2.6 Water Development in Curitiba Metropolitan Area

2.6.1 Population and Water Requirement

Municipalities which are included in Curitiba metropolitan area were assumed to be the following 9 municipalities: Curitiba, Almirante Tamandaré, Colombo, Piraquara, São José dos Pinhais, Araucária, Campo Largo, Pinhais, Fazenda Rio Grande.

Urban population of Curitiba metropolitan area was estimated based on population of municipalities in 2,000 which were the most up-to-date data projected by IPARDES as shown below:

$$\textit{Urban Population in Curitiba metropolitan area in } 2015$$
$$= \frac{\textit{Total urban population of 9 Municipalities in } 2000}{\textit{Urban population of MRH-268 in } 2000} \times \textit{Urban population of MRH-268 in } 2015$$
$$= \frac{2.207 \times 10^6}{2.306 \times 10^5} \times 3.280 \times 10^6 = 0.957 \times 3.280 \times 10^6 = 3.14 \times 10^6 \textit{ inhabitants}$$

Water requirement for urban area is mainly composed of urban domestic water and industrial water. Required water supply in 2015 and in 1993 were calculated by the same method as used in population estimation as shown in Table-2.13.

Table-2.13 Required Water Supply in Curitiba Metropolitan Area

(m^3/sec)

Year	Urban Domestic Water			Industrial Water			Total
	Demand	Loss	Intake	Demand	Loss	Intake	
2015	6.898	2.298	9.194	5.264	0.585	5.849	15.043
1993	2.808	1.872	4.679	2.785	0.491	3.277	7.956
Water to be newly developed			4.515			2.572	7.087

2.6.2 Surface Water Development by Dam

As studied in the section 2.4, there is no room for direct intake from river due to shortage of natural discharge in the upstream of Iguaçu river, therefore development of new water resources has to depend on construction of dam-reservoirs.

Water development in proposed 10 dams, planned by SANEPAR around Curitiba at the upstream tributaries of Iguaçu river (refer to Figure-2.4) was studied.

The water development calculation is made based on the following conditions.

a) Assuming that daily discharge at proposed dam sites are inflow to the reservoir, daily water balance in the reservoir is simulated for 20 years.

b) Maintenance discharge from the reservoir is assumed to be 50% of $Q_{10.7}$ and daily discharge from the reservoir is to be more than the maintenance discharge.

c) i) When inflow is less than the sum of proposed development water and maintenance discharge, deference is supplied from reservoir water.

ii) When inflow is more than the sum of proposed development water and maintenance discharge, excess of inflow is recharged to the reservoir. If the

reservoir is full at that time, excess water is discharged to the downstream of dam.

d) Evaporation from reservoir is also counted by applying average monthly evaporation data for 20 years at Piraquara observation station.

e) Seepage or infiltration from reservoir is neglected.

f) The maximum period of recovery is about 5 years.

Some cases of proposed water development volume range from 0.10 m^3/sec to 1.40 m^3/sec were assumed at each proposed dam. Simulation of daily water balance in reservoir was carried out for 20 years. The results of simulation are shown in Table-2.15. For example, judging from required recovery period of reservoir capacity, an appropriate water development volume by Pequeno dam (No.3) seems to be 0.9 m^3/sec.

(1) Condition of Computation

1) Dam Inflow

Design discharge for dam inflow is based on the available data at Fazendinha station (Pequeno river, St. No. 65010000), because observation period at other existing hydrological stations is too short to be obtained. The computation of dam inflow using Fazendinha station are given as the following equation.

$$Q_A = Q_F \times \frac{A_A}{A_F} \times \frac{q_{10,7,A}}{q_{10,7,P}}$$

,where

Q_A : Discharge at A dam site

Q_F : Discharge at Fazendinha station

A_A : Catchment area at A dam site

A_F : Catchment area at Fazendinha station (110.0 km^2)

$q_{10,7,A}$: $q_{10,7}$ at A dam site

$q_{10,7,P}$: $q_{10,7}$ at Pequeno dam site (0.465 $m^3/s/100km^2$)

Pequeno dam site locates at downstream of Fazendinha station in Pequeno river.

2) Evaporation from Reservoir

Although observation of evaporation using evaporation pan is carried out by related agencies in Parana, number of observation stations and observation period are not enough. In this study, evaporation data by using Penman's equation were employed. According to the determined the relation between evaporation pan data after converting by using a mean of pan coefficient 0.7 and evaporation data by Penman's equation at several stations. Using both annual evaporation data, the ratio of E_P / E_R ranges from 0.7 to 0.9, with a mean of 0.8. The mean value of 0.8 will be employed to estimate the evaporation value for planned dam reservoirs in surfacce water development study (refer to the section 1.2.4 in Sectoral Report Vol.B).

Thus, a relation between evaporation from reservoir and Penman's evaporation data is expressed as follows;

$E_R = 0.8\ E_P$

,where

E_R : evaporation from reservoir

E_P : evaporation data by using Penman's equation

Monthly evaporation data (1974 - 1993) by using Penman's equation at Piraquara station is employed in this study. (refer to Table-2.14)

Table-2.14 Evaporation data at Piraquara station

Month	Penman's Evaporation (mm/month)	Evaporation from Reservoir (Employed Evaporation) (mm/month)
Jan.	146.1	117
Feb.	123.4	99
Mar.	111.6	89
Apr.	85.3	68
May.	62.7	50
Jun.	48.7	39
Jul.	56.4	45
Aug.	72.9	58
Sep.	84.2	67
Oct.	116.6	93
Nov.	134.7	108
Dec.	138.3	111

3) Computation Method for Storage Capacity

The computation of storage capacity is given as the following procedure.

a) Dam Inflow (Q in)

b) Maintenance Discharge (Q maint)

$Q\ maint = 0.5 \times Q_{10,7}$

(Refer to the section 3.1.2 in Sectoral Report B)

c) Possible Water Development Volume (Q pos)

Q pos = Q in - Q maint

d) Developed Water Development Volume (Q dev)

5 alternative cases are employed.

e) Evaporation (Qevp)

$Q\ evp = E_R \times$ reservoir area

f) Required Replenishment Volume / Possible Recovery Volume (dQ), Outflow (Qout) and Required Storage Volume (Vres)

dQ = Min. {(Q pos - Q dev), (Q evp + V res, t-1 / 86.4)}

g) Outflow (Qout)

Q out = Q in - Q dev -dQ

h) Required Storage Volume (Vres)

V res, t = V res, t-1 - (dQ - Q evp) x 86.4

,where

V res,t : storage volume at t day ($10^3 \times m^3$)

V res, t-1 : storage volume the previous day ($10^3 \times m^3$)

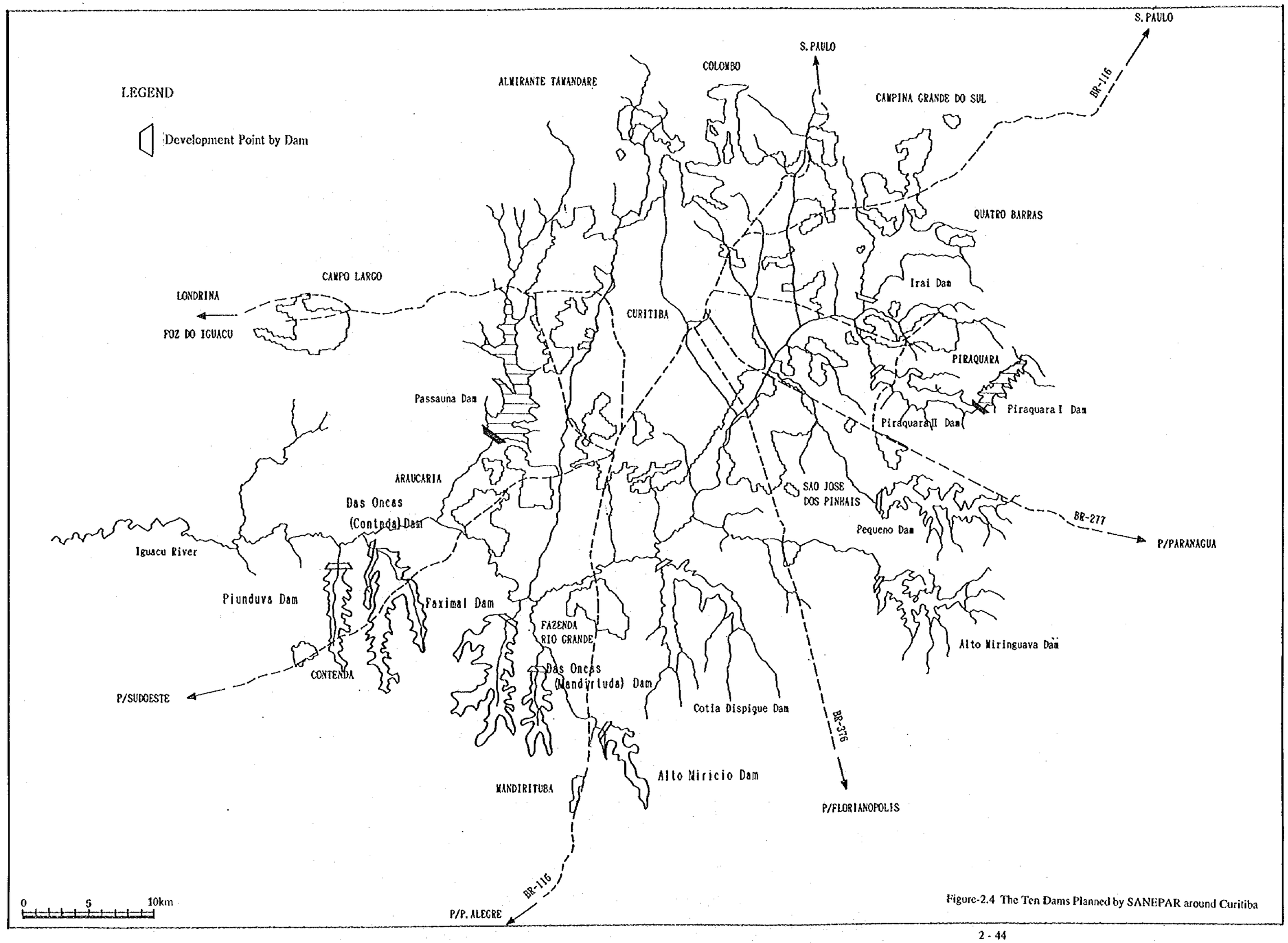


Figure-2.4 The Ten Dams Planned by SANEPAR around Curitiba

4) Results of Computation

Some cases of proposed water development volume range from 0.10 m^3/sec to 1.40 m^3/sec were assumed at each proposed dam. Simulation of daily water balance in reservoir was carried out for 20 years. The results of simulation are shown in Table-2.15 and Figure- 2.5(1)-(10).

For example, judging from required recovery period of reservoir capacity, an appropriate water development volume by Pequeno dam (No.3) seems to be 0.9 m^3/sec.

The water development volume by dams around Curitiba is as shown in Table-2.16.

Table-2.15 Developed Water and Required Reservoir Capacity by Planned Dam

Name of Dam		Development Water (m3/sec)	Reservoir Capacity (x $10^6 m^3$)	Period of Recovery (Year)
1	Irai	0.90	24.3	2.0
		1.00	29.1	4.5
		1.10	35.0	5.5
		1.20	41.4	9.0
		1.30	54.6	-
2	Piraquara II	0.50	10.1	2.0
		0.60	14.7	3.0
		0.70	19.8	5.5
		0.80	28.2	-
		0.90		-
3	Pequeno	0.70	15.3	2.0
		0.80	19.9	4.0
		0.90	31.3	5.5
		1.00	32.3	-
		1.10		-
4	Alto Miringuava	0.80	18.3	2.0
		0.90	23.0	4.5
		1.00	28.7	6.0
		1.10	39.0	-
		1.20		-
5	Cotia Despique	1.00	27.6	3.0
		1.10	32.9	4.5
		1.20	38.9	5.5
		1.30	47.2	-
		1.40		-
6	Alto Mauricio	0.15	3.0	1.5
		0.20	5.3	2.0
		0.25	7.8	5.0
		0.30	11.6	-
		0.36		-
7	Das Onças (Mandirituba)	0.10	1.7	1.5
		0.15	3.5	2.0
		0.20	5.8	4.5
		0.25	9.7	-
		0.30		-
8	Faxinal	0.30	5.2	1.5
		0.40	9.8	2.0
		0.50	14.9	5.5
		0.60	25.0	-
		0.70		-
9	Das Onças (Contenda)	0.40	7.2	2.0
		0.50	11.8	2.5
		0.60	16.8	5.0
		0.70	25.3	-
		0.80		-
10	Piunduva	0.10	1.8	1.5
		0.15	4.0	2.0
		0.20	6.7	5.5
		0.25		-
		0.30		-

[Note] "-" : It means that capacity is not recovery.

Table-2.16 Water Development Volume by Dams around Curitiba

Name of Dam (River)		Catchment Area (: C.A). (km^2)	Reservoir Area (km^2)	$q_{10,7}$ (m^3/sec /100 km^2)	$Q_{10,7}$	$Q_{10,7 \times 50\%}$	Development Volume (m^3/sec)	Effective Reservoir Capacity ($10^6 m^3$)	Correction Coefficient (: α)
1	Iraí	112.6	13.80	0.355	0.40	0.200	1.10	35.0	0.781
2	Piraquara II	58.0	5.54	0.397	0.23	0.115	0.70	19.8	0.450
3	Pequeno	62.3	6.17	0.465	0.29	0.145	0.90	31.3	0.566
4	Alto Miringuava	71.9	5.78	0.417	0.30	0.150	1.00	28.7	0.586
5	Cotia Despique	154.7	14.17	0.271	0.42	0.210	1.20	38.9	0.820
6	Alto Maurício	36.0	3.76	0.277	0.10	0.050	0.25	7.8	0.195
7	Das Onças (Mandirituba)	29.0	2.79	0.276	0.08	0.040	0.20	5.8	0.156
8	Faxinal	63.3	4.86	0.269	0.17	0.085	0.50	14.9	0.333
9	Das Onças (Contenda)	75.6	4.86	0.265	0.20	0.100	0.60	16.8	0.392
10	Piunduva	25.4	2.50	0.276	0.07	0.035	0.20	6.7	0.137
Total		688.8	-	-			6.55	205.7	-

[Note] Daily discharge at each dam site is calculated by multiplying daily discharge at Fazendinha station by correction coefficient.

Correction Coefficient : α = C.A./110.0 × $q_{10,7}$/0.465

110.0 : C.A. of Fazendinha

0.465 : q10,7 of Pequeno

$Q_{10,7}$ value was calculated by the HG64.

