Status of Sewage Treatment in India

Central Pollution Control Board

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FOREWORD

Pollution caused by sewage discharged from cities and towns is the primary cause for degradation of our water resources. A solution to this problem not only requires bridging the ever widening gap between sewage generation and treatment capacity (generation being 29000 million litre per day against the existing treatment capacity of 6000 million litre per day) but also calls for development of facilities to divert the treated sewage for use in irrigation to prevent nutrient pollution of water bodies, utilize the nutrient value of sewage in irrigation and bring down fresh water use in irrigation. The use of treated sewage in irrigation was emphasised in the Water (Prevention and Control of Pollution) Act 1974; however, by and large, the State Governments have failed to recognize its importance during the last 30 years. It is a matter of grave concern that due attention is not paid to operation and maintenance of existing sewage treatment facilities by State Governments and , as a result, 45 of the 115 sewage treatment plants studied recently by Central Pollution Control Board failed to achieve the prescribed discharge standards.

This reports analyzes and presents in detail the gap between sewage generation and treatment capacity, the technologies used for sewage treatment in India, performance of 115 sewage plants studied by Central Pollution Control Board with plant-specific technical remarks and also discusses the efficacies of various treatment technologies. We hope the information contained in the report would be useful to all concerned.

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CONTENTS

1. INTRODUCTION

1.1 The annual estimated precipitation, including snowfall, in India is 4000 billion cubic metres (bcm). The resources potential of the country in the form of annual natural run off in the rivers is about 1869 bcm, considering both surface and ground water as one system. However, owing mainly to uneven distribution of precipitation in time and space, the total water resources available for utilization, including ground water, is only about 1122 bcm.

1.2 The food requirement of the growing population will be about 450 million tons in 2050 as against the present highest food grain production of around 198 million tons. Two-third of this is obtained from irrigated food grain production areas. Thus, irrigation water requirements of the country are likely to exert tremendous pressure on our water resources in the future.

1.3 Power generation is another sector which exerts ever increasing pressure on our water resources as our major power plants are coal-based that consume significant quantity of water in their cooling systems. Our dependency on coal-based power plant will have to continue for long time. This entails an ever-increasing demand of water for power generation.

1.4 With the increasing population as well as all round development in the country, the competing demand for water for irrigation, domestic use and power generation sectors are exerting enormous pressure on our water resources as utilization of water has also been consequently increasing at a fast pace. In 1951, the actual utilization of surface and ground water was about 20% and 10%, respectively, of the utilizable potential. In 1997 - 1998, the utilization of surface and ground water increased to about 57.8% (329 bcm) and about 53.2% (230 bcm), respectively, of the utilizable potential. The precarious balance between growing demands and supplies brings forth the importance of recycling and reuse of water so that same water can be used for multiple uses one after the other thereby reducing demand for fresh supplies.

1.5 Disposal of about 29000 MLD domestic sewage from cities and towns is the biggest source of pollution of water bodies in India. A large number of rivers stretches are severely polluted as a result of discharge of domestic sewage. Treatment of domestic sewage and subsequent utilization of treated sewage for irrigation can prevent pollution of water bodies, reduce the demand for fresh water in irrigation sector and result in huge savings in terms of nutritional value of sewage in irrigation.

1.6 In spite of the urgencies of saving large number of river stretches from pollution and recycling treated sewage for reducing ever-increasing pressure on our water resources, sewage treatment and reuse remains a widely neglected field in our country. It is primary responsibility of state governments to establish sewage treatment and disposal facilities. Owing to the gross neglect of state governments in this area, Government of India took initiative and financed many sewage treatment plants in cities along bank of rivers under various river action plans. Whatever sewage treatment capacity exists in our country today were mostly created under schemes financed by Government of India. There still remains a large gap in sewage generation and sewage treatment capacity. This gap is widening because urban population is increasing at a fast rate and state governments continue their neglect towards this issue.

1.7 The existing sewage treatment plants, most of which have been established under schemes financed by Government of India are to be operated by respective state governments. It is observed that the neglect towards sewage pollution control is also reflected in the operation of these sewage treatment facilities as a large number of plants are found operating at sub optimal efficiency during their random inspections by Central Pollution Control Board.

1.8 This report compiles information on sewage generation and existing sewage treatment capacity in all Class I cities (having more than hundred thousand population) and Class II towns (having fifty to hundred thousand population), presents basic information on 269 existing and proposed sewage treatment plants and presents individual performance evaluation reports of about 115 sewage treatment plants studied by Central Pollution Control Board.

2. SEWAGE GENERATION AND EXISTING TREATMENT CAPACITY

2.1 In India, out of the total population of 1027 million in the year 2001, about 285 million live in urban areas. The percentage of urban population to the total population of the country, which in the year 1991 was 25.7 percent, stands at 27.8 percent in the year 2001. The percentage decadal growth of population in rural and urban areas during the decade 1991-2001 was 17.9 and 31.1 percent, respectively. Table A summarises the growth of urban population in the last 100 years.

Table A Rise in urban population since 1901

Year	Total	Rural	Urban	Urban, as % of total	Decadal % increase in urban population
1901	238,396,327	212,544,454	25,851,873	10.84	
1911	252,093,390	226,151,757	25,941,633	10.29	0.35
1921	251,321,213	223,235,043	28,086,170	11.18	8.3
1931	278,977,238	245,521,249	33,455,989	11.99	19.1
1941	318,660,580	274,507,283	44,153,297	13.86	32.0
1951	361,088,090	298,644,381	62,443,709	17.29	41.4
1961	439,234,771	360,298,168	78,936,603	17.97	26.4
1971	548,159,652	439,045,675	109,113,977	19.91	38.2
1981	683,329,097	523,866,550	159,462,547	23.34	46.1
1991	846,302,688	628,691,676	217,611,012	25.71	36.5
2001	1,027,015,247	741,660,293	285,354,954	27.78	31.1

Data source: 1991 Census of India

2.2 Problem of pollution of water bodies and that of ground water is more related to cities and towns and their surroundings as pollution caused by villages and very small towns is either assimilated by or has negligible effect on the surrounding environment. However, there is possibility of bacteriological impacts on smaller communities that come in direct contact of sewage. In India, cities having more than hundred thousand population are classified as Class I cities and towns having fifty to hundred thousand population as Class II towns. This report assesses pollution caused by sewage generated from these two classes of cities/towns. According to the Census figure of 2001, the number of class I cities is 414 and class II towns is around 489.

2.3 There are 211 sewage treatment plants (STPs) in 112 of the 414 Class I cities and 31 STPs in 22 of the 489 Class II towns. Besides, 27 STPs are in 26 other smaller towns. Of these, 186, 24 and 21 STPs are operational and 25, 7 and 6 are under construction in Class I cities, Class II towns and other smaller towns, respectively. Thus, in all there are 269 STPs, including 231 operational and 38 under construction. A state wise summary of sewage treatment plants (STPs) in various classes of cities is given in Annexure I -Table 1.

2.4 All Class I cities and Class II towns together generate an estimated 29129 MLD sewage. Against this, installed sewage treatment capacity is only 6190 MLD. There remains a gap of 22939 MLD between sewage generation and installed capacity. In percentage this gap is 78.7% of the sewage generation. Another 1743 MLD (equal to 6%) capacity is under planning or construction stage. If this is also added to existing capacity, we are left with a 21196 MLD (equal to 72.7% of the sewage generation) gap in sewage treatment capacity that has not even planned yet. Summary status of sewage generation and treatment capacity is given in Table B and detailes are given in Annexure I-Table 2 to 5.

Table B Sewage generation and treatment capacity in Class I cities and Class II towns (Sewage generation estimated on the basis of 2001 population)

City category & population	Number of cities	Sewage generation, MLD	Installed sewage treatment capacity, MLD	Capacity gap in cities having STPs, MLD (A)	Sewage generation in cities having no STPs, MLD (B)	Total capacity gap, MLD (A+B)	Planned treatment capacity, MLD
Class I cities having more than 10 lac population	39	13503	4472 (In 29 cities)	6135	2896	9031	1549
Class I cities having 5 to 10 lac population	32	3836	485 (In 13 cities)	1293	2058	3351	123
Class I cities having 2 to 5 lac population	119	4807	768 (In 34 cities)	804	3235	4039	4
Class I cities having 1 to 2 lac population	224	4018	322 (In 36 cities)	373	3323	3696	32.5
All the above Class I cities together	414	26164 (100%)	6047(23.1%) (In 112 cities)	8605 (32.9%)	11512 (44%)	20117 (76.9%)	1708.5 (6.5%)
Class II towns having 0.5 to 1 lac population	489	2965 (100%)	200 (>143*) (4.8%) (In 22 towns)	Nil	2822 (95.2%)	2822 (95.2%)	34.1 (1.15%)
All Class I cities and Class II towns	893	29129 (100%)	6190 (21.3%)	8605 (29.5%)	14334 (49.2%)	22939 (78.7%)	1742.6 (6.0%)

Figures arrived at using data provided in Annexure I Tables 2 to 5
*Estimated sewage of the cities having STPs

2.5 Estimation of sewage generation is primarily based on 2001 census population, the average water supply figures for respective states as given in CPCB's status reports on Class I cities (CUPS/44/1999-2000) and Class II towns CUPS/49/1999-2000) and assuming sewage to be 80% of the water supply. In few cases estimation is based on 2001 census population and the sewage generation factors wherever given in these two reports. Capacity of the STPs have been taken form "MIS Report of Programmes under NRCP-Volume-II, November, 2004" of Ministry of Environment & Forests, Govt. of India, as most of the STPs have been installed under various National River Action Plans of Govt. of India.

2.6 An estimated 14652 MLD sewage is generated from 112 Class I cities having STPs. The combined treatment capacity of the STPs in these Class I cities is 6047 MLD. Therefore, a capcity gap of 8605 MLD exists in 112 Class I cities having STPs.

2.7 An estimated 143 MLD sewage is generated from 22 Class II towns having STPs whereas the combined treatment capacity of the STPs in these 22 Class II towns is 234 MLD.

2.8 There remain 302 Class I cities and 467 Class II towns having no sewage treatment facilities. An estimated 11512 MLD sewage is generated from 302 Class I cities not having STPs and 2822 MLD sewage is generated from 467 Class II towns not having STPs.

2.9 State wise gap between sewage generation and treatment capacity for Class I cities and Class II towns are shown in Table C and Table D, respectively.

2.10 In case of Class I cities, Andhra Pradesh, Karnataka, Maharashtra, Rajasthan, Uttar Pradesh and West Bengal have a sewage treatment capacity gap of more than 1000 MLD each, and may be considered the most lagging states. Among these, abnormally high gap of 5223 MLD in Maharashtra is mainly attributed to inclusion of Mumbai where sewage is mostly discharged into sea untreated or after primary treatment. These states are followed by Bihar, Delhi, Gujrat, Madhya Pradesh, Punjab and Tamil Nadu that have sewage treatment capacity gaps in 500-1000 MLD range.

2.11 In case of Class II towns, Andhra Pradesh, Bihar, Gujrat, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal have a sewage treatment capacity gap of more than 100 MLD each, and may be considered the most lagging states. Incidentally, except for Jharkhand, these are the same states that have sewage treatment capacity gap of more than 500 MLD each in case of Class I cities.

Table C State wise gap in sewage generation and installed treatment capacity in Class I cities (Sewage generation estimated on the basis of 2001 population)

State	Number of cities	Estimated Sewage generation, MLD	Installed sewage treatment capacity, MLD	Capacity gap in cities having STPs, MLD (A)	Sewage generation in cities having no STPs, MLD (B)	Total capacity gap, MLD (A+B)	Planned sewage treatment capacity, MLD
Andaman & Nicobar Islands	1	11.2			11.2	11.2	
Andhra Pradesh	46	1245.5	62.0 (In 9 cities)	515.4	668.1	1183.5	592.0
Arunachal Pradesh	0						
Assam	4	295.1			295.1	295.1	
Bihar	19	863.5	135.5 (In 4 cities)	241.6	486.4	728.0	
Chandigarh	1	349.4	142.1 (In 1 city)	207.3		207.3	22.7
Chhattisgarh	7	310.1	69.0 (In 1 city)	46.2	194.9	241.1	
Dadra & Nagar Haveli	0						
Daman & Diu	0						
Delhi	1	2947.8	2330.3 (In 1 city)	617.6		617.6	
Goa	0						
Gujrat	23	1780.8	783.0 (In 5 cities)	571.9	425.9	997.8	
Haryana	20	440.4	>240.1 (In 7 cities)	Nil	200.3	200.3	
Himachal Pradesh	1	25.2	>25.162 (In 1 city)	Nil		0.0	
Jammu & Kashmir	2	142.6			142.6	142.6	
Jharkhand	7	438.5			438.5	438.5	
Karnataka	28	1455.6	43.4 (In 11 cities)	872.8	539.3	1412.2	
Kerala	7	418.4	**?** (In 1 city)	82.9	335.5	418.4	
Lakshadeep	0						
Madhya Pradesh	23	1089.7	168.1 (In 7 cities)	517.6	404.0	921.6	18.0
Maharashtra	40	5644.5	421.8 (In 19 cities)	2166.9	3055.8	5222.7	
Manipur	1	23.2			23.2	23.2	
Meghalaya	1	14.9			14.9	14.9	
Mizoram	1	25.7			25.7	25.7	
Nagaland	1	12.0			12.0	12.0	
Orissa	8	500.2	53.3 (In 3 cities)	264.4	182.5	446.9	
Pondicherry	2	49.1			49.1	49.1	
Punjab	13	677.5	**?** (In 2 cities)	308.2	369.3	677.5	411.0
Rajasthan	17	1173.3	27.0 (In 1 city)	340.2	806.1	1146.3	27.0
Sikkim	0						
Tamil Nadu	26	968.7	163.4 (In 6 cities)	348.1	457.2	805.3	170.0
Tripura	1	21.2			21.2	21.2	
Uttar Pradesh	52	2879.3	795.1 (In 14 cities)	874.4	1209.9	2084.3	445.0
Uttaranchal	3	118.7	18.0 (In 1 city)	21.6	79.1	100.7	
West Bengal	58	2241.5	487.6 (In 18 cities)	690.0	1063.9	1754.0	22.8
TOTAL	**414**	**26164**	**6047 (In 112 cities)**	**8605**	**11512**	**20117**	**1708.5**

Figures arrived at using data provided in Tables 2, 3, 5 & 6 (Annexure I)

Table D State wise gap in sewage generation and installed treatment capacity in Class II towns (sewage generation estimated on the basis of 2001 population)

State	Number of cities	Estimated Sewage generation, MLD	Installed sewage treatment capacity, MLD*	Capacity gap in cities having STPs, MLD (A)	Sewage generation in cities having no STPs, MLD (B)	Total capacity gap, MLD(A+B)	Planned sewage treatment capacity, MLD
Andaman & Nicobar Islands	0						
Andhra Pradesh	52	177.001	10.42 (>3.441) (In 1 city)	Nil	173.560	173.560	
Arunachal Pradesh	0						
Assam	9	73.411			73.411	73.411	
Bihar	18	124.984	2.0 (In 1 city)	5.6	117.350	122.984	
Chandigarh	0						
Chhattisgarh	7	37.469			37.469	37.469	
Dadra & Nagar Haveli	0						
Daman & Diu	0						
Delhi	0						
Goa	3	18.741	18.18 (>4.703) (In 1 city)	Nil	14.038	14.038	
Gujrat	36	286.777			286.777	286.777	
Haryana	7	30.053			30.053	30.053	
Himachal Pradesh	0						
Jammu & Kashmir	4	26.640			26.640	26.640	
Jharkhand	17	123.313			123.313	123.313	
Karnataka	30	186.478	12.18 (>11.984) (In 2 cities)	Nil	174.494	174.494	
Kerala	24	209.021			209.021	209.021	
Lakshadeep	0						
Madhya Pradesh	25	154.387	9 (>6.95) (In 1 city)	Nil	147.437	147.437	
Maharashtra	44	238.954	29(>9.807) (In 2 cities)	2.9	229.002	233.002	
Manipur	0						
Meghalaya	1	6.540			6.540	6.540	
Mizoram	0						
Nagaland	1	8.801			8.801	8.801	
Orissa	15	97.875			97.875	97.875	
Pondicherry	1	8.325			8.325	8.325	
Punjab	20	208.252	19.3(>12.654) (In 1city)	Nil	188.952	188.952	23.500
Rajasthan	28	139.197			139.197	139.197	
Sikkim	0						
Tamil Nadu	57	202.879	29.3(>10.795) (In 3 cities)	Nil	192.084	192.084	
Tripura	0						
Uttar Pradesh	57	379.100	4.5 (In 2 cities)	0.9	373.728	374.600	8.110
Uttaranchal	4	39.617	6.3 (In 1 city)	4.4	28.876	33.287	
West Bengal	29	160.656	59.4(>24.556) (In 6 cities)		134.938	136.100	2.480
TOTAL	**489**	**2965**	**200(>143*) (In 22 cities)**	**14****	**2822**	**2836**	**34.1**

Figures arrived at using data provided in Tables 2, 3, 5 & 6 (Annexure I)

*Figures within parenthesis show estimated sewage of the concerned cities

** Gap pertains to few towns even though the combined capacity exceeds estimated sewage generation in the 21 towns

3. TREATMENT TECHNOLOGIES IN VARIOUS SEWAGE TREATMENT PLANTS

3.1 Technologies employed in various sewage treatment plants are mentioned in the lists of STPs in Table 2 and Table 3 of Annexure I. Based on the information available, an analysis of various treatment technologies employed in different sewage treatment plants is presented in Table E and Table F for Class I cities and Class II towns, respectively.

3.2 In Class I cities, Activated sludge process (ASP) is the most commonly employed technology, covering 59.5% of total installed capacity followed by Up flow Anaerobic Sludge Blanket (UASB) technology, covering 26% of total installed capacity. These two technologies are mostly used as the main treatment unit of a scheme including other primary or tertiary treatment units. A break up of various treatment schemes involving ASP or UASB as one of the units is also given in the tables. Series of Waste Stabilization Ponds (WSP) technology is also important as it is employed in 28% of the plants even though its combined capacity is only 5.6%.

3.3 In Class II towns, series of Waste Stabilization Ponds (WSP) technology is the most commonly employed technologies, covering 71.9% of total installed capacity and 72.4% of STPs, followed by Up flow Anaerobic Sludge Blanket (UASB) technology, covering 10.6% of total installed capacity and 10.3% of STPs. UASB technology is mostly used as the main treatment unit of a scheme including other primary and tertiary polishing units.

3.4 Activated sludge process (ASP) technology is the most suitable one for large cities because it requires less space as compared to other two technologies, namely, UASB technology and WSP technology, as both these technologies employ land intensive ponds in treatment schemes. In treatment schemes based on conventional version of ASP technology, both primary and secondary sludges are commonly treated in anaerobic sludge reactors. Thus, only excess sludge of anaerobic reactor to be wasted to sludge beds. This reduces the required area of sludge beds and also substantially reduces aeration cost of that organic portion of primary and secondary sludge that is treated anaerobically as compared to the Extended-Aeration version of ASP technology where primary settling tank and anaerobic sludge digester are generally omitted from treated scheme and whole secondary excess sludge is directly taken on to sludge beds. Biogas generated in anaerobic reactors is a resource and, if utilized, further reduces overall operational cost. However, compared to conventional ASP process, Extended-Aeration ASP process is expected to provide a better quality effluent because the process is operated in a substrate-limited condition and also because of better settling properties of mixed liquor. The secondary excess sludge is also well stabilized and has better drainability. Since, treatment scheme based on conventional

ASP process and anaerobic digester for primary and secondary sludge have proven successful in providing good quality effluent and possible energy recovery, there seems no wisdom in opting for operationally costly Extended Aeration version for such large installations.

3.5 Most of the treatment schemes using UASB technology include grit chamber as preliminary treatment unit and one-day retention time pond as the terminal polishing unit. Operationaly, this treatment scheme is one of the most economical ones, as it merely requires passing the sewage through treatment scheme, with an added advantage of biogas generation. Ideally, this makes UASB technology as the most suited for cities of all sizes. However, all anaerobic treatment processes including UASB technology are very sensitive to environmental changes. Intermittent feeding can greatly affect the performance of a UASB reactor, as the anaerobic bacteria are very sensitive to shock loading. This happens frequently at most of the places due to power cuts. Performance of polishing ponds, which is the terminal unit of the scheme, is also very crucial in deciding overall performance of the plant. Many polishing ponds have been found releasing TSS higher than an expected value of <30 mg/L due to reasons discussed in next chapter. The combined effect of above factors often results in a final effluent having BOD >20 or 30 mg/L. Inadequate operation of the plants based UASB+Polishing Pond technology is gradually leading to development of a bad impression about the technology itself, which otherwise is the most suitable option for sewage treatment in our country.

3.6 Inclusion of polishing pond in most of the scheme employing UASB technology has made this a less suitable scheme for large cities due to land scarcity. Alternative treatment schemes having UASB as one treatment unit have been adopted at two places. An 86 MLD STP has been set up at Ataldhara, Vadodara, Gujrat where UASB is the primary treatment unit of the scheme followed by an ASP unit. Another 126 MLD STP has been set up at Vasna, Ahmedabad, Gujrat where UASB is main treatment unit followed by coagulant-aided tertiary sedimentation. This plant has been found reducing BOD, COD and TSS from 155, 753 and 218 mg/L to 49, 149 and 38 mg/L, respectively. This STP needs to be studied in detail to assess the optimal efficiency of the treatment scheme in reducing BOD, COD, TSS and Fecal & Total Coliform and its suitability for large cities.

3.7 It is observed that higher percentage of inert suspended solids that enter UASB has a direct impact on steady state VSS to TSS ratio in the reactor and ash content to the tune of 60% are common in UASB reactor. This leaves us with only about 40% active biomass that actually plays role in treatment of incoming organic matter. Such a low VSS/TSS ratio may not have been considered while deciding the normally encountered 8 hr hydraulic retention time for UASB reactors. Therefore, proper operation of grit removal facility is very important to improve performance of UASB reactors. It may also be studied if higher hydraulic retention time of UASB reactors can compensate for this situation. Higher hydraulic retention time will also provide large settling area in UASB reactor that will result in more clarified effluent. A treatment scheme including screening, grit removal, UASB reactor with higher hydraulic retention time and coagulant aided tertiary sedimentation, if proven successful, may provide an excelent solution for sewage treatment in cities, both operational cost wise and for improving bacterial quality also.

3.8 Series of Waste Stabilization Ponds (WSP) technology is also one of the most economical ones operationally, as it merely requires passing the sewage through treatment scheme. However, unlike UASB technology, no resource in the form of biogas is recovered. The advantages of WSP technology over UASB technology are its less sensitive operation and greater improvement in bacteriological quality. Mostly employed configuration of WSP technology uses two parallel streams of at least three stages of ponds, the first stage being anaerobic ponds, the second stage being facultative pond and the third stage being maturation pond. Total hydraulic retention time of all ponds is normally kept 5 to 7 days. At few places two-stage or even single-stage oxidation ponds have also been used. At few other places series of ponds have been used with final ponds used as fishponds, which helps improve the quality of treated sewage in terms of nutrients also.

Table E Sewage treatment technologies employed in STPs of Class I cities

S. No.	Technology	No. of plants	% age as number	Combined capacity, MLD	%age as capacity	Average size, MLD
1	Activated sludge process (ASP)					
	...PST+ASP	*42*	*28.0*	*3059.63*	*52.6*	*72.8*
	…ASP-Ext. Aer.	*3*	*2.0*	*63.36*	*1.1*	*21.1*
	…ASP-Ext. Aer.+ Ter. Sed.	*7*	*4.7*	*58.04*	*1.0*	*8.3*
	...High rate ASP+Biofilter	*1*	*0.7*	*181.84*	*3.1*	*181.8*
	…Aerated lagoon+fish pond	*3*	*2.0*	*49.50*	*0.9*	*16.5*
	…Facultative lagoon + ASP	*1*	*0.7*	*44.50*	*0.8*	*44.5*
	ASP (sum of all the above processes)	57	38.0	3456.87	59.5	60.6
2	Fluidized aerobic bio-reactor (attached growth)	5	3.3	66.00	1.1	13.2
3	Trickling Filters or Biofilters	6	4.0	192.62	3.3	32.1
4	UASB+Activated sludge process	1	0.7	86.00	1.5	86.0
5	UASB					
	…Grit channel or PST+UASB+PP	*24*	*16.0*	*1229.73*	*21.2*	*51.2*
	…UASB+Sedimentation	*1*	*0.7*	*126.00*	*2.2*	*126.0*
	…Grit channel or PST+UASB	*5*	*3.3*	*158.17*	*2.7*	*31.6*
	UASB (sum of all the above processes)	30	20.0	1513.90	26.0	*50.5*
6	Waste Stabilization Ponds	42	28.0	327.53	5.6	*7.8*
7	Oxidation Pond (single stage)	3	2.0	69.00	1.2	*23.0*
8	Anaerobic digester + Trickling filter	1	0.7	4.45	0.1	*4.5*
9	Karnal Technology (for plantation)	2	1.3	12.46	0.2	*6.2*
10	Only primary treatment	3	2.0	84.00	1.4	*28.0*
	Total	150 (100%)		5812.83 (100%)		

Table F Sewage treatment technologies employed in STPs of Class II towns

S. No.	Technology	No. of plants	% age as number	Combined capacity, MLD	%age as capacity	Average size, MLD
1	ASP (preceded by primary sedimentation)	1	3.4	12.5	5.6	12.5
2	Grit channel or PST+UASB+PP	3	10.3	23.83	10.6	7.9
3	Waste Stabilization Ponds	21	72.4	161.26	71.9	7.7
4	Trickling Filters	2	6.9	16.68	7.4	8.3
5	Karnal Technology (for plantation)	2	6.9	10.13	4.5	5.1
	Total	29 (100%)		224.4 (100%)		

4. PERFORMANCE EVALUATION OF SEWAGE TREATMENT PLANTS

4.1 Central Pollution Control Board has conducted performance evaluation of 115 sewage treatment plants. Based on these studies, operational performance of individual STPs along with technical remarks are presented in Annexure II.

4.2 Based on the performance evaluation studies carried out by Central Pollution Control Board, a state wise summary of performance status of STPs is given in Table G.

Table G State wise summary of performance status of STPs

State	STPs studied by CPCB	STPs that achieved general standards for discharge in surface waters*	STPs did not achieve general standards
Bihar	3	3	0
Chandigarh	2	1	1
Chhattisgarh	3	2	1
Delhi	26	20	6
Gujrat	9	6	3
Haryana	7	2	5
Himachal Pradesh	5	5	0
Karnataka	4	2	2
Madhya Pradesh	2	1	1
Maharashtra	4	0	4
Punjab	4	4	0
Rajasthan	1	0	1
Uttar Pradesh	25	8	17
Uttaranchal	2	1	1
West Bengal	18	15	3
TOTAL	**115**	**70**	**45**

*BOD: 30 mg/L; TSS: 100 mg/L and COD: 250 mg/L

4.3 Based on the analysis of 106 raw sewage samples, average sewage characterstics in terms of main parameters BOD, COD and TSS have been found 185.5 mg/L, 481 mg/L and 328 mg/L, respectively. Average COD to average BOD ratio is 2.6. A more detailed analysis of these results is presented in Table H.

Table H Raw sewage characteristics in 115 STPs studied by CPCB

BOD, mg/L		**COD, mg/L**		**TSS, mg/L**	
Range	No. of samples in the range	Range	No. of samples in the range	Range	No. of samples in the range
0-50	7	0-100	3	0-100	11
50-100	28	100-200	14	100-200	33
100-150	20	200-300	12	200-300	23
150-200	22	300-400	19	300-400	12
200-250	15	400-500	16	400-500	12
250-300	4	500-600	15	500-600	6
300-500	5	600-700	12	600-700	3
500-1000	6	700-800	9	700-1000	4
		800-1200	5	900-1200	1
		>2000	1	2000-2300	2
Average: 185.5 and SD: 175		**Average: 481 and SD: 343**		**Average: 328 and SD: 329**	

4.4 It is seen that BOD of raw sewage lies between 50-250 mg/L in nearly eighty six percent observations, COD of raw sewage lies between 100-700 mg/L in nearly eighty three percent observations and TSS of raw sewage lies between 100-500 mg/L in nearly eighty five percent observations.

4.5 Of the 115 STPs studied, capacity utilization has been reported in 80 cases. It is observed that average capacity utilization is only 72.2 %.

4.6 In 47 STPs employing Activated Sludge Process and having secondary clarifier as the terminal treatment unit, TSS has been found less than 30 mg/L in 26 cases, 30-50 mg/L in 6 cases and >50 mg/L in 15 cases. Thus, it is possible to achieve TSS value less than 30 mg/L in final clarified effluent of biological processes.

