2.14 Environment Examination

2.14.1 Project Description

The integrated railway and urban development within a 200 km radius from the center of Bangkok has been proposed in the master plan study, including the Eastern, Northern, Southern and Maeklong lines. The eastern line has been selected for the feasibility study.

It is proposed the Eastern Line be improved from Hua Mak to Chachoengsao for commuter service and from Hua Mak to Map Ta Phut (with a possible extension to Rayong) for intercity express service. Railway improvement includes double track (between Yommarat and Chachoengsao is on-going project), sufficient refuge tracks and crossing loops, electrification, high quality signalling systems with automatic train stop devices, grade separation, high quality at-grade crossing safety devices, depot and workshop, station facilities (including necessary facilities for passengers to/from the airport with luggage), station plazas, provision of access, etc.

Urban development covers the rail town and land use plan. Lat Krabang West and East new urban communities are proposed for this purpose. The development plan includes urban centers in new towns, urban facilities, land use and transport systems. The estimated area of Lat Krabang West and Lat Krabang East is 1,240 ha and 4,200 ha, and the targeted population is 100,000 persons and 200,000 persons, respectively.

The Environment Examination carried out for the Feasibility Study of the Integrated Urban and Railway Development aims to identify and evaluate project impact. Environmental variables, relating to both urban development and railway improvement, were investigated to access their impact, and mitigation measures were proposed to reduce/project the negative impact.

2.14.2 Environmental Consideration

The existing environmental situation, project impact and proposed mitigation measures are discussed in the following sections.

(1) Noise and vibration

1) General background

The objective of noise and vibration analysis is to determine noise and vibration levels which may develop from construction and operation of the project.

The Office of Environmental Policy and Planning (OEPP) has set guidelines for community noise, but no noise standard for train operation.

- Noise limit for health protection (L Aeq 24 hours) should be < 70 dB (A)
- Noise limit for annoyance (nuisance) level should be < 3 dB (A) above the ambient noise level.

The community noise standard proposed by the office of the National Environmental Board or OEPP at the present is shown in Table 2.14.1

Table 2.14.1 Draft Community Noise Standard Prepared by the Office of Environmental Policy and Planning

Zones	Std. for health protection		Std. for nuisance prevention			
	Leq (24hr) dB (A)	Peak level dB (A)	Leq (24hr) dB (A)	Leq dB (A)	Leq 5 min dB (A)	
					Day	Night
A	70	120	55	-	60	60
B	70	120	-	67	65	60
C	70	120	-	70	70	65
D	70	120	70	-	75	75

Note : A: area in which special low noise level is needed e.g., rural areas; recreational areas in the country, forest and woods; public parks; historic, cultural, and archeological sites etc.
B: area used mainly for residential purposes, schools, temples, and governmental institutions.
C: area used for residential and commercial purposes.
D: area used mainly for industrial purposes.

Source : Office of the National Environmental Board, 1991

The current noise levels in various areas of Bangkok measured by various studies are shown below.

- Urban Bangkok 69 - 85 dB(A)
- Rural area east of Bangkok 54 - 70 dB(A)
- Along the First Stage Expressway
  at 8-15 meters from curb 62.2 - 79.2 dB(A)

The noise levels of the King Mongkuts Institute of Technology (KMIT) measured in December 1994 are shown in Table 3.4.2. It should be noted that these noise levels are within the OEPP standard.

Table 2.14.2 Noise Level at KMIT

Date (Measurement)	Sound pressure level dB(A)			
	Lep.(24)	Average	Ldn	Lmax
Thu 14/12/94	60.7		65.9	81.9
Fri 15/12/94	61.2	60.8	66.3	82.4
Sat 16/12/94	60.4		65.6	81.9

2) Impact on noise and vibration

(a) Construction phase

Noise-generating sources during construction include noise from tractors, back holes, tower cranes, concrete mixers, pile drivers, power generators, and other construction equipment. The maximum sound power generated by various construction equipment is shown in Table 2.14.3. However, noise impact on the community is considered low since the area along the railway is mainly empty, rice fields, orchards or plantations.

Impact from vibration is usually caused by piling activities. The magnitude of vibration impact depends on soil properties, distance and building structure.

In Japan, noise control standards were issued in 1968 as summarized in Table 2.14.4 These activities cannot be carried out during the night time.

Table 2.14.3 Equipment Use Sound Power Level

Equipment	Sound power level L_{WA} dB	Activity equivalent continuous sound pressure level L_{AEN} at 10 m
Truck	112	85
Concrete pump	109	81
Concrete mixer	108	80
Pneumatic concrete barker	120	92
Jack hammer	117	89
Tracked excavator	113	87
Dump truck	117	89
Compressor	109	81

Source : MRTA, Volume 1: Environmental Impact Assessment, Nov. 1993.

Table 2.14.4 Enforcement Standards for Noise Control Concerning Specified Construction Operations in Japan

Construction activity	Noise limit at 30 m (A)
Work which requires pile drivers, pile extractors and pile drivers and extractors	85
Work which requires riveting hammers	80
Work which requires rock drills	75
Work which requires air compressors	75
Operations involving batching plant and/or asphalt plants	75

(b) Operation phase

Noise level generated by trains can be predicted by a mathematical model shown below.

a) $L_{max} = 40 \log_{10} V - 4$ dB(A) : for Disc-brakes of drum brakes.

where L_{max} : Maximum noise level at 25 m. from track

V : velocity (km./h)

b) $L_{p2} = L_{p1} - 20 \log R2/R1$

where L_{p2} : Noise level at distance R2

L_{p1} : Noise level at distance R1

(Source : Transportation Noise Reference Book)

Noise levels calculated for the suburban trains and regional trains (with schedule speeds of 60 km/h and 100 km/h, respectively) using the above model are shown in Table 2.14.5. It should be noted that at the distance beyond 20 meters and 50 meters, the noise level generated by trains is lower than 70 dB(A) for trains running at 60 km/h and 100 km/h respectively. Since crowded communities are located beyond the aforementioned distances from the railway track, the noise impact is considered to be low.

Table 2.14.5 Noise Level Generated by Train

Distance from Track (m)	Maximum noise level dB (A)		Distance from Track (m)	Maximum noise level dB (A)	
	60km/h	100km/h		60km/h	100km/h
5	81	90	105	55	64
10	75	84	110	54	63
15	72	80	115	54	63
20	69	78	120	54	62
25	67	76	125	53	62
30	66	74	130	53	62
35	64	73	135	52	61
40	63	72	140	52	61
45	62	71	145	52	61
50	61	70	150	52	60
55	60	69	155	51	60
60	60	68	160	51	60
65	59	68	165	51	60
70	58	67	170	50	59
75	58	66	175	50	59
80	57	66	180	50	59
85	56	65	185	50	59
90	56	65	190	50	58
95	56	64	195	49	58
100	55	64	200	49	58

Source : Study Team's estimate

3) Mitigation measures

(a) Construction phase

The following mitigation measures are proposed.

- High noise activities shall be carried out in the day time. If construction during the night time is needed, people in the affected areas must be notified in advance.
- Install temporary noise barriers.
- Exhaust mufflers should be installed on high-noise generating machines such as bulldozers, excavators, compactors, etc.
- Labor camp sites must be located far from the existing communities.

In general, vibration from construction activities can be minimized by using high construction standards.

(b) Operation Phase

To reduce noise during the operation phase, the following measures should be taken into consideration.

- Install noise barriers where the noise level exceeds the standard and where sensitive receptors exist.
- Install track in an appropriate method taking into account both vibration and noise reduction.
- Routine and periodic maintenance should be properly done.

At present, in Thailand, there is no problem of vibration from train operation. With the improvement of track, vibration is expected to be reduced. However, proper maintenance of the track and its foundation is necessary.

(2) Water Quality

1) General Background

In Thailand, effluent standards are presently employed for water pollution control. Regulations and legislation related to water quality issues include :

- Public Health Act, 1941;
- Act for the Cleanliness and Tidiness of the Country, 1960;
- Building Control Act, 1979;
- National Environmental Quality Act, 1975;
- Factories Act, 1979; and
- Toxic Substance, 1967

The Office of Environmental Policy and Planning (OEPP) has established the guidelines for analyzing water quality as shown in Table 2.14.6

Table 2.14.6 Methods for Water Quality Analysis Recommended by OEPP

Parameter	Methods of Analysis *
BOD	Azide Modification; 20℃, 5days
pH	pH Meter
Temperature	Thermometer
Dissolved Oxygen	Azide Modification
Suspended Solid	Non-Filterable Residue through Glass Fibre Filter Discs
Total Dissolved Solid	Galvanimetric Analysis
Nitrate	Cadmium Reduction
Phosphate	Ascorbic
Coliform Bacteria	Multiple Tube Fermentation Technique

Note : *Standard Methods for the Examination of Water and Waste Water by APHA-AWWA-WPCF(1989)

A water sample was collected from Khlong Hua Takhe in January, 1995, which provides the results shown in Table 2.14.7. The pH level is in a satisfactory level for fish to live and grow. Dissolved oxygen (DO) is quite low, due mainly to waste water from Hua Takhe communities and from industries located upstream.

Table 2.14.7 Water Quality of Khlong Hua Takhe

Parameter		Unit	Value
Temperature	Air	℃	28
	Water	℃	29
pH			6.5
SS		mg/l	18.0
DO		mg/l	2.3
TDS		mg/l	730
Total Phosphorus		mg/l	0.08
Total Coliform Bacteria		MPN/100ml	360
Fecal Coliform Bacteria		MPN/100ml	290

2) Impact on water quality

(a) Construction phase

During the construction period, water quality may be affected by construction materials such as particles of gravel, sand, brick, and stone, particularly in the rainy season. However, this is a minor impact since it can be washed away by rain.

(b) Operation phase

The existing operation of SRT trains may cause a little deterioration of water quality in several canals due to the direct discharge of waste water. However, this impact can be solved by installing septic tanks in the toilets and waste water should be treated before being discharged into canals or rivers.

3) Mitigation measures

The following measures to reduce the negative impact on water quality are proposed.

- Construction near river or canals must be carefully done to reduce the adverse impact on water quality.
- Shelters for workers must be located at least 150 meters from water sources. In addition, proper toilets should be adequately provided.
- Solid waste disposal into rivers or canals must be prohibited.

(3) Air quality

1) General background

With the rapid growth of motorization, air pollution has become a severe problem, particularly in urban areas. However, the improvement of the railways will attract some car users which will result in the reduction of air pollution. In addition, the introduction of electric trains will not generate additional air pollution.

In Bangkok, seventy percent of the air pollution is generated by motor vehicles. It was found that the levels of carbon monoxide (CO), suspended particulate matter (SPM) and ozone (O_3) are very high and far exceed WHO standards. Furthermore, it was estimated that an 8 hour exposure at road side to Bangkok's air, which is experienced by such people as pedestrians, traffic policemen and vendors, is equivalent to smoking 9 cigarettes a day. A study revealed that among 1,758 Bangkok traffic policemen, 753 suffer from a variety of respiratory diseases including asthma, conjunctivitis, lung cancer, etc., 420 of them have been suffering from these diseases for more than five years.

The National Ambient Air Quality Standards (NAAQS) used in Thailand is shown in Table 2.14.8. With the exception of carbon monoxide and lead, for which significantly higher concentrations are allowed in Thailand, the NAAQS is quite similar to the U. S. EPA standards. It can be safely said that Thailand's NAAQS is considered sufficient in protecting the public health form air pollution.

Table 2.14.8 Thailand's National Ambient Air Quality Standards

Pollutants	Measuring period	Concentration mg/m^3
Carbon monoxide (CO)	1 hr	50
	8 hr	20
Sulfur dioxide (SO_2)	24 hr	0.300
	annual	0.100
Lead (Pb)	24 hr	0.010
Suspended particulate matter (SPM)	24 hr	0.330
	annual	0.100
Ozone (O_3)	1 hr	0.200
Nitrogen dioxide (NO_2)	1 hr	0.320

Source : Office of the National Environment Board (1981)

Air quality measured at KMIT in December 1994 is shown in Table 2.14.9. It can be safely said that these qualities are acceptable.

Table 2.14.9 Air Quality Measured at KMIT

Date	TSP mg/m^3 (24 hr)	NO_2 mg/m^3 (1 hr)	CO ppm (1 hr)	Pb mg/m^3 (24 hr)
Tue 6/12/94	0.102	0.024	0.60	0.00022
Wed 7/12/94	0.099	0.021	0.65	0.00025
Thu 8/12/94	0.095	0.020	0.58	0.00018
Fri 9/12/94	0.115	0.023	0.69	0.00026
Sat 10/12/94	0.091	0.018	0.55	0.00015
OEPP'S Standard	0.330	0.320	50.0	0.01000

2) Impact on air quality

(a) Construction phase

During construction, air pollution can be caused by dust and ash. Major sources of dust are as follows.

- site clearance;
- mixing and batching of concrete;
- earthwork; and
- smoke from vehicle and equipment operation

Due to the above construction activities, air quality will be deteriorated. However, the impact on air quality is not considered serious since the construction site is located in the low populated area.

(b) Operation phase

The introduction of electric trains will mean no air emissions. Moreover, with the improvement of railways, some car users will be attracted to the railways which will result in the reduction of air pollution.

3) Mitigation measures

It is strongly recommended that the following measures should be seriously taken into account during the construction period, especially in the highly populated areas.

- Transport of materials must be properly done to avoid the falling materials.
- Frequently spray water on areas from where dust is emitted.
- Maintain vehicles and engines in good condition.
- Remove excess materials and waste from construction sites as soon as construction is finished.

