The present subdivision development is more than sufficient for the Antipolo area's expected expansion within the next five years. However, according to the present and anticipated growth of Metro Manila, the area is expected to be the main means of absorbing future population growth requiring new subdivision to be developed.

The influx of urban population is the basis for the future expansion of Antipolo. At the Municipality level, from 207,842 in 1990, its population will increase to 435,886 by the year 2010. The population in the study area will increase from 123,347 in 1990 to 255,831 by the year 2010.

By the year 2010, some 822 hectares of presently open/unoccupied area (776), grassland (2,660) and agricultural areas (796) will be devoted to residential use, especially along the western fringe of the Study Area.

By 2010, Antipolo area is also projected to have expanded outside its current boundaries, with the planned industrial estate some 10 km. east of the Antipolo town.

Figure 11.8.3 shows the land use projection. The future built-up area of 722 hectares in 1990 will increase to 1,544 hectares by 2010 (Tables 11.8.2 and 1.8.3).

Figure 11.8.4 shows a land-use comparison of the Antipolo area between 1991 and 2010.

1.8.3 Conclusions

(1) Land Use Plan

The land use plan is presented in general terms (Figure 11.8.5). In can be amended according to authorized decision from time to time. The land use plan shall be regulated under zoning regulations which may be dictated by the authorized regional or municipal agency. These should be strictly enforced in regard to each kind of development and any proposal shall be rigorously screened.

Space standards for community facilities and services and all future

land use shall be governed by zonal plans under the Master Plan.

a. Urban Consolidation Zone

This is the main built-up area. It is a densely populated urban area where implementation of the plan is needed to avoid water shortage, pollution and unhealthy environment created by mixed and uncontrolled land use.

- No more expansion
- No new heavy industries
- Rehabilitation of blighted areas
- Upgrading of urban service
- Land use planning and update zoning ordinance
- Closure of open dump sites

The improvement/rehabilitation/maintenance of natural drainage courses and existing facilities, particularly water supply, flood control/drainage and sewerage networks, should be given priority so as to prevent further deterioration of the urban ecosystem.

b. Complementary Urban Satellites

The metropolitan concern may be mitigated through the development of growth centers outside the metropolis which will act as complementary urban satellites of the National Capital Region.

(2) Residential and Open Areas

New settlement areas have to be specified outside of the NCR in view of the development of the east (Rizal) and south (Cavite) corridors.

In view of annual increase of population pressure from Metro Manila, population will increase in the contiguous provinces also. New settlement areas have been proposed in different parts of Rizal and Cavite in order to develop the town in a planned way, controlling the haphazard urban sprawl.

Open areas are needed to provide open spaces and community facilities.

(3) Industry and Tourism

It is necessary to create new jobs to ease the problem of unemployment. For that purpose, industries like handicrafts and cottage industries, which do not pollute the environment and will not stand as obstacles to residential planning, are to be established.

The appropriate land for industries may be located at the south of Imus and Bacoor in Cavite and at the east of Antipolo and Tanay in Rizal.

Two industrial estates are proposed in San Mateo and Antipolo (Pinugay). Other industries are to be spread over different places of the study area.

In the land use plan of Antipolo area, appropriate land has been allotted to the different small and medium scale industries which are feasible to run in the future.

If the different industries are allowed to establish only in the places shown in the land use plan, there will be substantial savings in expenditure for the development of infrastructures.

In the current process of establishment of industries, different industries are being established in arbitrary places due to the lack of coordination between authorized agencies and individuals.

It will take more time to start large-scale industries in the eastern part of Antipolo because the transportation cost is high in this mountainous area of Rizal, as compared to that in Cavite area.

It would, however, be unwise to locate large and heavy industries in Antipolo area, as these would pose problems on air pollution, waste disposal, traffic congestion, among others. Moreover, the area does not have enough water supply to sustain large scale industries.

There is an ample scope to develop the tourist industry in the Antipolo area. Properly developed, the tourist industry can increase national revenues, employment opportunities, and helps to earn convertible foreign currencies.

(4) Agro-Industry/Farming and Regional Open Space

The success of the agro-industrial thrusts of the provinces of Rizal and Cavite is seen as the key to the gradual deceleration of urbanization in Metro Manila and its eventual decongestion.

(5) Flooding Area

Lower areas are not suitable for residential use, industry, etc.

(6) Preservation Areas

a. Greenbelt/Forest Area

Creation of a green belt and construction of dike protection around the coastal lake against erosion and flooding in the lower zones is needed.

b. Watershed

The relatively underdeveloped northern Marikina valley has the potential for further development to meet the projected future demands for many years and is to be considered as preservation area.

(7) Zoning Regulations

It is necessary to formulate zoning ordinances to manage the trend of urban development and also to have development plans for settlement areas.

Zoning protects residential areas from the harmful intrusions of commercial and industrial uses while simultaneously promoting business and industry as a result of the planned and orderly development that it ensures. It prevents overcrowding in buildings and land, thus, facilitating the provision and continued adequacy of water, sewerage, transportation and other facilities.

The zoning regulations and their administration are major tools in carrying out the land use part of the Master Plan of which it is an integral part.

Table 11.1.1 POPULATION AND GROWTH RATE BY REGION FOR CENSUS YEARS

	POPULATION (THOUSANDS)												GROWTH RATE (%)				
	1960		1970		1975		1980		1985 (Estimate)		1990		1960/ 1970	1970/ 1975	1975/ 1980	1980/ 1985	1985/ 1990
Philippines	27,088	100.0	36,684	100.0	42,071	100.0	48,098	100.0	54,688	100.0	60,685	100.0	3.1	2.8	2.7	2.6	2.4
NCR (National Capital Region)	2,462	9.1	3,697	10.8	4,970	11.8	5,296	12.3	6,942	12.7	7,929	13.1	4.9	4.6	3.6	3.2	3.1
Region																	
1. Ilocos	2,428	9.0	2,991	8.1	3,269	7.8	3,541	7.4	3,903	7.1	3,551	5.9	2.1	1.8	1.6	2.0	1.6
2. Cagayan Valley	1,202	4.4	1,691	4.6	1,933	4.6	2,215	4.6	2,521	4.6	2,341	3.9	3.5	2.7	2.8	2.6	2.0
3. Central Luzon	2,525	9.3	3,615	9.9	4,210	10.0	4,803	10.0	5,456	10.0	6,199	10.2	3.7	3.1	2.7	2.6	2.5
4. Southern Tagalog	3,081	11.4	4,457	12.1	5,214	12.4	6,119	12.7	7,089	13.0	8,266	13.6	3.8	3.2	3.3	3.0	3.0
5. Bicol	2,363	8.7	2,967	8.1	3,194	7.6	3,477	7.2	3,922	7.2	3,910	6.4	2.3	1.5	1.7	2.4	1.3
6. Western Visayas	3,078	11.4	3,619	9.9	4,146	9.8	4,526	9.4	5,092	9.3	5,393	8.9	1.6	2.8	1.8	2.4	1.8
7. Central Visayas	2,523	9.3	3,033	8.3	3,387	7.9	3,787	7.9	4,195	7.7	4,593	7.6	1.9	2.2	2.3	2.1	1.9
8. Eastern Visayas	2,041	7.5	2,381	6.5	2,600	6.2	2,799	5.8	2,073	5.6	3,055	5.0	1.6	1.8	1.5	1.9	0.9
9. Western Visayas	1,351	5.0	1,869	5.1	2,048	4.9	2,528	5.3	2,863	5.2	3,159	5.2	3.3	1.8	4.3	2.1	2.3
10. Northern Mindanao	1,297	4.8	1,953	5.3	2,314	5.5	2,759	5.7	3,718	5.8	3,510	5.8	4.2	3.5	3.6	2.9	2.3
11. Southern Mindanao	1,353	5.0	2,201	6.0	2,715	6.5	3,347	7.0	3,836	7.0	4,457	7.3	5.0	4.3	4.3	2.8	2.9
12. Central Mindanao	1,383	5.1	1,941	5.3	2,070	4.9	2,271	4.7	2,598	4.8	3,171	5.2	3.4	1.3	1.9	2.7	3.5

Source: 1960-1980 Philippine Statistical Yearbook 1989 (NEDA)
1985 Philippine Yearbook 1989 (NSO)
1990 1990 Census of Population and Housing (NSO)

Table 11.1.2 POPULATION DENSITY OF THE STUDY AREA

City/Municipality	POPULATION DENSITY (Persons/Ha.)				
	1970	1975	1980	1985	1990
NCR	62.4	78.1	93.2	109.2	123.2
1. Manila	347.5	386.2	425.7	461.1	414.4
2. Pasay	148.4	183.5	207.0	238.7	254.7
3. Quezon	45.4	57.6	70.1	82.9	98.2
4. Caloocan	49.2	71.2	83.8	97.4	133.7
5. Las Pinas	11.0	19.7	32.9	50.1	68.9
6. Makati	88.6	111.9	124.6	140.9	151.2
7. Malabon	60.5	74.7	81.6	94.1	118.4
8. Mandaluyong	57.5	70.1	79.0	89.9	95.0
9. Marikina	29.2	43.3	54.4	66.8	79.2
10. Muntinlupa	13.9	20.2	29.3	39.3	59.5
11. Navotas	320.2	373.5	485.2	566.8	715.4
12. Paranaque	25.4	41.5	54.5	69.6	78.3
13. Pasig	120.4	161.5	206.6	257.5	303.8
14. Pateros	24.5	31.6	38.7	46.5	49.0
15. San Juan	100.5	117.8	125.1	137.0	122.1
16. Taguig	16.4	21.9	39.8	49.3	79.2
17. Valenzuela	20.9	32.0	45.2	61.8	72.3
CAVITE	12.4	14.4	17.5	21.0	24.7
18. Bacoor	9.2	11.9	17.2	22.3	30.6
19. Cavite City	64.0	69.7	74.1	81.7	77.5
20. Imus	4.5	5.0	6.1	7.4	9.5
21. Kawit	21.1	25.2	29.4	35.3	35.6
22. Noveleta	19.5	22.4	26.7	31.6	40.0
23. Rosario	42.0	50.7	58.8	71.5	80.0
RIZAL	2.4	3.2	4.3	5.2	6.8
24. Angono	4.7	6.8	10.2	13.0	17.5
25. Antipolo	0.9	1.3	2.3	3.0	5.7
26. Baras	3.1	4.2	4.8	5.7	7.1
27. Binangonan	7.2	8.7	11.1	12.9	12.8
28. Cainta	20.3	36.3	57.9	81.2	107.5
29. Cardona	5.4	6.8	7.9	8.8	10.5
30. Jala-Jala	1.6	1.9	2.4	2.8	3.3
31. Morong	5.0	5.6	6.6	7.0	8.6
32. Pililla	2.0	2.6	3.1	3.6	4.4
33. Montalban	0.7	1.0	1.3	1.6	2.0
34. San Mateo	4.5	6.0	8.0	9.5	12.6
35. Tanay	1.0	1.4	1.7	2.0	2.0
36. Taytay	13.8	17.3	22.3	25.6	33.3
37. Teresa	5.0	7.2	7.9	8.6	11.1

Table 11.1.3 POPULATION DISTRIBUTION OF THE STUDY AREA

CITY/MUNICIPALITY	POPULATION					LAND AREA (Has.)	DENSITY (Pers/Has.)
	1970	1975	1980	1985 (Estimate)	1990 (Preliminary)		(1990)
METRO MANILA	3,966,695	4,970,006	5,925,884	6,942,194	7,833,000	63,600	123.2
Manila	1,330,786	1,479,116	1,630,485	1,765,907	1,587,000	3,830	414.4
Pasay	206,283	254,999	287,770	331,860	354,000	1,390	254.7
Quezon	754,452	956,864	1,165,865	1,377,926	1,632,000	16,620	98.2
Caloocan	274,453	397,201	467,816	543,302	746,000	5,580	133.7
Las Pinas	45,732	81,610	136,514	207,770	286,000	4,150	68.9
Makati	264,918	334,448	372,631	421,367	452,000	2,990	151.2
Malabon	141,514	174,878	191,001	220,197	277,000	2,340	118.4
Mandaluyong	149,407	182,267	205,366	233,843	247,000	2,600	95.0
Marikina	113,400	166,453	211,613	259,806	308,000	3,890	79.2
Muntinlupa	65,057	94,563	136,679	183,693	278,000	4,670	59.5
Navotas	83,245	97,098	126,146	147,364	186,000	260	715.4
Paranaque	97,214	158,974	208,552	266,740	300,000	3,830	78.3
Pasig	156,492	209,915	268,570	334,770	395,000	1,300	303.8
Pateros	25,468	32,821	40,286	48,346	51,000	1,040	49.0
San Juan	104,559	122,492	130,088	142,444	127,000	1,040	122.1
Taguig	55,257	73,702	134,137	166,308	267,000	3,370	79.2
Valenzuela	98,436	150,605	212,363	290,551	340,000	4,700	72.3
CAVITE	230,689	267,926	324,273	389,775	459,122	18,572	24.7
Bacoor	48,440	62,225	90,364	116,783	160,287	5,240	30.6
Cavite City	75,739	82,456	87,666	96,639	92,000	1,183	77.8
Imus	43,686	48,566	59,103	71,440	92,144	9,701	9.5
Kawit	28,447	33,813	39,368	47,250	47,692	1,340	35.6
Noveleta	10,560	12,141	14,460	17,120	21,635	541	40.0
Rosario	23,817	28,725	33,312	40,543	45,364	567	80.0
RIZAL	307,238	414,192	555,473	673,066	880,608	130,383	6.8
Angono	12,127	17,574	26,511	33,864	45,563	2,600	17.5
Antipolo	26,508	40,944	68,912	93,242	173,908	30,610	5.7
Baras	7,166	9,722	11,196	13,321	16,680	2,340	7.1
Binangonan	52,296	63,215	80,980	93,858	93,305	7,270	12.8
Cainta	20,714	36,971	59,025	82,749	109,552	1,019	107.5
Cardona	16,880	21,266	24,503	27,313	32,841	3,120	10.5
Jala-Jala	8,115	9,276	11,945	13,667	16,314	4,930	3.3
Morong	18,970	21,058	24,858	26,295	32,220	3,760	8.6
Pililla	15,052	18,985	23,222	26,887	32,524	7,390	4.4
Montalban	20,882	31,176	41,859	49,856	63,824	31,280	2.0
San Mateo	29,183	38,955	51,910	61,381	81,917	6,490	12.6
Tanay	23,247	33,382	40,443	48,121	48,880	24,340	2.0
Taytay	46,717	58,274	75,328	86,507	112,414	3,374	33.3
Teresa	9,381	13,394	14,781	16,005	20,666	1,860	11.1
T O T A L	4,504,622	5,652,124	6,805,630	8,005,035	9,172,730	212,555	43.2

Source: Metro Manila — Philippine Yearbook 1989 (NSO)
1990 Census of Population and Housing (NSO)
(1990 figures are based on preliminary results of the 1990 Census of Population and Housing. Details may not add up total due to rounding and the results should be considered tentative.

Rizal — National Statistic Office, Rizal Branch

Cavite — National Statistic Office, Cavite Branch

Table 11.2.1 REGIONAL SOCIAL PROFILE

	CBR 1986	CDR 1987	IMR 1986	LITERACY RATE 1989	PREVAL. RATE 1989	UNEMPL. RATE(%) 1985
Philippines	26.70	5.80	35.00	89.90	19.42	7.12
NCR	32.10	7.00	33.40	98.10	9.44	22.11
CAR	-	-	-	86.30	17.07	-
Region I	29.40	7.00	37.70	90.60	19.87	3.65
Region II	27.90	5.80	43.60	88.50	17.41	5.76
Region III	28.50	5.50	29.60	93.60	18.70	6.91
Region IV	28.70	6.30	37.30	93.00	20.15	6.56
Region V	27.40	7.30	41.40	87.60	27.53	2.97
Region VI	20.20	6.20	43.50	88.00	22.77	4.52
Region VII	27.80	6.50	35.20	88.00	17.07	3.38
Region VIII	18.40	5.80	41.00	81.00	28.57	5.53
Region IX	19.10	3.30	32.40	81.70	16.85	6.55
Region X	28.40	4.90	33.20	90.50	19.04	4.20
Region XI	30.10	4.40	23.00	90.40	17.21	5.17
Region XII	18.30	2.70	25.30	78.9	19.46	1.99

Notes:

CBR - Crude Birth Rate per 1,000 population
CDR - Crude Death Rate per 1,000 population
IMR - Infant Mortality Rate per 1,000 population
LITERACY RATE - For the household population 10 years old and above
PREVALENCE RATE -

Sources: 1989 Philippine Statistical Yearbook, NSCB
1989 Functional Literacy, Education and Mass Media Survey, Department of Health

TABLE 11.2.2A POVERTY INCIDENCE BY REGION

REGION	POVERTY INCIDENCE (in percent)
Philippines	
NCR	31.04
CAR	1.55
Region I	3.16
Region II	1.96
Region III	8.21
Region IV	13.42
Region V	3.21
Region VI	6.68
Region VII	7.55
Region VIII	2.91
Region IX	3.71
Region X	5.54
Region XI	7.14
Region XII	3.91

Sources: 1989 Philippine Statistical Yearbook
National Statistics Coordination Board

TABLE 11.2.2B HOUSEHOLD POPULATION 15 YEARS OLD AND OVER
BY EMPLOYMENT STATUS AND BY REGION

Region	1986				1988			
	Number ('000)	% in Labor Force	Employment Rate %	Unemployment Rate %	Number ('000)	% in Labor Force	Employment Rate %	Unemployment Rate %
Philippines	33,838	63.8	88.9	11.1	35,865	65.4	91.7	8.3
Region IV	4,558	63.8	87.0	13.0	4,729	64.6	91.8	8.2
NCR	4,727	58.6	71.4	28.6	5,005	60.2	82.8	17.2
Cavite (*)	606	54.6	94.3	5.8	657	54.5	96.4	3.6
Rizal	455	62.2	84.8	15.2	480	67.7	91.1	8.9
Total	5,788	58.5	74.8	25.2	6,142	60.2	84.8	15.2

* All Cavite Province. The numbers are not applicable for the Study Area, but may be used as reference however.

