CHAPTER 5: BUDGET ESTIMATES FOR OPERATION AND MAINTENANCE

5.1 INTRODUCTION

As a result of sharp economic growth and urbanization, the environment in India has deteriorated. There is serious concern about the negative impact on public health and urban living environment. Under such circumstances, GOI has instituted the National River Conservation Plan (NRCP) and entrusted the JnNURM to tackle the environment degradation issue because of water pollution. The purpose is to improve water and the sewerage system by reducing water and environmental pollution. To ensure improvement in the water environment, not only construction of STP but also proper O&M of STP is essential. However, experience on management and O&M of STP is meagre in many Indian cities.

According to the "Report on Indian Urban Infrastructure and Services (March 2011)" the HPEC, the challenge of sanitation in Indian cities is huge. With very poor sewerage networks, a large number of the urban poor still depend on public toilets. A study by the Water and Sanitation Programme (WSP, 2010) of the WB using data for 2006 showed that the per capita economic cost of inadequate sanitation including mortality impact in India was quite high. In a City Sanitation Study conducted by the MoUD, none of the 423 cities was found to be 'healthy' or 'clean'. Of the 79 STPs under state ownership reviewed in 2007, 46 STPs were operating under very poor conditions. The assumptions used in preparing the estimates for investment in sewerage system and the associated O&M expenditure for existing and new assets are presented here.

In this chapter, the need for realistic budget estimate to cover O&M activities and approaches to calculation of O&M costs, O&M budget and cost recovery, per capita O&M costs for sewerage, and recommendations are addressed. Especially, for the convenience of readers, the calculation of O&M costs are illustrated as reference.

5.2 NEED FOR BUDGET ESTIMATE

For budget estimation, technical, managerial, administrative, personnel, financial and social aspects need to be considered. The most important problem is there are no norms for getting proper budget funds for O&M. The only norm is historical. Simply because some decades ago funds were allotted as an ad hoc procedure, the same is followed every year with an escalation. Newer schemes sanctioned for construction also follow the same approach. Since O&M of sewage works consists of a lot of diverse activities, the example of norms for a proper budget for O&M is proposed in this chapter.

5.3 O&M ACTIVITIES

O&M consists of activities such as execution of general affairs related to sewage, budget execution, asset management, coordination of service charges, guidance for house connections, monitoring and guidance on industrial effluent, O&M of sewers, O&M of pumping station, and treatment plant, water quality control, ledger management, environment conservation and others. Refer to section 3.14.3, section 3.14.4 and Table 3.7.

5.4 CALCULATION OF O&M COSTS

The calculation of O&M costs is a sum of the relevant costs for the following-

a. Establishment
b. Energy
c. Consumables and fuel
d. Laboratory analysis
e. Landscaping
f. Repairs, renewals and minor replacement of infrastructures
g. Depreciation
h. Seed capital
i. Debt servicing
j. Cess
k. Taxes and duties
l. Unforeseen

The probable assessment of these is discussed hereunder.

5.4.1 Establishment Costs

The present practice is to arrive at the establishment cost as a percentage of the project cost as per the age old practice of PWD, where the establishment charges are taken as anywhere between 12 to 15 %.

The fallacy here is this approach was adopted in the past era when the works were mostly civil works like dams, buildings, bridges, canals, roads etc., and which probably reflected the actual position because the number of staff required was also in proportion to the volume of work involved.

There are no guidelines for establishment costs for sewerage and almost the same PWD method is being followed.

Naturally, some local bodies have developed a slightly different approach. However, in the actual case this is not the position in sewerage.

An illustration of the establishment costs for sewers, SPS and STP are shown in Table 5.1 to Table 5.3.

Table 5.1 illustrates the approach for assessing the establishment cost per km of sewers.

Table 5.2 illustrates the approach for assessing the establishment cost per kW of pumping stations.

Table 5.3 illustrates the approach for assessing the establishment cost per MLD of STPs.

Table 5.1 Establishment Cost Calculation for Illustrative Capacities of Sewer Systems