(4) Land use

1) General background

Land use along the eastern railway, including important buildings, was surveyed in December, 1994 and is discussed below.

(a) Lat Krabang - Chachoengsao Section

Fig. 2.14.1 Shows existing land use over the Lat Krabang - Chachoengsao section, whereas Fig. 2.14.2 shows land use from Chachoengsao to Map Ta Phut. Land use is divided into 9 categories:

- Low density residential areas
  This type of land use is mainly found along roads and canals. This category includes scattered houses and single houses. It is the majority of residential areas.

- Medium density residential areas
  This type of land use is located along Luang Phaeng Road, close to King Mongkut's Institute of Technology (KMIT), Lat Krabang Campus.

- Commercial areas
  It is located in the same area with medium density residential area.

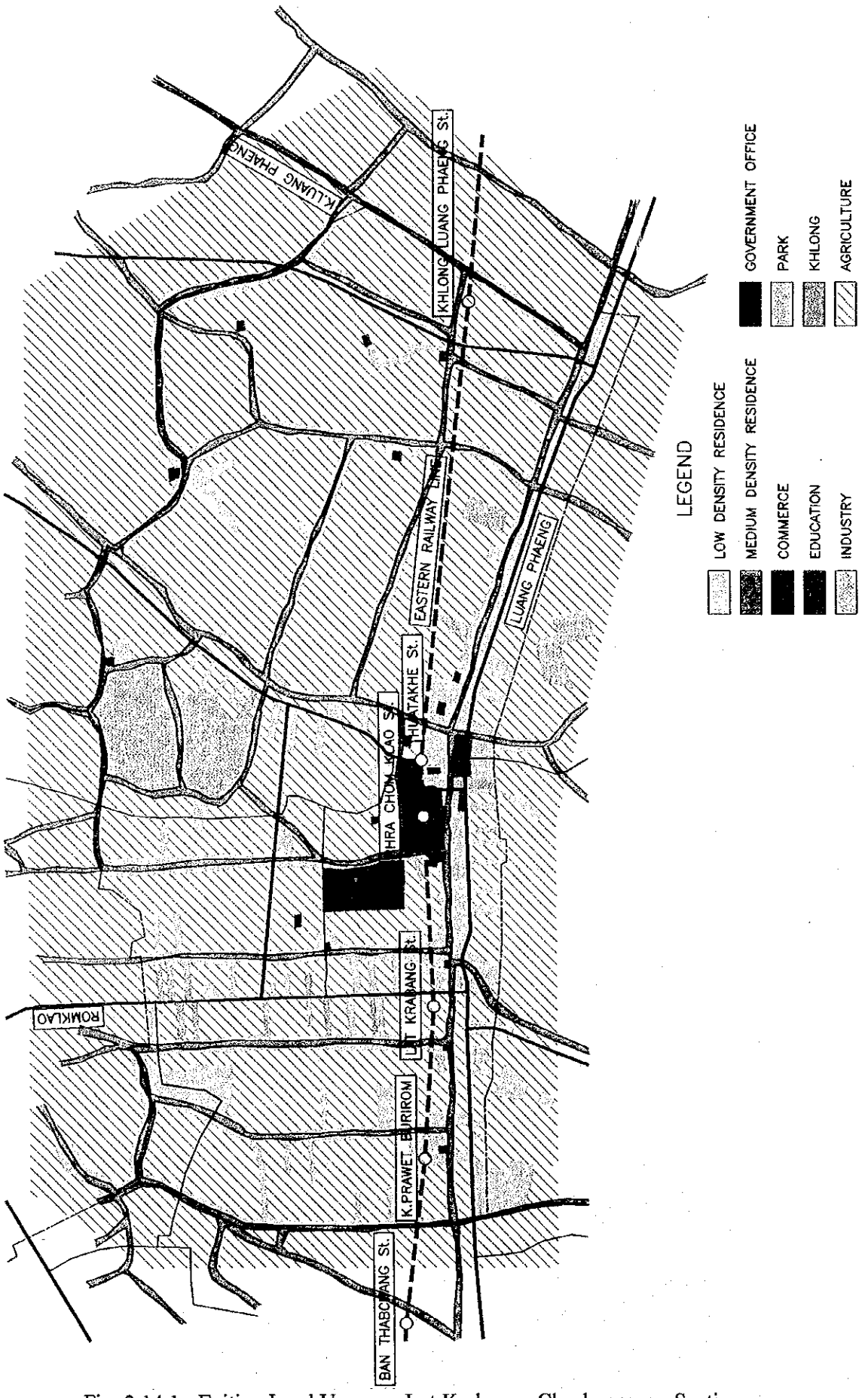


Fig. 2.14.1 Exiting Land Use over Lat Krabang - Chachoengsao Section

FIGURE LAND USE ALONG THE EASTERN RAILWAY

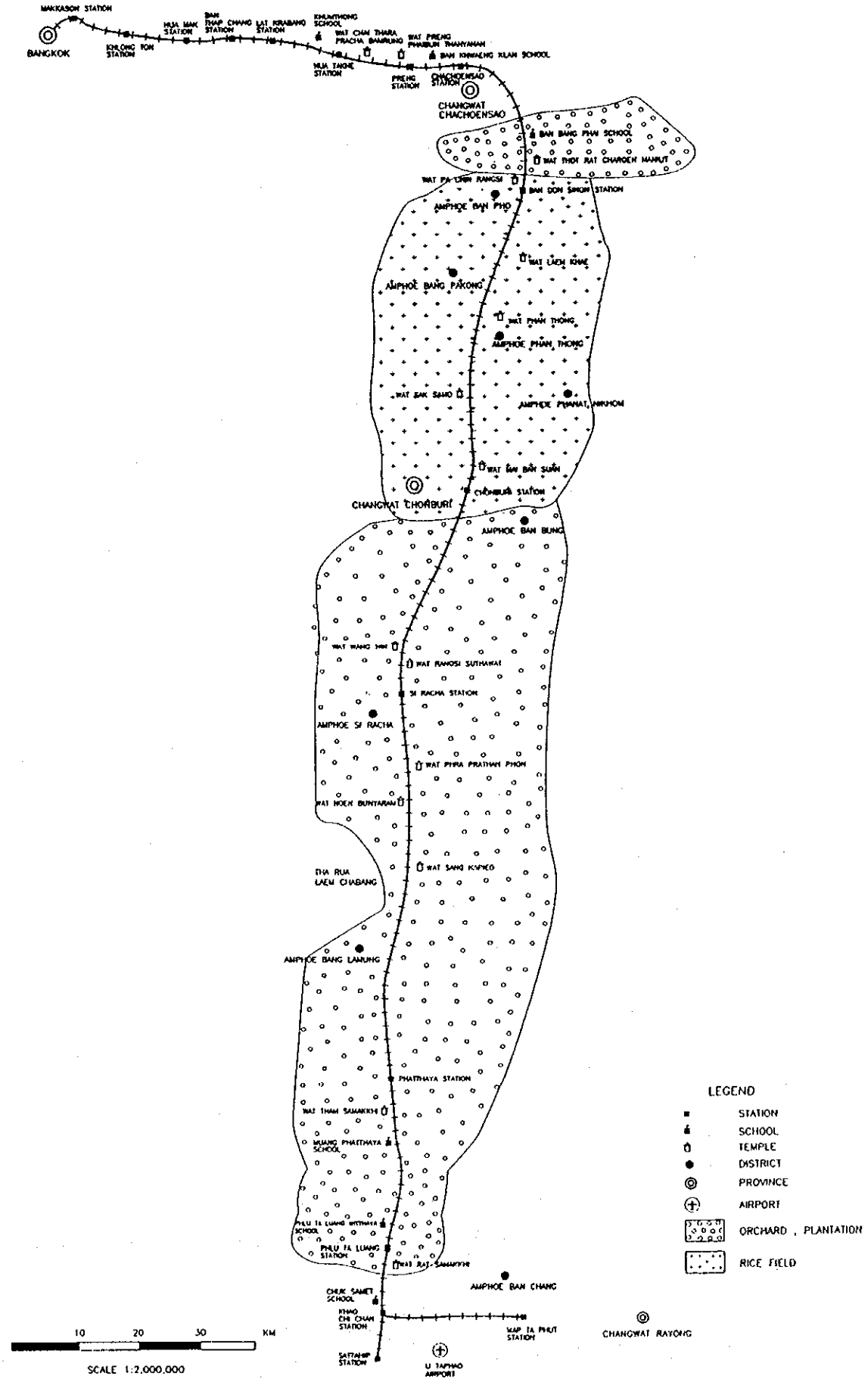


Fig. 2.14.2 Land Use along the Eastern Corridor

- Educational areas

  KMIT, Lat Krabang Campus is a significant educational area. In addition, there are several primary schools such as Wat Lat Krabang School, Prot Phitthaya School, Wat Phon Mani School and Wat Sutthaphot School.

- Industrial areas

  Several light to medium industries can be found along Romklao Road, Luang Phaeng Road and the canals. In addition, Lat Krabang Industrial Estate is also located in this area. These factories produce various kinds of products such as electronic parts, furniture, food, footwear, clothes, automobile parts, etc.

- Government offices

  Inland Container Depot (ICD) is located along Klong Chi, northwest of KMIT.

- Parks

  Several parks/playgrounds are located in the residential areas.

- Canals

  Several canals exist in this area such as Khlong Sam, Khlong Chit, Khlong Lam Pra Tiu and Klong Phrakhanong.

- Agricultural areas

  This category of land use occupies major areas. Rice fields account for is the majority of agriculture areas. Fish ponds can be generally found in this area.

(b) Chachoengsao - Chonburi section

Land use between this section is mainly rice fields with some orchards, plantations, swamps and marshs.

(c) Chonburi - Phatthaya section

The majority of land use is plantations and orchards with some rice fields. Several hills are located along the route, including Khao Choeng Thain, Khao Khai Nao, Khao Chalak, and Khao Yai.

(d) Phatthaya - Map Ta Phut section

Land use for this section is similar to that along the Chonburi - Phatthaya Section.

2) Impact on land use

The improvement of railways would encourage urban development, particularly in the areas surrounding stations. Actually, the changes in land use have already started in some areas due to the expectation of the New Bangkok - Chonburi Highway and High Speed Train. The development of housing estates along railways will stipulate the use of trains rather than road transport as it is nowadays. The loss of agricultural lands is a concern that should be considered. However, the improvement of railways will use only the existing right of way; thus, no agricultural lands will be affected.

3) Mitigation measures

It is suggested that appropriate landscape along the railways should be provided in community areas and around station areas.

(5) Aesthetic and archeological sites

1) General background

Many temples are located in the corridor of the eastern railway as listed below :

a) Lat Krabang - Chachoengsao section

- Wat Lan Bun
- Wat Lat Krabang
- Wat Pluk Sattha
- Wat Khum Thong
- Wat Chai Thara
- Wat Preng Phaibun

b) Chachoengsao - Chonburi section

- Wat Thot Rat Chareon Manilit
- Wat Prachin Rangsi
- Wat Laem Khae
- Wat Phan Thong
- Wat Sak Samo
- Wat Mai Ban Suan

c) Chonburi - Phatthaya section

- Wat Wang Hin
- Wat Ranosi Suthawat
- Wat Phra Prathan Phon
- Wat Noen Bunyaram
- Wat Sang Kapieu

d) Phatthaya - Map Ta Phut section

- Wat Tham Samakkhi
- Wat Rat Samakhi

The locations of these temples are shown in Fig. 2.14.2, above.

2) Impacts on aesthetic and archeological sites

Since the improvement of railways will be done within the existing railway corridor, no land acquisition is required. In other words, these important archeological sites will not be disturbed.

(6) Transport

1) General background

The majority of trips between Bangkok and the eastern region are made by road transport. Roads linking these two areas and serving traffic in these areas include : Highways 3, 34, 304, 314, 315, 3304, 344, 3241, and 36. Existing traffic volumes and vehicle composition

on these highways surveyed in December 1994, are shown in Fig. 2.14.3. Traffic volume is higher on the road sections located close to the city. Vehicle composition is dominated by passenger cars, followed by light trucks.

There are several canals in the project area; therefore, water transport still play a substantial role in some areas. The implementation of this project will not cause any obstruction to the waterways.

2) Impact on transport

The improvement of railways is expected to attract a part of road transport which will result in reducing road congestion, air pollution and vehicle operating costs. On the other hand, more train operation, due to the expected higher ridership, will cause the inconvenience to road transport at the railway crossings. However, these problems can be solved by elevating roads. The Study Team has proposed seven railway crossings, besides the four locations proposed by the Department of Highways (DOH), for grade separation. These seven locations are located between Hua Mak and Chachoengsao, including:

- km 16+752 (Railway kilometer)
- km 30+337
- km 33+966
- km 38+781
- km 45+456
- km 60+153

3) Mitigation measures

The following mitigation measures should be seriously taken into account

- The public should be notified in advance of the construction schedule so that they can choose reasonable routes for travelling, which can minimize traffic congestion.
- Appropriate traffic signs, signals and lights should be installed.

