No. 36

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

PT. PERUSAHAAN GAS NEGARA (Persero)
MINISTRY OF MINES AND ENERGY
DIRECTORATE GENERAL OF OIL AND GAS (MIGAS)
THE REPUBLIC OF INDONESIA

THE STUDY ON MASTER PLAN OF URBAN GAS DEVELOPMENT IN THE REPUBLIC OF INDONESIA

FINAL REPORT

August 1997

Osaka Gas Co., Ltd.
The Institute of Energy Economics, Japan

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PREFACE

In response to a request from the Government of the Republic of Indonesia, the Government of Japan decided to conduct the Study on Master Plan of Urban Gas Development in the Republic of Indonesia, and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent a Study team, led by Mr. Hiroki Okimi of Osaka Gas Co., Ltd. and constituted by members of Osaka Gas Co., Ltd. and The Institute of Energy Economics, Japan, to the Republic of Indonesia four times from July 1996 to July 1997.

The team held discussions with the officials concerned of the Government of the Republic of Indonesia, and conducted related field surveys. After returning to Japan, the team conducted further studies and compiled the final results in this report.

I hope this report will contribute to urban gas development in the Republic of Indonesia and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Indonesia for their close cooperation throughout the study.

August 1997

Kimio Fujita

Kimio Fujita
President
Japan International Cooperation Agency

August 1997

Mr. Kimio Fujita
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Mr. Fujita:

Letter of Transmittal

We are pleased to submit to you the report of the Study on Master Plan of Urban Gas Development in the Republic of Indonesia. The report reflects the advice and suggestions of the authorities concerned of the Government of Japan and your Agency as well as containing the formulation of the above mentioned Plan, the results of the feasibility studies and recommendations. Also reflected are the comments of the officials of the Ministry of Mines and Energy (MME), the General Directorate of Oil and Gas (MIGAS), the Bureau of National Development Planning (BAPPENAS) and PT. Perusahaan Gas Negara (Persero) ("PGN") of the Republic of Indonesia, through the discussions in the Steering Committee and the Counterpart Team meetings for this Study held in Jakarta from time to time in the study period.

This report presents the potential viability of the urban gas development for residential and commercial customers smaller than the large industrial customers currently served in the Jakarta area. The prerequisite for this viability, however, are the improved tariff system and other regulatory arrangements that facilitate the recovery of investment and the participation by private sector entities and financiers. The Government of Indonesia already recognizes such necessity through discussions.

In view of importance of the natural gas infrastructure in the metropolitan areas of Indonesia and the expected net benefit of such infrastructure as are shown in the report, we recommend that such regulatory changes be introduced as a top priority in the country.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs and the Ministry of International Trade and Industry. We also wish to express our deepest gratitude to PGN and the authoritative government agencies concerned of the Republic of Indonesia for the close cooperation and assistance extended to us during the period.

Very truly yours,

Hiroki Okimi
Team Leader
The Study on Master Plan of Urban Gas Development
in the Republic of Indonesia.

Table of Contents

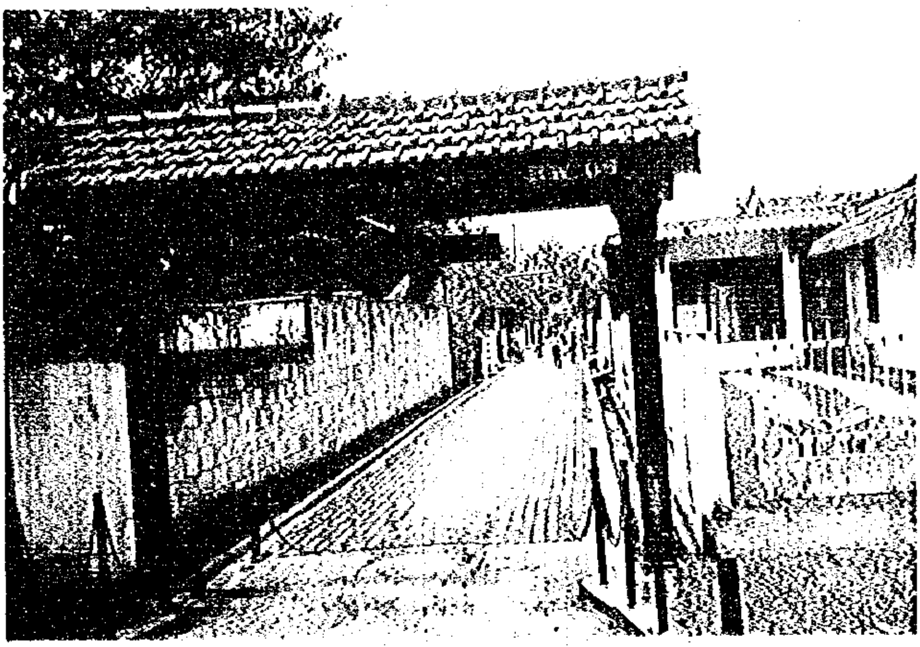
List of Inserted Tables and Figures

Acronyms and Abbreviations

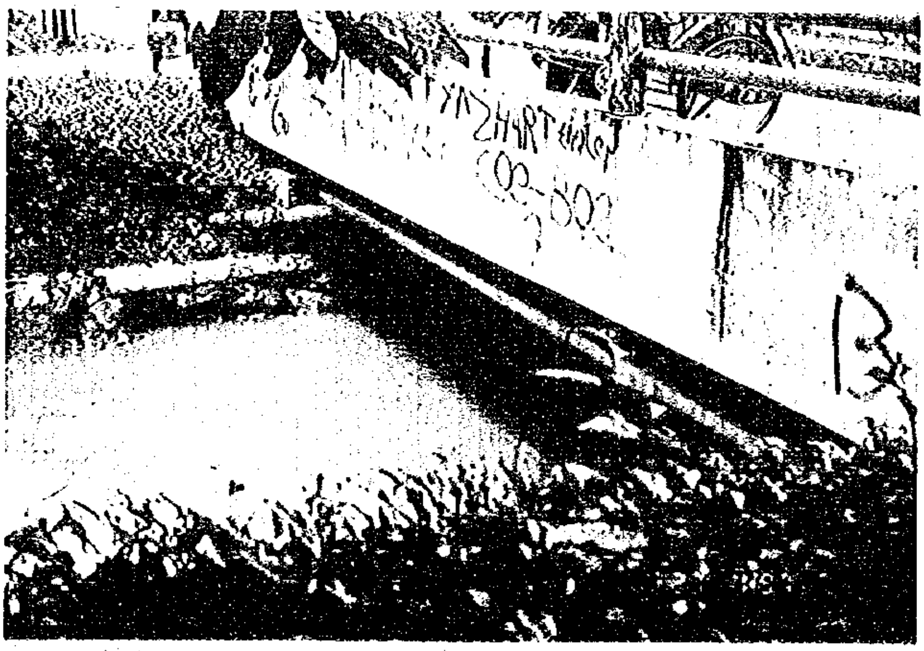
Abs.	Absorption; absorption chiller(s)
AC	air-conditioning, air-conditioner(s)
ADB	the Asian Development Bank
AIC	average incremental cost
ANSI	American National Standards Institute
API	American Petroleum Institute
Bapedal	Board of Environment Effect Control, RI
BAPPENAS	the Bureau of National Development Planning, RI
bar	a pressure unit; 1 bar=100 kPa (kilo-Pascal)=0.987 atm=1.0197 kg/cm^2=10206 mmH_2O
bloe, (bbloe)	barrel(s) oil equivalent; 1 bl=0.159 kl, 1 bloe ≒ 0.147toe ≒ 5.836 mmBtu
BSD	Bumi Serpong Damai, (peaceful Serpong land), an estate in Tangerang
BOTABEK	Bogor-Tangerang-Bekasi
Btu	British thermal unit. 1 Btu is equivalent to 0.252 kcal or 1.0551 kJ; mmBtu = million Btu
C	Celsius; conversion: C=(F-32)*5/9
CFCs	chloro-fluoro-carbons
CNG	compressed natural gas
COP	coefficient of performance (virtual efficiency in air-conditioning)
deg, dg	degree(s)
DKI, D.K.I.	D.K.I. Jakarta; the capital district of Indonesia
DW	Durbin-Watson ratio; an index to test the independence of errors in a regression model including time-lag variables; DW=2 meaning perfect independence.
EHP	electric heat pump (compared to GHP)
EIB	the European Investment Bank
EIRR	economic internal rate of return
F	Fahrenheit; conversion: F=C*9/5+32
FIRR	financial internal rate of return
GAKINDO	the Association of Indonesia Motor Vehicle Industries
GDP	gross domestic product
GHP	gas (engine) heat pump
GOI	the Government of Indonesia
GRDP	gross regional and domestic product
GRP	gross regional product
GT	gas turbine
HCFC	hydro-chloro-fluoro-carbons
HR	house regulator
IRR	internal rate of return
IFC	International Finance Corporation (a subsidiary of the World Bank)
IMF	the International Monetary Fund
IPP	independent power producer
JEXIM	Japanese Export and Import Bank
JICA	the Japan International Cooperation Agency
JMDP	Jabotabek Metropolitan Development Plan
JABOTABEK	Jakarta-Bogor-Tangerang-Bekasi metropolitan area integrated
JATABEK	Jakarta-Tangerang- Bekasi metropolitan area
Kab.	Kabupaten, or prefecture
LHV, LCV	lower heating value, lower calorific value, =net heating value (cf. gross ...)
LNG	liquefied natural gas
LPG	liquefied petroleum gas, with main component of propane and/or butane
LRMC	long run marginal cost
Mcal	Mega calories = million calories; 1 Mcal=1000 kcal=4.186 MJ
MIGAS	General Directorate of Oil and Natural Gas of MME

Mikrolet	a mini-bus
MJ	Mega (10^6) Joule, an SI thermal unit. 1 MJ=238.9 kcal=947.8 Btu
MME	the Ministry of Mines and Energy, Directorate of Planning, RI
MMSCFD, mmscfd	million standard cubic feet per day; 1 mmscfd (60 deg. F) is equivalent to 10.75 million cubic meters (27 deg. C) per year. "MM" is million only in American units.
MRT	the Mass Rapid Transit system
MSCF, mscf	thousand standard cubic feet; 1 mscf of gas is equivalent to 28.3 m^3 at 15.5 deg. C and 29.43 m^3 at 27 deg. C; "M" or "m" is "thousand" in American units only.
MTN	medium term notes (promissory notes)
NGV	natural gas vehicle
NPV	net present value(s)
NSB	net social benefit
OECF	the Overseas Economic Cooperation Fund of Japan
O & M	operation and maintenance
Perum Perumnas	National Urban Development Corporation
PGN	PT. Perusahaan Gas Negara (Persero), i.e., National Gas Limited Company
PKLN	Pinjaman Komersial Luar Negeri or the National Foreign Debt Regulatory Board
PJP	National 25 Years Plan of RI; e.g., PJP II: the Second 25 Year Plan (1994-2018)
PLN	PT. Perusahaan Listrik Negara (Persero), i.e., National Electric Limited Company
P/S, PSC	production sharing, production sharing contractors
RI	the Republic of Indonesia
Repelita, REPELITA	National Five Year Plan; Repelita VI: the 6th Five Year Plan (1994-1998)
ROE	return on equity
Rp	Rupiah; US$1.00=Rp 2350, JPYen 1= Rp 20 (January 1997)
R^2	the determination coefficient or square of the correlation coefficient used in regression analyses.
RT	refrigeration ton, a cold thermal flow unit. 1 RT=3024 kcal /h
SP	service pipe
t_i, t-value	Student's "t", for testing a regression coefficient of a (the i-th) variable.
toe	tons oil equivalent; 1 toe=10,000 kcal/kg x 1,000 kg/t=10^7 kcal
WB	The World Bank

