shadow pricing applied to convert market prices to border prices and the net cash-flow table are given in the Supporting Report.

The EIRRs were calculated on the basis of the new and the incremental cost and benefit streams associated with the proposed investment outlays over the period of maximum 6 years with the commencement in 1996. All the costs are shadow priced, being adjusted to convert market prices to shadow prices expressed in terms of border currency unit (US$). The projected level of tariffs being set as per the marginal opportunity cost of each of the sub-components of the Project are used as a proxy for benefits. No shadow pricing adjustment has been made to the project benefit attributed to capital works charge, since this portion is assumed to be well representing people's willingness to pay for the connection services provided by the authority.

In view of the foregoing, EIRR on the Project as a whole works out to 11.7 percent, with 10.8 percent and 12.9 percent for the sewerage and solid waste sub-components, respectively. Thus, the Project with those sub-projects altogether is substantially viable and acceptable, while the currently estimated opportunity cost of capital which stands at around 10 percent is taken into account. A summary net cash-flow table is attached as shown in *Table 3.5.*

It would be noteworthy that, in marginal cost pricing, internal rates of return result in little disparities between economic and financial analysis, largely due to the almost same proportion of impact of shadow pricing on the cost and benefit streams.

5.2 Health Effects of the Project

As recognized in the projects previously financed by external aid agencies and carried out in Indonesia, the sanitation subsector projects will reduce the morbidity or medical expenditures by expanding the coverage and using better ways and means for wastewater treatment and solid waste management. In particular, the proposed Project combined with the public education programs contained therein will lead to a shift in better service quality and reduced morbidity, thereby making the people in the region better off.

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which will enable higher tax bases.

[67] In the World Bank operation, economic benefit of human/solid waste is not quantified. Asian Development Bank points out that sub-projects in the water supply and low-income housing sectors be often feasible for economic analysis. (Framework for the Economic and Financial Appraisal of Urban Development Sector Projects) In IUIDP, FIRR is normally used as a proxy for EIRR. The Project Appraisal Manual of UNDP (draft, 1995) supports this approach in principle.

With the new and incremental supply of the sewerage and solid waste management services, the associated benefits of the Project will be the positive health, institutional and social impact and an improved policy and financial environment for the urban sanitation subsectors concerned. In the field of environmental beautification, the Project will reduce health hazards to the public by eventually creating well designed and appropriately located off-site sewerage system, in lieu of the existing unsanitary and costly on-site system, for the sewerage subsector, and by reducing unauthorized dumps and unsanitary open landfills associated with better operation systems of waste collection and landfills for the solid waste subsector, thereby making it possible for the people in the city to be better-off. Provided that the full economic value of the health effect is reflected by an individual's "willingness to pay (WTP)" to avoid a mortality risk with a very small probability, say, an increment of 0.0001, it is hypothetically estimated that WTP in Indonesia would be clustered in the range of $7.5 to $17.5 per person per year. This WTP across all people would be further summed up leading up to an estimated value of a statistical life. Given the foregoing postulate is to be held, the implied economic value of an avoided statistical death would range from $75,000 to $175,000. Let the economic value of an avoided death be equivalent to the discounted present value of lifetime income, inter alia, $10,000 in Jakarta and $5,000 (note that the average household income per annum has been estimated at Rp.3 million) in Ujung Pandang, $75,000 falls about in the middle of $5,000 and $175,000, thereby making it possible to approximate the economic value of the health effect.

In view of the foregoing, it could be acceptable to consider that the economic value attributable to the Project would be about $37.5 million per annum, with the range of $5 million to $175 million, if and only if about 500 deaths annually be attributed to the sanitation causality in Ujung Pandang[68].

[68] In respect of the hypothetical figures shown here, see the World Bank *Indonesia Environment and Development: Challenges for the Future*, 1994, P. 253, also see V. Lavy and J. Aquigley *Willingness to Pay for the Quality and Intensity of Medical Care, Low-Income Households in Ghana*, WB, 1993

Table 3.1 Available Fund Estimate as per 1995 Price, FY1995 - 2005, 1995 - 2015

Assumptive Parameters

Policy Targets (Bdgt/Alloc to the Sanitation Subsectors concerned)		
State (APBN, DDs, INPRES)	0.08%	of GDP (-2005)
	0.001	of GDP (2006-)
S.Sulawesi	0.001	of GRP
KMUP	0.01	of GRP (-2005)
	0.02	of GRP (2006-)
Real GDP Growth	0.055	average per year (-2005)
	0.07	average per year (2006-)
Population Growth	3.56%	average per year
FX Quotation	2250	Rp/$
UPG Sew/SW Sec Alloc fm State	0.004114953	of the State San Subsec Outlays
UPG Sew/SW Subsec Alloc fm SS	0.220516537	of the Prov San Subsec Outlays
Share of Non-Common Funds	0.774236368	of UPG funds alloc to San Subsecs
Project Fund	50%	of the available funds to the City
Household Ratio	0.181818182	of the total population
UPG # of Entities	300	
WTP for sewerage service	0.005	of household/entities' income
Beneficiaries' Contribution(Sew)	100000	Rp. per capita
Beneficiaries' Contribution(on-site)	400000	Rp. per capita
San Cons per year	3%	of the township households each year
Capital Works Charge	10000	Rp/sq m (-2005)
	50000	Rp/sq m (2006-)
Population (1993)	1019948	
High-rise bldg construction	10000	Rp/sq. meter per annum
	50000	Rp/sq. meter per annum
Share of sewerage/solid waste in the drainage subsec	15%	
Beneficiaries Contribution Ratio (Sewerage)	10%	of the total household per annum
WTP (or solid waste	0.01	of household/entities' income
WTP, Beneficiaries Ratio = service area pop/total popula	15%	

Simulation 1: No Mark-up budget allocation fm the State and the Province

Key Economic Indicators

	$ mil	Rp.bil
GDP (93,Ref:ADB)	144600	325350
GNP (93,ADB)	136400	306900
APBN (93,ADB)	23235.55556	52280
REP VI(Ref:OECF)	78208	175968
REP VI,Sew/SW Indo(Ref:BAPPENAS)	391.9111111	881.8
SS GRP (92,Ref:Bilo Statistik)	2823.8	6071.2
SS APBD (93,Ref:Nota Keuangan)	66.22222222	149
SS Dev Bdgt (94,Ref:BAPPDA I)	35.28888889	79.4
REP VI, Sew/SW SS (Ref:BAPPENAS)	11.88444444	26.74
KMUP GRP (93,Ref:Bilo Statistik)	622.7	1338.8
KMUP APBD (94,Ref:BAPPEDA II)	35.86666667	80.7
KMUP DBdgt (94,BAPPEDA II)	14.53333333	32.7
KMUP PAD (94,BAPPEDA II)	6.693333333	15.06
KMUPDebt S (94,BAPPEDA II)	1.511111111	3.4
UPG DK Bdgt (94,BAPPEDA II)	2.177777778	4.9
PLP Bdgt to SS (REP VI,BAPPENAS)		0.032

	$	Rp. '000	
Regional Income pc (UPG,93)	521.9	1174.275	(Ref:,Nota Keuangan92/93)
Household Income(pc,UPG,95)	1348.444444	3034	(Ref:DGCK Wastewater Dsep Proj, Review, 94))
Business Entity Income	52742.66667	118671	(Ref:JICA Field Survey, 94)

Unit: US$ million

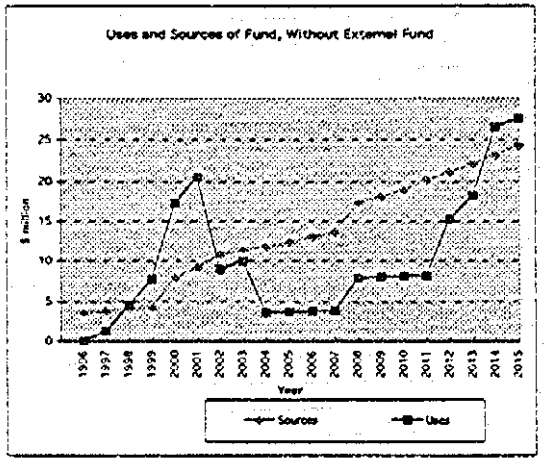
REP	Year	Real GDP	Population	Public Sector Contribution: State Sew/SW Budget	State Sew/SW SS Alloc	State UPG Alloc	Province GRP	Province Sanit'n OwnBdgt	Province UPG Alloc	KMUP GRP	KMUP Sanit'n Budget	Private Sector Contribution: WTP Sewerage	WTP Solid Waste	Beneficiaries' Contribution (Sew)	Capital WCharge (Sew)	Total	Accumulated Balance	Costs: Sewerage Const'n	Sewerage O/M	Sewerage Total	Solid Waste Const'n	Solid Waste O/M	Solid Waste Total	Total Cost Const'n	Total Cost O/M	Total Cost Total
REP VI	1994	132353	1056258.149	60.95733333	1.95	0.43	3142.959995	3.14	0.69	622.7	2.410584993					3.53	3.53									
	1995	160943.415	1093860.939	76.26	2.44	0.54	3315.822795	3.32	0.73	656.9485	2.543167168					3.81	7.35									
	1996	169795.3028	1132802.388	80.51066667	2.58	0.57	3498.193048	3.50	0.77	693.0806675	2.683041362					4.02	11.37	5.78	0.002	5.782	2.11		2.11	7.89	0.002	7.892
	1997	179134.0443	1173130.153	84.94	2.72	0.60	3690.595666	3.69	0.81	731.2001042	2.830608637					4.24	15.61	9.32	0.004	9.324	3.17		3.17	12.49	0.004	12.494
	1998	188986.4169	1214893.587	89.26666667	2.86	0.63	3893.576316	3.89	0.86	771.4161099	2.986292112		3.40			7.86	23.49	8.74	0.005	8.745	5.28	0.90	6.18	14.02	0.91	14.925
REP VII	1999	199380.6699	1258143.798	102.4424297	3.11	1.59	4107.723015	4.11	0.91	813.843996	3.150538178		3.52			9.17	32.66	8.74	0.006	8.746	5.28	1.48	6.76	14.02	1.49	15.506
	2000	210346.6067	1302933.718	102.4424297	3.11	1.64	4333.647781	4.33	0.96	858.6054158	3.323817778	0.37	3.64	0.92	0.04	10.88	43.54	8.74	1.08	9.82	5.28	2.12	7.4	14.02	3.20	17.22
	2001	221915.6701	1349318.158	102.4424297	3.11	1.69	4571.998409	4.57	1.01	905.8287136	3.506627756	0.38	3.76	0.93	0.04	11.34	54.88		1.40	1.4	5.28	2.77	8.05	5.28	4.17	9.45
	2002	234121.0319	1397353.883	102.4424297	3.11	1.75	4823.458321	4.82	1.06	955.6492929	3.699492283	0.39	3.89	0.98	0.04	11.81	66.69		1.40	1.4		2.84	2.84		4.24	4.24
	2003	246997.6887	1447099.683	102.4424297	3.11	1.81	5088.748529	5.09	1.12	1008.210004	3.902964358	0.40	4.02	1.02	0.04	12.31	79.01		1.40	1.4		2.90	2.9		4.30	4.3
REP VIII	2004	260582.5616	1498616.431	133.8881585	4.06	2.08	5368.629698	5.37	1.18	1063.661554	4.117627398	0.41	4.16	1.05	0.04	13.04	92.03		1.40	1.4		2.90	2.9		4.30	4.3
	2005	274914.6024	1551967.176	133.8881585	4.06	2.14	5663.904332	5.66	1.25	1122.16294	4.344096905	0.42	4.30	1.09	0.04	13.59	105.64		1.40	1.4		2.90	2.9		4.30	4.3
	2006	294158.6246	1607217.208	133.8881585	4.06	2.25	6060.377635	6.06	1.34	1200.714345	4.648183688	2.88	4.81	1.13	0.22	17.26	122.90		1.40	1.4		2.95	2.95		4.35	4.35
	2007	314749.7283	1664434.141	133.8881585	4.06	2.33	6484.604069	6.48	1.43	1284.76435	4.975556546	2.97	4.98	1.17	0.22	18.07	140.97		1.40	1.4		2.95	2.95		4.35	4.35
	2008	336782.2093	1723687.996	133.8881585	4.06	2.43	6938.526354	6.94	1.53	1374.697854	5.321705504	3.08	5.15	1.21	0.22	18.94	159.91		1.40	1.4		2.95	2.95		4.35	4.35
REP IX	2009	360356.964	1785051.289	174.9866685	5.31	2.81	7424.223199	7.42	1.64	1470.926704	5.69422489	3.18	5.33	1.25	0.22	20.12	180.03		1.40	1.4		2.95	2.95		4.35	4.35
	2010	385581.9514	1848599.114	174.9866685	5.31	2.92	7943.918825	7.94	1.75	1573.891573	6.092820632	3.29	5.51	1.30	0.22	21.09	201.12		1.40	1.4		2.95	2.95		4.35	4.35
	2011	412572.688	1914409.243	174.9866685	5.31	3.04	8499.993141	8.50	1.87	1684.063983	6.519318076	3.40	5.70	1.34	0.22	22.11	223.23		1.40	1.4		2.95	2.95		4.35	4.35
	2012	441432.7762	1982562.212	174.9866685	5.31	3.18	9094.59266	9.09	2.01	1801.948462	6.975670342	3.52	5.90	1.39	0.22	23.19	246.42		1.40	1.4		2.95	2.95		4.35	4.35
	2013	472354.4705	2053141.427	174.9866685	5.31	3.32	9731.642147	9.73	2.15	1928.084855	7.463967265	3.64	6.10	1.44	0.22	24.33	270.75		1.40	1.4		2.95	2.95		4.35	4.35
REP X	2014	505419.2835	2126233.262	228.700316	6.94	3.83	10412.4571	10.41	2.30	2063.050794	7.986444974	3.77	6.31	1.49	0.22	25.90	296.65		1.40	1.4		2.95	2.95		4.35	4.35
	2015	540798.6933	2201927.166	228.700316	6.94	3.99	11141.75709	11.14	2.46	2207.46435	8.545496122	3.90	6.53	1.55	0.22	27.18	323.83		1.40	1.4		2.95	2.95		4.35	4.35
Total	FY1995-2005					15.46982			11.356438		39.49885893	2.34906556	30.696513	6.005027719	0.266666667	105.64		41.32	8.097	49.417	26.4	18.81	45.21	67.72	26.907	94.627
	(Of which Public sector contribution)															66.32512										
	FY2006-2015					30.05759			18.464487		64.22138804	33.628537	56.308824	13.283586478	2.222222222	218.1898		0	14	14	0	29.5	29.5	0	43.5	43.5
	TOTAL					45.529579			29.820925		103.720247	35.9776026	87.005337	19.2886125	2.488888889	323.8312		41.32	22.097	63.417	26.4	48.31	74.71	67.72	70.407	138.13

Table 3.2 Anticipated Changes in Financial Position by Assistance Modality and Borrowing Amount

Alt 1: Multi-Lateral Agency Fund ($34 million of Loan and $20 million of Grant)

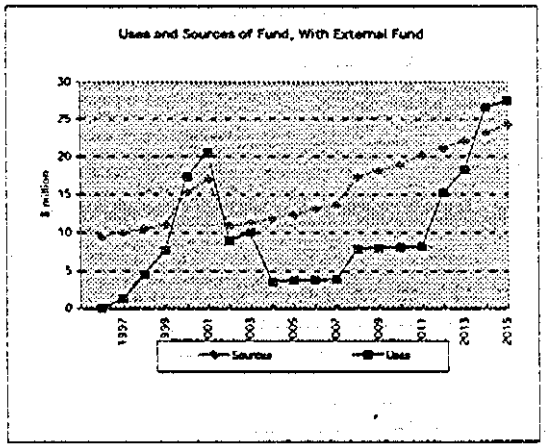
Case 1: Without Borrowing and Grant

Year	Sources	Uses	Net Change
1996	3.53	0.00	3.53
1997	3.81	1.20	2.61
1998	4.02	4.48	-0.46
1999	4.24	7.71	-3.46
2000	7.88	17.29	-9.41
2001	9.17	20.53	-11.36
2002	10.88	8.99	1.90
2003	11.34	10.06	1.28
2004	11.81	3.61	8.21
2005	12.31	3.68	8.64
2006	13.04	3.75	9.30
2007	13.59	3.82	9.77
2008	17.26	7.90	9.36
2009	18.07	8.00	10.07
2010	18.94	8.10	10.83
2011	20.12	8.21	11.91
2012	21.09	15.27	5.81
2013	22.11	18.24	3.87
2014	23.19	26.58	-3.39
2015	24.33	27.53	-3.20



Case 2: With Borrowing and Grant

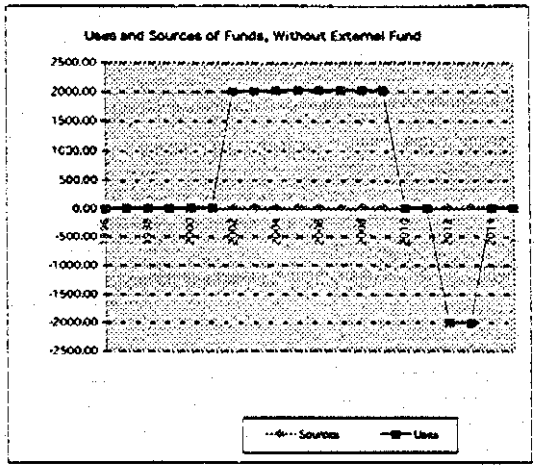
Year	Sources	Uses	Net Change
1996	9.45	0.00	9.45
1997	10.02	1.20	8.82
1998	10.53	4.48	6.06
1999	11.08	7.71	3.37
2000	15.26	17.29	-2.03
2001	16.90	20.53	-3.62
2002	10.88	8.99	1.90
2003	11.34	10.06	1.28
2004	11.81	3.61	8.21
2005	12.31	3.68	8.64
2006	13.04	3.75	9.30
2007	13.59	3.82	9.77
2008	17.26	7.90	9.36
2009	18.07	8.00	10.07
2010	18.94	8.10	10.83
2011	20.12	8.21	11.91
2012	21.09	15.27	5.81
2013	22.11	18.24	3.87
2014	23.19	26.58	-3.39
2015	24.33	27.53	-3.20



Alt 2: Bi-Lateral Agency Fund ($45 million of Loan and $30 million of Grant)

Case 1: Without Borrowing and Grant

Year	Sources	Uses	Net Change
1996	3.53	0.00	3.53
1997	3.81	1.20	2.61
1998	4.02	4.48	-0.46
1999	4.24	7.71	-3.46
2000	7.88	17.29	-9.41
2001	9.17	20.53	-11.36
2002	10.88	2009.53	-1998.64
2003	11.34	2010.59	-1999.25
2004	11.81	2013.61	-2001.79
2005	12.31	2014.68	-2002.36
2006	13.04	2015.75	-2002.70
2007	13.59	2016.82	-2003.23
2008	17.26	2021.90	-2004.64
2009	18.07	2023.00	-2004.93
2010	18.94	8.10	10.83
2011	20.12	8.21	11.91
2012	21.09	-1996.67	2017.76
2013	22.11	-2006.55	2028.66
2014	23.19	8.58	14.61
2015	24.33	8.71	15.62



2. With Borrowing and Grant

Year	Sources	Uses	Net Change
1996	9.45	0.00	9.45
1997	10.02	1.20	8.82
1998	10.53	4.48	6.06
1999	11.08	7.71	3.37
2000	15.26	17.29	-2.03
2001	16.90	20.53	-3.62
2002	10.88	2009.53	-1998.64
2003	11.34	2010.59	-1999.25
2004	11.81	2013.61	-2001.79
2005	12.31	2014.68	-2002.36
2006	13.04	2015.75	-2002.70
2007	13.59	2016.82	-2003.23
2008	17.26	2021.90	-2004.64
2009	18.07	2023.00	-2004.93
2010	18.94	8.10	10.83
2011	20.12	8.21	11.91
2012	21.09	-1996.67	2017.76
2013	22.11	-2006.55	2028.66
2014	23.19	8.58	14.61
2015	24.33	8.71	15.62

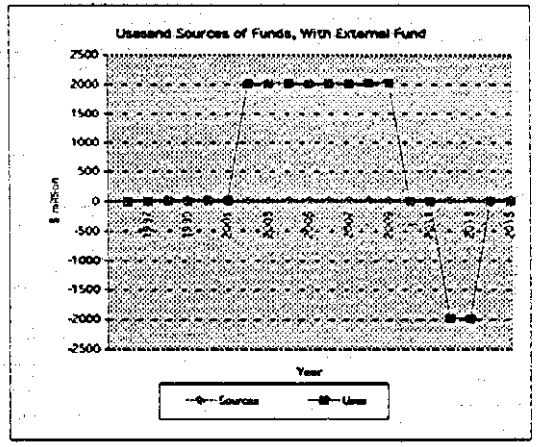


Table 3.3 Income Distribution In Ujung Pandang by Kechamatan, 1995 Rp.'000

	180	280	380	480	580	1000	WAI	Pop	PopWAI
Mariso	0.49	0.19	0.14	0.09	0.06	0.03	267.6	62,833	15.4
Mamajano	0.46	0.19	0.16	0.10	0.05	0.02	249.2	75,269	17.2
Makassar	0.54	0.22	0.13	0.06	0.03	0.01	238.6	101,412	22.2
U.Pandang	0.29	0.25	0.18	0.08	0.11	0.13	224.3	43,385	8.9
Wajo	0.14	0.18	0.19	0.15	0.15	0.19	219.9	50,142	10.1
Bontoala	0.41	0.18	0.10	0.13	0.11	0.08	222.2	72,729	14.8
Tallo	0.49	0.24	0.13	0.09	0.03	0.01	248.6	116,490	26.6
U.Tanah	0.57	0.22	0.12	0.05	0.03	0.02	232.2	54,230	11.6
Panakkukang	0.57	0.24	0.09	0.04	0.06	0.01	221.1	188,744	38.3
Tamalate	0.51	0.22	0.13	0.07	0.04	0.02	239.4	226,821	49.8
Biringkanaya	0.66	0.13	0.09	0.05	0.04	0.02	214.9	97,945	19.3
Kotamadya	0.47	0.21	0.13	0.08	0.07	0.05	231.6	1,090,000	234.2
									2,810.7

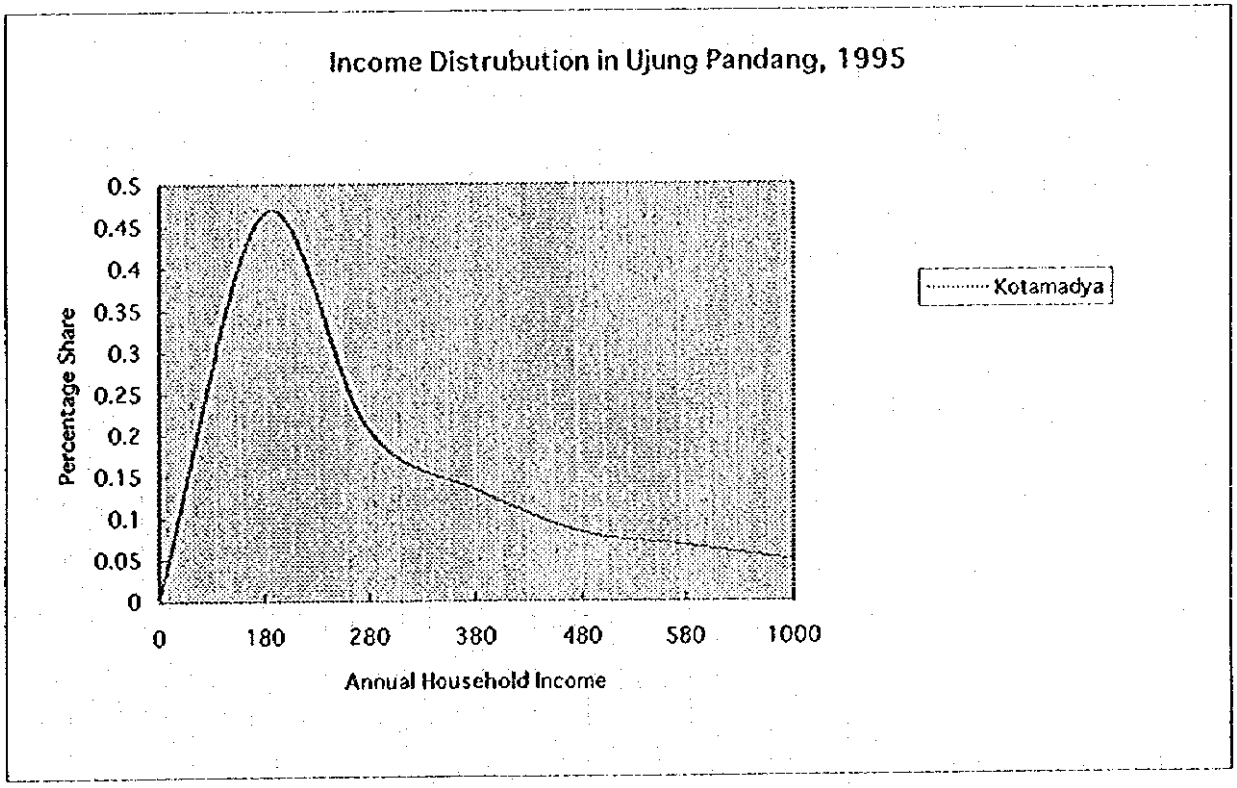


Table3.4 SUMMARY FINANCIAL INTERNAL RATE OF RETURN, TOTAL

(Marginal Cost Pricing)

