

3.5 Structural Development of Eastern Corridor

3.5.1 Purpose and Policy of Study

In the preceding chapters the master plan of the railway based capital city development including both railway and urban development, is presented. Subsequently, the eastern corridor development is studied in line with the development policies, directions and structures set forth in the master plan.

The principal concerns of the master plan are the total railway network covering the 200 km and 50 km radius areas from the center of Bangkok, and the global/general urban structure and land use shaped by the improved networks. In this section, discussions are focused on the railway improvement of one line, and the city planning and development in the eastern section of Bangkok capital city.

In the study area, namely the eastern corridor which is covered by the SRT eastern line, not a few development plans and projects such as those of SBIA M/P, NHA new towns, BMA sub-center and others have already been proposed. It seems that the proposed development plans including the location, land use, transport and others have been worked out mainly based on the conventional road transport system, and the development concepts such as those of self contained, job-housing balance or airport centered structure, which are not planned to make maximum utilization of the railway. It is anticipated that the railway based development of the Eastern corridor may call for change or adjustment of the development concepts and plans of the existing proposed projects to make them more dependent on the improved railway. For instance, the degree of self containment or independence from Bangkok needs to be reduced as a result of railway improvement from the view point of urban transport management. Accordingly, the development site and size, land use, transport system of the proposed projects may need to be modified so as to make the most of the reliable and convenient transport services of the improved railway.

In the master plan, the proposed development plans and projects are generally

incorporated into the rail based new towns development plans. In this section they must be closely examined with more attentions being paid to the local conditions of the Eastern corridor.

The Eastern corridor development proposed in the master plan is shown in the Fig. 3.5.1 and summarized below.

1) Railway improvement in association with urban development

- SRT commuter train service (50 km/h)
- SRT Regional express service (100 km/h)

These services are provided mainly to support passenger patronage along the railway line, which should result from the proposed large scale urban development.

2) Urban development in association with the railway improvement

- Rail urban center development
- Rail urban corridor development
- Rail city/town development
 - SBIA City (Estimated Pop. 200,000)
 - New Rail Town Development (200,000)
 - Chachoengsao Urban Area development (98,800)

The proposed railway improvement as listed above is designed to greatly improve the accessibility of the Eastern Corridor area as shown below.

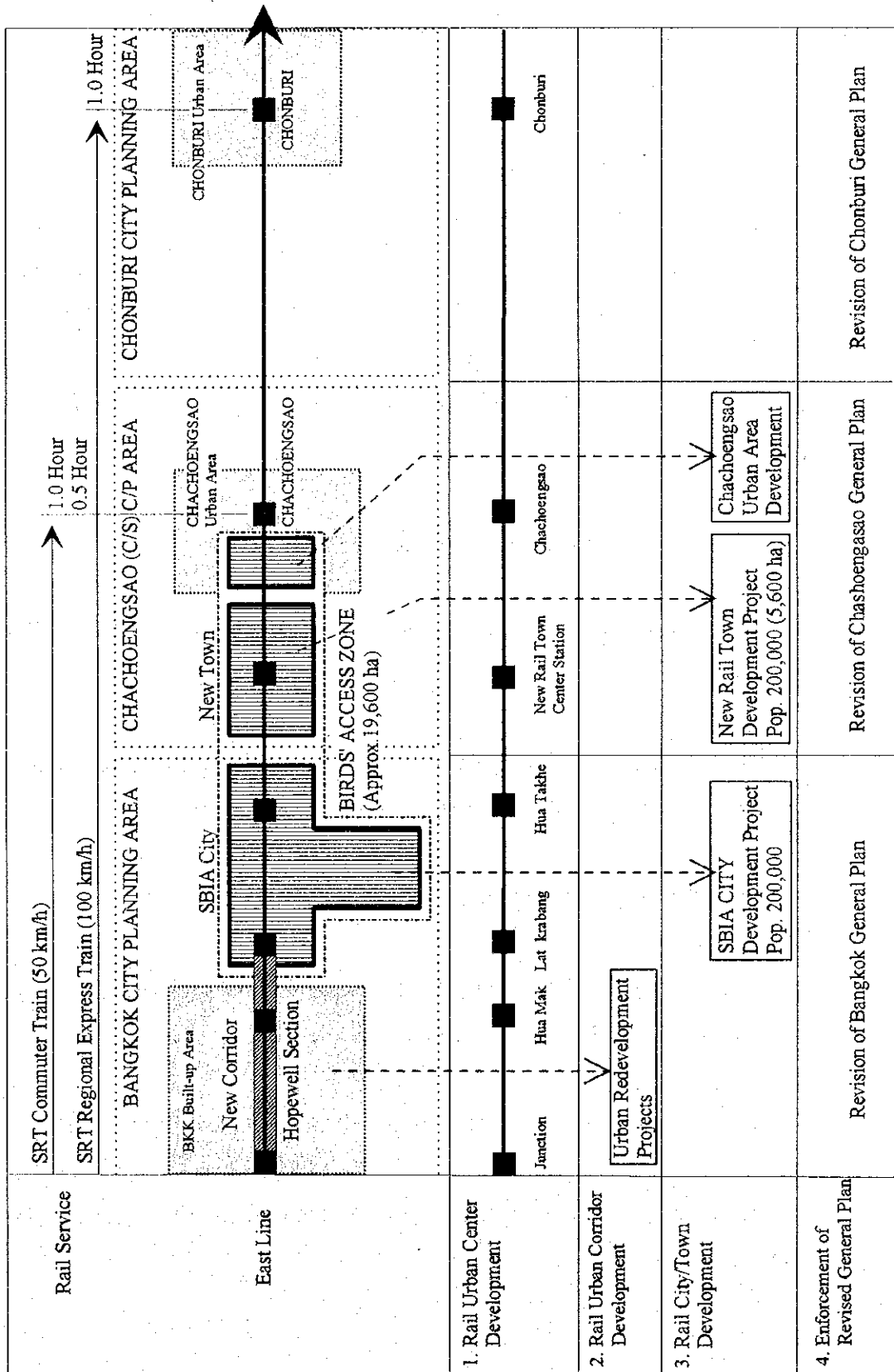
Travel Time from the center of Bangkok to Chachoengsao

By SRT commuter train approx. 1.0 hour

By Regional Express approx. 0.5 hour

This greatly improved accessibility, as compared to the unpredictable 2 to 3 hours travel time by car to Chachoengsao is sure to maximize the development potential, based on which the proposed urban development can be implemented.

Fig. 3.5.1 East Corridor Development Proposed in the Master Plan



3.5.2 Structural Urban Corridor Development

3.5.2.1 Planning Situation and Approach

(1) Present Planning Situation

There is no doubt that planning adjustment/coordination is necessary between the development concept and plans proposed in this study and other studies and proposed development projects in the Eastern corridor. It may also be said that planning adjustment/coordination will not stop at this study, but will last until and throughout the project implementation. The major studies and projects to be coordinated, among others, are:

Regional/Urban Development and Land Use Plan

- Metropolitan Regional Structure Planning Study (NESDB - Draft Final Report, June 1994)
- Master Plan and Feasibility Studies for Area Around Second Bangkok International Airport (NESDB - OSBC - Final Master Plan, August 1994)
- Strategic Planning for Metropolitan Bangkok (BMA)
- Government Metropolis to House All Government Offices (Sanam Chai Khet/Tha Takiap), (DTCP 1993, No detailed data available)
- New Town Project near Bangkok for some 300,000 people (NHA)
- Study on Phase II of Eastern Sea Board Development (NESDB - ESBD, not yet start)

Transportation Development

- SBIA Master Plan
 - GEC's Airport System Operation Concept - Scenario Development Report Use Planning Report Land Aviation Hub Development Report (1992)
- Study on Ground Access to Second Bangkok International Airport (AAT, March 1993)
- Mass Rapid Transit Systems Master Plan (OCMRT, July 1994)
- High Speed Train Study (NESDB, March 1994)
 - The Potential Long-Term Role of High Speed Rail in Thailand
 - The Eastern Seaboard Corridor
 - Implementation Study of HSR (will start January 1995)

As shown in the above list, many studies including this study have been and will be carried out related to the Eastern Sea Board Area, whether partially, sectorially or fully. This shows the importance and high exception for this area to spearhead the socio-economic development for the next generation of Thailand through the forthcoming 21st century.

It may be said that the study area is an embryo for city planning and development toward the 21st century. In fact, nothing has yet been definitively fixed in spite of the fact that many other large urban development projects have been proposed.:

1) Different Development Scenario and Interest

It must be admitted that the studies and projects listed above have been coordinated and incorporated in the master plan as much as possible and as far as data and information were available. However, it must be noted that it seems very difficult, if not impossible, to coordinate all the development factors proposed in the studies and accommodate all of them into one single development structure plan. This may be attributable to compatible or incompatible of different development theories and scenarios.

General guidelines and regional structures were set forth by NESDB in Chaophraya Multipolis (MRSP study) to be followed by individual development projects including infrastructure and industrial and urban development. In line with the guidelines for creating a multiple structural metropolis, it is proposed to develop, for instance, the Chachoengsao urban center to serve as the Future Governmental Administrative Sub-Center. In addition to this, the proposed large scale urban developments in other studies seem to commonly agree with the necessity of a decentralization policy for new developments, as shown by the following :

- Sub-centers along the outer ring roads (BMA)
- Government center in Tha Takiap district (DTCP)
- SBIA city at the fringe of Bangkok including Lat Krabang East, and Bang Phil/Bang Bo New Town, Chachoengsao City West
- NHA New Towns with population totaling 300,000 people
- ESB urban development (ex. Optimistic scenario in HST study)

The new urban centers, new towns/cities, aiming at the decentralization or restructuring of the metropolis seem to originate from the different development theories/scenarios and different favorable locations. It may be safely said that each individual development scenario will be correct and viable only without other development scenarios.

2) Excessive or uncoordinated development size (Population/Employment)

This may result from the following aspects of project proposals.

- a) Each Project has its own development logic and theory, whether appropriate or not, to maximize the development size with little regard to compatibility with other proposed projects.

It must also be added that there are some projects which are not likely to be completed within their proposed target year, and others have no explicit year of completion.

- b) It may be true that SBIA will become the locomotive for socio-economic development in the Eastern Corridor. However, each proposed project anticipate a larger share of the effect of SBIA in terms of population and employment in favor of its own project. To cite an example, the proposed BMA Suburban Center (Lat Krabang) and NHA New Town are planned to accommodate a large population and provide a large number of jobs based on the SBIA. In the other words, they rely on SBIA. However, they have not been incorporated in the SBIA M/P which estimated the total SBIA related employment at 185,500.

Summing up the employment which each project expects from SBIA, the total is beyond the estimated SBIA related employment. There may be duplication. The same can be said of the employment in government offices planning to relocate in this area. Taking a close look at the development proposals, almost all of them plan to develop government offices, more or less, in their development sites. There is again, duplication.

3) Uncertainty of Project Implementation

It is not certain at present that the proposed projects can be implemented either as planned or modified in project scale and completion period. It must be stated that urban development will never take place in such intensity and magnitude as planned in a traditional manner such as spontaneous/autonomous urbanization under the existing land use regulation of the General Plan.

It is obvious that without a newly-devised implementation system, the proposed projects will not materialize in scale and in time.

a) Implementation System

In the BMA suburban center program and SBIA City (especially Business Zone) development program a newly-devised implementation system including implementation organization, fund and coordination of private and public sectors

are proposed as important conditions for project implementation. However, it is uncertain whether these implementation systems can work as efficiently as planned.

b) Land Purchase

Land acquisition is one of decisive factors for NHA New Town development implementation. Although it is reported that NHA is now pursuing land acquisition, the project is destined to end or to be transferred elsewhere if it fails.

In conclusion, this integrated urban and railway development planning is placed in an uncertain and precarious situation.

(2) Planning Approach

The most difficult task of this study is to formulate the railway improvement plan in the uncertainty of urban development size and implementation. However, it seems realistic to believe that the proposed projects will mostly materialize with some changes in size and time in the distant future beyond the year 2010.

To cope with this difficulty at this point in time of planning, the following approach has been worked out to secure a flexible, as well as certain, implementation of the integrated urban and rail development.

1) Structure Planning Approach

At present, it is difficult to map out a development plan or land use plan in detail with a high certainty of implementation. Instead, it is advisable to establish a structure plan which will indicate the basic direction of development of the Eastern Corridor.

The basic concepts of the structural planning approach are outlined below.

- The structural plan is designed not to represent a single development theory but to generally control the development projects stemming from various

development theories and interests. This aims at maximization of total benefit to the region, but not to individual projects.

- The structural plan is designed so that urban development and railway development can be integrated. As long as they comply with the structural plan, integration can be secured even when they proceed separately.

2) Total Control Framework Approach

It is obvious that investment in railway development investment becomes risky if the railway development plan is based on the uncertainty of urban development along the railway in terms of size and implementation. Excessive population projection tends to lead to over-capacity or over-investment in railway improvement. Also, if the railway development plan is based on a planned urban development project, such as NHA New Town with 300,000 population and the project happens to be terminated or transferred somewhere else, capital investment for the railway will turn out to be wasteful. In both cases, the railway operation will surely fall into financial difficulty.

To avoid these cases, a total control approach should be applied to the planning of the integrated urban and railway development. This approach is summarized as follows :

- The total socio-economic framework of the area along the rail line as a whole should be established and this should work as a total control for planning should be established. This framework would not be calculated based on the development potential of individual new towns or centers and it is not merely a summation of the proposed individual development population/employment projections. The framework should be realistic, certain to some extent and reliable from the regional standpoint of population/employment distribution in the 50 km radius area of Bangkok.

The framework will show smaller figures than the total of population projections used in the proposed individual development projects, but with higher probability. As long as the structural plan is formulated under this total

control of socio-economic framework, the capital investment for the railway improvement and urban infrastructure development will come close to the appropriate and safe level.

3) Flexible approach by shifting system

In order to achieve the socio-economic framework described above, in uncertain and indefinite and uncertain development conditions, a flexible approach will be required through application of a shifting system in urban development planning and implementation procedure. In the course of project implementation if/when one project fails, other projects should cover it by enlarging them to accommodate the failed project under the control of the socio-economic framework. This is the shifting of development along the railway.

To cite an example, 200,000 of planned population is set for the Lat Krabang East New Town including NHA New Town. This implies that if the latter withdraws due to failure of land acquisition, the former should take all the planned population, and if/when NHA project proceeds, the Lat Krabang East New Town should be reduced correspondingly in development size.

3.5.2.2 Structure Plan of Eastern Corridor Development

(1) Planning and Policy Issues

1) Major Planning Issues

Analyzing the proposed development concepts and projects in the SBIA M/P area, the following major planning issues for structuring the regional urban development are raised as :

a) Characterization of Urbanization of the Eastern Corridor

The future urbanization in the SBIA M/P area will be a combination of two directions of development :

- Extension of the past (present) development trend (autonomous/spontaneous)
- New development represented by the existing proposed development projects

In order to show the magnitude of both developments, the share of population increase between them is calculated using the estimated population in the SBIA M/P study, as shown in Table 3.5.1.

Table 3.5.1 Past Trends and New Development Population Estimated in the SBIA Master Plan Study

Population Increase (1993 ~ 2010)	Number	%
Total	2,253,640	100
Extension of Past and Present Trends	1,613,640	71.6
New Development	640,000	28.4

This estimation shows that the extension of past trends will take a far larger share of the total number of population increase up to 2010 despite the great efforts represented by the new development projects.

It may be safely said that urbanization of SBIA M/P area, as a whole, in the coming decades will be mostly dominated by the characteristics of present urbanization, although the extension of present trends will be somewhat be effected by new developments.

Extension of present urbanization trend.

The urbanization in the suburban area on the Eastern Corridor, especially Pravat, Lat Krabang and Bang Phli is characterized by the following types of urban development :

- **Industrial Development in the Suburban Area**

At an earlier stage of urbanization, industrial development such as Lat Krabang, Bang Phli industrial estate development and the like have been developed, increasing the number of people employed at the workplaces in the districts.

- **Housing Development in the Suburban Area**

On the other hand, urbanization in the form of spilling over from the built-up area of Bangkok has been happening in the suburban area. The major factor for this urbanization is defined as housing development for commuters to existing urban centers and built-up areas of Bangkok for employment, thus increasing the number of workers on home base.

It may be predictable that industrial development creating jobs in the area and housing development increasing the number of commuters bound for outside will concurrently continue. This is attributable to the development potential of the area both as an industrial site as well as a housing site.

New Development

The basic characteristics common to almost all the existing proposed projects in the area is more or less “Self-supporting employment” as shown in Table 3.5.2.

Table 3.5.2 Self-Supporting Employment

Development Concept	Project	Projected Population	Projected Employment
Self-contained	NHA New Town	300,000	105,000 *
Job-housing balancing	BMA Sub-center	910,000	120,000
New Business Center	SBIA Business Zone	640,000	185,500
Regional Center	Chachoengsao	532,000	186,200 *
	Government Sub center		

* : Estimated in this study

This is understandable since reducing the volume of commuters to Bangkok for working with a view to alleviating the traffic congestion in Bangkok is one of the important concerns in planning development projects in the Bangkok region. In fact, if the projected employment in the area is achieved, a large volume of urban area will emerge without putting pressure on the congestion existing in the CBD and built-up areas of Bangkok.

However, the following factors must be taken into consideration for practical reasons of urban developments.

- Moderation of Employment Projection

There seem to be many factors supporting the creation of jobs in this area, including the following :

- Relocation/location trend of offices, commercial facilities and others outward from Bangkok. This will be accelerated by the infrastructure development in the Eastern Corridor ;
- Expected industrial and economic effects of SBIA (SBIA related employment) ;
- Planned relocation of government offices ;

- High development potential of Chachoengsao ; and
- Others.

However, it appears too optimistic to think that the estimated employment will all be realized within the planned period, for the following reasons :

- In general, industrial development will only take place gradually in response to increasing market requirements;
- In developing especially the tertiary industry, which will be the dominant industry in the future for the Bangkok region, the area will be subject to tough competition from the existing urban centers and CBD which have advantages due to benefits from the existing socio-economic accumulation and urban services. It is probable that the estimated employment will be shared between the existing CBD and the study area.
- It is undeniable that the considerable impact of SBIA will enhance the industrial development in this area. However, necessary measures for materializing the development must be taken including organizational set up, fund securing, land acquisition and so on. In this regard, employment development in this area will take longer than planned.

The estimated SBIA related employment, especially by the year 2000, as shown below, seems almost unattainable except for special cases.

Table 3.5.3 Estimation of SBIA Related Employment

Year	Employment
2000	147,000
2010	185,500

As discussed above, it is advisable to moderate the estimated amount of employment in the proposed development project.

- Continuous Housing Pressure

The current predominant factor of urbanization in the Eastern Corridor especially in the middle sections (Pravet), inner suburban area (Lat Krabang, Bang Phli) is housing development, either subdivision or individually for the commuters working in the center of Bangkok in spite of industrial development such as industrial estates. The commuters traveling outside the project area outnumber those employed within the area.

