

**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 1: EXECUTIVE SUMMARY**

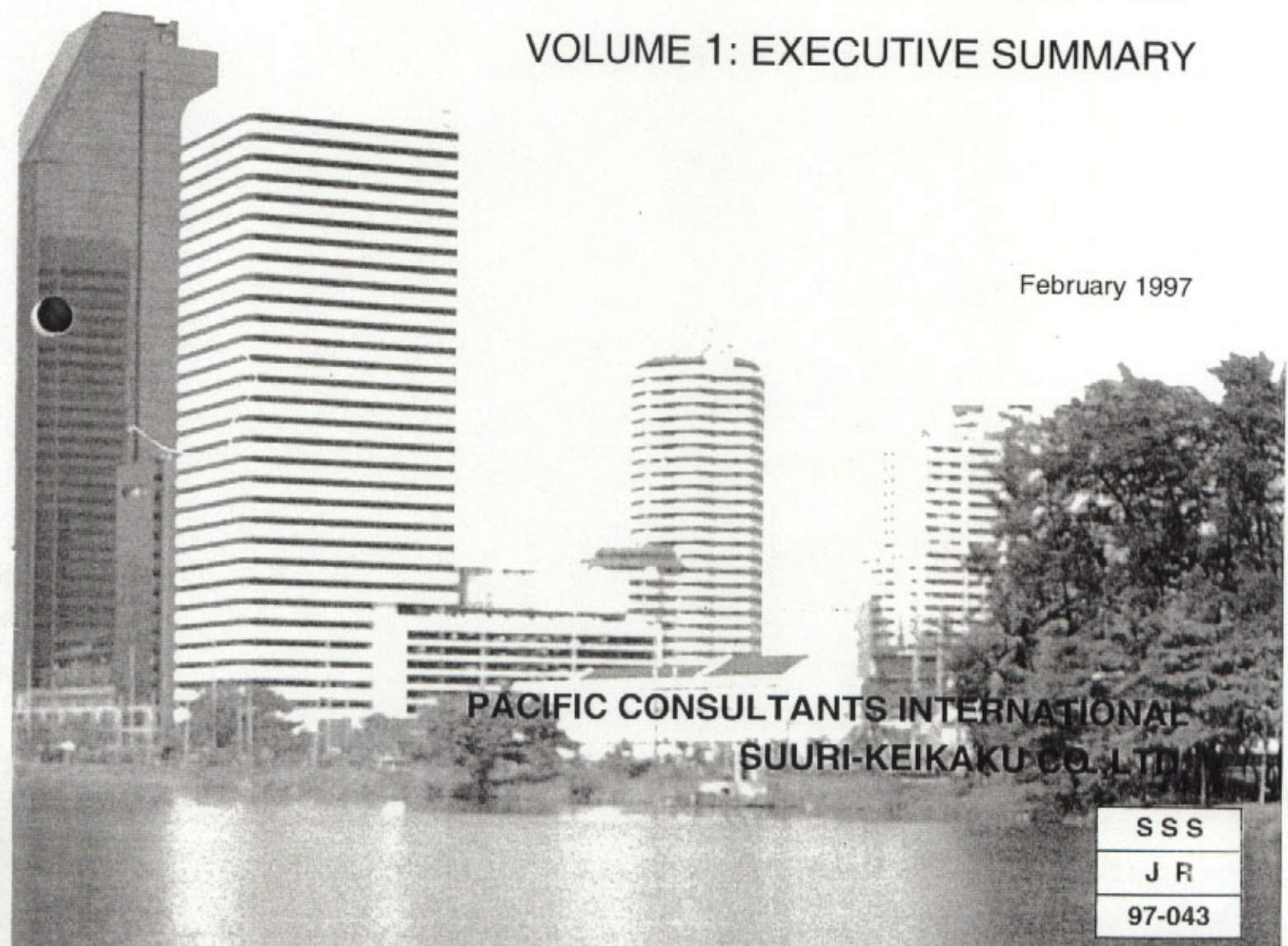
February 1997

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

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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

## Abstract

*This Study proposes a new urban growth system and social rules for forming adequate social capitals and appropriate uses of environmental resources, seeking sustainable development of the Bangkok Metropolis with the ultimate goal of up-grading people's quality of life.*

*The Study recommends that Bangkok Metropolitan Administration (BMA) and relevant national agencies make integrated efforts to:*

- 1) re-structure the physical urban structure towards a multi-polar metropolitan system instead of the present one-center system, by emphasizing "Mass transit-driven Urbanization";*
- 2) institutionalize urban planning-related systems effective for "Urban Growth Management" to materialize adequate land use;*
- 3) realize strategic projects/programs based on the following 6 planning policies:*
  - Sustainable resource utilization of vulnerable environment;*
  - Flood-free urbanization;*
  - Environment-initiative transportation system;*
  - Fresh and clean air;*
  - Water-friendly Eco-city; and*
  - Quality of Living*
- 4) Strengthen the implementability and financial absorptive capacity of BMA, improving the basis of local taxation and encouraging participation of people, communities and the business sector based on a bottom-up approach.*

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

Study Period: August 1995 - February 1997

Counterpart Agency: Bangkok Metropolitan Administration

## Outline of the Study

### 1 Background

Thailand has been enjoying a rapid economic growth at more or less 10% p.a. since 1987, in which the Bangkok economy does and will continuously strengthen its centric and higher urban functions rather than industrial function. More information-based and more value-added types of business with international linkages will be expanded.

Despite a long-standing "Decentralization Policy", Bangkok is still accepting rural-to-urban migrants at a significant rate and will grow to be one of the largest Mega-cities over the world with more than 10 million population in 2011. The expected economical development will eventually up-lift the per capita income level to be US\$13,000 in 2011, compared to US\$5,600 at present as of 1995.

Under this favorable circumstances, however, the city suffers from urban environmental problems such as traffic congestion and air pollution. As being economically affluent on one hand, people will become more environment-conscious and more cultural identity-oriented on the other hand. Environmental improvement will be a further critical policy issue on both short- and long-term perspective.

### 2 Objective

The objective of the Study is to formulate a comprehensive master plan for the urban environmental improvement of Bangkok Metropolitan Area with the target year of 2011. This Study proposes a new urban growth system and social rules for forming adequate social capitals and appropriate utilization of the environmental resources, seeking sustainable development of the Bangkok Metropolis with the ultimate goal of up-grading people's quality of life.

### 3 Outline of the Program

#### 3.1 Development Framework

Table 1 Socioeconomic Framework of BMA

	1995	2001	2006	2011	Increase 1995-2011	Avg. Growth Rate p.a. 1995-2011
<b>Socioeconomic</b>						
Population (,000)	8,126	9,044	9,761	10,496	2,370	1.6 %
GPP-BMA (Bill. Baht at 1988 const. Price)	1,149	1,823	2,557	3,422	2,273	7.1 %
<b>Urbanization</b>						
Urbanized Ratio (% as of BMA total area)	34.3	38.4	45.6	56.1	-	-
Population density (prs/ha)	150	149	136	119	-	-
<b>Motorization</b>						
No. of Vehicles registered (,000)	1,911	2,773	3,406	4,065	2,154	4.8 %
Vehicle Ownership per Household	0.94	1.20	1.32	1.42	-	-

### 3.2 Restructuring of the Bangkok Metropolis

#### 1) From One-center to Multi-polar Urban System

Metropolitan Subcenters should be developed at five locations in suburban areas within BMA, that will function as commercial/business centers to make job-and-housing balance, thereby releasing the concentration pressure.

#### 2) Urban Regeneration

Part of the central areas, where a number of warehouses and factories are going to be out of date and no longer economically functional, should be re-generated or re-developed. It is necessary to establish a re-generation program with a long-term perspective.

#### 3) Sub-urbanization

Infrastructure-led urbanization should be pursued, by employing institutional tools under well-coordination between urban planning and implementation of infrastructures.

#### 4) Mass-Rapid Transit-Driven Urbanization

Areas easily accessible to stations of the planned MRTs will induce intensive land use. Hence, such mass-transit driven urbanization is effective for management of traffic demands control. Physical urban design of transport facilities and their network systems should be made in such a way that pedestrians and public transport passengers may take advantages in services and amenities with convenient inter-modal transfer systems.

### 3.3 Planning Concepts for Bangkok Urban Environmental Improvement

#### 1) Pursuance of Sound Urban Environment

Planning of urban environmental improvement pursues four (4) vital elements of human life: *Healthiness*; *Safeness*; *Comfortableness*; and *Convenience*. The city should provide with environmental conditions to assure all the elements.

#### 2) Functioning Urban Metabolism System

The city itself is an organic system, therefore, always changes its land use and functions, in response to requirements of the times and the economy. This is called "Urban Metabolism" with two sub-systems working reciprocally:

- *Anabolism* : the urban system to provide with fresh and clean inputs sufficiently enough to maintain the organic system;
- *Catabolism* : the urban system to treat with emissions and wastes so as to minimize damages otherwise would-be-harmful.

To maintain the urban metabolism, man-made and natural environment should be co-existing. This is a vital planning issue for the environmental improvement.

### 3) Urban Growth Management

Bangkok needs to establish a urban growth management system. Growth shall be limited within the carrying capacity that the government can control in providing necessary public services to protect the environmental deterioration. The carrying capacity is determined by not only its spatial extent, but also authorities' managerial and economic capabilities.

### 3.4 Planning Issues, Targets and Macro Measures

#### 1) Planning Issues

Deterioration of "Bangkok environment" has been reaching a critical level, which means that further worsening of the quality of environment will jeopardize the people's lives as well as sustainable socioeconomic growth. The majority of the Bangkok residents has been already aware of that substantial solutions on environmental problems should be prioritized even though they pay some cost for the economic growth ("Environment Awareness Survey for Bangkok People", IDE). To resolve problems of environmental deterioration, an integrated approach is essential and new social rules are needed for using resources of the Metropolis.

Planning issues, in this sense, are identified to be the following six:

- Sustainable Resource Utilization in Vulnerable Environment;
- Flood-free Urbanization;
- Environment-initiative Urban Transport System;
- Creation of "Water-friendly Eco-city";
- Pursuance of "Fresh and Clean Air policy"; and
- Up-grading of Quality of Living Environment.

#### 2) Macro Measures to Achieve the Targets

For the achievement of the targets, the macro measures, including both soft and hard ones, should be pursued at the level of national as well as BMA. Some of them call for business sector's participation or people's strong involvement.

Table 2 Planning Target and Macro Measures for Environmental Improvement

PLANNING ISSUE	TARGET 2011	NUMERICAL TARGET	PROPOSED MACRO MEASURES
PLAN 1: Sustainable Resource Utilization in Vulnerable Environment	Creation of the robust urban environment against the natural disasters.		<ul style="list-style-type: none"> <li>- Pursuance of energy saving and resource recycling policy.</li> <li>- Establishment of social rules and guidelines for stopping land subsidence.</li> <li>- "Green and Water Network" Development.</li> </ul>
PLAN 2: Flood-Free Urbanization	Creation of the man-made environment for people to be free from fears and apprehensions of floods.	Keeping the drainage capacity to cope with 5 year rainfall probability.	<ul style="list-style-type: none"> <li>- Formulation of a long-term master plan.</li> <li>- Formulation of a hierarchical drainage system.</li> <li>- Establishment of well-functioning flood control system.</li> <li>- Control of environmental preserved land.</li> <li>- Development of guidelines regarding water retaining.</li> </ul>
PLAN 3: Environment - initiative Urban Transport System	Re-structuring of the Bangkok Urban Transport System with a more environment oriented system, or shifting to a public transport based system; and Mitigation of road traffic congestion, providing with alternative urban public transport modes suitable for their purposes and time constraint.	Anyone can reach his/her work place or school within 45-60 minutes; and the share of public transport as a primary mode shall be 70%(excluding walk trips)	<ul style="list-style-type: none"> <li>- Shift to a Mass Transit - driven Urban System</li> <li>- Public Transport Corridor development.</li> <li>- Development of hierarchical road system.</li> </ul>
PLAN 4: Pursuance of "Fresh and Clean Air Policy"	Mitigation of air pollution up to a level that people may feel no damage on health.	Ambient air pollution levels in most of Bangkok urban areas shall satisfy the presently regulated "Thai Environment Standard"	<ul style="list-style-type: none"> <li>- Strengthening of environmental administration.</li> <li>- Measures for mobil sources related to urban transport.</li> <li>- Stationary sources managed on voluntary basis.</li> </ul>
PLAN 5: Creation of "Water - friendly Eco - city"	Restoration of the Thai water culture in association with improvement of water quality in khlongs.	BOD: less than 15mg/l in major khlongs in the Special Policy Zone (Khlong Water Quality Improvement Promotion Zone)	<ul style="list-style-type: none"> <li>- Water quality improvement and restration of function of the urban khlongs.</li> <li>- Beautification of khlongs and river front area.</li> </ul>
PLAN 6: Up-grading of Quality of Living Environment	Materialization of Healthy, Safe, Comfortable and Convenient Environment for all people, with social cares for urban poor, elderly and handicappers.	<p>Solid Waste Management: reduction of per capita generation rate of solid waste by 10%.</p> <p>Water Supply: supply to all residents in urban areas, in association with reduction of the leakage ratio up to less than 20%</p>	<ul style="list-style-type: none"> <li>- Solid waste management for hygienic living environment.</li> <li>- One-more-step solution of slum problem.</li> <li>- Creation of pedestrian-advantageous society.</li> <li>- Attention to the environment for the weak.</li> </ul>

## 4 Programming of Projects/Programs

### 4.1 A Conceptual Ground for Programming

Projects/programs to materialize the urban environmental improvement plan are categorized into one of four categories characterized as follows:

- I. Public investment for local and sector solution;
- II. Involvement of voluntary private activities;
- III. Institutional system with guidelines, standards and regulations for urban environmental and growth management; and
- IV. Strategic public investment for urban restructure.

In the short-term, intensive efforts should be made to enhance the categories of I and III; and in the medium- to long-term, emphasis should be placed on the categories of II and IV.

### 4.2 Proposed Projects/Programs for Bangkok Environmental Improvement

For the macro measures to achieve the planning target, 105 projects/programs are recommended as summarized in the list compiled in the end of this report.

## 5 Basic Rules for the Implementation

### 5.1 Social Rules for the Implementation

Social rules are required to manage and support the deliberate implementation of the plans, taking into account:

- A decrease of environmental resources shall be compensated with an increase of environmental inputs at the corresponding economic value. Based on this rule, "Polluter-Pay-Principle (PPP)" or "User Charge System" should be justified.
- Any type of development should minimize anticipated negative impacts on the environment, based on another rule that one's gain never results in worsening the other's welfare.
- A preventive approach is less costly than a curative approach in the long-run. Before worsening the environment, effective measures against it should be undertaken.

## 5.2 Institutional Arrangement for Urban Growth Management

A number of institutional arrangement for urban growth management are necessary to support the administrative power to implement the plans, including:

- **Special Policy Zoning System**, supplementing the current Land Use Zoning System, to indicate policy directions and concrete measures of the environmental improvement in accordance with the zonal attributes;
- Institutionalization of **Parks and Open-space Development Act** which stipulates guidelines of development and preservation of public parks and green areas along khlongs and other valuable open space;
- Rationalization of the current **Floor Area Ratio** (a flat system of 1,000%) to rationalize the intensity of land use reflected by locational and environmental attributes with institutional links with the Urban Planning Act;
- Enhancement of **Environment-related Acts/Regulations** with enforcement power of the responsible authorities;
- Introduction of the regulation of **Traffic Assessment Study** which is obliged to submit the local government together with the application of building permission for a large-scale projects;
- Preparation of **Local Government's Guidelines** for land and subdivision development with deliberate measures for environmental improvement and preservation in a form of Local Government Ordinance.

## 6 Financing for the Implementation

### 6.1 Financial Demarcation System

Since environmental problems likely appear at local level, BMA as of the local government has to have a chief responsibility for resolving the problems.

For the implementation of projects, the budgetary autonomy of local government is limited, and most of environmental projects are carried out under the subsidy system where about 60-65% of the total costs come from the central government. Further devolution in the budgetary power for projects/programs should be pursued in such a way that BMA can directly tackle with local environmental problems, improving the existing subsidization system.

### 6.2 Enhancement of BMA Financial Capability

Financial and implementing capabilities of BMA itself should be further strengthened in order to put the plans into action, through:

- 1) Improvement of the executing system of the current Local Taxation, including:
  - preparation of **Land and Assets Ownership Maps, or Cadastral Maps**;
  - re-evaluation of **Asset Value**; and
  - improvement of **Tax Collection System**.
- 2) Introduction of **PPP or User Charge System** for environmental services;
- 3) Utilization of **External Financial Resources** (soft loans) to initiate urgent infrastructure projects and social capital formation; and
- 4) Development of **Training Programs of Local Government Personnel** particularly for planners, engineers and financial staff.

### 6.3 Evaluation of BMA's Financial Capability for the Implementation of Environmental Projects/Programs

#### 1) Evaluation of BMA's Financial Capability in the Short-term

During the period of the BMA 5th Development Plan (1996-2001), a number of projects/programs regarding the environmental improvement of Bangkok has been launched by relevant government agencies. Besides the above, adding the cost for all the projects/programs termed "Urgent Actions" proposed by the BEIP Study, which are to be implemented during the same period between 1996 and 2001, the total necessary cost amounts to approximately 283 billion Baht. Of which, those to be implemented by BMA is estimated at 152 billion Baht. Given the current subsidy system from the central government, BMA itself has to share approximately 53.3 billion Baht out of the total of 152 billion Baht.

If BMA succeeded in execution of the enhancement program for financial capability as proposed in the preceding section 6.2, BMA could enlarge its revenue sources through local taxes, thereby, could bear an accumulated budget of about 22.3 billion Baht available for the environmental investment up to the year 2001. Therefore, if BMA implements all the projects/programs proposed by both the 5th Plan and the BEIP Study in schedule, a fund shortage, or a budgetary deficit, will occur at an amount of 31 billion Baht in 2001.

Two ways are conceivable to fulfill this deficit, i.e., 1) to claim a special subsidy allocation to the central government; or 2) to seek some external fund sources in a form of soft loans.