Year	Capital Cost ($ Mil)	Incremental O/M Cost ($ Mil)	Incremental Cost ($ Mil)	Sewerage (Ton)	Average Price ($/ton)	Capital WCharge ($ Mil)	Incremental Desludge (Ton)	Average Price ($/ton)	Incremental Solid Waste (Ton)	Average Price ($/ton)	Incremental Benefit ($ Mil)	NET CFLOW ($ Mil)
1996	7.9		7.9		0.42		33,600	12.4		24.2	0.4	-7.5
1997	12.5		12.5		0.42		33,600	12.4		24.2	0.4	-12.1
1998	14.0	0.9	14.9		0.42		33,600	12.4	69,000	24.2	2.1	-12.8
1999	14.0	1.5	15.5		0.42		33,600	12.4	83,000	24.2	2.4	-13.1
2000	14.0	3.2	17.2	31,575	0.42		33,600	12.4	149,000	24.2	8.9	-8.4
2001	5.3	4.2	9.4	42,100	0.42	0.04	31,800	12.4	226,000	24.2	12.3	2.9
2002		4.2	4.2	42,100	0.42	0.04	31,800	12.4	240,000	24.2	12.6	8.4
2003		4.3	4.3	42,100	0.42	0.04	31,800	12.4	254,000	24.2	13.0	8.7
2004		4.3	4.3	42,100	0.42	0.04	31,800	12.4	268,000	24.2	13.3	9.0
2005		4.3	4.3	42,100	0.42	0.04	31,800	12.4	282,000	24.2	13.7	9.3
2006		4.3	4.3	42,100	0.42	0.08	31,800	12.4	282,000	24.2	13.7	9.3
2007		4.3	4.3	42,100	0.42	0.08	31,800	12.4	282,000	24.2	13.7	9.3
2008		4.3	4.3	42,100	0.42	0.08	31,800	12.4	282,000	24.2	13.7	9.3
2009		4.3	4.3	42,100	0.42	0.08	31,800	12.4	282,000	24.2	13.7	9.3
2010		4.3	4.3	42,100	0.42	0.08	31,800	12.4	282,000	24.2	13.7	9.3
2011		4.3	4.3	42,100	0.42	0.08	31,800	12.4	282,000	24.2	13.7	9.3
2012		4.3	4.3	42,100	0.42	0.08	31,800	12.4	282,000	24.2	13.7	9.3
2013		4.3	4.3	42,100	0.42	0.08	31,800	12.4	282,000	24.2	13.7	9.3
2014		4.3	4.3	42,100	0.42	0.08	31,800	12.4	282,000	24.2	13.7	9.3
2015		4.3	4.3	42,100	0.42	0.08	31,800	12.4	282,000	24.2	13.7	9.3

FIRR = 11.4%

SUMMARY FINANCIAL INTERNAL RATE OF RETURN, SEWERAGE

(Marginal Cost Pricing)

Capital Cost ($ Mil)	Incremental O/M Cost ($ Mil)	Incremental Cost ($ Mil)	Sewerage (Ton)	Average Price ($/ton)	Capital WCharge ($ Mil)	Incremental Desludge (Ton)	Average Price ($/ton)	Incremental Benefit ($ Mil)	NET CFLOW ($ Mil)
5.8		5.78		0.42		33,600	24.2	0.42	-5.4
9.3		9.33		0.42		33,600	24.2	0.42	-8.9
8.7		8.74		0.42		33,600	24.2	0.42	-8.3
8.7		8.74		0.42		33,600	24.2	0.42	-8.3
8.7	1.1	9.82	31,575	0.42		33,600	24.2	5.25	-4.6
	1.4	1.40	42,100	0.42	0.04	31,800	24.2	6.83	5.4
	1.4	1.40	42,100	0.42	0.04	31,800	24.2	6.83	5.4
	1.4	1.40	42,100	0.42	0.04	31,800	24.2	6.83	5.4
	1.4	1.40	42,100	0.42	0.04	31,800	24.2	6.83	5.4
	1.4	1.40	42,100	0.42	0.04	31,800	24.2	6.83	5.4
	1.4	1.40	42,100	0.42	0.08	31,800	24.2	6.83	5.4
	1.4	1.40	42,100	0.42	0.08	31,800	24.2	6.83	5.4
	1.4	1.40	42,100	0.42	0.08	31,800	24.2	6.83	5.4
	1.4	1.40	42,100	0.42	0.08	31,800	24.2	6.83	5.4
	1.4	1.40	42,100	0.42	0.08	31,800	24.2	6.83	5.4
	1.4	1.40	42,100	0.42	0.08	31,800	24.2	6.83	5.4
	1.4	1.40	42,100	0.42	0.08	31,800	24.2	6.83	5.4
	1.4	1.40	42,100	0.42	0.08	31,800	24.2	6.83	5.4
	1.4	1.40	42,100	0.42	0.08	31,800	24.2	6.83	5.4
	1.4	1.40	42,100	0.42	0.08	31,800	24.2	6.83	5.4

FIRR = 10.5%

SUMMARY FINANCIAL INTERNAL RATE OF RETURN, SOLID WASTE

(Marginal Cost Pricing)

Year	Capital Cost ($ Mil)	Incremental O/M Cost ($ Mil)	Incremental Cost ($ Mil)	Incremental Solid Waste (Ton)	Average Price ($/ton)	Incremental Benefit ($ Mil)	NET CFLOW ($ Mil)
1996	2.1		2.1		24.2		-2.1
1997	3.2		3.2		24.2		-3.2
1998	5.3	0.9	6.2	69,000	24.2	1.7	-4.5
1999	5.3	1.5	6.8	83,000	24.2	2.0	-4.7
2000	5.3	2.1	7.4	149,000	24.2	3.6	-3.8
2001	5.3	2.8	8.0	226,000	24.2	5.5	-2.6
2002		2.8	2.8	240,000	24.2	5.8	3.0
2003		2.9	2.9	254,000	24.2	6.1	3.3
2004		2.9	2.9	268,000	24.2	6.5	3.6
2005		2.9	2.9	282,000	24.2	6.8	3.9
2006		2.9	2.9	282,000	24.2	6.8	3.9
2007		2.9	2.9	282,000	24.2	6.8	3.9
2008		2.9	2.9	282,000	24.2	6.8	3.9
2009		2.9	2.9	282,000	24.2	6.8	3.9
2010		2.9	2.9	282,000	24.2	6.8	3.9
2011		2.9	2.9	282,000	24.2	6.8	3.9
2012		2.9	2.9	282,000	24.2	6.8	3.9
2013		2.9	2.9	282,000	24.2	6.8	3.9
2014		2.9	2.9	282,000	24.2	6.8	3.9
2015		2.9	2.9	282,000	24.2	6.8	3.9

FIRR = 12.7%

Table 3.5 SUMMARY ECONOMIC INTERNAL RATE OF RETURN, TOTAL

Year	Capital Cost ($ Mil)	Incremental O/M Cost ($ Mil)	Incremental Cost ($ Mil)	Wastewater (Ton/yr)	Average Price ($/ton)	Capital WCharge ($ Mil)	Incremental Desludge (Ton/yr)	Average Price ($/ton)	Incremental Solid Waste (Ton)	Average Price ($/ton)	Incremental Benefit ($ Mil)	NET CFLOW ($ Mil)
1996	3.9		3.9	-	0.26		-	27.5		15.8	-	-3.9
1997	2.9		2.9	-	0.26		33,780	27.5		15.8	0.9	-1.9
1998	14.1	1.3	15.4	-	0.26		34,248	27.5	93,805	15.8	2.4	-13.0
1999	13.1	1.4	14.5	-	0.26		34,716	27.5	110,230	15.8	2.7	-11.8
2000	14.5	1.7	16.1	-	0.26		36,120	27.5	168,630	15.8	3.7	-12.5
2001	5.2	2.1	7.3	16,498,000	0.26	0.04	37,524	27.5	185,420	15.8	8.3	1.0
2002		2.0	2.0	16,498,000	0.26	0.04	38,928	27.5	239,805	15.8	9.2	7.2
2003		2.1	2.1	16,498,000	0.26	0.04	40,332	27.5	282,875	15.8	10.0	7.8
2004		2.3	2.3	16,498,000	0.26	0.04	41,736	27.5	285,430	15.8	10.0	7.8
2005		2.3	2.3	16,498,000	0.26	0.04	43,140	27.5	329,960	15.8	10.8	8.5
2006		2.3	2.3	16,498,000	0.26	0.08	43,140	27.5	329,960	15.8	10.8	8.5
2007		2.3	2.3	16,498,000	0.26	0.08	43,140	27.5	329,960	15.8	10.8	8.5
2008		2.3	2.3	16,498,000	0.26	0.08	43,140	27.5	329,960	15.8	10.8	8.5
2009		2.3	2.3	16,498,000	0.26	0.08	43,140	27.5	329,960	15.8	10.8	8.5
2010		2.3	2.3	16,498,000	0.26	0.08	43,140	27.5	329,960	15.8	10.8	8.5
2011		2.3	2.3	16,498,000	0.26	0.08	43,140	27.5	329,960	15.8	10.8	8.5
2012		2.3	2.3	16,498,000	0.26	0.08	43,140	27.5	329,960	15.8	10.8	8.5
2013		2.3	2.3	16,498,000	0.26	0.08	43,140	27.5	329,960	15.8	10.8	8.5
2014		2.3	2.3	16,498,000	0.26	0.08	43,140	27.5	329,960	15.8	10.8	8.5
2015		2.3	2.3	16,498,000	0.26	0.08	43,140	27.5	329,960	15.8	10.8	8.5
	EIRR =	11.7%										

SUMMARY ECONOMIC INTERNAL RATE OF RETURN, SEWERAGE

Year	Capital Cost ($ Mil)	Incremental O/M Cost ($ Mil)	Incremental Cost ($ Mil)	Wastewater (Ton)	Average Price ($/ton)	Capital WCharge ($ Mil)	Incremental Desludge (Ton)	Average Price ($/ton)	Incremental Benefit ($ Mil)	NET CFLOW ($ Mil)
1996	2.92		2.92		0.26			27.50		-2.92
1997	1.42	0.27	1.69		0.26		33,780	27.50	0.93	-0.76
1998	9.34	0.37	9.71		0.26		34,248	27.50	0.94	-8.77
1999	9.13	0.38	9.52		0.26		34,716	27.50	0.95	-8.56
2000	9.09	0.40	9.49		0.26		36,120	27.50	0.99	-8.50
2001		0.80	0.80	16498000	0.26	0.04	37,524	27.50	5.39	4.58
2002		0.81	0.81	16498000	0.26	0.04	38,928	27.50	5.42	4.62
2003		0.81	0.81	16498000	0.26	0.04	40,332	27.50	5.46	4.65
2004		0.82	0.82	16498000	0.26	0.04	41,736	27.50	5.50	4.68
2005		0.83	0.83	16498000	0.26	0.04	43,140	27.50	5.54	4.71
2006		0.83	0.83	16498000	0.26	0.08	43,140	27.50	5.54	4.71
2007		0.83	0.83	16498000	0.26	0.08	43,140	27.50	5.54	4.71
2008		0.83	0.83	16498000	0.26	0.08	43,140	27.50	5.54	4.71
2009		0.83	0.83	16498000	0.26	0.08	43,140	27.50	5.54	4.71
2010		0.83	0.83	16498000	0.26	0.08	43,140	27.50	5.54	4.71
2011		0.83	0.83	16498000	0.26	0.08	43,140	27.50	5.54	4.71
2012		0.83	0.83	16498000	0.26	0.08	43,140	27.50	5.54	4.71
2013		0.83	0.83	16498000	0.26	0.08	43,140	27.50	5.54	4.71
2014		0.83	0.83	16498000	0.26	0.08	43,140	27.50	5.54	4.71
2015		0.83	0.83	16498000	0.26	0.08	43,140	27.50	5.54	4.71
EIRR	10.8%									

SUMMARY ECONOMIC INTERNAL RATE OF RETURN, SOLID WASTE

Year	Capital Cost ($ Mil)	Incremental O/M Cost ($ Mil)	Incremental Cost ($ Mil)	Incremental Solid Waste (Ton)	Average Price ($/ton)	Incremental Benefit ($ Mil)	NET CFLOW ($ Mil)
1996	0.95		0.95		15.76		-0.95
1997	1.45		1.45		15.76		-1.45
1998	4.72	0.95	5.67	93,805	15.76	1.48	-4.19
1999	3.99	0.99	4.98	110,230	15.76	1.74	-3.24
2000	3.99	1.27	5.26	168,630	15.76	2.66	-2.60
2001	5.38	1.33	6.71	185,420	15.76	2.92	-3.79
2002		1.24	1.24	239,805	15.76	3.78	2.54
2003		1.30	1.30	282,875	15.76	4.46	3.16
2004		1.46	1.46	285,430	15.76	4.50	3.04
2005		1.44	1.44	329,960	15.76	5.20	3.77
2006		1.44	1.44	329,960	15.76	5.20	3.77
2007		1.44	1.44	329,960	15.76	5.20	3.77
2008		1.44	1.44	329,960	15.76	5.20	3.77
2009		1.44	1.44	329,960	15.76	5.20	3.77
2010		1.44	1.44	329,960	15.76	5.20	3.77
2011		1.44	1.44	329,960	15.76	5.20	3.77
2012		1.44	1.44	329,960	15.76	5.20	3.77
2013		1.44	1.44	329,960	15.76	5.20	3.77
2014		1.44	1.44	329,960	15.76	5.20	3.77
2015		1.44	1.44	329,960	15.76	5.20	3.77
	EIRR =		12.9%				

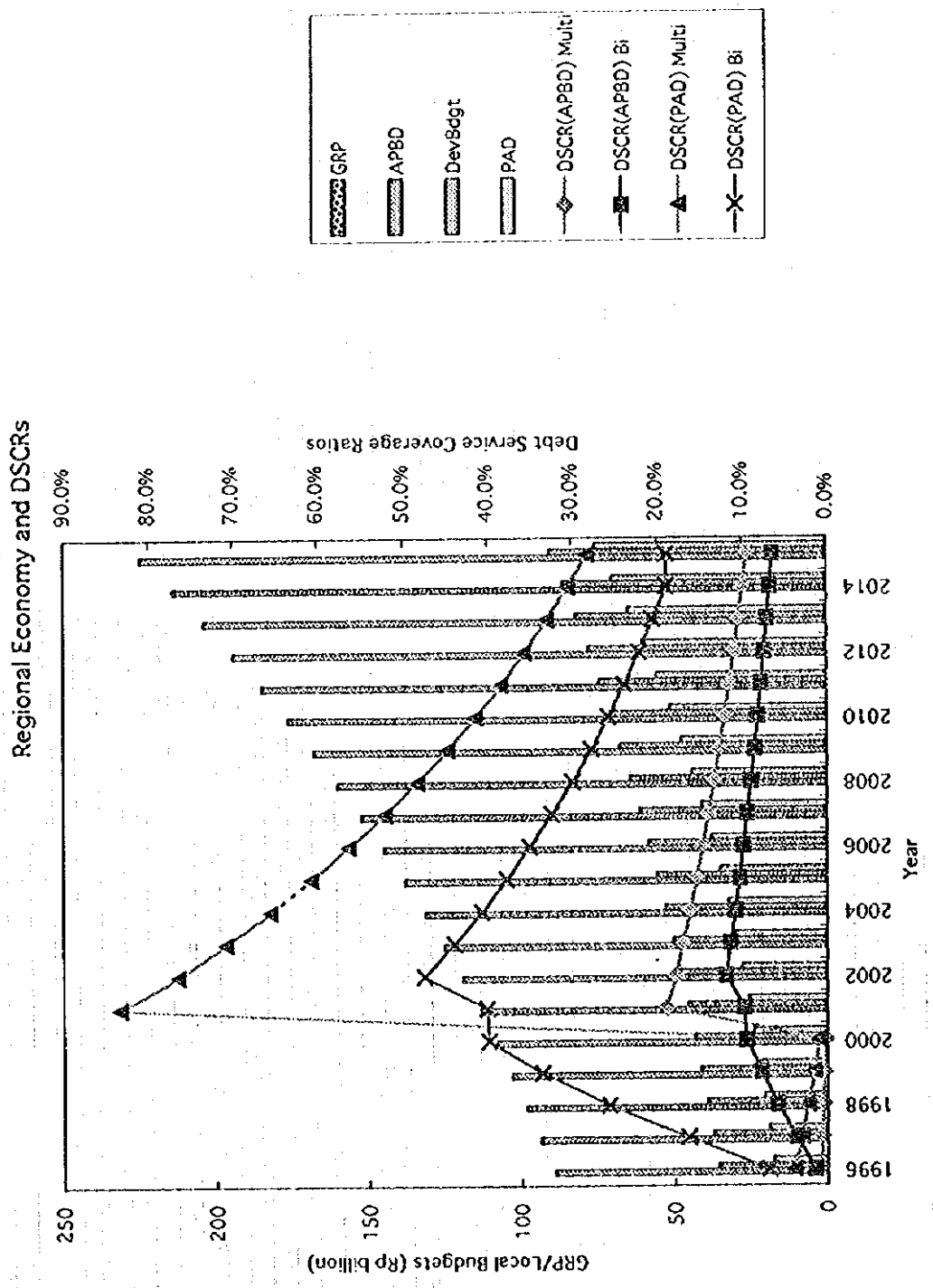


FIG. 3.1	Regional Economy of UPG (Rp billion) and the DSRs (percent), 1995 - 2015

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

JICA A.D.1994

IV ENVIRONMENTAL CONSIDERATIONS

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IV ENVIRONMENTAL CONSIDERATIONS

1. Introduction

There is a significant difference in environmental condition between the developed city centre areas adjacent to the coastal area and the undeveloped fringe areas at inland in the KMUP (Kotamadya Ujung Pandang).

The water quality of drains and canals through the city centre, including the Panampu - Jongaya channel, is visibly deteriorated. The principal cause of this surface water quality deterioration is the discharge of untreated graywater arising from washing and bathing, which essentially comprise the run-off during dry season.

On the other hand the water quality of surface waters at inland of the Panampu - Jongaya channel towards the east, the fringe areas with low population density, is relatively unpolluted.

The groundwater quality deterioration is rather widespread with bacterial pollution. The principal cause is anticipated to be the leaching from septic tanks/leaching pits. Still this groundwater quality deterioration is not a significant public health threat, since groundwater is not used for drinking whenever PDAM water supply is available. Moreover even when groundwater is used for drinking purpose, prior boiling is customary in all over Indonesia.

Concerning coastal seawater quality, significant deterioration including solid waste pollution is noted around the commercialized and high population density coastal areas of Kec. Ujung Pandang and Kec. Mariso.

The coastal areas of Kec. Mariso around the bay area (Mariso bay) comprises a congested low income slum area.

Vehicular emission is identified to be the principal source of ambient air quality deterioration. Significant air pollution was documented in the traffic congested areas like Jl. Somba Opu and the central bus terminal in Panaikang.

2. Water Environmental Conditions

The water environment of the Study Area is comprised of groundwater, coastal seawater and inland surface water. The water quality of these water bodies are studied both by using the recent available water quality data and direct sampling and analysis conducted by the Study Team.

2.1 Available Data

There exists no permanent water quality monitoring stations in the KMUP. Hence no time series data on water quality is available.

The recent water quality of groundwater, coastal seawater including the river mouth estuary areas and inland surface waters of rivers were measured by three (3) major recent project studies conducted during the period of 1992 ~ 1994. The locations of sampling by all these studies are shown in *Fig.* 4.1.

The title and the respective source of water measured for quality by each of these three (3) studies are given below.

(1) Monitoring of Water Pollution in the Coastal Sea Area of Ujung Pandang (Pemantauan Bahan Pencemar Kawasan Pantai Ujung Pandang), Centre of Environmental Studies, Hasanuddin University (1992). This will be referred to as Study-1.

The water quality sampling locations of the above project study covered groundwater, coastal seawater including the river mouth areas of Jeneberang and Tallo rivers.

The sampling locations of each type of sources are denoted as follows (ref. *Fig.* 4.1).

1) Groundwater quality sampling (Nine (9) locations, SM1 ~ SM9)

2) Seawater quality sampling (Fourteen (14) locations, L1 ~ L14)

3) River mouth water quality sampling (Four (4) locations, S1 ~ S4)

(2) Monitoring Report on Groundwater Quality in the Surrounding Area of Panampu - Jongaya Drainage Channel and Surface Water of Lower Jeneberang River, Directorate of Rivers (1993). This will be referred to as Study-2.

The sampling locations of the above study covered groundwater along Panampu - Jongaya Channel and its vicinity and lower reaches of Jeneberang river.

The locations for each type of sources are as follows (ref. *Fig.* 4.1).

1) Groundwater quality sampling along Pamampu - Jongaya Channel (Eight (8) locations, PJ1 ~ PJ8)

2) Groundwater quality sampling across Panampu - Jongaya Channel (Four (4) locations, I1 ~ I4)

3) Lower Jeneberang river water quality sampling (Four (4) locations, JB1 ~ JB4 The location JB4 is beyond the study area in Kab. Gowa)

(3) Monitoring of River Water Quality along the Coastal Areas in South Sulawesi (Kajian dan Pemetaan Kwalitas Air Pada Muara Sungai Sekitar Kawasan Pantai Sulawesi Selatan), Environmental Division of Level-1 Government of South Sulawesi (1994). This will be referred to as Study-3.

The sampling locations of the above study, though covered only rivers, covered many rivers of South Sulawesi Regency nearby their respective estuary areas. Only two (2) sampling locations were in an around the Study Area (KMUP), one each in Tallo River and Jeneberang River.

These river sampling locations are denoted as follows (ref. *Fig.* 4.1).

1) Tallo River (One location, R1)

2) Jeneberang River (One location, R2. This location is beyond the study area in Kab. Gowa)

Moreover, groundwater quality, in addition to that of supplied potable water by PDAM and that of raw water for PDAM water treatment plant from Maros River, is monitored by the Health Division of the KMUP (Dinas Kesahatan - KMUP).

The locations of groundwater quality sampling are selected randomly covering the entire KMUP (study area) with bacterial count being the principal parameter of measurement.

The water quality monitoring results of all these studies and programmes are delineated according to the source of sampling of groundwater, coastal seawater and inland surface water and illustrated below.

2.1.1 Groundwater quality

The recent available data on groundwater quality were obtained from Study-1 (1992), Study-2 (1993) and the Health Division of KMUP (1992 - 1993).

(1) Study-1 of 1992

The groundwater quality at nine (9) locations of existing wells were measured two (2) times by the Study-1 of 1992 (Locations SM1 ~ SM9 of *Fig.* 4.1), once each in rainy season (March, 1992) and dry season (July, 1992). As evident from *Fig.* 4.1, all these sampling locations are along the coastal area between Ujung Tanah and Mariso.

The parameters measured included physical, chemical and biological ones, including synthetic organics and heavy metals. The results of 38 parameters measured, respectively, during the rainy season and dry season are shown in *Table* 4.1a and *Table* 4.1b.

As the significant parameters, range in value of BOD and TC (total coliform) noted during each sampling were as follows:

BOD in rainy season:	1.6 ~ 2.3 mg/l
BOD in dry season:	1.5 ~ 2.1 mg/l
TC in rainy season:	nil (0) ~ 46 No./ml
TC in dry season:	nil (0) ~ 75 No./ml

The TC level of nil (0) was recorded only in one location, during both times, at SM1. Significant bacterial pollution was measured in all other locations. The heavy metal and synthetic organic matter levels measured during both sampling were insignificant.

In spite of the fact that all these sampling locations were nearby the coastal area, the chloride levels (Cl^-) measured were very low, in the range of 14 ~ 45 mg/l.

(2) Study-2 of 1993

The groundwater quality in and around Panampu - Jongaya Channel, a polluted drainage channel, were measured at 12 locations by this Study, of which eight (8) locations (PJ1 ~ PJ8) were along the channel and four (4), I1 ~ I4, across the channel (ref. *Fig.* 4.1).

The sampling of the wells along the channel (PJ1 ~ PJ8) were conducted twice, both during rainy season (April 1993) and dry season (July 1993). The results of rainy season and dry season samplings are shown, respectively, in *Table* 4.2a and *Table* 4.2b.

On the other hand, the sampling of wells across the channel (I1 ~ I4) was conducted only once in dry season (July 1993), and the results are shown in *Table* 4.2c.

In all these three (3) samplings rather high BOD levels were measured, as shown below.

Sampling	BOD Level
Rainy Season of PJ1 ~ 8	14.3 ~ 28.4 mg/l
Dry Season of PJ1 ~ PJ8	21.3 ~ 32.1 mg/l
Dry Season of I1 ~ I4	21.6 ~ 25.3 mg/l

Moreover significant bacterial pollution with total coliform (TC) in the range of 900 ~ 7,800 No/100 ml were measured in the eight (8) locations of PJ1 ~ PJ8.

Bacterial pollution level in the four (4) locations of I1 ~I4 was not known, as it was not measured.

(3) Monitoring by Health Division of KMUP

Groundwater quality in the KMUP is continuously monitored, principally for its bacterial quality, by the Health Division (Dinas Kesehatan) of KMUP, on a random basis.

The groundwater quality results obtained during the one (1) year period of 1992 - 1993 covered all eleven (11) Kecamatans, if not all 142 Kelurahans.

The breakdown of the number of sampling locations (dug wells) on a Kelurahan basis along with the respective results of groundwater quality are shown in *Table* 4.3.

The groundwater quality data for a total of 221 wells in KMUP are provided in *Table* 4.3. As evident from the above table, bacterial pollution with high TC value exceeding 1,000 No./100 ml is rather widespread throughout the Study Area (KMUP). In fact a total of 128 locations, representing about 58 % of the wells, recorded TC levels exceeding 1,000 No./100 ml.

2.1.2 Coastal seawater quality

The available data on coastal seawater quality including that of the river mouth estuary areas of the Jeneberang River and Tallo River were measured only by the Study-1 of 1992.

Water quality sampling was done two (2) times both during rainy season (March, 1992) and dry season (July, 1992). Moreover at each locations sampling were done twice both during low tidal and high tidal conditions of the sea.

The results of 38 water quality parameters measured in the fourteen (14) coastal seawater locations of L1 ~L14 (ref. *Fig.* 4.1), respectively during the rainy season and dry season are shown in *Table* 4.4a and *Table* 4.4b. The corresponding results in the four (4) river mouth locations of S1 ~ S4, respectively during the rainy season and dry season are shown in *Table* 4.5a and *Table* 4.5b. The range of significant water quality parameters of BOD, COD and TC measured in the 14 locations of coastal seawaters (L1 ~L14) are as follows (ref. *Table* 4.4).

