Sustaining WASH / SWM Infrastructure

- Identifying and Addressing O & M Challenges of ULBs

Research Study

2022-23

Regional Centre for Urban & Environmental Studies
All India Institute of Local Self-Government, Mumbai
Established in the year 1968, is fully supported by Ministry of Housing and Urban Affairs, Government of India

Preface

RCUES of AIILSG, Mumbai undertakes research studies on the topics related to urban governance and service delivery. The Government of India has launched several urban development missions with an aim to provide improved services to the citizens of India. It's the need of the hour to provide required support to the local governments for their effective implementation in urban areas by addressing various challenges, especially in the post pandemic times. With this intention, RCUES of AIILSG, Mumbai has shortlisted several research areas in support of the respective State and local governments. In view of involving experts from various sectors in the process of undertaking these studies, RCUES Mumbai called for proposals in the financial year (2022-23).

Prakruti Education and Research Foundation (PERF) is a Section 8 Not for Profit company under Companies Act 2013 established on 20/10/2020 and based in Mumbai. Its Corporate Identification Number (CIN) is U80903MH2020NPL348340, and registration number is 348340. Dr. Milind Kulkarni who is PhD from IIT Bombay and a renowned academician, researcher and expert in the field of Environmental Engineering is the President of PERF. Prakruti Research Institute was established under PERF to undertake research in the field of Environmental Engineering in areas such as Solid Waste Management, Air Pollution, Water and Wastewater Treatment etc.. The research study proposal submitted by Dr. Milind Kulkarni, Director, Prakruti Research Center, titled "Sustaining WASH/ SWM infrastructure - identifying and addressing O & M challenges of ULBs" was accepted by RCUES, AIILSG Mumbai and work order no.

AIILSG/Order/2022-2023/RCUES-26, dated 15th September 2022 was awarded. The order was received by email on October 4, 2022. The order acceptance letter was sent on October 10, 2022, and the work on the project commenced.

Water, Sanitation and Hygiene are together called as WASH. Many cities are facing issues related to the supply of potable water and there are serious complaints with authorities such as ULBs, MPCB etc.. The focus of authorities is to supply water. But the quality aspects are neglected. Many cities are facing problems related to sanitation. Sewerage systems and sewage treatment are provided only for the 30% wastewater generated. This is resulting in pollution of water bodies.

After the implementation of Solid Waste Management Rules (2016) in India, segregation of waste has been conducted on a large scale and this has created some challenges for ULBs. Many ULBs are finding it difficult to sustain SWM infrastructure. This has resulted in issues such as poor quality of compost, problems during composting, environmental damage, failure to achieve circular economy and sustainable development. Therefore, this study proposes to identify the operation and maintenance issues in SWM infrastructure and will try to address them.

This study will identify the O&M issues related to WASH and SWM infrastructure and try to address them and provide detailed guidance to ULBs regarding sustaining them.

Acknowledgement

I take this opportunity to put on record our deep appreciation for the Ministry of Housing & Urban Affairs (MoHUA), Government of India (GoI) for providing us an opportunity to work on this study.

I Also, take this opportunity to express my gratitude towards Shri. Ranjit Chavan, President, All India Institute of Local Self Government for providing valuable guidance and support to complete this report. I Also, express my sincere thanks to Dr. Jairaj Phatak, IAS (Retd.), Director General, All India Institute of Local Self Government for his continued support in completing this report.

This Research Study was undertaken by Prakruti Education and Research Foundation's (PERF) Prakruti Research Institute (PRI) with RCUES, AIILSG, Mumbai. I truly appreciate the sincere efforts of Dr. Milind Kulkarni, President of PERF and Director PRI in completing this report and identifying the O&M challenges of WASH and SWM infrastructure of urban local bodies in Maharashtra and Goa and coming up with recommendations for addressing them. This will help the urban local bodies in making strategies and action plans to address these challenges and increase efficiency of operation.

I am thankful to the RCUES's Research team for their continued support in the completion of this research study report.

Director
RCUES, AIILSG, Mumbai

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List of Abbreviations

Sr No	Abbreviation	Full Form
1	MOHUA	Ministry of Housing and Urban Affairs
2	AIILSG	All India Institute of Local Self Governments
3	RCUES	Regional Center of Urban and Environmental Studies
4	WASH	Water, Sanitation and Hygiene
5	SWM	Solid Waste Management
6	ULB	Urban Local Body
7	MCGM	Municipal Corporation of Greater Mumbai
8	BMC	Brihan-Mumbai Municipal Corporation
9	SMC	Sawantwadi Municipal Council
10	KMC	Kolhapur Municipal Corporation
11	PMC	Pune Municipal Corporation
12	CCP	Corporation of City of Panaji
13	MSW	Municipal Solid Waste
14	CPHEEO	Central Public Health & Environmental Engineering Organisation
15	WTP	Water Treatment Plant
16	STP	Sewage Treatment Plant
17	FSTP	Faecal Sludge Treatment Plant
18	MOEF	Ministry of Environment and Forests
19	NGT	National Green Tribunal
20	CPCB	Central Pollution Control Board
21	MPCB	Maharashtra Pollution Control Board
22	GSPCB	Goa State Pollution Control Board
23	BOD	Biochemical Oxygen Demand
24	COD	Chemical Oxygen Demand
25	MPN	Most Probable Number of Coliforms

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Introduction

Sustaining WASH infrastructure:

Sustainable service delivery remains a huge challenge in the Water, Sanitation, and Hygiene Sector. Achieving sustainable WASH, as defined by USAID, is when ULBs, partners and communities take ownership of the service, and there are local systems to deliver inputs to maintain results, quality and deliver impacts beyond the life of projects. In order to achieve this goal at scale, new approaches to WASH service delivery and sustainability are needed. The Research Study named "Sustaining WASH '' aims to develop, test, and document high-potential approaches to engaging local WASH systems across multiple ULBs within AIILSG, Western Region. It Also, aims to advance and to advance knowledge in the development, application and scaling up of local systems framework in WASH while Also, providing RECOMMENDATIONS to IMPROVE service delivery in the ULBs. To achieve this, the Research Study will work on:

1. Improving decentralized WASH service delivery by understanding and influencing local systems.
2. Develop a locally led infrastructure to coordinate WASH sector.
3. Test, revise, and scale up public-private partnership models that improve WASH service delivery.

Together, these activities are expected to lead to a stronger system that better engages of local actors for water and sanitation service delivery, resulting in better coordinated investment, improved uptake of good practices, and sustained service delivery. Ultimately, this will lead to improved health and development outcomes for communities involved in the selected ULBs.

Sustaining SWM Infrastructure:

After the adoption of Solid Waste Management Rules (2016), there is a paradigm shift in the way the solid waste is handled by the ULBs. The segregation of waste at the source in dry, wet and hazardous categories is mandatory. The wet waste is expected to be composted, dry waste to be recycled and hazardous waste to be incinerated. In the last five years the SWM infrastructure has been changed drastically for compliance to SWM Rules 2016. In many cities, new solid waste collection vehicles are purchased by ULBs for collecting and transporting the waste in segregated form. In big cities like Mumbai and Pune, it is made mandatory to compost wet waste and recycle dry waste within the premises. In Mumbai incentives are given in the form of rebate in property tax for old housing societies implementing solid waste management projects within the premises. The society needs to compost all the wet waste generated and recycle all dry waste generated. Five percent each rebate is given for composting and recycling. Please note that this rebate is a general component of property tax which is around 30% of overall property tax. Due to these efforts, there has been significant reduction in the quantity of waste going to landfills. For example, in the case of Mumbai there is reduction in solid waste reaching landfills from 9000 MT/day to 6000 MT/day [1]. This is a positive development in view of the opposition of landfills by the people living

in its neighborhood. Many cities have Also, implemented dry waste recycling projects which is good for the circular economy and sustainable development. However, there are many challenges which are facing in sustaining the SWM infrastructure such as segregation of solid waste at source & collection, disposal and treatment of solid waste at dumping sites, developing sound infrastructure for recycling of dry waste etc..

In this study, ULBs of Mumbai, Sawantwadi, Pune, Kolhapur and Panaji are selected based on: -

1. **Representation**: - An effort is made to give representation to all types of cities within the Western Region of AIILSG. Mumbai is selected as it represents an International city (Population ~ 1.25 Cr). Pune represents a metro city which is old as well as growing rapidly (Population ~ 30 lakhs). Sawantwadi is a small ULB and represents many such ULBs in Western Region (Population ~ 25000). Kolhapur (Population ~ 6.5 lakhs) is a district place and represents other district places. Panaji has a population of around 50000 and equal floating population in addition. It Also, represents another state in the Western Region apart from Maharashtra.
2. **Connectivity**: - The study involves 5 cities and parameters such as water supply, sanitation, solid waste management etc. for each city. It is necessary to meet concerned officials as well as make site visits in different parts in each city. Thus, a lot of work is required to be done in a few months. Therefore, it is necessary to have good connectivity and proximity to the workplace of i.e. Mumbai. All the cities/ULBs barring Panaji are well connected from Mumbai by Road. For Panaji regular flights are available from Mumbai.
3. **Familiarity with local language:** The principal investigator Dr. Milind Kulkarni's mother tongue is Marathi which is the local language for the cities of Mumbai, Sawantwadi, Pune and Kolhapur. In the case of Panaji (Goa) Also, Marathi is well understood by the local population. This is a great help in communication with the ground level staff.
4. **Best Practices in sustaining O&M challenges**: The Principal Investigator is a trainer for Municipal Functionaries in the training programs organized by AIILSG. Through these contacts he has preliminary knowledge of best practices in the selected cities, and it is felt that these should be studied further and reported for following by other cities. For example, ALMs in Mumbai, Swachh Sansthas in Pune, Dry waste processing at Sawantwadi, Waste Management Project at Saligaon, Goa are some of the practices which are prima fascia considered as best practices and selection these cities will give opportunity to have in depth study of the same.

The assessment of the selected ULBs is done based on parameters like:

- Water Supply: Adequacy in terms of quality and quantity, Water metering – Electronic/analog, non-revenue water/Leakages, Water balance, Contamination
- Sewerage System and Storm water drainage systems: Adequacy, flooding issues, Maintenance mechanism,
- Sewage Treatment: Coverage, Pollution of rivers and nallahs. O&M challenges, Extent of reuse of treated

sewage, Decentralized sewage treatment

- Solid Waste Management: Management of dumping sites/legacy wastes, Processing of dry waste, Decentralized wet waste processing, Performance of centralized facilities, Collection and transport, Progress on sanitary landfills. Material recovery facilities, involvement of waste pickers/NGOs

The components of Water Supply, Sewerage System, Storm water drainage, Sewage Treatment are together grouped under WASH. In Mumbai there are separate departments for each of these components. However, in smaller ULBs WASH comprises only two departments: Water Supply and Sanitation/Drainage.

Based on this framework, questionnaires were prepared for the site visits. Contacts were established with the authorities in the Water Supply, Sanitation and Solid Waste Management Departments of selected ULBs and site visits were carried out. Draft report is based on the interviews and data collected during the site visits.

Following ULBs are selected for the study: -

1. Mumbai
2. Sawantwadi
3. Pune
4. Kolhapur
5. Panaji

These ULBs are at different levels in achieving the successful O&M of WASH and SWM infrastructure.

Methodology for Research Study involves: -

1. Understanding the state of current WASH and SWM infra by way of recce survey, literature review and interviews with officials and site visits etc..
2. Analyze and assess WASH and SWM infra based on parameters.
3. Identification of O&M Challenges in WASH and SWM infra in respective ULB
4. Identification of best practices in WASH and SWM infra in respective ULB if any.
5. Recommendations to address the O&M challenges in WASH and SWM infrastructure to sustain the same.

Part 1 of the Report was on “Secondary Assessment and framework/questionnaire for site visits to ULBs. The report was submitted to AIILS for feedback. The suggestions by AIILSG staff are incorporated in the final report.

After this, communication was established with the authorities in the WASH and SWM in all the ULBs namely Mumbai, Sawantwadi, Pune, Kolhapur and Panaji in that order. Site visits were performed. Status of WASH and SWM infra was studied by way of recce survey and interviews with the officials. WASH and SWM infra in these ULBs was analyzed and assessed based on the parameters listed above. Gaps and best practices in WASH and SWM identified. Finally, recommendations are made to improve the gaps in WASH and SWM infrastructure.

Mumbai

Mumbai is one of the important cities of the world, is Also, recognized as the most densely populated city Inverse proportion of area and population causes serious impact on its environment. As per data received from Health Department of MCGM the estimated population of Mumbai is 12.87 million with the population density of 26645 person per sq m (excluding no development area). Mumbai is the most densely populated city in India. Mumbai water quality is declared as the best in India. The wastewater treatment projects are being constructed at 8 different places with the option of reuse. The solid waste dumped at landfills has been brought down from 6500 MT/day to 4500 MT/day due to the implementation of Solid Waste Management Rules 2016 and incentives. Though Mumbai was hard hit by COVID, the city received appreciation for effectively fighting the pandemic and bringing it under control.

Plate 1 : Map of Mumbai

WASH

Water Supply:

Mumbai receives raw water from seven impounded water resources viz. Vihar and Tulsi within Mumbai and Tansa, Modak Sagar, Upper Vaitarna, Middle Vaitarna and Bhatasa located at about 100 to 175 kms from Mumbai. Raw water available from these sources is conveyed with transmission main system ranging from 2235 mm to 5500 mm diameter pipelines and tunnels to the state-of-the-art water treatment facilities at Bhandup Complex (2810 M/D) and Panjrapur (1365 MLD) (Total: 4175 MLD). Water treatment facilities for Tulsi (18 MLD) and Vihar (90 MLD) are located near to these sources. At these treatment plants, water is treated with processes such as coagulation, flocculation, settling, rapid sand filtration and post Chlorination and quality of the treated water is maintained in accordance with IS 10500-2012 Drinking water Specifications.

The treated water is stored in the Master Balancing Reservoirs (MBR) located near to treatment plants at Bhandup Complex within Mumbai and Yewai (outside Mumbai). It is further distributed to 27 service reservoirs located throughout Mumbai city with a water supply network of about 450 kms this conveyance system remains charged for 24 hours and eliminates the chances of water contamination because of intrusion of ground water/sewage etc..

Rainwater Harvesting:

BMC supplies **3850 million liters of water every day**, against a demand of 4505 million

liters per day to Mumbai, the economic capital of our country. The demand for a metro city like Mumbai is assumed as 350 lit/capita/day. Against this water is supplied at 300 lit/capita/day. As more and more high-rise buildings are coming up, BMC is not able to fulfill the demand. Also,, the treated water is Also, used for flushing etc.. Therefore, it is necessary to conserve the water by using rainwater harvesting. BMC has made it mandatory to have rainwater harvesting to all new buildings from the year 2002. For bigger residential complexes, Sewage Treatment Plant and recycling of water for flushing and gardening is mandatory.

There are in all 18096 identified wells (4638 dug up wells, 1805 tube wells, 1653 Ring wells) in Mumbai. Assuming an average per day withdrawal of approx. 20000 lit (two tanker load per well, it can be safely presumed that 359 MLD of ground water is available every day in Mumbai. Protecting wells in the city is very important considering future water crises. RWH cell with help of staff of Insecticide officer has prepared list of wells, bore wells in Mumbai. The wells are now being digitized with available subsoil details to understand ground water scenario in each locality & identify the danger zones from ground water extraction considerations. MCGM has Also, prohibited unauthorized burying of existing wells from January 2003.

Sanitation:

Sewage Collection, Treatment and Disposal:

BMC has following departments for the above jobs-

a) **Sewage Operations (SO):** It operates and maintains sewerage systems, sewage pumping stations and sewage treatment plants and disposal systems.

b) **Sewerage Projects (SP):** This department looks after the work of planning and execution of sewerage systems, retrofication in the existing sewerage systems etc..

c) **Mumbai Sewage Disposal Project (MSDP):** This department carries out the work of planning and implementation of Sewage Treatment Plants and Disposal Projects.

SO: Dadar sewage laboratory is operated by this department, and it is accredited by NABL and QCI. The lab monitors water quality at seashore around outfalls at Colaba, Worli and Bandra.

The sewer network of the entire Mumbai is now mapped and available on Geographic Information System (GIS) through web application on MCGM domain. Further under GPS an exercise of mapping the sewerage assets up to 1 meter accuracy with reference to two geographic locations is undertaken by SO department using Handheld Rovers. The repair work of sewer lines, manholes, vent shafts etc.. are systematically being updated, recorded in GIS by following Data Updating Protocol. Also,, the yearly plan of the Systematic Cleaning Programme of sewer lines and its progress is regularly updated in GIS database and monitored through GIS Web application. Under the initiative of Automation of Sewerage Pumping Stations- SCADA system is implemented in phased manner. In its Phase I, total 10 pumping stations of Bandra Sewage Zone & 7 Wastewater Treatment Plants are commissioned in March 2018. With the help of this project Real Time online monitoring of

discharged treated flow is now achieved. Online Monitoring of various parameters of pumping stations i.e. status of pumps, levels in wet wells, energy consumed is achieved. It is seen that all 7 STPs process less than 50% of installed capacity indicating leakage of sewage.

Mumbai Sewage Disposal Projects (MSDP):

In MSDP-I, the zone wise Capacity and average dry weather flow in STPs is as follows:

Table 1: Details of Capacities of STPs under MSDP-I

Sr. No.	Name of STP	Installed Capacity MLD	Average Dry Weather Flow MLD
1	Colaba	41	21
2	Worli	757	257
3	Bandra	797	490
4	Versova	186	99
5	Malad	280	184
6	Bhandup	280	103
7	Ghatkopar	386	96
	Total		
	2727		1250

MSDP-II will have 8 Sewage Treatment Plants (STPs) for 7 Sewerage Zones as mentioned in Table 1 below. The table Also, gives capacities and area requirements of the Sewage Treatment Plants for each sewerage zone.

Table 2: Details of Capacities and Project Areas of STPs under MSDP-II

Zone No.	Name of Zone	Average Flow MLD	Project Area He.
I	Colaba	37	3.3
II	Worli	500	8.6
III	Bandra Bandra WwTF Dharavi WwTF	 360 250	 9.74 5
IV	Versova	240	15
V	Malad	605	35
VI	Bhandup	215	13.8
VII	Ghatkopar	337	14
	Total	2544	104.44

In MSDP – II, for the first time, focus is shifted to reuse and recycle. MCGM shall be creating tertiary treated water of around 1700 MLD in phases based on demand. Recycled water shall be used for non-potable and industrial purposes, charging of fire hydrants. Gardening, car washing, flushing, railways, defense are some other possible uses. Thus, eventually the treated water will not be discharged in sea but will be recycled leading to Zero Liquid Discharge (ZLD). Power generation will be done at STPs from anaerobic digestion of sludge. Generated power will be used for operations of STP. Thus MSDP-II is future ready and equipped for combating climate change.

Input and output characteristics:

Table 3: Input and output Characteristics of Sewage as per MoEF

Sr. No.	Characteristic	Raw Sewage	Treated Sewage at Colaba	Treated Sewage at other sites
1	BOD, 5-day, 20 C	260 mg/lit	10 mg/lit	20 mg/lit
2	COD	560 mg/lit	25 mg/lit	< 50 mg/lit
3	TSS	400 mg/lit	10 mg/lit	50 mg/lit
4	Faecal Coliforms		< 1000 (MPN/100ml)	< 1000 (MPN/100 ml)

Broad details of treatment

Preliminary Treatment: - Coarse Screen. Before Initial Pumping Station

Primary Treatment: - Fine Screens, Grit Chamber, Primary Sedimentation Tank

Secondary Treatment: - Sequential Batch Reactor

Tertiary Treatment: - UV Disinfection

Sludge Treatment: - Sludge Thickening, Anaerobic Sludge Digester, Sludge Dewatering by Centrifuge, Sludge Drying

Power Generation: - Gas Storage, Gas Generation

Pumping: - Pumping of sewage is done in the initial stages after coarse screens (IPS). Bypass arrangement is Also, provided. Treated effluent is pumped after disinfection either into marine outfall or for recycling (EPS). Sludge pumping is done as part of the process in SBR tanks. Thickened Sludge is Also, pumped into Anaerobic digester and for drying.

Automation: - Operations of the STP will be automated using SCADA. Sensors will be used in the SBR basins and the rate of air in the aeration will be adjusted based on the level of dissolved oxygen. This will make the process efficient as well as economic.

Status: Work delayed due to stricter NGT Norms

The work on Colaba STP has already started. Tenders for Bhandup and Ghatkopar STPs are floated in January 2018. Tenders for Versova, Bandra, Dharavi, Worli STPs have floated recently. Green signal for Malad STP is awaited from the central government.

As per the recent development, the National Green Tribunal (NGT) of India has made the norms for the quality of treated sewage more stringent. In an order on April 30, 2019, NGT set a norm of 10 mg/lit BOD (instead of MoEF norm of 20) as the base for all cities in the country (TOI, 2019). NGT has set a norm of 20 mg/lit for suspended solids (instead of MoEF norm of 50 mg/lit), of 100 MPN/100 ml for faecal coliforms (instead of MoEF norm of 1000 MPN/100 ml), of 10 mg/lit for Nitrogen (no MoEF norm earlier) and of 1 mg/lit for Phosphorous (no MoEF norm earlier). This will require retendering and will delay the process by two more years.

In a recent development, the cost has escalated significantly because of retendering. The role of consultants was questioned in the local media. There is a business opportunity of more than US $ 2 Billion in this project.

Storm Water Drains:

Mumbai is lined on the west by Arabian Sea and intercepted by several creeks. The tidal variation is a major concern in the system of storm water drains (SWD) to release rainwater as well as wastewater into the sea. The present SWD system in the city area is more than 100 years old and about 525 Km long. This network consists of underground drains, laterals and water entrances built based on area and weather conditions. The old SWD system is capable of handling rain intensity of 25 mm per hour at low tide with runoff coefficient of 0.5. If the rain intensity exceeds more than 25 mm per hour during high tide, there is always the possibility of water logging in low lying areas of the city.

In practice however, in addition to stormwater, they Also, carry sewage overflow from septic tank, surface water, etc.. The length of open SWD in Mumbai is about 1987 Km. The flow from the open SWD is discharged either into nallhas, culvert, creek or sea. This open SWD becomes an eyesore due to the

throwing of garbage by citizens especially in slum areas and creates unhygienic conditions. Therefore, desilting is carried out through registered contractual agencies throughout the year.

There are 85 major outfalls in the city area which drain to Arabian sea directly, 8 at Mahim creek and 12 at Mahul creek. There are 29 outfalls in western suburbs draining directly into Arabian sea while 14 drain into Mithi river which ultimately joins Mahim creek. In eastern suburbs, 14 outfalls discharge in Thane creek, while 6 discharge in Mahul creek and 8 into Mahim creek. In suburbs and extended suburbs area, open SWD are constructed on both sides of the road.

