Approaches to Capital Financing and Cost Recovery in Sewerage Schemes Implemented in India:

Lessons Learned and Approaches for Future Schemes

March 2016

wsp water and sanitation program

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Acknowledgments

The authors gratefully acknowledge the support provided by the Central Public Health and Environmental Engineering Organization, Ministry of Urban Development, Delhi. The team wishes to thank the cities of Hyderabad, Chennai, Bengaluru and Pune for the data and support provided.

The team would like to thank Almud Weitz, Regional Team Leader, Water and Sanitation Program – South Asia for her support and encouragement for the study and the report. The team further appreciates the insights and critique provided by our reviewers. Reviewers included Poonam Ahluwalia Khanijo, Raghava Neti and William Kingdom, World Bank, apart from officials from the Ministry of Urban Development.

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Abbreviations and Acronyms

ASP	Activated Sludge Process
BOD	Biochemical Oxygen Demand
BOT	Build Operate Transfer
BOOT	Build Own Operate Transfer
BWSSB	Bangalore Water Supply and Sewerage Board
CAPEX	capital expenditure
CMA	Commisionerate of Municipal Administration
CMWSSB	Chennai Metro Water Supply and Sewerage Board
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
CPCL	Chennai Petroleum Corporation Limited
CPHEEO	Central Public Health and Environmental Engineering Organization
DBFOT	Design Build Finance Operate and Transfer
DBOT	Design Build Operate and Transfer
DPR	Detailed Project Report
EA	Extended Aeration
EPC	Engineering, Procurement and Construction
FAB	Fluidized Aerobic Bioreactor
GDP	Gross Domestic Product
GoI	Government of India
GoTN	Government of Tamil Nadu
HH	Households
HPEC	High Powered Expert Committee
HSC	House Service Connection
IRR	Internal Rate of Return
kL	Kiloliter
km²	square kilometer
kWh	kilowatt hour
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
kg	kilogram
m	Meter
m³/d	cubic meter per day
MASP	Modified Activated Sludge Process
MBBR	Membrane Based Bio Reactor
MBR	Membrane Bio-reactor
mg/l	milligram per liter
MLA	Member of Legislative Assembly
MLD	million liters per day
MoEF	Ministry of Environment and Forests
MoUD	Ministry of Urban Development
MP	Member of Parliament
MW	Megawatt
NGO	nongovernmental organization
NRCP	National River Conservation Programme
O&M	Operation and Maintenance
PPCL	Pragati Power Corporation Limited
PPP	Public Private Partnership
RO	Reverse Osmosis
SMC	Surat Municipal Corporation
SPS	Sewage Pumping Station
STP	Sewage Treatment Plant
TMC	Thoothukudi Municipal Corporation
TNEB	Tamil Nadu Electricity Board
TNPCB	Tamil Nadu Pollution Control Board
TNUDF	Tamil Nadu Urban Development Fund
TNUDP	Tamil Nadu Urban Development Project
TNUIFSL	Tamil Nadu Urban Infrastructure Financial Services Limited
TSS	Total Soluble Solids
TWAD	Tamil Nadu Water and Drainage Board
UGD	Under Ground Drainage
UIDSSMT	Urban Infrastructure Development Scheme for Small and Medium Towns
ULB	Urban Local Body
WSP	Water and Sanitation Program

Executive Summary

This report aims to highlight some of the successful financial management practices adopted by Urban Local Bodies (ULBs) in India when implementing sewerage schemes. The findings are presented in two parts – the first part of the report discusses the approach adopted for capital financing of sewerage schemes in the state of Tamil Nadu, and the second part presents the findings from a review of the operational expenditure and revenue generation of various ULBs across the country. The aim of the report is to share successful capital financing and cost recovery practices adopted by ULBs in India and enable improvement in provisioning of sewerage systems (only where feasible and economically viable, typically only in larger towns with a population greater than 50,000) and ensure availability of sufficient funds for proper Operation and Maintenance (O&M) of the schemes implemented.

Challenges in Provisioning for Wastewater Collection and Treatment

Low provision of facilities for wastewater treatment, ineffective treatment of wastewater and existing treatment facilities working below par contribute to the discharge of partial or untreated wastewater, and are responsible for more than 80 percent of the pollution in surface waters in India (CPCB, 2007). Only 200 cities/towns in India have a partial sewerage network; only 32.7 percent of the urban population (that is, 25.78 of the total 78.9 million households) are sewered despite investments over 11 plan periods up to 2012 (Census, 2011).

Sewage treatment capacity is 30 percent of what is required in class I and class II cities. This is further exacerbated by the fact that existing treatment capacity is underused, with capacity utilization estimated to be about 66 percent of existing sewage treatment facilities (CPCB, 2013). Therefore, only about 20 percent of sewage generated in urban India is actually treated before disposal.

The Water and Sanitation Program (WSP, 2011) estimated that the total annual economic impact of inadequate sanitation in India amounted to a loss of INR 2.4 trillion (US$53.8 billion) in 2006, which was equivalent to about 6.4 percent of India's Gross Domestic Product (GDP) in 2006.

Several programs and schemes have been implemented to address the challenge of inadequate sanitation in India. Efforts are being made both by the central government and state and local governments. While some states lag in providing sewerage infrastructure (as compared to the national average of <30 percent treatment capacity), others have been more successful in the same effort. Some of these states have explored and tested new paradigms of implementing projects and attempted to address challenges associated with the current models, which is critical as we move ahead with creating a substantial sanitation infrastructure in the country.

According to a Central Pollution Control Board (CPCB) report (CPCB, 2013) evaluating the performance of 152 Sewage Treatment Plants (STPs) spread over 15 states in the country, the capacity utilization at these plants is only 66 percent. Of the total, nine STPs are under construction, 30 STPs are nonoperational and the performance of 28 STPs is not satisfactory. The treated effluent from 56 STPs is not in compliance with the discharge standards (Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and so on).

The lack of availability of adequate treatment capacity combined with underutilization and underperformance of sewerage infrastructure actually created is a significant

cause for the continued pollution of water bodies in the country despite significant investments having been made in several large river basins. Some of the major causes for the underperformance of existing STPs include inadequate and delayed planning, lack of availability of land and inaccurate estimation of treatment capacity required, delays in completion of schemes due to lack of inter-agency coordination at the field level, shortage of skilled manpower and regular staff, and inadequate availability of funds for O&M of the system. Another key limitation to the implementation of these projects is the underutilization of STPs, in some cases, due to low house service connections (HSC) in the sewer network or absence of upstream systems such as branch sewers and house connections.

Capital Financing of Sewerage Schemes in Tamil Nadu

Sewerage schemes in Tamil Nadu: Implementation of sewerage schemes was given attention by Tamil Nadu beginning in June 1997 when the Government of Tamil Nadu (GoTN) identified seven urban areas adjacent to Chennai for further investigation. The state formally proclaimed its commitment towards providing safe sanitation in denser areas through five-year plans and annual policy announcements. Alandur was the first project to be implemented on a Build-Operate-Transfer (BOT) model, which was also a first in the country and is often cited when discussing the role of Public Private Partnership (PPP) models in the sanitation sector. The Alandur project also set the precedent for the collection of public deposits towards meeting the capital expenditure.

Subsequently, sewerage schemes in seven cities were taken up under the National River Conservation Programme (NRCP), funded by the Government of India (GoI), with participatory funding from GoTN and ULBs. In 2003, 25 towns serving as district headquarters were taken up for implementation under the Tamil Nadu Urban Development Project III (TNUDP III) funded by the World Bank. The capital financing study has been undertaken to assess the design principles incorporated under TNUDP III projects through an analysis of the scheme details for projects implemented in five TNUDP III towns and compare this with three towns that received funding for their schemes under NRCP.

Key observations on the two schemes in Tamil Nadu reviewed to understand the capital financing approach are:

1. **House service connections**: All schemes have, in general, been relatively successful in ensuring that households connect to the network. This is true for projects implemented under both financing schemes (NRCP and TNUDP III); however, the connection efficiency appears to be marginally better in the TNUDP III towns. It is believed that this high level of connection efficiency in both NRCP and TNUDP III projects is a result of the public deposit collection strategy adopted by the state for all underground drainage (UGD) schemes.
2. **Treatment technology**: The treatment technologies in most of the schemes were based on the activated sludge process (ASP). The projects implemented under TNUDP appear to have incorporated innovations to attempt recycle and reuse of treated wastewater. One of the projects implemented under the TNUDP is based on the Membrane Bio-reactor (MBR)+ Reverse Osmosis (RO) treatment technology with the objective of treating wastewater up to tertiary treatment levels and reusing the treated wastewater for industrial use.
3. **Cost of project**: The cost of providing sewerage infrastructure comprising both the network and STP varies across cities. The unit cost of schemes appears to be slightly lower for projects implemented under TNUDP III (except the scheme based on the advanced MBR+RO treatment technology) as compared to projects implemented through NRCP support. This is significant considering that the TNUDP projects were implemented in 2009, several years after NRCP projects (implemented in 2002-03), and that most TNUDP III projects were based on technology configurations that

[1] Collection of public deposits and the impact thereof on scheme financing and household connections is discussed in detail in this report, and is also described briefly later in the Executive Summary.

were either the same or moderately better than that selected in the NRCP schemes. The decrease in cost of TNUDP III projects may be attributed to the execution approach adopted. Most of the TNUDP III projects were implemented through either Design Build Operate and Transfer (DBOT) or Design Build Finance Operate and Transfer (DBFOT) implementation models as opposed to simple BOT models adopted under NRCP. A DBOT model encouraged technology firms to participate in project execution, and improve the overall design to minimize the cost of the projects.

Approach towards capital financing of sewerage schemes: A mix of grant funds, loans and public equity through deposit collection was utilized for implementing the sewerage projects in Tamil Nadu. The proportion of grants in projects implemented in NRCP cities is relatively higher as compared to projects implemented through support under the TNUDP III. The share of loan and contribution made by ULB/public is higher in the TNUDP cities. Key observations related to capital financing of projects under TNUDP III and NRCP schemes in Tamil Nadu are:

1. Schemes implemented through NRCP support have a significant grant component provided either by GoI or GoTN (<70-85 percent of total project cost) with little or no loan component at all (two of the three schemes under NRCP did not avail any loan to meet the capital expenditure requirement);
2. The schemes implemented under TNUDP-III have a varying mix of both grant and loan to meet the capital expense, with the share of loan ranging from 20-45 percent of the total project cost. The loan-grant mix varies across cities since the extent of loan is limited by the borrowing capacity and debt servicing capacity of the ULBs; and
3. A unique feature in all schemes is that a portion of the capital expenditure (CAPEX) is funded through collection of public deposits levied on households, which is the 'one-time non-refundable deposit' obtained from the users. This money is structured as a nonrefundable one-time deposit from the project beneficiaries. The advantages of this deposit contribution from the public have been: (i) accountability on the part of the ULB to provide timely, quality services; (ii) ensuring that households connect to the network upon completion of the project;[2] and (ii) reduced debt servicing costs and therefore the user charge by up to INR 30-50 per household per month.

Findings from capital financing review: A review of successful sewerage schemes implemented in Tamil Nadu reveals that increase in share of loans to meet capital expenses and subsequent requirements of financial commitment towards debt servicing, seems to have a positive impact on the performance of the ULBs, with respect to providing HSCs. **Public deposits** can be effectively used to meet a share of the capital funds required as demonstrated in various towns across Tamil Nadu.[3] This formed the public equity in the project. This provides two benefits: a) it ensures that households connect to the sewer network upon completion of the project; and b) this public contribution also partly finances the capital cost of the sewer projects. In the absence of these deposits, the loan amount would have to increase by an equivalent amount. The impact of that would be an increase in the annuity payable, subsequently translating into higher costs for ULBs and user fee payable by citizens (up to INR 50/household/month).

[2] There is an additional expense for connection that has to be borne by the household after the network is operational, in addition to the public deposit contributed. Since the payment of the public deposit, which is <INR 5,000/household is a substantial investment already made by the household, its payment encourages households to make the balance (but smaller) additional investment for connection and plumbing within the house, thereby improving network utilization.

[3] GoTN has instructed cities vide a government circular that deposits cannot exceed INR 5,000 per household (as a weighted average amount for the city) In order to adhere to this, a graded structure was devised in most cities based on the plinth area, such that the weighted average amount for the entire city amounts to INR 5,000/household.

Impact of Deposit Collection on HSCs

- It was observed that, in most of the cities studied, a majority of the households had been connected to the network.[4] The HSC efficiency ranged from 50- 95 percent in most cities studied;[5]
- Further, almost 100 percent of households that had been provided sewer connections had paid their share of the deposit contributions owed to the ULB.[6] The deposit collection efficiency was close to 100 percent in most cases; and
- The high levels of deposit collections ensured that households connect to the sewer network and results in effective use of the infrastructure.[7]

Impact of deposit collection on loan requirement and annuity outflow: It was observed that the public deposits collected by ULBs contributed to about 10-20 percent of the project cost. The following key observations are made related to public deposit collection:

1. The deposits collected are significant when compared with the loan amount availed by ULBs to meet their project costs. The deposits collected amounted to about 30-60 percent of the loan component. In the absence of this public deposit contribution, it can be expected that the loan amount would have been higher by an equivalent amount, resulting in an additional debt service burden on the city;
2. Collecting public deposits allowed the ULBs to avoid additional loan amounts. Simple calculations (based on the actual loan terms availed by the cities under TNUDP III) indicate that this avoided loan reduces the annuity payable by >30 percent and the user charge by >INR 30-50/household/month.[8] It is evident that there is an impact on the end user fee. This is especially relevant given the reluctance of cities to levy user charges;
3. It is also interesting to note that many of these cities commenced collection of public deposits even before construction began. This is more evident in TNUDP III cities, where there is a loan covenant for collection of deposits at least to the extent of 30 percent of the project cost before availing loans. The efficiency in collection of deposits is discussed in more detail later in this report. This collection provides a source of funds to finance sewerage projects not typically seen in other schemes. In its absence, the quantum of loans would likely have been higher in all schemes;
4. Most public deposits were collected during the construction period before project commissioning; and
5. All ULBs visited appear to have invested significant time and resources on communication and engagement with the public on the need for the scheme and role of public deposits in ensuring success of the project. This has been supported by proactive and focused efforts towards collection of public deposits both before and after commencement of construction activities for the project.

Table ES1 summarizes the key features related to deposit collection and its impact based on the towns studied in Tamil Nadu.

[4] It was observed that the towns used a mix of strategies to encourage households to pay the public deposit, and subsequently connect to the network. These included provisions for payment in installments, enforcing regulatory provisions mandating households to connect to a network when available within 100 meter (m) of the household boundary, and expending significant resources towards communication and awareness generation within the community on the need to connect to the network.

[5] Low collection efficiency was reported in three of the eight towns. The reasons are linked to use of official figures for registered users only (whereas unauthorized users may also be connected and using the network, with the utility working on rectifying this situation) and ongoing works related to provisioning of connections (especially work in progress within the household premises). The report discusses this issue in more detail, and the reasons for the low connection efficiency in some cities.

[6] Funding provided under TNUDF mandated that ULBs pass council resolutions to provide sewer connections only after payment of the public deposit. Most ULBs have also resolved to increase tariffs and deposit rates every five years, which was an incentive for beneficiaries to contribute the public deposits early in the project cycle.

[7] In case a household does not pay the deposit, the connection chamber outside the house boundary is provided by the ULB, however, connection with the household chamber is not provided.

[8] The impact of public deposit collection on annuity and user fees is on account of reduction in the loan required for CAPEX funding. This reduction may only be realized in cities where CAPEX funding is dependent on the loan and user charges go towards capital repayment.

TABLE ES1: Public deposit collection from towns in Tamil Nadu for capital financing

Program Represented	ULB	Deposits Payable (Lakh)	Deposits Collected (Actual) (Lakh)	Deposit Collection Efficiency	Actual Public Deposits Collected (Lakh)	Annuity Avoided Due to Public Deposits (Lakh)[10]	Notional Reduction in User Charge Due to Annuity Avoided[11] (INR/ Household/Month)
NRCP	Karur	275	275	**100%**	275	**33.61**	**51**
	Mayiladuthurai	427	207	**48%**[12]	207	**25.30**	**25**
	Kumbakonam	670	670	**100%**	670	**81.90**	**51**
TNUDP III	Namakkal	360	360	**100%**	360	**44.00**	**51**
	Perambalur	368	370	**101%**	370	**45.23**	**51**
	Sivaganga	322	149[13]	**46%**[14]	149	**18.21**	**24**
	Chinnamanur	118	118	**100%**	118	**14.42**	**51**
	Thoothukudi	990	972	**98%**	972	**118.81**	**50**

Review of Cost Recovery Approaches for O&M of Sewerage Scheme

An analysis of operational expenditures and revenues of various ULBs across the country[9] reveals that they have adopted a variety of measures to recover O&M costs. The predominant cost recovery options employed by various ULBs across the country are summarized below, and discussed in detail in later sections of the report:

1. **User fee**: All ULBs in Tamil Nadu and several others in other Indian states collect a recurring fee called the 'user fee' which is meant to cover all or a portion of O&M cost of the sewer systems;
2. **Property tax**: For some ULBs, especially those outside Tamil Nadu, user fee collection in itself is not sufficient to meet full costs of operation. There are other sources of income that meet the O&M costs of sewer systems. Predominantly, these arise from the water and drainage tax component of the property tax;
3. **Deposit collection to reduce debt burden**: This practice is unique to the schemes implemented in Tamil Nadu where deposits are collected from the public (beneficiaries) even before project commissioning. While the deposits collected go towards meeting the capital expenditure until such time as the project is completed in all respects, all deposits which are collected after commencement of project go into a revenue account to meet O&M costs and;[15]
4. **Other methods of meeting costs**: There are several other ways of meeting costs such as sale of treated water to industries and power generation at the treatment plants that helps reduce energy costs which help to meet the cost of operations:

[9] The list of ULBs included in the cost recovery study is included in Section 4, Table 16.
[10] Calculated based on an interest rate of 8.75 percent and a loan tenor of 15 years.
[11] Computed for the actual number of households connected to the network.
[12] The lower deposit collection efficiency appears to have been a result of a lack of drive on the part of the ULB which may, in turn, be a result of no direct incentive for the ULB to raise funds from public deposit contribution. In the absence of any loan and the entire project funds coming through grants, collection of the public deposits does not appear to have been a priority and may have suffered.
[13] In Sivaganga, the deposit collection drive has been slow, due to delay in implementation owing to change of land and also due to a litigation.
[14] The lower collection of deposits in Sivaganga is on account of delay in the project commissioning due to an ongoing litigation at the National Green Tribunal related to the STP site.
[15] While all public deposits are aimed to be collected prior to project commissioning to contribute towards the project CAPEX, in reality, deposit collection from all targeted households can extend beyond commissioning, whence CAPEX funding requirements have already been met. In such cases, the deposit collected can go into a revenue account.

a. **Reduction in O&M costs due to power generation**: A study across eight cities in the country indicated that power generation within STPs has proved to have reduced nearly 50 percent of the O&M cost and have met up to 80 percent of energy costs; and
b. **Sale of treated wastewater**: Cities that have sold their treated wastewater have recovered up to 200 percent of their cost of operations. This provides an excellent opportunity for cities with industrial activity to generate revenue for their O&M needs.

The extent of recovery of O&M costs from the various options is summarized in the Table ES2.

Other enablers: In addition to project design and financial planning, it was observed that political will and commitment towards the project, a sustained and focused public awareness and engagement campaign, and a clearly and well-defined institutional structure were critical to the success of these projects.

TABLE ES2: Cost recovery approaches adopted by various ULBs

	Potential to Meet O&M Requirements	
Option for Cost Recovery	**Average Demonstrated Potential**	**Maximum Demonstrated Potential**
Levying user fees	~100%	More than 200%
Allocation from property taxes	~50%	More than 150%
Sale of treated wastewater	~40%	~100%
Reduction in O&M burden from power generation at STP	~80% reduction in energy costs ~40% reduction in overall O&M costs	
Collection of public deposits	~30% reduction in loan requirement ~30 reduction in debt servicing burden ~Reduction in household user fees by ~INR 30- 50/household/month	

1. Introduction

1.1 Status of Sewage Generation and Treatment in India

Urban India is characterized by partial provision of sewerage networks in Indian cities (covering less than a third of households), high proportion of onsite sanitation systems (septic tank systems and pit latrines, serving about 47 percent urban households (Census, 2011), with little or no treatment) and poorly maintained public and community toilets. This is exacerbated by low provision of facilities for wastewater treatment, ineffective treatment of wastewater, and existing treatment facilities working below par – all of which result in discharge of partial or untreated, wastewater contributing to 80 percent of the pollution of surface waters (CPCB, 2007).

Only 200 cities/towns in India (of a total 7,933 towns, according to Census 2011, of which 4,041 are statutory towns) have a partial sewerage network (HPEC, 2011) and even large cities such as Bengaluru or Hyderabad have a significant share of onsite sanitation provision (HPEC, 2011). According to Census 2011, only 32.7 percent of the urban population (that is, 25.78 of the total 78.9 million households) is sewered despite investments over 11 plan periods up to 2012.

Sewage treatment capacity is 30 percent of what is required: According to the Central Pollution Control Board (CPCB, 2009), of the 38,254 million liters per day (MLD) wastewater generated in class I and class II cities accounting for about 70 percent of the urban population, treatment capacities exist for only 11,787 MLD, or 30 percent of the requirement.

Existing treatment capacity (sewage and wastewater) is underused: Capacity utilization is about 66 percent of existing sewage treatment facilities (CPCB, 2013), indicating that only about 20 percent of sewage generated in urban India is treated before disposal. Household connectivity to networks is an issue (CII, cited in HPEC 2011; CPCB, 2013).

Performance of the existing wastewater treatment infrastructure also needs attention, as treated effluents from 46 of 79 Sewage Treatment Plants (STPs), under utility/Urban Local Body (ULB) ownership, assessed by CPCB in 2007, failed to comply with the CPCB discharge standards (CII, cited in HPEC 2011). More recent evaluations of existing treatment plants in the country also present a discouraging picture vis-à-vis the actual treatment performance of STPs, wherein CPCB evaluated 152 STPs constructed in the country under the National River Conservation Programme (NRCP) and found that 49 of 114 operational STPs[16] did not meet CPCB discharge standards for treated wastewater.

1.2 Impacts of Untreated Sewage

Environmental pollution from untreated sewage and wastewater is widespread: The discharge of untreated sewage is responsible for contamination of 80 percent of fresh water resources (CPCB, 2007) in the country. The sanitation rating of 423 class I cities done in 2009-10 by the Ministry of Urban Development (MoUD) revealed that only 39 cities passed the water quality tests (MoUD, 2010).

Health impacts and cost of inadequate sanitation: The Water and Sanitation Program (WSP, 2011) estimated that the total annual economic impact of inadequate sanitation in India amounted to a loss of INR 2.4 trillion (US$53.8 billion) in 2006, which was equivalent to about 6.4 percent

[16] Of 152 STPs evaluated, nine were under construction, 29 were not operational and 49 were not meeting CPCB effluent discharge standards for biochemical oxygen demand (BOD).

of India's Gross Domestic Product (GDP) in 2006. These losses and economic impacts are disproportionately borne by the poorer sections of society due to the lower levels of access to improved sanitation and water supply, and relatively more densely populated living conditions. Conversely, improvements in sanitation and hygiene can result in gains of INR 1.48 trillion (3.9 percent GDP; per capita gain INR 1,331), and prevent 338 million cases of diseases and 350,000 deaths.