Parameter	Rainy Season	Dry Season
BOD	1.1 ~ 2.4 mg/l	0.8 ~ 1.5 mg/l
COD	20.2 ~ 58.3 mg/l	19.0 ~ 53.1 mg/l
TC	nil (0) ~ 10 No./ml	nil (0) ~ 9 No./ml

The above results indicate significant COD levels at all locations.

Moreover significant heavy metal levels of Cr (chromium) and Zn (zinc), respectively in the range of about 0.02 ~ 0.09 mg/l (Cr) and 0.18 ~ 0.44 mg/l (Zn) were measured. Other than these no significant heavy metal or synthetic organic matters were noted.

In the case of the river mouth estuary locations of S1 ~ S4 (4 locations) the corresponding parameter ranges measured were as follows (ref. *Table* 4.5).

Parameter	Rainy Season	Dry Season
BOD	2.2 ~ 4.0 mg/l	1.9 ~ 3.3 mg/l
COD	14.9 ~ 35.6 mg/l	8.9 ~ 51.2 mg/l
TC	3 ~ 230 No./ml	nil (0) ~ 240 No./ml

The above river mouth water quality data are of the same order as those of the coastal seawaters. However the bacterial pollution level, measured as TC, is much higher than that of the coastal waters.

Morcover, similar to that of coastal water, significant levels of Cr and Zn, respectively, in the range of about 0.0 ~ 0.04 mg/l (Cr) and 0.17 ~ 0.41 mg/l (Zn) were measured. Other than those, no significant heavy metals or synthetic organics were noted.

2.1.3 Inland surface water quality

The recent available inland surface water quality data are confined to the two (2) major rivers in the Study Area, the Jeneberang River and Tallo River. Even among these two (2) rivers, most data are available for Jeneberang River.

Jeneberang River has more direct beneficial uses, including as a major source of potable raw water intake for Ujung Pandang, in comparison to Tallo River.

The available river water quality data were measured by the Study-2 of 1993 and Study-3 of 1994.

(1) Study-2 of 1993

The water quality of Jeneberang River in its lower reaches were measured at four (4) locations of JB1 ~ JB4 (ref. *Fig.* 4.1), during dry season (Sept. 1993), by this study.

The results of reported water quality data are shown in *Table* 4.6.

Significant water quality parameters measured were DO (dissolved oxygen) and COD.

The reported level of DO was in the range of about 6.0 ~ 6.5 mg/l, indicating aerobic conditions, while that of COD in a conspicuous range of about 93 ~ 144 mg/l.

High chloride (3.4 ~ 19.0 g/l) and salinity (6 ~ 34 g/l) levels were measured at all four (4) sampling locations of the river. Accordingly, all these river locations should be within the estuary (tidal) reaches.

(2) Study-3 of 1994

One location each in Tallo River (R1) and Jeneberang River (R2) are the only ones where water quality were measured in and around the vicinity of KMUP by this study (ref. *Fig.* 4.1). The sampling was conducted during rainy season in March 1994.

The results of reported water quality data are shown in *Table* 4.7.

The DO levels were in the range of about 7 ~ 7.3 mg/l, clearly indicating aerobic conditions in the two (2) river locations, while the BOD were the same of about 5.7 mg/l.

The measured levels of TC were in the range of 4,800 ~ 5,200 No./100 ml, a significant bacterial pollution.

A striking difference between the two (2) rivers was their difference in salinity. The salinity level measured at Tallo River (R1) was about 9.1 g/l while that of Jeneberang River (R2) was 0.14 g/l. Accordingly, it could be concluded that R1 (Tallo) is within the tidal reaches, while R2 (Jeneberang) beyond the tidal reaches.

2.2 Sampling by JICA

The Study Team conducted water quality sampling and analysis covering groundwater, coastal seawater and inland surface waters of canals and rivers in the Study Area. This survey is to supplement the available data on water quality and also to confirm the existing water environmental conditions of the Study Area (Kotamadya Ujung Pandang - KMUP).

The dry season sampling was conducted during August 1994, and the rainy season sampling in the same locations during January - February 1995.

The water quality sampling results obtained are illustrated in the subsequent sections, for each of groundwater, coastal seawater and inland surface water.

2.2.1 Groundwater Quality

The groundwater sampling was conducted in ten (10) existing dug wells covering the entire Study Area. Of these ten (10) locations, seven (7), No. 1 ~ No. 7, are in and around the existing urban area of Ujung Pandang, adjacent to the coastal area. While, the remaining ones are in rural areas, but still in the vicinity of housing/institutional developments. The sampling locations are shown in *Fig.* 4.2.

The water quality parameters measured are as follows.

Ambient Temperature, Water Temperature, pH, Total Solids (TS), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Nitrogen (T-N), Total Phosphorus (T-P), Total Coliform (TC), Ammonia Nitrogen (NH_4N), Nitrate Nitrogen (NO_3N), Chloride (Cl^-), Sulfate (SO_4^{2-}) and the heavy metal ions of Lead (Pb), Arsenic (As) Cadmium (Cd), Mercury (Hg) and Hexavalent Chromium (Cr^{6+}).

The results of groundwater quality analysis of dry season any rainy season are summarized respectively in *Table* 4.8a and *Table* 4.8b.

All sampled wells exhibited significant pollution both in terms of BOD (organic pollution) and TC (bacterial pollution) during dry season.

The dry season BOD levels of the wells were in the range of about 5 ~ 10 mg/l, with the minimum value of 5.2 mg/l being recorded at Sambung Jawa (No. 1) and the maximum value of 9.7 mg/l at Ujung Tanah (No. 6).

On the other hand, a very significant change in TC levels was noted between the dry season and rainy season sampling results of the wells.

The rainy season BOD levels were in the range of about 3 ~ 15 mg/l. Even though this BOD range exceeded that of dry season, in and overall sense, no significant seasonal change in BOD level, between the dry season and rainy season, in the sampled wells was noted.

The TC levels in dry season were the range of about 250 ~ 7,500 No./100 ml, with the minimum bacterial pollution level of 250 No./100 ml in the well located at Minasaupa housing area in Gunung Sari (No. 10), and the maximum level of 7,500 No./100 ml in the well located in a student hostel of Hasanuddin University (UNHAS - No. 9).

In contrast, excellent bacterial water quality was recorded in rainy season with most wells recording a nil (0) TC levels.

Heavy metal pollution level in all the sampled wells, both during dry season and rainy season is insignificant in an overall sense. Still, significant lead (Pb) in the order of about 0.05 mg/l was measured at five (5) locations (No. 4 ~ No. 6, No. 9 ~ No. 10), during dry season.

Hence as expected, very significant improvement is ground water quality during rainy season is noted, which is attributed to the dilution effect of rain water.

2.2.2 Coastal Seawater Quality

The coastal seawater quality sampling was conducted at four (4) locations, two (2) each in river mouth estuary areas (Tallo River and Jeneberang River) and coastal sea areas.

The locations are as follows:

No. 1: Tallo River Mouth area
No. 2: Central point of the coastal sea area between the main land area of Ujung Pandang and the tourism island of Kayangan
No. 3: Central point of the coastal area leading to the internal bay of Kec. Mariso, denoted as "Mariso Bay"
No. 4: Jeneberang River Mouth area

The locations of sampling are shown in *Fig.* 4.3.

The water quality parameters measured are as follows:

Ambient Temperature, Water Temperature, pH, Suspended Solids (SS), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Nitrogen (T-N), Total Phosphorus (T-P), Total Coliform (TC), Chloride (Cl^-), Sulfate (SO_4^{2-}) and the heavy metal ions of Lead (Pb), Arsenic (As), Cadmium (Cd), Mercury (Hg) and Hexavalent Chromium (Cr^{6+}).

The results of seawater quality analysis of dry season and rainy season are summarized respectively in *Table* 4.9a and *Table* 4.9b.

The BOD levels measured are in the range of 2.8 ~ 6.3 mg/l, while that of COD in the range of about 10 ~ 20 mg/l, with no significant difference between dry season and rainy season water quality.

This amount to significant organic pollution for coastal waters.

The TC (total coliform) levels measured in dry season were of very wide range, from 230 No./100 ml at the Jeneberang River Mouth to more than 100,000 No./100 ml at the Tallo River Mouth. Nevertheless , very low TC levels, mostly of nil (0) count, were noted in rainy season. In spite of this wide range of results, the bacterial pollution in the coastal waters, in an overall sense, is very significant.

The heavy metal elements of hexavalent chromium (Cr^{6+}), in dry season was measured to be in the range of about 0.01 ~ 0.02 mg/l. This heavy metal pollution level is rather significant. Still in an overall sense heavy metal elements measured are not significant.

2.2.3 Inland surface water quality

The inland surface water quality sampling was conducted at twelve (12) locations, that covered both the drainage canals and rivers in the Study Area. Of these twelve (12) locations, ten (10) locations are in the major drainage canals of the city centre of Ujung Pandang and it vicinity. The remaining two (2) locations are one each in the Pampang River (No. 4) and Jeneberang River (No. 5).

The sampling locations are shown in *Fig.* 4.4.

Composite sampling for four (4) times at 8-hour interval for 24 hours was done at each sampling locations of canals.

The water quality parameters measured are as follows:

Ambient Temperature, Water Temperature, pH, Suspended Solids (SS), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Nitrogen (T-N), Total Phosphorus (T-P), Total Coliform (TC), Chloride (Cl^-), Sulfate (SO_4^{2-}) and the heavy metal ions of Lead (Pb), Arsenic (As), Cadmium (Cd), Mercury (Hg) and Hexavalent Chromium (Cr^{6+}).

The results of water quality analysis of dry season and rainy season are summarized respectively in *Table* 4.10a and *Table* 4.10b.

All the sampled canals, as could be anticipated are polluted in comparison to that of rivers, specifically during the dry season.

The measured dry season BOD level in canals was in the range of about 50 ~ 180 mg/l while that of the two (2) rivers was 11 ~ 15 mg/l. In fact, the BOD level in most canals was in the range of 120 ~ 180 mg/l.

Hence, the organic pollution level in the canals is very high. In fact they are open sewers, with no other beneficial use.

It is also noted that the effect of dilution due to surface run-off of rain water, during rainy season, is very significant in improving the canal water quality.

This is evident from the rainy season BOD level, which did not exceed 30 mg/l in all twelve (12) sampling locations.

The bacterial pollution level, measured as TC (total coliform), in all sampling locations during dry season was mostly in the order of 10^4 ~ 10^5 No./100 ml, including the rivers, which is very significant. The only one (1) location with a TC count in the order of 10^3 No./100 ml (4.3×10^3 No./100 ml) was Canal Jongaya (No. 3).

However during rainy season, similar to that of BOD, very significant improvement in bacterial water quality of canals and rivers is noted.

Significant hexavalent chromium (Cr^{6+}) level in the order of about 0.01 mg/l was noted in most canal locations (No. 1, No. 2, No. 7, No. 9 ~ No. 12) during dry season. Significant cadmium (Cd) level in the order of 0.01 mg/l was also noted in some canal locations (No. 1, No. 2, No. 11) and the Jeneberang River (No. 5).

However, during rainy season no heavy metal pollution is noted

The chloride (Cl^-) level in most sampling locations during dry season including the two (2) rivers exceeded 1,000 mg/l. Only at two (2) canal locations in Jl. Veteran (No. 8) and Jl. Penghibur (No. 9) rather low chloride level of about 700 mg/l was measured. Accordingly, tidal effect on most of the canals and both the rivers seem to be very significant in dry season.

A striking improvement in chloride level in rainy season, to that of fresh water quality, was measured in all twelve (12) sampling locations. In fact the maximum chloride level measured was only 10 mg/l.

This clearly demonstrated the significance of surface run-off due to rain water in improving the water quality of canals in the city centre of Ujung Pandang.

2.3 Water Quality Evaluation

The overall water environmental conditions of the Study Area (KMUP) is determined based on the evaluation of water quality, as obtained from both the available data and sampling by JICA. The water quality conditions as per the above data are illustrated in the foregone sections. The relevant Indonesian water quality standards are referred to in evaluating the water quality, as appropriate.

An evaluation of water quality for each of the three (3) components of groundwater, coastal seawater and inland surface water is given below.

2.3.1 Groundwater quality

The available data on the quality of groundwater are shown in *Table* 4.1 ~ *Table* 4.3. The JICA sampling results are shown in *Table* 4.2.8. The sampling location are shown in *Fig.* 4.1 (available data) and *Fig.* 4.2 (JICA).

It is evident from all these results that bacterial pollution of groundwaters in the Study Area, measured mostly as TC (total coliform), is widespread. Only a few data indicated nil (0) TC count. None of the wells sampled by JICA during dry season produced nil (0) TC count, even though most wells showed nil (0) TC count during sampling in rainy season. This implies, as expected, the bacteriological groundwater quality during dry season is representative to critical condition.

Accordingly most well waters are not suited for direct potable use with no treatment, since they do not meet consistently the necessary bacteriological standards for such use as per Classification-A of the usage based national water quality standards of MENLH, shown in *Table* 4.11 (Decree-02/MENKLH/I/1988).

Standards of Classification-A stipulates a bacterial count of nil (0) with respect to both TC (total coliform) and FC (fecal coliform), for direct potable use.

The Classification-B as per the above national standards is for a potable source with treatment. The standard limitation of BOD and TC for Classification-B is as follows (ref. *Table* 4.11).

BOD ≤ 6 mg/l
TC ≤ 10,000 No./100 ml

Since none of the groundwater quality data produced an absolute TC count exceeding 10,000 No./100 ml, bacteriologically all wells meet the standards of Classification-B, for a potable source with treatment.

Still the BOD levels measured in all ten (10) wells of JICA sampling (ref. *Table* 4.8) was in the range of about 5 ~ 17 mg/l, with nine (9) wells recording BOD levels exceeding the standard limitation of 6 mg/l for Classification-B, at least once (either during the dry season sampling or the rainy season sampling), marginally.

In this regard, it is noted that usage based river water quality standards of DKI Jakarta (Governor's Decree No. 1608), shown in *Table* 4.12, allows a maximum BOD level of 10 mg/l for a potential river water source for potable use.

Leaching systems of onsite human waste disposal such as septic tanks and leaching pits, in fact leaching pits are predominant in the study area, should be the principal source of bacterial pollution of groundwaters. This may also a significant source of organic pollution (BOD), even though soil characteristics such as peat soil would as well be a significant source of dissolved organics in groundwaters.

Public health threat due to bacterial pollution of groundwaters may not be significant, as it is customary in the Study Area, in fact Indonesia as a whole in general, to boil drinking water, which is an effective bacteriological water treatment process.

High salinity/chloride (Cl^-) levels in some localized groundwaters, including some wells sampled by JICA, exceeding the recommended limitation of 600 mg - Cl/l for a potable source as per Classification-B of the national standards, were noted. Still, it is not related to the proximity of their location to the coastal areas. Extremely low salinity/chloride levels were also reported in wells located near coastal areas. Accordingly, salinity intrusion of seawater into groundwater is not suspected.

Based on the groundwater quality data on heavy metals, including the sampling results of JICA, heavy metal constituents in groundwaters, other than that of lead (Pb) as noted in some cases, are insignificant.

In an overall sense, it is concluded that the groundwaters in the Study Area are suited as potable sources with treatment, even though their bacteriological and organic pollution levels are very significant for a groundwater.

Still, the progressing of groundwater pollution is a serious concern to be dealt with appropriate countermeasures.

2.3.2 Coastal seawater quality

The available data on coastal seawater quality, including that of the river mouths of the Jeneberang and Tallo Rivers are shown in *Table* 4.4 and *Table* 4.5. The results of JICA sampling are shown in *Table* 4.9. The sampling locations are shown in *Fig.* 4.1 (available data) and *Fig.* 4.3 (JICA).

The bacteriological pollution measured as TC (total coliform) showed wide variation in both the available data as of Study-1 (1992) and the JICA results. Two sampling locations, Tallo River Mouth and Jeneberang River Mouth are essentially common to both the available data study, denoted respectively as locations S4 and S1, and JICA sampling, denoted respectively as location No. 1 and No. 4.

The highest TC levels by both the available data (ref. *Table* 4.5) and that of this JICA sampling during dry season (ref. *Table* 4.9a) were recorded at Tallo River Mouth (Location S4/No. 1).

Accordingly bacterial pollution in river mouth areas near to land is more pronounced than that of coastal seawaters at further off-shore.

The highest TC levels recorded by both data at Tallo River Mouth are as follows:

Source	TC level
Available data (July, 1992)	240 No./ml (2.4×10^4 No./100 ml)
JICA dry season sampling (Aug., 1994)	1.1×10^5 No./100 ml

The national coastal seawater quality standards shown in *Table* 4.13, stipulates a permissible limit of 1,000 No./100 ml as TC for most beneficial uses, including swimming/bathing (Decree-02/MENKLH/1/1988).

The above TC levels in the order of $10^4 \sim 10^5$ No./100 ml is well above the standard limitation of 10^3 No./100 ml.

Accordingly, it is concluded that the bacterial pollution in coastal waters of Ujung Pandang is very significant, specially during dry season.

The permissible limitation with respect to BOD and COD, as per this national coastal seawater quality standards of 1988, for most beneficial uses are as follows.

BOD ≤ 20 mg/l
COD ≤ 40 mg/l

The range of BOD and COD levels as per the available data and JICA sampling are as follows.

Source	BOD range	COD range
Available data (1992)	0.8 ~ 4.0 mg/l	8.9 ~ 58.3 mg/l
JICA dry season sampling (1994)	2.8 ~ 4.5 mg/l	14.7 ~ 22.6 mg/l
JICA rainy season sampling (1995)	3.8 ~ 6.3 mg/l	9.5 ~ 16 mg/l

According to above results, the range of BOD between both data are about the same order of 1 ~ 6 mg/l, while that of COD was rather wide. Hence, the results of BOD are considered to be representative to the coastal seawater quality.

This BOD range of about 1 ~ 6 mg/l is within the national standard limitation for most beneficial uses of 10 mg/l, for coastal seawaters.

Still, an average BOD level of 4 mg/l represents significant organic pollution for a coastal seawater, though not to a critical degree.

The heavy metal pollution level of hexavalent chromium (Cr^{6+}), in the range of about 0.01 ~ 0.02 mg/l, as measured by the JICA sampling during dry season is significant (ref. *Table* 4.9a). This level critically exceeds the national standard limitation of 0.01 mg/l for swimming/bathing use of coastal waters (ref. *Table* 4.13). Still, insignificant heavy metal pollution was measured during rainy season (ref. *Table* 4.9b).

A similar results of rather high chromium (Cr) level and also zinc (Zn) level was reported as per the available data (1992) as well. Other than these two (2) constituents the heavy metal and synthetic organic pollution levels of the coastal waters of the Study Area is assessed to be insignificant.

The principal cause of bacterial and organic pollution of the coastal waters is attributed to pollution load run-off from human activities at inland, the city of Ujung Pandang.

It is noted that bulk of the graywater resulting from washing, cooking and bathing is discharged to surface ditches/drains with no treatment, which finally end up in coastal waters. The inland surface water quality evaluation, as dealt with in the subsequent section, illustrates this surface water quality deterioration.

In an overall sense, it is concluded that the bacteriological pollution level of the coastal seawaters of the Study Area is very significant, while the organic pollution level is rather significant. Some heavy metal elements like hexavalent chromium (Cr^{6+}) is also measured to be rather significant.

2.3.3 Inland surface water quality

The available data on inland surface water quality are confined to the rivers of Jeneberang and Tallo only. They are shown in *Table* 4.6 (Jeneberang) and *Table* 4.7 (Jeneberang and Tallo). The JICA sampling results of drains and rivers (Jeneberang and Pampang), respectively during dry season and rainy season are shown in *Table* 4.10a and 4.10b. The sampling locations are shown in *Fig.* 4.1 (available data) and *Fig.* 4.4 (JICA).

The bacterial pollution level measured as TC, as per all available data, in the canals and rivers are in the order of 10^3 No./100 ml and above, even up to the order of 10^5 No./ 100 ml in most of the canals of JICA sampling during dry season.

This indicates significant bacterial pollution of surface waters, similar to that of groundwaters and coastal waters, in the Study Area, principally during dry season.

Still all the sampled rivers of available data (*Table* 4.7) and JICA (*Table* 4.10), with their measured TC level in the order of $10^3 \sim 10^4$ No./100 ml, critically meet the bacteriological standard limitation for a potable source of 10^4 No./100 ml•TC, as stipulated both by the national standards (Classification-B) and DKI Jakarta standards. These standards are shown in *Table* 4.11 (national standards for potable source) and *Table* 4.12 (river water quality standards of DKI - Jakarta).

The biological pollution level of rivers are assessed to be not very significant. This is in consideration to the fact that the DO levels reported in the rivers of Jeneberang and Tallo, as per the available data of *Table* 4.6 and *Table* 4.7, were in the range of about 6 ~ 7 mg/l. This is above the recommended maximum value of the minimum DO level of 5 mg/l, for any beneficial use, as per the river water quality standards of DKI - Jakarta. A minimum desirable DO level of 5 mg/l is stipulated by this standards for the beneficial use of fishery/aquaculture (Class-B).

Moreover the BOD level measured by JICA sampling in the rivers of Jeneberang and Pampang, during critical condition of dry season, which is about 11 ~ 15 mg/l (ref. *Table* 4.10a), though numerically exceeded the recommended permissible limit for a potential potable source of 10 mg/l (Class-A), as per the above DKI - Jakarta standards, still it is within the limit of 20 mg/l recommended for other beneficial uses of fishery/aquaculture (Class-B) and agriculture (Class-C). The corresponding range of BOD of about 4 ~ 9 mg/l, measured during rainy season, meets the standards for a potable source.

Nevertheless the BOD levels in most drainage canals sampled by JICA in and around the city centre of Ujung Pandang, during the critical condition of dry season were in the range of 120 ~ 180 mg/l.

The river water quality standards of DKI - Jakarta, shown in *Table* 4.12, stipulates a permissible BOD limit of 30 mg/l for the conservation of aquatic biota (Class-D), which is the highest permissible BOD level as per this standards.

Accordingly, the organic pollution level of most drains in the city areas is very severe. These canals have no beneficial use, other than as open sewers, specifically during dry season. The major cause of this water quality deterioration is the discharge of untreated graywaters that arise from the human activities of washing, cooking and bathing. The discharge of human waste due to population having inadequate and no toilet facilities may also be significant for the water quality deterioration, with respect to both bacterial and organic pollution.

These wastewater run-off essentially constitute the entire discharge in a canal of city centre, during dry season.

Finally in an overall sense, the bacteriological water quality deterioration of inland surface waters is widespread and very significant, in both rivers and canals of the Study Area and pronounced during dry season. While, the organic pollution is mostly confined to the drainage canals in and around the city centre and also pronounced during dry season.

It is also concluded that a remarkable improvement in the canal water quality of city centre with respect to all major parameters of BOD, TC and chloride (Cl) level is noted, during rainy season. This is attributed to the very significant dilution effect by surface run-off of heavy rainfall, a distinct climatic feature of the Study Area.

3 Ambient Air Quality

There exists no ambient air quality monitoring stations in the Study Area, including the developed city center of Ujung Pandang.

In the absence of significant industrial development with potential air pollution generation, under the existing conditions, vehicular emission would be the prime source of air pollution.

A one time ambient air quality monitoring survey was conducted in 1993 at three (3) separate occasions in and around the city of Ujung Pandang, principally targeting both traffic congested and non congested areas along public roads.

A total of twenty (20) locations were sampled at the possible maximum traffic congestion time of around noon. The air quality parameters measured in this one time sampling were CO (carbon monoxide) and SO_2 (sulfur dioxide).

The locations of sampling are shown in *Fig.* 4.5.

The ambient air pollution level measured by the survey in terms of CO and SO_2 levels, as reported by Ambo Upe and Nisbianti, are shown in *Table* 4.14.

The air pollution levels of *Table* 4.14 indicates wide variation in ambient air quality.

The worst air pollution level, as could be anticipated, was recorded at "Terminal Panaikang" (No. 2), the central bus terminal of minibuses (bemo) and other long distance transport buses of Ujung Pandang city. At this location the highest levels of both CO (75.6 ppm) and SO_2 (0.35 ppm) were measured.

The best ambient air quality with lowest levels of both CO (8.0 ppm) and SO_2 (0.01 ppm) was measured at "Kampus Unhas Raya" (Unhas Raya Campus - No. 20).

Still these data represent the possible worst air quality at a particular time, as all are one time measurement. In the absence of any long term ambient air quality monitoring data it is impossible to assess reasonably the overall ambient air pollution level.

Most ambient air quality standards specify air pollutant limitation based on the concept of data measurement taken over a continuous time span, like 8 hrs, 24 hrs etc. The ambient air quality standards of some selected countries, including the national standards of Indonesia (Decree-02/MENKLH/1/1988), for five (5) important air pollution indicator parameters of sulfur dioxide (SO_2), carbon monoxide (CO), suspended particulate matter (SPM), nitrogen dioxide (NO_2) and photochemical oxidants, are shown in *Table* 4.15.

The one time air quality measurement results under possible worst conditions of *Table* 4.14, though cannot be compared for compliance with the ambient air quality standards shown in *Table* 4.15, still could be used to assess relatively the ambient air quality among the twenty (20) locations of measurements.

Consequently the ten (10) locations that have recorded concurrently both CO and SO_2 levels of more than 20.0 ppm and 0.15 ppm, respectively, are evaluated to suffer from significant ambient air quality deterioration, in comparison to the other ten (10) locations.

Those locations of significant ambient air quality deterioration are as follows:

No. 1 : Kawasan Pasar Sentral (Central Market)
No. 2 : Terminal Panaikang (Panaikang Bus Terminal)
No. 3 : Jl. Jenderal Sudirman
No. 4 : Jl. Mesdjid Raya
No. 5 : Jl. Urip Sumoharjo
No. 6 : Jl. Tinumbu
No. 7 : Jl. Cendrawasih
No. 8 : Jl. A.P. Pettarani
No. 9 : Jl. Sultan Alaudin
No. 15 : Jl. Somba Opu

It is necessary to establish a long term ambient air quality monitoring programme, with fixed monitoring stations, to facilitate a continuous assessment of ambient air quality, and hence its compliance with the ambient air quality standards, in KMUP (Kotamadya Ujung Pandang).

