Part 2 Chapter 10

Water Resources Planning and Development

10.1 Introduction

10.1.1 The prosperity and growth of a region depends on the availability of infrastructure services. Water is the most crucial amongst these. The per capita consumption of water is an index of quality of life and economic and social conditions of the community. The siting of industries is also dependent on the availability of the desired quantity and quality of water. Water has multiple uses in the well being of the city. Besides domestic and industrial consumption, it is required for fire fighting, recreation, gardening etc. In MMR however there is a wide gap between demand and availability of water. In Greater Mumbai domestic water supply on an average is not more than 130 lpcd, whereas in outer MMR it is even less than 40 lpcd.

10.1.2 A water supply scheme comprises water source development, conveyance, treatment and distribution. Development of water resource has a long gestation period of 5 to 10 years depending upon the size of the project. Advance planning for the development of such resource is therefore necessary. Such planning must take into account the water demand of various sectors and need for judicious allocation of water resources to meet the demand.

10.2 Regional Plan-1973 Recommendations

10.2.1 The Regional Plan for MMR - 1973 worked out the water requirement of the Region for 1991 based on estimated population and also identified water resources for future development. The water availability in the Region in 1970 was around 1350 mld. To meet the 1991 estimated water demand of 3960 mld., the water resources which could yield 5600 mld. were identified. The norms considered were 335 litres per capita per day (lpcd) in urban areas and 110 lpcd in rural area. The water resources proposed for development in the Regional Plan and their capacities were as follows :

	Sources	Capacity in Mld
1.	Existing sources - Greater Mumbai	990
2.	Upper Vaitarna	540
3.	Bhatsai	1125
4.	Ulhas	225
5.	Barvi	450
6.	Kalu	900
7.	Pinjal	450
8.	Ransai	20
9.	Other sources	900
	TOTAL	**5600**

Among the water sources proposed for development in the Regional Plan-1973, works on some of the sources are completed either partly or fully; while the work on development of the sources at Kalu and Pinjal is not yet initiated.

10.3 Need for Review

10.3.1 In the context of the revision of Regional Plan it is necessary to review the expected water demand and supply situation over the next 20 years in the region. The Government agencies involved in water resource development and supply are Maharashtra Water Supply and Sewerage Board (MWSSB), Maharashtra Industrial Development Corporation (MIDC), Municipal Corporation of Greater Mumbai (MCGM), and Irrigation Department. The MCGM at present obtains its water supply from Tansa, Vaitarna- upper and lower, Ulhas at Shahad (which will be diverted in the near future to Kalyan), Bhatsa, Vihar, Tulsi and Powai. From these sources the total water supply to Greater Mumbai is about 2474 mld. The MIDC owns water sources at Barvi, Ransai, Rasayani-Patalganga, Amba-Nagothane and Ulhas at Shahad. However MIDC mainly supplies water to industrial areas, except in a few areas, such as, Thane, Kalyan, Navi Mumbai, where it also provides domestic supply. The MWSSB has completed water supply schemes at Temghar-Shahad, Jawahar-Patalganga and Pelhar. The Irrigation Dept. does not have any direct role in water supply though it supplies bulk quantity to MWSSB, MIDC and MCGM from the dams constructed for irrigation purpose. These agencies develop water resources to suit their individual requirements without any organised plan of action.

10.4 Water Resource Development Plan (WRMADP-1983)

10.4.1 In 1983, MMRDA undertook a detailed study of water resources in MMR and submitted to the State Government a Perspective Plan for 2001. The object of the Plan was to achieve proper planning, control, co-ordination and allocation of resources in the region for the future use of urban areas. In this study, water demand of various urban and rural areas of MMR was estimated on the basis of 1981 population and its future projections. For this purpose, the MMR was divided into following six zones :

1. MCGM,
2. Mira-Bhayandar(Zone I),
3. Vasai-Virar (Zone II),
4. TMC and Bhiwandi (Zone III),
5. KMC- Ulhasnagar-North Navi Mumbai (Zone IV), and
6. South Navi Mumbai- Pen, Panvel- Alibag etc. (Zone V).

10.4.2 The gross domestic water demand was estimated by assuming higher norms for MCGM than other areas of the region. The norms assumed were as follows:

1.	MCGM	-	234 lpcd.
2.	Urban and Rural	-	185 lpcd + 5% for misc. provisions
3.	Industrial	-	130 cum per ha./day at flat rate + 20% for ancillary industries.

10.4.3 To meet this demand water resources were identified. While identifying these resources, the potential and suitability of each source was examined by undertaking a detailed study of various water sources in Mumbai Hydrometric Area. Twelve sources were accordingly identified and allocated zone-wise in the Water Resources Management

and Development Plan (WRMADP) (Figure-10.1). In the WRMADP water availability in the region in 1985 was compared with the water demand of 2001. For the projected population of 198 lakhs in 2001, the study estimated water demand to be 7950 mld, whereas existing supply in 1985 was 4102 mld only. Consequently, additional sources having a capacity of 3640 mld were proposed for development. The details of these sources are given in Table-10.1

10.4.4 According to the WRMADP estimates, Greater Mumbai's demand estimates for 2001 was 4384 mld. To meet this demand, the WRMADP allocated additional water sources, namely, Middle Vaitarna, Kalu and Gargai with a total capacity of 1710 mld.

Source Development Recommended by WRMADP in 1983.

	Projects	Status in 1983	Zone served	Approx Total Cost Rs. in Lakhs	Storage in mcm for Water Supply
PHASE-I PROJECTS :					
1.	Middle Vaitarna	Submitted to Government which passed it on to M.C.G.M.	MCGM	3700	170
2.	Kalu	Submitted to Government	MCGM & Zone III & IV	4942	327
3.	Kaman	Submitted to Government	Zone II	860	13
4.	Poshir	Under preparation	Zone III & IV	3779	191
5.	Hetwane	Under construction	Zone V	1536	10
6.	Morbe	Under construction	Zone V	2639	95
	SUB TOTAL - I			**17456**	
	PHASE-II PROJECTS :				
1.	Gargai	Under investigation	MCGM	6600	127
2.	Pinjal	Admn. Approved	Zone-II	5246	12
3.	Chene	Under investigation	Zone-I	2000	12
4.	Shai	-do-	Zone-III & IV	3500	217
5.	Salpe-Tiwane	-do-	-do-	1700	48
6.	Mohali	-do-	-do-	1100	31
	SUB TOTAL - II			**20146**	
	GRAND TOTAL			**37602**	

Table-10.1

Note: Cost estimates are based on 1980-81 prices.

10.4.5 In outer MMR, the estimated water demand by 2001 was 3562 mld, whereas water availability in 1985 was 1151 mld only. To meet the then existing deficit and additional requirement by 2001 the sources allocated were Kaman, Pinjal, Poshir, Shai, Chene, Hetawane, Morbe, Salpetiwane, Mohil and Bhamkhori with total capacity of 1930 mld. The WRMADP also suggested priority for development of these sources in two phases over VI and VII Five Year Plan. This involved investment of Rs. 174.6 crores for

Mumbai Hydrometric Area

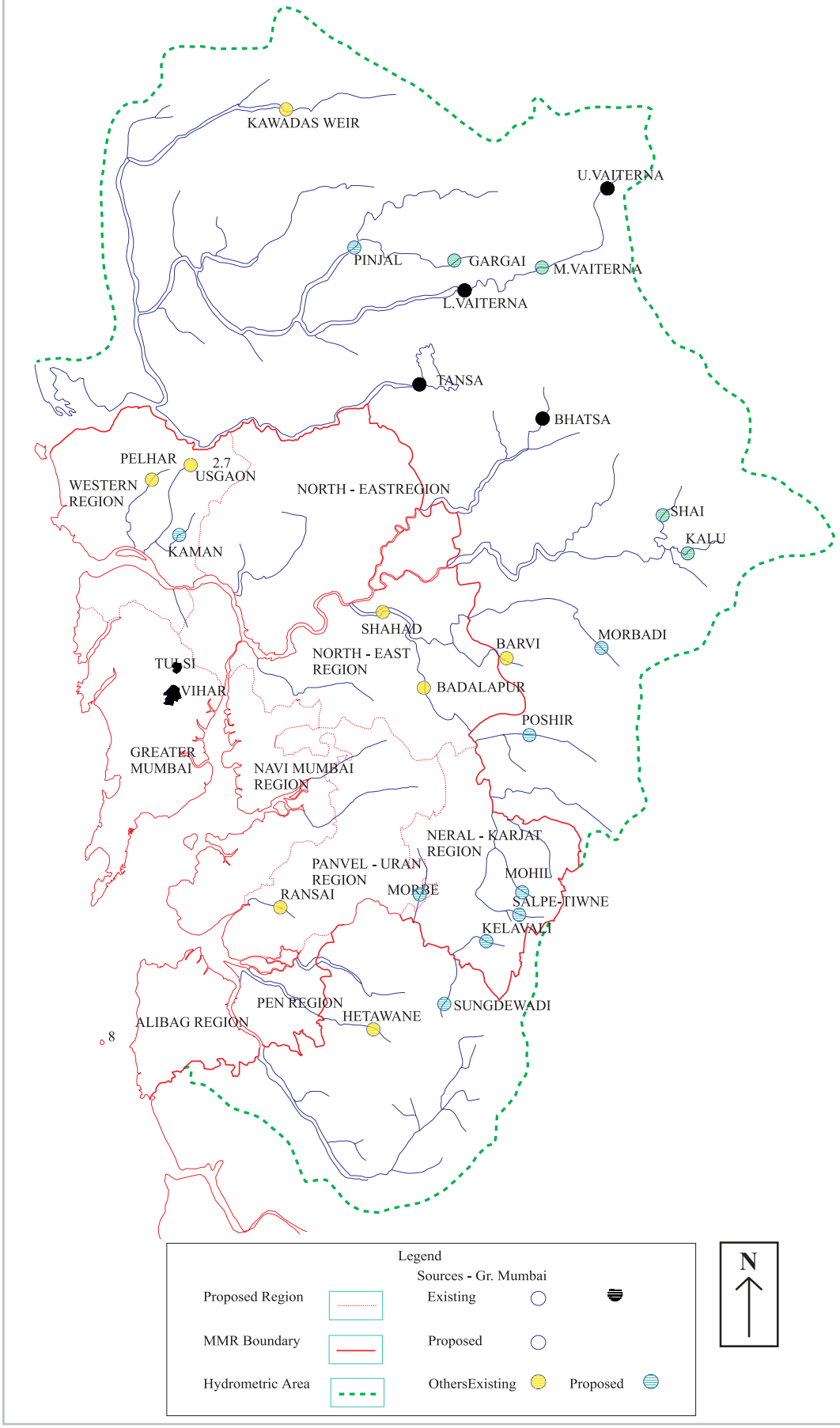

Figure -10.1

development of six sources in VIth Plan, and Rs. 201.5 crores during VIIth Plan for other six sources. Of the twelve resources recommended by MMRDA the sources at Poshir, Hetawane, Pinjal, Morbe and Kalu have figured in VI AND VII Five Year Plan. The total provision in both the plans made for the development was around Rs. 32 crores. However the actual expenditure was lower than the provision. The sources at Chene, Shai, Salpetiwane, Mohil, and Kaman did not even figure in the VI and VII Five Year Plan.

