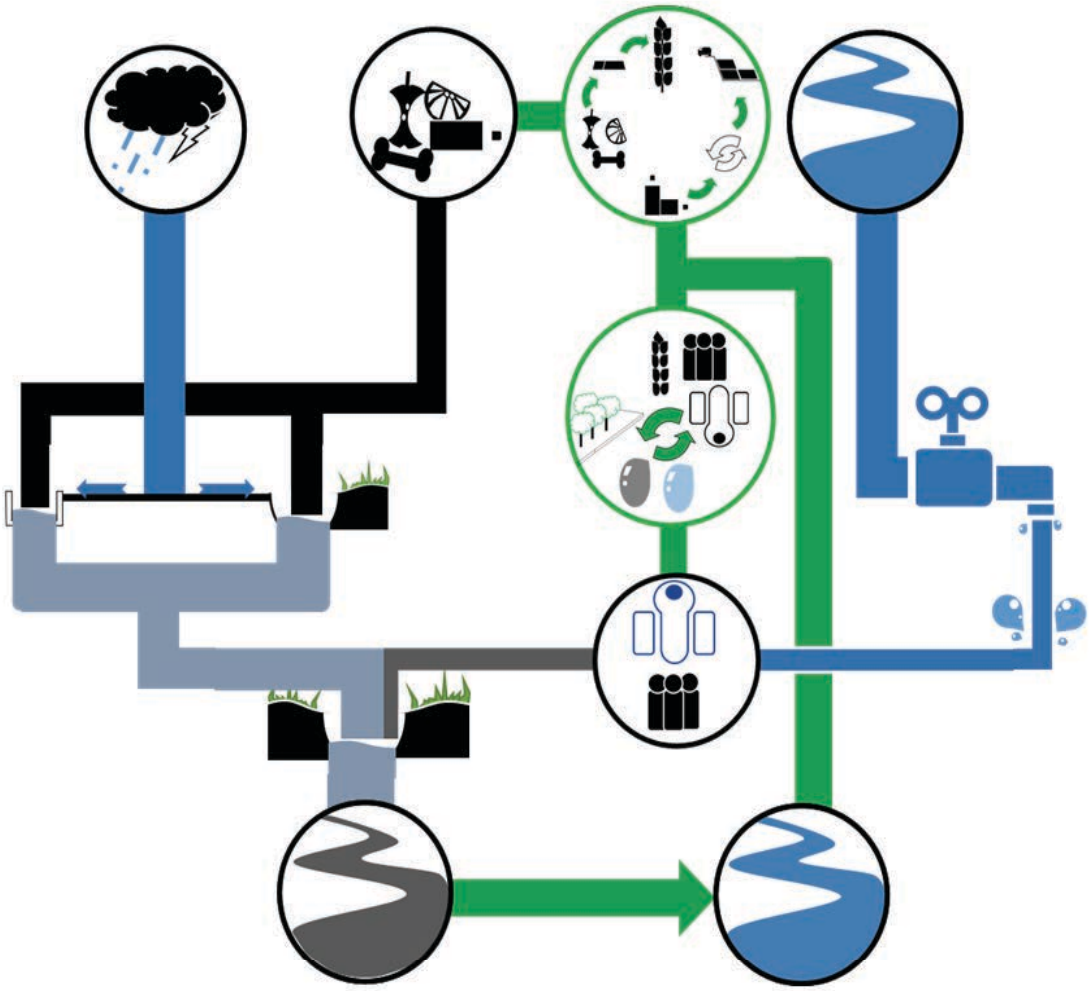
City Sanitation Plan for BHUBANESWAR



Preparation of CSPs for Cities of Odisha

Sanitation Action Plan

2017

Prepared By:

Consortium for DEWATS Dissemination Society

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NATIONAL INSTITUTE OF URBAN AFFAIRS

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LIST OF ACRONYMS

%	Percentage
°C	Degree Celsius
°F	Degree Fahrenheit
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
BIS	Bureau of Indian Standards
BMC	Bhubaneswar Municipal Corporation
CAPEX	Capital Expense
CDD SOCIETY	Consortium for DEWATS Dissemination Society
Cm	Centimetre
CPHEEO	Central Public Health and Environmental Engineering Organisation
CSP	City Sanitation Plan
CT	Community Toilet
cu m	Cubic Metre
IHHL	Individual Household Latrines
FSM	Faecal Sludge Management
FSSM	Faecal Sludge and Septage Management
H & UD Department	Housing and Urban Development Department
JICA	Japan International Cooperation Agency
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
Km	Kilometre
L	Litre
Lpcd	Litre per capita per day
Lts	Litres
m^3	Cubic Metre
MC	Municipal Corporation
MLA	Member of Legislative Assembly
MLD	Million litres per day
MoUD	Ministry of Urban Development
MPLAD	Members of Parliament Local Area Development Scheme
NIUA	National Institute of Urban Affairs
Nos	Numbers
OISIP	Orissa Integrated Sanitation Improvement Project
OPEX	Operating Expense
OWSSB	Orissa Water Supply & Sewerage Board
PHEO	Public Health Engineering Organization
PT	Public Toilet
Rs	Rupees
SAAP	State Annual Action Plan
SBM	Swachh Bharat Mission
SCBP	Sanitation Capacity Building Platform

SeTP	Septage Treatment Plant
SFC	State Finance Commission
SLIP	Service Level Improvement Plan
sq. km	Square Kilometre
SRT	Sludge Retention Time
STP	Sewage Treatment Plant
SWM	Solid Waste Management
ULB	Urban Local Body

1 CSP Self Review Checklist

1 MOUD CSP SELF REVIEW CHECKLIST

The checklist below shows all the sections that are required to be covered under the City Sanitation Planning process. The checklist, as developed by Ministry of Urban Development (MoUD), helps in the assessment of the scope of the City Sanitation Plan (CSP). The indicators in the Checklist are drawn to measure whether the key dimensions of sanitation are addressed in the contents; and ensure that the process followed in the preparation of the CSP was consultative and has full ownership of the city stakeholders.

TABLE (1): CSP CONTENT SELF-ASSESSMENT

No	Item	Yes/ No	Remarks/Status
I. Baseline Data Collection & Situational Analysis in terms of identification of short term or mid – term or long term measures			
1.	Has the city carried out a baseline data collection (secondary and primary) and Situation Analysis of different aspects of sanitation viz:	**Yes**	**Stakeholder consultations and field visits were conducted during the following periods:** • 4th Feb 2017 (Project Inception Meeting) • 6th, 7th and 8th of March 2017 (Stakeholder consultation and field visits) • 23rd March 2017 Meeting with SBM State PMU Cell, Bhubaneswar • 17th , 18th, 19th Apr 2017 (Stakeholder consultation, field visits, surveys, WW flow studies)
i.	Access to household level sanitation arrangements in general residential and slum areas	**Yes**	**SBM Data for number of applications for new toilets and 2011 Census Data** Information sources include • Data from SBM Cell of the city and • Census 2011 data (The city also uses the 2011 data for all its decision making) Note: • Swachh Sarvekshan survey for Bhubaneswar was underway at the time of CDD Society's site visits. The outcome of the survey includes a detailed account of the access to toilets and the nature of their ownership (individual or community/shared facility). The estimates from this survey needs to be collated with the demand supply gap estimates provided in this report to come to the most reliable estimate for becoming open defecation and discharge free. • 40,790 households have no access to toilets (Census 2011). Of these,

			there are the 17401 toilets (SBM 2016-17) which have applied for individual toilets under SBM. Thus, there is a demand for 23,389 additional toilets which have been considered as under the individual toilet recommendations in the CSAP. There could be an additional number of toilets required due to the population that has grown from 2011 to 2016-17. This can be found out by collating the new Swachh Sarvekshan survey data and the census data of 2011.
ii.	Community and Public Toilets – location and status	**Yes**	• Information source- SBA Cell. • Location available for existing CTs, no location for new CTs; locations are available for existing PTs • Toilet gap has been assessed. 161 Toilet seats required in the slums out of which 43 seats are available leaving a gap of 118 toilet seats.
iii.	Safe collection and conveyance of human excreta (on-site and sewerage) – infrastructure and management (including status of de-sludging services)	**Yes**	• Information for toilet containment units is sourced from Census 2011 • Information source for desludging trucks- Municipal Officials, Asst Engineer and Lower Division Clerk, Mechanical department • Information on sewerage sourced from OWSSB (Mr. P.K.Mohapatra). • Details and gaps in OSS and desludging services have been covered.
iv.	Treatment and safe disposal of human excreta	**Yes**	• Information source- Mr. P.K.Mohapatra, Project Director, OWSSB. • DPR shared for upcoming Faecal Sludge Treatment Plant • DPR of upcoming sewerage projects under JNNURM and JICA-OISIP.
v.	Solid waste collection, transport and safe disposal	**Yes**	All details on Human Resources, waste collection and conveyance assets, treatment site details collected from Solid waste specialist, SBM Cell
vi.	Drainage and flooding	**Yes**	Information sourced from Executive Engineer, Drainage division of Municipal Corporation • DPR for existing drainage system • Contour Map • Cross section of drains • Water logged and low lying areas • Location of drain outfalls

vii.	Drinking water quantity, quality and coverage	**Yes**	• Information Source- PHED • The focus on Water Supply sector is only to the extent that it has a bearing on the sanitation of the city. Technical inputs in this sector will be limited (and this has traditionally been the case). • These three data sets were collected and presented in the Situation Assessment reports. All these 3 points are covered here.
viii.	Institutional arrangements and finances for capital creation and O&M management of environmental services (water, sanitation, solid waste, drainage)	**Yes**	• Information source- Accounts section and Establishment section BMC. • Staffing situation is presented in the Situation Assessment report as well as institutional arrangements; • Municipal budget has been assessed.
ix.	Current population and socio-economic categories; and projections by different categories	**Yes**	Population data used in 2011 data; However existing situation of services were studied for all sectors
x.	Arrangements and practices of commercial, public and other institutions in respect of sanitation and solid wastes	**Yes**	Public Toilets data have been collected along with sample surveys at selected units to understand their O&M arrangements. Specific focus on commercial establishments was not placed in the CSP. The focus of the report was holistic and citywide.
xi.	Maps and physical features of settlements (wards, slums, etc.) and key city infrastructure (water, sewerage, drainage, roads, treatment plants, water and sewage pumping stations, etc.)	**Yes**	Map source SBA cell and drainage division BMC, GIS shape files from BMC and OWSSB for sewerage related projects. These have been used in the relevant sections.
xii.	Data on health-related indicators of sanitation and water supply	**No**	Health related indicators have not been evaluated in the study. However, solutions for solid waste and wastewater management have been sensitive to the public health situation in the city.
xiii.	Other important and locally relevant details (specify)	**Yes**	• Storm water flow and quality was studied. • Reuse potential was assessed and suggestions provided for FSM and SWM.
2.	Has the draft CSP identified specific data gaps and developed a plan for detailed data collection?	**Yes**	Supply demand gap assessment has been incorporated.
II. Institutional Roles and Issues			
3.	Has the city identified an institutional home/s for sanitation planning, implementation, monitoring and regulation?	**Yes**	The ULB anchors the implementation of CSP

4.	Has the draft CSP proposed specific actions to resolve institutional gaps and overlaps for:	**(Score overall "Yes" if at least five indicators below score "Yes", else "No")**	
i.	Planning and financing		• Plan has been provided with action points and their prioritization over a time frame • Costs for the same has also been highlighted in the action plan
ii.	Creation of physical infrastructure	**Yes**	Infrastructure assets to be built have been identified (costs and O&M considerations) for solid waste processing, wastewater conveyance, treatment and FS reuse
iii.	O&M Management	**Yes**	
iv.	Training and Capacity Building	**Yes**	Training and capacity building has been highlighted for toilet creation, FSM and SWM related activities.
v.	Monitoring of Outcomes	**Yes**	Monitoring activities have been suggested for water quality in the drains and solid waste management.
vi.	Communications	**Yes**	IEC activities to be undertaken have been provided for all the sectors.
vii.	Regulation	**Yes**	Regulatory provisions for FSM and SWM have been included.
III. City-wide Sanitation Campaign			
5.	Does the draft CSP contain a plan for the launch of a 100% Sanitation Campaign in the city?	**Yes**	The ancillary activities such as IEC campaigns and training programs have also been suggested within the action plan, which will help in the achievement of 100%.
IV. Technology Options and City-wide design			
6.	Has draft CSP detailed and evaluated different technology options (on or offsite as well for collection, transport and safe disposal – i.e. full-cycle) for sanitation?	**Yes**	Different technology options have been evaluated for: • Wastewater conveyance and treatment options • FS Reuse options • Solid waste processing facilities
7.	Do the proposed sanitation interventions (rehabilitation, retrofitting or new investments) consider the whole city? (not just a part thereof)	**Yes**	For conversion of insanitary to sanitary toilets
V. Urban Poor and Unreached			
8.	Has the draft CSP identified the locations or settlements of the urban poor and other unreached population segments with have no or limited access to sanitation?	**Yes**	Slum locations have been identified
9.	Does the draft CSP identify actions for assisting unreached/poor households with individual, community or public sanitation facilities (in that order); and efficient disposal from these facilities?	**Yes**	Information on the number of slums and their access to sanitation has been included.
10.	Has the draft CSP identified or proposed sources of financing the CSP (schemes, grants, loans, etc.) for extending access	**Yes**	• Costs have been identified for all action points (involving asset creation, capacity creation and

	to sanitation and related behaviour change communication activities?		awareness generation) and funds available from AMRUT and SBM are known. Additional avenues for funding have not been identified.
VI. Financing and O&M Management			
11.	Does the draft CSP consider an appropriate time-frame and spatial and demographic dimensions to remain relevant (at least for the 12th Five Year Plan period, even if investment numbers are indicative or work-in process)?	**Yes**	A short term, medium term and long term timeframe has been considered while providing solutions Spatial dimension has been considered wherever necessary, such as while locating the citywide composting unit. For HH level interventions, the ULB will have to do site level feasibility to exactly determine space availability for implementations. Funds available from the SAAP and municipal budget are known for meeting the costs of the actions (involving asset creation, capacity creation and awareness generation) identified in the plan.
12.	Were the different sanitation options (hardware plus software) evaluated on the basis of financial viability? (i.e. Cost Benefit Analysis done)	**Yes**	Cost comparison and pros and cons have been reflected for different technology options meant for toilet installation, solid waste treatment options and wastewater conveyance and treatment options
13.	Whether O&M implications of each of the investment options evaluated i.e. implications on tariff increases and willingness to pay for services; personnel number and capacities etc.?	**Yes**	
14.	Has the draft CSP considered options for partnering with private sector, NGOs etc. for implementation or O&M management of sanitation facilities?	**Yes**	• For toilets and wastewater management operations, the options for partnering with private sector are being indicated in Action Plan. • The O&M of 5 of the 8 FSM trucks is already on the verge of being outsourced to private agencies. • For SWM, collection is outsourced already to private agencies. • Outsourcing of biomedical waste treatment plant, C&D plant, biogas plants and material recovery facilities has been suggested.
VII. Expedient and Other Actions			
15.	Has the draft CSP identified the steps for implementing improved enforcement of existing laws and provisions? (e.g. prohibiting hazardous discharge of untreated sewage, scrutiny about sanitation arrangements before issue of building permits)	**Yes**	Enforcement frameworks have been suggested for effective SWM and FSM

16.	Have gaps and overlaps in existing regulations identified for resolution? (e.g. provisions in development regulations or building bye-laws to promote sanitation including safe disposal)	**Yes**	Gaps and overlaps are identified for access to toilets, FSM and SWM.
17.	Does the draft CSP have a plan for improving septage management?	**Yes**	See **FSM section**
18.	Whether the draft CSP includes an Implementation Plan and Timeline?	**Yes**	Action plan
19.	Whether the draft CSP has a disaster preparedness component?	**No**	
20.	Whether the draft CSP identifies Short term/Medium Term/Long Term Measures to achieve identified outcomes?	**Yes**	Action plan
21.	Does this draft CSP leads to improvement of service levels with respect of SLB related to MSW/Storm Water Drainage/Solid Waste Management?	**Yes**	If the ULB works in alignment with the action plan temporally and incrementally it will leads to improvement in service levels across the whole of the sanitation sector.
22.	Outline of expected improvements on rating as per NUSP?	**Yes**	The Action Plan reflects the expected improvements.

TABLE (2): CSP PROCESS SELF-ASSESSMENT

No.	Item	Yes/No	Remarks
	I. Stakeholder Participation		
1.	A multi-stakeholder City Sanitation Task Force has been formed and has met at least sufficient consultations have been held?	Yes;	• Discussions were conducted with executive members of the CSTF individually • Bhubaneswar has a SBA cell for toilets and SWM.
2.	All agencies working in the City (ULB, State Government, NGOs, private sector involved in planning, implementation, management or regulation of environmental services (water, sanitation, solid waste, drainage), representatives of different community groups, and key waste-generating segments have been consulted in the process of preparation of the draft CSP?	Yes	Unstructured interviews were conducted across stakeholders for assessing all sectors.
3.	Number of Area Sabhas/Mohallas/RWA's etc. consulted?	None	Discussions were limited to the executive members of the municipal corporation, OWSSB, other project consultants and PHED
4.	Whether sufficient consultations have been held with urban poor groups in the city? Indicate the number.	Yes	Field visits at slum settlements and community toilets
	II. Ownership of the Draft CSP		
5.	Has the draft CSP gone through an appropriate process of "appraisal" or "agreement" at the ULB and the City Sanitation Task Force?	Yes	Shared with the ULB. No adverse comments received.

6.	Is the draft CSP aligned to other plans of the city (CDP, Master-plan, Development Plan, etc.) and differences if any, highlighted for resolution in the CSP?	Yes;	
7.	Are there are any current or pending/ proposed projects (under various schemes) that are in conflict with the recommendations and decisions in the CSP? Have these been highlighted for resolution?	No	
III. Communications			
8.	Has the CSP process formally recognized the importance of communicating with stakeholders, right from the beginning of the process, and drawn up as a Communications Plan?	Yes;	• A project inception and stakeholder consultation was conducted across three meetings; Additionally a implementation support meeting is also envisaged • Discussions also conducted with E&Y who serve as TSU (Tech Support Unit) and activities and analysis shared with TSU. However, no citizen level communication was done.
9.	Have the basic steps of the communication plan started being implemented?	Yes;	• A project inception was conducted with the executive staff • Implementation support envisaged beyond the CSP submission
10.	Level of awareness in the city about CSP (Indicate Yes/No)?	Yes	
IV. Links with Related Exercises			
11.	If the city is participating in the Service Level Benchmarking (SLB) exercise, have the relevant indicators been measured and uniformity ensured between that and the CSP?	Yes	SLB data has been considered while analysing the sectors

2 Introduction

2 INTRODUCTION

2.1 Background

The National Institute of Urban Affairs (NIUA) with support of Consortium for DEWATS Dissemination (CDD) Society under its Sanitation Capacity Building Platform (SCBP) is assisting the Government of Odisha to revise the City Sanitation Plans for the 4 (four) cities and towns- Bhubaneswar, Cuttack, Puri, and Baripada. City Sanitation Plans were formulated for these respective cities in overall conformity to the framework proposed within the National Urban Sanitation Policy (NUSP). The plan documents will also align the sanitation priorities of the cities with the National Missions such as Swachh Bharat Mission (SBM) & Atal Mission for Rejuvenation and Urban Transformation (AMRUT).

2.2 Approach and Methodology

The preparation of the CSP will be organised to capture information across all segments of the sanitation value chain, for which all sanitation services will be evaluated. As such, the project will undertake following activities:

I. Stakeholder consultations with officials concerning sanitation from the city:
   A. State Government personnel including Joint Secretary, Project Team Leader and other key State Government Officials
   B. Municipality Officials, mainly responsible for solid waste management. The engagement includes discussions with the Chief Health Officer[1], City Engineer, Sanitary Inspector, Chief Finance Officer, Town Planner
   C. Officials from the Swachh Bharat Mission cell within the municipality- who are responsible for IHHL and solid waste management
   D. Officials from the Odisha Water Supply & Sewerage Board (OWSSB), who are mandated with the responsibility for septage and sewerage management in the project cities
   E. Officials from the Public Health Engineering Department (PHED), who are responsible for the supply of water in the project cities.
   F. Accounts department for assessment of municipal budgets for the latest three years
   G. Elected representatives from all project cities

II. Rapid feasibility studies for solid waste management, FSM and wastewater management across all segments of the value chain:
   A. Sector wise detailed engagements (for FSM) will include:
      i. Toilets from households, community, public toilets were surveyed to get an understanding of the user charges, O&M expenditure, service level agreement and issues faced.
      ii. Understanding of the containment systems: Sample households from low-income areas (slums) and public, community and hybrid toilets were surveyed for their desludging practices and user demand

[1] Note: The Chief Health Officer is the main nodal officer at the municipality for managing the mandate of solid waste

iii. Discussions with masons to assess construction practices for toilets and containment systems
iv. Discussions with mechanical sludge emptying operators to assess their activities and frequency
v. Discussion with sewage treatment plant operators to assess treatment processes within plant, O&M practices and costs
vi. Discussions with farmers to assess reuse potential of faecal sludge/septage
vii. Discussion with brick and cement industries for the reuse potential of faecal sludge/ septage

B. Evaluate Infrastructure availability within city (for FSM)
   i. Technology and capacity of existing wastewater/ faecal sludge treatment facility
   ii. Identifying the following for prospective plants:
      - Technology concept
      - Site assessment
      - Site identification
      - Soil Testing

C. The project will adopt a micro pocket planning approach[2] to optimize the systems (human resource, infrastructure assets and processes in place) for the existing solid waste value chain in the respective cities. The sector wise detailed engagements (for SWM) will be to assess activities, frequencies and resources deployed across all segments of the chain. This will include the following study activities:
   i. The project will undertake household surveys only to validate information on solid waste disposal and collection practices retrieved from the municipality
   ii. Discussion with waste collectors to assess waste collection quantities, activities and frequencies of waste collection routines
   iii. Survey of dry resource collection units
   iv. Survey of transfer stations (if any)
   v. Survey of solid waste processing units
   vi. Exploring recycling potential for dry solid waste resources (plastics, glass etc.)
   vii. Discussion with the municipal officials for setting up composting units in large market complexes

D. Evaluate Infrastructure availability within city (for SWM)
   i. Details of existing sanitary land fill
   ii. Technology and Capacity for existing solid waste processing unit
   iii. New technologies that can be incorporated, i.e. identifying prospects for improving treatment processes. Different technology concepts will be explored in this regard.

[2] The Micro Pocket planning approach is a planning methodology pioneered in Andhra Pradesh under the provisions of the A.P. State's Government Order 279

III. Secondary data collection (old CSP document, policy documents, DPRs etc.) and review from the cities on service levels and sectoral situation for the aforementioned sectors
IV. Rapid city level surveys (at sewage outfalls, topographic analysis of city, visits to sanitary landfills and solid waste processing site) specifically to map environmental and public health issues associated with sanitation
V. Flow assessment at main outfalls were also undertaken (in Bhubaneswar, Cuttack and Puri) to understand the quality of wastewater being conveyed out of the town.
VI. Undertaking situation assessments across water supply and Storm water management in the respective cities
VII. Identifying potential technical feasibility interventions for storm water management in the project cities
VIII. Preparing financing and business models for different components of the selected interventions for access to toilets, SWM and FSM. CAPEX and OPEX should both be considered for the business model to ensure sustainability. Recommend any incentives needed for contractors and/ or waste haulers to guarantee safe disposal of sludge and solid waste
IX. Evaluating the Municipal Budgets, State Annual Action Plan (SAAP) and the Service Level Improvement Plans (SLIP) and organizing the investment planning for sanitation in the project cities in alignment with these plans

2.3 Scope of the Report

The report focusses on solutions for each of the sections. Key issues and gaps are highlighted for the complete sanitation value chain, which includes access to toilets, sewerage and FSM, storm water drainage, and solid waste management. The demand supply gap in the infrastructure provided is also assessed through for each of the sectors. Specific on-site details have also been covered in this section. The key issues for each of the sectors in sanitation are given solutions through an action plan in the short term (within 2 years), medium (3-5 years), and long term (5-10 years). The solutions would also follow an incremental approach to improvements in all the sectors of sanitation. This would mean interventions and investments which can be sustained- technically, environmentally and socio- economically over a period of time, with a gradual improvement over the three terms.

The components that have been covered under each of the sectors are as follows:

2.3.1 Access to Toilets

The section focusses on the infrastructure required for providing access to toilets to all households. The following aspects were covered to provide solution to access to toilets.

- The demand supply gap in individual, community and public toilets are assessed for the population of Bhubaneswar.
- The location of the public and community toilets (including Project Samman toilets for Bhubaneswar and Cuttack) are also provided for this section. Details of some of the public and community toilets which were assessed in detail during the site visits have also been incorporated in the report. The details include information about the number of seats, user charges collected, septic tank dimensions, cleaning and desludging frequencies, and

issues faced by the toilets. The selection of the toilets has been done to cover all income segments within the municipality, and also in different areas of the city.

- The current situation and the issues/ gaps are highlighted for each type of toilet. The issues would include gaps in infrastructure, service level issues and future demand projections.
- The demand supply gap is assessed at a quantitative number where the number of toilets required is estimated. Based on the incremental approach of infrastructure provision, households with no toilets were estimated to be provided with community/ public toilets, and households with existing access to public/ community toilets were estimated to be provided with individual toilets. However, the actual number of toilets to be provided is to be finalised based on feasibility studies undertaken in the city/ town.
- An action plan for the provision of toilets is to be provided. Interventions were planned for the short, medium and long terms along the following areas- technical/ infrastructure interventions, operations, IEC and policy measures.

2.3.2 Sewerage

- In sewerage, the current situation in generation of wastewater, conveyance and treatment are assessed. Both the existing infrastructure and upcoming projects are detailed in this section, and the gaps from each of the segments of the value chain are estimated.
- The location of the existing sewerage treatment plants (if any) are provided through a map.
- The key issues in the sewerage system are highlighted and interventions are provided for the short, medium and long terms. Since all the towns/ cities have sewerage or FSM systems or a combination of both, solutions are provided both for FSM and wastewater management in the city/ town. Cross cutting interventions are also planned out for wastewater and FSM- such as IEC campaigns to be undertaken, floating of tenders for detailed projects and the preparation of DPRs.

2.3.3 Storm water Drainage

- For storm water drainage, the major concern areas are mapped out through the waterlogged areas. Other aspects of storm water drainage, such as coverage, major natural drains and rivers, and outfall points are mapped out in the map.
- The length of the drainage network, their slope, and the direction of the course of the storm water drains are provided to give a holistic view of the storm water drainage system in the city/ town. The details of the catchment area are also provided to give an idea of the major outfall points and waterbodies which convey greywater (or wastewater) from the town/ city.
- Water quality is assessed at various outfall points for each of the towns to provide an estimate of the chemical levels and nutrient content in the major drains conveying the wastewater from the city/ town.
- Solutions for the provision of sanitation systems in the city/ town are provided in the next part of the section. The details of implementation of decentralised systems, small bore systems, simplified sewers and conventional sewer line systems are provided through their main features, pros and cons of implementation. The capital cost, the water quality

after treatment and the O&M costing after implementation of the various systems are provided for each of the treatment technologies.

- Key issues in storm water management are then resolved through an action plan for short, medium and long terms, which would include both infrastructure development and also cross-cutting measures, such as IEC campaigns, policy mechanisms and the kind.

2.3.4 Faecal Sludge Management

- Since there has been an increased dependency on FSM in the project cities/ towns. The report provides an assessment of the faecal sludge management situation in the city/ town. The current situation is assessed across the FSM value chain- including containment, collection and conveyance, disposal and treatment, and reuse.
- The possible recommendation for each segment of the value chain is estimated from the assessment of the current situation and gaps.
- The action plan for faecal sludge management would include the highlighting of the key issues in FSM, definition of the major goals to be achieved for each of the issues, and the action plan over short, medium and long terms. Technical, operational, IEC and policy interventions are defined for solving each of the issues.

2.3.5 Solid Waste Management

- The report highlights the current situation based on the various components of the value chain in solid waste management.
- This would include the total amount of waste generated, amount of waste collected from households, road sweeping and drain cleaning. Details regarding the municipal and private operators responsible for the management of the solid waste are also given in the section.
- Conveyance details are provided through the number of vehicles and machines that are utilised for collection and conveying solid waste in the city/ town.
- Ward wise details of operational service providers, manpower engaged, number of dustbins utilised and the vehicle details are also provided in this section.
- Transfer station details, amount of waste treated and ultimately disposed are also provided in the section.
- Based on the above assessment, the gaps/ issues are highlighted for each segment of the value chain in SWM, followed by the possible recommendations. Gaps in policies related to SWM are also covered in this section.
- The major issues are highlighted, and goals are provided for resolution of the issues. Measures are undertaken in short, medium and long terms along the following aspects- technical, operational, IEC and policy mechanisms.
- Technical details of various technologies for the treatment of waste are also provided in the section. The feasibility of implementation of any of the solutions is to be further assessed by the town/ city.

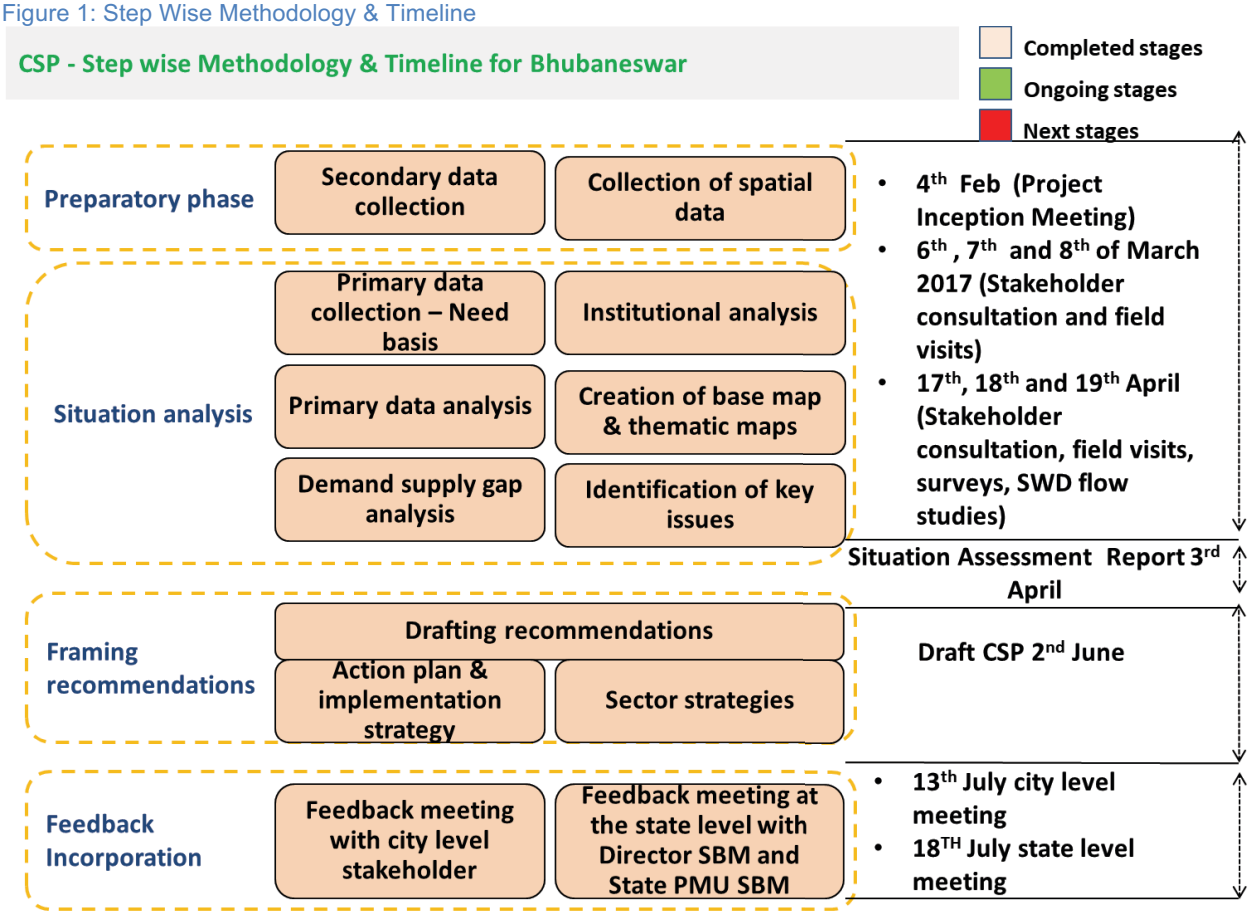
2.3.6 Institutional and Financial Interventions

- The report provides information on the responsibilities for water supply and sanitation sectors in the state of Odisha and the city/ town.

- The organogram of the municipal body is also provided, showing the responsible departments for water supply and sanitation related sectors.
- The section also provides the vacancies in the sanitation related departments, and in the overall municipal structure, allowing an estimate of the departments where capacities are to be immediately strengthened.
- The municipal budget assessment shows the financial capacity in the overall and sanitation related budgets.

2.4 Project Activities and Timeline

Figure 1: Step Wise Methodology & Timeline



The dates for the various project stages will be as follows:

- Project Inception: Feb 1st
- Project data collection: Up to March 20th
- Completion of Situation Assessment: April 3rd
- Defining solutions and technology options: By April 25th
- First Draft of CSP: 2nd June
- Final round of feedback meetings on draft CSP with city and the state-level with Director SBM and State SBM-PMU: completed on 13th and 18th July respectively

Tasks completed:

- Project Inception Meeting (NIUA)
- 1st city stakeholder meetings:
  - Bhubaneswar (1st Feb), Cuttack (2nd Feb) and Puri (3rd Feb)
  - Balasore (2nd Feb) and Baripada (3rd Feb)
- 2nd city stakeholder meetings:
  - Bhubaneswar (23rd Feb) and Puri (23rd Feb)
  - Cuttack (27th Feb)
- 3rd city (detailed city level consultations): 5th March to 20th March
- 4th city level consultations and completion of fieldwork: 17th April to 30th April
- 5th city level feedback meeting on the 1st draft of CSP : 13th July
- State Level meeting to get feedback on the 1st draft of CSP :18TH July

3 City Profile

3 CITY PROFILE

3.1 About the City

Table 1: City Profile- Bhubaneswar Municipal Corporation

District	Khordha
Demography	
Total Population 2001 (nos.)	6,47,302
Total Population 2011 (nos.)	8,40,834
Population Density (persons per km²)	2131
Number of Households (nos.)	2,01,873(Census 2011)
Avg. Household Size (nos.)[3]	4
Sex Ratio[4]	892
Slum Information	
Number of Slum settlements (nos.)	Authorized Slums: 116
	Unauthorized Slums: 320
Slum Population 2011 (nos.) –	3,01,611
Slum Population as a percentage of total population (%)	35
Location, Climate & Topography	
Area (km²)	186
Agro Climatic Zone	Tropical savanna climate
Soil Characteristics	Deltaic Alluvial
Ground Water Table (below ground level) (m)	7 m below ground level
Avg. max Temperature (°C)	37.2°C
Avg. min Temperature (°C)	15.6°C
Annual mean Rainfall (mm)	1436.1

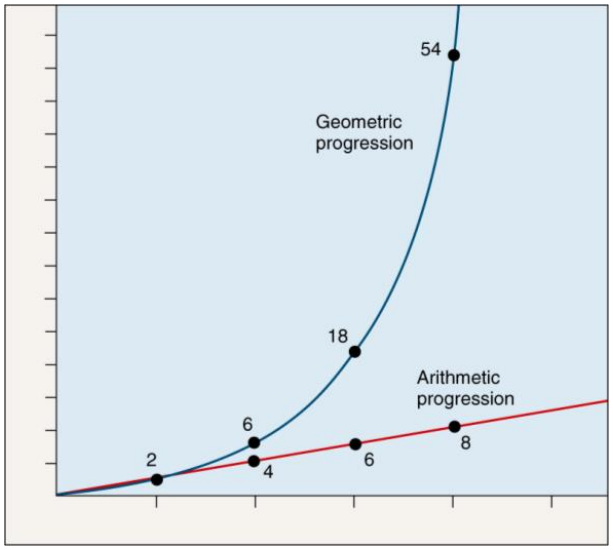
Table 2 Population Projection for Bhubaneswar

Population Projection (nos)			
Progression Method	**Year**	**Population**	**Households**
Census 2011 Population	2011	84,0834	20,1873
Swachh City Plan	2019	10,34,225	258,557
	2025	12,72,096	318,024
Exponential	2019	9,20,360	230,090
	2025	9,84,903	246,225

[3] Calculated from the Census 2011 population and households
[4] Based on Census 2011 information

Towards making the population projections, the numbers available from the Swachh City Plan were taken into consideration. The exponential progression of population was also reflected on. Two reasons for adopting an exponential projection of population over the arithmetic or geometric progression methods are:

Figure 2 Graphical Representation of arithmetic and geometric projections

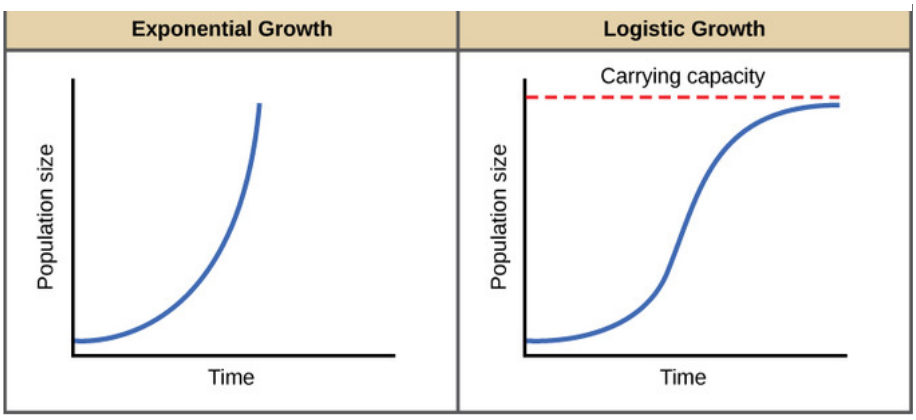


Source: McGraw Hill Companies Inc. (McGraw-Hill Online Learning Center Test)

- In a Geometric progression, the sequence of population increase for each term is by a fixed multiplier growth rate.
- In Arithmetic progression, the sequence of population increase is in a linear manner, where the same amount of population gets added to the base population every year.

Both the above cases of population projections would provide an unrealistic portrayal of the future increase in population. However, in an exponential population progression, the city's future population is proportional to the amount already present.