Housing pressure for commuters to Bangkok in the study area will continue to exist because of the following :

- The volume of employment (workplace) is overwhelmingly larger in the built-up areas of Bangkok than in the Eastern Corridor. Even the optimistic estimation of employment in the Eastern Corridor occupies a quite small share of the total.

In this regard, great pressure for housing for commuters to Bangkok will remain in this area.

- At present, it is almost impossible for Bangkok people to find housing sites within a range of one-hour commuting time to the center of Bangkok, their main working place.

As the improved railway makes this possible, it will enhance housing development for commuters in the Eastern Corridor. A large amount of housing backlog may be satisfied in the Eastern Corridor.

- In the JICA M/P Study, 1.7 million people are estimated to locate in new towns along the improved railway in the 50 km radius area. It is anticipated

that this total potential population will come mainly from Bangkok. This implies that a large number of people will commute to Bangkok to work after locating their homes in the Eastern Corridor.

Urbanization in the Eastern Corridor.

Synthesizing the above discussions, the urbanization of the Eastern Corridor can be summarized as follows:

- Housing development for commuters, especially toward the center of Bangkok, and industrial development creating jobs for the self-contained or job-housing balance will concurrently take place in the suburban area along the Eastern Corridor.
- Housing development will precede the industrial development and exceed it in development size especially in the short-medium term. The need for provision of housing sites for commuters in response to the large volume of housing demand in Bangkok seems quite high, although less attention is paid to such needs in the existing proposed development project.
- The self-contained, job-housing balance development will materialize in parallel with urbanization led by the strong housing demand as stated above, in the long run, especially after the completion of SBIA in the year 2000.

b) Regional Distribution and Composition of Urban Centers and New Towns

Taking a look at the distribution of the existing proposed development projects, it seems that the region along the Eastern Corridor will be disorderly dotted with the urban centers and new towns proposed. There seems to be no principles and structures for distributing them in as much as they are individually proposed and located on their own, in favorable conditions to fulfill their own purpose.

It must also be stated that the arterial road network radiating from Bangkok,

including both existing and planned roads, allows the dispersion of urban centers and new towns.

Moreover, the key factor which makes location of new towns haphazard leading to their dispersion is the claimed development concept of "self-contained or job-housing balance" because the development concepts claim that the socio-economic activities including commuting are to be mainly completed within the boundary of new towns, thus making the new towns free from and not dependent on the congested road network outside. They are justifiable wherever located since they are designed not to put additional pressure on the congested existing CBD and built-up areas of Bangkok.

These development theories are correct only when industrial development is fully achieved and is large enough to sustain the self-contained or job-housing balance. The distribution of urban centers and towns is therefore, relevant to the characteristics of their development.

The existing proposed urban centers and new towns including BMA suburban center, SBIA city, NHA new towns and Chachoengsao regional urban center happen to be located along the Eastern rail line. Although it seems that they were not necessarily located there because of the availability of the railway. Instead, the railway happens to exist close to their proposed sites, they plan to make use of the railway as one of the alternative transport systems serving the proposed sites.

The use of the railway is only partially because in their planning massive transport demand which the railway must respond to, is not supposed to occur place toward the center of Bangkok along the Eastern railway due to the development concepts of self-contained or job-housing balance. It appears that these concepts of an independent city have been proposed mainly because of transportation aspects of Bangkok, that is, urban growth either without putting additional traffic demand on the existing congested road network in the CBD and built-up area.

From the point of view of city planning and development of metropolis, it is interpreted that the suburban areas should independently develop themselves because the existing CBD and built-up areas are no longer reliable due to the difficulties of accessing them. However, it must be stressed that the suburban area can and should be effectively developed only in close connection and linkage with the existing CBD or urban centers. The CBD must play an important role for development of the suburban area leading to the efficient and effective growth of the capital city.

This also suggests that for the sound growth of the capital, the urban structure unifying the sprawling urban areas including the suburban areas must exist centering around the CBD so that the CBD can play a leading role for urban growth. Usually, orderly distribution of urban centers and new towns centered around the CBD are emerging. In this situation, what will and should happen if/when the railway is improved? The improved railway is to give the railway service area, specially the suburban area, superior locational and transport advantages as compared to the road service area. Great improvement is especially expected in direct access to and from Bangkok CBD and built-up areas.

The anticipated effects of the railway improvement on urban growth are as follows:

- Through securing the rapid and reliable access to and from the CBD of Bangkok, firstly, the CBD can be revitalized so as to play an important role as the prime urban center of the metropolitan area.
- Orderly or ranked allocation of urban centers and new towns along the railway with the existing CBD being at the apex of the urban center network, shall be made possible as compared to the random distribution of self-contained new towns. They will be aligned and developed in co-existence with the existing CBD.

- The urban centers and new towns will be better developed in cooperation with one another and mutually dependent so that the Eastern Corridor can work more efficiently and effectively as an urban corridor as a whole in the Bangkok metropolitan area rather than an agglomeration of self-contained or independent towns.

Consequently, it must be emphasized that urban structure with and without the improved railway are quite different in terms of urban development mechanism and contents of the new towns even if the location and distribution of new towns seem the same. The improvement of the railway is to establish a backbone of transport and land use in an area dotted with the sporadic distribution of new towns.

c) New Town Development

The new town and urban center development plans including transport and land use plans are presented in the existing proposed development projects. As earlier discussed the railway is not designed to play a vital role for developing the new towns, again because of self-contained or job-housing balance considerations.

In this regard the plans must be modified to accommodate the effects of the improved railway. The modification must be made with the following characteristics of urban development supported by the improved railway in mind :

Combination of General Urbanization by Railway and Existing Proposed Development Projects.

Firstly, it seems probable that the improvement of access to the center of Bangkok by the railway will attract massive housing demand for commuters to the CBD and built-up area (housing development for commuters) as well as the relocation of urban activities/industries which must keep close to and have direct contact with the existing CBD for their business operation, and which will be supported by the improved railway (relocating urban activities).

Secondly, it is anticipated to enhance the commercial and service industries around the main stations in such a manner as providing services to the housing developed and urban activities relocated.

Thirdly, the urban facilities and activities which would like to locate in such convenient areas as the CBD and built-up areas, but cannot do so due to the scarcity of available land, are anticipated to locate in the suburban areas with plenty of land available at economical prices relying on the accessibility to the CBD by railway transport service.

In addition to the general urbanization by railway, the existing proposed development projects should be implemented along the railway. The important aspects for planning the integrated urban and railway development are set forth as follows:

- Urban development plans along the railway should be formulated in such a manner that they accommodate general urbanization and the existing proposed urban development projects so as to develop them into substantial cities and towns, not merely a collection of fragmented urban areas.
- The proposed urban centers and new town development should be modified not only to accommodate the general urbanization triggered by the improved railway but also to make them more railway-oriented towns enjoying the benefits of rail transport services.

Effects of Railway in Developing and Systematizing Transport and Land Use.

It is well known especially in countries where railway transport is popular that the railway and its stations have significant effects in developing and forming the shape of new towns along the railway. Among these are the following :

- Urbanization Mechanism along the Railway.

Urbanization and rail transport development reinforce each other to establish a favorable cycle of development.

- Rail transport passenger flow will increase through the improvement of the railway. The commercial development potential will be raised along the railway in accordance with the increasing volume of passengers.
- A variety of urban activities/industries will locate and accumulate along the railway in response to the increased development potential. High availability and easy access to a variety of urban services and activities accumulated along the railway will turn the railway service area into very convenient corridors, thus further attracting urban activities and rail passengers as well.
- As such, the increase in passenger flow accordingly accelerates further urbanization, which again increases the passenger volume.

Through repeated reciprocal developments in the favorable cycle between railway and urbanization, finally a main arterial transport line with a large volume of passenger traffic and an urban corridor with intensive and high-density land use will take shape along the railway in the region.

It is likely that urban cores centering on the main railway stations with transport and locational advantages will emerge in the urban corridors.

- Formation/systematization of New Towns (Land Use and Transport)

The main arterial transport line of the railway and the high density urban corridor with urban cores will be effective in generally controlling and maintaining order in the urban transport and land use in the new towns

respectively. Therefore, it is advisable that the new towns be formed and systematized through the effects of the main transport line and urban corridors, as follows:

- New town areas be selected so that the urban cores around the main stations can be placed at the central point of the new town. The service area of the urban core should be included in the new town area. In this manner, the existing proposed development projects should be incorporated into new towns centering around the urban core close to the main rail stations.
- Orderly land use within the new towns should be instituted in response to the development effects of the railway. Due to the effects of railway, the closer to the station the land is, the higher the land value tends to be. Accordingly, gradational land use should be developed with higher productivity and density of land use closer to the rail urban core, and lower away from it. This also reflects the convenience of location in accordance with the distance from the railway station.
- The new town transport system, especially its road system, should be designed to provide not only high accessibility to the rail station and the urban core around it, but also transport service within the new town, connecting major land uses.

Since the development concept of a rail new town (new town development centering around the rail station) has not been considered in the existing proposed urban development projects, the main concern is transport access connecting the development sites and the rail stations. In this regard, the transport system in the study area must be elaborated to establish a new town transport system along the improved railway.

2) Basic Policies

a) Development Policies — in the Bangkok Region and Suburban Areas.

Summarizing the above discussions on planning issues, the two contrasting development policies can be summarized as follows:

Table 3.5.4 Contrasting Development Policies

	Self-contained City (Job-housing balance)	Rail-oriented City
Urban System	• Locally closed	• Open to outside
Economy	• Autonomous	• In linkage and contact with the existing urban area
Development	• New development independently	• Functional expansion of Bangkok Capital
Transport	• Road Transport	• Rail Transport

Both development policies aim at arresting the worsening traffic problems in the CBD and built-up areas, but by a different approach.

The self-contained approach is designed to put less burden on the existing road network by means of containing the generated traffic within the towns and cutting down the vehicle traffic volume (especially commuter) to the existing CBD.

On the other hand, the rail oriented approach aims to put less burden on the existing road network by means of transferring the traffic volume (especially voluminous commuter traffic) to the railway.

They are somewhat conflicting since one becomes less necessary or less useful if/when the other is successful enough to achieve its goal and target. It must also be stated that there are some fields where they are compatible and mutually helpful. For instance, the high quality transport service provided by railway is instrumental

for developing the self-contained cities, while enhancing the housing development for commuters.

In this study, it is not suggested that one should be adopted and the other rejected. Most probably both urban development trends will concurrently proceed. However, the mainstream of development which should be pursued even while accommodating the other, must be determined for formulating the structural plan.

The mainstream of development is set at the rail-oriented development in spite of the fact that the existing proposed development projects are mostly characterized by self-contained development concepts. This arises from the following considerations:

Current high pressure of urbanization

The current main trend of urbanization is the outward expansion of urban areas including housing development for commuters in connection with the urban centers and work places in Bangkok. It seems quite difficult to stop or limit this trend and it is realistic to think it will continue for some time. It appears easier and more practical to lead and reorganize this high demand urbanization to develop into rail cities rather than to create newly self-contained cities from scratch. Self-contained development is easier planned than implemented judging from past experience in Thailand as well as other countries in the world. It must also be stated that it is urgent to respond to this high pressure urbanization.

Future prospect of urban structure establishment

Another important aspect of selecting development policy as a mainstream of development is that this policy can achieve a higher level of development in the long run. It is obvious that as the self-contained cities are to be developed on the basis of or with the limitation of the existing constraints, especially the poor transport infrastructure represented by the road network, in contrast to the rail

oriented cities which are to be developed by overcoming the existing constraints and problems. The Bangkok capital will need a much larger urban structure for efficiently accommodating further growth, and should not be limited by the existing constraints.

The great advantage of the improvement of railway is the establishment of a rapid and reliable transport trunkline so as to allow the Bangkok capital to exert maximum effects as a whole through unifying the urban centers and areas including the suburban areas and regional centers such as Chachoengsao as compared to a partitioned urban structure consisting of self-contained communities.

Consequently, it is advisable that the rail oriented development policy be defined as a mainstream for development of the Eastern Corridor with the emphasis placed on the advantages of establishing a firm structure able to meet the future growth of Bangkok through the 21st century.

b) Urban Development through the Maximized Effects of the Railway Improvement.

Even though the rail oriented development is defined as a mainstream of development policy in the Eastern Corridor, the following questions may be raised:

- What should be the extent of railway utilization by the existing proposed urban developments?
- How much should they be adjusted to make best use of the railway?

It is recognized that all the existing proposed development projects which happen to be located along the railway refer to the utilization of the existing eastern railway line. However, they are commonly silent about how to make the improved railway operation feasible and viable. The planning attitude is only to make use of the railway, if improved. It also raises the issue of the effects of railway improvement on the new town development, either in way of being affected or making use of

effects. The effects are not fully incorporated into the development concepts and plans.

It is understandable that without the government's firm commitment or guarantee for improving the railway, it is difficult for other agencies including the public and private sector to propose rail transport based urban development projects. In this study, on the grounds that the eastern railway shall be fully improved, urban development shall be proposed in such a manner as to maximize the effects of railway improvement.

The effects of the railway, if fully materialized, will influence urban development affecting the urban structure of Bangkok, development characteristics and mechanism of the Eastern Corridor, regional distribution and composition of urban centers and new towns, and the formation/systematization of new towns (land use and transport).

(2) Basic Features of the Eastern Corridor

1) Physical Conditions

a) General

Regarding the Structural Plan of Eastern Corridor in consideration of railway improvement, the study area is shown in Fig. 3.5.2. The area is approximately 3,460 sq.km.

b) Geography

The Structural Plan Area is situated in the Chao Phraya and Bang Pakong river basins. The natural landscape consists mainly of marsh lands and the ground elevation is close to mean sea level. Therefore, the area is subject to seasonal flooding.

The soil conditions are characterized as follows:

- 1.0 - 1.5 m thick surface layer of weathered clay;
- 10 - 20 m of soft clay;
- 5 - 10 m of stiff clay; and
- Alternating layers of sand/gravel and very stiff clay.

In addition to the soil conditions, groundwater is extensively extracted from wells because the supply system for treated surface water (provided by MWA and PWA) has not yet reached most of the area. Excessive groundwater extraction lead to serious land subsidence in the area.

c) Rainfall

Table 3.5.5 shows the rainfall conditions at the Bangkok Metropolis Observatory that is located in the Structural Plan Area. Rainfall is concentrated in May to October.

Fig. 3.5.2 Study Area Boundary

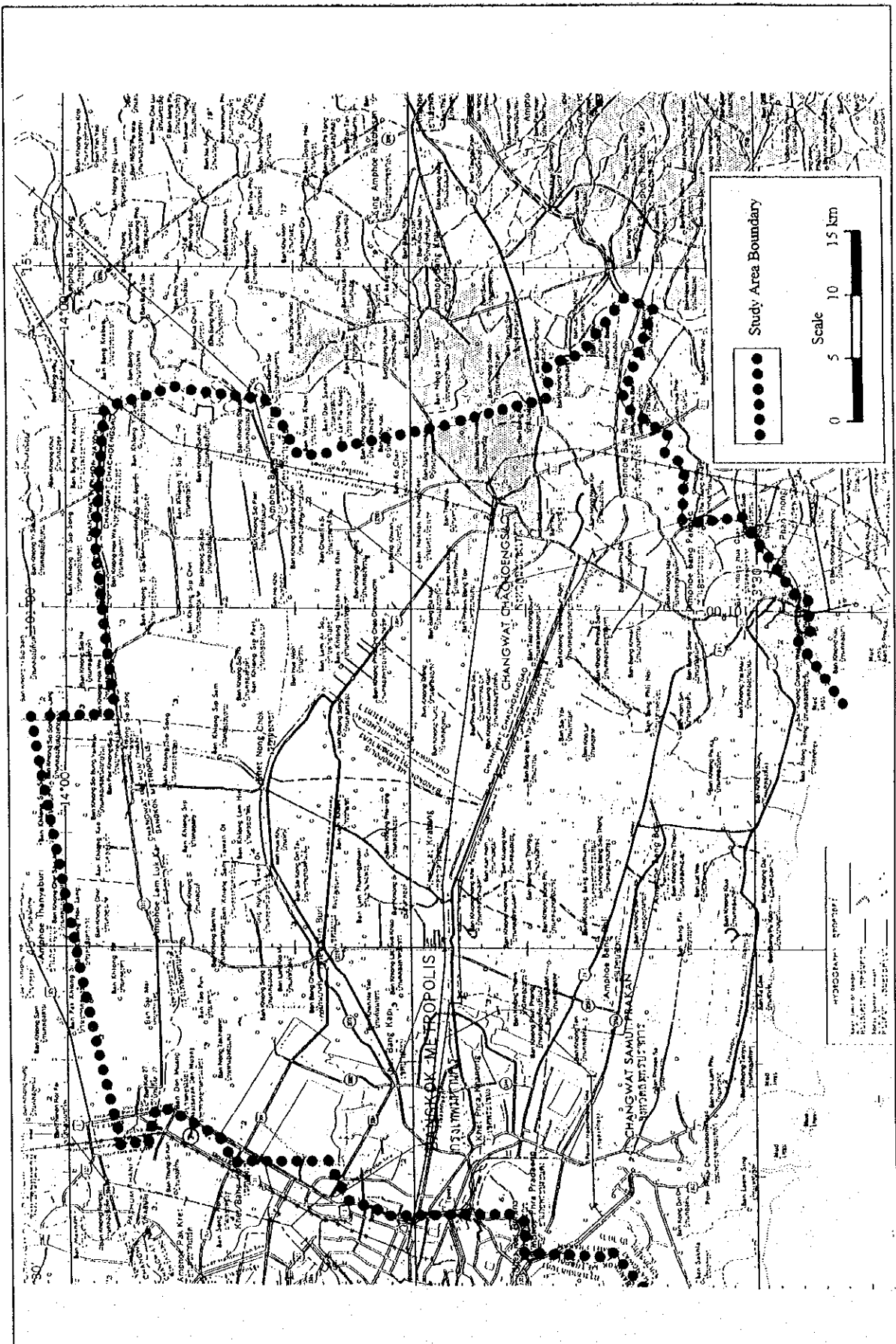


Table 3.5.5 Rainfall for the Period 1961-1990

Rainfall (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	9.1	29.9	28.6	64.7	220.4	149.3	154.5	196.7	344.2	241.6	48.1	9.7	1,496.8
Mean Rainy Day	1.3	2.9	2.9	6.3	16.2	16.3	17.9	20.0	20.9	17.1	6.2	1.3	129.3
Daily Maximum	39.3	73.0	88.4	76.2	248.6	167.3	108.6	97.8	156.7	143.9	116.6	32.0	248.6

Source: Climatological Data of Thailand for 30-Year Period / Meteorological Department

2) Land Use and Urbanization

The western side of the Structural Plan Area has already been urbanized as a result of expansion of Bangkok Metropolis. Mixed land use (residential, commercial, industrial, etc.) dominate this area.

