and Bus services.

Table 2.1 BEIP Proposal for Secondary Roads inside the Central Area

CODE	PROJECT NAME	LANE	LENGTH
BEIP_01	Connecting road between BMA1.18 and BEIP03	4	2.6
BEIP_02	Connecting road between Charan Sanit Rd., Itsaraphao Rd. and Arun Amarina along the Khlong Mon with "Eco-Street".	4	1.7
BEIP_03	Connecting road between Charan Sanit Rd. and Itsaraphao Rd. at the intersection of Wang Doem Rd. and Itsaraphao Rd..	4	1.5
BEIP_04	Connecting road between Charan Sanit Rd. and Itsaraphao Rd. along the Khlong Bangkok with "Eco-Street".	1	4
BEIP_05	Connecting road between BEIP03 and BEIP04.	4	1.3
BEIP_06	Connecting road between Rachadaphisek Rd. and Somdet Phra Chao Taksin Rd. along the railway (between Wongwian Yaist. and Taladplust.)	1.6	4
BEIP_07	Connecting road between BEIP06 Rd. and Somdet Phra Chao Taksin Rd. along the Khlong Samre. (crossing PWD01)	4	1.8
BEIP_08	Connecting road between Somdet Phra Chao Taksin Rd. and Charoen Nakhon Rd. along the Khlong Samre.	4	1.3
BEIP_09	Connecting road between Somdet Phra Chao Taksin Rd. and Charoen Nakhon Rd.	4	1.7
BEIP_10	Connecting road between Lad Ya Rd. and BEIP08 including flyover at Krung Thonburi Rd.	4	2.6
BEIP_11	Connecting road between Pracha Rat Rd. and BEIP13 along the railway.	4	3.6
BEIP_12	Extension of DOH74 project from Ratchadaphisek to Pracha Rat Sai 2 (Widening).	6	2.8
BEIP_13	Extension of BMA3.12 project from Ratchadaphisek to Techa Wanit Rd. with "Eco-street"	4	3.2
BEIP_14	Connecting road between Phahoyothin Rd. and BEIP13.	4	2
BEIP_15	Connecting road between Pracha Rat Sai 1 Rd. and Kamphaeng Phet Rd. along the Khlong with "Eco-Street".	4	2
BEIP_16	Connecting road between Pracha Rat Rd. and Pradiphat Rd. along the Khlong with "Eco-Street".	4	1.3
BEIP_17	Connecting road between Samsen Rd. and Rama V Rd. along the Khlong with "Eco-Street".	4	1.2
BEIP_18	Connecting road between Tha Han Rd. and Amnuai Song Khram Rd. with "Eco-Street".	4	1.25
BEIP_19	Connecting road between Tha Han Rd. and Nakhon Chaisri Rd.	4	1.8
BEIP_20	Connecting road between Phahoyothin Rd. and Rama V Rd..	4	1.2
BEIP_21	Connecting road between Phahoyothin Rd. and Rama V Rd..	4	1.2
BEIP_22	Widening Suthisarn Winit Chai Rd.	6-8	2.8
BEIP_23	Connecting road between Lad Phrao Rd. and Suthisarn Winit Chai Rd.	4	3
BEIP_24	Connecting road between Lad Phrao Rd. and Suthisarn Winit Chai Rd.	4	2.4
BEIP_25	Connecting road between Phahoyothin Rd. and Ratchadaphisek Rd.	4	3
BEIP_26	Connecting road between Suthisarn Winit Chai Rd. and Asok Din Daeng Rd.	4	3
BEIP_27	Connecting road between Suthisarn Winit Chai Rd. and Pracha Songkhro Rd.	4	1.6
BEIP_28	Connecting road between BEIP25 and BEIP30.	4	1
BEIP_29	Widening Suthisarn Winit Chai Rd.	6	1.4
BEIP_30	Widening to 6 lane due to Din Daeing Re-Development.	6	2
BEIP_31	Connecting road from Phahoyothin to Wireless Rd. including underpass.	6	1.5
BEIP_32	Connecting road from Prach Song Rd. to Soi Na Na Nua including underpass.	6	1.5
BEIP_33	Connecting road (including widening) between Henri Dunant Rd. and Rong Muang	4	1.7

