JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) NATIONAL HOUSING AUTHORITY (NHA)

THE STUDY FOR URBAN REDEVELOPMENT PLAN AND CASE STUDY IN THE BANGKOK METROPOLITAN AREA IN THE KINGDOM OF THAILAND

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FINAL REPORT

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ABBREVIATIONS

AC	Asbestos Cement
BCR	Building Coverage Ratio
BMA	Bangkok Metropolitan Administration
BMR	Bangkok Metropolitan Region
BOD	Biochemical Oxygen Demand
BTS	Bangkok Transit System
CAT	Communication Authority of Thailand
CBD	Central Business District
CI	Cast Iron
DCP	Department of Public Cleansing
DDS	Department of Drainage and Sewerage
DI	Ductile Iron
DMH Areas	Din Daeng, Makkasan, and Huai Khwang Areas
DO	Dissolved Oxygen
DOH	Department of Highway
DPC	Department of Public Cleansing
DS	Dry Solids
DSCV	Dry Solid Calorific Value
DTCP	Department of Town and Country Planning
DWF	Dry Water Flow
EGAT	Electricity Generation Authority of Thailand
EIA	Environmental Impact Assessment
ETA	Expressway and Rapid Transit Authority of Thailand
FAR	Floor Area Ratio
FY	Fiscal Year
GDP	Gross Domestic Product
GI	Galvanized Iron
GIS	Geographic Information System
GPP	Gross Provincial Product
IEE	Initial Environmental Examination
IMF	International Monetary Fund
JBIC	Japan Bank of International Cooperation
JICA	Japan International Cooperation Agency
LLC	Lowest Lower Class
LMC	Lowest Middle Class
M/M	Minutes of Meeting

MEA	Metropolitan Electricity Authority
MLC	Medium Lower Class
MMC	Medium Middle Class
MOI	Ministry of Interior
MOSTE	Ministry of Science, Technology, and Energy
MOTC	Ministry of Transport and Communications
MRTA	Metropolitan Rapid Transit Authority
MSL	Mean Sea Level
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
MWA	Metropolitan Water Supply Authority
NESDB	National Economic and Social Development Board (NESDB)
NHA	National Housing Authority
NIES	Newly Industrializing Economies
NSCD	Night Soil Control Division
NSTP	Night Soil Treatment Plant
OCMLT	Office of the Commission for the Management of Land Traffic
Pb	Plumbum
PB	Polybutylene
PC	Prestressed Concrete
PE	Polyethelene
PEA	Provincial Electricity Authority
PVC	Polyvinyl Chloride Pipe
RID	Royal Irrigation Department
S/W	Scope of Work
SO ₂	Sulfur Dioxide
SP	Steel Pipe
SRT	State Railway of Thailand
SS	Suspended Solids
STS	Sewerage Treatment System
TOT	Telecommunication Organization of Thailand
TSP	Total Suspended Particles
UFW	Unaccounted-for water
ULC	Upper Lower Class
ULC	Upper Lower Class
UMC	Upper Middle Class
UTDM	Urban Transportation Distribution Model
VAT	Value Added Tax
WQMC	Water Quality Management Center

WQMD	Water Quality Management Division
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

MEASUREMENT UNITS

Extent

- $cm^2 = Square-centimeters$ $m^2 = Square-meters$ $km^2 = Square-kilometers$ ha. = Hectares (10,000 m²)
- rai = 0.16 Hectares

mm = Millimeters

wah = 2 Meter

cm = Centimeters (cm = 10 mm)

km = Kilometers (km = 1,000 m)

m = Meters (m = 100 cm)

Length

- Volume
- $cm^3 = Cubic-centimeters$ $m^3 = cu.m = Cubic-meters$ l = Liter

Weight

g	=	Grams
kg	=	Kilograms
ton, t	=	Metric tonne
μ g	=	Micrograma (= Millionths of a
		gram)

Energy

kcal	=	Kilocalories
kW	=	Kilowatt
MW	=	Megawatt
kWh	=	Kilowatt-hour
MWh	=	Megawatt-hour
GWh	=	Gigawatt-hour
MVA	=	Mega Volt Ampere
V	=	Volt

kV = Kilovolt

Others

%	=	Percent
^{0}C	=	Degree Celsius
MPN	=	Most Probable Number
dB	=	Decibel
pcu	=	Passenger Car Unit
l/c/d	=	Litter per Consumer per Day

Time

sec, s	=	Seconds
min	=	Minutes
h, hr	=	Hour
d	=	Day

APPENDIX-1: EXISTING PLANS FOR ROAD NETWORK DEVELOPMENT

In the following, currently projected roads are presented in accordance with proposal of each organization related to road network development in Bangkok. These roads are all taken into consideration for the master planning work of URMAP conducted by OCMLT.

A1.1 ROADS PROPOSED BY ETA



Plan of Road Network Projects by ETA

Source: URMAP

Code No	Project	2000	2004	2011	2019
ETA's Project					
ETA01-D	Second Stage Expressway (Part D)		0	0	0
ETA02	Ram Indra - At Narong	0	0	0	0
ETA03-N1	Third Stage Expressway North (N1)			0	0
ETA03-N2-1	Third Stage Expressway North (N2-1)		0	0	0
ETA03-N2-2	Third Stage Expressway North (N2-2)			0	0
ETA03-N3	Third Stage Expressway North (N3)			0	0
ETA03-S1	Third Stage Expressway South (S1)		0	0	0
ETA03-S2	Third Stage Expressway South (S2)			0	0
ETA04	Up Ramp and Down Ramp of First Stage Expressway Improvement	0	0	0	0
ETA05	Bang Na-Bang Phli-Bang Pa Kong	O*	0	0	0

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Code No	Project	2000	2004	2011	2019
ETA06	Phayathai-Outer Ring			0	0
ETA07	Cheang Watthana-Bang Poon-Bang Sai	O*	0	0	0
ETA10	Dao Kanong-Bang Khun Thian-Samut Sakorn		0	0	0
ETA16-1	Fourth Stage Expressway			0	0
ETA16-2	Ram Indra-Outer Ring		0	0	0

A1.2 ROADS PROPOSED BY PWD



Plan of Road Network Projects by PWD

Source: URMAP

List of Road Network Projects by PWD

Code No	Project	2000	2004	2011	2019
PWD's Project					
PWD01	Tak Sin-Phetkasem		0	0	0
PWD02	New Krung Thep Bridge	0	0	0	0
PWD03	Wat Nakorn Inn Bridge		0	0	0
PWD04	Pak Kret Bridge		0	0	0
PWD05-a	Nonthaburi Bypass		0	0	0
PWD05-b	Nonthaburi Bypass-Sanam Bin Nam		0	0	0
PWD05-c	Sanam Bin Nam-Second Stage Expressway		0	0	0
PWD05-d	Pak Kret Bypass			0	0
PWD06	Sukhumvit 107 Improvement		0	0	0
PWD07	Wat King Kaew-Rattana Kosin			0	0
PWD09	Ta Nam Non-Ratchawithi-Nakhon Chaisri		0	0	0
PWD10	Tak Sin-Phetkasem (to ORR)		0	0	0

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Code No	Project	2000	2004	2011	2019
PWD12	Tak Sin-Phetkasem and Rama II			0	0
PWD13	Tak Sin-Phetkasem-Fourth Stage Expressway			0	0
PWD14	Rama II-Nakhon Khuan Khun			0	0
PWD25	New Krung Thon Bridge		0	0	0
PWD26	Industrial Ring Road		0	0	0

A1.3 ROADS PROPOSED BY DOH



Plan of Road Network Projects by DOH

Source: URMAP

List of Road Network Projects by DOH

Code No	Project	2000	2004	2011	2019
DOH's Project					
DOH01-a	Extension of DMT to Don Muang Airport	0	0	0	0
DOH01-b	Extension of DMT from Don Muang – Rangsit	0	0	0	0
DOH02	Bangkok-Chon Buri (Srinakarin-Onnutch)		0	0	0
DOH03	Bang Bua Thong-Bang Khun Thian		0	0	0
DOH04	Southern Outer Ring (Bang Khun Thian-Suksawat)		0	0	0
DOH05	Eastern Outer Ring (Bang Prain-Route No.36)		0	0	0
DOH06	Eastern Outer Ring (Route No.36-Route No.34)		0	0	0
DOH07	Southern Outer Ring (Suksawat-Bang Na)		0	0	0
DOH08	Motorway (Bang Yai-Ban Pong)		0	0	0
DOH10	Samrong-Samut Prakarn		0	0	0
DOH11	Kasetsart University-Kaelie (Section I)		0	0	0
DOH12	Kasetsart University-Kaelie (Section II)		0	0	0

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Code No	Project	2000	2004	2011	2019
DOH13	Dao Kanong-Phrapradang		0	0	0
DOH14	Lak Si-Pak Kret		0	0	0
DOH15	Lak Si-Nakhon Nayok (Section I)		0	0	0
DOH16	Rama VI-Kaelie-Pak Kret		0	0	0
DOH17	Samrong-Ta Hin-Pu Chao		0	0	0
DOH18	Lad Krabang-Min Buri		0	0	0
DOH20	Bang Bon-Ring Road			0	0
DOH21	Route No.35-Samut Sakorn (Section 1)		0	0	0
DOH22	Bang Phli-Lad Krabang		0	0	0
DOH23	Thephrarak Road		0	0	0
DOH24	Phetkasem-Buddhamonthol		0	0	0
DOH25	Phahonyothin-Lamlukka		0	0	0
DOH28	Pathum Thani-Ladlukkaew-Banglane (Section I)		0	0	0
DOH29	Pathum Thani-Ladlukkaew-Banglane (Section II)		0	0	0
DOH30	Route No.346-Outer Ring		0	0	0
DOH31	Thon Buri Sai 35-Paktho (Dao Kanong-Outer Ring)		0	0	0
DOH33	Buddhamonthol Sai2-Nakhon Chaisri Sai 338			0	0
DOH40	Ram Indra Tunnel	0	0	0	0
DOH71	Ratchadaphisak-Ram Indra			0	0
DOH72	Kasetsart University-Sukha Piban 1			0	0
DOH74	Liab Khlong Prapa Sai 3000		0	0	0
DOH75	Wang Noi-Thunya Buri-Lumlukka		0	0	0
DOH	DOH Local Road	0	0	0	0

A1.4 ROADS PROPOSED BY BMA



Plan of Road Network Project by BMA

Source: URMAP

List of Road Network Project by BMA

Code No	Project	2000	2004	2011	2019
BMA02	Naratiwat	0	0	0	0
BMA03	North-South (Sathon-Rama III)		0	0	0
BMA04	Arum Amarin-Prachathipok		0	0	0
BMA06	Sukhumvit 77-Sukhumvit 103		0	0	0
BMA07	North-South (Si Praya-Suri Wong)		0	0	0
BMA08	Krung Thep Kritha Road Improvement		0	0	0
BMA09	Phran Nok-Buddhamonthol Sai 4			0	0
BMA10	Aksa	0	0	0	0
BMA11	Buddhamonthol Sai 1			0	0
BMA12	Buddhamonthol Sai 3			0	0
BMA13	Ekamai-Ram Indra	0	0	0	0
BMA14	Ram Kham Haeng-Phattanakan		0	0	0
BMA15	Ram Kham Haeng-Phattanakan (Ram Kham Haeng 24)		0	0	0
BMA16	Sathu Pradit-Rama III		0	0	0
BMA19	Liabkhong Bang Kapi		0	0	0
BMA20	Rama II-Suksawat		0	0	0
BMA21	Sukhumvit 77 Road Improvement		0	0	0
BMA27	Rama III Road Improvement		0	0	0
BMA30	Bang Waek Road Improvement		0	0	0
BMA44A	Sukhumvit 105 Road Improvement	0	0	0	0
BMA44B	Sukhumvit 103-Phattanakan		0	0	0

Code No	Project	2000	2004	2011	2019
BMA44C	Phahonyothin-Rattana Kosin		0	0	0
BMA44D	Song Prapha Road Improvement		0	0	0
BMA44E	Rattana Kosin-Nimitmai		0	0	0
BMA45	Sukha Piban 3 Road Improvement		0	0	0
BMA50	Liab Khlong Thawi Watthana Road Improvement		0	0	0
BMA51A	Nimit Mai Widenning (Section A)		0	0	0
BMA51B	Nimit Mai Widenning (Section B)		0	0	0
BMA52	Chao Khun Thahan		0	0	0
BMA53	Phuttha Bucha		0	0	0
BMA115	Kamphaeng Phet 2 Road Improvement		0	0	0
BMA118	Liab Khlong Premprachakon		0	0	0
BMA119	Paeng Luang		0	0	0
BMA120	Chalong Krung Road Improvement		0	0	0
BMA123	Road Underneath Second Stage Expressway (From Victory Monument)		0	0	0
BMA124	Liab Bung Mak Ka San		0	0	0
BMA125	Soi Na Na Improvement	0	0	0	0
BMA126	Road Underneath Second Stage Expressway (From Kamphaeng Phet 2)		0	0	0
BMA130	Road Underneath First Stage Expressway (From Pracha U-thit)		0	0	0
BMA137	Rama VIII Bridge		0	0	0
BMA139	Sai Mai		0	0	0
BMA141	Lad Phrao-Din Daeng		0	0	0
BMA142	Ratchada Phisek-Sukhumvit		0	0	0
BMA145	Wireless-Ratchada Phisek		0	0	0
BMA146	Rama IV-Sukhumvit 26		0	0	0
BMA147	Rama IV-Sukhumvit 42		0	0	0
BMA148	Tak Sin-Charoen Nakhon-Thet Thai		0	0	0
BMA149	Indra Pitak-Isra Phap		0	0	0
BMA150	Isra Phap-Charan Sanit Wong		0	0	0
BMA151	Tak Sin-Rama II		0	0	0
	Srinakarin/Pattanakan Flyover		0	0	0
	Sinakarin/Sukhumvit 77 Flyover		0	0	0
	Sinakarin/Sukhumvit 103 Flyover		0	0	0
	Ramkamhaeng Flyover	0	0	0	0

* Partially Opened

(Million Baht (GPP) Baht (Income))

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APPENDIX 2: DEVELOPMENT POTENTIAL OF THE STUDY AREA

In this section, development potential of the Study Area will be examined in the aspect of commercial establishment and business offices based on the population and macro-economic forecast with the socio-economic trend and current urban structure of Bangkok as the background.

A2.1 Macro Analysis

(1) General

In this Study, macro economic framework of BMA with regard to GPP, consumer price and household income were set down as summarized in the following table

							-		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
ltem	1992	1994	1996	1998	1999	2000	2005	2010	2015	Avg. Growth Rate (1992-200 0)
G P P. (1988	917,560	1,080,736	1,204,133	1,007,930	1,050,475	1,096,696	1,360,157	1,686,908	2,092,155	
prices)	-	(6.0%)	(4.0%)	(-13.7%)	(4.2%)	(4.4%)	(4.4%)	(4.4%)	(4.4%)	(2.3%)
Household income	15,951	16,418	21,947	24,929	26,742	24,690	34,420	47,985	66,896	
(Current)	(16.6%)	(1.5%)	(15.6%)	(6.6%)	(7.3%)	(-7.7%)	(6.9%)	(6.9%)	(6.9%)	(5.6%)
Household income	17,490	16,418	19,613	19,645	20,995	19,184	21,461	24,008	26,858	
(1994 prices)	(11.6%)	(-3.1%)	(9.3%)	(0.1%)	(6.9%)	(-8.6%)	(2.3%)	(2.3%)	(2.3%)	(1.2%)
General consumer	91.2	100.0	111.9	126.9	127.4	128.7	160.4	199.9	249.1	
price index (1994=100)	(4.5%)	(4.7%)	(5.8%)	(6.5%)	(0.4%)	(1.0%)	(4.5%)	(4.5%)	(4.5%)	(4.4%)

Macro Economic Framework of BMA

Note: 998 GPP is preliminary record.