1	Establishment Cost Calculation for Illustrative Capacities of Sewer Systems										
2	The numbers in the cells bound by columns B to J and rows from 5–26 are considered reasonable										
3	The fraction of time charged is to utilize the services more effectively in other sectors in the remaining time										
4	A	B	C	D	E	F	G	H	I	J	
5	Length of sewers in km	5	10	20	50	100	150	200	250	300	Monthly pay
6	Executive Engineer					1	2	3	3	4	80000
7	Portion of time charged for sewers					1	0.75	0.75	1	1	
8	Assistant Executive Engineer			1	2	2	4	6	6	8	60000
9	Portion of time charged for sewers			1	1	1	1	1	1	1	
10	Assistant Engineer	1	2	2	2	2	3	3	4	4	40000
11	Portion of time charged for sewers	1	1	1	1	1	1	1	1	1	
12	Junior Engineer	2	2								30000
13	Portion of time charged for sewers	1	1								
14	ITI qualified plumber	1	1	2	2	3	4	5	6	8	15000
15	semi-skilled labourers	2	2	2	2	3	4	5	6	8	12000
16	unskilled labourers	2	2	4	6	8	10	12	16	18	10000
17	Watchman & security	3	3	4	6	8	10	12	16	18	10000
18	Office assistant	1	1	1	1	1	1	1	1	1	15000
19	Office computer operator	1	1	1	1	1	1	1	1	1	20000
20	Office driver						1	1	1	1	15000
21	Messenger	1	1	1	1	1	1	1	1	1	10000
22	Monthly salary in lakhs of rupees	2.34	2.74	3.09	3.89	5.16	7.78	10.05	11.72	14.66	
23	Leave salary allowances as %	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	
24	Administrative overheads as %	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
25	Margin for emergencies at %	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
26	Margin for retirement & gratuity	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
27	Monthly salary in Rs lakhs	3.28	3.84	4.33	5.45	7.22	10.89	14.07	16.41	20.52	
28	Monthly salary in Rs Lakhs per km	0.655	0.384	0.216	0.109	0.072	0.073	0.070	0.066	0.068	

The above is computed in Excel and the same will be available in the CD version of the manual. The users can easily change the entries as per their local situation and arrive at a cost which will be real and meet the actual expenditures appropriately.

Table 5.2 Establishment Cost Calculation for Illustrative Capacities of Sewage Pumping Stations

1	Establishment Cost Calculation for Illustrative Capacities of Sewage Pumping Stations										
2	The numbers in the cells bound by columns B to J and rows from 5–26 are considered reasonable										
3	The fraction of time charged is to utilize the services more effectively in other sectors in the remaining time										
4		A	B	C	D	E	F	G	H	I	J
5	Installed kW of pump sets	5	10	20	50	100	150	200	250	300	Monthly pay
6	Executive Engineer					1	1	1	1	1	80000
7	Portion of time charged for SPS					0.25	0.25	0.5	0.5	1	
8	Assistant Executive Engineer			1	2	2	2	2	3	4	60000
9	Portion of time charged for SPS			1	1	1	1	1	1	1	
10	Assistant Engineer	1	2	2	2	2	2	2	2	2	40000
11	Portion of time charged for SPS	1	1	1	1	1	1	1	1	1	
12	Junior Engineer	2	2								30000
13	Portion of time charged for SPS	1	1								
14	ITI qualified plumber / electrician[x]	1	2	4	6	6	6	6	6	6	15000
15	semi-skilled labourers	2	2	2	2	2	2	2	2	2	12000
16	unskilled labourers	2	2	2	2	4	4	4	4	4	10000
17	Watchman & security	3	3	3	3	3	3	3	3	3	10000
18	Office assistant	1	1	1	1	1	1	1	1	1	15000
19	Office computer operator	1	1	1	1	1	1	1	1	1	20000
20	Office driver						1	1	1	1	15000
21	Messenger	1	1	1	1	1	1	1	1	1	10000
22	Monthly salary in lakhs of rupees	2.34	2.89	3.19	4.09	4.49	4.64	4.84	5.44	6.44	
23	Leave salary allowances as %	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	
24	Administrative overheads as %	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
25	Margin for emergencies at %	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
26	Margin for retirement & gratuity	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
27	Monthly salary in Rs lakhs	3.28	4.05	4.47	5.73	6.29	6.50	6.78	7.62	9.02	
28	Monthly salary in Rs Lakhs per km	65.52	40.46	29.77	28.63	15.72	10.83	8.47	7.62	6.94	

The above is computed in Excel and the same will be available in the CD version of the manual. The users can easily change the entries as per their local situation and arrive at a cost which can be real and meet the actual expenditures appropriately. Note: [x] minimum one electrical qualified staff at all times.