4. Public Hygiene

The public health condition of KMUP is evaluated based on the number of population suffered from documented cases of water-borne and water related diseases.

The data on documented cases of such diseases for the last five (5) years from 1988 to 1993 was obtained from Dalam Angka - KMUP, Statistical office - KMUP and Dinas Kesehatan - KMUP (Public Health Division of KMUP).

The number of patients of seven (7) water-borne and related diseases, as recorded in Public Health Centres in KMUP (1988 ~ 1993), are shown in *Table* 4.16.

As evident from *Table* 4.16, number of cases suffered from diarrhea were consistent, in the range of about 40,000 to 50,000, during the last five (5) years.

Public health is a very complex issue that cannot be easily related to just to the availability of clean water or sanitary disposal of wastewater. It is also very much affected by personal hygiene which depend on the public health awareness. One such important aspect that contributes to better public health in Indonesia is the customary boiling of drinking water.

In this regard, public health awareness campaign to general populace is very important and strongly recommended.

5. Environmental Laws and Regulations

There are various environmental laws and regulations enacted not only by the State Ministry of Environment (MENLH, formerly known as MENKLH) of the national government, but also by the other national authorities/ministries.

The other national authorities/ministries that have promulgated environmental laws/ regulations, under the jurisdiction of their activities, include the Central Government, Presidential Office, State Ministry of Industry, State Ministry of Internal Affairs, State Ministry of Health, State Ministry of Transportation, State Ministry of Mining and Energy, State Ministry of Agriculture and the State Ministry of Public Works.

The environmental regulations promulgated by the respective authority/ministry of the national (central) government of Indonesia are itemized in *Table* 4.17.

Regulations that have much relevance to this study, are the following two (2) decrees, promulgated by the State Ministry of Environment (MENLH).

(1) Decree-02/MENKLH/I/1988 - on the guidance of environmental standard quality.

(2) Decree-11/MENLH/3/1994 - on the type of business activities which are compulsorily completed with environmental impact analysis (EIA/AMDAL).

The major environmental standards specified by this decree of Item 1 (Decree-02/MENKLH/I/1988) are as follows:

- environmental standards of water bodies
- effluent standards of wastewater
- ambient air quality standards
- air emission standards

The environmental water quality and ambient air quality standards, as stipulated by this decree, has already been referred to as required, in the foregone sections of water quality and ambient air quality.

Item 2 (Decree-11/MENLH/3/1994) defines the extent/size of the business and other development oriented project activities that required to be accomplished with environmental impact assessment (EIA/AMDAL). Such activities requiring EIA/AMDAL as stipulated by this decree are shown in *Table* 4.18.

This master plan and feasibility study on wastewater and solid waste management is a project activity delineated under Section III on Public Works Sector, as per this *Table* 4.18.

Items 11, 12 and 13 of this Section III defines the extent/size of final disposal facility for solid waste management that requires an EIA/AMDAL. While, Item 15 defines the extent/size of sewerage development and wastewater treatment facility requiring an EIA/AMDAL.

EIA/AMDAL study for the required project components of feasibility study of wastewater and solid waste management, until the initial ten (10) year period up the year 2005, conducted conforming the relevant environmental regulations, is briefed in the subsequent chapter.

It is noted that the Provincial Government of South Sulawesi is in the process of formulating the relevant environmental laws and regulations, to meet the specific environmental requirement of the province. As such, at present, there is no provincial law or regulation concerned to environment and the relevant laws and regulations of the national (central) government are applicable.

6. Environmental Impact Assessment Study

6.1 Introduction

The proposed project by the feasibility study, until the initial ten (10) year period up to the year 2005, is composed of two major components of wastewater management and solid waste management. The administrative area targeted by both the project components is the Municipality of Ujung Pandang (Area of about 176 sq.km), the KMUP (Kotamadya Ujung Pandang), Study Area.

These project components of feasibility study are described in Part II of the Main Report. Their detailed technical aspects are dealt with in the subsequent supporting reports.

Conforming relevant laws and regulations of the Government of Indonesia, concerned to the requirement of AMDAL study delineated the previous chapter, in particular the Decree-11/MENLH/3/94 of the State Ministry of Environment shown in *Table* 4.18, the Environmental Impact Assessment (EIA/AMDAL) study for the required feasibility study project components of wastewater and solid waste management was conducted in tandem with the feasibility study.

The AMDAL Study was carried out in accordance with the Terms of Reference (TOR), as approved by both the Provincial (South Sulawesi) and Central AMDAL Commissions.

6.2 Objective of AMDAL Study

The principal objectives of the AMDAL study are as follows;

(1) Identification of activity plans of the project that would cause significant/important impact to environment during the stages of pre construction, construction, post construction and post operation.

(2) Identification of initial environmental features, especially those related to significant/important environmental impact.

(3) Estimation and evaluation of environmental impacts during all four (4) stages of pre construction, construction, post construction and post operation

(4) Formulation of environmental monitoring and management plans so as to enhance the positive impacts and to minimize the negative impacts.

6.3 Methodology of AMDAL Study

6.3.1 Data collection

The primary and secondary data collection and analysis for the AMDAL Study was conducted during the three (3) month period from May to July 1995.

Specific primary data collection work was conducted principally at the three (3) locations of wastewater treatment plants and their respective service areas, and the two (2) locations of final solid waste disposal sites and their vicinity.

These are the major project components of the feasibility study and hence the projects requiring environmental impact assessment (EIA/AMDAL).

The three (3) wastewater treatment plant location and the related project aspects are briefed below.

(1) Pampang wastewater treatment plant-located in Kel. Pampang, nearby the Sinasara - Tallo river (area of treatment plant : 44 ha). This is the treatment plant for the conventional sewerage system having its service area in the city center, the central service area (service area : 435 ha). Population served in the year 2005 is about 130,500.

(2) Maccini Sombala wastewater treatment plant-located in Kel. Maccini Sombala, in between the Jongaya canal and Jeneberang river (area of treatment plant : 29 ha). This is the treatment plant for the conventional sewerage system with its service area in the southern part of the city, the southern service area (service area : 162 ha). Population served in the year 2005 is about 71,000.

(3) Lembo wastewater treatment plant-located in Kel. Lembo, near Panampu canal (area of treatment plant : 6 ha). This is the treatment plant for the large modular sewerage system with its service area in the northern part of the city, the northern service area (service area : 73 ha). Population served in the year 2005 is about 23,000.

The wastewater treatment system used at all these three (3) locations is Stabilization (Oxidation) Pond. Stabilization pond is a very simple wastewater treatment process that requires no significant mechanical and electrical installations.

The two (2) final solid waste disposal locations and the related project aspects are briefed below.

(1) The existing Tamangapa final disposal site-located in Kel. Tamangapa near the south eastern boundary of KMUP.

The existing area of final solid waste disposal site is about 7 ha, which will be expanded up to 32 ha, so that the use of site could be continued until the year 2001. Operation of this site is planned to be terminated by the end of the year 2001. The existing operation of controlled landfill at this Tamangapa site is planned to be improved to semi-sanitary landfill by instituting leachate collection and its primary treatment.

The population served in the year 2001 is estimated at 1,130,000 with a service ratio of about 86%. The corresponding quantity of solid waste collected would be 553 ton/day.

(2) The Samata final disposal site-located in Kel. Samata of Kab. Gowa beyond the south eastern boundary of KMUP. This is the future site located in the administrative region of Kab. Gowa (Kecamatan Somba Opu), the operation of which would commence in the year 2002, with the closure of Tamangapa site.

The area of solid waste disposal site planned for the operation during the initial ten (10) years (2002~2011) is 65 ha. Since the available area of this Samata site is about 168 ha, the operation could continue for a foreseeable future, well beyond target year of the Master Plan of 2015 (more than 20 years). In consideration to the location of this site beyond KMUP, project area of the Samata solid waste disposal project would include both KMUP area and Kel. Samata and its surroundings of Kab. Gowa, as appropriate. Samata solid waste disposal site is planned as a sanitary landfill site, consisting of leachate collection and treatment facilities.

The population served in the year 2005 is estimated at 1,360,000 with a service ratio of about 90%. The corresponding quantity of solid waste collected would be 774 ton/day.

The principal environmental components of primary data collection are as follows :

a. Surface water quality
b. Groundwater quality
c. Ambient air quality
d. Ambient noise level
e. Terrestrial biota (fauna and flora)
f. Aquatic biota (fauna and flora)
g. Geology

h. Traffic density
i. Socio-economy, culture and public health

6.3.2 Impact assessment

The environmental impact by the projects was assessed with due attention to the following factors, as per the guidelines of BAPEDAL (No. Kep.056 of 1994).

a. The number of people exposed to the impact.
b. The extent of area of spread of impact
c. The intensity and duration of impact
d. Other environmental components effected by impact
e. The cumulative nature of impact
f. The reversibility of impact

6.4 Composition of AMDAL Reports

The AMDAL reports are comprised of two (2) independent components, one (1) for wastewater management sector and one (1) for solid waste management sector, with respect the relevant feasibility study projects elaborated in the foregone section.

Each of the two (2) components of AMDAL report consists of three (3) sub components, namely, ANDAL Report (Environmental Impact Assessment (EIA) Report), RKL Report (Environmental Management Plan Report) and RPL Report (Environmental Monitoring Plan Report). Hence, a total of six (6) reports were prepared.

Details of the AMDAL study could be referred to in the above reports.

7 Conclusion

(1) The bacteriological water quality deterioration in the Study Area is widespread and encompasses all water bodies of groundwater, coastal water and inland surface water.

(2) The organic pollution level is very significant in the drainage canals located in and around the city centre. The dry weather flow in these canals is principally comprised of graywater arising from human activities.

(3) Ambient air quality deterioration is principally caused by vehicular emission. Air pollution in traffic congested city areas seems to be significant.

(4) An environmental monitoring programme targeting both water and air quality is recommended to be initiated. Such a programme with monitoring at regular time intervals is required to establish the trend in time series change of environmental quality, and hence to implement the necessary pollution control measures, as appropriate, in order to ensure the compliance with the concerned environmental standards.

Table 4.1a Groundwater Quality Sampling Data-March 1992 (Rainy Season)

Parameter	Unit	Location									
		SM_1	SM_2	SM_3	SM_4	SM_5	SM_6	SM_6	SM_7	SM_8	SM_9
TDS	g/ℓ	0.30	0.92	1.04	0.43	0.42	0.38	0.36	0.48	0.44	0.37
TSS	mg/ℓ	2.0	3.0	4.0	nd	6.0	5.0	3.0	6.0	9.0	8.0
EC	ms/cm	0.68	0.76	0.82	0.64	0.72	0.63	0.62	0.74	0.80	0.64
Turbidity	NTU	1.0	1.0	2.0	nd	2.0	2.0	1.0	3.0	3.0	3.0
pH	-	7.2	7.1	7.1	7.2	7.2	7.0	7.0	6.9	7.1	7.1
Ca	mg/ℓ	9.0	14.0	12.0	13.0	12.0	12.0	10.0	14.0	15.0	15.0
Mg	mg/ℓ	28	16	24	27	15	16	18	11	18	18
Mn	mg/ℓ	0.010	0.009	0.012	0.011	0.012	0.011	0.014	0.016	0.012	0.016
Fe	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Cu	mg/ℓ	0.036	0.034	0.026	0.030	0.016	0.018	0.018	0.019	0.017	0.020
Zn	mg/ℓ	0.032	0.029	0.027	0.028	0.026	0.032	0.031	0.030	0.032	0.030
Cr	mg/ℓ	0.006	0.008	0.002	0.009	0.009	0.006	0.004	0.009	0.008	0.014
Cd	mg/ℓ	0.002	nd	0.002	nd	nd	nd	nd	nd	nd	nd
Ni	mg/ℓ	0.004	0.002	0.006	0.002	0.002	0.001	0.001	nd	0.002	nd
Al	mg/ℓ	0.43	0.46	0.52	0.49	0.48	0.44	0.56	0.60	0.64	0.59
Pb	mg/ℓ	0.012	0.009	0.011	0.010	0.007	0.008	0.008	0.009	0.007	0.006
Hg	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
B	mg/ℓ	0.08	0.10	0.09	0.07	0.06	0.07	0.09	0.09	0.12	0.10
Co	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Se	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
As	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Sb	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Cl^-	mg/ℓ	14	24	18	16	25	23	18	22	20	22
$SO_4^=$	g/ℓ	2.04	1.96	1.87	1.68	2.06	1.98	1.86	1.94	1.92	2.04
T-P	mg/ℓ	0.084	0.076	0.072	0.074	0.062	0.058	0.074	0.078	0.068	0.066
NH_4N	mg/ℓ	0.009	0.007	0.008	0.006	0.006	0.008	0.009	0.006	0.010	0.006
NO_3N	mg/ℓ	0.14	0.13	0.12	0.11	0.09	0.10	0.11	0.10	0.12	0.10
NO_2N	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Surfactant	mg/ℓ	0.01	0.02	0.06	0.04	0.04	0.03	0.03	0.02	0.06	0.04
Phenol	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CN^-	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PO_4^{3-}	mg/ℓ	0.320	0.242	0.196	0.198	0.180	0.182	0.304	0.206	0.196	0.184
Org-N	mg/ℓ	1.84	1.73	1.70	1.32	1.44	1.38	1.44	1.38	1.36	1.54
DO	mg/ℓ	6.5	6.4	6.0	5.9	6.2	5.9	6.2	6.3	5.9	5.8
BOD	mg/ℓ	2.2	2.1	1.6	1.8	2.2	2.3	1.9	2.0	1.6	1.7
COD	mg/ℓ	15.92	22.36	28.86	23.67	27.84	24.36	21.08	22.27	26.84	22.97
Oil and Greese	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
TC	No./mℓ	nil	32	46	6	6	8	32	9	9	5

Note : nd-not detected
Source : Pemantauan Bahan Pencemar Kawasan Pantai Ujung Pandang-1992

Table 4.10 Groundwater Quality Sampling Data-July 1992 (Dry Season)

Parameter	Unit	Location									
		SM1	SM2	SM3	SM4	SM5	SM6	SM6	SM7	SM8	SM9
TDS	g/ℓ	0.35	1.01	1.26	0.43	0.58	0.48	0.45	0.62	0.56	0.43
TSS	mg/ℓ	nd	3.0	5.0	nd	2.0	4.0	nd	3.0	5.0	4.0
EC	ms/cm	0.86	1.47	1.24	0.96	0.82	0.65	0.76	0.87	0.94	0.86
Turbidity	NTU	nd	1.0	2.0	nd	1.0	1.0	nd	1.0	2.0	1.0
pH	-	7.1	7.2	7.0	7.3	7.0	7.1	7.1	6.9	7.0	7.2
Ca	mg/ℓ	10.0	20.0	16.0	18.0	14.0	14.0	12.0	18.0	16.0	18.0
Mg	mg/ℓ	32	14	28	36	17	18	22	14	24	26
Mn	mg/ℓ	0.018	0.017	0.024	0.020	0.018	0.017	0.020	0.024	0.018	0.020
Fe	mg/ℓ	nd	nd	0.100	nd	nd	0.040	nd	nd	0.060	nd
Cu	mg/ℓ	0.055	0.046	0.037	0.048	0.022	0.024	0.025	0.026	0.025	0.028
Zn	mg/ℓ	0.049	0.057	0.043	0.048	0.033	0.040	0.039	0.038	0.044	0.039
Cr	mg/ℓ	0.010	0.027	0.014	0.022	0.014	0.011	0.010	0.017	0.014	0.022
Cd	mg/ℓ	0.005	nd	0.008	nd	0.003	0.003	0.005	0.004	0.005	nd
Ni	mg/ℓ	0.004	0.002	0.006	0.002	0.006	0.004	0.004	0.002	0.006	0.002
Al	mg/ℓ	0.72	0.69	0.76	0.68	0.64	0.58	0.74	0.66	0.72	0.68
Pb	mg/ℓ	0.021	0.027	0.026	0.022	0.010	0.011	0.011	0.017	0.016	0.012
Hg	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
B	mg/ℓ	0.12	0.14	0.18	0.15	0.11	0.12	0.16	0.16	0.18	0.16
Co	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Se	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
As	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Sb	mg/ℓ	nd	0.002	0.002	nd	nd	nd	nd	nd	nd	nd
Cl^-	mg/ℓ	23	45	34	29	34	28	23	26	24	27
$SO_4^=$	g/ℓ	3.25	2.41	2.92	2.34	2.34	2.26	2.24	2.41	2.42	2.34
T-P	mg/ℓ	0.193	0.091	0.084	0.096	0.080	0.072	0.092	0.090	0.086	0.084
NH_4N	mg/ℓ	0.015	0.013	0.014	0.010	0.008	0.012	0.013	0.010	0.014	0.010
NO_3N	mg/ℓ	0.20	0.17	0.17	0.13	0.12	0.13	0.15	0.14	0.15	0.13
NO_2N	mg/ℓ	nd	0.001	0.002	0.001	nd	0.001	nd	0.001	nd	0.001
Surfactant	mg/ℓ	0.03	0.04	0.12	0.08	0.07	0.06	0.08	0.06	0.10	0.08
Phenol	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CN^-	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PO_4^{3-}	mg/ℓ	0.4923	0.2325	0.2144	0.2443	0.2200	0.2084	0.3220	0.2332	0.2242	0.2044
Org-N	mg/ℓ	2.42	2.04	2.06	1.62	1.34	1.36	1.42	1.34	1.46	1.60
DO	mg/ℓ	6.4	6.1	5.8	5.7	6.0	5.8	6.2	6.2	5.6	5.8
BOD	mg/ℓ	2.0	2.1	1.5	1.8	1.8	1.9	1.7	1.8	1.5	1.6
COD	mg/ℓ	13.9	21.49	28.20	22.16	26.22	23.62	20.20	21.47	26.24	22.18
Oil and Greese	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
TC	No./mℓ	nil	43	75	9	9	15	43	15	15	9

Note : nd-not detected

Source : Pemantauan Bahan Pencemar Kawasan Pantai Ujung Pandang-1992

Table 4.2a Groundwater Quality Sampling Data-Panampu Jongaya Channel-April 1993 (Rainy Season)

Parameter	Unit	Location							
		PJ-1	PJ-2	PJ-3	PJ-4	PJ-5	PJ-6	PJ-7	PJ-8
Temperature	°C	29.7	29.4	29.6	29.9	30.6	30.2	30.0	29.1
Turbidity	NTU	3.0	3.0	4.0	2.0	6.0	2.0	4.0	3.0
Colour	Pt-Co	5.0	5.0	6.0	4.0	9.0	3.0	6.0	5.0
Smell	-	+	+	++	+	++	+	+	+
TDS	g/l	0.70	0.87	0.75	2.40	2.12	0.45	0.58	0.58
EC	ms/cm	1.40	1.74	1.51	2.80	4.25	0.91	1.14	1.16
pH	-	7.5	7.6	7.4	7.5	7.3	7.2	7.4	7.5
Cl^-	g/l	0.145	0.159	0.213	0.516	0.845	0.073	0.102	0.094
NO_3-N	mg/l	0.043	0.017	0.014	0.064	0.043	0.092	0.132	0.067
NO_2-N	mg/l	0.024	0.006	0.003	0.035	0.021	0.069	0.063	0.036
NO_4-N	mg/l	0.009	0.012	0.013	0.015	0.012	0.009	0.013	0.011
$S^=$	mg/l	0.008	0.009	0.007	0.006	0.007	0.008	0.011	0.009
Salinity	g/l	0.262	0.287	0.385	0.932	1.527	0.132	0.184	0.170
DO	mg/l	4.8	6.0	5.8	4.6	4.6	4.2	5.2	5.6
BOD	mg/l	28.4	26.3	14.3	14.4	24.4	16.8	17.9	18.4
COD	mg/l	56.9	53.7	75.8	53.7	95.9	69.5	82.2	47.4
FC	No./100 ml	76	144	60	52	232	84	216	96
TC	No./100 ml	1200	1700	1100	1400	1400	1100	1200	900

Source : Monitoring Report on Groundwater Quality in the Surrounding Area of Panampu-Jongaya Drainage Channel and Surface Water of Lower Jeneberang River (Sept. 1993), Directorate of Rivers

Table 4.2b Groundwater Quality Sampling Data-Panampu Jongaya Channel-July 1993
(Dry Season)

Parameter	Unit	Location							
		PJ-1	PJ-2	PJ-3	PJ-4	PJ-5	PJ-6	PJ-7	PJ-8
Temperature	°C	31.2	30.9	31.3	31.4	316	31.5	31.3	30.8
Turbidity	NIU	2.0	2.0	3.0	2.0	4.0	1.0	2.0	2.0
Colour	Pt-Co	4.0	4.0	5.0	4.0	6.0	2.0	4.0	4.0
Smell	-	+	+	+	+	+	+	+	+
TDS	g/l	1.00	0.84	1.19	1.08	1.40	0.40	0.56	0.66
EC	ms/cm	1.99	1.69	2.37	2.15	2.81	0.79	1.14	1.33
pH	-	7.1	7.3	7.1	7.2	7.2	7.1	7.2	7.3
Cl^-	g/l	0.176	0.148	0.209	0.190	0.249	0.078	0.098	0.116
NO_3-N	mg/l	0.371	0.048	0.069	0.078	0.085	0.305	0.924	0.228
NO_2-N	mg/l	0.705	0.062	0.265	0.947	0.094	0.087	0.086	0.098
NO_4-N	mg/l	0.005	0.006	0.004	0.004	0.004	0.002	0.002	0.005
$S^=$	mg/l	0.009	0.011	0.008	0.006	0.008	0.008	0.009	0.007
Salinity	g/l	0.318	0.267	0.378	0.343	0.450	0.141	0.177	0.210
DO	mg/l	7.29	5.43	6.50	6.57	6.57	6.34	5.93	5.36
BOD	mg/l	25.20	21.60	21.30	25.74	32.10	27.10	26.63	21.90
COD	mg/l	79.00	91.64	63.20	66.36	135.83	85.32	94.80	66.36
FC	No./100 ml	600	650	650	600	550	600	500	450
TC	No./100 ml	4000	6800	7800	8200	3400	3200	2800	3000

Source : Monitoring Report on Groundwater Quality in the Surrounding Area of Panampu-Jongaya Drainage Channel and Surface Water of Lower Jeneberang River (Sept. 1993), Directorate of Rivers

Table 4.2c Groundwater Quality Sampling Data-Panampu Jongaya Channel-July 1993 (Dry Season)

Parameter	Unit	Location			
		I-1	I-2	I-3	I-4
Temperature	°C	31.2	30.9	31.3	31.4
Turbidity	NTU	2.0	2.0	3.0	2.0
TDS	g/l	0.43	0.70	0.89	3.77
EC	ms/cm	0.87	1.39	1.78	7.55
pH	-	7.2	7.3	7.1	7.2
Cl^-	g/l	0.076	0.132	0.304	2.031
Salinity	g/l	0.137	0.431	0.304	1.231
DO	mg/l	7.00	6.21	6.93	6.57
BOD	mg/l	22.47	25.26	21.60	23.31
COD	mg/l	66.36	79.00	60.04	72.68

Source : Monitoring Report on Groundwater Quality in the Surrounding Area of Panampu-Jongaya Drainage Channel and Surface Water of Lower Jeneberang River (Sept. 1993), Directorate of Rivers

Table 4.3 (1) Groundwater Quality Data-Public Health Division of KMUP (1992-1993)

	Kecamatan	Kelurahan	No.	Total Coliform (No./100 mℓ)	$KMnO_4$ Value (mg/ℓ)	Cl^- (mg/ℓ)
1	Mariso	Kunjung Mae	1	> 2400	-	-
			2	> 2400	-	-
			3	> 2400	-	-
			4	> 2400	-	-
			5	> 2400	-	-
			6	153	-	-
			7	153	-	-
		Matloanging	1	> 2400	-	-
			2	> 2400	-	-
			3	1100	-	-
		Bonto Rannu	1	> 2400	-	-
			2	> 2400	-	-
			3	> 2400	-	-
		Mariso	1	> 2400	-	-
			2	1100	-	-
			3	> 2400	-	-
			4	> 2400	-	-
			5	> 2400	-	-
		Lette	1	> 2400	-	-
			2	> 2400	0.316	10
2	Mamajang	Parang	1	> 2400	-	-
		Mamajang Luar	1	> 2400	-	-
			2	> 2400	-	-
			3	> 2400	-	-
		Mamajang Dalam	1	> 2400	-	-
			2	400	-	-
		Sambung Jawa	1	> 2400	-	-
			2	153	-	-
			3	> 2400	-	-
			4	> 2400	-	-
			5	> 2400	-	-
3	Makassar	Bara-Baraya	1	4	-	-
			2	< 3	-	-
			3	< 3	1.58	57.5
			4	< 3	-	-
			5	> 2400	-	-
			6	> 2400	-	-
			7	> 2400	-	-
		Maradekaya	1	> 2400	-	-
			2	> 2400	-	-
			3	> 2400	5.37	40
			4	> 2400	-	-
			5	< 3	-	-
			6	9	-	-
			7	< 3	-	-
		Machini	1	> 2400	-	-
			2	153	-	-
			3	93	-	-
			4	> 2400	-	-
4	Ujung Pandang	Mangkura	1	93	2.21	18
			2	> 2400	-	-
			3	> 2400	-	-

Note : - indicates not measured

Table 4.3 (2) Groundwater Quality Data-Public Health Division of KMUP (1992-1993)

