plant growth, even though the treatment plant will take away at least 9 ha of future mangrove plantation area.

In fact no significant effects on the surrounding mangrove plantation due to the treated effluent of Nusa Dua sewage treatment plant, that discharges its treated effluent to mangrove plantation for more than 10 years, is noted during this study. This may be due to the fact that any beneficial effect by added nutrient of treated effluent, considering the limited treatment capacity of this plant, is only marginal.

Based on this baseline environmental study of the mangrove plantation, the following six (6) mangrove species are identified over the entire swampy area of Benoa Bay.

- Sonneratia alba, Avicennia marina, Aegiceras corniculatam, Phizophora mucronata, Bruguiera cylindrica and Ceriops tagal.

The mangrove plant height ranges from 4 m to 10 m. The plant density varies from a minimum of 84 plant/ha in West Suwung (at north of Tuban) to a maximum of 900 plant/ha in East Suwung (at south of Sanur).

Thirteen (13) species of fish are identified around the mangrove ecosystem, while around the Benoa Bay, 10 species of fish are predominant (ref. Table D.6.1 and Table D.6.2).

The birds identified to be living over the mangrove forest counts 23 species (ref. Table D.6.3).

6.2 Initial Environmental Examination (PIL)

The Initial Environmental Examination (PIL) by the urgent project of sewerage development until the year 2000 was conducted, to justify the insignificance of adverse environmental effects by the project.

The PIL report (Initial Environmental Examination report) is compiled as a separate document as "Attachment" to this Appendix-D.

Table D.2.1 Definition of Sub-Divisions of Households, Restaurants, Shops and Factories

1. Households

High Income Class	Luxurious, permanent house. Big size. Has many rooms. Made of good materials. Has a car or more, a spacious garden and well-tended walls/fences. Occupied by rich people.
Middle Income Class	Ordinary, permanent house. Medium size. Made of ordinary materials. May not have a car. Has a small garden. May have mediocre fences. Neither rich, nor poor.
Low Income Class	Semi-permanent or temporary house. Small size. Has few rooms. Made of inferior, make-shift materials. May have no garden, nor fences. Occupied by poor people.

2. Restaurants

Large	Big, famous, spacious and luxurious restaurant with the capacity of 100 or more seats.
Medium	Medium-size restaurant with the capacity of 50 to 99 seats.
Small	Small-size restaurant with the capacity of less than 50 seats.

3. Shops

Large	Big, spacious. Lots of merchandise. Department store, super market, or any other large shop with 30 or more workers.
Medium	Medium-size shop with sufficient number of merchandise. 5 to 29 workers.
Small	Small-size shop with limited number of merchandise. Less than 5 workers.

4. Factories

Large	Big-scale industry with 50 or more workers.
Medium	Medium-scale industry with 10 to 49 workers.
Small	Small-scale industry with less than 10 workers.

Source : JICA

Table D.2.2 Estimation of No. of Households in Overall Sewerage Service Area

(Unit : Households)

No.	Code No.	Name of Kelurahan/ Desa & Area	1990				2000				2010			
			High	Middle	Low	Total	High	Middle	Low	Total	High	Middle	Low	Total
1	101	Dauh Puri	77	1,392	414	1,883	240	1,305	324	1,869	397	1,207	245	1,849
2	102	Dauh Puri Kaja	58	1,233	264	1,555	275	1,390	245	1,910	482	1,542	229	2,253
3	103	Dauh Puri Kauh	32	1,078	385	1,495	289	1,444	416	2,149	541	1,832	446	2,819
4	104	Dauh Puri Kangin	39	634	255	928	156	730	242	1,128	270	845	226	1,341
5	105	Dauh Puri Kelod	117	1,835	630	2,582	556	2,397	660	3,613	984	2,966	698	4,648
6	106	Pemecutan	120	1,829	1,598	3,547	524	2,310	1,509	4,343	921	2,776	1,434	5,131
7	107	Pemecutan Kaja	39	776	935	1,750	188	911	817	1,916	333	1,045	688	2,066
8	108	Pemecutan Kelod	24	593	452	1,069	144	731	425	1,300	269	875	402	1,546
9	115	Ubung	1	41	132	174	16	69	113	198	24	95	94	213
10	117	Tegal Kerta	38	589	531	1,158	125	611	427	1,163	206	638	321	1,165
11	118	Tegal Harum	59	688	267	1,014	143	672	226	1,041	238	655	170	1,063
12	201	Dangin Puri	102	1,172	431	1,705	270	1,224	358	1,852	453	1,254	297	2,004
13	202	Dangin Puri Kauh	46	568	173	787	209	805	191	1,205	365	1,034	208	1,607
14	203	Dangin Puri Kaja	122	1,509	302	1,933	444	1,845	302	2,591	762	2,172	302	3,236
15	204	Dangin Puri Kangin	114	1,313	457	1,884	317	1,379	396	2,092	524	1,448	340	2,312
16	205	Dangin Puri Kelod	124	1,760	200	2,084	429	1,948	189	2,566	730	2,138	170	3,038
17	206	Sumerta	38	658	636	1,332	159	759	566	1,484	283	853	485	1,621
18	207	Sumerta Kauh	69	758	427	1,254	264	963	444	1,671	441	1,214	449	2,104
19	208	Sumerta Kaja	41	495	816	1,352	177	697	782	1,656	317	897	736	1,950
20	209	Sumerta Kelod	54	838	755	1,647	240	1,061	723	2,024	429	1,276	679	2,384
21	210	Kesiman	3	129	144	276	30	169	137	336	61	209	133	403
22	211	Kesiman Petilan	5	192	233	430	47	250	217	514	96	311	206	613
23	213	Tonja	2	214	416	632	59	316	395	770	120	422	377	919
24	305	Panjer	7	373	629	1,009	107	527	598	1,232	200	685	560	1,445
25	306	Sesetan	15	374	442	831	101	494	415	1,010	185	615	390	1,190
26	308	Pedungan	2	29	59	90	10	42	55	107	18	55	51	124
		DENPASAR	1,348	21,070	11,983	34,401	5,519	25,049	11,172	41,740	9,649	29,059	10,336	49,044
27	301	Sanur Kaja	25	276	321	622	90	366	303	759	155	453	282	890
28	302	Sanur	73	835	1,071	1,979	317	1,241	1,094	2,652	571	1,638	1,113	3,322
29	303	Sanur Kauh	16	277	326	619	58	306	276	640	106	328	213	647
		SANUR	114	1,388	1,718	3,220	465	1,913	1,673	4,051	832	2,419	1,608	4,859
		Total	1,462	22,458	13,701	37,621	5,984	26,962	12,845	45,791	10,481	31,478	11,944	53,903

Source : JICA

Table D.2.3 Estimation of No. of Hotel Rooms in Overall Sewerage Service Area

(Unit : Rooms)

No.	Code No.	Name of Kelurahan/ Desa & Area	1990			2000			2010		
			Classified Hotels	Non-Classified Hotels and Other Accommodations	Total	Classified Hotels	Non-Classified Hotels and Other Accommodations	Total	Classified Hotels	Non-Classified Hotels and Other Accommodations	Total
1	101	Dauh Puri	0	217	217	0	225	225	0	232	232
2	102	Dauh Puri Kaja	0	28	28	0	54	54	0	83	83
3	103	Dauh Puri Kauh	0	0	0	0	14	14	0	28	28
4	104	Dauh Puri Kangin	0	62	62	0	91	91	0	120	120
5	105	Dauh Puri Kelod	0	269	269	0	345	345	0	421	421
6	106	Pemecutan	44	144	188	44	144	188	44	144	188
7	107	Pemecutan Kaja	0	25	25	0	19	19	0	25	25
8	108	Pemecutan Kelod	0	0	0	0	19	19	0	38	38
9	115	Ubung	0	5	5	0	5	5	0	5	5
10	117	Tegal Kerta	0	10	10	0	10	10	0	10	10
11	118	Tegal Harum	0	46	46	0	46	46	0	46	46
12	201	Dangin Puri	0	122	122	0	122	122	0	122	122
13	202	Dangin Puri Kauh	75	0	75	75	39	114	75	77	152
14	203	Dangin Puri Kaja	0	172	172	0	172	172	0	172	172
15	204	Dangin Puri Kangin	0	66	66	0	106	106	0	146	146
16	205	Dangin Puri Kelod	0	35	35	0	35	35	0	35	35
17	206	Sumerta	0	0	0	0	0	0	0	0	0
18	207	Sumerta Kauh	0	0	0	0	0	0	0	0	0
19	208	Sumerta Kaja	0	48	48	0	54	54	0	60	60
20	209	Sumerta Kelod	0	0	0	0	26	26	0	52	52
21	210	Kesiman	0	0	0	0	0	0	0	0	0
22	211	Kesiman Petilan	0	0	0	0	106	106	0	212	212
23	213	Tonja	0	0	0	0	0	0	0	0	0
24	305	Panjer	0	0	0	0	0	0	0	0	0
25	306	Sesetan	0	0	0	0	0	0	0	0	0
26	308	Pedungan	0	0	0	0	0	0	0	0	0
	DENPASAR		119	1,249	1,368	119	1,632	1,751	119	2,028	2,147
27	301	Sanur Kaja	649	141	790	1,385	301	1,686	2,120	461	2,581
28	302	Sanur	1,616	665	2,281	2,458	1,012	3,470	3,300	1,358	4,658
29	303	Sanur Kauh	0	74	74	340	113	453	680	151	831
	SANUR		2,265	880	3,145	4,183	1,426	5,609	6,100	1,970	8,070
Total			2,384	2,129	4,513	4,302	3,058	7,360	6,219	3,998	10,217

Source : JICA

Table D.2.4 Estimation of No. of Restaurant Seats in Overall Sewerage Service Area

(Unit : No. of Restaurant Seats)

No.	Code No.	Name of Kelurahan/ Desa & Area	1990				2000				2010			
			Large	Medium	Small	Total	Large	Medium	Small	Total	Large	Medium	Small	Total
1	101	Dauh Puri	0	610	299	909	0	621	304	925	0	631	309	940
2	102	Dauh Puri Kaja	0	0	0	0	0	0	13	13	0	0	13	13
3	103	Dauh Puri Kauh	197	236	66	499	198	237	66	501	199	238	66	503
4	104	Dauh Puri Kangin	0	257	156	413	0	262	159	421	0	267	162	429
5	105	Dauh Puri Kelod	117	215	68	400	126	230	73	429	134	245	78	457
6	106	Pemecutan	200	410	209	819	201	413	210	824	202	415	212	829
7	107	Pemecutan Kaja	429	0	43	472	429	0	43	472	429	0	43	472
8	108	Pemecutan Kelod	0	0	0	0	0	0	15	15	0	0	15	15
9	115	Ubung	0	0	23	23	0	0	23	23	0	0	23	23
10	117	Tegal Kerta	0	0	0	0	0	0	0	0	0	0	0	0
11	118	Tegal Harum	0	0	40	40	0	0	40	40	0	0	40	40
12	201	Dangin Puri	0	0	0	0	0	0	0	0	0	0	0	0
13	202	Dangin Puri Kauh	0	0	239	239	0	0	245	245	0	0	251	251
14	203	Dangin Puri Kaja	0	0	0	0	0	0	10	10	0	0	10	10
15	204	Dangin Puri Kangin	0	0	50	50	0	0	60	60	0	0	70	70
16	205	Dangin Puri Kelod	0	0	30	30	0	0	30	30	0	0	30	30
17	206	Sumerta	0	114	0	114	0	114	0	114	0	114	0	114
18	207	Sumerta Kauh	0	50	0	50	0	50	0	50	0	50	0	50
19	208	Sumerta Kaja	0	60	45	105	0	62	47	109	0	65	48	113
20	209	Sumerta Kelod	0	0	0	0	0	0	7	7	0	0	7	7
21	210	Kesiman	0	0	70	70	0	0	70	70	0	0	70	70
22	211	Kesiman Petilan	0	0	0	0	0	0	28	28	0	0	28	28
23	213	Tonja	0	0	0	0	0	0	0	0	0	0	0	0
24	305	Panjer	0	0	0	0	0	0	0	0	0	0	0	0
25	306	Sesetan	0	0	20	20	0	0	24	24	0	0	27	27
26	308	Pedungan	0	0	0	0	0	0	0	0	0	0	0	0
		DENPASAR	943	1,952	1,358	4,253	954	1,989	1,467	4,410	964	2,025	1,502	4,491
27	301	Sanur Kaja	348	91	95	534	439	116	120	675	531	140	145	816
28	302	Sanur	1,859	1,409	630	3,898	2,086	1,582	707	4,375	2,314	1,754	784	4,852
29	303	Sanur Kauh	0	0	0	0	0	61	28	89	0	121	56	177
		SANUR	2,207	1,500	725	4,432	2,525	1,759	855	5,139	2,845	2,015	985	5,845
		Total	3,150	3,452	2,083	8,685	3,479	3,748	2,322	9,549	3,809	4,040	2,487	10,336

Source : JICA

Table D.2.5 Estimation of No. of Shops
in Overall Sewerage Service Area

(Unit : No. of Shops)

No.	Code No.	Name of Kelurahan/ Desa & Area	1990				2000				2010			
			Large	Medium	Small	Total	Large	Medium	Small	Total	Large	Medium	Small	Total
1	101	Dauh Puri	2	70	30	102	2	71	30	103	2	70	30	102
2	102	Dauh Puri Kaja	0	17	109	126	0	21	135	156	0	24	161	185
3	103	Dauh Puri Kauh	1	4	33	38	1	6	47	54	1	8	63	72
4	104	Dauh Puri Kangin	1	4	190	195	1	5	230	236	1	6	281	288
5	105	Dauh Puri Kelod	3	20	124	147	4	28	176	208	6	37	228	271
6	106	Pemecutan	1	192	450	643	1	239	561	801	1	286	669	956
7	107	Pemecutan Kaja	0	44	16	60	1	49	18	68	1	54	20	75
8	108	Pemecutan Kelod	0	3	22	25	0	4	27	31	0	5	33	38
9	115	Ubung	0	0	5	5	0	0	6	6	0	0	6	6
10	117	Tegal Kerta	1	1	12	14	1	1	12	14	1	1	12	14
11	118	Tegal Harum	1	0	62	63	1	0	64	65	1	0	67	68
12	201	Dangin Puri	0	3	12	15	0	3	13	16	0	4	14	18
13	202	Dangin Puri Kauh	0	2	15	17	0	3	24	27	0	4	31	35
14	203	Dangin Puri Kaja	0	10	68	78	0	14	92	106	0	17	116	133
15	204	Dangin Puri Kangin	0	27	13	40	0	30	15	45	0	34	16	50
16	205	Dangin Puri Kelod	0	2	53	55	0	2	66	68	0	3	79	82
17	206	Sumerta	0	5	17	22	0	6	19	25	0	6	21	27
18	207	Sumerta Kauh	0	2	8	10	0	3	11	14	0	3	14	17
19	208	Sumerta Kaja	0	17	76	93	0	21	96	117	0	25	113	138
20	209	Sumerta Kelod	0	3	24	27	0	4	30	34	0	4	36	40
21	210	Kesiman	0	0	6	6	0	0	7	7	0	0	9	9
22	211	Kesiman Petilan	0	1	26	27	0	1	31	32	0	1	38	39
23	213	Tonja	0	0	34	34	0	0	42	42	1	0	52	53
24	305	Panjer	0	1	19	20	0	1	23	24	0	2	27	29
25	306	Sesetan	0	0	6	6	0	1	7	8	0	1	8	9
26	308	Pedungan	0	0	3	3	0	0	3	3	0	0	4	4
		DENPASAR	10	428	1,433	1,871	12	513	1,785	2,310	15	595	2,148	2,758
27	301	Sanur Kaja	0	1	79	80	0	1	117	118	0	2	155	157
28	302	Sanur	1	42	41	84	2	68	66	136	2	94	91	187
29	303	Sanur Kauh	0	4	17	21	0	5	22	27	0	6	26	32
		SANUR	1	47	137	185	2	74	205	281	2	102	272	376
		Total	11	475	1,570	2,056	14	587	1,990	2,591	17	697	2,420	3,134

Source : JICA

Table D.2.6 Estimation of No. of Factories in Overall Sewerage Service Area

(Unit : No. of Factories)

No.	Code No.	Name of Kelurahan/ Desa & Area	1990				2000				2010			
			Large	Medium	Small	Total	Large	Medium	Small	Total	Large	Medium	Small	Total
1	101	Dauh Puri	1	1	0	2	2	2	0	4	2	2	0	4
2	102	Dauh Puri Kaja	0	0	0	0	0	0	0	0	0	0	0	0
3	103	Dauh Puri Kauh	0	6	10	16	0	10	16	26	0	13	22	35
4	104	Dauh Puri Kangin	0	0	0	0	0	0	0	0	0	0	0	0
5	105	Dauh Puri Kelod	1	5	15	21	2	8	24	34	2	11	33	46
6	106	Pemecutan	0	5	25	30	0	8	40	48	0	11	55	66
7	107	Pemecutan Kaja	2	1	0	3	3	2	0	5	4	2	0	6
8	108	Pemecutan Kelod	0	5	0	5	0	8	0	8	0	11	0	11
9	115	Ubung	0	0	3	3	0	0	5	5	0	0	7	7
10	117	Tegal Kerta	0	0	0	0	0	0	0	0	0	0	0	0
11	118	Tegal Harum	0	0	0	0	0	0	0	0	0	0	0	0
12	201	Dangin Puri	0	0	0	0	0	0	0	0	0	0	0	0
13	202	Dangin Puri Kauh	0	0	0	0	0	0	0	0	0	0	0	0
14	203	Dangin Puri Kaja	0	4	6	10	0	6	10	16	0	9	13	22
15	204	Dangin Puri Kangin	1	2	1	4	2	3	2	7	2	4	2	8
16	205	Dangin Puri Kelod	0	0	0	0	0	0	0	0	0	0	0	0
17	206	Sumerta	0	3	12	15	0	5	19	24	0	7	26	33
18	207	Sumerta Kauh	0	0	0	0	0	0	0	0	0	0	0	0
19	208	Sumerta Kaja	0	6	11	17	0	10	18	28	0	13	24	37
20	209	Sumerta Kelod	1	1	1	3	2	2	2	6	2	2	2	6
21	210	Kesiman	0	2	3	5	0	3	5	8	0	4	7	11
22	211	Kesiman Petilan	0	3	5	8	0	5	8	13	0	7	11	18
23	213	Tonja	0	0	0	0	0	0	0	0	0	0	0	0
24	305	Panjer	0	1	1	2	0	2	2	4	0	2	2	4
25	306	Sesetan	0	2	2	4	0	3	3	6	0	4	4	8
26	308	Pedungan	0	3	3	6	0	5	5	10	0	7	7	14
		DENPASAR	6	50	98	154	11	82	159	252	12	109	215	336
27	301	Sanur Kaja	0	1	8	9	0	2	13	15	0	2	18	20
28	302	Sanur	1	12	27	40	2	19	43	64	2	26	60	88
29	303	Sanur Kauh	0	3	5	8	0	5	8	13	0	7	11	18
		SANUR	1	16	40	57	2	26	64	92	2	35	89	126
		Total	7	66	138	211	13	108	223	344	14	144	304	462

Source : JICA

Table D.2.7 Estimation of No. of Offices in Overall Sewerage Service Area

(Unit : No. of Offices)

No.	Code No.	Name of Kelurahan/ Desa & Area	1990				2000				2010			
			Bank	Other Offices		Total	Bank	Other Offices		Total	Bank	Other Offices		Total
				Private	Gov't			Private	Gov't			Private	Gov't	
1	101	Dauh Puri	10	14	12	36	10	14	12	36	10	14	12	36
2	102	Dauh Puri Kaja	7	10	26	43	9	13	32	54	10	15	39	64
3	103	Dauh Puri Kauh	3	5	1	9	4	8	1	13	5	10	2	17
4	104	Dauh Puri Kangin	8	2	12	22	10	2	15	27	12	3	18	33
5	105	Dauh Puri Kelod	8	210	10	228	11	298	14	323	15	387	18	420
6	106	Pemecutan	24	30	2	56	30	37	3	70	36	45	4	85
7	107	Pemecutan Kaja	6	5	2	13	7	5	2	14	8	6	2	16
8	108	Pemecutan Kelod	2	3	2	7	2	4	2	8	3	5	2	10
9	115	Ubung	1	0	1	2	1	0	1	2	1	0	1	2
10	117	Tegal Kerta	2	0	1	3	2	0	1	3	2	0	1	3
11	118	Tegal Harum	0	0	1	1	0	0	1	1	0	0	1	1
12	201	Dangin Puri	2	2	8	12	2	2	9	13	2	2	10	14
13	202	Dangin Puri Kauh	4	10	1	15	6	16	2	24	8	21	3	32
14	203	Dangin Puri Kaja	2	4	0	6	3	5	0	8	3	7	0	10
15	204	Dangin Puri Kangin	16	24	11	51	18	27	12	57	20	30	14	64
16	205	Dangin Puri Kelod	0	4	17	21	0	5	21	26	0	6	25	31
17	206	Sumerta	4	6	1	11	5	7	1	13	5	7	1	13
18	207	Sumerta Kauh	0	0	1	1	0	0	2	2	0	0	2	2
19	208	Sumerta Kaja	4	2	6	12	5	3	8	16	6	3	9	18
20	209	Sumerta Kelod	8	10	18	36	10	13	23	46	12	15	27	54
21	210	Kesiman	0	0	0	0	1	0	0	1	1	0	0	1
22	211	Kesiman Petilan	2	0	1	3	2	0	1	3	2	0	1	3
23	213	Tonja	1	1	0	2	1	1	1	3	1	1	1	3
24	305	Panjer	0	2	0	2	0	3	0	3	0	3	0	3
25	306	Sesetan	0	3	3	6	1	3	4	8	1	4	5	10
26	308	Pedungan	0	0	0	0	0	0	0	0	0	0	0	0
		DENPASAR	114	347	137	598	140	466	168	774	163	584	198	945
27	301	Sanur Kaja	3	3	1	7	5	4	1	10	7	6	1	14
28	302	Sanur	10	0	5	15	18	0	7	25	25	0	8	33
29	303	Sanur Kauh	0	4	1	5	0	5	1	6	0	6	1	7
		SANUR	13	7	7	27	23	9	9	41	32	12	10	54
		Total	127	354	144	625	163	475	177	815	195	596	208	999