Table 5.3 Establishment Cost Calculation for Illustrative Capacities of Mechanized STPs

1	The numbers in the cells bound by columns B to J and rows from 5–31 are considered reasonable										
2	The fraction of time charged is to utilize the services more effectively in other sectors in the remaining time										
3	A	B	C	D	E	F	G	H	I	J	
4	Operating MLD of STP	5	10	20	60	100	150	200	250	300	Monthly pay
5	Executive Engineer					1	1	1	1	1	80000
6	Portion of time charged for STP					0.25	0.5	0.75	1	1	
7	Assistant Executive Engineer			1	1	2	2	3	3	3	60000
8	Portion of time charged for STP			0.5	1	1	1	1	1	1	
9	Assistant Engineer			3	3	2	2	3	3	3	40000
10	Portion of time charged for STP			0.5	1	0.25	0.5	0.75	1	1	
11	Junior Engineer	2	2								30000
12	Portion of time charged for STP	1	1								
13	Diploma qualified electrician			1	1	3	3	3	3	3	20000
14	ITI qualified electrician	1	2	2	2						15000
15	ITI qualified plumber	1	1	1	1	1	2	2	2	2	15000
16	Semi-skilled labourers	1	2	2	2	2	2	3	3	4	12000
17	Unskilled labourers	2	2	2	4	4	6	6	9	9	10000
18	Watchman & security	3	3	3	3	3	3	3	3	3	10000
19	Office assistant	1	1	1	1	1	1	1	1	1	15000
20	Office computer operator	1	1	1	1	1	1	1	1	1	20000
21	Office driver						1	1	1	1	15000
22	Chemist	1	1	1	1	2	2	2	2	2	25000
23	Microbiologist								1	1	25000
24	Lab assistant	1	1	1	2	2	2	2	2	2	12000
25	Messenger	1	1	1	1	1	1	1	1	1	10000
26	Monthly salary in lakhs of rupees	2.34	2.61	3.11	4.33	4.48	5.38	6.8	7.85	7.97	
27	Leave salary allowances as %	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	

Continued...........

Table 5.3 Brought forward

1	The numbers in the cells bound by columns B to J and rows from 5–31 are considered reasonable										
2	The fraction of time charged is to utilize the services more effectively in other sectors in the remaining time										
3	A	B	C	D	E	F	G	H	I	J	
4	Operating MLD of STP	5	10	20	60	100	150	200	250	300	Monthly pay
28	Administrative overheads as %	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
29	Margin for emergencies at %	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
30	Margin for retirement & gratuity	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
31	Monthly salary in Rs lakhs	3.28	3.65	4.35	6.06	6.27	7.53	9.52	10.99	11.16	
32	Monthly salary in Rs Lakhs per MLD	0.66	0.37	0.22	0.10	0.06	0.05	0.05	0.04	0.04	

Note: The above is computed in Excel and the same is available in the CD version of the manual. The users can easily change the entries as per their local situation and arrive at a cost which can be real and meet the actual expenditures appropriately.

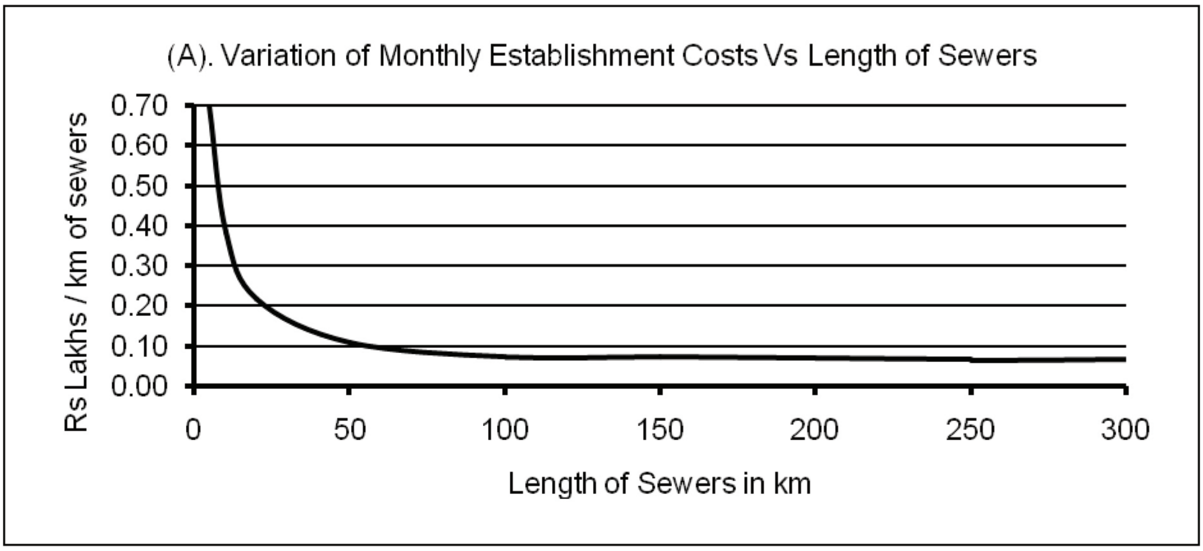
The tables as shown in this chapter are made available in MS Excel format in the CD version of the manual and can be downloaded. The entries in respect of the numbers of each category of staff and the fraction of time they will be needed (for the rest of the time, they will be on other duty in the sewerage system) can be varied as also the monthly salary, leave salary, retirement gratuity, etc. A graphical relationship between the monthly establishment costs versus the km of sewers, kW of pump stations and MLD of STP is presented in Figure 5.1 (overleaf).