BRIMSTOWAD Master Plan, constituted after 1985 floods, suggested improvements in SWD system with design criteria, of rainIall intensity of 50 mm/hr with runoff coefficient of 1.00. Subsequently in the year 2005 Mumbai faced unprecedented rains on 26th and 27th July 2005 and 944 mm rainfall was recorded in one day. This resulted in the flooding; therefore, the Government of Maharashtra had appointed a fact-finding Committee to analyze the factors responsible for the situation that arose in Mumbai and to find out the remedial measures to avoid such incident in future. Based on the recommendations of the Fact-Finding Committee, the BRIMSTOWAD Master Plan was modified with MWH(I) as consultant on 30/04/2018.

BRIMSTOWAD project is proposed to be implemented in two phases. There are 20 works in Phase-I and 38 works in Phase-II. The scope of the BRIMSTOWAD project is as below.

1. Rehabilitation and augmentation of underground drains in the city.
2. Construction of new drains in RCC.
3. Training oI nallhas in RCC M-40
4. Widening and deepening of nallhas
5. Construction of access road along the nallah
6. Construction of Stormwater Pumping Stations.

Table 4: Status of Pumping Stations under BRIMSTOWAD

Sr. No.	Pumping Station	Status
1	Haji Ali	Completed & commissioned in the month of May 2011
2	Irla	Completed & commissioned in the month of May 2011
3	Cleaveland	Completed & commissioned
4	Lovegrove	Completed & commissioned
5	Brittania	Completed & commissioned in the month of June 2016
6	Gazdarbund	Completed & commissioned in the month of June 2019
7	Mogra	Land acquisition of private land is in progress
8	Mahul	Land acquisition of private land is in progress

Desilting of Nallahs:

This is an important activity to avoid flooding during monsoon. 60% of the work is carried out before monsoon, 20% during monsoon and 20% post monsoon. 50% of the work is done by BMC staff and 50% by NGOs. As manual cleaning is prohibited, machinery such as firex, suction, jeeting etc.. are used for desilting operations.

Mithi River Development:

Government of Maharashtra has formed “Mithi River Development and Protection

Authority" under the Chairmanship of Honorable Chief Minister of Maharashtra State on 19th August 2005 for improvement of the Mithi River. The total length of Mithi River is 17.8 Km, out of which a length of 11.84 Km is in the jurisdiction of BMC and the balance length of 6 Km is under Jurisdiction of MMRDA. 95% widening and deepening oI Mithi river has been completed till date. MIAL will construct 840 m length of retaining wall and maintain it.

Health:

BMC has robust health infrastructure throughout the city.

Table 5: Three Tier Health Infrastructure System in BMC

PRIMARY	Health Posts	208
	Dispensaries	185
	Maternity Homes	28
SECONDARY	Peripheral hospitals	17
	Specialty hospitals	5
TERTIARY	Major hospitals (Medical and Dental Colleges) (5 Main hospitals and 1 HBT hospital joint with Cooper hospital	5

Environmental Pollution Research Centers at KEM Hospital is doing phenomenal work.

Table 6: Report of different diseases in Mumbai (April 2019 – March 2020)

Sr. No.	Disease	Number of patients	Death
1	Malaria	1691	-
2	Dengue	3031	3
3	Lepto	298	2
4	H1N1	159	11
5	COVID-19	168	4

The report shows cases of Malaria and Dengue. Awareness is needed about the preventive measures. Awareness is Also, needed about the health infrastructure of BMC in different parts of the city.

Challenges in WASH:

1. The Service Level Benchmarks are not available like Pune and Kolhapur.
2. There are frequent cases of water contamination due to ongoing construction activities. It is necessary to keep track of them and the resolution.
3. Water metering and its digitization is absent. This makes it difficult to keep track of NRW.
4. A water balance diagram for city level is not available.
5. Financial data for water infrastructure is not available.
6. Like Pune, there is no financial incentive available for rainwater harvesting in existing buildings.
7. Pollution of water bodies like Mithi, Dahisar, Poisar rivers and sea by sewage, plastic etc..
8. Flooding during rainy season
9. Non availability of sewage treatment at Malad.
10. Health issues due to the spread of dengue and other water borne diseases.
11. Health issues due to air pollution.

Framework for Site Visits - WASH:

1. Feedback of leadership and staff at AIILSG will be taken before finalizing the framework for site visits.
2. Discussions will be held with the top leadership of BMC such as Municipal Commissioner, Assistant Municipal Commissioners.
3. Public representatives and Ward officers will be Also, contacted.

4. Detailed discussions will be undertaken with the officers of the Water Supply Department and a small one-hour meeting will be organized to take their feedback.
5. Site visits at Water Treatment Plants (WTPs) at Bhandup Complex, Panjrapur, Tulsi, Vihar will be organized.
6. Water distribution systems, ESRs, and Water Testing Labs will be observed.
7. Other stakeholders such as Citizens, NGOs, Water entrepreneurs, academic community will be contacted for developing community partnerships.
8. A standard questionnaire will be prepared to capture the latest data on Water Supply, support needed for sustenance of Water infrastructure based on which recommendations will be made.
9. It is proposed to keep the final recommendations for sustenance of Water infrastructure before the stakeholders give feedback before finalization.
10. Site visits will be organized to Sewage Treatment Plants at Colaba, Worli, Bandra, Versova, Malad, Ghatkopar and Bhandup. Major rivers such as Meethi, Dahisar, Poisar as well as nallahs such as Mogra and those mentioned in the Brimstowad report will be visited.
11. Citizen's representatives, NGOs and other stakeholders will be contacted.
12. Health authorities at KEM hospital, especially chest medicine department, BMC Health Department etc.. will be contacted regarding the feedback.

Questionnaire WASH:

1. What is the per capita water supplied?
2. What is the existing infrastructure for sources of water, its treatment and distribution?
3. Do all areas get water in enough quantity and quality? Are there any complaints regarding the quality of water?
4. Any issues due to flooding in the last 2-3 years?
5. What are the issues regarding O&M of WTPs, pumping stations, ESRs, Distribution systems?
6. How are the finances raised for the Water infrastructure? Is PPP model tried?
7. What are the taxes collected for the O&M of Water infrastructure?
8. What is the existing infrastructure for sewage collection and its treatment?
9. What is the generation of sewage? What is the collection of sewage? What % of sewage is treated?
10. What is the status of septic tanks?
11. Are any detailed project reports prepared for improvement of sanitation infrastructure such as sewerage systems, sewage treatment plants etc..
12. What is the existing system of treating sewage? What are the improvements needed?
13. What are the existing byelaws for the new buildings regarding sewage treatment and recycling? How are these rules monitored?
14. How are the other stakeholders such as citizens and professional associations involved? Are any IEC programs and media are involved?
15. Are there any plans to monitor the quality of Panchganga river and Nallahs in their stretc.h? Are there any projects planned to revive the nallahs?
16. Are there any issues related to water pollution caused by industries?
17. What are the issues regarding O&M of STPs, sewage pumping stations?

18. How are the finances raised for the Sanitation infrastructure? Is PPP model tried?
19. What are the taxes collected for the O&M of sanitation infrastructure? Are user charges levied for public toilets, community toilets?
20. How many ODF++ projects implemented? Are SHGs involved in the maintenance?
21. Any general suggestions regarding the improvement of sewage collection, treatment infrastructure and quality water in river and nallahs?
22. Any feedback about health issues and infrastructure and plans for improvements?

Site Visits Wash:

The site visits were carried out Water Supply, Storm Water Drains and Sewerage Operations Departments. Meetings and interviews were conducted with the key officials of the departments and valuable information is collected for the Research Study. The details are as follows: -

1. Water Supply Department:

The Chief Hydraulic Engineer of Municipal Corporation of Greater Mumbai (MCGM) was contacted (email: hydraulicengineer@mcgm.gov.in) for information and questionnaire related to Water Supply Department of Mumbai. The information related to the water supply of Mumbai, framework for site visits and questionnaire was separated and sent to Hydraulic Engineer by email. As per his direction, the meeting was arranged with Executive Engineer of the Water Supply Department, Mr. Kotkar at the Engineering Hub Building, Worli on March 17, 2023, in the second half. The discussion took place in interview format and the questions in the questionnaire were answered in a consolidated format rather than one to one.

Plate 2: Site Visit Water Supply Department, MCGM, with Mr. Kotkar, Executive Engineer,

Dr. Kulkarni met Mr. Kotkar in the second half of March 17. The response of Mr. Kotkar to the questionnaire is as follows: -

“Mumbai is supplied water at the rate of 3850 million Liters per Day. The minimum supply ensured by the ULB - MCGM or BMC (Brihan-Mumbai Municipal Corporation) is 135 lpcd. However, at many places the water supplied is more than this. Chitale committee appointed by the Government of Maharashtra has recommended that Mumbai is a Metropolitan city and commercial capital of India, and the water should be supplied at 240 lpcd.

He said that the leakages are minimum, but water is lost due to thefts. There are many unauthorized connections. For permission to water connection 23 different approvals need to be taken. (As per a report in Maharashtra Times dated 24/03/2023, though officially the process of approvals should be completed in 15 days, this sometimes takes 6 months). Fourteen services of Water Supply Department are online now.

The problem of contamination is minimal. Sometimes when a connection is terminated, it is not sealed properly, and this results in contamination. Water mains are normally 3 feet down below ground. Sometimes there are

difficulties reaching this depth and this results in contamination.

Due to excess population growth, sometimes less supply issues take place. Redevelopment of buildings results in tripling the population. However, the diameter of the water supply line remains the same and it takes a long time to replace the same. This results in water scarcity.

There was a study conducted by M/s Suez Environment to estimate the leak detection in H-West and T wards. It was found that the water lost due to leakages was very low. Thus, the major sources of Non-Revenue Water (NRW) are thefts and unauthorized connections. On one occasion, it was revealed that the water tunnel was punctured at 5 places which resulted in a loss of Rs 8 to 10 Cr.

Service Level Benchmarks are mentioned on Performance Assessment Portal. Coverage is 100%. It is not feasible to execute 24 x 7 water supply. This requires 100% water metering per flat. One of the O&M challenges is the water meters. Only 50% of the water meters are working. They are not digital and are of analogue type. Many manufacturers use plastic parts instead of brass. This has resulted in higher water bills in some cases as sometimes the indicator moves due to air.

As per current DP condition, it is necessary to have separate tanks at ground level for Drinking and Flushing water. But in many old buildings there is a single tank on each floor. Also,, where the two separate tanks are provided, they are connected by an internal pipe. This makes it difficult to use treated or recycled water for flushing.

The use of electromagnetic and electronic sensor meters is limited. This poses hurdles in digitization of water supply system.

The manpower structure of the Water Supply Department is like this. It is headed by (Chief) Hydraulic Engineer who reports to Assistant Municipal Commissioner who in turn reports to Municipal Commissioner. Under Hydraulic Engineer, there are 12 Deputy Hydraulic Engineers. There are 6 Executive Engineers, 2 each for City, Eastern Suburbs and Western Suburbs. There are 24 wards in BMC and each Executive Engineer is responsible for around 4 wards. At each ward, there is one AE (Water Works) who is supported by Sub Engineer and Junior Engineer. In addition, there are blue collar staff like Mistry. As discussed earlier, Water Treatment Plants are located at Bhandup Complex and Pise. There is a Master Balancing Reservoir at Bhandup Complex and Yewai and water is supplied to 27 service reservoirs located in various parts of city by gravity. This results in considerable saving of energy.

The major sources of water are lakes which are located in forests and therefore the quality of treated water is very good, and it is best in India. Water quality is monitored continuously. 125 samples are tested daily in the BMC laboratory at G-North ward. As per the norm, 1 sample should be tested per day for 10000 people. This norm is complied with. Every month there are 3300 to 3500 samples tested for all parameters including MPN as specified in IS 14500.

Rainwater Harvesting (RWH) is now included as one of the DP conditions for every new building. However, there is no effective monitoring mechanism. There is one Rainwater Harvesting Cell under the Water Supply Department. It only provides technical support. (Dr. Kulkarni raised the point of efficacy of ground water recharge (as method of rainwater harvesting) in Mumbai considering the chances of Marine water intrusion.

As per DP requirement large number of STPs are operational in city particularly for big

projects with more than 2000 sqm built up area. But there are many complaints from residents, and this requires effective monitoring.

There are more than 18000 wells, and they are monitored by the Health Department. There are several bore wells operating in the city and they need effective monitoring to check over exploitation.

BMC gives water to ZP to supply villages. However, the water is supplied without comprehensive treatment."

Participating in the panel discussion on water in Maharashtra Times, Mr. Chakradhar Kandalkar, (Deputy Municipal Commissioner, Special Engineering-Hydraulic Engineer and Water Supply/Chief Engineer) stated that the treated sewage from Colaba STP is going to be recycled and a center is going to be established for the same. The capacity for this recycles center will be 12 MLD. A consultant has been appointed for this project and the next process is in progress. He Also, mentioned that a desalination project is being planned at Manori to convert sea water into drinking water. The consultant has prepared a Detailed Project Report and tendering process is on. In the first phase 200 MLD project will be executed and in the second phase additional 200 MLD project will be executed.

2. Storm Water Department:

The Chief Engineer, Storm Water Department of Municipal Corporation of Greater Mumbai (MCGM) was contacted (email: che.swd@mcgm.gov.in) for information and questionnaire related to Water Supply Department of Mumbai. The information related to the stormwater department of Mumbai, framework for site visits and questionnaire was separated and sent to Hydraulic Engineer by email. The meeting was arranged with Executive Engineer of the Storm Water Department, Mr. Gotarne (who is Also, holding the additional charge of Deputy Chief Engineer) at the Storm Water Department Office, Senapati Bapat Road, Dadar (West) on March 17, 2023, in the first half. The discussion took place in interview format and the questions in the questionnaire were answered in a consolidated format rather than one to one.

Regarding funding, Mr Gotarne informed us that funding is available from AMRUT, and 15th plan through Central Government. Sewerage tax is charged just 2 to 3% of water tax. Water is charged at the rate of around Rs 5 per m^3 for domestic use and Rs 60 per m^3 for commercial use. STPs are being constructed from self-funds.

Plate 3: Site Visit to Storm Water Department, with Executive Engineer Mr. Gotarne & team

Storm water drains (SWD) are designed to carry rainwater. But in practice they carry sewage to many places particularly in slums. SWDs are mostly underground. In the City (South Mumbai), there is 607 Km underground SWD pipeline. Some of them are constructed during the British period and made up of bricks. Open nallahs are Also, provided as SWDs particularly at some locations in suburbs. The storm water drains are telescopic in nature. They start with small diameters in lanes and end in big outfalls near disposal points in the sea.

Preventive maintenance is carried out. Before monsoon 100% cleaning is carried out. Systematic cleaning started in the year 2011-12. As manual scavenging is banned, machines are used for cleaning the SWDs. Manholes are located at C/C distance of 30 m. The reach of suction system of cleaning machine is only up to 5 m from both the ends. Hence there are problems in cleaning the central 20 m portion. Hence decrease in the C/C distance of manholes is under consideration for effective cleaning. CCTV scenarios before and after the cleaning are captured.

Plate 4: Mechanical Cleaning System : Storm Water Drains

Plate 5 : Mechanical Cleaning System - Sewers

Plate 6: Office of Deputy Chief Engineer, Storm Water Drains

Normally storm water drains are laid at the center of road underground and the storm water is collected through the gratings/traps laid at the side of the road. Many times shops, restaurants and other establishments dump their garbage in these gratings and this leads to the clogging of storm water drains. This problem recurs at the storm water drain at the famous *Khau Galli* near Churchgate station. Community toilets are connected to sewer system however the sullage/sewage from slums is many times connected to SWDs in an illegal manner. Thus, there is great need for awareness campaigns to improve civic sense to avoid clogging of SWDs and resultant flooding. Many times, the outfalls near the sea get clogged due to dumping from slums. Hence there is reverse flow during monsoon which results in flooding.

There are different cables of different utilities like sewer, water, electricity, gas, telephone etc.., which poses difficulties during maintenance work.

As stated above, BRIMSTOWAD project has made substantial recommendations to improve the storm water drainage infrastructure. The assumed rainfall intensity was increased from 25 mm to 50 mm and the coefficient of runoff increased from 0.5 to 1. It was necessary to widen the sizes of storm water drains to accommodate this additional discharge. This widening work is almost

complete. It was decided to build pumping stations at selected locations and the work of the same is almost complete as mentioned in Table 4 above.

There are some flooding prone spots like Hindmata theatre near Parel, Milan Subway, Santacruz, Gandhi market, Sion. Holding ponds are constructed at Dadar, St, Xavier's college and Milan Subway. Flood gate is being installed at Mogra Nalla on priority basis to stop the flooding at Andheri. Special pumping arrangements are implemented at Gandhi market, Sion. These arrangements have substantially reduced flooding in these spots.

Mumbai has four rivers: - Meethi, Dahisar, Poisar and Oshivara. They are supposed to carry rainwater. However, due to discharge of sewage, industrial wastes etc.. they are converted into Nallahs. BMC has appointed M/s Freshman Prabhu as consultants for revival of Meethi River and they have suggested 4 packets of works for the revival. Out of these packets, packet 1 is complete and remains on its way. As per these recommendations, the flow of sewage in Meethi River will be intercepted and it will be added to the river only after treatment. Project DPR will be made and executed. The tenders for Dahisar and Oshiwara river are in final stages. Reports are being made on the Poisar river Also,.

Sewerage Operations Department:

The Chief Engineer, SO, Mr. Satish Chavan was contacted (email: che.so@mcgm.gov.in) and the framework for site visit and questionnaire was sent to him. Mr. Kenia AE was contacted, and he advised meeting Dr. Ajit Salvi, Deputy Chief Engineer (SO) to collect data for the Research study. Site visit to Sewerage Operations Department at Bhyculla, Opposite J. J. Hospital was carried out on March 15, 2023. In spite of a busy schedule due to the assembly session, Dr. Salvi and his team were kind enough to give their time and answer all query related to research study.

Plate 7: Site Visit – DCE, SO Office City

Plate 8: Site Visit – QA session with Dr. Ajit Salvi, Deputy Chief Engineer, SO, BMC

Plate 9: QA Session with Executive Engineer, SO, Mr. Vinayak Gawas

Mr. Vinayak Gawas informed that SO departments operate 2000 Km sewer network which has 74000 manholes. The coverage by sewer lines is 97% as per the information given by Mr. Gawas. The 3% area which is not covered is mostly in the suburbs. In slums sewerage system is non-existent. The slum dwellers use public toilets which are

connected to sewerage system. However, the sullage is connected to storm water drains. With the new law banning manual scavenging, these manholes have become machine holes. The staff from the SO department mainly have mechanical engineering background.

The sewer diameter increases telescopically from 9" (230 mm) to 1800 mm diameter. Old sewers in the city are made up of brickwork. Desilting sewers are done with machines. Mechanization started from the year 1985 onwards. Power buckets, Power bench machines, suction units, Jetting units, Recycling units (Primary filtration) are used for jetting.

People dump so many things in sewer lines which results in their clogging. For example, public toilets discharge sanitary napkins, plastic bags etc.. Sometimes corps and fetuses are Also, found in sewer lines. The building sewer diameter is 6" while the road sewer diameter is 9". In the areas where sewer lines are not available, the building sewers are connected to storm water drains which are mainly covered but sometimes open Also,. Traps in the tenanted buildings are not maintained properly in the old, tenanted buildings. This results in O&M issues. The citizens can launch online complaints which are resolved in 24 hours. There is a dedicated control room with numbers 022-23717261/8363. City, Eastern and Western Suburbs are covered.

The water supplied to Mumbai is 3850 MLD. The installed capacity of STPs of Mumbai is 2190 MLD. However, the average dry weather flow is 1400 MLD which is around 64% of installed capacity. However, during monsoon 2 to 3 times the average dry weather flow is processed at the STPs. If 90% of supplied water is contributed as sewage, only 40% of this sewage reaches STPs. Thus 60% of sewage (2310 MLD) does not reach STPs and is lost. It is true that some of the sewage is treated at STPs in big residential complexes. Even then significant sewage is lost either through discharge in sea or percolation in ground. It is necessary to draw a water balance diagram for the city and efforts should be made to reduce the water footprint.

Best Practices in WASH:

1. Enough water is supplied to the citizens of Mumbai. The complaints of scarcity are minimum.
2. Regarding the quality of water Also, Mumbai city is best in India. Enough samples are collected, and the quality of water is tested continuously.
3. WTP at Bhandup Complex is the biggest in Asia. It is equipped with the state-of-the-art master control center with PLC and SCADA technology.
4. Both WTPs at Bhandup Complex and Panjrapur are operated nicely.
5. Separate and underground sewerage systems and storm water drainage system is provided to almost entire part of the city (97%).
6. Seven STPs with the latest technology are deployed at various locations in City, Eastern Suburbs and Western Suburbs for the treatment of 2190 MLD of sewage.
7. Online 24x7 complaints resolution mechanism is established.
8. BMC is the richest ULB in Asia and enough funds are made available for WASH projects.

Recommendations for addressing WASH O&M Challenges:

1. Challenge: - Fifty percent of the water meters are not in working condition. They are of mechanical/analog time.

Recommendation: - It is recommended to change the water meters from analog

types with electromagnetic/electronic sensor type. They can be connected to mobile apps and the consumption/wastage can be tracked online. This will help in reducing the loss due to leakages/thefts.

2. Challenge: - The water meters are provided at buildings. But the individual flats/consumers in society are not provided with the water meters. This results in excessive consumption as there is no incentive to save water like electricity.

Recommendation: - Now-a-days many start-ups have come up with solutions which use electronic meters which can be connected to cloud based mobile apps. It is recommended to try such solutions at selected buildings through BMC and then scale up the solutions to other buildings. It is recommended to attempt these solutions at commercial buildings where the rates of water are high (Rs 60 per m^3) and there is incentive to reduce water consumption. **It is decided to run a pilot project with individual electronic meters in a commercial building in Andheri area in collaboration with BMC.**

3. Challenge: - Clogging of storm water drains, sewers and nallahs.

Recommendation: - This needs a lot of public awareness campaigns. This should be followed by huge penalties which will deter the erring persons to litter. CCTV cameras should be used to nab the culprits. Technology like screens should be used to collect the plastic and other materials at the mouth of the rivers like Mithi. This technology is successfully used in Australia. Floating brooms are used in Mithi river, but there are allegations that the trapped garbage is not cleared immediately which gives rise to breeding of mosquitoes. In a report in Maharashtra Times dated March 24, 2023, there are allegations that the sludge which is removed by contractors from a river/nallah is again deposited in another river/nallah. The sludge is supposed to be treated at Taloja. But it is not done. Use of technology like GPS should be made to stop the malpractice if any. Blacklisting of contractors should be done if anyone is found doing such malpractice.