Source : JICA

Table D.2.8(1) Estimation of No. of Educational Institutions in Overall Sewerage Service Area

(Unit : No. of Educational Institutions)

No.	Code No.	Name of Kelurahan/ Desa & Area	1990							2000						
			Kinder-garten	Primary School	Junior High School	Senior High School	Religious School	College/ Univ.	Total	Kinder-garten	Primary School	Junior High School	Senior High School	Religious School	College/ Univ.	Total
1	101	Dauh Puri	1	1	0	0	0	3	5	1	1	0	0	0	3	5
2	102	Dauh Puri Kaja	3	6	3	2	2	1	17	3	8	3	2	2	1	19
3	103	Dauh Puri Kauh	1	6	1	1	0	1	10	2	9	2	2	0	1	16
4	104	Dauh Puri Kangin	1	0	0	0	1	0	2	1	0	0	0	1	0	2
5	105	Dauh Puri Kelod	8	11	3	3	0	1	26	11	16	4	4	0	1	36
6	106	Pemecutan	4	10	1	0	0	5	20	5	12	1	0	0	6	24
7	107	Pemecutan Kaja	2	5	2	1	0	0	10	3	5	2	1	0	0	11
8	108	Pemecutan Kelod	1	2	0	0	0	0	3	1	3	0	0	0	0	4
9	115	Ubung	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	117	Tegal Kerta	3	2	0	0	0	0	5	3	2	0	0	0	0	5
11	118	Tegal Harum	2	5	2	2	0	0	11	2	5	2	2	0	0	11
12	201	Dangin Puri	3	12	3	1	0	0	19	3	13	3	1	0	0	20
13	202	Dangin Puri Kauh	1	1	0	0	0	1	3	2	2	0	0	0	2	6
14	203	Dangin Puri Kaja	3	8	1	2	0	1	15	4	11	1	3	0	1	20
15	204	Dangin Puri Kangin	6	14	9	8	0	3	40	7	16	10	9	0	3	45
16	205	Dangin Puri Kelod	1	4	1	1	1	0	8	1	5	1	1	1	0	9
17	206	Sumerta	1	3	2	2	0	0	8	1	3	2	2	0	0	8
18	207	Sumerta Kauh	0	2	0	1	0	0	3	0	3	0	1	0	0	4
19	208	Sumerta Kaja	2	2	0	1	0	1	6	3	3	0	1	0	1	8
20	209	Sumerta Kelod	3	6	2	2	0	1	14	4	8	3	3	0	1	19
21	210	Kesiman	0	1	0	0	0	0	1	0	1	0	0	0	0	1
22	211	Kesiman Petilan	0	2	0	0	0	0	2	0	2	0	0	0	0	2
23	213	Tonja	1	2	0	1	0	0	4	1	2	0	1	0	0	4
24	305	Panjer	0	3	0	1	0	1	5	0	3	0	1	0	1	5
25	306	Sesetan	1	2	1	1	0	0	5	1	3	1	1	0	0	6
26	308	Pedungan	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		DENPASAR	48	110	31	30	4	19	242	59	136	35	35	4	21	290
27	301	Sanur Kaja	1	2	0	1	0	0	4	1	2	0	1	0	0	4
28	302	Sanur	1	8	2	0	0	1	12	1	11	3	0	0	1	16
29	303	Sanur Kauh	0	2	0	1	0	0	3	0	2	0	1	0	0	3
		SANUR	2	12	2	2	0	1	19	2	15	3	2	0	1	23
		Total	50	122	33	32	4	20	261	61	151	38	37	4	22	313

Source : JICA

Table D.2.8(2) Estimation of No. of Educational Institutions in Overall Sewerage Service Area

(Unit : No. of Educational Institutions)

No.	Code No.	Name of Kelurahan/ Desa & Area	2010						
			Kinder-garten	Primary School	Junior High School	Senior High School	Religious School	College/ University	Total
1	101	Dauh Puri	1	1	0	0	0	3	5
2	102	Dauh Puri Kaja	4	9	4	3	3	1	24
3	103	Dauh Puri Kauh	3	11	3	3	0	1	21
4	104	Dauh Puri Kangin	1	0	0	0	1	0	2
5	105	Dauh Puri Kelod	15	20	6	6	0	2	49
6	106	Pemecutan	6	15	1	0	0	7	29
7	107	Pemecutan Kaja	3	6	2	1	0	0	12
8	108	Pemecutan Kelod	2	4	0	0	0	0	6
9	115	Ubung	0	0	0	0	0	0	0
10	117	Tegal Kerta	3	2	0	0	0	0	5
11	118	Tegal Harum	2	5	2	2	0	0	11
12	201	Dangin Puri	4	14	4	1	0	0	23
13	202	Dangin Puri Kauh	2	2	0	0	0	2	6
14	203	Dangin Puri Kaja	5	14	2	3	0	2	26
15	204	Dangin Puri Kangin	8	18	11	10	0	4	51
16	205	Dangin Puri Kelod	1	6	1	1	1	0	10
17	206	Sumerta	1	4	2	2	0	0	9
18	207	Sumerta Kauh	0	3	0	2	0	0	5
19	208	Sumerta Kaja	3	3	0	1	0	1	8
20	209	Sumerta Kelod	4	9	3	3	0	1	20
21	210	Kesiman	0	2	0	0	0	0	2
22	211	Kesiman Petilan	1	2	1	0	0	0	4
23	213	Tonja	1	3	0	2	0	1	7
24	305	Panjer	1	4	1	2	0	1	9
25	306	Sesetan	1	4	1	1	0	0	7
26	308	Pedungan	0	0	0	0	0	0	0
		DENPASAR	72	161	44	43	5	26	351
27	301	Sanur Kaja	1	2	0	1	0	0	4
28	302	Sanur	2	14	3	0	0	2	21
29	303	Sanur Kauh	0	2	0	1	0	0	3
		SANUR	3	18	3	2	0	2	28
		Total	75	179	47	45	5	28	379

Source : JICA

Table D.2.9 Estimation of No. of Medical Institutions in Overall Sewerage Service Area

(Unit : No. of Medical Institutions)

No.	Code No.	Name of Kelurahan/ Desa & Area	1990				2000				2010			
			Hospital	Health Center	Clinic	Total	Hospital	Health Center	Clinic	Total	Hospital	Health Center	Clinic	Total
1	101	Dauh Puri	1	1	0	2	1	1	0	2	1	1	0	2
2	102	Dauh Puri Kaja	2	1	0	3	2	1	0	3	3	1	0	4
3	103	Dauh Puri Kauh	1	1	0	2	1	1	0	2	1	1	0	2
4	104	Dauh Puri Kangin	0	0	0	0	0	0	0	0	0	0	0	0
5	105	Dauh Puri Kelod	3	0	4	7	4	0	6	10	6	0	7	13
6	106	Pemecutan	0	0	1	1	0	0	1	1	0	0	1	1
7	107	Pemecutan Kaja	1	0	0	1	2	1	0	3	2	1	0	3
8	108	Pemecutan Kelod	0	0	0	0	0	0	0	0	0	1	1	2
9	115	Ubung	0	0	0	0	0	0	0	0	0	0	0	0
10	117	Tegal Kerta	0	0	1	1	0	0	1	1	0	0	1	1
11	118	Tegal Harum	0	1	1	2	0	1	1	2	0	1	1	2
12	201	Dangin Puri	0	0	0	0	0	0	0	0	0	0	0	0
13	202	Dangin Puri Kauh	0	0	0	0	0	0	0	0	0	0	0	0
14	203	Dangin Puri Kaja	0	0	1	1	0	0	1	1	0	0	2	2
15	204	Dangin Puri Kangin	1	1	1	3	1	1	1	3	1	1	1	3
16	205	Dangin Puri Kelod	0	1	0	1	0	1	0	1	0	1	0	1
17	206	Sumerta	0	1	0	1	0	1	0	1	0	1	0	1
18	207	Sumerta Kauh	0	0	0	0	0	0	0	0	0	0	0	0
19	208	Sumerta Kaja	0	0	0	0	0	0	0	0	0	0	0	0
20	209	Sumerta Kelod	0	1	0	1	0	1	0	1	0	1	0	1
21	210	Kesiman	0	0	0	0	0	0	0	0	0	0	0	0
22	211	Kesiman Petilan	0	0	0	0	0	0	0	0	0	0	0	0
23	213	Tonja	0	0	0	0	0	0	0	0	0	1	0	1
24	305	Panjer	0	0	1	1	0	0	1	1	0	1	1	2
25	306	Sesetan	0	0	0	0	0	0	0	0	0	0	0	0
26	308	Pedungan	0	0	0	0	0	0	0	0	0	0	0	0
	DENPASAR		9	8	10	27	11	9	12	32	14	12	15	41
27	301	Sanur Kaja	0	0	1	1	0	0	1	1	0	0	1	1
28	302	Sanur	0	1	0	1	0	1	0	1	0	2	0	2
29	303	Sanur Kauh	0	1	0	1	0	1	0	1	0	1	0	1
	SANUR		0	2	1	3	0	2	1	3	0	3	1	4
Total			9	10	11	30	11	11	13	35	14	15	16	45

Source : JICA

Table D.2.10 Estimation of No. of Religious Institutions in Overall Sewerage Service Area

(Unit : No. of Religious Institutions)

No.	Code No.	Name of Kelurahan/ Desa & Area	1990				2000				2010			
			Hindu Temple	Mosque	Church	Total	Hindu Temple	Mosque	Church	Total	Hindu Temple	Mosque	Church	Total
1	101	Dauh Puri	1	3	2	6	1	3	2	6	1	3	2	6
2	102	Dauh Puri Kaja	4	1	1	6	5	1	1	7	6	1	1	8
3	103	Dauh Puri Kauh	11	0	0	11	16	0	0	16	22	0	0	22
4	104	Dauh Puri Kangin	6	1	2	9	7	1	2	10	9	1	3	13
5	105	Dauh Puri Kelod	1	1	3	5	1	1	4	6	2	2	6	10
6	106	Pemecutan	28	2	2	32	35	2	2	39	42	3	3	48
7	107	Pemecutan Kaja	2	0	0	2	2	0	1	3	2	0	1	3
8	108	Pemecutan Kelod	0	0	0	0	0	0	0	0	1	0	1	2
9	115	Ubung	3	0	0	3	4	0	0	4	4	0	0	4
10	117	Tegal Kerta	1	1	1	3	1	1	1	3	1	1	1	3
11	118	Tegal Harum	2	0	1	3	2	0	1	3	2	0	1	3
12	201	Dangin Puri	1	1	5	7	1	1	6	8	1	1	6	8
13	202	Dangin Puri Kauh	3	0	0	3	5	0	0	5	6	0	0	6
14	203	Dangin Puri Kaja	11	0	1	12	15	0	1	16	19	0	2	21
15	204	Dangin Puri Kangin	3	1	0	4	3	1	0	4	4	1	0	5
16	205	Dangin Puri Kelod	12	3	1	16	15	4	1	20	18	4	1	23
17	206	Sumerta	11	0	0	11	12	0	0	12	14	0	0	14
18	207	Sumerta Kauh	11	0	0	11	15	0	0	15	19	0	0	19
19	208	Sumerta Kaja	31	0	0	31	39	0	0	39	46	0	0	46
20	209	Sumerta Kelod	19	0	0	19	24	0	0	24	28	0	0	28
21	210	Kesiman	4	0	0	4	6	0	0	6	7	0	0	7
22	211	Kesiman Petilan	16	0	0	16	19	0	0	19	23	0	0	23
23	213	Tonja	25	0	0	25	31	0	0	31	38	0	0	38
24	305	Panjer	7	0	0	7	9	0	0	9	11	1	0	12
25	306	Sesetan	4	0	0	4	5	1	0	6	6	1	0	7
26	308	Pedungan	2	0	0	2	3	0	0	3	3	0	0	3
		DENPASAR	219	14	19	252	276	16	22	314	335	19	28	382
27	301	Sanur Kaja	6	1	1	8	7	1	1	9	8	1	1	10
28	302	Sanur	12	0	0	12	16	0	0	16	21	0	0	21
29	303	Sanur Kauh	8	0	0	8	8	0	0	8	8	0	0	8
		SANUR	26	1	1	28	31	1	1	33	37	1	1	39
		Total	245	15	20	280	307	17	23	347	372	20	29	421

Source : JICA

Table D.2.11 Estimation of No. of Households in Urgent Conventional Sewerage Service Area

(Unit : Households)

No.	Code No.	Name of Kelurahan/ Desa & Area	1990				2000				2010			
			High	Middle	Low	Total	High	Middle	Low	Total	High	Middle	Low	Total
1	101	Dauh Puri	64	1,151	342	1,557	199	1,079	268	1,546	328	998	203	1,529
2	102	Dauh Puri Kaja	10	213	46	269	47	240	42	329	482	1,542	229	2,253
3	103	Dauh Puri Kauh	1	39	14	54	11	53	15	79	20	67	16	103
4	104	Dauh Puri Kangin	37	598	240	875	147	688	228	1,063	254	796	213	1,263
5	105	Dauh Puri Kelod	112	1,757	604	2,473	532	2,295	632	3,459	942	2,839	668	4,449
6	106	Pemecutan	0	0	0	0	0	0	0	0	0	0	0	0
7	107	Pemecutan Kaja	0	0	0	0	0	0	0	0	0	0	0	0
8	108	Pemecutan Kelod	0	0	0	0	0	0	0	0	0	0	0	0
9	115	Ubung	0	0	0	0	0	0	0	0	0	0	0	0
10	117	Tegal Kerta	0	0	0	0	0	0	0	0	0	0	0	0
11	118	Tegal Harum	0	0	0	0	0	0	0	0	0	0	0	0
12	201	Dangin Puri	95	1,094	403	1,592	252	1,143	335	1,730	423	1,171	277	1,871
13	202	Dangin Puri Kauh	29	361	110	500	133	511	122	766	365	1,034	208	1,607
14	203	Dangin Puri Kaja	24	303	61	388	89	370	61	520	762	2,172	302	3,236
15	204	Dangin Puri Kangin	97	1,109	386	1,592	268	1,165	335	1,768	518	1,434	336	2,288
16	205	Dangin Puri Kelod	74	1,055	120	1,249	257	1,168	113	1,538	437	1,281	102	1,820
17	206	Sumerta	0	0	0	0	0	0	0	0	6	18	10	34
18	207	Sumerta Kauh	35	388	219	642	135	493	227	855	433	1,194	442	2,069
19	208	Sumerta Kaja	0	0	0	0	0	0	0	0	147	416	342	905
20	209	Sumerta Kelod	2	27	24	53	8	34	23	65	14	41	22	77
21	210	Kesiman	0	0	0	0	0	0	0	0	0	0	0	0
22	211	Kesiman Petilan	0	0	0	0	0	0	0	0	0	0	0	0
23	213	Tonja	0	28	55	83	8	42	52	102	37	132	118	287
24	305	Panjer	1	29	49	79	8	41	46	95	15	53	43	111
25	306	Sesetan	5	131	155	291	35	173	146	354	65	216	137	418
26	308	Pedungan	0	0	0	0	0	0	0	0	0	0	0	0
	DENPASAR		586	8,283	2,828	11,697	2,129	9,495	2,645	14,269	5,248	15,404	3,668	24,320
27	301	Sanur Kaja	14	159	184	357	52	211	175	438	90	261	162	513
28	302	Sanur	41	468	601	1,110	178	696	614	1,488	321	920	625	1,866
29	303	Sanur Kauh	3	47	56	106	10	53	47	110	18	56	37	111
	SANUR		58	674	841	1,573	240	960	836	2,036	429	1,237	824	2,490
Total			644	8,957	3,669	13,270	2,369	10,455	3,481	16,305	5,677	16,641	4,492	26,810

Source : JICA

Table D.2.12 Estimation of No. of Hotel Rooms in Urgent Conventional Sewerage Service Area

(Unit : Rooms)

No.	Code No.	Name of Kelurahan/ Desa & Area	1990			2000			2010		
			Classified Hotels	Non-Classified Hotels and Other Accommodations	Total	Classified Hotels	Non-Classified Hotels and Other Accommodations	Total	Classified Hotels	Non-Classified Hotels and Other Accommodations	Total
1	101	Dauh Puri	0	179	179	0	186	186	0	192	192
2	102	Dauh Puri Kaja	0	6	6	0	11	11	0	83	83
3	103	Dauh Puri Kauh	0	0	0	0	0	0	0	0	0
4	104	Dauh Puri Kangin	0	62	62	0	91	91	0	120	120
5	105	Dauh Puri Kelod	0	258	258	0	330	330	0	403	403
6	106	Pemecutan	0	0	0	0	0	0	0	0	0
7	107	Pemecutan Kaja	0	0	0	0	0	0	0	0	0
8	108	Pemecutan Kelod	0	0	0	0	0	0	0	0	0
9	115	Ubung	0	0	0	0	0	0	0	0	0
10	117	Tegal Kerta	0	0	0	0	0	0	0	0	0
11	118	Tegal Harum	0	0	0	0	0	0	0	0	0
12	201	Dangin Puri	0	114	114	0	114	114	0	114	114
13	202	Dangin Puri Kauh	75	0	75	75	23	98	75	77	152
14	203	Dangin Puri Kaja	0	35	35	0	35	35	0	172	172
15	204	Dangin Puri Kangin	0	51	51	0	82	82	0	132	132
16	205	Dangin Puri Kelod	0	21	21	0	21	21	0	21	21
17	206	Sumerta	0	0	0	0	0	0	0	0	0
18	207	Sumerta Kauh	0	0	0	0	0	0	0	0	0
19	208	Sumerta Kaja	0	0	0	0	0	0	0	28	28
20	209	Sumerta Kelod	0	0	0	0	0	0	0	0	0
21	210	Kesiman	0	0	0	0	0	0	0	0	0
22	211	Kesiman Petilan	0	0	0	0	0	0	0	0	0
23	213	Tonja	0	0	0	0	0	0	0	0	0
24	305	Panjer	0	0	0	0	0	0	0	0	0
25	306	Sesetan	0	0	0	0	0	0	0	0	0
26	308	Pedungan	0	0	0	0	0	0	0	0	0
		DENPASAR	75	726	801	75	893	968	75	1,342	1,417
27	301	Sanur Kaja	649	141	790	1,385	301	1,686	2,120	461	2,581
28	302	Sanur	1,616	665	2,281	2,458	1,012	3,470	3,300	1,358	4,658
29	303	Sanur Kauh	0	74	74	340	113	453	680	151	831
		SANUR	2,265	880	3,145	4,183	1,426	5,609	6,100	1,970	8,070
		Total	2,340	1,606	3,946	4,258	2,319	6,577	6,175	3,312	9,487

Source : JICA

Table D.2.13 Estimation of No. of Restaurant Seats in Urgent Conventional Sewerage Service Area

(Unit : No. of Restaurant Seats)

No.	Code No.	Name of Kelurahan/ Desa & Area	1990				2000				2010			
			Large	Medium	Small	Total	Large	Medium	Small	Total	Large	Medium	Small	Total
1	101	Dauh Puri	0	504	247	751	0	513	251	764	0	522	255	777
2	102	Dauh Puri Kaja	0	0	0	0	0	0	0	0	0	0	13	13
3	103	Dauh Puri Kauh	0	0	18	18	0	0	18	18	0	0	18	18
4	104	Dauh Puri Kangin	0	242	147	389	0	247	150	397	0	251	153	404
5	105	Dauh Puri Kelod	112	206	65	383	120	220	70	410	128	235	75	438
6	106	Pemecutan	0	0	0	0	0	0	0	0	0	0	0	0
7	107	Pemecutan Kaja	0	0	0	0	0	0	0	0	0	0	0	0
8	108	Pemecutan Kelod	0	0	0	0	0	0	0	0	0	0	0	0
9	115	Ubung	0	0	0	0	0	0	0	0	0	0	0	0
10	117	Tegal Kerta	0	0	0	0	0	0	0	0	0	0	0	0
11	118	Tegal Harum	0	0	0	0	0	0	0	0	0	0	0	0
12	201	Dangin Puri	0	0	0	0	0	0	0	0	0	0	0	0
13	202	Dangin Puri Kauh	0	0	143	143	0	0	147	147	0	0	237	237
14	203	Dangin Puri Kaja	0	0	0	0	0	0	0	0	0	0	10	10
15	204	Dangin Puri Kangin	0	0	39	39	0	0	47	47	0	0	63	63
16	205	Dangin Puri Kelod	0	0	18	18	0	0	18	18	0	0	18	18
17	206	Sumerta	0	0	0	0	0	0	0	0	0	0	0	0
18	207	Sumerta Kauh	0	0	26	26	0	0	26	26	0	50	0	50
19	208	Sumerta Kaja	0	0	0	0	0	0	0	0	0	0	51	51
20	209	Sumerta Kelod	0	0	0	0	0	0	0	0	0	0	0	0
21	210	Kesiman	0	0	0	0	0	0	0	0	0	0	0	0
22	211	Kesiman Petilan	0	0	0	0	0	0	0	0	0	0	0	0
23	213	Tonja	0	0	0	0	0	0	0	0	0	0	0	0
24	305	Panjer	0	0	0	0	0	0	0	0	0	0	0	0
25	306	Sesetan	0	0	8	8	0	0	8	8	0	0	8	8
26	308	Pedungan	0	0	0	0	0	0	0	0	0	0	0	0
	DENPASAR		112	952	711	1,775	120	980	735	1,835	128	1,058	901	2,087
27	301	Sanur Kaja	348	91	95	534	439	116	120	675	531	140	145	816
28	302	Sanur	1,859	1,409	630	3,898	2,086	1,582	707	4,375	2,314	1,754	784	4,852
29	303	Sanur Kauh	0	0	0	0	0	61	28	89	0	121	56	177
	SANUR		2,207	1,500	725	4,432	2,525	1,759	855	5,139	2,845	2,015	985	5,845
Total			2,319	2,452	1,436	6,207	2,645	2,739	1,590	6,974	2,973	3,073	1,886	7,932

Source : JICA

Table D.2.14 Estimation of No. of Shops
in Urgent Conventional Sewerage Service Area

(Unit : No. of Shops)