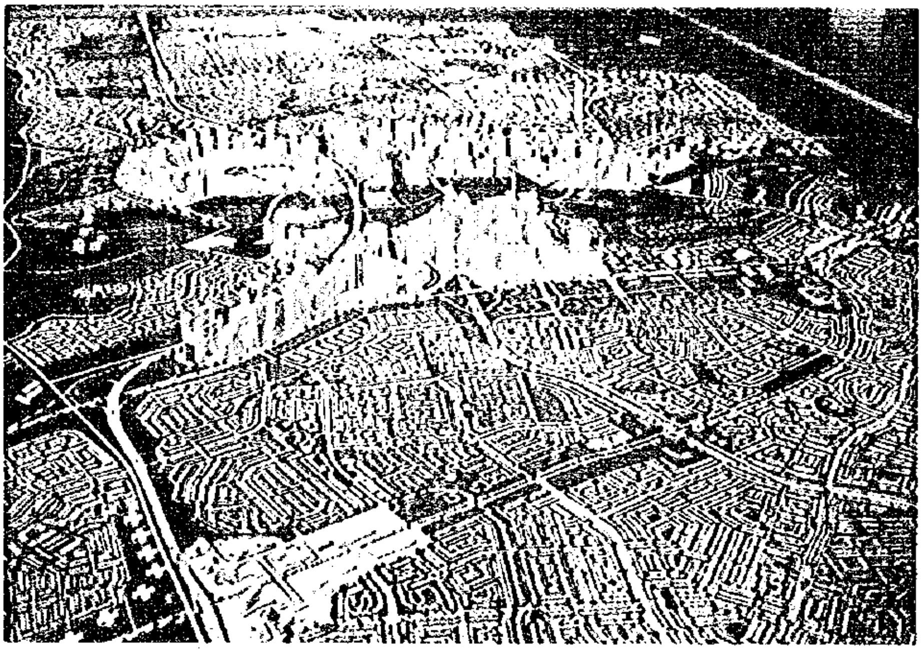
Bumi Bekasi Baru Area I



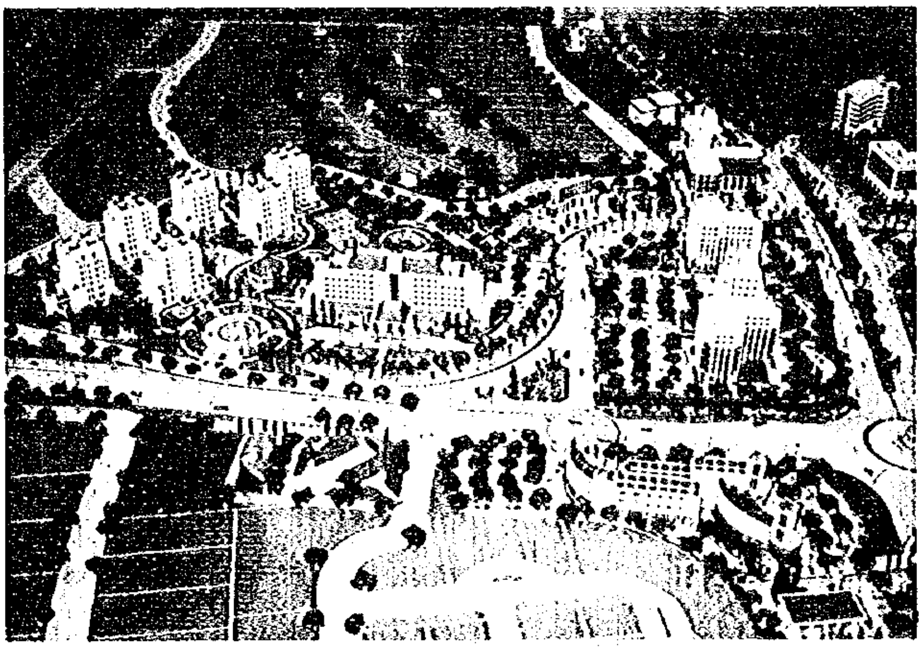
Bumi Bekasi Baru Area III



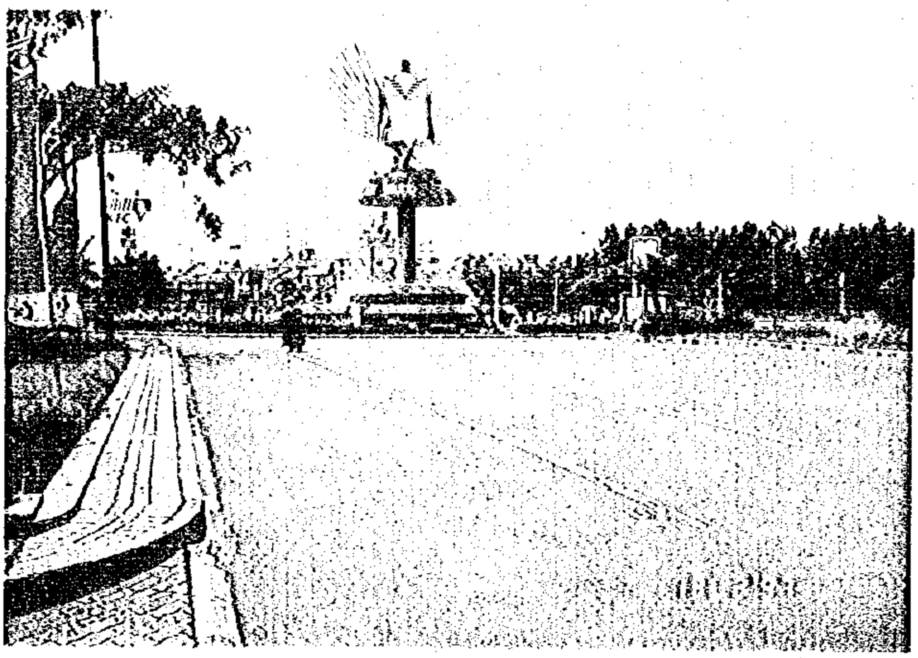
BSD (Bumi Serpong Damai)



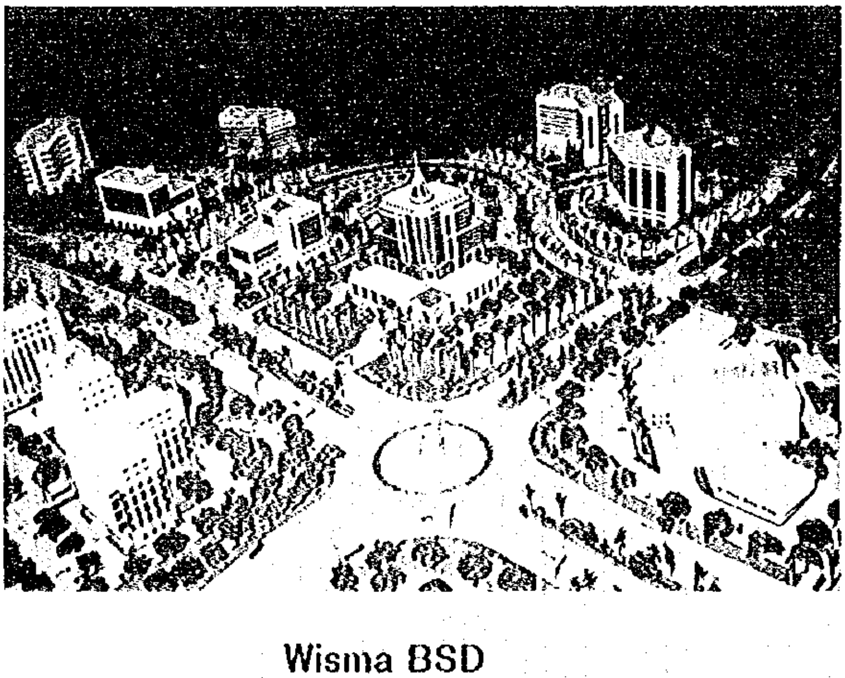
Model of Land Use in the BSD Master Plan



Model of a Planned Hotel



BSD Plaza



Wisma BSD


JAVA SEA
TELUKNAGA
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KEC.MAUK
Rajeg
KEC.RAJEG
KEC.BALARAJA
Balaraja
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KEC.PASARKEMIS
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BATUCEPER
CENGKARENG
GROGOL
TAMBORA
PADEMANGAN
KEMAYORAN
CEMPAKAPUTIH
MATRAMAN
JATIUWUNG
KEBON JERUK
CILEDUG
KEBAYORAN LAMA
KEBAYORAN BARU
MAMPANG
PONDOKAREN
CURUG
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KEC.CIKUPA
Kota Tigaraksa
KEC.TIGARAKSA
Cisoka
KEC.CISOKA
LEGOK
SERPONG
CILANDAK
PASARMINGGU
KRAMATJATI
JAGAKARSA
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BEJI
Kota Depok
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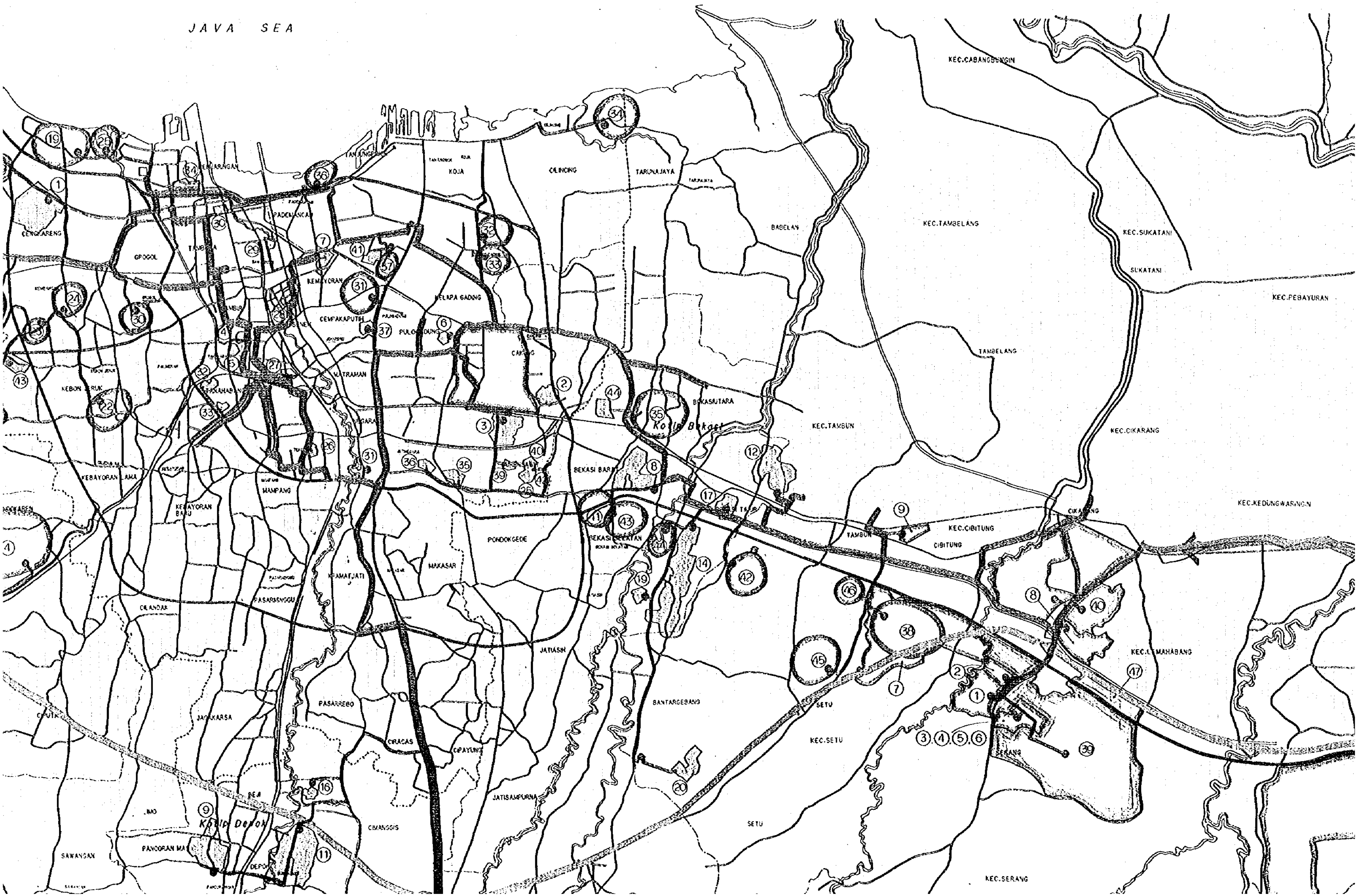
GUNUNGSINDUR
PANJANG