The eastern side of Structural Plan Area is dominated by rural characteristics such as land use as rice cultivation, fishfarming and waste land. This area is traversed by canals and drainage ditches mixed with water retention areas. Traditionally, the waterways are the main communication routes in this area. As such, villages and communities are located along the canals, surrounded by agricultural land.

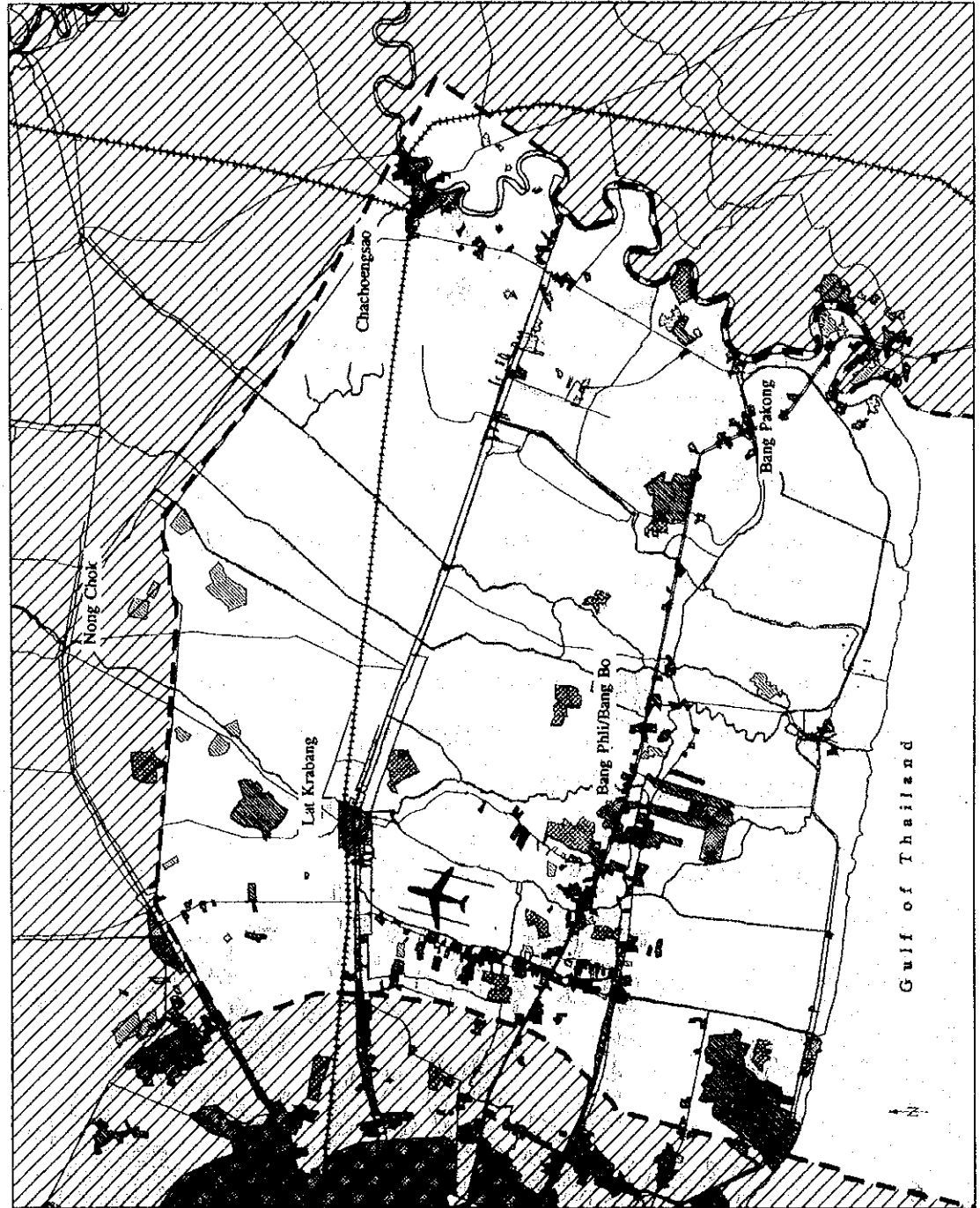
At present, Lat Krabang is defined as a front for the "pushing force of urbanization" caused by the expansion of Bangkok Metropolis toward the east. Recently, Lat Krabang has been rapidly developing.

Along National Highway No. 34, urbanization in the form of ribbon development is progressing very rapidly because convenient access and basic infrastructure are available along the highway.

Existing land use is shown in Fig. 3.5.3.

Master Plan and Feasibility Studies for Area around SBIA

Fig. 3.5.3 Existing Land Use of Structure Plan Area



- Legend**
- Residential
 - Mixed Residential and Commercial or Industrial
 - Industry
 - Education
 - New Development Area
 - Agriculture/Aquaculture/Nature
 - Poultry Farm
 - Recreation
 - Railway
 - Highway
 - Road
 - River/Khlong
 - Provincial Boundary
 - Landuse Area Boundary



Figure 4.3.1: Date: August 1994

Kingdom of Thailand
 Office of the Second Bangkok International Airport
 Development Committee (OSBAC)
 National Economic and Social Development Board
 (NESDB)

Source: Master Plan and Feasibility Studies for Area around SBIA in 1994

3) Population

Table 3.5.6 shows population (1990) of each amphoe. Existing urbanized amphoes are evidently recognized from figures of population density.

Table 3.5.6 Population of Amphoes(1990)

Amphoe by Province		Area (sq.km)	Population	Density
1. Bangkok				
(1) Middle	1) Eastern Corridor			
	Huai Kwang	18.499	255,207	13,796
	Khlong Toci	26.660	277,492	10,409
	Bang Kapi	48.904	295,396	6,040
	Bung Kum	69.900	181,417	2,595
	Pravet	81.660	228,385	2,797
	Phra Khanong	33.887	196,021	5,785
	2) Other Corridor			
Bang Khen	75.906	202,117	2,663	
Lat Phrao	30.476	122,457	4,018	
(2) Inner Suburb	1) Eastern Corridor			
	Lat Krabang	123.859	77,358	625
	Min Buri	174.000	103,403	594
	Nong Chok	236.000	56,461	239
2. Samut Phrakan				
(1) Middle	Phra Pradaeng	73.368	181,586	2,475
	Muang Samut Phrakan	190.557	306,347	1,608
	Phra Samut Chedi	120.378	70,025	582
(2) Inner Suburb	Bang Phli	374.782	132,271	353
(3) Outter Suburb	Bang Bo	245.007	79,593	325
3. Chachoengsao				
(1) Outter Suburb	Muang Chachoengsao	378.663	125,675	332
	Ban Pho	217.593	43,166	198
	Bang Pakong	257.893	69,988	271
(2) ESB(Inland)	Bang Nam Prieo	498.659	68,747	138
4. Pathum Thani				
(1) Inner Suburb	Lam Luk Ka	183.120	75,604	413
Total		3,459,771	3,148,716	910

Source: Metropolitan Regional Structure Planning Study / NESDB

4) Transport System

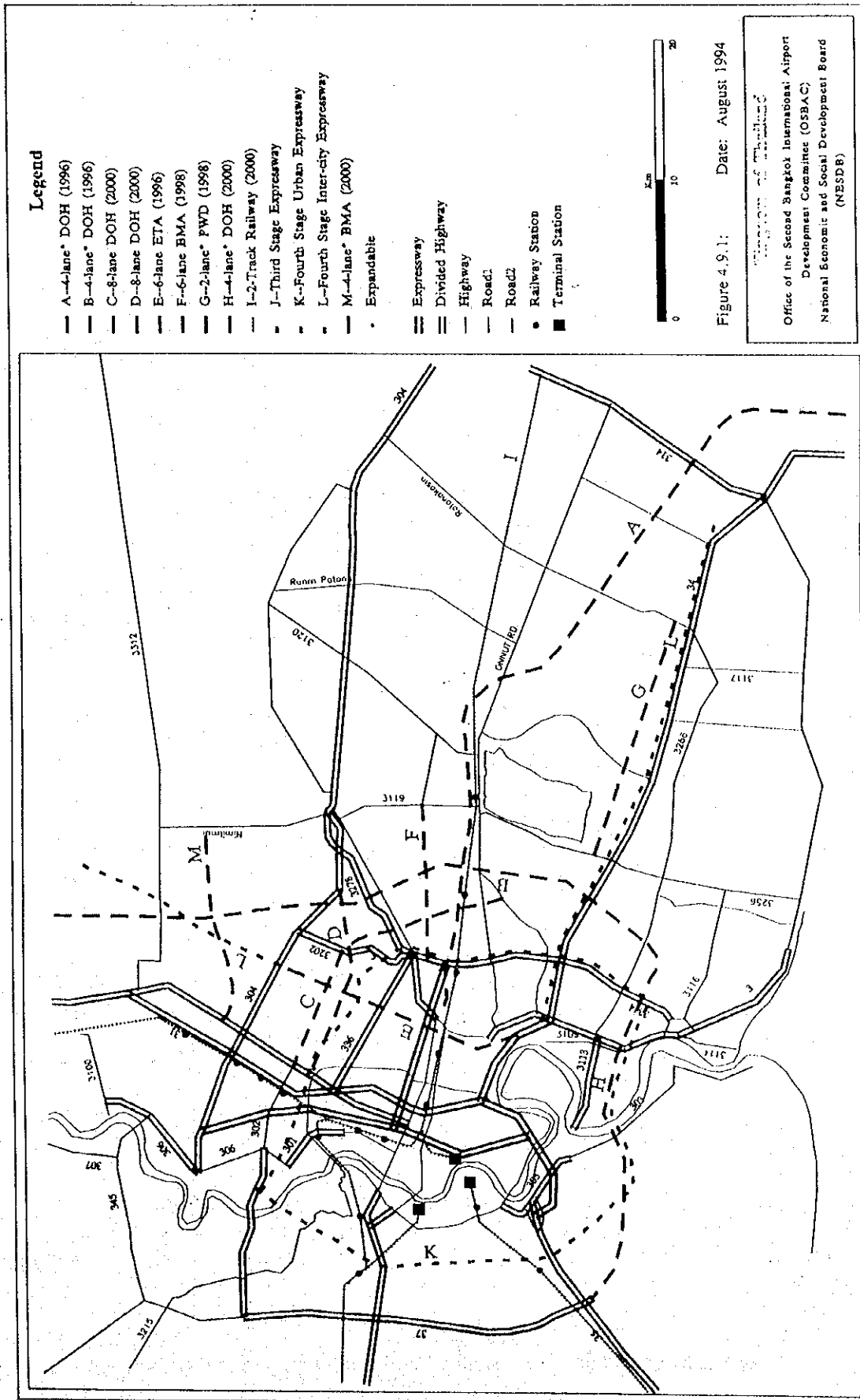
Fig. 3.5.4 shows the existing and planned transport system of the Structural Plan Area, and Table 3.5.7 gives a description and classification of existing and planned roads.

The responsible agencies for roads consist of Department of Highways (DOH), Public Works Department (PWD), Bangkok Metropolitan Administration (BMA), and Expressway and Rapid Transit Authority (ETA).

The eastern railway is presently a single-track, metre-gauge railway line. Most of the railway stations are not accessible by road, especially in rural areas. These conditions imply that the waterways in rural area are being used as main communication routes.

At present, three rail mass transit projects are planned, namely the 50 km SRT-MRT project under the SRT, the 20 km MRT Initial System of the MRTA, and the 20 km Bangkok Transit System of the BMA. Only one of these, the SRT-MRT project which is concessioned to Hopewell Co., has started construction. The others will most likely be constructed in the near future.

Fig. 3.5.4 Existing and Planned Transport System



Source: Master Plan and Feasibility Studies for Area around SBIA in 1994

Table 3.5.7 Existing and Planned Transport Infrastructures

Name	Type	Responsible Agency	Potential for Expansion
EXISTING ROAD AND RAIL NETWORK AROUND SBIA			
On-nut	2-lane, Secondary	PWD	Yes, 4/6-lane
Route 34	6-lane, Primary w/frontage	DOH	No
Route 3256	2-lane, Tertiary	DOH	Yes, 4-lane
Wat Sriwarinoi	2-lane, Local	PWD	Yes, 2-lane Secondary
Route 3119	2-lane, Tertiary	DOH	Yes, 4-lane
Route 3120	2-lane, Tertiary	DOH	Yes, 4-lane
Ruam Patana	2-lane, Local	PWD	Yes, 2-lane Secondary
Ratanakosin	2-lane, Local	PWD	Yes, 2-lane Secondary
Route 3268	2-lane, Tertiary	DOH	Yes, 4-lane
Route 3344	4-lane, Tertiary	DOH	Yes, 6-lane
Route 3	2/4-lane, Primary	DOH	Yes, 6-lane
Route 304	4-lane, Secondary	DOH	No
Route 314	4-lane, Primary	DOH	No
Eastern Railway	Single-track, Meter-gauge	SRT	Yes, double-track or more
Project Name	Type	Responsible Agency	Estimate Year of Completion
PLANNED ROAD AND RAIL PROJECTS			
New BKK-Chon Buri	4-lane, Expressway	DOH	1996
Outer Ring (east)	4-lane, Primary	DOH	1996
Ngarmwongwan-Udomsuk	8-lane, Primary	DOH	2000
Rachadapisek-ORR	8-lane, Primary	DOH	2000
Artnarong-Ramintra	6-lane, Expressway	ETA	1996
Srinakarin-Romklao	6-lane, Primary	BMA	2000
Wat King Kaeo-Ratanakosin	2-lane, Secondary	PWD	2000
Outer Ring (south)	4-lane, Primary	DOH	2000
Third Stage Expwy	6-lane, Expressway	ETA	(2010)
4th Stage Urban Expwy	6-lane, Expressway	ETA	(2010)
4th Stage Intercity	4-lane, Expressway	ETA	(2010)
Phaholyothin-ORR (east)	4-lane, Expressway	DOH	2000
Eastern Railway	Double-track	SRT	2000
System		Responsible Agency	Estimated Year of Completion
PLANNED AND PROPOSED MASS TRANSIT SYSTEMS			
SRT Road/Rail		SRT	2000
MRT Initial System		MRTA	2000
Bangkok Transit System		BMA	2000
MRT Phase 2		MRTA	(proposed by MRTA)
BTS Extension to Thana City		BMA	
High Speed Train		NESDB/SRT	(under study by NESDB)

Source: Master Plan and Feasibility Studies for Area around SBIA, 1994

5) Flood Control and Drainage

a) Organization

Responsibilities for flood control are lodged with the following agencies:

- Inside the BMR: the BMA with assistance from RID. Under BMA's Department of Drainage and Sewerage there is a Flood Control Operation Centre and also a Flood Control and Monitoring Centre, supported by JICA.
- Outside the BMR: the Municipalities and Sanitary Districts with assistance from PWD.
- RID is responsible for flood protection of agricultural areas and for allocation of water from the reservoirs for different uses.

b) Drainage

The general direction of drainage of the area is from north to south through a number of khlongs. Drainage capacity is limited, and gradually deteriorating, due to the following conditions:

- Low flow gradient: most of the undeveloped area has surface elevations between 0 and +1.0 msl. The elevations, and thereby the flow gradients, are reduced every year due to subsidence. The present gradient during flood conditions is estimated to be in the order of 1:20,000.
- Cross sections of the khlongs have been reduced by human activities. The main highways in the east-west direction, particularly the Bang Na - Trat Highway, have limited drainage openings. This creates bottlenecks in the water discharge.
- Silting along the coast and high tide conditions restrict natural drainage to the sea. Water from the khlongs therefore needs to be pumped into the Gulf.

Drainage of the area towards the west and east is also limited. Towards the west the area is bordered by the King's dike which was constructed after the large

flood in 1983, while drainage eastward towards the Bang Pakong river is restricted by nature.

- Flood Records

Flood problems are gradually increasing due to urbanization in the area. Water levels are observed by the Royal Irrigation Department. Table 3.5.8 shows recorded inundation during 1970-1983 in the three principal areas with corresponding rainfall.

Table 3.5.8 Flood Experience during 1970-1983

Year	Annual rainfall (mm)	Return Period (years)	Minburi (1.00)	Lat Krabang (0.50)	Bang Bo (1.00)
1970	1,900	25	1.82	1.30	1.25
1972	1,700	7	1.90	1.22	1.20
1974	1,500	3	1.90	1.33	1.30
1978	1,650	6	1.95	1.25	1.20
1980	1,500	3	1.90	1.20	1.24
1983	2,200	150	2.15	1.45	1.45

() Number in parentheses represents approximate ground elevation in m MSL.

Source: Master Plan and Feasibility Studies for Area around SBIA in 1994

6) Water Supply

Two different authorities under the Ministry of the Interior are responsible for the Structural Plan Area, namely Metropolitan Waterworks Authority (MWA) for the BMA and Samut Prakan Province, and Provincial Waterworks Authority (PWA) for Chachoengasao Province.

a) MWA Area

The main supply is from Bang Khen treatment plant which draws water from the Chao Phraya River. Under the Fourth Bangkok Water Supply Improvement Project (1992 - 1996), a new pumping station has been planned at Lat Krabang where MWA's distribution system has not yet reached. The pumping station is scheduled for completion in 1997 (Stage I), and it is also planned to supply water to the SBIA. The capacity is planned to be as follows:

Phase I	(1997)	300,000 cu.m./day
Phase II	(when needed)	500,000 cu.m./day
Phase III	(2012)	600,000 cu.m./day

Source: Master Plan and Feasibility Studies for area around SBIA in 1994

b) PWA Area

Water for the Chachoengsao area is presently drawn from the Bang Pakong river and nearby khlongs and distributed to a part of Muang Chachoengsao. There are problems with both water availability and quality (salinity).

As one of a number of projects embarked by PWA, a new diversion dam on the Bang Pakong river will be constructed 10 km upstream of Chachoengsao city. The dam which is scheduled for completion in 1998 will store water for domestic, industrial and agricultural purposes. A new treatment plant, Bang Khla Water Treatment Works, will be located 12 km upstream of the dam and is designed to supply both the Chachoengsao Municipality and the Bang Pakong area east of the river from 1998 and onwards.

7) Sewerage

Several levels of national and local government agencies are involved in the sewerage sector. Inside the BMR, the BMA is responsible for all aspects of waste water management. Elsewhere, municipalities, Sanitary Districts, and Provincial Administrative Organizations are responsible, with technical assistance from PWA. In addition, some national government agencies are also involved. However, it is reported in the Master Plan and Feasibility Studies for the Area around SBIA that the coordination among agencies is poor.

The existing sewerage situation is summarized as follows:

- i. Residential developments in BMA and Samut Prakan are generally served by on-site septic tank and leaching pit.
- ii. Large commercial and institutional developments are normally equipped with individual package waste water treatment plants.
- iii. Most factories have treatment facilities.
- iv. Large industrial estates located within the Structural Plan Area possess adequate waste water collection and treatment facilities.

