# CHAPTER II

# PERFORMANCE AUDIT

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This Chapter contains findings of a Performance Audit on Sewage Management in Chennai Metropolitan Area.

## MUNICIPAL ADMINISTRATION AND WATER SUPPLY DEPARTMENT

## 2.1 Sewage Management in Chennai Metropolitan Area


***Executive Summary***

***Government made substantial investment in the expansion of the sewerage system in Chennai Metropolitan Area (CMA). Sluggish pace of project implementation and lack of comprehensive planning marred the prospect of achieving 100 per cent safe disposal of sewage in the near future. Audit came across multiple failures in realising the right value for the money spent due to lack of concern for economy, deficient planning and inefficiency in project implementation.***

- ***The prospect of achieving the goal set in National Urban Sanitation Policy and Tamil Nadu Vision 2023 for 100 per cent safe disposal of sewage was bleak.***
- ***As of March 2019, only 52 per cent of the sewage generated in CMA was collected by the existing sewerage system, leaving the remaining 48 per cent uncollected. Further, only 88 per cent of the collected sewage was treated before being let out.***
- ***Underground Sewerage System (UGSS) is provided in the entire erstwhile Chennai Corporation areas. But, UGSS were not provided in 31 out of the 42 areas newly added to the city in 2009, seven out of the eight municipal towns, 10 of the 11 Town Panchayats and all the 10 Panchayat Unions.***
- ***Deficient planning, lack of coordination with line departments, unjustified delays in tender approval and issues in contract management caused abnormal delays in completion of projects underway for expansion of sewer networks.***
- ***An estimated 242.73 million litre per day (mld) of raw sewage illegally entered storm water drains and drained into water bodies such as Adyar river, Buckingham Canal, Cooum river, etc. This had resulted in high pollution load of the water bodies in CMA. Projects sanctioned to address this issue had limited success.***

- ***Inadequate treatment capacity of sewage treatment plants (STP), non-functioning of primary clarifier units in two STPs and deficiencies in testing of treated water had adverse impact on the quality of sewage treatment.***
- ***The achievement in recycling and reusing treated water was only 6.5 per cent of the sewage generated against the prescribed benchmark of 20 per cent.***
- ***Five STPs without biogas power generation plant and three in which the plants were non-functional released an estimated 5.7 million cubic metre of environmentally dangerous methane gas per annum into atmosphere and simultaneously CMWSSB lost an opportunity to save on electricity bills.***

## 2.1.1 Introduction

Sewage means contents of water closets, latrines, bathrooms, kitchen, stables, cattle-sheds and other like places, and includes trade effluent. Sewage is the single major source of water resource contamination, contributing 75 *per cent* of the pollution load to water bodies and thereby adversely impacts human health and aquatic life.

Sewerage system means the system for collection, treatment and disposal of sewage. Sewerage system consists of house service connections, sewer lines, lift stations, pumping stations and sewage treatment plants. The objective of the sewerage system is to ensure that the sewage discharged by the community is properly collected, transported and treated to safe levels, and disposed off or reused without causing any health or environmental problems.

### 2.1.1.1 Chennai Metropolitan Area

The Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB), established in 1978, provides safe drinking water and safe disposal of sewage in Greater Chennai Corporation (GCC), spread over an area of 426 sq.km. Chennai Metropolitan Area (CMA), which encompasses GCC, is spread over an area of 1,189 sq.km in three districts *viz*., the whole of Chennai district, and parts of Kancheepuram and Tiruvallur districts. Other than GCC, 16 local bodies[1] in Kancheepuram district and 13 local bodies[2] in Tiruvallur district fall within CMA.

In 2009, Government of Tamil Nadu (GoTN) expanded Chennai Corporation's jurisdiction by annexing 42 adjacent local bodies which include nine municipalities, eight town panchayats and 25 village panchayats. The newly added areas of the City came under the jurisdiction of CMWSSB from October 2011.

[1] Five municipalities, seven town panchayats and four panchayat unions.

[2] One Municipal Corporation (Avadi), two municipalities, four town panchayats and six panchayat unions.

While it is the sole responsibility of CMWSSB to provide sewage management services in the expanded GCC area, in respect of other local bodies in CMA, CMWSSB is the nodal agency for implementing sewerage schemes.

#### 2.1.1.2 Sanitation Policy and goals

The National Urban Sanitation Policy (NUSP), 2008, emphasises the need for spreading awareness about sanitation through an integrated city-wide approach and recommends that each State and City need to formulate their own sanitation strategy and respective City Sanitation Plan in overall conformity to the National Policy. Government of India (GoI) fixed a target of treating 69 *per cent* of sewage by 2030 at all India level. In respect of urban areas, NUSP has set a goal that 100 *per cent* of human excreta and liquid wastes from all sanitation facilities including toilets must be disposed of safely. GoTN, in its Vision 2023 Plan, envisaged 100 *per cent* safe sanitation in all local bodies by 2023**.**

### 2.1.2 Organisational setup

The Additional Chief Secretary to the Government, Municipal Administration and Water Supply (MAWS) Department is the Head of the Department. Managing Director, CMWSSB is the executive head of CMWSSB assisted by Engineering Director, Executive Director, Finance Director and Chief Engineers. Organisational chart of CMWSSB is given in **Appendix 2.1**.

### 2.1.3 Audit Objective

Audit objectives were to assess whether:

- Adequate plans were formulated to augment sewage collection capacity, transportation, treatment and disposal system;
- Sewage discharged from communities were properly collected, transported and treated to the required degree in sewered and unsewered areas and
- Treated water was reused as a resource or safely disposed of to protect public health and environment.

### 2.1.4 Audit Criteria

Audit criteria were derived from the following sources:

- The Water (Prevention and Control of Pollution) Act, 1974;
- The Environment (Protection) Act, 1986;
- The Chennai Metropolitan Water Supply and Sewerage Act, 1978;
- National Urban Sanitation Policy 2008;
- Central Public Health and Environmental Engineering Organisation (CPHEEO) Manual and Handbook;

- Notification/Orders of Central Pollution Control Board and Tamil Nadu Pollution Control Board (TNPCB) and
- Government orders, Circulars and Master Plan of CMWSSB.

### 2.1.5 Scope and methodology of Audit

Audit was conducted from April to September 2019 covering five years period from 2014-15 to 2018-19. An Entry Conference was held on 10 April 2019 with the Additional Chief Secretary, MAWS Department. Audit objectives, criteria, methodology and sampling were discussed. On conclusion of the Audit, an Exit Conference was held with the Additional Chief Secretary, MAWS Department on 12 December 2019 to discuss the audit findings. This report was prepared after considering the deliberations in the meeting and the reply furnished (April 2020) by GoTN.

Audit examined the records at the Secretariat, headquarters and sampled field units[3] of CMWSSB and sampled local bodies[4]. Sampling was done by using simple random sampling method. List of sampled units is given in **Appendix 2.2**.

### 2.1.6 Physical Performance

The growth in sewerage network in CMWSSB during last 40 years was as given in **Table 2.1**.

**Table 2.1: Sewer network of CMWSSB**

| Details | As of 1979 | As of 2019 | Percentage increase over 40 years |
|---|---|---|---|
| Sewer consumers (Nos.) | 1,14,000 | 9,72,833 | *753* |
| Length of sewer mains (km) | 1,223 | 5,200 | *325* |
| Pumping stations (Nos.) | 58 | 266 | *358* |
| Treatment Plants (Nos.) | 3 | 12 | *300* |
| Treatment capacity (Million litre per day (mld)) | 57 | 727 | *1,175* |

(Source: CMWSSB)

The growth in sewer network outpaced the urban population growth rate of 180 *per cent* in the State. However, the achievements in terms of collection of sewage from source, treatment of sewage and safe disposal of treated sewage continued to languish as discussed below.

The CPHEEO estimated (2013) a requirement of 135 litres per capita per day (LPCD) of water in areas with Underground Sewerage System (UGSS) and 90 LPCD in areas without UGSS.

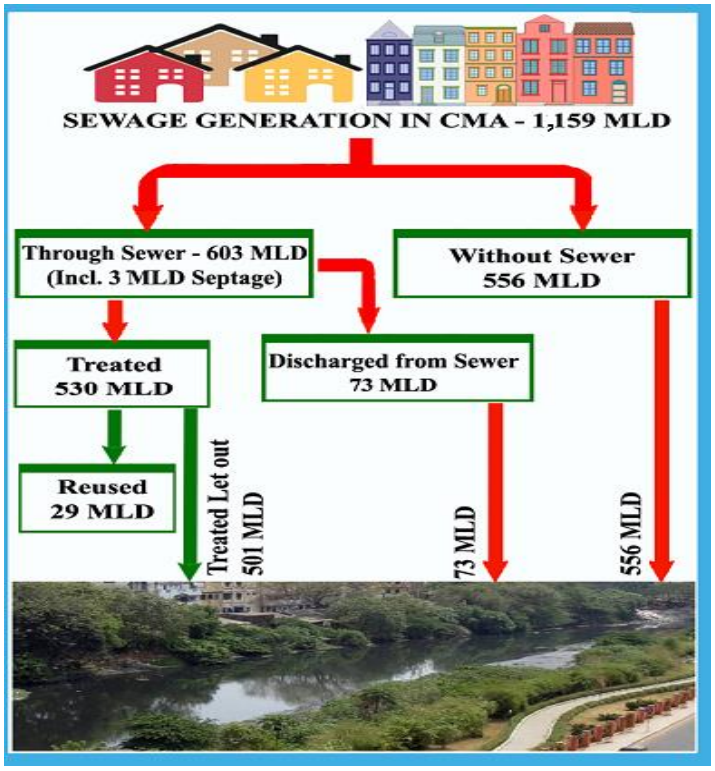
According to an estimate of CMWSSB, the sewage generated would be 85 *per cent* of the water consumed by residents. Based on the projected

[3] All Sewage Treatment Plants (12) and 10 *per cent* of Sewage Pumping Stations (28).