4. Pollution of water bodies due to discharge of wastewater.

Recommendation: - It is necessary to intercept and treat the sewage and dispose of the treated water in rivers and nallahs. This is already in progress at Mithi, Dahisar, Poisar and Oshiwara rivers. But it is necessary to increase the speed of the projects. Beautification of the riverbanks is Also, recommended. It is Also, necessary to intercept other outfalls which are disposing sewage into the sea and treat it before disposal into sea. This will ensure that pollution of water bodies is stopped.

5. 60% Sewage does not reach STPs.

Recommendation: - The sewage is lost due to various reasons like leakage in septic tanks, discharge into nallahs etc.. Sewage or wastewater is a resource, and efforts must be made to collect all the sewage, treat and recycle it and reduce water footprints. As discussed above, it is necessary to intercept the untreated sewage, treat and recycle it. Vigilance should be observed on septic tanks and storm water drains. Discharges from storm water drains should be treated during the dry season.

6. Inadequate recycling of treated sewage

Recommendation: - In countries like UAE, 95% of water is recycled. In Mumbai around 100 MLD treated sewage is available through STPs executed in MSDP-I. However, this treated sewage is disposed of in the sea. In MSDP-II, a consultant is appointed to suggest reuse of 12 MLD treated sewage at Colaba. However, this quantity is very small compared to the potential. **It is suggested that the BMC administration and engineers should study the examples of countries like UAE, Singapore and replicate it in Mumbai. This will be a big step towards reducing water footprint and sustainability.**

7. Absence of dual water systems
   Recommendation: - It is recommended to strictly implement dual water systems for Drinking and Flushing water. In many buildings drinking and flushing tanks are interconnected. This should be strictly prohibited. Also, in existing buildings, it should be made mandatory to provide separate systems for flushing water. This will avoid waste of costly treated water for flushing.

Solid Waste Management:

Solid waste generated in Mumbai is around 6500 to 6800 MTPD. This is transported to disposal sites by 1676 trips/day. The composition of dry waste from Mumbai is as follows: -

Table 7: Composition of Dry Waste in Mumbai

Sr. No.	Type of Solid Waste	Percentage
1	Food waste (Organic – wet)	72.6%
2	Wood, Cloth (Organic – dry)	3.51%
3	Sand, stone & fine earth (inerts)	17.37%
4	Plastic	3.24%
5	Paper & recyclables (including metals)	3.28%
		100

Source: NEERI Report 2016

Out of the total garbage generated 75% is processed at Kanjurmarg using Bioreactor and Windrow composting technology and 25% is disposed at Deonar where it is just spread in layers. Scientific closure project at Gorai is completed and O&M is in progress there. Deonar dumping ground has exhausted its capacity to receive the garbage. The activity of receiving fresh MSW at Mulund Dumping ground is stopped w.e.f. 21/12/2018 and the project work of recovering the land by processing the existing garbage with suitable technology is in progress.

Table 8: Capacities of various dumping sites in Mumbai

Sr. No.	Disposal Site	Area (Ha)	No of years in use	SWM in T/day
1	Deonar	120	88	1200-1700
2	Mulund	24	47	Stopped 2018
3	Kanjur Marg	65.96	4	4500 – 5500

There are 2110 no of 1.1cubic meter containers, 949 community collection points and 100% of total garbage is collected through House-to-House collection.

The number of services by various types of vehicles are as follows: -

Compactors 1584

Dumpers/Refuse vehicles 126

Tempo/Jeeps 4092

JCB Machines 63

Stationary compactors 80

Mumbai is declared as ODF+ by QCI on 22nd December 2019. Swacchata App developed by MoHUA is used for recording complaints of citizens and 99% complaints are resolved. Solid Waste Management Rules 2016 are strictly followed. Bulk generators are required to recycle dry waste and compost wet waste. Out of 3367 bulk generators 1696 have adopted this regulation. Waste going to the dumping ground has been reduced from 8500 MT per day to 6500-6800 MT/day. Mumbai takes part in Swachh Sarvekshan every year and IEC campaigns are launched in 24 administrative wards. 52 Ha of additional land is allocated to BMC for solid waste processing near Taloja.

Dry Waste Collection Centres:

BMC has set up 46 dry waste collection centres in 24 wards. 96 number of separate vehicles are deployed to collect dry waste. Associations of rag pickers and waste pickers are allotted jobs and space for dry waste segregation. Segregation is around 82%. Recovery from waste is 35%, which is less than the service level benchmark.

Pelltisation Project: Pelletisation “Green Coal '' Project of capacity 10 MT/Day is in operation since May 2014 through private operator M/s CIPL Resurge in N Ward. In this project, tree cuttings, green waste from gardens, coconut leaves and coconut shells are processed and converted into Briquettes/ pellets i.e. “Green Coal '' by pelletisation process. In addition, 2 new projects of M/s Godrej Industries of processing approximately 10 MT/Day green waste collected from 24 wards of BMC is processed in this project.

Bio-Medical Waste from hospitals etc.. is processed by BMC through M/s EnvoClean at Mankhurd Ghatkopar road near Deonar. They collect BMW through 46 vehicles and process it there. Authorization of MPCB is received.

E-Waste and Hazardous waste are recycled through authorized recycles.

Challenges:

1. Segregation at source is a challenge.
2. Many vehicles are not available for collecting dry waste.
3. There are complaints from the neighborhood about the processing of solid waste processing plants at Deonar and BMW plant at Govandi.
4. Waste recovery from waste is only 35%.
5. The incentives given for composting of wet waste and recycling of dry waste are not processed and there is no data available about the same.
6. There is scope for more waste to energy projects.

Framework for Site Visits:

1. Feedback of leadership and staff at AIILSG will be taken before finalizing the framework for site visits.
2. Discussions will be held with the top leadership of BMC such as Municipal Commissioner, Assistant Municipal Commissioners.
3. Public representatives and Ward officers will be Also, contacted.
4. Detailed discussions will be undertaken with the officers of the Solid Waste Department and a small one-hour meeting will be organized to take their feedback.

5. Site visits at Solid Waste Disposal sites at Deonar, Kanjur Marg, Mulund will be organized.
6. Waste Collection systems, Dry Waste Centers will be observed.
7. Other stakeholders such as Citizens, NGOs, SWM entrepreneurs, academic community will be contacted for developing community partnerships.
8. The scope of technology such as AI, ML etc.. resolving the issues of scientific closure of landfill sites will be explored.
9. A standard questionnaire will be prepared to capture the latest data on Water Supply, support needed for sustenance of Water infrastructure based on which recommendations will be made.
10. It is proposed to keep the final recommendations for sustenance of SWM infrastructure before the stakeholders for their feedback before finalization.
11. The Feasibility Study Report (FSR) will be prepared for all the components of Integrated Solid Waste Management of BMC for the requirement for next 20 years considering gap analysis to conform to SWM Rules 2016, CPHEEO SWM Manual 2016 will be referred.
12. All aspects such as collection and transport (C&T), Processing by different options such as composting, bio-methanation, waste to energy etc.. Disposal by sanitary landfills etc.. will be considered while preparing project reports in FSR.
13. The existing capacity of Collection and Transportation (C&T) facility will be assessed and a suitable mechanism to improve the C&T process will be proposed. The use of technology like GPS and RFID for tracking the collection will be explored.
14. Different components of Integrated Solid Waste management such as Dry Waste, C&D waste, RDF, Garden waste, E-Waste, Plastic & Thermocol waste will be considered, and project reports will be included for these components.
15. Legacy waste at landfills will be quantified. The existing arrangements like bio-mining and capping will be studied. Projects will be suggested if gaps exist. O&M after 15 years of capping will be suggested.
16. Leachate management, environmental issues of existing and future landfills will be considered.
17. Marketing of compost, RDF, Plastic waste, tetrapack waste, energy etc.., will be discussed. Linkages will be developed with farmers' bodies, cement and sugar factories etc.., for the same.

Questionnaire for SWM:

1. What is the solid waste generated in different categories at present? What is the per capita contribution? What is the solid waste generation expected in 20 years and what are the future?
2. What are the challenges in the existing system? What support is required from the government and private sector?
3. What are the financial resources allocated for SWM? Are any taxes collected from the public for SWM? Are any user charges levied? What is the revenue generated from all sources for SWM such as fines, penalties etc..?
4. What is the financial viability of the existing system? How is the O&M of

existing vehicles, laredfill sites etc.. carried out?

5. How many employees are available for SWM? Are there any efforts made for their capacity building?
6. What is the revenue generated from selling dry waste category wise?
7. How is dry waste such as plastic, thermocol, glass, paper etc.. processed?
8. What arrangements are made for C&D waste, E-Waste, tetrapack, wood/garden waste etc..
9. What land is available with SWM deptt for existing projects and future projects?
10. How are entrepreneurs engaged?
11. How are waste pickers, SHGs, NGOs etc.. involved in SWM activities?
12. How is community participation ensured in SWM? Are any IEC campaigns launched?
13. What is the performance of the city in Swachh Sarvekshan 2022?

Site Visits:

The Chief Engineer, Solid Waste Management, BMC office at Grant Road was visited on March 13, 2023. Before the visit, framework for site visits and a questionnaire was sent to him by email. A detailed discussion took place with him and Executive Engineer, SWM Mr. Nitin Parab.

Plate 10: Site Visit: With Chief Engineer SWM Mr. Prashant Tayshete and EE Mr. Nitin Parab

During the interview, the Chief Engineer Mr. Tayshete informed that now most of the solid waste is processed at Kanjurmarg in Eastern Suburb on the land of 118.41 hectares. The quantity of waste varies from 3000 to 6500 TPD with an average of 5500 TPD. Out of this 4000 to 4500 TPD is treated by Bioreactor Land filling. Under this technology, 1 to 4 MW electricity is generated from biogas which is used for internal purposes. The leachate generated is recycled into the reactor. The waste treated is mixed and not segregated.

1000 TPD solid waste is segregated by using Material Recovery Facility (MRF) and the segregated wet waste is treated by windrows composting. The compost generated is sold to RCF through a bidding process.

The contract is awarded to Anthony (India) & Lara (Brazil) JV for 25 years (13.02.2011 to 12.02.2036). The tipping fee paid is Rs 795/- per ton.

Deonar dumping ground is almost full to its capacity. Controlled dumping is undertaken there and 600 to 800 TPD of waste is processed. A Waste to Energy project of 600 TPD is in progress at Deonar.

Thus, total MSW transported in 6400 MT/Day.

Total Construction & Demolition (C&D) Waste transported is 800 MT/day. Contractors are appointed at Gorai and Thane to convert C&D waste into concrete blocks.

Bio-medical waste transported is 24 MT/day. It is treated by incineration at Govandi. There are complaints by residents of the surrounding area regarding the air pollution created by the same and efforts are going on to shift it out of Mumbai.

There are 46 dry waste segregation centers throughout Mumbai and 180 MT/day dry waste is segregated there and recycled. These are operated by various NGOs. At dry waste centers like Bandra (W) and Andheri (E), arrangements are made to segregate plastic waste and generate raw material for plastic manufacturing with machines. This initiative is supported by UNEP and CSR funds of Hindustan Unilever.

BMC has 24 municipal wards. In each ward there are good staff appointed in SWM department. There is one AE-SWM who gets the support of a Junior Engineer. There are 3-4 supervisors, 4-5 Junior Officers, and 8-10 Mukadams.

There are 3 Deputy Chief Engineers (Operations) to look after City, Eastern and Western suburbs and 7 Executive Engineers for seven zones. Under each Executive Engineer, there are 3 to 4 wards.

Best Practices:

1. BMC has an Advanced Locality Management (ALM) system in each ward. They are a group of citizens which support BMC in SWM works like segregation of waste apart from representing and resolving civic issues.
2. The SWM department is well structured and well-staffed.
3. BMC has made it mandatory for bulk generators that its organizations generating more than 100 Kg/Day solid waste to compost wet waste and recycle dry waste. Segregation of wastes is mandatory as per MSW Rules 2016. There are many success stories generated due to this and they are showcased for other organizations/housing societies.
4. BMC has provided employment to waste pickers through NGOs like Stree Mukti Saghatana, Aakar, Asara, etc..
5. BMC has supported NGOs like Prakruti Education and Research Foundation (PERF) in their efforts to recycle Thermocol.
6. BMC gives rebate in property tax for the residential housing societies which are composting wet waste, recycling dry waste and doing rainwater harvesting and recycling treated sewage.

Recommendations for addressing SWM O&M Challenges:

1. Challenge: Segregation of waste at source is the biggest challenge. Also,, it is difficult to maintain segregation at the collection and transportation stage.

   Recommendation: The problem of segregation should be tackled with a multi-prong approach. The awareness with the help of IEC and posters should be continuously undertaken. This should be followed by a penalty which will act as a deterrent. The ALMs should be effectively used for the purpose of segregation. The housekeeping staff many times mix

the segregated waste. This problem should be Also, tackled with awareness, incentives and penalties. Dry waste vehicles collect the dry waste from the buildings only once or twice a week. Their number is inadequate. This results in mixing of waste during transportation. To avoid this, vehicles with multiple compartments for wet, dry and domestic hazardous wastes should be purchased. Also,, the transport persons should insist on segregated waste. NGOs should be trained and incentivized on segregation of mixed waste if any. More NGOs can be roped in to face the challenge.

2. Challenge: Issues related to garden waste, wood waste, MLP

   Recommendation: Proper arrangement of composting of garden waste is not done. The palm leaves, coconuts cannot be composted easily. It is recommended to provide shredders in municipal gardens for shredding this type of garden waste. Other garden waste like leaves etc.. can be easily composted within the premises by using technology like vermi-composting, bio-composting etc.. MLP and other light plastic bags cannot be recycled. It is necessary to develop a supply chain for cement factories which can take this waste provided there is enough. For MLP, there is an NGO which accepts MLP and converts it into furniture. But they required large quantity and awareness can be created about the same.

   Godrej is working on a plant to develop RDF from garden waste. But this is on a small scale and needs to be scaled up.

   Cities like Toronto in Canada have made a lot of progress in converting used furniture products into useful byproducts and these technologies should be studied and replicated. There are 17 types of dry wastes, and it is necessary to develop proper database and material balance with respect to materials recycled and revenue generated.

3. Issues related to Composting.

   Recommendation: - After home composting or decentralized composting made mandatory, many complaints are coming up like quality of compost, foul smells etc.. There were confusions regarding the use of technology and use of standard operating protocol. To address this problem Swachh Maharashtra Mission appointed Dr. Milind Kulkarni to prepare “Home Composting Guidelines”. The project was sponsored by GIZ. These guidelines are comprehensive and can be circulated to ULBs and citizens to guide regarding the issues discussed. The guidelines are enclosed along with this report.

4. Challenge: - Inadequate number of Waste to Energy Projects

   Recommendation: - The wet waste can be converted into compressed biogas (CBG). There are many oil companies who can purchase CNG, and the project becomes viable under PPP model. Indore Municipal Corporation has successfully commissioned such a project and it needs to be replicated by BMC at several places in the city. This will generate renewable energy and help in meeting the targets of net zero by our country as declared by PM Shri Narendra Modi ji as part of Panchamrut target at COP25. This will Also, save our valuable foreign exchange.

5. Challenge: - Technical issues related to software for property tax rebate.
   Solution: - BMC has developed the software app My Waste. Housing societies need to upload data on this app before claiming a rebate on property tax. However, there are technical issues with respect to this app and very few societies can upload data. It is necessary to revamp this app and make it user friendly or make a new user-friendly app. It is necessary to collect the data from all housing societies on this app.
6. Challenge: - Issues related to bulk generators
   Solution: - Many bulk generators complained to BMC that they have inadequate space and they should be allowed to outsource the work of composting. BMC allowed this practice through authorized recyclers. However, there are allegations that this system is misused and the wet waste collected is dumped without composting or given back to BMC vehicles. It is necessary to investigate these allegations and scrap this system of outsourcing if necessary.
7. Challenge: Monitoring and Vigilance of Composting Systems:
   Recommendation: - It is observed that the builder/developer makes the system of composting to get OC or fulfill the condition of EC. But later, these systems are not monitored properly. This results in quality issues or sometimes flouting the norms. It is necessary to develop a proper system of monitoring and vigilance of composting systems.

Sawantwadi

Sawantwadi has a population of 23851 by census 2011. The town is located in Konkan region of Maharashtra.

WASH

Sawantwadi receives water by gravity. Thus, there is no expenditure on electricity, and it is supplied in a most sustainable manner.

There are two water sources: -

1. Kesari Spring: This brings water from the spring located in western ghats and the purity of water is very good. The spring is in the hills and the water is brought by a CI pipeline of 150 mm and 15 km length and stored in GSR. The scheme was implemented by the erstwhile king of Sawatwadi in the year 1893. The water is stored in GSR and supplied by gravity. This scheme is called the Sasthan Scheme, and the capacity of this scheme is estimated as 0.35 MLD.
2. As the population of Sawantwadi grew post-independence, a new scheme was constructed, and the source is Palnekond Dam in 1982. The raw water is treated in a water treatment plant of 3 MLD capacity. The treated water is stored in a master balance

reservoir and supplied by gravity through several GSRs by gravity.

1. Water supplied to 2 villages: 2.8 lakh per day.
2. GSR at Narendra Dongar: 4.0 Lakh lit.
3. GSR at Ubha Bajar: 1.0 lakh lit.
4. GSR at Chial Dongar: 16.0 lakh lit.

In addition, wells in the town supply 2 lakh lit water per day.

There are no incidences of water borne diseases in the town.

Revenue Data about Water:

Water in the inlet line is flowing for nearly 24 hours except maintenance. Timings of water flowing out of the Narendra Dongar GSR are listed in the table below.

From	To	Timings
Narendra Dongar GSR	Salaiwada	4 am to 6 am & 6 pm to 7 pm
Narendra Dongar GSR	Ubha bazaar, Zirng, Buran galli	4 am to 6 am

Ubha bazaar GSR

Ubha bazaar is located on Narendra Dongar GSR adjacent to Narendra Dongar GSR. It is a reinforced cement concrete structure and has a storage capacity of 1 lakh liters. The inlet pipeline is 150 mm AC, and the outlet pipeline is 150 mm PVC.

Due to complaints of insufficient water this new GSR was constructed, specifically to supply water to the people residing in Ubha Bazar, the market area in Sawantwadi. The area served by this pipeline is Ubha Bazar and timing of the supply is listed below:

From	To	Timings
Ubha bazaar GSR	Ubha bazaar	2.30 pm to 5.00 pm

After this scheme no major pipelines were laid except a small network, added to strengthen the water distribution system during operation and maintenance period. Currently the total distribution network is around 55 kilometers. A detailed survey has been carried out to update the pipe network and to understand the operation of the system.

Number of hours provided with - 6 hours.

i) Rate of Water -

Table 9: Revenue data of water, Sawantwadi Municipal Council

Type of connection	Category of water supply	Rates per 1000 lit.
Domestic	1000 लि. ते 19000 लि. 19001 लि. ते 50000 लि. 50001 लि. च्या पुढे	रु. 9.00 रु. 12.00 रु. 16.00
Domestic conn in grampanchayt area	1000 लि. ते 19000 लि. 19001 लि. ते 50000 लि. 50001 लि. च्या पुढे	रु. 15.00 रु. 20.00 रु. 22.00
Nondomestic	1000 लि. ते 50000 लि. 50001 लि. च्या पुढे	रु. 25.00 रु. 30.00
Non-Domestic for construction purpose	1000 लि. ते 50000 लि. 50001 लि. च्या पुढे	रु. 27.00 रु. 32.00
Institutional	1000 लि.	रु. 20.00
Co – op society	1000 लि. ते 250000 लि.	रु. 11.00

	250001 लि. च्या पुढे	रु. 12.00
Gram panchayat	प्रति 1000 लि.	रु. 10.00

ii) Revenue collected (सन २०२१-२२)

Demand	Collection	Percentage
15593295	14668246	94.07

iii) financial viability - Good

iv) Non-revenue water – 30%

Challenges

NRW is 30% and needs to be reduced. There is no underground sewerage system or sewage treatment plant. The septic tanks are cleaned by vacuum system trucks and faecal sludge is treated in FSTP.

Enough capacity of FSTP is not available. The number of vehicles to collect faecal sludge and septage from septic tanks are Also, inadequate.

Framework for Site Visits

Collect information about O&M issues of WTP. Explore the possibility of improving the FSS collection and treatment and financial aspects of the same.

Site Visits:

Site visits were conducted to collect the data and observe the infrastructure firsthand. Discussions were held with following officials: -

1. Mr. Jayant Jawadekar, Chief Officer
2. Mr. Natekar, Sanitary Inspector
3. Mrs. Rasika Nadkarni, Jr Supervisor, SWM, Sewerage & Sanitation
4. Mr. Bhise, Jr Supervisor, Water Supply

Best Practices Wash:

1. Major water supply by gravity. This saves energy.
2. There is no water scarcity. Water is supplied at an adequate rate of 100 lpcd.
3. Revenue collection for water is satisfactory (94%)
4. 100% water meters are in working condition.
5. If the water meter is not working, the bill is charged at a flat rate which is higher. Hence water meters are quickly repaired.

Challenges in Wash:

Challenge 1: NRW or loss due to leakages/thefts is 30% which is higher.

Recommendation: Digital meters with SCADA system were proposed. But the scheme was not approved. This will help in reading the water meters fast and to reduce the losses.

Challenge 2: FSTP capacity of 5 KLD is insufficient.

Recommendation: It is recommended to increase the capacity to 25 to 30 KLD. Due to inadequate capacities, there are problems like insufficient drying during the rainy season. There are three desludging vehicles. Out of which 1 is owned by ULB and 2 are private. Right now, the desludging is done only when there is demand or complaint. So, on an average one trip of a desludging vehicle (Capacity 6000 lit) is made daily. But when scheduled desludging is executed, around 4 trips will

be made daily, and this will require enhanced capacity (25 to 30 KLD).

Challenge 3: Sewerage System does not exist.

Recommendation: This is the problem of many ULBs all over India due to budget constraints and other issues. However, in the long-term sewerage system is required and planning can start from now.

Solid Waste Management

Sawantwadi generates 10 MT solid waste per day. Per capita generation of waste is 419 gm/day. Out of the total waste generated 7 MT is wet waste whereas 3 MT is dry waste. The ULB has 8 wards, 6 processing plants for wet waste with the capacity of 12.3 MTPD. The ULB does not process waste from bulk generators.

The Sawantwadi Municipal Council established well equipped infrastructure from waste management from collection of waste to scientific processing of waste. To maintain segregation till processing/disposal facilities all the 16 vehicles (9 non-motorized hand carts and 7 motorized vehicles) installed with the individual compartments for Wet Waste, Dry Waste, Domestic Hazardous Waste and Sanitary Waste.