JAVA SEA
KEC.CABANGBUNGIN
KEC.TAMBELANG
KEC.SUKATANI
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KEC.PEBAYURAN
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BABELAN
TARUMAJAYA
CILINCING
KOJA
PADEMANGAN
CENGKARENG
GROGOL
TAMBORA
KEMAYORAN
KELAPA GADING
CEMPAKAPUTIH
PULOGADUNG
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KEBON JERUK
MATRAMAN
BEKASIUTARA
Kotip Bekasi
KEC.TAMBUN
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KEBAYORAN LAMA
KEBAYORAN BARU
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TAMBUN
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KEC.KEDUNGWARINGIN
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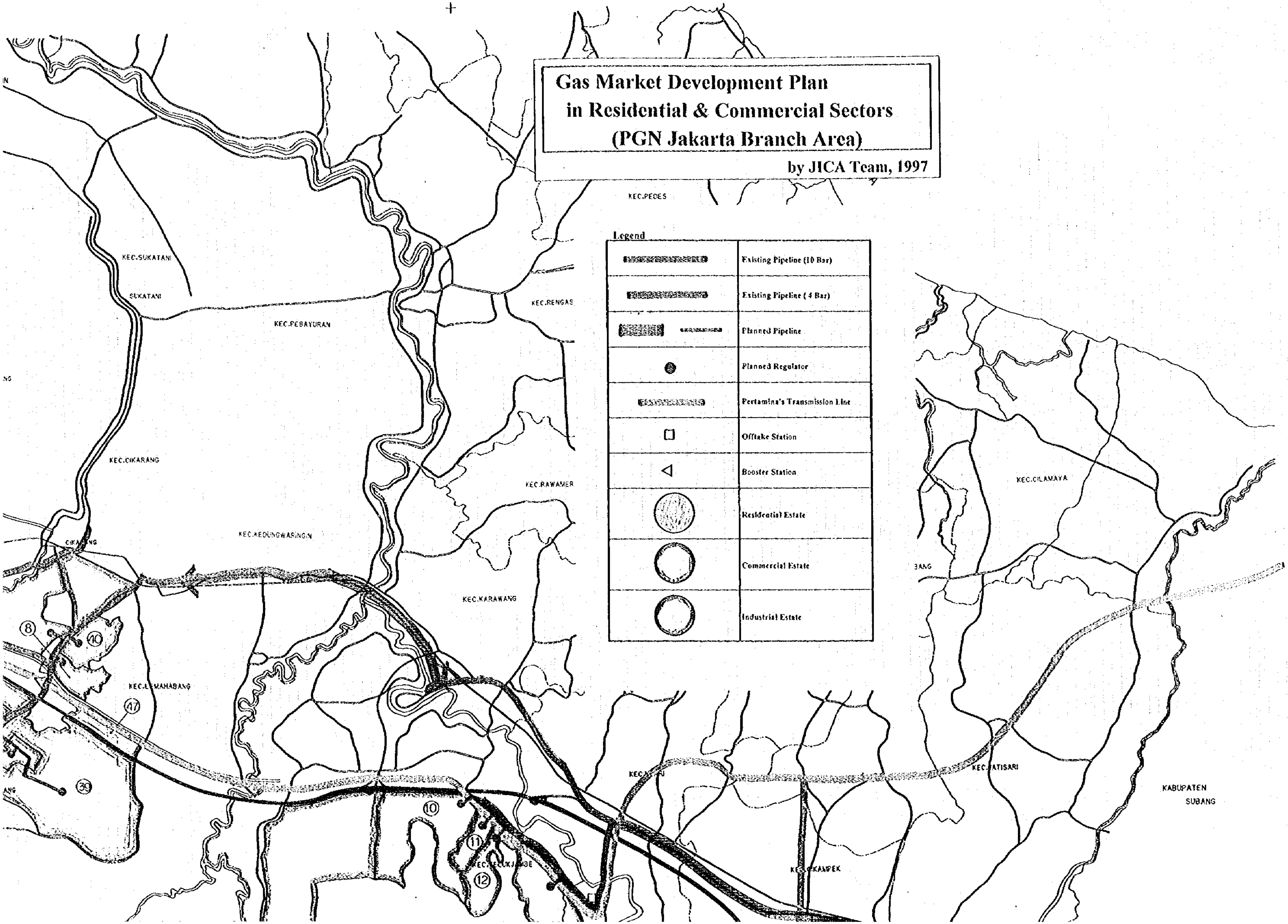
DEPOK
KEC.SERANG



Gas Market Development Plan
in Residential & Commercial Sectors
(PGN Jakarta Branch Area)
by JICA Team, 1997
Legend
Existing Pipeline (10 Bar)
Existing Pipeline (4 Bar)
Planned Pipeline
Planned Regulator
Pertamina's Transmission Line
Offtake Station
Booster Station
Residential Estate
Commercial Estate
Industrial Estate
KEC.PEDES
KEC.SUKATANI
SUKATANI
KEC.PEBAYURAN
KEC.RENGAS
KEC.CIKARANG
KEC.RAWAMER
KEC.KEDUNGWARINGIN
KEC.KARAWANG
KEC.CILAMAYA
KEC.JATISARI
KABUPATEN
SUBANG
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47
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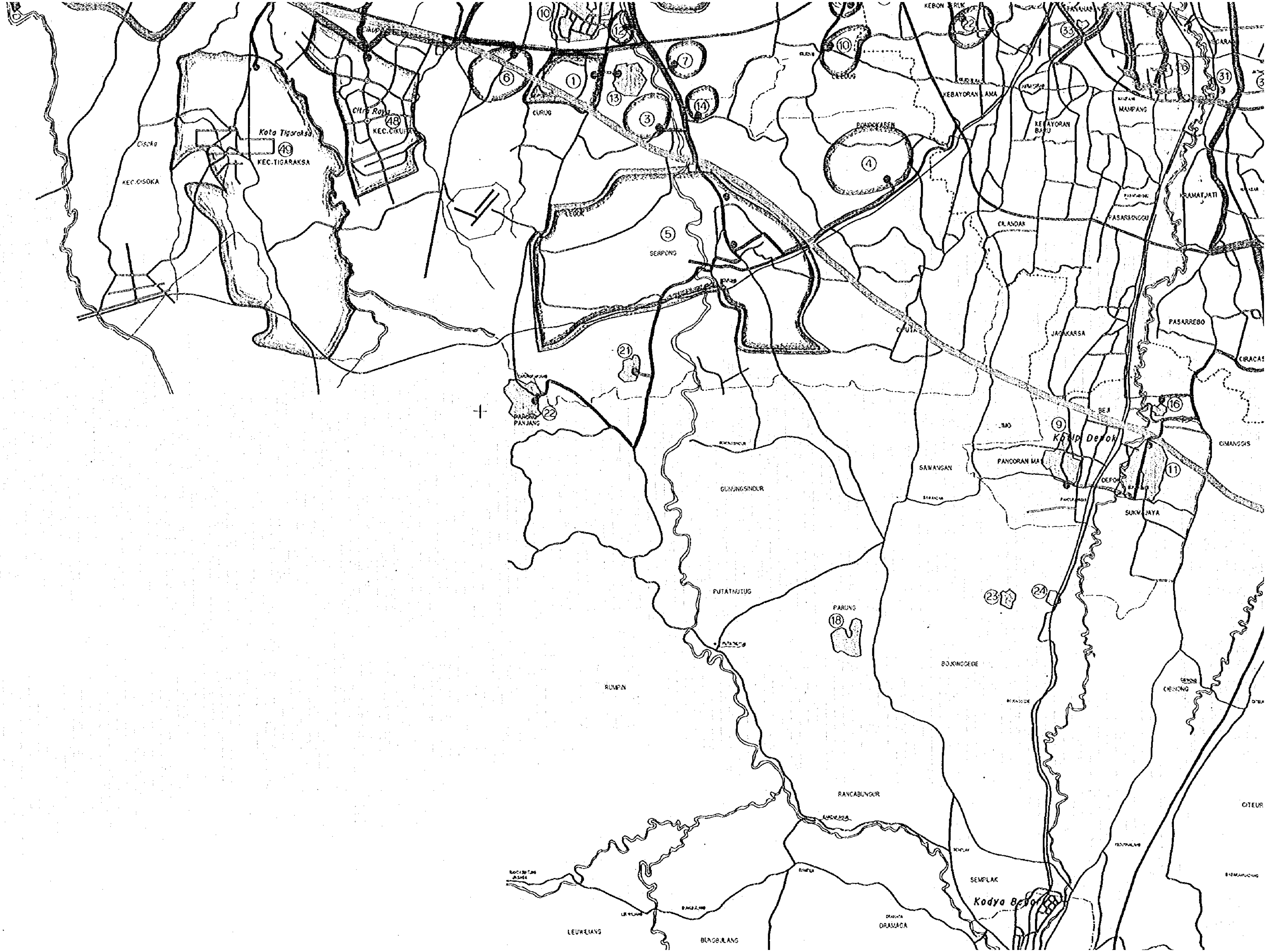
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KEC.TIGARAKSA
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LEGOK
SERPONG
CILANDAK
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KRAMATJATI
CIPUTAT
JAGAKARSA
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PANCORAN MAS
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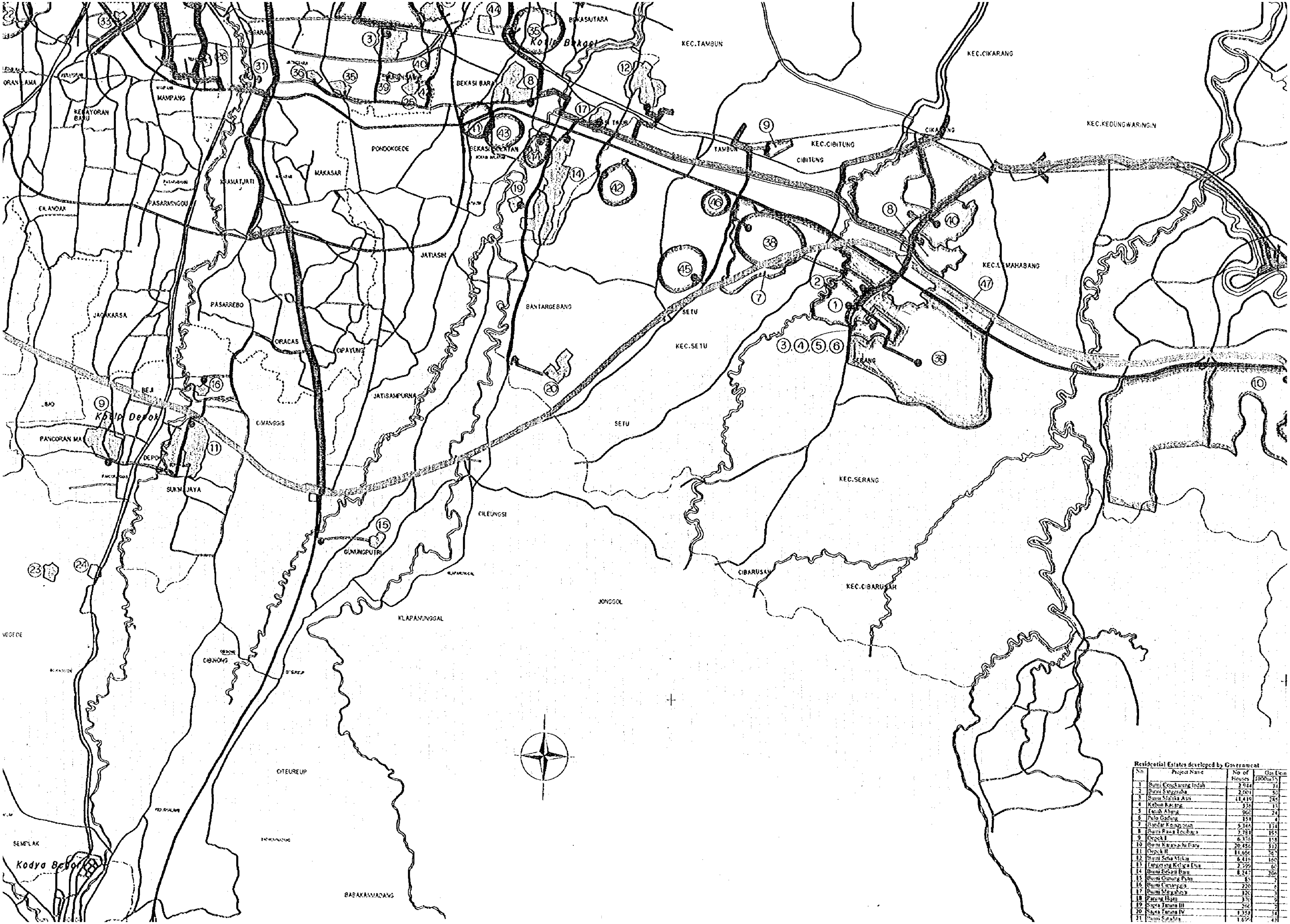
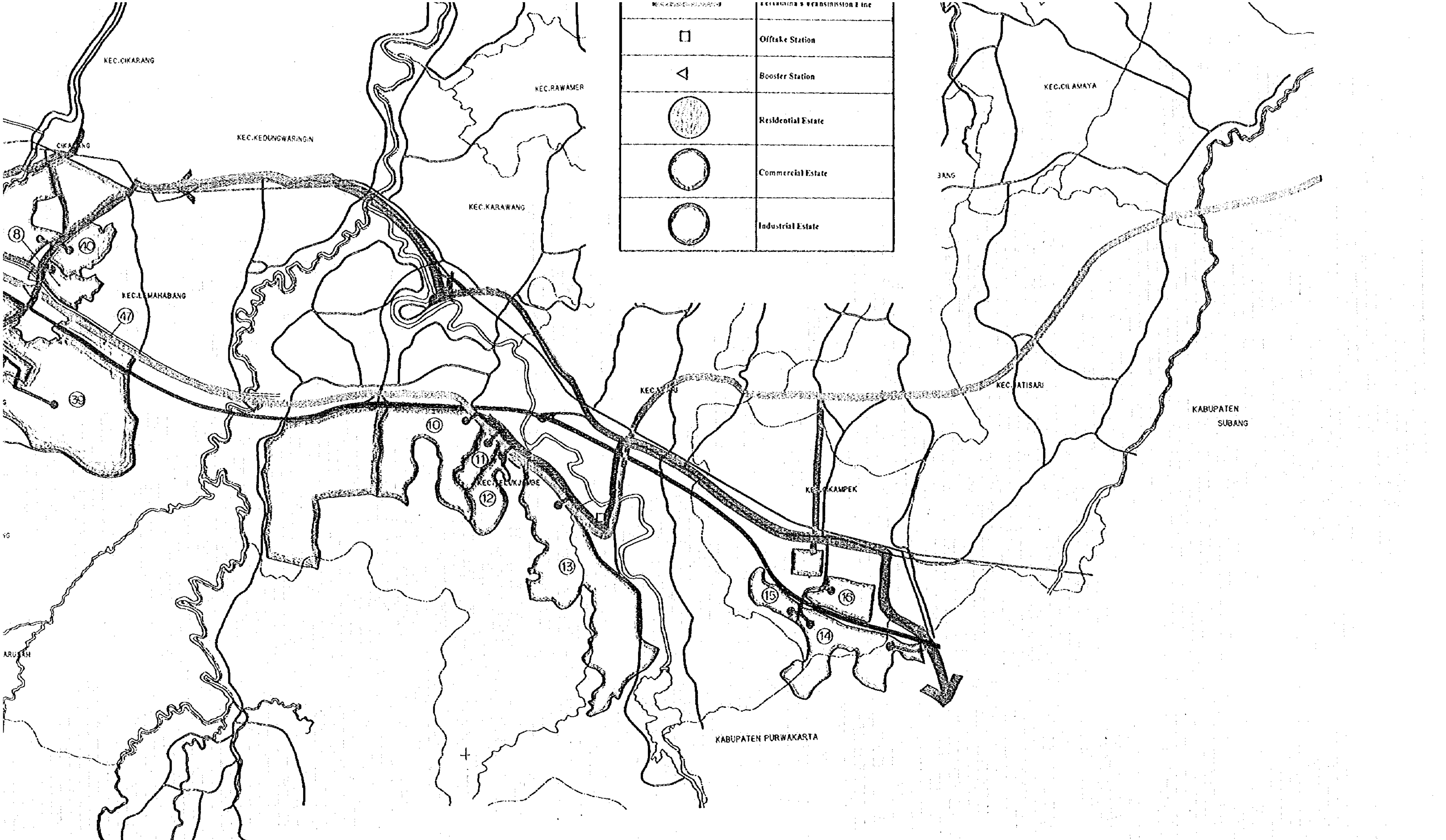
CITEUREUP
SEMPLAK
Kodya Bogor
LEUWILIANG
DRAMAGA



