Central System→ Without Dam

System	Alternatives	Explanation
Central System	C3	Water Source: Surface Water at River Mouths, Developmentt River and Volume: Balian R.→ 900lit/s, Hoo R. → 300lit/s, Empas R. → 200lit/s, Ayung R. → 200lit/s, Oos → 100lit/s, Sangsang R. → 100lit/s, Total Volume: 1,800lit/s
	C4	Water Source: Groundwater, Development Area: Tabanan, Total Volume: 1,800lit/s (180 Wells)
	C5	Water Source: Surface Water at River Mouths and Groundwater, <Surface Water> Hoo R. → 300lit/s, Empas R. → 200lit/s, Ayung R. → 200lit/s, Oos → 100lit/s, Sangsang R. → 100lit/s, Volume: 900lit/s, <Groundwater> Volume: 900lit/s (90 Wells)

Groundwater Use and Potential (Unit: lit/s)

Item \ Regency	TABANAN	BADUNG	DENPASAR	GIANYAR
Groundwater Potential	2,391	531	292	806
Existing Well	5	246	315	348
Proposed Well in Master Plan	0	150	0	150
Proposed Well in this Plan	900	0	0	0
Remaining Capacity	1,486	135	-23	308

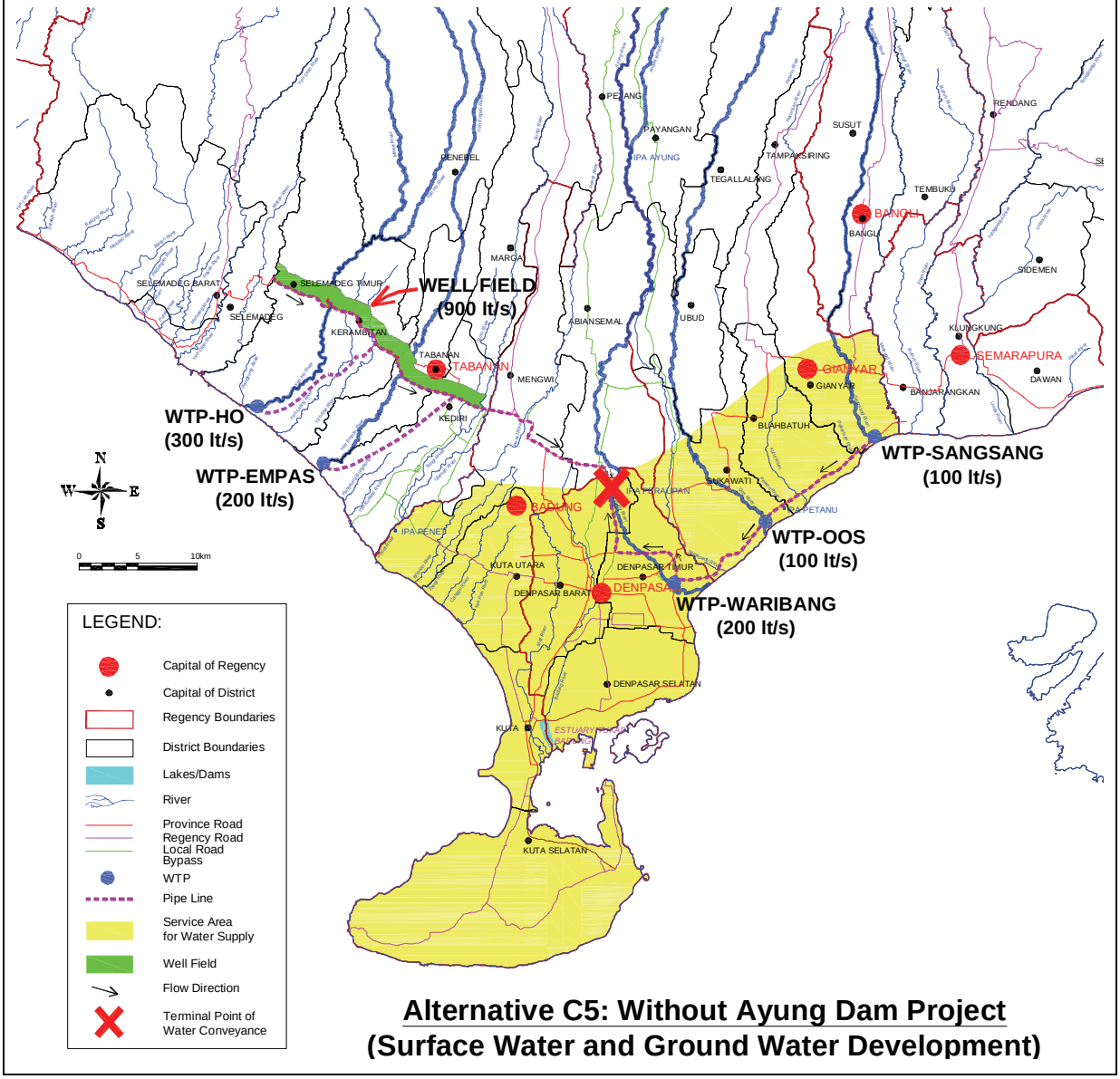

Figure-4.4 Alternative Plans without Ayung Dam
(Surface Water Development + Groundwater Development)

Central System→ With Small Scale Dam + Groundwater

System	Alternatives	Explanation
Central System	C6	Dam Development (Similar C2, Small Scale Dam) / Development Volume: 900lit/s Water Source: Groundwater, Development Area: Tabanan, Total Volume: 900lit/s (90 Wells)

Groundwater Use and Potential (Unit: lit/s)

Item \ Regency	TABANAN	BADUNG	DENPASAR	GIANYAR
Groundwater Potential	2,391	531	292	806
Existing Well	5	246	315	348
Proposed Well in Master Plan	0	150	0	150
Proposed Well in this Plan	900	0	0	0
Remaining Capacity	1,486	135	-23	308