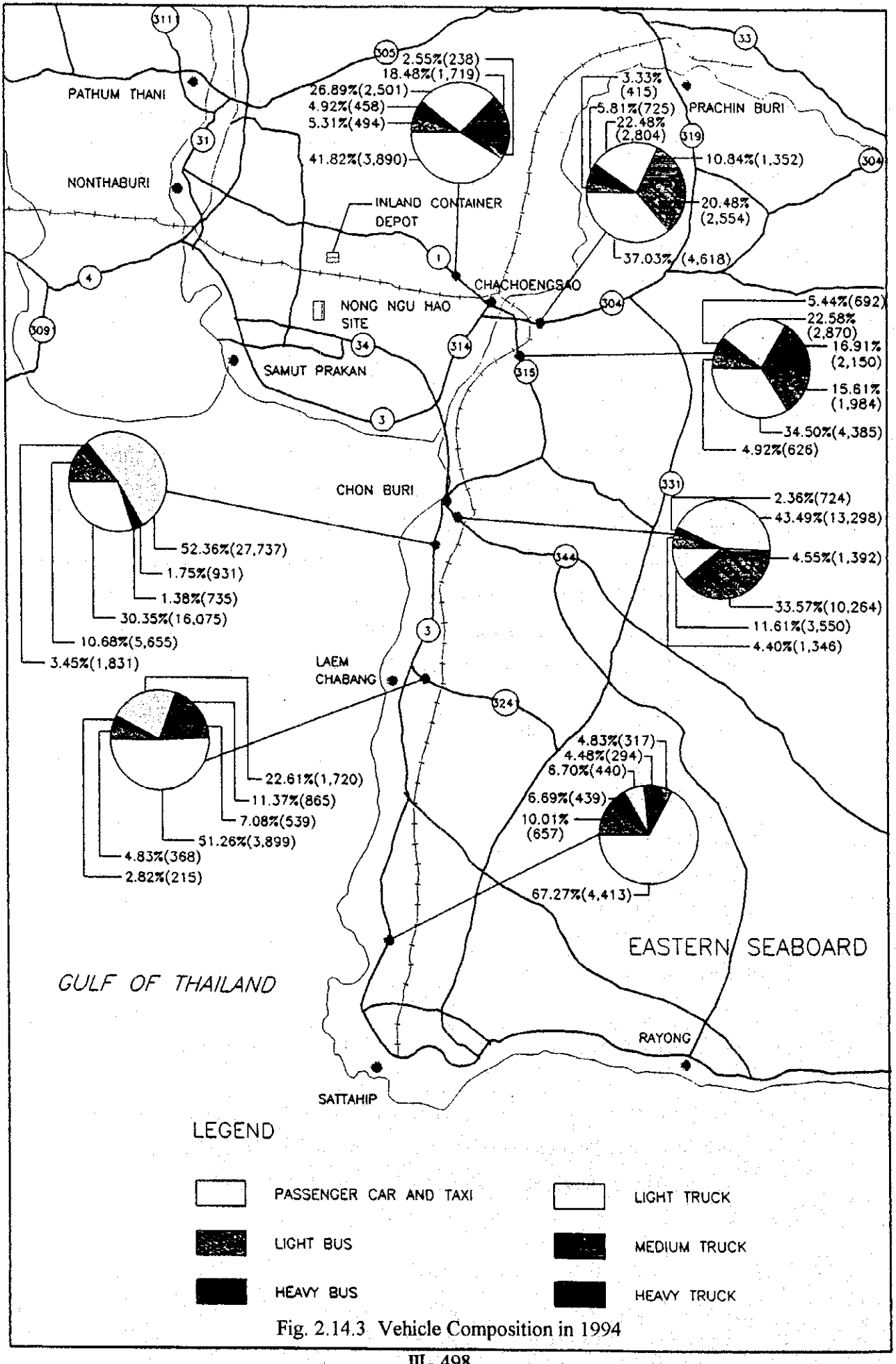


Fig. 2.14.3 Vehicle Composition in 1994

2.15 Economic Evaluation

2.15.1 Methodology

Steps required in the economic evaluation are as follows :

- estimate tangible benefits to which costs / values can be assigned
- estimate intangible benefits to which costs / values cannot be assigned
- calculate EIRR
- conduct sensitivity analysis

(1) Estimate of tangible benefits

The tangible benefits identified for this project are as follows :

- savings to SRT in operation costs
- time cost savings
- savings in road maintenance costs
- savings from prevention of derailment

1) Savings in operating costs

This benefit considers the benefit to the Thailand of having an increased proportion of passengers and freight carried by rail compared with road on the basis that the former has lower operating costs per passenger-kilometer and ton-kilometer than the road transport. The steps carried out in the estimation are summarized as follows :

- use historical data and estimated load factors to calculate historical unit cost for passenger and freight for both rail and road transport (Bath/passenger-km and Bath/ton-km)
- estimate operating costs under "with project" situation
- estimate operating costs under "without project" situation
- estimate benefits as savings in operating costs

2) Savings in time costs is relatively small for two reasons

- actual time savings are very conservatively estimated

- unit income costs are relatively low due to the relatively low average incomes of rail users

3) Savings in road maintenance costs

Savings from reduced number of derailments have excluded time costs of passengers and costs of lost / damaged freight in the interest of being conservative, as the basis for such costs is total subjective.

(2) Estimate of intangible benefits

1) Project implementation period

Significant benefits will derive from the project during the implementation phase. These may be summarized as :

- direct employment for people working on the project
- indirect benefits from the increased income of those employed on the project
- improved employment prospect post the project for those trained on the job

2) Ongoing benefits

Other intangible benefits due to the improvement of the Eastern Line are extensive as briefly explained below :

- Increase in reliability and safety in travel. When the railway is operated adequately, reliability and safety would be the major advantages in travel. This would become increasingly importune as road traffic grows and congestion becomes serious along the corridor, especially around cities and urban center.

- Availability of trunk transport system : Although road transport will continue to be the main mode in the region, the improved rail system will provide alternative and competitive transport which can provide security in mobility and opportunities for further improvement of road and rail transport through competition.

- Community health facilities can be expected to improve due to improved access this project will provide.

- The improved access will make it easier for trained health officers to attend the communities. This will support further education community health and hygiene.

- The upgraded rail facility will provide a means of transporting patients to more highly equipped facilities in other town. It will also provide a means of transport for medical specialist to more readily visit patients who normally cannot avail of their service due to inaccessibility.

- Promotion of effective land use : Rail transport normally encourages more intensive land use in its influence area, which is an important aspect in a country where population density relatively high and effective use of lands is needed.

- Environmental impact : The railway, in most cases, has much fewer negative environmental implications than has road transport.

- Other effect

a) Employment generation effect

In addition to employment which will be directly generated by the project, increased GDP is expected to generate other employment opportunities.

b) Effect to stimulate industrial structure evolution

Since more people can be transported faster after the project, the industrial structure is expected to shift to higher value-added sectors.

c) Effect to stimulate travel

New traffic demand will be induced by improvement of railway system. Also, increases in income level and free time will generate additional traffic demand.

d) Technological transfer effect

This project will bring advanced technologies in various fields to the Thailand, to stimulate modernization of local industries.

e) Energy saving effect

A considerable energy consumption volume can be saved by substituting road-based transport modes into an electric railway transit system.

f) Effect of alleviation of traffic accidents

Railway improvement will mitigate the road traffic congestion and thus reduce road accidents in BMR.

2.15.2 Examination Results

Three major economic indicators are carefully calculated for 3 alternatives. Although economic benefit for the project, alternative 1 as a sample case, is relatively high as of 21.8 billion bath by discounted, benefit, economic internal return ratio (EIRR) is just 16.3%. Among 3 alternatives, alternative 2 shows relatively high economic impact. Table 2.15.1 shows economic impact by third class fare base and Table 2.15.2 shows by second class fare respectively.

Table 2.15.1 Result of Economic Evaluation for Present Third Class Fare Level

	Alternative 1	Alternative 2	Alternative 3
B/C	2.28	2.81	1.99
N.P.V.*	12,282	19,036	13,567
IRR	16.3	18.7	15.3

*million baht

Table 2.15.2 Result of Economic Evaluation for Present Second Class Fare Level

	Alternative 1	Altenative 2	Alternative3
B/C	2.08	2.55	1.81
N.P.V	10,316	16,374	11,114
I.R.R	15.2	17.5	14.1

2.15.3 Sensitivity Analysis

The results of sensitivity analysis are shown in Table 2.15.3

Table 2.15.3 Sensitivity Analysis

Present third fare level

Alternative 1

		Demand			
		-20%	-10%	+-0%	+10%
Cost	+20%	12.0	13.1	14.2	15.3
	+10%	12.8	14.1	15.2	16.3
	+-0%	13.8	15.1	16.3	17.4
	-10%	14.9	16.3	17.5	18.6

Alternative 2

		Demand			
		-20%	-10%	+-0%	+10%
Cost	+20%	14.0	15.3	16.5	17.6
	+10%	15.0	16.7	17.5	18.7
	+-0%	16.0	17.4	18.7	19.9
	-10%	17.3	18.7	20.0	21.3

Alternative 3

		Demand			
		-20%	-10%	+-0%	+10%
Cost	+20%	10.8	12.0	13.1	14.2
	+10%	11.7	12.9	14.1	15.2
	+-0%	12.7	14.0	15.2	16.4
	-10%	13.9	15.2	16.5	17.7

Present second fare level

Alternative 1

		Demand			
		-20%	-10%	+-0%	+10%
Cost	+20%	11.0	12.2	13.3	14.3
	+10%	11.9	13.1	14.2	15.2
	+-0%	12.8	14.1	15.2	16.3
	-10%	13.9	15.2	16.4	17.5

Alternative 2

		Demand			
		-20%	-10%	+-0%	+10%
Cost	+20%	13.1	14.3	15.4	16.5
	+10%	14.0	15.2	16.4	17.5
	+-0%	15.0	16.3	17.5	18.7
	-10%	16.2	17.5	18.8	20.0

Alternative 3

		Demand			
		-20%	-10%	+-0%	+10%
Cost	+20%	9.8	11.0	12.1	13.1
	+10%	10.7	11.9	13.1	14.1
	+-0%	11.7	12.9	14.1	15.2
	-10%	12.8	14.1	15.3	16.5

Table 2.15.4 Cost Benefit Flow

Case 2

Year	Alternative 1				Alternative 2				Alternative 3			
	Undiscounted		Discounted		Undiscounted		Discounted		Undiscounted		Discounted	
	Cost	Benefit	Cost	Benefit	Cost	Benefit	Cost	Benefit	Cost	Benefit	Cost	Benefit
1996	191	0	177	0	283	0	262	0	303	0	280	0
1997	565	28	485	24	656	33	563	28	1476	136	1265	117
1998	1941	88	1541	70	2055	105	1631	83	2224	204	1766	162
1999	2561	124	1883	91	2846	148	2092	109	3057	247	2247	182
2000	2442	163	1662	111	2898	195	1972	133	3840	295	2614	201
2001	470	516	296	325	510	774	322	488	688	789	434	497
2002	618	638	361	372	657	939	384	548	840	935	490	546
2003	578	773	312	417	592	1118	320	604	785	1096	424	592
2004	797	960	399	480	811	1363	406	682	1009	1311	505	656
2005	1788	1123	828	520	1874	1580	868	732	2119	1504	982	697
2006	414	1597	178	685	460	2183	197	936	707	2021	303	867
2007	417	1798	165	714	491	2529	195	1004	745	2324	296	923
2008	422	2146	155	789	438	2907	161	1069	697	2654	256	976
2009	482	2465	164	839	440	3319	150	1130	703	3013	239	1026
2010	337	2778	106	876	354	3782	112	1192	481	3416	152	1077
2011	312	3049	91	890	332	4103	97	1198	518	3702	151	1081
2012	313	3318	85	897	333	4435	90	1199	524	3998	142	1080
2013	315	3594	79	899	334	4807	84	1203	524	4329	131	1083
2014	315	3920	73	908	334	5209	77	1207	526	4685	122	1086
2015	315	4242	68	910	335	5677	72	1218	531	5098	114	1094
2016	315	4575	63	909	335	6127	67	1217	533	5499	106	1092
2017	316	4932	58	907	336	6612	62	1216	537	5929	99	1091
2018	316	5335	54	909	336	7155	57	1219	537	6410	91	1092
2019	317	5751	50	907	336	7719	53	1217	538	6911	85	1090
2020	317	6218	46	908	337	8326	49	1216	545	7449	80	1088
2021	317	6701	43	906	337	8981	46	1214	545	8030	74	1086
2022	318	7223	40	904	337	9687	42	1213	551	8655	69	1084
2023	319	7807	37	905	338	10475	39	1214	552	9352	64	1084
2024	319	8414	34	903	338	11298	36	1213	553	10080	59	1082
2025	320	9093	32	904	339	12184	34	1211	560	10865	56	1080
Total	18770	99368	9564	19880	20405	133770	10538	26912	27745	120937	13693	24807

Case 2

	Alt. 1	Alt. 2	Alt. 3
B/C	2.08	2.55	1.81
N.P.V.	10316	16374	11114
IRR	15.2	17.5	14.1

2.15.4 Examination of Benefit of Alleviation of Air Pollution

The air within the BMA area is seriously polluted by road vehicle exhaust. If some part of the road-based urban transport -modes is replaced by the rail-based transport network, a benefit of alleviation of air pollution can be expected. Such a category of benefits has been measured by statistical estimations or by individual interviewing surveys. In this study, because of limitation of time and costs, the figure is deduced in a simple way, based upon some studies of Japanese urban areas, adjusted by the Thailand and the Japanese per capita national income.

According to the following data, it is estimated that Baht 816 per car per annum can be saved within the area. Thus, the benefit of alleviation of air pollution has been calculated.

Needless to say, it is necessary to deal with this figure very carefully as of its rough estimation.