[4] Two Municipal Corporations, one Municipality, three Town Panchayats and three Panchayat Unions.

population data and the estimated sewage generation, Audit worked out that as of March 2019, only 52 *per cent* of the sewage generated in CMA was collected by the existing sewerage system, leaving the remaining 48 *per cent* uncollected. GoTN replied to Audit that the collection of 52 *per cent* sewage was based on theoretical calculations. The reply was untenable as the quantity of sewage generation is always worked out theoretically based on a scientific formula devised by CPHEEO; and similar theoretical calculations are routinely used by CMWSSB for calculation of sewage generated in different parts of the city. The fact that 48 *per cent* of the waste remained uncollected, was an indicator of the enormity and seriousness of the issue. Further, only 88 *per cent* of the collected sewage was treated before being discharged. **Exhibit 2.1** provides an insight into the physical performance in terms of sewage management in CMA.

**Exhibit 2.1: Physical Performance**




(Source: Information collected from CMWSSB)

### 2.1.6.1 Performance in terms of outcome indicators

Improved water quality in water bodies in and around the city is an indicator of better sewage management. However, as per Tamil Nadu Pollution Control Board's (TNPCB) water sample test reports, the water quality in the water bodies of CMA did not register significant improvement between 2006-07 and 2016-17 as given in **Table 2.2**.

Biological Oxygen Demand (BOD), which should not exceed three mg/litre in a river with bathing quality water, was in the range of 35 to 51 mg/litre in the rivers, streams and canals crisscrossing CMA. Similarly, Chemical Oxygen Demand (COD), which should be below 20 mg/litre in unpolluted surface

water was in the range of 151 to 363. Total Suspended Solids (TSS), a measure of turbidity had also increased over the ten year period.

**Table 2.2: Water quality in city's water bodies**

**(Mg/L)**

| River/Stream/Canal | BOD | | COD | | TSS | |
|---|---|---|---|---|---|---|
| | 2006-07 | 2016-17 | 2006-07 | 2016-17 | 2006-07 | 2016-17 |
| Adyar | 27 | 35 | 148 | 151 | 40 | 57 |
| Cooum | 49 | 45 | 212 | 363 | 63 | 94 |
| Buckingham canal | 58 | 51 | 250 | 236 | 87 | 76 |
| OtteriNullah | 41 | 50 | 199 | 155 | 80 | 77 |

(Source: CMWSSB)

The largely unchanged quality of water in the rivers, streams and canals of CMA pointed to poor outcome of sewage management in CMA despite substantial investment and increase in the sewerage network.

### 2.1.7 Financial Performance

Under the Chennai Metropolitan Water Supply and Sewerage Act, 1978, the Board of CMWSSB, headed by the Minister concerned, has full powers on financial matters including approval of budget and expenditure sanction. In addition to its own revenue, CMWSSB receives funds under various schemes[5] of GoTN and GoI for implementation of sewerage projects. Local Bodies also meet a part of the cost of projects based on their financial position.

The capital budget of CMWSSB, source of funds and actual expenditure during 2014-19 are given in **Table 2.3**.

**Table 2.3: Details of Budget, Sources and Application of funds - CMWSSB**

**(₹ in crore)**

| Year | Budget Estimate (BE) for projects | Fund actually received for projects (source-wise) | | | | Actual expenditure (percentage to BE) |
|---|---|---|---|---|---|---|
| | | GoI | GoTN | Loans | Total | |
| 2014-15 | 655.94 | 33.30 | 275.23 | 8.36 | 316.89 | 106.70 (*16*) |
| 2015-16 | 925.93 | 0.10 | 359.82 | 0.04 | 359.96 | 240.96 (*26*) |
| 2016-17 | 718.27 | 26.00 | 327.23 | 0 | 353.23 | 233.05 (*32*) |
| 2017-18 | 427.14 | 60.85 | 256.14 | 3.62 | 320.61 | 244.54 (*57*) |
| 2018-19 | 377.92 | 50.98 | 159.01 | 50.00 | 259.99 | 419.16 (*111*) |
| **Total** | **3,105.20** | **171.23** | **1,377.43** | **62.02** | **1,610.68** | **1,244.41 (*40*)** |

(Source: CMWSSB)

[5] Chennai Mega City Development Mission, Tamil Nadu Investment Promotion Programme, Japan International Cooperation Agency (JICA) funded schemes, Tamil Nadu Urban Development Project-III, Tamil Nadu Sustainable Urban Development Project, Smart City Mission, Infrastructure and Amenities Fund, Integrated Cooum River Eco Restoration Projects, Jawaharlal Nehru National Urban Renewal Mission (JNNURM), Atal Mission for Rejuvenation and Urban Transformation (AMRUT), etc.

As could be seen from **Table 2.3**, during 2014-19, CMWSSB could spend only 40 *per cent* of the budgeted outlay on capital projects. Further, the expenditure of ₹ 1,244.41 crore on projects during the period was only 77 *per cent* of the actual receipt of ₹ 1,610.68 crore from funding sources for project implementation.

Audit found that all projects of CMWSSB witnessed delay as discussed in this report, leading to poor utilisation of project funds.

### 2.1.8 Expansion of sewerage network

The Action Plan for Chennai City Sewerage network under Twelfth Five Year Plan envisaged provision of sewerage network in all areas of GCC by 2017. Audit, however, found that as of November 2019, while UGSS was provided in the entire erstwhile Chennai Corporation areas, only 11 of the 42 areas newly added to the city in 2009 were provided with UGSS. Further, only one out of the eight Municipalities/Corporations in CMA had a functional UGSS. Areas under only one of the 11 Town Panchayats and none of the 10 Panchayat Unions had a functional UGSS as of September 2019. Audit found issues in comprehensive planning and funding, and poor pace of project execution.

#### 2.1.8.1 Planning for sewage schemes

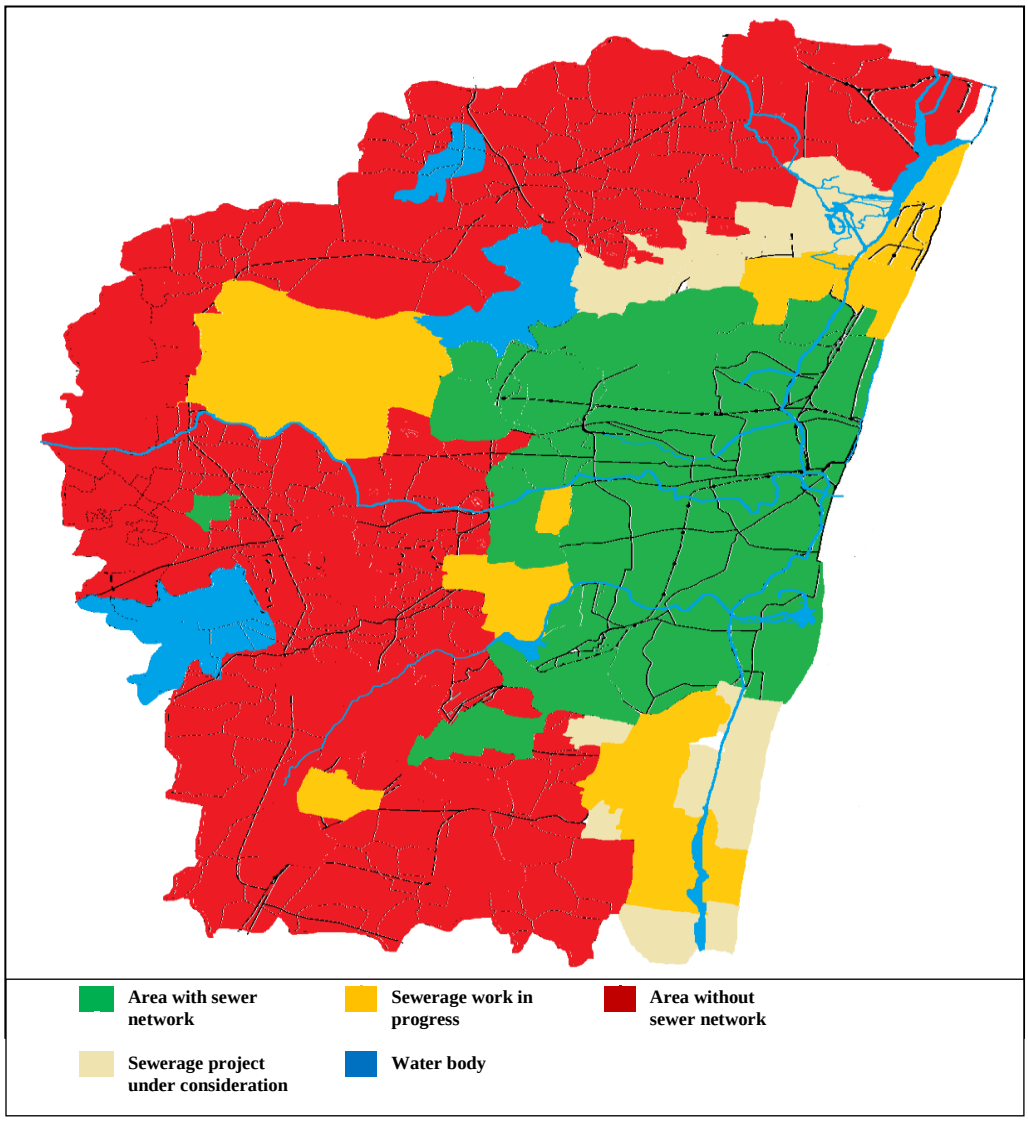
***Non-formulation of sanitation strategy and City Sanitation Plan***

The National policy recommends that each State and City need to formulate their own sanitation strategy and City Sanitation Plan (CSP) in overall conformity with the National Policy. CSP was to prioritise and plan area specific projects. Audit, however found that the sanitation strategy and CSP were not formulated for addressing the challenges of city sanitation. GoTN stated (April 2020) that the policy and strategy on sewage management were based on the Master Plan of CMWSSB. Audit observed that as the jurisdiction of CMWSSB was the area under GCC limits only, the master plan did not incorporate CMA level strategy. Non-availability of sanitation strategy and CSP for CMA adversely impacted the decisions on expansion of sewerage networks.