No.	Code No.	Name of Kelurahan/ Desa & Area	1990				2000				2010			
			Large	Medium	Small	Total	Large	Medium	Small	Total	Large	Medium	Small	Total
1	101	Dauh Puri	2	58	25	85	2	59	25	86	2	58	25	85
2	102	Dauh Puri Kaja	0	3	19	22	0	4	23	27	0	24	161	185
3	103	Dauh Puri Kauh	0	0	1	1	0	0	2	2	0	0	2	2
4	104	Dauh Puri Kangin	1	4	179	184	1	5	217	223	1	6	265	272
5	105	Dauh Puri Kelod	3	19	119	141	4	27	169	200	5	35	219	259
6	106	Pemecutan	0	0	0	0	0	0	0	0	0	0	0	0
7	107	Pemecutan Kaja	0	0	0	0	0	0	0	0	0	0	0	0
8	108	Pemecutan Kelod	0	0	0	0	0	0	0	0	0	0	0	0
9	115	Ubung	0	0	0	0	0	0	0	0	0	0	0	0
10	117	Tegal Kerta	0	0	0	0	0	0	0	0	0	0	0	0
11	118	Tegal Harum	0	0	0	0	0	0	0	0	0	0	0	0
12	201	Dangin Puri	0	3	11	14	0	3	12	15	0	3	13	16
13	202	Dangin Puri Kauh	0	1	10	11	0	2	15	17	0	4	31	35
14	203	Dangin Puri Kaja	0	2	14	16	0	3	19	22	0	17	116	133
15	204	Dangin Puri Kangin	0	23	11	34	0	26	12	38	0	34	16	50
16	205	Dangin Puri Kelod	0	1	32	33	0	1	40	41	0	2	47	49
17	206	Sumerta	0	0	0	0	0	0	0	0	0	0	0	0
18	207	Sumerta Kauh	0	1	4	5	0	1	5	6	0	3	13	16
19	208	Sumerta Kaja	0	0	0	0	0	0	0	0	0	12	53	65
20	209	Sumerta Kelod	0	0	1	1	0	0	1	1	0	0	1	1
21	210	Kesiman	0	0	0	0	0	0	0	0	0	0	0	0
22	211	Kesiman Petilan	0	0	0	0	0	0	0	0	0	0	0	0
23	213	Tonja	0	0	5	5	0	0	6	6	0	0	16	16
24	305	Panjer	0	0	1	1	0	0	2	2	0	0	2	2
25	306	Sesetan	0	0	2	2	0	0	2	2	0	0	3	3
26	308	Pedungan	0	0	0	0	0	0	0	0	0	0	0	0
	DENPASAR		6	115	434	555	7	131	550	688	8	198	983	1,189
27	301	Sanur Kaja	0	1	79	80	0	1	117	118	0	2	155	157
28	302	Sanur	1	42	41	84	2	68	66	136	2	94	91	187
29	303	Sanur Kauh	0	4	17	21	0	5	22	27	0	6	26	32
	SANUR		1	47	137	185	2	74	205	281	2	102	272	376
Total			7	162	571	740	9	205	755	969	10	300	1,255	1,565

Source : JICA

Table D.2.15 Estimation of No. of Factories
in Urgent Conventional Sewerage Service Area

(Unit : No. of Factories)

No.	Code No.	Name of Kelurahan/ Desa & Area	1990				2000				2010			
			Large	Medium	Small	Total	Large	Medium	Small	Total	Large	Medium	Small	Total
1	101	Dauh Puri	1	1	0	2	1	1	0	2	2	2	0	4
2	102	Dauh Puri Kaja	0	0	0	0	0	0	0	0	0	0	0	0
3	103	Dauh Puri Kauh	0	0	0	0	0	0	1	1	0	0	1	1
4	104	Dauh Puri Kangin	0	0	0	0	0	0	0	0	0	0	0	0
5	105	Dauh Puri Kelod	1	5	14	20	2	8	23	33	2	11	32	45
6	106	Pemecutan	0	0	0	0	0	0	0	0	0	0	0	0
7	107	Pemecutan Kaja	0	0	0	0	0	0	0	0	0	0	0	0
8	108	Pemecutan Kelod	0	0	0	0	0	0	0	0	0	0	0	0
9	115	Ubung	0	0	0	0	0	0	0	0	0	0	0	0
10	117	Tegal Kerta	0	0	0	0	0	0	0	0	0	0	0	0
11	118	Tegal Harum	0	0	0	0	0	0	0	0	0	0	0	0
12	201	Dangin Puri	0	0	0	0	0	0	0	0	0	0	0	0
13	202	Dangin Puri Kauh	0	0	0	0	0	0	0	0	0	0	0	0
14	203	Dangin Puri Kaja	0	1	1	2	0	1	2	3	0	9	13	22
15	204	Dangin Puri Kangin	1	2	1	4	1	3	1	5	2	4	2	8
16	205	Dangin Puri Kelod	0	0	0	0	0	0	0	0	0	0	0	0
17	206	Sumerta	0	0	0	0	0	0	0	0	0	0	1	1
18	207	Sumerta Kauh	0	0	0	0	0	0	0	0	0	0	0	0
19	208	Sumerta Kaja	0	0	0	0	0	0	0	0	0	6	11	17
20	209	Sumerta Kelod	0	0	0	0	0	0	0	0	0	0	0	0
21	210	Kesiman	0	0	0	0	0	0	0	0	0	0	0	0
22	211	Kesiman Petilan	0	0	0	0	0	0	0	0	0	0	0	0
23	213	Tonja	0	0	0	0	0	0	0	0	0	0	0	0
24	305	Panjer	0	0	0	0	0	0	0	0	0	0	0	0
25	306	Sesetan	0	1	1	2	0	1	1	2	0	2	2	4
26	308	Pedungan	0	0	0	0	0	0	0	0	0	0	0	0
		DENPASAR	3	10	17	30	4	14	28	46	6	34	62	102
27	301	Sanur Kaja	0	1	5	6	0	1	7	8	0	1	10	11
28	302	Sanur	1	7	15	23	1	11	24	36	1	15	33	49
29	303	Sanur Kauh	0	1	1	2	0	1	1	2	0	1	2	3
		SANUR	1	9	21	31	1	13	32	46	1	17	45	63
		Total	4	19	38	61	5	27	60	92	7	51	107	165

Source : JICA

Table D.2.16 Estimation of No. of Offices
in Urgent Conventional Sewerage Service Area

(Unit : No. of Offices)

No.	Code No.	Name of Kelurahan/ Desa & Area	1990				2000				2010			
			Bank	Other Offices		Total	Bank	Other Offices		Total	Bank	Other Offices		Total
				Private	Gov't			Private	Gov't			Private	Gov't	
1	101	Dauh Puri	8	12	10	30	8	12	10	30	8	12	10	30
2	102	Dauh Puri Kaja	1	2	5	8	1	2	6	9	10	15	39	64
3	103	Dauh Puri Kauh	0	0	0	0	0	0	0	0	0	0	0	0
4	104	Dauh Puri Kangin	8	2	11	21	9	2	14	25	11	3	17	31
5	105	Dauh Puri Kelod	8	201	9	218	11	286	13	310	14	370	17	401
6	106	Pemecutan	0	0	0	0	0	0	0	0	0	0	0	0
7	107	Pemecutan Kaja	0	0	0	0	0	0	0	0	0	0	0	0
8	108	Pemecutan Kelod	0	0	0	0	0	0	0	0	0	0	0	0
9	115	Ubung	0	0	0	0	0	0	0	0	0	0	0	0
10	117	Tegal Kerta	0	0	0	0	0	0	0	0	0	0	0	0
11	118	Tegal Harum	0	0	0	0	0	0	0	0	0	0	0	0
12	201	Dangin Puri	2	2	8	12	2	2	9	13	2	2	9	13
13	202	Dangin Puri Kauh	3	6	1	10	4	10	1	15	8	21	3	32
14	203	Dangin Puri Kaja	0	1	0	1	1	1	0	2	3	7	0	10
15	204	Dangin Puri Kangin	14	20	9	43	15	23	10	48	20	30	13	63
16	205	Dangin Puri Kelod	0	2	10	12	0	3	13	16	0	4	15	19
17	206	Sumerta	0	0	0	0	0	0	0	0	0	0	0	0
18	207	Sumerta Kauh	0	0	1	1	0	0	1	1	0	0	2	2
19	208	Sumerta Kaja	0	0	0	0	0	0	0	0	3	1	4	8
20	209	Sumerta Kelod	0	0	1	1	0	0	1	1	0	0	1	1
21	210	Kesiman	0	0	0	0	0	0	0	0	0	0	0	0
22	211	Kesiman Petilan	0	0	0	0	0	0	0	0	0	0	0	0
23	213	Tonja	0	0	0	0	0	0	0	0	0	0	0	0
24	305	Panjer	0	0	0	0	0	0	0	0	0	0	0	0
25	306	Sesetan	0	1	1	2	0	1	1	2	0	1	2	3
26	308	Pedungan	0	0	0	0	0	0	0	0	0	0	0	0
		DENPASAR	44	249	66	359	51	342	79	472	79	466	132	677
27	301	Sanur Kaja	3	2	0	5	5	2	0	7	7	3	1	11
28	302	Sanur	10	0	3	13	18	0	4	22	25	0	5	30
29	303	Sanur Kauh	0	1	0	1	0	1	0	1	0	1	0	1
		SANUR	13	3	3	19	23	3	4	30	32	4	6	42
		Total	57	252	69	378	74	345	83	502	111	470	138	719

Source : JICA

Table D.2.17(1) Estimation of No. of Educational Institutions in Urgent Conventional Sewerage Service Area

(Unit : No. of Educational Institutions)

No.	Code No.	Name of Kelurahan/ Desa & Area	1990							2000						
			Kinder-garten	Primary School	Junior High School	Senior High School	Religious School	College/ Univ.	Total	Kinder-garten	Primary School	Junior High School	Senior High School	Religious School	College/ Univ.	Total
1	101	Dauh Puri	1	1	0	0	0	2	4	1	1	0	0	0	3	5
2	102	Dauh Puri Kaja	0	1	0	0	0	0	1	1	1	1	0	0	0	3
3	103	Dauh Puri Kauh	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	104	Dauh Puri Kangin	1	0	0	0	1	0	2	1	0	0	0	1	0	2
5	105	Dauh Puri Kelod	8	11	3	3	0	1	26	11	15	4	4	0	1	35
6	106	Pemecutan	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	107	Pemecutan Kaja	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	108	Pemecutan Kelod	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	115	Ubung	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	117	Tegal Kerta	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	118	Tegal Harum	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	201	Dangin Puri	3	11	3	1	0	0	18	3	12	3	1	0	0	19
13	202	Dangin Puri Kauh	1	1	0	0	0	1	3	1	1	0	0	0	1	3
14	203	Dangin Puri Kaja	1	2	0	0	0	0	3	1	2	0	1	0	0	4
15	204	Dangin Puri Kangin	5	12	8	7	0	3	35	6	13	9	8	0	3	39
16	205	Dangin Puri Kelod	1	2	1	1	1	0	6	1	3	1	1	1	0	7
17	206	Sumerta	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	207	Sumerta Kauh	0	1	0	1	0	0	2	0	1	0	1	0	0	2
19	208	Sumerta Kaja	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	209	Sumerta Kelod	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	210	Kesiman	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	211	Kesiman Petilan	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	213	Tonja	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	305	Panjer	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	306	Sesetan	0	1	0	0	0	0	1	0	1	0	0	0	0	1
26	308	Pedungan	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		DENPASAR	21	43	15	13	2	7	101	26	50	18	16	2	8	120
27	301	Sanur Kaja	0	1	0	0	0	0	1	0	1	0	0	0	0	1
28	302	Sanur	1	4	1	0	0	1	7	1	6	2	0	0	1	10
29	303	Sanur Kauh	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		SANUR	1	5	1	0	0	1	8	1	7	2	0	0	1	11
		Total	22	48	16	13	2	8	109	27	57	20	16	2	9	131

Source : JICA

Table D.2.17(2) Estimation of No. of Educational Institutions in Urgent Conventional Sewerage Service Area

(Unit : No. of Educational Institutions)

No.	Code No.	Name of Kelurahan/ Desa & Area	2010						
			Kinder-garten	Primary School	Junior High School	Senior High School	Religious School	College/ University	Total
1	101	Dauh Puri	1	1	0	0	0	2	4
2	102	Dauh Puri Kaja	4	9	4	3	3	1	24
3	103	Dauh Puri Kauh	0	0	0	0	0	0	0
4	104	Dauh Puri Kangin	1	0	0	0	1	0	2
5	105	Dauh Puri Kelod	14	19	5	5	0	2	45
6	106	Pemecutan	0	0	0	0	0	0	0
7	107	Pemecutan Kaja	0	0	0	0	0	0	0
8	108	Pemecutan Kelod	0	0	0	0	0	0	0
9	115	Ubung	0	0	0	0	0	0	0
10	117	Tegal Kerta	0	0	0	0	0	0	0
11	118	Tegal Harum	0	0	0	0	0	0	0
12	201	Dangin Puri	3	13	3	1	0	0	20
13	202	Dangin Puri Kauh	2	2	0	0	0	2	6
14	203	Dangin Puri Kaja	5	14	2	3	0	2	26
15	204	Dangin Puri Kangin	7	17	11	10	0	4	49
16	205	Dangin Puri Kelod	1	4	1	1	1	0	8
17	206	Sumerta	0	0	0	0	0	0	0
18	207	Sumerta Kauh	0	3	0	2	0	0	5
19	208	Sumerta Kaja	1	1	0	1	0	1	4
20	209	Sumerta Kelod	0	0	0	0	0	0	0
21	210	Kesiman	0	0	0	0	0	0	0
22	211	Kesiman Petilan	0	0	0	0	0	0	0
23	213	Tonja	0	1	0	1	0	0	2
24	305	Panjer	0	0	0	0	0	0	0
25	306	Sesetan	0	1	0	0	0	0	1
26	308	Pedungan	0	0	0	0	0	0	0
		DENPASAR	39	85	26	27	5	14	196
27	301	Sanur Kaja	0	1	0	0	0	0	1
28	302	Sanur	1	8	2	0		1	12
29	303	Sanur Kauh	0	0	0	0	0	0	0
		SANUR	1	9	2	0	0	1	13
		Total	40	94	28	27	5	15	209

Source : JICA

Table D.2.18 Estimation of No. of Medical Institutions in Urgent Conventional Sewerage Service Area

(Unit : No. of Medical Institutions)

No.	Code No.	Name of Kelurahan/ Desa & Area	1990				2000				2010			
			Hospital	Health Center	Clinic	Total	Hospital	Health Center	Clinic	Total	Hospital	Health Center	Clinic	Total
1	101	Dauh Puri	1	1	0	2	1	1	0	2	1	1	0	2
2	102	Dauh Puri Kaja	0	0	0	0	0	0	0	0	3	1	0	4
3	103	Dauh Puri Kauh	0	0	0	0	0	0	0	0	0	0	0	0
4	104	Dauh Puri Kangin	0	0	0	0	0	0	0	0	0	0	0	0
5	105	Dauh Puri Kelod	3	0	4	7	4	0	5	9	5	0	7	12
6	106	Pemecutan	0	0	0	0	0	0	0	0	0	0	0	0
7	107	Pemecutan Kaja	0	0	0	0	0	0	0	0	0	0	0	0
8	108	Pemecutan Kelod	0	0	0	0	0	0	0	0	0	0	0	0
9	115	Ubung	0	0	0	0	0	0	0	0	0	0	0	0
10	117	Tegal Kerta	0	0	0	0	0	0	0	0	0	0	0	0
11	118	Tegal Harum	0	0	0	0	0	0	0	0	0	0	0	0
12	201	Dangin Puri	0	0	0	0	0	0	0	0	0	0	0	0
13	202	Dangin Puri Kauh	0	0	0	0	0	0	0	0	0	0	0	0
14	203	Dangin Puri Kaja	0	0	0	0	0	0	0	0	0	0	2	2
15	204	Dangin Puri Kangin	1	1	1	3	1	1	1	3	1	1	1	3
16	205	Dangin Puri Kelod	0	1	0	1	0	1	0	1	0	1	0	1
17	206	Sumerta	0	0	0	0	0	0	0	0	0	0	0	0
18	207	Sumerta Kauh	0	0	0	0	0	0	0	0	0	0	0	0
19	208	Sumerta Kaja	0	0	0	0	0	0	0	0	0	0	0	0
20	209	Sumerta Kelod	0	0	0	0	0	0	0	0	0	0	0	0
21	210	Kesiman	0	0	0	0	0	0	0	0	0	0	0	0
22	211	Kesiman Petilan	0	0	0	0	0	0	0	0	0	0	0	0
23	213	Tonja	0	0	0	0	0	0	0	0	0	0	0	0
24	305	Panjer	0	0	0	0	0	0	0	0	0	0	0	0
25	306	Sesetan	0	0	0	0	0	0	0	0	0	0	0	0
26	308	Pedungan	0	0	0	0	0	0	0	0	0	0	0	0
	DENPASAR		5	3	5	13	6	3	6	15	10	4	10	24
27	301	Sanur Kaja	0	0	0	0	0	0	0	0	0	0	0	0
28	302	Sanur	0	1	0	1	0	1	0	1	0	1	0	1
29	303	Sanur Kauh	0	0	0	0	0	0	0	0	0	0	0	0
	SANUR		0	1	0	1	0	1	0	1	0	1	0	1
Total			5	4	5	14	6	4	6	16	10	5	10	25

Source : JICA

Table D.2.19 Estimation of No. of Religious Institutions in Urgent Conventional Sewerage Service Area

(Unit : No. of Religious Institutions)

No.	Code No.	Name of Kelurahan/ Desa & Area	1990				2000				2010			
			Hindu Temple	Mosque	Church	Total	Hindu Temple	Mosque	Church	Total	Hindu Temple	Mosque	Church	Total
1	101	Dauh Puri	1	2	2	5	1	3	2	6	1	2	2	5
2	102	Dauh Puri Kaja	1	0	0	1	1	0	0	1	6	1	1	8
3	103	Dauh Puri Kauh	0	0	0	0	1	0	0	1	1	0	0	1
4	104	Dauh Puri Kangin	6	1	2	9	7	1	2	10	8	1	3	12
5	105	Dauh Puri Kelod	1	1	3	5	1	1	4	6	2	2	5	9
6	106	Pemecutan	0	0	0	0	0	0	0	0	0	0	0	0
7	107	Pemecutan Kaja	0	0	0	0	0	0	0	0	0	0	0	0
8	108	Pemecutan Kelod	0	0	0	0	0	0	0	0	0	0	0	0
9	115	Ubung	0	0	0	0	0	0	0	0	0	0	0	0
10	117	Tegal Kerta	0	0	0	0	0	0	0	0	0	0	0	0
11	118	Tegal Harum	0	0	0	0	0	0	0	0	0	0	0	0
12	201	Dangin Puri	1	1	5	7	1	1	5	7	1	1	6	8
13	202	Dangin Puri Kauh	2	0	0	2	3	0	0	3	6	0	0	6
14	203	Dangin Puri Kaja	2	0	0	2	3	0	0	3	19	0	2	21
15	204	Dangin Puri Kangin	3	1	0	4	3	1	0	4	4	1	0	5
16	205	Dangin Puri Kelod	7	2	1	10	9	2	1	12	11	3	1	15
17	206	Sumerta	0	0	0	0	0	0	0	0	0	0	0	0
18	207	Sumerta Kauh	6	0	0	6	7	0	0	7	18	0	0	18
19	208	Sumerta Kaja	0	0	0	0	0	0	0	0	21	0	0	21
20	209	Sumerta Kelod	1	0	0	1	1	0	0	1	1	0	0	1
21	210	Kesiman	0	0	0	0	0	0	0	0	0	0	0	0
22	211	Kesiman Petilan	0	0	0	0	0	0	0	0	0	0	0	0
23	213	Tonja	3	0	0	3	4	0	0	4	12	0	0	12
24	305	Panjer	1	0	0	1	1	0	0	1	1	0	0	1
25	306	Sesetan	1	0	0	1	2	0	0	2	2	0	0	2
26	308	Pedungan	0	0	0	0	0	0	0	0	0	0	0	0
		DENPASAR	36	8	13	57	45	9	14	68	114	11	20	145
27	301	Sanur Kaja	3	0	0	3	4	0	0	4	5	0	0	5
28	302	Sanur	7	0	0	7	9	0	0	9	12	0	0	12
29	303	Sanur Kauh	1	0	0	1	1	0	0	1	1	0	0	1
		SANUR	11	0	0	11	14	0	0	14	18	0	0	18
		Total	47	8	13	68	59	9	14	82	132	11	20	163

Source : JICA

Table D.2.20 Estimation of No. of Households in Urgent Interceptor Sewerage Service Area

(Unit : Households)

Code No.	Name of Keluraham/Desa	1990				2000			
		High	Middle	Low	Total	High	Middle	Low	Total
102	Dauh Puri Kaja	48	1,021	219	1,288	228	1,151	203	1,582
202	Dangin Puri Kauh	17	207	63	287	76	294	70	440
203	Dangin Puri Kaja	97	1,207	242	1,546	355	1,475	241	2,071
204	Dangin Puri Kangin	17	190	66	273	46	200	57	303
206	Sumerta	1	14	13	28	3	16	12	31
207	Sumerta Kauh	32	357	201	590	124	453	209	786
208	Sumerta Kaja	19	230	379	628	82	324	363	769
213	Tonja	0	39	76	115	11	58	72	141
Total		231	3,265	1,259	4,755	925	3,971	1,227	6,123

Source: JICA

Table D.2.21 Estimation of No. of Hotel Rooms in Urgent Interceptor Sewerage Service Area

(Unit : Rooms)

Code No.	Name of Keluraham/Desa	1990			2000		
		Classified	Non-classified	Total	Classified	Non-classified	Total
102	Dauh Puri Kaja	0	22	22	0	43	43
202	Dangin Puri Kauh	0	0	0	0	16	16
203	Dangin Puri Kaja	0	137	137	0	137	137
204	Dangin Puri Kangin	0	9	9	0	14	14
206	Sumerta	0	0	0	0	0	0
207	Sumerta Kauh	0	0	0	0	0	0
208	Sumerta Kaja	0	22	22	0	25	25
213	Tonja	0	0	0	0	0	0
Total		0	190	190	0	235	235

Source: JICA

Table D.2.22 Estimation of No. of Restaurant Seats in Urgent Interceptor Sewerage Service Area

(Unit : No. of Restaurant Seats)

