10.6 WATER SUPPLY DEVELOPMENT PLAN IN METRO CEBU

10.6.1 TARGET WATER RESOURCES DEVELOPMENT

DPWH's Infrastructure Development Medium Term Plan (1993 to 1998) indicated that the population to be served with adequate and potable water supply will increase to 71% in the urban areas. MCWD's plan will cover almost 100% supply of the target population in 2010.

10.6.2 WATER DEMAND AND WATER SUPPLY BALANCE

(1) Per Capita Demand of Domestic Water

Per Capita consumption of domestic water is 105 to 147 l/day based on MCWD's report. From the discontinuous supply of water in many parts of the service area, consumption is about 85% of the demand. It could be more if continuous water supply were available. Considering this effect to apply uniformly over the service area, the 1990 per capita demand of individuals connected to the system is 172 l/day/capita. A net increase of 1% per annum is considered by MCWD. Per capita demand of domestic water is 190 l/day in 2000 and 210 l/day in 2010.

The demand of communal faucet is also suppressed and a demand of 30 l/day in 1990 is obtained from the estimated consumption of 21 l/day. Per capita demand is 37 l/day in 2000 and 45 l/day in 2010.

(2) Industrial Water and Commercial Water

Industrial and commercial area in Metro Cebu occupies 946 ha and 1,266 ha, respectively, thus the total area is 2,215 ha in 1990. MCWD assumed the industrial and commercial water density of 10.56 cu.m/day/ha from an estimated total demand of 23,401 cu.m/day in 1990.

(3) Water Demand and Supply Balance

Water demand until 2010 can be estimated by 3 cases, namely, the moderate case (Case I), lowest case (Case II) and the highest case (case III), under the following conditions:

- Growth rate of the population including commercial area and industrial are assumed to have the following values:

Unit:%

	Population		Commercial Area		Industrial Area	
	1990 - 2000	2000 - 2010	1990 - 2000	2000 - 2010	1990 - 2000	2000 - 2010
Case I	3.0	3.0	6.3	3.2	2.79	0.69
Case II	3.0	2.5	4.0	1.0	2.04	0.46
Case III	3.5	3.0	7.5	4.4	3.75	1.14

- Water demand of per capita increase of 1% per annum
- Government demands net increase is 5% per annum from 2,565 cu.m/day/office in 1990 based on MCWD's report.

On the other hand, a water supply plan until 2010 can be designated from the following assumptions:

- Completion of Mananga Phase 1, well development project in 1996 and Phase 2, Mananga dam project in 2000.
- Ratio of non-revenue decrease at 1% per annum until it reaches 30%.
- Supply ratio of water demand is recovered by 1% per annum from 85% in 1990 until 100% in 2005.
- Safety withdrawal of private well is 92,000 cu.m/day until 1994 and 83,900 cu.m/day after 1995 based on the simulation study of "COASTAL AQUIFER GROUNDWATER MODEL STUDY", Mananga river Source Development Maghaway Phase 1, Pre-Design report of LWUA, 1986.

Water demand in the respective cases are shown in Tables 10.6.1 through 10.6.3

Water supply balance in Metro Cebu in each case is indicated in Tables 10.6.4 to 10.6.6. Three Cases are shown at Figure 10.6.1. These Tables and Figure show that:The gap between water demand and water supply by MCWD is filled by the private wells numbering more than 15,000 points being installed in Metro Cebu or no water supplied. The withdrawal of private wells exceed the safe yield of 92,000 cu.m/day within the study period from 1993 to 2010 in every case.

Current and fruture water supply demand is not sufficient to serve the population of Metro Cebu

TABLE 10.6.1 WATER DEMAND PROJECTION IN CASE 1

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1. URBAN POPULATION	1,037,234	1,068,351	1,100,402	1,133,414	1,167,416	1,202,438	1,238,512	1,275,667	1,313,937	1,353,355	1,393,956
2. POTENTIAL CONNECTED											
POPULATION (NOS.)	812,647	843,764	875,815	908,827	942,829	977,851	1,013,925	1,051,080	1,089,350	1,128,768	1,169,369
PERCAPITA DEMAND (l/day/cap.)	172	174	175	177	179	181	183	184	186	188	190
POTENTIAL DEMAND (cu. m/day)	139,775	146,579	153,668	161,055	168,751	176,770	185,124	193,827	202,893	212,337	222,174
3. POTENTIAL COMMUNAL FAUCET											
POPULATION (NOS.)	224,587	224,587	224,587	224,587	224,587	224,587	224,587	224,587	224,587	224,587	224,587
PERCAPITA DEMAND (l/day/cap.)	30	31	31	32	32	33	34	34	35	36	37
POTENTIAL DEMAND (cu. m/day)	6,738	6,872	7,010	7,150	7,293	7,439	7,588	7,739	7,894	8,052	8,213
4. POTENTIAL DOMESTIC WATER DEMAND	146,513	153,451	160,678	168,205	176,044	184,209	192,711	201,566	210,787	220,389	230,387
5. POTENTIAL INDUSTRIAL & COMMERCIAL											
COMMERCIAL AREA (ha)	952	1,012	1,076	1,144	1,216	1,292	1,374	1,460	1,552	1,650	1,754
INDUSTRIAL AREA (ha)	1,266	1,300	1,335	1,371	1,408	1,446	1,485	1,526	1,567	1,609	1,652
TOTAL AREA (ha)	2,218	2,312	2,411	2,515	2,624	2,739	2,859	2,986	3,119	3,259	3,406
WATER DENSITY (cu.m/day/ha)	10.55	10.55	10.55	10.55	10.55	10.55	10.55	10.55	10.55	10.55	10.55
TOTAL DEMAND (cu.m/day)	23,400	24,393	25,436	26,532	27,682	28,891	30,162	31,498	32,903	34,381	35,936
6. POTENTIAL GOV'T DEMAND(cu.m/day)	2,565	2,693	2,828	2,969	3,118	3,274	3,437	3,609	3,790	3,979	4,178
7. TOTAL POTENTIAL DEMAND(cu.m/day)	172,478	180,538	188,942	197,706	206,844	216,374	226,311	236,674	247,480	258,749	270,501

YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1. URBAN POPLN	1,435,774	1,478,848	1,523,213	1,568,909	1,615,977	1,664,456	1,714,390	1,765,821	1,818,796	1,873,360
2. POTENTIAL CONNECTED										
POPULATION (NOS.)	1,211,187	1,254,261	1,298,626	1,344,322	1,391,390	1,439,869	1,489,803	1,541,234	1,594,209	1,648,773
PERCAPITA DEMAND (l/day/cap.)	192	194	196	198	200	202	204	206	208	210
POTENTIAL DEMAND (cu. m/day)	232,421	243,093	254,209	265,785	277,842	290,398	303,473	317,090	331,268	346,032
3. POTENTIAL COMMUNAL FAUCET										
POPULATION (NOS.)	224,587	224,587	224,587	224,587	224,587	224,587	224,587	224,587	224,587	224,587
PERCAPITA DEMAND (l/day/cap.)	37	38	39	40	40	41	42	43	44	45
POTENTIAL DEMAND (cu. m/day)	8,377	8,545	8,716	8,890	9,068	9,249	9,434	9,623	9,815	10,012
4. POTENTIAL DOMESTIC DEMAND	240,798	251,638	262,925	274,676	286,910	299,647	312,908	326,712	341,084	356,044
5. POTENTIAL IND. & COMMER										
COMMERCIAL AREA (ha)	1,810	1,868	1,928	1,989	2,053	2,119	2,186	2,256	2,329	2,403
INDUSTRIAL AREA (ha)	1,664	1,675	1,687	1,699	1,710	1,722	1,734	1,746	1,758	1,770
TOTAL AREA (ha)	3,474	3,543	3,614	3,688	3,763	3,841	3,920	4,002	4,087	4,173
WATER DENSITY (cu.m/day/ha)	10.55	10.55	10.55	10.55	10.55	10.55	10.55	10.55	10.55	10.55
TOTAL DEMAND (cu.m/day)	36,648	37,380	38,133	38,906	39,702	40,519	41,360	42,224	43,113	44,027
6. POTENTIAL GOV'T DEMAND(cu.m/day)	4,387	4,606	4,837	5,079	5,332	5,599	5,879	6,173	6,482	6,806
7. TOTAL POTENTIAL DEMAND(cu.m/day)	281,833	293,625	305,894	318,661	331,944	345,765	360,146	375,110	390,678	406,877

TABLE 10.6.2 WATER DEMAND PROJECTION IN CASE 2

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1. URBAN POPULATION	1,037,234	1,068,351	1,100,402	1,133,414	1,167,416	1,202,438	1,238,512	1,275,667	1,313,937	1,353,355	1,393,956
2. POTENTIAL CONNECTED											
POPULATION (NOS.)	812,647	843,764	875,815	908,827	942,829	977,851	1,013,925	1,051,080	1,089,350	1,128,768	1,169,369
PERCAPITA DEMAND (l/day/cap.)	172	174	175	177	179	181	183	184	186	188	190
POTENTIAL DEMAND (cu. m/day)	139,775	146,579	153,668	161,055	168,751	176,770	185,124	193,827	202,893	212,337	222,174
3. POTENTIAL COMMUNAL FAUCET											
POPULATION (NOS.)	224,587	224,587	224,587	224,587	224,587	224,587	224,587	224,587	224,587	224,587	224,587
PERCAPITA DEMAND (l/day/cap.)	30	31	31	32	32	33	34	34	35	36	37
POTENTIAL DEMAND (cu. m/day)	6,738	6,872	7,010	7,150	7,293	7,439	7,588	7,739	7,894	8,052	8,213
4. POTENTIAL DOMESTIC WATER DEMAND	146,513	153,451	160,678	168,205	176,044	184,209	192,711	201,566	210,787	220,389	230,387
5. POTENTIAL INDUSTRIAL & COMMERCIAL											
COMMERCIAL AREA (ha)	952	990	1,020	1,050	1,082	1,114	1,148	1,182	1,218	1,254	1,292
INDUSTRIAL AREA (ha)	1,266	1,292	1,318	1,345	1,373	1,401	1,429	1,458	1,488	1,518	1,549
TOTAL AREA (ha)	2,218	2,282	2,338	2,395	2,454	2,515	2,577	2,640	2,706	2,773	2,841
WATER DENSITY (cu.m/day/ha)	10.55	10.55	10.55	10.55	10.55	10.55	10.55	10.55	10.55	10.55	10.55
TOTAL DEMAND (cu.m/day)	23,400	24,074	24,665	25,272	25,894	26,532	27,186	27,857	28,545	29,250	29,974
6. POTENTIAL GOV'T DEMAND(cu.m/day)	2,565	2,693	2,828	2,969	3,118	3,274	3,437	3,609	3,790	3,979	4,178
7. TOTAL POTENTIAL DEMAND(cu.m/day)	172,478	180,218	188,171	196,446	205,056	214,014	223,335	233,032	243,121	253,618	264,539

YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1. URBAN POPLN	1,428,805	1,464,525	1,501,138	1,538,666	1,577,133	1,616,561	1,656,975	1,698,400	1,740,860	1,784,381
2. POTENTIAL CONNECTED										
POPULATION (NOS.)	1,204,218	1,239,938	1,276,551	1,314,079	1,352,546	1,391,974	1,432,388	1,473,813	1,516,273	1,559,794
PERCAPITA DEMAND (l/day/cap.)	192	194	196	198	200	202	204	206	208	210
POTENTIAL DEMAND (cu. m/day)	231,083	240,317	249,887	259,806	270,085	280,738	291,778	303,218	315,073	327,358
3. POTENTIAL COMMUNAL FAUCET										
POPULATION (NOS.)	224,587	224,587	224,587	224,587	224,587	224,587	224,587	224,587	224,587	224,587
PERCAPITA DEMAND (l/day/cap.)	37	38	39	40	40	41	42	43	44	45
POTENTIAL DEMAND (cu. m/day)	8,377	8,545	8,716	8,890	9,068	9,249	9,434	9,623	9,815	10,012
4. POTENTIAL DOMESTIC DEMAND	239,461	248,862	258,603	268,696	279,153	289,988	301,212	312,841	324,889	337,370
5. POTENTIAL IND. & COMMER										
COMMERCIAL AREA (ha)	1,305	1,318	1,331	1,344	1,358	1,371	1,385	1,399	1,413	1,427
INDUSTRIAL AREA (ha)	1,556	1,564	1,571	1,578	1,585	1,593	1,600	1,607	1,615	1,622
TOTAL AREA (ha)	2,861	2,881	2,902	2,922	2,943	2,964	2,985	3,006	3,027	3,049
WATER DENSITY (cu.m/day/ha)	10.55	10.55	10.55	10.55	10.55	10.55	10.55	10.55	10.55	10.55
TOTAL DEMAND (cu.m/day)	30,185	30,399	30,614	30,830	31,049	31,269	31,491	31,715	31,940	32,168
6. POTENTIAL GOV'T DEMAND(cu.m/day)	4,387	4,606	4,837	5,079	5,332	5,599	5,879	6,173	6,482	6,806
7. TOTAL POTENTIAL DEMAND(cu.m/day)	274,033	283,867	294,054	304,605	315,534	326,855	338,582	350,729	363,311	376,343

TABLE 10.6.3 WATER DEMAND PROJECTION IN CASE 3

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1. URBAN POPULATION	1,037,234	1,073,537	1,111,111	1,150,000	1,190,250	1,231,909	1,275,025	1,319,651	1,365,839	1,413,643	1,463,121
2. POTENTIAL CONNECTED											
POPULATION (NOS.)	812,647	848,950	886,524	925,413	965,663	1,007,322	1,050,438	1,095,064	1,141,252	1,189,056	1,238,534
PERCAPITA DEMAND (l/day/cap.)	172	174	175	177	179	181	183	184	186	188	190
POTENTIAL DEMAND (cu. m/day)	139,775	147,480	155,547	163,994	172,838	182,097	191,791	201,938	212,560	223,678	235,315
3. POTENTIAL COMMUNAL FAUCET											
POPULATION (NOS.)	224,587	224,587	224,587	224,587	224,587	224,587	224,587	224,587	224,587	224,587	224,587
PERCAPITA DEMAND (l/day/cap.)	30	31	31	32	32	33	34	34	35	36	37
POTENTIAL DEMAND (cu. m/day)	6,738	6,872	7,010	7,150	7,293	7,439	7,588	7,739	7,894	8,052	8,213
4. POTENTIAL DOMESTIC WATER DEMAND	146,513	154,352	162,557	171,144	180,131	189,536	199,378	209,677	220,454	231,730	243,528
5. POTENTIAL INDUSTRIAL & COMMERCIAL											
COMMERCIAL AREA (ha)	952	1,023	1,100	1,183	1,271	1,367	1,469	1,579	1,698	1,825	1,962
INDUSTRIAL AREA (ha)	1,266	1,314	1,364	1,416	1,470	1,525	1,583	1,643	1,706	1,771	1,838
TOTAL AREA (ha)	2,218	2,337	2,464	2,598	2,741	2,892	3,052	3,223	3,404	3,596	3,800
WATER DENSITY (cu.m/day/ha)	10.55	10.55	10.55	10.55	10.56	10.56	10.56	10.56	10.56	10.56	10.56
TOTAL DEMAND (cu.m/day)	23,400	24,660	25,996	27,413	28,944	30,540	32,234	34,032	35,942	37,971	40,126
6. POTENTIAL GOV'T DEMAND(cu.m/day)	2,565	2,693	2,828	2,969	3,118	3,274	3,437	3,609	3,790	3,979	4,178
7. TOTAL POTENTIAL DEMAND(cu.m/day)	172,478	181,706	191,381	201,527	212,193	223,350	235,049	247,319	260,186	273,680	287,833

YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1. URBAN POPLN	1,507,015	1,552,225	1,598,792	1,646,756	1,696,158	1,747,043	1,799,454	1,853,438	1,909,041	1,966,312
2. POTENTIAL CONNECTED										
POPULATION (NOS.)	1,282,428	1,327,638	1,374,205	1,422,169	1,471,571	1,522,456	1,574,867	1,628,851	1,684,454	1,741,725
PERCAPITA DEMAND (l/day/cap.)	192	194	196	198	200	202	204	206	208	210
POTENTIAL DEMAND (cu. m/day)	246,091	257,315	269,003	281,176	293,853	307,054	320,801	335,115	350,021	365,541
3. POTENTIAL COMMUNAL FAUCET										
POPULATION (NOS.)	224,587	224,587	224,587	224,587	224,587	224,587	224,587	224,587	224,587	224,587
PERCAPITA DEMAND (l/day/cap.)	37	38	39	40	40	41	42	43	44	45
POTENTIAL DEMAND (cu. m/day)	8,377	8,545	8,716	8,890	9,068	9,249	9,434	9,623	9,815	10,012
4. POTENTIAL DOMESTIC DEMAND	254,469	265,860	277,719	290,066	302,921	316,304	330,235	344,738	359,836	375,552
5. POTENTIAL IND. & COMMER										
COMMERCIAL AREA (ha)	2,048	2,139	2,233	2,331	2,433	2,541	2,652	2,769	2,891	3,018
INDUSTRIAL AREA (ha)	1,859	1,880	1,901	1,923	1,945	1,967	1,989	2,012	2,035	2,058
TOTAL AREA (ha)	3,907	4,018	4,134	4,254	4,378	4,507	4,641	4,781	4,925	5,076
WATER DENSITY (cu.m/day/ha)	10.56	10.56	10.56	10.56	10.56	10.56	10.56	10.56	10.56	10.56
TOTAL DEMAND (cu.m/day)	41,259	42,434	43,653	44,919	46,233	47,597	49,014	50,485	52,013	53,601
6. POTENTIAL GOV'T DEMAND(cu.m/day)	4,387	4,606	4,837	5,079	5,332	5,599	5,879	6,173	6,482	6,806
7. TOTAL POTENTIAL DEMAND(cu.m/day)	300,114	312,900	326,209	340,064	354,486	369,500	385,128	401,396	418,331	435,959

TABLE 10.6.4 WATER BALANCE OF CASE I IN METRO CEBU

YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1. WATER SUPPLY CAPACITY											
MCWD /1											
EXISTING	96,800	96,800	96,800	96,800	96,800	96,800	96,800	96,800	96,800	96,800	96,800
MANANGA, WELL	-	-	-	33,000	33,000	33,000	33,000	33,000	33,000	33,000	33,000
MANANGA, DAM	-	-	-	-	-	-	-	95,000	95,000	95,000	95,000
TOTAL	96,800	96,800	96,800	129,800	129,800	129,800	129,800	224,800	224,800	224,800	224,800
2. WATER DEMAND /3	197,706	206,844	216,374	226,311	236,674	247,480	258,749	270,501	281,833	293,625	305,894
3. CONSUMPTION OF MCWD	57,041 /2	58,080	59,048	60,016	66,182	72,512	79,008	85,668	99,696	114,104	128,892
NON-REVENUE OF MCWD	39,759	38,720	37,752	36,784	38,869	40,788	42,543	44,132	49,104	110,696	95,908
TOTAL PROD. OF MCWD	96,800	96,800	96,800	96,800	105,050	113,300	121,550	129,800	148,800	167,800	186,800
% OF NON-REVENUE	41%	40%	39%	38%	37%	36%	35%	34%	33%	32%	31%
POPULATN SERVICED	325,270	322,921	320,005	316,975	344,463	371,527	398,152	424,326	491,176	557,261	622,572
4. PRIVATE AND PUBLIC WELL	140,665 /4	148,764	157,326	166,295	170,492	174,968	179,742	184,833	182,137	179,521	177,002
SAFE YIELD	92,000	92,000	83,900	83,900	83,900	83,900	83,900	83,900	83,900	83,900	83,900
OVER WITHDRAWAL	48,665	56,764	73,426	82,395	86,592	91,068	95,842	100,933	98,237	95,621	93,102

YEAR	2004	2005	2006	2007	2008	2009	2010
1. WATER SUPPLY CAPACITY							
1) MCWD							
EXISTING	96,800	96,800	96,800	96,800	96,800	96,800	96,800
MANANGA, WELL	33,000	33,000	33,000	33,000	33,000	33,000	33,000
MANANGA, DAM	95,000	95,000	95,000	95,000	95,000	95,000	95,000
TOTAL	224,800	224,800	224,800	224,800	224,800	224,800	224,800
2. WATER DEMAND /3	318,661	331,944	345,765	360,146	375,110	390,678	406,877
3. CONSUMPTION OF MCWD	144,060	157,360	157,360	157,360	157,360	157,360	157,360
NON-REVENUE OF MCWD	61,740	67,440	67,440	67,440	67,440	67,440	67,440
TOTAL PROD. OF MCWD	205,800	224,800	224,800	224,800	224,800	224,800	224,800
% OF NON-REVENUE	30%	30%	30%	30%	30%	30%	30%
POPULATN SERVICED	687,098	739,575	730,898	722,290	713,750	705,280	696,878
4. PRIVATE AND PUBLIC WELL	174,601	174,584	188,405	202,786	217,750	233,318	249,517
SAFE YIELD	83,900	83,900	83,900	83,900	83,900	83,900	83,900
OVER WITHDRAWAL	90,701	90,684	104,505	118,886	133,850	149,418	165,617

NOTES
/1 is estimated from MCWD data.
/2 means average dischrge of actual sold water of MCWD from Jan. to Aug. 1993.
/3 sees Table 3.6.1.
/4 is obtained from the MCWD report.

TABLE 10.6.5 WATER BALANCE OF CASE 2 IN METRO CEBU

YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1. WATER SUPPLY CAPACITY											
MCWD											
EXISTING	96,800 /1	96,800	96,800	96,800	96,800	96,800	96,800	96,800	96,800	96,800	96,800
MANANGA, WELL	-	-	-	33,000	33,000	33,000	33,000	33,000	33,000	33,000	33,000
MANANGA, DAM	-	-	-	-	-	-	-	95,000	95,000	95,000	95,000
TOTAL /3	96,800	96,800	96,800	129,800	129,800	129,800	129,800	224,800	224,800	224,800	224,800
2. WATER DEMAND	196,446	205,056	214,014	223,335	233,032	243,121	253,618	264,539	274,033	283,867	294,054
3. CONSUMPTION OF MCWD	57,041 /2	58,080	59,048	60,016	66,182	72,512	79,008	85,668	99,696	114,104	128,892
NON-REVENUE OF MCWD	39,759	38,720	37,752	36,784	38,869	40,788	42,543	44,132	49,104	110,696	95,908
TOTAL PROD. OF MCWD	96,800	96,800	96,800	96,800	105,050	113,300	121,550	129,800	148,800	167,800	186,800
% OF NON-REVENUE	41%	40%	39%	38%	37%	36%	35%	34%	33%	32%	31%
POPULATN SERVICED	327,993	326,770	325,078	323,379	352,316	380,951	409,283	437,309	505,025	572,013	638,262
4. PRIVATE AND PUBLIC WELL	139,405	146,976	154,966	163,319	166,851	170,609	174,611	178,871	174,337	169,763	165,162
SAFE YIELD	92,000 /4	92,000	83,900	83,900	83,900	83,900	83,900	83,900	83,900	83,900	83,900
OVER WITHDRAWAL	47,405	54,976	71,066	79,419	82,951	86,709	90,711	94,971	90,437	85,863	81,262

YEAR	2004	2005	2006	2007	2008	2009	2010
1. WATER SUPPLY CAPACITY							
MCWD							
EXISTING	96,800	96,800	96,800	96,800	96,800	96,800	96,800
MANANGA, WELL	33,000	33,000	33,000	33,000	33,000	33,000	33,000
MANANGA, DAM	95,000	95,000	95,000	95,000	95,000	95,000	95,000
TOTAL /3	224,800	224,800	224,800	224,800	224,800	224,800	224,800
2. WATER DEMAND	304,605	315,534	326,855	338,582	350,729	363,311	376,343
3. CONSUMPTION OF MCWD	149,800	157,360	157,360	157,360	157,360	157,360	157,360
NON-REVENUE OF MCWD	64,200	67,440	67,440	67,440	67,440	67,440	67,440
TOTAL PROD. OF MCWD	214,000	224,800	224,800	224,800	224,800	224,800	224,800
% OF NON-REVENUE	30%	30%	30%	30%	30%	30%	30%
POPULATN SERVICED	733,090	757,255	749,944	742,786	735,783	728,939	722,259
4. PRIVATE AND PUBLIC WELL	154,805	158,174	169,495	181,222	193,369	205,951	218,983
SAFE YIELD	83,900	83,900	83,900	83,900	83,900	83,900	83,900
OVER WITHDRAWAL	70,905	74,274	85,595	97,322	109,469	122,051	135,083

NOTES
/1 is estimated from MCWD data.
/2 means average dischrge of actual sold water of MCWD from Jan. to Aug. 1993.
/3 sees Table 3.6.2.
/4 is obtained from the MCWD report.