Residential Estates developed by Government

No.	Project Name	No. of Houses	Gas Dem 1000m3
1	Bumi Cengkareng Indah	2,944	74
2	Bumi Sanggraha	2,001	50
3	Bumi Malaka Asri	11,419	285
4	Kebon Kacang	536	13
5	Tanah Abang	960	24
6	Pulo Gadung	154	4
7	Bandar Kemayoran	5,346	134
8	Bumi Rawa Tembaga	7,781	195
9	Depok I	6,336	158
10	Bumi Karawachi Baru	20,456	512
11	Depok II	14,656	367
12	Bumi Setia Mekar	6,415	160
13	Tangerang Kelgra Dua	2,399	60
14	Bumi Bekasi Baru	8,247	206
15	Bumi Gunung Putri	85	2
16	Bumi Cimanggis	220	6
17	Bumi Margahayu	120	3
18	Parung Hijau	370	9
19	Sapta Taruna III	260	7
20	Sapta Taruna IV	1,358	34
21	Bumi Satelita	1,6[illegible]	42



Residential Estates developed by Goverament

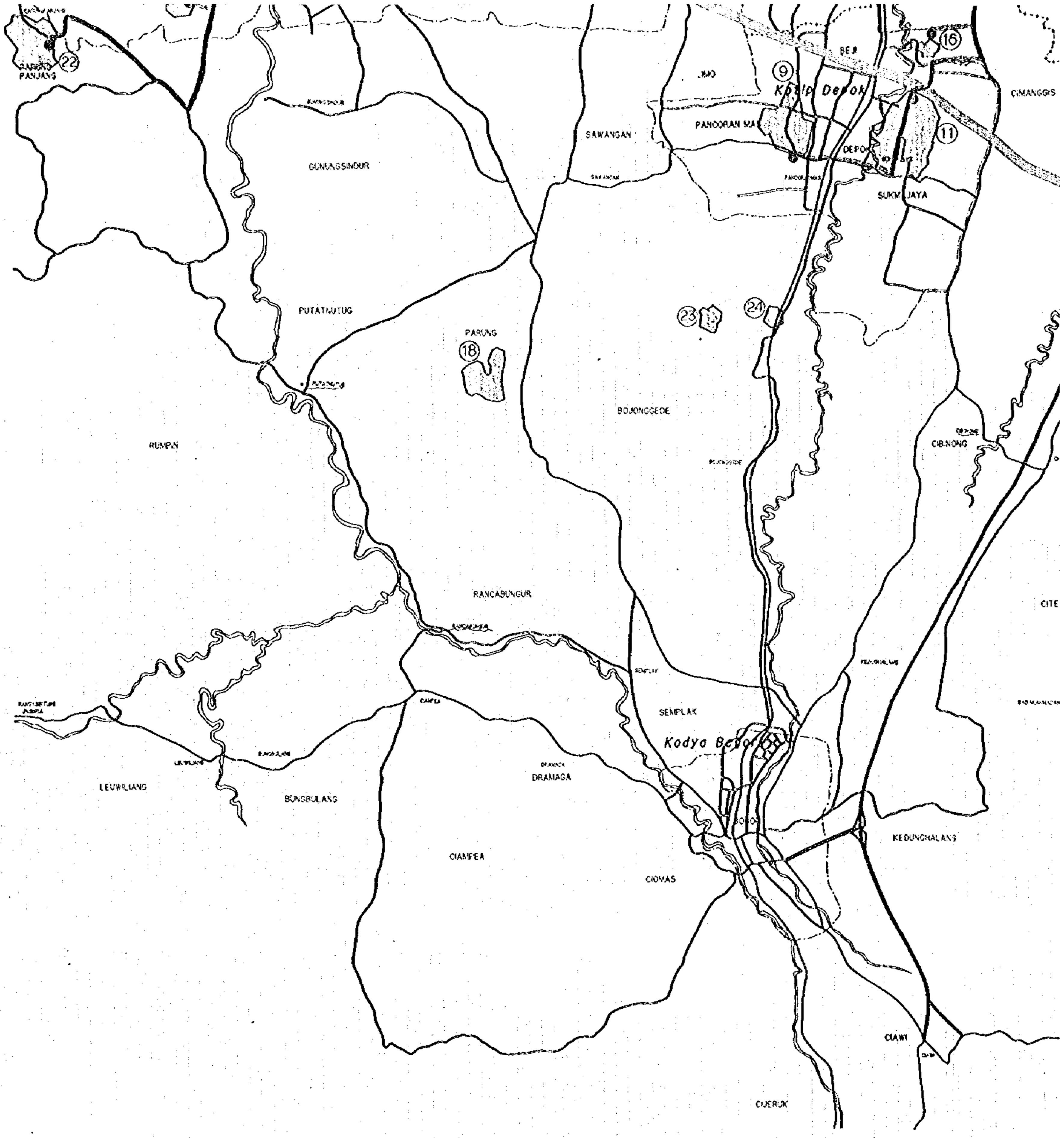
No.	Project Name	No of Houses	Gas Demand 1000m3/y	Gas Demand m3/h	Pipeline Necessary P	Pipeline Necessary D	Pipeline Necessary L
1	Bumi Cengkareng Indah	2,944	74	360	4 bar	125mm	1 km
2	Bumi Sangeraha	2,001	50	250	4 bar	90mm	2 km
3	Bumi Malaka Asri	11,419	285	1,380	4 bar	6"	1 km
4	Kebon Kacang	536	13	70	4 bar	63mm	1 km
5	Tanah Abang	960	24	120	4 bar	63mm	1 km
6	Pulo Gading	154	4	20	4 bar	63mm	1 km
7	Bandar Kemayoran	5,346	134	650	4 bar	150mm	1 km
8	Bumi Rawa Tembaga	7,794	195	940	4 bar	180mm	1 km
9	Depok I	6,336	158	770	4 bar	180mm	20 km
10	Bumi Karawachi Baru	20,496	512	2,460	4 bar	6"	1 km
11	Depok II	14,666	367	1,760	4 bar	8"	16 km
12	Bumi Setia Mekar	6,416	160	770	4 bar	180mm	1 km
13	Tangerang Kelapa Dua	2,399	60	290	4 bar	125mm	2 km
14	Bumi Bekasi Baru	8,247	206	990	4 bar	180mm	1 km
15	Bumi Gunung Putri	85	2	20	4 bar	63mm	5 km
16	Bumi Cimanggis	220	6	30	4 bar	63mm	12 km
17	Bumi Margahaya	120	3	20	4 bar	63mm	1 km
18	Parung Hijau	370	9	50	4 bar	63mm	25 km
19	Sapta Taruna III	260	7	40	4 bar	63mm	5 km
20	Sapta Taruna IV	1,358	34	170	4 bar	90mm	12 km
21	Bumi Sotafita	1,697	42	210	4 bar	90mm	12 km

Commercial + Residential Area Development Plans

No	Name of development	Area (ha)	Gas Demand 1000m3/y	Gas Demand m3/h	Pipeline Necessary P	Pipeline Necessary D	Pipeline Necessary L
1	Lippo Village	1,000	5,300	4,200	10 bar	6"	2 Km
2	Modern Land	1,000	5,300	4,200	10 bar	6"	1 Km
3	Gading Serpong	1,000	5,300	4,200	10 bar	6"	1 Km
4	Bintaro Jaya	1,000	5,300	4,200	10 bar	6"	3 Km
5	Bumi Serpong Damai	6,000	72,000	42,600	10 bar	12"	1 Km
6	Villa Permata	750	4,000	3,200	10 bar	6"	1 Km
7	Alam Sutera	750	4,000	3,200	10 bar	6"	1 Km
8	Banjar Wijaya	750	4,000	3,200	10 bar	6"	1 Km
9	Citra Garden	375	2,000	1,600	10 bar	4"	2 Km
10	Kebayoran Regency	375	2,000	1,600	10 bar	4"	10 Km
11	Kedaton	175	900	700	10 bar	4"	2 Km
12	Palm Spring Village	175	900	700	10 bar	4"	1 Km
13	Royyal Green Garden	175	900	700	10 bar	4"	1 Km
14	Villa Melati Mas	175	900	700	10 bar	4"	1 Km
15	Cipondoh Makmur	75	400	300	10 bar	4"	3 Km
16	Duta Taman Bandara	75	400	300	10 bar	4"	2 Km
17	Duta Garden	75	400	300	10 bar	4"	1 Km
18	Metro Permata	75	400	300	10 bar	4"	7 Km
19	Pantai Indah Kapuk	1,000	5,300	4,200	10 bar	6"	3 Km
20	Villa Taman Bandara	175	900	700	10 bar	4"	10 Km

Industrial Estate Development Plans

No.	Name of Industrial Estate	Area (ha)	Gas Demand 1000m³/y	Gas Demand m³/h	Pipeline Necessary P	Pipeline Necessary D	Pipeline Necessary L
1	EJIP (East Jakarta Industrial Park)	220	48,400	5,500	10 bar	6"	1 km
2	Hyundai (Bekasi International Industry)	200	44,000	5,000	10 bar	6"	1 km
3	Delta Silicon	158	34,800	4,000	10 bar	6"	1 km
4	Newton Techno Park	51	11,200	1,300	10 bar	4"	1 km
5	Diamond Techno Park	13	2,900	300	10 bar	4"	1 km
6	Boston Techno Park	12	2,600	300	10 bar	4"	1 km
7	MM 2100 Industrial Town	760	167,200	19,100	10 bar	12"	1 km
8	Jababeka (Cikarang Industrial Estate)	855	191,000	21,800	10 bar	12"	1 km
9	National Gobel Industrial	100	22,000	2,500	10 bar	4"	1 km
10	KIIC (Karawang International Industrial City)	735	161,700	18,500	10 bar	12"	3 km
11	Surya Cipta Industrial City	1,094	240,700	27,500	10 bar	16"	1 km
12	Mitra Industrial Park	500	110,000	12,600	10 bar	10"	1 km
13	Peruri	500	110,000	12,600	10 bar	10"	1 km
14	Bukit Indah City	4,700	1,034,000	118,000	10 bar	New	[illegible]