	Rd.4lanewith"Eco-Street".		
BEIP_34	'ConnectingroadbetweenHenriDunantRd.andBanthatThongRd.with"Eco-Street".	4	1.4
BEIP_35	'ConnectingroadbetweenRatchadamriRd.andBanthatThongRd.with"Eco-Street".	4	3.9
BEIP_36	'ConnectingroadbetweenRatchadaphisekRd.andWirelessRd.alongtheKhlongwith"Eco-Street".	6	2
BEIP_37	'ConnectingroadbetweenSukhumvitRd.andRamaIVRd.alongtherailway.	4	3
BEIP_38	WideningPrachaUthitRd.	6-8	5.2
BEIP_39	'ConnectingroadbetweenRatchadaphisekRd.andSoiSukhumvit4lanewith"Eco-Street".	4	4
BEIP_40	'ConnectingroadbetweenBEIP38andBEIP39.	4	3.7
BEIP_41	'ConnectingroadbetweenBEIP38andBEIP39.	4	3.7
BEIP_42	'ConnectingroadbetweenBEIP38andRamaIXRd.	4	1.8
BEIP_43	'ConnectingroadbetweenBEIP46andRatchadaphisekRd.	4	6.5
BEIP_44	'ConnectingroadbetweenBEIP46andSoiSukhumvit.	4	0.8
BEIP_45	'ConnectingroadbetweenBEIP46andSoiSukhumvitRd.	4	0.8
BEIP_46	ExtensionofBMA3.08toSukhumvitRd.		5.5
BEIP_47	ConnectionDOH72andSukhaPiban1Rd.	6	26
	TOTAL		137km



LEGEND


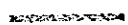
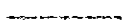

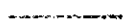
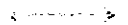



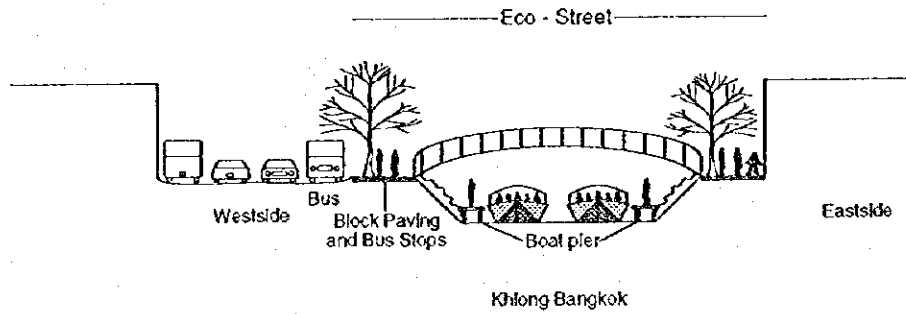
-  The Central Area (BEIP Definition)
-  Major Secondary Arterial Road
-  Minor Secondary Arterial Road
-  Mass Transit System
-  BMA Road Project
-  Proposed Secondary Road
-  Project Code
-  Metro Stations
-  Major Interface on the Middle Ring Road

Figure 2.4
Future Secondary Arterial System
and
Mass Transit System
in
The Central Area

THE STUDY
ON
URBAN ENVIRONMENTAL IMPROVEMENT PROGRAM
IN
BANGKOK METROPOLITAN AREA (BEIP)

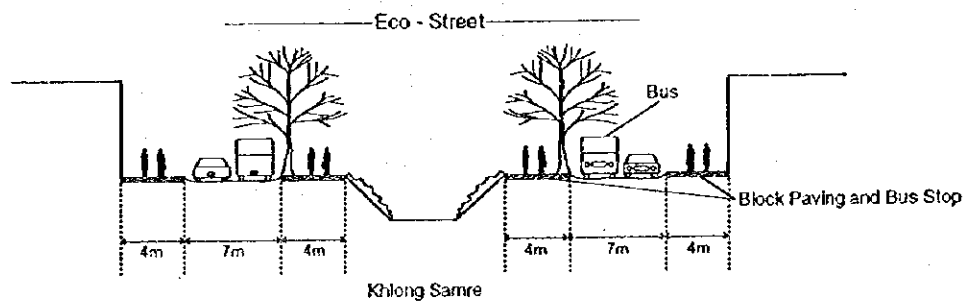
Note : Secondary System : Major Road System in the urbanized area.