TABLE 10.6.6 WATER BALANCE OF CASE 3 IN METRO CEBU

YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1. WATER SUPPLY CAPACITY											
MCWD											
EXISTING	96,800 /1	96,800	96,800	96,800	96,800	96,800	96,800	96,800	96,800	96,800	96,800
MANANGA, WELL	-	-	-	33,000	33,000	33,000	33,000	33,000	33,000	33,000	33,000
MANANGA, DAM	-	-	-	-	-	-	-	95,000	95,000	95,000	95,000
TOTAL	96,800	96,800	96,800	129,800	129,800	129,800	129,800	224,800	224,800	224,800	224,800
2. WATER DEMAND /3	201,527	212,193	223,350	235,049	247,319	260,186	273,680	287,833	300,114	312,900	326,209
3. CONSUMPTION OF MCWD	57,04 /2	58,080	59,048	60,016	66,182	72,512	79,008	85,668	99,696	114,104	128,892
NON-REVENUE OF MCWD	39,759	38,720	37,752	36,784	38,869	40,788	42,543	44,132	49,104	110,696	95,908
TOTAL PROD. OF MCWD	96,800	96,800	96,800	96,800	105,050	113,300	121,550	129,800	148,800	167,800	186,800
% OF NON-REVENUE	41%	40%	39%	38%	37%	36%	35%	34%	33%	32%	31%
POPULATN SERVICED	297,850	307,285	316,085	324,278	321,565	318,265	314,830	341,893	368,505	394,653	420,321
4. PRIVATE AND PUBLIC WELL	144,486 /4	154,113	164,302	175,033	181,137	187,674	194,672	202,165	200,418	198,796	197,317
SAFE YIELD	92,000 /4	92,000	83,900	83,900	83,900	83,900	83,900	83,900	83,900	83,900	83,900
OVER WITHDRAWAL	52,486	62,113	80,402	91,133	97,237	103,774	110,772	118,265	116,518	114,896	113,417

YEAR	2004	2005	2006	2007	2008	2009	2010
1. WATER SUPPLY CAPACITY							
MCWD							
EXISTING	96,800	96,800	96,800	96,800	96,800	96,800	96,800
MANANGA, WELL	33,000	33,000	33,000	33,000	33,000	33,000	33,000
MANANGA, DAM	95,000	95,000	95,000	95,000	95,000	95,000	95,000
TOTAL	224,800	224,800	224,800	224,800	224,800	224,800	224,800
2. WATER DEMAND /3	340,064	354,486	369,500	385,128	401,396	418,331	435,959
3. CONSUMPTION OF MCWD	144,060	157,360	157,360	157,360	157,360	157,360	157,360
NON-REVENUE OF MCWD	61,740	67,440	67,440	67,440	67,440	67,440	67,440
TOTAL PROD. OF MCWD	205,800	224,800	224,800	224,800	224,800	224,800	224,800
% OF NON-REVENUE	30%	30%	30%	30%	30%	30%	30%
POPULATN SERVICED	681,874	734,029	724,786	715,567	706,367	697,183	688,011
4. PRIVATE AND PUBLIC WELL	196,004	197,126	212,140	227,768	244,036	260,971	278,599
SAFE YIELD	83,900	83,900	83,900	83,900	83,900	83,900	83,900
OVER WITHDRAWAL	112,104	113,226	128,240	143,868	160,136	177,071	194,699

NOTES
/1 is estimated from MCWD data.
/2 means average dischrge of actual sold water of MCWD from Jan. to Aug. 1993.
/3 sees Table 3.6.3.
/4 is obtained from the MCWD report.

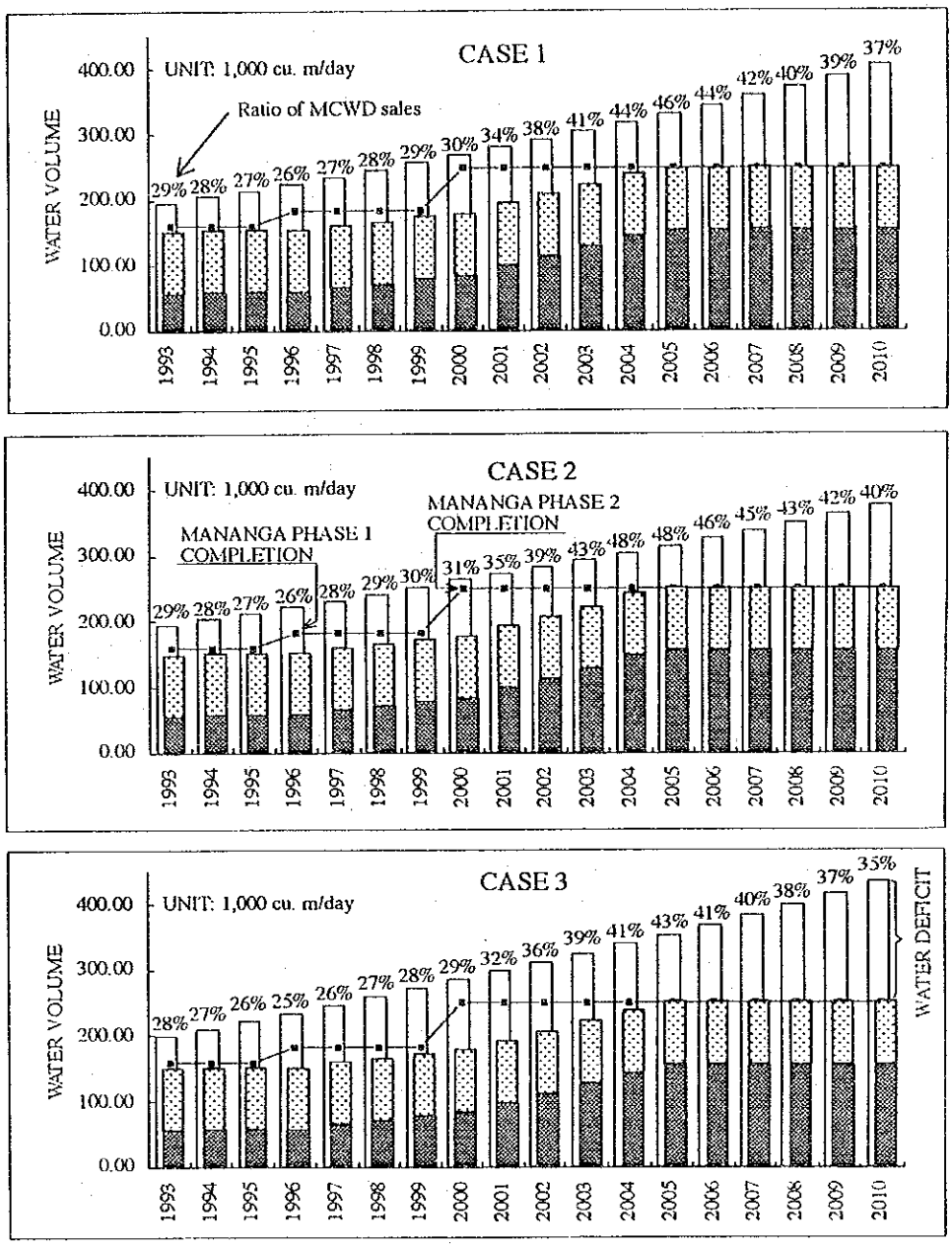


FIGURE 10.6.1 WATER BALANCE OF METORO CEBU

10.6.3 PROBLEMS AND ISSUES OF MCWD

(1) Countermeasures of Water Deficit

The case study reveals that the water deficit of more than 165,000 cu.m/day in 2010 from safe yield will remain for a long time. Unfortunately, government does not have a long-term plan aimed of solving water supply problems in Metro Cebu. MCWD's proposals for the development of Lusaran Dam Development and the Bohol-Inabanga Project remain on the table.

(2) Distribution Pipes

MCWD service connection to subscribers depend on a per request basis. The existing pipeline distribution system is an old. New pipes are laid parallel along the same road to the old ones. The pipes are not distinguished between main and secondary lines. There is no water meter for the transmission of water on the pipes. Hence, it is difficult to find the leakage point on system. The distribution network should separate the main pipelines from secondary pipelines to control the local water use as shown in the figure. It would be better if collection of water charges is done by another private company to make sure that collections are exact and fully paid.

(3) Computerization on the Collection Work of The Water Charge

There are more than 47,000 water meters. Therefore, it is necessary to computerize the service for efficient water charge accounting.

(4) Data Base of Technical Facility Management

It is necessary to build a technical data base of technical facility management such as distribution pipeline and so on in order to meet the requirements of efficient operation and maintenance. At least, data should be developed so as to identify the exact location of pipeline network and related facilities.

(5) Rehabilitation of Buhisan Dam

Buhisan dam has been constructed more than 60 years ago, its facilities looks still in good condition. However, the three crest gates cannot be opened and the water level is always higher than the dam crest during wet season. If the old crest gates are broken, then there will be a danger of flooding that may cause a large damage at downstream.

10.6.4 FRAMEWORK AND SCENARIOS

(1) Water to be Developed

The previous sections indicated that a water source from aquifer in Metro Cebu reaches the production capacity. Hence, new water sources will be able to be considered in three alternatives:

1. a surface water by using the dam and intake facilities near Metro Cebu
2. a groundwater and surface water around Metro Cebu through water pipeline
3. other water source such as desalination plant, transportation and rainfall collector

Alternative A: Figure 10.6.2 indicates the river basins within 30 km or 40 km radius area from the center of Cebu City to the possible areas of the proposed dam considering the geological point of view. Mananga river basin, Balamban river basin, and Kotkot river basin have a great advantage over the other areas under the consideration in Figure 10.6.2, natural condition, social condition and the location of large scale consumption in Cebu City. Inabanga river basin also takes more advantage due to its large scale catchment area, or large scale water source than Cebu island river basins.

Alternative B Groundwater and surface water near Metro Cebu where water potential is much larger than demand can be supplied to Metro Cebu through transmission pipeline. But, water transmission from west coastal area such as Toledo City and Balamban to Metro Cebu will be too expensive due to passing over the mountains whose height is more than 900 m ASL. Hence, the location of possible water source will be tapped from San Fernando, Carcar, Carmen, Danao City, and some municipalities and Cities in Metro Cebu.

Alternative C Other water sources to be considered are as the follows:

- Desalinization plant
- Transport by water tanker or tag boat with water bag (Water tank unit)
- Rainfall collecting by using open space such as a runway of airport

(2) Development Scenarios and Framework

The water supply volume is not sufficient due to the evaluation of water demand and supply analysis. Mananga river basin has an existing development project plan which involves two phases. First phase already has the finance from ADB. Construction will be started soon. Second phase also has the finance for detailed design by Swiss fund. Both projects product the potable water of 128,000 cu.m/day that 89,600 cu.m/day of consumption and 38,400 cu.m/day of 30% loss. After completion of the Mananga project, the water deficit is still large and serious by expansion of service area and increasing the population.

New water sources development should not only consider the short-term program such as Mananga project but also long-term programs.

The facilities and systems of MCWD is not sufficient for extended user in future. It is necessary to strengthen MCWD for extended user in future and stable operation and maintenance for long term.

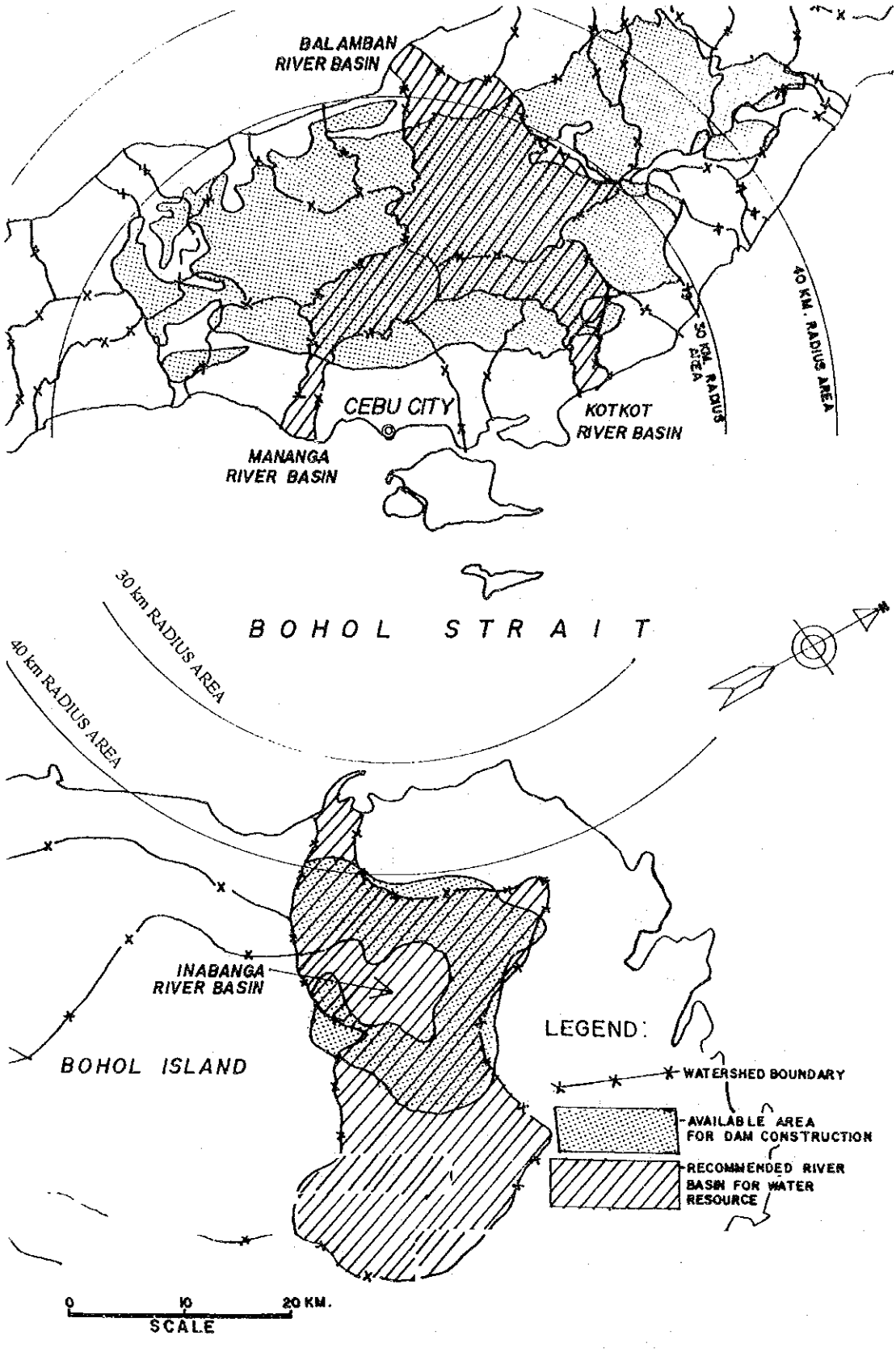


FIGURE 10.6.2 PRACTICABLE AREA FOR DAM CONSTRUCTION

Groundwater is one of the main source for potable water. Conservation of the groundwater is very important for aquifer in Metro Cebu.

Frameworks of water supply development of Metro Cebu is as following:

- New water resources development
- Improvement and reinforcement of finance and facilities in MCWD
- Conservation of water resources in Metro Cebu

Water demand and supplied plans until 2010 are shown below.

• Demand:	406,800 cu.m/day(in 2010)	
• Project	Production Vol.	Consumption Vol.
• Expected Water Supply:		
- Private Well:		89,400 cu.m/Day
- Existing Facilities:	93,229 cu.m/day	65,720 cu.m/Day
- Mananga Phase 1:	33,000 cu.m/day	23,100 cu.m/Day
- Mananga Phase 2:	95,000 cu.m/day	66,500 cu.m/Day
- Sub-Total (1)	128,000 cu.m/day	241,260 cu.m/Day
Water Balance After Mananga Pjt	165,540 cu.m/day(deficit)	
• Alternative A		
Lusaran Dam Project (2)	135,000 Cu.m/Day	94,500 Cu.m/Day
Inabanga Project (3)	160,000 Cu.m/Day	112,000 Cu.m/Day
• Alternative B		
Medium-Scale Project (4)	42,000 Cu.m/Day	60,000 Cu.m/Day
• Alternative C		
Other Water Source		500 to 10,000 cu.m/day (not certainly)

After Mananga Dam project, Metro Cebu will have a water deficit of 165,540 cu.m/day. The project considered in each Alternative cannot supply water of 165,540 cu.m/day by itself, so the implementation of additional is necessary to be more than two projects. Now it cannot be indicated that which project is the most suitable for construction. Because reliable exacted information is limited for selection and consideration. Most of the project proposals with feasibility study have not been carried out, and the data are already obsolete. The upgrading of the feasibility study of each project is necessary.

In short and middle term, the following items should be considered:

- Implementation of Mananga project including Phase 2
- Implementation of urgent program about improvement and reinforcement of finance and facilities in MCWD

- Preparation of the study of post Mananga project of water resource development project
- Implementation of urgent program on the conservation measures of aquifer in Metro Cebu

In long term, the following items should be considered:

- Implementation of post water resource development project in Mananga
- Implementation of conservation measures for Metro Cebu aquifer

10.6.5 FUTURE PROJECTS AND PROGRAMS

(1) New Water Resources Development

The projects which have the possibility of new water source development are as follows:

- Mananga I and II Water Resource Development,
- Lusaran Dam Project, and
- Inabanga-Bohol Project, As Alternative A,
- The Medium-Scale Water Supply Development Project, as Alternative B, and
- Other water source development, as Alternative C

(a) Alternative A: Dams near Metro Cebu

The projects about Alternative A a surface water by using the dam and intake facilities near Metro Cebu are identified with Balamban river basin, Kotkot river basin and Inabanga river basin development as well as Mananga river basin development.

1) Lusaran Dam Project

Balamban river basin has been considered as the catchment area for Lusaran dam project since 1979. It is necessary to update the feasibility study due to changing social condition of the water demand and supply situation. Study items of Lusaran Project is as the follows:

- To review the feasibility study of Lusaran dam project including:
- Kotkot river development; the water during wet season can be useful for MCWD by the construction of a weir, because water flow of Kotkot river discharge out into sea directly during wet season although downstream area is active.
- Considering the water reservoir made by embankment in some tributary near Metro Cebu for water storage and recharging the aquifer, and
- The study of environment and resettlement of houses around water storage

Figure 10.6.3 shows the diagram of the project system.

2) Nabanga-Bohol Project (Inabanga River Bsin)

Inabanga project is concerned with not only Cebu Province but also Bohol province. This project should give both Provinces the benefit. Now Inabanga-Bohol Project is necessary to be as follows:

- Feasibility study of this project after collecting the sufficient data of hydro-meteorology for hydrological analysis including,
- designating the water supply development plan around the project site in Bohol and proportion to western coastal development and
- Environmental impact assessment

(b) Alternative B: Groundwater and surface water development outside of Metro Cebu

1) The Medium-Scale Water Supply Project

Possible water source sites are Langtad river, Sabang river, Valladolid river, Layang river, Gagat river, Danao river and Kanamakan river and some small rivers as shown in Figure 10.6.4. Transmission pipeline length is about 70 km totally. This development named "The Medium-Scale Water Supply Project" and is necessary to be a feasibility study including: transmission pipe route, evaluation of groundwater volume capacity, construction cost, and environmental impact assessment.

This project has the merit that a water supply extension is easier along transmission pipeline.

(c) Alternative C: Other water sources

1) Desalinization plant

There are many process of desaltinating plant and many sizes over the world. Recently, Reverse Osmosis process (RO) represents the desalting plant above other types as shown in Figure 10.6.5. Generally speaking, the product cost of RO is US$1.6 /cu.m in case of from sea water source and US$0.4 to 0.8 /cu.m of brackish water. Its characteristics are as following;
Merit

- Independent of the climate
- Short-term construction and urgent response
- Less initial cost than dam construction
- less land area requirement
- Requirement
- Stable Electric power supply
- A considerably amount of initial cost for installation
- High technology and costs for maintenance
- 100% imported equipment

2) Transport by water tanker or tag boat with water bag (water tank unit)

This method as water transport by tanker or boats is used in mainly remote islands with no water source. Bohol or around Carmen may be available for water source. Transportation cost is not so much if initial cost such as port facilities, tanker or transport facilities can be acceptable.

3) Rainfall collecting by using open space

This method requires an open space for collecting water, water treatment, and water tank. Mactan island has the possibility of this method because the international air port is an open space, strict water supply, and limited water source.

Desalting plant is urgent response and not necessary to occupy the large land use, but this plant use the high-technology and 100% import equipment which is detrimental effect to Philippines economy. Thus this plant is recommendable to emergency water deficit or quite limited area where it is requisite to stable water supply. Water transfer method can be applied on the consideration that ship transfer capacity is limited and availability of supply is small compared to other methods due to transfer of water is difficult in bad wheather condition. Rain water collector method also can be adopted in some areas. Hence, Alternative C can be used as supplementary water supply method only.

(2) Improvement and Reinforcement Of Finance And Facilities in MCWD

Programs and projects for improvement and reinforcement of finance and facilities in MCWD are enumerated below based on current problems and issues:

- Distribution Pipe Upgrading Project
- Water Charge Collection Work Upgrading Project
- Buhisan Dam Rehabilitation Project

(a) Distribution Pipe Upgrading Project

"Distribution Pipe Upgrading Project" is composed of two works: rehabilitation work of distribution pipeline and preparation of database of distribution pipeline network. The purposes of the project are as follows:

- To reduce of the water leakage in the pipe
- To grasp the distribution pipeline network and water flow
- To prepare the future extended pipeline network system

Main features of the project are:

- To prepare the rehabilitation program of the pipeline and implementation of it
- To prepare the database of the pipeline network
- To Prepare the master plan of the future extension pipeline network

(b) Water Charge Collection Work Upgrading Project

This project's main objectives are to strengthen the financial foundation and make effective and rational system of water collection work. MCWD should provide a increasing consumers which is now more than 47,000 connection points and will become much more than 2 times of present numbers. Main feature of the project is :

- To computerize the consumer management
- To study the effective and rational system

(c) Buhisan Dam Rehabilitation Project

This project's purposes are to repair the non-functional parts including the raw water pipeline and treatment facilities and to check the dam system and find out the optimum system in order to maintaining the function for long time.

Main features of the project are :

- To check the safety of the dam
- To prepare the rehabilitation program
- To study the optimum system of the dam including the dredging in the water reservoir and connection with transmission pipeline of Mananga dam project.

(3) Conservation of Water Resources in Metro Cebu

The two projects related to conservation of water resources in Metro Cebu are:

- Retarding Dam Project of Metro Cebu Rivers
- Cebu Community-Base Resource Management

(a) Retarding dam project of Metro Cebu rivers

Detail of the project was mentioned in Section 10.5.10. This project needs the cooperation of inhabitants and NGOs for construction. Monitoring and observation of soil erosion and run-off volume are also important as same as construction in order to evaluation of the dams efficiency and calibration of discharge.