10.4.6 The development of water sources could not take place as envisaged in the WRMADP probably because of the absence of a single agency exclusively responsible for developing water resources for urban use. Availability of finances has been a major limiting factor on water resource development. The MCGM, on account of World Bank assistance, and its capacity to mobilise resources on its own (to the extent of 40% of total capital investment) has been in a position to develop water resources. The MIDC plans and develops water supply schemes essentially for industrial areas. Through its World Bank aided Stage I Project, the MWSSB made water available to 6 municipal towns and 104 villages for 1991 requirements. In this project, water supply scheme was executed based upon already developed water source. However, the Stage II project now being planned by MWSSB envisages development of storage at Poshir. The scope of this project covers augmentation of stage I facilities to cater to 2001 requirement, covering Thane and Kalyan Corporations, six municipal councils including 11 nodes of CIDCO and 257 villages and 119 villages merged in municipal councils/corporations. The 2001 design population of this project is 85 lakhs. In addition to this, the MWSSB is also constructing a dam at Morbe mainly for Navi Mumbai. Two small water supply schemes at Usgaon and Shirawali to obtain 20 mld of water at the cost of Rs. 32 crores for Virar and Vasai are also being implemented.

10.5 Water Supply Norms

10.5.1 Water Supply norms depend on the economic activities in a city, desired health and hygienic standards of population, its household income levels, and the availability or otherwise of the underground sewerage system. However, in practice, the norms actually get determined on the basis of the availability of water, conveyance and distribution network, and whether water is supplied through individual connections or stand posts. The water supply norms considered by various agencies, such as, Ministry Of Urban Development, MWSSB, MCGM, etc. are as follows :

1. The Manual on Water Supply prepared in the Central Public Health and Environmental Engineering Organisation (CPHEEO) of Ministry of Urban Development, GOI prescribes various norms for domestic and non-domestic needs depending upon the population of the community -

   a) For communities with population upto 20,000 - 70 to 100 lpcd

   b) For communities with population 20,000 to 1,00,000 - 100 to 125 lpcd

   c) For communities with population above 1,00,000 - 125 to 200 lpcd

In the case of communities with population upto 20,000 where house service connections are not contemplated and supply is through hand pumps or the supply is from central stand posts, the minimum recommended norm is 40 lpcd.

2. The MWSSB considered the following norms for its Stage I World Bank aided project.

   a) Urban Area:
      Through connections - 120 lpcd.
      Through stand pipes - 50 lpcd.

   b) Rural area:
      Through connection - 70 lpcd.
      Through stand pipes - 40 lpcd.

3. The MCGM, in its Mumbai Water Supply and Sewerage Project-III (BWSSP III) estimated domestic water demand for 1991 using a supply norm of 180 lpcd. Assuming a continuous improvement of living standards after 1991, the demand for 2001 was estimated at a higher norm of 190 lpcd. However, owing to financial constraints, the project envisaged only limited augmentation of water sources, and it has estimated that the water supply availability for Greater Mumbai's 12.78 million in 2001 would be 128 lpcd.

4. The National Commission on Urbanisation (NCU) suggested that in the worst of draught condition, and even in the poorest of colonies at least 70 lpcd be delivered so that human life can be sustained at minimum standard of hygiene. It cited example of Delhi where despite the average norm of 225 lpcd and despite stipulation that no residential area should get less than 135 lpcd, large areas were left virtually uncovered by any form of acceptable water supply which had led to serious epidemic. The NCU recommended that under the condition of minimum supply, and taking into account the resource constraint, the new norms should be not less than 120 lpcd inclusive of 25 to 30% non-domestic demand such as fire protection, gardening etc.

10.6 Water Demand Estimation

10.6.1 In most of the urban areas of MMR water borne sanitation system does not exist, except in MCGM area and newly developing nodes of Navi Mumbai. At present the thrust is on improving existing water supply situation to achieve at least the minimum norms as water is a basic need. Majority of the urban areas in MMR are therefore unlikely to have water borne sanitation system in the near future unless water supply requirement is fulfilled. It is, therefore, necessary to adopt feasible water supply norms for various sectors while planning future water supply projects. Moreover, the planning of water resources needs to be such that phase wise improvement in the water supply norms would be possible. This may also enable introduction of water borne sewerage system in a phased manner.

10.6.2 The estimation of the water demand for various areas in MMR for a period upto 2011 is made within the broad framework of norms recommended by the CPHEEO's manual. Within the range prescribed, the supply norms are increased progressively for 2001 and 2011. Norms adopted for Greater Mumbai and Navi Mumbai are higher than the CPHEEO norms. This is based on the observations that the water consumption in these areas is

much higher than other areas in MMR and is likely to be so in future. The precise norms adopted for domestic and non-domestic use (excluding industrial use) are as given in Table-10.2

Domestic Water Supply Norms

	Area	Net Supply norms in lpcd		
		1991	2001	2011
1.	Gr. Mumbai and Navi Mumbai	200	225	250
2.	Other large urban centres	150	175	200
3.	Smaller urban centres	100	125	150
4.	Villages in transition from rural to urban.	70	85	100
5.	Villages in rural areas.	40	50	70

Table-10.2

In addition to the net supply norms mentioned above, to estimate the gross demand, it is assumed that till 2001 losses will continue to be at the current rate of 25% (of the Gross Supply) and would decline to 20% thereafter. These norms are applied to the population projection from 1991-2011. The net and gross domestic demands for various zones of the MMR are given in Table-10.3. The gross domestic demand, which is 3453 mld in 1991 is expected to increase to 6415 mld by 2011.

10.6.3 The review of the industrial water supply-demand situation indicates that the actual water consumption by industries in Greater Mumbai and in MIDC's industrial areas has been far less than the projection made in the past. For instance, Greater Mumbai's industrial water requirement for 1991 was projected in MMRADP to be 785 mld, but the actual consumption is no more than 322 mld. In fact, the consumption trend indicates decline during the 1980's. This can be explained by the closure and sickness of many industries and the water conservation measures adopted by industries in response to steep hike in the water charges. In 1979, MIDC had projected water demand of the TTC industrial area to be 616 mld. The actual consumption is only 40 mld. though, as much as, 70% of this area is already developed.

10.6.4 In view of the foregoing, the demand estimation for industry is made, firstly, by assuming that the present level of supply is adequate for existing industries, and secondly, by adopting the CPHEEO's general norm of 65 cum/ha for the industrial areas to be developed in the future. For Greater Mumbai, the future estimation of industrial area (666 ha) is based on the revised Development Plan, and for the rest of the region the future area (5080 ha) is based on the revised land use plan for the MMR. In addition to this net demand, losses at a rate of 15% (of the gross supply) are assumed for the purpose of calculating gross industrial demand. The net and gross demands for various zones of MMR are given in Table-10.4. As may be industrial seen from this table, the gross demand, which is 918 mld in 1991, is expected to increase to 1461 mld by 2011.

10.6.5 Based on the foregoing norms, the aggregate gross water demand from domestic and industrial sectors is summarised in Table-10.5. The detail breakup is given in Table-10.6.

10.6.6 The demand pattern during 1991-2011 indicates that the overall water demand in the Region would increase at a rate of 2.28% per annum. While the growth rate of population beyond 2011 is expected to reduce, the water demand is expected to grow at the same