Table 2.15.5 Basic Data

	Osaka	Kawasaki
Yearly payments with relation to air pollution (million yen)	16,200 (1970)	1,738 (1965)
Ditto, per family (yen)	17,000	7,022
Ditto, per car (yen)	10,868	8,514

2.16 Financial Evaluation

(1) Prerequisites of financial evaluation

(a) Project life

Project life is 30 years from 1996 to 2025, while the target year of the project is 2010.

(b) Rate of foreign exchange

The Thai baht is calculated at 4 yen per baht and at 25 baht per U.S. dollar in the evaluation.

(c) Tax

Both import taxes and 7% of value-added tax are eliminated from the costs and expenses.

(d) Interest

All the interests are not calculated in the evaluation.

(e) Cost of labor

The nominal wage is used for the cost of labor.

(f) Price of real estate

The price of real estate, which is estimated by region and by usage, is used.

(g) Fare level

For the commuter service, the current second class fare (0.44 baht/km) is adopted as the basic fare for the calculation.

For the intercity express service, current second class fare combined with the express charge, the seat reservation charge and the air-conditioning charge (0.6 baht/km in total) is adopted.

As alternatives, the third class fare (0.215 baht/km) and the fare of 1 baht/km (average 0.7 baht/km) as an upper limit are used for the calculation of variations.

(h) Revenue

Revenue is calculated based on the estimated passenger-km.

(i) External free fund

As an external free fund, financial assistance is expected to be given by the Thai Government and/or others concerned to the investment on the railway construction, but not to the rolling stock or the current expenses.

(2) Outline of evaluation

As per Table 2.16.1 "Financial Situations Classified by Alternatives and their Conditions", it is admitted that the Eastern Line improvement for the commuter service could not be profitable and the railway would not be sustainable without an external free fund, unless the upper limit fare is supported by the government.

In consideration of the available foreign official interest rates between 3 to 7% p.a., the second class fare with an external free fund amounting to 60% of investment cost for facilities will yield 7.1% of FIRR by the year 2025 and prove to be sustainable.

For the SBIA access service and the intercity express service, the financial evaluation shows more profitable and sustainable results as 9.3% and 10.7% in FIRR, respectively, under the special charge of 10 baht for the access and 0.6 baht/km for the express, with no change in other conditions of the above-mentioned case.

(3) Cases of evaluation

There are mainly three alternatives in this Study, as follows:

Alternative 1 (Alt.1) Commuter service between Yommarat and Chachoengsao only

Alternative 2 (Alt.2) Commuter service and SBIA access service

Alternative 3 (Alt.3) Commuter service, SBIA access service and intercity express service between Hua Lamphong and Map Ta Phut

(4) Tables for the whole aspect

FIRR is calculated according to the following cases:

(a) Fare

i) Current 3rd class fare : 0.215 baht/km

ii) Current 2nd class fare : 0.44 baht/km

iii) Upper limit fare : 0.7 baht/km

This is an average fare roughly set under the idea that the high fare of 1 baht/km is applied up to a 15km ride and the lower fare of 0.44 baht/km over 15km.

(b) External free fund

The fund for all investments excluding purchase of rolling stock is raised by:

i) 100% by SRT's own money and borrowing

ii) 50% by an external free fund

iii) 60% by an external free fund

iv) 70% by an external free fund

(c) Alternatives

As for alternative operation, 3 alternatives mentioned above are adopted.

(d) Fare for SBIA access

The following 3 kinds of fare systems are calculated for SBIA access service in Alt.2, Alt.3:

i) As per the basic fare variations (mentioned in (a))

ii) To charge 10 baht as a one-way special charge for SBIA (5.1km)

iii) To charge 20 baht as a one-way special charge for SBIA (5.1km)

Totalling the above-mentioned variations, the cases are 84 in all, i.e.,

12 cases for Alt.1

36 cases for Alt.2

36 cases for Alt.3.

The most important 26 cases out of the 84 are calculated and studied in Table 2.16.1.

As a result, Alt.2 and Alt.3 are almost 1% higher in FIRR than Alt.1, which shows more efficient use of the existing line of Alt.1.

"More efficient use" means that, as well known, the investment for the demand at the peak time of commuters are the most inefficient and unprofitable for the railway management. On the other hand, dispersed demand throughout the day (in the case of Alt.2 and Alt.3 not deteriorating the inefficiencies of "rush hours" too much but taking advantage of utilizing the existing facilities prepared for "rush hours" during less crowded hours) is expected to produce a better ratio of revenue-expenses.

(5) Basic case

Out of variations pointed out in (3), the case of Alt.1 with 2nd class fare supported by an external free fund amounting to 60% of investment cost is selected as the basic case for this analysis. The annual investment cost, expenses and revenue are shown in Table 2.16.2.

Characteristics, of the basic case are as follows.

(a) Fair price of fare

Nowadays the 14.8km trip from Yommarat to Lat Krabang costs a passenger only 3.2 baht, while the average consumers' price has risen 1.4 times since 1985, when the present fares of the SRT were fixed.

The basic case fare is set at almost a doubled basis. The future trip of 14.8km will cost a passenger 6.5 baht, but it will be air-conditioned and fast. He will be able to reach the center of the metropolis within half an hour from the new town in Lat Krabang, with much more frequent service.

(b) Reasonable governmental assistance

In order to carry out the project of a new commuter service, it is necessary to obtain the cost-free fund or donations from outside of the SRT. Without such a free fund, the FIRR remains below 6% regardless of the three fare level choices.

Recently, the Thai Government has helped the SRT by giving a fund for new and improvement construction of railways and by compensating the current deficits caused by the low-fare policy.

The basic case expects a 60% free fund only for the investment costs, which does not include the cost of purchasing rolling stock, nor annual operating and maintenance expenses.

(c) Basic to all the services

As mentioned in the above paragraph (3), the most costly service is a commuter service with a big gap between "rush" hours and usual hours. In this project, especially, a new commuter service will be installed with huge investment including electrification facilities, electric railcars, new suburban stations and grade separations.

However, once the basic service installments are completed, other additional services such as intercity express and feeder line services will become easily feasible and sustainable.

(d) Evaluation

As shown in Table 2.16.2, the FIRR of the basic case is 7.06%. This is a bit higher than the expected interest rate of foreign institutional loans (Table 2.16.3 and Fig. 2.16.1).

This means that the cases, whose conditions are worse than the basic case, may not be viable or must reconsider the conditions.

For instance, the case Alt.1 e) in Table 2.16.1 with an external free fund of 50% results in 6.05% of FIRR. This case is more difficult to make viable than the basic case.

On the other hand, the case of Alt.2 e) in Table 2.16.1 with an external free fund 50% and with SBIA 10 baht special charge results in 8.12% and appears more viable than the basic case. Fig. 2.16.1 shows the relation between FIRR and funding costs.

In general, Alt.2 and Alt.3. are more profitable under the same conditions of fare level, an external free fund, an SBIA special charge, etc., but it is necessary to mention that both Alt.2 and Alt.3 require much more investment than Alt.1.

(e) Conclusions

The basic case is most recommendable from both the viewpoint of viability and the scale of investment among viable cases of Alt.1. The corresponding cases in Alt.2 and Alt.3 are also recommendable. Selection of these three alternatives is dependent on the Policy of the Government.

(6) Basic case and fund-raising

As shown annually in Table 2.16.4, if the project is implemented according to the basic case, the fund will be short until 2020 and long through the project life as follows.

(a) Assumptions

- Shortage of funds is covered by additional borrowing every year.

- Interest rate is 7% p.a.
- Annual inflation rate are 3.5% for 1996-2000, 3.0% for 2001-2005, 2.5% for 2006-2010 and 2.0% for 2011-2025.
- All the costs, expenses and revenues will be increased in parallel with the inflation rate annually.
- When the cash balance turns to surplus, the balance is all for repayment of loans.

(b) Financial Viability

As the foreign exchange market in this country is free enough, there is no problem in exchanging local currency into foreign currency or the reverse. Therefore, it is not necessary to raise foreign and local funds separately. The expected sources of funding are listed in Table 2.16.3.

(c) Summary of funding operation

i)	Peak year and amount of loan	: in 2009 and 9.6 billion baht
ii)	Start of repayment	: in 2010
iii)	Completion of repayment	: in 2020
iv)	Years of borrowing	: 25 years from 1996 to 2020
v)	Average loan amounts by year	: 5.6 billion baht

(7) Sensitivity analysis

In the basic case, the following sensitive variations are studied:

i) In case the demand is decreased by 5% and 10%
ii) In case the investment cost is increased by 5% and 10%
iii) In case the demand is decreased by 5% and the investment cost is increased by 5%.

Referring to Table 2.16.5, the rates of variability or deterioration are calculated as 3.1% at minimum for Case (4) in Table 2.16.5 and as 12.6% at maximum for Case (3), comparing with the basic case (Case (1)).

In the worst case (Case (3)), one of the countermeasures is to raise the rate of external free fund from 60% to 70% and the FIRR will be improved to 7.36%.

Table 2.16.1 Financial Situations Classified by Alternatives and Their Conditions

(million baht)

Alternatives and Conditions					Cost and Expenses					Revenue	Profit	FIRR (%)
Alternatives		Fare: Eastern Line	Fare: SBIA Line	External Fund	Investment Cost: Facilities	Investment Cost: Rolling Stock	Investment Cost: Total	Expenses	Total (A)	(B)	(B)-(A)	
Alt. 1	a)	3rd C.	--	--	8,308	5,855	14,163	4,930	19,093	12,903	-6,190	-4.09
	b)	2nd C.	--	--	8,308	5,562	13,870	4,684	18,554	24,291	5,737	2.69
	c)	Up.lim.	--	--	8,308	4,977	13,285	4,191	17,476	30,206	12,730	5.41
	d)	3rd C.	--	50%	4,154	5,855	10,009	4,930	14,939	12,903	-2,036	-1.74
	e)	2nd C.	--	50%	4,145	5,562	9,716	4,684	14,400	24,291	9,891	6.05
		2nd C.	--	60%	3,323	5,562	8,885	4,684	13,569	24,291	10,722	7.06
		2nd C.	--	70%	2,492	5,562	8,054	4,684	12,738	24,291	11,553	8.28
Alt. 2	a)	3rd C.	3rd C.	--	9,323	6,178	15,501	5,358	20,859	15,259	-5,600	-3.20
		3rd C.	10 B.	--	9,323	6,178	15,501	5,358	20,859	18,070	-2,789	-1.46
		3rd C.	20 B.	--	9,323	6,178	15,501	5,358	20,859	21,227	368	0.18
	b)	2nd C.	2rd C.	--	9,323	5,869	15,192	5,090	20,282	28,631	8,349	3.43
		2nd C.	10 B.	--	9,323	5,869	15,192	5,090	20,282	31,151	10,869	4.32
		2nd C.	20 B.	--	9,323	5,869	15,192	5,090	20,282	34,308	14,026	5.36
	c)	Up.lim.	Up.lim.	--	9,323	5,251	14,574	4,554	19,128	35,576	16,448	6.14
		Up.lim.	10 B.	--	9,323	5,251	14,574	4,554	19,128	37,944	18,816	6.86
	d)	3rd C.	10 B.	50%	4,662	6,178	10,840	5,358	16,198	18,070	1,872	1.29
	e)	2nd C.	10 B.	50%	4,662	5,869	10,531	5,090	15,621	31,151	15,530	8.12
		2nd C.	10 B.	60%	3,729	5,869	9,598	5,090	14,688	31,151	16,463	9.29
		2nd C.	10 B.	70%	2,797	5,869	8,666	5,090	13,756	31,151	17,395	10.75
Alt. 3	a)	3rd C.	10 B.	--	9,983	10,018	20,001	8,850	28,851	35,044	6,193	2.26
	b)	2nd C.	10 B.	--	9,983	9,709	19,692	8,583	28,275	48,125	19,850	6.08
	c)	Up.lim.	10 B.	--	9,983	9,091	19,074	8,048	27,122	54,918	27,796	8.01
	d)	3rd C.	10 B.	50%	4,992	10,018	15,010	8,850	23,860	35,044	11,184	5.16
	e)	2nd C.	10 B.	50%	4,992	9,709	14,701	8,583	23,284	48,125	24,841	9.68
		2nd C.	10 B.	60%	3,993	9,709	13,702	8,583	22,285	48,125	25,840	10.74
		2nd C.	10 B.	70%	2,995	9,709	12,704	8,583	21,287	48,125	26,838	12.01

Remarks: 3rd C. - Current 3rd class fare level
2nd C. - Current 2nd class fare level
Up.lim. - Upper limit fare
10 B. - 10 baht 20 B. - 20 baht

Table 2.16.2 Estimated Annual Cost, Expenses and Revenue of Railway Improvement Project

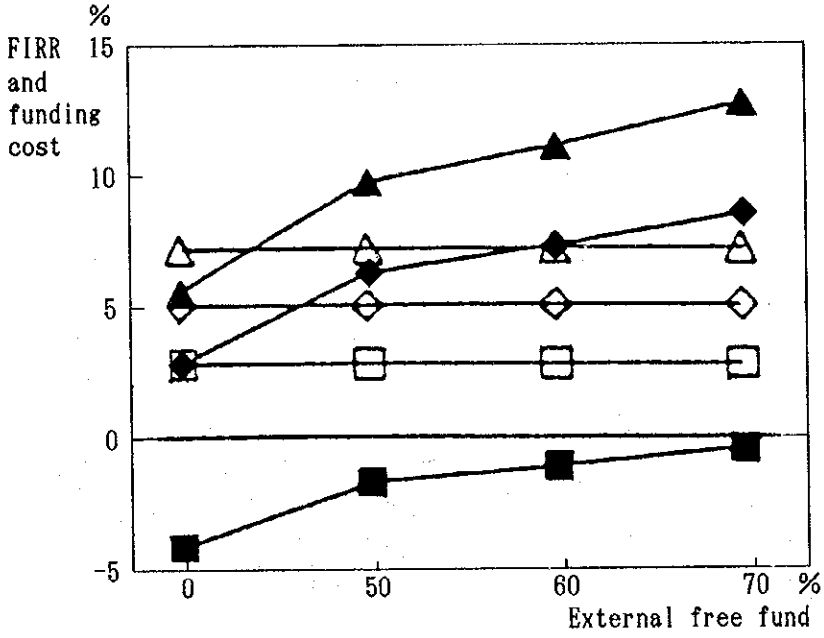
Alt.1 Case II (Commuter Service, Fare:2nd Class)
External Free Fund:60% Unit : Million Bahts