1999 and 2000 GPP are preliminary records of GDP.

General consumer price indexes are the figures of BMR.

Household incomes are the figures of Greater Bangkok.

2000 General consumer price is the figure in January 2000.

() shows average of annual growth rates.

Source: GPP.) Gross Provincial Product of Thailand 1998 Edition, NESDB (GDP.) National Income of Thailand 1999 Edition, NESDB (Population) Population Projections for Thailand 1990-2020, NESDB

(Household income) Household Socio-Economic Survey, NSO (General consumer price index) Price Indexes of Thailand, MOC

(2) Assumed Conditions

Assuming the socio-economic structure of Bangkok to transform to a stable growth stage from now on after the rapid economic growth and currency crisis in the 1980-1990s, various macro economic indexes during the period of 2000 - 2015 were set down as given below.

1) G.P.P

Annual G.P.P growth rate was assumed to be 4.4% (net). This rate corresponds to that of G.N.P in 1999 and 2000 in Thailand when the economy began to turn around. It is noted that UTDM assumes the growth rate at 4.3% (net).

2) Inflation Rate

Annual consumer price index hike was assumed to be 4.5% (net). This figure has been selected referring to the actual index hike during 1992 thru 2000 and the 4.5% hike rate assumed in Eighth National Socio-Economic Development Plan.

3) Household Income

-Average of Household Income

Annual average growth rate of household income in Greater Bangkok was assumed to be 2.3% (net) in reference to those of G.P.P and inflation rate. As a result, average household income during 2000 thru 2015 will increase 1.4 times, from 19,184 Baht/house/month to approx. 27,000 Baht/house/month (1994 price level. Nominal income: 24,690 Baht/house/month - 67,000 Baht/house/month).

It is noted that in assuming the average growth rate of household income, growth rate ratio between G.P.P and household income (0.52: actual during 1992 - 2000) was employed.

-Distribution of Household Income

NESDB has forecasted a distribution of household income during 2002 - 2006 in its Ninth National Socio-Economic Plan. In this Study, distributions up to the year 2015 were assumed applying 2.3% growth rate (net) following the classification set down by NESDB starting at the year 2002. The result shows that a group

earning household income of over 50,000 Bat/month in 2002 which accounts for a slightly over 10% will increase close to 20% in the year 2015 (all in 2002 price level).

Percentile		2002	2005	2010	2015
10	Less than	6,616	7,083	7,935	8,891
20	н	9,251	9,905	11,098	12,434
30	н	11,915	12,756	14,291	16,012
40	н	13,986	14,974	16,776	18,797
50	н	17,075	18,281	20,481	22,947
60	н	20,675	22,135	24,801	27,788
70	н	27,596	29,544	33,101	37,087
80	н	36,285	38,847	43,525	48,766
90	н	52,144	55,825	62,548	70,081
100	and over	52,144	55,825	62,548	70,081

Distribution of Household Income in BMR (2002-2015)

Source: (Y2002) Social-Economic 9th Plan, NESDB

Note: Figures in 2005-1015 are forecasted by the Study assuming annual growth rate 2.3%.

A2.2 DEMAND FORECAST

Demand forecasting for commercial facility and office floor in the Study Area was carried out based upon the socio-economic trend in BMA as described hereunder. The forecasting was carried out about development potential at the time of start of operation and thereafter focusing in the years 2010 and 2015

A2.2.1 Population and Number of Household

(1) General

Population forecast was conducted using Cohort Component Method based upon the forecast of population and number of household in BMA and the Study Area. Two cases of social movement pattern were examined; one according to the forecast by NESDB and the other the trend of Census Population

As a result, number of population in BMA will stay unchanged and that in the year 2015 was forecasted to be 8.1 million.

In the Study Area, as influx of population is expected owing to the urban redevelopment activities, number of population will turn to increase, reaching 246.8 thousand by 2015.

(2) Outline of Forecasting

-Population -

Population forecast was conducted using Cohort Component Method based upon the Census Population in 1990 and 2000 dividing them into 5-year age grades and in 5 yeas period intervals.

For natural movement of population, fertility and survival rate, "Population Projections for Thailand 1990-2020", March.1995, Human Resources Planning Division, NESDB was referred to.

For social movement of population, migration rate, an assumption was made by deducting natural variation portion from the overall variation during 1995- 2000. It is noted that Census Population in 1995 was assumed based on the variation trend of Registered Population.

Population forecasts by Cohort Component Method in Districts were obtained in proportion to the populations in each in coordination with the result of BMA

-Number of Household-

Concerning the number of household, regression analysis was performed on the basis of variation in number of family members during 1970- 2000 period. Numbers of household in the future were obtained by dividing the total population by the number of family members thus estimated.

(3) Outline of Forecast

In BMA, during the1990s, rate of emigration of older generation toward surrounding provinces or suburban areas was larger than that of immigration of young generation toward urban areas from rural regions. This trend is understood to remain the same for some time to come. Coupled with the current trend of producing less number of children among young families, population growth has been kept oppressed.

In view of these trend, population forecast by NESDB seems to be over-estimating.

Consequently, this Study adopted the population forecast by Case 2 which applied social movement trend to the Census Population during 1990- 2000.

-BMA-

Case1: Immigration of young generation continues while settling-down of older generation remains

-Applying social movement factor to NESDB's forecast

Population growth: 7.8 million(Y2000) 9.8 million(Y2015)

Population will grow at an annual rate of 1%, total population reaching 10 million in 2020.

Case2: Immigration of young generation and emigration of older generation continue same as in the 1990s

--Applying social movement factor to Census Population

Population growth: 7.8 million(Y2000) 8.1 million(Y2015)

Population will remain stable, reach a peak in 2015 and thereafter turn

downward.

									(x 1,000)
		1970	1980	1990	2000	2005*	2010*	2015*	2020*
Cacal	Population	3,908.2	5,965.3	7,470.7	8,026.6	8,774.3	9,452.2	10,050.6	10,583.7
Caser	Household	617.1	1,118.7	1,655.6	2,068.4	2,540.2	2,969.7	3,426.9	3,916.4
Casal	Population					8,202.6	8,289.5	8,319.9	8,302.7
Casez	Household					2,374.7	2,604.4	2,836.8	3,072.3
Househ	old size	6.3	5.3	4.5	3.9	3.5	3.2	2.9	2.7

Forecast of Population and Household in BMA

Source: 1970-2000, Population and Housing Census, NSO

Note: 1970 are total of Phara Nakhon and Thon Buri.

2005*- 2020* are projections.

Census population are multiplied by 1.27

-Study Area-

Decrease of population in the Study Area is attributable to the emigration of middle age generation in the 30s and 40s. This fact implies that if the current social movement trend continues, the current young generation in the 20s will occupy older age group in the future. This in turn would mean dwindling of population will accelerate in the future.

The population outflow stems partly from variation in life stage, marriage, acquisition of residence in the suburbs etc., which could be curbed by supply of adequate residences, improvement of living environment for these generations

In consideration of this fact, this Study decided to adopt the population forecast in Case 3; on the scenario of gradual dwindle of population plus recovery of population by implementation of urban redevelopment projects.

Case1: Immigration of young generation and emigration of older generation continues

-Applying social movement factor to NESDB's forecast

Population growth: 228.9 thousand(Y2000) 251.3 thousand (Y2015)

Population will grow, reaching 250 thousand in2015.

Case2: Immigration of young generation and emigration of older generation continues same as in the 1990s

-Applying social movement factor to Census Population

Population growth: 228.9 thousand (Y2000) 209.4 thousand (Y2015)

Population will dwindle, dropping by 20 thousand (8.5%) by 2015.

Case3: Assuming recovery of resident population by promotion of supply of inner city residences

On the basis of Case2, population increase of 37 thousand is considered on account of Din Daeng Community, Makkasan MarshallingYard(SRT), Huay Khwang Housing Community development projects

Population growth: 228.9 thousand (Y2000) 246.8 thousand (Y2015)

Population growth will be in the same level as Case1

							(x 1,000)
		1980	1990	2000	2005*	2010*	2015*
Case1	Population	227.8	314.9	228.9	239.0	246.4	251.3
	Household	45.9	76.3	63.9	72.7	80.5	89.2
Case2	Population				223.6	216.9	209.4
	Household				68.0	70.8	74.4
Case3	Population				230.2	243.5	246.8
	Household				70.0	79.5	87.6
Househ	old size	5.0	4.1	3.6	3.3	3.1	2.8

Forecast of Population and Household in the Study Area

Source: 1980-2000, Population and Housing Census, NSO

Note: 1980, 1990 is "Huay Khwan" District that included "Din Daeng" District in present time. 2005* - 2015* are projections.

2000 are estimated by 2000 Census, registered population.

Census population are multiplied by 1.234

Difference in Number of Actual and Statistical Populations

In Thailand, there are two published population statistics, Registered Population and Census Population. Real number of resident population in BMA is said to differ widely. According to "Non Permanent Resident Analysis in BMA" by DTCP, there is resident population as many as 1.423 times the registered population

As the real resident population is as many as 1.7 times that of Census Population, the 1.7 multiplication factor was used in this Study to obtain basis for population

forecast. However, the multiplication factor in the Study Area turned out to be 1.234, different factor was used in the Study Area.

(m2)

A2.2.2 Commercial Floor Demand

(1) General

Forecast of commercial floor demand in the Study Area was performed employing "Huff Model" analysis incorporating such parameters as distribution of households, commercial locational characteristics, household consumer spending within BMR in the year 2010.

As a result, demand for commercial floor in the Study Area was found out to be as summarized in the following table.

	(1112)
Modern Commercial facility	156,000
Medium and small scale commercial facility	70,000
Regional center market	9,000
Neighborhood shop	61,000
Total	226,000

Commercial Floor Demand Forecast

(2) Outline of Demand Forecasting Method

"Huff Model" analysis is a method modeling the behavior of consumers at the commercial facility. It assumes that the consumers tend to prefer the closer and more commercially attractive place and that probability of selection of the place is influenced in reverse proportion to distance and in proportion to scale of the facility of the place.

Hereunder, using the "Huff Model" commercial demand will be forecasted, upon which possible scale of commercial facility in the Study Area will be assumed.



Structure of Huff Model

(3) Settings for Huff Model Analysis

1) Extent of Analysis Area and Residential Area

The analysis area was delineated in BMR. Residential areas adjacent to the Study Area in a radius of 5km were grouped in residential districts while external area were divided into residential zones; Nontaburi, Samut Prakan, Phathum Thani were considered as unit residential zones.



Analysis Area Boundary

Populations by Distance Classification

			unit: thousand
Area	Population by Are	ea (2010)	Accumulation value
0-5km	931.4	(13.7%)	931.4
5-10km	2,555.1	(37.4%)	3,486.5
10-15km	2,227.9	(32.7%)	5,714.4
15-20km	1,108.4	(16.2%)	6,822.8
Total	6,822.8	(100.0%)	-

2) Commercial Area

Commercial areas were defined as described below assuming that existing major shopping centers would represent gravity center of commercial accumulation and commercial strength in each commercial area.

The commercial strength was defined by sales floor area of existing shopping centers in each commercail area. It was also assumed that as it is likely that current active opening of discount shops will continue, the pace of expansion of modern commercial facility as witnessed during 1996 - 2000 will be maintained until the year 2010.



Location Map of Commercial Territory

List of Commercial Area

П	Commercial Area	Commercial Accumulation (sq.m)		
U	Commercial Area	2000	2010	
1	Planning Area	0	226,000	
2	Ratchada Phisek Area	60,000	113,664	
3	Fortune Town Area	75,000	142,080	
4	Rajdamri Area	667,000	1,263,563	
5	Phayathai Area	104,000	197,017	
6	CENTRAL PLAZA Area	81,000	153,446	
7	Ram Kham Haeng Area	63,000	119,347	
8	CENTER ONE Area	5,000	9,472	
9	Asok Area	8,000	15,155	
10	Empolium S.C. Area	30,000	56,832	
11	PRACHA RAT Area	16,000	30,310	
12	Lak Si Area	513,000	971,825	
13	Ngam Wongwan Area	90,000	170,496	
14	Bang Kapi Area	51,000	96,614	
15	Bang Su Area	15,000	28,416	
16	Ramindra-Lotus Area	12,000	22,733	
17	Lat Phrao_Imperial Area	75,000	142,080	
18	Silom Area	164,000	310,681	
19	Rama3 Area	77,000	145,869	
20	Srinakarin Area	470,000	890,366	
21	Charansanitwong Area	98,000	185,651	
22	Petchkasem Area	412,000	780,491	

П	Commercial Area	Commercial Accumulation (sq.m)		
U		2000	2010	
23	Ram Indora Area	626,000	1,185,892	
	Total	3,712,000	7,032,000	

Assumption of Commercial Strength in Future

Bangkok Total Retail Stock in 2000	3,712,000	sq.m.	а
Annual Growth Stock in 1996-2000	332,000	sq.m.	b.
Estimated Growth Stock up to 2010	3,320,000	sq.m.	c=a*10.
Bangkok Total Retail Stock in 2000	7,032,000	sq.m.	d=a+c
Multiplied Coefficient	1.89		d/a

Source: Jones Lang LaSalle (Annual Growth Stock in 1996-2000)

3) Distance between Residential Area and Commercial Area

As the primary transport means in Bangkok is road transport by buses and personal cars, distances between residential areas and commercial areas were measured on the map.

4) Distance Resistance Parameter

Parameter to indicate degree of resistance to distance of the consumers (distance resistance parameter) was set at 2.0. This is a standard value used in "Huff Model" analysis.

5) Household Consumer Spending

Annual household consumer spending in targeted group for the object commercial facility was assumed to be 117,100 Bahts in the year 2010. This value was determined based on the annual household spending 93,300 Baht (Greater Bangkok) in 2000 and applying the growth rate of household income 2.3% per annum as set down in the macro economic framework.

93,288	Baht/year
117,107	Baht/year
2.3%	
	93,288 117,107 2.3%

Source: National Statistical Office, Office of the Prime Minister

6) Method of Simulation

- To assume commercial strength of the Study Area
- To obtain probability of households' in each residential district selecting the

Study Area as shopping destination

- To figure out total consumer spending or sales amount in the Study Area by multiplying the probability to number of households and consumer spending per household.
- To obtain sales floor efficiency (sales amount per unit floor area)

Following the above procedure, a computer simulation was carried out to see if it is possible to secure the sales amount to maintain the required sales floor efficiency under the assumed commercial strength (sales floor area). It is noted that the required sales floor efficiency level was set at the average sales efficiency 70,000 Baht/m2 in the year 2000 in Bangkok.

		• • • •	
Modern commercial floor area	3,712,000	(m2.)	а
Households	2,785,000		b
Expenditure per household	93,288	(Baht/year)	С
Amount of household expenditure	260	(Billion Baht)	D =b *c
Average of sales floor efficiency	70,000	(Baht/m2.)	d/a

Assumed Average Sales Floor Efficiency (BMR, 2000)

Note: Number of households in BMA was obtained based applying a factor 1.234 to the census population. Source: (Sales area) Sansiri Research

(Household) Population and Housing Census, NSO

(Household expenditure) 2000 Household Socio-Economic Survey, NSO

(2) Result of Simulation Analysis

The commercial strength in the Study Area (excluding JUSCO, Robinson and other large commercial establishment) was examined about sales amount and sales floor efficiency varying the sales floor area from 50,000 to 500,000m2

Generally, if commercial strength is set larger, in other words sales floor area is set larger, then sales amount would increase due to enhanced consumer induction power. On the other hand, sales floor efficiency would gradually drop owing to competition with other commercial accumulation.

