

APPENDIX M6

This appendix is reference to and supporting data of

Volume 2 Main Report – Master Plan Chapter 6 Master Plan for Sanitation

M61	Basic Condition for Master Plan
M62	Design Criteria for Sewerage Facilities
M63	Master Plan for Sewerage Facilities
M64	Required Land Area for New Sewage Treatment Plants

Appendix M61:

Basic Condition for Master Plan

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Appendix M61.1 Study on Infiltration from Soak Pit in Relation with Groundwater Level

(1) Groundwater Level in Goa

The data of groundwater level are collected from hydrogeologist in the Water Resources Department and the locations of measurement stations are shown in Figure M61.1.1, the groundwater level of each station are shown in Table M61.1.1 and the fluctuation of water level in north and south Goa district, north and south coastal belt, Mapusa and Ponda are shown in Figures M61.1.2 and M61.1.3 respectively. The following items are presented by these Table and Figures.

- ✧ In 1994, the groundwater level at the end of rainy season (August) is higher than the end of dry season (May) and examples of rising water level are shown as bellows.

$$\text{North Goa: } 7.82 - 3.33 = + 4.49\text{m}$$

$$\text{South Goa: } 7.10 - 4.40 = + 2.70\text{m}$$

- ✧ After the peak water level at the end of rainy season, it is falling till the end of dry season in next year

(2) Groundwater Level and Penetration of On-Site Facility

Generally, the groundwater level changes on accordance with the regional topographical conditions and/or precipitation. Some previous studies observed poor infiltration of soil and many soak pits in trouble, and indicated that the soil condition in a part of the Study area was not suitable for soak pits.

However, according to Table M61.1.1 and Figure M61.1.1, there is no measurement station for groundwater level, which is reaching to the ground level. The groundwater in Baga station, which is presented in Figure M61.1.2 is rising to the highest level in the South and North Coastal Belt and it was recorded GL -2.27m. That mean of GL -2.27m show easily filtrate from the soak pit of on-site facility.

The problems of overflow in the on-site facility will be percolation obstacle caused by the clogging of soak pit and/or inadequate maintenance of facilities. Therefore, a periodical replacement of soak pit for maintaining a sufficient penetration, cleaning and removal of accumulated sludge are recommended for the proper operation of on-site facilities.

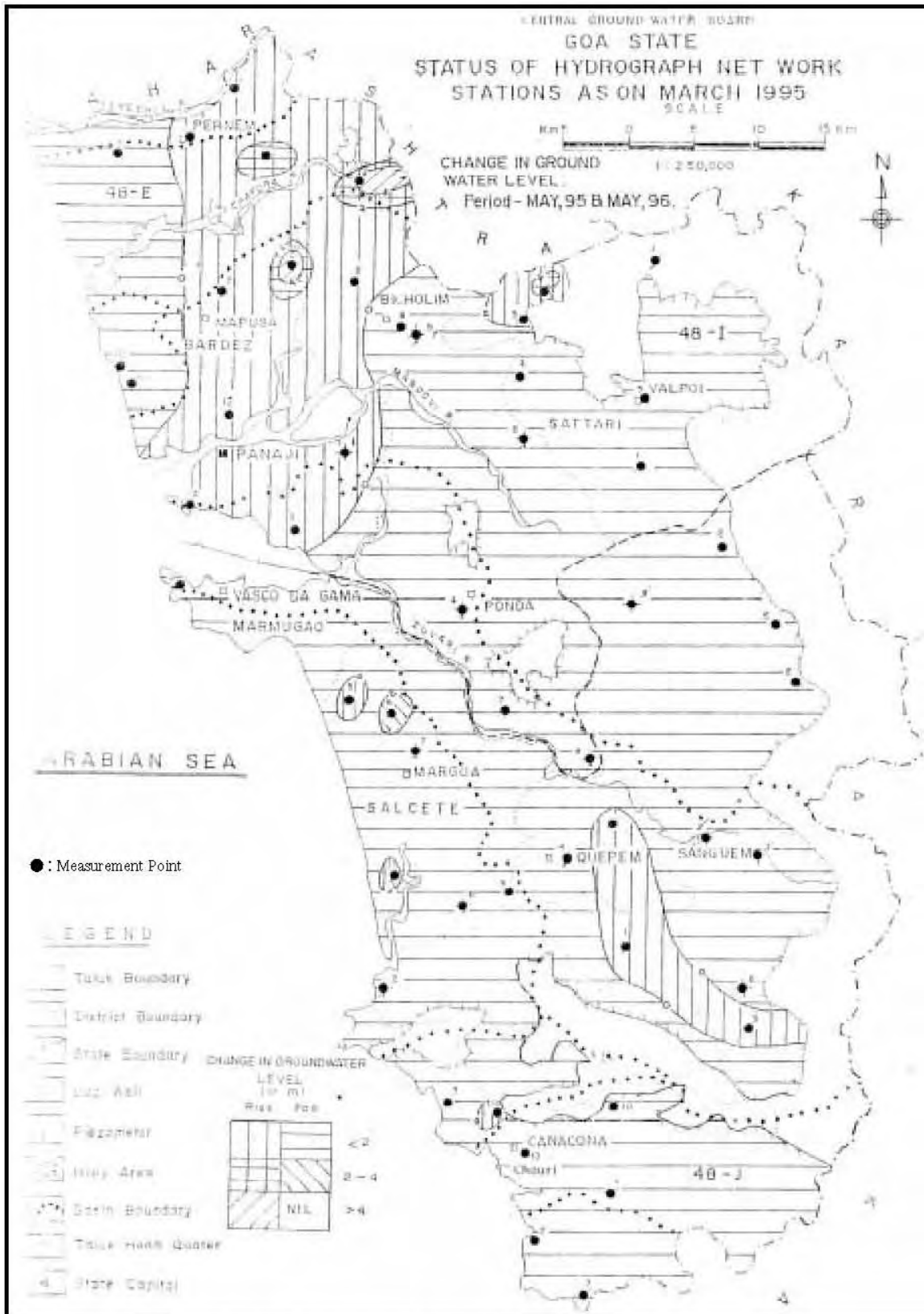
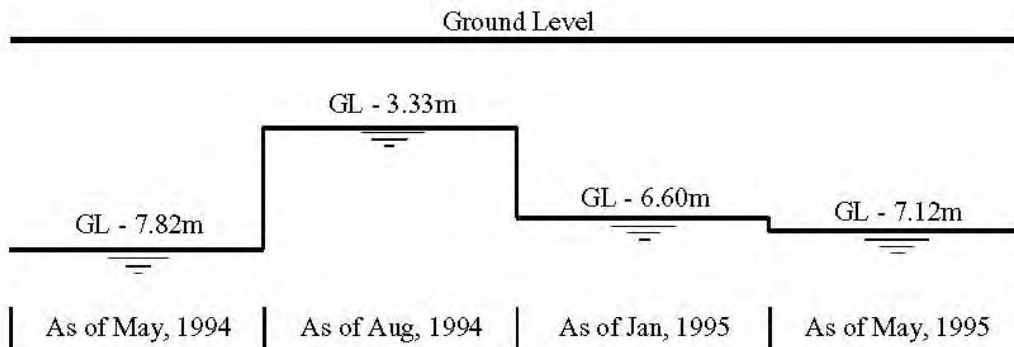
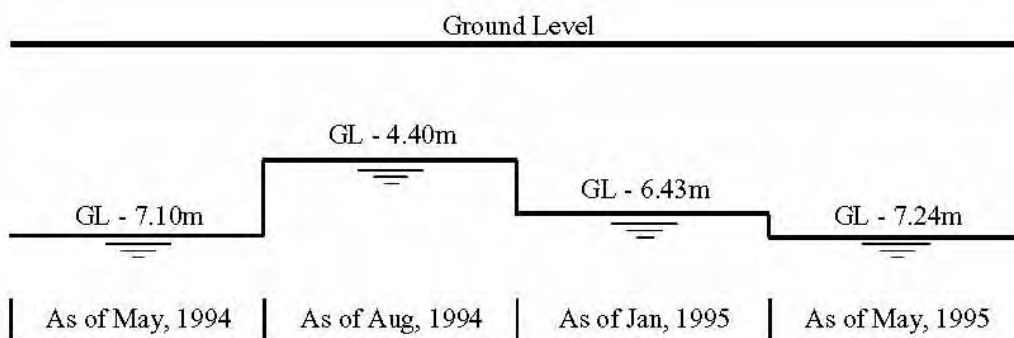