Table 10: Solid Waste Processing Plant Details, Sawantwadi

Sr. No.	Name of Processing Plant	Ward No	Processing Technique	Capacity in MT	Status
1	Waste to Compost	0	Bio-methanation	5	Non-functional
2	Waste to Compost	0	Aerobic Windrows	5	Functional
3	BCM (Veg Market)	5	Machine Composting	2	Functional
4	Waste to Compost	0	Aerobic Windrows	4	Functional
5	Waste to Compost	1	Vermicomposting	0.7	Functional
6	Waste to Compost (Fish Market)	5	Machine Composting	0.2	Functional
7	Waste to Compost	7	Vermicomposting	0.4	Functional

Sawantwadi Municipal Council generates 7 MT of waste, and the processing capacity is 12.3 MTD. Thus, processing capacity is greater than 1.75 times the production.

All the plants work smoothly, and good quality compost is generated. Vermicomposting is used for garden waste. Good quality compost is generated. Machine composting needs to be verified for sustainability and quality of compost. Generally, machines require O &M. Also, compost generation in 24 hours has its own reservations.

Framework for Site Visits:

1. Feedback of leadership and staff at AIILSG will be taken before finalizing the framework for site visits.
2. Discussions will be held with the top leadership of the Corporation of the City of Panaji (CCP) such as Municipal Commissioner, Assistant Municipal Commissioners.

3. Public representatives and Ward officers will Also, be contacted.
4. Detailed discussions will be undertaken with the officers of the Water, Sanitation and Health Departments, Solid Waste Management Department and a small one-hour meeting will be organized to take their feedback.
5. Site visits of landfill sites if present.
6. If any Dry waste recycling centers are present, the same will be Also, visited.
7. Other stakeholders such as NGOs, SWM entrepreneurs, and the academic community will be contacted for developing community partnerships.
8. A standard questionnaire will be prepared to capture the latest data on SWM, support needed for sustenance of SWM infrastructure based on which recommendations will be made.
9. It is proposed to keep the final recommendations for sustenance of SWM infrastructure before the stakeholders for their feedback before finalization.
10. The Feasibility Study Report (FSR) will be prepared for all the components of Integrated Solid Waste Management of BMC for the requirement for next 20 years considering gap analysis to conform to SWM Rules 2016, CPHEEO SWM Manual 2016 will be referred.
11. All aspects such as collection and transport (C&T), Processing by different options such as composting, bio-methanation, waste to energy etc.. Disposal by sanitary landfills etc.. will be considered while preparing project reports for FSR.
12. The existing capacity of the Collection and Transportation (C&T) facility will be assessed and suitable mechanisms to improve the C&T process will be proposed. The use of technology like GPS, RFID for tracking the collection will be explored.
13. Different components of Integrated Solid Waste management such as Dry Waste, C&D waste, RDF, Garden waste, E-Waste, Plastic & Thermocol waste will be considered, and project reports will be included for these components.
14. Legacy waste at landfills will be quantified. The existing arrangements like bio-mining and capping will be studied. Projects will be suggested if gaps exist. O&M after 15 years of capping will be suggested.
15. Leachate management, environmental issues of existing and future landfills will be considered.
16. Marketing of compost, RDF, Plastic waste, tetrapack waste, energy etc.. will be discussed. Linkages will be developed with farmers bodies, cement and sugar factories etc.. for the same.

Questionnaire for WASH & SWM:

1. What is the arrangement for faecal sludge & Septage management (FSSM)? What are future plans?
2. Are there any suggestions on the improvement of WASH & SWM infrastructure?
3. Are there any issues related to pollution of water bodies?
4. What is the solid waste generated in different categories at present? What is the per capita contribution? What is the solid waste generation expected in 20 years and what are the future plans?
5. What are the challenges in the existing system? What support is required

from the government and private sector?

6. What are the financial resources allocated for SWM? Are any taxes collected from the public for SWM? Are any user charges levied? What is the revenue generated from all sources for SWM such as fines, penalties etc.?
7. What is the financial viability of the existing system? How is the O&M of existing vehicles, landfill sites etc. carried out?
8. How many employees are available for SWM? Are there any efforts made for their capacity building?
9. What is the revenue generated from selling dry waste category wise?
10. How is dry waste such as plastic, thermocol, glass, paper etc. processed?
11. What arrangements are made for C&D waste, E-Waste, tetrapack, wood/garden waste etc.
12. What land is available with SWM dept. for existing projects and future projects?
13. How are entrepreneurs engaged?
14. How are waste pickers, SHGs, NGOs etc. involved in SWM activities?
15. How is community participation ensured in SWM? Are any IEC campaigns launched?

Site Visits:

Plat No. 11: Water Treatment Plant : Cascade Aerator, Flash Mixer

Plate 12: Water Treatment Plant : Filter

Plate 13: Faecal Sludge Treatment Plant

Plate 14: Collection of solid waste in segregated form

Plate 15: Transport of waste in segregated form

Plate 16 : Windrows Composting

Plate 17: Automatic Organic Waste Composter, Veg Market

Plate 18: Material Recovery Facility at Dry Waste Processing Center

Plate 19: Dry Waste Processing Center, outside

Plate 20: Dry Waste Processing Center, Inside

Plate 21: Transport of segregated dry waste for recycling

Plate 22: Baling Machine for plastic waste

Best Practices SWM:

1. Sawantwadi Municipal Council has been successful in maintaining the segregation of waste from source up to treatment. Other ULBs should replicate this success story.
2. The dry waste processing center is well managed, and it is neat and clean. Almost 100% of dry waste is recycled.
3. Dry waste is further segregated using material recovery facility into 32 different categories such as plastic, paper, glass, thermocol, slippers, chappals etc.
4. Plastic bags are pressed using a bailing machine which reduces the size of plastic bags by compressing them into bales. These bales are then transported to cement factories where they are used as fuel. Thus, the menace of plastic bags pollution is resolved as well as revenue is Also, obtained. It is Also, necessary to replicate this facility in other ULBs.
5. Garden waste is treated through vermi-composting and very good quality compost is obtained.
6. Kitchen or wet waste is treated through windrows composting. The plant is neat and clean and without any foul smells.

Challenges in O&M of SWM Infrastructure and Recommendations:

Challenge 1: O&M of biogas plant

Recommendation: The biogas plant based on Nisargruna technology was constructed. But the plant is not in working condition at present. There were leaks through the walls. The dome movement was restricted. In semi-urban areas, it is difficult to maintain complex technologies like bio-gas plants. Hence it is

recommended to use windows or bio-composting for composting wet waste rather than bio-gas plant.

Challenge 2: Compost Quality Monitoring

Recommendation: - One automatic organic waste composting machine is installed at Veg market. It appears that the machine generates compost in 24 hours. Various experts have expressed doubt about the quality of compost generated from such types of machines. It is recommended to check the quality of compost generated from this machine. Also, it is necessary to check the quality of compost generated from other composting plants from authorized laboratories. The quality of compost is checked once a year for all composts. It is recommended that the quality of compost should be checked more frequently in the laboratory and conformance with Harit brand of Maharashtra government verified. The possibility of participating in the RCF bidding process should be verified.

Kolhapur

Introduction:

The Principal Investigator's native place is Kolhapur city, and he is aware of the challenges in WASH and SWM infrastructure. The current population of Kolhapur is 6,35,000 (Source: Macrotrends.net) and it can be classified as a medium town. It is a district in southern and western Maharashtra. Kolhapur is one of the richest districts in India. Different sources of information such as Environmental Status Report (2016, TERI), local newspapers such as Pudhari, Sakal and other literature are used for Secondary Assessment. For the sake of brevity general information in Environment Status Report (ESR) is not repeated in secondary assessment. Based on the discussion in Secondary assessment, the framework for the site visits will be finalized.

UNDERSTANDING OF CURRENT STATE OF *WASH* INFRA BY WAY OF LITERATURE REVIEW:

WASH comprises the areas of Water Supply, Sanitation and Health. The focus as envisaged by AIILSG is on Water Supply and Sanitation.

Water Supply:

Based on the per capita supply of 135 lit/day, the water demand of Kolhapur city is 85.7 MLD. Against this demand 137 MLD treated water is supplied per day. Thus, the demand including residential, industrial and commercial is adequately taken care of. There are four water treatment plants (WTPs) at Puikhadi (50 MLD), Balinga (43 MLD), Bawda (36 MLD) and Kalamba (8 MLD) totaling 137 MLD. At Kalamba, the source is lake while at remaining places, the sources are Panchganga and Bhogawati river. Apart from these sources, there are 44 bore wells from which 0.2 MLD water is supplied. As per the ESR, water quality is monitored at two locations u/s of Panchganga river from city (Balinga) and d/s of Panchganga river from city (Gandhinagar, near NH4 bridge) and at both the locations the water quality as represented by Water Quality Index is good to excellent.

There are 6 major lakes (Table No. 15) in Kolhapur city which cover 3% of the entire area of Kolhapur city. The city is dependent on these resources for various activities including water supply, fishing, irrigation, recreation and so on. Apart from these, Kolhapur city has other lakes like Lasktirth, New Palace Lake and 2 lakes at Shivaji University campus.

Once the water gets treated at the treatment plants it is supplied to the city through the water supply network. The water supply distribution network is divided into 22 zones. There are in all 28 storage reservoirs: 20 ESRs (Elevated Storage Reservoirs) and 8 GSR (Ground Water Reservoirs) with a total capacity of about 53 million Litres. Out of the 140,748 households in Kolhapur city, around 89% (125,505) of the households connected with water supply lines of about 600 km in length.

Challenges:

1. Absence of well-designed storm water drainage system.
2. There is no underground sewerage system in Kolhapur. The sewage is transferred from open drains into Nallahs which dispose it into the Panchganga river and pollute the water.
3. The people in E ward frequently receive polluted water mainly because of the pollution caused by Dudhali nalla due to which occurrence of water borne diseases like jaundice, diarrhea occurs. To take care of this problem a new water supply scheme is developed under which water is being taken by pipeline from Kallamwadi and an additional water treatment plant is being constructed. Proposals are Also, submitted for underground sewerage systems.
4. Rankala Lake is in the heart of the city and a pride of Kolhapur. Due to the development of residential buildings near to it its water gets polluted, and it is covered with water hyacinth and weeds due to utrophication. However recently this problem has been tackled due to the projects completed through central funding.
5. Non-revenue water (NRW) and leakages is Also, a challenge in sustaining water infrastructure. Though Kolhapur Municipal Corporation (KMC) has reduced NRW,

it is still a challenge. The service level benchmark permits a maximum of 20% of NRW however Kolhapur city reports NRW of around 38% indicating that around 45 – 50 MLD of water is NRW for KMC. Extrapolating the average loss per day, it is estimated that in the year 2015–16 around 16–18 thousand million liters of water treated and supplied by KMC was NRW.

6. There is no systematic process and record of bore wells. This is causing a reduction in ground water tables in certain areas. Ground water quality is measured at two locations by MPCB and in the year 2014-15 it was found "very poor" at one location and not suitable for drinking at other locations.
7. Around 10% of households do not receive piped water supply connections.
8. The instances of flooding during monsoon have increased which results in damaging pumps and water treatment plants which further results in discontinuation of water supply for a significant number of days.

Framework for Site Visits:

1. Feedback of leadership and staff at AIILSG will be taken before finalizing the framework for site visits.
2. Discussions will be held with top leadership of Kolhapur Municipal Corporation (KMC) such as Municipal Commissioner, Assistant Municipal Commissioners.
3. Public representatives, Ward officers will Also, be contacted.
4. Detailed discussions will be undertaken with the officers of the Water Supply Department and a small one-hour meeting will be organized to take their feedback.
5. Site visits to Water Treatment Plants (WTPs) at Puikhadi, Balinga, Bawda, will be organized.
6. Water distribution systems, ESRs, and Water Testing Labs will be observed.
7. Other stakeholders such as Citizens, NGOs, Water entrepreneurs, academic community will be contacted for developing community partnerships.
8. A standard questionnaire will be prepared to capture the latest data on Water Supply, support needed for sustenance of Water infrastructure based on which recommendations will be made.
9. It is proposed to keep the final recommendations for sustenance of Water infrastructure before the stakeholders give feedback before finalization.
10. Preparation of Feasibility Study Report on Water projects/infrastructure needed for the next 30 years based on the assessment of existing infrastructure. The report will prepare block estimates for capital expenditure and Operating costs for these projects.

Sanitation:

As discussed earlier, there is no underground drainage system in Kolhapur. The wastewater is carried out through open drains in nallahs and pollutes the river water. Nallahs are the natural storm water drainage systems which carry the surface runoff during the monsoon season into rivers. Kolhapur city has 5 major nallahs – Dudhali, Jayanti, Bapat Camp, Line Bazar and Veet Bhati nallah. The total length of these nallahs is estimated to be about 94 km

and all these drain into Panchganga River. The process of conveyance of sewage through open drains and pollution of rivers gives rise to various water borne diseases and vector borne diseases. In the year 2006, Kolhapur Municipal Corporation received a grant of Rs. 6.86 Cr for undertaking revival of Rankala lake and significant improvements have taken place afterwards. Many buildings have septic tanks as a primary method of sewage treatment. But their work is not monitored. They are not cleaned regularly which leads to overflowing and pollution of groundwater and surface water apart from creating unhygienic conditions.

It is estimated that Kolhapur city generates about 83 MLD of wastewater per day. Out of this, the domestic wastewater accounts for 92% (76 MLD), followed by commercial establishments and sources 8% (7 MLD), while the industrial sources account for a negligible 0.1 MLD of wastewater. As per Census report 2011, the coverage of latrines (individual households and community) covers around 99% of the population of Kolhapur city, indicating that the city is relatively free from open defecation. Kolhapur city is supplied 137 MLD treated water. As per the assumptions in the Government of India manual, 90% of water supplied is contributed as sewage. Thus 123 MLD sewage should have been generated. But as per the record of KMC 83 MLD sewage is generated. This shows that around 32% sewage is unaccounted for. A significant amount of it may be polluting water bodies, land and groundwater.

The wastewater is collected through a drainage line of about 222 km across four zones Jayanti, Dudhali, Line Bazar and Bapat camp for sewage management. Around 45% of the households, translating to more than 64 thousand in Kolhapur city, are not connected with the drainage line. Of this more than 30 thousand households from the Line bazar zone and Bapat camp zone itself which is yet to be connected to the drainage network leaving 100% households from these areas without connection to drainage line. Around 43% of the households in Kolhapur city have a septic tank facility in their households. However, the treated waste water from the septic tanks is directly released to the roadside gutter. This is true for around 90% of the septic tanks installed by individual households. Kolhapur Municipal Corporation undertakes maintenance and repair work of the drainage network regularly. Drainage choke ups, removal of overflows and similar jobs are undertaken by the health department.

KMC has commissioned a 76 MLD capacity STP (Sewage Treatment Plant) as per funds received from NRCD (The National River Conservation Directorate) in the MoEFCC (Ministry of Environment, Forest and Climate Change) at Kasba Bawda based on SBR technology. The current operational load on this plant is around 52 MLD. The water quality for the inlet and the outlet is monitored every day by the laboratory established at STP. The water quality parameters tested for the outlet water samples released post treatment are well within the standards prescribed by CPCB. Pilot plants of 10 m3 capacity based on DEWATS (Decentralized WasteWater Treatment System) have been installed and commissioned at the Isolation Hospital, Rajendranagar and Salokhe Park to promote decentralized wastewater processing. Apart from the 76 MLD STP KMC, is in the process of constructing a 17 MLD capacity STP under the Maharashtra Suvarna Jayanti Nagarothan Maha Abhiyan and is expected to be commissioned by December 2016.

Challenges:

1. Pollution of Panchganga river, Rankala lake due to sewage disposal
2. Water borne diseases.

3. Pollution of water bodies due to offerings, agricultural residues
4. Lack of cleaning of septic tanks and inadequate faecal sludge and septage management.
5. Upgradation, O&M of Sewage Pumping Stations located in Nallahs.
6. Loss of sewage due to leakage and resultant less availability of treated water from sewage.
7. Vigilance of STPs installed at big residential complexes. Trained manpower.
8. Weed infestation in water bodies due to eutrophication.
9. Absence of proper system regarding reuse of treated water from STPs

Framework for Site Visits:

1. Feedback of leadership and staff at AIILSG will be taken before finalizing the framework for site visits.
2. Discussions will be held with top leadership of Kolhapur Municipal Corporation (KMC) such as Municipal Commissioner, Assistant Municipal Commisioners.
3. Public representatives, Ward officers will Also, be contacted.
4. Detailed discussions will be undertaken with the officers of the Sewage Operations and Projects Department and a small one-hour meeting will be organized to take their feedback.
5. Site visit at Sewage Treatment Plants (STP) at Kasba Bawda, DEWATS and sewage pumping stations at different Nallahs (Jayanti, Dudhali etc.) will be organized.
6. Wastewater collection systems and septic tanks will be observed.
7. More monitoring stations for water quality in Panchganga, Nallahs will be explored.
8. Other stakeholders such as Citizens, NGOs, FSSM entrepreneurs, academic community will be contacted for developing community partnerships.
9. A standard questionnaire will be prepared to capture the latest data on Sanitation, support needed for sustenance of Sanitation infrastructure based on which recommendations will be made.
10. It is proposed to keep the final recommendations for sustenance of Sanitation infrastructure before the stakeholders for their feedback before finalization.
11. Preparation of Feasibility Study Report on Sanitation projects/infrastructure needed for the next 30 years based on the assessment of existing infrastructure. The report will prepare block estimates for capital expenditure and Operating costs for these projects.

Questionnaire for WASH:

1. What is the per capita water supplied?
2. What is the existing infrastructure for sources of water, its treatment and distribution?
3. Do all areas get water in enough quantity and quality? Are there any complaints regarding the quality of water (E – Ward)?
4. Any issues due to flooding in the last 2-3 years?
5. What are the issues regarding O&M of WTPs, pumping stations, ESRs, Distribution systems?

6. How are the finances raised for the Water infrastructure? Is the PPP model tried?
7. What are the taxes collected for the O&M of Water infrastructure?
8. What is the existing infrastructure for sewage collection and its treatment?
9. What is the generation of sewage? What is the collection of sewage? What % of sewage is treated?
10. What is the status of septic tanks?
11. Are any detailed project reports prepared for improvement of sanitation infrastructure such as sewerage systems, sewage treatment plants etc.?
12. What is the existing system of treating sewage? What are the improvements needed?
13. What are the existing byelaws for the new buildings regarding sewage treatment and recycling? How are these rules monitored?
14. How are the other stakeholders such as citizens and professional associations involved? Are any IEC programs or media involved?
15. Are there any plans to monitor the quality of Panchganga river and Nallahs in their stretch? Are there any projects planned to revive the nallahs?
16. Are there any issues related to water pollution caused by industries?
17. What are the issues regarding O&M of STPs, sewage pumping stations?
18. How are the finances raised for the Sanitation infrastructure? Is the PPP model tried?
19. What are the taxes collected for the O&M of sanitation infrastructure? Are user charges levied for public toilets, community toilets?
20. How many ODF++ projects are implemented? Are SHGs involved in the maintenance?
21. Any general suggestions regarding the improvement of sewage collection, treatment infrastructure and quality water in river and nallahs?

UNDERSTANDING OF CURRENT STATE OF *WASH* INFRA BY WAY OF INTERVIEW WITH OFFICIALS AND SITE VISITS:

Meeting with Municipal Commissioner, Kolhapur Dr. Kadambari Balkawade, IAS

Dr. Milind Kulkarni visited Kolhapur Municipal Corporation (KMC) on 06/04/2023 and had brief interaction with Municipal Commissioner Dr. Kadambari Balkawade, IAS, about the WASH and SWM infrastructure of the city. She told Dr. Kulkarni that KMC will soon strengthen its WASH infrastructure with a new water supply scheme and sewage treatment plant. She sought his guidance about strengthening the SWM infrastructure. She directed Dr. Kulkarni to meet Mr. Netradip Sarnobat Head of Water Supply & Sanitation about WASH and Mr. Ravikant Adsul, Deputy Commissioner about SWM.

Meeting with KMC official & Engineer Mr. R. K. Patil for Water Supply & Sanitation, Kolhapur

Since Mr. Sarnobat was busy in high level meetings, he directed me to meet his engineer Mr. R. K. Patil for an interview. Mr. Patil informed that KMC has commissioned STP of 76 MLD under PPP model at Kasba Bawda. 70% of the funds are received from NRCD while the agency has put up 30%. The O&M is Also, looked after by the agency M/s Vishwa Infra, Hyderabad for 2014-2027. The company NJS Mumbai are the consultants. Another STP of 17 MLD is commissioned in 2018 at Dudhali under the PPP model by M/s Laxmi Civil Engineering Pvt Ltd. The agency is undertaking O&M for 2018-31. 50% of the funds for this project are received from Nagarothan and 50% from the Agency. The agencies submit trimonthly bills and they receive 20% commission. KMC collects 10% sewerage management surcharge in the water bills levied in KMC. The Sewage Treatment Plant (STP) is working in a satisfactory manner. The technology is SBR and there is an in-house laboratory in the plant. The treated sewage is of good quality, but there are no takers for it. Under AMRUT I scheme, two additional small STPs are approved and the work on the same is under progress. STPs of 6 MLD and 4 MLD are under implementation stage at Dudhali and Kasba Bawda by M/s Nobel.

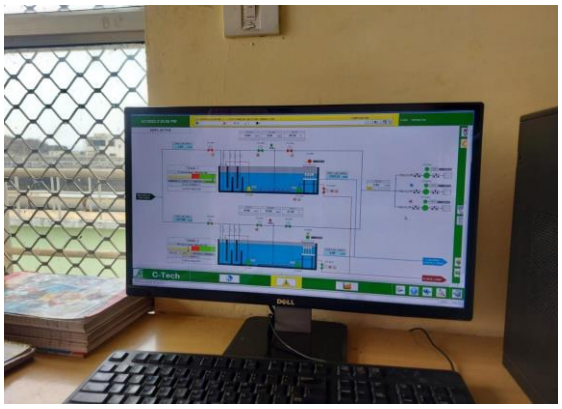
An underground sewerage system and storm water drainage system are now available in Zone I which covers the city center (60%). This has substantially reduced pollution of Rankala lake during the rainy season. 80 Km sewerage line is now available in Zone I under Amrut I. But the same is not available in suburbs. This results in discharging the sewage through open drains to nallahs which ultimately discharge into Panchganga river. To avoid the pollution of Panchganga river, nall tapping is done at the end of Dudhali Nallah at the point where it discharges in river / confluence point with river and the same is diverted to STP. There is a weir at the confluence point and sewage is diverted to STP through a pumping station. Also, the pumping station for the water treatment plant at Dudhali is now shifted to Shinganapur. This will resolve the complaints of E ward people about supply of contaminated water. Also, the direct pipeline scheme to bring water from Kallamawadi dam is in the final stages after which the issue of supply of contaminated water will be completely resolved.

As far as metering is concerned, Mr. Patil said that there is 100% metering. But the metering is mechanical and not digital. There are complaints of excessive bill due to air and there are plans to install air valves to avoid this. Around 140 MLD water is supplied from 4 WTPs in the city as discussed above. But leakage is one of the main issues faced by KMC. Around 35% of water is lost in the leakage. Provision of 144 MLD STP (76, 17,4, 6, 41) is available. But the full potential of STPs is not used. Only around 70% is used.