Figure 2.5 Images of Cross Section of Secondary Road with Eco-Street



PROJECT BEIP_04:

Connecting road between Charan Sanit Rd. and Itsaraphao Rd. along the Khlong Bangkok with "Eco-Street".



PROJECT BEIP_08:

Connecting road between Somdet Phra Chao Taksin Rd. and Charoen Nakhon Rd. along the Khlong Samre.

(4) Transport System Development Scenario

Transport facility and system development needs to be carried out continuously for the long term towards the "Traffic Calmed" city. Traffic management and modification in use of the system should cope with the existing situation at any time. Actions in each transportation system development should not be taken independently. It is very necessary that actions in each transportation system will be taken place in coordination with other system's actions as well as urban system development. In this sense, a transport system development scenario was prepared.

Short Term (8th Plan Period)

At the initial stage of the next two decades (8 Th. plan period), a rapid and reliable bus system based on exclusive bus-lane or bus priority lane should be developed. As mass rapid transit system will be still under construction, buses will play a vital role in commuting.

To attract more people to the bus system, pedestrian environment should also be improved. Sidewalk around major bus stops in the activity centers should be given priority.

In order to develop a good arterial road system in the central area, future road spaces should be designated and reserved by some form of act or law. New or renewal housing projects, among others should be watched and restricted by government staffs.

As discussed before, the ATC phase I should be fully in enacted.

Besides, at the beginning of this period, several studies including "Pedestrian Environment Improvement Plan", "Eco-Street Development Plan", "Water Transport Revitalization Plan", "Public Transport Integration Plan", among others should be prepared.

Medium Term (9th Plan Period)

At this stage, the "core" MRT system will be in operation. Accordingly, the bus system is required to provide better feeder services to/from the stations of the MRT system. Based on the bus re-routing plan prepared in 8th plan period, bus system should be modified. Some supplemental facilities development such as bus bay and bus stops are also needed.

Some form of restraint of private vehicle use can be introduced as effective alternatives such as the MRT core system and modified buses are available.

Long Term (10th Plan Period)

At this stage, the Priority MRT network will be in full operation. Bus system will again be reformed based on the bus re-routing plan prepared in 9th plan period. Besides, much restrictive way of private vehicle use can be introduced.

At The Year 2011

A complete integrated public transport system and quality environment for pedestrian will be fully realized. A very strict restraint on private vehicle use in the central area should be introduced. Bangkok will shine based on the "Traffic Calmed City".