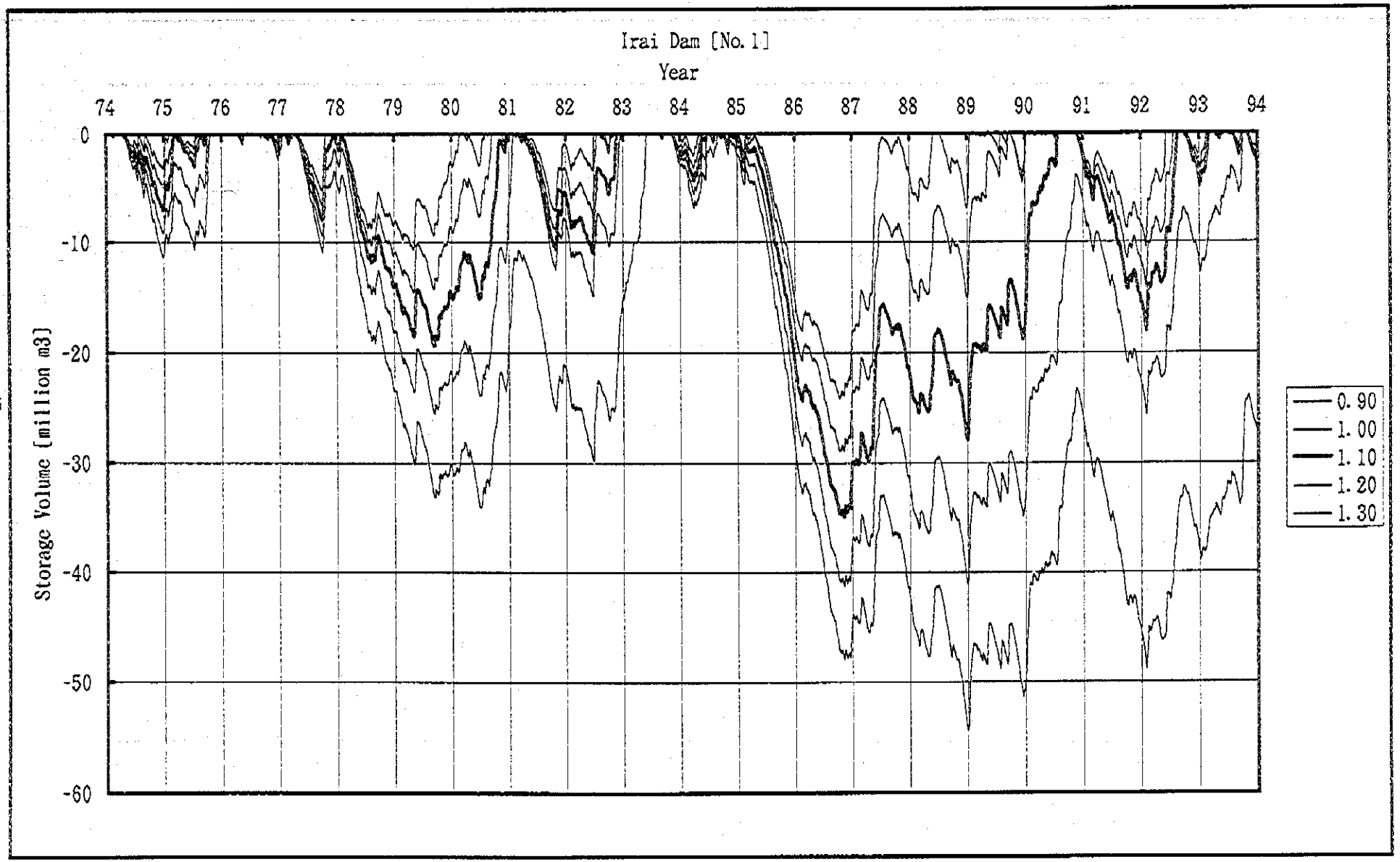


Figure-2.5 (1) Simulation of Water Balance of Proposed Dams

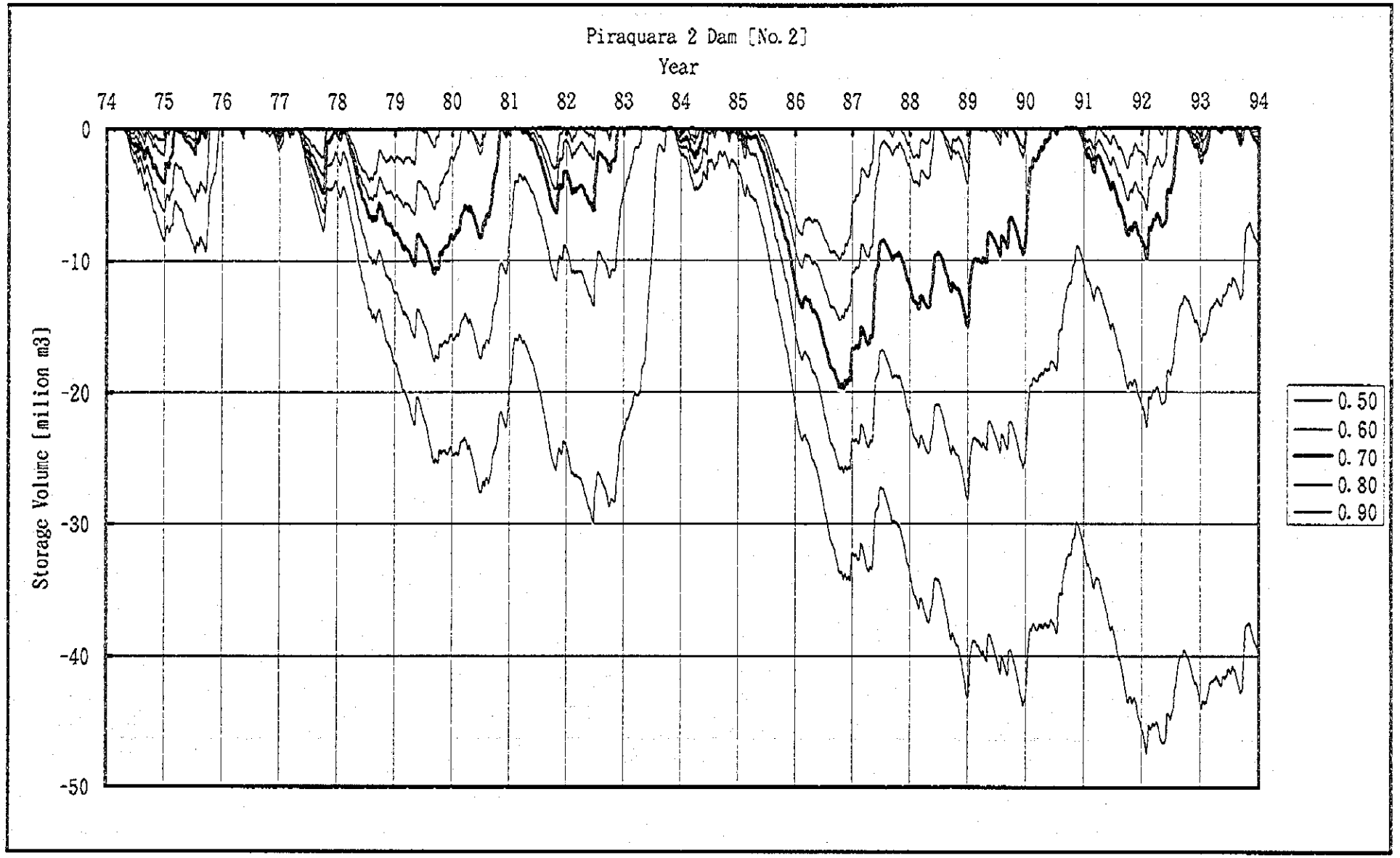


Figure-2.5 (2) Simulation of Water Balance of Proposed Dams

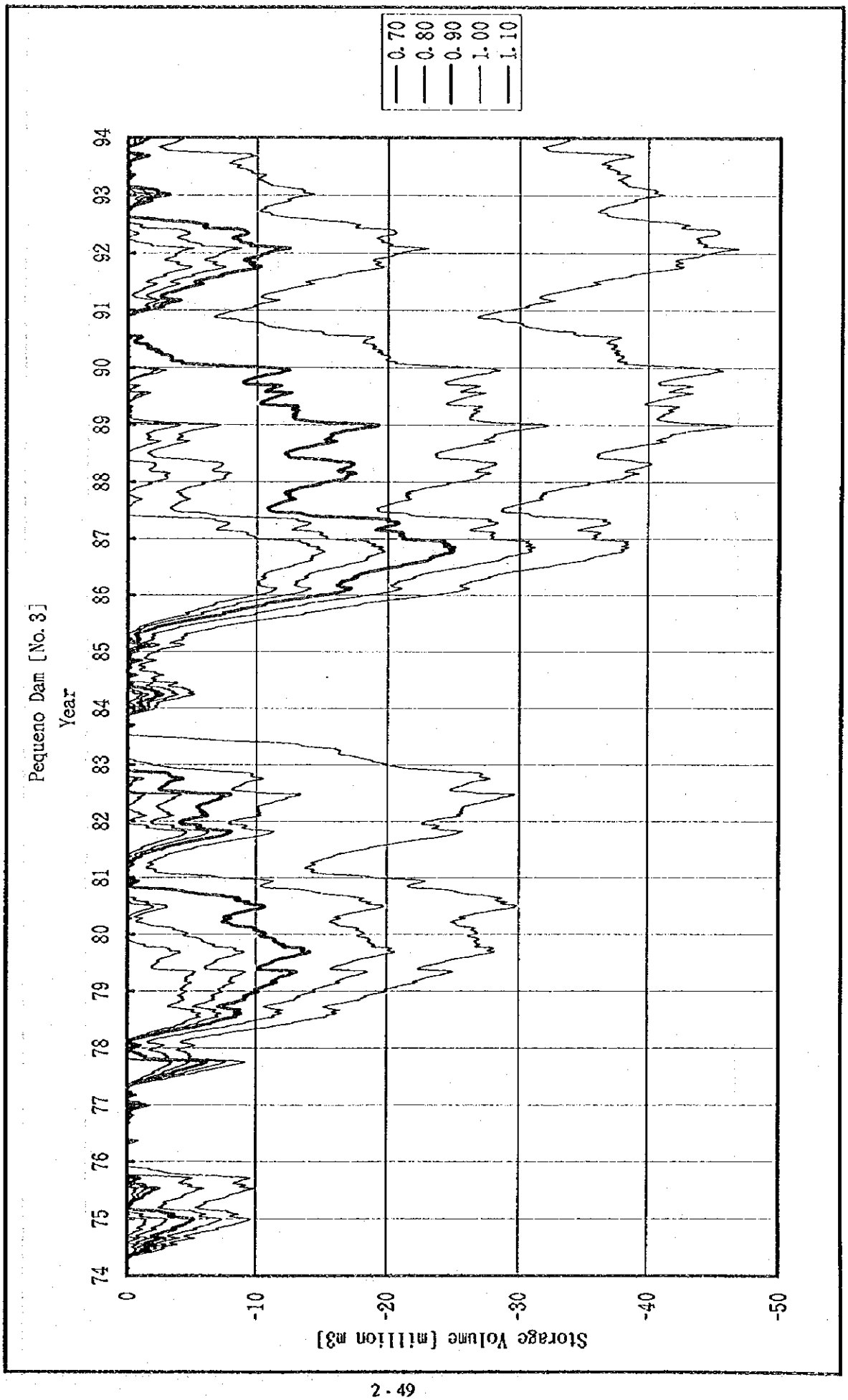


Figure-2.5 (3) Simulation of Water Balance of Proposed Dams

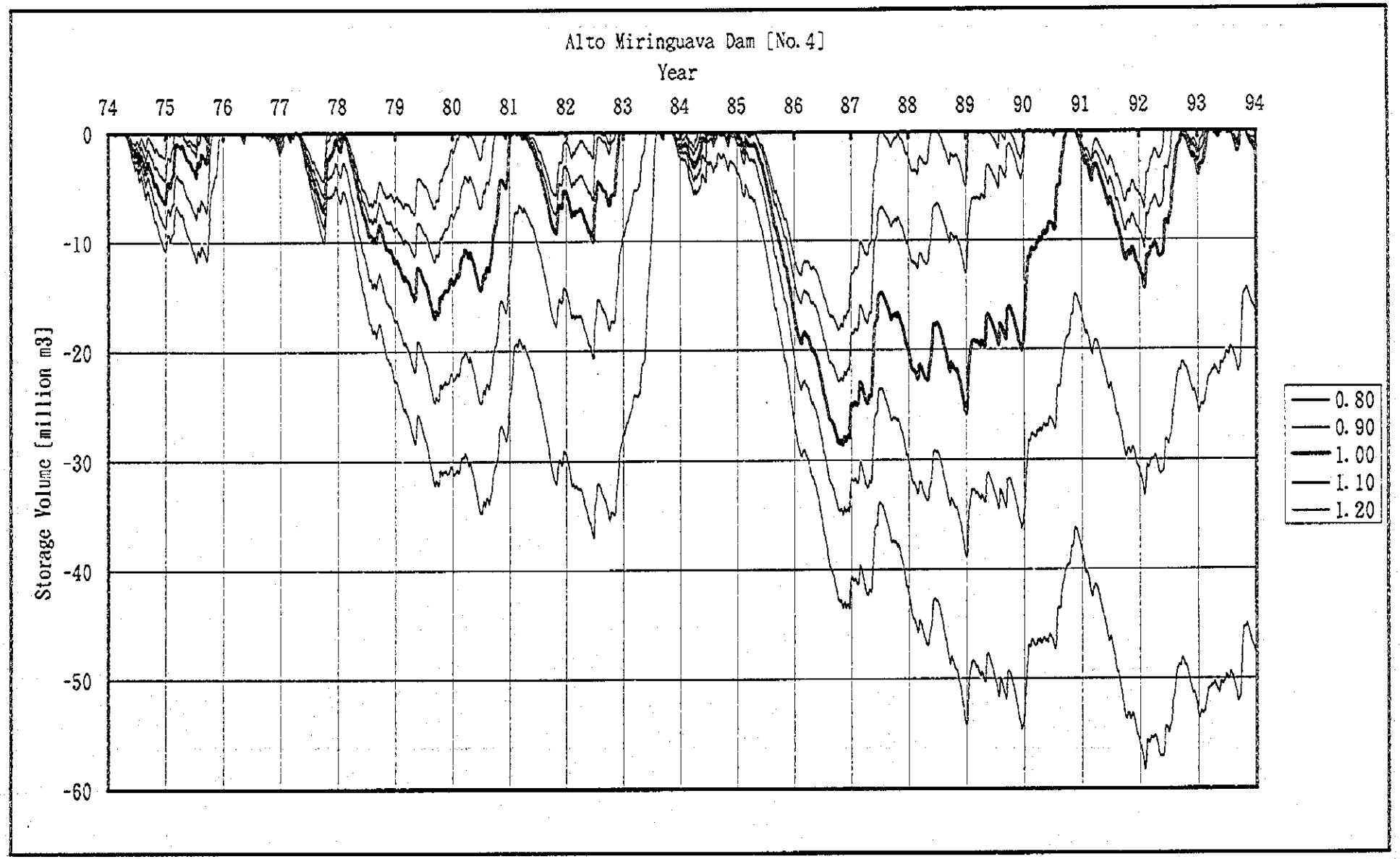


Figure-2.5 (4) Simulation of Water Balance of Proposed Dams

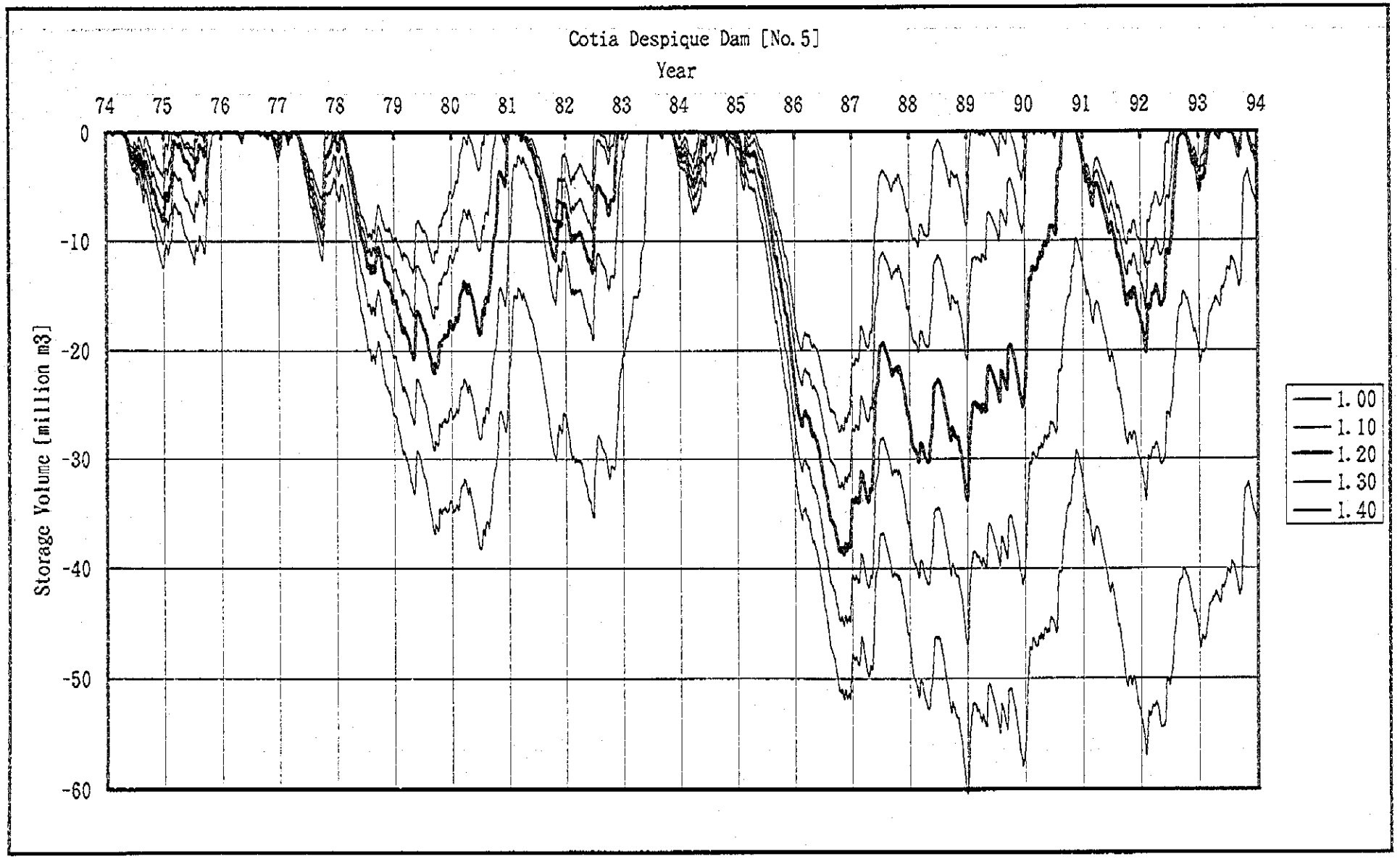


Figure-2.5 (5) Simulation of Water Balance of Proposed Dams

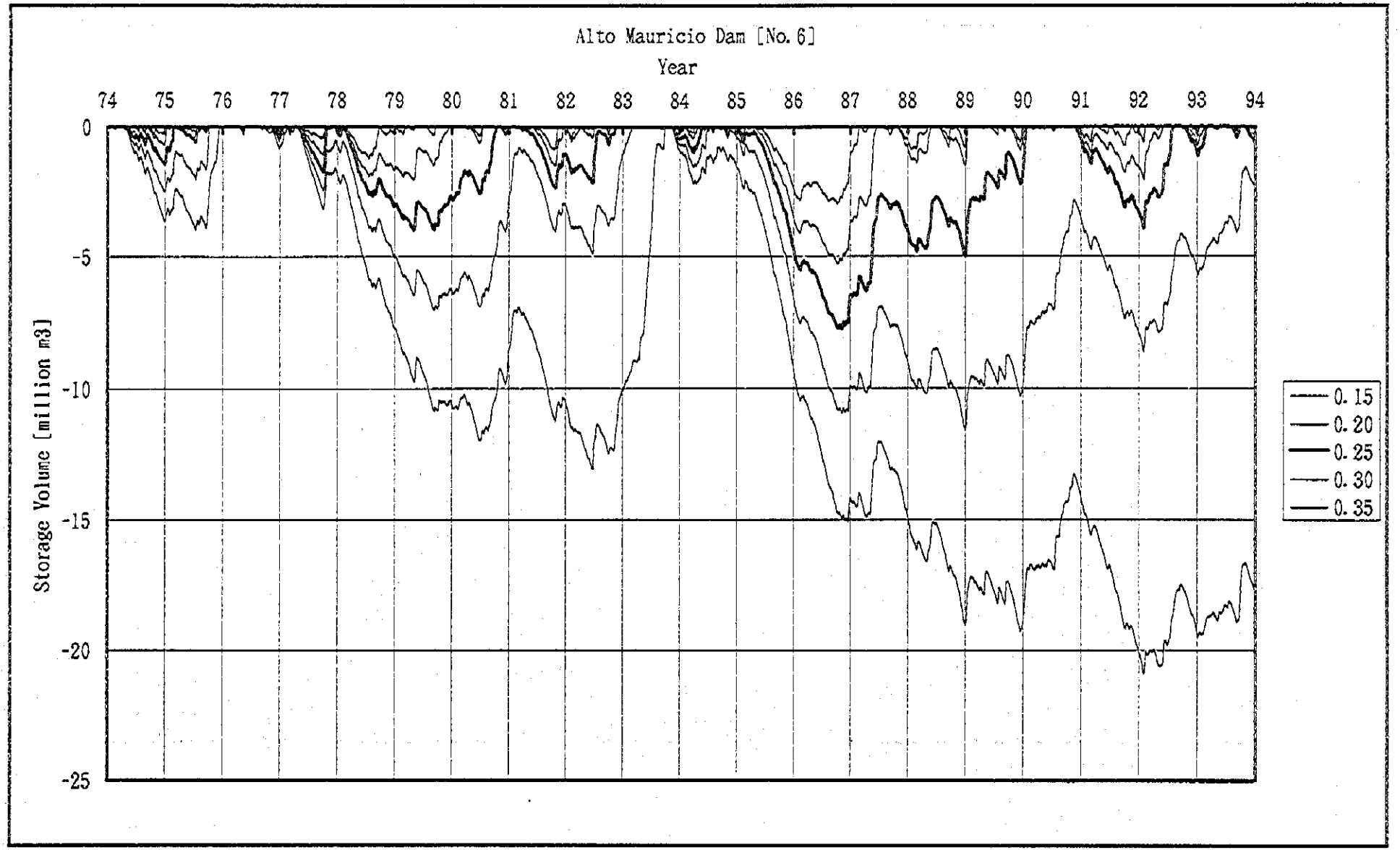


Figure-2.5 (6) Simulation of Water Balance of Proposed Dams

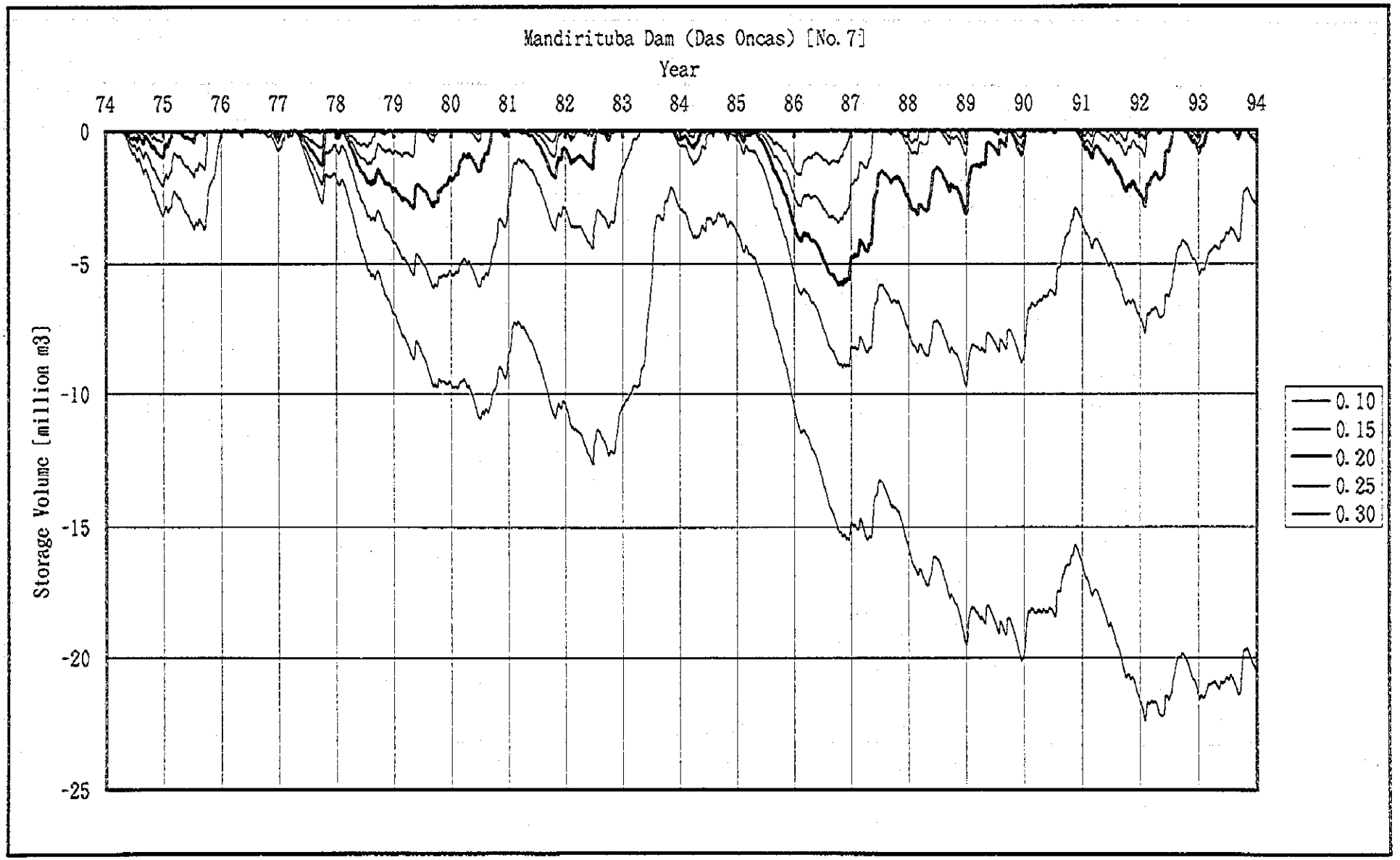


Figure-2.5 (7) Simulation of Water Balance of Proposed Dams

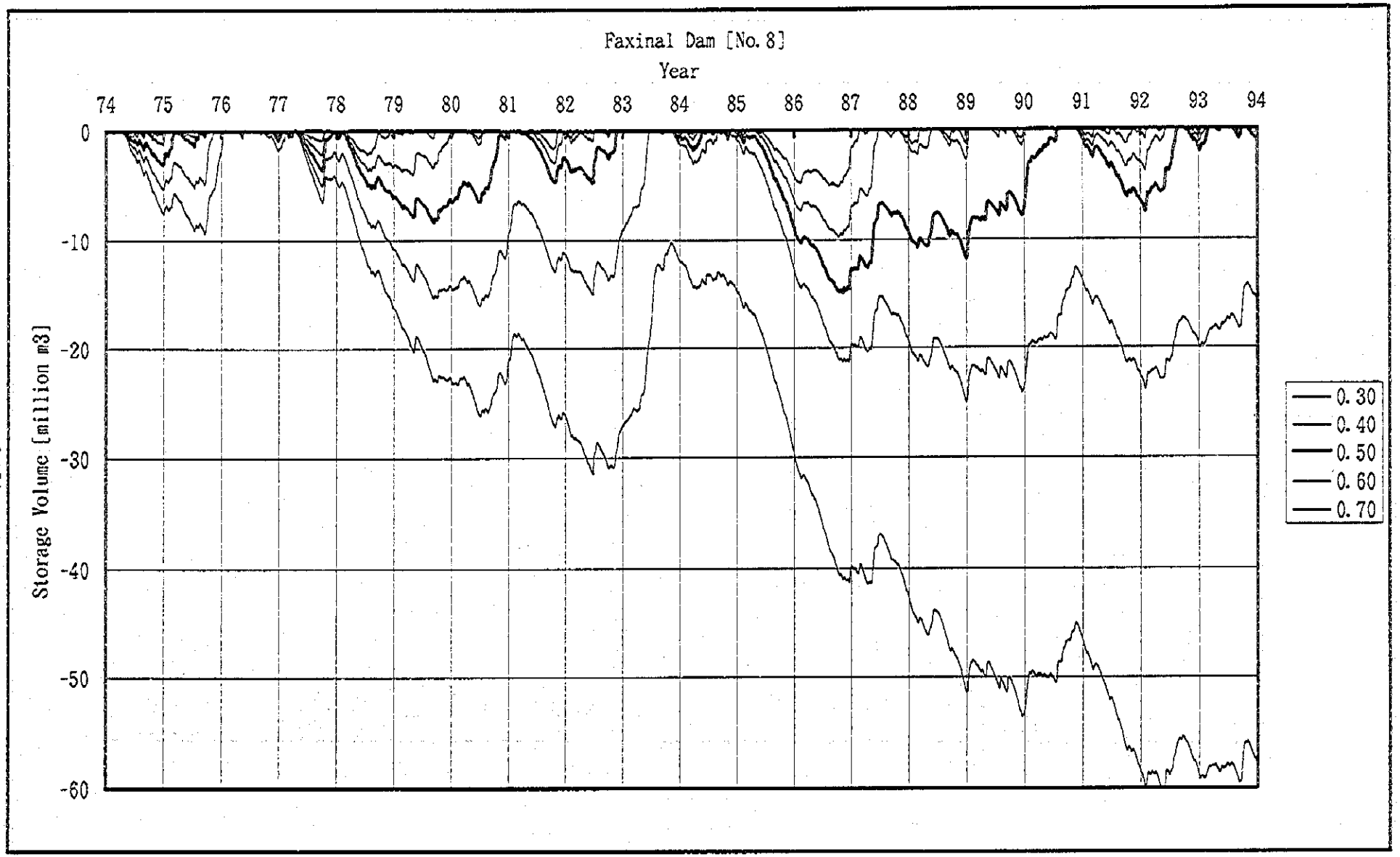


Figure-2.5 (8) Simulation of Water Balance of Proposed Dams

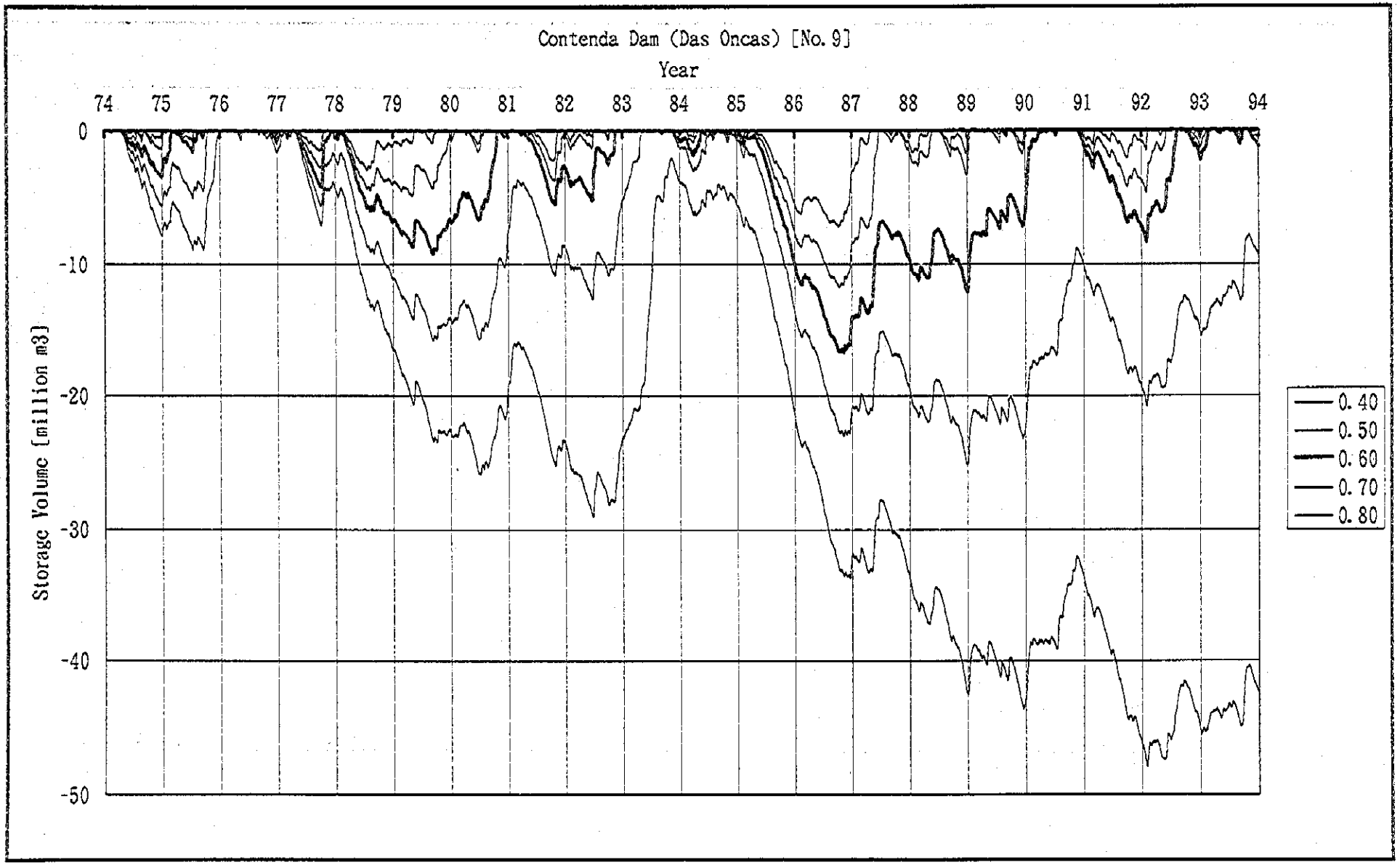


Figure-2.5 (9) Simulation of Water Balance of Proposed Dams

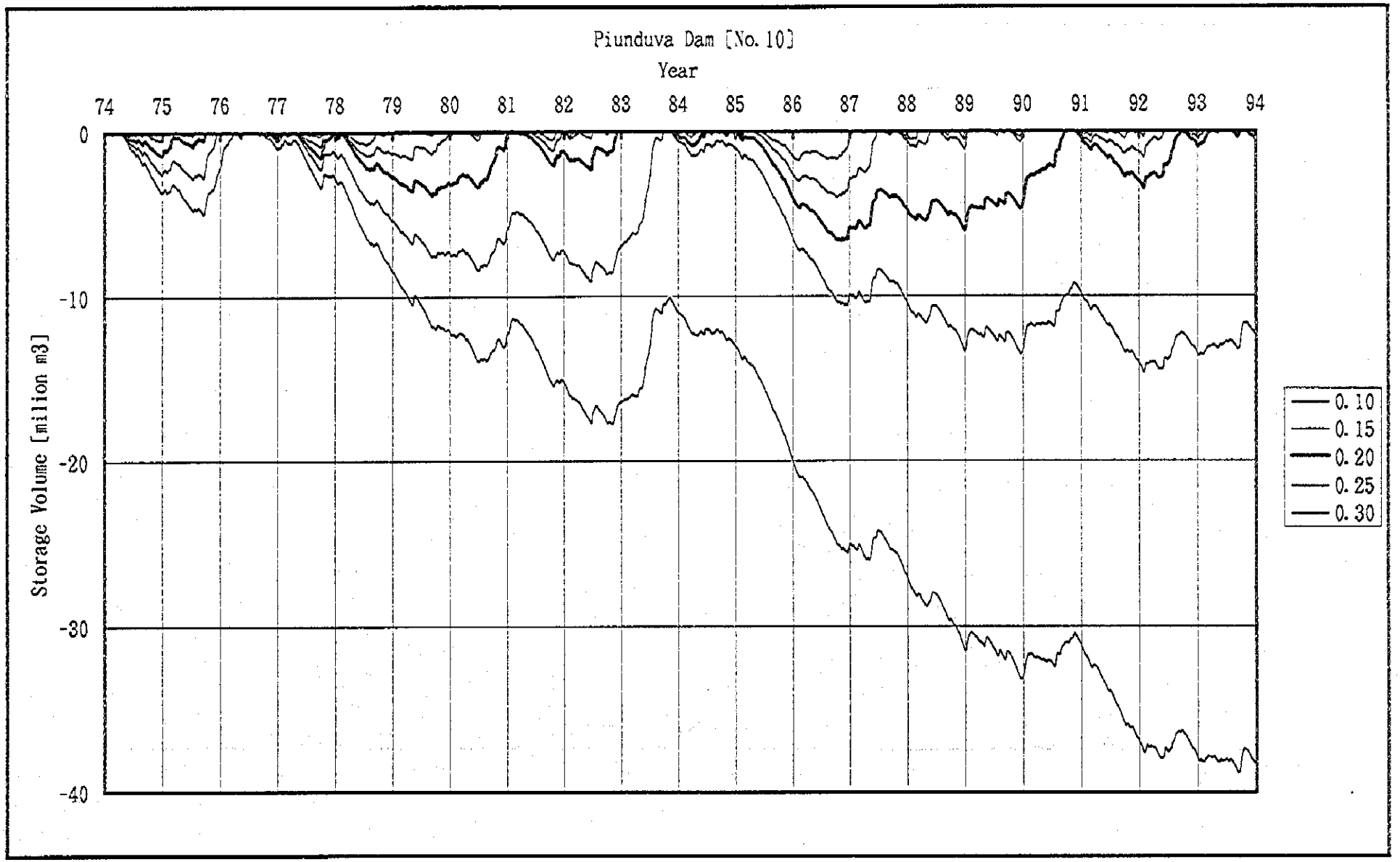


Figure-2.5 (10) Simulation of Water Balance of Proposed Dams

2.6.3 Groundwater Development in Curitiba Metropolitan Area

There is the Karst aquifer about 10 to 50 km north of Curitiba which has large potential to be developed.

The Karst aquifer has large potential, therefore, groundwater development might cover theoretically all required water. However, more economical well field near Curitiba in the Karst aquifer should be developed in early stage.

The stage development with 1.0 m^3/sec of groundwater development was considered. Number of required boreholes per each stage was calculated as follows.

Number of Boreholes per Stage = 1.0 (m^3/sec) / 0.044 (m^3/sec/well) = 23 wells

The optimization of water supply system between surface water and groundwater should be studied.

2.6.4 Optimization of Water Supply System

The combination of 10 dams mentioned above and wells was optimized for the water supply. Construction cost of each dam and well field was estimated as shown in Table-2.17.

Table-2.17 Construction Cost of Dams and Wells

Name of Dam (River) Well Field		Development Volume (m^3/sec)	Construction Cost (10^6 US$)	Unit Cost (10^6 US$/ m^3/s)
Surface Water				
1	Iraí	1.10	39.8	36.2
2	Piraquara II	0.70	18.0	25.7
3	Pequeno	0.90	30.6	34.0
4	Alto Miringuava	1.00	30.5	30.0
5	Cotia Despique	1.20	36.0	30.0
6	Alto Maurício	0.25	12.5	50.0
7	Das Onças (Mandirituba)	0.20	19.4	97.0
8	Faxinal	0.50	21.5	43.0
9	Das Onças (Contenda)	0.60	18.6	31.0
10	Piunduva	0.20	16.7	83.5
Total		6.55	243.6	37.2
Groundwater				
1	Wells (Stage I), 23 wells	1.00	30.0	30.0
2	Wells (Stage II), 23 wells	1.00	43.8	43.8
3	Wells (Stage III), 23 wells	1.00	62.7	62.7
Total		3.00	136.5	45.5

Since surface water development was more than groundwater development for the precedence of the large scale water resources development, the ratio of surface water development and groundwater development are assumed 7 : 3 at the Strategy Study. Detailed optimization will be carried out in the Master Plan Study. The required water supply in Curitiba metropolitan area is 7.09 m^3/s, therefore surface water development amount is 5.00 m^3/s and groundwater development amount is 2.09 m^3/s. The construction cost is estimated by the multiplication of water development amount and average unit cost by water source wise.

The cost for dam construction and well field is shown in Table-2.24 and 2.23.

2.6.5 Balance of Demand and Supply

(5) Balance of Demand and Supply

Balance of demand and supply in Curitiba metropolitan area is estimated to be as shown below:

	Q (m^3/s)
- Required Supply Water	7.09
- Possible Supply Water	
by dams	5.00
by wells	2.09
Total	7.09

2.7 Water Development in Other Areas

2.7.1 Large Urban Areas

As studied in the section 2.4, generally speaking, there is no water shortage area, except for block IG-1, upstream of Iguaçu river. However, large urban areas located at extremely upstream of main stream or tributaries will be sometimes problematic areas for water development. Generally, they are suffering from large amount of water demand, shortage of surface water, long distance and high head for water conveyance, low productivity of well, etc.

Studied urban areas are follows considering the above conditions;

1) Cascavel
2) Ponta Grossa
3) Londrina
4) Apucarana
5) Maringa
6) Umuarama

Water development for each urban area were considered by the following item, and determine the most suitable development method by using possible groundwater development volume, development cost and other necessary items.

1) Direct surface intake
2) Surface development by dam
3) Groundwater development

An adapted method was employed as same method described in the section 2.6. The development volume by using direct surface intake method was employed for an maximum volume (50 % of $Q_{10,7}$ at development points).

The surface water development volume by dam was determined as same method applied in

The surface water development volume by dam was determined as same method applied in the section 2.6.2.

The volume of dam inflow is usually employed long period discharge at the nearest hydrological station, but it was not available such a long term period discharge. Therefore, discharge data for 20 years (1974 - 1993) at Fazendinha station in Pequeno river was employed in this study. Necessary discharge is correlated as ration between $q_{10,7}$ and catchment area as follows;

$$Q_A = Q_F \times \frac{A_A}{A_F} \times \frac{q_{10,7,A}}{q_{10,7,P}}$$

, where

Q_A : Discharge at A dam site

Q_F : Discharge at Fazendinha station

A_A : Catchment area at A dam site

A_F : Catchment area at Fazendinha station (110.0 km^2)

$q_{10,7,A}$: q 10,7 at A dam site

$q_{10,7,P}$: q 10,7 at Pequeno dam site (0.465 $m^3/s/100km^2$)

Pequeno dam site locates at downstream of Fazendinha station in Pequeno river.

Evaporation from reservoir is applied the following equation.

$$E_R = 0.8\ E_P$$

, where

E_R : Evaporation from reservoir (mm)

E_P : Evaporation by using Penman's equation (mm)

Correlated monthly evaporation by selected urban area by using the above equation is shown in Table-2.18.

Table-2.18 Correlated Monthly Evaporation by Urban Area (20 years, 1974 - 1993)

Unit (mm/month)

Urban Area Station	Cascavel Cascavel	Ponta Grossa Ponta Grossa	Londrina Londrina	Apucarana Apucarana	Maringa Apucarana	Umuarama Umuarama
Jan.	140	130	140	131	131	148
Feb.	118	111	121	111	111	127
Mar.	115	106	117	111	111	126
Apr.	83	81	95	89	89	96
May	59	61	68	63	63	68
Jun.	45	50	53	47	47	53
Jul.	52	58	61	56	56	60
Aug.	69	74	82	74	74	79
Sep.	84	85	94	85	85	91
Oct.	116	114	128	121	121	126
Nov.	129	127	140	132	132	143
Dec.	140	128	136	133	133	148
Annual	1150	1125	1235	1153	1153	1256

Developed water volume by dam is shown in Table-2.19, and variation of storage volume with development water volume ratio are shown in Data Book.