4.7 In 47 STPs employing Activated Sludge Process with no tertiary treatment, BOD has been found less than 20 mg/L in 28 cases, 20-30 mg/L in 7 cases, 30-50 mg/L in 7 cases and 50-100 mg/L in 5 cases. In most of the cases where BOD exceeded 20 mg/L, TSS also exceeded 30 mg/L. From this and the observation given in section 4.6, it can be inferred that Primary Settling + Activated Sludge (PST+ASP) technology can provide treated effluent having BOD<20 mg/L and TSS< 30 mg/L

4.8 In 41 STPs employing Up flow Anaerobic Sludge Blanket (UASB) technology or Waste Stabilization Pond (WSP) technology and having ponds as the terminal treatment units, TSS has been found less than 30 mg/L in 9 cases, 30-50 mg/L in 11 cases, 50-100 mg/L in 13 cases and >100 mg/L in 8 cases. This indicates that in spite of a larger settling area available in ponds as compared to secondary clarifiers, fewer percentage of ponds are able to provide effluent having TSS less than 30 mg/L. Most obvious reasons behind this discrepancy appear to be excessive algal growth due to stagnation and high weir loading. Efficiency of ponds in terms of effluent TSS can be improved by preventing excessive algal growth, which generally occur when effluent remain stagnant in ponds, and providing adequate effluent structures with sufficient weir length and baffle preceding the effluent weir to arrest floating matter. With these precautions/ improvements, ponds are also expected to provide effluent having TSS <30 mg/L.

4.9 In 18 STPs employing UASB+Polishing Pond technology, BOD has been found less than 20 mg/L in 3 cases, 20-30 mg/L in 3 cases, 30-50 mg/L in 7 cases, 50-100 mg/L in 3 cases and >100 mg/L in 2 cases. In most of the cases where BOD exceeded 20 mg/L, TSS also exceeded 30 mg/L.

4.10 In 23 STPs employing series of Waste Stabilization Pond technology, BOD has been found less than 20 mg/L in 12cases, 20-30 mg/L in 2 cases, 30-50 mg/L in 6 cases, 50-100 mg/L in 2 cases and >100 mg/L in 1 case. In most of the cases where BOD exceeded 20-mg/L limit, TSS also exceeded 30-mg/L limit.

4.11 Importance of preventing excessive algal growth in ponds and improvement in outlet structures of ponds has been emphasised in section 4.8, 4.9 and 4.10 above. Cleaning of accumulated sludge from ponds after recommended 6 month / 1 year period is the other most important factor in operation of STPs based on Up flow Anaerobic Sludge Blanket (UASB) technology having ponds as the terminal treatment units or series of Waste Stabilization Pond (WSP) technology. Other important factors for improving overall efficiency of the UASB reactors are:

i) Uniform and continuous feeding of raw sewage
ii) Maintaining recommended VSS concentration in UASB reactor
iii) Proper removal of grit and wasting excess sludge from suitable pockets/levels of reactor to maintain good VSS/TSS ratio

4.12 Most of the of STPs in India employ any one of the three technologies, namely, Primary settling followed by Activated Sludge Process (PST+ASP), Up flow Anaerobic Sludge Blanket + Polishing Pond (UASB+PP) and series of Waste Stabilization Pond (WSP). The first technology has been found capable of providing final effluent having BOD<20 mg/L and TSS< 30 mg/L. The other two technologies are also expected to provide final effluent of this quality provided the STPs based on these technologies are operated properly. This standard is already made applicable to STPs in Delhi. An effluent conforming to this quality in terms of BOD and TSS will also easily conform to COD value<100 mg/L, as the average COD/BOD ratio of 115 treated sewage samples is found 3.3 . Gujrat State Pollution Control Board has already stipulated 20 mg/L, 100 mg/L and 30 mg/L limits for BOD, COD and TSS, respectively for treated sewage quality.

5. EFFICACY OF STPs IN IMPROVING BACTERIOLOGICAL QUALITY

5.1 Central Pollution Control Board analyzed in 2004 performance data of a large number of STPs employing different technologies for assessing their efficacy in improving bacterial quality so as to determine norms for permissible coliform level in treated sewage in Delhi and the process required for achieving the same keeping in view techno-economic feasibility. A large data comprising of 319 observations on 85 STPs was collected for the purpose but only those 44 observations were considered for evaluation of performance of STPs in terms of coliform reduction where STPs were found operating between 90% to 110% capacity utilization.

5.2 Analyzed data indicated that Fecal Coliforms levels in sewage treated with Oxidation Pond technology were 7×10^4, 3.1×10^5, 5×10^5 and 2.3×10^6. Geometric mean of these 4 values is 3.97×10^5 .

FC levels in sewage treated with UASB + Polishing Pond technology were 4.9×10^4, 2×10^5, 2.8×10^5, 3.5×10^5, 4.2×10^5, 6×10^5, 7×10^5, 2.1×10^6, 3.6×10^6, 4×10^6, 1.9×10^7, 1.98×10^7 and 6.3×10^7. Geometric mean of these 13 values is 1.45×10^6

FC levels in sewage treated with ASP technology were 1.1×10^5, 7.1×10^5, 1×10^6, 1×10^6, 1×10^6, 1.3×10^6, 2.9×10^6, 3×10^6, 7.2×10^6, 1.1×10^7, 2.2×10^7 and 2.5×10^7 . Geometric mean of these 12 values is 2.41×10^6 .

And FC levels in sewage treated with two stage bio-filtration technology followed by UV disinfection were 180, 1080, 2.17×10^4, 2.06×10^5, 7×10^5, 1.1×10^6, 5.9×10^6 2.1×10^7 and 2.9×10^7. Geometric mean of these 9 values is 2.375×10^5 .Frequent disfunctioning of UV unit in the STPs employing this technology was the reason behind the observed high levels of Fecal Coliforms.

5.3 It was found that Waste Stabilization Pond (WSP) and UASB+Polishing Ponds technologies provided fecal coliform reduction to a level of >99%. From field studies it is observed that there is further scope of increasing of coliform removal efficiency in the Waste Stabilization Pond (WSP) and UASB+Polishing Ponds technologies by way of improved outlet structures and modifications in flow regimes of Polishing Ponds. Efficiency of ponds in terms of effluent TSS and, as a result, effluent coliform can be improved by providing adequate effluent structures with sufficient weir length and baffle preceding the effluent weir to arrest floating matter.

5.4 CPCB observed that less than 50% of the entire sewage of Delhi is being collected and treated. Therefore to achieve the maximum removal of pollution load with the funds available, it was recommended to make arrangements for treatment of the entire sewage up to secondary level to achieve BOD<20 mg/l and SS<30 mg/l on priority basis rather than treating part of sewage to tertiary level to achieve BOD,10 mg/L, TSS<15 mg/L and FC<2500 MPN/100 ml while leaving significant part of sewage untreated. Afterwards, when secondary treatment facility for at least 90 % of sewage is installed, all STPs need to be augmented with tertiary treatment facilities for removal of FC to a standard 2500 MPN/100 ml so that the main objective of maintaining quality of Yamuna River may be fulfilled. A similar approach needs to be adopted at other places also.

5.5 It was also recommended to utilize treated sewage, as much as possible, for irrigation of trees or crops not eaten raw, for which no FC limit is prescribed as treatment of entire sewage to the required FC level of 2500 MPN/100 ml will be very expensive.

5.6 CPCB has also proposed to carry out experimental studies on treated sewage in Delhi to investigate effectiveness of following suggested tertiary treatment technologies required for augmentation of STPs based on ASP and Trickling Filter (TF) technologies to achieve the suggested FC standards of 2500 MPN/100ml for discharge into Yamuna or for utilization sports fields and public park.

A: Chemicals aided flocculation and tertiary sedimentation
B: Chemicals aided flocculation and tertiary sedimentation +
Granular media (Sand) filtration
C: Chemicals aided flocculation and tertiary sedimentation +
Chlorination
D: Chemicals aided flocculation and tertiary sedimentation +
Granular media (Sand) filtration + Chlorination

6. RECOMMENDATIONS

6.1 The estimated sewage generation from Class I cities and Class II towns (as per 2001 census) is 29129 MLD, which is expected to be 33212 MLD at present assuming 30% decadal growth in urban population. Against this, there exist STPs having 6190 MLD capacity while another 1743 MLD capacity is being added. Thus, the existing treatment capacity is just 18.6 % of present sewage generation and another 5.2 % capacity is being added. However, the actual capacity utilization of STPs is only 72.2% and as such only 13.5 % of the sewage is treated. This clearly indicates dismal position of sewage treatment, which is the main cause of pollution of rivers and lakes. To improve the water quality of rivers and lakes, there is an urgent need to increase sewage treatment capacity and its optimum utilization.

6.2 State Governments should realize the problem of pollution of water bodies and pay attention to their liability to set up sewage treatment plants in cities and towns to prevent this pollution. This activity requires to be recognized as one of the most important indicators of overall development of the States. If not realized urgently, this problem is fast going to magnify to an unmanageable level.

6.3 Utilization of conventionally treated sewage for irrigation of crops not eaten raw is also equally important i) to save fresh water considering our diminishing water resources, ii) to prevent nutrient pollution of our water bodies and iii) to utilize nutrient value of sewage in irrigation. Importance of utilization of treated sewage in irrigation was emphasized in Water (Prevention and Control of Pollution) Act 1974, i.e. more than thirty years back but this issue continues to be largely neglected by State Governments. Therefore, State Governments are required to take up sewage diversion and utilization schemes as an integral part of all sewage treatment schemes. Sewage diversion schemes should adopt at least 25-30 years plan period for design.

6.4 Considering the widening gap between sewage generation and treatment capacity, state governments are required to prepare a very thoughtful action plan to fill this gap in a minimum time frame. Large cities where pollution problem is more severe, cities/towns responsible for pollution of critically polluted stretches of rivers, and cities/towns polluting environmentally sensitive water bodies will be required to be taken up on priority basis in first phase. Continuous upgrading of capacity with rise in population in cities/town taken in first phase will also be required along with implementation of next phases.

6.5 Treatment schemes based on primary sedimentaion followed by activated-sludge-process with anaerobic sludge digester and sludge drying beds for anaerobic sludge is quit suitable scheme for large cities where land availability is a problem. However, the plant at Vasna, Ahmedabad based on anaerobic-sludge-blanket reactor followed by coagulant aided tertiary sedimentation needs to be studied in detail for assessing its optimal efficiency, as this scheme also require less land and may be suitable for large cities. This scheme is most likely to be operationally economical as compared to the scheme based on activated-sludge-process in vogue. Moreover, better bacteriological quality may be achieved with the help of coagulants in tertiary sedimentation.

6.6 Operation and maintenance of existing plants and sewage pumping stations is also a very neglected field, as nearly 39% plants are not conforming to the general standards prescribed under the Environmental (Protection) Rules for discharge into streams. STPs are usually run by personals that do not have adequate knowledge of running the STPs and know only operation of pumps and motors. The operational parameters are not regularly analyzed hence the day-to-day variation in performance is not evaluated at most of the STPs. Thus, there is a need that persons having adequate knowledge and trained to operate the STPs be engaged to manage STPs and an expert be engaged to visit the STPs at least once a month and advice for improvement of its performance. In a number of cities, the existing treatment capcity remains underutilized while a lot of sewage is discharged without treatment in the same city. Auxiliary power back-up facility is required at all the intermediate (IPS) & main pumping stations (MPS) of all the STPs.

6.7 In treatment schemes employing activated-sludge-process, plant operators must recognize the importance of using Solids Retention Time (SRT) as a plant control parameter because treatment efficiency, sludge production, oxygen requirements and nutrients requirements are all dependent on SRT. Moreover, SRT being the ratio of total suspended solids in the system and that wasted per day, it is most simple to operate plants on the basis of SRT. Operation of a conventional activated-sludge-process near 5 day SRT is recommended, as it will provide sufficient safety factor. If a plant based on conventional activated-sludge-process receives low strength sewage than it was designed for, then operator has a choice to either operate the plant at higher than 5 day SRT, or he may opt for energy saving by operating fewer aeraters provided mixing requirements of the plant are still fulfilled. But all this maneouring requires a basic knowledge of intricacies of aerobic biological treatment, which an operator must be equipped with. It is also necessary to recognize the importance of return flow and waste sludge flow measurement, in addition to influent flow measurement, as without this it is difficult to have proper control on plant operation and it is not possible to use SRT as a plant control parameter.

6.8 Treatment schemes based on grit removal followed by up-flow-anaerobic-sludge-blanket reactor followed by polishing pond is a siuitable technology for all medium and small size cities/towns where required land can be made available. The operation of these plants is somewhat sensitive. Continuous uniform feeding to the plant, proper removal of grit, maintainence of design VSS concentration and VSS/TSS ratio in UASB reactor, cleaning accumulated sludge from polishing pond after a year time, avoiding stagnation of water in ponds to prevent excessive algal growth and providing proper wier length and baffle in the outlet structure of polishing pond, are the most important factors for successful operation of such plants therefore these factors must not be ignored. Biogas generated in reactors must be utilized; if arrangements for utilization of biogas are not available they must be installed immediately.

6.9 Treatment scheme based on series of Waste Stabilization Ponds (WSP) technology is quit rugged, one of the most economical ones and suitable for small towns where sufficient land is easily available. Multiple stage ponds (at least three) with first pond as anaerobic one is the most widely used and suitable configuration. Continuous uniform feeding to the plant, cleaning accumulated sludge from ponds after suitable intervals (prefrebly less than 6 month for primary anaerobic pond and once a year for subsequent ponds), avoiding stagnation of water in ponds to prevent excessive algal growth, providing proper wier length and baffle in the outlet structure of pond and not allowing hycinth growth are the most important factors for successful operation of such plants therefore these factors must not be ignored.

6.10 As mentioned in section 6.2 and 6.3 above, the first emphasis should be given to development of 100% treatment capacity upto secondary level of treatment and diversion of treated sewage for its utilization in irrigation of crops not eaten raw. Improvement in bacterial quality of remaining sewage to be used for irrigation of sports fields and public parks or that has to be discharge into water bodies due to unavoidable circumstances is the next area of concern. This will require augmentation of treatment plants with tertiary treatment units, such as coagulent-aided tertiary sedimentation and chlorination etc.

6.11 Six STPs in Shimla and one STP in Chandigarh have tertiary sedimentation unit after activated sludge process. These plants need to be studied in detail with different combinations of lime and alum dozing and also with additional chlorine dozing to assess efficacy of this scheme in providing coliform reduction to the desired FC level of 2500 MPN/100 mL for utilization of treated sewage in sports field and public parks or where sewage has to discharged in streams providing negligible/insufficient dilution.

6.12 Considering the urgency of preventing pollution of our water bodies and preserving our precious water resources, sewage treatment and reutilization of treated sewage need to be accorded higher priority.

ANNEXURE I

Table 1 State wise summary of STPs in Class-I cities and Class-II towns

State	Class-I cities			Class-II cities			Smaller towns having STPs	
	Total no. of cities	Cities having STPs	No. of STPs	Total no. of towns	Towns having STPs	No. of STPs	Towns having STPs	No. of STPs
Andaman & Nicobar Islands	1	0	0	0	0	0		
Andhra Pradesh	46	9	15	52	1	2	1	1
Arunachal Pradesh	0	0	0	0	0	0		
Assam	4	0	0	9	0	0		
Bihar	19	4	7	18	1	1		
Chandigarh	1	1	4	0	0	0		
Chhattisgarh	7	1	3	7	0	0		
Dadra & Nagar Haveli	0	0	0	0	0	0		
Daman & Diu	0	0	0	0	0	0		
Delhi	1	1	30	0	0	0		
Goa	0	0	0	3	1	2		
Gujrat	23	5	10	36	0	0		
Haryana	20	7	12	7	0	0	5	5
Himachal Pradesh	1	1	6	0	0	0		
Jammu & Kashmir	2	0	0	4	0	0		
Jharkhand	7	0	0	17	0	0		
Karnataka	28	11	14	30	2	2	3	3
Kerala	7	1	1	24	0	0	1	1
Lakshadeep	0	0	0	0	0	0		
Madhya Pradesh	23	7	12	25	1	1	2	2
Maharashtra	40	19	21	44	2	2	1	1
Manipur	1	0	0	0	0	0		
Meghalaya	1	0	0	1	0	0		
Mizoram	1	0	0	0	0	0		
Nagaland	1	0	0	1	0	0		
Orissa	8	3	3	15	0	0	1	1
Pondicherry	2	0	0	1	0	0		
Punjab	13	2	4	20	2	3	4	4
Rajasthan	17	1	2	28	0	0		
Sikkim	0	0	0	0	0	0		
Tamil Nadu	26	6	10	57	3	3	1	1
Tripura	1	0	0	0	0	0		
Uttar Pradesh	52	14	28	57	2	5	2	2
Uttaranchal	3	1	1	4	1	2	2	3
West Bengal	58	18	28	29	6	8	3	3
TOTAL	**414**	**112**	**211**	**489**	**22**	**31**	**26**	**27**

Remarks: Figures arrived at from Census2001data, MIS-Nov04 report and 1995 Class-I cities questionaire survey

Table 2 Sewage generation and treatment capacity in Class I cities having STPs

S.N.	City/Town and STP	Population, 2001	Sewage generation factor*	Sewage generation, MLD	Capacity of STP, MLD**	Year of STP's comm.	Technology of STP	Treated sewage disposal***	River basin
	Andhra Pradesh								
	City-20+								
1	Hyderabad M.Corp	3449878	*87*	300.139				Musi River	Krishna
	…I				**339.00**	**2007**			
	…II				**172.00**	**2007**			
	…III				**21.00**	**2007**			
	…IV				**30.00**	**2007**			
	…V				**30.00**	**2007**			
2	Vijayawada	**825436**	101	83.369		Pre-95		Krishna River	Krishna
	City-5+								
3	Guntur	514707	124	63.824		Pre-95		Krishna River	Krishna
	City-2+								
4	Nellore	378947	*87*	32.968		Pre-95		Pennar River	Pennar
5	Rajahmundry	313347	*87*	27.261	30.04	2004		Godavari River	Godavari
6	Ramagundam	235540	*87*	20.492				Godavari River	Godavari
	…I				14.00	2003	WSP		
	…II				4.00	2003	WSP		
	…III				14.00	2004	WSP		
7	Tirupati	227657	*87*	19.806		Pre-95		Kalyani River	NMB
	City-1+								
8	Eluru	189772	*87*	16.510		Pre-95		Godavari delta	NMB
9	Tenali	149839	*87*	13.036		Pre-95		Krishna delta	NMB
	Bihar								
	City-10+								
10	Patna	1376950	*181*	249.228				Punpun, Ganga	Ganga
	…I Kermallichak				4.00	1988	WSP		
	…II Saidpur (28+17)				45.00	1985	ASP		
	…III Beur (20+15)				35.00	1985	ASP		
	…IV Pahari				25.00	1988	AL+FP		
	City-2+								
11	Bhagalpur (M.Corp)	340349	*181*	61.603	11.00	1988	AL+FP	Ganga River	Ganga
	City-1+								
12	Munger	187311	*181*	33.903	13.50	1988	AL+FP	Ganga River	Ganga
13	Chapra	178835	*181*	32.369	2.00	1988	WSP	Ghaghara River	Ganga
	Chandigarh								
	City-5+								
14	Chandigarh	808796	432	349.400		Pre-95		Ghaggar	NMB
	…Mohali(Diggiyan)				68.19		ASP+Tertiary	For Irrigation	
	…Mohali(Diggiyan)				68.19		ASP	For Irrigation	
	…Raipur Khurd				5.68	2004	ASP		
	…Raipur Kalan				**22.73**	**2005**	UASB+PP		
	Chhatisgarh								
	City-5+								
15	Bhilai Nagar	553837	208	115.198				Seonath River	Mahanadi
	…Kutelabhata vill.				46.00	1965	OP		
	…Risali village				14.00	1965	OP		
	…Bhilai House				9.00	1965	OP		

S.N.	City/Town and STP	Population, 2001	Sewage generation factor*	Sewage generation, MLD	Capacity of STP, MLD**	Year of STP's comm.	Technology of STP	Treated sewage disposal***	River basin
	Delhi *								
	City-100+								
16	Delhi Mun Corp (U)	10453394	*282*	2947.849				Yamuna River	Ganga
	Coronation Piallar10-I				45.46		ASP		
	Coronation Piallar10-II				45.46		TF		
	…Coronation Piallar 20-II				90.92		ASP		
	…Delhi Gate 2.2				10.00		HR Biofilter		
	...Ghitorni 5				22.73		ASP		
	...Keshopur 12				54.55		ASP		
	...Keshopur 20				90.92		ASP		
	...Keshopur 40				181.84		ASP		
	...Kondli 10-I				45.46		ASP		
	...Kondli 25-II				113.65		ASP		
	...Kondli 10-II				45.46		ASP		
	…Mehrauli 5				22.73		ASP-ExAer.		
	…Najafgarh 5				22.73		ASP		
	...Nilothi 40				181.84		ASP		
	...Narela 10				45.46		ASP		
	…Okhla 12				54.55		ASP		
	…Okhla 16				72.73		ASP		
	…Okhla 30				136.38		ASP		
	…Okhla 37				168.20		ASP		
	…Okhla 45				204.57		ASP		
	…Pappankalan 20				90.92		ASP		
	…Rithal 40-O				181.84		ASP		
	…Rithal 40-N				181.84		HR ASP+ Biofilter		
	...Rohini 15				68.19		ASP		
	...Sen N.H. 2.2				10.00		HR Biofilter		
	…Timarpur 6				27.27		WSP		
	…Yamuna Vihar 10-I				45.46		ASP		
	…Yamuna Vihar 10-II				45.46		ASP		
	…Vasant Kunj 2.2				10.00		ASP		
	…Vasant Kunj 3				13.63		ASP-Ext. Aer.		
	Gujarat								
	City-20+								
17	Ahmedabad	3515361	181	636.280				Sabarmati / Khari	Sabarmati
	…I Pirana				106.00	2003	UASB+FL		
	…Vasna				126.00	2004	UASB+CL		
18	Surat	2433787	*138*	335.863					Tapi
	…Anjana				82.50	1996	ASP	Mithikhadi	
	…Bhatar				120.00	2000	ASP	Koyalikhadi	
	…Singanapur				100.00	2003	ASP	Tapi	
	City-10+								
19	Vadodara	1306035	*138*	180.233				Kansa, Vishwamitri	Dhadhar
	…Ataladara				86.00	2002	UASB+ASP		
	…Tarsali				52.00	2001	ASP		
	…Gajarwadi				66.00	2003	ASP		

S.N.	City/Town and STP	Population, 2001	Sewage generation factor*	Sewage generation, MLD	Capacity of STP, MLD**	Year of STP's comm.	Technology of STP	Treated sewage disposal***	River basin
20	Rajkot	966642	*138*	133.397	44.50	1994	FL+ASP	Aji River	NMB
	City-1+								
21	Gandhinagar	195891	353	69.150		Pre-95		Sabarmati River	Sabarmati
	Haryana								
	City-10+								
22	Faridabad	1054981	112	118.158				Yamuna River	Ganga
	…I				20.00	2000	UASB+PP		
	…II				45.00	2000	UASB+PP		
	…III				50.00	2000	UASB+PP		
	City-2+								
23	Panipat	261665	102	26.690					Ganga
	…I				10.00	2000	UASB+PP		
	…II				35.00	2000	UASB+PP		
24	Sonipat	216213	*98*	21.189	30.00	2000	UASB+PP		Ganga
25	Karnal	210476	136	28.625					Ganga
	…I				40.00	2000	UASB+PP		
	…II				8.00	2000	WSP		
	City-1+								
26	Yamunanagar	189587	*98*	18.580					
	…I				10.00	2002	UASB+PP	W. Yamuna Canal	Ganga
	…II				25.00	2002	UASB+PP	W. Yamuna Canal	Ganga
27	Gurgaon	173542	*98*	17.007	30.00	2000	UASB+PP		Ganga
28	Palwal	100528	*98*	9.852	9.00	2003	WSP	Yamuna River	Ganga
	Himachal Pradesh								
	City-1+								
29	Shimla	142161	*177*	25.162				Sutlej River	Indus
	…Snowdon				1.35		ASP(Ext.Aer+ Tertiary Sed)		
	…Dhalli				0.76		-do-		
	…Summer Hill				3.93		-do-		
	…Lalpani				19.35		-do-		
	…Maliyana				4.44		-do-		
	…North Disposal				5.80		-do-		
	Karnataka								
	City-20+								
30	Bangalore	4292223	*126*	540.820				Ponnaiyar River	NMB
	...Medwala						UASB		
	…K.C.Valley						ASP		
	…Hebbal						ASP		
	…V.Valley						Bio-filter		
	City-5+								
31	Mysore	742261	150	111.339		Pre-95		Kabbani River	Kaveri
	City-2+								
32	Davanagere	363780	*126*	45.836	19.45	2001	WSP	Tungabhadra	Krishna
33	Bellary	317000	*126*	39.942		Pre-95		Tungabhadra	Krishna
34	Shimoga	274105	*126*	34.537	18.16	2003	WSP	Tunga River	Krishna
35	Tumkur	248592	*126*	31.323		Pre-95		Shimsa River	Kaveri
36	Bijapur	245946	*126*	30.989		Pre-95		Talekta Stream	Krishna
37	Raichur	205634	*126*	25.910		Pre-95		Krishna River	Krishna

S.N.	City/Town and STP	Population, 2001	Sewage generation factor*	Sewage generation, MLD	Capacity of STP, MLD**	Year of STP's comm.	Technology of STP	Treated sewage disposal***	River basin
	City-1+								
38	Hospet	163284	*126*	20.574		Pre-95		Tungabhadra	Krishna
39	Bhadravati	160392	*126*	20.209	5.83	2001	WSP	Bhadra River	Krishna
40	Hassan	117386	*126*	14.791		Pre-95		Hemavati	Kaveri
	Kerala								
	City-10+								
41	Kochi	596473	*139*	82.910		Pre-95		Perriyar River	Coastal
	Madhya Pradesh								
	City-10+								
42	Indore	1597441	133	212.460	90.00	2005	UASB	Khan, Shipra	Ganga
43	Bhopal	1433875	178	255.230					Ganga
	…South T.T. Nagar				4.55	1959	An. Dig.+ TF	Lake (Shahpura)	
	…Bherkheda				9.09	1959	Bio-filter (TF)	For Irrigation	
					8.00	**99/UC**	WSP		
	City-5+								
44	Gwalior	826919	138	114.115		Pre-95		Vaishali River	Ganga
	City-2+								
45	Ujjain	429933	*115*	49.442				Shipra River	Ganga
	…I				52.00	2001	WSP		
	…II				3.46	2001	Karnal		
	City-1+								
46	Burhanpur	194360	*115*	22.351				Tapi River	Tapi
	…I				**6.00**	**2005**	WSP		
	…II				**2.00**	**?**	FAB		
	…II				**2.00**	**?**	FAB		
47	Bhind	153768	*115*	17.683		Pre-95			Ganga
48	Vidisha	125457	*115*	14.428	9.00	2004	Karnal	Betwa River	Ganga
	Maharashtra								
	City-20+								
49	Pune	2540069	192	487.693	110.00	Pre-95	ASP	Mula&Mutha/Bhima	
50	Nagpur	2051320	*172*	352.827	*45.46*	Pre-95	*Primary*	Maur River	Godavari
	City-10+								
51	Thane (54 or **36**)	1261517	*172*	216.981	36.00	1978	UASB	Thane Creek	NMB/Coastal
52	Kalyan-Dombivali	1193266	*172*	205.242				Ulhas	NMB/Coastal
	…Kalyan				24.00	1978	ASP		
	…Dombivali				14.00	1985	ASP		
53	Nashik	1076967	*172*	185.238				Godavari River	Godavari
	…Nasik				78.00	2003	UASB+FP		
	…Triambak				22.00	2003	UASB		
54	Pimpri Chinchwad	1006417	*172*	173.104	16.00		ASP	Mallamukta	
	City-5+								
55	Aurangabad	872667	*172*	150.099	2.50	Pre-95	Primary+OP		Godavari
56	Solapur	873037	*172*	150.162	*54.00*		*Primary*	Sina, Bhima River	Krishna
57	Bhiwandi	598703	*172*	102.977	8.00		ASP	Kamwadi/Ulhas	NMB
	City-2+								
58	Sangli-Miraj & Kupwad	436639	*172*	75.102	23.82	2004	Primary+OP	Krishna River	Krishna
59	Nanded-Waghala	430598	*172*	74.063	26.0/*8.9*	2000	WSP/*Primary*	Godavari River	Godavari
60	Jalgaon	368579	*172*	63.396	18.9	Pre-95	OP	Girna River	Tapi
61	Ahmadnagar	307455	*172*	52.882	*2.00*	Pre-95	*Primary*	Sina, Bhima	Godavari