8) Electric Power Supply and Telecommunications

a) Electric Power Supply

Three government authorities are responsible for the electric power supply and distribution systems in Thailand. They are:

- Electricity Generating Authority of Thailand (EGAT): power generation and transmission throughout the whole country;
- Metropolitan Electricity Authority (MEA): power distribution in BMA, Samut Prakan and Nonthaburi; and
- Provincial Electricity Authority (PEA): power distribution in all other provinces.

b) Telecommunications

Telecommunications facilities in the area are operated by the Telephone Organization of Thailand (TOT). The existing facilities are currently being expanded under the 7th Economic and Social Development Plan (1992-1997). The systems are relatively easy to expand and are capable of offering a wide range of services in addition to the basic telephone service.

(3) Proposed Regional Urban Structure and Framework

The regional urban structure and framework of the study area (SBIA M/P area) are presented in Fig. 3.5.5.

This framework is rooted on the basic regional development concept of "appropriate allocation and consolidation of new urban centers and new towns based on the physical framework".

1) Orderly allocation of new towns and center on the Eastern Corridor

The Eastern Corridor is defined as an urban corridor with new towns and urban centers being allocated in an orderly way from the existing CBD to Chachaengsao

along the railway. They are developed, according to the classification of urban areas of Bangkok, that is the CBD, middle built-up area, inner suburban and outer suburban areas, relative to the distance from the CBD.

The development concept and potentials of new town centers shall be characterized by the urban area to which they belong.

2) Consolidation of Rail Cities/Towns

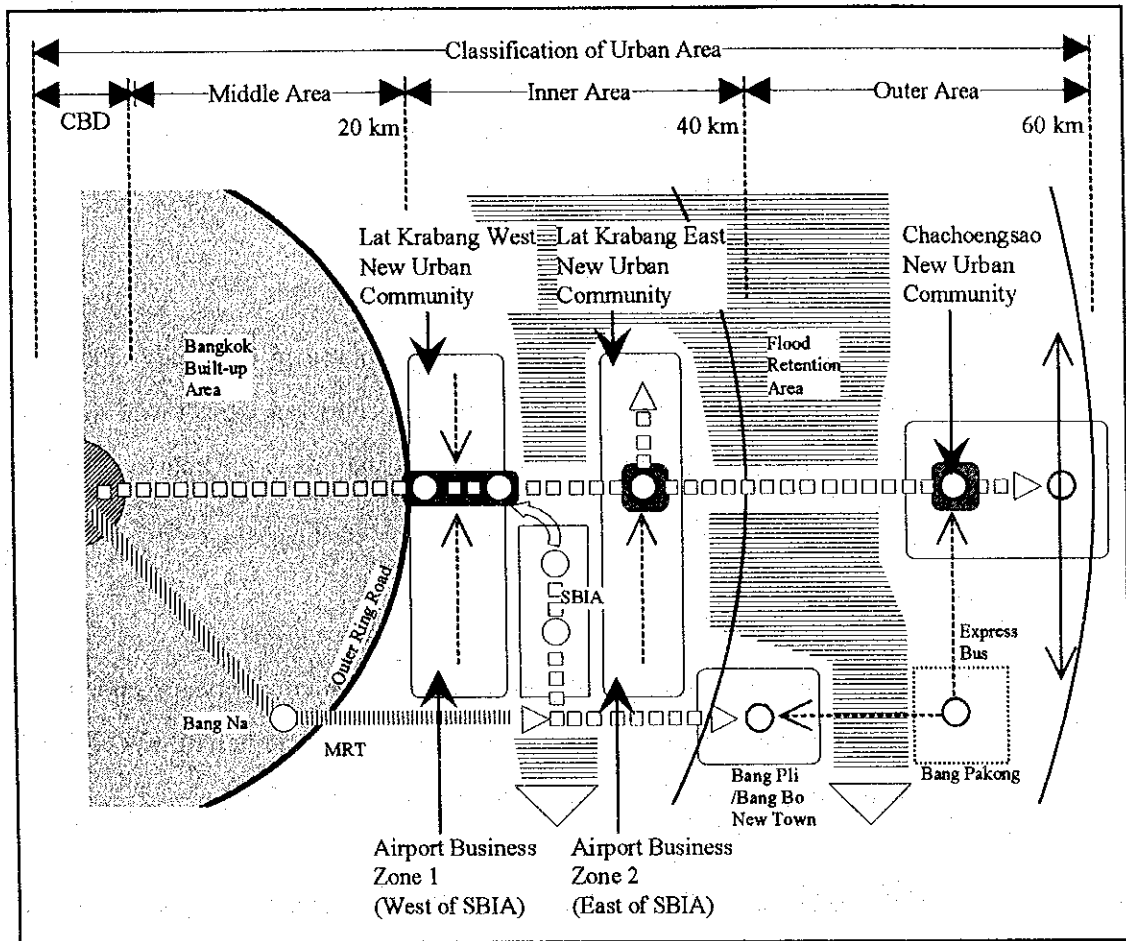
Existing development projects and those proposed in this study, and the existing urban areas are designed to be consolidated into rail cities/towns with the town center being developed around the main rail stations in the course of full operation of the improved railway.

3) Physical Framework

The natural and physical conditions of the Eastern corridors are among the factors taken into consideration in allocating urban centers and new towns. This allocation is made in the physical framework, as shown in Fig. 3.5.6.

The area along the Eastern line, especially suburban areas in the 20 to 60 km range from Bangkok, is divided into three (3) urban areas by the following physical barriers:

Fig. 3.5.5 Proposed Regional Urban Structure - Orderly Allocation of New Towns and Urban Centers on the Eastern Urban Corridor

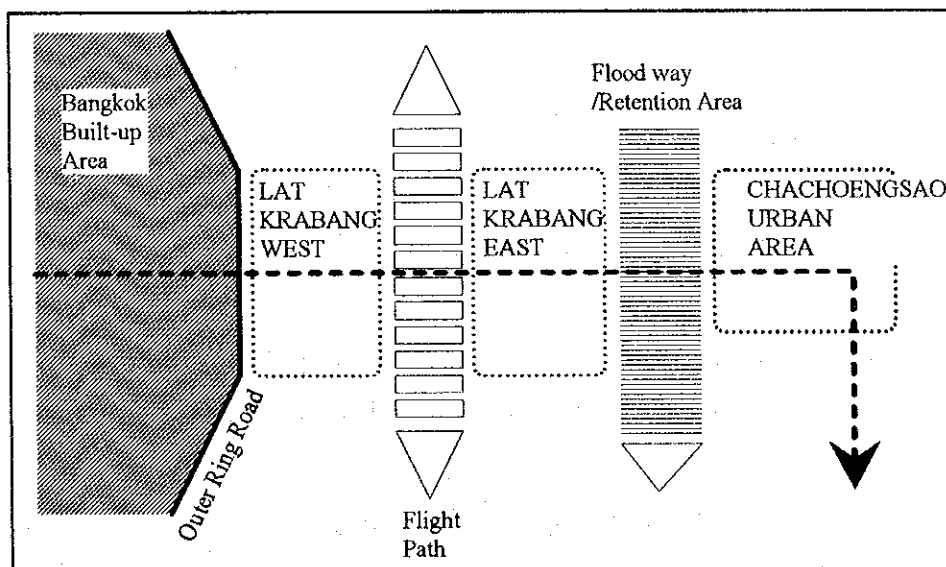


- a) North-South lying SBIA and the open land which must be kept undeveloped due to the building height control, noise problems and among others safety under the flight path; and
- b) North-South lying floodway and flood retention area between Chachoengsao and Lat Krabang. In the course of the study, conflicting views on urban development in the flood area were presented. One is in favor of urban development, saying that it will never cause serious problems to flood protection judging from the preliminary flood simulation study, while the other is more on the side of natural conservation.

This study recommends that the area should be generally preserved as a flood

retention or natural area, but not totally prohibiting urban development. This is subject to detailed study of the flood protection system and the economic feasibility.

Fig. 3.5.6 Physical Framework



4) Structure Plan of the Integrated Urban and Railway development

a) Outline of Proposed Integrated Development plan and projects

The proposed development projects under the integrated urban and railway development scheme are shown in Fig. 3.5.7 and listed below.

New Town (New Urban Community) Development Projects.

- Lat Krabang West new urban community including South (SBIA Airport Business Zone 1) and North of the eastern line and proposed BMA Suburban Center;

- Lat Krabang East new urban community including South (SBIA Airport Business Zone 2) and North of the eastern line and NHA proposed New Town;
- Bang Phli Bang Bo New Town; and
- Chachoengsao new urban community including the proposed sub-government center.

Urban Center Development

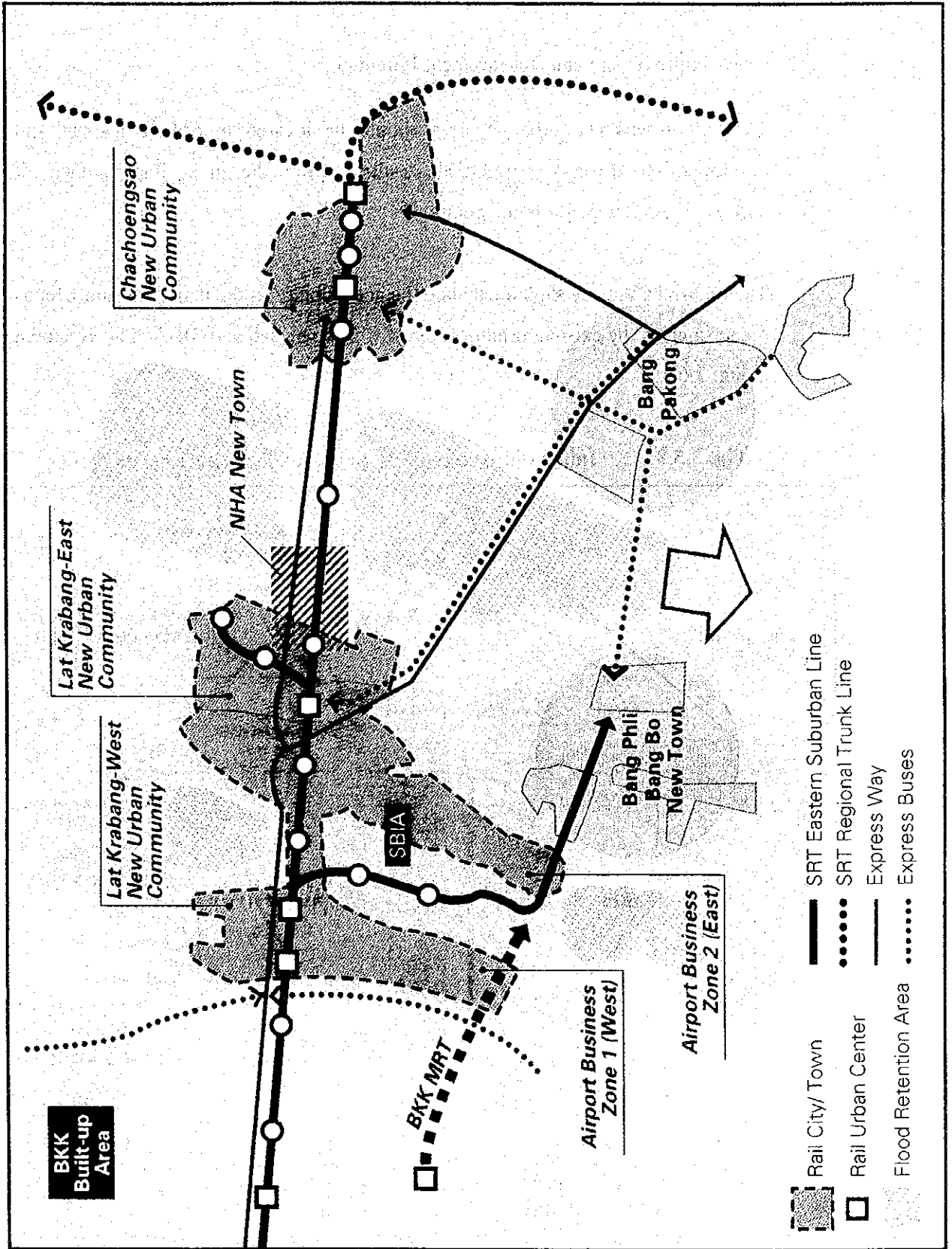
The following Urban Center Development projects are proposed to serve as town centers for the proposed new towns as well as rail urban centers (urban core):

- Lat Krabang Subcenter (BMA Proposed);
- Lat Krabang Junction Urban Center;
- Lat Krabang East Urban Center; and
- Chachoengsao Regional Urban Center.

Railway Improvement and Development Projects

- Eastern Main Line
 - (Regional Train Service Line)
 - Section: Hua Lamphon - Rayong through Chachoengsao
 - Speed: 100 km/H
 - (Suburban Commuter Service Line)
 - Section: Hua Lamphon - Chachoengsao
 - Speed: 60 km/H
- Eastern Branch Line (Lat Krabang junction - Bang Phli / Bang Bo)
 - (SBIA Access Service Line)
 - Hua Lamphon - SBIA
 - (Suburban Commuter Line)
 - Hua Lamphon - Bang Phli / Bang Bo

Fig. 3.5.7 Structure Plan of Integrated Urban and Railway Development along the Eastern Line



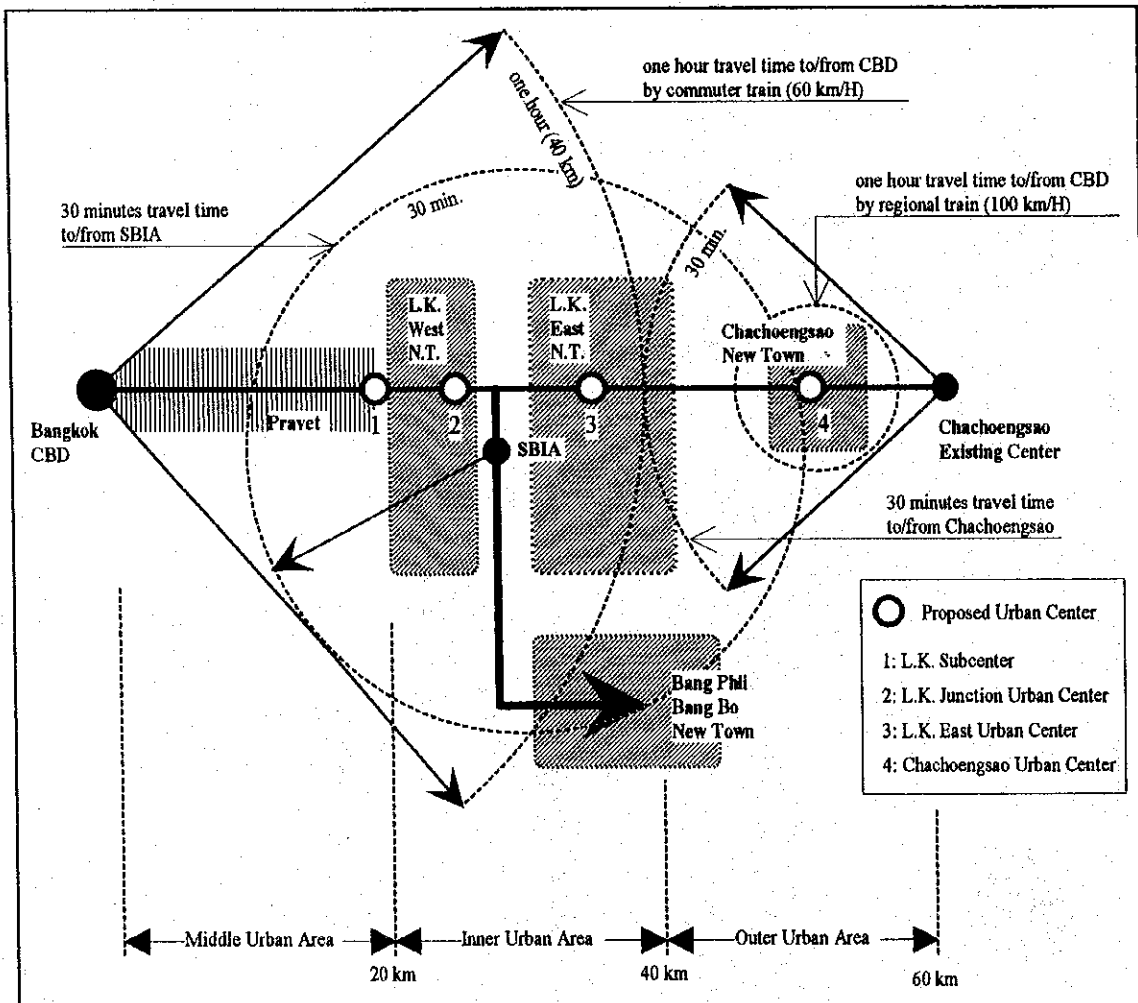
(4) Urban Development Plan

1) Access Improvement and Development Potential.

The new towns and urban centers should be located in orderly manner and developed based on the potential resulting from the great improvement of accessibility to the major focus points.

The improved railway should enhance the accessibility to the major transport focus points such as the existing urban center of Chachoengsao and SBIA. This is shown in Fig. 3.5.8.

Fig. 3.5.8 Improved Accessibility to Major Transport Focus Points



The travel times, including rail and feeder travel time, are set for evaluating the accessibility and development potential of the area along the railway, as follows:

- One hour travel time to and from the existing CBD;
- 30 minutes travel time to and from the existing urban center of Chachoengsao;
and
- 30 minutes travel time to and from SBIA (terminal station).

These travel times show the following geographic boundaries of urban development potential:

a) Direct Influential Area of Bangkok

The area within one hour travel time to the CBD will be a major venue for the following urban activities/development:

- Housing development for commuters to Bangkok;
- Relocating Urban activities from Bangkok; and
- CBD oriented offices and industries in close connection with the existing built-up areas.

The development thrust in this area is characterized by expansion of the urbanization of Bangkok to the newly established urban structure.

b) Direct Influential Area of Chachengsao

The area within 30 minutes travel time to the existing urban center of Chachengsao is the major venue for regional and urban development enhancement based on the potential of Chachengsao itself. This should be more closely connected to the

existing urban area and center of Chachengsao than Bangkok.

c) Direct Influential area of SBIA

The area within 30 minutes travel time to and from the SBIA is the major venue for accommodating the effect of SBIA (SBIA related employment and population) or promoting urban development in connection with SBIA operation. Judging from the classification of urban areas by accessibility, new town development can be defined as follows:

- The new towns for the most part are to be located within one hour travel time to and from the CBD of Bangkok:

(By commuter train service (60 km/h))

Lat Krabang West and East New Towns

Bang Phli / Bang Bo New Towns

(By the regional train service)

Chachengsao New Town

Among these new towns, those in Lat Krabang West and East will be most intensively exposed to urbanization from Bangkok, especially residential development.

- The new towns placed under the development effects of SBIA are Lat Krabang West and East new towns as well as Bang Phli / Bang Bo.
- The new town placed under the development potential of Chachengsao is the Chachengsao new town.