Figure 3 Graphical representation of exponential and logistic growth

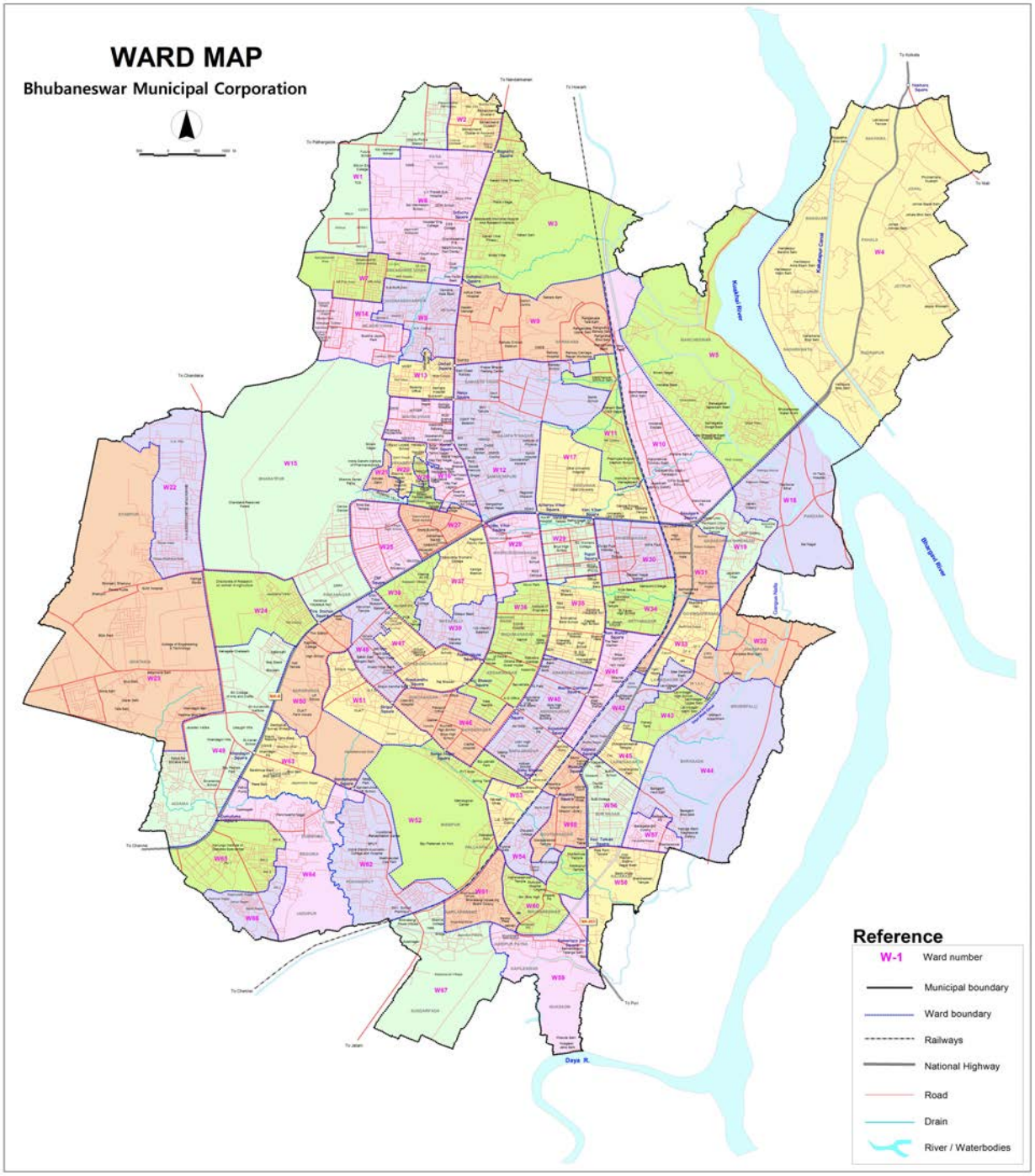


Source: (Socratic organisation)

Although growth may initially be exponential, the modelled phenomena will eventually enter a region in which previously ignored negative feedback factors like lack of regional resources become significant (leading to a logistic growth model). Moreover, there are not enough data to adopt the logistic growth model and calculate accordingly. For a logistic model, the carrying capacity of the region needs to be known after which the population growth rate becomes stagnant.

Taking all these aspects into account, the exponential approach is the most realistic approach to be adopted in this project case.

Figure 4: Bhubaneswar Municipal Corporation- Ward Map



Source: Bhubaneswar Municipal Corporation (2017)

4 Sanitation Interventions


Water Supply
265 MLD
Total supply:
62.5% lost
Non-revenue water
69 municipal wards
34 of which is partially covered
Future Demand
In 2025: 197 MLD (Swachh City Planl)
152 MLD (Exponential)

4 SANITATION INTERVENTIONS

4.1 Water Supply

Water supply in Bhubaneswar has been abundant in nature. There is a lack in the number of coverage of piped water supply connections in the city. Water supply is the function of the Public Health and Engineering Organisation (PHEO) in each of the towns. Bhubaneswar has three divisions for the total of 69 wards. The details are as follows:

- Total water demand (MLD) @ 155 lpcd (including 15% loss): 130 MLD (approx.)
- Total water supplied (MLD) 265 MLD (223 MLD from surface water sources and 42 MLD from groundwater sources.) (Service Level Improvement Plan Bhubaneswar, 2015)
- Rate of supply (lpcd): 350
- 33 wards are fully covered with piped water supply
- 34 wards are partially covered with piped water supply
- 62.5% of the water supplied is non-revenue water with more than 2,300 public water stand posts
- Water quality[5] has been reported as 100% in Bhubaneswar.

Other details of water supply are provided as follows

Table 3 Water Supply Details

Divisions	Surface water sources	Groundwater (P wells and open wells)	Total daily supply from groundwater	Total daily supply from surface source	Total number of service connections	Total no. of stand posts
I	**Daya and Kuakhai rivers, spring tank- 24.50 MLD**	185	33.93	110.78	0	1045
II	**Kuakhai- 110.47 MLD**	95	9.26	83.22	89535	893
III	**Mahanadi at Mundali (Naraj)- 101.25 MLD**	51	13.01	45.20	0	549

4.1.1 Future projects:

There are a number of projects which have been planned for Bhubaneswar under AMRUT funding. The projects are as follows:

1. **Improvement in water metering in Bhubaneswar**

[5] The quality of water supplied is as important a performance indicator as other service delivery indicators. Poor water quality can pose serious public health hazards. Water-borne diseases are quite common in Indian cities, particularly among the urban poor. Although, in most cases, the source of water that causes such diseases/epidemics is not the municipal piped water supply, it is very important to monitor the supply. Therefore, this performance indicator must be regularly monitored, the benchmark value for which is 100 percent

a. There are 3 projects of a total cost of Rs. 8499.6 lakhs in 2015-16

2. **Construction of treatment plants and ancillary works**
   a. Construction of WTP and other ancillary works were at a total cost of Rs.1946 lakhs in 2015-16
   b. Construction of a retaining wall at a total cost of Rs. 385 lakhs in 2015-16
   c. Installation of a DG set for Mundali WTP at a cost of Rs. 5 crores in 2017-18
3. **Improvement of water supply to uncovered areas**
   a. Improvement of water supply to the uncovered areas, including slum areas at a total cost of Rs. 112.74 crores in 2017-18.

4.1.2 Projection for Water Supply Demand

Table 4 Projection for water supply demand

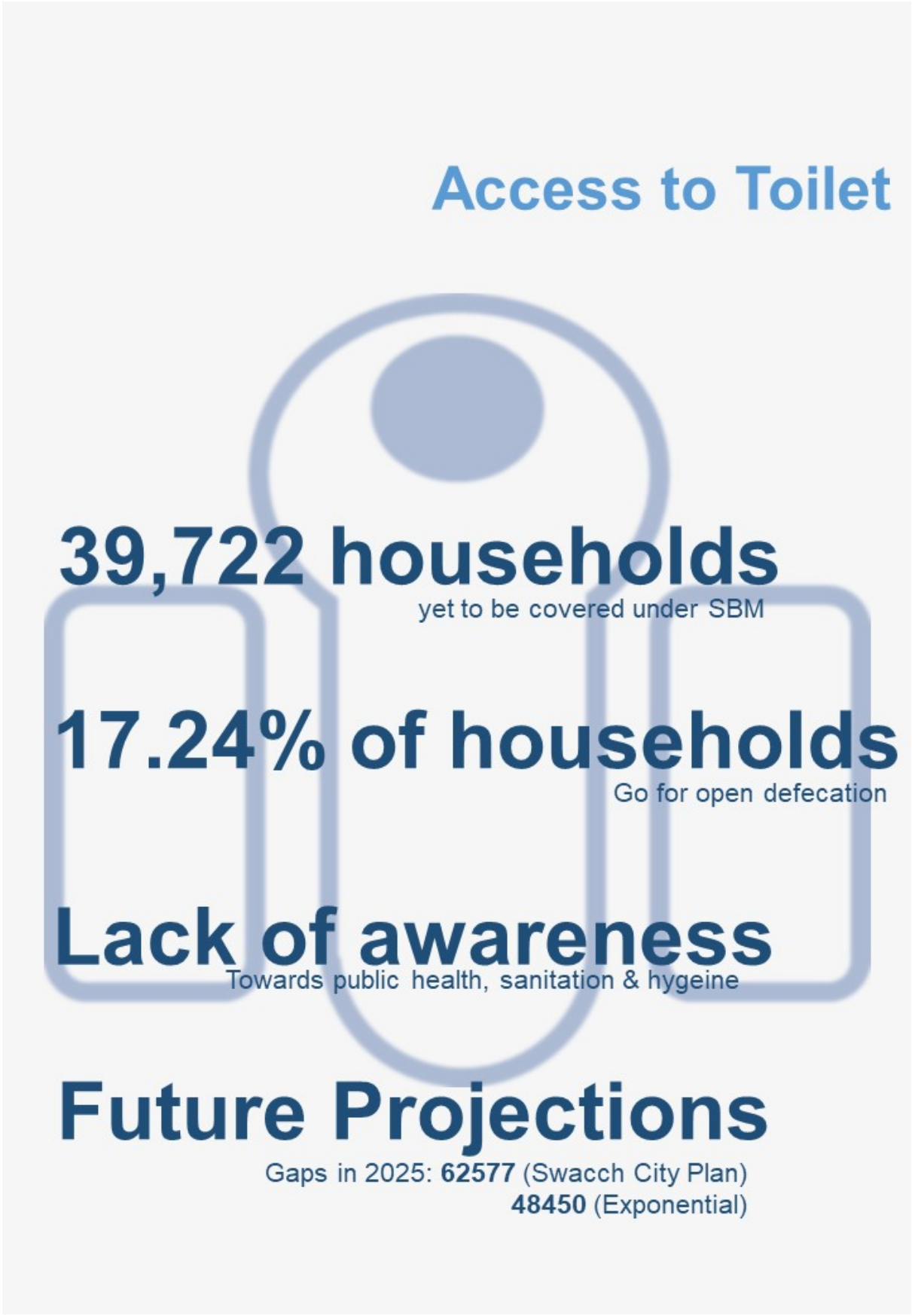
Progression Method	Year	Population	Water supply demand in MLD (approx.)
Census 2011 Population	2011	8,40,834	130
Swachh City Plan	2019	10,34,225	160
	2025	12,72,096	197
Exponential	2019	9,20,360	143
	2025	9,84,903	152

For the purpose of projection, we are using exponential projections. (see Population Projection for Bhubaneswar for details)

Assuming that the per capita water supply remains unchanged, the demand for water supply has been calculated. As per Swachh City Plan in 2019, the projected population of Bhubaneswar will be 10,34,335 and the consequent water supply demand will be 160 MLD. In 2025, the population is projected to increase to 12,72,096 and the consequent water supply demand will be 197 MLD.

As per exponential projections, in 2019, the projected population of Bhubaneswar will be 920360 and the consequent water supply demand will be 143 MLD. In 2025, the population is projected to increase to 9,84,903 and the consequent water supply demand will be 152 MLD.

As evident, in both the cases the water demand can be met using the existing quantity of water supplied. However, this requires strengthening and improvements on water supply distribution network. The coverage needs to be improved in slums and in partially covered wards so that the distribution of water is more equitable.


Access to Toilet
39,722 households
yet to be covered under SBM
17.24% of households
Go for open defecation
Lack of awareness
Towards public health, sanitation & hygeine
Future Projections
Gaps in 2025: 62577 (Swacch City Plan)
48450 (Exponential)

4.2 Access to Toilets

This section focuses on the solutions proposed at the user interface to address the following:

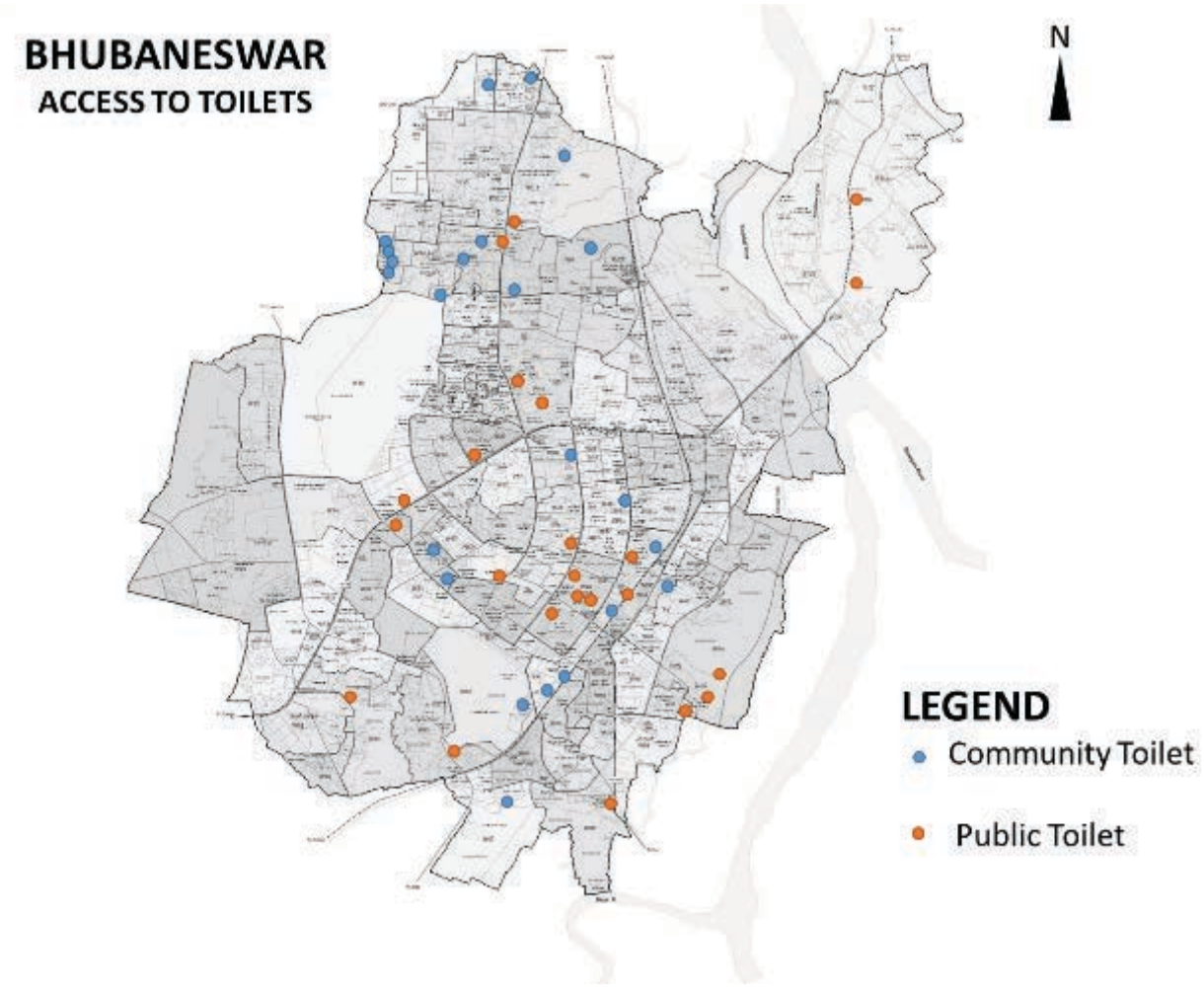
- Access to household toilets; in terms of provision of individual and community toilets
- Refurbishing existing infrastructure; this includes provision of super structure and containment structure
- Access to public sanitary infrastructure like public toilets

Individual toilets are used by the members of one household. Community toilets are shared by a group of households, primary in low income and/ or informal settlements/ slums, where space and/ or land are constraints in providing a household toilet.

4.2.1 Public and Community Toilets

There are 23 Public Toilet blocks and 22 Community Toilet blocks in Bhubaneswar. The map below shows the location of the public and community toilets in Bhubaneswar. There are also hybrid toilets in Bhubaneswar, which are not yet operational, and have not been marked in the map. Toilets under Project Samman have also been marked as community toilets in the map.

Figure 5: Map showing Access to Toilets in Bhubaneswar



Source: CDD Society (2017)

During the field visit, information was collected on the number of public toilets in the town and their location (as marked above).

All public toilets are owned and constructed by the municipal corporation and then leased out privately either through Project Samman or to Sulabh, who are then responsible for the operation and maintenance.

Some of the public and community toilets were surveyed as a part of the surveying exercise. The details of the survey are as follows:

Public Toilets (PTs)

1. **Lingaraj Temple Public Toilet**
   There are 3 latrines, and 2 washing areas for gents, while there are 3 latrines and 2 washing areas for ladies. There is an average footfall of 150-200 people to the toilet. User charges of Rs. 1600 collected daily, with Rs. 450 being paid to Sulabh Toilet regularly, irrespective of the collection. The collection is variable since it is a tourist spot. There are no user charges for using urinals for gents, while Rs. 5 is charged for ladies toilet. Rs. 5 is charged for the WC for both gents and ladies. The septic tank of the toilet has not been cleared in the last 6 months. There is 1 sweeper and 1 caretaker for the maintenance of the toilet. Rs. 3500 and Rs. 4000 are the respective salaries of the sweeper and the caretaker. The caretaker stays in the complex itself. The public toilet is cleaned every day.

Figure 6: Lingaraj Public Toilet

Figure 7: Washing Facility at Manju Public Toilet

2. **Manju Service Public Toilet, Bus Stand**
   The toilet is run with the help of a private contractor. There are 150-200 users daily. The septic tank has a dimension of 12 feet* 8 feet. There are 3 personnel in the public toilet, with 1 cleaner and 2 staff members. Each personnel has a monthly salary of Rs. 6000. The public toilet is cleaned daily.
3. **Sulabh Toilet, Bus Stand**
   One of the oldest toilets in the area, the public toilet has been operational for more than 20 years. The toilet is used by 350-400 people on a daily basis. User charge is Rs. 5 for both gents and ladies. Daily collection is a total of Rs. 2000-2500. The dimensions of the septic tank are 30 feet *12 feet. The septic tank was last desludged 5-6 months ago.

Desludging of the septic tank was conducted through a desludging truck, for which Rs. 15000 was charged. There are 3 personnel in charge of the public toilet- 3 caretakers with a salary of Rs. 4000, and 4 cleaners with a salary of Rs. 3500. The toilets are cleaned 5 times daily.

During field visits it was observed that though the outward maintenance of the toilets seemed adequate for the water closets, the urinals in most locations were inadequately maintained and badly designed. The maintenance of containment could not be assessed. First impressions indicate that the centrally located high footfall areas had enough access to such facilities, but a detailed survey by the municipal officials is suggested to ***measure the footfall against the seats provided***: to ascertain the average daily floating population at strategic locations, which would help exactly estimate the demand for public toilets. The Municipality is advised to undertake such detailed footfall surveys during the peak hours of **7 to 9 am and 7 to 9 pm** at:

- Railway stations, bus depots etc. where use of toilet block is round the clock: **Here the footfall survey needs to be undertaken during the three suggested time frames**
- Market places, hospitals, religious place where the toilets are mostly used in daytime: **Here the survey should be undertaken during 9 to 11 am**

Community Toilets (CTs)

1. **Science Park Slum**
   The community toilet is 11 years old, and has been constructed by Bhubaneswar Municipal Corporation. Around 1000 people use the toilet, or 600-700 households. There are 4 seats each for gents and ladies. The septic tank is of 10 feet*7 feet. The septic tank is cleaned every 2-3 months. The cleaning of the slums is done by a sweeper, once every 1-2 months, who is paid of Rs. 500-600.
2. **Birsa Slum**
   The toilet has been constructed by Bhubaneswar Municipal Corporation. There are 2 toilets, one each for gents and ladies. The toilet is 2 years old. The cleaning of the toilets is done every 2-3 days. The community toilet is connected to sewer lines. The cost of cleaning of toilet is Rs. 200 per month. Around 40 of the total 45 households use the community toilets in the slum.

Figure 8 Hybrid Toilet under construction in Bhubaneswar

4.2.2 Current Situation and Gaps

As per Census 2011, 19.8% of households (40,790 households) either have no toilets or have access to public/ community toilets. Of this, 17.24% of the current households (35,517) undergoes open defecation 2.6% of the households are dependent on community/ public toilets.

Additionally, 7.7% of the households (16,441 households) are having insanitary latrines which includes single pit latrines (with and without slabs), service toilets (by humans and animals) and toilets directly connected to drains.

4.2.2.1 IHHL Gap

For the purpose of IHHL construction the Bhubaneswar Municipal Corporation is using the 2011 Census data for planning and estimating the number of IHHL required. For implementation, they rely on application for IHHL and physical verification of the same to construct the toilets with the SBM funds (Social Mobilisation Expert SBM PMU Cell, 2017).

In the absence of up to date and reliable data of urban habitation and sanitation (IHHLs), we have proceeded with Census 2011 figures for the purpose of defining the gaps in the total number of toilets. The individual toilets sanctioned to be constructed under SBM have been considered while calculating the gap in individual toilets. Once the total number of households with no access to individual toilets and those with insanitary toilets are calculated (57,231 households), the toilets approved for construction under SBM have been deducted (17509 IHHL). Thus, **39,722 sanitary IHHL is the gap is left** after the SBM interventions, as on 8th of August 2017. (see Projection for IHHL Gap)

4.2.2.2 Community Toilet Seat Gap

The slum population in Bhubaneswar (as per Census 2011) is 301611. As per the existing practice followed by BMC, 8.67% of slum population is calculated assuming that they will be dependent on community toilets. This gives a total requirement of 883 community toilet seats. Currently there exists, 228 community toilet seats and an additional 139 are under construction. Thus there is a gap of **516 community toilet seats** need to be constructed. (see Projection for CT seat gap)

4.2.2.3 Public Toilet Seat Gap

The floating population for Bhubaneswar is 42,041, as per2011 Census. Assuming the male to female ratio in the floating population is 1:1, 86 CT seats for male (1 per 100 persons up to 400 persons; for over 400 persons, adding at the rate of one per 250 persons or part thereof) and 212 CT seats for female (2 for 100 persons up to 200 persons; over 200 persons, add at the rate of one per 100 persons or part thereof) will be required. This equals to a requirement of **300 public toilet seats**. Currently, there are 364 PT seats existing of which 20 are defunct. Thus, there exist 344 functional PT seats. (see Projection for PT seat gap)

Table 5: Toilet- Current status, gaps and Recommendations- Bhubaneswar Municipal Corporation

Current Situation	Current Issues/ Gaps	Possible Recommendations
• The Census data (2011) shows that around 19.8% of the households (40,790 households) do not have latrines and they either use public toilets or community toilets or defecate in the open. • Additionally, 7.7% of the households (16,441 households) are having insanitary latrines which includes single pit latrines (with and without slabs), service toilets (by humans and animals) and toilets directly connected to drains. • Apart from the individual household latrines (IHHL), there are 22 Community toilets (CTs) in Bhubaneswar. • 17509 toilets have been approved for construction under SBM of which 4232 have been completed under the SBM as on 8th of August 2017. • A total of 667 community toilet seats (136 in authorized and 531 in unauthorized) is required. • Existing and under construction: o 228 existing toilet seasts (43 in authorized and 185 in unauthorized). o 139 under construction toilet seats (53 in authorized and 86 in unauthorized). • Gap- 516 community toilet seats (40 in authorized slums and 350 in unauthorized slums) need to be constructed. • Currently, there are 364 PT seats existing of which 20 are defunct. Thus, there exist 344 functional PT seats. • Refer Slum wise requirement of community toiletsfor a detailed slum wise estimate of the number of toilets.	• **Gap as per 2011 Census**: o **39,722** sanitary household toilets need to be constructed. o 516 additional community toilet seats are required o The number of PT seats is adequate as per the 2011 floating population estimates. • **Public lacks awareness** towards sanitation, public health and hygiene. In most of the cases people, mostly male population prefer to defecate in open even if they have individual toilet at home. This was validated based on discussions with municipal officials and during visits to slum settlements. • Beneficiaries receive full amount i.e. Rs. 5300 only after the toilet and containment system is fully constructed by beneficiary. The amount as subsidy is very less when compared to the expenditure that is incurred in construction of toilet and septic tank.	• **As per 2011 Census:** o 39,722 remaining sanitary toilets are to be constructed. Depending on the space and funds availability, the remaining toilets would be constructed for individual households. There might be an additional extra number of toilets from the population that has grown between 2016 and 2017. o Construction of 516 community toilet seats to be constructed in the authorised slums of Bhubaneswar. • The focus for public toilet is the O&M. Also it was noted that, presently the use of urinals is not charged. If the urinals are cleaner, then the use of the same can be charged and in this case the number of users is adequate to create a viable business model for the O&M of public toilets at least in these central locations. • All Public Toilets constructed under SBM must have a minimum 5 year maintenance contract. • Increasing the incentive given to households in order to meet the actual expenditure incurred in building toilets IHHL. In order to achieve this, other sources of funding apart from SBM needs to be approached. (Refer Fund Mobilisation for IHHL)

4.2.3 Requirement based on population projection

For the purpose of projection, we are using exponential projections. (see Population Projection for Bhubaneswar for details)

4.2.3.1 Gap projection for IHHL[6]

Table 6 Projection for IHHL Gap

Progression Method	Year	Population	Household	Households with either no toilet and dependent on PT/CT	Insanitary Toilets	SBM Coverage till 2017	Gap for IHHL (if SBM coverage doesn't increase beyond 2017)	SBM Coverage till 2019 (End of SBM)	Gap for IHHL (if SBM coverage increases at 8754 IHHL per year till 2019- end of SBM)
Census 2011 Population	2011	840834	201873	40790	16441	17509	39722		
	2019	1034225	258557				50876	29180	39204
Swachh City Plan	2025	1272096	318024				62577		48221
	2019	920360	230090				45275		33603
Exponential	2025	984903	246226				48450		32001

As per Swachh City Plan in 2019, the projected population of Bhubaneswar will be 1034335 and the number of households will be 258557. In 2025, the population is projected to increase to 1272096 and the number of households will be 319024.

As per exponential projections, in 2019, the projected population of Bhubaneswar will be 920360 and the number of households will be 230090. In 2025, the population is projected to increase to 984903 and the number of households will be 246226.

For calculating the gap two approaches have been used:

1. If IHHL approvals under SBM continue till 2017
2. If IHHL approvals under SBM continue upto 2019 (the terminating year of SBM) at the same rate.

[6] The number might vary depending of the actual changes on the ground such as people taking initiative to construct individual household latrines owing to increased awareness.

If the IHHL approval continue only till 2017, the number of households lacking access to **sanitary IHHL** (this includes households with insanitary toilets) **will be 50,876** (as per Swachh City Plan) **or 45,275** (as per exponential projection) in 2019. If the gap is not addressed by 2019, it will further increase to **62,577** (as per Swachh City Plan) or **48,450** (as per exponential projection) in 2025.

If the IHHL approval continues at the same rate till 2019, **39,204** (as per Swachh City Plan) **or 33,603** (as per exponential projection) households will still lack access to **sanitary IHHL** (this includes households with insanitary toilets) in 2019. The gap will further increase to **48,221** (as per Swachh City Plan) or **32001** (as per exponential projection) in 2025.

Ideally, all these households should be provided individual household toilet. Since this is limited by space and financial constraints, therefore it is assumed that 8.67% of the slum population will be covered under community toilets.

4.2.3.2 Gap projection for Community Toilet Seat[7]

Table 7 Projection for CT seat gap

Progression Method	Year	Population	Slum population	Requirement for CT seats male	Requirement for CT seats female	Total Requirement for CT seats	Existing CT seats	Under construction	Gap for CT seats
Census 2011 Population	2011	840834	301611	393	490	883	228	139	516
	2019	1034225	370982	460	644	1104			737
Swachh City Plan	2025	1272096	456307	566	792	1358			991
	2019	920360	330138	409	573	982			615
Exponential	2025	984903	353290	438	613	1051			684

Assuming that slum population as a percentage of total population remains constant at 35%, the slum population will be **3,70,982** (as per Swachh City Plan) **or 3,30,138** (as per exponential projection) in 2019. This will further increase to **4,56,307** (as per Swachh City Plan) or **3,53,290** (as per exponential projection) in 2025.

As per current BMC standards, calculating 8.67% of this slum population will be served by community toilets (CT). Assuming the male to female ratio in the slum population is 1:1, the number of CT seats is calculated as 1 community toilet seat for 35 male and 1 community toilet seat for 25 female. The total of these seats gives the total requirement of CT seats. From this total, the existing and

[7] The number will vary depending of the actual changes on the ground such as construction of more community toilet seats and change in slum population.

under construction CT seats are deducted to arrive at the gap. (Guidelines for Swachch Bharat Mission-urban, 2017) (refer to Slum wise requirement of community toilets)

Based on the above calculations the gap in CT seats will be **737 CT seats** (as per Swachh City Plan) or **615 CT seats** (as per exponential projection) in 2019. If the gap is not addressed, it will further increase to **991 CT seats** (as per Swachh City Plan) or **684 CT seats** (as per exponential projection) in 2025.

4.2.3.3 Gap projection for Public Toilet Seat[8]

Table 8 Projection for PT seat gap

Progression Method	Year	Population	Floating population	Requirement for PT seats male	Requirement for PT seats female	Total Requirement for PT seats	Existing PT seats (Functional)	Gap for PT seats
Census 2011 Population	2011	840834	42042	87	213	300	344	-44
Swachh City Plan	2019	1034225	51712	106	261	367		23
	2025	1272096	63605	130	321	451		107
Exponential	2019	920360	46018	95	233	328		-16
	2025	984903	49246	101	249	350		6

Assuming that floating population as a percentage of total population remains constant at 5%, the floating population will be **51,712** (as per Swachh City Plan) **or 46,018** (as per exponential projection) in 2019. This will further increase to **63,605** (as per Swachh City Plan) or **49,246** (as per exponential projection) in 2025.

Assuming the male to female ratio in the slum population is 1:1, the number of PT seats is calculated as 1 per 100 persons up to 400 persons; for over 400 persons, adding at the rate of one per 250 persons or part thereof and PT seats for female has been calculated 2 for 100 persons up to 200 persons; over 200 persons, add at the rate of one per 100 persons or part thereof. The total of these seats gives the total requirement of PT seats. From this number, the existing PT seats are deducted to arrive at the gap. (Guidelines for Swachch Bharat Mission-urban, 2017)

[8] The above projections will vary depending of the actual changes on the ground such as the increase in number of high footfall areas in the cities and construction of more public toilet seats.

Based on the above calculations the gap in PT seats will be **23 PT seats** (as per Swachh City Plan). If calculated exponentially the existing number of PT seats will be sufficient in 2019. If the gap is left unaddressed, then it would increase to **107 PT seats** (as per Swachh City Plan) or **6 PT seats** (as per exponential projection) in 2025. For PT seats, there exists **344 functional PT seats in Bhubaneswar and an additional 20 PT seats which are defunct**. Together, there are 364 PT seats. Considering that the current requirement is 300 PT seats, **the PT seats will be sufficient to meet the future demand till 2025 (if the population grows exponentially)**. Even if the population grows as per the Swachh City Plan, repairing the defunct PT seats and regular maintenance of the existing functional PT seats, would reduce the need for new PT seats, significantly (to 3 seats in 2019; to 87 seats as per Swachh City Plan 2025).

4.2.4 Site specific conditions to be considered while addressing the gap

- Sewered areas: Apart from Ward No 4, the almost the whole city will be covered under sewer network in next 5 years. The toilets in these areas can be connected to the sewer network once the network is in place. Till then containment systems need to be built as appropriate for the site-specific conditions such as Groundwater table and soil conditions.
- Unsewered area: Containment systems need to be built as appropriate for the site-specific conditions such as Groundwater table and soil conditions. If building a containment system is challenging for each toilet, alternate conveyance and treatment systems such as simplified (shallow) sewer lines with decentralised treatment systems and community septic tanks with soak pits can be implemented.

4.2.5 Fund Mobilisation for IHHL

With regard to the public funding for individual toilets, it is largely left to the SBM Funds. That apart, there are various approaches for making available the investment towards construction of new toilets have been explored in this part of the report. The selection of the investment strategy is the discretion of the BMC. To begin with, 3 possibilities of funding toilet construction can be considered:

Table 9 Funding Models for financing Construction of Toilets

Financing Source	Options
Bipartite Model	BMC's contribution
	Government of Odisha's contribution
Tripartite Model	Beneficiary Contribution
	BMC's contribution
	Government of Odisha's contribution
	Beneficiary Contribution

Financing Source	Options
Quadripartite model	BMC's contribution
	Government of Odisha's contribution
	Aid Organisation/ Not-for-Profit that can bring funding and/or for-profit entities involved in Corporate Social Responsibility

Note: Within these models also, BC could range from 12% to 50% depending on the income segments.

The following aid organisations and for-profit organisations involved in Corporate Social Responsibility should be contacted by the BMC for mobilizing funds for increasing the incentives for construction of IHHL.

Table 10 Aid agencies

Name	Scope of work	Relevance
Sulabh International Social Service Organisation	Cost-effective sanitation, liberation of scavengers, social transformation of society, prevention of environmental pollution and development of non-conventional sources of energy.	They undertake CSR activities of various organisations like SAIL, IOCL, etc. for household level, community level toilets.
Gram Vikas	Water and Sanitation; Livelihoods; Social Housing; Community Health; Education; Renewable Energy	Initiated as a support volunteer group during the cyclone in Odisha, and since then, has been one of the NGOs that get things done; lead by Joe Madiath who's known in the sanitation sector
Water Aid	Safe water; Sanitation & Hygiene; Menstrual hygiene; Urban WASH; School WASH; WASH in health; CC & DRR	An international aid agency in WASH sector
Care Today	Construction of Clean toilets	It is a part of India Today group and has been active in construction of household toilets under Clean Toilet Initiative

Table 11 For-profit entities involved in Corporate Social Responsibility

S.N	Name	Scope of Work	Relevance
1	**Mahanadi Coalfields Limited**	Healthcare;, Sanitation	They have done similar kind of projects based on water supply as well as building toilets in the schools.
2	**National Aluminium co. Ltd.**	Drinking water; Sanitation & Health	They have been involved actively involved in SBM in Korapat and Angul districts; in setting up drinking water treatment plant in villages etc.

3	**M/S Indian Farmers Fertilisers Co Op.Ltd**	Building toilets, cleaning of ponds, providing water cooler/ filter	They are very active in constructing the bio-toilets in villages and also care about water purification
4	**Paradeep Phosphates Ltd.**	Health, Drinking water & sanitation	Their objective and work focuses on providing healthcare and sanitation.
5	**M/S. Jindal Stainless Limited**	Health care, Rural Development	They have been focusing on health care and being part of Swatch Bharat Mission
6	**Infosys Limited**	Healthcare, Sanitation, safe drinking water	Their focus areas include promoting healthcare and sanitation as per their CSR policy
7	**M/S Cybertech Software and Multimedia Pvt Ltd**	Sanitation	One of their project include working under Swachh Bharat Mission
8	**M/S Hindustan Aeronautics Limited**	Drinking water, Healthcare, Developing Infrastructure	They have installed BioToilets on ,any public spaces in Koratpur district
9	**M/S Sail Rourkela Steel Plant**	Water Sanitation Project	SAIL has actively involved in Swachh Vidhyalaya
10	**OCL India Ltd Rajgangpur**	Health, Drinking water	Have spent 34 Lakhs in making a village ODF in Sundergadh district
11	**Tata Sponge Iron Ltd**	Health, Drinking Water	Have invested in water and sanitation projects

4.2.6 Action Plan

The key action points to improve access to toilets is in terms of construction of new toilets (both individual latrines and community and public toilets) and upgrading the insanitary toilets to sanitary toilets; creating a policy mechanism for scheduled desludging and IEC campaign for improving toilet usage.

Table 12 Action plan for access to toilets

Issue 1	**Individual Toilets**
Key Issue	1. To provide toilets to those who either have access to community toilets or have no toilets; or ae having insanitary latrines. 2. Behavioural block of resorting to open defecation even when toilets are there. 3. The amount given as incentive under SBM for IHHL doesn't meet the entire cost of construction of toilet and septic tank.
Goal	➢ To provide 100% access to sanitary toilets to the city

		➢ To improve the understanding of health and hygiene among individuals and communities ➢ To increase the most given under SBM for toilet construction.
Actions	**Short term (within 2 years) To Medium term (3- 5 years)**	**Technical** • The focus on improving access to toilets is not only to construct new toilets but also upgrade insanitary toilets to sanitary toilets. • Constructing **50876 IHHL** (as per Swachh City Plan projection) **or 45275 IHHL** (as per exponential projection) by 2019. • The household toilets can be connected to the sewerage network in the sewered areas. Ensuring last mile connectivity to the sewer line is hence of prime importance in these areas. • For unsewered areas, the cost of construction of one individual toilet connected to septic tank and soak pits. In such cases, regular deluding of the septic tanks need to be done tanks at least once every 2 or 3 years and transported off-site for treatment prior to disposal. Municipal utility or private contractors are required for desludging of septic tanks and to ensure safe disposal of septage at a treatment plant. However the responsibility for O&M of the septic tank itself lies with the owner of the property. • In unsewered areas, localised wastewater treatment systems can also be put in place. (ReferApproaches for wastewater management in unsewered pockets and newly constructed multi-storeyed building) • Detailed design of the individual toilets are given in Toilet Designs Increasing the incentive given to households in order to meet the actual expenditure incurred in building toilets IHHL. In order to achieve this, other sources of funding apart from SBM needs to be approached. (Refer Fund Mobilisation for IHHL) **IEC** • Households and community members should be made aware for the need for the use of toilets. Awareness programs focussed on the environmental and health issues faced due to open defecation should be highlighted. • Training should be conducted on the O&M mechanisms for individual toilets. **Policy** • Policy measures which would discourage individuals to go for open defecation should be formalised- this would include penalties, incentives for construction of individual toilets, and others. • Upgradation of households with public/ community toilets to individual toilets. If funds and conditions are viable, households should be encouraged to construct individual toilets.
	Long term (5-10 years)	• Constructing **11,701 IHHL** (as per Swachh City Plan projection) **or 3175 IHHL** (as per exponential projection) by 2025.
Issue 2		**Community/ Public Toilets**
Key Issue		1. Construction of community toilet seats for the slums in Bhubaneswar 2. Construction and repair of public toilet seats
Goal		➢ To provide community/ public toilets in areas where there are no individual toilets due to lack of space or funds. ➢ Conversion of unhygienic/ defunct community and public toilets to functional community/ public toilets ➢ To improve the understanding of health and hygiene amongst individuals and communities

Actions

Short term (within 2 years) To Medium term (3- 5 years)

Technical

- Constructing **737 CT seats** (as per Swachh City Plan projection) or **615 CT seats** (as per exponential projection) in 2019.
- **Repairing the 20 defunct PT seats**.
- If the population grows as per the Swachh City Plan Projections, then **3 new PT seats** will be needed to be constructed.
- The CTs and PTs must be connected to sewer network in sewered areas.
- In case of unsewered areas, septic tanks need to be constructed and regular deluding must be done. Recommended sizes of septic tanks for CT/ PT (up to 300 users) is given in the table below

No. of Users	Length (m)	Breadth	Liquid depth (Cleaning Interval of)	
			2 years	3 years
50	5.0	2.00	1.0	1.24
100	7.5	2.65	1.0	1.24
150	10.0	3.00	1.0	1.24
200	12.0	3.30	1.0	1.24
300	15.0	4.00	1.0	1.24

Source: Manual on Sewerage and Sewage Treatment Systems, 2013 Part A Engineering

Note 1: *A provision of 300 mm should be made for free board.*

Note 2: *The sizes of septic tanks are based on certain assumptions on peak discharges, as estimated in IS: 2470 (Part 1) and while choosing the size of septic tank exact calculations shall be made.*

Note 3: *For population over 100, the tank may be divided into independent parallel chambers of maintenance and cleaning*

- In case of community toilets, the responsibility of O&M should be clearly defined.

IEC

- Awareness programs focussed on the environmental and health issues faced due to open defecation should be highlighted.

Training

- Training should be conducted on the O&M mechanisms for community toilets.
- Training should be conducted for the O&M of public toilets within the sanitation staff members of the municipality, if the public toilets are maintained by the Municipality itself.

Policy

- Policy measures which would discourage individuals to go for open defecation should be formalised- this would include penalties, and others.
- There should be policy directives for the regular maintenance of community toilets by the users of the community toilets.

Long term (5-10 years)

- Constructing to **254 CT seats** (as per Swachh City Plan projection) or **69 CT seats** (as per exponential projection) by 2025 to cater to the additional demand.
- If floating population grows exponentially, then constructing **87** new PT seats.