Gross Domestic Water Demand Estimation For - Regions/Sub-Regions of MMR

	Region/ Sub-Region	Population			Supply Standards in LPCD			Net Demand in MLD			Gross Water Demand in MLD.		
		1991	2001	2011	1991	2001	2011	1991	2001	2011	1991	2001	2011
1.	Greater Mumbai	9,925,891	11,430,000	12,931,000	200	225	250	1,985	2,572	3,233	2,647	3,429	4,041
1.1	Island City	3,174,889	3,000,000	2,825,000	200	225	250	635	675	706	847	900	883
1.2	Western Suburb	3,947,979	4,930,000	5,910,000	200	225	250	790	1,109	1,478	1,053	1,479	1,847
1.3	Eastern Suburb	2,803,023	3,500,000	4,196,000	200	225	250	561	788	1,049	747	1,050	1,311
2.	Western Region	595,868	1,063,093	1,619,031	73	168	308	97	224	385			
2.1	Mira-Bhayandar Sub-Region	175,605	375,000	617,000	150	175	200	26	66	123	35	87	154
2.2	Vassai-Navghar Sub-Region	127,975	162,069	207,867	16	24	38	21	33	48			
2.2.1	Urban	83,734	119,000	175,000	150	175	200	13	21	35	17	28	44
2.2.2	Rural	44,241	43,069	32,867	70	85	100	3	4	3	4	5	4
2.3	Nallasopara Sub-Region	83,800	229,507	426,386	12	39	85	16	53	106			
2.3.1	Urban	74,428	221,000	420,000	150	175	200	11	39	84	15	52	105
2.3.2	Rural	9,372	8,507	6,386	70	85	100	1	1	1	1	1	1
2.4	Virar Sub-Region	77,965	168,574	270,885	10	28	53	13	37	66			
2.4.1	Urban	57,600	149,000	256,000	150	175	200	9	26	51	12	35	64
2.4.2	Rural	20,365	19,574	14,885	70	85	100	1	2	1	2	2	2
2.5	VVNA Coast Sub-Region	91,304	89,494	68,065	70	85	100	6	8	7	9	10	9
2.6	VVNA Rural Sub-Region	25,206	24,713	18,382	70	85	100	2	2	2	2	3	2
2.7	Outside VVNA Sub-Region	14,013	13,735	10,446	40	50	70	1	1	1	1	1	1
3.	North-East Region	2,921,172	4,216,704	5,283,176	406	703	1,028	542	937	1,285			
3.1	TMC Sub-Region	803,389	1,121,000	1,435,000	150	175	200	121	196	287	161	262	359
3.2	KMC Sub-Region	820,584	1,400,348	1,766,503	150	175	200	123	245	353	164	327	442
3.3	Ulhasnagar Sub-Region	385,095	491,513	613,400	150	175	200	58	86	123	77	115	153
3.4	Ambernath Sub-Region	125,801	153,351	186,934	150	175	200	19	27	37	25	36	47
3.5	Badlapur Sub-Region	52,154	70,091	85,440	150	175	200	8	12	17	10	16	21
3.6	Bhiwandi Sub-Region	497,300	748,247	1,019,334	67	122	197	89	163	246			
3.6.1	Urban	401,411	654,000	948,000	150	175	200	60	114	190	80	153	237
3.6.2	Rural	95,889	94,247	71,334	70	85	100	7	8	7	9	11	9
3.7	Bhiwandi Rural Sub-Region	128,756	126,204	95,985	40	50	70	5	6	7	7	8	8
3.8	South Kalyan Ulhas Sub-Region	65,402	64,106	48,756	70	85	100	5	5	5	6	7	6
3.9	North Kalyan Tehsil Sub-Region	42,691	41,845	31,825	40	50	70	2	2	2	2	3	3
4.	Navi Mumbai Region	548,476	1,166,558	1,816,376	92	244	439	123	325	549			
4.1	NMMC (Excl. 15 Villages)	307,724	905,000	1,533,000	200	225	250	62	204	383	82	271	479
4.2	NMMC (15 Vlillages)	10,723	10,513	7,995	70	85	100	1	1	1	1	1	1
4.3	Panvel Sub-Region	158,362	172,349	199,625	22	28	41	29	38	52			
4.3.1	Urban	81,508	97,000	142,000	200	225	250	16	22	36	22	29	44
4.3.2	Rural	76,854	75,349	57,625	70	85	100	5	6	6	7	9	7
4.4	Uran Sub-Region	71,667	78,696	75,756	8	11	14	11	15	17			
4.3.1	Urban	24,178	32,000	40,000	200	225	250	5	7	10	6	10	13
4.3.2	Rural	47,489	46,696	35,756	70	85	100	3	4	4	4	5	4
5.	Neral-Karjat Region	166,021	180,471	177,308	11	16	21	14	21	26			
5.1	Karjat Sub-Region	93,629	95,709	84,141	5	7	9	7	9	11			
5.1.1	Urban	23,956	29,000	35,000	100	125	150	2	4	5	3	5	7
5.1.2	Rural	69,673	66,709	49,141	40	50	70	3	3	3	4	4	4
5.2	Khalapur Sub-Region	72,392	84,762	93,167	6	9	12	7	11	15			
5.2.1	Urban	45,039	58,000	73,000	100	125	150	5	7	11	6	10	14
5.2.2	Rural	27,353	26,762	20,167	40	50	70	1	1	1	1	2	2
6.	Panvel-Uran Region (Out side NB)	180,828	227,193	287,327	11	24	47	14	32	59			
6.1	Rasayani-Panvel Sub-Region	77,602	106,230	135,454	5	14	26	7	19	33			

Table 10.3 Contd.

(Concld.)

6.1.1	Urban	55,000	125,000	150	175	200	0	10	25	0	13	31	
6.1.2	Rural	77,602	51,230	10,454	70	85	100	5	4	1	7	6	1
6.2	Rest-Panvel Sub-Region	52,064	51,032	38,812	40	50	70	2	3	3	3	3	3
6.3	Khopta Sub-Region	34,530	53,624	100,660	2	7	18	3	9	22			
6.3.1	Urban	25,000	75,000	150	175	200	0	4	15	0	6	19	
6.3.2	Rural	34,530	28,624	25,660	70	85	100	2	2	3	3	3	3
6.4	Rest-Uran Sub-Region	5,586	5,477	4,165	40	50	70	0	0	0	0	0	0
6.5	Karnala Sub-Region	11,046	10,830	8,236	40	50	70	0	1	1	1	1	1
7.	Pen Region	88,297	92,444	138,693	6	11	23	8	14	28			
7.1	Urban	21,588	50,000	100,000	150	175	200	3	9	20	4	12	25
7.2	Rural	66,709	42,444	38,693	40	50	70	3	2	3	4	3	3
8.	Alibag Region	107,811	110,097	188,061	6	8	33	8	11	41			
8.1	Urban	16,289	20,000	150,000	150	175	200	2	4	30	3	5	38
8.2	Rural	91,522	90,097	38,061	40	50	70	4	5	3	5	6	3
	TOTAL	**14,534,364**	**18,486,560**	**22,440,973**				**2,590**	**3,745**	**5,132**	**3,453**	**4,993**	**6,415**

Note : The Gross Demand is calculated assuming losses at 25 % (of gross demand) in 1991 & 2001 and 20% in 2011

Table-10.3

rate of 2.28% per annum. This is largely because of the rise in living standard and improved availability of water. Based on these assumptions, the water demand in 2021 will be 9972 mld and in 2031, 12493 mld. The water demand with respect to supply for years 1991, 2001, 2011 is shown diagramatically in Figure-10.2. The geographical distribution of the demand in 1991 and 2011 is shown in Figure-10.3

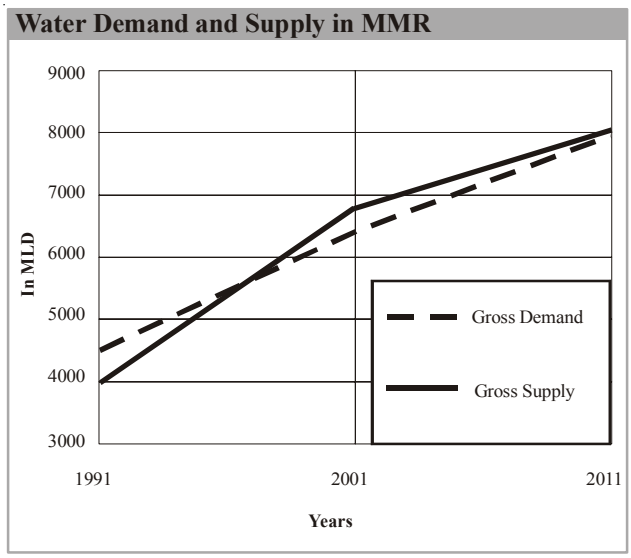

Figure 10.2

10.7 Availability of Water

10.7.1 The potential availability of water in the Mumbai Hydrometric Area, comprising Vaitarna and Ulhas valleys, was first estimated by the Irrigation Department in 1977. The Irrigation Department reviewed these estimates in March, 1994, taking into account the up-to-date rainfall data from 85 rain-gauge stations located in Mumbai Hydrometric Area. These estimates include potential resources from Patalganga and Amba valleys which were not considered earlier for water supply to MMR. According to these estimates, the total availability of water in the Mumbai Hydrometric Area is 10439 mcm (28603 mld) at 75% dependability and 7869 mcm (21561 mld) at 95% dependability (Table-10.7). This is inclusive of the water required for irrigation purposes. The net potential availability of water for domestic and industrial purposes is therefore 3771 mcm (10333 mld) at 95% dependability. The source-wise break-up of the water availability in MHA is given in Table-10.8.

10.7.2 In addition to this, about 1000 mcm (2740 mld) water is available in Damanganga basin which is partly located in Maharashtra and partly in Gujarat. Thus, the potential resources in and around MMR are adequate to meet MMR's water supply demand well beyond