Source: National Statistic Office (NSO), Region IV

TABLE 11.2.2C EMPLOYMENT GENERATION IN METRO MANILA BY SECTOR

	1980-1983	1983-1986	1986-1988	1980-1988
	(in thousands)			
All Industries	195	11	326	532
Agriculture	2	2	4	8
Mining & Quarrying	2	(2)	6	6
Manufacturing	(29)	(81)	97	(13)
Electricity Gas and Water	5	(9)	5	1
Construction	10	(23)	44	31
Wholesale & Retail Trade	75	100	35	210
Transportation, Storage and Communication	(17)	12	34	29
Financing, Insurance, Real Estate	12	29	5	46
Community, Social and Personal Services	135	(18)	97	214

Source: Metro Manila Authority (MMA)
Bureau of Local Employment

TABLE 11.2.2D LABOR PRODUCTIVITY, 1980-1988
(AT CONSTANT 1978 PRICES)

(in thousand pesos)

Year	Philippines	NCR
1980	1,252	3,423
1981	1,242	3,531
1982	1,272	3,514
1983	1,159	3,495
1984	1,089	2,963
1985	1,019	2,769
1986	998	2,844
1987	987	2,531
1988	1,917	2,663

Source: NSCB, NSO

TABLE 11.2.3A GROSS REGIONAL DOMESTIC PRODUCT FOR 1987-1988
(AT CONSTANT 1972 PRICES)

REGION	Actual (in PM)		Growth Rate	Per Capita GRDP (in P)	Growth Rate (in %)
	1987	1988*	1987-1988	1988	1987-1988
PHIL.	95,948	101,758	6.63	1,733	3.56
NCR	28,502	31,323	9.90	4,143	6.89
I	4,323	4,507	4.25	1,090	2.28
II	2,301	2,432	5.70	897	3.16
III	7,664	8,286	8.12	1,413	5.59
IV	14,221	14,929	4.97	1,941	2.19
V	3,120	3,257	4.41	776	2.09
VI	6,545	6,902	5.44	1,269	3.19
VII	6,905	7,421	7.48	1,669	5.45
VIII	2,323	2,383	2.60	735	0.76
IX	3,350	3,492	4.24	1,141	1.96
X	5,248	5,570	6.13	1,620	3.41
XI	7,082	7,186	1.47	1,739	-0.98
XII	3,844	4,064	5.74	1,451	3.14

(*) As of January 1989

Sources: Economic and Social Statistics Office
National Statistical Coordination Board

TABLE 11.2.3B REGIONAL SHARE OF GROSS REGIONAL DOMESTIC PRODUCT
(AT CONSTANT 1972 PRICES)

	1989 (in million pesos)	REGIONAL SHARE (in percent)
Philippines	107,144	
NCR	33,256	31.04
CAR	1,665	1.55
Region I	3,388	3.16
Region II	2,104	1.96
Region III	8,792	8.21
Region IV	14,384	13.42
Region V	3,437	3.21
Region VI	7,154	6.68
Region VII	8,086	7.55
Region VIII	3,121	2.91
Region IX	3,977	3.71
Region X	5,937	5.54
Region XI	7,655	7.14
Region XII	4,190	3.91

Sources: Economic and Social Statistics Office
National Statistics and Coordination Board

* Revised Estimate as of June 1990

TABLE 11.2.3C NCR GROSS REGIONAL DOMESTIC PRODUCT BY SECTOR (AT CONSTANT 1972 PRICES)

Sector/ Subsector	1980		1986		Average, 1980-86		
	Amount (mil. P)	Growth (%)	Amount (mil. P)	Growth (%)	GRDP (mil. P)	Percent (%)	Growth Rate (%)
INDUSTRY	15.25	52.00	13.37	50.2	15.30	51.8	-5.7
Mining	-	-	-	-	-	-	-
Manufacturing	12.26	41.8	11.60	43.6	12.40	42.0	-0.8
Constructions	2.44	8.3	0.90	3.4	2.20	7.4	-12.8
Electricity, Gas and Water	0.55	1.9	0.87	3.3	0.70	2.4	7.9
SERVICES	14.05	48.0	13.26	49.8	14.30	48.3	19.4
Transport, Communication and Storage	2.04	7.0	2.20	8.3	2.20	7.4	1.3
Trade	2.91	9.9	3.77	14.2	3.40	11.5	4.5
Finance and Housing	3.31	11.3	1.12	4.2	2.50	8.5	12.4
Other Services	5.79	19.8	6.17	23.2	6.20	20.9	1.2
T O T A L	29.30	100.0	26.63	100.0	29.60	100.1	13.7

Note : Figures may not add up to totals due to rounding
Source: National Account Staff, NEDA

TABLE 11.2.3D FAMILY INCOME DISTRIBUTION AND SOURCES

Income Distribution (Unit: %)

Region/Province	Average Family Income (in Peso)	Below P 10,000	P 10,000 19,999	Below P 19,999 Sub-Total	P 20,000 39,999	Above P40,000
REGION IV	29.985	12.7	33.1	45.8	33.2	21.0
Cavite	39.759	0.0	16.2	16.2	48.3	35.5
Rizal	38.517	4.9	35.5	40.4	30.9	28.7
METRO MANILA	57.193	1.5	11.9	13.4	37.0	49.6
PHILIPPINES	31.052	15.2	33.7	48.9	30.7	20.4

Income Sources (Unit: %)

Region/Province	Wages and Salaries Agriculture	Wages and Salaries Non-Agriculture	Entrepreneurial Activities Agriculture	Entrepreneurial Activities Non-Agriculture	Other Income Sources
REGION IV	10.30	35.97	24.00	11.21	18.53
Cavite	4.00	67.48	6.20	7.39	14.39
Rizal	8.57	44.89	17.09	13.71	15.73
METRO MANILA	0.50	57.96	0.09	16.60	24.85
PHILIPPINES	9.20	31.24	28.62	12.40	18.54

Source: 1985 Family Income and Expenditures Survey (NSO)

TABLE 11.2.3E 1985 NCR AVERAGE ANNUAL FAMILY INCOME AND EXPENDITURE BY INCOME CLASS

Income Class	Families			Average Income (₱)	Average Expenditure (₱)
	Number	% to Total	Accumulative		
Under P6,000	1,719	0.1	-	5,520	7,205
P 6,000 - P 9,999	17,697	1.4	1.5	8,504	11,308
P10,000 - P14,999	51,118	3.9	5.4	13,076	14,484
P15,000 - P19,999	104,882	8.0	13.4	17,706	18,319
P20,000 - P29,999	256,991	19.6	33.0	24,975	24,823
P30,000 - P39,999	228,460	17.4	50.4	34,719	32,176
P40,000 - P49,999	281,570	21.5	71.9	48,716	43,046
P50,000 - P99,999	222,246	17.0	88.9	75,962	64,074
P100,000 and over	146,965	11.1	100.0	187,182	140,697
NCR	1,310,549			57,193	48,453

Source: 1985 Family Income and Expenditure Survey (NCSO)

TABLE 11.2.3F 1988 NCR AND CAVITE PROVINCE FAMILY INCOME AND EXPENDITURE BY INCOME CLASS

INCOME CLASS AND AREA	Total Number of Families		Average Income	Average Expenditure
	No. of Families	%	(₱)	(₱)
NATIONAL CAPITAL REGION	1,435,437	100	79,314	60,355
Under P10,000	5,390	0.4	7,822	12,939
P10,000 14,999	14,501		12,705	17,209
P15,000 19,999	44,191	3.1	17,505	18,897
P20,000 29,999	190,062	13.2	25,281	24,888
P30,000 39,999	210,456	14.4	35,073	32,529
P40,000 50,999	327,560	22.8	49,291	43,897
P60,000 AND OVER ...	643,277	44.8	131,387	92,544
Manila	343,744		60,394	43,447
Pasig	71,987		95,093	64,747
Quezon	287,214		97,759	74,555
Caloocan	113,884		59,074	46,926
Pasay	69,912		63,816	49,007
Makati	84,376		127,037	98,963
Other Metro	464,318		78,090	61,395
CAVITE	195,935	100	45,506	39,540
Under P10,000	1,255	0.6	9,064	8,656
P10,000 14,999	6,290	3.2	12,887	12,644
P15,000 19,999	15,322	7.8	17,581	17,481
P20,000 29,999	43,879	22.4	25,025	23,761
P30,000 39,999	36,334	18.6	34,829	33,125
P40,000 50,999	49,792	25.4	47,969	43,425
P60,000 AND OVER ...	43,063	22.0	88,302	69,218
RIZAL (No Data)				

Source: 1988 Family Income and Expenditure Survey (NSO)

TABLE 11.2.3G NUMBER OF ESTABLISHMENTS BY KIND OF TRADE/ BUSINESS BY MUNICIPALITY, CAVITE (S.A), 1989

City/Municipality	Wholesale/ Retail	Public and Private Services	Financing Insurance & Real Estate	Total
Cavite (Province)	9,314	1,848	388	11,550
Cavite City	2,403	690	82	3,175
Bacoor	754	170	79	1,003
Imus	692	114	25	831
Kawit	891	96	63	1,050
Noveleta	228	54	11	293
Rosario	337	52	11	400
TOTAL	5,305	1,176	271	6,752
Percent	78.57	17.42	4.01	100

Source: Office of the Provincial Planning and Development Coordination Trece Martires, Cavite

TABLE 11.2.3H NUMBER AND TYPE OF COMMERCIAL ESTABLISHMENTS BY KIND OF TRADE, PROVINCE OF CAVITE

Trade/Business	1987		1989		% Increase
	Number	% of Total	Number	% of Total	
Wholesale/Retail	8,710	81.67	9,314	80.64	6.93
Financing/Insurance Real Estate	156	1.46	388	3.36	148.72
Public and Private Business	1,799	16.87	1,848	16.00	2.72
TOTAL	10,665	100.00	11,550	100.00	8.30

Source: Office of the Provincial Planning and Development Coordination
Trece Martires, Cavite

TABLE 11.2.31 NUMBER OF ESTABLISHMENTS BY KIND OF TRADE/BUSINESS BY MUNICIPALITIES, PROVINCE OF RIZAL, 1990

Municipality	Manufac-turing	Electricity Gas and Water	Construc-tion	Wholesale/ Retail	Trans. Comm. Storage	Banking and Finance	Comm.,Social and Personnel Water	Total	Percentage of Total
Angono	65	-	6	489	-	4	158	722	7.8
Antipolo	116	-	3	912	6	13	319	1,369	14.9
Baras	13	1	3	78	-	1	27	123	1.4
Binangonan	82	6	2	487	2	5	96	680	7.5
Cainta	117	7	21	1,005	3	20	109	1,282	14.0
Cardona	15	4	2	304	2	1	49	377	4.2
Jalajala	-	-	-	131	-	-	7	138	1.5
Morong	26	-	5	200	9	5	143	388	4.3
Pililla	11	2	-	293	-	-	48	258	2.8
Montalban	6	-	16	197	13	2	64	706	7.7
San Mateo	45	3	6	600	20	4	6	684	7.5
Tanay	32	4	4	532	6	5	193	776	8.5
Taytay	450	5	5	874	-	7	124	1,465	16.0
Teresa	15	-	5	123	-	2	32	177	1.9
TOTAL	933	32	78	6,537	61	69	1,375	9,145	100
Percent	10.86	0.35	0.85	71.48	0.67	0.75	15.04	100	

Source: Socio Economic Profile, Province of Rizal
(Department of Trade and Industry)

TABLE 11.3.1A POPULATION AND NUMBER OF HOUSEHOLDS

City/Municipality	1980			1990			
	No. of Households	Population	Average size of Households	No. of Households		Population	Average size of Households
PHILIPPINES	8,697,000	48,098,460	5.6	11,380,000		60,477,000	5.3
NCR	1,102,000	5,925,884	5.4	1,557,000	85.3%	7,833,000	5.0
Manila	301,000	1,630,485	5.4	310,000		1,587,000	4.9
Caloocan	89,000	467,816	5.2	150,000		746,000	4.8
Pasay City	55,000	287,770	5.2	73,000		354,000	4.9
Quezon City	218,000	1,165,865	5.2	327,000		1,632,000	5.0
Las Pinas	25,000	136,514	5.5	56,000		286,000	5.1
Makati	69,000	372,631	5.4	89,000		452,000	5.0
Malabon	36,000	191,001	5.3	58,000		277,000	4.8
Mandaluyong	39,000	205,366	5.3	49,000		247,000	5.0
Marikina	39,000	211,613	5.4	62,000		308,000	5.0
Muntinlupa	24,000	136,679	5.6	53,000		278,000	5.1
Navotas	23,000	126,146	5.4	35,000		186,000	5.2
Paranaque	36,000	208,552	5.6	61,000		300,000	4.9
Pasig	50,000	268,570	5.4	77,000		395,000	5.1
Pateros	7,000	40,288	5.5	10,000		51,000	5.2
San Juan	24,000	130,086	5.5	24,000		127,000	5.2
Taguig	25,000	134,137	5.3	53,000		267,000	5.0
Valenzuela	40,000	212,363	5.3	70,000		340,000	4.9
CAVITE	(No data per	324,273		91,435	5.0%	458,771	5.0
Bacoor	municipality)	90,364		30,948		160,287	5.2
Cavite City		87,666		19,043		91,649	4.8
Imus		59,103		18,667		92,144	4.9
Kawit		39,368		9,763		47,692	4.9
Noveleta		14,460		4,013		21,635	5.4
Rosario		33,312		9,001		45,364	5.0
RIZAL	(No data per	555,473		188,129	9.7%	880,608	4.9
Angono	municipality)	26,511		8,939		45,563	5.1
Antipolo		68,912		34,205		173,908	5.1
Baras		11,196		3,116		16,680	5.4
Binangonan		80,980		24,394		93,305	3.8
Cainta		59,025		20,969		109,552	5.2
Cardona		24,503		6,263		32,841	5.2
Jala-Jala		11,945		3,035		16,314	5.4
Morong		24,858		6,255		32,220	5.2
Pililla		23,222		6,132		32,524	5.3
Montalban		41,859		12,454		63,824	5.1
San Mateo		51,910		15,925		81,917	5.1
Tanay		40,443		10,603		48,880	4.6
Taytay		75,328		21,861		112,414	5.1
Teresa		14,781		13,978		20,666	1.5
TOTAL (Study Area)		6,805,630		1,836,564	100%	9,172,379	5.0

Source: NCR 1990 Census of Population and Housing (NSO)
(1990 figures and 1980 No. of Households are based on Preliminary results of the 1990 Census of Population and Housing
CAVITE National Statistics Office, Cavite Branch
RIZAL National Statistics Office, Rizal Branch

TABLE 11.3.1B NUMBER OF FAMILIES BY TYPE OF BUILDING OCCUPIED: PHILIPPINES, NCR AND REGION IV, 1985

Area/Region	Total Number of families	Type of Building					
		Single House	Duplex	Apartment/ accesoria/ condominium	Improvised (Barong-Barong)	Commercial/ industrial/ agricultural	Other housing units, natural shelter, boat, etc.
Philippines	9,847,340	8,830,688	234,349	409,406	313,960	49,371	9,566
Metro Manila Area (NCR)	1,310,549	879,680	55,408	283,357	63,492	23,662	4,950
IV. Southern Tagalog	1,303,730	1,199,302	42,645	19,894	37,563	2,723	1,603

Source: 1985 Family Income and Expenditures Survey (NSO)

TABLE 11.3.1C NUMBER OF OCCUPIED DWELLING UNITS BY TYPE OF BUILDING, MUNICIPALITY OF CAVITE, 1980

Municipality	Total Number of Occupied Dwelling Units	Type of Building								
		Single House	Duplex	Apartment/ accesoria/ condominium	Improvised (Barong-Barong)	Commercial/ industrial/ agricultural	Other housing units, natural shelter, boat, etc.	Hotel, Lodging house Dormitory, etc.	Institutional (hospital, Convent, School Dormitory, etc.)	Other collective Living quarters (Military camp, etc.)
CAVITE (Prov.)	138,327	130,072	3,177	2,606	1,981	478	7	1	2	3
Cavite City	16,781	13,903	974	1,304	412	184	3	-	1	-
Bacoor	16,081	14,384	793	606	263	32	2	-	1	-
Imus	11,025	10,741	115	135	17	17	-	-	-	-
Kawit	7,208	6,738	96	218	119	37	-	-	-	-
Noveleta	2,532	2,397	95	20	14	6	-	-	-	-
Rosario	5,872	5,577	197	79	19	-	-	-	-	-
CAVITE (Study Area)	59,499	53,740	2,270	2,362	844	276	5	0	2	0
Percentage	100	90.3	3.8	3.9	1.4	0.5	0.08	-	0.02	-

Source: Cavite Provincial Development Plan (HLURB)

TABLE 11.3.1D NUMBER OF BUILDINGS BY REGION AND PROVINCE: 1989

Region/Province	No. of Buildings	Region/Province	No. of Buildings
PHILIPPINES	4,259,941	CAVITE	116,158
NCR	893,524	(NDA)	
Manila	130,504		
Caloocan City	96,749	RIZAL	113,060
Pasay City	35,322	(NDA)	
Quezon City	192,276		
Las Pinas	47,151		
Makati	45,543		
Malabon	26,558		
Mandaluyong	24,228		
Marikina	37,291		
Muntinlupa	40,367		
Navotas	24,287		
Paranaque	51,564		
Pasig	50,698		
Pateros	6,118		
San Juan	11,777		
Taguig	34,261		
Valenzuela	38,830		

NDA (No data available per municipality)

Source: 1989 Census of Buildings (NSO)
(Preliminary Data)

TABLE 11.3.2 PROJECTED NUMBER OF HOUSEHOLDS OF THE STUDY AREA

Region/Province	1990	1995	2000	2005	2010
Philippines	11,380,000	13,212,456	15,152,959	16,812,192	18,381,100
Metro Manila (NCR)	1,557,000	1,847,899	2,150,299	2,384,682	2,605,799
Cavite (S.A.)	91,435	110,543	130,774	150,646	170,319
Rizal	188,129	225,154	264,926	299,520	331,549
TOTAL	1,836,564	2,183,596	2,545,999	2,834,848	3,107,667

Source: Study Team

TABLE 11.3.3 METRO MANILA PRIORITY RESETTLEMENT PROGRAM
MAGNITUDE BY CITY/MUNICIPALITY

City/Municipality	ESTIMATED NUMBER OF FAMILIES BY CLASSIFICATION					
	No. of Areas	Esteros/ Waterways	PNR Tracks	DPWH Infra. Projects	Other Gov't. Projects	TOTAL
Manila	86	733	732	1,198	7,476	10,139
Navotas	3	4,352	-	135	-	4,487
Malabon	2	3,344	-	26	-	3,370
Valenzuela	5	981	-	-	208	1,189
Caloocan	4	83	-	430	500	1,013
Quezon City	20	1,489	-	2,210	3,867	7,566
Pasig	9	132	-	144	148	424
San Juan	15	161	-	150	399	710
Marikina	5	530	-	150	-	680
Mandaluyong	10	27	4,000	400	10,515	14,942
Makati	11	388	945	1,678	576	3,587
Pasay	12	1,013	-	702	299	2,014
Las Pinas	4	1,097	-	-	1,200	2,297
Paranaque	12	1,030	-	515	58	1,603
Taguig	2	32	-	-	200	232
Pateros	3	600	-	-	-	600
Muntinlupa	17	-	1,569	100	2,549	4,218
TOTAL	220	15,992	7,246	7,838	27,995	59,071

Source: NHA, 1990

TABLE 11.4.1 ESTIMATED AREA BY LAND USE CATEGORY

Region/ Province	LAND USE					TOTAL AREA (Has.)
	BUILT-UP AREA Residential Commercial Industrial Institutional Facilities	AGRICULTURAL Rice field Cropland Plantation	FOREST/GRASSLAND Forest Grassland Shrubland Pasture	WETLAND Lake Pond Swamp/Marsh	OPEN SPACE	
NCR	33,840	2,500	6,700	1,760	18,800	63,600
	(53.2)	(3.9)	(10.5)	(2.8)	(29.6)	(100)
CAVITE (S.A.)	6,497	10,235	840	1,000	-	18,572
	(35.0)	(55.1)	(4.5)	(5.4)		(100)
RIZAL	15,231	20,178	94,230	304	19,240	130,383
	(11.7)	(15.5)	(72.3)	(0.2)	(9.1)	(100)
TOTAL	51,585.5	30,238	94,228	1,003.5	29,761	212,555
	(24.3)	(14.2)	(44.3)	(0.5)	(14.0)	100)

Filename:TAB1051.PRN

TABLE 11.5.1A LENGTH OF EXISTING ROADS BY SYSTEM CLASSIFICATION
AS OF DECEMBER 31, 1989

Region/Province City	National	Provincial	City	Municipal	Barangay	Total (km)
PHILIPPINES	26110.084	29143.717	3949.38	12706.896	87159.104	159069.181
NCR	896.992		1273.741	554.339	271.286	2996.358
(*) Cavite (S.A.)	NDA					67.849
(**) Rizal	245.009	66.830		143.39	782.930	1238.159
TOTAL (S.A.)						4302.366

NDA: No data available

Source: Department of Public Works and Highways (DPWH)
(*) Department of Public Works and Highways
Trece Martires Branch
(**) Socio-Economic Profile, Rizal Branch

TABLE 11.5.1B EXISTING ROADS BY SURFACE TYPE (CAVITE AND RIZAL)

City/ Municipality	Length (KM)	Width (KM)	TYPE OF PAVEMENT									
			Concrete		Asphalt		Gravel		Earthfill		Bit. Seal Coat	
			Length	%	Length	%	Length	%	Length	%	Length	%
Cavite City	55.705		40.696	73.06	5.567	10.00	2.675	4.80	6.767	12.14		
Bacoor	1.595		1.595	100.00								
Imus	6.689		6.689	100.00								
Kawit	0.749		0.749	100.00								
Noveleta	2.000		2.000	100.00								
Rosario	1.111		1.111	100.00								
CAVITE (Total	67.849		52.840		5.567		2.675		6.767			
RIZAL	1,238.159		228.563		267.773		615.276		126.548			

Source: Department of Public Works and Highways,
Trece Martires, Cavite Branch

Socio-economic Profile, Rizal Branch

TABLE 11.5.2 SOURCE OF POTABLE WATER AND HOUSEHOLD SERVED

Municipality/ City	WATERWORK SYSTEM				Deepwell		Shallow Well		Dugwell		Spring River	
	Level III		Level II									
	No.	Household Served	No.	Household Served	No.	Household Served	No.	Household Served	No.	Household Served	No.	Household Served
Bacoor	4	2,490	-	-	2264	4,964	3223	9,036	6	12	-	-
Imus	1	698	-	-	567	969	5945	11,159	-	-	-	-
Kawit	1	1,889	-	-	1602	3,748	2012	4,734	3	4	-	-
Noveleta	-	-	-	-	435	1,090	808	2,945	-	-	-	-
Rosario	-	-	1	105	1995	4,963	1003	1,964	-	-	-	-
Cavite City	17	7,308	-	-	-	-	-	-	-	-	-	-
CAVITE (Total)	23	12,385	1	105	6853	15,634	12991	28,938	9	16	-	-
Angono	-	-	-	-	58	459	230	1,410	8	157	-	-
Antipolo	7	30,290	-	-	534	5,916	196	3,915	32	685	24	1,855
Baras	1	351	-	-	122	1,839	110	1,390	8	23	5	21
Binangonan			13	42,567	128	2,574	348	1,487	-	-	-	-
Cainta	2	9,786	-	-	43	580	356	3,224	2	5	-	-
Cardona	-	-	3	1,645	77	1,085	346	1,788	2	5	-	-
Jala-jala	-	-	1	1,753	63	870	389	1,117	3	211	-	-
Montalban	1	21,871	-	-	45	3,551	98	2,101	-	-	-	-
Morong	2	11,300	-	-	37	2,924	157	1,429	-	-	-	-
Pililla	-	-	3	8,689	11	435	53	2,210	20	122	7	1,816
San Mateo	1	17,651	-	-	58	4,967	76	1,785	-	-	-	-
Tanay	-	-	-	-	32	408	526	2,529	-	-	3	55
Taytay	2	37,257	-	-	62	451	63	449	1	35	-	-
Teresa	-	-	1	594	43	1,798	137	386	3	51	4	117
RIZAL (Total)	16	128,506	21	55,248	1313	27,857	3085	25,220	79	1,294	43	3,864