Stormwater Management
340km
of drains
49.3 MLD
of Blackwater
Direct Discharge
Waterlogging Issues
Solid waste disposal in the drains

4.3 Storm water Management

Figure 9 Contour Profile of Bhubaneswar

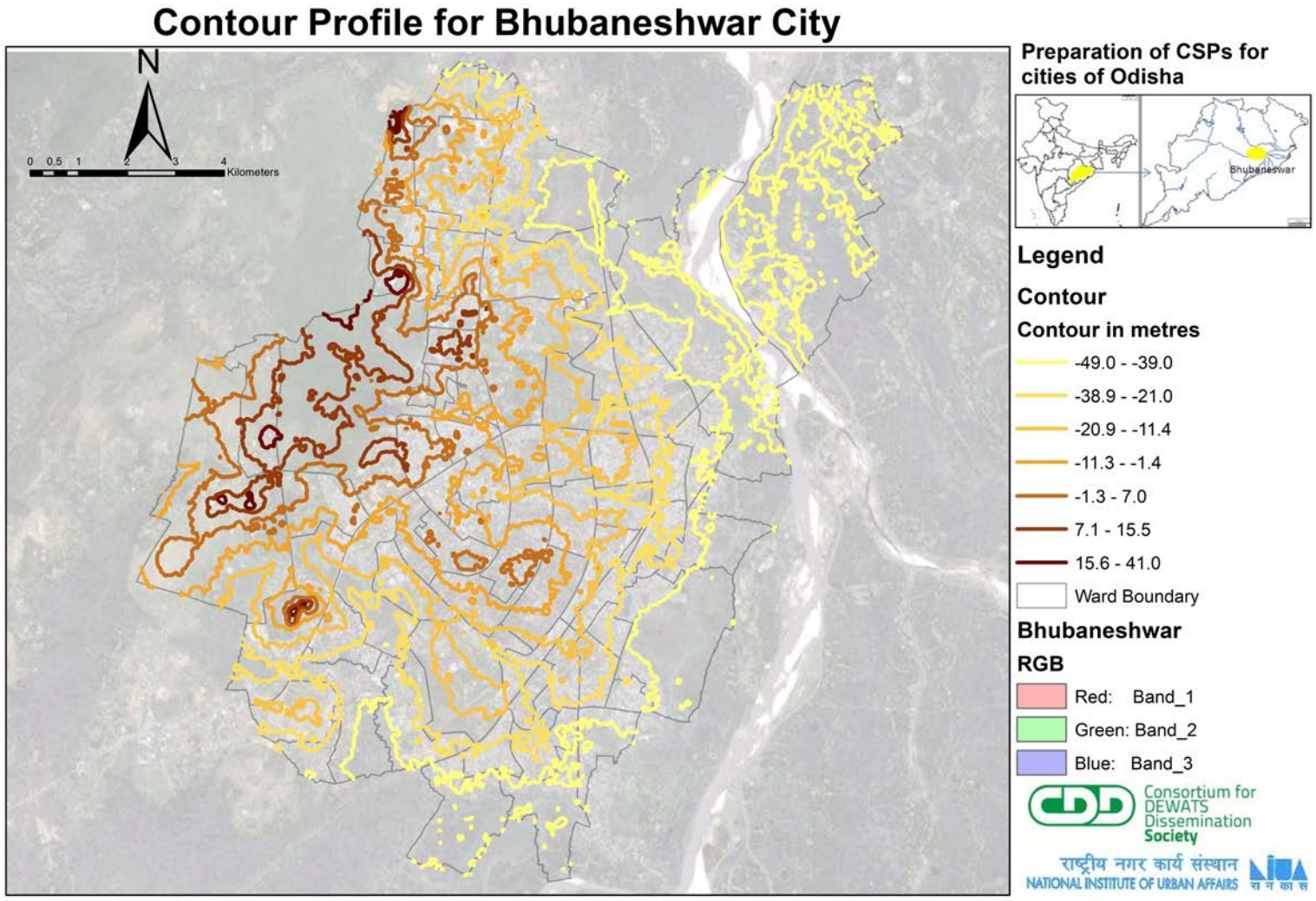
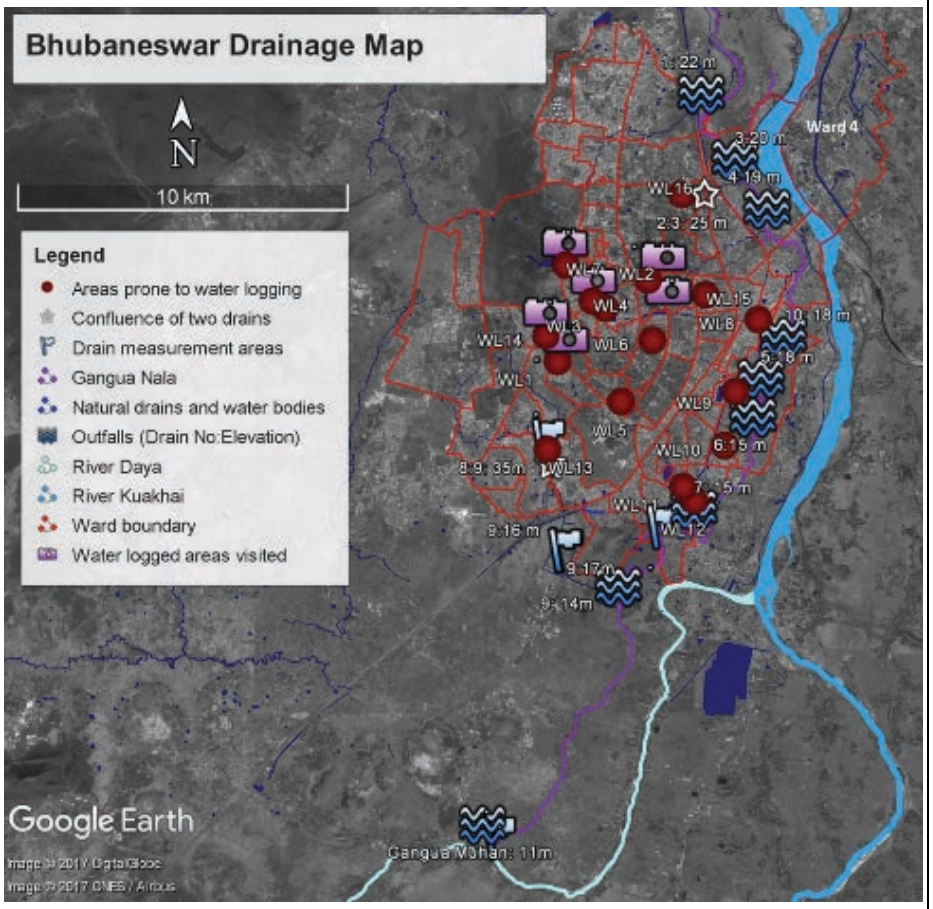


Figure 10: Drainage Map- Bhubaneswar Municipal Corporation



Consortium for DEWATS Dissemination Society

राष्ट्रीय नगर कार्य संस्थान
NATIONAL INSTITUTE OF URBAN AFFAIRS

Areas prone to water logging

WL1 Satabdi Nagar

WL2 Acharya Vihar

WL3 Behera Sahi (Nayapalli)

WL4 ISKCON Temple, N.H. East, Nayapalli

WL5 Ganga Nagar, Aerodrome area, Unit-VI

WL6 Balitothasahi, near Jama Masjid, Nayapalli

WL7 Ekambra Park

WL8 Jharpada-Bamikhal-GGP Colony

WL9 Laxmisagar

WL10 Sabarsahi

WL11 Gouri Nagar (Old Town)

WL12 Samantarapur

WL13 Jagamohan Nagar

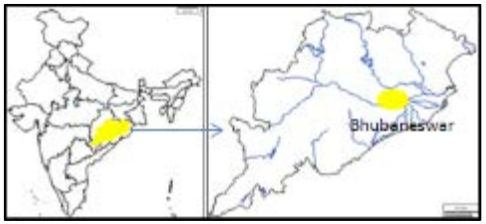
WL14 Paika Nagar

WL15 Shahid Nagar

WL16 Mancheswar Industrial Area

Source: Problematic areas and flood prone areas map, as prepared under the Final DPR Phase II, Prerpartion of Comprehensive Master Plan and Detailed Project Report for Stormwater Drainage system of Bhubaneswar City under JNNURM Scheme of Government of India

Preparation of CSPs for Cities of Odisha



Source: CDD Society (2017); Prepared from site visits and OWSSB offices

4.3.2 Drainage network- Issues and Recommendations

- Currently, there are 340 kms of drains in Bhubaneswar. Of this, 10 are natural drains with a total length of 71 km. Drain coverage is 45% of the road network length in Bhubaneswar. (Service Level Improvement Plan Bhubaneswar, 2015)
- All the drains flow from west to east.
- The 10 natural drains are kuchha drains and serve as primary drains carrying storm water from the city to the outfalls at Gangua Nala. From Gangua Nala, the water is conveyed into the River Daya.
- Usually, the water is conveyed through tertiary drains to the secondary drains and to the Primary drains which empty into the Gangua Nala and from there conveyed to the River Daya. However, at places, secondary drains may directly open into Gangua Nala or River Daya.
- **Gap-** Inadequate drain network. Even after considering the kuchcha drains (natural drains) the coverage is only about 56% leaving a significant area of the drainage uncovered.
- **Recommendation-** Construction new drains to improve drain coverage in the city.

4.3.3 Catchment area- Issues and Recommendations

- The outfalls of natural drains (except for Natural Drain No 9) into Gangua Nala are located within the city. Outfall of Natural Drain 9 is located outside the city limits. The Gangua Nala joins the Daya River at Gangua Muhan, which is around 9 km from the city limits.
- Only in case of the Ward No 4, the water from the drains ends up in ponds located in the ward.
- A study on drainage of Bhubaneswar has been carried out under the project “Preparation of Comprehensive Master Plan and Detailed Project Report for Stormwater Drainage System of Bhubaneswar City under JNNURM Scheme of Government of India”, which was prepared in 2010. However, since the time of the study, the city has expanded and new areas have been included within the municipal boundary. Thus, another detailed study is required to be taken up to include the new areas.

4.3.4 Natural Drains (kuchcha drains) of Bhubaneswar

Natural storm water drains or kuchcha drains of the city and the vegetation and wetland around them are playing a key role in ensuring the quality of drainage in a city. The vegetation in this drainage system not only take up the nutrients in the water, but also slows down the velocity of water thereby controlling flooding in the downstream areas. However, these systems are constantly under threat from human activities like construction and littering. Therefore, these natural systems need to be protected.

Solutions

- Demarcating drain using pillars or fencing and protecting them from encroachment by maintaining buffer zones (such as 50m, 25m and 15m from the primary drains, secondary and tertiary drains respectively) as mentioned in the Wetland Rules (Conservation and Management) 2010. (National Green Tribunal)
- Maintaining the vegetation around the natural drains: Bush cutting along the drains and clearing the vegetation in the drain at the beginning of monsoons in order to increase the

water carrying capacity of the drains for the season and allowing vegetation growth towards the end of the monsoon so that it can treat the dry season flow.

- Clearing solid waste at regular intervals from the drains.
- Concretization of natural drains should be avoided.

Figure 11 Natural drains in Bhubaneswar

Figure 12 Marked in yellow: Property boundaries on the edge of the natural drains

It was informed that the natural drains in many parts of the cities may be concretised owning to lack of space necessitating water to drain out fast. However, it was agreed in the feedback meetings that there should be minimum concretisation in the peripheral areas and outskirts.

Factors that need to be taken into consideration to maintain natural drains and create new constructed kuchha drains are:

- In areas with less population density avoiding concretisation.
- Settlement pattern- areas with scattered population are ideal for natural drains
- Road width

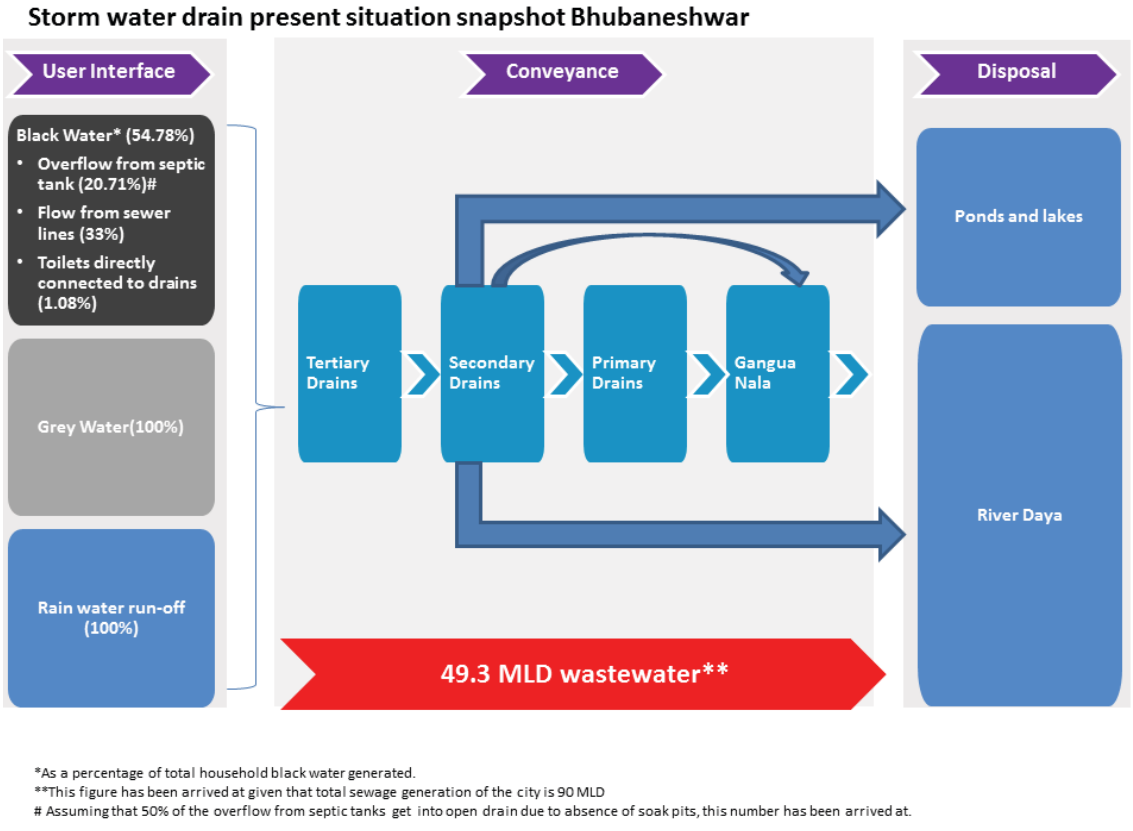
The OWSSB is taking measures like recharge pits and sand traps for better maintenance of the natural drains and these needs to be promoted.

4.3.5 Assessment of water quality in storm water drains- Issues and Recommendations

An estimated 54.78% of the total 90 MLD sewage generation of Bhubaneswar is flowing through the storm water drains. This amounts to 49.3 MLD of Wastewater which includes overflows from septic tanks in the absence of soak pits (20.71%[9] i.e. fifty percent of the 41.42 % of toilets connected to septic tanks); black water from toilets directly connected to drains (1.08%) and wastewater from the sewerage network (33%) is conveyed through the open drains in absence of sewage treatment plant (District Census Handbook Khordha Part XII B, 2011) (Service Level Improvement Plan Bhubaneswar, 2015). Greywater is entirely conveyed through the drains.

Field studies were undertaken to assess the water quality in drains in some of the areas. Heavy flow of wastewater and dense growth of water hyacinth plants have been observed in the natural drains in the upper course of the drains during the field visits conducted during dry season in April. This indicates the presence of high amounts of nutrients in the water. The wastewater conveyed in the drains could be attributed to the insanitary systems at the user interface.

Figure 13: Storm water Drainage snapshot- Bhubaneswar Municipal Corporation



[9] This figure has been arrived at based on the assumption that 50% of septic tanks do not have soak pits. This is supported by the field observations and conversations with the sanitation staff of urban local bodies. The Census definition of toilets with septic tanks refers to only the containment system and doesn't distinguish between septic tank with soak pit and septic tank without one (Latrine facility, 2017) . However, it is well known that overflow from septic tanks is one of the key reasons for pollution of water bodies. (Biswas & Jamwal, 2017). . This number doesn't include unhygienic/ insanitary toilets. A detailed survey of the containment systems of the toilets should be undertaken to get the percentage of toilets with soak pits.

4.3.5.1 Analysis of water samples from drains

In the field visit undertaken as a part of the current project, drain and flow measurements were carried out at 3 locations and water samples were collected at 3 locations to assess the quantity and quality of water flowing through the drains in Bhubaneswar. Freshwater from an open well next to Drain 9 in Jatani was collected to gauge possible seepage of wastewater into groundwater.

Table 13: Drain water sampling and flow tests- Bhubaneswar Municipal Corporation (as taken on 28th April 2017)

Sample Points	Sample ID	Time of sampling	Wastewater generation	Avg Daily Discharge (MLD)	Quality					
					TSS, mg/l (CPCB Standard- 20)	pH (CPCB Standard- 6.5-9.0)	TDS, mg/l	BOD, mg/l (CPCB Standard- 10)	COD, mg/l (CPCB Standard- 50)	VS, mg/l
Gangua muhan (marked as Gangua muhan on Drainage Map- Bhubaneswar Municipal Corporation)  Gangua drain ends at the River Daya at this point after after travelling around 10 km from the city boundary. The water appear very clear. A difference in the colour of the two water bodies can be noticed.	143(I)	11.00 AM	90 MLD		50	7.4	240	20	76	92

Well next to Drain 9 in Jatani (marked as 9:14m on Drainage Map- Bhubaneswar Municipal Corporation)  The well is located next to the drain 9 at Jatani. The water from this well is used for drinking and other domestic purposes.	143(H)	12.00 PM			30	7	452	7	28	134
Drain-9 at Jatani (marked as 9:14m on Drainage Map- Bhubaneswar Municipal Corporation)  Measurements at Drain 9 at Jatani. This is closer to the outfall of Drain 9 into the Gangua Nala	143(J)	12.00 PM		13.54	20	7.4	216	18	76	100

Drain 9 , Near ITER confluence of Drain 8 with Drain 9 (marked as Drainage Map- Bhubaneswar Municipal Corporation)  This is the upper course of drain 9.		1.00 PM		32.94						
Drain 7, just before joining Gangua Nallah (marked as 7:15m in Drainage Map- Bhubaneswar Municipal Corporation) 		2.00 PM		32.94						

Gangua D-7 (marked as 7:15m on Drainage Map- Bhubaneswar Municipal Corporation) 	143(K)	2.16 PM			150	7.1	208	45	208	224

4.3.5.2 Inferences

- The samples were taken at three points: Drain 7 joining Gangua Nala; on Drain 9 two kms before joining Gangua Nala; and at Gangua Muhaan where Gangua Nala joins the River Daya. The parameters of pollution at the three key outfalls are:
  - BOD mg/l
    - 45 at Drain 7 point; 18 at Drain 9 point and 20 at Gangua Muhaan
  - COD mg/l
    - 208 at Drain 7 point; 76 at Drain 9 point and 76 at Gangua Muhaan
  - TSS mg/l
    - 150 at Drain 7 point; 20 at Drain 9 point and 50 at Gangua Muhaan
  - PH mg/l
    - 7.1 at Drain 7 point; 7.4 at Drain 9 point and 7.4 at Gangua Muhaan
- Natural drains create scope for treatment natural treatment of water to some extent. Also, the main trunk drain of Gangua Nala travels for over 10 km from the city before joining the river. The combination of these two factors has resulted in the low levels of pollution at the outfall of the storm water drains. However, the pollution levels at the outfalls are still higher than the CPCB limits. Therefore, treatment interventions are required in order to bring down the levels of pollution of the receiving water body, which is in this case the river Daya.

- Calculating from the discharge of the storm water drain outfalls, 46 MLD (approx.) of water is discharged through the drains. Since the time of sampling was dry season, this was wastewater flowing through these drains. This is close to the estimated 49.3 or 50 MLD of wastewater flowing through the drains.

4.3.5.3 Recommendations for improving water quality in drains

1. **Stopping entry of wastewater into storm water drains**:
   A major portion of wastewater in storm water drain comes from domestic wastewater. In order to keep this wastewater out of the drains, all the domestic wastewater should be safely disposed. In unsewered areas this issue can be addressed by mandating construction of septic tanks with soak pits. In the sewered areas ensuring that all the households are connected to sewer network will address the issue.
2. **Treating the wastewater from the drains by creating constructed wetlands:**
   a) At Bhubaneswar, there are 10 primary drains which carry water to the Gangua Nala, which act as the trunk drain that carry the water till the receiving water body of river Daya (Refer Drainage Map- Bhubaneswar Municipal Corporation).
   b) The wetlands can be constructed either at the near the outfall of primary drains joining the Gangua Nala or can be constructed at the end near the Gangua Muhan. The treated wastewater from this unit will be discharged to flow downstream after ensuring the required level of treatment is achieved. This would result in treated water flowing through the drains resulting in bringing down the pollution levels of the reaching the river Daya.
   c) Also, the treated water is reused for irrigation of landscaped areas, ornamental water bodies and brooks either by gravity flow or by pumping of the required volume from drain.
3. **Maintaining and increasing the number of natural drains:**
   As said in Natural Drains (kuchcha drains) of Bhubaneswar, natural drains due to their ecosystem act as a treatment system to treat limited quantities of wastewater. Maintaining the drain ecosystem is the major part of this. The vegetation in the drains should be minimised at the beginning of monsoons in order to increase the water carrying capacity of the drains for the season. Thereafter, the vegetation should be allowed to grow towards the end of the monsoon so that it can treat a limited dry season flow.
   Hence, more drains should be maintained as natural and the newly constructed drains should be constructed as kuchcha drains to improve the water quality in drains by means of treating the small quantities of wastewater flowing through them.

4.3.6 Water logging areas- Issues and Recommendations

As evident from the contour profile of Bhubaneswar (refer Contour Profile of Bhubaneswar), most of the city is having a very low elevation. In addition to this, a prominent rainy season coupled with a lack of drainage system (only 45% coverage of drains), the city faces water logging issues at numerous places. Field visits were conducted at some of the areas here waterlogging is a common issue. The observations were as follows:

- Waterlogging prone areas where visits were made are Behera Sahi, ISKCON, Ekamra Kanan, Nicco Park Nala at Acharya Vihar , Fire Station Chak (Near Paika Nagar) and Satabdi Nagar Chak.
- The cause of water logging in most of the above areas was that the drains were fully covered and the inlets into the drains were either too small or choked by solid waste.
- **Gap-** Issues in drain design, inaccessibility and clogging of drains with solid waste

Table 14: Details of Waterlogged Areas

SN	Area Name	Issue	Photo		
1	Behera Sahi (marked as WL3 on Drainage Map- Bhubaneswar Municipal Corporation	This area is low lying as compared to the nearby areas of ISKCON Temple and Ekamra Kanan. The drains in the nearby areas are fully covered with very small opening left for the inlet pipes resulting in the water not flowing into the drains fast enough. As a result the water overflows into nearby areas.			
			Drains full of wastewater		Water from nearby areas flows into this area during rains.

2	Outside ISKCON TEMPLE (marked as WL4 on Drainage Map- Bhubaneswar Municipal Corporation)	The drains outside ISKCON Temple are fully covered with tiny or holes for the water to pass. As a result water logging occurs here and nearby area of Behera Sahi	
3	Ekamra Park (marked as WL7 on Drainage Map- Bhubaneswar Municipal Corporation)	The drains outside ISKCON Temple are fully covered with tiny or holes for the water to pass. As a result water logging occurs here and nearby area of Behera Sahi	
4	Fire Station Chak (marked as WL1 on Drainage Map- Bhubaneswar Municipal Corporation)	Water logging for 3-4 days at times of heavy rains.	
5	Satabdi Nagar Chak (marked as WL3 on Drainage Map- Bhubaneswar Municipal Corporation)	Inlet pipe into covered storm water drains is covered with a layer of asphalt and solid waste, decreasing its inflow significantly.	

4.3.6.1 Recommendations

1. **Improving inlets into the existing drains**- This can be done by using alternative options while dealing with covered drains such as mesh covers (see Drain Mesh); keeping the inlet pipes into covered concrete drains free of solid waste; and managing solid waste in the drains.

Figure 14Drain Mesh

Source : Steel Mesh

2. **Increasing drain coverage and constructing new drains as constructed kuchha drains.** The vegetation in the natural drains (kuchcha drains) helps in controlling flooding as referred to in Natural Drains (kuchcha drains) of Bhubaneswar
3. **Water sensitive urban design using swales and raingardens**
   "Water Sensitive Urban Design" or WSUD for short is an approach that recognizes the adverse impact of traditional urban forms have on the urban water cycle. (Water Sensitive Urban Design in UK, 2013) Hence WSUD takes the approach of finding opportunities to renew and redesign existing urban forms so they may positively enhance the urban water cycle. Examples of such redesigning of roadside to include incorporation of permeable surfaces as well as vegetated and landscaped areas (such as raingardens and swales see Diagrammatic representation of roadside swales and rain garden) that are specially designed to slow down the flow of the storm water run-off from road and other paved surfaces, retain and treat the pollutants that is often picked up by the first flush of the storm water run-off and discharge cleaner water to the discharge point. Such WSUD elements provide other multiple benefits such as enhancement of the aesthetics of the urban areas and reduced flooding and water logging following rains. This means the City of Bhubaneshwar, swales can be constructed in the roadsides as shown in Diagrammatic representation of roadside swales and rain garden and incorporate a program of building raingardens in public

premises in partnership with the agency responsible for road and storm water; as well as in private premises in partnership with private landowners.

4.3.6.1.1 Diagrammatic representation of roadside swales and rain garden

Figure 15 Roadside swale

(Swale, 2017)

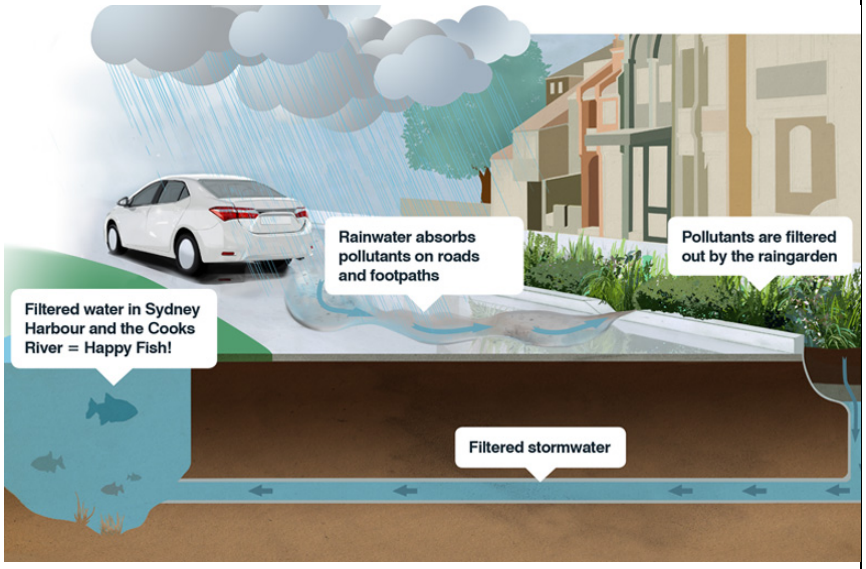
Figure 16 Roadside swales installation

a. Road patch without swale

b. Road patch with swale

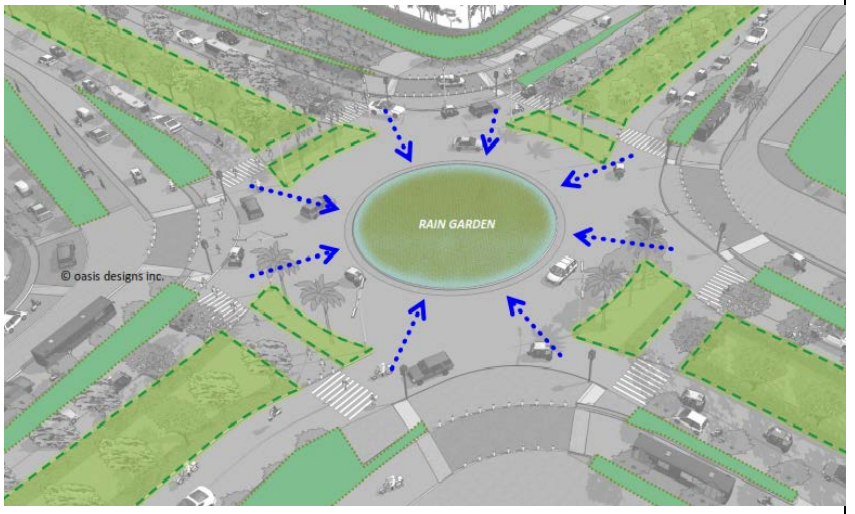
(Storm Water Management, Uttipec, Delhi Development Authority, 2012)

Figure 17 Representation of working of a rain garden and swale



(Rain gardens)

Figure 18 Representation of rain garden at roundabouts for Delhi



(Storm Water Management, Uttipec, Delhi Development Authority, 2012)

4.3.7 Upcoming Projects

Upcoming projects include construction of internal drains for wards and constructing retaining walls on 67 km of main (primary) drains. The transferable development rights (TDR) for land acquisition for these projects is under process. The main (primary) drains might also be concretized at the bottom wherever necessary leaving wells on the drain floor for groundwater recharge. These projects are funded by the state government.

4.3.8 Action Plan

The key action points for improvement in storm water drainage are in terms of construction of water sensitive drainage in order to address multiple challenges of drain coverage, control the problems of inundation and letting maximum water to seep into the ground in order to improve the ground water levels. Maintaining and increasing the coverage of natural drains and constructed kuchcha drains and construction of swales and raingardens are central to this idea of water sensitive urban design. Also, stopping wastewater from entering the drains and regular maintenance of drains in terms of solid waste management and maintaining the vegetation in the drains are essential to improve upon storm water drainage system.

Table 15: Action Plan for Storm water Management

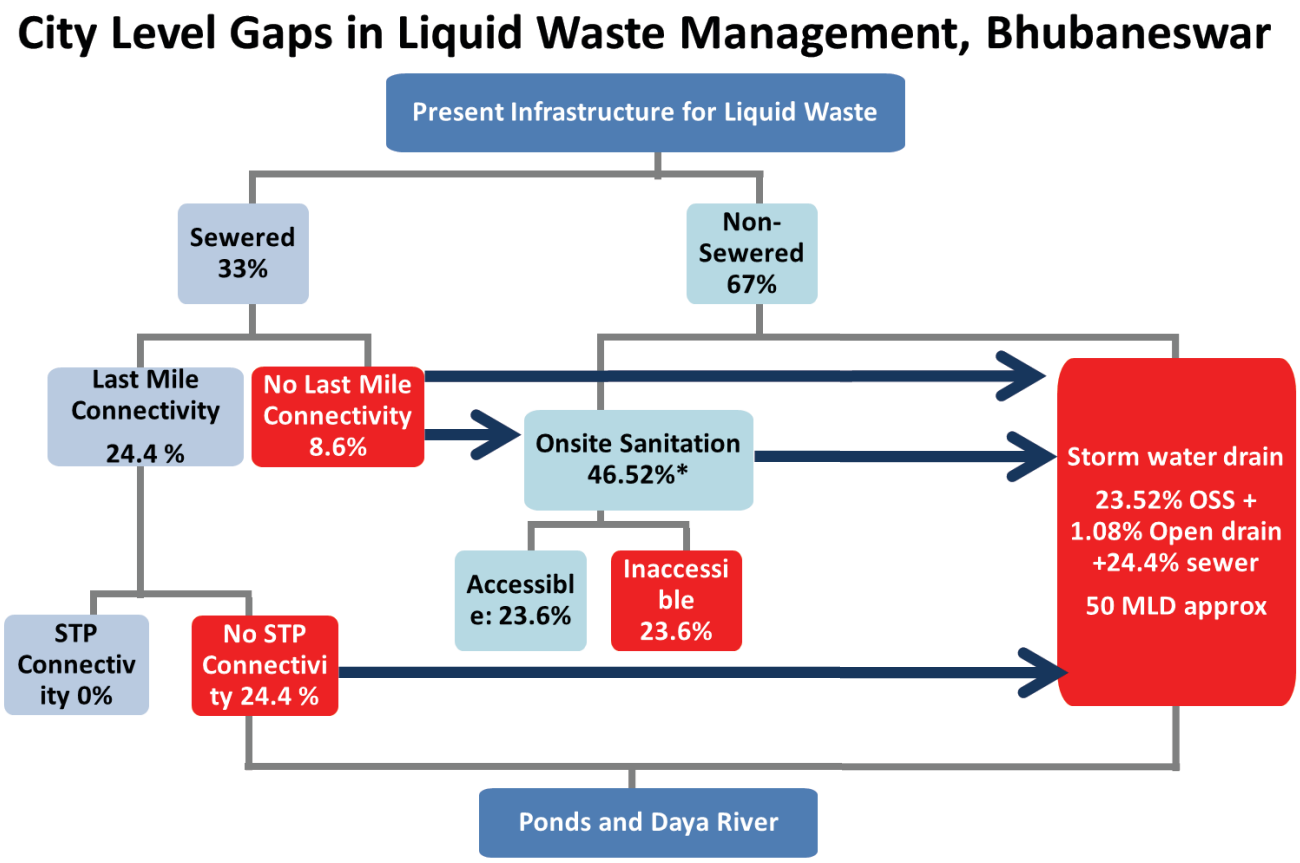
Issue 1		**Inadequate drain coverage**
Key Issue		65% deficit in stormwater drain coverage
Goal		To improve drain coverage
Actions	**Short term (within 2 years)**	• To implement the recommendation of laying 1036 km drains as stated in the 2008 Master Plan. • The newly constructed drains should be constructed kuchcha drains (wherever possible) in order to improve the water quality in the drains
Issue 2		**Inundation issues**
Key Issue		Drain design issues- covered drains and related issues
Goal		To create new drain designs using water sensitive urban design approach.
Actions	**Short term (within 2 years)**	• **Improving inlets into the existing drains by unclogging inlet pipes; and switching to alternate covering such as mesh cover.** • **Increased coverage of natural drains.**
	Medium term (3- 5 years)	• **Water sensitive urban design using swales and raingardens** (See Diagrammatic representation of roadside swales and rain garden)

Issue 3		Solid waste into drains
Goal		To addressing the issue of open disposal of waste
Actions		Refer to the solid waste management section
Issue 4		**Wastewater into storm water drains**
Goal		To improve the water quality in the drains
Actions	**Short term (within 2 years)**	• **Stopping the entry of sewage into the storm water drain** • **Maintaining and increasing the number of natural drains**
	Medium term (3- 5 years)	• **Treating the wastewater from the drains by creating constructed wetlands**


Wastewater Management
90 MLD
Wastewater Generation
67% un-sewered
Sewerage projects under OWSSB by 2017
Future Projections
In 2025: 136 MLD (Swacch City Plan)
105 MLD (Exponential)

4.4 Wastewater Management

Figure 19 City Level Gaps in Liquid waste Management



4.4.1 Current Situation, Gaps and Possible Recommendations

Table 16 Wastewater Management: Current Situation, Gaps and Possible Recommendations

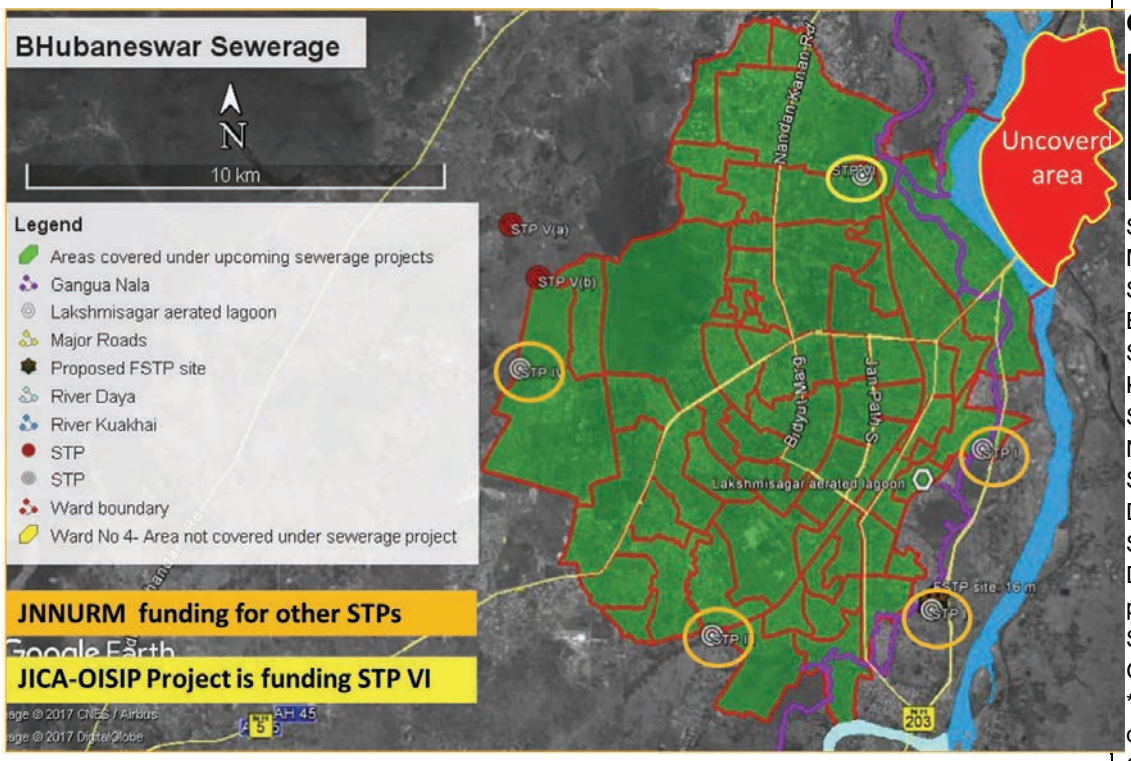
Sl. No.	Aspects	Details	Gap	Recommendations
1	**Generation**	As of 2015, the sewage generation is 90 MLD. Of this, 33% i.e. 29.7 MLD is conveyed through the existing sewer lines. (Service Level Improvement Plan Bhubaneswar, 2015)		
2	**Conveyance**	**Existing Network** 365 km of sewer line covering 33% of Bhubaneswar.	Direct discharge into river Daya.	Covering the unserved area faecal sludge/septage management (FSM)

		Upcoming Projects 254 km sewer network is being laid under Japan International Cooperation Agency (JICA)-funded Orissa Integrated Sanitation Improvement Project (OISIP) project. 312 km to be laid under the Jawaharlal Nehru Urban Renewal Mission (JNNURM) Project. The present status of the JNNURM Project is that the financial bid of the contractor has opened and the price bid of L1 bidder is submitted for approval in H & UD Department.	Even after completion of the projects, the Ward No 4 i.e. the ward beyond River Kuakhai (refer Bhubaneswar sewerage map) city will remain unserved.	solutions. Given that the farthest point in the ward is about 20 km away from the proposed SeTP, alternatives such as sludge transfer stations or additional SeTP can be looked into upon assessing the demand-supply of FSM services. In places where FSM solutions are not feasible or inadequate, wastewater treatment solutions such as small bore systems can be used.
3	**Treatment**	**Existing situation** 3 aerated lagoons and 7 oxidation ponds. Of these, only 1 aerated lagoon at Laxmisagar is functioning and rest is defunct or damaged. (Detailed Project Report Integrated Sewerage System for Bhubaneswar City under JNNURM, 2007) **Upcoming Projects** There 6 new STPs coming up in Bhubaneswar. One is under the OISIP[10] (48 MLD) and other 5 are under JNNURM (each of 56 MLD, 28 MLD, 43.5 MLD, 8.5 MLD and 1.2 MLD). This is likely to get completed in next 5 years. (Town-wise status of Sewerage Projects under OWSSB, 2017) According to the latest information, the 1.2 MLD STPs in Sewerage District V (SD V) (marked in Bhubaneswar sewerage map as STP V (a) and STP V (b)[11]) is being cancelled. (Project Director, 2017)		

[10] Orissa Integrated Sanitation Improvement Project (OISIP)

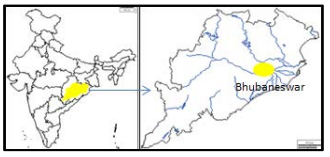
[11] Although site of two STPs in the same SD V is being shown in the Integrated Sewerage System DPR, only the combined capacity is giving in it.