S.N.	City/Town and STP	Population, 2001	Sewage generation factor*	Sewage generation, MLD	Capacity of STP, MLD**	Year of STP's comm.	Technology of STP	Treated sewage disposal***	River basin
62	Latur	299828	*172*	51.570	12.87	Pre-95	OP	Manjeera River	Godavari
	City-1+								
63	Kolhapur	485183	*172*	83.451	29.00		Primary+TF	Bharathi River	Krishna
64	Ulhasnagar	472943	*172*	81.346	*28.00*		*Primary*	Ulhas	NMB
65	Ambarnath	203795	*172*	35.053	*12.00*		*Primary*	Ulhas	NMB
66	Bhusawal	172366	*172*	29.647		Pre-95		Tapi	Tapi
67	Panvel	104031	*172*	17.893	*1.7*		*Primary*		Coastal
	Orissa								
	City-5+								
68	Bhubaneswar	647302	286	185.128		Pre-95		Kuakhai/Kathjodi	Mahanadi
69	Cuttack	535139	193	103.282	33.00	2003	WSP	Mahanadi River	Mahanadi
	City-1+								
70	Puri	157610	*186*	29.315	20.30	2004		Coastal	Coastal
	Punjab								
	City-10+								
71	Ludhiana	1395053	*147*	205.073				Sutlaj River	Indus
	…Bhattian				**111.00**	**04/UC**	UASB+PP		
	…Balloke				**152.00**	**04/UC**	UASB+PP		
	…Jamalpur				**48.00**	**2005**	UASB+PP		
	City-5+								
72	Jalandhar	701223	*147*	103.080	**100.00**	**04/UC**	UASB+PP	Sutlaj River	Indus
	Rajasthan								
	City-20+								
73	Jaipur	2324319	*158*	367.242					Ganga
	…Jalmahal				27.00	1979	ASP Ext.Aer.	Lake	
	…Jaisinghpur Khoh				**27.00**	**2005**			
	Tamil Nadu								
	City-20+								
74	Chennai	4216268	*81*	341.518				Adiyar/Coom	Coasta
	…I					Pre-95			
	…II				**60.00**	**2005**			
	…III				**110.00**	**2005**			
	City-5+								
75	Tiruchirappalli	746062	*81*	60.431				Kaveri	Kaveri
	…I				58.00	2004	WSP		
	…II				28.00	2003	WSP		
	City-2+								
76	Tirunelveli	411298	164	67.453	24.20	2004		Tambirpani	NMB
77	Thanjavur	215725	*81*	17.474	28.05	2004		Noyyal	Kaveri
	City-1+								
78	Kancheepuram	152984	*81*	12.392		Pre-95		Pallar+Cheyyar	NMB
79	Erode	151184	*81*	12.246				Kaveri	Kaveri
	…I				20.00	2004	WSP		
	…II				5.17	2003	UASB		
	Uttar Pradesh								
	City-20+								
80	Kanpur	2532138	*134*	339.306				Ganga River	Ganga
	…I				36.00	1989	UASB		
	…II (Jajmau)				130.00	1989	ASP		

S.N.	City/Town and STP	Population, 2001	Sewage generation factor*	Sewage generation, MLD	Capacity of STP, MLD**	Year of STP's comm.	Technology of STP	Treated sewage disposal***	River basin
	…III (Jajmau)				5.00	1989	UASB		
	(Experimental)				**0.07**	**2006**			
81	Lucknow	2207340	*134*	295.784				Gomti River	Ganga
	…I				42.00	2003	FAB		
	…II				**375.00**	**2007**			
	City-10+								
82	Agra	1259979	168	211.676				Yamuna River	Ganga
	…Dhandupura				78.00	2002	UASB+PP		
	…Peela Khar				10.00	2001	WSP		
	…Burhi ka Nagla				2.25	2001	WSP		
83	Varanasi	1100748	170	187.127				Ganga River	Ganga
	Bhagwanpur(8or12)				12.00	1988	ASP+TF		
	…Dinapur				80.00	1994	ASP		
	…DLW				12.00	1985	ASP		
	…				37.00	2004			
84	Allahabad	**990298**	210	207.963				Ganga River	Ganga
	…I				60.00	1987	ASP		
	…II				**29.00**	**2005**			
	City-5+								
85	Ghaziabad	968521	*134*	129.782				Hindon River	Ganga
	…I Cis Hindon				70.00	2001	UASB+PP		
	…II Trans Hindon				56.00	2001	UASB+PP		
	City-2+								
86	Saharanpur	452925	*134*	60.692	38.00	2001	UASB+PP	Hindon River	Ganga
87	Muzaffarnagar	316452	183	57.911	32.00	2001	WSP	Kali (W) River	Ganga
88	Mathura	298827	*134*	40.043				Yamuna River	Ganga
	Bangalighat dairy farm				14.5	2001	WSP		
	…Masani				12.5	2001	WSP		
89	Noida	293908	*134*	39.384				Yamuna River	Ganga
	…I				34.00	2001	UASB+PP		
	…II				27.00	2001	UASB+PP		
	…III				9.00	1999	WSP		
90	Farrukhabad-cum-Fatehgarh	227876	*134*	30.535	3.96	1988		Ganga River	Ganga
91	Etawah	211460	*134*	28.336	10.45	2001	WSP	Yamuna River	Ganga
92	Mirzapur-cum-Vindhy.	205264	*134*	27.505				Ganga River	Ganga
	…I				14.00	1988	UASB+PP		
	…II				**4.00**	**04/Pro**			
	City-1+								
93	Sultanpur	100085	*134*	13.411	6.40	1998		Gomti River	Ganga
	Uttaranchal								
	City-1+								
94	Hardwar	175010	226	39.552	18.00	1993	ASP	Ganga River	Ganga
	West Bengal								
	City-20+								
95	Kolkata	4580544	*135*	618.373				Ganga River	Ganga
	..G.Reach (**79** or 47.5)				79.00	1987	ASP		
	...S.Sub-E				30.00	1987	WSP		
	...Cos.Chit (63.9 or **45**)				63.90	1987	ASP		

S.N.	City/Town and STP	Population, 2001	Sewage generation factor*	Sewage generation, MLD	Capacity of STP, MLD**	Year of STP's comm.	Technology of STP	Treated sewage disposal***	River basin
	City-10+								
96	Haora	1008704	*135*	136.175	63.90	1987	TF	Ganga River	Ganga
	City-2+								
97	Bhatpara	441956	*135*	59.664				Ganga River	Ganga
	…B-Old (Jagaddal)				10.00	1987	ASP		
	…B-New (Jagaddal)				8.50	1988	ASP		
	…E (Madrail)				10.00	1987	WSP		
98	Maheshtala	389214	*135*	52.544	3.93	2003	WSP		
99	Panihati (16.5or**12**)	348379	*135*	47.031	16.50	1988	WSP	Irrig, Pissic, Canal	Ganga
100	Bally (45or**30**)	261575	*135*	35.313	45.00	1988	WSP	Irrig, Pissic, Ganga	Ganga
101	Baranagar (44.5 or**40**)	250615	*135*	33.833	44.50	1987	TF		Ganga
	City-1+								
102	Serampore	197955	*135*	26.724	18.90	1988	TF	Pissic+Ganga River	Ganga
103	Chandannagar	162166	*135*	21.892				Ganga River	Ganga
	…I				18.16	1987	TF		
	…II				4.54	1987	WSP		
104	Baharampur (8 or 3.7)	160168	*135*	21.623	8.00	1987	WSP	Beel	Ganga
105	Barrackpur	144331	*135*	19.485					Ganga
	…I				5.90	2003	WSP		
	…II				1.00	2003	WSP		
	…III				10.90	2003	WSP		
	…IV				4.35	2003	WSP		
106	Titagarh	124198	*135*	16.767				Irrig, Pissicult, Khal	Ganga
	…Bandipur				14.1	1988	WSP		
	…Titagarh				4.54		WSP		
	…Titagarh				4.5		ASP		
107	Khardaha	116252	*135*	15.694	3.00	2003	WSP		Ganga
108	Nabadwip (**10** or 4.5?)	115036	*135*	15.530	10.00	1988	WSP	Ganga River	Ganga
109	Baidyabati	108231	*135*	14.611	**2.00**	**2005**			Ganga
110	Bhadreswar	105944	*135*	14.302	**6.00**	**2005**			Ganga
111	Bansberia	104453	*135*	14.101	**2.80**	**2006**			Ganga
112	Champdani	103232	*135*	13.936	**12.00**	**2005**			Ganga
			Total	**14652**	**7756*******				

ASP: Primary Sedimentation+Activated Sludge Process, UASB: Upflow anaerobic sludge blanket reactor+Polishing pond, WSP: Waste Stabilization Ponds, TF: Primary Sedimentation+Trickling filter

*Figures in italics are based on average water supply of state, other on sewage generation factor

**Capacities shown in bold are for the planned/under construction STPs

*** Shaded river stretches are already identified as most polluted stretches

**** Installed capacity: 6047 MLD + Proposed capacity: 1709 MLD

Table 3 Sewage generation and treatment capacity in Class II towns having STPs

S.N.	City/Town and STP	Population, 2001	Sewage generation factor*	Sewage generation, MLD	Capacity of STP, MLD**	Year of STP's comm.	Technology of STP	Treated sewage disposal***	River basin
	Andhra Pradesh								
1	Mancherial	70231	*49*	3.441					
	…I				6.46	2001	WSP		
	…II				3.96	2001	WSP		
	Bihar								
2	Buxar	82975	*92*	7.634	2.00		WSP		
	Goa								
3	Panaji	58785	*80*	4.703					
	…I				5.68	2004	TF		
	…II				12.50	2004	ASP		
	Karnataka								
4	Kollegal	52450	*94*	4.930	3.34	2001	WSP		
5	Harihar	75042	*94*	7.054	8.84	2004	WSP	Tungabhadra	Krishna
	Madhya Pradesh								
6	Nagda	96525	*72*	6.950	9.00	2004	KARNAL	Chambal	Ganga
	Maharashtra								
7	Karad	56149	106	5.952	28.00	2002	WSP	Krishna	Krishna
8	Wani	52814	*73*	3.855	1.00		OP		
	Punjab								
9	Kapurthala	84361	*150*	12.654	19.30	2003	WSP		
10	Phagwara	95626	*150*	14.344					
	North side				**20.00**	**2006**	**UASB**		
	South side				**3.50**	**2006**	**UASB**		
	Tamil Nadu								
11	Karur	76328	*55*	4.198	15.00	2004	WSP		
12	Mayiladuthurai	84290	*44*	3.709	8.30	2004			
13	Kumara-palayam	65640	*44*	2.888	6.00	?	WSP		
	Uttar Pradesh								
14	Bijnor	79368	*96*	7.619					
	…I				**4.32**		**WSP**		
	…II				**2.66**		**WSP**		
	…III				**1.13**		**KARNAL**		
15	Vrindavan	56618	*96*	5.435				Yamuna	Ganga
	…Pagal Baba				4.00	2000	WSP		
	…Kali Deh				0.50	2000	WSP		
	Uttaranchal								
16	Rishikesh	59671	180	10.741					
	… Swargashram				0.33	1988	UASB+PP		
	…Lakkadghat				6.00	1988	WSP		
	West Bengal								
17	Katwa	71573	*86*	6.155	**2.30**	**2005**	**WSP**		
18	Konnagar	72211	*86*	6.210	22.00	2003	WSP		
19	Gayespur	55028	*86*	4.732					
	…I				6.00	2003	WSP		
	…II				6.50	2003	WSP		
20	Kalyani	81984	*86*	7.051				Irrig, Ganga	
	…I				11.00	1987	TF		
	…II				6.00	1987	WSP		
21	Garulia	76309	*86*	6.563	7.90	2003	WSP		
22	Budge Budge	75465	*86*	6.490	**0.18**	**2005**	**WSP**		
			Total	**143.308**	**233.7********				

ASP: Primary Sedimentation+Activated Sludge Process, UASB: Upflow anaerobic sludge blanket reactor+Polishing pond, WSP: Waste Stabilization Ponds, TF: Primary Sedimentation+Trickling filter

*Figures in italics are based on average water supply of state, other on sewage generation factor

**Capacities shown in bold are for the planned/under construction STPs

*** Shaded river stretches are already identified as most polluted stretches

**** Installed capacity: 199.61 MLD + Proposed capacity: 34.09 MLD

Table 4 Sewage generation in Class I cities having no STP

S.No.	City	Population	Per capita sewage, l/d *	Total sewage, MLD	Treated sewage disposal **	River basin
	Andaman & Nicobar Islands					
	City-1+					
1	Port Blair	100186	***112***	11.221		
	Andhra Pradesh					
	UA-10+					
2	Visakhapatnam	**969608**	90.4	87.653	Coastal	Coastal
	City-5+					
3	Warangal	528570	132.2	69.877	Maner River	Godavari
	City-2+					
4	Kukatpalle	290591	*86*	24.991	Musi/Manjira	Krishna/ Godavari
5	Kakinada	289920	*86*	24.933	Godavari delta	Godavari
6	Nizamabad	286956	*86*	24.678	Manjira River	Godavari
7	Kurnool	267739	*86*	23.026	Tungabhadra River	Krishna
8	L.B. Nagar	261987	*86*	22.531		
9	Gajuwaka	258944	*86*	22.269		
10	Quthbullapur	225816	*86*	19.420		
11	Anantapur	220951	*86*	19.002	Penneru River	Penneru
12	Secunderabad	204182	*86*	17.560	Musi River	Krishna
13	Karimnagar	203819	*86*	17.528	Maner River	Godavari
	City-1+					
14	Machilipatnam	183370	*86*	15.770	Krishna Delta	Krishna
15	Malkajgiri	175000	*86*	15.050		
16	Vizianagaram	174324	*86*	14.992	Konada stream	NMB
17	Proddatur	164932	*86*	14.184	Penneru River	Penneru
18	Kapra	159176	*86*	13.689		
19	Khammam	158022	*86*	13.590	Muneru	Godavari
20	Adoni	155969	*86*	13.413	Tungabhadra River	Krishna
21	Chittoor	152966	*86*	13.155		
22	Nandyal	151771	*86*	13.052	Kunderu River	Pennar
23	Serilingampalle	150525	*86*	12.945		
24	Ongole	149589	*86*	12.865		
25	Rajendranagar	143184	*86*	12.314		
26	Bheemavaram	137327	*86*	11.810	Godavari delta	Godavari
27	Mahbubnagar	130849	*86*	11.253		Krishna
28	Cuddapah	125725	*86*	10.812	Penneru River	Penneru
29	Hindupur	125056	*86*	10.755	Penneru River	Penneru
30	Uppal Kalan	118259	*86*	10.170		
31	Guntakal	117403	*86*	10.097	Penneru River	Penneru
32	Gudivada	112245	*86*	9.653	Krishna Delta	Krishna
33	Nalgonda	110651	*86*	9.516		Krishna
34	Srikakulam	109666	*86*	9.431	Nagavati River	NMB
35	Adilabad	108233	*86*	9.308	Penganga River	Godavari
36	Alwal	106424	*86*	9.152		

S.No.	City	Population	Per capita sewage, l/d *	Total sewage, MLD	Treated sewage disposal **	River basin
37	Dharmavaram	103400	*86*	8.892	Chitravati River	Penneru
38	Tadepalligudem	102303	*86*	8.798	Godavari delta	Godavari
	Assam					
	City-5+					
39	Guwahati	808021	*250*	202.005	Bharlu/ Brahmaputra	Brahmaputra
	City-1+					
40	Silchar	142393	*250*	35.598		NMB
41	Dibrugarh	122523	*250*	30.631	Brahmaputra River	Brahmaputra
42	Nagaon	107471	*250*	26.868	Kalong River	
	Bihar					
	City-2+					
43	Gaya	383197	*181*	69.359	Phangun River	Ganga
44	Muzaffarpur	305465	*181*	55.289	Ganga River	Ganga
45	Darbhanga	266834	*181*	48.297	Ghughri River	Ganga
46	Bihar	231972	*181*	41.987	Phangun River	Ganga
47	Arrah	203395	*181*	36.814	Son River	Ganga
	City-1+					
48	Katihar	175169	*181*	31.706		Ganga
49	Purnia	171235	*181*	30.994		Ganga
50	Sasaram	131042	*181*	23.719	Chandrabhaga River	Ganga
51	Dinapur Nizamat	130339	*181*	23.591		
52	Saharsa	124015	*181*	22.447	Simrahi Stream	Ganga
53	Hajipur	119276	*181*	21.589	Great Gandak River	Ganga
54	Dehri	119007	*181*	21.540	Son river	Ganga
55	Bettiah	116692	*181*	21.121	Gurhi gandak River	Ganga
56	Siwan	108172	*181*	19.579		Ganga
57	Motihari	101506	*181*	18.373	Gurhi gandak River	Ganga
	Chhatisgarh					
	City-5+					
58	Raipur	605131	*115*	69.590	Kharoon River	Mahanadi
	City-2+					
59	Korba	315695	*115*	36.305	Hasdeo River	Mahanadi
60	Bilaspur	265178	125.1	33.174	Arpa/Son River	Mahanadi
61	Durg	231182	*115*	26.586	Seonath River	Mahanadi
	City-1+					
62	Rajnandgaon	143727	*115*	16.529	Seonath River	Mahanadi
63	Raigarh	110987	*115*	12.764		Mahanadi
	Gujarat					
	City-5+					
64	Bhavnagar	510958	*138*	70.512	Kalubhar River	NMB
	City-2+					
65	Jamnagar	447734	*138*	61.787	Nagamathi River	NMB
	City-1+					
66	Nadiad	192799	*138*	26.606	Shedi River	Sabarmati

S.No.	City	Population	Per capita sewage, l/d *	Total sewage, MLD	Treated sewage disposal **	River basin
67	Junagadh	168686	*138*	23.279	Ozat River	NMB/Sabarmati
68	Surendranagar Dudhrej	156417	*138*	21.586		NMB/Sabarmati
69	Bharuch	148391	*138*	20.478	Narmada River	Narmada
70	Veraval	141207	*138*	19.487		Coastal
71	Navsari	134009	142.7	19.123	Purna River	NMB/Coastal
72	Porbandar	133083	*138*	18.365		Coastal
73	Anand	130462	*138*	18.004		Sabarmati
74	Godhra	121852	*138*	16.816	Meshri/Panam River	Mahi
75	Vejalpur	113304	*138*	15.636		Mahi
76	Patan	112038	*138*	15.461		NMB
77	Palanpur	110383	*138*	15.233		
78	Ghatlodiya	106259	*138*	14.664		Sabarmati
79	Jetpur Navagadh	104311	203.9	21.269	Bhadar	NMB
80	Botad	100059	*138*	13.808		NMB
81	Kalol	100021	*138*	13.803		Sabarmati
	Haryana					
	City-2+					
82	Rohtak	286773	*98*	28.104		Ganga
83	Hisar	256810	*98*	25.167		Ganga
	City-1+					
84	Bhiwani	169424	103.6	17.552		Ganga
85	Sirsa	160129	103.7	16.605	Ghaggar	Ganga
86	Panchkula Urban Estate	140992	117.4	16.552		Indus
87	Ambala	139222	127.4	17.737		Indus/Ghaggar
88	Jind	136089	*98*	13.337		Ganga
89	Thanesar	120072	*98*	11.767		Ganga
90	Bahadurgarh	119839	*98*	11.744		Ganga
91	Kaithal	117226	*98*	11.488		Ganga
92	Ambala Sadar	106378	*98*	10.425		Indus/Ghaggar
93	Jagadhri	101300	*98*	9.927	Yamuna River	Ganga
94	Rewari	100946	*98*	9.893		Ganga
	Jammu & Kashmir					
	City-5+					
95	Srinagar	894940	***112***	100.229	Jhelum River	Indus
	City-2+					
96	Jammu	378431	***112***	42.384	Tawi River	Indus
	Jharkhand					
	UA-10+					
97	Jamshedpur	**570349**	*181*	103.233	Subarnrekha River	Subarnrekha
98	Dhanbad	**198963**	*181*	36.012	Damodar River	Ganga
	City-5+					
99	Ranchi	846454	*181*	153.208	Subarnrekha River	Subarnrekha

S.No.	City	Population	Per capita sewage, l/d *	Total sewage, MLD	Treated sewage disposal **	River basin
	City-2+					
100	Bokaro Steel City	394173	*181*	71.345	Damodar River	Ganga
	City-1+					
101	Mango	166091	*181*	30.062		
102	Hazaribag	127243	*181*	23.031	Damodar River	Ganga
103	Adityapur	119221	*181*	21.579		
	Karnataka					
	City-5+					
104	Hubli-Dharwad	786018	*126*	99.038	Malprabha River	Krishna
	City-2+					
105	Gulbarga	427929	*126*	53.919	Benxithona river	Krishna
106	Belgaum	399600	*126*	50.350	Markendya River	Krishna
107	Mangalore	398745	204.9	81.703	Nethravati	NMB/Coastal
108	Dasarahalli	263636	*126*	33.218		
109	Bommanahalli	201220	*126*	25.354		
	City-1+					
110	Krishnarajapura	187453	*126*	23.619	Ponnayar	NMB
111	Byatarayanapura	180931	*126*	22.797		
112	Bidar	172298	*126*	21.710	Manjira River	Godavari
113	Gadag-Betigeri	154849	*126*	19.511	Malprabha River	Krishna
114	Robertson Pet	141294	*126*	17.803	Ponnayar	NMB
115	Mahadevapura	135597	*126*	17.085		
116	Mandya	131211	*126*	16.533	Shimsa River	Kaveri
117	Chitradurga	122594	*126*	15.447	Vedavati River	Krishna
118	Kolar	113299	*126*	14.276	Palar + Cheyyar	NMB
119	Udupi	113039	*126*	14.243	Swarna River	NMB/Coastal
120	Chikmagalur	101022	*126*	12.729	Yagachi, Hemavati	Kaveri
	Kerala					
	City-5+					
121	Trivandrum	744739	152.7	113.722	Karmana River	NMB/Coastal
	City-2+					
122	Kozhikode	436527	*139*	60.677		Coastal
123	Kollam	361441	*139*	50.240		Coastal
124	Thrissur	317474	214.5	68.098		
	City-1+					
125	Alappuzha	177079	*139*	24.614		Coastal
126	Palakkad	130736	*139*	18.172		NMB
	Madhya Pradesh					
	UA-10+					
127	Jabalpur	**951469**	*115*	109.419	Narmada River	Narmada
	City-2+					
128	Sagar	232321	*115*	26.717	Dhasan River	Ganga
129	Dewas	230658	*115*	26.526	Cchoti Kali Sindh	Ganga
130	Satna	225468	*115*	25.929	Tons River	Ganga

S.No.	City	Population	Per capita sewage, l/d *	Total sewage, MLD	Treated sewage disposal **	River basin
131	Ratlam	221267	*115*	25.446	Malini River	Mahi
	City-1+					
132	Murwara (Katni)	186738	*115*	21.475		Ganga
133	Singrauli	185580	*115*	21.342	Gopad, Sone River	Ganga
134	Rewa	183232	*115*	21.072	Baichaiya, Tons	Ganga
135	Khandwa	171976	*115*	19.777	Cchota Tawa River	Ganga
136	Morena	150890	*115*	17.352	Kunwari River	Ganga
137	Shivpuri	146859	*115*	16.889	Sindh River	Ganga
138	Guna	137132	*115*	15.770	Sindh River	Ganga
139	Chhindwara	122309	*115*	14.066	Wainganga River	Godavari
140	Mandsaur	116483	135.5	15.783	Chambal River	Ganga
141	Damoh	112160	125.4	14.065	Sonar, Bearma River	Ganga
142	Neemuch	107496	*115*	12.362	Chambal River	Ganga
	Maharashtra					
	UA-100+					
143	Greater Mumbai	11914398	181.3	2160.080		
	1.2 km marine outfall Colaba-40 mld	Zone-1			S. East coast/Harbour	
	3.7 km marine outfall Worli-360 mld	Zone-2			West coast / Arabian sea	
	3.7 km marine outfall Bandra-400 mld	Zone-3			West coast / Arabian sea	
	Versova (lagoons)-110 mld	Zone-4			Malad creek	
	Malad-110 mld	Zone-5			Malad creek	
	Bhandup (lagoon)-140 mld	Zone-6			Thane creek	
	Ghatkopar (lagoon)-90 mld	Zone-7				
	UA-10+					
	City-5+					
144	Navi Mumbai	703947	*172*	121.079		Coastal
145	Amravati	549370	*172*	94.492	Purna River	Tapi
146	Mira-Bhayandar	520301	*172*	89.492	Pedhi	
	City-2+					
147	Malegaon	409190	*172*	70.381	Girna River	Tapi
148	Akola	399978	*172*	68.796	Morna River	Tapi
149	Dhule	341473	*172*	58.733	Panjhara River	Tapi
150	Chandrapur	297612	*172*	51.189	Godavari	Godavari
151	Parbhani	259170	*172*	44.577	Purna River	Godavari
152	Ichalkaranji	257572	*172*	44.302	Bharthi River	Krishna
153	Jalna	235529	*172*	40.511	Purna River	Godavari
	City-1+					
154	Nala Sopara	184664	*172*	31.762		NMB
155	Bid	138091	*172*	23.752	Bindusara River	Godavari
156	Yavatmal	122906	*172*	21.140	Penganga River	Godavari
157	Gondiya	120878	*172*	20.791	Waingana River	Godavari
158	Virar	118945	*172*	20.459	Taharpur stream	NMB
159	Navghar-Manikpur	116700	*172*	20.072		
160	Wardha	111070	*172*	19.104	Wardha River	Godavari
161	Satara	108043	*172*	18.583	Satara stream	Krishna

S.No.	City	Population	Per capita sewage, l/d *	Total sewage, MLD	Treated sewage disposal **	River basin
162	Achalpur	107304	*172*	18.456	Chandrabhaga River	Tapi
163	Barshi	104786	*172*	18.023	Sina, Bhima river	Krishna
	Manipur					
	City-2+					
164	Imphal	217275	*107*	23.248		NMB
	Meghalaya					
	City-1+					
165	Shillong	132876	***112***	14.882	Umkhara, Kalang	Brahmaputra
	Mizoram					
	City-2+					
166	Aizawl	229714	***112***	25.728		NMB
	Nagaland					
	City-1+					
167	Dimapur	107382	***112***	12.027	Dhansiri River	Brahmaputra
	Orissa					
	City-2+					
168	Brahmapur	289724	*186*	53.889	Rushikulya Delta	NMB
169	Raurkela	224601	*186*	41.776	Brahmani river	Brahmani
170	Raurkela Ind. Township	206566	*186*	38.421	Brahmani river	Brahmani
	City-1+					
171	Sambalpur	154164	*186*	28.675	Mahanadi River	Mahanadi
172	Baleshwar	106032	*186*	19.722	Burha Balang River	NMB
	Pondicherry *					
	City-2+					
173	Pondicherry	220749	***112***	24.723	Arian Kuppam River	Coastal
174	Ozhukarai	217623	***112***	24.374	Pannaiyar Delta	NMB
	Punjab					
	UA-10+					
175	Amritsar	**975695**	*147*	143.427		Indus
	City-2+					
176	Patiala	302870	*147*	44.522	Ghaggar	NMB
177	Bathinda	217389	*147*	31.956		Indus
	City-1+					
178	Pathankot	159559	*147*	23.455	Beas River	Indus
179	Hoshiarpur	148243	*147*	21.792		Indus
180	Batala	126646	*147*	18.617		Indus
181	Moga	124624	*147*	18.320		Indus
182	Abohar	124303	*147*	18.273		Indus
183	S.A.S. Nagar (Mohali)	123284	*147*	18.123		Indus
184	Malerkotla	106802	*147*	15.700		Indus
185	Khanna	103059	*147*	15.150		Indus
	Rajasthan					
	City-5+					
186	Jodhpur	846408	*158*	133.732		NMB

S.No.	City	Population	Per capita sewage, l/d *	Total sewage, MLD	Treated sewage disposal **	River basin
187	Kota	695899	208.4	145.025	Chambal River	Ganga
188	Bikaner	529007	*158*	83.583		NMB
	City-2+					
189	Ajmer	485197	*158*	76.661		NMB
190	Udaipur	389317	*158*	61.512	Banas/Berach River	Mahi
191	Bhilwara	280185	*158*	44.269	Banas River	Ganga
192	Alwar	260245	*158*	41.119		Ganga
193	Ganganagar	210788	*158*	33.305		Indus
194	Bharatpur	204456	*158*	32.304		Ganga
	City-1+					
195	Pali	187571	*158*	29.636		NMB
196	Sikar	184904	*158*	29.215		NMB
197	Tonk	135663	*158*	21.435	Banas River	Ganga
198	Hanumangarh	129654	*158*	20.485	Ghaggar	NMB
199	Beawar	123701	*158*	19.545		NMB
200	Kishangarh	116156	*158*	18.353		NMB
201	Jhunjhunun	100476	*158*	15.875		Ganga
	Tamil Nadu					
	UA-10+					
202	Coimbatore	**923085**	*81*	74.770	Noyyal River	Kaveri
203	Madurai	**922913**	*81*	74.756	Vaigai River	NMB
	City-5+					
204	Salem	693236	*81*	56.152	Kaveri River	Kaveri
	City-2+					
205	Tiruppur	346551	*81*	28.071	Noyyal River	Kaveri
206	Ambattur	302492	*81*	24.502	Adiyar/Coom	NMB
207	Avadi	230913	*81*	18.704	Adiyar/Coom	NMB
208	Thoothukkudi	216058	*81*	17.501		Coastal
209	Tiruvottiyur	211768	*81*	17.153	Nagari River	NMB/Coastal
210	Nagercoil	208149	*81*	16.860		NMB
	City-1+					
211	Dindigul	196619	*81*	15.926	Amravati River	Kaveri
212	Vellore	177413	*81*	14.370	Pallar	NMB
213	Cuddalore	158569	*81*	12.844	Ponnayar Delta	Coastal
214	Alandur	146154	*81*	11.838	Adiyar/Coom	NMB
215	Pallavaram	143984	*81*	11.663	Adiyar/Coom	NMB
216	Kumbakonam	140021	*81*	11.342	Kaveri River	Kaveri
217	Tambaram	137609	*81*	11.146	Adiyar/Coom	NMB
218	Tiruvannamalai	130301	*81*	10.554		NMB
219	Neyveli	128133	*81*	10.379	Veppar Delta	NMB
220	Rajapalayam	121982	*81*	9.881	Veppar River	NMB
221	Pudukkottai	108947	*81*	8.825	Thanjavur	Kaveri
	Tripura (City-1+)					
222	Agartala	189327	***112***	21.205	Titas River	