#### 2) Evaluation of BMA's Financial Capability in the Medium- and Long-term

Out of the projects/programs proposed by the BEIP Study, those to be chiefly implemented by BMA will cost approximately 123 billion Baht for the medium-term (2001-2006), and 141 billion Baht for the long-term (2006-2011). Under the current subsidy system from the central government, BMA itself has to share 43 billion Baht in the medium-term (2001-2006), and 49.4 billion Baht in the long-term (2006-2011). On the fund supply side, BMA will bear available budgets for the environmental investment of 49.8 billion Baht for the medium-term, and 75.3 billion Baht for the long-term. As the result, obviously, BMA will be able to be affordable and manageable to implement all the projects/programs proposed by the BEIP Study. In the long-term, the deficit born in the short-time will be fulfilled with the surplus, and the balance will be all clear in 2011. The above discussed are summarized in Table 3.

#### 3) Overall Evaluation of Project Implementability of BMA

Under two premises that the current subsidy system is workable and that BMA implements the proposed program to enhance its budgetary base, BMA is assessed to be financially capable of executing all the projects/programs stipulated by the 5th Plan and the BEIP Study, despite that BMA will suffer from a budget shortage in the short-run.

Therefore, it is critical whether or not BMA will challenge to put forth the Enhancement Program which is included in the list of the proposed projects/programs compiled in this BEIP Study.

**Table 3 BMA's Financial Capability of Implementation of the Proposed Projects and Programs for Environmental Improvement**

		million baht			
		Urgent Actions	Medium-term	Long-term	Total
		(1997-2001)	Projects /programs (2002-2006)	Projects /programs (2007-2011)	
<b>1) Required Environment Investment Costs, 1997-2011</b>					
Investment Budget of Environment Projects in BMA Fifth Five-Year Plan	(a)	120,500			120,500
Investment Budget of MWA Five-Year Plan	(b)	114,900			114,900
Total Costs of Projects/Programs of BEIP Study	(c)	47,330	415,450	472,600	935,380
- BMA	(d)	31,740	122,730	141,140	295,610
- Central government		2,320	4,690	1,860	8,870
- State Enterprise		8,680	180,690	216,500	405,870
- Private Sector		4,590	107,340	113,100	225,030
Total Investment Cost	(a)+(b)+(c)	282,730	415,450	472,600	1,170,780
<b>2) BMA Budget Revenue in Challenging Case</b>					
Estimated BMA Budget Revenue	(e)	115,100	182,300	255,800	553,200
<b>3) Require Amount for Environmental Investment of BMA</b>					
Required Amount for Environmental Investment	(f)=(a)+(d)	152,240	122,730	141,140	416,110
- Required Investment of BMA	(g)=(f)x35%	53,280	42,960	49,400	145,640
- Required Subsidies from Central Government	(h)=(f)x65%	98,960	79,770	91,740	270,470
<b>7) Potential Investment Budget of BMA for Environment</b>					
Potential Investment Budget of BMA for Environment	(i)	22,300	49,790	75,320	147,410
Required Investment of BMA	(g)	53,280	42,960	49,400	145,640
Balance of BMA Budget	(j)=(i)-g)	-30,980	6,830	25,920	1,770
Percentage of BMA Total Budget	(j)/(e)	-27%	4%	10%	0%

Source: BEIP Study

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# 1 A LONG-TERM VISION ON THE BANGKOK ECONOMY AND DEVELOPMENT FRAMEWORK

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## 1.1 A Vision of New Bangkok 2011

Thailand has been enjoying a rapid economic growth at more or less 10% p.a. since 1987, in which the Bangkok economy does and will continuously strengthen its centric and higher urban functions rather than industrial function. More information-based and more value-added types of businesses together with international linkages will be expanded. Appreciating this favorable trend, Bangkok is expected to shift towards a **"Knowledge-based international hub city"** of the Southeast Asia, having the urban environment as good as corresponding to such a reputable city.

Bangkok is still accepting rural-to-urban migrants at a significant rate, despite a long-standing "Decentralization Policy". Although this increasing trend will cease in the long-run along with a more balanced economic growth in a spatial term, Bangkok will grow to be one of the largest **Mega-cities** over the world with more than 10 million population in the year 2011.

The expected economical development will eventually up-lift the per capita income level to be US\$13,000 in 2011, compared to US\$5,600 at present as of 1995. As being economically affluent on one hand, people will become more environment-conscious and more cultural identity-oriented on the other hand. Thus, environmental improvement will be a further critical policy issue.

The current energy-consuming structure of the urban transport system will be enforced to be shifted towards an **"Energy-saving City"** to manage the more efficient and internationally competitive urban economy. To this end, **Urban Re-structuring** will be a key issue for urban planning, based on **"Mass Transit-driven Urbanization"**. And, the society will call for people's awareness of importance of efficient resource utilization and recycling in the course of modernization and up-grading of their living environment.

**"Urban Metabolism"** will apparently be more activated in land use, affected by a structural change in demands at real estate and housing markets. The inner urban area will be pressured to be re-generated due to land economization, and suburban areas will be further developed to accommodate increasing land demands. **Urban Growth Management System**, therefore, will be strictly required to materialize an orderly urbanization which is symbiotic with the environment.

## 1.2 Development Framework

Table 1.1 tabulates the development framework which should be a basis of planning for Bangkok environmental improvement.

**Table 1.1 Development Framework for Bangkok Environmental Improvement**

	1995	2001	2006	2011	Increase 1995-2011	Avg. Growth Rate 1995-2011 (% p.a.)
<b>Socioeconomic</b>						
Population ('000)	8,126	9,044	9,761	10,496	2,370	1.6
No. of Households ('000)	2,037	2,316	2,578	2,870	833	2.2
Household Size	3.99	3.91	3.79	3.66	-	-
No. of Jobs ('000)	4,338	4,757	5,222	5,681	1,265	1.7
GPP-BMA (Bill. Baht at 1988 const. Price)	1,149	1,823	2,557	3,422	2,273	7.1
Per Capita Income -BMA ('000 Baht at 1988 const. Price)	141.4	201.6	261.2	326.0	184.9	5.4
Average Monthly Household Income-BMA (Baht/month at 1995 Price)	21,032	25,128	30,021	33,802	12,770	3.0
<b>Urbanization</b>						
Urbanized Land Area (Km <sup>2</sup> )	541	606	719	884	343	3.1
Urbanization Ratio (% as of BMA total area)	34.3	38.4	45.6	56.1	-	-
Population Density (prs/ha)	150	149	136	119	-	-
<b>Motorization</b>						
No. of Vehicles Registered ('000 in BMA)	1,911	2,773	3,406	4,065	2,154	4.8
No. of Motorcycles Registered ('000 in BMA)	1,335	1,936	2,355	2,730	1,395	4.6
Vehicle Ownership per Households in BMA (excl. Motorcycle)	0.94	1.20	1.32	1.42	-	-

Source: The JICA-BEIP Study Team

## 2 MACRO SPATIAL STRUCTURE

### 2.1 A Regional Spatial Context

The Thai Government has long pursued the decentralization policy, fostering several regional growth poles other than Bangkok in the spatial framework with a 100-200 Km radius from the center of Bangkok.

For the 8th National Plan, NESDB has depicted the regional spatial framework for the extended Bangkok Region, as shown in Fig. 2.1. High priority development is given to **Airtran Corridor** (Bangkok-Chachoengsao) to accommodate 940,000 additional population by the year 2010, driven by the Second Bangkok International Airport, including three new centers:

- Lat Krabang Center (target population: 180,000) : knowledge activities requiring close access to the SBIA;
- NHA New Town (target population: 250,000) : housing for direct and indirect aviation-related workers of the SBIA; and
- Chachoengsao West Complex (target population: 400,000) : a regional center with manufacturing and R & D center.

Other two growth centers are highlighted with high priority

- the Eastern Sea Board (ESB) Core, centered on Chonburi; and
- the Greater Suraburi Industrial Core (GSIC).

### 2.2 A Conceptual Spatial Structure of the Bangkok Metropolis

For the decentralization policy, a conceptual structure with a multi-polar system is proposed, as shown in Fig. 2.2, taking into account the followings:

- Publicly-initiated **Metropolitan Subcenters** should be developed at five locations in suburban areas within BMA that will function as commercial/business centers to make job-and-housing balance, thereby releasing the concentration pressure.
- Out of five subcenters, three subcenters will be self-sustained newtowns with a total of 1.5 to 1.6 million population, driven by mass transit systems. Other two will be functional centers with regional cargo distribution and light industrial centers which are to be linked with the relocation and regeneration policy for the inner city.

Fig. 2.1 Regional Spatial Framework in the Extended Bangkok Metropolitan Region (NESDB)

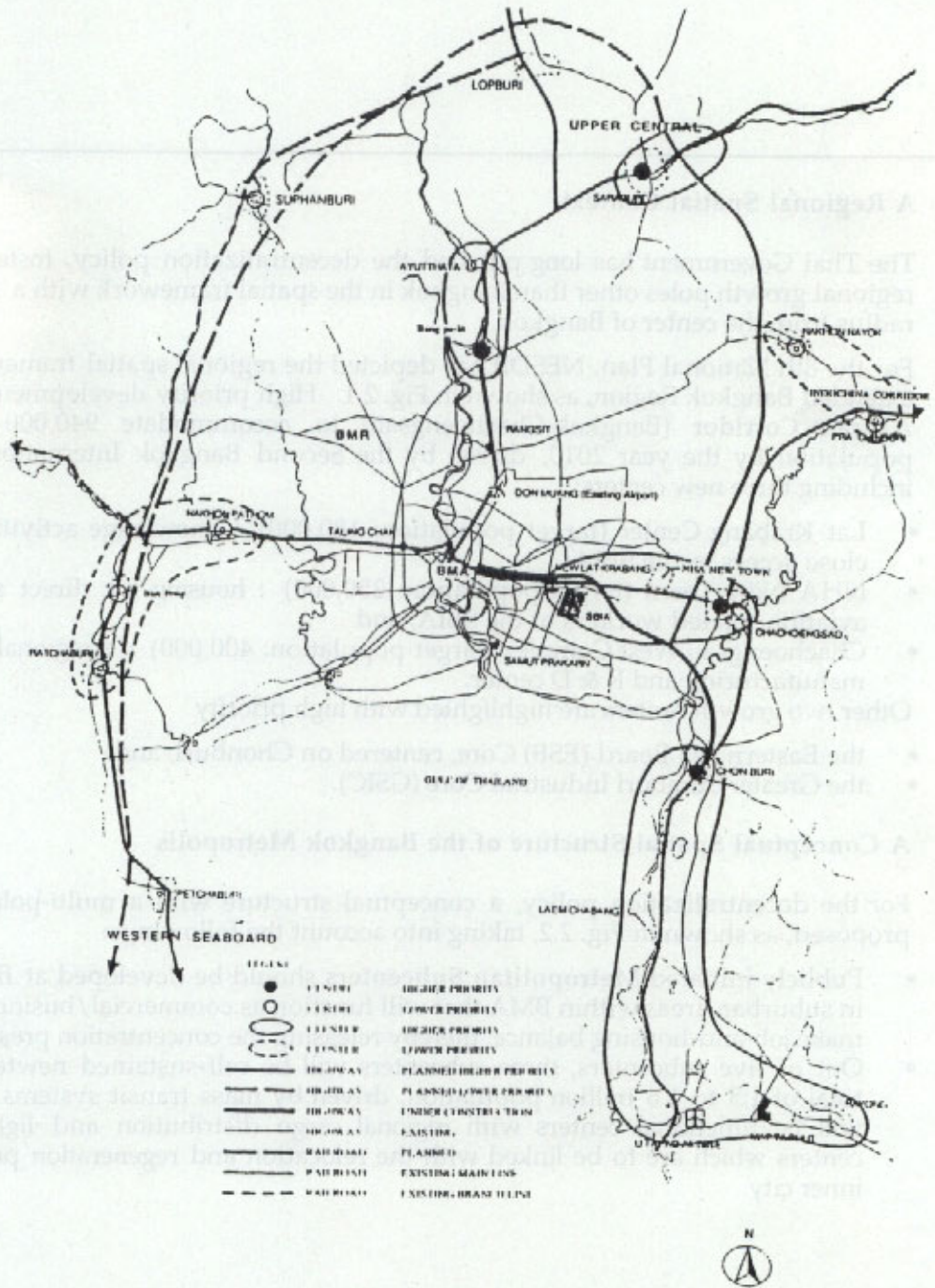


Fig. 2.1 Regional Spatial Framework in the Extended Bangkok Metropolitan Region (NESDB)

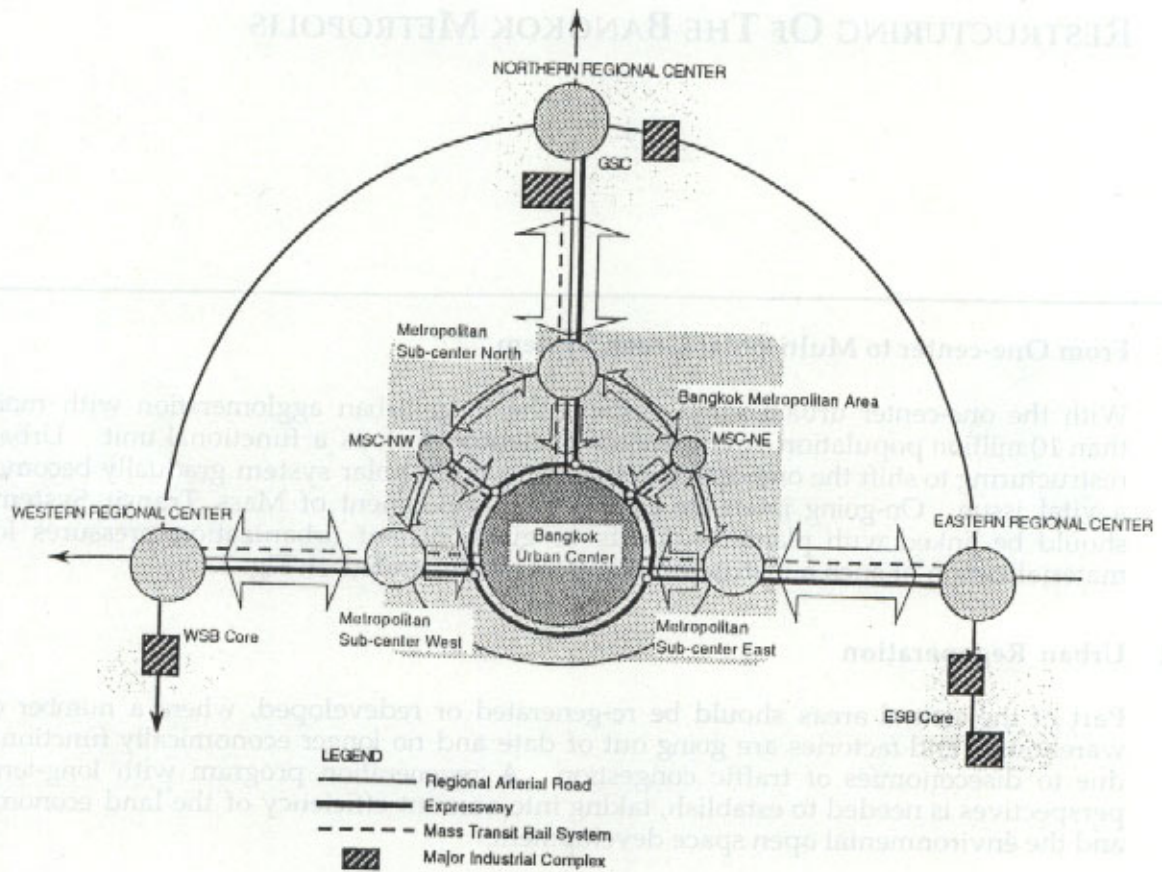


Fig. 2.2 A Conceptual Spatial Structure of Bangkok Metropolis (Proposed)

### 3 RESTRUCTURING OF THE BANGKOK METROPOLIS

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#### 3.1 From One-center to Multi-polar Urban System

With the one-center urbanization system, the mega-urban agglomeration with more than 10 million population can no longer efficiently work as a functional unit. Urban restructuring to shift the one-center system to a multi-polar system gradually becomes a vital issue. On-going intensive efforts for development of Mass Transit Systems should be linked with planning efforts to guide current urbanization pressures for materialization of such a restructured system, as illustrated on Fig. 3.1.

#### 3.2 Urban Regeneration

Part of the central areas should be re-generated or redeveloped, where a number of warehouses and factories are going out of date and no longer economically functional due to diseconomies of traffic congestion. A regeneration program with long-term perspectives is needed to establish, taking into account efficiency of the land economy and the environmental open space development.

#### 3.3 Sub-urbanization

Urban sprawl has rapidly been proceeding along several major corridors without any adequate landuse management system. Eventually, provision of infrastructures and public services cannot catch up with the demands. Infrastructure-led urbanization should be pursued, by employing institutional tools under well-coordination between urban planning and implementation of infrastructures.

#### 3.4 Mass-Rapid Transit-Driven Urbanization

Areas easily accessible to stations of the planned MRTs will be of highly value-added land in the real estate and housing market, thereby easily leading to intensive land use. Hence, such mass-transit driven urbanization is effective for management of traffic demands control.

Physical urban design of transport facilities and their network systems should be made in such a way that pedestrians and public transport passengers may take advantages in services and amenities with convenient inter-modal transfer systems.