2) New Town Development Schemes

a) Character of New Towns

Taking into account the development potential, the characteristics of the planned new towns are specified as follows:

- Lat Krabang West and East new towns will have turn characteristics, both as an industrial (Airport City) and a residential (Commuter Housing) new town. Lat Krabang West new town and East new town will be located at the Western and Eastern gateway of the SBIA, respectively.
- Bang Phli / Bang Bo new town will have more or less the same characteristics as the above-mentioned new town. However, it will be more connected with industrial development proceeding along highway No. 3, especially manufacturing industries.
- Chachengsao new town will be a part of the regional urban center development of the provincial capital, not a residential new town for commuters to Bangkok and SBIA / SBIA city. This new town should be more independent from Bangkok than the others since it is fostered in association with the Chachengsao capital development. However, it should be connected with Bangkok through the regional express train service for industrial and economic purposes.

b) Area and Location of New Towns

The areas and location of planned new towns as shown in the structural plan in Fig. 3.5.7 are proposed, with special attentions being paid to the following development policies.

- The development size and area should be large enough to maintain an independent urban service provision system.
- The new towns should be developed centered around the main express train service stations, newly opened for serving the planned new towns.
- The new towns shall be constructed around a one-hour access area to and from the center of Bangkok, as shown in Fig. 3.5.9. They shall be visibly,

closely linked with the CBD of Bangkok - not only for commuters to Bangkok, but more importantly for socioeconomic interaction with it.

- The area and location of new towns should be planned to include the existing proposed development projects as far as possible.

c) New Town Development Schemes

Based on the above development policies, the proposed new town development schemes are as follows:

- Lat Krabang West New Town

Airport Business District 1 (SBIA M/P) and BMA subcenter are to be combined into a city or town with the new town centers around the Lat Krabang West station (newly opened) and Lat Krabang Junction station (existing).

- Lat Krabang East New Town

Airport Business District 2 (SBIA M/P) and the undeveloped area on the north side of the railway are to be combined into another city with the new town center around the newly opened Lat Krabang East Station (Express train).

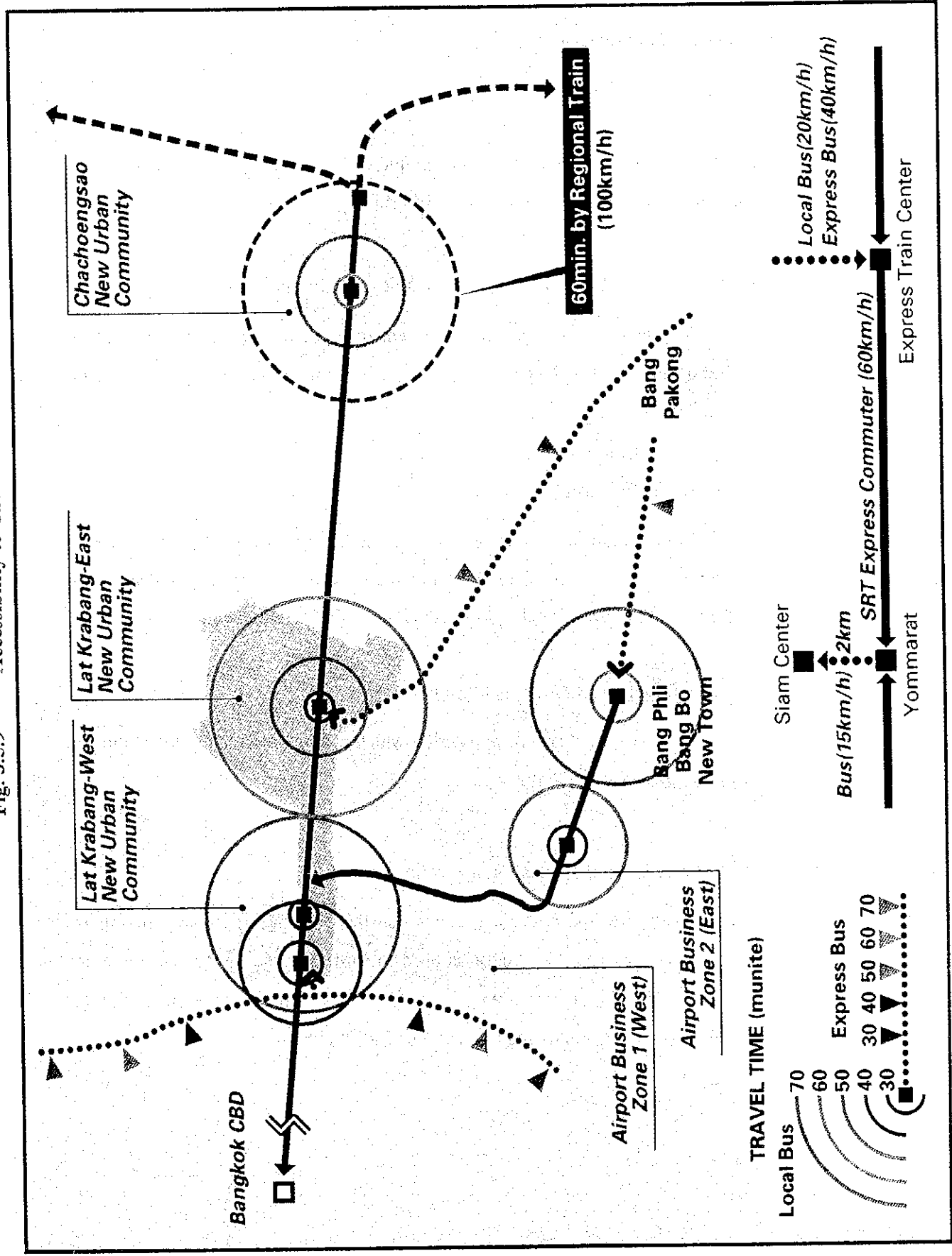
- Bang Phli / Bang Bo New Town

Along with the construction of the Eastern Branch line, Bang Phli / Bang Bo new town shall be developed.

- Chachoengsao New Town

Along with the improvement of the regional trunk rail line to Chachoengsao, Chachoengsao new town shall be developed with the town center around the New Chachoengsao express station.

Fig. 3.5.9 Accessibility to CBD



3) Socio-economic Framework

a) Population

The procedure for population projection and distribution is shown in Fig. 3.5.10. The basic features of the methodology of projection are outlined below.

- **Growth Trend and New Development Potential Population**

Trends in the new development potential population which consists of the total population by region or district, are estimated based on the following definitions.

Trends Population:

The population is assumed to increase at the past average growth rate by district. This is considered as the population projection and distribution without the new town development along with the railway improvement.

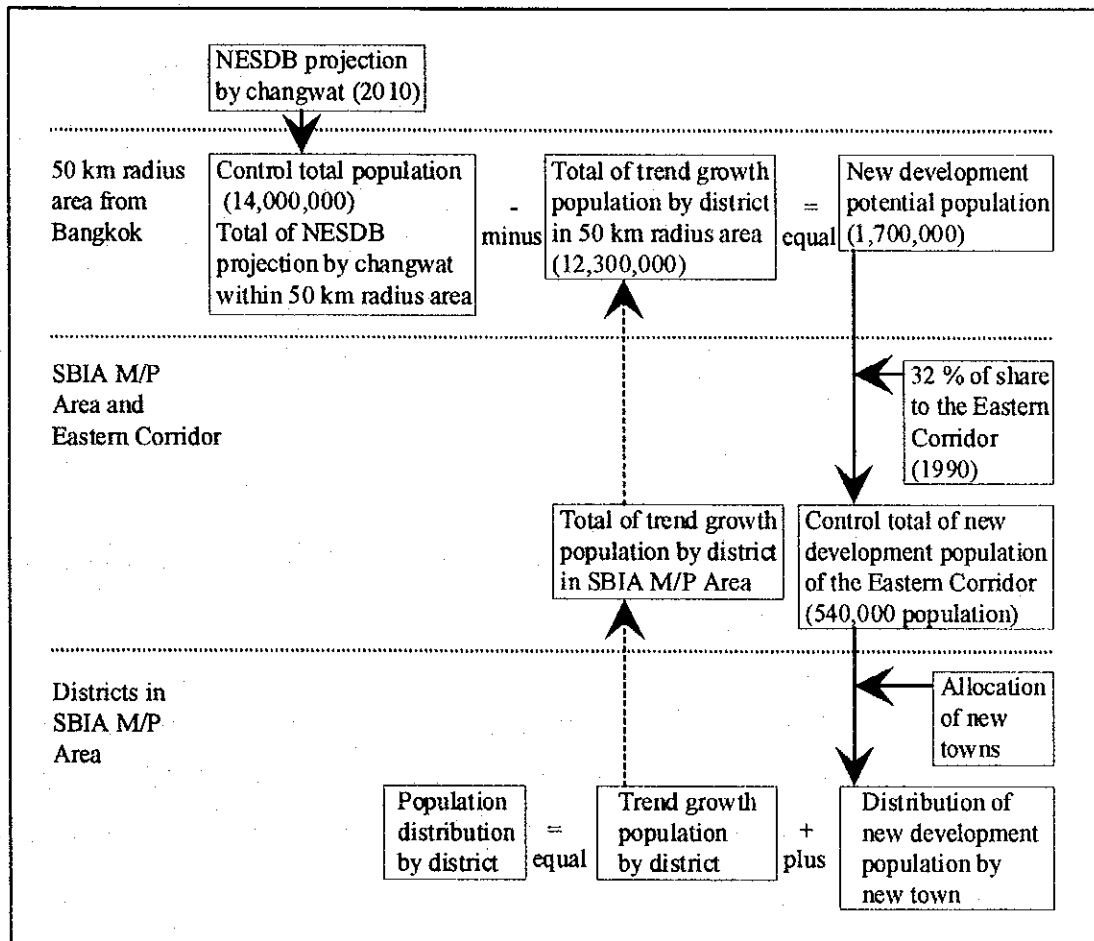
New Development Potential Population:

This will show the size of population which can be potentially moved into the new towns along the railway.

- **Control Total of Population Projection**

As stressed in the preceding chapter on the planning approach, the control total of population projection is used to formulate the integrated urban and railway development plan in this study. The control total of population is projected at the following two (2) levels of the region.

Fig. 3.5.10 The Procedure of Population Projection and Distribution



Control Total Population of the 50 km Radius Area

NESDB has made a population projection by province (changwat) and district (amphor) up to the year 2010 (MRSP Study). The total within the 50 km radius area is set as the total population in the year 2010. This is equal to the total of trend and new development potential population. It implies that the total future population within the 50 km radius area is assumed not to change whether with or without the railway and new town development. Change will take place only in the population distribution pattern within the area.

In the preceding JICA Master Plan Study (First Phase), the total control population, trend population and the new development potential population

are calculated as follows:

Table 3.5.9 Population Projection of 50 km Radius Area

1. Total control population of 50 km radius	Total of NESDB projection by changwat	14,000,000
2. Trend population	Total of trend population by district	12,300,000
3. New development potential population	Difference between 1 and 2	1,700,000

Source : JICA M/P Study

Control Total of New Development of the Eastern Corridor (SBIA Master Plan Area)

The control total new development population of the SBIA Master Plan Area, through the Eastern Corridor goes, is established by determining its share among the total new development potential population of 1.7 million in the 50 km radius area.

This potential population is distributed among the four (4) corridors radiating from the center of Bangkok mainly with the concern to attain a balanced population distribution among them leading to balanced railway transport. About 0.5 million of population is allocated to the new town development along the Eastern Corridor.

It is disputable whether the figure of 0.5 million is under or over-estimated, especially taking into account the expected high development potential represented by such large projects as SBIA and SBIA related projects, Eastern Seaboard Development and so on.

In 1990, the share of the Eastern Corridor's population of the total population in the 50 km radius area was 32%. As has been shown in the section under

“Control total population of the 50km radius area,” new development population is 1.7 million. It is considered that taking the same percentage of the Eastern Corridor population in the year 1990 could result in a conservative estimate of the population increase along the railway. Hence, 32% is applied as shown below.

As stated in the planning issues and approach, there exist many proposed development projects in the area. However, it may be safely said that their population projections do not seem so certain that planning and investment for railway improvement can rely on them. More probably the population projection of the Eastern Corridor as a whole, not individual projects is needed for safe and realistic capital investment for the railway improvement. The existing population share of 32 % applied to the Eastern Corridor assumes the most probable and safe population projection since it is anticipated that the Eastern Corridor will maintain at least the existing level of population concentration.

It must also be stated that insofar as far as the railway improvement is based on this basic population projection, the railway can easily respond to an unexpected population increase, if any, beyond the population projection through additional measures of increasing transport capacity.

Of equal importance is the development goal of balanced rail transport among the four corridors, set up in the Master Plan, in spite of the high urban development potential on the Eastern Corridor. An excessive share or population concentration threaten to result in failure of railway improvement in the other corridors.

Based on the above discussions the control total new development population on the Eastern Corridor is set at 542,000 ($1,700,000 \times 32.0 = 542,000$).

- **Distribution of New Development Population of New Towns**

Development population of new towns is estimated by distributing the control total new development population as elaborated above, along the Eastern Corridor.

The new development population distribution is presented mainly in consideration of the accessibility improved by the railway and development potential.

Higher population pressure will be found in the order of Pravet, Lat Krabang and Chachoengsao along the Eastern Rail Line in accordance with the distance from the CBD of Bangkok in the form of housing development for commuters to Bangkok. This will be accelerated by the improvement of the railway and will be greater in the short and medium term.

On the other hand, higher urbanization pressure related to SBIA will be found in the order of Lat Krabang and Pravet/Chachoengsao, especially the housing development for the employees working at SBIA and airport business zone 1, 2. But it is only when the operation of SBIA reaches full swing that urban development related to SBIA will take shape.

The population growth of Bang Phli/Bang Bo New Town and Chachoengsao New Town depend on the following development factors respectively.

- The possibility either of housing development for commuters toward Bangkok on rail transport or manufacturing industrial development for sustaining a self-contained community in Bang Phli/Bang Bo.
- The possibility of realizing the highly expected regional development potential of Chachoengsao.

The least number of population are allocated to both of the new towns due to the indefinite development conditions.

Taking into account the high population pressure from Bangkok and the high urbanization pressure from SBIA, a population volume of 200,000 is assigned to Pravet and Lat Krabang, respectively, including the west and east New towns while the remaining new development population of 140,000 have been assigned to Chachoengsao New Town.

- Population Distribution by District

The population distribution by district is calculated by means of summing up the trend population and new development population for new towns.

b) Workers on Home Base and Employment at Workplace

The numbers of workers and employment in the year 1990 and 2010 are calculated according to the procedure shown in Fig. 3.5.11 and outlined below.

- Trend growth and new development employment

As with the population projection, the trend growth employment and new development employment are estimated. The trend growth employment is dependent on the past trend of growth while the new development employment by district is dependent on the urban development policy and plan as set forth in the preceding chapter.

- Major Indicators Employed for Estimating the Number of Worker and Employment by District

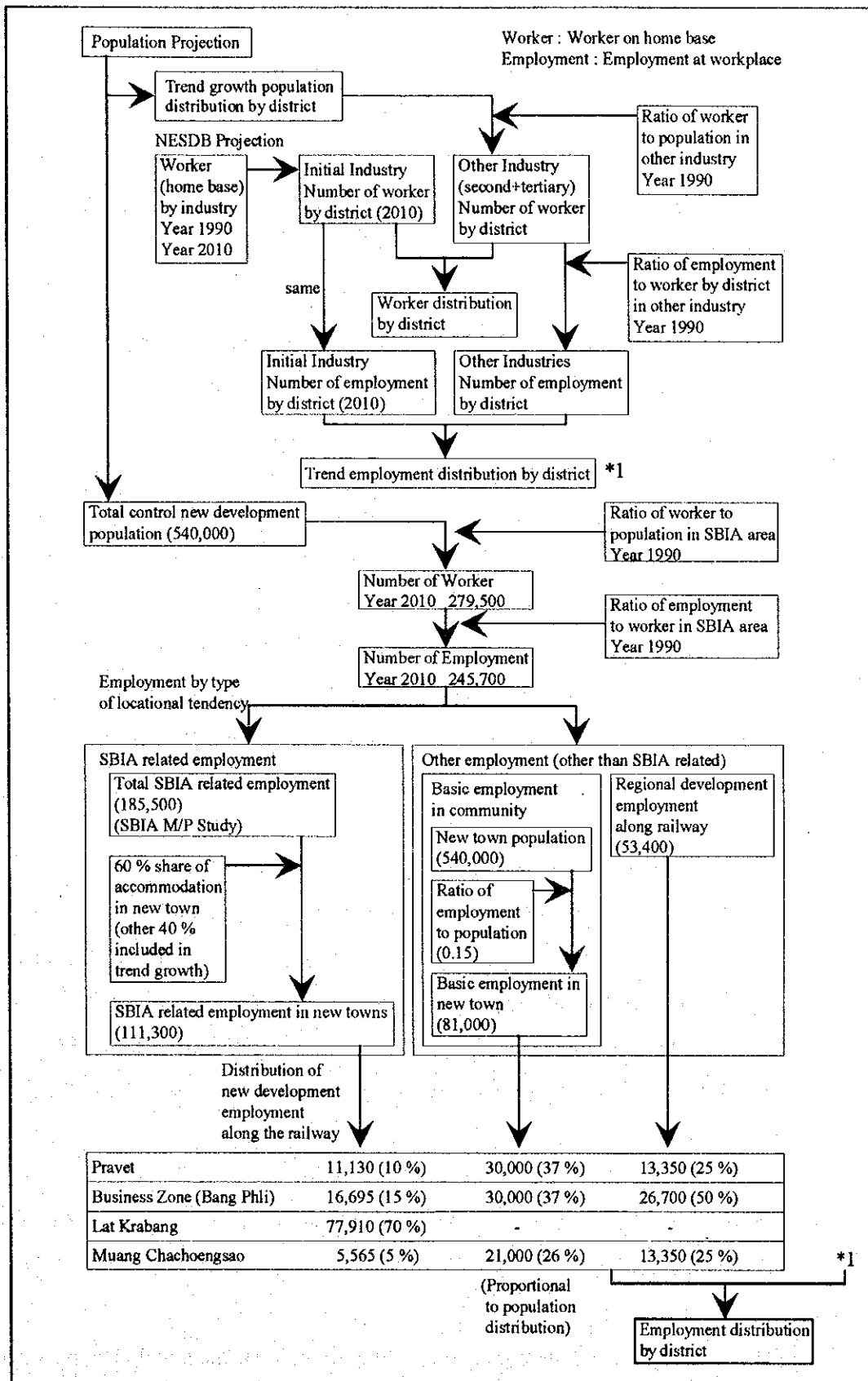
Given the above population distribution, the major indicators interpreting the future socio-economic structure of the Eastern Corridor must be set up for estimating the number of workers and employment in the area.