Code No.	Name of Keluraham/Desa	1990				2000			
		Large	Medium	Small	Total	Large	Medium	Small	Total
102	Dauh Puri Kaja	0	0	0	0	0	0	13	13
202	Dangin Puri Kauh	0	0	82	82	0	0	84	84
203	Dangin Puri Kaja	0	0	0	0	0	0	10	10
204	Dangin Puri Kangin	0	0	7	7	0	0	8	8
206	Sumerta	0	0	0	0	0	0	0	0
207	Sumerta Kauh	0	0	24	24	0	0	24	24
208	Sumerta Kaja	0	0	51	51	0	0	51	51
213	Tonja	0	0	0	0	0	0	0	0
Total		0	0	164	164	0	0	190	190

Source: JICA

Table D.2.23 Estimation of No. of Shops
in Urgent Interceptor Sewerage Service Area

(Unit : No. of Shops)

Code No.	Name of Keluraham/Desa	1990				2000			
		Large	Medium	Small	Total	Large	Medium	Small	Total
102	Dauh Puri Kaja	0	14	90	104	0	17	112	129
202	Dangin Puri Kauh	0	1	5	6	0	1	9	10
203	Dangin Puri Kaja	0	8	54	62	0	11	74	85
204	Dangin Puri Kangin	0	4	2	6	0	4	2	6
206	Sumerta	0	0	0	0	0	0	0	0
207	Sumerta Kauh	0	1	4	5	0	1	5	6
208	Sumerta Kaja	0	8	35	43	0	10	44	54
213	Tonja	0	0	6	6	0	0	8	8
Total		0	36	196	232	0	44	254	298

Source: JICA

Table D.2.24 Estimation of No. of Factories
in Urgent Interceptor Sewerage Service Area

(Unit : No. of Factories)

Code No.	Name of Keluraham/Desa	1990				2000			
		Large	Medium	Small	Total	Large	Medium	Small	Total
102	Dauh Puri Kaja	0	0	0	0	0	0	0	0
202	Dangin Puri Kauh	0	0	0	0	0	0	0	0
203	Dangin Puri Kaja	0	3	5	8	0	5	8	13
204	Dangin Puri Kangin	0	0	0	0	0	0	0	0
206	Sumerta	0	0	0	0	0	0	0	0
207	Sumerta Kauh	0	0	0	0	0	0	0	0
208	Sumerta Kaja	0	3	5	8	0	4	8	12
213	Tonja	0	0	0	0	0	0	0	0
Total		0	6	10	16	0	9	16	25

Source: JICA

Table D.2.25 Estimation of No. of Offices
in Urgent Interceptor Sewerage Service Area

(Unit : No. of Offices)

Code No.	Name of Keluraham/Desa	1990				2000			
		Bank	Other Offices		Total	Bank	Other Offices		Total
			Private	Gov't			Private	Gov't	
102	Dauh Puri Kaja	6	9	22	37	7	11	27	45
202	Dangin Puri Kauh	1	4	0	5	2	6	1	9
203	Dangin Puri Kaja	2	3	0	5	2	4	0	6
204	Dangin Puri Kangin	2	3	2	7	3	4	2	9
206	Sumerta	0	0	0	0	0	0	0	0
207	Sumerta Kauh	0	0	1	1	0	0	1	1
208	Sumerta Kaja	2	1	3	6	2	1	4	7
213	Tonja	0	0	0	0	0	0	0	0
Total		13	20	28	61	16	26	35	77

Source: JICA

Table D.2.26 Estimation of No. of Educational Institutions in Urgent Interceptor Sewerage Service Area

(Unit : No. of Educational Institutions)

Code No.	Name of Keluraham/Desa	1990							2000						
		Kinder-garden	Pri-mary School	Junior High School	Senior High School	Reli-gious School	College /Univ.	Total	Kinder-garden	Pri-mary School	Junior High School	Senior High School	Reli-gious School	College /Univ.	Total
102	Dauh Puri Kaja	2	5	2	1	1	1	12	3	6	3	2	2	1	17
202	Dangin Puri Kauh	0	0	0	0	0	0	0	1	1	0	0	0	1	3
203	Dangin Puri Kaja	2	6	1	2	0	1	12	3	9	1	2	0	1	16
204	Dangin Puri Kangin	1	2	1	1	0	0	5	1	2	1	1	0	0	5
206	Sumerta	0	0	0	0	0	0	0	0	0	0	0	0	0	0
207	Sumerta Kauh	0	1	0	0	0	0	1	0	1	0	1	0	0	2
208	Sumerta Kaja	1	1	0	0	0	0	2	1	1	0	1	0	1	4
213	Tonja	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		6	15	4	4	1	2	32	9	20	5	7	2	4	47

Source: JICA

Table D.2.27 Estimation of No. of Medical Institutions in Urgent Interceptor Sewerage Service Area

(Unit : No. of Medical Institutions)

Code No.	Name of Keluraham/Desa	1990				2000			
		Hospital	Health Center	Clinic	Total	Hospital	Health Center	Clinic	Total
102	Dauh Puri Kaja	1	1	0	2	2	1	0	3
202	Dangin Puri Kauh	0	0	0	0	0	0	0	0
203	Dangin Puri Kaja	0	0	1	1	0	0	1	1
204	Dangin Puri Kangin	0	0	0	0	0	0	0	0
206	Sumerta	0	0	0	0	0	0	0	0
207	Sumerta Kauh	0	0	0	0	0	0	0	0
208	Sumerta Kaja	0	0	0	0	0	0	0	0
213	Tonja	0	0	0	0	0	0	0	0
Total		1	1	1	3	2	1	1	4

Source: JICA

Table D.2.28 Estimation of No. of Religious Institutions in Urgent Interceptor Sewerage Service Area

(Unit : No. of Religious Institutions)

Code No.	Name of Keluraham/Desa	1990				2000			
		Hindu Temple	Mosque	Church	Total	Hindu Temple	Mosque	Church	Total
102	Dauh Puri Kaja	4	1	1	6	4	1	1	6
202	Dangin Puri Kauh	1	0	0	1	2	0	0	2
203	Dangin Puri Kaja	9	0	1	10	12	0	1	13
204	Dangin Puri Kangin	0	0	0	0	0	0	0	0
206	Sumerta	0	0	0	0	0	0	0	0
207	Sumerta Kauh	5	0	0	5	7	0	0	7
208	Sumerta Kaja	14	0	0	14	18	0	0	18
213	Tonja	5	0	0	5	6	0	0	6
Total		38	1	2	41	49	1	2	52

Source: JICA

Table D.4.1 Ratio of Tourists Who Would Not Revisit

(Unit : %)

Item		Those who would not revisit Bali if sea water deteriorated	Those who would revisit Bali even if sea water deteriorated
Nationality	Australia	65.6	34.4
	Other Nationalities	64.6	35.4
Age	< 30	73.5	26.5
	30 ≤	59.0	41.0
Sex	Male	66.1	33.9
	Female	63.6	36.4
Marriage Status	Single	72.9	27.1
	Married	56.9	43.1
Purpose of Visit	Other than Holiday	80.0	20.0
	Holiday	63.0	37.0
Frequency of Visits	2nd Visit or More	65.1	34.9
	1st Visit	63.8	36.2
Total Average		64.9	35.1

Source : JICA

Table D.4.2 Projection of No. of Tourists to Stay in the F/S Area by Class of Accommodations

(Unit : No. of Tourists)

Year	Classified Hotels			Non-Classified Hotels & Other Accommodations			Total
	International Tourists	Domestic Tourists	Sub-Total	International Tourists	Domestic Tourists	Sub-Total	
1990	133,104	37,571	170,675	25,305	260,142	285,447	456,122
1991	149,244	41,398	190,642	28,697	286,011	314,708	505,350
1992	166,943	45,540	212,483	32,402	312,131	344,533	557,016
1993	185,282	49,693	234,975	36,274	338,277	374,551	609,526
1994	204,245	53,845	258,090	40,310	364,425	404,735	662,825
1995	223,821	57,987	281,808	44,506	390,555	435,061	716,869
1996	243,999	62,111	306,110	48,859	416,647	465,506	771,616
1997	264,768	66,206	330,974	53,367	442,684	496,051	827,025
1998	286,121	70,267	356,388	58,026	468,653	526,679	883,067
1999	308,050	74,286	382,336	62,834	494,540	557,374	939,710
2000	330,548	78,256	408,804	67,789	520,331	588,120	996,924
2001	353,610	82,171	435,781	72,889	546,018	618,907	1,054,688
2002	377,229	86,025	463,254	78,133	571,590	649,723	1,112,977
2003	401,401	89,811	491,212	83,517	597,039	680,556	1,171,768
2004	426,123	93,526	519,649	89,043	622,356	711,399	1,231,048
2005	451,388	97,163	548,551	94,706	647,533	742,239	1,290,790
2006	477,197	100,717	577,914	100,507	672,565	773,072	1,350,986
2007	503,543	104,185	607,728	106,444	697,445	803,889	1,411,617
2008	530,425	107,561	637,986	112,517	722,167	834,684	1,472,670
2009	557,840	110,840	668,680	118,724	746,726	865,450	1,534,130
2010	585,786	114,020	699,806	125,064	771,119	896,183	1,595,989

Sources : 1) Buku Data Kepariwisataan TH 1990

2) Survey Kepariwisataan Tahun 1990 di Bali

3) Badung dalam Angka 1990

4) JICA

Table D.4.3 Projection of No. of Rooms to be Occupied by Tourists in the F/S Area by Class of Accommodations

(Unit : No. of Rooms)

Year	Classified Hotels			Non-Classified Hotels & Other Accommodations			Total
	International Tourists	Domestic Tourists	Sub-Total	International Tourists	Domestic Tourists	Sub-Total	
1990	65,893	18,599	84,492	12,527	128,783	141,310	225,802
1991	73,883	20,494	94,377	14,207	141,590	155,797	250,174
1992	82,645	22,545	105,190	16,041	154,520	170,561	275,751
1993	91,724	24,600	116,324	17,957	167,464	185,421	301,745
1994	101,112	26,656	127,768	19,955	180,408	200,363	328,131
1995	110,803	28,707	139,510	22,033	193,344	215,377	354,887
1996	120,792	30,748	151,540	24,188	206,261	230,449	381,989
1997	131,073	32,775	163,848	26,419	219,151	245,570	409,418
1998	141,644	34,786	176,430	28,726	232,006	260,732	437,162
1999	152,500	36,775	189,275	31,106	244,822	275,928	465,203
2000	163,638	38,741	202,379	33,559	257,590	291,149	493,528
2001	175,054	40,679	215,733	36,084	270,306	306,390	522,123
2002	186,747	42,587	229,334	38,679	282,965	321,644	550,978
2003	198,714	44,461	243,175	41,345	295,564	336,909	580,084
2004	210,952	46,300	257,252	44,080	308,097	352,177	609,429
2005	223,460	48,100	271,560	46,884	320,561	367,445	639,005
2006	236,236	49,860	286,096	49,756	332,953	382,709	668,805
2007	249,279	51,577	300,856	52,695	345,270	397,965	698,821
2008	262,587	53,248	315,835	55,701	357,508	413,209	729,044
2009	276,159	54,871	331,030	58,774	369,666	428,440	759,470
2010	289,993	56,445	346,438	61,913	381,742	443,655	790,093

Sources : 1) Buku Data Kepariwisataan TH 1990
2) Survey Kepariwisataan Tahun 1990 di Bali
3) Badung dalam Angka 1990
4) JICA

Table D.4.4 Projection of Room Nights to be Realized by Tourists in the F/S Area by Class of Accommodations

(Unit : Room Nights)

Year	Classified Hotels			Non-Classified Hotels & Other Accommodations			Total
	International Tourists	Domestic Tourists	Sub-Total	International Tourists	Domestic Tourists	Sub-Total	
1990	283,339	57,658	340,997	47,604	296,201	343,805	684,802
1991	317,697	63,532	381,229	53,985	325,656	379,641	760,870
1992	355,374	69,889	425,263	60,954	355,396	416,350	841,613
1993	394,412	76,261	470,673	68,238	385,167	453,405	924,078
1994	434,780	82,634	517,414	75,831	414,939	490,770	1,008,184
1995	476,452	88,990	565,442	83,724	444,691	528,415	1,093,857
1996	519,404	95,318	614,722	91,914	474,400	566,314	1,181,036
1997	563,616	101,604	665,220	100,393	504,046	604,439	1,269,659
1998	609,070	107,836	716,906	109,157	533,615	642,772	1,359,678
1999	655,750	114,003	769,753	118,202	563,090	681,292	1,451,045
2000	703,642	120,096	823,738	127,524	592,456	719,980	1,543,718
2001	752,734	126,104	878,838	137,118	621,704	758,822	1,637,660
2002	803,013	132,018	935,031	146,982	650,820	797,802	1,732,833
2003	854,468	137,830	992,298	157,112	679,797	836,909	1,829,207
2004	907,094	143,530	1,050,624	167,506	708,623	876,129	1,926,753
2005	960,876	149,111	1,109,987	178,159	737,290	915,449	2,025,436
2006	1,015,815	154,566	1,170,381	189,073	765,791	954,864	2,125,245
2007	1,071,899	159,888	1,231,787	200,242	794,121	994,363	2,226,150
2008	1,129,123	165,068	1,294,191	211,666	822,269	1,033,935	2,328,126
2009	1,187,482	170,101	1,357,583	223,342	850,233	1,073,575	2,431,158
2010	1,246,969	174,980	1,421,949	235,269	878,006	1,113,275	2,535,224

Sources : 1) Buku Data Kepariwisataan TH 1990

2) Survey Kepariwisataan Tahun 1990 di Bali

3) Badung dalam Angka 1990

4) JICA

Table D.4.5 Projection of Bed Nights to be Realized by Tourists in the F/S Area by Class of Accommodations

(Unit : Bed Nights)

Year	Classified Hotels			Non-Classified Hotels & Other Accommodations			Total
	International Tourists	Domestic Tourists	Sub-Total	International Tourists	Domestic Tourists	Sub-Total	
1990	572,345	116,469	688,814	96,159	598,327	694,486	1,383,300
1991	641,748	128,334	770,082	109,050	657,826	766,876	1,536,958
1992	717,855	141,175	859,030	123,127	717,901	841,028	1,700,058
1993	796,711	154,048	950,759	137,841	778,036	915,877	1,866,636
1994	878,256	166,920	1,045,176	153,178	838,177	991,355	2,036,531
1995	962,432	179,761	1,142,193	169,123	898,275	1,067,398	2,209,591
1996	1,049,196	192,543	1,241,739	185,666	958,287	1,143,953	2,385,692
1997	1,138,504	205,240	1,343,744	202,793	1,018,173	1,220,966	2,564,710
1998	1,230,322	217,829	1,448,151	220,498	1,077,902	1,298,400	2,746,551
1999	1,324,615	230,287	1,554,902	238,769	1,137,442	1,376,211	2,931,113
2000	1,421,357	242,594	1,663,951	257,598	1,196,762	1,454,360	3,118,311
2001	1,520,522	254,730	1,775,252	276,979	1,255,841	1,532,820	3,308,072
2002	1,622,086	266,677	1,888,763	296,904	1,314,656	1,611,560	3,500,323
2003	1,726,026	278,416	2,004,442	317,366	1,373,189	1,690,555	3,694,997
2004	1,832,329	289,930	2,122,259	338,362	1,431,419	1,769,781	3,892,040
2005	1,940,970	301,204	2,242,174	359,882	1,489,326	1,849,208	4,091,382
2006	2,051,947	312,224	2,364,171	381,927	1,546,898	1,928,825	4,292,996
2007	2,165,237	322,973	2,488,210	404,488	1,604,124	2,008,612	4,496,822
2008	2,280,829	338,438	2,619,267	427,564	1,660,983	2,088,547	4,707,814
2009	2,398,713	343,604	2,742,317	451,150	1,717,470	2,168,620	4,910,937
2010	2,518,878	353,461	2,872,339	475,243	1,773,573	2,248,816	5,121,155

Sources : 1) Buku Data Kepariwisataan TH 1990
2) Survey Kepariwisataan Tahun 1990 di Bali
3) Badung dalam Angka 1990
4) JICA

Table D.4.6 Projection of Tourists' Expenditures in the F/S Area by Class of Accommodations

(Unit : Rp. Million)

Year	Classified Hotels			Non-Classified Hotels & Other Accommodations			Total
	International Tourists	Domestic Tourists	Sub-Total	International Tourists	Domestic Tourists	Sub-Total	
1990	85,852	11,647	97,499	7,212	29,916	37,128	134,627
1991	96,262	12,833	109,095	8,179	32,891	41,070	150,165
1992	107,678	14,118	121,796	9,235	35,895	45,130	166,926
1993	119,507	15,405	134,912	10,338	38,902	49,240	184,152
1994	131,738	16,692	148,430	11,488	41,909	53,397	201,827
1995	144,365	17,976	162,341	12,684	44,914	57,598	219,939
1996	157,379	19,254	176,633	13,925	47,914	61,839	238,472
1997	170,776	20,524	191,300	15,210	50,909	66,119	257,419
1998	184,548	21,783	206,331	16,537	53,895	70,432	276,763
1999	198,692	23,029	221,721	17,908	56,872	74,780	296,501
2000	213,204	24,259	237,463	19,320	59,838	79,158	316,621
2001	228,078	25,473	253,551	20,773	62,792	83,565	337,116
2002	243,313	26,668	269,981	22,268	65,733	88,001	357,982
2003	258,904	27,842	286,746	23,802	68,659	92,461	379,207
2004	274,849	28,993	303,842	25,377	71,571	96,948	400,790
2005	291,146	30,120	321,266	26,991	74,466	101,457	422,723
2006	307,792	31,222	339,014	28,645	77,345	105,990	445,004
2007	324,786	32,297	357,083	30,337	80,206	110,543	467,626
2008	342,124	33,344	375,468	32,067	83,049	115,116	490,584
2009	359,807	34,360	394,167	33,836	85,874	119,710	513,877
2010	377,832	35,346	413,178	35,643	88,679	124,322	537,500

Sources : 1) Buku Data Kepariwisataan TH 1990

2) Survey Kepariwisataan Tahun 1990 di Bali

3) Badung dalam Angka 1990

4) JICA

Table D.4.7 Estimation of Tourism Benefits

(Unit : Rp. million)

Year	Tourism Income			Tourism Benefits	
	Theoretical With Case	With Case	Without Case	Total	Sewerage Contribution
	A 1	A 2	B	C = A2 - B	D = C x .35
1990	40,388	40,388	40,388	0	0
1991	45,050	43,588	43,588	0	0
1992	50,078	46,828	46,828	0	0
1993	55,245	49,867	49,867	0	0
1994	60,548	52,689	52,689	0	0
1995	65,982	55,276	55,276	0	0
1996	71,542	57,613	57,613	0	0
1997	77,225	59,684	59,684	0	0
1998	83,029	68,660	61,475	7,185	2,515
1999	88,950	80,291	62,972	17,319	6,062
2000	94,986	94,986	64,163	30,823	10,788
2001	101,135	101,135	65,035	36,100	12,635
2002	107,394	107,394	65,575	41,819	14,637
2003	113,762	113,762	65,772	47,990	16,797
2004	120,237	120,237	65,613	54,624	19,118
2005	126,817	126,817	65,089	61,728	21,605
2006	133,501	133,501	64,187	69,314	24,260
2007	140,288	140,288	62,898	77,390	27,087
2008	147,175	147,175	61,210	85,965	30,088
2009	154,163	154,163	59,114	95,049	33,267
2010	161,250	161,250	56,599	104,651	36,628

Source : JICA

Table D.5.1 Estimation of SCF

1. Formula for SCF Calculation

$$SCF = \frac{M + X}{(M + Tm) + (X - Tx)}$$

where, SCF : Standard conversion factor
M : Value of imports
X : Value of exports
Tm : Value of tax on imports
Tx : Value of tax on exports

2. Estimation of SCF

(Unit: US$ million)

Item	1988	1989	1990
M	13,249	16,360	20,104
X	19,219	22,159	25,801
Tm	938	1,192	1,587
Tx	184	156	172

Source: Statistical Yearbook of Indonesia, 1990

SCF : 0.977, 0.974, 0.970
(1988) (1989) (1990)
3 year average = 0.974

Table D.5.2 Cost Benefit Streams
- Economic Analysis -

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits
CF=Cash Flow (=BF - CS)

(Unit:Rp Million)

NO.	YEAR	CC	OM	CS	BF	CF
1	1994	1210	0	1210	0	-1210
2	1995	2975	0	2975	0	-2975
3	1996	19524	0	19524	0	-19524
4	1997	22630	0	22630	0	-22630
5	1998	16724	398	17122	2515	-14607
6	1999	9134	796	9930	6062	-3868
7	2000	8786	1194	9980	10788	808
8	2001	10229	1194	11423	12635	1212
9	2002	10229	1194	11423	14637	3214
10	2003	12475	1194	13669	16797	3128
11	2004	19765	1194	20959	19118	-1841
12	2005	18741	1194	19935	21605	1670
13	2006	15416	1489	16905	24260	7355
14	2007	8802	1784	10586	27087	16501
15	2008	8717	2080	10797	30088	19291
16	2009	8541	2375	10916	33267	22351
17	2010	7199	2670	9869	36628	26759
18	2011	810	2670	3480	36628	33148
19	2012	2960	2670	5630	36628	30998
20	2013	771	2670	3441	36628	33187
21	2014	0	2670	2670	36628	33958
22	2015	0	2670	2670	36628	33958
23	2016	0	2670	2670	36628	33958
24	2017	0	2670	2670	36628	33958
25	2018	0	2670	2670	36628	33958
26	2019	2738	2670	5408	36628	31220
27	2020	2685	2670	5355	36628	31273
28	2021	0	2670	2670	36628	33958
29	2022	0	2670	2670	36628	33958
30	2023	0	2670	2670	36628	33958
31	2024	1488	2670	4158	36628	32470
32	2025	2065	2670	4735	36628	31893
33	2026	810	2670	3480	36628	33148
34	2027	2960	2670	5630	36628	30998
35	2028	771	2670	3441	36628	33187
36	2029	0	2670	2670	36628	33958
37	2030	0	2670	2670	36628	33958
38	2031	0	2670	2670	36628	33958
39	2032	0	2670	2670	36628	33958
40	2033	0	2670	2670	36628	33958
41	2034	2738	2670	5408	36628	31220
42	2035	2685	2670	5355	36628	31273
43	2036	0	2670	2670	36628	33958
44	2037	0	2670	2670	36628	33958
45	2038	0	2670	2670	36628	33958
46	2039	1488	2670	4158	36628	32470
47	2040	2065	2670	4735	36628	31893
48	2041	810	2670	3480	36628	33148
49	2042	2960	2670	5630	36628	30998
50	2043	771	2670	3441	36628	33187