Source: DPWH, Cavite Provincial Profile (1989)
Socio-Economic Profile Province of Rizal (1990)

TABLE 11.7.1 TOTAL POPULATION, HOUSEHOLD POPULATION AND NUMBER OF HOUSEHOLDS IN THE STUDY AREA (1990)

CITY/MUNICIPALITY	TOTAL POPULATION	HOUSEHOLD POPULATION	NUMBER OF HOUSEHOLDS
METRO MANILA	7,928,867	7,887,861	1,567,665
1. Manila	1,598,918	1,585,887	308,874
2. Pasay City	366,623	364,959	73,642
3. Quezon City	1,666,766	1,659,940	331,760
4. Calookan City	761,011	759,420	150,972
5. Las Pinas	296,851	296,645	57,774
6. Makati	452,734	450,163	89,310
7. Malabon	278,380	278,161	58,051
8. Mandaluyong	244,538	242,526	49,065
9. Marikina	310,010	309,103	60,090
10. Muntinlupa	276,972	268,960	53,449
11. Navotas	186,799	186,642	38,864
12. Parañaque	307,717	306,865	61,252
13. Pasig	397,309	396,764	77,621
14. Pateros	51,401	51,359	9,808
15. San Juan	126,708	125,815	24,338
16. Taguig	266,080	265,043	53,153
17. Valenzuela	340,050	339,609	69,642
CAVITE	457,020	456,569	91,396
1. Bacoor	159,685	159,663	30,928
2. Cavite City	91,641	91,480	19,040
3. Imus	92,125	91,875	18,648
4. Kawit	47,755	47,755	9,767
5. Noveleta	20,409	20,409	4,012
6. Rosario	45,405	45,387	9,001
RIZAL	980,194	978,596	189,712
1. Angono	46,014	45,439	8,941
2. Antipolo	207,842	207,665	40,852
3. Baras	16,880	16,880	3,163
4. Binangonan	127,561	127,421	24,378
5. Cainta	126,839	126,680	24,775
6. Cardona	32,962	32,958	6,264
7. Jala-Jala	16,318	16,318	3,035
8. Morong	32,165	32,165	6,255
9. Pililla	32,771	32,771	6,131
10. Montalban	67,074	67,011	12,891
11. San Mateo	82,310	82,289	16,079
12. Tanay	58,410	58,196	11,089
13. Taytay	112,403	112,163	21,881
14. Teresa	20,645	20,640	3,978
T O T A L	9,366,081	9,323,026	1,848,773

Source: National Statistics Office
1990 Census of Population and Housing

TABLE 11.7.2 POPULATION DISTRIBUTION IN ANTIPOLO (1990)

MUNICIPALITY/ BARANGAY	TOTAL POPULATION	HOUSEHOLD POPULATION	NUMBER OF HOUSEHOLDS
ANTIPOLO	207,842	207,665	40,852
1. Bagong Nayon	18,002	18,002	3,472
2. Beverly Hills	1,034	1,034	191
3. Calawis	1,662	1,662	353
4. Cupang	25,696	25,690	5,005
5. Dalig	20,334	20,334	3,964
6. De La Paz	21,033	21,033	4,158
7. Inarawan	4,965	4,965	1,023
8. Mambugan	15,636	15,611	2,970
9. Mayamot	15,887	15,887	3,142
10. San Isidro	19,260	19,248	3,776
11. San Jose	26,121	26,049	5,067
12. San Juan	1,394	1,394	298
13. San Luis	6,241	6,241	1,340
14. San Roque	17,227	17,165	3,287
15. Sta. Cruz	13,340	13,340	2,806

Source: National Statistics Office
1990 Census of Population and Housing (Report No. 2-A)

TABLE 11.7.3 GROWTH RATE OF THE STUDY AREA'S POPULATION (1990-2010)

CITY/MUNICIPALITY	ANNUAL GROWTH RATE				
	1990/ 1980	1995/ 1990	2000/ 1995	2005/ 2000	2010/ 2005
I. METRO MANILA	2.83	2.47	2.07	1.73	1.42
1. Manila	-0.27	0.82	0.47	0.20	0.00
2. Pasay City	2.34	2.28	1.98	1.86	1.59
3. Quezon City	3.50	3.15	2.96	2.76	2.47
4. Calookan City	4.79	2.74	2.31	1.89	1.56
5. Las Pinas	7.69	6.63	5.77	5.00	4.28
6. Makati	3.68	1.55	1.14	0.81	0.53
7. Malabon	3.69	1.88	1.43	1.08	0.77
8. Mandaluyong	1.67	1.67	1.24	0.91	0.62
9. Marikina	3.74	2.95	2.41	1.96	1.56
10. Muntinlupa	6.99	4.50	3.82	3.24	2.70
11. Navotas	3.85	2.11	1.64	1.26	0.94
12. Parañaque	3.81	3.65	3.05	2.54	2.08
13. Pasig	3.84	3.21	2.65	2.17	1.75
14. Pateros	2.36	2.56	2.06	1.64	1.27
15. San Juan	-0.33	1.01	0.64	0.36	0.13
16. Taguig	6.77	3.12	2.57	2.10	1.68
17. Valenzuela	4.63	4.63	4.10	3.49	2.93
II. CAVITE	3.43	3.11	2.69	2.33	1.92
1. Bacoor	5.69	4.16	3.61	3.11	2.63
2. Cavite City	0.44	1.46	1.14	1.03	0.49
3. Imus	4.43	3.02	2.57	2.17	1.79
4. Kawit	1.93	2.90	2.46	2.07	1.70
5. Noveleta	3.44	2.67	2.25	1.88	1.53
6. Rosario	3.09	3.14	2.68	2.26	1.88
III. RIZAL	5.46	3.20	2.84	2.52	2.07
1. Angono	5.28	3.59	3.07	2.56	2.03
2. Antipolo	10.83	4.61	4.01	3.40	2.79
3. Baras	3.89	2.42	2.01	1.59	1.17
4. Binangonan	4.33	1.97	1.60	1.22	0.84
5. Cainta	7.44	5.22	4.56	3.90	3.24
6. Cardona	2.75	1.31	1.00	0.68	0.35
7. Jala-Jala	2.91	1.75	1.40	1.04	0.68
8. Montalban	4.50	2.44	2.02	1.61	1.17
9. Morong	2.36	1.42	1.36	1.69	1.47
10. Pililla	3.23	1.96	1.58	1.21	0.83
11. San Mateo	4.52	2.31	1.91	1.50	1.09
12. Tanay	3.46	2.42	2.01	1.59	1.17
13. Taytay	3.79	2.83	2.72	3.08	2.61
14. Teresa	3.13	0.82	0.55	0.27	0.03

TABLE 11.7.4 POPULATION PROJECTION FOR THE STUDY AREA, 1990-2010

CITY/MUNICIPALITY	1980 (CENSUS)	1990 (CENSUS)	1995	2000	2005	2010
I. NCR	5,970,307	7,928,867	8,971,500	9,948,977	10,847,652	11,649,608
1. Manila	1,642,708	1,598,918	1,666,014	1,705,567	1,723,126	1,723,147
2. Pasay City	289,927	366,623	402,932	433,048	457,147	475,225
3. Quezon City	1,174,605	1,666,766	1,870,519	2,049,017	2,200,635	2,323,154
4. Calookan City	471,323	761,011	872,801	979,527	1,076,883	1,164,630
5. Las Pinas	137,537	296,851	413,469	551,308	708,704	878,109
6. Makati	375,424	452,734	489,333	517,961	539,315	553,794
7. Malabon	192,433	278,380	305,870	328,653	346,868	360,515
8. Mandaluyong	206,906	244,538	265,870	282,944	296,044	305,315
9. Marikina	213,199	310,010	359,368	405,480	447,289	483,621
10. Muntinlupa	137,704	276,972	346,829	419,916	493,739	565,215
11. Navotas	127,092	186,799	207,567	225,328	240,031	251,550
12. Paranaque	210,115	307,717	369,370	430,253	488,493	541,964
13. Pasig	270,583	397,309	466,552	532,663	593,885	648,283
14. Pateros	40,590	51,401	58,438	64,776	70,318	74,945
15. San Juan	131,063	126,708	133,478	137,583	140,304	141,007
16. Taguig	135,143	266,080	311,031	353,627	392,792	427,323
17. Valenzuela	213,955	340,050	432,359	530,524	632,076	731,811
II. CAVITE	324,273	457,020	534,043	611,062	686,525	756,085
1. Bacoor	90,364	159,685	196,636	235,538	275,150	313,838
2. Cavite City	87,666	91,641	98,576	104,379	109,908	112,628
3. Imus	59,103	92,125	107,162	121,860	135,518	148,542
4. Kawit	39,368	47,755	55,217	62,446	69,254	75,407
5. Noveleta	14,460	20,409	23,325	26,102	28,673	30,955
6. Rosario	33,312	45,405	53,127	60,737	68,022	74,715
III. RIZAL	567,346	980,194	1,150,043	1,325,537	1,503,547	1,667,350
1. Angono	27,136	46,014	55,062	64,219	72,979	80,738
2. Antipolo	70,377	207,842	261,738	319,819	379,154	435,586
3. Baras	11,434	16,880	19,051	21,063	22,808	24,182
4. Binangonan	82,702	127,561	140,791	152,533	162,155	169,117
5. Cainta	60,280	126,839	164,650	206,860	251,447	295,646
6. Cardona	25,024	32,962	35,194	36,995	38,270	38,952
7. Jala-Jala	12,199	16,318	17,814	19,109	20,131	20,826
8. Montalban	42,749	67,074	75,766	83,837	90,845	96,318
9. Morong	25,387	32,165	34,528	36,957	40,222	43,304
10. Pililla	23,716	32,771	36,137	39,119	41,556	43,312
11. San Mateo	53,014	82,310	92,401	101,679	109,620	115,769
12. Tanay	41,303	58,410	65,923	72,889	78,925	83,678
13. Taytay	76,930	112,403	129,481	148,322	173,025	197,131
14. Teresa	15,095	20,645	21,507	22,106	22,410	22,441
T O T A L	6,861,926	9,366,081	10,655,886	11,885,576	13,038,024	14,073,043

Source: Estimation made by the Study Team based on NSO data

TABLE 11.7.5 POPULATION PROJECTION FOR THE MUNICIPALITY OF ANTIPOLO, 1990-2010

MUNICIPALITY/ BARANGAY	1990	1995	2000	2005	2010
ANTIPOLO	207,842	261,738	319,849	379,154	435,886
1. Bagong Nayon	18,002	22,644	27,647	32,752	37,637
2. Beverly Hills	1,034	1,385	1,767	2,161	2,532
3. Calawis	1,662	2,172	2,725	3,293	3,831
4. Cupang	25,696	32,283	39,380	46,620	53,551
5. Dalig	20,344	25,566	31,204	36,956	42,461
6. De La Paz (Pob.)	21,033	26,441	32,269	38,215	43,906
7. Inarawan	4,965	6,312	7,767	9,254	10,673
8. Mambugan	15,636	19,680	24,039	28,487	32,743
9. Mayamot	15,687	19,995	24,423	28,941	33,264
10. San Isidro	19,260	24,220	29,566	35,020	40,240
11. San Jose	26,121	32,815	40,028	47,385	54,428
12. San Juan	1,394	1,838	2,319	2,813	3,280
13. San Luis	6,241	7,910	9,712	11,553	13,311
14. San Roque	17,227	21,673	26,465	31,355	36,034
15. Sta. Cruz	13,340	16,804	20,535	24,349	27,995

Source: Estimation made by the Study Team based on NSO data. Due to the absence of population data at barangay level prior to 1990, population projections at barangay level were based on the growth rate of the whole Antipolo municipality.

TABLE 11.7.6 POPULATION DISTRIBUTION, LAND AREA AND POPULATION DENSITY: ANTIPOLO AREA (1990, 2000 AND 2010)

BARANGAY/ MUNICIPALITY	POPULATION						LAND AREA (Ha.)		DENSITY S.A. (Person per Ha.)		
	1990		2000		2010		Total				
	Barangay	Study Area	Barangay	Study Area	Baragay	Study Area	Barangay	Study Area	1990	2000	2010
1. Bagong Nayon	18,002	14,402	27,647	22,117	37,637	30,110	648.0	319.2	45	69	94
2. Santa Cruz	13,340	9,338	20,538	14,377	27,995	19,597	1,108.0	778.4	12	18	25
3. De La Paz	21,033	21,033	32,269	32,269	43,906	43,906	420.6	420.6	50	77	104
4. Beverly Hills	1,034	1,034	1,767	1,767	2,532	2,532	31.4	31.4	33	56	81
5. San Roque	17,227	17,227	26,465	26,465	36,034	36,034	380.4	380.4	45	70	95
6. Dalig	20,344	14,241	31,204	21,843	42,461	29,723	556.5	332.6	43	66	89
7. San Jose	26,121	13,061	40,028	20,014	54,428	27,214	5,640.1	270.0	48	74	101
8. San Isidro	19,260	19,260	29,566	29,566	40,240	40,240	360.8	360.8	53	82	112
9. San Luis	6,241	3,121	9,712	4,856	13,311	6,656	697.2	233.6	13	21	26
SUB-TOTAL	142,602	112,717	219,196	173,274	298,544	236,012	9,843.0	3,127.0	36	55	75
10. Taytay	-----	7,870	------	10,517	------	13,978	------	764.8	10	14	18
11. Angono	-----	1,750	------	2,705	------	4,169	------	935.0	2	3	4
12. Binangonan	-----	700	------	958	------	1,334	------	141.0	5	7	9
13. Teresa	-----	210	------	256	------	318	------	120.0	2	2	3
SUB-TOTAL	-----	10,630	------	14,436	------	19,819	------	1,960.8	5	7	10
TOTAL		123,347		187,710		255,831		5,087.8	24	37	50

TABLE 11.7.7 POPULATION DISTRIBUTION, LAND AREA AND POPULATION DENSITY: AQUIFER BASIN ZONE (1990, 2000 AND 2010)

BARANGAY/ MUNICIPALITY	POPULATION						LAND AREA (Ha.)		DENSITY S.A. (Person per Ha.)		
	1990		2000		2010		Total				
	Barangay	Study Area	Barangay	Study Area	Baragay	Study Area	Barangay	Study Area	1990	2000	2010
BARANGAY											
Santa Cruz	13,340	4,002	20,538	6,161	27,995	8,399	1,108.0	123.6	32	50	68
De La Paz	21,033	16,826	32,269	25,815	43,906	35,125	420.0	159.4	106	162	220
San Roque	17,227	15,504	26,465	23,819	36,034	32,431	380.4	309.4	50	77	105
Dalig	20,344	14,241	31,204	21,843	42,461	29,723	556.5	332.6	43	66	89
San Jose	26,121	13,061	40,028	20,014	54,428	27,214	5,640.1	270.0	48	74	101
San Isidro	19,260	15,408	29,560	23,653	40,240	32,192	360.8	169.0	91	140	190
San Luis	6,241	3,121	9,712	4,856	13,311	6,656	607.2	233.6	13	21	28
MUNICIPALITY											
Angono	-----	1,750	------	2,705	------	4,189	------	572.4	3	5	7
Binangonan	-----	700	------	958	------	1,334	------	141.0	5	7	9
Teresa	-----	210	------	256	------	318	------	120.0	2	2	3
TOTAL	123,566	84,823	189,782	130,080	258,375	177,581	9,103.0	2,430.0	35	54	73

TABLE 11.7.8 BLIGHTED POPULATION BY CITY/MUNICIPALITY, NATIONAL CAPITAL REGION

CITY/ MUNICIPALITY	1982			1985			1990		
	NHA BLIGHTED POPULATION ESTIMATES	TOTAL POPULATION	%	NHA BLIGHTED POPULATION ESTIMATES	TOTAL POPULATION	%	BLIGHTED POPULATION ESTIMATES	TOTAL POPULATION	%
1. MANILA	545,496	1,723,044	32	470,237	1,765,903	26.6	425,312	1,598,918	26.6
2. CALOOCAN CITY	130,080	492,549	26	196,507	543,903	36.2	304,404	761,011	40.0
3. PASAY CITY	76,902	294,709	26	289,490	331,861	87.2	319,695	366,623	87.2
4. QUEZON CITY	371,904	1,296,099	29	566,415	1,377,927	41.1	755,045	1,666,766	45.3
5. LAS PINAS	29,592	98,655	30	35,235	207,770	17.0	53,433	296,851	18.0
6. MAKATI	81,612	393,537	21	77,033	421,367	18.3	82,850	452,734	18.3
7. MALABON	48,883	203,313	24	51,092	220,198	23.2	79,617	278,360	28.6
8. MANDALUYONG	63,570	217,505	29	68,629	233,844	29.3	86,811	244,538	35.5
9. MARIKINA	32,484	204,995	16	80,000	259,807	30.8	105,035	310,010	33.9
10. MUNTINLUPA	39,594	116,754	34	47,200	183,694	25.7	79,491	276,972	28.7
11. NAVOTAS	56,020	129,314	43	73,683	147,365	50.0	93,399	186,799	50.0
12. PARANAQUE	36,180	156,955	23	22,580	266,741	8.5	32,310	307,717	10.5
13. PASIG	37,898	309,337	12	78,348	334,771	23.4	112,836	397,309	28.4
14. PATEROS	2,946	45,277	7	8,000	48,347	16.5	8,481	51,401	16.5
15. SAN JUAN	21,972	135,590	16	15,000	142,444	10.5	13,304	126,708	10.5
16. TAGUIG	49,614	134,238	37	38,231	166,308	23.0	66,529	266,080	25.0
17. VALENZUELA	21,060	160,841	13	157,500	290,552	54.2	187,027	340,050	55.0
TOTAL	1,645,807	6,112,712	27	2,275,180	6,942,207	32.8	2,805,579	7,928,867	35.4

TABLE 11.7.9 BLIGHTED POPULATION PROJECTION, NCR

YEAR	TOTAL POPULATION (Thousands)	GROSS BLIGHTED POPULATION (Thousands)	% OF THE TOTAL POPULATION
1985	6,942.21	2,275.18	32.8
1986	7,036.55	2,305.09	32.7
1987	7,244.38	2,414.25	33.3
1988	7,462.03	2,533.21	33.9
1989	7,690.01	2,663.38	34.6
1990	7,928.87	2,805.57	35.4
1995	8,971.80	3,172.40	35.4
2000	9,948.98	3,512.38	35.3
2005	10,847.65	3,820.59	35.2
2010	11,649.61	4,091.27	35.1

Source: NHA-CORPLAN (1985-1990)
STUDY TEAM (1995-2010)

TABLE 11.8.1 ESTIMATED AREA COVERED BY THE ANTIPOLO (1991)

BARANGAY/ MUNICIPALITY	LAND AREA BRGY./ MUNICIPALITY	AREA COVERED BY THE STUDY AREA (Ha.)	PERCENTAGE OF THE TOTAL BRGY./MUNICIPALITY AREA (%)
BARANGAY			
Bagong Nayon	648.0	319.2	49.3
Santa Cruz	1,108.0	778.4	70.3
De la Paz	420.6	420.6	100.0
Beverly Hills	31.4	31.4	100.0
San Roque	380.4	380.4	100.0
Dalig	556.5	332.6	59.8
San Jose	5,640.1	270.0	4.8
San Isidro	360.8	360.8	100.0
San Luis	697.2	233.6	33.5
MUNICIPALITY			
Taytay	3,374.0	764.8	22.7
Angono	2,600.0	935.0	36.0
Binangonan	7,270.0	141.0	1.9
Teresa	1,860.0	120.0	6.5
TOTAL	--	5,087.8	--