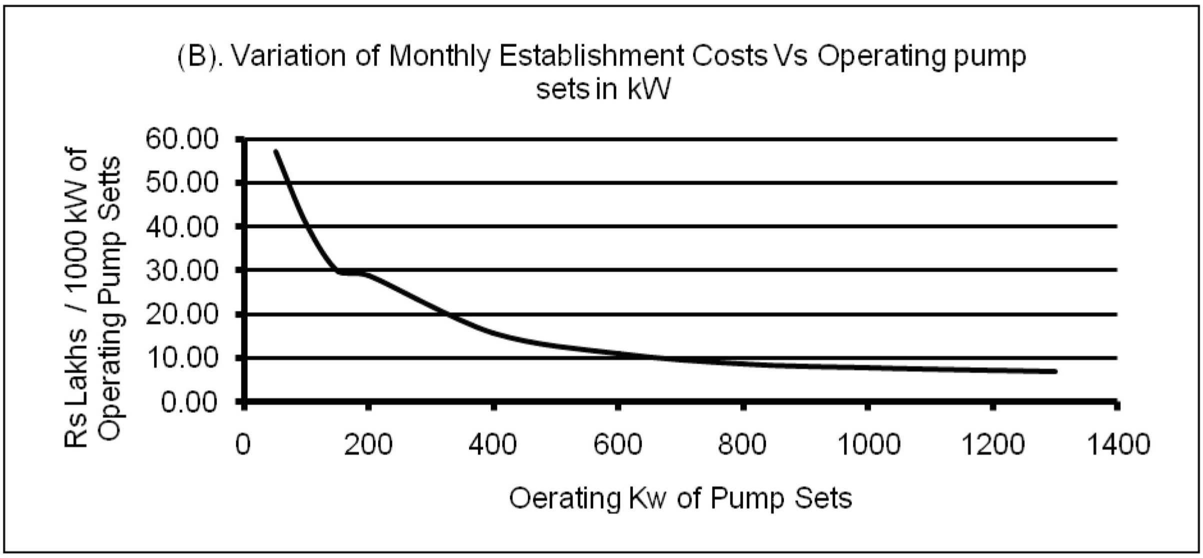
It may be seen that the cost tapers down rather steeply when the size of the system increases and it is very high in the case of smaller systems. In effect, the cost of an infrastructure increases in proportion to the size or length or volume of a project.

Thus, for example, if we consider a STP of say 50 MLD and another of 300 MLD, the cost of the latter will be 6 times maximum and about 4 times minimum. If we go by the conventional method of calculating the establishment costs as a fixed percentage of the cost of the work, the establishment cost to project cost will be a fixed percentage and the curve in Figure 5.1 should be a straight line. But in reality, it is not so. This method of computing can be adopted with suitable changes in the number of staff.

5.4.2 Energy Costs

The energy costs are straightforward calculation based on the running kW, numbers and hours of electrical equipment. Usually, these cannot be worked out in detail at the stage of project proposal. A rule of thumb can be arrived at based on similar reported STPs. A sample illustration of this calculation is presented in Table 5.4. The Excel is available in the CD version of this manual.