Industrial Water Demand for MMR 1991 to 2011

	Rgion / Sub Region	Ind. Area	Ind. Area	Ind. Area	Sub-Tots	Net Water Demand in mld. Existing				Gross Water Demand in mld. Existing		
		1991	2001	2011		1991	2001	2011		1991	2001	2011
1.	Greater Mumbai	4712	533	133	5378	322	35	9	365	379	419	430
1.1	Island City											
1.2	Western Suburb											
1.3	Eastern Suburb											
2.	Western Region	375	210	462	1047	4	14	30	48	5	21	56
2.1	Mira-Bhayander Sub Region	134	11	–	145	3	1	0	4	4	4	4
2.2	Vasai-Navghar Sub Region	11	55	127	193	0	4	8	12	0	4	14
2.3	Nallasopara Sub Region	200	95	221	516	1	6	14	22	1	8	25
2.4	Virar Sub Region	30	49	114	193	–	3	7	11	0	4	12
2.5	VVNA Coast Sub Region											
2.6	VVNA Rural Sub region											
2.7	Out side VVNA Sub Region											
3.	North East Region	2800	582	677	4059	290	51	44	385	341	401	452
3.1	TMC Sub Region	976	139	139	1254	42	9	9	60	49	60	71
3.2	KMC Sub Region	1055	48	47	1150	219	3	3	225	258	261	265
3.3	Ulhasnagar Sub Region	123	19	142								
3.4	Ambernath Sub Region	447	247	246	940	21	30	16	67	25	60	79
3.5	Badlapur Sub Region	80	24	104	4	2	6	5	7	7		
3.6	Bhiwandi Sub Region	119	105	245	469	4	7	16	27	5	13	31
3.7	Bhiwandi Rural Sub Region											
3.8	South Kalyan-Ulhas Sub Region											
3.9	North Kalyan Tehsil Sub Region											
4.	Navi Mumbai Region	2497	1801	825	5123	101	117	54	272	119	256	320
4.1	NMMC (Excl. 1 5 Villages)	1610	562	140	2312	62	37	9	108	73	116	127
4.2	NMMC (15 Vilages)											
4.3	Panvel Sub Region	565	338	84	987	17	22	5	44	20	46	52
4.4	Uran Sub Region	322	901	601	1824	22	59	39	120	26	95	141
5.	Neral - Karjat Region	252	100	24	376	58	6	2	66	68	75	77
5.1	Karjat Sub Region	3	5	–	8							
5.2	Khalapur Sub Region	249	95	24	368	58	6	2	66	68	75	77
6.	Panvel-Uran Region (Outside NB)	439	30	70	539	17	12	5	34	20	34	39
6.1	Rasayani-Panvel Sub Region	439	–	–	432	17	10	–	27	20	32	32
6.2	Rest-Panvel Sub Region											
6.3	Khopta Sub-Region	–	30	70	100	–	2	5	7	–	2	8
6.4	Rest-Uran Sub-Region											
6.5	Karnala Sub-Region											
7.	Pen Region	11	30	70	111	1	2	5	8	1	3	9
8.	Alibag Region	330	60	140	530	60	69	9	138	71	152	162
	TOTAL	**11416**	**3346**	**2401**	**17163**	**853**	**305**	**156**	**1314**	**1003**	**1362**	**1545**

Table-10.4

2031. However, the water account that attempts to match zone-wise demand and valley-wise availability for different time periods indicates supply-demand imbalances. Severe shortages may result, in some areas, if water sources are not developed in time.

Gross Water Demand in MMR 1991-2011

	Area	in mld		
		1991	2001	2011
1.	Gr. Mumbai	3026	3848	4471
2.	Western Region	102	245	441
3.	North Eastern Region	883	1338	1737
4.	Navi Mumbai Region	242	581	869
5.	Neral-Karjat Region	82	96	103
6.	Panvel-Uran (outside N.B)	34	66	98
7.	Pen Region	9	17	37
8.	Alibag Region	79	162	203
	Total Gross Demand	**4,457**	**6,354**	**7,959**

Table-10.5

Total Domestic and Industrial Water Demand in MMR For 1991-2011

	Region/Sub-Region	Gross Domestic Demand in mid			Gross Industtial Water Demand in mid			Gross Overall Water Demand in mid		
		1999	2001	2011	1991	2001	2011	1991	2001	2011
1.	Gr. Mumbai	2,647	3,429	4,041	379	419	430	3,026	3,848	4,471
2.	Western Region	97	224	385	5	21	56	102	245	441
3.	North Eastern Region	542	937	1,285	341	401	452	883	1,338	1,737
4.	Navi Mumbai Region	132	325	549	119	256	320	242	581	869
5.	Neral-Karjat Region	14	21	26	68	75	77	82	96	103
6.	Panvel-Uran Region (outside N.B)	14	32	59	20	34	39	34	66	98
7.	Pen Region	8	14	28	1	3	9	9	17	37
8.	Alibag Region	8	11	41	71	152	162	79	163	203
	Total	**3,453**	**4,993**	**6,414**	**1,004**	**1,361**	**1,545**	**4,457**	**6,354**	**7,959**

Table-10.6

Summary of Water Potential in M.H.A

Sr. No.	Name of Valley	CA IN Sq. K.m.	Yield estimated by CDO1994		Utilisation Planned @ 95% DEP.		Total Utilisation
			75% DEP. (MCM)	95% DEP. (MCM)	DOM & IND. (MCM)	IRRL (MCM)	Planned (MCM)
1	2	3	4	5	6	7	8
1	Vaitarna	1857.83	3129.49	2415.71	1633.75	650.89	2284.64
2	Ulhas	3204.73	6193.95	4680.91	1628.59	1240.92	2869.51
3	Patalganga	327.79	712.38	489.12	379.07	146.58	525.65
4	Amba	365.52	403.42	283.58	237.00	146.19	383.19
	Sub-Total	5755.87	10439.24	7869.32	3878.41	2184.58	6062.99
5	Damanganga			1000.00	1000.00	0.00	1000.00
	TOTAL MCM			**8869.32**	**4878.41**	**2184.58**	**7062.99**

Table-10.7

Source : Note submitted by the Irrigation Dept. to the Chitale Committee on Bombay's Water Supply (1994)

Note : The allocation of water supply for domestic and industrial use from each source is subject to the final allocation to be approved by I.D.GOM.