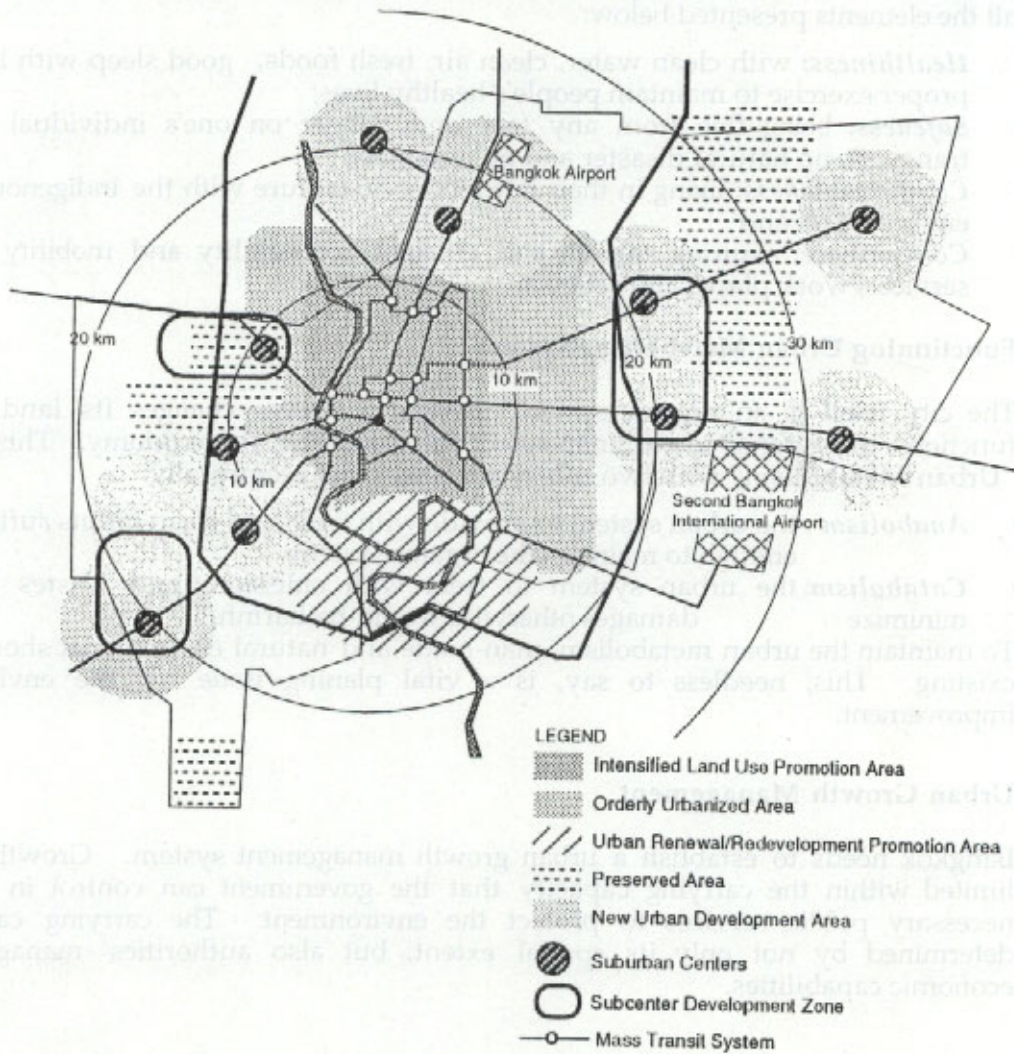
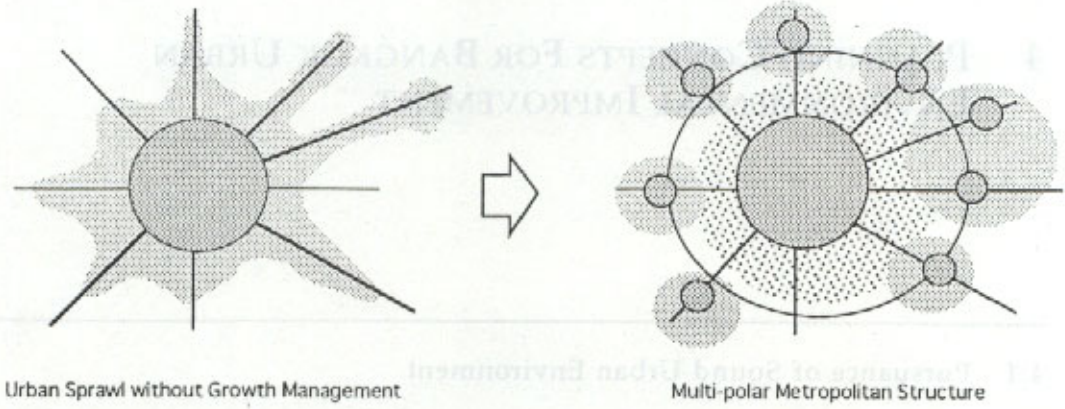


Fig. 3.1 A Concept of Urban Re-structuring towards Mass Transit-driven Urbanization

## 4 PLANNING CONCEPTS FOR BANGKOK URBAN ENVIRONMENTAL IMPROVEMENT

### 4.1 Pursuance of Sound Urban Environment

Planning of urban environmental improvement pursues four (4) vital elements of human life. The city should provide with environmental conditions in order to assure all the elements presented below:

- *Healthiness*: with clean water, clean air, fresh foods, good sleep with less noise, proper exercise to maintain people's healthy lives;
- *Safeness*: being free from any fear and danger on one's individual life: safe transport, no natural disaster and no criminals;
- *Comfortableness*: living in their inherent socio-culture with the indigenous natural environment; and
- *Convenience*: assuring smooth and efficient accessibility and mobility to urban services, work places and schools.

### 4.2 Functioning Urban Metabolism System

The city itself is an organic system, therefore, always changes its land use and functions, in response to requirements of the times and the economy. This is called "Urban Metabolism" with two sub-systems working reciprocally:

- *Anabolism*: the urban system to provide with fresh and clean inputs sufficiently enough to maintain the organic system;
- *Catabolism*: the urban system to treat with emissions and wastes so as to minimize damages otherwise would-be-harmful.

To maintain the urban metabolism, man-made and natural environment should be co-existing. This, needless to say, is a vital planning issue for the environmental improvement.

### 4.3 Urban Growth Management

Bangkok needs to establish a urban growth management system. Growth shall be limited within the carrying capacity that the government can control in providing necessary public services to protect the environment. The carrying capacity is determined by not only its spatial extent, but also authorities' managerial and economic capabilities.

## 5: PLANNING ISSUES, TARGETS AND MACRO MEASURES

### 5.1 Planning Issues

Deterioration of Bangkok environment has been reaching a critical level, which means that further worsening of the quality of environment will jeopardize the people's lives as well as a sustainable socioeconomic growth. The majority of the Bangkok residents has been already aware of that substantial solutions on environmental problems should be prioritized even though they pay some cost against the economic growth (refer to Box-1).

A fragmented symptomatic approach will no longer be effective to resolve problems of environmental deterioration, but an integrated approach is essential. New social rules are needed in using resources of the Metropolis, which are unique, intrinsic and compatible to the Thai socio-culture. Planning issues, in this sense, are identified to be the following six:

- Sustainable Resource Utilization in Vulnerable Environment;
- Flood-free Urbanization;
- Environment-initiative Urban Transport System;
- Creation of "Water-friendly Eco-city";
- Pursuance of "Fresh and Clean Air policy"; and
- Up-grading of Quality of Living Environment.

These issues are reciprocally related with each other, refer to Fig. 5.1.

### 5.2 Planning Target 2011

Planning targets for urban environmental improvement are set forth in accordance with the identified planning issues, aiming at the year 2011, as shown in Tables 5.1. The proposed targets are both descriptive and numerical, based on the visions derived from the following three:

- **Analyses** of the most-likely future perspective, based on assessment of present environmental attributes, potentials and constraints;
- **Attainability**, taking into account the performance of past and on-going projects and policies directed by the central government and BMA; and
- **A vision** of planners on what Bangkok should or could be developed and improved to be like.

### 5.3 Macro Measures to Achieve the Targets

Macro measures to achieve the targets are recommended, based on results of the studies and simulation analyses (refer to Table 5.1). The measures, including both soft and hard ones, should be pursued by the national level as well as BMA. And, some of them call for business sector's participation or people's strong involvement.

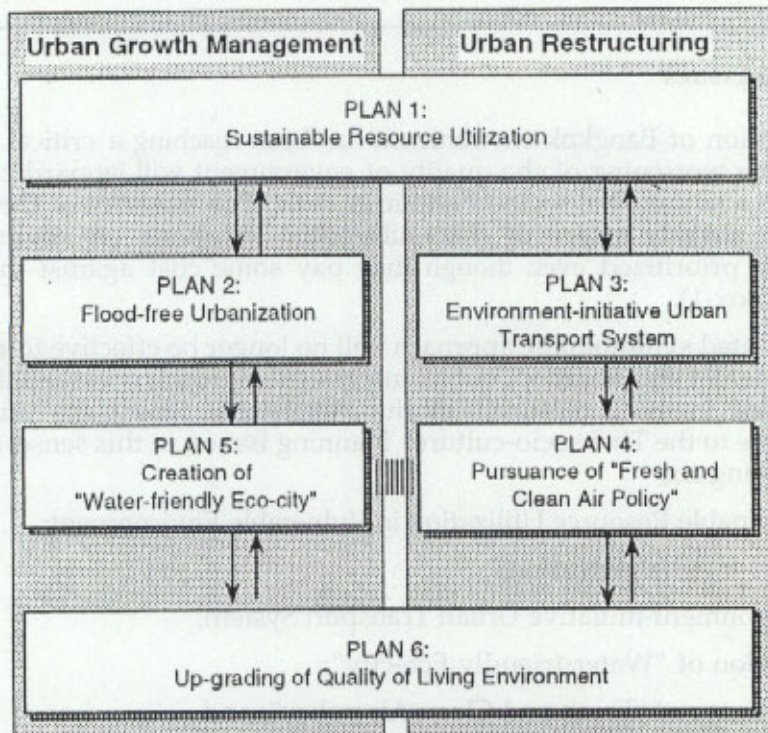


Fig. 5.1 Planning Issues and Linkage

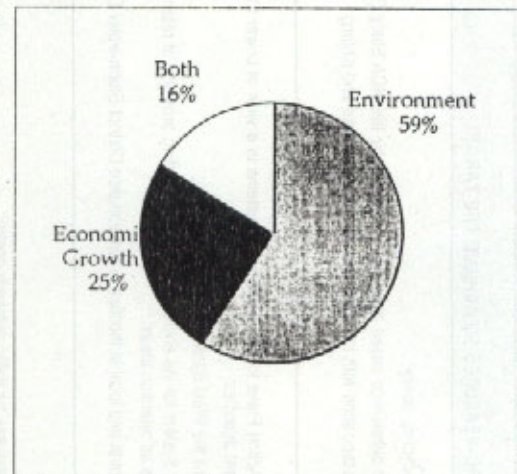
### Box-1: Environment Awareness Survey for Bangkok People

#### 1. People's Awareness regarding Urban Environment:

##### Environment VS. Economic Growth

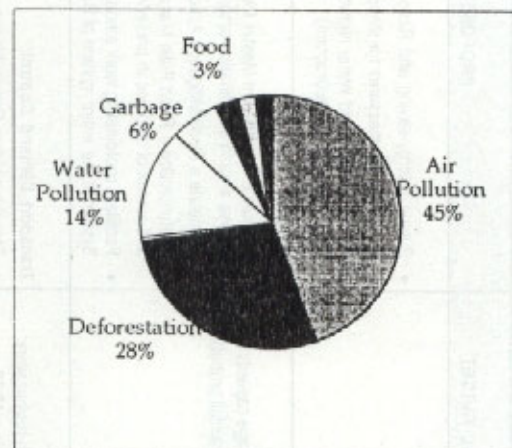
Which do you think more important "Economic Growth" or "Environment"?

- 1) Environment
- 2) Economic Growth
- 3) Both



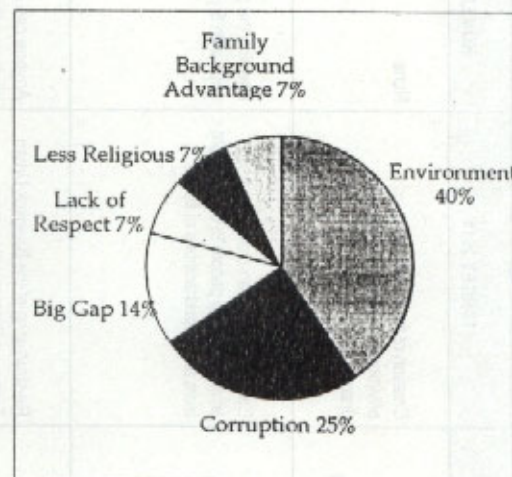
#### 2. Most Serious Problems in Bangkok

- 1) Air Pollution
- 2) Deforestation
- 3) Water Pollution
- 4) Garbage
- 5) Food
- 6) Drought
- 7) Noise Pollution



#### 3. Most Serious Problems in Thai

- 1) Natural/Environmental Deterioration
- 2) Rife Corruption and Bribery
- 3) Too Big Gap between the Rich and the Poor
- 4) Lack of Respect for the Superious and the Elderly People
- 5) People are Less Religious
- 6) Good Family Background is an Advantage for Job Opportunity



Source: Environmental Awareness Survey, September - December 1994, IDE

Table 5.1 PLANNING TARGET AND MACRO MEASURES FOR ENVIRONMENTAL IMPROVEMENT (1/3)

PLANNING ISSUE	TARGET 2011	NUMERICAL TARGET	PROPOSED MACRO-MEASURES TO ACHIEVE THE TARGET
PLAN 1: Sustainable Resource Utilization in Vulnerable Environment	Creation of the robust urban environment against the natural disasters.	None	<ul style="list-style-type: none"> <li>Pursue Energy-saving and Resources-recycling policy;</li> <li>Undertake the measures for stopping land subsidence based on recommendations by the JICA Study (1992-95);</li> <li>Develop "Green and Water Network" (in association with road improvement, public parks and Khlong beautification projects/program).</li> </ul>
PLAN 2: Flood-free Urbanization	Creation of the man-made environment for people to be free from fears and apprehensions of floods	Keeping the drainage capacity to cope with 5 year rainfall probability	<ul style="list-style-type: none"> <li>Formulate a Long-term Master Plan and Action Plans for flood protection systems in a view of Lower Chao Phraya area in coordination among relevant agencies;</li> <li>Formulate a Flood Mitigation Action Plan for the West Bank Area (Thonburi Side);</li> <li>Institutionalize a Flood Plan Management System for the entire urban areas, including provision of retention ponds and control of land use in preserved areas as retention areas;</li> <li>Facilitate coordinating work among the central and local authorities to functionalize District Storm-water Drain System in the entire system of Bangkok.</li> </ul>
PLAN 3: Environment-initiative Urban Transport System	Re-structuring of the Bangkok Urban Transport System with a more environment-oriented system, or shifting to a public transport-based system; and Mitigation of road traffic congestion, providing with alternative urban public transport modes by which people may select means suitable for their purposes and time constraint.	Anyone can reach his/her work place or school within 45-60 minutes; and The modal share of public transportation shall be more than 50 % (as of all modes including walking trips), compared to 42% at present.	<p><b>Transport Demand Control:</b></p> <ul style="list-style-type: none"> <li>Straighten Urban Growth Management measures for traffic demands control;</li> <li>Designate a policy zone of "Public Transit Advantage Zone" in part of CBD, where public transport services are intensively improved and in-flow of the private vehicles is controlled with institutional schemes;</li> <li>Introduction of "Traffic Assessment Study" for permission of large-scale projects</li> </ul> <p><b>Public Transport System Development:</b></p> <ul style="list-style-type: none"> <li>Facilitation of on-going Mass Transit Systems Projects based on the OC MRT Master Plan;</li> <li>Reroute bus service network/routes in the total public transport system;</li> <li>Improve waterway transport systems on major khlongs;</li> <li>Develop intermodal facilities/stations to transfer between "MRT-bus", "bus-waterway" and "MRT-waterway", in association with taxi and other para-transit systems;</li> <li>Improvement of pedestrian facilities;</li> </ul> <p><b>Road Transport Development:</b></p> <ul style="list-style-type: none"> <li>Made further efforts to construct more arterial and collector roads, reviewing the priority scheme under well-coordination among relevant organizations of DCH, BMA and ETA;</li> <li>Develop tertiary/local road network in association with urban renewal and new urban development projects;</li> <li>Accelerate the construction of the Ring Expressway System given the highest priority;</li> <li>Improve the traffic control system, based on technical and analytical implications, including functionalization of the vested ATCS.</li> </ul>

PLANNING TARGET AND MACRO MEASURES FOR ENVIRONMENTAL IMPROVEMENT (2/3)

PLANNING ISSUE	TARGET 2011	ALLIEMENTAL TARGET	PROPOSED MACRO-MEASURES TO ACHIEVE THE TARGET
<p><b>PLAN 4:</b> Pursuance of "Fresh and Clean Air Policy"</p>	<p>Mitigation of air pollution up to a level that people may feel no damage on health</p>	<p>Ambient air pollution levels in most of Bangkok urban areas shall satisfy the Environmental Standard: CO: 9 ppm (8 hrs. avg.) NO<sub>2</sub>: 0.17 ppm (1 hr. avg.) SO<sub>2</sub>: 0.3 ppm (1 hr. avg.) TSP: 0.1 mg/m<sup>3</sup> (1 year avg.) PM10: 0.12 mg/m<sup>3</sup> (24 hrs. avg.) O<sub>3</sub>: 0.1 ppm (1 hr. avg.)</p>	<p><b>Environmental Administration:</b></p> <ul style="list-style-type: none"> <li>Enhance monitoring and analytical technique of environmental administrators;</li> <li>Review the current environmental standards and formulate policies and strategies to achieve the standards;</li> <li>Promote "public awareness" of air pollution to enlighten driving manners and promote environmental concerns to constructors for mitigating pollutant emission from construction sites;</li> <li>Strengthen voluntary environmental management in the business sector through introduction of "ISO 14000".</li> </ul> <p><b>Measures for Mobile Sources:</b></p> <p>All measures for mitigation of traffic congestion is simultaneously effective to mitigation of air pollution. On this background, the sectoral measures are to:</p> <ul style="list-style-type: none"> <li>Enhance control measures for "vehicle emission" with introduction of new vehicle regulation and inspection/maintenance systems;</li> <li>Promote replacement to Low-pollution Buses and Trucks by both public and private operators with provision of institutional incentives;</li> <li>Introduction of Quality Fuel: diesel oil with less sulfur contents and lower particulate matter (PM) emission (to be refined with lower distillation temperature);</li> <li>Promote R &amp; D of less pollution vehicles;</li> <li>Improve the road structure with buffer greens, particularly for arterial heavy traffic roads;</li> <li>Explore effective traffic management to increase the average vehicle travel speed;</li> </ul> <p><b>Measures for Stationary Sources:</b></p> <ul style="list-style-type: none"> <li>Monitor regularly emissions of potential stationary sources;</li> <li>Guide and introduce technologies for appropriate combustion management as well as installation of environmental protection equipment so as to save energy as well as mitigate air pollution;</li> <li>Promote fuel conversion to less pollution fuel like LPG and/or LNG;</li> <li>Provide an incentive scheme for factories to undertaken these measures against air pollution.</li> </ul>