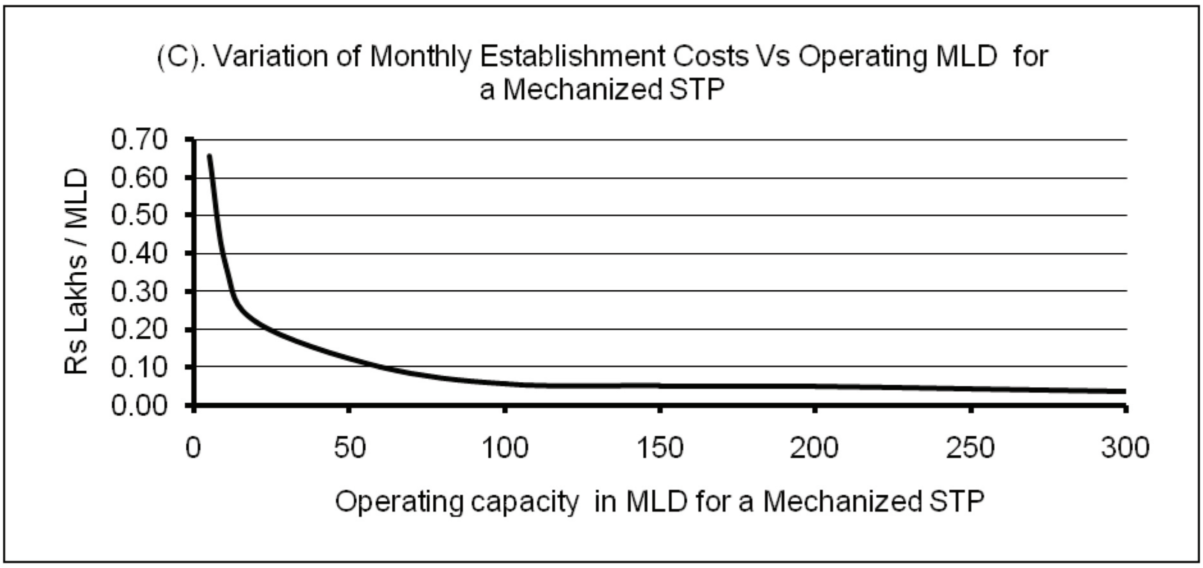


Figure 5.1 Illustration of Relationship of Establishment Costs to the Scale of Sewers, SPS & STP

Table 5.4 Illustration of Calculation of Electrical Energy for an STP with DAF-Nitrification-denitrification and Dual Media Filters

	Operating capacity of STP in MLD							Enter	15
	Cost of electricity in Rs per kwhr							Enter	6
No	Equipment	kW Rating	Efficiency	Load factor	working	PF at full load	Operating Load in kW	Running Hours	kWh
1	Raw Sewage pump for wet weather	90	0.85	0.85	1	0.88	76.50	8	612.00
2	Raw Sewage pump for dry weather	55	0.85	0.85	1	0.87	46.75	24	1122.00
3	Mechanical coarse bar screen	1.1	0.77	0.85	1	0.81	0.94	24	22.44
4	Mechanical fine bar screen	1.1	0.77	0.85	1	0.81	0.94	24	22.44
5	Conveyor for coarse screenings	1.5	75	0.85	1	0.81	1.28	24	30.60
6	Grit Remover	0.75	0.75	0.85	2	0.77	1.28	24	30.60
7	Classifier for grit chamber	1.5	0.75	0.85	2	0.77	2.55	24	61.20
8	Organic Pump for Grit chamber	0.75	0.75	0.85	2	0.77	1.28	24	30.60
9	Air Compressor for DAF	5.5	0.85	0.85	1	0.82	4.68	24	112.20
10	Dosing Pump for DAF	2.2	0.7	0.85	4	0.9	7.48	24	179.52
11	Agitator for DAF dosing tank	3.7	0.75	0.85	8	0.9	25.16	24	603.84
12	Pump for DAF (HPP)	37	0.92	0.85	1	0.9	31.45	24	754.80
13	DAF Unit	1.5	0.75	0.85	2	0.81	2.55	24	61.20
14	DAF Clarified Water Transfer Pump	30	0.85	0.85	2	0.83	51.00	24	1224.00
15	Agitator for pH correction tank	0.37	0.77	0.85	1	0.81	0.31	20	6.29
16	Primary Clarifiers	1.5	0.75	0.85	2	0.77	2.55	24	61.2
17	Primary sludge pump sets	10	0.5	0.85	2	0.77	17	6	102
18	Agitator for Nutrient Dosing Tank	11	0.8	0.85	2	0.83	18.70	24	448.80
19	Agitator for anoxic tank	3.7	0.8	0.85	2	0.83	6.29	24	150.96
20	Internal return pump	37	0.95	0.85	2	0.88	62.90	24	1509.60
21	Air Compressor for aeration tank	110	0.95	0.85	4	0.88	374.00	24	8976.00