	Kecamatan	Kelurahan	No.	Total Coliform (No./100 mℓ)	$KMnO_4$ Value (mg/ℓ)	Cl^- (mg/ℓ)
5	Wajo	Pattunuang	1	> 2400	-	-
			2	4	-	-
			3	< 3	-	-
			4	15	-	-
			5	43	-	-
		Butung	1	> 2400	-	-
			2	> 2400	-	-
			3	> 2400	-	-
		Melayu	1	> 2400	-	-
			2	> 2400	-	-
			3	43	-	-
			4	23	5.06	57.5
			5	23	-	-
			6	24	-	-
6	Bontoala	Layang	1	> 2400	-	-
			2	> 2400	-	-
			3	> 2400	9.48	-
			4	21	-	-
			5	93	-	-
			6	15	-	-
			7	21	3.16	30
		Mal. Baru	1	> 2400	-	-
			2	> 2400	-	-
			3	> 2400	-	-
			4	23	-	-
			5	> 2400	-	-
			6	43	-	-
			7	< 3	-	-
7	Tallo	Kalukuang	1	> 2400	-	-
			2	43	7.26	40
		Rappo Jawa	1	> 2400	-	-
			2	< 3	-	-
			3	43	-	-
			4	15	-	-
			5	93	-	-
			6	< 3	-	-
		Rappo Kalling	1	> 2400	-	-
			2	> 2400	-	-
			3	> 2400	-	-
			4	43	-	-
			5	< 3	-	-
			6	< 3	-	-
			7	< 3	-	-
		Kaluku Bodoa	1	> 2400	-	-
			2	> 2400	-	-
			3	< 3	-	-
			4	43	11.06	150
			5	9	-	-
			6	< 3	-	-
		Panampu	1	> 2400	1.58	30
8	Ujung Tanah	Ujung Tanah	1	< 3	-	-
			2	9	-	-
			3	43	-	-
			4	43	-	-

Note : - indicates not measured

Table 4.3 (3) Groundwater Quality Data-Public Health Division of KMUP (1992-1993)

	Kecamatan	Kelurahan	No.	Total Coliform (No./100 ml)	$KMnO_4$ Value (mg/l)	Cl^- (mg/l)
8	Ujung Tanah	Taberingan	1	> 2400	-	-
			2	> 2400	-	-
			3	> 2400	-	-
			4	< 3	-	-
			5	20	-	-
			6	93	-	-
			7	240	-	-
		Pattingalloang	1	> 2400	-	-
			2	> 2400	-	-
			3	> 2400	-	-
9	Panakkukang	Pampang	1	4	6	75
			2	9	-	-
		Karang Puang	1	43	-	-
			2	< 3	-	-
		Tamamaung	1	460	-	-
			2	> 2400	-	-
			3	23	-	-
			4	> 2400	-	-
			5	> 2400	-	-
		Antang	1	> 2400	4.74	3
			2	> 2400	-	-
			3	> 2400	-	-
			4	> 2400	-	-
			5	153	-	-
			6	> 2400	-	-
			7	43	-	-
			8	153	-	-
			9	< 3	-	-
			10	153	-	-
			11	< 3	-	-
		Tamangapa	1	4	3.16	57.5
			2	< 3	-	-
			3	9	-	-
			4	9	-	-
		Bangkala	1	1100	-	-
		Kaluwisi	1	> 2400	-	-
			2	> 2400	150.1	180
			3	> 2400	-	-
			4	> 2400	-	-
			5	153	-	-
			6	> 2400	-	-
			7	> 2400	-	-
		Batua	1	> 2400	1.58	60
			2	> 2400	-	-
			3	> 2400	-	-
			4	93	-	-
			5	93	-	-
			6	> 2400	-	-
			7	> 2400	-	-
10	Tamalate	Mangasa	1	> 2400	-	-
			2	> 2400	-	-
			3	> 2400	-	-
			4	> 2400	-	-
			5	> 2400	-	-
			6	> 2400		
			7	> 2400		

Note : - indicates not measured

Table 4.3 (4) Groundwater Quality Data-Public Health Division of KMUP (1992-1993)

	Kecamatan	Kelurahan	No.	Total Coliform (No./100 mℓ)	$KMnO_4$ Value (mg/ℓ)	Cl^- (mg/ℓ)
10	Tamalate	Gunung Sari	1	153	3.16	30
			2	> 2400	-	-
			3	> 2400	-	-
			4	> 2400	-	-
		Kassi-Kassi	1	> 2400	-	-
			2	> 2400	-	-
			3	> 2400	-	-
			4	> 2400	-	-
			5	460	-	-
			6	> 2400	-	-
			7	153	-	-
		Jongaya	1	153	-	-
			2	> 2400	-	-
			3	210	-	-
			4	45	-	-
			5	> 2400	-	-
			6	23	-	-
			7	< 3	-	-
		Maccini Sombala	1	> 2400	-	-
			2	> 2400	-	-
			3	> 2400	-	-
			4	> 2400	-	-
			5	> 2400	-	-
			6	> 2400	-	-
			7	93	-	-
			8	23	-	-
			9	< 3	2.53	40
		Barombong	1	> 2400	-	-
			2	> 2400	-	-
			3	93	-	-
			4	153	-	-
			5	210	-	-
			6	> 2400	-	-
			7	> 2400	9.48	-
11	Biringkanaya	Tamalanrea	1	> 2400	3.16	10
			2	> 2400	-	-
			3	> 2400	-	-
			4	> 2400	-	-
			5	> 2400	-	-
			6	> 2400	-	-
			7	> 2400	-	-
			8	< 3	8.85	6
			9	< 3	5.37	75
		Daya	1	> 2400	-	-
			2	> 2400	-	-
			3	< 3	6.90	75
			4	< 3	4.74	3
			5	460	-	-
			6	> 2400	-	-
			7	93	5.69	9
		Sudiang	1	< 3	-	-
		Bulurokeng	1	> 2400	-	-
			2	> 2400	-	-
		Bira	1	> 2400	3.16	3
			2	9	-	-
			3	1100	-	-
			4	93	-	-
			5	> 2400	-	-
			6	> 2400	-	-

Note : - indicates not measured

Table 4.4a (1) Coastal Seawater Quality Sampling Data-March 1992 (Rainy Season)

Parameter	Unit	Location											
		L_1S	L_1P	L_2S	L_2P	L_3S	L_3P	L_4S	L_4P	L_5S	L_5P	L_6S	L_6P
TDS	g/ℓ	32.86	31.92	37.36	32.84	37.23	34.98	35.18	35.89	27.86	34.62	35.24	35.16
TSS	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	1.0	1.5	1.0	1.0
EC	ms/cm	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	nd	nd	nd	nd	nd	nd	nd	nd	1.0	1.0	1.0	1.0
pH	-	7.1	7.2	7.3	7.2	7.3	7.2	7.3	7.2	7.2	7.1	7.2	7.2
Ca	mg/ℓ	12.0	11.0	13.0	13.0	11.0	9.0	14.0	10.0	13.0	14.0	13.0	9.0
Mg	mg/ℓ	580	122	486	106	425	104	460	108	496	92	628	106
Mn	mg/ℓ	0.013	0.004	0.012	0.014	0.031	0.018	0.006	0.014	0.022	0.018	0.016	0.012
Fe	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	0.118	0.214	0.286	nd
Cu	mg/ℓ	0.026	0.024	0.048	0.037	0.059	0.046	0.047	0.038	0.049	0.036	0.048	0.062
Zn	mg/ℓ	0.228	0.219	0.226	0.244	0.246	0.268	0.376	0.384	0.366	0.392	0.356	0.328
Cr	mg/ℓ	0.042	0.036	0.052	0.034	0.068	0.032	0.063	0.022	0.062	0.024	0.032	0.026
Cd	mg/ℓ	0.005	0.007	0.004	0.008	0.004	0.007	0.005	0.006	0.007	0.006	0.006	0.005
Ni	mg/ℓ	0.084	0.072	0.074	0.068	0.092	0.086	0.032	0.028	0.036	0.028	0.030	0.026
Al	mg/ℓ	0.080	0.090	0.100	0.110	0.120	0.135	0.34	0.32	0.34	0.30	0.32	0.38
Pb	mg/ℓ	0.062	0.054	0.060	0.058	0.059	0.043	0.022	0.024	0.023	0.024	0.028	0.026
Hg	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
B	mg/ℓ	0.32	0.34	0.33	0.32	0.33	0.30	0.16	0.18	0.18	0.20	0.16	0.18
Co	mg/ℓ	0.028	0.029	0.024	0.028	0.030	0.032	0.048	0.052	0.064	0.050	0.068	0.042
Se	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
As	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Sb	mg/ℓ	nd	nd	nd	nd	nd	0.001	nd	nd	nd	nd	nd	nd
Cl^-	g/ℓ	19.08	18.96	19.08	17.92	18.94	17.34	20.68	18.04	19.02	16.24	20.23	17.65
$SO_4^=$	g/ℓ	3.86	3.66	3.04	3.28	3.24	3.36	1.23	2.12	1.83	2.38	2.64	2.66
T-P	mg/ℓ	0.043	0.038	0.056	0.046	0.048	0.042	0.054	0.062	0.108	0.112	0.070	0.078
NH_4N	mg/ℓ	0.004	0.003	0.006	0.005	0.008	0.007	0.010	0.008	0.012	0.009	0.009	0.008
NO_3N	mg/ℓ	0.08	0.06	0.08	0.07	0.08	0.10	0.12	0.09	0.14	0.11	0.10	0.12
NO_2N	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Surfactant	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Phenol	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CN^-	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PO_4^{3-}	mg/ℓ	0.088	0.084	0.092	0.088	0.094	0.090	0.124	0.136	0.242	0.328	0.166	0.142
Org-N	mg/ℓ	0.84	0.72	0.86	0.82	0.94	0.88	0.82	0.64	0.76	0.78	0.56	0.62
DO	mg/ℓ	6.2	6.4	6.8	6.5	6.2	6.4	6.4	6.5	6.4	6.6	6.3	6.2
BOD	mg/ℓ	1.6	1.4	1.5	1.4	1.4	1.6	2.4	2.0	2.2	1.5	1.6	1.4
COD	mg/ℓ	27.44	51.46	25.79	58.26	28.84	53.62	28.84	56.20	24.64	48.25	24.58	32.14
Oil and Greese	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
TC	No./mℓ	nil	nil	nil	nil	nil	nil	nil	nil	7	10	6	4

Note : nd-not detected
L_1-L_{14}-Sampling Locations LxS-Sampling during Low Tide LxP-Sampling during High Tide

Source : Pemantauan Bahan Pencemar Kawasan Pantai Ujung Pandang - 1992

Table 4.4a (2) Coastal Seawater Quality Sampling Data-March 1992 (Rainy Season)

Parameter	Unit	Location											
		L_7S	L_7P	L_8S	L_8P	L_9S	L_9P	$L_{10a}S$	$L_{10a}P$	$L_{10b}S$	$L_{10b}P$	$L_{11}S$	$L_{11}P$
TDS	g/ℓ	38.68	32.96	31.84	30.24	30.28	32.15	34.04	34.98	35.26	35.62	33.46	33.84
TSS	mg/ℓ	nd	nd	1.0	1.5	1.0	1.0	nd	nd	nd	nd	nd	nd
EC	ms/cm	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	nd	nd	1.0	1.0	1.0	1.0	nd	nd	nd	nd	nd	nd
pH	-	7.2	7.3	7.3	7.2	7.4	7.2	7.1	7.1	7.2	7.1	7.3	7.2
Ca	mg/ℓ	18.0	16.0	13.0	9.0	14.0	10.0	24.0	13.0	22.0	13.0	18.0	10.0
Mg	mg/ℓ	426	96	402	92	248	94	542	98	646	84	582	94
Mn	mg/ℓ	0.018	0.014	0.028	0.039	0.034	0.015	0.024	0.012	0.018	0.019	0.014	0.016
Fe	mg/ℓ	nd	nd	0.126	0.104	0.218	0.286	nd	nd	nd	nd	nd	nd
Cu	mg/ℓ	0.024	0.016	0.032	0.022	0.028	0.012	0.068	0.022	0.072	0.039	0.028	0.026
Zn	mg/ℓ	0.248	0.292	0.246	0.262	0.227	0.209	0.182	0.206	0.238	0.246	0.292	0.224
Cr	mg/ℓ	0.036	0.018	0.032	0.026	0.012	0.014	0.054	0.052	0.078	0.069	0.058	0.052
Cd	mg/ℓ	0.004	0.003	0.005	0.004	0.005	0.004	0.002	0.003	0.004	0.003	0.005	0.004
Ni	mg/ℓ	0.014	0.012	0.016	0.015	0.022	0.019	0.018	0.015	0.009	0.012	0.018	0.020
Al	mg/ℓ	0.22	0.23	0.24	0.36	0.34	0.36	0.28	0.16	0.27	0.22	0.32	0.26
Pb	mg/ℓ	0.024	0.026	0.028	0.030	0.025	0.024	0.018	0.024	0.020	0.022	0.018	0.020
Hg	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
B	mg/ℓ	0.30	0.32	0.29	0.29	0.32	0.34	0.16	0.14	0.17	0.18	0.16	0.18
Co	mg/ℓ	0.026	0.024	0.029	0.030	0.028	0.012	0.008	0.014	0.016	0.018	0.018	0.020
Se	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
As	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Sb	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.001	nd
Cl^-	g/ℓ	19.84	14.24	17.96	13.44	13.86	10.98	18.96	15.24	18.84	15.33	18.28	14.79
$SO_4^=$	g/ℓ	1.06	2.63	2.48	1.96	0.98	1.88	2.89	2.78	2.76	2.64	2.98	2.84
T-P	mg/ℓ	0.052	0.053	0.064	0.066	0.052	0.054	0.088	0.084	0.082	0.086	0.080	0.081
NH_4N	mg/ℓ	0.009	0.008	0.008	0.006	0.010	0.009	0.006	0.004	0.005	0.006	0.009	0.008
NO_3N	mg/ℓ	0.12	0.11	0.09	0.08	0.14	0.13	0.08	0.07	0.06	0.07	0.09	0.08
NO_2N	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Surfactant	mg/ℓ	0.006	nd	0.008	0.006	nd	nd	nd	nd	nd	nd	nd	nd
Phenol	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CN^-	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PO_4^{3-}	mg/ℓ	0.184	0.169	0.188	0.194	0.172	0.164	0.164	0.158	0.156	0.162	0.168	0.162
Org-N	mg/ℓ	1.54	1.52	1.07	0.98	1.26	1.03	1.16	0.98	0.88	0.96	1.02	0.98
DO	mg/ℓ	6.0	6.1	6.4	6.3	6.3	6.2	6.0	6.1	6.2	6.3	6.3	6.2
BOD	mg/ℓ	1.4	1.6	1.4	1.3	1.4	1.4	1.2	1.4	1.3	1.6	1.4	1.6
COD	mg/ℓ	29.24	31.02	20.22	30.86	32.18	28.34	23.68	28.04	24.22	29.86	23.98	28.96
Oil and Greese	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
TC	No./mℓ	6	4	10	8	nil	nil	nil	nil	nil	nil	nil	nil

Note : nd-not detected
L_1~L_{14}-Sampling Locations LxS-Sampling during Low Tide LxP-Sampling during High Tide

Source : Pemantauan Bahan Pencemar Kawasan Pantai Ujung Pandang - 1992.

Table 4.4a (3) Coastal Seawater Quality Sampling Data-March 1992 (Rainy Season)

Parameter	Unit	Location					
		$L_{12}S$	$L_{12}P$	$L_{13}S$	$L_{13}P$	$L_{14}S$	$L_{14}P$
TDS	g/ℓ	35.88	35.36	36.24	32.80	36.92	35.82
TSS	mg/ℓ	nd	nd	nd	nd	nd	nd
EC	ms/cm	-	-	-	-	-	-
Turbidity	NTU	nd	nd	nd	nd	nd	nd
pH	-	7.2	7.1	7.2	7.2	7.1	7.1
Ca	mg/ℓ	14.0	10.0	18.0	14.0	16.0	11.0
Mg	mg/ℓ	520	128	608	116	596	106
Mn	mg/ℓ	0.014	0.013	0.015	0.014	0.012	0.014
Fe	mg/ℓ	nd	nd	nd	nd	nd	nd
Cu	mg/ℓ	0.016	0.022	0.015	0.018	0.018	0.019
Zn	mg/ℓ	0.243	0.266	0.248	0.226	0.264	0.242
Cr	mg/ℓ	0.028	0.029	0.024	0.026	0.032	0.034
Cd	mg/ℓ	0.003	0.005	0.009	0.007	0.010	0.008
Ni	mg/ℓ	0.018	0.014	0.017	0.014	0.016	0.014
Al	mg/ℓ	0.20	.018	0.18	0.16	0.18	0.18
Pb	mg/ℓ	0.018	0.015	0.015	0.016	0.020	0.018
Hg	mg/ℓ	nd	nd	nd	nd	nd	nd
B	mg/ℓ	0.18	0.15	0.22	0.20	0.19	0.21
Co	mg/ℓ	0.026	0.022	0.018	0.017	0.019	0.018
Se	mg/ℓ	nd	nd	nd	nd	nd	nd
As	mg/ℓ	nd	nd	nd	nd	nd	nd
Sb	mg/ℓ	nd	nd	nd	nd	nd	nd
Cl^-	g/ℓ	19.22	14.85	18.92	15.96	20.38	16.54
$SO_4^=$	g/ℓ	2.82	3.26	3.32	3.14	3.06	3.12
T-P	mg/ℓ	0.062	0.064	0.060	0.066	0.058	0.060
NH_4N	mg/ℓ	0.012	0.010	0.008	0.009	0.008	0.008
NO_3N	mg/ℓ	0.14	0.16	0.12	0.10	0.14	0.12
NO_2N	mg/ℓ	nd	nd	nd	nd	nd	nd
Surfactant	mg/ℓ	nd	nd	nd	nd	nd	nd
Phenol	mg/ℓ	nd	nd	nd	nd	nd	nd
CN^-	mg/ℓ	nd	nd	nd	nd	nd	nd
PO_4^{3-}	mg/ℓ	0.154	0.148	0.162	0.168	0.152	0.150
Org-N	mg/ℓ	1.04	1.16	1.12	1.24	1.28	1.18
DO	mg/ℓ	6.4	6.2	6.3	6.1	6.2	6.0
BOD	mg/ℓ	1.4	1.6	1.3	1.6	1.1	1.3
COD	mg/ℓ	32.18	29.34	24.62	31.84	28.27	32.65
Oil and Greese	mg/ℓ	nd	nd	nd	nd	nd	nd
TC	No./mℓ	nil	nil	nil	nil	nil	nil

Note : nd-not detected
L_1~L_{14}-Sampling Locations LxS-Sampling during Low Tide LxP-Sampling during High Tide
Source : Pemantauan Bahan Pencemar Kawasan Pantai Ujung Pandang - 1992

Table 4.4b (1) Coastal Seawater Quality Sampling Data-July 1992 (Dry season)

Parameter	Unit	Location											
		L_1S	L_1P	L_2S	L_2P	L_3S	L_3P	L_4S	L_4P	L_5S	L_5P	L_6S	L_6P
TDS	g/ℓ	33.78	32.04	38.26	34.76	38.06	36.46	35.06	36.46	28.76	34.34	35.82	35.72
TSS	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	1.0	nd	nd
EC	ms/cm	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	nd	nd	nd	nd	nd	nd	nd	nd	nd	1.0	nd	nd
pH	-	7.3	7.4	7.4	7.3	7.5	7.3	7.2	7.2	7.4	7.3	7.2	7.3
Ca	mg/ℓ	12.0	10.0	14.0	14.0	12.0	6.0	16.0	8.0	14.0	16.0	16.0	8.0
Mg	mg/ℓ	610	122	590	118	594	116	580	120	608	86	882	118
Mn	mg/ℓ	0.013	0.004	0.012	0.014	0.031	0.018	0.003	0.024	0.039	0.023	0.024	0.018
Fe	mg/ℓ	0.446	nd	nd	nd	nd	nd	nd	nd	nd	0.559	0.415	nd
Cu	mg/ℓ	0.038	0.038	0.054	0.043	0.065	0.048	0.081	0.059	0.064	0.070	0.054	0.081
Zn	mg/ℓ	0.386	0.349	0.359	0.404	0.366	0.382	0.425	0.413	0.441	0.436	0.409	0.421
Cr	mg/ℓ	0.049	0.038	0.063	0.035	0.074	0.031	0.081	0.001	0.081	nd	0.070	0.056
Cd	mg/ℓ	0.005	0.006	0.002	0.009	0.004	0.008	0.004	0.010	0.007	0.008	0.010	0.009
Ni	mg/ℓ	0.080	0.070	0.085	0.072	0.102	0.095	0.040	0.035	0.045	0.033	0.042	0.038
Al	mg/ℓ	0.140	0.100	0.110	0.130	0.180	0.205	0.38	0.36	0.36	0.35	0.38	0.40
Pb	mg/ℓ	0.071	0.076	0.063	0.064	0.071	0.050	0.024	0.026	0.027	0.027	0.032	0.029
Hg	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
B	mg/ℓ	0.39	0.37	0.36	0.35	0.38	0.37	0.33	0.34	0.36	0.38	0.32	0.34
Co	mg/ℓ	0.038	0.037	0.032	0.039	0.038	0.044	0.044	0.054	0.070	0.045	0.076	0.040
Se	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
As	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Sb	mg/ℓ	0.001	nd	0.002	0.001	nd	0.002	nd	0.002	nd	0.002	0.001	nd
Cl^-	g/ℓ	21.51	17.82	19.24	17.47	20.16	17.68	20.73	17.47	18.89	15.05	20.73	17.25
$SO_4^=$	g/ℓ	3.43	6.23	2.11	4.80	1.09	4.02	0.93	3.06	1.60	2.55	3.94	3.96
T-P	mg/ℓ	0.086	0.079	0.082	0.081	0.072	0.075	0.077	0.078	0.128	0.240	0.074	0.086
NH_4N	mg/ℓ	0.013	0.009	0.015	0.012	0.016	0.015	0.010	0.008	0.012	0.009	0.009	0.08
NO_3N	mg/ℓ	0.20	0.13	0.20	0.17	0.20	0.20	0.13	0.10	0.17	0.13	0.10	0.13
NO_2N	mg/ℓ	nd	nd	nd	0.004	0.001	0.008	0.001	0.001	nd	nd	nd	nd
Surfactant	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	0.006	nd	0.010	nd
Phenol	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CN^-	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PO_4^{3-}	mg/ℓ	0.2214	0.2020	0.2127	0.2141	0.1840	0.1906	0.1975	0.1980	0.3280	0.6143	0.1889	0.2199
Org-N	mg/ℓ	1.62	1.02	1.54	1.10	1.50	1.52	1.04	0.92	1.12	0.98	0.84	0.96
DO	mg/ℓ	6.7	6.6	7.1	6.9	6.8	7.1	6.5	6.6	7.2	6.8	6.5	6.3
BOD	mg/ℓ	1.2	1.0	1.0	1.3	0.8	1.0	0.8	1.0	1.0	1.0	1.3	0.8
COD	mg/ℓ	22.22	41.96	22.75	53.08	28.44	47.72	25.60	51.50	22.12	44.45	23.38	28.12
Oil and Greese	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
TC	No./mℓ	nil	nil	nil	nil	nil	nil	nil	nil	4	9	4	nil

Note : nd-not detected
L_1~L_{14}-Sampling Locations LxS-Sampling during Low Tide LxP-Sampling during High Tide

Source : Pemantauan Bahan Pencemar Kawasan Pantai Ujung Pandang - 1992

Table 4.4b (2) Coastal Seawater Quality Sampling Data-July 1992 (Dry season)

Parameter	Unit	Location											
		L_7S	L_7P	L_8S	L_8P	L_9S	L_9P	$L_{10a}S$	$L_{10a}P$	$L_{10b}S$	$L_{10b}P$	$L_{11}S$	$L_{11}P$
TDS	g/ℓ	39.42	33.66	32.10	30.33	25.88	33.02	34.56	35.08	36.84	37.01	33.06	34.70
TSS	mg/ℓ	nd	nd	nd	1.0	nd	1.0	nd	nd	nd	nd	nd	nd
EC	ms/cm	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	nd	nd	nd	1.0	nd	1.0	nd	nd	nd	nd	nd	nd
pH	-	7.4	7.2	7.2	7.3	7.5	7.3	7.1	7.2	7.3	7.2	7.4	7.5
Ca	mg/ℓ	22.0	14.0	12.0	8.0	18.0	8.0	26.0	12.0	24.0	14.0	20.0	12.0
Mg	mg/ℓ	684	98	660	86	226	92	710	96	738	72	636	96
Mn	mg/ℓ	0.022	0.012	0.032	0.049	0.050	0.020	0.037	0.013	nd	0.029	0.020	0.035
Fe	mg/ℓ	nd	nd	0.118	0.100	nd	0.434	nd	nd	nd	nd	nd	0.446
Cu	mg/ℓ	0.035	0.021	0.046	0.038	0.035	0.016	0.081	0.027	0.099	0.043	0.035	0.038
Zn	mg/ℓ	0.396	0.408	0.376	0.329	0.295	0.306	0.227	0.244	0.335	0.321	0.402	0.230
Cr	mg/ℓ	0.088	0.028	0.067	0.056	0.024	0.038	0.067	0.067	0.092	0.077	0.060	0.049
Cd	mg/ℓ	0.008	0.007	0.011	0.009	0.013	0.010	0.006	0.006	0.009	0.008	0.011	0.012
Ni	mg/ℓ	0.022	0.032	0.030	0.029	0.042	0.036	0.021	0.018	0.012	0.033	0.026	0.032
Al	mg/ℓ	0.25	0.28	0.22	0.42	0.48	0.44	0.28	0.16	0.27	0.22	0.32	0.26
Pb	mg/ℓ	0.026	0.029	0.030	0.033	0.029	0.024	0.029	0.032	0.025	0.031	0.029	0.027
Hg	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
B	mg/ℓ	0.32	0.35	0.31	0.30	0.38	0.40	0.23	0.22	0.26	0.24	0.24	0.26
Co	mg/ℓ	0.035	0.031	0.036	0.038	0.035	0.018	0.016	0.022	0.031	0.037	0.035	0.042
Se	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
As	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Sb	mg/ℓ	nd	0.001	nd	nd	0.002	nd	0.002	0.001	nd	0.001	0.002	nd
Cl^-	g/ℓ	21.02	14.56	18.74	13.63	14.54	11.86	19.74	15.19	19.10	14.91	18.96	14.98
$SO_4^{=}$	g/ℓ	1.87	3.49	4.46	3.23	0.67	3.84	3.57	3.55	3.52	2.94	3.47	3.51
T-P	mg/ℓ	0.080	0.080	0.088	0.099	0.084	0.077	0.082	0.080	0.077	0.084	0.076	0.075
NH_4N	mg/ℓ	0.014	0.017	0.012	0.010	0.018	0.013	0.010	0.008	0.008	0.009	0.012	0.010
NO_3N	mg/ℓ	0.20	0.23	0.17	0.13	0.23	0.17	0.15	0.12	0.10	0.12	0.17	0.13
NO_2N	mg/ℓ	0.001	0.001	nd	nd	nd	nd	0.001	0.001	nd	0.001	nd	nd
Surfactant	mg/ℓ	0.008	nd	0.010	nd	nd	nd	nd	nd	nd	nd	nd	nd
Phenol	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
CN^-	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
PO_4^{3-}	mg/ℓ	0.2026	0.2047	0.2254	0.2538	0.2152	0.1956	0.2078	0.2030	0.1967	0.2144	0.1938	0.1915
Org-N	mg/ℓ	1.56	1.62	1.18	1.02	1.64	1.15	1.24	0.96	0.82	0.98	1.17	1.02
DO	mg/ℓ	5.8	5.9	6.7	6.3	6.4	6.1	5.9	6.2	6.0	6.3	6.4	6.2
BOD	mg/ℓ	0.8	1.3	1.2	1.1	1.0	1.0	0.8	1.0	0.8	1.5	1.0	1.5
COD	mg/ℓ	27.18	27.49	18.96	29.39	30.02	26.91	22.44	27.18	22.44	29.39	23.07	30.65
Oil and Greese	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
TC	No./mℓ	4	nil	9	4	nil	nil	nil	nil	nil	nil	nil	nil