Table 3.5.10 Population Projection (Year 2010)

	1990	MRSPS (NESDB)	SBIA		JICA Study	
			Total	New Development	Total	New Development
Bangkok						
(1) Middle						
1) Eastern Corridor Area	1,433,918	2,023,976	2,196,000		2,108,575	
Huai Kwang	255,207	378,028	378,000		339,686	
Khlong Toei	277,492	355,331	355,000		369,348	
Bang Kapi	295,396	334,981	335,000		393,178	
Bung Kum	181,417	343,591	316,000		241,470	
Pravet	228,385	332,633	533,000		503,985	(20,000)
Phra Khanong	196,021	279,412	279,000		260,908	
2) Other Corridor	324,574	557,259	519,000		336,469	
Bang Khen	202,117	321,676	302,000		173,476	
Lat Phrao	122,457	235,583	217,000		162,993	
(2) Inner Suburb (Eastern Corridor)	237,222	344,374	433,000		516,414	
Lat Krabang	77,358	112,704	213,000	(100,000)	303,631	(200,000)
Min Buri	103,403	151,055	143,000		137,632	
Nong Chok	56,461	80,615	77,000		75,151	
Samut Phrakan						
(1) Middle	557,958	966,937	935,000		898,422	
Phra Pradaeng	181,586	315,145	292,000		292,389	
Muang Samut Phrakan	306,347	530,524	531,000		493,279	
Phra Samut Chedi	70,025	121,268	112,000		112,754	
(2) Inner Suburb						
Bang Phli	132,271	261,568	327,000	(66,000)	212,982	
(3) Outer Suburb						
Bang Bo	79,593	135,610	276,000	(140,000)	128,160	
Chachoengsao						
(1) Outer Suburb	238,829	377,756	712,000		473,416	
Muang Chachoengsao	125,675	197,912	532,000	(334,000)	315,054	(140,000)
Ban Pho	43,166	66,750	67,000		60,412	
Bang Pakong	69,988	113,094	113,000		97,950	
(2) ESB(Inland)						
Bang Nam Pricco	68,747	109,408	102,000		97,059	
Pathum Thani						
(1) Inner Suburb						
Lam Luk Ka	75,604	165,012	149,000		117,747	
Total	3,148,716	4,941,900	5,649,000	(640,000)	4,889,244	(540,000)

Note: Total population include the new development population

Fig. 3.5.11 Procedure of Worker and Employment Projection/Distribution



Among others, those include the following:

Ratio of Workers on Home Base to the Total Population by District

This ratio shows the employment conditions of people living in the districts whether they work outside or inside of these districts. This figure tends to be the same, more or less, throughout the districts.

Ratio of Employment (at Workplace) to Worker (on Home Base) by District in Other Industry (second and tertiary industry)

This figure shows the number of people working in the district to the total number of workers living in every district. This ratio reflects the development and land use characteristics of district. It becomes low in districts where housing development especially for commuters is dominant. Such districts include those in suburban residential areas and subdivision development areas. On the other hand, it is quite high for such districts as those in the CBD, urban center, and industrial development zones where employment at workplace outnumber workers on home base.

The official statistics on the number of people employment at workplaces by district are not available in Thailand. Fortunately, a survey on this item was carried out in the past JICA study on Medium to Long Term Improvement/Management Plan of Road and Road Transport in Bangkok in the Kingdom of Thailand, 1990. This study, however, only covered the districts within the Outer Ring Road. In this situation, the figures of SBIA M/P area are estimated, making use of the data in the JICA study.

Numbers of workers and employment in established industries are estimated on the following conditions:

Firstly, the NESDB estimation is used on the ground that the initial industry would

not be drastically affected by the railway and the effect of urbanization on agriculture would have already been incorporated in the NESDB estimation.

Secondly, it is supposed that the numbers of workers and employment would be the same since the farmers are not likely to commute beyond their districts.

Ratio of Employment (Workplace) to Population by District

The average ratio of employment to population of BMR as a whole is calculated at 0.407. This implies that 407 jobs are needed to sustain 1,000 people in BMR. However, this figure varies depending on the districts because of differences between the employment and population distribution patterns, with the former concentrated in the CBD and urban centers, and the latter accumulated in the vicinity of the CBD and suburban housing areas. This disparity will generate commuter traffic beyond district boundaries.

This figure indicates either the independence from or dependence on the other districts, especially the CBD and urban center for its socio-economic activities.

- **Employment Distribution by District and New Town for New Development**

The total number of new development employment (workplace), estimated at 245,700 is to be divided by type of employment with different locational tendencies.

SBIA related employment (including the direct and indirect)

- Numbers Employed

SBIA Master Plan Study estimated the SBIA related employment at 147,000 in the year 2000, and 185,500 in the year 2010. It seems very difficult to achieve the 2000 year estimation, but the 2010 year estimation seems attainable taking into consideration the longer time span for

development .In this regard, SBIA related employment is set at 185,500 in the year 2010 out of the total developed employment of 245,700.

- Location of Employment

For this type of employment, industries tend to locate at points which are convenient for access to/from SBIA as well as the existing CBD of Bangkok. Therefore, the improved railway directly connecting SBIA and CBD will attract the location of this type of employment along the railway, especially at the gateway to SBIA in Lat Krabang. It must also be stated that not all the SBIA related jobs will locate at the airport business zones planned at both sides, east and west, and along the railway. This study assumes that 60 %, or 111,300 jobs will be located in the planned new towns including the business zones, while the remaining 40 % is included in the trend growth employment of the SBIA Master Plan Area estimated before.

Thus, the total SBIA related employment in new towns along the railway is estimated at 111,300, which are distributed among the districts and new towns as follows:

Table 3.5.11 Distribution of SBIA Related Employment in New Towns

District/New Towns	Potential	Employment Share
Pravet	High potential located in the middle between CBD and SBIA along railway	10 %
Lat Krabang	High potential located at the Gateway to SBIA along the railway	15 %
Business Zone (Bang Phli)	Original plan (employment concentration)	70 %
Muang Chachoengsao	Low potential before the completion of the regional train service	5 %

Other Employment/Indigenous Employment

Other employment is defined as future employment without the SBIA project, that is, employment created based on the indigenous development potential of SBIA M/P area and the eastern corridor. This employment is to be divided into 2 types with different locational tendencies:

- Basic employment in the communities; and
- Regional development employment along the Corridors.

Basic employment tends to disperse following the population distribution pattern, while regional development employment tends to converge on some central points such as transport nodes on the corridor.

- Basic Employment in the Communities

Number of Employment

This is the employment for urban industries and activities providing basic services in order to sustain the daily lives of people in new towns, in other words they cannot locate outside the communities or new towns for their operation. Basic employment is estimated at 81,000 with the ratio of employment to population of 0.15 being applied to the new towns of 540,000 population. These people are supposed to be locally employed in the new towns.

Distribution of Employment

The estimated basic employment is distributed in proportion to the population volume of each new town.

- Regional Development Employment on the Eastern Corridor

Number of Employment

The number of the SBIA related employment subtracted from the basic employment from the total number of new developments leaves the regional development employment on the Eastern Corridor.

Distribution of Employment

This type of employment is foot loose in location so that they tend to converge at any advantageous location on the transportation network, such as urban centers, main transport nodes and the like. The urban industries for this type of employment cover a relatively large area of market and operation. This is why they need a rapid and reliable transport system covering a wider range of area.

The integrated urban and railway development targets this type of employment to be allocated along the railway, especially at the rail urban center with high quality transport services.

The regional development employment is distributed, especially with special attention paid to the development effect of the improved railway, as follows:

Table 3.5.12 Distribution of Regional Development Employment

District/New Town	Potential	Employment Share
Pravet	Relatively high as a part of Bangkok built-up area, and serving the increasing population	25 %
Lat Krabang	High potential 1. large volume of new town population 2. Gateway to SBIA 3. Within one hour travel time to CBD	50 %
Muang Chachoengsao	Relatively high based on the potential of Chachoengsao	25 %

c) Results of Socioeconomic Projection and Some Indications

- Results of Socioeconomic Projection

The output of the above socioeconomic projection are shown in Table 3.5.14 and summarized in Table 3.5.13.

Table 3.5.13 Summary of Socio-economic Projection of SBIA M/P Area

	1990	2010
Population	3,148,716	4,883,244 (540,000)
Worker (home base)	1,573,709	2,527,481 (279,500)
Employment (workplace)	1,407,868	2,214,690 (245,700)

() : New Development

- Analysis of Other Socio-economic Projections

The analysis on the SBIA M/P Projection in the Study on the Master Plan for Area around Second Bangkok International Airport (SBIA Master Plan) population and employment projection is made. This analysis is done because it has great effect on the formulation of the integrated urban and railway development in this study.

No explicit definition of employment

Employment in the year 2010 is estimated in two cases- of “with” and “without” the SBIA project. The estimation in the “with” case is made as follows:

$$\begin{aligned} & \text{The employment estimation in the “with” case} \\ & = \text{The employment estimation in the “without” case} \\ & \quad + \text{New development employment estimation} \end{aligned}$$

Here, the new development employment is equal to SBIA related employment.

Although the term of employment used in this report is not explicitly defined, it is probable that the employment used in estimation of employment without project is

Table 3.5.14 Output of Socio-economic Projection

	Year 1990				Year 2010			
	Population		Employment (workplace)		Population		Employment (workplace)	
	Worker (home base)	Worker (workplace)	Trend	Total	Worker (home base)	Worker (workplace)	Trend	Total
Bangkok	1,995,714	970,387	2,561,458	2,961,458	1,257,690	1,464,730	1,092,541	1,220,416
(1) Middle	1,758,492	850,688	2,245,044	2,445,044	1,098,581	1,202,101	979,945	1,034,425
1) Eastern Corridor	1,433,918	723,217	1,908,575	2,108,575	959,678	1,063,198	923,351	977,831
Huai Kwang	255,207	128,718	339,686	339,686	170,803	170,803	170,803	127,526
Khlong Toei	277,492	139,957	369,348	369,348	185,718	185,718	185,718	281,637
Bang Kapi	295,396	148,987	393,178	393,178	197,699	197,699	188,066	188,066
Bung Kum	181,417	91,500	241,470	241,470	121,416	121,416	115,500	115,500
Pravet	228,385	115,189	303,985	503,985	152,851	256,371	85,823	140,303
Phra Khanong	196,021	98,866	260,908	260,908	131,191	131,191	124,799	124,799
2) Other Corridor	324,574	127,471	336,469	336,469	56,947	56,947	29,745	29,745
Bang Khlen	202,117	65,735	173,476	173,476	81,956	81,956	26,849	26,849
Lat Phrao	122,457	61,736	162,993	162,993	159,109	262,629	112,596	185,991
(2) Inner Suburb (Eastern Corridor)	237,222	119,899	316,414	516,414	103,520	103,520	73,395	110,277
Lat Krabang	77,358	39,269	103,631	303,631	69,205	69,205	48,973	48,973
Min Buri	103,403	52,153	137,632	137,632	37,788	37,788	26,741	26,741
Nong Chok	56,461	28,477	75,151	75,151	660,714	660,714	567,625	645,535
Samut Prakan	769,822	411,046	1,239,564	1,239,564	478,878	478,878	417,856	417,856
(1) Middle	557,958	297,921	898,422	898,422	155,850	155,850	135,236	135,236
Phra Pradaeng	181,586	96,958	292,389	292,389	262,928	262,928	230,469	230,469
Muang Samut Phrakan	306,347	163,573	493,279	493,279	60,100	60,100	52,151	52,151
Phra Samut Chedi	70,025	37,390	112,754	112,754	113,524	113,524	93,504	77,910
(2) Inner Suburb	132,271	70,626	212,982	212,982	68,312	68,312	56,265	56,265
Bang Phli	79,593	42,499	128,160	128,160	267,595	267,595	253,100	293,015
(3) Outer Suburb	307,576	192,034	430,475	570,475	212,164	212,164	200,251	240,166
Bang Bo	238,829	152,555	333,416	473,416	99,974	99,974	93,317	39,915
Chachoengsao	125,675	72,171	175,054	315,054	56,250	56,250	51,599	51,599
(1) Outer Suburb	43,166	40,192	60,412	60,412	55,940	55,940	53,335	53,335
Muang Chachoengsao	69,988	40,192	97,950	97,950	55,431	55,431	52,849	52,849
Bang Pho	68,747	39,479	97,059	97,059	61,982	61,982	55,724	55,724
Bang Pakong	75,604	42,213	111,747	111,747	61,982	61,982	245,700	35,724
(2) ESB (Inland)	75,604	42,213	111,747	111,747	61,982	61,982	55,724	55,724
Bang Nam Prieo	75,604	42,213	111,747	111,747	61,982	61,982	245,700	35,724
Bang Nam Prieo	75,604	42,213	111,747	111,747	61,982	61,982	245,700	35,724
Pattani	75,604	42,213	111,747	111,747	61,982	61,982	245,700	35,724
(1) Inner Suburb	75,604	42,213	111,747	111,747	61,982	61,982	245,700	35,724
Lam Luk Ka	75,604	42,213	111,747	111,747	61,982	61,982	245,700	35,724
Total	3,148,716	1,615,880	4,343,244	4,883,244	2,247,981	2,527,481	1,968,990	2,214,690

viewed as worker on home base while that of new development employment estimation as employment at workplace.

The following seem to support this probability.

- The ratio of employment to population in the “without” case estimation by district calculated in this study happens to be more or less same throughout the districts, ranging from 0.471 to 0.541, and averaging 0.5. This is the characteristic of worker on home base by district.
- The report claims that the estimation is made based on the employment data provided by NESDB, or official statistics agency. However, it is reported that in Thailand the data on employment at workplace by district have not been surveyed and, hence, is not available.
- The SBIA related employment is calculated and distributed among the major districts such as business zone, Lat Krabang and so on. In this case, it is surely the employment at workplace.

Imbalance in Population and Employment Projection and Distribution

The projection and distribution of population/employment of new development by SBIA M/P Study is summarized in Table 3.5.15.

The projection gives 185,500 employment against 640,000 population. The ratio 0.290 of employment to population ($185,500 / 640,000$) is quite small even when compared with 0.5 of the estimation in the “without” case.

Table 3.5.15 Distribution of Population and Employment of New Development by SBIA M/P Study

Year 2010

	Population	Employment
Pravet	(200,000)	9,300
Lat Krabang	100,000	18,500
Muang Samut Prakan	0	9,300
Bang Phli (airport business zone)	66,000	129,900
Bang Bo	140,000	9,200
Muang Chachoengsao	334,000	9,300
Total	640,000	185,500

Note: Pravet (200,000) is not defined as new development

This simply means that almost half of the workers in the new development will commute outside the SBIA M/P Area for their working.

It is the policy of SBIA Master Plan to concentrate the employment in the planned airport business zone east and west (Bang Phli) and discourage housing development around the SBIA. This is the reason why a large number of employment is assigned to Bang Phli.

In general, the estimated employment by district is quite small as compared with the estimated population, for instance, Bang Bo and Muang Chachoengsao. Except Bang Phli (airport business zone), all the districts and new towns are designed to be residential areas for commuters to SBIA and airport business zone.

The following issues must be argued.

- What is the relationship between the government development policy of self-contained new town of Bang Bo and regional urban center of Chachoengsao, and the estimated employment distribution? As little as 9,300 employment is allocated to Chachoengsao compared to the large population of 334,000. This is in marked contrast from the regional urban

center concept, but only the residential area. Also questionable is the relationship between the large area for commercial and industrial use in the proposed strategic land use plan 2010 in the SBIA master plan study and the volume of employment estimated in Chachoengsao New Town.

- Even though it is admitted that a large number of workers must commute to SBIA and the business zones planned around SBIA, why must they be forced to travel the long distance from Chachoengsao? This is the reason why the Lat Krabang New Towns are proposed so as to accommodate the workers for SBIA and SBIA related development at the points closer to them.

Inconsistent Socioeconomic Projections

In addition to the SBIA Master Plan, other development projects present their own socioeconomic projections. These include the following:

- MIT Proposed Lat Krabang Metropolitan Center

The report on this development study does not explicitly give the socioeconomic projection for this suburban center, instead states that:

360,000 employment might be attracted to the 3 centers of the BMA — New Lat Krabang, the expanded Minburi Center and New Tailing Chan.

780,000 new housing units would need to be located on sites near these centers.

The population and employment size of the Lat Krabang Center is estimated, assuming that it will take one third of the above-projected figures:

Population	260,000 house × 3.5 people/house = 910,000
Employment	120,000

- NHA Proposed New Town in Chachoengsao West

The report on the new town development study made by NHA shows the following figures of population and employment.

Population	300,000
Worker on home base	150,000*
Employment at workplace (base)	105,000* (70 % of workers on home base)

* : Estimated

- Chachoengsao Regional Urban Center

It is estimated that the population of Muang Chachoengsao will reach 532,000 in the year 2010 based on the high potential of Chachoengsao province. The following socioeconomic projection is estimated:

Population	532,000
Worker	266,000
Employment	186,200

Table 3.5.16 Comparison of Socio-economic Projection

Population						
	1990	2010				
		SBIA	MIT Subcenter	NHA New Town	Chachoengsao Urban Center	JICA Study
Lat Krabang	77,358	213,000 (100,000)	910,000 including other district	0	0	303,631 (200,000)
Chachoengsao	125,675	532,000 (334,000)	0 0	(300,000)	532,000	315,054 (140,000)

() ; new development

Employment						
	1990	2010				
		SBIA	MIT Subcenter	NHA New Town	Chachoengsao Urban Center	JICA Study
Lat Krabang	27,788	97,200 (18,500)	120,000	0	0	110,277 (73,395)
Chachoengsao	68,772	147,400 (9,300)	0	(105,000)	186,200 (117,428)	135,232 (39,915)

() ; new development

d) Some Indications

The socioeconomic framework worked out in this study is indicated as follows:

- **Magnitude of New Development**

New development will occupy only 11.1 % of total population of SBIA M/P Area in 2010. As a whole, the urban area and population pattern would not drastically change. In general, the present urbanization trend will continue. However, it must be stated that the new town development will to share as much as 31.1 % of the population increase up to 2010. This implies that the rail town development must take the lead in urban development in the SBIA M/P Area.

- **Balance Between Worker (Home Base) and Employment (Workplace) and Commuter Traffic**

The ratio of employment to worker of the total area and major development sites are calculated as follows:

Table 3.5.17 Ratio of Worker to Employment at the Major Development Spots

Year 2010

District	Ratio
Pravet	0.547
Lat Krabang	0.709
Bang Phli (airport business zone)	1.510
Muang Chachoengsao	0.784
Total of SBIA M/P Area	0.876

A ratio lower than 1.0 means that the worker outnumbered the employment in the district, so that commuter traffic takes place outside the district for working. Judging from the balance between worker and employment, it may be concluded that SBIA M/P area as a whole generates commuter traffic to the outside, especially the CBD of Bangkok while Bang Phli (airport business zone) with excess employment over worker, attract commuters.

The major commuter traffic will emerge in two directions, that is to Bangkok and SBIA city.

Although large volumes of employment are allocated in Pravet and Lat Krabang in the course of employment distribution, workers still exceed employment in these districts. This is attributable to the high population pressure from Bangkok, that is, development potential for commuters to Bangkok.