#### 2.1.8.2 Inordinate delays in completion of UGSS projects

As of September 2019, (i) works on provision of UGSS was in progress in 14 newly added areas of GCC and in two other local bodies in CMA **(Appendix 2.3)** at an estimated cost of ₹ 1,252.05 crore, (ii) Detailed Project Reports (DPR) were approved or under preparation in respect of 12 more added areas of GCC and six local bodies in CMA and (iii) there was no proposal under consideration in respect of five added areas of GCC and 19 other local bodies in CMA. **Exhibit 2.2** illustrates the status of UGSS in CMA.

**Exhibit 2.2: Coverage of sewer network in CMA**




(Source: Based on data furnished by CMWSSB)

The status of ongoing UGSS projects are given in **Appendix 2.3** and an abstract of those projects which are delayed beyond the scheduled date of completion are given in **Table 2.4**.

**Table 2.4: Delayed UGSS works in progress**

| Name of the Local body | Number of UGS schemes | Estimated cost | Expenditure | Delay in completion of UGSS | |
|---|---|---|---|---|---|
| | | (₹ in crore) | | 3 to 5 years | 5 to 10 years |
| Added areas of GCC | 7* | 513.79 | 371.39 | 2 | 5 |
| Municipalities - Avadi and Tambaram | 2 | 319.02 | 299.06 | 1 | 1 |
| **Total** | **9** | **832.81** | **670.45** | **3** | **6** |

* Two added areas *viz*., Sholinganallur and Karapakkam came under a single scheme

(Source: Monthly Progress Report of CMWSSB)

Audit scrutiny of UGSS projects show that these projects are plagued by abnormal delays, mainly due to

(a) deficiencies in contract management, wherein contractors for pipeline and STP works, were retained despite poor output as discussed in **Paragraphs 2.1.8.2 (ii), 2.1.8.2 (iii) and 2.1.8.2 (iv)**,

(b) lack of co-ordination with line departments, especially in digging of roads for laying of sewer pipelines, as discussed in **Paragraphs 2.1.8.2 (ii), 2.1.8.2 (v) and 2.1.8.2 (vi) (a)**,

(c) poor planning and faulty technical designs, as discussed in **Paragraphs 2.1.8.2 (i), 2.1.8.2 (ii), 2.1.8.2 (iii), 2.1.8.2 (iv)** and **2.1.8.2 (vi) (d)**, and

(d) ineffective handling of issues connected with encroachment of work sites as commented in **Paragraph 2.1.8.2 (iv)**.

Specific failures in implementation of the projects are discussed below:

### *(i) Porur UGSS*

Porur is one of the 42 areas newly added to GCC in 2009. Details of Porur UGSS and its status as of May 2020 were as given in **Table 2.5**.

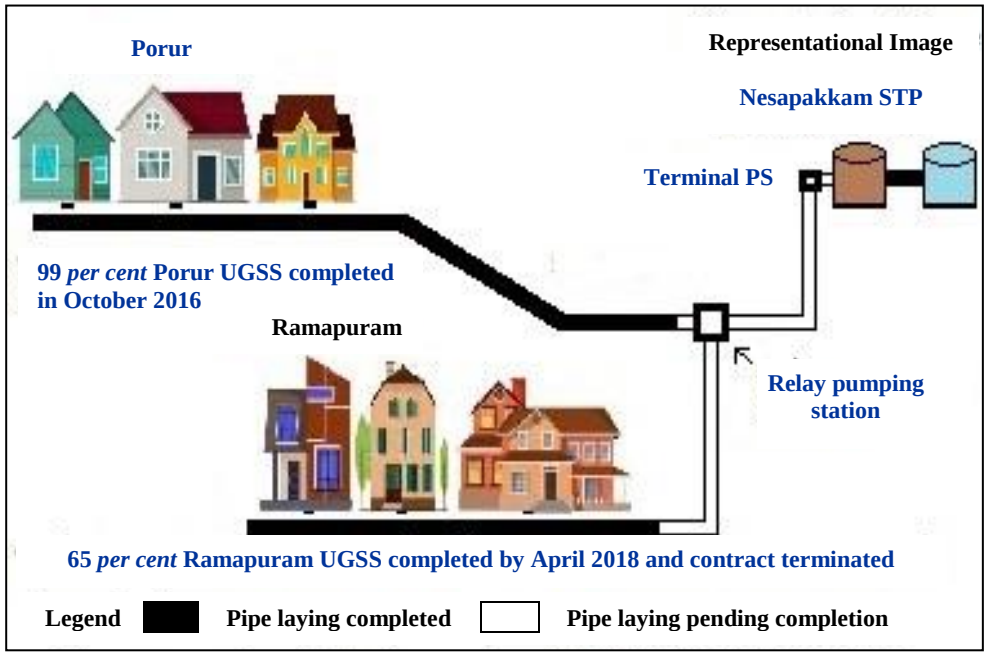
**Table 2.5: Details and present status of Porur UGSS**

| | |
|---|---|
| **Administrative sanction** | July 2009/₹ 38.29 crore |
| **Technical sanction** | ₹ 40.87 crore |
| **Project components** | Collection system, Pumping mains and Sewage Pumping Stations (SPS). |
| **Population benefitting** | 28,924 (2011 census) |
| **Contract value** | ₹ 34.42 crore |
| **Work commencement** | September 2010 |
| **Schedule date for commissioning** | September 2012 |
| **Number of extensions of time (EOTs) granted and penalty imposed** | 11 EOTs , ₹ 5 lakh |
| **Total expenditure incurred** | ₹ 37.77 crore (till pre-closure in October 2016) |
| **Present status** | Not commissioned. 99 *per cent* completed<br>(All works except commissioning were completed in October 2016) |

(Source: Data collected from CMWSSB)

While the work was in progress, in October 2012, CMWSSB prepared a DPR for providing UGSS in Ramapuram, an area abutting Porur. At that stage, CMWSSB altered the original design for the pumping mains of Porur UGSS and to connect it with the terminal pumping station and pumping main of Ramapuram UGSS, so as to carry the sewage collected from both these areas through a single pumping main to the STP at Nesapakkam **(Exhibit 2.3)**.

**Exhibit 2.3: Illustrative diagram of Porur and Ramapuram-Manapakkam UGSS**




(Source: Based on maps of CMWSSB)

After a delay of four years, consequent on 11 EOTs granted to the contractor due to delay on his part, all works under Porur UGSS were completed by October 2016. The project, however, could not be commissioned till date (May 2020) due to delay in completion of pumping main works and terminal pumping station forming part of Ramapuram UGSS, as discussed in **Paragraph 2.1.8.2 (vi) (d)**.

Audit observed that both Porur and Ramapuram were added to GCC in 2009. The policy being provision of UGSS in the entire GCC area, CMWSSB should have planned to provide common terminal pumping station and common mains of adequate capacity at the time of planning Porur UGSS itself.

Due to lack of comprehensive planning, an estimated 7.9 mld of sewage generated in Porur area was not collected and treated. GoTN replied (April 2020) that pending completion of Ramapuram UGSS, a plan to carry the sewage from Porur area through an alternative alignment at a cost of ₹ 1.47 crore was in tender stage. The reply pointed to an avoidable liability of ₹ 1.47 crore due to poor planning and slow progress of Porur UGSS work in addition to non-realisation of the benefits of the scheme for nearly eight years.

### *(ii) Thiruvottiyur UGSS*

The erstwhile Thiruvottiyur Municipality was added to GCC in 2009. Details and status of the works as of May 2020 are given in **Table 2.6**.

**Table 2.6: Details and present status of Thiruvottiyur UGSS**

| | |
|---|---|
| **Administrative sanction** | February 2004 - ₹ 28.55 crore (RAS - December 2009 - ₹ 87.63 crore) |
| **Technical sanction** | September 2006, January 2011 (Revised) |
| **Project components and Number of packages** | Collection system, Lift stations and SPS in Package I to IV, Pumping main from SPS to STP in Package V and STP in package VI. |
| **Population benefitting** | 2,11,436 (2011 census) |
| **Contract value** | ₹ 55.71 crore |
| **Issue of work order** | Between March 2007 and October 2010 |
| **Schedule date for commissioning** | November 2008 - March 2013 |
| **Number of EOTs granted** | 42 (5 to 11 EOTs to different contactors) |
| **Penalty levied on contractors** | ₹ 2.79 crore |
| **Expenditure incurred** | ₹ 56.04 crore (as of September 2019) |
| **Present status** | Not commissioned. Packages I-V completed. Package VI (STP) is in progress. |

(Source: Data collected from CMWSSB)

Deficiencies in implementing the project are discussed below:

- **Packages I & II** of the project suffered initial delay of five to twelve months in handing over the sites for SPS. Further, as per the original plan, the sewage from the areas covered under these packages was to be led into the existing sewer mains of neighbouring areas. Only when the project was under execution, it was found that the existing sewer mains were at a shallow depth which necessitated provision of a lift station and consequent delay in linking the sewer lines. While all sewer lines under these packages were completed by December 2016, the work on lift station which was omitted in the original plan, was still under progress (May 2020).
- **Package III** got delayed due to redesigning components of the work on account of road upgradation. All works under the package were completed by February 2016, with a delay of over seven years.
- **Package IV** got delayed initially by four years due to legal dispute over the site selected for lift station. All works under the package were completed by March 2018, with a delay of over nine years.

- **Package V,** involving pumping main from terminal SPS to the STP, was foreclosed in November 2008 due to change in the alignment warranted by the change in the location of STP, and inordinate delay in getting permission for carrying pipelines underneath railway lines. The work was retendered by CMWSSB (May 2010) and completed by May 2015, against the targeted completion in June 2012. The delay of three years was due to slow progress of work covered by five EOTs on account of site conditions which included an ongoing road widening work and delay in obtaining permission for railway line crossings.