(b) Cebu community-base resource management

See Chapter 7 "Environmental Management"

10.6.6 OTHERS TO BE RECOMMENDED

The following items are recommended as non-structure measure for water resource and conservation of the aquifers:

- Publicity of MCWD activities and current water condition
- Regulating the wells using, especially by factory
- Monitoring the industrial waste and guarding from illegal industrial waste dumping for the purpose of conservation of the groundwater in Metro Cebu

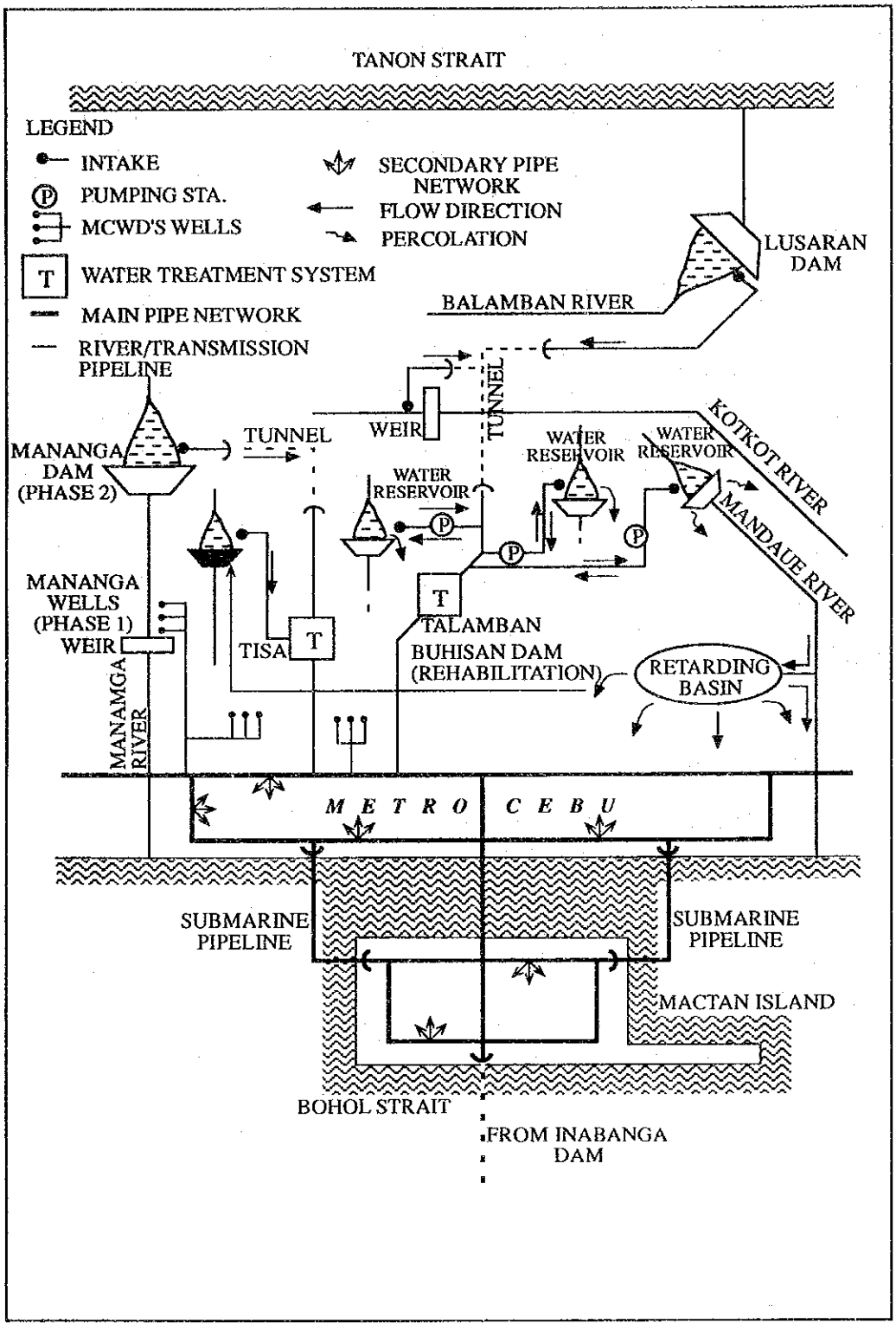


FIGURE 10.6.3 ALTERNATIVE PLAN OF WATERT SOURCES DEVELOPMENT IN METRO CEBU.

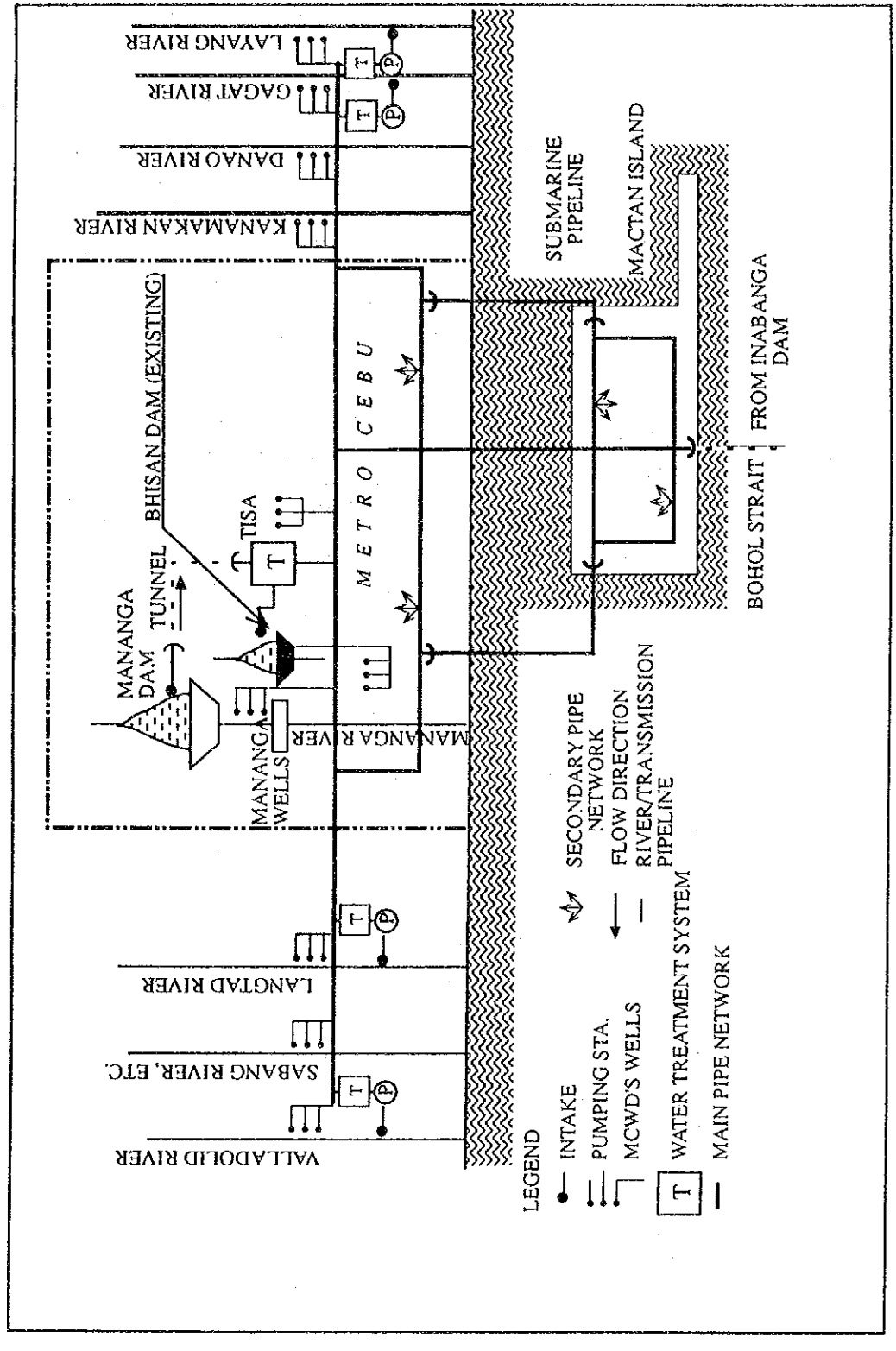


FIGURE 10.6.4 ALTERNATIVE PLAN OF WATERT SOURCES DEVELOPMENT IN METRO CEBU.

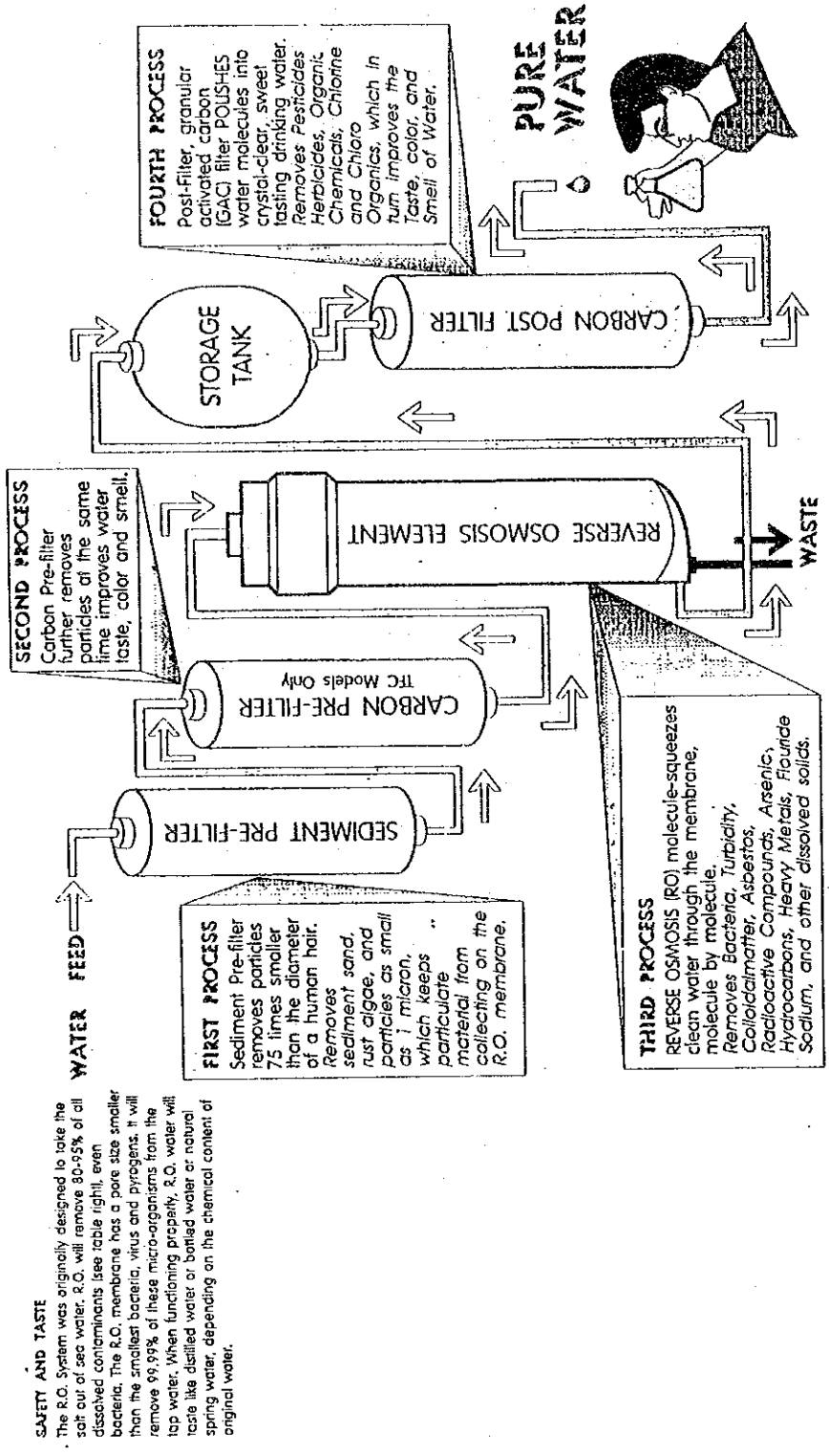


FIGURE 10.6.5 DIAGRAM OF REVERSE OSMOSIS PORCESS (RO)

10.7 WATER SUPPLY DEVELOPMENT PLAN IN RURAL AREA

10.7.1 TARGET SERVICE LEVEL OF EXISTING PLAN

The Regional Development Plan of Central Visayas expects to increase the coverage of population served with potable water increase from 69% in 1990 to 85% in 1998. The population is expected to be in this increase by 77% in 1990.

The Water Supply, Sewerage and Sanitation Master Plan of the Philippines expects to establish Level 3 water supply system in all towns, Level 2 in 20% of all barangays and Level 1 in the remaining barangays by 2000. The 1988 figures reveal that there are 30% of Level 3, 46% of Level 1 and the remaining 38% have other sources of water.

10.7.2 WATER DEMAND AND WATER SUPPLY BALANCE

(1) Per Capita Demand of Domestic Water

Per capita demand of domestic water in rural area is smaller than in the urban area. The estimated water demand of the municipalities are classified as follows:

A municipality: Domestic water demand: 110 l/day/capita,
Public faucet: 35 l/day/capita

B municipality: Applying the coefficient of allotment provided for in the LWUA methodology manual, the unit consumptions for each of the income groups are estimated as follows:

	Average Consumption per Income Group (Unit: l/day/capita)				
	Low	Middle	Middle-high	high	Average
1993	77	94	110	132	103.3
2000	84	102	120	144	112.5

C municipality (not Cebu Island): Domestic water demand 3.3 l/day/capita The estimated water demand for the above data computed for each water supply system and the social and physical condition are as follows:

Level 1 and other water source: 30 l/day/capita
Level 2: 60 l/day/capita
Level 3: 110 l/day/capita

(2) Water Demand

The present water demand shown in Table 10.7.1 was obtained by multiplying per capita water use by the number of household of 5.6 persons/household.

TABLE 10.7.1 WATER POTENTIAL AND PRESENT DEMAND

	Potential (1,000cu.m/day)		Present Demand(1,000cu.m/day)			
	Surface water	Ground water	Irrigation		Drinking	
	(a)	(b)	(c)	(c)/(a)	(d)	(d)/(b)
District 1	838	210	35	4%	14	7%
District 2	1,698	425	46	3%	13	3%
District 3	1,942	485	115	6%	15	3%
District 4	1,141	285	1	0%	13	5%
District 5	1,189	297	19	2%	14	5%
District 6	280	70	2	1%	5	7%
Total	7,264	1,816	217	3%	74	4%

(3) Sufficiency of Water Source

The water potential in Table 10.5.2 and the water demand in present time is summarized in Table 10.7.2.

TABLE 10.7.2 SUMMARIZED RURAL WATER DEMAND

Unit : 1,000 cu. m/day

	Groundwater Capacity (a)	Demand 1990	Demand 2000 (b)	Demand 2010	Ratio 1990	Ratio 2000 (b)/(a)	Ratio 2010
CASE I							
District 1	210	15	20	25	7 %	10 %	12 %
District 2	425	16	20	22	4 %	5 %	5 %
District 3	485	16	20	22	3 %	4 %	5 %
District 4	285	12	17	18	4 %	6 %	6 %
District 5	297	14	17	19	5 %	6 %	6 %
Total	1,816	73	94	105	4 %	5 %	6 %
CASE II							
District 1	210	15	19	23	7 %	9 %	11 %
District 2	425	16	16	19	4 %	4 %	4 %
District 3	485	16	16	19	3 %	3 %	4 %
District 4	285	12	12	16	4 %	4 %	6 %
District 5	297	14	14	17	5 %	5 %	6 %
Total	1,816	73	78	94	4 %	4 %	5 %
CASE III							
District 1	210	15	19	24	7 %	9 %	11 %
District 2	425	16	16	21	4 %	4 %	5 %
District 3	485	16	16	21	3 %	3 %	4 %
District 4	285	12	12	18	4 %	4 %	6 %
District 5	297	14	14	18	5 %	5 %	6 %
Total	1,816	73	77	104	4 %	4 %	6 %

Groundwater as a water source accounts for less than 10% of the supply. Water sources in rural areas is enough for their needs in present time. It must be remembered that the drinking water is not sufficient in the off-shore islands and near

the coastal area where there is an absence of groundwater sources or where the groundwater is of poor quality.

(4) Estimated Future Water Demand in Rural Area

Water demand until 2010 can be estimated by the same manner as section 10.6.2. The three cases, namely, moderate case (CASE I), lowest case (CASE II) and highest case (CASE III), are calculated on the following assumptions that:

(a) Annual growth rate of the rural population

The annual growth rates of the rural and urban population are followed in the below.

	Rural		Urban	
	1990 - 2000	2000 - 2010	1990 - 2000	2000 - 2010
Case I	1.25%	0.62%	3.0%	3.0%
Case II	0.89%	-0.50%	3.0%	2.5%
Case III	0.47%	0.30%	4.0%	3.5%

(b) Construction speed of water supply system

The formation of development plan will be varied by several local conditions, budgets and so on. Construction of water supply system can be classified into two kinds of upgrading as follows:

System Setting Level:	Others (less than Level 1; non-safety drinking water) to Level 1 or Level 2
Upgrading Level:	Level 1 or Level 2 to Level 3

Recently DPWH has executed about 500 wells drilling per year of Level 1 or Level 2. Fund for the construction of wells of Level 1 or Level 2 came form not only DPWH, but also LGUs, some CDFs and so on. It can be assumed that a total 700 wells of Levels 1 and 2 can be constructed until 2010 in every year by all fund. And upgrading Level can be presumed that one barangay in every district have the new system every year . Hence, numbers of serviced households are:

- Others (less than Level 1; non-safety drinking water) to Level 1 or Level 2:
  700 wells/year x 10 HH/well = 7,000 HH/year

So, Others to Level 1 is 3,500 HH/year and Others to Level 2 is 3,500 HH/year

- Level 1 or Level 2 to Level 3:

  2,200 persons/barangay/year x 1 barangay/district x 6 district (Cebu Province) / 5.2 persons/HH = 2,500 HH/year

TABLE 10.7.3. RURAL WATER DEMAND

CODE	NAME	HOUSEHOLD NO. (nos) /1				WATER DEMAND (cu.m/day) /2				
		LEVEL 3	LEVEL 2	LEVEL 1	OTEHRS	LEVEL 3	LEVEL 2	LEVEL 1	OTHER	TOTAL
100	DISTRICT I	3,987	15,878	24,611	17,871	2,412	5,240	4,061	2,949	14,661
101	Talisay	0 /3	6,443	7,332	1,524	0	2,126	1,210	251	3,587
102	Minglanilla	801	2,278	4,871	1,283	485	752	804	212	2,252
103	Naga	768	1,853	4,891	3,860	465	611	807	637	2,520
104	San Fernando	339	1,137	2,695	2,510	205	375	445	414	1,439
105	Carcar	1,380	2,595	3,537	5,926	835	856	584	978	3,253
106	Sibonga	699	1,572	1,285	2,768	423	519	212	457	1,610
200	DISTRICT II	6,156	17,459	13,400	24,500	3,724	5,761	2,211	4,043	15,739
201	Argao	519	1,048	3,757	4,814	314	346	620	794	2,074
202	Dalaguete	582	2,512	1,908	3,805	352	829	315	628	2,124
203	Alcoy	104	1,126	288	464	63	372	48	77	559
204	Boljoon	293	120	790	1,101	177	40	130	182	529
205	Oslob	762	1,475	646	1,173	461	487	107	194	1,248
206	Santander	292	1,278	221	696	177	422	36	115	750
207	Samboan	627	917	405	1,034	379	303	67	171	919
208	Ginatilan	442	683	311	871	267	225	51	144	688
209	Malabuyoc	359	705	238	1,479	217	233	39	244	733
210	Alegria	461	834	197	2,069	279	275	33	341	928
211	Badian	424	2,910	665	1,169	257	960	110	193	1,519
212	Moalboal	262	1,220	923	1,472	159	403	152	243	956
213	Alcantara	217	446	477	669	131	147	79	110	468
214	Ronda	417	753	673	1,243	252	248	111	205	817
215	Dumanjug	395	1,432	1,901	2,441	239	473	314	403	1,428
300	DISTRICT III	5,435	14,151	17,250	30,428	3,288	4,670	2,846	5,021	15,825
301	Barili	556	2,519	1,043	4,920	336	831	172	812	2,152
302	Aloguinsan	51	464	673	2,628	31	153	111	434	729
303	Pinamungahan	212	1,086	2,398	3,898	128	358	396	643	1,525
304	Toledo City	3,479	6,146	4,432	8,215	2,105	2,028	731	1,355	6,220
305	Balamban	264	1,552	4,192	3,190	160	512	692	526	1,890
306	Asturias	351	960	2,506	2,461	212	317	413	406	1,349
307	Tuburan	522	1,424	2,006	5,116	316	470	331	844	1,961
400	DISTRICT IV	2,306	6,626	15,189	38,845	1,395	2,187	2,506	6,409	12,497
401	Tabuelan	162	294	565	2,104	98	97	93	347	635
402	San Remegio	198	810	1,952	4,388	120	267	322	724	1,433
403	Daanbantayan	792	1,279	3,436	5,484	479	422	567	905	2,373
404	Medellin	245	679	2,269	3,580	148	224	374	591	1,337
405	Bogo	534	2,828	3,875	3,396	323	933	639	560	2,456
406	Tabogon	245	192	1,449	3,190	148	63	239	526	977
407	Santa Fe	31	0	360	3,356	19	0	59	554	632
408	Bantayan	59	11	184	10,576	36	4	30	1,745	1,815
409	Madridejos	40	533	1,099	2,771	24	176	181	457	839
500	DISTRICT V	4,558	15,539	18,224	21,864	2,758	5,128	3,007	3,608	14,500
501	Borbon	170	246	997	3,231	103	81	165	533	882
502	Sogod	437	798	1,542	2,061	264	263	254	340	1,122
503	Catmon	217	821	672	2,257	131	271	111	372	886
504	Carmen	725	1,222	851	2,773	439	403	140	458	1,440
505	Danao City	1,499 /3	3,814	4,925	4,222	907	1,259	813	697	3,675
506	Compostela	0 /3	688	1,699	1,435	0	227	280	237	744
507	Liloan	0 /3	837	4,883	1,855	0	276	806	306	1,388
508	San Francisco	510	2,340	1,947	1,988	309	772	321	328	1,730
509	Poro	233	1,839	355	1,484	141	607	59	245	1,051
510	Tudela	538	831	330	470	325	274	54	78	732
511	Pilar	229	2,103	23	88	139	694	4	15	851
600	DISTRICT VI	0	0	0 /3	0	0	0	0	0	0
601	Consolacio	0 /3	0 /3	0 /3	0	0	0	0	0	0
602	Mandaue City	0 /3	0 /3	0 /3	0 /3	0	0	0	0	0
603	Lapu-Lapu City	0 /3	0 /3	0 /3	0 /3	0	0	0	0	0
604	Cordova	0 /3	0 /3	0 /3	0	0	0	0	0	0
700	Cebu city	0 /3	0 /3	0 /3	0 /3	0	0	0	0	0
TOTAL		22,442	69,653	88,674	133,508	(19%) 13,577	(31%) 22,985	(20%) 14,631	(30%) 22,029	(100%) 73,223

NOTES
/1 sourced from Census 1990.
/2 is calculated by the following assumptions;
- ave. person per household 5.6 persons/household
- LEVEL 3 water demand 110 l/day/capita
- LEVEL 2 water demand 60 l/day/capita
- LEVEL 1 water demand 30 l/day/capita
- OTHERS water demand 30 l/day/capita

/3 is included in urban area.