Table-2.19 Developed Water and Required Reservoir Capacity by Planned Dam

Municipality	Name of Dam	Development Water (m3/s)	Reservoir Capacity (million m3)	Period of Recovery (Year)
Cascavel	D-C1	0.40	7.2	2.0
		0.50	11.8	4.5
		0.55	14.5	5.5
		0.60	18.5	-
		0.70	43.1	-
	D-C2	0.25	4.4	2.0
		0.30	6.7	3.0
		0.35	9.3	5.5
		0.40	14.5	-
		0.45	31.3	-
	D-C3	1.10	25.1	3.5
		1.20	29.9	4.5
		1.30	35.7	5.5
		1.40	45.2	-
		1.50	60.4	-
	D-C4	0.40	5.6	1.5
		0.50	10.3	2.0
		0.60	15.2	5.5
		0.70	27.3	-
	D-C5	0.70	13.3	2.0
		0.80	17.9	4.0
		0.90	23.0	5.5
		1.00	32.0	-
		1.10	51.8	-
	D-C6	0.10	0.6	0.5
		0.15	1.9	2.0
		0.20	4.2	3.0
		0.25	7.4	-
Ponta Grossa	D-P1	0.40	7.5	2.0
		0.50	12.1	4.5
		0.55	15.0	5.5
		0.60	20.4	-
		0.70	52.6	-
	D-P2	0.15	1.5	1.5
		0.20	3.7	2.0
		0.25	6.1	4.5
		0.30	10.9	-
Londrina	D-L1	0.30	5.0	2.0
		0.35	7.3	3.0
		0.40	9.6	5.0
		0.45	13.2	-
		0.50	22.3	-
	D-L2	0.15	2.0	1.5
		0.20	4.2	2.0
		0.25	6.5	4.5
		0.30	9.6	9.0
Apucarana	D-A1	0.01	0.7	2.0
		0.02	1.5	5.0
		0.03	2.1	-
		0.04	4.1	-
	D-A2	0.01	0.5	2.0
		0.02	1.3	-
Maringa	D-M1	0.30	3.3	1.5
		0.40	7.9	2.0
		0.50	12.9	5.0
		0.60	29.1	-
	D-M2	0.40	3.0	2.0
		0.50	11.0	3.5
		0.55	13.4	5.0
		0.60	16.3	9.0
		0.70	36.1	-
Umuarama	D-U1	0.50	10.4	2.0
		0.60	15.1	3.5
		0.70	20.4	5.0
		0.80	30.5	-
		0.90	56.7	-
	D-U2	0.20	3.5	1.5
		0.30	7.7	2.0
		0.40	12.7	5.5
		0.50	23.2	-

[Note] "-": It means that capacity is not recovery.

Required water supplies for large urban areas in both base and alternative cases were summarized in Table-2.20.

Water supply systems for large urban areas were also determined in terms of the lowest cost. The specifications and locations of dams and conveyance pipes are shown in Table-2.21, 2.22, 2.24 and Figure-2.7 respectively, and ones of wells are shown in Table-2.23 and Figure-2.8. Table-2.25 denotes the construction cost from intake to purification of water.

This study was executed depending on mainly topographical maps and available hydrological data, therefore, they are on very rough basis and will require further detailed studies for realization.

1) Cascavel

Construction of a dam at D-C5 is enough to satisfy the required supply, 0.690 m^3/s, and its cost, US$ 29.0 million (US$ 42.0 million/m^3/s), is the lowest among alternatives. Groundwater development to meet the required supply costs US$ 35.1 million and it is approximately twice as much as the dam construction.

From the economical point of view, water supply by the D-C5 is optimum; however, it takes time to complete its construction and thus water is not available until the completion. Therefore, it is necessary to consider the groundwater development depending on the actual trend of water demand. Besides D-C5, construction of a dam at D-C3 (US$ 31.4 million) is also worth to be considered as an alternative.

2) Ponta Grossa

The most economical way to satisfy the required water supply, 0.602 m^3/s, is the direct intake from Tibagi river at S-P1 by means of weir and it costs US$ 7.4 million (US$ 12.3 million/m^3/s). If dam was applied, it would require two dams and the total cost would be approximately US$ 50 million. Since there is no suitable aquifer for water supply around Ponta Grossa, its development would cost comparatively high, US$ 70 million. Consequently, the direct intake from Tibagi river is optimum.

3) Londrina

The optimum water supply to Londrina is the direct intake from Tibagi river at S-L1 by means of weir to satisfy the requirement, 0.874 m^3/s, and its cost is US$ 11.6 million (US$ 13.3 million/m^3/s). There are only two sites suitable for dam construction around Londrina; however, the water supply from two dams would not meet the requirement and further it would cost US$ 120 million/m^3/s. Groundwater development would cost approximately five times as much as the cost of the direct intake, US$ 53.2 million. Therefore, neither dam nor groundwater is suitable for the water supply.

4) Apucarana

There are only two sites for dam development and the water supply from the two dams would be 0.030 m^3/s, which is much less than the requirement, 0.192 m^3/s. And further, it would cost high, US$ 400 million/m^3/s. On the other hand, groundwater is available to meet the requirement and its cost of development is US$ 8.9 million (US$ 46.4 million/m^3/s), which is much less than dam development. In conclusion, the required water supply in Apucarana should be satisfied by the groundwater. There is one alternative that water is conducted from Londrina to Apucarana because of the low cost of surface water development in Londrina.

5) Maringa

The optimum water supply to Maringa is the direct intake from Pirapo river at S-M1 and its cost to meet the water requirement, 0.737 m^3/s, is US$ 8.9 million (US$ 12.1 million/m^3/s). It needs two dams to satisfy the water requirement and it would cost more than US$ 60 million. Groundwater is not suitable due to its high cost (US$ 32.3 million), four times more than the cost of the direct intake.

6) Umuarama

Compared to other large urban areas, the unit cost of water development in Umuarama is high. The cost of dam to satisfy the water requirement, 0.10 m^3/s, is US$ 11.3 million (US$ 94.2 million/m^3/s) at D-U1 and US$ 11.5 million (US$ 95.8 million/m^3/s) at D-U2, while the cost of groundwater development to meet the requirement is US$ 19.6 million (US$ 163.3 million/m^3/s). From the economical point of view, the water supply by a dam, either D-U1 or D-U2, is appropriate; however, the combination of dam and groundwater might be an alternative because of small difference in their cost.

In conclusion, the most desirable water development facilities for each large urban area is tentatively assumed as shown in Table-2.26.

Table-2.20 Required Water Supply Amount in Urban Area

No.	Municipality	MRH	Population Ratio in 2000 [Mun./MRH]%	Year	Required Supply in MRH		Required Supply in Municipality		Remark
					Base Case	Alternative Case	Base Case	Alternative Case	
			1000/1000		m3/s	m3/s	m3/s	m3/s	
-	Urban Area in Parana		-	1993 2015 2015-1993	-	-	20.953 39.945 18.992	20.953 39.903 18.950	
1	Curitiba Metropolitan Area	268	2207.4 /2306.2= 95.7	1993 2015 2015-1993	8.313 15.719 7.406	8.313 13.380 5.067	7.956 15.043 7.088	7.956 12.805 4.849	
2	Cascavel	288	221.1 /938.3= 23.6	1993 2015 2015-1993	1.892 4.480 2.588	1.892 5.336 3.444	0.447 1.057 0.611	0.447 1.259 0.813	
3	Ponta Grossa	273	250.9 /401.3= 62.5	1993 2015 2015-1993	1.134 2.118 0.984	1.134 2.414 1.280	0.709 1.324 0.615	0.709 1.509 0.800	
4	Londrina	281	442.4 /851.2= 52.0	1993 2015 2015-1993	2.378 4.387 2.009	2.378 5.102 2.724	1.237 2.281 1.045	1.237 2.653 1.416	
5	Apucarana	284	98.1 /232.8= 42.1	1993 2015 2015-1993	0.556 1.035 0.479	0.556 1.035 0.479	0.234 0.436 0.202	0.234 0.436 0.202	
6	Maringa	282	288.7 /505.7= 57.1	1993 2015 2015-1993	1.443 3.030 1.587	1.443 3.461 2.018	0.824 1.730 0.906	0.824 1.976 1.152	
7	Umuarama	285	84.0 /283.9= 29.6	1993 2015 2015-1993	0.631 0.779 0.148	0.631 0.779 0.148	0.187 0.231 0.044	0.187 0.231 0.044	

Table-2.21 Specifications of Dam and Reservoir

Site NO.	Name	Location	Type	Catchment Area(km²)	Reservoir					Dam Embankment			
					N.W.L. (m)	Development Volume (m^3/s)	Dead Storage ($10^6 m^3$)	Active Storage ($10^6 m^3$)	Gross Storage ($10^6 m^3$)	Crest (m)	Lengh (m)	Height (m)	Embankment Volume ($\times 10^3 m^3$)
1	Irai	near Curitiba	Earth fill Dam	112.6	890.5	1.10	5.0	35.0	40.0	894.5	1,100	12.4	724
2	Piraquara II	ditto	ditto	58.0	889.8	0.70	1.1	19.8	20.9	893.8	550	10.8	220
3	Pequeno	ditto	ditto	62.3	896.3	0.90	3.0	31.3	34.3	900.3	330	16.8	160
4	Alto Miringuava	ditto	ditto	71.9	897.2	1.00	3.2	28.7	31.9	901.2	500	16.5	500
5	Cotia Despique	ditto	ditto	154.7	879.2	1.20	7.4	38.9	46.3	883.2	880	13.6	608
6	Alto Mauricio	ditto	ditto	36.0	892.2	0.25	2.4	7.8	10.2	896.2	450	12.2	150
7	Das Oncas(Mandirituba)	ditto	ditto	29.0	884.3	0.20	1.7	5.8	7.5	888.3	470	11.8	330
8	Faxinal	ditto	ditto	63.3	878.9	0.50	3.2	14.9	18.1	882.9	590	13.4	343
9	Das Oncas(Contenda)	ditto	ditto	75.6	871.7	0.60	1.5	16.8	18.3	875.7	380	13.7	250
10	Piunduva	ditto	ditto	25.4	875.7	0.20	1.1	6.7	7.8	879.7	410	15.7	270
C_1	Baneiro(I)	near Cascavel	Earth fill Dam	38.6	638.0	0.55	1.7	14.5	16.2	642.0	600	24.0	799
C_2	Tesouro	ditto	ditto	24.2	646.4	0.35	1.1	9.3	10.4	650.4	500	22.4	585
C_3	Bameiro(II)	ditto	ditto	83.0	634.0	0.69	3.7	7.4	11.1	626.5	500	14.5	320
C_4	Aroeira	ditto	ditto	47.6	643.5	0.60	2.2	15.2	17.4	647.5	600	27.5	1,035
C_5	Antos	ditto	ditto	68.9	639.2	0.69	3.1	12.8	15.9	638.0	450	20.0	473
C_6	C.S.Salvador	ditto	ditto	17.5	639.2	0.20	0.8	4.2	5.0	643.2	300	25.2	438
P_1	Pitangvi	near Ponta Grossa	Earth fill Dam	70.9	877.2	0.55	3.2	15.0	18.2	881.2	550	27.2	929
P_2	Verde	ditto	ditto	32.4	928.8	0.25	1.5	6.1	7.6	932.8	400	24.8	567
L_1	Cafezal	near Londrina	Earth fill Dam	157.8	480.0	0.40	7.1	9.6	16.7	484.0	400	34.0	1,035
L_2	Jacutinga	ditto	ditto	96.7	410.0	0.25	4.4	6.5	10.9	414.0	300	19.0	258
A_1	Pirapo	Apucarana	Earth fill Dam	20.9	646.4	0.02	0.9	1.3	2.2	650.4	200	10.4	57
A_2	Bara Nova	ditto	ditto	15.6	678.0	0.01	0.7	0.5	1.2	682.0	200	7.0	29
M_1	Ribeirao Sarandi	Maringa	Earth fill Dam	59.7	467.2	0.50	2.7	12.9	15.6	471.2	600	26.2	944
M_2	Ribeirao Pinguim	ditto	ditto	81.6	420.0	0.55	3.7	13.4	17.1	424.0	500	28.0	893
U_1	Corrego Pinhalzinho	Umuarama	Earth fill Dam	44.2	364.0	0.12	2.0	0.8	2.8	359.5	300	7.5	54
U_2	Ribeirao Verde	ditto	ditto	28.4	318.1	0.12	1.3	1.8	3.1	316.0	300	8.0	60

(Note) : NWL is Normal water level

Table-2.22 Pipeline and Pumping Head Capacity

Site ·NO.	Name	River Basin Location	Development Volume (m³/s)	Type of System	Specification	
					Pipeline	Pumping
1	Irai	near Curitiba	1.10	Pump and Pipeline system	φ800(mm) ×	
2	Piraquara II	do	0.70	do	φ700(mm) ×	
3	Pequeno	do	0.90	do	φ800(mm) ×	
4	Alto Miringuava	do	1.00	do	φ800(mm) ×	
5	Cotia Despique	do	1.20	do	φ900(mm) ×	
6	Alto Mauricio	do	0.25	do	φ400(mm) ×	
7	Das Oncas(Mandirituba)	do	0.20	do	φ400(mm) ×	
8	Faxinal	do	0.50	do	φ600(mm) ×	
9	Das Oncas(Contenda)	do	0.60	do	φ700(mm) ×	
10	Piunduva	do	0.20	do	φ400(mm) ×	
C_1	Banciro(I)	near Cascavel	0.55	do	φ600(mm) × 15.000(m)	270(m) ×2.200(kw)
C_2	Tesovro	do	0.35	do	φ500(mm) × 17.000(m)	280(m) ×1.500(kw)
C_3	Bameiro(II)	do	0.69	do	φ700(mm) × 21.000(m)	270(m) ×2.800(kw)
C_4	Arocira	do	0.60	do	φ700(mm) × 12.000(m)	210(m) ×1.900(kw)
C_5	Antos	do	0.69	do	φ700(mm) × 8.000(m)	200(m) ×2.100(kw)
C_6	C.S.Salvaror	do	0.20	do	φ400(mm) × 10.000(m)	240(m) × 710(kw)
P_1-S		near Ponta Grossa	0.602	do	φ700(mm) × 11.000(m)	200(m) ×1.800(kw)
P_1	Pitangvi	do	0.55	do	φ600(mm) × 8.500(m)	150(m) ×1.300(kw)
P_2	Verde	do	0.25	do	φ400(mm) × 10.000(m)	160(m) × 600(kw)
L_1-S		near Londrina	0.874	do	φ800(mm) × 15.000(m)	310(m) ×4.100(kw)
L_1	Catezai	do	0.40	do	φ600(mm) × 7.000(m)	180(m) ×1.100(kw)
L_2	Jacutinga	do	0.25	do	φ400(mm) × 10.000(m)	330(m) ×1.300(kw)
A_1	Pirapo	Apucarana	0.02	do	φ200(mm) × 4.500(m)	200(m) × 60(kw)
A_2	Bara Nova	do	0.01	do	φ200(mm) × 6.000(m)	160(m) × 30(kw)
M_1-S		Maringa	0.737	do	φ700(mm) × 13.000(m)	260(m) ×2.900(kw)
M_1	Ribeirao Sarandi	do	0.50	do	φ600(mm) × 8.000(m)	170(m) ×1.300(kw)
M_2	Ribeirao Pinguim	do	0.55	do	φ600(mm) × 8.000(m)	220(m) ×1.800(kw)
U_1	Comegio Pinaizinho	Umuarama	0.120	do	φ400(mm) × 6.000(m)	140(m) × 300(kw)
U_2	Ribeirao Verde	do	0.120	do	φ400(mm) × 6.000(m)	180(m) × 400(kw)

注) $P = \frac{0.163 \times r_w \times Q \times H}{\sigma_1 \times \sigma_2}(1+\beta)$ r_w = 1.0tf/m³, Q : Discharge m³/min. H : Head. σ_1 = 0.8. σ_2 = 0.95. β = 0.15 P = 14.798 × Q × H

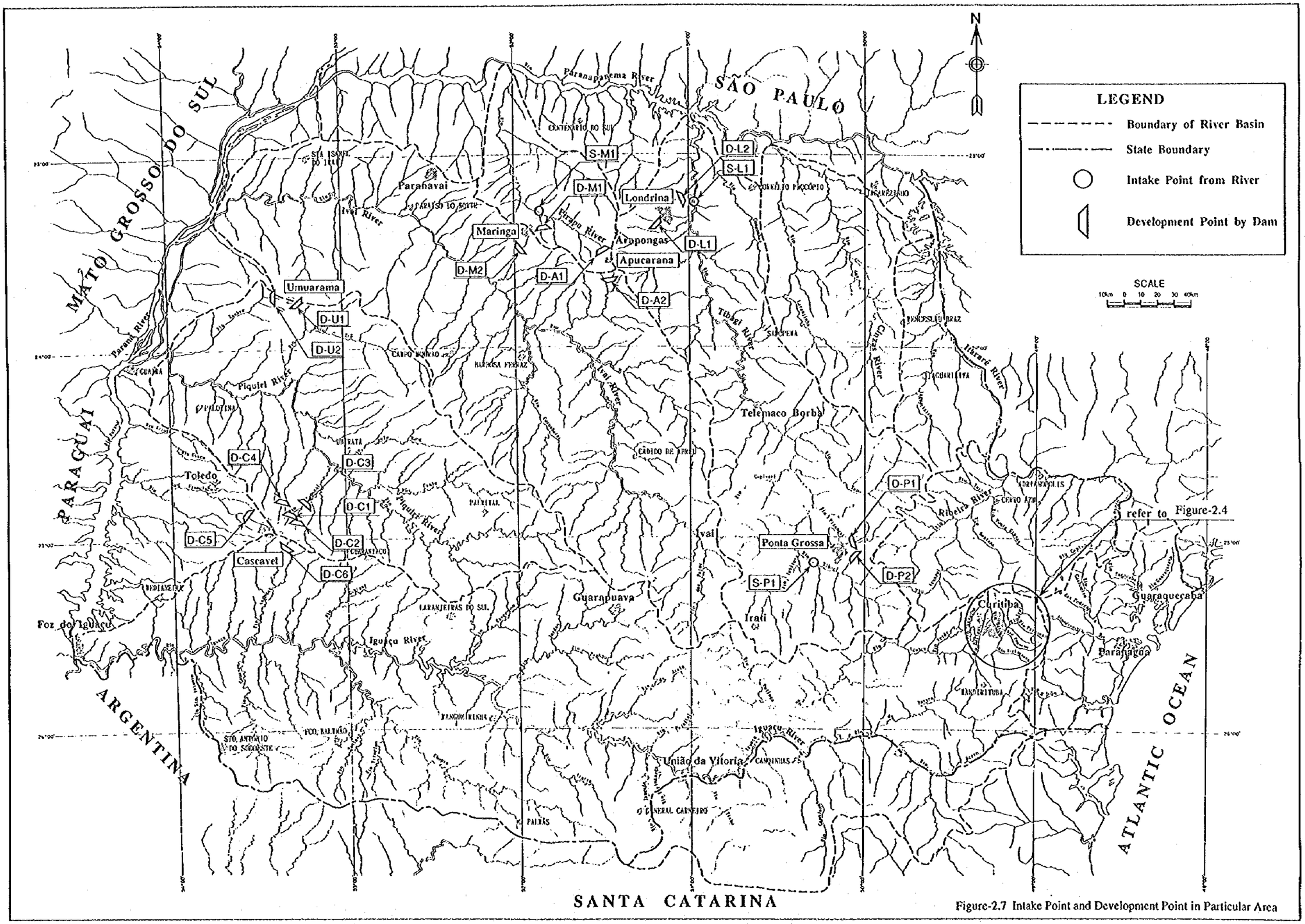
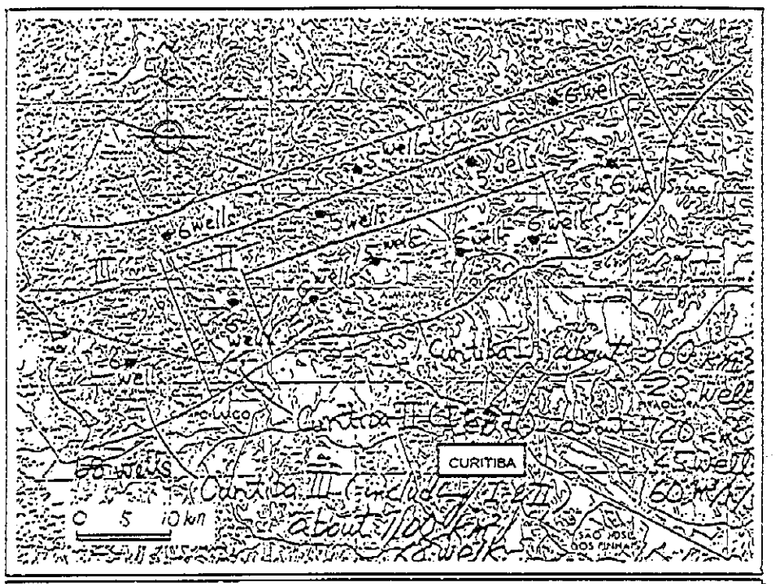


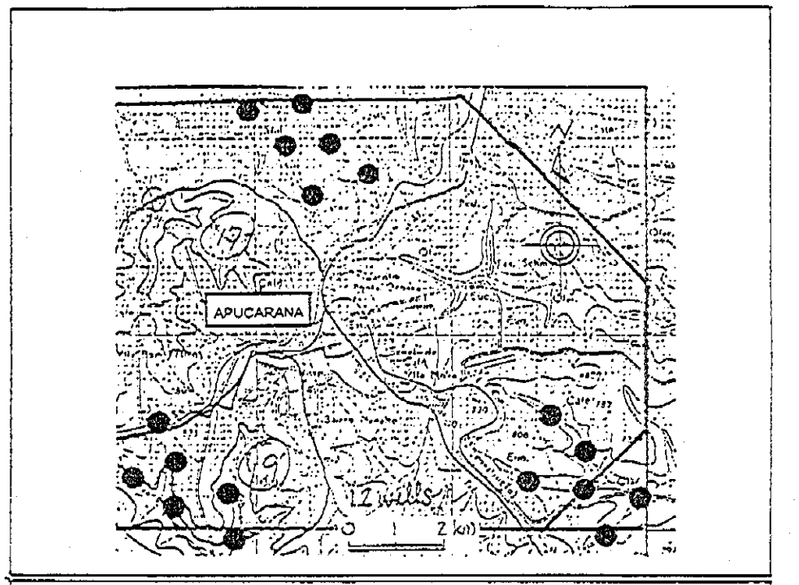
Figure-2.7 Intake Point and Development Point in Particular Area

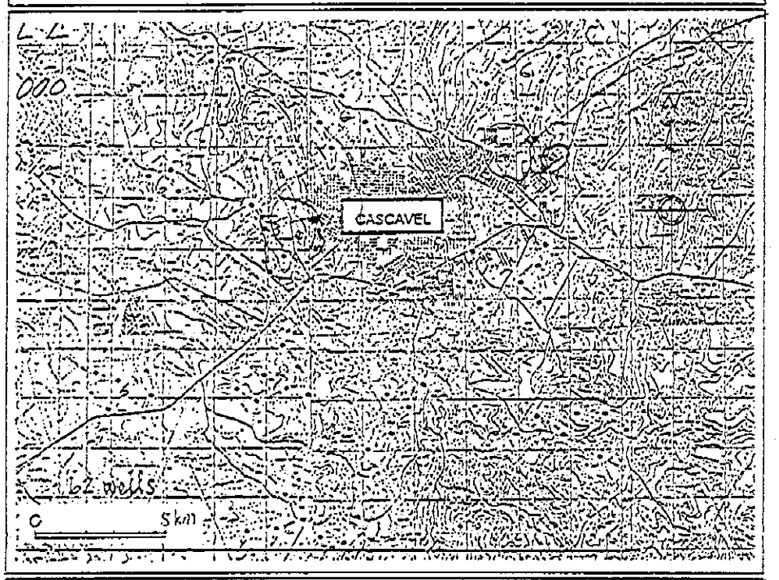
Table-2.23 Groundwater Development Cost by Development Volume

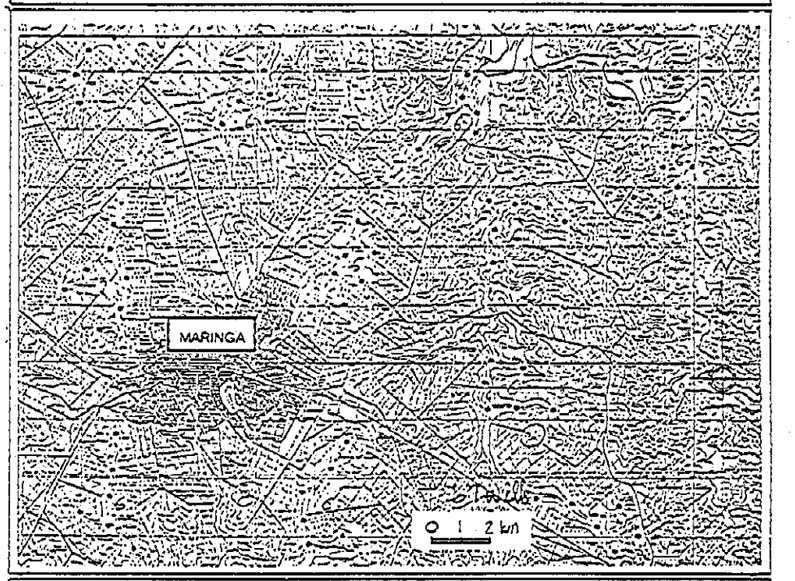
Site No.	Development Volume (m^3/s)	Diameter of Conduit (mm)	Unit Cost US$/m	Distance (m)	Number of Pipeline	Cost x10³US$ (1)	Boring number	Depth /Well (m)	Cost/m US$	Cost x10³US$ (2)	Pumping Cost x10³US$ (3)	Access Read (km)	Cost x10³US$ (4)	Total	Accumulate
1-1 (23)	1.00	φ400	290	12,000	4	13.9	23 (31)	80	880	2.2	2.6	16	5.0	30.0	30.0
1-2 (22)	1.00	φ400	290	20,000	4	23.2	22 (30)	80	880	2.2	4.2	16	5.0	43.8	73.8
1-3 (23)	1.00	φ400	290	30,000	4	34.8	23 (31)	80	880	2.2	6.4	20	6.2	62.7	136.5
2-1 (7)	0.08	φ300	160	1,000	1	0.16	7 (10)	120	490	0.59	0.05	5	1.7	2.9	2.9
2-2 (8)	0.09	φ300	160	2,000	1	0.32	8 (11)	120	490	0.65	0.08	4	1.4	2.9	5.8
2-3 (8)	0.09	φ300	160	4,000	1	0.64	8 (11)	120	490	0.65	0.13	3	1.1	3.0	8.8
2-4 (8)	0.09	φ300	160	6,000	1	0.96	8 (11)	120	490	0.65	0.19	3	1.1	3.4	12.2
2-5 (7)	0.08	φ300	160	4,000	1	0.64	7 (10)	120	490	0.59	0.13	7	2.3	4.4	16.6
2-6 (8)	0.09	φ300	160	9,000	1	1.44	8 (11)	120	490	0.65	0.28	4	1.4	4.5	21.1
2-7 (8)	0.09	φ300	160	15,000	1	2.40	8 (11)	120	490	0.65	0.45	4	1.4	6.0	27.1
2-8 (8)	0.09	φ300	160	22,000	1	3.52	8 (11)	120	490	0.65	0.65	5	1.7	8.0	35.1
3-1 (30)	0.08	φ300	160	5,000	1	0.80	30 (40)	150	370	2.22	0.21	5	1.7	6.2	6.2
3-2 (30)	0.08	φ300	160	5,000	1	0.80	30 (40)	150	370	2.22	0.21	5	1.7	6.2	12.4
3-3 (30)	0.08	φ300	160	10,000	1	1.60	30 (40)	150	370	2.22	0.35	6	2.0	7.8	20.2
3-4 (30)	0.08	φ300	160	10,000	1	1.60	30 (40)	150	370	2.22	0.35	6	2.0	7.8	28.0
3-5 (30)	0.08	φ300	160	15,000	1	2.40	30 (40)	150	370	2.22	0.50	7	2.3	9.4	37.4
3-6 (30)	0.08	φ300	160	15,000	1	2.40	30 (40)	150	370	2.22	0.50	8	2.6	9.8	47.2
3-7 (30)	0.08	φ300	160	20,000	1	3.20	30 (40)	150	370	2.22	0.64	11	3.5	12.1	59.3
3-8 (7)	0.08	φ300	160	20,000	1	3.20	7 (10)	150	370	0.56	0.59	12	3.8	10.3	69.6
4-1 (7)	0.08	φ300	160	8,000	1	1.28	7 (10)	120	490	0.59	0.25	5	1.7	4.9	4.9
4-2 (6)	0.07	φ300	160	7,000	1	1.12	6 (8)	120	490	0.47	0.21	4	1.4	4.1	9.0
4-3 (6)	0.07	φ300	160	12,000	1	1.92	6 (8)	120	490	0.47	0.36	3	1.1	4.9	13.9
4-4 (7)	0.08	φ300	160	3,000	1	0.48	7 (10)	120	490	0.59	0.10	3	1.1	2.9	16.8
4-5 (8)	0.09	φ300	160	5,000	1	0.80	8 (11)	120	490	0.65	0.16	7	2.3	4.9	21.7
4-6 (7)	0.08	φ300	160	4,000	1	0.64	7 (10)	120	490	0.59	0.13	4	1.4	3.5	25.2
4-7 (8)	0.09	φ300	160	2,000	1	0.32	8 (11)	120	490	0.65	0.08	4	1.4	3.1	28.3
4-8 (8)	0.09	φ300	160	7,000	1	1.12	8 (11)	120	490	0.65	0.22	5	1.7	4.7	33.0
4-9 (6)	0.07	φ300	160	8,000	1	1.28	6 (8)	120	490	0.47	0.24	4	1.4	4.3	37.3
4-10(7)	0.08	φ300	160	10,000	1	1.60	7 (10)	120	490	0.59	0.30	4	1.4	4.9	42.2
4-11(6)	0.07	φ300	160	11,000	1	1.76	6 (8)	120	490	0.47	0.33	4	1.4	5.0	47.2
4-12(6)	0.07	φ300	160	15,000	1	2.40	6 (8)	120	490	0.47	0.45	4	1.4	6.0	53.2
5-1 (6)	0.07	φ300	160	2,000	1	0.32	6 (8)	120	490	0.47	0.07	3	1.1	2.5	2.5
5-2 (6)	0.07	φ300	160	2,000	1	0.32	6 (8)	120	490	0.47	0.07	4	1.4	2.9	5.4
5-3 (6)	0.07	φ300	160	3,000	1	0.48	6 (8)	120	490	0.47	0.10	5	1.7	3.5	8.9
6-1 (13)	0.07	φ300	160	2,000	2	0.64	13 (18)	120	490	1.06	0.14	4	1.4	4.1	4.1
6-2 (12)	0.07	φ300	160	3,000	2	0.96	12 (16)	120	490	0.94	0.20	4	1.4	4.4	8.5
6-3 (12)	0.07	φ300	160	6,000	2	1.92	12 (16)	120	490	0.94	0.37	6	2.0	6.6	15.1
6-4 (12)	0.07	φ300	160	8,000	2	2.56	12 (16)	120	490	0.94	0.49	5	1.7	7.2	22.3
6-5 (12)	0.07	φ300	160	12,000	2	3.84	13 (18)	120	490	1.06	0.72	7	2.3	10.0	32.3
7-1 (3)	0.025	φ200	110	7,000	1	0.77	3 (4)	120	490	0.24	0.15	4	1.4	3.2	3.2
7-2 (3)	0.025	φ200	110	4,000	1	0.44	3 (4)	120	490	0.24	0.09	4	1.4	2.7	5.9
7-3 (3)	0.025	φ200	110	7,000	1	0.77	3 (4)	120	490	0.24	0.15	6	2.0	4.0	9.9
7-4 (3)	0.025	φ200	110	11,000	1	1.21	3 (4)	120	490	0.24	0.22	5	1.7	4.3	14.2
7-5 (3)	0.025	φ200	110	13,000	1	1.43	3 (4)	120	490	0.24	0.26	7	2.3	5.4	19.6