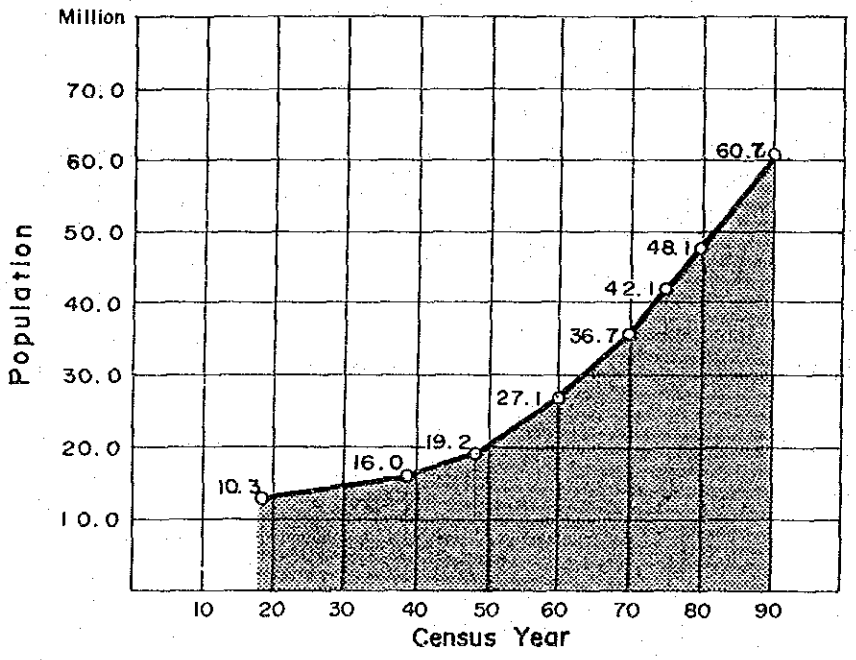
TABLE 11.8.2 ESTIMATED AREA BY LAND CATEGORY, ANTIPOLO AREA, 1991

BARANGAY/ MUNICIPALITY	LAND USE							LAND AREA (Ha.)
	BUILT-UP Residential Institutional Facilities	COMMERCIAL	INDUSTRIAL	OPEN SPACE	AGRICULTURAL Ricefield Cropland Plantation	FOREST/ GRASSLAND Forest Grassland Shrubland Pasture	OTHERS Wetland Quarry	
Bagong Nayon	69.1	2.S	-	36.2	44.0	157.1	10.0	319.2
Sta. Cruz	115.0	1.0	-	147.6	S5.0	385.0	44.S	77S.4
De la Paz	50.0	1.S	-	134.6	72.0	150.2	-	420.6
Beverly Hills	20.0	-	-	7.0	4.4	-	-	31.4
San Roque	95.0	2.0	5.0	74.4	87.0	117.0	-	3S0.4
Dalig	S5.0	0.S	6.0	75.0	100.5	65.3	-	332.6
San Jose	56.0	2.0	3.6	47.0	90.5	6S.9	-	270.0
San Isidro	43.4	2.0	0.4	S2.0	57.0	176.0	-	360.S
San Luis	10.0	-	-	13.6	30.0	180.0	-	233.6
Taytay	115.2	-	5.2	122.6	41.S	477.0	-	764.S
Angono	45.0	-	10.S	35.0	149.0	665.2	30.0	935.0
Binangonan	6.S	-	6.4	-	10.6	117.2	-	141.0
Teresa	-	-	-	0.S	24.2	95.0	-	120.0
TOTAL	721.5	12.4	37.4	775.S	796.0	2,659.9	S4.S	5087.S

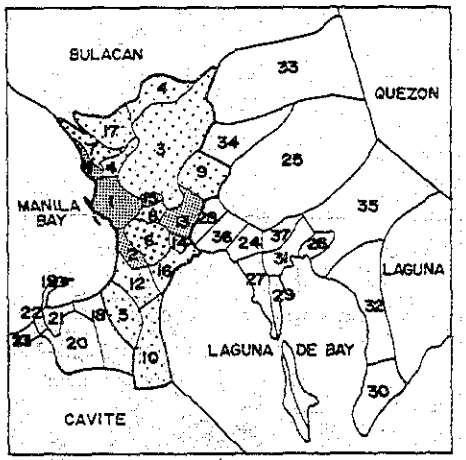
TABLE 11.8.3 ESTIMATED AREA BY LAND CATEGORY, ANTIPOLO AREA, 2020

BARANGAY/ MUNICIPALITY	LAND USE							LAND AREA (Ha.)
	BUILT-UP Residential Institutional Facilities	COMMERCIAL	INDUSTRIAL	OPEN SPACE	ACRICULTURAL Ricefield Cropland Plantation	FOREST/ GRASSLAND Forest Grassland Shrubland Pasture	OTHERS	
Bagong Nayon	113.0	3.9	-	20.1	29.2	135.6	12.4	319.2
Sta. Cruz	298.5	2.0	-	134.0	58.6	285.3	-	778.4
De la Paz	151.2	3.6	-	95.8	35.0	135.0	-	420.6
Beverly Hills	29.6	-	-	-	1.8	-	-	31.4
San Roque	168.6	4.0	6.0	61.8	42.8	97.2	-	380.4
Dalig	155.5	3.2	6.0	28.2	88.5	51.2	-	332.6
San Jose	114.0	3.8	6.5	15.4	66.5	63.8	-	270.0
San Isidro	108.4	3.5	1.0	54.2	38.4	155.3	-	360.8
San Luis	32.7	-	-	8.8	26.5	165.6	-	233.6
Taytay	224.4	-	7.0	63.4	49.2	420.8	-	764.8
Angono	130.5	-	15.2	20.0	145.2	597.7	26.4	935.0
Binangonan	10.5	-	6.4	-	10.6	113.5	-	141.0
Teresa	2.0	-	-	-	24.0	94.0	-	120.0
TOTAL	1,543.9	24.0	48.1	501.7	616.3	2,315.0	38.8	5,087.8

GROWTH OF PHILIPPINE POPULATION



STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA	FIGURE 11.1.1 GROWTH OF PHILIPPINE POPULATION
JAPAN INTERNATIONAL COOPERATION AGENCY	



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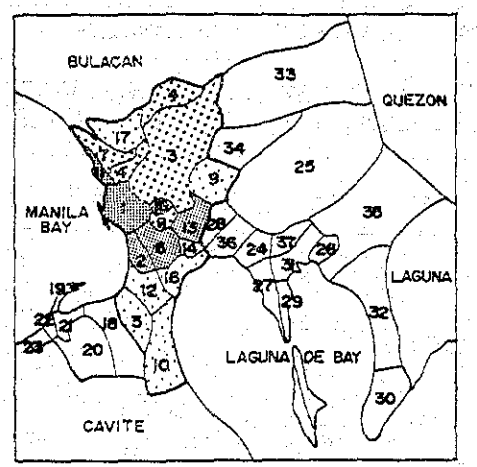

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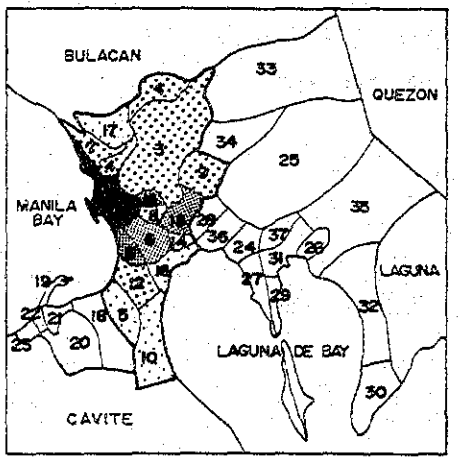
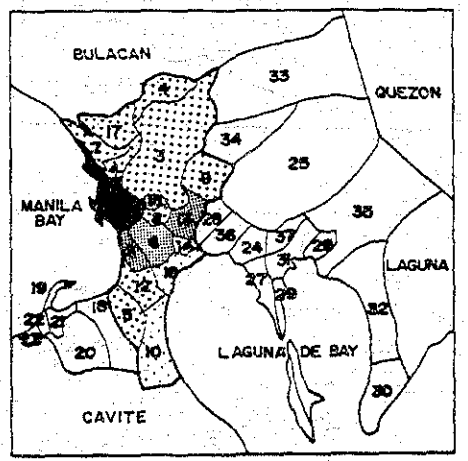
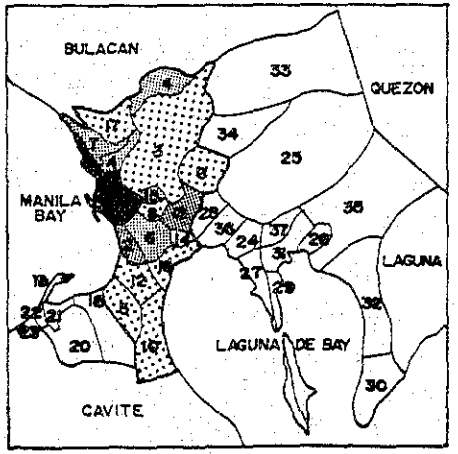


1980



1985



1990

CITY / MUNICIPALITY

1. Manila	20. Imus	
2. Pasay	21. Kawit	
3. Quezon	22. Noveleta	
4. Caloocan	23. Rosario	
5. Las Piñas	24. Angono	
6. Makati	25. Antipolo	
7. Malabon	26. Bosoo	
8. Mandaluyong	27. Binangonan	
9. Marikina	28. Cainta	
10. Muntinlupa	29. Cardona	
11. Navotas	30. Jala - Jala	
12. ParaRaque	31. Morong	
13. Pasig	32. Pililla	
14. Pateros	33. Montalban	
15. San Juan	34. San Mateo	
16. Taguig	35. Tanay	
17. Valenzuela	36. Taytay	
18. Bacoor	37. Teresa	
19. Cavite City		

LEGEND

DENSITY (Pers./Ha.)

0 - 50

50.1-100

100.1-200

200.1-400

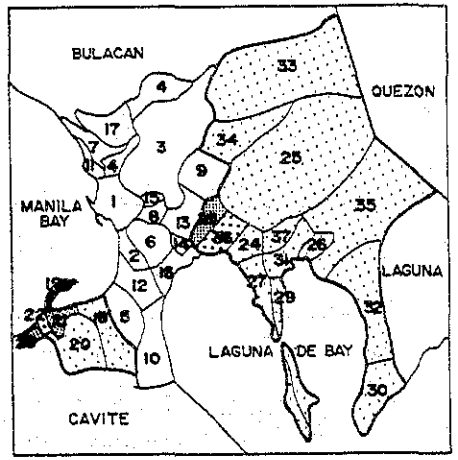
400 +

STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA

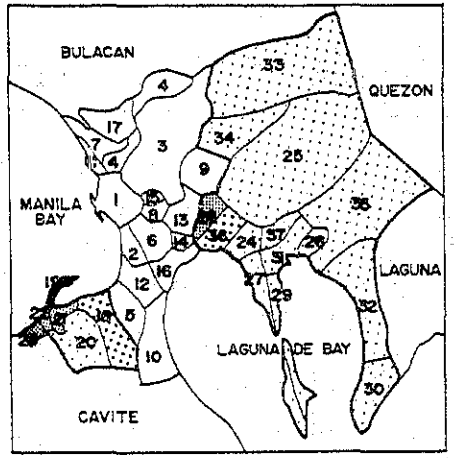
JAPAN INTERNATIONAL COOPERATION AGENCY

FIGURE 11.1.2

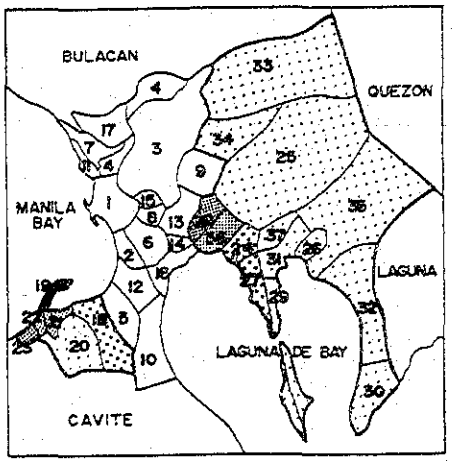
POPULATION DENSITY OF NCR



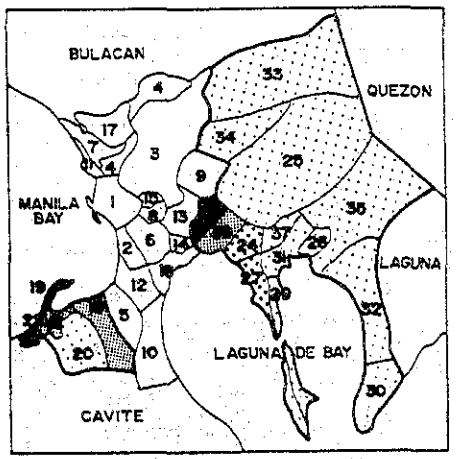
1970



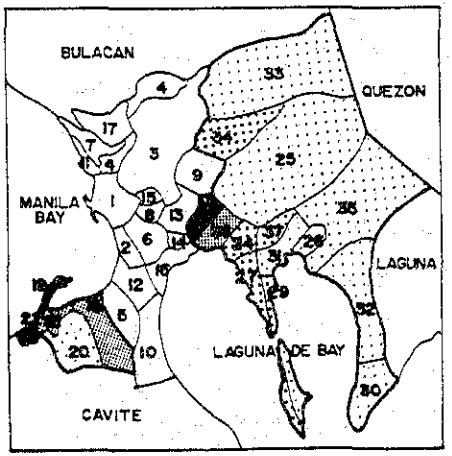
1975



1980



1985



1990

CITY / MUNICIPALITY

1. Manila	20. Imus	
2. Pasay	21. Kawit	
3. Quezon	22. Noveleta	
4. Caloocan	23. Rosario	
5. Las Piñas	24. Angono	
6. Makati	25. Antipolo	
7. Malabon	26. Baras	
8. Mandaluyong	27. Binangonan	
9. Marikina	28. Cainta	
10. Muntinlupa	29. Cardona	
11. Navotas	30. Jala - Jala	
12. Parañaque	31. Morong	
13. Pasig	32. Pililla	
14. Pateros	33. Montalban	
15. San Juan	34. San Mateo	
16. Taguig	35. Teneo	
17. Valenzuela	36. Tayray	
18. Bacoor	37. Teresa	
19. Cavite City		

LEGEND

DENSITY (Pers./Ha.)

0 - 10	10.1 - 20
20.1 - 40	40.1 - 60
60.1 - 80	80.1 +

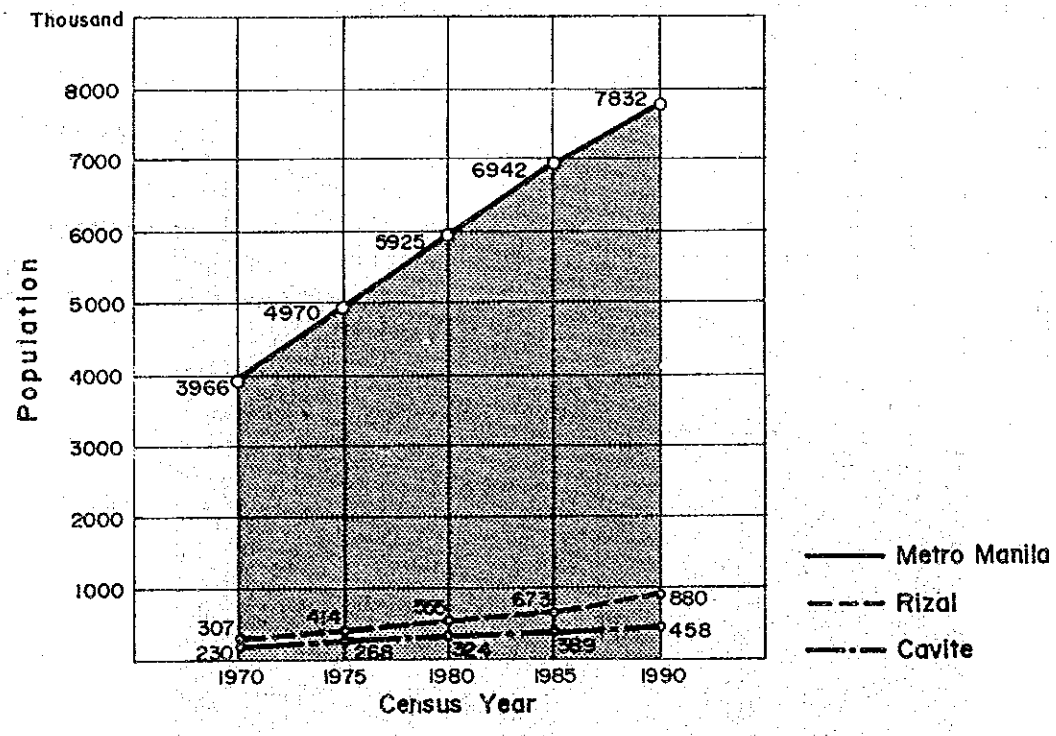
STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA

JAPAN INTERNATIONAL COOPERATION AGENCY

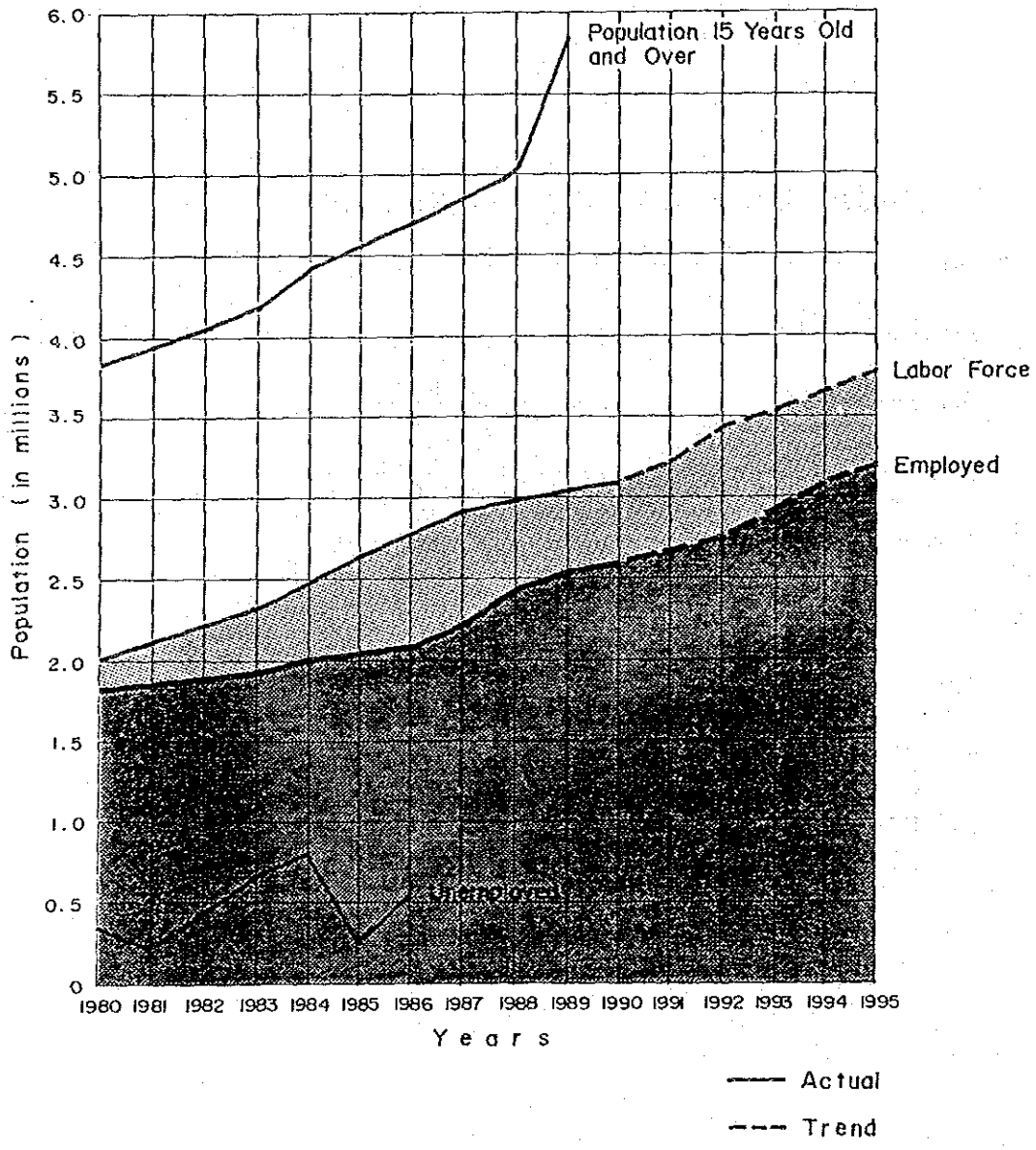
FIGURE 11.1.3

POPULATION DENSITY OF CAVITE AND RIZAL

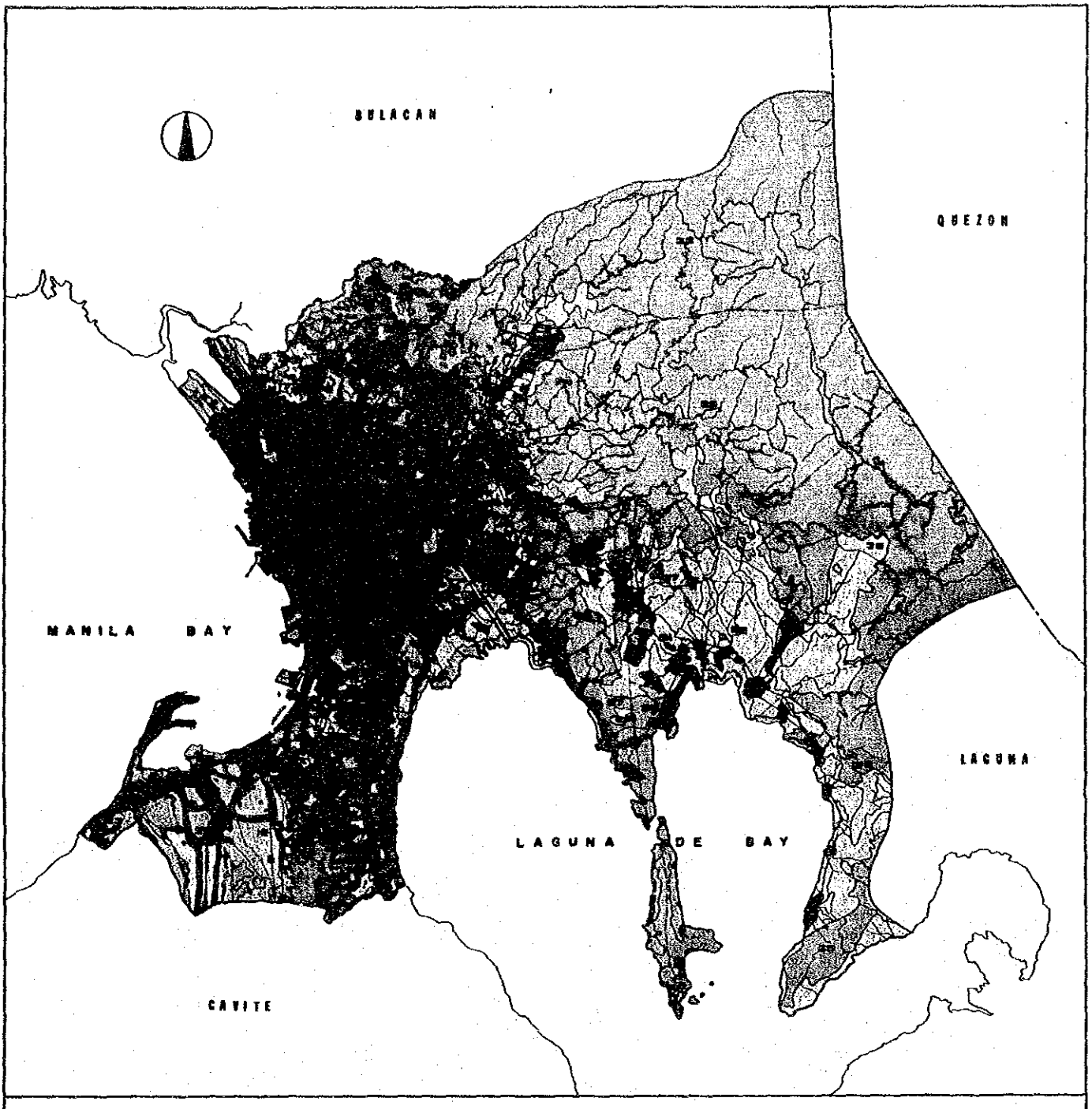
GROWTH OF STUDY AREA POPULATION



STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA	FIGURE 11.1.4 GROWTH OF STUDY AREA POPULATION
JAPAN INTERNATIONAL COOPERATION AGENCY	



STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA JAPAN INTERNATIONAL COOPERATION AGENCY	FIGURE 11.2.1 EMPLOYMENT SITUATION 1980 - 1990



CITY / MUNICIPALITY

1. Manila	20. Imus
2. Pasay	21. Kawit
3. Quezon	22. Noveleta
4. Caloocan	23. Rosario
5. Las Piñas	24. Angono
6. Makati	25. Antipolo
7. Malabon	26. Baras
8. Mandaluyong	27. Binangonan
9. Marikina	28. Cainta
10. Muntinlupa	29. Cardona
11. Navotas	30. Jala - Jala
12. Parañaque	31. Morong
13. Pasig	32. Pililla
14. Pateros	33. Rodriguez
15. San Juan	34. San Mateo
16. Taguig	35. Tanay
17. Valenzuela	36. Taytay
18. Bacoor	37. Teresa
19. Cavite City	

STUDY AREA

PROVINCIAL BOUNDARY

CITY / MUNICIPALITY BOUNDARY

SCALE

0 2 4 6 8 10 km

LEGEND

- LOW DENSITY
- MIDDLE DENSITY
- HIGH DENSITY

} BUILT-UP AREA

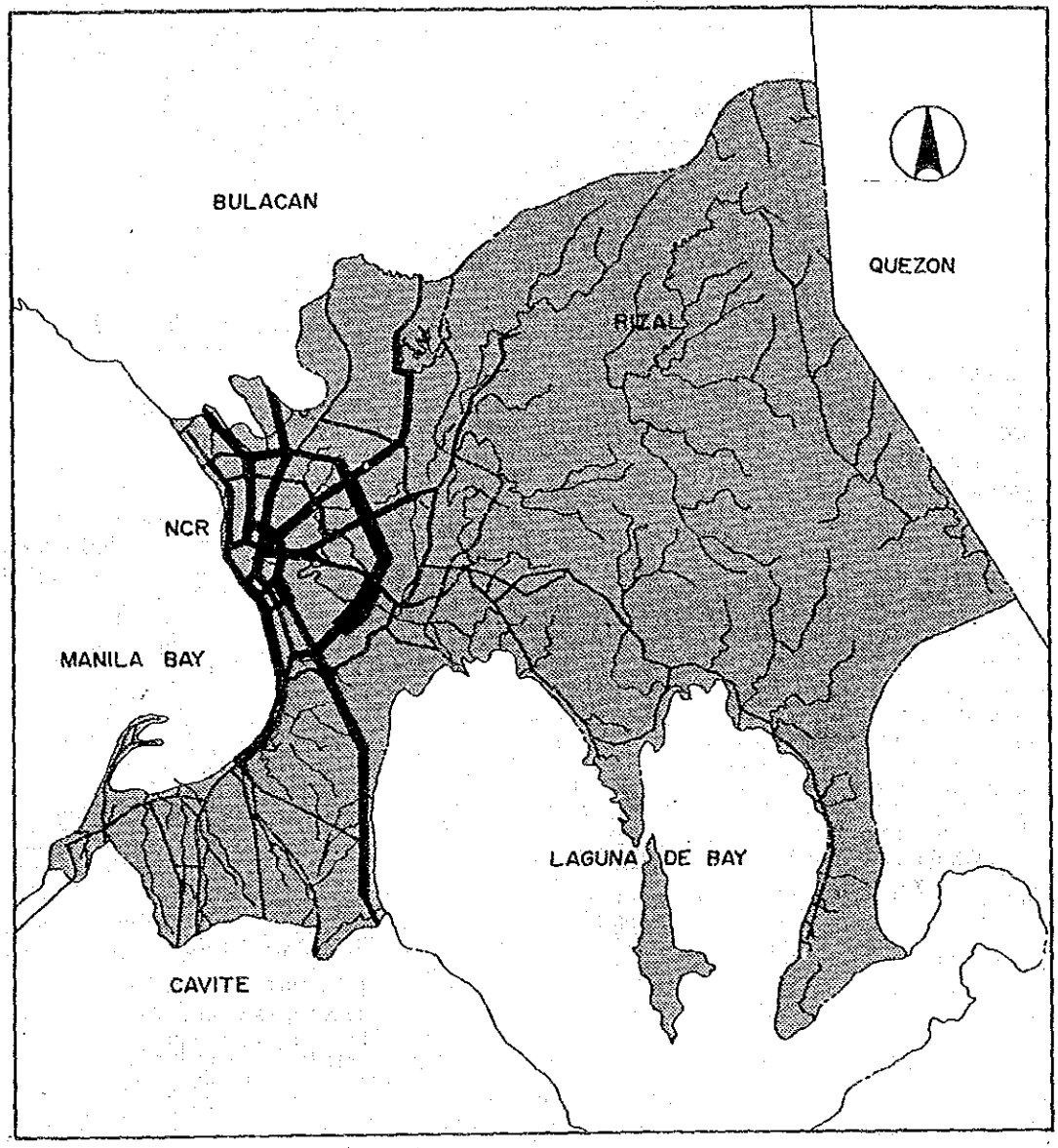
- INDUSTRIAL AREA
- AGRICULTURAL LAND
- FOREST / GRASSLAND
- WETLAND
- OPEN SPACE

STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA

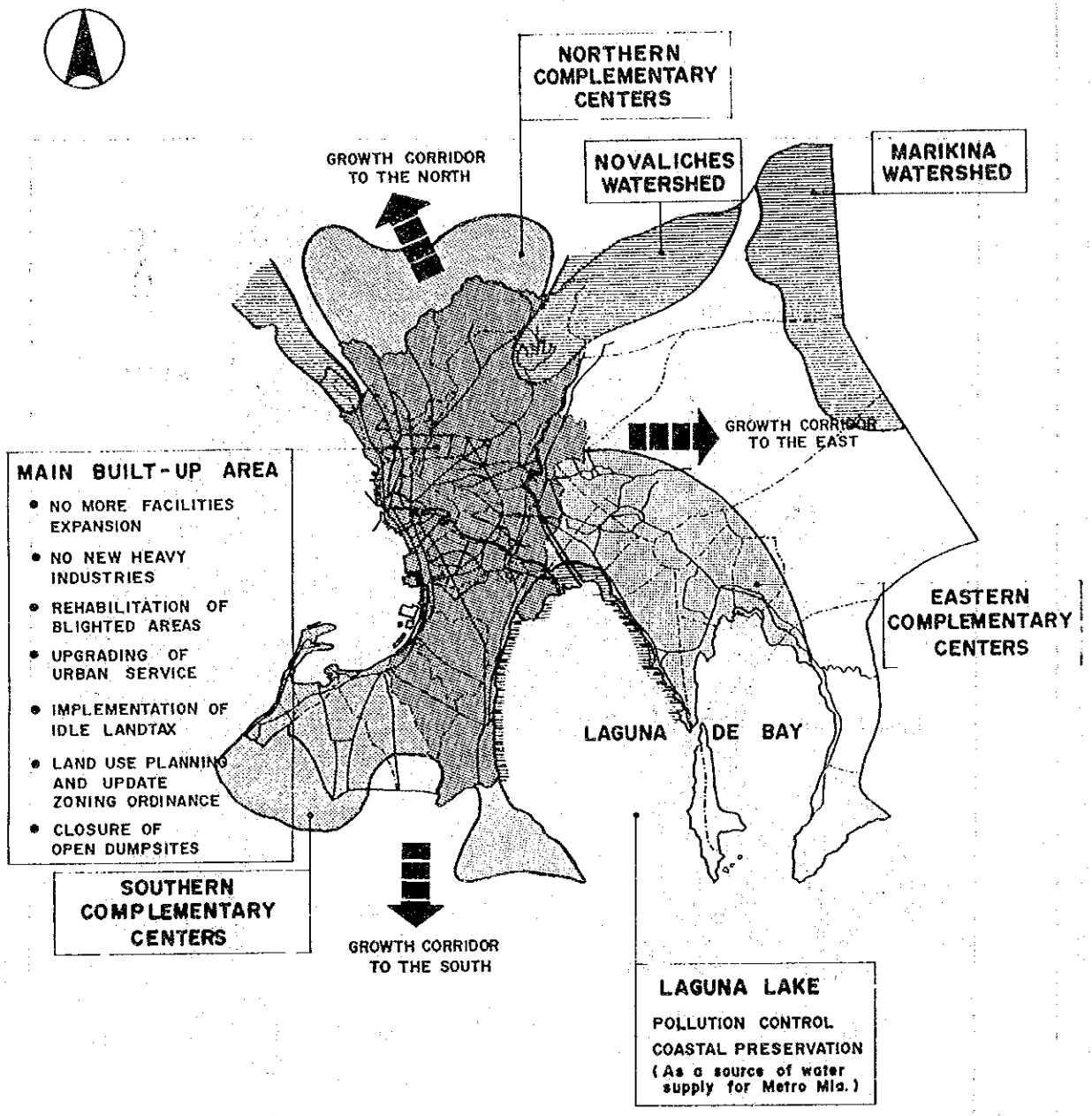
JAPAN INTERNATIONAL COOPERATION AGENCY

LAND USE MAP 1990

FIGURE 11.4.1



STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA JAPAN INTERNATIONAL COOPERATION AGENCY	FIGURE 11.5.1 TRAFFIC FLOW (1989)