Figure M61.1.1 Location of Measurement Points of Groundwater Level

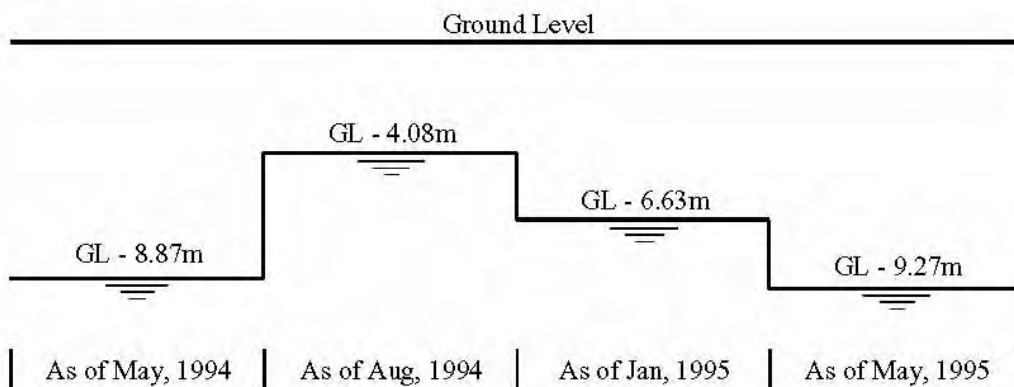
(1) Average Level in North Goa District



(2) Average Level in South Goa District



(3) Calangute (North Coastal Belt)



(4) Baga (North Coastal Belt)

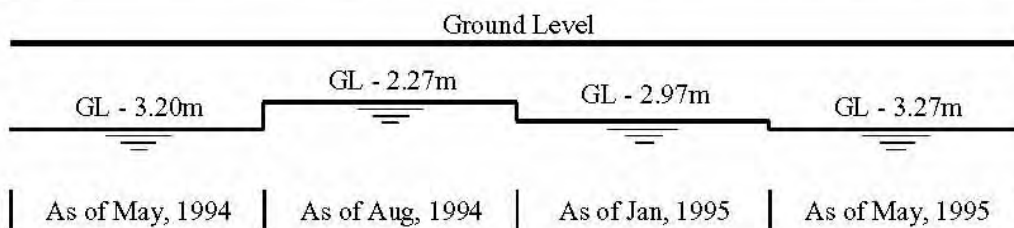
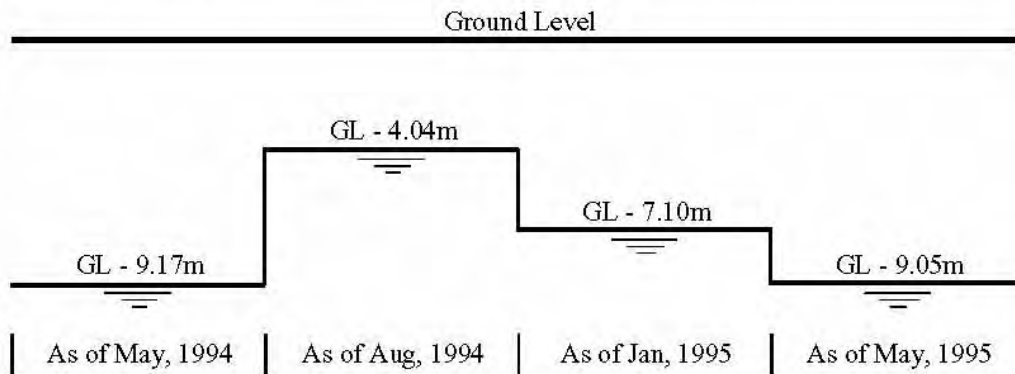
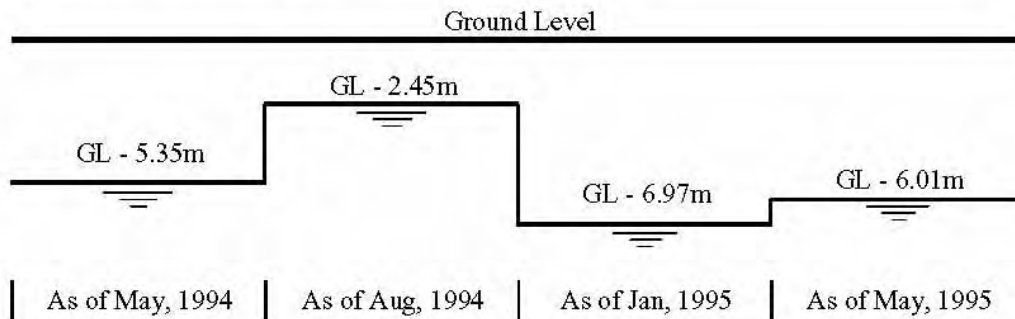


Figure M61.1.2 Groundwater Level in the Study Area

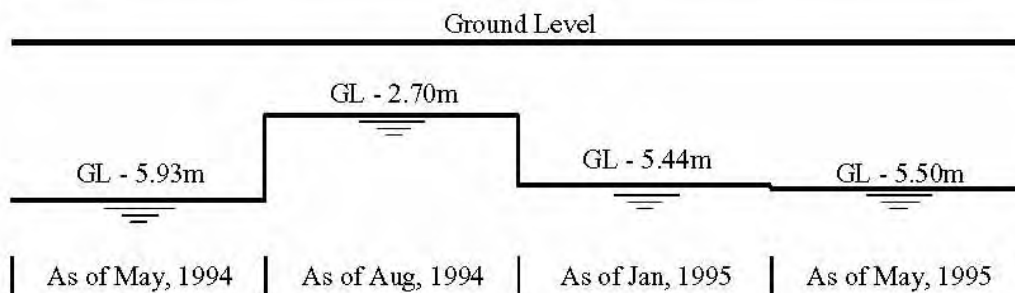
(5) Carmona (South Coastal Belt)



(6) Majorda (South Coastal Belt)



(7) Mapusa



(8) Ponda

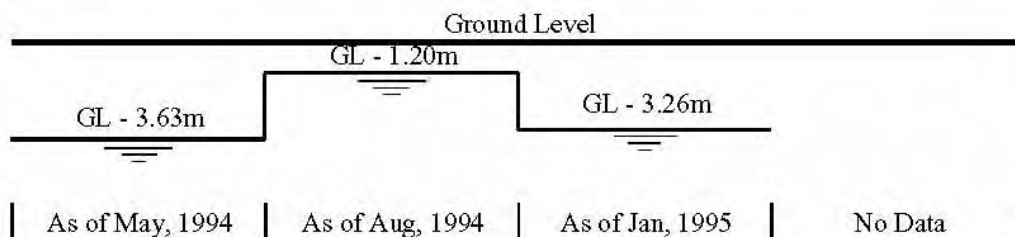


Figure M61.1.3 Groundwater Level in the Study Area

Table M61.1.1 Groundwater Level in Goa

Period : May 1994 - May 1995

North Goa District					Groundwater Level			
Name of Station	①	②	③	④	Rise/Fall (m)			
	May, 1994	Aug., 1994	Jan., 1995	May, 1995	Period			
	Groundwater Level (below ground level)				① - ②	② - ③	③ - ④	① - ④
	(m)							
Goa velha	2.20	1.65	5.58	2.40	0.55	-3.93	3.18	-0.20
Marmagao	3.36	2.39	6.31	3.58	0.97	-3.92	2.73	-0.22
Old Goa	5.00	2.72	4.34	-	2.28	-1.62	-	-
Karnzalem	4.40	2.19	3.60	-	2.21	-1.41	-	-
Alto Belim	17.97	-	15.84	-	-	-	-	-
Calangute	8.87	4.08	6.63	9.27	4.79	-2.55	-2.64	-0.40
Baga	3.20	2.27	2.97	3.27	0.93	-0.70	-0.30	-0.07
Mapusa	5.93	2.70	5.44	5.50	3.23	-2.74	-0.06	0.43
Kargaon	5.39	3.02	6.38	5.92	2.37	-3.36	0.46	-0.53
Marsi	2.84	0.76	1.38	-	2.08	-0.62	-	-
Pernem	5.97	1.80	2.20	5.28	4.17	-0.40	-3.08	0.69
Ugave	5.10	2.60	3.85	5.16	2.50	-1.25	-1.31	-0.06
Sirsuim	5.11	1.44	4.35	-	3.67	-2.91	-	-
Nagzar	11.31	1.95	8.38	11.36	9.36	-6.43	-2.98	-0.05
Sal	4.91	2.19	3.45	-	2.72	-1.26	-	-
Bicholim	5.80	0.80	5.76	6.17	5.00	-4.96	-0.41	-0.37
Bicholim (Pz)	16.59	11.57	16.33	-	5.02	-4.76	-	-
Surla (Pz)	19.69	16.60	19.25	-	3.09	-2.65	-	-
Hirve	9.55	1.99	5.60	-	7.56	-3.61	-	-
Valim	7.41	-	6.20	-	-	-	-	-
Khadji	12.37	2.95	8.55	12.26	9.42	-5.60	-3.71	0.11
Darbandhara	12.42	4.20	-	12.86	8.22	-	-	-0.44
Molem	14.61	1.70	10.28	14.24	12.91	-8.58	-3.96	0.37
Collem	10.38	2.77	10.33	10.05	7.61	-7.56	0.28	0.33
Balchanem	7.95	5.59	6.57	7.80	2.36	-0.98	-1.23	0.15
Honda	5.07	1.50	3.63	5.10	3.57	-2.13	-1.47	-0.03
Morlem	4.64	2.90	4.17	4.79	1.74	-1.27	-0.62	-0.15
Mulgaon	3.80	2.16	4.36	5.17	1.64	-2.20	-0.81	-1.37
Querim	4.92	-	3.17	5.17	-	-	-2.00	-0.25
Average level	7.82	3.33	6.60	7.12	4.49	-3.28	-0.52	0.70