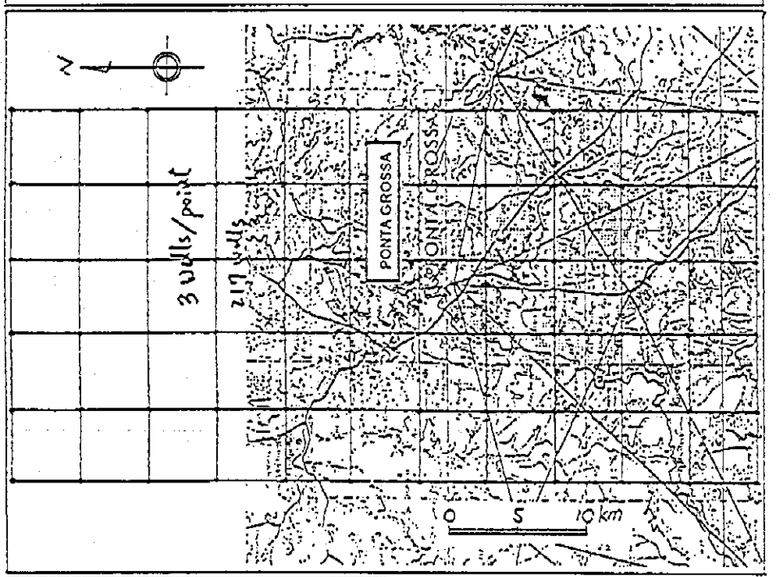
(1) Access Road 300,000US$/km, 200,000US$/site Contigency : 15%, Engineering Service 10%
(2) Pumping Cost is 18% of Pipeline cost , Pumping cost of well 3,100US$/site (KARST) 2,200US$/site (others)
(3) The unit cost of Pipeline includes price change (1.571times)
(4) Site No. 1- : Curitiba, 2- : Cascavel, 3- : Ponta Grossa, 4- : Londrina, 5- : Apucarana, 6- : Maringa, 7- : Umuarama

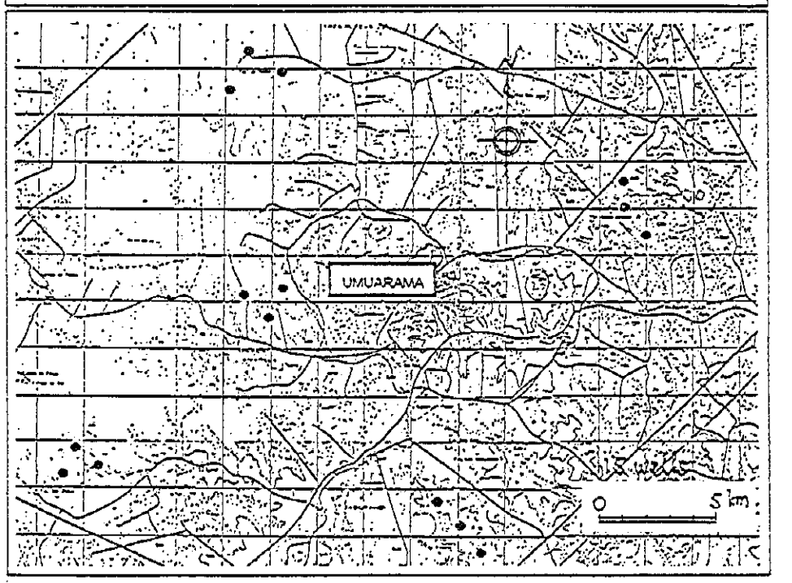












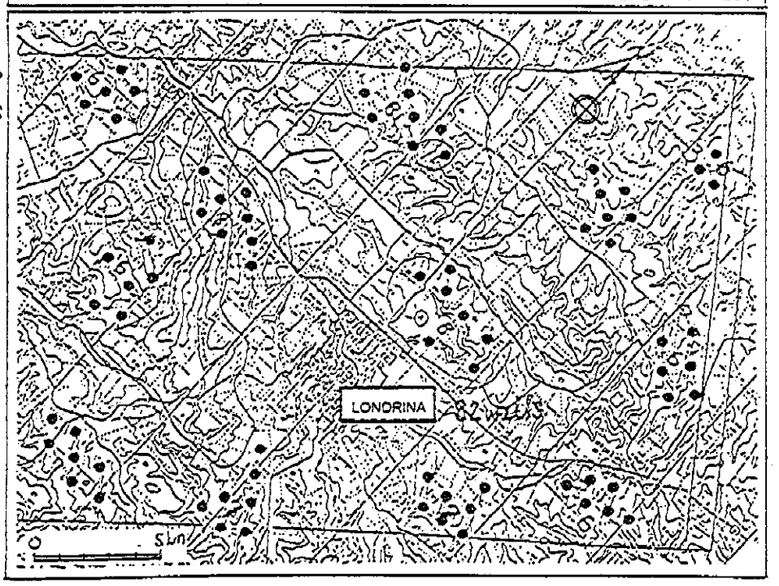


Figure-2.8 Well Field for Large Urban Area

Table-2.24 Estimated Construction Cost of Planned Dams and Pipeline

Site NO.	Name	Location	Construction Cost of Dam (×10³US$)	Convenyance Facility Cost (×10³US$)	(×10³US$)	Development Volume (m³/s)	(×10³US$
1	Irai	near Curitiba	33.1	6.7	39.8	1.10	36.2
2	Piraquara II	do	13.7	4.3	18.0	0.70	25.7
3	Pequeno	do	25.1	5.5	30.6	0.90	34.0
4	Alto Miringuava	do	24.4	6.1	30.5	1.00	30.5
5	Cotia Despique	do	28.7	7.3	36.0	1.20	30.0
6	Alto Mauricio	do	11.0	1.5	12.5	0.25	50.0
7	Das Oncas(Mandirituba)	do	17.9	1.5	19.4	0.25	77.6
8	Faxinal	do	18.4	3.1	21.5	0.50	43.0
9	Das Oncas(Contenda)	do	14.9	3.7	18.6	0.60	31.0
10	Piunduva	do	15.5	1.2	16.7	0.20	83.5
①	Well Field	do			30.0	1.00	30.0
②	Well Field	do			73.8	2.00	36.9
③	Well Field	do			136.5	3.00	45.5
C_1	Baneiro(I)	near Cascavel	36.0	8.2	44.2	0.55	80.4
C_2	Tesovro	do	27.8	7.5	35.3	0.35	100.9
C_3	Bameiro(II)	do	17.5	13.9	31.4	0.69	45.5
C_4	Aroeira	do	45.1	8.2	53.3	0.60	88.8
C_5	Antos	do	23.4	5.6	29.0	0.69	42.0
C_6	C.S.Salvaror	do	22.1	2.0	24.1	0.20	120.5
①	Well Field	do			35.1	0.69	50.9
P_1-S		near Ponta Grossa		7.4	7.4	0.602	12.3
P_1	Pitangui	do	41.0	4.7	45.7	0.55	83.1
P_2	Verde	do	27.1	3.3	30.4	0.25	121.6
①	Well Field	do			69.6	0.602	115.6
L_1-S		near Londrina		11.6	11.6	0.874	13.3
L_1	Catezai	do	45.1	3.3	48.4	0.40	121.0
L_2	Jacutinga	do	15.1	3.5	18.6	0.25	74.4
①	Well Field	do			53.2	0.874	60.9
A_1	Pirapo	Apucarana	7.3	0.8	8.1	0.02	405.0
A_2	Bara Nova	do	6.3	0.9	7.2	0.01	720.0
①	Well Field	do			8.9	0.192	46.4
M_1-S		Maringa		8.9	16.3	0.737	12.0
M_1	Ribeirao Sarandi	do	41.6	4.6	46.2	0.50	92.4
M_2	Ribeirao Pinguim	do	39.7	4.6	44.3	0.55	80.5
①	Well Field	do			32.3	0.737	43.8
U_1	Conegio Pinaizinho	Umuarama	7.3	4.0	11.3	0.12	94.2
U_2	Ribeirao Verde	do	7.5	4.0	11.5	0.12	95.8
①	Well Field	do			19.6	0.120	163.3

Table-2.2.5 Alternative Solutions for Water Development in Particular Area

Location	Required Supply Amount	River	Specific Drought Discharge q10,7	Coordinates X	Coordinates Y	Catchment Area	Direct Intake from River: Developed Water	Direct Intake from River: Pipe Line Length	Direct Intake from River: PumpHead	Development by Dam: Developed Water	Development by Dam: Effective Capacity	Development by Dam: Pipe Line Length	Development by Dam: PumpHead	Development from Groundwater: Aquifer No.	Development from Groundwater: Required Well Num.	Development from Groundwater: Required Well Field	Remark
	m3/s		m3/s/100km2			km2	m3/s	km	m	m3/s	million m3	km	m			km2	
Cascavel	0.611	:Base Case															
	(0.813)	:Alternative Case															
[1] D-C1		Barreiro	0.411	264	7,244	38.6				0.55	14.5	15.0	160				
[2] D-C2		Tesouro	0.410	266	7,243	24.2				0.35	9.3	17.0	150				
[3] D-C3		Barreiro	0.445	266	7,247	83.0				1.30	35.7	21.0	170				
[4] D-C4		Aroeira	0.339	258	7,248	47.8				0.60	15.2	12.0	160				
[5] D-C5		Antos	0.365	244	7,244	68.9				0.90	23.0	8.0	160				
[6] D-C6		C.S.Salvador	0.351	259	7,230	17.5				0.20	4.2	10.0	160				
[7] Wells														[6]	55	382	for 0.611m3/s
Ponta Grossa	0.615	:Base Case												[6]	(73)	(508)	:Alternative Case
	(0.800)	:Alternative Case															
[1] S-P1		Tibagi	0.214	586	7,214	1,520.0	1.63	11.0	160								
[2] D-P1		Pitangui	0.214	590	7,231	70.9				0.55	15.0	8.5	90				
[3] D-P2		Verde	0.221	594	7,226	32.4				0.25	6.1	10.0	30				
[4] Wells														[3]	221	1,367	for 0.615m3/s
Londrina	1.045	:Base Case												[3]	(288)	(1,778)	:Alternative Case
	(1.416)	:Alternative Case															
[1] S-L1		Tibagi	0.088	501	7,429	21,955.0	9.66	15.0	250								
									150 or 200								SI.64-507-011
[2] D-L1		Cafezal	0.072	482	7,416	157.8											Using COPEL dam
[3] D-L2		Jacutinga	0.091	491	7,428	96.7				0.40	9.6	7.0	150				
[4] Wells										0.25	6.5	10.0	200				
														[6]	97	653	for 1.045m3/s
Apucarana	0.202	:Base Case												[6]	(127)	(885)	:Alternative Case
[1] D-A1		Pirapo	0.082	450	7,398	20.9											
[2] D-A2		Bara Nova	0.056	451	7,391	15.6				0.02	1.3	4.5	160				
[3] Wells										0.01	0.5	6.0	120				
														[6]	19	126	for 0.202m3/s
Maringa	0.906	:Base Case															
	(1.152)	:Alternative Case															
[1] S-M1		Pirapo	0.269	414	7,420	1,252.0	1.68	13.0	190								
[2] D-M1		Ribeirao Sarandi	0.224	414	7,412	59.7				0.50	12.9	8.0	120				
[3] D-M2		Ribeirao Pinguim	0.191	403	7,402	81.6				0.55	13.4	8.0	160				
[4] Wells														[6]	77	566	for 0.906m3/s
Umuarama	0.044	:Base Case												[6]	(104)	(720)	:Alternative Case
[1] D-U1		Corregio Pinaizinho	0.503	270	7,368	44.2				0.70	20.4	6.0	120				
[2] D-U2		Ribeirao Verde	0.524	259	7,372	28.4				0.40	12.7	6.0	160				
[3] Wells														[8]	6	398	for 0.044m3/s

Note : D ; dam, S ; direct intake from river, C1,P1 etc. ; Location of Site
Aquifer Classification ;
[3]:Early Paleozoic;Castro/Parana Group
[6]:Botucatu & Serra Geral F.(Norte)
[8]:Caiua Formation

Table-2.26 Specifications and Cost of Desirable Water Development Facilities for Large Urban Area

Urban Name	Location or Construction Name	Development Volume (m^3/s)	Embankment Volume ($1000m^3$)	Pumping Head (m)	Well Numbers	Well Depth (m)	Pipeline (mm)*(m)	Cost (million us$)
Curitiba	Dams	5.000						186.0
Metropolitan	Wells	2.090						95.1
Cascavel	D-C5 Dam	0.611	473	200			800* 8,000	29.0
Ponta Grossa	S-P1 Direct Intake	0.615		200			700*11,000	7.4
Londrina	S-L1 Direct Intake	1.045		310			800*15,000	11.6
Apucarana	Wells	0.202			18	120	300* 2,000	8.9
Maringa	S-M1 Direct Intake	0.906		260			700*13,000	8.9
Umuarama	D-U1 Dam	0.044	54	140			400* 6,000	11.3

2.7.2 Other Urban Areas

There are 356 municipalities except for above large urban areas in Paraná State. The required water for both domestic and industrial uses was described in Table-2.27. An amount of required water by each urban area depends on the scale of municipality, and required water volume at the target year of 2015 ranges from 0.001 in minimum to 0.795 m^3/sec in maximum at Foz do Iguaçu, with a mean of 0.024 m^3/sec.

Although a recommendable method of water development in this scale of urban areas is applied for a direct intake method, such as using a pipeline or an open channel which is led water from weir reservoir, an area located on the top of mountain ridge is necessary to apply pumping the water from river.

The cost estimation of the water supply system for other urban areas follows the procedure below.

1) Identification of the relationship between the water requirement and its development cost at the range of 0.01 m^3/s to 0.90 m^3/s based on the cost estimation of 24 municipalities selected
2) Cost estimation of all municipalities applying the above relationship to the water requirement of each municipality, except ones selected in (1).

The cost of water development of each municipality was summarized in MRH wise as shown below.

The total cost of water development of urban areas, except Curitiba metropolitan area and large urban areas, is US$ 306.3 million as shwon Table-2.28.

Table-2.27 Required Water Supply Amount in Each Municipality Urban Area

Municipality Name	1993 m3's	2015 m3's	2015-93 m3's	Municipality Name	1993 m3's	2015 m3's	2015-93 m3's	Municipality Name	1993 m3's	2015 m3's	2015-93 m3's	Municipality Name	1993 m3's	2015 m3's	2015-93 m3's	Municipality Name	1993 m3's	2015 m3's	2015-93 m3's
Mandirituba	0.038	0.072	0.034	Jacarezinho	0.078	0.132	0.054	Presidente Castero Branco	0.007	0.011	0.004	Campo Mourao	0.199	0.373	0.174	Chopinzinho	0.021	0.042	0.021
Rio Blanco do Sul	0.091	0.172	0.081	Ribeirao Claro	0.016	0.027	0.011	Nova Esperanca	0.041	0.070	0.029	Ara Una	0.014	0.027	0.013	Coronel	0.030	0.062	0.032
Bocaiuva do Sul	0.010	0.020	0.010	Santo Antonio da Planita	0.071	0.120	0.049	Cruzeiro do Sul	0.008	0.014	0.006	Peabiru	0.021	0.039	0.018	Sao Joao	0.012	0.025	0.013
Campinha Grande do Sul	0.107	0.202	0.095	Barra do Jacare	0.004	0.006	0.002	Paranacity	0.014	0.023	0.009	Engenheiro Beltrao	0.023	0.043	0.020	Itapejara D'Oeste	0.010	0.020	0.010
Quatro Barras	0.052	0.098	0.046	Cambara	0.042	0.072	0.030	Inaja	0.005	0.009	0.004	Quinta do Sol	0.008	0.015	0.007	Pato Branco	0.113	0.233	0.120
Contenda	0.020	0.038	0.018	Andira	0.044	0.075	0.031	Paranapoema	0.006	0.010	0.004	Fenix	0.009	0.017	0.008	Mariopolis	0.007	0.014	0.007
Balsa Nova	0.013	0.025	0.012	Itambaraca	0.020	0.034	0.014	Jardim Olinda	0.003	0.005	0.002	Barbora Ferraz	0.024	0.046	0.022	Vitorino	0.007	0.013	0.006
Tunas do Parana	0.003	0.006	0.003	Bandeirantes	0.064	0.109	0.045	Alto Parana	0.020	0.034	0.014	Iretama	0.018	0.034	0.016	Renascenca	0.005	0.009	0.004
Itaperucu	0.023	0.044	0.021	Santa Amelia	0.006	0.010	0.004	Sao Joao do Caiua	0.011	0.019	0.008	Roncador	0.019	0.035	0.016	Marmeleiro	0.019	0.038	0.019
MRH-268	0.357	0.677	0.320	Abatia	0.016	0.028	0.012	Santo Antonio do Caiua	0.004	0.006	0.002	Nova Cantu	0.012	0.022	0.010	Francisco Beltrao	0.138	0.283	0.145
Guaraquecaba	0.004	0.007	0.003	Ribeirao do Pinhal	0.022	0.037	0.015	Tamboa	0.007	0.012	0.005	Campina da Lagoa	0.030	0.057	0.027	Vere	0.007	0.015	0.008
Antonina	0.027	0.043	0.016	Jundiai do Sul	0.005	0.009	0.004	Paraiso do Norte	0.019	0.033	0.014	Ubirata	0.046	0.087	0.041	Dois Vizinhos	0.065	0.135	0.070
Morretes	0.012	0.018	0.006	Congonhinhas	0.012	0.020	0.008	Nova Alianca do Ivai	0.002	0.003	0.001	Mambore	0.022	0.040	0.018	Sao Jorge D'Oeste	0.008	0.016	0.008
Paranagua	0.210	0.332	0.122	Santo Antonio do Paraiso	0.003	0.005	0.002	Mirador	0.005	0.008	0.003	Boa Esperanca	0.007	0.012	0.005	Salgado Filho	0.005	0.009	0.004
Guaratuba	0.039	0.063	0.024	Nova Fatima	0.015	0.026	0.011	Paranavai	0.153	0.259	0.106	Janiopolis	0.010	0.020	0.010	Barracao	0.014	0.029	0.015
Matinhos	0.038	0.060	0.022	Nova America do Colina	0.005	0.009	0.004	Amapora	0.010	0.016	0.006	Goio-Ere	0.071	0.133	0.062	Santo Antonio do Sudoeste	0.021	0.042	0.021
MRH-269	0.330	0.523	0.193	Cornelio Procopio	0.104	0.177	0.073	Planaltina do Parana	0.005	0.008	0.003	Moreira Sies	0.026	0.049	0.023	Eneas Marques	0.003	0.007	0.004
Cerro Azul	0.014	0.024	0.010	Santa Mariana	0.020	0.033	0.013	Guairaca	0.007	0.012	0.005	Mariluz	0.018	0.033	0.015	Salto do Lontra	0.013	0.026	0.013
Adrianopolis	0.007	0.012	0.005	Leopolis	0.007	0.011	0.004	Terra Rica	0.027	0.045	0.018	Rancho Alegre do Oeste	0.005	0.009	0.004	Santa Izabel do Oeste	0.010	0.021	0.011
Doutor Ulysses	0.002	0.003	0.001	Sertaneja	0.012	0.020	0.008	Diamante de Norte	0.013	0.021	0.008	Farol	0.005	0.009	0.004	Ampere	0.014	0.029	0.015
MRH-270	0.023	0.039	0.016	MRH-279	0.566	0.960	0.394	Itauna do Sul	0.010	0.017	0.007	Luiziana	0.010	0.019	0.009	Realeza	0.020	0.041	0.021
Tijucas do Sul	0.002	0.004	0.002	Urai	0.023	0.036	0.013	Nova Londrina	0.026	0.044	0.018	Corumbataí do Sul	0.004	0.008	0.004	Perolaza	0.007	0.015	0.008
Agudos do Sul	0.001	0.002	0.001	Rancho Alegre	0.009	0.013	0.004	Loanda	0.033	0.056	0.023	Juranda	0.010	0.019	0.009	Planalto	0.009	0.019	0.010
Pien	0.008	0.014	0.006	Jataizinho	0.021	0.033	0.012	Santa Izabel do Ivai	0.011	0.018	0.007	MRH-286	0.611	1.146	0.535	Capanema	0.017	0.034	0.017
Quitandinha	0.005	0.009	0.004	Assai	0.033	0.051	0.018	Santa Cruz do Monte Castelo	0.016	0.027	0.011	Pitanga	0.030	0.056	0.026	Saudade do Iguacu	0.005	0.010	0.005
MRH-271	0.016	0.029	0.013	Sao Sebastiao da Amoreira	0.014	0.022	0.008	Querencia do Norte	0.017	0.028	0.011	Palmital	0.008	0.015	0.007	Pinhal do Sao Bento	0.001	0.003	0.002
Campo de Tenente	0.011	0.020	0.009	Santa Cecilia do Pavao	0.006	0.009	0.003	Sao Pedro do Parana	0.003	0.005	0.002	Manoel Ribas	0.008	0.016	0.008	Nova Esperanca do Sudoeste	0.002	0.004	0.002
Rio Negro	0.079	0.143	0.064	Sao Jeronimo da Serra	0.015	0.023	0.008	Porto Rico	0.004	0.006	0.002	Santa Maria D'Oeste	0.002	0.004	0.002	Flor da Serra do Sul	0.001	0.001	0.000
Lapa	0.080	0.144	0.064	Nova Santa Barbara	0.005	0.008	0.003	Marilena	0.009	0.016	0.007	Mato Rico	0.001	0.001	0.000	Cruzeiro do Iguacu	0.006	0.013	0.007
Palmeira	0.059	0.106	0.047	MRH-280	0.126	0.195	0.069	Santa Monica	0.001	0.002	0.001	Laranjal	0.001	0.003	0.002	Bom Sucesso do Sul	0.003	0.006	0.003
Porto Amazonas	0.009	0.017	0.008	Primeiro de Maio	0.030	0.055	0.025	MRH-283	0.497	0.837	0.340	Nova Tebas	0.006	0.012	0.006	Boa Esperanca do Iguacu	0.002	0.003	0.001
MRH-272	0.238	0.430	0.192	Sertanopolis	0.031	0.058	0.027	Grandes Rios	0.012	0.022	0.010	Altamira do Parana	0.003	0.005	0.002	Sulina	0.002	0.004	0.002
Castro	0.142	0.266	0.124	Ibipora	0.112	0.206	0.094	California	0.012	0.023	0.011	MRH-287	0.059	0.112	0.053	Pranchita	0.007	0.015	0.008
Pirai do Sul	0.040	0.074	0.034	Cambe	0.238	0.439	0.201	Rio Bom	0.004	0.008	0.004	Guaraniacu	0.018	0.042	0.024	Nova Prata do Iguacu	0.009	0.019	0.010
Tibagi	0.030	0.056	0.026	Bela Vista do Paraiso	0.038	0.070	0.032	Marilandia do Sul	0.013	0.025	0.012	Catanduvas	0.011	0.027	0.016	MRH-289	0.613	1.255	0.642
Telemaco Borba	0.200	0.373	0.173	Alvorada do Sul	0.017	0.032	0.015	Faxinal	0.029	0.054	0.025	Corbelia	0.023	0.055	0.032	Guarapuava	0.335	0.636	0.301
Ventania	0.014	0.026	0.012	Miraselva	0.011	0.020	0.009	Borrazopolis	0.013	0.024	0.011	Capitao Leonidas Marques	0.011	0.027	0.016	Inacio Martins	0.007	0.013	0.006
MRH-273	0.426	0.795	0.369	Flovestopolis	0.028	0.053	0.025	Cambira	0.009	0.016	0.007	Formosa do Oeste	0.011	0.026	0.015	Pinhao	0.021	0.040	0.019
Jaguariaiva	0.103	0.276	0.173	Porecatu	0.029	0.054	0.025	Jandaia do Sul	0.040	0.074	0.034	Assis Chateaubriand	0.061	0.144	0.083	Laranjeiras do Sul	0.049	0.092	0.043
Senges	0.041	0.110	0.069	Jaguapita	0.026	0.048	0.022	Bom Sucesso	0.013	0.024	0.011	Palotina	0.045	0.105	0.060	Quedas do Iguacu	0.044	0.084	0.040
Arapoti	0.063	0.170	0.107	Centenario do Sul	0.032	0.058	0.026	Sao Pedro do Ivai	0.021	0.038	0.017	Terra Roxa	0.023	0.055	0.032	Virmond	0.002	0.003	0.001
MRH-274	0.207	0.556	0.349	Guaraci	0.012	0.023	0.011	Marumbi	0.008	0.014	0.006	Guaira	0.046	0.110	0.064	Rio Bonito do Iguacu	0.002	0.003	0.001
Antonio Olinto	0.002	0.005	0.003	Nussa Senhora dos Gracas	0.007	0.013	0.006	Kalore	0.007	0.014	0.007	Marechal Candido Rondon	0.042	0.098	0.056	Nova Laranjeiras	0.001	0.001	0.000
Sao Mateus do Sul	0.053	0.099	0.046	Cafera	0.005	0.010	0.005	Sao Joao do Ivai	0.026	0.048	0.022	Toledo	0.203	0.482	0.279	Candoi	0.005	0.010	0.005
Sao Joao do Triunfo	0.010	0.019	0.009	Lupinopolis	0.011	0.020	0.009	Jardim Alegre	0.016	0.030	0.014	Matelandia	0.018	0.043	0.025	Turvo	0.010	0.020	0.010
MRH-275	0.065	0.123	0.058	Colorado	0.057	0.105	0.048	Ivaipora	0.066	0.124	0.058	Medianeira	0.067	0.160	0.093	Cantagalo	0.034	0.064	0.030
Prudentopolis	0.030	0.055	0.025	Santo Inacio	0.013	0.025	0.012	Novo Itacolomi	0.002	0.004	0.002	Sao Miguel do Iguacu	0.024	0.056	0.032	MRH-290	0.510	0.966	0.456
Imbituba	0.021	0.038	0.017	Santa Ines	0.003	0.005	0.002	Maua da Serra	0.008	0.015	0.007	Foz do Iguacu	0.581	1.376	0.795	Uniao da Vitoria	0.112	0.182	0.070
Texeira Soares	0.013	0.024	0.011	Itaguaje	0.010	0.019	0.009	Lidianopolis	0.005	0.008	0.003	Ceu Azul	0.012	0.029	0.017	Paula Freitas	0.007	0.011	0.004
Irati	0.085	0.156	0.071	Rolandia	0.109	0.201	0.092	Godoy Moreira	0.003	0.005	0.002	Nova Aurora	0.019	0.045	0.026	Paulo Frontin	0.006	0.009	0.003
Rebouças	0.015	0.027	0.012	Arapongas	0.185	0.342	0.157	Rosario do Ivai	0.006	0.012	0.006	Santa Helena	0.013	0.032	0.019	Cruz Machado	0.008	0.013	0.005
Rio Azul	0.008	0.015	0.007	Sabaudia	0.011	0.021	0.010	Lunardelli	0.008	0.015	0.007	Nova Santa Rosa	0.009	0.021	0.012	Bituruna	0.020	0.033	0.013
Mallet	0.018	0.033	0.015	Astorega	0.059	0.110	0.051	MRH-284	0.321	0.597	0.276	Sao Pedro do Iguacu	0.007	0.016	0.009	Porto Vitoria	0.006	0.009	0.003
MRH-276	0.190	0.348	0.158	Munhoz de Melo	0.006	0.011	0.005	Alto Piquiri	0.020	0.025	0.005	Santa Lucia	0.004	0.009	0.005	General Carneiro	0.026	0.043	0.017
Ortigueira	0.008	0.014	0.006	Iguaracu	0.011	0.020	0.009	Ipora	0.030	0.037	0.007	Ramilandia	0.004	0.010	0.006	Palmas	0.086	0.139	0.053
Reserva	0.015	0.025	0.010	Santa Fe	0.021	0.039	0.018	Xambre	0.006	0.007	0.001	Quatro Pontes	0.002	0.005	0.003	Mangueirinha	0.020	0.033	0.013
Candido de Abreu	0.008	0.013	0.005	Florida	0.006	0.011	0.005	Icaraima	0.015	0.019	0.004	Pato Bragado	0.003	0.006	0.003	Clevelandia	0.037	0.060	0.023
Ivai	0.006	0.010	0.004	Lobato	0.011	0.020	0.009	Maria Helena	0.006	0.008	0.002	Mercedes	0.001	0.003	0.002	Honorio Serpa	0.003	0.005	0.002
Ipiranga	0.006	0.010	0.004	Fitangueiras	0.004	0.007	0.003	Cidade Gaucha	0.019	0.023	0.004	Maripa	0.005	0.012	0.007	MRH-291	0.331	0.537	0.206
MRH-277	0.043	0.072	0.029	Angulo	0.007	0.012	0.005	Cruzeiro do Oeste	0.037	0.046	0.009	Itaipulandia	0.002	0.005	0.003				
Carlopolis	0.010	0.017	0.007	MRH-281	1.140	2.107	0.967	Gauporema	0.003	0.003	0.000	Iracema do Oeste	0.005	0.011	0.006				
Salto do Itarare	0.005	0.008	0.003	Mandaguari	0.073	0.154	0.081	Rondon	0.011	0.013	0.002	Iguatu	0.002	0.005	0.003				
Santana do Itarare	0.005	0.007	0.002	Marialva	0.055	0.116	0.061	Tapejara	0.023	0.028	0.005	Entre Rios do Oeste	0.002	0.005	0.003				
Sao Jose da Boa Vista	0.006	0.010	0.004	Itambe	0.016	0.034	0.018	Tuneiras do Oeste	0.013	0.016	0.003	Diamante so Sul	0.002	0.004	0.002				
Wenceslau Braz	0.023	0.036	0.013	Floresta	0.013	0.028	0.015	Japura	0.011	0.013	0.002	Anahy	0.003	0.007	0.004				
Siqueira Campos	0.014	0.022	0.008	Ivatuba	0.006	0.012	0.006	Sao Tome	0.006	0.008	0.002	Santa Tereza do Oeste	0.007	0.017	0.010				
Tomazina	0.007	0.011	0.004	Doutor Camargo	0.014	0.030	0.016	Cianorte	0.097	0.119	0.022	Ouro Verde do Oeste	0.007	0.017	0.010				
Quatigua	0.008	0.013	0.005	Paicandu	0.107	0.225	0.118	Jussara	0.014	0.018	0.004	Lindoeste	0.001	0.003	0.002				
Joaquin Tavora	0.010	0.016	0.006	Ourizona	0.009	0.019	0.010	Terra Boa	0.022	0.027	0.005	Ibema	0.015	0.036	0.021				
Guapirama	0.005	0.009	0.004	Mangaguacu	0.041	0.086	0.045	Altonia	0.030	0.037	0.007	Sao Jose des Palmeiras	0.005	0.012	0.007				
Conselheiro Mairink	0.004	0.007	0.003	Sao Jorge do Ivai	0.013	0.028	0.015	Perola	0.017	0.021	0.004	Diamante D'Oeste	0.009	0.021	0.012				
Jaboti	0.003	0.005	0.002	Florai	0.012	0.025	0.013	Indianapolis	0.004	0.005	0.001	Campo Bonito	0.004	0.009	0.005				
Japira	0.003	0.005	0.002	Atalaia	0.010	0.020	0.010	Tapira	0.007	0.008	0.001	Boa Vista da Aparecida	0.006	0.014	0.008				
Ibaiti	0.024	0.039	0.015	Unifor	0.005	0.011	0.006	Nova Olimpia	0.008	0.010	0.002	Missal	0.010	0.025	0.015				
Piuhalao	0.005	0.007	0.002	Sao Carlos do Ivai	0.012	0.025	0.013	Francisco Alves	0.008	0.010	0.002	Santa Terezinhodo do Itaipu	0.029	0.069	0.040				
Curiuva	0.009	0.014	0.005	Sarandi	0.232	0.489	0.257	Vila Alta	0.005	0.006	0.001	Iesuitas	0.012	0.028	0.016				
Sapopema	0.006	0.010	0.004	MRH-282	0.618	1.302	0.684	Sao Manoel do Parana	0.002	0.002	0.000	Braganey	0.007	0.017	0.010				
Figueira	0.019	0.030	0.011					Cafezal do Sul	0.005	0.006	0.001	Vera Cruz d Oeste	0.011	0.026	0.015				
MRH-278	0.166	0.266	0.100					Brasilandia do Sul	0.006	0.007	0.001	Tres Barras do Parana	0.008	0.019	0.011				
								Ivate	0.005	0.007	0.002	Catelandia	0.020	0.048	0.028				
								Douradina	0.007	0.008	0.001	Iupassi	0.011	0.026	0.015				
								Sao Jorge do Patrocinio	0.007	0.008	0.001	MRH-288	1.441	3.418	1.977	Total Required Water	9.338	17.835	8.497
								MRH-285	0.444	0.545	0.101					Average Required Water	0.026	0.050	0.024