TABLE 10.7.4 ESTIMATED HOUSEHOLD NUMBER IN RURAL AREA

CASE I (POP. GROWTH RATE URBAN=3%-3%,RURAL=1.25%-0.62%)

CODE NAME	POPULATION IN 1990			NO. OF	DENSITY	POPULATION IN 20				POPULATION IN 2010			
	URBAN	RURAL	TOTAL	HH	OF HH	URBAN	RURAL	TOTAL	NO OF HH	URBAN	RURAL	TOTAL	NO OF HH
	(1)	(2)	(3)=(1)+(2)	(4)	(5)=(3)/(4)	(6)	(7)	(8)=(6)+(7)	(9)=(8)/(5)	(10)	(11)	(12)=(10)+(11)	(13)=(12)/(5)
100 DISTRICT I	57,330	290,606	347,936	62,347	5.58	77,047	329,045	406,091	72,768	103,544	350,024	453,569	81,275
200 DISTRICT II	51,570	262,026	313,596	61,515	5.10	69,306	296,684	365,990	71,793	93,141	315,601	408,742	80,179
300 DISTRICT III	47,033	299,028	346,061	67,264	5.14	63,208	338,581	401,789	78,096	84,947	360,168	445,115	86,517
400 DISTRICT IV	76,783	250,293	327,076	62,966	5.19	103,190	283,399	386,589	74,423	138,679	301,469	440,147	84,734
500 DISTRICT V	38,634	252,008	290,642	60,185	4.83	51,921	285,341	337,262	69,839	69,777	303,534	373,312	77,304
600 DISTRICT VI	-	-	-	-	-	-	-	-	-	-	-	-	-
700 Cebu city	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	271,350	1,353,961	1,625,311	314,277	5.17	364,672	1,533,051	1,897,722	366,918	490,088	1,630,796	2,120,884	410,009

CASE II (POP. GROWTH RATE URBAN=3%-3%,RURAL=1.25%-0.62%)

CODE NAME	POPULATION IN 1990			NO. OF	DENSITY	POPULATION IN 2000				POPULATION IN 2010			
	URBAN	RURAL	TOTAL	HH	OF HH	URBAN	RURAL	TOTAL	NO OF HH	URBAN	RURAL	TOTAL	NO OF HH
	(1)	(2)	(3)=(1)+(2)	(4)	(5)=(3)/(4)	(6)	(7)	(8)=(6)+(7)	(9)=(8)/(5)	(10)	(11)	(12)=(10)+(11)	(13)=(12)/(5)
100 DISTRICT I	57,330	290,606	347,936	62,347	5.58	77,047	317,531	394,577	70,705	98,626	302,007	400,633	71,790
200 DISTRICT II	51,570	262,026	313,596	61,515	5.10	69,306	286,303	355,609	69,756	88,717	272,306	361,023	70,818
300 DISTRICT III	47,033	299,028	346,061	67,264	5.14	63,208	326,733	389,941	75,793	80,912	310,759	391,671	76,129
400 DISTRICT IV	76,783	250,293	327,076	62,966	5.19	103,190	273,483	376,673	72,514	132,092	260,112	392,204	75,504
500 DISTRICT V	38,634	252,008	290,642	60,185	4.83	51,921	275,357	327,278	67,771	66,463	261,894	328,358	67,995
600 DISTRICT VI	-	-	-	-	-	-	-	-	-	-	-	-	-
700 Cebu city	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	271,350	1,353,961	1,625,311	314,277	5.17	364,672	1,479,406	1,844,078	356,539	466,811	1,407,078	1,873,889	362,236

CASE III (POP. GROWTH RATE URBAN=3%-3%,RURAL=1.25%-0.62%)

CODE NAME	POPULATION IN 1990			NO. OF	DENSITY	POPULATION IN 2000				POPULATION IN 2010			
	URBAN	RURAL	TOTAL	HH	OF HH	URBAN	RURAL	TOTAL	NO OF HH	URBAN	RURAL	TOTAL	NO OF HH
	(1)	(2)	(3)=(1)+(2)	(4)	(5)=(3)/(4)	(6)	(7)	(8)=(6)+(7)	(9)=(8)/(5)	(10)	(11)	(12)=(10)+(11)	(13)=(12)/(5)
100 DISTRICT I	57,330	290,606	347,936	62,347	5.58	84,862	304,557	389,419	69,780	119,707	313,818	433,525	77,684
200 DISTRICT II	51,570	262,026	313,596	61,515	5.10	76,336	274,605	350,941	68,841	107,680	282,955	390,635	76,627
300 DISTRICT III	47,033	299,028	346,061	67,264	5.14	69,620	313,383	383,004	74,445	98,206	322,913	421,119	81,853
400 DISTRICT IV	76,783	250,293	327,076	62,966	5.19	113,658	262,309	375,966	72,378	160,325	270,285	430,610	82,898
500 DISTRICT V	38,634	252,008	290,642	60,185	4.83	57,188	264,106	321,294	66,532	80,669	272,137	352,806	73,058
600 DISTRICT VI	-	-	-	-	-	-	-	-	-	-	-	-	-
700 Cebu city	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	271,350	1,353,961	1,625,311	314,277	5.17	401,664	1,418,960	1,820,624	351,976	566,587	1,462,108	2,028,695	392,119

NOTE: THE DATA IN 1990 IS SOURCED FROM 1990 CENSUS

TABLE 10.7.5 ESTIMATED RURAL WATER DEMAND IN CASE I

CASE 1

CODE	NAME	TOTAL	WATER LEVEL IN 1990 (No. of HH) LEVEL 3		LEVEL 2		LEVEL 1		OTEHRS	
100	DISTRICT I	62,347	3,987	(6%)	15,878	(25%)	24,611	(39%)	17,871	(29%)
200	DISTRICT II	61,515	6,156	(10%)	17,459	(28%)	13,400	(22%)	24,500	(40%)
300	DISTRICT III	67,264	5,435	(8%)	14,151	(21%)	17,250	(26%)	30,428	(45%)
400	DISTRICT IV	62,966	2,306	(4%)	6,626	(11%)	15,189	(24%)	38,845	(62%)
500	DISTRICT V	60,185	4,558	(8%)	15,539	(26%)	18,224	(30%)	21,864	(36%)
600	DISTRICT VI	0	0	(0%)	0	(0%)	0	(0%)	0	(0%)
700	Cebu city	0	0	(0%)	0	(0%)	0	(0%)	0	(0%)
TOTAL		314,277	22,442	(7%)	69,653	(22%)	88,674	(28%)	133,508	(42%)

CODE	NAME	TOTAL	WATER LEVEL IN 2000 (No. of HH) LEVEL 3		LEVEL 2		LEVEL 1		OTEHRS	
100	DISTRICT I	72,768	9,611	(13%)	20,738	(28%)	30,931	(43%)	11,488	(16%)
200	DISTRICT II	71,793	12,076	(17%)	24,353	(34%)	19,616	(27%)	15,748	(22%)
300	DISTRICT III	78,096	11,631	(15%)	21,746	(28%)	25,344	(32%)	19,374	(25%)
400	DISTRICT IV	74,423	7,796	(10%)	15,480	(21%)	25,601	(34%)	25,546	(34%)
500	DISTRICT V	69,839	10,048	(14%)	21,384	(31%)	24,500	(35%)	13,907	(20%)
600	DISTRICT VI	0	0	(0%)	0	(0%)	0	(0%)	0	(0%)
700	Cebu city	0	0	(0%)	0	(0%)	0	(0%)	0	(0%)
TOTAL		366,918	51,163	(14%)	103,701	(28%)	125,991	(34%)	86,064	(23%)

CODE	NAME	TOTAL	WATER DEMAND IN 2000 (cu. m/day) LEVEL 3	LEVEL 2	LEVEL 1	OTEHRS	TOTAL
100	DISTRICT I	19,946	5,900	6,944	5,178	1,923	
200	DISTRICT II	19,629	6,772	7,449	3,000	2,408	
300	DISTRICT III	20,197	6,582	6,713	3,912	2,990	
400	DISTRICT IV	17,250	4,455	4,825	3,989	3,981	
500	DISTRICT V	17,098	5,337	6,196	3,549	2,015	
600	DISTRICT VI	0	0	0	0	0	
700	Cebu city	0	0	0	0	0	
TOTAL		94,120	29,047	32,126	19,629	13,318	

CODE	NAME	TOTAL	WATER LEVEL IN 2010 (no. of HH) LEVEL 3		LEVEL 2		LEVEL 1		OTEHRS	TOTAL
100	DISTRICT I	81,275	16,682	(21%)	24,573	(30%)	35,957	(44%)	4,064	(5%)
200	DISTRICT II	80,179	19,353	(24%)	31,054	(39%)	25,763	(32%)	4,009	(5%)
300	DISTRICT III	86,517	19,216	(22%)	29,495	(34%)	33,481	(39%)	4,326	(5%)
400	DISTRICT IV	84,734	15,076	(18%)	26,949	(32%)	38,472	(45%)	4,237	(5%)
500	DISTRICT V	77,304	16,778	(22%)	26,606	(34%)	30,055	(39%)	3,865	(5%)
600	DISTRICT VI	0	0	(0%)	0	(0%)	0	(0%)	0	(0%)
700	Cebu city	0	0	(0%)	0	(0%)	0	(0%)	0	(0%)
TOTAL		410,009	87,105	(21%)	138,676	(34%)	163,727	(40%)	20,500	(5%)

CODE	NAME	TOTAL	WATER DEMAND IN 2010 (cu. m/day) LEVEL 3	LEVEL 2	LEVEL 1	OTEHRS	TOTAL
100	DISTRICT I	25,169	10,241	8,228	6,020	680	
200	DISTRICT II	24,904	10,853	9,498	3,940	613	
300	DISTRICT III	25,815	10,875	9,105	5,168	668	
400	DISTRICT IV	23,669	8,615	8,399	5,995	660	
500	DISTRICT V	21,536	8,912	7,709	4,354	560	
600	DISTRICT VI	0	0	0	0	0	
700	Cebu city	0	0	0	0	0	
TOTAL		121,093	49,495	42,939	25,477	3,181	

TABLE 10.7.6 WATER BALANCE OF CASE 2 IN METRO CEBU

YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1. WATER SUPPLY CAPACITY											
MCWD											
EXISTING	96,800 /1	96,800	96,800	96,800	96,800	96,800	96,800	96,800	96,800	96,800	96,800
MANANGA, WELL	-	-	-	33,000	33,000	33,000	33,000	33,000	33,000	33,000	33,000
MANANGA, DAM	-	-	-	-	-	-	-	95,000	95,000	95,000	95,000
TOTAL /3	96,800	96,800	96,800	129,800	129,800	129,800	129,800	224,800	224,800	224,800	224,800
2. WATER DEMAND	196,446	205,056	214,014	223,335	233,032	243,121	253,618	264,539	274,033	283,867	294,054
3. CONSUMPTION OF MCWD	57,041 /2	58,080	59,048	60,016	66,182	72,512	79,008	85,668	99,696	114,104	128,892
NON-REVENUE OF MCWD	39,759	38,720	37,752	36,784	38,869	40,788	42,543	44,132	49,104	110,696	95,908
TOTAL PROD. OF MCWD	96,800	96,800	96,800	96,800	105,050	113,300	121,550	129,800	148,800	167,800	186,800
% OF NON-REVENUE	41%	40%	39%	38%	37%	36%	35%	34%	33%	32%	31%
POPULATN SERVICED	327,993	326,770	325,078	323,379	352,316	380,951	409,283	437,309	505,025	572,013	638,262
4. PRIVATE AND PUBLIC WELL	139,405	146,976	154,966	163,319	166,851	170,609	174,611	178,871	174,337	169,763	165,162
SAFE YIELD	92,000 /4	92,000	83,900	83,900	83,900	83,900	83,900	83,900	83,900	83,900	83,900
OVER WITHDRAWAL	47,405	54,976	71,066	79,419	82,951	86,709	90,711	94,971	90,437	85,863	81,262

YEAR	2004	2005	2006	2007	2008	2009	2010
1. WATER SUPPLY CAPACITY							
MCWD							
EXISTING	96,800	96,800	96,800	96,800	96,800	96,800	96,800
MANANGA, WELL	33,000	33,000	33,000	33,000	33,000	33,000	33,000
MANANGA, DAM	95,000	95,000	95,000	95,000	95,000	95,000	95,000
TOTAL /3	224,800	224,800	224,800	224,800	224,800	224,800	224,800
2. WATER DEMAND	304,605	315,534	326,855	338,582	350,729	363,311	376,343
3. CONSUMPTION OF MCWD	149,800	157,360	157,360	157,360	157,360	157,360	157,360
NON-REVENUE OF MCWD	64,200	67,440	67,440	67,440	67,440	67,440	67,440
TOTAL PROD. OF MCWD	214,000	224,800	224,800	224,800	224,800	224,800	224,800
% OF NON-REVENUE	30%	30%	30%	30%	30%	30%	30%
POPULATN SERVICED	733,090	757,255	749,944	742,786	735,783	728,939	722,259
4. PRIVATE AND PUBLIC WELL	154,805	158,174	169,495	181,222	193,369	205,951	218,983
SAFE YIELD	83,900	83,900	83,900	83,900	83,900	83,900	83,900
OVER WITHDRAWAL	70,905	74,274	85,595	97,322	109,469	122,051	135,083

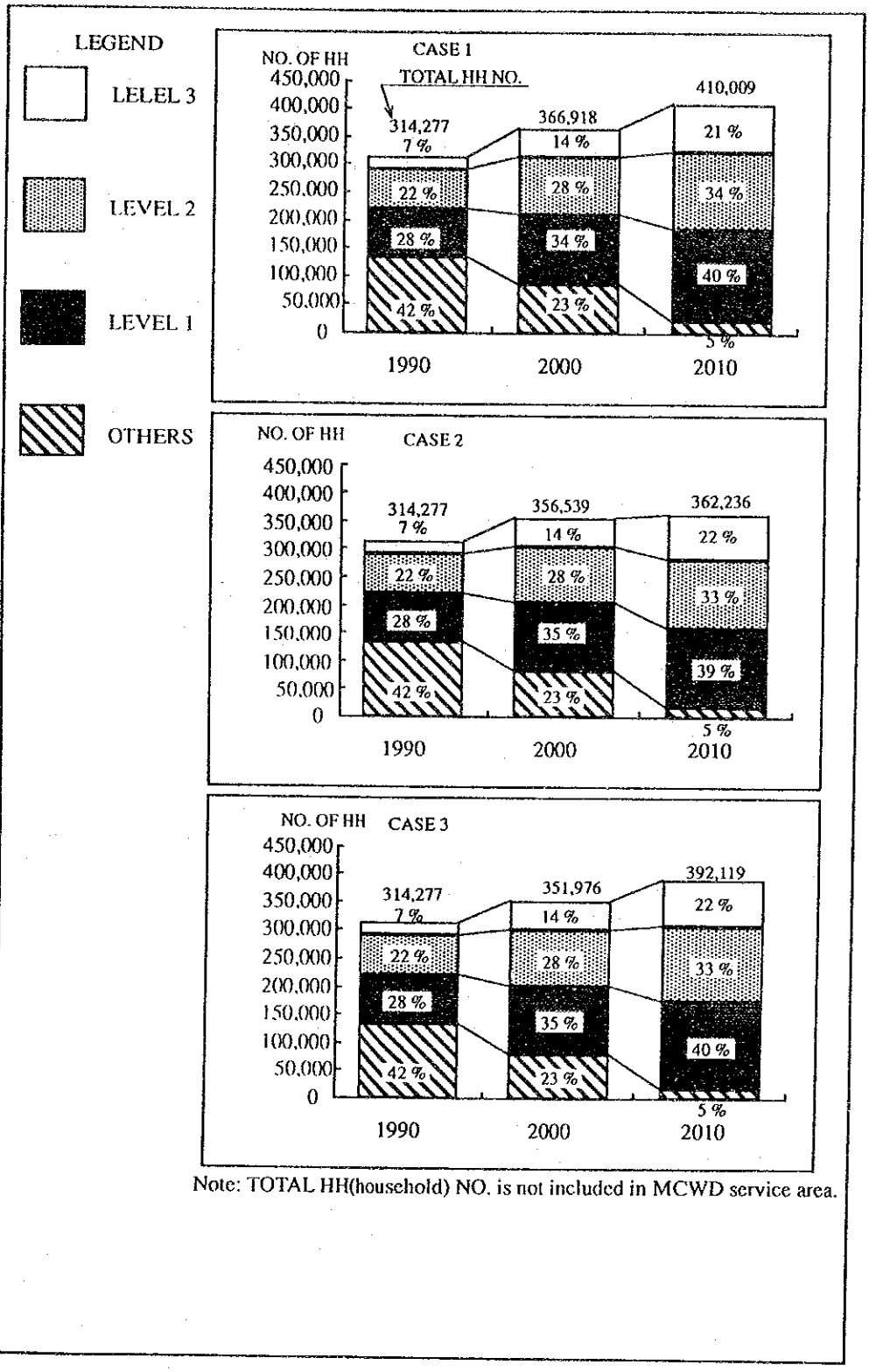
NOTES
/1 is estimated from MCWD data.
/2 means average dischrge of actual sold water of MCWD from Jan. to Aug. 1993.
/3 sees Table 3.6.2.
/4 is obtained from the MCWD report.

TABLE 10.7.7 WATER BALANCE OF CASE 3 IN METRO CEBU

YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1. WATER SUPPLY CAPACITY											
MCWD											
EXISTING	96,800 /1	96,800	96,800	96,800	96,800	96,800	96,800	96,800	96,800	96,800	96,800
MANANGA, WELL	-	-	-	33,000	33,000	33,000	33,000	33,000	33,000	33,000	33,000
MANANGA, DAM	-	-	-	-	-	-	-	95,000	95,000	95,000	95,000
TOTAL	96,800	96,800	96,800	129,800	129,800	129,800	129,800	224,800	224,800	224,800	224,800
2. WATER DEMAND /3	201,527	212,193	223,350	235,049	247,319	260,186	273,680	287,833	300,114	312,900	326,209
3. CONSUMPTION OF MCWD	57,041 /2	58,080	59,048	60,016	66,182	72,512	79,008	85,668	99,696	114,104	128,892
NON-REVENUE OF MCWD	39,759	38,720	37,752	36,784	38,869	40,788	42,543	44,132	49,104	110,696	95,908
TOTAL PROD. OF MCWD	96,800	96,800	96,800	96,800	105,050	113,300	121,550	129,800	148,800	167,800	186,800
% OF NON-REVENUE	41%	40%	39%	38%	37%	36%	35%	34%	33%	32%	31%
POPULATN SERVICED	297,850	307,285	316,085	324,278	321,565	318,265	314,830	341,893	368,505	394,653	420,321
4. PRIVATE AND PUBLIC WELL	144,486	154,113	164,302	175,033	181,137	187,674	194,672	202,165	200,418	198,796	197,317
SAFE YIELD	92,000 /4	92,000	83,900	83,900	83,900	83,900	83,900	83,900	83,900	83,900	83,900
OVER WITHDRAWAL	52,486	62,113	80,402	91,133	97,237	103,774	110,772	118,265	116,518	114,896	113,417

YEAR	2004	2005	2006	2007	2008	2009	2010
1. WATER SUPPLY CAPACITY							
MCWD							
EXISTING	96,800	96,800	96,800	96,800	96,800	96,800	96,800
MANANGA, WELL	33,000	33,000	33,000	33,000	33,000	33,000	33,000
MANANGA, DAM	95,000	95,000	95,000	95,000	95,000	95,000	95,000
TOTAL	224,800	224,800	224,800	224,800	224,800	224,800	224,800
2. WATER DEMAND /3	340,064	354,486	369,500	385,128	401,396	418,331	435,959
3. CONSUMPTION OF MCWD	144,060	157,360	157,360	157,360	157,360	157,360	157,360
NON-REVENUE OF MCWD	61,740	67,440	67,440	67,440	67,440	67,440	67,440
TOTAL PROD. OF MCWD	205,800	224,800	224,800	224,800	224,800	224,800	224,800
% OF NON-REVENUE	30%	30%	30%	30%	30%	30%	30%
POPULATN SERVICED	681,874	734,029	724,786	715,567	706,367	697,183	688,011
4. PRIVATE AND PUBLIC WELL	196,004	197,126	212,140	227,768	244,036	260,971	278,599
SAFE YIELD	83,900	83,900	83,900	83,900	83,900	83,900	83,900
OVER WITHDRAWAL	112,104	113,226	128,240	143,868	160,136	177,071	194,699

NOTES
/1 is estimated from MCWD data.
/2 means average dischrge of actual sold water of MCWD from Jan. to Aug. 1993.
/3 sees Table 3.6.3.
/4 is obtained from the MCWD report.



Note: TOTAL HH(household) NO. is not included in MCWD service area.

FIGURE 10.7.1 ESTIMATED WATER SUPPLY LEVEL

(c) Limit of application of the water system

It is difficult for some area to install the water supply system due to the physical condition, no community organization, too high investment cost, etc. These area cannot be calculated and is supposed to be 5% of the total population.

The results of the estimation (Case I) is given in Table 10.7.5 and Figure 10.7.1. These tables and figure show in each case that 95% of the people can be served by safety water and some 20% of them can enjoy Level 3 water supply system in 2010.

Water demand occupies some 10% or less than 10% of groundwater capacity in 2010. It means that the supplied water volume is much less than usable water which can be applied to be 50% of the potential and there is much surplus water for drinking.

10.7.3 PROBLEM AND ISSUES OF RURAL WATER SUPPLY

(1) Insufficient Water Supply System

In principle, the water supply system of Levels 1, 2, and 3 is provided by the local government or from DPWH funded by international assistance. Many people in rural areas have long been in cline need for the safety drinking water on the fact that some 60% of the people use a safety potable water only . Diseases related to water are significant contributors to illness and death, especially on young children in poorer communities. To make good quality of drinking water is much important for improving the health status in rural area.

(2) Lack of Maintenance and Operation

Many of the existing schemes are inadequate service and needs to be repaired or rehabilitated. In most cases this is due to poor operation and maintenance. The procedure of installing the rural water system shows the Figure 10.7.2. Part of the reason is financial constrain; emphasis is on new construction instead of the repair and maintenance of existing facilities.

The maintenance and minor repairs in Level 1 systems is not provided by the RWSAs. This is because of the weak organizational structure because they do not understand their responsibilities in maintaining these systems. The people often believe that water supply system is a public service which must be provided and maintained by the government.

Levels 2 and 3 systems are often poorly managed leading to break-downs in service. This results in users not paying their water bill which results in unavailability of funds for repair and maintenance. RWSAs and even some of the water districts and water service cooperative have not been properly organized or are not being efficiently managed. Furthermore, members do not understand their obligations. Accordingly many Level 2 and most Level 3 systems serve only a small fraction of the households which they are supposed to be served more.

Bigger budgets have to be allocated for the repair, maintenance and rehabilitation of water supply systems.

(3) Lack of The Hydraulic and Water Supply Engineer

In the implementation of a water supply project, the location of wells is determined by the barangay people and municipal officers. An engineer who has the knowledge of aquifer and hydraulics does not take a part in its implementation. This means that the location is not properly identified from the technical point of view.

Of the 94 deep wells which were constructed by a city as of 1993, 47 wells were out of order or are experiencing trouble. This situation need the importance of technical assistance.

10.7.4 FRAMEWORKS AND SCENARIOS

(1) Available Water To Be Used

(a) Basic strategy

Drinking water should be safe and clean. Potable water sources available are as follows: Practically, the groundwater is most available in every level.

Level 1	Groundwater Spring water in closed pit Rainfall by a collector
Level 2 and 3	Groundwater Spring water in closed pit

(b) Other sources

Solar pumping system for water supply is convenient to take safe water. But, initial cost is large and maintenance, especially replacement of spare parts, is difficult without international assistance. Hence, solar pumping system will be able to be applied to limited area where access to maintain is easy and cost efficiency is high.

Remote islands where a water source is poor can be considered to use both desalinization plant by electric power, solar power or manpower, or water transport system such as a water tank ship or tag boat with water bags from the point of view of minimum life line. As studying both measures, cost efficiency and maintenance shall be considered on high priority. Operation and maintenance cost of desalinization plant is not so high if brackish water used. Its cost of water transport also is not high if port facility and supply system is being.

(2) Frameworks and Scenarios

The framework is as follows:

- To install the safety water supply system
- To strengthen the operation and maintenance system

The condition of Cebu province is in terms of water supply poorer as compared to the national level. The situation affects mostly women and children that takes heavy burden of carrying water from a far distance to the water source. A safe water supply system is a basic infrastructure facility for rural development. and would also relieve

the women and children from the said situation who mostly belong to poor communities. Therefore, it is very important to develop the water supply system.

Technical assistance strengthening the operation and maintenance system means not only supporting the technical assistance, but also reinforcing the communities as their basic and important energy for rural development.

10.7.5 FUTURE DEVELOPMENT PLAN

(1) Water Supply Development Plan

" Rural Water Supply Facility Development " is carried out in the rural area of the whole Province. This project is not a special project, but totally considering the projects related to rural water development. And the project will expect the fund from not only local governments, but also international financial assistance like Rural Water Supply V funded by OECF (Japan).

"A Study of Groundwater in The Cebu Province" studies the groundwater location and hydro potential in detail and prepare the groundwater map. This map will become basic data in determining the well drilling sites. Although the project is not directly into rural development, but is very important from the macro economic points of view.

(2) Strengthening the Operation and Maintenance

"Establishment Of Provincial Technical Center For Rural Water Development" is to assist the organizations of communities, instruct communities, transfer knowledge, support the maintenance, and supply the data in the design stage. "Cebu Provincial Water Development Committee (CPWDC)" also is constituted for the purpose of planning, coordinating and decision-making functions for provincial rural water development, involving the provincial government, LWUA and other related institutes. Both Center and Committee should be linked together.