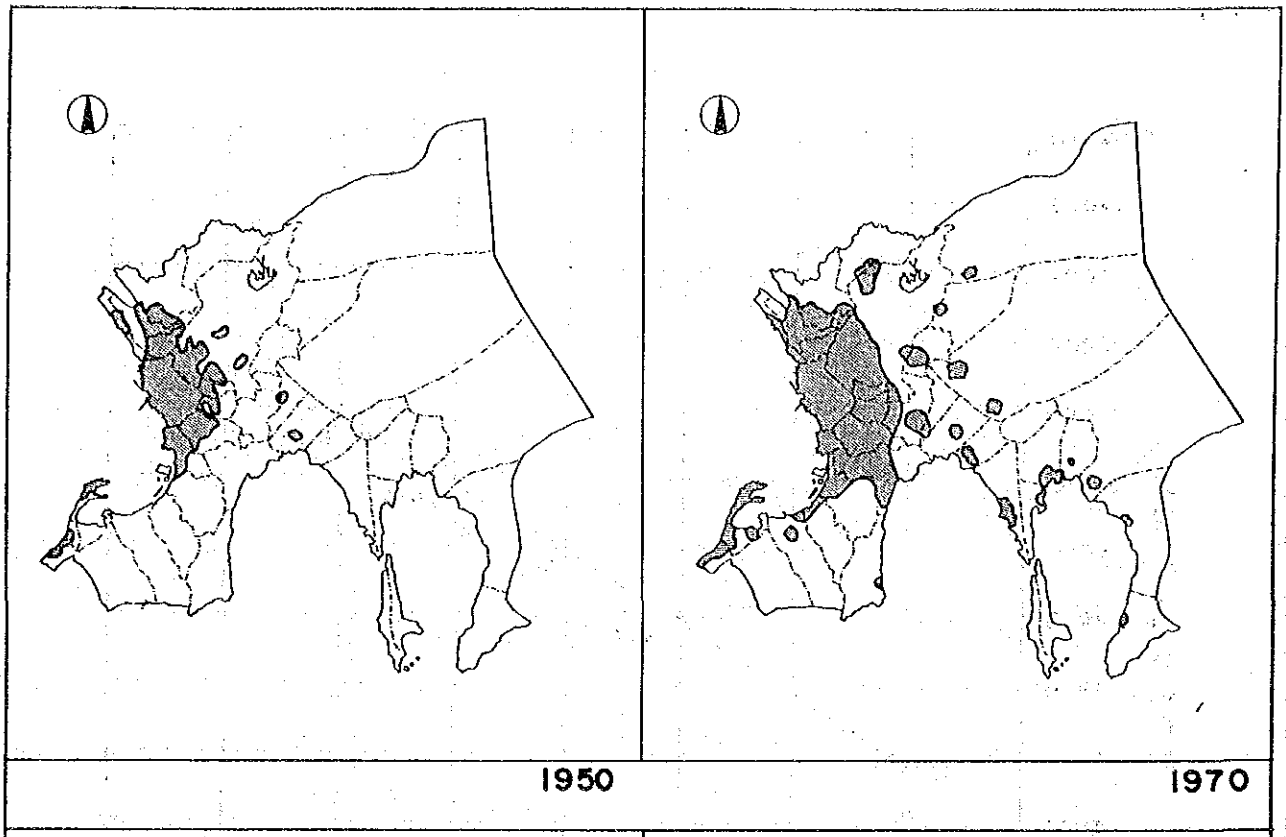


STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA

JAPAN INTERNATIONAL COOPERATION AGENCY

PHYSICAL GROWTH STRATEGY

FIGURE 11.6.1

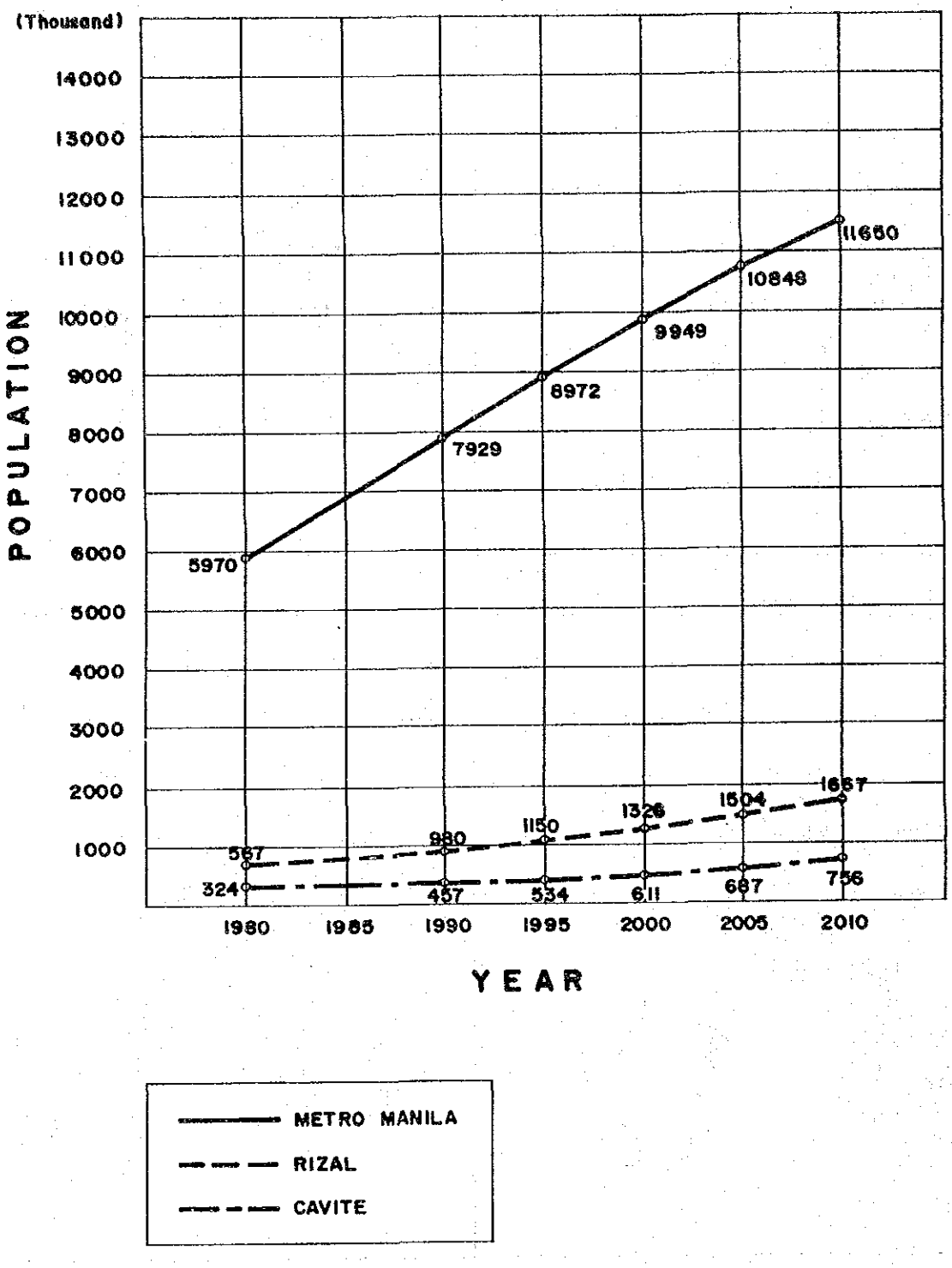


STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA

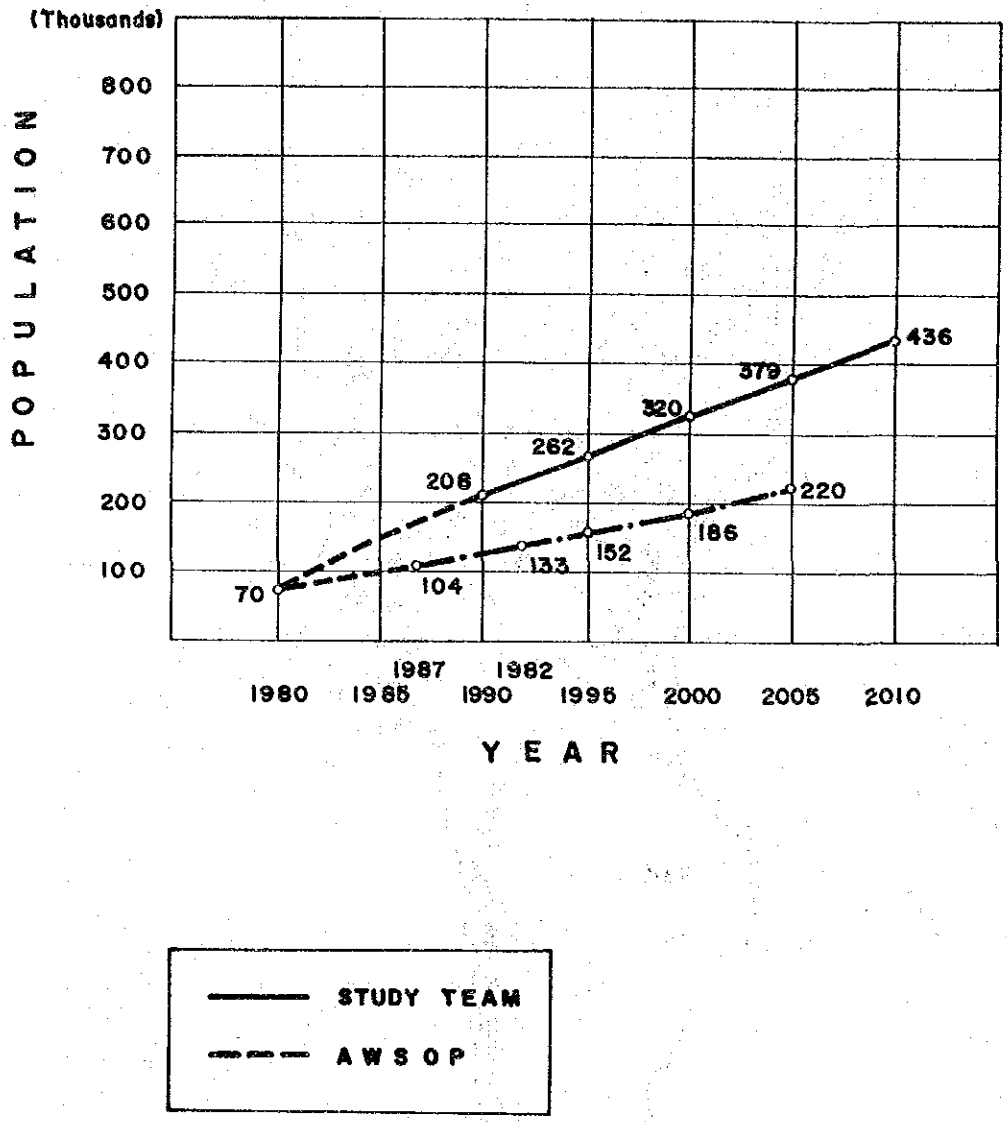
JAPAN INTERNATIONAL COOPERATION AGENCY

GROWTH OF THE STUDY AREA

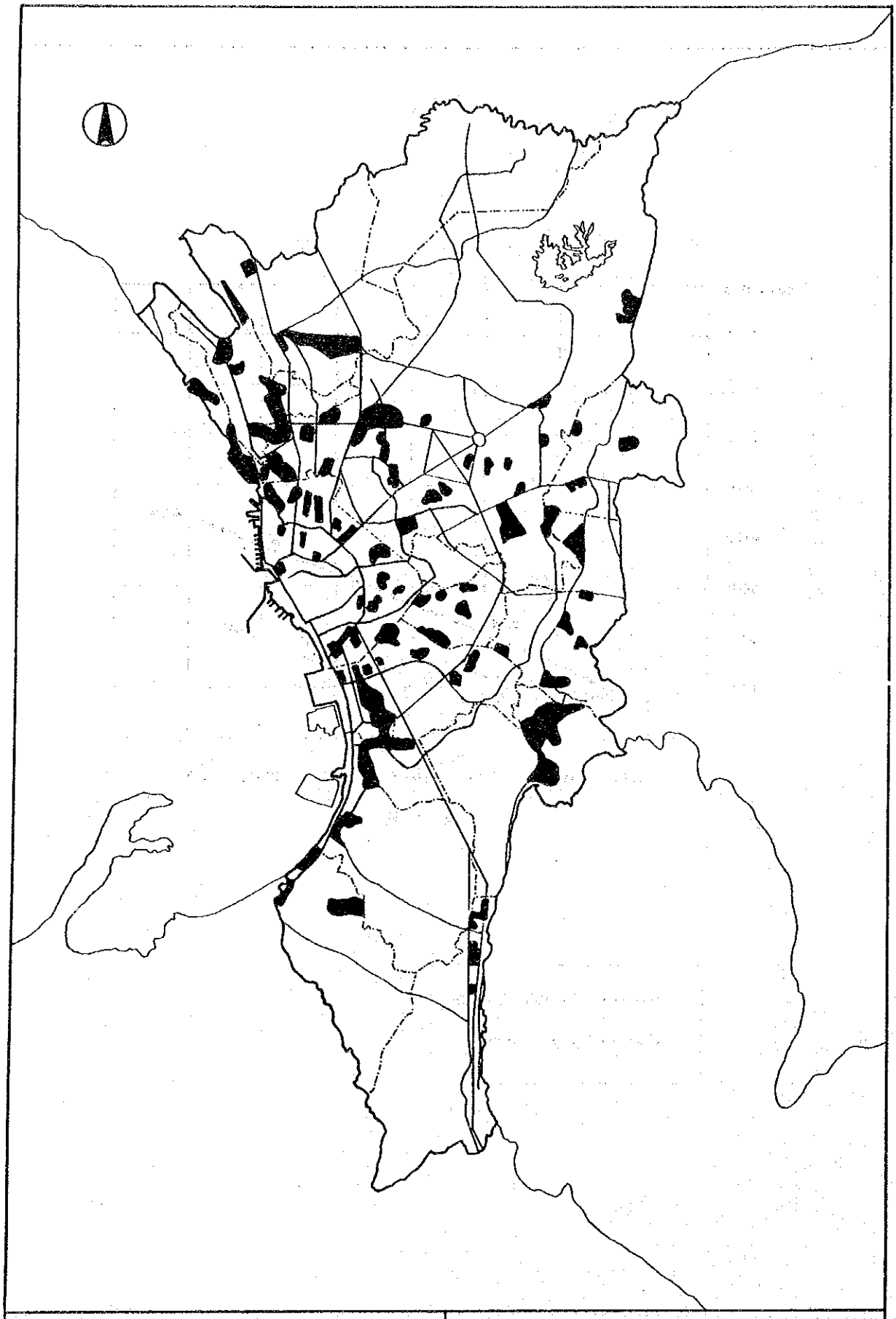
FIGURE 11.6.2



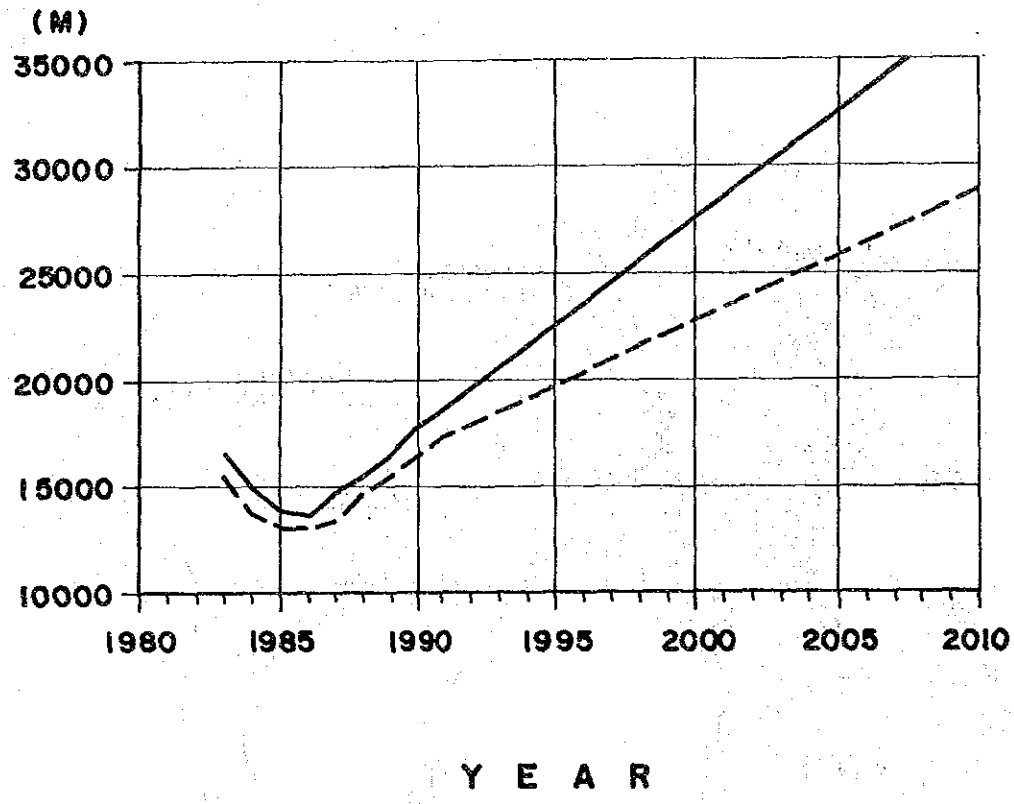
STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA	FIGURE 11.7.1 ESTIMATED POPULATION GROWTH OF THE STUDY AREA
JAPAN INTERNATIONAL COOPERATION AGENCY	



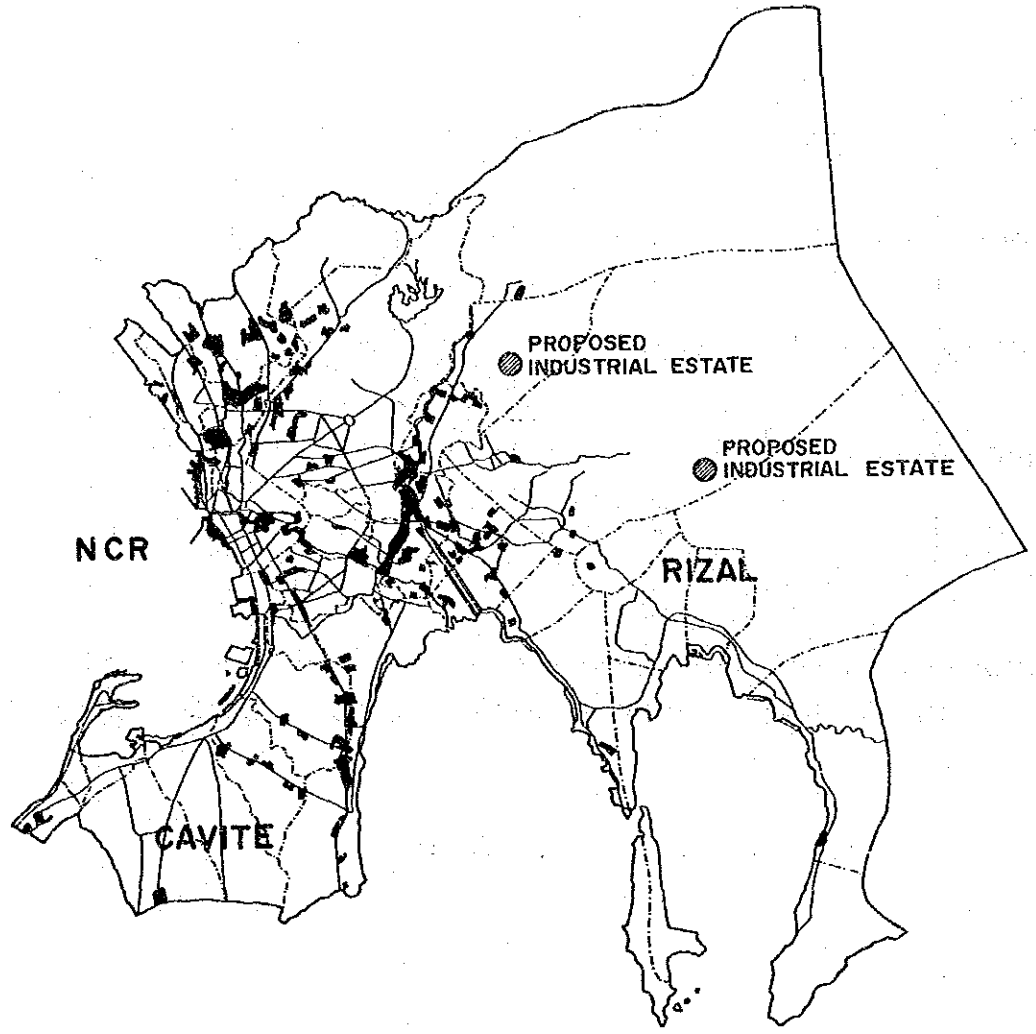
STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA JAPAN INTERNATIONAL COOPERATION AGENCY	FIGURE 11.7.2 COMPARISON BETWEEN AWSOP'S AND THE JICA STUDY TEAM'S POPULATION PROJECTION FOR THE MUNICIPALITY OF ANTIPOLO



STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA	FIGURE 11.7.3
JAPAN INTERNATIONAL COOPERATION AGENCY	BLIGHTED AREAS IN THE NCR



STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA JAPAN INTERNATIONAL COOPERATION AGENCY	FIGURE 11.7.4 GROSS DOMESTIC PRODUCT (GDP) NATIONAL OF THE CAPITAL REGION



INDUSTRIES

PROPOSED INDUSTRIAL ESTATE

STUDY AREA

PROVINCIAL BOUNDARY

CITY / MUNICIPALITY BOUNDARY

SCALE

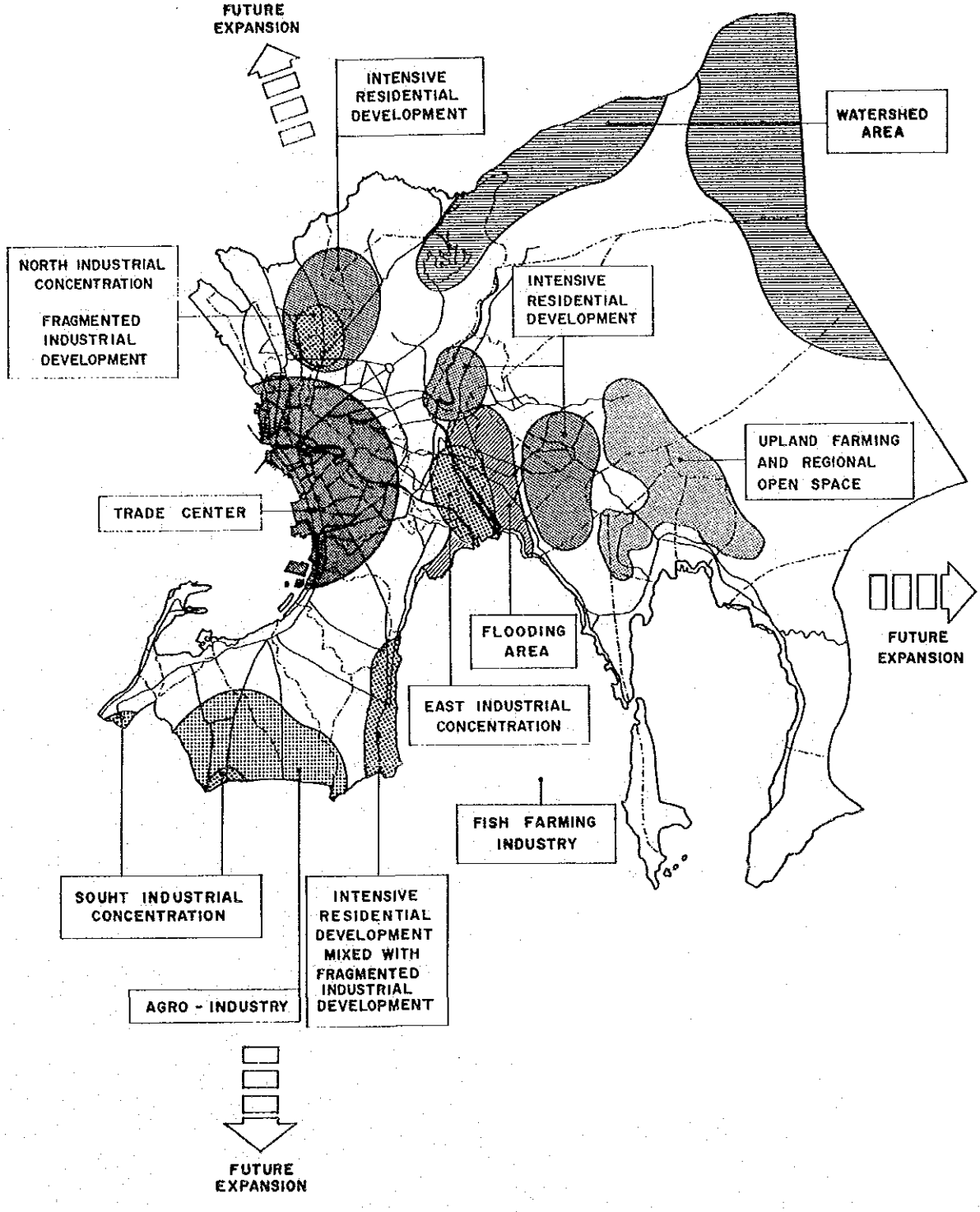
0 2 4 6 8 10km

STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA

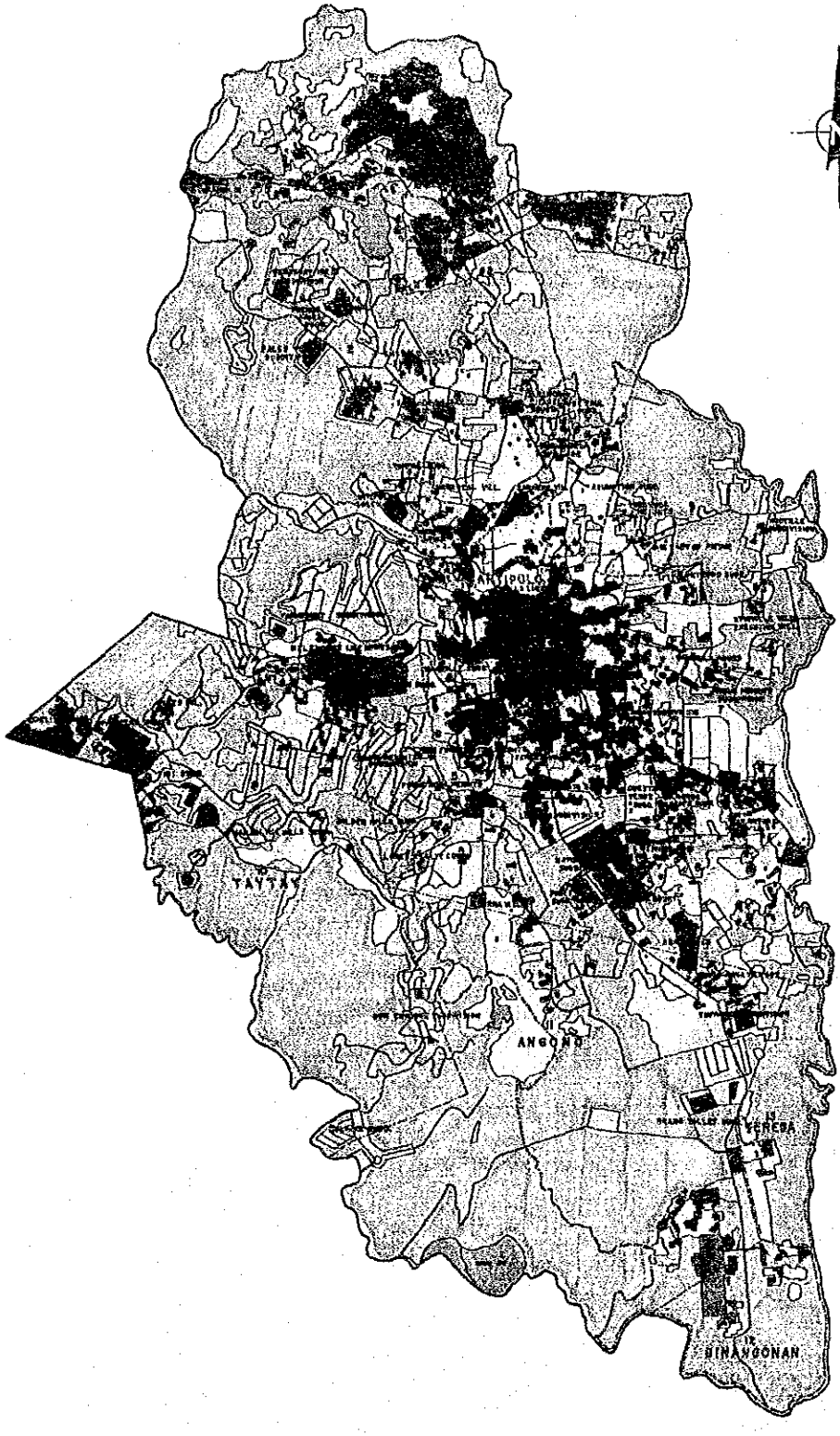
JAPAN INTERNATIONAL COOPERATION AGENCY

INDUSTRIAL LOCATIONS

FIGURE 11.7.5



STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA	STRUCTURE PLAN
JAPAN INTERNATIONAL COOPERATION AGENCY	FIGURE 11.8.1