1.3 Efforts to Provide Adequate Sanitation

Several programs and schemes have been implemented to address the challenge of inadequate sanitation in India. Efforts are being made both by the central government and state and local governments. The Government of India (GoI) has been providing central funding assistance through programs such as the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) and Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT), administered by MoUD; the NRCP administered by the Ministry of Environment and Forests (MoEF), and so on. MoUD has provided financial assistance for 116 sewerage schemes under JNNURM at a total approved cost over INR 15,000 crore (GoI commitment of ~INR 7,200 crore).[17] MoEF has funded 179 STPs under various schemes. The investment required, however, to provide universal sanitation to the entire country is estimated to be in the range of INR 242,688-348,258 crore over the next 20 years (HPEC, 2011; WSP, 2014), which is about 15 to 20 times the investments planned under the GoI programs mentioned above (JNNURM, UIDSSMT, NRCP, and so on). In addition to investments that have lagged, the effectiveness of these projects in terms of sanitation outcomes is also not very encouraging as the assets that have been created are operating well below capacity or not operating at all.

There have also been efforts made by various states to implement sewerage schemes. While some states lag in providing sewerage infrastructure (as compared to the national average of ~30 percent treatment capacity), others have been more successful. Some of these states have explored and tested new paradigms of implementing projects and attempted to address challenges associated with the current models, which is critical as we move ahead with creating substantial sanitation infrastructure in the country.

1.4 Key Challenges to Successful Implementation of Sewerage Projects

A recent study undertaken by the CPCB (CPCB, 2013) evaluating the performance of 152 STPs spread over 15 states in the country, finds that the capacity utilization at these plants is only 66 percent. Of the total, nine STPs are under construction and 29 STPs are nonoperational. The treated effluent from 56 of the 114 operational STPs were found to be violating the CPCB effluent discharge standards ((49 STPs were not compliant with Biochemical Oxygen Demand (BOD) discharge standards, and seven were not compliant with Chemical Oxygen Demand (COD) discharge standards).

There are several shortcomings in implementing typical sewerage projects as highlighted under the NRCP (MoEF, 2011):

- Increasing gap between requirement of sewage treatment infrastructure and actual pollution load being tackled due to continuous increase in population in towns along the river banks, and inadequate financial resources invested in river cleaning. While the availability of financial resources may not be a limiting constraint, inadequate and delayed planning, lack of availability of land, and inaccurate estimation of treatment capacity required are significant challenges (PC, 2011);
- Delays in completion of schemes due to lack of inter-agency coordination at the field level, delays in acquisition of land for STPs and pumping stations, contractual problems, court cases, and so on, leading to cost overruns;
- Shortage of skilled manpower and regular staff and inadequate provision of funds by the states and ULBs for Operation and Maintenance (O&M) of the sewage treatment infrastructure. This is exacerbated by the

[17] As of March 2014.

reluctance of ULBs to charge user fees and lack of a sustainable O&M financing plan for servicing the sewerage infrastructure created;

- Erratic availability of power supply for operation of assets, underutilization of STPs, in some cases, due to low house service connections (HSC) in the sewer network or absence of upstream systems such as branch sewers and house connections. This results in a misguided focus on creation of asset without sufficient focus on its O&M; and
- Lack of involvement of civil society in the program, including lack of citizen engagement and support for completion of the project and connection with the network post commissioning.

This is also supported by the assessment done in 2009 by Member (Water Resources), Planning Commission, for the Supreme Court which found that STP capacities created along River Ganga were inadequate to treat sewage generated in the cities and that they did not have the funds to maintain STPs. Inadequate O&M of the STP by the states was also seen as a major cause for concern. The assessment concluded that cleaning of rivers would require adequate resources, proper planning, anticipation of capacities with levying of user charges, and proper maintenance of assets created.

1.5. Study Objective

This study has been undertaken to identify successful implementation models that have been implemented in various states/cities and towns across India, with a special focus on the state of Tamil Nadu, where a large number of sewerage projects have been implemented, both through GoI assistance, as well as other means of finance. This report presents the findings from the study undertaken on various sewerage projects.

The report findings are presented in two parts – the first part discusses the findings related to capital financing of sewerage projects, and the second discusses cost recovery approaches adopted by various ULBs to meet O&M expenditures for sewerage projects.

2. The Case of Tamil Nadu

2.1 Introduction

Among the major states, Tamil Nadu is the most urbanized state in India with about 48.45 percent[18] population residing in urban areas, compared to the national average of about 31 percent. Tables 1 and 2 present key statistics related to the urban population and status of urban sanitation in Tamil Nadu.

TABLE 1: Level of urbanization in Tamil Nadu

Type of City/ Town	Number of Cities	Population
Class I	31	13,717,441
Class II	73	5,128,336
Class II	192	5,816,806
Class IV	290	4,114,176
Class V	124	1,013,519
Class VI	11	42,488
Census towns	376	4,999,310
Total	**1097**	**34,832,076**
Share of urban population in total population (%)		48.4%
Share of urban population residing in slums		15%
Population density		555/square kilometer (km^2)

Source: Census 2011.

TABLE 2: Status of sanitation in urban areas in Tamil Nadu

Households (HHs) relying on individual toilets (%)	75.1%
HHs relying on Community/public toilets (%)	8.6%
HHs practicing Open defecation (%)	16.2%
HHs connected to sewers (%)	27.4%
HHs on septic tanks (%)	37.9%
HHs on pit latrines (%)	6.8%
HHs connected to insanitary latrines (%)	1.8%

Source: Census 2011.

Due to rapid urbanization, the demand for basic urban services has seen a steep rise. Provision of services, however, has not progressed rapidly enough to keep pace with the growth in demand, due to various institutional, financial and capacity constraints. These constraints have been overcome to varying levels in recent schemes implemented in the state, which can provides insights into the design and implementation of future schemes both within the state and across the country.

In the past, the state struggled with provision of basic sanitation infrastructure, and for a while the sanitation situation, even in major urban centers, was quite poor. The sanitation situation in the state prevalent in 2001 (as per Census 2001 data) compared with the improvements achieved in the subsequent decade (based on Census 2011 data) is presented in Table 3. Table 3 reveals that there have

[18] Source: http://moud.gov.in/%20levelurbanisation.

TABLE 3: **Improvements in urban sanitation in Tamil Nadu achieved between 2001 and 2011**

Indicator	2001 (Urban)		2011 (Urban)	
	Number of HHs	% of total HHs	Number of HHs	% of total HHs
Total no. of HHs (urban)	5,898,836		8,929,104	
HHs with latrine facility within premises	**3,917,969**	**66%**	**6,709,788**	**75%**
HHs connected to piped sewer system	3,136,708	**53%**	2,447,780	**66%**
HHs connected to septic tank			3,385,422	
HHs connected to other system			102,476	
HHs with no latrine within premises	658,193	**11%**	585,026	**7%**
HHs using open pit			24,720	
HHs with no latrine within premises	2,103,935	**36%**	2,219,316	**25%**

been improvements in all aspects of safe sanitation, including increase in share of urban households having a latrine facility within their premises and share of households connected to a flush/pour flush toilet. While the 2001 Census did not differentiate between the various flush/pour flush options (piped sewer or septic tanks), the overall levels of such systems have increased in the state from 53 percent to 66 percent, with 27 percent of the urban population connected to sewer systems in 2011 (Census, 2011).

Realizing the need for focused investments aimed at improved sanitation outcomes, the state prepared a roadmap for the development of sewerage systems in urban centers.

2.2 Evolution of Sewerage Projects in Tamil Nadu

As a majority of households in the state was dependent on septic tanks or other on-plot arrangements for human waste disposal, the nonavailability of service providers to empty the septic tanks together with the lack of treatment facilities posed significant health and environmental risk to households. This, together with partial sewerage system which only benefited a fifth of Chennai's population, contributed to the abysmal sanitation situation in the state and led to the conceptualization of underground sewerage projects for large towns and suburbs. The basic aim of some of the first sewerage projects in the state was to improve the sanitation situation in suburban towns of Chennai and other corporations and large municipalities. In June 1997, the Government of Tamil Nadu (GoTN) identified seven adjacent urban areas of Chennai for further investigation. These included, Alandur, Ambattur, Pallavaram, Tambaram, Avadi, Valasaravakkam and Madhavaram. The state formally proclaimed its commitment towards providing safe sanitation in denser areas through five-year plans and annual policy announcements.[19] The annual policy notes of GoTN placed special emphasis on the environmental front and directed for the preparation and execution of sewerage systems in a phased manner. Other legislative and policy enablers prevailing in Tamil Nadu are discussed in **Annex 1**.

[19] 2001-02 – announced implementation of underground schemes under NRCP in three Corporations, five municipalities and three Town Panchayats (Source: http://www.tn.gov.in/documents/dept/21/2001-2002);
2003-04 – announced implementation of underground schemes in 15 cities and directed investigation of underground systems in all the District Headquarters; and
2012-13 – announced underground schemes for all Municipalities in a phased manner.
[20] Chennai city was fully covered with sewer. These adjacent areas of Chennai were densely populated. They are now part of Chennai city itself.

Owing to the capital-intensive nature of sanitation projects, GoTN devised implementation policies and a financing framework before commencement of projects for smooth implementation. Understanding the sanitation needs of the state, GoTN began its efforts on implementation of the sanitation schemes with the preparation of Detailed Project Reports (DPRs) for seven urban areas in the vicinity of Chennai[20] (adjacent urban areas). Of these, two projects, that is, Alandur and Valasaravakkam, were subsequently executed. While Alandur was implemented on a Build-Operate-Transfer (BOT) model, a first in the country, Valasaravakkam was implemented by the parastatal agency, the Chennai Metropolitan and Sewerage Board (CMWSSB). The example of Alandur is often cited when discussing the role of Public Private Partnership (PPP) models in the sanitation sector. The construction of the underground sewerage system was done through an Engineering, Procurement and Construction (EPC) contract and the STP was constructed on a BOT basis. The Alandur project also set the precedent for the collection of public deposits towards meeting the capital expenditure. Public awareness and support was sought through an extensive communication campaign. Over INR 160 million or 40 percent of the project cost of INR 350 million came from such user deposits. The project resulted in several successful initiatives which were replicated in other sewerage projects implemented across Tamil Nadu. **Annex 2** includes further details on the Alandur sewerage scheme.

Subsequently, sewerage schemes in seven cities were taken up under NRCP, funded by GoI, with participatory funding from GoTN and ULBs. The projects were successfully executed by implementing the concept of Project Recourse Financing, which enabled public participation in contributing towards the capital cost of the project, and also in maintenance of the system.

The experience and learnings gained from implementing these projects were used in developing the state government's vision to implement underground drainage (UGD) systems in all district headquarters, which was presented in the State Assembly in 2003. Accordingly, 25 towns serving as district headquarters were taken up for implementation under the Tamil Nadu Urban Development Project III (TNUDP III) funded by the World Bank. As mentioned earlier, the scheme design under TNUDP III incorporated the findings from the schemes previously implemented by the state, and the following key design features were included in all schemes financed under this program:

- Citizen's participation in execution of the scheme, by contribution towards the capital costs and, in certain cases, project monitoring;
- Incorporation of monthly user charges to support O&M and debt servicing;
- Proactive community discussions and disseminations to highlight the importance of the public good of sewerage systems; and
- Linking of services to user charges, that is, 'pay for service' model.

A snapshot of sewerage projects implemented in Tamil Nadu over the last 15 year period is presented in Table 4.

2.2.1. Sewerage Schemes Implemented under NRCP

The sanitation status of major urban centers in Tamil Nadu was found to be quite poor. The NRCP provided financial support to improve sanitation in some of the riverside towns in Tamil Nadu through a grant of INR 269.25 crores which benefited seven towns. The key project feature included collection of public connection deposits, and levy of tariffs which were set to recover full costs and at levels that were affordable (made possible by connection deposits and grants (70 percent)) that enabled sustainable asset maintenance.

[20] Chennai city was fully covered with sewer. These adjacent areas of Chennai were densely populated. They are now part of Chennai city itself.

TABLE 4: **History of sewerage projects implemented in Tamil Nadu**

Period	No. of Cities	Implementation	Financing	Remarks
1997-2003	7	PPP and ULB	1. Loan – grant blend 2. Private financing 3. Public contribution – 50% of the project cost for sewer network alone	▪ 2 of 5 implemented (Alandur and Valasaravakkam); ▪ Densely populated areas near Chennai
2002-08	7 (NRCP)	Implementation by parastatal agencies	1. 65% NRCP grants 2. 20% state contribution 3. 15% from public contribution	▪ Construction period average of 7 years; river-side cities
2006-14	25 (TNUDP III)	1. Implementation by ULBs under their direct supervision (corporations/ selection grade municipalities); 2. Under the supervision of parastatal agencies with respect to other ULB grades	1. 60% loans 2. 10-15% public contribution 3. Capital grants as a gap-filler	▪ 12 projects completed; rest ongoing (as of March 2013) ▪ Implemented in district headquarters (growth hubs) ▪ Additional treatment capacity - 271 MLD ▪ Coverage - 34 lakh population

In this context, GoTN planned projects across three Corporations and four Municipalities through a loan-grant blend for underground sewerage projects under the NRCP of MoEF, GoI. The project cost worked out to INR 566.60 crores and GoI sanctioned a grant of INR 269.25 crores. The GoI grant approved for ULBs was in the range of 40-50 percent of the total project cost. The balance funding was to be shared between GoTN and the concerned ULBs along with public contributions. The GoTN grant was in the range of 10-15 percent for the Municipal Corporations and about 30- 35 percent for the Municipalities taken up under the program. The balance funds were raised through public contributions (~10- 30 percent of project cost) and loans from TNUDF (~10-25 percent of total project cost). Table 5 summarizes the key project elements, including the responsible implementation agency, project costs and sources of finance.

TABLE 5: Sewerage projects implemented under NRCP

			CORPORATIONS			MUNICIPALITIES			TOWN PANCHAYATS		
S. No.	Particulars		Tirunelveli	Trichy	Madurai	Kumbakonam	Mayiladuthurai	Thanjavur	Karur & Inam Karur	Tiruchendur	Rameshwaram
1	Implementing Agency		TWAD	TWAD	CMWSSB	CMWSSB	TWAD	TWAD	TWAD	TWAD	TWAD
2	Approved DPR Cost (Lakhs)		5200	11667	16500	5060	3963	5655	2764	815	840
3	Means of Finance (% of total project cost)	GoI Grant	36%	57%	52%	43%	47%	42%	40%	6%	0%
		GoTN Grant	12%	16%	13%	35%	35%	32%	29%	2%	0%
		CPCB	0%	0%	0%	0%	0%	0%	0%	43%	23%
		State Pollution Control Board	0%	0%	0%	0%	0%	0%	0%	18%	23%
		MLA/MP Fund	0%	0%	0%	0%	0%	0%	0%	18%	0%
		Other grants	0%	0%	0%	0%	0%	0%	0%	6%	12%
		Loan (from TNUDF)	25%	18%	15%	5%	9%	18%	0%	0%	25%
		Public deposits	26%	9%	20%	17%	9%	8%	31%	6%	17%
4	Total connections		31,000	22,241	60,501	16,500	7,350	10,000	15,000	4,500	3,301
5	One-time deposit rates (INR/HH)	Domestic	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
		Commercial	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
		Industrial	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
6	Tariff rates (Rs./Month/HH)	Domestic	150	150	150	150	150	150	150	150	150
		Commercial	200	200	200	200	200	200	200	200	200
		Industrial	200	200	200	200	200	200	200	200	200
7	O&M cost as a % of project cost		2.00%	2.00%	0.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%

Note: MLA/MP: Member of Legislative Assembly/Member of Parliament, TWAD: Tamil Nadu Water and Drainage Board.

2.2.2. Sewerage Schemes Implemented under TNUDP III

Sewerage schemes in 25 district headquarter towns were implemented under TNUDP III. Table 6 presents an overview of the schemes implemented under TNUDP III.

TABLE 6: List of sewerage projects implemented under TNUDP III

S. No.	City/Project	Collection System (length) (km)	STP Capacity (MLD) (actual as per contract)	STP Technology (MLD) (actual as per contract)
1	Ambattur		NA	NA
2	Chinnamanur	31.93	3.99	EA
3	Cuddalore	169.36	12.5	ASP
4	Dharmapuri	32.13	4.86	ASP
5	Dindugul	96.04	13.65	ASP
6	Kanchipuram	33.5	14.1	Existing WSP
7	Krishnagiri (2/2)	46.05	9	ASP
8	Madhavaram	74.58	NA	-
9	Nagapatinam	97.29	12.59	ASP
10	Namakkal	71.83	5	EA/ASP
11	Pallavaram	171.78	NA	-
12	Perambalur	89.7	4.2	ASP
13	Pudukottai	147.92	10.62	ASP
14	Ramanathapuram	75.01	7	MASP
15	Salem	86.13	13	EA
		150.65	44	FAB
		184.82	6	MBBR
		NA	35	FAB
16	Sivaganga	54.48	7.38	ASP
17	Theni	61.26	12.05	EA
18	Thiruvallur	92.69	6.2	MBBR
19	Thiruvanamalai	53.9	8.7	ASP
20	Thiruvarur	76.25	6.92	ASP
21	Thiruvottiyur	80.84	31	EA
22	Thootukudi	123.4	23.85	ASP
23	Uthagamundalam	9.7	NA	-
24	Vellore	65.7	10.28	ASP
25	Virudhunagar	77.11	7.65	ASP

Note: ASP: Activated Sludge Process; EA: Extended Aeration; FAB: Fluidized Aerobic Bioreactor; MASP: Modified Activated Sludge Process; MBBR: Membrane Based Bio Reactor.

The key principles guiding the design of this program were:

- **Public deposits**: State infused equity participation by the public in the form of 'one-time, non-refundable deposits,' which contributed towards meeting a portion of the capital costs, thereby reducing the debt burden on municipalities;
- **Focus on a cost recovery framework**: The user fees, in all schemes, were to be levied in order to cover 100 percent of the cost of operations and a 100 percent of the costs incurred towards debt-servicing;[21]
- **Lower land footprint**: As finding adequate land for the STPs delayed many projects (in earlier schemes), this challenge became a driver towards the adoption of technologies with low footprint;
- **Innovative procurement techniques**: Adoption of implementation models such as Design Build Operate and Transfer (DBOT) and Design Build Finance Operate and Transfer (DBFOT) helped bring in external expertise along with hands-on capacity building for local engineers; and
- **Avoiding overlap in institutional responsibilities**: The state also devised an institutional framework (discussed below) within the available legal structures, which provided clarity on roles and responsibilities among the various institutions operating in the sector and enabled delivery of services.

The institutional arrangement followed for implementation of sewerage projects under TNUDP III was aimed at successful delivery through implementation of a large number of sewerage projects by assigning clear roles and responsibilities. GoTN nominated Tamil Nadu Urban Infrastructure Financial Services Limited (TNUIFSL) for tasks related to project preparation, financing and determining contracting arrangements. ULBs were responsible for community mobilization, providing HSCs, and were the prime borrower responsible for the loan and its repayment. The project development (feasibility, DPRs) was carried out by consultants under the supervision of TNUIFSL. The projects were implemented either as EPC or PPP contracts with O&M responsibility for five to seven years. Table 7 presents the roles and responsibilities of the different organizations.

TABLE 6: List of sewerage projects implemented under TNUDP III

Organization	Roles and Responsibility
GoTN	Policy environment and gap funding support
TNUIFSL	Project preparation (feasibility and DPR – through consultants on behalf of ULB), financing and contracting
TNUDF	Term loan
ULB	Prime borrower with responsibility for repayment; community mobilization; house service connection
Contractor	Project implementation (EPC or PPP) with 5-7 years O&M
CMA and TNPCB	Advisory role, according necessary approvals and monitoring and evaluation

Note: CMA: Commissionerate of Municipal Administration; TNPCB: Tamil Nadu Pollution Control Board.

[21] While full cost recovery was one of guiding principles of the TNUDP III, a subsequent notification by GoTN limited the monthly user fees that may be charged from households, and mandated that the fee may not exceed INR 100/month/household. The actual fees levied by ULBs in select TNUDP III schemes and the extent of costs covered by them are discussed in subsequent sections.

3. Review of Capital Financing of Sewerage Schemes Implemented in Tamil Nadu

3.1. Scope of Capital Financing Review Study

This review has been undertaken to delve deeper into each of the scheme features incorporated under TNUDP III (as mentioned in the preceding section) through an analysis of the scheme details for projects implemented in five TNUDP III towns. We also compare this with three towns that received funding for their schemes under NRCP. The scope of this study is to:

(i) Understand the basic city details including city finances;
(ii) Obtain first-hand information on the financing of sewerage sub-project;
(iii) Understand ground-level difficulties during implementation and monitoring; and
(iv) Understand the efforts undertaken at the city level for project implementation.

Table 8 summarizes the cities selected for detailed analysis. These include cities that received funding though NRCP and TNUDP III mentioned earlier.

3.2. Study Approach

For the purpose of developing this note, a team of WSP consultants visited the eight (NRCP and TNUDP III) towns mentioned in Table 8. The questionnaires used for soliciting data related to scheme implementation, financing, and performance are included in **Annex 3**. The team met officials from all ULBs and site visit summaries, along with details of the meetings held, are included in **Annex 4**. The data collected from the ULBs were supplemented with relevant information available publicly (municipal websites, and so on) and other reports through desk-based research.

3.3. Project Overview

The sewerage schemes implemented in the eight selected cities include conventional sewer networks and treatment systems that were designed according to the guidelines of the Central Public Health and Environmental Engineering Organization (CPHEEO) and standard industry practices.

TABLE 8: **Cities selected for capital financing analysis**

Program Represented	City Studied	Number of Households	Households Targeted to be Covered by Scheme	Year of Implementation	Analysis Undertaken
NRCP	Karur	64,631	15,000	2002	Data used for analysis of capital financing
	Mayiladuthurai	17,779	10,728	NA	
	Kumbakonam	15,382	15,382	NA	
TNUDP III	Namakkal	43,510	13,000[22]	2009	
	Perambalur	10,344	10,344	NA	
	Sivaganga	14,596	6,778	2009	
	Chinnamanur	13,078	4,650	2009	
	Thoothukudi	131,915	20,921	2009	

[22] The original targeted households are 6,500 only, as it was restricted to denser areas. With the expansion of the city, the sewer system is also expanding and hence the number of target connections given here is high.

The collection system in all schemes starts from the house service connections, which are connected to street sewers/ laterals, sub-mains and main/trunk sewers leading to the Sewage Pumping Station (SPS) or STP as the case may be. The conveyance systems are designed as conventional network systems comprising lift stations and pumping stations. The STP capacities in the different cities range from 2.6 to 24 MLD. The treatment technologies are aerobic treatment systems and are ASP, EA, or a Waste Stabilization Pond. The Thoothukudi has implemented a Membrane Bio Reactor (MBR) with Reverse Osmosis (RO). Project details including the conveyance system and STP are summarized in Table 9.