Item / Year	Cost & Expenses					Revenue (B)	Profit (B)-(A)
	Investment Cost			Expenses	Total (A)		
	Facilities	Rolling Stock	Total				
1996	82	0	82	0	82	0	-82
1997	234	0	234	11	245	20	-225
1998	797	0	797	19	816	59	-757
1999	1,084	0	1,084	26	1,110	79	-1,031
2000	306	1,729	2,035	31	2,066	99	-1,967
2001	58	217	275	100	375	272	-103
2002	89	278	367	111	478	323	-155
2003	68	278	346	124	470	375	-95
2004	193	185	378	131	509	446	-63
2005	267	1,019	1,286	134	1,420	498	-922
2006	0	217	217	188	405	680	275
2007	0	217	217	188	405	751	346
2008	0	217	217	193	410	826	416
2009	0	278	278	196	474	902	428
2010	0	124	124	199	323	977	654
2011	0	0	0	199	199	1,005	806
2012	0	124	124	200	324	1,036	712
2013	0	0	0	201	201	1,064	863
2014	0	124	124	201	325	1,100	775
2015	83	0	83	201	284	1,127	843
2016	0	93	93	201	294	1,151	857
2017	0	0	0	202	202	1,175	973
2018	0	0	0	202	202	1,203	1,001
2019	0	93	93	202	295	1,226	931
2020	62	123	185	202	387	1,254	867
2021	0	0	0	202	202	1,278	1,076
2022	0	123	123	204	327	1,302	975
2023	0	0	0	205	205	1,329	1,124
2024	0	123	123	205	328	1,353	1,025
2025	0	0	0	206	206	1,381	1,175
Total	3,323	5,562	8,885	4,684	13,569	24,291	10,722
FIRR							0.0706

Table 2.16.3 Terms and Conditions of Financing Sources as in July, 1995

Items / Sources	Interest Rate (%p.a.)	Term (year)	Grace (year)	Repayment
Governmental Loan	2.7	25	7	Semi-annual installment
Institutional Overseas Loan	7.0*	20	5	Semi-annual installment
Domestic Loan	12.0-13.0	7-10	various	various

*6months variable



FIRR (Alt. 1)

- 3rd class (0.215 baht/km)
- 2nd class (0.44 baht/km)
- Upper limit (0.7 baht/km)

Funding cost

(↓Interest)

- Governmental loan (2.7 %p.a.)
- G.L. 1/2, I.L. 1/2 (4.85%p.a.)
- Institutional loan (7.0 %p.a.)

FIRR (Alt. 1) (%)

External free fund / Fare	0%	50%	60%	70%
3rd class (0.215 baht/km)	-4.1	-1.7	-1.1	-0.4
2nd class (0.44 baht/km)	2.7	6.1	7.1	8.3
Upper limit (0.7 baht/km)	5.4	9.5	10.8	12.4

Remarks: External free fund to be used only for investment excluding rolling stock

Fig. 2.16.1 Financial Situations of Alternative 1

Table 2.16.4 Finance Program of Railway Improvement Project

Alt.1 Case II (Commuter Service, Fare:2nd Class, External Free Fund:60%)

Unit : Million Bahts

Item / Year	Fare Revenue (B)	Fare Revenue (Inflated)* (B')	Investment & Expenses: Investment: Facilities	Investment: Rolling Stock	Investment: Total	Expenses	Total (B)	Total (Inflated)* (B')	Money Position (B')-(B')	Borrowed Money (Repayment(-))	Borrowed Money Balance	Interest Paid 7%p.a.	Cash Balance
1996	0	0	82	0	82	0	82	82	-82	90	90	3	5
1997	20	21	234	0	234	11	245	254	-233	250	340	15	2
1998	59	63	797	0	797	19	816	874	-811	870	1,210	54	5
1999	79	88	1,084	0	1,084	26	1,110	1,231	-1,143	1,280	2,490	130	7
2000	99	114	308	1,729	2,035	31	2,066	2,371	-2,257	2,520	5,010	263	0
2001	272	312	58	217	275	100	375	430	-118	490	5,500	358	4
2002	323	382	89	278	367	111	478	565	-183	590	6,090	406	1
2003	375	457	68	278	346	124	470	572	-116	570	6,660	446	8
2004	446	559	193	185	378	131	509	638	-79	570	7,230	486	5
2005	498	643	267	1,019	1,286	134	1,420	1,831	-1,191	1,760	8,990	568	1
2006	680	905	0	217	217	188	405	539	366	280	9,270	539	7
2007	751	1,024	0	217	217	188	405	552	472	190	9,460	656	6
2008	826	1,154	0	217	217	193	410	573	581	90	9,550	665	6
2009	902	1,292	0	278	278	196	474	679	613	60	9,610	671	3
2010	977	1,435	0	124	124	199	323	474	960	-290	9,320	663	8
2011	1,005	1,513	0	0	0	199	199	300	1,213	-580	8,740	632	1
2012	1,036	1,590	0	124	124	200	324	497	1,093	-490	8,250	595	8
2013	1,064	1,666	0	0	0	201	201	315	1,351	-800	7,450	550	2
2014	1,100	1,757	0	124	124	201	325	519	1,238	-740	6,710	496	2
2015	1,127	1,836	83	0	83	201	284	463	1,373	-930	5,780	437	6
2016	1,151	1,787	0	93	93	201	294	451	1,336	-940	4,840	372	4
2017	1,175	1,840	0	0	0	202	202	316	1,524	-1,220	3,620	296	8
2018	1,203	1,921	0	0	0	202	202	323	1,599	-1,390	2,230	205	4
2019	1,226	1,997	0	93	93	202	295	481	1,517	-1,410	820	107	0
2020	1,254	2,084	62	123	185	202	387	643	1,441	-820	0	29	592
2021	1,278	1,952	0	0	0	202	202	310	1,652	0	0	0	1,652
2022	1,302	2,039	0	123	123	204	327	512	1,527	0	0	0	1,527
2023	1,329	2,123	0	0	0	205	205	327	1,795	0	0	0	1,795
2024	1,353	2,204	0	123	123	205	328	534	1,670	0	0	0	1,670
2025	1,381	2,295	0	0	0	206	206	342	1,953	0	0	0	1,953
Total	24,291	37,042	3,323	5,562	8,885	4,684	13,569	18,002	19,040	0	139,260	9,748	
											av. 5,570	av. 390	

* Inflation Rate:3.5% for '96-'00, 3.0% for '01-'05, 2.5% for '06-'10, 2.0% for '11-'25

Table 2.16.5 Sensitivity Analysis

Basic Case : Commuter Service(Yommarat-Chachoengsao)
2nd Class Fare(B.0.44/km)
External Free Fund 60%

Unit : Million Bahts

	Case	Cost of Facilities	Rolling Stock	Expenses	Revenue	Profit	FIRR
(1)	Basic Case	3,323	5,562	4,684	24,291	10,722	7.06%
(2)	In case Demand is decreased by 5%	3,323	5,423	4,567	23,076	9,763	6.63%
(3)	In case Demand is decreased by 10%	3,323	5,284	4,450	21,862	8,805	6.17%
(4)	In case Facil.Cost is increased by 5%	3,489	5,562	4,684	24,291	10,556	6.84%
(5)	In case Facil.Cost is increased by 10%	3,655	5,562	4,684	24,291	10,390	6.64%
(6)	In case both of (2) & (4) occur	3,489	5,423	4,567	23,076	9,597	6.41%

CONCLUSION AND RECOMMENDATION

3. Conclusion and Recommendations

3.1 Conclusion

(1) Necessity for railways/MRT in the Bangkok Metropolis

The Bangkok Metropolis, although it is one of the world's prominent city areas with a population of 13 million, has no railways / mass rapid transit systems (MRT) for urban transport. Therefore, road traffic is extremely congested. It has reached the extent that it prevents the further prosperity of the area and has brought about remarkable environmental disruption.

In order to cope with such situations, introduction of railways/MRT is a pressing need of the Bangkok Metropolis. Railways/MRT are fast and reliable transport means which are environment-friendly and natural-resource-saving. Besides, they are the only space-saving transport means which can realize to actually carry a vast number of passengers (as many as 50 thousand per hour per direction) in such a great city area as the Bangkok Metropolis where space is valuable and hard-to-get.

It is necessary for the Government of Thailand to make efforts to establish a railway/MRT network in the Bangkok Metropolis as an indispensable part of the social infrastructure of the city area.

At present in the center of Bangkok, three MRT projects (Hopewell Project, BMA Tanayong Project and MRTA Sky Train Project) are planned and some construction work has been started. Subway projects have also come to be examined.

(2) Railway improvement integrated with urban development

Railways/MRT for urban transport are important in the suburban areas as well as within the center of Bangkok. In the suburban areas outside the 15 km radius area vast fields spread. Along trunk roads extending in every direction, the ribbon-like development sprawl has expanded, which has worsened traffic congestion in the Bangkok Metropolis, especially on

the edge of the center (15 km radius area), and further development has come to difficult.

A fast and reliable railway can deal with such transport requirements radially connecting the CBD and suburban areas within a "50 km" radius . Thus, urban development providing a fine living environment with high-quality transport means can be executed. In order to realize the concept, integrated urban and railway development is examined (in this Study). The integrated development can bring to railway investment sure demand, which is a source of revenue, and good funds through value capture.

(3) Master Plan

For planning railway improvement integrated with urban development, the existing four lines of the SRT are considered. They extend to the east, north, west and southwest from the center of Bangkok and function almost as trunk lines. They have enough room to provide full-scale urban transport with necessary improvement. Besides, they have the possibility of further reinforcement because of the broad right-of-ways held. On the other hand, vast fields suitable for new town development spread out surrounding these lines. Therefore, for the first step of integrated urban and railway development, the areas along the exiting SRT four lines are appropriate, and improvement to provide commuter service within the "50 km" radius area on these lines is proposed. In the future, in further steps, areas with new lines will be taken up.

The Second Bangkok International Airport (SBIA) project is ongoing with its commencement of service targeted for the year 2000, which expects railways/MRT ground access as a reliable means as well as road transport. The SRT line from Lat Krabang is proposed as the most advantageous access line because of its effectiveness of synthetic management with the improved Eastern Line as well as the shortest approach with no uncertainty of land acquisition.

Within the 200 km radius area for activating regional core cities, intercity express service connecting among those cities and Bangkok by fast, reliable, comfortable and safe trains is proposed.

(4) Economic evaluation of the Master Plan

The result of the economic evaluation of the Master Plan is as follows:
In the proposed case that integrated urban development as well as feeder service improvement will be executed, the project will be feasible with EIRR of more than 20%.

(5) Financial evaluation of the Master Plan

Financial evaluation is carried out for the alternatives of fare levels and external free funds. The current third class fare (0.215 baht/km) has been held down since 1985 politically and is too low to manage the improved railway. Compared with actual price levels and taking into consideration high service levels of speed and comfort, applying a second class fare (0.44 baht/km) is not unreasonable.

The result is as follows:
In the case that the second class fare level is applied and 1/2 of the investment cost for facilities (except rolling stock) is of an external free fund, the proposed project will manage with FIRR of over 9% on the Eastern Line and Northern Line, but on the Southern Line and Maeklong Line the project can hardly manage without additional free fund.

(6) Selection of priority project for a feasibility study

Out of the Master Plan Projects, the Eastern Line improvement project is selected as the priority project on which a feasibility study will be executed, because the Eastern Line connects the Bangkok Metropolis with the Eastern Sea Board where the Government lays stress on development at present and can provide SBIA railway access easily and without uncertainty, and along the Line, the NHA plans a large-scale housing development project.

(7) Feasibility Study project

Along the Eastern Line, the structure plan of urban development is established and based on the structure plan, demand forecast is set up and the railway improvement plan is conducted. The proposed improvement plan consists of the following:

a) Commuter service of high speed and high frequency by electric railcars

Step I : Yommarat - Khlong Luang Phaeng 37.1 km opening in 2000

Step II : Khlong Luang Phaeng Chachoengsao 21.5 km opening in 2005

b) SBIA access service of rapid shuttle trains by electric railcars

Lat Krabang - SBIA North Terminal 5.1 km opening in 2000

c) Intercity express service of high speed by high quality diesel railcars

Hua Lamphong - Map Ta Phut 200.3 km opening in 2000 (Provisionally 1997)

Alternatives to evaluate the project are set up into the following packages:

Alternative 1 : a) in the above

Alternative 2 : a) and b) in the above

Alternative 3 : a),b) and c) in the above

(8) Economic evaluation

On condition that the integrated urban development is carried out according to the proposed structure plan and feeder service improvement is realized, the proposed railway improvement plan is feasible with an EIRR of approx. 15%.