GUNUNGSINDUR
PARUNG
RUMPIN
RANCABUNGUR
LEUWILIANG
CIAMPEA
DRAMAGA
CIOMAS
SEMPLAK
Kodya Bogor
BOJONGGEDE
SAWANGAN
LIMO
BEJI
CIMANGGIS
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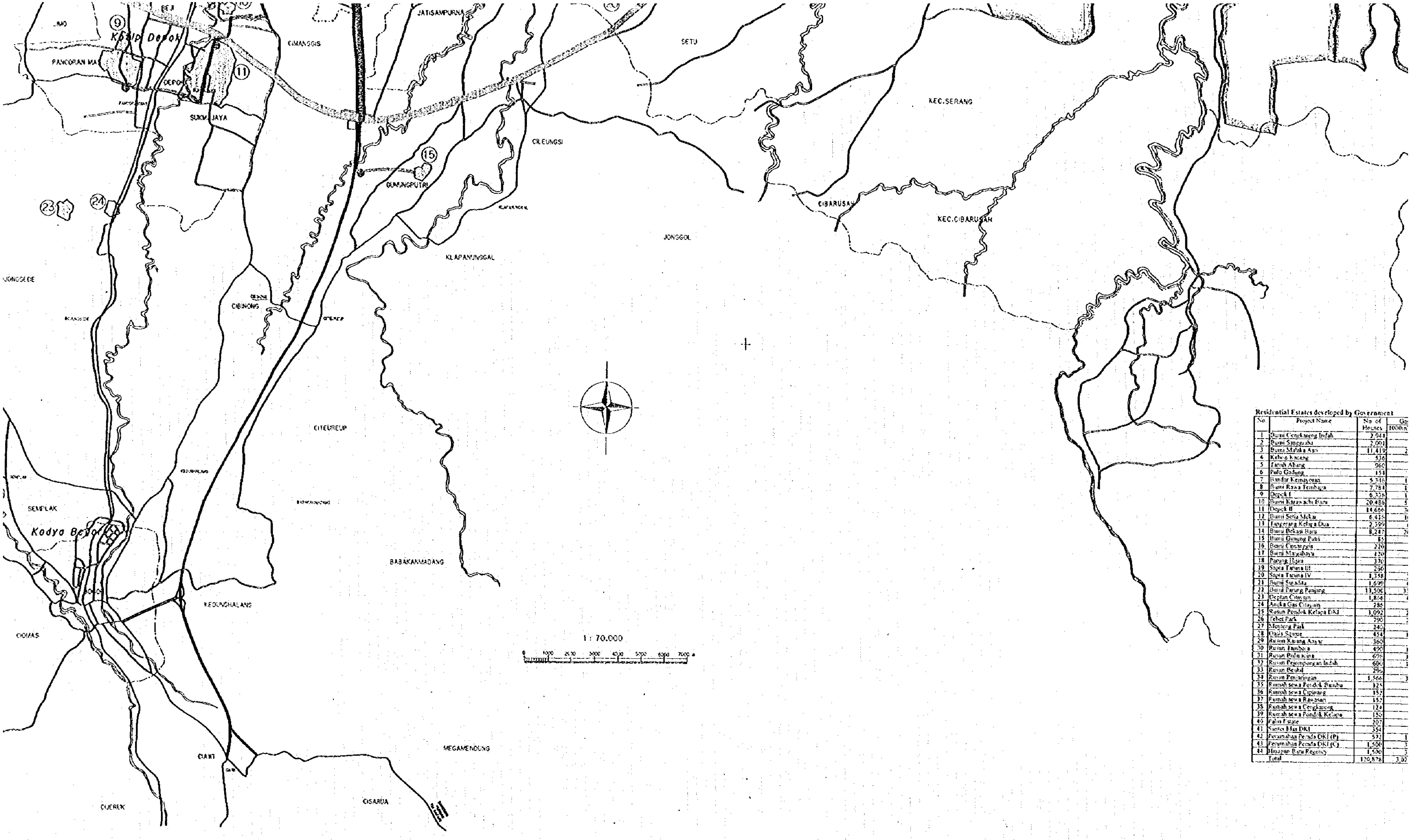
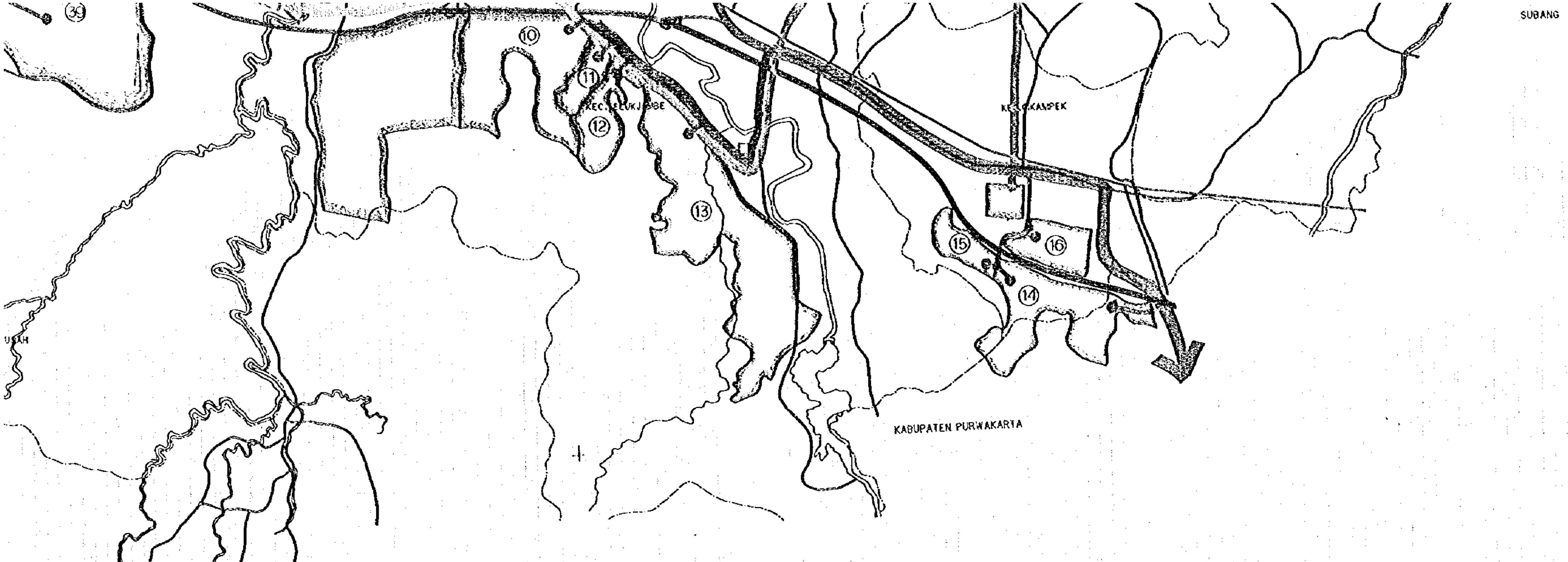


Residential Estates developed by Government

No.	Project Name	No. of Houses	Ga… 1000m…
1	Bumi Cengkareng Indah	2,949	
2	Bumi Sanggraha	2,091	
3	Bumi Malaka Asri	11,419	2…
4	Kebon Kacang	536	
5	Tanah Abang	960	
6	Pulo Gadung	154	
7	Bandar Kemayoran	5,346	1…
8	Bumi Rawa Tembaga	7,784	1…
9	Depok I	6,336	1…
10	Bumi Karawachi Baru	20,436	5…
11	Depok II	14,666	3…
12	Bumi Setia Mekar	6,435	1…
13	Tangerang Kelapa Dua	2,399	[illegible]
14	Bumi Bekasi Baru	8,247	2…
15	Bumi Gunung Putri	85	
16	Bumi Cimanggis	220	
17	Bumi Margahayu	120	
18	Parung Hijau	370	
19	Sapta Taruna III	260	
20	Sapta Taruna IV	1,358	[illegible]
21	Bumi Suradita	1,699	[illegible]
22	Bumi Parung Panjang	13,500	3…
23	Deptan Citayam	1,866	[illegible]
24	Aneka Gas Citayam	285	
25	Rusun Pondok Kelapa DKI	1,092	2…
26	Tebet Park	790	[illegible]
27	Menteng Park	240	
28	Oasis Square	454	1…
29	Rusun Karang Anyar	360	
30	Rusun Tambora	490	1…
31	Rusun Bidaracina	696	1…
32	Rusun Pejompongan Indah	600	1…
33	Rusun Benhil	296	
34	Rusun Penjaringan	1,566	3…
35	Rumah sewa Pondok Bambu	325	
36	Rumah sewa Cipinang	352	
37	Rumah sewa Rawasari	152	
38	Rumah sewa Cengkareng	124	
39	Rumah sewa Pondok Kelapa	156	
40	Palm Estate	207	
41	Sunter Mas DKI	354	
42	Perumahan Pemda DKI (P)	572	1…
43	Perumahan Pemda DKI (C)	1,500	3…
44	Harapan Baru Regency	1,500	3…
	Total	120,878	3,02…



Residential Estates developed by Government

No.	Project Name	No. of Houses	Gas Demand 1000m3/y	m3/h	Pipeline Necessary P	D	L
1	Bumi Cengkareng Indah	2,944	74	360	4 bar	125mm	1 km
2	Bumi Sanggraha	2,001	50	250	4 bar	90mm	2 km
3	Bumi Malaka Asri	11,419	285	1,380	4 bar	8"	1 km
4	Kebon Kacang	536	13	70	4 bar	63mm	1 km
5	Tanah Abang	960	24	120	4 bar	63mm	1 km
6	Pulo Gadung	154	4	20	4 bar	63mm	1 km
7	Bandar Kemayoran	5,336	134	650	4 bar	160mm	1 km
8	Bumi Rawa Tembaga	7,794	195	940	4 bar	160mm	1 km
9	Depok I	6,336	158	770	4 bar	160mm	20 km
10	Bumi Karawachi Baru	20,486	512	2,460	4 bar	6"	1 km
11	Depok II	14,666	367	1,760	4 bar	8"	16 km
12	Bumi Setia Mekar	6,416	160	770	4 bar	180mm	1 km
13	Tangerang Kelapa Dua	2,399	60	290	4 bar	125mm	2 km
14	Bumi Bekasi Baru	8,247	206	990	4 bar	180mm	1 km
15	Bumi Gunung Putri	85	2	20	4 bar	63mm	5 km
16	Bumi Cimanggis	220	6	30	4 bar	63mm	12 km
17	Bumi Margahayu	120	3	20	4 bar	63mm	1 km
18	Parung Hijau	370	9	50	4 bar	63mm	25 km
19	Sapta Taruna III	260	7	40	4 bar	63mm	5 km
20	Sapta Taruna IV	1,358	34	170	4 bar	90mm	12 km
21	Bumi Suradita	1,699	42	210	4 bar	90mm	12 km
22	Bumi Parung Panjang	13,500	338	1,620	4 bar	8"	20 km
23	Deplan Citayam	1,866	47	230	4 bar	90mm	25 km
24	Aneka Gas Citayam	286	7	40	4 bar	63mm	25 km
25	Rusun Pondok Kelapa DKI	1,092	27	140	4 bar	63mm	6 km
26	Tebet Park	790	20	100	4 bar	63mm	1 km
27	Menteng Park	240	6	30	4 bar	63mm	1 km
28	Oasis Square	454	11	60	4 bar	63mm	1 km
29	Rusun Karang Anyar	360	9	50	4 bar	63mm	2 km
30	Rusun Tambora	490	12	60	4 bar	63mm	1 km
31	Rusun Bidaracina	696	17	90	4 bar	63mm	1 km
32	Rusun Pejompongan Indah	600	15	80	4 bar	63mm	3 km
33	Rusun Bendhil	296	7	40	4 bar	63mm	1 km
34	Rusun Penjaringan	1,566	39	190	4 bar	90mm	1 km
35	Rumah sewa Pondok Bambu	125	3	20	4 bar	63mm	4 km
36	Rumah sewa Cipinang	152	4	20	4 bar	63mm	2 km
37	Rumah sewa Rawasari	152	4	20	4 bar	63mm	2 km
38	Rumah sewa Cengkareng	124	3	20	4 bar	63mm	3 km
39	Rumah sewa Pondok Kelapa	150	4	20	4 bar	63mm	3 km
40	Palm Estate	207	5	30	4 bar	63mm	4 km
41	Sunter Mas DKI	354	9	50	4 bar	63mm	1 km
42	Perumahan Pemda DKI (P)	572	14	70	4 bar	63mm	6 km
43	Perumahan Pemda DKI (C)	1,500	38	180	4 bar	90mm	5 km
44	Harapan Baru Regency	1,500	38	180	4 bar	90mm	2 km
	Total	120,878	3,022	14,710			242 km

Commercial + Residential Area Development Plans

No	Name of development	Area (ha)	Gas Demand 1000m3/y	m3/h	Pipeline Necessary P	D	L
1	Lippo Village	1,000	5,300	4,200	10 bar	6"	2 Km
2	Modern Land	1,000	5,300	4,200	10 bar	6"	1 Km
3	Gading Serpong	1,000	5,300	4,200	10 bar	6"	3 Km
4	Bintaro Jaya	1,000	5,300	4,200	10 bar	6"	5 Km
5	Bumi Serpong Damai	6,000	72,000	42,600	10 bar	12"	1 Km
6	Villa Permata	750	4,000	3,200	10 bar	6"	4 Km
7	Alam Sutera	750	4,000	3,200	10 bar	6"	1 Km
8	Banjar Wijaya	750	4,000	3,200	10 bar	6"	1 Km
9	Cina Garden	375	2,000	1,600	10 bar	4"	2 Km
10	Kebayoran Regency	375	2,000	1,600	10 bar	4"	10 Km
11	Kedaton	175	900	700	10 bar	4"	2 Km
12	Palm Spring Village	175	900	700	10 bar	4"	1 Km
13	Royyal Green Garden	175	900	700	10 bar	4"	1 Km
14	Villa Melati Mas	175	900	700	10 bar	4"	1 Km
15	Cipendoh Makmur	75	400	300	10 bar	4"	5 Km
16	Duta Taman Bandara	75	400	300	10 bar	4"	2 Km
17	Duta Garden	75	400	300	10 bar	4"	3 Km
18	Metro Permata	75	400	300	10 bar	4"	7 Km
19	Pantai Indah Kapuk	1,000	5,300	4,200	10 bar	6"	5 Km
20	Vila Taman Bandara	175	900	700	10 bar	4"	10 Km
21	Taman Surya	175	900	700	10 bar	4"	6 Km
22	Permata Hijau Regency	175	900	700	10 bar	4"	3 Km
23	Puri Indah	175	900	700	10 bar	4"	5 Km
24	Green Garden	175	900	700	10 bar	4"	2 Km
25	Pantai Mutiara	175	900	700	10 bar	4"	2 Km
26	Kosambi Baru	75	400	300	10 bar	4"	2 Km
27	Taman Semanan Indah	75	400	300	10 bar	4"	2 Km
28	Palm View Garden	75	400	300	10 bar	4"	1 Km
29	Taman Kencana	75	400	300	10 bar	4"	5 Km
30	Green Ville	75	400	300	10 bar	4"	2 Km
31	Sunter Agung Podomoro	750	4,000	3,200	10 bar	6"	4 Km
32	Gading Kirana	750	4,000	3,200	10 bar	6"	3 Km
33	Kelapa Gading	750	4,000	3,200	10 bar	6"	2 Km
34	Pantai Modern	750	4,000	3,200	10 bar	6"	13 Km
35	Harapan Indah	750	4,000	3,200	10 bar	6"	1 Km
36	Taman Impian Estate	375	2,000	1,600	10 bar	4"	1 Km
37	Sunter Paradise	75	400	300	10 bar	4"	2 Km
38	Kota Legenda	1,000	5,300	4,200	10 bar	6"	1 Km
39	Lippo City	1,000	5,300	4,200	10 bar	6"	1 Km
40	Cikarang baru	750	4,000	3,200	10 bar	6"	1 Km
41	Jakamulya	175	900	700	10 bar	4"	4 Km
42	Kumang Pratama	175	900	700	10 bar	4"	2 Km
43	Taman Galaxy Indah	75	400	300	10 bar	4"	3 Km
44	Pondok Pekayon Indah	75	400	300	10 bar	4"	2 Km
45	Taman Narogong Indah	75	400	300	10 bar	4"	6 Km
46	Jatimulya Jaya	75	400	300	10 bar	4"	2 Km
47	Sentosa Garden	75	400	300	10 bar	4"	3 Km
48	Cita Raya	2,000	10,600	8,400	10 bar	8"	1 Km
49	Kota Tigaraksa	3,000	15,900	12,600	10 bar	10"	3 Km
	Total	29,100	194,400	139,500			149 Km