10.7.6 WATER SUPPLY DEVELOPMENT PLAN IN TOLEDO-BALAMBAN AREA

Toledo-Balamban area will become the most important core zone of Western Sea Board. This area has two proposed industrial estates/parks as Western Corridor Industrial Core. Urbanization in the area will progress expeditiously in the near future.

It is estimated an additional water demand in 2010 of 31,150 cu.m/day as shown in Table 10.7.8 on the assumption that:

- Urban population of Toledo and Balamban will increase to 41,000 people and the per capita water demand is 0.15 cu.m/day.
- Medium factory at the proposed industrial estates will not use much water based on factory's character like a light industrial, machinery and cement industry.

"Water Supply Extension Project For Toledo-Balamban Area" will become an important project in future. Local governments or LWUA will develop at that area.

Water source that can be tapped is the groundwater. Future main water demand area and proposed water service area, 3,300 has, are given in Figure 10.7.4 as against presently both poblacion areas only covered.

Present organization of water supply service at Toledo City and Balamban is under the local government units. But the two waterworks system should be restructured into one water district in order to have an effective water development, consolidating the financial foundation and avoiding the political constraints.

TABLE 10.7.8 FUTURE WATER SUPPLIED VOLUME IN TOLEDO-BALAMBAN AREA

unit: cu.m/day

Item	Unit	Unit Volume	Number	Supplied Volume
Domestic	Persons	0.15 cu.m/day	41,000	6,150
Industrial	has	60 cu.m/day	350	21,000
Others	L.S.			1,000
Total				31,150

10.7.7 WATER SUPPLY DEVELOPMENT PLAN IN DANAO-CARMEN AREA

This area has two proposed industrial estates/parks as the Metro Cebu North Industrial Core. Urbanization development will be accelerated in the near future.

It is estimated that an additional water demand in 2010 is 43,150 cu.m/day as shown in Table 10.7.9 on the assumption that :

- Urban population of Danao and Carmen will increase up to 41,000 persons and the per capita water demand is 0.15 cu.m/day.
- Typical factory at the proposed industrial estates will consume much water based on its characteristic such as a agro-base industries.

"Water Supply Extension Project For Danao-Carmen Area" will become important project in the future for the development of that area.

Water source can be tapped from the groundwater based on the topographical condition. Future main water demand area and proposed water service area is, 1,600 has, as given in Figure 10.7.5. Presently both poblacion areas only covered more than half of its poblacion.

Present organization of water supply service in Danao City and Carmen is under the respective local government units. But the two (2) waterworks system should be integrated into one water district or may belong to MCWD to have an effective water development, consolidating the financial foundation and avoiding the political constraints.

TABLE 10.7.9 FUTURE WATER SUPPLIED VOLUME IN DANAO-CARMEN AREA

unit: cu.m/day

Item	Unit	Unit Volume	Number	Supplied Volume
Domestic	Persons	0.15 cu.m/day	41,000	6,150
Industrial	has	80 cu.m/day	450	36,000
Others	L.S.			1,000
Total				43,150

10.7.8 OTHERS TO BE RECOMMENDED

(1) Limit of Withdrawal by Factories

Generally speaking, the withdrawal of factories affect the groundwater condition because these discharge volume is much more than the domestic consumption. And the government encounters the same difficulty to control the groundwater withdrawal, which NWRB usually does monitoring, once the system is in operation. The governments should limit the direct water use from an aquifer from factories and should requires these factories to use the water supplied from the water district or public waterworks or other water system controlled by the government. The financial foundation of public waterworks or water districts will be strengthen by stable and large payment of these factories after its implementation.

(2) Publicity to the People

It is very necessary for the rural people to know who has a responsibility of the well maintenance and importance of water tariff.

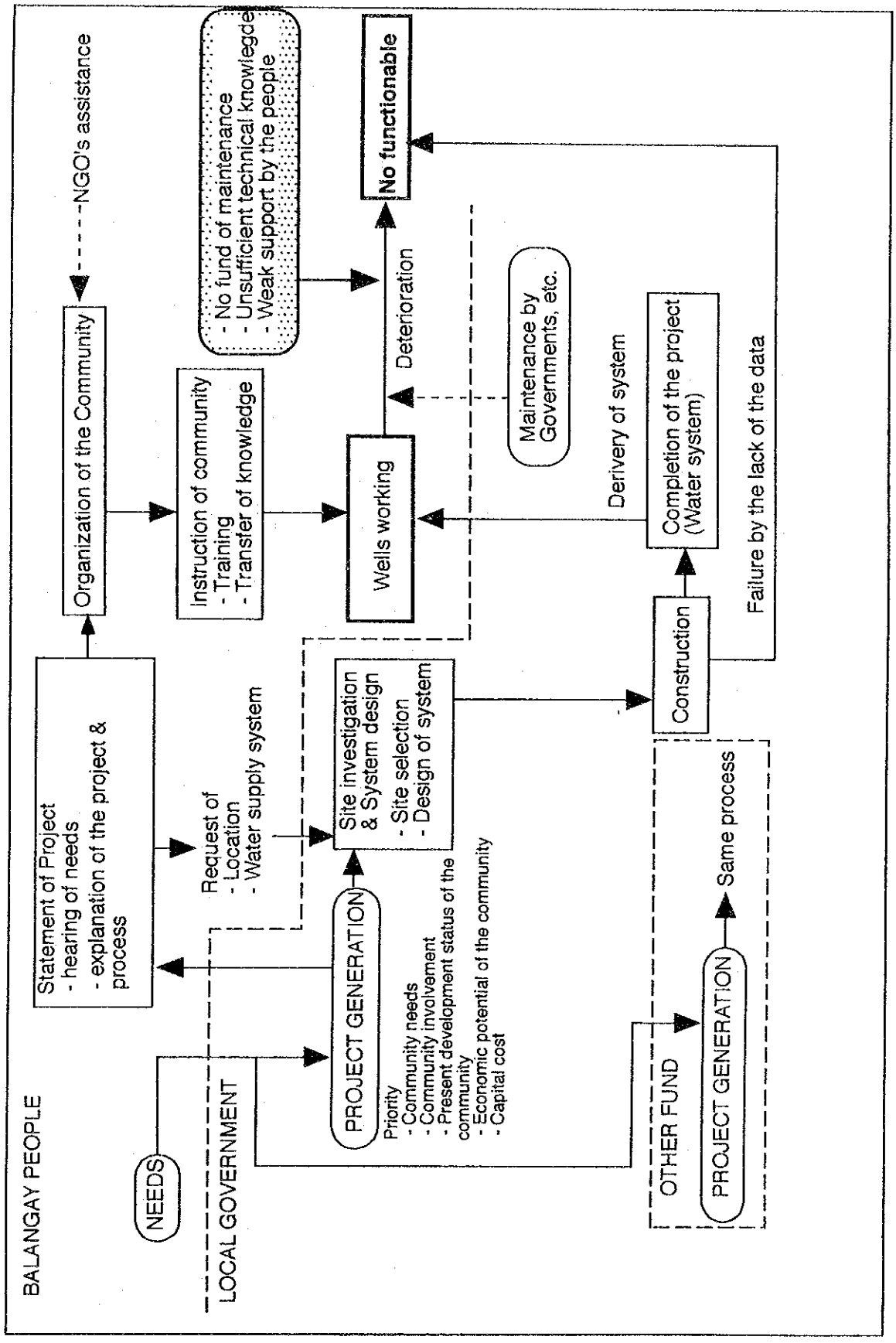


FIGURE 10.7.2 FLOWCHART OF RURAL WATER SUPPLY SYSTEM

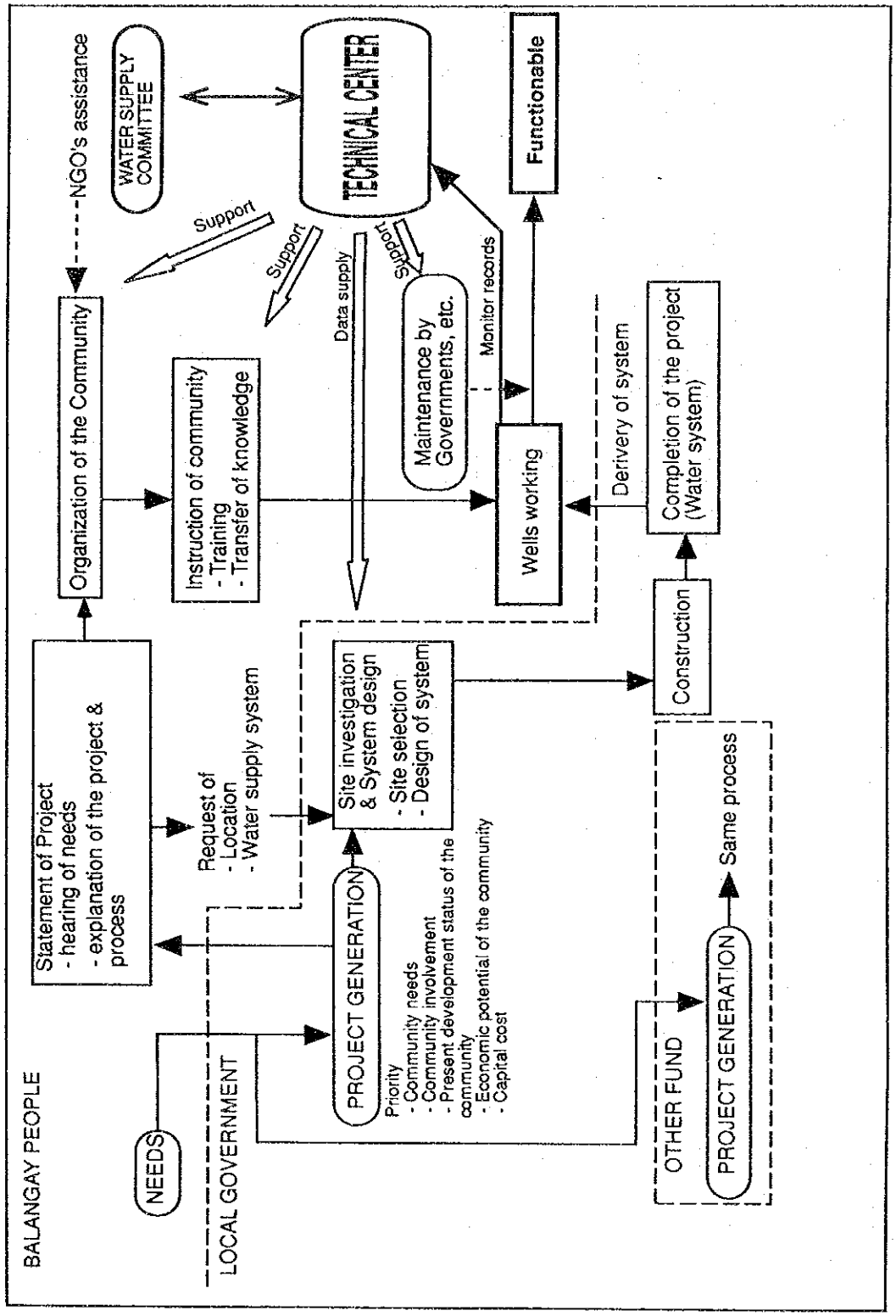


FIGURE 10.7.3. FLOWCHART OF PROPOSED RURAL WATER SUPPLY SYSTEM

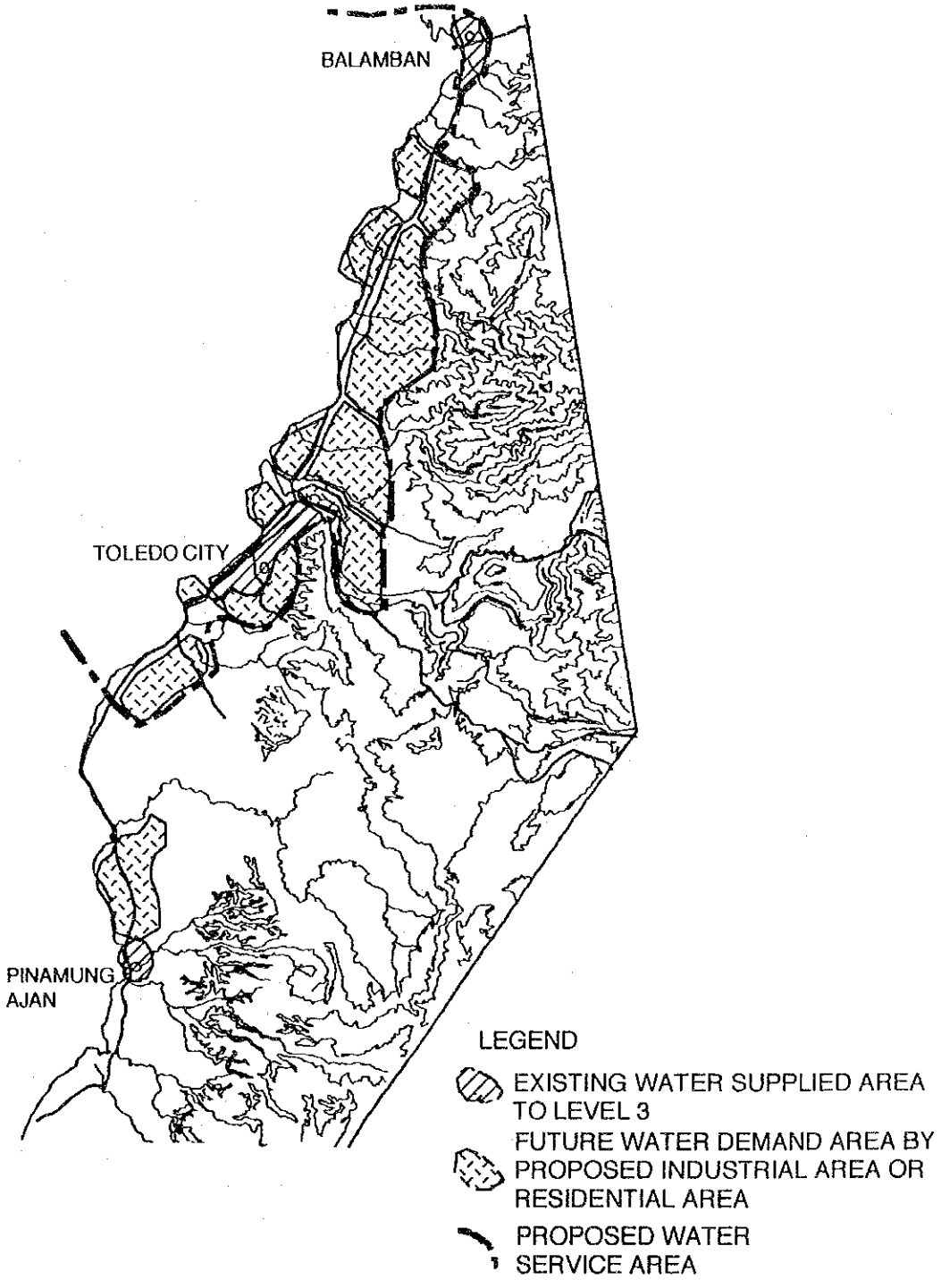


FIGURE 10.7.4 FUTURE SERVICE AREA IN TOLEDO-BALAMBAN AREA

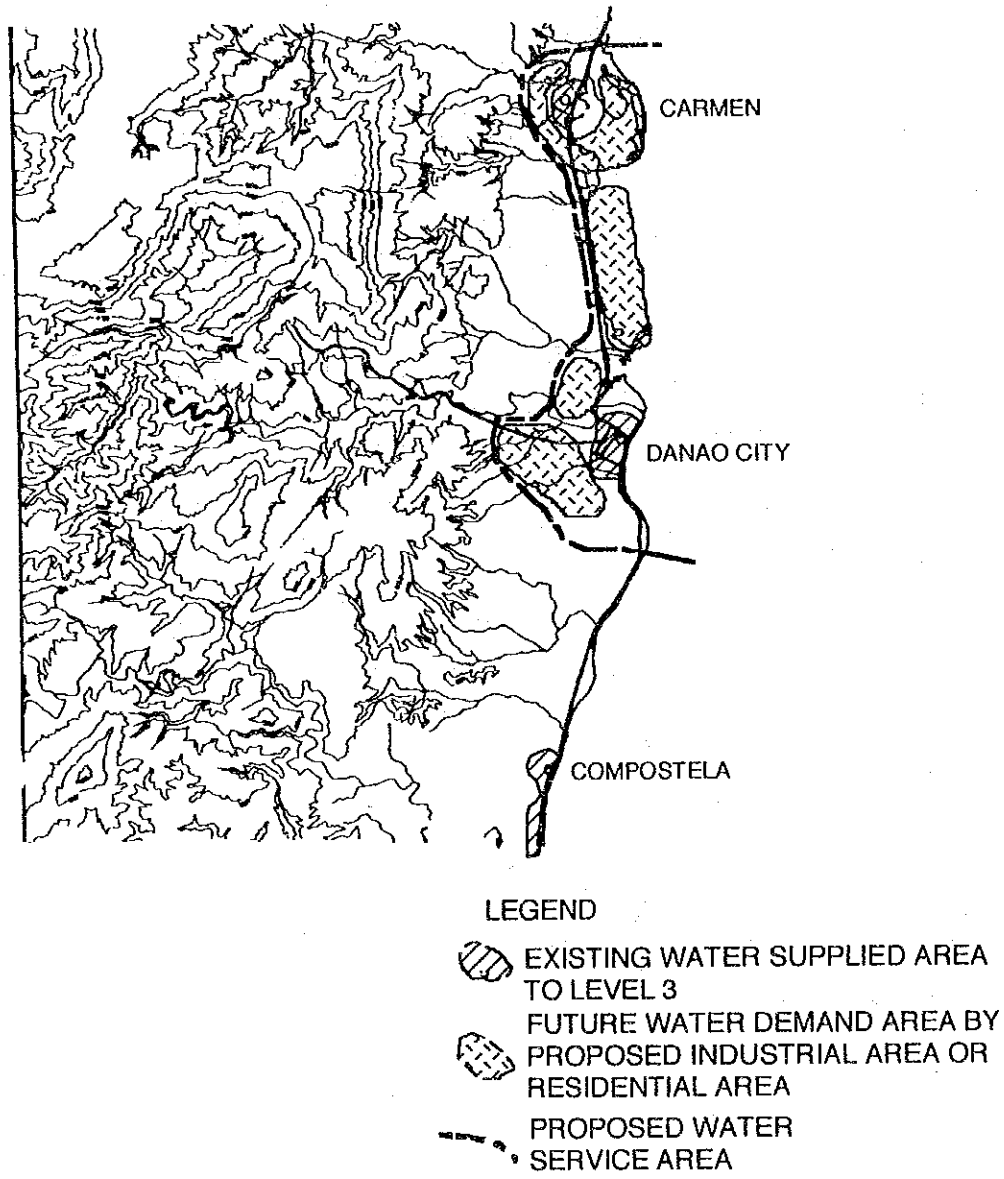


FIGURE 10.7.5 FUTURE SERVICE AREA IN DANAO-CARMEN AREA

10.8 FLOOD CONTROL PLAN

There are substantial project proposals from LGUs to mitigate flood prone in rural area. But, flooding in these areas does not cause serious damages because these are low productive areas such as cropping intensity or less density resident except in some poblacion areas. Thus, it is difficult to implement the large-scale protection works to mitigate flooding due to its low economic benefit.

On the other hand, flooding and inundation is serious problem in urban areas, especially Cebu City. These problems were triggered due to insufficient capacity and inadequate drainage system of the rivers in the locality. A JICA study team for flood control reveals that some areas in Mandaue City are flooded by river passing through it as shown in Figure 10.8.1.

10.8.1 PROBLEMS AND ISSUES

The problems and issues are summarized as follows:

1. Insufficient flood mitigation structures and drainage systems, especially urban areas,
2. Poor maintenance services to drainage systems,
3. No proper drainage system plan based on land use, and
4. Lack of people's awareness on the important of the drainage system and their responsibility of maintaining the for long term use.

10.8.2 DEVELOPMENT FRAMEWORKS

Development frameworks of flood control and drainage system is to improve river and drainage system at placea where:

- Development is accelerated or is expected to be accelerated, and
- The damage by flooding and inundation is presently serious.

10.8.3 PROPOSED PROJECTS

The Study Team proposes the following two projects:

- Metro Cebu Drainage System Development Project
- Master Plan Of Drainage System Of Mactan Island

(1) Metro Cebu Drainage System Development Project

This project involves both flood control and drainage projects. Flood control plan is necessary along the downstream of Mandaue river basin and some rivers in Cebu City because flooding may damage seriously by the high population and industrial areas. Drainage system is necessary of not only the implementation of new system but also repair of existing one which was damaged by siltation or garbage. River improvement project includes: (1) resettlement of squatters along the river side, and (2) the possibility of entering the sea water to aquifer fresh water if dredging the river

bed near river mouth in order to removing the sediment. Drainage system project should link together with the solid waste disposal system, road improvement project, and sewer system.

(2) Master Plan of Drainage System of Mactan Island

Mactan island has a complex land use that the expected tourist resort areas that avoid waste water contamination and the developing industrial area at MEPZ which generates waste water are recognized to coexist. Coexistence of these firms should continue in the future. But there is no existing systematic drainage and waste water collection system in the area. It is expected that the aquifer and sanitation condition in the locality will deteriorate if no drainage system to cater the waste water and rain water . Hence, the systematic drainage system including the sewer is required. This project should link with Mactan land use plan and road plan.

10.9 SEWER SYSTEM PLAN

10.9.1 NECESSITY OF THE SEWER SYSTEM

It is clear that the water quality of rivers and sea around Cebu City is contaminated by the domestic and industrial waste water as mentioned in Captor 7 "Environmental Management." The damage such as diseases related to drinking water increases in urban areas. The absence of sewer system in the locality will continues to deteriorate the urban condition.

Presently, foreign investors take into account seriously the industrial waste water in industrial estates. Before they are interested the cost performance only, now they do take care of the treatment of waste water, polluted air and any other polluted materials which they discharge. Governments in many countries have focus their attention on these, too. In fact, Japanese government requested Japanese companies in 1991 to follow the domestic environmental standards when they built factories in foreign countries. Hence, the industrial estates or factory zones for foreign investors should be necessary to install the sewer system.

Local governments also recognize that the waste water treatment plant and sewer are important and necessary on the urban development.

10.9..2 PLAN OF SEWER SYSTEM

Presently in Cebu City, some commercial centers and supermarkets are undertaking the construction or planning stage to have their own waste water treatment plant as required by Cebu City Government. likewise, subdivision and other urban area in Metro Cebu should put up their own waste water treatment plant to solve waste water pollution in the locality

The "Cebu City Sewerage Project" feasibility study conducted by JICA on 1991 is necessary for immediate implement. Its expense including operation and maintenance should be provided on the policy of "Polluter-Payment-Principle (PPP)." The project is Financial Internal Rate of Return (FIRR) as indicated below were bared on three scenarios of sewer charge. The charges that would be imposed by the system is too much high for the lower class users to pay.

Sewer rates	FIRR
30% of water rates:	4%
40% of water rates:	7%
50% of water rates:	10%

It is indispensable to reconsider the cost allocation as PPP in order to easy implementation. The cost is supported by not only the people, but also beneficiaries by the implementation. The beneficiaries are fisherman, farmer, or hotel owner by improving the water quality and land owner by increasing the land values. Urgently Stage 1 of Phase 1 of the Project should be carried out. And it necessary to implement Phase 1 of the Project until 2010.

The other hand, the waster water from the factories should be controlled by the government regulations immediately and monitor even if no public water treatment.