Table-2.28 The Cost of Water Development in MRH

MRH Name	1993 m3/s	2015 m3/s	2015-'93 m3/s	Cost million US$
MRH-268	0.357	0.677	0.320	9.80
MRH-269	0.330	0.523	0.193	6.06
MRH-270	0.023	0.039	0.016	1.77
MRH-271	0.016	0.029	0.013	2.22
MRH-272	0.238	0.430	0.192	5.68
MRH-273	0.426	0.795	0.369	8.05
MRH-274	0.207	0.556	0.349	6.82
MRH-275	0.065	0.123	0.058	2.46
MRH-276	0.190	0.348	0.158	6.11
MRH-277	0.043	0.072	0.029	2.99
MRH-278	0.166	0.266	0.100	10.65
MRH-279	0.566	0.960	0.394	16.50
MRH-280	0.126	0.195	0.069	5.14
MRH-281	1.140	2.107	0.967	30.09
MRH-282	0.618	1.302	0.684	17.75
MRH-283	0.497	0.837	0.340	20.60
MRH-284	0.321	0.597	0.276	15.07
MRH-285	0.444	0.545	0.101	16.36
MRH-286	0.611	1.146	0.535	19.94
MRH-287	0.059	0.112	0.053	4.90
MRH-288	1.441	3.418	1.977	49.39
MRH-289	0.613	1.255	0.642	27.30
MRH-290	0.510	0.966	0.456	11.80
MRH-291	0.331	0.537	0.206	8.89
Total	9.338	17.835	8.497	306.34

2.8 Water Development in Rural Areas

In rural areas, it is difficult to supply the water requirement by surface water systematically, because demand of domestic water is scattered due to topographic condition. Therefore, supply for domestic water will be done by groundwater development.

The demand of domestic water in rural areas tends to decrease in Paraná state. As a result, the development of rural water will not be necessary and only improvement of maintenance of existing wells is enough to satisfy the future water demand.

2.9 Water Development for Agricultural Water

Supply method of agricultural water at rural areas is generally a pipeline method with a direct intake using a pipeline and head works.

According to hearing and field reconnaissance, an average of intake volume was less than 0.001 m^3/s , and average length of pipeline was 3 km.

The total water requirement for agricultural sector is 1.02 m^3/s. The total cost of its development was estimated applying the cost of unit water development determined during the cost estimation for large urban areas and thus the total cost is US$ 12.2 million.

2.10 Total Cost for Water Development

The cost estimated in the previous sections covers from intake to purification of water. In this section, the total cost including from intake to water supply to house/industry was estimated and summarized in Table-2.29.

Table-2.29 Total Cost for Water Development

	Q (m^3/s)	Cost (10^6US$)	Unit Cost (10^6US$/m^3/s$)	Water Supply System
(1) Domestic and Industrial Water Development (Urban Area)				
1) Curitiba	7.088(2.572)	759.7	107.2	dams & groundwater
2) Cascavel	0.611(0.145)	78.4	128.3	1 dam
3) Ponta Grossa	0.615(0.283)	20.0	32.5	direct intake
4) Londrina	1.045(0.300)	31.4	30.0	direct intake
5) Apucarana	0.202(0.058)	24.1	119.3	groundwater
6) Maringa	0.906(0.339)	24.1	26.6	direct intake
7) Umuarama	0.044(0.010)	30.5	693.2	1 dam
8) Other urban area	8.497(1.603)	827.9	97.4	direct intake
Sub-total	19.008(5.310)	1,796.1	94.5	
(2) Agricultural Water Development (Rural Area)				
	1.018	12.2	12.0	direct intake
Total	20.026	1,808.3	90.3	

Note: ( )shows industrial water.

CHAPTER 3 MASTER PLAN FOR WATER UTILIZATION PLAN

3.1 General

3.1.1 Water Demand and Sources

Water demands are estimated for urban domestic water, rural domestic water, industrial water and agricultural water. Water source which is appropriate for each water demand seems to be basically as shown in Table-3.1, from the view point of developed amount, technology, realization, etc.

Table-3.1 Water Demand and Source

Water Demands	Region	Main Water Sources	Sub Water Sources
Domestic	Urban	Surface Water	Groundwater
	Rural	Groundwater	Surface Water
Industrial	Urban	Surface Water	Groundwater
Agricultural	Rural	Surface Water	Groundwater

Water source of urban domestic water and industrial water will be established by considering the characteristics of the region, surface water potential, groundwater potential, etc.

3.1.2 Water Losses

Required water supply amount is calculated by adding various losses to each water demand. Percentage of total water loss which includes losses for intake, conveyance, treatment, distribution of water, etc., is assumed as shown in Table-3.2 taking into consideration present loss percentage, future improvement and type of water development.

Table-3.2 Percentage of Water Losses

Purpose of Water Use	Region	1993(%)	2005(%)	2015(%)
Domestic	Urban	40	30	25
	Rural	15	10	10
Industry	Urban	15	10	10
Agriculture	Rural	20	20	20

3.1.3 Process of Water Development Study

Process of water development study is as shown below:

1) Require supply amount is calculated by adding various water losses to each water demand.

2) Urban areas are zoned by considering municipality population and location.

3) Demand and supply in the large urban areas such as Curitiba metropolitan area, Cascavel, Londrina, etc. are studied.

4) Demand and supply in the medium urban areas such as Francisco Beltrao, Castro, Cambe, etc. are studied.

5) Demand and supply in other urban areas are studied.

6) Demand and supply for the domestic water in the rural areas are studied.

7) Demand and supply for the agricultural water in the rural areas are studied.

8) Total cost for water development are estimated by each section.

3.1.4 Classification and Zoning of Region

The urban areas were classified into the following categories by considering characteristics of each area:

(1) Type-A: Large urban areas

The large urban areas were defined that their population will be more than approximately 100,000 in 2015.

(2) Type-B: Medium urban areas

The medium urban areas were defined that their population will be more than approximately 50,000 in 2015.

(3) Type-C: Other urban areas

The other urban areas were classified into the following zoning by considering topographic conditions:

1) Zone-a: Urban areas located nearby main streams

These areas located nearby main stream or downstream of tributaries, therefore problems of the shortage of intake rate and water quality are few.

2) Zone-b: Urban areas located upstream of second or third tributaries

Although there are problems of possible water development volume and intake method, water quality problems are quite few.

3) Zone-c: Urban areas located at top or ridge of mountains

These areas require to intake the water from the downstream of urban town, and water volume, water quality and intake method have many problems.

A hundred and one municipalities belong to Iguaçu river basin, out of which 17 urban areas were classified into Type-A and other 6 urban areas were classified into Type-B. Seventy six urban areas belong to Type-C and 2 municipalities belong to only rural areas.

Forty-three municipalities belong to Tibagi river basin, out of which 3 urban areas were classified into Type-A and other 7 urban areas were classified into Type-B. Twenty six urban areas belong to Type-C and 7 municipalities belong to only rural areas.

Type-C urban areas were classified into 3 zones by considering topographic conditions. Urban classification and zoning of Type-C urban areas are shown in Table-3.3 (1) ~ (2) and Figure-3.1 and Figure-3.2.

Table-3.3 (1) Classification and Zoning of Urban Areas in Iguaçu River Basin

No.	Municipality Name	Type	Zone	MRH
1-14	Curitiba Metropolitan Area	14 municipalities of MRH 268		
1	-Alm. Tamandare	A		MRH 268
2	-Araucaria	A		MRH 268
3	-Balsa Nova	A		MRH 268
4	- Campina Grande do Sul	A		MRH 268
5	-Campo Largo	A		MRH 268
6	-Colombo	A		MRH 268
7	-Contenda	A		MRH 268
8	-Curitiba	A		MRH 268
9	-Fazenda Rio Grande	A		MRH 268
10	-Mandirituba	A		MRH 268
11	-Pinhais	A		MRH 268
12	-Piraquara	A		MRH 268
13	-Quatro Barras	A		MRH 268
14	-Sao Jose dos Pinhais	A		MRH 268
15	Cascavel	A		MRH 288
16	Foz do Iguacu	A		MRH 288
17	Guarapuava	A		MRH 290
18	Medianeira	B		MRH 288
19	Dois Vizinhos	B		MRH 289
20	Francisco Beltrao	B		MRH 289
21	Pato Branco	B		MRH 289
22	Palmas	B		MRH 291
23	Uniao da Vitoria	B		MRH 291
24	Quitandinha	C	a	MRH 271
25	Campo do Tenente	C	a	MRH 272
26	Porto Amazonas	C	a	MRH 272
27	Rio Negro	C	a	MRH 272
28	Sao Joao do Triunfo	C	a	MRH 275
29	Sao Mateus do Sul	C	a	MRH 275
30	Mallet	C	a	MRH 276
31	Rebouças	C	a	MRH 276
32	Capitao Leonidas Marques	C	a	MRH 288
33	Boa Esperanca do Iguacu	C	a	MRH 289
34	Bom Sucesso do Sul	C	a	MRH 289
35	Itapejara do Oeste	C	a	MRH 289
36	Marmeleiro	C	a	MRH 289
37	Realeza	C	a	MRH 289
38	Santa Izabel do Oeste	C	a	MRH 289
39	Saudade do Iguacu	C	a	MRH 289
40	Sulina	C	a	MRH 289
41	Quedas do Iguacu	C	a	MRH 290
42	Rio Bonito Iguacu	C	a	MRH 290
43	Virmond	C	a	MRH 290
44	Bituruna	C	a	MRH 291
45	Paula Freitas	C	a	MRH 291
46	Porto Vitoria	C	a	MRH 291
47	Agudos do Sul	C	b	MRH 271
48	Pien	C	b	MRH 271
49	Rio Azul	C	b	MRH 276
50	Boa Vista da Aparecida	C	b	MRH 288
51	Catanduvas	C	b	MRH 288
52	Ibema	C	b	MRH 288
53	Santa Lucia	C	b	MRH 288
54	Tres Barras Parana	C	b	MRH 288
55	Ampere	C	b	MRH 289
56	Capanema	C	b	MRH 289
57	Chopinzinho	C	b	MRH 289
58	Coronel Vivida	C	b	MRH 289
59	Cruzeiro do Iguacu	C	b	MRH 289
60	Eneas Marques	C	b	MRH 289
61	Mariopolis	C	b	MRH 289
62	Nova Esperanca do Sudoeste	C	b	MRH 289
63	Perola do Oeste	C	b	MRH 289
64	Pinhal Sao Bento	C	b	MRH 289
65	Planalto	C	b	MRH 289
66	Pranchita	C	b	MRH 289
67	Renascenca	C	b	MRH 289
68	Salgado Filho	C	b	MRH 289
69	Salto do Lontra	C	b	MRH 289
70	Santo Antonio Sudoeste	C	b	MRH 289
71	Sao Joao	C	b	MRH 289
72	Sao Jorge do Oeste	C	b	MRH 289
73	Vere	C	b	MRH 289
74	Vitorino	C	b	MRH 289
75	Cantagalo	C	b	MRH 290
76	Pinhao	C	b	MRH 290
77	Clevelandia	C	b	MRH 291
78	Cruz Machado	C	b	MRH 291
79	General Carneiro	C	b	MRH 291
80	Honorio Serpa	C	b	MRH 291
81	Mangueirinha	C	b	MRH 291
82	Paulo Frontin	C	b	MRH 291
83	Tijucas do Sul	C	c	MRH 271
84	Lapa	C	c	MRH 272
85	Antonio Olinto	C	c	MRH 275
86	Ceu Azul	C	c	MRH 288
87	Guaraniacu	C	c	MRH 288
88	Lindoeste	C	c	MRH 288
89	Matelandia	C	c	MRH 288
90	Santa Tereza do Oeste	C	c	MRH 288
91	Santa Terezinha Itaipu	C	c	MRH 288
92	Sao Miguel do Iguacu	C	c	MRH 288
93	Barracao	C	c	MRH 289
94	Flor da Serra do Sul	C	c	MRH 289
95	Nova Prata do Iguacu	C	c	MRH 289
96	Candoi	C	c	MRH 290
97	Inacio Martins	C	c	MRH 290
98	Laranjeiras do Sul	C	c	MRH 290
99	Nova Laranjeiras	C	c	MRH 290
100	Palmeira	*		MRH 272
101	Irati	*		MRH 276

* : Urban area is not included in Iguacu river basin. Only rural area spreaded in the basin.

No.	Municipality Name	Type	Zone	MRH
1	Ponta Grossa	A		MRH 273
2	Londrina	A		MRH 281
3	Apucarana	A		MRH 284
4	Castro	B		MRH 273
5	Telemaco Borba	B		MRH 273
6	Irati	B		MRH 276
7	Cornelio Procopio	B		MRH 279
8	Arapongas	B		MRH 281
9	Camoe	B		MRH 281
10	Ibipora	B		MRH 281
11	Pirai do Sul	C	a	MRH 273
12	Tibagi	C	a	MRH 273
13	Ipiranga	C	a	MRH 277
14	Ortigueira	C	a	MRH 277
15	Sapopema	C	a	MRH 278
16	Jataizinho	C	a	MRH 280
17	Nova Santa Barbara	C	a	MRH 280
18	São Jeronimo da Serra	C	a	MRH 280
19	Primeiro de Maio	C	a	MRH 281
20	Palmeira	C	b	MRH 272
21	Reserva	C	b	MRH 277
22	N. America da Colina	C	b	MRH 279
23	Santo Antonio do Paraiso	C	b	MRH 279
24	Santa Cecilia do Pavao	C	b	MRH 280
25	Sao Sebastião da Amoreira	C	b	MRH 280
26	Urai	C	b	MRH 280
27	Sertanopolis	C	b	MRH 281
28	Imbituva	C	c	MRH 276
29	Teixeira Soares	C	c	MRH 276
30	Curiuva	C	c	MRH 278
31	Congonhinhas	C	c	MRH 279
32	Sertaneja	C	c	MRH 279
33	Assai	C	c	MRH 280
34	Rancho Alegre	C	c	MRH 280
35	Califormia	C	c	MRH 284
36	Maua da Serra	C	c	MRH 284
37	Porto Amazonas		*	MRH 272
38	Ventania		*	MRH 273
39	Ivai		*	MRH 277
40	Leopolis		*	MRH 279
41	Nova Fatima		*	MRH 279
42	Rolandia		*	MRH 281
43	Marilandia do Sul		*	MRH 284

* : Urban area is not included in Tbagi river basin. Only rural area spreaded in the basin.

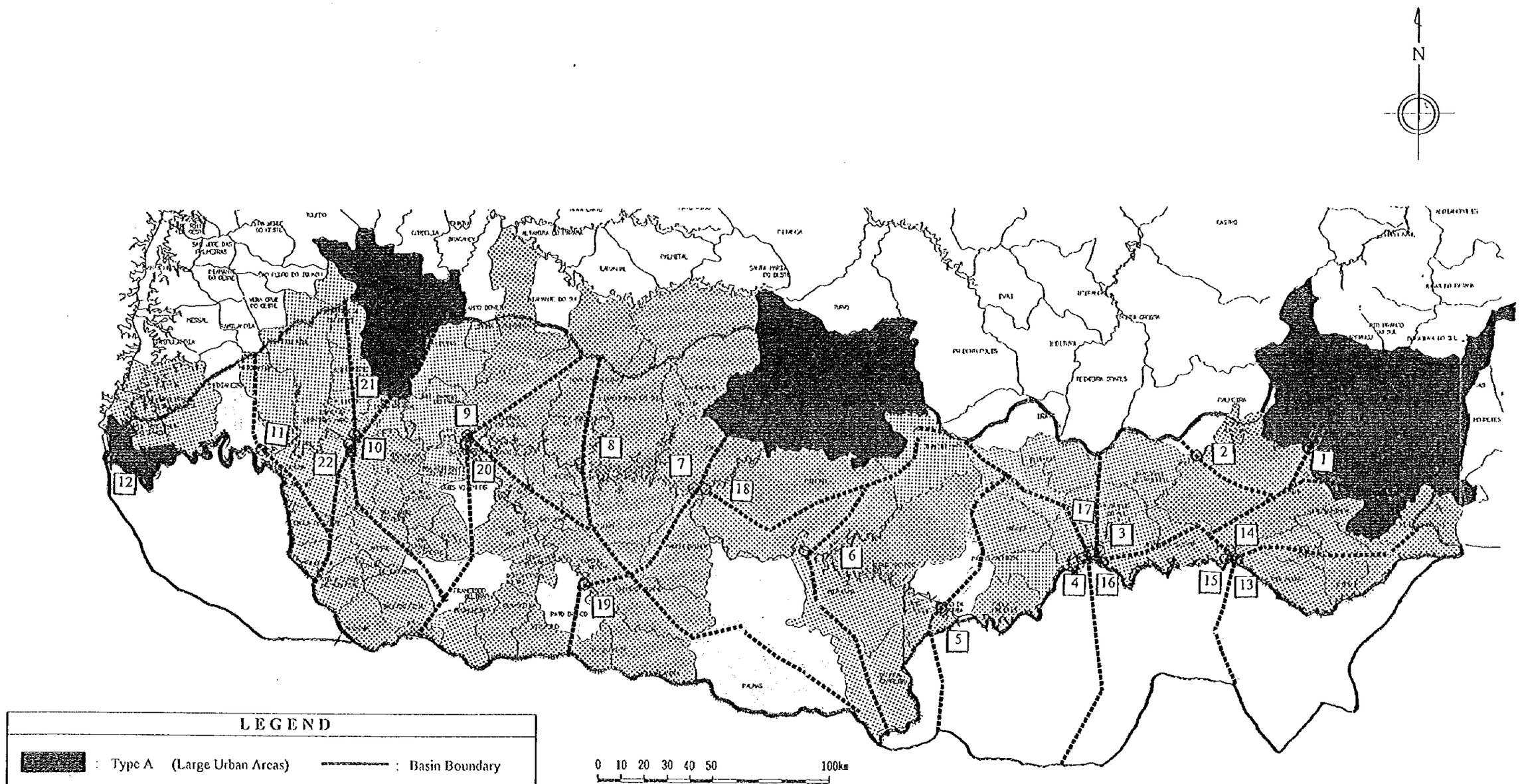


Figure-3.1 Classification and Zoning of Urban Areas in Iguaçu River Basin

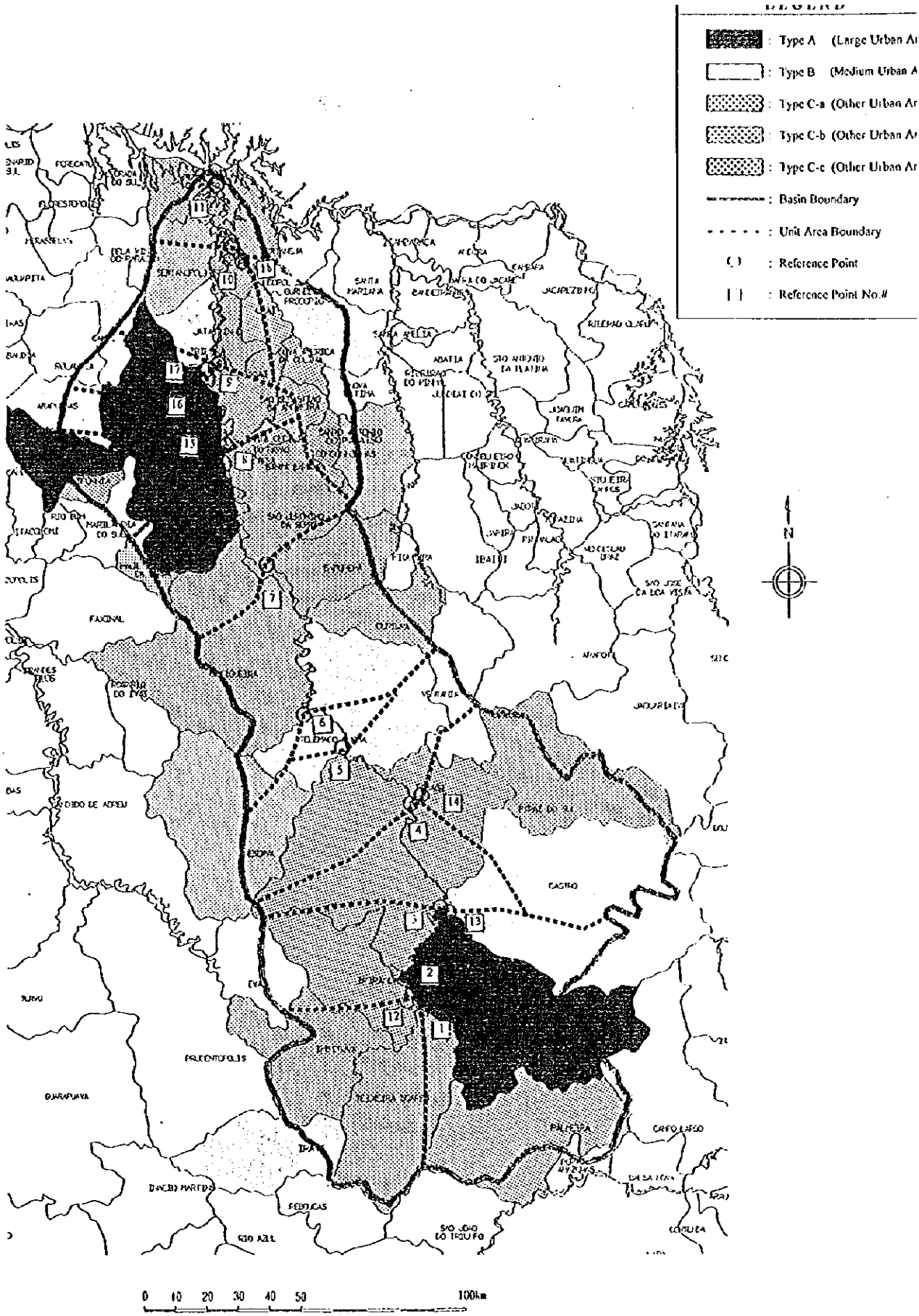


Figure-3.2 Classification and Zoning of Urban Areas in Tibagi River Basin

3.2 Existing Intake Facilities

Field reconnaissance was conducted in the following municipalities in order to identify the existing intake facilities.

(1) Iguacu River Basin

- Foz do Iguacu
- Cascavel
- Guarapiacu
- Nova Laranjeiras
- Laranjeiras do Sul
- Guarapuava
- Pinhao
- Ibema

(2) Tibagi River Basin

- Londrina
- Apucarana
- Ortigueira
- Telemaco Borba
- Tibagi
- Castro
- Ponta Grossa

The result of the field reconnaissance is summarized in Table-3.4 and the specifications of the existing intake facilities in the above municipalities are given in Data Book.