Industrial Estate Development Plans

No	Name of Industrial Estate	Area (ha)	Gas Demand 1000m³/y	m³/h	Pipeline Necessary P	D	L
1	EJIP (East Jakarta Industrial Park)	220	48,400	5,500	10 bar	6"	1 km
2	Hyundai (Bekasi International Industry)	200	44,000	5,000	10 bar	6"	1 km
3	Delta Silicon	158	34,800	4,000	10 bar	6"	1 km
4	Newton Techno Park	51	11,200	1,300	10 bar	4"	1 km
5	Diamond Techno Park	13	2,900	300	10 bar	4"	1 km
6	Boston Techno Park	12	2,600	300	10 bar	4"	1 km
7	MM 2100 Industrial Town	760	167,200	19,100	10 bar	12"	1 km
8	Jababeka (Cikarang Industrial Estate)	868	191,000	21,800	10 bar	12"	1 km
9	National Gobel Industrial	100	22,000	2,500	10 bar	4"	1 km
10	KIIC (Karawang International Industrial City)	735	161,700	18,500	10 bar	12"	3 km
11	Surya Cipta Industrial City	1,094	240,700	27,500	10 bar	16"	1 km
12	Mitra Industrial Park	500	110,000	12,600	10 bar	10"	1 km
13	Peruri	500	110,000	12,600	10 bar	10"	1 km
14	Bukit Indah City	4,700	1,034,000	118,000	10 bar	New Offtake	8 km
15	Indotaisei	400	88,000	10,000	10 bar	8"	8 km
16	Tumor	210	46,200	5,300	10 bar	6"	8 km
	Total	10,521	2,314,700	264,300			39 km

THE STUDY ON THE MASTER PLAN OF URBAN GAS DEVELOPMENT IN THE REPUBLIC OF INDONESIA — FINAL REPORT

EXECUTIVE SUMMARY

1. Overview

Introduction:
This Final Report on the Study on the Master Plan of Urban Gas Development in the Republic of Indonesia ("the Study") focuses on the Jakarta area and consists of 4 parts. Part I describes our findings and analyses on current situations and sets forth most common assumptions for the Master Plan ("M/P") and Feasibility Studies ("F/S") to follow in Parts II and III respectively. Conclusions and recommendations are re-assembled in Part IV.

Formerly, the Government of Indonesia ("GOI") and the Japanese Government agreed that the Japan International Cooperation Agency ("JICA") conduct this Study with a stress on smaller customers in the Jakarta area than the currently served industrial customers and also consider applicability to other areas than the Jakarta area. The main text of this Study is in considerable detail in an expectation that the Counterpart, PT. Perusahaan Gas Negara (Persero), or "PGN", can apply the procedures and the results of this report to other regions that it originally requested to include in the study areas.

Background: Recent rapid economic and industrial growth in the Republic of Indonesia ("RI") has spurred the increase of domestic oil consumption with a forecast that the country will become a net oil importer early in the next century. Since the country's gas resource base is considerably large on the other hand, to promote domestic use of gas from appropriate gas fields has been a mandate.

Use of natural gas used to be limited in the areas close to gas fields and prioritized for large and strategically important industries, and mostly handled by Pertamina. PGN instead embarked on natural gas distribution two decades ago and has successfully expanded natural gas distribution in Jakarta, Bogor and Cirebon using gas from Pertamina's transmission lines, and also in Medan and Surabaya, mainly targeting large industrial customers. Total national domestic gas utilization either through Pertamina or PGN is increasing and approaching 50 % of the total national gas production.

Further domestic use of gas may involve more general industries, including smaller ones, and even commercial and residential customers. Market development activities are important in such smaller customer markets. Since new pipelines are planned to transport gas from Sumatra to Java, it is a high time to consider how to newly develop such smaller customer markets in a way that RI has never experienced.

Major Findings: This Study has found that the economic development in the Jakarta area is at a level that makes the area fully qualified for an urban gas system. It even will be necessary as a streamlined energy infrastructure in a modern capital area. This can be demonstrated by considerations on energy efficiency, urban energy transportation, traffic congestion, environment, safety, affordability and residents' desire for more convenience in the urban areas.

The urban gas network development, if feasible, is thus significant in two ways: to contribute to the national energy policy to promote the domestic use of non-oil energy to liberate as much oil for export and to modernize the urban energy infrastructure in the capital area of the country. The Study aims at clarifying the ways both in national policy and PGN's management strategies to accomplish such purposes.

Objectives: The objectives of the Study, in response to the foregoing, are to:

① formulate a master plan comprising the optimum development plan of an urban gas distribution system in the household (residential), commercial and industrial market sectors in the Jakarta area, and to conduct feasibility studies in the selected districts;

② propose appropriate plans for improving institutional and administrative systems of urban gas supply service; and

③ transfer the technical and administrative expertise to PGN, in the course of conducting the study.

Focus of Master Plan and Feasibility Studies:
The Study has defined a master plan of gas distribution to smaller customers, i.e., smaller than the current industrial customers, including residential, commercial, industrial and new technology gas market sectors. The Study focuses on the potential gas market in the east-west belt from Balaraja to Cikampek in PGN's Jakarta Branch service area as was initially agreed. It has also shown the result of feasibility studies on the two areas, Bumi Bekasi Baru and Bumi Serpong Damai as the selected candidate populated estates. The projection period both for the Master Plan and the Feasibility Studies is through 2020. It also discusses all policy and management issues to accomplish the plans. The Study Team held seminars for technical transfer during the study period.

2. Economic Scenarios

We have set national and regional economic development scenarios including three cases, i.e., base, high and low, as the base for demand projection after a considerable study (Table 1).

Table 1 GDP (National) Growth Assumptions %/y

year /case	till 2000	2000-2010	2010-2020
Base	6.5	6.4	6.7
High	6.9	7.1	8.7
Low	6.2	5.7	4.5

JICA Team

In this regard, the GDP projection in the 25 Year Plan of Indonesia was hired for our "high case" for the later years in our period through 2020. Looking at a separate report, JICA's Electricity Study of 1995 assumed a little lower growth rate through and beyond 2010; upon some modification for extrapolation, we took it as our "low case".

In the near term, both projections are close, with said JICA's slightly higher, while actual GDP growth these years surpasses the targeted GDP of both. The Repelita assumptions give the lowest figures and so are to become our "low case". JICA 1995's near term projections are accordingly our "high case". Smooth projections connecting those near-term and later year projections were considered as the mid-term projections. The averages of "high" and "low" are our "base case".

Table 2 GRP (Jakarta) Growth Assumptions %/y

case / year	till 2000	2000-2010	2010-2020
Base	7.7	7.6	7.9
High	8.1	8.3	10.3
Low	7.3	6.7	5.3

JICA Team

To study the Jakarta area, we rather need to project the local gross regional product (GRP) which is much higher than the national average. Its growth projections are determined as in Table 2. The level of GRP per capita in Jakarta is also far higher than in other areas but its growth rate seems to be somewhat suppressed by a significantly higher population growth in the area. We recognize that GRP per capita in Jakarta is close to or over US$3,000 and consider that the area can now well afford to have urban gas distribution.

3. Gas Supply

Although the Study assumes sufficient gas supply in West Java in the future, we have recognized constraints having existed in the gas fields to supply Java and in existing pipelines presently and at least for the time being. PGN has secured a sizable amount of natural gas supply from the off-shore Jakarta North gas fields as of May 1997 and has been relieved from the supply problem for the near future. We will assume the Indonesia Integrated Transmission Pipelines which are being planned will solve the problem of quantity for the further future. We understand the supply capacity of 450 mmscfd is planned for West Java looking for market after completion of the Sumatra-Java pipeline in the near future.

The detail of gas supply is out of our scope of work. The development of upstream infrastructures, however, will affect the gas supply cost in real terms and we examined approximate costs to be used for our economic analyses by assuming the future gas production and transmission conditions.

4. Master Plan

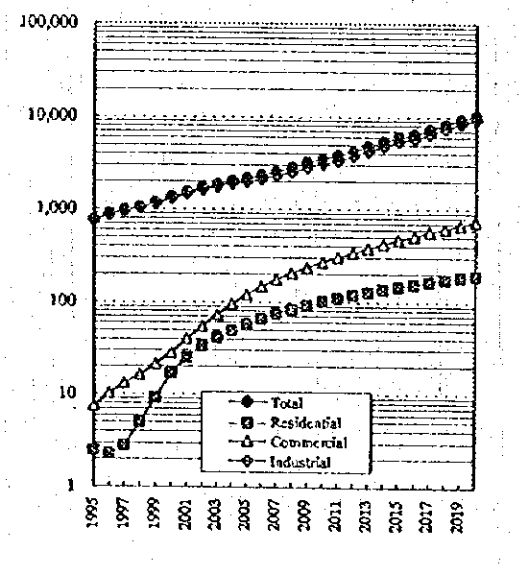
4.1 Master Plan Areas

We have defined the target area of the Master Plan as the high population density belt, with the width of about 10 km, along both the existing West Java Transmission lines and the already planned distribution mains, and the whole JATABEK area. Since the residential and commercial gas distribution requires especially careful cost and economic examination, it is better to begin from the areas which are very close to the existing lines with shorter additional distribution mains required.

4.2 Demand Projections in the Master Plan Areas

The Team laid out the gas demand projection in the Master Plan areas based on the economic scenarios and the field demand survey.

Fig. 1 Gas Demand Projections
Base Case million m3/y



Source: JICA Team 1997

4.3 Demand Survey Results

The Team devoted major efforts to field demand survey work and the findings are briefed in each demand sector as in the following:

1) Residential: Average estimated gas consumption per month per family, or "per meter", in Indonesia is found to be rather large as compared to commonly expected levels for tropical countries, if considering certain income groups presumed suitable to have urban gas. The survey was conducted in two ways: collecting about 1200 questionnaire returns and actually visiting with more than 200 potential sample customers over wide income levels. The face to face discussions with sample customers revealed much preference for gas.

   Based on the larger than expected per-meters, economics of residential gas distribution seems feasible based on economic prices and costs, and is encouraging for future planning. The best customers are found in middle income groups. Current residential gas prices, however, are still too low before economic feasibility.

Also, we conducted "load pattern surveys" for selected existing gas customers using state of the art intelligent gas meters with a function to record gas flow signals showing the pattern of gas use within a day, which reflects the everyday life of Indonesian customers. The information is useful for correctly designing the distribution pipelines that must accommodate maximum, and not average, gas flows.

Residential energy demand mix is first projected to 2020 considering the trends of income level and size of family as well as their elasticity to energy consumption. Gas consumption was then determined approximately as a share in the residential energy mix, the shares being assumed as 5 to 9 %. The considerations on this share include the constraints by the closeness to the main pipelines being planned. This, however, gives still only a potential estimated consumption. The Team's real projection, defined as "possible demand" is determined after checking gas pipeline installation possibilities and the final projections are included in Fig. 1, together with other demand sectors.

2) Commercial: Combined with the gas cooling market, commercial gas distribution will be feasible for customers at current gas prices under certain presumptions. The Team conducted interview surveys with 60 plus customers. The data confirmed that experiences of the cooling market in Japan are applicable to Indonesia and economics are far better with gas cooling here because of more hours of operation due to climate reasons. Future economy will depend on electric prices in an upward trend, which we hope will be still favorable to gas.