Furthermore, various effects brought about by modal shift from automobiles to railways for a large number of trips (about 300 thousand trips a day) can bring additional value. The effect is that environmental pollution caused by exhaust fumes can be eased and that many people can feel at ease by travelling by reliable transport means and so on.

(9) Financial evaluation

Cases involving changes in the combination of a fare level, a portion of an external free fund and an alternative of the project package are set up and the most important 26 cases out of the 84 total cases are calculated and studied. As a result, the case of the existing second class fare (0.44 baht/km) with an external free fund amounting to 60% of investment cost for facilities (not including rolling stock) of each alternative of the project package is selected as the recommendable case.

The FIRR of this case on Alternative 1 is 7.1%, which is a little higher than the expected interest rate including foreign institutional loans and those of Alternative 2 and Alternative

3 are higher because of effective use of facilities, rolling stock and employees. (The track-doubling of this section is ongoing and will be completed by the year 2000. This cost is not included and the cost of infrastructure within the SBIA area is to be borne by the airport project.)

The results show that the project, as well as similar projects, can manage bearing the investment cost of rolling stock and management/maintenance expenses by itself.

The government and/or others concerned will have to bear some portion of the investment cost of infrastructure and grand facilities which is heavy in the initial stage compared with revenue.

(10) Environmental evaluation

This project does not have a strong enough impact on the environment to prevent execution.

(11) General Evaluation

This project can give many people fine housing/business situations, ease the worsening of traffic congestion and ease environmental pollution in the center of Bangkok and its outskirts.

If the existing second class fare, which is no longer high compared with general prices, is used, the project will manage with an external free fund amounting to 60% of investment cost of facilities (not including track-doubling cost), for which the government is responsible and value capture is appropriate. The amounts are 5 billion baht for the commuter service only, 5.6 billion baht for the commuter service and SBIA access service and 6 billion baht for the above and intercity express service. This is not so high compared with the expected development gains. Therefore, the external free fund can be realized by some methods such as earmarked tax, real estate tax, general tax and value capture.

3.2 Recommendations

(1) Establishment of network of railways/MRT

Establishment of a network of railways/MRT in the Bangkok Metropolis is a pressing need of the Government of Thailand. It should be executed by the Government as a part of the indispensable infrastructure of the great city area. Since it requires a large amount of initial investment cost, some external free fund will have to be introduced. However, no assistance is required for investment in rolling stock and management/maintenance expenses, unless the fare level is forced to be held too low. It is essential that the Government makes effort to set up a system to introduce some external free fund for construction of railways/MRT and to establish a network of railways/MRT in the Bangkok Metropolis.

(2) Consensus concerning the external free fund

Consensus within the Government concerning the external free fund proposed above should be established promptly.

(3) Regulation of speculation in land

Regulation of speculation in land should be established promptly.

(4) Promotion of the ongoing MRT Projects

First of all, it is desirable that the ongoing three MRT projects will be realized and used and the value of railways/MRT will actually be shown to citizens. They should be promoted earnestly and should not be delayed by private business. The projects are the important core of the network to be expanded, and delays in them make the other projects now under consideration unuseful.

(5) Promotion of integrated urban and railway development in Eastern Line area

It is desirable to promote the proposed integrated urban and railway development project on the Eastern Line and the surrounding area including the SBIA access line. The project

has no uncertainty caused by railway land acquisition and effect of the integrated development can be shown early.

(6) Innovation of management system of the SRT

The SRT has a high potential with the experience and personnel suitable to carry out this Project. However, in order to manage the expanded and modernized railways, establishment of an innovative management system, which should not be an extension of the existing system with various vested rights, is desirable.

In order to introduce an external free fund by internalizing development gains, establishment of a system wherein the SRT can execute development projects in surrounding areas by itself is preferable.

(7) Problem of at-grade crossings

One of the most serious problems of the railways in Thailand is that of at-grade crossings. At present, the priority for trains to pass the crossing is not clearly established. Trains are forced to reduce their speed or to stop in front of crossings. This not only reduces the usefulness of the railways but also worsens traffic congestion because of the lengthened passing time of trains brought about by speed reductions or stops.

Besides, there is no rule on who bears construction costs for grade separation, which prevents smooth execution of grade separation.

It is urgent to make the priority of trains clear and to establish a rule on who bears the costs of grade separation for smooth traffic on both the railways and roads at the remaining at-grade crossings and for promotion of grade separation.

This problem is not only in the Bangkok Metropolis but all over the country. In the center of Bangkok, completion of the Hopewell Project can solve the problem. However, in other areas, it will become more serious because of the sudden increase in automobiles, and unless some countermeasures are established, the railways will no longer be able to function efficiently.

APPENDIX

Appendix II - 1 Provisional Countermeasures for Intermediate Stage of the Bangkok Mass Transit Projects

This Feasibility Study Project is planned based on the precondition that the three ongoing mass rapid transit projects, Hopewell Project, Tanayong Project and Sky Train Project, should be on schedule. This Project is especially closely related to the Hopewell Project which is announced to be completed by the year 2000.

At present, out of the whole plan, a concrete plan has been worked out only the part between Yommarat Junction and Hua Mak along the Eastern Line, between Yommarat Junction and Khlong Rangsit along the Northern Line and the connecting line for SRT tracks between Hua Lamphong Yard and the planned elevated tracks at Yommarat Junction, and, at some sections, construction work is underway. However, there is no concrete plan for the sections between Makkasan and Taling Chan through Yommarat of the East-West Alignment and between Yommarat Junction and Pho Nimit. In this Feasibility Study Project, the suburban area along the improved Eastern Line will be connected with the CBD (central business district) by a commuter service through-operation between the Eastern Line and the Southern Line utilizing stations in the CBD such as Yommarat, Makkasan and Hua Lamphong (transferring at Yommarat). Therefore, unless the East-West Alignment of the Hopewell Project is completed, the proposed Eastern Line commuter service will not function sufficiently.

As provisional countermeasures, the following may be adopted, on the condition that the sections of the Hopewell Project on which the construction work already started, as mentioned above, is completed.

(a) Operation into Hua Lamphong

In case the westerly part from Makkasan of the Hopewell Project East-West Alignment is not completed, the Eastern Line commuter service may function by operating into Hua Lamphong just in the CBD. However, in the section between Yommarat Junction and Hua Lamphong, train operations of both the Eastern Line and the Northern Line will compete and at the Junction will interfere with each other. Thus, their capacity will be restricted. Room

for train operation of the Eastern Line commuter service will be limited to within 10 minutes headway in rush hours by utilizing high performance electric railcars and a reinforced signalling system in this section until demand on the Northern Line commuter service as well as trunk line service significantly increases, maybe until near the year 2010.

Proposed train operation on the Eastern Line in rush hours in 2010, which is the target year of this Project, will consist of one rapid train made up of 10 cars and one local train made up of 5 cars every 10 minutes. Therefore, if a rapid train and a local train are coupled to make up a train of 15cars at Hua Mak, the necessary capacity of train operation will not be reduced. In the Hopewell Project section, the effective length of station track layout is 500 m and enough for a electric railcar train of up to 21 cars. Thus, even though efficiency of train operation is reduced and convenience for passengers is slightly worsened because of the additional time and work necessary for coupling/uncoupling at Hua Mak, transport capacity can be maintained until near to 2010.

According to the Master Plan, improvement of the Northern Line such as electrification will be carried out at the same time with that of the Eastern Line. However, if electrification of the Northern Line is not carried out, the minimum electrification facilities necessary for the Eastern Line commuter service may be provided. This is mainly on overhead contact system on two main tracks and only two tracks (arrival track, draw-out track [Southerly part from the over bridge of Rama I Road] and No. 1 and No. 2 tracks) within Hua Lamphong Yard. Further reinforcement of the substation is not necessary.

(b) Turn back at Makkasan

An alternative is to turn back at Makkasan. This would be possible but Makkasan is located on the edge of the CBD and passengers to/from the CBD will be forced to use secondary access means for longer distances, which is not convenient and reduces the effect of this Project. Therefore, it is not recommended.

Appendix II - 2 Scope of Work and Minutes of Meeting

SCOPE OF WORK

FOR

THE STUDY

ON

AN IMPROVEMENT PLAN FOR RAILWAY TRANSPORT IN AND AROUND THE BANGKOK METROPOLIS IN CONSIDERATION OF URBAN DEVELOPMENT

IN

THE KINGDOM OF THAILAND

AGREED UPON BETWEEN

OFFICE OF THE NATIONAL ECONOMIC AND SOCIAL DEVELOPMENT BOARD

STATE RAILWAY OF THAILAND

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

BANGKOK, DECEMBER 16, 1992

Mr.Sansern Wongcha-um
ASSISTANT SECRETARY GENERAL
OFFICE OF THE NATIONAL ECONOMIC
AND SOCIAL DEVELOPMENT BOARD

Professor Yoshitsugu Hayashi
LEADER, JAPANESE PREPARATORY STUDY
TEAM, JAPAN INTERNATIONAL
COOPERATION AGENCY

Mr.Vichit Chansrakao
ASSISTANT GENERAL MANAGER
THE STATE RAILWAY OF THAILAND

I. INTRODUCTION

In response to the request of the Government of the Kingdom of Thailand (hereinafter referred to as "the Government of Thailand"), the Government of Japan has decided to conduct a Study on An Improvement Plan for Railway Transport in and around the Bangkok Metropolis in consideration of Urban Development in the Kingdom of Thailand (hereinafter referred to as "the Study"), within the general framework of technical cooperation between Japan and Thailand, which is set forth in the Agreement on Technical Cooperation between the Government of Japan and the Government of Thailand signed on November 5, 1981.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programmes of the Government of Japan, will undertake the Study, in accordance with the relevant laws and regulations in force in Japan and in close cooperation with the authorities concerned of the Government of Thailand.

The State Railway of Thailand (hereinafter referred to as "SRT") shall act as counterpart agency to the Japanese Study Team for the Study (hereinafter referred to as "the Team"). Office of the National Economic and Social Development Board (hereinafter referred to as "NESDB") and SRT shall act as coordinating bodies in relation with other relevant organizations for the smooth implementation of the Study.

The present document sets forth the Scope of Work with regard to the Study.

II. OBJECTIVES OF THE STUDY

The objective of the Study is to prepare a master plan and implementation programmes to substantially improve railway services which couple the urban developments and to realize a better modal balance for releasing chaotic road congestions and the consequent environmental damage.

III. STUDY AREA

The study area will cover the Bangkok Metropolis and the area surrounded by a radius of 200 kilometers from Hua Lamphong, but it will not include the Hopewell project area.

IV. SCOPE OF THE STUDY

In order to achieve the objective mentioned above, the Study shall cover the following items:

1. Phase I Study (Master Plan)

(1) Review all relevant studies and plans.

(2) Analyze existing information on natural conditions, socioeconomic activities, land use and urban development plans, transport systems, regional development policies and framework in the Study area.

(3) Carry out field surveys.

(4) Set up a general framework concerning future land use and transport demand in the urban areas considering major projects.

(5) Set up a general framework concerning future demand for railway services in the fringe area from a national view point.

(6) Determine requirements for improving railway transport in the study area from the urban and national view points.

(7) Analyze the effects of modal shift on congestion in the trunk road network , economic productivity and the environment.

(8) Identify urban development potentials in the influential areas of the railway transit improvement schemes.

(9) Forecast intra-urban demand and inter-regional demand for the improved railway network including newly generated demand from the other major projects and the proposed urban development. [Master Plan]

(10) Formulate railway service improvement plans.

(11) Prioritize the railway corridor(s) to be improved considering the optimum land use plan along the selected corridor(s).

2. Phase II Study (Feasibility Study)

(1) Review financing measures and typical examples of relevant railway improvement plans including implementation procedures in foreign countries.

(2) Carry out supplementary surveys.

(3) Conduct surveys on the natural conditions such as meteorology, hydrography, topography and geology, if necessary.

(4) Forecast the railway passenger and freight demand.[Feasibility study]

(5) Carry out preliminary design of railway facilities including tracks, signaling and telecommunication systems, stations and rolling stocks.

(6) The following plans are recommended to increase railway travel demand.
   1) plans for station plazas, related commercial development, land readjustment and streets.
   2) plans for access transport systems from the surrounding areas.
   3) land use development plans for the areas along the railway corridor.

(7) Prepare preliminary estimates of initial, operating and maintenance cost of railway facilities including rough cost estimate of station plazas, commercial development, land readjustment and streets.

(8) Carry out financial and economic analysis.

(9) Prepare an implementation programme(s).

(10) Conduct an environmental assessment.

(11) Recommend operation and management systems for improving railway services.

(12) Recommend financing measures which can promote the priority project(s) and also realize the whole master plan in long term.

V. STUDY SCHEDULE

The whole work will be conducted in accordance with the tentative schedule shown in the Annex.

VI REPORTS

JICA shall prepare the following reports in English and submit them to the Government of Thailand.

1. Inception Report (50 copies) will be submitted within one (1) month after the commencement of the Study.

2. Progress Report (50 copies) will be submitted within four (4) months after the commencement of the Study.

3. Interim Report I (80 copies) will be submitted within ten (10) months after the commencement of the Study.

4. Interim Report II (50 copies) will be submitted within seventeen (17) months after commencement of the Study.

5. Draft of the Final Report (100 copies) will be submitted within twenty (20) months after commencement of the Study. The Government of Thailand shall provide the JICA with its comments within two (2) months after submission of the Draft of the Final Report.