Source: JICA

Table D.6.1 Common Fishes Living Around Mangrove Ecosystem

No.	Local Name	Scientific Name
1.	Belodo/Belodok	(*Periopthalmus dipus, Blkr*)
2.	Beloso/Boso	(*Glossogobius giceris*)
3.	Bandeng	(*Channos channos*)
4.	Pajos/payos	(*Silligo sihama*)
5.	Belanak	(*Mugil dussmieri*)
6.	Mujair	(*Oreochromis mossambicus*)
7.	Belut	(*Pluta alba*)
8.	Kerong-kerong	(*Therapos theraps*)
9.	Bulan-bulan	(*Megalops cyprinoides*)
10.	Udang Windu	(*Penaens monodon, Fab*)
11.	Udang Manis	(*Methapenaeus Sp.*)
12.	Udang Putih	(*Penaus Merguensis*)
13.	Kepiting Bakau	(*Scylla Serrata*)

Table D.6.2 Common Fishes Living Around the Benoa Bay

No.	Local Name	Scientific Name
1.	Peperek	(*Leiognathus splendens*)
2.	Belanak	(*Mugil dessumeiri*)
3.	Bandeng	(*Channos channos*)
4.	Kerapu	(*Epinephelus tauvina*)
5.	Swangli	(*Priacanthus tayenus*)
6.	Lingkis	(*Siganus canaliculatus*)
7.	Ekor Kuning	(*Caesio erythrogoster*)
8.	Udang Windu	(*Penaeus monodon*)
9.	Udang Windu	(*Penaeus merguensis*)
10.	Bronang	(*Siganus*)

Table D.6.3 Species of Birds over Mangrove Forest at East Suwung

No.	Local Name	Scientific Name	Family
1.	Pecuk Ular	(*Anhinga anhinga melanogaster*)	Phalacrocoracidae
2.	Cangak	(*Ardea cinerea rectirostris*)	Ardeidae
3.	Kuntul	(*Egretta garzettanigripes*)	Ardeidae
4.	Blekok	(*Ardeola speciosa*)	Ardeidae
5.	Kuntul malam	(*Nycticorax nycticorax*)(*Linn*)	Ardeidae
6.	Kokokan	(*Ixobrychus cinnanomeus cinnanomeus*)(*Gmell*)	Ardeidae
7.	Tekukur	(*Streptopelia chinensis tigrina*) (*Temm*)	Cuculidae
8.	Perkutut	(*Geopelia striata*)(*Linn*)	Cuculidae
9.	Kucica	(*Copsychus saularis javensis*)	Muscicapidae
10.	Perenjak	(*Prinia familiaris olivacea*)	Muscicapidae
11.	Walet	(*Collocalia gigas*)(*Hart&Butl*)	Apodidae
12.	Walet	(*Collocalia esculenta linchi*) (*Horsf & Moore*)	Apodidae
13.	Walet coklat	(*Collocalia inexpectata bartelsi*) (*Stress*)	Apodidae
14.	Burung rangkong	(*Aceros undulatus*)	Bucerotidae
15.	Burung leher kuning	(*Zosterops palpebrosa williamsoni*)	Zosteropidae
16.	Ulung-ulung	(*Spizaetus cirhatus limnaeetus*)	Accipitridae
17.	Elang	(*Haliastur indus intermedius*) (*Gurney*)	Accipitridae
18.	Tilil	(*Tringa glareola*)(*Linn*)	Scalopocidae
19.	Prit	(*Lonchura leucogastroides*) (*Horsf & Moore*)	Sturnidae
20.	Burung madu	(*Antreptes singalensis phoenicotis*) (*Temm*)	Nectariniidae
21.	Burung manyar	(*Pleceus manyar*)	Ploceidae
22.	Cerucuk	(*Pynonotus analis*)	Pycnonotidae
23.	Gagak	(*Corvus enca*)	Curvidae

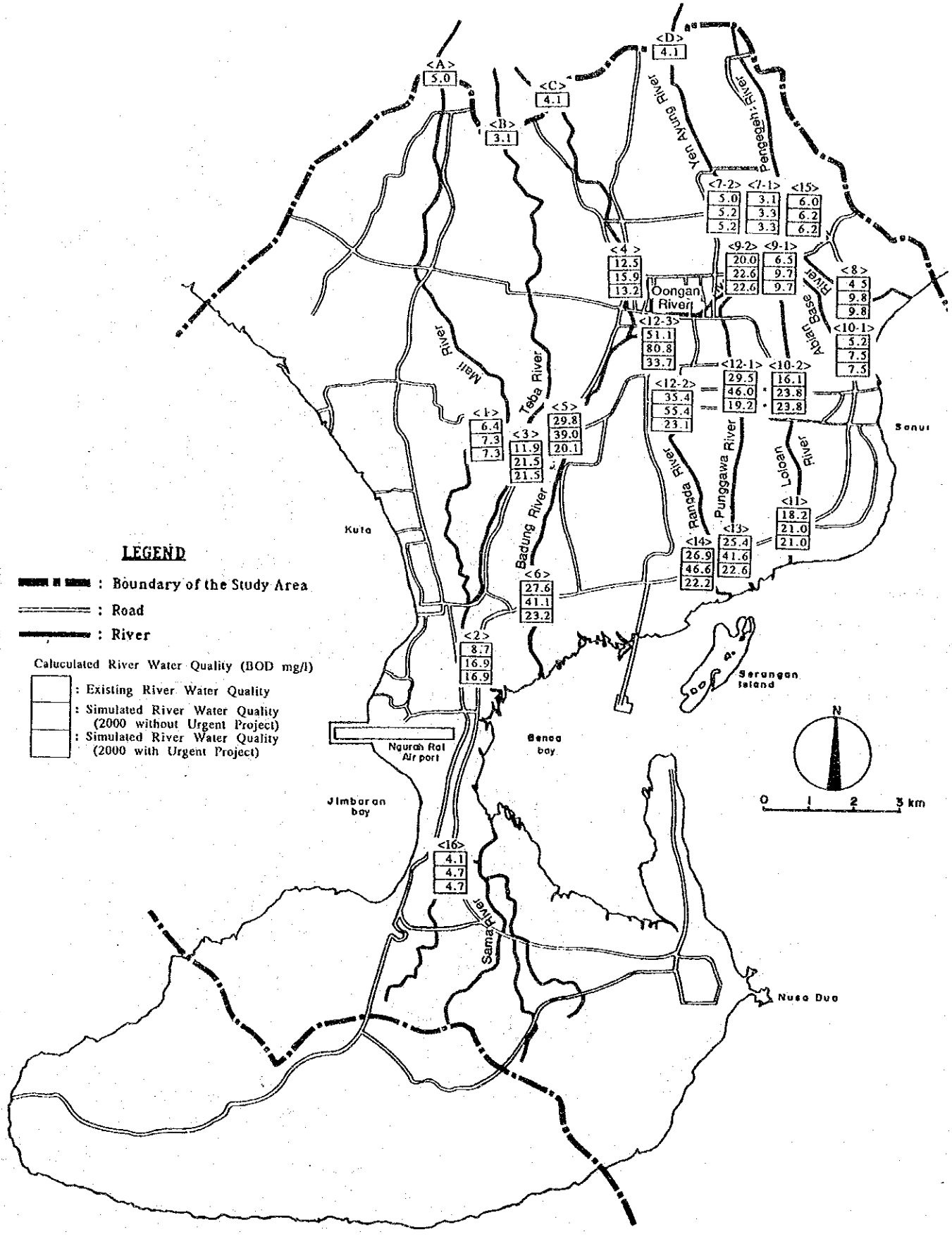


FIG. D.1.1(1) SIMULATED RIVER WATER QUALITY IN 2000 (DRY SEASON)

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

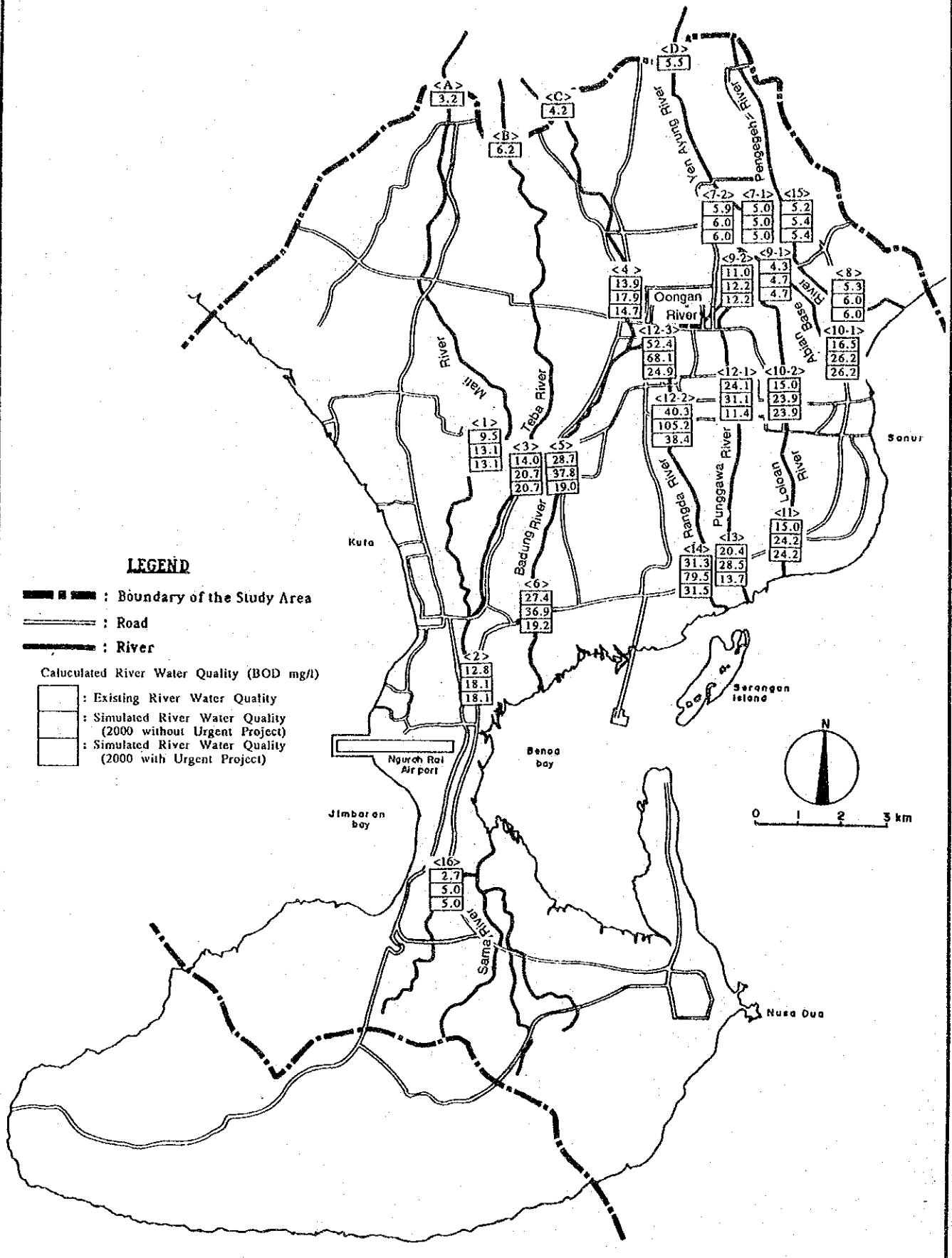


FIG. D.1.1(2) SIMULATED RIVER WATER QUALITY IN 2000 (RAINY SEASON)