S.No.	City	Population	Per capita sewage, l/d *	Total sewage, MLD	Treated sewage disposal **	River basin
	Uttar Pradesh					
	UA-10+					
223	Meerut	1074229	*134*	143.947	Kali (E) River	Ganga
	City-5+					
224	Bareilly	699839	*134*	93.778	Ramganga River	Ganga
225	Aligarh	667732	*134*	89.476	Karwan River	Ganga
226	Moradabad	641240	*134*	85.926	Ramganga River	Ganga
227	Gorakhpur	624570	*134*	83.692	Haldi, Rapti River	Ganga
	City-2+					
228	Jhansi	383248	*134*	51.355	Betwa River	Ganga
229	Shahjahanpur	297932	*134*	39.923	Deoha River	Ganga
230	Rampur	281549	*134*	37.728	Kosi River	Ganga
231	Firozabad	278801	*134*	37.359	Yamuna River	Ganga
232	Hapur	211987	*134*	28.406	Kali (E) River	Ganga
233	Maunath Bhanjan	210071	*134*	28.150	Cchoti Saryu River	Ganga
	City-1+					
234	Sambhal	182930	*134*	24.513	Badaun stream	Ganga
235	Bulandshahr	176256	*134*	23.618	Kali (E) River	Ganga
236	Rae Bareli	169285	*134*	22.684	Sai River	Ganga
237	Bahraich	168376	*134*	22.562	Ghaghara River	Ganga
238	Amroha	164890	*134*	22.095	Badaun stream	Ganga
239	Jaunpur	159996	*134*	21.439	Gomti River	Ganga
240	Sitapur	151827	*134*	20.345	Sarangan River	Ganga
241	Fatehpur	151757	*134*	20.335	Yamuna/Ganga	Ganga
242	Budaun	148138	*134*	19.850	Badaun stream	Ganga
243	Faizabad	144924	*134*	19.420	Ghaghara River	Ganga
244	Unnao	144917	*134*	19.419	Ganga River	Ganga
245	Orai	139444	*134*	18.685	Yamuna River	Ganga
246	Banda	134822	*134*	18.066	Ken River	Ganga
247	Pilibhit	124082	*134*	16.627	Deoha River	Ganga
248	Hathras	123243	*134*	16.515	Karwan River	Ganga
249	Gonda	122164	*134*	16.370	Ghaghara River	Ganga
250	Loni	120659	*134*	16.168		Ganga
251	Lakhimpur	120566	*134*	16.156	Ghaghara River	Ganga
252	Modinagar	112918	*134*	15.131	Kali (E) River	Ganga
253	Hardoi	112474	*134*	15.072	Sai River	Ganga
254	Lalitpur	111810	*134*	14.983	Betwa River	Ganga
255	Etah	107098	147.8	15.829	Sirsa River	Ganga
256	Basti	106985	*134*	14.336	Ghaghara River	Ganga
257	Azamgarh	104943	*134*	14.062	Cchoti Saryu River	Ganga
258	Deoria	104222	*134*	13.966	Lttle Gandak	Ganga
259	Chandausi	103757	*134*	13.903	Badaun stream	Ganga
260	Ballia	102226	176.1	18.002	Ganga River	Ganga
	Uttaranchal					
	City-2+					

S.No.	City	Population	Per capita sewage, l/d *	Total sewage, MLD	Treated sewage disposal **	River basin
261	Dehradun	447808	138.1	61.842	Ganga River	Ganga
	City-1+					
262	Haldwani-Kathgodam	129140	*134*	17.305	Ramganga River	Ganga
	West Bengal					
	UA-10+					
263	Asansol	**486304**	*135*	65.651	Damodar River	Ganga
	City-2+					
264	Durgapur	492996	*135*	66.554	Damodar River	Ganga
265	Siliguri	470275	*135*	63.487	Mahananda River	Ganga
266	South Dumdum	392150	*135*	52.940	Ganga River	Ganga
267	Rajpur Sonarpur	336390	*135*	45.413	Ganga River	Ganga
268	Kamarhati	314334	*135*	42.435	Ganga River	Ganga
269	Kulti	290057	*135*	39.158	Damodar River	Ganga
270	Barddhaman	285871	*135*	38.593	Damodar River	Ganga
271	Rajarhat Gopalpur	271781	*135*	36.690		Ganga
272	Barasat	231515	*135*	31.255	Bidyadhari River	Ganga
273	North Dumdum	220032	*135*	29.704	Ganga River	Ganga
274	Naihati	215432	*135*	29.083	Ganga River	Ganga
275	Kharagpur	207984	*135*	28.078	Kosai River	Ganga
276	Uluberia	202095	*135*	27.283	Ganga River	Ganga
	City-1+					
277	Haldia	170695	143.5	24.495	Ganga River	Ganga
278	Hugli-Chinsurah	170201	*135*	22.977	Mahananda River	Ganga
279	Bidhan Nagar	167848	*135*	22.659		Ganga
280	Raiganj	165222	*135*	22.305	Mahananda River	Ganga
281	English Bazar	161448	*135*	21.795		
282	Madhyamgram	155503	*135*	20.993	Sunti	
283	Medinipur	153349	*135*	20.702	Kosai River	Ganga
284	Uttarpara Kotrung	150204	*135*	20.278		Ganga
285	Krishnanagar	139070	*135*	18.774	Jalangi River	Ganga
286	Santipur	138195	*135*	18.656	Ganga River	Ganga
287	Balurghat	135516	*135*	18.295	Padma River	Ganga
288	Jamuria	129456	*135*	17.477	Damodar River	Ganga
289	Bankura	128811	*135*	17.389	Roopnarayan River	Ganga
290	Habra	127695	*135*	17.239	Ganga Delta	Ganga
291	Kanchrapara	126118	*135*	17.026	Ganga River	Ganga
292	Halisahar	124479	*135*	16.805	Ganga River	Ganga
293	North Barrackpur	123523	*135*	16.676	Ganga River	Ganga
294	Raniganj	122891	*135*	16.590	Damodar River	Ganga
295	Puruliya	113766	*135*	15.358	Haldi River	Ganga
296	Rishra	113259	*135*	15.290	Ganga River	Ganga
297	Basirhat	113120	*135*	15.271	Ganga River	Ganga
298	Ashoknagar Kalyangarh	111475	*135*	15.049	Ganga River	Ganga
299	Darjiling	107530	*135*	14.517	Tista River	Brahmaputra

S.No.	City	Population	Per capita sewage, l/d *	Total sewage, MLD	Treated sewage disposal **	River basin
300	Bangaon	102115	*135*	13.786		Ganga
301	Dumdum	101319	*135*	13.678		Ganga
302	Jalpaiguri	100212	*135*	13.529	Tista River	Brahmaputra
			Total	**11512 MLD**		

*Figures in italics are based on average water supply of state, other on sewage generation factor
** Shaded river stretches are already identified as most polluted stretches

Table 5 Sewage generation in Class II towns having no STP

S.No.	City	Population	Per capita sewage, l/d *	Total sewage, MLD	Treated sewage disposal **
	Andhra Pradesh				
1	Kaghaznagar	59549	*49*	2.918	
2	Mandamarri	66176	51	3.375	
3	Bellampalle	66660	*49*	3.266	
4	Nirmal	74017	*49*	3.627	
5	Rayadurg	54127	*49*	2.652	Nagavalli River
6	Kadiri	76261	*49*	3.737	
7	Tadpatri	86641	*49*	4.245	
8	Srikalahasti	70876	77	5.457	
9	Madanapalle	97964	73	7.151	
10	Chinnachowk	64053	*49*	3.139	
11	Rayachoti	72196	50	3.610	
12	Tuni	50217	*49*	2.461	
13	Pitapuram	50301	*49*	2.465	
14	Amalapuram	50889	*49*	2.494	
15	Samalkota	53402	*49*	2.617	
16	Sattenapalle	51350	*49*	2.516	
17	Vinukonda	52589	*49*	2.577	
18	Ponnur	56504	*49*	2.769	
19	Mangalagiri	59443	*49*	2.913	
20	Bapatla	68103	*49*	3.337	
21	Chilakaluripet	89888	*49*	4.405	
22	Narasaraopet	95002	*49*	4.655	
23	Koratla	54021	*49*	2.647	
24	Sirsilla	65016	*49*	3.186	
25	Jagtial	89438	*49*	4.382	
26	Palwancha	68561	*49*	3.359	
27	Kothagudem	79727	*49*	3.907	
28	Nuzvid	50338	*49*	2.467	
29	Kallur	52880	*49*	2.591	
30	Yemmiganur	76428	*49*	3.745	
31	Wanaparthi	50262	*49*	2.463	
32	Gadwal	51428	*49*	2.520	
33	Ramachandrapuram	52586	*49*	2.577	
34	Sangareddy	56691	*49*	2.778	
35	Siddipet	61650	*49*	3.021	
36	Miryalguda	90247	*49*	4.422	
37	Suryapet	94797	60	5.688	
38	Gudur	69303	71	4.921	
39	Kavali	78351	*49*	3.839	
40	Kamareddy	64222	*49*	3.147	
41	Bodhan	71355	*49*	3.496	
42	Kandukur	50084	*49*	2.454	
43	Markapur	58454	*49*	2.864	
44	Chirala	85455	*49*	4.187	
45	Gaddi annaram	53622	*49*	2.627	
46	Tandur	57943	*49*	2.839	
47	Anakapalle	84523	*49*	4.142	

S.No.	City	Population	Per capita sewage, l/d *	Total sewage, MLD	Treated sewage disposal **
48	Bobbili	50140	*49*	2.457	
49	Palacole	57171	58	3.316	
50	Narsapur	58508	66	3.862	
51	Tanuku	66779	*49*	3.272	
	Assam				
52	Bongaigaon	60550	*134*	8.114	
53	Dhubri	63965	*134*	8.571	
54	Jorhat	66450	*134*	8.904	
55	Diphu	52062	*134*	6.976	
56	Karimganj	52316	*134*	7.010	
57	North Lakhimpur	54262	*134*	7.271	
58	Sibsagar	54482	*134*	7.301	
59	Tezpur	58240	*134*	7.804	
60	Tinsukia	85519	*134*	11.460	
	Bihar				
61	Araria	60594	*92*	5.575	
62	Aurangabad	79351	*92*	7.300	
63	Begusarai	93378	*92*	8.591	
64	Gopalganj	54418	*92*	5.006	
65	Jamui	66752	*92*	6.141	
66	Jehanabad	81723	*92*	7.519	
67	Kishanganj	85494	112	9.575	
68	Lakhisarai	77840	*92*	7.161	
69	Madhubani	66285	*92*	6.098	
70	Jamalpur	96659	*92*	8.893	
71	Nawada	82291	*92*	7.571	
72	Bagaha	91383	*92*	8.407	
73	Phulwari Sharif	53166	*92*	4.891	
74	Mokameh	56400	142	8.009	
75	Samastipur	55590	*92*	5.114	
76	Sitamarhi	56769	115	6.528	
77	Supaul	54020	*92*	4.970	
	Chhatisgarh				
78	Jagdalpur	73687	91	6.706	
79	Dhamtari	82099	*72*	5.911	
80	Dalli-Rajhara	50615	*72*	3.644	
81	Bhilai Charoda	87170	*72*	6.276	
82	Chirmiri	91312	*72*	6.574	
83	Bhatapara	50080	*72*	3.606	
84	Ambikapur	65999	*72*	4.752	
	Goa				
85	Margao	78393	80	6.271	
86	Mormugao	97085	80	7.767	
	Gujarat				
87	Viramgam	53095	124	6.584	
88	Dholka	53792	*120*	6.455	
89	Chandlodiya	56135	*120*	6.736	
90	Ranip	87573	*120*	10.509	
91	Savarkundla	73695	*120*	8.843	
92	Amreli	90243	*120*	10.829	

S.No.	City	Population	Per capita sewage, l/d *	Total sewage, MLD	Treated sewage disposal **
93	Petlad	51153	*120*	6.138	
94	Borsad	56541	*120*	6.785	
95	Khambhat	80439	136	10.940	
96	Deesa	83340	*120*	10.001	
97	Anklesvar	67952	*120*	8.154	Amlakhadi River
98	Palitana	51934	*120*	6.232	
99	Mahuva	70633	*120*	8.476	
100	Dohad	79185	*120*	9.502	
101	Chandkheda	55477	*120*	6.657	
102	Una	51260	*120*	6.151	
103	Mangrol	55094	*120*	6.611	
104	Keshod	63253	*120*	7.590	
105	Unjha	53868	*120*	6.464	
106	Kadi	56241	*120*	6.749	
107	Visnagar	65826	*120*	7.899	
108	Mahesana	98987	*120*	11.878	
109	Bilimora	51087	*120*	6.130	Ambica River
110	Vijalpor	53912	*120*	6.469	
111	Sidhpur	53581	*120*	6.430	
112	Upleta	55341	*120*	6.641	
113	Dhoraji	80807	*120*	9.697	Bhadar River
114	Gondal	95991	*120*	11.519	
115	Modasa	54056	*120*	6.487	
116	Himatnagar	58267	*120*	6.992	
117	Bardoli	51963	*120*	6.236	
118	Wadhwan	61739	*120*	7.409	
119	Dhrangadhra	70653	*120*	8.478	
120	Dabhoi	54930	179	9.832	
121	Valsad	68825	141	9.704	
122	Vapi	71395	*120*	8.567	Amalkhadi/ Damanganga/ Kolak/ Par
	Haryana				
123	Ambala Cantt.	61625	*72*	4.437	
124	Tohana	51518	*72*	3.709	
125	Fatehabad	59863	*72*	4.310	
126	Hansi	75730	74	5.604	
127	Narwana	50659	*72*	3.647	
128	Narnaul	62091	*72*	4.471	
129	Mandi Dabwali	53812	*72*	3.874	
	Jammu & Kashmir				
130	Anantnag	63437	***112***	7.105	
131	Sopore	53246	***112***	5.964	
132	Baramula	61941	***112***	6.937	
133	Udhampur	59236	***112***	6.634	
	Jharkhand				
134	Phusro	83463	*92*	7.679	
135	Chas	96923	*92*	8.917	
136	Deoghar	98372	*92*	9.050	
137	Katras	51182	*92*	4.709	
138	Tisra	53547	*92*	4.926	
139	Sindri	76827	*92*	7.068	

S.No.	City	Population	Per capita sewage, l/d *	Total sewage, MLD	Treated sewage disposal **
140	Jharia	81979	*92*	7.542	
141	Jorapokhar	85218	*92*	7.840	
142	Bhuli	89584	*92*	8.242	
143	Giridih	98569	*92*	9.068	
144	Ramgarh Cantonment	73455	98	7.199	
145	Saunda	85037	*92*	7.823	
146	Jhumri Tilaiya	69444	105	7.292	
147	Daltonganj	71307	*92*	6.560	
148	Chaibasa	63615	*92*	5.853	
149	Bagbera	67100	*92*	6.173	
150	Sahibganj	80129	*92*	7.372	
	Karnataka				
151	Ilkal	51956	*94*	4.884	
152	Jamkhandi	57887	*94*	5.441	
153	Rabkavi Banhatti	70242	*94*	6.603	
154	Bagalkot	91596	*94*	8.610	
155	Yelahanka	93263	*94*	8.767	
156	Pattanagere	95769	*94*	9.002	
157	Channapatna	63561	*94*	5.975	
158	Rama-nagaram	79365	*94*	7.460	
159	Dod Ballapur	71509	*94*	6.722	
160	Nipani	58061	*94*	5.458	
161	Gokak	67166	*94*	6.314	
162	Basavakalyan	58742	*94*	5.522	
163	Chamrajnagar	60810	*94*	5.716	
164	Shahabad	50587	*94*	4.755	
165	Yadgir	58802	*94*	5.527	
166	Haveri	55900	*94*	5.255	
167	Ranibennur	89594	*94*	8.422	
168	Chik Ballapur	54938	*94*	5.164	
169	Chintamani	65456	*94*	6.153	
170	Koppal	56145	*94*	5.278	
171	Gangawati	93249	*94*	8.765	
172	Sindhnur	61292	*94*	5.761	
173	Sagar	50115	*94*	4.711	
174	Sira	50056	*94*	4.705	
175	Tiptur	53043	*94*	4.986	
176	Dandeli	53287	***112***	5.968	Kali River (Karnataka)
177	Sirsi	58711	*94*	5.519	
178	Karwar	62960	***112***	7.052	
	Kerala				
179	Kayamkulam	65299	*133*	8.685	
180	Thrippunithura	59881	*133*	7.964	
181	Kalamassery	63176	*133*	8.402	
182	Edathala	67137	*133*	8.929	
183	Kannur	63795	*133*	8.485	
184	Taliparamba	67441	*133*	8.970	

S.No.	City	Population	Per capita sewage, l/d *	Total sewage, MLD	Treated sewage disposal **
185	Payyannur	68711	*133*	9.139	
186	Thalassery	99386	*133*	13.218	
187	Kasaragod	52683	*133*	7.007	
188	Kanhangad	65499	*133*	8.711	
189	Changanassery	51960	*133*	6.911	
190	Kottayam	60725	*133*	8.076	
191	Cheruvannur	57111	*133*	7.596	
192	Beypore	66883	*133*	8.895	
193	Quilandy	68970	*133*	9.173	
194	Vadakara	75740	*133*	10.073	
195	Tirur	53650	*133*	7.135	
196	Malappuram	58490	*133*	7.779	
197	Manjeri	83704	*133*	11.133	
198	Ponnani	87356	*133*	11.618	
199	Thiruvalla	56828	*133*	7.558	
200	Nedumangad	56138	*133*	7.466	
201	Neyyattinkara	69435	*133*	9.235	
202	Kunnamkulam	51585	*133*	6.861	
	Madhya Pradesh				
203	Balaghat	75061	*72*	5.404	
204	Betul	83287	*72*	5.997	
205	Sarni	95015	*72*	6.841	
206	Chhatarpur	99519	*72*	7.165	
207	Datia	82742	*72*	5.957	
208	Pithampur	68051	*72*	4.900	
209	Dhar	75472	*72*	5.434	
210	Ashok Nagar	57682	*72*	4.153	
211	Dabra	56665	*72*	4.080	
212	Harda	61712	*72*	4.443	
213	Itarsi	93783	*72*	6.752	
214	Hoshangabad	97357	*72*	7.010	
215	Mhow Cantt.	85023	162	13.774	
216	Jabalpur Cantt.	66482	*72*	4.787	
217	Jaora	63736	*72*	4.589	
218	Bina Etawa	51189	140	7.166	
219	Sehore	90930	77	7.002	
220	Seoni	89799	93	8.351	
221	Shahdol	78583	*72*	5.658	
222	Shajapur	50086	*72*	3.606	
223	Sheopur	55026	*72*	3.962	
224	Tikamgarh	68572	*72*	4.937	
225	Basoda	62358	*72*	4.490	
226	Khargone	86443	127	10.978	
	Maharashtra				
227	Kopargaon	59996	*73*	4.380	
228	Sangamner	61958	*73*	4.523	
229	Shrirampur	81270	*73*	5.933	
230	Akot	80796	*73*	5.898	
231	Anjangaon	51163	*73*	3.735	
232	Bhandara	85034	123	10.459	

S.No.	City	Population	Per capita sewage, l/d *	Total sewage, MLD	Treated sewage disposal **
233	Ambejogai	69277	77	5.334	
234	Parli	88510	*73*	6.461	
235	Shegaon	52418	*73*	3.827	
236	Malkapur	61015	*73*	4.454	
237	Buldana	62979	*73*	4.597	
238	Khamgaon	88670	*73*	6.473	
239	Bhadravati	56679	*73*	4.138	
240	Ballarpur	89995	*73*	6.570	
241	Shirpur-Warwade	61688	*73*	4.503	
242	Basmath	57360	*73*	4.187	
243	Hingoli	69552	*73*	5.077	
244	Chopda	60865	*73*	4.443	
245	Chalisgaon	91094	*73*	6.650	
246	Amalner	91456	*73*	6.676	
247	Udgir	91908	*73*	6.709	
248	Kamptee	84340	*73*	6.157	
249	Nandurbar	94365	*73*	6.889	
250	Deolali	50617	*73*	3.695	
251	Manmad	72412	*73*	5.286	
252	Osmanabad	80612	*73*	5.885	
253	Baramati	51342	*73*	3.748	
254	Lonavala	55650	*73*	4.062	
255	Kirkee	76608	*73*	5.592	
256	Pune	80191	*73*	5.854	
257	Khopoli	58657	*73*	4.282	Patalganga River
258	N.Mumbai (Panvel,Raigarh)	81886	*73*	5.978	
259	Ratnagiri	70335	*73*	5.134	
260	Uran Islampur	58330	*73*	4.258	
261	Phaltan	50798	*73*	3.708	
262	Pandharpur	91381	120	10.966	
263	Palghar	52699	*73*	3.847	
264	Badlapur	97917	*73*	7.148	
265	Hinganghat	92325	*73*	6.740	
266	Karanja	60158	*73*	4.392	Panchganga
267	Washim	62863	*73*	4.589	
268	Pusad	67152	88	5.909	
	Meghalaya				
269	Tura	58391	***112***	6.540	
	Nagaland				
270	Kohima	78584	***112***	8.801	
	Orissa				
271	Balangir	85203	*90*	7.668	
272	Bargarh	63651	*90*	5.729	
273	Bhadrak	92397	*90*	8.316	
274	Dhenkanal	57651	*90*	5.189	
275	Paradip	73633	*90*	6.627	
276	Jharsuguda	75570	*90*	6.801	Ib River
277	Brajarajnagar	76941	*90*	6.925	Ib River
278	Bhawanipatna	60745	*90*	5.467	
279	Kendujhar	51832	*90*	4.665	

S.No.	City	Population	Per capita sewage, l/d *	Total sewage, MLD	Treated sewage disposal **
280	Barbil	52586	*90*	4.733	
281	Jatani	54550	*90*	4.910	
282	Sunabeda	58647	*90*	5.278	
283	Jeypur	76560	*90*	6.890	
284	Baripada	94947	142	13.482	
285	Rayagada	57732	*90*	5.196	
	Pondicherry *				
286	Karaikal	74333	***112***	8.325	
	Punjab				
287	Tarn Taran	55587	*150*	8.338	
288	Faridkot	71986	*150*	10.798	
289	Kot Kapura	80741	*150*	12.111	
290	Sirhind -Fategarh	50788	*150*	7.618	
291	Gobindgarh	55416	*150*	8.312	
292	Firozpur Cantt.	57418	*150*	8.613	
293	Fazilka	67424	*150*	10.114	
294	Fiozpur	95451	*150*	14.318	
295	Gurdaspur	67455	*150*	10.118	
296	Jagraon	60106	*150*	9.016	
297	Mansa	72608	*150*	10.891	
298	Malout	70958	*150*	10.644	
299	Muktsar	83099	*150*	12.465	
300	Nabha	61953	*150*	9.293	
301	Rajpura	82551	*150*	12.383	
302	Sunam	51024	*150*	7.654	
303	Sangrur	78717	*150*	11.808	
304	Barnala	96397	*150*	14.460	
	Rajasthan				
305	Banswara	85638	*66*	5.652	
306	Baran	78372	68	5.329	
307	Balotra	61724	*66*	4.074	
308	Barmer	83517	75	6.264	
309	Bundi	88312	70	6.182	
310	Nimbahera	53323	*66*	3.519	
311	Chittaurgarh	96028	67	6.434	Banas/ Berach River
312	Ratangarh	63463	*66*	4.189	
313	Sardarshahar	81378	*66*	5.371	
314	Sujangarh	83808	*66*	5.531	
315	Churu	97627	78	7.615	
316	Dausa	61589	*66*	4.065	
317	Bari	50475	*66*	3.331	
318	Dhaulpur	92137	74	6.818	
319	Suratgarh	58076	*66*	3.833	
320	Chomu	50717	*66*	3.347	
321	Jaisalmer	58286	*66*	3.847	
322	Nawalgarh	56482	*66*	3.728	
323	Karauli	66179	*66*	4.368	
324	Hindaun	84784	*66*	5.596	
325	Kuchaman City	50566	*66*	3.337	
326	Ladnu	57047	*66*	3.765	

S.No.	City	Population	Per capita sewage, l/d *	Total sewage, MLD	Treated sewage disposal **
327	Makrana	83289	*66*	5.497	
328	Nagaur	88313	*66*	5.829	
329	Rajsamand	55671	*66*	3.674	
330	Sawai Madhopur	97491	*66*	6.434	
331	GangapurCity	96794	*66*	6.388	
332	Fatehpur	78471	*66*	5.179	
	Tamil Nadu				
333	Kuniyamuthur	56901	*44*	2.504	
334	Udumalaipettai	58893	*44*	2.591	
335	Mettupalayam	66313	*44*	2.918	
336	Kurichi	76794	*44*	3.379	
337	Pollachi	88293	*44*	3.885	
338	Valparai	94962	112	10.636	
339	Panruti	55400	56	3.102	
340	Chidambaram	58968	56	3.302	
341	Virudhachalam	59300	*44*	2.609	
342	Dharmapuri	64444	54	3.480	
343	Krishnagiri	65024	*44*	2.861	
344	Hosur	84314	*44*	3.710	
345	Palani	67175	60	4.031	
346	Kasipalayam (E)	52500	*44*	2.310	
347	Gobichet-tipalayam	55150	*44*	2.427	
348	Dharapuram	65137	54	3.517	
349	Veerappan-chatram	72607	*44*	3.195	
350	Chengalpattu	62631	52	3.257	
351	Avaniapuram	51587	*44*	2.270	
352	Nagapattinam	92525	*44*	4.071	
353	Namakkal	53040	*44*	2.334	
354	Tiruchengode	80177	58	4.650	
355	Paramakudi	82239	*44*	3.619	
356	Ramanatha-puram	61976	*44*	2.727	
357	Mettur	53790	*44*	2.367	
358	Attur	58150	*44*	2.559	
359	Karaikkudi	86422	*44*	3.803	
360	Pattukkottai	65453	*44*	2.880	
361	Coonoor	50079	58	2.905	
362	Udhagaman-dalam	93921	*44*	4.133	
363	Kambam	58713	*44*	2.583	
364	Bodinayak-kanur	73430	77	5.654	
365	TheniAllinagaram	85424	55	4.698	
366	Madavaram	76793	*44*	3.379	
367	Thiruvarur	56280	*44*	2.476	
368	Mannargudi	61588	50	3.079	
369	Sankarankoil	53613	*44*	2.359	
370	Puliyankudi	60142	*44*	2.646	
371	Tenkasi	62828	*44*	2.764	
372	Kadayanallur	75604	49	3.705	
373	Arani	60888	*44*	2.679	
374	Kovilpatti	87458	*44*	3.848	
375	Arcot	50267	112	5.630	

S.No.	City	Population	Per capita sewage, l/d *	Total sewage, MLD	Treated sewage disposal **
376	Tirupathur	60803	*44*	2.675	
377	Arakonam	77453	*44*	3.408	
378	Vaniyambadi	85459	***112***	9.571	Palar River
379	Gudiyatham	91376	*44*	4.021	
380	Ambur	99855	*44*	4.394	
381	Tindivanam	67826	*44*	2.984	
382	Viluppuram	95439	*44*	4.199	
383	Sivakasi	72170	*44*	3.175	
384	Virudhunagar	73003	*44*	3.212	
385	Srivilliputhur	73131	*44*	3.218	
386	Aruppukkottai	83999	*44*	3.696	
	Uttar Pradesh				
387	Agra Contonment Board	56198	*96*	5.395	
388	Tanda	83079	*96*	7.976	
389	Auraiya	64598	*96*	6.201	
390	Mubarakpur	51080	123	6.283	
391	Baraut	85822	*96*	8.239	
392	Balrampur	72220	97	7.005	
393	Nawabganj	75087	*96*	7.208	
394	Baheri	58577	*96*	5.623	
395	Faridpur	61026	*96*	5.858	
396	Sherkot	52870	*96*	5.076	
397	Kiratpur	55310	*96*	5.310	
398	Chandpur	68359	*96*	6.562	
399	Nagina	71310	*96*	6.846	
400	Najibabad	79087	*96*	7.592	
401	Ujhani	51044	*96*	4.900	
402	Sahaswan	58194	*96*	5.587	
403	Jahangirabad	51369	*96*	4.931	
404	Sikandrabad	69902	*96*	6.711	
405	Khurja	98403	*96*	9.447	
406	Mughalsarai	88386	180	15.909	
407	Kasganj	92485	100	9.249	
408	Shikohabad	88075	*96*	8.455	
409	Dadri	57457	*96*	5.516	
410	Pilkhuwa	67191	*96*	6.450	
411	Muradnagar	74080	*96*	7.112	
412	Behta Hajipur	94414	*96*	9.064	
413	Ghazipur	95243	***112***	10.667	
414	Rath	55938	*96*	5.370	
415	Shahabad	67661	*96*	6.495	
416	Jalaun	50033	*96*	4.803	
417	Konch	50731	*96*	4.870	
418	Mauranipur	50886	*96*	4.885	
419	Hasanpur	53340	*96*	5.121	
420	Chhibramau	50279	*96*	4.827	
421	Kannauj	71530	*96*	6.867	Ganga/ Kali (E)
422	Kanpur	94780	*96*	9.099	
423	Gola Gokarannath	53832	*96*	5.168	
424	Lucknow	59593	*96*	5.721	