Figure 20: Bhubaneswar sewerage map



Source: Detailed Project Report for STPs, OWSSB

Preparation of CSPs for Cities of Odisha



STP I Proposed STP at Meherpalli
STP II Proposed STP at Basughai
STP III Proposed STP at Kochilaput
STP IV Proposed STP at Nargoda
STP V(a) Proposed STP at Daspur*
STP V(b) Proposed STP at Daspur* (near Bharatpur BDA plots)
STP VI Proposed STP at Gadakan
*These STPs are not being constructed, as reported by OWSSB.

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4.4.2 Upcoming Sewerage Projects funding details

The sewerage projects in Bhubaneswar are getting funded under two projects. (Town-wise status of Sewerage Projects under OWSSB, 2017)

- **JNNURM Project**- Under this project, 312 km of sewer network is to be laid and 5 STPs each of 56 MLD (in Sewerage District I and marked in Bhubaneswar sewerage map as STP I), 28 MLD (in Sewerage District I and marked in Bhubaneswar sewerage map as STP II), 43.5 MLD (in Sewerage District I and marked in Bhubaneswar sewerage map as STP III), 8.5 MLD (in Sewerage District I and marked in Bhubaneswar sewerage map as STP IV), and 1.2 MLD (in Sewerage District I and marked in Bhubaneswar sewerage map as STP V(a) and STP V (b)),are to be built. (Detailed Project Report Integrated Sewerage System for Bhubaneswar City under JNNURM, 2007) The total cost of this project is 754.23 crore. The present status of the JNNURM Project is that the financial bid of the contractor has opened and the price bid of L1 bidder is submitted for approval in H & UD Department. (Town-wise status of Sewerage Projects under OWSSB, 2017). According to the latest information, the 1.2 MLD STPs in Sewerage District V (marked in Bhubaneswar sewerage map as STP V (a) and STP V (b)) is being cancelled. (Project Director, 2017)
- **Japan International Cooperation Agency (JICA)** - funded Orissa Integrated Sanitation Improvement Project (OISIP) project- Under this project, 254 km sewer network is being laid

and 1 STP of 48 MLD (marked in Bhubaneswar sewerage map as STP VI) in Sewerage District VI is being proposed. (Town-wise status of Sewerage Projects under OWSSB, 2017)

4.4.3 Projections for Wastewater Generation

Table 17 Wastewater generation projection

Progression Method	Year	Population	Water demand in MLD (approx.)	Wastewater generation in MLD (approx.)
Census 2011 Population	2011	840834	130	90
Swachh City Plan	2019	1034225	160	110
	2025	1272096	197	136
Exponential	2019	920360	143	98
	2025	984903	152	105

For the purpose of projection, we are using exponential projections. (See Population Projection for Bhubaneswar for details). Considering that the per capita wastewater generation remains constant; the projection for wastewater generation has been made. The total capacity of the upcoming STPs is 184 MLD. Considering this, the STPs will be able to cater to the wastewater demand till 2025. However, in order to avoid the need for putting more STPs beyond this point, unsewered areas such as Ward No 4 and bulk wastewater generators such as new multi-storeyed buildings (more than 50 households or institutional and commercial complexes) and new areas should be mandated to have localised treatment plants. This policy legislation has been instituted in the city of Bangalore. It would allow gated communities to be self-sufficient in terms of their wastewater treatment and thus not create a negative impact on the environment. The earlier such measures are taken, the lesser would be the pressure to create new centralised STPs. Also, the earlier such mandates are passed, the greater is the likelihood of compliance as the city as maximum number of new buildings can go for decentralised solutions.

4.4.4 Action plan

The key action points for improvement in wastewater management focuses on the intervention in the Ward No 4 which will be the only area which will remain unsewered after the completion on the ongoing projects.

Table 18 Action plan for wastewater management

Issue 1		**Area out of sewer network**
Key Issue		The entire city except for Ward No 4 will be covered either under JICA-OISIP or under JNNURM projects.
Goal		➢ To deliver FSM solutions ➢ To deliver wastewater treatment solutions
Actions	**Short term (within 2 years)**	**FSM Solutions** • Implementation of the FSM solutions as highlighted in the FSM sections. **Wastewater solutions** • Implementation of localised conveyance and treatment solution in, clusters left out of the sewered areas as suggested in the Approaches for wastewater

		management in unsewered pockets and newly constructed multi-storeyed building
	Medium term (3- 5 years) To Long term (3- 5 years)	• Identifying potential reuse options • Bulk generators of sewage such as apartments and institutions; and any new multi-storeyed buildings can be mandated to treat their wastewater at source.

4.4.5 Approaches for wastewater management in unsewered pockets and newly constructed multi-storeyed building

Decentralized sanitation systems: Considering the future infrastructure development in the town, the cluster approach for wastewater treatment can be proposed for the town. This requires the clustering the town based on the contours available and provide conveyance system along with wastewater treatment. This allows the usage of low energy for conveyance system and low construction cost. As per the information given by the Bhubaneswar Municipal Corporation, the total road length in this ward is 81.79 km. Based on this; the cost estimates for laying different types of conveyance system have been calculated.

Table 19: Options for Conveyance Systems

Options	Features	Pros	Cons	Cost per running meter	Estimated cost for the Ward No 4[12] (in Rs. Crores)[13]
Small bore systems	A solids-free sewer is a network of small-diameter pipes that transports pre-treated and solids-free wastewater (such as Septic Tank effluent).	• Does not require a minimum gradient or flow velocity • Can be used where water supply is limited • Lower capital costs than conventional gravity sewers; low operating costs • Can be extended as a community grows	• Space for interceptors is required Interceptors require regular desludging to prevent clogging • Requires training and acceptance to be used correctly • Requires repairs and removals of blockages more frequently than a conventional gravity sewer • Requires expert design and construction Leakages pose a risk of wastewater exfiltration and groundwater infiltration	Rs 2400	19
Simplified sewer systems	A simplified sewer describes a sewerage network that is constructed using smaller diameter pipes laid at a shallower depth and at a flatter gradient than conventional Sewers	• Lower capital costs than Conventional Sewers; low operating costs • Can be extended as a community grows • Greywater can be managed concurrently • Does not require onsite primary treatment units	• Requires repairs and removals of blockages more frequently than a Conventional Gravity Sewer • Requires expert design and construction • Leakages pose a risk of wastewater exfiltration and groundwater infiltration and are difficult to identify	Rs 2800	22
Conventional sewer lines	Conventional gravity sewers are large networks of underground pipes that convey	• Less maintenance compared to Simplified and Solids-Free Sewers • Greywater and possibly storm water can be managed concurrently	• Very high capital costs; high operation and maintenance costs • A minimum velocity must be maintained to prevent the deposition of solids in the sewer	Rs 4800	39

[12] Calculated by multiplying the cost per running meter with the road length in the ward i.e. 81.79 km as received from the BMC.

	blackwater and greywater	• Can handle grit and other solids, as well as large volumes of flow	• Requires deep excavations • Difficult and costly to extend as a community changes and grows • Requires expert design, construction and maintenance		

One of the most challenging aspects of a sustainable sewage treatment system (either centralized or decentralized) design is the analysis and selection of the treatment processes and technologies capable of meeting the requirements. The process is to be selected based on required quality of treated water. While treatment costs are important, other factors should also be given due consideration. For instance, effluent quality, process complexity, process reliability, environmental issues and land requirements should be evaluated and weighted against cost considerations

Table 20: Wastewater Treatment Technologies

Sl.No	Parameters	Activated Sludge Process (ASP)	Sequential batch Reactor (SBR)	DEWATS	Membrane Bioreactor (MBR)	Moving bed Bioreactor (MBBR)[14]
1	**Capital Cost (Rs. Lacs/MLD)**	**80**	**125**	**300**	**220**	**130**
	Civil Construction/Prefab (% Capital Cost and Electrical and Mechanical)	55	30	100	20	40
2	**Area Required (Sq./MLD)**	**800**	**400**	**4750**	**200**	**400**
3	**Performance of Technology-Effluent**					
	BOD (mg/l)	<20mg/l	85-98%	<20mg/l	<2mg/l	92-97%
	COD (mg/l)			<50mg/l	15-20mg/l	94%
	TSS (mg/l)	<30	85-98%		NA	
4	**Operation and Maintenance cost**					
	Energy Cost					
	Total Power required(Treatment Process) (KW/day)	184	172.5	0	302.5	202.5

[14] ASP cost estimates based on Ganga River Basin Management Plan
SBR, MBR and MBBR cost estimates based on Kavali STP DPR.
DEWATS cost estimates based on CDD Society quotation.

	Yearly Power cost (Rs. Lacs PA/MLD)	2.65	2.48	0	4.36	2.92
	Recurring cost (Rs in Lacs PA/MLD) (List of chemicals, safety equipments will be attached)	5.3	0.2	0		0.4
	Annual Maintenance Cost (Equipments)					
	Civil Parts Maintenance Cost (% Of civil works cost) (List of equipments will be attached)	1.94	1	3.72	1	
	Electrical and Mechanical parts Maintenance cost (% Of civil works cost)	3	2.5	0		3
	Other Repair Cost Rs. Lacs	3.2	2.34			3.2
	Annual Human Resource Cost, in Lacs PA/MLD					
	Plant Manager	4.8	4.8	0	4.8	4.8
	Operator	1.44	1.44	0.6	1.44	1.44
	Chemist/Engineer	2.4	2.4	0	0	2.4
	Total O&M cost in Lacs PA/MLD	24.73	17.16	4.32	11.6	18.16


Faecal Sludge Management
8
cesspool vehicles
4 dumping sites
of untreated faecal sludge
41.4% of households
Connected to a containment system

4.5 Faecal Sludge Management

4.5.1 Faecal Sludge Management- Current Situation, Gaps and Possible Recommendations

Table 21 Faecal Sludge Management- Current Situation, Gaps and Possible Recommendations

Faecal Sludge Management cycle in Bhubaneswar Containment → Collection and Conveyance → Disposal and treatment → Reuse				Actions to be taken
Aspect/Parameter		**Current Situation**	**Gaps**	
1	**Containment**	As per Census 2011, the toilets in majority of the households in Bhubaneswar: • 41.4% are connected to septic tanks (with and without soak pits). • Another 6.8% of the households have toilets connected to pits (this includes pits with and without slabs and latrines serviced by humans and animals) • 1.1% of the households release their liquid waste directly into drains. • 4.2% have their toilets connected to other containment units.	• Presently there are no standards followed or enforced for the containment size and the construction mostly depends on space available within the house. Design of septic tanks is not controlled through building / planning rules • There is very less incentive for building the standard containment structures. • In addition, the Pits/Septic Tanks are un-scientifically constructed resulting in frequent overflow, leakages and inadequate reduction[15] and confinement. • There is a clear inadequacy in the understanding of the operations and maintenance of these containment units. • Septic tanks were also observed – during the field visit – to be broken. • Grey water was observed as entering the septic tanks. • In many cases, septic tanks are inaccessible for cleaning, as they are built with no accessible manhole for cleaning. • Most septic tanks are built with no soak pits, and the outlets of these tanks are let into the open environment through storm water drains.	• Enforcement of standard containment size code regulations strictly. This would require a concerted and programmatic effort on the part of the municipal body engaging the executive engineering staff, deploying additional resources and also organizing awareness programs for the citizens. The awareness programs should be followed by the enforcement notification. • Increasing the incentive mechanisms/amount for converting the insanitary to sanitary • Awareness/IEC campaigns on open defecation and other aspects
2	**Collection and Conveyance**	• There are both government desludging service and private desludging service providers.	• There is no proper mechanism for monitoring and tracking the cesspool vehicle esp. the private players.	• Gulper/small cesspool vehicles where the

[15] This is in the case of Septic tanks only wherein the wastewater entering the containment unit undergoes reduction of up to 30% in organic (BOD) and chemical (COD) content

		• There are total of 8 cesspool vehicles with BMC of which 3 are old (2 working, 1 under repair) which are of 4500 lts and 5 new vehicles which have been procured but not used for providing desludging as of now. These are of 3000 lts capacity. • Apart from government players, there are about 20 – 25 private cesspool vehicles operated in Bhubaneshwar.	• Accessibility is an issue in few areas and –as well as the manual handling of faecal sludge poses a problem (as per the discussion with private cesspool operators) • Lack of data on private operators involved in desludging. • The private operators are not regulated. Desludging of septic tanks is not carried out regularly (once in every 2-3 years). • 3 trucks will be operated by BMC and 5 trucks are outsourced to private parties. The monitoring would be difficult because for certain vehicles O&M are outsourced while few of them are controlled by BMC. • Lack of usage of proper safety gears by personnel during desludging.	existing cesspool vehicles cannot access • Make GPS and other ICT interventions mandatory for both private and government vehicles. • Licensing of the private operators required • Form to be filled by the customer availing the desludging service which has to be submitted at the MC/during the disposal. • Separate account for handling cesspool vehicles account. • Provision of proper saftey gears for the working personnel by BMC/ private truck owners.
3	**Disposal and treatment**	• There are 4 dumping sites for the municipal owned trucks for disposing the faecal sludge. • There is no existing treatment facility in the town but the construction of 75 Cu m SeTP is under process and which would cater to around 14-18 wards(nearly 20% of the town)	• Unsafe faecal sludge/septage disposal practices currently (SeTP is due in Oct,2017) • The distance of the disposal point/treatment plant site from the city center. • Incentive mechanism/regulation to promote the disposal at treatment site is not yet available. • Disposal at 4 designated disposal locations (but its not scientifically disposed as it do not contain the treatment modules)	• Introducing temporary transfer[16] stations at the SWM transferstations in the form of huge tanks for disposal of FS • Once constructed disposal at the SeTP, to be mandatory • IEC campaign with the cesspool operators both private and government
4	**Reuse**	• No reuse/reuse plan is present in the form of usage of waste water and sludge in few areas in the agriculture	• There were agricultual fields near to the city. One should explore the potential of reuse of dried sludge/co-compost.	• Reuse plan for selling the dried FS

[16] Transfer stations or underground holding tanks act as intermediate dumping points for faecal sludge and septage when it cannot be easily transported to a (Semi-) Centralized Treatment facility. A vacuum truck is required to empty transfer stations when they are full.

				• Converting the dried FS into co-compost for enriching the nutrient content • Exploring it to sell for cement industries/ brick factories • To encourage reuse among the farmers through IEC campaigns • Possible reuse options are provided in Reuse Options for FSM

4.5.2 Upcoming Projects

The SeTP is planned to be constructed and be operational by the end of 2017. The following table shows the key issues, action plan and cost estimates for improvement of faecal sludge management in Bhubaneswar. These measures will help in the proper functioning of the SeTP.

The following table shows the progress of septage projects under AMRUT in Odisha.

Table 22: Progress of Septage Projects under AMRUT in Odisha (2017)

Planning and Design	Construction/ Implementation	O&M
• Planning and design of the Faecal Sludge Treatment Plant (FSTP) of is undertaken by OWSSB • Procurement of the cess pool vehicles is however done by the Municipal Corporation.	• Construction/Implementation of the Faecal Sludge Treatment Plant (FSTP) is undertaken by OWSSB • Regarding the operationalization of the FSTP, the following are the Work Order details: 1. Agency: M/s Ionex Envirotech Pvt. Ltd., Mumbai 2. Agreement cost: Rs. 2,59,00,000 3. Scheduled Date of Completion: 17th October 2017 4. Status of FSTP Construction and implementation : ▪ The land has been physically handed over to the agency on the 18th of Jan 2017. ▪ The Topographical and Geotechnical surveys have been completed.	• The overall responsibility of operation and maintenance of the FSTP is the responsibility of the Bhubaneswar Municipal Corporation. • Though the trucks are procured by OWSSB, they will be owned and managed by the ULB. • As such, the O&M of cess pool vehicles will be under the supervision of the Municipal Corporation

	▪ General Agreement and Site technical drawings (Hydraulic Flow Diagram) approved by OWSSB (coordinating the implementation). ▪ Earthwork excavation is under progress • Status of truck procurement: Trucks procured by OWSSB and tendered out by the Municipal Corporation. The tender allotment is in process.	

4.5.3 Catering to future demand

In order to meet to the future demand, the city can rely increasingly on localised wastewater treatment (Refer to Projections for Wastewater Generation). This way the septage generation of the city can be limited, thereby reducing the pressure on the SeTP.

4.5.4 Action Plan

The key action points for improvement in faecal sludge management pertain to improvements in various segments in the value chain. At the user interface, policy and IEC interventions for standardisation of septic tanks and scheduled desludging are suggested. For the conveyance system, use of GPS tracking and licensing of the vehicles is important to ensure that the amount of the faecal sludge/ septage collected is being disposed in the proposed septage plant. Business models have been suggested to sustain the O&M of the SeTP.

Table 23 Action Plan for FSM

Issue 1	Containment	Costs
Key Issue	• No enforcement of standard pit/septic tank design and size (mostly depends on space available within the house) • Unhygienic Toilets, i.e. pits/Septic Tanks are un-scientifically constructed resulting in frequent overflow and leakages • Lack of understanding - O&M of containment units. • Grey water is entering the septic tanks, • Septic tanks are inaccessible for cleaning.	
Goal	• Complete conversion of existing insanitary toilets to sanitary toilets • New constructions or toilets construction in the pipeline are to be completely standardized • Creating capacities to undertake O&M of containment units • Implementation of rules and regulations which would standardize the existing and upcoming containment systems	
Action **Short term**	**Technical**	

	(within 2 years)	• Enforcement of standard size/designs of the septic tanks which needs to be incorporated in the house construction design which needs to be in accordance with the provisions of the o National Building Code of India, 2005; o Bureau of Indian Standards, Code of Practice for Installation of Septic Tanks; o Manual on Sewerage and sewage treatment systems, CPHEEO, 2013; o Swachh Bharat Mission Guidelines, 2014 **Operations** • Implementation of standard containment size code regulations strictly by making Bhubaneswar Development Authority (BDA)/ relevant monitoring authority accountable **IEC** • Awareness/IEC campaigns on open defecation and other aspects • Masons training for building the containment systems **Policy** • Enforcement of Odisha Urban Septage Management Guidelines, 2016.	
	Medium term (3- 5 years)	**Operations** • Increasing the incentive mechanisms/amount for converting the insanitary to sanitary **IEC** • Behaviour change campaigns and workshops periodically in the newly developing areas	• Rs 8,000 – Rs 10,000 increase in incentive for every toilet converted from insanitary to sanitary toilet (based on other states implementation of incentives under SBM plan)
Issue 2	**Collection and Conveyance**		
Key Issue	• There is no proper mechanism for monitoring and tracking the cesspool vehicle esp. the private players. • Accessibility is an issue in few areas and unscientific method • Manual handling of faecal sludge is a significant issue (as per the discussion with private cesspool operators) • The private operators are not regulated. Lack of data on private operators involved in desludging. • Desludging of septic tanks is not carried out regularly (once in every 2-3 years). • 3 trucks will be operated by BMC and 5 trucks are outsourced to private parties. The monitoring would be difficult because certain vehicles O&M are outsourced and few of them are controlled by BMC. • Proper safety gears are not used while desludging both by government and private operators	

Goal		➢ 100% collection of FS/Septage generated in the city and 100% conveyance to the treatment/disposal site ➢ No manual scavenging/ manual handling of FS ➢ Use of safety gears and proper equipment while desludging ➢ Regulating the private operators through licensing and periodic renewal	
Actions	**Short term (within 2 years)**	**Technical** • Monitoring of private and government cesspool vehicles by mandating GPS and other ICT interventions. • Safety gears to be given to government operators and are to be made compulsory for the government and private operators **Operations** • Separate account for handling government cesspool vehicles account. • Maintain the database of private operators • Mechanisms to fill the form by the customer availing the desludging service which has to be submitted at the MC/during the disposal. **Training** • Training the operators on standard practices and safety measures for collection and conveyance • Training of ULB officials on monitoring of cesspool vehicles **Policy** • Licensing the private operators and periodic renewal • Enforcement of Odisha Urban Septage Management Guidelines, 2016.	For ICT technology interventions: CapEX and OpEx is approx. Rs 1.2 Lakh per vehicle per year. It becomes Rs 9.6 Lakh for 8 vehicles per year
	Medium term (3- 5 years)	**Technical** • Procure 3-4 Gulper machines /small cesspool vehicles where the existing cesspool vehicles cannot access **IEC** • Behaviour change campaigns and workshops periodically in the newly developing areas	**For Gulper machines/small cesspool vehicles:** - Rs 32 Lakh for 4 vehicles as CapEx and Rs 2.8 Lakh for OpEx of vehicles(which will not include the fuel costs) - HR salaries will be around Rs 14.4 Lakh per year for 8 people employed(2 per vehicle)

	Long term (5-10 years)	**Operations** • Assess between the demand generated for collection and supply of FS collection in the city and accordingly procure cesspool vehicles if necessary **Policy** • Scheduled desludging should be implemented by incorporating user fee or property tax incorporation	**For procuring of new cesspool vehicles:** Rs 28 Lakh for 1 cesspool of 4.5 Kld Rs 20 Lakh for 1 cesspool of 3 Kld
Issue 3		**Disposal and treatment**	
Key Issue		• There are 4 dumping sites for the municipal owned trucks for disposing the faecal sludge. • There is no existing treatment facility in the town but the construction of 75 Cu m SeTP is under process and which would cater to around 14-18 wards(nearly 20% of the town) which is based on the assessment of the upcoming sewage projects in the city	
Goal		➢ 100 % disposal of FS generated at the treatment plant ➢ 100% of the FS generated is to be treated ➢ Scientific disposal sites are made available	
Actions	**Short term (within 2 years)**	**Technical**. • Complete SeTP by end of 2017 • Outsource the operations and maintainence of the SeTP to third party **Operations** • Introducing temporary transfer stations at the SWM transferstations in the form of huge tanks for disposal of FS • Depending on the need, tankers of 15,000- 20,000 Litres may be required to transport faecal sludge from the tranfer station to the SeTP. • This would be at the same places where SWM tranferstantions are present and would be operating 24x7 Disposal at the SeTP to be mandatory **IEC** • Capacity building of ULB and operators for handling the SeTP • IEC campaign with the cesspool operators both private and government for behaviour change regarding the disposal **Policy** • Licensing the private operators and periodic renewal and disposal to be made mandatory at the designated sites • Enforcement of Odisha Urban Septage Management Guidelines, 2016.	• To build a transfer station of 30,000 litres, the total CapEX would be Rs. 30,000*12= Rs. 3.6 lakhs. • Cost of the trucks for transport

	Medium term (3- 5 years)	**Technical** • Different business models assessment for the SeTP and work on sustainability of the operations of treatment plant **Operations** • Outsourcing of O&M of the plant to third party by releasing tenders **Policy** • Inclusion of property tax as part of making the operations of SeTP sustainable	• Tender Handling charges: Rs 2.5 Lakh approx. for design of tender • Business models for possible reuse options are provided in Business Models for FSM
	Long term (5-10 years)	**Technical** • Integrating the solid-liquid waste treatment at the same location **Operations** • Plan for ODF++ declaration **Policy** • Policy resolution leading to 100% disposal and treatment of the FS generated	
Issue 4		**Reuse**	
Key Issue		• No reuse is present or formally institutionalized in the city	
Goal		• 100% reuse of the treated sludge	
Actions	**Short term (within 2 years)**	**Technical** • Co-compost plan for enhancing the nutient value • Explore other technologies for reuse **Operations** • Collaborate with chemical fertilisers companies • Reuse plan for selling the dried FS and to be outsourced • Converting the dried FS into co-compost for enriching the nutrient content **IEC** • To encourage reuse among the farmers through IEC campaigns **Policy** • Reuse policy to be formulated for the city	• Cost of setting up co-composting unit[17] = Rs 0.7 Crore/70 Lakhs • The OpEx costs would be approx. = Rs 7 Lakh per year assuming 10% of CapEx. • For the compost to be sold in the market, it should pass the FCO (2013)[18] norms.

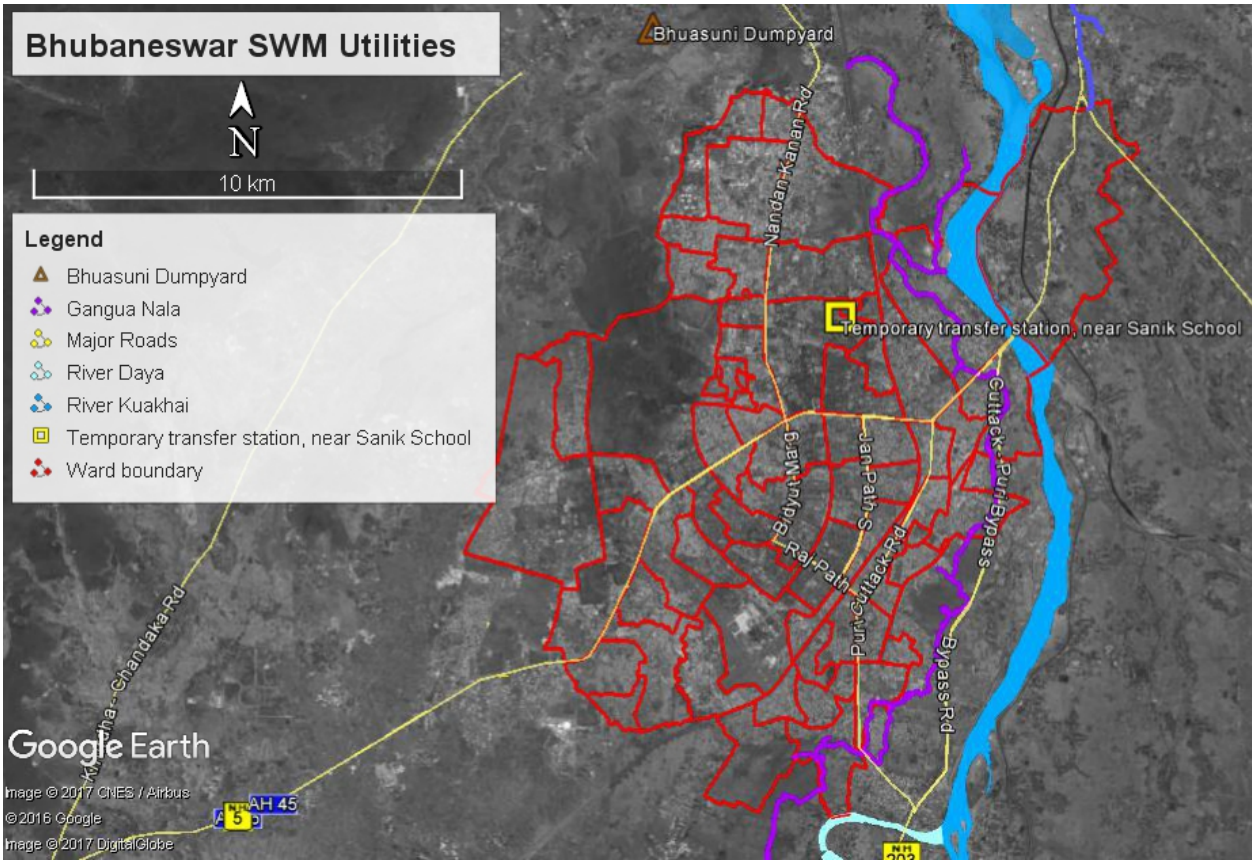
[17] Based on case study of FSTP Devenahalli, the Co-composting unit CapEx will cost 25% of the FSTP cost
[18] Fertiliser (Control) Order 2013 Norms, brought out by the Department of Agriculture and Cooperation

	Medium term (3-5 years)	**Technical** • Exploring possibilities of using Black soldier flies usage of solar energy at the SeTP **Operations** • Exploring possibilities to sell for cement industries/ brick factories	


Solid Waste Management
520 MT
of MSW generated
100% collection
Majority of D2D collection done by pvt. contractor
2 MT Recycled
0.3% of total of 520MT
centralized WTE plant not futureproof
Future Projections
In 2025: 787 MT (Swacch City Plan)
610 MT (Exponential)

4.6 Solid Waste Management

Figure 21 Bhubaneswar SWM Utilities map



4.6.1 Generation of Municipal Solid Waste

AS per Swachha Bharat City Plan, Bhubaneswar generates around **520 MT** of municipal solid waste per day[19].

4.6.2 Solid Waste Collection & Conveyance

In Bhubaneswar, solid waste is collected through both door to door collection and collection from secondary and community bins. Out of 67 municipal wards, 10 wards are serviced by Municipal Corporation and in the remaining 57 wards door to door waste collection is carried out through private service providers. Field visits to particularly stressful areas, such as Bapuji Nagar slum were undertaken to understand the current situation of solid waste. The details of these field reports have been provided in the Situation Assessment Report, as provided earlier.

[19] Swachha Bharat City Plan, Bhubaneswar Municipal Corporation (2017)

As per the Swachha Bharat city plan out of 520 MT generated on daily basis, all of **520 MT** is collected per day[20]. There is a transfer station for solid waste in the Sainik school transfer station, which has an area of 25 acres. At the transfer station, all the waste brought is weighed. From the transfer station, all the waste is then transported to dumping site at Bhuasuni using 16 tipper trucks and 25 Hiwa trucks of 20 cubic meter capacity.[21]. Details of the SWM service providers and their operational details have also been provided in the Situation Assessment Report.

There is no treatment being carried out at the dumpsite in Bhuasuni currently. All the waste collected is transferred from the transfer station and dumped at the dumping yard. At Bhuasuni, BMC and CMC had proposed for cluster waste to energy plant of 11MW but due to protest of locals proposal has not gone further.[22]

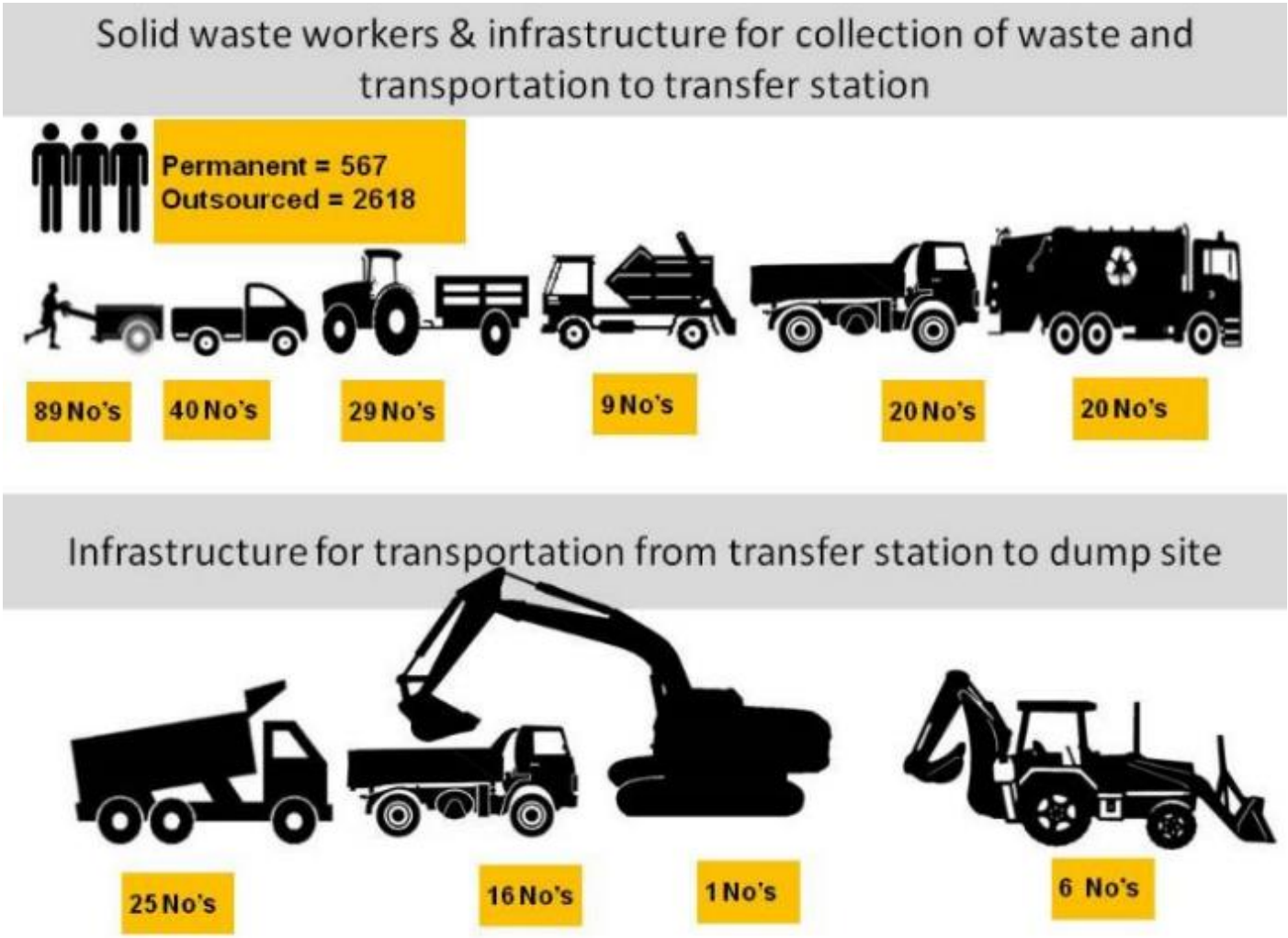
Figure 22: SWM Collection Vehicle

Further details about collection, conveyance and treatment of solid waste in Bhubaneswar have been provided in the Situation Assessment Report for Bhubaneswar.

An overview of the infrastructure and personnel involved in the SWM in Bhubaneswar is given through the process flow diagram in below.

[20] Swachha Bharat City Plan, Bhubaneswar Municipal Corporation
[21] Bhubaneswar Municipal Corporation (2017)
[22] Bhubaneswar Municipal Corporation (2017)

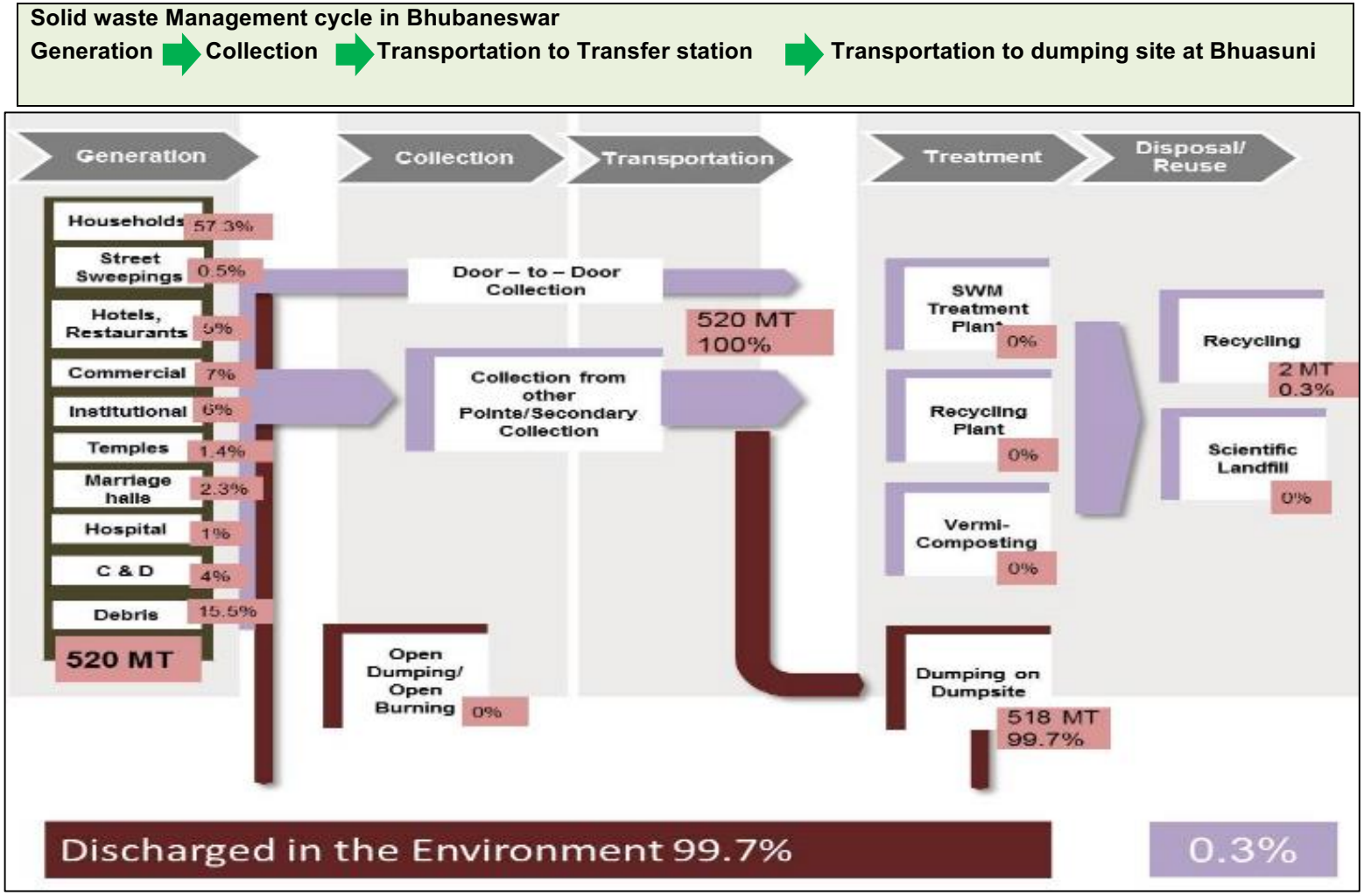
Figure 23: Solid Waste Management Staff and Vehicles, Bhubaneswar



Source: Swachh Bharat Cell, Bhubaneswar Municipal Corporation

4.6.3 Salient features of current Solid waste system

Figure 24 Solid Waste Process Flow



Source: Bhubaneswar Municipal Corporation

Table 24 Solid Waste Management- Current Situation, Gaps and Possible Recommendations

	Aspects/ parameters	Current situation	Issues/ Gaps	Possible Recommendations
1	**Generation**	• Households and small commercial= 420MT • Bulk waste generators= >100MT • Total waste generated= 520 MT per day		
2	**Collection and transportation**	• Waste collection is carried out by both Municipal Corporation and private service providers. • Out of total 67 total wards 10 wards are handled by MC and 57 wards outsourced to M/s. Jagruti, M/s PMR Consortium and M/s. Ramky Enviro Engineers Ltd.	• Segregation of waste is not managed at source • Labourures are differentiated for door to door waste collection, street sweeping and drain cleaning. • Increase in collection cost due to collection of unsegregated waste • Frequency of door to door waste collection is low in slums and lower income settlements.23	**Solid Waste collection using Micro-pocket planning approach.** For efficient handling of the sanitation and solid waste management function, MC Bhubaneswar is required to bundle the related activities (door to door collection, into three major work units based on the size and work load quantities. Work packages can be classified as follows:- •Residential Micro Pocket •Commercial and Bulk Solid Waste Handling •Mechanical Sweeping of Main Roads The SWM activities within one micro-pocket is supposed to be handled by one or two set of dedicated personnel who will work as a team and takecare of all the activities in the given micropocket. (refer Micro Planning Approach)
3	Segregation	• No household segregation happening • Informal segregation at transfer station(behind Sainik school) • 30-40 rag pickers present at transfer station. Each segregate around 40-50kgs for recyclables on daily basis.	• No incentives given to promote segregation at source	• Provision of incentives in the form of property tax rebates or rebate on solid waste collection charges under polluters pay principle. • IEC campaign for awareness generation towards segregation of waste.

[23] CDD Society site visit (2017) Discussion with Sanitary Inspector.