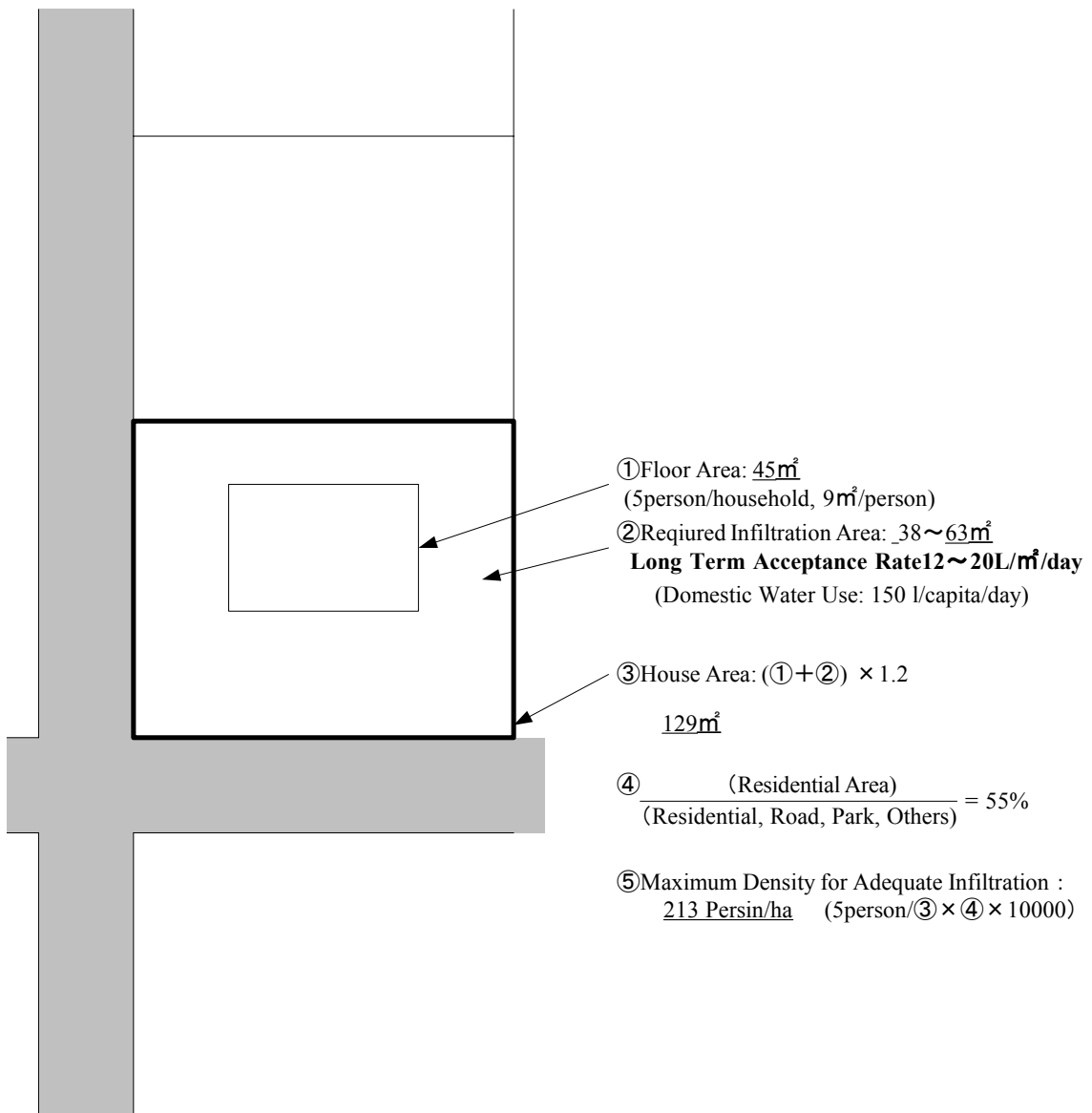
Source: Data acquire from Hydrogiologist in the Water Resources Department in Goa
(Pz) : Measured by Piezometer

South Goa District					Groundwater Level			
Name of Station	①	②	③	④	Rise/Fall (m)			
	May, 1994	Aug., 1994	Jan., 1995	May, 1995	Period			
	Groundwater Level (below ground level)				① - ②	② - ③	③ - ④	① - ④
	(m)							
Datamaple	15.99	15.80	15.93	16.03	0.19	-0.13	-0.10	-0.04
Hathipal	9.05	-	5.23	9.34	-	-	-4.11	-0.29
Canacoan	8.10	2.20	5.25	8.76	5.90	-3.05	-3.51	-0.66
Desaiwada	4.30	2.53	3.75	4.61	1.77	-1.22	-0.86	-0.31
Cuncalim (Pz)	5.34	3.55	5.40	-	1.79	-1.85	-	-
Kanagni	17.18	7.38	16.44	-	9.80	-9.06	-	-
Shirodha	5.63	5.68	7.90	-	-0.05	-2.22	-	-
Ballynurhem	7.95	5.25	6.80	6.28	2.70	-1.55	0.52	1.67
Fathodha (Pz)	4.08	-	3.42	-	-	-	-	-
Carmona	9.17	4.04	7.10	9.05	5.13	-3.06	-1.95	0.12
Quepem	4.53	1.78	3.17	3.64	2.75	-1.39	-0.47	0.89
Deulwada	3.61	2.66	-	3.85	0.95	-	-	-0.24
Netranlim	11.23	9.84	10.98	11.68	1.39	-1.14	-0.70	-0.45
Ugem (Pz)	9.45	2.75	8.38	7.01	6.70	-5.63	1.37	2.44
Panchwadi (Pz)	7.19	7.15	6.66	-	0.04	0.49	-	-
Ponda (Pz)	3.63	1.20	3.26	-	2.43	-2.06	-	-
Polem	3.83	1.90	2.36	4.29	1.93	-0.46	-1.93	-0.46
Anamol	-	-	3.55	-	-	-	-	-
Kalkinim	5.05	-	5.18	-	-	-	-	-
Ghadiwadi	2.93	1.71	2.60	3.57	1.22	-0.89	-0.97	-0.64
Majorda	5.35	2.45	6.97	6.01	2.90	-4.52	0.96	-0.66
Qulem	5.45	1.29	4.67	-	4.16	-3.38	-	-
Average level	7.10	4.40	6.43	7.24	2.70	-2.03	-0.81	-0.14

Source: Data acquire from Hydrogiologist in the Water Resources Department in Goa
(Pz) : Measured by Piezometer

Appendix M61.2 Long Term Infiltration for Soak Pit

Long term acceptance rate for soak pit infiltration is 12 - 20 L/m²/day. The adequate density is calculated as following method.



Appendix M61.3 Study on Cost Threshold Sewer Length

Septic Tank	Construction Cost		
	Septic Tank	20,000 Rs/household	
	Pipe	1,800 Rs/household	10 m
	Total	21,800 Rs/household	Cs1
	Maintenance Cost		per 30 years
	Desludging	5,000 Rs/household	2 times
	Soakpit Renovator	25,000 Rs/household	5 times
	Total 30 years	51,800 Rs/household	Cind
Sewerage			
	STP	4,800 Rs/household	
	Maintenance Cost		per 30 years
	Sewage Tariff	28,744 Rs/household	150L, 5person
	Total 30 years	33,544 Rs/household	Csew
	Tariff	less than 15m ³	2.5 Rs/m ³
		15 - 50 m ³	5.5 Rs/m ³
		22.5 m ³ /household/month	11000
		Averagely 3.5Rs/m ³	8250

Maximum Cost Effective Sewer Length for Sewerage i

$$MSL \times UC + C_{sew} = C_{ind}$$

Where

MSL: Maximum Sewer Length of Cost Effective for Sewerage (m)

UC: Unit cost for sewer (Rs/m)

Cind - Csew	18,256 Rs	
UC	1,600 Rs/m	
Maximum Sewer Length	11.4 m	
X=	-5.815047074 · Y +	107.1285772
	X: Population Density (person/ha)	
	Y: Pipe Length per Household	
Y=	11.4 m	
X=	<u>41 person/ha</u>	

Appendix M61.4 Selection of Sanitation System

Table M61.4.1 Selection of Sanitation System

Area		Settlement Area (ha)	Population		Population Density (Person/ha)	Treatment System Selection			
			in 2001 (Person)	in 2025 (Person)		Sewerage	Decentralized	Onsite	
Panaji	City	439	29,621	30,413	69	○			
	Others	Taleigao	372	17,267	17,729	48	○		
		Dona Paula & Caranzalem	92	8,196	8,415	91	○		
		Ribandar	84	3,982	4,088	49		○	
	Panaji Municipality Total		987	59,066	60,645	61	-	-	-
	St. Cruz	Calapor	134	11,830	17,261	129	○		
	Merces	Moranbi O Grandi	49	2,066	1,368	28			○
		Moranbi O Pequeno	19	1,127	1,312	69		○	
	Porvorim		795	35,119	63,127	79	○		
	Total		1,983	109,208	143,713	72	-	-	-
Margao		1,059	78,382	118,193	157	○			
Ponda		201	17,713	19,401	96	○			
Mapusa		330	40,487	69,338	219	○			
Coastal Belt of South Goa	Cavelossim		99	2,378	2,609	26			○
	Carmona		161	3,425	3,991	25			○
	Orlim		93	1,757	2,038	22			○
	Varca		249	4,865	6,836	27			○
	Benaulim		468	10,158	10,824	23			○
	Adsulim		10	232	523	53		○	
	Cana		13	407	460	36			○
	Sernabatim		56	1,391	1,748	31			○
	Vanelim		76	1,413	2,135	28			○
	Colva		110	3,719	5,279	48	○		
	Gandaulim		19	265	249	13			○
	Betalbatim		186	3,206	3,788	20			○
	Gonsua		8	217	241	31			○
	Majorda		137	2,968	3,609	26			○
	Utorda		100	2,096	2,303	23			○
Total		1,783	38,497	46,633	26	-	-	-	
Coastal Belt of North Goa	Candolim		200	8,604	13,224	68	○		
	Calangute		446	15,783	27,509	65	○		
	Anjuna		447	8,624	11,030	25			○
	Aprora		116	3,095	4,088	35			○
	Total		614	24,387	55,851	66	-	-	-
Total		5,815	308,674	453,129	77	-	-	-	

Appendix M61.5 Tourists Population

Table M61.5.1 Village wise Tourists Ratio

Name of Taluka/Village/Town	Number of Beds	Ratio	Talrawise Tourist Arrivals Ratio		Weighted Average	Villagewise Tourist Ratio
			Domestic	Foreign		
GOA STATE	24,516	100.00%	100.0%	100.0%	100.00%	100.00%
NORTH GOA DISTRICT	15,723	64.13%				
PERNEM TALUKA	109	0.44%	0.4%	0.4%	0.40%	
Tiracol	10	0.04%				0.04%
Arambol	11	0.04%				0.04%
Mandrem	44	0.18%				0.18%
Morgim	10	0.04%				0.04%
Pernem (M CI)	34	0.14%				0.12%
BARDEZ TALUKA	10,545	43.01%	20.8%	38.2%	25.27%	
Assagao	33	0.13%				0.08%
Anjuna	598	2.44%				1.43%
Arpora	1,310	5.34%				3.14%
Parra	10	0.04%				0.02%
Stolim (CT)	14	0.06%				0.03%
Mapusa (M CI)	615	2.51%				1.47%
Guirim (CT)	50	0.20%				0.12%
Calangute (CT)	4,340	17.70%				10.40%
Candolim (CT)	2,978	12.15%				7.14%
Perha-de-Franca (CT)	60	0.24%				0.14%
Socorro (Serula) (CT)	537	2.19%				1.29%
TISWADI TALUKA	4,307	17.57%	35.5%	14.7%	30.15%	
Corlim	32	0.13%				0.22%
Bainguinim	44	0.18%				0.31%
Panaji (M CI)	4,151	16.93%				29.06%
Bambolim (CT)	80	0.33%				0.56%
BICHOLIM TALUKA	54	0.22%	0.6%	0.0%	0.45%	
Maem	17	0.07%				0.14%
Bicholim (M CI)	37	0.15%				0.31%
SATARITALUKA	23	0.09%	0.0%	0.0%	0.03%	
Morlem	23	0.09%				0.03%
PONDA TALUKA	685	2.79%	4.2%	0.2%	3.17%	
Orgao	57	0.23%				0.26%
Savoi-Verem	152	0.62%				0.70%
Gangem	12	0.05%				0.06%
Usgao	42	0.17%				0.19%
Cundaim	30	0.12%				0.14%
Ponda (M CI)	392	1.60%				1.82%
SOUTH GOA	8,793	35.87%				
MORMUGAO TALUKA	2,011	8.20%	12.2%	6.2%	10.66%	
Dabolim	332	1.35%				1.76%
Cortalim	20	0.08%				0.11%
Cansaulim	742	3.03%				3.93%
Mormugao (M CI)	917	3.74%				4.86%
SALCETE TALUKA	6,597	26.91%	25.4%	39.2%	28.95%	
Verna	20	0.08%				0.09%
Majorda	330	1.35%				1.45%
Betalbatim	238	0.97%				1.04%
Colva	1,032	4.21%				4.53%
Cavelossim	1,980	8.08%				8.69%
Velim	40	0.16%				0.18%
Ambelim	96	0.39%				0.42%
Margao (M CI)	1,071	4.37%				4.70%
Benaolim (CT)	926	3.78%				4.06%
Varca (CT)	836	3.41%				3.67%
Navelim (CT)	28	0.11%				0.12%
QUEPEM TALUKA	24	0.10%	0.0%	0.0%	0.03%	
Quitol	24	0.10%				0.03%
SANGUEM TALUKA	10	0.04%	0.5%	0.2%	0.42%	
Sanguem (M CI)	10	0.04%				0.42%
CANACONA TALUKA	151	0.62%	0.3%	0.9%	0.47%	
Agonda	24	0.10%				0.07%
Canacora	127	0.52%				0.39%

Source: Goa Accommodation Directory, Department of Tourism, Government of Goa 3/2004

Table M61.5.2 Number of Tourist Arrival

Unit: Person/year

Year	2004	2025	Remarks
Domestic	2,085,729	3,387,713	
Foreign	363,230	650,581	
Total	2,448,959	4,038,294	

Table M61.5.3 Daily Cumulative Tourist: Average

Unit: Person/day

Year	2004	2025	Duration
Domestic	28,572	46,407	5
Foreign	8,956	16,042	9
Total	37,528	62,449	

Table M61.5.4 Daily Cumulative Tourist: Peak

Unit: Person/day

Year	2004	2025	Peak
Total	69,427	115,531	1.85

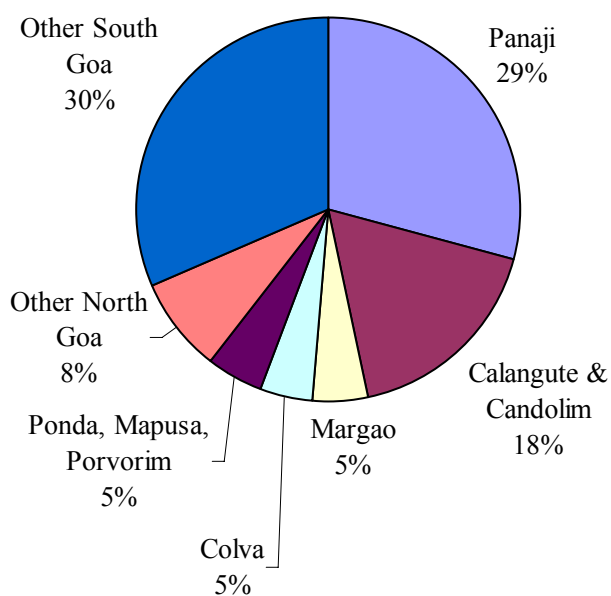


Figure M61.5.1 Percentage of Tourists Destination

Table M61.5.5 Fluctuation of Tourism

	Number of Tourist Arrival 1997 -2004		Cumulative Tourist per Day	
	Domestic	Foreign	Domestic & Foreign	
	Person/year		Person/day	Fluctuation to average
January	118,032	41,312	31,626	1.30
February	87,788	36,289	25,169	1.03
March	90,049	35,151	25,203	1.03
April	96,004	23,857	22,841	0.94
May	118,722	8,816	22,125	0.91
June	76,628	4,534	13,938	0.57
July	61,726	3,622	11,219	0.46
August	81,029	7,754	15,614	0.64
September	85,986	8,757	16,726	0.69
October	119,789	25,483	27,232	1.12
November	142,901	42,883	36,179	1.48
December	180,778	51,795	45,043	1.85
Average	104,953	24,188	24,409	1.00

Table M61.5.6 Tourist Population

Unit: Person/day

Area	Average		Peak	
	2015	2025	2015	2025
Panaji	12,429	18,149	22,994	33,576
St. Cruz	0	0	0	0
Porvorim	611	894	1,132	1,653
Margao	2,010	2,935	3,718	5,429
Ponda	776	1,134	1,436	2,097
Mapusa	630	920	1,166	1,703
Colva	1,937	2,828	3,583	5,231
Candolim & Calangute	7,500	10,952	13,876	20,261
Total	25,893	37,812	47,905	69,950

Appendix M61.6 Sewage Unit Flow

Table M61.6.1 Water Consumption Record

	Category	Unit	Bardez	Tiswadi	Ponda	Salcete	Remarks
Number of Customers (Number of Connections)	1 Domestic	Nos.	42,248	27,228	16,471	41,640	
	2 Commercial	Nos.	739	575	344	315	
	3 Government	Nos.	141	270	110	313	
	4 Industries	Nos.	17	12	59	502	
	5 Municipality	Nos.		29	6	2	
	6 V. Panchayat	Nos.				0	
	7 Defense	Nos.	1	14		4	
	8 Temporary Sup	Nos.	5			84	
	9 Inst. Bills	Nos.				0	
	10 Public Stand Post	Nos.				83	
	Total	Nos.	43,151	28,128	16,990	42,943	
Water Consumption Billed per Month	1 Domestic	m ³ /month	848,745	599,368	471,097	1,005,207	
	2 Commercial	m ³ /month	48,373	34,908	11,163	69,513	
	3 Government	m ³ /month	2,903	4,050	10,440	50,650	
	4 Industries	m ³ /month	14,449	42,194	70,430	62,862	
	5 Municipality	m ³ /month		290	71	66	
	6 V. Panchayat	m ³ /month				0	
	7 Defense	m ³ /month		28,389		151,846	
	8 Temporary Sup.	m ³ /month	103			7,727	
	9 Inst. Bills	m ³ /month				0	
	10 Public Stand Post	m ³ /month				962	
	Total	m ³ /month	914,573	709,199	563,201	1,348,833	
Served Population	Person	225,954	150,152	110,454	251,594	(2005 projected)	
Per Capita Water Use	ℓ/day/capita	123	131	140	131		
Population	Urban	Person	133,445	105,072	48,615	151,579	(2001 Census)
	Rural	Person	94,250	55,019	100,826	110,456	
Standard	Urban	ℓ/day/capita	135	135	135	135	CPHEEO
Water Use	Rural	ℓ/day/capita	70	70	70	70	
Estimated per capita Water Use							Average
	Urban	ℓ/day/capita	154	157	208	165	171
	Rural	ℓ/day/capita	80	82	108	86	89
Commercial / Domestic			6.0%	6.5%	4.6%	12.0%	7.3%
(Government + Municipality)/Domestic			0.3%	0.7%	2.2%	5.0%	2.1%
Remarks			2005 Jun	2004 Dec	2005 Jul	2005 Jan	

Appendix M61.7 Study of Panaji STP Sewage Inflow

Present Panaji STP Sewage Inflow ranges 8,200 - 9,600m³/day, refer to Table M61.7.1.
 100 % of sewage return ratio as Case 2 is preferable and adopted
 81 % of sewage return ratio in Panaji as Case 1 is too small.

2005 with Average Tourism

Case 1. Sewage Return Ratio of 80 %

	Population Person	Per Capita L/day/capita	Return Ratio	Flow m ³ /day
Domestic	29,805	150	80%	3,577
Institution		3%	80%	86
Groundwater		20%		732
Tourist	6,151	326	80%	2,005
Defense		900	80%	720
Total				7,120

2005 with Peak Season Tourism

Case 1. Sewage Return Ratio of 80 %

	Population Person	Per Capita L/day/capita	Return Ratio	Flow m ³ /day
Domestic	29,805	150	80%	3,577
Institution		3%	80%	86
Groundwater		20%		732
Tourist	11,380	326	80%	3,710
Defense		900	80%	720
Total				8,825

Case 2. Sewage Return Ratio of 100 %

	Population Person	Per Capita L/day/capita	Return Ratio	Flow m ³ /day
Domestic	29,805	150	100%	4,471
Institution		3%	100%	134
Groundwater		20%		921
Tourist	6,151	326	100%	2,005
Defense		900	100%	900
Total				8,431

Case 2. Sewage Return Ratio of 100 %

	Population Person	Per Capita L/day/capita	Return Ratio	Flow m ³ /day
Domestic	29,805	150	100%	4,471
Institution		3%	100%	134
Groundwater		20%		921
Tourist	11,380	326	100%	3,710
Defense		900	100%	900
Total				10,136

Table M61.7.1 Panaji STP Sewage Inflow RecordUnit: m³/day

Day	July	August	September	October	November
1	-	-	11,371	11,190	5,036
2	-	-	10,517	9,984	9,841
3	-	-	7,272	11,169	10,277
4	-	-	8,423	11,402	11,506
5	-	-	12,313	11,961	10,826
6	-	-	11,010	11,790	6,368
7	-	2,714	11,129	11,432	9,233
8	-	12,969	8,906	11,513	9,521
9	-	20,160	11,264	10,713	7,676
10	-	14,753	13,330	10,812	6,490
11	-	13,353	12,016	7,988	5,941
12	-	12,721	13,572	13,159	6,751
13	-	13,547	13,320	13,979	6,072
14	8,041	14,578	9,300	14,069	7,688
15	10,524	13,097	12,669	14,936	8,213
16	10,312	12,563	10,527	9,142	7,578
17	10,025	15,319	8,985	8,567	7,297
18	7,747	13,365	7,893	9,464	9,118
19	3,712	15,099	Plant was working, meter was not working	8,202	6,470
20	10,041	14,762		11,173	8,459
21	10,213	12,776		10,962	9,503
22	9,614	14,031		11,114	8,763
23	-	13,009		2,023	6,051
24	-	10,846	15,188	8,806	6,048
25	9,816	12,958	12,320	6,731	9,337
26	20,113	10,262	4,085	5,474	9,298
27	19,601	9,929	14,098	3,840	8,465
28	12,258	10,020	14,053	3,512	9,479
29	-	9,711	10,939	4,149	9,254
30	-	10,666	11,448	9,918	-
31	-	11,259	-	8,866	-
Ave	10,924	12,579	11,379	9,614	8,157
Max	20,113	20,160	19,901	14,936	11,506
Min	3,712	2,714	4,085	2,023	5,036

Considering October and November records, present inflow of Panaji STP ranges 8,200 - 9,600m³/day.

Appendix M61.8 Groundwater Infiltration

Groundwater Infiltration Rate on CPHEEC

	Method	Unit	Rate		Remarks
			Minimum	Maximum	
①	Per Area	ℓ/ha/day	5,000	50,000	CPHEEO
②	Per Pipe Length	ℓ/km/day	500	5,000	
③	Per Manhole	ℓ/day/manhole	250	500	

Assuming following value from the Study Area, per capita ground water is calculated as follow

Population Density	96 person/ha	(Average of Study Area)
Pipe Density	100 m/ha	(as Panaji Existing Area)
Manhole Density	30 m/piece	(CPHEEO)

	Method	Unit	Value		Remarks
			Minimum	Maximum	
①	Per Area	ℓ/day/capita	52	521	
②	Per Pipe Length	ℓ/day/capita	0.5	5	
③	Per Manhole	ℓ/day/capita	9	17	

As the Domestic per capita water use is set to 150 L/day/capita

Ground water / Domestic water	①	35%	347%
	②	0%	3%
	③	6%	12%

Groundwater/domestic water ranges 6% to 347%, 20 % is adopted in Margac
 In Japanese guideline, groundwater/domestic water ranges 10% to 20%
20% against domestic water use is applied in this projec

Appendix M61.9 Sewage Flow (1) Sewage Flow for STP

Unit: m³/day

Area	2010				2015				2020				2025			
	D&I	T	I & D	Total	D&I	T	I & D	Total	D&I	T	I & D	Total	D&I	T	I & D	Total
Panaji	5,534	4,556	1,028	11,118	5,565	5,546	1,166	12,277	5,596	6,712	1,308	13,616	5,626	8,098	1,473	15,197
Taleigao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taleigao	2,616	254	0	2,870	2,630	309	0	2,939	2,645	373	0	3,018	2,659	451	0	3,110
Dona Paula & Caranzalem	1,242	1,025	0	2,267	1,248	1,247	0	2,495	1,255	1,510	0	2,765	1,262	1,821	0	3,083
Subtotal	3,858	1,279	0	5,137	3,878	1,556	0	5,434	3,900	1,883	0	5,783	3,921	2,272	0	6,193
Toncoi Total	9,392	5,835	1,028	16,255	9,443	7,102	1,166	17,711	9,496	8,595	1,308	19,399	9,547	10,370	1,473	21,390
Ribandar	603	0	0	603	607	0	0	607	610	0	0	610	613	0	0	613
(Panaji Total)	9,995	5,835	1,028	16,858	10,050	7,102	1,166	18,318	10,106	8,595	1,308	20,009	10,160	10,370	1,473	22,003
St. Cruz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calapor	1,963	0	0	1,963	2,139	0	0	2,139	2,433	0	0	2,433	2,538	0	0	2,538
Merces	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Moranbi O Grandi	298	0	0	298	269	0	0	269	238	0	0	238	205	0	0	205
Moranbi O Pequenc	207	0	0	207	204	0	0	204	200	0	0	200	197	0	0	197
Subtotal	505	0	0	505	473	0	0	473	438	0	0	438	402	0	0	402
Porvorim	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Socorro	1,058	218	0	1,276	1,294	265	0	1,559	1,583	320	0	1,903	1,937	387	0	2,324
Penha de Franca	2,929	24	0	2,953	3,263	30	0	3,293	3,593	36	0	3,629	3,919	43	0	3,962
Reisnagos	238	0	0	238	247	0	0	247	255	0	0	255	261	0	0	261
Sangolda	49	0	0	49	56	0	0	56	63	0	0	63	72	0	0	72
Salvador do Mundo	260	0	0	260	264	0	0	264	269	0	0	269	274	0	0	274
Pileme	467	0	0	467	538	0	0	538	620	715	0	620	715	0	0	715
Subtotal	5,001	242	0	5,243	5,662	295	0	5,957	6,383	356	0	6,739	7,178	430	0	7,608
Total	17,464	6,077	1,028	24,569	18,324	7,397	1,166	26,887	19,360	8,951	1,308	29,619	20,278	10,800	1,473	32,551
Margao	13,715	794	785	15,294	14,940	967	989	16,896	16,275	1,170	1,283	18,728	17,729	1,412	1,718	20,859
Ponda	2,749	307	0	3,056	2,802	373	0	3,175	2,856	452	0	3,308	2,910	545	0	3,455
Mapusa	7,268	249	23	7,540	8,149	303	38	8,490	9,135	367	62	9,564	10,238	443	100	10,781
Coastal	372	1,468	0	1,840	379	1,787	0	2,166	386	2,163	0	2,349	391	2,610	0	3,001
Belt	533	0	0	533	554	0	0	554	576	0	0	576	599	0	0	599
of	287	0	0	287	293	0	0	293	300	0	0	300	306	0	0	306
Soouth	827	620	0	1,447	889	755	0	1,644	955	913	0	1,868	1,025	1,102	0	2,127
Goa	1,570	687	0	2,257	1,590	836	0	2,426	1,607	1,012	0	2,619	1,624	1,220	0	2,844
Adsunlim	40	0	0	40	50	0	0	50	63	0	0	63	78	0	0	78
Carra	64	0	0	64	66	0	0	66	67	0	0	67	69	0	0	69
Sernabatim	230	0	0	230	241	0	0	241	251	0	0	251	262	0	0	262
Vanelim	243	0	0	243	267	0	0	267	292	0	0	292	320	0	0	320
Colva	638	765	0	1,403	689	932	0	1,621	740	1,127	0	1,867	792	1,360	0	2,152
Gandaulim	40	0	0	40	39	0	0	39	38	0	0	38	37	0	0	37
Betalbatim	518	177	0	695	535	215	0	750	552	260	0	812	568	314	0	882
Gonsata	35	0	0	35	36	0	0	36	36	0	0	36	36	0	0	36
Majorda	483	245	0	728	503	298	0	801	523	361	0	884	541	435	0	976
Utorda	336	0	0	336	339	0	0	339	343	0	0	343	345	0	0	345
Total	6,216	3,962	0	10,178	6,470	4,823	0	11,293	6,729	5,836	0	12,565	6,993	7,041	0	14,034
Coastal	1,548	1,206	0	2,754	1,688	1,468	0	3,156	1,834	1,777	0	3,611	1,984	2,144	0	4,128
Belt of	2,741	1,758	0	4,499	3,088	2,140	0	5,228	3,479	2,590	0	6,069	3,920	3,124	0	7,044
North Goa	4,289	2,964	0	7,253	4,776	3,608	0	8,384	5,313	4,367	0	9,680	5,904	5,268	0	11,172
Grand Total	51,701	14,353	1,836	67,890	55,461	17,471	2,193	75,125	59,668	21,143	2,653	83,464	64,052	25,509	3,291	92,852

D&I: Domestic and Institutional Sewage including groundwater

T: Tourism sewage

I & D: Industry & Defence sewage

(2) Sewage Flow for O&M Cost

Unit: m³/day

Area	2010				2015				2020				2025			
	D&I	T	I & D	Total	D&I	T	I & D	Total	D&I	T	I & D	Total	D&I	T	I & D	Total
Panaji	5,534	2,463	1,028	9,025	5,565	2,998	1,166	9,729	5,596	3,628	1,308	10,532	5,626	4,377	1,473	11,476
Taleigao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taleigao	2,616	137	0	2,753	2,630	167	0	2,797	2,645	202	0	2,847	2,659	244	0	2,903
Dona Paula & Canaconha	1,242	554	0	1,796	1,248	674	0	1,922	1,255	816	0	2,071	1,262	984	0	2,246
Subtotal	3,858	691	0	4,549	3,878	841	0	4,719	3,900	1,018	0	4,918	3,921	1,228	0	5,149
Tonea Total	9,392	3,154	1,028	13,574	9,443	3,839	1,166	14,448	9,496	4,646	1,308	15,450	9,547	5,605	1,473	16,625
Ribandar	603	0	0	603	607	0	0	607	610	0	0	610	613	0	0	613
(Panaji Total)	9,995	3,154	1,028	14,177	10,050	3,839	1,166	15,055	10,106	4,646	1,308	16,060	10,160	5,605	1,473	17,238
St. Cruz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calapor	1,963	0	0	1,963	2,139	0	0	2,139	2,433	0	0	2,433	2,538	0	0	2,538
Mfeross	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Moranhi O Grandi	298	0	0	298	269	0	0	269	238	0	0	238	205	0	0	205
Moranhi O Pequeno	207	0	0	207	204	0	0	204	200	0	0	200	197	0	0	197
Subtotal	505	0	0	505	473	0	0	473	438	0	0	438	402	0	0	402
Porvorim	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Socorro	1,058	118	0	1,176	1,294	143	0	1,437	1,583	173	0	1,756	1,937	209	0	2,146
Penha de Franca	2,929	13	0	2,942	3,263	16	0	3,279	3,593	19	0	3,612	3,919	23	0	3,942
Reismago	238	0	0	238	247	0	0	247	255	0	0	255	261	0	0	261
Sangolda	49	0	0	49	56	0	0	56	63	0	0	63	72	0	0	72
Salvador do Mundo	260	0	0	260	264	0	0	264	269	0	0	269	274	0	0	274
Pileme	467	0	0	467	538	0	0	538	620	0	0	620	715	0	0	715
Subtotal	5,001	131	0	5,132	5,662	159	0	5,821	6,383	192	0	6,575	7,178	232	0	7,410
Total	17,464	3,285	1,028	21,777	18,324	3,998	1,166	23,488	19,360	4,838	1,308	25,506	20,278	5,837	1,473	27,588
Margao	13,715	429	785	14,929	14,940	523	989	16,452	16,275	633	1,283	18,191	17,729	763	1,718	20,210
Ponda	2,749	166	0	2,915	2,802	202	0	3,004	2,856	244	0	3,100	2,910	295	0	3,205
Mapusa	7,268	135	23	7,426	8,149	164	38	8,351	9,135	198	62	9,395	10,238	239	100	10,577
Salvete	372	794	0	1,166	379	966	0	1,345	386	1,169	0	1,555	391	1,411	0	1,802
Coastal	533	0	0	533	554	0	0	554	576	0	0	576	599	0	0	599
Belt	287	0	0	287	293	0	0	293	300	0	0	300	306	0	0	306
of	827	335	0	1,162	889	408	0	1,297	955	494	0	1,449	1,025	596	0	1,621
South	1,570	371	0	1,941	1,590	452	0	2,042	1,607	547	0	2,154	1,624	660	0	2,284
Goa	40	0	0	40	50	0	0	50	63	0	0	63	78	0	0	78
Adullim	64	0	0	64	66	0	0	66	67	0	0	67	69	0	0	69
Canha	230	0	0	230	241	0	0	241	251	0	0	251	262	0	0	262
Sernabatim	243	0	0	243	267	0	0	267	292	0	0	292	320	0	0	320
Vanelim	638	414	0	1,052	689	504	0	1,193	740	609	0	1,349	792	735	0	1,527
Colva	40	0	0	40	39	0	0	39	38	0	0	38	37	0	0	37
Gandaulim	518	95	0	613	535	116	0	651	552	141	0	693	568	170	0	738
Betalbatim	35	0	0	35	36	0	0	36	36	0	0	36	36	0	0	36
Gonsua	483	132	0	615	503	161	0	664	523	195	0	718	541	235	0	776
Majorda	336	0	0	336	339	0	0	339	343	0	0	343	345	0	0	345
Utorda	6,216	2,141	0	8,357	6,470	2,607	0	9,077	6,729	3,155	0	9,884	6,993	3,807	0	10,800
Total	1,548	652	0	2,200	1,688	794	0	2,482	1,834	960	0	2,794	1,984	1,159	0	3,143
Coastal	2,741	950	0	3,691	3,088	1,156	0	4,244	3,479	1,400	0	4,879	3,920	1,689	0	5,609
Belt of	4,289	1,602	0	5,891	4,776	1,950	0	6,726	5,313	2,360	0	7,673	5,904	2,848	0	8,752
North Goa	51,701	7,758	1,836	61,295	55,461	9,444	2,193	67,098	59,668	11,428	2,653	73,749	64,052	13,789	3,291	81,132
Grand Total																

D&I: Domestic and Institutional Sewage including groundwater

T: Tourism sewage

I & D: Industry & Defense sewage

Appendix M61.10 Pollution load and Sewage Quality (1) Breakdown of BOD Load

Unit: kg/day

Area	2010				2015				2020				2025			
	D&I	T	I & D	Total	D&I	T	I & D	Total	D&I	T	I & D	Total	D&I	T	I & D	Total
Panaji	1,346	629	308	2,283	1,354	765	350	2,469	1,361	927	392	2,680	1,369	1,118	442	2,929
Taleigao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taleigao	785	44	0	829	789	53	0	842	793	65	0	858	798	78	0	876
Dona Paula & Caranzalem	372	177	0	549	375	216	0	591	377	261	0	638	379	315	0	694
Subtotal	1,157	221	0	1,378	1,164	269	0	1,433	1,170	326	0	1,496	1,177	393	0	1,570
Tonca Total	2,503	850	308	3,661	2,531	1,034	350	3,902	2,531	1,253	392	4,176	2,546	1,511	442	4,499
Ribandar	181	0	0	181	182	0	0	182	183	0	0	183	184	0	0	184
(Panaji Total)	2,684	850	308	3,842	2,700	1,034	350	4,084	2,714	1,253	392	4,359	2,730	1,511	442	4,683
St. Cruz																
Calapor	589	0	0	589	642	0	0	642	730	0	0	730	761	0	0	761
Marcos																
Morambi O Grandi	89	0	0	89	81	0	0	81	71	0	0	71	62	0	0	62
Morambi O Pequeno	62	0	0	62	61	0	0	61	60	0	0	60	59	0	0	59
Subtotal	151	0	0	151	142	0	0	142	131	0	0	131	121	0	0	121
Porvorim																
Socorro	317	38	0	355	388	46	0	434	475	55	0	530	581	67	0	648
Penha de Franca	879	4	0	883	979	5	0	984	1,078	6	0	1,084	1,176	7	0	1,183
Reismagos	71	0	0	71	74	0	0	74	76	0	0	76	78	0	0	78
Sangolda	15	17	0	32	17	19	0	36	19	22	0	41	22	22	0	44
Salvador do Mundo	78	0	0	78	79	81	0	160	81	82	0	163	82	82	0	164
Pileme	140	0	0	140	161	186	0	347	186	215	0	401	215	215	0	430
Subtotal	1,500	42	0	1,542	1,698	51	0	1,749	1,915	61	0	1,976	2,154	74	0	2,228
Total	4,924	892	308	6,124	5,182	1,085	350	6,617	5,490	1,314	392	7,196	5,766	1,585	442	7,793
Margao	4,114	137	236	4,487	4,482	167	297	4,946	4,882	203	385	5,470	5,319	244	513	6,078
Ponda	825	53	0	878	841	65	0	906	857	78	0	935	873	94	0	967
Mapusa	2,180	43	7	2,230	2,445	52	11	2,508	2,741	63	19	2,823	3,071	77	30	3,178
Coastal Belt of South Goa	112	254	0	366	114	309	0	423	116	374	0	490	117	452	0	569
Cavelossim	160	0	0	160	166	0	0	166	173	0	0	173	180	0	0	180
Carmona	86	0	0	86	88	0	0	88	90	0	0	90	92	0	0	92
Orlhim	248	107	0	355	267	131	0	398	286	158	0	444	308	191	0	499
Varea	471	119	0	590	477	145	0	622	482	175	0	657	487	211	0	698
Benaulim	12	0	0	12	15	0	0	15	19	0	0	19	24	0	0	24
Adaulim	19	0	0	19	20	0	0	20	20	0	0	20	21	0	0	21
Cana	69	0	0	69	72	0	0	72	75	0	0	75	79	0	0	79
Sernabatim	73	0	0	73	80	0	0	80	88	0	0	88	96	0	0	96
Vanelim	191	132	0	323	207	161	0	368	222	195	0	417	238	235	0	473
Colva	12	0	0	12	12	0	0	12	11	11	0	11	11	0	0	11
Gandaulim	155	31	0	186	161	37	0	198	166	45	0	211	170	54	0	224
Betalbatim	11	0	0	11	11	0	0	11	11	0	0	11	11	0	0	11
Gonsua	145	42	0	187	151	52	0	203	157	62	0	219	162	75	0	237
Majorda	101	0	0	101	102	103	0	102	103	0	0	103	104	0	0	104
Ultorda	1,865	685	0	2,550	1,943	835	0	2,778	2,019	1,009	0	3,028	2,100	1,218	0	3,318
Total	4,64	209	0	673	506	254	0	760	550	308	0	858	595	371	0	966
Coastal Belt of North Goa	822	304	0	1,126	926	370	0	1,296	1,044	448	0	1,492	1,176	541	0	1,717
Calangute	1,286	513	0	1,799	1,432	624	0	2,056	1,594	756	0	2,350	1,771	912	0	2,683
Total	15,194	2,323	551	18,068	16,325	2,828	658	19,811	17,583	3,423	796	21,802	18,900	4,130	987	24,017

D&I: Domestic and Institutional Sewage including groundwater

T: Tourism sewage

I & D: Industry & Defense sewage

(2) Breakdown of SS Load

Unit: kg/day

Area	2010				2015				2020				2025			
	D&I	T	I & D	Total	D&I	T	I & D	Total	D&I	T	I & D	Total	D&I	T	I & D	Total
	Panaji	1,137	531	262	1,930	1,143	646	297	2,086	1,149	782	334	2,265	1,156	944	376
Taleigao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taleigao	663	37	0	700	666	45	0	711	670	55	0	725	674	66	0	740
Dona Paula & Caranzalem	315	150	0	465	316	182	0	498	318	221	0	539	320	266	0	586
Subtotal	978	187	0	1,165	982	227	0	1,209	988	276	0	1,264	994	332	0	1,326
Tonca Total	2,115	718	262	3,095	2,125	873	297	3,295	2,137	1,058	334	3,529	2,150	1,276	376	3,802
Ribandar	153	0	0	153	154	0	0	154	155	0	0	155	155	0	0	155
(Panaji Total)	2,268	718	262	3,248	2,279	873	297	3,449	2,292	1,058	334	3,684	2,305	1,276	376	3,957
St. Cruz																
Calapor	497	0	0	497	542	0	0	542	616	0	0	616	643	0	0	643
Meroes																
Morambi O Grandi	75	0	0	75	68	0	0	68	60	0	0	60	52	0	0	52
Morambi O Pequeno	53	0	0	53	52	0	0	52	51	0	0	51	50	0	0	50
Subtotal	128	0	0	128	120	0	0	120	111	0	0	111	102	0	0	102
Povorim																
Socorro	268	32	0	300	328	39	0	367	401	47	0	448	491	57	0	548
Penha de Franca	742	4	0	746	827	4	0	831	910	5	0	915	993	6	0	999
Reisnago	60	0	0	60	63	0	0	63	65	0	0	65	66	0	0	66
Sangolda	13	13	0	26	14	14	0	28	14	14	0	28	16	18	0	34
Salvador do Mundo	66			66	67			67	68			68	69			69
Pileme	118			118	136			136	157			157	181			181
Subtotal	1,267	36	0	1,303	1,435	43	0	1,478	1,617	52	0	1,669	1,818	63	0	1,881
Total	4,160	754	262	5,176	4,376	916	297	5,589	4,636	1,110	334	6,080	4,868	1,339	376	6,583
Margao	3,474	116	200	3,790	3,785	141	252	4,178	4,123	171	327	4,621	4,491	206	438	5,135
Ponda	696	45	0	741	710	55	0	765	723	66	0	789	737	80	0	817
Mapusa	1,841	36	6	1,883	2,065	44	10	2,119	2,314	54	16	2,384	2,594	65	26	2,685
Coastal	94	215	0	309	96	261	0	357	98	316	0	414	99	381	0	480
Carmona	135	0	0	135	140	0	0	140	146	0	0	146	152	0	0	152
Orlim	73	0	0	73	74	0	0	74	76	0	0	76	77	0	0	77
Varea	210	91	0	301	225	110	0	335	242	133	0	375	260	161	0	421
Benaulim	398	100	0	498	403	122	0	525	407	148	0	555	411	178	0	589
Adulim	10	0	0	10	13	0	0	13	16	0	0	16	20	0	0	20
Cana	16	0	0	16	17	0	0	17	17	0	0	17	17	0	0	17
Sernabatim	58	0	0	58	61	0	0	61	64	0	0	64	66	0	0	66
Vanelim	62	0	0	62	68	0	0	68	74	0	0	74	81	0	0	81
Colva	162	112	0	274	174	136	0	310	187	165	0	352	201	199	0	400
Gandaulim	10	0	0	10	10	0	0	10	10	0	0	10	9	0	0	9
Betalbatim	131	26	0	157	136	31	0	167	140	38	0	178	144	46	0	190
Gonsua	9	0	0	9	9	0	0	9	9	0	0	9	9	0	0	9
Majora	122	36	0	158	127	44	0	171	132	53	0	185	137	64	0	201
Utorda	85	0	0	85	86	0	0	86	87	0	0	87	88	0	0	88
Total	1,575	580	0	2,155	1,639	704	0	2,343	1,705	853	0	2,558	1,771	1,029	0	2,800
Bardez	392	176	0	568	428	215	0	643	465	260	0	725	503	313	0	816
Calangute	694	257	0	951	782	313	0	1,095	881	378	0	1,259	993	457	0	1,450
Total	1,086	433	0	1,519	1,210	528	0	1,738	1,346	638	0	1,984	1,496	770	0	2,266
Grand Total	12,832	1,964	468	15,264	13,785	2,388	559	16,732	14,847	2,892	677	18,416	15,957	3,489	839	20,285

D&I: Domestic and Institutional Sewage including groundwater

T: Tourism sewage

I & D: Industry & Defense sewage

(3) Breakdown of BOD Quality

Unit: mg/l

Area	2010			2015			2020			2025		
	D&I	T	I & D	Total	D&I	T	I & D	Total	D&I	T	I & D	Total
Panaji	243	138	300	205	243	138	300	201	243	138	300	197
Taleigao	300	173		289	300	172		286	300	174		284
Dona Paula & Caranzalem	300	173		242	300	173		237	300	173		231
Subtotal	300	173		268	300	173		264	300	173		259
Tonca Total	267	146	300	225	267	146	300	220	267	146	300	215
Ribandar	300			300	300			300	300			300
(Panaji Total)	269	146	300	228	269	146	300	223	269	146	300	218
St. Cruz												
Calapor	300			300	300			300	300			300
Merces												
Moranbi O Grandi	299			299	301			301	298			298
Moranbi O Pequeno	300			300	299			299	300			299
Subtotal	299			299	300			300	299			299
Porvortim												
Socorro	300	174		278	300	174		278	300	172		279
Penha de franca	300	167		299	300	167		299	300	167		299
Reismago	298			298	300			298	298			298
Subtotal	300	174		294	300	173		294	300	171		293
Total	282	147	300	249	283	147	300	246	284	147	300	243
Margao	300	173	300	293	300	173	300	293	300	174	300	292
Ponda	300			287	300			285	300			283
Mapusa	300	173	300	296	300	172	300	295	300	172	300	295
Coastal	301	173		199	301	173		195	301	173		192
Belt	300			300	300			300	300			300
of	300			300	300			300	300			300
South	300	173		245	300	174		242	299	173		238
Goa	300	173		261	300	173		256	300	173		251
Adsulim	300			300	300			300	302			302
Caná	297			297	303			303	299			299
Sernabatim	300			300	299			299	299			299
Vanelim	300			300	300			300	301			301
Cobva	299	173		230	300	173		227	300	173		223
Gandaulim	300			300	308			308	289			289
Betalbatim	299	175		268	301	172		264	301	173		260
Gousua	314			314	306			306	306			306
Majorda	300	171		257	300	174		253	300	172		248
Utorda	301			301	301			301	300			300
Total	300	173		251	300	173		246	300	173		241
Coastal	300	173		244	300	173		241	300	173		238
Belt of	300	173		250	300	173		248	300	173		246
North Goa	300	173		248	300	173		245	300	173		243
Grand Total	294	162	300	266	294	162	300	264	295	162	300	261

D&I: Domestic and Institutional Sewage including groundwater

T: Tourism sewage

I & D: Industry & Defense sewage

(4) Breakdown of SS Quality

Unit: mg/l

Area	2010				2015				2020				2025			
	D&I	T	I & D	Total	D&I	T	I & D	Total	D&I	T	I & D	Total	D&I	T	I & D	Total
	Panaji	203	117	255	174	203	116	255	170	203	117	255	166	203	117	255
Taleigao	253	146		244	253	146		242	253	147		240	253	146		238
Dona Paula & Caranzalem	254	146		205	253	146		200	253	146		195	254	146		190
Subtotal	253	146		227	253	146		222	253	147		219	254	146		214
Tonca Total	225	123	255	190	225	123	255	186	225	123	255	182	225	123	255	178
Ribandar	254			234	254			254	254			254	253			233
(Panaji Total)	227	123	255	193	227	123	255	188	227	123	255	184	227	123	255	180
St. Cruz																
Calapor	253			253	253			253	253			253	253			253
Merces																
Moranbi O Grandi	252			252	253			253	252			252	254			254
Moranbi O Pequeno	256			256	255			255	255			255	254			254
Subtotal	253	254		253	254			254	253	254		253	254			254
Porvortim																
Socorro	253	147		235	253	147		235	253	147		235	253	147		236
Penha de franca	253	167		253	253	133		252	253	139		252	253	140		252
Reismago	252			252	255			255	255			255	253			253
Subtotal	253	149		249	253	146		248	253	146		248	253	147		247
Total	238	124	255	211	239	124	255	208	239	124	255	205	240	124	255	202
Margao	253	146	255	248	253	146	255	247	253	146	255	247	253	146	255	246
Ponda	253	147		242	253	147		241	253	146		239	253	147		236
Mapusa	253	145	255	250	253	145	255	250	253	147	255	249	253	147	255	249
Coastal	253	146		168	253	146		163	254	146		162	253	146		160
Belt	253			253	253			253	253			253	254			254
of	254			254	253			253	253			253	252			252
South	254	147		208	253	146		204	253	146		201	254	146		198
Goa	254	146		221	253	146		216	253	146		212	254	146		207
Adaulim	250			250	260			260	254			254	256			256
Caná	250			250	258			258	254			254	246			246
Sernabatim	252			252	253			253	255			255	252			252
Vanelim	255			255	255			255	253			253	253			253
Colva	254	146		195	253	146		191	253	146		189	254	146		186
Gandaulim	250			250	256			256	263			263	243			243
Betalbatim	253	147		226	254	144		223	254	146		219	254	146		215
Gousua	257			257	250			250	250			250	250			250
Majorda	253	147		217	252	148		213	252	147		209	253	147		206
Utorda	253			253	254			254	254			254	255			255
Total	253	146		212	253	146		207	253	146		204	253	146		200
Coastal	253	146		206	254	146		204	254	146		201	254	146		198
Belt of	253	146		211	253	146		209	253	146		207	253	146		206
North Goa	253	146		209	253	146		207	253	146		205	253	146		203
Grand Total	248	137	255	223	249	137	255	223	249	137	255	221	249	137	255	218

D&I: Domestic and Institutional Sewage including groundwater

T : Tourism sewage

I & D : Industry & Defense sewage