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

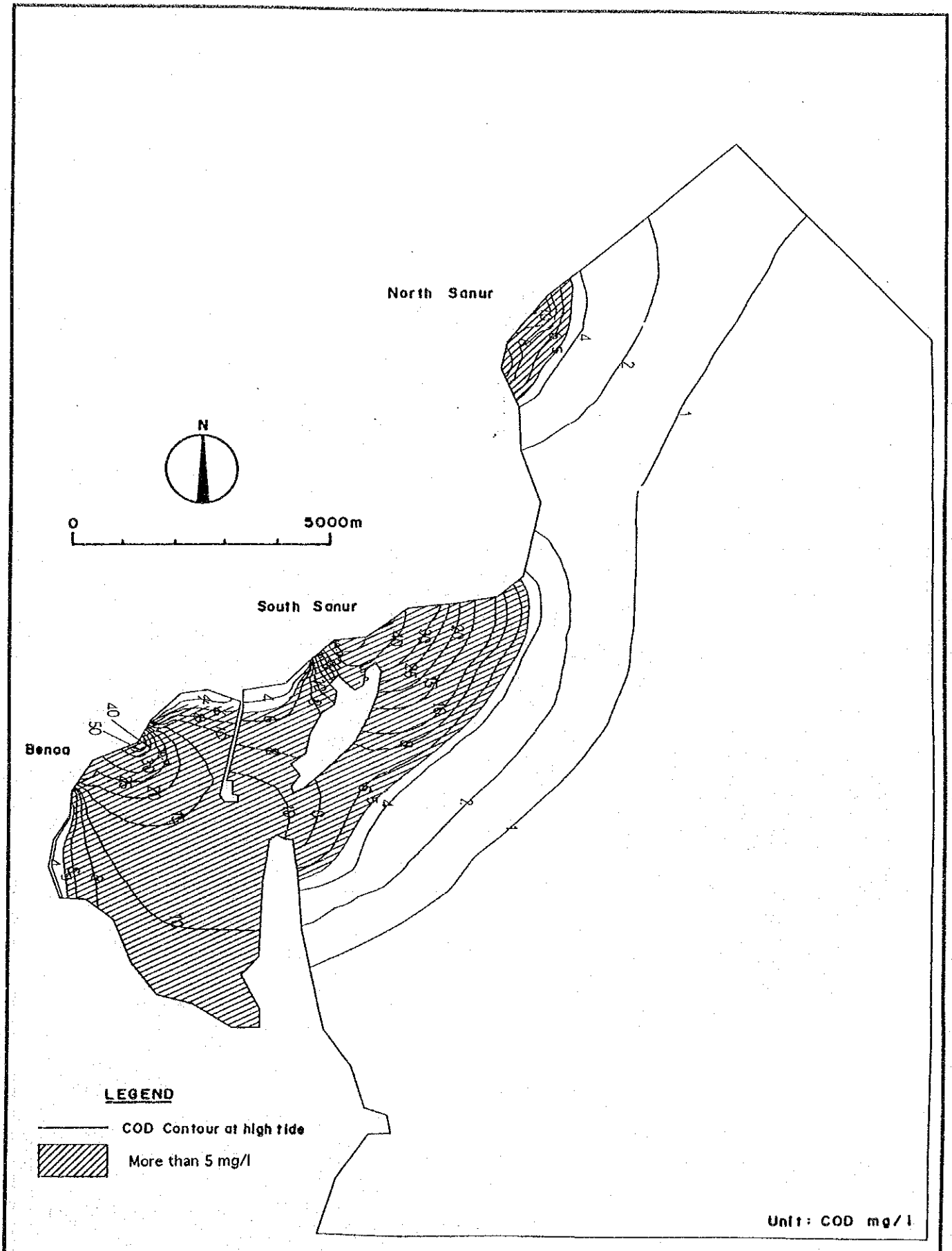


FIG. D.1.2(1) COD DISTRIBUTION IN 2000 (DRY SEASON) - WITHOUT URGENT PROJECT

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

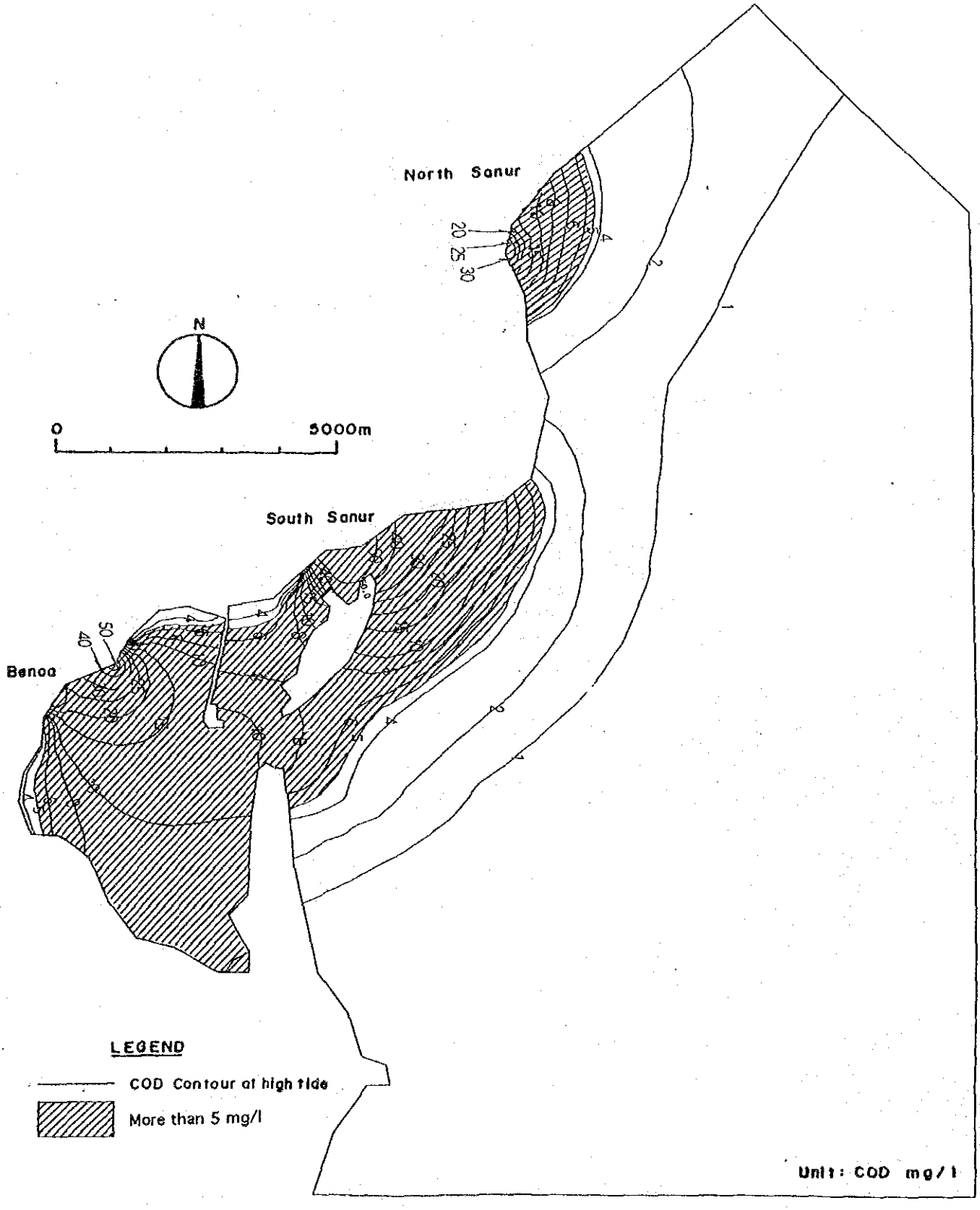


FIG. D.1.2(2) COD DISTRIBUTION IN 2000 (RAINY SEASON) - WITHOUT URGENT PROJECT

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

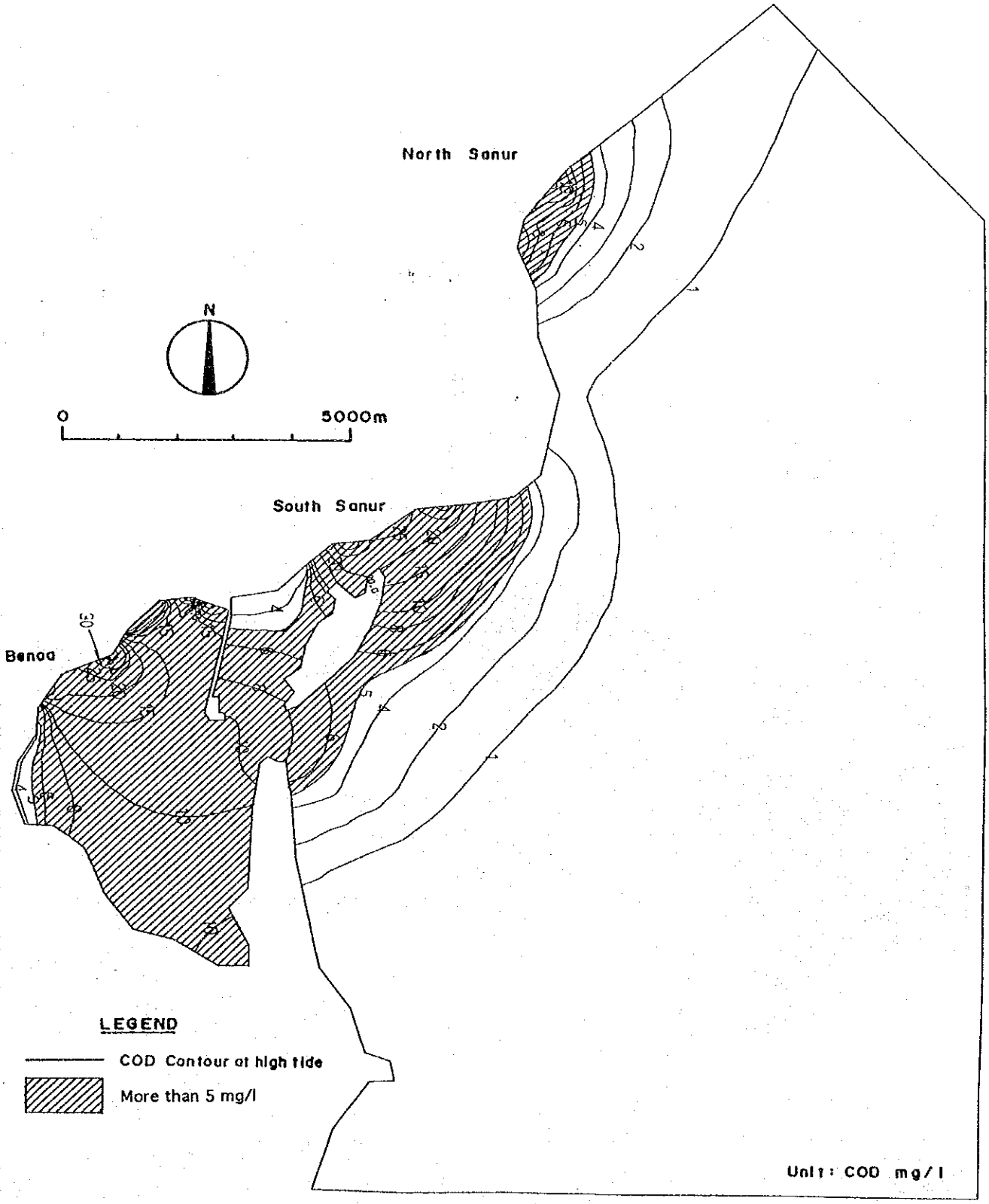


FIG. D.1.2(3) COD DISTRIBUTION IN 2000 (DRY SEASON) - WITH URGENT PROJECT

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

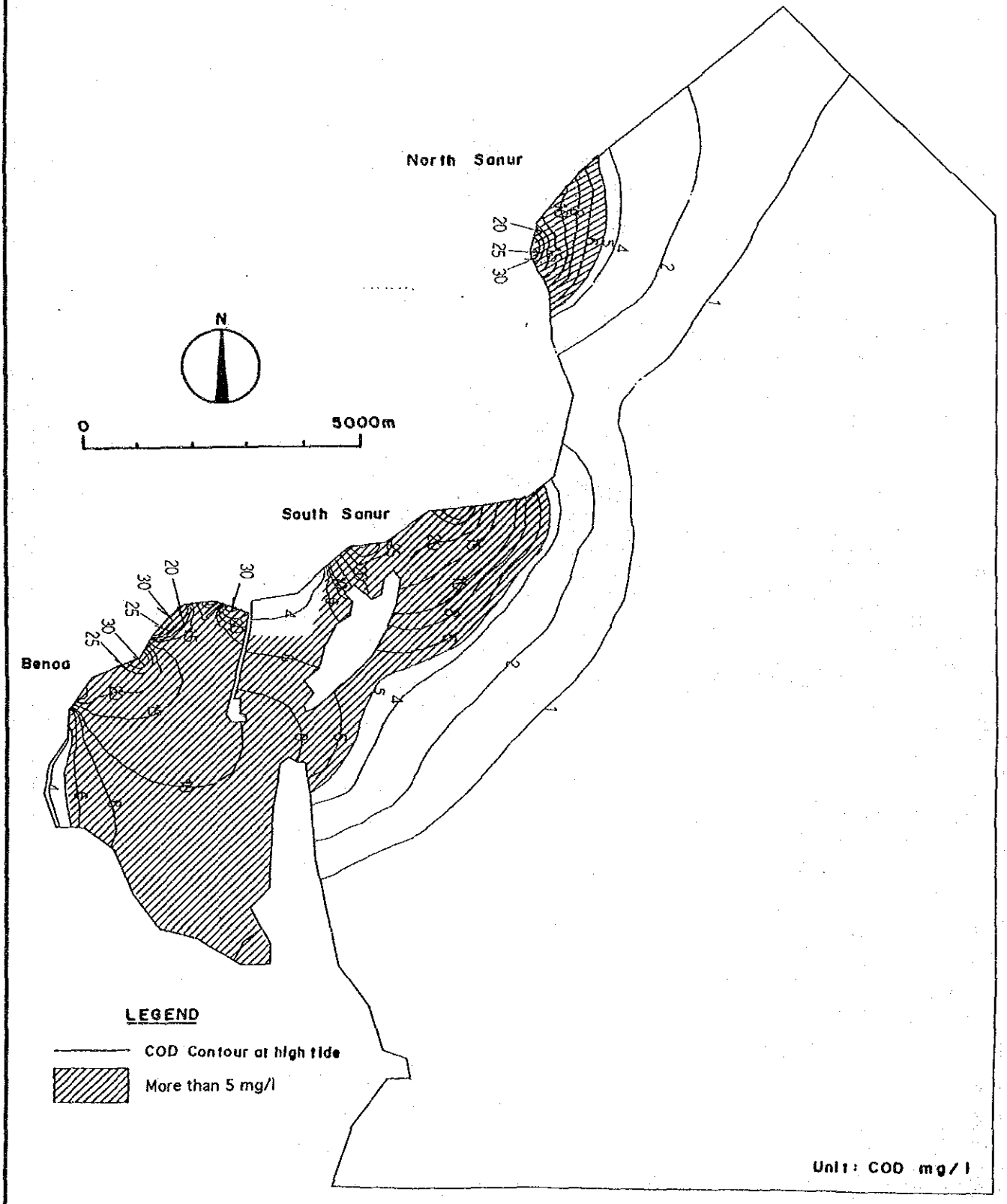
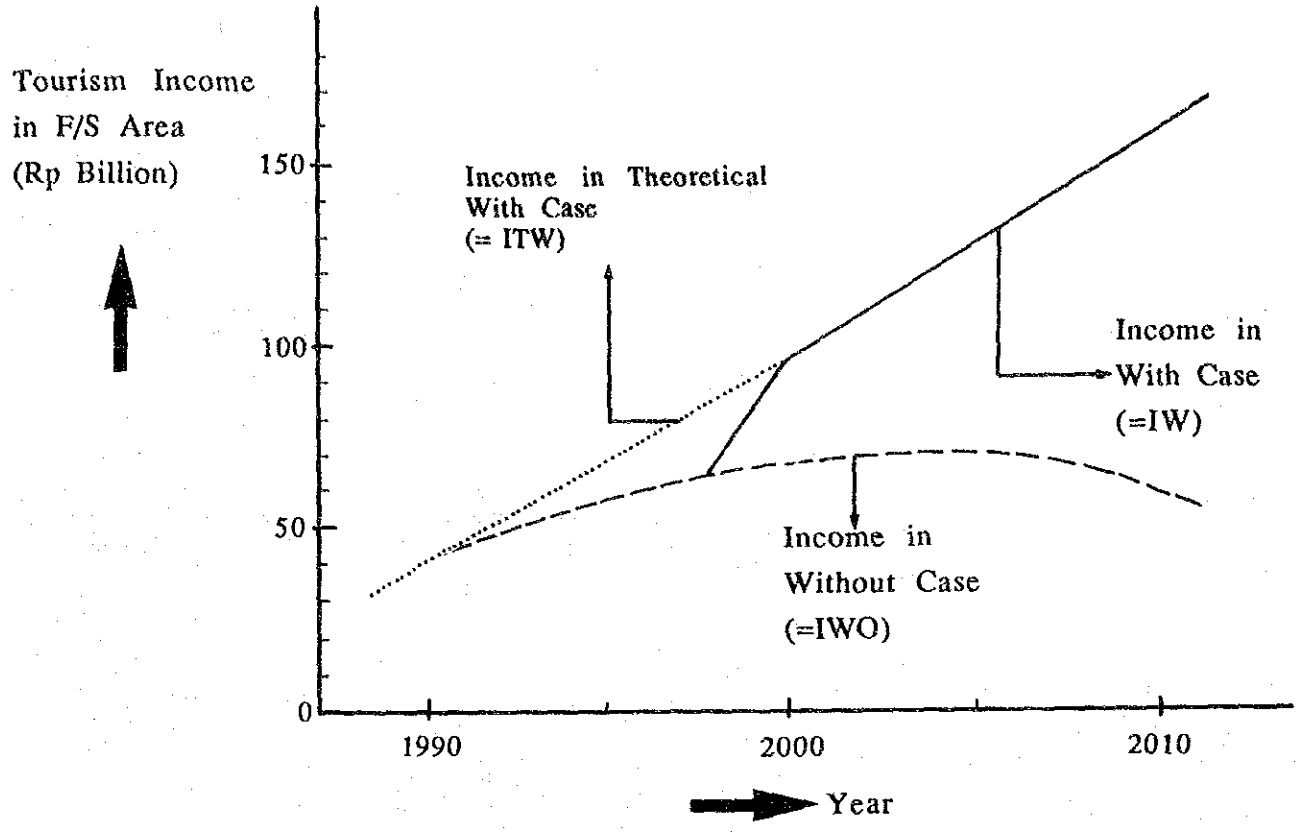


FIG. D.1.2(4) COD DISTRIBUTION IN 2000 (RAINY SEASON) - WITH URGENT PROJECT

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR



Tourism Income

1. Without Case

$IWO(t) = ((21-r) + (r-1) \times t)/20 \times ITW(t)$

Where IWO(t) : IWO in the year t
r : Ration of IWO to ITW in the year 2010
t : Year (1 = the year 1990)
ITW (t) : ITW in the year t

2. With Case

$(1990 \leq t \leq 1997)$

$IW(t) = IWO(t)$

$(1997 < t)$

$IW(t) = IWO(t) + ITW(t) - IWO(t) \times c$

Where IW(t) : IW in the year t
c : Completion rate of sewerage project

FIG. D.4.1 TOURISM INCOME IN WITH AND WITHOUT CASES

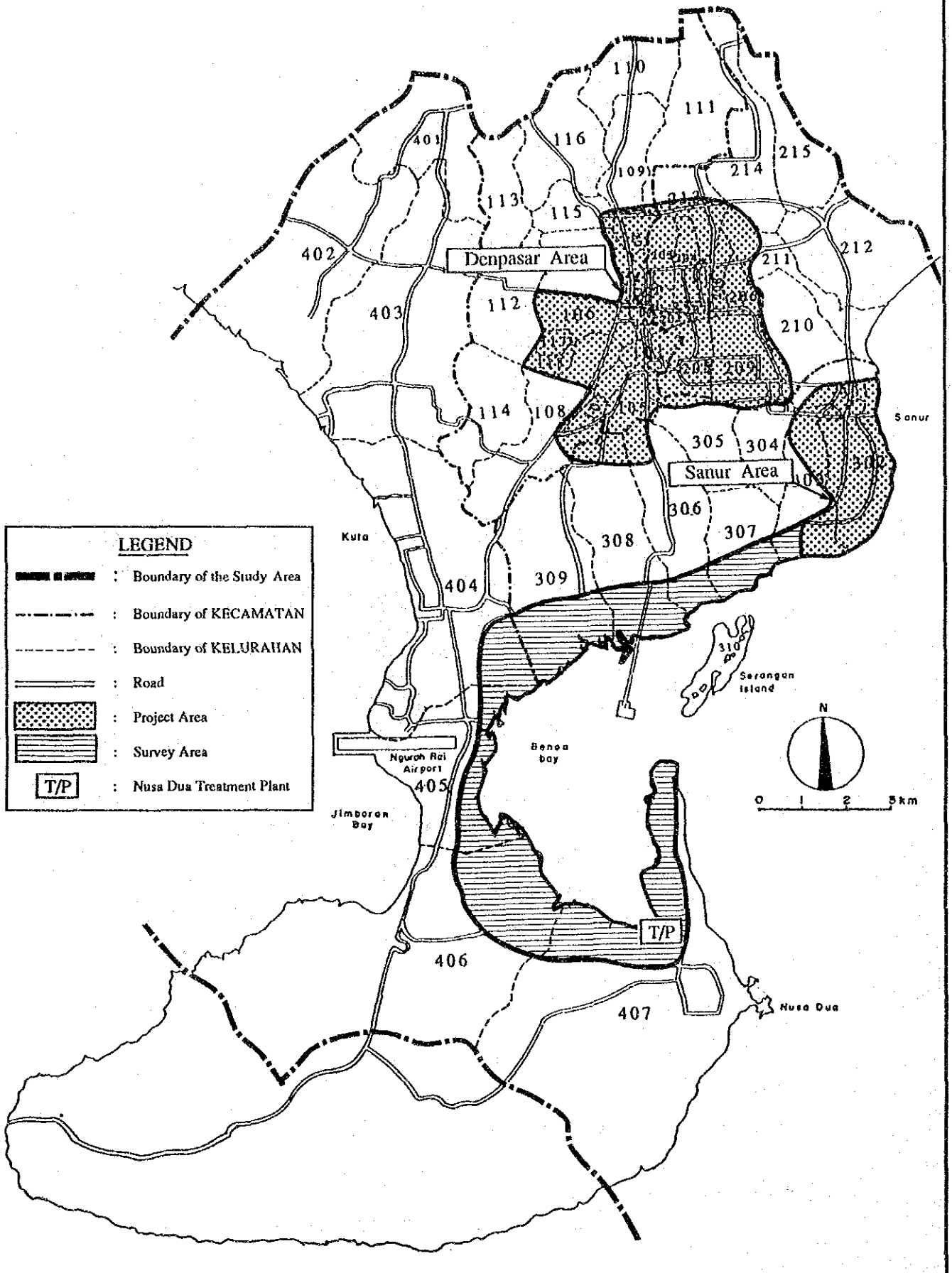


FIG. D.6.1 ENVIRONMENTAL SURVEY AREA

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

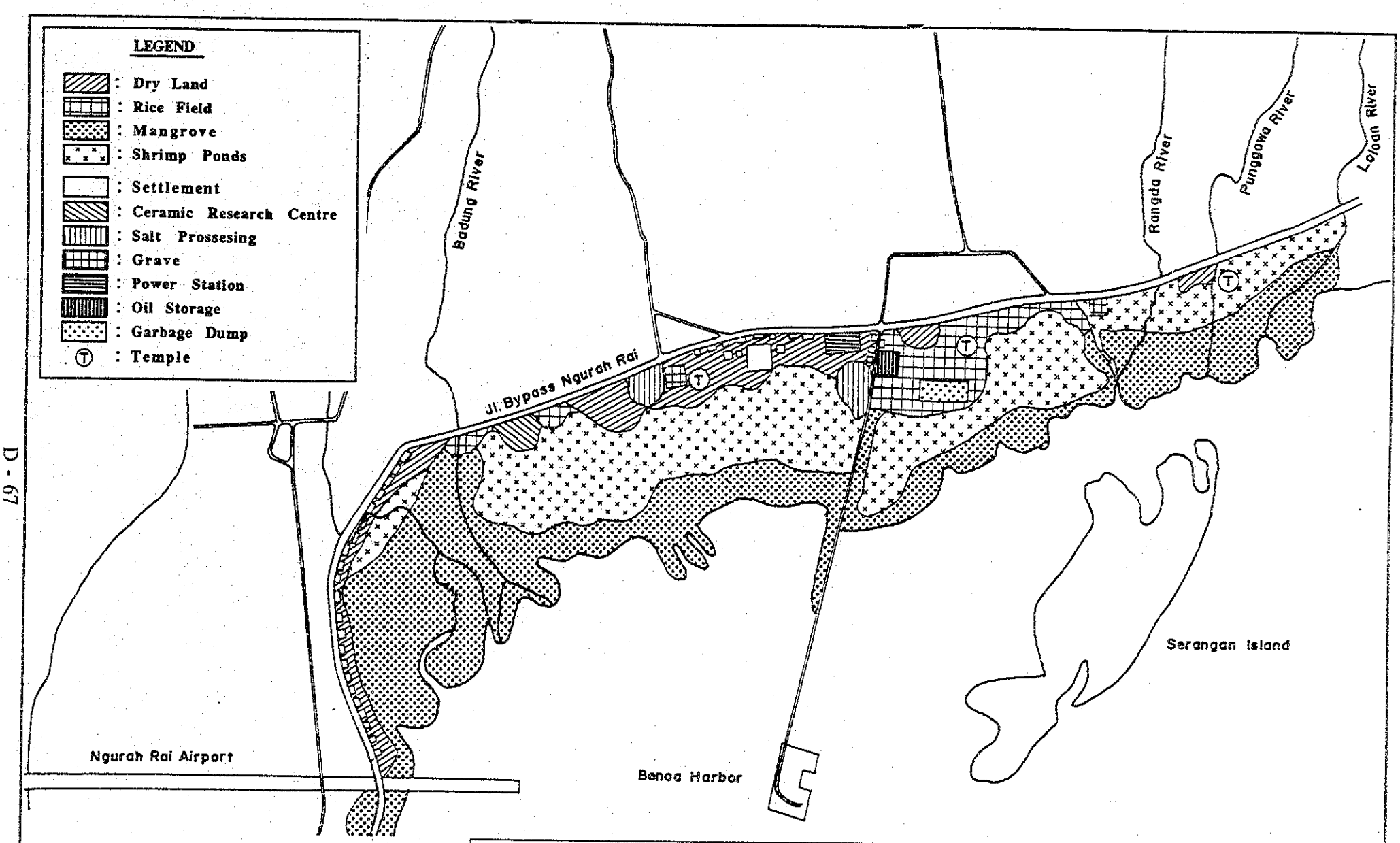


FIG. D.6.2 EXISTING LAND USE ALONG BENOA COAST

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

ATTACHMENT

INITIAL ENVIRONMENTAL EXAMINATION (PIL)

FOR

THE DEVELOPMENT STUDY ON

WASTEWATER DISPOSAL FOR DENPASAR

AUGUST 1992

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

Table of Contents

1. Introduction

1.1 Background

The activities for improvement and development of sanitation and wastewater infrastructures, starting from pre-construction to operation stage, will exert impacts to the environment. According to the Government of Indonesia's regulations, namely, Article 2 No : 29/1986 concerning Environmental Impact Analysis and Ministerial Decree of Public Work No: 506/KPTS/1991 concerning Guidelines on the Managing of Environmental Impact Analysis for Department of Public Work, all such feasibility studies of wastewater development will incorporate an Initial Environmental Examination (PIL) study. This PIL document is prepared to conform the above regulations.

1.2 Objectives and Benefits of PIL Study

1.2.1 Objectives

The objectives of PIL Study for the Development Study on Wastewater Disposal for Denpasar are as follows :

- Identify project activity plan, which may lead an environmental impact.
- Identify original environmental condition which may be affected by project activities.
- Predict and evaluate important impact to the environment.

1.2.2 Benefits

This PIL document will be used for the following :

- To screen whether the activity plan will require an Environmental Impact Analysis or not.
- As the reference in making a terms of reference, if the Environmental Impact Analysis is required.
- As the reference in formulating the Environmental Management Plan (RKL) and Environmental Monitoring Plan (RPL), if the Environmental Impact Analysis is not required.

1.3 Scoping

1.3.1 Administrative Boundary

The administrative boundary covers the Kotamadya Denpasar with an area of about 124 km^2 (ref. Fig.1).

1.3.2 Project Boundary

The project boundary for sewerage development covers the central Denpasar Area with an area of 1,031 ha and Sanur Area with an area of 332 ha with a total area of about 1,363 ha (ref. Fig.2).

1.3.3 Ecological Boundary

Ecological Boundary covers predicted areas of environmental impacts caused by the project activities of sewer collection and treatment systems. Accordingly, the ecological boundary of the project covers the swampy area at south of Sanur, known as Suwung Swamp, bounded by Jl. By-pass Sanur and coast line of Benoa Bay and the coastal waters of Benoa Bay as well, in addition to the Project Boundary (ref. Fig.2).

1.4 Environmental components

Environmental components examined with respect to the initial environmental condition are as follows :

i) Socio-Economics and culture
ii) Physical condition
iii) Water resources
iv) Biological resources
v) Climate
vi) Ambient air quality
vii) Related infrastructure

1.5 Methodology

1.5.1 Method of Data Collection

The entire data/information used for the preparation of this PIL document are either directly obtained or duly enumerated from the master plan study report of JICA dated February 1992, and the feasibility study report dated August 1992 (JICA).

Title of the above master plan and feasibility study reports are follows :

The Development Study on Wastewater Disposal for Denpasar, Interim Report, Japan International cooperation Agency (JICA), February 1992.

The Development Study on Wastewater Disposal for Denpasar, Progress Report(II), (JICA), August 1992.

During the formulation of the above master plan and feasibility study the required technical data/information are generated primarily, whenever reliable secondary data were not available. The sources of secondary data used are identified as foot notes of Table/Figure in the above Interim Report/Progress Report(II).

1.5.2 Method of Impact Prediction

The prediction of impact is carried out by using a simple matrix integrating both activities components and environmental components. The future environmental condition is predicted based on the respective initial condition.

1.5.3 Method of Impact Evaluation

Impact evaluation is done as follow :

- Investigation of the whole impacts.
- Prediction of the whole impact.
- Choosing the best alternative based on the technical, economical and institutional judgment.
- Determination of residual impact.

- Determine the possibility of important impact based on :
  - Number of people potentially affected
  - Extent of area affected by the spread of impact
  - Duration of impact
  - Intensity of Impact
  - Number of other environmental components affected by impact
  - Cumulative characteristic of impact
  - Reversibility or irreversibility of impact

1.6 Project Initiator and Executor

1.6.1 Project Initiator

Name : Directorate General of Human Settlements, Ministry of Public Works, Government of Indonesia.

Address : Jl. Raden Patah I/1, Kebayoran Baru, Jakarta.

1.6.2 Project Executor

Name : Japan International Cooperation Agency (JICA) Study Team on Development Study of Wastewater Disposal for Denpasar.

Address : Jl. M.H. Thamrin 59, Jakarta.

2. Project Description

2.1 General

Bali Island is a volcanic island located to the east of Java Island, Indonesia. Its area is about 5,630 km^2 with a circumferential length of about 450 km.

The Island is a famous international tourist destination predominantly due to its abundant white sand beaches and blue ocean. The number of tourists has been steadily increasing in recent years.

About 2.5 million tourists visited the Bali Island in 1990, of which foreigners accounted for a 34%. Moreover, about 50% of the whole tourist came by air. The number of tourists in the year 2010 is expected to increase up to about 8 million with foreigners accounting for a 47% share.

The major tourist destinations in the Island are, Denpasar city, the provincial capital, and the beach resorts toward the south of Denpasar, namely, Sanur, Kuta and Nusa Dua.

There exist many hotels, restaurants, shops and other coastal tourism facilities in and along these Sanur, Kuta and Nusa Dua beach areas. In the beaches tourists enjoy swimming, sun-bathing, diving, para-sailing, boating and others.

Neither the Denpasar city nor the beach resort areas have sewerage or any organized wastewater disposal means, other than a limited sewerage system serving the hotels in recently developed Nusa Dua beach resort area of about 325 ha. Nevertheless, a sewerage development plan for Kuta is already formulated under the IUIDP.

In order to ensure a continued international tourism potential of these areas a master plan of comprehensive wastewater disposal until the year 2010 was formulated by this JICA Study during the period of October 1991 and February 1992 covering the administrative area (Kotamadya Denpasar) and a southern portion of Kabupaten Badung.