Work related to construction of the network, that is, the collection and conveyance system has been completed in all ULBs. Work on the STPs has been completed and commissioned in all cities except Sivaganga and Thoothukudi, where construction is yet to commence. We discuss the issues related to delayed construction of the STP in these two cities later in this section. The data collected from ULBs/nodal agency on these schemes, including salient features of each scheme, in terms of collection system, pipes, sizes, pumping, capacity of STP, effluent quality, and so on, are presented in **Annex 5** of this report.

The key aspects for projects implemented through NRCP and through TNUDP III are:

1. **House service connections:** All schemes have, in general, been relatively successful in ensuring that households connect to the network. This is true for projects implemented under both financing schemes (NRCP and TNUDP III); however, the connection efficiency appears to be marginally better in the TNUDP III towns. It is believed that this high level of connection efficiency is an outcome of the approach to public deposit collection adopted by the state for all UGD schemes;

TABLE 9: Project details in eight Tamil Nadu cities

Program Represented	ULB	Targeted HSCs	No. of HSCs Provided	Connection Efficiency (%)	Total Project Cost (Rs. Lacs)	Year[23]	Cost/ Targeted HH (INR/HH)	Cost/ Actual HSC (INR/HH)	Length of Sewer Network (km)	Treatment Technology	Treatment Capacity (MLD)
NRCP	Karur	15,000	5,503	**37%**	2,399	2002	15,993	43,594	92	EA	15
	Mayiladuthurai	10,728	8,538	**80%**	4,200	NA	39,150	49,192	86	Waste Stabilization Pond	8
	Kumbakonam	15,382	13,398	**87%**	5,324	NA	31,210	39,737	125	ASP	17
TNUDP III	Namakkal	13,000[24]	7,197	**55%**[25]	1,952	2009	15,015	27,122	71	Modified ASP	5
	Perambalur	10,344	7,359	**71%**	2,056	NA	19,876	27,939	95	ASP	4
	Sivaganga	6,778	6,448	**95%**	1,982	2009	29,242	30,738	54	Extended Aeration ASP	7
	Chinnamanur	4,650	2,358	**51%**[26]	1,190	2009	25,598	50,466	32	EASP with recycling	4
	Thoothukudi	20,921	19,801	**95%**	9,244	2009	44,186	46,685	110	MBR with RO System	24

[23] Year of project implementation.
[24] The project was originally designed for a target of 6,500 households (covering the denser areas of the city). The city has now expanded to 55.24 square kilometer (km^2) from the original area of 10.24 km^2. If we consider the target of 6,500 households under the project, the city has achieved more than 100 percent household connections, and is meeting connection demands on a priority basis.
[25] Connection efficiency increases to 111 percent with the originally targeted connections.
[26] While connections from the household compound wall to the manholes have been provided for all the households, provision of internal plumbing within the household premises is still underway, and this percentage reflects the actual number of household where work related to internal plumbing has also been executed. The municipality is in the process of ensuring connections for the balance households as well.

2. **Treatment technology**: The treatment technologies in most schemes were based on ASP. The projects implemented under TNUDP appear to have incorporated innovations to attempt recycle and reuse of treated wastewater. One of the projects implemented under the TNUDP is based on the MBR+RO treatment technology with the objective of treating wastewater up to tertiary treatment levels and reusing the treated wastewater for industrial use. Annex 6 discusses the salient features of this scheme (under implementation in Thoothukudi) in more detail; and
3. **Cost of project**: The cost of providing sewerage infrastructure comprising both the network and STP varies across cities. The unit cost of schemes appears to be slightly lower for the projects implemented under TNUDP III (except the scheme based on the advanced MBR+RO treatment technology) as compared to the projects implemented with NRCP support. This is significant considering that the TNUDP projects were implemented after the NRCP projects, and that most were based on technology configurations that were either the same or moderately better than those selected in the NRCP schemes. It should be pointed out that, in the NRCP schemes, the treatment technology was determined prior to tendering and bids were evaluated on the basis of the least cost for the bill of quantities provided in the bid documents; the TNUDP III projects provided flexibility to the bidders to choose the treatment technology option that would be cost-effective and meet discharge standards. This helped in bringing in not only technology providers more suited to executing the project instead of just civil contractors, but also newer technologies such as MBR and RO, based on the needs of the project. Table 10 summarizes the typical unit cost of the scheme under the two programs.

3.4. Financing Sewerage Schemes in Tamil Nadu

A mix of grant funds, loans and public equity through deposit collection was utilized for implementing the sewerage projects in Tamil Nadu. All cities studied had a significant share of the project cost covered through grant support, as may be observed from Table 11. It may be surmised, however, that the proportion of grants in projects implemented in NRCP cities is relatively higher as compared to that in projects implemented under the TNUDP III. The share of loan and contribution made by ULB/public is higher in the TNUDP cities.

As is evident from Table 11 and Figure 1, the following key observations can be made related to funding of capital expense:

1. Schemes implemented with NRCP support have a significant grant component provided either by GoI or GoTN (~70-85 percent of total project cost) with little or no loan component at all (two of the three schemes under NRCP did not avail any loan to meet the capital expenditure requirement);
2. The schemes implemented under TNUDP-III have a varying mix of both grant and loan to meet the capital expense, with the share of loan ranging from 20-45 percent of the total project cost. The loan-grant mix varies across cities since the extent of loan is limited by the borrowing capacity and debt servicing capacity of the ULBs. The approach adopted by ULBs to identify sources of finance is briefly discussed in Box 1; and

TABLE 10: Comparison of cost of sewerage schemes implemented under different programs

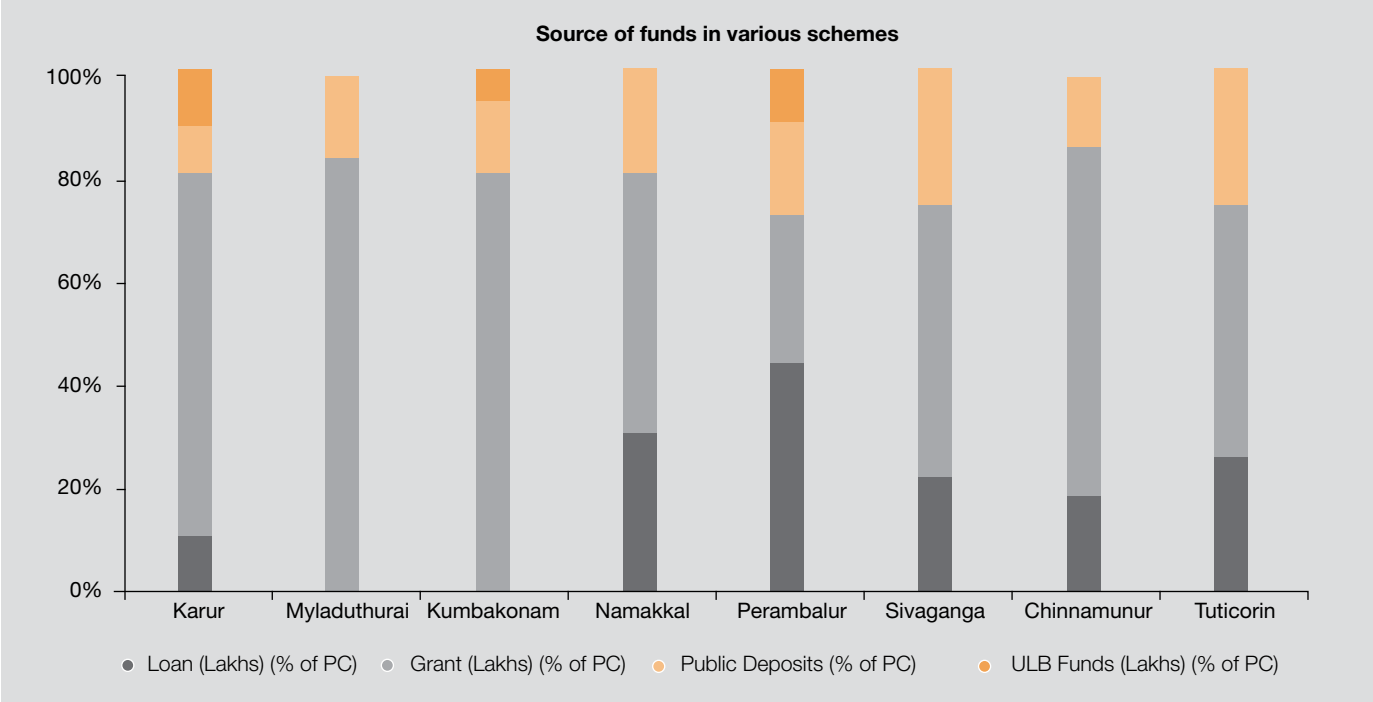
Programs	Number of Projects	Year of Implementation	Average Capital Cost (INR/Household)
NRCP	7	2002-03	20,000- 40,000
TNUDP III	25	2009	15,000–30,000[27]
Comparison with High Powered Expert Committee (HPEC)			**25,000**

[27] The range of costs for the TNUDP III projects exclude the cost for the sewerage project being implemented in Thoothukudi since this is STP is based on tertiary treatment technology (MRB + RO), and is still under implementation.

TABLE 11: Funding sources for sewerage schemes in Tamil Nadu

Program	ULB	Total Project Cost (INR Lakh)	Total Financing Secured (Lakh)	Loan (Lakh) (% of Project Cost)	Grant (Lakh) (% of Project Cost)[28]	Public Deposits (Lakh) (% of Project Cost)	ULB Funds (Lakh) (% of Project Cost)
NRCP	Karur	2,399	2,439	306	1,896	237	0
				12.5%	**77.7%**	**9.7%**	**0%**
	Mayiladuthurai	4,200	4,200	0	3,500	700	0
				0.0%	**83.3%**	**16.7%**	**0.0%**
	Kumbakonam	5,324	5,324	0	4,320	740	264
				0.0%	**81.1%**	**13.9%**	**5.0%**
TNUDP III[29]	Namakkal	1,952	1,972	615	726	631	0
				31.2%	**36.8%**	**32.0%**	**0.0%**
	Perambalur	2,056	2,075	1,032	673	370	0
				49.7%	**32.4%**	**17.8%**	**0.0%**
	Sivaganga	1,982	2,340	519	1,241	580	0
				22.2%	**53.0%**	**24.8%**	**0.0%**
	Chinnamanur	1,190	1,108	215	738	155	0
				19.4%	**66.6%**	**14.0%**	**0.0%**
	Thoothukudi	9,244	9,500	2,446	4,669	2,385	0
				25.7%	**49.1%**	**25.1%**	**0.0%**

FIGURE 1: Share of different funding sources in overall project cost



Note: Data presented above are based on approved and sanctioned costs and sources of finance, and differ from the costs estimated in the DPR, as presented in Table earlier for NRCP towns. PC: Project Cost.

[28] Including both GoI grant and GoTN grant.

[29] The funding pattern across cities included under TNUDP III varies (varying loan-grant blends), based on the borrowing capacity of ULBs, as well as the capacity of ULBs to service the loan raised to meet capital expenses. The approach adopted by ULBs to determine the loan-grant blend is discussed in Box 1.

BOX 1: Typical Approach to Determine the Means of Finance

While it can be observed from Table 11 that the source of funding for the creation of sanitation infrastructure in the study cities is a mix of loans, grants, local body funds and public contribution, it is interesting to understand the methodology used to determine the share of different sources in the overall fund, and reasons for differences among the different cities. The typical approach to identify sources of funds to meet the project cost is based on a scientific appraisal process, undertaken by the appraising agency. The following steps are involved:

1. Obtain data on anticipated HSC (targeted HSCs);
2. Analyze the city's borrowing capacity based on standard norms (TE/TR<1;[30] DS/TR[31]<30 percent are the criteria based on which loans are sanctioned);
3. Determine the borrowing capacity of the city to determine the extent of loan that can be availed. The loan and grant blend is then determined keeping in mind the minimum available grant, which is typically 10 percent of project cost;
4. The gap to meet the capital is then determined. This gap is divided by the number of households which will determine the contribution required per household in the form of public deposits. GoTN, however, has instructed cities vide a government circular that deposits cannot exceed INR 5,000 per household (as a weighted average amount for the city). In order to adhere to this, a graded structure was devised in most cities based on the plinth area;
5. Even after public contribution, if a city is unable to meet its project cost, the cost is either sourced as a contribution from the ULB or as an additional grant which is availed of as gap funding;
6. This project structure is part of the loan covenant and forms part of the loan sanction letter; and
7. The city's consent on the structure is obtained prior to entering into the loan agreement in the form of a council resolution.

3. A unique feature in all schemes is that a portion of the capital expenditure (CAPEX) is funded through the collection of public deposits levied on households, which is the 'one-time nonrefundable deposits' obtained from users. The modalities for levying it, its impact on overall project finance at both capital financing and O&M stages, and its benefits are discussed in the following section.

3.4.1. Financing Capital Expenditure through Public Deposits

An interesting aspect emerging from the analysis of the selected TN sewerage schemes is the collection of public deposits from users, which are collected, in most cases, even prior to project commissioning. GoTN, taking cognizance of the poor financial status of most ULBs in the state, has been structuring all UGD schemes using public money to fund a part of the CAPEX requirement of the project. This is generally termed as 'deposit contribution'. This money is structured as a nonrefundable one-time deposit from the project beneficiaries. The physical part of it is justified by the pipeline that connects the manhole to the compound wall of the house.[32] Any household that wants to connect to the sewer system is required to deposit this money with the local body upfront, prior to commencement of construction activities, on receipt of which the household will be provided with sewer connection by the ULB on completion of the network.

The advantages of this deposit contribution from the public have been: (i) accountability on the part of the ULB to

[30] TE/TR – Total Revenue Expenditure/Total Revenue Income – should be less than 1, meaning that costs of the ULB should be within their means. If not, it leads to revenue deficit.
[31] DS/TR – Debt Servicing/Total Revenue – should be less than 30 percent; the ULB incurs roughly about 45 percent on an average for establishment, and 20 percent for O&M. Therefore, if debt servicing is at 30 percent, it leaves them with a minimum surplus. This is based on a thumb rule and there are no directives in this regard.
[32] It should be noted that the connection if brought up to the boundary of the household only. The household is responsible for providing the pipeline within the house premises to connect to the network provided up to the house boundary. A separate fee is levied for this, though this is significantly lower than that paid as the household connection deposit.

provide timely, quality services; (ii) ensuring that households connect to the network upon project completion; and (ii) reduced debt servicing costs and, therefore, the user charge to varying extents, as discussed in Table 12.

Improving provision of HSCs: Regulatory provision in the state provide for mandatory HSCs when a sewer line is laid and available within 100 meters (m) from any household, thereby barring any household from refusing to connect to the network. The Municipal bye-laws from the town of Pallavaram in Tamil Nadu, mandating connection to the network, and providing detailed guidance on the connection requirements are presented as Annex 7. While such provisions mandating households to connect to a sewer network may exist in other cities and towns in India, achieving high levels of household connectivity remains a challenge in most cities. It is one of the reasons often cited for the underutilization of existing sewerage infrastructure in the country. Collecting upfront deposits from households prior to construction of the network ensures that the households connect as soon as it becomes operational. It was observed that most schemes included in this study had achieved high levels of HSCs, as evident from Table 12.

The following observations can be made based on our analysis:

- It was observed that, in most of the cities studied, a majority of the households had been connected to the network. The HSC efficiency ranged from 50-95 percent in most cities studied;[38]
- Further, almost 100 percent of households that had been provided sewer connections had paid their share of the deposit contributions owed to the ULB. The deposit collection efficiency was close to 100 percent in most cases, except the cities of in Mayiladuthurai and Sivaganga; and
- The high levels of deposit collections ensure that households connect to the sewer network and results in effective use of the infrastructure.

TABLE 12: Funding sources for sewerage schemes in Tamil Nadu

Program Represented	ULB	Targeted HSCs	No. of Sewer Connections Provided	Connection Efficiency	Deposits Payable[33] (Lakh)	Deposits Collected (Actual) (Lakh)	Deposit Collection Efficiency
NRCP	Karur	15,000	5,503	**37%**	275	275	**100%**
	Mayiladuthurai	10,728	8,538	**80%**	427	207	**48%**[34]
	Kumbakonam	15,382	13,398	**87%**	670	670	**100%**
TNUDP III	Namakkal	13,000	7,197	**55%**[35]	360	360	**100%**
	Perambalur	10,344	7,359	**71%**	368	370	**101%**
	Sivaganga	6,778	6,448	**95%**	322	149[36]	**46%**[37]
	Chinnamanur	4,650	2,358	**51%**	118	118	**100%**
	Thoothukudi	20,921	19,801	**95%**	990	972	**98%**

[33] Based on actual HSC provided @ INR 5,000/household.
[34] The lower deposit collection efficiency appears to have been a result of a lack of drive on the part of the ULB which may, in turn, be a result of no direct incentive for the ULB to raise funds from the public deposit contribution. In the absence of any loan and all project funds coming through grants, collection of the public deposits does not appear to have been a priority and may have suffered.
[35] This is 111 percent based on the original number of targeted households as the originally targeted number of households was 6,500, and the connections are based on this number. The area within the municipal boundary was subsequently increased, along with the scope of the sewerage scheme.
[36] In Sivaganga, the deposit collection drive has been slow, due to delay in implementation owing to change of land and also due to litigation.
[37] The lower collection of deposits in Sivaganga is on account of delay in project commissioning due to an ongoing litigation at the National Green Tribunal related to the STP site.
[38] The only exception appears to be Karur, where only 37 percent of households are reported to have official connections. Interviews with the ULB staff, however, indicated that the actual number of connections is much higher, and close to about 12,000 households (while 5,503 connections are legitimate connections, the balance are unauthorized, and are in the process of being regularized by the ULB).
[39] This estimate is for deposits actually collected by ULBs and not the deposits targeted to be collected based on 100 percent HSCs.

Impact of deposit collection on loan requirement and annuity outflow: It was observed that the public deposits collected by ULBs contributed to about 10-20 percent of the project cost.[39] This collection provides an additional source of funds. In its absence, the quantum of loans would likely have been higher in all schemes.

With respect to the eight cities taken up for study, Table 13 presents the extent of public contribution, amount of debt avoided from collection of these deposits, and consequently reduction in the debt service liability that could be avoided on account of deposit collection. As can be seen from the table, fund collection through public contributions is comparable to the total loan amount raised by several ULBs.

In order to understand the quantum of debt service that would have been required in the absence of public deposits, annuity payable on the public contribution was determined at an interest rate of 8.75 percent and considering a 15 year loan tenor (typical World Bank lending rates in Tamil Nadu). The results are presented in **Table 13**.

The annuity avoided on account of public contributions as compared to the annuity payable on the existing loans availed by ULBs is summarized in **Table 14.**

TABLE 13: **Impact of deposit collection on ULB and debt service burden**

Program Represented	ULB	Total Project Cost (Rs. Lakh)	Total Financing Secured (Lakh)	Actual Public Deposits Collected (Lakh)	Public Deposits as a % of Total Project Cost	Public Deposits as a % of Project Loan	Annuity Avoided due to Public Deposits (Lakh)[40]	Notional Reduction in User Charge due to Annuity Avoided[41] (Rs./HH/month)
NRCP	Karur	2,399	2,764	275	11%	90%	**33.61**	**51**
	Mayiladuthurai	4,200	4,200	207	5%		**25.30**	**25**
	Kumbakonam	5,324	5,324	670	13%		**81.90**	**51**
TNUDP III	Namakkal	1,952	1,972	360	18%	59%	**44.00**	**51**
	Perambalur	2,056	2,338	370	18%	36%	**45.23**	**51**
	Sivaganga	1,982	2,340	149	8%	29%	**18.21**	**24**
	Chinnamanur	1,190	1,108	118	10%	55%	**14.42**	**51**
	Thoothukudi	9,244	9,500	972	11%	40%	**118.81**	**50**

TABLE 14: **Reduction in annuity on account of pubic deposit collection**

ULB		Impact on Annuity	Reduction in Annuity
NRCP	**Annuity on Loan Amount (Rs. Lakh)**	**Annuity Avoided due to Public Deposit Collection (Actual Collection) (INR Lakh)**	**(Excluding Grant Component of Project Cost) (INR Lakh)**
Karur	37.40	33.61	47%
Mayiladuthurai	-	25.30	100%
Kumbakonam	-	81.90	100%
Namakkal	75.17	44.00	37%
Perambalur	126.15	45.23	26%
Sivaganga	63.44	18.21	22%
Chinnamanur	26.28	14.42	35%
Thoothukudi	298.98	118.81	28%

[40] Calculated based on an interest rate of 8.75 percent and a loan tenor of 15 years.
[41] Computed for the actual number of households connected to the network.

The following key observations are made related to public deposit collection:

1. The deposits collected are significant when compared with the loan amount availed of by the ULBs to meet their project costs. The deposits collected amounted to about 30-60 percent of the loan component. In the absence of this public deposit contribution, it can be expected that the loan amount would have been higher by an equivalent amount, resulting in an additional debt service burden on the city;
2. Collecting public deposits allowed the ULBs to avoid additional loan amounts. Simple calculations (based on the actual loan terms availed of by the cities under the TNUDP III) indicate that this avoided loan reduces the annuity payable by ~30 percent and user charge by ~INR 30-50/household/month. It is evident that there is an impact on the end user fee. This is especially relevant given the reluctance of cities to levy user charges; and
3. It is also interesting to note that many of these cities commenced collection of public deposits even before the construction began. This is particularly so in TNUDP III cities, where there is a loan covenant for the collection of deposits at least to the extent of 30 percent of the project cost before availing of loans. The idea behind imposing this condition was to ensure that the public has been adequately informed and demonstrated their willingness to participate in the equity of the project, and hence will also connect and use the infrastructure upon completion. While many cities have not provided this information as they did not have relevant documentation, the team was informed the cities started the communication and deposit collection drive well before construction and have been able to collect a significant share of deposits even before construction commenced; a majority of the deposits are collected prior to commissioning. ULBs did acknowledge that the deposit collection, while initiated even prior to construction, was most efficient after there was visible activity on the ground in the construction phase. Most public deposits were collected during the construction period before project commissioning. Table 15 presents details on the stage at which public deposits were collected for four out of the eight cities in the study.

3.4.2. ULB Focus on Collection of Deposits

All ULBs visited appear to have invested significant time and resources on communication and engagement with the public on the need for the scheme and role of public deposits in ensuring success of the project. This has been supported by proactive and focused efforts towards collection of public deposits both before and after commencement of construction activities for the project. Major efforts made by ULBs in this area are discussed in **Box 2**.

TABLE 15: **Collection of public deposit at different stages of the project**

ULB	Share of Total Deposits Collected			
ULB	Collected from Tender to Construction	Collected during Construction until Commissioning	Collected after Commissioning or Anticipated	Total
Mayiladuthurai	32%	40%	29%	100%
Perambalur	24%	54%	22%	100%
Thoothukudi	0%	41%	59%*	100%
Sivaganga	44%	0%	56%*	100%

* Estimated based on collections anticipated by the ULBs.