- ***Thiruvottiyur STP Package*:** The site identified for the STP was changed twice; first due to issues in getting clearance under Coastal Zone Regulations, and second time due to public protest as the identified site was a burial ground. The third site identified and handed over (March 2011) to the contractor was a garbage dumping ground with about 10 feet of garbage pile up. The contractor, *inter alia*, cited the delay in handing over the site as the reason for delay and the same was accepted as one of the reasons for repeated EOTs. Audit, however, observed that the delay was unjustified as the contractor had not completed the work even after nine years of handing over of the site. CMWSSB had allowed 10 EOTs to cover the delay and levied penalties totaling to ₹ 1.10 crore. As of April 2017, 97 *per cent* of the work was completed, but the work did not progress thereafter. In July 2019, CMWSSB decided to study the possibility of upgrading the technology used in the STP from the Activated Sludge Processing (ASP) technology into Sequencing Batch Reactor (SBR) technology[6]. This proposal was under consideration to meet the new (April 2019) norms. No further progress was made (March 2020).

- As per CPHEEO Manual, the STP work should be scheduled before the pipe line works, so as to synchronise the different packages. CMWSSB, however, scheduled the packages for sewer lines before the scheduled completion of STP. As a result, the pipeline works in five packages were fully completed, but the project could not be commissioned as the STP was not ready.

Thus, due to failures in planning and scheduling, lack of effective coordination in land allocation and handing over site and granting unjustified EOTs, the project sanctioned administratively in 2009, could not be commissioned even as of March 2020. As a result, (i) even seven years after the scheduled date of completion, an estimated 16.14 mld of sewage generated in that area was not collected for treatment and (ii) 2,620 manholes of the Thiruvottiyur UGSS,

[6] Both the technologies primarily use aeration and aerobic microorganisms to digest organic matter in the sewage. SBR is a relatively newer technology with better treatment at lower cost by processing the sewage in batches in the same tanks.

constructed long back without synchronising with the construction of STP, got buried due to relaying of roads. CMWSSB had to incur ₹ 1.44 crore for tracing and raising these manholes.

GoTN accepted the facts and stated (April 2020) that the contractor met with financial crunch and consequently could not show any progress in work. The reply was untenable as CMWSSB had termed the performance of the contractor as poor in May 2013 itself, but the contractor was given repeated EOTs leading to the abnormal delays. Further GoTN did not explain the indecisiveness in respect of the technology to be used in the STP, which caused further delay.

### *(iii) Avadi UGSS*

Avadi is a western suburb of GCC. Details and status of completion of the works of Avadi UGSS, as of May 2020, were as given in **Table 2.7**.

**Table 2.7: Details and stage of Avadi UGSS**

| | |
|---|---|
| **Administrative sanction** | April 2008, ₹ 158.07 crore |
| **Technical sanction** | July 2008. June 2012 (revised)/₹ 193.88 crore |
| **Project components and Number of packages** | Collection system, HSC, Pumping mains and SPS in Package I to VI, two STPs (36 mld + 4 mld) in package VII and an effluent pumping station and pumping mains in package VIII. |
| **Population benefitting** | 3,80,000 |
| **Contract value** | ₹ 173.53 crore |
| **Issue of work order** | Between December 2008 and November 2011 |
| **Schedule date for commissioning** | Between February 2011 and April 2014 |
| **Number of EOTs granted** | 41 (3 to 10 EOTs to different contractors) |
| **Penalty levied on contractors** | ₹ 40 lakh |
| **Expenditure incurred** | ₹ 173.62 crore (as of September 2019) |
| **Present status** | Collection system is completed. Not yet commissioned due to non-completion of STP. |

(Source: Data collected from CMWSSB)

All packages except the STP were completed between August 2013 and July 2017, after a delay of two to three years and 32 EOTs. The work on the 36 mld Paruthipattu STP scheduled to be completed in April 2014 was still under progress (May 2020).

- Award of contract for the 36 mld STP (Package VII) got delayed primarily due to change in the mode of disposal of treated sewage. The project was approved under Jawaharlal Nehru National Urban Renewal Mission (JNNURM), with a condition to discharge the treated sewage into an adjoining lake. CMWSSB, on the insistence (July 2010) of TNPCB, revised the design to let out the treated sewage into the Cooum river. The change in design, contrary to JNNURM conditions and CPHEEO guidelines, involved an

additional expenditure of ₹ 5.74 crore. The contract awarded in November 2011 was scheduled to be completed in April 2014. However, due to slow progress, CMWSSB granted nine EOTs to the contractor and in July 2019 issued a show cause notice. After arbitration (August 2019) the contractor was granted further extension. The work was incomplete as of March 2020. In the meantime, the STP with a capacity of four mld was completed and commissioned in March 2019.

- Even as a decision on discharge of treated effluent was being debated, in violation of CPHEEO manual provision of scheduling UG pipeline works after scheduling STP, CMWSSB proceeded with tendering and award of contracts for pipeline works in all the seven packages in December 2008 and completed between June 2014 and July 2017. As a result of non-synchronising of UG pipeline works with the STP works, pipeline works were completed and the entire infrastructure was lying idle for over three years.

Thus, as a result of the delay caused by deficient planning and contract management, (i) an estimated 20.65 mld of sewage generated in Avadi area remained uncollected and (ii) as the designed capacity of the STP would cater to the projected population as of 2023[7], the STP would require capacity expansion within a very short period of its commissioning, as 12 years out of design life of 15 years had already lapsed. Similarly, 12 years out of the design life of 30 years of the sewer lines had also lapsed, and pipelines in 120 reaches and 2,869 manholes got damaged over the years by other civic agencies working in that stretches. CMWSSB's contractor estimated (April 2018) that it would cost ₹ 7.50 crore to rectify the damages.

GoTN replied (April 2020) that the sewage collection systems were handed over to the Local Body and partial operations were started. GoTN also stated that once house service connections were effected, the projects would be fully commissioned. The reply was untenable as only the four mld STP was commissioned in March 2019 after a delay of five years and the main 36 mld STP was still under construction, leading to only partial utilisation of the infrastructure created.

### *(iv) Tambaram UGSS*

Details and status of completion of the works of Tambaram UGSS, as of May 2020, were as given in **Table 2.8**.

[7] STP was designed in 2008 with a 15 year design life, i.e., to meet the projected population as of 2023.

**Table 2.8: Details and stage of Tambaram UGSS**

| | |
|---|---|
| **Administrative sanction** | May 2009 at a cost of ₹ 160.97 crore |
| **Technical sanction** | February 2009 - February 2011/₹ 174.27 crore |
| **Project components and Number of packages** | Collection system, HSC and SPS in Package I and II, a 30 mld STP in package III and pumping main from terminal SPS to STP in Package IV. |
| **Population benefitting** | 1,72,260 (2001) |
| **Estimated cost / Contract value** | ₹ 216.06 crore |
| **Issue of work order** | Between December 2009 and May 2012 |
| **Schedule date for commissioning** | Between December 2011 and July 2015 |
| **Number of EOTs granted** | 20 (2 to 11 EOTs to different contractors) |
| **Penalty levied on contractors** | ₹ 1.66 crore |
| **Expenditure incurred** | ₹ 125.44 crore (as of September 2019) |
| **Present status** | Not commissioned. Package IV completed; Packages I - III in progress. |

(Source: Data collected from CMWSSB)

Audit scrutiny disclosed the following deficiencies:

- The site for STP was not free of encroachments, but was handed over to the contractor in August 2012. CMWSSB took one year to clear the encroachments. The actual handing over of work site was considered as August 2013. Further, despite giving five EOTs to the contractor, and levying a penalty of ₹ 23.86 lakh for delays attributable to the contractor, the STP remained incomplete (May 2020).

- The agreement for Package I, involving collection system and related works in East Tambaram area, was terminated in June 2014 due to slow progress and the Tambaram Municipality took over the work and awarded to contractors after splitting the work into three sub-packages. As of August 2019, only 51 to 80 *per cent* of the awarded works were completed. Audit noticed that the contract under this package had to be terminated *inter alia* due to non-inclusion of estimates for rock cutting and controlled blasting. On pointing out the failure in considering the rock formations on UG pipeline stretches at the time of DPR, the Executive Director, CMWSSB, stated that these factors would be included in future DPRs.

- Package II of the project involves collection system and related works in West Tambaram area. The work was to be completed on May 2012. Only 81 *per cent* of the work was completed as on March 2020. CMWSSB granted 11 EOTs on grounds such as elections, monsoon, scarcity of building materials, etc. CMWSSB imposed penalties totalling to ₹ 1.27 crore. Audit observed that the EOTs were unjustified as monsoon was a usual phenomenon,

election related code of conduct would not affect ongoing works and GoTN being the regulator of sand quarrying, scarcity could have been avoided by proper coordination. While the STP (Package III) was still under construction, by June 2019, the Municipality operationalised house service connections (HSC) to 1,100 houses[8]. The collected raw sewage stagnated in the basin of the STP (**Exhibit 2.4**), before being let out in to Adyar river without due treatment. GoTN replied (April 2020) that it was not possible to run the STP due to low quantity of sewage being collected and hence the collected sewage was being let out after minimum treatment through chlorination. Thus, the delay in execution of the project due to faulty soil survey and issues in contract management and the imprudent decision to operationalise HSCs even before completion of STP, had resulted in disposal of untreated sewage into Adyar river.

**Exhibit 2.4: Stagnant raw sewage in the basin of Tambaram STP**

(Source: Audit team)

### *(v) Ambattur UGSS*

The erstwhile Ambattur Municipality was merged into GCC in 2009. As of 2008, areas falling under 35 out of 52 wards of the Municipality had UGSS and CMWSSB proposed (May 2008) to implement UGSS in the remaining 17 wards as Phase III. Details and stage of completion of the works of Ambattur UGSS, as of May 2020, were as given in **Table 2.9**.

[8] Out of 2,163 houses in 2 (zone 9 and 10) out of the 17 sewage zones.