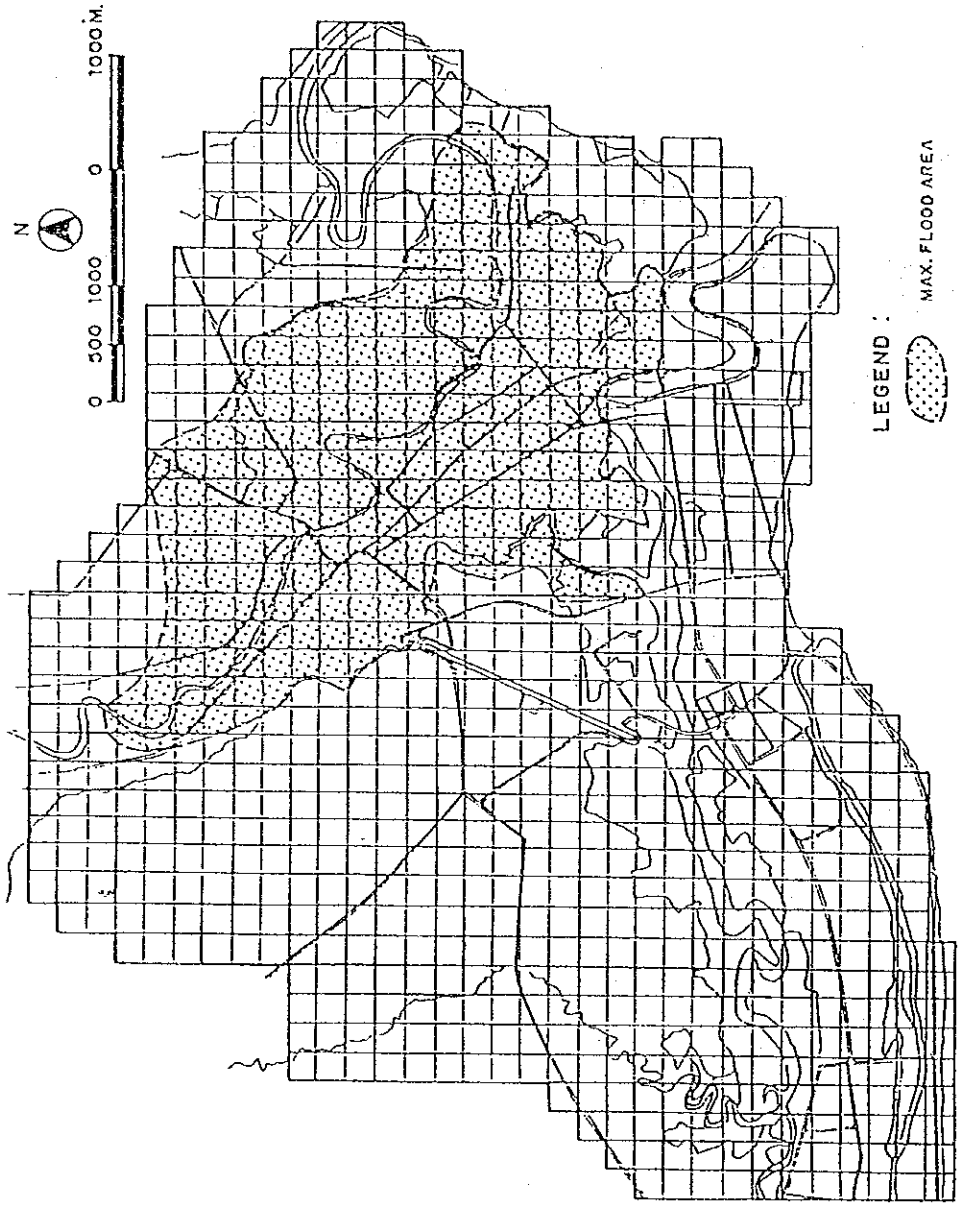


FIGURE 10.8.1 MAXIMUM RECORDED FLOOD AREA

CHAPTER 11

POWER AND ENERGY DEVELOPMENT

CHAPTER 11

POWER AND ENERGY DEVELOPMENT

11.1 THE SITUATION OF ENERGY IN THE PHILIPPINES AND THE STUDY AREA

11.1.1 OVERVIEW OF ENERGY SETTING IN THE PHILIPPINES

Since the oil crisis in the early 70s, the Philippines has embarked on a comprehensive program of energy self-reliance in order to reduce the country's dependence on imported oil.

Towards this end, massive effort to develop indigenous energy resource such as oil and gas, coal, geothermal and non-conventional energy resources have been actively pursued over the past two decades. As a result of efforts, the country has successfully reduced its dependence on imported energy from 92% in 1973, to 55% in 1985.

Beginning 1986, however, the import dependence was again rose, reaching as much as 66% in 1990. Along with this change, by the economic recovery, the increasing commercial energy consumption rose at a rate of 4.7% per annum in the 1986 to 1991 period. During this period, petroleum consumption has grown rapidly at the yearly average of 7.2% and has reached to highest level at 85.5 million barrels in 1990.

With the increased dependence on oil-based power generation and the growth of transport fuel demand energy and oil intensity of the economy continued rise during the period 1985 to 1990.

11.1.2 ELECTRICITY

(1) Power Supply System

The installed capacity of power generation plant in the Philippines is 6,036.8 megawatts in 1990, and plant type is 2,611.9 megawatts or 43.3% in total for oil-based, 2131.9 megawatts or 35.3% in total for hydro plant, 888.0 megawatts or 14.7% in total for Geothermal and 405 megawatts or 6.7% in total for Coal Fired.

(2) Consumption and Generation of Electricity

Power generation in the Philippines at 1990 accounted by 24,799 million kWh, losses by station use and transmission losses (7.6% in total generation) and energy sales in 1990 was 22.915 million kWh, respectively.

(3) Average Rate of Electricity

Electricity sales rate from NPC to the cooperatives, private utility and large industrial consumer is calculated based on generating cost which is different by generation type such as fuel based, Hydro power, Geothermal and coal fired. Mainly, the generation cost is cheaper by hydropower, followed by geothermal, coal fired, and fuel based.

Hydropower is mainly used in Mindanao grid, accordingly the average rate is cheaper (62.5% to total Philippines) than other grids.

Average rate is shown in Table 11.1.1.

TABLE 11.1.1 AVERAGE RATE (P/KWH)

GRID	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
PHILIPPINES	0.3423	0.4166	0.4299	0.5790	0.8754	1.0835	0.9548	0.9038	0.9354	0.9381	1.1263
LUZON	0.3641	0.4480	0.4670	0.6152	0.9740	1.2082	1.0552	0.9793	1.0031	0.9877	1.2049
VISAYAS	0.4078	0.4982	0.5444	0.7244	0.9980	1.0401	0.9063	0.8671	0.9252	1.0385	1.2424
CEBU	0.4520	0.5640	0.6090	0.7320	1.1010	1.0718	0.9479	0.8502	0.9430	1.0710	1.2703
NEGROS	0.3290	0.5260	0.5400	0.6550	0.8580	1.1531	1.0386	1.0936	1.0932	1.1028	1.3133
PANAY	0.4310	0.5250	0.5630	0.7190	1.1660	1.1185	0.7756	0.7322	0.8000	1.0714	1.2735
LEYTE-SAMAR	0.2750	0.2810	0.5300	0.6130	0.7930	0.9583	0.8550	0.8248	0.8462	0.9045	1.1158
BOHOL	0.3400	0.4240	0.4580	0.6640	0.9540	1.1154	0.7742	0.6579	0.7857	1.0851	1.2941
MINDANAO	0.1644	0.1800	0.1859	0.2996	0.3740	0.5205	0.5086	0.5657	0.6252	0.6669	0.7043

Note: Based on Adjusted rates to reflect actual billing to customers.
Sources: NPC Annual Reports NPC-VRC, NPC-MRC, NPC-Financial Data Bank

(4) Comparative Per Capita Electricity Consumption

In 1990, the per capita electricity consumption of the country stood at a low of 380 kWh compared with those of developed and other ASEAN countries.

The following table represents the comparison of the per capita electricity consumption of the Philippines versus the developed and other ASEAN countries.

TABLE 11.1.2 PER CAPITA ELECTRICITY COMSUMPTION

Country	Per Capita kWh C
USA	10,100
Japan	6,300
Singapore	6,218
Korea	2,206
Malaysia	1,216
Thailand	723
Philippines	381
Indonesia	166

11.1.3 POWER SUPPLY SYSTEM IN THE STUDY AREA

In the study area, existing power sources have a total capacity of 333.5 MW. In order to meet future increasing power demand, the National Power Corporation (NAPOCOR) is planning the development of geothermal plant in Leyte and Negros Oriental and the power interconnection between Cebu and Negros and between Cebu and Leyte. The final objective which is already included in the NAPOCOR's corporate plan is to integrate the whole Visayas grid into one grid and eventually interconnect this with the Luzon and Mindanao grids in 1998.

(1) Power Supply Organization

Power supply in Cebu is being generated by the National Power Corporation (NAPOCOR) and is being distributed through various power distribution utilities. Those in the outlying municipalities within the Cebu mainland, power is being distributed by the Electric Cooperatives, namely: the CEBECO I, CEBECO II, and CEBECO III while on the island municipalities, it is being supplied by BANELCO for Bantayan Island and CELCO for Camotes Island. On the other hand, power in Metro Cebu is being distributed by two private utilities, the Visayas Electric Company (VECO) for Cebu City and nearby municipalities and the Mactan Electric Company (MECO) for the island of Mactan. Figure 11.1.1 shows their areas of coverage.

(2) Energy Sales

In 1981, energy sales in the Cebu grid totaled only 240 GWH and rose to 725 in 1990 or average increase of 13.1%. This then increased to 839.00 GWH in 1991 and then to 938.1 GWH in 1992. The average growth rate for this period is 11.8%.

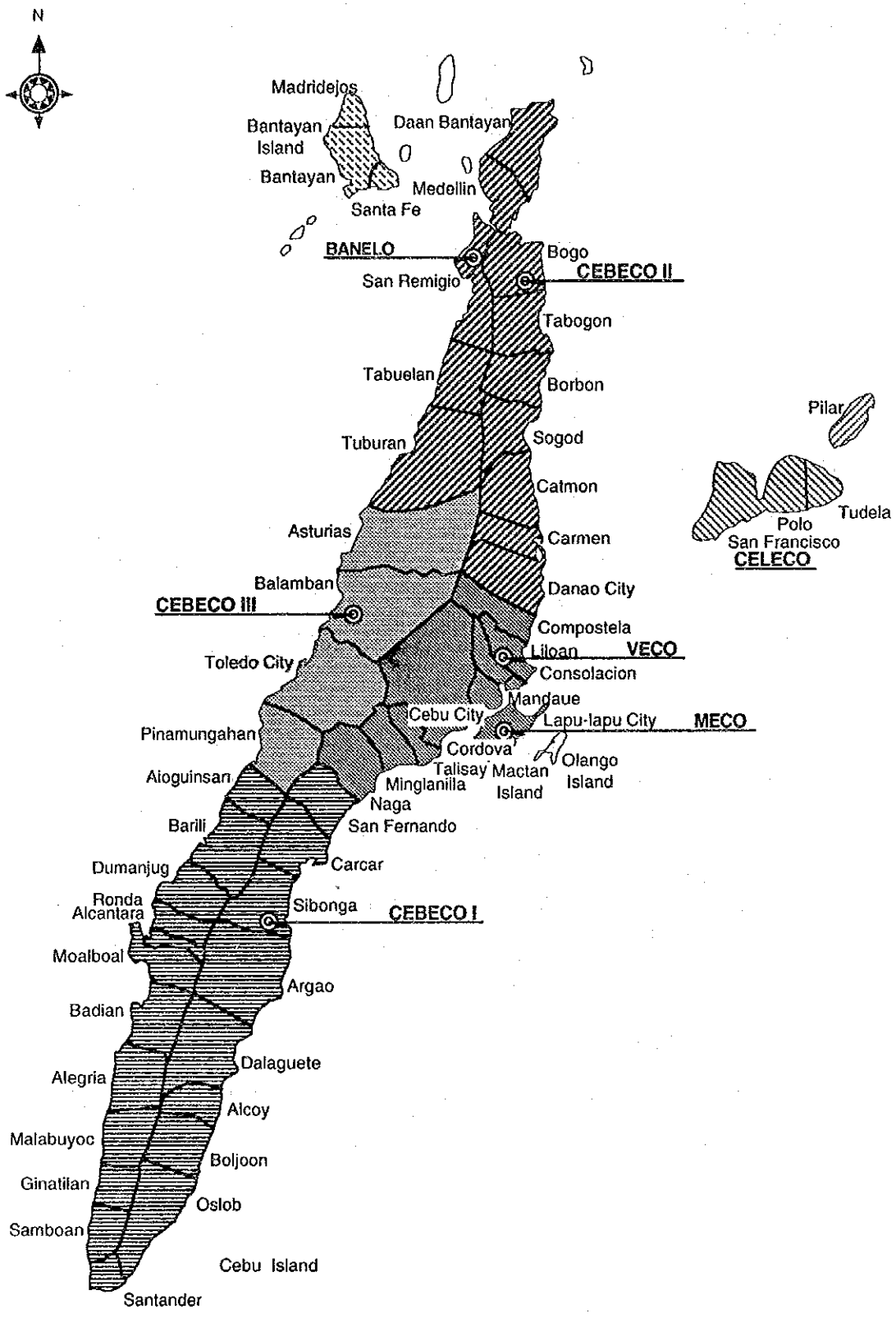


FIGURE 11.1.1 COOP ENERGIZED AREA

(3) Gross Power Generation of Power Plants

Total power generation in the Cebu grid in 1981 totaled 257 GWH and grew at an average of 13.5% until it reached 804.0 GWH in 1990. In 1992, the total power generated by the Cebu grid reached to 879.0 GWH.

(4) Power Supply Facility

Power supply system including power generating plants, transmission and distribution line length and substation capacity are shown in Tables 11.1.3. and 11.1.4. Installed capacity in Cebu grid is 334 MW in 1990 and 396 MW in 1994, or average growth rate of 4.4% from 1990 to 1994. It is noted that the power capacity already includes (1) the 55 MW purchased from Atlas Cosolidated MIninig and Development Corporation, (2) the 396 MW does not include the other generators in Cebu such as VECO and other private groups, and (3) the Cebu

Transmission and distribution line length in Visayas Line length is 806 km at 1981 and 2317 km at 1990, average growth rate is 12 % per annum. Substation capacity in Visayas is 629 MVA at 1981 and 1,649 MVA at 1990, average growth rate is 13.7%. As of 1990, line length by voltage is as follows:

Single line diagram in Cebu grid and power supply system map including expansion plan are shown in Figures 11.1.2 and 11.1.3, respectively.

TABLE 11.1.3 POWER SUPPLY CAPACITY IN CEBU

Plant Name	Capacity (MW)	Commissioned
Naga Coal I	50.0	1981
Naga Coal II	55.0	1986
Cebu Diesel I	43.8	1977-1978
Cebu Diesel II	57.8	1982-1983
Power Barge I, II	64.0	1981
Power Barge IV	32.0	1985
Gas Turbine	30.9	1990
Total	333.5	

TABLE 11.1.4 VOLTAGE AND LINE LENGTH OF VISAYAS LINE

Voltage (KV)	Line Length (Circuit -km)	Line Length (Circuit -km)
138	820	1,309
69	1,370	318
below 69	127	22
Total	2,317	1,649

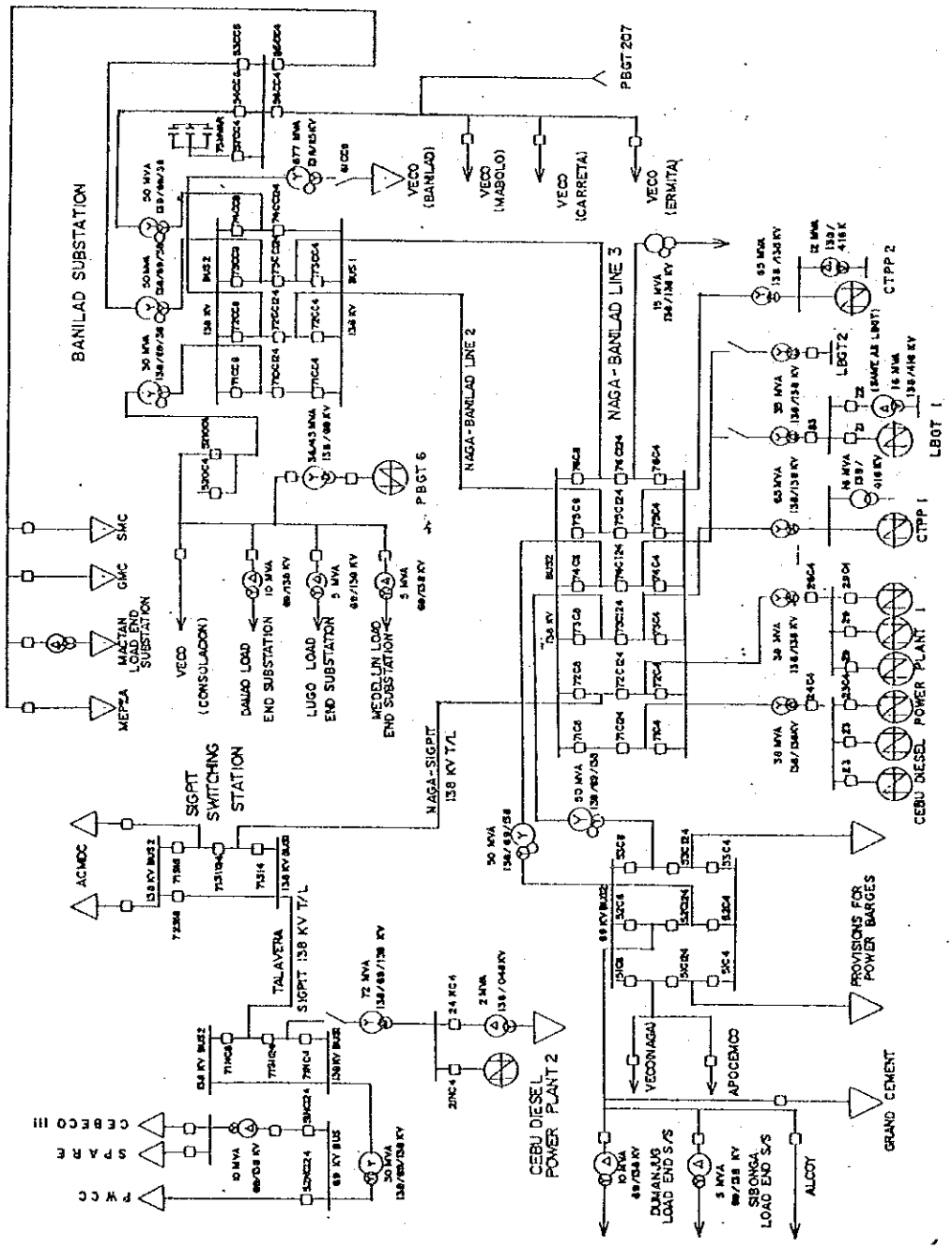


FIGURE 11.1.2 SIGLE LINE DIAGRAM CEBU GRID

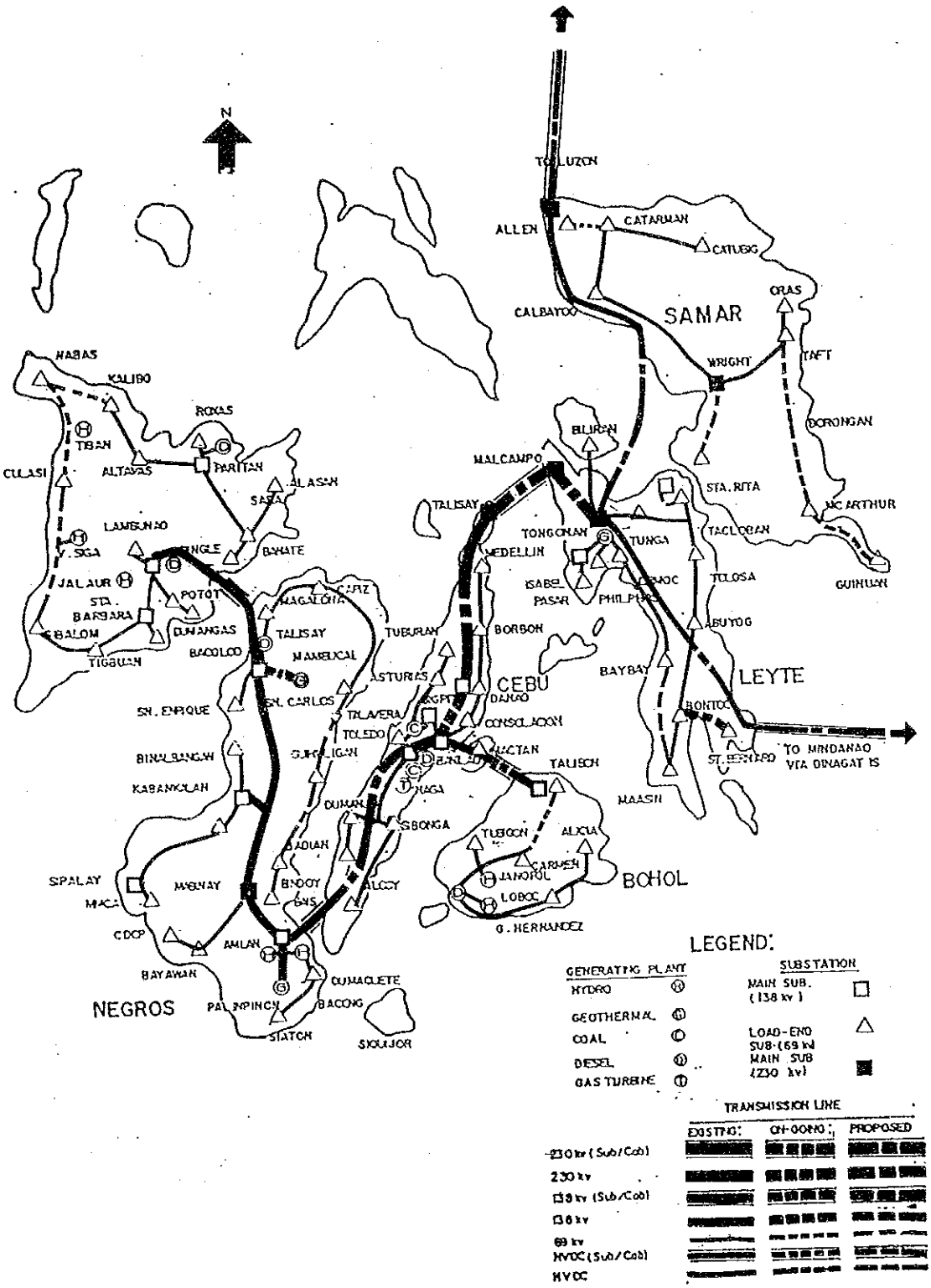


FIGURE 11.1.3 VISAYAS GRIDS SYSTEM DEVELOPMENT MAP

(5) Electrification

As of the second quarter of 1993, the status of electrification in Central Visayas is shown in Table 11.1.5 with 43% of the total households being energized.
This page is for Figure 4.5.2

TABLE 11.1.5 REGION VII STATUS OF ELECTRIFICATION

	Municipalities		Barangay			Total Household Connection		
CO-OP	Coverage	Energized	Coverage	Energized	%	Potential	Energized	%
BOHECO I	26	26	601	499	83	66,749	40,239	60
BOHECO II	21	21	499	324	65	68,817	29,989	44
CELECO I	18	18	366	213	58	66,000	29,630	45
CELECO II	13	13	315	202	64	74,591	34,215	46
CELECO III	5	5	134	73	54	49,158	23,501	48
NORECO I	11	11	285	119	42	60,488	18,490	31
NORECO II	14	14	272	188	69	94,176	41,942	45
BANTAYAN	3	3	47	40	85	15,370	7,155	47
CELCO	4	4	54	41	76	11,000	3,521	32
PROSIELCO	6	6	135	93	69	13,485	4,473	33
Total	121	121	2,708	1,792	66	519,834	233,155	43

(6) Electricity Tariff (Region VII)

Average electricity tariff sold to each of the sectors by the cooperatives are shown in Table 11.1.6.

TABLE11.1.6 AVERAGE EFFECTIVE RATE (P/KWH) AS OF 1993

CO-OP	BOHECO I	BOHECO II	CEBECO I	CEBECO II	CEBECO III
Residential	3.49	3.57	2.85	2.95	2.85
Commercial	3.45	3.53	2.86	2.89	2.84
Industrial	3.46	3.53	2.84	2.49	2.83
Public Building	3.46	3.54	2.82	2.91	2.80
Street Lights	3.38	3.38	2.62	2.82	2.59
Coop (all types)	3.47	3.55	2.85	2.57	2.75
Bulk (NPC)	-	-	-	1.94	1.90

CO-OP	NORECO I	NORECO II	BANTAYAN	CAMOTES	SIQUIJOR
Residential	3.42	3.07	3.26	4.22	3.98
Commercial	3.39	3.05	3.28	4.23	3.90
Industrial	3.48	2.98	3.21	4.39	3.83
Public Building	3.32	3.00	3.25	3.93	3.95
Street Lights	3.31	2.93	3.06	4.20	3.82
Coop (all types)	3.17	3.04	3.25	4.21	3.94
Bulk (NPC)	2.59	-	-	-	-

(7) Power Outage in NPC's Supply System of Visayas Grid

Power outage rate in Cebu is 1.36% in 1991 and 6.84% in 1992. Forced Outage of Power Plant are shown in Table 11.1.7.