In order to achieve a desired sales floor efficiency 69,000 - 71,000 Baht/m2, required commercial strength has to be in a range 197,000 - 262,000m2. This seems to be the feasible commercial floor area to be set up in the Study Area. Consequently, the sales amount 15.6 billion Baht/year in a floor area 226,000m2 (average of the above) could be said to be the commercial demand in the Study Area.



Result of Computer Simulation Analysis by "Huff Model"

Area	Sales / sq.m.	
50,000	76,946	
100,000	74,637	
196,726	71,000	
200,000	70,891	
220,000	70,249	
261,634	69,000	
250,000	69,338	
300,000	67,938	
400,000	65,503	
500,000	63,430	



Forecast of Commercial Territory of the Study Area

Distribution of Customers Traffic to Study Area by Route



Now, let us examine the proportion of modern commercial establishment and traditional medium- small commercial businesses.

Assuming 70% share in sales amount by the modern commercial establishment which would constitute the core of the commercial territory, its annual sales amount comes to be 11 billion Bahts in sales floor area156,450m2. In the meantime, annual sales amount and floor area of medium- small commercial business having 30% share will be 4.7 billion Baht and 70,000m2 respectively. Assuming the existing regional market has 9,000m2 floor area including Huay Khwang, Phayathai and the like, remaining floor area 61,000m2 comes to be for medium- small commercial business. Assuming the average individual sales floor 40m2, it could be claimed that there will be a demand for as many as 1,500 shops in the Study Area.

According to the survey by Din Daeng Tax Office, there are 559 numbers of food and drink shops in Din Daeng District (nearly equal to the Study Area) in 2000.

In sum, it can be claimed that there will be a good demand not only for large scale commercial establishment in over 100,000m2 floor but also for small- medium commercial business.

Population in BMR	1,103.8	(thousand)	
Households in BMR	3,530.7	(thousand)	
Households in Study Area	79.5	(thousand)	
Target households of Study Area*	133.6	(thousand)	а
Expenditures per household	117,107	(Baht/year)	b
Expenditures of target households	15.6	(Billion Baht/year)	c =a *b
Sales floor area demand	226,000	(m2)	d
Gloss Floor area demand	348,000	(m2)	e=d/0.65

Total Commercial Floor Area Demand

Modern Commercial Floor Area Demand

Gloss Floor area demand	240,000	(m2)
Sales floor area demand	156,000	(m2)
Sales per unit space	70,000	(Baht/m2/year)
Expenditure in modern commercial establish.	11.0	(Billion Baht/year)
Share of modern commercial establish.	70%	

Share of modern commercial establishment	30%		
Expenditure in medium-small commercial establish.	4.7	(Billion	
		Baht/year)	
Sales per unit space	67,500	(Baht/m2/year	Refer to
)	parameters
Sales floor area	70,000	(m2)	
Regional center market	9,000	(m2)	
-Huay Khwang Market (Existing)	4,500		
-Phayathai Market (Expanded)	4,500		
Neighborhood shop	61,000		а
Number of shops	1,525		b =a / 40m2
Labor per shop	3		С
Total of labors	4,575		b *c

Features of Medium- Small Commercial Business

Parameters of Medium - Small Commercial Business

Salary / labor / month	45,000	(Baht/month)	а
Salary / year	540,000	(Baht/year)	b=12*a
Ratio of salary to sales amount	20%		С
Annual sales	2,700,000	(Baht/year)	d =b/c
Shop area	40	(m2)	е
Sales per unit space	67,500	(Baht/m2/year)	f =d/e

A2.2.3 Office Space Demand

(1) General

Forecasting net additional demand for office floor area in BMA gave 283.3 thousand m2 by the year 2010.based upon number of office workers and supply trend of office floor.

In the Study Area, net additional office floor 535.0 thousand m2 will be required by 2010, where approx. 193.0 thousand m2 will be occupied by new BMA city hall and SRT Makkasan Development Project.

		(x 1,000m2)
Existing office floor area in BMA	(2000)	6,900.0
Forecasted office floor area in BMA	(2010)	8,497.7
Net growth of office floor area in BMA	(2000-2010)	1,597.7
- Case study area	(2000-2010)	405.0

Summary of Office Floor Demand Forecast

Source: (Existing office floor area in BMA) Jones Lang LaSalle Research.

(2) Outline of Forecasting Method

Demand for office floor was conducted about newly constructed floor excluding those by re-building or expansion as described below: The forecasting was made for the entire BMA first and thereafter the total demand was distributed to various business districts

a) Number of Employees

Number of employees was forecasted according to the forecasted demographic structure by age and employment rate in BMA.

b) Proportion of Office Workers

Among workers classified by occupation, following were categorized as office workers:

- Professional, technical and related workers
- Administrative, executive and managerial workers
- Clerical workers

Proportion of office workers in all was forecasted assuming that the current proportion will not change until the year 2010.

c) Number of Office Workers

Number of office workers was forecasted according to the number of employees and the share of office workers among them.

d) Office Floor Demand

Demand of office floor was forecasted based on the number of office workers (increase portion) and unit floor area per office worker.

e) Distribute Office Floor Demand to Business Areas

Distribution of office floor area was performed based on existing stock in office accumulation areas and referring to contents of the published urban development projects.

(3) Outline of the Forecast

a) Number of Employees

Number of employees will increase by 281.0 thousand (6.5%) from 4,350,3 thousand in 2000 to 4,631.3 thousand in 2021.

	-		(x 1,000)
Age Group	2000	2005	2010
13-14	6.6	5.7	5.2
15-19	176.8	150.4	152.5
20-24	443.2	400.6	337.8
25-29	767.2	765.1	668.7
30-34	755.0	724.3	725.5
35-39	639.8	659.7	654.7
40-49	988.1	1,110.3	1,155.9
50-59	455.2	611.1	748.9
60+	117.6	148.7	182.1
Total	4,350.3	4,575.9	4,631.3

Forecast of Number of Employees

b) Proportion of Office Workers

It was assumed that share of office workers in all will increase from 33.6% in 2000 to 34.5% in 2010. Particularly, professional and technical workers will increase while clerical workers tends to decrease.

Occupations	2000	2005	2010
Professional, technical and related workers	17.0%	17.7%	18.3%
Administrative, executive and managerial workers	7.7%	7.7%	7.8%
Clerical workers	9.0%	8.6%	8.2%
Office workers	33.6%	34.0%	34.2%

Forecast of Share of Office Workers

Number of Office Workers c)

Number of office workers is expected to increase by 12.9 thousand from 1,462.9 thousand in 2000 to 1,585.8 thousand in 2010. Majority of increase, 109.2 thousand, will be occupied by professional and technical workers.

Forecast of Number of Office Workers

			(x 1,000)
Occupations	2000	2005	2010
Professional, technical and related workers	737.6	807.9	846.8
Administrative, executive and managerial workers	333.8	352.5	359.7
Clerical workers	391.5	393.8	379.3
Office workers	1,462.9	1,554.2	1,585.8

d) **Demand for Office Floor**

Assuming a net floor area occupied by an office worker to be 13m2, additional floor area for office workers in BMA in 2010 will amount to 1,597.7 thousand m2. On the other hand, office floor stock in 2010 will be 8,497 thousand m2 which is the sum of current stock 6,900.0 thousand m2 and the expected new supply.

It is noted that total office floor stock in December, 2000 was estimated at 7,328.8 thousand m2 including those under construction. Total estimated office floor stock in 2010, 8,497.7 thousand m2 exceeds the current stock by 1,168.9 thousand m2. This additional space will not be enough to accommodate the expected increase of office workers in view of the increase trend in the 1990s.

Demand Forecast for Office Floor					
Occupations	2000-2005	2005-2010			
Growth number of office workers	91.3	31.6	(thousand)		
Floor area demand (Net)	1,186.9	410.8	(thousand m2)		
Cumulative floor area demand (Net)	1,186.9	1,597.7	(thousand m2)		

E) Distribute Office Floor Demand to Business Areas

Distribution of the office floor demand 1,597.7 thousand m2 by 2010 to various business districts in BMA was attempted hereunder.

Distribution was made in proportion to existing floor area in each district and at the same time assuming that 15% of the expected workers in such urban development projects as Rama 3, Phaholyotin, 7 Subcenters C and SRT Makkasan projects in the Case Study Area is net increase of workers during this period.

AS a result, it was found out that 405.0 thousand m2 floor area will be allocated to the Study Area, which will mainly be occupied by the new BMA city hall and Makkasan project.

Zone	2000		2010		Rate of Growth		Remarks
Study Area (500 ha)	0.0	(0%)	405.0	(5%)	405.0	(25%)	+15% of 100,000 employees and BMA New City Hall
CBD	2,123.1	(31%)	2,267.2	(27%)	144.1	(9%)	
Rama 3 area	2,255.8	(33%)	2,743.3	(32%)	487.5	(31%)	+15% of 250,000 employees
Phaholyotin Rd. area	1,459.6	(21%)	1,654.6	(19%)	195.0	(12%)	+15% of 100,000 employees
Rattanakosin + Dusit area	265.4	(4%)	167.9	(2%)	-97.5	(-6%)	Move out to Phaholyotin Rd. area
Sukhumvit Rd.area	796.2	(12%)	850.2	(10%)	54.1	(3%)	
7 Sub-center Project	0.0	(0%)	409.5	(5%)	409.5	(26%)	+3% of 1,050,000 employees
Total	6,900.0	(100%)	8,497.7	(100%)	1,597.7	(100%)	

Distribution of Office Floor by Business Districts in BMA
APPENDIX-3: PROPERTY MARKET SURVEY

A3.1 OVERVIEW OF PROPERTY MARKET

Participation of private sector would no doubt exert great impact to the financial arrangement and the profitability of the Plan; its substantial participation will enhance the financial feasibility.

After the currency crisis in 1997, real estate market in Bangkok has gradually been recovering. However, there is still a large inventory of office and condominium stocks.

Currently retail business seems the only prospective sector that earns profit and therefore are keen on the kind of urban development as that in DC Area.

The DC Area is understood to have a high potential for retail business because of the projected new city hall of BMA, various government agencies' offices, Thai-Japan Youth Center which draw as many as 1,336,000 people/year (average 3,700 people/day) as well as the NHA housing community.

However, introduction of a large-scale commercial establishment would inevitably exert great influence over local society. While they will afford large employment opportunity of over 5,000 per shop, they tend to create, if set up disorderly, negative impact such as traffic congestion, giving a blow to small retailer in the locality and environmental degradation.

It is, therefore, the key to success for an urban redevelopment plan to introduce these large retail businesses systematically such that they will contribute to betterment of local community.

			<u> </u>	, ()	
	Total	Future	Under	% comparison over E	Dec-99
	stock	supply	construction	Occupancy rate	Avg. price /m2
			but on hold		Avg. rent /m2/month
Condominium	80,724	520 units	13,970 units	CBD 86%	CBD down 1%
	units			SKV 96%	48,000-68,000
					Sukhumvit
					up 6%
					30,000-35,000
Apartment	10,000	340 units	0 units	Overall 91% up 6%	CBD
	units				Well-maintained:
					UP 1%,327B/m2/m0nm
					un 3% 229R/m2/month
					Sukhumvit
					Well-maintained
					Stabilized, 286B/m2/month
					Old buildings:
					Stabilized, 215B/m2/month
Sonvicod	0.000	1 212 unite	N/o	Quorall 710/.	CDD
anartmont	9,090 Units		IV/d	stabilizod	CDD Grade A:
apartment	units			Stabilized	un 1% 814B/m2/month
					Lower grade:
					up 2%, 602B/m2/month
					Sukhumvit
					Grade A:
					Down 7%, 843B/m2/month
					Lower grade:
Office	/ //1	1(1000 m2)	702.000 m2	Overall (70/. up	up 1%, 445B/m2/month
Unice	0,401 million	104,000 1112	703,000 112		CBD Grade A:
	m2			570	Down 1% 393B/m2/month
					Sukhumvit
					Overall:
					Down 2%, 299B/m2/month
Retail	3,712Milli	335,000 m2	158,000 m2	Overall 87%: down	Overall:
	on m2			2%	up8%, 1,143B/m2/month

Bangkok Property Market (2000)

Source: Sansiri Research, January 2001

A3.2 CONDOMINIUM

Total condominium stock in Greater Bangkok in December in 2000 was 80,724 and adding to this will be new supply of 520 units, making the total stock to 81,244 units. In addition to these, there are 13,970 stocks which are in the holding of construction (construction suspended).

From the fact that the average selling price per unit floor area is in a range of 48,000-68,000 Bahts/m2 in CBD and 30,000-35,000 Baht/m2 along Sukhumvit, target customer group for these condominiums is obviously high income population. This fact implies the difficulty of clearing inventory unless economy recovers and demand bounce back. Following are the condominium stock by districts.

	Existing	g Units	In Progress	Units	On-hold l	Jnits
CBD	7,810	10%	51	10%	1,642	12%
Sukhumvit	11,778	15%		0%	305	2%
Rama 3	6,171	8%		0%	2,865	21%
Phayathai	4,204	5%		0%	472	3%
Phaholyothin	5,749	7%	140	27%	2,631	19%
Ratchadaphisek	14,786	18%	155	30%		18%
Srinnakarin	15,728	19%	174	33%	80	1%
Riverside	5,427	7%		0%	3,044	22%
Others	9,071	11%		0%	435	3%
Total	80,724	100%	520	100%	13,970	100%

Existing and Future Supply of Condominium

Source: Sansiri Research, January 2001

A3.3 SERVICE APARTMENT

It is assumed that there are around 9,090 units of serviced apartments in Greater Bangkok in December, 2000. There will be new supply of about 1,310 units by 2002, raising the total stock to10,400 units. Current average occupancy rate is 71%. The occupancy rates differ from district to district; in Sukhumvit area it is 83% while in peripheral area it is around 50%.

There is also a wide difference in the rent; as opposed to 843 Baht/m2/month for Grade A apartment in Sukhumvit area, the average rent in the peripheral area is 424 Baht/m2/month.

Apartments, 2000						
	Existi	ng	Projected Supply to 2002		Occupancy.	Rents
					Rate	Baht/month/m2
CBD	2,060	23%	800	27%	72%	Grade A :814
						Lower Grade :602
Sukhumvit	3,234	36%	512	36%	83%	Grade A :843
						Lower Grade :445
Narathiwas, Ratchanakarin	614	7%		6%	90%	
Phayatai/Petchburi	850	9%		8%	41%	241-623
Upper Phaholyothin	137	2%		1%	57%	Aveg.424
Ratchadapisek/Rama 9	323	4%		3%	57%	
Srinakarin/Bangna	898	10%		9%	63%	
Riverside/Rama 3	480	5%		5%	45%	
Vipahavadee/Changwattana	494	5%		5%	53%	
Total	9,090	100%	10,402	100%	71%	

Existing and Future Supply, Occupancy Rates and Average Rents of Serviced

Source: Sansiri Research, January 2001

A3.4 OFFICE

Total office stock in Greater Bangkok in December, 2000 was 6,461,000 m2, and there is expected new supply of 164,000m2 by the end of year 2002, making the total stock 6,625,000m2 at the end of 2002. On top of these, there is stock of 703,777m2 of which construction has been put on hold.

Occupancy rate is low 67% on average. The rent for Grade A office which commanded 500 baht/m2/month before the currency crisis has fallen to 400 baht/m2/month and down trend is still continuing.