MMR Water Demand 1991, 2011

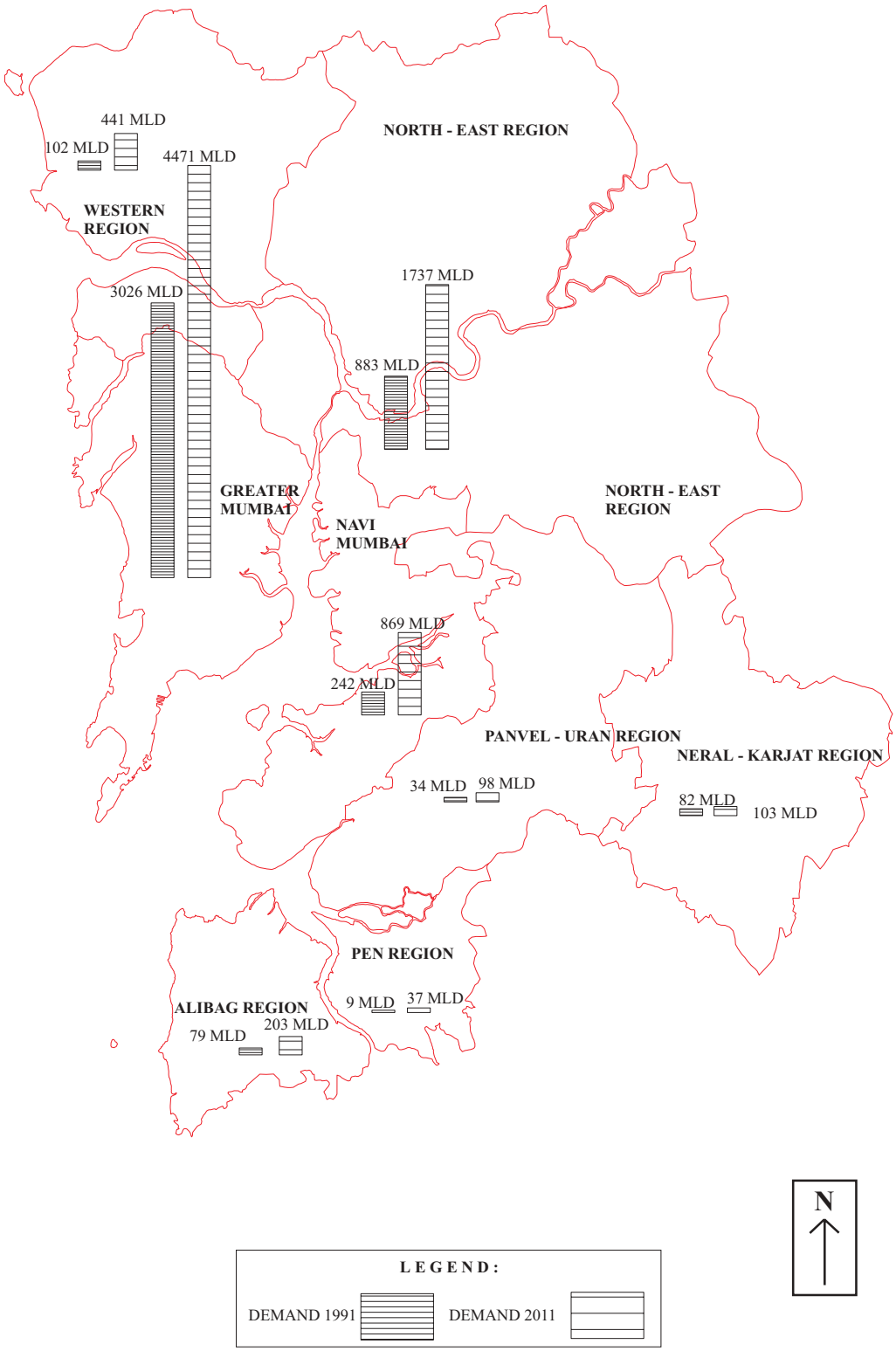

Figure-10.3

Sourcewise Water Potential and Utilisation in MHA

Sr. No.	Name of Project	C. A. Sq. Km.	Yield computed by CDO		Planned Utilisation		Planned Total Utilisation MCM
			75% MCM	95% MCM	Domestic and/or Industry MCM	Irrigation	
I	**Vaitarna Valley**						
a.	**Surya Sub Valley**						
1	Dhamani Project	205.90	316.13	253.37	35.82	227.25	263.07
2	Susari Project	79.98	108.29	85.71	0.00	13.23	13.23
3	Shensari Nalla	70.00	99.69	77.54	77.54	0.00	77.54
4	Kawadas Barrage	154.10	236.60	189.62	0.00	221.00	221.00
	Sub-Total (a)	509.98	760.71	606.24	113.36	461.48	574.84
b.	**Vaitarna Sub-Valley**						
1	Upper Vaitarna	160.84	219.00	179.00	224.00	0.00	224.00
2	Middle Vaitarna	131.74	212.60	173.61	172.00	0.00	172.00
3	Lower Vaitarna	289.80	415.11	338.62	152.00	0.00	152.00
4	Gargai at Ogade	113.37	190.62	162.41	180.00	0.00	180.00
5	Pinjal at Kirdara	315.95	609.49	434.29	425.81	0.00	425.81
6	Deharji Nalla Near Sukhsale	67.34	119.42	96.14	0.00	94.00	94.00
7	Nalla New Khand	18.70	34.85	24.57	24.57	0.00	24.57
8	Kumta Nalla	41.75	57.19	45.06	45.06	0.00	45.06
9	Kumbhari Nalla	8.78	11.72	8.89	0.00	12.00	12.00
10	Hatnar Project	14.24	19.02	14.92	0.00	19.00	19.00
11	Wandri Project	28.82	38.49	29.19	0.00	37.44	37.44
12	Kolsapada	7.80	10.42	7.89	0.20	10.56	10.76
13	Chikali Nalla		117.00	81.90	81.90	0.00	81.90
14	Chinchghar		62.00	44.28	44.28	0.00	44.28
15	Lohape		26.00	18.57	18.57	0.00	18.57
	Sub-Total (b)	1197.16	2142.93	1659.34	1368.39	173.00	1541.39
c.	**Tansa Sub-Valley**						
1	Tansa Resarvoir	136.57	204.09	135.83	152.00	0.00	152.00
2	Waghivali Project	14.12	21.76	14.30	0.00	16.41	16.41
	Sub-Total (c)	150.69	225.85	150.13	152.00	16.41	168.41
	Total for Vaitarna Valley (a+b+c)	1857.83	3129.49	2415.71	1633.75	650.89	2284.64
II	**Ulhas Valley**						
a.	Ulhas Sub-Valley						
1	Ulhas at Kondane	53.87	131.17	109.57	105.10	18.64	123.74
2	Salpe	25.20	60.40	50.45	0.00	63.40	63.40
3	Shilar at Sugwe	121.70	394.45	313.12	0.00	256.28	256.28
4	Thakurwadi Nalla	16.83	54.55	43.30	43.30	0.00	43.30
5	Poshir at Kurung	125.61	271.33	212.24	195.00	79.80	274.80
6	Murbadi at Bhandivali	14.24	22.29	19.05	19.05	0.00	19.05
7	Barvi at Vashivali	166.00	357.01	258.08	250.00	0.00	250.00
8	Pej Project	23.62	57.37	44.64	18.00	0.00	18.00
9	Free Catchment area of Shilar below Sugwe	36.26	57.37	44.64	18.00	0.00	18.00
10	Free C.A. of Poshir below Kurung	110.83	289.94	218.67	0.00	0.00	0.00
11	Free C.A. between Mohili & Khedsaware	193.00	474.83	361.13	0.00	0.00	0.00
12	Free C.A. of Murbadi below Bandiwali	167.05	253.04	205.04	0.00	0.00	0.00
13	Free C.A. of Barvi	64.75	85.11	59.29	0.00	0.00	0.00

Table-10.8 (Contd)

Sourcewise Water Potential and Utilisation in MHA

Sr. No.	Name of Project	C. A. Sq. Km.	Yield computed by CDO		Planned Utilisation		Planned Total Utilisation MCM
			75% MCM	95% MCM	Domestic and/or Industry MCM	Irrigation	
	below Vashivali						
14	Free C.A. of Ulhas between Badlapur and Jambhul	43.12	64.82	45.91	0.00	0.00	0 . 0 0
15	Kushivali Project	6.89	10.36	7.34	0.00	10.34	10.34
	Sub-Total (a)	1168.97	2621.53	2019.37	630.45	428.46	1058.91
b.	**Kalu Sub-Valley**						
1	Kalu at Khapri	226.62	427.35	308.56	143.59	230.58	373.87
2	Shai at Nampada	190.62	497.83	348.16	268.34	79.82	348.16
3	Kanakvira at Gondyachapada	31.47	78.99	62.19	13.17	4.00	17.17
4	Doiphodi at Dhasai	28.43	77.08	60.85	0.00	53.70	53.70
5	Bhamkhori at Thane	58.79	137.63	108.67	0.00	102.80	102.80
6	Kanvi at Ambapada	21.00	30.82	21.47	12.01	14.79	26.80
7	Kalu at Bhagad	400.72	621.02	481.10	0.00	0.00	0.00
8	Kalu at Titwala	114.68	186.78	156.26	0.00	0.00	0.00
	Sub-Total (b)	1072.33	2057.50	1547.57	436.81	485.69	922.50
c.	**Bhatsa Sub-Valley**						
1	Bhatsa at Saijvali	388.50	610.00	456.00	436.30	240.65	676.95
2	Momri at Sarangpuri	41.00	87.97	61.19	0.00	67.38	67.38
3	Kharivali at Aure	36.16	52.67	33.11	0.00	0.00	0.00
4	Bhatsa at Pise	460.73	711.77	523.13	0.00	0.00	0.00
	Sub-Total	926.39	1462.41	1073.43	436.30	308.03	744.33
d.	**Ulhas Beyond Kalyan**						
1	Sakharoli Nalla	15.54	23.01	17.53	17.53	0.00	17.53
2	Chene	21.50	29.50	23.01	0.00	18.74	18.74
	Sub-Total (d)	37.04	52.51	40.54	17.53	18.74	36.27
	Total for Ulhas Valley (a+b+c+d)	3204.73	6193.95	4680.91	1521.09	1240.92	2762.01
III	**Patalganga Valley**						
1	Hetwane	70.00	127.00	95.22	54.75	72.25	127.00
2	Sungadewadi	20.20	38.33	26.37	0.00	30.56	30.56
3	Morbe	57.00	137.00	98.00	98.00	0.00	98.00
4	Balganga	134.68	243.00	148.89	127.76	0.00	127.76
5	M.I. Schemes (6 Nos.)	15.37	27.67	19.60	19.60	0.00	19.60
6	Ransai	14.00	22.84	16.32	15.24	0.00	15.24
7	Patalganga (TLRC)	-	86.69	63.72	63.72	22.77	86.49
8	MI. Schemes (10 Nos.)	16.54	29.85	21.00	0.00	21.00	21.00
	Total for Patalganga Valley	327.79	712.38	489.12	379.07	146.58	525.65
IV	**Amba Valley**						
1	Amba Valley Project	270.00	247.46	10.21	237.00	10.46	247.46
2	Chimboda-Thakurwadi	35.35	67.96	48.53	0.00	67.73	67.73
3	Warap	15.61	18.00	12.85	0.00	16.00	16.00
4	Shidheshwar	30.56	48.00	34.28	0.00	30.00	30.00
5	Harnoli	14.00	22.00	15.71	0.00	22.00	22.00
	Total for Amba Valley	365.52	403.42	121.58	237.00	146.19	383.19
V	**Damanganga Valley**			**1000.00**	**1000.00**	**0.00**	**1000.00**

Source : *Note submitted by the Irrigation Dept. to the Chitale Committee on Bombay's Water Supply (1994.)*

Note : *The Allocation of water supply to Dom/Ind use from each sources subjected by final allocation to approve by I.D.GOM*

Table-10.8 (Concld.)

10.8 Water Account

10.8.1 So far, Water Account was prepared using 6 water supply zones mentioned in para 10.4.1 which are essentially based on different river basins of the Mumbai Hydrometric Area. The water transmission network evolved over the years and proposed under some water supply projects for the future indicates that there is considerable cross-valley transmission. Hence, Water Account is presented here as a matrix between water sources and the water consumption zone that are co-terminus with various planning zones defined for the purpose of revised Regional Plan.

10.8.2 Current Demand-Supply Situation

The water account for 1991 presented in Table-10.9 indicates the current demand-supply situation in the Region. This highlights scarcity of water in the Western region, i.e. Mira-Bhayandar and Vasai-Virar areas, where the gross average supply ranges from just about 10 to 90 lpcd. The supply in Mira-Bhayandar has improved recently with supply of 21 mld of water from Temghar, but Vasai, Nallasopara and Virar continue to reel under acute shortage.

Greater Mumbai's current demand from domestic, industrial and other non-domestic sectors is placed at 3026 mld. Against this, the supply is 2474 mld, which indicates a deficit of 524 mld. Although this represents the largest deficit in the Region, Mumbai still enjoys a gross supply level of about 200 lpcd, which represents the higher range of standards recommended by the CPHEEO at national level.

Navi Mumbai represents the surplus supply zone in the region. At a relatively higher supply standard of 200 lpcd, the water demand in Navi Mumbai is estimated at 242 mld, whereas the supply is 295 mld. This is largely on account of recent augmentation on supply from 50 to 80 mld from the MWSSB's Patalganga (Jawahar Plant) source.

Most other zones in the Region, namely, Neral-Karjat, Panvel-Uran outside Navi Mumbai, Pen and Alibag are moderately deficit zones. The total current supply in the Region is 3804 mld. and the deficit 653 mld.

10.8.3 Demand-Supply Account for 2001

Water Account for 2001 is presented in Table-10.10 indicates that the total water demand in the Region is expected to increase from 4457 mld in 1991 to 6354 mld. The supply is also expected to increase from 3804 mld to 6283 on account of development of new sources and augmentation of the existing ones. These would balance demand-supply situation in all zones except Greater MUMBAI and KMC where small of 38 and 40 mld respectively are projected for 2001.