PLANNING TARGET AND MACRO MEASURES FOR ENVIRONMENTAL IMPROVEMENT (3/3)

PLANNING ISSUE	TARGET 2011	NUMERICAL TARGET	PROPOSED MACRO MEASURES TO ACHIEVE THE TARGET
<p><b>PLAN 5:</b> Creation of "Water-friendly Eco-city"</p>	<p>Restoration of the Thai water culture in association with improvement of water quality in Khlongs</p>	<p>BOD: less than 15 mg/liter in major Khlongs in the special policy zone (Khlong Water Quality Improvement Promotion Zone)</p>	<ul style="list-style-type: none"> <li>• Designate a policy zone for "Khlong Water Quality Improvement Promotion Zone" in the central areas where special efforts should be intensively made with the highest priority;</li> <li>• Review the existing Sewage Master Plan, based on recommendations by the BEIP Study;</li> <li>• Facilitate the implementation on-going sewage projects under well-coordination among BMA, PCD and the newly established Waste Water Management Authority (WMAA);</li> <li>• Further encourage the implementation of the on-going "Khlong Water Quality Improvement Project" in East Bank, and expand the project in West Bank (Thonburi area) as proposed by the BEIP Study;</li> <li>• Create "Green-cum-Water Network System" along major khlongs, implementing the expanded "Beautification Programs";</li> <li>• Promote Public Campaigns for "Clean, Green, Khlong"</li> </ul>
<p><b>PLAN 6:</b> Up-grading of Quality of Living Environment</p>	<p>Materialization of Healthy, Safe, Comfortable and Convenient Environment for all people, with social cares for the urban poor, elderly and handicappers</p>	<p><b>Solid Waste Management:</b> Reduction of Per Capita Generation Rate of Solid Waste: by 10% <b>Water Supply:</b> Supply to all residents in urban areas, in association with reduction of the leakage ratio up to less than 20%</p>	<p><b>Solid Waste Management:</b></p> <ul style="list-style-type: none"> <li>• Formulate a Long-term Master Plan for Solid Waste Management for BMA;</li> <li>• Facilitate on-going Solid Waste Treatment Projects as urgent projects;</li> <li>• Acquire and prepare the land for final disposal on the long-term perspective within the BMA jurisdiction;</li> <li>• Promote community organization activities for people to participate in reducing, recycling and separation collection;</li> </ul> <p><b>Water Supply:</b></p> <ul style="list-style-type: none"> <li>• Review the existing Master Plan of Water Supply, taking into account the current and future urbanization process, and formulate "Rehabilitation Action Plans" of existing distribution systems;</li> <li>• Facilitate water supply and rehabilitation projects based on the reviewed Master Plan and Action Plans;</li> <li>• Strengthen the operation, maintenance and management system for distribution facilities and subscribers (GIS technique etc.)</li> </ul> <p><b>Housing and Community Development:</b></p> <ul style="list-style-type: none"> <li>• Facilitate provision of low and middle income housing by both HNA and the private sector;</li> <li>• Make further efforts for tackling slum problems with a comprehensive approach, including financial support institutions;</li> <li>• Creation of pedestrian-advantageous environment;</li> </ul>

## 6 PLAN 1: SUSTAINABLE RESOURCE UTILIZATION IN VULNERABLE ENVIRONMENT

Planning started with recognizing the fact that Bangkok locates with environmentally vulnerable conditions as represented by the following. Hence, emphasis should be placed on sustainable resources utilization to get on well with the environment.

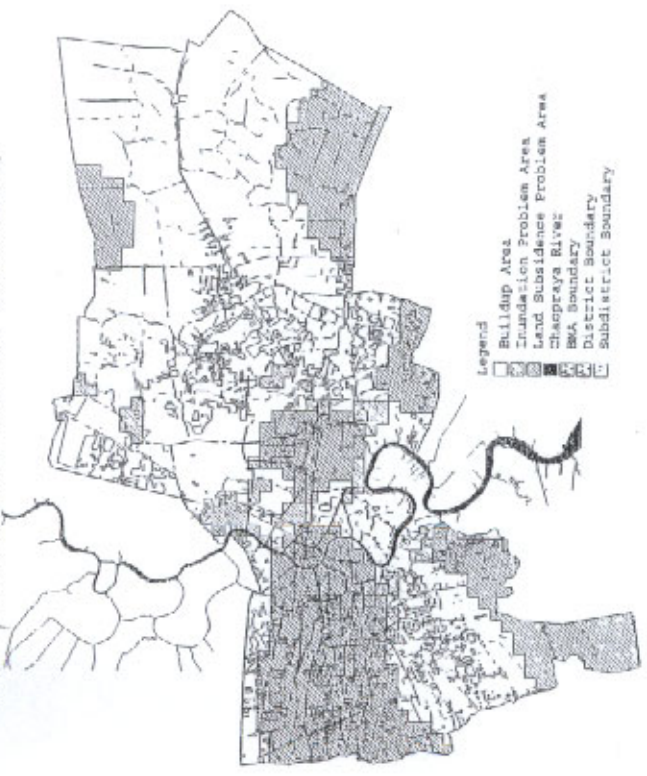
- **Tropical Climate Severe for Human Environment:** It has too much precipitation in monsoon season (more than 300 mm per month) and too little in dry season (less than 10 mm per month). This naturally causes floods in monsoon season and serious air pollutants in dry season.
- **Low Alluvium Plain Susceptible to Natural Disasters:** the Bangkok metropolis locates in the low alluvium flat plain of the Chao Phraya River Delta (1 to 2 meter MSL), and environmentally sensitive to land subsidence and "Global Warming" (the sea level will rise by 50 cm in coming 100 years on the average).
- **Water and Greens Vulnerable to Environmental Changes:** Water and greens are the natural gifts to moderate the serious climatic conditions, and the most effective tools to mitigate the environmental pollution<sup>1</sup>.
- **Energy-consuming Modernization:** The modernization cannot be stopped, but the current movement is running on the energy-consuming economy. For instance, the energy consumption to produce one unit of value-added in Thailand is 5 times as much as that in Japan. The per capita garbage generation amount in Bangkok is almost same as that of London. Thus, Bangkok economy needs to shift towards an energy-saving and energy-recycling systems in the process of modernization and urbanization.

The Thai culture is based on an exquisite and delicate natural system with water and greens. Planning, therefore, should focus on:

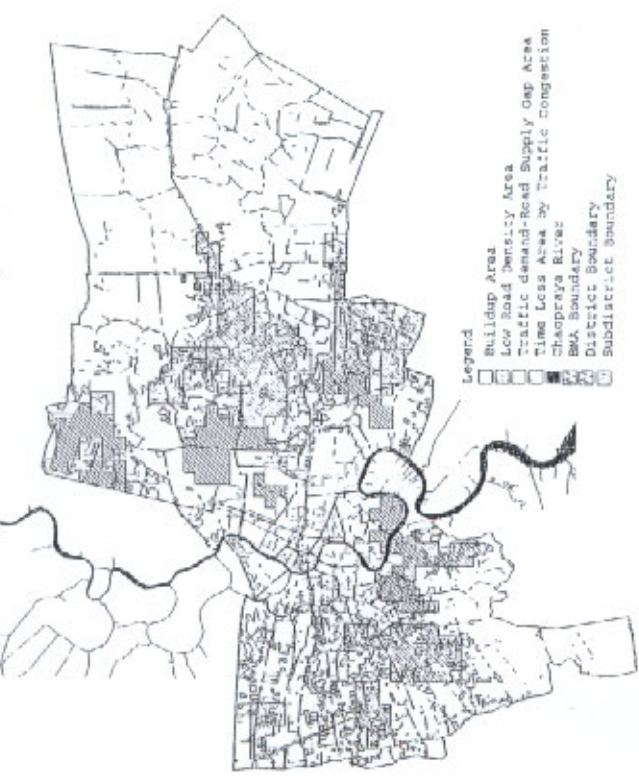
- Restoration and rehabilitation of "Green and Water Network System";
- Establishment of social rules and guidelines for stopping the land subsidence and protecting the living environment from floods; and
- Pursuance of Resource-recycling system and guiding to Energy-saving urban economic development.

<sup>1</sup> An Investigation on the Distribution of Air Temperature and the Effect of Open Space on Mitigating Server Climate in Bangkok, Thailand (Nath Pichakum and Yorikazu Maruta, 1995) presents the result of simulation analysis using isotherm maps of Bangkok. Two interesting discussions are: 1) the difference of air temperature between built-up area and open space areas is identified to be 3.0 °C at 3:00 PM; and 2) when green coverage increases by 10%, air temperature reduces by 0.43-0.55 °C.

Problem Areas on Natural Conditions



Problem Areas on Urban Transport



Problem Areas on Living Environment



Problem Areas on Air Quality and Solid Waste



Fig. 6.1  
Bangkok Urban Environmental Problem  
Evaluation Map



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



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



JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

## 7 PLAN 2 : FLOOD-FREE URBANIZATION

The most important urban planning issue must be first on how to manage water wisely and how to realize a flood protection system. However, taking into account the severe natural conditions, it seems almost impossible to create the everlasting man-made environment to perfectly protect all the areas from floods. A vital issue, therefore, is how to minimize the socioeconomic damages from chronic floods by mobilizing both institutional and technical tools for appropriate land use and water management. To this end, the following are proposed:

### 7.1 Long-term Master Plan

Substantial flood protection systems and the action programs should be formulated on long-term perspectives. This may include some large-scale projects (century projects) to release Bangkok from the chronic problem.

### 7.2 Formation of A Hierarchical Drainage Network System

The drainage system, same as the road network, should be functionally networked with a hierarchical system (refer to Fig. 7.1), i.e.,

- the primary drain may be the Chao Phraya River;
- the secondary drain system comprised of diversion canals and major khlongs, connecting directly the primary drain; and
- the tertiary drain comprised of the klong network, linking with the secondary drain system.

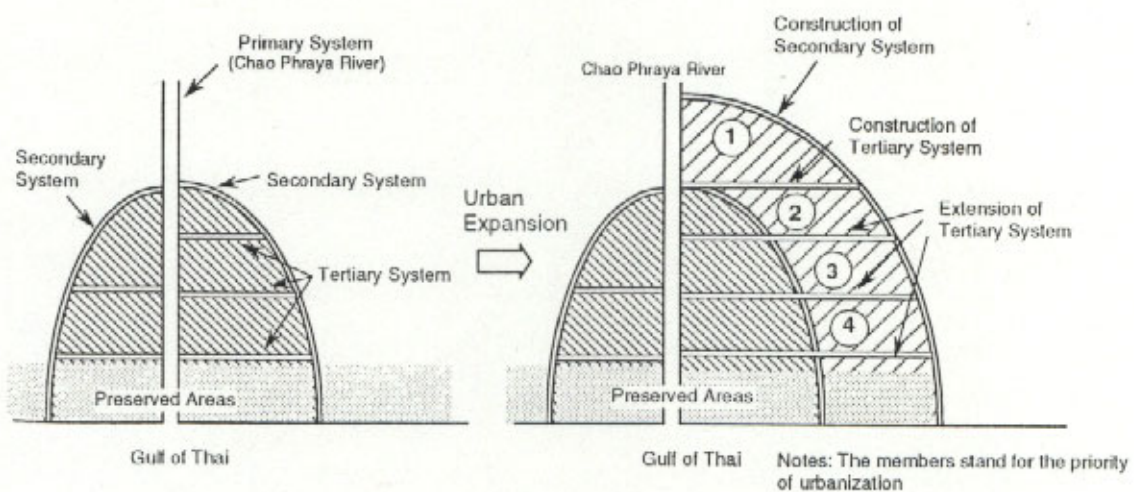


Fig. 7.1 A Conceptual Structure of Drainage and Urbanization

### 7.3 Establishment of Well-functioning Flood Control System

Rehabilitation and improvement of existing drainage facilities should be further strengthened with establishment of the well-organized maintenance and management system under coordination between the relevant agencies. Especially, engineering and technical aspects of local drainage systems need to be functionally and rationally organized in the total system of Bangkok.

### 7.4 Control of Environmentally Preserved Land

The geological condition of Bangkok is not homogeneous but heterogeneous in terms of suitability of land uses. Therefore, proper land use should be located on the suitable land, and priority for urbanization needs to be coherent with development of the flood protection systems. Areas where are assessed to be preserved from the environmental standpoints need to be strictly controlled. Those are:

- Eastern areas from the so-called the King's Dike (flood wall); and
- Coastal transition area facing the Gulf of Thailand.

The area between King's Dike and the middle flood wall and the Taling Chan area should be given special attention in land development activities. A strict guideline is needed, that is, the water retaining capacity of the land after the activity must not be less than the status quo.

7.2 Formation of a Hierarchical Drainage Network System  
 The drainage system, same as the road network, should be functionally networked with a hierarchical system (refer to Fig. 7.1).  
 • the primary drain may be the Chao Phraya River;  
 • the secondary drain system composed of distributary canals and water bridges connecting directly the primary drain; and  
 • the tertiary drain composed of the lateral network joining with the secondary drain system.

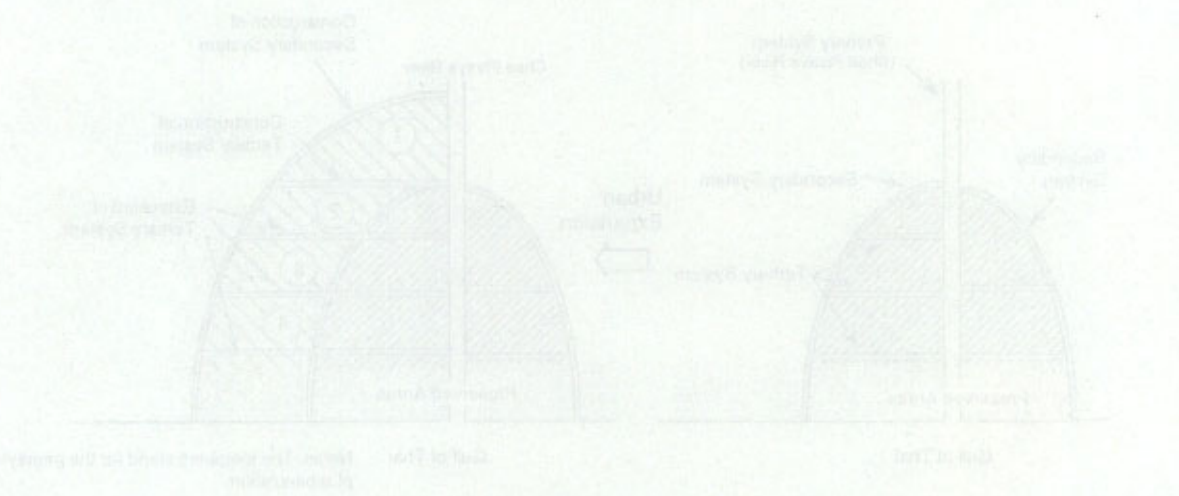


Fig. 7.1 A Conceptual Structure of Drainage and Urbanization

## 8 PLAN 3: ENVIRONMENT-INITIATIVE URBAN TRANSPORTATION SYSTEM

### 8.1 Structure of Road Traffic Congestion

Environmental problems of Bangkok are attributed mainly to excessive concentration of economic activities and centric urban functions into the Bangkok Metropolis. However, "concentration" does not necessarily stand for "congestion". Road traffic congestion takes place where adequate and sufficient provision of road spaces and public transport services cannot meet the travel demands generated in the car-oriented society.

Current road traffic congestion in Bangkok is accrued from a gap between transport demands and supplies, that is:

- Shortage in the surface road density (5% of urbanized areas are occupied for road areas in Bangkok, compared to 15% in Tokyo, 20% in London);
- Lack of a well-functioning secondary road network systems;
- Lack of reliable public transport systems as alternative means;
- Less coordination between land development and road provision; and
- Lack of "Demand Control Measures".

### 8.2 Planning Implications from Transport Simulation Analyses

The simulation analyses were made to identify the effectiveness of some transport policies to fulfill the gap between transport supplies and demands. The following implications were derived from the computerized simulation results (refer to Tables 8.1 and 8.2):

- At present, as of 1995, out of the total road length of 1,732 km within BMA, 663 km, or 38%, are assessed to be heavily congested in morning peak hours;
- Given a hypothetical assumption that the road projects committed for the 8th National Plan with additional 664 km, including ETA expressways, DOH and BMA roads were provided at present, the heavily congested roads would be reduced to half, or 354 Km. Furthermore, given an additional assumption of the completion of MRT systems, the length of heavily congested roads would come down to 219 km. Thus, the planned road projects and MRTs are significantly effective to mitigate the road congestion on the present demand structure. This means that those planned projects should have been implemented 10 years earlier.
- Taking into account the increasing demand in 2011, even if all the planned road and MRT projects are completed, the road traffic conditions in 2011 will never be improved, but worsen in terms of the total length of congested roads, say, 1,100 Km out of 2,376 Km, or 46 % which represent a Congestion Index (CI) 121, compared to CI=100 at present. This means that the projects of the 8th Plan will be too short to mitigate the road traffic congestion in the future. More effective policies and measures are needed.