			•					
	Existir	ng	Under Constr	uction	On Ho	ld	То	tal
	(m2)		(m2).		(m2).		(m	.2).
Silom/Sathorn	1,730,000	27%	30,000	19%	60,000	9%	1,820,000	25%
Ploenchit	700,000	11%	60,000	38%	60,000	9%	820,000	11%
Sukhumvit	1,190,000	18%	40,000	25%	170,000	24%	1,400,000	19%
Rama 3	250,000	4%		0%	60,000	9%	310,000	4%
Payathai	230,000	4%	10,000	6%	70,000	10%	310,000	4%
Phaholyothin	850,000	13%	20,000	13%	90,000	13%	960,000	13%
Ratchadaphisek	650,000	10%		0%	160,000	23%	810,000	11%
Bangna-Trad	370,000	6%		0%	30,000	4%	400,000	5%
Changwattana	240,000	4%		0%		0%	240,000	3%
Thonburi	250,000	4%					250,000	3%
Total	6,460,000	100%	160,000	100%	700,000	100%	7,320,000	100%

Existing and Future Supply of Office

Source: Sansiri Research, January 2001

(2) Trend of Shopping Centers

1) Current development of shopping centers

Retail business is the only bright segment in property market maintaining steady growth. And retail sector is shifting to modern trade.

There are currently 184 numbers of retail establishments with 3,712,200m2 floor in Greater Bangkok in December 2000. There will be another 12 shops with 335,700 m2 floor by the year 2002. This will make the total 196 shops with 4,047,900m2 floor (up10%).

	M2	%
Rajdamri	300,103	8%
Silom	164,191	4%
Sukhumvit	315,506	8%
Rama 3	77,000	2%
Phayathai	470,762	13%
Srinakarin	469,945	13%
Laksi	778,640	21%
Charansanitwong	98,247	3%
Petchkasem	412,305	11%
Ram Indora	625,536	17%
Total	3,712,235	100%

Existing Supply of Commercial Floor by Locality

Source: Sansiri Research, January 2001

	Dec 2000 (m2)	2002 (m2)	%
Shopping center	1,993,560	2,193,560	110%
Department store	428,035	428,035	100%
Independent retailer	274,259	312,559	114%
Cash and carry wholesaler	87,096	87,096	100%
Dependent retailer	400,826	424,208	106%
Discount department store	417,500	491,000	118%
Specialty store	111,459	111,459	100%
Total	3,712,735	4,047,917	109%

Existing and Future Supply by Retail Type

Source: Sansiri Research, January 2001

2) Occupancy rate

Average occupancy rate of retail floor dropped in 10 Districts from June to December in 2000 whereas major retail establishments maintained good record. Medium to small stores are struggling for survival under low demand.

	June 2000	Dec 2000	%
Rajdamri	94%	94%	0%
Silom	96%	94%	-2%
Sukhumvit	90%	86%	-4%
Rama 3	88%	73%	-15%
Phayatai	93%	91%	-2%
Srinakarin	94%	94%	0%
Laksi	80%	79%	-1%
Charansanitwong	100%	100%	0%
Petchkasem	97%	87%	-10%
Ram Indora	90%	83%	-7%
Sourco: Sansiri Dos	oarch Janus	ny 2001	

Occupancy Rate by District

Source: Sansiri Research, January 2001

Occupancy Rate by Retail Type

	Jun 2000	Dec 2000	Variation
Shopping center	93%	91%	-2%
Independent retailer	51%	46%	-5%
Dependent retailer	83%	81%	-2%
Specialty store	88%	88%	0%

Source: Sansiri Research, January 2001

3) Rent

Average rent per unit shopping floor was 1,143 Baht/m2/month in December 2000. There was a wide difference in the rent by location and by type.

Location wise, gap was rather large; 1,353 Baht/m2/month in Sukhumvit to 782 Baht/m2/month in Rama III. The same is true of the difference by type; from 669 Baht/m2/month in specialty shop to 1,305Baht/m2/month in shopping center.

	-	•	
	June –00, B/m2/mon	Dec-00, B/m2/mon	Dec / June
Rajadamri	914	1,262	38%
Silom	1,200	950	-21%
Sukhumvit	1,262	1,353	7%
Rama 3	873	782	-10%
Phayathai	1,236	1214	-2%
Srinakarin	956	923	-3%
Average	1,063	1,143	8%

Average Rents by Location

Source: Sansiri Research, January 2001

	June –00, B/m2/mon	Dec-00, B/m2/mon	Dec / June
Shopping center	1,206	1,305	8%
Independent retailer	836	850	2%
Dependent retailer	857	936	9%
Specialty store	656	669	2%

Average Rents by Retail Type

Source: Sansiri Research, January 2001

Average rent in Rajdamri and Sukhumvit rose from June through December in 2000, which is considered to be due to the impact of the BTS sky train. Referring to the survey result conducted at 20 shops in 4 Districts to see the degree of impact by the sky train, positive impact to commercial establishment along the train was apparent. There was a rise in sale of 35% in Siam Center and Siam Discovery in Rajadamri area. However, benefit of the sky train has not come by yet in office and residential sectors; mixed use commercial facility in Silom area even registered a drop of 38%

	June 20	000	December	Rent	
	June –00, B/m2/mon	Occupancy rate	Dec-00, B/m2/mon	Occupancy rate	Dec / June
Rajadamri	973	94%	1,312	94%	35%
Silom	1,191	89%	737	92%	-38%
Sukhumvit	1,676	88%	1,689	94%	1%
Phyathai	1,854	93%	1,870	96%	1%

Average Rents by Location along BTS (Sky-Train)

Source: Sansiri Research, January 2001

APPENDIX-4: RECORD OF INTERVIEW TO PRIVATE RETAILERS/DEVELOPERS

A4.1 CP LAND

Wednesday June 6, 2001 at 10.00-12.00 hr.

Conference Room, 29thfloor, CP2 Building

CP Land is an affiliated company of CP groups of companies. The mother company is a big entrepreneur in the animal feed industry in Thailand and Asian region. It consists of about 250 affiliated companies with overall employees about 100,000. The head office is in Bangkok. There are 25 affiliated companies operating or working as consultants in construction business. CP Land has a joint venture and cooperates with investors from UK, Korea, Hong Kong, China and Japan in real estate development. At present, the real estate business is in crisis. This has caused delay in development of real estate on the company's own un-used land. It is expected that the situation will turn around within next 4-5 years.

(Brief on the Concept of the Din Daeng Project)

- Din Daeng project has a high potential to success. The reason being the advantage of the location; it is the site of the new BMA city hall and is close to the center of the city .
- Physical and social development of the Project should be realized in the cooperation between the government and private sectors.
- Although the duration of the Project is quite long, the cooperation between the government and private sectors will not be a problem providing that the government policy is firm and clear.
- The Group is ready to invest in the Project but would need the government's support in fund seeking from sources in the country and abroad. The ROI is expected to be about 15%
- Governmental investment in public utilities is essential for big projects such as the Project.
- The target group of the commercial facility is the local population. The people

outside the area will only be considered as additional benefit.

• Two to three years from now is considered to be a good timing to start the Project. The government should be the one who makes the first start.

(Suggestions)

- Enlighten the people who will be the resident to be aware and get prepared for living in high-rise buildings.
- The administration and management after completion of the construction needs to be considered along with the planning of the Project. Public area and facilities such as public park should be under the responsibility of local authority.
- The investment does not end at the completion of construction. After 30 years of occupancy of residence the condition of buildings and environment should be redeveloped or rehabilitated again.

A4.2 SECON

Wednesday June 13, 2001 at 14.00-15.00 hr.

Conference Room, 5thfloor, SEACON Building

Seacon Square is located at Srinakarin Road, Prawet District, Bangkok. It is founded and managed by Seacon Square Group, Seacon Construction, Nanyang (Shoes) and Thai Churod. The Group has experienced in management of Siam Square. The main shareholder, about 68.24%, is Sorsoattikul family who also owns the land where Siam Square is located. The land area is 77 Rai.

Seacon Square is the department store that is located in the center of medium-income residential area. Transport is convenient and there is a road that connects to the second international airport and to the north eastern region. Business strategy of the department store is a one-stop shopping and entertainment complex. There are more than 400 retail shops. The facilities consist of supermarket, discount store, department store, cinema, etc. There are more than 5000 employees at the site. The spending of the customers is estimated to be 400 Baht/person/day.

The operation result of the year 2000 was good and could pay dividend to shareholders. The duration of operation to get to this point was 10 years. This is 3

years delay from the original plan. It is also true of financial return, as a result of the economic slump during the last 4 to 5 years.

(Brief on the Concept of the Project)

- The Project has high potential to success. The reason being the advantageous location close the center of the city. It is the site for the new BMA city hall.
- Physical and social development of the Project should be realized through the cooperation between the government and private sectors.
- Although the duration of the project is quite long, the cooperation between the government and private sectors will not be a problem providing that the government policy is firm and clear.
- The group is in the ready position to invest. Return on investment (ROI) is expected to be about 15%. But ROI is not the main factor for decision. The group puts more emphasis on cash flow.
- Governmental investment on public utilities is essential for a big project like this one.
- The proper commercial investment in the Project is considered to be on medium-sized department store and discount store.
- The long duration of investment, 10 years, is not a problem.

(Suggestions)

- The residential buildings of low-income and the high-income population needed to be clearly separated. The distance between buildings and structural barriers between buildings can serve the purpose.
- Construction of residential buildings for low-income population should be the responsibility of the government.
- To attract people to come to the department stores and retail shops, shopping center should comprise diverse services such as education center, IT center etc.
- If the area is to be used as a cultural center to support tourism, the true demand of tourists coming from abroad should be carefully figured out before any layout of the Project is determined.

A4.3 MBK

Thursday July 12, 2001 at 14.00-15.45 hr.

Conference Room, 7thfloor, MBK Building

MBK Properties and Development Public Company Limited (MBK) was founded in 1974 to operate in agribusiness. In 1988 the big shareholder, Khunying Chanut Piyaoui, led the company into real estate business. MBK got registered in the stock market in April 1996.

Main income of MBK Center is floor rental fee and parking lot fee. Short-term contract, less than 3-year time, is about 50%. The long-term contract is about 50%.

Total area of the center	262,794.25 m2
Comprises of :	
- Shopping Plaza	96,711.51m2
- Common Space	49,249.25 m2
- Parking Space	60,615.06 m2 (18 floors 1,780 cars)
- Office Building	21,532.79 m2
- Hotel	34,685.65m2

Saleable area for rent is 60% and another 40% are parking lot and circulation space.

Beside rental fee, the long-term contract owners have to pay the management fee of 140 Baht/month/m2. Short-term rental fee already includes the management fee.

Number of employees in MBK Center

- MBK company	500 persons
- Hotel	500 persons

Retail shops about 2,000 in number employ about 2-3 persons per shop

Total	6,000 persons
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- Tokyu Department store employee N.A.

Average spending of people coming to the Center is estimated to be 1,000 Baht/person/day. Number of people coming into the Center is 90,000 persons per

day. Target customer group is medium-income to low-income groups, especially school and college students.

BTS has impacted on the business. After BTS started the service in December 5,1999, traveling pattern of Bangkokians has changed. It also has influenced real estate industry and trading business along the route of the sky train

MBK Center has an overpass to BTS National Stadium Station. The impacts of the overpass on the Center are: it enhanced convenience for the customers to come to the Center. Customers who come from the entrance at the overpass increased by 64%. The overall customers also increased by 32%.

Because the Project site located in the heart of the city, its development potential is high. This is especially true of building as business center.

The key to success is the access to the Project. The traffic management is very important. The size of roads that pass the Project should be wide enough. Mass transport system has to be convenient.

The proper size of the area to be developed for commercial purposes is about 40 Rai. Considering the site, Wiphawadi Rangsit Road side is not suitable for the purpose. It is located on the left side of the road that is the inbound route into the city. It is used in the morning by people who go to work. They would not stop for a shopping as they usually go shopping on the way back home. If the tunnel is to be built to go under Wiphawadi Rangsit Road to connect to Phahol Yothin Road, it will make the Project more feasible.

The size of the land area on Pracha Songkhro Road side should be 50 Rai. It is considered to be suitable for commercial development. One problem is that the road at present is very narrow. If it is widened to match the new Chaturathit Road, it will increase the potential of the Project. If it is possible to get the approval for having a bus depot and the underground passage to the site it will enable the Project to be commercially viable. This would include a hotel and other businesses.

The duration of renting the area should be not less than 50 years.

The Group's view on the economy in the next 2-3 years; low-income population will not be affected or affected only slightly if any. There will not be any expansion of luxury goods market.

A4.4 THAI-REAL ESTATE DEVELOPMENT ASSOCIATION

Thursday, August 9, 2001 at 10.30-12.00 hr.

Conference Room, 14thfloor, NHA Head Office

NHA had carried out a study, analysis and worked out the project details in order to get the concept of rehabilitation of Din Daeng Community area. The details cover physical aspect, marketing, financial and investment. The view of the real estate entrepreneurs on the Project is that it is feasible and should be implemented within a few years time.

Physical Aspect; location

The land is in a very good location. Public utilities provided cover all of the area, which will be beneficial to the Project. Since it is located in the heart of the city, NHA should proceed with the Project without delay. The reasons being that at present, the surrounding environment is undergoing development and times will change, for example, by the construction of new BMA city hall, and Kakkasan development project of National Railway of Thailand. The land price of Din Daeng area is high. It should be administered and managed to the best of the potential.

Marketing Aspect

The Project has a clear plan. The area is segmented into low-income population, the average residents, and the area for the new comers. The commercial development should also generate jobs for the residents because most of the target residents are from the low-income population. The area for commercial purpose should be arranged into groups of diversified activities. There should be an area for small shops as well.

The business center is to be geared for the medium to low income group in order to match their life style.

Commercial development plan should aim at profit-generating operation. It is attractive for developers and investors. Because of the current slow growing economy, the finance institutions are not likely to lend big amount of money to one borrower. This is to prevent them from getting into trouble with bad loans. Therefore, the development plan and construction work need to be divided into

sections to spread out the investment. This is true especially of a big project such as the business center.

Buildings for low-income population will not generate profit so private sectors will not be interested in this part of the Project. Buildings should be of high-rise type. The administration and management fee should not be set at high rate. The present technology of building design and service systems to be used can save construction investment and the expense of management.

Financial aspect

The concept of investment and return on investment will convince private sector to get ready to proceed with the Project. All investment plans for low-income population should be on the basis of self-finance. If financial support is needed it should come from the government through a clearly defined policy. The example is to give a financial support for the first 5-10 years, and the residents will have to pay the actual rents after that. The reason is that the residents will have more convenience than other people in the city. The average income of Din Daeng residents is estimated to be 20,000-30,000 Baht per household.

Suggestions

NHA has to set the rent for the existing residents that will move out of the Project area because this will affect the financial planning.

The duration of the project planned by NHA is 10 years. This is too long. The plan should be accelerated to be within 5 years so that the investors may consider the plan is ready to start. Marketing of the project then is not a problem.

APPENDIX-5: TRAFFIC DEMAND FORECAST AND CAPACITY EVALUATION

A5.1 GENERAL

Traffic demand forecast in this Study is aimed at evaluating traffic impact in and around Din Daeng, Makkasan and Huay Khang Area (DMH Area) in the year 2011 due to implementation of the redevelopment plan (Plan) in Din Daeng Community Area (DC Area) including the new city hall of BMA, and the commercial facilities and new housing of NHA. Since employees and customers to the city hall and shopping centers will be newly created by the Plan, traffic situation is anticipated to change in DC Area (100ha) and surrounding area in 2011.