**Table 2.9: Details and stage of Ambattur UGSS (Package II of Phase III)**

| | |
|---|---|
| **Administrative sanction** | May 2008 |
| **Technical sanction** | August 2009 |
| **Project components** | Sewer lines, pumping stations and HSCs in all seven packages |
| **Population benefitting** | 2,57,319 (Base year 2009) |
| **Estimated cost / Contract value** | ₹ 74.32 crore |
| **Issue of work order** | April 2009 - May 2010 |
| **Schedule for commissioning** | July 2012 |
| **Number of EOTs granted** | Five |
| **Penalty levied on contractor** | ₹ 13.32 lakh |
| **Expenditure incurred** | ₹ 65.05 crore (as of September 2019) |
| **Present status** | Partially completed. |

(Source: CMWSSB)

CMWSSB called for tender to implement the scheme in seven packages. Three packages were awarded and completed between February 2014 and March 2015 and put to use. The remaining four packages were clubbed together as a single package and awarded in May 2010. But the contract was terminated in June 2016 due to poor progress and a penalty of ₹ 10 lakh was imposed on the contractor. Fresh tenders were awarded between January 2018 and January 2019, by splitting the work into six smaller packages. GoTN stated that as of March 2020, works in three of the six smaller packages were completed and were progressing in the rest. CMWSSB attributed delays to road cut permission, handing over of site by local body and public protest.

Audit observed that despite poor progress, the termination of agreement was done six years after award of contract. This indicated failure in proper monitoring and review of progress in the four packages. Thus, failure of CMWSSB in contract management and in ensuring effective coordination with the line departments contributed to the delay and non-achievement of objectives of the scheme for over seven years.

### *(vi) UGSS in other areas of CMA*

Audit scrutiny of implementation of smaller UGSS projects in other areas of CMA disclosed unexplained delays and consequently the investments made in these projects continued to remain unfruitful for long durations and the sewage from these areas were not collected by CMWSSB. The features and stages of these projects are given in **Appendix 2.4** and the reasons for the delays are discussed hereunder.

**(a) Karapakkam and Sholinganallur:** Against the scheduled commissioning in March 2016, 90 *per cent* of works were physically completed as of July 2017 and thereafter the works progressed very slowly due to issues in obtaining road cut permission. GoTN stated (April 2020) that trial for commissioning was under progress and the project would be

commissioned soon. But, the fact was that as of May 2020, the project was delayed by more than four years, mainly due to deficiencies in coordination with other agencies connected with the work site.

**(b) Pallikaranai:** Against the scheduled commissioning in February 2013, 96 *per cent* of supply and erection of electrical, mechanical and instrumentation works along with construction of pumping station were physically completed as of July 2017. There was no progress thereafter. Due to slow progress of work, show cause notice was issued (October 2018) for termination of the contract and the contractor filed (November 2018) a case in the Hon'ble Madras High Court and the arbitrator appointed (January 2019) by the Court allowed (November 2019) the termination. CMWSSB called for fresh tenders (January 2020). Thus, primarily due to issues in contract management, the Pallikaranai UGSS project was delayed by over seven years. GoTN stated (April 2020) that the process for retendering was going on.

**(c) Perungudi:** The project was scheduled for commissioning in November 2012, however no progress was achieved as on May 2020. GoTN attributed reasons such as sandy soil, delay in handing over site and issues with shifting of electricity cables and water pipelines, etc,. for the slow progress of work. Audit observed that lapses in planning and project management were the primary reasons for the delay.

**(d) Ramapuram:** As of July 2017, 88.48 and 66 *per cent* of construction of manholes and pumping stations were completed. Thereafter, the contractor did not show any progress in the work. Therefore, the contract was terminated (November 2018) and CMWSSB imposed a penalty of ₹ 66 lakh. GoTN (April 2020) stated that action was being taken for calling fresh tenders.

**(e) Nerkundram UGSS:** In 2009, GoTN brought Nerkundram under GCC. In March 2016, a DPR for the Nerkundram UGSS was prepared at a cost of ₹ 106.55 crore and technical sanction was accorded (July 2016) by the Engineering Director. In the meantime, CMWSSB proposed (June 2016) to Government to accord revised administrative sanction under Chennai Rivers Restoration Trust (CRRT). In anticipation of revised administrative sanction from Government, CMWSSB invited (July 2016) tender and the single responsive tender was rejected. In the meantime, Government accorded (January 2017) revised administrative sanction and the estimate for the work was revised (September 2017) for ₹ 100.35 crore. Re-tender was invited during September 2017 and work order was awarded in January 2019 after a delay of one year and four months for a contract value of ₹ 56.51 crore with contract period of 30 months. Work was commenced in June 2019 and was under progress (August 2019). Thus, due to abnormal delay in finalisation of tender, the project could not be completed, thereby impacting sewage collection.

### *(vii) Abandoned projects*

In September 2008, CMWSSB prepared a DPR for providing UGSS to eight town panchayats[9] (TP) in CMA at a total cost of ₹ 312.04 crore. GoI approved (January 2009) the project under JNNURM with GoI, GoTN and local body share at the ratio of 35:15:50. GoI and GoTN released (March 2009) ₹ 27.15 crore and ₹ 11.63 crore as their share and share of local bodies was proposed to be met by obtaining loan from Tamil Nadu Urban Finance and Infrastructure Development Corporation Limited. Of the eight TPs, works were taken up only in Pallikaranai and Perungudi, which were added (October 2011) to GCC and in Tirumazhisai TP. Audit noticed that mainly due to inability in mobilising funds for local body share, the projects proposed for the remaining five town panchayats were dropped and the grant of ₹ 38.78 crore already received from GoI and GoTN were refunded.

Thus, despite availability of 35 *per cent* of project cost as grant from GoI, GoTN did not attach due importance, leading to scrapping of sanctioned projects. Audit found that there was no plan to revive these projects.

### *(viii) Impact of delays in project implementation*

The delays in completion of sewerage projects discussed in **Paragraphs 2.1.8.2 (i)** to **2.1.8.2 (vi)** resulted in continued unsafe disposal of sewage. Further, Audit observed that:

- The undue delays in completion of UGSS projects had resulted in cost escalation of ₹ 82.91 crore in respect of three projects **(Appendix 2.5)** which are under implementation beyond their target date for completion. The remaining projects were also likely to overshoot the estimated cost when they are finally completed.
- Six[10] of the nine UGSS projects delayed beyond the target date were implemented with JNNURM funds. Against the total sanction of ₹ 198.45 crore under JNNURM for these six projects, only ₹ 179.96 crore was received from GoI as of March 2019. As JNNURM has since been wound up and these long pending projects were not approved for continued funding under AMRUT scheme, which succeeded JNNURM, GoI grant of ₹ 18.49 crore would not be received and hence would be an additional burden on GoTN's budgetary resources.
- As per the CPHEEO manual, sewerage projects are designed for serving the projected population over the next 30 years. The STP component is designed with the projected population at the end of 15 years from the base year. Audit observed that the abnormal

[9] Chitlapakkam, Madambakkam, Pallikaranai, Peerkankaranai, Perungalathur, Perungudi, Sembakkam and Thirumazhisai.

[10] Ambattur, Avadi, Pallikaranai, Perungudi, Porur and Tambaram.

delays in Avadi, Tambaram and Thiruvottiyur STP projects would lead to saturation of capacity in less than four/five years of commissioning of these infrastructure and consequent possible deterioration in the quality of treatment and need for further investments. Further, these delays adversely impacted the economic life span of the infrastructure created at huge cost.

- Commissioning of completed packages were delayed due to non-completion of other related packages. This would help contractors of the completed packages to evade responsibilities for construction defects which would ultimately come to notice only at the time of trial run/commissioning of the project. The defect liability periods and warranty period for electro mechanical items would lapse as happened in the case of Package VI of Avadi UGSS.
- An estimated 74.69 mld of sewage generated (**Appendix 2.6)** in the project area was not collected for treatment due to the delay in completion of the projects. Further, as the septage generated in these areas were not handled properly, as commented in **Paragraph 2.1.9.3,** the delayed completion of projects contributed to water pollution in CMA.

In response to the delays pointed in **Paragraphs 2.1.8.2 (i) to 2.1.8.2 (vi)** above, in the Exit Conference, the Executive Director stated that the sub soil conditions of CMA region varied widely and monsoon season impacted the timely completion of schemes. The Additional Chief Secretary, MAWS Department observed that the involvement of multiple agencies for clearances also contributed to the delay. Further, the Executive Director stated that the time period adopted at present for completion of UGSS was 36 months, irrespective of the conditions involved, and agreed that scheme specific factors would be taken into consideration in future projects. In view of the facts discussed in **Paragraphs 2.1.8.2 (i) to 2.1.8.2 (vi)** and the views expressed in the Exit conference, Audit observed that effective planning, coordination with line departments and contract management would have helped to avoid the delay.

### 2.1.9 Sewage collection

As discussed in **Paragraph 2.1.6**, the sewerage network failed to collect 556 mld of sewage from CMA. Audit found that sewage from areas already having sewer network as well as areas without sewer network were directly flowing into the waterways of Chennai. Issues and deficiencies in sewage collection are discussed hereunder.

#### 2.1.9.1 Non-installation of flow meters in Sewage Pumping Stations

CPHEEO Manual envisages installation of flow meters for measuring sewage received by pumping stations. Measuring sewage at SPSs would facilitate identification of seepages in pipes carrying sewage to the SPS by enabling comparison of daily collection. It will also facilitate identification of seepage

in the pipeline from SPS to STP by comparing the pumped quantity with the quantity received by STPs. Audit found that flow meters were not installed in any of the SPSs of CMWSSB. It was replied that the sewage discharge quantity was calculated based on pump running hour and efficiency of the pump sets.

Audit found that in Pallavaram SPS of Pallavaram Municipality, the flow meter was working properly for collecting charges from Pallavaram Municipality. Therefore, Audit observed that providing meters for better measurement of operational efficiency in sewage collection and pumping was not a complex task and there was no reason why the flow meters could not be made operational in SPSs of CMWSSB.

Audit also observed that in the absence of flow meters, SPSs and STPs of CMWSSB were not in position to ascertain whether volume of sewage stated to be pumped by the preceding SPS was actually received in the wells of receiving SPS or STP. Measuring the performance of SPSs using pump running hours would not give accurate data as the quantity actually pumped would vary from the designed capacity of the pumps due to ageing, power fluctuations etc. This would help to hide operational deficiencies as the system lack transparency, which would ultimately affect the efficiency in sewage collection. Availability of accurate data on sewage collection assumes importance in the context of partial UGSS coverage in the city and large amount of sewage entering water bodies through SWD as discussed in **Paragraph 2.1.10**.