BOX 2: ULB Efforts for Collection of Public Deposits

1. **Participatory, proactive and friendly approach adopted by ULBs**: Through public awareness campaigns, strategic meetings/camps at the ward level by involving officers, staff, elected representatives, the importance of sanitation and public health, and advantages of the proposed system, disadvantages of open defecation, and so on, were communicated to citizens. Apart from this, whenever the public/households came into contact with ULB officials for any administrative issue, say, payment of property tax, water connection, birth/death certificates, and so on, the ULB staff made provisions to highlight the deposit contribution of the households. Each ULB has developed its own unique way to reach the citizens. Some ULBs have involved local nongovernmental organizations (NGOs)/social organizations based on situation/needs. In Namakkal, a dedicated team/task force was formed involving all staff across functional roles. The campaign relied on pamphlets in simple local language to explain the concept and advantages of the system. This approach proved to be cost-effective as the ULB used its own staff and made it a part of their routine duties.

   Annex 8 contains copies of some such notices and material used by the ULBs.

2. **Transparency in cost of road cutting and linking of house connections to the street sewers**: Every ULB has prepared an estimate of materials, labor and supervision charges to be paid by the households to link their domestic wastewater pipes to the UGD network. These have been printed in the form of a handout and distributed to each household with a warning not to pay anything more than the amount indicated for each category of household (based on floor area) in any case. This is a positive proactive approach, increasing the citizen's confidence in the ULB. A copy of such handouts issued by Chinnamanur Municipality is presented in **Annex 9**.

3. **Collection of deposits in installments**: The ULBs have been flexible with middle and low income households by way of allowing them to pay the deposits in installments. At the same time, ULBs have been strict with commercial units (such as hotels, restaurants, marriage halls, and so on) and high income group to collect the deposits. This approach was found to have been followed by all ULBs.

4. Review of O&M Cost Recovery in Sewerage Schemes

Creation of sanitation infrastructure is only the beginning of the sanitation solution. To achieve meaningful outcomes and improvements in health and environmental indicators, the asset created needs to be operated and maintained to consistently deliver the desired outcomes. Past evaluations of existing STPs in the country reveal that the underperformance or ineffective management of sewerage infrastructure created is a significant cause for the continued pollution in the country's rivers despite significant investments having been made in several large river basins. This is also supported by the assessment done in 2009 by Member (Water Resources), Planning Commission, for the Supreme Court (PC, 2009) which found that STP capacities created along River Ganga were inadequate to treat sewage generated in the cities and that they did not have the funds to maintain STPs.

4.1. Study Objective and Scope

This part of the study is focused on exploring the various options available to cities to meet their O&M requirements, and to illustrate this based on actual data collected from various cities. In this section, when discussing cost recovery options for sewerage schemes, the eight cities in Tamil Nadu discussed in the preceding section were supplemented with additional cities from across India to develop a country-wide perspective. Table 16 presents an overview of the cities included in the analysis and discussion presented in this section.

4.2. Study Findings: Options for Cost Recovery

The approach adopted by various ULBs across India to recover O&M costs of their sewerage schemes was evaluated based on field visits and data collected from ULBs.

TABLE 16: Cities included in the study on cost recovery options for sewerage scheme

City	Population (in lakh)
Tamil Nadu	
Chennai*	30
Alandur	1.46
Kumbakonam	1.13
Mayiladuthurai	0.73
Karur	0.80
Namakkal	0.55
Perambalur	0.38
Sivaganga	0.40
Chinnamanur	0.38
Thoothukudi	3.2
Karnataka	
Bengaluru*	30
Maharashtra	
Kolhapur	4.1
Pune*	38
Gujarat	
Surat	47

*Population served by the network systems.

Two sets of analyses are presented here to discuss options for cost recovery. The first level is based on a broad analysis of cities across India (including some of the NRCP and TNUDP III cities discussed in the review on capital financing earlier in this report). This broad analysis aims to evaluate the different sources of revenue used by cities to meet their O&M costs. The findings from this analysis are presented in Table 17 and discussed here.

TABLE 17: Revenue sources to meet O&M expenses in select cities across India

Revenue Options	Karur	Mayiladuthurai	Alandur	Kumbakonam	Kolhapur	CMWSSB	Pune	Surat	BWSSB
Sewer tax	22%	42%		38%	26%	44%	42%		
Sewer charges					33%				27%
User fee	180%	113%	161%	52%		14%		75%	
Sale of wastewater						7%[42]		99%	2%
Total	**202%**	**155%**	**161%**	**90%**	**58%**	**65%**	**42%**	**174%**	**29%**

Table 18 shows the different methods of apportioning funds to meet costs of sewer systems in different cities.

TABLE 18: Mode of allocation of funds towards sewerage schemes

Name of City	Mode of Allocation	Basis of Apportioning Costs to Sewer System
CMWSSB (Chennai)	Sewerage tax; sewer charges and connection charges	7% of property tax (handled by Chennai Corporation) is transferred to Water and Sanitation (CMWSSB) Board. Of this, 2% goes towards sewer system. In addition, sewerage charges are collected at INR 50 per month per household Connection charges are levied at an average of INR 10,000 per household
Other Municipalities in Tamil Nadu	Sewerage tax; sewerage charges; deposit fee & connection charges	10.84% of General Purpose Tax is allocated to Water and Drainage Account. There is no data available on actual allocation towards sewer systems. This is accounted as water and drainage tax User fee is collected, which is accounted as sewerage charges on a monthly basis (for practical purposes collected biannually) Deposits at an average of INR 5,000 per household, is collected for providing connections to households. In addition, connection charges are collected for connecting sewer systems inside the household. This is at an average of INR 1,000 per household
Bangalore Water Supply and Sewerage Board (BWSSB)	Sewerage charges	18% of water charges is allocated towards meeting sewerage costs. This is accounted as sewerage charge
Pune	Sewerage tax	4% of property tax is allocated as sewer tax
Kolhapur	Sewerage tax; sewerage charges and connection charges	7% of property tax is apportioned as sewerage tax 20% surcharge on water rates is levied and apportioned as sewerage charges Connection fee of INR 12,000 per HH is collected at the time of providing connections
Kolkata	Sewer tax and sewer charges	15% if property tax is apportioned as sewer tax 25% of water fee is allocated as sewerage fee
Vishakhapatnam	User fee	INR 10 per month per household is collected as user fee to meet sewerage costs
Delhi Jal Board	Sewerage charges	60% of water charges is accounted to meet sewer charges

[42] This is estimated when considering the utility as a whole (and considering the expenses and revenues for seven plants). When looking at individual plants, the sale of treated wastewater can meet almost a 100 percent of the plant's O&M requirements. This is discussed in more detail in subsequent sections.

Based on our analysis of all cities mentioned above, it is observed that the following cost recovery options are employed:

1. **User fee**: All ULBs in Tamil Nadu and several others in other Indian states collect a recurring fee called the 'user fee' which is meant to cover all or a portion of the O&M cost of the sewer systems. The user fee is normally determined by the funding agency, based on the operating costs[43] and debt servicing costs. The typical approach adopted for determining the user fee is briefly described in Box 3.

BOX 3: Determining User Fees for Sewerage Projects

In order to meet O&M cost, user fee[41] calculations are made, based on the anticipated assessments. Here, the average user fee is determined to cover both operations cost and debt service. Again, a graded structure (proportion to the plinth area) is developed to meet the average user fee.

While doing appraisals, the connection and collection efficiency are considered at 90 percent and 70 percent, respectively, or property tax collection efficiency trends followed.

2. **Property tax**: User fee is not adequate to meet full costs in many cases. There are other sources of income that meet the O&M costs of sewer systems. Predominantly, these come from the water and drainage tax component of the property tax. In Tamil Nadu, this is generally in the order of 22 percent of property tax which is allocated to water and drainage.[45] However, this allocation extends to the combined water supply and sewerage systems. Internal allocation separately between water and sewerage systems is unclear.
3. **Deposit collection to reduce debt burden**: This practice is unique to the schemes implemented in Tamil Nadu where deposits are collected from the public (beneficiaries) even before project commissioning. While the deposits collected go towards meeting the capital expenditure until such time as the project is completed in all respects, all deposits which are collected after commencement of project go into a revenue account to meet O&M costs. This essentially means that deposits from new connections after commencement are parked in a revenue account and get credited to the 'water supply and drainage' account. This generates an additional source of funds for the ULBs to meet their O&M expenses.
4. **Other methods of meeting costs**: There are several other ways of meeting costs such as sale of treated water to industries and power generation at the treatment plants that helps reduce energy costs which help to meet the cost of operations:

    a. **Reduction in O&M costs due to power generation**: A study across eight cities in the country indicated that power generation within STPs has proved to have reduced nearly 50 percent of the O&M cost and met up to 80 percent of energy costs; and
    b. **Sale of treated wastewater**: Cities that have sold their treated water have recovered up to 200 percent of their cost of operations. This provides an excellent opportunity for cities with industrial activity to generate revenue for their O&M needs.

The second round of analysis is based on a detailed review of operational expenditures and revenue of cities in Tamil Nadu and is used to support the different options mentioned above. The following sections present the findings from this analysis.

4.3. User Fee and Sewer Taxes–Major Components of Cost Recovery

Table 19 presents a summary of the user fees and sewer tax levied in various ULBs across India and the share of O&M expenses and total revenues met from revenue generated from these sources.

[43] O&M costs as mentioned in the DPR are taken for appraisal purposes.
[44] GoTN has issued a circular to ULBs that the user fee shall not exceed INR 100 for the minimum category households. Therefore, adjustments are made in the other categories to meet the average user fee.
[45] GoTN follows the Standard Accounting Practice, where there are three account heads, that is, General Purpose Account, Water and Drainage Account and Education Account.

TABLE 19: User fees and O&M met through user fees and sewer tax collection

S. No.	City/Town	User fees Levied (INR/HH/Month)	Share of O&M Cost Met (% of O&M)		Contribution of Revenue to Total Revenue[46]	
			Through User Fees	Through Sewer Tax/Charge[47]	From User Fees	Through Sewer Tax/Charge
1	Karur	115	180%	22%	89%	11%
2	Alandur	75	161%	0%	100%	0%
3	Thanjavur	75	229%	165%	58%	42%
4	Kumbakonam	75	52%	38%	58%	42%
5	Mayiladuthurai	100	113%	42%	73%	27%
6	CMWSSB	50	14%	44%	21%	66%
7	BWMSSB	-	-	27%	-	94%
8	Pune	-	-	42%	-	100%
9	Kolhapur	-	-	58%	-	100%
10	Kolkata	-	-	176%	-	100%
11	Surat	Not known	75%	-	33%	-
12	Vishakhapatnam	Not known	12%	-	48%	-

The following key observations are made based on our analysis:

- As observed from Table 19, user fee and sewer tax or sewer charges form a major part of the revenue generation in ULBs, allocated exclusively for meeting the O&M costs for sewerage systems;
- The cities in Tamil Nadu rely predominantly on levying user fees to meet their O&M burden, and augment this with water and drainage tax collection. The smaller ULBs, especially, rely significantly on collection of user fees to meet their O&M burden (revenue from user fees often exceeding the O&M expenses) and overall revenue generation (~70-100 percent of the total revenue generation comes from collection of user fees);
- In ULBs outside Tamil Nadu, the contribution of user fees becomes insignificant, with most ULBs not generating any revenue from user fees collection at all (except Surat, which raised 75 percent of its O&M requirements through user fees); and
- Most ULBs outside Tamil Nadu seem to rely on sewer taxes and collection of sewer charges to meet their O&M expenses.

The O&M fees and their capacity to cover the O&M and debt service burden of eight cities in Tamil Nadu are further discussed below. Table 20 presents the portion of O&M costs that may be recovered from collection of user fees. Wherever the user fee exceeds the amount required for O&M recovery, there is potential to use additional revenue generation to meet the debt-service obligations. The table also presents the current status of user fees collection and property tax collection and apportionment towards the sewerage system.

TABLE 20: User fees required to meet O&M expenses in Tamil Nadu cities

Program	City	O&M Cost (Rs. Lakh)	% of Project Cost	User Fee Required to be Levied (Actual HSCs Connected) (INR/HH/month)	Actual User Fees (INR/HH/Month)
NRCP	Karur	42.45	1.8%	64.28	115
	Mayiladuthurai	92	2.2%	89.79	100
	Kumbakonam	208.52	3.9%	129.70	75
TNUDP III	Namakkal	35	1.8%	40.53	61
	Perambalur	50.45	2.5%	57.13	85
	Sivaganga	70.5	3.6%	91.11	78
	Chinnamanur	46	3.9%	162.57	63
	Thoothukudi	103	1.1%	43.35	60

[46] This column presents the contribution of revenue generated through user fees in the overall revenues of the ULB. The overall revenues may or may not cover the total O&M cost of the sewerage, as the individual case may be.
[47] The cities levy either a sewer tax (all Tamil Nadu ULBs and Pune) or a sewer charge (BWSSB) or both (Kolhapur, Kolkata).

The following observations may be made based on analysis of user fees in Tamil Nadu towns:

- The effectiveness or success of user fees depends on two aspects: (i) connection efficiency, which means that more the household connections higher the user fee collectable; and (ii) collection efficiency, which implies the amount of user fees actually collected which is the real success of cost recovery;
- The sewerage schemes implemented under TNUDP III have only been operational for one or two years in most towns, and hence it is difficult to comment on the actual collection of user fees for the sewerage system. Average collection efficiency of property taxes, however, ranges from just under 50 percent in NRCP towns to more than 80 percent in TNUDP III towns. Using property tax collection as an indicator for ULBs' commitment to realize demand assessment, it seems likely that ULBs will bring a similar focus in the area of collection of sewerage charges;
- The mode of collection of 'user fee' is understood to be through demand notices sent along with property tax which is biannual collection. This will help ULBs to streamline processes quickly and methodically. The user fee recovery so far has been at an average of 5 to 10 percent only;
- It may be inferred that, in most cases (especially in Tamil Nadu), the user fee has been designed to cover 100 percent of O&M costs as well as provide some support to cover debt servicing costs. User fee collections will be supported by allocation of funds from collection of property tax in all ULBs; and
- Assuming that 40 percent of property tax allocated to the water and drainage account is further allocated exclusively for the sewerage system, and maintenance thereof, the amount, in most ULBs, appears to be sufficient to cover O&M costs and further support full/part debt servicing.

4.4. Impact of Power Generation from Sludge Reduction in O&M Costs

A broad analysis of the O&M expenses of sewerage systems indicates roughly about 40-50 percent of the total O&M costs comprise power costs. To overcome the huge expenses related to power, sustainable methods of cost saving are under active consideration. One such measure is producing power within the treatment plants (energy recovery from sludge treatment), for captive consumption of power. This enables a plant to run its own machinery with the energy generated.

4.4.1. Power Generation from Biogas Digestion at STPs

Certain cities in the country have attempted power generation within the STPs, which has helped them to save about at least 80-95 percent of power costs, resulting in a savings of nearly 40 percent in the O&M costs. Of the 15 cities chosen for the study, Surat Municipal Corporation (SMC) and CMWSSB are currently generating power in their STPs. SMC has power generating plants in four out of nine STPs, while Chennai has such facilities in all six STPs located in Chennai. They commenced their operations way back in 2005. Table 21 presents the potential to meet the energy needs and associated power costs of the STPs through biogas generation at the STPs.

Table 22 summarizes the quantity of savings in power costs from CMWSSB's six STPs based on actual power generation at STPs.

TABLE 21: Potential for power and costs savings from power generation at STPs

Name of the STP	Power (kilowatt hour (kWh)/day)						Savings	
	Requirement for Plant	Generated from Biogas Plant	Accessed from Grid	From Diesel Generator Set	Cost (Rs./day)	Biogas (INR/day)	Energy Needs met from Biogas Plant (%)	Energy Cost met from Biogas Plant (%)
Kodungaiyur 110 MLD	12,500	12,000	100	400	72,300	66,000	96	91
Koyambedu 60 MLD	9,000	5,500	3,200	300	69,350	30,250	61	44
Nesapakkam 40 MLD	5,000	4,900	0	100	28,250	26,950	98	95
Nesapakkam 54 MLD	9,000	3,000	6,000	0	49,500	16,500	33	20
Perungudi 54 MLD	7,500	7,000	400	100	44,200	38,500	93	87
Perungudi 60 MLD	8,500	8,000	300	200	49,900	44,000	94	88

[48] Based on the following unit costs: biogas power (INR 5.5/kWh, grid power INR11/kWh –diesel generator set – INR 13/kWh).

TABLE 22: Power generation and savings in power costs at STPs

STP Location	Capacity of Gas Engine (kW)	Total power Generated up to June (kWh)	TNEB Power Savings up to June 2014 (INR lakh)	No. of Years of Operation	Average Savings per Annum (INR Lakh)
Kodungaiyur 110 MLD	1,064	36,038,095	1,475.61	7.5	197
Koyambedu 60 MLD	625	14,022,200	566.38	8.5	67
Nesapakkam 40 MLD	469	13,981,286	570.74	8	71
Nesapakkam 54 MLD	1,064	634,720	28.56	0.7	41
Perungudi 54 MLD	1,064	22,615,950	920.49	7.75	119
Perungudi 60 MLD	1,064	4,624,410	200.21	2.5	80
Total (378 MLD)	**5,350**	**91,916,661**	**3,761.99**		**574.38**

The average daily savings in CMWSSB's STP is in the order of INR 200,000 adding up to roughly INR 700 lakh per annum, as demonstrated in Table 22. Interestingly, in CMWSSB, the contract to the private operator is so designed that twice the amount (at Tamil Nadu Electricity Board's (TNEB's) energy rate) for the power is charged whenever power is drawn from the grid to meet the plant's energy need and this is deducted from the payment made to the contractor. Reportedly, all the energy recovery plants have been operating successfully, and the demand for grid power has been reducing progressively at all the plants.

4.4.2. Capital Expenditure and Financial Returns for Biogas Plant

The capital cost of a biogas plant to be set up in the STP costs roughly about 15 percent of the STP's cost itself. However, the pay-back period works out to only two years. This is demonstrated as follows: The cost of the Nesapakkam STP (40 MLD) belonging to CMWSSB is INR 1,000 lakh. The cost of the power generator set is INR 150 lakh. The projected energy savings on account of this power plant over a 10-year period indicates a payback period of three years and an Internal Rate of Return (IRR) of 33 percent. An increase of 2 percent in the savings from the third year were considered on account of the anticipated increase in power tariffs

The analysis below indicates that power generation not only reduces maintenance costs, but is also an attractive investment as the pay-back period is three years; the IRR is 33 percent.

4.5. Revenue Generation from Sale of Treated Wastewater

Cities could sell the treated wastewater to industries to recover their O&M costs. Utilities, when operating well managed STPs, are in a position to sell the treated effluent to industrial customers depending on the need and availability of other water sources. Use of treated wastewater for industrial applications frees up water which can be used by water utilities to increase coverage and meet domestic water requirements. The following cities and states have utilities that are deemed to be pioneers in the field of water reuse:

TABLE 23: Payback period for capital expenditure on power generation

	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
CAPEX	-150										
Savings		51	51	52	53	54	55	56	57	58	59
Cumulative		51	101	153	205	259	314	370	427	485	544
Payback	3 Years										
IRR	**33 percent**										

- Chandigarh: 45,000 cubic meter per day (m^3/d) of wastewater is treated to the tertiary level and reused for irrigating green spaces;
- Pragati Maidan Power Plant, Delhi, uses treated wastewater for power production;
- Chennai and Mumbai are using treated effluent for airconditioning requirements;
- Chennai STP at Kodungaiyur sells its treated water to industry for cooling purposes; and
- Nagpur Municipal Corporation has decided to give its wastewater to Mahagenco, a local company engaged in power production which will use treated wastewater to produce power.

Experience from Chennai demonstrates that sale of treated wastewater to industries at INR 8-11/kiloliter (kL) is adequate to cover O&M costs of the treatment plants (WSP, 2014). Box 4 discusses some select initiatives and experience of wastewater recycling from two cities.

BOX 4: Experience on Wastewater Recycling and Reuse from Indian Cities

The **Chennai Petroleum Corporation Limited (CPCL) plant in Chennai** was faced with acute water shortage and scarcity of supply in the wake of severe water shortages in the city. The plant had to rely on expensive tanker-supplied water. During a 20-year period, the cost of water increased seven fold, as demand rose. The plant was also forced to shut operations occasionally due to lack of water availability resulting in business and revenue losses for the company.[49] Recognizing that the water supply from the water utility was not only unreliable but also uneconomical, the industry set up a wastewater recycle plant to treat the partially treated wastewater from the water utility. The cost of the recycled wastewater to the industry worked out to INR 45/kL as compared to INR 60/kL for the water purchased from the water utility. Besides being economically attractive, the quantum (of partially treated wastewater) was also able to meet the current and future water needs of industry.

The case of **Mahagenco in Maharashtra** presents similar learnings. The company, in 2008, was in need of an additional 130 MLD of water supply for the expansion of its 1980 megawatt (MW) Koradi Thermal Power Station. There were no municipal or command area projects available to supply this additional water requirement. Mahagenco decided to reuse the treated wastewater from Nagpur to meet the water requirement at the Koradi station and, to secure this source of supply, has taken on the responsibility of construction and O&M of the STP. The treatment and provision of water through this arrangement will cost Mahagenco about INR 3.4/m^3, which would have been significantly higher if it had sourced fresh water from another municipal or irrigation command project (about INR 9.6/m^3 for recent projects).

Delhi supplies treated sewage to industrial establishments such as power plants, industrial areas and hospitals. In 2004, the Delhi government had denied Pragati Power Corporation Limited (PPCL) a fresh water linkage to operate its 330 MW gas-based power plant. However, the Delhi government gave an option to PPCL to operate two of Delhi Jal Board's 20 MLD STPs to meet their water requirement. The treated water is sourced from the Rithala STP, Sen Nursing Home Nallah STP and Delhi Gate Nallah STP. O&M of services is undertaken by Degremont Limited. The current O&M cost incurred by PPCL stands at about INR 4/kL (IDFC, 2011). The Delhi Jal Board has also evaluated technologies to retrofit the existing 113 MLD portion of the Okhla STP for recycle and reuse of wastewater for nonpotable applications in the nearby industrial units. It has identified prospective end users of treated sewage. These include the Okhla industrial area, upcoming townships, and cooling water for National Thermal Power Corporation's power plant in Badarpur (Kelkar, 2012).

BWSSB is one of the few agencies involved in tertiary treatment of wastewater and its supply to nearby industries/plants. Currently, four of the seven STPs undertake tertiary treatment. The average cost of tertiary treatment comes to about INR 10-15/kL (IDFC, 2011). Notably, Bengaluru

Cont...

[49] http://www.cpcl.co.in/projects0102.html.

Experience on Wastewater....

charges INR 60/kL for fresh water to be used for industrial purposes. The treated sewage from the 180 MLD Vrishabhavathi Valley STP is supplied to a number of industries and is expected to supply treated sewage water to the upcoming Bidadi power plant. Further, treated wastewater from the 10 MLD Yelahanka Tertiary STP is being supplied to Bengaluru International Airport, Bharath Electronic Limited, Indian Tobacco Company, Rail Wheel Factory and Indian Air Force. Further, BWSSB has initiated a scheme on the Integrated Water Resource Management Reuse of Wastewater from Vrishabhavathi Valley. It consists of a 135 MLD reuse process scheme to be undertaken in four phases. The landed cost of high quality treated water from Vrishabhavathi Valley to River Arkavathy will be INR 12/kL.[50]

SMC is also involved in the supply of treated wastewater to industrial units in the Pandesara Industrial Estate from the Bamroli STP. SMC is also developing a 40 MLD tertiary treatment plant at Bamroli on a PPP basis. The plant is being developed by city-based Enviro Control Associates. The project is expected to bring down the cost of procuring freshwater from the current level of INR 22/kL for industrial use (Kelkar, 2012).