6. The Final Report (200 copies) will be submitted within two (2) months after the receipt of the comments.

VII. UNDERTAKINGS OF THE GOVERNMENT OF THAILAND

1. In accordance with the Agreement on Technical Cooperation between the Government of Japan and the Government of Thailand dated November 5, 1981, the Government of Thailand shall accord benefits to the Team as follows:

   (1) to permit the members of the Team to enter, leave and sojourn in Thailand for the duration of their assignment therein, and exempt them from foreign registration requirements and consular fees;

   (2) to exempt the members of the Team from taxes, duties and charges on equipment, machinery and other materials brought into Thailand for the conduct of the Study;

   (3) to exempt the members of the Team from income tax and other charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Team for their services in connection with the implementation of the Study;

   (4) to bear claims, if any arise, against the members of the Team resulting from, occurring in the course of, or otherwise connected with the discharge of their duties in the implementation of the Study except when such claims arise from gross negligence or willful misconduct on the part of the members of the Team.

2. To facilitate the smooth conduct of the Study, SRT shall take necessary measures in cooperation with other relevant organizations:

   (1) to seek permission for entry into private properties or restricted areas for the conduct of the Study;

   (2) to seek permission for the Team to take all data and documents (including maps, photographs) related to the Study out of Thailand to Japan;

   (3) to provide medical services as needed (Expenses will be chargeable to the members of the Team);

   (4) to ensure the safety of the members of the Team, when and as required in the course of the Study.

3. SRT shall, at its own expense, provide the Team with the following:

(1) Available data and information related to the Study;

(2) Counterpart personnel;

(3) Suitable office space with necessary equipment;

(4) Credentials or identification cards;

(5) To seek permission for aerial photograph surveying.

VIII. UNDERTAKINGS OF JICA

In order to conduct the Study, JICA shall take the following measures:

1. To dispatch, at its own expense, the Team to Thailand.

2. To pursue technology transfer to Thai counterpart personnel in the course of the Study.

IX. CONSULTATION

Both sides shall consult with each other in respect to any matter that may arise from or in connection with the Study.

Annex

TENTATIVE SCHEDULE OF THE STUDY

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Work in Thailand	———		———							—		———					—			—										
Work in Japan	—			———							—				———			———			—									
Reports presentation	△ Ic/R		△ P/RI							△ It/RI						△ IR/RII			△ DF/R				△ F/R						

Ic/R : Inception Report
P/R : Progress Report
It/RI : Interim Report I
It/RII: Interim Report II
DF/R : Draft of the Final Report
F/R : Final Report

MINUTES OF MEETING

ON

SCOPE OF WORK

FOR

THE STUDY ON AN IMPROVEMENT PLAN FOR RAILWAY TRANSPORT IN AND AROUND THE BANGKOK METROPOLIS IN CONSIDERATION OF URBAN DEVELOPMENT

IN

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Mr.Sansern Wongcha-um
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TEAM, JAPAN INTERNATIONAL
COOPERATION AGENCY

Mr.Vichit Chansrakao
ASSISTANT GENERAL MANAGER
THE STATE RAILWAY OF THAILAND

The Japanese Preparatory Study Team (hereinafter referred to as "the Team"), organized by the Japan International Cooperation Agency (hereinafter referred to as "JICA") and headed by Professor Yoshitsugu Hayashi, visited Thailand from December 6 to December 17, 1992, in connection with the Study on An Improvement Plan for Railway Transport in and around the Bangkok Metropolis in Consideration of Urban Development (hereinafter referred to as "the Study").

The Team had a series of discussions with authorities concerned in the Government of Thailand and carried out field surveys of candidate areas for the Study.

The final meeting was held on December 16, 1992, with the list of attendees attached as an Annex.

The main items discussed by both sides are as follows:

1. The Team expressed recognition of the study as follows:
   The improvement of railway transport in and around the Bangkok Metropolis is regarded as one of the most urgent issues in order for the nation to make progress in future social and economic development.

2. Both sides agreed that the existing rail transit projects in the Bangkok metropolitan area such as the Hopewell, Skytrain and Thanayong Projects will be considered to assure the consistency with this study.

3. The Steering Committee will be composed of concerned authorities and are following:
   - NESDB (National Economic and Social Development Board)
   - SRT (The State Railway of Thailand)
   - DTCP (Department of Town and Country Planning)
   - OEPP (Office of Environmental Policy and Planning)
   - ETA (Expressway and Rapid Transit Authority)
   - MRTA (Metropolitan Rapid Transit Authority)
   - NHA (National Housing Authority)
   - MOTC (Ministry of Transport and Communications)
   - DOH (Department of Highways)
   - BMA (Bangkok Metropolitan Administration)
   - OCMRT (Office of Commission for Management of Road Traffic)
   - OESD (Office of The Eastern Seaboard Development Committee)

   Other authorities will be added if necessary

4. The target year for the master plan is 2010.

5. The feasibility study will be conducted for about a 100km long railway line section(s) in total.

6. The preliminary design of stations will be carried out for two(2) to three(3) selected stations which have considerable potential for development.

7. Both sides agreed that an environmental impact assessment is to be performed under OEPP guidelines on the following items:

(1) Physical resources
- Noise/Vibration
- Surface water especially generated from construction work
- Soil erosion
- Resident removal

(2) Ecological resources
- Forest/Wild life
- Aquatic biology

(3) Land use

(4) Quality of life
- Historical
- Archaeological
- Aesthetic (Landscape)
- Socioeconomic (Resettlement)

8. The Final Report will be prepared to consist of the following separate documents:
- Executive Summary
- Main Report
- Appendix

9. The Thai side requested of the Team the following:

(1) Seminar
A one-day seminar on the findings of the study for 150 attendants (both public and private sectors) shall be held at the end of the Draft of the Final Report stage.

(2) Training in Japan
Two NESDB and Two SRT officials related to the Study shall receive a counterpart training in Japan including technical visits to railway and planning authorities in major conurbations for the approximate duration of three weeks.

10. Both sides agreed that office space for 20 members of the study team will be provided by SRT.

11. The Team requested the Thai side to issue an invitation letter for entry visas for members of the full-scale study team. SRT accepted this request.

12. The Team reqested the Thai side to pursue the organizing process for the Steering Committee. NESDB agreed to ask each authority concerned to participate in the Steering Committee and to select an appropriate representative member from each authority.

Annex ATTENDEES LIST

THAI SIDE

1. NATIONAL ECONOMIC AND SOCIAL DEVELOPMENT BOARD (NESDB)

Mr. Sansern Wongcha-um	: Assistant Secretary General
Mr. Piromsakdi Laparojkit	: Director of Infrastructure Projects Division
Mr. Kriangkrai Boonyayothin	: Chief of Transport sector, Policy & Planning Analyst
Mr. Komol Chobehveuchom	: Infrastructure Planning Specialist, Policy & Planning Analyst
Mr. Prasert Kmonwatananisa	: Policy & Planning Analyst
Mr. Sran Bunyasiri	: Policy & Planning Analyst
Miss. Suthirat Vanasrisawasd	: Policy & Planning Analyst

2. STATE RAILWAY OF THAILAND (SRT)

Mr. Vichit Chansrakao	: Assistant General Manager
Mr. Amnuay Tonmukayakul	: Superintending Engineer, Project & Planning Division, Civil Engineering Department
Mr. Prasert Attanandana	: Engineer i/c Planning Section, Project & Planning Division, Civil Engineering Department
Mr. Thiti Lertsatchayarn	: Chief of Train Operation Section, Traffic Department
Mr. Somkiat Promrat	: Chief of Passenger Traffic Section, Passenger Division, Traffic Department
Mr. Viroj Treamphongpun	: Chief of Marketing Division, Marketing Department
Mr. Supachai Dechakhum	: Chief of Information Section, Marketing Department
Mr. Suthee Ploysook	: Chief of Policy & Planning Coordination Division, Policy & Planning Bureau
Mr. Thira Ratanavit	: Chief of Marketing & Development Division, Property Management & Development Bureau
Mr. Krit Anurakamonkul	: Chief of Project Management Section, Project Development Bureau
Miss. Yawamal Chutathong	: Chief of Foreign Affairs Division, General Manager Bureau
Miss. Nantipa Wattanaparuda	: Chief of Foreign Relations Section, Foreign Affairs Division General Manager Bureau
Mr. Masamichi Takizawa	: JICA Expert to SRT

JAPANESE SIDE

1. PREPARATORY STUDY TEAM

Prof. Yoshitsugu Hayashi	: Leader of Preparatory Study Team
Mr. Takeo Takamura	: Member of Preparatory Study Team
Mr. Yasushi Kamata	: Member of Preparatory Study Team
Mr. Yoshiharu Takamura	: Member of Preparatory Study Team
Mr. Shingo Saito	: Member of Preparatory Study Team
Mr. Takao Inami	: Member of Preparatory Study Team
Mr. Masashi Oshitari	: Member of Preparatory Study Team

2. EMBASSY OF JAPAN

Mr. Hiroshi Yoneda	: Secretary
Mr. Koichi Noguchi	: Secretary

3. JICA THAILAND OFFICE

Mr. Tokuhisa Ishiwata	: Staff

(INFORMAL) MEMORANDUM

FOR

THE STUDY

ON

AN IMPROVEMENT PLAN FOR RAILWAY TRANSPORT IN AND AROUND THE BANGKOK METROPOLIS IN CONSIDERATION OF URBAN DEVELOPMENT

IN

THE KINGDOM OF THAILAND

BANGKOK, DECEMBER 16, 1992

PREPARED BY

JAPANESE PREPARATORY STUDY TEAM

(LERDER, PROFESSOR Yoshitsugu Hayashi)

JAPAN INTERNATIONAL COOPERATION AGENCY

This memorandum is tentatively prepared to describe possible matters for examination in the study.

1. Expected effects of railway improvement which couples urban developments
   (1) Linking residential areas to business and commercial districts
   (2) Linking ports, airports and other major facilities to urban activities
   (3) Shifting modes substantially from car and bus to rail
   (4) Releasing serious road congestion
   (5) Improving economic productivity
   (6) Vitalizing suburban centers of economic activities
   (7) Reducing environmental damage
   (8) Forming well planned urban areas

2. Making railways attractive
   (1) Measures to improve service level of railways
      - Frequent service is required
      - Delays in operation should be avoided
      - Measures to increase train operation speed are to be examined
        (e.g.)
        by double tracking, elevating tracks, improving signalling systems, introducing new rolling stocks
   (2) Measures to improve accessibility
      - Access transport to the stations is to be provided in suburban residential areas.
      - Opening new stations and provision of access services are necessary for existing residential agglomerations and new towns.
      - Feeder service from the Hua Lamphong station to downtown business districts is to be provided by measures which include the connecting of new rail transit systems such as Skytrain and Thanayong, restructuring bus routing and introducing new limousine services.
   (3) Measures to improve rolling stocks
      - New attractive rolling stocks should be introduced to effect a change in the car user's image of trains.

3. Effectively utilizing lands owned by SRT and the areas in the vicinity of stations
   (1) Residential development around the stations located 15 to 50 km from Hua Lamphong are to be examined
   (2) Commercial property developments are to be examined in the station sites in suburban centers of the Bangkok metropolitan area such as Chachoengsao and Bang Bamru.
   (3) Package development(s) of commercial and residential areas are also to be examined near appropriate stations.

4. Financing

(1) Measures to internalize the external benefit of railways

- Property development projects are to be promoted in the land owned by SRT in the vicinity of stations
  (e.g.)
  station buildings containing shopping centres, hotels, offices, etc.
  car and bicycle parking houses
- Developer fee for the developments carried out in the areas in the vicinity (e.g. in 3 km distance) of stations are to be established
- Pre-purchase right of land in the vicinity of stations and tracks is to be given to SRT

(2) Measures for public funding

- Establishment of ear marked tax through fuel, car registration and car tonnage and the usage for long-term continuous improvement of rail transit is to be examined from the view point of comprehensive transport planning and environmental considerations
- Railway improvement projects should appeal to international public funds from the view point of improvement of the environment

5. Roles of public and private sectors

The role of public and private sectors in financing and enforcing the projects are to be examined.

Note:

(1) The Phase I Study is expected to finish in ten (10) month time and its result , i.e. the Master Plan, will be included in the Interim Report I.

(2) The Phase II Study is expected to finish in twenty three (23) month time and its result , i.e. the Implementation Programme, together with the Master Plan will be included in the Final Report.

MINUTES OF MEETING

ON

FIRST STEERING COMMITTEE

FOR

THE STUDY ON AN IMPROVEMENT PLAN FOR RAILWAY TRANSPORT

IN AND AROUND THE BANGKOK METROPOLIS IN

CONSIDERATION OF URBAN DEVELOPMENT

IN

THE KINGDOM OF THAILAND

AGREED UPON BETWEEN

OFFICE OF THE NATIONAL ECONOMIC AND SOCIAL DEVELOPMENT BOARD

STATE RAILWAY OF THAILAND

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

BANGKOK, OCTOBER 4, 1993

Mr. Sansern Wongcha-Um
Chairman of the Steering Committee
Office of the National Economic
and Social Development Board

Dr. Misao Sugawara
Team Leader
JICA Study Team

Mr. Thasanai Chantarangkul
Assistant General Manager
The State Railway of Thailand

MINUTES OF MEETING
ON
THE FIRST STEERING COMMITTEE MEETING
3RD FLOOR, OPERATION ROOM, SRT
OCTOBER 4, 1993 AT 2.00 - 4.00 P.M.

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1. Opening speech given by the Chairman.