In response to Audit, GoTN stated (April 2020) that provision of flow meter in SPS has not been made mandatory in the CPHEEO Manual; but, as pointed out by Audit, the flow meters would be installed in all SPSs of CMWSSB in due course.

#### 2.1.9.2 Sewage not received at STP due to pipeline burst

Keelkattalai pumping station of Pallavaram Municipality pumps an average of 12.05 mld of sewage to Perungudi STP of CMWSSB. CMWSSB treats and disposes the treated sewage and for that collects sewage treatment and disposal charges at ₹ 4.65 per KL from Pallavaram Municipality. Audit found that for 199 days during November 2017 to June 2018, an estimated 2,398 million litres of sewage was not received from Pallavaram Municipality due to pipeline burst. Evidently, during this period, the uncollected sewage was discharged into water bodies without treatment.

#### 2.1.9.3 Non-adherence of guidelines of septage management by CMWSSB and local bodies in CMA

Thirty one out of forty two added areas of GCC, seven out of eight municipalities, 10 out of 11 Town Panchayats and all 10 Panchayat Unions of CMA were not provided with UGSS. In unsewered areas, sewage are collected in septic tanks for onward transmission to STPs. Sewage that is stored in a septic tank is commonly called as septage. In September 2014, GoTN

reviewed the situation and felt that even as the available STPs were underutilised[11], septage from unsewered areas were let out into water bodies without treatment. In view of that**,** GoTN issued (September 2014) comprehensive guidelines which contemplated the initiatives for management of septage in unsewered areas. The major elements of septage management which requires the involvement of local bodies/statutory bodies (CMWSSB) are septage transportation, treatment, septage disposal, record-keeping and reporting (Management Information System) as discussed below:

- Local body clusters have been identified for treatment of collected septage at earmarked STP locations. All septage transportation vehicles should be directed to transport septage to their designated STP.
- Only certified and licensed septage transporters to de-sludge and transport waste to the designated STP. The transporters should be selected in accordance with The Tamil Nadu Transparency in Tenders Act, 1998, as per the terms and conditions.
- Information related to septage generation from residents and commercial establishments needs to be collected by the local bodies, household level details of insanitary latrines, identification of septic tank location, operator in-charge for each location, vehicle details, name and location of STP earmarked for disposal of septage, and decant facility details should be duly collected by all local bodies.

Audit observations in management of septage by CMWSSB and local bodies are discussed below:

### *(a) GCC areas including added areas of GCC*

CMWSSB did not maintain any data on houses within its jurisdiction without sewer connections. The 2014 orders of GoTN on septage management was not implemented by CMWSSB even as of October 2019.

### *(b) Other local body areas in CMA*

A total of eight[12] local bodies were test-checked. None of them had a functioning UGSS. The status of implementation of GoTN's instructions on septage management in the sampled local bodies was as given below:

- Septic tank enumeration was not carried out in four[13] LBs, which made it difficult to monitor septage disposal.

---

11 Average actual sewage treatment was 530 mld against the combined installed capacity of 727 mld of the 12 STPs in operation.

12 Avadi, Chitlapakkam, Poonamallee, St. Thomas Mount, Tambaram, Thirumazhisai, Thiruneermalai and Villivakkam.

13 Chitlapakkam and Thiruneermalai TPs; Poonamallee and St. Thomas Mount PUs.

- The list of locations where sewage is getting mixed with storm water drain were not enumerated and maintained by any of the eight LBs.
- Licenses were not granted for transporting septage in five[14] LBs. Although licenses were issued in the remaining three LBs, records relating to details of STPs where the trucks decanted the septage, were not made available to Audit. In the absence of monitoring of septage trucks, safe disposal of the collected septage could not be ensured and would entail the risk of letting out septage into the water bodies. None of the LBs had details of their designated STP and its decanting facilities.
- Training sessions for LB staff, training/orientation sessions for septage transporters/private vendors have not been conducted in any LBs.

Thus, due to non-enforcement of the orders of GoTN, proper collection and treatment of septage from unsewered areas was not ensured. The failure of CMWSSB and local bodies to implement the guidelines pointed to lack of willingness on their part and improper disposal of septic tank effluents and septage pose direct and indirect socio-economic impacts.

#### 2.1.9.4 Inadequate decanting facilities

Construction of decanting facility for receiving septage from areas not covered by sewerage system is a mandatory part of sewage management. Major decanting facilities for receiving septage through lorries are available only in Nesapakkam and Perungudi STPs. The STPs at Kodungaiyur and Koyambedu, which are closer to nine unsewered added areas of GCC with a sewage generation of 54.42 mld, did not have decanting facilities. Audit found that only 3.6 mld out of an estimated 375 mld generated in areas without sewer lines was received by the decanting facilities of CMWSSB. Audit observed that non-availability of sufficient decanting facilities at STPs was one reason for non-collection and non-treatment of septage from areas without sewer networks.

GoTN stated that in addition to the two STPs with decanting facilities, three SPSs[15] also had facility to receive septage through tankers. Audit found that the total sewage handled by these three SPSs was only 85 mld and hence in view of the total estimated uncollected sewage of 629 mld, the existing facilities to receive septage through lorries were grossly inadequate, which would result in the lorries letting out septage into the water bodies.

#### 2.1.9.5 Non-maintenance of database on licensed septage transporters

Audit observed that data on volume of septage received in STP through lorries were alone maintained. The data on details of certified and licensed septage

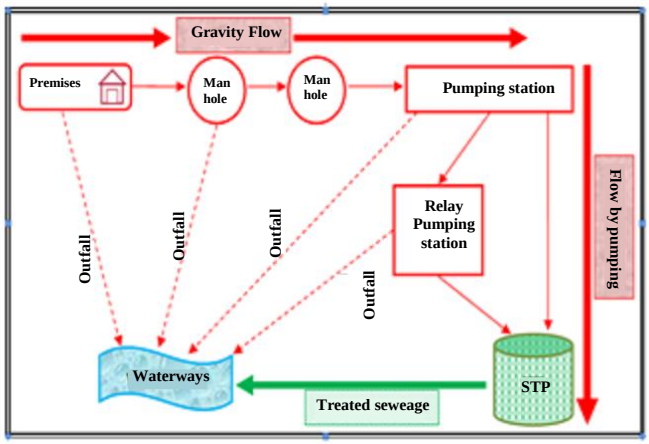
14 Poonamallee, St. Thomas Mount, Thirumazhisai, Thiruneermalai and Villivakkam.
15 Erukkencheri, Ganga Nagar and Mogappair.

transporters to de-sludge and transport waste to the designated STP were not maintained by STPs and local bodies. CMWSSB replied that septage vehicles were being operated by private transporters and they decant sewage at STPs by paying charges fixed by CMWSSB. Audit observed that in the absence of information on the local bodies from which septage was transported to the STP, CMWSSB was not in a position to quantify separately the volume of sewage received from each local bodies. GoTN stated (April 2020) that private sewer lorries were not registered with government agencies, but CMWSSB was maintaining data on septage transported by its lorries. The reply was untenable as CMWSSB was providing septage transportation service only in GCC area and the private operators in the rest of CMA were not monitored.

### 2.1.10 Sewage outfalls into storm water drains

Sewage outfalls into waterways occur either due to inadequate handling capacity of the sewerage system or unauthorised sewer connection to storm water drains (SWD) (**Exhibit 2.5**). SWDs are meant for carrying rain water to drain the city. Section 56 of CMWSS Act, 1978, prohibits letting of sewage into SWDs. CMWSSB estimated (April 2019) that 242.73 mld of raw sewage entered SWDs and drained into water bodies such as Adyar river, Buckingham Canal, Cooum river, etc. This has resulted in high pollution load of the water bodies in the city. This issue was due to illegal letting of sewage into SWD by occupants of premises and overflowing and puncturing of sewer lines adjoining SWDs. Efforts started by CMWSSB in 2012 to plug the sewage outfalls had not borne fruit even as of 2019, as discussed below.

**Exhibit 2.5: Anatomy of sewage outfall**




(Source: CMWSSB)

The eco-restoration of these rivers and water bodies include plugging of polluted sewage outfalls which are being executed under the aegis of the CRRT[16] which is formed for rehabilitation of Chennai water ways and water bodies. An action plan was formulated to prevent flow of untreated sewage into waterways and to improve the sewerage system under Infrastructure and Amenities Fund of Housing and Urban Development Department. Implementation of Plugging of polluted sewage outfalls are discussed in succeeding paragraphs.

[16] Chennai Rivers Restoration Trust (CRRT) is a wholly owned body under GoTN.

### 2.1.10.1 Plugging of outfalls using Infrastructure and Amenities Fund

In 2012, CMWSSB claimed to have surveyed the basins of the three waterways of the city, *viz.,* Adyar river, Buckingham canal and Cooum river and identified 337 sewage outfalls, flowing into these water bodies. Based on the proposal of CMWSSB, GoTN approved (July 2012 and December 2014) a project at a cost of ₹ 313 crore to plug these outfalls in two phases, using the Infrastructure and Amenities Fund of the Town and Country Planning Department. As per original plan, all the 337 sewage outfalls were to be plugged by March 2016, but work on 46 outfalls were incomplete even as of March 2020.

- Under Phase I of the project to plug 179 outfalls, the works were awarded[17] to a Contractor in November 2013. 170 out of 179 sewage works were completed after a delay of over two years and the contract for the balance nine works were terminated (November 2018) by CMWSSB due to slow progress of works by the Contractor. The works were abandoned.
- Under Phase II, works on 158 outfalls were split into seven packages and separate contracts were awarded for each package. Only three of the seven packages were completed **(Appendix 2.7)** between March 2018 and January 2019 and remaining four packages, with scheduled completion between September 2019 and January 2020, were incomplete (March 2020).

Audit found that the delays were mainly due to unjustified delays in finalisation of tenders by CMWSSB as discussed below:

(a) In respect of Buckingham Canal River Basin Package-II, overall time taken to issue work order after opening of technical bid was 31 months. Of which, the Board took 25 months to accord approval.