In addition, cities such as Hyderabad, Nagpur and Pimpri-Chinchwad are also undertaking initiatives to promote the use of treated wastewater. Hyderabad is planning to implement a project to recycle wastewater at its three major STPs (Amberpet, Nagole and Nallacheruvu) and supply to industries. Recently, the Japan International Cooperation Agency approved financial assistance to the project. INR 1/kL is charged for treated water.[51]

The Gurgaon District Authority has made it mandatory for all construction firms to use treated wastewater from its STPs for construction and other nonpotable purposes. The Authority has started supplying tertiary treated wastewater from two STPs – Behrampur (15 MLD) and Dhanwapur (25 MLD) at a rate of INR 4/kL.

The Jaipur Municipal Corporation has implemented an Asian Development Bank-funded STP in Delawas. The treated wastewater from the 62.5 MLD STP is supplied to nearby small-scale industrial units and for irrigation purposes. Also, the sludge generated is used as manure for agriculture and in nurseries. The STP was commissioned in September 2006.

Chandigarh Municipality charges INR 500/acre of land for supplying treated wastewater to be used for agricultural irrigation and charges INR 50/kanal (500 square yard plot)/month for irrigation of green spaces.[52]

Similar initiatives were also undertaken in Delhi, Surat, Jamnagar and Bengaluru. The cost of secondary treated wastewater to industries ranges from INR 8-15/kL (Chennai – INR 8-11/kL and Bengaluru INR 10- 15/kL). This often compares favorably with the industrial tariff levied for fresh water in a few states/cities shown in Table 24.

TABLE 24: Industrial tariff levied for fresh water in different cities/states

Sl. No.	State	Industrial Water Tariff (INR/kL)
1.	West Bengal	12-15
2.	Uttar Pradesh	10-35
3.	Madhya Pradesh	24
4.	Punjab	7.60
5.	Jharkhand	9.90
CITIES		
6.	Chennai, Bengaluru and Mumbai	60

Source: Analysis by WSP, 2014.

[50] Source: http://bwssb.org/sewage-treatment-5/
[51] Source: http://sulabhenvis.nic.in/LatestNewsArchieve.aspx?Id=2870&Year=2012; Kelkar (2012).
[52] Source: http://chandigarh.gov.in/cmp2031/physical-infra.pdf

5. Conclusion

While there are many examples of best practices that can be gleaned from the Tamil Nadu sewer system implementation and other ULBs reviewed in this study, the major takeaways are summarized below, which can possibly contribute to relevant policies applicable for sewer systems.

1. **Unique approach towards capital financing to offset the burden on ULBs and users**: ULBs in Tamil Nadu have set a trend in financing sewer systems to meet their capital costs. The concept of collecting 'public deposits' to meet capital construction costs has not been practiced by many and can further be justified by the physical connection provided to the household. The deposits which come in at zero cost to ULBs have reduced their cost of debt immensely which subsequently had an impact on the household user charges. They also have the benefit of ensuring that households connect to the network upon completion of construction.
2. **Options for 100 percent cost recovery**: ULBs across the country have adopted various options to meet the O&M and debt service burden for the sewerage systems. These have been discussed in detail in this report, and are summarized here in conclusion:
   a. **Levying user fee:** User fees, charged on a monthly basis, are meant to recover the O&M and debt service costs, which enables the project to sustain itself by not depending on external sources of funding to meet O&M deficits (such as revenue grants from the government). This practice is especially prevalent in the ULBs in Tamil Nadu, with the smaller ULBs relying heavily on this option to meet their overall expenditure burden;
   b. **Allocation from property tax collection**: Most ULBs have allocations, either in the form of a sewer tax or sewer charge that gets allocated to the sewerage account for the maintenance of the sewer system. This can meet up to 100 percent of the O&M requirements of ULBs; and
   c. **Power generation to reduce O&M burden**
      - **Sale of recycled wastewater**: Examples of this practice are available from various utilities across India. Our analysis suggests that the ULBs can meet up to 100 percent of their O&M requirements from the sale of treated wastewater. The utilities in Kodungaiyur (under CMWSSB) and Surat both meet 99 percent of their O&M requirements through the sale of treated wastewater.
      - **Collection of public deposits**: As presented in this report, this approach has the potential to reduce the loan requirement by up to a third of the project cost, thereby reducing the debt servicing burden for the ULB. In the absence of this contribution, the user fees required for full cost recovery would need to be higher by about INR 30-50/household/month. This was avoided in the schemes implemented in Tamil Nadu.

Table 25 summarizes the different options for cost recovery and potential to meet the O&M requirements for sewerage schemes as discussed throughout this report.

TABLE 25: Cost recovery options for sewerage schemes

Option for Cost Recovery	Average Demonstrated Potential	Maximum Demonstrated Potential
Levying user fees	~100%	More than 200%
Allocation from property taxes	~50%	More than 150%
Sale of treated wastewater	~40%	~100%
Reduction in O&M burden from power generation at STP	~80% reduction in energy costs	
Collection of public deposits	~30% reduction in loan requirement; ~30 reduction in debt servicing burden Reduction in household user fees by ~INR 30- 50/HH/month	

This makes the project independent and also generates adequate revenues for capital replacement in the future with the possible surplus that could be generated. The key takeaways here are:

i. Striving towards making projects self-sustainable;
ii. Analyzing products that could make the above happen. It need not restrict itself to user fees. There can be sources such as sale of treated water or power generation, and so on, which will be a savings in O&M cost. This needs to be analyzed, based on adequacy at a city-level; and
iii. These modes should have a legal binding in terms of municipal laws or by-laws.

1. **Political will and commitment**: All ULBs demonstrated extraordinary commitment to both execution of the project, as well as ensuring that the execution happens in a financially sound and sustainable manner. Collection of public deposits, which has been a unique and innovative feature of all sewerage schemes implemented in Tamil Nadu, required extensive engagement with the public and concerted effort by both the political class and ULB officials to convey a focused message on the need and benefits of the scheme, and specifically the deposit collection exercise. It is difficult to imagine any scheme being implemented in this manner without this critical component.

2. **Focus on public communication and transparency**
It is to be understood that the citizens have not volunteered on their own to contribute; the ULBs in Tamil Nadu have been advocating for the need of public money for projects and also the need for the project to improve health and environment of their cities. Many public/community discussions have been held with citizens prior to the project to propagate these concepts, which has resulted in the acceptance by the public of partly funding the project through deposits. Many ULBs conducted roadshows to obtain public acceptance, without which this success would not have been possible. The ULBs followed a transparent process and user charges were posted on the websites of ULBs, and on bill boards in front of municipal office. The councils were apprised and passed resolutions approving collection of deposits and also engaged in discussion with citizens and helped in the collection of deposits. This implies that the decentralization process has worked effectively here.

Similar was the case for user fees, which are expected to cover O&M and debt service. This has resulted in making the project financially sustainable. Councils were apprised of the need for imposing user fees and facilitated in making decisions.

The ULBs have included these aspects in the by-laws, which are legally binding on citizens. In addition, ULBs also facilitated citizens in providing plumbing lines within households and created awareness on the rate to be paid through bill notices. They also monitored the implementation.

The key takeaways here are:

i. Need for one-to-one communication with the public (the real decentralization to be practiced);
ii. Transparency in approach; and
iii. Appropriate legal framework and accountability on everyone's part.

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Annex 1

Legislative and Policy Enablers Prevalent in Tamil Nadu

The 74th Constitutional Amendment Act, adopted by GoI in 1992, was a crucial watershed that marked the transfer of powers from the center and states to the ULBs. Its salient features include:

- Appointment of an independent election commission in each state;
- Mandatory elections for ULBs, with reservation for women and weaker sections of society; and
- Setting up of a state finance commission to recommend basis for transfer of resources from state to local bodies.

Tamil Nadu was one of the leading states to implement the provisions of 74th Constitutional Amendment, an important catalysts, among others, contributing to the success of several sewerage projects in the state. The key enablers arising from the 74th Constitutional Amendment were:

- Transfer of powers to determine and levy user charges; and
- ULBs empowered to raise finances for infrastructure projects.

In 1998, just before commencement of the first sewerage project in the state, GoTN announced its policy on private sector participation. This provided a framework for engaging with the private sector.

GoTN Policy Framework for Private Sector Participation in Municipal Infrastructure Projects

The Municipal Administration and Water Supply Department, GoTN, issued an order (GO NO. 69, dated May 4, 1998) with regard to privatization of municipal services. It contains the guidelines on PPP:

- All services opted for private participation should go through an open and competitive bidding process;
- There should not be retrenchment of the existing staff;
- The conditions of the contract should be clear;
- To create an open and healthy competition, TNUIFSL will be requested to make a generic document for each aspect of privatization of the service;
- If necessary, the local administration can make changes in the generic document according to the local status; and
- The cost of service delivery shall be such that there is no increase due to private sector participation.

The order also mentioned that the local body for capital investment in services could look at various options of private participation such as BOT, Build Own Operate Transfer (BOOT), and so on.

Source: NIUA 2002, Kampsax.

Around the same time, GoTN also implemented financial reforms in favor of ULBs. As part of this, ad hoc fiscal transfer was replaced by rational statutory allocations linked to the state's revenue growth. Major features of the reformed financing are:

- 3.60 percent of the state's tax revenue passed onto ULBs;
- Inter se allocation based on population, per capita expenditure and per capita revenue;
- 15 percent of the allocation set aside as an equalization/ incentive fund to reward performance and handhold weak and unviable ULBs; and
- 90 percent of entertainment tax passed on to ULBs.

Thus, decentralization promoted through the 74th Constitutional Amendment, private sector participation policy, and state-level financial reforms together contributed to the success of these projects.

Annex 2

Case Study on Alandur

Alandur is a selection grade municipality located adjacent to Chennai. It forms a part of the Chennai Metropolitan Area and is classified as Adjacent Urban Area by the Chennai Metropolitan Development Authority. Spread over an area of 19.50 km^2, Alandur comprises Adambakkam, Nanganallur, Pazhavanthangal and Thalakanancheri. Alandur has primarily developed as a residential suburb of Chennai, with most of its residents employed in Chennai. Alandur has no major industrial units.

In 1991, the population of Alandur was 125,444, which increased to 146,287 in 2001 (Census 1991 and 2001), registering a decadal growth of about 17 percent. There are 21 slums within the municipal limits; the slum population is estimated to be more than 40,000.

Urban Basic Services: Pre-project Situation

In the mid-1990s, Alandur had a population of about 137,000. Water was supplied from the TWAD operated 'Alandur Pallavaram scheme.' Though the scheme was designed to supply 9 MLD of water, the town received only 4.50 MLD, on account of an insufficient source, leading to a per capita supply of only about 33 liters per day. In addition, the Municipality maintains 375 borewells and 26 mini water schemes through which about 1.50 MLD water is being supplied. The water supply being inadequate, residents installed individual borewells or relied on private water suppliers.

Alandur Sewerage Project

The Alandur sewerage and sanitation project was implemented at a cost of about INR 337 million. Key components of the underground sewerage scheme included:

1. **Sewerage (underground drainage) network**: A total of 120 km of sewerage network comprising main sewers (19 km) and branch sewers (101 km), designed to serve a population of 300,000 in 2027 AD;
2. **Sewerage pumping station and pumping mains:** Construction of a sewage pumping station, where the sewerage network terminates. And the laying of a 6 km-long pumping main for transferring sewage to the STP;
3. **STP**: Construction of a STP at Perungudi, estimated to receive an intermediate flow of 12 MLD till the year 2012 AD and an ultimate flow of 24 MLD for the year 2027 AD;
4. **Low cost sanitation**: Construction of community toilets for slum communities, connected to the sewerage network, where possible; and
5. **HSC** to the sewerage network (this component is not included in the cost estimate mentioned above).

By March 2003, the municipality managed to complete all infrastructure works (including one 12 MLD unit of STP) as envisaged and, within the next two years, nearly 12,000 households were connected to the underground sewerage system. Additionally, 14 community toilets (operated on a pay-and-use basis) catered to the sanitation needs of slum households – those who could not construct individual household latrines.

There were multiple factors responsible for this turnaround. These are discussed in following section.

1. Enabling Policy at the National, State and ULB Level

a. In 1992, GoI adopted the 74th Constitutional Amendment. The 74th Constitutional Amendment Act was a crucial watershed that marked the transfer of powers from the Center and states to the ULBs;
b. GoTN Policy Framework for Private Sector Participation in Municipal Infrastructure Projects: The Municipal Administration and Water Supply Department, GoTN, issued an order (GO NO. 69, dated May 4, 1998) with regard to privatization of municipal services. The order also mentioned that the local body for capital investment in services could look at various options of private participation such as BOT, BOOT, and so on; and
c. Around the same time, GoTN also implemented financial reforms in favor of ULBs. As part of this, ad hoc fiscal transfer was replaced by rational statutory allocations linked to the state's revenue growth.

2. National and State Level Institutional Framework

In Tamil Nadu, prior to the implementation of the 74th Constitutional Amendment, the responsibility was divided between TWAD (planning and implementation) and ULBs (O&M). In case of Chennai, CMWSSB, a city level board, is responsible for provision of water and sanitation services. Thus, in most states, the responsibility remained fragmented among multiple institutions. The implementation of the 74th Amendment resolved this to an extent by empowering ULBs. The ULBs were no longer needed to depend only on parastatal agencies. They could hire specialized agencies to support infrastructure planning.

3. Community Participation in Urban Sanitation

According to project design, Alandur Municipality was the prime borrower for the project and required to raise funds for the underground sewerage system and to ensure household connections. In order to mobilize funds for the project, the Alandur Municipality launched a well-planned communications strategy to inform the residents of the town. The strategy received tremendous response and a strong willingness to pay. Survey findings revealed that as many as 97 percent of the respondents were desirous of disposing of domestic sewage into the proposed sewerage system. And about 86 percent of the respondents expressed willingness to pay monthly sewer charges in the range of INR 21 to 50 per month (similar to the existing water charges).

4. Vibrant Political Leadership

The potential of reforms that began in the early 1990s continue to be seldom understood by local politicians. In many a ULB, the empowerment is merely viewed as an instrument to rule, thus ignoring the potential offered by reforms to benefit people. The situation in Alandur was,

TABLE A1: **Roles and responsibilities of stakeholder organizations**

Organisation	Responsibility
GoTN	Policy environment and gap funding support
TNUIFSL	Overall facilitation support
TNUDF and TUFIDCO	Term loan
Alandur Municipality	Prime borrower with responsibility for repayment, community mobilisation, HSC
Kirloskar Consultants	Assisting TNUIFSL is preparation of contract
Consulting Engineering Services	Consultant contract carried out comprehensive investigations and engineering reports including detailed designs
Ms IVRCL	Private sector company - Contractor for *laying sewerage network and construction of sewage pumping station including laying of pumping main*[53] - Construction of STP[54] (2 units of 12 MLD each) on BOT basis
CMA, CMWSSB and TWAD, TNPCB	- Advisory role and according necessary approvals - CMWSSB also provided land for construction of STP

Note: TNUDF: Tamil Nadu Urban Development Fund; TNPCB: Tamil Nadu Pollution Control Board

Source: More (2008).

[53] The contract for laying the underground sewerage network, sewage pumping station and pumping main was a conventional item rate contract.
[54] STP has two modules of 12 MLD each: the first module to be completed along with the sewerage network; and the construction of the second module to commence when either the *inflow of sewage into the existing STP reaches 9.60 MLD when measured for a continuous period of three months, or one-and-a-half years before the completion of the lease period, whichever is earlier.*

however, encouraging as the Mayor (Mr. R.S. Bharathi) was a self-motivated individual. He had successfully negotiated (with the state government) a water supply project for the town in the mid-1980s. The Mayor had understood the (latent) demand for improving the environmental situation and thus embarked on the mission to provide sewerage for the town. He succeeded in all his negotiations with GoTN and TNUIFSL. He was able to bring all 42 council members to a consensus and mobilize public contribution to achieve the goal.

5. **Financing arrangement**: GoTN had, in 1996, established TNUDF as a trust fund engaged in the development of urban infrastructure in Tamil Nadu. TNUDF is a PPP between GoTN and three all India financial institutions: ICICI, HDFC and ILFS. GoTN's equity in the venture is restricted to 49 percent (motivation to facilitate private sector management in investment decisions). This is the first fund to provide debt finance to the municipalities on a nonguarantee basis. This opened access to long-term debt to finance capital investment with a principal moratorium for three years. Alandur municipality decided to tap into this resource. GoTN also extended its support in the form of gap funding up to INR 30 million.

6. **Public contribution**: Project finances were sensitive to the number of house sewer connections. In order to counter the risk, it was agreed that, prior to issuing tenders, a collection deposit from at least 10,000 residents would be credited into a separate account. Effective and timely communications enabled the community to be involved from the initial phase of the project. This was primarily due to the strong and concerted effort of the Alandur Municipality. An election style campaign was launched to generate awareness on the project – officials and councilors canvassed door-to-door; spot advertisements were aired on local cable TV networks; pamphlets were distributed in English and Tamil; onsite meetings were held with residents associations and the public to explain the nuances of the project and the potential benefits it will generate in terms of improved health and clean environment. Associations were formed, which were responsible for collecting deposits and connection fees from households. This collaborative effort of the municipality led households to provide upfront contributions to the project. There was thus full transparency regarding the financial aspects of the project. There was effective communication to ensure accountability, streamlined implementation and sustainability.

Public response was so overwhelming that the municipality achieved the target. As of August 2008, more than 22,000 households had remitted deposits and total collections stood at INR 147.60 million. The municipality made the smart move of investing the public contribution amount in fixed deposits with Tamil Nadu Power Finance Corporation Ltd. and earned nearly INR 24.6 million as interest. Higher collections than originally envisaged, and the interests earned led the municipality to proportionately reducing the quantum of loan.

TABLE A2: **Means of finance and component-wise breakdown of project costs**

Means of Finance		Revised Project Cost	
Component	**Amount (INR million)**	**Source and Type of Finance**	**Amount (INR million)**
Sewerage Network	186.08	Rupee term loan from TUFIDCO	162.00
Pumping Main	59.43	Rupee term loan from TNUDF	42.00
Pumping Station	24.49	Deposit collection	80.00
House Service Connections	22.50	Gap funding by GoTN	32.00
Physical Contingency (5%)	14.63	Interest from deposits	20.00
Price Contingency (10%)	30.41	Grant fund for supervision	10.00
Total	**337.54**	**Total**	**346.00**

Source: NIUA (2001).

7. **Operation and Maintenance Financing**: The O&M financing plan stipulated that the responsibility for financing O&M of both – sewerage network and the STP – remained with Alandur Municipality. In principle, the O&M is to be financed by the beneficiaries, paid in the form of user charges. During the project planning stage, a cross subsidy scheme was thought to be appropriate for tariff fixation. Accordingly Alandur Municipality, in 1998, decided to levy connection as well as monthly O&M charges. The ratio of O&M charges across consumer segments was decided to be 1:3:5 = household (domestic): commercial: industrial consumers. The municipal council decided to give a concession to the consumers and revised starting tariffs as presented in Table A3.

8. **Project implementation and O&M management**: Nearly three years of detailed planning and concerted efforts in garnering support from multiple stakeholders (including the community) resulted in a well-planned sewerage scheme for the city. The project implementation finally began in 2000 with a call for tenders. The tender was packaged such that the contractor who undertakes to build the STP (on BOT basis) also had to lay the sewerage network and build the pumping station. The house sewer connections were planned as a separate component.

   In order to ensure timely and simultaneous completion of the STP and sewerage network, the payment for the sewerage network was linked to completion stages of the STP.

9. **Sewerage network and SPS**: The construction contract for the sewerage network and the SPS included 'defect liability' for a period of one year. Since the completion of the defect liability period, Alandur Municipality had been responsible for its maintenance. The sewerage network is maintained by the municipality itself, whereas the SPS maintenance is being carried out through the O&M service contractor (Richardson Cruddas). However, despite an increase in burden on O&M, the municipality has not engaged additional manpower. But with increasing HSCs and aging of the network, blockage related grievances are reportedly increasing. The municipality is now planning to buy a sewer cleaning machine.

10. **STP**: The responsibility for the maintenance of the STP, as per the DBOT contract, rests with the private sector operator for a period of 14 years. The operator has sublet the O&M of the STP to VA-Tech WABAG, an international systems supplier for waste/wastewater technologies.

Achievements

Thus Alandur became the first ULB in the country to successfully mobilize financing support for sanitation infrastructure – from the private sector as well as the community. Key achievements of the ULB include:

- Successful public participation: Alandur Municipality collected deposits[55] from more than 10,000 households before the award of contract (as agreed with TNUIFSL) in March 2000;

TABLE A3: **Revised initial user charges for underground drainage network**

S No	Property Area (sq. ft.)	User Charge (INR per month)	
		Domestic	Non-domestic*
1	< 500	60	200
2	500-1,500	80	400
3	1,500 – 3,000	100	600
4	> 3000	120	1000

Notes: *Non-domestic category includes commercial and industrial users
Source: Alandur Municipality.

[55] In July 2008, public contribution was INR 147.58 million. The municipality earned an interest of INR 24.62 million by depositing the public contribution amount with the Tamil Nadu Power Finance Corporation.

- Since the ULB collected more amount in public contribution than initially envisaged, the quantum of loan reduced accordingly;
- It mobilized private equity of about INR 66 million for STP construction;
- Construction of both the sewerage network and STP module-1 was completed before time; the scheme was ready in September 2002[56] as against the target of March 2003;
- Despite the importance given within the program to the sewerage network and STP, the focus on the poor was not lost. Alandur Municipality has constructed 14 Community Toilet Blocks; 10 of these are connected with the UGS network. Also house connections for slum households are being provided free of cost; and
- The project has set precedence.

[56] Discussion with IVRCL representative.

Annex 3: Questionnaires

WSP, New Delhi

STUDY ON SEWERAGE SYSTEMS IN TAMILNADU EXECUTED UNDER TNUDPIII

Questionnaire/Checklist for Data Collection from ULBs	
NAME OF MUNICIPALITY/ULB	:
Chairman/President	:
Vice Chairman/Vice President	:
Commissioner/Executive Officer	:
Municipal Engineer/Executive Engineer	:

Part A: Technical

1. General

2. Collection & Conveyance System

3 Treatment, Reuse and Disposal System

4. O&M of Sewer Network, SPS and STP

1. GENERAL

S. No.	Item/Description	Response/Reply/Data from ULBs
1	Name of Municipality/ULB	
2	Area of ULB (km^2 or hectare)	
3	Piped water supply provided (yes/no) and tariff imposed on drinking domestic/industrial/commercial	
4	Per capita water supply (liter per capita per day)	
5	Number of households	
5a	Number of non-slum households	
5b	Number of slum households	
6	Number of households connected to the sewer	
6a	Non-slum households	
6b	Slum households	
7	Number of community toilets connected to the sewerage network	
8	End point of disposal of the treated wastewater	
9	Did you have any community participation/involvement through NGOs while in design/execution/O&M stage, if so please list here	
10	Any awareness campaign/camps conducted so far; if so, has it been helpful in getting deposits from households? Please add.	