Traffic forecast model was carried out following the transport models developed by the Office of the Commission for Management of Land Traffic (OCMLT), and the Bangkok Metropolitan Extended City Model (BECM) by Transport Database and Model Development Project (UTDM) based on Person Trip Survey in 1995. Also, Urban Rail Transportation Master Plan In Bangkok and Surrounding Areas (URMAP) which is the latest study on transportation system in Bangkok were referred to for traffic forecast in 2011 as the base data.

Following figure shows traffic analysis procedure.



Traffic Analysis Procedure

A5.2 REVIEW OF RELEVANT STUDIES

A5.2.1 Mega-project Technical Support (MTS IV), 1999 (OCMLT)

MTS IV has recommended modification of investment plans for mega-projects of various agencies to match the economic circumstances in Bangkok Metropolitan Region (BMR). To analyze and evaluate the megaprojects proposed by the responsible agencies, an extensive transportation modelling program was conducted covering the period 1999 to 2011. A comparison of socio-economic data in Din Daeng District in 2001 and 2011 is shown below.

Year	2001	2011	Increase	Change
Population	306,028	289,984	-16,044	-5.2%
House Hold	81,066	78,348	-2,718	-3.4%
Income	94,317	133,762	39,445	41.8%
Primary Employment	158	106	-52	-32.9%
Secondary Employment	31,663	34,349	2,686	8.5%

Socio-economic Data of MTS IV in 2001 and 2011

Year	2001	2011	Increase	Change
Tertiary Employment	84,497	119,554	35,057	41.5%
Student	82,958	106,193	23,235	28.0%

Source: Megaprojects Technical Support (MTS IV)

A5.2.2 Urban Rail Transportation Master Plan In Bangkok and Surrounding Areas (URMAP) (OCMLT)

URMAP is the latest master plan including future plans of road, railway, urban centers and sub-centers in BMR, and suggests implementation program for railway covering the period 2001 to 2021.

A5.3 SOCIO-ECONOMIC FRAMEWORK

Since the traffic demand is substantially affected by economic activities, it is necessary to estimate the future traffic demand based on the anticipated future economic framework induced by implementation of the Plan. Following table shows economic indicators of DC Area (100ha) in 2001 and 2011.

Indicators	2001	2011	Increase
Population	29,400	29,900	+500
Employment for BMA Employees	14,000	40,000	+26,000
Employment for Commercial Center Staff	-	10,000	+10,000
Student	2,760	3,137	+377
Shopper	-	47,000	+47,000
Average Household Size	3.6	3.5	-
Household Income (Bahts/month)	17,121	23,700	-

Socio-economic Framework of Din Daeng Area (100ha) in 2001 and 2011

Source: JICA Study Team

A5.4 TRIP GENERATION AND ATTRACTION MODEL

Most trip generations occur at the home of the trip maker (majority of urban trips begin or end at home). According to BECM Model of UTDM based on person trip survey in 1995, it is recommended to estimate generation of trips using population, household number and household income of each zone. Since the study is for future traffic volumes in and around DMH Area in the year 2011 and of which forecast has already been included in the trend growth in URMAP, only the increased trip generation due to implementation of the Plan is considered in

this analysis. In DMH Area, population and students will increase by 500 persons and 377 students respectively as additional trip generators. These trips, however, is so small compared with the assumed ones in the trend growth in URMAP that they are deemed to be negligible as a part of the internal trips in DMH Area.

Trip attractions were estimated using number of employees and shoppers concentrating in the new city hall of BMA and commercial facilities of NHA. URMAP has already taken into account an increase of 4,800 employees by urban development of DC Area (100ha) in 2011. Therefore, the increased employees were assumed to be 31,200 employees deducting the 4,800 employees from 36,000 employees estimated by the implementation of the Plan.

Trip attractions are classified by purpose and household as shown below:

Trip Purpose

- Home-Based Work (HBW) Trips between home and primary work location.
- Home-Based Other (HBO) Trips between home and all other locations (shopping, recreational, religious and personal business locations).
- Non-Home-Based (NHB) Trips which neither start nor end at home (for example, a trip between work place and restaurant).

Vehicle Availability Group

- Group 1 : No vehicles
- Group 2 : At least one motorcycle (but no car)
- Group 3 : One car (and possibly a motorcycle)
- Group 4 : Two or more cars (and possibly a motorcycle)

Trip attraction is figured out by a linear regression analysis to calibrate the coefficients as shown in the following equation:

$$A_j = a_1 + b_1 x_1 + b_2 x_2 + b_n x_n$$

Where

	Non-Home				
Variable	0-Vehicle	1-Motrcycle	1-Car	Multi-vehicle	Based Work
Employment	0.323	0.178	0.282	0.217	0.791

Attraction Model Coefficients for HBW and NHB

Source: UTDM

Trip attraction of HBO was assumed as the number of shoppers to the commercial facilities. The trip attractions increased by the Plan in 2011 are shown in the table below.

				Unit: P	erson per day
	0 Vehicle	1 Motorcycle	1 Car	2 Vehicle	Total
Home based Work	10,078	5,554	8,798	6,770	31,200
Non-Home based	7,971	4,393	6,960	5,355	24,679
Home base Others	4,254	17,962	17,455	7,328	47,000
Total	22,303	27,908	33,213	19,454	102,879

Trip Attractions Increased by Redevelopment Plans in 2011

Source: JICA Study Team

A5.5 TRIP DISTRIBUTION

In order to estimate trip distribution, BMR was divided into 55 zones which are comprised of 50 districts of Bangkok Metropolitan Area, Samut Prakan province, Nonthaburi province, Pathumtani province, Samut Sakhon province and Nakhon Pathom province. The zoning map for BMR is illustrated below:



Source: JICA Study Team

Zoning Map for Bangkok Metropolitan Region

Trip distribution estimate by the gravity model is illustrated in the following desired trip lines.



Source: JICA STRADA



A5.6 MODAL SPLIT

The modal split is the process of forecasting preferred modes of travel. The modal split model is carried out firstly to see the proportion of the choice between public and private modes. The public modes include rail, ferry and all bus services. The private modes are car, motorcycle and taxi. The private modes were divided into vehicle types applying the modal share found out by the traffic survey in the Study Area conducted by the Study. The procedure of modal split is as shown in following figure.



Procedure of Modal Split

A5.7 CONVERSION FACTOR

Prior to assignment of the trip tables to the network, it is necessary to develop the Vehicle Am Peak Hour Trip by converting, in PCU format, values of the total daily person trip. This procedure as described below enables the assignment of traffic values from the Vehicle Am Peak Hour trip to the road network.

For the Vehicle Am Peak Hour Trip, following formula was used:

$$OD_{ij} = a^*PA_{ij} + b^*TR\{PA_{ij}\}$$

Where :

 OD_{ij} = Vehicle AM peak hour trip

 $PA_{ij} = OD$ matrix of traffic volume increased by redevelopment plan

 $TR\{--\}$ = Mathematical matrix transpose function

a and b = Peak hour factor constants

	Normal Matrix				Transposed Matrix		
	HBW	HBW HBE HBO NBO				HBE	HBO
Car	0.0867	0.0647	0.0192	0.0101	0.0058	0.0043	0.0192
Motorcycle	0.0272	0.0235	0.0082	0.0034	0.0018	0.0016	0.0082
Taxi	0.1379	0.1029	0.0305	0.0161	0.0092	0.0069	0.0305

Peak Hour Factor Constants

Source: UTDM

The resulting matrix is still in the form of the person trip. Hence, it is necessary to convert the values to a PCU format using the following two factors.

Vehicle Type	PCU	Vehicle Occupancy Factor Trip Purpose			
	Factor	HBW	NHB		
Car	1	1.73	2.32	2.08	1.97
Motorcycle	0.25	1.38	1.6	1.22	1.47
Taxi	1	1.43	1.43	1.43	1.43

Vehicle Occupancy and PCU Factors

Source: UTDM

A5.8 TRAFFIC ASSIGNMENT

The traffic forecast in this study is to be based on 2011 assignment result of Din Daeng district in URMAP. To these assignments, the traffic increase by

implementation of the Plan in 2011 is added to the road network to examine the congestion ratio on each link. The 2001 and 2011 assignment results of Din Daeng District in URMAP are shown in following figures.



Source: URMAP





Source: URMAP

2011 AM Peak Volume in Din Daeng District

For this study, the road network including new roads in DC Area in 2011were assumed to be as shown below which is the one for Alternative A of the Plan. For the traffic assignment, each link of road network has been vested with



information of speed, capacity and directional regulation.

Road Network of Din Daeng Area (100ha) in 2011

(1) Assumption of Traffic Assignment

- Traffic volumes of turning movement were determined referring to the ratio of turning movement found out by the traffic survey conducted the Study.
- Traffic increases by the Plan were assumed to be assigned to the following directions in corresponding to each zone.



Direction of Din Daeng Area (100ha)

The software used for the traffic assignment is JICA STRADA (System for Traffic Demand Analysis). Following figures show the result of traffic demand forecast for the DC Area (100ha) in 2011.





Source: JICA STRADA





2011 Turning Movement of Din Daeng Road - Wiphawadi Randsit Road Junction



2011 Turning Movement of Din Daeng Road - Prachasongkhro Road Junction



2011 Turning Movement of Prachasongkhro Road Junction

(2) Diversion of Traffic

In the URMAP, Jaturathid Road which runs in parallel with the Din Daeng Road has not been included as a future road. It is therefore necessary to consider the effect of diverting traffic because Jaturathid Road as a new bypass is expected to play an important role to connect the east and west areas directly. Since this road is still under construction at present, the Din Daeng Road is the sole road for traffic movement of the east-west as illustrated below.



Present Traffic Movement of East-West

Upon completion of the Jaturathid Road part of the traffic, say half, could be diverted from the Din Daeng Road, as illustrated below.



Traffic Movement of East-West Considering Diversion Traffic

(3) Revised Traffic

Considering the above diversion traffic to the Jaturathid Road, the traffic demand forecast for the DC Area (100ha) in 2011 will be as illustrated below.





2011 Turning Movement of Din Daeng Road - Wiphawadi Randsit Road Junction Considering Diversion Traffic





A5.9 EVALUATION OF AFTER-REDEVELOPMENT TRAFFIC CONDITION

In this section, future traffic condition in and around DC Area is evaluated with future traffic volumes which have been calculated in the preceding section.

A5.9.1 METHOD OF EVALUATION

Evaluation for traffic condition was carried out calculating congestion ratio on each road link and saturation degree at major road intersections.

(1) Subject section for evaluation

Subjected sections for evaluation were selected from highly frequented and highly functional roads.

Since the sections that have been selected are located surrounding the re-developed area, they are considered to be highly representative of the future traffic conditions. They are namely Wiphawadi Rangsit Road, Din Daeng Road, Pracha songkhro Road, Mit Mitri Road as illustrated below.

Subjected intersections for evaluation were selected from the points of crossing of the above subject links. Wiphawadi Rangsit Road- Din Daeng Road, Wiphawadi Rangsit Road- Mit Mitri Road, Pracha Songkhro Road-Mit Mitri Road, Pracha songkhro Road- Din Daeng Road were thus picked up. However, the junction at Wiphawadi Rangsit Road- Mit Mitri Road was excluded from the evaluation because here traffic is limited to one way exit from Mit Mitri to Wiphawadi Rangsit.



(2) Factors of cosideration

1) Congestion ratio on links

Traffic Volume : forecasted hourly peak traffic volume in target year

Road traffic capacity : refer to URMAP Study

Congestion ratio is obtained by dividing forecasted traffic volume by road capacity considering the effect of inclease of traffic volume by re-development.

2) Saturation degree at intersection

Turning movement traffic volume: forecasted hourly peak traffic volume on target year (refer to the following figure)

Phasing Pattern: Cycle time is set at less than 180 seconds and phasing pattern



Din Daeng Road - Wiphawadi Randsit Road Junction Din Daeng Road -Prachasongkhro Road Junction



Mit Mitri Road - Prachasongkhro Road Junction




Calculation result of saturation degree at major intersections



A5.9.2 Evaluation of Future Traffic Conditions

Above figures show calculated congestion ratios and saturation degrees. As seen, there is no links where the congestion ratio exceeds 1.0. Also there is no intersection where sturation degrees exceed 1.0. Consequently, it can be claimed that by implementation of the Plan in DC Area, traffic volume will not overload the major roads and intersections in and around DC Area.

APPENDIX-6: INITIAL ENVIRONMENTAL EXAMINATION

The objectives of Initial Environmental Examination (IEE) for Din Daeng Community Area (DC Area) are to review the existing environmental conditions and preliminarily identify the potential impacts due to the proposed redevelopment project (the Plan). The Plan as has been described in the previous Chapters, includes construction of medium to high rise housing buildings with 8,700 housing units, large scale commercial facility with 100,000 m² floor and 6,500 m² of neighborhood shop, plaza, local community rejuvenation center, green area, road s and a bus terminal. Activities of such redevelopment could create impacts on environment to the extent as described below.

A6.1 TOPOGRAPHY, GEOLOGY, SEISMOLOGY AND GROUNDWATER

A6.1.1 Existing Condition

The place for the BMA's proposed new city hall used to be where there was a compost factory during 1961-1977 and where approximately 500,000 m3 of solid waste had been dumped over the ground. In 1977, garbage disposal was transferred to several other landfill sites, for instances to Demonstration School and Faculty of Veterinary in Kasetsart University and Wichutit School. Besides garbage, night soil was transferred into cement lined ponds approximately 10 m wide, 10 m. long and 0.80 m. deep, and dispersed to dry covering an area 3,200 m² where a part of Cho 7 Building in Block 1.11 and part of DD5 building are currently located. Other than these areas, there is no record of solid waste disposal elsewhere in DC Area.

DC Area is located on a plain land of which ground elevation ranges from 0 to +1.1 m MSL. There is Khlong Sam Sen Nai on the south and Lamrang beside Mae Phra Fatima Church

Geology of DC Area is consisted of alluvial deposit of quaternary age. Soil profile comprises the Bangkok Soft Clay 1-25m thick, the first sand layer 25-43m thick which is the foundation level for high rise building and the second sand layer 43-51m. thick. Between these two sand layers, there is a stiff clay which is more compressible than the Bangkok Soft Clay.

DC Area is located in a low seismic zone and no earthquake has been recorded. Rate of land subsidence is about 1-3 cm/year and receding rate of ground water about 2-3 m/year. There is no record of water well in DC Area.

A6.1.2 Impact Assessment

Construction Phase: DC Area has been densely built up as an urban community. Therefore, the redevelopment project involving construction of buildings and other physical facilities may not cause any significant impact on the features of topography and geology. The Area is included in low seismic zone, therefore impact on this aspect is also negligible. The garbage and night soil disposal in open dump 40 years previously may not cause an explosion of methane gas because they were dumped on the open ground not in the landfill, however it may have contaminated groundwater in the past 40 years. The groundwater contamination, however, is not a major issue in this redevelopment project because there is no plan of making water well in the Plan.

Operation Phase: None

A6.1.3 Mitigation Measure

Construction and operation Phases: None

A6.2 STORM WATER AND WASTEWATER

A6.2.1 Existing Condition

Wastewater from septic tanks and other sources generated in DC Area (12,743 m³/d estimated in the year 2000) is being directly discharged into drainage pipes, khlong Sam Sen Nai and eventually to Chao Phraya River. This is causing high deterioration of water in Khlong Sam Sen Nai although Department of Drainage and Sewerage pumps in water from Chao Phraya River to dilute water in khlong Sam Sen Nai during dry season (December-April). The water in Khlong Sam Sen during 1997-2000 was characterized by low DO (0-0.2 mg/l), high concentration of BOD₅ (39-49 mg/l) and contamination by high amount of total coliform bacteria ($2.3x10^{6}$ - $3.9x10^{7}$ MPN/100ml). The water is green to black in color with bad smell, unsuitable for aquatic life and human consumption.

A6.2.2 Impact Assessment

Construction Phase: Wastewater will be generated in the construction sites and labor camps. Wastewater from construction sites may contain large amount of suspended solids due to the site preparation work and washing construction equipment, while that from labor camps may contain large amount of organic substances. Wastewater from these sources will deteriorate water quality in the khlongs unless properly treated.

Operation Phase: Wastewater from septic tanks and general wastewater from redevelopment project (15,819 m^3/d estimated in the year 2011) will be collected for treatment in Din Daeng Sewerage Treatment Plant Stage-1 (the Treatment Plant) having a capacity of 350,000 m³/d. The Treatment Plant is being constructed on 17 Rai land near BMA City Hall on Mit Mitri Road and scheduled to be completed in December 2002. This Plant is one of the six Central Wastewater Treatment Plants in BMA. The system is of activated sludge, comprising biological activated sludge process with nutrients (nitrogen and phosphor) and odor removal, and wastewater interceptor system with a total length 57 km to collect wastewater from eight districts namely, Pom Prab Sattru Phai District, Samphanthawong District, Pathum Wan District, Ratchathewi District and part of Phra Nakhon District, Dusit District, Phaya Thai District and Din Daeng District. Effluent from the Plant will meet the effluent quality standard prior to discharge to Makkasan Pond as a receptor, and sludge from the Plant will be digested and dehydrated at Nong Khaem Sludge Treatment Center before disposal in a landfill site or for agricultural use. The Plant's capacity will be sufficient to accommodate the wastewater $15,819 \text{ m}^3/\text{d}$ generated in DC Area after execution of the redevelopment. With this treatment system, water quality of khlong Sam Sen Nai should be improved and suitable for aquatic life.

A6.2.3 Mitigation Measure

Construction Phase: Temporary settling basin should be provided at the construction sites to reduce the high amounts of suspended solids. Moreover, an adequate bathroom and toilet including on-site wastewater treatment unit such as septic tank should be provided to treat wastewater from the labor camps. The bathroom and toilet should be designed to comply with the Specification of Bathroom and Toilet Structures by Engineering Institutes of Thailand under His Majesty's King Patronage, B.E. 2534

Operation Phase: Although the Treatment Plant Stage-1 is capable of treating wastewater from the redevelopment projects, the sewage pipelines should be properly designed according to the land use allocation of the redevelopment projects in order for them to be well integrated in the treatment process of the Plant. It is also recommended to regularly examine the quality of effluent prior to discharge to the Makkasan Pond. Besides, the septic tanks should be regularly maintained to effectively treat waste water.

A6.3 SOLID WASTE

A6.3.1 Existing Condition

(1) Solid waste collection in Din Daeng District

Solid waste generation in Din Daeng District decreased by about 10% from 336 ton/day in 1999 to 304 ton/day in 2000

Din Daeng District does not have solid waste receiving site, except a small one in the BMA City Hall compound where dried solid waste is compacted in-situ by 10 ton-compactor truck before transported to On Nuch transfer site. Consequently, the solid waste is daily collected during 03.00-06.00 hours a.m., 3 times/day along the main and sub roads, short cut roads, at school and market places, while it is collected 1 time/day in every two days in the alleys, and twice a week at high-rise buildings, condominium and NHA's Housing Complex sites. Solid waste in Din Daeng District is collected by 73 collecting vehicles having capacity between 1-10 ton. Capacity of the existing collecting vehicles totally is 266 ton and the maximum trips is 2 trips/vehicle/day.

The solid waste in Din Daeng District is prescribed to be collected in 75 trips/day and directly hauled to the transfer sites at On Nuch (Khet Prawet) and Tha Raeng (Khet Bangkhen). The problems of waste collection are, firstly difficulty of waste collection in the alleys and crowded communities especially in the NHA's Din Daeng Housing Complex where accesses are narrow and obstructed by commercial activities, secondly uncollected waste which has been damped outside the designated time causing bad smell and ugly view, and thirdly illegal disposal on idle private land.

(2) Waste collection in NHA's Housing Complex

Solid waste from NHA's Din Daeng Housing Complex is disposed of through the garbage chute within the building causing waste dispersion and bad smell in the disposal pit. The waste is then taken out from the pit, piled in front of it and collected by the workers of Din Daeng District. Left over waste is causing bad smell and eyesores regularly in these communities. Campaigns for exercising separation of the waste has not been successful in these communities. Handling of waste in here is carried out by contractors on annual contract as follows:.

Din Daeng Community 1 (Flat N0. 1-20 and No.21-32); 11 workers (age between 18-55 years) are engaged during 08.00-17.00 p.m. hours except holiday to clean the whole area, maintain trees, inspect and inform the staff of NHA if any facilities of NHA are out of order.

Din Daeng Community 2 (Flat No. 33-64, Flat Cho 1-Cho 6 and Flat Cho 7-Cho11); the committee of the community receives a part of the subsidy from NHA and payment from the residents to engage 5 workers to handle the solid waste, cleansing the area and flats along the Pracha Songkrou Road, during 10.00 a.m.-13.00 p.m. hours.

A6.3.2 Impact assessment

Construction Phase: The impact will mainly be caused by waste generation from demolition of the existing flats and construction materials as well as from labors.

Operation Phase: The Study has estimated a solid waste generation in Din Daeng Area during 2000-2015. The waste quantity will increase by 20.7 ton/day from 304.8 ton/day in 2000 to 325.5 ton/day in 2015 without the redevelopment projects, while the increase will be 78.8 ton/day from 304.8 ton/d in 2000 to 383.6 ton/day in 2015 with the project implementation. The required trip during 2000-2015 will be less than 2 trips/vehicle/day in both with and without the project. The estimation is also extended to the waste quantity in DC Area where its quantity will increase by 21 ton/day from 44.81 ton/day in 2000 to 65.89 ton/day in 2015 with the development projects. The increase of waste 21 ton/day in 2015 could be transferred to On Nuch (existing capacity 3,650 ton/day) and Tha Raeng (existing capacity 2,356 ton/day) sites that are planned to be enlarged of their capacities in 2019 to 6,500 ton/day and 4,300 ton/day respectively

according to the master plan formulated by PCD in 1999. Therefore, the increase of waste due to the redevelopment projects could still be accommodated.

A6.3.3 Mitigation Measure

Construction Phase: Waste from demolition and construction materials should be collected and disposed of outside the project sites. Garbage bins and disposal spots should be adequately provided in the construction sites. Operation Phase: Although the increase of solid waste from the project implementation could still be accommodated at the disposal sites, it is recommended to keep DC Area better livable by campaigning to reduce the waste generation, separation of the waste, enhancing efficiency of waste collection and provision of adequate garbage bins and disposal spots.

A6.4 AIR QUALITY

A6.4.1 Existing Condition

The air quality as characterized by concentrations of sulfur dioxide (SO₂), lead (Pb) and Total Suspended Particulate (TSP) is within the MOSTE Standard. The TSP, SO₂ and Pb values range from 0.070-0.156 mg/m³, less than 0.001-0.051 mg/m³ and 0.0007-0.3550 μ g/m³, respectively.

A6.4.2 Impact Assessment

Construction Phase: Fugitive dust from demolition of the existing flats and hauling of construction materials may cause a health hazard to labors and vicinity residents. This is particularly true of particle matters with its size less than 10 micron (PM-10) when inhaled through the inner respiratory system often causing bronchitis. Moreover, the fugitive dust will impair visual amenities and smear the nearby buildings.

Operation Phase: The increasing traffic volumes on the roads may cause deterioration of air quality or pose some health problem to the vicinity population.

A6.4.3 Mitigation Measure

Construction Phase; The fugitive dust has to be suppressed taking the measures as prescribed by the following laws:

• Ministerial Announcement, B.E. 2534 regarding criteria, methods and

conditions of construction, modification, demolition or removal of buildings to prevent hazards to life, health and property of people and the Ministerial Regulation No.4 regarding criteria, methods and conditions of construction, removal, utilization or change of the building issued under the Building Control Act, B.E. 2522

- Statute of Bangkok Metropolitan Administration, B.E. 2523 regarding maintenance of cleanliness and order in Bangkok Metropolis; and the Maintenance of the Country Cleanliness and Order Act.
- Request for cooperation from the contractor to control dust from the construction.
- In addition, transportation routes of materials has to be properly developed in order to prevent traffic congestion which is a major cause of air pollution. The design of buildings should also consider to secure natural ventilation to maintain air quality.

Operation Phase: None

A6.5 NOISE LEVEL

A6.5.1 Existing Condition

Noise in DC Area is mainly caused by traffic, however the noise level in the Area is not currently available except at the police station near the Rama IX junction where Leq(24) ranges from 77.2-78.1 dB(A) and at Dokya Bookstore around the Victory Monument where Leq(24) ranges from 76.9-79.2 dB(A). These noise levels exceed the ambient noise standard (70 dB(A)).

A6.5.2 Impact Assessment

Construction Phase: Noise will be generated by demolition of the existing flats, driving foundation piles and construction of the new buildings.

Operation Phase: Noise is mainly caused by traffic congestion due to increase of traffic volumes.

A6.5.3 Mitigation Measure

Construction Phase: Noise should be suppressed adopting an appropriate technique such as wet piling, provision of fence around the construction sites, provision of ear protection to the labors and limiting the speed of trucks.

Operation phase: Developing a transportation system to reduce the traffic congestion.

A6.6 HYDROLOGY/DRAINAGE SYSTEM/FLOOD CONTROL

A6.6.1 Existing Condition

Din Daeng Area is protected from flood water by Din Daeng Sub Polder which is bordering along Wiphawadi Rangsit Road, Ratchada Phisek Road, Khlong Bang Sua and Khlong Sam Sen. Moreover, flood water is pumped out to khlong Sam Sen at the two main pumping stations at Khlong Nha Song and at Maephra Fatima. Therefore, flood is not a potential problem in this area with regular maintenance of drainage facility to evacuate storm water. However, there still remeains some local inundation in NHA's Housing Complex and cul-de-sac parts of the narrow roads.

A6.6.2 Impact Assessment

Construction Phase: Construction waste may if unchecked block the flow in the drainage pipes.

Operation Phase: The Study has proposed to revise the drainage pipes in DC Area according to the new land use allocation. Capacity of drainage pipes and pumping stations will be improved on the basis of 5-year return period. Run off water at a rate about 13 m³/s is designed to be discharged from the sub-catchment areas no. I, II, III and IV of DC Area to the water course along Wiphawadi Rangsit Road (ref. Figure). This large water discharge may cause flood to the nearby area.

A6.6.3 Mitigation Measure

Construction Phase: The waste disposal spots should be provided in the construction sites to prevent construction waste from flowing into the drainage pipes. The water course along Wiphawadi Rangsit Road should be properly modified to receive 13 m^3 /s run off water.

Operation Phase: Coordinate and cooperative with Din Daeng District office to conduct the flood protection programs and regularly check the efficiency of drain channels which are designed to receive runoff water from DC Area.

A6.7 LAND USE

A6.7.1 Existing Condition

The land users in DC Area is mainly composed of several government agencies such as BMA City Hall (40.7%), NHA (32.6%), Ministry of Education (7.1%), Ministry of Public Health (5.9%), Ministry of Labor and Social Welfare (4.1%), Ministry of Industry (0.65%), Office of Prime Minister (0.133%) and others (8.61%). This type of land use is compatible with the land use plan of Department of Town and Country Planning.

A6.7.2 Impact Assessment

Construction and Operation Phases: The Plan has proposed to construct medium to high rise housing buildings, large scale commercial facility, local community rejuvenation center, plaza, green area, bus terminal and expansion of roads. These developments will not induce any adverse impact on land use because the facilities are compatible with the land use as designated by the Department of Town and Country Planning. However, the re-allocation of lands for alteration of BMA and NHA facilities to enhance the land use efficiency will require a great deal of negotiation.

A6.7.3 Mitigation Measure

Construction and Operation Phases: None

A6.8 TRANSPORTATION

A6.8.1 Existing Condition

DC Area can be accessed by two main and sub roads. The main roads linking the Area to other major parts of BMA are Wiphawadi-Rangsit Road on the west and Din Daeng Road on the south. The sub roads to facilitate access to DC Arae are Pracha Songkhro Road in the center and Mit Maitri Road on the north. Traffic condition in DC Area is heavy due to the narrow local roads which are directly connected to the main roads.

The Study has conducted a traffic survey during 8-12th January, 2001 on the roads around Din Daeng District (ref. Chapter). The surveyed roads include Wiphawadi Rangsit Road, Asoke-DinDaeng Road, Ratchadaphisek Road and

Sutthisarn Winitchai Road. These roads are mainly occupied by passenger cars and taxis, coaches and pick-up truck. The traffic volume is the highest on Wiphawadi Rangsit Road to Sutthisarn Intersection where the passenger car units (pcu) in the evening peak reaches 9,541, higher than morning peak 6,754 pcu.

Traffic volume at the junction of Wiphawadi Rangsit Road and Mit Maitri Road is 1,447 pcu during morning and 1,063 pcu during evening peaks in outgoing direction, while in the reverse direction from Mit Maitri Road to Wiphawadi Rangsit Road has a traffic volume 777 pcu during morning and 870 pcu during evening peaks. Traffic volume at a junction at Pracha Songkhro Road are 582 pcu and 843 pcu during morning and evening peaks respectively while in reverse direction from Pracha Songkhro Road has traffic volume 1,061 pcu during morning and 616 pcu during evening peaks.

The average travelling speed is the fastest (34.4 km/hr) on Nikom Makkasan Road during morning peak due to fewer connecting roads, while it is slower on the roads with many connecting roads such as Prachasuk Road, Pracharat Bampen Road and Pracha Songkhro Road (range 10.9-19.7 km/hr.).

Among the vehicles, motor bikes are one of the most popular vehicles in DC Area. However, there is no motor bike route. Consequently motor bikes have to share the carriageway with other vehicles and exposed to a high accident risk.

The pedestrian walkway along Pracha Songkhro Road and the market area is crowded during rush hours. The poor condition of pedestrian walkway and the surrounding area is causing inconvenience to the pedestrians at all time.

A6.8.2 Impact Assessment

Construction Phase: Increase of traffic volumes due to the trucks hauling construction materials may damage the road surface and increase the chance of traffic accident.

Operation Phase: The redevelopment project will increase population by at least 73,000 in DC Area and may slightly increase the traffic volume as forecasted in 2011 by the Study. The forecast indicates slight increase of traffic volume on the main roads namely Din Daeng Road, Asoke-Din Daeng Road, Ratchadaphisek Road, Sutthisarn Winitchai Road and the sub roads such as Mit Maitri Road, Pracha Songkhro Road, and Pracha Suk Road, while the traffic volume on Wiphawadi Rangsit Road will be decreased.

A6.8.3 Mitigation Measure

Construction Phase: The Regulating Signs and Warning Signs should be installed and force the trucks to follow the Land Transportation Act.

Operation Phase: The traffic signal should be sufficiently provided to suite to the traffic volume and turning movement.

A6.9 UTILITY

A6.9.1 Existing Condition

(1) Water supply

Metropolitan Waterworks Authority (MWA) produces and distributes water for consumers in BMA, Nonthaburi and Samut Prakarn, covering 3,080 km² area. Water is produced at 7 water treatment plants with a total capacity 4.47 million m3 (MCM)/day in 2000.

In Din Daeng District, the water demand is estimated at 94,170 m³/day in 2000. The MWA (Phaya Thai Branch Office) is responsible for water supply system in Din Daeng District through the pipes connected to Phahon Yothin Pumping Station. The water supply system of Din Daeng District comprises steel pipe in 1,200 mm dia. along Asoke-Din Daeng Road, Ratchadaphisek Road and Wiphawadi Road. Asbestos cement pipe in 300 mm dia. is used along Mitmitri Road, and Prachasongkro Road. The asbestos cement pipe should be replaced with steel pipes to reduce leakage. Each building provides a water tank in the ground and on the roof.

(2) **Power Supply**

Metropolitan Electricity Authority (MEA) distributes electricity to customers in BMA, Nontha Buri and Samut Prakarn of which peak demand was 5,357 MW in 1999.

In Din Daeng District, the maximum electricity demand is 39.4 MW in 2001 and the power is supplied from San Saeb substation (capacity 3x40 MVA) which receives power from Ratchadaphisek terminal station (2x300 MVA). In NHA's Din Daeng Housing Complex, power is distributed to each building unit with cable installed at the building's front canopy. On each floor, there are individual electric meter to record the power consumption.

A6.9.2 Impact Assessment

(1) Water Supply

Construction and Operation Phases: Metropolitan Waterworks Authority is producing 4.47 Mm3/day in 2000 and plans to generate 6.48 and 7.9 Mm3/day in 2007 and 2015, respectively according to the Master Plan of MWA in 1990.

In Din Daeng District, the water demand was 93,196 m³/day in 1990 and estimated to decrease to 78,654 m³/day in 2015 without the redevelopment project. In case of implementation of the redevelopment project, water demand is estimated at 92,690 m³/day, less than the 93,196 m³/day as estimated in 1990.

In DC Area, the water demand is 12,945 m^3 /day in 2001 and estimated to rise to 15,819 m^3 /day after implementation of the redevelopment project in 2015. The increase of water demand during 2001 and 2015 is about 22% and could be accommodated by MWA. Therefore, there would be no problem in water supply for project implementation.

(2) **Power Supply**

Construction and Operation Phases: In Din Daeng Area, the maximum power demand is 34.20 MW in 2001 and will increase to 77.8 MW in 2015 after redevelopment projects. Total electricity demand in 2015 is about 117.3 MW (130.4 MVA) which will exceed the existing capacity of San Saeb substation. However, MEA plans to improve the power supply system in DC Area by construction of Wiphawadi terminal station (2x300 MVA) that will be put in operation in 2002, and Din Daeng substation (2x60 MVA) in 2004 and to upgrade the distribution line from 12 kV to 24 kV by 2002. These improvements will cover the additional electricity demand in 2015

A6.9.3 Mitigation Measure

Construction and Operation Phases: None

A6.10. SOCIOECONOMIC

A6.10.1 Existing Condition

In 2001, there is 46,200 population in DC Area and the proportion of female to male is 1.23:1. Most of them are aged between 20-44 years. They are being educated at primary school level (30.7 %), bachelor (20%), secondary school as Matthayom 4-6 (19.4 %), secondary school as Matthayom 1-3 (10.6%) and diploma (10%). There are about 4.6 % who never attended any school, and the rests are educated at higher than bachelor level. Many residents are not employed (34.2%) and the remaining is labor (21.1%), wage earner (16.1%) and government service workers (12.9%). The average income is 14,008 bath/household/month

Regarding the attitude of residents on the redevelopment project, there are about 51%, 38% and 11% of households who are not in favor, in favor and uncertain respectively based on their abilities to secure the new residences.

The socio-economic problems in Din Daeng Community found out on the workshop with community leaders are increase of crimes, drug addicts, illegal money trades, gambles, disorderly use of flats, lack of public health center and recreation facility, illegal immigrants from Cambodia and Burma.

A6.10.2 Impact Assessment

Construction Phase: The relocation of people from the present flats is a major concerns and calls for a proper plan as well as fair compensation. On the other hand, immigrating labor from the other areas would increase the crimes, and public health problem.

Operation Phase: The Study team has estimated the number of population in DC Area (ref. Table)

In 2011, the increase of 26,800 population is mainly the employees working for BMA and customers to the large-scale commercial facility. The proportion of female to male is estimated at 1.2:1 and most of them are in the age group between 30-49 years. The increasing population may positively influence the local society. However, the traffic congestion, increase of crimes and security risk could be negative impacts.

A6.10.3 Mitigation Measure

Construction Phase: The relocation of residents should be seriously conducted.

A6.11 HISTORICAL AND ARCHAEOLOGY

A6.11.1 Existing Condition

There is no registered historical or archaeological place in DC Area based on the registered ancient document in BMA. However, there is Muharin Mosque on Mit Maitri Road.

A6.11.2 Impact Assessment

Construction Phase: The construction activity may temporarily impair scenery of the Area.

Operation Phase: The redevelopment project does not plan to remove Muharin mosque. On the other hand, it plans to develop larger green area. This would improve spatial environment.

A6.11.3 Mitigation Measure

Construction and Operation Phases: None

A6.12 RECREATION AREA

A6.12.1 Existing Condition

There are two recreation facilities in the Area, namely Thai-Japan Youth Center and Wiphawadi forest plantation. The Youth Center is a green area and sport ground comprising soccer field, running track, volleyball, basketball, badminton courts and swimming pool. The Wiphawadi forest plantation is a village public park located on Mit Maitri Road.

A6.12.2 Impact Assessment

Construction Phase: Relocation of the indoor gymnasium if executed may deprive the Area temporarily of indoor recreation facility. Operation Phase: The Plan proposes to develop green area on the left of Muharin mosque and other areas increasing the recreation (open green area) to 204,981m2 in 2011.

The BMA Comprehensive Plan has proposed the rate of recreation area per capita to be 2 m²/person for the next 5 years and 10 m²/person for the longer period. The recreation area in DC Area will be 149,914 m² resulting in per capita rate 3.2 m²/person in 2001 based on 46,160 population. The recreation area per capita in 2011 will be decreased to 2.8 m²/person in 2011 based on the recreation area $204,981 \text{ m}^2$ and 73,000 population.

A6.12.3 Mitigation Measure

Construction and Operation Phase: The recreation area should be maintained at the required level to preserve a healthy living environment in DC Area.

A6.13 PUBLIC HEALTH

A6.13.1 Existing Condition

DC Area is in Public Health Center Region 4 Din Daeng serving for general illness during the official hours. Number of patients increased during 1995 to 1999 from 15,899 to 30,197. The increasing rate of patient is relatively higher at 17.76% compared to the surrounding public health center region. The nearby Public Health Centers include Public Health Center Regions 2 Ratchathewi, Public Health Center Regions 25 Huai Khwang and Public Health Center Regions 52 Huai Khwang where the annual increasing rate of patient were 9.11%, 7.59% and 1.62%, respectively. These public health centers provide two medical doctors to serve 40-60 patients/day and also provide the medical security card for poor people. Moreover, there are mobile medical service for general illness 4 times/month, 10 public hospitals and 2 private hospitals in and around the Area. These hospitals have 5,301 beds serving the in-patient and the emergency case.

Most of the disease groups in DC Area are respiratory disease, cardiovascular disease, dermatological disease, endocrine, malnutrition and metabolism disease, musculo-skeletal disease and gastrointestinal disease.

A6.13.2 Impact Assessment

Construction Phase: The labor and residents in the neighborhood may have health problem due to noise and air pollution, dust and traffic accident.

Operation Phase: The increase of 73,000 population in DC Area may require a sufficient public health facilities and medi-care personnels.

A6.13.3 Mitigation Measure

Construction: Follow the security and accident prevention measures during demolition and construction works to assure the safety for labor and residents in the neighborhood.

Operation Phase: The public health facilities and medical personnels should be adequately provided.

A6.14 CONCLUSION

Based on the existing environmental condition and the facilities to be developed in the Plan, the preliminarily identified potential impact on environment has been assessed. The major environmental concerns may include traffic congestion which would induce air and noise pollution, disposal of wastewater and solid waste as well as socioeconomic aspects. The impact and mitigation measures for each aspect have been discussed above. The results from this study will further be studied in detail through the Environmental Impact Assessment which will be submitted to OEPP for approval prior to start of the redevelopment the projects. This will be performed according to Enhancement and Conservation of National Environmental Quality Act, B.E. 2535, section 46.

APPENDIX-7:

ECONOMIC EVALUATION

A7.1 COSTS

Cost items in the initial project cost and operation and maintenance cost (O/M cost) were assumed to be constituted of the following items:

Description	Unit Price	Remarks		
Initial Cost	(same with unit prices for financial evaluation.)			
Survey, Design and Planning Cost				
Land Clearance Cost				
Demolition and Land Readjustment Cost				
Construction Cost				
Building Construction Cost		BMA city hall was estimated at an unit floor cost 16,000 Baht/m2		
Landscape Construction Cost				
Infrastructure Construction Cost				
Public Facility Construction Cost				
Relocation of School and Office				
Operation & Maintenance Cost				
Commercial Facility	Floor Area*60%*9600Baht/sq.m* 20%–3650million Baht/30years	OM cost was computed applying certain rate to the market floor rent, excluding lease hold fee portion.		
Social Service Space	Floor Area*60%*6000Baht/sq.m* 20%	OM cost was computed applying 20% to floor rent.		
Road	1%/build.cost	!% of construction cost		
Utilities	2%/build.cost	2% of construction cost		

Project Cost

(1) Initial Cost

Initial project cost was computed including the construction cost and O/M cost for the BMA new city hall (total floor area 423,300m2). The transfer payment items like compensation expense, and reserved money in the project management cost of which dispense has not been identified were excluded from the initial cost.

(2) Operation and Management Cost

O/M costs were considered for the buildings, roads and public utilities to be developed under the project.

 O/M cost for commercial and social service facilities were assumed to be composed of personnel expense for management of the facilities, water and energy cost, cleaning cost, security expense, repair cost, and other administrative cost. As these O/M costs normally amounts to about 20% of the rent collectively, their total was figured out by multiplying 20% to the assumed floor rent.

It is noted that the lease hold fee (for 30 years) for the commercial facility was reflected in the cash flow not independently but by deducting the O/M cost portion from the floor rent, although theoretically speaking it should be designated as benefit accrued by the project as it is revenue to the project.

- 2) Administration and repair costs in residential buildings were not counted in the O/M cost. The same cost items occur both in "with project " and "without project" cases, number of housing units are the same in both cases (between existing and renewed houses) and the difference between the existing O/M cost and that of after-project are very much the same and their share in the overall cost is minimal.
- 3) O/M cost for the new BMA city hall was not counted separately as, in the comparison between "with project" and "without project", the current O/M cost and rent being paid to private sector will be equivalent to the O/M cost for the new city hall.
- 4) Car park is appurtenant facility to residential building and commercial facility. O/M cost for the car park in the commercial facility is a part of the overall O/M cost, and therefore, does not have to be counted separately. Regarding the car park in the residential building, O/M cost for it does not have to be counted as well because a car park charge is collected separately from the house rent and benefit and cost there would offset each other.

5) O/M cost for roads and public utilities were assumed to be 1% and 2% of construction costs respectively.

A7.2 BENEFIT

Benefit accrued from the project were assumed to be the following items:

	i ioject benent	
Description	Valuation indicator	Remarks
Value created by commercial facility	Profit from commercial floor lease	Evaluation of building by expected sales amount and average profit ratio based on demand forecast. Rentable (saleable) floor area: 153,300m2 Expected sales amount: 1,801 million Baht/year Profit ratio: 1.8%
Value created by residential building	House rent	Evaluation of building by house rent at market rate derived from new residential units (difference amount between current and market rate) House rent: 140 Baht/m2/month
Improvement of accessibility by consolidation of administrative/social services in new BMA city hall	Transport benefit (vehicle operation cost, travelling time reduction)	Evaluation of transport benefit by improved accessibility for approx. 26,000 employees in and visitors to new BMA city hall.
Increase of values in land, buildings and others in surrounding area.	Transport benefit (vehicle operation cost, travelling time reduction)	Evaluation of transport benefit by improved accessibility to new commercial facility in 153,300m2 floor area for customers in and around the project area.

Project Benefit

Primary direct benefit accrued by an urban redevelopment project can be substituted by the new value created by new buildings and associated facilities. In the Din Daeng Community Redevelopment Plan, major developed items are residential buildings, commercial facility and new BMA city hall. Direct benefits from these facilities are considered to be represented by house rent in the residential buildings, and floor rent in the commercial facility. These benefits were measured in monetary term year by year as the indicative value of these facilities.

Though the new BMA city hall is not a profit oriented building, it could be appraised from indirect benefit facet; contribution to improvement of accessibility to municipal administration and social services by consolidation of these functions to Din Daeng. This will counter the tendency of concentration of commercial and business function into inner city which would accompany traffic congestion and pollution and cause gravity shift of resident population toward suburbs.

Generally, an urban redevelopment induces rise of value of fixed property in and around the project site on account of comprehensive improvement of urban environment by development of roads, parks, public utilities, residences and other service facilities. Improvement of accessibility to commercial/business establishment or public transport hub, for instance, would raise value of land in the vicinity. In this context, the indirect benefit attributable to improvement of accessibility in the Plan was appraised in terms of an expected rise in land value (land price).

(1) Value of new commercial facility: 2,001.1 million Baht/year

Profit generated at approx.153,300m2 saleable commercial floor is considered to be indicative value of the building. Based upon a "Huff Model" demand analysis for commercial facility in Din Daeng area, an expected annual sales amount from 153,300m2 floor space is approx. 11,117 million Bahts. Applying the average profit ratio (gross profit/sales amount) 18% in the department stores and discount shops in Bangkok, one will get a profit of 2,0001.1 million Bahts.

<u>Annual profit of commercial facility: 2,001.1million Baht = 11,117.1million Baht*</u> <u>18% (upon opening of all commercial facility)</u>

-	
Туре	Gross profit/Sales amount
Department Store	18%
Discount Store	18%
Super Market	11%
Convenience Store	18%
Overall	13%

Average of Gross Profit/Sales Amount of Retailer (1999)

Source: Financial data of 15 major retailers (1999)

(2) Value of new residential building: 387.2million Baht/year

Value of the residential building can be translated to the sum of house rent earned from the new residential units in as many as approx. 7,000 in numbers. Current market rate of house rent in Din Daeng area has been found out to be 140 Baht/m2/month while the one in NHA housing is 14 Baht/m2/month on average according to the survey by the Study. By renewing the residential buildings by the

Plan, it is theoretically possible to charge the market rent to the residents, either they be returning or new ones on the ground that the residential units and living environment have been substantially upgraded. Consequently, the difference of earning of house rent between "without project" and "with project" can be taken as the benefit accrued from the Plan.

Total rent revenue from new residences (upon completion of all)	422.0million Baht/year
Total rent revenue from current residences (those subjected to renewal, as of 2001)	34.8million Baht/year
Benefit	387.2million Baht/year

(3) Improvement of accessibility by new BMA city hall: 94.9million Baht/year

Transport benefit accrued from the new BMA city hall was examine in the following steps:

-Object persons: approx. 26,000

This number is the difference between the expected total number of employees in the new city hall approx.40,000 and the current municipal employees working in existing municipal offices approx.14,000. There will be a number of visitors on top of these personnel.

-Assumed number of trip generation/attraction: 13,041.3 PCU/day

Trip generation/attraction was examined about the new BMA city hall between "without project" and "with project". The "without project" case is the current situation where approx.26,000 employees commuting to the municipal offices in Phra Nakhon district while the "with project" case is where all these people commute to the new city hall in Din Daeng.