Based on the above master plan study the feasibility study areas for sewerage development until the year 2000 were identified and referred to as Project Areas herein after.

2.2 Project Area

The Central Denpasar Area of the Project Area is the most developed region with high population density. Its total population and population density were 93,770 and 91.0 person/ha in 1990 respectively. The Sanur Area includes both the international beach resort area and the surrounding residential area. The population and population density of the Sanur Area in 1990 were 8,735 and 26.3 person/ha respectively (ref. Fig.2).

The Project Area virtually lacks an environmentally and sanitarily acceptable means of wastewater disposal. Large volumes of the graywater generated by miscellaneous domestic uses of washing and bathing, and even a portion of toilet wastes from households are discharged to nearby ditches and drains without any treatment. Septic tank/leaching pit is the sole on-site sanitation facility used to treat toilet waste only. As the consequence, the waterways like streams and rivers have virtually become open sewers with marginal beneficial use. The urbanized river reaches are brown to black in color and emanate offensive odor with BOD levels of more than 35 mg/l.

As the result, the sea water of the surrounding beaches is also aggravated with the average CODcr level of more than 5 mg/l.

Sewerage system will be developed to improve such serious environmental and sanitary conditions in those areas. The proposed sewerage development plan collects wastewater of the highly populated and commercial area of Denpasar area and the tourism area along the south-eastern coastal area of Sanur. All the collected wastewater of both Denpasar and Sanur areas will be treated together by aerated lagoon system proposed in Kel. Pedungan along Jl. Pelabuhan Benoa.

2.3 Related Projects

It is noted that the Kuta-Legian area of about 355 ha, the other international beach resort along the south-western coast, has already been planned for sewerage development under the IUIDP, Ministry of Public Works, as a component of East Java and Bali Development Project.

The wastewater treatment system of this Kuta-Legian area incorporates a sludge treatment plant as well, to treat the sludge desludged and transported from on-site sanitation facilities of septic tanks/leaching pits. The sludge desludged from the on-site sanitation areas of this master plan of JICA, the areas not demarcated for sewerage development until the year 2010, are proposed to be treated in the above sludge treatment plant.

This Kuta-Legian sewerage system is expected to be integrated with this project is future, beyond the year 2000.

Moreover, the Estuary Reservoir Project proposed at the mouth of Badung and Mati rivers in Benoa coastal area, for potable water supply to Nusa Dua area is related to this project, in consideration to the sewerage development for Central Denpasar area. Sewerage development in Central Denpasar area will enhance the water quality of these rivers, which receive much of their pollution loads from the urbanized reaches of Denpasar. This in turn will enhance the raw water quality of the proposed Estuary Reservoir for potable use, an important secondary benefit by the implementation of this project.

A tourism development study, known as "Bali Turtle Island Development", is on-going covering the adjacent Serangan Island and its surrounding coastal waters of Benoa Bay of this Project Area, with private sector initiative. The improvement of coastal water quality of Benoa Bay by this project will be beneficial for this tourism development study as well.

These related project areas are shown in Fig.3.

2.4 Project Activities

2.4.1 Pre-construction Stage

Prior to construction of the sewage treatment plant, a land of 9.2 ha in Kel. Pedungan belonging to the Government of Indonesia need to be acquired for the treatment system (ref. Fig.4).

Moreover, another area of 0.05 ha for booster pump station in Sanur belonging to the private sector need to be acquired (ref. Fig.5). In both these cases no resettlement is involved.

This pre-construction stage includes detailed engineering design works of sewer system and treatment plant as well.

2.4.2 Construction Stage

The sewerage system consists of sewer networks and a treatment plant. The construction works will be carried out by both international and local contractors utilizing local and imported materials and equipment, which will be implemented from 1995 to 2000.

It is noted that the whole sewer net work will be installed underneath public roads. Hence no further land acquisition, or resettlement or demolition of structures are required.

The major project activities involved are briefed below.

(i) Collection system for Central Denpasar Area

- Conveyance sewer ..... 4.4 km
- Main sewer ..... 15.2 km
- Tertiary and secondary ..... 126.0 km
- Disposal of surplus soil ..... 227,000 m^3

(ii) Collection system for Sanur Area

- Force main ..... 5.2 km
- Main sewer ..... 4.3 km
- Tertiary and secondary ..... 32.7 km
- Booster pump station..... Q = 17.8 m^3/min, H = 40 m
- Disposal of surplus soil ..... 74,000 m^3

(iii) Construction of treatment plant

- Treatment plant area ..... 9.2 ha
  - Treatment facility : 8.0 ha
  - Control building : 1.2 ha
- Excavation of lagoon ..... 89,000 m^3
- Embankment of lagoon dyke and control building ..... 89,000 m^3
- Disposal of surplus soil ..... nil
- Installation of aerator
  - Power rating 75 kW x 6 units and 22 kW x 6 units
- Installation of inflow pump
  - Capacity 66 m^3/min with 7.4 m hydraulic head,
  - 85 kW x 2 units and 35 kW x 1 unit (including 1 stand-by)
- Sludge drying bed ..... 5,500 m^2

The surplus soils generated during sewer construction can be used to raise ground elevation of the housing development areas nearby the construction sites.

2.4.3 Operation Stage

(i) Operation and maintenance requirement/demand

After completion of the construction, the following operation and maintenance activities will be performed to ensure a full function of the sewerage system and hence to realize the planned environmental benefits.

i) Sewer networks

- Repairing of sewers

ii) Treatment plant
- Daily operation of treatment plant
- Periodical maintenance of equipment
- Periodical monitoring of influent and effluent water quality
- Repairing of structure and equipment

The operational requirement of the treatment plant is described below in the order of treatment process.

1. Pump-up of wastewater by inflow pump station
2. Aeration of wastewater in aerated lagoon and facultative aerated lagoon
3. Settlement of suspended solids in facultative aerated lagoon and digestion of organic materials under anaerobic condition at lagoon bed
4. Disinfection of treated water in polishing pond
5. Desludging in facultative aerated lagoon
6. Drying of sludge in drying bed and disposal

Among the above activities, the operations 1.~4. are continuous, while the operations 5. and 6. will be necessary once a year on an average.

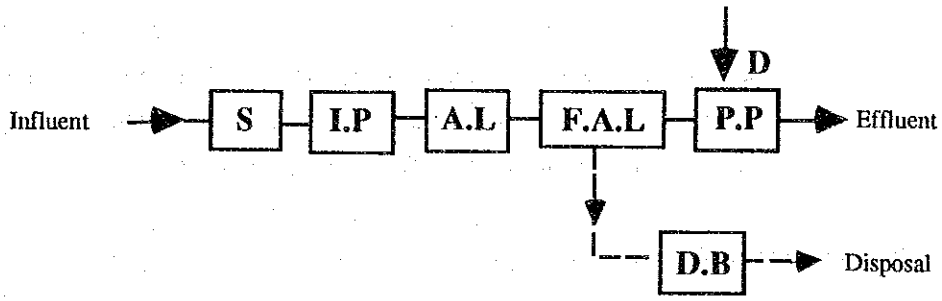
The design wastewater treatment volume in 2000 is as follows.

- Denpasar Area	:	34,570 m^3/day
- Sanur Area	:	9,420 m^3/day
Total	:	43,990 m^3/day

The sewage treatment plant is designed to conform the following effluent criteria.

- BOD and SS reduction : 90%
- Effluent water quality : BOD 20 mg/l

The flow diagram of the sewage treatment stream is shown below (ref. Fig.4).



S : Screen
I.P : Inflow Pump
A.L : Aerated Lagoon
F.A.L : Facultative Aerated Lagoon
P.P : Polishing Pond
D : Disinfection
D.B : Sludge Drying Bed

The treated effluent is discharged to Benoa Bay.

The quantity of dried sludge for disposal once in a year is about 900 m^3. This dried sludge can be used as soil conditioner or fertilizer.

(ii) Major environmental benefits

A proper functioning of the treatment system will ensure the realization of the following direct environmental benefits.

i) Stream river water quality

The treated effluent quality of 20 mg/l as BOD will also ensure a minimum stream river water quality of 20 mg/l as BOD, which is the recommended stream water quality standards of DKI, Jakarta for the beneficial use of irrigation and fishery. This is

adequate to meet the existing major beneficial use of agriculture as mentioned under Surface Water in the subsequent Section 3.3.1. This is in fact an improvement even from existing average stream river water quality of about 35 mg/l as BOD.

It is further noted that under no project condition, the stream water quality of the rivers in the year 2000 will deteriorate to an average level of more than 50 mg/l BOD, rendering them unsuited for any beneficial use, as per the above DKI Jakarta standard. A minimum standard stream river water quality of 30 mg/l as BOD is necessary for the conservation of aquatic biota.

ii) Coastal water quality

The above enhancement of stream river water quality will ensure a minimum coastal sea water quality of 5 mg/l as COD_{cr} in Benoa Bay, the recommended minimum international standards for coastal water recreational use. It is to be noted that under the existing conditions, the coastal water quality of Sanur area exceeds even 8 mg/l as COD, hence under critical condition for this beneficial use (ref. also to Coastal Water in the subsequent Section 3.3.2).

3. Initial Environmental Condition

3.1 Socio-Economic Condition

3.1.1 Population

The Project Area covers 29 Kelurahan, some of which are only partially covered. The total population of the Project Area was about 102,500 in 1990, and is expected to increase to about 129,400 in 2000.

3.1.2 GRDP

The per capita GRDP (gross regional domestic product) of the Project Area is estimated at Rp. 1,827,442 as of 1990 at 1990 prices. It corresponds to US$ 980. GRDP of the Project Area in the same year works out at Rp. 187,322 million.

3.1.3 Income Level

The average monthly per capita income on a Kelurahan/Desa basis in the Project Area ranged from Rp. 44.500 to Rp. 61,000 in the year 1990.

The corresponding average per capita income in the Project Area is estimated at Rp. 55,100.

3.1.4 Religion

As well known, Hinduism is the predominant religion of Bali, including the Project Area. In the Project Area about 82% of the population belongs to Hinduism, while Islam constituted a 12.5% followed with Christianity of 3.5% and Buddhism of 2%.

3.1.5 Culture

The unique Balinese culture of indigenous as well as Indian/Hindu origin is vividly alive in everyday life in the Project Area. It is exemplified by dances (Barong, Legong, Kecak, etc.), paintings, sculptures, architecture, daily offerings to God, daily Mandi, wedding and funeral ceremonies, festivals, clothes, foods and others.

3.1.6 Tourism

Of the 2.5 million tourists visited the Bali Island in 1990, it is estimated that about 35% stayed at least one night within the Project Areas of Denpasar and Sanur. Their total expenditure in the Project Area for the entire year was around Rp. 135,000 million. The contribution of tourism to the economy of the Project Area in 1990 was about Rp. 40,000 million, which accounted for a hefty 11% of the total economy.

3.1.7 Public Health

The population in the Project Area suffer from a high contraction of water-borne disease due to its unsanitary conditions. The annual contraction rate per 1,000 persons has an average of 57.1 cases in the last three (3) years.

3.2 Physical Condition

3.2.1 Topography & Geology

The Project Area is low-lying and its ground elevation is in the range of TTG 0 m and TTG 40 m. The ground surface declines gently toward south from north.

Most of the Project Area is underlain by the Quaternary volcanics.

3.2.2 Soil Permeability

The Central Denpasar area of the Project Area is of medium soil permeability while that of Sanur is of high permeability due to its sandy soil characteristics. The high soil permeability in Sanur area leads to high infiltration of surface run-off including wastewater, resulting in dry road drains but with a potential of groundwater pollution.

3.2.3 Land Use

The Central Denpasar area of the Project Area is the most developed and land use for commercial and institutional activities is dominant beside residential use. The existing and future land use patterns are estimated as

follows, based on land use plans prepared by BAPPEDA of Badung and CIPTA KARYA.

(Central Denpasar Area)

Land Use	Area (ha) Existing	Future
Residential area	325.3 (31.6%)	456.5 (44.3%)
Commercial & Institutional area	94.3 (9.1%)	106.0 (10.3%)
Tourism area	9.1 (0.9%)	11.2 (1.1%)
Industrial area	3.0 (0.3%)	3.3 (0.3%)
Others	599.1 (58.1%)	453.8 (44.0%)
Total	1,030.8 (100.0%)	1,030.8 (100.0%)

(Sanur Area)

Land Use	Area (ha) Existing	Future
Residential area	48.6 (14.6%)	57.9 (17.5%)
Commercial & Institutional area	9.2 (2.8%)	9.5 (2.9%)
Tourism area	66.8 (20.1%)	128.0 (38.6%)
Industrial area	2.4 (0.7%)	2.4 (0.7%)
Others	204.8 (61.8%)	134.0 (40.3%)
Total	331.8 (100.0%)	331.8 (100.0%)

3.2.4 Swamp

There exists a vast swampy area in the vicinity of the Project Area, known as Suwung Swamp, with rich mangrove forest. This swampy area extends along the coast line of Benoa Bay from the south of Sanur to the Cape of Benoa.

However, a considerable portion of this swampy area has already been converted into shrimp aquaculture ponds, mainly in Suwung area, at the expense of swamp lands and mangrove forests.

The proposed sewage treatment plant by this project, similar to the existing Nusa Dua plant, is located in this area. Nevertheless, the proposed treatment plant will be sited at the existing shrimp pond area resulting in the conversion of shrimp pond to wastewater treatment plant. Hence no further loss to mangrove forest will result by this project.

The existing landuse of this swampy area is shown in Fig.6.

3.3 Water Resources

3.3.1 Surface Water

The Oongan and Badung rivers, and their tributaries and distributaries run through the Project Areas. These rivers are used for washing/bathing, agriculture and solid/liquid waste disposal. Fishery and recreational uses are very low, while potable use is not noted. All these rivers drain to south-eastern coastal area bounded by Sanur coast and Benoa Bay.

The discharge of these rivers range from 0.06 m^3/s to 2.3 m^3/s in dry season, and from 0.07 m^3/s to 3.0 m^3/s in rainy season.

Water quality of the above rivers in and around Denpasar ranges from 29.2 mg/l to 50.4 mg/l with an average of 36.2 mg/l as BOD in dry season (ref. Annex-1).

The central Denpasar reaches of the above rivers are deposited with sediments and dumped garbage to a considerable extent, and are black in color and emanates offensive odor.

3.3.2 Coastal Water

The coastal water quality around the Project Area, the Sanur coast, is affected principally due to the pollution load run-off from urbanized Denpasar area, drained by the major rivers into the south-eastern coastal

area, as mentioned under surface water. High COD values of more than 5 mg/l, even up to about 25 mg/l was recorded in this coastal area of Sanur-Benoa (ref. Annex-1).

This coastal water is used for recreation, as Sanur is an international beach resort, the major beneficial use. The other significant beneficial use of coastal water around the Project Area is brackish water shrimp cultivation (shrimp aquaculture) that predominates in Suwung area around Benoa Bay (ref. Fig.6). Though some off-shore fishery is conducted by fishermen located along sea coast around the Project Area, its economic contribution is not very significant.

3.3.3 Tide

The southern low-lying area of the Project Area is affected by tide of the Benoa Bay. The tide level is shown below.

Spring High Tide (High Tide)	:	TTG + 1.0 m
Mean Sea Water	:	TTG ± 0 m
Spring Low Tide (Low Tide)	:	TTG - 1.0 m

3.3.4 Groundwater

Groundwater table in the Project Areas is shallow, except in the northern part of the Central Denpasar project area, where in ranges from 3m to more than 10m. The groundwater table in southern part of Central Denpasar project area is shallower than 3m, while it ranges from 3m to 5m in the Sanur project area.

Organic contamination in groundwater is concentrated in the central and southern parts of Denpasar project area (ref. Annex-1).

3.4 Biological Resources

The Provincial Government of Bali is concerned with preservation of the mangrove forest in the swampy coastal area along the Benoa Bay (ref. Section 3.2.4).

There exist following six(6) species of mangrove over the entire swamp area of the Benoa Bay.

- Sonneratia alba, Avicennia marina, Aegiceras corniculatam, Phizophora mucronata, Bruguiera cylindrica and Ceriops tagal.

The plant height ranges from 4 m to 10 m.

Thirteen(13) species of fish live around the mangrove ecosystem,while around the Benoa Bay, 10 species of fish are predominant.

The birds living over the mangrove forest counts 23 species (ref. Annex - 2).

3.5 Climate

The climate of the Project Area is characterized by two (2) distinct seasons : rainy season (November - April) and dry season (May - October). The average annual rainfall is 1,890 mm, of which more than 50% concentrate in the three (3) rainy months from December to February.

Wind from the west and north-west direction predominates during rainy season and vice-versa during dry season. The wind direction is instable during the transitional periods of April~May and October~November.

The average monthly temperature ranges from 26.0°C in July and August to 28.0°C in November and December with an yearly average of 27.2°C.

The relative humidity ranges from 77.5% during October to 81.1% during March~April, with an annual average of 79.6%.

3.6 Ambient Air Quality

There exist no ambient air quality monitoring stations in the Project Area or its vicinity. In fact there is no such station in the Bali Island as a whole, hence no specific information on air quality could be presented.

However, in the absence of any significant industrial development, vehicular traffic is assessed to be the prime source of air pollution. Accordingly, highly commercialized Central Denpasar Project Area is potentially polluted in comparison to its surroundings and Sanur area.

The Sanur area could be safely assumed as fine air quality area, further in consideration to its favourable topographic location in coastal area with active air exchange between land and sea.

3.7 Related Infrastructure

3.7.1 Road Networks

The road networks in the Project Area have been considerably developed in recent years. The total length of road networks within the Project Area is estimated to be about 220 km, of which 80% is paved roads. The major road networks crisscrossing the Project Area include Jl. Tamblingan, Jl. Gajah Mada, Jl. Diponegoro and Jl. Patimura.

3.7.2 Urban Drainage

The drainage system in the Project Area has been developed for a long time. However, the low-lying areas are still occasionally flooded. Most drains in the Project Area, other than those in commercial areas, are of open type. Their structural condition is good. However many drains are silted. Garbage accumulation is also prevalent in some drains. This indicates inadequate operation and maintenance of the drainage system.

3.7.3 Water Supply

The Project Area is entirely included in the PDAM water supply service area. Accordingly, the existing population of 102,500 in the Project Area are availed of piped water. The average per capita domestic piped water consumption is estimated to be about 180 l/day. Nevertheless, combined usage of piped water and well water is widely prevalent.

3.7.4 Electricity and Telecommunication

The electricity and telecommunication service level in the Project Area is developed and considered to be in par with other major cities of Indonesia, including the capital city, Jakarta. Cable of telecommunication are mostly installed under the major roads covered with earth.

4. Prediction and Assessment of Environmental Impact

4.1 Prediction of Environmental Impacts

The anticipated environmental impacts due to the Project activities are mostly beneficial, as the project in itself is an environmental improvement project. Significant beneficial effects include improvements of surface water , groundwater and coastal water quality and public health. However, some negative impacts may be also expected to some extent. The impacts in the pre-construction, construction and operation stages are listed in Table 1.

The anticipated negative impacts in the three(3) stages are described in detail as follows.

4.1.1 Pre-construction Stage

The required lands for construction of the treatment plant belongs to the Indonesian Government. However at present, this land is used as shrimp aquaculture ponds by private sector (ref. Fig.4).

The booster pump station in Sanur requires acquisition of private land area of about 500 m^2 (ref. Fig.5).

4.1.2 Construction Stage

The possible negative impacts which may occur during the construction stage are summarized as follows, but they will be all temporary and short term ones, and would disappear with the completion of construction activities.

- Nuisances by vibration and noise during sewer installation works, especially due to sheet piling of sewer trenches.
- Temporary lowering of groundwater table caused by dewatering of trenches during sewer installation in shallow groundwater table zones, especially in the southern part of the Project Area.
- Noise due to construction works, especially caused by soil compaction of embankments of treatment plant and sheet piling of sewer trenches.

- Dust caused by earth works during sewer installation and construction works of treatment plant.
- Traffic disturbance caused by sewer installation works and construction of treatment plant, and transportation for soil dumping and of construction materials.
- Road damages caused by sewer installation works and transportation of sewers construction materials.
- There may be aesthetic nuisance due to construction works.

4.1.3 Operation Stage

- Effects on surrounding environment of the sewage treatment plant due to odor, foams and noise predominantly caused by the operation of aerators in the aerated lagoon.
- No other long term negative impacts are anticipated.

4.2 Evaluation and Mitigation of Impacts

4.2.1 Pre-construction Stage

No negative impact is anticipated even concerned to land acquisition for treatment plant as the lands belong to the Government of Indonesia and no resettlement is involved.

Though this land is used as shrimp ponds by private sector, it will be returned to the government by the end of 1992 (ref. Attachment). Moreover no impact on the surrounding communities is anticipated as the site is remote from residential areas.

However, co-ordination among the concerned local and central government agencies is necessary to expedite the land acquisition procedure.

The land area required in Sanur for booster pump station is rather small (500 m^2). Though the land belongs to the private sector, it is a vacant land requiring no resettlement. Hence no significant impact is anticipated concerning this land acquisition.

4.2.2 Construction Stage

The anticipated negative impacts are short term ones. They could be minimized by proper construction planning and schedule as follows.

(i) Vibration and noise nuisance

Evaluation

The sewer pipe will be installed based on pipe diameter and earth covering depth of sewer pipe as shown below.

Covering Depth / Diameter	0 - 2.0 m (1.5 m)	2.0 - 4.0 m (3.0 m)	4.0 - 6.0 m (5.0 m)	6.0 - 8.0 m (7.0 m)
150 - 600 mm	I	II	III	III
700 - 1,000 mm	I	III	III	III
1,100 - 1,800 mm	II	III	III	III

Note : I : Open trench with no sheeting - 173 km
II : Open trench with retaining wall - 2.3 km
III : Open trench with sheet piling - 11.3 km

Total - 186.6 km

The sewer length of open trench with sheet piling is not so long (11.3 km, about 6% of total sewer length of 186.6 km).

Mitigation

Pre-boring method will be adopted instead of conventional hammering method, if necessary, to minimize vibration and noise for this 11.3 km of sewer line requiring sheet piling.

In principle only day time sewer installation works is planned. Still, night time works that may cause a serious nuisance of noise and vibration if any, shall not be permitted, especially in residential areas.