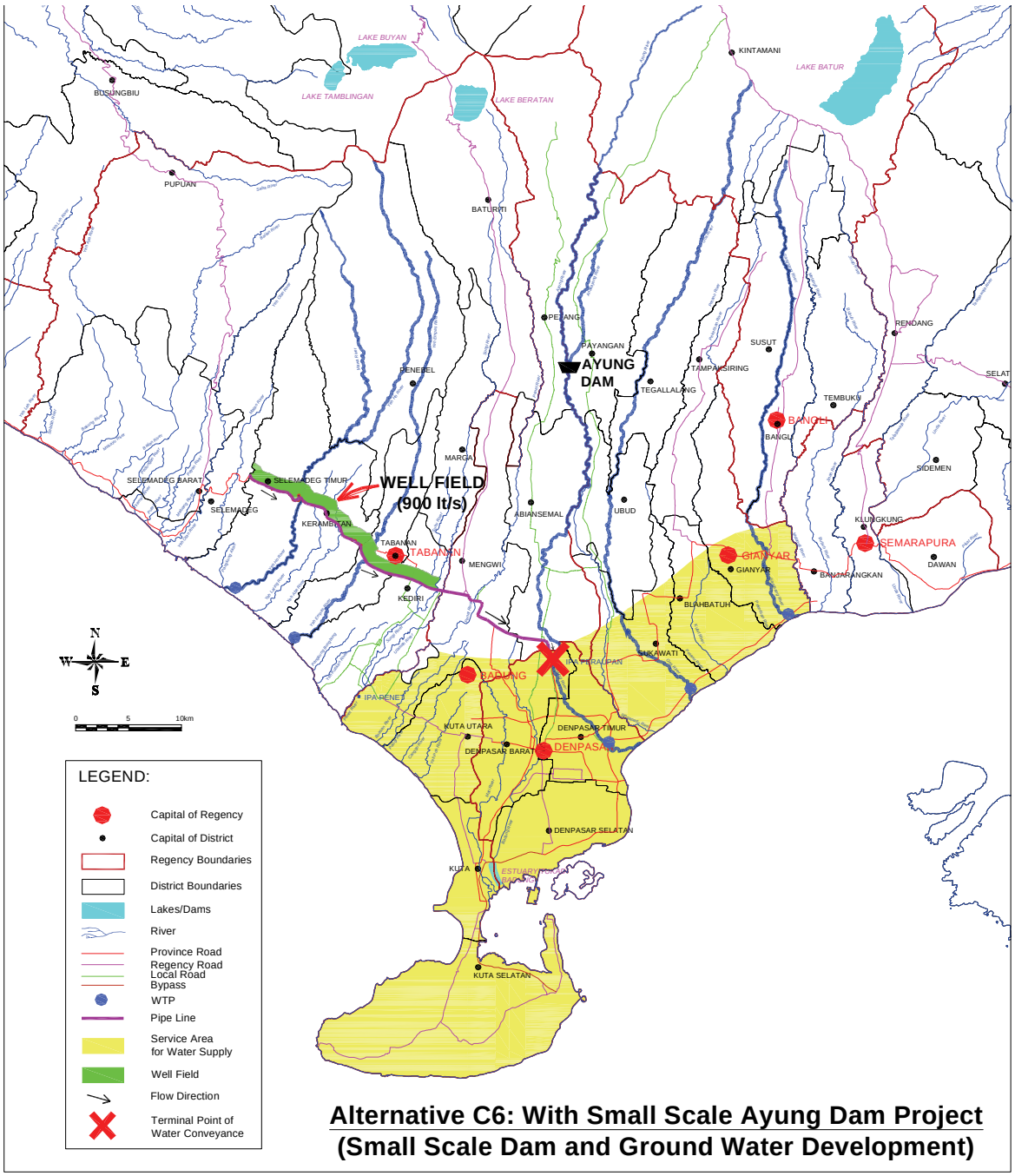

Figure-4.5 Alternative Plans with Small Scale Ayung Dam (+ Groundwater)

Comparison for Alternative Plans by Cost

The comparison for alternative plans by cost is shown in Table-4.7. The conditions of cost estimate are as follows.

- The cost estimate is based on the costs and prices of the average values in 2004. Exchange rates of Indonesian "Rupiah" to US$ and Japanese Yen is as follows: (Average: May/04 – April/05).
  - US$ 1 = Rp. 9,260 = JP¥ 106.97.
- To estimate the depreciation cost of each, life years are employed for facilities.
- To estimate O&M costs of each facility, the actual O&M data in Indonesia is referred.
- O&M cost for dam and reservoir is 0.5% of construction cost.
- Electric power rate is 8.5yen/kwh.

Table-4.7 Comparison for Alternative Plans by Cost

Items	Western S.		Central System						Eastern System				
	W1	W2	C1	C2	C3	C4	C5	C6	E1	E2	E3	E4	E5
1. Construction Cost (Mil. Yen)	789	867	5,868	5,301	8,016	6,601	7,537	6,666	3,416	2,700	3,119	3,166	2,927
1.1 Dam & Reservoir	-	-	2,744	2,744	-	-	-	1,922	-	-	-	-	-
1.2 Deep Wells	-	-	-	-	-	3,240	1,782	1,782	-	-	-	-	-
1.3 Measures for Env.	-	-	137	137	-	-	-	96	-	-	-	-	-
1.4 Water Pipeline	266	212	567	-	3,590	1,654	2,011	618	2,340	1,625	1,563	1,623	1,783
1.5 Buster Pump	120	252	-	-	2,006	1,147	2,254	758	-	-	480	468	68
1.6 Water Treatment	337	337	2,022	2,022	2,022	162	1,092	1,092	899	899	899	899	899
1.7 Water Distribution	66	66	398	398	398	398	398	398	177	177	177	177	177
2. Depreciation Cost (Mil. Yen/year)	22.1	27.7	120.2	108.2	240.4	174.6	232.1	232.1	77.8	62.6	85.5	86.2	69.4
2.1 Dam & Reservoir	-	-	42.9	42.9	-	-	-	24.0	-	-	-	-	-
2.2 Deep Wells	-	-	-	-	-	68.9	37.9	37.9	-	-	-	-	-
2.3 Measures for Env.	-	-	2.2	2.2	-	-	-	1.2	-	-	-	-	-
2.4 Water Pipeline	5.6	4.5	12.0	-	76.3	35.1	42.7	13.1	49.7	34.5	33.2	34.5	37.9
2.5 Buster Pump	6.0	12.7	-	-	101.0	57.7	113.5	38.2	-	-	24.2	23.6	3.4
2.6 Water Treatment	9.1	9.1	54.6	54.6	54.6	4.4	29.5	29.5	24.3	24.3	24.3	24.3	24.3
2.7 Water Distribution	1.4	1.4	8.5	8.5	8.5	8.5	8.5	8.5	3.8	3.8	3.8	3.8	3.8
3. O&M Cost (Mil. Yen/year)	35.9	46.6	177.5	175.8	633.6	614.4	566.5	289.9	77.1	75.0	137.0	128.6	86.1
3.1 Dam & Reservoir	-	-	17.2	17.2	-	-	-	9.6	-	-	-	-	-
3.2 Deep Wells	-	-	-	-	-	160.5	105.8	-	-	-	-	-	-
3.3 Measures for Env.	-	-	0.9	0.9	-	-	-	0.5	-	-	-	-	-
3.4 Water Pipeline	0.8	0.6	1.7	-	10.8	5.0	6.0	1.9	7.0	4.9	4.7	4.9	5.4
3.5 Buster Pump	8.9	19.8	-	-	465.1	381.9	342.3	165.5	-	-	62.2	53.6	10.6
3.6 Water Treatment	19.9	19.9	119.6	119.6	119.6	28.9	74.3	74.3	53.2	53.2	53.2	53.2	53.2
3.7 Water Distribution	6.3	6.3	38.1	38.1	38.1	38.1	38.1	38.1	16.9	16.9	16.9	16.9	16.9
4. Annual Cost (Mil. Yen/year)	58.0	74.3	297.7	284.0	874.0	789.0	798.6	442.3	154.9	137.6	222.5	214.8	155.5
5. Production (Mil. m^3/ year)	9.5	9.5	56.8	56.8	56.8	56.8	56.8	56.8	25.2	25.2	25.2	25.2	25.2
6. Water Cost (Yen/m^3)	6.1	7.9	5.2	5.0	15.4	13.9	14.1	7.8	6.1	5.5	8.8	8.5	6.2
- For Construction	2.3	2.9	2.1	1.9	4.2	3.1	4.1	2.7	3.1	2.5	3.4	3.4	2.8
- For O&M	3.8	5.0	3.1	3.1	11.2	10.8	10.0	5.1	3.0	3.0	5.4	5.1	3.4