Greater Mumbai's water demand is expected to increase from 3026 mld. in 1991 to 3848 mld. in 2001. During this period, the completion of ongoing Bhatsa, Phase-III will add 455 mld. to the available supply. Despite this, if no other source is developed during this period, the deficit will increase from 524 to 970 mld. It is therefore imperative to develop Middle Vaitarna with 477 mld. capacity. However, since the full potential of this source is not likely to be available by 2001, Mumbai will have a large deficit. This can be reduced to some extent if, as recommended by the Expert Committee on Water Planning for Greater Mumbai (MCGM, 1994), the 455 mld. water earmarked for irrigation use can be

Water Demand and Supply Account for MMR 1991

	Region/ Sub-Region	Gross Demand - 1991 (in mld.)			Water Sources			Vaitarna					Ulhas						Patalganga						
		Dom.	Ind.	Total	Local	Vihar BMC	Tulsi BMC	Vait-tarna BMC	U. VTNA BMC	Bhatsa BMC	Tansa MW-SSB	Pelhar BMC	Ulhas MIDC	Barvi MIDC	Shahad PVT	Shahad MW-SSB	BDLPR MW-SSB	SHD /TEM MIDC	Rasai MIDC	Rasyni MW-SSB	P.Gnga. PVT/LA	P.Gnga. MIDC	Amba Poynd MIDC	Total Supply	Deficit 0 Sur-plus
	Gross Capacity				**68**	**18**	**490**	**544**	**910**	**408**	**12**	**90**	**450**	**163**	**165**	**50**	**210**	**40**	**54**	**80**	**64**	**117**			
1.	Greater Mumbai	2,647	379	3,026	68	18	484	544	910	388		90												2,502	(524)
2.	Western Region	97	5	102	3.9	0	0	0	0	0	0	9.6	0	0	0	0	0	21	0	0	0	0	0	35	(67)
2.1	Mira Bhayander Sub Region	35	4	39	1							3						21						22	(17)
2.2	Vasai-Navaghar Sub Region	21	0	21								6.2												3	(18)
2.3	Nallasopara Sub Region	16	1	17								6.2												6	(11)
2.4	Virar Sub Region	13	0	13	0.9							0.4												1	(12)
2.5	VVNA Coast Sub Region	9		9	2																			2	(7)
2.6	VVNA Rural Sub Region	2		2																				0	(2)
2.7	Outside VVNA Sub Region	1		1																				0	(1)
3.	North East Region	542	341	883	4.6	0	0	6	0	0	20	0	0	269	139	165	42	177	0	0	0	0	0	823	(60)
3.1	TMC Sub Region	161	49	210										100	30			128						258	48
3.2	KMC Sub Region	164	258	422	0.6									118	51	165								335	(88)
3.3	Ulhasnagar Sub Region	77	0	77										36	58									94	17
3.4	Ambernath Sub Region	25	25	50										7			37							44	(6)
3.5	Badlapur Sub Region	10	5	15													5							5	(10)
3.6	Bhiwandi Sub Region	89	5	94	4	6	20	5	49	84	(10)														
3.7	Bhiwandi Rural Sub Region	7		7																				0	(7)
3.8	South Kalyan Ulhas																								

Table-10.9 (Contd.)

Water Demand and Supply Account for MMR 1991

	Region/ Sub-Region	Gross Demand - 1991 (in mld.)			Water Sources			Vaitarna					Ulhas							Patalganga						
		Dom.	Ind.	Total	Local	Vihar BMC	Tulsi BMC	Vait-tarna BMC	U. VTNA BMC	Bhatsa BMC	Tansa MW-SSB	Pelhar BMC	Ulhas MIDC	Barvi MIDC	Shahad PVT	Shahad MW-SSB	BDLPR MW-SSB	SHD /TEM MIDC	Rasai MIDC	Rasyni MW-SSB	P.Gnga. PVT/LA	P.Gnga. MIDC	Amba Poynd MIDC	Total Supply	Deficit 0 Sur-plus
	Sub Region	6		6										3										3	(3)
3.9	North Kalyan Tehsil Sub Region	2		2																				0	(2)
4.	Navi Mumbai Region	123	119	242	2.75	0	0	0	0	0	0	0	0	159	0	0	0	0	28	20	85	0	0	295	53
4.1	NMMC (Excl. 15 Villages)	82	73	155										158										158	3
4.2	NMMC (15 Villages)	1	0	1										1										1	(0)
4.3	Panvel Sub Region	29	20	49	2.75															20	70			93	44
4.4	Uran Sub Region	11	26	37	28	15	43	6																	
5.	Neral-Karjat Sub Region	14	68	82	2.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	63.4	0	66	(16)
5.1	Karjat Sub Region	7		7	2.92																			3	(4)
5.2	Khalpur Sub region	7	68	75																		63.4		63	(12)
6.	Panvel-uran Reg.Outside NB.	14	20	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	20	(14)
6.1	Rasyani-Panvel Sub Region	7	20	27	20	20	(7)																		
6.2	Rest- Panvel Sub Region	3	0	3	0	(3)																			
6.3	Khopta Sub RegionN	3	0	3	0	(3)																			
6.4	Rest- Uran Sub Region	0	0	0	(0)																				
6.5	Karnala Sub Region	1	1	0	(1)																				
7.	Pen Region	8	1	9	1.39																			1	(7)
8.	Alibag Region	8	71	79	2.1																		60	62	(17)
	Total	**3,453**	**1,004**	**4,457**	**18**	**68**	**18**	**490**	**544**	**910**	**408**	**10**	**90**	**428**	**139**	**165**	**42**	**198**	**28**	**40**	**85**	**63**	**60**	**3,804**	**(653)**
	Total Gross Supply				**18**	**68**	**18**	**490**	**544**	**910**	**408**	**12**	**90**	**450**	**163**	**165**	**50**	**210**	**40**	**54**	**80**	**63**	**117**	**3,950**	
	Surplus /Deficit ( )				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**22**	**24**	**0**	**8**	**12**	**12**	**14**	**(5)**	**0**	**57**	**146**	

Table-10.9 (Concld.)

Water Demand and Supply Account for MMR-2001

				Source s in mld			Vaitarna						Surya		Ulhas						Patalganga						Amba Poy-and MIDC	Bho-gesh Het-wne CID-CO	Total Supply	Deff-iciet () Sur-plus
	DOM.	IND.	Total	Local	Vihar	Total	Tulsi Va-itarna U. BMC	Vaita-rna M. BMC	Vaita-rna BaMC	Bhatsa BMC	Tansa BMC	Pelhar MW-SSB	USF / SHV ME-SSB	Mas-yan MIa-DC	Ulhas MW-SSB	Barvi MIDC	Sha-had MIDC	Shahad PVT.	Bdlpur MIDC	SHD/ TEM MW-SSB	Poshir MW-SSB MW-SSB	Ransai MIDC MW-SSB	Ras-yani MIDC MW-SSB	P. Ganga MW-SSB	P. Ganga PVT.	Morbe MW-SSB				
Gross Capacity in 2001					68	18	490	544	477	1805	408	12	20	100	90	540	163	165	50	620	296	40	74	80	85	350	117	150		
1. Greater Mumbai	3,429	419	3,848		68	18	490	544	477	1805	408																		3,810	(38)
2. Western Region	224	21	244	2.9	0	0	0	0	0	0	0	12	20	100	0	0	0	0	0	110	0	0	0	0	0	0	0	0	245	1
2.1 Mira-Bhayander Sub-Region	87	4	92									3	13	10						92									92	0
2.2 Vasai-Navghar Sub-Region	33	4	37											11															37	0
2.3 Nallasopara Sub-Region	53	8	61									6		51						4									61	0
2.4 Virar Sub-Region	37	4	41	0.9									7	33															41	0
2.5 VVNA Coast Sub-Region	10		10	2										5						3									10	(0)
2.6 VVNA Rural Sub-Region	3		3									3																	3	0
2.7 Outside VVNA Sub-Region	1		1											1															1	0
3. North East Region	937	401	1,338	11.6	0	0	0	0	0	0	0	0	0	0	90	218	124	165	50	453	186	0	0	0	0	0	0	0	1,298	(40)
3.1 TMC Sub-Region	262	60	322													36				286									322	0
3.2 KMC Sub-Region	327	261	588	0.6											90	100	66	165			126								548	(40)
3.3 Ulhasnagar Sub-Region	115		115													36	58				21								115	0
3.4 Ambernath Sub-Region	36	60	96	7												26			29		34								96	0
3.5 Badlapur Sub-Region	16	7	23													7			16										23	0
3.6 Bhiwandi Sub-Region	163	13	176	4												13				159									176	(0)
3.7 Bhiwandi Rural Sub-Region	8		8																	8									8	(0)
3.8 South Kalyan Ulhas Sub-Region	7		7																5		2								7	(0)
3.9 North Kalyan Tehsil Sub-Region	3		3																		3								3	0
4. New Bombay Region	325	256	581	3	0	0	0	0	0	0	0	0	0	0	0	266	0	0	0	0	0	28	0	61	0	87	0	100	588	6
4.1 NMMC (Excl. 15 villages)	271	116	387													266								34		87			387	0
4.2 NMMC (15 villages)	1		1													1													1	(0)
4.3 Panvel Sub-Region	38	46	84	3												42								12				29	86	2
4.4 Uran Sub-Region	15	95	110																			28		15				71	114	4
5. Neral-Karjat Region	21	75	96	2.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	85	8	0	0	96	(0)
5.1 Karjat Sub-Region	9		9	2.92																						6			9	(0)
5.2 Khalapur Sub-Region	11	75	87																						85	2			87	0
6. Panvel-Uran Reg. outside NB	32	34	66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	32	19	0	4	0	0	66	(0)
6.1 Rasayani-Panvel Sub-Region	19	32	51																				32	19					51	0
6.2 Rest Panvel Sub-Region	3		3																							3			3	(0)
6.3 Kopta Sub-Region	9	2	11																			11							11	(0)
6.4 Rest Uran Sub-Region	0		0																										0	(0)
6.5 Karnala Sub-Region	1		1																							1			1	0
7. Pen Region	14	3	18	1.39																						17			18	0
8. Alibag Region	11	152	162	2.1																						43	117		162	(0)
Total	**###**	**1,362**	**6,354**	**24**	**68**	**18**	**490**	**544**	**477**	**1,805**	**408**	**12**	**20**	**100**	**90**	**484**	**124**	**165**	**50**	**563**	**186**	**39**	**32**	**80**	**85**	**159**	**117**	**100**	**6,283**	**(72)**
Total Gross Supply				**24**	**68**	**18**	**490**	**544**	**477**	**1,805**	**408**	**12**	**20**	**100**	**90**	**540**	**163**	**165**	**50**	**620**	**296**	**40**	**74**	**80**	**85**	**350**	**117**	**150**	**6,786**	
Surplus/Deficit ( )				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**56**	**39**	**0**	**0**	**57**	**110**	**1**	**42**	**0**	**0**	**191**	**0**	**50**	**503**	

Table-10.10

temporarily diverted for domestic and industrial use. This should not pose much difficulty as the irrigation use in the command area is developing rather slowly and might take another decade to use the available water fully.