Site Visit: 76 MLD STP at Kasba Bawda, Kolhapur

STP Aeration Tank (C-Tech Basin)

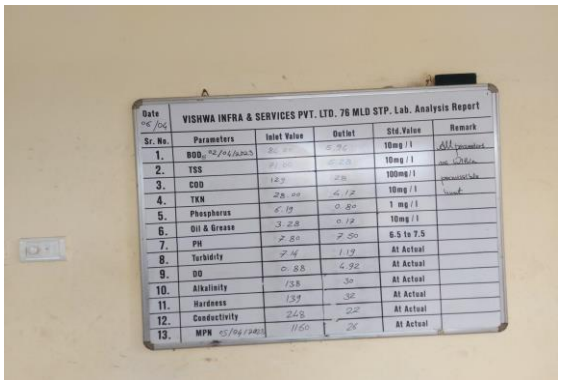
STP under construction – Aeration Tank (SBR basin)



Operations through PLC & SCADA powered Control Center

STP under construction – Blower Room

In-house laboratory



VISHWA INFRA & SERVICES PVT. LTD. 76 MLD STP, Lab. Analysis Report

Sr. No.	Parameters	Inlet Value	Outlet	Std.Value	Remark
1.	BOD			10mg / l	
2.	TSS			10mg / l	
3.	COD			100mg / l	
4.	TKN			10mg / l	
5.	Phosphorus			1 mg / l	
6.	Oil & Grease			10mg / l	
7.	PH			6.5 to 7.5	
8.	Turbidity			At Actual	
9.	DO			At Actual	
10.	Alkalinity			At Actual	
11.	Hardness			At Actual	
12.	Conductivity			At Actual	
13.	MPN			At Actual	

Daily Laboratory Report

ASSESSMENT OF WASH INFRASTRUCTURE AND IDENTIFICATION OF O&M CHALLENGES:

Water Supply:

Quantity of Water: - Population of Kolhapur is 6.35 lakh. As per the supply rate of 135 lit/capita/day, the demand is around 86 MLD. Against this the four WTPs of Kolhapur provide around 140 MLD of water. Thus, there is an adequate quantity of water supplied by KMC.

Quality of Water: - For so many years there were complaints about poor quality of water particularly from E-ward. However, after shifting of pumping station from Dudhali to Shinganapur, this problem is resolved. Also, the direct pipeline scheme from Kallamawadi is almost complete and this will improve the water quality further.

Water Metering: - Though water metering is 100%, all the meters are mechanical which are prone to error due to air/wind etc.. Also, in the case of big residential complexes, a water

meter is provided to the complex. It should be provided to every household which will motivate people to conserve water and eventually reduce the water footprint of the city.

Leakages: - Kolhapur is the ULB with one of the highest leakages in the range of 35 to 40%. There should be efforts on the war footing to curtail the same. Already the KMC has launched programs to stop leakages from filter of WTPs, Storage tanks etc. Mass leak detection program should be undertaken.

Water Balance Diagram: - On a broad scale water balance diagram is available. But it should be drawn up on micro level so that all the leakages can be identified, and the water supply system can be better managed. This will Also, help in reducing water thefts and reduce Non-Revenue Water (NRW)

Sanitation:

Sewerage System: - Underground sewerage system is provided in Zone I i.e. city center in around 60% of the area. But it is absent in suburbs. It should be provided.

Pollution of Panchaganga River: - In the absence of sewerage system in suburbs, the sewage is discharged into various nallahs which discharge to Panchganga river and pollute the same. Due to tapping of Dudhali nalla and treatment of sewage in STP, the major problem of pollution of panchaganga river is resolved. But there are other nallahs. Also, there are reports of industries disposing their effluents in Panchaganga river which results in killing of fish and deteriorating the quality of water. Action should be taken in co-ordination with Maharashtra Pollution Control Board.

Flooding: Late incidences of flooding in monsoon have increased. Areas such as Nagala Park, Basant Bahar cinema, Mukt Sainik Vasahat are getting flooded. It is necessary to undertake the assessment and technical audit of the storm water drainage system.

Sewage Treatment:- Adequate capacity of 141 MLD is generated by way of 4 STPs. But the full potential is not used due to leakages. It is necessary to cover the entire city with a sewerage system so that the leakages are stopped.

Decentralized Sewage Treatment Plants: - Big residential complexes must be mandated to treat the sewage generated by them. The treated sewage must be used for flushing and gardening. This will reduce the load on KMC and help in sustainable development. The performance of individual septic tanks and STPs should be monitored and proper scheduling of their cleaning and treatment of FSS should be observed.

Recycling of Treated Sewage: - At present the treated sewage is disposed of into Panchganga river. Thus, no revenue is generated. In cities from Surat to Singapore, treated water from STPs is sold to industries and revenue is obtained. The same example should be followed by KMC, and revenue should be generated.

RECOMMENDATIONS FOR ADDRESSING O&M CHALLENGES IN WASH INFRASTRUCTURE FOR SUSTAINING:

1. **Absence of Digital Water Metering**: - In the long run mechanical water meters should be replaced with digital meters: either electromagnetic or electronic sensor based. This will help in better managing the water infrastructure and, control losses.

Residential complexes should be motivated to provide digital water meters with software to effectively manage the billing and control losses.

2. **High Water Leakages:** - In view of the high percentage of water leakages (> 35%), it is recommended to act on detected leakages on priority basis and launch a leak detection program.
3. **Absence of Water Balance Diagram**: - A detailed water balance diagram for Kolhapur city should be prepared considering all data such as water treated, water revenue received from different wards, sewage treated and disposed. This will help in better O&M of WASH infrastructure, increase revenues and reduce losses.
4. **Inadequate Sewerage System**: - Entire Kolhapur city should be provided with an underground sewerage system on a priority basis.
5. **Panchaganga River Pollution**: - To maintain the good quality of Panchaganga river, the number of monitoring stations should be increased. No sewage should be allowed to dispose in river without treatment either directly or through nallahs. Surprise checks should be made on industrial units disposing of their waste in rivers without treatment in co-ordination with MPCB.
6. **Flooding in the rainy season**: - Study on Assessment of existing storm water drainage system should be undertaken, and high flood line undertaken and remedial measures such as construction of storage tanks, pumping stations etc. explored.
7. **Absence of revenue from Treated Sewage**: - Arrangement should be explored with industries and other organizations for the sale of treated sewage.

Solid Waste Management:

It is estimated that the total quantity of MSW (Municipal Solid Waste) generated in Kolhapur city is about 185 MT (Metric Tons) per day which translates to more than 300 gm per capita/day. Out of the total generated, about 180 MT of MSW is collected daily in Kolhapur city through an effective system established by KMC. Of this, around 150 MT of waste is directly dumped at the open dumping spread across 8 acres site at Kasba Bawda which is within the city limits. About 10 MT of the waste collected from the markets is sent for bio-composting process via windrows technology at the Katyani area. 10-15 MT of waste collected from the hotels and restaurants via a dedicated collection trip is used for generating biogas by the food processing industry. KMC has proposed a new waste to energy plant to be erected at the Kasba Bawda and has identified a contractor for the same. The corporation has already undertaken the work of developing a scientific landfill site of about 1.5 hectares at Takala area which is an abandoned stone quarry site. The site has been layered with HDPE (High Density Polyethylene) at the bottom to prevent leakage and seepage of the leachate. The site has further been developed by constructing concrete walls along the periphery of the site. The work for shifting of the waste was started in July 2016 and was expected to end by December 2017. KMC has Also, acquired another abandoned stone quarry site spread across 7 hectares at Toap village, in Hatkangale taluka for developing a landfill site. It is located around 15 kms from the city. The site has the potential to cater to the scientific landfill requirements of Kolhapur city's waste for about 25–30 years. Kolhapur city generates about 0.7 tons/day of BMW (Bio-Medical Waste) from various hospitals, clinics and health care facilities. There are approximately 906 health care

facilities, clinics blood banks, and hospitals in Kolhapur city which generate biomedical waste. In 2015– 16, about 274 MT of biomedical waste was treated at the facility installed by a private agency appointed by MPCB. Out of the total BMW, 91% (250 MT) was disposed through incineration while 5% (13 MT) and 4% (10 MT) was disposed by chemical treatment and autoclaving/shredding respectively. Environmental Status Report of Kolhapur city 2015-16 9 KMC, under the Swachh Bharat Abhiyaan, has proposed erecting two biogas plants of 5-ton capacity each at Bawada and Central Jail, Kalamba, to treat the biodegradable waste and generate power for meeting power requirements of local streetlights. The plant would be based on Nisargruna Technology.

Challenges:

1. In cities like Mumbai, it has been made mandatory for bulk generators to compost wet waste and recycle dry waste. In Pune as well as Mumbai, there are incentives for residential complexes like rebate in property tax for managing solid waste within the premises. This has significantly reduced the solid waste dumped in landfills. It is necessary to develop a similar system for Kolhapur.
2. Cities like Indore are adopting big waste to energy projects developing bioCNG. Kolhapur should Also, work on similar projects.
3. Segregation remains a challenge. There are small tempos for collection of segregated waste with audio clips but segregation of waste at source is not ensured.
4. Infrastructure for recycling of and reuse of dry waste is to be developed fully.
5. There are issues related to branding of compost generated.

Framework for Site Visits:

1. Feedback of leadership and staff at AIILSG will be taken before finalizing the framework for site visits.
2. Discussions will be held with top leadership of Kolhapur Municipal Corporation (KMC) such as Municipal Commissioner, Assistant Municipal Commisioners.
3. Public representatives, Ward officers will Also, be contacted.
4. Detailed discussions will be undertaken with the officers of the Solid Waste Management Department and a small one-hour meeting will be organized to take their feedback.
5. Visit the existing SWM infrastructure in Kolhapur and observe all its components such as collection and transport system, primary and secondary collection, temporary storage, transfer station, composting, biomethanation projects, waste to energy project, dry waste processing, bmw processing, landfill sites etc.
6. **The Feasibility Study Report (FSR) will be prepared for all the components of Integrated Solid Waste Management of KMC for the requirement for next 20 years considering gap analysis to conform to SWM Rules 2016, CPHEEO SWM Manual 2016 will be referred.**
7. **All aspects such as collection and transport (C&T), Processing by different options such as composting, bio-methanation, waste to energy etc., Disposal by sanitary landfills etc.**

will be considered while preparing project reports in FSR.

8. The existing capacity of Collection and Transportation (C&T) facility will be assessed and a suitable mechanism to improve the C&T process will be proposed. The use of technology like GPS and RFID for tracking the collection will be explored.
9. **Different components of Integrated Solid Waste management such as Dry Waste, C&D waste, RDF, Garden waste, E-Waste, Plastic & Thermocol waste will be considered, and project reports will be included for these components.**
10. **Legacy waste at landfills will be quantified. The existing arrangements like bio-mining and capping will be studied. Projects will be suggested if gaps exist. O&M after 15 years of capping will be suggested.**
11. Leachate management, environmental issues of existing and future landfills will be considered.
12. Marketing of compost, RDF, Plastic waste, tetrapack waste, energy etc. will be discussed. Linkages will be developed with farmers bodies, cement and sugar factories etc. for the same.
13. Site visits of landfill sites at Bawda, Takala as well as waste to energy projects at Kalamba and Bawda will be organized.
14. If any Dry waste recycling centers are present, the same will be Also, visited.
15. Use of advanced technology like GPS, RFID, AI, Data mining to sustain solid waste management infrastructure will be explored.
16. Different financial models to sustain SWM infrastructure will be explored.
17. Other stakeholders such as NGOs such as Ektai, SWM entrepreneurs, and academic community will be contacted for developing community partnerships.
18. A standard questionnaire will be prepared to capture the latest data on SWM, support needed for sustenance of SWM infrastructure based on which recommendations will be made.
19. It is proposed to keep the final recommendations for sustenance of SWM infrastructure before the stakeholders for their feedback before finalization.

Questionnaire for SWM:

1. What is the solid waste generated in different categories at present? What is the per capita contribution? What is the solid waste generation expected in 20 years and what are the future plans?
2. What are the challenges in the existing system? What support is required from the government and private sector?
3. What are the financial resources allocated for SWM? Are any taxes collected from the public for SWM? Are any user charges levied? What is the revenue generated from all sources for SWM such as fines, penalties etc.?
4. What is the financial viability of the existing system? How the O&M of existing vehicles, landfill sites etc. is carried out?
5. How many employees are available for SWM? Are there any efforts made for their capacity building?
6. What is the revenue generated from selling dry waste category wise?

7. How is the dry waste such as plastic, thermocol, glass, paper etc. processed?
8. What arrangements are made for C&D waste, E-Waste, tetrapack, wood/garden waste etc.
9. What land is available with SWM dept. for existing projects and future projects?
10. How are entrepreneurs engaged?
11. How are waste pickers, SHGs, NGOs etc. involved in SWM activities?
12. How is community participation ensured in SWM? Are any IEC campaigns launched?
13. What is the performance of the city in Swachh Sarvekshan 2022?

UNDERSTANDING OF CURRENT STATE OF *SWM* INFRA BY WAY OF INTERVIEW WITH OFFICIALS AND SITE VISITS:

Interview with Mr. Ravikant Adsul, Deputy Municipal Commissioner, KMC

Interviews took place with Mr. Ravikant Adsul, Deputy Commissioner, KMC and Dr. Vijay Patil Chief Sanitary Inspector, KMC. Dr. Vijay Patil informed Dr. Kulkarni that the KMC collects and transports all the solid waste from residences to Kasba Bawda where it is segregated in Material Recovery Facility from where the RDF is sent to cement factories which are located far away places like Chandrapur. He requested Dr. Kulkarni to guide regarding dry waste processing so that recycling could be done locally. He said that wet waste is composted in a 20 MT/Day Digester at Kasba Bawda. Biogas is used to generate electricity. But the generated electricity is much less than anticipated.

Dumping site at Kasba Bawada

20 TPD slurry plant

Crusher at Slurry Plant

Shredder at Slurry Plant

Waste to Energy Project based on Bio-Digester

Micro-segregation and crusher for Bio-digester

Material Recovery Facility (MRF)

Bailing of materials as Refuse Derived Fuel for dispatch to factories

ASSESSMENT OF SWM IFRASTRUCTURE AND IDENTIFICATION OF O&M CHALLENGES:

Management of dumping sites / legacy wastes: The collected solid waste is dumped at open dumping site at Kasba Bawada. A big mountain of dumped waste is generated which is a nuisance to the surrounding population due to foul smells generated, leachate generated particularly in monsoon. It is necessary to clear the dumping site by following the process of bio-mining.

Sanitary Landfill Site: - KMC is in the process of acquiring abandoned stone queries in Takala which is within city limits and in Top which is a few km outside the city as sanitary landfill sites. However full-fledged utilization of these sites is not yet started. Due to this the size of the dumping site mountain is increasing.

Processing of Dry Waste: - At present the dry waste is brought to the Bawada dumping site and processed through the material recovery facility. Most of the dry waste is packaged in what they call RDF (Refuge Derived Fuel) and sent to cement factories where it is used as fuel. However, this method is against the principles of circular economy. It is necessary to separate dry waste such as glass, paper, cardboard, hard plastic, metal etc. for recycling and only the non-recyclable material sent for cement factories. It is necessary to set up a number of dry waste processing center within

city limits. According to a research study in Shivaji University [3], around 13.02 T/D paper, 27.36 T/D of plastic and 7.2 T/D of glass can be recycled instead of sending to Cement factories.

Segregation at Source: - It is necessary to segregate the waste in dry, waste and reject waste at the source itself. The audio clips as well as the vehicles to collect waste in different compartments are provided. However, it is difficult to get good quality segregated waste. This poses challenges to subsequent processes of solid waste management.

Decentralized Wet Waste Processing: - There are two wastes to energy projects based on nisargruna technology of 5 MT capacity each located at Central Jail and Kalamba. They treat wet waste in a bio-digester. Biogas is used to generate electricity. It is advisable to develop more decentralized waste to energy projects of smaller capacities (100 Kg/day to 5 MT/day) in various parts of the city so that the load of wet waste reaching the central facility is reduced. It is observed that in general the performance of waste to electrical energy generation projects is not satisfactory [2]. Hence priority should be given to waste on energy projects where biogas is used as fuel. Goa has developed many such projects with the support from the Department of Biotechnology, Government of India and similar example can be followed.

Performance of Central Waste Processing Facilities: At the central waste processing facility, there is slurry plant of 20 TPD capacity. In this plant shredder was used for shredding garden was such as palm leaves etc. The shredded portion was then mixed in water and slurry was made, which was then taken through tankers by sugar factories and other organizations. However, after covid there is halt to this activity and pile of palm leaves etc. is found lying. It is recommended to convert this garden waste into brickets through pyrolysis which can be used as fuel. In Canada this process is widely used. Godrej in Mumbai has Also, set up bricket manufacturing plant.

It is not clear how the C&D waste is treated. It is a good practice to convert C&D waste into building materials.

There is a material recovery facility for dry waste which is already discussed above.

There is a bio-digester of 20 MT capacity. However, electricity generation is not happening. The ministry of Petroleum is promoting the Bio_CNG plants. They have plans to set up 5000 such plants all over the country and use the bio-CNG either for transportation or cooking. Indore city is successfully running such a plant. It is recommended to have one such plant at the central facility under the PPP model.

Involvement of Waste Pickers / NGOs: Segregation of waste at source is a big challenge. Considerable IEC efforts are required to change the behavior and attitude of the people. KMC can take the support of the NGOs active in this field and organized awareness programs about segregation and recycling of waste all over the city. The support of waste pickers can be Also, taken for the segregation and collection of waste. Pune city has successfully implemented the model of Swacch Sanstha which can be studied and adopted.

RECOMMENDATIONS FOR ADDRESSING O&M CHALLENGES IN SWM IFRASTRUCTURE FOR SUSTAINING:

Nuisance due to dumping site / legacy waste: It is recommended to clear the dumping site at Kasaba Bawda by adopting the process of Bio-mining.

Operations of sanitary landfill sites: It is recommended to expedite the operationalization of two identified sanitary landfill sites.

Processing of Dry Waste: It is recommended to set up Dry Waste Collection/Processing centers in various parts of the city for proper recycling of dry waste such as paper, plastic, glass etc. in collaboration with NGOs. KMC should allocate them space and shed. Housing societies should be motivated to segregate and store dry waste in their premises and a system of the purchase of segregated dry waste should be developed.

Segregation of waste at source: It is recommended to launch information exchange and communication initiatives such as awareness programs in collaboration with NGOs to create awareness about segregation of waste. Penalties can be levied for consistent non-compliance. Revenue and incentives should be awarded for segregation.

Decentralized Wet Waste Processing: It is recommended to establish more wet waste processing projects like bio-digesters in different parts of the city. It is recommended to use biogas as cooking fuel rather than using it for generation of electricity.

Management of Garden Waste: It is recommended to develop fuel like brickettes from garden waste. The option of shredding and composting can be Also, explored.

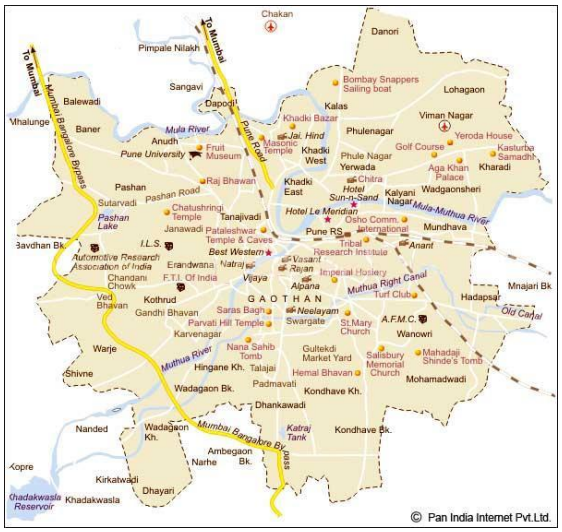
Management of Construction and Demolition Waste: It is recommended to develop a project to convert C&D waste into building materials.

Performance of Material Recovery Facility: It is recommended to install state of the art material recovery facility for dry waste with proper manpower and with the development of an effective supply chain for the recycling and circular economy in collaboration with NGOs or entrepreneurs. The space, shed and machinery to be given by KMC and operations should be carried out by NGOs/ entrepreneurs.

Centralized Wet Waste Processing: It is recommended to go for a centralized bio-CNG plant of bigger capacity as done in Pune and Indore.

Citizen Involvement: It is necessary to engage with citizens to resolve the issues with respect to solid waste management. The support of NGOs, social organizations, professional bodies, audio-visual media, print media can be explored for the same.

Pune



The current population of Pune is around 35,56,824 (Source: Census 2021) and it can be classified as a metropolitan city. The area of Pune city is 519 sq.km. It is a district in the western part of Maharashtra state and in western India. Pune is the cultural and educational capital of Maharashtra state. It is the 8th largest city in India and second largest city in Maharashtra after Mumbai. Due to industries, growth of IT sector, good climate, availability of water more and more people want to settle in Pune. Different sources of information such as Environmental Status Report (2021-22), Newspapers and other literature are used for Secondary Assessment. For the sake of brevity general information in Environment Status Report (ESR) is not repeated in secondary assessment. Based on the discussion in Secondary assessment, the framework for the site visits will be finalized.

Secondary Assessment of WASH:

WASH comprises the areas of Water Supply, Sanitation and Health.

Water Supply:

Based on the per capita supply of 135 lpcd the water demand of Pune city is 480 MLD. Against this demand 1768 MLD treated water from WTPs is supplied per day. However around 35% water is lost in leakages etc. Thus, the average water supply of Pune city is 250 lpcd which is very good. The works are done through the Water Supply Division of the Pune Municipal Corporation, like providing water to Pune, connecting new taps, laying water channels, fixing and stopping water leakages, repairing water pipes of citizens who are getting metered water supply, etc. 1335 to 1350 MLD is supplied from Pune Khadakwasla Dam. The total storage capacity of five dams namely Khadakwasla, Temghar, Panshet, Varasgaon and Bhama Askhed is as much 31.72 TMC (thousand million cubic feet). And the other source is Pavana river of capacity 30 MLD through Chikali WTP. Water quality at all the locations as represented by the Water Quality Index is good to excellent.

There are three main zones from a water supply point of view: - 1. Swargate 2. SNDT 3. Camp

Existing 9 treatment plants are there with a treatment capacity of **1768 MLD**. Total additional water treatment units planned and under construction have a total treatment capacity of 1125 MLD. The existing water treatment projects are as follows, 1) Parvati at Simhgad Rasta of 450MLD (traditional) and 500MLD (unconventional), 2) Cantonment (Complete) of 100 MLD, 3) Vadgaon at Simhgad rasta of 250MLD, 4) Waraje of 382 MLD, 5) Junae Holkar at Holkar Bridge of 20 MLD, 6) Naveen Holkar at Holkar bridge of 40 MLD, 7) Wakholi project at Wakholi of 26 MLD.