3) Industrial: The Team's survey focused on the growth potential of new industrial estates since PGN already did detail work for industrial customers outside those estates and confirmed feasible. The Team made visits and analyses with 20 plus factories. Uncertainty exists in each estate and only long term plans will include gas distribution in those estates so that PGN may be ready to consider them when demands (and supply availability) come out closer.

4) New technology markets:

Gas air-conditioning, when applicable, is found to be technically and economically feasible in Indonesia. Detail results are in the main text and the gas development in this sector is encouraged for building the distribution infrastructure.

Marketing of high efficiency cogeneration may be difficult to generalize but seems to require higher electricity prices before becoming feasible. There is no doubt that the economics in cogeneration are favorable in the long term due to its high energy efficiency if there is certain amount of heat demand in customers' buildings, but the higher up-front cost sometimes discourages investors who are interested in a short period pay-back. Since electric prices have to rise based on the future cost of facilities, the feasibility of cogeneration may be a matter of time.

District cooling has a possibility, too. The Team made a detail study on this for the BSD's commercial area. Large benefits such as convenience, cleanliness, space saving and prestige in commercial facilities give high premium values to a community and an economic analysis shows it beneficial. A high up-front cost, however, may inhibit it in situations, e.g., when they are not interested in longer term benefits or where facility build-up time is very long. From this view, this Study has taken a little pessimistic stance on the district cooling for the moment but does not mean no future.

NGV is found to be beneficial for the Indonesian urban environment with the costs for conversion much less than we initially expected. A bottleneck, however, will be the penetration of filling stations which have constraints in finding the sites in urban areas. The government's target to have 30,000 NGVs to be available in 2000 is tough and more time may be necessary.

5. Policy and Pricing Considerations

5.1 Policy

The policy for the gas distribution sector is not well defined yet. We are concerned with the inter-fuel price competition, distribution cost and gas pricing mechanism, business entry constraints, conditions to make financing available to both the gas distributor's and customer's sides, safety standards and regulatory framework. We recommend all policies be favorable to encouraging quick gas customer connection to maximize efficient gas use in the market.

The result of the ongoing consultant works for the gas regulatory framework to come out to MIGAS is being waited for. It has come to the Team's knowledge that some of relevant items in the draft of such works may appear to affect gas distribution business as follows:

- A bundled gas supply service on a local basis
- gas prices on negotiated basis for larger customers
- Any subsidy, if applicable, directly from Government and on a fixed sum
- No exclusivity in distribution territories
- prices to small customers to be under simple ceiling price control

We recommend to treat natural gas as an urban energy infrastructure with a high priority considering the energy resource situation in Indonesia, its particular suitability to urban areas and high efficiency in its direct use.

Smaller customer markets generally require an advance investment and longer term orderly planning. Investors in this sub-sector usually expect sure returns instead of high risky returns and the regulatory framework should consider this.

Natural gas to smaller urban customers may be a little expensive in thermal value terms in the future, but is a premium fuel to attract them in view of convenience, cleanliness, safety and efficiency as well as some pride even at a higher price.

5.2 Pricing

Gas prices have been improved by the recent revision for the first time since 5 years ago. It is welcomed as a beginning toward more rational gas pricing to assure investment in all the streams of natural gas as well as for the gas to remain competitive in the market. In view of the future smaller customer market, the price rise is clearly not yet enough and also we expect more strategic price structures to be worked out in the future when more market categories are explored.

A gas price, in principle, should be appropriately or strategically set in between the cost of distributed gas at customer's end and the net-back value which a targeted customer is willing to pay in view of competing fuels. To accurately determine such costs and values is not always easy, but approximate levels should always be recognized. The aggregate price should well cover all the costs of gas supply and attaining such price status is desired at least before inviting private sector financing. Long run marginal costs (LRMC) or average incremental costs (AIC) should be considered as an indication to minimum price for utility services accompanying future investment. Pricing proposals based on such mechanisms should be granted by the government.

A two-part tariff system should be studied especially for smaller customer markets. While considerations in the former paragraph give the concept of average gas costs and prices, how to allocate the costs into the tariff table is another problem, and the point is in how to quickly recover the rather high up-front costs. A tariff table should basically follow a principle of "the simpler the better" in view of accountability and transparency, but how to recover the cost by way of pricing is too important a topic. This may not necessarily apply to large customer markets because gas is currently competitive enough to be with economic rent in the sector. The situation, however, might be changed by other low cost fuels depending on the region and type of customers.

6. Utility Management

The organization of the utility, i.e., the gas company, will need to accommodate future changes and expansion of market sub-sectors or categories. A market is not simply there but is to be developed. Smaller customer markets may be explored by persistent marketing activities by the personnel with engineering knowledge and by customer education, and there may not be a waiting list even if gas is preferred. Constant employee training may enable PGN to face this challenge with intensive training activities (and relevant facilities) with the current size of staff- and work-force of PGN for the time being.

7. Feasibility Studies

The concept of the urban gas expansion is to initially pick-up relatively larger customers even in the smaller customer market in the areas close to existing pipelines, or otherwise particularly low cost-of-supply customers, who are mainly commercial and high efficiency or premium use customers, as well as industrial and conveniently located residential customers, in order to develop the gas distribution infrastructure in an economical way. After that, eventually all potential customers in the area may be served with gas by extending pipes bit by bit to attain a core customer market. An existing residential area and a newly developing area, however, will require distinctive approaches. Also a dilemma exists in financing both PGN's and a customer's facilities. These will be discussed later.

For the Feasibility Study, the Steering Committee and the Team selected two areas in pursuant to the above concept: firstly the Perumnas Bekasi Baru, an existing detached residential housing estate operated by a governmental body, and secondly the Bumi Serpong Damai (BSD), a very large residential and commercial estate developed by private sector companies. While there were other candidates, too, those two estates are excellent comparative samples for the Study.

8. Conclusions

8.1 Energy and Economic Situations and Policies

(1) *Affordability:* The economic growth of the Jakarta area has been significant with the current average GRP per capita being about 3,000 US Dollars, a level perceived as sufficient to afford urban gas infrastructure. GRP per capita in other major metropolitan areas where gas is available are also growing fast and approaching the 1,000 US Dollar line. Perspective urban gas infrastructure in those areas will be worth consideration, too.

(2) *Gas Priority for Urban Use:* Urban gas priority is good enough to be built into the national energy policy at least in high growth metropolitan areas like Jakarta. Looking into the country's energy resource base available to domestic use and assuming abundance of natural gas in a long-term perspective, the gas could be best used for urban

energy infrastructure. This is because a modern urban area requires a streamlined energy distribution contributing to better traffic conditions, better environment, more convenience, safety and higher energy efficiency, and the direct use of gas can meet such requirements. Other energy resources are better used by larger customers and in more rural areas.

(3) *Competition with LPG:* Gas networks can compete well with LPG at economic price levels. Since urban gas can be available only through pipeline systems that require large up-front costs, economics have to be carefully examined in view of affordability by people and competition with LPG. The use of LPG is rapidly growing in suburban areas and it is also a clean energy suitable for household use with care. Due to safety issues and the nature of distribution system, however, the LPG is more suitable for rural areas. Natural gas is more suitable and preferred in urban areas.

(4) *Regulatory Framework and Policy:* There is almost no transparent framework yet to regulate urban gas distribution. Gas prices are set by the Government after discussions among PGN, Pertamina, MIGAS and political parties. By policy, the national one price system is applied so that the distributed gas has the same price throughout the nation if the use of gas is in a same category. While the constitution stipulates that gas and oil be marketed by a national company, whether or not it governs the delivery to the end use is unclear. GOI well recognizes this situation and the need to formulate a streamlined framework as a prerequisite in inviting investors, it is drafting one with the help of ADB and WB.

With recognition that economic prices work best in a market economy, it is desired that as long as the pricing is reasonable in view of affordability, the efficiency cost and competitiveness, price changes can be approved smoothly under transparent regulatory rules. Also in view of large up-front investments required, more favorable tariff systems like a two part tariff system is desired to be employed for smaller customers.

While PGN is authorized as the sole gas distributor to smaller customers, the approval of some variations in a flexible policy, like setting up a separate company for limited gas distribution, is desired, especially when a one price policy rule is too rigid, a different system is economically justified and residents select such a different system.

(5) *Importance of Market Development:* While when it is a mandate to develop the domestic use of natural gas, more attention is usually paid to upstream development, it should be recognized that market development is equally important. When only large industries are a target such burden is small, but as the gas is to be used by smaller but abundant number of customers, large development efforts and more intricate plans are necessary. Upstream and downstream have to be developed in parallel.

8.2 Assessment of Master Plan

(1) *Overall*: The Team concludes from the analysis of the Master Plan that the gas distribution to smaller customers is economically feasible and beneficial on the national economic basis. This is judged mainly from the overall EIRR (the economic internal rate of return) and NSB (the net social benefit) over the calculation period from 1997 and 2020. The IRR and the NSB values of cash flows are shown in Table 3.

Table 3 Economic Result of M/P

	IRR (%/y)	NSB (mil.Rp)
Base case	34.2	970,601
High case	40.2	1,353,508
Low case	28.1	653,777

Source: JICA Team

We set gas prices at a level competitive with alternative energies in calculating IRR rather than directly determining the economic gas distribution cost in each market sector. There is complexity in the gas market that includes residential, commercial, industrial and new technology sub-sectors which all use the same distribution network. Instead, the residential gas distribution cost is exemplified in a feasibility study that follows later.

The feasibility of the gas distribution to smaller customer markets is expected if:

- the price is set at a cost recoverable price;
- the price is at a level competitive with LPG;
- financing is available;
- all the effort to cut the cost is made; and
- large markets such as gas cooling is sought together.

(2) *Gas Purchase Price:* Before discussing gas sales prices, in our Study, the gas purchase price was set to gradually increase from the current price of 167 Rp/m3 in 1996 to 278 Rp/m3 in 2020, in real terms, reflecting future gas coming from farther gas fields with higher costs. We assume a reader knows that prices in real terms have to be inflated in the actual world according to the inflation rates in the future. The above price increase means an escalation over inflation. Also if the price is contracted in a fixed price, the real term price should be deflated.

(3) *Residential:* The residential gas price was set at 800 Rp/m3 in real terms (1997) in the above economic analysis. This is a level still low enough to compete with LPG and to recover the investment; thus is deemed as an economic price. The difference between the purchase price and 800 Rp/m3 represents the distribution cost which is based on efficient operations.

The set price of 800 Rp/m3 is far higher than the current residential gas price, but has to be realized for the independent feasibility of residential gas distribution. This level is both economically competitive and affordable by many potential customers.

A quick increase of the residential gas price to a level of 800 Rp/m3 is desired since a case of gradual increase in ten years proved not a high enough rate of return for inviting private sector investors.

(4) *Separate Entity:* How to virtually raise the price is a political or corporate theme and we have proposed a concept of the "separate entity distribution operation". In this concept PGN sells gas to a separate distribution entity, PGN's subsidiary or a third party company, at a wholesale price and the rest of the work of gas distribution is handled by such an entity which charges an 800 Rp/m3 level price to residential customers in a designated area. This is because PGN is currently required by the Government to apply a unique gas price to residential customers in the country regardless of the region and actual cost differences, and it is presumed that a separate company may be allowed to apply a different but economically reasonable price to customers A similar scheme is already applied to apartment buildings, where a landowner charges a price to end customers, though the price is different from such a high level. To maintain the safety and common gas distribution standards, PGN may still act as a contractor for physical operations and patrols, not really feeling the loss of a market. The estate operator may be rewarded with certain economic returns, keeping privileges and attractiveness to the property. By this scheme, the final price to the customer could be divided into a distribution charge and a gas price, the latter of which is still in line with the PGN gas tariff.

(5) *Financial Analysis:* Whether to adopt the separate entity concept and how quickly to raise the price for residential customers affects the economics of the whole Master Plan mildly because of an implicit cross subsidy from more lucrative industrial sectors. The situation is shown in Table 4. Since the portion of the residential gas market in the whole PGN operation is small, a less economical element is well absorbed, except in the combined cases of current gas price and low demand. This can work as a back-stop element to PGN for venturing into new market sectors, but it is never desirable that the residential gas market damage the financial picture of other sectors when PGN requires large investment in transmission lines. Thus an arrangement for self sustainability of the residential gas operation is necessary.

Table 4 Financial Analysis on the Master Plan

	Scenario		Base		High		Low	
			IRR %/y	NPV milRp	IRR %/y	NPV milRp	IRR %/y	NPV milRp
1	Managed by separate utility. Gas purchased at 315, sold at 800	PGN side	27.0	432,524	31.5	727,665	20.8	191,685
		Sep. U.	17.5	120,337	17.9	130,910	17.0	106,697
2	PGN operates. Price up in ten years		20.7	456,244	24.5	769,701	16.1	203,656
3	PGN operates. No price hike		16.6	259,105	21.2	574,686	10.4	8,837

Source: JICA Team 1997

(6) *Commercial Air-conditioning:* Gas absorption air-conditioning is mostly feasible in commercial facilities at the current gas and electric prices if the pipelines are located close to the customer facilities. The estimated pay-back is 3 to 4 years. Assuming the electric prices will be raised in the future reflecting the clearly more expensive generation costs, absorption chillers will be feasible in the future, too.