### 8.3 A Shift to a Mass Transit-driven Urban System

As far as the Bangkok transport system is/will be based on the "car-oriented society", a substantial solution for the traffic congestion problem seems impossible. A shift from the road transport-based to a mass transit-driven urban system is a vital environmental issue for future Bangkok. To this end, the following strategies are strongly endorsed:

- to guide intensive urbanization onto selected Metropolitan **Subcenters** where will be structured with MRT systems;
- to develop **inter-modal transfer** terminals/facilities with pedestrians, buses, waterways and MRTs;
- to re-route to rationalize the current bus service network in association with improvement of the existing operation systems;
- to develop "**park-and-ride**" facilities to encourage a modal shift from individual cars to MRTs;
- to improve the "**pedestrian environment**" especially in the Public Transport Advantageous Zone" and "Public Transport Corridors".

### 8.3 Public Transport Corridor Development

Special policy emphasis should be placed on development of "Public Transport Corridors" combined with MRTs and buses, using radial arterial/secondary roads. Eight (8) corridors with traffic advantages to MRT and buses are proposed. In the corridors, inter-modal transfer facilities and pedestrian environment should intensively be improved.

### 8.4 Hierarchical Road Network System

A hierarchical road network system should be developed with special emphasis on the followings:

- Middle Ring Expressways should be given a higher priority rather than radial expressways;
- Inter-regional arterial road network should be linked with Outer Ring Road and Middle Ring Expressways to make a stem structure with a Ring-and-Ladder Pattern;
- Development of "Secondary and Tertiary" roads in built-up areas should be further facilitated in association with Urban Renewal and Land Readjustment Projects;
- Infrastructure-led suburbanization should be guided by institutional tools such as guidelines for the private sector's land development activities;
- Coordination in planning among relevant organizations such as BMA, DOH, PWD and ETA should be made to avoid duplicated efforts and funds; and
- Traffic control systems should be improved, based on analytical bases, and
- The vested Area Traffic Control System (ATCS) should be made more functional with necessary institutional arrangement and human resource development to operate the system.

Table 8.1 Ten Cases of Transport Simulations

	DEMAND			SUPPLY			SPECIAL POLICY
	1995	TREND 2011	NEW 2011	1995	8th Plan Road Projects	MRT	
CASE 1	•			•			
CASE 2	•			•	•		
CASE 3	•			•	•	•	
CASE 4		•		•			
CASE 5		•		•	•		
CASE 6		•		•	•	•	
CASE 7		•		•	•	•	BUS PRIORITY
CASE 8		•		•	•	•	ROAD CAPACITY INCREASE
CASE 9		•		•	•	•	AREA RESTRAINT
CASE 10			•	•	•	•	SUB CENTER DEVELOPMENT

## Notes:

- 1: The 8th Plan Road Project includes all the major road projects as supplied by agencies .
2. MRT is the mass transit system as defined by CMIP, the mass transit master plan of OCMRT .

Table 8.2 Results of Simulation Analysis:

## Congestion Ranking for Roads within BMA in Morning Peak Hour

RANK/ CASE	1	2	3	4	5	6	7	8	9	10
1. SATURATED	13.2%	3.4%	1.5%	62.2%	35.5%	23.8%	10.1%	32.0%	16.8%	18.2%
2. HEAVILY CONGESTED	15.7%	6.0%	3.8%	13.2%	14.6%	13.8%	14.1%	13.2%	14.8%	13.3%
3. CONGESTED	9.4%	5.5%	4.0%	5.8%	8.4%	8.6%	9.0%	7.2%	9.1%	9.3%
4. ACCEPTABLE	12.6%	10.1%	8.0%	5.8%	10.4%	10.3%	11.5%	9.8%	11.9%	11.5%
5. UNDER CAPACITY	49.1%	75.0%	82.7%	13.0%	31.1%	43.5%	55.3%	37.8%	47.4%	47.7%
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Simulated Length(km)	1732	2376	2376	1732	2376	2376	2376	2376	2376	2376
EVALUATION										
Sub -Total of Rank1 - 3.	38.3%	14.9%	9.3%	81.2%	58.5%	46.2%	33.2%	52.4%	40.7%	40.8
Congested Road (km)	(663)	(354)	(219)	(1406)	(1389)	(1100)	(789)	(1246)	(965)	(971)
Congestion Index (C.I)	100	39	24	212	152	121	87	137	106	106
Public Transport Share (%PT)	55%	50%	60%	55%	43%	58%	63%	48%	61%	50%

Note C.I. : Congestion Index (Based on Percentage of Congested Roads in 1995=100)

%PT : Modal share of public transport in person trip, not including walking trip



Fig. 8.1

**BEIP Proposal  
for BMA Transport Structure**

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**LEGEND**

- ..... Mass Rapid Transit System
- E.T.A. Expressway System
- Primary Arterial System (inter-urban Road)
- Major Secondary Arterial System (Major Inter-urban Road)
- BEIP Proposal for Secondary System
- BEIP Proposal for Sub-Centre

## 9: PLAN 4: FRESH-AND-CLEAN AIR POLICY

### 9.1 Measures for Air Pollutant Sources

**"Healthy Bangkok"** with no air pollution should be created so that people can take deep breath and absorb fresh air into their bodies.

Mitigation of air pollution depends greatly on policies and/or political will, as proved by the dramatic success in reduction of "lead" in Thailand. Important environmental measures are:

- Enhancing ambient air quality monitoring;
- Strengthening of regulations and monitoring for individual of potential pollutant sources with both institutional installment and technical approach;
- Employing a policy of the total pollutant load control in the long-term; and
- Promoting R & D to develop environmental technologies of less pollution vehicles as Thai National Car, with strong supports by the government and the private sector.

### 9.2 Mobil Sources Related to Urban Transport System

PM-10 (or SPM) and NO<sub>2</sub> are the most serious pollutants in Bangkok, which are caused by vehicular traffic. The air pollution simulation analysis reveals that most of the built-up areas are covered with the air with significantly higher concentration of PM-10 and NO<sub>2</sub> than the Thai environmental standard, as shown in Fig. 9.1.

The level of air pollutant loads are determined by three factors: 1) emission factors; 2) traffic volume; and 3) average travel speed. The optimal policy-mix needs to address proper measures to each element.

The simulation analysis also provides a planning implication that without a considerably severe policy mix, the air pollution cannot be mitigated to be under the designated standard level in terms of PM-10 and NO<sub>2</sub>. The effective policy-mix calls for:

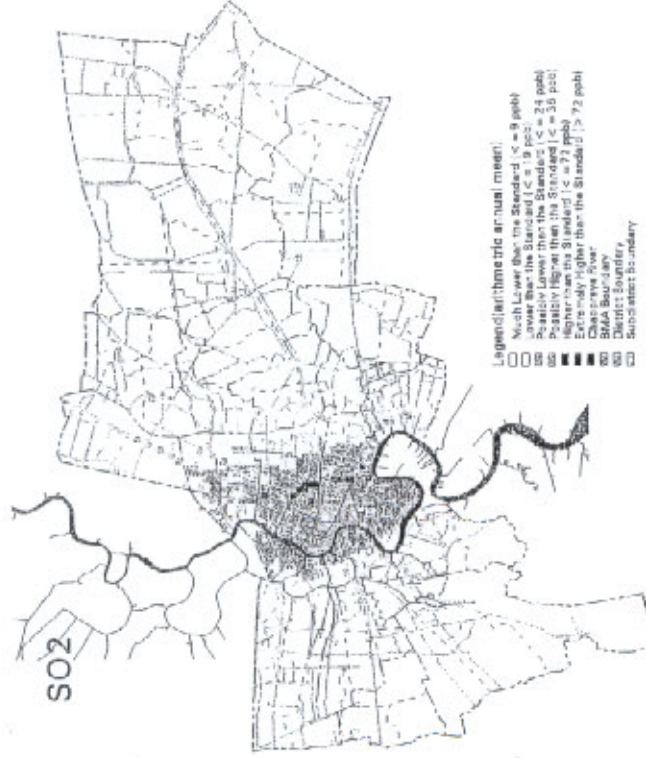
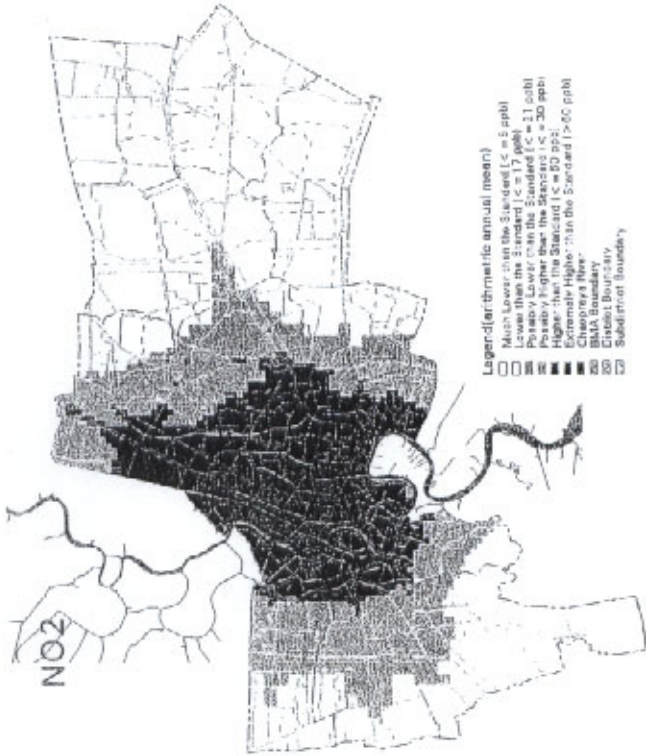
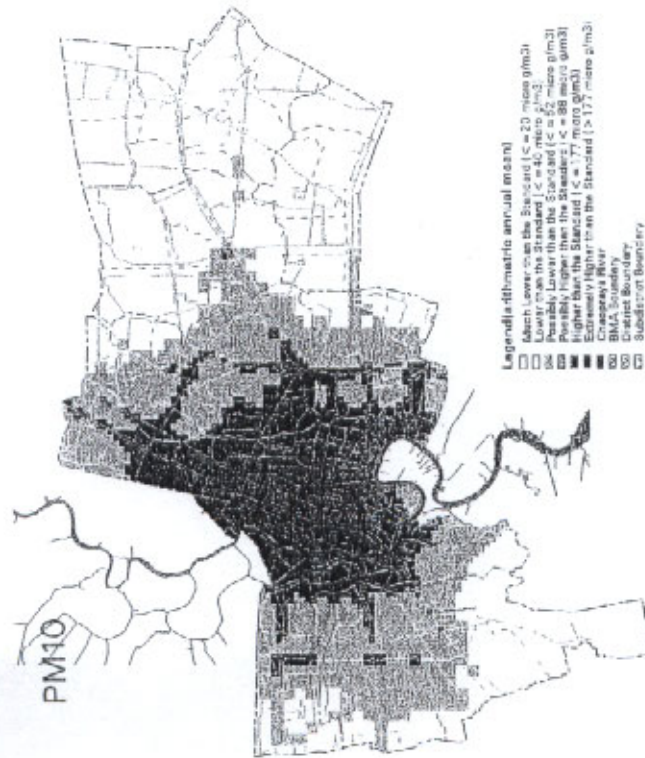
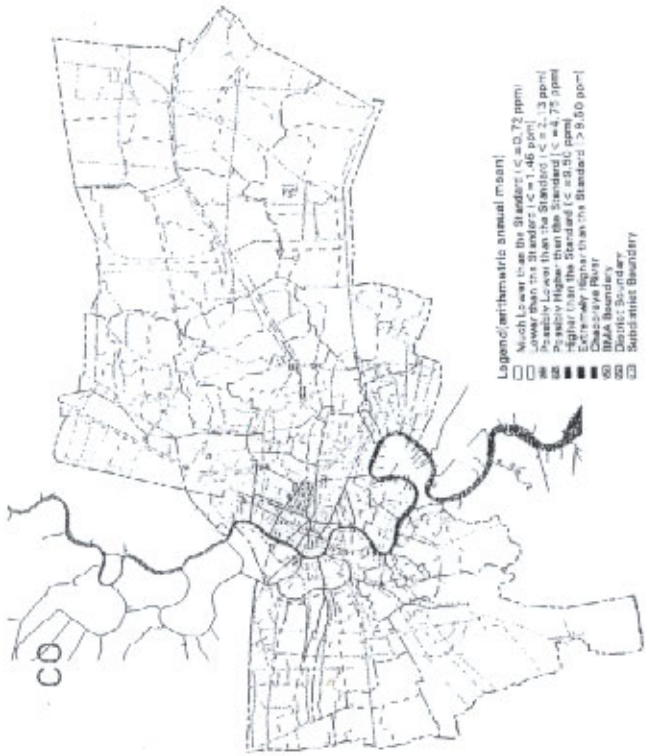
- Significant shift of passengers from road transport to MRTs;
- Strong vehicle emission regulation policy (as the European standard) and effective inspection/maintenance system; and
- Travel speed up on road traffic in the inner city.

The state of air quality depends greatly on the urban structure and the transport system. The simulation analysis, again, reveals that given the urban re-structuring policy strengthened by a shift to the public transport-oriented system as well as subcenter development as proposed in the BEIP Study, the air pollutant diffusion pattern in 2011 would be significantly changed, as shown in Fig. 9.2. Despite that in the central area there will still exist a number of areas with higher concentration of PM-10 and NO<sub>2</sub> than the standard, the air condition of Bangkok will be improved as a whole.

Fig. 9.1 Simulated State of Air Quality in 1995

### Case 1

- Present Vehicle Emission Factor
- Present Road Network
- Present Mass Transit Network
- Present Transport Demand



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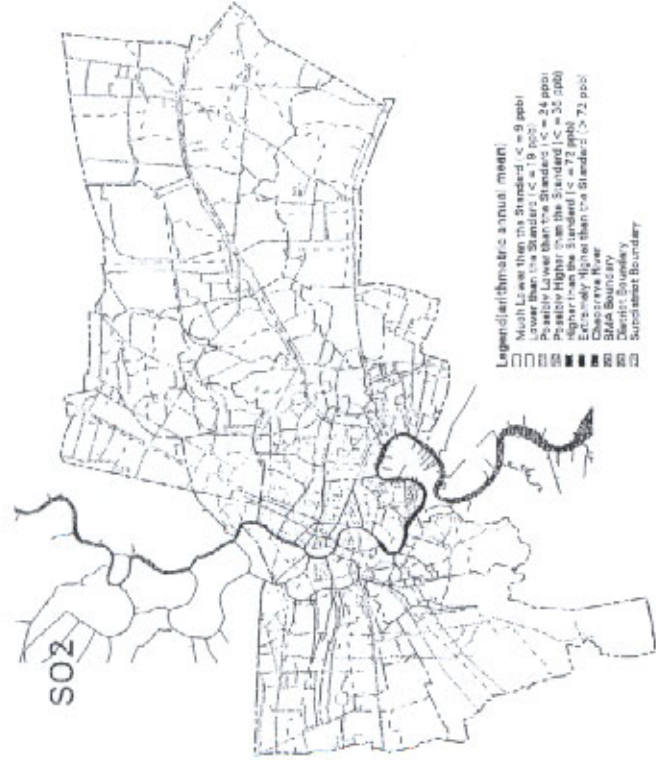
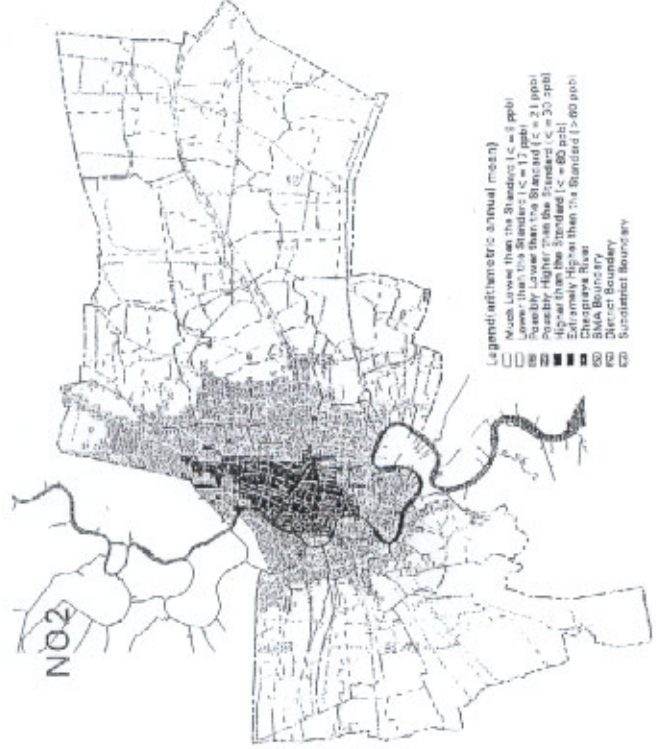
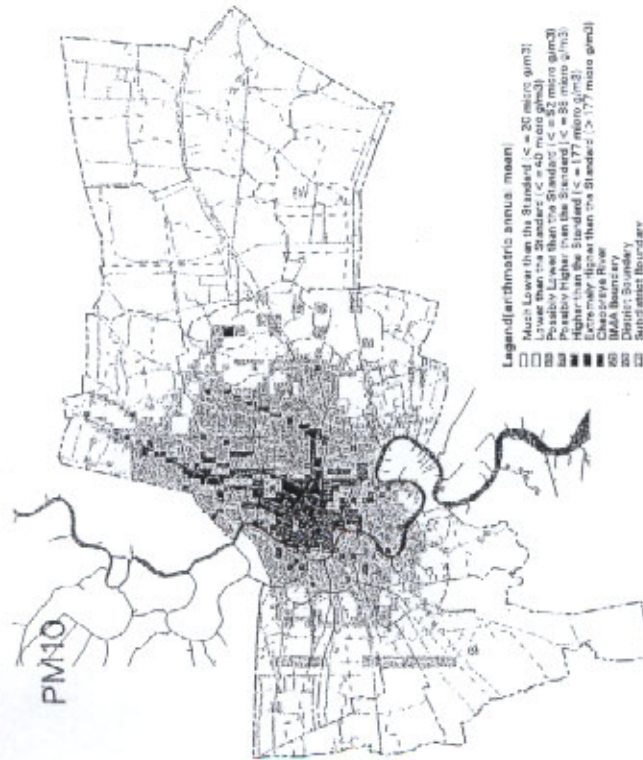
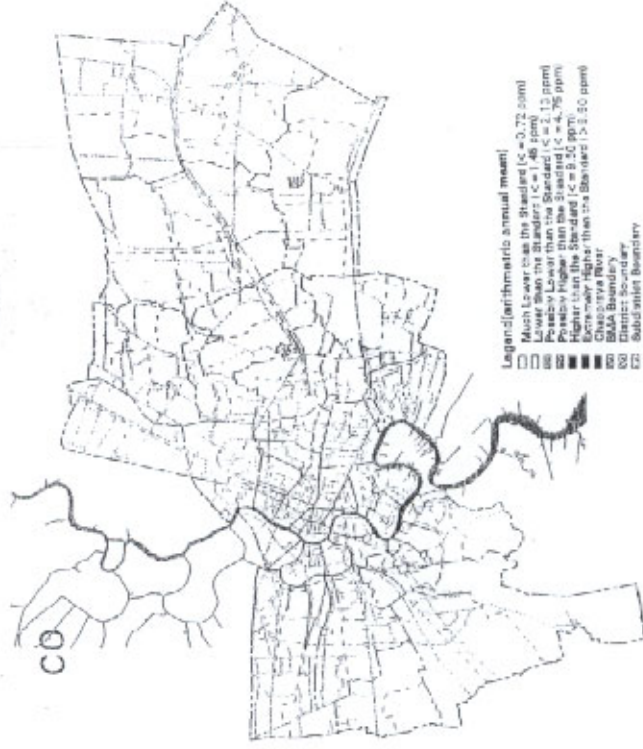
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Fig. 9.2 Simulated State of Air Quality in 2011

**Case 7**  
 Future Vehicle Emission Factor  
 Future Road Network  
 Future Mass Transit Network  
 Future Transport Demand with  
 Sub Center Development



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## 10 PLAN 5: WATER-FRIENDLY ECO-CITY

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### 10.1 Appreciation of the Thai Water Culture

The planning concept of "Water-friendly Eco-city" is derived from appreciation of the historical water system which the Thai socio-culture has been deeply rooted in. Thai people are traditionally well-knowledgeable of how to get along with water, and their living culture was based on such a respect on "water". Let us remind it again and restore the water-culture.