TABLE 11.1.7 POWER OUTAGE IN VISAYAS

	Operating Hours		Forced Outage Hours		Forced Outage Rates		% Inc (Dec)
	YTD 1991	YTD 1992	1991	1992	1991 (A)	1992 (B)	(B) - (A) (A)
Cebu Grid	89,939.36	52,054.09	1,243.04	3,822.49	1.36%	6.84%	401.81
CDPP I	21,571.40	15,177.30	26.80	227.18	0.12%	1.47%	1,088.52
CDPP II	7,762.50	9,763.54	104.07	616.18	1.32%	5.94%	348.73
CTPP I	6,477.15	7,342.97	280.58	618.16	4.15%	7.76%	87.01
CTPP II	0.00	1,357.38	720.00	1,116.77	100.00%	45.14%	(54.86)
PPB I	21,682.43	891.39	15.29	0.00	0.07%	0.00%	-
PPB II	0.00	0.00	0.00	0.00	-	-	-
PPB IV	19,865.60	744.20	19.60	17.02	0.10%	2.24%	-
PBGT VI	3,422.10	2,880.21	5.68	24.04	0.17%	0.83%	-
PBGT VII	1,232.80	5,758.10	1.96	173.64	0.16%	2.93%	1,744.14
LBGT I	4,044.34	4,073.80	17.97	18.75	0.44%	0.46%	3.57
LBGT II	3,881.04	4,065.20	51.09	1,010.75	1.30%	19.91%	1,432.56
Negros Grid	43,272.44	38,806.10	167.59	272.15	0.39%	0.70%	80.52
PGPP	25,891.33	22,352.67	135.36	203.37	0.52%	0.90%	-
NGPP	8,678.12	7,795.03	4.23	61.28	0.05%	0.78%	-
AHEP	8,702.99	8,658.40	28.00	7.50	0.32%	0.09%	(73.01)
Bohol Grid	38,608.94	35,847.42	184.93	317.88	0.48%	0.88%	84.39
BDPP	17,834.30	19,190.30	149.13	99.64	0.83%	0.52%	(37.71)
LHEP	20,774.64	16,657.12	35.80	218.24	0.17%	1.29%	651.76
Panay Grid	9,968.23	26,097.38	23.49	467.80	0.24%	1.76%	649.04
PDPP I	3,751.56	9,202.63	22.35	337.41	0.59%	3.54%	497.20
PDPP II	939.80	0.00	0.32	0.00	0.03%	-	-
PPB III	5,276.87	12,633.65	0.82	18.59	0.02%	0.15%	845.68
PPB IV	0.00	4,261.10	0.00	111.80	-	2.56%	-
Leyte Grid	23,845.32	25,562.04	137.10	41.52	0.57%	0.16%	(71.63)
LGPP	23,103.44	25,562.04	136.22	41.52	0.59%	0.16%	(72.33)
PBGI VII	741.88	0.00	0.88	0.00	0.12%	-	-
Visayas	205,634.29	178,367.03	1,756.15	4,921.84	0.85%	2.69%	(217.12)

11.1.4 ORGANIZATION STRUCTURE OF THE ENERGY SECTOR

The structure of electric power administration is shown on Figure 11.1.4. Function of each of the related agencies are described below.

(1) Office of Energy Affairs (OEA)

OEA is the governmental agency is responsible primarily for the formulation, planning, monitoring, implementation and coordination of policies and programs in the field of energy including the power subsection.

(2) National Power Corporation (NPC)

NPC is wholly-owned and controlled by the Government and tasked primarily to undertake the development and production of electric power generation, as well as the transmission of electric power on a nationwide basis. NPC sells by wholesale generated energy to MERALCO for Manila metropolitan area and electric cooperatives for other areas.

(3) Manila Electric Company (MERALCO)

MERALCO is the largest private electric distribution utilities in the Country, and holds the franchise for power distribution in the metropolitan area, including the CALABARZON region.

(4) National Electrification Administration (NEA)

NEA is wholly-owned and controlled by the Government and undertakes the rural electrification programs on an area coverage basis with electric cooperatives to achieve the objective of making electric services available throughout the Country. NEA has jurisdiction over all private power production in other areas not served by NPC's grids.

(5) Rural Electric Cooperative (REC)

A REC is a non-stock, non-profit, member-owned public utility enterprise designed for adequate and reliable electric service at reasonable cost to its members. A REC generally covers an average of 10 municipalities with a total population of 100,000 to 500,000 people. REC's of 118 in total have been established as of 1988 throughout the Country for supplying electric energy to the end users through their own power distribution systems.

(6) Energy Regulatory Board (ERB)

The ERB has the right to permit the licensing of crude and product importation as well as the regulation of petroleum refining and marketing operations. Similarly, ERB was empowered to regulate coal importation. The ERB has also jurisdiction over the operations of and tariff setting for the private electric utilities.

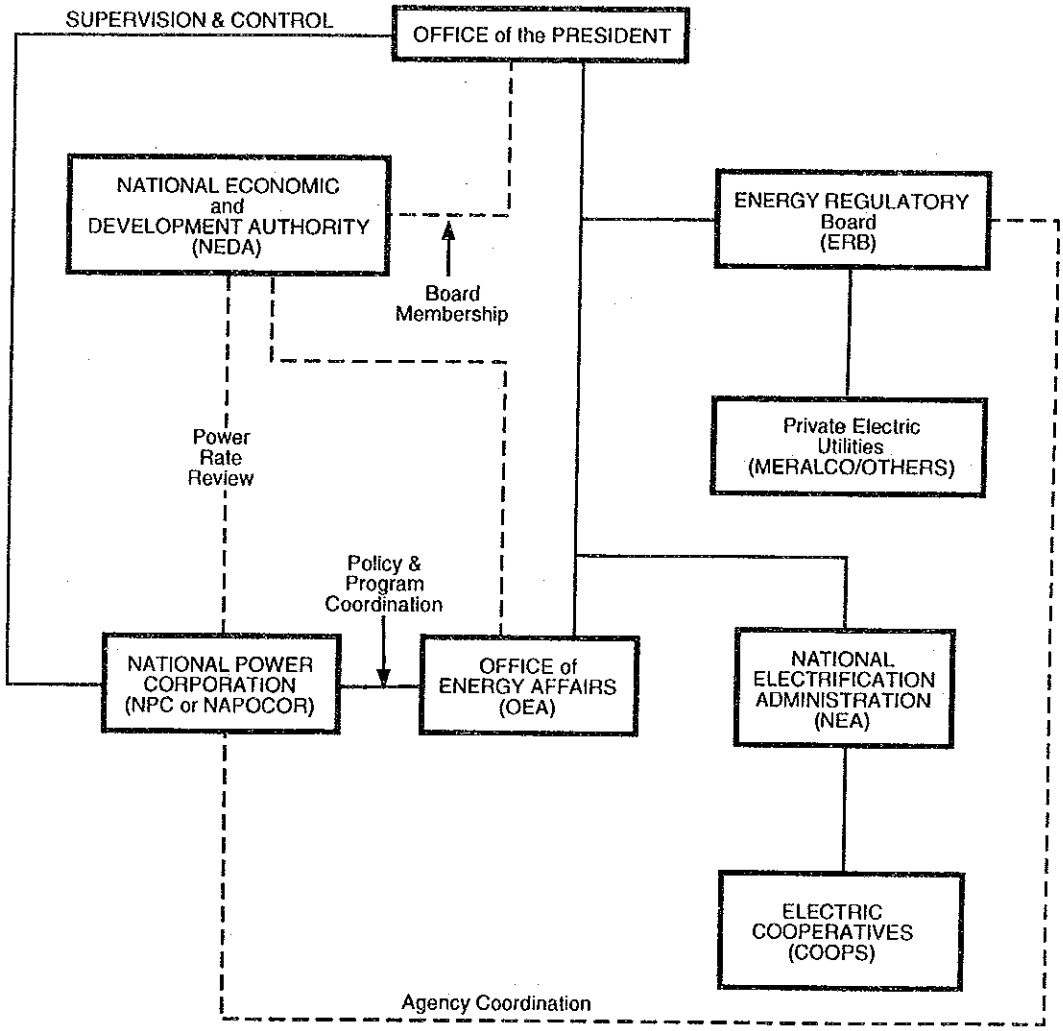


FIGURE 11.1.4 ORGANIZATIONAL STRUCTURE OF THE PHILIPPINE ENERGY INDUSTRY

(7) National Economic Development Authority (NEDA)

The NEDA gives macroeconomics parameters to line energy agency to formulate their program targets and also exercise some form of regulatory authority over the energy sector.

Project with capital investment of at least $10 million must be approved by Investment Coordinating Committee chaired by NEDA.

(8) Other electric utilities

Other major private utilities operating on islands area:

- Luzon region : San Fernando Electric & Power Co., and Philippines Power Development Co.
- Visayas region : Visayas Electric Co., Mactan Electric Co. and Panay Electric Co.
- Mindanao region : Cotabato Electric Power & Lighting Co., and Davao Electric Light & Power Co.

11.2 OVERALL OBJECTIVES, POLICIES AND STRATEGIES FOR POWER AND ENERGY DEVELOPMENT

11.2.1 OBJECTIVES

For promoting a sustainable economic growth and social uplift of the citizenry, the Philippine energy program should supply the adequate energy to economic activities and basic daily life.

For achieving such goal the energy program was formulated as follows:

1. Supply objective:	To provide adequate timely and reasonably priced energy forms and equitably distribute them to markets in support of production goals.
2. Demand objective:	To promote the judicious and efficient use of energy resources within techno-economic bounds.
3. Environmental objective:	To accomplish both the above objectives in an environmentally sustainable manner.

11.2.2 POLICIES AND STRATEGIES

The specific energy policy is necessary to formulate the national energy framework for serving as guidelines within the 1992-2000 period. These guidelines can be elaborated as follows:

1. Sustain momentum in the exploration and development of oil and other indigenous resources.
2. Diversity sources of energy imports.
3. Intensity encouragement of private sector participation in energy projects.
4. Enhance market-based reorientation of domestic energy pricing.
5. Promote fuel-substitution and diversification in power generation.
6. Intensity promotion of energy conservation and energy-efficient techniques.
7. Enhance assessment of and planning for the energy needs of countryside development.
8. Enhance integration of environmental concerns in the planning and implementation of energy projects.
9. Rationalize operation of energy institutions and strengthen coordination of energy policy and program execution.

11.2.3 ENERGY RESOURCE DEVELOPMENT PROGRAM (1992-2000)

(1) Projected Energy Consumption

The economic reorientation since 1986 has stressed the primacy of adequate energy to support the country's development aspirations.

The Philippine Energy Plan for the decade of 1990s provide a framework for an optimum mix of specific policies and strategies for attaining great reliability of energy supply, efficiency of energy use, and environmental sustainability.

Philippine energy demand is forecast to rise by 7.1% per year between 1992 and 2000. By the year 2000, national energy demand is projected to reach 219.8 MMBFOE, almost double the 1991 volume of 118.2 MMBFOE.

TABLE 11.2.1 PROJECTED ENERGY CONSUMPTION

(Percent of Total)

	1992	1995	2000
Indigenous	35.1	37.5	38.0
Oil & Gas	2.1	2.2	0.7
Coal	3.9	6.0	7.0
Hydro	8.4	7.1	5.8
Geothermal	7.8	9.9	12.9
Non conventional	13.0	12.3	11.5
Imported	64.9	62.5	62.0
Oil	59.9	54.8	50.8
Coal	5.0	7.8	11.3
Total Energy	100.0	100.0	100.0
Total Volume (MMBFOE)	127.4	155.8	219.8
Ave. Annual Growth, %	6.9	7.1	
Power Use, %	37.5	40.0	41.0
Oil Share in Power,%	48.2	32.1	16.0

(2) Energy Resource Assessment

In line with the national policy of reducing the country's dependence on imported energy sources. NAPOCOR, together with other government agencies, is continually identifying and developing indigenous energy potentials.

(a) Hydro potentials

A total of about 14,367 MW of hydro power potentials has been identified in 293 sites throughout the country. This include the 2,214 MW of hydroelectric power plants already operational or ready for operation as of end 1922. In the main island of Luzon, 8,874 MW out of 10,100 MW of hydro potentials remain to be developed in the future.

For the Visayas, around 638 MW of untapped hydroelectric power resources were identified while in Mindanao, 2,641 MW can still firmness. On a country wide basis, around 12,153 MW of hydro capacity or around about 84% of the total potential capacity, offer an opportunity for future development.

(b) Geothermal reserves

Geothermal energy resources have been initially in thirty one (31) sites to have a total potential capacity between 2,205 MW and 3,405 MW. Of these geothermal potentials, 887 MW are already being utilized. Five (5) sites with possible geothermal resources of 588 to 818 MW are now under development stage while two (2) sites with a potential of 180 to 410 MW are under advanced exploration stage. The remaining sites, with a potential of 550 to 1,290 MW, are still under preliminary exploration stage.

(c) Coal deposits

Coal deposits in the country are estimated at 521 million tons of mine reserve. This reserve is capable of supporting a maximum of 1,820 MW of coal-based capacity. Semirara Island and Cagayan Valley in Luzon account for the largest reserves of 93 and 88 million tons, respectively. Surigao and Zamboanga in Mindanao represent a total of 45 million tons, while the rest have less than 10 million tons per locations.

(d) Natural gas reserves

The estimates of the natural gas reserve in Palawan are capable of sustaining 1,760 MW of power generation for 15 years. At the earliest, full utilization of the reserves can be realized only before the turn of the century at the earliest.

(e) Imported energy options

NAPOCOR is cognizance of the possibility that its indigenous energy reserves may not be enough or cannot be developed in time to meet the country's requirements. As such, NAPOCOR also considers the use of imported energy: oil, coal and liquefied natural gas (LNG)

(3) Development of Energy Resource

(a) Energy supply requirements

The geothermal energy resources represent the largest share in the supply mix starting 1993. From 41.0 MMBFOE in 1991, consumption of indigenous energy fuels will be more than double at 83.5 MMBEOF by the year 2000. Consequently, their contribution to the energy mix is anticipated to grow from 35% in 1991 to nearly 40% at the end of the plan period.

Meanwhile, due to volume and specific quality requirements of end users, the share of imported coal will remain on a rising trend, from the 1991 level of 2.6% to 7.0% and 10% by 1995 and 2000, respectively.

At the end of the planning horizon, the energy mix will consist of 51% imported oil, 13% geothermal, 12% non conventional, 11% imported coal, 7% domestic coal, 6% hydro, and 1% domestic oil.

Annual Program Targets is shown on Table 11.2.2.

TABLE 11.2.2 ANNUAL PROGRAM TARGET

	1995		1996		1997		1998		1999		2000	
	Vol.	%	Vol.	%	Vol.	%	Vol.	%	Vol.	%	Vol.	%
Indigenous Energy	58.4	37.5	60.6	36.5	67.3	37.6	75.4	39.4	79.2	38.5	83.5	38.0
I. Conventional	39.2	25.2	40.4	24.3	46.0	25.7	52.9	27.6	55.3	26.9	58.1	26.5
Oil	3.4	2.2	2.9	1.7	2.5	1.4	2.1	1.1	1.8	0.9	1.5	0.7
Coal	9.3	6.0	9.7	5.9	10.3	5.8	13.4	7.0	13.4	6.5	15.4	7.0
Hydro	11.0	7.1	11.0	6.6	11.0	6.2	11.0	5.8	11.0	5.4	12.8	5.8
Geothermal	15.5	9.9	16.8	10.1	22.2	12.4	26.4	13.8	29.1	14.2	28.4	12.9
II. Nonconventional	19.2	12.3	20.2	12.2	21.3	11.9	22.6	11.8	23.9	11.6	25.3	11.5
Bagasse	8.6	5.5	9..41	5.7	10.3	5.8	11.3	5.9	12.4	6.0	13.6	6.2
Agrowaste	10.1	6.5	10.3	6.2	10.5	5.9	10.7	5.6	11.0	5.3	11.2	5.1
Others	0.5	0.3	0.5	0.3	0.5	0.3	0.5	0.3	0.6	0.3	0.6	0.3
Imported Energy	97.4	62.5	105.6	63.5	111.6	62.4	116.0	60.6	126.3	61.5	136.3	62.0
Oil	85.3	54.8	88.8	53.4	90.8	50.8	98.6	51.5	105.5	51.4	111.6	50.8
Coal	12.1	7.8	16.8	10.1	20.7	11.6	17.4	9.1	20.8	10.1	24.7	11.3
Total	155.8	100.0	166.3	100.0	178.9	100.0	191.4	100.0	205.5	100.0	219.8	100.0
Growth rate (% over prev. year)		6.6		6.7		7.6		7.0		7.3		7.0
Power Use (% of Total)	61.6	39.5	66.3	39.9	72.3	40.4	77.7	40.6	83.7	40.7	90.1	41.0
Oil share in power use (%)	19.8	32.1	17.3	26.1	14.1	19.5	15.4	19.8	15.5	18.6	14.4	16.0

(b) Oil and gas

Development activities in the sector shall focus on the recent oil and gas discoveries in northwest Palawan, namely West Linapacan, Octon, Calauit, and Camago. Natural gas production is expected to commence in 1998, subject to results of further exploratory drilling in the Camago area.

In Linapacan and Octon, expected output from these oil fields should boost domestic oil production to 2.7 million barrels in 1992 until it reaches a peak of 4.0 million barrels by 1994, translating to 3.5% share of total energy needs for that year.

(c) Geothermal

The geothermal development program is most expected to support the national power development program and can be able to supply relatively cheaper electricity for the country. The development at least six new fields is scheduled to be undertaken up to the end of the decade. These will make available steam fields capacity totaling 2,839 MW by that final year.

By 1993, additional 150 MW capacity from the Bacon-Manito area in Luzon will come on-stream. In the Visayas region, the huge geothermal potential of Leyte and Palinpinon shall be developed in line with the plan for the total interconnection of the country into single grid by 1997 to maximize resource utilization.

Installed geothermal power generating capacity is programmed to increase from the present level of 888 MW to 2,483 MW by the year 2000, generating accumulative output of 104 billion Kwh for the 1992-2000 period. This means an aggregate fuel oil displacement of 173.3 million barrels.

(d) Coal

The production of coal rose from 1.3 million MT in 1992 to 4.4 million MT in 2000, for an average growth rate of 13.6% yearly. This will result in an aggregate displacement of 88.8 million barrels of fuel oil for the plan period.

The bulk of production is expected to come from the main coal bearing areas of Semirara, Cebu, Surigao and Zamboanga del Sur.

The program targets is to increase proven reserve to 486 million MT by the end of the decade. Meanwhile coal imports will continue to provide the specific quality requirements of end users.

New and clean coal technologies in developed countries such as gas, coal-oil and coal-water mixture, coal-briquetting, and liquefaction shall likewise be promoted. Coal area in the Philippines is shown in Figure 11.2.1.

(e) Hydro electric power

Although the use of hydro power is expected to grow by a yearly average of 4.5% its share will decline as a proportion of total energy demand from about 8% in 1992 to 6% in the year 2000. Programmed hydro capacity additions of NPC up to the end of the decade will total 354 MW.

This should bring installed hydro capacity 2,509 MW by 2000. In addition, mini-hydro projects with an aggregate capacity of 29 MW will be undertaken by private developers to augment power supply in small and isolated power grids.

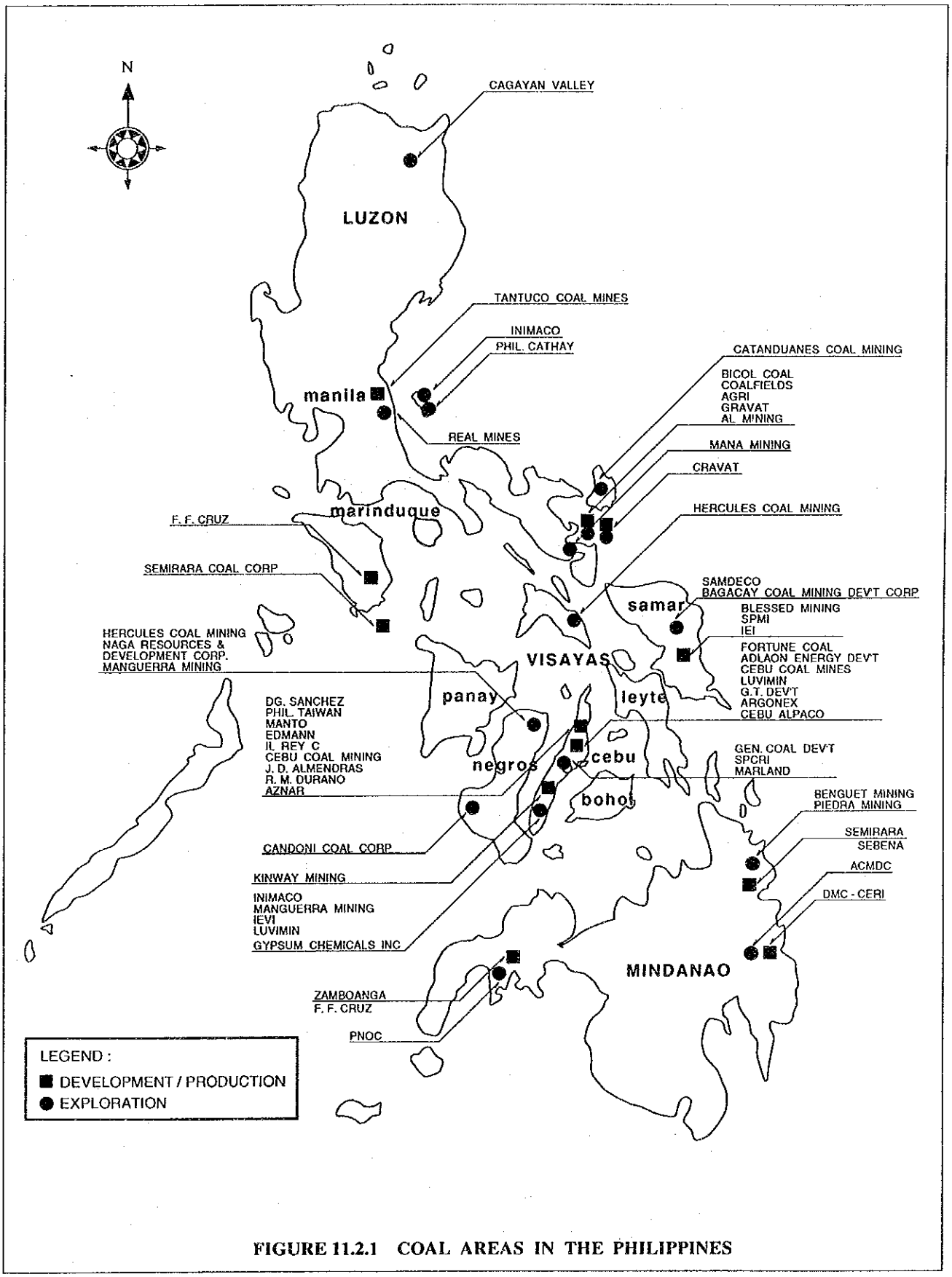


FIGURE 11.2.1 COAL AREAS IN THE PHILIPPINES

(f) Non-conventional energy

The consumption of non conventional energy derived from biogas, agri-industrial wastes and biomass is projected to increase modestly from an estimated level of 16.5 MMBFOE in 1992 to 23.5 MMBFOE in 2000, of at a growth rate of 4.5%.

(g) Power development

The power development features the installation of largely indigenous resource based generating capacity and the interconnection of the fragmented power network into a single national grid. The period 1991-1992 focuses on the installation of diesel and gas turbine plants and the rehabilitation of oil based and coal fired plants to meet short to medium term demand. Total capacity addition for the planning horizon is 5,397 MW.

This should increase the country's power generation capacity from the present 6,789 MW to 12,186 MW by the year 2000.

The expanded use of hydro power, geothermal and coal fired plants is expected to effect a significant shift in the power supply structure from the present 48% dependence on oil-based capacity to only 16% by the end of the plan period.