S.No.	City	Population	Per capita sewage, l/d *	Total sewage, MLD	Treated sewage disposal **
425	Mahoba	78806	*96*	7.565	
426	Mainpuri	89535	***112***	10.028	
427	Mawana	69199	*96*	6.643	
428	Meerut	93170	*96*	8.944	
429	Khatauli	58497	*96*	5.616	
430	Kairana	73046	*96*	7.012	
431	Shamli	89861	*96*	8.627	
432	Bisalpur	60680	*96*	5.825	
433	Bela Pratapgarh	71835	112	8.046	
434	Gangoh	53947	*96*	5.179	
435	Deoband	81706	*96*	7.844	
436	Bhadohi	74439	*96*	7.146	
437	Tilhar	52909	*96*	5.079	
438	Laharpur	50080	*96*	4.808	
439	Obra	52398	*96*	5.030	
440	Renukoot	53524	*96*	5.138	
441	Gangaghat	70817	*96*	6.798	
	Uttaranchal				
442	Roorkee	97064	113	10.968	
443	Rudrapur	88720	*96*	8.517	
444	Kashipur	92978	101	9.391	
	West Bengal				
445	Bishnupur	61943	*86*	5.327	
446	Kalna	52176	*86*	4.487	
447	Rampurhat	50609	*86*	4.352	
448	Suri	61818	96	5.935	
449	Bolpur	65659	*86*	5.647	
450	Gangarampur	53548	*86*	4.605	
451	Bally	92906	*86*	7.990	
452	Arambag	56129	*86*	4.827	
453	Alipurduar	73047	*86*	6.282	
454	Koch Bihar	76812	124	9.525	
455	Old Maldah	62944	*86*	5.413	
456	Ghatal	51586	*86*	4.436	
457	Jhargram	53158	*86*	4.572	
458	Contai	77497	*86*	6.665	
459	KharagpurRly. Settlement	88339	*86*	7.597	
460	Kandi	50345	*86*	4.330	
461	Dhulian	72906	*86*	6.270	
462	Jangipur	74464	*86*	6.404	
463	Phulia	50254	*86*	4.322	
464	Ranaghat	68754	*86*	5.913	
465	Chakdaha	86965	96	8.349	
466	New Barrackpur	83183	*86*	7.154	
467	Islampur	52766	*86*	4.538	
			Total	**2822**	

*Figures in italics are based on average water supply of state, other on sewage generation factor
** Shaded river stretches are already identified as most polluted stretches

Table 6 Sewage treatment plants in small towns having <50000 population

S.N.	City/Town and STP	Population, 2001	Sewage generation factor	Sewage generation, MLD	Capacity of STP, MLD	Year of STP's comm.	Technology of STP*	Sewage disposal	River basin
	Andhra Pradesh								
1	Bhadrachalam				4.00	2003	WSP		
	Haryana								
2	Chhchhrauli				1.00	2001	WSP		
3	Gharaunda				3.00	2004	WSP		
4	Gohana				3.50	2004	WSP		
5	Indri				1.50	2001	WSP		
6	Radaur				1.00	2001	WSP		
	Karnataka								
7	K R Nagar				1.45	2004	WSP		
8	Nanjagud				1.47	2001	WSP		
9	Sri Rangapatna				1.36	2001	WSP		
	Kerala								
10	Pamba				**4.50**	**2007**			
	Maharashtra								
11	Trimbakeshwar				1.00	2003	WSP		
	Madhya Pradesh								
12	Chapara				1.20	2001	KARNAL		
13	Keolari				0.75	2001	KARNAL		
	Orissa								
14	Talcher				**2.00**	**2005**	**WSP**		
	Punjab								
15	Phillaur				2.56	2004	WSP		
16	Sultanpur Lodhi				2.60	2003	WSP		
17	Nangal				5.68	1994	ASP		
18	Naya nangal				6.62	1994	ASP		
	Tamil Nadu								
17	Bhawani				3.94	2003	WSP		
	Uttaranchal								
18	Ranipur				8.00	2003			
19	Uttarkashi								
	…I				0.44	2004			
	…II				**1.00**	**2006**			
	Uttar Pradesh								
20	Anupshaher				2.56	2004	FAB		
21	Farrukhabad				3.96	1988	WSP		
	West Bengal								
22	Murshidabad				**1.90**	**2005**	**WSP**		
23	Jiaganj Ajimganj				**1.39**	**2006**	**WSP**		
24	Diamond Harbour				**0.52**	**2005**	**WSP**		
				Total	**56.64**				

*ASP: Primary Sedimentation+Activated Sludge Process, UASB: Upflow anaerobic sludge blanket reactor+Polishing pond, WSP: Waste Stabilization Ponds, TF: Primary Sedimentation+Trickling filter

**Capacities shown in bold are for the planned/under construction STPs

ANNEXURE II

DATA SHEETS OF PERFORMANCE EVALUATION STUDIES OF STPs

Performance of STPs in Bihar

35 MLD STP at Beur, Patna (02.03.05)

Design capacity of STP: 35 ML/d; Average flow reaching STP: **18-20** ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Primary clarifiers	2nos.: 28 m and 24 m dia, 3 m SWD	32.8 $m^3/m^2/d$ SOR, 2.2 hr HRT
Aeration tank	5 lines.: each having 3 aerators of 25 HP	
Final clarifier	32 m dia, 3.12 m SWD	**43.5** $m^3/m^2/d$ SOR, 1.72 hr HRT
Sludge digestor	2 nos.: 26 m dia and 11 m dia	
Sludge drying beds	8 nos.: 28 m x 15 m each 8 nos.: 32 m x 8 m each	Can handle about 405 m^3 sludge per day with a 8 day filling/ drying/ emptying cycle

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	8.18	52	120	116	798	$1.1x10^7$	$5x10^7$		
After primary clarifiers	8.15	20	72	60	468				
After final clarifier	7.49	18	72	66	432	$8x10^5$	$1.7x10^6$		
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant was receiving very low strength sewage and most of the treatment was achieved in primary stage itself.
ii) Plant faces problem of power failures and there is no standby arrangement.
iii) Plant faces problem of shortage of funds for operation and maintetance.
iv) Sludge scrapper of final clarifier is not functioning since January 2005.
v) One more final clarifier is required as SOR is high for the present final clarifier.
vi) The gas generated in sludge digestor is not utilized.
vii) One aeration tank and one final clarifiers are proposed in GAP

45 MLD STP at Saidpur, Patna (02.03.05)

Design capacity of STP: 45 ML/d; Average flow reaching STP: **22-25** ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Primary clarifiers	3nos.: 21 m dia each, 2.4 m SWD	43.3 $m^3/m^2/d$ SOR, 1.33 hr HRT
Aeration tank	4 lines.: each having 4 aerators of 12.5 HP	
Final clarifier	3 nos.: 30 m dia each, 2.6 m SWD 4 nos.: 7 m x 7 m dia each, 2.3 m SWD	21.2 $m^3/m^2/d$ SOR, 2.94 hr HRT
Sludge digestor		
Sludge drying beds	5400 m^2	Can handle about 405 m^3 sludge per day with a 8 day filling/ drying/ emptying cycle

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.45	90	264	96	674	$1.4x10^7$	$1.6x10^8$		
After primary clarifiers	7.65	40	144	68	544				
After Final clarifiers	7.91	12	40	76	456	$5x10^5$	$1.1x10^6$		
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant was receiving low strength sewage that is effectively treated in primary units before feeding to subsiquent activated sludge process. The activated sludge process recieves very low organic loading owing to low inlet BOD (40 mg/L) and low flow (50% of design flow). This condition may allow operation of few aerators instead of all just to fulfill the aeration and mixing requirements that will help reducing operation costs.
ii) Plant faces problem of power failures and there is no standby arrangement.
iii) Sludge scrapper of final clarifier is not functioning since January 2005.
iv) One more final clarifier is required.
v) The gas generated in sludge digestor is not utilized.
vi) One aeration tank and one final clarifiers are proposed in GAP

25 MLD STP at Pahari, Patna (02.03.05)

Design capacity of STP: 25 ML/d; Average flow reaching STP: **17** ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Aeratied lagoon	2 nos.: 200.5 x 47.5 x 4.6 m each; and 5 nos. aerators of 10 HP capacity each	3.5 d HRT
Fish pond	165 x 48.5 x 1.5 m	11.52 hour HRT

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.68	65	188	112	700	$9x10^7$	$2.4x10^8$		
After Aerated lagoon	8.04	23	100	74	492				
After Fish pond	8.32	20	80	90	472	$5x10^5$	$9x10^5$		
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant was receiving very low strength sewage.
ii) Plant faces problem of power failures and there is no standby arrangement.
iii) One lagoon was not functioning due to repairing of aeration system.
iv) Accumulation of sludge is less but desludgng may be needed once in few years.

Performance of STPs in Chandigarh

30 MGD STP at Mohali (Diggiyan), Chandigarh (17.05.05)

Design capacity of STP: 30 MG/d (136.38 ML/d); Average flow reaching STP: 45 MG/d
(30 MG/d is being treated)

Unit sizes and loading on main treatment units at full load condition:

15 MGD stream (10 MGD: primary+secondary+tertiary and 5 MGD primary+secondary treatment)

Treatment unit	Number/Size	HRT/SOR/Loading
Primary clarifiers	4nos.: for 5, 5, 2.5 and 2.5 MG/d each	
Aeration tank	2 nos.: for 7.5 MG/d each	
Secondary clarifier	2 nos.: for 7.5 MG/d each	
Tertiary clarifier	One: for 10 MGD only	
Sludge digestor	?	
Sludge drying beds	?	

Other 15 MGD stream (secondary treatment)

Treatment unit	Number/Size	HRT/SOR/Loading
Aeration tank	2 nos.: for 7.5 MGD each	
Secondary clarifier	2 nos.: for 7.5 MGD each	
Sludge digestor	?	
Sludge drying beds	?	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

First 15 MGD stream

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.0	227	548	311		$5x10^8$	$9x10^8$		50.5
After primary clarifiers	7.0	122	281	117					4.7
After sec.clarifiers(15MGD)	7.2	39	92	49					29.3
After tert.clarifiers(10MGD)	8.8	18	46	35					2.2

Second 15 MGD stream

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.0	227	548	311		$5x10^8$	$9x10^8$		50.5
After secondary clarifiers	7.1	43	134	67					7.5

Mixed streams

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Discharged into drain 5 MGD primary + secondary treated +15 MGD secondary treated +15 MGD untreated	7.1	112	246	251		$2.5x10^7$	$5x10^7$		8.0
Utilized for gardening Tertiary treated 10 MGD	8.8	18	46	35					2.2
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				
Standards for discharge on land									

Remarks:

i) Primary clarifiers of the first stream are not performing at optimum efficiency both in terms of percentage TSS removal (only 62%) and TSS in effluent (117 mg/L).

ii) Secondary treatment (ASP) unit of first stream providing 68% individual eficiency in terms of BOD reduction is not performing at the expected efficiency for a conventional ASP

iii) Secondary treatment (ASP) unit of second stream providing 81% individual efficiency in terms of BOD reduction is also not performing at the required efficiency for discharge of sewage in streams. If it is an extended aeration type ASP, as indicated by absence of primary treatment unit, then the observed efficiency is also less than expected from such systems.

iv) The two streams of secondary treated sewage of 5 MGD and 15 MGD are not conforming to the discharge standards individiully. These streams are combined and further mixed with 15 MGD untreated sewage and the total 35 MGD combined sewage is discharged into a drain.

v) 10 MGD tertiary treated sewage conforming to the standards for on land discharge is utilized for gardening.

vi) Overall housekeaping at the STP was not satisfactory.

1.25 MGD STP at Raipur Khurd, Chandigarh (17.05.05)

Design capacity of STP: 1.25 MG/d (5.62 ML/d); Average flow reaching STP: ? ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen and Grit chamber	One each	
Aeration tank	One: having 6 aerators of 20 HP each	
Final clarifier	One	
Sludge drying beds	8 nos.	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.1	236	781	689		$3x10^8$	$5x10^8$		6.5
Aeration tank				5859					
After Final clarifiers	7.7	15	25	42.8		$5x10^5$	$1.1x10^6$		6.9
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				
Standards for discharge on land									

Remarks:

i) Plant mostly serves urban villages and mixing of organic load of animal dung is expected.

ii) Treated effluent is utilised for irrigation.

iii) Overall performance of the plant is good.

Performance of STPs in Chhattisgarh

46 MLD STP at Kutelbhata village, Bhilai (Decmber 2002)

Design capacity of STP: 46 ML/d; Average flow reaching STP: ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Oxidation pond	One	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.4	66	672	180					
Final outlet	7.8	27	230	154			210		
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant was receiving low BOD sewage but COD/BOD ratio (10.2) is very high indicating possible mixing of industrial effluents.

ii) Plant is able to achieve prescribed norms in terms of BOD, COD and TSS.

14 MLD STP at Risali, Bhilai (Decmber 2002)

Design capacity of STP: 14 ML/d; Average flow reaching STP: ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Oxidation pond	One	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.6	75	634	190					
Final outlet	8.1	22	211	64		32	120		
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant was receiving low BOD sewage but COD/BOD ratio (8.5) is very high indicating possible mixing of industrial effluents.

ii) Plant is able to achieve prescribed norms in terms of BOD, COD and TSS.

9 MLD STP at Bhillai House, Bhilai (Decmber 2002)

Design capacity of STP: 14 ML/d; Average flow reaching STP: ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Oxidation pond	One	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.8	21	173	110					
Final outlet	8.4	14	49	70			105		
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

iii) Plant was receiving very low BOD sewage but COD/BOD ratio (8.5) is very high indicating possible mixing of industrial effluents.

iv) Plant is able to achieve prescribed norms in terms of BOD, COD and TSS.

Performance of STPs in Delhi

An specific publication on STPs of Delhi has been brought out by Central Pollution Control Board. However, results of two rounds of performance evaluation of STPs of Delhi are presented below:

S. No	STP	Technology	Date of study	Cap.	Flow	Sample	BOD	COD	TSS	Fecal Coliform	Total Coliform
1	DR.SEN NH-2.2	HR-BIO Filter-DEG	2003 Nov-Dec	10	10	Influent	236	585	370	1.02x10^{8}	1.33 x10^{8}
						Effluent	16	46	36	2.17 x10^{4}	2.4 x10^{5}
	--do--		2004 Sep	10	11	Influent	573	662	662	1 x10^{8}	3.1 x10^{9}
						Effluent	31	29	29	2.9 x10^{7}	3.3 x10^{7}
2	DELHI GATE-2.2	HR-BIO Filter-DEG	2003 Nov-Dec	10	10	Influent	147	605	263	1.9 x10^{7}	2.6 x10^{7}
						Effluent	20	62	26	1.1 x10^{6}	1.7 x10^{6}
	--do--		2004 Sep	10	10.91	Influent	209	394	176	8.0 x10^{8}	2.0 x10^{9}
						Effluent	46	120	25	2.1 x10^{7}	2.9 x10^{7}
3	RITHALA-NEW-40	HR-BIO Filter-DEG	2003 Nov-Dec	181.84	185.07	Influent	205	399	330	7.1 x10^{8}	1.08 x10^{9}
						Effluent	55	151	47	5.9 x10^{6}	4.9 x10^{7}
	--do--		2004 Sep	181.84	136.38	Influent	97	405	177	7.0 x10^{8}	1.0 x10^{9}
						Effluent	33	137	39	1.5 x10^{7}	3.2 x10^{7}
4	MEHRAULI -5	ASP-EXT.AER.	2003 Nov-Dec	22.73	4.95	Influent	126	326	251	2.1 x10^{8}	2.9 x10^{8}
						Effluent	7	35	12	2.0 x10^{4}	4.9 x10^{5}
	--do--		2004 Sep	22.73	2.273	Influent	179	338	169	4.0 x10^{8}	8.0 x10^{8}
						Effluent	6	46	18	8.0 x10^{5}	4.4 x10^{6}
5	VASANT KUNJ(2)-3	ASP-EXT.AER.	2003 Nov-Dec	13.63	4.36	Influent	306	565	479	3.9 x10^{7}	6.9 x10^{7}
						Effluent	20	80	49	1.01 x10^{5}	1.78 x10^{5}
	--do--		2004 Sep	13.63	5.046	Influent	299	484	321	5.0 x10^{8}	8.0 x10^{8}
						Effluent	11	58	13	8.0 x10^{5}	7.9 x10^{8}
6	TIMARPUR -6	OXIDATIO N P.	2003 Nov-Dec	27.27	4.79	Influent	106	272	412	1.08 x10^{7}	4.6 x10^{7}
						Effluent	4	26	11	4.1 x10^{3}	9.0 x10^{4}
	--do--		2004 Sep	27.27	9.092	Influent	110	224	172	1.0 x10^{8}	3.0 x10^{8}
						Effluent	17	51	50	1.0 x10^{6}	2.0 x10^{6}
7	CORO. PILLAR(1)-10	TRICKLING F.	2003 Nov-Dec	45.46	0	Influent					
						Effluent					
	--do--		2004 Sep	45.46	0	Influent					
						Effluent					
8	CORO. PILLAR(2)-20	ASP	2003 Nov-Dec	90.92	56.55	Influent	48	172	342	4.4 x10^{7}	7.8 x10^{7}
						Effluent	15	48	93	2.0 x10^{5}	7.0 x10^{5}

S. No	STP	Technology	Date of study	Cap.	Flow	Sample	BOD	COD	TSS	Fecal Coliform	Total Coliform
	CORO. PILLAR(2)-20		2004 Sep	90.92	43.46	Influent	148	278	205	3.0×10^{8}	4.0×10^{8}
						Effluent	21	57	17	4.1×10^{6}	4.7×10^{6}
9	CORO. PILLAR(3)-10	ASP	2003 Nov-Dec	45.46	40.84	Influent	112	317	179	3.2×10^{7}	3.9×10^{7}
						Effluent	18	61	35	1.1×10^{5}	2.0×10^{5}
	--do--		2004 Sep	45.46	52.507	Influent	140	273	156	3.0×10^{8}	4.0×10^{8}
						Effluent	19	44	18	3.0×10^{5}	7.0×10^{5}
10	GHITORNI-5	ASP	2003 Nov-Dec	22.73	0	Influent					
						Effluent					
	--do--		2004 Sep	22.73	0	Influent					
						Effluent					
11	KESHOPUR (1) -12	ASP	2003 Nov-Dec	54.55	0	Influent					
						Effluent					
	--do--		2004 Sep	54.55	0	Influent					
						Effluent					
12	KESHOPUR (2)-20	ASP	2003 Nov-Dec	90.92	95.1	Influent	282	560	404	1.35×10^{8}	4.3×10^{8}
						Effluent	45	149	78	7.2×10^{6}	9.1×10^{7}
	--do--		2004 Sep	90.92	90.92	Influent	246	386	248	1.0×10^{8}	
						Effluent	94	191	87		
13	KESHOPUR (3)-40	ASP	2003 Nov-Dec	181.84	106.46	Influent	282	560	404	1.35×10^{8}	4.3×10^{8}
						Effluent	10	55	21	5.1×10^{6}	1.15×10^{7}
	--do--		2004 Sep	181.84	183.21	Influent	257	397	269	4.0×10^{8}	7.0×10^{8}
						Effluent	20	61	23	1.3×10^{6}	2.3×10^{6}
14	KONDLI (1)-10	ASP	2003 Nov-Dec	45.46	56.55	Influent	241	507	363	3.2×10^{8}	**6.7** $\times 10^{8}$
						Effluent	27	140	68	1.39×10^{7}	2.4×10^{7}
	--do--		2004 Sep	45.46	34.959	Influent	155	252	212	2.0×10^{8}	4.0×10^{8}
						Effluent	28	123	55	7.0×10^{6}	1.4×10^{7}
15	KONDLI(2)-25	ASP	2003 Nov-Dec	113.65	57.96	Influent	261	588	604	**4.8** $\times 10^{8}$	**9.1** $\times 10^{8}$
						Effluent	34	50	45	1.8×10^{6}	5.5×10^{6}
	--do--		2004 Sep	113.65	83.648	Influent	192	420	212	3.0×10^{8}	8.0×10^{8}
						Effluent	5	48	11	3.0×10^{6}	5.0×10^{6}
16	KONDLI(3)-10	ASP	2003 Nov-Dec	45.46	28.36	Influent	237	615	519	3.7×10^{8}	**5.7** $\times 10^{8}$
						Effluent	14	50	16	1.4×10^{5}	2.7×10^{6}
	--do--		2004 Sep	45.46	42.324	Influent	192	420	212	3.0×10^{8}	8.0×10^{8}
						Effluent	18	129	68	1.1×10^{7}	2.3×10^{7}
17	NAJAFGARH-5	ASP	2003 Nov-Dec	22.73	2.27	Influent	54	205	165	5.1×10^{6}	1.09×10^{7}
						Effluent	1	38	29	1.2×10^{5}	3.2×10^{5}

S. No	STP	Technology	Date of study	Cap.	Flow	Sample	BOD	COD	TSS	Fecal Coliform	Total Coliform
	NAJAFGARH-5		2004 Sep	22.73		Influent					
						Effluent					
18	NILOTHI-40	ASP	2003 Nov-Dec	181.84	15	Influent	90	328	432	5.0×10^{7}	6.1×10^{7}
						Effluent	4	26	21	7.0×10^{4}	1.2×10^{5}
	--do--		2004 Sep	181.84	21.59	Influent	74	190	1105	2.0×10^{8}	4.0×10^{8}
						Effluent	3	41	15	1.2×10^{6}	2.3×10^{6}
19	NARELA-10	ASP	2003 Nov-Dec	45.46	2.5	Influent	100	447	426	1.0×10^{7}	1.7×10^{7}
						Effluent	8	72	38	4.0×10^{3}	1.1×10^{5}
	--do--		2004 Sep	45.46	7.319	Influent	151	331	122	4.0×10^{8}	6.0×10^{8}
						Effluent	34	104	29	3.0×10^{5}	8.0×10^{5}
20	OKHLA(1)-12	ASP	2003 Nov-Dec	54.55	39.09	Influent	204	517	498	6.5×10^{7}	3.7×10^{8}
						Effluent	10	54	21	2.3×10^{5}	2.9×10^{85}
	--do--		2004 Sep	54.55	52.735	Influent	206	411	364	8.0×10^{8}	1.1×10^{9}
						Effluent	4	33	3	1.0×10^{6}	3.0×10^{6}
21	OKHLA(2)-16	ASP	2003 Nov-Dec	72.73	40.91	Influent	207	486	291	2.7×10^{7}	5.1×10^{7}
						Effluent	48	108	83	5.3×10^{5}	9.9×10^{5}
	--do--		2004 Sep	72.73	67.282	Influent	206	411	364	8.0×10^{8}	1.1×10^{9}
						Effluent	18	60	32	1.0×10^{6}	8.0×10^{6}
22	OKHLA(3)-30	ASP	2003 Nov-Dec	136.38	136.98	Influent	222	551	647	1.07×10^{8}	2.04×10^{8}
						Effluent	45	153	76	2.5×10^{7}	1.2×10^{8}
	--do--		2004 Sep	136.38	122.744	Influent	206	411	364	8.0×10^{8}	1.1×10^{9}
						Effluent	48	138	33	2.2×10^{7}	5.1×10^{7}
23	OKHLA(4)-37	ASP	2003 Nov-Dec	168.2	159.11	Influent	249	515	480	1.11×10^{8}	1.97×10^{8}
						Effluent	12	62	32	7.1×10^{5}	1.28×10^{6}
	--do--		2004 Sep	168.2	150.93	Influent	206	411	364	8.0×10^{8}	1.1×10^{9}
						Effluent	20	48	24	3.0×10^{6}	5.0×10^{6}
24	OKHLA(5)-45	ASP	2003 Nov-Dec	204.57	181.84	Influent	249	515	480	1.11×10^{8}	1.97×10^{8}
						Effluent	19	51	27	6.0×10^{5}	4.1×10^{6}
	--do--		2004 Sep	204.57	190.026	Influent	206	411	364	8.0×10^{8}	1.1×10^{9}
						Effluent	8	42	6		
25	PAPANKALAN-20	ASP	2003 Nov-Dec	90.92	37.73	Influent	103	275	142	1.03×10^{8}	1.31×10^{8}
						Effluent	10	46	39	7.0×10^{4}	1.2×10^{5}
	--do--		2004 Sep	90.92	45.461	Influent	326	602	642	3.0×10^{8}	5.0×10^{8}
						Effluent	16	41	24	2.9×10^{6}	3.2×10^{6}
26	RITHALA-OLD-40	ASP	2003 Nov-Dec	181.84	46.28	Influent	205	399	330	7.1×10^{8}	**1.08** $\times 10^{9}$

S. No	STP	Technology	Date of study	Cap.	Flow	Sample	BOD	COD	TSS	Fecal Coliform	Total Coliform
						Effluent	14	54	75	4.6 x10^6	3.2 x10^7
	RITHALA-OLD-40		2004 Sep	181.84	45.461	Influent	110	374	148	7.0 x10^8	1.0 x10^9
						Effluent	17	64	18	5.0 x10^8	9.0 x10^5
27	ROHINI-15	ASP	2003 Nov-Dec	68.19	0	Influent					
						Effluent					
	--do--		2004 Sep	68.19	0	Influent					
						Effluent					
28	YAMUNAVIHAR (1)-10	ASP	2003 Nov-Dec	45.46	27.27	Influent	174	505	391	4.1 x10^8	**1.21** x10^9
						Effluent	17	84	44	4.6 x10^6	1.9 x10^7
	--do--		2004 Sep	45.46	7.728	Influent	195	513	245	1.0 x10^8	3.0 x10^8
						Effluent	5	59	27	3.0 x10^6	7.0 x10^6
29	YAMUNAVIHAR (2)-10	ASP	2003 Nov-Dec	45.46	14.77	Influent	199	538	405	3.7 x10^8	**1.57** x10^9
						Effluent	20	44	39	5.2 x10^6	8.5 x10^6
	--do--		2004 Sep	45.46	9.092	Influent	185	373	140	1.0 x10^8	7.0 x10^8
						Effluent	11	59	15	3.2 x10^7	4.2 x10^7
30	VASANT KUNJ(1)-2.2	ASP	2003 Nov-Dec	10	3.18	Influent	323	460	379	4.6 x10^7	7.1 x10^7
						Effluent	7	43	23	8.0 x10^3	1.7 x10^4
	--do--		2004 Sep	10	7.274	Influent	464	665	359	3.0 x10^8	7.0 x10^8
						Effluent	4	37	14	1.1 x10^6	9.5 x10^6
			Standards for discharge in streams				*30*	*250*	*100*		
			Sttandards for discharge in streams (Delhi)				*20*		*30*		

<u>Performance of STPs in Gujrat</u>

106 MLD STP at Pirana, Ahmedabadt (xxx)

Design capacity of STP: 106 ML/d; Average flow reaching STP: 100% of design capacity

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screens+Deteriters		
UASB reactors		
Facultative lagoons		
Sludge drying beds		

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.1	210	506	182	847	>1600	>1.6x10^6	22	
Final outlet	7.5	21	<u>118</u>	15	860	>1600	>1.6x10^6	34	
Standards for discharge prescribed by GPCB	*6.5-8.5*	*30*	*100*	*30*				*50*	
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant generates 17000 Kg/d sludge. Biological sludge is sold to farmers and is used as manure.

ii) UASB unit of the plant generates about 2000-4000 m^3/d biogas. This gas is used for electricity generation in dual fuel engines.

iii) Efffluent COD (118 mg/L) is higher than the limit (100 mg/L) prescribed by Gujrat Pollution Control Board. Other parameters are within the prescribed limits.

iv) Individual performance of UASB unit and facultative ponds cannot be commented upon as sample has not been collected at intermediate point.

126 MLD STP at Vasna, Ahmedabad (xxx)

Design capacity of STP: 126 ML/d; Average flow reaching STP: 100% of design capacity

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screens+Deteriters		
UASB reactors		
Pre-aerator/De-gasifier		
Flash mixer		
Clariflocculator		
Sludge drying beds		

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.3	155	753	218	1542	$5x10^4$	$3x10^6$	24	
Final outlet	7.4	<u>49</u>	<u>149</u>	<u>38</u>	1137	$5x10^4$	$3x10^6$	23	
Standards for discharge prescribed by GPCB	*6.5-8.5*	*30*	*100*	*30*				*50*	
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant generates 25000 Kg/d sludge. Biological sludge is sold to farmers and is used as manure.

ii) UASB unit of the plant generates about 2200 m^3/d biogas. This gas is used for electricity generation in dual fuel engines.

iii) Efffluent BOD, COD and SS exceed the limits prescribed by Gujrat Pollution Control Board. BOD exceeds even the general standards prescribed under the Environmental Protection Rules.

iv) Individual performance of UASB unit and the tertiary sedimentation cannot be commented upon as sample has not been collected at intermediate point.

44.5 MLD STP at Rajkot (03.02.2005)

Design capacity of STP: 44.5 ML/d; Average flow reaching STP: 44.5 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screens+Deteriters		
Facultative lagoons		
Aeration tank		
Final clarifier		
Sludge drying beds		

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.1	200	703	355	913			34	
Final outlet	7.5	<u>53</u>	<u>197</u>	<u>111</u>	946			45	
Standards for discharge prescribed by GPCB	*6.5-8.5*	*30*	*100*	*30*				*50*	
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Efffluent BOD, COD and TSS exceed the limits prescribed by Gujrat Pollution Control Board. BOD and TSS exceed even the general standards prescribed under the Environmental Protection Rules.

ii) Individual performance of Facultative lagoon and ASP unit cannot be commented upon as sample has not been collected at intermediate point.

iii) High TSS in final clarifier indicates that it is not operating well. A well performing ASP clarifier is expected to provide TSS< 50 mg/L in effluent.