4	**Treatment/ Processing**	• No treatment of waste is happening at present. • All collected waste is dumped at dumping yard at Bhuasuni. • BMC and CMC together have plan of setting up 11 MW waste to energy plant but due to protest from locals, BMC is not being able to go forward with the plan.	• All the 520MT of waste collected is dumped without any treatment and processing • Increase in garbage heaps affects environment due to release to greenhouse gases • Loss of resources in the form of recyclable materials (plastic, metals, glass, paper etc.) and compostable materials. • No scientific landfill for safe disposal of inert materials • No separate treatment happening for Bio medical waste and sanitary waste.	• Material Recovery facility for recovering recyclable materials • C & D waste plant to handle construction and demolition waste • **Source Treatment for bulk generators:** Biogas plant at source reduction for bulk waste generators like vegetable Market • Windrow composting of wet waste for reovering compostable materials. • Separate incineration treatment for Bio medical and sanitary waste to be constructed under PPP mode. • Installation of Organic waste converter (OWC) machine at public parks for source reduction of waste[24]
5	**Policy**		• No holistic Soild waste management DPR prepared which is a mandate under Swaccha Bharat Mission	• Solid waste management DPR for claiming funds under Swachha Bharat Mission

4.6.4 Projections for Solid Waste Generation

Table 25 Projection for solid waste generation

Progression Method	Year	Population	Solid waste generation (MT) (approx.)
Census 2011 Population	2011	840834	520
Swachh City Plan	2019	1034225	640
	2025	1272096	787
Exponential	2019	920360	570
	2025	984903	610

For the purpose of projection, we are using exponential projections. (see Population Projection for Bhubaneswar for details)

The solid waste generation has been calculated with the assumption that the per capita waste generation of the city will remain constant. The total capacity of the proposed centralised waste to energy plant at Bhuasuni is 600 MT. However, owing to the constant protest against it, the implementation will remain a challenge for a while. Also, it will be shared by Cuttack Municipal Corporation and Bhubaneswar Municipal Corporation. Therefore, **even if the plant is set up, it will not be able to cater to all the waste generated in the city. Hence, it is important that maximum amount of waste is retrieved locally and sent through the reuse and recycle channels.** Therefore, the action plan focusses on maximum segregation to promote

[24] All the above waste technologies are suggested based on general characteristics of Municipal Solid Waste in India. Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume I, Page-43, Government of India.

recycle and localised management of waste. The aim is to reduce the quantity of waste reaching the dump yard so as to enhance resource retrieve maximum resources from waste.

4.6.5 Action Plan

The key action points for improvement in solid waste management pertain to improvements in various segments in the value chain. At the user interface, policy and IEC interventions for household segregation are suggested. For the collection system, micro-pocket approach in which the city is divided into multiple micro-pockets and all the solid waste collection activities - door-to-door collection, road sweeping and drain cleaning- is assigned to one or two individual workers who will take care of all the activities. This will lead to increased accountability of workers and easy monitoring of their work. For treatment, it is suggested that the city must have dry resource collection centre/s in order to ensure that there is a place where the segregated dry waste collected is received and processed (or sent for processing from this facility). For bulk generator of wet waste, it is suggested that treatment units are made mandatory in order to manage the solid waste at source itself.

Table 26 Action plan for SWM

Issue 1		**Collection of waste**	**Cost**
Key Issue		1. Segregation of waste is not managed at source 2. Labourures are differentiated for door to door waste collection, street sweeping and drain cleaning. 3. Frequency of door to door waste collection is low in slums and lower income settlements.	
Goal		➢ 100% collection of solid waste generated in the city and 100% conveyance to the treatment/disposal site. ➢ To achieve 80% source segregation of waste	
Actions	**Short term (within 2 years)**	**Micro-pocket planning approach.** For efficient handling of the sanitation and solid waste management function, MC Bhubaneswar is required to bundle the related activities (door to door collection, drain cleaning and road sweeping) into three major work units based on the size and work load quantities. Work packages can be classified as follows:- •Residential Micro Pocket •Commercial and Bulk Solid Waste Handling •Mechanical Sweeping of Main Roads The SWM activities within one micro-pocket is supposed to be handled by one or two set of dedicated personnel who will work as a team and takecare of all the activities in the given micropocket. (refer Micro Planning Approach) Steps involved: I. Clear demarcation of residential, commercial and main road sweeping pockets for carrying out the sanitation and solid waste management activities II. Clearly defining of job responsibilities and key performance indicators for the service providers III. Making realistic estimates of resource requirements in rationalized and standardized manner (manpower, transportation vehicles, tools, implements and conservancy materials)	

		IV. Develop clear resource inputs and results-outputs correlations to achieve standard service delivery results across the ULBs in a uniform manner. V. Identifying and developing clear wok quantities, key performance indicators and performance monitoring mechanisms, in the event of outsourcing complete work packages to private agenciesClear demarcation of areas and tasks for waste collectors. VI. Calculating total human resource requirements. It can be calculated as per 2 workers per micropocket who would undertake all the activities such as door to door waste collection, road sweeping and drain cleaning inside designated micropocket. (Refer to Micro Planning Approach) VII. For the micro-planning approach to succeed secondary bins should be removed from all the areas except high floating population areas. **Training** • Training for solid waste collection workforce for both Govt. and private waste collectors about waste collection process in micro pockets **IEC** • Household awareness campaigns about segregation of waste to be carried out by waste collectors **Policy** • Policy amendment for Provision of incentives in the form of property tax rebates or rebate on solid waste collection charges under polluters pay principle.[25]	

Issue 2		**Treatment/ Processing of waste**	**Cost**
Key Issue		1. All the 520 MT of waste collected is dumped without any treatment and processing 2. Increase in garbage heaps affects environment due to release to greenhouse gases 3. Loss of resources in the form of recyclable materials (plastic, metals, glass, paper etc.) and compostable materials. 4. No scientific landfill for safe disposal of inert materials	
Goal		➢ **Management of waste at source for bulk generators**	
Actions	**Short term (within 2 years)**	**Technical** • Carry out waste composition study to know the actual content of wet and dry waste and composition of different materials like, biodegradable, paper, metals, glass etc. [26] • Mandating all bulk waste generators whose waste characteristics are mainly wet waste eg vegetable market, public parks etc. to treat waste at source by means of using technology opetions such as bio gas digestors and Organic waste converter to be outsourced to private service providers	• Prefeasibity study, waste compostion study, and a preparation of holistic solid waste management DPR= **Rs.7.5 lakhs** • Biogas digestor= **Rs.15-16 Lakhs per tonne** • Onsite composting (windrow)= **Rs.3-4 lakhs per tonne** • Onsite Composting (Vermicomposting)= **Rs. 5 lakhs per tonne**

[25] This model is being implemented In State of Andhra Pradesh.

[26] Waste composition study should be carried out according to this given reference- Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume II, Page-47, Government of India.

			• Organic waste converter machine = Rs.4-5 lakhs per unit
	Medium term (3-5 years)	Replicating this model for other bulk waste generators and for newly developed market areas.	
Goal		➢ 100% treatment of waste generated in Bhubaneswar.	
Actions	**Short term (within 2 years)** **To Medium term (3- 5 years)**	**Technical** • Construction of new treatment facilities at city level: o Material Recovery Facility o Windrow composting facility for processing wet waste of small residential units collectively at the city level o C & D Waste Plant Exisiting SWM facility such as Transfer station behind Sainik school can be used to locate the plants. **Operation** • For windrow composting operations, there shold be 2 full time supervisor, 4 helpers permanently stationed at windrow composting site. **Training** • Training for supervisors and helpers.	• Windrow composting= Assuming 60% of total waste generated is wet waste Total waste to be treated is= 310 MT Capital cost = 9.3- 12.4 Crore • Material Recovery Facility= Assuming 40% of total waste as dry waste Total waste to be treated= 200MT Capital cost = Rs.2- 2.5 Crore (the above cost is just an indicative cost, however deatiled assessment study to be corried out before setting up the plant.) • C & D plant= Rs. 3.6 lakhs pe tonne.
Goal		➢ 100% treatment of Bio-medical and domestic sanitary waste.	
Actions	**Short term (within 2 years)**	**Technical** • Construction of incinaration facility to treat biomedical and sanitary waste. Exisiting SWM facility such as the Transfer station behind Sainik school can be used to locate the plants. **Financial** • To be constructed on BOOT mode. • O & M cost to be recovered from hospitals and clinics depending upon no. of beds.	Bio medical waste treatment plant= Rs. 40 Lakhs per tonne
Goal		➢ To achieve 100 % scientific disposal of inert waste by 2020.	
Actions	**Short term (within 2 years)**	**Technical** • Construction of construction of scientific landfill. **Operational** • For operations, there shold be 1 full time technical person, 2 supervisors, 4 helpers permanently stationed at sanitary landfill site. **Financial** • SBM, 14th Finance Commission Grants, State Government Grants.	

		Training • Training for supervisors and helpers.	

5 MT Treatment plant

Following are 3 technological options for treatment of 5 MT of waste which should be installed at bulk waste generators, to achieve treatment of waste at source:

Table 27 Technology Options for 5MT Solid Waste Treatment Plant

Technology options	Cost assumption	CapEx	OpEx	Odour issues	Space required
Biogas digestor	Rs.15-16 Lakhs per tonne	Rs.15-16 Lakhs (1 tonne) Rs.45-48 Lakhs (3 tonne) Rs.75-80 Lakhs (5 tonne)	O & M operations to be outsourced.	Low	9 sq.mt for 1-5 MT (System can be also buried under ground in places of space constraints.)
Onsite composting (windrow)	Rs.3-4 lakhs per tonne	Rs.3-4 Lakhs (1 tonne) Rs.9-12 Lakhs (3 tonne) Rs.15-20 Lakhs (5 tonne)	Less than Rs.2 per kg	High	6- 10 sq.mt for 1 – 5 MT (depends on height of the windrow)
Onsite Composting (Vermicomposting)	Rs.5 lakhs per tonne	Rs.5 Lakhs (1 tonne) Rs.15 Lakhs (3 tonne) Rs.25 Lakhs (5 tonne)	Less than Rs.2 per kg	Medium	5 sq.mt (1 tonne) 15 sq.mt (3 tonne) 25 sq.mt (5 tonne)

- The above costs are calculated for a prototype facility of 1 tonne, 3 tonne and 5 tonne capacities for one bulk waste generator like vegetable market, Hotels, Hostels etc.
- Technology option should be selected based on space availability, odour issues and availability of funds.
- Advantages of biogas over windrow and vermicomposting is low space requirements, low odour issues and biogas generated can be converted into electricity and used for lighting of market premises and for cooking in case of bulk generators like hotels, hostels and restaurants.
- Total cost of installation of below 5 MT treatment plants should be calculated depending upon type of technology selected and number of bulk waste generators at which these facilities will be installed.

Table 28: Investment Plan for SWM interventions

Proposed Work	Cost assumption	Amount (CapEx)	Amount (OpEx)
Carring out Prefeasibity study, waste compostion study, and a preparation of holistic solid waste management DPR		7.5 Lakhs	
Biogas digestor	Rs.15-16 Lakhs per tonne	Rs.15-16 Lakhs (1 tonne) Rs.45-48 Lakhs (3 tonne) Rs.75-80 Lakhs (5 tonne)	O & M operations to be outsourced.

Onsite composting (windrow)	Rs.3-4 lakhs per tonne	Rs.3-4 Lakhs (1 tonne) Rs.9-12 Lakhs (3 tonne) Rs.15-20 Lakhs (5 tonne)	Less than Rs.2 per kg[27]
Onsite Composting (Vermicomposting)	Rs.5 lakhs per tonne	Rs.5 Lakhs (1 tonne) Rs.15 Lakhs (3 tonne) Rs.25 Lakhs (5 tonne)	Less than Rs.2 per kg[28]
Organic waste converter machine		Rs.4- 5 lakhs (per unit)	Rs.0.1 lakhs per year
Material Recovery Facility (200 MT dry waste)	Rs.1 Crore for 75-100MT plant	Rs.2- 2.5 Crore	O & M cost to be borne by private agencies
Windrow composting (310MT wet waste)	Rs.3-4 lakhs per tonne	9.3- 12.4 Crore	Less than Rs.2 per kg
C & D Plant	Rs.3.6 lakhs per tonne	To be calculated as per requirements.	
Bio medical waste treatment plant	Rs.40 lakhs per tonne	To be calculated as per requirements.	O & M cost to be borne by private agencies

4.6.6 Contractual amendments to solid waste service contracts for incorporating advantages of micro-pocketing planning approach in the collection and conveyance process

1. **Outsourcing of work as opposed to outsourcing of labourers**: This implies that the contract with private agencies for collection and conveyance of solid waste should be based on the work that needs to be done. The supervision and management of the labourers should be with the private agency and not the municipality. The municipality would be monitoring and evaluating only the work under taken.
2. **Different the pockets for solid-waste collection based on area wise and not on activities i.e. collection of waste, street sweeping and drain cleaning.** Refer to 0 for the detailed micro-pocket plan
3. **Incentivizing segregation process** – Building an incentive structure in the contract for waste collectors to advocate and push for more segregation at the HH level
4. **Waste collector has to double up as advocates for segregation in their respective micro-pockets**. For this appropriate capacity building has to done to enable this.

[27] Amount may change according to place.
[28] Amount may change according to place.

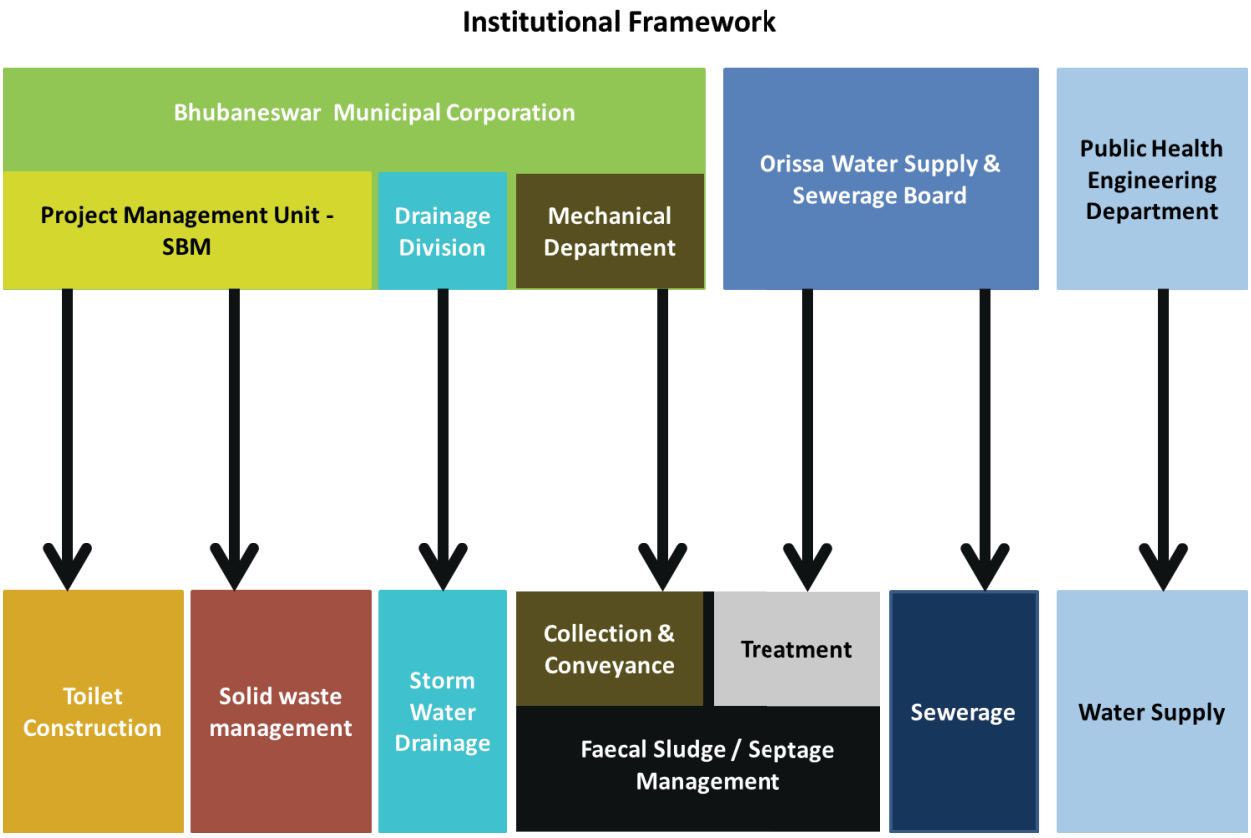
5 Institutions & Financial Capacity

5 INSTITUTIONAL & FINANCIAL CAPACITY GAPS

5.1 Institutional Framework

The institutional framework for sanitation sectors in Bhubaneswar is illustrated below.

Figure 25 Institutional Framework for sanitation in Bhubaneswar



Source: Consultation meeting with city level officials at Bhubaneswar Municipal Corporation, OWSSB and PHED

A number of organisations are handling the sanitation infrastructure in Bhubaneswar.

Bhubaneswar Municipal Corporation (BMC) handles toilet construction (IHHL, CTs and PTs) through the Project Management Unit- SBM. The same PMU also handles solid waste management initiatives.

The responsibility of maintaining storm water drains and construction of the new drains is handled by the Drainage Division of the BMC.

The Mechanical Department of the BMC is responsible for collection and conveyance of faecal sludge as it manages the operations of the cesspool vehicles maintained by the BMC.

Orissa Water Supply and Sewerage Board (OWSSB) is currently handling the treatment of faecal sludge since the construction of the Faecal Sludge/Septage Treatment Plant (FSTP/ SeTP) is with them.

Sewerage (construction of sewer network and sewage treatment plants; and managing household connections to the sewer) is also handled by the OWSSB.

Public Health Engineering Department is responsible for water supply (construction of sewer network and water treatment plants; managing household connections to the water supply; and connections to public stand posts).

5.2 Capacity Assessment

The following table shows the capacity of the Bhubaneswar Municipal Corporation. The total staff vacancy is 6.46%, with the maximum number of vacancies in the deputation staff.

Table 29: Sanctioned and Vacant Posts in Bhubaneswar MC

Department	Sanctioned Posts	No. of existing staff	No. of vacant posts
Deputation Staff	83	57	26 *(31.33%)*
Regular Employees	1186	1085	101 (8.52%)
Contractual Employees	37	35	02 *(5.41%)*
DLR (General and Sweeper/ Sweepers)	37	35	02 *(5.41%)*
CLR (General and Sweeper/ Sweepers)	686	686	-
Total	**2029**	**1898**	**131 *(6.46%)***

Source: Bhubaneswar Municipal Corporation (2017)

5.3 Capacity Building Interventions

5.3.1 Capacity Building Interventions for Access to Toilets

5.3.1.1 Training on Introduction on hygienic sanitation

The one day workshop would be planned to provide a basic understanding of access to toilets to the officials of the cities. Workshop should me aimed to complete following training modules:-

- ✓ Introduction to current sanitation situation in India
- ✓ Importance of Swachh Bharat Mission and access to toilets
- ✓ Importance of Public health and hygiene
- ✓ Benchmarks
- ✓ Hygienic and unhygienic user interface
- ✓ Types of containment units.
- ✓ Public and community access to sanitation.

Target Group: Commissioners, Municipal Engineers, health officer, public representatives who are involved in provision of sanitation services and improvement in access to sanitation.

5.3.2 Capacity Building for Wastewater Management

5.3.2.1 Training of Sewage Treatment Plant Operators

The aim of these training sessions was to create a cadre of operators of STPs who have a strong understanding of the basic principles behind what they do, which gives them a foundation to work on as they operate and maintain the technology on which the STP is based. The operators who are responsible for the maintenance and upkeep of the treatment systems need to be abreast of the correct protocol and the basics behind operations they do on a daily basis.

Target Group: STP operators

5.3.3 Capacity Building Interventions for Faecal Sludge Management

Appropriate and adequate management of faecal sludge from on-site containment systems is imperative for the protection of human and environmental health. Through these various capacity building activities, we intend to strengthen the knowledge and skills of the officials working with the various town municipalities on various aspects of Faecal Sludge Management.

We propose various capacity building activities through workshops which would address the current knowledge elements of this rapidly evolving field, and present an integrated solutions approach that includes technology, management and planning. It will focus on the planning and organisation of the entire faecal sludge management service chain, from the collection and transport of sludge and treatment options, to the final end-use or disposal of treated sludge.

In addition to providing fundamentals and an overview of technologies, the workshop will go into details of operational, institutional and financial aspects, and will provide guidance on how to plan a city-level faecal sludge management project with the involvement of all stakeholders.

The objectives of these proposed workshops are to:

- To provide participants with technical and practical knowledge and skills on the concept and principles of design and implementation of FSM in Indian context.
- To enable participants to gain knowledge and skills for systematic planning and implementation of a series of activities for collection, containment, transportation, treatment and safe disposal/reuse in FSM.

3 workshops are proposed as part of capacity building activities and both of them have different target groups and are aimed to achieve the objectives. The details of the workshops are discussed below.

5.3.3.1 Workshop on FSM

Introduction on FSM

The one day workshop would be planned to provide a basic understanding of FSM to the officials of the cities. Upon completion of the one day workshop the participants will be able to appreciate the need of FSM in their city.

Target Group: Commissioners, Engineers & Planners of the cities who are involved in the management of sanitation infrastructures.

Introductory Workshop & Exposure visit on FSM

The two day workshop is planned to provide customised inputs towards the potential of the FSM activities in the city. The workshop would provide in-depth understanding of the methodology involved in planning FSM for a city and the participants will be able to get first-hand experience about operations of a FSTP.

Target Group: City Commissioners and State level officials who are involved in the planning of sanitation in state and city levels.

Location: Bangalore

5.3.3.2 Training for Toilet Builders on Onsite Sanitation Systems

Masons play a vital role in the overall faecal sludge value chain in construction of toilets and containment systems for the individual users in every city. The success of faecal sludge management in any city relies heavily on its onsite sanitation systems which includes the toilets, septic tanks etc. To ensure the sustainability of the activities, capacity building of the masons who are responsible for the construction of these facilities is mandatory.

The workshop is planned to create awareness on the significance of toilets in sanitation and its impact on environmental protection, to provide Mason's with technical knowledge and skills on the design and principles of the Onsite Sanitation Systems (OSS) as specified under Swachh Bharat Mission, to familiarise the participants with the construction norms and the specific requirements for construction of OSS Systems and to stress on the importance of O& M of these OSS Systems in order to understand the role played by the elements of the OSS relevant to O&M.

Target Group: Masons working in the Bhubaneshwar who have been building toilets under the Swachh Bharat Mission

5.3.3.3 Training for cesspool vehicle operators on using of technology integrated with faecal sludge transport and conveyance

A good quality, reliable faecal sludge transport and conveyance systems are required to ensure end-to-end Faecal Sludge Management services are provided by the city. The cesspool vehicle operators play an important role in the faecal sludge management.

The two day workshop is planned to provide overview of the technology integrated with faecal sludge transport and conveyance. The activities are designed in such a way that the cesspool operators get hands on experience with the technology which would strengthen the faecal sludge management. They will be provided with customised inputs towards the potential of the FSM activities in the city and how using the technology will help in addressing the key issues faced. The workshop would provide in-depth understanding of the technology and various aspects of undertaking a business/service in the form of desludging services for Bhubaneshwar.

Target Group: Cesspool operators working in the Bhubaneshwar who have been handling desludging services and also potential desludging services in order to develop the team.

5.3.4 Capacity Building Interventions for Solid Waste Management

Suitable and acceptable solid waste management techniques are necessary for the protection of human and environmental health. Through these various capacity building activities, we intend to strengthen the knowledge and skills of the officials working with the various town municipalities on various aspects of solid waste management right from waste collection to waste treatment and reuse.

We propose various capacity building activities through workshops which would address the current knowledge elements of this rapidly evolving field, and present an integrated solutions approach that includes technology, management and planning. It will focus on the planning and organisation of the entire solid waste management service chain, from the waste collection to waste treatment and reuse options.

Training should be carried out for following groups

1. Public representatives (ward counsellors, corporators, ward members)
2. Engineers, health officers and managers
3. Sanitary supervisors, sanitary inspectors and contractors supervisors
4. PH workers, sweepers and waste collectors
5. Household and commercial waste generators

5.3.4.1 Training on Introduction on Solid waste Management

The one day workshop would be planned to provide a basic understanding of SWM to the officials of the cities. Workshop should me aimed to complete following training modules:-

- ✓ Introduction to SWM in India
- ✓ Importance of SWM Rules 2016
- ✓ Best Practices in SWM
- ✓ SWM System -Implementation STEPS
- ✓ Infrastructure requirements for the short-term and long-term ISWM
- ✓ Benchmarks
- ✓ Micro-planning approach of solid waste management
- ✓ Ensuring proper records of daily work output
- ✓ Maintaining Cordial Relations with community
- ✓ Maintain complaints and feedback for waste generators.
- ✓ Handling the Workforce (Labour Management – challenges – welfare)

Target Group: Commissioners, Municipal Engineers, health officer, public representatives who are involved in the management of Solid waste infrastructures.

5.3.4.2 Training waste collectors on sanitation and public health awareness.

The one day workshop would be planned to provide a basic understanding of SWM to the solid waste collectors. Workshop should me aimed to complete following training modules:-

- ✓ Introduction to SWM in India
- ✓ Importance of SWM Rules 2016
- ✓ Best Practices in SWM
- ✓ Trainings on proper waste collection process.
- ✓ Trainings on micro pocketing, steps to increase efficiency of waste collection.
- ✓ Training on handling different types of wastes.

Target group- Sanitary supervisors, sanitary inspectors, contractor's supervisors, PH workers, sweepers and waste collectors responsible for collection and transportation of waste.

5.3.4.3 Training waste generators on sanitation and public health awareness.

The one day workshop would be planned to provide a basic understanding of SWM to the solid waste generators i.e. general public and commercial establishment owners. Workshop should me aimed to complete following training modules:-

- ✓ Introduction to SWM in India
- ✓ Importance of SWM Rules 2016
- ✓ Best Practices in SWM
- ✓ Awareness creation about solid waste management and public health.
- ✓ Trainings on process of segregation of waste, storage of waste and handing over of waste to waste collectors in prescribed manner.
- ✓ Trainings of household treatment of waste eg. Composting, biogas etc.

Target group- General public, commercial establishment owners, and bulk waste generators.

5.4 Financial Capacity

This section provides a measure of the financial capacity of Bhubaneswar to maintain the new infrastructure built in Bhubaneswar. In maintaining new facilities like Public Toilets, and operating a city FSM, or water supply related activities such as increasing metering or the number of connections, the MC would have to undertake the operating expenses related to running these infrastructures, and so the existing gap in the water supply and sanitation budget is bound to increase. As such, the new interventions are proposed to make the MC as self-sufficient as possible.

The income and expenditure patterns under sanitation have been calculated for Bhubaneswar Municipality by analysing the estimated budgets for the years of 2014-15, 2015-16, and 2016-17 respectively[29]. It has been observed that Bhubaneswar registers a **surplus** of about 10.19% in 2014-15, 10.09% in 2015-16 and 15.26% in 2016-17. The maximum revenue generators are taxes and assigned revenue grants, as explained below:

- Tax Revenue (2016-17): 51, 35, 70,971 (18.2%)
- Revenue Grant (2016-17): 74, 10, 59,500 (26.27%)

[29] Source: Assessment of the Municipal Budgets for MC Bhubaneswar (2014-15,2015-16 and 2016-17)

The major contributors in tax revenue were holding taxes, advertisement taxes, and entertainment taxes. Assigned revenues include compensation in lieu of entertainment tax/ public resort, Octroi. Revenue grants, as per the budget of 2016-17 include central grants such as IGNOAP, IGNWP, IGNDP, National Family Benefit Scheme (NFBS), Election Fund, Old Age Pension, MBPY, Harichandra Sahayata, Grant for SWM, Animal Birth Control, CMRF, Odisha State Disaster Management Fund, NULM, JnNURM Challenge Fund, Grant from Sewerage Board, 14th FC Grant, Grant towards AHAAR.

Relevant funding details as used in water supply and sanitation have also been added in the assessment of the various sectors, as given below.

Water Supply

In Bhubaneswar, provision of water supply is the responsibility of the Public Health Engineer Organisation (PHEO), who handles the construction of the water supply related infrastructure, and is also responsible for the provision of connections and collection of revenue from the consumers. However, in this section, water supply revenue and expenditure components from the municipal budget are undertaken. Since there are no different budget heads for water supply, there can be investments for water supply under other budget components, which has also been included.

In Table 30: Income Heads and Percentage for Water supply - Bhubaneswar Municipal Corporation (all figures in INR), it can be observed that there is only one revenue component from water supply for the years 2014-15 and 2015-16 and 2016-17, which are the charges for supply of water by tankers.

Table 30: Income Heads and Percentage for Water supply - Bhubaneswar Municipal Corporation (all figures in INR)

Income Heads- Water Supply	2014-15	2015-16	2016-17
Charges for supply of water by tankers	1, 00,000 *(100%)*	1, 00,000 *(100%)*	97,829 *(100%)*
Total Income from WS	**1, 00,000**	**1, 00,000**	**97,829**

Source: Assessment of the Municipal Budgets for Bhubaneswar Municipal Corporation (2014-15. 2015-16, 2016-17)

In Table 31: Expenditure Heads and Percentage for Water supply - Bhubaneswar Municipal Corporation (all figures in INR), it can be observed that water purification charges form the major expenditure component for water supply in 2015-16, while expenditure on water ATMs form the major expenditure component in 2016-17.

Table 31: Expenditure Heads and Percentage for Water supply - Bhubaneswar Municipal Corporation (all figures in INR)

Expenditure Heads- Water Supply	2014-15	2015-16	2016-17
Water Purification Charges	-	1, 00,000 *(100%)*	1, 00,000 *(0.22%)*
Water ATM	-	-	4, 50, 00,000 *(99.78%)*
Total Expenditure from WS and Drainage	**-**	**1, 00,000**	**4,51,00,000**

Source: Assessment of the Municipal Budgets for Bhubaneswar Municipal Corporation (2014-15. 2015-16, 2016-17)

It can be observed from the above that the BMC registers a deficit in the 2016-17 budget. However, the huge disparity reflects on certain heads which may have been combined with other sectors of expenditure, Therefore, there is a need for a separate revenue and expenditure assessment for water supply within BMC, which would also be overseen by PHEO, who is responsible for water supply in BMC.

Storm Water Drainage

Storm water drainage is the responsibility of the Drainage Department of the Municipal Corporation. Since there are no different budget heads for storm water drainage, there can be investments for the sectors under other budget components, which have not been included.

In Table 32: Income Heads and Percentage for Storm water Drainage - Bhubaneswar Municipal Corporation (all figures in INR), there is only one revenue component for storm water project, which is a grant for the Drainage Division for the years 2014-15 and 2015-16.

Table 32: Income Heads and Percentage for Storm water Drainage - Bhubaneswar Municipal Corporation (all figures in INR)

Income Heads- Storm water Drainage	2014-15	2015-16	2016-17
Storm water Project (Drainage Division)	10, 00, 00,000 *(100%)*	10, 00, 00,000 *(100%)*	-
Total Income from Storm water Drainage	**10, 00, 00,000**	**10, 00, 00,000**	**-**

Source: Assessment of the Municipal Budgets for Bhubaneswar Municipal Corporation (2014-15. 2015-16, 2016-17)

In Table 33: Expenditure Heads and Percentage for Storm water Drainage - Bhubaneswar Municipal Corporation (all figures in INR), the highest expenditure component for storm water drainage for all the years has been in open drains and covers slabs.

Table 33: Expenditure Heads and Percentage for Storm water Drainage - Bhubaneswar Municipal Corporation (all figures in INR)

Expenditure Heads - Storm water Drainage	2014-15	2015-16	2016-17
R & M Storm Water Drains	2, 00, 00,000 *(20%)*	5, 00, 00,000 *(33.33%)*	89, 13,704 *(8.98%)*
Open Drains and Cover Slabs	8, 00, 00,000 *(80%)*	10, 00, 00,000 *(66.66%)*	9, 03, 46,642 *(91.02%)*
Total Expenditure from Storm water Drainage	**10,00,00,000**	**15,00,00,000**	**9,92,60,346**

Source: Assessment of the Municipal Budgets for Bhubaneswar Municipal Corporation (2014-15. 2015-16, 2016-17)

From the above tables, we can observe that storm water management has a deficit of 50% in 2015-16. There were no marked revenue components in 2016-17 as well.

Sewerage and Waste Water Management

In Bhubaneswar, execution of sewerage and wastewater projects is the responsibility of the OWSSB. However, maintenance of existing sewerage projects is the responsibility of the Municipal Corporation. In this section, sewerage and wastewater revenue and expenditure

components from the municipal budget are taken into consideration. There are no different budget heads for sewerage and wastewater in the municipal budget, and there may be some budget heads with a sewerage and wastewater component in its combined figure. However, those heads have not been included since it is not possible to differentiate the components.

In Table 35: Expenditure Heads and Percentage for Sewerage and Wastewater Management - Bhubaneswar Municipal Corporation (all figures in INR), it can be observed that funds from the integrated sewerage system under the OWSSB form the major revenue component from sewerage and wastewater management for all the years.

Table 34: Income Heads and Percentage for Sewerage and Wastewater Management- Bhubaneswar Municipal Corporation (all figures in INR)

Income Heads- Sewerage and Wastewater Management	2014-15	2015-16	2016-17
Integrated Sewerage system(OWSSB)	70, 00, 00,000 *(90.40%)*	50, 00, 00,000 *(94.25%)*	1, 00, 00,000 *(57.14%)*
Sewerage cleaning charges	50,000 *(0.01%)*	20,000 *(0.004%)*	-
Septic tank cleaning charges (Sludge Pump)	7, 00,000 *(0.09%)*	5, 00,000 *(0.09%)*	-
Latrine Tax	4, 35, 71,429 *(5.63%)*	-	-
Grants for Construction of Public Toilets	-	1, 00, 00,000 *(1.88%)*	-
Grant for development of Bindusagar lake	2, 00, 00,000 *(2.58%)*	1, 00, 00,000 *(1.88%)*	-
Fund for Dying Water Bodies	1, 00, 00,000 *(1.29%)*	1, 00, 00,000 *(1.88%)*	75, 00,000 *(42.86%)*
Total Income from Sewerage and Solid Waste Management	**77,43,21,429**	**53,05,20,000**	**1,75,00,000**

Source: Assessment of the Municipal Budgets for Bhubaneswar Municipal Corporation (2014-15. 2015-16, 2016-17)

In Table 35: Expenditure Heads and Percentage for Sewerage and Wastewater Management - Bhubaneswar Municipal Corporation (all figures in INR), it can be observed that expenditure from the integrated sewerage system (OWSSB) form the major expenditure component from sewerage and waste water management in 2014-15 and 2015-16, while salary for conservancy staff members form the major expense head in 2016-17.

Table 35: Expenditure Heads and Percentage for Sewerage and Wastewater Management - Bhubaneswar Municipal Corporation (all figures in INR)

Expenditure Heads- Sewerage and Wastewater Management	2014-15	2015-16	2016-17
Salary for Conservancy Staff members	12, 70, 94,308 *(14.72%)*	17, 45, 90,808 *(22.83%)*	16, 85, 43,664 *(68.58%)*
R & M Public Toilets	90, 00,000 *(1.04%)*	1, 00, 00,000 *(1.31%)*	10, 00,000 *(0.41%)*
Public Toilet	50, 00,000 *(0.58%)*	3, 00, 00,000 *(3.92%)*	5, 00, 00,000 *(20.34%)*
Integrated Sewerage System	70, 00, 00,000 *(81.05%)*	50, 00, 00,000 *(65.39%)*	-
R & M Lakes & Ponds	1, 00, 00,000 *(1.16%)*	1, 00, 00,000 *(1.31%)*	2, 62, 18,432 *(10.67%)*
Lakes & Ponds (Dying Water Bodies)	1, 25, 24,000 *(1.45%)*	4, 00, 00,000 *(5.23%)*	-

Total Expenditure	**86,36,18,308**	**76,45,90,808**	**24,57,62,096**

Source: Assessment of the Municipal Budgets for Bhubaneswar Municipal Corporation (2014-15. 2015-16, 2016-17)

From the above table, it can be observed that for all the years, BMC registers a deficit in wastewater management and FSM. However, this includes revenue and expenditure components as included in the municipal budget. Since BMC is undergoing the construction of the STPs, SeTP and also the construction of wastewater drains, there will be no returns on the investment from the infrastructure unless it is fully constructed. The OWSSB should work with BMC to have an efficient revenue system for the sewerage and FSM infrastructure constructed.

The reuse potential from the FSM and wastewater sector needs to be taken into special account to consider any serious revenue from the sanitation sector in the long run. However, the revenue from public amenities like public toilets can only be taken into account for the operation and maintenance of these facilities.

Solid Waste Management

In Bhubaneswar, solid waste management is the responsibility of the Municipal Corporation. Solid waste management has a separate component in the budget document. In Income Heads and Percentage for Solid Waste Management- Bhubaneswar Municipal Corporation (all figures in INR) express cleaning services form the major revenue component in 2014-15, while income from the solid waste management fund forms the major income component for the years 2015-16 and 2016-17.

Table 36: Income Heads and Percentage for Solid Waste Management- Bhubaneswar Municipal Corporation (all figures in INR)

Income Heads- Sewerage and Sanitation	2014-15	2015-16	2016-17
Express Cleaning Service (Hotel and Restaurants, Hospitals and Nursing Homes, Apartments)	25, 00,000 *(100%)*	32, 56,000 *(5.15%)*	9, 14,650 *(4.63%)*
Solid waste Management Fund	-	3, 00, 00,000 *(47.43%)*	1, 88, 60,232 *(95.37%)*
Grant for Solid Waste Management	-	1, 00, 00,000 *(15.81%)*	-
Grant for Slaughter House	-	2, 00, 00,000 *(31.62%)*	-
Total Income from Sewerage and Solid Waste Management	**25, 00,000**	**6,32,56,000**	**1,97,74,882**

Source: Assessment of the Municipal Budgets for Bhubaneswar Municipal Corporation (2014-15. 2015-16, 2016-17)

In Table 37: Expenditure Heads and Percentage for Solid Waste Management - Bhubaneswar Municipal Corporation (all figures in INR), it can be observed that expenditure from the cleaning of solid waste through private agencies form the major expenditure component for solid waste management for in all the years.

Table 37: Expenditure Heads and Percentage for Solid Waste Management - Bhubaneswar Municipal Corporation (all figures in INR)

Expenditure Heads- Sanitation	2014-15	2015-16	2016-17
Garbage & Clearance expenses	15, 00, 00,000 *(32.97%)*	12, 00, 00,000 *(24.97%)*	10, 00, 00,000 *(16.08%)*
Cleaning by Private agencies	30, 00, 00,000 *(65.93%)*	33, 00, 00,000 *(68.68%)*	47, 15, 05,800 *(75.80%)*
Public Toilet	50, 00,000 *(1.10%)*	3, 00, 00,000 *(6.24%)*	5, 00, 00,000 *(8.04%)*
Wheelbarrow	-	5, 00,000 *(0.10%)*	5, 00,000 *(0.08%)*
Total Expenditure	**45,50,00,000**	**48,05,00,000**	**62,20,05,800**

Source: Assessment of the Municipal Budgets for Bhubaneswar Municipal Corporation (2014-15. 2015-16, 2016-17)

In solid waste management, BMC registers a deficit in all the three years. However, the huge disparity reflects on certain heads which may have been combined with other sectors of expenditure, Therefore, there is a need for a separate revenue and expenditure assessment for SWM within BMC, which would also be overseen by the SBA cell, who are in charge of the operations in BMC. The solid waste sector also eventually needs to collect the cost for collection of solid waste (there are plans to begin charging collection of solid waste in BMC), which would be a substantial cost for the solid waste management sector.

The Bhubaneswar Municipal Corporation budget calculates revenue and developmental budget accounts. The revenue income budget has heads on taxes and fees, rent, own source income. The developmental income budget includes SFC and grants awarded to the municipality. The revenue expenditure budget has heads on own income expenditure, delegated functions, maintenance/repair / depreciation of assets and other expenditure heads. The developmental expenditure budget has expenditure from the SFC and grants awarded.

Budget components from other organisations related to water supply and sanitation, such as OWSSB and PHEO will be detailed in the next phase when the solutions are formulated for each of the sectors.