Figure 2.6 Environment Initiative Transport Development Scenario

SYSTEM	Plan Period			DISTANT FUTURE
	8 th Plan period 2001	9 th Plan period 2006	10 th Plan period 2011	
	SHORT TERM	MEDIUM TERM	LONG TERM	
Mass Rapid Transit System	Core Network Development (Hopewell, BTSC, MRTA Blue : 103 km)	Priority 1 Network Development (BTSC, MRTA Blue, MRTA Orange) Core Network Operation	Priority 2 Network Development (Hopewell, MRTA Orange, MRTA Purple) Priority 1 Network Operation	Full Master Plan Network Operation
Bus-System	Bus Transport Improvement : Bus Priority Corridor - Exclusive Bus Lane, Bus Priority Lane - Improvement of Terminal	Inter Modal Facility Development Bus System Modernization and Supplemental System Development Bus re-routing Phase 1 - Feeder service to/from the Core Network	Inter Modal Facility Development Bus re-routing Phase 2 - Feeder service to/from the Priority 1 Network	Inter Modal Facility Development
Water Transport System	Water Transport Improvement - Pier Capacity Improvement - Landscape Improvement	Inter Modal Facility Development - Make piers into part of inter-modal facilities - Introduction of electric boats	Inter Modal Facility Development	Inter Modal Facility Development
Pedestrian	Pedestrian Environment Improvement - Pedestrian Improvement around public transport terminals	Inter Modal Facility Development Footpath development with "Green and Waterway"	Inter Modal Facility Development	Inter Modal Facility Development
Street System	Reservation of land for new secondary system	Provision of better routes for public transport		
Primary Arterial System	ORR southern section connecting HWY 34 and HWY 35 Primary arterial system development together with ETA system Introduction of Exclusive Bus Lane on the primary system			
Expressway System	Accelerate development of the ring system (northern part first) Introduction of Exclusive Highway Bus System Raising tariff of private cars			
Traffic Management	Study on restraint of private vehicle ATC Phase 1 Full Operation	Introduction of several scheme (trial) ATC Phase 2 Development	Full operation of ATC within the MRR	
Urban System		Development of Sub-Centers		
		Housing and Commercial Development at the terminals of the Core MRT system		
				<p>Bangkok is shining based on</p> <ul style="list-style-type: none"> - Integrated Transport System - Multi Modal Corridor - Quality Pedestrian Facilities - Well organized Secondary System - Sophisticated Traffic Management <p>The People are enjoying</p> <ul style="list-style-type: none"> - Safe and Friendly Environment - Beautiful Scene of Walk Street - Improved Mobility and Accessibility - Multiple Choices of Transport Mode <p>Bangkok Urban Economy become more strong based on the efficient transport system for commodity</p> <p>Research and Development on More Sophisticated Technology of Freight Transport</p>

Table 2.2 Major Component of Strategic Projects (1: Short Term)

Urgent Actions				
	Proposals for Environment-Initiative Urban Transport	Implementing Body	Related Agency	Total Cost (mil. Baht)
ET11	Pedestrian Environment Improvement Plan - sidewalk around inter-modal facilities (800 m x 100 locations) - sidewalk improvement in commercial area (Silom, World Trade Center) - sidewalk improvement in the heritage area (Ratana Kosin) - pedestrian bridge development on major secondary roads - soil revitalization projects (connecting and block paving selected soils to develop effective footpaths to public transport terminals)	BMA		60
ET12	Eco-Street Development Plan Sidewalk and path for non motorized vehicle along the major khlong and connecting streets between major parks)	BMA	MOTC	40
ET13	Water Transport Revitalization Program - improvement of waterways and boat piers in Chao Phraya River and major Khlongs - Landscape and footpath development along major khlongs (Water & Green Network)	MOTC /BMA		40
ET14	Public Transport Integration Plan - bus re-routing plan - fare and ticket integration plan	OCMRT /BMA	BMTA	60
ET15	Master Plan and Feasibility Study on Public Transport Terminals and Inter-Modal Facilities - metro to metro transfer (22 locations) - metro to bus transfer facilities (5 inter-city bus terminals and 22 metro transfer locations) - bus/metro to boat	OCMRT /BMA	MOTC /BMTA	60
ET16	Feasibility study and Engineering Study on Major Primary and Secondary Road - BEIP proposal (Primary road : 47 km , Secondary road : 137 km)	BMA		140
ET17	Area Road Pricing plan - more detail analyses and assessment should be proceeded.	OCMRT	BMA /MOTC	60
ET18	Review of Primary Road System Sub-center development, WSB, ESB, GSIC should be taken into consideration in prioritizing	OCMRT	MOTC /ETA	20
ET19	Implementation of Projects for BMA 5th Five-year Plan	BMA		54,400
ET20	Implementation of Projects for DOH 5th Five-year Plan	DOH		
ET21	Implementation of Projects for PWD 5th Five-year Plan	PWD		
ET22	Implementation of Projects for ETA 5th Five-year Plan	ETA		
ET23	Proceed BERTS, BTSC, MRTA (Blue and Orange)			