Note : nd-not detected
L_1–L_{14}-Sampling Locations LxS-Sampling during Low Tide LxP-Sampling during High Tide

Source : Pemantauan Bahan Pencemar Kawasan Pantai Ujung Pandang - 1992

Table 4.4b (3) Coastal Seawater Quality Sampling Data-July 1992 (Dry season)

Parameter	Unit	Location					
		$L_{12}S$	$L_{12}P$	$L_{13}S$	$L_{13}P$	$L_{14}S$	$L_{14}P$
TDS	g/ℓ	36.66	35.54	39.84	32.78	37.22	38.08
TSS	mg/ℓ	nd	nd	nd	nd	nd	nd
EC	ms/cm	-	-	-	-	-	-
Turbidity	NTU	nd	nd	nd	nd	nd	nd
pH	-	7.1	7.2	7.3	7.2	7.3	7.3
Ca	mg/ℓ	16.0	10.0	20.0	16.0	18.0	10.0
Mg	mg/ℓ	640	138	712	128	708	112
Mn	mg/ℓ	0.019	0.018	0.017	0.016	0.005	0.025
Fe	mg/ℓ	nd	0.446	0.338	nd	0.154	nd
Cu	mg/ℓ	0.022	0.034	0.023	0.016	0.024	0.027
Zn	mg/ℓ	0.379	0.381	0.363	0.371	0.399	0.345
Cr	mg/ℓ	0.033	0.035	0.032	0.049	0.045	0.047
Cd	mg/ℓ	0.007	0.009	0.016	0.014	0.018	0.014
Ni	mg/ℓ	0.022	0.018	0.026	0.024	0.022	0.026
Al	mg/ℓ	0.26	0.24	0.28	0.24	0.22	0.26
Pb	mg/ℓ	0.024	0.023	0.031	0.036	0.031	0.029
Hg	mg/ℓ	nd	nd	nd	nd	nd	nd
B	mg/ℓ	0.23	0.26	0.32	0.28	0.29	0.31
Co	mg/ℓ	0.032	0.028	0.023	0.023	0.028	0.026
Se	mg/ℓ	nd	nd	nd	nd	nd	nd
As	mg/ℓ	nd	nd	nd	nd	nd	nd
Sb	mg/ℓ	0.003	0.002	0.001	nd	0.002	nd
Cl^-	g/ℓ	19.67	14.91	19.01	16.47	21.37	17.40
$SO_4^=$	g/ℓ	0.61	5.08	4.02	4.27	4.21	3.82
T-P	mg/ℓ	0.078	0.079	0.078	0.080	0.073	0.073
NH_4N	mg/ℓ	0.018	0.016	0.012	0.013	0.015	0.010
NO_3N	mg/ℓ	0.17	0.20	0.13	0.17	0.20	0.13
NO_2N	mg/ℓ	0.001	0.001	nd	nd	0.001	0.001
Surfactant	mg/ℓ	nd	nd	nd	nd	nd	nd
Phenol	mg/ℓ	nd	nd	nd	nd	nd	nd
CN^-	mg/ℓ	nd	nd	nd	nd	nd	nd
PO_4^{3-}	mg/ℓ	0.1992	0.2006	0.1988	0.2034	0.1873	0.1860
Org-N	mg/ℓ	1.12	1.54	0.98	1.58	1.62	1.02
DO	mg/ℓ	6.6	6.2	6.5	6.0	6.1	5.8
BOD	mg/ℓ	0.8	1.3	1.0	1.3	0.8	1.0
COD	mg/ℓ	30.02	27.18	22.44	29.39	23.07	30.65
Oil and Greese	mg/ℓ	nd	nd	nd	nd	nd	nd
TC	No./mℓ	nil	nil	nil	nil	nil	nil

Note : nd-not detected
L_1~L_{14}-Sampling Locations LxS-Sampling during Low Tide LxP-Sampling during High Tide

Parameter	Unit	Location							
		S_1S	S_1P	S_2S	S_2P	S_3S	S_3P	S_4S	S_4P
TDS	g/ℓ	6.34	6.86	0.28	0.36	14.28	15.85	4.68	6.24
TSS	mg/ℓ	15.0	14.0	78.0	72.0	9.0	8.0	8.0	7.0
EC	ms/cm	3.26	3.82	0.23	0.34	8.42	9.28	8.24	9.36
Turbidity	NTU	5.0	6.0	8.0	10.0	4.0	4.0	nd	3.0
pH	-	7.5	7.4	7.3	7.3	7.4	7.3	7.1	7.0
Ca	mg/ℓ	10.0	8.0	6.0	4.0	14.0	12.0	14.0	15.0
Mg	mg/ℓ	30.0	24.0	12.0	10.0	80.0	90.0	84	92
Mn	mg/ℓ	0.009	0.008	0.008	0.009	0.014	0.016	0.009	0.009
Fe	mg/ℓ	0.323	0.348	0.256	0.348	0.392	0.386	nd	nd
Cu	mg/ℓ	0.004	0.002	0.009	0.008	0.012	0.010	0.024	0.032
Zn	mg/ℓ	0.242	0.248	0.276	0.294	0.298	0.303	0.189	0.173
Cr	mg/ℓ	nd	nd	0.004	0.006	0.009	0.010	0.016	0.018
Cd	mg/ℓ	0.006	0.004	0.008	0.006	0.009	0.007	0.004	0.003
Ni	mg/ℓ	0.032	0.034	0.036	0.034	0.042	0.040	0.024	0.032
Al	mg/ℓ	0.38	0.34	0.44	0.48	0.36	0.32	0.42	0.39
Pb	mg/ℓ	0.019	0.024	0.022	0.029	0.019	0.023	0.028	0.026
Hg	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd
B	mg/ℓ	0.28	0.30	0.26	0.29	0.29	0.30	0.14	0.16
Co	mg/ℓ	0.026	0.025	0.030	0.029	0.022	0.020	0.008	0.009
Se	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd
As	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd
Sb	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd
Cl^-	g/ℓ	3.24	3.65	0.28	0.32	8.67	8.84	4.73	5.25
$SO_4^=$	g/ℓ	1.26	1.28	1.84	2.02	1.36	1.98	2.84	3.21
T-P	mg/ℓ	0.042	0.046	0.068	0.072	0.084	0.076	0.072	0.078
NH_4N	mg/ℓ	0.014	0.012	0.008	0.009	0.008	0.007	0.008	0.006
NO_3N	mg/ℓ	0.24	0.21	0.13	0.15	0.16	0.12	0.12	0.12
NO_2N	mg/ℓ	nd	nd	nd	nd	nd	nd	0.001	nd
Surfactant	mg/ℓ	0.01	nd	nd	nd	0.01	nd	0.02	0.02
Phenol	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd
CN^-	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd
PO_4^{3-}	mg/ℓ	0.132	0.126	0.140	0.123	0.233	0.209	0.160	0.198
Org-N	mg/ℓ	2.32	2.04	2.42	2.62	2.46	2.08	1.36	1.34
DO	mg/ℓ	6.4	6.3	6.4	6.3	6.5	6.3	6.4	6.2
BOD	mg/ℓ	3.8	4.0	3.1	3.2	2.4	2.3	2.3	2.2
COD	mg/ℓ	24.43	32.26	14.86	17.65	34.22	35.64	29.48	31.65
Oil and Greese	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd
TC	No./mℓ	6	4	120	140	3	5	120	230

Note : nd-not detected
S_1~S_{14}-Sampling Locations SxS-Sampling during Low Tide SxP-Sampling during High Tide

Source : Pemantauan Bahan Pencemar Kawasan Pantai Ujung Pandang - 1992

Table 4.5b Riverwater Quality Sampling Data at River Mouth-July 1992 (Dry Season)

Parameter	Unit	Location							
		S_1S	S_1P	S_2S	S_2P	S_3S	S_3P	S_4S	S_4P
TDS	g/ℓ	11.04	10.36	0.29	0.36	19.53	23.30	12.77	16.47
TSS	mg/ℓ	3.0	12.0	20.0	61.0	3.0	4.0	2.0	4.0
EC	ms/cm	6.48	5.52	0.83	1.34	12.46	14.61	15.52	13.23
Turbidity	NTU	1.0	4.0	5.0	7.0	1.0	1.0	nd	3.0
pH	-	7.6	7.5	7.3	7.4	7.3	7.2	7.2	7.1
Ca	mg/ℓ	12.0	4.0	4.0	2.0	18.0	18.0	16.0	16.0
Mg	mg/ℓ	40.0	14.0	10.0	8.0	70.0	150	72	128
Mn	mg/ℓ	0.013	0.012	0.012	0.014	0.031	0.057	0.017	0.017
Fe	mg/ℓ	nd	nd	0.154	0.376	0.454	0.376	0.100	nd
Cu	mg/ℓ	0.005	nd	0.017	0.016	0.027	0.029	0.032	0.054
Zn	mg/ℓ	0.309	0.343	0.379	0.400	0.396	0.409	0.173	0.200
Cr	mg/ℓ	nd	0.006	0.006	0.028	0.031	0.035	0.024	0.031
Cd	mg/ℓ	0.016	0.014	0.014	0.016	0.017	0.019	0.008	0.007
Ni	mg/ℓ	0.043	0.036	0.040	0.032	0.052	0.046	0.024	0.032
Al	mg/ℓ	0.58	0.54	0.62	0.68	0.48	0.42	0.62	0.58
Pb	mg/ℓ	0.027	0.033	0.039	0.043	0.029	0.034	0.036	0.037
Hg	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd
B	mg/ℓ	0.32	0.35	0.31	0.34	0.36	0.34	0.23	0.25
Co	mg/ℓ	0.034	0.031	0.040	0.040	0.032	0.027	0.013	0.018
Se	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd
As	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd
Sb	mg/ℓ	0.003	0.001	0.001	nd	0.002	0.003	nd	0.001
Cl^-	g/ℓ	6.11	5.50	0.36	0.38	11.71	15.83	6.75	7.60
$SO_4^=$	g/ℓ	1.31	2.27	1.67	2.16	1.35	6.66	3.34	6.73
T-P	mg/ℓ	0.088	0.088	0.096	0.087	0.131	0.098	0.090	0.082
NH_4N	mg/ℓ	0.018	0.016	0.009	0.015	0.013	0.012	0.012	0.010
NO_3N	mg/ℓ	0.28	0.25	0.10	0.20	0.20	0.15	0.15	0.15
NO_2N	mg/ℓ	0.003	0.001	0.001	nd	0.001	0.003	0.002	0.002
Surfactant	mg/ℓ	0.02	0.03	0.05	0.04	0.02	0.01	0.05	0.04
Phenol	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd
CN^-	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd
PO_4^{3-}	mg/ℓ	0.2323	0.2243	0.2448	0.2229	0.3363	0.2493	0.2300	0.2099
Org-N	mg/ℓ	3.36	3.00	1.22	2.42	2.40	1.86	1.84	1.86
DO	mg/ℓ	6.8	6.3	6.4	6.0	6.7	6.4	6.2	5.9
BOD	mg/ℓ	2.8	3.3	2.8	3.2	2.0	1.9	2.0	1.9
COD	mg/ℓ	14.22	51.19	8.85	17.70	31.28	36.02	27.49	31.60
Oil and Greese	mg/ℓ	nd	nd	nd	nd	nd	nd	nd	nd
TC	No./mℓ	4	nil	75	150	nil	nil	15	240

Note : nd-not detected
S_1~S_{14}-Sampling Locations SxS-Sampling during Low Tide SxP-Sampling during High Tide

Source : Pemantauan Bahan Pencemar Kawasan Pantai Ujung Pandang - 1992

Table 4.6 Lower Jeneberang River Water Quality Sampling Data-Sept. 1993 (Dry Season)

Parameter	Unit	Location			
		JB-1	JB-2	JB-3	JB-4
Temperature	°C	28.5	29.5	29.5	30.0
Turbidity	NTU	2.0	1.0	1.0	0.5
TDS	g/ℓ	30.85	13.15	5.57	25.39
EC	ms/cm	61.65	26.29	11.14	46.75
pH	-	7.2	7.1	7.2	7.3
Cl^-	g/ℓ	19.018	8.043	3.380	14.194
Salinity	g/ℓ	34.370	26.269	6.108	25.652
DO	mg/ℓ	6.47	6.54	5.98	5.86
COD	mg/ℓ	143.78	105.86	92.84	115.34

Source : Monitoring Report on Groundwater Quality in the Surrounding Area of Panampu-Jongaya Drainage Channel and Surface Water of Lower Jeneberang River (Sept. 1993), Directorate of Rivers

Table 4.7 Tallo and Jeneberang River Water Quality Data-March 1994 (Rainy Season)

Parameter	Unit	Location	
		Tallo (R1)	Jeneberang (R2)
Temperatere	°C	29.4	29.4
Turbidity	NTU	22.0	21.0
Colour	Pt-Co	134.0	138.0
Smell	-	Normal	Normal
TDS	mg/ℓ	14050.0	192.0
EC	ms/cm	28.06	0.38
pH	-	7.3	6.9
Ca	mg/ℓ	1098	1481
Mg	mg/ℓ	741	906
Fe	mg/ℓ	0.491	0.372
Pb	mg/ℓ	0.095	0.146
Cr^{6+}	mg/ℓ	nd	nd
Cu	mg/ℓ	0.015	0.006
Zn	mg/ℓ	0.146	0.036
Mn	mg/ℓ	0.007	0.017
Cl^-	mg/ℓ	5041.0	74.62
NO_3-N	mg/ℓ	0.070	0.062
NO_2-N	mg/ℓ	0.010	0.025
$SO_4^=$	mg/ℓ	9.62	13.62
PO_4^{3-}	mg/ℓ	0.380	0.174
NH_4-N	mg/ℓ	0.004	0.004
Salinity	g/ℓ	9.107	0.135
DO	mg/ℓ	7.29	7.09
BOD	mg/ℓ	5.68	5.68
COD	mg/ℓ	37.92	59.82
FC	No./100 mℓ	464	514
TC	No./100 mℓ	4800	5200

Note : nd-not detected
Source : Kajian dan Pemetaan Kualitas Air Pada Muara Sungai Sekitar Kawasan Pantai Sulawesi Selatan, March 1994

Table 4.8a Groundwater Quality Sampling Results-JICA (Aug. 1994)-Dry Season

No.	Location	Water Quality Parameters														
		pH	TS (mg/l)	BOD (mg/l)	COD (mg/l)	T-N (mg/l)	T-P (mg/l)	TC (No./100 ml)	NH_4-N (mg/l)	NO_3-N (mg/l)	Cl^- (mg/l)	$SO4^=$ (mg/l)	Pb (mg/l)	As (mg/l)	Cd (mg/l)	Hg (mg/l)	Cr^{6+} (mg/l)
1	SAMBUNG JAWA	7.8	683	5.2	44	0.13	0.09	1.5×10^3	0.08	0.04	576.9	25.3	0	0	0	0	0
2	Mattoanging Stadium MARIO	7.8	474	8.7	51	0.1	0.06	9.0×10^2	0.04	0.04	399.4	53.9	0	0	0	0	0
3	Fort Rotterdam BULOGADING	7.8	467	7.3	44	0.14	0	2.3×10^2	0.08	0.04	399.4	49.1	0	0	0	0	0
4	MARADEKAYA	7.9	833	6.7	57	0.05	0.21	9.0×10^2	0	0.04	621.3	49.1	0.04	0	0	0	0
5	KALUKUANG	7.9	449	7	46	0.15	0.09	4.3×10^3	0.11	0.03	399.4	28.5	0.06	0	0	0	0
6	UJUNG TANAH	7.8	468	9.7	50	0.07	0.13	7.3×10^3	0.02	0.04	310.6	50.7	0.04	0	0	0	0
7	IDI Housing MASALE	7.1	1297	9.1	53	0.22	0.07	2.1×10^3	0.17	0.03	1198	50.1	0	0	0	0	0
8	PEPABRI Housing SUDIANG	7.6	92	6.7	37	0.06	0.01	9.1×10^2	0.02	0.03	88.8	0	0	0	0	0	0
9	UNHAS TAMALANREA INDAH	7.7	389	5.7	42	0.26	0	7.5×10^3	0.04	0.2	310.6	66.6	0.04	0	0	0	0
10	Minasaupa Housing GUNUNG SARI	7.8	916	6.7	44	0.25	0.19	2.5×10^2	0.2	0.04	843.1	57.1	0.05	0	0	0	0

Table 4.8b Groundwater Quality Sampling Results-JICA (January 1995)-Rainy Season

No.	Location	Water Quality Parameters														
		pH	TS (mg/l)	BOD (mg/l)	COD (mg/l)	T-N (mg/l)	T-P (mg/l)	TC (No./100 ml)	NH_4-N (mg/l)	NO_3-N (mg/l)	Cl^- (mg/l)	$SO4^=$ (mg/l)	Pb (mg/l)	As (mg/l)	Cd (mg/l)	Hg (mg/l)	Cr^{6+} (mg/l)
1	SAMBUNG JAWA	7.9	386	3.6	9.1	0.75	1.0	Nil	0.24	0	40.9	46.4	0	0	0	0	0
2	Mattoanging Stadium MARIO	7.1	900	7.2	18	7.6	0.3	Nil	0.23	6.9	141.4	61.9	0	0	0	0	0
3	Fort Rotterdam BULOGADING	8.4	412	3.6	9.1	4.8	0	Nil	0.28	4.0	23.8	44.1	0	0	0	0	0
4	MARADEKAYA	7.4	691	17	42	5.7	0.4	Nil	0.51	4.1	81.5	45.3	0	0	0	0	0
5	KALUKUANG	8.1	394	2.5	6.1	1.8	0.5	Nil	0.23	1.0	42.9	31.0	0	0	0	0	0
6	UJUNG TANAH	8.0	660	2.4	0.1	2.1	1.5	9.0×10^0	0.26	1.2	17.9	26.8	0	0	0	0	0
7	IDI Housing MASALE	7.8	219	7.3	3.2	0.5	0	5.0×10^0	0.17	0	25.2	22.8	0	0	0	0	0
8	PEPABRI Housing SUDIANG	5.8	79	2.6	6.4	0.2	0	Nil	0.04	0	13.9	2.02	0	0	0	0	0
9	UNHAS TAMALANREA INDAH	6.4	79	7.6	3.2	0	0	Nil	0	0	4.1	6.96	0	0	0	0	0
10	Minasaupa Housing GUNUNG SARI	6.9	843	4.6	11	8.6	1.8	1.5×10^1	0	8.51	57.7	40.9	0	0	0	0	0

Table 4.9a Coastal Seawater Quality Sampling Results-JICA (August 1994)-Dry Season

No.	Location	Water Quality Parameters													
		pH	SS (mg/l)	BOD (mg/l)	COD (mg/l)	T-N (mg/l)	T-P (mg/l)	TC (No./100 ml)	Cl^- (mg/l)	$SO4^=$ (mg/l)	Pb (mg/l)	As (mg/l)	Cd (mg/l)	Hg (mg/l)	Cr^{6+} (mg/l)
1	Tallo River Mouth	7.2	4.0	4.3	23	0.06	0.09	1.1×10^5	11875	2476	0.02	0	0.004	0	0.012
2	Kayangan-Ujung Centre	7.3	1.0	4.5	15	0.06	0.07	1.5×10^3	18718	2352	0.02	0	0.002	0	0.019
3	Mariso Bay	7.3	1.0	3.7	16	0.04	0.09	9.3×10^2	17593	3087	0.03	0	0.002	0	0.011
4	Jeneberang River Mouth	7.2	2.0	2.8	20	0.04	0.10	2.3×10^2	14937	5631	0.03	0	0.030	0	0.008

Table 4.9b Coastal Seawater Quality Sampling Results-JICA (January 1995)-Rainy Season

No.	Location	Water Quality Parameters													
		pH	TS (mg/l)	BOD (mg/l)	COD (mg/l)	T-N (mg/l)	T-P (mg/l)	TC (No./100 ml)	Cl^- (mg/l)	$SO4^=$ (mg/l)	Pb (mg/l)	As (mg/l)	Cd (mg/l)	Hg (mg/l)	Cr^{6+} (mg/l)
1	Tallo River Mouth	7.5	10135	6.3	16	0.43	0	Nil	5382	732	0	0	0	0	0
2	Kayangan-Uiung Centre	8.1	10559	5.0	13	0.40	0	Nil	5661	822	0	0	0	0	0
3	Mariso Bay	7.8	12988	6.3	16	1.3	0	$2.7x10^1$	7130	494	0	0	0	0	0
4	Jeneberang River Mouth	8.3	11385	3.8	9.5	0.54	0	Nil	6005	343	0	0	0	0	0

Table 4.10a Inland Surface Water Quality Sampling Results-JICA (August 1994)-Dry Season

No.	Location	Water Quality Parameters													
		pH	SS (mg/l)	BOD (mg/l)	COD (mg/l)	T-N (mg/l)	T-P (mg/l)	TC (No./100 ml)	Cl^- (mg/l)	$SO_4^{=}$ (mg/l)	Pb (mg/l)	As (mg/l)	Cd (mg/l)	Hg (mg/l)	Cr^{6+} (mg/l)
1	Canal Panampu	7.5	62	52	170	0.23	0.61	4.3×10^4	14165	381	0	0	0.014	0	0.012
2	Canal Sinrijala	7.6	3566	140	320	0.54	0.89	9.3×10^5	5369	121	0.014	0	0.009	0	0.011
3	Canal Jongaya	7.9	3084	46	170	0.93	0.83	4.3×10^3	8875	349	0.018	0	0.004	0	0.007
4	Pampang River	7.0	-	11	120	0.13	0.05	4.6×10^4	16973	413	0.008	0	0.004	0	0.005
5	Jeneberang River	7.4	-	15	55	0.18	0.01	2.4×10^4	2130	92.0	0.012	0	0.008	0	0.004
6	Drainage (Jl. Tarakan)	7.3	28	170	360	0.15	0.56	2.6×10^5	1509	38.0	0.095	0	0	0	0.007
7	Drainage (Jl. Ujung Pandang)	7.2	53	180	350	0.16	0.51	2.8×10^5	2884	135	0.115	0	0	0	0.009
8	Drainage (Jl. Veteran)	7.3	19	120	240	0.45	0.60	1.1×10^5	754	47.6	0.018	0	0	0	0.004
9	Drainage (Jl. Penghibur)	7.5	46	130	280	0.19	0.45	2.6×10^5	666	34.9	0.033	0	0	0	0.008
10	Drainage (Jl. Rajawali)	7.4	59	130	330	0.15	0.61	2.7×10^5	1109	28.5	0.014	0	0	0	0.009
11	Drainage (Jl. Landak Baru)	7.7	2347	150	330	0.34	0.89	4.0×10^4	2707	25.3	0.009	0	0.012	0	0.009
12	Drainage (Jl. Nuri Baru)	7.3	47	180	340	0.19	0.71	2.5×10^5	1021	28.5	0.028	0	0	0	0.011

Table 4.10b Inland Surface Water Quality Sampling Results-JICA (February 1995)-Rainy Season

No.	Location	Water Quality Parameters													
		pH	SS (mg/l)	BOD (mg/l)	COD (mg/l)	T-N (mg/l)	T-P (mg/l)	TC (No./100 ml)	Cl^- (mg/l)	$SO4^=$ (mg/l)	Pb (mg/l)	As (mg/l)	Cd (mg/l)	Hg (mg/l)	Cr^{6+} (mg/l)
1	Canal Panampu	7.0	759	21	169	5.1	0.45	Nil	8.6	231	0	0	0	0	0
2	Canal Sinrijala	7.1	761	25	165	6.0	4.8	Nil	9.9	227	0	0	0	0	0
3	Canal Jongaya	7.2	506	20	165	4.9	3.5	Nil	8.1	107	0	0	0	0	0
4	Pampang River	6.6	122	8.8	22	-	-	Nil	18	-	-	-	-	-	-
5	Jeneberang River	7.3	180	3.8	9.5	-	-	Nil	31	-	-	-	-	-	-
6	Drainage (Jl. Tarakan)	7.1	284	21	127	5.1	0.55	1.9×10^1	8.4	41.1	0	0	0	0	0
7	Drainage (Jl. Ujung Pandang)	7.0	1.6	27	120	3.2	1.5	3.8×10^2	11	60.5	0	0	0	0	0
8	Drainage (Jl. Veteran)	7.4	331	16	161	4.9	0	2.4×10^1	6.4	36.7	0	0	0	0	0
9	Drainage (Jl. Penghibur)	7.2	609	21	100	3.8	1.3	5.8×10^1	8.3	162	0	0	0	0	0
10	Drainage (Jl. Rajawali)	7.2	365	22	115	6.4	2.1	1.9×10^2	8.8	47.3	0	0	0	0	0
11	Drainage (Jl. Landak Baru)	7.4	456	17	138	11	6.7	Nil	6.9	54.2	0	0	0	0	0
12	Drainage (Jl. Nuri Baru)	7.1	653	25	124	8.2	1.8	3.6×10^2	10	152	0	0	0	0	0