(7) *Cogeneration:* High efficiency cogeneration may have some difficulty in attracting investors, who generally want a quick property investment return, due to high capital expenditure and generally low energy prices as well as an insufficient amount of heat demand depending on facilities. The pay-back for this is 5 to 6 years and the IRR may be in the range of 10 to 13 %/y in a 15 year project period. It is still economical to an investor with enough financial capability and long-term perspective of property investment. It is worth consideration to hotels and hospitals in urban areas. The gas cogeneration is challenged by another cogeneration using low priced oil products without environmental restrictions in urban areas.

(8) *NGV:* An NGV (natural gas vehicle) is simply beneficial for the environment in urban areas as long as economics allow it and the policy of the government to spread CNG (compressed natural gas) for taxis, buses and other fleet are appreciated if the price of a conversion kit is maintained at the current level and safety is ensured. There are still barriers of land prices in installing CNG filling stations in urban areas and so the economics are difficult to generalize. Certain density of the number of stations are required for NGVs to take off for a self sustaining market. It may be worth certain cross-subsidy in a transition period in view of the importance of urban environment.

(9) *Industrial Market:* There is a large potential in industrial gas markets in many industrial estates being developed in the east of Jakarta as well as in Serang. Uncertainty is also large in estimating the potential gas demand since many estates are in very early stage of development. The Team, nevertheless dared to approximate the potential. There are recently challenges from low cost oil products, so PGN should feel competition and think in advance for possible demand areas. The Team appreciates that PGN well knows the industrial gas sector from abundant experiences.

(10) *Environmental and Social Effect:* The Team conducted a detail environmental assessment for the Master Plan projections. As gas is good only compared to other fuels to damage the environment, it is essentially to assess how good natural gas is in urban areas. Gas considerably decreases SOx and NOx in urban areas by replacing oil for factories as well as greenhouse gases effective globally. Gas absorption chillers decreases ozone depleting CFCs. The gas is safer than LPG which has recently caused many large explosion incidents as well as more convenient. It is felt by people as having a premium value which, though, changes with income levels and hard to quantitatively determine.

8.3 Conclusions from Feasibility Studies

(1) The Team has confirmed the economic feasibility of the gas distribution to smaller customers under certain conditions in two estates: the Perum Perumnas Bumi Bekasi Baru and the Bumi Serpong Damai. The former is almost purely residential and the latter is the combination of large commercial centers and residential estates. Another distinction is that the former is a government sponsored estate while the latter is very large and purely a private sector estate. Table 5 shows the results of the assessment.

(2) *Bumi Bekasi*: The results on Bumi Bekasi Baru shows a typical genuine residential gas distribution which has proved rather tough economics. It is economically feasible if:

- the gas price is raised to 800 Rp/m3 from the beginning, and
- the operation cost is kept minimum by only the limited number of staff and workers.

(3) *Separate entity*: Assuming the difficulty in raising the gas price directly by PGN, the Team considers the case of a "separate entity" is the only possibility, in which a gas bill to a customer is broken down into gas charge and distribution service charge.

Table 5 Financial Results of Feasibility Studies

No.	Scenario		Bekasi		BSD			
					100% Progress		50% Progress	
			IRR %/y	NPV mil Rp	IRR %/y	NPV mil Rp	IRR %/y	NPV mil Rp
1	Operated by separate utility. Gas sold at 800 Rp, purchased at 315 Rp/m3	PGN	15.2	403	94.7	16,886	40.6	16,509
		S. Ut.	14.5	1,971	22.7	13,786	21.2	12,027
2	PGN operates. Up to 800 Rp in 10 yrs.		7.3	-1,722	17.4	10,203	8.6	-1,932
3	PGN operates. Price remains w/o hike.			-7,824	10.3	304		-11,832
4	PGN operates. Gov. help pipes; no price hike.			-4,613	38.0	11,701	8.5	777
5	PGN operates. Gov. help pipes; To 800 in 10 yrs.		13.6	1,489	52.5	21,600	24.1	9,122

Source: JICA Team

PGN has enough return by whole-selling the gas to a separate gas distributor at 315 Rp/m3 applying the current K2 tariff in line with the size of the demand from Bekasi. Based on our financial analysis on PGN's profitability, PGN will even be able to give a discount in the whole-sale price to such an entity or establish a new and lower tariff table, attracting more customers in the estate.

Responsibilities should be clearly defined in such a separate entity gas operation since it is matter of fact a joint distribution operation. Our analysis assumes PGN invest in all high pressure gas mains above 3 bars, all regulators from the main and a gas meter for the whole sale gas transfer. PGN also takes care of the patrolling along low pressure lines.

We assumed these be included in the wholesale price. Measure for gas leaks, if found, is a responsibility of the entity.

Safety is very important to assure the customers and for sustaining the business for long time and it is for this reason that PGN is expected to assume patrolling the low pressure pipelines since it is more experienced than a new entity which may be only financially interested in the residential gas distribution.

(4) *Responsibility of PGN:* By keeping the high pressure mains as PGN's property, PGN can expand its own service area through the estate to other larger customers, since PGN is basically given the right of a natural monopoly.

The price to existing residential gas customers will have to be gradually increased to eventually match the level at those estates. Since a tariff system more honest to the actual cost levels should be recognized as a fair system, we hope it will be accepted.

PGN should be able to invest in such a separate entity, but considering the regulation by PKLN which restricts the foreign investment in RI's governmental entities, PGN's share may be well restricted to a small level for quick implementation. Such consideration enables pipeline investment to be smoother.

(5) BSD: BSD is characterized by large commercial facilities as well as the residential districts and the overall economics of gas distribution will be much better than in Bekasi. The same discussions as in Bekasi can go for the residential part of the estate, but when the separate entity handles both commercial and residential districts in the estate as is expected, the performance of the entity of BSD will be more attractive due to a large demand for gas from air-conditioning if properly installed. Our Study has focused only on the eastern half of the estate divided by a river, which suggests that the study will be a good indication to the future development of the western half.

(6) *Gradual Development of Commercial Facilities:* The prospect of gas air conditioning market is heavily affected by the commercial facility build-up progress. Performance is best when all facilities are starting at the same time (defined as 100% Progress in Table 5) but such is unlikely. With a more conservative build-up progress (say, 50% in 5 years), however, the economics will still be attractive.

(7) *District Cooling:* District cooling has an economic possibility in BSD because of a sizable accumulation of cooling demand in a central area of commercial facilities. A more centralized energy system, it increases the energy efficiency, convenience, safety, smartness and privilege, and saves space in buildings. Premium values due to these factors, however, are felt differently according to the type people and income levels generally. Because of higher up-front costs of the system, than for decentralized systems, the decision will rest with the land developers on whether to take the long-term or short-term advantage. We have not necessarily been optimistic.

8.4 Utility Management

(1) Financial and market status: While PGN has successfully expanded gas distribution to industrial customers so far, further expansion of the entity is to involve enormous investment in high pressure and long haul transmission pipelines, drastically changing its financial status. Future projects are very large compared to the size of the current PGN and large borrowings are envisaged as well as inviting equity investors. Still the Debt/Equity ratio is expected to increase. When the ratio of Cost of Goods/ Total Sales and Profit/Total Sales are decreasing these years, each new project should be very carefully examined of the feasibility and maximum efforts must be devoted to securing the market and cutting the cost by further efficient operations.

Since these projects are national dream projects which are important for the national policy to promote the domestic gas use to replace oil, the government is expected to fully support the projects, subject to PGN's own effort as the major transmission and distribution company.

Market oriented approach will be more necessary in the future to secure the market, since without the market there will be no new pipelines and that means more efforts and expertise required. All possibility of the market especially in the Jakarta area will have to be explored and examined. For further expansion, the smaller customer markets will have to be explored, too, with more carefulness.

(2) Organization and human resource development: Restructuring of organization in PGN is actively going on to adapt to new business status for the future. PGN has successfully expanded the business without any large increase in the number of employees in the last decade. Further expansion, however, may require the involvement of more people in and out of the company with higher expertise because a more diversified gas market development is required. It will be necessary to involve and organize more outside contractors, to further develop own human resources for higher expertise and to cultivate more team-work among employees to exploit every employee for common targets.

Fort the Master Plan to be implemented, additional functions will have to be added to the organization, various gas sales promotion techniques have to be learned, safety standards have to be streamlined and more system developments will be necessary to handle more customers and to control gas networks more efficiently.

(3) Gas pricing: This Study finds that the current gas price level is insufficient to target smaller customer markets except for gas air-conditioning and any measures is desired to virtually increase the price within an economically justified range. It is also desired to restructure the tariff system to adapt to the new markets mainly to facilitate to more easily recover the investment costs by adopting a two-part tariff system or any other comparable system. To continuously study into the tariff system will be necessary as all

gas companies in the world do to cope with the changing world.

(4) Gas Networks: Through detail network analyses, the Study finds many bottlenecks existing in the gas distribution networks as PGN recognizes, too. Most problems will be solved by precisely locating those problems and by small additional investment. Some problems, however, appear to exist in between PGN and Pertamina, since the high pressure transmission line and distribution network is closely linked. In this regard, close talks and cooperation with Pertamina will be desired.

To cope with expanding gas networks, more technologies will have to be introduced without too much dependence on labor force in the future. The Study finds that personnel expenses are already becoming a heavier burden in the distribution costs with the increase of per-head income due to the economic growth and so personnel expenses.

(5) Marketing: Future marketing to target new smaller customer markets requires a more diversified approach to various potential customers, like land developers, building owners, architects and gas appliance sellers. New strategies to diversified markets will have to be gradually developed to implement the Master Plan

9. Recommendations

(1) Policy Level:

1) The government should recognize in its policy that the Jakarta area can already afford to have an urban gas infrastructure due to its economic strength while such development has been inhibited by low gas prices.

2) The government policy is recommended to put a high priority on urban gas for a streamlined urban energy infrastructure.

3) The policy should recognize that gas can have a competitive price with that of LPG, that gas is more suitable for urban residents and that LPG is an important fuel for more rural areas for the residential purpose.

4) Regulatory framework should allow the prices to be at a level to recover the justifiable costs for urban gas infrastructure. The two-part tariff system which is more appropriate in recovering the investment cost, should be considered. Efficient gas pricing based on economic costs and prices should be more easily approved in the approval process.

5) The policy makers should recognize that market development is important equally to

upstream development to promote domestic gas use.

(2) Master Plan:

1) It should be recognized that the gas distribution to smaller customer markets is feasible at economic prices under certain conditions including joint development of residential and commercial, and the gas cooling market. Mid-income group residents can be better targeted for the residential gas market and so they can be a locomotive for building up the gas energy infrastructure.

2) When the distribution cost in a certain region is different from an other region and such a cost can still compete with other fuels, it is recommended to approve a mechanism to apply a different price through a separate entity establishment

3) The government is recommended to endorse the promotion of gas air-conditioning and cogeneration, when feasible, for commercial buildings and complexes.

4) NGVs are beneficial and recommended to be promoted in the urban areas. More filling stations are necessary for sustainability.

5) It is recommended to continue to watch new industrial estate development, since industrial estates in West Java are growing and early pipeline planning is better for securing the gas market.

(3) Feasibility Studies:

1) We recommend that a policy of a gas price increase or of establishing a separate utility for gas distribution, which is granted to apply separate tariffs, be established early especially for Bekasi. While gas distribution is economically feasible in Bekasi, subject to economic gas tariff of 800 Rp/m3, any lower price may inhibit development, since it is a purely residential estate, without commercial customers.

2) BSD is highly encouraging for gas distribution to the combination of residential and commercial customers and so we recommend that an agreement among relevant organizations be reached early.

(4) Gas Utility Management:

1) We recommend that human resource development in strategic areas for market development be effectively promoted.

2) PGN is recommended to lead an improved tariff system development to facilitate a quicker recovery of the investment cost.

3) We recommend to solve the bottlenecks of gas networks for future gas expansion.

4) More cooperation between Pertamina and PGN recommended to optimize the gas network operation.

5) More technology be introduced because the burden of personnel expense is rising as is seen in the analysis of the distribution costs in the Feasibility Studies.

10. Technology Transfer

Technology transfer is one of major items in this Study. The Team performed a technology seminar on October 10, 1996, and other small seminars in PGN. Also the second seminar was held on June 26, 1997 before the audience including potential investors and financiers. Some of these together with other relevant items are recorded in the Appendix.

11. Next Steps

11.1 Immediate Future:

This Study includes recommendations involving policy changes both at national and PGN levels which are a prerequisite for implementation of the Master Plan and other plans from feasibility studies. Establishing policies or a direction of policies on gas prices and PGN's policies for organizational and managerial improvement will be crucial for future steps from this Study.

All projections and analyses in this Study assume that such policy changes be made in 1997 and implementation begin in 1998. A delay of one year in policy formulations means a one year delay of all plans in this Study.

11.2 For Implementation:

There are still more steps to be followed until implementation, if implementation is decided.

a. Clearing government policies and regulations

b. Establish the direction for gas prices
c. Gas purchase arrangement
d. Acquiring supervising consultants
e. Establishing company policies
f. Establishing concrete rolling plans
g. Revised and finalized feasibility studies for financial institutions
h. Financing arrangement
i. Establishing work forces
j. Education and training for employees and contractors
k. Adjusting with gas appliance manufacturers and sellers
l. Procurement procedures