Transfer of Damanganga Water as an alternative way of augmenting Greater Mumbai's water supply in the near future, the National Water Development Agency of the Ministry of Water Resources, GOI, has suggested transfer of water from Damanganga valley in Gujarat to Mumbai via Pinjal. The proposal envisages linking Bhugad and Khargihill reservoirs in Damanganga valley with Pinjal through 48 km. long 7 meter diameter tunnel, and further transmission of water from Pinjal to Mumbai. About 2740 mld (1000 mcm) surplus water from Damanganga valley can thus be used in conjunction with new source at Pinjal for MUMBAI's water supply need well beyond 2001. The proposal is currently under study by the Govt. of Maharashtra and MCGM.

In the Western Region, water demand of Vasai-Virar is expected to increase sharply from the current demand of 63 to 152 mld by 2001. With a view to meeting a part of the demand, MWSSB is implementing a Rs. 32 crore scheme to provide water to Virar and Vasai towns. The scheme, which will use Usgaon M.I. tank and Tansa river at Shiravali as source, will provide about 20 mld of water. In addition, a new 100 mld. water supply project for this area has also been proposed using the Irrigation Department's Surya Dam as a source. In the 1st stage, the water will be released in the Surya River and will be picked up at MIDC's Maswan weir, and, in the 2nd stage, the pipeline will be extended to Kavdas weir near the dam. The DPR for scheme has been prepared, but financing arrangements have not yet been finalised. Even with these two schemes, Vasai-Virar area will have deficit of about 14 mld which will have to be met by bringing water from Temghar.

In North-east Region, i.e. in Kalyan-Thane area, the demand during 1991-2001 is expected to increase from 883 to 1338 mld. The major project proposed for meeting this additional demand during this period is the Maharashtra Water Supply and Sewerage Project (MWSSP-II) which the World Bank is expected to assist. Under this project, new source of 296 mld will be developed at Poshir and the intake from Shahad will be increased from 210 mld to 620 mld with corresponding increase in the capacity of Temghar water works (MWSSB, 1989). The progress of finalisation of this project including funding arrangements is, however, not satisfactory, which creates uncertainty about its completion by 2001. If this project is delayed, serious water shortage in this zone will result. As an immediate measure to improve water supply to Kalyan, MCGM's 90 mld water works at Shahad is being transferred to KMC. The scheme which includes new treatment works and transmission network is being implemented under Bombay Urban Development Project (BUDP).

Navi Mumbai will be one area in the Region where water supply situation may continue to be comfortable till 2001. The demand is expected to rise from 242 to 581 mld, but supply will be able to keep pace with the growth. This is on account of a) development of 350 mld new source at Morbe, the work on which has commenced; b) CIDCO's 150 mld new water supply scheme from Hetawane, and c) augmentation of Barvi from 450 to 540 mld. In fact, the Water Account in table 9 indicates that Morbe source, if fully developed, will remain underutilised until 2001. CIDCO, which will be the main beneficiary of this project (for Navi Mumbai), has taken over the responsibility for financing it.

In the revised Regional Plan, Rasayani is identified as a new Growth Centre. Water demand in this area is therefore likely to increase from 27 mld in 1991 to 51 mld in 2001. Presently, water is supplied to this area from the MIDC's 54 mld water works on Patalganga. Although this is being augmented to 74 mld, additional water will increasingly be made available to MIDC's existing and proposed industrial area. Hence, Rasayani's demand upto 2001 will have to be met by water from Morbe.

Presently, major water demand in Pen and Alibag Regions are met by supply from MIDC's 120 mld work on Amba. Although the present utilisation is only 60 mld, the demand upto 2001, i.e. 162 mld, will exceed the spare capacity. If the demand actually reaches projected levels, new source will have to be developed or water from Morbe will have to be diverted.

10.8.4 Demand Supply Account for 2011

The overall scenario for 2011 presented in Table-10.11 indicates that as against total demand of 7960 mld, the supply potential is 8039 mld. Although this indicates overall balance between supply and demand, certain areas, namely, Greater Mumbai and Thane-Kalyan will experience small deficits.

Between 2001 and 2011, the demand for Greater Mumbai is expected to increase from 3848 to 4471 mld. As recommended by the Expert Committee on Water Planning for Greater Mumbai (MCGM, 1994), this demand can be met by developing sources at Kalu with 590 mld. and Gargai with 452 mld. On development of these sources it would be possible to withdraw the temporary arrangement of using 455 mld. of irrigation water at Bhatsa for domestic and industrial purpose. For the increase in demand beyond 2011, new source at Shai with 1069 mld. will have to be developed.

As mentioned above, the north-east region, particularly, Thane and Kalyan areas, will have a marginal deficit of 36 mld. If necessary, this can be made good by diverting some surplus water from MCGM sources. Vasai-Virar area of the western region indicates a balanced demand-supply situation but this is subject to developing a new source of 200 mld on the tributary of Surya River, as the present permission to lift 100 mld water from the Surya Irrigation Dam is only a stop-gap arrangement.

Navi Mumbai's water demand in 2011 is estimated to be 869 mld. This demand can be adequately met, largely because of the possibility of expansion of Morbe from 350 to 450 mld. During this period, CIDCO is also expected to develop Balganga for 350 mld capacity and discontinue 150 mld intake from Hetawane as it is temporary arrangement. Even after meeting Navi Mumbai's water demand, Balganga will have some surplus water. The Pen and Alibag Region's demand in 2011 will be 240 mld. Against this, the MIDC's scheme on Amba River has a potential of 117 mld. To avoid scarcity of water in these regions, either new sources are developed or part of the CIDCO's Balganga water is temporarily diverted to Pen-Alibag regions.

10.9 Costing

10.9.1 The foregoing Water Account envisages augmentation of existing sources or development of new sources. Although most of these projects have been identified, further work on estimating their costs has not been done for all projects. For some projects, costs of source development are roughly estimated, but conveyance or treatment costs are not calculated. In Table-10.12 cost data obtained from various sources are presented. This

Water Demand Supply Account for 2011

		Gross Demand-2011 in mld.			Sources in mld.			Vaitarna							Surya			Ulhas																Patalganga					Amba Poyand	Bigang Bigang CIDCO	Total Supply	Deficit ()
		Dom.	Ind.	Total	Local	Vihar	Tulsi	Vaita-rna	Upper Vaitrn	Mid-dle Vaitrn	Bhatsa	Tansa	Gargai	Pelhar	USG/ SHV	Kaman	Kav-das	Ulhas	Barvi	Sha-had	Sha-had	Badla-pur	SHD/ TEM	Poshir	Kalu	SLP-TVN	Mohil	Ran-sai	Ras-yni	P. Ganga	P. Ganga	Morbe								
						BMC	BMC	BMC	BMC	BMC	BMC	BMC	BMC	MW-SSB	MW-SSB	MW-SSB	MW-SSB	MIDC	MIDC	PVT	MW-SSB	MW-SSB	MW-SSB	BMC	MW SSB	MW SSB	MIDC	MIDC	MW-SSB	PVT/ LA	MW-SSB	MIDC					Sur-plus
	Gross Capacity in 2011					68	18	490	544	477	1365	408	452	12	20	35	200	90	540	163	165	50	620	296	590	131	85	40	74	80	85	450	117	350			
1.	Greater Bombay	4,041	430	4,471		68	18	490	544	477	1365	408	452												590											4,412	(59)
2.	Western Region	385	56	442	2.9	0	0	0	0	0	0	0		12	20	35	200	0	0	0	0	0	159	0	0			0	0	0	0	0	0			429	(13)
2.1	Mira-Bhayander Sub-Region	154	4	159																			159													159	0
2.2	Vasai-Navghar Sub-Region	48	14	62										3	13	28	16																			60	(2)
2.3	Nallasopara Sub-Region	106	25	131										7		5	116																			128	(3)
2.4	Virar Sub-Region	66	12	78	0.9										7		62																			70	(8)
2.5	VVNA Coast Sub-Region	9		9	2											2	5																			9	0
2.6	VVNA Rural Sub-Region	2		2										2																						2	0
2.7	Outside VVNA Sub-Region	1		1													1																			1	0
3.	North East Region	1285	453	1738	11.6	0	0	0	0	0	0	0		0	0		0	90	250	163	165	50	461	295	0	131	85	0	0	0	0	0	0			1,702	(36)
3.1	TMC Sub-Region	359	71	430															50				211			96	60									417	(13)
3.2	KMC Sub-Region	442	265	707	0.6													90	100	105	165			203			20									684	(23)
3.3	Ulhasnagar Sub-Region	153		153															36	58				59												153	(0)
3.4	Ambernath Sub-Region	47	79	126	7														26			29		29		35										126	0
3.5	Badlapur Sub-Region	21	7	28															7			16					5									28	0
3.6	Bhiwandi Sub-Region	246	31	277	4														31				242													277	0
3.7	Bhiwandi Rural Sub-Region	8		8																			8													8	0
3.8	South Kalyan-Ulhas Sub-Rn	6		6																		5		1												6	0
3.9	North Kalyan Tehsil Sub-Rn	3		3																				3												3	0
4.	New Bombay Region	549	320	869	3	0	0	0	0	0	0	0		0	0		0	0	290	0	0	0	0	0	0			26	0	61	0	395	0	94	869	0
4.1	NMMC (Excl. 15 villages)	479	127	606															237											34		335				606	0
4.2	NMMC (15 villages)	1		1															1																	1	0
4.3	Panvel Sub-Region	52	52	104	3														52											12		24		13	104	0
4.4	Uran Sub-Region	17	141	158																								26		15		36		81	158	0
5.	Neral-Karjat Sub-Region	26	77	104	2.92	0	0	0	0	0	0	0		0	0		0	0	0	0	0	0	0	0	0			0	0	0	85	16	0	0	104	0
5.1	Karjat Sub-Region	11		11	2.92																										8			11	0
5.2	Khalapur Sub-Region	15	77	93																											85	8			93	0
6.	Panvel-Uran Reg. Outside NB	59	40	99	0	0	0	0	0	0	0	0		0	0		0	0	0	0	0	0	0	0	0			14	29	19	0	21	0	16	99	0
6.1	Rasayani-Panvel Sub-Region	33	32	65																									29	19		17			65	0
6.2	Rest Panvel Sub-Region	3		3																												3			3	0
6.3	Kopta Sub-Region	22	8	30																								14						16	30	0
6.4	Rest Uran Sub-Region	0		0																															0	0
6.5	Karnala Sub-Region	1		1																												1			1	0
7.	Pen Region	28	9	37	1.39																													36	37	0
8.	Alibag Region	41	162	203	2.1																												117	84	203	0
	Total	6,415	1,546	7,961	24	68	18	490	544	477	1,365	408	452	12	20	35	200	90	540	163	165	50	620	295	590	131	85	40	29	80	85	432	117	230	7,855	(107)
	Total Gross Supply				24	68	18	490	544	477	1,365	408	452	12	20	35	200	90	540	163	165	50	620	296	590	131	85	40	74	80	85	450	117	350	8,039	
	Surplus/Deficit ( )				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	45	0	0	18	0	120	184	

Table.10.11

indicates that the source development, conveyance and treatment involve outlay of Rs. 1237.31 crores during 1991-2001 and Rs. 1013.17 crores during 2001-2011.