Table 4.11 Water Quality Standards for Potable Source

No.	Parameter		Unit	Maximum Content	
				Classification-A	Classification-B
I	PHISICAL				
1	Temperature		□	Normal	Nomal
2	Colour		Pt-Co	50	
3	Smell		-	5	
4	Taste		-	No Taste	
5	Turbidity		mg/ℓ SiO_2	25	
6	TDS		mg/ℓ	1500	1500
II	CHEMICAL				
1	pH		-	6.5 - 8.5	5 - 9
2	Calcium	(Ca)	mg/ℓ	200	
3	Magnesium	(Mg)	mg/ℓ	150	
4	Barium	(Ba)	mg/ℓ	0.5	1
5	Soluble Iron	(Fe)	mg/ℓ	1	5
6	Manganese	(Mn)	mg/ℓ	0.5	0.5
7	Copper	(Cu)	mg/ℓ	1	1
8	Zinc	(Zn)	mg/ℓ	15	15
9	Hexavalent Chromium	(Cr^{6+})	mg/ℓ	0.05	0.05
10	Cadmium	(Cd)	mg/ℓ	0.01	0.01
11	Total Mercury	(Hg)	mg/ℓ	0.001	0.001
12	Lead	(Pb)	mg/ℓ	0.1	0.1
13	Arsenic	(As)	mg/ℓ	0.05	0.05
14	Selenium	(Se)	mg/ℓ	0.1	0.1
15	Cyanide	(CN^-)	mg/ℓ	0.05	0.05
16	Sulfide	($S^=$)	mg/ℓ	-	-
17	Fluoride	(F^-)	mg/ℓ	1.5	1.5
18	Chloride	(Cl^-)	mg/ℓ	600	600
19	Sulfate	($SO_4^=$)	mg/ℓ	400	400
20	Ammonia Nitrogen	(NH_4N)	mg/ℓ	-	0.5
21	Nitrate Nitrogen	(NO_3-N)	mg/ℓ	10	10
22	Nitrite Nitrogen	(NO_2-N)	mg/ℓ	-	1
23	Permanganate Value		mg/ℓ $KMnO_4$	10	
24	DO		mg/ℓ		
25	BOD		mg/ℓ		6
26	COD		mg/ℓ		10
III	MICROBIOLOGICAL				
1	Fecal Coliform		No./100 mℓ	Nil	2000
2	Total Coliform		No./100 mℓ	Nil	10,000

Note : Classification-A is for direct potable use
Classification-B is for potable water source

Source : State Ministry of Environment
Decree-02/MENKLH/I/1988, dated 19 January 1988

Table 4.12 (1) River Water Quality Standards of DKI Jakarta

Parameter	Unit	A Drinking Water Source		B Fishery		C Agriculture		D Aquatic Biota	
		Desirable Limit	Permissible Limit	Desirable Limit	Permissible Limit	Desirable Limit	Permissible Limit	Desirable Limit	Permissible Limit
I. PHYSICAL									
- Conductivity	micro-mhos/cm	500	500	500	750	750	750	1000	1500
- Turbidity	NTU	100	150	50	100	100	150	100	150
- Temperature	C	Normal	Normal	Normal 3	Normal 3	Normal	Normal	Normal	Normal
- Color	color unit	50	100	50	100	50	100	-	-
- Dissolved solids	mg/ℓ	500	500	-	-	-	-	-	-
II. CHEMICAL									
- NH_4 - N	mg/ℓ	0.01	2	1	2	-	-	1	1
- Hg	mg/ℓ	0.0005	0.001	0.002	0.002	0.002	0.005	0.002	0.002
- As	mg/ℓ	none	0.05	0.05	0.05	0.05	0.05	0.05	0.05
- Ba	mg/ℓ	none	1	1	1	1	1	1	1
- Fe	mg/ℓ	1	2	1	2	-	-	1	3
- B	mg/ℓ	1	1	-	-	0.7	0.7	-	-
- F	mg/ℓ	0.5-1.5	0.5-1.5	1	1	1	1	1.5	1.5
- H_2S	mg/ℓ	none	none	none	0.002	-	-	none	none
- Cd	mg/ℓ	none	0.01	0.01	0.01	0.01	0.01	0.01	0.01
- Cr	mg/ℓ	none	0.02	0.05	0.05	0.05	0.05	0.05	0.05
- Hardness	mg/ℓ	100	100	60	100	-	-	60-100	60-100
- Co	mg/ℓ	-	-	0.5	0.5	-	-	-	-
- Mn	mg/ℓ	0.05	1	0.5	0.5	-	-	-	-
- Ni	mg/ℓ	0.1	0.1	0.01	0.01	-	-	-	-
- NO_3N	mg/ℓ	5	10	10	10	10	10	10	10

Table 4.12 (2) River Water Quality Standards of DKI Jakarta

Parameter	Unit	A Drinking Water Source		B Fishery		C Agriculture		D Aquatic Biota	
		Desirable Limit	Permissible Limit	Desirable Limit	Permissible Limit	Desirable Limit	Permissible Limit	Desirable Limit	Permissible Limit
II CHEMICAL (Continued)									
- NO_2-N	mg/ℓ	none	2	1	2	-	-	1	1
- Ag	mg/ℓ	none	none	-	-	-	-	-	-
- pH	-	6 - 8.5	6 - 8.5	6 - 8.5	6 - 8.5	6 - 8.5	6 - 8.5	6 - 8.5	6 - 8.5
- PO_4-P	mg/ℓ	0.5	0.5	0.2 - 0.5	0.2 - 0.5	0.2	0.2	0.5	0.5
- Se	mg/ℓ	none	none	0.02	0.02	0.01	0.01	0.04	0.04
- Zn	mg/ℓ	1	1	0.2	0.2	1	1	1	1
- SO_4	mg/ℓ	50	100	12	50	12	25	12	15
- Cu	mg/ℓ	none	0.1	0.02	0.02	0.05	0.05	0.05	0.05
- Pb	mg/ℓ	0.05	0.1	0.03	0.03	0.05	0.05	0.05	0.05
- Ca	mg/ℓ	-	-	-	-	-	-	25 - 40	25 - 40
III. ORGANIC									
- Carbon chloroform extract	mg/ℓ	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
- M. Blue active substance	mg/ℓ	none	1	-	-	-	-	-	-
- Oil & grease	mg/ℓ	none	none	none	none	none	none	none	none
- CN	mg/ℓ	none	0.05	0.01	0.01	0.02	0.02	0.2	0.2
- Phenol	mg/ℓ	0.001	0.05	0.01	0.02	0.02	0.2	0.2	0.2
- Detergent	mg/ℓ	-	-	0.1	0.5	0.02	0.25	0.2	0.2
- Pesticide									
- Organo-chlorine	mg/ℓ	none	none	none	none	none	none	none	none
Organo-phosphorus	mg/ℓ	none	none	none	none	none	none	none	none

Table 4.12 (3) River Water Quality Standards of DKI Jakarta

Parameter	Unit	A Drinking Water Source		B Fishery		C Agriculture		D Aquatic Biota	
		Desirable Limit	Permissible Limit	Desirable Limit	Permissible Limit	Desirable Limit	Permissible Limit	Desirable Limit	Permissible Limit
IV. SPECIAL									
- BOD_5 (20□)	mg/ℓ	5	10	20	20	20	20	30	30
- COD (Cr)	mg/ℓ	10	20	30	30	30	30	50	50
- DO	mg/ℓ	>3	>3	>5	>3	>4	>3	>3	>3
- SS	mg/ℓ	100	150	100	100	200	200	200	200
- SAR	meq/ℓ	-	-	-	-	10 - 18	10 - 18	-	-
- Na	%	-	-	-	-	40	50	-	-
V. BACTERIOLOGY									
- Total coliform	MPN/100 mℓ	10,000	10,000	20,000	20,000	-	-	10,000	10,000
- Fecal coliform	MPN/100 mℓ	2,000	2,000	4,000	4,000	-	-	2,000	2,000

Source : Governor's Decree No. 1608, 1988

Table 4.13 (1) Coastal Seawater Quality Standards

No.	Parameter	Unit	Swimming/bathing		Mining and Industry		Fishery		Sea Park		Public and Aesthetic		Cooling	
			Permissible Limit	Desirable Limit	Permissible Limit	Desirable Limit	Permissible Limit	Desirable Limit	Permissible Limit	Desirable Limit	Permissible Limit	Desirable Limit	Permissible Limit	Desirable Limit
	Physical													
1	Color	CU	50	30	50	30	50	30	50	30	50	30	-	-
2	Smell	-	Natural	None	Natural	Natural	Natural*	None*	Natural*	None*	Natural*	None*	-	-
3	Transparency	m	10	30	-	-	3*	5*	10*	30*	Natural	Natural	-	-
4	Turbidity	NTU	30	10	-	-	30*	5*	30*	5*	-	-	-	-
5	Suspended Solids	mg/ℓ	23	20	200*	25*	80*	25*	80*	25*	-	-	2500*	1000*
6	Floating Matters	-	None	None	Natural	Natural	None*	None*	None	None	None*	None*	Natural	Natural
7	Oil Appearance	-	None	None	None	None	None*	None*	None*	None	None*	None*	None	None
8	Temperature	℃	Natural	26 - 30	Natural*	Natural*	Natural*	Natural*	-	-	Natural	Natural		
							7 20							
	Chemical													
1	pH	-	6 - 9	6.5 - 8.5	6 - 9*	6.5 - 8.5*	6 - 9*	6.5 - 8.5*	6 - 9*	6.5 - 8.5*	-	-	6 - 9*	6.5 - 8.5*
2	Salinity	%	Natural	Natural	Natural	Natural	Natural	Natural	Natural	Natural	-	-	Natural	Natural
			7 10%		7 10%		7 10%		7 10%				7 10%	
3	Dissolved Oxygen (DO)	mg/ℓ	>5	>5	-	-	>4*	>6*	>4*	>6*	-	-	-	-

Source : State Ministry of Environment, Decree-02/MENKLH/1/1988, dated 19 January 1988
Remarks: * indicates key parameter

Table 4.13 (2) Coastal Seawater Quality Standards

No.	Parameter	Unit	Swimming/bathing		Mining and Industry		Fishery		Sea Park		Public and Aesthetic		Cooling	
			Permissible Limit	Desirable Limit	Permissible Limit	Desirable Limit	Permissible Limit	Desirable Limit	Permissible Limit	Desirable Limit	Permissible Limit	Desirable Limit	Permissible Limit	Desirable Limit
4	BOD_5	mg/ℓ	20	10	20*	10*	45*	25*	45*	25*	-	-	-	-
5	COD (Cr)	mg/ℓ	40	20	40	20	80	40	80	40	-	-	-	-
6	NH_4N	mg/ℓ	4	None	-	-	1*	0.3*	0.3*	0.1*	-	-	-	-
7	NO_2N	mg/ℓ	None	None	-	-	None*	None*	None*	None*	-	-	-	-
8	Cyanide (CN)	mg/ℓ	0.20	0.05	0.20	0.05	0.20*	0.05*	0.20*	0.05*	-	-	-	-
9	H_2S	mg/l	-	-	-	-	0.03*	0.01*	0.03*	0.01*	-	-	-	-
10	Oil	mg/ℓ	3	None	2*	None*	5*	None*	5*	None*	5	None	-	-
11	Phenol	mg/ℓ	0.02	None	-	-	0.002*	None*	0.002*	None	-	-	-	-
12	Pesticides (Organic Chlorides)	mg/ℓ	0.042	None	0.02	None	0.02*	None*	0.02*	None*	-	-	-	-
13	PCB	mg/ℓ	0.001	None	0.001	None	0.001*	None*	0.001*	None*	-	-	-	-
14	Detergents	mg/ℓ MBAS	0.5	None	1.5	None	1.0*	None*	1.0*	None*	-	-	-	-
15	Mercury (Hg)	mg/ℓ	0.005	0.0001	0.005	0.0001	0.003*	0.0001*	0.006	0.0001*	-	-	-	-
16	Hexavalent Chromium (Cr^{6+})	mg/ℓ	0.01	0.00004	0.01	0.00004	0.01*	0.00004	0.05*	0.00001*	-	-	-	-
17	Arsenic (As)	mg/l	0.05	0.0026	0.05	0.0026	0.01*	0.0026*	0.01*	0.0026*	-	-	-	-

Source : State Ministry of Environment, Decree-02/MENKLH/1/1988, dated 19 January 1988
Remarks: * indicates key parameter

Table 4.13 (3) Coastal Seawater Quality Standards

No.	Parameter	Unit	Swimming/bathing		Mining and Industry		Fishery		Sea Park		Public and Aesthetic		Cooling	
			Permissible Limit	Desirable Limit	Permissible Limit	Desirable Limit	Permissible Limit	Desirable Limit	Permissible Limit	Desirable Limit	Permissible Limit	Desirable Limit	Permissible Limit	Desirable Limit
18	Selenium (Se)	mg/ℓ	0.006	0.00045	0.006	0.00045	0.005*	0.00045*	0.005	0.00045	-	-	-	-
19	Cadmium (Cd)	mg/ℓ	0.01	0.00002	0.01	0.00002	0.01*	0.00002*	0.01*	0.00002*	-	-	-	-
20	Copper (Cu)	mg/ℓ	1	0.001	1	0.001	0.06*	0.001*	0.06	0.001	-	-	-	-
21	Lead (Pb)	mg/ℓ	0.05	0.00002	0.05	0.00002	0.01	0.00002	0.75	0.00002	-	-	-	-
22	Zinc (Zn)	mg/ℓ	0.15	0.002	0.15	0.002	0.1	0.002	0.1	0.002	-	-	-	-
23	Nickel (Ni)	mg/l	0.1	0.007	0.1	0.007	0.002	0.007	0.1	0.007	-	-	-	-
24	Silver (Ag)	mg/ℓ	0.05	0.0004	0.05	0.0004	0.05	0.0003	0.05	0.0003	-	-	-	-
	Biology													
1	Total Coliform	No./ 100 mℓ	1000	None	1000	None	1000	None	1000	None	-	-	-	-
2	Fecal Coliform	No./ 100 mℓ	None	None	None	None	None	None	None	None	-	-	-	-
3	Planktons	No.	None	None	None	None	None	None	-	-	-	-	-	-
	Radio Activity													
1	α (Alpha)	pCi/l	1	None	1	None	1	None	1	None	-	-	-	-
2	β (Beta)	pCi/l	100	None	100	None	100	None	100	None	-	-	-	-
3	Sr-90	pCi/l	1	None	1	None	1	None	1	None	-	-	-	-
4	Ra-226	pCi/l	3	None	3	None	3	None	3	None	-	-	-	-

Source : State Ministry of Environment, Decree-02/MENKLH/1/1988, dated 19 January 1988
Remarks: * indicates key parameter

Table 4.14 Ambient Air Quality in Ujung Pandang

No.	Location	Polution Level (ppm)	
		CO	SO_2
1	Kawasan Pasar Sentral	50.50	0.28
2	Terminal Panaikang	75.60	0.35
3	Jl. Jenderal Sudirman	22.30	0.15
4	Jl. Mesdjid Raya	32.50	0.20
5	Jl. Urip Sumoharjo	40.30	0.18
6	Jl. Tinumbu	44.70	0.21
7	Jl. Cendrawasih	38.70	0.16
8	Jl. A.P. Pettarani	28.20	0.18
9	Jl. Sultan Alaudin	41.90	0.15
10	Jl. Tarakan	18.50	0.13
11	Jl. Nusantara	15.30	0.13
12	Jl. RE. Martadinata	15.00	0.13
13	Jl. Riburane	9.70	0.10
14	Kompleks Pelabuhan	12.50	0.13
15	Jl. Somba Opu	22.00	0.18
16	Jl. Batua Raya	9.40	0.06
17	Jl. Daeng Tata	12.00	0.06
18	Jl. Galangan Kapal	12.50	0.08
19	Perumnas	13.00	0.08
20	Kampus Unhas Raya	8.00	0.01

Source : Penelitian Lapangan Ambo Upe and Nisbianti 1993

Table 4.15 Ambient Air Quality Standards in Various Countries

Country	Sulfur dioxide (ppm)	Carbon monoxide (ppm)	Suspended particulate matter (mg/m^3)	Nitrogen Dioxide (ppm)	Photochemical oxidants (ppm)
Indonesia	Daily average 0.10	8-hour average 20	Daily average 0.26	Daily average 0.05	1-hour average 0.10 (as ozone)
Japan	Daily average 0.04 1-hour average 0.10	Daily average 10 8-hour average 20	Daily average 0.10 1-hour average 0.20	Within or less than the daily average of 0.04 - 0.06 zone	1-hour average 0.06
USA	Primary Standards Annual average 0.03 Daily average 0.14 Secondary Standards 3-hour average 0.50	8-hour average 9 10-hour average 35 Same as for the primary standards	Annual average 0.08 Daily average 0.26 Annual average 0.06 Daily average 0.15	Annual average 0.05 Short-term vaue not determined Same as for the primary standards	1-hour average 0.12 (as ozone) Same as for the primary standards
Germany	Long-term effect 0.05 Short-term effect 0.15	9 26	0.15 0.30	0.04 0.01	None None

Note : Simple comparison of values is not appropriate because the concepts of establishment differ among the countries.
Indonesian standards are as per Decree-02/MENKLH/1/1988, State Ministry of Environment.

Table 4.16 Cases of Water-borne Diseases Recorded in Public Health Centres in KMUP-1988 to 1993

No.	Name of Disease	1988	1989	1990	1991	1992	1993
1	Diarrhea	41,035	44,256	39,667	39,179	49,941	47,191
2	Typhoid	216	–	6,095	655	48	479
3	Chicken Fox.	–	–	534	424	487	–
4	Varicella (Small Fox.)	–	–	1,691	3,114	–	16
5	Dysentery	–	1,863	–	–	–	1,751
6	Cholera	39	90	85	42	–	–
7	Skin Diseases	–	146,993	–	114,555	–	125,573

Source : KMUP Dalam Angka 1988 to 1992
Kantor Statistik KMUP 1993
Kantor Dinas Kesehatan KMUP 1988 to 1993

Table 4.17 (1) Environmental Regulations of the Government of Indonesia

I	GOVERNMENTAL REGULATION
1	Regulation Number 20, 1990 on Water Pollution Control
2	Regulation Number 35, 1991 on River
3	Regulation on Domestic Investment to Build the Limited Corporation for the Dangerous and Poisonous Waste Industrial Disposal Service Site in Cileungsi - Bogor West Java
4	Regulation Number 51, 1993 on Environmental Impact Analysis
II	PRESIDENTIAL DECREE
1	Decree - 23, 1990 on Controlling Board of Environmental Impact
2	Decree - 1, 1992 on Management of Tourism Site of Borobudur Temple and Prambanan Temple and the Local Environmental Control
III	DECREE OF THE STATE MINISTRY OF ENVIRONMENT
1	Decree - 49/MENKLH/6/1987 on the Guidance of the Import Impact Determination and Appendix
2	Decree - 50/MENKLH/6/1987 on the Guidance of the Important Environmental Impact and Appendix
3	Decree - 51/MENKLH/6/1987 on the Guidance of the Evaluation Study Arrangement of Environmental Impact
4	Decree - 52/MENKLH/6/1987 on the Deadline of Evaluation Study Arrangement of Environmental Impact
5	Decree - 53/MENKLH/6/1987 on the Guidance of the Structural Membership and Work Commision
6	Letter No. - 03/SE/MENKLH/6/1987, on the Procedural Prevention of Polution and Destruction Cases of Environment
7	Decree - 02/MENKLH/1/1988 on the Guidance of Environmental Standard Quality
8	Decree - 03/MENKLH/11/1991 on the Wastewater Quality Standard for the on Going Activity
9	Decree - 10/MENLH/3/1994 on the Cancellation of the State Ministry of Population and Environment, Decree - 49/MENKLH/6/1987 up to Decreee - 53/MENKLH/6/1987
10	Decree - 11/MENLH/3/1994 on the Type of Business of Activity which are Compulsorily Completed with the Analysis of Environmental Impact (AMDAL)
11	Decree - 12/MENLH/3/1994 on the General Guidance of the Environmental Development Efforts and Environmental Observation
12	Decree - 13/MENLH/3/1994 on the Guidance of Structural Membership and Operational Committee of AMDAL
IV	DECREE OF THE STATE MINISTRY OF INDUSTRY
1	Decree Letter of the State Ministry of Industry No. 148/M/Sk/4/1985 on the Isolation of Poisonous and Hazardous material in Industrial Company
2	Decree Letter of the State Ministry of Industry No. 20/M/SK/1/1986 on Task Scope of Industrial Department in Controlling Industrial Polution of Environment
3	Decree Letter of the State Ministry of Industry No. 134/M/SK/1988 on Preventing and Overcoming the Pollution as the Result of Industrial Business Activity to Environment
4	Decree Letter of the State Ministry of Industry No. 135/M/SK/1988 on the Formation of Commision Center for Analysis Environmental Impact (AMDAL) in the Industrial Department
V	DECREE OF THE STATE MINISTRY OF INTERNAL AFFAIRS
1	Decree of the State Ministry of Internal Affairs No.29/1992 on the Guidelines of the AMDAL Operation for Foreign Invesment Project in the Regions
2	Decree of the State Ministry of Internal Affairs No.33/1992 on the Guidelines of Arranging Regional Regulation of the Spatial Plan for Provinces and the General Spatial Plan for Regencies

Table 4.17 (2) Environmental Regulations of the Government of Indonesia

VI	REGULATION OF THE STATE MINISTRY OF HEALTH
1	Regulation of the State Ministry of Health No.157/MENKES/PER/III/1990 on Analysis of Environmental Impact of Pharmacy Industry
2	Regulation of the State Ministry of Health No.416/MENKES/PER/IX/1990 on the Requirements and Supervision of Water Quality
3	Regulation of the State Ministry of Health No.477/MENKES/PER/X/1990 on Analysis of Environmental Impact of Health Laboratory
4	Regulation of the State Ministry of Health No.512/MENKES/PER/X/1990 on Analysis of Environmental Impact of Hospitals
5	Regulation of the State Ministry of Health No.061/MENKES/PER/1991 on the Health Requirements of Swimming Pools and Public Bathing
VII	DECREE OF THE STATE MINISTRY OF TRANSPORTATION
1	Decree of the State Ministry of Transportation No. KM.86/1990 on the Oil Pollution Prevention from Ship
VIII	DECREE OF THE STATE MINISTRY OF MINING AND ENERGY
1	Decree of the Ministry of Mining and Energy No. 1158/K/008/M.PE/1989 on the Operational Stipulation of Environmental Impact Analysis in Mining and Energy
2	Decree of the State Ministry of Mining and Energy No. 523.K/201/M.PE/1993 on the Technical Guidance of Environmental Presentation Information Arrangement and Environmental Management Plan and Environmental Surveying Plan for Mining Exploitation of C-Classification Mining Material
IX	DECREE OF THE STATE MINISTRY OF AGRICULTURE
1	Decree of the State Ministry of Agriculture No. 362/Kpts/TN-120/5/1990 on the Stipulation and Operational Procedure of the Licencing and the Business Registration of Animal Husbandry
X	REGULATION OF THE STATE MINISTRY OF PUBLIC WORKS
1	Regulation of the State Ministry of Public Works, No. - 45/PRT/1990 on the Water Quality Control in the Water Resources
XI	DECREE OF THE GOVERNOR OF DKI JAKARTA
1	Decree of the Governor of DKI JAKARTA No.-45/1992 on the Stipulation of the Wastewater Process with Drainage System in the Region of JAKARTA Municipality

Source : Himpunan Peraturan Dibidang Lingkungan Hidup, Penerbit CV. Eko Jaya, Jakarta (1994)