Total Evaluation of Alternative Plans

<Western System>

Alternative W2 is selected as Western Water Supply System. Considerations in selection are as follows: (See Table-4.8)

- The construction costs of both alternatives are almost same cost.
- As the depreciation cost and O&M cost of Alternative-W2 are bit higher than those of Alternative-W1, the water cost of Altrnative-W2 is 16% higher than that of Alternative-W1.
- From social aspect (namely arrangement water right with downstream users), Alternative-W1 is critical. Generally it is very difficult to take water from the river in which SUBAK has water right for irrigation without big enough water storage facilities (such as reservoirs and ponds).

<Central System>

Alternative C2 is selected as Central Water Supply System. Considerations in selection are as follows: See Table-4.8)

- Among the alternatives, the depreciation cost of Alternative-C2 (With Dam – Downstream Intake by Pump) is lowest and that of Alternative-C3 (Without Dam – Surface Water Development) is highest.
- The construction of dam will not give a critical impact to environment and social.

<Eastern System>

Alternative E4 is selected as Western Water Supply System. Considerations in selection are as follows: (See Table-4.8)

- The water cost for Alternative E2 is the lowest. But, from social aspect (arrangement of water right for downstream users), alternative-E1, E2, E5 will be critical.
- Comparing with alternative E3 and E4, the score makes no difference. However, there is difference on water cost 8.5 yen/m3 for E4, whereas 8.8 yen/m^3 for E3.
- Alternative-E4 gives first evaluation result among the 5 alternatives.

Table-4.8 Evaluation of Alternative Plans

Items		Western S 300 lit/s		Central System 1.800 lit/s						Eastern System 800 lit/s				
		W1	W2	C1	C2	C3	C4	C5	C6	E1	E2	E3	E4	E5
(1) Average Score for Economic Aspect		**3.0**	**2.5**	**4.0**	**4.0**	**0.5**	**1.5**	**1.0**	**3.0**	**3.0**	**3.5**	**2.5**	**2.5**	**3.0**
Depreciation Cost (A) (Mil¥/year)	Specific (A) = a (Mil¥/year/100lit/s)	7.4	9.2	6.7	6.0	13.4	9.7	12.9	8.5	9.7	7.8	10.7	10.8	8.7
	Score	3	2	4	4	0	2	1	3	2	3	2	2	3
O&M Cost (B) (Mil¥/year)	Specific (B) = b (Mil¥/year/100lit/s)	12.0	15.5	9.9	9.8	35.2	34.1	31.5	16.1	9.6	9.4	17.1	16.1	10.8
	Score	3	3	4	4	1	1	1	3	4	4	3	3	3
(2) Average Score for Environmental & Social Aspect		**2.8**	**3.6**	**2.8**	**3.0**	**3.4**	**3.2**	**3.2**	**2.8**	**3.0**	**2.6**	**4.0**	**4.0**	**2.8**
Natural Environment		4	4	2	2	4	3	3	2	4	4	4	4	4
Resettlement		4	4	4	4	4	4	4	4	4	4	4	4	4
Land Acquisition		3	3	3	3	3	3	3	3	3	3	3	3	3
Water Right Arrangement		0	4	3	3	4	4	4	3	0	0	4	4	0
Impact to Social Activities from Const. Work		3	3	2	3	2	2	2	2	2	2	4	4	3
Water Cost (Yen/m^3)		6.1	7.9	5.2	5.0	15.4	13.9	14.1	7.8	6.1	5.5	8.8	8.5	6.2
Total Score		**5.8**	**6.1**	**6.8**	**7.0**	**3.9**	**4.7**	**4.2**	**5.8**	**6.0**	**6.1**	**6.5**	**6.5**	**5.8**
(Total Evaluation)		2	1	2	1	6	4	5	3	4	3	2	1	5