Water from the Khadakwasi dam is pumped through closed pipes to the city's water treatment plant, thereby maintaining good water quality for the city. After processing the water at the Khadakwasi Dam Water Purification Centre, a total of 20 pumping stations are used to supply the city with closed pipelines. The water supply distribution network is divided into 67 zones. There are in all 58 storage reservoirs, with a total capacity of about 250.37 million Liters. Distribution networks of about 2326 km in length and transmission networks of 93.54 km in length. Out of the planned length of 1550 km water channels, 696 km work has been completed in the said work. Out of 115 km of transmission work, 56 km length work has been completed. Out of 3,18,847 AMR meters, 70,212 meters have been installed.

Due to the scarcity of water in the north-eastern parts of Pune city, Bhama Askhed Dam was used for water supply there. In the year 2013, after surveying the dam area, a water supply scheme was planned for Bhama Akshed dam. These are being completed with financial assistance from the Central and State Governments. Approximately 22 different administrative bodies are coordinating the construction of the project. The capacity of the Bhama Akshed dam is 200 MLD and availability of water is 2.64 TMC according to reservation. Area and population-Water under this scheme will be distributed in the areas of Kalas, Sangamwadi, Yerwada, Lohgaon, Dhanori, Vadgaon for about 12 lakh population in the north-east area.

The desired efficiency of Water Supply in Pune city coverage is 100% and status is 98%. The desired and current efficiency of Complaint Redressal is of 100%. The desired and current efficiency of Quality of Water Supply is 100%. The desired efficiency of Water Supply is 24 Hours and current is 4 hours. Desired Efficiency for Non-Revenue Water (NRW) 20% and current is 35%. Per Capita Water Supply (LPCD) is 150 and status is 250 LPCD. Coverage of Metered Connection has a desired efficiency of 100% and status of 30%. Desired efficiency In Collection of Water Supply Related Charges is 90% and status of 88.

In addition to the water supply provided by the Municipal Corporation of Pune, many residents are using borewells to meet the water needs of large areas. It is necessary to control the use of such ground water. Pune Aquifers - Strategic hydrological report has been prepared by Acwadam organization. It includes Mapping & Registration of Key Groundwater Sources, Aquifer Mapping, a Recharge plan, Strategic recharge activities, protection of groundwater recharge zones Regulatory framework, Securing Groundwater from impacts of Sanitation and Waste Disposal, Protection of Recharge Zones from any activity etc.

Pune M.N.P provides a 5% exemption from income tax if any one activity is implemented in solar energy, vermicomposting, rainwater harvesting, and 10% exemption from income tax if two or more activities are implemented. In 2021, the total number of properties in the city receiving tax relief is approximately 1,11,213 (solar energy, vermicomposting, rainwater harvesting).

RWH- Number of properties after tax: -

2013-14 - 2144

2020-21 - 20597

2021-22 - 18833

From 2013-14 to 2020-21 no. of properties using rainwater harvesting drastically increased to 860% and decreased to 8.5% from 2020-21 to 2021-22.

Challenges:

1. Intermittent supply and wide variation of supply hours.
2. Absence of well-designed storm water drainage system.
3. The distribution system is very old in many areas and high physical losses occur.
4. The sewage is transferred from open drains into Nallahs which dispose it into Mulla mutha river and pollute the water.
5. The quantity of per capita supply varies substantially and is very low in north of Mulla Mutha river.
6. Inadequate storage capacity. Construction of water tank to increase storage capacity as required as part of 24x7 water supply project proposed for 1550 km water line. 696 km work is over. Laying of necessary pressure pipes to supply water to water tanks. Only 70212 AMR water meters out of 318847 are installed.
7. Water meters are installed only for non-residential buildings. At other places water is charged on an integrated basis.
8. Reservoirs working as distribution reservoirs Also, feeding other storage tanks using distribution mains.
9. Construction of water treatment units planned on behalf of a 24x7 water supply project.
10. Leak detection, sealing off old and damaged water pipes and installing new pipes as required. 100% pipe laying and installation of modern technology level meters. Construction of new pumping stations and installation of modern automatic systems as required. Replacing Gi pipe HSC to blue MDPE pipes as required.
11. There is no systematic process and record of bore wells. This is causing a reduction in ground water tables in certain areas.
12. The instances of flooding during monsoon have increased which results in damaging of pumps and water treatment plants which further results into discontinuation of water supply for a significant number of days.
13. Promoting rainwater harvesting in the city by encouraging the tax rebate.
14. High level of non-revenue water 35% (NRW).

Framework for Site Visits:

1. Feedback of leadership and staff at AIILSG will be taken before finalizing the framework for site visits.
2. Discussions will be held with top leadership of Pune Municipal Corporation (PMC) such as Municipal Commissioner, Assistant Municipal Commissioners.
3. Public representatives, Ward officers will Also, be contacted.
4. Detailed discussions will be undertaken with the officers of the Water Supply Department and a small one-hour meeting will be organized to take their feedback.
5. A site visit at Water Treatment Plants (WTPs) will be organized.
6. Water distribution systems, ESRs, and Water Testing Labs will be observed.
7. Other stakeholders such as Citizens, NGOs, Water entrepreneurs, academic community will be contacted for developing community partnerships.
8. A standard questionnaire will be prepared to capture the latest data on Water Supply, support needed for sustenance of Water infrastructure based on which recommendations will be made.

9. It is proposed to keep the final recommendations for sustenance of Water infrastructure before the stakeholders give feedback before finalization.

Sanitation:

Daily report of sewage treatment plants of P.M.C., water treatment plant wise inspection figures as per the criteria set by Maharashtra Pollution Control Board are made available in PMC.'s mobile app (PMC-STP). Due to the increasing population of Pune city, a large amount of sewage is generated in the city. The municipal corporation manages the wastewater in the city, which includes the transportation and treatment of sewage. Pune Municipal Corporation has a capacity of 567 MLD of sewage treatment plants and around 477 MLD of sewage is treated daily through these projects. A total of 1020.50 MLD of sewage treatment has been arranged for existing and proposed. The main sewage treatment plants by PMC are STP at Bopodi located near Harris bridge with capacity of 18 MLD, the sewage generated from Aundh ITI, Aundhgaon, Sindh Colony, Bopodi, and Bopodi Gaothan, NCL, Raj Bhavan etc. area is treated in this plant. The treated wastewater is discharged in Mula River. Total area served is about 15 sq. kms. Another STP is at Naidu Hospital which is located near Naidu Hospital. Its present capacity is 90 MLD. The sewage generated from the central part of the city is collected at Kasba pumping station & then treated in this STP. The process used in this plant is an activated sludge process followed by anaerobic digestion. The new plant of 115 MLD is proposed in the same premises. Other STP is at Erandwane located near Mhatre Bridge and its capacity is 50 MLD. The process used in this plant is a modified activated sludge process followed by aerobic digestion. Aeration with the help of diffusers & settling with the help of inclined tube settlers are the salient features of this plant. The sewage from Erandwana, Kothrud, Warje, Karvenagar, Paud Road, Karve Road etc. area is treated in this plant. Total area served is about 26.15 sq. kms. Other STP is at Bhairoba Nala, located at Koregaon park and its capacity is 130 MLD. The process used in this plant is an activated sludge process followed by anaerobic digestion. The gas generated in the digester is useful for power generation & the treated water is presently used for irrigation. Sewage generated from Kondhwa, Vanawadi, Kalyaninagar, Dhanori, Vimannagar, Kalas, Vishrantwadi and Ghorapadi etc. area is treated in this plant. Total area served is about 82.00 sq. kms. Other STP at Tanajiwadi, with a capacity of 17 MLD. Two stage biological processes are used in this plant, i.e. Bio towers and aeration tank with diffused aeration system. The sewage generated from Model Colony, Shivajinagar, Janwadi, Gokhale Nagar and Ganesh Khind area is treated in this plant. Total area served is about 18 sq. kms. Apart from this, the total private STPs capacity in the city is 32 MLD. This will be made from the provision of the budget of the Municipal Corporation.

Sewage Treatment Plants at Pune city

Sr. No.	Sewage treatment plants at Pune city	Location & Area	Capacity (MLD)	Year of commissioning	Areas covered
1	Bhairoba Nala	Koregaon Park, 82.00 Sq.Kms	130 MLD	July 2003	Kondhwa, Vanawadi, Kalyaninagar, Dhanori, Vimannagar, Kalas, Vishranthwadi and Ghorapadi
2	Erandwane	Near Mhatre Bridge, 26.15 Sq. Kms	50 MLD	December 2004	Erandwana, Kothrud, Warje, Karvenagar, Paud Road, Karve road, etc
3	Tanajiwadi	Tanajiwadi, 18 Sq. Kms	17 MLD	April 2004	Model colony, Shivajinagar, Janwadi, Gokhale nagar and Ganesh
4	Bopodi	Near Harris Bridge, 15 Sq. Kms	18 MLD	June 2003	Aundh ITI, Aundhgaon, Sindh colony, Bopodi, Bopodi Gaothan, NCL, Raj Bhavan etc
5	Naidu Hospital	Near Naidu hospital	90 MLD	2005	Central Park of the city
6	Vitthalwadi	Near Rajaram Bridge	32 MLD	2006	-
7	New Naidu hospital	Near Naidu hospital	115 MLD	2006	-

A total of 11 sewage treatment plants (total 396 MLD) are to be constructed under Jayaka Project under the National River Conservation Scheme. Also, a sewage treatment plant of 105.5 MLD capacity will be constructed in the newly included 11 villages and 10 MLD capacity at Ramtekdi, and their total capacity will be 115.5 MLD. The expected expenditure

For the collection of sewage generated in Pune City conveyance lines are laid down along the river and main Nallas for transporting the sewage to STP through 300 mm to 1800 mm diameter R.C.C NP 2 and NP 3 pipelines. 95% of the work on this project is completed by the year 2005. Total length of laid lines is about 227 Km.

Sewage collection for the newly merged villages there was no sewage network to convey the wastewater, therefore Pune

Municipal Corporation has designed and laid sewerage network in this added area of the Pune city to improve Public Sanitation in this area. Total length of sewer lines of the city is about 1500 kms. The diameter varies from 250 mm to 600 mm. The sewage network covers about 95% of the developed area of the newly added villages.

The National River Conservation Directorate, New Delhi, has approved the Sewage management project scheme through the Central Government to control the pollution of Mula-Mutha river in Pune city under the National River Conservation Scheme. The project mainly includes construction of sewage treatment plants at 11 places, development of sewers, construction of GIS, community toilet blocks, construction of wastewater treatment plants etc. In Pune Municipal Corporation area, sewerage connectivity and laying of large diameter sewers have been started to reach the open sewage from rivers and drains to the nearest sewage treatment plant. In this work, development of 450mm to 1600mm diameter sewers is in progress. Work is under progress to develop a large diameter truck line within the boundaries of PMC. The work of collecting ward wise information is underway in this department by dividing the area in the newly included 11 villages of Pune city into various drainage areas (zones). Sludge to be removed from the sewage treatment plant will be subjected to gamma radiation by 500 KCI COBALT-60. For this, Radioactive Element will be provided free for 3 years through Bhabha Atomic Research Centre. Due to this radiation, the harmful pathogens (bacteria) in the sludge are destroyed and it is planned to use it as a good organic fertilizer for the farmers by mixing the culture in it to increase the fertility of the soil.

Challenges:

1. Pollution of Mula mutha river due to sewage disposal
2. Water borne diseases.
3. Upgradation, O&M Sewage treatment plants and Sewage Pumping Stations.
4. Loss of sewage due to leakage and resultant less availability of treated water from sewage.
5. Vigilance of STPs installed at big residential complexes. Trained manpower.
6. Weed infestation in water bodies due to eutrophication.
7. Absence of proper system regarding reuse of treated water from STPs
8. Disposal of sludge from sewage treatment plants.

Framework for Site Visits:

1. Feedback of leadership and staff at AIILSG will be taken before finalizing the framework for site visits.
2. Discussions will be held with top leadership of Pune Municipal Corporation (PMC) such as Municipal Commissioner, Assistant Municipal Commissioner, Public representatives, Ward officers will Also, be contacted.
3. Detailed discussions will be undertaken with the officers of the Sewage Operations and Projects Department and a small one-hour meeting will be organized to take their feedback.
4. Site visits at Sewage Treatment Plants (STP) at Bopodi, Naidu Hospital, Erandavane, Bhairoba Naka, Tanajuwadi will be organized. The O&M issues faced will be noted.
5. The works being executed under NRC for protection of rivers Mula, Mutha and Mula-Mutha will be observed.

6. The projects for the sewerage system will be studied.
7. Helath issues will be discussed with doctors at BJ Medical College/Sasoon Hospital.
8. Modifications in the WASH infrastructure considering the requirement of the next 30 years will be suggested.
9. Wastewater collection systems and septic tanks will be observed.
10. Other stakeholders such as Citizens, NGOs, FSSM entrepreneurs, academic community will be contacted for developing community partnerships.
11. A standard questionnaire will be prepared to capture the latest data on Sanitation, support needed for sustenance of Sanitation infrastructure based on which recommendations will be made.
12. It is proposed to keep the final recommendations for sustenance of Sanitation infrastructure before the stakeholders for their feedback before finalization.

Health:

Diseases like Dengue, malaria, chikungunya, typhoid etc. was common in Pune city. The highest number of dengue patients was in October 2021 which was 408 cases while the lowest was recorded in January 2022 of only 16 cases. If we talk about Malaria patients in Pune, in the last ten years, the number of patients has decreased by 7% since 2015, but in the year 2022, not a single malaria patient has been found. Most of these diseases are found in the period of July and November. In the year 2021-22, the highest number of chikungunya patients in Pune city is observed in September 2021 and the lowest in June 2021. Also, in April 2021, May, June and March 2022, not a single case of cases have been detected. While no. of covid19 cases in Pune city from march 2020 to march 2022 reported were 654599 and no. of recovered cases were 650744. According to the chart, the number of deaths due to Covid-19 in Pune was the highest in the last two years in April 2021, after which the number of deaths has been steadily decreasing. On 09 March 2020, the first Covid-19 infected patient was found in Pune. After that, the covid virus started to spread rapidly. During the Corona pandemic, Pune was one of the worst affected cities in Maharashtra. Out of the diseases discussed above, Malaria and Dengue are vector borne diseases whereas TB and Corona are air borne diseases. Rest all are water borne diseases.

Questionnaire WASH:

1. What is the per capita water supplied?
2. What is the existing infrastructure for sources of water, its treatment and distribution?
3. Do all areas get water in enough quantity and quality? Are there any complaints regarding the quality of water?
4. Any issues due to flooding in the last 2-3 years?
5. What are the issues regarding O&M of WTPs, pumping stations, ESRs, Distribution systems?
6. How are the finances raised for the Water infrastructure? Is PPP model tried?
7. What are the taxes collected for the O&M of Water infrastructure?
8. What is the existing infrastructure for sewage collection and its treatment?
9. What is the generation of sewage? What is the collection of sewage? What % of sewage is treated?
10. What is the status of septic tanks?
11. Are any detailed project reports prepared for improvement of sanitation

infrastructure such as sewerage systems, sewage treatment plants etc.?

12. What is the existing system for use of treated sewage? What are the improvements needed?
13. What are the existing byelaws for the new buildings regarding sewage treatment and recycling? How are these rules monitored?
14. How are the other stakeholders such as citizens and professional associations involved? Are any IEC programs or media involved?
15. Are there any issues regarding the quality of rivers and Nallahs? Are there any projects planned to revive the nallahs?
16. Are there any issues related to water pollution caused by industries?
17. What are the issues regarding O&M of STPs, sewage pumping stations?
18. How are the finances raised for the Sanitation infrastructure? Is the PPP model tried?
19. What are the taxes collected for the O&M of sanitation infrastructure? Are user charges levied for public toilets, community toilets?
20. How many ODF++ projects are implemented? Are SHGs involved in the maintenance?
21. Any general suggestions regarding the improvement of sewage collection, treatment infrastructure and quality water in rivers and nallahs?
22. Any feedback about health issues and infrastructure and plans for improvements?

UNDERSTANDING OF CURRENT STATE OF *WASH* INFRA BY WAY OF INTERVIEW WITH OFFICIALS AND SITE VISITS:

Meeting with Shri Aniruddha Pawaskar, Chief Engineer, Water Supply, PMC

Dr. Milind Kulkarni visited Pune Municipal Corporation building in Pune on April 5, 2023, to meet the officials connected with WASH and SWM. A meeting took place between him and the Chief Engineer, Water Supply, Mr. Aniruddha Pawaskar regarding WASH. Mr. Pawaskar told Dr. Kulkarni that the major issues concerning WASH are resolved. All the mechanical water meters are replaced with electromagnetic meters. Regarding the sanitation issue, he directed Dr. Kulkarni to meet Mr. Ramdas Taru, Superintending Engineer, PMC. As Mr. Taru was not available in the office, a discussion took place with him on the phone. Mr. Tare said that all the Sewage Treatment Plants under PMC are working satisfactorily. He preferred handing over O&M operations to private parties under the PPP model for better sustenance. He said that inadequate coverage of sewerage network is an issue. But the same will be taken care by JICA funded project. At present there is a 92% sewerage network of 2200 kms. At present there is a 92% sewerage network of 2200 kms. But much of it is very old and needs

rehabilitation. Similarly, the pollution of Mula-Mutha river will Also, be taken care by JICA project.

Pollution Abatement of River Mula-Mutha under JICA Project:

The MulaMutha river is one of the 302 polluted rivers stretc.hes of the country identified by the Central Pollution Control Board (CPCB). The major reasons for pollution of MulaMutha are discharge of untreated domestic wastewater into the river due to inadequate sewerage system (including pumping stations) & sewage treatment capacity as well as open defecation on the riverbanks.

A loan agreement was signed on 13th January 2016 with Japan International Cooperation Agency (JICA) for pollution abatement of river MulaMutha by January 2022. Under the agreement, the government of Japan is committed to provide a soft loan of Rs. 1000 Crore to India for the project at an interest rate of 0.3 % per annum.

The major components proposed under the project include construction of 11 new Sewage Treatment Plants (STPs) which will result in a creation of an additional treatment capacity of 396 million litre per day (MLD) over the existing treatment capacity of 477 MLD, laying of 113.6 kms of sewer lines and renovation/rehabilitation of 4 existing intermediate pumping stations. This will be sufficient to cater to sewage generation up to the year 2027.

The project Also, includes installation of a system for centralized monitoring of a system for centralized monitoring of functioning of STPs, construction of 24 units of community toilet facilities in slum and fringe areas, public participation and awareness programme, GIS mapping of sewerage facilities for better asset management.

Funding Pattern

Government of India – 85% - Rs. 841.72 Crore, Pune Municipal Corporation – 15% - Rs. 148.54 Crore: Total- Rs. 990.26 Crore

Project Components	**Cost (Rs. in Crore)**
Sewage Treatment Plants (396 MLD, 11 Nos), augmentation of existing Pumping Stations (4 Nos) & Centralized SCADA	611.20
Collection Network, Main Sewers (133.60 Km)	179.80
Land Acquisition, Project Management Costs and Taxes	177.66
GIS/MIS	13.00
Public Awareness & Capacity Building Activities	5.40
Construction of Community Toilets (24 Nos)	3.20
	990.26

Institutional Development Programme

- Training for enhancement of technical capabilities of existing manpower to reduce the support of senior management in day to day operations.
- Strengthening of existing computerized system for accounting and e-Governance.
- Technical, Financial and Management Training Program for Project Implementation Unit (PIU)
- GIS based sewerage system mapping for proper operation & maintenance and monitoring of the sewerage systems.
- Application of GIS based asset management system with property details including details about owners,

their ARV details, details of water and sewerage connections and PMC taxes.

Public Participation and Awareness

- For sound operation and maintenance of sanitation facilities, and ensure its sustainability, public participation and public awareness programme has been proposed involving the NGOs and CBOs (Community Based Organizations).
- Participation of Schools for pollution awareness programs.
- Radio programs and advertisements through CSR for creating awareness for abatement of pollution of Mula-Mutha.

Outcome of the Proposed Works

- Domestic wastewater discharging directly or indirectly into the river will be intercepted and the target of total prevention of sewage discharge into the river will be achieved.
- Provide relief to the existing 90 years old trunk sewer.
- Treated sewage will be used for irrigation in agriculture.
- Effluent of proposed STPs will be utilized for irrigation of nearly 21000 Hectares by pumping 515 MLD of treated water into the Canal network of the irrigation Department. Irrigation has given a discount on raw water usages to PMC.
- Provide up-gradation and rehabilitation of existing sewerage facilities in the city.

ASSESSMENT OF WASH IFRASTRUCTURE AND IDENTIFICATION OF O&M CHALLENGES:

Water Balance Diagram, Water Metering and Leakages:

When PMC draws water from Khadakwasla Dam, 35 to 40 percent of it leaks till it reaches households. To stop this leakage, the Municipal Corporation has decided to install a meter at every tap under the Uniform Water Supply Scheme. [4] 132 zones have been created in the city, and the installation of electromagnetic meters has been completed in two of them. Municipal Commissioner Vikram Kumar informed that water leakage has been detected due to the installation of these meters in these two zones and the rate of water leakage has come down from 40 percent to 16 percent. He said that the aim is to supply 150 lpcd water in Pune. 3.18 lakh water meters will be installed. Till now 35 % of the meter installation work has been completed. The Municipal Corporation has claimed that the rest will be completed by June 2023. At present most of the water meters are mechanical. As the said meter Also, rotates due to air, even though the water was not used, earlier billing was being done. Also, the water pressure was decreasing. However, the Municipal Corporation has now decided to buy an AMR meter costing Rs. 7500/- Mr. Anirudh Pawaskar, Chief Engineer of the Water Supply Department, said that since this is an electric full-bore meter, there will be no obstruction in the water flow and no effect on the water pressure. The life span of these meters is 10 years. All the meters will be connected to the main server of the Municipal Corporation through the GPRS system. He Also, said that a drop-by-drop account can be maintained. Suppose 10000 litres of water is taken from the Khadakwasla dam – How much water comes from the water channel to the municipal tanks, and from there how much goes directly to the house through the pipe connection? The Municipal Corporation will receive all the records of this in fifteen minutes. Areas with

less water supply and areas with more water supply – everything will be recorded. Due to this, equal distribution of water can be controlled and excess water or wasted water can be prevented.

24 X 7 Water Supply: The Municipal Corporation undertook the work of 24 by 7 Uniform Water Supply Scheme in 2018. The work was halted due to the pandemic. But this work gained momentum in the last few months and 400 km of new water pipes have been laid in place of the old water pipes. [4]

Water Quality: The water quality of Pune and Pimpri Chinchwad cities is reported as highly satisfactory in an independent survey.

Pollution of MulaMutha Rivers: This is an issue. However, the JICA project discussed above is expected to resolve the same. It is necessary to monitor the project for its timely completion.