Table 2.2 Major Component of Strategic Projects (2 : Medium Term)

Medium-term Projects/programs				
	Proposals for Environment-Initiative Urban Transport	Implementing Body	Related Agency	Total Cost (mil Baht)
ET24	Pedestrian Environment Improvement Phase 1 (based on ET11) - sidewalk improvement around BTS, MRTA, BERTS stations (60 locations) - sidewalk improvement in commercial areas (2.5km in Silom area, 20 km along the Sukhumvit Rd, Petchaburi Rd, Rama IX Rd.) - sidewalk improvement in Para Nakhon (2km) - pedestrian bridge (100 locations) - soi revitalization projects (20km inside the MRR)	BMA		3,910
ET25	Eco-Street Development Phase 1 (based on ET12) - Khlong Samsen (11km) - Khlong San Sap (6.5km)	BMA	MOTC	680
ET26	Water Transport Revitalization Phase 1 (based on ET13) - Khlong Samsen (11km) - improvement of boat pier (Pattu Nam and other 6 locations close to metro system)	MOTC /BMA		840
ET27	Public Transport Integration Phase 1 (based on ET14) - together with the Green Line implementation schedule, bus re-routing should be implemented. - monthly ticket for BTS, MRTA, BERTS and feeder buses - common ticket for BTS, MRTA, BERTS	BMTA	MOTC	100
ET28	Public Transport Terminals and Inter-Modal Facilities Development (based on ET15) - Mor Chit Terminal (Bus/BTS/MRTA) - Sukhumvit / Soi Asok Terminal (Bus/BTS/MRTA) - Huay Khwang Terminal (together with MRTA Depot development) - Pattu Nam Boat Station with bus terminal - Bus stop and bus bay at MRT stations	MOTC /BMTA /BMA	OCMRT	7,480
ET29	Implementation of Major Secondary Road Projects (based on ET16) BEIP Proposal (50%)	BMA		2,450
ET30	Implementation of Area Road Pricing Project (based on ET17)	BMA	MOTC /OCMRT	300
ET31	Formulation of Transport Master Plan for 9th National Development Plan	OCMRT	NESDB	60
ET32	Proceed Implementation of Extended Mass Transit System Projects (71.4km)	MRTA	MOTC /BMA	42,080

Table 2.2 Major Component of Strategic Projects (3 : Long Term)

Long-term Projects/Programs				
	Proposals for Environment-initiative Urban Transport	Implementing Body	Related Agency	Total Cost (mil Baht)
ET33	Pedestrian Environment Improvement Phase 2 (based on ET11) - sidewalk improvement around MRTA Purple stations (15 locations) - sidewalk improvement in commercial area (10km) - pedestrian bridges on major khlongs - soil revitalization projects	BMA		1,360
ET34	Eco-Street Development Phase 2 (based on ET12) - Khlong Samsen (and Khlong San Sap, 40km)	BMA	MOTC	1,560
ET35	Water Transport Revitalization Phase 2 (based on ET13) - improvement of waterway (40km) - improvement remaining boat piers (38 locations)	MOTC	BMA	1,550
ET36	Public Transport Integration Phase 2 (based on ET14) - bus re-routing - fare and ticket integration (common ticket for all metro system)	OCMRT	BMTA	100
ET37	Public Transport Terminals and Inter-Modal Facilities Development (based on ET15) - 20 metro to metro transfer stations - 44 boat stations with bus terminal - bus stops and bus bay at metro stations	MOTC /BMTA /BMA	OCMRT	640
ET38	Implementation of Major Secondary Road Projects (based on ET16) - BEIP proposal (50% of 184 km)	BMA		32,390
ET39	Formulation of Transport Master Plan for 10th National Development Plan	OCMRT	NESDB	100
ET40	Proceed Implementation of Mass Transit System Projects (63.6km)	MRTA	MOTC /BMA	37,400