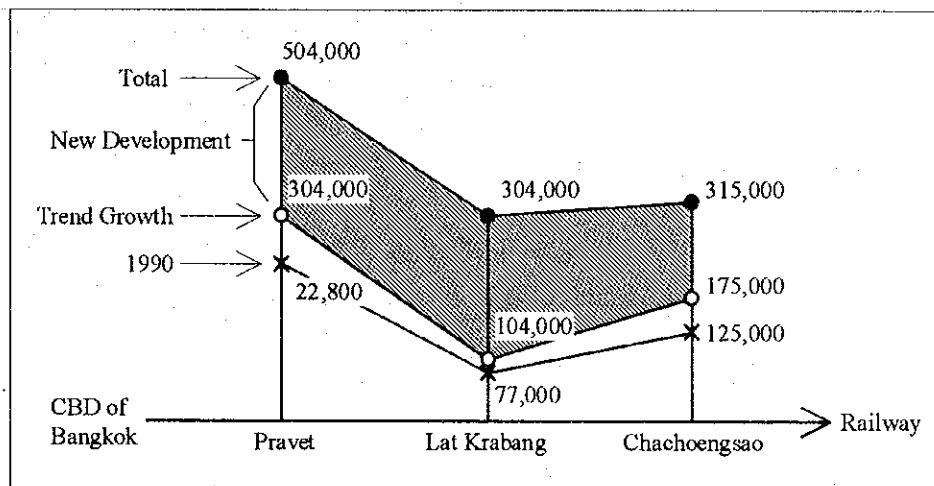
- **Orderly Population Distribution Along the Railway.**

As repeatedly stated, new development population distribution by new town is not elaborated based on population projections of the individual proposed development projects, though not disregarding them. The Urbanization along the railway has the tendency to allocate population with the higher density and

the larger size of population closer to the CBD, and the lower and smaller far away from the CBD.

The population distribution is based on this tendency is shown in Fig. 3.5.12. The population size tends to decrease in accordance with the distance from the center of Bangkok.

Fig. 3.5.12 Orderly Population Distribution along Railway



It is natural that this order may be modified by large scale urban development such as BMA sub center, SBIA city and Chachoengsao regional urban center and the like. However, it is surely expected that this projected population distribution can accommodate the population growth of the proposed development projects, but not all the maximum growth. If/when an unexpected increase of population beyond these population projection occurs, it is on the safe side for the railway improvement investment.

Although all the existing proposed development projects are taken into consideration, this population projection would never specify the population size of each individually. In practice the population size of districts and new towns may be subject to change.

The followings are examples:

- If/when BMA proposed metropolitan center is quite successful in absorbing the increasing population as planned, the estimated population of Pravet will decrease while the population of Lat Krabang will increase correspondingly.
- The NHA new towns planned to locate close to Lat Krabang in Muang Chachoengsao can be part of either Lat Krabang new town development or Chachoengsao regional urban center development.

(5) Railway Development Plan

The railway development plan is elaborated in detail in Volume III. The basic policies and conceptual system of rail transport are presented in this section.

1) Basic Policies

Basic Policies are set forth as follows:

- a) Public transport system with the railway being an arterial trunk line should mostly cover most of the Eastern Corridor area. In particular, major urban centers should be made accessible to/from the CBD of Bangkok within about one hour travel time.
- b) The railway should be designed to provide the most suitable transport service to the urban areas being developed, as planned in this study.
- c) The railway should be developed in a coordinated and integrated manner with urban development along the line.

2) Conceptual System of Rail Transport on the Eastern Corridor

The conceptual system of the rail transport on the Eastern Corridor is illustrated in Fig. 3.5.13.

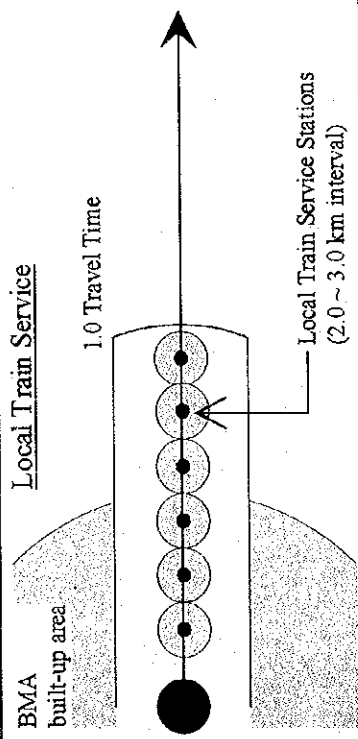
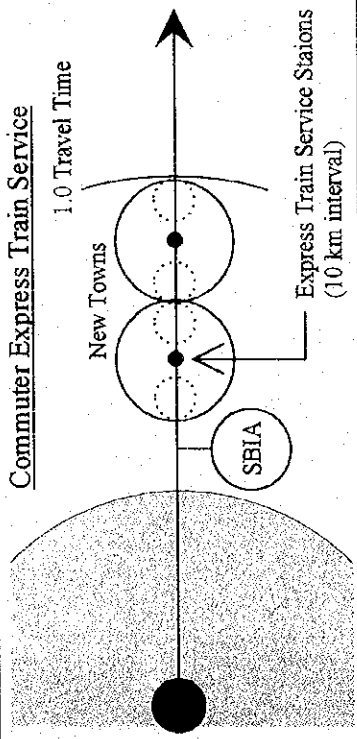
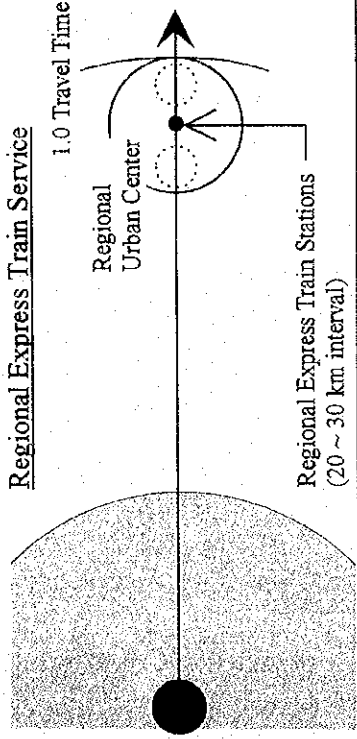
a) Main Roles of Railway for System Designing

The Eastern Line is expected to respond to the multi-purpose transport demand. However, the railway system is designed firstly to be able to play the main role of transport assigned to the Eastern Line, which is supposed to share the largest traffic demand and determine the maximum capacity of the rail system in passenger volume.

Basically, the main role of the Eastern Line section is defined as commuter transport, especially connecting the new towns/centers with the CBD and built-up areas of Bangkok. Commuter traffic will be the main stream of transport due to the current high population pressure along the railway in spite of the existing proposed development projects characterized by self-contained or job-housing balance as discussed in the urban development plan in the preceding section.

This is especially important at the earlier stage of the planning period since industrial development will lag behind housing development along the railway. In addition to commuter transport, business and social trips will be served by the railway in the course of accelerated urban industrial development represented by such projects as the SBIA business zone and urban center development, especially at the latter part of the planning period.

Fig. 3.5.13 Conceptual System of Rail Transport on the Eastern Line

Component of Train Service on the Eastern Line	Dimension of Transport System			Characteristics of Passenger Traffic Flow		Corresponding Urban Developments
	Schedule Speed	Frequency	Travel Time Distance	Purpose of Main Traffic	Pattern of Traffic	
 <p><u>Local Train Service</u> 1.0 Travel Time Local Train Service Stations (2.0 ~ 3.0 km interval)</p>	30 km/h	10 minutes	(including feeder) 1.0 hour (30 km)	Private (shopping, entertainment and others) (along the rail way)	Hourly flat with high density (daily)	Mixed land use with high density (urban axis) (Expansion of Bangkok built-up area)
 <p><u>Commuter Express Train Service</u> 1.0 Travel Time New Towns SBIA Express Train Service Stations (10 km interval)</p>	60 km/h	10 ~ 20 minutes	1.0 hour (40 km)	Commuting (to Bangkok)	Standardized with large volume at peak hour (morning and evening) (daily)	New towns and urban centers (semi-independent)
 <p><u>Regional Express Train Service</u> 1.0 Travel Time Regional Urban Center Regional Express Train Stations (20 ~ 30 km interval)</p>	100 km/h	60 minutes	1.0 hour (50 km)	Business/Social Purpose (to the CBD of Bangkok)	Sporadic (weekly or once a couple of days)	Regional urban center (dependent)

b) Multi-train Service System

The main focus of rail transport systematization on the Eastern Line is how to operate multi-service trains with different transport conditions/requirement using one and the same rail track. The Eastern Line is supposed to consist of suburban commuter line and national/regional trunk line.

- Suburban Commuter Line — Express and Local Train Service

The suburban line is defined to be placed functionally at the middle of intra-urban and inter-urban transport system.

The intra- urban system places higher priority on local convenience or access to the railway, that is, more stations with shorter interval/distance between them, while the inter- urban system is to put higher priority on high speed trains to overcome the longer distance of travel, with lesser number of stations in the longer intervals.

Suburban rail system, in reality, varies very much depending on the roles they must play, the characteristics of the area they must serve and the riderships (length and volume) they must transport.

In general, some suburban rail systems are designed to put more emphasis on the function/service of intra urban transport system, others on the function/service of inter-urban system, in order to provide the suitable service to the areas/communities along the line. It is apparent that the intra- urban and inter- urban transport system are limited in the maximum length and minimum length of main haul respectively.

Taking into consideration the length of travel distance of as long as 40 and 50 km the Eastern Suburban Line must serve and intensive ridership resulting from the urban developments, the Eastern Suburban Line is required to fulfill

the both functions of intra and inter urban transport systems.

In order for the suburban line to simultaneously achieve the conflicting 2 transport services, the two types of train service are to be operated on one rail line. One is local service train which is designed to make stops at every station (local train service station) with the view to make the railway more accessible to/from the urban area, the other is express service train which is to make stops at the few number of main stations with the view to keeping higher schedule speed.

The railway passengers are required to transfer from the local train to the express train, and vice versa, at the main express stations. The local service trains work as the collector/distributor of the express trains.

Consequently, the Eastern Suburban Commuter Line should consist of the following types of train, service and stations.

Table 3.5.18 Eastern Suburban Commuter Line

Train Service	Schedule Speed	Station (Interval)
Express Train	60 km/h	Express Train Station (10 km)
Local Train	40 km/h	Local Train Station (2.0 ~ 3.0 km)

- National/Regional Trunk Line

In addition to the suburban commuter train the national/regional trains will run on the same track of the Eastern Line connecting Bangkok with the Eastern Sea Board area beyond Chachoengsao. Thus, the Eastern Line works also as a national/regional trunk line as follows:

Table 3.5.19 Eastern Regional Trunk Line

Train Service	Schedule Speed	Station (Interval)
Regional Express Train	100 km/h	Regional Train Station (20 ~ 30 km)

c) Correspondence with Urban Developments

These types of train services correspond with the following urban development mechanisms:

Table 3.5.20 Train Service Corresponding to Urban Development

Local Train (Like Intra-urban System)	Urban Axis radiating from the Built-up Area of Bangkok
Commuter Express Train	New Towns/Urban Center
Regional Express Train	Regional Urban Center (Chachoengsao)

It must be stressed that according to this classification, the new towns/urban centers are promoted by the commuter express train service with the regional urban center of Chachoengsao by the regional express train, not commuter express train, because the regional center is not supposed to grow as a residential area for commuters.

Accordingly, characteristics of passenger flow which these types of train must transport vary. The appropriate transport operation system must be designed to be suitable to each of them.

3) Rail Transport Network

a) Integration With the Other Proposed Improved SRT Rail Lines and the Existing Proposed Urban Mass Transport System

The proposed urban rail network consisting of the four corridor rail lines covering the 50 km radius area of Bangkok is presented in the JICA Master Plan Study. The four corridor rail lines, of which the major one is the Eastern Line, are expected to function in an integrated manner with each other.

In this regard, the SRT lines in the section of Hopewell project (viaduct) are very important in integrating the rail operation of the four lines, especially in constructing a junction system for the East-West line and North-South line at

their crossing point, as well as securing access for the Eastern Suburban and regional trains to the central station of Hua Lampong. Also, the Eastern line must be connected with the existing proposed urban mass transport system at the transfer stations which should be built at the crossing points.

In spite of the fact that the SRT section of Hopewell system is excluded from this JICA study, the Eastern suburban and regional rail line improvement is viable on condition of its access to the major stations and integrated with mass transport system in Bangkok, through the Hopewell section of the SRT right of way.

b) The Proposed Network of Eastern Line

The proposed rail network of Eastern Line is conceptually shown in the Fig. 3.5.14. The important aspects of the proposed network are summarized below.

- Independently Workable and Expandible to the Integrated Network

It must be noted that the Eastern Suburban line (running Electric car) must be operated by itself until the suburban lines on the other corridors are improved and connected to the Eastern Corridor. Thus, the railway transport system and network must be designed taking into consideration the following requirements:

Independently workable system of the Eastern Suburban line before the completion of the total electrified rail network in Bangkok

On the completed rail network system, the trains coming from the Eastern line can go to either terminal of Hua Lampong and Bang-su and to the west side through the western line. However, it must terminated at the existing junction with the northern rail line. The terminal station for the Eastern suburban line must be carefully located and constructed in the Hopewell section of SRT including turn- back facilities.

Expandable System of the Eastern Suburban Line

The rail transport system of the Eastern line must be designed to expand into the integrated rail network with northern/southern and western suburban rail lines.

- **Main and Branch Lines**

The proposed rail network of the Eastern Corridor is composed of the main and branch lines. The regional and suburban commuter trains will, of course, run on the main line with the commuter on the branch line, connected with the main line. Construction of the branch line is one of measures to expand the railway service area and increase the railway passenger volume. However, it should be proposed only when/where large volume of passengers is expected to the extent that the railway operation is made feasible.

As discussed in Volume III on railway sector, SBIA access branch line is proposed.

Extension of SRT SBIA branch line up to Bang Phli/Bang Bo New Town is recommended as a future potential rail line. The main reasons for this are summarized below.

To increase self-supporting ridership for the branch line operation

Usually rail branch operation faces financial difficulties due to insufficient transport passenger volume, especially the volume of airport passengers who use the railway is relatively low as compared to the transportation capacity of the rail line.

Therefore, measures for increasing the rail transport demand must be taken. The extension of the branch line is one of these measures taking into consideration the large scale new town development with the population

projection of 600,000, proposed in the master plan for the area around SBIA.

This is also proposed in line with the goals set forth in the Mass Transport System Development Plan, which targets all urban area to be covered by Mass Transport System within around one hour access to the CBD of Bangkok.

To connect the rail corridor and the road corridor

At present, urban development is predominant on Expressway No.34 connecting Bangkok and ESB. In this study, it is proposed that the development corridor be transferred toward the railway service area along the Eastern line. In order to develop the rail corridor along the Eastern line, it is of great importance to connect it with the existing eastern corridor along the Expressway No.34.

To provide higher rail transportation service to SBIA

It is not uncommon that the level of transportation services which can be provided by the railway is subject to the transportation demand - the passenger volume using it. For instance, higher frequency of rail transport becomes possible with a larger volume of passengers to be transported.

The extension of the SBIA SRT branch line is in harmony with the policy of increasing the transport demand on this line.

4) Railway Alignment and Stations

a) Railway Alignment

It is a basic policy and precondition in this study to make use of the existing property of SRT, especially the right of way for improving and developing the railway of Thailand. In this regard, it is natural that alignment of the improved Eastern line — main line -follows the existing rail line within the right of way of SRT.

The branch line connecting with the main line at Lat Krabang Station (existing) is designed to go through the north and south terminals of SBIA to Bang Phli/Bang Bo. The section of the branch line along the expressway No.34 must be scrutinized.

b) Railway Stations

The following factors need to be considered in locating the railway stations:

The Existing Stations

Existing stations should not be removed as much as possible. However, shifting the existing station some distance should be allowed.

New Stations

The intervals between existing stations are relatively long since they were constructed as regional train stations. The existing interval seems too long for a suburban commuter line. New stations should be constructed, especially in association with urban development around them.

Criteria of locating stations

- **Standard Interval**

Standard interval is set at 0.5 ~ 1.0 km for local train stations, 2.0 ~ 3.0 km for express train station and 20 ~ 30 km for regional train stations.

- **Express Train Station**

The express train stations are located in/around the planned new town centers with good regional transportation conditions as shown in the Table 3.60 and Fig. 3.5.15.