2. COLLECTION & CONVEYANCE SYSTEM

S. No.	Item/Description	Response/Reply/Data from ULBs
1	Total length of sewerage network (km) with maximum size of pipe	
2	Length of a) trunk mains, b) mains, c) sub mains, d) street sewers in km	
3	Total number of house connections aimed at by the project	
4	What is the minimum and maximum offset distance that was maintained to link the house connection to the lateral sewer/manhole	
5	Total number of manholes as per DPR/tender against which total number of manholes actually constructed	
6	What is the total delay (days) against original project schedule in DPR/tender?	
7	Total number of intermediate pumping stations proposed vs. actually constructed	
8	Total length of pumping mains as per DPR/tender vs. actually provided	
9	Total length of pipeline executed using trenchless technology if any	
10	Total number of river crossings/cross drainage works if any encountered	
11	Did you need any bailing of water during excavation and blasting/chiseling of soft/hard rocks? If so, please attach details	
12	Materials of pipes used, viz., RCC/GRP/PVC, etc.	
13	Describe any other salient features/new approach that you may feel it is a challenge for execution of sewerage projects in India	

3. SEWAGE TREATMENT PLANT/REUSE/RECYCLE/DISPOSAL OF TREATED SEWAGE

S. No.	Item/Description	Response/Reply/Data from ULBs
1	Name and capacity (MLD) of STPs existing	
2	Name and capacity (MLD) of STPS newly constructed, with year of start-up and year of completion/ commissioning	
3	Estimated cost of STP (excluding land cost) in INR	
4	Awarded cost of STP at the time of tender award in INR	
4a	Type of contract chosen for bidding (Turnkey/DBOT/ BOT/BOOT/etc.)	
5	Actual cost of STP at the time of completion of works in INR including all extra claims settled/unsettled in INR	
6	Any mixing up of industrial/trade effluents into the STP. If yes, please indicate average flow (MLD)	
6a	In case of mix of industrial effluent, what is the tariff imposed on industries/trading units for treating their wastewater in your sewerage system/STP?	
7	Reasons for any underutilization or overloading of STP	
8	Do you require additional capacity of STP to be provided? If so, additional capacity/expansion required in MLD	
9	Process adopted for treatment (ASP/EA/SBR/UASB/TF/ AL/WSP……)	
10	Please attach copy of raw sewage characteristics assumed in design stage vs. actual sewage characteristics measured after completion or during O&M	
11	Monthly average BOD and TSS at the inlet and outlet of each process unit in milligram per liter (mg/l) as analyzed for the last two years or from start up	
12	Actual hourly flows (MLD) measured at STP inlet or outlet as the case may be	

Cont...

S. No.	Item/Description	Response/Reply/Data from ULBs
12	Actual hourly flows (MLD) measured at STP inlet or outlet as the case may be	
13	Process adopted for sludge treatment (drying beds/ mechanical dewatering/another method)	
13a	List of chemicals if any used in the process of treatment of sewage and their respective dosage and annual average consumption (ton/year)	
14	Any anaerobic digester existing/newly provided? If so what is the gas generation/day?	
15	Are you using biogas for any purpose or flaring it off?	
16	In case power generation unit is provided, please indicate units of power generated per day (kWh/day)…and installed capacity of plant in kW	
17	Total annual average energy consumption (kWh) vs average inflow (MLD) for the last two years or since commissioning of plant	
18	Total area of STP (hectare) and area available for future expansion (hectare) in the same site	
19	List of alternate sites if any identified	
20	Did you get environmental clearance/Environmental Impact Assessment approved?	
21	List of noncompliances if any reported by the Pollution Control Board/court if any	
22	Type of land use on which STP is constructed	
23	Any public interest litigation cases pending against STP in Court	
24	Any other nuisance inside the STP and nearby vicinity reported?	

Cont...

S. No.	Item/Description	Response/Reply/Data from ULBs
25	Environmental management practices adopted if any during construction; if so, please list	
26	Any awards or appreciation from society/public/ government on wastewater management?	
27	Monthly average production of dried sludge cake (tons)	
28	End use/disposal of treated sewage (irrigation/non-potable/ industrial/disposal to water body)?	
29	In case reuse/recycle is practiced, please indicate quantity (MLD) used for reuse/recycle out of total production	
30	Total annual revenue from sale of sludge/treated effluent/ biogas/any other produce from STP	
31	Any power back up/diesel generator sets provided? If so, indicate capacity	
32	Total amount of power charges paid annually (last two years) or since commissioning as of STP/pumping stations	
34	List out any structural damages and malfunctioning of process units/equipment of STP within the guarantee period	
35	List out any value addition/innovation made with regard to the conventional STP in terms of process, technology, equipment and methods of execution,/management	
36	What are all the positive impacts realized in your project after completion? Any appreciation in value of land/properties? Any improvement in economic status of the society in the project areas? Any reduction in cases on water borne diseases against that of previous scenario without sewerage system and STP? Any improvement in quality of groundwater in the project areas?	
37	List out the technology/equipment/instruments that have been imported from outside India and their value, tax/duty exemption if any	

4. OPERATION & MAINTENANCE OF SEWER NETWORK/PUMPING STATION AND STP

S. No.	Item/Description	Response/Reply/Data from ULBs
1	**O&M of sewerage network & SPS**: is it operated & maintained by your own department or a contractor/ agency? If so please indicate name, period of contract	
2	**O&M of STP**: is it by your own department or a contractor/agency? If so please indicate name, period of contract	
3	a) Estimated amount for O&M contract for sewer network + SPS (INR)	
	b) Awarded cost of O&M contract for sewer network + SPS (INR)	
	c) Actual cost incurred with extra claims, etc., for sewer network + SPS (INR)	
4	How is that O&M cost met by you? Say, through your own funds, or funds collected from households, or state government funds or a combination of all? If so, please provide break up for each source.	
5	Feasibility of private participation if any or proposal for PPP if any	
6	Was there any survey on "willingness to pay for better service" with households conducted by you at any stage of this project? If so, what was the outcome? Attach a copy of field report if any	
7	Mode of billing and collection of revenue – manual/fully computerized/partly computerized?	

5. COPIES OF THE FOLLOWING REPORTS, IF AVAILABLE, MAY ALSO BE PROVIDED FOR REFERENCE IN CASE YOU FEEL MOST OF THE ANSWERS ARE AVAILABLE IN THE REPORTS

a. Detailed Project Report
b. Financial Appraisal/Sanction Report
c. EIA Report/Environmental Clearances/Noncompliances reported by Pollution Control Board if any
d. Tender documents/specifications/Terms of Reference with flow sheet and layout plan, site plan, and so on
e. Completion certificates issued to contractors if any or Project Completion Report submitted to funding agency
f. O&M manual submitted by contractor if any
g. Monthly Status/Progress Report on O&M of sewer network +SPS+STP submitted by contractor
h. Report, if any, on field survey conducted at any stage of project regarding willingness to pay for better service

WSP, NEW DELHI

STUDY ON SEWERAGE SYSTEMS IN TAMIL NADU EXECUTED UNDER TNUDPIII

Questionnaire/Checklist for Data Collection from ULBs

PART B: FINANCIAL

The following information is required for our analysis on Tamil Nadu sewerage systems, preferably in the following format:

1. Sanctions

Type of sanction	Date	Value
Administrative sanction		
Technical Sanction		

2. Sanctions

Particulars	As in Administrative Sanction (INR in lakhs)	As in Tender (INR in lakh)	At Commissioning (INR in lakh)
Project Cost			
Cost of network			
Cost of STP			
Means of Finance			
Loans			
Grants			
ULB contribution			
Public contribution			

3. Final Loan Details

Particulars	Details	
Loan amount		
Rate of interest	(as in loan agreement)	
Tenor	(as in loan agreement)	
Annuity	(as in loan agreement)	

4. Deposit Collection

a. Number of households – at the time of commissioning of project
b. Number of households – currently connected
c. Number of households – applications pending

Particulars	Collection before tendering until commencement of procurement	Collection of deposits after tenders and up to construction	Collection of deposits after commencement of construction until commissioning	Collection of anticipated deposits after commissioning

Also, is there any subsidy provided to Schedules Caste, Schedules Tribe or economically weaker households? If yes,

a. How much subsidy is available per household?
b. Who bears the cost of the subsidy?
c. How many such households exist?
d. What is the total quantum of subsidy borne for deposits?

5. User Fee

a. Demand Collection and Balance (DCB) statement with respect to user fee

Slab rates–residential	At commencement	At commissioning	No. of customers

Also, is there any subsidy provided to Schedules Caste, Schedules Tribe or economically weaker households? If yes,

b. How much subsidy is available per household?
c. Who bears the cost of the subsidy?
d. How many such households exist?
e. What is the total quantum of subsidy burden per year?

6. Other Revenue Sources

1. Property tax collection (DCB/last five years' annual accounts)
2. Share for sewerage – percentage of property tax
3. Water charges – rate and actual collection (DCB/last five years annual accounts)

7. O&M Cost

Details	O&M Cost as in AS (INR Lakh)	O&M Cost at Commissioning (INR Lakh)

8. O&M Cost Break-up

Details	INR Lakh (as in DPR)	INR Lakh (as per Tender Award)	INR Lakh (at Commissioning)
Power			
Establishment			
Consumables			
Administrative expenses			
Others			

8.1 Who meets the cost of O&M – ULB or the state government? (Is the user charge adequate enough to meet O&M?)

9. Other Documents/Questions for Discussion

1. Council resolutions – user fee/deposits
2. Annual accounts for last five years with DCB statements
3. Basis for estimation of user charge
4. Bye-laws for sewerage system
5. Contract document – (i) collection system ; (ii) STP
   a. Power cost is whose responsibility?
   b. Operator's cost
6. Deposits – rationale/basis
7. Collection efficiency – user fee and deposits
8. Technology & its impact (CAPEX & OPEX)
   a. Cost/MLD – with old technology
      i. For STP
      ii. For network
   b. Cost/MLD - with the new technology identified
      i. For STP
      ii. For network
9. Tax/duty exemptions/benefits availed in the project?

Annex 4: Site Visit Reports

Major Observations at Site on each Schemes

1

Name of ULB/STP: **Karur**

Date of Visit to Site/STP: **26.08.2014**

Capacity of STP: **15 MLD with Extended Aeration**

A. General

a. The scheme was completed in the year 2007 with a delay of 15 months from schedule for various reasons.

b. The original area of the ULB was about 17 km^2 and was extended to about 53.26 km^2 (almost three times), whereas the target for HSC (15,000) was fixed under this project was aimed for the original area of Karur against the present level of households touching 64,631.

c. Only 37 percent of the targeted HSCs exist and are linked to the system (engineering progress is slower than that of financial progress).

d. The flow from few areas is not reaching the system owing to its topography with reverse gradients.

e. It is learnt from the ULB that the percentage of deposits collected is higher than that of HSCs officially reported as 37 percent (5,503 achieved out of targeted 15,000). Some unauthorized connections have been created by the public on their own in few wards and are being identified/ rectified and data are being updated to reflect the actual (matching physical and financial progress made). Actuals will be reported soon after providing HSCs to all those who deposited the amount. Hence, presently HSCs linked physically to the system are fewer than deposits and applications received from households. The ULB is targeting to achieve HSCs at the rate of at least 10 per week.

B. Observations on STP

- O&M of the system and STP is done by the ULB on its own. Percentage utilization of the plant is about 27 percent.
- Presently, the flow is about 4 MLD of 15 MLD and is bypassed at the SPS into open drains because floating aerators are taken out for repairs; action is being taken for inviting tenders.
- From records, it was revealed that the total cost of the scheme as per the tender was INR 2,399 lakh in the year 2002-03. The breakup of this total with regard to the collection system and STP are not available with the ULB.
- There is no land area available for future expansion at this site.
- Based on the data given by the ULB in the questionnaire for this study, the key parameters on an average are:

Footprint of plant = 0.68 acres; MLD and energy consumption = 49 kWh/MLD; total O&M cost is about INR 2.3/kL treated.

2

Name of ULB/STP: **Namakkal**

Date of Visit to Site/STP: **26.08.2014**

Capacity of STP: **5 MLD with MASP process**

A. General

- The scheme was completed with a delay of three years eight months from schedule for various reasons, one being the hard rock blasted for about 17,622 cubic meter.
- The area of the ULB was extended to about 55.24 km^2 (almost three times) whereas the target for HSC (13,000) fixed under this project aimed at the original area against the present level of households touching 43,510 after expansion/ merger.
- Only 55 percent (that is, 7,191 out 13,000) of targeted HSCs is achieved and linked to the system and, hence, half of the sewage does not reach the plant.

B. Observations on STP

- O&M of the STP is undertaken by the contractor of the STP appointed through the nodal agency, TWAD, as it is part of the turnkey contract on the STP.
- Presently, the flow is about 2.6 MLD of 5 MLD; the plant is operational and reported as meeting the standards prescribed. Hence, the percentage utilization of the plant is about 52 percent.
- As such, the plant was generally neat; there was not much screening of raw sewage, nor was there no odor and chlorine leakage smell. Almost all units were in working condition except the sludge dewatering system. It was reported that the plant was meeting effluent standards and values furnished.
- As such, operation of sludge handling was noticeably lacking. It was learnt that the dewatered sludge was disposed for compost with municipal solid waste and there were no supporting information/data records provided on this. No sludge digester/biogas recovery has been provided at present.
- Disinfection is done using chlorine, and polyelectrolytes are used for sludge dewatering.
- Based on the data given by the ULB in the questionnaire for this study, the key parameters on an average are:

Footprint of the plant = 0.44 acres; MLD and energy consumption = data not available; total O&M cost: data not available.

3

Name of ULB/STP: **Perambalur**

Date of Visit to Site/STP: **27.08.2014**

Capacity of STP: **4.2 MLD with ASP**

A. Perambalur

- The scheme was completed with a delay of 21 months (1.75 years) from schedule for various reasons.
- The area of the ULB was 20.6 km^2; the target for HSCs (10,344) was fixed under this project.
- About 71 percent (that is, 7,934 out 10,344) of the targeted HSCs was achieved and linked to the system.

B. Observations on STP

- O&M of the STP was undertaken by the contractor of the STP appointed through the nodal agency, TWAD, as it is part of the turnkey contract on STP.
- Presently, the flow is about 1.5 MLD of 4.2 MLD; the plant is operational and reported as meeting the standards prescribed. Hence, the percentage utilization of plant is about 36 percent.
- The plant was aesthetically pleasing; it was generally neat, there was not much screening of raw sewage, no odor and chlorine leakage smell. Almost all units were in working condition. It was reported that the plant was meeting effluent standards and values furnished.
- It was noted that sludge production was low. It was learnt that the dewatered sludge was disposed for compost with municipal solid waste and there were no supporting information/data records provided on this.
- Sludge digester/biogas recovery has been provided at present. It was reported that a meager quantity of biogas was generated and flared off.
- No energy recovery system has been provided in the original design itself.
- The area available for future expansion is 1.5 acres.
- Disinfection is done using chlorine, and polyelectrolytes are used for sludge dewatering.
- It was noted that the average annual consumption of polyelectrolyte is about 74 kilogram (kg).
- Based on the data given by the ULB in the questionnaire for this study, the key parameters on an average are:

Footprint of the plant = 0.44 acres; MLD and energy consumption = 237 kWh/MLD; total O&M cost: data not available.

4

Name of ULB/STP: **Kumbakonam**

Date of Visit to Site/STP: **27.08.14 but visit to STP site skipped due to nonavailability of time, hence only a desk study was done**

Capacity of STP: **17 MLD with ASP**

A. General

- The scheme was completed/commissioned in the year 2009 with a delay of about 15 months from schedule for various reasons.
- The area of the ULB is 12.56 km^2; the target for HSCs (15,382) was fixed under this project of total households of 17,058.
- As such the ULB has not provided clear information on the actual number of households from which deposits were collected. Hence, a comment on the progress on HSCs is reserved.

B. Observations on STP

- As the tenure of O&M by TWAD was just ending and the STP was handed over to the ULB by TWAD within a month of the visit, the ULB had finalized a separate O&M contractor.
- The ULB did not provide information on the present level of flow against a total capacity of 17 MLD, hence the percentage of utilization was not forthcoming.
- The site visit to this STP was not possible; however, observations from data analysis are:
  - Sludge digester/biogas recovery has been provided at present. However, no energy recovery system has been provided in the original design itself.
  - The BOD/Total Soluble Solids (TSS) values obtained through monitoring by the TWAD laboratory for the year 2013, furnished by the ULB, indicate that the sewage is diluted with regard to design values of BOD/TSS, and the plant is meeting the standards.
  - The area available for future expansion is 1.0 acres at same site.
  - No information/data were given on chemicals used and their consumption.
  - Based on the data given by the ULB in the questionnaire for this study, the key parameters on an average are:

Footprint of the plant = not given; energy consumption = 72 kWh/MLD; total estimated O&M cost for both sewer network +STP is INR 145 lakh/year.

5

Name of ULB/STP: **Mayiladuthurai**

Date of Visit to Site/STP: **27.08.14 but the visit to the STP site skipped due to nonavailability of time, hence only the desk study was done**

Capacity of STP: **8.3 MLD with WSP**

A. General

- The scheme was completed/commissioned in the year 2009 with a delay of about 18 months from schedule for various reasons.
- The ULB has not furnished any information regarding delay in construction and commissioning of the system.
- The area of the ULB is 11.27 km^2; the target for HSCs (10,728) was fixed under this project of which a total of 8,578 HSCs have been achieved.
- As such 80 percent of the HSC target has been achieved. Physical progress is slower than that of deposit collection as there is a delay in linking household.

B. Observations on STP

- Recently, the ULB has appointed a contractor for O&M of both the STP and network; the tender has been awarded for this.
- The site visit to this STP was not possible; however, observations from data analysis are:
  - The ULB has only provided data on raw sewage and treated sewage characteristics, which appear to be unusual and, hence, analysis on this performance of STP is omitted for want of validated data.
  - As it is a Waste Stabilization Pond process, there is no scope for energy recovery at present, and no chemical and power consumption for treatment reported.
  - The area available for future expansion is about 31.84 acres at the same site owned by the ULB and also for cultivating fodder crops/grass presently.
  - No information/data were given on chemicals used and their consumption.

Based on the data given by the ULB in the questionnaire for this study, the key parameters on an average are:

Footprint of the plant = not given; energy consumption = not significant as it is Waste Stabilization Pond process; total estimated O&M cost for both sewer network +STP is INR 92 lakh/year.

6

Name of ULB/STP: **Sivaganga**

Date of Visit to Site/STP: **28.08.14**

Capacity of STP: **7.38 MLD with EA**

A. General

a. The collection system has been completed except for the SPS with delay of about four years; the construction of the STP is yet to start.

b. About 95 percent of the deposits have been collected (6,448 of 6,778). There are no house connections that are physically linked as the STP is not yet ready in spite of the fact that street sewers/primary/secondary/pumping systems are all completed and ready for commissioning.

c. As such, the STP site is still under litigation at the National Green Tribunal; construction of STP has not started except for the compound wall. Hence, untreated sewage is flowing into open drains presently.

B. Observations on STP

- The site/land proposed for the STP is owned by ULB. A public interest litigation case against the STP site has been pending before the National Green Tribunal. O&M will be undertaken by the contractor as part of construction through TWAD, the nodal agency, for five years after completion.
- As such, there is no operational data on the STP and hence no further analyses on the O&M of units, and so on.

7

Name of ULB/STP: **Chinnamanur**

Date of Visit to Site/STP: **28.08.14**

Capacity of STP: **3.99 MLD with EA**

A. General

- The scheme was completed with a delay of 16 months (1.3 years) from schedule for various reasons.
- The area of the ULB is 25.98 km^2; the target for HSCs (4,650) was fixed under this project.
- About 50 percent of targeted HSCs are provided, deposits collected and linked to the system so far in spite of the fact that the street sewers, primary/secondary collection system and STPs are already completed and commissioned. It was reported that the STP is functioning and meeting the effluent standards.

B. Observations on STP

- O&M of the STP has been undertaken by the contractor of the STP appointed through the nodal agency, TWAD, as it is part of the turnkey contract on the STP.
- Presently, the flow is about 1.6 MLD out of 3.99 MLD and the plant is operational and reported as meeting the standards prescribed. Hence, percentage utilization of the plant is about 40 percent.
- The plant was aesthetically pleasing; it was generally neat, there was not much screening of raw sewage; however, the smell of chlorine was prevalent as there was a leakage on the day of the visit. All other units were in working condition except the centrifuge/sludge handling system. It was reported that the plant was meeting effluent standards and values furnished.
- With the given level of TSS being 760 mg/l in raw sewage brought down to 22 mg/l after treatment, there could be substantial solids removal, say, about 97 percent (that is, about 1.2 ton of solids removed daily); however, this was not evidenced to such an extent in the plant.
- As this is an EA process, assuming that sludge production is lower in the order of 0.1 kg/kg BOD removed, with the given BOD removal efficiency of 92 percent, solids produced must be at least 350 kg/day; this was not so evidenced in the plant and in the absence of data given by the ULB/contractor, further comments are reserved on this. However, it was noted that the sludge handling system is not being operated regularly and no record of polyelectrolyte/chemical/power consumption/number of hours of operation, and so on, in the log books were shown.
- There is no area available for future expansion at this site.
- Disinfection is done using chlorine, and polyelectrolytes are used for sludge dewatering.
- Based on the data given by the ULB in the questionnaire for this study, the key parameters on an average are:

Footprint of the plant = 0.38 acres; MLD and energy consumption = not given; total O&M cost: data not available.

8

Name of ULB/STP: **Thoothukudi**

Date of Visit to Site/STP: **29.08.14**

Capacity of STP: **24 MLD with MBR+RO**

A. General

a. The collection system has been completed except for the SPS with a delay of about five years. The construction of the STP is yet to start in PPP mode, the revised target date is March 31, 2015. The SPS is nearing completion.

b. About 95 percent of deposits have been collected (19,801 of 20,921) and no house connections are physically linked as the STP is not yet ready in spite of the fact that street sewers/primary/secondary/pumping systems are all completed. Hence, untreated sewage is flowing into open drains.

B. Observations on STP

- As such, there are no operational data on the STP and hence no further analyses on the O&M of units, and so on.
- In Thoothukudi, the proposed STP is located on the land/site owned by the Corporation. While the collection system was under implementation, the Corporation opted for the PPP mode of tendering for the STP of 24 MLD to ensure reuse/recycle of treated sewage and revenue. The Corporation was successful in this attempt and signed a concession agreement with a private corporate which will invest 100 percent in the DBFOT model through PPP. Therefore, the CAPEX sanctioned for the STP has not been utilized so far. This helped the Corporation to free itself from the interest burden and loan repayment liability.