- Point 4: Good or no problem, Point 2: Average or some small problems included, Point 0: Bad or some critical problems included, Point 3: Between Point 4 and Point 2, Point 1: Between Point 1 and Point 0
- Score for Depreciation Cost: Point 4 (a<7), Point 3 (a<9), Point 2 (a<11), Point 1 (a<13), Point 0 (a>13), Refer to Table-4.7.
- Score for O&M Cost: Point 4 (a<10), Point 3 (a<20), Point 2 (a<30), Point 1 (a<40), Point 0 (a>40), Refer to Table-4.7.
- Total Score = Score (1) + Score (2)
- Number in Total Evaluation means priority order in each system
- In case of same score, priority is evaluated by water cost

(4) Proposed Plan of Public Water Supply System for Metropolitan Area

The proposed Plan of Public Water Supply System for Metropolitan Area is shown in Figure-4.6.

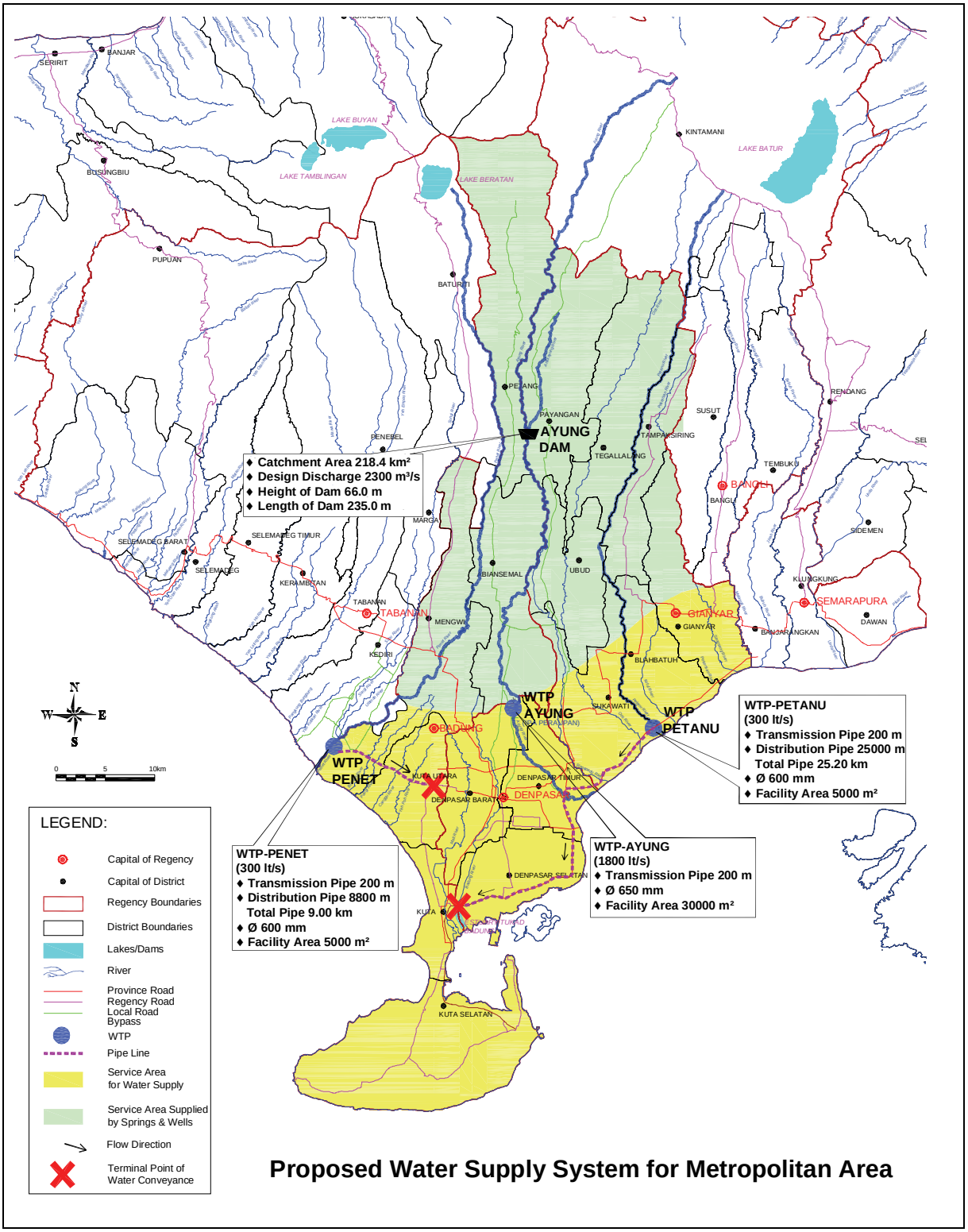

Figure-4.6 Proposed Integrated Water Supply System for Metropolitan Area

(5) Review of Plans according to Water Demand Variation

The facility plans proposed in the Master Plan should be reviewed and modified or changed if necessary according to the change of socio-economic conditions including the water demand projections.

For the public water supply plan targeting the metropolitan area, the water demand projection proposed in the Master Plan might be changeable. The alternative plan described below is tentative plan in case of lower water demand

As discussed in Table-4.2, in the lowest case of water demand for the metropolitan area, around 500 lit/s will be decreased than the projection done in the Master Plan. In this case the recommendable measure will be the cancel of the water supply system from Unda river (Refer to Table-4.9). Because the water cost of the Eastern System (Und a system) is higher than that of the Central System (Ayung system). It is another reason that the water is conveyed from the area outside of the consumer area. As discussed in Page 4-2, "User's Territory and User' Basin" is basic requirement of water source. When each water supply company seeks new water sources to meet new water demand, he has to find them first in his territory (Regency) and his river basin. Other territory and other basin are the second option.