(b) The overall time taken to issue work order after opening of technical bid for Cooum River Basin Package-IB, was 20 months. Of which, the Board took 11 months for according approval.

(c) In respect of Buckingham Canal River Basin Package-IB, after opening of technical bid, the Board took more than 11 months to open price bid with overall time taken of 16 months to issue work order.

Recorded reasons for the delay in finalisation of tender were neither available nor produced to Audit when called for.

Thus, Audit observed that the objective of plugging of polluted sewage outfalls into water bodies remained unachieved in full, even four years after the scheduled date.

[17] For a contract value of ₹ 136.08 crore, with target date of completion as 19 January 2016.

**Exhibits 2.6 and 2.7: Photos of untreated sewage being let out into water bodies**

**L.G. Road 300mts downstream of Harris Road Bridge**

(Source: DPR of CRRP)

### 2.1.10.2 Plugging of outfalls under Cooum River Eco Restoration Project

The Cooum River traverses a distance of 20 kilometres within Chennai city limits before draining into the Bay of Bengal. GoTN has acknowledged that the river is highly polluted and is an urban sewer due to drainage of municipal and industrial waste.

**Exhibit 2.8: Photos of untreated sewage being let out into water bodies**

(Source: DPR of CRRP)

In January 2015 GoTN accorded administrative sanction for Cooum River Eco Restoration Project[18] (CRRP) at a cost of ₹ 604.77 crore, including 15 sewage management projects at a cost of ₹ 186.19 crore. The 15 sewage management projects sanctioned for implementation by CMWSSB included 10 new sewer mains to intercept and divert the sewage outfalls along 11.53 km of Cooum river, four sewage treatment plants and UGSS for Nerkundram, a newly added area lying close to the river. The status of the works sanctioned under CRRP was as follows:

- ***Interceptor and Diversion works:*** Interceptor and Diversion (I and D) works, to convey the outfalls to the current sewers and STPs, were entrusted (January 2015) to CMWSSB in 10 packages. Out of the ten works, one work awarded in February 2016 had not

[18] The project includes sewage and sanitation projects, improving the flood carrying capacity of the river, maintaining minimum ecological flow, developing river front, resettlement of slum dwellers along the river margins, etc.

commenced even as of May 2020 due to encroachments, four works were started[19] after a delay of about two years, four other works[20] were started after a delay of 6 to 11 months and one work was yet to be awarded.

- ***Modular Sewage Treatment Plants:*** The I and D systems discussed above will convey the flow directly to three modular STPs proposed to be established on the river bank. CMWSSB issued work order for all the three modular STPs in November 2016. However, as the sites for two of the three modular STPs at Chetpet and Choolaimedu were falling within the alignment of Maduravoyal Elevated Expressway, NOC was delayed. NOCs, applied in December 2016, were received only in February 2019 and April 2019, after redesigning the STPs according to the extent of land allotted by PWD. For the proposed modular STP at Maduravoyal, as the site allotted by PWD was a burial ground, the CMWSSB requested (May 2019) for allotment of alternate site and the same is pending with PWD.

Audit observed that constraints in putting up STPs due to site availability indicated deficiencies in DPR, which should have assessed the feasibility of the STP site. In the light of the faulty location of all the three STPs, the project has not delivered the intended objectives of diverting the sewage outfalls and the treatment of sewage.

Thus, as a result of unjustified delays in award of tender, lack of effective coordination with line departments to ensure availability of work site and inadequate planning, the projects to plug sewage outfalls into rivers had not succeeded, even four to seven years after sanction.

### 2.1.11 Functioning of Sewage Treatment Plants

STPs treat the collected sewage for safe disposal. Against the estimated sewage generation of 880 mld in GCC areas under the jurisdiction of CMWSSB, the treatment capacity of the 12 STPs was only 727 mld (82.6 *per cent*). In August 2018, GoTN, based on the recommendations made by a Consultant engaged by CMWSSB for rejuvenation and rehabilitation of STPs, issued orders for phasing out 5 of 12 STPs, as they had crossed their respective design life period. Average capacity of STPs available for utilisation and allocation of sewage are detailed in **Appendix 2.8**.

Audit scrutiny of functioning of STPs disclosed the following:

[19] Between February 2018 and February 2019.
[20] Between October 2016 and December 2018.

### 2.1.11.1 Non-functioning of primary clarifier units

Treatment of raw sewage primarily involved multiple stages *viz.*, primary settling, aeration, secondary settling, etc. Since primary settling is the first stage of treatment, any shortfall thereof would have a consequent detrimental effect on the treatment quality of the subsequent stages.

In 3 of the 12 STPs with two units of primary clarifiers, only one unit was functioning. The installed capacity of the STPs was based on the total capacities of the two units of primary clarifiers. As one of the two units of primary clarifiers were not functional in three STPs, these three STPs continued to handle sewage volumes higher than the capacity of the functional unit.

Hydraulic Retention Time (HRT) of primary clarifier is a critical parameter of STPs for efficient treatment of sewage. As per CPHEEO Manual, HRT depends on the volume of sewage received and the capacity of the primary clarifier. Ideally, the sewage entering the primary clarifier should be retained there for 2 to 2.5 hours for efficient functioning of STP, and shorter retention would result in poor treatment of sewage. Another important parameter is the overflow rate of primary clarifier, which should be in the range of 25 to 35 cu.m/sq.m/day. Audit found that the overflow rate[21] of each functional units of the three STPs were higher than the recommended maximum as worked out in **Table 2.10**, leading to lesser than the minimum HRT.

**Table 2.10: Shorter than required HRT in primary clarifiers of three STPs**

| Name of Plant | Rated treatment capacity of primary clarifier of the STP (mld) | Average quantity actually treated (mld) | Actual overflow rate ($m^3$ per day per $m^2$ of surface area) (Recommended maximum is 25 to 35 $m^3$ / $m^2$/Day ) | Actual retention time (Hours) (Recommended minimum time is 2-2.5 hours) |
|---|---|---|---|---|
| Kodungaiyur - Z-I (80 mld) | 40.00 | 59.00 | 46.97 | 1.53 |
| Kodungaiyur - Z-II (80 mld) | 40.00 | 58.00 | 46.18 | 1.56 |
| Nesapakkam (23 mld) | 11.50 | 17.50 | 48.68 | 1.18 |

(Source: Records of CMWSSB)

Audit observed that the above STPs were not meeting the recommended ranges of HRT and overflow rate due to overloading. GoTN stated (April 2020) that the recommended overflow rate was 35 to 50 $m^3$ per $m^2$ of surface area per day, and the same was adhered to. The reply was untenable as the standard stipulated by CPHEEO for primary clarifier with sludge return design was 25 to 35 $m^3$/ $m^2$/day.

Thus, by operating only one of the required two primary clarifiers in three STPs, CMWSSB compromised on the quality of treatment.

[21] Ratio of overflow of primary clarified sewage in cubic metre to surface area of the clarifier in square metre.

### 2.1.11.2 Plant control tests not conducted

All 12 STPs of CMWSSB were designed to treat municipal sewage alone. CPHEEO Manual recommended 56 parameters to be tested to measure the physical, chemical and biological characteristics of treated sewage water irrespective of the treatment process. These tests were conducted to meet the statutory need as well as plant control needs. Audit noticed that tests were conducted and documented at STPs for only 11[22] out of the 56 parameters recommended by CPHEEO Manual. Five out of the eleven tests conducted by CMWSSB were mandatory tests as stipulated by the TNPCB and the remaining six tests were conducted for plant control. Eleven tests presently conducted at the STPs related to organic and biological parameters, except for oil and grease.

GoTN stated (April 2020) that the mandatory tests were conducted. Audit, however observed that the mandatory tests being conducted were not capable of detecting industrial wastes. As the STPs were not designed to handle industrial waste, it was necessary to analyse the presence of industrial wastes in the inflow to ensure proper treatment. Audit found that a study conducted (June 2018) by a Consultant engaged by CMWSSB found that by 2020 an estimated 62 mld of industrial effluent would flow into the STPs from pumping stations. Further, the Tamil Nadu Agricultural University, which conducted a study on converting the sludge into manure, also found traces of heavy metals in the sludge. Therefore, Audit observed that conducting all mandatory and plant control tests is critical for ensuring optimum performance of the STPs and the quality of the treated water.

### 2.1.11.3 Absence of independent audit of wastewater quality

Municipal sewage contains various wastes. If improperly collected and improperly treated, this sewage and its related solids could hurt human health and the environment. A treatment plant's primary objectives are to clean the sewage and meet the plant's discharge standards.

With a view to ensure the quality of treated water let out by STPs, the Handbook of Benchmarks of the Ministry of Urban Development of GoI envisages availability of own laboratory or easy and regular access to accredited testing centers for carrying out tests in addition to periodic independent audit of wastewater quality. Audit scrutiny disclosed that:

- CMWSSB has established testing laboratories in all the STPs. But, these laboratories were either operated by the operation and maintenance (O&M) contractor of the respective STP or by using staff outsourced from the contractor. Audit observed that this arrangement paved way for conflict of interest as the contractors were responsible for ensuring proper treatment of sewage.

[22] Bio-Chemical Oxygen Demand, Chemical Oxygen Demand, Dissolved Oxygen, Fecal Coliform, MLSS, MLVSS, Oil and Grease, pH, Suspended Solids, Temperature and Total Dissolved Solids.

- Further, CMWSSB had not put in place the envisaged system of periodical independent audit of the quality of treated water.

GoTN stated (April 2020) that a proposal was under way to establish a full-fledged laboratory for conducting all tests.

### 2.1.12 Reuse of treated sewage water

Water recycling is the reuse of treated wastewater for beneficial purposes such as agricultural and landscape irrigation, industrial processes, toilet flushing, etc. As per the Benchmark devised by Ministry of Urban Development, GoI, at least 20 *per cent* of the treated water should be reused/recycled. Audit scrutiny of performance in handling treated water disclosed the following:

#### 2.1.12.1 Poor achievement in sale of treated water

As per the directions issued (June 2015) by the TNPCB, secondary treated sewage water should be mandatorily sold for use for non-potable purposes such as industrial process, railway & bus cleaning etc. Sale of treated water for non-potable purposes would bring down the consumption of drinking water for non-potable purpose and has the potential to earn revenue to CMWSSB.