Table 38: Municipal Income across all sanitation sectors

Sector	Income in Municipal Budget
Access to Toilets	-
Storm water management	10, 00, 00,000
Wastewater management	53,05,20,000
Solid waste management	6,32,56,000

Source: Assessment of the municipal budgets of Bhubaneswar and Odisha SAAP for 2016-17

In the above table, the municipal budget of 2015-16 shows the total income for all the sanitation sectors as Rs. 69.38 crores. The total allocation under SAAP is Rs. 112.48 crores. Therefore, depending on the discretion of the municipality and suitability of technological options, interventions can be planned for Bhubaneswar.

6 Implementation & Rollout Plan

6 IMPLEMENTATION AND ROLL-OUT PLAN

Table 39: Indication of Phases

Phase	Time Period	Characteristics
Short Term	Upto 2 years	Urgent improvements that require some planning steps
Medium Term	3- 5 years	Recommendations with a significant impact; needs more elaborate planning steps and requires substantial funding
Long Term	5- 10 years	Recommendations for the sustainable functioning of the system and adaptation to future developments

Table 40: Phase-Wise Implementation of Actions

Phase	Activity
Improvements in Water Supply	
Short Term	• The focus should be on improving water supply distribution to create more equitable distribution of water. • Completion of upcoming projects which include improving of water supply infrastructure by means of improvement in water metering; construction of water treatment plant and improvement of water supply to uncovered areas.
Medium Term	• Improvement of water supply to the uncovered areas, including slum areas
Improvements in Toilet Access	
Short Term	• Constructing **50876 IHHL** (as per Swachh City Plan projection) or **45275 IHHL** (as per exponential projection) by 2019. • Constructing **737 CT** seats (as per Swachh City Plan projection) or **615 CT** seats (as per exponential projection) in 2019. • **Repairing the 20 defunct PT seats**. • If the population grows as per the Swachh City Plan Projections (refer Gap projection for Public Toilet Seat), then 3 new PT seats will be needed to be constructed. • Mandating connections to sewer network in sewered areas and to septic tanks or localised treatment systems in case of unsewered areas. • **Awareness programs** focussed on the environmental and health issues faced due to open defecation for households and other communities. • Training on the O&M mechanisms for individual toilets. • Policy measures discouraging individuals to go for open defecation should be formalised- this would include penalties, incentives for construction of individual toilets, and others • Increasing the incentive given to households in order to meet the actual expenditure incurred in building toilets IHHL. In order to achieve this, other sources of funding apart from SBM needs to be approached. (Refer Fund Mobilisation for IHHL)
Medium Term	• Upgradation of households with public/ community toilets to individual toilets. If funds and conditions are viable, households should be encouraged to construct individual toilets.
Long Term	• Constructing **11701 IHHL** (as per Swachh City Plan projection) **or 3175 IHHL** (as per exponential projection) by 2025. • Constructing to **254 CT seats** (as per Swachh City Plan projection) or **69 CT seats** (as per exponential projection) by 2025 to cater to the additional demand. • If floating population grows exponentially, then constructing **87** new PT seats.
Storm water Management	

Short Term	• To increase drain coverage o To implement the recommendation of laying 1036 km drains as stated in the 2008 Master Plan. o The **newly constructed drains should be constructed kuchcha drains (wherever possible)**. (refer Recommendations for improving water quality in drains) • For solving water logging problems: o **Improving inlets** into the existing drains by unclogging inlet pipes; and switching to alternate covering such as mesh cover. • Addressing the problem of wastewater in drains o Stopping the entry of wastewater into the storm water drain o Maintaining and increasing the number of natural drains since it would enable the drain ecosystem can then handle small quantities of wastewater.
Medium Term	• Addressing the problem of wastewater in drains o Constructed wetlands at select areas to bring down the pollution levels within permissible limits. • For solving water logging problems: o **Water sensitive urban design using swales and raingardens**
Wastewater Management	
Short Term	• **Implementation of localised conveyance and treatment solution** in clusters left out of the sewered areas as suggested in the Approaches for wastewater management in unsewered pockets and newly constructed multi-storeyed building • **Ensuring last mile connectivity for the sewer network** in areas covered under sewer system o IEC activities for citizens to connect to the sewer network o Legal enforcement for mandating connections in sewered areas o Incentivising or subsiding the sewer connection cost to households. • Training of operators
Medium Term	• Identifying potential reuse options
Long Term	• **Bulk generators of sewage** such as apartments and institutions; and any new multi-storeyed buildings can be mandated **to treat their wastewater at source** in order to reduce the pressure on the centralised sewer infrastructure.
Improvements in Faecal Sludge Management	
Short Term	• **Implementation of standard containment size code regulations** • **Awareness/IEC campaigns on open defecation** and other aspects, training the operators on standard practices and safety measures for collection and conveyance • **Masons training** for building the containment systems • Adhering to **Odisha Urban Septage Management Guidelines, 2016.** • **Monitoring of private and government cesspool vehicles** by mandating **GPS and other ICT** interventions. • **Mandating safety gears** to be given to government operators private operators • Separate account for handling government cesspool vehicles. • Maintain the **database of private operators** • Mechanisms to fill the form by the customer availing the desludging service which has to be submitted at the MC/during the disposal. • **Licensing the private operators** and periodic renewal • Complete SeTP by end of 2017 • **Introducing temporary transfer stations** at the SWM transferstations in the form of huge tanks for disposal of FS • Depending on the need, tankers of 15,000- 20,000 Litres may be required to transport faecal sludge from the tranfer station to the SeTP. • **Capacity building of ULB and operators for handling the SeTP**

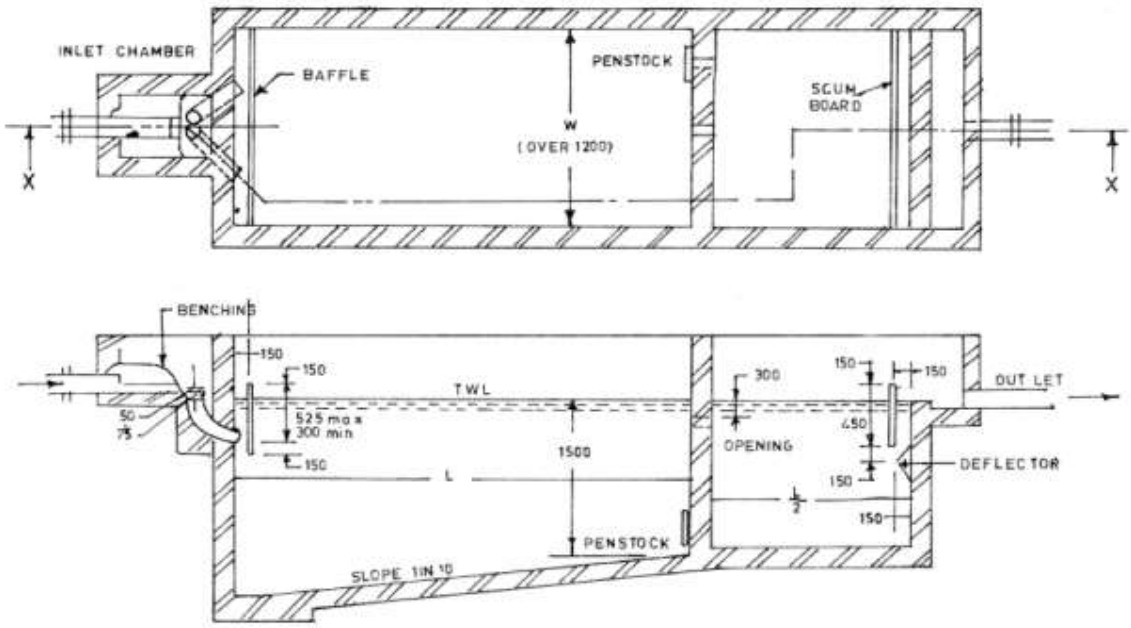
	• **IEC campaign with the cesspool operators** both private and government for behaviour change regarding the disposal • Co-compost plan for enhancing the nutrient value • **Plan for selling the dried and co-composted FS to farmers** and through collaboration chemical fertilisers companies to sell it as a part of their product. • Converting the dried FS into co-compost for enriching the nutrient content • To encourage reuse among the farmers through IEC campaigns • **Treated FS Reuse policy** to be formulated for the city
Medium Term	• **Procure 3-4 Gulpur machines /small cesspool** vehicles where the existing cesspool vehicles cannot access • **Different business models assessment for financial sustainability** of the SeTP. • **Inclusion of property tax as part of making the operations of SeTP sustainable** • **Policy resolution leading to 100% disposal and treatment of the FS generated** • Exploring possibilities of using Black soldier flies usage of solar energy at the SeTP • Exploring possibilities to sell for cement industries/ brick factories
Long Term	• **Scheduled desludging should be implemented** by incorporating user fee or property tax incorporation
Solid Waste Management	
Short Term to medium term	• Implementation of **Micro-pocketing approach** for solid waste collection (Refer to Micro Planning Approach) • **Household awareness campaigns about segregation of waste** to be carried out by waste collectors • Policy amendments for provision of incentives in the form of property tax rebates or rebate on solid waste collection charges under polluters pay principle. • Carry out waste composition study to know the actual content of wet and dry waste and composition of different materials like, biodegradable, paper, metals, glass etc. • **Mandating all bulk waste generators** whose waste characteristics are mainly wet waste eg vegetable market, public parks etc. **to treat waste at source** by means of installation of biogas digester/ onsite composting system/ Organic waste Converter (OWC) machines in the bulk waste generation sites. • Identify and Demarcate land parcel for construction of Material Recovery Facility (MRF) for recyclable dry waste, windrow composting for wet waste and C & D waste plant at Transfer station behind Sainik school. • **Construction of new treatment facilities at city level**: o Material Recovery Facility o Windrow composting facility for processing wet waste of small residential units collectively at the city level o C & D Waste Plant o Incineration facility for biomedical waste o Scientific landfill for inert waste • **Training for solid waste management personnels-** from the gound level worker to the officials implementing the systems.
Long Term	• Integrating the solid-liquid waste treatment at the same location

7 Annexures

7 ANNEXURES

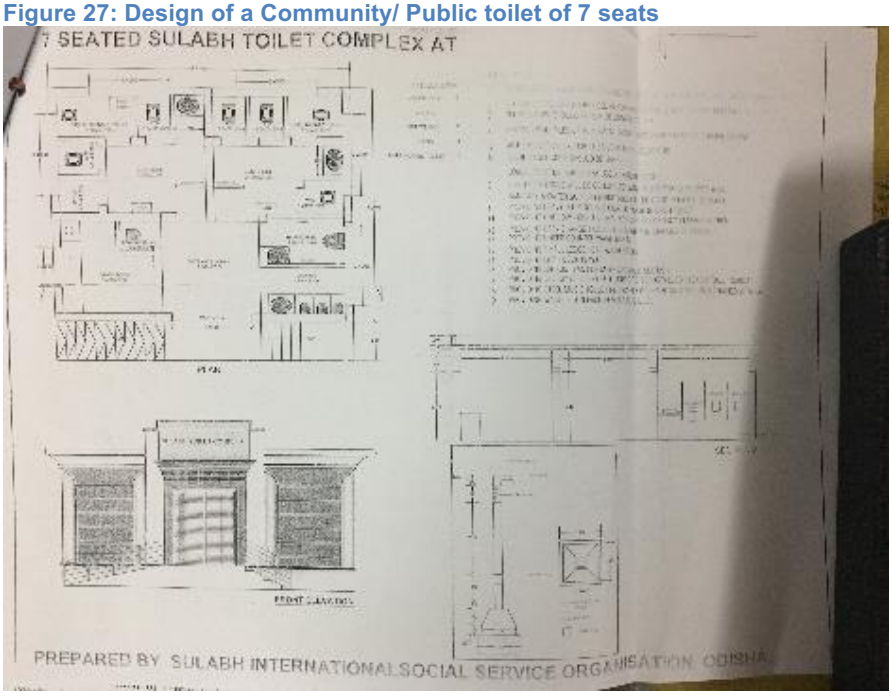
7.1 Toilet Designs

Figure 26: Typical sketch of a two- compartment septic tank for 5 users (dimensions in mm)



Source: Manual on Sewerage and Sewage Treatment Systems, 2013, Part A: Engineering

Figure 27: Design of a Community/ Public toilet of 7 seats



Source: Sulabh International Social Service Organisation, Odisha

7.2 Slum wise requirement of community toilets

Table 41 No of CT seats construction requirement in authorised slums (No. of Community Toilet Seats construction requirement for slums (Authorised slum), 2017)

No. of Seater construction requirement for slum wise (Authorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing CT seats	Total CT required (excluding existing CT seats)	Under construction CT seats	CT seats gap (yet to be constructed)	Average person per household	Estimated household covered by the required number of CT seats
Sikhar Chandi Cluster-II	2	320	1173	101	54	47	2	2	4	0	4	0	4	4	28
Sikharachandi Cluster-I	2	355	1352	117	62	55	2	2	4	0	4	0	4	4	31
Sikharchandi Cluster-III	2	162	609	53	28	25	1	1	2	0	2	0	2	4	14
C S Pur Sabar Sahi	3	86	301	26	14	12	0	0	0	0	0	0	0	4	8
Patia Barik Sahi Tala Bhoi Sahi	3	53	194	17	9	8	0	0	0	0	0	0	0	4	5
Patia Kabari Sahi Sehty Sahi	3	35	117	10	5	5	0	0	0	0	0	0	0	4	4
Patia Mangala Sahi	3	102	396	34	18	16	1	1	2	0	2	0	2	4	9
Patia Uppar Bhoi Sahi	3	57	200	17	9	8	0	0	0	0	0	0	0	4	5

No. of Seater construction requirement for slum wise (Authorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing CT seats	Total CT required (excluding existing CT seats)	Under construction CT seats	CT seats gap (yet to be constructed)	Average person per household	Estimated household covered by the required number of CT seats
Hanspala Bhoi Sahi	4	45	140	12	6	6	0	0	0	0	0	0	0	4	4
Haridaspur Akka Biram Sahi	4	41	169	15	8	7	0	0	0	0	0	0	0	5	4
Haridaspur Bandha Sahi	4	55	224	19	10	9	0	0	0	0	0	0	0	5	5
Haridaspur Majhi Sahi	4	57	223	19	10	9	0	0	0	0	0	0	0	4	5
Haridaspur Mallick Sahi	4	34	108	9	5	4	0	0	0	0	0	0	0	4	3
Haridaspur Muslim Sahi	4	58	247	21	11	10	0	0	0	0	0	0	0	5	6
Jaypur Bhoi Sahi	4	94	374	32	17	15	0	1	1	0	1	0	1	4	9
Jaypur Samal Sahi	4	62	204	18	9	8	0	0	0	0	0	0	0	4	6
Johala Bhoi Sahi	4	73	295	25	13	12	0	0	0	0	0	0	0	5	7
Naharakanta Bhoi Sahi	4	76	281	24	13	11	0	0	0	0	0	0	0	4	7

No. of Seater construction requirement for slum wise (Authorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing CT seats	Total CT required (excluding existing CT seats)	Under construction CT seats	CT seats gap (yet to be constructed)	Average person per household	Estimated household covered by the required number of CT seats
Naharakanta Kandi Bhoi Sahi	4	59	255	22	12	10	0	0	0	0	0	0	0	5	6
Naharakanta Samal Sahi	4	52	207	18	9	8	0	0	0	0	0	0	0	4	5
Nakhara Jena Sahi	4	33	127	11	6	5	0	0	0	0	0	0	0	4	3
Nakhara Samal Sahi	4	20	61	5	3	2	0	0	0	0	0	0	0	4	2
Nuapatna Bhoi Sahi	4	49	195	17	9	8	0	0	0	0	0	0	0	4	5
Nuapatna Rana Sahi	4	27	84	7	4	3	0	0	0	0	0	0	0	4	3
Banguari	4	116	662	57	30	27	1	1	2	0	2	0	2	6	11
Johala Gopal Sahi	4	42	350	30	16	14	0	1	1	0	1	0	1	9	4
Bhot Pada	5	57	218	19	10	9	0	0	0	0	0	0	0	4	5
Mancheswar Bhoi Sahi	5	31	115	10	5	5	0	0	0	0	0	0	0	4	3
Sameigadia Sabar Sahi Basti	5	26	83	7	4	3	0	0	0	0	0	0	0	4	3

No. of Seater construction requirement for slum wise (Authorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing CT seats	Total CT required (excluding existing CT seats)	Under construction CT seats	CT seats gap (yet to be constructed)	Average person per household	Estimated household covered by the required number of CT seats
Bhoi Sahi Gadakana	9	195	761	66	35	31	1	1	2	0	2	0	2	4	17
Gadakan Sabar Sahi	9	146	561	48	26	23	1	1	2	0	2	6	-4	4	13
Rangamatia Behera Sahi	9	15	59	5	3	2	0	0	0	0	0	0	0	4	2
Rangamatia Bhoi Sahi	9	22	81	7	4	3	0	0	0	0	0	0	0	4	2
Rangamatia Tala Sahi	9	158	679	59	31	28	1	1	2	0	2	0	2	5	14
Rangamatia Uppar Sahi	9	230	967	83	44	39	1	2	3		3	0	3	5	20
Bhot Pada	10	42	127	11	6	5	0	0	0	0	0	5	-5	4	4
Rasulgarh Canal Road Bhoi Sahi	10	42	166	14	8	7	0	0	0	0	0	0	0	4	4
Harekrushna Nagar (Niladri Vihar)	14	392	1455	126	66	59	2	2	4	20	0	20	-20	4	34
Omfed Basti (Niladri Vihar)	14	265	1037	90	47	42	1	2	3	0	3	0	3	4	23

No. of Seater construction requirement for slum wise (Authorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing CT seats	Total CT required (excluding existing CT seats)	Under construction CT seats	CT seats gap (yet to be constructed)	Average person per household	Estimated household covered by the required number of CT seats
Panda Park-A (Niladri Vihar)	14	239	835	72	38	34	1	1	2	10	0	10	-10	4	21
Rickshaw Colony (Niladri Vihar)	14	194	861	74	39	35	1	1	2	0	2	0	2	5	17
Science Park Basti (Niladri Vihar)	14	56	162	14	7	7	0	0	0	4	0	0	0	3	5
Palasuni Bhoi Sahi	18	34	116	10	5	5	0	0	0	0	0	0	0	4	3
Pandra Bhoi Sahi	18	75	298	26	14	12	0	0	0	0	0	0	0	4	7
Rasulgarh Sabar Sahi	19	91	289	25	13	12	0	0	0	0	0	0	0	4	8
Bhoi Sahi Shampur	22	99	358	31	16	15	0	1	1	0	1	0	1	4	9
Jokalandi Cluster-1	22	308	1080	93	49	44	1	2	3	0	3	0	3	4	27
Jokalandi Cluster-10	22	187	790	68	36	32	1	1	2	0	2	0	2	5	17
Jokalandi Cluster-11	22	200	785	68	36	32	1	1	2	0	2	0	2	4	18

No. of Seater construction requirement for slum wise (Authorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing CT seats	Total CT required (excluding existing CT seats)	Under construction CT seats	CT seats gap (yet to be constructed)	Average person per household	Estimated household covered by the required number of CT seats
Jokalandi Cluster-12	22	209	718	62	33	29	1	1	2	0	2	0	2	4	19
Jokalandi Cluster-2	22	256	950	82	43	39	1	2	3	0	3	0	3	4	23
Jokalandi Cluster-3	22	237	875	76	40	36	1	1	2	0	2	0	2	4	21
Jokalandi Cluster-4	22	332	1405	121	64	57	2	2	4	0	4	0	4	5	29
Jokalandi Cluster-5	22	282	1136	98	52	46	1	2	3	0	3	0	3	5	25
Jokalandi Cluster-6	22	288	1056	91	48	43	1	2	3	0	3	0	3	4	25
Jokalandi Cluster-7	22	388	1507	130	69	61	2	2	4	0	4	0	4	4	34
Jokalandi Cluster-8	22	69	292	25	13	12	0	0	0	0	0	0	0	5	6
Jokalandi Cluster-9	22	283	1090	94	50	44	1	2	3	0	3	0	3	4	25
Ghatikia Baramana Sahi	23	68	250	22	11	10	0	0	0	0	0	0	0	4	6
Ghatikia Bhoi Sahi	23	60	240	21	11	10	0	0	0	0	0	0	0	4	6

No. of Seater construction requirement for slum wise (Authorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing CT seats	Total CT required (excluding existing CT seats)	Under construction CT seats	CT seats gap (yet to be constructed)	Average person per household	Estimated household covered by the required number of CT seats
Ghatikia Gada Sahi	23	21	86	7	4	3	0	0	0	0	0	0	0	5	2
Ghatikia Tala Gada Sahi	23	73	279	24	13	11	0	0	0	0	0	0	0	4	7
Ghatikia Uppar Sahi	23	35	132	11	6	5	0	0	0	0	0	0	0	4	4
Shampur	23	413	1604	138	73	65	2	3	5	0	5	12	-7	4	36
Sabar Sahi (Nuasahi) Baramunda	24	52	192	17	9	8	0	0	0	0	0	0	0	4	5
Nayapalli Sabar Sahi	28	84	335	29	15	14	0	1	1	0	1	0	1	4	8
Gobinda Prasad Tala And Uppar Sahi	31	82	272	23	12	11	0	0	0	0	0	0	0	4	8
Harijan Sahi	32	69	248	21	11	10	0	0	0	9	0	0	0	4	6
Jharapada Bhoi Sahi	32	56	216	19	10	9	0	0	0	0	0	0	0	4	5
Muslim Basti	32	425	1691	146	77	69	2	3	5	0	5	0	5	4	37

No. of Seater construction requirement for slum wise (Authorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing CT seats	Total CT required (excluding existing CT seats)	Under construction CT seats	CT seats gap (yet to be constructed)	Average person per household	Estimated household covered by the required number of CT seats
Nayapalli Bhoi Sahi	38	88	407	35	19	17	1	1	2	0	2	0	2	5	8
Laxmi Sagar Majhi Sahi	43	90	373	32	17	15	0	1	1	0	1	0	1	5	8
Laxmi Sagar Tala Sahi	43	46	186	16	8	8	0	0	0	0	0	0	0	5	4
Laxmi Sagar Uppar Sahi	43	111	425	37	19	17	1	1	2	0	2	0	2	4	10
Baragarh Bhoi Sahi	44	153	597	52	27	24	1	1	2	0	2	0	2	4	14
Baragarh Hadi Sahi	44	31	108	9	5	4	0	0	0	0	0	0	0	4	3
Sethi Sahi	44	65	231	20	11	9	0	0	0	0	0	0	0	4	6
Baragada Sabar Sahi	45	101	418	36	19	17	1	1	2	0	2	0	2	5	9
Aiginia Bhoi Sahi	49	143	516	45	24	21	1	1	2	0	2	0	2	4	13
Bhoi Sahi Baramunda	49	36	127	11	6	5	0	0	0	0	0	0	0	4	4
Kolathia Bhoi Sahi	49	104	421	36	19	17	1	1	2	0	2	0	2	5	9

No. of Seater construction requirement for slum wise (Authorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing CT seats	Total CT required (excluding existing CT seats)	Under construction CT seats	CT seats gap (yet to be constructed)	Average person per household	Estimated household covered by the required number of CT seats
Sabar Sahi Baramunda	49	43	149	13	7	6	0	0	0	0	0	0	0	4	4
Maa Mangala Harijan Sahi, Baramunda	50	65	350	30	16	14	0	1	1	0	1	0	1	6	6
Siripur Sabar Sahi	51	181	664	57	30	27	1	1	2	0	2	0	2	4	16
Bharati Matha Bhoi Sahi	54	37	152	13	7	6	0	0	0	0	0	0	0	5	4
Huda Bhoi Sahi Gyana Nagar	54	120	427	37	19	17	1	1	2	0	2	0	2	4	11
Mati Sahi	54	36	129	11	6	5	0	0	0	0	0	0	0	4	4
Jayadev Nagar Basti	55	92	324	28	15	13	0	1	1	0	1	0	1	4	8
Nalamuha Sahi	55	36	119	10	5	5	0	0	0	0	0	0	0	4	4
Kancha Bhoi Sahi And Dhoba Sahi	58	52	170	15	8	7	0	0	0	0	0	0	0	4	5
Brahmeswar Patna Bhoi Sahi	58	101	375	32	17	15	0	1	1	0	1	0	1	4	9
Gada Bhoi Sahi	59	32	110	9	5	4	0	0	0	0	0	0	0	4	3

No. of Seater construction requirement for slum wise (Authorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing CT seats	Total CT required (excluding existing CT seats)	Under construction CT seats	CT seats gap (yet to be constructed)	Average person per household	Estimated household covered by the required number of CT seats
Gangua Bhoi Sahi	59	28	125	11	6	5	0	0	0	0	0	0	0	5	3
Kapileswar Bhoi Sahi	59	33	109	9	5	4	0	0	0	0	0	0	0	4	3
Nuagaon Jena Sahi	59	66	277	24	13	11	0	0	0	0	0	0	0	5	6
Nuagaon Khauda Sahi	59	89	376	32	17	15	0	1	1	0	1	0	1	5	8
Nuagaon Uppar Sahi	59	137	524	45	24	21	1	1	2	0	2	0	2	4	12
Rama Bhoi Sahi	59	43	163	14	7	7	0	0	0	0	0	0	0	4	4
Kapilaprasad Jaganath Patna Tangi Sahi	61	22	76	7	3	3	0	0	0	0	0	0	0	4	2
Pokhariput Bhoi Sahi	62	131	524	45	24	21	1	1	2	0	2	0	2	4	12
Dumuduma Bhoi Sahi-A	63	82	329	28	15	13	0	1	1	0	1	0	1	5	8
Dumuduma Pana Sahi	63	27	98	8	4	4	0	0	0	0	0	0	0	4	3

No. of Seater construction requirement for slum wise (Authorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing CT seats	Total CT required (excluding existing CT seats)	Under construction CT seats	CT seats gap (yet to be constructed)	Average person per household	Estimated household covered by the required number of CT seats
Jagamara Bhoi Sahi	63	37	194	17	9	8	0	0	0	0	0	0	0	6	4
Dumduma Bhoi Sahi	64	50	197	17	9	8	0	0	0	0	0	0	0	4	5
Allia Maa Sahi Jadupur	64	172	722	62	33	29	1	1	2	0	2	0	2	5	15
Begonia Jadupur	64	88	564	49	26	23	1	1	2	0	2	0	2	7	8
Jadupur Odia Sahi	64	176	921	79	42	37	1	1	2	0	2	0	2	6	16
Jadupur Puruna Sahi	64	179	886	76	40	36	1	1	2	0	2	0	2	5	16
Barabari Raghunath Nagar	66	192	691	60	32	28	1	1	2	0	2	0	2	4	17
Raghunath Nagar	66	246	941	81	43	38	1	2	3	0	3	0	3	4	22
Sastri Nagar	66	231	897	77	41	36	1	1	2	0	2	0	2	4	20
Satya Nagar	66	564	2097	181	96	85	3	3	6	0	6	0	6	4	49
Suka Vihar	66	408	1700	147	78	69	2	3	5	0	5	0	5	5	36
Kapilaprasad Basti	67	52	189	16	9	8	0	0	0	0	0	0	0	4	5

No. of Seater construction requirement for slum wise (Authorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing CT seats	Total CT required (excluding existing CT seats)	Under construction CT seats	CT seats gap (yet to be constructed)	Average person per household	Estimated household covered by the required number of CT seats
Kapilaprasad Bhata Bhoi Sahi	67	51	186	16	8	8	0	0	0	0	0	0	0	4	5
Sundarapada Patna Sahi	67	47	209	18	10	8	0	0	0	0	0	0	0	5	5
							71	89	160	43	117	53	64		1206

Table 42 No of CT seats construction requirement in unauthorised slums (No. of Community Toilet Seat construction requirement for slum wise .(Unauthorised slum), 2017)

No. of Community Toilet Seat construction requirement for slum wise (Unauthorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing Community toilet seats	Total Toilet seat required	Under construction toilet seats	CT seat gap	Average person per household	Estimated household covered by the required number of CT seats
Prasanti Vihar Basti Near Housing Board Colony	1	183	634	55	29	26	1	1	2	0	2	0	2	4	16
Prasanti Vihar Chirgal Tola	1	731	2592	224	118	105	3	4	7	0	7	12	-5	4	64
Chunukuli Basti	1	207	1035	89	47	42	1	2	3	0	3	0	3	5	18
Patia Jali Munda Sahi	2	176	651	56	30	26	1	1	2	0	2	6	-4	4	16
Santi Nagar Basti (Near Cluster-III)	2	139	549	47	25	22	1	1	2	0	2	0	2	4	12
Johala Adivasi Sahi	4	31	121	10	6	5	0	0	0	0	0	0	0	4	3
Hadabai Basti	5	195	756	65	35	31	1	1	2	0	2	0	2	4	17
Palasuni Munda Sahi	5	221	824	71	38	33	1	1	2	0	2	0	2	4	20

No. of Community Toilet Seat construction requirement for slum wise (Unauthorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing Community toilet seats	Total Toilet seat required	Under construction toilet seats	CT seat gap	Average person per household	Estimated household covered by the required number of CT seats
Patadei Basti	5	202	786	68	36	32	1	1	2	0	2	0	2	4	18
Sameigadia Durga Basti	5	38	155	13	7	6	0	0	0	0	0	0	0	5	4
Sriram Nagar	5	554	2055	177	94	84	3	3	6	0	6	0	6	4	48
Jagannath Ambatota	6	67	260	22	12	11	0	0	0	0	0	0	0	4	6
Nageswar Basti Sissuvihar Near Odm School	6	72	289	25	13	12	0	0	0	0	0	10	-10	5	7
Nila Padia Basti	6	164	614	53	28	25	1	1	2	0	2	0	2	4	15
Bajrang Basti	7	49	181	16	8	7	0	0	0	0	0	0	0	4	5
Srikrinsha Nagar	7	130	485	42	22	20	1	1	2	0	2	0	2	4	12
Damana Hata Basti	8	173	746	64	34	30	1	1	2	0	2	6	-4	5	15
Nilamadhab Basti	8	364	1318	114	60	54	2	2	4	0	4	0	4	4	32
Pani Tanki Basti	8	131	516	45	24	21	1	1	2	0	2	0	2	4	12

No. of Community Toilet Seat construction requirement for slum wise (Unauthorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing Community toilet seats	Total Toilet seat required	Under construction toilet seats	CT seat gap	Average person per household	Estimated household covered by the required number of CT seats
Radhakrushna Basti	8	217	784	68	36	32	1	1	2	0	2	0	2	4	19
Aurobinda Basti	9	291	1083	93	49	44	1	2	3	0	3	0	3	4	26
Kalyani Sahi Basti Gadakana	9	107	452	39	21	18	1	1	2	0	2	0	2	5	10
Mancheswar Munda Sahi	9	214	844	73	39	34	1	1	2	0	2	0	2	4	19
Mandap Basti Cs Pur	9	230	829	72	38	34	1	1	2	0	2	0	2	4	20
Munda Sahi Cs Pur	9	146	538	46	25	22	1	1	2	0	2	0	2	4	13
Rangamatia Basti	9	13	41	4	2	2	0	0	0	0	0	0	0	4	2
Tarini Basti	9	140	514	44	23	21	1	1	2	0	2	0	2	4	13
Akhandalmani Basti	10	84	273	24	12	11	0	0	0	0	0	0	0	4	8
Gopabandhu Basti (Karalaput)	10	135	532	46	24	22	1	1	2	0	2	0	2	4	12
Hadabai Basti	10	190	763	66	35	31	1	1	2	0	2	0	2	5	17

No. of Community Toilet Seat construction requirement for slum wise (Unauthorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing Community toilet seats	Total Toilet seat required	Under construction toilet seats	CT seat gap	Average person per household	Estimated household covered by the required number of CT seats
Jagannath Leprocy Colony	10	58	193	17	9	8	0	0	0	5	0	5	-10	4	6
Jharana Sahi-A	10	203	704	61	32	29	1	1	2	0	2	0	2	4	18
Jharana Sahi-B	10	141	487	42	22	20	1	1	2	0	2	0	2	4	13
Maa Banadurga Basti	10	20	75	6	3	3	0	0	0	0	0	0	0	4	2
Maa Bhagabati Basti	10	185	658	57	30	27	1	1	2	0	2	0	2	4	16
Mancheswar Tuyu Gutu Basti	10	134	504	43	23	20	1	1	2	0	2	2	0	4	12
Mani Nageswari	10	36	112	10	5	5	0	0	0	0	0	0	0	4	4
Occ Basti	10	63	208	18	9	8	0	0	0	0	0	0	0	4	6
Purusottam Basti	10	293	1047	90	48	43	1	2	3	0	3	0	3	4	26
Mahavir Basti Vss Nagar	11	145	567	49	26	23	1	1	2	0	2	0	2	4	13

No. of Community Toilet Seat construction requirement for slum wise (Unauthorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing Community toilet seats	Total Toilet seat required	Under construction toilet seats	CT seat gap	Average person per household	Estimated household covered by the required number of CT seats
Trinath Basti	11	179	667	58	30	27	1	1	2	0	2	0	2	4	16
Vss Nagar Behera Sahi (Goja Bayani)	11	81	307	26	14	12	0	0	0	0	0	0	0	4	7
Atmaram Basti	12	27	110	9	5	4	0	0	0	0	0	0	0	5	3
Dasraj Basti	12	160	619	53	28	25	1	1	2	0	2	0	2	4	14
Mancheswar Dhirikuti Sahi	12	686	2585	223	118	105	3	4	7	0	7	6	1	4	60
Patra Sahi	12	196	757	65	35	31	1	1	2	0	2	0	2	4	17
Sanatapur Near Siet	12	124	441	38	20	18	1	1	2	0	2	0	2	4	11
Trinath Basti	12	58	222	19	10	9	0	0	0	0	0	0	0	4	6
Ananta Basti	13	204	761	66	35	31	1	1	2	0	2	0	2	4	18
Nilamadhab Basti Phase-1	13	420	1545	133	71	63	2	3	5	0	5	0	5	4	37
Sion Sramika Basti	13	237	867	75	40	35	1	1	2	0	2	4	-2	4	21
Adarsha Basti Niladri Vihar	14	175	689	59	31	28	1	1	2	0	2	0	2	4	16

No. of Community Toilet Seat construction requirement for slum wise (Unauthorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing Community toilet seats	Total Toilet seat required	Under construction toilet seats	CT seat gap	Average person per household	Estimated household covered by the required number of CT seats
Isaneswar Basti	14	191	748	65	34	30	1	1	2	0	2	6	-4	4	17
Maa Mangala Basti	14	63	251	22	11	10	0	0	0	0	0	0	0	4	6
Mahavir Basti (Niladri Vihar)	14	79	298	26	14	12	0	0	0	0	0	0	0	4	7
Sitanath Nagar (Niladri Vihar)	14	303	1158	100	53	47	2	2	4	0	4	0	4	4	27
Ekamra Villa Behera Basti (Near Ekamra Kanan Park)	15	90	335	29	15	14	0	1	1	0	1	0	1	4	8
Rental Colony Sahid Laxman Behera Basti	15	695	2695	233	123	110	4	4	8	0	8	0	8	4	60
Ambedkar Sahi	16	63	209	18	10	8	0	0	0	0	0	0	0	4	6
Bajpai Nagar	16	911	3080	266	141	125	4	5	9	0	9	0	9	4	79

No. of Community Toilet Seat construction requirement for slum wise (Unauthorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing Community toilet seats	Total Toilet seat required	Under construction toilet seats	CT seat gap	Average person per household	Estimated household covered by the required number of CT seats
Behera Sahi Near Sworna Hospital	16	124	420	36	19	17	1	1	2	0	2	0	2	4	11
Birsa Nagar	16	88	315	27	14	13	0	1	1	0	1	0	1	4	8
Gajalaxmi Nagar	16	56	199	17	9	8	0	0	0	0	0	0	0	4	5
Laxmi Nagar	16	141	480	41	22	20	1	1	2	0	2	0	2	4	13
May Fair Nagar	16	259	1081	93	49	44	1	2	3	0	3	0	3	5	23
Nalco Nagar Behera Sahi	16	101	389	34	18	16	1	1	2	0	2	0	2	4	9
Nayagada Sahi	16	752	2663	230	122	108	3	4	7	0	7	0	7	4	65
Nilachakra Nagar	16	1327	4649	401	212	189	6	8	14	0	14	0	14	4	115
Santala Basti Laxmipur	16	148	583	50	27	24	1	1	2	0	2	0	2	4	13
Tarini Nagar	16	71	242	21	11	10	0	0	0	0	0	0	0	4	7
Tarini Nagar Salia Sahi	16	1414	5091	439	232	207	7	8	15	0	15	0	15	4	123
Trinath Nagar	16	33	119	10	5	5	0	0	0	0	0	0	0	4	3

No. of Community Toilet Seat construction requirement for slum wise (Unauthorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing Community toilet seats	Total Toilet seat required	Under construction toilet seats	CT seat gap	Average person per household	Estimated household covered by the required number of CT seats
Vinayak Nagar	16	26	90	8	4	4	0	0	0	0	0	0	0	4	3
Biseswari Basti	17	467	1716	148	78	70	2	3	5	0	5	0	5	4	41
Patharabandha Behera Sahi	17	265	1133	98	52	46	1	2	3	0	3	0	3	5	23
Patharabandha North	17	471	1939	167	89	79	3	3	6	0	6	0	6	5	41
Patharabandha South	17	303	1273	110	58	52	2	2	4	0	4	0	4	5	27
Talapadeswari Basti	17	32	101	9	5	4	0	0	0	0	0	0	0	4	3
Tarini Basti	17	248	926	80	42	38	1	2	3	0	3	0	3	4	22
Vani Vihar 1st And 2nd Gate Slum Behind Hostel	17	125	496	43	23	20	1	1	2	0	2	0	2	4	11
Vani Vihar Front Gate Slum	17	92	391	34	18	16	1	1	2	0	2	0	2	5	8

No. of Community Toilet Seat construction requirement for slum wise (Unauthorized slum)															
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Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing Community toilet seats	Total Toilet seat required	Under construction toilet seats	CT seat gap	Average person per household	Estimated household covered by the required number of CT seats
Vani Vihar Old Colony	17	80	339	29	15	14	0	1	1	0	1	0	1	5	7
Baliapata	18	375	1548	134	71	63	2	3	5	0	5	0	5	5	33
Kimbhiria Jagannath Basti	19	499	1994	172	91	81	3	3	6	0	6		6	4	44
Nalabandha Munda Basti	19	53	221	19	10	9	0	0	0	0	0		0	5	5
Aditya Nagar Basti	20	185	603	52	28	25	1	1	2	0	2	0	2	4	16
Ekamra Vihar	20	1120	3996	345	182	162	5	6	11	0	11	0	11	4	97
Hatiasuni	20	465	1569	135	72	64	2	3	5	0	5	0	5	4	41
Jagannath Vihar	20	56	229	20	10	9	0	0	0	0	0	0	0	5	5
Mahavir Nagar	20	63	230	20	11	9	0	0	0	0	0	0	0	4	6
Mangala Nagar	20	211	719	62	33	29	1	1	2	0	2	0	2	4	19
Reddy Sahi	20	59	223	19	10	9	0	0	0	0	0	0	0	4	6
Santoshi Nagar	20	219	734	63	34	30	1	1	2	0	2	0	2	4	19

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Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing Community toilet seats	Total Toilet seat required	Under construction toilet seats	CT seat gap	Average person per household	Estimated household covered by the required number of CT seats
Srikrishana Basti Near Loyala	20	198	700	60	32	28	1	1	2	0	2	0	2	4	18
Sriram Nagar	20	711	2510	217	115	102	3	4	7	0	7	0	7	4	62
Adivasi Gaon	21	293	1134	98	52	46	1	2	3	0	3	0	3	4	26
Janata Nagar	21	862	2943	254	134	120	4	5	9	0	9	0	9	4	75
Nirakari Nagar	21	826	2984	258	136	121	4	5	9	0	9	0	9	4	72
Sakti Nagar	21	696	2636	228	120	107	3	4	7	0	7	0	7	4	61
Swadhin Nagar	21	366	1389	120	63	56	2	2	4	0	4	0	4	4	32
Godam Sahi	23	120	519	45	24	21	1	1	2	0	2	0	2	5	11
Gudiatota Sahi	23	105	384	33	18	16	1	1	2	0	2	0	2	4	10
Khandagiri Bari	23	741	2701	233	123	110	4	4	8	0	8	0	8	4	64
Nakagate Chala Sahi	23	210	832	72	38	34	1	1	2	0	2	0	2	4	19
Omkar Basti Infront Of Kalinga Studio	23	66	229	20	10	9	0	0	0	0	0	0	0	4	6
Panda Kudia	23	66	256	22	12	10	0	0	0	0	0	4	-4	4	6