	Operating capacity of STP in MLD							Enter	15
	Cost of electricity in Rs per kwhr							Enter	6
No	Equipment	kW Rating	Efficiency	Load factor	working	PF at full load	Operating Load in kW	Running Hours	kWh
22	Return and excess sludge pump	37	0.92	0.85	2	0.9	62.90	8	1509.60
23	Agitator for ferric chloride dosing tank	1.1	0.77	0.85	2	0.81	2.55	24	22.44
24	Secondary Clarifiers	1.5	0.75	0.85	2	0.77	0.94	24	61.2
25	Thickener mechanism	1.1	0.75	0.85	2	0.77	1.87	24	44.88
26	Dilution Water Pumps	20	0.9	0.8	2	0.9	32.00	24	768.00
27	Digester feed pumps	30	0.5	0.85	2	0.9	51.00	24	1224.00
28	Digester mixers	60	0.85	0.85	1	0.87	51.00	24	1224.00
29	Centrifuge feed pump	0.75	0.7	0.85	2	0.72	1.28	24	30.60
30	Poly dosing pump for centrifuge	0.37	0.75	0.85	1	0.77	0.31	24	7.55
31	Centrifuge	7.5	0.75	0.85	1	0.83	6.38	24	153.00
32	Filtrate transfer pumps	10	0.85	0.85	2	0.83	17.00	24	408.00
33	Air Compressor for Instruments	7.5	0.83	0.85	1	0.84	6.38	20	127.50
34	DMF feed pump	1.5	0.75	0.85	2	0.83	17.00	24	2550.00
35	DMF backwash pump	30	0.92	0.85	2	0.9	51.00	4	204.00
36	DMF air blower	11	0.884	0.85	2	0.87	18.70	4	74.80
37	Single Phase Receptacles& Exhaust	22.5	0.9	0.8	2	0.9	36.00	24	864.00
38	Treated water transfer pump	45	0.925	0.85	1	0.9	38.25	20	765.00
39	Lighting Load	55	0.9	0.8	1	0.9	44.00	15	660.00
40	Total up to end of tertiary filtration						1285		26821
41	Electrical energy in kwhr per Kilolitre of sewage up to end of secondary treatment								18232
42	Electrical energy in kwhr per Kilolitre of sewage for tertiary filtration								5653
43	Electrical cost per kilolitre of sewage up to end of secondary treatment								7.29
44	Electrical cost per kilolitre of sewage for tertiary filtration								2.26

Note: Based on the above value of 26821 kWh consumed for the applicable unit charges and KVA charges can be easily arrived at.

5.4.3 Consumables and Fuel

Chemical consumption in respect of biological STPs will be mainly for the final chlorine consumption and addition of sodium carbonate if adequate bicarbonate alkalinity is not available in the raw sewage to the extent of at least eight times the ammonia to be nitrified. This cannot be easily calculated when a new STP is being planned for. However, generally sewage has the required bicarbonate alkalinity. Costs on other consumables and fuel should be also calculated as the occasion demands. The best method is to mention in the DPR that this will be met as per actuals at site when the STP is commissioned.

5.4.4 Repairs and Renewals

As stated earlier, the prevailing practice is to take repairs and renewals as at about 2% of the STP or SPS cost. This is where most of the problems of inadequate funding of O&M start. The civil works in a sewage contact cannot go on for 30 years as is the case of normal civil structures as per PWD norms. It is necessary to consider a period of only 25 years for civil tanks of aerobic reactors and 20 years for anaerobic tanks. It is not that the tanks are to be demolished after this period. It only means that there is a need to look into the state of the civil works and carry out rectifications of masonry or concrete or roof protection items. It is difficult to predict this value while preparing the DPR. Hence, it is to be taken as occurring at that time but provide a head of account of 10% of civil works cost under the head “unforeseen items” of future works and deposit the money in a security, where it will be needed only after 20 years. By that time, the value appreciation and inflation will normally even out. For equipment, it is suggested to consider that mechanical equipment will need replacement in 10 years and electrical equipment will need renewal in 15 years. Here again, repairs and renewals are usually provided for as a percentage of the cost of the plant, but this is not going to help the already prevailing shortfall in the O&M needs in many local bodies. A better method will be to assess the cost of the civil, mechanical and electrical parts of a similar sized plant, which has been commissioned recently. The better approach will be to assume a compounding rate for the coming years and arrive at the cost of these portions at the renewal year. Thereafter, the equivalent cost can be calculated and added together for the total renewal cost to be provided for in the DPR stage.

The formula for compounding factor is S = (1+ r) raised to n
Where S is compounding factor, n is the number of years and r is the interest rate as a numeral.

The formula for equivalent cost is EC = (1) / ((1+ r) raised to n)
Where EC is the equivalent cost in the zero year, n and r as mentioned above

A worked out example is illustrated in Table 5.5 (overleaf). The cells marked as “enter” are the cells where the values can be inserted as desired by the designer in the cell to its right. It may be seen that if a project plant is to be provided now at Rs 200 lakhs, the additional money required at the zero-year is Rs. 47.25 lakhs or nearly 23%. However, if this amount is deposited in the bank at the zero-year itself and if the rate of interest is as entered in Table 5.5, there should be no difficulty in prompt renewals of the plant at the corresponding year as provided for in Table 5.5. The table is available in MS Excel in the CD version of this manual. Hence, it will be easy to find out the money which is to be set aside in the zero-year and invested at as high an interest accrual as possible.