Table-3.4 Existing Intake Facilities

No.	Location: Municipality	Name of Intake	Basin	River (Reservoir)	River Width (m)	Proprietor	System Description: Water Source	Method	Weir/dam Height (m)	Mean Intake Rate (m3/sec)	Operation Hour (hour/day)	Operation Year (year)	Description of Pipeline: Length (km)	Diameter (mm)	Water Head (m)	Intake Pump (pumps)	Water Loss (%)	Remarks
<Urban Area in Iguacu River Basin>																		
1	Foz do Iguacu	Tamandua	Iguacu	Tamandua	16	SANEPAR	Surface	Direct Weir	2	0.36	24	Aug.1978		500	20	3	46.2	Water loss indicates a
2	Foz do Iguacu	Vila "C"	Parana	Itaipu Res.		SANEPAR	Surface	Direct	Non	0.3	21		5.0	500	29	2	46.2	distribution loss.
3	Cascavel	Cascavel	Iguacu	Cascavel	5	SANEPAR	Surface	Direct	Non	0.11	24	Jan.1973	7.2	700	173.3		41	(as of Nov.1994)
4	Cascavel	Peroba	Iguacu	Rio de Pez	7	SANEPAR	Surface	Direct Weir	2	0.13	13	1982	1.8	400,500	26.6	2	41	
5	Cascavel	Saltinho	Iguacu	Saltinho		SANEPAR	Surface	Direct Weir		0.06		1982	4.0	400	106	2	41	
6	Guaraniacu	Firela	Piquiri	Firela	15	SANEPAR	Surface	Direct Weir	2	0.025	12	Sep.1980	5.1	150	258.5	4	31.4	
7	Nova Laranjeiras	Cobras	Iguacu	Cobras	7	SANEPAR	Surface	Direct Weir		0.006	5	1983	0.2	75	11	2	37.6	
8	Laranjeiras do Sul	Leao	Iguacu	Leao		SANEPAR	Surface	Direct Weir	1	0.05	18.5	1978	5.7	150,200	160	4	37.8	
9	Guarapuava	Pedras	Iguacu	Pedras		SANEPAR	Surface	Direct Weir		0.3	17	1966	1.1	400,350	200	3	37.7	
10	Pinhao	Invernada	Iguacu	Invernada		SANEPAR	Surface	Direct	Non	0.019	16	1980	1.5	150	40	2	27.9	
<Urban Area in Tibagi River Basin>																		
1	Londrina	Tibagi	Tibagi	Tibagi	150	SANEPAR	Surface	Direct	Non	1.2	16	Dec.1991	12.0	900,800	230	4	40.6	Water loss indicates a
2	Londrina	Cafezal	Tibagi	Cafezal	10	SANEPAR	Surface	Direct Weir	2	0.55	16	1959	5.7	500,600		3	40.6	distribution loss.
3	Apucarana	Caviuna	Ivai	Caviuna	5	SANEPAR	Surface	Direct	Non	0.22	22	1976	6.0	400	267	3	37	(as of Nov.1994)
4	Ortigueira	Formigas	Tibagi	Formigas	8	SANEPAR	Surface	Direct Weir	1.5	0.013	16.5	1982	4.0	100,150	35	2	28.9	
5	Telemaco Borba	Tibagi	Tibagi	Tibagi	80	SANEPAR	Surface	Direct	Non	0.16	18	1963/64	6.0	200,350	183.3	3	33	
6	Tibagi	Tibagi	Tibagi	Tibagi	120	SANEPAR	Surface	Direct	Non	0.03	10	1978	0.8	100,150	60	2	26.2	
7	Castro	Iapo	Tibagi	Iapo	25	SANEPAR	Surface	Direct	Non	0.058	20	1963	0.3	250	61.7	2	30.5	
8	Castro	Sao Cristovao	Tibagi	Sao Cristovao		SANEPAR	Surface	Dam	4	0.021	24	1940	0.5	200	27	2	30.5	
9	Ponta Grossa	Pitangui	Tibagi	Pitangui	15	SANEPAR	Surface	Direct Weir	4	0.3	21	1985	6.0	700	150	3	39.4	
10	Ponta Grossa	Alagados	Tibagi	Alagados Reservoir		SANEPAR	Surface	Dam (COPEL)		0.4	21	1971	14.8	600		5	39.4	

Intake from Groundwater

No.	Location: Municipality	Name of Intake	Basin	Aquifer Source	Proprietor	System Description: Water Source	Method	Well Number (well)	Mean Intake Rate (m3/sec)	Operation Hour (hour/day)	Operation Year (year)	Description of Pipeline: Length (km)	Diameter (mm)	Well Depth (m)	Intake Pump (pumps)	Water Loss (%)	Remarks
<Urban Area in Iguacu River Basin>																	
1	Cascavel	Santa Cruz	Parana 3	Serra Geral	SANEPAR	Ground	Well	3	0.026	16	Aug.1993			103	1	40	Water loss indicates a
2	Cascavel	Periolo	Piquiri	Serra Geral	SANEPAR	Ground	Well	2	0.032	14	Sep.1993			47.35	2	40	distribution loss.
3	Cascavel	Mulumbi	Piquiri	Serra Geral	SANEPAR	Ground	Well	2	0.015							40	(as of Nov.1994)
4	Ibema	Ibema	Iguacu		SANEPAR	Ground	Well	1	0.008	15.8	Aug.1993	3.0	200	150	1	34.1	
<Urban Area in Tibagi River Basin>																	
1	Londrina	Tibagi	Tibagi		SANEPAR	Ground	Well	2	0.029	18							
2	Apucarana	Schmidt Farm	Tibagi	Serra Geral	SANEPAR	Ground	Well	1	0.026	4	1991			150			
3	Ortigueira	Ortigueira	Tibagi		SANEPAR	Ground	Well	1	0.001	11		0.15	60	36			

3.3 Water Demand

Water demand volume by municipality are computed for present (as of Dec., 1993), base and alternative cases as shown in Table-3.5 ~ Table-3.8 respectively. The water demand volume were estimated for the following categories.

- Domestic water in Urban Area
- Domestic water in Rural Area
- Industrial Water
- Agricultural Water

3.4 Required Water Supply

Assuming water loss percentage as shown in Table-3.2, based on water demand estimated in the Section-3.3, required water supply by sector and by region was calculated for both base and alternative cases as shown in Table-3.9 ~ Table-3.16.

Table-3.5 (1) Water Demand by Sector and by Region in Iguaçu River Basin (Base Case)

MRH	No.	Name	Type	Zone	1993				2005				2015			
					Urban		Rural		Urban		Rural		Urban		Rural	
					Domestic	Industrial	Domestic	Agricultural	Domestic	Industrial	Domestic	Agricultural	Domestic	Industrial	Domestic	Agricultural
MRH 268	1	Alm. Tamandare	A		6,560	1,640	180	110	15,850	2,550	180	120	29,700	3,520	180	140
MRH 268	2	Araucaria	A		5,930	68,000	540	410	13,300	62,800	530	500	24,270	66,610	540	620
MRH 268	3	Balsa Nova	A		260	3,090	370	160	570	4,750	370	210	1,020	6,510	330	250
MRH 268	5	Campina Grande do Sul	A		1,520	660	70	80	5,210	1,600	60	100	10,750	2,440	60	130
MRH 268	6	Campo Largo	A		5,580	6,530	310	150	9,370	12,140	280	180	14,980	15,380	250	210
MRH 268	7	Colombo	A		12,080	4,400	350	90	27,120	7,270	320	100	49,530	9,860	310	120
MRH 268	8	Contenda	A		490	80	290	170	780	130	290	200	1,210	190	300	230
MRH 268	9	Curitiba	A		193,990	141,020	0	30	278,370	231,160	0	40	377,770	303,270	0	50
MRH 268	10	Fazenda Rio Grande	A		2,650	260	240	220	9,920	440	280	270	20,850	640	260	330
MRH 268	12	Mandirituba	A		470	90	660	890	870	150	710	1,140	1,470	210	640	1,360
MRH 268	13	Pinhais	A		7,500	3,870	270	20	13,330	9,250	340	20	22,000	13,210	300	30
MRH 268	14	Piraquara	A		2,050	230	900	40	3,330	560	1,010	40	5,190	800	920	50
MRH 268	15	Quatro Barras	A		910	1,670	70	90	2,360	2,020	60	110	4,520	2,510	50	130
MRH 268	17	Sao Jose dos Pinhais	A		12,260	12,550	860	370	27,340	27,550	820	440	49,800	38,510	750	510
MRH 268	268	Critiba Metropolitan Area	A		252,250	244,090	5,110	2,830	407,720	362,370	5,250	3,470	613,060	463,660	4,890	4,160
MRH 288	274	Cascavel	A		20,430	8,700	550	1,010	40,040	8,230	380	1,230	60,660	8,600	260	1,450
MRH 288	282	Foz do Iguacu	A		28,610	1,190	170	200	63,710	1,510	50	230	103,070	1,580	20	270
MRH 290	352	Guarapuava	A		12,330	5,870	1,550	2,530	20,070	8,810	1,790	3,110	28,790	12,930	1,890	3,700
MRH 288	294	Medianeira	B		2,570	740	460	910	5,090	1,120	290	1,100	7,220	1,170	190	1,270
MRH 289	324	Dois Vizinhos	B		2,150	2,680	720	1,470	4,210	5,920	420	1,850	6,610	8,500	240	2,170
MRH 289	327	Francisco Beltrao	B		5,570	4,330	1,050	1,980	10,630	6,830	810	2,450	17,590	9,810	520	2,920
MRH 289	333	Pato Branco	B		5,040	740	640	1,190	8,190	1,980	550	1,500	11,820	2,840	410	1,780
MRH 291	367	Palmas	B		2,730	2,060	690	2,580	4,600	2,590	500	3,170	7,230	2,660	300	3,800
MRH 291	371	Uniao da Vitoria	B		4,200	2,960	260	470	5,350	4,540	250	580	6,630	4,230	230	680
MRH 271	30	Quitandinha	C	a	210	30	860	550	310	50	970	670	410	70	1,030	810
MRH 272	32	Campo do Tenente	C	a	240	20	230	170	510	10	260	210	850	10	280	250
MRH 272	35	Porto Amazonas	C	a	260	50	60	70	370	120	80	90	500	180	80	110
MRH 272	36	Rio Negro	C	a	2,170	6,420	430	350	3,140	9,160	460	440	4,340	12,610	470	520
MRH 275	47	Sao Joao do Triunfo	C	a	270	30	670	100	530	10	720	120	800	10	710	140
MRH 275	48	Sao Mateus do Sul	C	a	1,730	1,740	1,230	370	2,750	2,310	1,350	440	4,000	3,360	1,370	520
MRH 276	51	Mallet	C	a	620	250	430	510	1,180	470	390	640	1,860	650	330	750
MRH 276	53	Rebouças	C	a	590	70	530	220	910	100	570	270	1,310	110	580	320
MRH 288	273	Capitao Leonidas Marques	C	a	490	30	420	570	790	40	170	710	950	40	80	840
MRH 289	318	Boa Esperanca do Iguacu	C	a	50	0	220	310	110	0	150	380	170	0	90	450
MRH 289	319	Bom Sucesso do Sul	C	a	100	0	200	590	160	10	190	720	230	10	160	870
MRH 289	328	Itapejara do Oeste	C	a	400	120	340	850	550	190	250	1,060	730	280	150	1,250
MRH 289	330	Marmeleiro	C	a	620	80	650	550	1,180	210	700	670	1,840	300	680	770
MRH 289	338	Realeza	C	a	920	90	510	390	1,080	200	310	470	1,240	290	190	540
MRH 289	342	Santa Izabel do Oeste	C	a	460	20	520	510	540	40	340	630	620	50	160	730
MRH 289	346	Saudade do Iguacu	C	a	190	70	190	360	270	110	170	450	370	160	130	540
MRH 289	347	Sulina	C	a	90	270	280	350	100	450	170	420	100	650	110	500
MRH 290	357	Quedas do Iguacu	C	a	1,720	1,450	1,040	540	2,500	2,250	910	650	3,180	3,300	830	750
MRH 290	358	Rio Bonito Iguacu	C	a	70	460	320	90	90	520	280	100	100	760	250	110
MRH 290	360	Virmond	C	a	60	40	200	90	80	60	170	100	90	90	160	110
MRH 291	361	Bituruna	C	a	620	650	500	3,810	1,110	1,190	450	4,700	1,700	1,180	390	5,700
MRH 291	368	Paula Freitas	C	a	170	20	220	200	420	20	180	260	720	20	140	300

MRH	No.	Name	Type	Zone	1995				2000				2010			
					Urban		Rural		Urban		Rural		Urban		Rural	
					Domestic	Industrial	Domestic	Agricultural	Domestic	Industrial	Domestic	Agricultural	Domestic	Industrial	Domestic	Agricultural
MRH 291	370	Porto Vitoria	C	a	200	20	130	80	270	100	130	100	350	60	120	110
MRH 271	28	Agudos do Sul	C	b	60	10	380	360	70	20	440	440	70	30	470	530
MRH 271	29	Pien	C	b	130	250	450	320	320	330	510	390	500	460	550	460
MRH 276	54	Rio Azul	C	b	340	120	660	540	480	190	760	650	650	280	800	790
MRH 288	269	Boa Vista da Aparecida	C	b	270	20	490	250	390	20	470	290	450	20	420	340
MRH 288	275	Catanduvas	C	b	430	20	400	420	870	30	280	500	1.260	30	200	590
MRH 288	285	Ibema	C	b	340	250	160	280	790	300	150	340	1.220	310	140	410
MRH 288	305	Santa Lucia	C	b	160	10	190	260	250	0	100	320	300	10	50	370
MRH 288	313	Tres Barras Parana	C	b	340	30	700	550	550	30	460	660	670	30	310	760
MRH 289	316	Ampere	C	b	600	390	470	1.180	800	600	320	1.490	1.020	860	150	1.760
MRH 289	320	Capanema	C	b	780	60	750	750	880	110	450	930	980	160	160	1.090
MRH 289	321	Chopinzinho	C	b	840	150	780	1.480	1.170	300	550	1.840	1.540	430	300	2.170
MRH 289	322	Coronel Vivida	C	b	1.250	250	860	820	1.710	570	660	990	2.210	820	430	1.160
MRH 289	323	Cruzeiro do Iguacu	C	b	200	200	220	800	410	650	140	1.020	630	940	90	1.220
MRH 289	325	Eneas Marques	C	b	140	10	410	260	190	10	320	450	240	20	210	500
MRH 289	329	Mariopolis	C	b	290	60	240	280	390	120	210	330	510	180	180	390
MRH 289	331	Nova Esperanca do Sudoeste	C	b	70	0	330	490	100	0	330	590	130	10	300	690
MRH 289	334	Perola do Oeste	C	b	320	20	590	320	390	40	380	390	470	60	160	440
MRH 289	335	Pinhal Sao Bento	C	b	50	0	150	160	80	0	110	200	100	0	60	240
MRH 289	336	Planalto	C	b	410	20	720	470	500	40	470	560	610	60	200	640
MRH 289	337	Pranchita	C	b	270	20	390	490	450	70	240	600	650	100	90	710
MRH 289	339	Renascenca	C	b	210	110	370	720	240	220	360	880	270	320	310	1.050
MRH 289	340	Salgado Filho	C	b	180	10	650	630	260	30	550	770	350	40	410	880
MRH 289	341	Salto do Lontra	C	b	480	20	600	1.580	760	30	380	1.980	1.070	50	150	2.370
MRH 289	343	Santo Antonio Sudoeste	C	b	860	80	590	940	1.170	160	380	1.160	1.530	220	160	1.390
MRH 289	344	Sao Joao	C	b	490	30	580	1.230	710	50	380	1.540	960	70	170	1.820
MRH 289	345	Sao Jorge do Oeste	C	b	370	30	430	580	400	60	280	730	420	80	130	870
MRH 289	348	Vere	C	b	280	20	500	710	450	50	360	880	640	70	200	1.050
MRH 289	349	Vitorino	C	b	260	30	260	620	370	60	210	770	490	90	150	910
MRH 290	351	Cantagalo	C	b	710	110	590	210	2.330	200	700	240	6.300	290	740	280
MRH 290	356	Pinhao	C	b	1.060	750	1.690	780	1.010	710	2.010	940	900	1.050	2.150	1.060
MRH 291	362	Clevelandia	C	b	1.390	870	330	1.650	1.750	1.030	330	2.020	2.140	660	310	2.430
MRH 291	363	Cruz Machado	C	b	270	200	1.000	980	410	840	1.090	1.180	580	900	1.110	1.360
MRH 291	364	General Carneiro	C	b	700	580	360	320	1.530	940	320	380	2.570	920	270	450
MRH 291	365	Honorio Serpa	C	b	80	20	500	120	200	10	570	130	340	10	610	160
MRH 291	366	Mangueirinha	C	b	500	1.290	970	360	1.180	1.210	1.080	420	2.030	1.260	1.120	490
MRH 291	369	Paulo Frontin	C	b	170	30	350	540	310	40	410	660	470	40	440	790
MRH 271	31	Tijucas do Sul	C	c	110	120	410	180	150	220	490	220	200	340	520	270
MRH 272	33	Lapa	C	c	2.110	840	1.460	680	3.230	870	1.490	850	4.640	1.050	1.440	970
MRH 275	46	Antonio Olinto	C	c	70	20	510	150	150	30	550	180	240	30	560	200
MRH 288	276	Ceu Azul	C	c	490	870	200	460	910	1.310	200	550	1.260	1.360	200	620
MRH 288	284	Guaraniacu	C	c	680	30	430	630	1.330	40	320	760	1.880	40	240	880
MRH 288	290	Lindoeste	C	c	70	10	380	480	70	10	240	570	50	10	160	660
MRH 288	293	Matelandia	C	c	730	130	310	700	1.340	210	150	830	1.820	220	80	970
MRH 288	306	Santa Tereza do Oeste	C	c	290	20	100	210	550	30	60	250	760	40	40	290
MRH 288	307	Santo Terezinha Itaipu	C	c	1.040	90	90	140	2.300	80	60	160	3.480	90	40	180
MRH 288	309	Sao Miguel do Iguacu	C	c	880	350	300	480	1.800	340	150	570	2.610	360	80	660
MRH 289	317	Barracao	C	c	480	20	640	320	890	40	400	580	1.360	50	160	450
MRH 289	326	Flor da Serra do Sul	C	c	30	0	340	1.120	40	10	330	1.380	60	10	290	1.650
MRH 289	332	Nova Prata do Iguacu	C	c	410	20	480	670	500	50	270	780	600	80	160	880

Table-3.5 (3) Water Demand by Sector and by Region in Iguaçu River Basin (Base Case)

MRH	No.	Name	Type	Zone	1993				2005				2015			
					Urban		Rural		Urban		Rural		Urban		Rural	
					Domestic	Industrial	Domestic	Agricultural	Domestic	Industrial	Domestic	Agricultural	Domestic	Industrial	Domestic	Agricultural
MRH 290	350	Candoi	C	e	190	230	1,220	700	300	240	1,500	820	400	360	1,580	930
MRH 290	353	Inacio Martins	C	e	270	330	810	720	370	380	1,080	890	450	560	1,140	1,060
MRH 290	354	Laranjeiras do Sul	C	e	2,100	310	710	470	2,520	400	520	580	2,720	590	410	670
MRH 290	355	Nova Laranjeiras	C	e	30	50	380	210	40	70	330	250	40	100	300	280
MRH 272	34	Palmeira			0	0	190	140	0	0	210	150	0	0	220	180
MRH 276	50	Irati			0	0	520	200	0	0	440	250	0	0	350	280
Total					373,410	294,780	49,970	58,010	628,920	434,920	45,210	71,050	946,980	556,340	39,090	83,890

Table-3.6 Water Demand by Sector and by Region in Iguaçu River Basin (Alternative Case)

MRH	No.	Name	Type	Zone	1993				2005				2015			
					Urban		Rural		Urban		Rural		Urban		Rural	
					Domestic	Industrial	Domestic	Agricultural	Domestic	Industrial	Domestic	Agricultural	Domestic	Industrial	Domestic	Agricultural
MRH 268	268	Curitiba Metropolitan Area	A		252,250	244,090	5,110	2,830	367,240	326,370	5,250	3,470	529,060	393,360	4,890	4,160
MRH 283	274	Cascavel	A		20,430	8,700	550	1,010	45,100	12,790	380	1,230	72,580	17,480	260	1,450
MRH 283	282	Foz do Iguacu	A		28,610	1,190	170	200	71,850	7,990	50	230	121,370	14,530	20	270

Table-3.7 Water Demand by Sector and by Region in Tibagi River Basin (Base Case)

MRH	No.	Municipality Name	Type	Zone	1993				2005				2015			
					Urban		Rural		Urban		Rural		Urban		Rural	
					Domestic	Industrial	Domestic	Agricultural	Domestic	Industrial	Domestic	Agricultural	Domestic	Industrial	Domestic	Agricultural
MRH 273	39	Ponta Grossa	A		23,810	17,360	700	810	35,080	24,850	650	990	49,080	28,840	550	1,160
MRH 281	124	Londrina	A		53,340	16,210	1,540	2,370	85,470	22,470	970	2,880	121,750	26,070	670	3,340
MRH 284	184	Apucarana	A		10,590	4,470	190	140	16,520	8,280	130	170	23,380	10,580	70	190
MRH 273	37	Castro	B		4,310	4,790	1,290	1,250	7,440	11,550	1,370	1,530	11,370	17,360	1,330	1,790
MRH 273	40	Telemaco Borba	B		6,040	8,120	660	590	10,450	13,020	370	730	15,970	15,340	220	890
MRH 276	50	Irati	B		3,400	1,940	180	70	5,260	2,940	150	80	7,540	3,960	120	90
MRH 279	85	Cornelio Procopio	B		5,110	2,930	230	260	7,210	3,620	120	310	10,040	4,150	50	360
MRH 281	109	Arapongas	B		7,330	3,640	150	280	10,230	6,430	90	340	14,540	8,440	50	380
MRH 281	113	Cambe	B		8,430	8,440	140	60	13,990	11,210	100	80	21,970	15,420	70	90
MRH 281	119	Ibipora	B		3,890	1,120	290	310	6,630	1,880	150	380	10,560	2,520	90	440
MRH 273	38	Pirai do Sul	C	a	1,320	980	340	610	1,960	2,140	320	740	2,750	3,130	280	860
MRH 273	41	Tibagi	C	a	800	50	630	1,560	1,660	100	500	1,870	2,740	140	340	2,170
MRH 277	57	Ipiranga	C	a	280	20	670	550	410	20	810	670	530	20	830	800
MRH 277	59	Ortigueira	C	a	460	50	870	1,250	540	70	410	1,520	620	100	190	1,780
MRH 278	75	Sapopema	C	a	270	20	210	290	480	30	140	340	690	40	90	390
MRH 280	100	Jataizinho	C	a	900	210	130	120	1,280	40	90	140	1,750	10	70	160
MRH 280	101	Nova Santa Barbara	C	a	220	0	110	20	280	0	80	20	360	10	60	30
MRH 280	104	Sao Jeronimo da Serra	C	a	550	10	550	530	1,000	10	300	640	1,570	10	120	730
MRH 281	131	Primeiro de Maio	C	a	1,190	30	50	70	1,640	60	20	80	2,320	120	10	90
MRH 272	34	Palmeira	C	b	1,600	1,200	830	640	2,330	2,300	950	770	3,240	3,210	1,000	890
MRH 277	60	Reserva	C	b	660	30	380	410	1,120	50	350	500	1,590	70	270	600
MRH 279	90	N. America da Colina	C	b	180	110	150	110	280	230	100	120	420	330	70	140
MRH 279	97	Santo Antonio do Paraiso	C	b	110	0	80	100	150	0	40	120	200	0	30	150
MRH 280	103	Santa Cecilia do Pavao	C	b	280	170	150	30	350	250	90	30	430	300	60	40
MRH 280	105	Sao Sebastiao da Amoreir	C	b	510	10	230	110	970	10	170	120	1,550	10	130	150
MRH 280	106	Urai	C	b	980	90	260	260	1,410	50	150	330	1,950	20	100	390
MRH 281	137	Sertanopolis	C	b	1,220	360	260	670	1,730	830	120	820	2,480	1,350	70	970
MRH 276	49	Imbituva	C	c	850	380	960	210	1,300	540	1,060	260	1,840	720	1,090	300
MRH 276	55	Teixeira Soares	C	c	500	90	640	520	820	60	630	630	1,220	30	590	740
MRH 278	63	Curiuva	C	c	370	20	270	30	690	20	220	40	1,020	30	190	40
MRH 279	84	Congonhinhas	C	c	400	10	40	50	680	40	30	60	1,050	70	10	70
MRH 279	98	Sertaneja	C	c	470	10	60	30	660	500	40	40	890	990	30	50
MRH 280	99	Assai	C	c	1,390	1,130	480	190	2,000	1,140	280	220	2,760	970	190	260
MRH 280	102	Rancho Alegre	C	c	350	290	80	30	540	430	40	40	760	500	20	50
MRH 284	187	California	C	c	390	50	130	90	680	120	80	110	1,030	180	50	130
MRH 284	200	Mauo da Serra	C	c	260	810	30	30	440	1,000	20	30	650	1,380	20	30
MRH 272	35	Porto Amazonas			0	0	20	20	0	0	30	30	0	0	30	30
MRH 273	42	Ventania			0	0	90	120	0	0	80	150	0	0	70	170
MRH 277	58	Ivai			0	0	200	390	0	0	200	470	0	0	170	580
MRH 279	89	Leopolis			0	0	30	40	0	0	20	40	0	0	10	50
MRH 279	91	Nova Fatima			0	0	60	80	0	0	40	100	0	0	20	110
MRH 281	132	Rolandia			0	0	60	60	0	0	30	70	0	0	20	90
MRH 284	198	Marilandia do Sul			0	0	120	140	0	0	80	170	0	0	70	200
Total					142,760	75,150	14,540	15,500	223,680	116,290	11,620	18,780	322,610	146,420	9,520	21,970

Table-3.8 Water Demand by Sector and by Region in Tibagi River Basin (Alternative Case)

MRH	No.	Municipality Name	Type	Zone	1993				2005				2015			
					Urban		Rural		Urban		Rural		Urban		Rural	
					Domestic	Industrial	Domestic	Agricultural	Domestic	Industrial	Domestic	Agricultural	Domestic	Industrial	Domestic	Agricultural
MRH 273	39	Ponta Grossa	A		23,810	17,360	700	810	38,230	28,210	650	990	56,060	35,500	550	1,160
MRH 273	40	Telemaco Borba	B		6,040	8,120	660	590	11,410	14,220	370	730	18,110	17,380	220	890
MRH 273	37	Castro	B		4,310	4,790	1,290	1,250	8,170	12,270	1,370	1,530	12,970	18,840	1,330	1,790
MRH 281	124	Londrina	A		53,340	16,210	1,540	2,370	95,870	30,870	970	2,880	144,160	42,170	670	3,340
MRH 281	113	Cambe	B		8,430	8,440	140	60	15,720	12,890	100	80	25,910	18,750	70	90
MRH 281	109	Arapongas	B		7,330	3,640	150	280	11,380	7,630	90	340	17,170	10,480	50	380

Table-3.9 Required Water Supply of Urban Area by Sector and by Region in Iguaçu River Basin

(1) Required Water Supply of Urban Area by Sector and by Region in Iguacu River Basin [Base Case] [m3/sec]

Municipality Name	Type	Zone	1993 Urban			2005 Urban			2015 Urban			2005-1993 Urban			2015-1993 Urban		
			Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total
Curitiba Metropolitan Area	A		4.866	3.324	8.190	6.740	4.661	11.401	9.463	5.962	15.425	1.874	1.337	3.211	4.597	2.638	7.235
Cascavel	A		0.394	0.118	0.512	0.662	0.106	0.768	0.936	0.111	1.047	0.268	0.000	0.268	0.542	0.000	0.542
Foz do Iguacu	A		0.552	0.016	0.568	1.053	0.019	1.072	1.591	0.020	1.611	0.501	0.003	0.504	1.039	0.004	1.043
Guarapuava	A		0.238	0.080	0.318	0.332	0.113	0.445	0.444	0.166	0.610	0.094	0.033	0.127	0.206	0.086	0.292
Medianeira	B		0.050	0.010	0.060	0.084	0.014	0.098	0.111	0.015	0.126	0.034	0.004	0.038	0.061	0.005	0.066
Dois Vizinhos	B		0.041	0.036	0.077	0.070	0.076	0.146	0.102	0.109	0.211	0.029	0.040	0.069	0.061	0.073	0.134
Francisco Beltrao	B		0.107	0.059	0.166	0.176	0.088	0.264	0.271	0.126	0.397	0.069	0.029	0.098	0.164	0.067	0.231
Pato Branco	B		0.097	0.010	0.107	0.135	0.025	0.160	0.182	0.037	0.219	0.038	0.015	0.053	0.085	0.027	0.112
Palmas	B		0.053	0.028	0.081	0.076	0.033	0.109	0.112	0.034	0.146	0.023	0.005	0.028	0.059	0.006	0.065
Uniao da Vitoria	B		0.081	0.040	0.121	0.088	0.058	0.146	0.102	0.054	0.156	0.007	0.018	0.025	0.021	0.014	0.035
Total of Type-C/Zone-a	C	a	0.236	0.161	0.397	0.312	0.228	0.540	0.409	0.310	0.719	0.076	0.067	0.143	0.173	0.149	0.322
Total of Type-C/Zone-b	C	b	0.296	0.077	0.373	0.392	0.117	0.509	0.545	0.141	0.686	0.099	0.043	0.142	0.256	0.070	0.326
Total of Type-C/Zone-c	C	c	0.193	0.045	0.238	0.272	0.056	0.328	0.349	0.069	0.418	0.079	0.012	0.091	0.156	0.024	0.180
Total			7.204	4.004	11.208	10.392	5.594	15.986	14.617	7.154	21.771	3.191	1.606	4.797	7.420	3.163	10.583

(2) Required Water Supply of Urban Area by Sector and by Region in Iguacu River Basin [Alternative Case] [m3/sec]