86 MLD STP at Atladara, Vadodara, Gujrat (xxx)

Design capacity of STP: 86 ML/d; Average flow reaching STP: **43** ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Grit chamber		
UASB reactors		
Aeration tank		
Final clarifier		
Sludge thickener		
Sludge digestor		
Sludge drying beds		

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.45	125	647	66		>$1.6x10^4$	>$1.6x10^4$		
Final outlet	8.0	30	37	6		>$1.6x10^4$	>$1.6x10^4$		
Standards for discharge prescribed by GPCB	*6.5-8.5*	*30*	*100*	*30*				*50*	
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Efffluent BOD, COD and TSS are well within the limits of 20, 100 and 30 mg/L, respectively, prescribed by Gujrat Pollution Control Board.

ii) Individual performance of UASB unit and the tertiary sedimentation cannot be commented upon, as sample has not been collected at intermediate point.

iii) Sludge digestor unit of the plant generates about 1200 m^3/d biogas. This gas is used for electricity generation.

52 MLD STP at Tarsali, Vadodara (xxx)

Design capacity of STP: 52 ML/d; Average flow reaching STP: **18** ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Grit chamber		
Primary clarifier		
Aeration tank		
Final clarifier		
Sludge thickener		
Sludge digestor		
Sludge drying beds		

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.33	88.2	569	110		>$1.6x10^4$	>$1.6x10^4$		
Final outlet	7.78	15.6	90	13		>$1.6x10^4$	>$1.6x10^4$		
Standards for discharge prescribed by GPCB	*6.5-8.5*	*30*	*100*	*30*				*50*	
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Effluent BOD, COD and TSS are well within the limits of 30, 100 and 30 mg/L, respectively, prescribed by Gujrat Pollution Control Board.
ii) Individual performance of Primary clarifier and ASP unit cannot be commented upon, as sample has not been collected at intermediate point.
iii) UASB unit of the plant generates about 1900 m^3/d biogas. This gas is flarred.
iv) Gas generated in sludge digester is not utilized for lack of any arrangement.

66 MLD STP at Gajarwadi, Vadodara (xxx)

Design capacity of STP: 66 ML/d; Average flow reaching STP: **42** ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screens		
Grit chamber		
Primary clarifier		
Aeration tank		
Final clarifier		
Sludge thickener		
Sludge digestor		
Sludge drying beds		

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.05	162	634	81		>1.6x10^4	>1.6x10^4		
Final outlet	7.67	20	86	28		>1.6x10^4	>1.6x10^4		
Standards for discharge prescribed by GPCB	*6.5-8.5*	*30*	*100*	*30*				*50*	
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Effluent BOD, COD and TSS are well within the limits of 30, 100 and 30 mg/L, respectively, prescribed by Gujrat Pollution Control Board.
ii) Individual performance of Primary clarifier and ASP unit cannot be commented upon, as sample has not been collected at intermediate point.
iii) UASB unit of the plant generates about 6000 m^3/d biogas. This gas is flarred.
iv) Gas generated in sludge digester is not utilized for lack of any arrangement.

82.5 MLD STP at Anjana, Surat (xxx)

Design capacity of STP: 82.5 ML/d; Average flow reaching STP: **35-40** ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screens		
Grit chamber		
Primary clarifier		
Aeration tank		
Final clarifier		
Sludge thickener		
Sludge digestor		
Sludge drying beds		

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	6.91	93.7	748	138		>1.6x10^4	>1.6x10^4		
Final outlet	7.56	19.6	<u>106</u>	12		>1.6x10^4	>1.6x10^4		
Standards for discharge prescribed by GPCB	*6.5-8.5*	*30*	*100*	*30*				*50*	
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Efffluent BOD and TSS are well within the limits of 30 mg/L prescribed by Gujrat Pollution Control Board. However, COD is slightly higher than the prescribed limit because of very high COD in influent.

ii) Influent COD/BOD ratio is very high (=8) indicating possible mixing of some industrial effluent that must be investigated and rectified.

iii) Individual performance of Primary clarifier and ASP unit cannot be commented upon, as sample has not been collected at intermediate point.

iv) UASB unit of the plant generates about 1500 m^3/d biogas. This gas is flarred.

v) Gas generated in sludge digester is not utilized for lack of any arrangement.

120 MLD STP at Bhatar, Surat (xxx)

Design capacity of STP: 120 ML/d; Average flow reaching STP: **80-90** ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screens		
Grit chamber		
Primary clarifier		
Aeration tank		
Final clarifier		
Sludge thickener		
Sludge digestor		
Sludge drying beds		

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	6.92	101	439	53		>$1.6x10^4$	>$1.6x10^4$		
Final outlet	7.3	10.4	<u>180</u>	<u>35</u>		>$1.6x10^4$	>$1.6x10^4$		
Standards for discharge prescribed by GPCB	*6.5-8.5*	*30*	*100*	*30*				*50*	
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Efffluent BOD is within the limits of 30 mg/L but COD and TSS exceed the limits of 100 and 30 mg/L, respectively, prescribed by Gujrat Pollution Control Board. COD in influent.

ii) Individual performance of Primary clarifier and ASP unit cannot be commented upon, as sample has not been collected at intermediate point.

iii) UASB unit of the plant generates about 7000-8000 m^3/d biogas. This gas is flarred.

iv) Gas generated in sludge digester is not utilized for lack of any arrangement.

100 MLD STP at Singanapore, Surat (xxx)

Design capacity of STP: 100 ML/d; Average flow reaching STP: **50** ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screens		
Grit chamber		
Primary clarifier		
Aeration tank		
Final clarifier		
Chlorination		
Sludge thickener		
Sludge digestor		
Sludge drying beds		

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.17	62	601	128		>1.6x10^4	>1.6x10^4		
Final outlet	7.38	29	252	60		>1.6x10^4	>1.6x10^4		
Standards for discharge prescribed by GPCB	*6.5-8.5*	*30*	*100*	*30*				*50*	
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Efffluent BOD is within the prescribed limit but COD and TSS exceed the limits of 100 and 30 mg/L, respectively, prescribed by Gujrat Pollution Control Board.

ii) Influent COD/BOD ratio is very high (=9.7) indicating possible mixing of some industrial effluent that must be investigated and rectified.

iii) Individual performance of Primary clarifier and ASP unit cannot be commented upon, as sample has not been collected at intermediate point.

iv) UASB unit of the plant generates about 1100-1200 m^3/d biogas. This gas is flarred.

v) Gas generated in sludge digester is not utilized for lack of any arrangement.

Performance of STPs in Haryana

25 MLD STP at Yamunanagar/Jagadhari (March 05)

Design capacity of STP: 25 ML/d; Average flow reaching STP: (?) ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen and Grit channel		
UASB reactors	2 nos.: 40 x 24 x 5.5 m each	8 hr HRT
Polishing pond	323 x 63 x 1.2 m	24 hr HRT
Sludge drying beds	20 nos.: 16 m x 16 m each	Can handle about 384 m^3 sludge per day with a 8 day filling/ drying/ emptying cycle

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.3	194	501	492		2.3x10^6	3x10^6		1.55
After UASB reactors	7.1	113	499	128					2.27
After Polishing pond	7.1	39	131	51		1.1x10^5	1.7x10^5		1.40
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remark: UASB unit is functioning at suboptimal efficiency in terms of reduction in organic matter.
TSS in UASB outlet is also high.

10 MLD STP at Yamunanagar/Jagadhari (March 05)

Design capacity of STP: 10 ML/d; Average flow reaching STP: (?) ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen and Grit channel	10 x 4 m	
UASB reactors	2 nos.: 24 x 16 x 5.5 m each	8 hr HRT
Polishing pond	120 x 79 x 1.2 m	24 hr HRT
Sludge drying beds	12 nos.: 14 m x 14 m each	Can handle about 176 m^3 sludge per day with a 8 day filling/ drying/ emptying cycle

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.2	168	556	295		$8x10^5$	$1.7x10^6$		3.57
After UASB reactors	7.0	71	447	200					5.60
After Polishing pond	7.1	36	219	43		$4x10^5$	$8x10^5$		6.26
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:
- i) UASB unit is functioning at suboptimal efficiency in terms of COD reduction. TSS in UASB outlet is also high.
- ii) Polishing pond is effecting about 50% reduction to its inlet BOD/COD

40 MLD STP at Karnal (March 05)

Design capacity of STP: 40 ML/d; Average flow reaching STP: (?) ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen and Grit channel		
UASB reactors	4 nos.: 32 x 24 x 5.5 m each	8 hr HRT
Polishing pond	241 x 135 x 1.25 m	24 hr HRT
Sludge drying beds	20 nos.: 18 m x 18 m each	Can handle about 486 m^3 sludge per day with a 8 day filling/ drying/ emptying cycle

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.4	133	483	261		$8x10^6$	$1.3x10^7$		5.73
After Grit channel	7.5	170	487	266					6.04
After UASB reactors	7.7	28	165	53					5.90
After Polishing pond	7.9	19	91	17		$2x10^5$	$4x10^5$		5.78
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remark: The overall performance of the plant is very good.

8 MLD STP at Karnal (March 05)

Design capacity of STP: 8 ML/d; Average flow reaching STP: (?) ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Anaeribic ponds	2 nos.: 48 x 33 x 4 m each	
Oxidation ponds-I stage	2 nos.: 165 x 102 x 1.25 m each	
Maturation ponds-II stage	2 nos.: 165 x 102 x 1.25 m each	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.4	233	715	549		$8x10^6$	$1.3x10^7$		7.19
Final outlet of STP	8.0	11	61	17		$8x10^5$	$1.1x10^6$		6.36
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remark: The overall performance of the plant is very good.

35 MLD STP at Panipat (March 05)

Design capacity of STP: 35 ML/d; Average flow reaching STP: (?) ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen and Grit channel		
UASB reactors	2 nos.: 24 x 20 x 5 m each and 1no.: 32 x 24 x 5 m	8 hr HRT
Polishing pond	241.9 x 116 x 1.5 m	24 hr HRT
Sludge drying beds	20 nos.: 15.4 m x 15.4 m each	Can handle about 356 m^3 sludge per day with a 8 day filling/ drying/ emptying cycle

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.5	176	441	218		$8x10^6$	$1.3x10^7$		3.43
After Grit channel	7.5	168	418	157					3.71
After UASB reactors	7.6	91	332	53					2.67
After Polishing pond	7.6	83	254	17		$2x10^5$	$4x10^5$		3.45
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) UASB unit is functioning at suboptimal efficiency in terms of COD reduction.
ii) Polishing pond is also effecting only mariginal reduction in BOD.
iii) The overall performance of the plant is not satisfactory.

10 MLD STP at Panipat (March 05)

Design capacity of STP: 10 ML/d; Average flow reaching STP: (?) ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen and Grit channel		
UASB reactors	2 nos.: 24 x 18 x 5 m each	8 hr HRT
Polishing pond	128 x 64 x 1.5 m	24 hr HRT
Sludge drying beds	12 nos.: 14 m x 14 m each	Can handle about 176 m^3 sludge per day with a 8 day filling/ drying/ emptying cycle

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	6.7	955	2187	326		$8x10^7$	$2x10^8$		8.66
After Grit channel	6.5	955	2249	382					8.74
After UASB reactors									
After Polishing pond		365	796	176					
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant is receiving sewage of exceptionally high strength indicating mixing of industrial effluents in sewerage system.
ii) Plant is functioning at an overall BOD/COD removal efficiency of 60-65 %. TSS in Polishing pond outlet is very high. Outlet structure of Polishing pond may be checked.
iii) Plant is not able to comply with the discharge standards due to above reasons.

30 MLD STP at Sonipat (March 05)

Design capacity of STP: 30 ML/d; Average flow reaching STP: (?) ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen and Grit channel		
UASB reactors	3 nos.: each for 10 ML/d flow	8 hr HRT
Polishing pond	220 x 110 x 1.22 m	24 hr HRT
Sludge drying beds	22 nos.: 16 m x 16 m each	Can handle about 422 m^3 sludge per day with a 8 day filling/ drying/ emptying cycle

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.7	230	536	330		$4x10^7$	$3x10^8$		6.67
After UASB reactors	7.9	114	174	76					6.85
After Polishing pond	8.2	<u>64</u>	99	45		$3x10^5$	$5x10^5$		6.02
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) UASB unit is functioning at suboptimal efficiency in terms of reduction in organic matter. TSS in UASB outlet is also high.

ii) Polishing pond is also effecting 44% and 43% reduction in BOD and COD, respectively, which is rather low

iii) All sludge beds were filled with sludge and there was no further space for sludge.

iv) Plant is not able to comply with the discharge standards due to above reasons.

Performance of STPs in Himachal Pradesh

1.35 MLD STP at Snowdon, Shimla (April 05)

Design capacity of STP: 1.35 ML/d; Average flow reaching STP: (?) ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen	2 nos. 3.5 x 0.5 x 0.1 m SWD each	
Grit channel	2 nos. 4 x 0.6 x 1.15 m SWD each	
Extended Aeration tank	29.7 x 9.9 x 3 m with three aerators of 7.5 HP each	15.68 hr HRT,? d SRT, and 0.43 d^{-1} F/M at 3200 mg/L MLVSS and observed BOD
Secondary clarifier	9.85 m dia and 3 m SWD	17.7 $m^3/m^2/d$ SOR, 4.1hr HRT
Flash mixer	0.75 x 0.75 x 1 m	
Clariflocculator	7.7 m dia and 2.5 m SWD with 3.2 m dia flocculation zone	35 $m^3/m^2/d$ SOR, 2.1 hr HRT
Filter press for Sludge	One: 90 litre wet cake holding capacity	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	6.8	904	1931	2253		$1.7x10^8$	$9x10^8$		14.5
Aeration tank				665					
Final outlet of STPs	7.4	2	21	8		$9x10^5$	$1.4x10^6$		3.57
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant receives very high strength sewage. Its reasons need to be investigated.

ii) It is seen that even if the plant was operated at a MLSS level of 4000 mg/L (or 3200 mg/L MLVSS) it would run at an F/M ratio 0.43 for the observed influent BOD. Thus the plant can operate as conventional process and not as an extended process.

iii) Overall efficiency of the plant is very good. However, it appears that tertiary sedimentation played a major role in achieving this efficiency.

iv) Low MLSS in aeration tank indicates that the biological treatment is not being utilized to its full capacity. Optimum use of biological unit will help reducing chemical costs in tertiary treatment.

0.76 MLD STP at Dhalli, Shimla (April 05)

Design capacity of STP: 0.76 ML/d; Average flow reaching STP: (?) ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen	2 nos. 3.5 x 0.5 x 0.4 m SWD each	
Grit channel	2 nos. 4.7 x 0.5 x 0.15 m SWD each	
Extended Aeration tank	29.7 x 9.9 x 3 m with three aerators of 7.5 HP each	27.9 hr HRT, ? d SRT and 0.15 d^{-1} F/M at 3200 mg/L MLVSS and observed BOD
Secondary clarifier	9.85 m dia and 3 m SWD	10 $m^3/m^2/d$ SOR, 7.2 hr HRT
Flash mixer	0.75 x 0.75 x 1 m	
Clariflocculator	7.7 m dia and 2.5 m SWD with 3.2 m dia flocculation zone	19.7 $m^3/m^2/d$ SOR, 3.7 hr HRT
Filter press for Sludge	One: 90 litre wet cake holding capacity	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.3	550	755	552		$5x10^7$	$9x10^7$		10
Aeration tank				2950					
Final outlet of STPs	6.6	24	95	62		$1.4x10^6$	$1.4x10^6$		16.5
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant receives high strength sewage.
ii) Overall efficiency of the plant was very good.
iii) MLSS in aeration tank appear low for an extended aeration process. Use of Extended Aeration ASP to its fullest will help reducing chemical costs in tertiary treatment..
iv) A lttle high TSS value in tertiary sedimentation tank indicates that its performance can also be improved further.

3.93 MLD STP Summer Hill Shimla (April 05)

Design capacity of STP: 3.93 ML/d; Average flow reaching STP: (?) ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen	2 nos. 3.5 x 0.625 x 0.4 m SWD each	
Grit channel	2 nos. 13.5 x 0.9 x 0.5 m SWD each	
Extended Aeration tank	3 nos.: 25.1 x 12.55 x 3.6 m each with six aerators of 15 HP each	20.8 hr HRT,? d SRT and 0.13 d^{-1} F/M at 3200 mg/L MLVSS and observed BOD
Secondary clarifier	2 nos.: 15.85 m dia and 3 m SWD each	10 $m^3/m^2/d$ SOR, 7.2 hr HRT
Flash mixer	2.1 x 1.2 x 2 m	
Clariflocculator	17.1 m dia and 2.5 m SWD with 6.5 m dia flocculation zone	20 $m^3/m^2/d$ SOR, 3.5 hr HRT
Filter press for Sludge	One: 120 litre wet cake holding capacity	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.3	370	1102	464		$2x10^7$	$3.5x10^7$		21.7
Aeration tank				1942					
Final outlet of STPs	7.1	7	64	29		$2x10^5$	$2x10^5$		15
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Overall efficiency of the plant is very good.
ii) MLSS in aeration tank appear low for an extended aeration process. Use of Extended Aeration ASP to its fullest will help reducing chemical costs in tertiary treatment.

4.44 MLD STP at Maliana, Shimla (April 05)

Design capacity of STP: 4.44 ML/d; Average flow reaching STP: (?) ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen	2 nos. 5 x 0.7 x 0.4 m SWD each	
Grit channel	2 nos. 13.75 x 1 x 0.5 m SWD each	
Extended Aeration tank	2 nos.: 26.7 x 13.75 x 3.6 m each 1no. : 26.7 x 11.85 x 3.6 m with six aerators of 20 HP each	20.4 hr HRT,? d SRT and 0.09 d^{-1} F/M at 3200 mg/L MLVSS and observed BOD
Secondary clarifier	2nos. :16.9 m dia and 3 m SWD each	9.9 $m^3/m^2/d$ SOR, 7.3 hr HRT
Flash mixer	1.25 x 1.25 x 2 m	
Clariflocculator	18.55 m dia and 2.5 m SWD with 7.7 m dia flocculation zone	19.9 $m^3/m^2/d$ SOR, 3.65 hr HRT
Filter press for Sludge	One: 120 litre wet cake holding capacity	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.1	242	630	454		$3x10^8$	$5x10^8$		7
Aeration tank				4465					
Final outlet of STPs	7.4	15	45	24		$5x10^5$	$8x10^5$		10.6
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Overall efficiency of the plant is very good and ASP is operating in the usual range of F/M ratio for an extended prosses.

ii) Individual performance of the extended aeration process and the chemical aided tertiary sedimentation cannot be commented upon as intermediate sample was not collected.

5.8 MLD STP, North Disposal, Shimla (April 05)

Design capacity of STP: 5.8 ML/d; Average flow reaching STP: (?) ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen	2 nos. 5 x 0.75 x 0.8 m SWD each	
Grit channel	2 nos. 13.3 x 1.6 x 1 m SWD each	
Extended Aeration tank	3 nos.: 30.44 x 15.22 x 3.6 m each with six aerators of 25 HP each	20.7 hr HRT, ? d SRT and 0.16 d^{-1} F/M at 3200 mg/L MLVSS and observed BOD
Secondary clarifier	2 nos.: 19.5 m dia and 3 m SWD	19.9 $m^3/m^2/d$ SOR, 3.6 hr HRT
Flash mixer	2.45 x 1.65 x 2 m	
Clariflocculator	21.2 m dia and 2.5 m SWD with 8.8 m dia flocculation zone	20 $m^3/m^2/d$ SOR, 3.65 hr HRT
Filter press for Sludge	One: 120 litre wet cake holding capacity	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.2	452	1096	718		$1.7x10^8$	$5x10^8$		14.9
Aeration tank				2991					
Final outlet of STP	7.4	5	19	13		$1.4x10^6$	$2.2x10^6$		4
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Overall efficiency of the plant is very good.

ii) MLSS in aeration tank appear low for an extended aeration process. Use of Extended Aeration ASP to its fullest will help reducing chemical costs in tertiary treatment.

Performance of STPs in Karnataka

----MLD STP, Madiwala, Bangalore (xxx)

Design capacity of STP: ML/d; Average flow reaching STP: ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screens		
Grit channels		
UASB reactors		
Polishing ponds		
Sludge drying beds		

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	6.9	190	570	222	468				
Final outlet of STP	7.6	3	39	4	434				
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks: Overall efficiency of the plant is very good.

----MLD STP, K & C Valley, Bangalore (xxx)

Design capacity of STP: ML/d; Average flow reaching STP: ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Primary clarifiers ?		
Aeration tank		
Secondary clarifiers		
Sludge digester ?		
Sludge drying beds		

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.8	220	771	317	483				
Final outlet of STP	7.8	46	205	83	431				
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks: Overall efficiency of the plant is not satisfactory as the plant is not able to meet the prescribed standards in terms of BOD.

----MLD STP, V. Vally, Bangalore (xxx)

Design capacity of STP: ML/d; Average flow reaching STP: ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Primary clarifiers ?		
Biological filters		
Secondary clarifiers		
Sludge digester ?		
Sludge drying beds		

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.4	203	562	307	823				
Final outlet of STP	7.9	56	173	60	576				
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks: Overall efficiency of the plant is satisfactory as the plant is able to meet the prescribed standards in terms of BOD, COD and TSS.

----MLD STP, Hebbal, Bangalore (xxx)

Design capacity of STP: ML/d; Average flow reaching STP: ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Primary clarifiers ?		
Aeration tank		
Secondary clarifiers		
Sludge digester ?		
Sludge drying beds		

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.3	160	379	186	592				
Final outlet of STP	7.6	23	67	29	555				
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks: Overall efficiency of the plant is satisfactory as the plant is able to meet the prescribed standards in terms of BOD, COD and TSS.

Performance of STPs in Madhya Pradesh

1 MGD STP at South T. T. Nagar, Bhopal (xxx)

Design capacity of STP: 1 MG/d; Average flow reaching STP: MG/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screens		
Grit chamber		
Claridigestor		
Trickling filter		
Final clarifier		
Sludge drying beds		

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.06	167	380	190		20	1700	22	
After Claridigester	7.02	94	212	134					
Outlet of trickling filter	7.29	76	184	108					
Final outlet STP	7.27	67	169	136		Nil	200	20	
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Operation and maintenance of the plant is very poor and it is merely working as a holding tank. More over sewage is passed through the plant only for 6 hour duration every day during peak hours.

ii) Plant is not able to meet the prescribed norms.

2 MGD STP at Bherkheda, BHEL, Bhopal (25.09.04)

Design capacity of STP: 2 MG/d; Average flow reaching STP: ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screens		
Grit chamber		
Primary clarifier		
Bio filter		
Final clarifier		
Sludge drying beds		

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.27	77	144	113		>1600	>1600		
Final outlet STP	7.47	18	38	14		>1600	>1600		
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				
Standards for discharge on land									

Remarks:

i) Operation and maintenance of the plant is good.

ii) Overall performance of the plant is satisfactory so that the plant is able to meet the prescribed norms.

iii) About 16000 Ft gas is generated per day from the digester, which is fully utilized.

iv) Treated effluent from the plant is utilized for irrigation.

Performance of STPs in Maharashtra

16 MLD-Adharwadi primary sewage treatment plant, Kalyan (17.02.05)

Design capacity of STP: 16 ML/d; Average flow reaching STP: 16 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screens		
Grit chamber		
Primary treatment unit		
Sludge digester		
Sludge drying beds		

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	69	130	574	172	572	$1.1x10^6$	$1.1x10^6$	22	
Final outlet of primary STP	6.9	103	232	73	447	$9x10^5$	$9x10^5$	20	
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Installed capacity of sewage treatment (16 MLD Kalyan + 14 MLD Dombivali) is negligible compared to estimated 200 MLD total sewage generation from the city.

ii) Efficiency of primary clarifiers in terms of BOD reduction (21%) is less than expected. High effluent TSS value also indicate suboptimal performance of primary clarifier.

22 MLD STP at Triambak, Nashik (03.02.05)

Design capacity of STP: 22 ML/d; Average flow reaching STP: ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screens		
UASB reactor ?		
Sludge drying beds		

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	6.7	930	1574	2071	698			38	
Final outlet of STP	7.3	143	353	111	491			26	
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant operation and maintenance and housekeeping were very poor.
ii) Plant was not meeting the prescribed norms in terms of main pollutants BOD, COD and TSS

78 MLD STP at Nashik (03.02.05)

Design capacity of STP: 78 ML/d; Average flow reaching STP: 90-95 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screens		
UASB reactor		
Sludge drying beds		

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.5	138	328	114	392			38	
Final outlet of STP	7.5	51	172	9	395			26	
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant operation and maintenance and housekeeping were very poor.
ii) Plant was not meeting the prescribed norms in terms of BOD.

54 MLD Kopri STP at Thane (17.02.05)

Design capacity of STP: 54 ML/d; Average flow reaching STP: 49 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screens	2 nos.: 2 x 1.45 m each	
Grit channel	2 nos.: 9.6 x 9.6 x 1.3 m each	
Primary clarifiers	2 nos.: 30 m dia and 3 m SWD and 28.5 m dia and 3 m SWD	40 $m^3/m^2/d$ SOR, 1.8 hr HRT
Sludge thickener	11 m dia and 3 m SWD	
Sludge digesters	2 nos.: 24 m dia and 9 m SWD and 12.5 m dia and 6 m SWD	
Centrifuge	3000 L/hr	
Sludge drying beds		

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	6.8	105	331	119		3×10^6	3×10^6	21	
Final outlet of primary STP	6.9	56	179	74		5×10^4	9×10^4	16	
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Installed capacity of sewage treatment (56 MLD) is only about one fourth of estimated 216 MLD total sewage generation from the city.

ii) High effluent TSS value indicates suboptimal performance of primary clarifier.

iii) Plant was not meeting the prescribed norms in terms of main pollutant BOD.

Performance of STPs in Punjab

1.75 MGD (6.62 MLD) STP at Naya Nangal (17.05.2005)

Design capacity of STP: 1.75 MG/d (6.62 ML/d); Average flow reaching STP: (?) ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen and Grit channel	One	
Primary clarifier	One	
Aeration tank	One with four aerators of 10 HP each	
Secondary clarifier	One	
Chlorination		
Sludge drying beds	8 nos	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	6.8	93	322	271		$5x10^7$	$9x10^7$		
Final outlet of STPs	7.3	6.5	12.8	15.5		$2.3x10^7$	$8x10^7$		
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant receives low sewage of low BOD.

i) Overall efficiency of the plant is very good.

1.5 MGD (5.68 MLD) STP at Nangal (17.05.2005)

Design capacity of STP: 1.5 MG/d (5.68 ML/d); Average flow reaching STP: (?) ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen and Grit channel	One	
Primary clarifier	One	
Aeration tank	One with four aerators of 10 HP each	
Secondary clarifier	One	
Sludge digester	One	
Sludge drying beds	10 nos	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	6.7	63	174	82		$1.6x10^8$	$1.6x10^8$		1.8
Final outlet of STPs	7.4	5.3	9.3	13.8		$4x10^4$	$8x10^4$		4.4
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant receives low strength sewage.
ii) Overall efficiency of the plant is very good.
iii) Reduction of coliform is also of very high level.

2.6 MLD STP at Sultanpur Lodhi (18.05.2005)

Design capacity of STP: 2.6 ML/d; Average flow reaching STP: (?) ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Anaeribic pond	40.5 x 23 x 3.5 m	5 d HRT for all ponds
Facultative pond	136 x 55 x 2 m	--do--
Maturation pond	75.5 x 28 x 2 m	--do--

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.2	244	571	439		2.4×10^7	5×10^7		6.53
Final outlet of STP	7.8	13	93	24		9×10^5	4×10^6		6.87
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remark: At the time of power failures, whole sewage is bypassed. This defeats the purpose of having STP to an extent. Otherwise, observed overall efficiency of the plant in terms of reduction of organic matter and solids was good.

2.56 MLD STP at Phillore (18.05.2005)

Design capacity of STP: 2.56 ML/d; Average flow reaching STP: (?) ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Oxidation ponds	2 nos.: 72 x 30 x ? m	5 d HRT for all ponds
Maturation pond	72 x 30 x ? m	--do--
Sludge drying beds	27 nos.: 25 x 10 m each	--do--

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.4	111	318	274		9×10^7	9×10^7		2.0
Final outlet of STP	7.4	19	99	53		8×10^6	1.49×10^7		1.9
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remark: Plant is not looked after properly and no records are maintained. Otherwise, observed overall efficiency of the plant in terms of reduction of organic matter and solids was good.

Performance of STPs in Rajasthan

27 MLD STP at Jaipur (20.04.2005)

Design capacity of STP: 27 ML/d; Average flow reaching STP: **16** ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen channel	2 nos.:	
Grit channel	2 nos.:	
Extended Aeration tank	One	
Final clarifiers	One	
Sludge thickener	One	
Sludge digester	One	
Centrifuge	One	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.46	745	1558	964					0.20
After Grit channel	7.51	1013	2050	1196					0.20
Aeration tank				6048					
Recycled sludge				7280					
Final outlet of STP	7.84	<u>128</u>	<u>328</u>	<u>124</u>					0.02
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Fifty percent wastewater was being bypassed without treatment to Jalmahal lake even though capacity of the plant remained under utilized.

ii) At the time of study the plant was mainly receiving industrial effluent of textile processing units located in Grahmapuri instead of sewage and overall operation and maintenance of the plant was very poor. Screens and grit channels were not being cleaned and only 15 of the total 46 aerators were operational.

iii) As a consequence of high strength wastewater coming to STP and poor operation and maintenance, the plant was not able to meet the standards.

iv) High TSS in final clarifiier outlet also indicate that the plant is not operating properly.