10.10 Resource Mobilisation

10.10.1 As no new water source was developed since 1980 the water supply situation is

Water Resource Development Costs

	Source	Capacity in mld	Total Cost Rs.in Crores	Capacity in mld	Total Cost Rs.in Crores
		1991-2001		2001-2011	
1	Middle Vaitarna	477	377.00		
2	Kalu			590	328.00
3	Gargai			452	371.00
4	Usgaon-Shiravali	20	46.00		
5	Kaman			35	24.36
6	Surya (Maswan/Kavdas)	100	245.25	100	73.20
7	Ulhas	90	48.03		
8	Barvi Augmentation	540	26.45		
9	Shahad (Temghar)	620	182.80		
10	Poshir	296	94.00		
11	Rasayani Left Bank	74	14.38		
12	Morbe	350	112.40		
13	Salpe-Tiwane			131	48.15
14	Mohil			85	31.16
15	Hetawane	150	91.00		
16	Balganga			350	102.87
17	Amba Valley			117	34.39
	TOTAL		**1237.31**		**1013.13**

Table.10.12

Notes:

1. *Figures 1 to 3 are based on the Irrigation Dept. and MCGB's estimates for Expert Committee (MCGB, 1994).*
2. *Costs for 4,5,6,7,8,11,12,13,14,15 are updated to 1994-95 by applying WPI.*
3. *Costs for 8,16,17 are based on average source development cost of projects 1 to 5.*
4. *Costs for 1 to 4,6,9,15 include source development, conveyence and treatment costs*

worsening year after year particularly in Western Zone and North-Eastern Zone of MMR. Water supply scheme has two major components namely, a) water resources development and b) conveyance, treatment and distribution. Unless the first part is completed, second cannot be taken up for execution. The time required for completion of the first part varies between 3 to 10 years depending on the size of the project. Though the actual period of construction of dam is much shorter, considerable amount of time is required for preliminaries like clearances from Environment and Forest Ministry, land acquisition and rehabilitation of oustees. The availability of funds is a major factor influencing the source development. So far, water resource development has been considered as an exclusive responsibility of the government. However, the past experience indicates that the government may not be able to allocate adequate amount of resources for the development of water resources in MMR, particularly on

account of the demands of the backward areas of the rest of the state. Various alternatives for mobilisation of financial resources therefore need consideration.

10.10.2 Private Sector Participation

It is possible to attract private investment in water resource development if purchase of bulk water at attractive rates is guaranteed. Considering the incentives offered and the policy changes being made to attract private investments in other sectors, such as, power, telecom and transport, it should not be difficult to create conditions in which investment in water resource development would also be remunerative. Such private sector investment would also imply that the local government manage their water distribution system efficiently and charge economic water rates.Investment in source development as well as distribution system are currently financed through borrowed capital and the debt servicing, and O & M costs are sought to be financed by water tariffs or property taxes. In addition, the Local Authorities have been empowered since August 1992 to levy a Development Charge under the provisions of the MR&TP Act, 1966. They should fix the rates of the Development Charge (within the permissible limit) at such level as to ensure collection of adequate funds to partly finance the source development.

10.10.3 Fiscal

Pricing is an important technique of conserving and allocating a scarce resource in an optimal manner. Though water is differentially priced for various uses such as industrial and domestic consumption, for a given consumer there is a uniform rate irrespective of volume of consumption. For example, the water tariff is same for a slum dwellers' cooperative which shares a stand post between 15 families and probably receives less than 50 lpcd. of water and an apartment owner on Malabar Hill who consumes over 200 lpcd. Differential pricing related to level of consumption is justifiable from the point of generation of funds for future water supply schemes as well as to promote equitable distribution of water.Another important aspect of fiscal policy regarding water supply is the presence of widely varying water tariff in MMR. In Greater Mumbai the domestic tariff is RS 0.50 per 1000 litres whereas in outer areas it is over Rs 1.50 per 1000 litres. The MCGM through differential pricing for industrial and commercial consumption can recover not only O & M and debt servicing cost but also generate 40% of its capital requirement. In outer areas, however, industrial demand being separately catered to by the MIDC there is practically no scope for such differential pricing. With the result local authorities find it difficult to recover their O & M costs, leave aside the capital investments requirements. This is indicative of the urgent need to take a more integrated view of tariff policies and resource mobilisation for water source development.

10.11 Technology and Research

10.11.1 Given the scarcity of water, consumption and optimal use of water need to be promoted. A few promising ways are described below:

Sewerage Alternatives

At present only two sanitation alternatives are considered. Two-pit pour flush latrines or a water borne underground sewerage. The former requires minimum of water use

(and therefore does not take care of sullage water) but is unsuitable for high density development particularly where water table is high. The latter is water intensive as water is used as a vehicle for transporting the waste. To use water brought from hundreds of kilometer, treated and pumped for this purpose is obviously wasteful. Innovative methods particularly small bore shallow sewers which essentially carry liquid effluents after separation of solids and suspended matter need to be explored and used to minimise wasteful use of water.

Recycling of Waste Water

In Mumbai dual stack system is used in high rise buildings that is there are separate waste water and soil down take pipes. It may be possible to recycle the waste water for gardening, cooling and flushing purposes. After some pilot projects this needs to be made mandatory in commercial, office and industrial complexes.

Reverse Osmosis for Water and Waste Water

The water requirement of small village and industries situated along the sea coast of the region where availability of potable water is either difficult or uneconomical the Reverse Osmosis technique needs to be explored for obtaining water from sea water/ brackish water. In India this process is being practiced in Tamilnadu, Andhra Pradesh, and Rajastan on experimental basis. In MMR in areas like Vasai-Virar such system can be experimented on pilot basis.

Regulation of Tail Race Discharges

For improving the water supply situation in Ulhas and Patalganga river the regulation of tail race release from Bhivpuri and Khopoli power station will be necessary. For this purpose it is necessary to regulate power generation according to downstream water requirement, instead of regulating it according to power requirement. As the contribution of hydel power is very limited, this should be possible without any significant impact on power situation.

10.12 Institutional Set Up

10.12.1 The planning and development of water resources is thus a very urgent, resource intensive and complex task. Under the present administrative set-up, however, there is no single agency which has a direct and comprehensive mandate in this regard. Hence it is imperative to establish a suitable institutional mechanism. Various functions involved in the water resource planning, development and management are as follows :

1. Planning and policy direction.
2. Allocation of resources and arbitration in disputes.
3. Resource mobilisation and financing.
4. Deciding tariff policies.
5. Purchase and sale of bulk water.
6. Source development.
7. Conveyance and treatment.
8. Distribution.

10.12.2 The institutional arrangement recommended in the Study on Environmental Management Strategy and Action Plan for MMR (GOM, Coopers & Lybrand, AIC, 1994) has envisaged creation of an independent authority at the State Government level for overall policy making, resource planning and allocation. Such authority will be headed by the Chief Minister and represented by the key agencies involved in the water supply in the Region.

The study has suggested that the State Irrigation Dept. should be converted into the Water Resource Development Agency responsible for planning and meeting the requirement of water for domestic, industrial and irrigation use. The study has envisaged continuing role for other existing agencies in conveyance, treatment and distribution of water on the present lines. It has however emphasised the role of MWSSB in planning, investigation, design and construction of the water supply schemes for various local authorities in the Region. According to the study, the MWSSB will also continue to be responsible for transmission and treatment of water and its delivery upto the master balancing reservoir of the local authorities.

The suggested arrangement cannot be considered as a great improvement over the present set-up as it does not address some critical issues, such as, improving efficiency of water resource management and raising finances for resource development.

10.12.3 Alternatively, a Company could be formed to own and manage all water resources in the Region. The Company will arrange for the conveyance and treatment of water and sell bulk water to Local Authorities and other distributing agencies in the Region. The existing owners of the reservoirs, pipelines and treatment plants could sell their assets to the Company at the book value, and in return, obtain equivalent equity of the Company. Other non-asset holding Local Authorities and organisations, like, MMRDA and CIDCO, could also be allowed to buy the Company's equity. The sale proceeds of the bulk water will form the Company's main source of revenue which would be used to meet the O & M costs of the reservoirs, conveyance system and treatment plants, and raise resources from the market for new investments. The equity holding by the Local Authorities would ensure rational pricing for the bulk water and would help to remove eventually disparities in the tariff structure prevalent in different parts of the Region.

Since the proposed arrangement is radically different from the present one, the Government will have to take initiative by promoting the Company, perhaps as a joint venture with private promoters and private management. This will ensure greater operational efficiency and more critical planning for the management of water resources in the region.