Sale of treated water involves identifying potential buyers, signing MoUs with them, providing requisite pipelines for carrying the treated water and other related arrangements. CMWSSB has tied up with three major industries[23] and GCC for supply of treated water from only two[24] out of its 12 STPs. During 2014-19, CMWSSB supplied an average of 28.42 mld of secondary treated water to these industries and GCC earned an average revenue of ₹ 16.45 crore per annum. During the same period, 463.27 mld of treated water was let out into water bodies.

During the audit period, while the cost of treatment of sewage was in the range of ₹ 12.50 to ₹ 18.40 per KL, the sale price of treated water to industries was in the range of ₹ 12.49 to ₹ 16.16 per KL. Thus, the sale of treated water helps in reducing the city's dependence on fresh water for industrial uses and in augmenting the revenue of CMWSSB.

The achievement in sale of treated water being only 6.5 *per cent* as of March 2019, was well below the prescribed benchmark of 20 *per cent.* CMWSSB lost an opportunity to earn ₹ 175 crore per annum by achieving benchmark sale of 20 *per cent* of treated water. Instances of failures in meeting the demand for secondary treated water and tertiary treated water are discussed below:

- In July 2014, the Divisional Railway Manager (DRM), Southern Railway (SR), requested for 7.5 mld of treated water for use in the Railway Yard. CMWSSB decided (February 2015) to supply 7.5 mld treated water to SR from its proposed 10 mld tertiary

[23] Chennai Petroleum Corp. Ltd., Madras Fertilizers Ltd., and Manali Petro Products Ltd.

[24] Kodungaiyur STP and Nesapakkam STP.

treatment plant at Langs Garden, Chennai, close to the Railway Yard. The proposed tertiary treatment plant at Langs Garden, Chennai, was approved by GoTN in January 2015. The work on the plant, however, was started only in April 2019. As a result, the treated water requested by SR in July 2014 was not supplied even as of May 2020, as a result of which SR continued to consume potable water from CMWSSB for non-potable purposes.

- The Tariff Policy of Ministry of Power, GoI, envisaged (January 2016) that thermal power plants within 50 kms radius of STPs should mandatorily use treated sewage water produced by these STPs. Accordingly, GoTN directed (June 2017) CMWSSB to sign MoU with the five thermal power plants[25] located near STPs of CMWSSB for supply of treated water. From the correspondence exchanged between CMWSSB and the thermal plants, it was noticed that the plants were insisting for enhanced quality of treated water. Meanwhile, CMWSSB supplied an average of 13.79 mld of fresh water to the five thermal power plants, which could have been avoided had appropriate quality of treated water been supplied to these thermal power plants.

Thus, CMWSSB did not fulfill the existing demand for treated water, leading to continued supply of potable water to industrial and commercial establishments even as the city faced acute water scarcities.

### 2.1.13 Environmental issues in sewage treatment

#### 2.1.13.1 Non-operation of biogas power generation plants

The sewage sludge includes organic matter. Decomposition of sludge releases sludge gas, which contains methane (60 to 70 *per cent),* carbon-di-oxide (25 to 35 *per cent*) and other gases. Methane and carbon-di-oxide are greenhouse gases (GHG), which contribute to global warming. CPHEEO Manual envisages provision of biogas plant in STPs to capture the combustible methane gas for generation of electricity, which provides two pronged benefits by cutting down emission of GHG and simultaneously reducing power consumption of the STP.

Audit found that 5 of 12 STPs of CMWSSB did not have the facility to generate electricity. Neither these plant had the facility to flare up methane gas to prevent direct releasing of GHG into atmosphere. In the remaining seven STPs, only four were generating electricity and the biogas plant in three others were under repair. Audit examined the measures initiated by CMWSSB to prevent GHG emission and noticed the following:

[25] NTECL and four TANGEDCO's coal based thermal power plants.

### *(a) Non-establishment of infrastructure facilities*

The five STPs that did not have biogas generation facility were erected between 1974 and 2003. CMWSSB did not take any effort for retrofitting these STPs with biogas power generation plants. Based on CPHEEO's formula, Audit worked out that these five STPs theoretically released 15,676 $m^3$ of methane per day (5.72 million $m^3$ per annum). In an ideal situation, it could have been possible for CMWSSB to generate about 30,000 units of electricity per day during 2014-19, against their average energy requirement of 19,727 units of electricity per day during the same period.

It was also found that biogas power generation plants were not provided in the design for the three new STPs under construction at Avadi, Tambaram and Thiruvottiyur.

GoTN stated (April 2020) that the biogas plant work in Nesapakkam 40 mld STP was under litigation and the work for providing biogas plants in four STPs commenced in December 2019. Audit observed that lack of timely interventions delayed provision of biogas plants in these STPs.

### *(b) Non-working of biogas power generation units in STPs*

In three STPs, the biogas power generation units were under repair for periods ranging from 37 to 43 months during 2014-19. Audit found that STPs were completely dependent on grid power for day to day operations and two of the STPs incurred ₹ 4.95 crore on electricity bills, which could have largely been avoided if the biogas plants were functional. Audit noticed that work orders for rehabilitation of the above STPs were issued in August 2019 with a scheduled period of completion of 18 months.

In the Exit Conference, the Executive Director stated that the issues would be resolved on implementation of scheme of rehabilitation of STPs.

## 2.1.13.2 Sludge disposal

Sludge is a by-product of sewage treatment. According to CPHEEO Manual, dried sludge may be used as fertiliser for lawns and for growing cash crops and fodder grasses and heat-dried sludge can be used as fertiliser along with farm yard manure. Further, using sludge as a land fill was not usually recommended as it could lead to surface water contamination and leaching into ground water.

Audit, however, found that CMWSSB had not taken any effort to convert the sludge as fertiliser. During 2014-19, the STPs of CMWSSB produced 42,644 MT of dried sludge. The entire quantity of dried sludge was spread over low lying areas adjoining the STP. By not taking effective action for disposal of sludge as fertiliser, CMWSSB lost opportunity for revenue generation through such sale and continued to cause threat to the environment.

### 2.1.14 Achievement against Service Level Benchmarks

Measuring service levels of civic agencies implies measuring outcomes, and indirectly also reflects on institutional capacity, financial performance and other parameters. The Handbook of Service Level Benchmarks (Benchmark) designed by Ministry of Urban Development of GoI is a ready reckoner to assess the quality of services, as discussed below:

(i) Against the benchmark of 100 *per cent* sewer network coverage, the coverage was only 60 *per cent* in CMA.

(ii) Against the benchmark of 20 *per cent* reuse/recycling of treated sewage, the achievement was only 6.5 *per cent*.

(iii) As per the benchmark for redressal of sewage related complaints, 80 *per cent* of the complaints were to be redressed within 24 hours of receipt. Details of complaints received and redressed by CMWSSB during 2014-19 are detailed in **Table 2.11**.

**Table 2.11: Complaints and Redressal**

| Year | Number of sewerage/sewage complaints | | Efficiency as per Benchmark as against a target of 80 *per cent* |
|---|---|---|---|
| | Received | Redressal within 24 hours | |
| 2014-15 | 18,567 | 3,845 | *20.71* |
| 2015-16 | 28,023 | 5,102 | *18.21* |
| 2016-17 | 22,845 | 5,218 | *22.84* |
| 2017-18 | 31,255 | 6,721 | *21.50* |
| 2018-19 | 33,387 | 7,094 | *21.25* |

(Source: Records and data of CMWSSB)

Audit found that an average of only 20.9 *per cent* of the complaint were redressed within 24 hours during the years 2014-19, as against a target of 80 *per cent*. Further, the Benchmark envisages satisfactory resolution of the complaint being endorsed by the complainant in writing; however, CMWSSB did not institute this system.

(iv) The extent of cost recovery in sewage management was 5.91 *per cent* up to 2016-17, 4.55 *per cent* and 16.41 *per cent* for 2017-18 and 2018-19 respectively as against the Benchmark of 100 *per cent.*

(v) CMWSSB classified complaints under four categories and set redressal durations in its Citizen's Charter as follows (a) blockage of sewer line (mains) - 4 days, (b) house sewer block - 2 days, (c) sewage overflow - 4 days and (d) repair to damaged sewer line/renewal of sewer line - 20 days. Audit evaluated compliance by CMWSSB to the committed timelines and found that the achievement ranged (a) between 27 and 52 *per cent* in respect of blockage of sewer lines (main), (b) between 58 and 68 *per cent* in respect of house sewer block, (c) between 22 and 42 *per cent* in

respect of sewer overflow and (d) between 0 and 12 *per cent* in respect of renewal of sewer lines.

### 2.1.15 Conclusion

Despite according due importance and making substantial investment, the sewage network in CMA did not meet the needs of the growing population. Inadequate treatment capacity and unchecked illegal discharge of untreated sewage continued to pollute the waterways. As a result, there was no improvement in the outcomes in terms of reduced pollution load in the water bodies in CMA. All project suffered abnormal delays due to sluggish pace of project implementation and lack of comprehensive planning. Failure to achieve the benchmark sale of secondary treated water, poor achievements in biogas power generation and non-conversion of sludge into manure contributed adversely to the environment, besides resulting in lost opportunities to augment revenue through these efforts**.**

### 2.1.16 Recommendations

In line with the audit findings, the following recommendations are made:

- Government should formulate CMA-wide City Sanitation Plan in line with NUSP for a focused approach and time-bound execution of interconnected projects.
- Government may consider putting in place an institutional mechanism for ensuring coordination of all line departments in implementing UGSS.
- CMWSSB should ensure availability of work site and all mandatory clearances from line departments before awarding tenders for UGSS.
- CMWSSB needs to focus on ensuring the quality of sewage treatment by commissioning independent audit of water quality and performing all recommended laboratory tests.
- CMWSSB should be sensitive to the environmental issues by increasing reuse of treated water, minimising release of greenhouse gases into atmosphere and converting sludge into manure.