<u>Performance of STPs in Uttar Pradesh</u>

2.7 MLD STP at Fatehgarh (xxx)

Design capacity of STP: 2.7 ML/d; Average flow reaching STP: (?) ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Oxidation ponds-first stage 1A & 1B	2 nos.: 150 x 100 x 1.4 m each	
Oxidation ponds-second stage	131 x 115 x 1.4 m	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	PH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.66	33	124	133		$8x10^6$& $1.7x10^7$	$1.7x10^7$ & $2.2 x10^7$		7.22
After Oxidation Pond 1A	8.32	36	248	168					2.85
After Oxidation Pond 1B	8.64	32	350	198					1.97
After final Oxidation Pond	9.13	<u>55</u>	232	<u>133</u>		$4x10^4$	$9x10^4$		1.88
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				
Standards for discharge on land									

Remark:

i) No reduction in BOD and an increase in COD are observed within the first stage oxidation ponds. Simillarly, an increase in BOD is observed in the second stage oxidation pond. This phenomenon can be attributed to algal growth, which was also observed physically. High TSS in oxidation ponds' effluents also supports this observation.

ii) Plant is not able to meet the standards for discharge in streams due to high algal growth eventhough it is receiving very dilute sewage.

iii) There is no standby arrangement of generator during power cuts for running sewage pumps.

iv) Treated sewage is utilized for irrigatio/farming.

5 MLD STP at Jajmau, Kanpur (June 2005)

Design capacity of STP: 5 ML/d; Average flow reaching STP: 4.7 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Bar Screen		
Grit channel	2 nos.: 13.5 x 0.9 x 0.35 m each	
UASB reactors	1 no.: 10.22 x 13.04 x 4.5 m SWD 2 nos.: 10.22 x 6.52 x 4.5 m SWD each	5.75 hrs HRT
Sludge drying beds		

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage		300	503	520					
After UASB reactors		90	220	81					
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Observed efficiency of UASB unit is terms of BOD reduction (70%) and COD reduction (56%) indicates that its performance can be improved further.

ii) Treated sewage quality does not conform to the standards for discharge in streams.

36 MLD STP at Jajmau, Kanpur (June 2005)

Design capacity of STP: 36 ML/d; Average flow reaching STP:**31** ML/d (**24** MLD on day of monitoring)
(27 MLD sewage+9 MLD ind. Effluent) (25 MLD sewage+6 MLD ind. Effluent)

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen channel (Industrial)	2 nos.: 9.4 x 2 x 0.3 m each	
Grit channel (Ind.)	2 nos.: 11.15 x 2 x 0.7 m each	
Equalization tank (Ind.)	2 nos.: 38 m dia and 3.84 m WD	24 hrs
Screen channel (sewage)	2 nos.: 8.56 x 1.2 x 0.3 m each	
Grit channel (sewage)	2 nos.: 9.63 x 1.5 x 0.63 m each	
Mixing tank	4.25 m dia and 3.24 m WD	
UASB reactors	2 nos.: 38.94x 20.8x 7.45 m SWD each	8 hrs HRT, 0.5 Kg COD/ Kg VSS
Sludge drying beds	64 nos.: 25 x 16 m each	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.87	480	793	954					
After UASB reactors	8.0	193	321	58					
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Observed efficiency of UASB unit is terms of BOD and COD reduction (60%) indicates that its performance can be improved further.

ii) Treated sewage quality does not conform to the standards for discharge in streams.

130 MLD STP at Jajmau, Kanpur (June 2005)

Design capacity of STP: 130 ML/d; Average flow reaching STP: **94** ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen channel	4 nos.: 3 mechanical + 1 manual	
Grit channel	3 nos.: 9.3 x 9.3 m each	
Primary clarifiers	3 nos.: 44 m dia and 3.5 m SWD each	28.5 m^3/m^2/d SOR, 2.95 hr HRT
Aeration tanks	3 nos: 52.5x 35x 5 m WD each	5.1 hrs HRT and 0.34 d^{-1} F/M* (design SRT: 9 d)
Final clarifiers	3 nos.: 48 m dia and 3.5 m SWD each	24 m^3/m^2/d SOR, 3.5 hr HRT
Sludge drying beds		

* at 2400 mg/L MLVSS and 0.65 times the observed BOD (assuming 35% removal in primary treatment),

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage		264		548					
Final outlet of STP		67		99					
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) The Sewage interception works at Kanpur are maintained and operated poorly. During heavy shortage of power (5 hr. load shedding) the sewage pumping station at Jajmau, Kanpur remains non-operational resulting in discharge of 25 to 30 MLD untreated sewage into R. Ganga every day.

ii) Individual performance of primary settling unit and ASP unit can to be commented upon. However, overall performance of the plant is suboptimal.

iii) Considering the minimal HRT of the aeration tank, it may not be possible to operate the plant at the recommended SRT of 9 days. However, if the plant could be operated at any SRT value higher than 5 day, it may provide sufficient safety factor.

iv) High TSS in final clarifiier outlet also indicate that the plant is not operating properly.

v) Treated sewage quality does not conform to the standards for discharge in streams.

vi) It is observed that the performance of plant can be improved further.

60 MLD STP at Allahabad (March 2005)

Design capacity of STP: 60 ML/d; Average flow reaching STP: **48.84** ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Primary clarifiers	3 nos.: 31 m dia each	2.49 hr HRT, 28 $m^3/m^2/d$ SOR
Aeration tanks	3 nos.: 17.8 x 16.6 x 5 m WD each with 9 aerators of 50 BHP each	12.3 hr HRT, 0.42 d^{-1} F/M*
Final clarifiers	3 nos.: 34 m dia each	3.26 hr HRT, 28 $m^3/m^2/d$ SOR
Sludge digesters	3 nos.: 27 m dia each	30 d HRT
Sludge drying beds	24 nos.: 24.6 x 24.6 m	

* at 2400 mg/L MLVSS and 0.65 times the observed BOD (assuming 35% removal in primary treatment),

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.6	115	439	276		$2.7x10^6$	$1.3x10^7$	40.3	2.5
After Primary clarifier 1	7.7	53	108	82				44.4	3.1
After Primary clarifier 2	7.8	50	161	71				49.0	2.71
After Primary clarifier 3	7.8	32	82	66				47.0	3.61
Aeration tank 1				512					
Aeration tank 2				798					
Aeration tank 3				1207					
After Secondary clarifier 1	8.0	23	29	32				44.2	2.26
After Secondary clarifier 2	8.0	28	51	47				45.1	2.14
After Secondary clarifier 3	8.0	29	35	39				40.0	3.19
Final outlet of STP	8.0	28	54	47		1.710^4	$2.2x10^6$	41.0	2.41
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Distribution of sewage to STP & bypass is not regular, sometimes plant gets huge amount of sewage & sometimes very low.

ii) Results of analysis of samples indicate that the primary settling units are performing fairly well in terms of BOD/COD reduction. Their operation needs further improvement to achieve <50 mg/L TSS in outlet.

iii) The low MLSS contents and further lower content of its organic proportions, MLVSS indicate that the plant is not properly operated. This may also be due to dilute inlet characteristics

iv) ASP unit is being fed with low organic load. Still, its performance in terms of percentage BOD/COD reduction is not upto the mark. Performance of biological unit can be improved. Scope for using fewer aerators can be studied.

v) Treated sewage quality conforms to the standards for discharge in streams.

vi) It is observed that the performance of plant can be improved further.

14 MLD STP at Mirzapur (March 2005)

Design capacity of STP: 14 ML/d; Average flow reaching STP: 13.78 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen channel	9.43 x 4.2 m	
Grit channel	2 nos.: 9.4 x 2 x 0.6 m each	
UASB reactors	2 nos.: 46.02x20.81x5.03 m SWD each	
Polishing pond	One	24 hour HRT
Sludge drying beds	12 nos.: 18 x 14 m each	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.5	125	326	279		$8x10^6$	$1.3x10^7$	24.46	3.06
After UASB reactor 1	7.4	51	176	104				27.73	4.04
After UASB reactor 2	7.8	44	177	99				30.23	4.23
Before Polishing pond	7.5	46	144	100				29.29	3.96
After Polishing pond	7.6	29	123	41		$2.7x10^5$	$3.3x10^5$	25.4	4.07
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant recieves low strength sewage.

ii) Gas formation in UASB system was found below optimum level and thus the treatment economics of the plant is being affected.

iii) Flow in inlet varied highly and thus put pressure on reactor's performance and in maintenance of sludge blanket.

iv) Proper screening must be ensured; otherwise it is delivering trash into the reactors.

v) Overall performance of the plant is satisfactory. TSS in UASB effluent seems higher. If it can be improved, efficiency of UASB in terms of BOD/COD will also improve correspondingly.

vi) Treated sewage quality conforms to the standards for discharge in streams.

12 MLD STP at Bhagwanpur, Varanasi (March 05)

Design capacity of STP: 12 ML/d; Average flow reaching STP: **10.82** ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screens	2 nos.: 2 x 0.5 x 1 m each	
Grit chambers	2 nos.: 7.15 x 1.2 x 1.3 m each	
Primary clarifiers	2 nos.: 4.6 m dia and 3.5 m SWD each	3 hr HRT, $m^3/m^2/d$ SOR
Aeration tanks	2 nos.: 15.6 m dia and 3.5 m WD each with aerators of 130 BHP	2.7 hr(?) HRT, 0.21 d^{-1} F/M*
Final clarifiers	2 nos.: 16 m dia and 3.5 m SWD each	3.5 hr HRT $m^3/m^2/d$ SOR
Fish Pond	45 x 45 x 2 m	
Sludge digesters	2 nos.: 18 m dia and 8 m WD each	
Sludge drying beds	9 nos.: 28 x 12 m each	

* at 2400 mg/L MLVSS and 0.65 times the observed BOD (assuming 35% removal in primary treatment),

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.7	86	169	113		$2.3x10^6$	$5x10^6$	10.9	1.8
After Primary clarifier 1	7.5	43	135	70				9.1	1.8
After Primary clarifier 2	7.5	27	96	43				3.3	2.1
Aeration tank 1				150					
Aeration tank 2				704					
After Secondary clarifier 1	7.6	30	158	161		$8x10^4$	$1.1x10^5$	3.4	1.8
After Secondary clarifier 2	7.6	8	59	23		$7x10^4$	$8x10^4$	8.3	1.6
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Results of analysis of samples indicate that the primary settling units are performing fairly well in terms of BOD/COD reduction. Their operation needs further improvement to achieve <50 mg/L TSS in outlet.

ii) ASP unit is being fed with low organic load. Still, its performance in terms of percentage BOD/COD reduction is not upto the mark. Performance of biological unit can be improved. Scope for using fewer aerators can be studied.

iii) Treated sewage quality conforms to the standards for discharge in streams.

iv) It is observed that the performance of plant can be improved further.

80 MLD STP at Dinapur, Varanasi (March 2005)

Design capacity of STP: 80 ML/d; Average flow reaching STP: 81.63 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Primary clarifiers	3 nos.: 31.2 m dia and 3.5 m SWD each	2.4 hr HRT, 35 $m^3/m^2/d$ SOR
Trickling filters	3 nos. 22.5 m dia and 1m depth each	
Aeration tanks	3 nos.: 60 x 20 x 3.75 m WD each with 9 aerators of 10 BHP each	4.05 hr(?) HRT, 0.25 d^{-1} F/M*
Final clarifiers	3 nos.: 40 m dia and 3.5 m SWD each	4 hr HRT, 21.2 $m^3/m^2/d$ SOR
Sludge digesters	2 nos.: 21 m dia and 8.7 m WD each	2500 m^3 each
Sludge drying beds	25 nos.: 30 x 30 m each 3 nos.: 30 x 20 m each +1 no.: 30 x 15 m	

* at 2400 mg/L MLVSS and 0.65 times the observed BOD (assuming 35% removal in primary treatment),

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.3	156	438	417		$2.3x10^6$	$5x10^6$	42	1.99
After Primary clarifier 1	7.5	90	238	195				42	1.65
After Primary clarifier 2	7.4	89	263	181				45	1.30
After Primary clarifier 3	7.4	80	172	144				49	1.84
After Trickling filter 1	7.4	79	253	149				54	1.47
After Trickling filter 2	7.4	66	215	142				49	1.50
After Trickling filter 3	7.5	62	227	167				50	1.44
Aeration tank 1				3257					
Aeration tank 2				2347					
Aeration tank 3				2903					
After Secondary clarifier 1	7.7	26	96	55				35	1.59
After Secondary clarifier 2	7.6	37	85	42				50	0.61
After Secondary clarifier 3	7.8	25	46	54				50	0.50
Final outlet	7.7	27	72	53		$7x10^4$	$8x10^4$	40	0.92
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Results of analysis of samples indicate that the primary settling units are performing well in terms of BOD/COD reduction but not in terms of outlet TSS. Their operation needs to be improved to achieve <50 mg/L TSS in outlet.

ii) ASP unit is being fed with low organic load. Still, its performance in terms of percentage BOD/COD reduction is not upto the mark because of BOD/COD associated with escaping solids. Scope for using fewer aerators can be studied.

iii) Treated sewage quality conforms to the standards for discharge in streams.

iv) It is observed that the performance of plant can be improved further.

12 MLD STP at DLW, Varanasi (xxx)

Design capacity of STP: 12 ML/d; Average flow reaching STP: ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Grit chamber	2 nos.: 6.15 x 1 x 1.3 m each	
Primary clarifiers	2 nos.: 13.24 m dia and 3.8 m SWD each	2.1 hr HRT, 43.6 $m^3/m^2/d$ SOR
Aeration tanks	2 nos.: 15 x 14 x 3.38 m WD each with 2 aerators of 10 HP each	2.84 hr(?) HRT, 0.37 d^{-1} F/M*
Final clarifiers	2 nos.: 16.8 m dia and 3.5 m SWD each	3.1 hr HRT 27.1 $m^3/m^2/d$ SOR
Sludge digesters	2 nos.: 14 m dia and 6 m WD each	2500 m^3 each
Sludge drying beds	10 nos.: 28 x 12 m each	

* at 2400 mg/L MLVSS and 0.65 times the 160 mg/L BOD (assuming BOD same as for other plant and 35% removal in primary treatment),

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage									
After Primary clarifier									
Aeration tank									
Final outlet									
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant is always under loaded (3-4MLD) and has always been receiving highly diluted sewage. Intermittent sewage supply from the Main Pumping Station (MPS) is a major problem.

ii) Raw sewage characteristics are appreciably diluted and this makes plant operation difficult as the plant has been designed for higher organic loading.

42 MLD STP at Lucknow (28.02.05)

Design capacity of STP: 42 ML/d; Average flow reaching STP: Approx. 40 ML/d
(Instant values varied widely between 290 m^3/hr to 2900 m^3/hr)

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screens	4 nos.: 6.8 x 1 x 0.566 m each	
Grit chambers	3 nos.: 6 x 6 x 1 m each	
Primary clarifiers	3 nos.: 31.2 m dia and 3.5 m SWD each	4.6 hr HRT, 18.31 m^3/m^2/d SOR
Fluidized aerobic bed reactors	6 nos.: 10.6 m dia and 5.5 m WD each	
Secondary clarisettlers	3 nos.: 17.5 m dia and 3.75 m SWD each	1.55 hr HRT, 58.2 m^3/m^2/d SOR
Chlorine contact tank	3 nos.: 21.5 m dia and 2.75 m WD	
Sludge thickener	14.4 m dia and 3 m SWD	
Sludge drying beds	11 nos.: 16 x 15 m each 3 nos.: 16 x 12.5 m each 4 no.: 7.5 x 7.5 m each	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.8	153	297	275		$1.6x10^{10}$	$1.6x10^{11}$		
After Grit chamber		139	293	285					
After FAB reactor 1		122	259						
After FAB reactor 2		121	186						
After FAB reactor 3		127	241						
After Clarisettler 1		45	97	52					
After Clarisettler 2		63	145	106					
After Clarisettler 3		61	158	124					
Final outlet	7.9	<u>58</u>	132	<u>107</u>		$1.5x10^9$	$1.9x10^9$		
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant operation and maintenance is very poor as indicated by fluctuation in flow being fed to the plant and high TSS in final califiers' outlet.

ii) Final clarifiier being an integral part of aerobic biological system for it seperates settleable organic matter and results in a clarified effluent, proper operation of final clarifiers is key to achieve better overall efficiency. It is observed that overall performance of the plant could have improved if clarifiiers were operated properly. SOR is too high.

iii) Treated sewage quality does not conform to the standards for discharge in streams.

38 MLD STP at Saharanpur (March 2005)

Design capacity of STP: 38 ML/d; Average flow reaching STP: **26** ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen chamber	2 nos.: 10 x 5 x 2 m and 10 x 5 x 1.8 m	
Grit channel	3 nos.: 2 x 2 x 1.65 m each	
UASB reactors	4 nos.: 28 x 24 x 5.55 m each	
Polishing pond	2 nos.: 12667.5 m2 each	
Sludge drying beds	20 nos.: 25 x 14 m each	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.5	67	440	415		$8x10^5$	$2.3x10^6$		3.34
After Grit channel	7.5	67	465	320					3.29
After UASB reactor	7.3	18	135	64					4.50
After Polishing pond	7.3	8	99	24		$1.4x10^5$	$1.7x10^6$		4.64
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant recieves low BOD sewage but COD to BOD ratio of raw sewage (6.6) is quit high indicating possiblity of industrial waste being mixed with sewage.

ii) Overall performance of the plant is satisfactory.

iii) Treated sewage quality conforms to the standards for discharge in streams.

iv) Of the two polishing ponds, only one was in use and the other was damaged.

v) During power cuts of arround 10 hr per day, the sewage is bypassed untreated.

32.5 MLD STP at Muzzafarnagar (March 05)

Design capacity of STP: 32.5 ML/d; Average flow reaching STP: ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen chamber	2 nos.:	
Grit channel	3 nos.:	
Primary ponds	2 nos.: 10.5 ha area and 1.5 m depth each	
Secondary ponds	2 nos.: 10.5 ha area and 1.1 m depth each	
Sludge drying beds	20 nos.: 25 x 14 m each	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.4	156.6	564	570		$1.9x10^7$	$1.9x10^7$		5.19
After Secondary pond 1	8.5	23.7	205	70					3.29
After Secondary pond 2	8.4	41.9	218	72					2.83
Final outlet (Average of the two secondary ponds)	8.5	<u>32.8</u>	111.5	71		$9.5x10^5$	$4.6x10^6$		3.06
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant is not able to achieve the discharge standards in terms of BOD.

ii) It was obseved that the primary ponds were nearly full with sludge and their cleaning was over due. This condition must have led to reduced efficiency

iii) TSS in final effluent is also high. Control of TSS by checking adequacy of outlet structures will also help in improving overall efficiency of the plant.

70 MLD STP at Cis Hindon area Ghaziabad (xxx)

Design capacity of STP: 70 ML/d; Average flow reaching STP: **55** ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen chamber	4 nos.: 6 x 2.5 x 1.13 m each	
Grit channel	4 nos.: 20 x 2.75 x 1.5 m each	
UASB reactors	4 nos.: 40 x 32 x 6.38 m each	
Polishing pond	2 nos.: 190 x 144 x 1.5 m each	
Sludge drying beds	16 nos.: 35.5 x 23.66 m each	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.3	209	608	479		1.7×10^6	1.3×10^6		5.18
After Grit channel	7.3	178	500	379					4.82
After UASB reactor	7.4	80	248	105					5.24
After Polishing pond	7.4	50	149	40		2×10^5	2.4×10^6		4.01
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Overall performance of the plant is not satisfactory and plant is not able to achieve the norms for dicharge in strems.

ii) Effiency of UASB reactor in terms of COD reduction is less. High TSS in UASB outlet appaers to be main reason for this.

iii) Efficiency of polishing pond unit in terms of BOD/COD reduction is also low because only one pond was in use the other was closed for removal of accumulated sludge.

iv) Gas generated in UASB reactors is not being utilized in dual fuel generators.

56 MLD STP at Trans Hindon area Ghaziabad (xxx)

Design capacity of STP: 56 ML/d; Average flow reaching STP: ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen chamber	2nos.: 5 x 1.6 m each 2nos.: 5 x 1.3 m each	
Grit channel	4 nos.: 20 x 2 x 1.5 m each	
UASB reactors	4 nos.: 32 x 32 x 6.1 m each	
Polishing pond	2 nos.: 180 x 120 x 2 m each	
Sludge drying beds	16 nos.: 35.5 x 23.66 m each	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
After Grit channel	7.1	140	325	228					
After UASB reactor	7.3	51	145	68					
After Polishing pond	7.3	37	114	39		1.3×10^5	2.4×10^6		
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Overall performance of the plant is not satisfactory and plant is not able to achieve the norms for dicharge in strems.

ii) Efficiency of polishing pond unit in terms of BOD/COD reduction is low because only one pond was in use the other was closed for removal of accumulated sludge.

iii) Gas generated in UASB reactors is not being utilized in dual fuel generators.

27 MLD STP at Sector 54 NOIDA (xxx)

Design capacity of STP: 27 ML/d; Average flow reaching STP: 27 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen channel (for 36 MLD flow)	2nos.: 6 x 2 x 1 m each	
Grit channel (for 36 MLD flow)	3 nos.: 21.2 x 2 x 1.28 m each	
UASB reactors	3 nos.: 26 x 24 x 5.9 m each	
Polishing pond	2 nos.: 111.5 x 95 x 1.3 m each	
Sludge drying beds	10 nos.: 25.58 x 15 m each	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.06	139	454	317		$8x10^6$	$2.3x10^7$		3.75
After Grit channel	7.15	151	559	161					3.79
After UASB reactor	7.22	62	213	90					5.70
After Polishing pond	7.38	30	99	47		$8x10^4$	$3x10^5$		5.11
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Overall performance of the plant is such that it is just able to achieve the norms for dicharge in strems.
ii) Efficiency of polishing pond unit in terms of BOD/COD reduction is low.
iii) Gas generated in UASB reactors is not being utilized in dual fuel generators.
iv) Plant receives 36 MLD flow of which 9 MLD is diverted after Grit channel to another 9 MLD plant based on oxidation pond technology.

34 MLD STP at Sector 50 NOIDA (xxx)

Design capacity of STP: 34 ML/d; Average flow reaching STP: 34 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen channel	2nos.: 6.25 x 2 x 1.2 m each	
Grit channel	3 nos.: 20 x 2 x 1.25 m each	
UASB reactors	4 nos.: 24 x 24 x 5.9 m each	
Polishing pond	2 nos.: 237.4 x 55.1 x 1.3 m each	
Sludge drying beds	16 nos.: 22.7 x 13.4 m each	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.07	92	330	183					3.14
After Grit channel	7.20	114	418	280		$1.7x10^7$	$3x10^7$		3.53
After UASB reactor	7.11	47	221	70					4.43
After Polishing pond	7.59	35	123	31		$4x10^5$	$4x10^5$		4.89
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant receives low BOD sewage but COD to BOD ratio (3.6) is high.
ii) Overall performance of the plant is not satisfactory and it is not able to achieve the norms for dicharge in strems inspite of low BOD raw sewage.
vii) Efficiency of polishing pond unit in terms of BOD/COD reduction is very low.

9 MLD STP at Sector 54 NOIDA (xxx)

Design capacity of STP: 9 ML/d; Average flow reaching STP: 9 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen channel (for 36 MLD flow at 27 MLD plant)	2nos.: 6 x 2 x 1 m each	
Grit channel (for 36 MLD flow at 27 MLD plant)	3 nos.: 21.2 x 2 x 1.28 m each	
Oxidation ponds	2 nos.:	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.02	161	616	363					4.63
Final outlet	7.45	39	178	134		$1.3x10^5$	$2.3x10^5$		0.42
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks: Plant is not maintained properly and is not able to achieve the discharge standards.

10.445 MLD STP at Etawah (July 5, 2005)

Design capacity of STP: 10.445 ML/d; Average flow reaching STP: 16 ML/d

10.445 ML/d treated in plant

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Anaerobic ponds	2 nos.: 832.69 m^2 and 672.06 m^2	1 d HRT
Primary facultative ponds	3 nos.: 9728.2 m^2, 6319 m^2 and 5007.04 m^2	4 d HRT for two stages
Secondary facultative ponds	2 nos.: 4777.41 m^2 and 6154.99 m^2	..do..

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.70	52	262	434		$3x10^6$	$7x10^6$		4.4
Final outlet	8.02	21	167	118		$4x10^4$	$8x10^4$		3.1
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant receives low BOD sewage but COD to BOD ratio (5) is high.

ii) Plant is not able to meet the standards in terms of TSS which is 118 mg/L in final effluent. High TSS in effluent primarily consisted of algae.

iii) Improvement in outlet structure to arrest floating algal floccs will help reducing outlet TSS and increase effiency of BOD/COD removal.

iii) Plant receives 16 MLD effluents. 10.445 MLD is treated in the plant and the rest is bypassed untreated. Epantion of the plant is proposed in Phase-3

0.5 MLD STP at Kali Deh, Vrindavan (March 29, 2005)

Design capacity of STP: 0.5 ML/d; Average flow reaching STP: **0.315** ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Anaerobic ponds	2 nos.: depth 3.5 m	
Primary facultative ponds	4 nos.: depth 1.5 m	
Secondary facultative ponds	2 nos.: depth 1.5 m	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.3	118	407	329		$5x10^7$	$9x10^7$		3.81
Final outlet	7.4	57	223	74		$1.7x10^6$	$1.7x10^6$		4.38
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) About half of the sewage reaching STPs was being bypassed and only half was taken for treatment in the plant.
ii) Excess sludge accumulation was observed in anaerobic and facultative ponds, which reduced retention time and efficiency.
iii) Plant is not able to meet the standards in terms of BOD, which was 57 mg/L in the final effluent.
iv) Plant is facing problem of availability of funds for operation and maintenance.

4 MLD STP near Pagal Baba Mandir, Vrindavan (March 30, 2005)

Design capacity of STP: 4 ML/d; Average flow reaching STP: **8.2** MLDML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Anaerobic ponds	2 nos.: 47 x 34 x 3.5 m each	
Primary facultative ponds	4 nos.: 94.6 x 44.6 x 1.5 m each	
Secondary facultative ponds	2 nos.: 94.6 x 44.6 x 1.5 m each	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.49	240	628	554		$8x10^7$	$1.3x10^8$		8.15
Final outlet	7.56	125	197	108		$1.1x10^6$	$6.54x10^6$		6.54
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant was overloaded because more than twice the design flow was reaching the plant.
ii) Excess sludge accumulation was observed in ponds, which reduced retention time and efficiency.
iii) Plant is not able to meet the standards in terms of BOD and SS.
iv) Overloading, reduced retention time are the main reasons responsible for poor performance of the plant. However, improvement in outlet structures may be required to control high TSS, and the associated BOD/CODin the effluent.
v) Plant is facing problem of availability of funds for operation and maintenance.

13.59 MLD STP at Masani, Mathura (March 29, 2005)

Design capacity of STP: 13.59 ML/d; Average flow reaching STP: 15.4 MLDML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Anaerobic ponds	2 nos.: 90 x 50 x 3.8 m each	
Primary facultative ponds	4 nos.: 82 x 75.5 x 1.5 m each	
Secondary facultative ponds	2 nos.: 179 x 82 x 1.5 m & 117 x 35.2 x 1.5 m	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.6	10	62	75		$3x10^5$	$3x10^6$		1.07
Final outlet	7.8	31	185	60		$2x10^3$	$2x10^3$		3.76
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) About 60% flow was being bypased and only 40 % was being treated in the plant.
ii) Outlet BOD/COD were observed higher than inlet values due possibly to dilution of sewage.
iii) Plant operation and maintenance was very poor. Desludging of only anaerobic pond is done and desludging of facultative ponds is not done.
iv) Plant is not able to meet the standards in terms of BOD.

14.5 MLD STP at Bangali Ghat, Dairy Farm Zone, Mathura (March 29, 2005)

Design capacity of STP: 14.5 ML/d; Average flow reaching STP: MLDML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Anaerobic ponds	2 nos.: 94 x 52 x 3.5 m each	
Primary facultative ponds	4 nos.: 127 x 85 x 1.5 m each	
Secondary facultative ponds	2 nos.: 127 x 85 x 1.5 m each	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.8	141	752	861		$3x10^5$	$3x10^6$		3.99
Final outlet	7.9	<u>41</u>	140	<u>168</u>		$2x10^3$	$2x10^3$		4.43
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Desludging of only anaerobic pond is inpractice.
ii) Plant was nonoperational in the moring hours of day of monitoring due to power cut.
iii) Plant is not able to meet the standards in terms of BOD and TSS. Improvement in outlet structures may be required to control high TSS, and the associated BOD/CODin the effluent. It is expected that control of TSS within 50 mg/L may enable achieving BOD standards also.
iv) About 20% of treated sewage is utilized for irrigation but the rest 80% is discharged into an unlinned drain and this is accumulating and water logging a large area.
v) High TSS and COD as compared to BOD in raw sewage indicates possibility of addition of industrial waste.