Table 4.18 (1) List of Activities Requiring Environmental Impact Assessment

NO.	TYPE OF ACTIVITY	SIZE
I	MINING AND ENERGY SECTOR	
	1. Mining area during exploitation, phase for production of :	>= 200 ha and/or
	* Coal	>= 200,000 ton/yr
	* Primary ores	>= 60,000 ton/yr
	* Secondary ores	>=100,000 ton/yr
	* Non metallic minerals, sand and gravel (Golongan C)	>= 300 m3/yr
	* Radioactive materials, including mining, processing and purification	
	2. Transmission lines	> 150 KV
	3. Electricity generating stations : diesel, gas steam and combined cycle	>= 100 MW
	4. Hydroelectric generating stations of all types and sizes, except mini hydro and direct current types	
	5. Geothermal electricity generating stations	>= 55 MW
	6. Other types of electricity generating stations	>= 5 MW
	7. Oil and gas exploitation	
	8. Oil and gas processing (refinery)	>= 25 km
	9. Oil and gas pipelines	
II	HEALTH SECTOR	
	1. Class A hospital	
	2. Other hospital which are equivalent to Class A or Class I	
	3. Other hospitals	>= 400 rooms
	4. Hospitals with full/comprehensive specialist service	
	5. Pharmaceutical industry facilities producing basic drug materials	
III	PUBLIC WORKS SECTOR	
	1. Construction of dams or embankments	Height >= 15 m or impounded area >= 100 ha
	2. Irrigation area development	Irrigated area >= 2,000 ha
	3. Tidal swamp area development	Area >= 5,000 ha
	4. Coastal protection in large cities	Population >= 500,000
	5. River improvement works in large cities	Population >= 500,000
	6. Canalization/flood control facilities in large cities	Length >= 5 km or width >= 20 m
	7. Canalization other than item 6 above (coastal areas, swamps, etc.)	Length >= 25 km or width >= 50 m
	8. Construction of toll roads and fly-overs	
	9. Highway construction	Length = 25 km
	10. Arterial and collector road construction and upgrading outside of large cities or metropolitan areas	Length = 5 km or area >= 50 m
	11. Garbage disposal using incineration	>=800 ton/ha
	12. Garbage disposal using controlled landfill or sanitary landfill system	>=800 ton/ha
	13. Garbage disposal using open dumping systems	>= 80 ton/ha
	14. Drainage system using canals in large cities and metropolitan areas	Primary canal length >=5 km
	15. Wastewater treatment :	
	* Construction of wastewater treatment facilities in urban areas	Area >= 50 ha
	* Construction of sewerage	Service area >= 2,500 ha
	16. Systems for withdrawal of water from lakes, rivers, springs or other water sources	Withdrawal >= 2 m3/sec
	17. Public housing and settlement construction	Area >= 200 ha
	18. Urban renewal projects	Area >= 5 ha
	19. Construction of multi-storied and apartment buildings	Height >= 60 m
IV	AGRICULTURE SECTOR	
	1. Shrimp/fish culture	Area >= 50 ha
	2. Development of rice fields in forested areas	Area >= 1,000 ha
	3. Plantations	Area >= 10,000 ha
	4. Cash crop farms	Area >= 5,000 ha

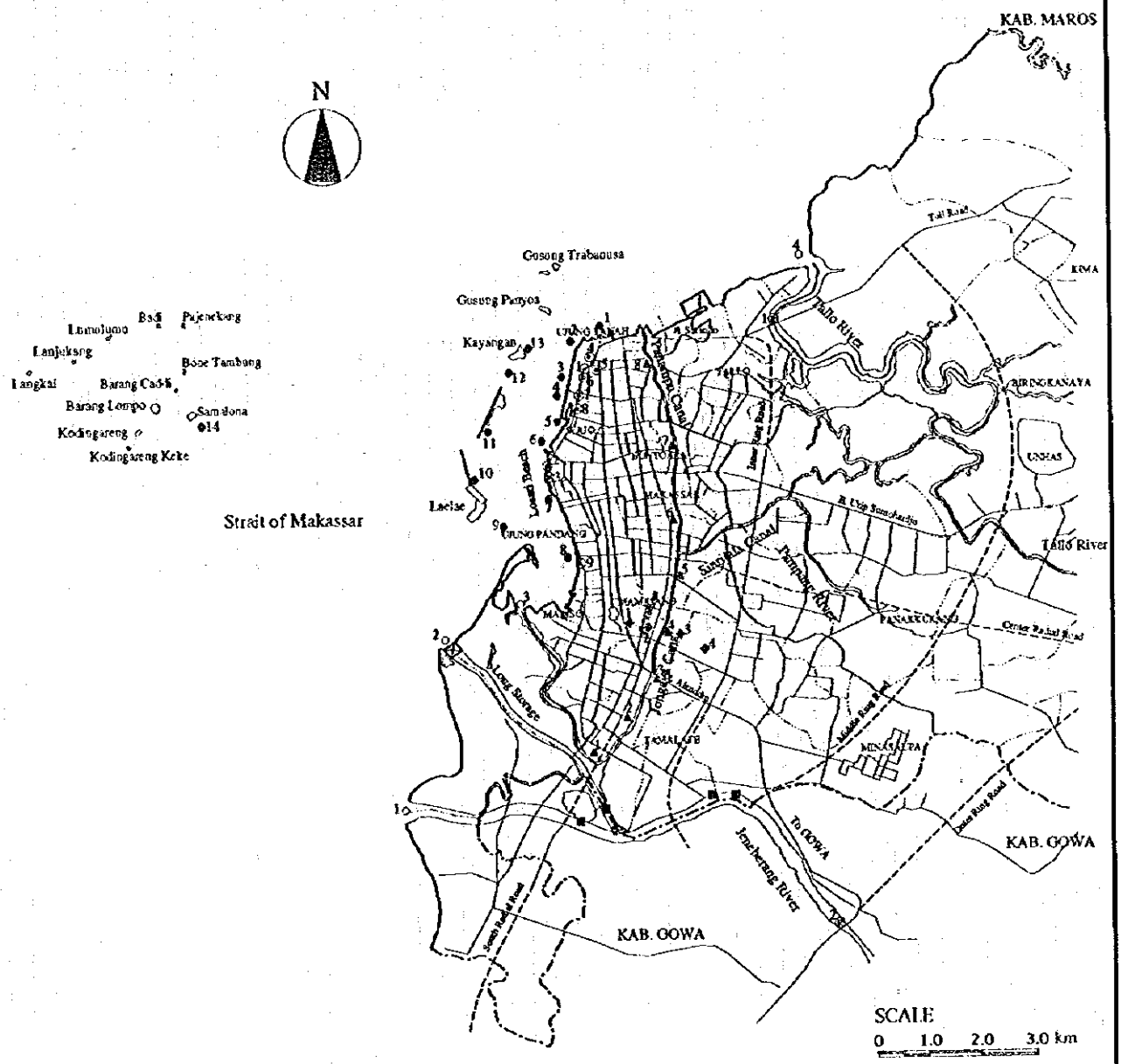
Table 4.18 (2) List of Activities Requiring Environmental Impact Assessment

V	TOURISM SECTOR	
	1. Hotels 2. Golf courses 3. Recreational parks 4. Tourism resort areas or states	Size >= 200 rooms or area >= 5 ha > = 100 ha
VI	TRANSMIGRATION AND FOREST RESETTLEMENT SECTOR	
	1. Proposed transmigration settlement construction Note : General transmigration types Primary activities : food crops and/or plantations Scope of study to cover entire SKP (Satuan Kelompok Pemukiman)	Area > = 3,000 ha
VII	INDUSTRY SECTOR	
	1. Cement (made through production of cement clinker) 2. Pulp and paper industry 3. Chemical fertilizer (synthetic) 4. Petrochemical industry 5. Steel smelting 6. Lead smelting 7. Copper smelting 8. Alumina production 9. Blended steel smelting 10. Aluminum ingot production 11. Production of metal pellet and sponge products 12. Production of pig iron 13. Production of ferro alloys 14. Industrial estates 15. Ship-Building 16. Aircraft production 17. Integrated plywood production 18. Production of weapons, munitions explosives 19. Battery production	 Vessels >= 3,000 DWT Including associated facilities, such as glue production
VIII	COMMUNICATIONS SECTORS	
	1. Railway construction and associated facilities 2. Subway construction 3. Construction of Class I, II and III harbors and associated facilities 4. Construction of special ports 5. Coastal reclamation projects 6. Marine dredging 7. Port handing areas 8. Airports and associated facilities	Length > = 25 km Area >= 25 ha Volume >= 100,000 m3
IX	TRADE SECTOR	
	1. Trading/shopping centers (relatively concentrated)	Area >= 5 ha or building area >= 10,000 m2
X	DEFENSE AND SECURITY SECTOR	
	1. Construction of munitions storage facilities 2. Construction of naval bases 3. Construction of airforce bases 4. Construction of battlefield training centres/shooting ranges	 Classes A,B,C Classes A,B,C or equivalent Area >= 10,000 ha

Table 4.18 (3) List of Activities Requiring Environmental Impact Assessment

XI	NUCLEAR ENERGY DEVELOPMENT SECTOR	
	1. Nuclear reactor construction and operation * Energy production reactor * Research reactor 2. Construction and operation of non-reactor nuclear energy facilities * Nuclear materials fabrication * Radioactive waste treatment facilities * Radiation source materials * Radioisotope production for all facilities	 >= 100 kW Production >= 50 fuel elements/yr All facilities Sources >= 1,850 TBq (5000 Ci)
XII	FORESTRY SECTOR	
	1. Safari park construction 2. Zoo construction 3. Forest concessions (HPH) 4. Sago palm forest concessions (HTI) 5. Industrial forest concessions 6. Establishment of parks, including : national parks, nature reserves, hunting preserves, marine parks, wildlife preserves, biosphere preserves	> = 250 ha > = 100 ha
XIII	TOXIC AND HAZARDOUS MATERIALS MANAGEMENT	
	1. Construction of toxic and hazardous (B3) waste treatment facilities	
XIV	INTEGRATED/MULTISECTORAL ACTIVITIES	
	Businesses and activities comprised of related activities in single ecosystem type which each require an EIA, and which are under the authority of more than one government agency.	

Source : State Ministry of Environment
Decree-11/MENLH/3/94, dated 19 March 1994



LEGEND

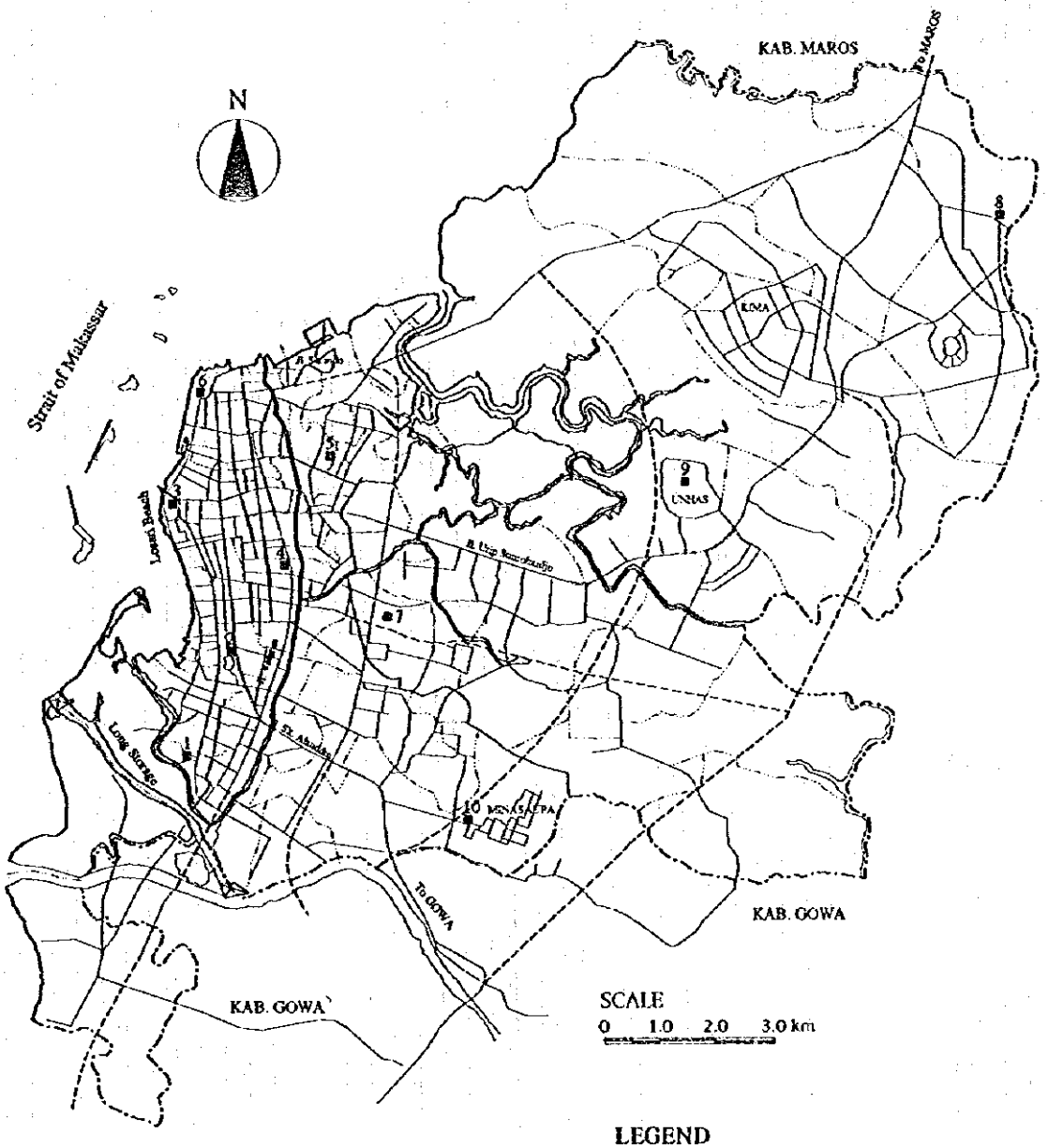
SYMBOL	LOCATION	SAMPLE TYPE	YEAR
⊙	SM1 - SM9	Groundwater	1992
•	L1 - L14	Seawater	1992
○	S1 - S4	River Mouth Water	1992
▲	PJ1 - PJ8	Groundwater	1993
♦	I1 - I4	Groundwater	1993
■	JB1 - JB4	Jeneberang River	1993
⊗	R1 - R2	River Water	1994

(Source : Previous Studies)

FIG. 4.1 Water Quality Data Sampling Location

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

JICA A.D.1995



LEGEND

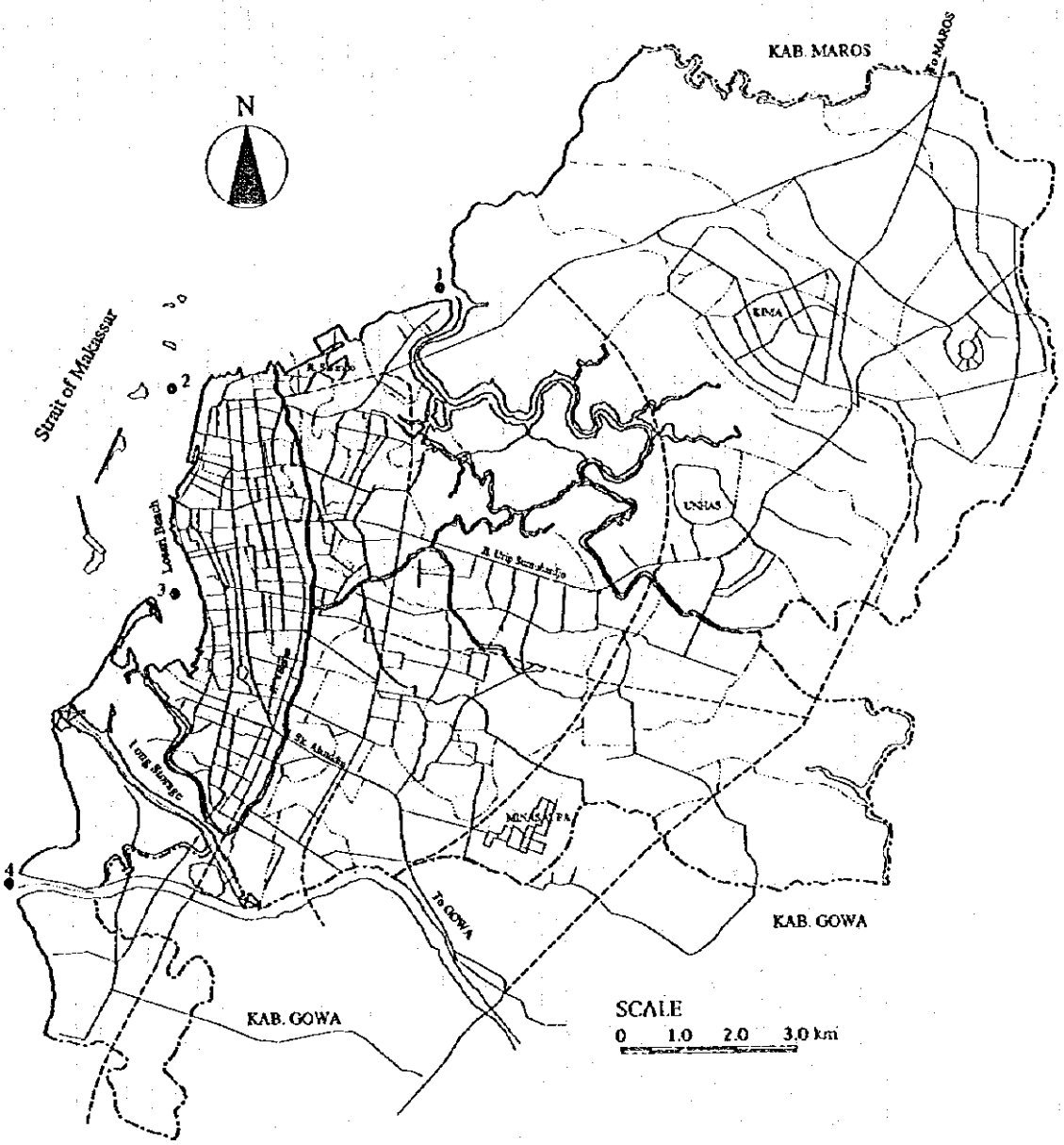
■ Groundwater Sampling Point

No.	Location
1	SAMBUNG JAWA
2	Mattoanging Stadium, MARIO
3	Fort Rotterdam, BULOGADING
4	MARADEKAYA
5	KALUKUANG
6	UJUNG TANAH
7	IDI Housing, MASALE
8	PEPABRI Housing, SUDIANG
9	UNHAS, TAMALANREA INDAH
10	Minasaupa Housing, GUNUNG SARI

FIG. 4.2 Groundwater Quality Sampling Location - JICA

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

JICA A.D.1995



LEGEND

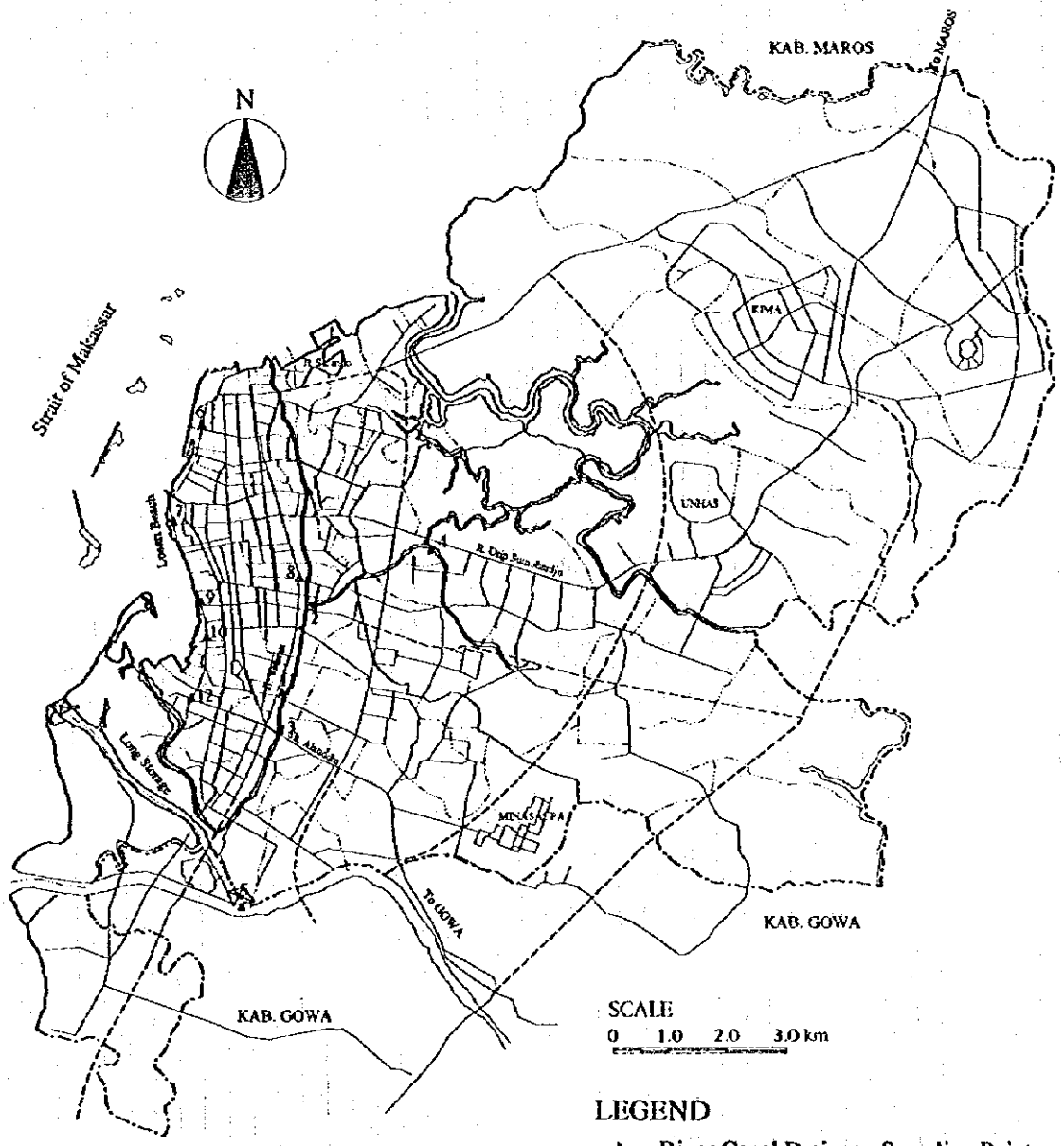
- Coastal Sea Water Sampling Point

No.	Location
1	Tallo River Mouth
2	Kayangan-Ujung Centre
3	Mariso Bay
4	Jeneberang River Mouth

FIG. 4.3 Coastal Seawater Quality Sampling Location - JICA

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

JICA A.D.1995



LEGEND

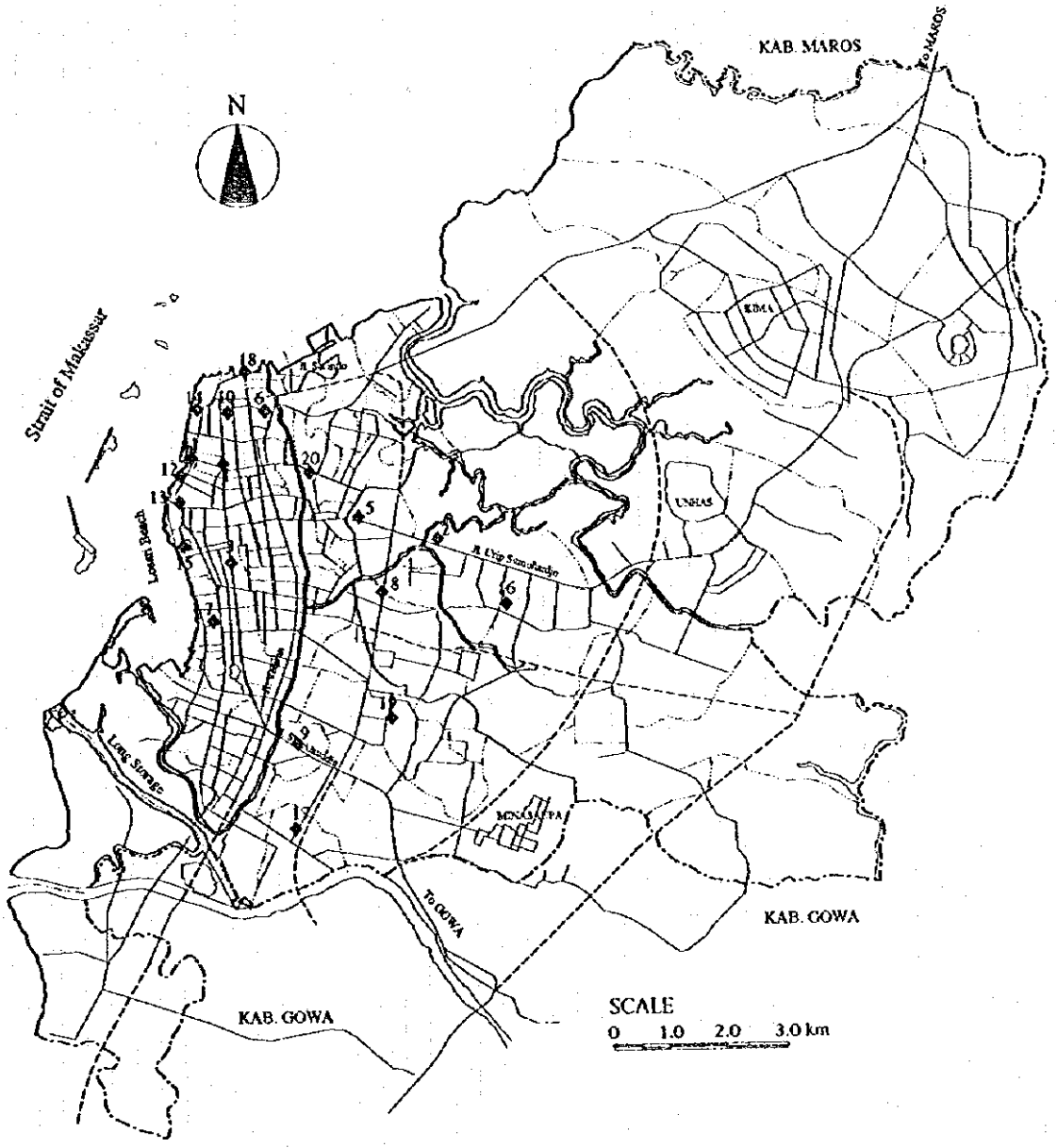
▲ River Canal Drainage Sampling Point

No.	Location
1	Canal Panampu
2	Canal Sinrijala
3	Canal Jongaya
4	Pampang River
5	Jeneberang River
6	Drainage (Jl.Tarakan)
7	Drainage (Jl.Ujung Pandang)
8	Drainage (Jl.Veteran)
9	Drainage (Jl.Penghibur)
10	Drainage (Jl.Rajawali)
11	Drainage (Jl.Landak Baru)
12	Drainage (Jl.Nuri Baru)

FIG. 4.4 Inland Surface Water Quality Sampling Location - JICA

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

JICA A.D.1995



LEGEND

◆ Air Quality Sampling Point

FIG. 4.5 Ambient Air Quality Data Sampling Location

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

JICA A.D.1995