Annex 5: Salient Features of Selected Schemes

Description	Karur	Namakkal	Perambalur	Kumbakonam	Mayiladuthurai	Sivaganga	Chinnamanur	Thoothukudi
1. Total Area of Municipality in km^2								
- Originally	17.29	N.A	N.A	12.56	11.27	6.97	25.95	N.A
- Presently with new areas merged	**53.26**	**55.24**	**20.59**	**12.56**	**11.27**	**6.97**	**25.95**	**90.66**
2. Total Number of Households								
- No. of Non Slum HH	579,61	40,500	7,978	BNA	15,329	12,860	10,020	11723
- No. of Slum HH	6,670	3,010	2,366	BNA	2,450	1,736	3,058	2777
Total	**64,631**	**43,510**	**10,344**	**17,058**	**17,779**	**14,596**	**13,078**	**14,500 (131,915)**
3. Total Number of Households Connected to Sewers/Deposits Collected								
- Non slum HH	4,843	7,042	7,125	BNA	BNA	BNA	2,301	BNA
- Slum HH	660	155	234	BNA	BNA	BNA	57	BNA
Total	**5,503**	**7,197**	**7,359**	**Not given**	**8,538**	**6,448**	**2,358**	**19,801**
4. No. of Sewer Connections Aimed at								
- Domestic	13,000	11,500	BNA	BNA	BNA	BNA	BNA	BNA
- Nondomestic	2,000	1,500	BNA	BNA	BNA	BNA	BNA	BNA
Total	**15,000**	**13,000**	**10,344**	**15,382**	**10,728**	**6,778**	**4,650**	**20,921**
5. Percentage of Progress in Collection Deposits/Providing HSCs against Target = Item 4/Item 5 in Percentage								
	37%	**55%**	**71%**	**Not given**	**80%**	**95%**	**51%**	**95%**
6. Total Length of Sewer Network Provided (km)								
	92.25	70.66	94.7	125	86.3	53.94	32.12	109.73
7. Size of Pipes (millimeter) and Material of Pipes Used								
Size(mm)	150 to 900	150 to 600	200 to 600	200 to 800	150 to 600	200 to 600	150 to 450 mm	150 to 450mm
MOC	SW/RCC/ PSC	SW/uPVC/ RCC	SW/RCC	SW/RCC	SW/RCC	SW/RCC	SW/RCC	SW/RCC uPVC/ PSC/CI
8. No. of Sewage Pumping and Lifting Stations								
As per DPR	NA	NA	4	10	8	2	No SPS, As it is 100% by gravity	NA
As constructed	3	6	5	10	8	2		12
9. Length of Pumping Mains								
As per DPR	NA	NA	3.1 km	NA	NA	4.38 km	NA	NA
As Provided	2.77 km	2.3 km	2.7 km	NA	7.78 km	4.38 km	As it is 100% by gravity	9.1 km

Description	Karur	Namakkal	Perambalur	Kumbakonam	Mayiladuthurai	Sivaganga	Chinnamanur	Thoothukudi
10. Design Capacity of STP								
	15 MLD	5 MLD	4.2 MLD	17 MLD	8.3 MLD	7.38 MLD (intermediate is 4.92 MLD)	3.99 MLD	24 MLD
11. Avg flow of sewage at present								
	4 MLD	**2.6 MLD**	**1.5 MLD**	**Not given**	**4.0 MLD**	**Construction of STP yet to start due to PIL pending @NGT)**	**1.6 MLD**	**Construction of STP yet to start as it is on DBFOT type through PPP**
12. Treatment Process								
	Extended Aeration	Modified ASP	Activated Sludge	Activated Sludge	Waste Stab Pond	Extended Aeration	Extended Aeration	**MBR with Reverse Osmosis**
13. Quality of Sewage as per DPR (mg/l)								
- Raw Sewage	BOD:300 TSS:500	BOD:280 TSS:350	BOD:280 TSS:350	BOD:280 TSS:350	BOD:280 TSS:350	BOD:300 TSS:450	BOD:300 TSS:900	BOD: 300 TSS: 550
- Treated Effluent	BOD:20 TSS: 30	BOD:20 TSS: 30	BOD:20 TSS: 30	BOD:30 TSS: 100	BOD:30 TSS: 100	BOD:20 TSS: 30	BOD:20 TSS: 30	BOD: <20 TSS: <30
14. Quality of Sewage (Average) at Present (mg/l)								
- Raw Sewage	Not available as Plant bye-passed	BOD:228 TSS : 214	BOD:150 TSS:360	BOD:195 TSS:150	BOD:32 TSS:108	Not available as plant is yet to be constructed	BOD: 240 TSS: 760	Not available as plant is yet to be constructed
- Treated Effluent		**BOD :21 TSS : 29**	**BOD:12 TSS: 16**	**BOD:30 TSS: 100**	**BOD:18 TSS: 96**		**BOD:18 TSS: 22**	
15. Disposal/Reuse of Treated Sewage								
	Into irrigation channel for agro use	Into irrigation channel for agro use	Into irrigation channel for recharging Agriculture wells	Into irrigation channel	On land for cultivating grass/fodder crops	On land for cultivating fodder crops	Open drain leading to tank-for agricultural use	Marine disposal and industrial use/recycling

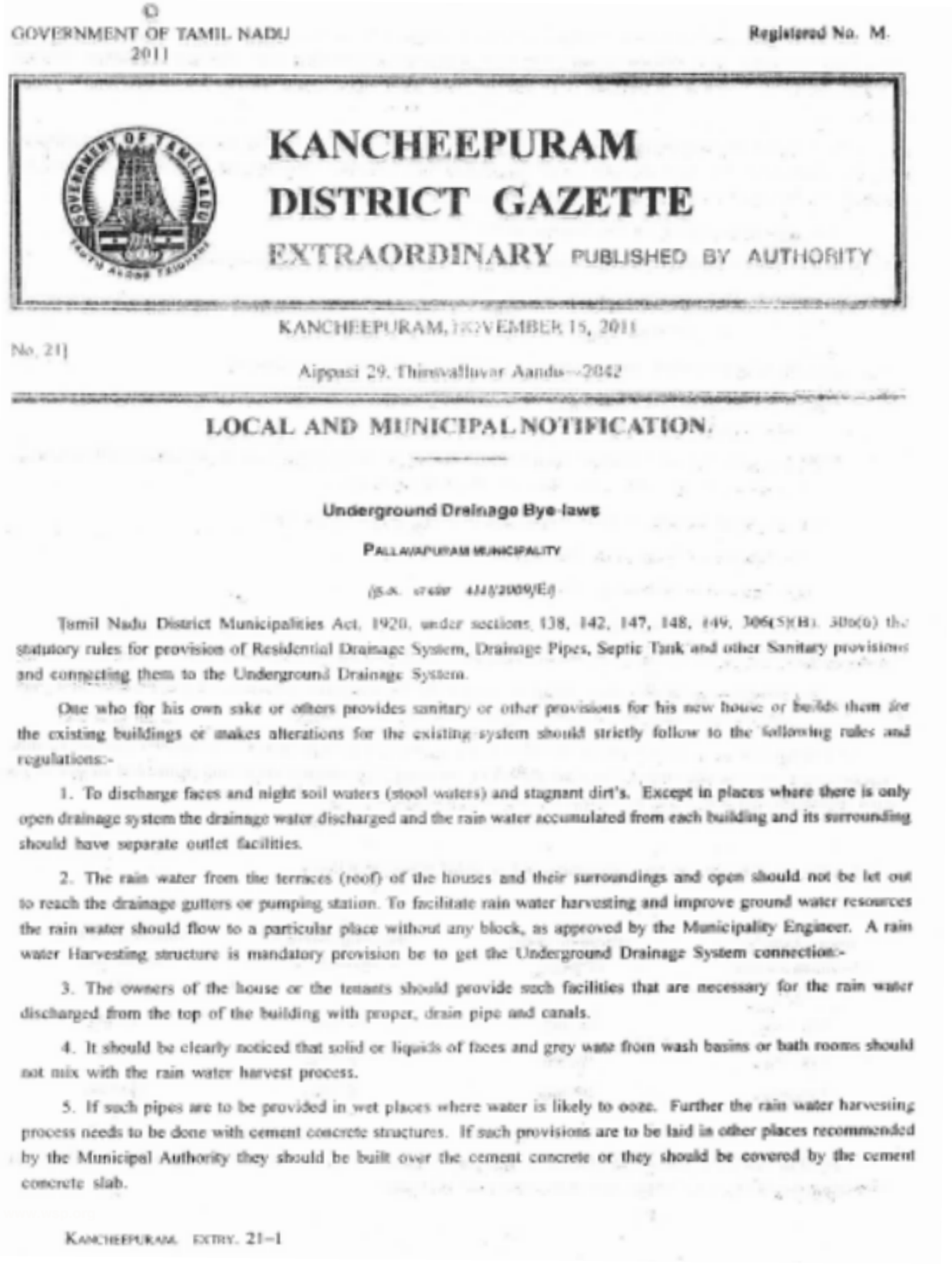
Annex 6: Sewerage Scheme being Implemented though PPP in Thoothukudi

The city of Thoothukudi is a rapidly expanding industrial town and a commercial hub for industrial import and export. The Thoothukudi Municipal Corporation (TMC) is responsible for providing water and sanitation services to a population of 3,76,439 (as per 2011 census). Before TMC began its current project, the construction of a 24 MLD wastewater treatment plant, facilities for water treatment were almost nonexistent in the city. TMC approached the CMA to help it undertake the project. The CMA, through a Transaction Advisor (CRISIL Risk and Infrastructure Solution Ltd), structured the wastewater treatment plant on a DBFOT basis. The project is being implemented on a PPP basis for a concession period of 30 years (including two years of construction), with the TMC responsible for providing land for construction and supply of sewage free of cost at the inlet. CMA would be free to sell the treated water to industrial units with a tariff structure of its choice during the concession period. The bidding parameter selected was a grant quoted for the project.

The developer selected for the project offered a negative grant to TMC, which was feasible, given the prevalence of saline water in the city limits, drinking water being procured from long distances, and high demand for industrial water with industries purchasing water from private suppliers at INR 65-70/kL.

The project will result in benefits for all stakeholders, ensuring that untreated sewage is not being discharged into the sea, thereby controlling water pollution resulting from rampant dumping of untreated sewage and providing industries access to a reliable alternate source of water.

Annex 7: Municipal Bye-Laws for the Town of Pallavaram



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Registered No. M.

KANCHEEPURAM DISTRICT GAZETTE

EXTRAORDINARY PUBLISHED BY AUTHORITY

KANCHEEPURAM, NOVEMBER 15, 2011

No. 21] Aippasi 29, Thiruvalluvar Aandu—2042

LOCAL AND MUNICIPAL NOTIFICATION.

Underground Drainage Bye-laws

PALLAVAPURAM MUNICIPALITY

(G.O. 4141/2009/E)

Tamil Nadu District Municipalities Act, 1920, under sections 138, 142, 147, 148, 149, 306(5)(B), 306(6) the statutory rules for provision of Residential Drainage System, Drainage Pipes, Septic Tank and other Sanitary provisions and connecting them to the Underground Drainage System.

One who for his own sake or others provides sanitary or other provisions for his new house or builds them for the existing buildings or makes alterations for the existing system should strictly follow to the following rules and regulations:-

1. To discharge faces and night soil waters (stool waters) and stagnant dirt's. Except in places where there is only open drainage system the drainage water discharged and the rain water accumulated from each building and its surrounding should have separate outlet facilities.

2. The rain water from the terraces (roof) of the houses and their surroundings and open should not be let out to reach the drainage gutters or pumping station. To facilitate rain water harvesting and improve ground water resources the rain water should flow to a particular place without any block, as appeoved by the Municipality Engineer. A rain water Harvesting structure is mandatory provision be to get the Underground Drainage System connection:-

3. The owners of the house or the tenants should provide such facilities that are necessary for the rain water discharged from the top of the building with proper, drain pipe and canals.

4. It should be clearly noticed that solid or liquids of faces and grey wate from wash basins or bath rooms should not mix with the rain water harvest process.

5. If such pipes are to be provided in wet places where water is likely to ooze. Further the rain water harvesting process needs to be done with cement concrete structures. If such provisions are to be laid in other places recommended by the Municipal Authority they should be built over the cement concrete or they should be covered by the cement concrete slab.

KANCHEEPURAM. EXTRY. 21—1

(a) The faces and the black water discharged from the latrines and the grey water from the kitchen, bathroom or other places should have two different separate pipe connections in all residential areas. The internal building structure should be designed in such a way that the faces and the black water alone should fall into the underground drainage canals.

6. Construction of drainage system with Stonewater or C.I. pipes. Those who lay drainages should use pipes of prescribed diameters. The inner diameter should not be less than 100 mm. The diameter limit should be above the approved one by the Municipal Engineer or above the level of the water discharged.

(a) The specification for the drainage gutter :-

The drainage should be in the pattern approved by the Municipal Engineer, as detailed below :-

Drainage of 100 mm inner diameter - 40 : 1

150 mm inner diameter - 80 : 1

If it is lesser than the prescribed norms approval of the Municipal Engineer is necessary.

(b) The drainage should be straight with a minimum number of bends in its course. suitable bend pipes and canals.

(c) Necessary inspection chamber should be provided at the points of junction and bends to enable for future inspection in the event of dry block or failure in the system.

(d) The following rules will be observed for granting connection for flats :-

(1) Up to four latrines-pipe 100 mm

(2) Above 4-8 latrines-pipe 150 mm

(3) Above 8 latrines-pipe 200 mm

In the event of increase in residence the norms prescribed by the Municipal Engineer should be followed strictly.

(e) For every residential flat occupied by owners the deposit, service charges and property tax must be collected separately from each and every owner of the apartments.

7. Drainage pipe connecting manhole should be round in shape, smooth surface, leak proof, rust proof, C.I. pipes, stoneware pipes or concrete pipes. The pipes should be plastered with cement mortar both inside and outside or the joints should be tight and strong to prevent any inflow or outflow of water.

8. The specification for pipe connection laid as stated above as follows :-

Inner Diameter Maximum volume. (1)	Minimum gauge of pipes. (2)	Minimum depth of the socket. (3)	Minimum volume of cement. (4)
100 mm	12 mm	50 mm	10 mm
150 mm	16 mm	57 mm	12 mm
250 mm	20 mm	70 mm	16 mm

Pipes like the connection pipes should in the proper from with proper curves forming perfect circular shape. These pipe should be of C.I. pipes, stoneware pipes or PVC pipes.

9. All kind of pipes connections should be perfectly fixed of spare parts approved by the Municipal Engineer.

When the concrete pipes are used in the drainage system the pipe joints must be sealed properly with cement sand mix of 1:1. In case of usage of C.I. pipes, the joints must be sealed with melted lead to the depth of 9.4 mm. If the pipe is 100 mm dia, the gap between two pipe joint must be not less than 10 mm.

10. There should be wooden barricade in the pit to avoid any damage to surrounding places.

(a) Every pipe should be properly laid strong, further strengthened by pouring water. Where the soil is porous and wet drainage pipe should be laid on bed of cement concrete and plastered around as prescribed by the Municipal Engineer.

(b) The design of above said drainage should be arranged in such a way that there should not be any in flow of water and the pressure resistance capacity must be prescribed. It must be got approved by the Municipal Engineer.

11. In addition to the air-holes for providing air every drainage should have a trap inside with a capacity to hold water level up to 50 mm. The trap may be either bell trap or dip trap.

12. The trap or the covering lid should be of the same specification approved and confirm to standard by the Municipal Engineer. The trap should be built on 100 mm concrete base with gratings of 2.5 cm. water level less than 31 cm. It should be below the path level and the path should be built slanting to the level of the grating.

13. There should be proper iron lids covering them to chek the in flow of surface water at street level into the drainage system.

14. Building pipe should not be connected with main drain pipe in a perpendicular or at same gradient level. In the event of connecting building drain to the main drain the building drain should run and connect linear angular path.

15. At no point the building drain should run under the building, in exceptional cases with following conditions:-

(a) All drainage should be built in such a way as they are in a straight line.

(b) The drainage pipe should be of C.I. pipe connected with lead or concrete pipes. They should be connected to the extent of 15 cm. with concrete.

(c) The drainage system under the building should have manhole arrangements have an open check.

16. When a drainage has to pass through or under a wall, a circular arch of RCC concrete or of iron strong enough to bear the weight of the drainage need to be built to safe guard the circular portion. But at no time should the arch binder the drainage. When a wall needs to be built over or around the drainage. Proper protection has to be made as narrated above.

17. Air facilities to the drainage:—For larger drainages or at the entrance of the tributary drainages trapless opening need to be provided. These opening should have free access to air without any trap or other such provisions. Every opening should be connected with the top of the drainage through a horizontal pipe. Such connections should be built as detailed below:—

(a) The connection should not end 6 meters below or above a window or entrace of any building.

(b) The connection that falls on the wall supporting the room should necessarily above 60 cm or more.

(c) Such connection should in no way be detrimental to the interests of the residents.

18. There should be hole without traps near the buildings as per the above rules at places where the engineer directs the connections to be made. The opening should be above but near the surface with connections for drainage pipes and tanks.

19. The gratings or ones made of other substances should be in relation to the diameter or top pipes enable free flow of air, without being smaller than the inner surface of the pipe, but with adequate holes.

20. Unless there is no other way, the pipes position should not be circular or angular but should strictly adhere to sub-rule 17. The pipes as stated earlier should have an inner diameter of not less than 100 mm the cover and edge should have been made of C.I. iron as per Indian Standard Specifications and they should be open to the provisions of air.

21. It will be considered that if the stoneware pipe of the water tank or in every respect of their location, cross section area, height and building pattern as per rule 18 they are supposed to have openings as per rule 20.

22. Pipes discharging the black and grey water should have an inner diameter of 40-50 mm and made of lead or cast-iron. They should be placed just below the level of the toilet with siphon arrangements. It should also be possible to open them in times of need and clean. Further no outer air should enter into it.

23. Every discharge pipe should be laid concealed along the outer wall and end at the open drainage of the canal. It should as far as possible be of short in length.

24. Every such pipe as stated above should be fixed concealed as desired by the Engineer. If the pipes are of cast iron they should have holder bats or handles suitably fixed at proper points.

25. The water tank, the drainage cell, their accessories of operation, the basins for black grey water, urinal and porcelain should all have connection with separate tubes of water. A side of the urinal should be the outer wall. No urinal or latrine should have access through a kitchen, store-room in use or machine rooms of factories. Normally they should have access through an open area.

26. Such urinal or latrine should have 125 cm. 85 cm as their minimum inner scale specifications. If they are located near the residential room of the house or machine rooms of a factory they should have a complete concealing wall or bricks and jelly from the top to the bottom. Such urinal or latrines should be built of smooth out with strong materials. The floor should be wet free from any water inflow. If they are built in a higher level they should have 13 mm to 30 cm and flow near at a distance of 0.05 mm. The floor level of any urinal or latrine should be 15 cm above the outer floor level. The urinals and the latrines should have doors with locking facilities.

27. There should be a window or an opening of 1,900 sq.cm. on one of the walls of the urinal and latrine. Air hole of 120 sq.cm. near the floor of 460 sq.cm. at higher level should be provided for free air flow.

28. Solely To clean the urinals or the latrines a twelve litre tank or if permitted by the Municipal Engineer a fifteen litre tank may be built there without room for water wastes. The tanks or its pipe should have no connection with drinking or other normal use water provision. The tank should be 1.5 meter abvoe the floor level where water is likely to fall.

29. Under no circumstances no automatic water discharge arrangements can be made in less a written permission is obtained from the Municipal Commissioner. In addition to the permission from the commissioner permission has to be got from the Municipal Commissioner for the plan of the construction informing him the details of the construction with the materials to be used. The plan needs to be modified as directed by the Municipal Engineer.

30. The pipes, connecting the basins of the discharged water and water from urinal or latrine, with lids and joints should have an inner minimum diameter of not less than 32 mm in all places and should be horizontal to the maximum extent possible.

31. The basin accessories for the urinal basin or latrine used should be similar to ones approved by the Municipal Engineer. They should satisfy the following conditions :-

(1) The shape model and capacity of the container :-

(a) It should contain enough water

(b) The faces discharged in the basin should move down freely to the water on its own. The urinal basin should as far as possible be small.

(c) It should be possible to have them clean completely with a little water.

(2) The basin should not be of the type of remove it out and clean it. If permitted as a special case alone, they should be connected directly with syphon arrangements. There should be water upto the level of not less than 51-1/2 mm between the drainage and the stonewater pipes. The outer mouth of the syphon should be except in extraordinary case, visible to the viewers.

(3) There should be provision to the flush the water in and discharge the water out.

(4) No basin, tank or other provision should be covered with lids of wood or any other thing.

32. Drainages pipes—The primary pipe carrying solid and liquid discharges should be far outside the buildings, as far as possible. They should have been made of cast iron or lead. If for some reason or other they have to laid inside the building they should be of melted lead; built with connections easily visible from outside. The Lead used should be strong. The inner diameter should be uniformaly 100 mm through out weighs 11 Kg per meter. If the diameter is 125 mm the weight may be 15 Kg. per meter C.I. pipes of the ends and the cover should have the Indian Standard Specification.

33. The base of the drainage pipe should be made of concrete and strongly connected. The C.I. pipes e used should have holder bats. It is enough these pipe should be connected with the proper provisions of the wall to the satisfaction of the Municipal Engineer.

34. If the lead of the drainage pipes, inside or outside should be away from the rain water pipes or other such pipes without contaminating them. There should be no traps between the heads of the drainage pipes and the outer drainage pipes.

35. The head of the drainage pipes should be of circular shape of not less than 50 mm diameter.Except where it is impossible the inner or outer pipes running high in a building should have a diameter of not less than 100 mm. They should be sufficiently be in a higher position with no curved or angular structure. Such pipes taken no higher levels should have a suitable opening to discharge the impure air. They should be in accordance with the provisions of the rule IV a, b and c.

36. The drainage pipes and other pipes discharging water if built over higher terrace they should be air tight and should be got tested in the presence of the Municipal Engineer one authorized by him smoke should be sent inside the pipe and got confirmed that or does not leak put anywhere.

37. Ventilation to urinal trap:—When an urinal is built, if the pipes of the urinal are connected with the trap lines of the drainage every trap should have facilities to let outer air in, it should be placed higher at the top time (head pipe) or at the top of the urinal line pipe whichever is at a higher level to enable free flow of air. The line connecting the trap and air pipe should face the pipe line carrying the water.

38. The air pipes should be of cast lead or iron as specified in rule 27 and fixed as stated in rule 29. If the pipes are to be laid inside a building it is enough they made of lead.

(1) If one for himself or for others builds drainage it should never be connected with the urinal built of mud, ash or the container of the waste.

(2) Open drainage:— If there is already an open drainage for the discharge of rain water or other discharged water, no permission will be granted for building a fresh open drainage for black water.

(3) A trap and a sand filter should be provided for every drainage of the house at places specified by the Municipal Engineer as per the instructions.

(4) The owner of the building should make every arrangement for the Municipal Engineer or his deputy to inspect all the aspected of the drainage pipes and traps.

(5) If one wants to build a drainage in a building or effect alteration for the existing ones he should apply with plan 30 days in advance by applying in the prescribed form obtainable paying rupees fifty.

(6) If the engineer suggests any alteration in the proposed plan a fresh plan should be prepared and got approved and such approved plan should be placed at the construction site.