BARANGAY / MUNICIPALITY

1. Bagong Nayon
2. Sto. Cruz
3. De la Paz
4. Beverly Hills
5. San Roque
6. Dalig
7. San Jose
8. San Isidro
9. San Luis
10. Taytay
11. Angono
12. Binangonan
13. Teresa

STUDY AREA
AQUIFER BASIN ZONE
MUNICIPALITY BOUNDARY
BARANGAY BOUNDARY

SCALE

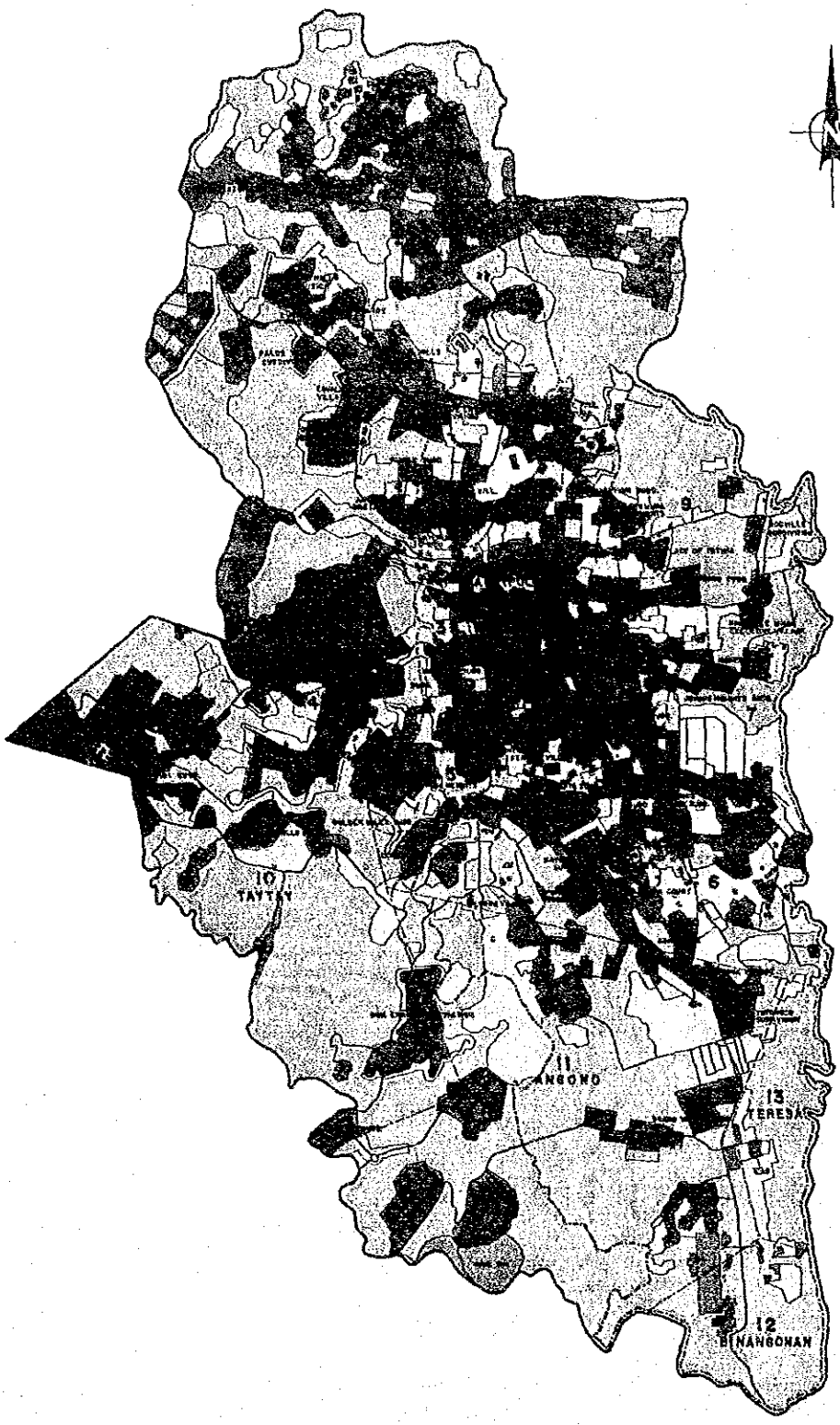
LEGEND

BUILT-UP AREA
COMMERCIAL AREA
INDUSTRIAL AREA
AGRICULTURAL LAND
FOREST/GRASS LAND
OPEN SPACE
OTHERS

STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA
JAPAN INTERNATIONAL COOPERATION AGENCY

LAND USE MAP
ANTIPOLO AREA

1991
FIGURE 11.8.2



BARANGAY / MUNICIPALITY

1. Bagong Nayon
2. Sta. Cruz
3. De la Paz
4. Beverly Hills
5. San Roque
6. Dalig
7. San Jose
8. San Isidro
9. San Luis
10. Taytay
11. Angono
12. Binangonan
13. Teresa

STUDY AREA
AQUIFER BASIN ZONE
MUNICIPALITY BOUNDARY
BARANGAY BOUNDARY

LEGEND

- BUILT-UP AREA
- COMMERCIAL AREA
- INDUSTRIAL AREA
- AGRICULTURAL LAND
- FOREST GRASS LAND
- OPEN SPACE
- OTHERS

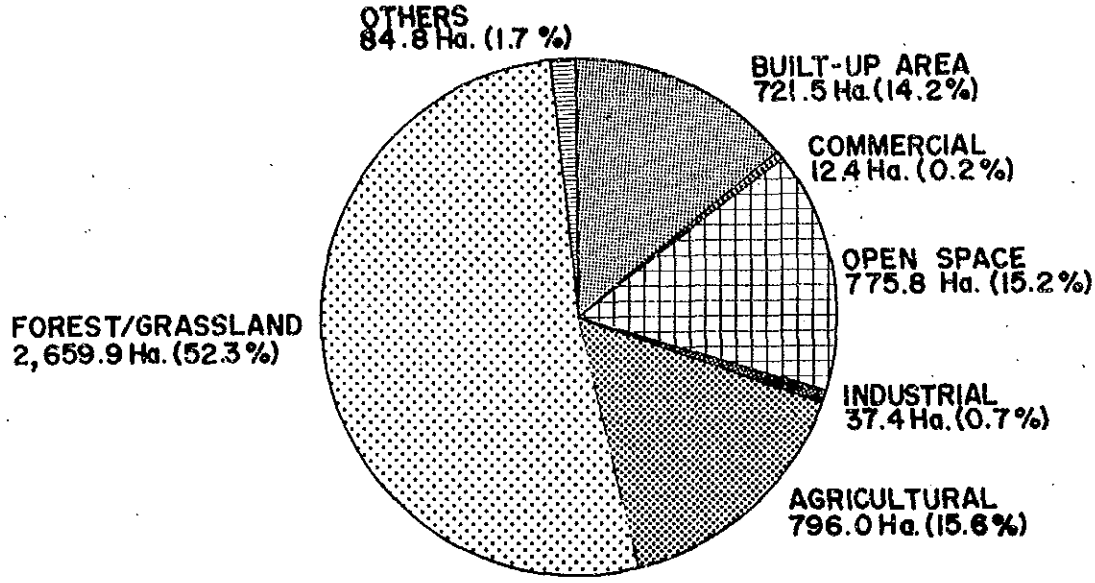
STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA

JAPAN INTERNATIONAL COOPERATION AGENCY

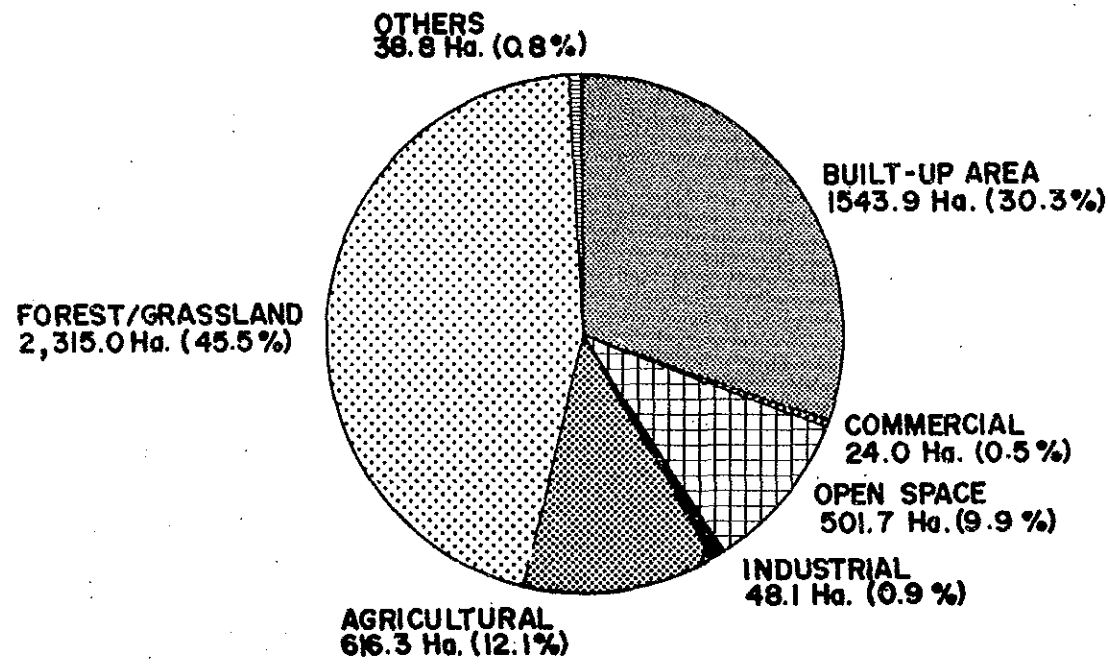
FUTURE LAND USE MAP
ANTIPOLO AREA

2010
FIGURE 11.8.3

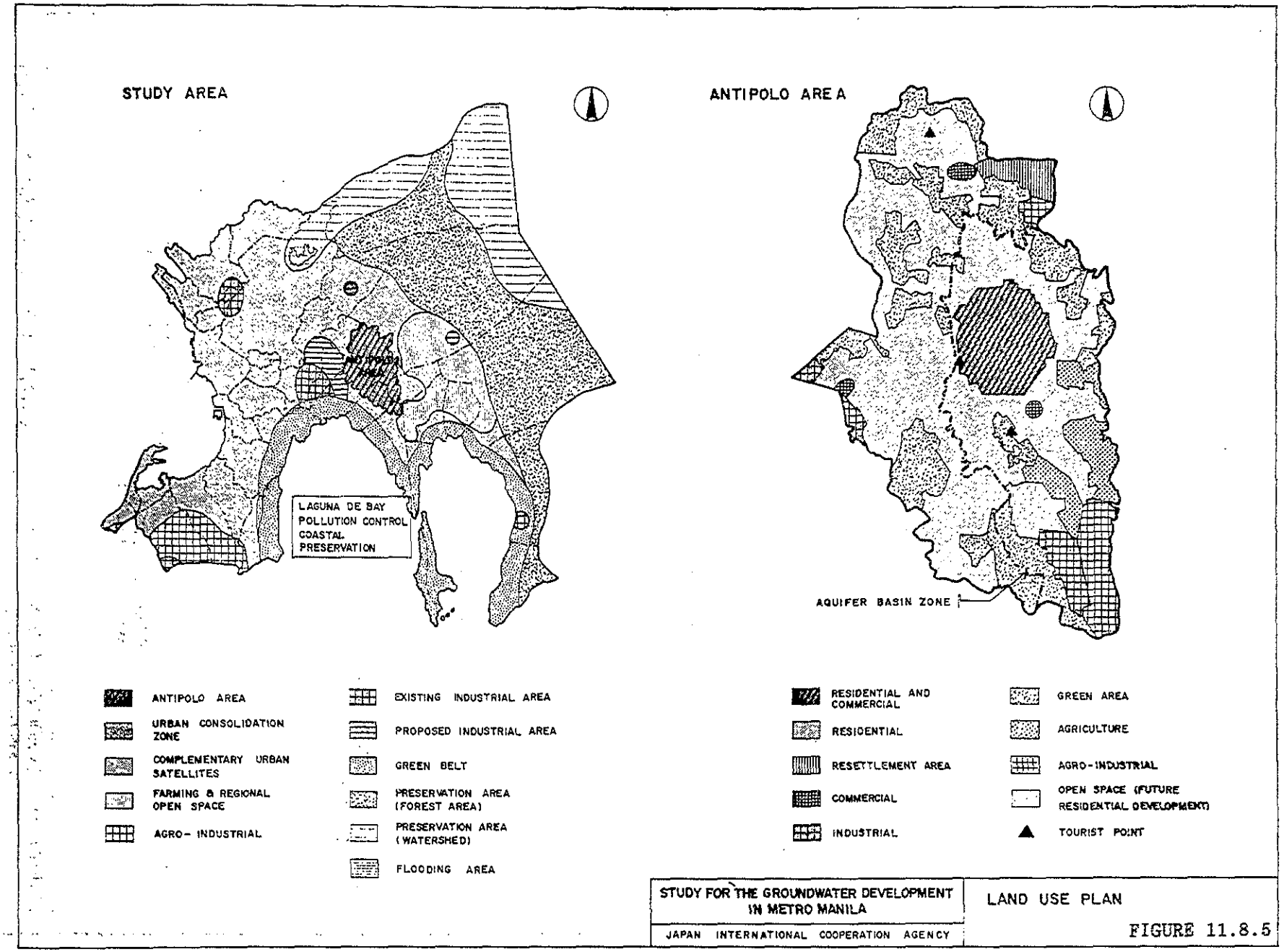
ESTIMATED AREA BY LAND CATEGORY
ANTIPOLO AREA (1991)



ESTIMATED AREA BY LAND CATEGORY
ANTIPOLO AREA (2010)



STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA	LAND AREA COMPARISON 1991 - 2010 FIGURE 11.8.4
JAPAN INTERNATIONAL COOPERATION AGENCY	



STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA

JAPAN INTERNATIONAL COOPERATION AGENCY

LAND USE PLAN

FIGURE 11.8.5

CHAPTER 12

WATER SUPPLY SYSTEMS

CHAPTER 12 WATER SUPPLY SYSTEMS

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CHAPTER 12 WATER SUPPLY SYSTEMS

12.1 GENERAL SITUATION IN THE COUNTRY

12.1.1 Present Water Supply Services

As of end-1987, around 63% of the country's total population have access to public water supply systems. The rest of the population, approximately 37%, sourced their water from open dug wells, rainwater cisterns, lakes and streams, a number of which are of doubtful quality. The service area coverage included 86% for Metro Manila and its contiguous areas, 55% for other urban areas,and 62% for the rural areas. Out of the 86% covered in Metro Manila, however, only 57% were directly served with MWSS water, 16% were served indirectly by MWSS through ambulant vendors, and the rest acquired water through private wells and other undetermined sources. Present water supply coverage in the country is shown in Table 12.1.1. Number of families by main water sources and respective percentage are shown in Table 12.1.2 and Figure 12.1.1.

In Metro Manila, water supply service consists of individual house connections, private wells, some public standpipes in blighted areas and ambulant vendors. In large urban centers outside Metro Manila, majority of the people is served by Level III systems. In the rural areas, however, the most common water supply facilities are protected wells and developed springs. There are also some Level II and III systems but the latter are generally found only in large poblaciones. Table 12.1.3 shows the condition of existing water supply facilities.

12.1.2 Institutional Aspect

The provision of potable water is under the responsibility of the Department of Public Works and Highways (DPWH) and two of its attached agencies, namely, the Metropolitan Waterworks and Sewerage System (MWSS) and the Local Water Utilities Administration (LWUA). The MWSS operates the water supply and sewerage systems in Metro Manila and its contiguous areas, while the LWUA handles the development and improvement of water and sewerage systems in the areas not covered by MWSS.

The DPWH is concerned mainly with the development of Level I systems. It is also the lead agency in establishing national water supply plans and programs upon which all involved agencies in the sector base their respective development plans. Other agencies involved in water supply include the National Water Resources Board (NWRB) and the Department of Local Governments (DLG). The DLG's role is limited to the general administrative/institution building activities. The NWRB on the other hand is involved mainly in policies and regulations concerning the proper utilization and rights thereof of water resources all over the Philippines.

A matrix of responsibility of the concerned agencies in the water supply sector is presented in Table 12.1.4.

12.1.3 Master Plan of the Philippines

To provide direction, establish priorities, and rationalize implementation of projects in the sector, the Philippine Government prepared in 1980 the Integrated Water Supply Program for the period 1980-2000 and the 1982 Philippine Rural Water Supply Master Plan. These were later superseded by the Water Supply, Sewerage, and Sanitation Master Plan for the period 1988-2000 that was formulated in 1987. The master plan contains the sectoral objectives, policies, programs, institutional arrangements, and financial and economic considerations.

The Master Plan calls for a two-stage implementation of projects: the first stage covering the period 1988 to 1992 and the second stage encompassing the period 1993-2000.

As shown in Table 12.1.5, several activities are envisaged during the first stage (1988-92). In Metro Manila and its contiguous areas, a package of projects is to be undertaken to improve the existing facilities and expand their coverage. These are the Manila Water Supply Rehabilitation Project I (MWSRP I), the Metro Manila Water Distribution Project (MMWDP), the Angat Water Supply Optimization Project (AWSOP), Manila Water Supply Rehabilitation Project II (MWSRP II), Fringe Areas Water Supply Project (FAWSP) and Rizal Province Water Supply Improvement Project (RPWSIP). These projects will expand and improve the service coverage of the system to 87% of the metropolitan population.

In other urban areas, it is envisaged that 450 Piped Systems (Levels II and III) will be constructed, and 250 systems will be rehabilitated to increase the population coverage to 77%.

In the rural areas, about 933 piped systems and around 87,146 point sources (Level I) will be constructed and 21,620 facilities to be repaired or rehabilitated to raise the service coverage to about 92% of the rural population.

The second stage (1993-2000) of this Master Plan considers the complete water supply coverage of both urban and rural areas with emphasis on proper operation and maintenance of facilities, and the gradual construction of sewerage systems. Table 12.1.6 reflects the physical targets, investment requirements and service coverage per sector of the second stage.

In Metro Manila, the Manila Water Supply Project III was planned to boost the service coverage to 97%. This project, however, was deferred after construction has already started because its estimated cost had escalated.

In other urban areas, 654 piped systems are programmed for construction, while 350 systems are scheduled for rehabilitation, to expand population coverage to 95%.

In the rural areas, about 794 piped systems will be constructed. Likewise, 13,340, 9,500, and 21,500 Level I systems will be constructed, replaced and rehabilitated, respectively, to increase population coverage to 93%.

Table 12.1.7 summarizes the physical targets of the water supply sector outside of Metro Manila for the years 1988-2000.

12.2 Present Situation in the MWSS Service Area (MSA)

12.2.1 Service Area

Based on Republic Act No. 5234, the MWSS has jurisdiction over the

following areas (refer to Figure 12.2.1):

- Metropolitan Manila (National Capital Region):
  - 4 cities: Manila, Pasay, Quezon, and Caloocan
  - 13 municipalities: Las Piñas, Makati, Malabon, Mandaluyong, Marikina, Muntinlupa, Navotas, Parañaque, Pasig, Pateros, San Juan, Taguig, Valenzuela

- Rizal Province:
  - 14 municipalities: Angono*, Antipolo, Baras*, Binangonan*, Cainta, Cardona*, Jala-Jala*, Montalban, Morong*, Pililla*, San Mateo, Tanay*, Taytay, Teresa*
    * Merged into MSA by the Batas Pambansa Blg. 799, approved April 27, 1984.

- A Part of Cavite Province:
  - 1 city: Cavite
  - 5 municipalities: Bacoor, Imus, Kawit, Noveleta, Rosario

- Lungsod Silangan (Tagalog word, Eastern City - not specified)

- Other areas that may come within the development path of the expanding Metropolitan Manila Area, which areas the Board of MWSS may determine and declare as contiguous to its service area and requiring immediate attention, under such terms and conditions that may be agreed upon by the parties concerned. -- Subject to the approval of the President.

Among these areas, the Central Distribution System (CDS) of MWSS, which distributes water from two surface water treatment plants, services only those within Metro Manila including a part of Bacoor and Kawit of Cavite Province. But even in Metro Manila, peripheral areas such as the northern part of Caloocan City, the northern part of Quezon City, most of Valenzuela, the eastern part of Marikina, part of Taguig, a part of Parañaque, most of Las Piñas, and most of Muntinlupa, are not covered by the CDS. These areas and the other areas in said two provinces predominantly rely on isolated groundwater supply systems operated by MWSS and other public entities such as Water Districts, municipalities, and barangays. Figure 12.2.2 presents the areas covered by existing MWSS water supply systems. The meshed area in this figure is covered by the CDS and is mainly supplied with surface water; the striped area (outly-

ing area) is served by the MWSS groundwater supply systems. The groundwater supply is very important to places under these latter areas, though representing only a small percentage of the total water supply of MWSS.