### 10.2 Water Quality Improvement and Restrain of Function of the Urban Khlongs

Currently, water quality of Khlongs are getting worse and the problem areas are expanding along with urbanization, as shown in Fig. 10.1. In order to improve the water quality, sewage treatment systems need to be facilitated together with technical measures such as introduction of the Chao Phraya water and direct aeration.

Functions of khlongs should be restored again in a view of creating "urban ecology" in which people's living systems are integrated with the natural environment.

- **Drainage System:** The most important function of khlongs is for drainage canals for flood protection. This function should be maintained properly and strengthened.
- **Waterways for Public Transportation:** Some of major khlongs are being used as an alternative public transportation meeting commuting and daily traffic demands<sup>2</sup>.
- **Open Space, Greens and Community Amenities:** Water is functioning as community links assorted with greens and open space. Thai people have already developed an outstanding urban design to form a comfortable combination with streets, khlongs and greens.

### 10.3 Beautification of Khlongs and River Front Areas

Water is an effective element of urban amenity and brings out a "Taste of Bangkok", thereby attracting international tourists. Thai landscape design concept should be applied for the beautification program along selected khlongs and Chao Phraya River.













The beautification program needs to be concomitant with sewerage system and housing development.

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<sup>2</sup> For crossing the east-west corridor, it takes 55 minutes by boat from the pier near Wat Saket to the Bangkok Pier in Khlong Saen Saep (17 Km). The average speed is 20 km/h, even in peak hours. By car, it takes more than 2 hours in peak hours.

Fig. 10.1 Water Quality  
(Contaminated Area)

**Legend**

-  Klong Water Contaminated Area
-  Chaopraya River
-  River/Khlong
-  Rail
-  Road
-  BMA Boundary
-  District Boundary
-  Subdistrict Boundary
-  More than 40 mg/l
-  30 to 39 mg/l
-  20 to 29 mg/l
-  Less than 20 mg/l



Source: DDS

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## 11 PLAN 6: UP-GRADING OF QUALITY OF LIVING ENVIRONMENT

### 11.1 Hygienic Living Environment

Solid waste management is one of the most vital issue for BMA, including the following measures:

- Promotion of social awareness for correct recognition of current problems on solid waste;
- Facilitate people's participation in the improvement with an community approach;
- Establish a sustainable system for solid waste management with the coherent system, including collection, transportation, intermediate treatment, and final disposal; and
- Explore a recycling system, encouraging participation of communities and the business sector, and support recycling industries.

### 11.2 One-more-step Solution of Slum Problems:

Housing issues are broad and various, and call for a wide variety of social development approach. The "slum problems", reviewing the previous and on-going NHA's attempts and projects/programs, should be further tackled. The financial institutions to support their "self-help solution" should be explored.

### 11.3 Pedestrian-advantageous Society

In the urban transportation network system, "walking" is the most important transport mode, which shares 29% of the total person-trips. In order to encourage people to utilize public transportation such as buses and mass transit systems, "walking" should be also encouraged. More pedestrian-advantageous urban environment should be created in Bangkok.

### 11.4 Environment for the Weak

More attention should be paid to the weak such children, handicappers, women and elders in urban design and uses of public service facilities. This is regard as an indicator for the social maturity. Bangkok should never stand behind the maturity, rather go ahead in the world in environment for the weak.

## 12 PROGRAMMING OF PROJECTS/PROGRAMS

### 12.1 A Conceptual Ground for Programming

Formulation of projects/programs to materialize the plans was considered in a conceptual frame with two axes: the axis of implementing bodies and the axis of policy approach, as illustrated on Fig. 12.1. In this coordinates, projects/programs are situated as one of four categories characterized as follows:

- I. Public investment for local and sector solution;
- II. Involvement of voluntary private activities;
- III. Institutional system with guidelines, standards and regulations for urban environmental and growth management; and
- IV. Strategic public investment for urban restructure.

All the four (4) types of projects/programs are substantially needed to implement in an integrated manner. However, in the short-term, intensive efforts should be made to enhance the categories of I and III; and in the medium- to long-term, emphasis should be placed on the categories of II and IV.

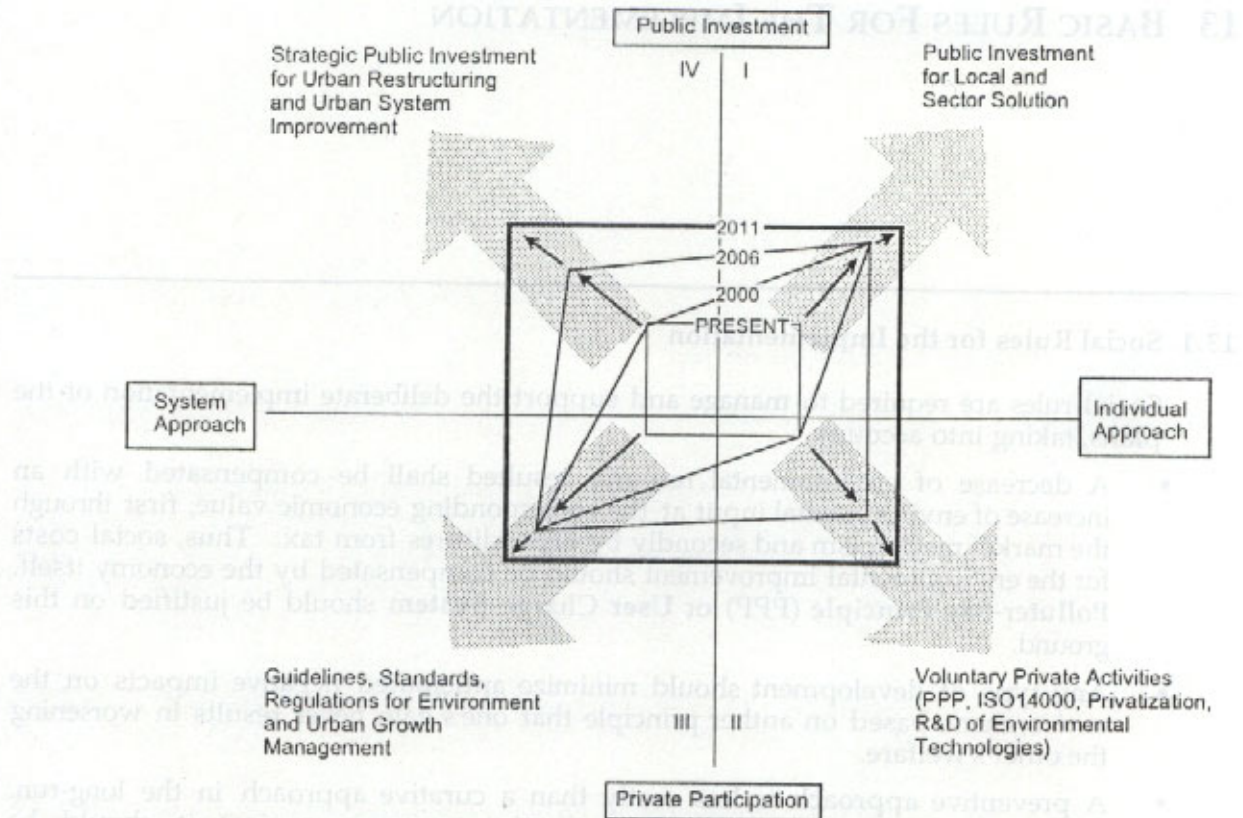
### 12.2 Proposed Projects/Programs for Bangkok Environmental Improvement

In the line with the 6 plans, a number of projects/programs were recommended as summarized in the list compiled in the end of this report. The implementing body who has chief responsibility, the relevant authorities with whom well-coordination is required, the degree of private sector's participation for successful completion; and the estimated cost and its allocation. The costs described here are preliminary estimates (at 1995 prices), and subject to changes after reviewing the detailed scheme. Beneficiaries of all the projects are Bangkok people or Thai people.

### 12.3 Prioritization Criteria

In addition to the above-mentioned basic concepts in Section 12.1, the highest priority is given to projects and programs with the following attributes:

- Effective/supportive to facilitate on-going and planned environmental projects/programs which were assessed to be crucial;
- Necessary or indispensable to achieve **Environmental Minimum**, referring to the attainable level of socioeconomic development in Bangkok;
- Preparatory for massive investment for social capital formation to be implemented in the medium- and long-term;
- Solvable and implementable with additional less investment or institutional improvement;
- Effective to strengthen the governmental capabilities in environmental administration as well as planning and financing.



**Fig. 12.1 A Conceptual Framework for Projects/Program Identification and Priority**

## 13 BASIC RULES FOR THE IMPLEMENTATION

### 13.1 Social Rules for the Implementation

Social rules are required to manage and support the deliberate implementation of the plans, taking into account:

- A decrease of environmental resource resulted shall be compensated with an increase of environmental input at the corresponding economic value, first through the market mechanism and secondly by expenditures from tax. Thus, social costs for the environmental improvement should be compensated by the economy itself. **Polluter-Pay-Principle (PPP) or User Charge System** should be justified on this ground.
- Any type of development should minimize anticipated negative impacts on the environment, based on another principle that one's gain never results in worsening the other's welfare.
- A preventive approach is less costly than a curative approach in the long-run. Before worsening the environment, effective measures against it should be undertaken. The sooner action, the more benefits.

### 13.2 Institutional Arrangement for Urban Growth Management

A number of institutional arrangement for urban growth management are necessary to support the administrative power to implement the plans, including:

- **Special Policy Zoning System**, supplementing the current Land Use Zoning System, to indicate policy directions and concrete measures of the environmental improvement in accordance with the zonal attributes (refer to Table 13.1 and Fig. 13.1);
- Institutionalization of **Parks and Open-space Development Act** which stipulate guidelines of development and preservation of public parks and green areas along khlongs and other open valuable space;
- Rationalization of the current **Floor Area Ratio** (a flat system of 1,000%) to rationalize the intensity of land use reflected by locational and environmental attributes with institutional links with the Urban Planning Act;
- Enhancement of **Environment-related Acts/Regulations** with enforcement power of the responsible authority;
- Introduction of the regulation of **Traffic Assessment Study** which is obliged to submit the local government together with the application of building permission for a large-scale projects;
- Preparation of **Local Government's Guidelines** for land and subdivision development with deliberate measures for environmental improvement and preservation in a form of **Local Government Ordinance**.

Fig. 13.1

# Policy Zoning

## Legend

- Historical Conservation Zone
- Urban Regeneration Zone
- Land Use Intensification Zone
- Environmental Infrastructure Improvement Zone
- Infrastructure Land Upgrader Zone
- Controlled Urbanization Zone
- Preservation Zone
- New Sub-center Development Zone
- Rilling Water Improvement Promotion Zone
- Land Scaping/Scenic Zone
- Land Development / Transit-oriented Supervisor Zone
- Park / Open Space Provision Zone
- Public Transport Priority Zone
- Existing Road (Class 1, 2)
- Existing Road (Class 3)
- Existing Expressway
- MFT Systems
- MFT Systems Expansion
- Expressway in 2000
- Improvement of Existing Road (DOH)
- New Road in 2000 (DOH)
- Improvement of Existing Road (BMA)
- New Road in 2000 (BMA)
- Improvement of Existing Road (PWD)
- New Road in 2000 (PWD)
- BMA Boundary
- District Boundary
- Chao Phraya River



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Table 13.1 Proposed Policy Zone System and Criteria for the Designation

Zone	Criteria for Designation
1. Historical Conservation Zone	<ul style="list-style-type: none"> <li>• Ralhanakosin District;</li> <li>• Extended District recommended by the Bangkok Plan</li> </ul>
2. Urban Regeneration Zone	<ul style="list-style-type: none"> <li>• Chao Phraya rive side area with mixed land use of warehouses, factories, etc. which are no longer functioning well;</li> <li>• Part of the Klong Toey Port Area where integrated development is required;</li> <li>• Part of CBD where infrastructures have been developed but the land uses are highly congested with mixed functions;</li> <li>• Part of CBD where urban redevelopment is assessed to be necessary from the disaster prevention point of view.</li> </ul>
3. Land Use Intensification Zone	<ul style="list-style-type: none"> <li>• Intensified land use is required to maximize the location advantages and land economy;</li> <li>• Mass-transit terminal areas;</li> <li>• Business areas with comparatively high road density and</li> </ul>
4. Environmental Infrastructure Improvement Zone	<ul style="list-style-type: none"> <li>• Part of built-up areas with poor infrastructures and poor environmental conditions: low road density, too high population density, less services of green and park, low service of water supply and sewerage, fears of land subsidence and occasional floods, etc.</li> <li>• Part of built-up area with so-called super block problems</li> </ul>
5. Infrastructure-led Urbanization Promotion Zone	<ul style="list-style-type: none"> <li>• Area where urban land use should be promoted to accommodate increasing population and land use demands;</li> <li>• Areas with a high urbanization potential and a comparatively low built-up ratio at present where the urbanization pressure is thought to be high;</li> <li>• Areas with poor infrastructures and public facilities</li> <li>• Area where disorderly subdivision development is anticipated without provision of advanced infrastructure.</li> </ul>
6. Controlled Urbanization Zone	<ul style="list-style-type: none"> <li>• Areas with low urbanization potential and serious natural constraints ;</li> <li>• Areas where active urbanization needs to be controlled from the environmental point of view even though high urbanization potentials are observed;</li> <li>• Areas along rivers and Klongs necessary for flood prevention and environmental purposes.</li> </ul>
7. Preservation Zone	<ul style="list-style-type: none"> <li>• Areas with considerably low urbanization potential and to be conserved from the environmental viewpoint;</li> <li>• Areas to be reserved on a long-term perspective.</li> </ul>
8. Soocial Development Zones	
8.1 Public Transit Advantage Zone	<ul style="list-style-type: none"> <li>• Part of CBD with intensive services by mass-transit systems are to provided (covered with 800 m walking distance from stations of MRTs); and</li> <li>• Part of CBD with extremely high traffic generation and/or attraction, and functionally accessible by alternative public transportation.</li> </ul>
8.2 New Sub-center Development Zone	<ul style="list-style-type: none"> <li>• Locations proposed by the Bangkok Plan, or</li> <li>• Another areas where are assessed to be suitable for publicly initiated sub-center development from the environmental view point.</li> </ul>
8.3 Khlong Water Quality Improvement Promotion Zone	<ul style="list-style-type: none"> <li>• Central urbanized areas both side of Chao Phraya River, encompassed with Khlong Lad Phrao in the eastern side and Khlong Bangkok Yai in the western side.</li> </ul>
8.4 Park and Open Space Zone	<ul style="list-style-type: none"> <li>• Existing large-scale parks and open space alongside Khlongs;</li> <li>• Community parks to be planned;</li> <li>• Green areas to be conserved.</li> </ul>
8.5 Special Scenic Zone	<ul style="list-style-type: none"> <li>• Area with historical, cultural and tourism assets</li> <li>• Special area where landscaping should be improved</li> <li>• Part of Chao Phraya River side areas to be scenically preserved</li> </ul>

## 14 MICRO STUDY

### 14.1 Major Issues and Selected Areas

Since environmental problems always appear at local level, the solutions need to address local reality with concrete images including institutional, administrative as well as implementation of infrastructure projects. In this context, based on the implications derived from the macro study, the Micro Study aims at seeking some of the feasible ways to solve the local problems by the urban planning approach.

Six areas are selected as the model areas where there are typical environmental problems for which urban planning tools should be employed. The six areas have respective attributes as follows, and the locations are shown in Fig. 14.1. A conceptual physical plan is prepared for each selected area.