(7) The work should commence within three days after the approval is obtained from the Municipal Engineer. After the permission is obtained, except for the final completion at the road end, all other work can be finished by the applicant.

(8) No one except the authorities of the Municipality should undertake drainage work without the prior permission of the Municipal Commissioner.

(9) One who builds, effects alteration or attends to work related to it in a drainage should pay in advance the due fixed deposit and service charges as detailed below (service of discharge of black and grey water):—

(a) Fixed Deposit :–

Residential	Rs. 10,000
Commercial	Rs. 20,000
Factories	Rs. 20,000

(b) Service Charges :–

Residential	Rs. 150 per month
Commercial	Rs. 450 per month
Factories	Rs. 750 per month

He should inform in writing the municipal authorities before 7 days of the details of open drainage, the foundation and other provisions and their readiness for inspection. He should also inform the date and time of the closure of the drainage work (for the quarters, rest houses or commercial agencies).

(10) No drainage pipes or other similar provisions should be connected with the municipal drainage unless and until they are inspected and certified to the effect that they are all in accordance with the rules and needs of the municipality, by the Municipal Engineer. Permission will be granted only on application for the connection by the copy of the order of approval. If it comes to the notice of the municipality that pollute water flows into the connection pipe or something, causes obstruction to the drainage, connection will be withdrawn.

(11) One who is desirous of connecting the drainage of his house with that of the municipality he should pay the expenses for it to the municipality. The amount so paid, will under no circumstances be refunded. A plan and estimate should also be given to the municipality for effecting the pipe connection. A further amount of 10 percentage of the estimate should also be paid before the construction starts towards supervisory charges.

38. (11) (1) the plan should contain the following :—

(a) it should be of 2 cm to one;

(b) An index plan of 1 : 10 should be drawn with the new drainage proposed and manhole marked in red and the existing ones marked in a different colour other than red. The correct addres, the door number and the name of the street should also be furnished.

(c) The cross diagram of the proposed connection should also be furnished;

(d) The approved building plan of the municipality also be enclosed with any application for drainage connection.

38. (12) Fines:—If one deviates from the above rules they will be subject to following punishments:—

(a) A fine of Rs.1,000 will be levied; or

(b) A further recurring fine of Rs.100 per day also be levied if one continues to deviate from the rules even after he receives a notice from the municipal authorities. An owner or a building on his behalf who starts construction in deviation to the rules of the municipality will be issued a notice by the Municipal Commissioner to remove, alter or demolish it on a particular day.

Contrary to the notice of the builder on the owner fails to justify his construction and represents its needlessness to remove orafter the municipality has the right to remove or alter demolish the construction and collect the charges for such acts from him. If one fails to abide by the conditions it is informed that he is liable for punishments stated above.

13. (1) In case of transfer of the right of the construction, the receipt of the payment of charges should also be transferred to the new names on proper application to the municipality. Otherwise such the connection will be considered illegal and additional service charges for connection and fixed deposit will be collected.

(2) An additional surcharge of 18% will be collected from the owner if the service charges are not paid within 15 days or the receipt of the notice from the Municipal Commissioner.

General Rules

1. No one should damage the drainage pipe knowingly or not.

2. No one take away or steal the lids of the manholes, police action will be taken against such persons.

3. The municipality has rights to take action as per the sub-rules against persons altering or damaging ventilation pipes for air facilities in the course of the drainage.

4. No pits for any erection of pandals or constructing building should be dug in the course of the drainage. If necessary they should do it only with the consent of the municipality. Otherwise a fine of Rs.1,000 will be levied against any unapproved action.

5. Any block in course of the drainage should immediately be intimated to the municipal authorities. They should under no circumstances dig any pit themselves creating any stagnation of water.

6. The rainwater or other drainage water should not enter the manholes breaking away the holes. Serious action will be taken against them and punishment up to a fine of Rs.1,000 will be levied when it comes to the notice of the municipal authorities.

7. No rubbish should be thrown out that would cover the manhole or their ventilation provision. Severe action will be taken against person who commit such and they liable to pay a fine of Rs.100 per day.

8. Things stated in sub-rule 6a brought by the builder need be scrutinized and approved on satisfaction of standard specifications and permission granted for drainage connection. On completion of the work the cover of the builder should apply in the prescribed form and connection permission obtained from the commissioner, engineer or an authorized official. After the work is over, the completion report duly signed by the competent person should be furnished to the municipality.

9. If without the knowledge of the municipality, any work of repair for damage, leakage of the extention of the service is undertaken against the sub-rules the license granted earlier will be cancelled, deposit forfeited and further proceedings initiated.

10. Every one who undertakes repair work in drainage system should produce the particulars of earlier sanction of its original construction for due scrutiny of the municipal authorities under proper acknowledgement.

11. All materials used and all works carried out are subject to the supervision charges of the Municipal Commissioner, Engineer or any authorized officer.

12. The pipes, Y bends, traps and other acessories used in drainage connection should be on par with the things kept in the office or store of the municipality satisfying the specification of the standard control authorities. No pipes, bend or other accessories not approved by the municipality should be made use of.

8

13. If the drainage connection needs to the discontinued or renewed the owner of the building should apply to the municipality in writing and no license should undertake it without prior permission.

14. One who does the drainage connection work or repairs without observing the sub-rules or regulations or if he does not obey the order of the municipal authorities or if the work if found to be unsatisfactory and brought to the executive officer or commissioner his license will be cancelled, fine levied and further proceedings undertake against him.

15. The estimate for drainage connection, repairs or extension should be an accordance with the sub-rules and other rules.

Punishment

Whoever deviates from the rules (even if a child deviates if he should be prevented from doing it) will be levied a fine of Rs.100 and in case of continued deviation or compound (daily) fine of Rs.100 will be levied and legal action through the police executed.

Pallavapuram,
Date:

Commissioner,
Pallavapuram Municipality.

APPLICATION FOR GETTING DRAINAGE CONNECTION
Form – A

To
The Commissioner,
Madhavaram Municipality.

Sir,

I am the owner / resident of Door No. ..... in the street given below, I request you to make necessary arrangements to get underground drainage connection.

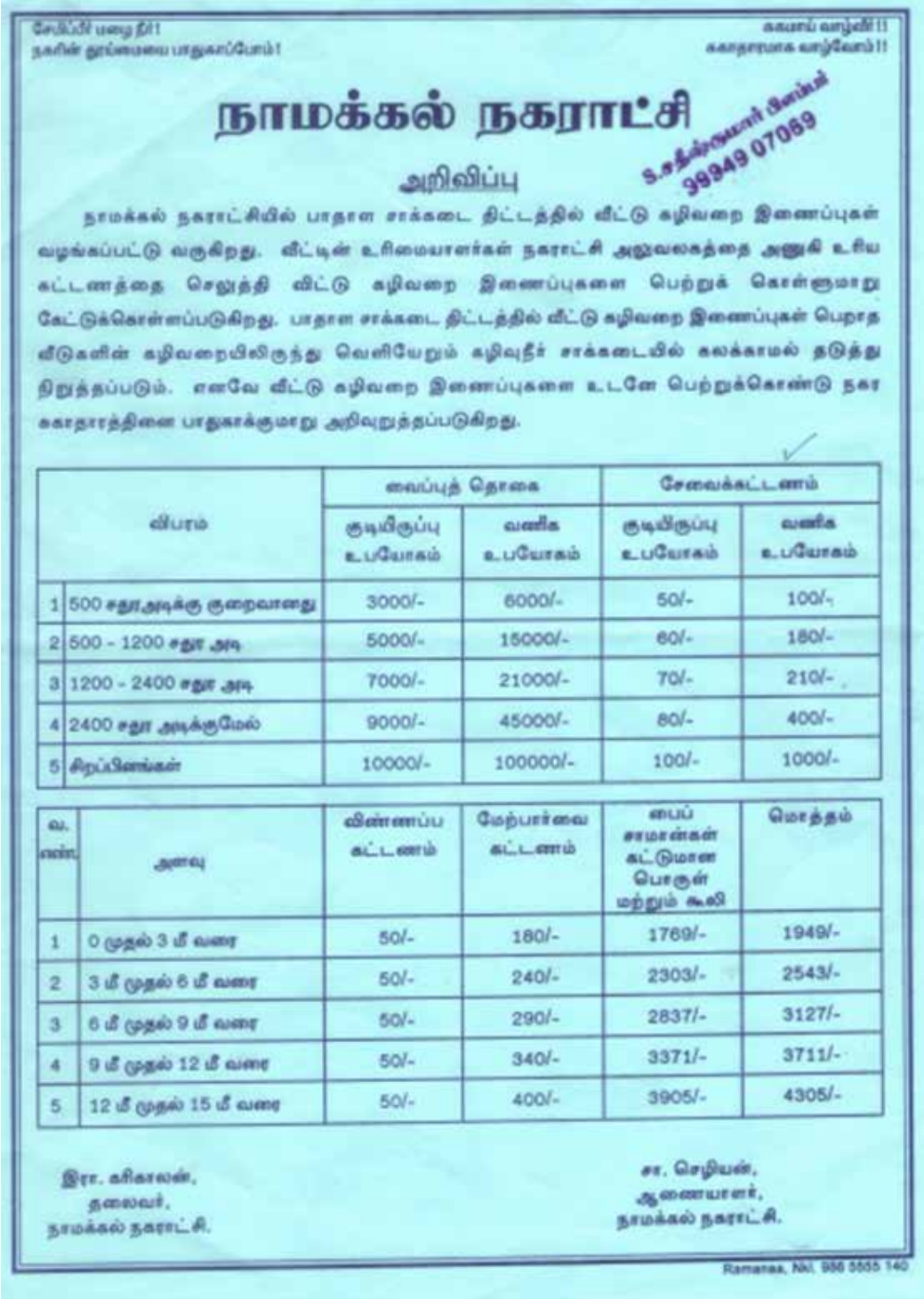
I hereby agree to remit security deposit and service charges as per the Rules. I hereby further agree to remit the cost and maintenance charges for the accessories for this purpose.

I hereby agree that if I / We desire to disconnect the above connection I will issue a notice before 30 days in writing to the Commissioner of Municipal Corporation.

(Signed)————
Commissioner

Pallavapuram.

Annex 8: Pamphlets and Communication Material Used by ULBs



சேமிப்பீர் மழை நீர்!
நகரின் நீர்மையை பாதுகாப்போம்!

சுகமாய் வாழ்வீர்!!
சுகாதாரமாக வாழ்வோம்!!

நாமக்கல் நகராட்சி

S.சதீஷ்குமார் மேஸ்திரி
99949 07059

அறிவிப்பு

நாமக்கல் நகராட்சியில் பாதாள சாக்கடை திட்டத்தில் வீட்டு கழிவறை இணைப்புகள் வழங்கப்பட்டு வருகிறது. வீட்டின் உரிமையாளர்கள் நகராட்சி அலுவலகத்தை அணுகி உரிய கட்டணத்தை செலுத்தி வீட்டு கழிவறை இணைப்புகளை பெற்றுக் கொள்ளுமாறு கேட்டுக்கொள்ளப்படுகிறது. பாதாள சாக்கடை திட்டத்தில் வீட்டு கழிவறை இணைப்புகள் பெறாத வீடுகளின் கழிவறையிலிருந்து வெளியேறும் கழிவுநீர் சாக்கடையில் கலக்காமல் தடுத்து நிறுத்தப்படும். எனவே வீட்டு கழிவறை இணைப்புகளை உடனே பெற்றுக்கொண்டு நகர சுகாதாரத்தினை பாதுகாக்குமாறு அறிவுறுத்தப்படுகிறது.

	விபரம்	வைப்புத் தொகை		சேவைக்கட்டணம்	
		குடியிருப்பு உபயோகம்	வணிக உபயோகம்	குடியிருப்பு உபயோகம்	வணிக உபயோகம்
1	500 சதுர அடிக்கு குறைவானது	3000/-	6000/-	50/-	100/-
2	500 - 1200 சதுர அடி	5000/-	15000/-	60/-	180/-
3	1200 - 2400 சதுர அடி	7000/-	21000/-	70/-	210/-
4	2400 சதுர அடிக்குமேல்	9000/-	45000/-	80/-	400/-
5	சிறப்பினங்கள்	10000/-	100000/-	100/-	1000/-

வ. எண்.	அளவு	விண்ணப்ப கட்டணம்	மேற்பார்வை கட்டணம்	பைப் சமான்கள் கட்டுமான பொருள் மற்றும் கூலி	மொத்தம்
1	0 முதல் 3 மீ வரை	50/-	180/-	1769/-	1949/-
2	3 மீ முதல் 6 மீ வரை	50/-	240/-	2303/-	2543/-
3	6 மீ முதல் 9 மீ வரை	50/-	290/-	2837/-	3127/-
4	9 மீ முதல் 12 மீ வரை	50/-	340/-	3371/-	3711/-
5	12 மீ முதல் 15 மீ வரை	50/-	400/-	3905/-	4305/-

இரா. ஸ்ரீகாலன்,
தலைவர்,
நாமக்கல் நகராட்சி.

சா. செழியன்,
ஆணையாளர்,
நாமக்கல் நகராட்சி.

Ramanaa, Nkl. 956 5555 140

சேமிப்பீர் மழை நீர்!
நகரின் தூய்மையை பாதுகாப்போம்!

சுகமாய் வாழ்வீர்!!
சுகாதாரமாக வாழ்வோம்!!

சின்னமனூர் நகராட்சி

அறிவிப்பு

சின்னமனூர் நகராட்சியில் பாதாள சாக்கடை திட்டத்தில் வீட்டு கழிவறை இணைப்புகள் வழங்கப்பட்டு வருகிறது. வீட்டின் உரிமையாளர்கள் நகராட்சி அலுவலகத்தை அணுகி உரிய கட்டணத்தை செலுத்தி வீட்டு கழிவறை இணைப்புகளை பெற்றுக்கொள்ளுமாறு கேட்டுக்கொள்ளப்படுகிறது. பாதாள சாக்கடை திட்டத்தில் வீட்டு கழிவறை இணைப்புகள் பெறாத வீடுகளில் கழிவறையிலிருந்து வெளியேறும் கழிவு நீர் சாக்கடையில் கலக்காமல் தடுத்து நிறுத்தப்படும். எனவே வீட்டு கழிவறை இணைப்புகளை உடனே பெற்றுக்கொண்டு நகர சுகாதாரத்தினை பாதுகாக்குமாறு அறிவுறுத்தப்படுகிறது.

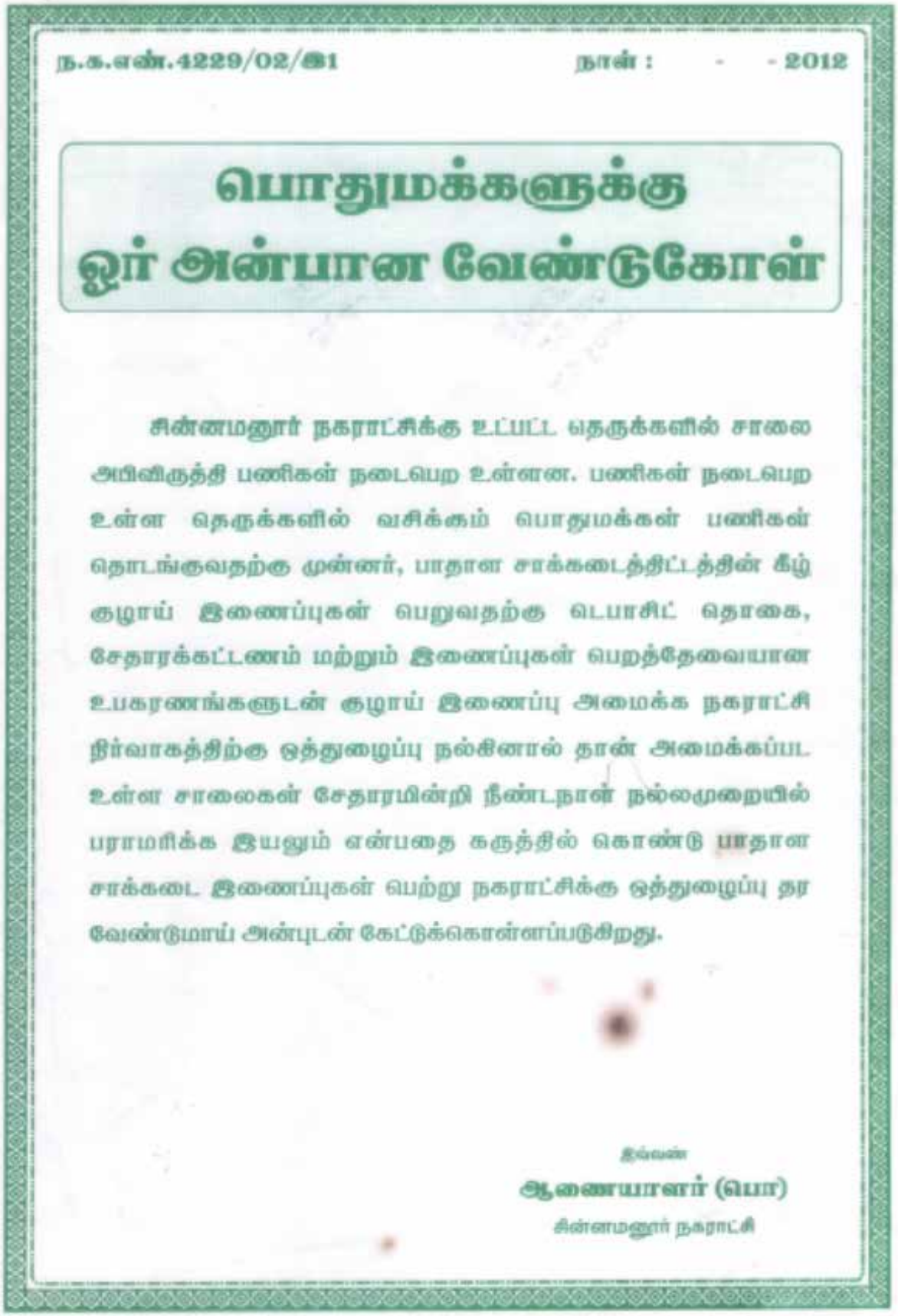
விபரம்		வைப்புத்தொகை		சேவைக்கட்டணம் மாதம் நகராட்சிக்கு செலுத்த வேண்டியது	
		குடியிருப்பு உபயோகம்	வணிக உபயோகம்	குடியிருப்பு உபயோகம்	வணிக உபயோகம்
1.	500 சதுர அடிக்கு குறைவானது	4000/-	8000/-	60/-	120/-
2.	500 -1200 சதுர அடி	5000/-	15000/-	70/-	210/-
3.	1200 -2400 சதுர அடி	7000/-	21000/-	80/-	240/-
4.	2400 சதுர அடிக்குமேல்	8000/-	25000/-	90/-	450/-
5.	சிறப்பினங்கள்	9000/-	100000/-	100/-	1000/-

வ எண்	அளவு	விண்ணப்ப கட்டணம்	பைப் சாமான்கள் கட்டுமான பொருள் மற்றும் கூலி	மொத்தம்
1.	0 முதல் 3 மீ வரை	400/-	1769/-	2169/-
2.	3 மீ முதல் 6 மீ வரை	400/-	2503/-	2943/-
3.	6 மீ முதல் 9 மீ வரை	400/-	2837/-	3237/-
4.	9 மீ முதல் 12 மீ வரை	400/-	3471/-	3871/-
5.	12 மீ முதல் 15 மீ வரை	400/-	4125/-	4525/-

P.சுரேஷ் M.A.,DFTNE.,
நகர்மன்றத்தலைவர்,
சின்னமனூர் நகராட்சி.

இதற்குமேல் பணம் வசூலித்தால் நகராட்சி நிர்வாகத்திடம் தெரிவிக்கவும்.

ஒப்பம்
ஆணையாளர்
சின்னமனூர் நகராட்சி.



ந.க.எண்.4229/02/இ1 நாள் : - - 2012

பொதுமக்களுக்கு ஓர் அன்பான வேண்டுகோள்

சின்னமனூர் நகராட்சிக்கு உட்பட்ட தெருக்களில் சாலை அறிவிருத்தி பணிகள் நடைபெற உள்ளன. பணிகள் நடைபெற உள்ள தெருக்களில் வசிக்கும் பொதுமக்கள் பணிகள் தொடங்குவதற்கு முன்னர், பாதாள சாக்கடைத்திட்டத்தின் கீழ் குழாய் இணைப்புகள் பெறுவதற்கு டெபாசிட் தொகை, சேதாரக்கட்டணம் மற்றும் இணைப்புகள் பெறத்தேவையான உபகரணங்களுடன் குழாய் இணைப்பு அமைக்க நகராட்சி நிர்வாகத்திற்கு ஒத்துழைப்பு நல்கினால் தான் அமைக்கப்பட உள்ள சாலைகள் சேதாரமின்றி நீண்டநாள் நல்லமுறையில் பராமரிக்க இயலும் என்பதை கருத்தில் கொண்டு பாதாள சாக்கடை இணைப்புகள் பெற்று நகராட்சிக்கு ஒத்துழைப்பு தர வேண்டுமாய் அன்புடன் கேட்டுக்கொள்ளப்படுகிறது.

இவண்

ஆணையாளர் (பொ)

சின்னமனூர் நகராட்சி

Annex 9: Cost Estimation Details for HSCs Provided by Karur Municipality

KARUR MUNICIPALITY

ESTIMATE FOR UGSS CONNECTION FOR 0 - 15 mtr BT Road

Sl.No	Qty	Description of Materials	Rate Rs. P	Per	Amount Rs. P
1	A	**Materials to be supplied by Party**			
	15	110mm PVC pipe 6ksc	194.00	M	2910.00
	2	110mm PVC Bend 6ksc	196.00	NO	392.00
	1	110mm PVC coupler	131.00	NO	131.00
		Total			**3433.00**
2	B	**Work to be done by the Municipality**			
	1.00	Cost of Taping the Main	200.00	NO	200.00
		Total			**200.00**
3	C	**Work to be done by the Party**			
	1.00	Construction of Inspection chamber	750	NO	750.00
	15.00	Laying of 110mm PVC pipe 6ksc	7.25	M	108.75
	1.01	BT Road cutting charge(15X0.45X0.15)	354.55	M^3	358.10
	5.06	Earth work for pipe line(15X0.45X0.75)	104.63	M^3	529.43
	6.07	Refilling charges(15X0.45X0.90)	13.00	M^3	78.91
		Total			**1825.18**
		ESTIMATE COST (A+B+C)			**5458.18**

(A+B+C) X 10/100=(3433+200+1826) X 10/100	=	Rs.	**547.00**
B	=	Rs.	**200.00**
Road restoration charge for BT Road upto 30m	=	Rs.	**2878.00**
TOTAL	=	Rs.	**3625.00**

(Rupees Three Thousand Six Hundred and Twenty Five only)

Overseer
Karur Municipality

Assistant Engineer
Karur Municipality

Municipal Engineer
Karur Municipality

Notes:

Notes:

Water and Sanitation Program
The World Bank
HT House, 18-20
Kasturba Gandhi Marg,
New Delhi 110001, India

Telephone: (91-11) 41479301, 49247601
E-mail: wspsa@worldbank.org

wsp
water and
sanitation program

WORLD BANK GROUP