Table-4.9 Public Water Supply System for the Metropolitan Area

Water Supply System	<Total>
＜Integrated System＞	*2,900 lit/s*
Western System - Intake at the mouth of Penut River (Pump Transport / Pump Distribution)	*300 lit/s*
Central System - Development by Ayung Dam (Gravity Transport / Gravity Distribution)	*1,800 lit/s*
Eastern System - Intake at the mouth of Petanu River (Pump Transport / Pump Distribution): Phase-1	*800 lit/s* *(300 lit/s)*
- Intake at the mouth of Petanu River (Pump Transport / Pump Distribution): Phase-2 &3	*(500 lit/s)*
＜Independent System＞	
Water supply to the areas near the water sources, by developing groundwater and spring water etc. according to the demand	*650 lit/s*
<Total>	*3,550 lit/s*

: Facility to be cancelled in case of the lowest water demand

(6) Water Supply Plan for Northern Bali Area

Current Water Supply Capacity and Water Demand

The Current Water Supply Capacity and Water Demand are shown in Table-4.10.

Table-4.10 Water Supply Capacity and Water Demand in Northern Bali Area

Area	Water Supply Company	Items	2005	2010	2015	2020	2025
Northern Bali	(1) JembranaPDAM	Demand (lit/s)	152	184	254	324	395
		Capacity (lit/s)	139				
		Balance (lit/s)	-13	-45	-115	-185	-256
	(2) Buleleng PDAM	Demand (lit/s)	245	344	515	687	859
		Capacity (lit/s)	394				
		Balance (lit/s)	149	50	-121	-293	-465
	(3) Bangli PDAM	Demand (lit/s)	89	123	180	232	287
		Capacity (lit/s)	120				
		Balance (lit/s)	31	-3	-60	-112	-167
	(4) Karangasem PDAM	Demand (lit/s)	166	236	333	430	526
		Capacity (lit/s)	224				
		Balance (lit/s)	58	-12	-109	-206	-302
	Total [1+2+3+4]	Demand (lit/s)	652	887	1,282	1,673	2,067
		Capacity (lit/s)		235	395	391	394
		Balance (lit/s)	877				
		Demand (lit/s)	225	-10	-405	-795	-1,190