AWSOP which is currently under implementation targets an additional 15 m^3/sec of surface water. It also aims to expand the area covered by CDS. After completion of this project, the northern part of abovesaid outlying area will be part of the CDS.

Under a Memorandum of Agreement executed in 1990 between the MWSS, LWUA and the Province of Bulacan, MWSS agreed to provide bulk water to Obando and Meycauayan in 1991. There will be direct service connections to San Jose del Monte, Norzagaray and Angat in 1993 after MSA has expanded to encompass these three towns. By 1995, ten other towns of Bulacan, namely Balagtas, Bocaue, Bulacan, Marilao, Guiguinto, Malolos, Calumpit, Paombong, Hagonoy, and Sta. Maria will be supplied by MWSS with bulk water after the completion of the Umiray-Angat Transbasin Project. The Bulacan Bulk Water Supply Project is a component of AWSOP. However, its implementation schedule has not been decided yet.

In the future, there will be a diminution in the relative importance of groundwater because of the increase in surface water supply. However, the areas that could not be reached by surface water, i.e., areas in the Rizal Province, shall solely rely on groundwater.

12.2.2 Served Population and Water Amount

The total population within the MSA, except the area under BP799, was estimated at 8.83 million through a NSCO census in 1990. From the MWSS Annual Report in 1989, the total served population by MWSS is about 7.98 million.

Using census population and estimated served population, the ratio of served population to total population is calculated at more than 90% as of the 1989 year-end. However, about 30% of said total served population is estimated as indirectly served population.

Table 12.2.1 presents the status of water supply amount and served popu-

lation in last the 7 years. Figure 12.2.3 is derived from the year-1990 of the said table. Based on 1990 data, the total served population is 8.2 million or 90% of the total population within MSA. Out of this figure, 2.6 million or 29% of total population is estimated as illegal users of the system.

Average per capita water consumption in 1990 is calculated at 303 liter per capita per day (lpcd) including Non-Revenue Water (NRW). Non-effective Water consisting of leakage and meter error is estimated around 35% of total distributed amount. Thus, the actual average per capita water consumption is 198 lpcd, while the average per capita water consumption for house connection is 138 lpcd.

Per capita water consumption for the last 7 years has been decreasing. Comparing with the per capita water consumption for house connection in the year 1984, a decrease of 22% or 39 lpcd was registered. This fact does not imply the water saving by users. It seems to be the result of water shortage caused by insufficient water supply capacity of the MWSS system. In this regard, development of new water sources is urgently needed in the MWSS.

The distributed water is shown in Table 12.2.2. As to NRW, it was estimated at around 58% of the total distributed water, while the Revenue Water is at 42%. However, 17% of NRW is suspected to be illegally used water. Therefore, effective water amount is about 52% of distributed water, while 41% of total distributed water is estimated as leaked water. Therefore, leakage detection and repair are indispensable for optimization of the MWSS system. The eradication of illegal use such as illegal connections and tampering of fire hydrants will contribute to the reduction of NRW and increase MWSS revenue.

12.2.3 Existing Water Supply Facilities

(1) Outline of the System

The MWSS has two water sources consisting of surface water and groundwater. The raw water drawn from surface water sources, namely, Ipo Dam (Angat River, Ipo River), La Mesa Dam (Novaliches Watershed), and Alat Diversion Dam (Alat River), is conveyed to two (2) treatment plants,

namely, the Balara Treatment Plant (Nos. 1 and 2) and the La Mesa Treatment Plant.

Treated water from the Balara Treatment Plant is sent to the San Juan and the Pasig Treated Water Reservoirs and the Balara Pumping Station. That from the La Mesa Treatment Plant is sent to the Bagbag Reservoir.

The groundwater drawn from MWSS deepwells is injected directly into the distribution systems after chlorination.

The distribution system serving Metro Manila and Cavite City operates eight booster pumping stations and eight mini-booster pumping stations.

The outline of the system from the surface water sources to the treated water reservoirs is illustrated by Figure 12.2.4.

(2) Water Source

The water sources of the MWSS water supply system consist of surface water and groundwater. The total capacity of these water sources is around 2,495,000 m3 per day as presented in Table 12.2.3.

The water drawn from above sources is conveyed to existing treatment plants through two tunnels and four aqueducts. Schematic drawing and flow balance of these facilities are shown in Figures 12.2.5 and 12.2.6. Outlines of facilities are described below:

Angat Reservoir and Dam

The Angat Reservoir and Dam are located on the Angat River in San Lorenzo, Norzagaray, Bulacan approximately 7.5 km upstream of the New Ipo Dam. The Angat Dam is a rockfill dam with a dike and a spillway. It is operated by the National Power Corporation (NPC) as a hydroelectric plant. Although basically a power project, it is multi-purpose in concept and provides power, water supply, irrigation and flood control benefits. Water is supplied to the MWSS at an annual mean of 22 m^3/sec (1,900,800 m^3/day). The water released through the existing four (4) auxiliary turbines travels downstream to the New Ipo Dam.

The Angat Reservoir and Dam have the following features:

o Reservoir

Drainage	568 km2.
Lowest river elevation at dam site	Elev. 92.50 m.
Maximum normal pool	Elev. 217 m.
Minimum power pool	Elev. 219 m.
Usable storage	850 million m3.
Length	35 km.
Maximum width	3 km.
Reservoir area at maximum normal pool	23 km2.

o Earth and Rockfill Dam

Maximum Height	131 m.
Length at crest	568 m.
Widest section	550 m.
Type of impervious core	Inclined Earth
Elevation at Crest (middle)	Elev. 223.5 m.
Elevation at Crest (Abut.)	Elev. 221.5 m.
Upstream slope	1 on 2.5
Downstream slope	1 on 1.35
Quantities of fill:	
a) Impervious earthfill core	880,000 m3.
b) Rockfill	5,725,000 m3.
c) Filters	464,000 m3

New Ipo Dam and Reservoir

The New Ipo Dam was completed in January 1984. It is one of the components of the Manila Water Supply Project II (MWSP II) whose main purpose is to increase the water supply capacity of MWSS. When it was completed, it increased the water supply capacity of MWSS to an average of 2,500,000 m3/day (28.9 m3/sec.).

The New Ipo Dam is located on the Angat river near its confluence with the Ipo River in Bulacan. It is about 7.5 km downstream of the Angat Dam and 200 m downstream of the old Ipo Dam, which was submerged when the

New Ipo Dam was completed.
The New Ipo Reservoir has its maximum flood pool at Elev. 102.0 m. The dam crest is at Elev. 103.5 m. To develop a 28.6 m3/sec transmission capacity in the Ipo-Bicti tunnels, a normal operating water surface of Elev. 100.0 m at the New Ipo Dam is required. This selected reservoir operating level results in a nominal 2.5 m permanent impairment on the Angat auxiliary (4 turbines) plant design tailwater level.

Water is diverted at the New Ipo Dam through the new intake structure; through the new connecting tunnel into the two existing Ipo-Bicti tunnels.

First and Second Ipo-Bicti Tunnels

Tunnel No. 1 was constructed in the 1930s and has a hydraulic area of about 4.00 m^2. It is 6,440 m. long and invert elevations at Ipo and at Bicti are respectively 86.02 m and 84.23 m. Vertical walls and slightly curved invert are concrete-lined throughout. Crown lining of selected sections only, with a total length of 400 m, was completed in October 1983. With the completion of the crown lining, the tunnel capacity is estimated at 8.6 m3/sec for the 12.0 m head differential.

Tunnel No. 2 was completed in 1969 and has a standard 3.0 m horseshoe cross section with a flat invert. It is 6,500 m long and has similar invert elevations as Tunnel No. 1. It is completely concrete-lined for the full length. It delivers 20.0 m^3/sec. with New Ipo Dam at Elev. 100.0 m and Bicti at Elev. 88.0 m.

First, Second, Third and Fourth Bicti-Novaliches Aqueducts

There are interconnection structures at Bicti, interconnecting Tunnel No. 1 and Tunnel No. 2 to the Bicti-Novaliches Aqueducts. At the Bicti interconnection structures, the hydraulic grade line (HGL) is generally at elev. 88.0 m.

Aqueducts Nos. 1, 2 and 3 are each about 15 km long and each is composed of multiple segments of pipe siphon and tunnel. Aqueduct Nos. 1 and 2 share common tunnel segments interconnected with parallel dual pipe siphons. Aqueduct No. 3 is not interconnected with Aqueduct Nos. 1 and 2

downstream of Bicti. All tunnel segments were constructed with crown-line elevations that follow a design HGL sloping from elev. 87.2 m at Bicti to Elev. 79.7 m at Novaliches. A reconstruction of the aqueduct interconnection structure at the outlets of Tunnel No.1 and No.2 at Bicti was completed in 1980. This raised the HGL at Bicti to elev. 88.0 m. Under this new condition, Aqueduct No. 3can deliver 9.2 m^3/sec.

Aqueduct No. 4 was completed in 1985 and is fully concrete-lined. With water level at Bicti at Elev. 88.0 m, Aqueduct No. 4 can deliver 14.1 m^3/sec. The 4 aqueducts' total maximum capacity to deliver water to Novaliches is 28.6 m^3/sec.

Novaliches Reservoir and La Mesa Dam

Over the normal reservoir operating range from Elev. 69 to Elev. 79.7 m, the Novaliches Reservoir and La Mesa Dam provide an active volume of 40 million m^3 for regulation of streamflows and seasonal demand variations at the Balara Treatment Plant.

On the Alat River near Novaliches, a low weir with flashboards on the ogee crest diverts streamflows through an aqueduct to Novaliches. The reliable streamflow for the combined Novaliches-Alat watershed is relatively small.

In 1990, the total volume of raw water drawn from all surface water sources was 916.9 million m^3 with an average daily supply of 2,512 thousands m^3 or about 101% of available water source yield. Table 12.2.4 compares the raw water supply drawn from all surface water sources for last five years.

Average daily raw water supply from surface water sources for the last five years is about 2,436 thousands m^3. Considering the drought during the dry season, this amount is insufficient to answer demand. New water sources must be developed to cope with this problem of water shortage. Table 12.2.5 presents monthly raw water amount. Figure 12.2.7 derived from this table shows that raw water from Ipo/Alat/La Mesa dams varied monthly in wide range. Especially, it extremely decreased during dry season, in April down to only about 6% of average monthly flow. Thus the stability of MWSS system is much rely on the Angat Dam water source. In

connection with this matter, AWSOP has been launched to gain 15 m^3/sec. (129,600 m^3/day) of water from Angat Dam through Ipo Dam and a new conveyance system to be constructed.

Based on the 1990 MWSS Annual Report, MWSS gained about 33 million m^3 of groundwater in said year through MWSS-owned deepwells. (This is discussed in the following subsection on water production.)

(3) Water Production

MWSS's two treatment plants, namely, the Balara Treatment Plant (Nos. 1 and 2) and the La Mesa Treatment Plant, have a combined treatment capacity amounting to some 2,600 thousands m^3/day (Figures 12.2.8 to 12.2.11). In addition to this output, MWSS produced about 82,000 m^3/day of groundwater through its 131 operational deepwells scattered within MSA excluding BP799 area. Table 12.2.6 presents the statistics of water production by MWSS for the last 6 years. Table 12.2.7 shows its monthly record in 1990.

Because of insufficient flow capacity of the aqueduct No. 4, the La Mesa Treatment Plant has been producing less water than the Balara Treatment Plant despite its treatment capacity; while the Balara Treatment Plant has been operating beyond its normal capacity. In AWSOP, La Mesa Treatment Plant No. 2 is planned to be constructed for the additional 15 m^3/sec. (1,296,000 m^3/day) raw water. However, a part of the additional water will be diverted to the existing La Mesa Treatment Plant so that the plant will operate at 100% capacity. Thus the capacity of new plant is planned to accommodate for the remaining water (about 900,000 m^3/day) Outlines of existing two treatment plants are shown in Table 12.2.8.

As of March 1991, MWSS has 258 deepwells of which 131 wells are in operation. The water from these wells is injected into the distribution pipelines directly or distributed through booster pumping stations. Details on this subject are discussed in Section 3.3 of Main Report.

(4) Water Distribution

The water produced in the Balara and the La Mesa Treatment Plants and groundwater deepwells are distributed in the Central Distribution System

(CDS) and other isolated distribution systems directly or through distribution reservoirs and booster pumping stations (Figure 12.2.12).

The supply system that serves most of the MSA is the CDS. It is composed of the following:

(a) Primary Distribution System (PDS):
It consists of a general network of main pipes with diameters of 300 mm and above, which forms a skeleton of the CDS with two treatment plants, pumping stations and reservoirs. The PDS ensures the flow transfers from the Main Treated Water Tanks to the Secondary Distribution System.

(b) Secondary Distribution System (SDS):

It consists of pipes with diameters from 100 mm to 250 mm. The SDS provides the water to the Tertiary Distribution System and service connections.

(c) Tertiary Distribution System (TDS):

It consists of pipes with diameters of 50 mm and 75 mm. The TDS is installed to serve isolated groups of consumers, and to avoid long service connections.

Figure 12.2.12 also presents the schematic layout of the existing primary distribution system. The main sources of treated water for the PDS are two treatment plants, namely Balara and La Mesa Treatment Plants. Water from Balara is regulated by the San Juan Reservoir with a total capacity of 150,000 m^3 while the Bagbag reservoir with a total capacity of 200,000 m^3 regulates the water coming from La Mesa.

During peak demand periods, the supply from the treatment plants is partially supplemented by the regulating reservoirs, i.e. San Juan and Bagbag, and partially by gravity and pumped flow from the balancing storage reservoirs located within the distribution network. Since the hydraulic performance of the CDS has been improved by MWSP II and works carried out after MWSP II, several reservoirs and pumping station were phased out or decommissioned. The abandoned elevated concrete reservoirs

that have little effect on the improvement of the hydraulic performance of the system are as follows:

- Camp Murphy Water Tanks
- Balintawak Pumping Station and Tank
- Port Area Pumping Station and Tank
- Paranaque Pumping Station and Tank
- Pasig Reservoir

Because of the same reason, several pumping stations are decommissioned in areas where water can be adequately served by gravity flow. Table 12.2.9 presents the status of existing 15 pumping stations.

12.2.4 Water Quality

Water samples from various points in and out of the distribution system, different stages of purification process are continuously analyzed for bacteriological, physical, chemical and biological characteristics. Samples are checked and counterchecked by the four coordinating laboratories; namely, the Manila Health Laboratory, the Bureau of Research and Laboratory of the Department of Health, The Central Laboratory Division and the Process Quality Laboratory of MWSS.

Table 12.2.10 presents the results of physical and chemical analysis on the raw water, chemical treated water, sedimented water, filtered water and finished water of the Balara and the La Mesa Treatment Plants in 1989. The finished water of Balara indicates worse water quality in turbidity though other parameters are almost even.

Based on the Accomplishment Report for CY 1989 of the Central Laboratory Division, the percentage of satisfaction in the Bacteriological Examination on 1,714 MWSS tap water samples was 100%, while 747 samples from MWSS deepwells shows 78.4% satisfaction as shown in Table 12.2.11. On the other hand, the Process Quality Unit reported less satisfaction percentage for the same kind of examination. Considering the residual chlorine samples, this contamination seems to be caused by low pressure in the distribution system and insufficient construction work of service connection and small size distribution pipes.

The results of water quality analysis on the physical and chemical characteristics of various samples obtained in 1989 are shown in Table 12.2.12. Though the water quality of tap water satisfies the Philippine water quality standard for drinking water on the average, it exceeds the values of this standard in the city of Manila and other cities and municipalities during drought/flood periods.

12.3 ONGOING AND PROPOSED PROJECTS

12.3.1 Ongoing Projects

MWSS is implementing several rehabilitation and expansion projects to reduce NRW and to increase service concessionaires(Table 12.3.1).

Outline of these projects are as follows:

(1) Manila Water Supply Rehabilitation Project (I) (MWSRP I)
1983 - 1991

This ongoing project, better known as REHAB I covers 8,872 ha within 57 zones out of the MWSS's 120 water supply zones with an initial estimated cost of ₱ 974 million and was initially scheduled to be completed by 1989. Presently, physical targets of the project are identified as: replacement of 150 km tertiary line; installation of 280 public faucets; construction of 50 km new tertiary lines and new/replacements of 108,000 house connections; and relocation of 12,000 water meters. Estimated project cost is revised to a total of ₱ 1.83 billion, of which $35.1 million will be lent by ADB. Through implementation of these works, NRW in the said zones will be reduced to 25%. Recovery of unaccounted water will be 500,000 m^3/day. Areas covered by MWSRP I is shown in Figure 12.3.1.

The project we expected to be completed at the year-end of 1990 initially. However, due to delay of implementation, 86.35% was reported as its physical accomplishment as of 1990 year-end. As to NRW, Table 12.3.2 shows effects of MWSRP I as of July 1990. Though only 16 zones have been rehabilitated, the average percentage of NRW in these zones has been significantly reduced by around 47% down to 25.8%. Comparing with the

reduction of water supply amount and increase of the revenue water, the reduction of the NRW can be considered mainly as a due to the reduction of leakage. Assuming that the water consumption is stable between pre- and post-rehabilitation and the illegal use was cleared by the project, the ratio of illegal use water is calculated at 11.4% of NRW.

(2) Manila Water Supply Rehabilitation Project II (MWSRP II)
1988 - 1992

With the same objectives as the MWSRP I, the MWSRP II is envisioned to accelerate the rehabilitation program of the MWSS with its area coverage of another 9,061 hectares (within 52 zones out of 63 remaining). The area of the 11 zones not covered by both projects is located within the fringe areas, as shown in Figure 12.3.1. MWSRP II will replace 1,000 km of tertiary lines, install 285 public faucets and replace 87,121 water meters. Total project cost is estimated to be ₱ 1.4 billion at present. The ADB will lend $26.4 million for the project in total. This project aims to reduce NRW in the project area to 25% or less and over NRW to about 30% by 1992. Recovery of unaccounted water will be 265,450 m^3/day.

This project which was started in May 1989 will be completed at year-end 1992. As of year-end 1990, its physical accomplishment was reported to be 35.37%. Table 12.3.3 presents the results of measurement regarding NRW in 3 zones rehabilitated in the project. As a result, the NRW of 51.4% before rehabilitation was reduced to 21.50% by this project.

(3) Angat Water Supply Optimization Project (AWSOP)
1989 - 1994

The Angat Water Supply Optimization Project is designed to meet the domestic water needs of Metro Manila prior to the entry of MWSP III into the mainstream of the MWSS Central Distribution System. The project aims to augment the present water capacity of Metro Manila by 15 m^3/sec.

Under this project, it is also programmed that the available flow of 9 m^3/sec. from the adjacent Umiray River is integrated into the project's structure (Umiray-Angat Transbasin Project). The project has been divided into four (4) components, namely: AWSOP I, II, III, and IV. Among of them, AWSOP I and II have commenced last year. AWSOP III and IV have not

been started yet.

Location of major facilities to be constructed in the project is illustrated in Figure 12.3.2. The project cost is estimated at ₱ 7,898 million in total. The loan agreements for $40 million with IBRD, and $130 million with ADB were signed on November and December 1989 respectively. New loan agreement for additional $80 million was agreed recently.

AWSOP I includes the construction of a 4.3 m diameter, 6.16 km long tunnel from Ipo Intake to Bicti Outlet, and an 18 MW Auxiliary Hydro-Power Plant. Construction of the tunnel was started on June 6, 1989. As to the power plant, it is still in the preconstruction stage while the designing stage has been completed.

AWSOP II includes the construction of 16.1 km long aqueduct and La Mesa Treatment Plant No. 2 with a capacity of 900,000 m^3/day, with the construction work for the aqueduct having been started during the middle of 1989. The other component is still in the preconstruction stage.

AWSOP III has not been started yet. It is aimed at the construction of a distribution network with a total length of more than 1,000 km, including construction of additional 360,000 service connections, 4 pumping stations and 4 treated water reservoirs with a combined capacity of 250,000 m^3/day, and the rehabilitation of existing 11 pumping stations.

Construction of transmission pipeline with a total length of 35 km for Bulacan Bulk Water Supply Project and telemetering system for the facilitates existing and to be constructed under this project will be composed in AWSOP IV.

(4) Metro Manila Groundwater Development Project (MMGWDP)
1990-1992

The project will provide a holistic management of the total groundwater utilization in Metro Manila. The components of the project include the formulation of a plan for the rehabilitation, operation, maintenance and development of MWSS wells; evaluation of groundwater development in MSA; development of remedial measures and preventive schemes for saline-intruded areas; and the establishment of a standard groundwater monitor-