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Santosi Nagar	23	244	883	76	40	36	1	1	2	0	2	0	2	4	22
Sarada Palli	23	143	597	52	27	24	1	1	2	0	2	6	-4	5	13
Sitaram Basti Near Abhiram Ashram	23	78	274	24	13	11	0	0	0	0	0	0	0	4	7
Tapoban School Basti	23	185	717	62	33	29	1	1	2	0	2	0	2	4	16
Jadumani Vihar Sandha Sahi	24	254	929	80	42	38	1	2	3	0	3	0	3	4	22
Jagannath Vihar Behera Sahi	24	98	364	31	17	15	0	1	1	0	1	0	1	4	9
Mahavir Basti Baramunda	24	340	1255	108	57	51	2	2	4	0	4	0	4	4	30
Adivasi Basti	25	157	553	48	25	22	1	1	2	0	2	0	2	4	14
Behera Basti	25	336	1160	100	53	47	2	2	4	0	4	10	-6	4	29
Govinda Basti	25	170	604	52	28	25	1	1	2	0	2	0	2	4	15
Iscon Back Side Basti	25	137	511	44	23	21	1	1	2	0	2	0	2	4	12

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Basti Bikash Parishad	26	926	3202	276	146	130	4	5	9	0	9	0	9	4	80
Basti Bikash Parishad	26	363	1277	110	58	52	2	2	4	0	4	0	4	4	32
Mahavir Nagar	26	531	1852	160	85	75	2	3	5	0	5	0	5	4	46
Maitre Nagar	26	227	811	70	37	33	1	1	2	0	2	0	2	4	20
Pradhan Sahi-1	26	214	677	58	31	28	1	1	2	0	2	0	2	4	19
Pradhan Sahi-2	26	155	329	28	15	13	0	1	1	0	1	0	1	3	14
Sarala Nagar	26	44	143	12	7	6	0	0	0	0	0	0	0	4	4
Saran Palli	26	430	1553	134	71	63	2	3	5	0	5	0	5	4	38
Satya Narayan Nagar	26	120	427	37	19	17	1	1	2	0	2	0	2	4	11
Ganapati Nagar	27	838	3102	268	142	126	4	5	9	0	9	0	9	4	73
Gandhi Basti	27	307	1089	94	50	44	1	2	3	0	3	0	3	4	27
Khola Building	27	88	340	29	16	14	0	1	1	0	1	0	1	4	8
Trinath Nagar	27	554	2047	177	93	83	3	3	6	0	6	0	6	4	48

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Nandini Palli Munda Sahi	28	128	462	40	21	19	1	1	2	0	2	0	2	4	12
Rampur Basti-A Bhouma Nagar	28	211	747	64	34	30	1	1	2	0	2	0	2	4	19
Rampur Basti-B Madhusudan Nagar	28	210	770	66	35	31	1	1	2	0	2	0	2	4	19
Science Park Basti	28	806	2882	249	132	117	4	5	9	4	5	0	1	4	70
Bhoi Nagar Basti	29	322	1212	105	55	49	2	2	4	0	4	0	4	4	28
Bhoi Nagar Basti Suka Vihar	29	92	323	28	15	13	0	1	1	0	1	0	1	4	8
Laxmi Narayan Basti	29	482	1613	139	74	66	2	3	5	4	1	0	-3	4	42
Sani Mandir Vani Vihar Basti	29	31	111	10	5	5	0	0	0	0	0	0	0	4	3

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Unit-9 Flat Basti	29	196	700	60	32	28	1	1	2	0	2	0	2	4	17
Birsa Munda Slum 1	30	87	349	30	16	14	0	1	1	2	-1	0	-3	5	8
Birsa Munda Slum 2	30	62	198	17	9	8	0	0	0	4	-4	0	-8	4	6
Sahid Nagar Telgu Basti	30	373	1370	118	63	56	2	2	4	0	4	0	4	4	33
Canal Sahi Gobinda Prasad	31	304	1209	104	55	49	2	2	4	0	4	0	4	4	27
Hathat Colony	31	77	319	28	15	13	0	1	1	2	-1	0	-3	5	7
Jharapada Over Bridge	31	38	143	12	7	6	0	0	0	0	0	0	0	4	4
Kalaraput Basti	31	279	998	86	46	41	1	2	3	0	3	0	3	4	25
Laxmi Sagar Refuge Colony	31	253	1265	109	58	51	2	2	4	0	4	0	4	5	22
Julie Colony	32	142	501	43	23	20	1	1	2	0	2	0	2	4	13

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Haladi Padia Basti Laxmi Sagar	33	654	2354	203	107	96	3	4	7	0	7	0	7	4	57
Maa Dalakhai Basti Laxmi Sagar	33	52	194	17	9	8	0	0	0	0	0	5	-5	4	5
Budheswari Labour Colony	33	184	826	71	38	34	1	1	2	0	2	0	2	5	16
Behera Sahi	34	281	1050	91	48	43	1	2	3	0	3	0	3	4	25
Durga Mandap Side Basti Satya Nagar	34	116	417	36	19	17	1	1	2	0	2	0	2	4	11
Navin Nagar	34	73	233	20	11	9	0	0	0	0	0	0	0	4	7
Rajkumar Basti	34	188	660	57	30	27	1	1	2	0	2	0	2	4	17
Santi Palli Sahid Nagar	34	944	3575	309	163	145	5	6	11	6	5	0	-1	4	82
Timber Colony	34	97	367	32	17	15	0	1	1	0	1	0	1	4	9

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Bayababa Basti	35	463	1799	155	82	73	2	3	5	4	1	0	-3	4	40
Bhagabati Basti-2	35	114	461	40	21	19	1	1	2	0	2	0	2	5	10
Labour Colony Unit-3	35	68	240	21	11	10	0	0	0	0	0	0	0	4	6
Maa Bhagabati Basti	35	112	424	37	19	17	1	1	2	0	2	0	2	4	10
Maa Mangala Basti	35	136	508	44	23	21	1	1	2	0	2	0	2	4	12
Mali Colony	35	191	678	59	31	28	1	1	2	0	2	0	2	4	17
Sudhanidhiswar Basti	35	136	495	43	23	20	1	1	2	4	0	0	-4	4	12
Macha Market Basti Near Kar Clinic	36	163	636	55	29	26	1	1	2	0	2	0	2	4	15
Nico Park Basti	36	58	203	18	9	8	0	0	0	0	0	0	0	4	6
Jagannath Basti	37	221	884	76	40	36	1	1	2	4	0	0	-4	4	20

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Kalinga Stadium Gauda Sahi	37	91	349	30	16	14	0	1	1	0	1	0	1	4	8
Mangala Basti Nayapalli	37	109	393	34	18	16	1	1	2	6	-4	0	-10	4	10
Nayapalli Behera Sahi	37	87	319	28	15	13	0	1	1	0	1	0	1	4	8
Sitapur Basti	37	91	336	29	15	14	0	1	1	0	1	0	1	4	8
Baliatota Sahi Nilakantha Nagar	38	130	489	42	22	20	1	1	2	0	2	0	2	4	12
Masani Basti	38	64	235	20	11	10	0	0	0	0	0	0	0	4	6
Munda Sahi	38	41	140	12	6	6	0	0	0	0	0	0	0	4	4
Slum Near Indira Maidan	38	31	125	11	6	5	0	0	0	0	0	0	0	5	3
Trinath Basti In Front Of Cbi Office	38	49	166	14	8	7	0	0	0	0	0	0	0	4	5
Balitota Sahi	39	21	81	7	4	3	0	0	0	0	0	0	0	4	2
Dehuri Sahi Back Side Of	39	37	145	13	7	6	0	0	0	0	0	0	0	4	4

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Kalyan Mandap															
Kalyani Krushna Nagar Nayapalli Nuasahi	39	203	721	62	33	29	1	1	2	2	0	0	-2	4	18
Shastri Nagar Uppar Sahi	39	81	318	27	15	13	0	1	1	0	1	0	1	4	7
Sitapur Basti	39	164	599	52	27	24	1	1	2	0	2	0	2	4	15
Akhandalmani Basti Unit-1	40	144	563	49	26	23	1	1	2	0	2	0	2	4	13
Harijan Basti Unit-1	40	92	405	35	18	16	1	1	2	9	0	0	-9	5	8
Jagannath Basti Unit-1	40	105	393	34	18	16	1	1	2	0	2	0	2	4	10
Kalinga Basti Unit-1	40	44	155	13	7	6	0	0	0	0	0	0	0	4	4
Kasturaba Narimahal Basti Unit-1	40	33	121	10	6	5	0	0	0	0	0	0	0	4	3

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Laxmi Narayan Pragati Basti Unit-1	40	63	231	20	11	9	0	0	0	0	0	0	0	4	6
Maa Mangala Basti Unit-1	40	41	149	13	7	6	0	0	0	0	0	0	0	4	4
Maa Tarini Basti Unit-3	40	155	577	50	26	23	1	1	2	0	2	0	2	4	14
Patel Hall Basti	40	74	247	21	11	10	0	0	0	0	0	0	0	4	7
Ram Mandir Basti	40	26	125	11	6	5	0	0	0	0	0	0	0	5	3
Sweeper Colony Unit-6	40	407	1608	139	73	65	2	3	5	0	5	0	5	4	36
Tarini Basti Unit-2	40	121	423	37	19	17	1	1	2	0	2	0	2	4	11
Tati Basti Near Adibasi Padia Unit-1	40	97	449	39	21	18	1	1	2	0	2	0	2	5	9
Ashok Nagar	41	115	413	36	19	17	1	1	2	0	2	0	2	4	10
Janata Lodge Side Colony Basti Unit-3	41	40	164	14	7	7	0	0	0	0	0	0	0	5	4

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Kalimandir Side Basti Unit-2	41	122	454	39	21	18	1	1	2	2	0	0	-2	4	11
Kanjiahoda Harijan Sahi	41	157	587	51	27	24	1	1	2	4	-2	0	-6	4	14
Masjid Colony	41	507	2176	188	99	88	3	4	7	8	-1	0	-9	5	44
Phd Sahi Unit-3	41	66	243	21	11	10	0	0	0	0	0	0	0	4	6
Press Colony Basti	41	317	1084	94	49	44	1	2	3	0	3	0	3	4	28
Ramkrushna Leprocy Colony	41	109	333	29	15	14	0	1	1	3	0	0	-3	4	10
Rickshaw Colony Near Press Colony High School	41	42	165	14	8	7	0	0	0	3	0	0	-3	4	4
Shanti Nagar Fci Colony	41	404	1427	123	65	58	2	2	4	0	4	0	4	4	35
Tiranga Sahi	41	93	333	29	15	14	0	1	1	8	-7	0	-15	4	9

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Behera Sahi (Old Station Bazar)	42	42	159	14	7	6	0	0	0	0	0	0	0	4	4
Budha Nagar Banaphula Basti	42	208	730	63	33	30	1	1	2	0	2	0	2	4	18
Budha Nagar Bhoi Sahi	42	127	435	38	20	18	1	1	2	4	0	0	-4	4	11
Gopabandhu Leprocy Colony	42	39	107	9	5	4	0	0	0	6	0	0	-6	3	4
Mochi Sahi Old Station Bazar	42	203	835	72	38	34	1	1	2	8	0	0	-8	5	18
Pradhan Sahi Old Station Bazar	42	77	269	23	12	11	0	0	0	0	0	0	0	4	7
Pwd Store Basti	42	305	1058	91	48	43	1	2	3	8	0	0	-8	4	27
Reddy Sahi Basti Old Station Bazar	42	231	805	69	37	33	1	1	2	0	2	0	2	4	20

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Laxmi Sagar Pana Baraja Basti	43	60	211	18	10	9	0	0	0	0	0	0	0	4	6
Mahila Samiti Basti	43	64	275	24	13	11	0	0	0	0	0	0	0	5	6
Akhandalmani Basti	45	40	145	13	7	6	0	0	0	0	0	0	0	4	4
Baba Trinath Adibasi And Harijan Basti (Pichupadia Kha)	45	57	211	18	10	9	0	0	0	0	0	0	0	4	5
Champa Pokhari	45	139	516	45	24	21	1	1	2	0	2	0	2	4	12
Kalpana Flat Basti	45	24	61	5	3	2	0	0	0	0	0	0	0	3	3
Kela Basti	45	39	140	12	6	6	0	0	0	0	0	0	0	4	4
Maa Banadurga Shramika Kalyana Basti	45	33	99	9	5	4	0	0	0	0	0	0	0	3	3

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Radhakrushna Basti	45	23	83	7	4	3	0	0	0	0	0	0	0	4	2
Akhandalamani Basti	46	53	195	17	9	8	0	0	0	0	0	0	0	4	5
Baba Trinath Adibasi And Harijan Basti (Pichupadia Kha)	46	207	787	68	36	32	1	1	2	0	2	0	2	4	18
Durga Mandap Basti	46	175	655	57	30	27	1	1	2	0	2	0	2	4	16
Kalimandir Basti	46	79	302	26	14	12	0	0	0	0	0	0	0	4	7
Maa Mangala Basti Unit-7	46	176	644	56	29	26	1	1	2	6	0	0	-6	4	16
Pichu Basti	46	131	510	44	23	21	1	1	2	0	2	0	2	4	12
Radha Krushna Tala Sahi (Ka) Unit-6	46	114	437	38	20	18	1	1	2	0	2	0	2	4	10
Radha Krushna Tala	46	103	369	32	17	15	0	1	1	0	1	0	1	4	9

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Sahi (Kha) Unit-6															
Sabar Sahi	46	44	163	14	7	7	0	0	0	0	0	0	0	4	4
Sadak Sahi	46	168	629	54	29	26	1	1	2	0	2	0	2	4	15
Simili Basti	46	91	339	29	15	14	0	1	1	0	1	0	1	4	8
Bachelors Barrack (Narayani Basti)	47	369	1437	124	66	58	2	2	4	0	4	0	4	4	32
G Type Basti Unit-8	47	89	315	27	14	13	0	1	1	0	1	0	1	4	8
Gopabandhu Nagar Unit-8	47	139	487	42	22	20	1	1	2	0	2	0	2	4	12
Jayadurga Basti Unit-8	47	125	462	40	21	19	1	1	2	0	2	0	2	4	11
Neheru Basti	47	204	751	65	34	31	1	1	2	0	2	0	2	4	18
Nila Panitanki Basti	47	340	1164	100	53	47	2	2	4	0	4	0	4	4	30
Occ Basti	47	119	384	33	18	16	1	1	2	0	2	0	2	4	11
Power House Basti	47	66	244	21	11	10	0	0	0	0	0	0	0	4	6

No. of Community Toilet Seat construction requirement for slum wise (Unauthorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing Community toilet seats	Total Toilet seat required	Under construction toilet seats	CT seat gap	Average person per household	Estimated household covered by the required number of CT seats
Venketeswar Basti	47	382	1441	124	66	59	2	2	4	0	4	0	4	4	33
Yogi Sahi	47	27	95	8	4	4	0	0	0	0	0	0	0	4	3
Jadi Sahi	48	56	210	18	10	9	0	0	0	4	0	0	-4	4	5
Jaleswar Colony Paika Nagar	48	301	1114	96	51	45	1	2	3	0	3	0	3	4	26
Krushi Vihar Basti	48	104	447	39	20	18	1	1	2	0	2	0	2	5	9
Mundasahi Nilakanthanagar	48	674	2337	202	107	95	3	4	7	0	7	0	7	4	59
Siripur Kandha Sahi	48	81	313	27	14	13	0	1	1	3	0	0	-3	4	7
Tulasi Basti	48	75	249	21	11	10	0	0	0	0	0	0	0	4	7
Chala Sahi	49	71	257	22	12	10	0	0	0	0	0	0	0	4	7
Bhagabati Basti	50	148	590	51	27	24	1	1	2	0	2	0	2	4	13
Fire Station Basti	50	222	871	75	40	35	1	1	2	0	2	0	2	4	20
Gandamunda	50	281	1067	92	49	43	1	2	3	0	3	0	3	4	25
Farm Gate Ouat Basti	51	614	2397	207	109	97	3	4	7	0	7	0	7	4	53

No. of Community Toilet Seat construction requirement for slum wise (Unauthorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing Community toilet seats	Total Toilet seat required	Under construction toilet seats	CT seat gap	Average person per household	Estimated household covered by the required number of CT seats
Farm Pada	51	28	94	8	4	4	0	0	0	0	0	0	0	4	3
Rangani Sahi	51	126	446	38	20	18	1	1	2	0	2	0	2	4	11
Ganga Nagar	52	94	345	30	16	14	0	1	1	0	1	0	1	4	9
Ganga Nagar Bhimpur Basti	52	59	215	19	10	9	0	0	0	0	0	0	0	4	6
Ganga Nagar Hostel Side Basti	52	246	869	75	40	35	1	1	2	0	2	0	2	4	22
Ganga Nagar Palli-A	52	147	530	46	24	22	1	1	2	0	2	0	2	4	13
Ganga Nagar Palli-B	52	288	1011	87	46	41	1	2	3	0	3	0	3	4	25
Ananda Nagar Palasapalli	53	294	1092	94	50	44	1	2	3	0	3	0	3	4	26
Bapuji Nagar Railway Basti	53	365	1374	119	63	56	2	2	4	0	4	0	4	4	32
Bhimpur Bhoi Sahi	53	243	905	78	41	37	1	1	2	0	2	0	2	4	21
Jharana Sahi Tala Basti	53	148	508	44	23	21	1	1	2	4	0	0	-4	4	13

No. of Community Toilet Seat construction requirement for slum wise (Unauthorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing Community toilet seats	Total Toilet seat required	Under construction toilet seats	CT seat gap	Average person per household	Estimated household covered by the required number of CT seats
Jharana Uppar Sahi	53	478	1873	162	86	76	2	3	5	2	3	0	1	4	42
Kalinga Basti	53	42	132	11	6	5	0	0	0	0	0	0	0	4	4
Kedar Palli Basti	53	641	2447	211	112	99	3	4	7	0	7	0	7	4	56
Kukuteswar Basti	53	111	403	35	18	16	1	1	2	0	2	0	2	4	10
Lingaraj Leprocy Colony	53	38	104	9	5	4	0	0	0	22	0	0	-22	3	4
Punamagate Bhoi Sahi	54	60	201	17	9	8	0	0	0	0	0	0	0	4	6
Rameswar Patna	54	190	701	61	32	28	1	1	2	0	2	0	2	4	17
Goutam Nagar Basti	55	251	961	83	44	39	1	2	3	0	3	0	3	4	22
Adei Khal-A	56	69	258	22	12	10	0	0	0	0	0	0	0	4	6
Adei Khal-B	56	110	354	31	16	14	0	1	1	0	1	0	1	4	10
Aurobinda Colony	56	230	774	67	35	31	1	1	2	0	2	0	2	4	20
Bijay Laxmi Basti Tala Sahi-B	56	125	438	38	20	18	1	1	2	0	2	0	2	4	11

No. of Community Toilet Seat construction requirement for slum wise (Unauthorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing Community toilet seats	Total Toilet seat required	Under construction toilet seats	CT seat gap	Average person per household	Estimated household covered by the required number of CT seats
Bijaya Laxmi Colony-A	56	38	123	11	6	5	0	0	0	0	0	0	0	4	4
Hari Nagar Mahishikhal	56	202	727	63	33	30	1	1	2	2	0	0	-2	4	18
Kalpana Labour Colony (Pani Tanki Sahi)	56	194	700	60	32	28	1	1	2	10	0	0	-10	4	17
Kalpana Medical Sahi	56	72	228	20	10	9	0	0	0	0	0	0	0	4	7
Mahishikhal	56	546	1925	166	88	78	3	3	6	8	0	0	-8	4	48
Telgu Basti(Kalpana Labour Colony)	56	185	624	54	28	25	1	1	2	8	0	0	-8	4	16
Kalinga Basti	57	383	1511	130	69	61	2	2	4	0	4	0	4	4	34
Tarini Basti Pandaba Nagar	57	182	667	58	30	27	1	1	2	0	2	0	2	4	16
Kusapadia Basti	57	141	473	41	22	19	1	1	2	0	2	0	2	4	13
Badhi Huda	58	120	457	39	21	19	1	1	2	0	2	0	2	4	11
Chili Pokhari	58	257	933	81	43	38	1	2	3	0	3	0	3	4	23

No. of Community Toilet Seat construction requirement for slum wise (Unauthorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing Community toilet seats	Total Toilet seat required	Under construction toilet seats	CT seat gap	Average person per household	Estimated household covered by the required number of CT seats
Gouri Nagar Basti	58	47	166	14	8	7	0	0	0	0	0	0	0	4	5
Gyarej Chhaka Canal Basti	58	67	222	19	10	9	0	0	0	0	0	0	0	4	6
Mahavir Basti Gada Mahavir	58	42	172	15	8	7	0	0	0	0	0	0	0	5	4
Samantarapur Basti	58	159	549	47	25	22	1	1	2	0	2	0	2	4	14
Bishnu Nagar Basti	58	143	540	47	25	22	1	1	2	0	2	0	2	4	13
Samantarapur Telenga Sahi	59	49	200	17	9	8	0	0	0	0	0	0	0	5	5
Baunsa Khani Basti	61	41	154	13	7	6	0	0	0	0	0	0	0	4	4
Bhagabati Basti	61	138	509	44	23	21	1	1	2	0	2	0	2	4	12
Bhimtangi Peoples Basti	61	97	376	32	17	15	0	1	1	0	1	0	1	4	9

No. of Community Toilet Seat construction requirement for slum wise (Unauthorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing Community toilet seats	Total Toilet seat required	Under construction toilet seats	CT seat gap	Average person per household	Estimated household covered by the required number of CT seats
Bhimeswar Patna Behera Sahi	61	135	462	40	21	19	1	1	2	0	2	0	2	4	12
Khandual Basti	61	100	408	35	19	17	1	1	2	0	2	0	2	5	9
Bhakta Madhu Nagar	62	153	587	51	27	24	1	1	2	0	2	0	2	4	14
Kargil Basti	62	1018	3866	334	177	157	5	6	11	0	11	0	11	4	88
Kela Sahi	62	327	1225	106	56	50	2	2	4	0	4	0	4	4	29
Maa Tarini Basti Pokhariput	62	96	359	31	16	15	0	1	1	0	1	0	1	4	9
Tarini Basti Gandamunda	62	118	466	40	21	19	1	1	2	0	2	0	2	4	11
Barabhuja Basti Jagamara	63	43	169	15	8	7	0	0	0	0	0		0	4	4
Tapoban Basti Khandagiri	63	484	1834	158	84	75	2	3	5	6	0	4	-10	4	42
Tarinibasti Khandagiri	63	138	515	44	24	21	1	1	2	0	2	0	2	4	12
Asian Plaza	64	67	214	18	10	9	0	0	0	0	0	0	0	4	6

No. of Community Toilet Seat construction requirement for slum wise (Unauthorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing Community toilet seats	Total Toilet seat required	Under construction toilet seats	CT seat gap	Average person per household	Estimated household covered by the required number of CT seats
Dumduma Nua Bhoi Sahi	64	32	140	12	6	6	0	0	0	0	0	0	0	5	3
Khetrapala Basti Nuasahi	64	72	287	25	13	12	0	0	0	0	0	0	0	4	7
Mangal Sahi	64	90	330	28	15	13	0	1	1	0	1	0	1	4	8
Subas Bose Nagar Basti	64	962	3753	324	171	153	5	6	11	0	11	0	11	4	84
Tangi Sahi-A Jadupur	64	79	422	36	19	17	1	1	2	0	2	0	2	6	7
Abanti Bihar Basti	66	87	323	28	15	13	0	1	1	0	1	0	1	4	8
Rehmat Nagar	66	304	1286	111	59	52	2	2	4	0	4	0	4	5	27
Abhiram Nagar Basti	67	237	862	74	39	35	1	1	2	0	2	0	2	4	21
Azad Nagar Muslim Basti	67	70	293	25	13	12	0	0	0	0	0	0	0	5	7
Gokhibaba Leprocy Colony	67	22	58	5	3	2	0	0	0	0	0	0	0	3	2

No. of Community Toilet Seat construction requirement for slum wise (Unauthorized slum)															
Data received														Inference	
Slum	Ward No	Total HH	Total Population	8.63075% of total population	M	F	No. of Seat Male	No. of Seat Female	Total	Existing Community toilet seats	Total Toilet seat required	Under construction toilet seats	CT seat gap	Average person per household	Estimated household covered by the required number of CT seats
Jogeswar Patna Beherasahi	67	81	259	22	12	11	0	0	0	0	0	0	0	4	7
Football Padia Basti	67	104	473	41	22	19	1	1	2	0	2	0	2	5	9
Total							322	401	723	185	531	86	452		5910

7.3 Solid Waste Management Options

7.3.1 Micro Planning Approach

For efficient handling of the sanitation and solid waste management function, MC Bhubaneswar is required to bundle the related activities into three major work units based on the size and work load quantities. Work packages can be classified as follows:-

- Residential Micro Pocket
- Commercial and Bulk Solid Waste Handling
- Mechanical Sweeping of Main Roads

Further all these above packages should include sweeping of streets and cleaning of drains within the package boundary.

Steps involved:

I. Clear demarcation of residential, commercial and main road sweeping pockets for carrying out the sanitation and solid waste management activities
II. Clearly defining of job responsibilities and key performance indicators for the service providers
III. Making realistic estimates of resource requirements in rationalized and standardized manner (manpower, transportation vehicles, tools, implements and conservancy materials)
IV. Develop clear resource inputs and results-outputs correlations to achieve standard service delivery results across the ULBs in a uniform manner.
V. Identifying and developing clear wok quantities, key performance indicators and performance monitoring mechanisms, in the event of outsourcing complete work packages to private agencies

Strategies for handling work packages:

1. Residential micro package

A household is defined as a domestic living accommodation of any type such as: a) any type of a dwelling structure; b) a slum house; c) a multi-floor housing complex of not more than 20 units and also small shops and petty commercial units situated in residential areas. For solid waste collection purpose, each of these households will be counted as one unit. Single residential micro package should consist of a continuous area with 300- 350 of waste generating units.

Residential micro packaging include:-

i. Collection of source segregated solid waste (wet, dry and hazardous waste separately) at the gates / doors of the households, shops, vendors and public places - Daily
ii. Manual sweeping of streets, footpaths, pavements and open spaces and removal of any litter in these areas, and removal of animal carcasses - Daily
iii. Cleaning of and removal of garbage, litter, silt or blocks from the street side shallow surface drains – Daily
iv. Sweeping of main and arterial roads and all the abutting road surfaces, foot paths and paved areas – Daily
v. Sweeping and Litter Collection in Parking Lots, Foot Over Bridges, Bus Shelters, Sub Ways, Traffic Islands, and any other structure abutting the main roads – Daily
vi. Cleaning of Shallow Surface and Storm Water Drains (other than underground sewerage drains)

vii. Observe the places of water logging and water stagnation and clear the clogging garbage and silt for ensuing free flow of water.
viii. Disinfectant spraying, shrubs cutting, removing earthen heaps and or any other vector control activities as specified by the ULB.
ix. Transfer of the collected waste from all the above activities to the points of designated locations such as Transfer Stations, Compost or Material Recovery Yard, Landfill Facility – Daily

2. Commercial and bulk waste handling package

A Bulk Waste Generating Unit is an independent building structure or a building complex which houses a Commercial or Institutional unit(s); a high rise building or a gated community of more than 20 units used for either residential, commercial or mixed purposes. For example, any entity such as a restaurant, bank, chit fund office, educational institution, government or private office, religious place, hostel, hotel, training institute, function hall etc., which generate waste in bulk volumes can be classified as a bulk waste generating source. A group of more than 20 dwelling units located in the same complex used for either residential or commercial purpose will also be classified as a bulk waste generator.

For enumerating bulk waste generating units, each gate at which the waste can be handed over to the waste collector should be considered as one unit. Bulk waste will be collected at the gates of the buildings. It is the responsibility of the building owner on whom the property is registered, to arrange for handing over the waste at the gate of the building to the waste collector. Roadside vending units are to be considered as bulk waste generators and to be enumerated in the respective roads and streets in which they are located. Mobile vending carts are also to be enumerated in the respective streets / roads in which they normally cart for maximum time.

Depending on the size of the commercial activities and the physical spread of these commercial and institutional establishments in the ULB, a ULB can have more than one Commercial bulk waste zone.

3. Mechanized road sweeping

Based on the conditions of the roads and the financial capacity of the MC to bear the costs, specific road stretches can be swept by mechanical sweeping. MC Bhubaneswar shall deploy power driven mechanical sweeping machines for specific stretches

Outsourcing work packages:

Instead of taking workers on contract basis for deployment in Solid waste collection activities, MC Bhubaneswar is required to shift to a system of outsourcing complete work packages to any registered legal entity/ society / contractor / agency that are covered by income tax and other statutory regulations. The system of outsourcing complete work packages is meant for getting the following benefits to the MC as measurable operational results such as better delivery of services; compliance to MSW rules & NGT directives; availing better technology, management methods and capital through private, social sector & CSR participation and overall positive impact on the living environment by mitigating pollution and environmental hazards.

Outsourcing of residential Micro Pocket Work Packages:

For outsourcing micro pocket Work Packages, MC is required to adopt the following steps.

I. The available permanent PH workers on the rolls of the MC are to be fully allocated for all micro pocket management activities in the wards that are identified as high density

low public movement and low density low public movement areas. They should be allocated for the activities such as micro pocket management – (Gate-to-gate solid waste collection, street sweeping, litter collection, drains cleaning, disinfectant spraying, vector control, removal of weeds and unwanted vegetative growth, berms cutting, removal of animal carcasses from residential areas and the main and arterial roads that are part of the micro pocket.), as loaders for secondary transportation and gang Work

II. The remaining micro pockets and the respective wards should be earmarked for outsourcing. The micro pockets that are earmarked for outsourcing are to be bundled into 2-3 work packages, covering the rest of the MC area other than those micro pockets and wards that are identified for services by the MC permanent staff. As an illustration, each work package for outsourcing may contain 80-100 micro pockets. However, MC can decide on the number of micro pocket work packages that can be outsourced, not exceeding three.

Outsourcing of Commercial, Institutional and Bulk Solid Waste and C&D Collection and Transportation

I. Commercial, institutional and bulk solid waste collection and transportation activity shall be outsourced as a complete work package.

II. MC shall suitably make the RFP, following the model RFP and shall procure the services of a competent bidder.

III. Based on the size and spread of the commercial activities in the MC, the required number of packages can be worked out. Municipal Corporations and larger Special Grade ULBs may have 2-3 Commercial and Bulk Waste Wok Packages, whereas other smaller ULBs may have one work package for commercial, institutional and bulk waste collection and transportation. For deciding upon the work packages, MC shall consider the financial viability on the part of the MC to outsource this activity as a permanent arrangement.

IV. As the approximate quantities of C&D waste that need to be lifted and transported to designated places cannot be determined based on some norms, lifting of this component is to be outsourced to the successful contractors as an additional work on rate contract basis. As and when the C&D wastes are to be lifted, the MC will notify the contractors and make payments separately according to the work executed by them. To this effect, MC shall set up a process to enable citizens to approach MC for service at a quantity based fixed rate. The citizen can make the specified amount through a challan and this amount will be transferred to the contractor after completing the lifting.

Outsourcing Mechanical Sweeping

Mechanical Sweeping of the select road stretches based on the road conditions (well paved longer roads) can be outsourced as a complete work package.

MC can follow the decision matrix as given in the following table:-

Table 43: Decision Making Matrix for Outsourcing of Work

Residential Area and Main Roads Sanitation, Solid Waste Collection and Drains Cleaning	Commercial and Bulk Waste Collection and Transportation	Mechanical Sweeping

1. Adjust all the available permanent workers to as many micro pockets as possible 2. Outsource the remaining micro pockets	Outsource	Outsource
- In case, where outsourcing the works as independent work packages is not possible, create one package for outsourcing after adjusting the existing permanent workers to as many micro pockets as possible. - Where Mechanical Sweeping is not feasible, this package need not be considered as the sweeping and litter collection in the major road areas will be carried out by the respective micro pocket workers		

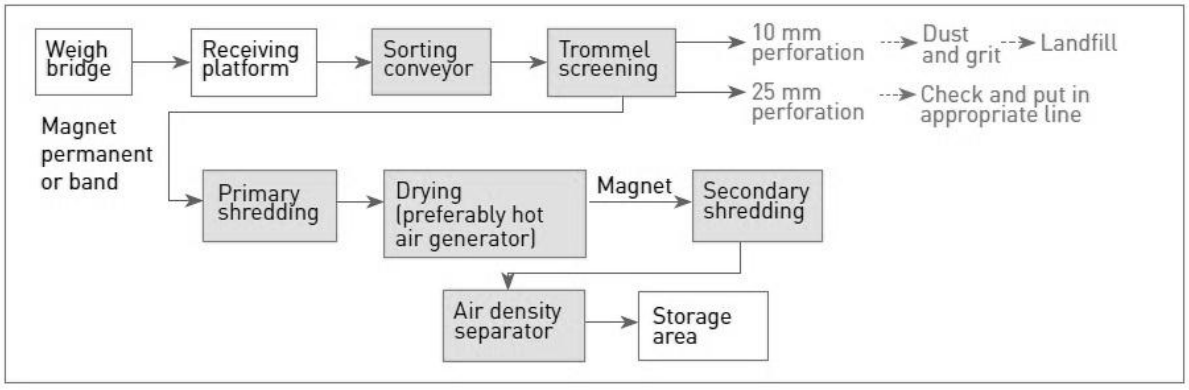
- MC should issue separate government orders / guidelines for levy of user fee in the form of SWM Cess.
- MC is required to identify suitable locations for depositing the collected waste from the processes as detailed above by the contractors / MC sanitation workers teams.
- Ongoing monitoring of the field activities that are carried out by the MC staff and the outsourced agencies by the senior officials of MC under the management and supervisory guidance of the Commissioner is an important component.

- Municipal Commissioners are required to ensure implementation of the guidelines issued for micro planning, micro pocket management, bulk waste handling, street sweeping etc., without fail.
- Penalties will be levied on the citizens / repeat violators, if they
  - Fail to handover waste, despite the visit of the service provider Fail to handover waste in segregated manner
  - Resort to public littering.
- Municipality should conduct training and capacity building for responsible personnel and agencies for solid waste management. Community IEC should also be conducted on regular basis.

7.3.2 Solid Waste Management Technologies

Material Recovery Facility

Figure 28: Indicative Material Recovery Facility and Pre-sorting Facility dedicated to Dry waste



Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume II, Government of India.

Salient features of Material Recovery Facility

- Depending on the scale of operations and the level of mechanisation in the facility, MRFs may be classified as manual or mechanised.
- Usually small- scale units, manual MRFs largely employ manual sorting practices and are typically owned, managed, and operated by the informal sector.
- Mechanised MRFs are large facilities with sophisticated systems and equipment that enable efficient separation of large quantity of material into different fractions.
- Dry segregated material is received in a mixed form consisting of a combination of fibres (paper, card board, mixed paper, magazines, etc.) and commingled containers (plastic, glass, metal, etc.), among other materials.
- The first stage of processing typically uses manual labour or equipment that separate material into various streams (fibre, paper, plastic, containers, etc.).
- Land Requirements:
  - 500 m for facilities dealing with 100 TPD or more of MSW
  - 400 m for facilities dealing with 75–100 TPD of MSW
  - 300 m for facilities dealing with 50–75 TPD of MSW
  - 200 m for facilities dealing with 10–50 TPD of MSW
  - No buffer zone for facilities dealing up to 5 TPD of MSW
  - No buffer zone for decentralised plants handling less than 1 TPD of MSW (but adequate environmental controls are required)
- Different process or stages and equipment employed in material recovery facility are shown in table below.

Table 44 Stages of Material Recovery Facility

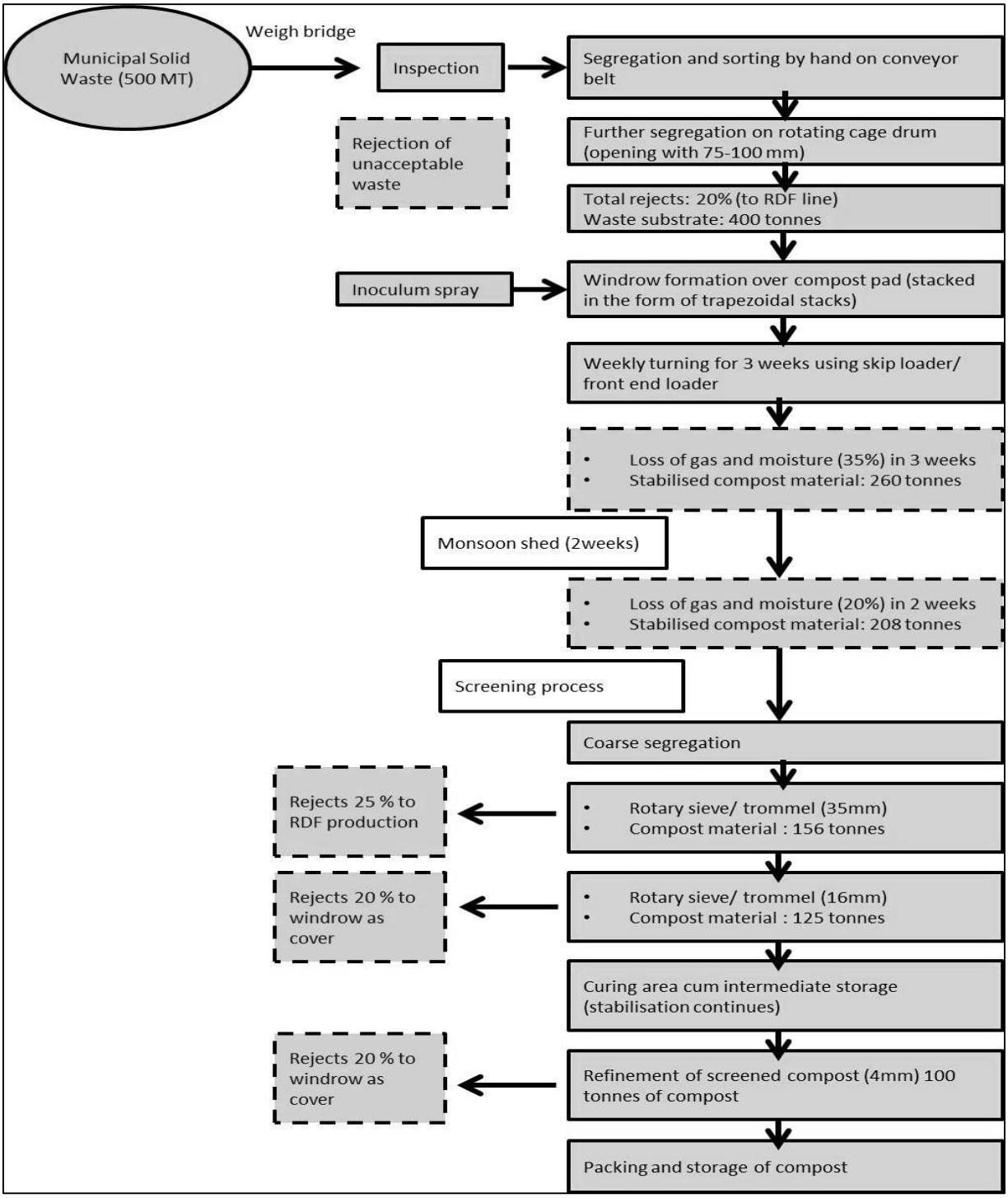
PROCESS OR STAGES	EQUIPMENT
Pre-sorting material handling equipment	• Belt conveyor • Screw conveyor • Apron conveyor • Bucket elevator • Drag conveyor • Pneumatic conveyor
Ferrous metal separation	• Magnetic separator and screening
Screening	• Disc Screening
Air classification	• Horizontal air classifier • Vibrating inclined air classifier
Non-ferrous metal separation	• Rotating disk separator
Size reduction	• Can densifier • Can flattener • Glass crusher • Plastic granulator • Plastic perforator
Pollution control	• Dust collection system • Noise suppression devices • Odour control system

Other fixed equipment	• Fixed storage bin • Live-bottom storage bin • Floor scale for pallet or bin loads • Truck scale

Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume II, Government of India.