2. Introduction of the Steering Committee Members.

3. Introduction of the JICA Study Team Members.

4. Discussion among the Steering Committee Members to understand the objectives and scope of work for this project.

5. Dr. Sugawara explained the scope of work, working schedule and study approach.

6. Mr. Tanaka gave a presentation on the "Concept of an Integrated Urban and Railway Development System (IURD)", which was supported, having the following comments:

7. Comments

Dr. Utis (NESDB):

- The preference of passengers in selecting the mode of travel should be identified (refer to High Speed Train Project).
- The shift percentage from private vehicles to railway should be determined.
- Referring to Figure 5, universities, government offices, industrial estates and new towns can be expanded up to 100 km, if the train speed can be 100 km/h.
- Cost recovering methods should also include the land readjustment as an alternative.
- How to make the cost recovering methods practicable in Thailand?
- For IURD zone, priority should be given to the north and east.
- A study on Land Management and Profit Sharing Schemes should be carried out.

7. Comments (Cont.)

Khun Sansern (NESDB):

- The first priority of IURD zone should be allocated to the Eastern Seaboard Development area.
- Additional information on behavior of trip makers could be obtained from Dr. Kamropluk, OCMRT.

Khun Piromsakdi (NESDB):

- What will affect this approach JICA Study Team if three MRT projects will not be realized as planned?
- Will new railways be considered/proposed?

Khun Thasanai (SRT):

- General taxation as an alternative of cost recovering may not be applicable in Thailand.
- Methods used for cost recovering in the western countries should be investigated.

Dr. Prapon (BMA):

- Somethings (concerning cost recovering methods), which are presently thought not applicable, might be applicable in the future. At this moment, the JICA Study Team should not be disencourage in carrying out the study.
- Regarding the questionnaire survey form to be used for traffic demand forecast, the question on demand elasticity with subject to fare should be incorporated.

Minutes of Meeting on the Interim Report (I)
for the Study on an Improvement Plan for Railway Transport
in and around the Bangkok Metropolis
in Consideration of Urban Development
in the Kingdom of Thailand

The JICA Study Team arrived in Bangkok on January 17, 1994 to hold consultations with the concerned personnel of the Thai Government concerning the Interim Report (I) on "The Study on an Improvement Plan for Railway Transport in and around the Bangkok Metropolis in Consideration of Urban Development in the Kingdom of Thailand".

On January 19 and 20, the Study Team held a workshop for the Thai counterparts, and gave explanation to and had discussions with them about the Interim Report (I). On January 24, the Study Team together with the membefs of the JICA Advisory Committee and JICA staff gave explanation to and held discussions with the Steering Committee of the Thai Government.

The Study Team submitted to the Steering Committee 50 copies of the Interim Report (I). The Steering Committee expressed their appreciation for the efforts of the JICA Study Team in drawing up the Report.

Major items relating to the Interim Report (I) were raised as follows :

1. Both sides agreed that a Master Plan for the integrated implementation of urban development and railway improvement should be drawn up, on the basis of the basic principles and strategies described in the Interim Report (I).
2. JICA Study Team pointed out that the pre-condition of this study is that the on-going three MRT projects will be completed as scheduled. The Steering Committee requested the JICA Study Team to propose the possible alternatives in the case that the Hopewell Project will not be completed as scheduled or will not be materialized.

M.S. Y.H.

The JICA Study Team explained that the countermeasures to be taken by SRT are described in the Interim Report (I).

3. The Steering Committee requested the JICA Study Team to coordinate with the other four relevant studies, including Strategic Planning for Metropolitan Bangkok; Bangkok Metropolitan Region Structure Plan Development; Infrastructure Surrounding the Second Bangkok International Airport, and High Speed Train.

   The JICA Study Team requested the Steering Committee to submit any available information related to above mentioned projects.

4. The Steering Committee requested to the JICA Study Team to submit the reports two weeks in advance so that they can have sufficient time to review.

5. The Steering Committee requested:

   (1) For each stage of railway improvement, the followings should be specified :

   - time required
   - area
   - cost/financing method
   - expected results
   - other related information required from F/S in phase II

   (2) For IURD, the followings should be identifled :

   - area/location and priority
   - cost
   - financing method

   (3) The study should be concentrated in the eastern and western areas.

6. The Study Team requested the Steering Committee to give additional comments, if any, by February 10, 1994. The Steering Committee agreed.

Bangkok, 25 January 1994

Mr. Sansern Wongcha-um
Senior Advisor in Planning
Office of the National Economic
and Social Development Board

Dr. Misao Sugawara
Leader of the Study Team
Japan International Cooperation
Agency

Mr. Thasanai Chantarangkul
Assistant General Manager
The State Railway of Thailand

Professor Yoshitsugu Hayashi
Chairman of Advisory Committee
Japan International Cooperation
Agency

Minutes of Meeting on the Interim Report (II)
for the Study on an Improvement Plan for Railway Transport
in and around the Bangkok Metropolis
in Consideration of Urban Development
in the Kingdom of Thailand

The JICA Study Team stayed in Bangkok from August 3 to August 12, 1994. During this period, the Study Team held series of discussion with the concerned personnel of the Thai Government, concerning the Interim Report (II) on " The Study on an Improvement Plan for Railway Transport in and around the Bangkok Metropolis in Consideration of Urban Development in the Kingdom of Thailand ".

The Study Team submitted to the Steering Committee 80 copies of the Interim Report (II). The Steering Committee expressed their appreciation for the effort of the JICA Study Team in drawing up the useful report.

Major items raised relating to the Interim Report (II) were as follows:

1. Thai side generally accepted the Master Plan of integrated urban development and railway improvement proposed by the Study Team.

2. Both sides showed common understanding on the fact that Hopewell project is essential for successful implementation of the Integrated Urban Development and Railway Improvement project, and Thai side expressed that Hopewell project could be implemented following the original schedule.

3. Both sides agreed to take the development of the section from Hua Mak to Chon Buri of the Eastern Line and its branch line to the SBIA (approximate total length of 100km) as the priority project for the feasibility study.

4. The Steering Committee requested the Study Team to show some examples of railway oriented urban development plan in the feasibility study without limiting the area to the "100ha" prescribed in the Inception Report. It was also requested to examine the land use plan covering the whole subject area. The area where the NHA has a plan of development is expected to be included. The Study Team expressed the intention to take into consideration these requests in the next stage of the study .

5. For the feasibility study of the Eastern Line, JICA Study Team agreed to carry out the following tasks requested by the Steering Committee:

(1) To conduct an Environmental Impact Assessment (EIA) according to the Thai legislation.

(2) To recommend an appropriate institution, method and size etc. for the subsidization to the railway improvement including utilization of the development benefit.

(3) To review the investment cost of the branch line to the SBIA. to implement the detailed financial analysis of the said line.

(4) To recommend the most appropriate connection line to SBIA among the three projects of the High Speed Train (HST) Project, the extension of existing SRT line and the extension of one of the urban rapid transit systems.

(5) To take into consideration the Master Plan of Mass Rapid Transit (MRT) systems in Bangkok and its surrounding areas prepared by the OCMRT.

(6) To review the ridership forecasts, especially for the branch line to SBIA, by taking into account the following items:

1) different fare levels and moving rates

2) different scenarios of population growth and personnel income

6. The JICA Study Team requested the Steering Committee to provide the latest information of the relevant transport projects to be used as basic data for the feasibility study of the Eastern Line.

Bangkok, 11 August 1994

Mr. Sansern Wongcha-um
Senior Advisor in Planning
Office of the National Economic
and Social Development Board

Dr. Misao Sugawara
Leader of the Study Team
Japan International Cooperation Agency

Mr. Thasanai Chantarangkul
Assistant General Manager
The State Railway of Thailand

Professor Yoshitsugu Hayashi
Chairman of Advisory Committee
Japan International Cooperation Agency

Minutes of Meeting
of 4th Steering Committee
for
the Study on an Improvement Plan for Railway Transport
in and around the Bangkok Metropolis
in Consideration of Urban Development
in the Kingdom of Thailand

The JICA Study Team has started the Feasibility Study in Thailand on 6 October 1994 and has submitted 30 copies of report on the Initial Plan of the Integrated Urban and Railway Development including the urban and railway sectors to the Steering Committee.

On 29 November 1994, the Study Team made a presentation to the Steering Committee on the aforementioned initial plan which finally came to the common understanding between both parties.

The major topics discussed in the Steering Committee meeting are summarized as follows:

1 Population Distribution within 50 km Radius

The Steering Committee committed to consider in more details regarding the population distribution, particularly the allocation of population to Lat Krabang West and East New Towns. The population distribution will be finalized as soon as possible in order not to delay the ridership forecast, and other related tasks.

2 Right of way Provided by the Hopewell Project

It is recognized that the right of way of the SRT railways provided in the Hopewell section is vital for the implementation of the proposed improvement plan of the SRT Eastern line, especially in terms of transport capacity and operation.

3. Flooding Problem

It is stressed that special attention must be paid to the flooding problem inherent to the eastern corridor, for population distribution, specifically the location of new towns.

Bangkok, 30 November 1994

Mr. Sansern Wongcha-um
Senior Advisor in Planning
Office of the National Economic
and Social Development Board

Dr. Misao Sugawara
Leader of the Study Team
Japan International Cooperation Agency

Mr. Amnuay Tonmukayakul
Superintending Engineer, Project Development Center
Deputy Project Manager
State Railway of Thailand

MINUTES OF MEETING

OF

THE FIFTH STEERING COMMITTEE

FOR

THE STUDY ON AN IMPROVEMENT PLAN FOR RAILWAY TRANSPORT

IN AND AROUND THE BANGKOK METROPOLIS

IN CONSIDERATION OF URBAN DEVELOPMENT

IN

THE KINGDOM OF THAILAND

AGREED UPON BETWEEN

OFFICE OF THE NATIONAL ECONOMIC AND SOCIAL DEVELOPMENT BOARD

STATE RAILWAY OF THAILAND

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

BANGKOK, JUNE 6, 1995

Mr. Sansern Wongcha-Um
Deputy General Secretary
Office of the National Economic and
Social Development Board

Dr. Misao Sugawara
Team Leader
JICA Study Team

Mr. Thasanai Chantarangkul
Assistant General Manager
The State Railway of Thailand

Prof. Yoshitsugu Hayashi
Chairman of the Advisory
Committee

MINUTES OF MEETING
OF
THE FIFTH STEERING COMMITTEE MEETING
THIRD FLOOR, OPERATION ROOM, SRT
JUNE 5, 1995 AT 1:30-4:00 P.M.

The JICA Study Team stayed in Bangkok from May 30 to June 7, 1995, and has submitted 50 copies of the Interim Report (III) to the Steering Committee.

On June 5, 1995, the Study Team made a presentation to the Steering Committee on the Interim Report (III) which came to the common understanding between both parties.

The major topics discussed in the Steering Committee meeting are summarized as follows:

1. Thai Side asked about the connecting line to the SBIA (Second Bangkok International Airport) in the case that the High Speed Rail (HSR) Project would be materialized by the government. It was agreed that SRT and HSR studies would be carried out independently.

2. Thai Side asked about the modal split between rail and road transport of commuters from/to new towns. The Study Team explained that it would be determined as a result of calculation by the modal split model and that it would be incorporated into the Draft Final Report.

3. Thai Side requested that other methods of urban development, in addition to the land readjustment, should also be considered. The Study Team explained that, as one of the most needed measure, land readjustment was proposed not denying other measure method for urban development of the core area.

4. Thai Side noted that the plan and programmes presented in the Interim Report (III) are most appreciable. However, more attention should be paid to the phasing, timing and invest cost of the development in the course of implementation.

Y.H.

MINUTES OF MEETING
OF
THE SIXTH STEERING COMMITTEE
FOR
THE STUDY ON AN IMPROVEMENT PLAN FOR RAILWAY TRANSPORT
IN AND AROUND THE BANGKOK METROPOLIS
IN CONSIDERATION OF URBAN DEVELOPMENT
IN
THE KINGDOM OF THAILAND

AGREED UPON BETWEEN
OFFICE OF THE NATIONAL ECONOMIC AND SOCIAL DEVELOPMENT BOARD
STATE RAILWAY OF THAILAND
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

BANGKOK, AUGUST 23, 1995

MR. Sansern Wongcha-Um
Deputy Secretary-General
Office of the National Economic and
Social Development Board

Dr. Misao Sugawara
Team Leader
JICA Study Team

Mr. Amnuay Tonmukayakul
Superintending Engineer,
Project Development Center
Deputy Project Manager
State Railway of Thailand

Prof. Yoshitsugu Hayashi
Chairman of the Advisory
Committee

MINUTES OF MEETING
OF
THE SIXTH STEERING COMMITTEE MEETING
THIRD FLOOR, RAILWAY CLUB BUILDING, SRT
AUGUST 23, 1995

The JICA Study Team stayed in Bangkok from August 16 to August 24, 1995, and has submitted 100 copies of the Draft Final Report to the Steering Committee for discussion, which was finally approved with their appreciation expressed to the Japanese technical cooperation. The Steering Committee committed itself to inform the Study Team, not later than September 21, 1995, of the comments of the concerned agencies which should be screened through the committee including the following items of discussions, among others, made in the Seminar held on August 21, 1995.

1. OCMRT proposed to incorporate, in addition to SRT, appropriate agencies such as NHA into the Urban Development Corporation.
2. NHA new town development, which has been already incorporated into the proposed integrated urban and railway development plan
3. Railway transport system in the city including capacity of track and connection with the planned MRT, which have already been examined in the Draft Final Report

In addition to the above comments, a seminar to appeal the importance of the project is proposed and a full financial/technical support by J I CA is also requested.

AM.
M.S
Y.H.