Fig. 3.5.14 Proposed Rail-oriented Transport System in the 60 km Radius Area of Eastern Corridor

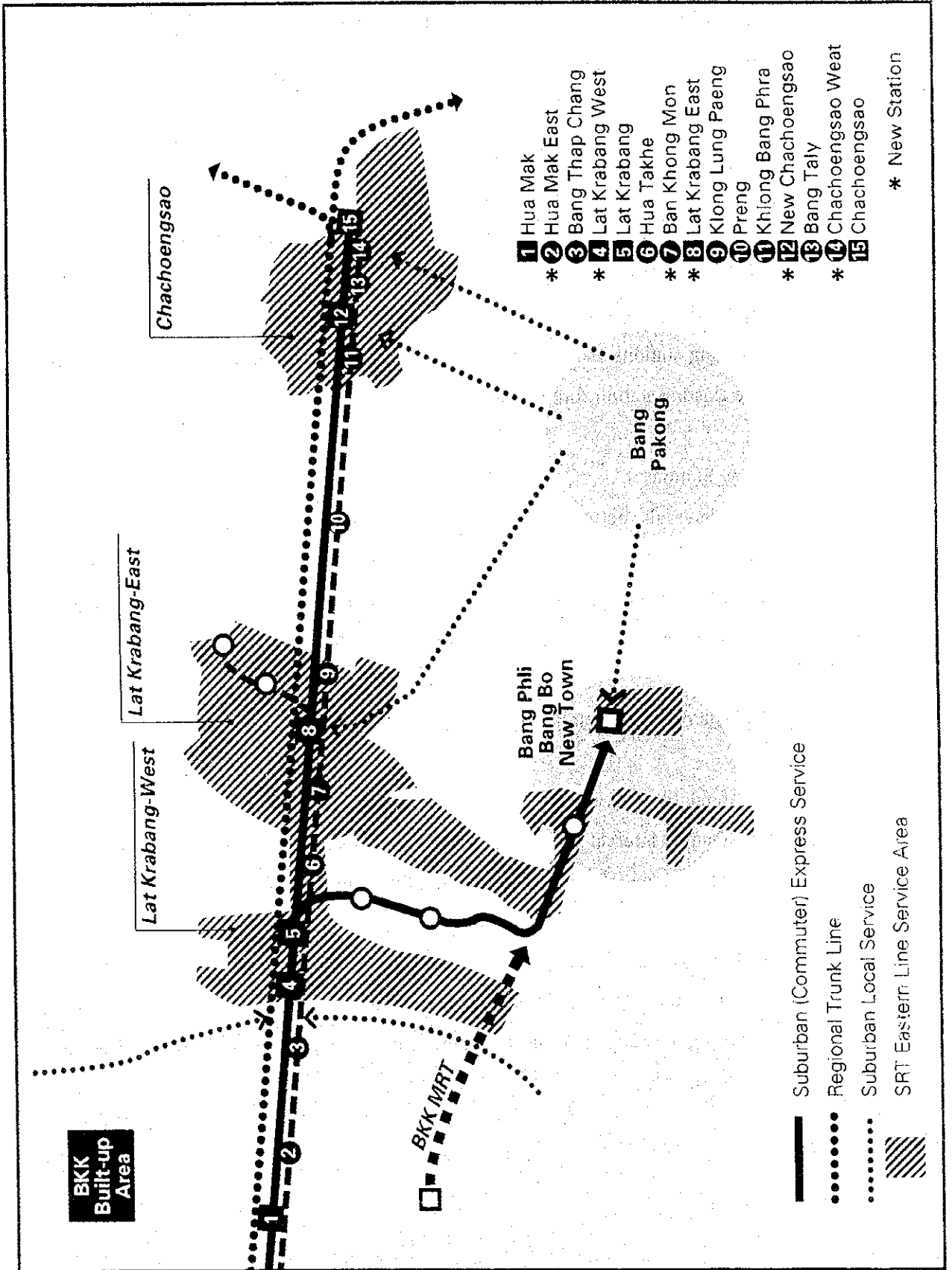
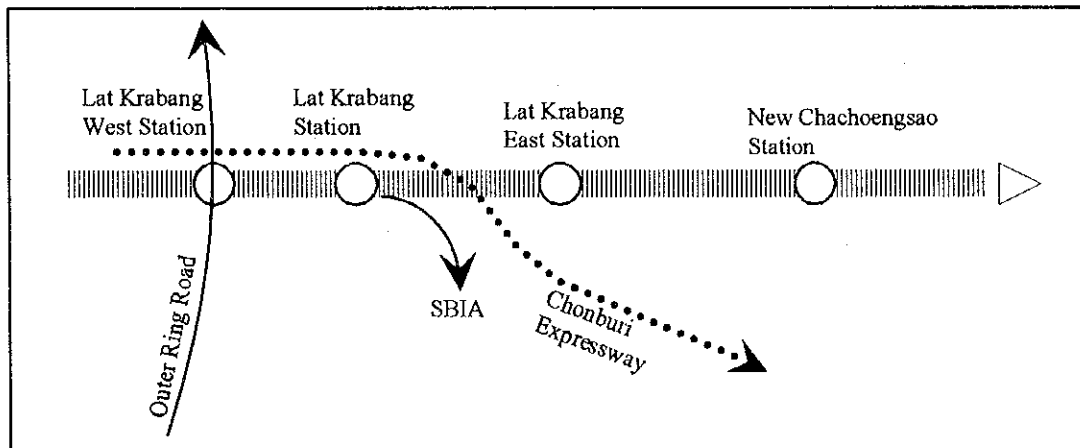


Table 3.5.21 Location of Express Train Stations

Name of Station	Location	Corresponding New Town
Lat Krabang West Station (new)	Around the crossing point with the Outer ring road	Lat Krabang West New Town
Lat Krabang Station (existing)	At the junction with SBIA access branch	
Lat Krabang West Station	Close to the ramp of Chonburi expressway	Lat Krabang East New Town
New Chachoengsao Station	Close to the arterial road to Chachoengsao and Bang Pakong	Chachoengsao West New Town

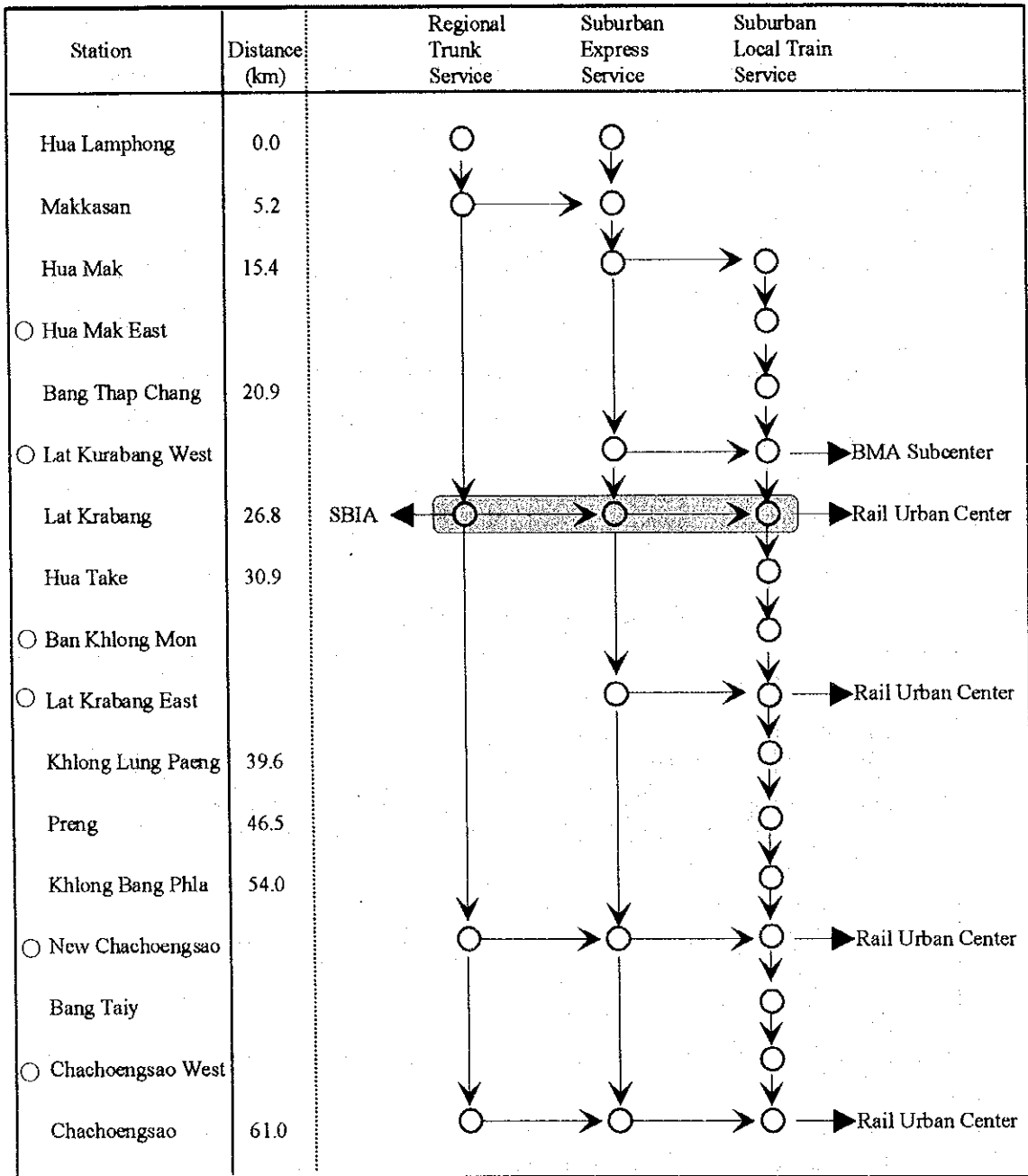
Fig. 3.5.15 Express Train Stations



- Train Service and Transfer System

The location of stations is elaborated so as to established effective train service and transfer system as shown in the Fig. 3.5.16.

Fig. 3.5.16 Express/Local Services and Stations



○ : New Station

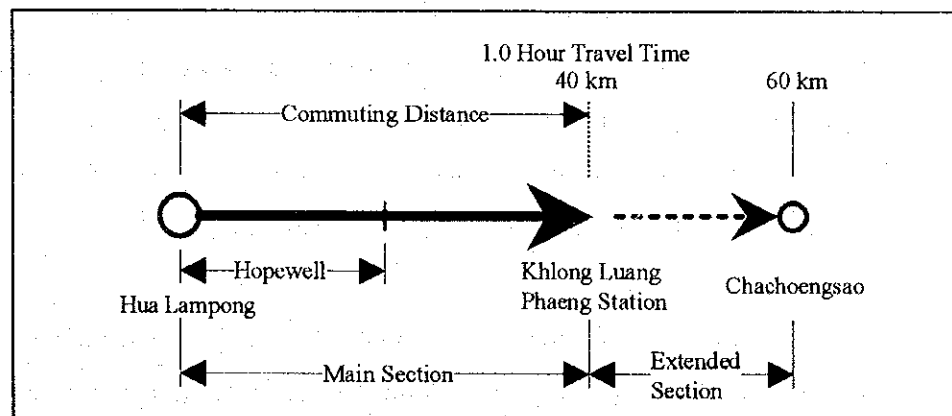
(6) Development Program

1) Proposed Development System of Commuter Transport

The Eastern Suburban line with a total length of 60 km from Hua Lampong to Chachoengsao, is divided into two sections or systems — the main section stretching 40 km long from Hua Lampong to Khlong Luang Phaeng station, and the extended section of the remaining 20 km up to Chachoengsao see Fig. 3.5.17).

The main purpose of this development scheme is to provide massive housing accessible to/from the urban center of Bangkok within a reasonable travel time of around one hour (or within a range of 40 km) from the viewpoint of Bangkok city planning and development, or to transport commuters within one hour travel time from the viewpoint of urban transport improvement.

Fig. 3.5.17 Main and Extended Section of the Eastern Suburban Commuter Line



The main section 40 km long is supposed to play a significant role for the Eastern Suburban rail transport in terms of transport operation/service as well as transport passenger volume, especially at the earlier stage of the planning period.

Generally evaluating the length of suburban commuter rail line improvement, the 40 km length seems appropriate in terms of scale and size of project and capital

investment for the first stage of the Eastern railway improvement, and manageability and efficiency of rail transport operation (neither too long nor too short).

On these premises, the first target is the establishment of a complete suburban commuter rail transport system on the selected main section of the Eastern line. It is recommended that based on the experience of the construction and operation of the main section, the commuter rail line should be extended beyond the 40 km point to Chachoengsao, covering the remaining 20 km length of line in such a manner as to integrate the extended system into the main system.

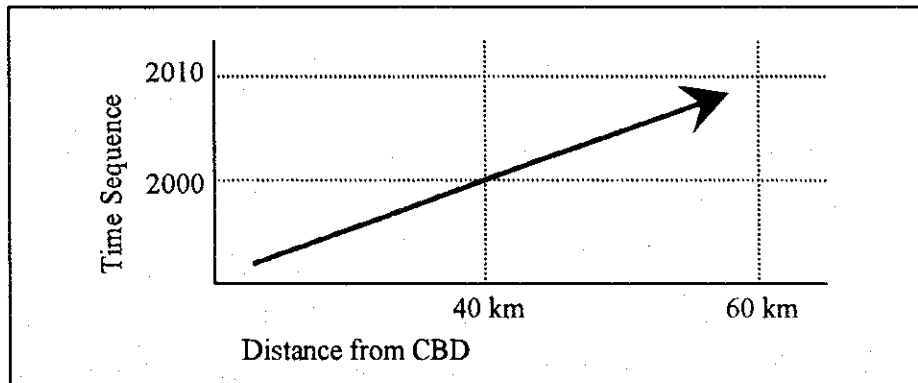
Before connecting with Chachoengsao by extended commuter line, it will be served by the improved regional trunk line, making it possible to access the center of Bangkok within one hour travel time.

2) General Rule of Urban and Railway Development

It is a general rule of the integrated urban and railway development that it starts at areas closer to the CBD of Bangkok and expands outward, where there is available land for urban development. First of all, the suburban line must be linked with the CBD, otherwise the suburban line cannot work. Also, higher development potentials are envisaged due to higher convenience to the CBD.

The integrated urban and railway development should expand outward from the center of Bangkok according to the time and distance sequence shown in Fig. 3.5.18

Fig. 3.5.18 General Rule of Expansion of the Urban and Railway Development



However, there can be an exceptional case where the urban development starts far away from the center of Bangkok. This is the case where the size of urban development, or the expected volume of rail ridership from the urban development is large enough to justify the lengthening rail line from the CBD.

In situations of uncertainty of project size and implementation, it is a wiser decision to follow the general rule in planning the urban and railway development on the Eastern line.

This simply means that railway improvement and investment are not proposed based on the existing proposed NHA new town development and Chachoengsao regional center, both located relatively far from Bangkok, especially at the earlier stage of development.

3) Development by Phase or at a Stroke (in One Phase)

Another issue is whether the Eastern suburban commuting line of 60 km length from Hua Lampong to Chachoengsao should be improved in phases or at a stroke (in one phase).

Although any kind of development project usually tends to be implemented in phases, depending on the size of project, there can be the case where implementation of the entire scope of the project in one phase becomes more

economical and efficient than. This applies all the more to complicated and fragmented small projects.

It is suggested that the entire length of 60 km of the Eastern commuter line improvement can be technically accomplished in a time interval as short as 5 years, within the already acquired right of way.

However, the development implementation program is subject to the financial capability of the implementing and operating agencies, ridership forecast by that time, the extent of urban development along the railway, and financial/economic feasibility.

In this study, the safer option of implementation in phases is recommended.

4) Urban Growth through Developing the Railway System

The development system of commuter transport on the Eastern line must be well designed to manage the urban growth along the railway as shown (see Fig. 3.5.19)

Urbanization will shift outward from Bangkok in accordance with the expansion of the improved suburban line, first to the middle area (Pravet), second to the inner suburb (Lat Krabang), finally to the outer suburb (Chachoengsao), just like waves moving outward.

Urbanization and population growth by stage are projected as follows:

- 1995 ~ 2000
 - Urbanization from Bangkok (mainly housing development) will be accelerated
 - Development at Lat Krabang will start
- 2000 ~ 2005
 - Full scale development in Lat Krabang, Chachoengsao development will start

- 2005 ~ 2010 - Lat Krabang development will continue
- Full scale development in Chachoengsao

It must be noted that the existing proposed urban development projects such as BMA suburban center, SBIA city and NHA new towns are all located in the area accessible to the main section of the Eastern suburban commuter line.

Fig. 3.5.19 Sequential Urban Development

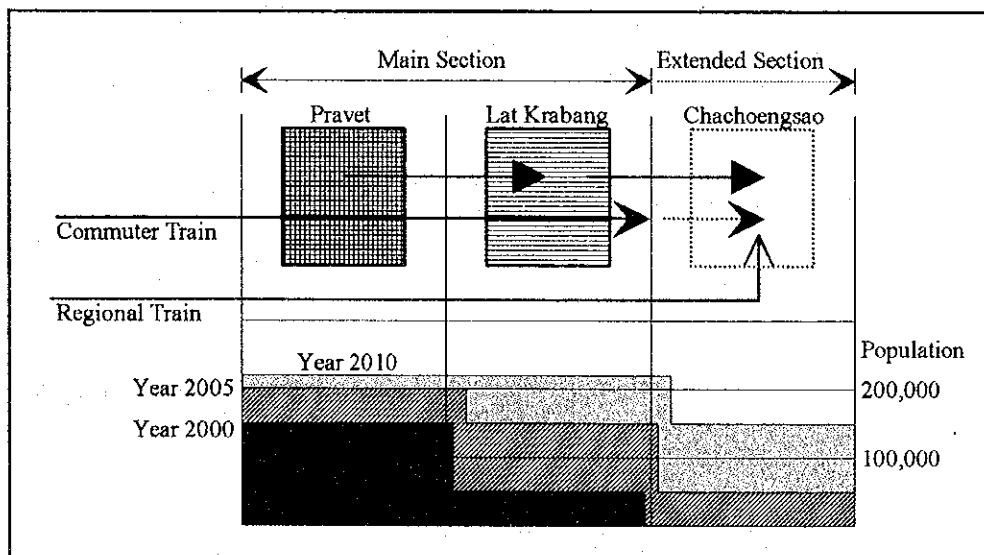
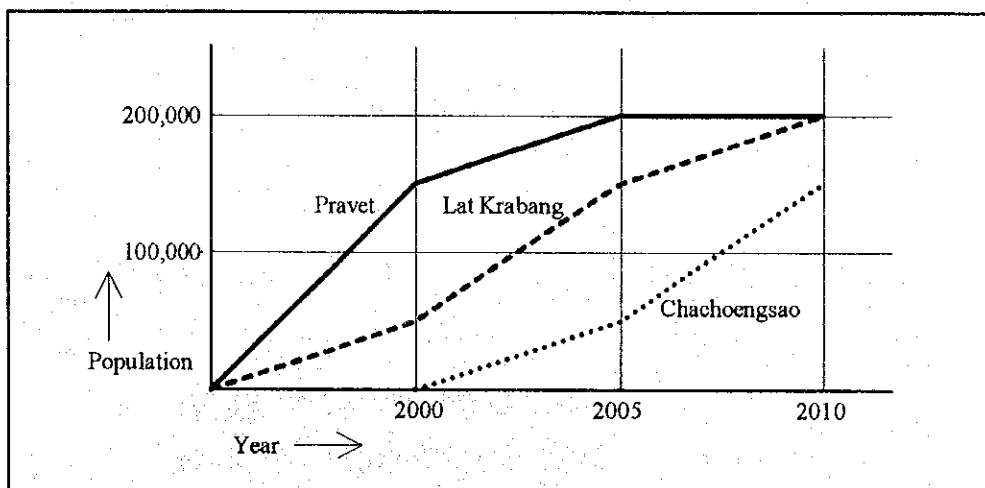


Fig. 3.5.20 Population Growth by District



5) Development Program

Based on the above discussion on the development system, IURD development program is formulated with the following phasing policies (Table 3.5.22)

a) Suburban Line

Step 1 : First establishment of modern SRT Suburban Corridor within 40 km distance from Bangkok (main Section including SBIA Access Line)

Step 2 : Expansion of the Suburban Corridor up to 60 km distance from Bangkok (Extended Section)

Step 3 : Future potential development

b) Regional Trunk Line

Step 1 : Functional improvement and strengthening of the existing system

Step 2 : Responding to increasing transport demand

Step 3 : Future potential development

Table 3.5.22 IURD Development Program on the Eastern Corridor

Rail development	Step 1	Step 2	Step 3
SRT Eastern Suburban Line			
1. Main Line	Up to 40km (Hua Lampong - Lat Krabang - Khlong Luang Paeng)	Up to 60 km (Khlong Luang Paeng - Chachoengsao)	
2. Branch Line			
a. Airport Access Line	Lat Krabang - SBIA North Terminal	SBIA North - South Terminal	Extension to Bang Phli/Bang Bo
b. Lat Krabang East Branch Line			Lat Krabang East Line
SRT Inter City (Regional) Trunk Line	Hua Lampong - Lat Krabang - Map Ta Phut		Map Ta Phut - Rayong
Urban Development	Step 1	Step 2	Step 3
1. Lat Krabang West New Town (1,240 ha)			
2. Lat Krabang East (4,200 ha)			
3. Bang Phli/Bang Bo New Town			
4. Chachoengsao New Town			