Municipality Name	Type	Zone	1993 Urban			2005 Urban			2015 Urban			2005-1993 Urban			2015-1993 Urban		
			Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total
Curitiba Metropolitan Area	A		4.866	3.324	8.190	6.072	4.197	10.269	8.026	5.059	13.085	1.206	0.873	2.079	3.160	1.735	4.895
Cascavel	A		0.394	0.118	0.512	0.746	0.164	0.910	1.120	0.225	1.345	0.352	0.046	0.398	0.726	0.107	0.833
Foz do Iguacu	A		0.552	0.016	0.568	1.188	0.103	1.291	1.873	0.187	2.060	0.636	0.087	0.723	1.321	0.171	1.492

(3) Required Water Supply of Rural Area by Sector and by Region in Iguacu River Basin [m3/sec]

Municipality Name	Type	Zone	1993 Rural		2005 Rural		2015 Rural		2005-1993 Rural		2015-1993 Rural	
			Domestic	Agricult.	Domestic	Agricult.	Domestic	Agricult.	Domestic	Agricult.	Domestic	Agricult.
Total of Type-A	A		0.099	0.094	0.098	0.116	0.090	0.140	0.004	0.022	0.003	0.046
Total of Type-B	B		0.052	0.124	0.035	0.154	0.024	0.182	0.000	0.030	0.000	0.058
Total of Type-C/Zone-a	C	a	0.141	0.165	0.118	0.204	0.109	0.250	0.000	0.039	0.003	0.085
Total of Type-C/Zone-b	C	b	0.261	0.327	0.217	0.403	0.177	0.470	0.008	0.076	0.012	0.143
Total of Type-C/Zone-c	C	c	0.121	0.121	0.104	0.144	0.097	0.170	0.005	0.023	0.008	0.049
Total			0.674	0.831	0.572	1.021	0.497	1.212	0.017	0.190	0.026	0.381

Table-3.10 (1) Required Water Supply of Urban Area by Sector and by Region in Iguaçu River Basin (Base Case)

MRH	No.	Municipality Name	Type	Zone	1993			2005			2015			2005-1993			2015-1993		
					Urban			Urban			Urban			Urban			Urban		
					Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total
MRH 268	1	Alm. Tamandare	A		0.127	0.022	0.149	0.262	0.033	0.295	0.458	0.045	0.503	0.135	0.011	0.146	0.331	0.023	0.354
MRH 268	2	Araucaria	A		0.114	0.926	1.040	0.220	0.808	1.028	0.375	0.857	1.232	0.106	0.000	0.106	0.261	0.000	0.261
MRH 268	3	Balsa Nova	A		0.005	0.042	0.047	0.009	0.061	0.070	0.016	0.084	0.100	0.004	0.019	0.023	0.011	0.042	0.053
MRH 268	5	Campina Grande do Sul	A		0.029	0.009	0.038	0.086	0.021	0.107	0.166	0.031	0.197	0.057	0.012	0.069	0.137	0.022	0.159
MRH 268	6	Campo Largo	A		0.108	0.089	0.197	0.155	0.156	0.311	0.231	0.198	0.429	0.047	0.067	0.114	0.123	0.109	0.232
MRH 268	7	Colombo	A		0.233	0.060	0.293	0.448	0.093	0.541	0.764	0.127	0.891	0.215	0.033	0.248	0.531	0.067	0.598
MRH 268	8	Contenda	A		0.009	0.001	0.010	0.013	0.002	0.015	0.019	0.002	0.021	0.004	0.001	0.005	0.010	0.001	0.011
MRH 268	9	Curitiba	A		3.742	1.920	5.662	4.603	2.973	7.576	5.830	3.900	9.730	0.861	1.053	1.914	2.088	1.980	4.068
MRH 268	10	Fazenda Rio Grande	A		0.051	0.004	0.055	0.164	0.006	0.170	0.322	0.008	0.330	0.113	0.002	0.115	0.271	0.004	0.275
MRH 268	12	Mandirituba	A		0.009	0.001	0.010	0.014	0.002	0.016	0.023	0.003	0.026	0.005	0.001	0.006	0.014	0.002	0.016
MRH 268	13	Pinhais	A		0.145	0.053	0.198	0.220	0.119	0.339	0.340	0.170	0.510	0.075	0.066	0.141	0.195	0.117	0.312
MRH 268	14	Piraquara	A		0.040	0.003	0.043	0.055	0.007	0.062	0.080	0.010	0.090	0.015	0.004	0.019	0.040	0.007	0.047
MRH 268	15	Quatro Barras	A		0.018	0.023	0.041	0.039	0.026	0.065	0.070	0.032	0.102	0.021	0.003	0.024	0.052	0.009	0.061
MRH 268	17	Sao Jose dos Pinhais	A		0.236	0.171	0.407	0.452	0.354	0.806	0.769	0.495	1.264	0.216	0.183	0.399	0.533	0.324	0.857
MRH 268	268	Critiba Metropolitan Area	A		4.866	3.324	8.190	6.740	4.661	11.401	9.463	5.962	15.425	1.874	1.337	3.211	4.597	2.638	7.235
MRH 288	274	Cascavel	A		0.394	0.118	0.512	0.662	0.106	0.768	0.936	0.111	1.047	0.268	0.000	0.268	0.542	0.000	0.542
MRH 288	282	Foz do Iguacu	A		0.552	0.016	0.568	1.053	0.019	1.072	1.591	0.020	1.611	0.501	0.003	0.504	1.039	0.004	1.043
MRH 290	352	Guarapuava	A		0.238	0.080	0.318	0.332	0.113	0.445	0.444	0.166	0.610	0.094	0.033	0.127	0.206	0.086	0.292
MRH 288	294	Medianeira	B		0.050	0.010	0.060	0.084	0.014	0.098	0.111	0.015	0.126	0.034	0.004	0.038	0.061	0.005	0.066
MRH 289	324	Dois Vizinhos	B		0.041	0.036	0.077	0.070	0.076	0.146	0.102	0.109	0.211	0.029	0.040	0.069	0.061	0.073	0.134
MRH 289	327	Francisco Beltrao	B		0.107	0.059	0.166	0.176	0.088	0.264	0.271	0.126	0.397	0.069	0.029	0.098	0.164	0.067	0.231
MRH 289	333	Pato Branco	B		0.097	0.010	0.107	0.135	0.025	0.160	0.182	0.037	0.219	0.038	0.015	0.053	0.085	0.027	0.112
MRH 291	367	Palmas	B		0.053	0.028	0.081	0.076	0.033	0.109	0.112	0.034	0.146	0.023	0.005	0.028	0.059	0.006	0.065
MRH 291	371	Uniao da Vitoria	B		0.081	0.040	0.121	0.088	0.058	0.146	0.102	0.054	0.156	0.007	0.018	0.025	0.021	0.014	0.035
MRH 271	30	Quitandinha	C	a	0.004	0.000	0.004	0.005	0.001	0.006	0.006	0.001	0.007	0.001	0.001	0.002	0.002	0.001	0.003
MRH 272	32	Campo do Tenente	C	a	0.005	0.000	0.005	0.008	0.000	0.008	0.013	0.000	0.013	0.003	0.000	0.003	0.008	0.000	0.008
MRH 272	35	Porto Amazonas	C	a	0.005	0.001	0.006	0.006	0.002	0.008	0.008	0.002	0.010	0.001	0.001	0.002	0.003	0.001	0.004
MRH 272	36	Rio Negro	C	a	0.042	0.087	0.129	0.052	0.118	0.170	0.067	0.162	0.229	0.010	0.031	0.041	0.025	0.075	0.100
MRH 275	47	Sao Joao do Triunfo	C	a	0.005	0.000	0.005	0.009	0.000	0.009	0.012	0.000	0.012	0.004	0.000	0.004	0.007	0.000	0.007
MRH 275	48	Sao Mateus do Sul	C	a	0.033	0.024	0.057	0.045	0.030	0.075	0.062	0.043	0.105	0.012	0.006	0.018	0.029	0.019	0.048
MRH 276	51	Mallet	C	a	0.012	0.003	0.015	0.020	0.006	0.026	0.029	0.008	0.037	0.008	0.003	0.011	0.017	0.005	0.022
MRH 276	53	Rebouças	C	a	0.011	0.001	0.012	0.015	0.001	0.016	0.020	0.001	0.021	0.004	0.000	0.004	0.009	0.000	0.009
MRH 288	273	Capitao Leonidas Marques	C	a	0.009	0.000	0.009	0.013	0.001	0.014	0.015	0.001	0.016	0.004	0.001	0.005	0.006	0.001	0.007
MRH 289	318	Boa Esperanca do Iguacu	C	a	0.001	0.000	0.001	0.002	0.000	0.002	0.003	0.000	0.003	0.001	0.000	0.001	0.002	0.000	0.002
MRH 289	319	Bom Sucesso do Sul	C	a	0.002	0.000	0.002	0.003	0.000	0.003	0.004	0.000	0.004	0.001	0.000	0.001	0.002	0.000	0.002
MRH 289	328	Itapejara do Oeste	C	a	0.008	0.002	0.010	0.009	0.002	0.011	0.011	0.004	0.015	0.001	0.000	0.001	0.003	0.002	0.005
MRH 289	330	Marmeleiro	C	a	0.012	0.001	0.013	0.020	0.003	0.023	0.028	0.004	0.032	0.008	0.002	0.010	0.016	0.003	0.019
MRH 289	338	Realeza	C	a	0.018	0.001	0.019	0.018	0.003	0.021	0.019	0.004	0.023	0.000	0.002	0.002	0.001	0.003	0.004
MRH 289	342	Santa Izabel do Oeste	C	a	0.009	0.000	0.009	0.009	0.001	0.010	0.010	0.001	0.011	0.000	0.001	0.001	0.001	0.001	0.002
MRH 289	346	Saudade do Iguacu	C	a	0.004	0.001	0.005	0.004	0.001	0.005	0.006	0.002	0.008	0.000	0.000	0.000	0.002	0.001	0.003
MRH 289	347	Sulina	C	a	0.002	0.004	0.006	0.002	0.006	0.008	0.002	0.008	0.010	0.000	0.002	0.002	0.000	0.004	0.004
MRH 290	357	Quedas do Iguacu	C	a	0.033	0.020	0.053	0.041	0.029	0.070	0.049	0.042	0.091	0.008	0.009	0.017	0.016	0.022	0.038
MRH 290	358	Rio Bonito Iguacu	C	a	0.001	0.006	0.007	0.001	0.007	0.008	0.002	0.010	0.012	0.000	0.001	0.001	0.001	0.004	0.005
MRH 290	360	Virmond	C	a	0.001	0.001	0.002	0.001	0.001	0.002	0.001	0.001	0.002	0.000	0.000	0.000	0.000	0.000	0.000
MRH 291	361	Bituruna	C	a	0.012	0.009	0.021	0.018	0.015	0.033	0.026	0.015	0.041	0.006	0.006	0.012	0.014	0.006	0.020
MRH 291	368	Paula Freitas	C	a	0.003	0.000	0.003	0.007	0.000	0.007	0.011	0.000	0.011	0.004	0.000	0.004	0.008	0.000	0.008

Table-3.10 (2) Required Water Supply of Urban Area by Sector and by Region in Iguaçu River Basin (Base Case)

MRH	No.	Municipality Name	Type	Zone	1993			2005			2015			2005-1993			2015-1993		
					Urban			Urban			Urban			Urban			Urban		
					Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total
MRH 291	370	Porto Vitoria	C	a	0.004	0.000	0.004	0.004	0.001	0.005	0.005	0.001	0.006	0.000	0.001	0.001	0.001	0.001	0.002
MRH 271	28	Agudos do Sul	C	b	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000
MRH 271	29	Pien	C	b	0.003	0.003	0.006	0.005	0.004	0.009	0.008	0.006	0.014	0.002	0.001	0.003	0.005	0.003	0.008
MRH 276	54	Rio Azul	C	b	0.007	0.002	0.009	0.008	0.002	0.010	0.010	0.004	0.014	0.001	0.000	0.001	0.003	0.002	0.005
MRH 288	269	Boa Vista da Aparecida	C	b	0.005	0.000	0.005	0.006	0.000	0.006	0.007	0.000	0.007	0.001	0.000	0.001	0.002	0.000	0.002
MRH 288	275	Catanduvas	C	b	0.008	0.000	0.008	0.014	0.000	0.014	0.019	0.000	0.019	0.006	0.000	0.006	0.011	0.000	0.011
MRH 288	285	Ibema	C	b	0.007	0.003	0.010	0.013	0.004	0.017	0.019	0.004	0.023	0.006	0.001	0.007	0.012	0.001	0.013
MRH 288	305	Santa Lucia	C	b	0.003	0.000	0.003	0.004	0.000	0.004	0.005	0.000	0.005	0.001	0.000	0.001	0.002	0.000	0.002
MRH 288	313	Tres Barras Parana	C	b	0.007	0.000	0.007	0.009	0.000	0.009	0.010	0.000	0.010	0.002	0.000	0.002	0.003	0.000	0.003
MRH 289	316	Ampere	C	b	0.012	0.005	0.017	0.013	0.008	0.021	0.016	0.011	0.027	0.001	0.003	0.004	0.004	0.006	0.010
MRH 289	320	Capanema	C	b	0.015	0.001	0.016	0.015	0.001	0.016	0.015	0.002	0.017	0.000	0.000	0.000	0.000	0.001	0.001
MRH 289	321	Chopinzinho	C	b	0.016	0.002	0.018	0.019	0.004	0.023	0.024	0.006	0.030	0.003	0.002	0.005	0.008	0.004	0.012
MRH 289	322	Coronel Vivida	C	b	0.024	0.003	0.027	0.028	0.007	0.035	0.034	0.011	0.045	0.004	0.004	0.008	0.010	0.008	0.018
MRH 289	323	Cruzeiro do Iguacu	C	b	0.004	0.003	0.007	0.007	0.008	0.015	0.010	0.012	0.022	0.003	0.005	0.008	0.006	0.009	0.015
MRH 289	325	Enea Marques	C	b	0.003	0.000	0.003	0.003	0.000	0.003	0.004	0.000	0.004	0.000	0.000	0.000	0.001	0.000	0.001
MRH 289	329	Mariopolis	C	b	0.006	0.001	0.007	0.006	0.002	0.008	0.008	0.002	0.010	0.000	0.001	0.001	0.002	0.001	0.003
MRH 289	331	Nova Esperanca do Sudoeste	C	b	0.001	0.000	0.001	0.002	0.000	0.002	0.002	0.000	0.002	0.001	0.000	0.001	0.001	0.000	0.001
MRH 289	334	Perola do Oeste	C	b	0.006	0.000	0.006	0.006	0.001	0.007	0.007	0.001	0.008	0.000	0.001	0.001	0.001	0.001	0.002
MRH 289	335	Pinhal Sao Bento	C	b	0.001	0.000	0.001	0.001	0.000	0.001	0.002	0.000	0.002	0.000	0.000	0.000	0.001	0.000	0.001
MRH 289	336	Planalto	C	b	0.008	0.000	0.008	0.008	0.001	0.009	0.009	0.001	0.010	0.000	0.001	0.001	0.001	0.001	0.002
MRH 289	337	Pranchita	C	b	0.005	0.000	0.005	0.007	0.001	0.008	0.010	0.001	0.011	0.002	0.001	0.003	0.005	0.001	0.006
MRH 289	339	Renascenca	C	b	0.004	0.001	0.005	0.004	0.003	0.007	0.004	0.004	0.008	0.000	0.002	0.002	0.000	0.003	0.003
MRH 289	340	Salgado Filho	C	b	0.003	0.000	0.003	0.004	0.000	0.004	0.005	0.001	0.006	0.001	0.000	0.001	0.002	0.001	0.003
MRH 289	341	Salto do Lontra	C	b	0.009	0.000	0.009	0.013	0.000	0.013	0.017	0.001	0.018	0.004	0.000	0.004	0.008	0.001	0.009
MRH 289	343	Santo Antonio Sudoeste	C	b	0.017	0.001	0.018	0.019	0.002	0.021	0.024	0.003	0.027	0.002	0.001	0.003	0.007	0.002	0.009
MRH 289	344	Sao Joao	C	b	0.009	0.000	0.009	0.012	0.001	0.013	0.015	0.001	0.016	0.003	0.001	0.004	0.006	0.001	0.007
MRH 289	345	Sao Jorge do Oeste	C	b	0.007	0.000	0.007	0.007	0.001	0.008	0.006	0.001	0.007	0.000	0.001	0.001	0.000	0.001	0.001
MRH 289	348	Vere	C	b	0.005	0.000	0.005	0.007	0.001	0.008	0.010	0.001	0.011	0.002	0.001	0.003	0.005	0.001	0.006
MRH 289	349	Vitorino	C	b	0.005	0.000	0.005	0.006	0.001	0.007	0.008	0.001	0.009	0.001	0.001	0.002	0.003	0.001	0.004
MRH 290	351	Cantagalo	C	b	0.014	0.001	0.015	0.039	0.003	0.042	0.097	0.004	0.101	0.025	0.002	0.027	0.083	0.003	0.086
MRH 290	356	Pinhao	C	b	0.020	0.010	0.030	0.017	0.009	0.026	0.014	0.014	0.028	0.000	0.000	0.000	0.000	0.004	0.004
MRH 291	362	Clevelandia	C	b	0.027	0.012	0.039	0.029	0.013	0.042	0.033	0.008	0.041	0.002	0.001	0.003	0.006	0.000	0.006
MRH 291	363	Cruz Machado	C	b	0.005	0.003	0.008	0.007	0.011	0.018	0.009	0.012	0.021	0.002	0.008	0.010	0.004	0.009	0.013
MRH 291	364	General Carneiro	C	b	0.014	0.008	0.022	0.025	0.012	0.037	0.040	0.012	0.052	0.011	0.004	0.015	0.026	0.004	0.030
MRH 291	365	Honorio Serpa	C	b	0.002	0.000	0.002	0.003	0.000	0.003	0.005	0.000	0.005	0.001	0.000	0.001	0.003	0.000	0.003
MRH 291	366	Mangueirinha	C	b	0.010	0.018	0.028	0.020	0.016	0.036	0.031	0.016	0.047	0.010	0.000	0.010	0.021	0.000	0.021
MRH 291	369	Paulo Frontin	C	b	0.003	0.000	0.003	0.005	0.001	0.006	0.007	0.001	0.008	0.002	0.001	0.003	0.004	0.001	0.005
MRH 271	31	Tijucas do Sul	C	c	0.002	0.002	0.004	0.002	0.003	0.005	0.003	0.004	0.007	0.000	0.001	0.001	0.001	0.002	0.003
MRH 272	33	Lapa	C	c	0.041	0.011	0.052	0.053	0.011	0.064	0.072	0.014	0.086	0.012	0.000	0.012	0.031	0.003	0.034
MRH 275	46	Antonio Olinto	C	c	0.001	0.000	0.001	0.002	0.000	0.002	0.004	0.000	0.004	0.001	0.000	0.001	0.003	0.000	0.003
MRH 288	276	Ceu Azul	C	c	0.009	0.012	0.021	0.015	0.017	0.032	0.019	0.017	0.036	0.006	0.005	0.011	0.010	0.005	0.015
MRH 288	284	Guaraniacu	C	c	0.013	0.000	0.013	0.022	0.001	0.023	0.029	0.001	0.030	0.009	0.001	0.010	0.016	0.001	0.017
MRH 288	290	Lindoeste	C	c	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000
MRH 288	293	Matelandia	C	c	0.014	0.002	0.016	0.022	0.003	0.025	0.028	0.003	0.031	0.008	0.001	0.009	0.014	0.001	0.015
MRH 288	306	Santa Tereza do Oeste	C	c	0.006	0.000	0.006	0.009	0.000	0.009	0.012	0.001	0.013	0.003	0.000	0.003	0.006	0.001	0.007
MRH 288	307	Santa Terezinha Itaipu	C	c	0.020	0.001	0.021	0.038	0.001	0.039	0.054	0.001	0.055	0.018	0.000	0.018	0.034	0.000	0.034
MRH 288	309	Sao Miguel do Iguacu	C	c	0.017	0.005	0.022	0.030	0.004	0.034	0.040	0.005	0.045	0.013	0.000	0.013	0.023	0.000	0.023
MRH 289	317	Barracao	C	c	0.009	0.000	0.009	0.015	0.001	0.016	0.021	0.001	0.022	0.006	0.001	0.007	0.012	0.001	0.013
MRH 289	326	Flor da Serra do Sul	C	c	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000
MRH 289	332	Nova Prata do Iguacu	C	c	0.008	0.000	0.008	0.008	0.001	0.009	0.009	0.001	0.010	0.000	0.001	0.001	0.001	0.001	0.002

Table-3.10 (3) Required Water Supply of Urban Area by Sector and by Region in Iguaçu River Basin (Base Case)

MRH	No.	Municipality Name	Type	Zone	1993			2005			2015			2005-1993			2015-1993		
					Urban			Urban			Urban			Urban			Urban		
					Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total
MRH 290	350	Candoi	C	o	0.004	0.003	0.007	0.005	0.003	0.008	0.006	0.005	0.011	0.001	0.000	0.001	0.002	0.002	0.004
MRH 290	353	Inacio Martins	C	o	0.005	0.004	0.009	0.006	0.005	0.011	0.007	0.007	0.014	0.001	0.001	0.002	0.002	0.003	0.005
MRH 290	354	Laranjeiras do Sul	C	o	0.041	0.004	0.045	0.042	0.005	0.047	0.042	0.008	0.050	0.001	0.001	0.002	0.001	0.004	0.005
MRH 290	355	Nova Laranjeiras	C	o	0.001	0.001	0.002	0.001	0.001	0.002	0.001	0.001	0.002	0.000	0.000	0.000	0.000	0.000	0.000
MRH 272	34	Palmeira			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MRH 276	50	Irati			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total					7.204	4.004	11.208	10.392	5.594	15.986	14.617	7.154	21.771	3.191	1.724	4.915	7.420	3.232	10.652

Table-3.11 Required Water Supply of Urban Area by Sector and by Region in Iguaçu River Basin (Alternative Case)

MRH	No.	Municipality Name	Type	Zone	1993			2005			2015			2005-1993			2015-1993		
					Urban			Urban			Urban			Urban			Urban		
					Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total
MRH 268	268	Curitiba Metropolitan Area	A		4.866	3.324	8.190	6.072	4.197	10.269	8.026	5.059	13.085	1.206	0.873	2.079	3.160	1.735	4.895
MRH 288	274	Cascavel	A		0.394	0.118	0.512	0.746	0.164	0.910	1.120	0.225	1.345	0.352	0.046	0.398	0.726	0.107	0.833
MRH 288	282	Foz do Iguacu	A		0.552	0.016	0.568	1.188	0.103	1.291	1.873	0.187	2.060	0.636	0.087	0.723	1.321	0.171	1.492

Table-3.12 (1) Required Water Supply of Rural Area by Sector and by Region in Iguaçu River Basin

MRH	No.	Municipality Name	Type	Zone	1993		2005		2015		2005-1993		2015-1993	
					Rural		Rural		Rural		Rural		Rural	
					Domestic	Agricultural	Domestic	Agricultural	Domestic	Agricultural	Domestic	Agricultural	Domestic	Agricultural
MRH 268	1	Alm. Tamandare	A		0.002	0.002	0.002	0.002	0.002	0.002	0.000	0.000	0.000	0.000
MRH 268	2	Araucaria	A		0.007	0.006	0.007	0.007	0.007	0.009	0.000	0.001	0.000	0.003
MRH 268	3	Balsa Nova	A		0.005	0.002	0.005	0.003	0.004	0.004	0.000	0.001	0.000	0.002
MRH 268	5	Campina Grande do Sul	A		0.001	0.001	0.001	0.001	0.001	0.002	0.000	0.000	0.000	0.001
MRH 268	6	Campo Largo	A		0.004	0.002	0.004	0.003	0.003	0.003	0.000	0.001	0.000	0.001
MRH 268	7	Colombo	A		0.005	0.001	0.004	0.001	0.004	0.002	0.000	0.000	0.000	0.001
MRH 268	8	Contenda	A		0.004	0.002	0.004	0.003	0.004	0.003	0.000	0.001	0.000	0.001
MRH 268	9	Curitiba	A		0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.001
MRH 268	10	Fazenda Rio Grande	A		0.003	0.003	0.004	0.004	0.003	0.005	0.001	0.001	0.000	0.002
MRH 268	12	Mandirituba	A		0.009	0.013	0.009	0.016	0.008	0.020	0.000	0.003	0.000	0.007
MRH 268	13	Pinhais	A		0.004	0.000	0.004	0.000	0.004	0.000	0.000	0.000	0.000	0.000
MRH 268	14	Piraquara	A		0.012	0.001	0.013	0.001	0.012	0.001	0.001	0.000	0.000	0.000
MRH 268	15	Quatro Barras	A		0.001	0.001	0.001	0.002	0.001	0.002	0.000	0.001	0.000	0.001
MRH 268	17	Sao Jose dos Pinhais	A		0.012	0.005	0.011	0.006	0.010	0.007	0.000	0.001	0.000	0.002
MRH 268	268	Critiba Metropolitan Area	A		0.069	0.039	0.069	0.050	0.063	0.061	0.002	0.011	0.000	0.022
MRH 288	274	Cascavel	A		0.007	0.015	0.005	0.018	0.003	0.021	0.000	0.003	0.000	0.006
MRH 288	282	Foz do Iguacu	A		0.002	0.003	0.001	0.003	0.000	0.004	0.000	0.000	0.000	0.001
MRH 290	352	Guarapuava	A		0.021	0.037	0.023	0.045	0.024	0.054	0.002	0.008	0.003	0.017
MRH 288	294	Medianeira	B		0.006	0.013	0.004	0.016	0.002	0.018	0.000	0.003	0.000	0.005
MRH 289	324	Dois Vizinhos	B		0.010	0.021	0.005	0.027	0.003	0.031	0.000	0.006	0.000	0.010
MRH 289	327	Francisco Beltrao	B		0.014	0.029	0.010	0.035	0.007	0.042	0.000	0.006	0.000	0.013
MRH 289	333	Pato Branco	B		0.009	0.017	0.007	0.022	0.005	0.026	0.000	0.005	0.000	0.009
MRH 291	367	Palmas	B		0.009	0.037	0.006	0.046	0.004	0.055	0.000	0.009	0.000	0.018
MRH 291	371	Uniao da Vitoria	B		0.004	0.007	0.003	0.008	0.003	0.010	0.000	0.001	0.000	0.003
MRH 271	30	Quitandinha	C	a	0.012	0.008	0.012	0.010	0.013	0.012	0.000	0.002	0.001	0.004
MRH 272	32	Campo do Tenente	C	a	0.003	0.002	0.003	0.003	0.004	0.004	0.000	0.001	0.001	0.002
MRH 272	35	Porto Amazonas	C	a	0.001	0.001	0.001	0.001	0.001	0.002	0.000	0.000	0.000	0.001
MRH 272	36	Rio Negro	C	a	0.006	0.005	0.006	0.006	0.006	0.008	0.000	0.001	0.000	0.003
MRH 275	47	Sao Joao do Triunfo	C	a	0.009	0.001	0.009	0.002	0.009	0.002	0.000	0.001	0.000	0.001
MRH 275	48	Sao Mateus do Sul	C	a	0.017	0.005	0.017	0.006	0.018	0.008	0.000	0.001	0.001	0.003
MRH 276	51	Mallet	C	a	0.006	0.007	0.005	0.009	0.004	0.011	0.000	0.002	0.000	0.004
MRH 276	53	Rebouças	C	a	0.007	0.003	0.007	0.004	0.007	0.005	0.000	0.001	0.000	0.002
MRH 288	273	Capitao Leonidas Marques	C	a	0.006	0.003	0.002	0.010	0.001	0.012	0.000	0.002	0.000	0.004
MRH 289	318	Boa Esperanca do Iguacu	C	a	0.003	0.004	0.002	0.005	0.001	0.007	0.000	0.001	0.000	0.003
MRH 289	319	Bom Sucesso do Sul	C	a	0.003	0.009	0.002	0.010	0.002	0.013	0.000	0.001	0.000	0.004
MRH 289	328	Itapejara do Oeste	C	a	0.005	0.012	0.003	0.015	0.002	0.018	0.000	0.003	0.000	0.006
MRH 289	330	Marmeleiro	C	a	0.009	0.008	0.009	0.010	0.009	0.011	0.000	0.002	0.000	0.003
MRH 289	338	Renleza	C	a	0.007	0.006	0.004	0.007	0.002	0.008	0.000	0.001	0.000	0.002
MRH 289	342	Santa Izabel do Oeste	C	a	0.007	0.007	0.004	0.009	0.002	0.011	0.000	0.002	0.000	0.004
MRH 289	346	Saudade do Iguacu	C	a	0.003	0.005	0.002	0.007	0.002	0.008	0.000	0.002	0.000	0.003
MRH 289	347	Sulina	C	a	0.004	0.005	0.002	0.006	0.001	0.007	0.000	0.001	0.000	0.002
MRH 290	357	Quedas do Iguacu	C	a	0.014	0.008	0.012	0.009	0.011	0.011	0.000	0.001	0.000	0.003
MRH 290	358	Rio Bonito Iguacu	C	a	0.004	0.001	0.004	0.001	0.003	0.002	0.000	0.000	0.000	0.001
MRH 290	360	Virmond	C	a	0.003	0.001	0.002	0.001	0.002	0.002	0.000	0.000	0.000	0.001
MRH 291	361	Bituruna	C	a	0.007	0.055	0.006	0.068	0.005	0.082	0.000	0.013	0.000	0.027
MRH 291	368	Paula Freitas	C	a	0.003	0.003	0.002	0.004	0.002	0.004	0.000	0.001	0.000	0.001