Windrow Composting

Figure 29: Process Flowchart and mass balance for anaerobic windrow composting of 500 MT per day of waste of waste



Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume II, Government of India.

Salient Features of Windrow Composting: -

- Land Requirements:
  o 500 m for facilities dealing with 100 TPD or more of MSW

- o 400 m for facilities dealing with 75–100 TPD of MSW
- o 300 m for facilities dealing with 50–75 TPD of MSW
- o 200 m for facilities dealing with 10–50 TPD of MSW
- o No buffer zone for facilities dealing up to 5 TPD of MSW
- o No buffer zone for decentralised plants handling less than 1 TPD of MSW (but adequate environmental controls are required)

- Composting in coastal/high rain- fall areas should have a shed to prevent waste from becoming excessively wet and thereby to control leachate generation.
- Land requirement: - For 300 TPD of segregated/pre-sorted MSW: 5 ha of land including buffer zone is required.
- Upto 500MT of waste can be managed by a single facility.
- High requirement of segregation prior to technology
- If only composting is done the about 30% of rejects including inert materials are obtained. If RDF facility is located in same plant then percentage of rejects can be reduced to 15%.
- Capital cost comes up to 15-20Cr for a 500 TPD plant. I.e. around 3-4 lakhs per tonne.
- Quality of compost should be compliant with FCO 2013. It has a good market potential.
- Windrow composting is labour intensive. It required technically qualified and experienced and semi-skilled staff.
- Atmospheric pollution is low. Only odour issues.
- In high rainfall areas, the windrow need to be covered either temporarily or permanently to control leachate generation. However, the design of the shed should be such that good natural ventilation is maintained.
- Fire and safety issues should be taken care of.[30]

Vermi Composting

- Vermicomposting is the process of composting the biodegradable fraction of MSW with the help of earthworms, resulting in the production of vermicompost which can be used in agricultural fields as a soil conditioner and nutrient supplier.
- Vermicomposting draws better market price as compared with compost and, in addition, sale of worms can bring in additional revenue.
- Vermicomposting is typically suited for managing smaller waste quantities.
- Land Requirements:
  - 500 m for facilities dealing with 100 TPD or more of MSW
  - 400 m for facilities dealing with 75–100 TPD of MSW
  - 300 m for facilities dealing with 50–75 TPD of MSW
  - 200 m for facilities dealing with 10–50 TPD of MSW
  - No buffer zone for facilities dealing up to 5 TPD of MSW
  - No buffer zone for decentralised plants handling less than 1 TPD of MSW (but adequate environmental controls are required)
- Composting in coastal/high rainfall areas should have a shed to prevent waste from becoming excessively wet and thereby to control leachate generation.
- Land Requirement: - For 20 TPD of segregated/pre-sorted: 1.25 ha.

[30] Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume I, Government of India.

- 1 TPD – 20 TPD quantity of waste can be managed in single facility. Higher capacities can be also planned but then the land requirements become very high.
- Very high requirement of segregation prior to technology
- 30% of the rejects including inert materials are rejected.
- Capital cost comes up to 1Cr per 20 TPD plant i.e. around 5 lakhs per tonne.
- By-product has Good market potential in urban and rural areas.
- Vermi-composting is labour intensive. It required technically qualified and experienced and semi-skilled staff.
- Very low leachate problems.[31]
- Following are some vermin-compost problems, possible causes and solutions.

Table 45 Problems and solutions to vermicomposting issues

PROBLEMS	POSSIBLE CAUSES	SOLUTIONS
Foul odour	Overfeeding	Remove the excess food, remove meat or dairy products if any
	Not enough air circulation or anaerobic	Fluff up or loosen bedding
	Bed too wet	Add bedding to absorb moisture
Flies	Waste exposed	Bury the waste completely
Ant infestation		Immerse the base or feet of the vermi bed in water
		A barrier of chalk or petroleum jelly may repel the ants
		If bedding seems dry, add water
Mite infestation		Avoid adding foods with high moisture content
Worms are dying or crawling away	Bed too wet	Do not water till it reaches appropriate moisture
	Bed too dry	Sprinkle water till it turns moist
	Excess temperature, not enough air, not enough food	Sprinkle water till it turns moist and temperature drops, add waste appropriately
	Bed packed tightly	Turn bed and make it fluffy

Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume II, Government of India.

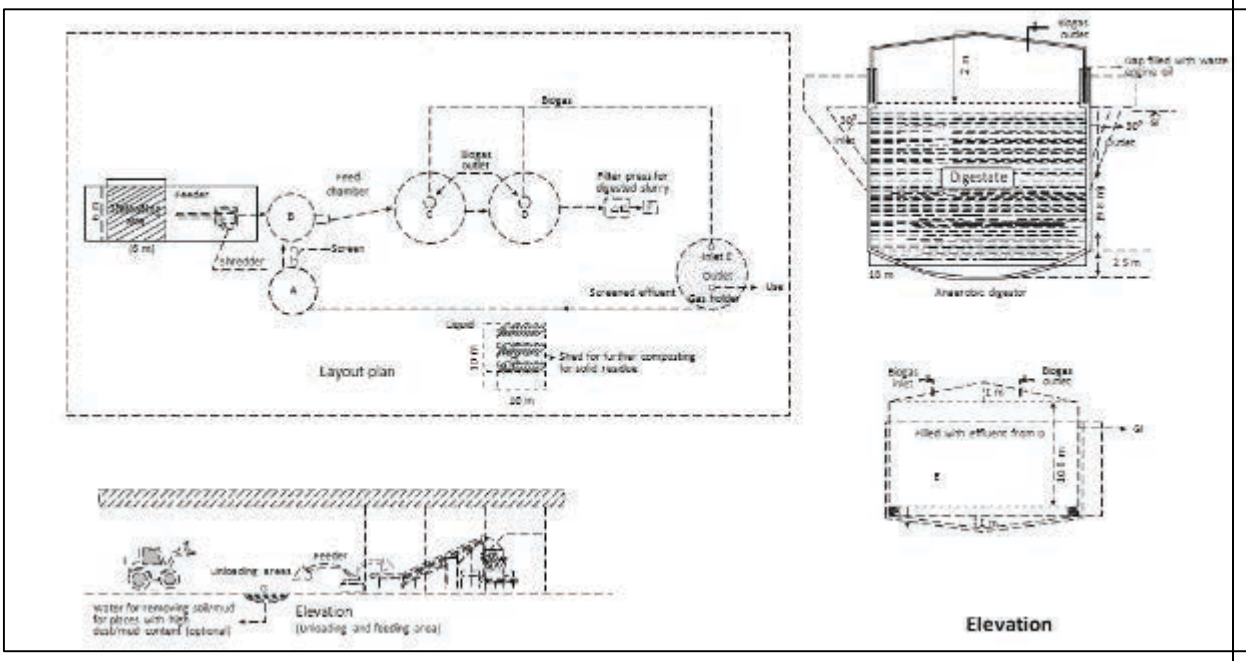
Bio- Methanation

- Land Requirements:
  - 500 m for facilities dealing with 100 TPD or more of MSW
  - 400 m for facilities dealing with 75–100 TPD of MSW
  - 300 m for facilities dealing with 50–75 TPD of MSW
  - 200 m for facilities dealing with 10–50 TPD of MSW
  - No buffer zone for facilities dealing up to 5 TPD of MSW
  - No buffer zone for decentralised plants handling less than 1 TPD of MSW (but adequate environmental controls are required)

[31] Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume I, Government of India.

- Land Requirement: - For 300 TPD of segregated/pre-sorted: 2.5 ha.
- 1 TPD can be managed at small scale 500 TPD can be managed at larger scale.
- Very high requirement of segregation prior to technology
- 30% of the rejects from mixed waste are rejected.
- There is a potential for direct energy recovery
- Capital cost comes up to 75-80Cr for 500 TPD plant i.e. around 15-16 lakhs per tonne.
- Biogas generated can be used for generation of electricity which can be used for illumination of market premises and other bulk wet waste generators which supply raw materials for the plant
- Bio-methanation is less labour intensive which require only technically qualified and experienced staff.
- Leakage of biogas and fire and safety issues to be taken care of. [32]
- General plan and elevation for 50 TPD is shown below, however it is only for illustration purpose and will change according to quantity and type of waste.

Figure 30: Bio-methanation plant for 50 TPD of waste

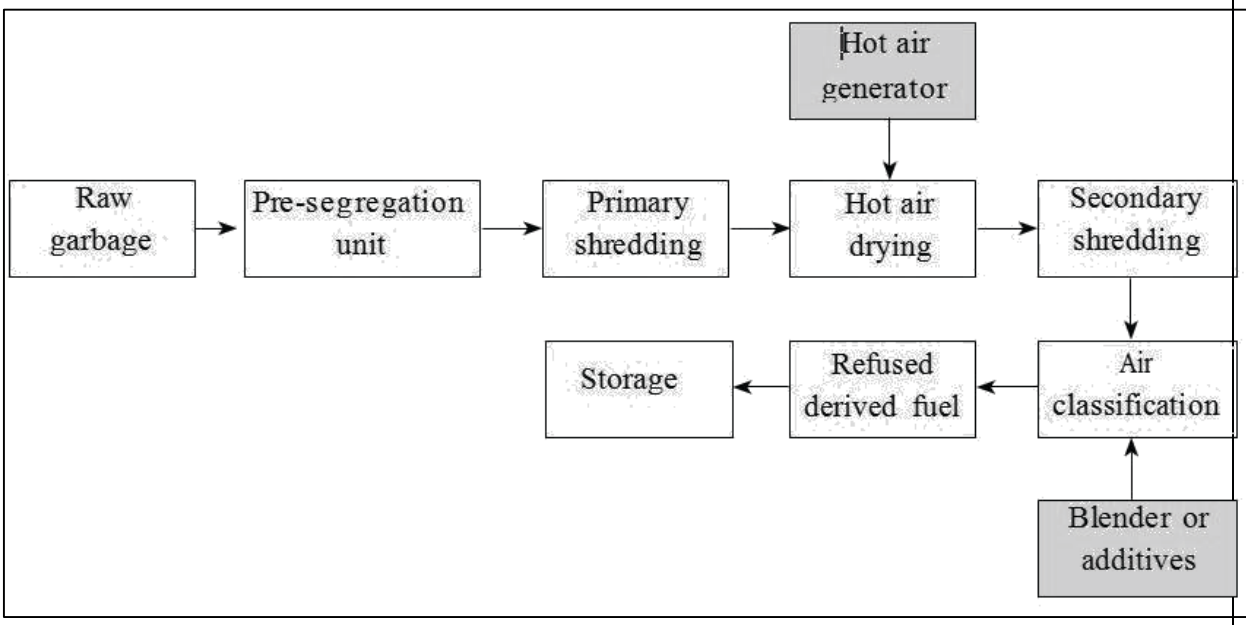


Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume II, Government of India.

Refused Derived Fuel (RDF)

[32] Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume I, Government of India.

Figure 31: Refused Derived Fuel production line (Palletization).



Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume II, Government of India.

- Land Requirements:
  - 500 m for facilities dealing with 100 TPD or more of MSW
  - 400 m for facilities dealing with 75–100 TPD of MSW
  - 300 m for facilities dealing with 50–75 TPD of MSW
  - 200 m for facilities dealing with 10–50 TPD of MSW
  - No buffer zone for facilities dealing up to 5 TPD of MSW
  - No buffer zone for decentralised plants handling less than 1 TPD of MSW (but adequate environmental controls are required)
- Land Requirement: - For 300 TPD of segregated/pre-sorted: 2 ha.
- 100 TPD and above of segregated waste can be managed in a single plant facility.
- High requirement of segregation prior to technology
- 30% of the rejects from mixed waste are rejected.
- No direct potential for energy, but RDF is an excellent fuel for burning in other industries like cement.
- Capital cost comes up to 17-20 Cr for 500 TPD plant.
- Good market potential for RDF especially for the areas where cement plants are located in radius of 100km.
- RDF is labour intensive which require only technically qualified and experienced staff.[33]

[33] Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume I, Government of India.

7.4 Reuse Options for FSM

Co-composting Technologies

Two main types of composting systems are generally distinguished: 1) open systems such as windrows and static piles and 2) closed 'in-vessel' systems. These in- vessel or 'reactor' systems can be static or movable closed structures where aeration and moisture are controlled by mechanical means. Such systems usually require an external energy supply, either by electricity or through decentralized electricity generators, whereas the latter is often provided by diesel engines. In general, in vessel or reactor systems require higher investment compared with static systems and are also more expensive to operate and maintain. Static composting systems on the other hand, require much lower investments and are hence the preferred option for composting in developing countries. Among them, windrow composting is the most commonly applied system.

The identification of the best-suited option for composting depends on numerous parameters. The main choices to be made are related to a) scale (household, community, commercial), b) input materials, c) business models (public, private or combined), d) demand and market situation, e) Investment and operation cost, f) technology option and equipment, f) standards and legal framework and g) environmental and health concerns as shown in Figure 5. Decision-making has to be done on a case-by-case basis aiming at the highest possible cost- and co-benefits and sustainability level for the operator, community, stakeholder and the environment.

Different technological options are available to establish a specific composting project, as presented in Composting Technologies - their advantages and disadvantages:

Table 46Composting Technologies - their advantages and disadvantages

Key Features	Advantages	Disadvantages
Static Pile		
Static piles are the simplest form of composting Typically larger than heap size whereas heaps are usually not turned Generally ideal for feedstock with larger particle size and higher porosity	Requires minimal management and equipment Aerobic conditions can be achieved if the porosity in the initial pile is high (>60%) and if there is a high proportion of bulking materials to keep pores open for air exchange	While simple, this method takes longer to produce matured compost; the final product is often quite heterogeneous due to the lack of mechanical treatment and physical breakdown of feedstock during the process. Anaerobic conditions can occur in the core of the heap which can also result in odor emissions
Trench and Pit composting		
Characterized by heaps which are partly or fully contained under the soil surface Structuring the heap with bulky material or turning is usually the choice for best aeration In some cases, composting materials are completely buried	Requires low capital investment Requires less moisture, thus suitable for dry areas	Control of leaching is difficult in trench or pit composting Monitoring the composting process is difficult The process is labor-intense, especially digging of the pit and emptying it

in the trench which then serves as a planting bed		
Aerated static pile/heap		
Aerated static pile (ASP) composting is comprised of forcing (positive) or pulling (negative) air through the pile. In a static aerated pile, a 15-30 cm thick layer of finished compost or wood chips is placed all around the MSW pile to provide insulation. This arrangement minimizes odor generation and also leads to uniform sustained heating of waste leading to destruction of plant pathogens and weed seeds The ASP can be used together with other composting technologies at the curing stage	The land requirements for this method are lower than that of windrow composting The technology allows for capturing and treating air to reduce odor generation Large volumes of feedstock can be treated with the help of aeration systems	The primary disadvantage of using this technology is the lack of mechanical agitation, which slows down physical breakdown of materials Usually suitable for feedstock of similar consistency and homogeneity The compost pile/heap can dry out quickly and therefore requires regular monitoring The aeration system may require capita-intensive installations
Windrow composting		
The material is piled up in heaps or elongated heaps (called windrows) Suitable for outdoor composting in piles that rely on passive, manual or mechanical aeration Some portions of waste piled up in the windrows may not be exposed sufficiently to a temperature of over 55 °C for a period of 7-10 days	Can be low cost Windrow composting produces the highest volume reduction compared to static piling (passively aerated with minimum turning) and forced aeration (static aerated pile) Introducing air mechanically speeds up the composting process and greatly reduces emissions of methane Methane emissions from windrow composting are comparably lower, e.g. passively aerated piles produce higher methane emissions (x100) than windrow turned piles whereas forced aeration piles produced even 1,000 times greater methane emissions	Anaerobic conditions could occur in the core of large piles or windrows, and together with a larger emitting surface, could result in odor generation Such plants often experience resistance from the community where they are set up ƒ Should be sited with consideration of the risk of odor Workers are in close contact with material during composting The minimum windrow/pile size must be 3 m3
In vessel- enclosed composting		
Refers to a group of composting systems, which range from enclosed halls to tunnels and containers, rotary drum or bins Often have one exhaust air outlet	Allows easy collection and discharge (through a chimney) or treatment of air (e.g. bio filter) to minimize emissions of odors and greenhouse gases Operating temperature is uniform, more efficient in sterilizing the compost compared to open composting	More costly than other units and, in addition, more equipment maintenance is required Skilled labor required for operation and maintenance Comparable higher investment cost and energy consumption Additional cost for operation and maintenance

	techniques ƒ Production of leachate is low (can be recycled if any) Requires less processing time (2-3 weeks) and less labor Less land requirement Effect of weather on the composting process is limited Public acceptance of the facility is higher	There is a need to treat exhaust air
Vermi-composting		
A non-thermophilic, bio oxidative process that uses earthworms and associated microbes to transform organic waste into rich humus, similar to compost Local varieties of both surface and burrowing earthworms can be used In broad-scale vermiculture, the earthworms are introduced to organic waste piled in elongated rows that are covered with protection layers to prevent water logging Appropriate process indicators are survival rate, biomass production and reproduction of earthworms	Both pathogens and weed seeds can be destroyed in the intestines of worms during vermicomposting. Protozoa and fungi are important parts of their diet The earthworms mix, grind, aerate, fragment and digest waste Vermicomposting hastens the decomposition process by 2-5 times Produces much more homogeneous materials compared to thermophilic composting It is particularly suited to urban agriculture because it can be applied in a variety of settings and at different scales	A pre-composting may be required before earthworms are added to the mixture Tolerates temperatures between 0 and 40 °C with pH of 7, while optimal growth is at temperatures from 25-40 °C Optimal moisture content: 40-45%. Higher moisture content may result in the death of earthworms Organic matter is rich in nitrogen Sorting is required after composting to allow removal of earthworms Earthworms may die when conditions are unfavorable; e.g. anaerobic They may be affected by pests/mites

All composting technologies allow production of a safe recycling product but require variable processing time, process control, human and financial resources while having different impacts on the environment and health. The degree of compost stability attained within a certain time is a key indicator which can be used to compare different composting techniques. Decomposition of organic matter through composting can be achieved in the presence or in the absence of oxygen. Therefore, different composting methods involve either aerobic (with oxygen), anaerobic (without oxygen) phases and sometimes even alternate between the two during the decomposition process. Under anaerobic conditions, composting is often achieved at mesophilic temperatures with the disadvantage that the process temperature may be too low to efficiently eliminate pathogens that are especially present if organic input materials from municipal waste management, manures and faecal sludge are utilized for composting. Anaerobic conditions may also generate strong odors which could pose a major nuisance in urban areas. Conversely, under aerobic conditions, composting is achieved at thermophilic temperatures due to the accelerated growth rate of bacteria that results in a higher biodegradation rate of the waste. As a result, pathogens are more quickly eliminated. A composting facility which is not well managed could

generate odor that can expand over a radius of 2 to 3 kilometres (km) around the plant and bother residents.

So one should use/undertake implementation of co-composting technologies based on above discussed points.

Other reuse technologies which can be explored apart from co-composting are Biochar and Black Soldier Flies (BSF)

Biochar

The term charcoal refers to the carbon-rich material obtained from heating wood or plants anaerobically. Biochar is charcoal produced for mixing into soil. Technically, biochar is nothing but a new term for charcoal that is intended for application to soils as a soil amendment and or carbon sequestration

Process

There is a cycle in nature wherein plants use solar energy to covert carbon dioxide into biomass. Biomass is then transformed into biochar thereby producing energy and other co-products. Approximately 50% of the carbon remains in the form of biochar acting as a soil conditioner and delaying release of carbon into atmosphere by 1000 to 2000 years.

Biomass can be transferred to biochar through three processes: slow pyrolysis, fast pyrolysis and gasification. The plant takes faecal sludge along with carbon rich materials like coffee husks. They are subjected in the ratio of 7:3 for a smooth charring process. The faecal sludge has a lot of moisture content in it. It is dried down to a moisture content of 30-35% with the help of using the energy deriving from the carbonizer. In carbonizer a direct pyrolysis happens at temperatures of 300-600°C. Direct pyrolysis here refers to no steering through external heating of the chamber but through the heat generated from the pyrolysis process only.

The material is fed into a reactor after being transferred from a drying belt with the material flow being vertical and the ember remaining on top of the added material.

The hot fumes that originate from the process are redirected from the carbonization chamber and for further processing in a catalyst chamber, where the gases, for example carbon monoxide (CO) is burned.

Simultaneously, cooling of the whole system is maintained by circulating water through the drying component of the plant and thereby, drying the sludge at a temperature of 40-55°C.

The output of the plant, 30 kg per 100 kg of the mixed input material (70% Sludge, 30% carbon rich material), is a fine crumbled charcoal, with a carbon content of 55%.

The carbonizer unit faces problem of sand content. Directly drying faecal content on sand bed is thereby not an option as it was in co-composting. However, a geotextile or filter bag can be sandwiched between sand and the put in the bottom to separate the sand from the drying material if we choose to use drying beds for dewatering.

The plant is equipped with sensors for temperature and can be steered via computer and monitored via Wi-Fi. The plant needs to be under constant surveillance to be able to remove disturbance, such as stones getting stuck in the spiral conveyor.

Outputs

The biochar process results into three outputs:

Biochar (Solid): The charcoal as the main product is currently not sold, but the price is estimated to be in the range of Rs. 9 to 13 per kg. Slow pyrolysis results into high amounts of biochar in comparison to other processes.

Bio-oil (Liquid): Bio-oil is a synthetic fuel being worked upon as a potential substitute for petroleum. It is a kind of tar with high level of oxygen. Fast pyrolysis gives 60% gas and 20% biochar and syngas each. Bio-oil is not a ready to use product. It requires further up gradation into a special engine fuel or syngas and then bio-diesel for making it usable (Zafar, 2015).

Syngas (Gaseous): Also called synthesis gas, syngas is a mixture of fuel gas consisting primarily of carbon monoxide, hydrogen, and very often some carbon dioxide. It is mainly used in electricity generation. Being combustible, it can be used as fuel of internal combustion engines.

Leachate: The leachate obtained from the dewatering process is a valuable output too. If treated properly and applied in adequate doses, it can be an excellent fertilizer. On the contrary discharging it into water bodies would lead to eutrophication.

Costs

The cost of the whole plant is estimated to be around Rs. 30, 48,000 per annum, including two labourers and the energy costs. The energy needed is 4 kW; 1 kW for each of the two exhausters alone, in addition to the consumption in feeding and transporting mechanism (spiral conveyors, belt) and the steering equipment. The cost of a similar machine used in India for pyrolysis of tires is Rs. 55, 00,000.

The salary of composting workers is around Rs. 9,000 to Rs. 10,000. The plant can scale up through adding more carbonization chambers with one chamber being able to process 70kg of solids per hour. The plant size is suitable for towns with a population of 30,000-40,000 people.

Snake and scorpion bites: Charcoal attracts reptiles like snakes and scorpions and can pose a threat to life of farmers. It might result to increased deaths, effect on saving and income due to medical expenditure and reduced productivity.

Benefits

Farmers

- **Higher pH of soil:** Biochar can be used as a buffer for acidic soils, improving the pH and thus increase nutrient uptake for plants. It brings down the minute cost incurred for liming agents.
- **Increased resistance against crop diseases:** Biochar can buffer the soil and increase their resistance against crop diseases.
- **Enhance microbial population:** Biochar has a significant impact on population of healthy microbial organisms in the soil. It also results create a suitable environment for earthworms.
- **Absorption of harmful elements:** Biochar is known to absorb harmful chemicals like phytotoxins and nitrification inhibiters.
- **Increased plant uptake of fertilizer:** Soil requires at least 3% carbon in them to make fertilisers use adequate enough to recover the initial investment. Biochar can act as a substrate for nutrients and raise efficiency of plants to uptake the fertilisers used. This will bring down the overall cost of fertiliser and reduce the damage caused by fertilisers on the soil.
- **Increased nutrient holding capacity:** Compost increases the **cation exchange capacity (CEC)** of soil increasing the nutrient holding capacity of the soil. The increased supply of nutrients to the soil reduces the expense on additional artificial fertilizer to fulfil those requirements.
- **Lower expenditure on Fertilizers:** Farmers are highly dependent on fertilizer for agriculture production. This has led to a surge in fertilizer prices since its introduction in India. Using biochar, the fertilizer requirement will come down due to better absorption from the current supply of nutrients.
- **Improved germination of seedling:** Biochar is known to have positive effects on germination of seedling.
- **Higher water retention capacity:** Biochar altered soil increases the capacity of soil to hold water, thus reducing cost of irrigation and letting crops survives in drought like situation.

The table below describes various effects that biochar has on property of soil as a result of certain property of biochar.

Effect of Biochar on Soil, Plant and Environment

Property	Effect	Biochar property
Soil		
Organic matter	Increased	High C content
Water-holding capacity	Increased	Porous structure
Porosity	Increased	Porous structure
pH	Increased	Alkaline nature
Cation exchange capacity (CEC)	Increased	Specific surface area
Plant		
Crop yield	Increased	Soil organic matter, pH, bulk density, CEC, high porosity
Plant productivity	Increased	Colour, P and K cycling
Environment		
CH_4 emissions	Decreased	Porous structure, pH
N_2O emissions	Decreased	Recalcitrant, porous structure
Carbon sequestration	Increased	Recalcitrant or stable C; black carbon (BC) resists decomposition
Nutrient leaching	Decreased	Porous structure, surface area and negative surface charge

Public

- **Reduced Green House Gases:** The biochar results in retention of as much as 50% of the carbon from escaping into the environment. The carbon gets locked down for 100s to 1000s of years. Lower CO_2 results in lowering of global warming and all the problems caused by it. It reduces the risk of many diseases caused by increased temperature and CO_2 in the air. Every 1% increase in retained Soil Organic Matter (SOM) through biochar, 100 tons of atmospheric CO_2 will be taken out from environment. Other than CO_2, biochar also reduces emission of nitrous oxide (N_20) by 50-80%, Nitrogen Oxide (NO_X) and Methane (CH_4) from soil. Gases like nitrous oxide are 310 more potent as a greenhouse gas then CO_2.
- **Reduced groundwater contamination:** Increased quantities of biochar in soil will lead to higher absorption of agriculture chemicals and other fertilisers and thus reduced groundwater contamination.
- **Reduced eutrophication and bioaccumulation:** Eutrophication is a result of fertilisers being washed off in rain to river bodies. Biochar will help absorb a great part of the

fertilisers applied and thus result in less eutrophication. Biochar is the best method when it comes to absorbing nutrients in all the three methods and thus has the greatest impact.

- **Energy generation:** Biochar production produces bioenergy in two forms: syngas and bio-oils. These can be further processed and upgraded into biodiesel and gasoline substitute thereby reducing pressure on fossil fuels. Syngas can be put into use directly in gas turbines or be processed to produce ammonia, synthetic natural gas and other energy sources. Syngas also has the potential to replace petroleum as a material to create certain products and chemicals from it. Bio-oil is a substitute for heating oil or fuel oil. It also has the potential to be used in a bio-refinery where valuable chemicals and compounds are extracted and the remainder is upgraded to fuel or syngas.

Government

- **Aid in solving energy crises:** The government can take care of the energy crises through biochar while taking care of faecal sludge at the same time. It proves to be a better alternative on this aspect than compost since its energy producing outcomes is greater in quantity.

Limitations

- **Skilled labor required:** Operating a biochar plant requires people with in-depth technical knowledge of the field. The search cost and the salary paid would be higher in comparison to what was paid earlier.
- **Further processing:** Bio-oil cannot be used directly and needs to be processed further to be made usable. This would require further cost and labor charges.
- **Only long term benefits:** Biochar does not reveal short term benefits and thus, can be used only by farmers who are financially able enough to experiment with it and afford to take long term benefits.

Black Soldier Flies (BSF)

Black Soldier Flies in their pupae stage uses organic waste and produce some compost as a result that can be used in small scales in farms or gardens.

Process

An adult BSF has a sole objective of reproduction. It lays its eggs in decomposing organic matter and dies right after. The male would have already died right after mating. The larva stays in the mix while slowly progressing in its growth stages. After some time they burrow into the mix to complete their development into adults. When the larvae are ready to pupate (around 2 to 4 weeks

after eggs are laid), they secrete their digestive system, lose their mouth, and produce an antibiotic coating. Therefore, unlike house flies, they cannot carry disease between wastes and foods we plan to eat. This also makes them safe to feed to our animals.

Each day BSF larvae can digest up to 15 kg of waste per m^2 of feeding surface area (2 lbs/ft^2). The input used in the current facility in Tamil Nadu for experimental purpose is 10 tons of dry sludge along with 3.5-4 tons other organics.

Outputs

- **Feed for hens and fish:** The BSF larvae or pupae that remains at the end has proved to be a good source of balanced lipids, complete protein and calcium and thus can be fed to one's chickens. They can also be fed to fish and livestock. The larvae are approximately 34% – 45% protein, 42% fat, 7% fibre, and 5% calcium. The protein is priced at Rs. 40 per kg and is the main source of income. It will cover a huge amount of expenditure incurred.
- **Compost:** There is a very little amount of compost left after the process. For every 100 kg, 5 kg of compost is made generally.
- **Biodiesel:** One of the products that can be generated on further processing the larvae is biodiesel which has various energy applications. The pupae obtained from it can be further fractionated into their two parts: protein for animal feeds and fats converted into biodiesel.

Costs

- **Capital and Operating and Maintenance expenditure:** The capital expenditure required to establish a BSF plant is Rs. 3, 71, 80,000. The operation and maintenance expenditure along with other supplementary expenses amount to Rs. 1, 05, 36,000.
- **Pathogen infection:** It has been found through various experiments that black soldier flies is inefficient in eliminating pathogens like Enterococcus spp. and A. sum ova. It might run a health risk for farmers and consumers of the final produce. It can be taken care of with additional expenditure incurred in treating the compost with ammonia sanitization.
- **CO_2 emission:** BSF during composting release a very negligible amount of CO_2. It is not a major concern in comparison to the actual CO_2 emission it is saving.

Benefits

Farmers

- **Nutritious feed:** BSF pupae are a very protein rich feed for chicken and fish. They will result into decreased expense on chicken feed and increased productivity in terms of

eggs. Alternatively, it can be sold in market or directly to farmers as chicken feed or fish food. It will be obtained in the range of 16-40% of the input.

- **Compost:** The process yields small amount of compost that can be used in small area of farming. Thus, a small scale of nutrient recycling happens when using black solider flies for composting. It is generally obtained as a 5% of the input supplied. However, in the plant in Tamil Nadu, the plant operators were able to obtain up to 30% of the input.

Public

1. **Biodiesel:** The larvae can be used to produce biodiesel. Although the process will get a lot more complicated but might result into bringing in profit and making the whole operation sustainable.
2. **Reduced houseflies:** BSF larvae acts as a repellent for many pests and problematic flies like houseflies. Houseflies are responsible for serious diseases like typhoid. Typhoid costs were 100 and 29 US $ to public sector and private sector respectively.
3. **Wound dresser:** BSF shells left can be used as a wound dresser for no healing wounds.
4. **Reduced CH_4 and CO_2 emissions:** BSF have an advantage over other methods like composting when it comes to methane and carbon dioxide production. It prevents anaerobic bacteria from transferring waste into carbon methane and mesophilic and thermophilic bacteria from producing huge amount of CO_2 from waste.

Government

5. **Aid in solving energy crises:** The government can take care of the energy crises through biochar while taking care of faecal sludge at the same time.

Limitations

- **Small quantity of compost:** Agriculture is not the main purpose of using black soldier flies because compost produced through BSF is very low and thus, does not serve the purpose of an entity looking for a technology to produce commercial compost.
- **Winter season:** BSF are inactive during the winters and thus, might not provide a round the year solution for all the places. They might be made active by creating a warm environment through consumption of electricity.

7.5 Business Models for FSM

This write up discusses aspects of effective financial models complementing sustainable sanitation solutions such as revenue/business models, sales channels, equity models which can be implemented at various parts of the sanitation value chain and also to strengthen the faecal sludge management.

1. PPP: Public private partnership Model

Also known as P3 model, is a long term contractual agreement between the government and private entity to provide public services. Under this model the government shares the burden of cost through partnership with private entities. Such financial models have been successful project such as “Bhakra Nangal Dam”, “Akshaya Patra”, “Mars orbital project”, “Kerala tourism” etc.

Table 47 Available Options under PPP model and their details

Type of Model	What is it?	Potential Strength	Drawback
Lease contracts	Private player is responsible for overall service chain, leases the component from public sector based but capital investment done by government	High incentives for operators	Very risky since Private player is responsible for any loss
Concessions	Private player is responsible for entire capital expenditure, operations and maintenance expenditure and public entity only sets norms and monitors	Highly incentives for operators ,effective and efficient systems can be established	Complex contracts, government needs to have better monitoring process and resources for the same.
Build Operate Transfer Model (BOT)	The private player generates capex to build the facility and owns it for the definite time period to generate the returns then transfers the entity to gov.	Reduced commercial risk for private player since only one type of customer is present	Less impact on operations and output
Management contracts	The investment is provided by the government but working capital is provided by private players.	Without transferring the asset to private player operational gains be leveraged.	No autonomy of authority for private player required to efficient returns.
Service contracts	The government contracts out certain parts of its operations/services to private players majorly done for a time period of 1-3 years.	Building of managerial strength and provide quick impact on operations efficiency. Can be monitored easily	Since operator does not source capex, is not effective of other sources of fund such as government funds etc. not available

Other models under PPP are BOO model, DBO model etc. and in the long run the PPP models tend to be more effective.

2. Hybrid Annuity based PPP model

Hybrid version of the BOT model: 40% of project cost paid by the government and 60% of the project cost paid by private party. Private player bears the operations and maintenance and is paid periodically for the service rendered by government and to meet the costs government issues

taxes and tariffs. Service level standards are set and based on the delivery and adherence to the standards the government pays the private players. Major benefits being; reduced initial investment, private player manages the operations, pay only if services are delivered by private party.

Governance and management:

With proper monitoring protocols, regulations and standards supported by effective policies and resolutions, better return on investment is probable in terms of positive social impact. This approach allows creating sustainable business models around each of the components which results in inclusive socio-economic uplift. It is paramount to look at human excreta as a potential resource for the agricultural and energy industry, rather than a problem. With this approach the realization of real sustainable sanitation services is possible.

7.6 Brief about Transfer stations

Transfer stations or underground holding tanks act as intermediate dumping points for faecal sludge and septage when it cannot be easily transported to a (Semi-) Centralized Treatment facility. A vacuum truck is required to empty transfer stations when they are full. Transfer stations reduce transport distance, may encourage more community-level emptying solutions and prevent illegal dumping. The moderate capital costs may be offset with access permits and the construction and maintenance can create local income. However, expert design and construction supervision are necessary.

Operators of small-scale cesspool vehicles discharge the sludge at a local transfer station rather than illegally dumping it or travelling to discharge it at a remote treatment or disposal site. When the transfer station is full, a vacuum truck empties the contents and takes the sludge to a suitable treatment facility. Municipalities or sewerage authorities may charge for permits to dump at the transfer station to offset the costs of operating and maintaining the facility. In urban settings, transfer stations have to be carefully located; otherwise odours could become a nuisance, especially, if they are not well maintained.

Design Considerations

A transfer station consists of a parking place for vacuum trucks or sludge carts, a connection point for discharge hoses, and a storage tank. The dumping point should be built low enough to minimize spills when labourers manually empty their sludge carts. Additionally, the transfer station should include a vent, a trash screen to remove large debris (garbage) and a washing facility for vehicles. The holding tank must be well constructed to prevent leaching and/or surface water infiltration.

A variation is the **sewer discharge station (SDS)**, which is like a transfer station, but is directly connected to a **conventional gravity sewer** main. Sludge emptied into the SDS is released into the sewer main either directly or at timed intervals (e.g., by pumping) to optimize the performance of the sewer and of the wastewater treatment plant, and/or reduce peak loads. Transfer stations can be equipped with digital data recording devices to track quantity, input type and origin, as well

as collect data about the individuals who dump there. In this way, the operator can collect detailed information and more accurately plan and adapt to differing loads.

The system for issuing permits or charging access fees must be carefully designed so that those who most need the service are not excluded because of high costs, while still generating enough income to sustainably operate and maintain the transfer stations.

Table 48: Advantages and Disadvantages of a FS Transfer Station

Advantages	Disadvantages/limitations
- Makes sludge transport to the treatment plant more efficient, especially where small-scale service providers with slow vehicles are involved - May reduce the illegal dumping of faecal sludge - Costs can be offset with access permits - Potential for local job creation and income generation	- Requires expert design and construction - Can lead to odours if not properly maintained

Appropriateness

Transfer stations are appropriate for dense, urban areas where there are no alternative discharge points for faecal sludge. Establishing multiple transfer stations may help to reduce the incidence of illegal sludge dumping and promote the emptying market. Transfer stations are especially adequate where small-scale sludge emptying takes place. In big cities, they can reduce the costs incurred by truck operators by decreasing transport distances and waiting times in traffic jams. Local service providers can discharge sludge at transfer stations during the day, while large trucks can empty the tanks and go to the treatment plant at night when traffic is light.

Transfer stations should be located where they are easily accessible, convenient, and easy to use. Depending on their maintenance, odours could become a problem to local residents. However, the benefits gained from them compared to open-air illegal dumping greatly offset any nuisances.

Health Aspects/Acceptance

Transfer stations have the potential to significantly increase the health of a community by providing an inexpensive, local solution for faecal sludge disposal. By providing a transfer station, independent or small-scale service providers are no longer forced to illegally dump sludge, and homeowners are more motivated to empty their pits/ septic tanks. When pits/ septic tanks are regularly emptied and illegal dumping is minimized, the overall health of a community can be significantly improved. The location must be carefully chosen to maximize efficiency and minimize odours and problems to nearby residents.

Operation & Maintenance

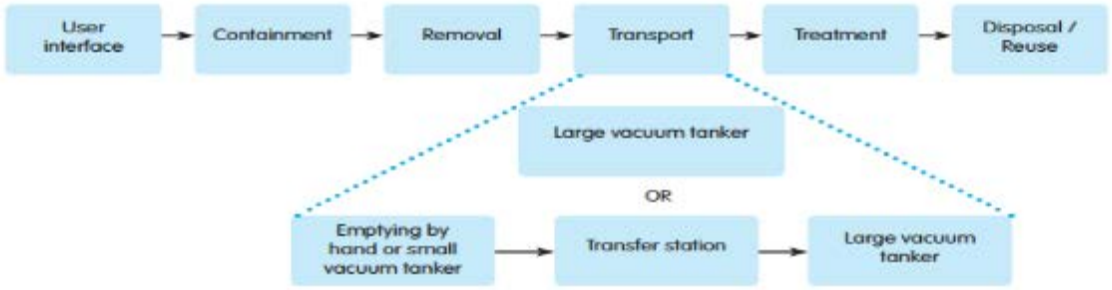
Screens must be frequently cleaned to ensure a constant flow and prevent back-ups. Sand, grit and consolidated sludge must also be periodically removed from the holding tank. There should be a well-organized system to empty the transfer station; if the holding tank fills up and overflows,

it is no better than an overflowing pit. The pad and loading area should be regularly cleaned to minimize odours, flies and other vectors from becoming nuisances.

Upgrading

Transfer stations are relatively common in North America. There, they are equipped with digital data recording devices to track quantities, input types and origin, as well as collect data from the individuals who dump there. In this way, the facilitators can collect detailed information and more accurately plan and adapt to the changing loads.

Figure 32: Process flow of conveyance of faecal sludge through a transfer station



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