Cumulative Installed Generating Capacities by Plant Type is shown in Table 11.2.3.

TABLE 11.2.3 CUMULATIVE INSTALLED GENERATING CAPACITY BY PLANT TYPE (MW)

	1992	1993	1994	1995	1996	1997	1998	1999	2000
Hydro	2,236	2,241	2,241	2,241	2,241	2,241	2,241	2,241	2,509
NPC	2,212	2,217	2,217	2,217	2,217	2,217	2,217	2,217	2,485
NEA	24	24	24	24	24	24	24	24	24
Coal	405	405	1,005	1,655	1,955	2,305	2,305	2,605	3,205
NPC	405	405	705	1,355	1,655	2,005	2,005	2,305	2,905
PU	0	0	300	300	300	300	300	300	300
Geothermal	888	1,123	1,143	1,323	1,483	1,923	2,263	2,483	2,483
Diesel/Oil	3,457	3,457	3,463	3,463	3,463	3,463	3,469	3,469	3,469
NPC	3,229	3,229	3,235	3,235	3,235	3,235	3,241	3,241	3,241
NEA	69	69	69	69	69	69	69	69	69
PU	159	159	159	159	159	159	159	159	159
MERALCO	0	0	0	0	0	0	0	0	0
Combined Cycle	0	520	520	520	520	520	520	520	520
Total	6,986	7,746	8,372	9,202	9,662	10,452	10,798	11,318	12,186
NPC	6,734	7,494	7,820	8,650	9,110	9,900	10,246	10,766	11,634
NEA	93	93	93	93	93	93	93	93	93
MERALCO	0	0	0	0	0	0	0	0	0
PU	159	159	459	459	459	459	459	459	459

Notes:
1) Capacity of self-generating industries is not included.
2) % MW Janopol hydro power plant is included in NEA capacity.
3) The 300 MW caol plant of Magellan Utilities (PU) is expected to be commisioned by mid 1994.
4) NPC's additional Diesel installations for small islands are counted.
5) Diesel generator set of NEA's RECs estimated based on NEA's 1986 status report less those taken over by NPC.

(h) Economic ranking of development options

Table 11.2.4 shows the various development options to their cost of producing a kilowatt-hour electric energy. The geothermal alternative remains as the least cost option, followed by imported coal, combined cycle, gas turbine and hydro Simple cycle gas turbine ranks last among alternatives.

TABLE 11.2.4 PRODUCTION OF COST CANDIDATE GENERATION PROJECTS

Plant	Capacity (MW)	Capital Cost (S/MW)	Plant Factor (%)	Lead Time	Production Cost (P/kWh)
Geothermal	120	1,571	80	4	1.25
Plant		1,190			
Field		535			
Coal	300	1,282	75	4	1.60
Combined-Cycle	300	893	75	2	1.66
Gas Turbine	100	466	15	1	4.17
Hydro	390	1,158	36	7	1.98

Notes: 1) Production Cost with IDS and useing levelized fuel cost.
2) Crude Oil, leveleized Cost is $24.55BBL.
3) Imported Coal, levelized cost is $40.96/MT
4) Exchange rate is P28 per dollar.
5) IDS is 12% per annum.

(i) Electrification

As a major force for rural development, the government's rural electrification program is geared towards accelerating the pace of rural electrification to achieve a higher rate of growth and improve the quality of life in the countryside.

By 1992, the total electrification of all municipalities in the franchised area of Rural Electric Cooperatives (RECs) will have been completed.

Electric service is expected to cover an additional 2.3% of all rural households every year, thereby attaining a 77% electrification level by the year 2000.

This is equivalent to a total of 4.7 million households energized.

(j) Downstream infrastructure plan

To meet the expected growth in petroleum demand, the oil refining subsection has programmed to undertake capacity expansion. This will increase the capacity utilization of both crude oil and secondary process units. Philippine Shell Petroleum Corporation is pouring investments into new refinery with a capacity of 110 thousand barrels per stream day (MBSD), while the Philippine National Oil Company is presently undertaking a study that with look into required refining capacities to provide the basis for its investment decision.

(3) Capital Investment Requirement

The ten-year energy program shall require capital investments of at least ₱401.7 billion.

The projected foreign exchange component is ₱274.2 billion (68%) while the local component is 127.5 billion.

Power development still represents the most capital-intensive energy sector, taking up ₱277.9 billion or 70% of total estimated investments for the ten-year energy program. Electrification follows 15% or ₱59.4 billion. The balance of 13% or ₱54.8 billion shall be channeled for energy resource development activities.

The figure on the downstream sector will involve a total investment of ₱9.5 billion over the plan period for expansion of petroleum facilities. All told, government expenditure account for about 81% or ₱326.5 billion.

The balance which translates to some ₱75.1 billion is expected to come from private sector investments.

11.2.4 POWER DEVELOPMENT PROGRAM (1993-2005)

(1) Energy Sales Forecast

In Luzon, 1992 energy sales of 18,880 GWH is expected to reach 32,420 GWH by 1998 and 65,360 GWH by 2005. This is equivalent to an annual average growth rate of 9.4% during the period 1993-1998, 10.5% for the period 1999-2005, and 10.0% for the planning years 1993-2005.

In the Visayas, the energy sales will grow at a compounded growth rate of 13% for the period 1993-2005 from an absolute level of 2,307 GWH in 1992 to 11,720 GWH in 2005. A compounded rate of 14% is indicated for the period 1993-1998 and 12% during 1999-2005.

For the first six years, 1993-1998, energy sales will grow at an average annual growth of 13.5% and then to 15.6% in the next seven years, 1999-2005.

The aggregate electricity sales for the Philippines will grow by 10.6% for the period 1993-1998, increasing slightly to 11.8% for the next seven years. For the period 1993-2005, the average annual growth rate will be about 11.3%.

Table 11.2.5 provides the summary of the resulting energy sales and power demand forecast for the various grids.

(2) Power Demand Projection

The electricity sales projections translate to the following annual average increase in power demand. For the period 1993-1998, the average yearly increase in power demand is 487 MW in Luzon, 85 MW in the Visayas and 165 MW in Mindanao or total yearly increase of 735 MW for the whole country.

On the other hand, for the last seven years of the planning horizon, the average annual increase in power demand for all the grids was projected to be more than double: 1,100 MW in Luzon, 165 MW in Visayas, and 395 MW in Mindanao, or an equivalent countrywide yearly increase of 1,700 MW.

TABLE 11.2.5 SYSTEM LOAD FORECAT

	Energy Sales in GWH				Peak Demand in MW			
	Luzon	Visayas	Mindanao	Philippines	Luzon	Visayas*	Mindanao*	Philippines
Actual								
1986	13,535	1,355	2,960	17,850	2,435	309	489	3,233
1987	14,980	1,305	3,146	19,431	2,592	334	533	3,459
1988	16,319	1,768	3,486	21,573	2,780	358	573	3,711
1989	17,142	1,881	3,708	22,731	2,938	378	618	3,934
1990	17,638	1,924	3,761	23,323	3,023	381	626	4,030
1991	18,123	2,138	4,010	24,271	3,045	427	730	4,202
% Growth Rate								
(1987-1991)	6.01	9.55	6.26	6.34	4.57	6.68	8.34	5.38
Forecast								
1992	18,880	2,307	4,237	25,424	3,250	475	727	4,452
1993	19,874	2,639	4,892	27,405	3,463	511	837	4,811
1994	21,592	3,125	5,381	30,098	3,762	600	920	5,282
1995	23,678	3,501	6,027	33,206	4,126	663	1,031	5,820
1996	26,051	3,956	6,841	36,848	4,539	752	1,183	6,474
1997	28,913	4,510	7,832	41,255	5,038	858	1,354	7,250
1998	32,420	5,142	9,046	46,608	5,732	978	1,564	8,274
% Growth Rate								
(1993-1998)	9.43	14.29	13.47	10.63	9.92	12.79	13.62	10.88
1999	37,400	5,913	10,472	53,785	6,613	1,124	1,810	9,547
2000	42,022	6,794	12,123	60,939	7,430	1,291	2,096	10,817
2001	46,561	7,872	14,184	68,617	8,232	1,495	2,452	12,179
2002	51,031	8,821	16,451	76,303	9,023	1,675	2,844	13,542
2003	55,623	9,772	18,919	84,314	9,977	1,856	3,271	15,104
2004	60,295	10,526	21,756	92,577	10,816	2,000	3,761	16,577
2005	65,360	11,270	25,020	101,650	11,724	2,143	4,326	18,193
% Growth Rate								
(1993-2005)	10.54	11.86	15.64	11.78	10.76	11.86	15.64	11.91
(1999-2005)	10.02	12.98	14.64	11.25	10.37	12.29	14.70	11.44

Note: * Non-coincident

(3) Generation Projects

The power program calls for a total capacity addition of 20,698 MW during the period 1993-2005. Coal at 2,800 MW (14%), hydro at 1,872 MW (9%), geothermal at 1,673 MW (8%), oil -based capacity in the form of diesel, gas-turbine combined cycle unit at 4,753 MW (23%), and other base-load plants which are still identified at 9,600 MW (46%). Table 4.4.2 summarizes the Power Development Plan (PDP) capacity additions by plant type However, there are power projects in the Luzon grid totaling to about 9,600 MW where their sites and type are still to be identified. It can also be noted that the additional power plant installation in the Cebu grid is reflected in the table during the plan period.

(4) Generating Capacity Mix

With the implementation of the power program, NAPOCOR installed capacity will increase from 6,700 MW in 1992 to 11,400 MW in 1998 and then to 25,000 MW by the year 2005. The projected overall capacity already considers the retirement of about 2,200 MW oil-based power plans.

(5) Energy Generation Mix

The generation mix is characterized by energy production from indigenous sources, imported fuel and still to be identified other baseload plants. The share of indigenous component will drop from 43% in 1992 to 29% in 2005.

Likewise, the share of imported fuel will decrease from 57% in 1992 to 20% in 2005. The other based-load plants will initially contribute 4% in 1998 increasing to 51% in 2005.

Specifically, geothermal will increase from 22% in 1992 to 36% in 1998 then drop to 16% in 2005. On the identified imported fuel oil, the share of coal will be 21% in 1998 and 14% in 2005 from a 1992 level of 3%. Fuel oil from a 1992 share of 54% will decrease to 23% in 1998 and 6% in 2005.

Table 11.2.6 presents the detail of the energy generation mix.

TABLE 11.2.6 GENRATION MIX (GWH)

	Hydro	Geo-thermal	Oil Bunker	Oil Dist.	Coal Local	Coal Imported	Base Load	Total
1992	4,270	5,693	10,899	2,713	1,154	829	0	25,558
1993	4,953	6,577	11,434	2,885	1,519	863	0	28,231
1994	5,066	8,078	15,048	1,806	1,558	948	0	32,504
1995	5,197	8,832	16,383	1,419	1,941	952	0	34,724
1996	5,197	10,658	12,771	1,246	3,474	5,577	0	38,923
1997	5,050	15,687	12,999	835	3,332	7,466	0	45,369
1998	5,050	18,604	11,051	667	3,252	10,710	1,944	51,278
1999	5,388	18,604	10,567	765	3,253	15,252	4,972	58,801
2000	5,388	18,210	8,325	814	3,253	15,252	15,523	66,765
2001	6,112	18,210	9,524	1,318	3,253	15,252	21,397	75,066
2002	6,274	18,210	9,895	1,705	3,253	15,252	28,845	83,434
2003	6,274	18,210	7,662	1,146	3,253	15,252	40,519	92,316
2004	8,375	18,210	6,754	939	3,253	15,252	48,496	101,279
2005	10,778	18,210	5,960	816	3,253	15,252	56,814	111,083

(6) Interconnection Between Negros-Panay, Cebu-Leyte, Mindanao-Luzon, and Leyte-Luzon

A major feature of the current program is the interconnection of Luzon, Visayas, and Mindanao into a single integrated grid. The interconnection projects aim to maximize the use of indigenous energy, improve overall system reliability and reduce capacity requirements through pooling of reserves. The interconnection program will be accomplished together with the development of geothermal project expansion programs.

The expansion program of the geothermal plants and interconnection program are planned as follows:

(a) Development of geothermal plant

- Luzon	80 MW	MAK-BANMOD	
	16 MW	ORMAT MAK-BAN	1993-1994
	11 MW	MAJBARARA	
	120 MW	DEL GALLEGO	1997
	150 MW	BAC-MAN I & II	
	16 MW	ORMAT BAK-MAN	1993-1994
- Mindanao	240 MW	MINDANAO GEO	1995-1998
- Negros	80 MW	MAMBUCAL	1996-1997
	80 MW	PALIMPINON	1993-1994
- Leyte	880 MW	TONGANON GEO	1996-1998

Total 1,673 MW

(b) Interconnection

Negros - Panay	100 MW	1990
Leyte - Cebu	300 MW	1996
Leyte - Luzon	800 MW	1997
Leyte - Mindanao	300 MW	1997-1998
Cebu - Negros	20-40 MW	1994
	(100 MW	1996)
Cebu - Bohol	21 MW	2001

The development of geothermal plant and interconnection program are shown in Figure 11.2.2

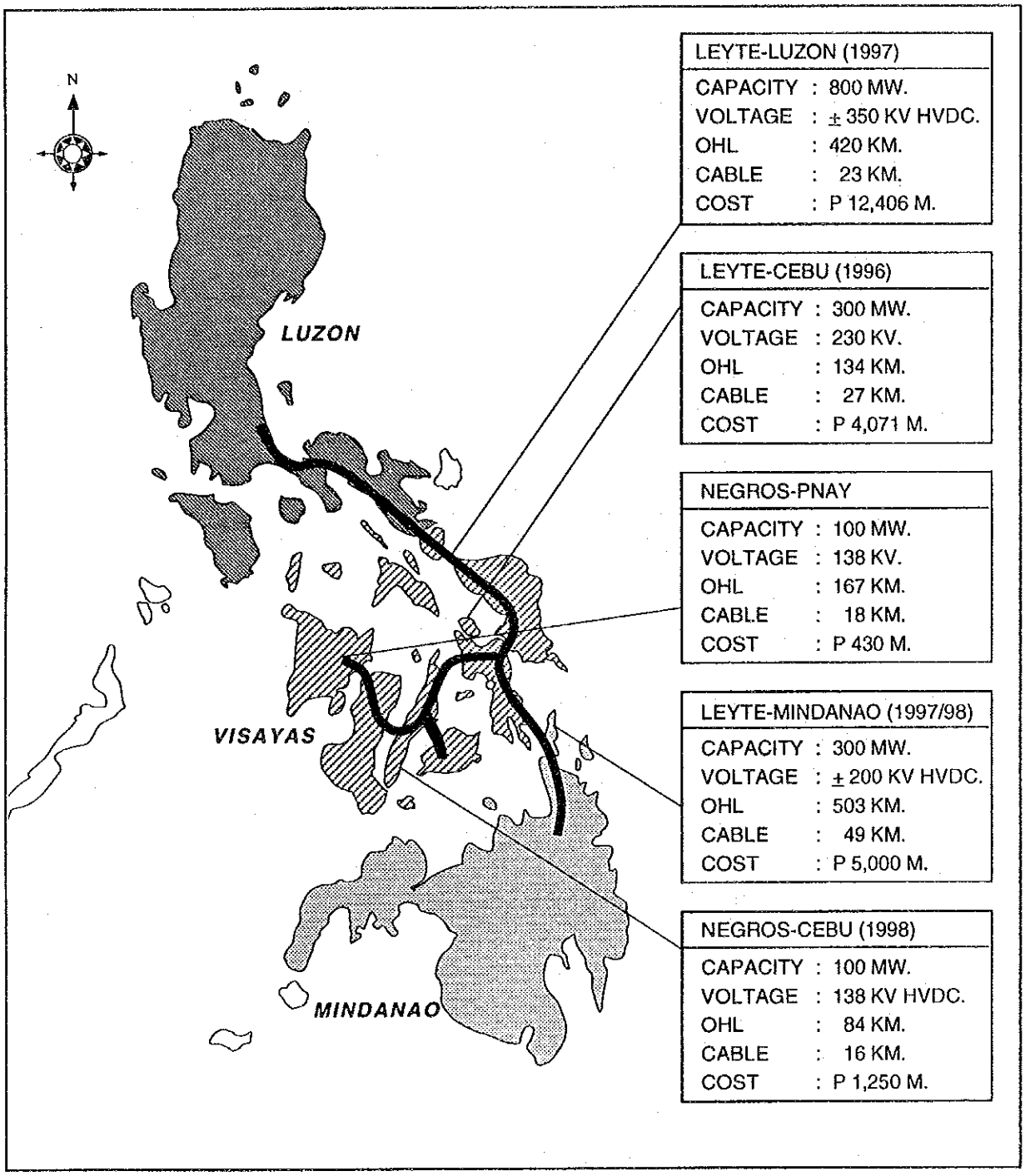


FIGURE 11.2.2 INTERCONNECTION PROJECT

11.2.5 POWER BALANCE IN VISAYAS

(1) Power Balance For Each Grid As An Isolated Grid

We studied and reviewed with the power balance in the grids of Cebu, Negros-Panay, Bohol and Leyte involved in total Visayas grid.

We assumed that the peak demand in Cebu, Negros-Panay, Bohol and Leyte to be 37.5%, 35.6%, 3.8% and 23.2% of the Visayas respectively, as the average value referred to the historical record between 1985 and 1990 by NPC Annual Report "System Peak Demand".

The reserve for each grids is estimated based on the power development plan including the peak power demand, retirement schedule and power development schedule without considering interconnection. Power balance for Cebu, Negros-Panay, Bohol and Leyte are shown on Table 11.2.7. It can be noted that in the Cebu grid, the Power reserve in 1977 becomes (-32.5 MW) rising to minus 604.5 MW in year 2005. Power reserves in the Negros-Panay grids will be negative in the year 1998 (-33.2 MW) and would further rise to minus 117.2 MW in year 2000 and minus 394.2 MW in year 2005. Also, power reserves in Bohol grid will be negative starting this year (-3.9 NW) rising to minus 7.9 MW in the year 2000 and 39.9 MW at the end of the planning period. In the Leyte grid where the Tongonan geothermal plants are located, power reserves are also in the negative starting 1993 and this will be up for completion of the new geothermal plants in 1995.

(2) Power Balance Considered With Interconnection

A power balances study taking into consideration the interconnection of the whole Visayas grid was also conducted. Negros - Cebu interconnection would entail 100 MW, Layte - Cebu by 300 MW and Cebu - Bohol by 21 MW. The study result which is shown in Table 11.2.8 would tend to show that power shortage in Cebu in year 2000 is 33.5 MW and is projected to rise to 404.5 MW in year 2005. In the Negros-Panay grid, power shortage is only 17.2 MW in year 2000 but is also expected to rise 294.2 MW in year 2005. Meanwhile, Bohol grid would be experiencing a very minimal power shortage of only 7 MW in the year 2000 but this will eventually increase to 39.9 MW in 2005.

(3) Further Requirement for Addition of Power Plant

Based on the Power Balance study for each grid as an isolated grid, it is recommended that additional power plants would be installed in each of the island grids; 400 MW for Cebu (200 MW in year 2000 and another 200 MW in 2002), 300 MW for the Negros - Panay grid (150 MW in 2000 and 150 MW in 2002), 50 MW for the Leyte grid and 20 MW for Bohol grid (15 MW in 1993 and another 5 MW in 2001)

These additional power plants shall be combined cycle or diesel power type, and in the Leyte grid, additional plant shall be replaced and to be utilized in other grids after the completion of the Tongonal geothermal plant.

The Study Team strongly feel that the power balance study in the Visayas area is very critical and the installation of additional power plant to augment the existing capacity is deemed necessary for further study and consideration.

TABLE 11.2.7 RESERVES I CEBU BOHOL, NEGROS-PANAY & LEYTE

YEAR	CEBU Demand Peak (MW)	Add. Cap. (MW)	Retired Plant (MW)	Installed Cap MW) (MW)	Reserve (MW) (%)	BOHOL Demand Peak (MW)	Add. Cap. (MW)	Retired Plant (MW)	Installed Cap. (MW)	Reserve (MW) (%)
					190.5					6.6
1990	143	-	-	333.5	(57.1)	14.5	-	-	21.1	(31.3)
					173.5					5.1
1991	160	-	-	333.5	(52.0)	16.0	-	-	21.1	(24.2)
					155.5					3.1
1992	178	-	-	333.5	(46.0)	18.0	-	-	21.1	(14.7)
		Ceb-Neg			141.5					1.7
1993	192	Intcon (100)	-	333.5	(42.4)	19.0	-	-	21.1	(8.1)
					108.5					-(1.9)
1994	225	-	-	333.5	(32.5)	23.0	-	-	21.1	-(9.0)
					84.5					-(3.9)
1995	249	-	-	333.5	(25.3)	25.0	-	-	21.1	-(18.5)
		Leyte-Cebu(20)			7.5					-(16.9)
1996	282	Intcon(300)	44	289.5	(2.6)	29.0	11.0	20.0	12.1	-(8.0)
					-(32.5)					-(14.9)
1997	322	-	-	289.5	-(11.2)	33.0	6.0	-	18.1	-(82.3)
					-(77.5)					-(7.9)
1998	367	-	-	289.5	-(26.8)	37.0	11.0	-	29.1	-(27.1)
					-(132.5)					-(7.9)
1999	422	-	-	289.5	-(45.8)	43.0	6.0	-	35.1	-(22.5)
					-(233.5)					-(7.9)
2000	484	-	39	250.5	-(93.2)	49.0	6.0	-	41.1	-(19.2)
					-(329.5)		Ceb-Bohol			-(15.9)
2001	561	-	19	231.5	-(142.0)	57.0	Intcon(21)	-	41.1	-(38.7)
					-(356.5)					-(29.9)
2002	628	-	-	231.5	-(171.0)	64.0	-	-	41.1	-(55.7)
					-(496.5)					-(29.9)
2003	696	-	32	199.5	-(248.0)	71.0	-	-	41.1	-(72.7)
					-(550.5)					-(34.9)
2004	750	-	-	199.5	-(276.0)	76.0	-	-	41.1	-(84.9)
					(604.5)					-(39.9)
2005	804	-	-	199.5	-(303.0)	81.0	-	-	41.1	-(97.0)

	NEGROS-PANAY Demand Peak (MW)	Add. Cap. (MW)	Retired Plant (MW)	Installed Cap MW) (MW)	Reserve (MW) (%)	LEYTE Demand Peak (MW)	Add. Cap. (MW)	Retired Plant (MW)	Installed Cap. (MW)	Reserve (MW) (%)
					59.8					24.5
1990	136	-	-	195.8	(30.5)	88	-	-	112.5	(21.8)
					43.8					13.5
1991	152	-	-	195.8	(22.4)	99	-	-	112.5	(12.0)
					26.8					2.5
1992	169	-	-	195.8	(13.7)	110	-	-	112.5	(2.2)
		Ceb-Neg			53.8					-(6.5)
1993	182	40	-	235.8	(22.8)	119	-	-	112.5	-(5.8)
					61.6					-(26.5)
1994	214	40	-	275.8	(22.4)	139	-	-	112.5	-(23.6)
					39.8					-(41.5)
1995	236	-	-	275.8	(14.4)	154	-	-	112.5	-(37.0)
		Leyte-Cebu(20)			16.8		Leyte-Cebu			61.5
1996	268	(300)	11	284.8	(8.9)	174	110	-	222.5	(27.6)
					24.8					518.5
1997	305	60	15	329.8	(7.5)	199	495	-	717.5	(72.3)
					-33.2					765.5
1998	348	-	15	314.8	-(10.5)	227	275	-	992.5	(77.1)
					-57.2					731.5
1999	400	35	7	342.8	-(16.7)	261	-	-	992.5	(73.7)
					-117.2					692.5
2000	460	-	-	342.8	-(34.2)	300	-	-	992.5	(69.8)
					-189.2					645.5
2001	532	-	-	342.8	-(55.2)	347	-	-	992.5	(65.0)
					-253.2					603.5
2002	596	-	-	342.8	-(73.8)	389	-	-	992.5	(60.8)
					-318.2					561.5
2003	661	-	-	342.8	-(92.8)	431	-	-	992.5	(56.6)
					-369.2					528.5
2004	712	-	-	342.8	(108.0)	464	-	-	992.5	(53.2)
					-394.2					495.5
2005	763	29	3	368.8	-(16.7)	497	-	-	992.5	(49.9)