Table-3.12 (2) Required Water Supply of Rural Area by Sector and by Region in Iguaçu River Basin

MRH	No.	Municipality Name	Type	Zone	1993		2005		2015		2005-1993		2015-1993	
					Rural		Rural		Rural		Rural		Rural	
					Domestic	Agricultural	Domestic	Agricultural	Domestic	Agricultural	Domestic	Agricultural	Domestic	Agricultural
MRH 291	370	Porto Vitoria	C	a	0.002	0.001	0.002	0.001	0.002	0.002	0.000	0.000	0.000	0.001
MRH 271	28	Agudos do Sul	C	b	0.005	0.005	0.006	0.006	0.006	0.008	0.001	0.001	0.001	0.003
MRH 271	29	Pien	C	b	0.006	0.005	0.007	0.006	0.007	0.007	0.001	0.001	0.001	0.002
MRH 276	54	Rio Azul	C	b	0.009	0.008	0.010	0.009	0.010	0.011	0.001	0.001	0.001	0.003
MRH 288	269	Boa Vista da Aparecida	C	b	0.007	0.004	0.006	0.004	0.005	0.005	0.000	0.000	0.000	0.001
MRH 288	275	Catanduvas	C	b	0.005	0.006	0.004	0.007	0.003	0.009	0.000	0.001	0.000	0.003
MRH 288	285	Ibema	C	b	0.002	0.004	0.002	0.005	0.002	0.006	0.000	0.001	0.000	0.002
MRH 288	305	Santa Lucia	C	b	0.003	0.004	0.001	0.005	0.001	0.005	0.000	0.001	0.000	0.001
MRH 288	313	Tres Barras Parana	C	b	0.010	0.008	0.006	0.010	0.004	0.011	0.000	0.002	0.000	0.003
MRH 289	316	Ampere	C	b	0.006	0.017	0.004	0.022	0.002	0.025	0.000	0.005	0.000	0.008
MRH 289	320	Capanema	C	b	0.010	0.011	0.006	0.013	0.002	0.016	0.000	0.002	0.000	0.005
MRH 289	321	Chopinzinho	C	b	0.011	0.021	0.007	0.027	0.004	0.031	0.000	0.006	0.000	0.010
MRH 289	322	Coronel Vivida	C	b	0.012	0.012	0.008	0.014	0.006	0.017	0.000	0.002	0.000	0.005
MRH 289	323	Cruzeiro do Iguacu	C	b	0.003	0.012	0.002	0.015	0.001	0.018	0.000	0.003	0.000	0.006
MRH 289	325	Eneas Marques	C	b	0.006	0.005	0.004	0.007	0.003	0.007	0.000	0.002	0.000	0.002
MRH 289	329	Mariopolis	C	b	0.003	0.004	0.003	0.005	0.002	0.006	0.000	0.001	0.000	0.002
MRH 289	331	Nova Esperanca do Sudoeste	C	b	0.004	0.007	0.004	0.009	0.004	0.010	0.000	0.002	0.000	0.003
MRH 289	334	Perola do Oeste	C	b	0.008	0.005	0.005	0.006	0.002	0.006	0.000	0.001	0.000	0.001
MRH 289	335	Pinhal Sao Bento	C	b	0.002	0.002	0.001	0.003	0.001	0.003	0.000	0.001	0.000	0.001
MRH 289	336	Planalto	C	b	0.010	0.007	0.006	0.008	0.003	0.009	0.000	0.001	0.000	0.002
MRH 289	337	Pranchita	C	b	0.005	0.007	0.003	0.009	0.001	0.010	0.000	0.002	0.000	0.003
MRH 289	339	Renascenca	C	b	0.005	0.010	0.005	0.013	0.004	0.015	0.000	0.003	0.000	0.005
MRH 289	340	Salgado Filho	C	b	0.009	0.009	0.007	0.011	0.005	0.013	0.000	0.002	0.000	0.004
MRH 289	341	Salto do Lontra	C	b	0.008	0.023	0.005	0.029	0.002	0.034	0.000	0.006	0.000	0.011
MRH 289	343	Santo Antonio Sudoeste	C	b	0.008	0.014	0.005	0.017	0.002	0.020	0.000	0.003	0.000	0.006
MRH 289	344	Sao Joao	C	b	0.008	0.018	0.005	0.022	0.002	0.026	0.000	0.004	0.000	0.008
MRH 289	345	Sao Jorge do Oeste	C	b	0.006	0.008	0.004	0.011	0.002	0.013	0.000	0.003	0.000	0.005
MRH 289	348	Vere	C	b	0.007	0.010	0.005	0.013	0.003	0.015	0.000	0.003	0.000	0.005
MRH 289	349	Vitorino	C	b	0.004	0.009	0.003	0.011	0.002	0.013	0.000	0.002	0.000	0.004
MRH 290	351	Cantagalo	C	b	0.008	0.003	0.009	0.003	0.010	0.004	0.001	0.000	0.002	0.001
MRH 290	356	Pinhao	C	b	0.023	0.011	0.026	0.014	0.027	0.015	0.003	0.003	0.004	0.004
MRH 291	362	Clevelandia	C	b	0.004	0.024	0.004	0.029	0.004	0.035	0.000	0.005	0.000	0.011
MRH 291	363	Cruz Machado	C	b	0.014	0.014	0.014	0.017	0.014	0.020	0.000	0.003	0.000	0.006
MRH 291	364	General Carneiro	C	b	0.005	0.005	0.004	0.005	0.003	0.007	0.000	0.000	0.000	0.002
MRH 291	365	Honorio Serpa	C	b	0.007	0.002	0.007	0.002	0.008	0.002	0.000	0.000	0.001	0.000
MRH 291	366	Mangueirinha	C	b	0.013	0.005	0.014	0.006	0.014	0.007	0.001	0.001	0.001	0.002
MRH 291	369	Paulo Frontin	C	b	0.005	0.008	0.005	0.010	0.006	0.011	0.000	0.002	0.001	0.003
MRH 271	31	Tijucas do Sul	C	c	0.006	0.003	0.006	0.003	0.007	0.004	0.000	0.000	0.001	0.001
MRH 272	33	Lapa	C	c	0.020	0.010	0.019	0.012	0.019	0.014	0.000	0.002	0.000	0.004
MRH 275	46	Antonio Olinto	C	c	0.007	0.002	0.007	0.003	0.007	0.003	0.000	0.001	0.000	0.001
MRH 288	276	Ceu Azul	C	c	0.005	0.007	0.003	0.008	0.003	0.009	0.000	0.001	0.000	0.002
MRH 288	284	Guaraniacu	C	c	0.006	0.009	0.004	0.011	0.003	0.013	0.000	0.002	0.000	0.004
MRH 288	290	Lindoeste	C	c	0.005	0.007	0.003	0.008	0.002	0.010	0.000	0.001	0.000	0.003
MRH 288	293	Matelandia	C	c	0.004	0.010	0.002	0.012	0.001	0.014	0.000	0.002	0.000	0.004
MRH 288	306	Santa Tereza do Oeste	C	c	0.001	0.003	0.001	0.004	0.001	0.004	0.000	0.001	0.000	0.001
MRH 288	307	Santa Terezinha Itaipu	C	c	0.001	0.002	0.001	0.002	0.001	0.003	0.000	0.000	0.000	0.001
MRH 288	309	Sao Miguel do Iguacu	C	c	0.004	0.007	0.002	0.008	0.001	0.010	0.000	0.001	0.000	0.003
MRH 289	317	Barracao	C	c	0.009	0.005	0.005	0.005	0.002	0.007	0.000	0.000	0.000	0.002
MRH 289	326	Flor da Serra do Sul	C	c	0.005	0.016	0.004	0.020	0.004	0.024	0.000	0.004	0.000	0.008
MRH 289	332	Nova Prata do Iguacu	C	c	0.007	0.010	0.005	0.011	0.002	0.013	0.000	0.001	0.000	0.003

Table-3.12 (3) Required Water Supply of Rural Area by Sector and by Region in Iguaçu River Basin

MRH	No.	Municipality Name	Type	Zone	1993		2005		2015		2005-1993		2015-1993	
					Rural		Rural		Rural		Rural		Rural	
					Domestic	Agricultural	Domestic	Agricultural	Domestic	Agricultural	Domestic	Agricultural	Domestic	Agricultural
MRH 290	350	Candoi	C	o	0.017	0.010	0.019	0.012	0.020	0.013	0.002	0.002	0.003	0.003
MRH 290	353	Inacio Martins	C	o	0.011	0.010	0.014	0.013	0.015	0.015	0.003	0.003	0.004	0.005
MRH 290	354	Laranjeiras do Sul	C	o	0.010	0.007	0.007	0.008	0.005	0.010	0.000	0.001	0.000	0.003
MRH 290	355	Nova Laranjeiras	C	o	0.005	0.003	0.004	0.004	0.004	0.004	0.000	0.001	0.000	0.001
MRH 272	34	Palmeira			0.003	0.002	0.003	0.002	0.003	0.003	0.000	0.000	0.000	0.001
MRH 276	50	Irati			0.007	0.003	0.006	0.004	0.005	0.004	0.000	0.001	0.000	0.001
		Total			0.684	0.836	0.581	1.027	0.505	1.219	0.017	0.191	0.026	0.383

Table-3.13 Required Water Supply of Urban Area by Sector and by Region in Tibagi River Basin

(1) Required Water Supply of Urban Area by Sector and by Region in Tibagi River Basin [Base Case] [m3/sec]

Municipality Name	Type	Zone	1993 Urban			2005 Urban			2015 Urban			2005-1993 Urban			2015-1993 Urban		
			Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total
Ponta Grossa	A		0.459	0.236	0.695	0.580	0.320	0.900	0.757	0.371	1.128	0.121	0.084	0.205	0.298	0.135	0.433
Londrina	A		1.029	0.221	1.250	1.413	0.289	1.702	1.879	0.335	2.214	0.384	0.068	0.452	0.850	0.114	0.964
Apucarana	A		0.204	0.061	0.265	0.273	0.106	0.379	0.361	0.136	0.497	0.069	0.045	0.114	0.157	0.075	0.232
Castro	B		0.083	0.065	0.148	0.123	0.149	0.272	0.175	0.223	0.398	0.040	0.084	0.124	0.092	0.158	0.250
Telemaco Borba	B		0.117	0.111	0.228	0.173	0.167	0.340	0.246	0.197	0.443	0.056	0.056	0.112	0.129	0.086	0.215
Irati	B		0.066	0.026	0.092	0.087	0.038	0.125	0.116	0.051	0.167	0.021	0.012	0.033	0.050	0.025	0.075
Cornelio Procopio	B		0.099	0.040	0.139	0.119	0.047	0.166	0.155	0.053	0.208	0.020	0.007	0.027	0.056	0.013	0.069
Arapongas	B		0.141	0.050	0.191	0.169	0.083	0.252	0.224	0.109	0.333	0.028	0.033	0.061	0.083	0.059	0.142
Cambe	B		0.163	0.115	0.278	0.231	0.144	0.375	0.339	0.198	0.537	0.068	0.029	0.097	0.176	0.083	0.259
Ibipora	B		0.075	0.015	0.090	0.110	0.024	0.134	0.163	0.032	0.195	0.035	0.009	0.044	0.088	0.017	0.105
Total of Type-C/Zone-a	C	a	0.114	0.018	0.132	0.153	0.032	0.185	0.206	0.046	0.252	0.039	0.016	0.055	0.092	0.031	0.123
Total of Type-C/Zone-b	C	b	0.107	0.025	0.132	0.139	0.049	0.188	0.183	0.067	0.25	0.032	0.024	0.056	0.076	0.043	0.119
Total of Type-C/Zone-c	C	c	0.097	0.037	0.134	0.128	0.051	0.179	0.174	0.061	0.235	0.031	0.014	0.045	0.077	0.028	0.105
Total			2.754	1.020	3.774	3.698	1.499	5.197	4.978	1.879	6.857	0.944	0.481	1.425	2.224	0.867	3.091

(2) Required Water Supply of Urban Area by Sector and by Region in Tibagi River Basin [Alternative Case] [m3/sec]

Municipality Name	Type	Zone	1993 Urban			2005 Urban			2015 Urban			2005-1993 Urban			2015-1993 Urban		
			Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total
Ponta Grossa	A		0.459	0.236	0.695	0.632	0.363	0.995	0.865	0.457	1.322	0.173	0.127	0.300	0.406	0.221	0.627
Telemaco Borba	B		0.117	0.111	0.228	0.189	0.183	0.372	0.279	0.224	0.503	0.072	0.072	0.144	0.162	0.113	0.275
Castro	B		0.083	0.065	0.148	0.135	0.158	0.293	0.200	0.242	0.442	0.052	0.093	0.145	0.117	0.177	0.294
Londrina	A		1.029	0.221	1.250	1.585	0.397	1.982	2.225	0.542	2.767	0.556	0.176	0.732	1.196	0.321	1.517
Cambe	B		0.163	0.115	0.278	0.260	0.166	0.426	0.400	0.241	0.641	0.097	0.051	0.148	0.237	0.126	0.363
Arapongas	B		0.141	0.050	0.191	0.188	0.098	0.286	0.265	0.135	0.400	0.047	0.048	0.095	0.124	0.085	0.209

(3) Required Water Supply of Rural Area by Sector and by Region in Tibagi River Basin [m3/sec]

Municipality Name	Type	Zone	1993 Rural		2005 Rural		2015 Rural		2005-1993 Rural		2015-1993 Rural	
			Domestic	Agricult.	Domestic	Agricult.	Domestic	Agricult.	Domestic	Agricult.	Domestic	Agricult.
Total of Type-A	A		0.034	0.048	0.022	0.058	0.017	0.068	0.000	0.010	0.000	0.020
Total of Type-B	B		0.040	0.041	0.031	0.049	0.026	0.057	0.000	0.008	0.000	0.016
Total of Type-C/Zone-a	C	a	0.049	0.073	0.033	0.087	0.026	0.101	0.001	0.014	0.002	0.028
Total of Type-C/Zone-b	C	b	0.032	0.034	0.026	0.041	0.022	0.049	0.001	0.007	0.002	0.015
Total of Type-C/Zone-c	C	c	0.038	0.016	0.032	0.022	0.027	0.025	0.001	0.006	0.001	0.009
Total			0.193	0.212	0.144	0.257	0.118	0.300	0.003	0.045	0.005	0.088

Table-3.14 Required Water Supply of Urban Area by Sector and by Region in Tibagi River Basin (Base Case)

MRH	No.	Municipality Name	Type	Zone	1993			2005			2015			2005-1993			2015-1993		
					Urban			Urban			Urban			Urban			Urban		
					Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total
MRH 273	39	Ponta Grossa	A		0.459	0.236	0.695	0.580	0.320	0.900	0.757	0.371	1.128	0.121	0.084	0.205	0.298	0.135	0.433
MRH 281	124	Londrina	A		1.029	0.221	1.250	1.413	0.289	1.702	1.879	0.335	2.214	0.384	0.068	0.452	0.850	0.114	0.964
MRH 284	184	Apucarana	A		0.204	0.061	0.265	0.273	0.106	0.379	0.361	0.136	0.497	0.069	0.045	0.114	0.157	0.075	0.232
MRH 273	37	Castro	B		0.083	0.065	0.148	0.123	0.149	0.272	0.175	0.223	0.398	0.040	0.084	0.124	0.092	0.158	0.250
MRH 273	40	Telemaco Borba	B		0.117	0.111	0.228	0.173	0.167	0.340	0.246	0.197	0.443	0.056	0.056	0.112	0.129	0.086	0.215
MRH 276	50	Irati	B		0.066	0.026	0.092	0.087	0.038	0.125	0.116	0.051	0.167	0.021	0.012	0.033	0.050	0.025	0.075
MRH 279	85	Cornelio Procopio	B		0.099	0.040	0.139	0.119	0.047	0.166	0.155	0.053	0.208	0.020	0.007	0.027	0.056	0.013	0.069
MRH 281	109	Arapongas	B		0.141	0.050	0.191	0.169	0.083	0.252	0.224	0.109	0.333	0.028	0.033	0.061	0.083	0.059	0.142
MRH 281	113	Cambe	B		0.163	0.115	0.278	0.231	0.144	0.375	0.339	0.198	0.537	0.068	0.029	0.097	0.176	0.083	0.259
MRH 281	119	Ibipora	B		0.075	0.015	0.090	0.110	0.024	0.134	0.163	0.032	0.195	0.035	0.009	0.044	0.088	0.017	0.105
MRH 273	38	Piraí do Sul	C	a	0.025	0.013	0.038	0.032	0.028	0.060	0.042	0.040	0.082	0.007	0.015	0.022	0.017	0.027	0.044
MRH 273	41	Tibagi	C	a	0.015	0.001	0.016	0.027	0.001	0.028	0.042	0.002	0.044	0.012	0.000	0.012	0.027	0.001	0.028
MRH 277	57	Ipiranga	C	a	0.005	0.000	0.005	0.007	0.000	0.007	0.008	0.000	0.008	0.002	0.000	0.002	0.003	0.000	0.003
MRH 277	59	Ortigueira	C	a	0.009	0.001	0.010	0.009	0.001	0.010	0.010	0.001	0.011	0.000	0.000	0.000	0.001	0.000	0.001
MRH 278	75	Sapopema	C	a	0.005	0.000	0.005	0.008	0.000	0.008	0.011	0.001	0.012	0.003	0.000	0.003	0.006	0.001	0.007
MRH 280	100	Jataizinho	C	a	0.017	0.003	0.020	0.021	0.001	0.022	0.027	0.000	0.027	0.004	0.000	0.004	0.010	0.000	0.010
MRH 280	101	Nova Santa Barbara	C	a	0.004	0.000	0.004	0.005	0.000	0.005	0.006	0.000	0.006	0.001	0.000	0.001	0.002	0.000	0.002
MRH 280	104	Sao Jeronimo da Serra	C	a	0.011	0.000	0.011	0.017	0.000	0.017	0.024	0.000	0.024	0.006	0.000	0.006	0.013	0.000	0.013
MRH 281	131	Primeiro de Maio	C	a	0.023	0.000	0.023	0.027	0.001	0.028	0.036	0.002	0.038	0.004	0.001	0.005	0.013	0.002	0.015
MRH 272	34	Palmeira	C	b	0.031	0.016	0.047	0.039	0.030	0.069	0.050	0.041	0.091	0.008	0.014	0.022	0.019	0.025	0.044
MRH 277	60	Reserva	C	b	0.013	0.000	0.013	0.019	0.001	0.020	0.025	0.001	0.026	0.006	0.001	0.007	0.012	0.001	0.013
MRH 279	90	N. America da Colina	C	b	0.003	0.001	0.004	0.005	0.003	0.008	0.006	0.004	0.010	0.002	0.002	0.004	0.003	0.003	0.006
MRH 279	97	Santo Antonio do Paraiso	C	b	0.002	0.000	0.002	0.002	0.000	0.002	0.003	0.000	0.003	0.000	0.000	0.000	0.001	0.000	0.001
MRH 280	103	Santa Cecilia do Pavao	C	b	0.005	0.002	0.007	0.006	0.003	0.009	0.007	0.004	0.011	0.001	0.001	0.002	0.002	0.002	0.004
MRH 280	105	Sao Sebastiao da Amoreir	C	b	0.010	0.000	0.010	0.016	0.000	0.016	0.024	0.000	0.024	0.006	0.000	0.006	0.014	0.000	0.014
MRH 280	106	Urai	C	b	0.019	0.001	0.020	0.023	0.001	0.024	0.030	0.000	0.030	0.004	0.000	0.004	0.011	0.000	0.011
MRH 281	137	Sertanopolis	C	b	0.024	0.005	0.029	0.029	0.011	0.040	0.038	0.017	0.055	0.005	0.006	0.011	0.014	0.012	0.026
MRH 276	49	Imbituva	C	c	0.016	0.005	0.021	0.021	0.007	0.028	0.028	0.009	0.037	0.005	0.002	0.007	0.012	0.004	0.016
MRH 276	55	Teixeira Soares	C	c	0.010	0.001	0.011	0.014	0.001	0.015	0.019	0.000	0.019	0.004	0.000	0.004	0.009	0.000	0.009
MRH 278	63	Curiuva	C	c	0.007	0.000	0.007	0.011	0.000	0.011	0.016	0.000	0.016	0.004	0.000	0.004	0.009	0.000	0.009
MRH 279	84	Congonhinhas	C	c	0.008	0.000	0.008	0.011	0.001	0.012	0.016	0.001	0.017	0.003	0.001	0.004	0.008	0.001	0.009
MRH 279	98	Sertaneja	C	c	0.009	0.000	0.009	0.011	0.006	0.017	0.014	0.013	0.027	0.002	0.006	0.008	0.005	0.013	0.018
MRH 280	99	Assai	C	c	0.027	0.015	0.042	0.033	0.015	0.048	0.043	0.012	0.055	0.006	0.000	0.006	0.016	0.000	0.016
MRH 280	102	Rancho Alegre	C	c	0.007	0.004	0.011	0.009	0.006	0.015	0.012	0.006	0.018	0.002	0.002	0.004	0.005	0.002	0.007
MRH 284	187	California	C	c	0.008	0.001	0.009	0.011	0.002	0.013	0.016	0.002	0.018	0.003	0.001	0.004	0.008	0.001	0.009
MRH 284	200	Maua da Serra	C	c	0.005	0.011	0.016	0.007	0.013	0.020	0.010	0.018	0.028	0.002	0.002	0.004	0.005	0.007	0.012
MRH 272	35	Porto Amazonas			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MRH 273	42	Ventania			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MRH 277	58	Ivai			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MRH 279	89	Leopolis			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MRH 279	91	Nova Fatima			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MRH 281	132	Rolandia			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MRH 284	198	Marilandia do Sul			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total					2.754	1.020	3.774	3.698	1.499	5.197	4.978	1.879	6.857	0.944	0.481	1.425	2.224	0.867	3.091

Table-3.15 Required Water Supply of Urban Area by Sector and by Region in Tibagi River Basin (Alternative Case)

MRH	No.	Municipality Name	Type	Zone	1993			2005			2015			2005-1993			2015-1993		
					Urban			Urban			Urban			Urban			Urban		
					Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total	Domestic	Industrial	Total
MRH 273	39	Ponta Grossa	A		0.459	0.236	0.695	0.632	0.363	0.995	0.865	0.457	1.322	0.173	0.127	0.300	0.406	0.221	0.627
MRH 273	40	Telemaco Borba	B		0.117	0.111	0.228	0.189	0.183	0.372	0.279	0.224	0.503	0.072	0.072	0.144	0.162	0.113	0.275
MRH 273	37	Castro	B		0.083	0.065	0.148	0.135	0.158	0.293	0.200	0.242	0.442	0.052	0.093	0.145	0.117	0.177	0.294
MRH 281	124	Londrina	A		1.029	0.221	1.250	1.585	0.397	1.982	2.225	0.542	2.767	0.556	0.176	0.732	1.196	0.321	1.517
MRH 281	113	Cambe	B		0.163	0.115	0.278	0.260	0.166	0.426	0.400	0.241	0.641	0.097	0.051	0.148	0.237	0.126	0.363
MRH 281	109	Arapongas	B		0.141	0.050	0.191	0.188	0.098	0.286	0.265	0.135	0.400	0.047	0.048	0.095	0.124	0.085	0.209

Table-3.16 Required Water Supply of Rural Area by Sector and by Region in Tibagi River Basin

MRH	No.	Municipality Name	Type	Zone	1993		2005		2015		2005-1993		2015-1993	
					Rural		Rural		Rural		Rural		Rural	
					Domestic	Agricultural	Domestic	Agricultural	Domestic	Agricultural	Domestic	Agricultural	Domestic	Agricultural
MRH 273	39	Ponta Grossa	A		0.010	0.012	0.008	0.014	0.007	0.017	0.000	0.002	0.000	0.005
MRH 281	124	Londrina	A		0.021	0.034	0.012	0.042	0.009	0.048	0.000	0.008	0.000	0.014
MRH 284	184	Apucarana	A		0.003	0.002	0.002	0.002	0.001	0.003	0.000	0.000	0.000	0.001
MRH 273	37	Castro	B		0.018	0.018	0.018	0.022	0.017	0.026	0.000	0.004	0.000	0.008
MRH 273	40	Telemaco Borba	B		0.009	0.009	0.005	0.011	0.003	0.013	0.000	0.002	0.000	0.004
MRH 276	50	Irati	B		0.002	0.001	0.002	0.001	0.002	0.001	0.000	0.000	0.000	0.000
MRH 279	85	Cornelio Procopio	B		0.003	0.004	0.002	0.004	0.001	0.005	0.000	0.000	0.000	0.001
MRH 281	109	Arapongas	B		0.002	0.004	0.001	0.005	0.001	0.005	0.000	0.001	0.000	0.001
MRH 281	113	Cambe	B		0.002	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000
MRH 281	119	Ibipora	B		0.004	0.004	0.002	0.005	0.001	0.006	0.000	0.001	0.000	0.002
MRH 273	38	Piraí do Sul	C	a	0.005	0.009	0.004	0.011	0.004	0.012	0.000	0.002	0.000	0.003
MRH 273	41	Tibagi	C	a	0.009	0.023	0.006	0.027	0.004	0.031	0.000	0.004	0.000	0.008
MRH 277	57	Ipiranga	C	a	0.009	0.008	0.010	0.010	0.011	0.012	0.001	0.002	0.002	0.004
MRH 277	59	Ortigueira	C	a	0.012	0.018	0.005	0.022	0.002	0.026	0.000	0.004	0.000	0.008
MRH 278	75	Sapopema	C	a	0.003	0.004	0.002	0.005	0.001	0.006	0.000	0.001	0.000	0.002
MRH 280	100	Jataizinho	C	a	0.002	0.002	0.001	0.002	0.001	0.002	0.000	0.000	0.000	0.000
MRH 280	101	Nova Santa Barbara	C	a	0.001	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000
MRH 280	104	Sao Jeronimo da Serra	C	a	0.007	0.008	0.004	0.009	0.002	0.011	0.000	0.001	0.000	0.003
MRH 281	131	Primeiro de Maio	C	a	0.001	0.001	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.000
MRH 272	34	Palmeira	C	b	0.011	0.009	0.012	0.011	0.013	0.013	0.001	0.002	0.002	0.004
MRH 277	60	Reserva	C	b	0.005	0.006	0.005	0.007	0.003	0.009	0.000	0.001	0.000	0.003
MRH 279	90	N. America da Colina	C	b	0.002	0.002	0.001	0.002	0.001	0.002	0.000	0.000	0.000	0.000
MRH 279	97	Santo Antonio do Paraiso	C	b	0.001	0.001	0.001	0.002	0.000	0.002	0.000	0.001	0.000	0.001
MRH 280	103	Santa Cecilia do Pavao	C	b	0.002	0.000	0.001	0.000	0.001	0.001	0.000	0.000	0.000	0.001
MRH 280	105	Sao Sebastiao da Amoreir	C	b	0.003	0.002	0.002	0.002	0.002	0.002	0.000	0.000	0.000	0.000
MRH 280	106	Uraí	C	b	0.004	0.004	0.002	0.005	0.001	0.006	0.000	0.001	0.000	0.002
MRH 281	137	Sertanopolis	C	b	0.004	0.010	0.002	0.012	0.001	0.014	0.000	0.002	0.000	0.004
MRH 276	49	Imbituva	C	c	0.013	0.003	0.014	0.004	0.014	0.004	0.001	0.001	0.001	0.001
MRH 276	55	Teixeira Soares	C	c	0.009	0.008	0.008	0.009	0.008	0.011	0.000	0.001	0.000	0.003
MRH 278	63	Curiuva	C	c	0.004	0.000	0.003	0.001	0.002	0.001	0.000	0.001	0.000	0.001
MRH 279	84	Congonhinhas	C	c	0.001	0.001	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.000
MRH 279	98	Sertanja	C	c	0.001	0.000	0.001	0.001	0.000	0.001	0.000	0.001	0.000	0.001
MRH 280	99	Assai	C	c	0.007	0.003	0.004	0.003	0.002	0.004	0.000	0.000	0.000	0.001
MRH 280	102	Rancho Alegre	C	c	0.001	0.000	0.001	0.001	0.000	0.001	0.000	0.001	0.000	0.001
MRH 284	187	California	C	c	0.002	0.001	0.001	0.002	0.001	0.002	0.000	0.001	0.000	0.001
MRH 284	200	Maua da Serra	C	c	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MRH 272	35	Porto Amazonas			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MRH 273	42	Ventania			0.001	0.002	0.001	0.002	0.001	0.002	0.000	0.000	0.000	0.000
MRH 277	58	Ivai			0.003	0.006	0.003	0.007	0.002	0.008	0.000	0.001	0.000	0.002
MRH 279	89	Leopolis			0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.000
MRH 279	91	Nova Fatima			0.001	0.001	0.001	0.001	0.000	0.002	0.000	0.000	0.000	0.001
MRH 281	132	Rolandia			0.001	0.001	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.000
MRH 284	198	Marilandia do Sul			0.002	0.002	0.001	0.002	0.001	0.003	0.000	0.000	0.000	0.001
Total					0.201	0.225	0.150	0.271	0.122	0.317	0.003	0.046	0.005	0.092