Capacity building: Capacity building as envisaged in the JICA Puen project should be undertaken through training of staff particularly at the ground level.

Public Participation and Public Awareness: This is required as envisaged in WASH.

Best Practices:

Installation of Electro-Magnetic Water Meters: This will reduce the water leakages and ensure uniform water distribution.

RECOMMENDATIONS FOR ADDRESSING O&M CHALLENGES IN WASH IFRASTRUCTURE FOR SUSTAINING:

1. **Pollution of MulaMutha River**: Timely and quality implementation of all proposals in the JICA project should be ensured.
2. **Public Participation and Public Awareness:** This is important for sustaining WASH infrastructure and should be undertaken with the support from NGOs and community-based organizations.
3. **Capacity building:** Training of municipal functionaries in the latest technology and other aspects of WASH is required.

Solid Waste Management

It is estimated that the total quantity of MSW (Municipal Solid Waste) generated in Pune city is about 2100 to 2200 MT (Metric Tons) per day which translates to more than 315 gm per capita/day. Out of them, 1200 MT is dry waste and 900MT of wet waste. Dry waste other than plastic processed is 1100 MT. Plastic waste processed is 92 MT. Wet waste being composted in plants by PMC is of 450-460 MT. Bulk waste generator process around 125MT. Home composting of 75MT and composting done by farmers outside the city around 250MT/day. Biomedical waste is 5MT and sanitary waste processed is of 8MT/day. The Municipal Corporation and the Citizens manage it in a strategic manner. The rate of collection of segregated waste is around 90 to 95 %. Approximately 40% of the waste generated daily in Pune is biodegradable or wet waste.

Wet waste treatment projects in Pune city at present are, Composting grabber of installed capacity 200MT and working capacity 225MT by Bhoomi Green Energy, Biogas Projects of installed and working capacity 60MT, Mechanical composting by Save environmental Pvt. Ltd of installed and working capacity 3MT, Bio CNG Nobel exchange by Nobel exchange LLP of installed capacity 200MT and working capacity 100MT, HTS wadgaon by Mitra green energy of

installed and working capacity of 20MT, Devachi Uruli RTF compost by Bhoomi green energy of installed capacity 100 MT and working capacity of 50MT. Here waste generated by bulk waste generators as per municipal solid waste management norms-2016, by private societies, merchants, restaurants etc. of 125MT. Home composting is 75MT and Garbage composted by farmers is of 250MT. Pune MNP has completely stopped open dumping of any kind of waste at Uruli Garbage Depot from 02.01.2020 and 100% of waste is being processed in various industrial waste treatment projects in Pune.

After June 2022, the Pune MP has decided to stop the disposal of classified waste in the nearby villages of Pune city and dispose of the waste as follows.

- 50 MT capacity 4 projects – Making briquettes from wet waste (HDS high density stalk) – 200MT/day.
- Capacity expansion of Uruli Devachi - Bhumi Green energy project-100MT/day

Dry waste generated in Pune city is 1200 to 900 MT/day. Dry waste is waste that does not decompose naturally but can be treated and recycled. Open dumping and burning of garbage is prohibited in Pune city. Garbage to be recycled through Swachh Sevak is 150MT/day.

Dry waste treatments done at present are as follows-

	Dry waste treatment projects	**Project Driver**	**installed capacity**	**Working capacity**
1	Rochem, Ramthekdi, Hadpasar	Rochem green energy	700	0
2	R.T.F, Wadgaon	Bhoomi green energy	150	150
3	M.R.F, Dhayri	Green solutions	50	50
4	R.T.F, Ramtekdi	Adarsh Bharat Enviro Pvt. Ltd.	75	75
5	M.R.F, Katraj	A.T. Ecosolutions	50	25
6	M.R.F , Hontewadi	New global Eco solutions	25	25
7	M.R.F, Wadgaon	Samskriti waste management	25	25
8	M.R.F, Keshavnagar1	Sairam Engineerings	50	50
9	M.R.F Sughsagar nagar	Aditya waste paper	75	75
10	M.R.F, Keshavnagar2	Nepra Research Recycle	100	75
11	M.R.F, Ambegaon	Adarsh bharath Enviro	200	0
12	M.R.F, compost Uruli	Bhoomi green energy	300	300
13	Waste to energy, Ramtekdi	Pune bio energy	300	200
		Total dry waste	**2100**	1050
		Recycle through garbage collectors (as		150

		per requirement of Swach h Sansth a)		
		Total (Recycled + Dry)		**1200**

34 (11+23) villages have been newly included in Pune City and assuming the population growth of the city in the next ten years, the following projects are being planned.

Power generation from waste – 350 MT

Separation of briquettes from waste- 200MT

Dry waste transfer from PMC to cement company- 150 MT.

Generation of RDF (Refused derived fuel) from dry waste – 100MT.

300 mt/day capacity under phase 1 by MRF (material recovery/recycling facility) is under construction -400 MT.

Leachate- A tank of 12-liter capacity has been constructed and RO (Reverse Osmosis) process is being done on the said leachate with a capacity of 100 cubic meters per day.

Landfill- About 10 to 15% (about 300 to 350 MT per day) of waste generated from waste treatment plants in Pune is taken into the resort's landfills and care is taken to periodically spray medicine and cover the soil to prevent pollution.

Biogas initiative- At 35 km from Pune, the Bio methanation project is being set up in Talegaon Industrial Park. They have started 75 tons of bio methanation per day. 15,000 square feet of space is being provided in Talegaon for disposing of wet waste produced from food waste. The collected food waste is segregated from the Baner district centre and transported to the Talegaon district project. The process of extracting biogas from waste is carried out in a traditional way at Talegaon. Some other compounds that are produced from this process are used as fertilizers in agriculture. The use of compressed biogas (CBG) from the project has started to be used as fuel for buses.

Bio-medical waste- All the biomedical waste (about 5 MT per day) generated in Pune City is collected and disposed of in the Pasco Environmental Solution System. Also, planning has been done for the construction of a 5 MT capacity Comprehensive Bio-medical waste collection & Processing System for Allopathy, Ayurvedic, Homeopathic, Dentist and household waste. This waste is collected from three types of color-coded bags Yellow - for incineration, Red – for shredding/recycling/landfill, white – plastic, glassware, small bricks which have been chemically treated were sent to the hazardous waste processing project at Ranjangaon.

Construction & Demolition Waste- Currently in Pune city, around 200 MT of construction waste has been generated and disposed.

Sanitary Waste- Red dot campaign is being implemented in Pune and under this every day 8 MT of waste is being collected. Sanitary facilities are made for buildings, private and government buildings, palaces, private and public offices, public toilets, malls, hospitals, slums and other residential areas by P M C. It is necessary to dispose of such sanitary waste like diapers, sanitary napkins and household waste and biomedical waste. A concerned effort has been made through procter & Gamble, Rochem and PMC for this. The project

is underway on a 12-acre area in Ramtekdi of Pune city, and it has zero emissions due to the steam sterilisation process.

E- Waste- There are 15-20 types of E-Waste identified by the Maharashtra Pollution Control Board in Pune. The project has been started on a pilot basis at Chittaranjan Vatika Chanya through Janvani and Cummin's India. Approximately 500 Kg of E-waste were collected in a single month in March 2022. 68 tons of e-waste was collected from 200 societies and Rabavilles 40 camps in Pune city throughout the year through Pune Municipal Corporation and Cummins India, Poonam Ecovision, Janvani etc. Similarly, 62 tonnes of e-waste were collected in 242 campaigns under the 'We Collect' initiative of Pune Municipal Corporation and Swachh organisation. To scientifically dispose of e-waste with a capacity of 8 tons per day, the use of electric vehicles will increase in the future, it is necessary to take measures on the e-waste of batteries in these vehicles.

Chicken center, Mutton, Fish waste- According to the report of the health department of Pune Municipal Corporation, every day 9MT of chicken mutton and fish waste is produced in the city. There are two technologies being proposed to deal with this waste – a) Rendering technology - using animal carcasses to make meat bone paste like pedigree and also, to make tallow (oil, fat) soap. b) Bio Composting- 2MT of biogas project and 2.5 MT of bio composting projects are included.

Plastic to Fuel- A project of 100 to 150 kilo capacity has been set up through CSR funding and municipality to scientifically dispose of the plastic waste generated daily in Pune city and to produce fuel from plastic by pyrolysis.

Activities undertaken by Municipal Corporation for plastic waste management.

Under the initiative of Global environment Pune Project 2022 organized by PMC, 29,870 kg of solid waste, 753 kg of Garbage and 3,854 kg other wastes, a total of 34,477 kg were collected. Even with the ban on low thickness bags by the Maharashtra, Plastic Bags (Production and Use of Carry Bags) Rules, 2006, the increasing amount of waste is causing damage to the environment and health. The production, use, manufacture, distribution, wholesale and sale, storage and transportation of these are banned from 2018 onwards. This includes all plastic bags (with and without handles) and single-use disposable articles made of plastic (Poly-Tarren) and plastic, viz. Plates, cups, glasses, bowls, spoons, pots, plates, utensils used as food containers in hotels, bowls, teas, non-woven polypropylene bags (non-woven polypropylene bags) used for liquid storage, Carrying plastic pouch/cups etc.

Prohibition of single use plastic

The central government has banned 'Single Use Plastic' from 1st June 2022 and an action plan is being drawn up. Pune Municipal Corporation has issued a notice in the local newspaper of the city about banning the use of single use plastic to create awareness among the citizens about single use plastic. Pune Municipal Corporation has banned the use of single use plastic since 2019 and penal action will be taken against the culprits. Also, a special squad has been formed under the solid waste department of the Pune Municipal Corporation and punitive action is taken from time to time through them.

Challenges:

1. Cities like Indore are adopting big waste to energy projects developing bio CNG. Pune should Also, work on similar projects on a bigger scale. There is a project at Talegaon. More such projects are needed.
2. Segregation remains a challenge.
3. Infrastructure for recycling of and reuse of dry waste is to be developed fully.
4. There are issues related to branding of compost generated.
5. There are complaints from citizens about the existing landfill site at Fursungi.

Framework for Site Visits:

1. Feedback of leadership and staff at AIILSG will be taken before finalizing the framework for site visits.
2. Discussions will be held with top leadership of Pune Municipal Corporation (PMC) such as Municipal Commissioner, Assistant Municipal Commisioners.
3. Public representatives, Ward officers will Also, be contacted.
4. Detailed discussions will be undertaken with the officers of the Solid Waste Management Department and a small one-hour meeting will be organized to take their feedback.
5. Site visits of landfill sites at Fursungi as well as waste to energy projects at Talegaon and other places will be organized.
6. Dry waste recycling centers will be Also, visited.
7. Other stakeholders such as NGOs, SWM entrepreneurs, and the academic community will be contacted for developing community partnerships.
8. A standard questionnaire will be prepared to capture the latest data on SWM, support needed for sustenance of SWM infrastructure based on which recommendations will be made.
9. It is proposed to keep the final recommendations for sustenance of SWM infrastructure before the stakeholders for their feedback before finalization.
10. **The Feasibility Study Report (FSR) will be prepared for all the components of Integrated Solid Waste Management of BMC for the requirement for next 20 years considering gap analysis so as to conform to SWM Rules 2016, CPHEEO SWM Manual 2016 will be referred.**
11. **All aspects such as collection and transport (C&T), Processing by different options such as composting, bio-methanation, waste to energy etc., Disposal by sanitary landfills etc. will be considered while preparing project reports in FSR.**
12. The existing capacity of the Collection and Transportation (C&T) facility will be assessed and suitable mechanism to improve the C&T process will be proposed. Use of technology like GPS, RFID for tracking the collection will be explored.
13. **Different components of Integrated Solid Waste management such as Dry Waste, C&D waste, RDF, Garden waste, E-Waste, Plastic & Thermocol waste will be considered, and project reports will be included for these components.**
14. **Legacy waste at landfills will be quantified. The existing arrangements like bio-mining,**

capping will be studied. Projects will be suggested if gaps exist. O&M after 15 years of capping will be suggested.

15. Leachate management, environmental issues of existing and future landfills will be considered.
16. Marketing of compost, RDF, Plastic waste, tetrapack waste, energy etc. will be discussed. Linkages will be developed with farmers' bodies, cement and sugar factories etc. for the same.

Questionnaire for SWM:

1. What is the solid waste generated in different categories at present? What is the per capita contribution? What is the solid waste generation expected in 20 years and what are the future plans?
2. What are the challenges in the existing system? What support is required from the government and private sector?
3. What are the financial resources allocated for SWM? Are any taxes collected from the public for SWM? Are any user charges levied? What is the revenue generated from all sources for SWM such as fines, penalties etc.?
4. What is the financial viability of the existing system? How the O&M of existing vehicles, landfill sites etc. is carried out?
5. How many employees are available for SWM? Are there any efforts made for their capacity building?
6. What is the revenue generated from selling dry waste category wise?
7. How is dry waste such as plastic, thermocol, glass, paper etc. processed?
8. What arrangements are made for C&D waste, E-Waste, tetrapack, wood/garden waste etc.
9. What land is available with SWM dept. for existing projects and future projects?
10. How are entrepreneurs engaged?
11. How are waste pickers, SHGs, NGOs etc. involved in SWM activities?
12. How is community participation ensured in SWM? Are any IEC campaigns launched?
13. What is the performance of the city in Swachh Sarvekshan 2022?

UNDERSTANDING OF CURRENT STATE OF *SWM* INFRA BY WAY OF INTERVIEW WITH OFFICIALS AND SITE VISITS:

Interview with Deputy Municipal Commissioner Ms Asha Raut

Meeting with Dr. Ketaki Ghatge from SWM Department

Dr. Milind Kulkarni met Ms Asha Raut, Deputy Municipal Commissioner of Pune Municipal

Commissioner on April 5, 2023. Interview of Dr. Ketaki Ghatage was Also, taken about the SWM infrastructure. Interviews were Also, held with Mr. Mukund Barve EE, SWM Department. Mr. Nitin Shinde Engineer from SWM accompanied Dr. Kulkarni on site visits on April 9, 2023.

Capped Legacy Wastes Site at Urali Dewachi, Pune

Stack for flaring bio-gas generated at Capping Site, Urali Dewachi, Pune

Bio-mining plant, 2000 TPD for Legacy Wastes – Urali Dewachi, Pune

Initial step in Bio-mining

Inside view of Bio-mining Plant, Processing of Legacy Wastes

Generation of bio-soil a result of bio-mining

RDF and Compost Plant for the current waste generated.

Segregated glass waste at the processing site

Inside view of RDF and Compost Plant with Material Recovery Facility, Pune

Panaji

The current population of Panaji is 1,14,759 (Source: www.census2011.co.in) and it can be classified as a metropolitan city. Panaji is a popular Tourist destination both on the national & international Tourist circuits. Panaji is the capital of the Indian state of Goa and the headquarters of North Goa district. It lies on the banks of the Mondovi River. Panaji has a geographical area of 7.5 sq.km with more than 50% of the town area under various residential uses while the central core area represents the major commercial area. Different sources of information such as Environmental Status Report and other literatures are used for Secondary Assessment. For the sake of brevity general information in Environment Status Report (ESR) is not repeated in secondary assessment. Based on the discussion in Secondary assessment, the framework for the site visits will be finalized.

Secondary Assessment of WASH:

WASH comprises the areas of Water Supply, Sanitation and Health.

Water Supply:

Based on the per capita supply of 135 lit/day, the water demand of Panaji city is 30 MLD. Against this demand 20.2 MLD treated water is supplied per day with a shortfall of 9.8 MLD.

The present water supply system of Panaji Corporation is a part of the combined water supply system for Tiswadi and Ponda Talukas. The Khandepar river, a perennial river, flowing through Opa at Ponda Taluka is the place of Intake. Intake work having an individual delivery pipe of 450 mm diameter and with horizontal centrifugal pumps, (2W + 1S), 400 KW each. Raw water rising main is of nominal diameter 600 mm M.S of 1.7 km. The river flow is controlled by the Water Resource Department (WRD) and sufficient water will be made available for the exclusive use of Panaji and other areas of Ponda and Tiswadi Talukas.

There are 4 WTP's of 8 MLD 12 MLD at Opa and 55 MLD & 45 MLD at Curti. The water is transmitted from Curti to service reservoirs at Altinho, Panaji, 40 Kms by gravity mains and distributed to the city from there. Presently there are 3 water supply distribution zones with the following reservoirs.

1) Zone 1- Total 8 Service Reservoirs at Altinho (6 GSLR and 2 OHT) with capacity of service reservoir of 10100 Cu.M which serves Panaji city. The quantity of water supplied is 15MLD.
   GLSR 1- 5000 Cu.M
   GLSR 2- 800 Cu.M
   GLSR 3- 800 Cu.M
   GLSR 4- 800 Cu.M
   GLSR 5- 800 Cu.M
   GLSR 6- 800 Cu.M
   OHT 7- 450 Cu.M
   OHT 8- 650 Cu.M
2) Zone 2- Service Reservoirs at Rebander (2 GLR) of 450 Cu.M. that serves Ribandar. The quantity of water supplied is 1.20 MLD.
   GSR 1- 150 Cu.M

GSR2- 300 Cu.M

3) Zone 3- Service Reservoirs (3 OHT) at Talegao and Nagali. Total capacity of 2250 Cu.M. It serves at Paula, the part of CCP area in Talegao with a quantity of water supplies of 4MLD.
   Nagali OHT – 200 Cu.M
   Talegao, OHT1 – 1600 Cu.M, OHT 2- 650 Cu.M

The Census-2011 provides data for the combined population of the CCP and the 7 Out-growths on the outskirts. Available information is for administrative zones as given below and not as per the Water supply zones. According to Panaji CDP, 2014, Total number of households in CCP is 10158 and households with tap connections are only 8829 with a gap of 1329 houses. The total number of houses of CCP including the outgrowths is 17807 with houses having tap connections of 15534 with a gap of 2273 houses.

The total road length of the city is 77 km. The coverage of the water supply distribution pipeline network w.r.t. the existing road length in the city to be taken up is 100% within the CCP area and presently 79% of the households within the CCP area are provided with HSCs. The present supply to the Panaji CCP is 15.0 MLD while 24.2 MLD for the city region (CCP+ OG). With these 8 projects under execution, universal coverage of the water supply pipeline is to be achieved.

Total length of the distribution network is DI pipes of 350mm to 450mm diameter of 7179 meters and of HDPE pipes 90mm to 315mm of 80347 meters.

There are 7030 domestic connections and 1000 commercial service connections. There are seven zones, however distribution system is characterized by intermittent supply wherein the duration in different wards varies from 1.5 to 3 hr/day, while in couple of wards it is 7 hr/day; high pressure losses on account of smaller size of pipes and consequent low pressure at the consumer end; and high unaccounted for water, etc. As per available records, total supply to the distribution system is estimated to be of the order of 20 MLD. Unaccounted for water is estimated to be rather high at around 35% which is attributed to, among others, leakages from old and corroded distribution mains; leakages from corroded GI pipe-based service connections; and illegal connections. Distribution of water is widely varying in terms of pressure and duration. Most of the service connections in Panaji are G.I and are corroded and leaking. Leaking pipelines have high potential for contamination. NRW is nearly 35%.

As per the information from the PHE office, by and large there are no issues with water quality. However, during supply there is risk of contamination due to leakages, pipe breaks, cross connections with open drains or sewer lines, illegal tapping, etc.. This is reported to be the case particularly in ward 26. Shallow groundwater table Also, poses risk of contamination and requires better quality and workmanship in laying of pipelines and fixtures.

Efficiency of coverage of water supply connections has a service benchmark of 100% and the status is of 100%. Per capita supply of water is of service benchmark 135 lpcd but the status is of 230 lpcd and a target benchmark of 250 lpcd. The Extent of metering of water connections has a benchmark of 100% and the status is 100%. Efficiency of the extent of non-revenue water (NRW) has a benchmark of 20% and the status is 32% and the target is 20%. Benchmark for Continuity of water supply is 24 hours, and the status is only 4-5 hrs. and the target is 12 hrs. Benchmark of the quality of water supplies is 100% and status is 100%. Efficiency in the redressal of customer complaints is 80% and the status and target is

of 60% and 80% respectively. Cost recovery in water supply services has a benchmark of 100% and the status is 60% and the target is 100%. Efficiency in water supply collection charges have a service benchmark of 90% and the status and target are 60% and 90% respectively.

Challenges:

1. Absence of well-designed storm water drainage system.
2. The present supply is intermittent, and the supply is only for 2 hrs. Presently the existing system is unable to meet equality in supply.
3. Some of the distribution mains are very old and there are heavy leakages in the system. Distribution of water is widely varying in terms of pressure and duration. During supply there is risk of contamination due to leakages, pipe breaks, cross connections with open drains or sewer lines, illegal tapping, etc. This is reported to be the case particularly in ward 26.
4. Most of the service connections in Panaji are G.I and are corroded and leaking pipelines have high potential for contamination.
5. NRW is nearly 35%. Presently, NRW in Panaji city is in the region of 35%. Studies are carried out by special teams formed under NRW cell to conduct household surveys and detect leakages and replace damaged supply lines, nonperforming meters etc. to reduce real and apparent losses.
6. There is no systematic process and record of bore wells. This is causing a reduction in ground water tables in certain areas.
7. Around 10% of households do not receive piped water supply connections.
8. The instances of flooding during monsoon have increased which results in damaging of pumps and water treatment plants which further results in discontinuation of water supply for significant number of days.
9. Lack of proper zoning
10. Multiple valve operations
11. Increase in revenue collection of the ULB by way of metered connections.

Framework for Site Visits:

1. Feedback of leadership and staff at AIILSG will be taken before finalizing the framework for site visits.
2. Discussions will be held with top leadership of the Corporation of city of Panaji (CCP) such as Municipal Commissioner, Assistant Municipal Commissioners.
3. Public representatives, Ward officers will Also, be contacted.
4. Detailed discussions will be undertaken with the officers of the Water Supply Department and a small one-hour meeting will be organized to take their feedback.
5. Site visits to Water Treatment Plants (WTPs) at Opa and Curti, will be organized.
6. Water distribution systems, ESRs, and Water Testing Labs will be observed.
7. Other stakeholders such as Citizens, NGOs, Water entrepreneurs, academic community will be contacted for developing community partnerships.
8. A standard questionnaire will be prepared to capture the latest data on Water Supply, support needed for sustenance of Water infrastructure based on which recommendations will be made.

9. It is proposed to keep the final recommendations for sustenance of Water infrastructure before the stakeholders give feedback before finalization.

Sanitation:

With the recent execution of laying of sewer network in the uncovered areas of wards 1,2,3,4 and remaining parts of ward 5, CCP has now achieved sewerage coverage in almost 85% of the city. The remaining uncovered areas including ward 29 and 30 in the Ribander across the Ourem Creek in the north-east & some unserved pockets which largely belong to EWS/LIG migrants, have on-site sanitation system. For achieving 100% sewerage coverage, CCP has already initiated the survey works in the uncovered areas.