Using the traffic forecast model applied in the traffic demand forecast in the previous Chapter, it was found out that there will be a trip generation/attraction approx.13,041.3 PCU/day.

-Assumed annual travel distance · vehicle: Reduction by 8.4%

Annual travel distance \cdot vehicle by each zone was summed up and compared between "without project" and "with project". As a result, it was found out that

the sum of the annual travel distance \cdot vehicle would be reduced by about 8.4%. This implies that as Din Daeng area is closer to the population center, so is effective in the overall travel distance.

-Assumed transport benefit: 94.9 million Baht/year

Vehicle operating cost (VOC) and time saving cost were computed according to the following formula set down by "Highway Development and Management Model III (HDM III)", World Bank.

VOC=3.34+1.20*X (Baht/km)

X: Traveling time/km (minute)

Time saving cost=102.39 Baht/hour/PCU

(Source: "Feasibility Study for Ring Road in Southern Bangkok" JETRO, 2000)

The VOC and time cost saving between "without-project" and "with-project" cases could assumed to be as summarized in the following table.

VOC saving	55.7million Baht/year
Time saving cost	39.2million Baht/year
Total:	94.9million Baht/year

(4) Rise in value of surrounding area: 215.9 million Baht/year

An attempt was made to appraise the rise of value in the surrounding area of Din Daeng by measuring the impact that the new commercial facility of the Plan would give to the commercial convenience in the surrounding area.

Sum of travel distances for shopping of the residents in Din Daeng area was compared in "with project" and "without project" cases in "Huff Model" analysis for purchasing behavior in the year 2010. As turned out, the sum of travelling distance will reduce by 18.1% between them. The same measurement was attempted to examine the transport benefit in the surrounding area in the same way as for the new BMA city hall, and the economic benefit in this aspect was found out to reach 215.9 million Baht/year.

VOC saving	126.7million Baht/year
Time saving costs	89.2million Baht/year
Total:	215.9million Baht/year

			Survey,	Land	Construction (NHA Part)						
Y	'ear	Initial Cost	Design and Planning (NHA Part)	Clearance* (NHA Part)	Total	Building	Landscape	Road	Utility	Relocation of School	BMA city hall Construction
1	2545	216.4	7.9	5.1	203.4	179.7	2.7	12.6	0.0	8.4	0.0
2	2546	304.7	0.0	0.0	304.7	269.4	4.0	18.8	0.0	12.5	0.0
3	2547	1,022.8	37.6	42.3	942.9	857.6	15.4	60.0	9.9	0.0	0.0
4	2548	1,414.3	0.0	0.0	1,414.3	1,286.1	23.3	90.0	14.9	0.0	0.0
5	2549	272.3	7.2	0.0	265.1	164.9	27.6	66.5	6.1	0.0	0.0
6	2550	448.0	0.0	50.3	397.7	247.4	41.5	99.6	9.2	0.0	0.0
7	2551	4,038.5	38.2	133.7	1,162.0	873.7	10.1	6.3	229.3	42.6	2704.6
8	2552	5,799.6	0.0	0.0	1,742.6	1,310.5	15.2	9.4	343.7	63.8	4,057.0
9	2553	4,029.0	0.0	0.0	4,029.0	4,029.0	0.0	0.0	0.0	0.0	0.0
10	2554	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	2555	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	2007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	2550	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	2560	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	2561	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	2562	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	2563	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	2564	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	2565	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	2566	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	2567	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	2568	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	2569	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	2570	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	2571	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	2572	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	2573	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	2574	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	2575	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	2576	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	2577	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	2578	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	2579	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	2580	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	2581	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
აი 20	2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	2584	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	2585	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	2586	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	2587	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	2588	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	2589	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	2590	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	2591	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	2592	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	2593	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	2594	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Cash Flow of Initial Cost (Financial Rate) (Million Baht)

Note: "Land Clearance" is not included "Compensation" Cost.

Cash Flow of Operation & Maintenance Cost (Financial Rate)

(Million Baht)

Maar			Facility Maintenance (NHA Part)					
	Year	OM Cost	Commercial	Social Service	Road	Utility		
1	2545	0.0	0.0	0.0	0.0	0.0		
2	2546	1.6	0.8	0.7	0.1	0.0		
3	2547	3.9	2.0	1.6	0.3	0.0		
4	2548	8.9	3.6	4.2	0.9	0.2		
5	2549	16.3	6.0	8.0	1.8	0.5		
6	2550	17.2	6.1	8.0	2.5	0.6		
7	2551	18.6	6.3	8.0	3.5	0.8		
8	2552	25.3	6.3	10.1	3.5	5.4		
9	2553	35.4	6.3	13.2	3.6	12.3		
10	2554	186.8	157.7	13.2	3.6	12.3		
11	2555	186.8	157.7	13.2	3.6	12.3		
12	2556	186.8	157.7	13.2	3.6	12.3		
13	2557	186.8	157.7	13.2	3.6	12.3		
14	2558	186.8	157.7	13.2	3.6	12.3		
15	2559	186.8	157.7	13.2	3.6	12.3		
16	2560	186.8	157.7	13.2	3.6	12.3		
17	2561	186.8	157.7	13.2	3.6	12.3		
18	2562	186.8	157.7	13.2	3.6	12.3		
19	2563	186.8	157.7	13.2	3.6	12.3		
20	2564	186.8	157.7	13.2	3.6	12.3		
21	2565	186.8	157.7	13.2	3.6	12.0		
22	2566	186.8	157.7	13.2	3.6	12.0		
23	2567	186.8	157.7	13.2	3.6	12.0		
20	2568	186.8	157.7	13.2	3.6	12.3		
25	2569	186.8	157.7	13.2	3.0	12.3		
26	2505	186.8	157.7	13.2	3.0	12.3		
20	2570	186.8	157.7	13.2	3.6	12.0		
28	2572	186.8	157.7	13.2	3.0	12.3		
20	2572	186.8	157.7	13.2	3.0	12.3		
30	2573	186.8	157.7	13.2	3.0	12.3		
31	2575	186.8	157.7	13.2	3.0	12.3		
32	2576	186.8	157.7	13.2	3.0	12.3		
32	2570	100.0	157.7	13.2	3.0	12.3		
34	2578	186.8	157.7	13.2	3.0	12.3		
35	2570	186.8	157.7	13.2	3.0	12.3		
36	2580	186.8	157.7	13.2	3.0	12.3		
30	2581	186.8	157.7	13.2	3.0	12.3		
30	2582	186.8	157.7	13.2	3.0	12.3		
30	2582	186.8	157.7	13.2	3.0	12.3		
40	2505	186 9	157.7	13.2	3.0 3.6	12.3		
40	2504	100.0	157.7	10.2	3.0 3.6	12.3		
41	2505	100.0	157.7	10.2	3.0 3.6	12.3		
42	2500	196.0	157.7	13.2	3.0	12.3		
43	2301	100.0	107.7	13.2	3.0 3.6	12.3		
44	2000	100.0	107.7	13.2	3.0 2.6	12.3		
40	2009	100.8	101.1	13.2	3.6	12.3		
40	2090	100.0	101.1	13.2	3.0	12.3		
4/	2091	100.0	101.1	13.2	3.0	12.3		
40	2092	100.0	101.1	13.2	3.0	12.3		
49	2093	100.8	15/./	13.2	3.6	12.3		
50	2094	180.8	157.7	13.2	3.0	12.3		

Cash Flow of Project Benefit (Financial Rate)

(Million Baht)

Year		Total	Net income from commercial facility	House rent	BMA city hall	Rise of land value in surrounding area
1	2545	0.0	0.0	0.0	0.0	0.0
2	2545	5.0	5.4	0.0	0.0	0.0
2	2540	35.0	13.4	20.2	0.0	0.3
4	2548	47.2	24.4	20.2	0.0	2.6
5	2540	206.0	41.0	160.6	0.0	2.0
6	2550	200.0	41.0	160.6	0.0	4.4
7	2551	200.0	43.1	207.4	0.0	4.5
8	2552	286.3	43.1	238.6	0.0	4.0
9	2553	484.8	43.1	342.2	94.9	4.6
10	2554	2 699 1	2 001 1	387.2	94.9	215.9
11	2555	2,699,1	2,001.1	387.2	94.9	215.9
12	2556	2,699.1	2,001.1	387.2	94.9	215.9
13	2557	2,699.1	2,001.1	387.2	94.9	215.9
14	2558	2,699.1	2,001.1	387.2	94.9	215.9
15	2559	2,699.1	2,001.1	387.2	94.9	215.9
16	2560	2,699.1	2,001.1	387.2	94.9	215.9
17	2561	2,699.1	2.001.1	387.2	94.9	215.9
18	2562	2.699.1	2.001.1	387.2	94.9	215.9
19	2563	2,699,1	2.001.1	387.2	94.9	215.9
20	2564	2.699.1	2.001.1	387.2	94.9	215.9
21	2565	2.699.1	2.001.1	387.2	94.9	215.9
22	2566	2.699.1	2.001.1	387.2	94.9	215.9
23	2567	2.699.1	2.001.1	387.2	94.9	215.9
24	2568	2.699.1	2.001.1	387.2	94.9	215.9
25	2569	2,699.1	2,001.1	387.2	94.9	215.9
26	2570	2,699.1	2,001.1	387.2	94.9	215.9
27	2571	2,699.1	2,001.1	387.2	94.9	215.9
28	2572	2,699.1	2,001.1	387.2	94.9	215.9
29	2573	2,699.1	2,001.1	387.2	94.9	215.9
30	2574	2,699.1	2,001.1	387.2	94.9	215.9
31	2575	2,699.1	2,001.1	387.2	94.9	215.9
32	2576	2,699.1	2,001.1	387.2	94.9	215.9
33	2577	2,699.1	2,001.1	387.2	94.9	215.9
34	2578	2,699.1	2,001.1	387.2	94.9	215.9
35	2579	2,699.1	2,001.1	387.2	94.9	215.9
36	2580	2,699.1	2,001.1	387.2	94.9	215.9
37	2581	2,699.1	2,001.1	387.2	94.9	215.9
38	2582	2,699.1	2,001.1	387.2	94.9	215.9
39	2583	2,699.1	2,001.1	387.2	94.9	215.9
40	2584	2,699.1	2,001.1	387.2	94.9	215.9
41	2585	2,699.1	2,001.1	387.2	94.9	215.9
42	2586	2,699.1	2,001.1	387.2	94.9	215.9
43	2587	2,699.1	2,001.1	387.2	94.9	215.9
44	2588	2,699.1	2,001.1	387.2	94.9	215.9
45	2589	2,699.1	2,001.1	387.2	94.9	215.9
46	2590	2,699.1	2,001.1	387.2	94.9	215.9
47	2591	2,699.1	2,001.1	387.2	94.9	215.9
48	2592	2,699.1	2,001.1	387.2	94.9	215.9
49	2593	2,699.1	2,001.1	387.2	94.9	215.9
50	2594	2,699.1	2,001.1	387.2	94.9	215.9

Cash Flow of Project Benefit and Cost (Economic Rate)

(Million Baht)

Ye	ear	Cost	Benefit	B-C	PV(Cost)	PV(Benefit)	PV(B-C)
1	2545	190.4	0.0	-190.4	170.0	0.0	-170.0
2	2546	269.6	5.6	-264.0	214.9	4.5	-210.5
3	2547	903.8	33.0	-870.8	643.3	23.5	-619.8
4	2548	1,253.0	44.5	-1,208.5	796.3	28.3	-768.0
5	2549	254.9	193.9	-61.0	144.6	110.0	-34.6
6	2550	410.4	194.8	-215.6	207.9	98.7	-109.2
7	2551	3.571.4	240.1	-3.331.3	1.615.5	108.6	-1.506.9
8	2552	5.127.4	269.4	-4.858.0	2.070.9	108.8	-1.962.1
9	2553	3,578.8	461.7	-3,117.1	1,290.6	166.5	-1,124.1
10	2554	175.6	2.555.8	2.380.2	56.5	822.9	766.4
11	2555	175.6	2.555.8	2.380.2	50.5	734.7	684.3
12	2556	175.6	2,555.8	2,380.2	45.1	656.0	610.9
13	2557	175.6	2,555.8	2,380,2	40.2	585.7	545.5
14	2558	175.6	2,555.8	2,380.2	35.9	523.0	487.0
15	2559	175.6	2,555.8	2,380.2	32.1	466.9	434.9
16	2560	175.6	2,555.8	2,380.2	28.6	416.9	388.3
17	2561	175.6	2 555 8	2,380.2	25.6	372.2	346.7
18	2562	175.6	2 555 8	2,380.2	22.8	332.4	309.5
19	2563	175.6	2 555 8	2 380 2	20.4	296.7	276.4
20	2564	175.6	2,555.8	2,380.2	18.2	265.0	246.7
21	2565	175.6	2,555.8	2,380.2	16.2	236.6	220.3
22	2566	175.6	2,555.8	2,380.2	14.5	200.0	196.7
22	2567	175.6	2,555.8	2,380.2	14.0	188.6	175.6
23	2568	175.6	2,555.8	2,380.2	11.0	168.4	175.0
25	2569	175.6	2,555.8	2,300.2	10.3	150.3	140.0
26	2570	175.6	2,555.8	2,300.2	9.2	130.3	140.0
20	2570	175.6	2,555.8	2,300.2	9.2	119 9	111 6
28	2572	175.6	2,555.8	2,300.2	7.4	107.0	99.7
20	2572	175.6	2,555.8	2,300.2	7.4 6.6	95.5	89.0
20	2573	175.6	2,555.8	2,300.2	5.0	95.3	70.4
30	2575	175.0	2,555.8	2,300.2	5.9	76.2	79.4
37	2575	175.0	2,555.8	2,300.2	J.Z	68.0	63.3
32	2570	175.0	2,555.0	2,300.2	4.7	60.7	56 F
24	2577	175.0	2,555.0	2,300.2	4.2	54.2	50.5
25	2570	175.0	2,555.0	2,300.2	3.7	.2 .2	30.3
26	2579	175.0	2,555.0	2,300.2	3.3	40.4	45.1
27	2500	175.0	2,555.0	2,300.2	3.0	43.2	40.2
37	2001	175.0	2,000.0	2,300.2	2.7	30.0	30.9
30	2002	175.0	2,555.6	2,360.2	2.4	34.5	32.1
39	2000	175.0	2,000.0	2,300.2	2.1	30.0 07.5	20.0
40	2304	175.0	2,000.0	2,300.2	1.9	21.5	25.0
41	2000	175.0	2,555.6	2,360.2	1.7	24.5	22.0
42	2586	175.6	2,555.8	2,380.2	1.5	21.9	20.4
43	2587	1/5.6	2,555.8	2,380.2	1.3	19.6	18.2
44	2588	175.6	2,555.8	2,380.2	1.2	17.5	16.3
45	2589	1/5.6	2,555.8	2,380.2	1.1	15.6	14.5
46	2590	1/5.6	2,555.8	2,380.2	1.0	13.9	13.0
47	2591	175.6	2,555.8	2,380.2	0.9	12.4	11.6
48	2592	175.6	2,555.8	2,380.2	0.8	11.1	10.3
49	2593	175.6	2,555.8	2,380.2	0.7	9.9	9.2
50	2594	175.6	2,555.8	2,380.2	0.6	8.8	8.2
To	otal	22,759.3	106,230.8	83,471.5	7,676.7	8,255.6	578.9

Discount Rate	12.0%
EIRR	12.9%
NPV	578.9
B/C	1.08