2.25 MLD STP at Burhi Ka Nagla, Agra (March30, 2005)

Design capacity of STP: 2.25 ML/d; Average flow reaching STP: ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Anaerobic ponds	2 nos.: 29.5 x 28.5 x 3.5 m each	
Primary facultative ponds	2 nos.: 61 x 40 x 1.5 m each and 2 nos.: 59 x 42 x 1.5 m each	
Secondary facultative ponds	2 nos.: 61 x 40 x 1.5 m each	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.5	149	514	294		$5x10^7$	$9x10^7$		5.86
Final outlet	7.4	<u>37</u>	214	64		$1.7x10^7$	$2.2x10^7$		4.82
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) About 90% flow was being bypased and only 10 % was being treated in the plant.
ii) Outfall of treated as well as untreated sewage is upstream of Old water works at Agra and affects raw water quality.
iii) Plant is not able to meet the standards in terms of BOD.
iv) Desludging of anaerobic ponds was in progress and removed sludge was being placed very near to Yamuna River, which will flow into the river with rain water.

10 MLD STP at Peela Khar, Agra (March 30, 2005)

Design capacity of STP: 10 ML/d; Average flow reaching STP: ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Anaerobic ponds	2 nos.: 47 x 20 x 3.5 m each	
Primary facultative ponds	4 nos.: 97 x 40 x 1.5 m each	
Secondary facultative ponds	2 nos.: 97 x 40 x 1.5 m each	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.6	98	411	182		$5x10^7$	$5x10^7$		5.54
Outlet of STP	7.7	42	210	97		$1.3x10^6$	$1.7x10^6$		4.83
Final outlet (treated + untreated streams)	7.5	<u>46</u>	233	74					4.86
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

- i) About 90% flow was being bypased and only 10 % was being treated in the plant.
- ii) Outfall of treated as well as untreated sewage is upstream of Old water works at Agra and affects raw water quality.
- iii) Plant is not able to meet the standards in terms of BOD.
- iv) Desludging of anaerobic ponds was in progress and removed sludge was being placed very near to Yamuna River, which will flow into the river with rain water.

78 MLD STP at Dhandupura, Agra (March, 2005)

Design capacity of STP: 78 ML/d; Average flow reaching STP: **50** ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen channels	2 nos.: 6 x 2.5 x 0.52 m each	
Grit channels	3 nos.: 20 x 3.05 x 0.75 m each	
UASB reactors	6 nos.: 40 x 24 x 5.35 m each	
Polishing ponds	3 nos.: 214 x 93 x 1.25 m, 160 x 129 x 1.25 m, and 162 x 122 x 1.25 m	
Sludge drying beds	36 nos.: 26 x 14 m each	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.3	120	424	57		$3x10^7$	$9x10^7$		5.67
Outlet of UASB reactors 1-3 (combined)	7.5	56	208	399					6.27
Outlet of UASB reactors 4-6 (combined)	7.7	46	224	80					6.39
Final outlet after polishing ponds	7.4	<u>38</u>	173	71		$5x10^6$	$5x10^6$		6.22
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

- i) Plant capacity is under utilized as less than the design flow is being treated in the plant.
- ii) Very less flow reaches STP during night hours 1200 midnight to 0400 am.
- iii) Excess sludge accumulation in ponds was observed as the main reasons for under performance.
- iv) Plant is not able to meet the standards in terms of BOD.

Performance of STPs in Uttranchal

0.32 MLD STP at Swargashram, Rishikesh (xxx)

Design capacity of STP: 0.32 ML/d; Average flow reaching STP: (?) ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Settling pit	5 x 4.24 x 2.2 m	15 $m^3/m^2/d$ SOR, 3.5 hr HRT
Primary clarifier	5 m dia and 2.55 m SWD	16.3 $m^3/m^2/d$ SOR, 3.8 hr HRT
UASB reactors	2 nos.: 20 x 7.3 x 2 and 20.5 x 6.5 x 2	
Polishing pond	20 x 6.5 x 1.2 m	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	6.8	212	456	210		2.4×10^8	5×10^8		1.91
After Primary clarifier	6.8	212	464	204					2.3
After UASB reactors	6.8	194	440	184					2.55
After Polishing pond	7.1	126	325	109		3×10^7	9×10^7		3.74
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Primary settling unit is performing badly as there is almost no change in sewage characterstics within this unit.
ii) UASB unit is also functioning very poorly as there is negligible improvement in characterstics of sewage within this unit.
iii) Polishing pond is also effecting only mariginal reduction in BOD (35%) and COD (26%).
iv) High TSS levels in the outlets of primary clarifier, UASB reactor and Polishing pond indicates that settling in each of these unit is not satisfactory. TSS level after proper settling is expected <50 mg/L and should not exceed 100 mg/L.
v) There is no arrangement for handling/disposal of primary and secondary sludge, which is a must for proper functioning of primary clarifier and UASB reactors.
vi) Plant is not able to comply with the discharge standards due to above reasons.

18 MLD STP at Jagjeetpur, Haridwar (xxx)

Design capacity of STP: 18 ML/d; Average flow reaching STP: 18 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Screen	4 nos.: 3 mechanical, 1 manual; each for 15 MLD flow	
Grit channel	3 nos. 3.2 m^2 each; each for 15 MLD flow	
Primary clarifiers	3 nos.: 15 m dia and 3 m SWD each	34 $m^3/m^2/d$ SOR, 2.1 hr HRT
Aeration tanks	3 nos.: 15 x 15 x 5.2 m each with three aerators of 40 HP each	4.68 hr(?) HRT, 0.27 d^{-1} F/M*
Secondary clarifier	3 nos.: 18.6 m dia and 3.5 m SWD each	22 $m^3/m^2/d$ SOR, 3.8 hr HRT
Sludge thickeners	2 nos.: 11.4 m dia and 3 m SWD each	6 % consistency
Sludge digesters	2 nos.: 18 m dia and 7.9 m SWD	25 day HRT
Sludge drying beds	12 nos.: 34.8 x 24 m	

* at 2400 mg/L MLVSS and 0.65 times the observed BOD (assuming 35% removal in primary treatment),

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.1	195	557	463		1.4×10^8	2.5×10^8		2.73
After Primary clarifier	7.1	93	174	121					3.02
Final outlet of STP	7.2	6	47	26		2×10^4	2×10^4		1.84
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant receives 30 MLD sewage. 18 MLD sewage is treated in the plant, and the rest is bypassed.
ii) High TSS in outlet of primary settling unit indicates that its performing can be improved further.
iii) ASP unit is being fed with low organic loading and it is performing well even though one of the three aeration tank was under maintenance at the time of study.
iv) Gas generated in anaerobic sludge reactor is not being utilised
v) Plant is able to comply with the discharge standards.

Performance of STPs in West Bengal

45 MLD STP Cossipore-Chitpore, Bangur, VIP Road, Kolkata, West Bengal (24.05.04)

Design capacity of STP: 18 ML/d; Average flow reaching STP: 25-45 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Grit channel		
Primary clarifiers	2 nos.: 26.5 m dia and 3.5 m SWD each	40.8 $m^3/m^2/d$ SOR, 2.06 hr HRT
Aeration tank	91 x 15 x 3.5 m with 14 aerators of 25 HP each	2.56 hr HRT, 119-174 mg/L MLSS, 2.84 d^{-1} F/M* , (?) d SRT
Secondary clarifier	2 nos.: 36 m dia and 3.5 m SWD each	22.1 $m^3/m^2/d$ SOR, 3.8 hr HRT
Sludge thickeners	2 nos.: 15.3 m dia and 3.5 m SWD each	
Primary sludge digester	15.3 m dia and 3.5 m(?) SWD	20-25day HRT (will depend on sludge qty)
Sec.sludge digester+gas holder	24 m dia and 3.5 m(?) SWD	10-15day HRT (will depend on sludge qty)
Sludge centrifuge	3 nos.: 20 HP each	

* at MLVSS=0.8 x 147 mg/L(observed average MLSS) and BOD=35.5 mg/L (observed average BOD after primary treatment)

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.2	69	194	165	458				
After Primary clarifier-1	7.12	34	103	60	448				
After Primary clarifier-2	7.15	37	101	70	449				
After Secondary clarifier-1	7.72	9	54	21	414				
After Secondary clarifier-2	7.7	9	53	15	440				
Final outlet of STP	7.79	8	49	16	464	$3x10^5$			
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Sewage flow reaching STP varied between 25-45 MLD.

ii) Plant is able to acheve standards because very low strength sewage is being received.

iii) Considering a little high SOR at full design flow on PSTs, hourly flowrate may be regulated to improve their efficiency if total flow reaching STP per day is less than full design flow.

iv) A lot of energy is being consumed in ASP unit to achieve a marginal reduction of BOD in this unit. It is required that under existing conditions of low strength sewage, a minimum number of aerators may be aerators may be operated.

v) Abnormally high F/M (2.84) is observed at design flow condition. Even at half the design flow F/M will be very high.

vi) Gas digestors have never been used as the solids content of sewage is very less.

10 MLD STP Bhatpara, Madrail, Kakinara, Bhatpar, West Bengal (24.05.04)

Design capacity of STP: 10 ML/d; Average flow reaching STP: 10 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Anaerobic pond	106 x 50 x 4.8 m	
Facultative ponds 2 in parallel	2 nos.: 170 x 88 x 4.3 m each	
Maturation pond	178 x 116 x 3.9 m	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage		29	56	59	525				
After Anaerobic pond									
After Facultative pond-1		18	47	33	483				
After Facultative pond-2		7	14	18	466				
After Maturation pond		4	11	BDL	443	$3x10^5$			
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant receives very low strength sewage because most of the sewage connected is first treated in septic tanks. Even the raw sewage quality is meeting the discharge standards.

ii) Accumulated sludge from the ponds has never been cleaned since the plant was established in 1991.

10 MLD STP Bhatpara (Old), Jagaddal, Bhatpara, West Bengal (24.05.04)

Design capacity of STP: 10 ML/d; Average flow reaching STP: 11 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Grit channel		
Primary clarifier		Reported HRT 2.36 hr
Aeration tank	8 aerators of 10 HP each	Reported HRT 5.61 hr, MLSS: 352 mg/L
Secondary clarifier		Reported HRT 2.94 hr
Sludge thickeners	Two	
Primary sludge digester		
Sec.sludge digester		
Sludge drying beds	24 nos.: 240 m^2 each	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage		60	127	168					
After Primary clarifier									
After Secondary clarifier		23	58	51		$1x10^6$			
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant is able to acheve standards because very low strength sewage is being received.

ii) A lot of energy is being consumed in ASP unit to achieve a marginal reduction of BOD in this unit. It is required that under existing conditions of low strength sewage, a minimum number of aerators may be aerators may be operated.

iii) Gas digestors have never been used, as the solids content of sewage is very less.

10 MLD STP Bhatpara (new), Jagaddal, Bhatpara, West Bengal (24.05.04)

Design capacity of STP: 10 ML/d; Average flow reaching STP: ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Grit channel		
Primary clarifier		Reported HRT 2.36 hr
Aeration tank	8 aerators of 10 HP each	Reported HRT 5.61 hr, MLSS: 352 mg/L
Secondary clarifier		Reported HRT 2.94 hr
Sludge thickeners		
Primary sludge digester		
Sec.sludge digester		
Sludge drying beds	24 nos.: 240 m^2 each	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage		179	466	442					
After Primary clarifier									
After Secondary clarifier		54	141	72		$1.4x10^8$			
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant is not able to acheve standards..

ii) Reasons for poor performance of STP need to be investigated and plant needs to be operated properly to achieve the standards.

iii) Gas digestors have never been used.

4.5 MLD STP Titagarh, Dumping Ground, Dangapara, Rahra, West Bengal (27.05.04)

Design capacity of STP: 4.5 ML/d; Average flow reaching STP: 4-4.5 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Grit channel		
Primary clarifier	9.45 m dia and 8.45 m SWD	64.16 $m^3/m^2/d$ SOR
Aeration tanks 3 in parallel	3 nos.: 7.3 x 7.3 x 3.6 m each. Each having 2 aerators of 7.5 HP each	3.07 hr HRT, 394-746 mg/L MLSS, 1.56 d^{-1} F/M*, (?) d SRT
Secondary clarifier	2 nos.: 9.45 m dia and 8.45 m SWD each 1 no.: 7.3 x 7.3 x 3.6 SWD	21.4 $m^3/m^2/d$ SOR for circular clarifiers 28.15 $m^3/m^2/d$ SOR for rectangular settling tank
Sludge lagoon/ponds	2 nos.: 55 x 40 m each and 1 : .: 40 x 35 m	

* at MLVSS=0.8 x 570 mg/L(observed average MLSS) and BOD=91 mg/L (observed BOD after primary treatment)

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.47	96	303	249	698				
After Primary clarifier	7.02	91	289	153	596				
After Secondary clarifier-1	7.6	15	104	53	640				
After Secondary clarifier-2	7.5	12	95	47	598				
After Secondary clarifier-3	7.65	11	84	36	577				
Final outlet of STP		12	95	42	652	$5x10^6$			
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant is able to acheve standards because very low strength sewage is being received.
ii) Considering a very high SOR at full design flow on PST, additional PST mayt be added to the scheme.
iii) Abnormally high F/M (1.56) is observed at full design flow condition
iv) About 90% of the treated sewage is used for irrigation

4.54 MLD STP Titagarh, Dumping Ground, Dangapara, Rahra, West Bengal (27.05.04)

Design capacity of STP: 4.54 ML/d; Average flow reaching STP: 4-4.54 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Oxidation pond-single stage	90 x 55 x 1.5 m	2 day HRT

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage		96	303	249	698				
After Oxidation pond		22	113	54	617	$5x10^7$			
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant is able to acheve standards because very low strength sewage is being received.
ii) Separate flow measurement after distribution box of ASP plant and Oxidation pond is not possible.
iii) About 90% of the treated sewage is used for irrigation

14.1 MLD STP Titagarh, Bandipur Gram Panchayat, Titagarh, West Bengal (27.05.04)

Design capacity of STP: 14.1 ML/d; Average flow reaching STP: 12 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Grit chamber		
Anaerobic pond 2 in parallel	0.7 Hectare area, 2.5 m depth	Reported HRT: 1 d
Facultative ponds 3 in parallel	4.8 Hectare area, 1.5 m depth	Reported HRT: 4 d
Maturation pond 2 in parallel	4.8 Hectare area, 1 m depth	Reported HRT: 4 d

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.37	94	303	284	584				
After Anaerobic pond-1	6.92	91	281	82	594				
After Anaerobic pond-2	7.4	107	947	963	571				
After Facultative pond-1	8.57	5	89	72	548				
After Facultative pond-2	8.94	14	82	31	529				
After Maturation pond -1	8.48	4	72	32	510	$3x10^4$			
After Maturation pond -2	8.97	6	41	15	388	$1.7x10^4$			
Final outlet (average)		5	57	24	449	$2.4x10^4$			
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant receives very low strength sewage and treated sewage quality is meeting the discharge standards.
ii) Accumulated sludge from the ponds has never been cleaned since the plant was established in 1993. Anaerobic ponds were filled with accumulated sludge.
iii) Bunds between the ponds have been damaged at few places and need repair.

12 MLD STP Panihati, Natagarh Gram Panchayat, Panihati, West Bengal (27.05.04)

Design capacity of STP: 12 ML/d; Average flow reaching STP: 4.2 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Grit chamber		
Anaerobic pond 3 in parallel		
Facultative ponds 3 in parallel		
Maturation pond 2 in parallel		

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.17	93	315	441	625				
After Anaerobic pond-1		39	122	122	604				
After Anaerobic pond-2		33	110	110	648				
After Anaerobic pond-3		29	99	107	681				
After Facultative pond-1		29	106	70	575				
After Facultative pond-2		33	122	56	540				
After Facultative pond-3		36	133	60	619				
After Maturation ponds (combined)	8.47	20	72	55	602	$2.3x10^3$			
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant receives very less flow as compared to its capacity and the treated sewage quality is meeting the discharge standards.
ii) Accumulated sludge from the ponds has never been cleaned since the plant was established.
iii) Bunds between the ponds have been damaged at few places and need repair.

47.5 MLD STP Garden Reach & South Suburban, Garden Reach, Kolkata, West Bengal (03.06.04)

Design capacity of STP: 47.5 ML/d; Average flow reaching STP: 30-38 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Grit channel		
Primary clarifiers	2 nos.: 29.3 m dia and 3.5 m SWD each	35.22 $m^3/m^2/d$ SOR, 2 hr HRT
Aeration tanks 2 in parallel	2 nos.: 50 x 25 x 4.05 m each. Each having 2 aerators of 25 HP each and 6 aerators of 20 HP each	5 hr HRT, 224-730 mg/L MLSS, 0.54 d^{-1} F/M*, (?) d SRT
Secondary clarifiers	2 nos.: 37.8 m dia and 3.5m SWD each	21.2 $m^3/m^2/d$ SOR, 3.45 HRT
Sludge thickeners	2 nos.: 14.5 m dia and 3.05 m SWD each	
Primary sludge digesters	2 nos.: 15.7 m dia and 8.4 m SWD each	16 hr HRT (will depend on sludge qty)
Secondary sludge digesters	2 nos.: 15.5 m dia and 7.7 m SWD each	14 hr HRT (will depend on sludge qty)
Sludge cntrifuge	3 nos.: 5 m^3/hr capacity	

* at MLVSS=0.8 x 477 mg/L(observed average MLSS) and BOD=44 mg/L (observed average BOD after primary treatment)

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	6.9	115	297	221	494				
After Primary clarifier-1	6.95	53	138	57	487				
After Primary clarifier-2	6.98	35	127	57	289				
After Secondary clarifier-1	7.6	21	101	55	390				
After Secondary clarifier-2	7.61	19	101	62	358				
Final outlet of STP		32	112	62	402	$1.7x10^7$			
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant is not able to acheve standards inspite of very low influent BOD level to activated sludge process.
ii) Reasons for poor performance of STP need to be investigated and plant needs to be operated properly to achieve the standards.
iii) Considering low influent BOD to aeration tank, use of aerators may be optimised to save energy.
iv) Gas digestors have never been used.

30 MLD STP South Suburban (East) and Tollyganj-Jadavpur, South Suburban (East), Kolkata, West Bengal (27.05.04)

Design capacity of STP: 30 ML/d; Average flow reaching STP: ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Anaerobic pond 2 in parallel	2 nos.: 5.26 acre each, 3m depth	1 d HRT
Facultative ponds 2 in parallel	2 nos.: 20.38 acre each, 1.5 depth	4.5 d HRT
Maturation pond 2 in parallel	2 nos.: 15.71 acre each, 1.5 depth	3 d HRT

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.65	29	107	130	312				
After Anaerobic pond-1	7.80	17	50	86	416				
After Anaerobic pond-2	7.70	34	103	35	285				
After Facultative pond-1	7.9	15	68	64	362				
After Facultative pond-2	7.86	20	68	124	737				
After Maturation ponds (combined)	7.85	14	57	99	495	$1.7x10^4$			
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant receives very low strength sewage. Treated sewage quality is meeting the discharge standards except fro TSS. Reasons for high TSS need to be investigated and rectified.
ii) Accumulated sludge from the ponds has never been cleaned since the plant was established.
iii) Bunds between the ponds have been damaged at few places and need repair.

45 MLD STP Howrah, Arupara, Howrah, West Bengal (07.06.04)

Design capacity of STP: 45 ML/d; Average flow reaching STP: ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Grit channel		
Primary clarifiers	2 nos	
Trickling filters 2 in parallel	2 nos	
Secondary clarifiers	2 nos	
Primary sludge digesters	2 nos.: 15.7 m dia and 8.4 m SWD each	16 hr HRT (will depend on sludge qty)
Secondary sludge digesters	2 nos.: 15.5 m dia and 7.7 m SWD each	14 hr HRT (will depend on sludge qty)
Sludge drying beds	24nos.: 31.7 x 8 x 0.4 5 m each	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	6.7	96	285	464	481				
After Primary clarifier-1	7.1	14	39	23	501				
After Primary clarifier-2	7.15	14	39	20	511				
Final outlet of STP		7	21	11		$1.1x10^6$			
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant receives very low strength sewage. Treated sewage quality is meeting the discharge standards

ii) Gas digestors were being used but no gas production was observed.

18.16 MLD STPChandannagore, Khalisani, Chandannagore, West Bengal (07.06.04)

Design capacity of STP: 18.16 ML/d; Average flow reaching STP: 15 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Grit channel		
Primary clarifier	34.4 m dia and 3.4 m SWD	19.54 $m^3/m^2/d$ SOR, 4.18 hr HRT
Trickling filter	47.5 m dia and 1.43 m media depth	
Secondary clarifier	46.5 m dia and 3 m SWD	10.69 $m^3/m^2/d$ SOR, 6.73hr HRT
Primary sludge digester	24.8 m dia and 7.5 m SWD	
Secondary sludge digester	24.8 m dia and 7.5 m SWD	
Sludge drying beds	24nos: 562 m^2 each	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.54	9	28	31	474				
After Primary clarifier	7.65	8	25	20	447				
After Trickling filter	8.2	9	25	18	457				
Final outlet	8.1	5	14	9	438	$9x10^5$			
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant receives very low strength sewage. Treated sewage quality is meeting the discharge standards

ii) Gas digestors have never been used because of low strength of waste and low solids content.

11 MLD STP Kalyani, Block B2 & B3 Kalyani, West Bengal (10.06.04)

Design capacity of STP: 11 ML/d; Average flow reaching STP: 3 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Grit channel		
Primary clarifier	24.2 m dia and 5 m SWD	19.54 $m^3/m^2/d$ SOR, 4.18 hr HRT
Trickling filter	35 m dia and 1 m media depth	
Secondary clarifiers	2 nos.: 18.3 m dia and 2.27 m SWD and 19.1 m dia and 2.44 m SWD	10.69 $m^3/m^2/d$ SOR, 6.73hr HRT
Sludge ponds	2 nos.: 66.5 x 40.7 x 2 m and 66.5 x 39.8 x 2 m	
Sludge drying beds	20 nos.: 30 x 8 m each	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	6.4	38	126	266	706				
After Primary clarifier	6.6	40	130	146	560				
After Trickling filter	6.8	36	126	165	558				
After Secondary clarifier-1	6.85	26	85	121	555				
After Secondary clarifier-2	6.89	24	68	49	564				
Final outlet of STP	7.02	23	85	87	540	$2.2x10^4$			
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant receives very low strength sewage. Treated sewage quality is meeting the discharge standards
ii) Trickling filter was found submerged due to clogging of pores and therefore trickling filter was operating under anaerobic conditions.
iii) Industrial effluent mixed acidic sewage from Kalyani Silpanchal Area causes frequent corrosion of sewers.

6 MLD STP Kalyani, Block B2 & B3 Kalyani, West Bengal (10.06.04)

Design capacity of STP: 6 ML/d; Average flow reaching STP: 4.5 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Anaerobic pond 2 in parallel	2 nos.: 52 x 26 x 2 m each	1 d HRT
Facultative ponds 2 in parallel	2 nos.: 150 x 64 x 1.5 m each	5 d HRT
Maturation pond 4 in parallel	4 nos.: 156 x 52 x 1 m each	4 d HRT

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	6.4	38	126	266	706				
After Anaerobic pond-1	7.05	37	92	172	**781**				
After Anaerobic pond-2	7.1	21	82	152	716				
After Facultative pond-1	7.7	21	68	35	468				
After Facultative pond-2	7.1	12	38	36	599				
After Maturation ponds (combined)	7.9	17	55	58	394	$1.7x10^3$			
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant receives very low strength sewage. Treated sewage quality is meeting the discharge.
ii) There is no flow measurement facility and flow distribution is also uneven.
iii) Water hyacinth was present in abundance in anaerobic ponds.
iv) Bluegreen algae were seen in some portion of one of the facultative ponds. Dead fish were also observed in the facultative ponds.
v) Algae and fish were observed in abundance in maturation ponds.

40 MLD STP Baranagar Kamarhati, Mathkol, Near Belgachia Metro Car Shed, Baranagar, West Bengal (14.06.04)

Design capacity of STP: 40 ML/d; Average flow reaching STP: 25 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Grit channel		
Primary clarifiers	2 nos.: 26.2 m dia and 3.5 m SWD each	37.1 $m^3/m^2/d$ SOR, 2.26 hr HRT
Trickling filters	2 nos.: 34.6 m dia and 2 m media depth	
Secondary clarifiers	2 nos.: 34 m dia and 3 m SWD each	22.03 $m^3/m^2/d$ SOR, 3.27 hr HRT
Sludge thickeners	2 nos.: 11.25 m dia and 3 m SWD each	
Primary sludge digesters	2 nos.: 16.8 m dia and 6.45 m SWD each	20-25 d HRT
Secondary sludge digesters	2 nos.: 11 m dia and 7.5 m SWD each	10-15 d HRT

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	7.1	54	189	170	307				
After Primary clarifier-1	6.99	31	108	42	544				
After Primary clarifier-2	6.95	19	102	27	255				
After Trickling filter	7.3	13	89	32	540				
After Secondary clarifier/Final outlet	7.4	11	59	17	551	$5x10^6$			
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant receives very low strength sewage. Treated sewage quality is meeting the discharge standards

ii) One Trickling filter unit was found completly damaged due to break down of shaft and bearings and it was under maintenance.

18.9 MLD STP Serampore, Jannagar Road, Serampore, West Bengal (14.06.04)

Design capacity of STP: 18.9 ML/d; Average flow reaching STP: 10 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Grit channel		
Primary clarifiers	2 nos.: 24.4 m dia and 3.05 m SWD each	20.21 $m^3/m^2/d$ SOR, 3.62 hr HRT
Trickling filter		
Secondary clarifiers	2 nos.: 30.48 m dia and 3 m SWD and 15.24 m dia and 2.5 m SWD	24 $m^3/m^2/d$ SOR (provided flow is distributed proportionate to the surface areas of two clarifiers)
Sludge thickeners	2 nos.: 11.25 m dia and 3 m SWD each	
Primary sludge digesters		
Secondary sludge digesters		
Sludge drying beds	20 nos.: 31.7 x 8 x 0.4 m each	

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	6.95	52	113	90	474				
After Primary clarifier-1		27	71	53	349				
After Secondary clarifier-1		12	38	13					
After Secondary clarifier-2		12	38	13					
Final outlet	7.6	8	57	13	359	$3x10^6$			
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant receives very low strength sewage. Treated sewage quality is meeting the discharge standards

ii) The treated sewage was slightly red in colour due to probabily to mixing of some cottage dying industry.

iii) Owing to clogging of orifice of trickling filter, uneven distribution of wastewater and non-uniform growth of biomass over the media bed and shortcircuiting of wastewater were observed.

10 MLD STP Nabadwip, West Bengal (17.06.04)

Design capacity of STP: 10 ML/d; Average flow reaching STP: 4.5 ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Grit chamber		
Anaerobic pond 2 in parallel	2 nos.: 75 x 50 x 2 m each	3.5 d HRT
Facultative ponds 2 in parallel	2 nos.: 165 x 85 x 1.5 m each	9 d HRT
Maturation pond 2 in series	2 nos.: 215 x 55 x 1.5 m each	7.8 d HRT

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage	6.95	154	286	86	809				
After Anaerobic pond-1	7.10	42	112	26	599				
After Anaerobic pond-2	7.15	44	109	26	607				
After Facultative pond-1		32	155	69	620				
After Maturation ponds	8.5	12	99	18	622	$1.7x10^4$			
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Treated sewage quality is meeting the discharge.
ii) Water hyacinth was present in abundance in anaerobic ponds. No flow at outlet of one facultative pond was observed indicating high ground seepage from the pond.
iii) Accumulated sludge has never been cleaned since establishment of the STP.

3.7 MLD STP Behrampore, Interception-Diversion Treatment Scheme, Behrampore, West Bengal (17.06.04)

Design capacity of STP: 3.7 ML/d; Average flow reaching STP: ML/d

Unit sizes and loading on main treatment units at full load condition:

Treatment unit	Number/Size	HRT/SOR/Loading
Anaerobic pond	3462.7 m^2 area	1 d HRT
Facultative pond	28323.45 m^2 area	5 d HRT
Maturation pond	69129.37 m^2 area	4 d HRT

Results of analysis of composite samples after different stages of treatment (All values in mg/L except pH, and Colliform in MPN/100 mL):

Sample point	pH	BOD	COD	TSS	TDS	Fecal Colliform	Total Coliform	Amm-N	PO_4-P
Raw sewage-Baramuri drain	7.0	82	263	131	722				
Raw sewage-Saidabad drain	7.05	93	276	130	883				
Raw sewage-Gorabazar drain	7.10	100	213	74	687				
After Anaerobic pond-1									
After Anaerobic pond-2									
After Facultative pond-1									
After Facultative pond-2									
After Maturation ponds (combined)									
Standards for discharge in streams	*5.5-9*	*30*	*250*	*100*	*2100*				

Remarks:

i) Plant does not receives sewage due to failure of civil structure near main pumping station, which occurred within a fortnight time of its commissioning in 1994.
ii) There are three nearby drains that presently discharge sewage into three different Beels (Ponds). Gorabazar drain discharges sewage into Chaltia Beel, Barmuri drain that carries about 70% sewage discharges into Bishnupur Beel, and Saidabad drain discharges sewage into Chatra Beel. The three Beels meet another biger Beel, namely, Bhanderdah Beel and thereafter the sewage is discharged into River Pagla Chandi.