**Table 14.1 Selected Areas and Their Nature**

Selected Areas	Nature of Area
Lat Krabang Subcenter Zone	As a model of guided urbanization of subcenter zone development in the eastern Bangkok area where vast potentials are still available to accommodate increasing population and job places.
Taling Chan Subcenter Zone	As a model of MRT-driven urbanization in the western Bangkok with great potential for rapid urbanization, where disorderly sprawl would take place without infrastructure-led development.
Part of Khlong Toey	As a model of improvement of road network in the highly built-up area, in relation to the forthcoming MRT systems and restructuring of the inner city areas.
Din Daeng Renewal	As a model of the public housing renewal project (NHA) in the inner city in association with public projects of New Bangkok City Hall, MRT stations and other new urban projects in the vicinities. Public transportation-based urban re-structuring is the main theme.
Chao Phraya River-front Renewal	As a mode of Chao Phraya River-front redevelopment by relocation of existing less-functioning warehouses and factories, and new land use for a purpose of environmental facilities development.
Rathanakosin Historical Conservation	As a model of institutional building for historical conservation based on a review of the on-going Master Plan Study by the national committee for Rathanakosin Conservation. The conservation of historical assets must be one of important environmental policies.

As the quality of urban environment depends largely on quality of urban design, three design principles are recommended, which should be commonly applicable to the selected six areas.

### Three Design Principles

- Design Principle 1: Appreciation of Thai Traditional Urban Design;
- Design Principle 2: Functional Inter-modal Transfer Facilities and Pedestrian Environment;
- Design Principle 3: Building Set-back and Street Design.

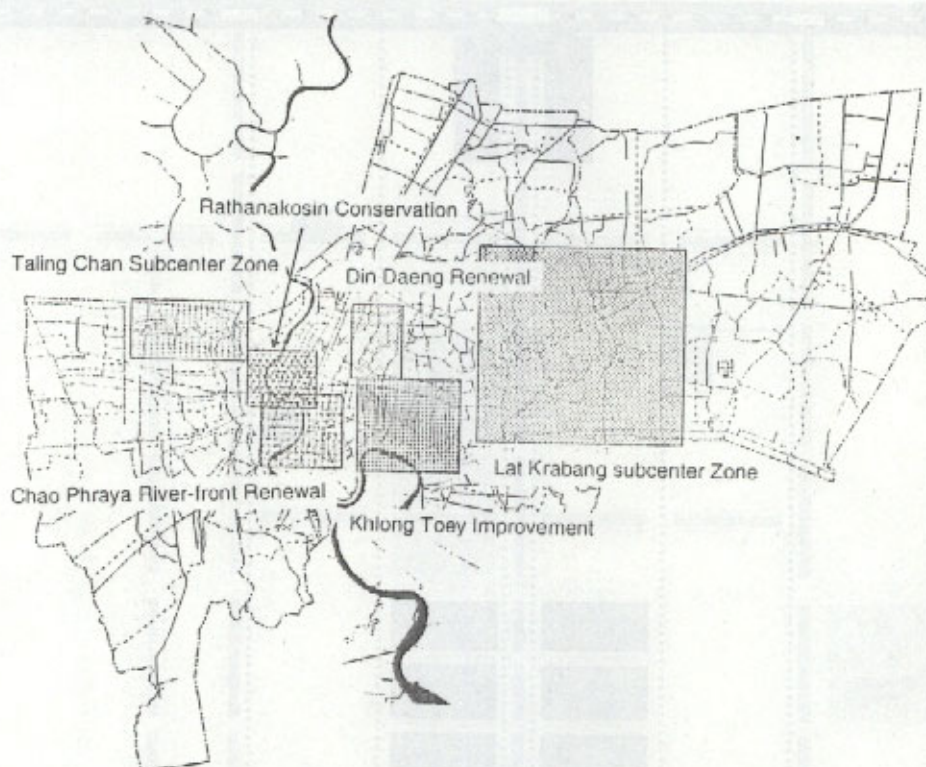
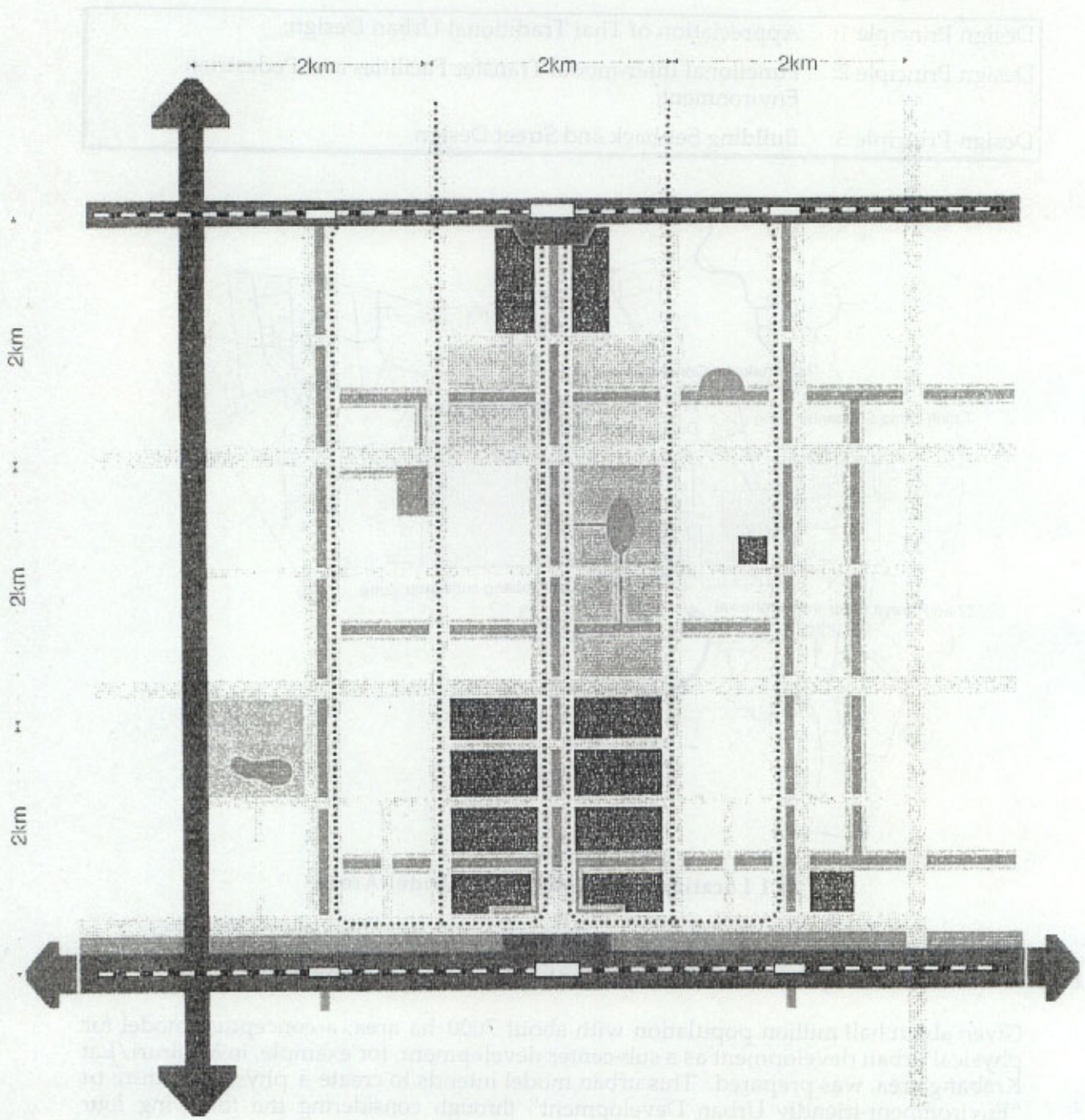


Fig. 14.1 Locations of Micro Study Model Areas

#### 14.2 A Conceptual Physical Model of Sub-center Zone Development

Given about half million population with about 7000 ha area, a conceptual model for physical urban development as a sub-center development, for example, in Minburi/Lat Krabang area, was prepared. This urban model intends to create a physical feature of "Environment-friendly Urban Development" through considering the following four planning concepts:

- 1) Rational Land Use Pattern:
  - Moderate population density (140 persons/ha in average in a total land area of 3,500 ha);
  - Concise activity center area (200 jobs/ha in the area of 750 ha); and
  - Sufficient open spaces for the environment and public uses.
- 2) Mass Transit-based Urban Development
- 3) Water Channel-cum-road System
- 4) Feeder Public Transport System



LEGEND

Land Use

- Business, Commercial
- Higher Education and Government Services
- R & D and Information, Light Industrial
- Park, Open Space and Public Utilities
- Residential
- Drainage Channels and Retaining Ponds

Transportation

- Regional Arterial Road (Express Highway)
- Arterial Road
- Secondary Road
- Tertiary (Local) Road
- Mass Transit System and Station
- Bus Service Routes

Fig. 14.2 A Conceptual Urban Model of Sub-center Zone Development

## 15 FINANCING FOR THE IMPLEMENTATION

### 15.1 Financial Demarcation System

Since environmental problems always appear at local level, the local government like BMA has to have a chief responsibility for resolving the problems. However, the current local administrative system does not allow the local government to share a large portion of the financial responsibility, which would thereby be a hindrance against up-lifting of planning ability and project implementability of the local government.

For the implementation of projects, the budgetary autonomy of local government like BMA is limited, and its power is greatly concentrated in the central government. Most of environmental projects are carried out under the current subsidy system that about 60-65% of the total costs come from the central government. Further devolution in the budgetary power for projects/programs should be pursued in such a way that BMA can directly tackle with local environmental problems, improving the existing subsidization system.

### 15.2 Enhancement of BMA Financial Capability

Financial and implementing capabilities of BMA itself should be further strengthened in order to put the plans into action, though:

- (1) Improvement of the executing system of the current Local Taxation, including 1) preparation of "Land and Assets Ownership Map, or Cadastral Maps; 2) Re-evaluation of Asset Value; and 3) improvement of Tax Collection System;
- (2) Introduction of PPP or User Charge System for environmental services;
- (3) Utilization of External Financial Resources (soft loans) for initiation of infrastructure projects and social capital formation; and
- (4) Development of Training Programs of Local Government Personnel particularly for planners, engineers and financial staff.

### 15.3 Evaluation of BMA's Financial Capability for the Implementation of Environmental Projects/Programs

The financial capability of BMA for the implantation of the proposed projects/programs was assessed. Table 14.1 summarizes the estimated financial requirements and budget revenues of BMA in a phased time-frame up to 2011.

#### (1) Evaluation of BMA's Financial Capability in the Short-term

The BMA 5th Development Plan (1996-2001) has lunched a number of projects/programs for the environmental improvement, including roads and transport projects. The total amount of investment costs for all those projects/programs are estimated at approximately 120,000 million Baht., as shown in Table 14.1.

On the other hand, besides the above, the cost of all the BEIP proposed projects/programs as "Urgent Actions" which are to be implemented in the same

period between 1996 and 2001, amounts to approximately 47,300 million Baht, of which those to be implemented by BMA is estimated at 31,700 million Baht. Therefore, adding this 31,700 million Baht to the cost of the 5th Plan projects/programs, a total of about 152,000 million Baht should be allocated for the Bangkok environmental projects for coming 5 years up to 2001.

In the meantime, this amount of 152,000 million Baht is equivalent to 2.7% of the anticipated GPP of Bangkok during the same period. This amount, in fact, is huge, but not assessed to be an over-investment, taking into account the World Bank report that a total amount of 2.0 to 3.0% of GDP needs to be invested for environmental projects/programs in developing countries up to 2000.

Given the current subsidy system from the central government, BMA itself has to share approximately 53,300 million Baht out of the total of 152,000 million Baht. Now, a question is whether or not BMA will be able to afford its budget for this amount of investment. The answers, based on the outcomes of the financial analysis of BMA, are as follows (refer to Table 14.1):

- If BMA succeeded in execution of the enhancement program for financial capability as proposed in the preceding section 14.2, BMA could enlarge its revenue sources through local taxes, thereby, could bear an accumulated budget up to 2001 of about 22,300 million Baht available for the environmental investment.
- Therefore, if BMA implements all the projects/programs proposed by both the 5th Plan and the BEIP Study in schedule, a fund shortage, or a budgetary deficit, will occur at an amount of 31,000 million Baht in 2001. This deficit is equivalent to 27% of the total BMA budget income.
- Two ways are conceivable to fulfill this deficit, i.e., 1) to claim a special subsidy allocation to the central government; or 2) to seek some external fund sources in a form of soft loans.

## (2) Evaluation of BMA's Financial Capability in the Medium and Long-term

As shown in Table 14.1, out of the projects/programs proposed by the BEIP Study, those to be chiefly implemented by BMA will cost approximately 123,000 million Baht for the medium-term (2001-2006), and 141,000 million Baht for the long-term (2006-2011). Under the current subsidy system from the central government, BMA itself has to share 43,000 million Baht for the medium-term (2001-2006), and 49,400 million Baht for the long-term (2006-2011).

On the fund supply side, BMA will bear available budgets of 49,800 million Baht for the medium-term, and 49,400 million Baht for the long-term for the environmental investment. This estimate is based on an assumption that BMA will continuously make efforts to strengthen its financial base through the program proposed in Section 14.2.

As the result, obviously, BMA will be able to be affordable and manageable to implement all the projects/programs proposed by the BEIP Study, that is, the available budgets will be greater than all the costs. In the long-term, the deficit born in the short-time (1996-2001) will be fulfilled with the surplus, and the balance will be all clear in 2011.

### 15.4 Overall Evaluation of Project Implementability of BMA

As proved above, under two premises that the current subsidy system is workable and that BMA implements the proposed program to enhance its budgetary base, BMA is assessed to be financially capable of executing all the projects/programs stipulated by the 5th Plan and the BEIP Study, despite that BMA will suffer from a budget shortage in the short-run.

Therefore, it is critical whether or not BMA will challenge to put forth the Enhancement Program which is included in the list of the proposed projects/programs compiled in this report.

**Fig. 15.1 BMA's Financial Capability of Implementation of the Proposed Projects and Programs for Environmental Improvement**

million baht					
		Urgent Actions (1997-2001)	Medium-term Projects (2002-2006)	Long-term Projects (2007-2011)	Total
<b>1) Required Environment Investment Costs, 1997 - 2011</b>					
Investment Budget of Environment Projects in BMA Fifth Five-Year Plan	(a)	120,500			120,500
Investment Budget of MWA Five-Year Plan	(b)	114,900			114,900
Total Costs of Projects/Programs of BEIP Study	(c)	47,330	415,450	472,600	935,380
- BMA	(d)	31,740	122,730	141,140	295,610
- Central government		2,320	4,690	1,860	8,870
- State Enterprise		8,680	180,690	216,500	405,870
- Private Sector		4,590	107,340	113,100	225,030
Total Investment Cost	(e)=(a)+(b)+(c)	282,730	415,450	472,600	1,170,780
<b>2) Estimated GPP of BMA in Socio-economic Framework of BEIP Study</b>					
Aggregated GPP (1993 price)	(f)	10,362,000	14,786,000	20,138,000	45,286,000
Increased GDP	(g)	2,187,000	6,611,000	11,963,000	20,761,000
<b>3) Share of Environmental Investment Cost of GPP</b>					
Total Environment Costs as Percentage of GPP	(e)/(f)	2.7%	2.8%	2.3%	2.6%
Total Environment Costs as Percentage of Increased GPP	(e)/(g)	12.9%	6.3%	4.0%	5.6%
<b>4) BMA Budget Revenue in Challenging Case</b>					
Estimated BMA Budget Revenue	(h)	115,100	182,300	255,800	553,200
Percentage of GPP	(h)/(f)	1.1%	1.2%	1.3%	1.2%
<b>5) Source of Investment Budget of BMA</b>					
Investment Budget (BMA)	(i)	28,100	58,070	86,600	172,770
- Percentage of Total Expenditure Budget of BMA	(i)/(h)	24.4%	31.9%	33.9%	31.2%
Investment Budget of Environment Sector	(j)	22,300	49,790	75,320	147,410
- Share of Environment of Total Investment Budget	(j)/(i)	79%	86%	87%	85%
<b>6) Require Amount for Environmental Investment of BMA</b>					
Required Amount for Environmental Investment	(k)=(a)+(d)	152,240	122,730	141,140	416,110
- Required Investment of BMA	(l)=(k)x35%	53,280	42,960	49,400	145,640
- Required Subsidies from Central Government	(m)=(k)x65%	98,960	79,770	91,740	270,470
<b>7) Potential Investment Budget of BMA for Environment</b>					
Potential Investment Budget of BMA for Environment	(j)	22,300	49,790	75,320	147,410
Balance of BMA Budget	(n)=(j)-(l)	-30,980	6,830	25,920	1,770
Percentage of BMA Total Budget	(n)/(h)	-27%	4%	10%	0%

Source: BEIP Study

**A List  
of  
Proposed Projects and Programs  
for  
Bangkok Environmental Improvement**



PROPOSED PROJECTS AND PROGRAMS FOR URBAN ENVIRONMENTAL IMPROVEMENT IN BANGKOK

Title of Projects/Programs	Type of Project A: Development Study B: Institutional Building C: Infrastructure Dev. D: Others	Prioritization Criteria M: Minimum B: Basic S: Strategic	Implementing Body	Related Agencies	Private Participation I: Major II: Supporting	Cost and Allocation (million baht)			
						Total Cost	BMA	Central Government	State Enterprise
<b>FL22:</b> Implementation of the Extended Flood Plain Management Project for the Eastern Bank Area (following-up FL13)	C	B	BMA	MOI		880	880		
<b>Long-term Projects/Programs</b>									
<b>FL31:</b> Implementation of Phase II Projects for Flood Protection System/Facilities Development (based on FL11)	C	B	BMA	RID/MOI		880	880		
<b>Plan 3: Environment-initiative Urban Transport (Eco-transport) System</b>									
<b>Urgent Actions</b>									
ET11 Pedestrian Environment Improvement Plan	A	M	BMA	MOTC		60	60		
ET12 Eco-Street Development Plan	A	B	BMA			40	40		
ET13 Water Transport Revitalization Program	A	B	MOTC /BMA			40	40		
ET14 Public Transport Integration Plan	A	M	OCMRT /BMA	BMTA		60	60		
ET15 Master Plan and Feasibility Study on Public Transport Terminals and Inter-Modal Facilities	A	B	OCMRT /BMA	MOTC /BMTA		60	60		
ET16 Feasibility study and Engineering Study on Major Secondary Road	A	B	BMA			140	140		
ET17 Area Road Pricing plan	A	B	OCMRT	BMA /MOTC		60	60		
ET18 Review of Primary Road System	A	B	OCMRT	MOTC /ETA		20	20		
ET19 Implementation of Projects for BMA 5th Five-year Plan						54,400	54,400		
<b>Medium-term Projects/programs</b>									
ET24 Pedestrian Environment Improvement Phase 1 (based on ET11)	C	M	BMA		II	3,910	3,910		
ET25 Eco-Street Development Phase 1 (based on ET12)	C	B	BMA	MOTC	II	680	680		
ET26 Water Transport Revitalization Phase 1 (based on ET13)	C	M	MOTC /BMA		II	840	840		
ET27 Public Transport Integration Phase 1 (based on ET14)	C	M	BMTA	MOTC	II	100	100	100	
ET28 Public Transport Terminals and Inter-Modal Facilities Development (based on ET15)	C	B	MOTC /BMTA /BMA	OCMRT	II	7,480	2,490	2,490	2,500
ET29 Implementation of Major Secondary Road Projects (based on ET16)	C	B	BMA			2,450	2,450		