Table 5.5 Illustration of Compounding and Equivalent Costs in Lakhs of Rupees for Repairs and Renewals

No	Components for Calculation		Rs Lakhs
1	Present assessed cost of a plant	Enter	200
2	Percent of civil costs	Enter	0.40
3	Percent of mechanical costs	Enter	0.35
4	Percent of electrical costs		0.25
5	Cost of civil works		80
6	Cost of mechanical works		70
7	Cost of electrical works		50
8	Life of civil works before renewal in years		25
9	Life of mechanical works before renewal, in years		15
10	Life of electrical works before renewal, in years		10
11	Interest rate in percent	Enter	9
12	Compounding factor for civil works		8.62
13	Compounding factor for mechanical works		3.64
14	Compounding factor for electrical works		2.37
15	Percent of civil cost for repairs	Enter	10
16	Percent of mechanical costs for renewal	Enter	60
17	Percent of electrical costs for renewal	Enter	40
18	Compounded value of civil works at renewal year		68.98
19	Compounded value of mechanical works at renewal year		152.98
20	Compounded value of electrical works at renewal year		47.35
21	Rate of interest for equivalent cost factor	Enter	12.00
22	Equivalent cost factor for civil renewals		0.06
23	Equivalent cost factor for mechanical renewals		0.18
24	Equivalent cost factor for electrical renewals		0.32
25	Equivalent cost at zero year for civil works renewal		4.06
26	Equivalent cost at zero year for mechanical works renewal		27.95
27	Equivalent cost at zero year for electrical works renewal		15.24
28	Total equivalent cost at zero year for all renewals later		47.25

Note: The table is available in MS Excel in the CD version of the manual and can be used easily.

5.4.5 Depreciation Cost

Depreciation can be understood as an expense that reduces the utility of an asset by its wear and tear and its age as number of years. Equipment is to be recognized for depreciation and must be replaced once the end of their useful life is reached. There are several accounting methods that are used in order to calculate the depreciation cost over the period of its useful life. Accounting for it and treating the equipment as practically of no value at the end of its life term helps in reducing the revenues by off-setting depreciation and thus permits a free cash flow for expenditures. Among the many methods of arguing how much is depreciated, the two useful ones are as given below.

If we assume that the equipment will have only a scrap value at the end of its service life, the annual depreciation is calculated as:

Annual depreciation = (Cost at zero year – Cost of the scrap value) / life years

The difficulty in using this method in sewerage infrastructure is the fixing of the scrap value after the life years. This is also not practically applicable in sewerage infrastructure because the equipment cannot be replaced completely after its service life years since it can be renewed and operated for some more years. Moreover, there will be criticism from the auditors that whereas the equipment could have been serviced and used for some more time, it was deliberately thrown out to pave the way for a totally new purchase.

The other method of calculating the depreciation is by the formula:

D = [r] / ((1+r) power L)) – 1

Where D is the depreciation, L is the life years, and r is the interest rate as a numeral

The same example in Table 5.5 when calculated by using this formula will result in depreciation over the life years of both mechanical and electrical equipment as in Table 5.6 overleaf. It may be seen from Table 5.5 that the total equivalent costs at zero-year by following the compounding and equivalent value method is Rs 47.25 lakhs. It may be seen that by following the depreciation formula method, the net accrual will be Rs. 50 lakhs at the end of the 15th year. By following this method, the written off money would have been invested as savings over the 15-year period as follows: For first 10 years at Rs. 3.73 lakhs per annum and yielding Rs. 72 lakhs and then at Rs. 1.18 lakhs up to the 15th year yielding Rs. 8 lakhs. The reinvesting of Rs. 72 lakhs for 5 years will yield Rs. 130 lakhs. This will yield a revenue of Rs. 8 + 30 = Rs. 138 lakhs in 16 years. However, the cost of renewals will be as follows as shown in Table 5.5:

Renewal of electrical equipment at the 11th year	Rs. 47.35 lakhs
Renewal of mechanical equipment at the 16th year	Rs. 152.98 lakhs
Total cost at the 16th year	Rs. 200.33 lakhs.

Though this example will tend to prove that the compounding and equivalent cost method is safer for renewals of equipment, the per cent of interests assumed will dictate the relative gains. There are also fluctuations in market lending rates. It appears better to use the best-ascertained interest rates and calculate for both these methods, and then use the method that will result in the higher monetary value at the 16th year. The money for repair of civil works is a minor component and can be adjusted in the annual budgets spread over a two- to three-year period.