It is noted that out of the total 16,244 households across CCP and the adjoining OG areas, almost 87% households have access to individual toilets, 7% use community/ public toilets and the rest 6% resort to open defecation. In absolute terms, there are only about 916 households which are either constrained to or prefer open defecation. Among those households having individual toilets, about 42% have off-site sanitation facility while the balance 58% practice on-site sanitation in one form or the other.

In absence of separate census data on access to sanitation in the CCP area, estimates have been developed based on field surveys and interaction with Municipal Corporators of the concerned wards. It may be noted that with the commissioning of the ongoing sewerage scheme for Taleigao, Donapaula and Caranzalem, the number of household connections to sewer line is expected to increase to 85%. It is noted that an overwhelming 97% of the households within the CCP area have individual toilets and about 2.6% have access to and use community/public toilets. The practice of open defecation is resorted by a rather small fraction of 0.6%, which corresponds to about 66 households. However, it is Also, noted that a small number of households have built unsafe latrines, i.e., although they offer privacy, but sewage/ excreta is directly discharged into open drains which is equally risky in terms of threat to environment and public health. About 61% of the households have access to sewerage system while 39% have developed on-site sanitation solutions - the latter almost entirely depending on private septic tanks. In addition to the domestic households, there are number of schools, colleges, hotels, restaurants, hospitals and other commercial and institutional establishments located within the town as well as in the OG areas. Information on sanitation arrangements in such properties is not available, however, it is clear that availability of toilets is not an issue here but safe disposal of sewage and wastewater in areas outside the coverage of sewerage system may be an issue.

As Panaji is a popular tourist destination both on the national and international tourist circuits, the floating population on an average day is estimated to be in excess of 15,300 with a typical stay of 4 days. To cater to the sanitation needs of visitors, transit passengers and Tourists, public toilets are one of the essential social infrastructure components. These need to be typically located near bus stations, railway stations, and Tourist spots, especially beaches, recreational centers, main markets / commercial places, hospitals, transit points, and any other place that attracts large number of visitors. Six public toilets have been constructed by CCP itself and six by the Department of Tourism. Another set of five public toilets have been developed by CCP under PPP through a 'build operate and

transfer' (BOT) contract. Sewage from all but five public toilets is discharged into sewers. In the case of five public toilets sewage is discharged in septic tanks and it is frequently emptied by vacuum tankers for disposal at the STP at Tonca. During the course of the field survey, we were able to locate 11 community toilets in different parts of the city. This was done after consulting with CCP Engineers, Sulabh and all the elected ward councillors. In this case Also, it is noted that all the toilets are based on water-sealed cistern-flush or pour flush technology, which essentially requires water for operation and generates sewage. In each of the community toilets water supply is through the PHE network, however this is intermittent and unreliable. In the absence of alternate reliable sources of supply e.g., dedicated tube wells or storage, adequate water is not available for flushing and frequent cleaning. However, the poor sanitary condition of these facilities is leading communities in their catchments to resort to open defecation or alternate unsafe practices e.g., use of bucket and disposal along with domestic solid waste, etc. Evidently, the performance of the service provider was lacking, which could be attributed to low revenue from user charges, lack of financial support from the ULB, etc.

According to CCP records, there are no habitations/ settlements designated or notified as slums within the Panaji municipal limits as well as the adjoining Out-growths and the Census Towns. However, within the CCP area, especially in Ward no. 1, 3, 13 and 16 few low-income households with temporary or semi-permanent construction are noticed. There are 8 habitations with an aggregate of 324 households (i.e., 3.2% of total CCP households) falling in this category which has limited access to basic municipal infrastructure and services. About half of the households in these habitations have satisfactory access to sanitation in the form of either individual or community toilets. About two fifths of the households have constructed individual toilets. Intriguingly while all the 45 households along St. Inez Creek (mainly belonging to CCP sanitary workers) have individual latrines, they do not have safe disposal arrangements and instead excreta/ sewage is directly discharged into the water body/ drain. In some of these communities, it has been brought to our notice that in some households where individual latrines are not available, dispose of excreta along with domestic solid waste or into nearby drains or open areas. Thus, the footprint of poor sanitation is likely to be much broader than what appears from the above data. The present situation in several parts of the town is not deemed to be satisfactory and therefore concerted measures need to be taken on the part of CCP as well as other local bodies and stakeholders.

It is noted that the present combined installed capacity for sewage treatment in Panaji is 13.1 mld, and it is expected to soon increase to 27 mld. Installed sewage treatment plants at Panaji are at Tonca and Patto. The installed capacity of Tonca is 12.5MLD and the technology used is SBR. As established in an earlier section on sewage volumes, it is understood that the STP is hydraulically under-loaded, i.e., it is working at around 60-72% capacity utilization. The capacity of the sewage treatment plant at Patto is 0.6 MLD and ASP is used there. About 90% of the incoming flow is picked up and treated while the balance 10% is bypassed and discharged into the Mandovi Estuary. At Tonca there is a treatment plant under commissioning with a capacity of 12.5MLD using SBR. And a proposed treatment plant is at Patto of 2 MLD using SBR.

Challenges:

1. The footprint of poor sanitation and intermittent and unreliable water

supply seen in public and community toilets.

2. In Ward no. 1, 3, 13 and 16 few low-income households with temporary or semi-permanent construction are noticed where 8 habitations with an aggregate of 324 households (i.e., 3.2% of total CCP households) falling in this category which have limited access to basic municipal infrastructure and services. Intriguingly while all the 45 households along St. Inez Creek (mainly belonging to CCP sanitary workers) have individual latrines, they do not have safe disposal arrangements and instead excreta/ sewage is directly discharged into the water body/ drain. In some of these communities, it has been brought to our notice that in some households where individual latrines are not available, dispose of excreta along with domestic solid waste or into nearby drains or open areas.
3. It is observed that the condition of most of the Sewage pumping stations are very poor due to very old pumps, motors and electric panels that have completed their useful life. The machinery was found to be worn-out or corroded and therefore requires frequent repairing. Electric installations are Also, almost damaged resulting into low operational efficiency. During monsoons, the increase in the water flow volume often results in backflow or surcharge in the incoming sewers causing the problem of choking and overflowing from manholes onto roads, low lying areas or into drains and creeks, thereby leading to pollution of surface water bodies.
4. Almost all intermediate sewage pumping stations are in rather poor condition and require urgent improvements and capacity augmentation. Particularly SPS-5 near the Thakur Petrol Pump which is overloaded and requires immediate refurbishing and strengthening.
5. Sewer pipes in several stretches including the critical outfall sewers are more than40 years old and have outlived their designed life. These pipes are of smaller diameter and therefore do not have the capacity to carry increased sewage flows resulting from increased resident and floating population and higher water consumption pattern, etc. Same is the case with other components of the collection and transmission system.
6. At several places sewer lines and manholes are worn out which Also, leads to infiltration of groundwater and surface runoff and consequently significantly higher flows at the STP especially during the monsoon.
7. High sewage discharge in the receiving manhole of the outfall sewer which starts near the St. Inez Church is resulting in back flow in the sewer lines as well as overflows from damaged manholes in lower-level areas of St. Inez. This creates insanitary and unsafe conditions in some habitations.
8. Inadequate capacity, poor condition and irregular operations of intermediate sewage pumping stations invariably leads to backflows, overflows and bypassing of sewage into water bodies, undermining environmental sanitation and public health.
9. At the sewage treatment plant at Patto, there are operational issues e.g., lack of flow measurement facility,

inadequate recirculation of activated sludge, lower efficiency of removal of solids in the secondary sedimentation tank, and of course odour emission.

10. At the sewage treatment plant at Tonca, it is understood that the STP is hydraulically under-loaded, i.e., it is working at around 60-72% capacity utilization.
11. Water borne diseases.
12. Pollution of water bodies.
13. Lack of cleaning of septic tanks and inadequate faecal sludge and septage management.
14. Loss of sewage due to leakage and resultant less availability of treated water from sewage.
15. Weed infestation in water bodies due to eutrophication.
16. Absence of proper system regarding reuse of treated water from STPs

Framework for Site Visits:

1. Feedback of leadership and staff at AIILSG will be taken before finalizing the framework for site visits.
2. Discussions will be held with the top leadership of CCP, PWD Goa.
3. Public representatives, Ward officers will be Also, contacted.
4. Detailed discussions will be undertaken with the officers of the Sewage Operations and Projects Department and a small one-hour meeting will be organized to take their feedback.
5. A site visit to Sewage Treatment Plants (STP) at Tonca will be organized.
6. Wastewater collection systems and septic tanks will be observed.
7. Other stakeholders such as Citizens, NGOs, FSSM entrepreneurs, academic community will be contacted for developing community partnerships.
8. A standard questionnaire will be prepared to capture the latest data on Sanitation, support needed for sustenance of Sanitation infrastructure based on which recommendations will be made.
9. It is proposed to keep the final recommendations for sustenance of Sanitation infrastructure before the stakeholders for their feedback before finalization.

Questionnaire WASH:

1. What is the per capita water supplied?
2. What is the existing infrastructure for sources of water, its treatment and distribution?
3. Do all areas get water in enough quantity and quality? Are there any complaints regarding the quality of water?
4. Any issues due to flooding in the last 2-3 years?
5. What are the issues regarding O&M of WTPs, pumping stations, ESRs, Distribution systems?
6. How are the finances raised for the Water infrastructure? Is the PPP model tried?
7. What are the taxes collected for the O&M of Water infrastructure?
8. What is the existing infrastructure for sewage collection and its treatment?
9. What is the generation of sewage? What is the collection of sewage? What % of sewage is treated?
10. What is the status of septic tanks?
11. Are any detailed project reports prepared for improvement of sanitation infrastructure such as sewerage systems, sewage treatment plants etc.?
12. What is the existing system for use of treated sewage? What are the improvements needed?

13. What are the existing byelaws for the new buildings regarding sewage treatment and recycling? How are these rules monitored?
14. How are the other stakeholders such as citizens and professional associations involved? Are any IEC programs or media involved?
15. Are there any issues regarding the quality of rivers and Nallahs? Are there any projects planned to revive the nallahs?
16. Are there any issues related to water pollution caused by industries?
17. What are the issues regarding O&M of STPs, sewage pumping stations?
18. How are the finances raised for the Sanitation infrastructure? Is the PPP model tried?
19. What are the taxes collected for the O&M of sanitation infrastructure? Are user charges levied for public toilets, community toilets?
20. How many ODF++ projects are implemented? Are SHGs involved in the maintenance?
21. Any general suggestions regarding the improvement of sewage collection, treatment infrastructure and quality water in rivers and nallahs?
22. Any feedback about health issues and infrastructure and plans for improvements?

UNDERSTANDING OF CURRENT STATE OF *WASH* INFRA BY WAY OF INTERVIEW WITH OFFICIALS AND SITE VISITS:

In the case of Panaji, the WASH is under the control of PWD of Goa state rather than the ULB. Discussion took place with following officials of PWD, Goa: -

1. Mr. Dias, Executive Engineer
2. Mr. Mapari, Assistant Engineer
3. Mr. Krishna Reddy, Supervisor, STP Goa

The Sewage Treatment Plant of Goa is well operated and is the first plant of India which works on SBR technology with PLC and SCADA. This plant was visited.

Layout of STP of 12.5 MLD at Tonca, Goa

Oil & Grease Removal at STP, Goa

SBR Basin with Decanter

Centrifuge for sludge drying, STP Goa

Regarding the status of water meters, Dr. Kulkarni had a discussion with Mr. Mapare, AE, PWD Goa. He informed that all the water meters at the consumer end are mechanical, and they will replace them with electro-magnetic meters in due course. He Also, told that they are in the advance state of installing electro-magnetic meters at the bulk supply points. They have Also, initiated the process of replacing old water pipelines.

Best Practices:

The STP at Tonca of 12.5 MLD is based on SBR technology. It is operated through PLC and SCADA and worth practicing by other ULBs.

Monitor at Control Center with PLC and SCADA based O&M of STP

ASSESSMENT OF WASH IFRASTRUCTURE AND IDENTIFICATION OF O&M CHALLENGES:

Water metering, Water balance diagram and Water Leakages: It is observed that most of the challenges identified in the secondary assessment above are verified after discussions with the officials and during site visits. In the absence of electronic meters, it is not possible to have an accurate water balance diagram. The leakages are due to the old GI pipelines which are corroded at many places. Goa PWD is in the process of replacing the same to control the loss of water due to leakages which is more than 35%.

Inadequate Sewerage Network: As described above and verified around 85% of households are provided with the sewerage system. The areas which are not covered dispose of the sewage in water bodies and pollute the same. Very few localities have provided onsite sewage treatment facilities.

Inadequate water supply to community and public toilets: Due to this these toilets are unclean, and people tend to do open defecation. The issue needs closer scrutiny. It is likely that due to inadequate user charges contractors may not be able to afford the water charges.

Underutilization of STP at Tonca: It is observed that the STP is utilized only up to 60 to 70% of the capacity. The provision of the sewerage system should be accelerated so that the full potential of STP can be utilized.

RECOMMENDATIONS TO ADDRESS O&M CHALLENGES OF WASH IFRASTRUCTURE:

1. Replace the old water distribution network with new to reduce water leakages and NRW.

2. Provide electro-magnetic water meters at all points in place of mechanical meters to control leakages and better manage the water supply schemes.
3. Cover all areas with sewerage network and brings all the sewage to STPs.
4. Resolve the issue of inadequate water supply to community and public toilets.
5. Onsite sewage treatment must be provided if the toilets are not connected to the sewerage system.

Solid Waste Management:

CCP comprises of 30 Municipal Wards within its territorial jurisdiction. Within the 30 Wards, seven waste management zones have been set up. CCP, through its door-to-door collection system covering all the 30 Wards collects segregated municipal solid waste, which is transported by different vehicles assigned for wet waste and dry waste fractions. The wet and dry fractions are transported to the decentralized facilities within the City. At present Panaji generates around 50 TPD of Municipal solid waste, out of which 28 TPD is organic waste out of which around 40% originates from the hotels/restaurant, remaining 7 TPD is non-biodegradable waste, 9 TPD is horticulture/garden waste and 6 TPD of littered waste. At present, Panaji generates and collects around 42 TPD of MSW from 30 municipal wards of 7 zones and about 40,000 residents and 30000 of floating population. CCP collects almost 100% of Municipal Solid Waste from generators under door-to-door collection service with the help of municipal workers. Since September 2011, CCP has Also, initiated a '5-way segregation' system to enhance the recovery and recycling from the MSW. This segregation system includes Organic waste, Glass & metal waste, Plastic waste, Paper & Carton waste and non-recyclable waste. Waste generated in Panaji consists of 46.27% of organic waste, 13.25% of glass waste, 13.24% of plastic waste, 7.29% of paper waste, 7.16% of rag waste, 1.49% of metal waste, and 11.3% of waste including inert, cement, soils, etc.

CCP adopts a combination of centralized and decentralized composting to treat its organic (wet) waste and has a centralized material recovery facility (MRF) to recycle and auction/sell non-biodegradable (dry) waste. The centralized MRF is supplemented by the services of 12 decentralized sorting centers across the city. CCP has three centralized composting facilities (Heera plant 5 TPD, LIC plant 3 TPD & Market plant 3 TPD) and about 100 decentralized pit composting stations (total 1.5 TPD) to process the segregated wet waste. The total capacity of these facilities stands aggregated at 12.5 TPD. The Heera facility has a capacity of 5 TPD but receives 21 TPD of waste (i.e., 8 TPD of residential waste, 11 TPD from hotels/restaurants, and 2 TPD of fish/slaughter waste). CCP has about 31 vehicles of different types that are used for various stages of primary collection and transportation to the sorting centre, treatment plants or to the disposal sites. There are twelve decentralized sorting centers in the city, where all the collected dry waste is first aggregated. It is then sent to the Heera site for weighing, and from there it is then sent to the MRF, which has a capacity to process 7 TPD of dry waste. All the recyclable material salvaged (about 3 TPD) is then auctioned to the vendors at the site itself, and the combustible non-recyclable waste (4 TPD) is sent for co-processing in cement plants based in the neighboring state of Karnataka. The Heera plant is overloaded by almost four times its handling capacity creating an acute lack of space. The city has proposed to set up biomethanation plants of 5 TPD capacity

(cumulative capacity of 20 TPD) to manage its organic waste.

In Panaji, Household level coverage of solid waste management services has a service benchmark of 100% and status of 100%. Efficiency in the collection of municipal solid waste having a service benchmark of 100% and status is only 90%. And the target efficiency is 100%. Efficiency of the extent of segregation of municipal solid waste having a benchmark of 100% and status is of 100%. The efficiency of extent of municipal solid waste recovered is having a service benchmark of 80% and the status is only 72% and a target of 80%. Efficiency of extent of scientific disposal of municipal solid waste having a service benchmark of 100% and its status and target is nil 0%. Efficiency in redressal of customer complaints has a service benchmark of 80% and status and target is of 80%. Efficiency of collection of SWM charges having a benchmark of 90% and status of 70% only and a target of 90%. Efficiency of extent of cost recovery in SWM services having a service benchmark of 100% and a status and target of only 40% and 50% respectively.

Challenges:

1. In cities like Mumbai, it has been made mandatory for bulk generators to compost wet waste and recycle dry waste. In Pune as well as Mumbai, there are incentives for residential complexes like rebate in property tax for managing solid waste within the premises. This has significantly reduced the solid waste dumped in landfills. It is necessary to develop a similar system for Panaji.
2. The Heera composting facility has a capacity of 5 TPD but receives 21 TPD of waste. This plant is overloaded by almost four times its handling capacity creating an acute lack of space.
3. Cities like Indore are adopting big waste to energy projects developing bio CNG. Panaji should Also, work on similar projects.
4. Segregation remains a challenge. There are small tempos for collection of segregated waste door to door but segregation of waste at source is not ensured.
5. Infrastructure for recycling of and reuse of dry waste is to be developed fully.
6. There are issues related to branding of compost generated.

Framework for Site Visits:

1. Feedback of leadership and staff at AIILSG will be taken before finalizing the framework for site visits.
2. Discussions will be held with top leadership of Corporation of city of Panaji (CCP) such as Municipal Commissioner, Assistant Municipal Commissioners.
3. Public representatives, Ward officers will Also, be contacted.
4. Detailed discussions will be undertaken with the officers of the Solid Waste Management Department and a small one-hour meeting will be organized to take their feedback.
5. Site visits of landfill sites if present.
6. If any Dry waste recycling centers are present, the same will be Also, visited.
7. Other stakeholders such as NGOs, SWM entrepreneurs, and the academic community will be contacted for developing community partnerships.
8. A standard questionnaire will be prepared to capture the latest data on SWM, support needed for sustenance

of SWM infrastructure based on which recommendations will be made.

9. It is proposed to keep the final recommendations for sustenance of SWM infrastructure before the stakeholders for their feedback before finalization.
10. **The Feasibility Study Report (FSR) will be prepared for all the components of Integrated Solid Waste Management of BMC for the requirement for next 20 years considering gap analysis to conform to SWM Rules 2016, CPHEEO SWM Manual 2016 will be referred.**
11. **All aspects such as collection and transport (C&T), Processing by different options such as composting, bio-methanation, waste to energy etc., Disposal by sanitary landfills etc. will be considered while preparing project reports in FSR.**
12. The existing capacity of the Collection and Transportation (C&T) facility will be assessed and suitable mechanisms to improve the C&T process will be proposed. The use of technology like GPS and RFID for tracking the collection will be explored.
13. **Different components of Integrated Solid Waste management such as Dry Waste, C&D waste, RDF, Garden waste, E-Waste, Plastic & Thermocol waste will be considered, and project reports will be included for these components.**
14. **Legacy waste at landfills will be quantified. The existing arrangements like bio-mining and capping will be studied. Projects will be suggested if gaps exist. O&M after 15 years of capping will be suggested.**
15. Leachate management, environmental issues of existing and future landfills will be considered.
16. Marketing of compost, RDF, Plastic waste, tetrapack waste, energy etc. will be discussed. Linkages will be developed with farmers' bodies, cement and sugar factories etc. for the same.

Questionnaire for SWM:

1. What is the solid waste generated in different categories at present? What is the per capita contribution? What is the solid waste generation expected in 20 years and what are the future plans?
2. What are the challenges in the existing system? What support is required from the government and private sector?
3. What are the financial resources allocated for SWM? Are any taxes collected from the public for SWM? Are any user charges levied? What is the revenue generated from all sources for SWM such as fines, penalties etc.?
4. What is the financial viability of the existing system? How the O&M of existing vehicles, landfill sites etc. is carried out?
5. How many employees are available for SWM? Are there any efforts made for their capacity building?
6. What is the revenue generated from selling dry waste category wise?
7. How is dry waste such as plastic, thermocol, glass, paper etc. processed?
8. What arrangements are made for C&D waste, E-Waste, tetrapack, wood/garden waste etc.
9. What land is available with SWM deptt for existing projects and future projects?
10. How are entrepreneurs engaged?
11. How are waste pickers, SHGs, NGOs etc. involved in SWM activities?
12. How is community participation ensured in SWM? Are any IEC campaigns launched?

13. What is the performance of the city in Swachh Sarvekshan 2022?

UNDERSTANDING OF CURRENT STATE OF SWM INFRA BY WAY OF INTERVIEW WITH OFFICIALS AND SITE VISITS:

Meeting with Mr. Sachin Ambe, Head, Waste Management Cell, Panaji

Meeting with Mr. Shagun Teli from Goa Waste Management Center, Saligaon

Segregation of dry waste at housing society level 1

Segregation of dry waste at housing society level – 2

Dry Waste Collection Center, Dona Paula, Panaji, Goa

Inside the Dry Waste Collection Center, Dona Paula, Panaji – I

Inside the Dry Waste Collection Center, Dona Paula, Panaji – II

Digester for small communities – Capacity 150 Kg/day

Digester for Centralized treatment of Wet Waste

Dry waste processing Center for small buildings & communities - I

Dry waste processing Center for small buildings & communities – II

Dry waste processing Center for small buildings & communities - III

Veg Market Composting Project - Shed

Veg Market Composting – OWC Machine

Veg market composting – Composting Pits

Composting Pit: - Aeration arrangement

Sieving & storage arrangement of Compost

Dry Waste Processing at Saligaon, Goa

Coconut Storage Shed – Saligaon, Goa

Dry Waste Micro Segregation facility at Saligaon, Goa

Bio-Digester for Wet Waste Processing at Saligaon, Goa

Unloading of Wet Waste, Saligaon, Goa

Composting of Wet Waste at Saligaon, Goa

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5. Municipal Solid Waste Rules 2016, Government Resolution
6. Reports in newspaper Maharashtra Times dated 25/03/2023 about water recycling, nallah cleaning works.
7. Reports in newspaper Maharashtra Times dated 19/03/2023 about solid waste management project at KanjurMarg
8. Report in the newspaper Times of India in 2019 about NGT order on proposed STPs in Mumbai
9. IS 10500 on drinking water standards.

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