PROPOSED PROJECTS AND PROGRAMS FOR URBAN ENVIRONMENTAL IMPROVEMENT IN BANGKOK

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						Total Cost	BMA	Central Government	State Enterprises	Private
ET30 Implementation of Area Road Pricing Project (based on ET17)	C	B	BMA	MOTC /OCMRT		300				
ET31 Formulation of Transport Master Plan for 9th National Development Plan	A	M	OCMRT	NESDB		60	60			
ET32 Proceed Implementation of Extended Mass Transit System Projects (71.4km)	C	S	MRTA	MOTC /BMA	I	42,080			29,290	12,790
<b>Long-term Projects/Programs</b>										
ET33 Pedestrian Environment Improvement Phase 2 (based on ET11)	C	M	BMA	MOTC /OCMRT	II	1,360	1,360			
ET34 Eco-Street Development Phase 2 (based on ET12)	C	B	BMA	MOTC	II	1,560	1,560			
ET35 Water Transport Revitalization Phase 2 (based on ET13)	C	M	MOTC	BMA	II	1,550	1,550	1,550		
ET36 Public Transport Integration Phase 2 (based on ET14)	C	M	OCMRT	BMTA		100			100	
ET37 Public Transport Terminals and Inter-Modal Facilities Development (based on ET15)	C	B	MOTC /BMTA /BMA	OCMRT		640	210	210	220	
ET38 Implementation of Major Secondary Road Projects (based on ET16)	C	B	BMA			32,390	32,390			
ET39 Formulation of Transport Master Plan for 10th National Development Plan	A	M	OCMRT	NESDB		100	100	100		
ET40 Proceed Implementation of Mass Transit System Projects (63.6km)	C	S	MRTA	MOTC /BMA	I	37,400			26,520	10,880
<b>Plan 4: Pursuance of "Fresh and Clean Air Policy"</b>										
<b>Urgent Actions</b>										
AR11: Environmental Administration Enhancement Program, including:	B, D	M	MOSTE	BMA		130	130			
• Extension of Monitoring Stations and Equipment for Meteorology and Ambient Air Quality;										
• Establishment of Epidemiological Surveillance System; and										
• Training and Technology Transfer of Analytical Technique.										
AR12: Establishment of Air Pollutants Protection Guidelines for Private Activities, including:	B	M	MOSTE	BMA	I					
• Construction Site Management and Truck Cleaning; and										
• Combustion Management and Emission Control for Factories.										

PROPOSED PROJECTS AND PROGRAMS FOR URBAN ENVIRONMENTAL IMPROVEMENT IN BANGKOK

Title of Projects/Programs	Type of Project A: Development Study B: Institutional Building C: Infrastructure Dev. D: Others	Prioritization Criteria M: Minimum B: Basic S: Strategic	Implementing Body	Related Agencies	Private Participation I: Major II: Supporting	Cost and Allocation (million Baht)				
						Total Cost	BMA	Central Government	State Enterprises	Private
AR13: Improvement of Vehicle Inspection and Maintenance System Program, including <ul style="list-style-type: none"> <li>Standardization and Technical Guidelines of Emission Inspection;</li> <li>Training and Qualification System for Inspectors /Mechanics;</li> <li>Public Relation of the System, and Institution Building, and so on.</li> </ul>	B, D	M	MOTC	MOSTE /BMA	I	600	600			
AR14: Implementation of "Fresh and Clean Air Program for Public Bus", including: <ul style="list-style-type: none"> <li>Checking System of Maintenance and Exhaust Gas; and</li> <li>Low-Pollution Bus Replacement (Introduction of CNG Bus, ect.) Program.</li> </ul>	B, D	B	BMTA	MOTC /BMA	II	9,350	940	8,410		
AR15: Public Campaign for Promotion of People's Awareness of Vehicle Maintenance and Dust Reduction by Construction	D	M	MOSTE /BMA	MOTC	II	60	60			
AR16: Establishment of Transportation Research Center (in coordination with ERTC), including <ul style="list-style-type: none"> <li>Study for environmentally sound transportation policies;</li> <li>Research for low-emission-vehicles and transportation technology suitable for South East Asia</li> </ul>	B, D	S	MOTC	MOSTE /MOI		90	90			
AR17: Study of Action Plans for "Comprehensive Urban Traffic Pollution Management"	A	M	MOSTE /MOTC	BMA	II	40	40			
AR18: Implementation of Projects for BMA 5th Five-year Plan <b>Medium-term Projects/programs</b>	C	M	BMA	MOSTE	II	240	240			
AR21: Implementation of the Extended Environmental Administration Enhancement Program (following-up AR11)	C, D	M	MOSTE		II	70	70			
AR22: Enhancement of Voluntary Activities by the Private Sector, including: <ul style="list-style-type: none"> <li>Introduction of Voluntary Environment Management System;</li> <li>Promotion of Private Laboratory and Monitoring Activities;</li> <li>Establishment of Public Qualification System for Environmental Engineers/Managers; and</li> <li>Introduction of ISO14000 System.</li> </ul>	B	B	MOSTE	NESDB /MOID	I	60	60			

PROPOSED PROJECTS AND PROGRAMS FOR URBAN ENVIRONMENTAL IMPROVEMENT IN BANGKOK

Title of Projects/Programs	Type of Project A: Development Study B: Institutional Building C: Infrastructure Dev. D: Others	Prioritization Criteria M: Minimum B: Basic S: Strategic	Implementing Body	Related Agencies	Private Participation I: Major II: Supporting	Cost and Allocation (million baht)				
						Total Cost	BMA	Central Government	State Enterprise	Private
AR23: Implementation of the Extended Vehicle Inspection and Maintenance System Improvement Program (following-up AR13)	C	M	MOTC	MOSTE	I	170		90		80
AR24: Implementation of "Energy-saving Policy", including: • Incentive Provision for Shifting to Cleaner Energy/Fuel; and • Institutional Support for Fuel Efficiency Improvement.	B	S	MOSTE	NESDB /MOF /MOID	I	60		60		
AR25: R & D Support Program for Less Pollutant Vehicle Production (Hybrid Electric Vehicle etc.)	A	S	MOSTE		I	5,100		1,020		4,080
<b>Plan 5: Creation of Water-friendly Eco-city</b>										
<b>Sewerage System Development</b>										
<b>Urgent Actions</b>										
SS11: Review of the Existing Sewerage Master Plan in Priority, Facility Sites, Systems, Engineering Design and Implementation Scheme	A	M	BMA	WMA/ MOSTE	II	20	20			
SS12: Feasibility Study on Priority Sewerage System Projects, Committed in the BMA 5th Five Year Strategic Plan (based on SS11)	A	M	BMA	WMA/ MOSTE	II	40	40			
SS13: Procurement of Sewerage Treatment Facility Construction Sites for the Priority Project (related to SS12)	C	B	BMA	WMA/ MOSTE	II	22,870	22,870			
SS14: Promotion of Public Campaign for Saving Water and Reducing Water Pollutants	D	M	BMA	WMA/ MOSTE		90	90			
SS15: Implementation Project for BMA 5th Five-year Plan	C	B	BMA	WMA/ MOSTE		18,300	18,300			
<b>Medium-term Projects/programs</b>										
SS21: Implementation of the Priority Projects (based on SS11-13)	C	B	BMA	WMA/ MOSTE	II	50,020	50,020			
SS22: Feasibility Study on Second Priority (Phase II) Sewerage System Projects (based on SS11)	A	B	BMA	WMA/ MOSTE		40	40			
SS23: System Management and Maintenance Capability Enhancement Project (related to UR22)	B	B	BMA	WMA/ MOSTE	II	590	590			
<b>Long-term Projects/Programs</b>										
SS31: Implementation of Second Priority (Phase II) Sewerage System Projects (based on SS22)	C	B	BMA	WMA/ MOSTE	II	46,890	46,890			
SS32: Implementation of Extended Project for Sewerage System Development	C	B	BMA	WMA/ MOSTE	II	1,070	1,070			

PROPOSED PROJECTS AND PROGRAMS FOR URBAN ENVIRONMENTAL IMPROVEMENT IN BANGKOK

Title of Projects/Programs	Type of Project A: Development Study B: Institutional Building C: Infrastructure Dev. D: Others	Prioritization Criteria M: Minimum B: Basic S: Strategic	Implementing Body	Responsible Agencies	Private Participation I: Major II: Supporting	Cost and Allocation (million baht)				
						Total Cost	BMA	Central Government	State Enterprise	Private
<b>River and Khlong Water Improvement</b>										
<b>Urgent Actions</b>										
WE11: Extension of the on-going Khlong Beautification Program in the Eastern Bank Area	C	M	BMA		II	200	200			
WE12: Feasibility Study for Khlong Waterway and Boat Piers Improvement Project (related to ET13)	A	M	BMA	MOTC		30	30			
WE13: Formulation of "Khlong Water Beautification Program" in Thonburi Area	A	M	BMA	MOSTE/ MOTC		30	30			
WE14: Master Plan Study for Chao Phraya River Water Front Regeneration Project	A	M	BMA	MOSTE /MOTC		30	30			
WE15: Promotion of Public Campaign for "Clean, Green, Khlongs"	D	M	BMA	MOSTE /MOI	II	90	90			
<b>Medium-term Projects/Programs</b>										
WE21: Implementation of Khlong Waterway and Boat Piers Improvement Project (based on WE12)	C	M	BMA	MOTC	II	530	530			
WE22: Implementation of "Khlong Water Beautification Program" in Thonburi Area" (based on WE13)	C	M	BMA	MOSTE /MOTC	II	200	200			
WE23: Implementation of Phase I Project for Chao Phraya River Water Front Regeneration (based on WE14)	C	S	BMA	MOSTE /MOTC /MOI	I	980	490			490
WE24: "Green and Water Network" Project along Major Khlongs	C	B	BMA	MOI	II	780	780			
<b>Long-term Projects/Programs</b>										
WE31: Implementation of the Extended Phase II Projects for Chao Phraya River Water Front Regeneration (following-up WE23)	C	S	BMA	MOI	I	980	490			490
<b>Plan 6: Up-grading of Quality of Living Environment</b>										
<b>Solid Waste Management</b>										
<b>Urgent Actions</b>										
SW11: Master Plan, Feasibility and Engineering Study for Final Disposal Sites/Facilities Development in Bangkok	A	M	BMA			60	60			
SW12: Feasibility and Engineering Study on Intermediate Solid Waste Treatment Facilities and Long-term System Development (including Improvement of Collection and Transport Systems)	A	M	BMA			40	40			

PROPOSED PROJECTS AND PROGRAMS FOR URBAN ENVIRONMENTAL IMPROVEMENT IN BANGKOK

Title of Projects/Programs	Type of Project A: Development Study B: Institutional Building C: Infrastructure Dev. D: Others	Prioritization Criteria M: Minimum B: Basic S: Strategic	Implementing Body	Related Agencies	Private Participation I: Major II: Supporting	Cost and Allocation (million baht)			
						Total Cost	BMA	Central Government	State Enterprise Private
SW13: Bangkok Incineration Plant Development Project (based on a review of the existing BOT/Turn-key program)	C	B	BMA	MOSTE	II	9,180	4,590		4,590
SW14: Public Campaign for Promotion of People's Awareness for Solid Waste Reduction and Community Collection System	D	M	MOSTE	BMA	II	90		90	
SW15: Implementation of Projects for BMA Fifth Five-year Plan • Facilities Development • Disposal contract	C	B	BMA		II	23,930	23,930		
Medium-term Projects/programs									
SW21: Development of "Solid Waste Recycling Center" and Encouragement of Recycling Industries	C	B	BMA	MOID	I	4,750	2,380		2,370
SW22: Implementation of Final Disposal Site/Facility Development Project (based on SW11)	C	M	BMA	MOSTE	II	5,430	5,430		
SW23: Implementation of Intermediate Waste Treatment System Development (following-up SW12)	C	B	BMA		II	980	980		
SW24: Extended Project of Incineration Plant Development (linked with SW13)	C	B	BMA	MOSTE	I	27,550	13,780		13,770
Long-term Projects/Programs									
SW31: Implementation of Extended Projects of Solid Waste Intermediate and Final Disposal Facilities Development (linked with SW21-23)	C	B	BMA	MOSTE	II	5,430	5,430		
<b>Water Supply System</b>									
<b>Urgent Actions</b>									
WS11: Feasibility Study for Improvement and Rehabilitation of Existing Water Supply Facilities and Subscriber Management System	A	M	MWA	BMA		60			60
WS12: Review of the Existing Long-term Master Plan of Water Supply System Development	A	M	MWA	BMA		30			30
WS13: Implementation of Projects for MWA 5th Five-year Plan	C	B	MWA	BMA		114,900			114,900
<b>Medium-term Projects/programs</b>									
WS21: Implementation of Improvement/Rehabilitation of Water Supply System (based on WS11 and WS12)	C	M	MWA	BMA		58,620			58,620
WS22: Development of Computerized Management and Maintenance Systems for Water Supply Facilities and Subscribers	C	S	MWA			780			780

BANGKOK INCINERATION PLANT DEVELOPMENT PROJECT FOR URBAN ENVIRONMENTAL IMPROVEMENT IN BANGKOK

PROPOSED PROJECTS AND PROGRAMS FOR URBAN ENVIRONMENTAL IMPROVEMENT IN BANGKOK

Title of Projects/Programs	Type of Project A: Development Study B: Institutional Building C: Infrastructure Dev. D: Others	Prioritization Criteria M: Minimum B: Basic S: Strategic	Implementing Body	Related Agencies	Private Participation I: Major II: Supporting	Cost and Allocation (million baht)				
						Total Cost	BMA	Central Government	State Enterprise	Private
<b>Long-term Projects/Programs</b> WS31: Implementation of Extended Water Resource Development and Supply System Development (based on WS12)	C	M	MWA	BMA		87,930			87,930	
<b>Housing and Community Development</b>										
<b>Urgent Actions</b>										
HC11: Feasibility and Engineering Study of the NHA Five-Year Program for Provision of Low and Middle Income Households (related to UR11)	A	B	NHA	BMA		40			40	
HC12: Feasibility Study for Slum Resettlement and Up-grading Programs with Enhancement of Financial Support	A	M	NHA	BMA	II	40			40	
HC13: Public Campaign for Promotion of Community Participation in Solving Environmental Problems (related to SW14)	D	M	NHA	BMA	II	40			40	
HC14: Master Plan and Action Programs Study for Metropolitan Sub-center Development	A	M	BMA	NESDB /MOI /NHA		60			60	
<b>Medium-term Project/Programs</b>										
HC21: Implementation of the NHA Five-Year Program for Provision of Low and Middle Income Households (based on HC11)	C	B	NHA	BMA	II	15,630			15,630	
HC22: Implementation of Slum Resettlement and Up-grading Programs with Enhancement of Financial Support (based on HC12)	C	M	NHA	BMA /MOF /NESDB /MOI	I	39,080			19,540	19,540
HC23: Support Program for Development of Community Parks, Environmental Green and Pedestrian Facilities (following-up HC13)	C	B	BMA		II	3,910		3,910		
HC24: Implementation of Redevelopment Projects of NHA Housing Areas (given to priority to Din Daeng Project)	C	B	NHA	BMA	I	19,540			7,820	7,810
HC25: Implementation of Infrastructure Projects of Sub-center Zone Development (based on HC14)	B, C	S	BMA /NHA	NESDB /MOI /MOTC, etc.	I	116,030		23,210	46,410	46,410

PROPOSED PROJECTS AND PROGRAMS FOR URBAN ENVIRONMENTAL IMPROVEMENT IN BANGKOK

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						Total Cost	BMA	Central Government	State Enterprise Private
<b>Long-term Projects/Programs</b> HC31: Implementation of Infrastructure Projects of Extended Sub-center Zone Development (based on HC14)	C	S	BMA /NHA	NESDB /MOI /MOTC, etc.	I	254,320	50,860	101,730	101,730
<b>Special Projects/Programs for Urban Planning and Institutional Enhancement</b>									
<b>Urgent Actions</b>									
UR11: Formulation and Empowerment of Local Environmental Plans and Guidelines by District	A	M	MOSTE			40		40	
UR12: Strategic Study for Urban Management System and Financial Enhancement Programs of BMA	A	M	BMA	MOSTE		70	70		
UR13: Establishment of "Bangkok Information & System Development Center (BISDC)" in BMA	C, D	B	BMA	MOI /MOF		780	780		
UR14: Development of Large Scale Topographical and Cadastral Maps for Urban Planning and Tax Assessment Administration (linked with UR12 and UR13)	C, D	B	BMA			1,370	1,370		
<b>Medium-term Projects/programs</b>									
UR21: Computerization of Local Tax Administration in BMA (based on UR14 and UR15)	B, C	M	BMA		II	290	290		
UR22: Establishment of "Environmental Engineering & Technology Center (EETC)" in BMA, for Staff Training and R&D Promotion	C, D	B	BMA			780	780		

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