Table 5.6 Depreciation of Mechanical and Electrical Equipment of the Plant in Table 5.5

No	Components for Calculation		Lakhs of Rupees
1	Present assessed cost of a plant	Enter	200
2	Percent of civil costs	Enter	0.40
3	Percent of mechanical costs	Enter	0.35
4	Percent of electrical costs		0.25
5	Cost of civil works		80
6	Cost of mechanical works		70
7	Cost of electrical works		50
8	Life of civil works before renewal in years		25
9	Life of mechanical works before renewal, in years		15
10	Life of electrical works before renewal, in years		10
11	Interest rate in percent	Enter	9
12	Interest true value, r		0.09
13	1+r		1.09
14	(1+r) power L for mechanical works		0.04
15	(1+r) power L for electrical works		0.02
16	Annual depreciation for mechanical works		2.55
17	Annual depreciation for electrical works		1.18
18	Annual depreciation of equipments		3.73
19	Total depreciation for first common years		37.33
20	Total depreciation for balance years		12.75
21	Net depreciation		50.08

Note: The table is available in MS Excel in the CD version of the manual and can be used easily.

5.5 BUNDLING THE ESTABLISHMENT COSTS OF SPSs AND STPs

The financial burden of allocating dedicated establishment for scattered and small SPSs and STPs need to be recognized in Figure 5.1. If these smaller facilities can be bunched together for purpose of establishment, the initial steep portion of the curves can be virtually eliminated and the costs can be practically made into a straight line parallel to the x-axis. In actual practice, the allocated establishment in these SPSs and STPs are not having a continuous work in the O&M except for random checking of the status of machineries. This can be easily done by keeping the establishment moving between a grouped numbers of SPSs and STPs. In fact, this will also help in keeping the establishment getting involved with the work and avoid the staleness of being forced to be idling for most time when handling a small SPS or STP, where there is nothing much to do daily.

In some cases, the bundling of these SPSs and STPs may bring in geographical issues and jurisdictions. These can be easily got over. Whether the O&M is by contractors or by ULBs, the functional responsibility of the contractor/ULB staff will be to the respective ULBs and the administrative control can be under the concerned revenue official with integrated jurisdiction on the ULBs concerned. This is similar to the functioning of the law and order system in our country.

5.6 O&M BUDGET AND COST RECOVERY

The preparation of O&M budget is an exercise for performing all the above calculations and also providing for the other components listed in section 5.4 as:

a. Consumables and fuel
b. Seed capital
c. Debt servicing
d. Cess
e. Taxes and duties

The seed capital is a provision that would serve to take up system improvements and unforeseen expenditures. There are no hard and fast rules for its value. It depends on whether there is revenue surplus in the first place. The rest of the components of debt servicing, cess and taxes and duties are components as become available.

A good budget exercise is one, which has iterations. Firstly, the expenses are worked out and then revenues are verified based on levies. The rate of levies can be varied to result in a revenue surplus budget. The final decision will rest with the consumers and if they do not come forward to pay for services availed by them (or) if they question the cross subsidies policy, there can be difficulties. An exercise has been carried out by HPEC, constituted by the MoUD. They have worked out the per capita O&M cost for various classes of cities at 2009-2010 price level as shown in Table 5.7.

Table 5.7 Per Capita O&M Costs (PCOM) for Sewerage at 2009–2010 prices

No	City size and class	PCOM / year
1	Class IA	414
2	Class IB	373
3	Class IC	290
4	Class II	290
5	Class III	207
6	Class IV	145

Source: HPEC, MoUD. 2011.

5.7 RECOMMENDATIONS

The O&M costs can be calculated by appropriately using the Excel versions of Table 5.1 to Table 5.6. Thereafter, the other expenditures as in the para above should be added. The extent of the surplus, however marginal, has to be verified. Once the figures have been arrived at, the PCOM equivalent can be decided by dividing the expenditures by the population and the resulting value compared with Table 5.7. If the resulting value is less than the value given in Table 5.7, once again the exercise has to be repeated to ensure no item is left out. If it is higher, the same must be maintained. If the Government policies do not empower the local bodies to levy a workable levy, it has to be taken up with the Government and discussed.

5.8 SUMMARY

O&M of sewerage works in India is not in any great shape. One of the reasons is the inadequate O&M budget. This in turn is traceable to the absence of a structured approach to forecast O&M fund requirements, as also human resources needs. In this chapter, these are analysed and examples of calculation methods of necessary costs are proposed. In addition, a CD of Excel spreadsheets is included. In order to customize the Excel sheet to specific ULB, accumulation of data and periodical assessment are necessary. The recommendation shows some precaution for application to specific ULB. This is only a genesis and needs progressive refining.