(ii) Lowering of groundwater table

Evaluation

Installation of some sewers in the southern part of the Project Areas are below the groundwater table level. Its length is about 8.3 km of the total sewer length of 186.6 km (4.6%).

Groundwater table will be temporarily lowered by dewatering of trenches during these sewer installation. However, it is considered to be limited to a small area around the construction site. Moreover, it is expected that the groundwater table will be recovered to the original state immediately after completion of the construction works.

Mitigation

Sheet piling of trenches will be performed to minimize lowering of ground water table, if necessary.

(iii) Dust nuisance

Evaluation

Dust nuisance to some extent is inevitable during construction.

Mitigation

Cleaning and water spraying of the roads in and/or around the construction site will be employed to minimize dust nuisance. The soil loads on the vehicles will be covered with sheets to mitigate dust spreading.

(iv) Traffic disturbance

Evaluation

This is the heaviest negative impacts in the construction stage, which will be mainly caused by sewer installation works.

The anticipated traffic disturbance is both due to excavation of sewer trenches as well due to transportation of construction materials and surplus excavated soil.

Though the impact due to sewer trench excavation on traffic may be significant, the impact by the transportation of soil and other materials is not expected to be that significant.

The total quantity of excavated surplus soil by sewer installation is estimated at 301,000 m^3. While, no surplus soil transportation is involved with treatment plant construction.

Such surplus soil will be generated over a construction period of six (6) years, which is equivalent to 140 m^3/d on average.

This surplus soil transportation will result in an additional 23 trips/day (140 m^3/6m^3/vehicle), which is not significant.

Mitigation

Further traffic disturbance will be minimized by the following construction management/scheduling measure.

Sewer installation and transportation of construction materials and equipment will be scheduled to avoid peak hours of daily traffic with proper work plan. Roads with heavy traffic will be avoided from the routes of project vehicle operation, as far as possible.

The one time length of sewer trench excavation will be limited in heavy traffic roads. If necessary, the work shall be scheduled to night time in order to avoid interference with traffic.

(v) Road Damages

Evaluation

The road damages anticipated are evaluated to be minimal, provided the following mitigatory measures are adopted.

Mitigation

Over-loading by project vehicles shall not be allowed to minimize road damages. Road damages by project vehicles, if caused, will be immediately repaired.

Road surface damaged by sewer installation will be restored to the initial condition immediately after completion of the sewer installation.

4.2.3 Operation Stage

Odor, noise and foam nuisance due to the operation of treatment system is the anticipated potential long term impact by the project.

(i) Odor

Evaluation

Odor due to aerated lagoon treatment system is considered to be minimal, because the treatment will be performed under aerobic conditions.

The treatment plant is located more than 300 m away from the nearest permanent structure, and expected to be surrounded by mangrove forestation in future. Hence the site is remote from residential areas.

The favourable topographic location of the treatment plant near the coastal area of Benoa Bay with active air exchange between land and sea will further contribute to the dispersion of any potential odor nuisance.

Mitigation

According to the master plan of land use prepared by Ministry of Forestry, the mangrove area will surround the treatment plant. This mangrove forestation can mitigate odor nuisance.

(ii) Noise

Evaluation

Noise nuisance due to operation of pumps and aerators is considered minor. The above buffer zone will minimize any potential noise nuisance.

Mitigation

The pump house of noise-proof structure may be constructed, if necessary.

(iii) Foam

Evaluation

Foam due to aerator operation in the aerated lagoon may occur some times. However it will be minimized by the surrounding buffer zone.

Mitigation

Water and/or chemical spraying system to the aerated lagoon may be constructed, if necessary.

The negative impacts and their mitigatory measures are summarized in Table 2.

5. Guidance for Environmental Management and Monitoring Plans

5.1 General

In formulating the document of Environmental Management Plan (RKL) and Environmental Monitoring Plan (RPL) the following Guidelines shall be referred :

(i) Attachment IV of Ministerial Decree No : 50/MNKLH/1987 concerning Guidelines on the Environmental Management Plan (RKL) for Activity Plan.

(ii) Attachment V of Ministerial Decree No : 50/MNKLH/1987 concerning Guidelines on the Environmental Monitoring Plan (RPL) for Activity Plan.

(iii) Ministerial Decree of Public works No. 46/1990 concerning Technical Guidelines on the Environmental Impact Analysis of Public Work.

(iv) Ministerial Decree of Public Works No : 779/1990 concerning Technical Instruction on the Environmental Impact Analysis of Wastewater Project.

5.2 Guidance of Environmental Management Plan (RKL)

5.2.1 Environmental Management Approach

(i) Location of RKL

The location is not just limited to the project area, but also covers the surrounding areas which will be affected by impacts.

(ii) Technological Approach

The technological approach shall follow the recommended impact mitigatory measures illustrated in Chapter 4.

(iii) Economical Approach

Detail description of economical approach should be presented, including the overall fund needed for environmental management and its fund sources. Besides, recommendations are needed if the project manager can not provide the overall fund to finance the environmental management.

(iv) Institutional Approach

Description of institutional manners to develop integrated environmental management system, starting from cooperation among agencies, regulations, and monitoring system, is necessary.

5.2.2 RKL Document

The RKL report will be divided into four(4) parts, namely, Introduction, Impact Management, Implementation of Environmental Management, and Monitoring of Implementation for Environmental Management.

(i) Introduction

This will contain :
- Background
- Objectives
- Benefits
- Location of Management
- Environmental Management Approach

(ii) Impact Management Plan

This part contains description about method of impact mitigation for each project stage from pre-construction stage to operation stage.

(iii) Implementation of Environmental Management

This will contain :
- Executing institution for environmental management
- Executing organization for management

- Scope and organizational jobs
- Management fund

(iv) Monitoring of RKL Implementation

This part contains descriptions about related institutions in the monitoring and mechanism of work.

5.3 Guidance of Environmental Monitoring Plan (RPL)

5.3.1 Environmental Monitoring Approach

The objective of RPL is to monitor the emerging impacts after environmental management has been done so that it could be used as feedbacks for RKL improvement, as appropriate.

Environmental factors that are to be monitored and described in detail in the RPL report are :

(i) Pre-construction Stage
Land price in surrounding wastewater treatment area

(ii) Construction Stage
Interference to the project implementation by local population

(iii) Operation Stage

- Community complaints
- Road condition
- Aesthetics in wastewater treatment plant area
- Noise
- Operational realization
- Quality of surface water, groundwater and sea water
- Change in land use in the surroundings of wastewater treatment plant

5.3.2 RPL Document

In general, RPL report contains four(4) primary parts as follow :

(i) Introduction

It consists of description about background, objectives, benefits, and approach of environmental monitoring.

(ii) Impact Monitoring Plan

Impact monitoring describes about impact type, environmental factor, impact magnitude, monitoring location, time and period of monitoring.

(iii) Implementation of Environmental Monitoring System

This part contains description of executing agencies, executing organization, scope and organizational job, and monitoring fund.

(iv) Monitoring of Implementation

It will explain about related institution in monitoring and its working mechanism.

6. Conclusion and Recommendation

6.1 Conclusion

6.1.1 Criteria of Impact Conclusion

Conforming the Regulation No. 49 (1987), by the Ministry of Population and Environment, the impacts by the project described in Chapter 4 are concluded with respect to the following seven (7) factors of the Regulation.

a) Population affected
b) Area of impact distribution
c) Duration of impact
d) Intensity of impact
e) Other environmental components affected
f) Cumulativeness of impact
g) Reversibility of impact

The three (3) project stages of pre-construction, construction and operation are considered separately in relation to the above seven (7) factors.

6.1.2 Pre-construction Stage

No impact is caused with respect to any of the above seven (7) factors, as no resettlement of population with respect to land acquisition for treatment plant or booster pump station is involved.

Hence impact at pre-construction stage is nil (o).

6.1.3 Construction Stage

Sewer pipe installation and treatment plant construction are the major works that will be carried out over a period of six (6) years (1995 ~ 2000).

The total length of sewer pipe works is about 190 km. Hence the average daily sewer installation length becomes 90 m.

It is assumed that such 90 m sewer pipe installation affects residents up to 100 m width. Hence area affected by impact becomes 1.8 ha on a daily average basis (90 m x 100 m x 2).

The number of population directly affected daily is 180 person (100 person/ha x 1.8 ha).

In addition, treatment plant construction is assumed to affect the whole area of 9.2 ha with no relation to any significant affected population due to its remoteness from residential area.

a) Population affected

Based on above discussion, the daily average population affected is 180 person. While the sewered population is 129,000. Accordingly, the ratio of population affected to that of benefited becomes 0.14%.

Hence the impact is assessed to be less important.

b) Area of impact distribution

The affected area during the construction stage is as follows :

Sewer installation per day	:	1.8 h a
Treatment plant construction (maximum)	:	9.2 h a
Total area affected	:	11.0 h a

The area of benefit (Project Area) : 1,363 h a

The ratio of affected area to benefited area is 0.8%.

The impact is assessed to be less important.

c) Duration of impact

The duration of impact is the duration of construction period of 6 years. This is a very short period in comparison to the long term benefit of the project beyond its implementation.
Accordingly, the impact is assessed as less important.

d) Intensity of impact

Based on the assessment with respect to those items of a), b) and c) of above, it could be concluded that the intensity of impacts over the period of 6 years, which is a temporary activity of construction works, is less important.

e) Other environmental components affected

The other environmental components affected by construction activities are described in Chapter 4, in details (Section 4.2.2). Those effects are briefed below.

(i) Vibration and noise nuisance

The sewer length prone to vibration and noise nuisance, the sewer length of open trench with sheet piling, is 11.3 km. This is only a 6% of the total sewer length of about 190 km.

Hence the impact is assessed to be less important.

(ii) Lowering of groundwater table

The sewer installation works below groundwater table is about 8.3 km, which is about 4.6% of the total sewer installation.

Hence the impact is assessed to be less important.

(iii) Dust nuisance

Dust nuisance can be minimized easily by adopting accepted procedures like water spraying and covering of soil transportation vehicles.

Accordingly, the impact is considered as less important.

(iv) Traffic disturbance

The effect due to the passage of additional 23 trips of surplus transportation soil trucks on overall traffic is not significant. While, other transportation can be planned to avoid heavy traffic duration.

The average daily sewer installation length of 90 m represents 0.04% of the total road length in the Project Area of 220 km.

Based on the above considerations, the impact is assessed to be less important.

(v) Road damages

In consideration to the available mitigatory measures of road damages and the amenability of quick repairs of road damages, the impact is considered as less important.

Hence, in an overall sense the entire effect of the construction activities on the above five (5) components is assessed as less important.

f) Cumulativeness of impact

In consideration to the very temporary nature of the construction activities, the cumulativeness of impact is assessed to be nil (o).

g) Reversibility of impact

The impact is reversible as the construction activities are only temporary ones.

6.1.4 Operation Stage

The operation stage relates to the treatment plant only, which is remote from residential areas. The impact related to each of the seven (7) factors are given below.

a) Population affected

The impact is less important, in consideration to the remoteness of the treatment plant from residential areas and its surrounding buffer zone of mangrove forestation.

b) Area of impact distribution

The area of any impact distribution of odor, noise would be confined to the treatment plant area of 9.2 ha, in consideration to a surrounded mangrove forestation.

Accordingly, the impact is assessed to be less important

c) Duration of impact

The duration of impact is long term, as the facilities are of permanent nature.

Still, it is assessed to be less important, as the site is located in a remote area.

d) Intensity of impact

The intensity of impact is assessed to be less important based on the foregone assessment under a), b) and c).

e) Other environmental components affected

(i) Odor

The odor nuisance will be minimal due to aerobic nature of treatment, ample buffer zone, favorable topographic location and remoteness of treatment plant.

Accordingly, the impact is assessed to be less important.

(ii) Noise

In consideration to the buffer zone, remoteness of the treatment plant location and the available technology for noise-proof structures, the impact of noise nuisance is assessed to be less important.

(iii) Foam

Based on the same consideration as of (ii) above, the impact is considered as less important.

f) Cumulativeness of impact

There is no accumulative effect concerned to the operation of treatment plant, as all end products are dispersed to the environment. Hence the cumulative impact is nil (o).

g) Reversibility of impact

The land utilization within the 14 ha of treatment plant area will be irreversibly changed, with the operation of treatment system.

Nevertheless, the effect is assessed to be less important in consideration to the small extent of this area and its remoteness.

6.2 Recommendation

The negative impacts during the construction stage are temporary ones and less important. They still could be managed by proper construction planning, method and scheduling.

The potential long term negative impacts in operation stage are mainly odor, foam and noise nuisance due to operation of the sewage treatment plant. They are basically considered to be less important and could be managed with the provided green belt of 50 m around the treatment plant. Water and/or chemical spraying in the aerated lagoon may also be considered, if necessary.

The proposed project, which is an environmental improvement project, is highly beneficial to the environment. The significant direct benefits by the project are enhancement of living environmental sanitation and the improvements of surface water, groundwater and coastal water quality. An early implementation of the project is recommended in order to realize these environmental benefits.

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Table 1 Environmental Impacts

Activities Components / Environmental Components	(1) Economic condition	(2) Education	(3) Income	(4) Health	(5) Perception	(6) Sanitary	(7) Traffic	(8) Aesthetic	(9) Soil stability	(10) Land use	(11) River water	(12) Groundwater	(13) Water use	(14) Irrigation	(15) Roads	(16) Fauna & Flora	(17) Odor	(18) Noise	(19) Vibration	(20) Dust	(21) Foam
I Pre-construction Stage																					
II Construction stage																					
1. Sewer networks	(+)		(+)		(-)		(-)	(-)				(-)	(-)		(-)			(-)	(-)	(-)	
2. Treatment plant	(+)		(+)			(-)										(-)		(-)	(-)	(-)	
III Operation & maintenance stage																					
1. Sewer networks		(+)		(+)	(+)	(+)		(+)	(+)	(+)	(+)	(+)	(+)		(+)						
2. Treatment plant	(+)	(+)		(+)	(+)	(+)		(+)		(+)	(+)		(+)	(+)		(+)	(-)				(-)

Table 2 Negative Impact and Management Measures

No.	Stage	Project Activities	Affected Objectives	Negative Impact	Management Measures	Monitoring
I.	Pre-construction	-	-	-	-	-
II.	Construction	Sewer Networks	Community	Noise, Vibration	Proper construction method & schedule	-
			Traffic	Interference	Proper construction method & schedule	-
			Road	Damage	Road repairing	-
			Groundwater	Groundwater table lowering	Proper construction method & schedule	Groundwater table
		Treatment Plant	Community	Noise, Vibration & Water Pollution	Proper construction method & schedule	-
			Traffic	Interference	Proper construction method & schedule	-
III.	Operation	Sewer Networks	-	No negative impact	-	-
		Treatment Plant	Community	Noise, Odor, & Foam	Greenbelt, water and/or chemical spray	Periodical observation

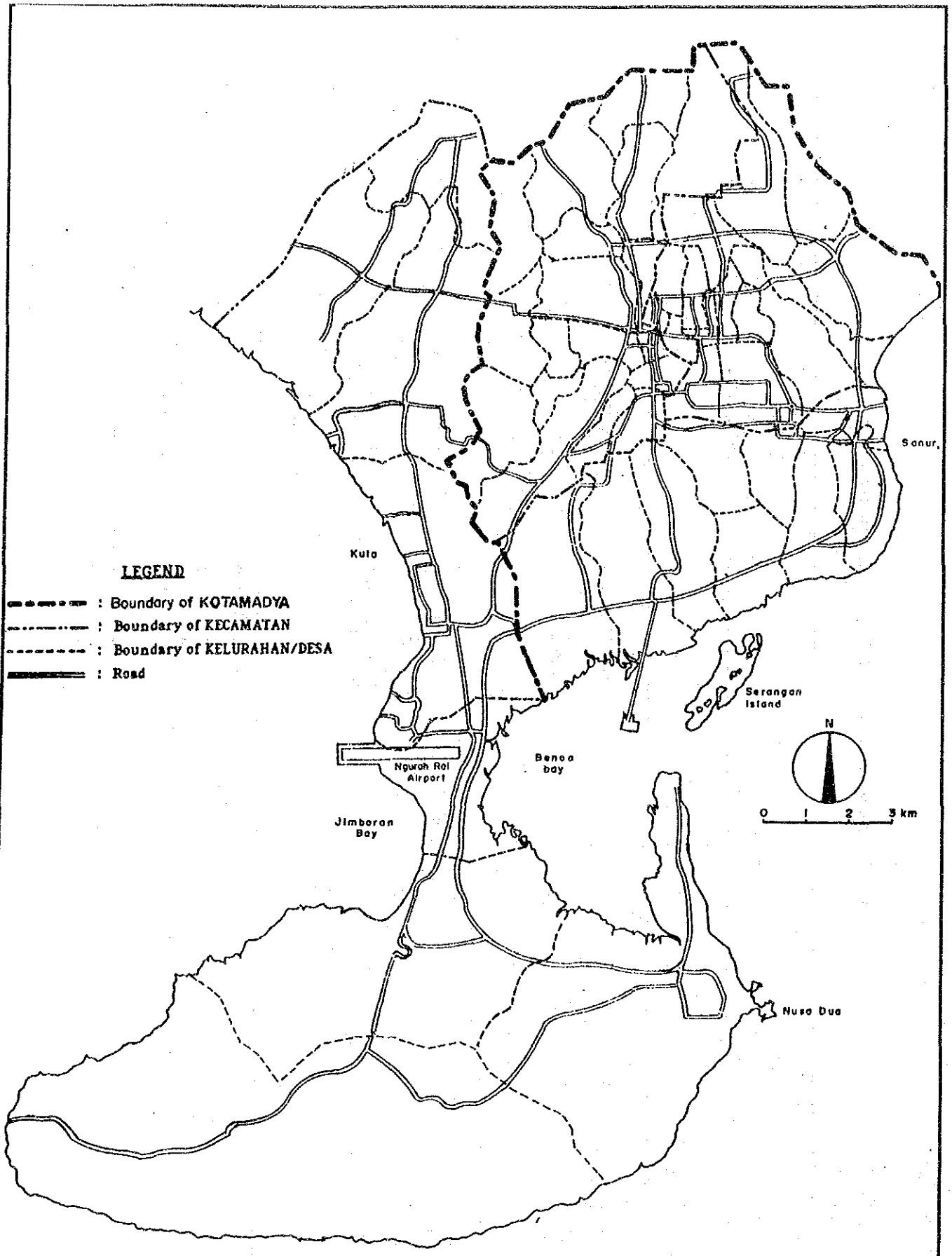

FIG. 1 ADMINISTRATIVE AREA

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

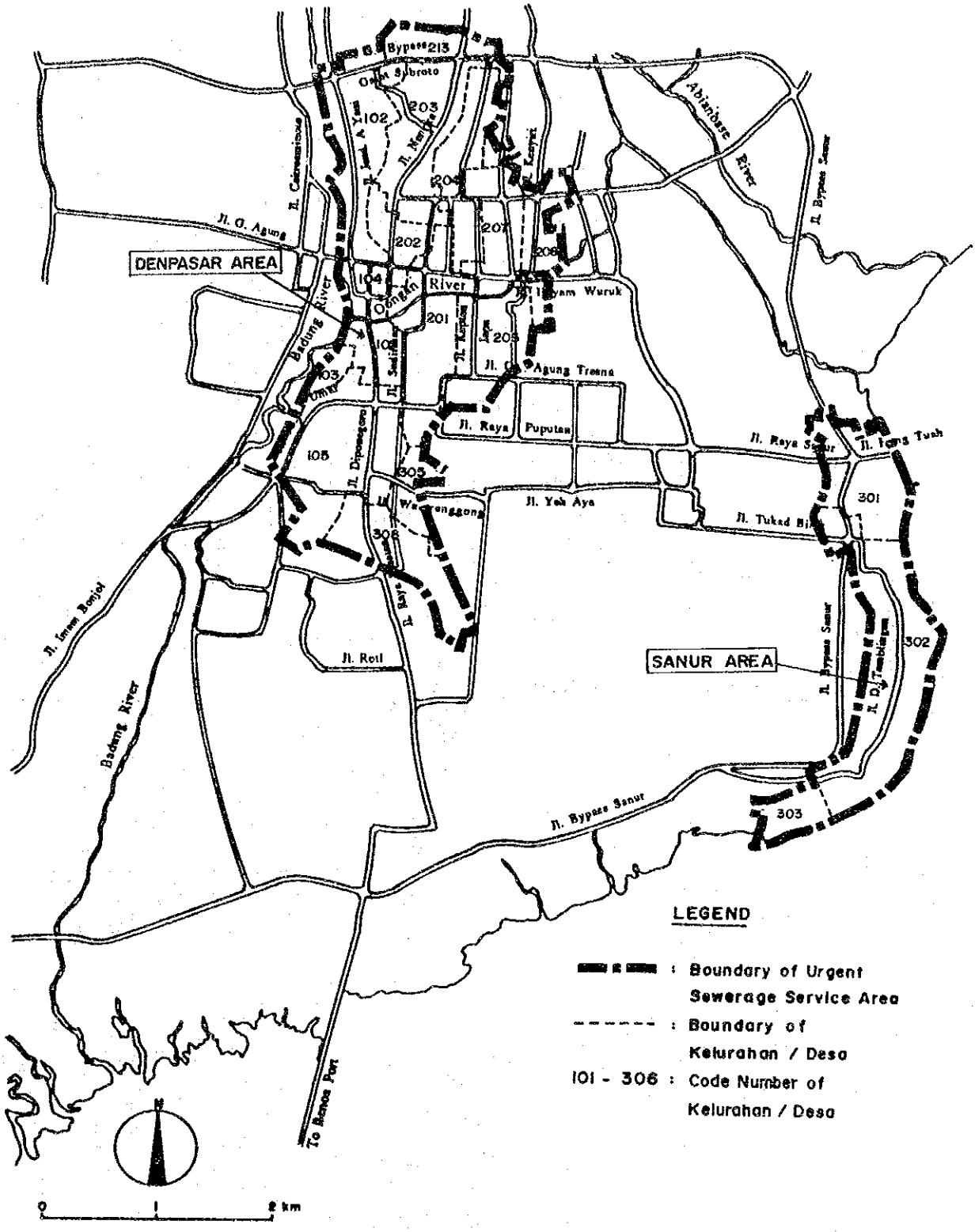

FIG. 2A INTEGRATED PROJECT AREA

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR