List of Abbreviations

CSP	City Sanitation Plan
NUSP	National Urban Sanitation Policy
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
MDG	Millennium Developments Goals
GOUP	Government of Uttar Pradesh
UIDSSMT	Urban Infrastructure Development for Small and Medium Towns
NPP	Nagar Palika Parishad
ULB	Urban Local Body
CSTF	City Sanitation Task Force
HUPA	Housing and Urban Poverty Alleviation
ILCS	Integrated Low Cost Service
IEC	Information Education and Communication
DPR	Detailed Project Report
O & M	Operation and Maintenance
ODF	Open Defecation Free
M & E	Monitoring and Evaluation
NGO	Non-Government Organization
GIS	Geographic Information System
VAMBAY	Valmiki Ambedkar Awas Yojna
ILCS	Integrated Low Cost Sanitation
DFID	Department for International Development
ADB	Asian Development Bank
PPP	Public Private Partnership
TSC	Total Sanitation Campaign
AUWSP	Urban Water Sanitation Programme
BIA	Bureau of Indian Affairs
MOWR	Ministry of Water Resources
MOF	Ministry of Finance
MOEF	Ministry of Environment and Forests
AUSAID-WB	Australian Agency for International Development –World bank Group

EXECUTIVE SUMMARY

Introduction

The sanitation situation in India depicts a very grim picture as Census of India 2011 results have indicated that nearly 17 million urban households (more than 20 percent of the total 79 million urban households) suffer from inadequate sanitation. About 11.88 million households are not connected to any kind of drainage network, 23.28 million households are connected to open drains (*ref: various publications of MoUD, Govt. of India*). This situation has resulted into significant public health issues and very high environmental cost for urban area affecting the country's GDP. The problem is further compounded by the fact that as high as 69% of the waste water generated in urban areas is not treated & is disposed into the water bodies without any treatment due to which three fourths of surface water resources are polluted (*ref: Central Pollution Control Board, 2009*).

Realizing the vastness and implications of this serious environmental and socio economic issue, the Ministry of Urban Development, Government of India (GoI) announced the National Urban Sanitation Policy (NUSP) in December 2008. As directed by the policy, cities are to prepare City Sanitation Plans (CSPs) addressing all aspects of sanitation in the city. JT Urja Pvt. Ltd. has been entrusted with the task of preparation of City Sanitation Plan for Unnao.

Objectives of the City Sanitation Plan in Unnao City

The City Sanitation Plan has been prepared after carrying out a situation analysis and after a structured consultation with stakeholders. The Plan attempts to achieve the following objectives:

- To adopt locally suitable methods, technology and materials, and provide necessary facilitation support to Unnao Nagar Palika Parishad.
- To encourage community and private participation and define their role in creation and maintenance of sanitation infrastructure, thereby ensuring a sense of ownership.
- To ensure coordination between various departments working in the field of water supply and sanitation, such as departments of health, education, public health and engineering, industry, environment, transport, pollution control board, etc.

- To ensure an optimum use of funds allocated by 13th Finance Commissions for solid waste management and other sanitation related projects. To coordinate various externally aided projects for their optimum results.
- To promote novel ideas in mobilization of funds, including reforms in tax regime, public private partnerships, exploring the private market, user charges, beneficiary contribution, etc.

Approach and methodology

The overall work is divided into four broad tasks as shown in the chart and the steps to be taken and deliverables for completion of the tasks are provided below:

Step 1 - Formation of City-level Implementation Committee/Cell
Step 2 - Conduct 1st Consultation
Step 3 - Reconnaissance Survey
Step 4 - Preparation of Situation Analysis
Step 5 - Conduct 2nd Consultation
Step 6 - Preparation of Draft City Sanitation Plan
Step 7 - Preparation of Implementation Plan
Step 8 - Conduct 3rd Consultation
Step 9 - Final City Sanitation Plan

About Unnao

The town of Unnao is the head quarter of Unnao District in Uttar Pradesh, India between Kanpur and Lucknow

The geographical area of the Unnao city is 21.50 Km2 as per census of 2011. It may be noticed that size of the city has increased more than five times during last ten years. The city has 29 wards year 2011. City administration is headed by the Nagar Palika Parishad E.O and Executive Officer.

Population projection

The population is one of the major factors in determining future patterns of progress and development of the city. As per Census 2011 Unnao has population of 177,658 persons. There are 3 commonly used methods to assess population projection namely, Arithmetic Increase method, Geometric increase method and Incremental increase method.

Year	Arithmetic	Geometric	Incremental	Population
2011	177658	177658	177658	177658
2016	199651	201090	206945	202562
2021	219136	227612	210863	219204
2026	237024	257633	228929	241195
2031	256373	291613	247971	265319
2036	274360	330075	267989	290808
2041	293610	373609	288982	318734
2046	300566	422886	310952	344801

Projections of Water Demand, Sewage & Solid Waste Generation

As per recommendations of Section 2.2.8.3 of the CPHEEO Manual, city level water demand has been projected considering 135 LPCD for residential population and sewage generation as 80% of the water demand. Solid waste generation is taken as 350 gm. per capita as prescribed by CPHEEO. Considering the projected population per capita water demand, per capita sewage and solid waste generation, the total water demand, sewage and solid waste generated is calculated for

Year	Population	Water (MLD)	Solid Waste(TPD)	Sewage (MLD)
2011	177658	24	62	19
2016	202562	27	71	22
2021	219204	30	77	24
2026	241195	33	84	26
2031	265319	36	93	29
2036	290808	40	101	31
2041	318734	43	111	34
2046	344801	47	121	38

Situation Analysis

Situation will be analyzed by taking into consideration the ground realities, local conditions, and assessment of the present sanitation situation The Situational Analysis will address all issues like: coverage of sewer network and zone wise STP capacity utilization, status of public toilets, disposal of night soil where sewer connection does not exist, disposal of domestic wastewater/ storm water/ solid waste disposal of wastes of special category.

Water Supply System

In the city, total numbers of water supply connections are 9424, which is only 28.32% of total required water supply coverage. All the available connections are domestic, unmetered and serving to the households only. The total water production capacity of the city is 13.87 MLD, 24 tube wells are located in the various parts of city. People are directly drawn water from 2300 hand pumps. Out of total water production 20% is wasted in leakages and available water to the public is hardly 13.87 MLD, which is supplied to 33273 household.

Gap Analysis

1. Gap in water demand is 10.13 MLD
2. Gap in domestic connection is 23849(72%)
3. Water supply network is 199 kms (31.84%) Required
4. Water treatment plant is required.
5. Quality of water is poor.

Access to Toilet

Under the sewerage and sanitation arrangement information for year 2011-12, Unnao is having 26890 flush toilets and 8 community toilets. So there are 26890 properties (10.0%) out of total 33273 properties.

Gap Analysis

- At present there are 33273 households are exists in which 5656 households does not have toilets in their premises.

- Firstly up gradation of existing 5 toilets is a priority and then addition of more 7-8, 10 Seater for Public Toilets is must.
- Community toilets maximum 143 sulabh complex (10seater) are required for slum population

Sewerage System

The trend of wastewater generation and future projections is calculated based on the sewage return factor taken as 0.8 which indicates that 80% of water supplied returns as sewage. By 2011 the total estimated wastewater generated by 177658 populations is 11 MLD in Unnao city. The total water supplied is 13.87 MLD. At presents only 11 %(32kms) area covered by the sewer network. As of now there is no waste water treatment facility.

Gap Analysis

- At presents only 11 %(32kms) area covered by the sewer network remaining 259kms (68%) required.
- The sewage collection system is not laid to cover all areas of the city. In fact it does not fully cover even the areas for which branch and main sewers have been laid. Sewer connections for each household (33273) are required.
- Sewerage Treatment Plant also required.

Drainage and Storm Water System

There is no provision for storm water drainage system in the city. Storm water drains are severely abused with grey water flows and solid waste dumping. Around 34.7Kms storm water drains and remains 256 area unserved by these drains. The total length of pukka drains is 8.5 km and Kaccha drains are 15km.

Solid waste system

Local residents, Hotels, Restaurants, Bazaar and vegetable markets, Hospital and dispensaries are the major sources of generation of waste at city. About 65.4 MT of solid waste is generated every day in the city.

Solid Waste Management is a critical issue in Unnao city due to spread of area under its jurisdiction. Based on the population of the city, it is estimated that the City generates approximately 65.4 MT of solid waste per day and waste generated per day is .31kg/capita/day. Nagar Palika is capable to clears only 40-50% of the waste through vehicles available with Nagar Palika and staff engaged for the purpose.

Gap Analysis

- 50-60 municipal solid waste not collected.
- Door to door to door collection is missing.
- As peer the standard 1164 bins are required all over the city.
- Proper landfill site are required.
- So most of the people are putting waste in the nearby dustbins.
- Machinery and equipment available with the Nagar Palika are not capable to lift and clear total daily waste generated.

Findings from Primary Survey & Prioritization Workshop

More than 2000 primary survey was carried out across all the wards of Unnao. The survey predominantly concentrated on availability of water and sanitation facility in the city like toilet facility, MSW facility, water source and quality etc. A willingness to pay survey was also carried out as a part of primary survey.

Most of the respondents reported presence of toilet facility at household level. Most of the respondent reported access to individual toilets. However, visual inspection during survey revealed a much higher fraction of disposal of night soil directly in drains. Since most of the respondents surveyed have reported access to individual toilet, a majority of them do not desire any toilet facility. Most of the respondents reported absence of community toilet facility. Community toilets are critical for reaching the goal of open defecation free city.

Disposal of Municipal Solid waste in Open is common in city. A number of respondent reported waste disposal site to be less than 100 meters. Though these are open dumping sites not covered under municipal waste collection system, in absence of a designated waste disposal area it is

common for citizen to dispose waste in nearby areas. Most of the respondents reported absence of designated area of garbage disposal resulting in open dumping being common in the city.

Even Municipal supply of water is extracted from ground water. The current sanitation and waste management practices in Unnao as witnessed earlier are highly detrimental to ground water quality and there is immediate threat of contamination of ground water if preventive measures are not taken. Most of the respondents reported acceptable quality of water. However if the current malpractice with regards to sanitation situation continue, the quality of water is expected to be severely affected in Unnao.

Unnao does not have a centralized sewage system and septic tank is the only source of treatment. The construction of the septic tanks is often faulty leading to contamination of ground water. Most of the respondents were not willing to pay for installation of a sewerage system of the city thus ruling out a PPP approach.

Results of prioritization workshop

A workshop was conducted by the city sanitation task force to:

- ✓ Priorities the goal of CSP,
- ✓ The key issues linked to sanitation situation of the city and
- ✓ The key projects that should be taken up in the city on a priority basis.

The workshop was backstopped by the CSP consultants. The Key findings of the workshop are presented below

Unnao lacks basic sanitation facility like a sewerage system. The city has no sewer line or treatment facility resulting disposal of waste water in river through storm water drain.

Key issues related to sanitation of the city

Members of city sanitation task force and stakeholders were requested to deliberate the key issues related to sanitation of the city. The result of their deliberation is presented. As evident from the graph, absence of centralized sewage collection network and indiscriminate dumping of solid waste in drains and water body were identified as key issue. Both results in contamination of ground water which is the only source of water supply in the city. Hence the stakeholders felt that these practices which leads to contamination of water supply and pose health risk should be addressed immediately.

Since the basic sanitation services like a sewage network and waste treatment facility is missing in the city higher level requirement like a robust institutional framework, financial management system and sustainability of sanitation facilities were not considered to be important by the stakeholders at this level.

Key Projects Linked to Sanitation of the City

At the conclusion, the stakeholders deliberated on the key projects that should be implemented in the city. Understanding that limited funds may be available for implementation of sanitation projects this exercise aimed at deciding on short term, medium term and long term projects.

As evident from the graph, a centralized treatment of drinking water facility followed by PPP approach for improvement of quality of public toilet was given highest priority and it was argued that these projects can be taking up immediately as a short term measure.

Unnao already has some infrastructure with related to drinking water supply and DPR for improvement of quality of drinking water has already been prepared. Since the project has received government sanction and necessary funds are available for the implementation of project activity, the stakeholders felt that necessary action should be taken for fast track implementation of the project activity.

Similarly a number of public toilets exist in the city. However their poor maintenance discourages the user from using the facility and open defecation is common in the city. The stakeholders felt a PPP approach may not be very cost intensive and be implementation can be achieved at a relatively short period of time. This would result in achievement of one of the objective of Urban Sanitation Policy i.e. creating an open defecation free city.

On a medium term a sewage collection and treatment facility was recommended. Understanding that first a detailed project report needs to be prepared and necessary funds needs to be sanctioned for implementation of this large scale initiative the stakeholders agreed to keep the sewage collection and treatment facility as a medium term goal.

Under long term goal the stakeholders agreed to keep initiatives like capacity building, sustainability, institutional strengthening and solid waste treatment facilities. They argued that since the city lakes basic infrastructure there is no logic in conducting awareness campaigns, capacity buildings etc until the basic infrastructure like sewage system is in place.

Information, Education and Communication (IEC) and Capacity Building

The objective of IEC & Capacity Building Strategy for effective implementation of CSP in Unnao is to evolve an effective plan of sustainable programmes for capacity building and sensitization of implementers, education and enhanced awareness for stakeholders specifically citizens regarding sanitation activities in Unnao City. The strategy is designed to:

- Strengthening CSP implementation by Nagar Palika Parishad Unnao (NPP Unnao) through training and capacity building;
- Sensitize citizens for adopting water wastage minimization, segregation & management of solid waste and open defecation free practices through IEC campaign.
- By working at both levels mentioned above a culture of communications and consultations are fostered leading to participation.

Communication needs assessment identified three stages for implementation of Information, Education and Communication strategy for improvement in water and sanitation services. These are 1) Awareness, 2) Process and 3) Compliance. While it is generally understood that these stages would lead to better citizen participation in the schemes, it is in fact imperative for all stakeholders to be appraised from their own specific stand points. Awareness includes an understanding of health and hygiene related education specifically directed towards slums. Equally important is an awareness of municipal officials about the problems face by all the city residents including slum & middle class households and sanitation workers. This awareness is generally taken for granted. Here, we propose that open and specific appraisals be carried out without assuming too much of prior knowledge regarding sanitation issues. Next is to create processes which are essential to maintain improved services. These could include citizen participation in community toilet maintenance etc.

Implementation Strategy

Implementation strategy has been divided in 4 phases starting from immediate to Long term (till 2046). Different actions and resultant awareness generation is detailed below:

Phase I immediate

Action at NPP level

- Finalize the Sanitation Vision for Unnao approved by the Council;
- Initiate the establishment of a permanent management representative responsible for sanitation management;
- Finalize the Inventory of all relevant regulations;
- Initiate the assessment of the training needs regularly and to develop training calendar and program to impart trainings to staff across all categories;
- Budget allocation for training and sanitation activities;
- Initiate the creation of a training database capturing a record of the name, position and function of the employee as well as the content, duration and date of the training programme participated in including participant feedback about the relevance and efficiency of the course to the roles and responsibilities;
- To implement an internal and external communication protocol and train the ULB staff in accordance to the plan;
- Develop Staffing Plan & Strategy and initiate recruitment in accordance;
- Initiate the development of Knowledge Exchange Mechanism among cities using the web based knowledge platform
- Sanitation Awareness Workshop for the ULB staff and elected representatives resulting in identification and prioritization of all sanitation aspects;
- Prepare a City level CSP

Awareness Generation at City Level

- Pilot awareness campaign to be conducted in two (2) wards
- Awareness Campaign strategy to be developed
- Prepare effective IEC material for awareness campaign
- Initiate School Sanitation Workshops
- Initiate workshops on sanitation and related infrastructure
- Involve NGOs to work continuously with the community to bring about change.

- Institutionalize the role of CTF to disseminate the information on sanitation issues, projects undertaken and progress of each component
- Press release of sanitation scenario of the city

Phase II Short Term (2017- 2019)

Action at NPP level

- Finalize the Formulation of HR Policy for the ULB and finalize the Induction Training Curriculum; Finalization institutional reform to strengthen sanitation department;
- Finalize the Knowledge Exchange System;
- Preparation of Annual Training Calendar and Undertake institutional review;
- State level Steering Committee meeting to finalize steps to be taken for strengthening ULBs
- Training Programme and training on Urban Management for the ULB
- Update the City level CSP
- Initiate and finalize DPR for Sewage and Waste Management system for the city.
- Finalize funding mechanism for city wide Sewage system and MSW collection and treatment system

Awareness Generation at City Level

- Involve media in demonstrating healthy sanitation practices
- Finalize school sanitation program – train school children and make them aware of the sanitation situation and need for healthy sanitation practices.
- Create community groups specifically targeting their sanitation needs
- Address the tenure security issues of urban poor which in turn help them build basic services of permanent nature
- Develop Information Management System

Phase III Medium Term (2021- 2030)

Action at NPP level

- Implement city wide Sewage collection and treatment system
- Implement city wide MSW collection and treatment system

- Update and upgrade Training Calendar and Training Programs
- Conduct sanitation Workshops
- Update the CSP
- Create Monitoring & Evaluation Systems for air and water quality
- Create Monitoring & Evaluation Systems for effective implementation and achievement of Goals of CSP

Awareness Generation at City Level

- NPP Unnao and the CSTF have to periodically take feedback from the community groups and provide necessary support.
- Update IEC material and the sanitation awareness programs
- Periodically hold awareness campaign
- Monitor and feedback on sewage and MSW system
- Source segregation of MSW Campaign

Phase IV Long-term (2031 – 2046)

Action at NPP level

- Update and upgrade Training Calendar and Training Programs.
- Update the HR Policies and incentive programs.
- Conduct Sanitation Workshops.
- Update the CSP.
- Update and upgrade Monitoring & Evaluation Systems.

Awareness Generation at City Level

- A long term and permanent effect on awareness can be made by sustained effort from the NPP Unnao and community.
- The CSTF is recognized as a body holding the sanitation campaign for Unnao. The CSTF will also ensure long term influence in the sanitation scenario of Unnao city.
- NPP Unnao and the CSTF have to periodically take feedback from the community groups and provide necessary support.

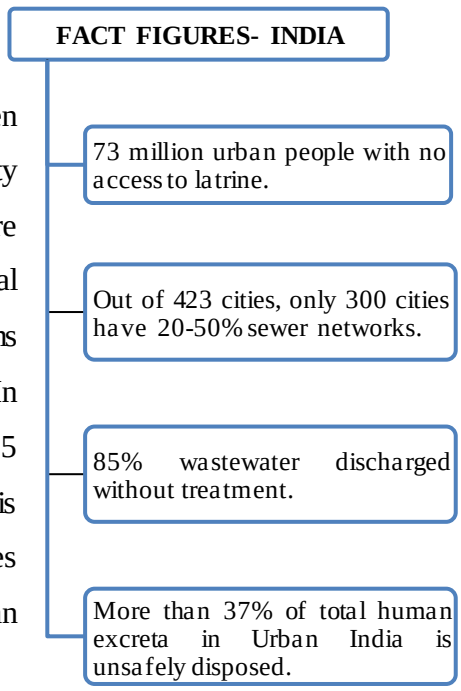
1 INTRODUCTION

1.1 Concept

Sanitation is defined as safe management of human excreta, including its safe confinement treatment, disposal and associated hygiene-related practices.

During the last fifty years the population of India has grown two and half times, while the urban India has grown by nearly five times. According to Census of India 2011, 31.16% of Indians, i.e. 377.1 million people live in urban areas. The Census 2011 also showed that in 4,041 statutory towns, close to eight million households do not have access to toilets and defecate in the open (7.90 million).The positive role of urbanization has often been over-shadowed by the deterioration in the physical environment and quality of life in the urban areas caused by widening gap between demand and supply of essential services and infrastructure. It is further associated with many problems, such as high levels of poverty, environmental stress, risks to productivity, high health costs, lack of access to basic services, such as water supply, sanitation, sewerage system and housing. The insufficient availability of services, inadequate awareness and also poor operation and maintenance has also given rise to poor sanitation conditions.

As per the projections of Registrar General and Census Commissioner, Govt. of India (2006), 73 million urban people do not have access to latrines and practice open defecation with 5.48 million urban households use community latrines and 13.4 million households use shared latrines. More than 75% of surface water pollution is due to municipal sewage. The percentage of notified and non-notified slums without latrines is 17 percent and 51 percent respectively. In respect of septic latrines the availability is 66 percent and 35 percent. In respect of underground sewerage, the availability is 30 percent and 15 percent respectively. This imposes significant public health and environmental costs to urban areas that contribute more than 60% of the country's GDP.



1.2 National Urban Sanitation Policy

Therefore, in 2008 Government of India (GoI) has recognized that there is an urgent need to address the issue to provide environmental sanitation, i.e. solid waste management; generation of industrial and other specialized / hazardous wastes; drainage in the cities and formulated National Urban Sanitation Policy 2008 with the vision of to make

''All Indian cities and towns 100% sanitized, healthy and livable and ensure and `sustain good public health and environmental outcomes for all their citizens with a special focus on hygienic and affordable sanitation facilities for the urban poor and women.''

It is understood that without proper city sanitation plan and resulting state sanitation strategy, as indicated in National Urban sanitation policy-2008 comprehensive planning cannot be achieved.

The Govt. of India had identified 100% sanitation as a goal during 11th five year plan. The Ministry of Urban Development (MoUD) officially launched a country wide NUSP on Nov. 12, 2008 with an objective to call upon individual states to draft their own strategy based on NUSP while taking into account their specific requirements.

The key issues of urban sanitation policy are to address the awareness in poor, social and occupational hazards to sanitation workers, gaps and overlaps existing in roles and responsibilities of institutions at national, state and city levels, full scale integrated safe confinement, disposal and treatment, searching for alternative cost effective and sustainable technological options, reaching to the un-served and poor (non-notified slums) population and needs to demand responsive.

1.2.1 Policy Goals

The overall goal of this policy is to transform Urban India into community-driven, totally sanitized, healthy and liveable cities and towns. The specific goals are:

- Awareness Generation and Behavior Change
- Open Defecation Free Cities
- Integrated City-Wide Sanitation

NUSP GOAL

"Urban India with community-driven, totally sanitized, healthy and livable cities and towns"

- Sanitary and Safe Disposal
- Proper Operation & Maintenance of all Sanitary Installations

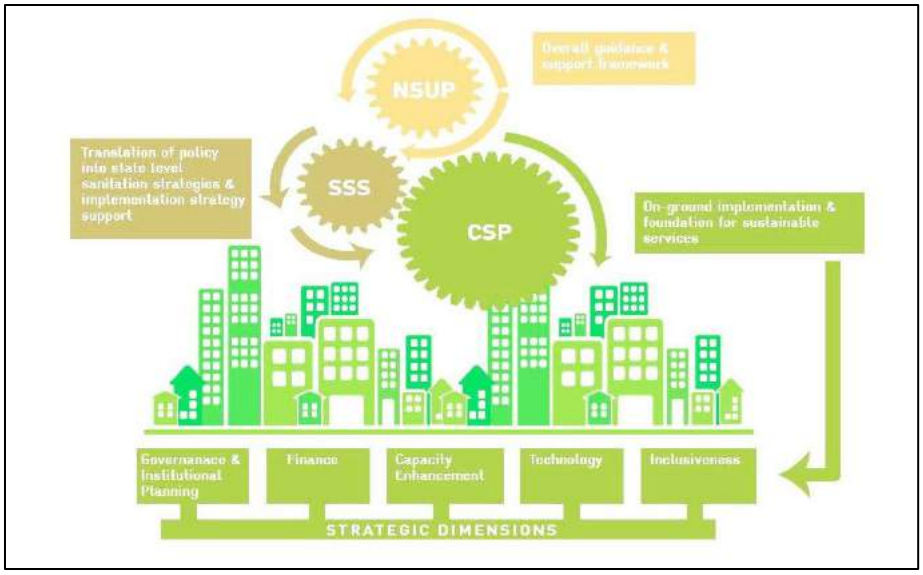
1.2.2 NUSP Planning Instruments

NUSP provides states and cities with a comprehensive set of planning tools that will help in achieving the specific goals of NUSP. The two main instruments are the State Sanitation Strategies (SSS) and City Sanitation Plans (CSP), both vision documents to drive economic, social and environmental development:

State Sanitation Strategies (SSSs): Sanitation is a state subject. Hence, NUSP requires states to develop state sanitation strategies that define clear objectives and approaches to improve sanitation across the state.

City Sanitation Plans (CSPs): City Sanitation Plans are sector-planning instruments developed in synchronization with the SSS. CSPs guide Urban Local Bodies in achieving citywide sanitation through coordinated development, prioritization and optimization of investments in sanitation infrastructure, services and management. CSPs detail short- medium and long-term action plans for technical solution and strategies for improved governance, financial sustainability, capacity building, advanced technology and inclusiveness (CSP's 5 strategic dimensions explained in the diagram below). Under the policy, all states are requested to act at par with the NUSP to develop respective SSSs and prepare CSPs

Figure 1 Strategic Dimensions for Sustainable City Wide Sanitation



1.2.3 Rating and Categorization of Cities by NUSP

The rating of cities in regard to their performance in sanitation improvements will be based on set of objective indicators of outputs, processes and outcomes.

Three Categories of Indicators

The rating exercise will involve three categories of indicators:

Output Related Indicators: pertain to the city having achieved certain results or outputs in different dimensions of sanitation ranging from behavioral aspects and provision, to safe collection, treatment and disposal without harm to the city's environment. There are nine main output-indicators accounting for 50 points of the total of 100 points.

Process Related Indicators: pertain to systems and procedures that exist and are practiced by the city agencies to ensure sustained sanitation. There are seven main process-indicators accounting for 30 points of the total of 100 points.

Outcome Related Indicators: include the quality of drinking water and that of water in water-bodies of city, as also the extent of reduction in sanitation-related and water-borne diseases in the city over a time period. There are three main outcome-indicators accounting for 20 points of a total of 100 points1.

Ideally, data for the above outputs, processes and outcomes are regularly collected by city authorities but at present, very few cities will have at best partial data available. This rating exercise will help in highlighting the need for regular data-collection and monitoring of indicators.

On the basis of the said rating scheme, cities will be placed in different categories as presented in Table 1 and the distribution of the 436 cities is also depicted. National rating survey data will utilize these categories for publication of results. On the basis of plans prepared and implemented, cities will be able to measure the results of their actions, and be able to clearly chart out their improvements over time compared to their baseline situation.

Table 1 Ratings of Cities

S. No.	Category	points	No. of Cities	Description
1	Red	≤33	204	Cities needing immediate remedial action
2	Black	34-66	228	Needing considerable improvements
3	Blue	67-90	4	Recovering but still diseased
4	Green	91-100	0	Healthy and Clean city

On achievement of remarkable results, i.e. coming into the Green category (Healthy and Clean City), cities will typically become eligible for the national award. Other cities showing remarkable incremental performance or selective achievements may also be given special or honorary awards. Cities in different size-classes may also be considered for category-wise awards. Based on results of the Rating survey and selection of awardees, cities will be invited to participate in a National Urban Sanitation Award ceremony.

The survey was undertaken across 423 cities including Municipal Corporations and Class A cities across the country. As per the national ranking, Unnao was ranked 121 at the national level with an overall aggregate mark of 39.10 on 100. Mark as a black category.

1.3 Municipal Solid Waste Rules, 2000

The Municipal Solid Wastes (Management and Handling) Rules, 1999 were published under the notification of the Government of India in the Ministry of Environment and Forests. In exercise of the powers conferred by section 3, 6 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government hereby made the rules to regulate the management and handling of the municipal solid wastes, 2000.

Municipal Solid Waste (Management & Handling) Rules, 2000 (MSW Rules) are applicable to every municipal authority responsible for collection, segregation, storage, transportation, processing and disposal of municipal solids. The Rules contains four Schedules namely;

Table 2 Schedule Details of MSW Rules, 2000

Schedule-I	Relates to implementation Schedule
Schedule-II	Specifications relating to collection, segregation, storage, transportation, processing and disposal of municipal solid waste (MSW).
Schedule-III	Specifications for land filling indicating; site selection, facilities at the site, specifications for and filling, Pollution prevention, water quality monitoring, ambient air quality monitoring, Plantation at landfill site, closure of landfill site and post care.
Schedule-IV	Indicate waste processing options including; standards for composting, treated l lakhtates and incinerations.

The MSW Rules -2000 categorically state the roles and responsibilities of ULBs, the State Govt., the Union Territory Administrations and the Pollution Control Boards. The roles of the ULBs as stated are as follows:

- Every municipal authority shall, within the territorial area of the municipality, be responsible for the implementation of the provisions of these rules, and for any infrastructure development for collection, storage, segregation, transportation, processing and disposal of municipal solid wastes.
- The municipal authority or an operator of a facility shall make an application in Form-I, for grant of authorization for setting up waste processing and disposal facility including landfills from the State Board or the Committee in order to comply with the implementation programme laid down in Schedule I.
- The municipal authority shall comply with these rules as per the implementation schedule laid down in Schedule I.
- The municipal authority shall furnish its annual report –
    - To the Secretary-in-charge of the Department of Urban Development of the concerned State or as the case may be of the Union territory, in case of a metropolitan city; or

- To the District Magistrate or the Deputy Commissioner concerned in case of all other towns and cities, with a copy to the State Board or the Committee on or before the 30th day of June every year.

1.4 Swachh Bharat Mission (SBM)

This campaign aims to accomplish the vision of a 'Clean India' by 2 October 2019, the 150th birthday of Mahatma Gandhi.

1.4.1 Mission Objectives

- Elimination of open defecation
- Eradication of Manual Scavenging
- Modern and Scientific Municipal Solid Waste Management
- To effect behavioral change regarding healthy sanitation practices
- Generate awareness about sanitation and its linkage with public health
- Capacity Augmentation for ULB's
- To create an enabling environment for private sector participation in Capex (capital expenditure) and Opex (operation and maintenance)

1.5 Jawaharlal Nehru National Urban Renewal Mission (JNNURM)

The aim of JNNURM is to encourage reforms and fast track planned development of identified cities. The prime focus of JNNURM is stimulating efficiency in urban infrastructure and service delivery mechanisms, community participation, and accountability of ULBs/ parastatal agencies towards citizens.

1.5.1 Objectives of JNNURM:

- Focused attention to integrated development of infrastructure services in cities covered under the Mission;
- Establishment of linkages between asset-creation and asset-management through a slew of reforms for long-term project sustainability;
- Ensuring adequate funds to meet the deficiencies in urban infrastructural services;

- Planned development of identified cities including peri-urban areas, outgrowths and urban corridors leading to dispersed urbanization;
- Scale-up delivery of civic amenities and provision of utilities with emphasis on universal access to the urban poor;
- Special focus on urban renewal programme for the old city areas to reduce congestion; and
- Provision of basic services to the urban poor including security of tenure at affordable prices, improved housing, water supply and sanitation, and ensuring delivery of other existing universal services of the government for education, health and social security.

1.6 UIDSSMT Scheme

Urban Infrastructure Development Scheme aims at improvement in urban infrastructure in towns and cities in a planned manner. The scheme seeks to enhance public and private investments in infrastructural development of urban areas.

1.6.1 Objectives

The objectives of the scheme are to:

a) Improve infrastructural facilities and help create durable public assets and quality-oriented services in cities & towns.

b) Enhance public-private partnership in infrastructural development.

c) Decentralize urbanization and promote planned development of towns, cities and metros.

1.6.2 Duration of the Scheme

The duration of the Scheme will be for five years beginning from 2005-06. An evaluation of the outcomes of the Scheme will be undertaken before the commencement of the 11th Five Year P\an and, if necessary, the scheme would be suitably calibrated.

1.6.3 Coverage

The scheme will apply to all cities/towns as per 2001 census, excepting cities/towns covered under JNNURM. Allocation of funds among states will be on the basis of the state's urban

population to total urban population in the country. States may allocate funds to towns/cities based on similar formula. However, funds would be provided to only those towns and cities where elections to local bodies have been held and elected bodies are in position. The State Governments may prioritize towns and cities on the basis of their felt-need.

1.6.4 Components

The components for assistance under the scheme will include all urban infrastructure development projects including water supply and sewerage. Cost of land for such infrastructure projects will not be provided under the programme. Admissible Components

i. Urban Renewal i.e. redevelopment of inner (old) city areas (this would include items like widening of narrow streets, shifting of industrial/commercial establishments from non-conforming (inner-city) areas to 'conforming' (outer-city) areas to reduce congestion, replacement of old and worn-out water pipes by new/higher capacity ones, renewal of sewerage/drainage/solid waste disposal systems, etc.), land acquisition cost will not be financed under this component of the program me.
ii. Water Supply and sanitation, including setting up de-salination plants, where necessary;
iii. Sewerage and Solid Waste Management
iv. Construction and improvement of drains/storm water drains
v. Laying/improvement /widening of arterial/sub-arterial roads and bridges to remove transport bottlenecks,
vi Construction and development of bus and truck terminals
vi. Environmental improvement and city beautification schemes,
vii. Construction of working women hostels, marriage halls, old age and
viii. Destitute Children's homes, night shelters with community toilets, street lighting and Slaughter house
xi. Civic amenities like playgrounds/stadia, community halls,
xii. Hospital Waste Management

1.6.5 Funding Pattern of the Scheme

The sharing of funds would be in the ratio of 80: 20 between Central Government & State Government. Out of 20% of state share 10% will be borne by the ULB which could be raised by the nodal/implementing agencies from the financial institutions or internal resources for funds.

1.7 City Sanitation Plan

City Sanitation (Master) Plans (CSP), are the outputs of strategic planning processes for citywide sanitation sector development. Its objective is to develop and maintain a clean, safe and pleasant physical environment to promote social, economic and physical wellbeing of all sections of the population. It encompasses plan of action for achieving 100 percent sanitation in the city through demand generation and awareness campaign, sustainable technology selection, construction and maintenance of sanitary infrastructure, provision of services, O&M issues, institutional roles and responsibilities, public education, community and individual action, regulation and legislation.

1.7.1 Components of City Sanitation Plan

A city sanitation plan is guided by the vision, missions, and goals of sanitation development as well as strategies to meet these goals. The city sanitation plan covers:

- **Technical Aspects**, including strategies and programs for the development of (a) domestic as well as industrial wastewater services, (b) solid waste including clinical and other hazardous waste management, and (c) storm water drainage system.
- **Non-Technical Aspects**, including strategies for the development of non-physical aspects such as (a) community awareness and participation, (b) policy and regulation, (c) institutional capacity, (d) private sector engagement, (e) NGO engagement, (f) financing and tariffs, and (g) monitoring and evaluation.

1.7.2 Strategy for City Sanitation Plan

A broad city level strategy for preparation and implementation of the City Sanitation Plan is based on five strategic pillars (1) Technology Options; (2) Financial Options; (3) Institutional and Governance Options; (4) Capacity Enhancement and Awareness Generation Options; and (5) Inclusive Approach. The strategic outputs and proposals are guided by the following points:

Ensured Coordination-Enhancing synergy among the actors in various departments working in the field of water supply and sanitation, such as health, education, public health and engineering department, including municipal government agencies, industry, environment, transport, pollution control board, the private sector, NGOs, and others.

- **Locally Adaptable Plan:** Employing appropriate technologies that are suitable to user needs, while ensuring that they are relevant to the city's actual conditions, comply with technical standards and prevent potential impacts.
- **Equitable:** Develop sanitation in all parts of the city (city-wide), prioritizing poor residential areas where the health risks are highest.
- **IEC**: Promote awareness of health and hygiene behavior while creating demand for better sanitation services.
- **Resource Generation and Mobilization:** Create opportunities and incentives for private sector initiatives in the development and operation of sanitation services. Increase funding from sources other than municipal government, such as from the national and provincial governments, donor agencies, the private sector and the public.
- **Existing Infrastructure Utilization:** Foster better use of existing sanitation services, which becomes the basis for developing new services.
- **Partnering citizens:** Encourage the development of community-based sanitation services, especially in areas where public and private services are difficult to establish. Engage stakeholder groups, including women groups, in sanitation planning, in line with their respective capacities.
- **Institutional and regulatory Frame Work:** Create enabling institutional and regulatory frameworks to accelerate sanitation services development.

1.7.3 CSP Approach and Methodology

The goal of the exercise is to achieve 100% sanitation in the project cities. The following are the indicators of 100% sanitation in a city:

Primary Indicators

- Every citizen has access to a toilet & the city is "Open Defecation Free (ODF)"
- All the sewage generated is collected, treated, and disposed of safely

Secondary Indicators

Secondary indicators are optional and are not mandated by the NUSP. However, for holistic sanitation in a city it is important that the following indicators are also addressed. We will advocate for the inclusion of these indicators into the city sanitation planning

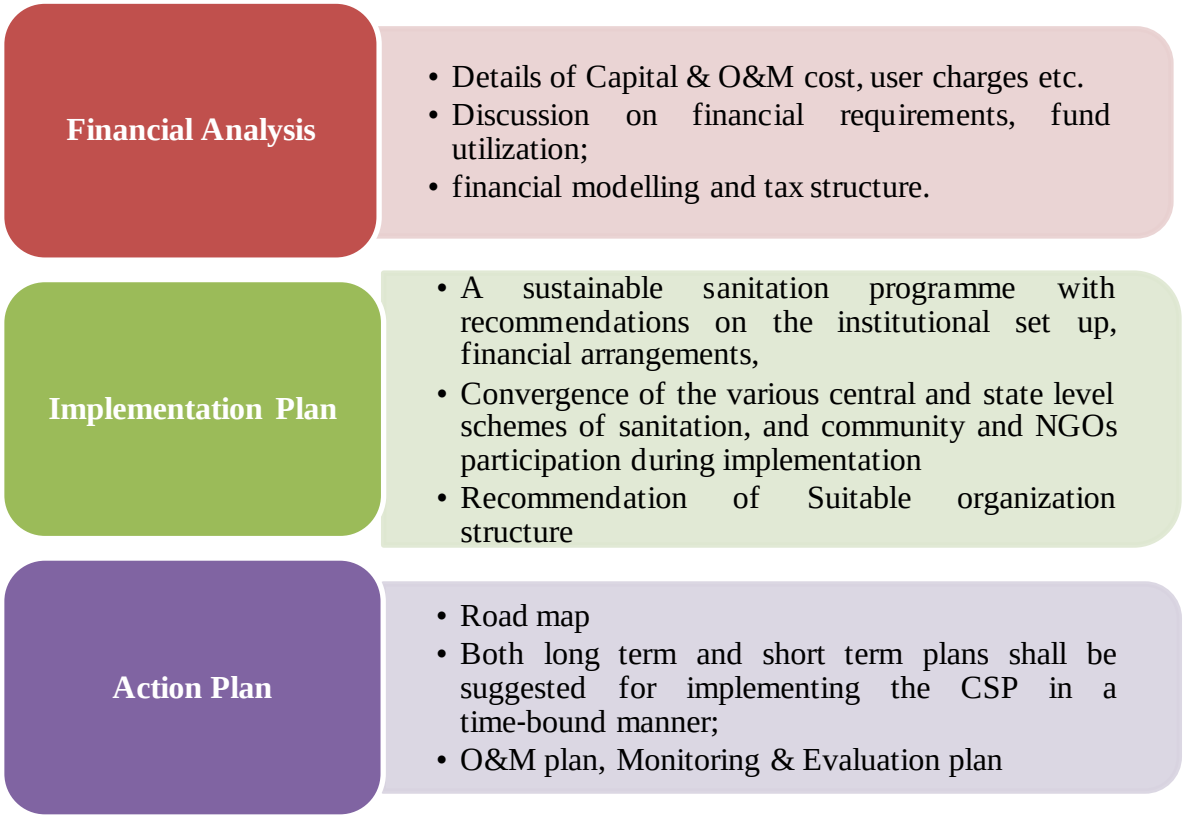
- All the solid waste generated is collected, treated, and disposed of safely
- All water bodies and drainages are preserved and kept clean
- All the storm water drains are kept clean

Every aspect of the process and infrastructure provision must integrate community participation and must be inclusive. In addition, water and wastewater management must be carried out in an environmentally sustainable manner, thus recycling and reusing the by-products as far as possible.

Implementation Strategy

There should be complete financial analysis of all sectors like water, access to toilet, sewerage network, solid waste management etc. which will also include details of operation and maintenance charges, funds required and sources of fund. Then for implementation of plan recommendations on its institutional framework is necessary to analysis additional fund arrangement. This would include Convergence of the various central and state level schemes of sanitation, and community and NGOs participation during implementation. This would lead to action plan.

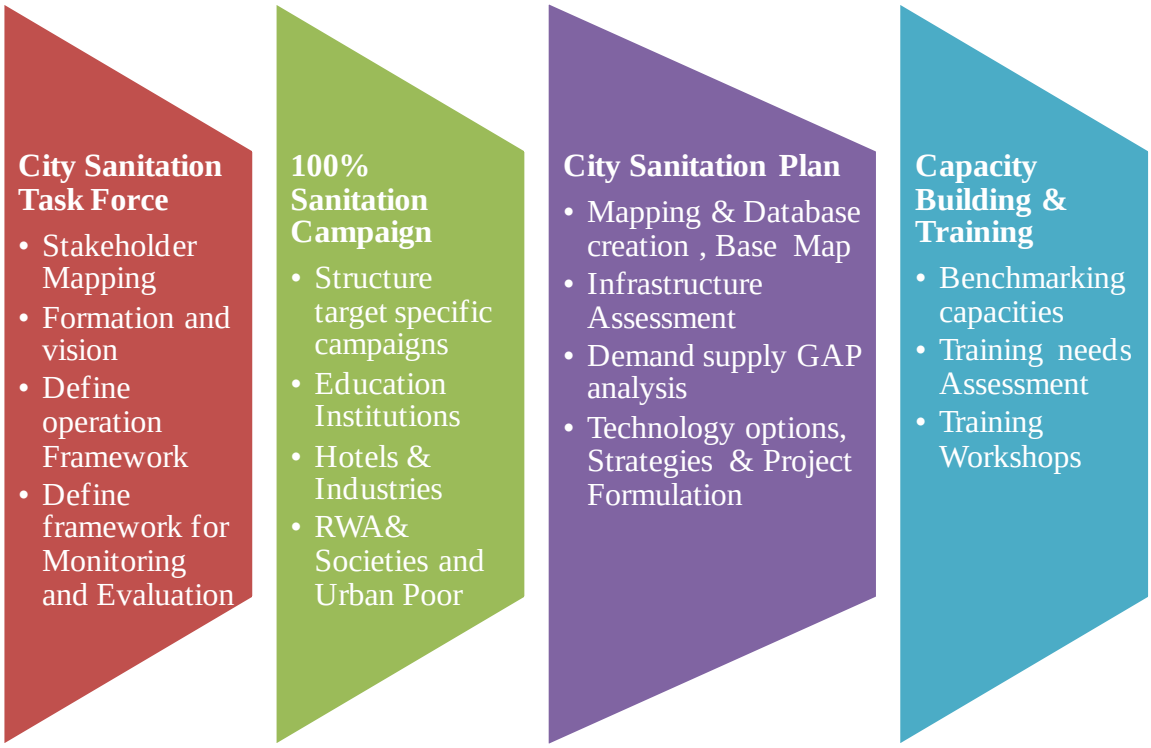
Figure 2 Implementing Strategies



1.7.4 Building Local Institutions and Community Participation

The creation of the city sanitation task force, the 100% sanitation campaign (pilots), an integrated City Sanitation Plan, capacity building and training are seen as the four key services to be provided by the consortium. The city sanitation task force is the institutional structure that will hold the vision of "Total sanitation" for the project cities. Within this context it shall ensure the successful implementation of the 100% sanitation campaign as well as oversee the plan and project formulation, implementation and operations. The four key tasks are divided into sub-components as follows –

Figure 3 Pillars Supporting Inclusive Sanitation



1.7.5 Methodology

Each of the key services has been broken down into a series of executable tasks as follows. These tasks are not linear and many of the activities are happening in a parallel and iterative manner. The entire CSP formulation exercise is an effort to generate much-needed momentum, both within government and civil society, in a segment of urban infrastructure that requires demand-led planning and renewed attention. To this end, a structured, participatory and multi-stakeholder engaging consultative process was adopted to create City Sanitation Task Force (CSTF) and engage different stakeholders including staff of the NPP departments, para statal agencies and other state and local institutions, policy makers and citizens.

A good base map is required for effective representation of the ground situation and subsequent planning and implementation of infrastructure interventions. The base map of Unnao City has been prepared using satellite images and maps as provided by the Nagar Palika Parishad. The mapping is done on GIS platform. This helps in overlaying multiple layers of information and

conducting a detailed analysis. The following layers have been digitized for preparing the base map.

- Administrative boundaries – Nagar Palika Parishad boundary and ward boundaries
- Transportation network – roads and railways
- Building foot print
- Water bodies and natural drainage
- Contours
- Green belt – forest, cultivation, orchard

The following maps provided by the Corporation have been extensively used for preparation of the base map:

- Nagar Parishad boundary and ward boundary map
- Proposed land use map (image) provided by Town Planning Department
- Survey of India topo-sheets

Based on the above information and considering the revised corporation/ward boundaries (finalized in consultation with ward councillors and city officials) the final base map of Unnao City was prepared. This base map has been taken as base for the preparation of CSP for Unnao City.

Table 3 Layers Used in Map Preparation

S. No.	Layers	Source	Data Type
1	Locations	Landmarks have been extracted from NPP, satellite data, Survey of India Map and identified locations during survey.	Point
2	Unnao Municipal Boundary	Municipal boundary has been extracted from NPP Unnao administration.	Polygon
3	Ward boundaries	Ward boundaries have been digitized according to Ward councillors and existing maps from NPP Unnao.	Polygon
4	National and State Highways	Existing Highways have been extracted from NPP, Survey of India Map and NPP Unnao administration map	Line

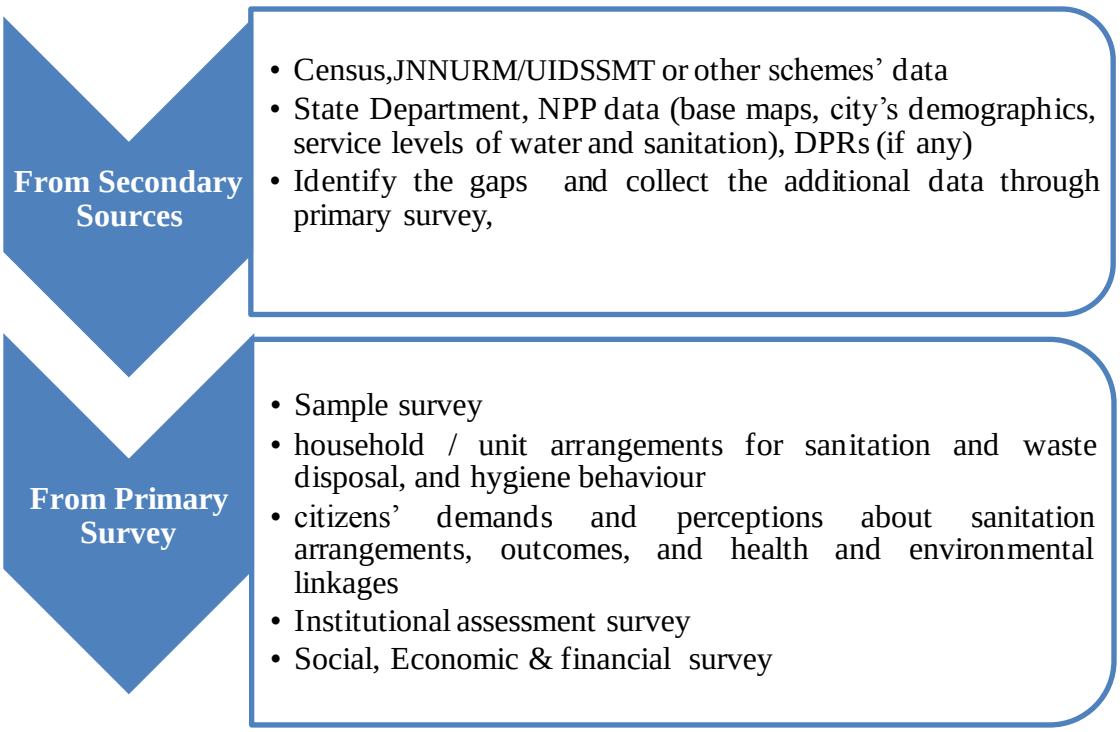
S. No.	Layers	Source	Data Type
5	Major District Road, City Main Road and Streets, Rail road	Existing District roads have been extracted from NPP, satellite data, Survey of India Map and NPP Unnao administration map.	Line
6	Nallah / water bodies / drains / ponds	Existing Nallah/water bodies/drains/ponds have been extracted from NPP, jalkal, Survey of India Map and identified from satellite image.	Line
7	Building Footprints	Existing building footprints have been digitized from satellite image	Polygon
8	Landuse map	Landuse map has been extracted from prescribed govt. authority of the state of U.P.	Polygon
9	Handpump/ Overhead tank	Existing locations and number of Handpump / Overhead tanks have been extracted from NPP / jalkal of Unnao city	Point

1.7.6 Overlaying Secondary Information on the Base Map

For the preparation of sanitation maps (including water supply, sewerage system, solid waste management and public sanitation) various primary (collected through field surveys) and secondary data has been collected and overlapped on the base map in GIS platform. The following layers of information have been added to the base map for the purpose of preparing thematic sanitation maps and thereafter demand supply gap analysis:

- Sewerage network – existing and proposed sewer lines (diameter and length), sewerage zones, location of existing and proposed Sewage Treatment Plant (STP)
- Storm water drainage network and natural drains
- Water supply network – existing and proposed water supply network, water supply zones, rising main and feeder network, storage reservoirs
- Location of public toilets
- Location of dumper containers (for solid was collection)

Figure 4 Situation Analysis from Primary & Secondary Data



1.7.7 Land-Use and Sanitation Survey

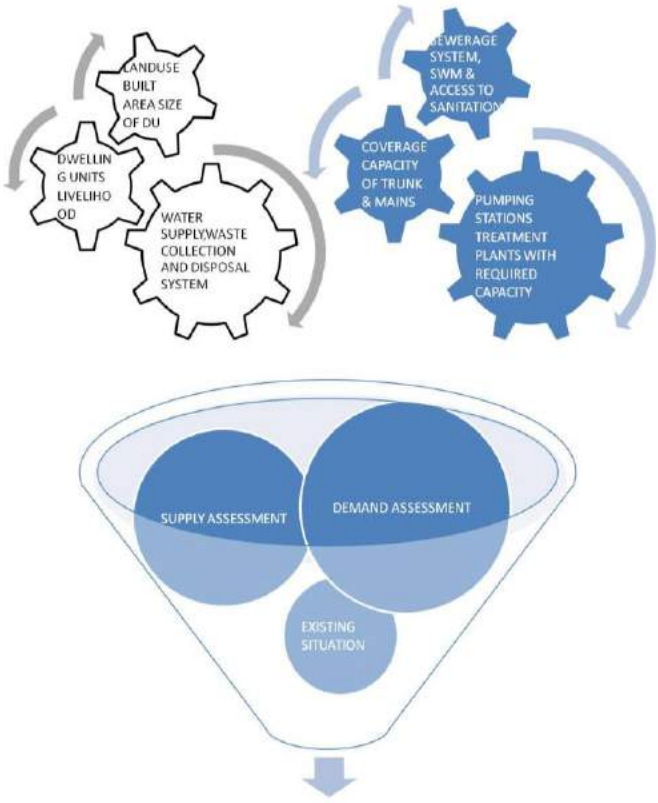
The data available from the city authorities regarding existing water supply system, sewerage system, solid waste management system and public sanitation is mostly at the ward level. For more accurate assessment of the ground situation and effective planning thereafter, it is necessary to have data at sub ward level .To this determining the existing sanitation condition at disaggregate level survey was conducted to know the existing land use pattern, built up density in different areas and the urban form, current sanitation condition, and infrastructure facilities available for sanitation. A detailed questionnaire (Annexure-2) was designed to capture information on access to water supply, access to sewerage system, solid waste management, access to public sanitation, willingness to pay for the basic services etc. The surveyors were oriented on the need and purpose of the survey and the methodology of conducting the same. Maps and the questionnaires were used to conduct the survey. The city was divided into several survey blocks based on the road and ward boundaries. The surveyors went through the area to understand the various land uses. Each survey block is further divided into building blocks

demonstrating homogeneous land use and built typology. The survey was conducted in each building block capturing the land use and sanitation information. The homogeneous land uses were identified based on use (e.g. residential, commercial etc.), built characteristics (e.g. number of floors, type of construction) and socio-economic characteristics (e.g. Middle Income Group (MIG) residential apartments, residential villas, slums etc.).Open land parcels and water bodies are also marked on the map and information was entered in the questionnaire. The information collected from the survey is entered in a structured format. The homogeneous land use parcels are digitized. The field data and the map are linked on the GIS platform for further analysis.

1.7.8 Demand – Supply Gap Assessment

This includes the assessment of the demand for sanitation infrastructure which is determined by the extent of water required for daily activities, waste water and solid waste generated. The assessment of the supply of sanitation infrastructure is determined by the aggregate of Sewage and Solid Waste collected, transported and safely disposed.

Figure 5 Gap Analysis



1.7.9 Consultation with the CSTF

After the assessment of demand supply situation and the gap analysis, a consultation meeting shall be organized with the CSTF members to share the findings.

1.7.10 Assessing Technology Options

Based on the situation analysis an internal workshop will be organized to discuss possible strategies and approaches for solving the sanitation issues. Here technology options will be discussed and decided upon by the experts in the team. Based on this discussion, schematic designs will be prepared.

1.7.11 Strategies and Project Formulation

Strategies and solutions shall be prepared for all the un-served areas in the city. In addition, a strategy to address the sanitation needs of future population growth shall also be formulated through project solutions as well as recommendations to policy and legislation.

1.7.12 Draft City Sanitation Plan

Based on the situation analysis, strategy formulation and technology selection, a draft city sanitation plan shall be prepared for Unnao. This shall include schematic designs, broad cost estimates and an implementation strategy.

1.7.13 Final City Sanitation Plan

In consultation with the CSTF, the city sanitation plan will be finalized.

1.8 Capacity Building & Training Needs Assessment

- Benchmarking of capacities of the Nagar Palika Parishad
- Training needs Assessment
- Formation of a Technical Core Group & Training Workshop Series

1.9 Timeline for totally Sanitized City

The system shall be designed under the broad framework as per the guidelines for a design period of 30 years; however, the planning shall entail the implementation of the design in phases to meet the ultimate goals of the CSP. The phased approach aims to navigate through the

challenges posed by the limitations in investments, institutional capacities and community engagement in a proficient manner. The phases and the corresponding timelines are defined as stated below:

Table 4 Timeline for Totally Sanitized City

Phase	Year
Immediate	2016- 2019
Short-Term	2020- 2025
Mid-Term	2026- 20-35
Long-Term	2036- 2045

Source: Manual City Sanitation Plan

2 CITY PROFILE

2.1 Unnao City

The town of Unnao is the head quarter of Unnao District in Uttar Pradesh, India between Kanpur and Lucknow. It is connected to Kanpur and Lucknow cities by roadway as well as by railway. The nearest airport is at Amausi about 50 km from Unnao. The city is enlisted as a municipality of Kanpur Metropolitan Area.

The geographical area of the Unnao city is 21.50 Sq. Km as per census of 2011. It may be noticed that size of the city has increased more than five times during last ten years. The city has 29 wards year 2011. City administration is headed by the Nagar Palika Parishad Chairman and Executive Officer. Figure 6 shows the location map of Unnao city with its major road network, and establishments.

Figure 6 Location Map of Unnao City

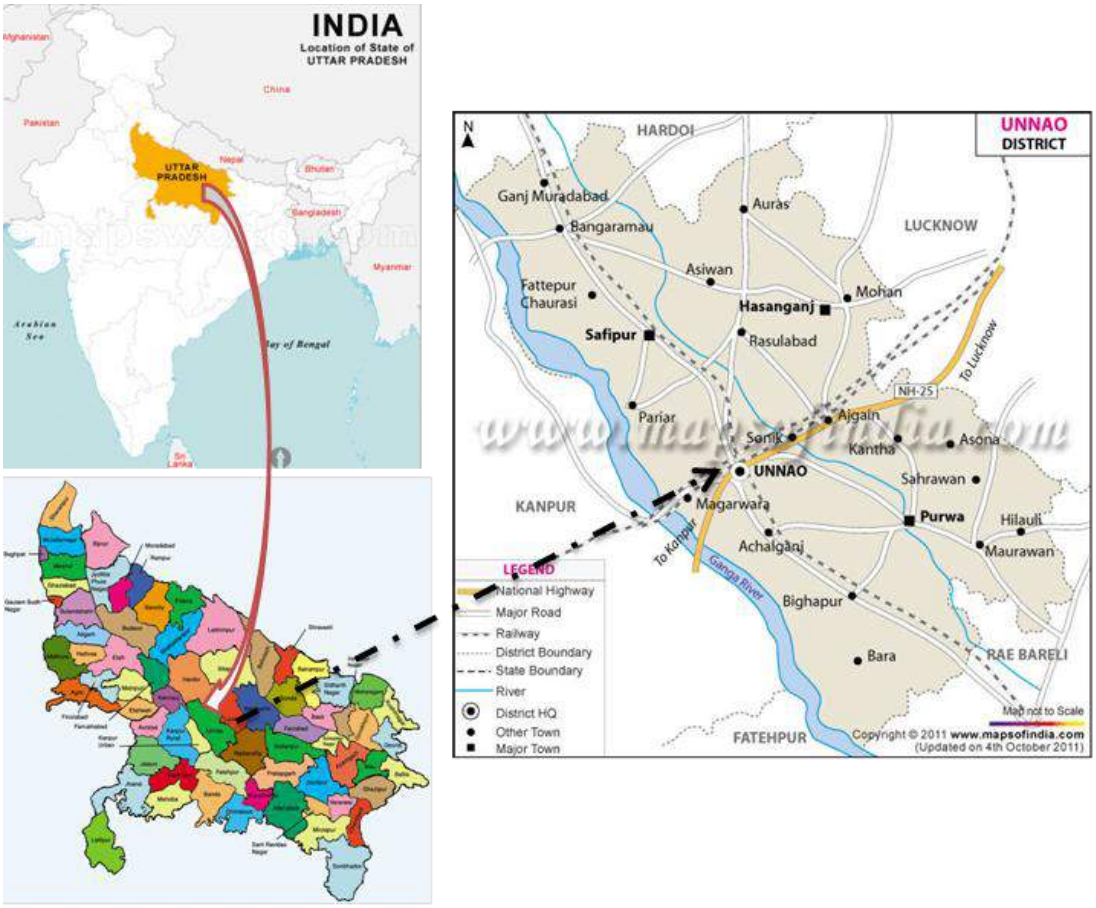
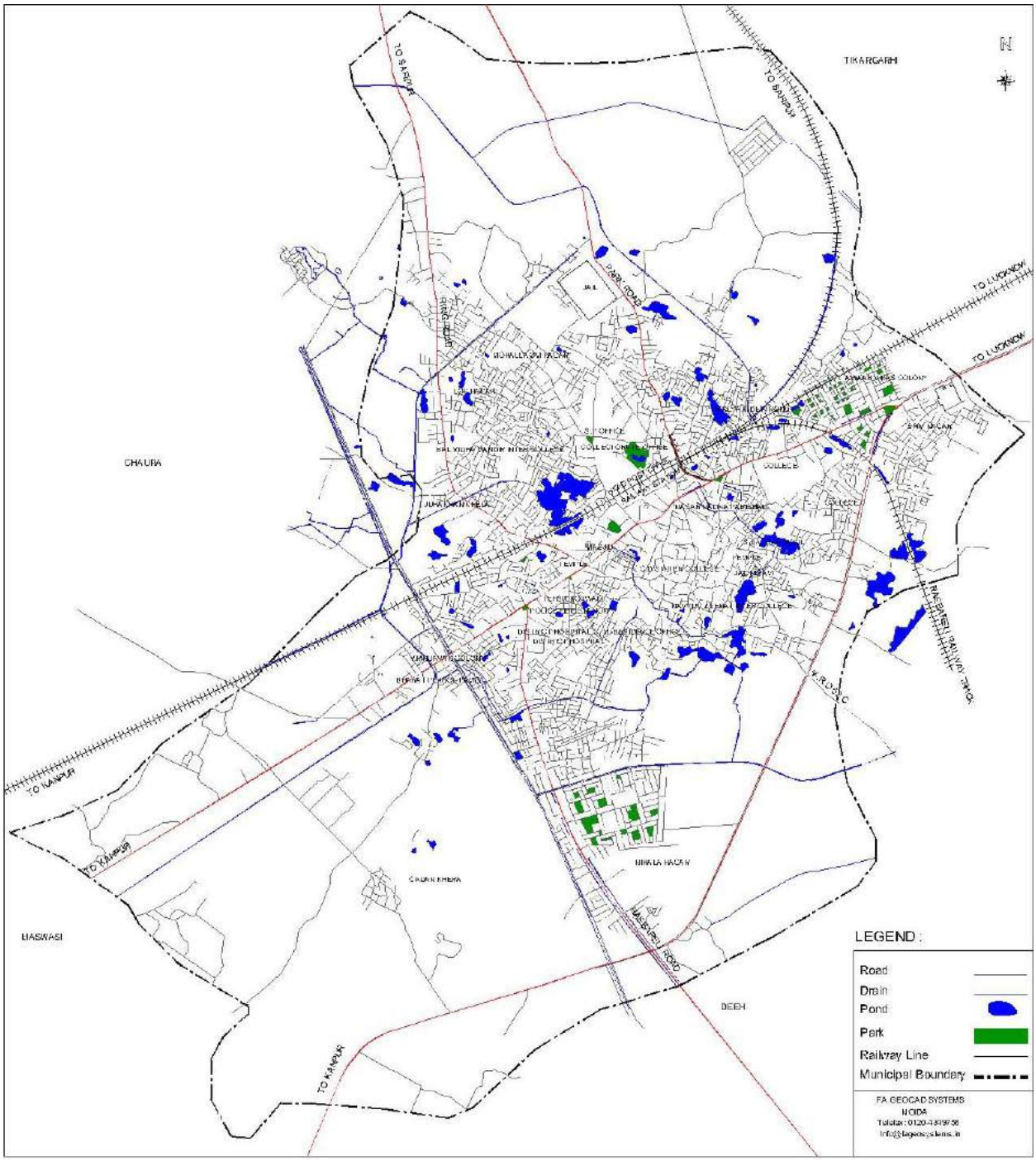


Figure 7 Unnao City with Major Road Network



2.2 Physical Features

The District is roughly a parallelogram in shape and lies between Latitude 26°8' N & 27°2' N and Longitude 80°3' E & 81°3' E. It is bounded on the North by District Hardoi, on the East by District Lucknow, on the South by District Rae Bareli and on the West by the Ganga which separates it from districts of Kanpur & Fatehpur.

Unnao lies in the great plains of the Ganges and hence the land is highly fertile. The soil is mostly alluvial. The Ganges separates Unnao from Kanpur district. The district is bounded by river Ganges in the west and the river Sai in the east. The entire district falling in Sai Sub-basin of the Ganges basin represents flat topography. The irrigation in the district takes place through Sharda Canal network system and tube wells. About 92% of the district area is under cultivation. The district has a subtropical climate. The district is mainly drained by the river Ganges and its tributaries Kalyani, Khar, Unnao and Marahai in the western part of the district, and by Sai River in the eastern part of the district. All these rivers are perennial in nature. About 87% area of the net sown area (3, 00,000 hectares) is irrigated both by surface water (Sharda Canal network system) and ground water through shallow and moderately deep tubewells. The share of surface water irrigation is 48% while that of ground water is 52%. The economy of the district mainly depends on agriculture.

2.3 History

The town of Unnao gives its name to the district of which it forms a part. About 1200 years ago, the site of this town was covered with extensive forests. Prashan Singh Chauhan, a Chauhan Rajput, cleared the forests, probably in the third quarter of the 12th century, and founded a town called Sawai Godo, which shortly afterwards passed into the hands of the rulers of the Kannauj, who appointed Khande Singh as the Governor of the place. Unwant Singh, a Bisen Rajput and a lieutenant of the Governor, killed him and built a fort here, renaming the place as Unnao after himself. In ancient times, the area which comprises Unnao formed part of the Kosala Mahajanapada. It was later included in Oudh. This region has been inhabited since antiquity as traces from ancient times remain at some places in the district. After the First War of Indian Independence in 1857, power was transferred from the British East India Company to the British Crown, by the Queen's Proclamation of 1858. Once the order was restored, the civil

administration was re-established in the district which was named Unnao, with headquarters at Unnao. It assumed its present size in 1869. The same year the town of Unnao was constituted a Municipality. There are various historical articles available on Unnao. The latest one is still in progress by Shaheer A. Mirza, who is tracking the history of early Mughal settlements in a village called Jalalabad (settled by one Mirza Jalal Beg during the reign of Humayun) around Qasba Asiwan of Hasanganj Tehseel.

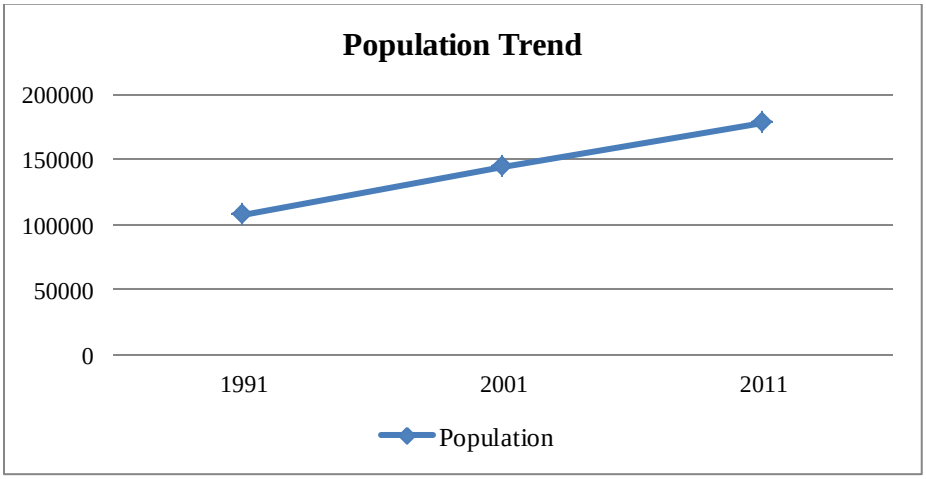
2.3.1 Industry

Tanning is the biggest industry in Unnao. Unnao is well known for its leather industry and its leather goods. Superhouse Group, Mirza Tanners, Rahman Exports, and Zamzam Tanners, Mahavir Spinfab Pvt. Ltd., Parash Nathtech Garments Pvt. Ltd. has large factories in Unnao.

2.4 Demographic Data

In 2011, Unnao had a population of 177,658 of which male and female were 93,021 and 84,637 respectively. Average literacy rate of Unnao in 2011 were 72.51 compared to 54.64 of 2001.

Figure 8 Population Trend (1981 -2011)



2.4.1 Sex Ratio

With regards to Sex Ratio in Unnao, it stood at 907 per 1000 male compared to 2001 census figure of 898. The average national sex ratio in India is 940 as per latest reports of Census 2011

Directorate. In 2011 census, child sex ratio is 920 girls per 1000 boys compared to figure of 923 girls per 1000 boys of 2001 census data.

2.4.2 Infrastructure Status of City

Table 5 City Status

S. No.	Parameters	Value and Range
1	Total Population	177658
2	No. of Households	35288
3	City Area	22 Sq. km
4	Literacy Rate	72.50%
5	Number of Election Ward	29
6	Slum Population	43150
7	No. of Slums	57
8	No. of Markets	6
9	No. of Sabzi Mandi	2
10	No. of Bus Station(Public & Private)	1
11	No. of Railway Station	1

Source: Nagar Palika Parishad, Unnao

2.5 City Level Population Projections

The population is one of the major factors in determining future patterns of progress and development of the city. As per Census 2011 Unnao has population of 177,658 persons. There are 3 commonly used methods to assess population projection namely, Arithmetic Increase method, Geometric increase method and Incremental increase method.

2.5.1 Arithmetic increase method:

In this method, the rate of growth of population is assumed to be constant. This method a low estimate, and can be adopted for forecasting populations of large cities which have achieved saturation conditions. The average decadal increase in population as forms the basis of projections.

Pn = P (last year known) + n*x where Pn, Population of the year to be known

n = number of decades

x = average arithmetic increase per decade

2.5.2 Geometric increase method:

This method assumes that the percentage of increase in population from decade to decade is constant. This method gives high results, as the percentage increase gradually drops when the growth of the cities reach the saturation point. This method is useful for cities which have unlimited scope for expansion and where a constant rate of growth is anticipated.

Geometric mean, Rg =3.66

Population, $Pn = P_{\text{year known}} (1+rg)^n$

2.5.3 Incremental Increase Method: (Method of Varying Increment)

In this technique, the average of the increase in the population is taken as per arithmetic method and to this, is added the average of the net incremental increase, one for every future decade whose population figure is to be estimated. In this method, a progressive increasing or decreasing rate rather than constant rate is adopted.

$P\ n=P1+ n*x+ \{n\ (n+1)/2\}\ x\ y$

Where Pn = population of the year to be known

n = number of decades

x = average arithmetic increase per decade

y = average incremental increase per decade

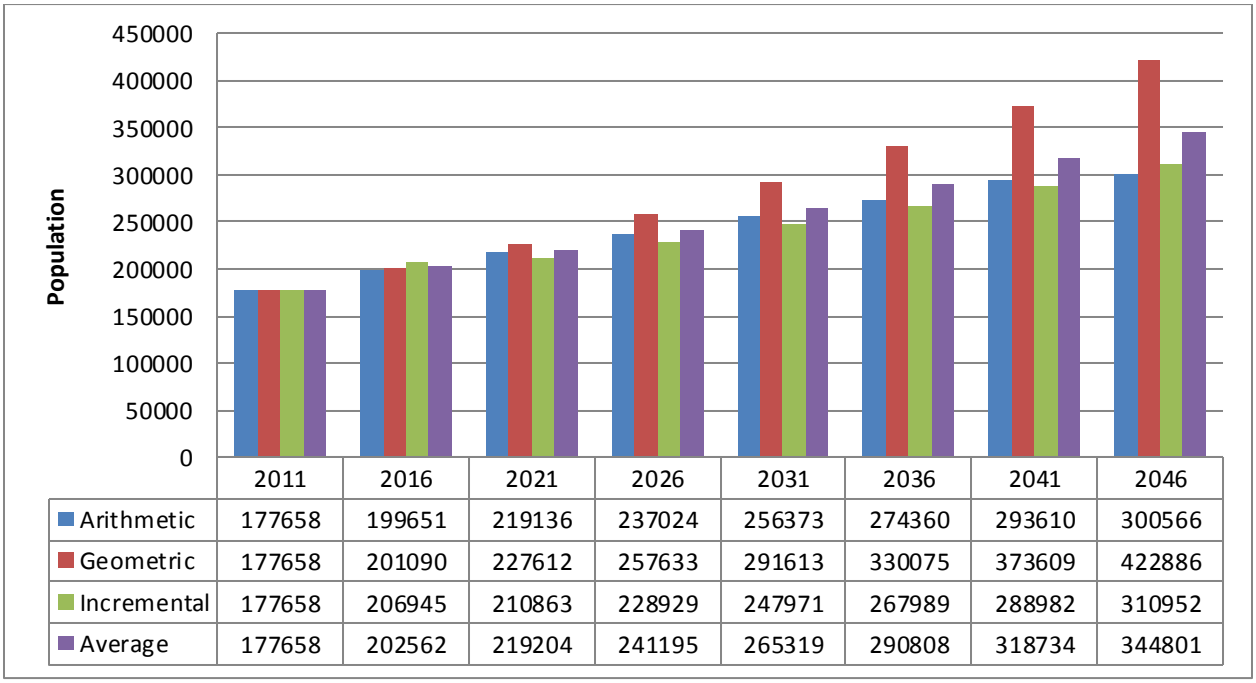
The population projection for Unnao has been carried out for 35 years at an interval of 5 years and result are summarized in Table below -

Table 6 City Wise Projected Population (2016-2041)

Year	Arithmetic	Geometric	Incremental	Population
2011	177658	177658	177658	177658
2016	199651	201090	206945	202562
2021	219136	227612	210863	219204
2026	237024	257633	228929	241195
2031	256373	291613	247971	265319
2036	274360	330075	267989	290808
2041	293610	373609	288982	318734
2046	300566	422886	310952	344801

Source: - Calculated value

Figure 9 City Wise Projected Population (2016-2046)



	2011	2016	2021	2026	2031	2036	2041	2046
Arithmetic	177658	199651	219136	237024	256373	274360	293610	300566
Geometric	177658	201090	227612	257633	291613	330075	373609	422886
Incremental	177658	206945	210863	228929	247971	267989	288982	310952
Average	177658	202562	219204	241195	265319	290808	318734	344801

2.6 Projections of Water Demand, Solid Waste & Sewage Generation

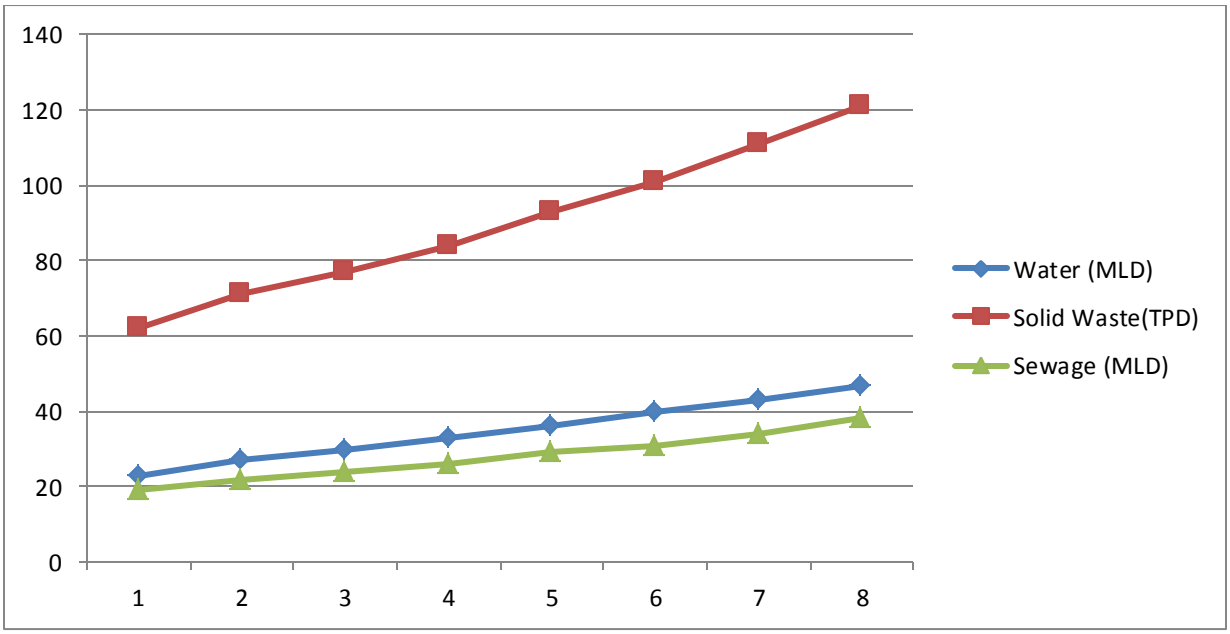
As per recommendations of Section 2.2.8.3 of the CPHEEO Manual, city level water demand has been projected considering 135 LPCD for residential population and sewage generation as 80% of the water demand. Solid waste generation is taken as 350 gm. per capita as prescribed by CPHEEO. Considering the projected population per capita water demand, per capita sewage and solid waste generation, the total water demand, sewage and solid waste generated is calculated for Unnao City as mentioned in Table below.

Table 7 Summary of City Level Infrastructure Demand

Year	Population	Water (MLD)	Solid Waste(TPD)	Sewage (MLD)
2011	177658	24	62	19
2016	202562	27	71	22
2021	219204	30	77	24
2026	241195	33	84	26
2031	265319	36	93	29
2036	290808	40	101	31
2041	318734	43	111	34
2046	344801	47	121	38

Source: - calculated value

Figure 10 Infrastructure Demand



Gross Water Supply demand will be 30 MLD in 2021 and increase to 40 MLD in 2036 and 47 MLD in 2046. These translate to a waste water generation (@ 80% of net water consumed.

Solid Waste generation is likely to grow at a faster place due to a combination of population growth and increase in per capita consumption to 77 TPD in 2021, 101 TPD in 2036 and 121 TPD in 2046.

The demand for Public Toilet blocks and Community toilet blocks is expected to increase with increasing public awareness.

2.6.1 Ward Wise Population

The population of Unnao city in 2011 was 177,658 and Unnao has total 29 wards. Wards 1, 8 and 20 have highest population in comparison to other wards of the city. While the wards 25 and 27 are exhibiting lowest population in the city of Unnao. The ward wise population and male female population of all the 29 wards of NPP, Unnao is presented in Table below.

Table 8 Ward Wise Population Unnao City

Ward No.	Households	Population	Male	Female
1	1994	10095	5250	4845
2	1341	7546	3899	3647
3	1023	5672	2957	2715
4	1051	5402	2730	2672
5	1175	6155	3141	3014
6	829	4754	2471	2283
7	869	5063	2661	2402
8	1747	9392	4943	4449
9	1280	7396	3862	3534
10	1258	6947	3675	3272
11	1077	5749	2997	2752
12	988	5447	2881	2566
13	983	4865	2559	2306
14	980	5393	2773	2620
15	917	4657	2475	2182
16	824	5019	3035	1984
17	873	4895	2559	2336
18	1083	5826	3084	2742
19	1396	7835	4094	3741
20	2413	9703	5084	4619
21	1478	7252	3872	3380
22	1123	5859	3079	2780
23	1041	5203	2686	2517
24	886	5316	2744	2572
25	751	4236	2191	2045
26	1193	6549	3424	3125
27	717	4252	2171	2081
28	1153	6438	3313	3125
29	830	4742	2411	2331
Total	**33273**	**177658**	**93021**	**84637**

Source: - Census 2011

2.6.2 Slum Population

The chapter discusses about the slum population in the city with their access to basic services drawn from discussions with the slum people, discussions with the DUDA officials and the secondary data. The aim is to identify the various issues related to the status of infrastructure and

suggest strategies and proposals for the improvement and efficient service delivery. It also deals with the spatial location of the slums in the city.

As per the Census 2001, the total slum population in the city is 43150. The percentage of slum population in the city is 24.28 per cent of the total population. As per NHM there are 57 slum pockets. The slum population in the city has been spread over in city. As per Census, The household (HH) size in slums works out to be 6.86, which is more than the HH size of the total population (6.00).

Table 9 Slum Population

Sr.No.	Ward No.	Name of the Slum	Population
1	1	Puran Nagar	885
2	1	Dariyai Kheda	200
3	12	Pathar Kta Colony	970
4	17	Ghandhi Nagar	500
5		Eidgah Road Harijan Basti	1250
6	8	Eabrahimabad	605
7	4	Krishna Dei Kheda	1045
8	4	Pitamber Kheda	750
9	9	Shekhpur	1885
10	9	Kuddu Khera (Sinrausi)	175
11	7	Jawahar Kheda	340
12		Munwwar Kheda	300
13	9	Darbari Kheda	310
14	9	Sultan Kheda	350
15	9	Akrampur	1980
16	3	Chubhana Kheda	200
17	9	Kuddu Khera (Akarmpur)	250
18	5	Rajepur	490
19	8	Gadan Kheda	1325
20	20	Aadarsh Nagar	1500
21	20	Hiran Nagar	555
22	10	Pashicham Kheda	300
23	10	Purab Kheda	150
24		Kewta Talab	1350

Sr.No.	Ward No.	Name of the Slum	Population
25	19	Talib Sanray	2940
26	6	Nuruddin Nagar	750
27	6	Ram Nagar	1085
28	9	Purani Bazar	600
29	25	Purani Kotwali	275
30	27	Utsanr	1000
31	15	Moti Nagar (Gariyan Kheda)	500
32	26	M.B.Nagar	800
33	7	Narendra Nagar	575
34	22	Lodhanhar	935
35	22	Prayag Narayan Kheda	350
36	22	Gangu Kheda	410
37	18	Kalyani Harijan Basti	500
38	7	Kakarhabag	250
39	28	Abbas Bag Jawahar Nagar	500
40		Satti Talab	1000
41	16	Ram Baksh Kheda	390
42	16	Kishori Kheda	565
43	28	Budhwari	1200
44	23	Aawas Vikas Colony Durga Mandir	1000
45	25	Buchdan	200
46	25	Bhuri Devi	400
47	25	Kesarganj	355
48	11	Pahli Kheda	375
49	11	Kasif Ali Sanray	200
50	11	Girjabag	250
51	8	Kasim Nagar	455
52	27	Jerdhus	4000
53	15	Kaji Sanray	450
54	24	Padiyan Tola	900
55	21	Jurakhan Kheda	1000
56	4	Pitamber Kheda Part-2 (Shiv Nagar)	475
57	1	Banduhar	800

Source: - NUHM 2013

3 WATER SUPPLY

Drinking water supply is also very important for upkeep of sanitation facilities and environment/health status it is necessary to have sufficient water. Poor quality of water as well as insufficient quantity of potable water can pose serious public health hazardous water borne diseases are quite common in the cities, particularly among the urban poor. MoUD, GoI has specified a performance indicator for drinking water sector. Hence drinking water supply is also taken into consideration as one of the element of CSP.

3.1 City Level Status

In the city, total numbers of water supply connections are 9424, which is only 28.32% of total required water supply coverage. All the available connections are domestic, unmetered and serving to the households only. The total water production capacity of the city is 13.87 MLD, which is all from ground water sources (power pumps). The city does not have any surface water source and treatment facility for drinking water.

Table 10 Water Infrastructure in Unnao City

Sr. No	Sources of Water	No.
1	Coverage of Water Supply	28.32
2	Per capita supply of Water	78.00
3	No. of Tube Wells	24
4	No. of Over Head Tanks	9
5	No. of Hand Pumps	2300
6	Water Treatment Plant (WTP)-	Nill
7	Length of Line(Total)	292 kms
8	Length of distribution network	93 kms

Source: Nagar Palika Parishad, Unnao

3.1.1 Sources and Availability

The total water consumption of the city is 61.6 MLD through 9424 domestic water supply connections. This data indicates that rest of the city is getting water from unauthorized sources. Last year, the total revenue demand of the city from users was 60.00 Lakhs, out of which total collection was of 55.69 Lakhs.

Table 11 Number of drinking water Connection Household Level.

Sr. No	Type of Connection	No.
1	Household service connections	9424 nos.
2	Commercial Connections	Nil
3	Duration of supply daily	4 hrs on average

Source: Nagar Palika Parishad, Unnao

24 tube wells are located in the various parts of city. People are directly drawn water from 2300 hand pumps. Out of total water production 20% is wasted in leakages and available water to the public is hardly 13.87 MLD, which is supplied to 33273 household. The average household water supply is 78 LPCD. As per the standard of 135 LPCD, the present water demand for domestic use in city is 24 MLD, bulk demand of 10.13 MLD. So water demand in the city is 24 MLD and the current.

Table 12 Source of Ground Water in Unnao City

Sources	Tap water	Hand pump	Tube well/Borehole	Other sources
%	40.2	51.6	6.9	1.3

Source: - Census 2011(Households by Main Source of Drinking Water and Location)

3.2 Water Quality

The quality of the water is more or less up to the mark of desired quality of water as out of 200 samples collected within month, 190 passed the quality test. But according to primary survey most of the respondents were not satisfied with the quality of water supplied and complained of water being turbid.

3.3 Service Level Benchmark

There are 9 key performance indicators developed for water supply system under SLB initiative. The details of indicators for Unnao NPP for year 2011-2012 are given below

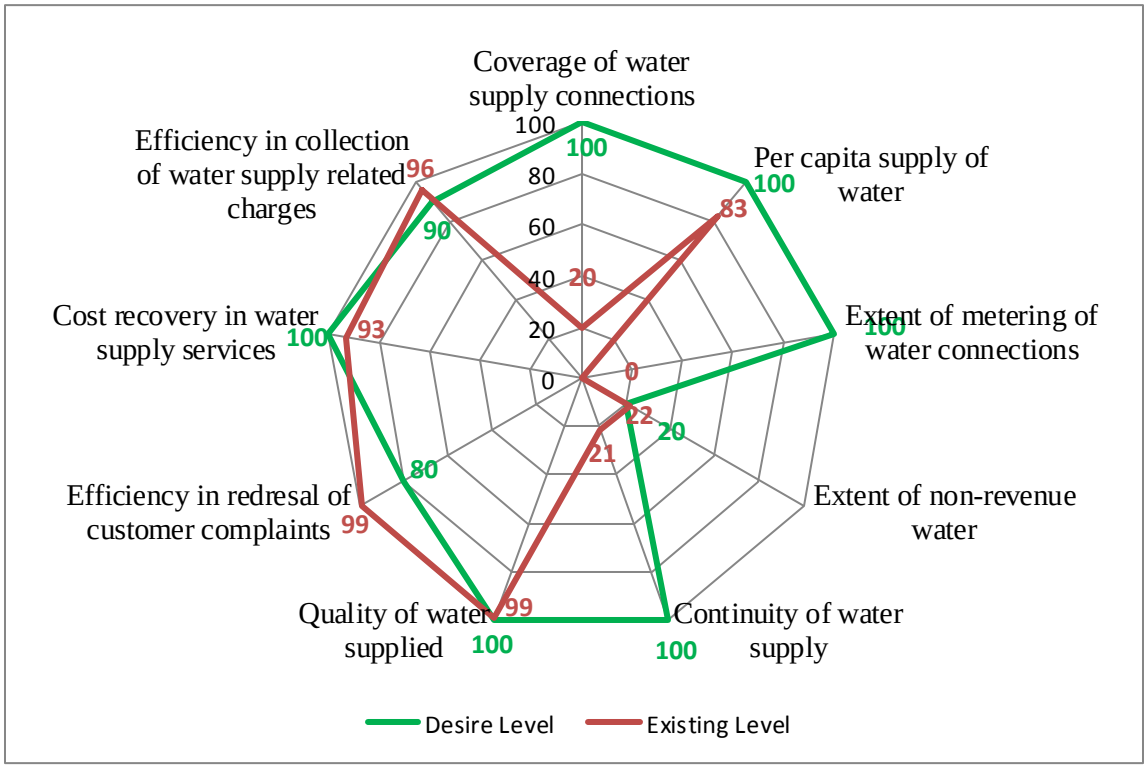
Table 13 Services Level Benchmark

Indicator (Water Supply)	Benchmark	Status (2011-12)
Coverage	100%	28.%
Per capita supply of Water	135 lpcd	78 lpcd
Extent of Metering	100%	0

Indicator (Water Supply)	Benchmark	Status (2011-12)
Extent of Non-revenue Water	20%	21.8%
Continuity of water supply	24 hrs	4hrs
Quality of water Supplied	100%	98.6%
Efficiency in re-dressal of customer complaints	80%	98.2%
Cost recovery	100%	93.3%
Efficiency in collection of water charges	90%	95.6%

Source: Local Bodies UP (Service Level Benchmark document)

Figure 11 Services Level Benchmark



Source: Local Bodies UP (Service Level Benchmark document)

The above table shows the performance of NPP, Unnao in the water supply as against the benchmarks. The coverage of water supply network should be 100% while in NPP, Unnao its just 20%. Per capita supply of water is also very low at 78.00 LPCD whereas it should be 135 LPCD. There is no metering taking place in Unnao city for the water supplied when it should be 100%. The performance of NPP, Unnao is near to benchmark in non-revenue water which should be 20% and in Unnao it is 25%. In Unnao water is supplied for 4 hours whereas it should be

24hrs and efficiency of complaint redressal is high at 98.2%. The quality of water supplied is marginally lower at 98.2%. The efficiency in collecting water charges is 95.6%.

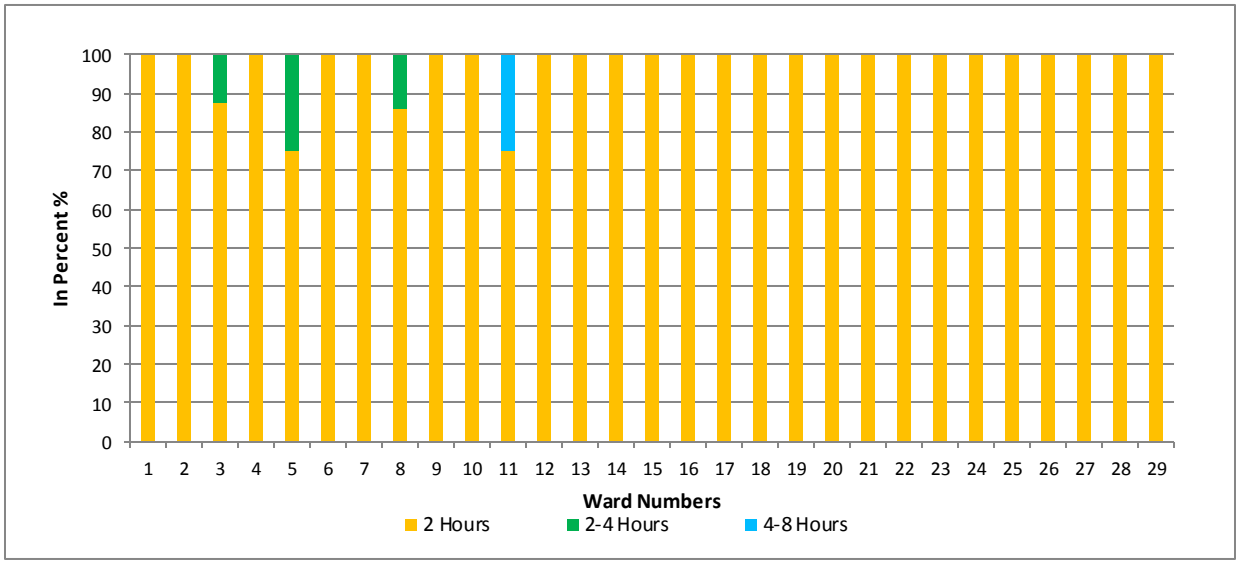
3.4 Findings from the Primary Survey

Primary survey was carried out with the purpose of gathering information from the sample population regarding water supply. The source of water supplied and used by people and quality of water were the two aspects on which light was thrown via primary survey.

3.4.1 Frequency of Water Supply

Most of the respondents reported that water comes only for 2 hours. The hours of supplying water is not enough.

Figure 12 Frequency of Water Supply (Ward Wise)

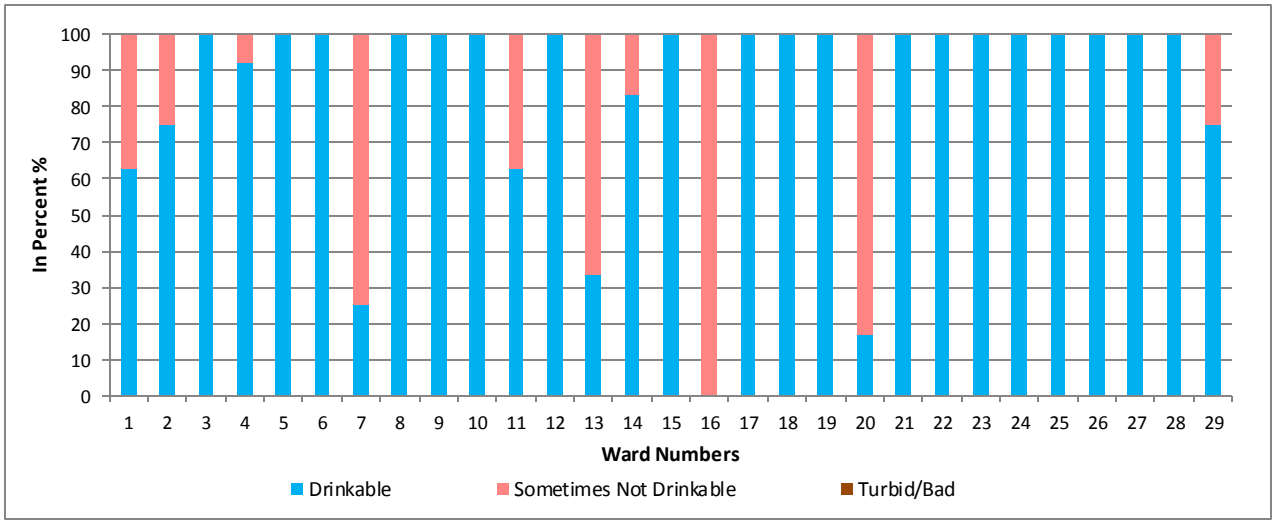


Source: Primary Survey, 2015

3.4.2 Quality of Water

Many of the respondents reported acceptable quality of water, at the same time some of respondents were also reported that sometimes it is not suitable for drinking purpose. However if the current malpractice will continue then quality of water is expected to be severely effected in Unnao city.

Figure 13 Quality of Water (Ward Wise)

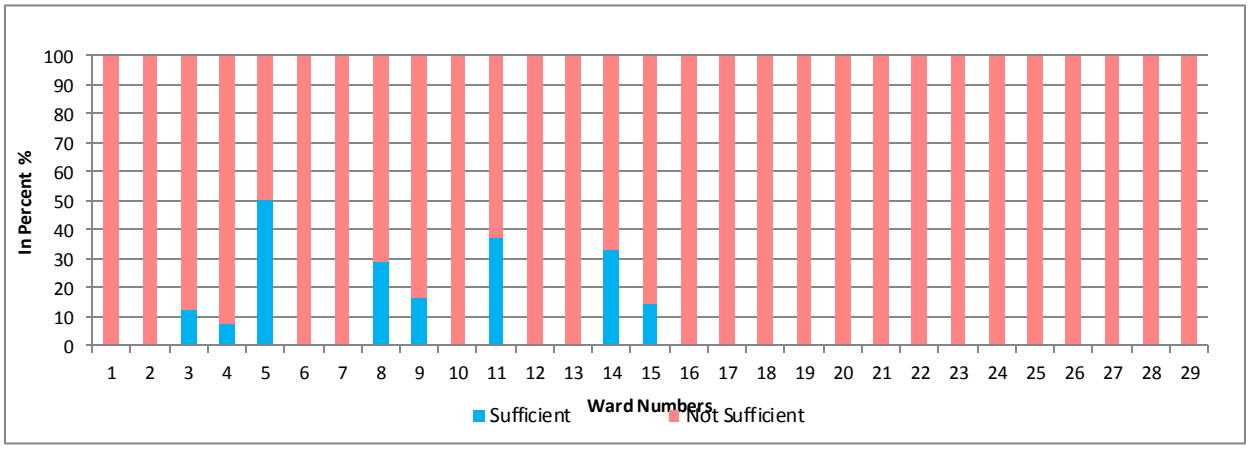


Source: Primary Survey, 2015

3.4.3 Water Sufficiency

Sufficient water is not supplied to the people according to the respondents. Only in few wards like 3, 4, 5, 8, 9, 11, 14 and 15 are getting sufficient water otherwise most of the respondents are not getting enough water for their needs.

Figure 14 Water Sufficiency (Ward Wise)



Source: Primary Survey, 2015

3.5 Current and Projected Water Demand

The water demand has been calculated keeping in mind the decadal population projections, rate of water supply which is 135 LPCD (as per CPHEEO manual) and adding the provision of 15%

for unaccounted water. For example the projected water demand for year 2021 is 177658 *135 KLD

Table 14 Present & Projected Water Demand

Year	Population	Water Demand (MLD)	Water Supplied (MLD)	Gap in Supply (MLD)
2011	177658	24	13.87	10.13
2016	202562	27	13.87	13.13
2021	219204	30	13.87	16.13
2026	241195	33	13.87	19.13
2031	265319	36	13.87	22.13
2036	290808	40	13.87	26.13
2041	318734	43	13.87	29.13
2046	344801	47	13.87	33.13

Source: - calculated value

3.6 Gap Analysis

- Gap in water demand is 10.13 MLD
- Gap in domestic connection is 23849 (72%)
- Water supply network is 199 kms (31.84%) Required
- Water treatment plant is required.
- Quality of water is poor.

3.6.1 Issues

- Varying quantum of water availability at source, Water supply is erratic; especially during summer.
- Low coverage of network and few water connections.
- Poor metering system and low water charges collection efficiency
- Poor maintenance of water sources and infrastructure
- Lower per capita water supplied to the population of the city.

3.7 Vision and Goals

Vision

"Achieve Water Security through provision of equitable and efficient access to continuous water supply in an environmentally sustainable manner"

Goals

The table below translates the above vision into tangible service delivery targets

Table 15 Goals, SML Term Targets

Parameter	Unit	Norm	SLB	Short	Medium	Long
Coverage	%	100%	12%	✓		
Per Capita Supply	LPCD	135	48		✓	
Non-Revenue Water	%	20%	-		✓	
Metered connections	%	100%	-		✓	
Continuity	Hours	24.00	-			✓
Complaints Redress	%	80%	-	✓		
Quality of Supply	%	100%	15	✓		
Cost Recovery	%	100%	-		✓	
Collection Efficiency	%	90%	-		✓	

Table 16 13th Finance Commission: Declaration of Service Level Benchmarks

Indicators	Norm	Current	Target
Coverage of water Supply Connections	100%	30	32
Per capita supply of water	135	69	72
Extent of metering of water Connections	100%	0	5
Extent of Non-Revenue Water	20%	24	23
Continuity of Water Supply	24.00	7	8
Quality of Water Supplied	80%	100	100
Efficiency in redressal of customer complaints	100%	99	98
Cost Recovery in water Supply Service	100%	15	16
Efficiency in collection of water supply related	90%	37	39

3.8 Financial Options (Water Supply Network)

Broad cost estimates for capital expenditure are assessed for the key components of the various design sectors discussed in the preceding sections. The broad implementation strategy adopted for the Water Supply system envisages that the first two years as the major investment phase (2016-2019), whereas the subsequent years over the plan timeline until the year 2046 predominantly involve incremental procurements for augmentation of the services or replacements.

Table 17 Rate for Proposed Water Supply network

Sr.No	Item	Unit	Rate(Lakh)
1	Construction cost for water network	1 KM	14.00
2	Construction cost of WTP for	1MLD	8.00
Total Cost			
1	Construction cost for water network	191Kms	2674.00
2	Water Treatment Plant	1 (50MLD)	0400.00
Total Capital Investment			**3074.00**

Source: - calculated value according to Delhi Schedule Rate 2014.

The approximate cost for implementation of this recommendation is Rs. 30.74 Crores

3.9 Recommendations

The DPR proposed and implemented had carefully rezoned water supply zones to develop a comprehensive system of water supply and for distribution of water in the most equitable and efficient manner in Unnao.

The various considerations on which zoning was based –

- Optimum utilization of existing works
- No valley line was traverse.
- No Crossing of National Highway and Railway track
- Size of zone considered was neither very large nor very small.
- Well defined zonal boundaries or at least along the main roads or other geographical features as far as possible.
- Zonal water works are preferably proposed in the center of the zone to economize the distribution system.
- Ward boundaries

Along with this the given table summarizes a set of suggested actions on Water Supply

Table 18 Recommendation, Water Supply

Actions	Recommended Body
Strengthen Baseline information on water and sanitation indices	NPP
Conduct a Household Sanitation Survey to capture baseline sanitation information	
For future install Bulk Meters at Intake points, Treatment Plants, Storage and Pumping points on priority; shift to consumer level metering in medium to long term.	
Implement a water quality monitoring protocol for piped supply and ground water	
Develop and implement an Investment Program to achieve SLB norms within 5-10 years	PHED/NPP
Conduct a Water Loss Audit within corporation areas and implement actions to reduce losses; Follow up this initiative to prepare and implement a DPR to achieve SLB norms.	
Constitute a Coordination Committee among PHED and MCT to implement the investment program.	State Gov./NPP
Constitute a Coordination Committee among PHED and MCT to implement the investment program.	
Formulate and enforce a) Bye-laws on Ground water conservation/ Rainwater Harvesting, b) Tariff Policy, c) Connection Policy	State Gov./NPP
Constitute a Water and Sanitation Committee to implement water tariff policy which could be formed from among the CTF members.	State Gov./NPP
Initiate measures to increase penetration of piped connections; implement measures to improve and sustain collection efficiency.	NPP
Implement differentiated area based tariffs among residential connections; progressively shift to volumetric tariffs for all connections.	NPP

Priorities:

a) Achieve water security; improve service levels and meet SLB norms
b) Improve information Availability and Reliability
c) Improve capacity and coordination; strengthen monitoring and regulation

4 ACCESS TO TOILETS

Access to toilet is an integral part of Sanitation. Population of migration stream from rural to urban, according to 2001 census was 20 million people during last decade. 12.04 million (7.87 %) out of 55 million urban households do not have access to toilets and defecate in open. The Millennium Development Goals (MDGs) enjoin upon the signatory nations to extend access to improved sanitation to at least half the urban population by 2015, and 100% access by 2025.

4.1 City Sanitation Rating Project

City Sanitation Rating Project was undertaken by MoUD in 2008 to rate Indian cities on various Sanitation related infrastructure, practices prevalent and information available at ULB.

The vision of the NUSP is to make Indian cities open defecation free, which will be possible only when all the residents of the cities will have universal access to toilet facility. Thus access to toilet facility is one of the main components of the rating which was given to the Indian cities under National Rating and Award Scheme for Sanitation for Indian Cities.

Access to toilet has have been covered under the outcome and process related indicators' categories. It covers access and use of toilets by urban poor, un-served households and floating population, visible open defecation, elimination of manual scavenging and M&E systems to track incidences of open defecation. NPP, Unnao has performed very poorly in this section.

4.2 Present Condition

Under the sewerage and sanitation arrangement information for year 2011-12, Unnao is having 26890 flush toilets and 8 community toilets. So there are 26890 properties (10.0%) out of total 33273 properties.

Table 19 Ward Wise Toilets Facility in Unnao

Wards	Households	Households having latrine facility (%)	Households not having latrine facility (%)
1	1994	84	16
2	1341	93	7
3	1023	45	55

Wards	Households	Households having latrine facility (%)	Households not having latrine facility (%)
4	1051	84	17
5	1175	78	22
6	829	83	17
7	869	90	10
8	1747	54	46
9	1280	48	52
10	1258	95	5
11	1077	78	22
12	988	76	28
13	983	93	7
14	980	97	3
15	917	93	7
16	824	78	22
17	873	98	2
18	1083	93	7
19	1396	76	24
20	2413	94	6
21	1478	79	21
22	1123	90	30
23	1041	99.9	0.1
24	886	98	2
25	751	89	11
26	1193	93	7
27	717	99	1
28	1153	97	3
29	830	96	4

Source: - Census 2011

According to Census 2011, the total population of Unnao is 177658 and the number of households is 33273. Among these households 83% have toilet facility within the premises and rest of the 17% of the population either going for open defecation or using public toilets like sulabh complex. The critical condition in ward number 3, 8, 9 there are facility of toilets 50% and below 50%. People are going for open defecation in surrounding vacant land and in agricultural lands.

Table 20 Number of Latrine Facility in Unnao City

Sr.No	Description	No.	%
1	Total number of Households	33273	100
2	Number of households having latrine facility within the premises	27617	83.00
	Gap	**5656**	**17.00**

Source: - Census 2011

Here under Swachh Bharat Mission (SBM) Nagar Nigam Unnao is proposing individual toilets. Particularly it is proposing in the areas where people are going open defecation. The mobile toilets should be placed in the in the congested areas where sufficient land is not available for the construction of toilet and septic tank. All the toilets septic tanks should connected with sewer system.

4.2.1 Community Toilets

There are total 8 sulabh complex (Public and Community) within area of Unnao city.

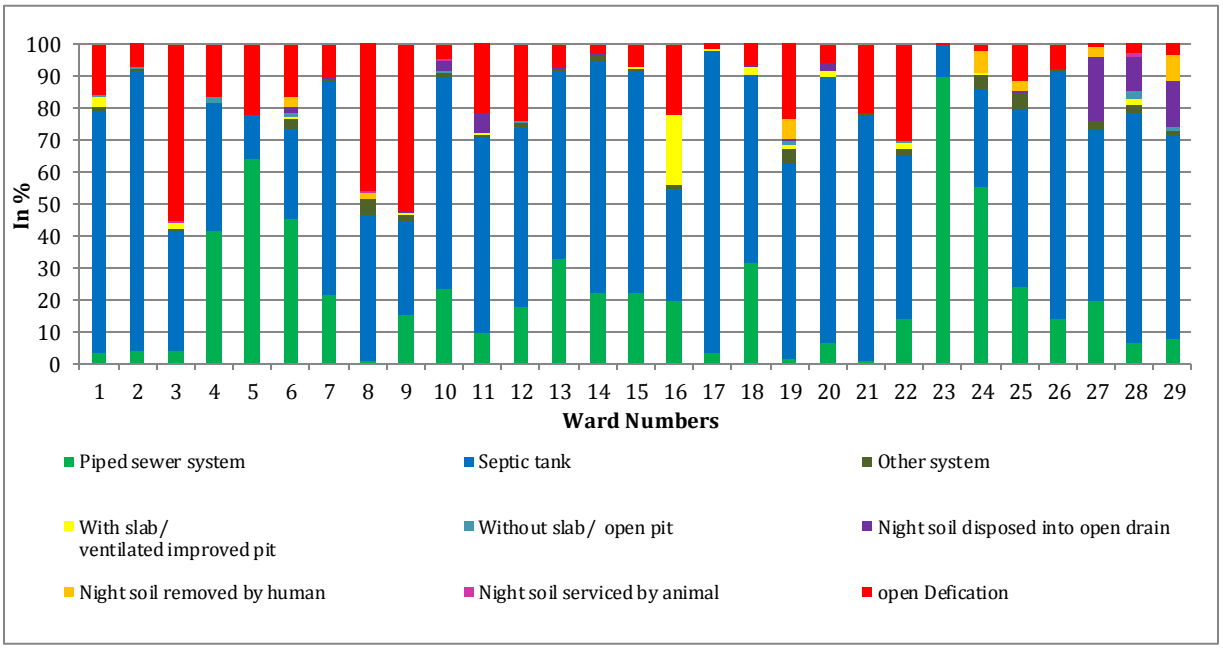
4.3 Finding from Primary Survey

As can be witnessed below most of the respondents reported presence of toilet facility at household level except some of resident living in wards 2,3,9,25 and 27 reported absence of Toilet facility at household level. Community toilet should be given a priority in these wards.

4.3.1 Type of Toilet Facility (Ward Wise)

As can be witnessed through graph below, most of the respondent reported access to individual toilets of Wet Flush with septic Tanks. Non availability of Toilet was reported in all wards. On the other hand all these people those doesn't have Toilet facility at household level, shares neighbor's toilet or goes to outside for Open Defecation.

Figure 15 Type of Toilet Facility (Ward Wise)

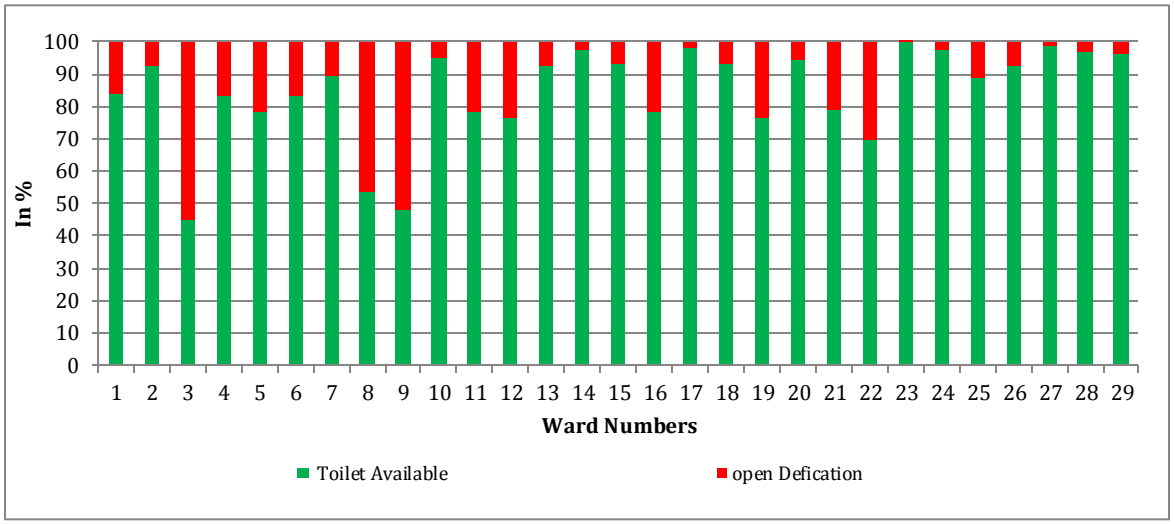


Source: Primary Survey, 2015

4.3.2 Open Defecation (Ward Wise)

All these people those doesn't have Toilet facility at household level, shares neighbor's toilet or goes to outside for Open Defecation. The graph shows that in wards 2, 3, 9, 25 and 27 do not go for the open defecation.

Figure 16 Open Defecation (Ward Wise)

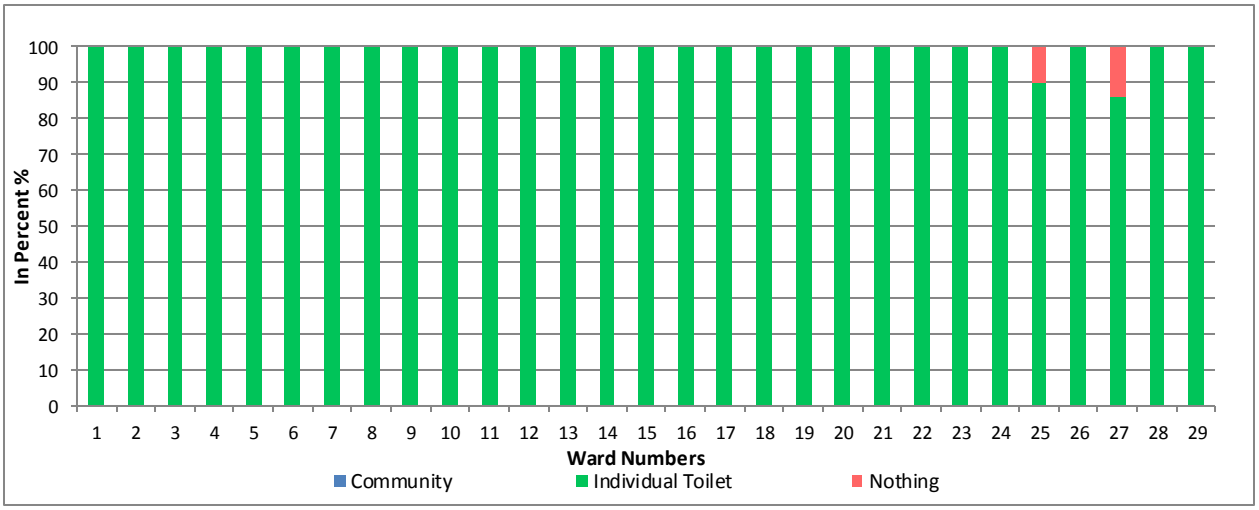


Source: Primary Survey, 2015

4.3.3 Availability of Desired Facility (Ward Wise)

Every surveyed respondent have reported that they do have desire event toilet facility in their concerned area except ward number 25 and 27 etc.

Figure 17 Desired Toilet Facility in the absence of Household Toilet facility

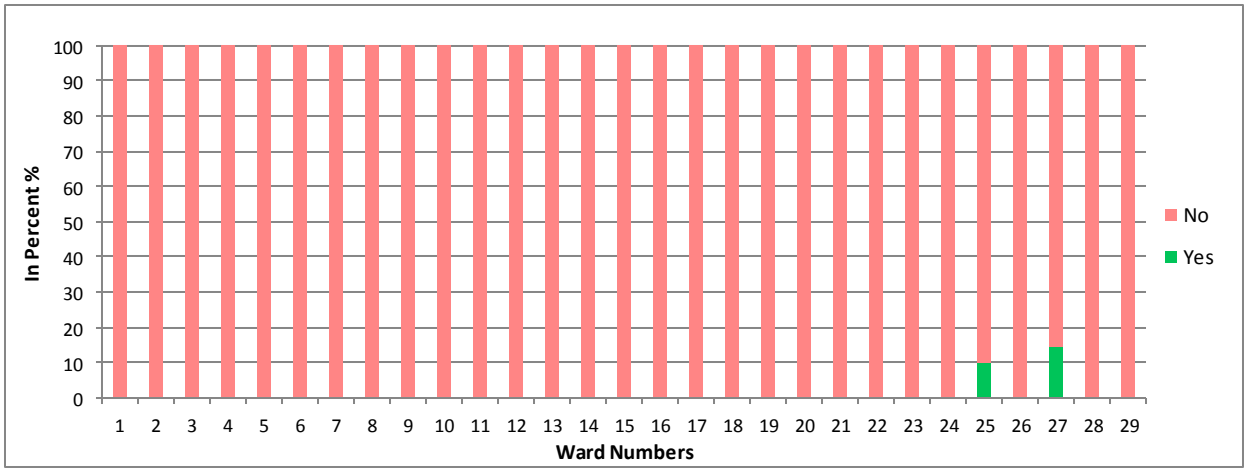


Source: Primary Survey, 2015

4.3.4 Presence of Community Toilet in Locality (Ward Wise)

As evident from figure below most of the respondents reported absence of community toilet facility in their concerned residential area. It is well known that Community toilets are critical for reaching the goal of open defecation free city.

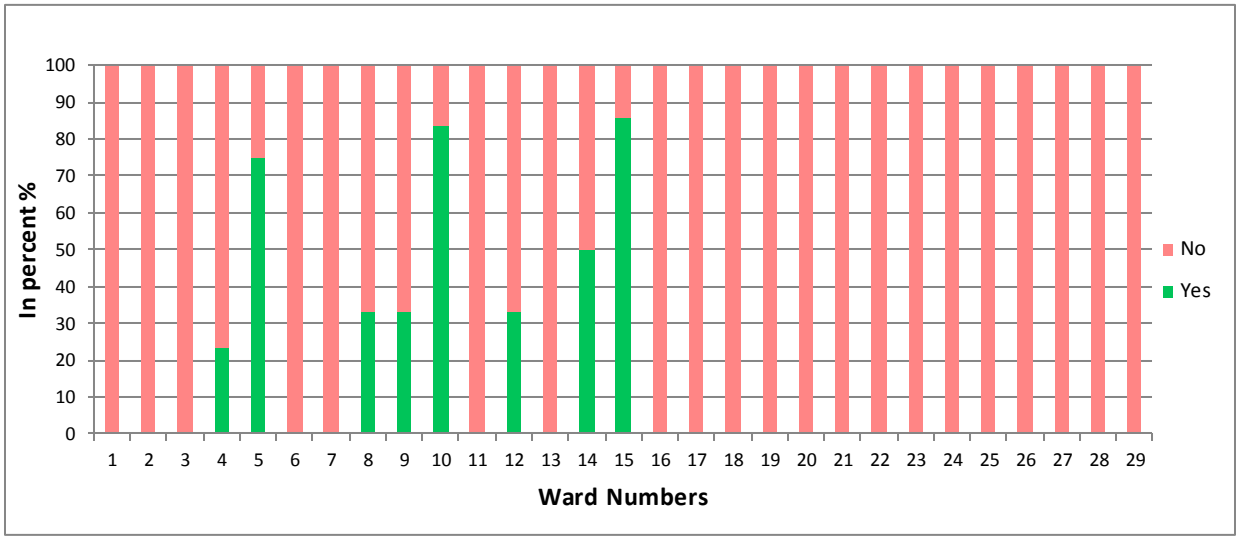
Figure 18 Community Toilets in Locality (Ward Wise)



Source: Primary Survey, 2015

There is no toilet facility for Physical Handicapped people in the city. As evident from the graph below most of respondents expressed no willingness to pay for Physical Handicapped toilet facility except some wards like 4, 5, 8,9,10, 12, 14, and 15.

Figure 19 Willingness to Pay for Physical Handicapped Toilet (Ward Wise)

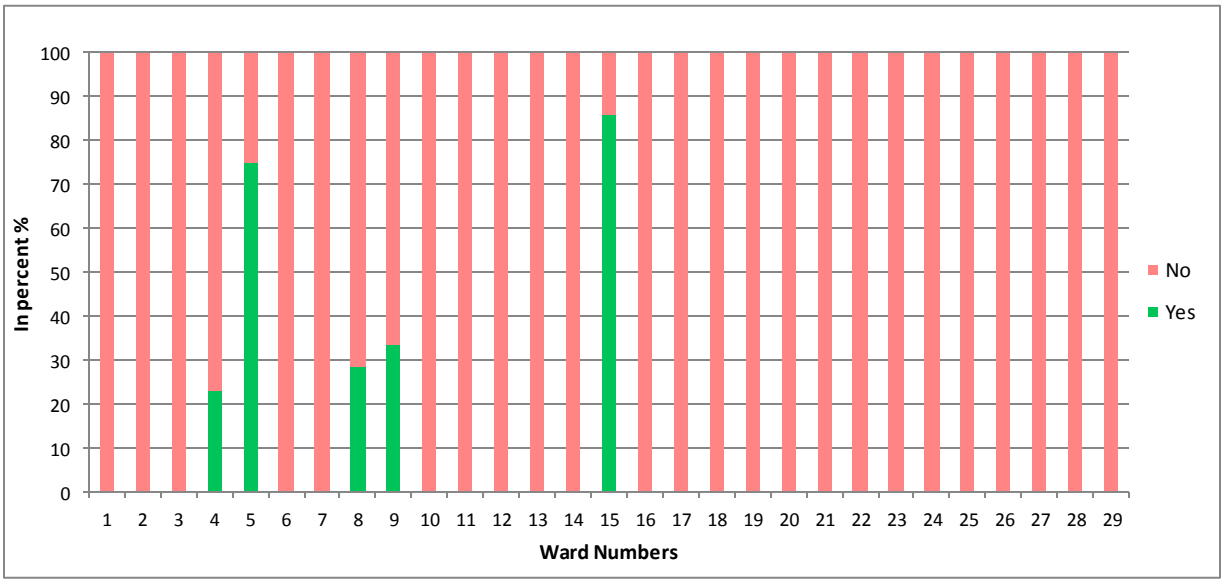


Source: Primary Survey, 2015

4.3.5 Willingness to Contribute to O& M for Toilet (Ward Wise)

As evident from the graph below most of respondents denied contributing for maintenance of toilet facility. Only native of few Wards like 4,5,8,9, and 15 has willingness to some extant for contribute to O & M of Toilets in the city. Hence, there is needed to take initiative by Unnao Nagar Palika in order to organize maintenance of toilets in the city with the help of Public Private Partnership.

Figure 20 Willingness to Contribute To Toilet (O&M)



Source: Primary Survey, 2015

4.3.6 Service Level Benchmark

According to CPHEEO guidelines, benchmark for the coverage of toilets is 100% in India, while NPP, Unnao is still left behind on this standard. To have better sanitation level in the city universal coverage of population with access to toilet is necessary.

Table 21 Services Level Benchmark

Sewage Management indicators	Bench Mark	Status (2011-12)
Coverage of toilets	100 %	83 %

Source: Local Bodies Uttar Pradesh (Service Level Benchmark document)

In Unnao predominant Land use is Residential with some percentage of Commercial, Industrial, Institutional and Public places. Population Density, Presence of Slums and Land uses clearly indicates the requirement of Public Toilets and Community/Shared Toilets for slums dwellers and general public.

4.4 SWOT, Issues and Priorities

The given table captures the SWOT analysis for access to toilets within NPP.

Table 22 Access to Toilet SWOT

Strength	Weaknesses
• Good Coverage for Toilets Access even if temporary • General awareness on sanitation hygiene is good	• Open Defecation in Slums • Open urination particularly in commercial areas • Limited availability of community toilets in slum pockets and constrained availability of Public Toilets
Opportunities	**Threats**
• Open defecation is limited to selected low-income pockets • People desire individual in house toilets • Limited identifiable areas with no toilet	• No willingness to pay for construction of Community Toilets and its O & M. • Poor Hygiene conditions near open defecation spots and open urination would create health hazards

Key issues with respect to Access to Toilets within NPP are summarized below-

- Open Defecation while rare is still prevalent in selected pockets of the city.
- Open Urination in public places along roadside is rampant in congested commercial areas.
- Priority should be given to the construction of Public toilets with the NPP accountable for it.

4.5 Conceptual Basis and Best Practices

While individual household toilets are preferable to communal/public toilets, shared toilet access solutions are still appropriate in specific situations; notably as Community Toilets in slums when a high proportion of tenants are without access to toilets and even Public Toilets in urban pockets such as commercial areas and transit points are loaded. Nonetheless, financing and sustainable management of communal/ public toilets has been challenging, and requires extensive consultation and careful analysis. Our action plans and recommendations for Shared Toilet Access in Unnao are built on insights from recent studies and research initiatives on this subject.

Where are public toilets used: **-** The Sulabh organization runs Pay-per-use toilets throughout India. Reports suggest that these facilities are profitable in public locations, but tend to be loss-making in residential areas and are often inadequately maintained.

Community toilets: **-** are seen in low-income communities of many African and Asian cities. The SPARC model, implemented in Pune and Mumbai are constructed and managed by NGOs under contract from municipality with community involvement. A moderate per-household monthly fee is collected.

Key conclusions

- Communal or public toilets should only be introduced after exploration of the social and economic context.
- People will generally prefer communal toilets closer to home over public toilets located far-off.
- Communal or public toilets are only acceptable if they provide effective service for women and children.
- Communal toilets serving small groups of households and charging a monthly per household fee will be preferred by users, especially women, than pay-per-use public toilets. However, per-capita capital costs tend to be higher.

4.6 Options for Improving Service Delivery

Advertising rights potential does make toilet complexes profitable, so that maintenance is commercially viable. The challenge is to develop contracts so that the public service is delivered to an acceptable standard. The following could help:

- Assess Local Demand before developing New Toilet Blocks. Where demand is high, toilets can be profitable without advertising revenue. Demand is a prerequisite for contracts based on user charges.
- Revitalize Monitoring and Strengthen Accountability. Municipalities need to enforce contract compliance. Media interest, municipal accountability, consumer feedback are possible solutions. Further, service level parameters should be defined and monitored. Punitive measures should be contractually enforced to disincentives in case of poor maintenance.

- Increase the Lease Period. Longer lease periods could enable longer term cost recovery plans with proper attention to maintenance when backed by contractually enforcing penalties for poor performance.

4.7 Vision and Goals

Vision

Equitable and Efficient access to Public and Community toilet to "Eliminate Open Defecation" and by making all citizens sanitation-conscious through sustained awareness effort"

Goals

To meet service delivery targets to achieve the above Vision.

Table 23 Access to Toilet Supply, SML Term Targets

Parameter	Unit	Norm	Baseline/Ward No.
Open Defecation			
No. of open urination Spots	No.	0	
No. of open defecation spots	No.	0	Near Slum Pockets
Toilet Coverage			
% households with Toilet access	**%**	99%	83%
Access to Public Toilets	Floating Population/Public	-	5%
Access to Community Toilets	Slum Dwellers/Community		0

In case like Unnao all the above targets should be met on a short term basis (3years) as the service delivery rate must be equivalent to rate of growth of city. Medium term (5 years) and Long term (10 years) targets can be proposed in large scale projects.

4.8 Gap Analysis

Since most of the wards are low-income high density Shared Toilets in Slums, Public Toilets in busy commercial wards or a combination seems to be an appropriate solution.

4.8.1 Household toilets

In Unnao, at present there are 33273 households are exists in which 5656 households does not have toilets in their premises.

4.8.2 Public Toilets

For calculating requirement of Public Toilets, we assume floating population is 5% of existing population which is 8883. These toilets will also be accessed by intercity commuters.

Assumption

As per the Manual on Sewerage and Sewage Treatment Systems, 2013 Part an Engineering for male One per 100 persons up to 400 persons; For over 400 persons, add at the rate of one per 250 persons or part thereof and for female Two for 100 persons up to 200 persons; over 200 persons, add at the rate of one per 100 persons or part thereof

Requirement

Therefore, 7-8 Public Toilets are required in the city. Now these public toilets will be located in different wards of the city which may or may not have slums but definitely will be a high density ward with busy areas so some Toilets will be commercially viable and some will not be commercially viable.

4.8.3 Community Toilets

Apart from this each slum must have at least 1 Shared Toilet facility. Now as per below Table the total population of slum is 43150 .Also, minimum slum population is approximately 200 and maximum is 5000.Using the baseline information and assumption taken above, the table below gives us no. of shared toilets required in each ward with slum.

- At present there are 33273 households are exists in which 5656 households does not have toilets in their premises.
- Firstly up gradation of existing 8 toilets is a priority and then addition 8, 10 Seater for Public Toilets is must.
- Community toilets maximum 57 sulabh complex are required for slum population

4.9 Financial Options

Broad cost estimates for capital expenditure are assessed for public toilet complexes and mobile toilets with appropriate wastewater treatment systems.

Table 24 Unit Costs for Construction of Toilet (Households, Community and Public Complex)

Component	Total units	Cost	Rate (Lakhs)*
Household toilets	5656	08,000	452.48
Community toilets complex	57 (10 seats with bathing unit)	65,000	037.05
Public toilets complex	8 (10 seats with bathing unit)	75,000	06.00
Total Capital Investment			**495.43**

Source: - Calculated value As Per S.B.M., 2014

Construction costs for public toilets and community toilets in Unnao city vary significantly according to the public requirement. The table above presents capital expenditure currently for household, community and public toilets. This approximately translates Rs. 20,000 (household) for construction of one toilet seat. The construction expenditures for one community complex translate 65,000 and 75,000 for public toilet complex. The costs for the rehabilitation of public toilets are approximately 60% of the capital costs for the construction of a public toilet.

It is estimated that Unnao has to mobilise funds in the range of Rs. 4.95 Crores approximately for achieving 100% sanitation access for the communities in Unnao City.

4.10 Timeline

The system shall be designed under the broad framework as per the guidelines for a design period of 30 years; however, the planning shall entail the implementation of the design in phases to meet the ultimate goals of the CSP.

The phased approach aims to navigate through the challenges posed by the limitations in investments, institutional capacities, and community engagement in a proficient manner. The phases and the corresponding timelines are defined as stated below

Table 25 Timeline Indication

Phase	Year	Activity
Immediate	2016-2019	• Review condition of existing facilities against design considerations through a detailed ward level survey • Rehabilitate all facilities which do not comply to the design considerations (repairs and up-gradation of public toilets) • Initiate preparation of Public Sanitation DPR • Identify possible construction sites for new infrastructure • Construction of new facilities (toilet seats as well as urinals) mainly focussing on core city area • Conduct awareness generation campaign on health and hygiene aspects of public sanitation • Promotion of individual household toilets through subsidies/incentives
Short-Term	2020 - 2025	• Construction of new facilities in core city (balance) and peripheral areas • Promotion of individual household toilets through subsidies/incentives
Mid-Term	2026 - 2035	• Augment existing infrastructure as per the demand • Endure provision of 1/35 seat/user ratio for residential areas and 1/100 for tourist areas • Promotion of individual household toilets through subsidies/incentives
Long-Term	2036 - 2046	• Augment existing infrastructure as per the demand • Endure provision of 1/35 seat/user ratio for residential areas.

4.11 Recommendations

We suggest PPP model for the large number of requirement. There are 2 ways in which the bidding can take place in PPP model. Firstly all the public toilets can be bid for separately and all shared toilets in slums can be bid separately. But the slum is occupied by economically weaker section so for a successful sanitation scheme in these wards it is advisable for grouping of Toilet facility(group bidding) to a contractor with few commercially viable and few commercially unviable located toilet sites. This would be a win- win situation where profit from the viable sites can be used to run the toilets in unviable sites.

Also once the private party develops the facility on the land provided by ULB, it can avail 20% subsidy from the ULB for the O and M of the facility every month. Recommendations are summarized in detail below.

Table 26 Recommendation, Access to Toilets

Actions	Recommended body
Prepare and Implement a city wide Public and Community Toilet Development/Rehabilitation Plan	NPP
• identify locations, configuration and sizing of Public and Community Toilets	
• Replace dilapidated open urinals with enclosed toilets where feasible and required	
• Provide Community Toilets, starting with identified locations with high OD prevalence	
• Provide Public Toilets starting with identified areas having high floating population	
Implement a comprehensive inspection/monitoring protocol for Toilet monitoring and upkeep	NPP/UPSIDC
• Render existing toilets usable through designated accountability among sanitation officials	
• Engage local stakeholders in maintenance, monitoring and oversight of shared toilets	
• Periodic Third Party Audit of facilities and reviews	
Strengthen basis and capacity through formulation of bye-laws and guidelines	State Gov.
• Incorporate Toilet Sizing and specifications as part of Building regulations.	
• Incorporate fines for open defecation and urination in Sanitation bye-laws	
Drive behaviour change through awareness campaigns	NPP/UPSIDC
• Initiate a Slum level sanitation campaign to eliminate open defecation	
• Initiate a Trader-support campaign in commercial areas to eliminate open urination	
• Initiate a school campaign to impart positive behaviors on civic duties, sanitation and toilet use	
Initiate actions to improving financial sustainability	NPP/UPSIDC
• Prepare a Toilet Budget annually	
• Explore appropriate outsourcing models for Public Toilets	

Priorities:

a) Create access to Public/Community Toilets to eliminate Open Defecation and Urination

b) Create Awareness on Hygiene and Health Impacts and drive behaviour change

c) Fix accountability, Enforce Standards, and Strengthen Monitoring

d) Assess financing needs and address them innovatively to ensure Sustainable operations.

5 SEWERAGE SYSTEM

5.1 City Level Status

The city does not have sewer network properly. There was lack of willingness by the people to access the facility which was reflected during the site visits. In this situation absence of required Sewage Treatment Plant and storm water drains makes it even worse. Waste water is either treated in septic tank or discharged directly in broken drain or water bodies. The city does not have sewerage treatment plant.

5.1.1 Sewage Generation

The trend of wastewater generation and future projections is calculated based on the sewage return factor taken as 0.8 which indicates that 80% of water supplied returns as sewage. By 2011 the total estimated wastewater generated by 177658 populations is 11 MLD in Unnao city. The total water supplied is 13.87 MLD. At presents only 11 %(32kms) area covered by the sewer network. As of now there is no waste water treatment facility. Indiscriminate disposal of waste water through storm water drain is detrimental to environment and public health.

Table 27 Sewerage Infrastructure within the City

Sr.No	Indicator	No.
1	Population	177658
2	Total water supply	13.87 MLD
3	Waste generate	11 MLD
4	Total No. of sewer connection	Nil
5	Total covered area	11 %(32kms)
6	STP	Nil

Source: Nagar Palika Parishad, Unnao

5.1.2 Collection

Presently, the city has the system of septic tank connections at house hold level and there is no sewage collection network in the city. The waste water overflows from the septic tanks mix into the drain and poses the problem of ground water contamination.

5.1.3 Treatment and Disposal

Off Site

The laid sewerage system in not being accessed by people therefore there is no offsite treatment of water is happening.

On Site

There are many households in Unnao which discharge their black water (from toilets) into septic tanks and soak pits. The grey water from kitchens and bathrooms is discharged into open drains without treatment. At present the extent of households relying on the septic tank or coverage of septic tanks in household & slums for wastewater disposal is not know.

Table 28 Present and Projected Water and Waste Water in MLD

Year	Average	Water (MLD)	Solid Waste(TPD)	Sewage (MLD)
2011	177658	24	62	19
2016	202562	27	71	22
2021	219204	30	77	24
2026	241195	33	84	26
2031	265319	36	93	29
2036	290808	40	101	31
2041	318734	43	111	34
2046	344801	47	121	38

Source: - Calculated Value

However based on the survey conducted by JT Urja, it is estimated that most of the households are using soak pits or septic tanks. During discussions with the communities, it was observed that most of the houses construct septic tanks based on the available space rather than following the norms of CPHEEO. Surveys in the city indicate that a significant portion of sullage water find their way into drains unchecks.

Figure 21 Water and Waste Water Projections

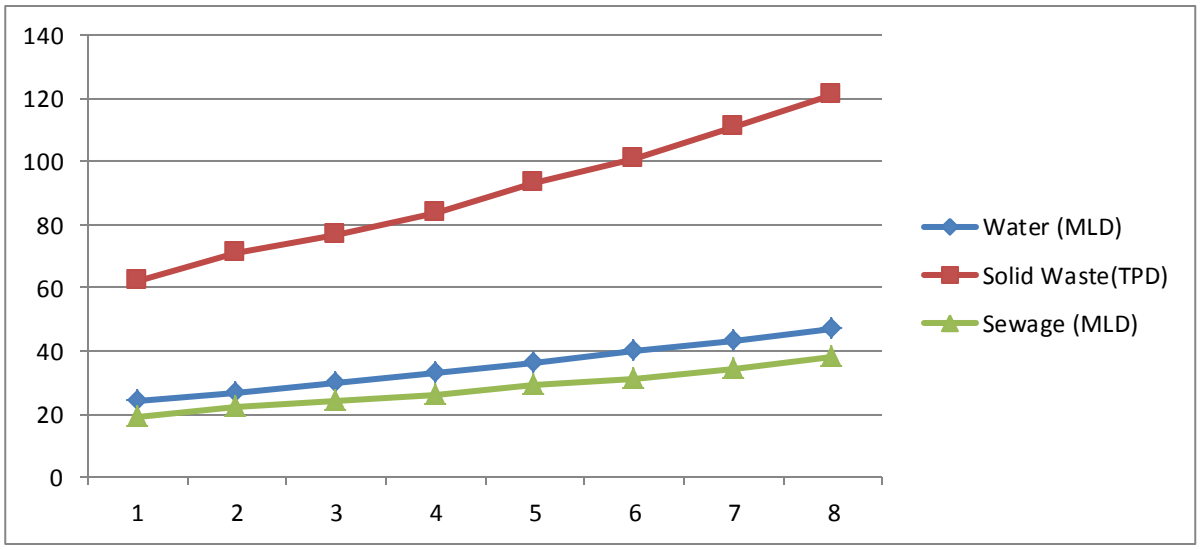


Table 29 Service Level Benchmark for Sewerage System

Performance Indicator	Benchmarks	Status
Coverage of Sewerage Network	100%	11%
Coll. Eff. of Sewerage Network	100%	0%
Adequacy of Sewage Treatment Capacity	100%	0%
Quality of Sewage Treatment	100%	0%
Extent of Reuse and Recycling of Sewage	20%	0%
Extent of cost recovery	100%	0%
Eff. in re-dressal of customer complaints	80%	0%
Eff. In Collection of Sewage Water Charges	90%	0%

Source: Local Bodies Uttar Pradesh (Service Level Benchmark document)

5.1.4 Finding from Primary Survey

- Management of septic tanks: No information from respondents reported that the septic tank maintenance and cleaning in managed by individuals directly.
- Cleaning frequency: No information from respondents about cleaning their septic tanks which seems to suggest that there could be either percolation or leakage into available drains or ground water.

Table 30 13th Finance Commission: Declaration of Service Level Benchmarks

Indicators	Norm	Current	Target
Coverage of water Supply Connections	100%	30	32
Per capita supply of water	135	69	72
Extent of metering of water Connections	100%	0	5
Extent of Non-Revenue Water	20%	24	23
Continuity of Water Supply	24.00	7	8
Quality of Water Supplied	80%	100	100
Efficiency in redressal of customer complaints	100%	99	98
Cost Recovery in water Supply Service	100%	15	16
Efficiency in collection of water supply related	90%	37	39

5.2 SWOT Issues and Priorities

Table 31 Waste Water Management SWOT

Strength	Weaknesses
• Prevalent use of septic tanks	• In spite of coverage people not accessing sewer connections • Absence of Sewage Treatment Plant • Mixing of storm water and sewage • No clear accountability / regulation for monitoring septic tanks (On site sanitation) • Unorganised sludge removal; Weak guidelines / safety practices • Dumping of sludge in nearby areas; no safe disposal
Opportunities	**Threats**
By some initiatives, campaign and awareness program Nagar Palika can gain confidence of people and convince them to access laid network. • There is Potential to improve connections / cost recovery in offsite sanitation. • Potential for introducing bye-laws and regulation for onsite sanitation and septage management.(frequency of de sludging)for onsite sanitation	• Major threat is pollution of water bodies which can be a major source of water supply • Potential Ground Water contamination which is currently the most reliable source in the absence of standards and regulations • Mixing of storm water and sewage prevents from the opportunity of ground water recharge and increase in water levels of the existing water bodies. • Absence of Treatment Quality Monitoring in case of people resisting connections.

The key issues and priorities with respect to waste-water management within NPP are summarised below

- Limitations of existing sewerage system due to lack of access by people.
- Flows of grey water and in some cases black water into water bodies going unchecked.

5.3 Gap Analysis

- At presents only 11 % (32kms) area covered by the sewer network remaining 259kms (68%) required.
- The sewage collection system is not laid to cover all areas of the city. In fact it does not fully cover even the areas for which branch and main sewers have been laid. Sewer connections for each household (33273) are required.
- Sewerage Treatment Plant also required.

5.3.1 Conceptual Basis and Best Practices

A. Options for waste-water management

- **Fully on-site sanitation:** Fully on-site sanitation arrangements will involve on-plot treatment and disposal of all waste water and involves septic tank and soak pits - to receive and treat waste water. Septage (sludge from septic tanks) is transferred to another location for treatment. Onsite sanitation typically covers:
- **Improvements in existing household disposal facilities:** Existing household sanitation arrangements, which do not have proper disposal, can be improved by
  - Construction of soak pits for existing toilets having only septic tanks, and
  - Providing a septic tank / soak pits.
- **Public toilets:** Community/public toilets could also be provided with a septic tank based on-site system with a soak pit or soakage trenches (for effluent disposal).
- **Septage management:** An efficient septage collection system, operated by the ULB or private agencies is required along with regulation and monitoring of septic tanks and septage disposal.

  Small-bore sewerage: Septic tank is connected to small-bore sewerage network: all domestic waste water is partially treated in septic tank and the effluent is disposed into small-bore sewerage network. Septage is periodically cleared.

- Twin pit latrine waste water is disposed into soak pits. Small diameter sewer pipe (< 200 mm) is laid at a flatter gradient to carry the effluent from septic tanks.

5.3.1.1 Centralized or decentralized sewerage system

This alternative includes the regular sewerage network to collect the waste water from the households. The network is normally laid through most of the town. A detailed topographical and land availability survey will be necessary to determine the feasibility and required number of decentralized waste water treatment plants.

In the area covered with a sewerage network, efforts should be made to connect all households to the sewerage network. Even in this alternative, there is a possibility that a few households will still be served by on-site sanitation systems – mainly pit latrines. And Public sanitary conveniences will be directly connected to the nearest sewer line of the network.

5.3.1.2 Combined System

Following arrangements are envisaged for household/public sanitation and waste water treatment and disposal arrangements.

- **Household Sanitation:**

a) Septic tank with soak pits receives the entire household waste water. Septage is periodically cleared and taken away to a common treatment facility.

b) Sewerage network receives all the household waste water and conveys it to the centralized or decentralized treatment plant(s).

- **Public Conveniences:**

Waste water discharge is disposed into the sewerage network for further treatment and final disposal, in areas where some sewer network is provided and in other areas, waste water is discharged into a septic tank with soak pits.

- **Disposal of Septage:**

For households served by on-site sanitation systems, an efficient septage collection system, operated by the ULB or private agencies is required along with regulation / monitoring of septage disposal.

- **Waste Water Conveyance and Treatment:**

Domestic waste water, disposed into the sewerage network, is transported to the waste water treatment site(s) for treatment and final disposal. Treatment will meet the disposal standards

B. Challenges and Practices in Regulating onsite Sanitation

ULBs and Governments have realized the importance of onsite systems as long-term solutions to domestic wastewater treatment and disposal. The NUSP makes specific reference to on-site sanitation systems. However, institutional structure, organizational resources and personnel dedicated to the task of septage management is largely not yet in place.

Municipal laws typically contain provisions for punitive actions against properties causing nuisance, including letting out untreated human excreta into drains and open areas; but enforcement is patchy. Most references to on-site sanitation regulation exist within building regulations/building bye-laws or the development control rules (DCRs) usually developed for large cities.

Typically, the problems associated with on-site sanitation facilities can be grouped into four primary areas:

- Insufficient knowledge/capacity/awareness and public involvement
- Inappropriate system design and selection processes
- Poor O&M:
- Poor Monitoring

5.3.2 Vision and Goal

Vision: - Collection and Treatment of all waste water to prescribed standards and incorporate recycling and re-use to conserve fresh water resources.

Goal

Table below indicates targets in short, medium and long-term.

Table 32 Waste Water Management, SML Term Targets

Parameter	Unit	Norm	SLB	Short T	Medium T	Long T
% of area with sewerage network	%	100%	-	✓		
% of households with sewerage connections	%	100%	0%	✓		
WW Collection Efficiency	%	100%	-		✓	
WW Treatment Adequacy	%	100%	-		✓	
Quality of WW Treatment	%	100%	-			✓
Reuse and Recycling	%	20%	-	✓		
Cost Recovery	%	100%	-	✓		
Complaints Redress	%	80%	-		✓	
Collection Efficiency	%	100%	-		✓	

5.4 Financial Options (Sewerage Network)

Broad cost estimates for capital expenditure are assessed for the key components of the various design sectors discussed in the preceding sections. The broad implementation strategy adopted for the sewerage system envisages that the first two years as the major investment phase (2015-2017), whereas the subsequent years over the plan timeline until the year 2046 predominantly involve incremental procurements for augmentation of the services or replacements.

Table 33 Rate for Proposed Sewerage network

Sr.No	Item	Unit	Rate(Lakh)
1	Length of sewage network NP2 R.C.C 600mm Dia. Pipe	259 Kms	3572.00
2	Cost of treatment plant	11 MLD	0118.80
Total Capital Investment			**3690.80**

Source: - Calculated Value as per D.S.R. 2014

The approximate cost for implementation of this recommendation is Rs. 36.90 Crores

5.5 Cost Recovery Options

The challenge for Unnao is to establish a rate structure that adequately addresses the true cost of services associated with the capital investments, operations, maintenance and regulatory requirements. The recovery of costs incurred in each revenue area shall be through a tax levied upon the property owners within the jurisdiction of the catchment area in addition to the user charges and the revenue.

5.6 Implementation Strategy

Based on the availability of manpower, machinery, requisite resources – technical and financial, the proposed interventions are prioritised over immediate phase, short-term, mid-term, and long-term.

Table 34 Phase wise Implementation Plan

Phase	Year	Activity
Immediate	2016-2019	**Collection** Unnao shall conduct detailed survey Provision of household sewer connection in all wards **Conveyance** Rehabilitation of missing links and worn out network in existing sewerage system
Short-Term	2020 - 2025	**Collection** Provision of household sewer connection in un-served areas in all sewerage zones for remaining households **Treatment** Provision for STP **O&M and M&E** Establish O&M and M&E systems

Phase	Year	Activity
Mid-Term	2026 - 2035	**Conveyance** Provision of sewerage network **Conveyance** Extension of sewerage network Replacements of components **Treatment** Provision of new STPs for uncovered areas Augmentation of STP capacity
Long-Term	2036 - 2046	**Conveyance** Provision of sewerage network in newly extended areas **Treatment** Augmentation of STP capacity Replacements of components **O&M and M&E** Regular O&M and M&E of entire sewerage system

5.6.1 Recommendations

The Sewer network in the city is laid but is not operational. There is a need to generate awareness among the people regarding the importance of efficient discharge of sewage from the city.

Table 35 Recommendations, Waste Water Management

Actions	Recommended body
Initiate a connection drive to increase penetration of sewerage connections covering black and grey water flows;	NPP
Waste-water recycling should be priority; explore further opportunities to meet SLB norms in the medium to long term	NPP/PHED
Action plan for using treated sewage for horticulture, irrigation, industrial & other non-potable use in order to conserve fresh water.	NPP/PHED

Actions	Recommended body
Efforts to involve PPP in O & M and STP's & other components	
Formulate bye-laws / guidelines on septage management and on-site sanitation	NPP/State Gov.
Establish a waste-water quality monitoring protocol in coordination with CPCB	NPP
Regulate tariffs for desludging / cleaning	NPP

6 STORM WATER MANAGEMENT

6.1 City Level Status

There is no provision for storm water drainage system in the city. Storm water drains are severely abused with grey water flows and solid waste dumping. Around 34.7Kms storm water drains and remains 256 area unserved by these drains. The total length of pukka drains is 8.5 km and Kaccha drains are 15 km.

Table 36 Condition of Storm Drains in Unnao City

Sr.No	Type of drains	Approx. length (KM)	%
1	Total length	291	100
2	Present drains	34.7	12%
3	Total length of pucca drains	8.5	3%
4	Total length of Kaccha drains	15	5.15%
	Gap	**256**	**78%**

Source: Nagar Palika Parishad, Unnao

Table 37 Storm Water Management, SWOT

Strength	Weaknesses
✓ Topography of old town allows several parts to be drained off, other parts, of the town have quite flat.	✓ Grey and in some cases black water let out into drains ✓ Solid Waste being dumped into drains ✓ Poorly maintained drains
Opportunities	**Threats**
• Plans under UIDSSMT scheme.	• Health hazards due to poor maintenance and waste clogging

6.1.1 Issues and Priorities

NPP, Unnao does not have any centralized database or map of drainage system available. No cleaning, repair and maintenance of drains is undertaken pre-monsoon and one other time of the year.

Priorities:

a) Very Low or rather no coverage in the city.

6.1.2 Vision and Goals

Vision

100 % coverage in the city and prevention of discharge of black and grey water into storm water drains.

Goal

Table 38: Storm Water Management, SML Term Targets

Norm				Short T	Medium T	Long T
Coverage (Drain length / Road length)		Incidence of water logging/flooding				
100%		0%		✓		
C	T	C	T	✓		
56	57	4	3	✓		

Table 39 Cost Estimate for Drainage Improvement

Sr.No	Item	Km	Rate (Lakh/Km)	Total Cost (lakh)
1	Construction of new drain	126	7.7	**970.70**
2	Up gradation of Kutcha drain	15	1.6	**024.00**
Total Capital Investment				**994.70**

Source:-calculated value as per Schedule of Rate (SOR)

Assumption drain length should cover 150 % of concrete and dammar road length and 100% of Kutcha road network. Total road length in the Unnao city is 291 Km.

Hence, 437 km of drains are required out of which 8.5 km of pucca and 15 km of Kaccha drain exist. Thus there is a need of construction of 126 km of new drain and upgrading 15 km of Kaccha drain.

The approximate cost for implementation of this recommendation is Rs. 9.94 Crores

Table 40 Phase wise Implementation Plan

Phase	Year	Actions
Immediate	2016-2019	• Installation of grating points for collection of solid waste entering into storm water drains • Conduct feasibility study for treatment measures • Cleaning of drainage system – removal of silt and solid waste • Database management – detailed mapping of natural and built storm water drains
Short-Term	2020 – 2025	• Source control strategies - Construction of rain water harvesting structures • Removal of unauthorised structures and encroachments on natural drains • Construction of road side drains as per the drainage designs • O&M and M&E systems • Technical and O&M Manual
Mid-Term	2026 – 2035	• Ensure 100% coverage by storm water drainage system • Augmentation of storm water drainage system
Long-Term	2036 - 2046	• Augmentation of storm water drainage system

6.1.3 Recommendations

- Under the UDISSMT scheme storm waters should be constructed
- Strictly prevent waste dumping into natural drains followed by O&M of storm water drains along the major roads, streets and natural drains.

7 SOLID WASTE MANAGEMENT

7.1 City Level Status

Solid waste Management is an obligatory function of Unnao Nagar Nigam. However, this service is not properly performed, resulting in problems of health, sanitation and environmental degradation. The major draw backs in the management of solid waste in the city are; Lack of sanitary workers Lack of collection efficiency Improper choice of technology Improper site of solid waste Lack of trained manpower Poor public participation and cooperation Unnao city is not an exception and different from other cities in terms of solid waste management. With the growth of population the problem of solid waste is increasing day by day.

7.1.1 Waste Generation

Local residents, Hotels, Restaurants, Bazaar and vegetable markets, Hospital and dispensaries are the major sources of generation of waste at city. About 65.4 MT of solid waste is generated every day in the city.

Solid Waste Management is a critical issue in Unnao city due to spread of area under its jurisdiction. Based on the population of the city, it is estimated that the City generates approximately 65.4 MT of solid waste per day and waste generated per day is .31kg/capita/day. Nagar Palika is capable to clears only 40-50% of the waste through vehicles available with Nagar Palika and staff engaged for the purpose.

Table 41 Daily Waste Generation within the City

Sr.No.	Source	Waste Generation Per day (MT)	Percentage
1	Domestic	62.18	95.08
2	Shops/Commercial	0.5	0.76
3	Hospital waste*	0.22	0.34
4	Industry*	2.5	3.82
Total		**65.4**	**100**

*Approximate

Source Nagar Palika, Unnao

7.1.2 Domestic Waste

Domestic waste is generated at the household level and varies from town to town and at an average, range between 200 to 500 gm. As per the standards, a town like Unnao will generate 350 gms of solid waste per head per day. Thus this domestic sector will generate 62.18Metric tonne solid waste per day with the current population of 177658. It comprises of maximum of organic material like vegetable waste, papers, cloths etc. which can be easily disposed. The household wastes include a small percentage of inorganic materials like metals and plastics.

Figure 22 Road Side Disposal within the City

7.1.3 Commercial Waste

The commercial waste includes the waste from hotels and eating establishments, shops, trading units, small street traders, etc. The daily waste generated is about 0.5MT, which is 0.76 percent of the total waste generated in the town. It mainly comprises of paper, plastics and other in-organics, which are finding their way to the disposal yard along with the domestic waste.

7.1.4 Industrial Waste

2.5 MT of industrial waste is generated in the city per day. The industries (small and medium) mainly deal with glass and bangles making. The waste from industries is collected every alternate day.

7.1.5 Hazardous Waste

The hazardous wastes include the biomedical wastes from hospitals and clinics, nursing homes, medical research laboratories. The components of biomedical wastes are; (i) Human anatomical waste (tissues, organs, body parts etc.), (ii) Animal waste (as above, generated during research/experimentation, from veterinary hospitals etc.), (iii) Microbiology and biotechnology waste, such as, laboratory cultures, micro-organisms, human and animal cell cultures, toxins etc., (iv) Waste sharps, such as, hypodermic needles, syringes, scalpels, broken glass etc., (v) discarded medicines and cyto-toxic drugs (vi) soiled waste, such as dressing, bandages, plaster casts, material contaminated with blood etc., (vii) Solid waste (disposable items like tubes, catheters etc. excluding sharps), (viii) Liquid waste generated from any of the infected areas, (ix) Incineration ash, (x) chemical waste.

At present 0.22 MT of bio-medical waste is generated in the city. At present 1 Hospitals approximate 5 nursing home and 50 private clinics are there. The waste is segregated at source into Red (Plastics), Yellow (Cotton, Body parts, Blood), Blue (Syringe, blades, metals) and Black (General Waste) bins at the source. The hospitals are charged Rs.3.20/bed/day.

Table 42 present waste generation and projections (Domestic)

Year	Population	Waste Generation
2011	177658	62
2016	202562	71
2021	219204	77
2026	241195	84
2031	265319	93
2036	290808	102
2041	318734	112
2046	344801	121

Source Calculated Value

7.2 Collection & Transportation

Door to door collection service does not exist in the city. Machinery and equipment available with the Nagar Palika is not capable to lift and clear total daily waste generated. The residents throw their waste outside their houses which is manually collected by wheel carts and transported to exiting temporary collection centers.

7.2.1 Primary Collection System

Primary Storage - In Unnao there are masonry type temporary collection centers. The wastes from these centers are transported to low-lying area for dumping without any cover and treatment. The present system is absolutely against the norms of proper Solid Waste Management system as per MSW rule 2000.The Nagar Palika Parishad does not have sufficient staff and proper infrastructure for solid waste management.

7.2.2 Details of Equipment

The total fleet of vehicles engaged in transportation activity is 30 and each vehicle makes at least 2 trips to the final dumpsite. Below table illustrates the details of the fleet of vehicles.

Table 43 Description of Vehicles in NNP Unnao

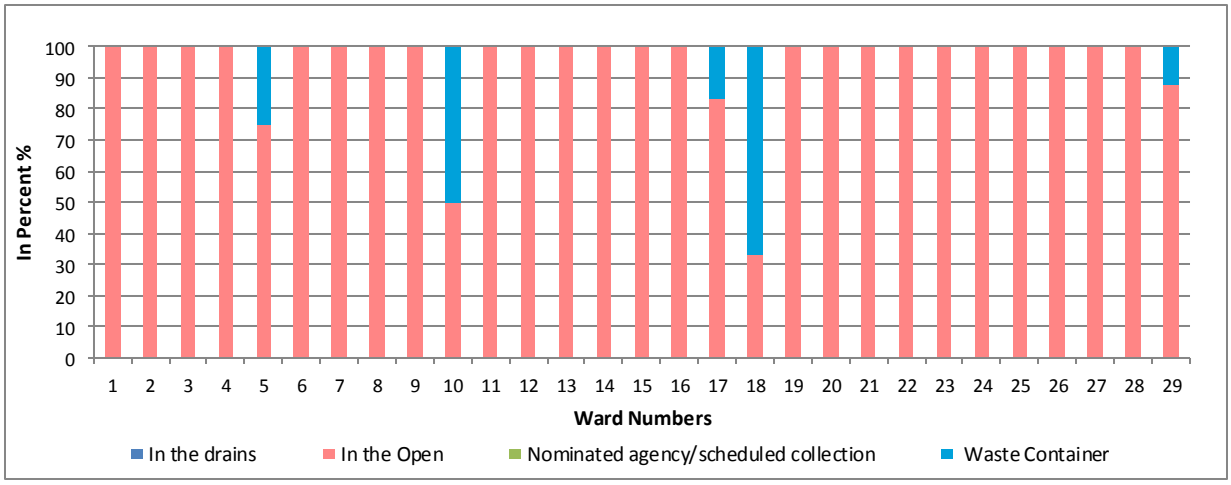
S. No	Vehicles	No.
1	Heavy	8
2	Medium	12
3	Small	10

Source: Nagar Palika Parishad, Unnao

7.2.3 Finding from Primary Survey

Disposal of Solid waste in Open is common in most of the part in city. Ward number 5, 10, 17, 18, 29 etc. has Waste Container facility for disposal of solid waste to some extent.

Figure 23 Method of Solid Waste Disposal Facility (Ward Wise)

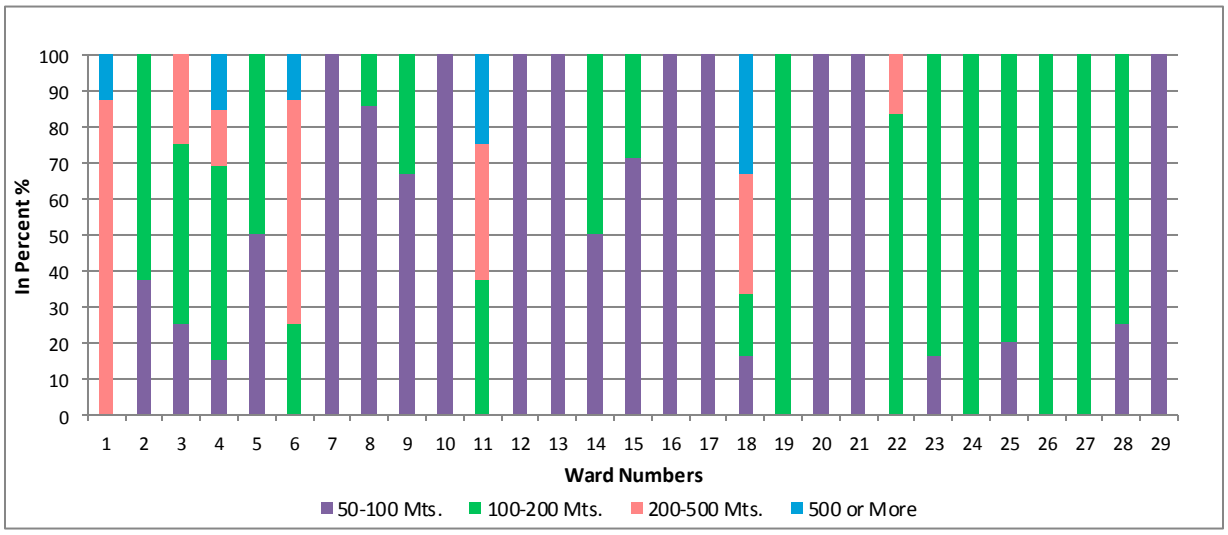


This may cause environmental and health hazard. The waste disposed in open finds its way in storm water drain and water bodies. Most of the time waste is disposed in low lying open areas and on surface water system, causing contamination of ground and surface water. Proper waste collection system needs to be designed for the city to prevent this.

7.2.4 Distance of Waste Disposal Site (Ward Wise)

A number of respondent reported waste disposal site to be less than 100 meters. Though most of these are open dumping sites and are not covered under municipal waste collection system, in absence of a designated waste disposal area and Dustbin in various parts of city, it is common for citizen to dispose waste in nearby areas.

Figure 24 Distance of Waste Disposal Site (Ward Wise)

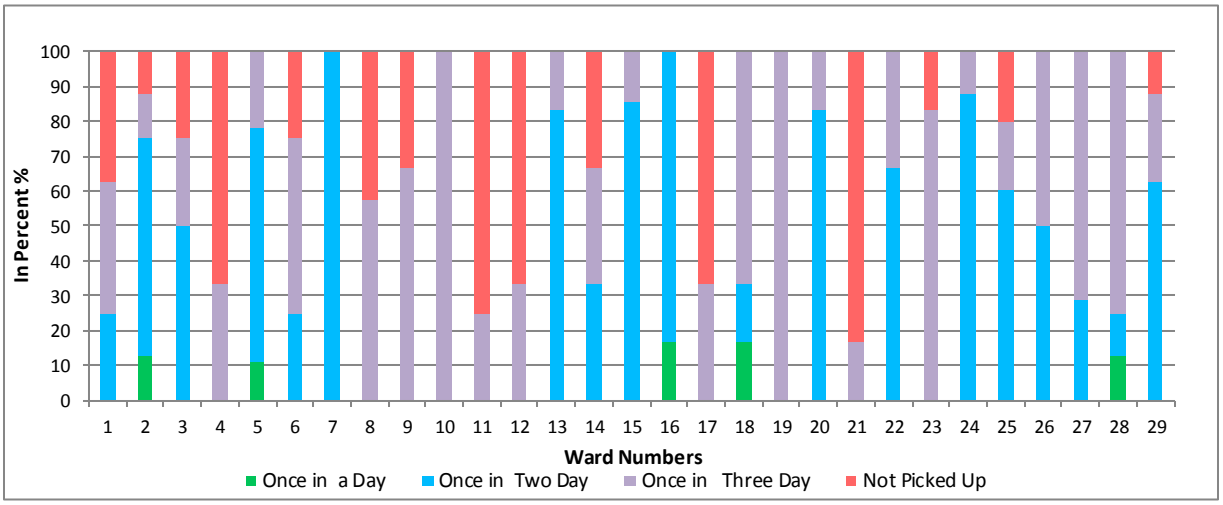


Source: Primary Survey, 2015

7.2.5 Frequency of Waste Collection (Ward Wise)

It can be seen in the graph that collection of waste varies once in a day to once in three days in various wards of Unnao city. Most of respondent reported that Nagar Palika collects waste from various locations in once in a day but some of them also responded that waste in not being picked up continuously in a specific interval.

Figure 25 Frequency of Waste Collection (Ward Wise)

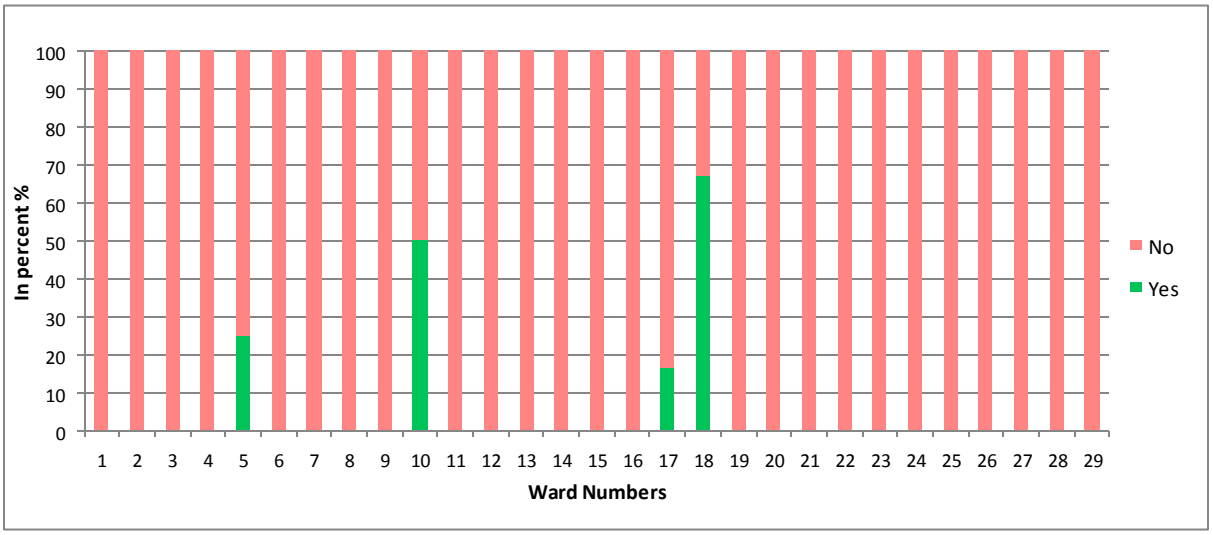


Source: Primary Survey, 2015

7.2.6 Presence of Designated Area for Garbage Disposal (Ward Wise)

Most of respondent reported absence of designated area of garbage disposal resulting in open disposal being common in the city. Thus, Designate a disposal site or Dustbin, designing an efficient collection and transportation system of municipal solid waste becomes very necessary for the entire city.

Figure 26 Presence of Designated Area for Garbage Disposal (Ward Wise)

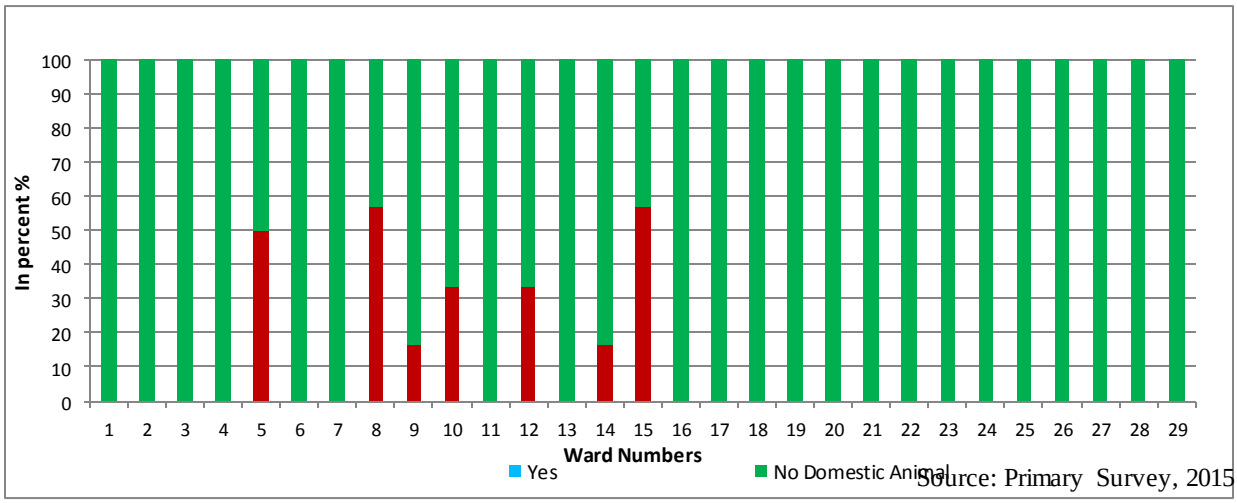


Source: Primary Survey, 2015

7.2.7 Presence of Domestic Animals at Household Level (Ward Wise)

A majority of respondent revealed absence of domestic animal in their household hence a separate animal waste management system should not be required for the city. Whatever limited amount of animal waste is generated, the same can be collected and treated along with municipal solid waste generated in the city.

Figure 27 Presence of Domestic Animals at Household Level (Ward Wise)

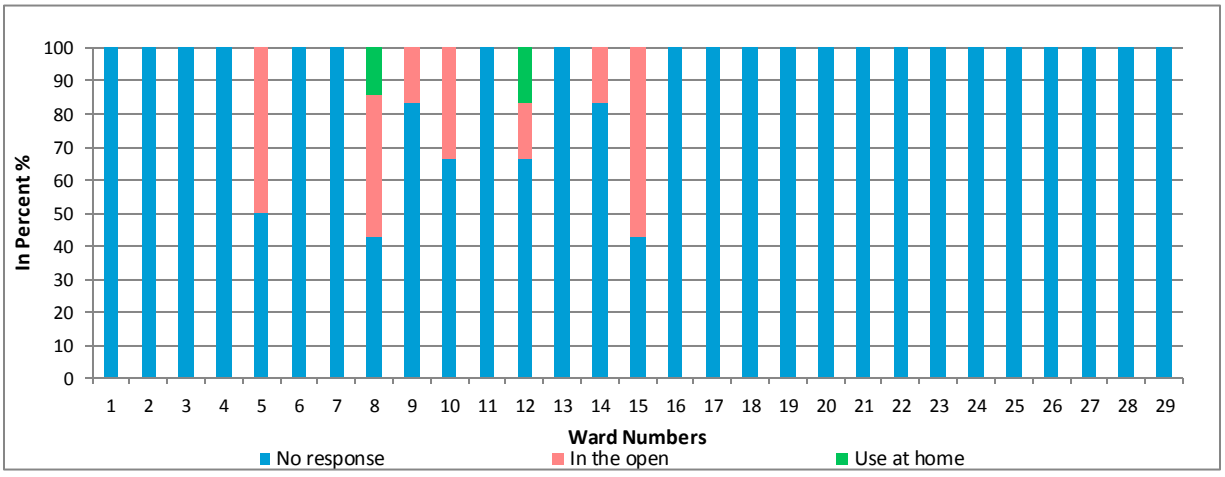


Source: Primary Survey, 2015

7.2.8 Location for the Animal Waste Disposal (Ward Wise)

Since a majority of respondent do not own animal, they did not respond to location of animal

Figure 28 Location for the Animal Waste Disposal (Ward Wise)



Source: Primary Survey, 2015

Waste disposal facility. The remainder reported that whatever animal waste is generated, disposing animal waste in open used. Very few responded used at home possibly as fuel or manure thus reiterating the fact that a separate animal waste management system is not required in the city.

7.3 Treatment and Disposal

Unnao town does not have any recognized system of Solid waste disposal due to lack of proper and sufficient number of equipment and lack of Public Awareness. Currently there is no waste treatment facility in the city and the waste is disposed randomly in low lying areas or local pond areas.

Figure 29 Disposal of Waste in pond (Ward Number 7)

Only 40% of waste is being cleared & transported to dumping sites without treatment along with municipal waste.

7.4 Service Level Benchmarks

Table 44 Service Benchmark for Solid Waste Management

Solid waste Management	Norms	Current
Household coverage of solid waste management services	100%	0.0
Efficiency of collection of municipal solid waste	100%	40-50
Extent of segregation of municipal solid waste	100%	0.0
Extent of municipal solid waste recovered	80%	0.0

Solid waste Management	Norms	Current
Extent of scientific disposal of municipal solid waste	100%	-
Efficiency in redressal of customer complaints	80%	00
Extent of cost recovery in SWM services	100%	-
Efficiency in collection of SWM charges	90%	-

7.5 Gap analysis

- 50-60 municipal solid waste not collected.
- Door to door collection is missing.
- As per the standard 1164 bins are required all over the city.
- Proper landfill site are required.
- So most of the people are putting waste in the nearby dustbins.
- Machinery and equipment available with the Nagar Palika are not capable to lift and clear total daily waste generated.

7.6 SWOT Issues and Priorities

- Service levels in SWM within NPP is below as per SLB norms
- Open dumping and ignorance by people reflects lack of awareness on their responsibilities towards SWM.
- Accountability for SWM is diffused which overlaps between health and engineering departments.
- Around 20 to 30% of the households are throwing the waste in nearby open land and in roads. Since the secondary collection is not done in regular intervals, the animals and birds are attracted by these wastes in the containers. These creatures will drag out the waste and make the surrounding ugly. In this situation also people are reluctant to approach the dustbins.

Table 45 Solid Waste Management SWOT

Strength	Weaknesses
• Compact city; amenable to city wide PPP initiatives	• 0 % coverage ,Negligible levels of Door-to-door collection • Dumping of wastes in water bodies and neighborhoods • Low frequency of collection • Inadequate Machinery and Staff leading to weak accountability. • No processing and landfill facilities
Opportunities	**Threats**
• Exposure to modern waste management practices. • Proposed landfill site • Scope for generating revenue from processing • Scope for PPP interventions in secondary transfer and processing	• Health hazards • Filling of water bodies by wastes • Mixing of solid waste with waste water leading to choking of existing line network.

7.7 Conceptual Basis and Best Practices

Municipal solid waste management activities are inter-related, and there are several technical options for every activity in the chain.

Segregation

Source segregation is a requirement as per MSWM Rules 2000. However, when source level sorting is not developed, then sorting at the community level/ storage / processing facility may be considered till a house level sorting is established. Pre-sorting at processing facilities is desirable to ensure that output (such as compost) meets regulatory standards.

Sorting

Manual sorting comprises activities like unloading of waste collected, manually spreading the waste, handpicking visually identifiable waste for reuse, and collecting the remaining waste.

Semi-mechanized sorting comprises mechanized unloading, mechanized loading on conveyor belts, handpicking reusable waste, and mechanized collection, stocking and reloading of remaining waste; and

Fully-mechanized sorting comprises mechanized unloading, size reduction through shredders, size separation/ screening, density and magnetic separation and compaction

Storage, Collection and Transportation

Doorstep collection of waste through containerized handcarts/tricycles or motorized vehicles having non-conventional/ sounding horns deployed for doorstep waste collection with active community participation.

Bin-free collection systems are becoming popular. The commonly used waste storage include

(i) Metal containers/dumpers and (ii) plastic bins

- A maximum loaded weight of around 30 kg if the collection is manual
- Devices that facilitate its movement between its place in the building and the place of collection
- Closable in order to avoid waste spillage or exposure
- Economical and affordable for the general public
- Not producing excessive noise while handling
- Easy to empty without leaving waste at the bottom

Transfer Stations: Transfer stations are considered when the distance between the location of large-scale collection activities and the landfill is greater than 20 km.

Treatment

Biological processes include; (i) aerobic stabilization and composting processes that principally generate water, carbon dioxide and heat; and (ii) anaerobic important for the production of methane. ULB should look at alternate uses for dry/non-degradable waste like RDF, utilization of inerts. Other options including thermal processes like incineration.

Sanitary Landfill

Sanitary landfill uses engineering principles to confine the waste to as small areas as possible, covering it daily with layers of earth and compacting to reduce its volume.

7.8 Vision and Goals

Vision

Litter- free through implementation of sustainable waste management practices.

Goals

Table 46 Solid Waste Management, SML Term Targets

Parameter	Unit	Norm	SLB	Short T	Medium T	Long T
% of area with sewerage network	%	100%	-	✓		
% of households with sewerage connections	%	100%	0%	✓		
WW Collection Efficiency	%	100%	-		✓	
WW Treatment Adequacy	%	100%	-		✓	
Quality of WW Treatment	%	100%	-			✓
Reuse and Recycling	%	20%	-	✓		
Cost Recovery	%	100%	-	✓		
Complaints Redress	%	80%	-		✓	
Collection Efficiency	%	100%	-		✓	

7.9 Functional Assessment

The department of solid waste management is under the administrative control of Health Officer who is assisted by Chief Sanitary Inspector, Project Coordinator, Sanitary Inspectors, Sanitary Dafedars and Safai Karmacharis. Total 224 employees including permanent, daily wagers and contract workers are required for engaged in providing SWM services.

7.9.1 SWM Staff and Qualification

The education qualification, number of personnel required for different positions and number of positions filled against requirement for Unnao city is mentioned in table below:

Table 47 Staff Required

Sr.No.	Position	Qualification	Required
1	Sanitary Officer	Sanitary Diploma	1
2	Sanitary Inspector	Sanitary Diploma	3
3	Sanitary Sub-inspector	Sanitary Diploma	7
4	Sanitary Supervisors	who can read, write and report	14
5	Dafedars	No qualification required	14
6	Safai Karmachari	No qualification required	185

Source: - Manual on "Municipal Solid Waste Management MoUD .Govt. 2000

7.10 Financial Option

Broad cost estimates for capital expenditure are assessed for the key components of the various design sectors discussed in the preceding sections. The broad implementation strategy adopted for the solid waste management system envisages that the first six years as the major investment phase (2016-2019), whereas the subsequent years over the plan timeline until the year 2046 predominantly involve incremental procurements for augmentation of the services or replacements.

The assessments are based on the costs mentioned in the DPR for augmentation, replacement and construction of SWM infrastructure, scheduled rates of construction (Delhi) for activities. The following tables represent the major estimates for the various design stages as mentioned in the SWM.

Table 48 Fund Required For Solid Waste Management (Primary Collection)

Solid Waste Management	Rate(Lakh)
Community Bins (130 bins with capacity 1.1.Cum)	44.62
Primary waste collection (door to door waste collection) – street sweeping equipment	11.95
safety kits	00.92
Total Capital Investment	**57.49**

Source: - Delhi schedule rate, 2014

The approximate cost for implementation of this recommendation is Rs. 00.57 Crores

7.11 Cost Recovery Options

The challenge for Unnao is to establish a rate structure that adequately addresses the true cost of services associated with the capital investments, operations, maintenance and regulatory requirements. The recovery of costs incurred in each revenue area shall be through a tax levied upon the property owners within the jurisdiction of the catchment area in addition to the user charges. The components of cost recovery could be user charges and tax component as percentage of property tax.

7.12 Timeline

The system shall be designed under the broad framework as per the guidelines for a design period of 30 years; however, the planning shall entail the implementation of the design in phases to meet the ultimate goals of the CSP.

The phased approach aims to navigate through the challenges posed by the limitations in investments, institutional capacities, and community engagement in a proficient manner. For the solid waste management sector, the phases and the corresponding timelines are defined as stated below –

Table 49 Phase-Wise Implementation Plan

Phase	Year	Actions
Short Term	2016-2019	Initiate primary segregation , storage and door to door collection system Procurement of gears/equipment's for street sweeping, waste transportation as per the SWM DPR Construct and operationalize the transfer station Promote decentralised solid waste management practices Enforcement of application of Polluter pays Principle/penalty for littering as per MSW Rules 2000 Initiate measures to enhance the safety and dignity of sanitary workers
Mid-Term	2020-2030	Augmentation of SWM system to meet the demands of growing population Regular O&M involving in entire system of SWM Replacements of components as per the maintenance plan Regular M&E of entire SWM system
Long-Term	2031-2046	Augmentation of SWM system to meet the demands of growing population Regular O & M involving in entire system of SWM Replacements of components as per the maintenance plan

7.13 Recommendations

Actions	Recommended body
Give priority to any Initiatives in the form of DPR's made.	NPP
Initiate actions to improve accountability, oversight and public participation.	NPP
• Improve coordination among health and engineering departments and create a separate SWM department to facilitate better accountability in the medium term • Engage local stakeholders in monitoring and oversight of SWM activities	

8 CSP SUPPORT PILLARS

8.1 City Sanitation Task Force

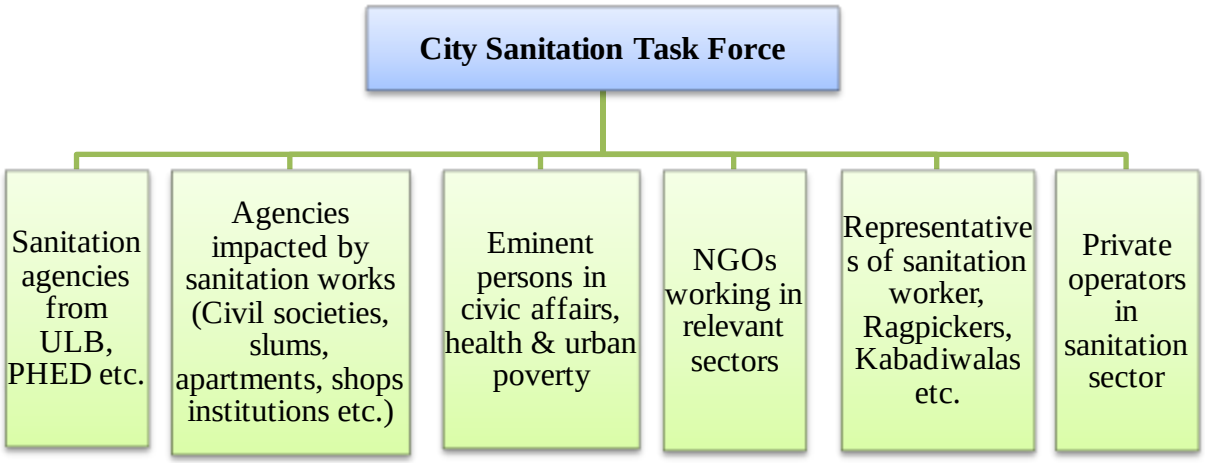
The first step in making the cities 100% sanitized is to elevate the consciousness about sanitation in the mind of municipal agencies, government agencies and most importantly, amongst the people of the city. Hence, it is one of the main recommendations and pre-requisites for the preparation of the city sanitation plan, under the National and state policy framework that a city sanitation task force (CSTF) is formulated at

city level. The CSTF is involved in the preparation and execution of the sanitation plan from the very initial stage of the planning and conceptualization.

8.2 City Sanitation Task Force Members

The City sanitation task force (CSTF) should comprise of representative from diversified sectors of the society:

Figure 30 CSTF Representatives



- CSTF directly responsible for sanitation including on- site sanitation, sewerage, water supply, solid waste, drainage, etc. including the different divisions and departments of the ULB, PHED, etc.;
- CSTF indirectly involved in or impacted by sanitation conditions including representatives from the civil society, floating population slum areas, apartment buildings, etc.,
- Eminent persons and practitioners in civic affairs, health, urban poverty,
- Representatives from shops, industries and establishments,
- Representatives of other large institutions in the city (e.g. Cantonment Boards, Govt. of India or State Govt. Enterprise campuses, etc.).
- NGOs working on water and sanitation, urban development and slums, health and environment,
- Representatives of unions of safai karamcharies, sewerage sanitary, recycling agents/ kabaries etc.
- Representatives from private firms/ contractors formally or informally working in the sanitation sector (e.g. garbage collectors, septic tank de-sludging firms etc.)
- Representatives from educational and cultural institutions

8.3 Responsibilities of CSTF

- Launching the City 100% Sanitation Campaign.
- Generating awareness amongst the city's citizens and stakeholders.
- Approving the City Sanitation Plan for the city prepared by the Sanitation Implementation. Agency after consultations with citizens.
- Undertaking field visits from time to time to supervise progress.
- Issue briefings to the press/ media and state government about progress.
- Providing overall guidance to the Implementation.
- The Task Force should meet formally frequently (at least once in two months) in the initial stages to monitor and guide the process of planning and implementation.
- The Sanitation Task Force will recommend the assigning of permanent responsibilities for city- wide sanitation to the ULB including the following aspects:

- The ULB to have final overall responsibility for city- wide sanitation, including devolving power, functions functionaries and funds to them
- Planning and Financing including State Government and Govt. of India schemes
- Fixing tariffs and revenue collections in order to make O&M sustainable
- Improving access and instituting special O&M arrangements for the urban poor and un served populations in slum areas and in mixed areas

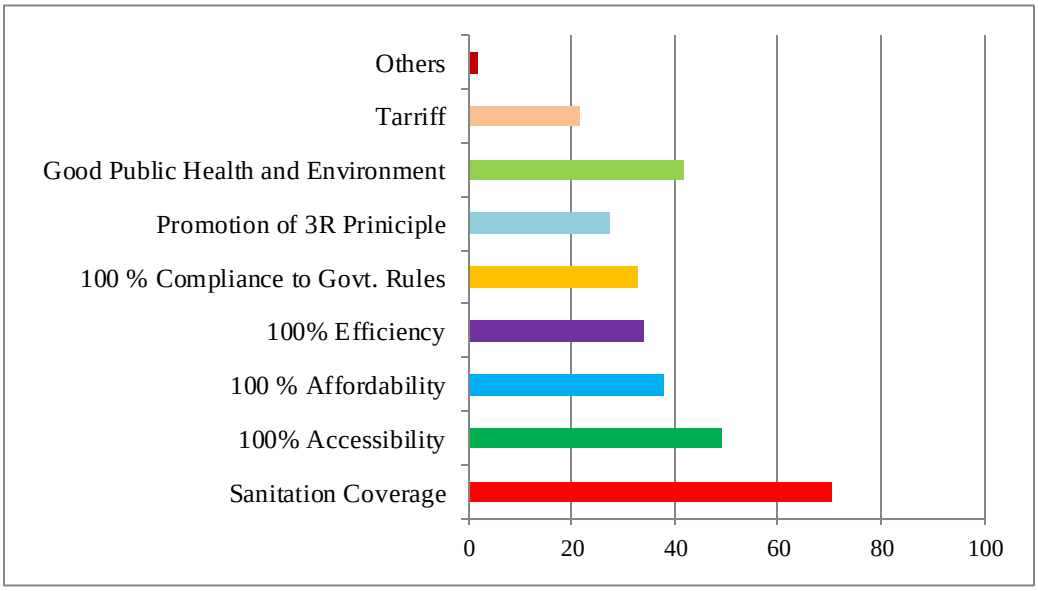
❖ Adopting standards- for

- Environment Outcomes (e.g. State pollution Control Board standards on effluent parameters).
- Public- Health Outcomes(e.g. State Health Departments),
- Processes(e.g. safe disposal of on- site septage)
- Service Delivery standards(e.g. by Urban Development departments)
- Adoption of Regulatory roles including environmental standards (e.g. State pollution Control Boards), Health outcomes (e.g. Health Departments).

8.4 Stakeholders Workshop Feedback

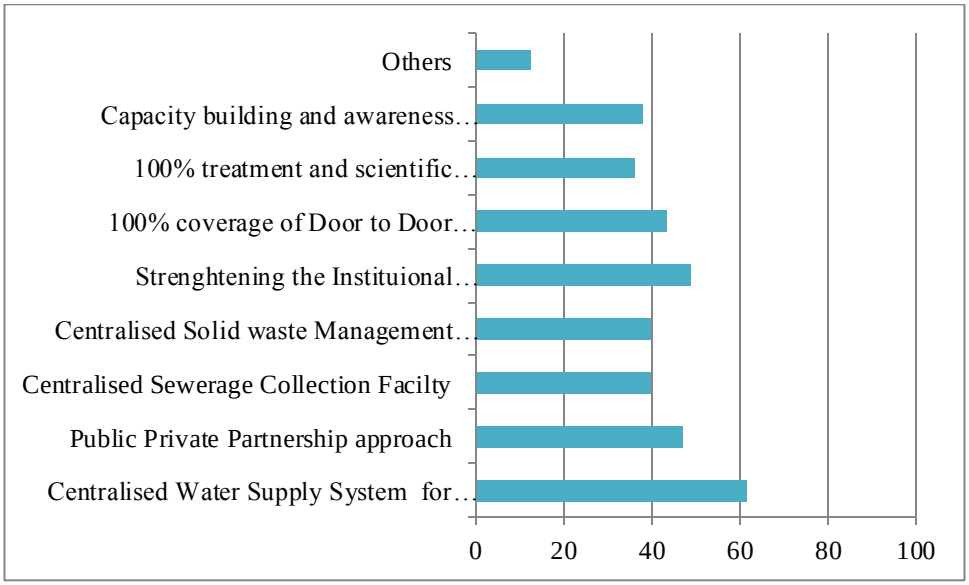
Before finalizing the CSP of Unnao it is critical for the stakeholders to agree on the key goals of the CSP of the CSP. The results of discussions are presented below:

Figure 31 Goals of City Sanitation



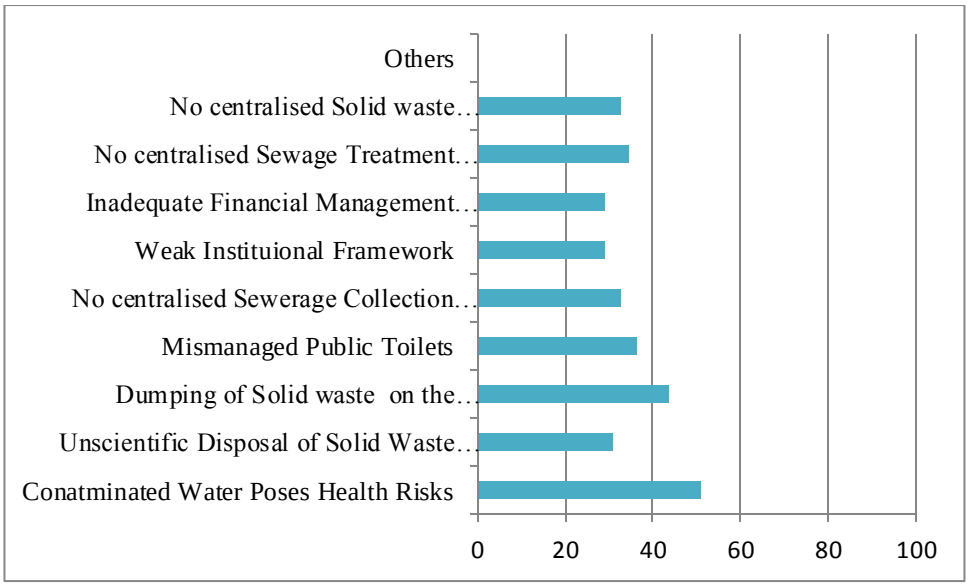
As evidenced from the figure above, 100% coverage and accessibility of sanitation services was given top most priority followed by affordability good public health and 100% efficiency.
Goals like 3R principal, Compliance with government rules were not given too much of priority. Surprisingly, awareness among people of Unnao which is an equally important issue was not recommended by stakeholders. In light of above situation it is pertinent that immediate steps are taken to increase coverage and accessibility of sanitation facility along with quarterly campaigning to sensitize public on sanitation issues affecting their health's. Below are the results of deliberation by CSTF and stakeholders on the key issues related to sanitation of the city.

Figure 32 Key Projects Linked To Sanitation of City



As evident from figure above absence of centralized sewage collection network and indiscriminate dumping of solid waste in drains and water body were identified as key issue. Both results in contamination of ground water which is the only source of water supply in the city. Hence the stakeholders felt that these practices which leads to contamination of water supply and pose health risk should be addressed immediately. At the conclusion the stakeholders deliberated on the key projects that should be implemented in the city. Understanding that limited funds may be available for implementation of sanitation projects this exercise aimed at deciding on short term, medium term and long term project. The result of their deliberation is presented below:

Figure 33 Key Issues related to Sanitation of the City



The major concern comes to be the absence of centralized sewerage collection network and dumping of wastes in water bodies and open drains.

Unnao already has some infrastructure like, sewer network in the city (needs to be accessed by people), and 12% water supply. Also the DPR for water supply and SWM have been prepared and are under execution. Absence of STP, Storm water drains and public toilets is definitely the key issue highlighted.

Understanding that first a detailed project report needs to be prepared and necessary funds needs to be sanctioned for implementation of this large scale Draft City Sanitation initiative the stakeholders rest of the facilities as a medium term goal.

Under long term goal the stakeholders agreed to keep initiatives like capacity building, sustainability, institutional strengthening and solid waste treatment facilities. They argued that since the city lakes basic infrastructure there is no logic in conducting awareness campaigns, capacity buildings etc until the basic infrastructure is in place.

8.5 Recommended Structure

According to the Model Municipal Law (MML) the municipal bodies should be responsible for basic facilities for the city including:

1. Water supply;
2. Drainage, waste management (sewerage & solid waste);

3. Economic and social development plans;
4. Transportation systems;
5. Community health and protection of environment;
6. Construction and maintenance of slaughterhouses.

Accordingly, the entire range of sanitation functions in any city should be vested in a single (well structured, capacitated, and (financially) resourced) institution. Hence, for the effective implementation of the city sanitation plan, it is very important to upgrade the existing institutional strength of the Nagar Palika of Unnao. Hence, restructuring of the current set up is proposed, with an officer from UP state services of the equivalent rank of the Superintendent Engineer, as Chief Executive of the organization. Details of the proposed administrative set up are presented below

Figure 34 Proposed Organization Structure

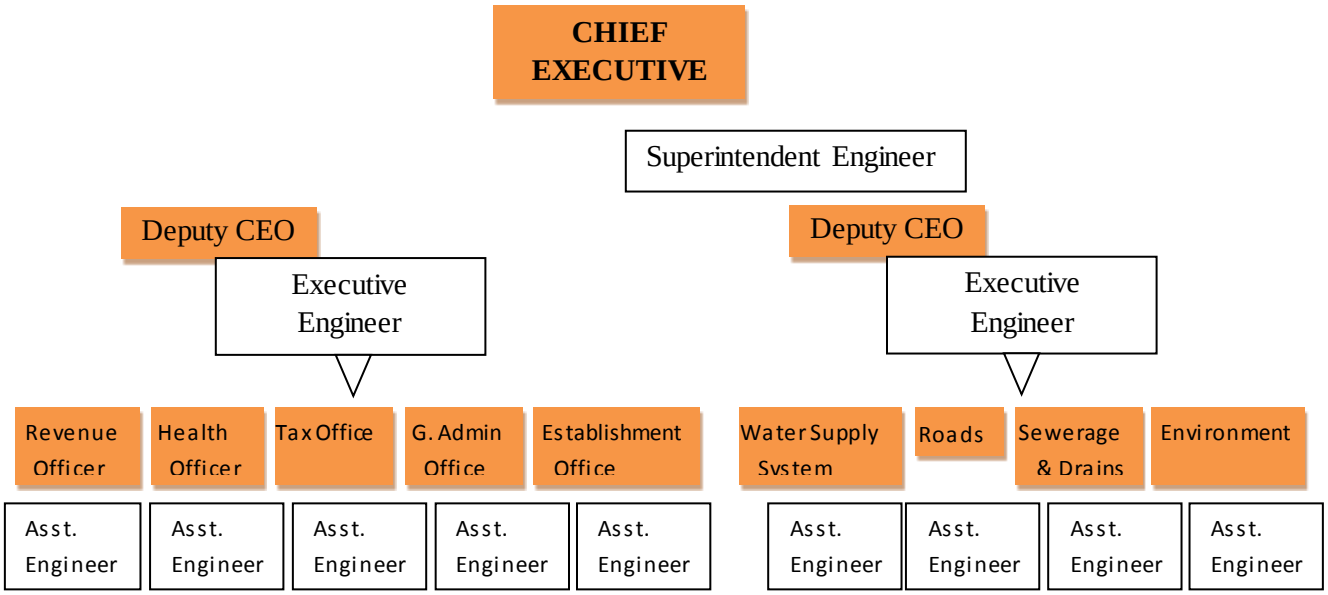


Table 50 Revised Institutional Responsibilities for Basic Services

Sr.No	Urban Services	Planning	Execution	O&M	Tariff fixing & collection
1	Water Supply	PHED	PHED	NPP	NPP
2	Sewerage	PHED	PHED	NPP	NPP
3	Public & Community Toilets	Multiple Agencies	NPP/PPP	NPP/PPP	NPP/PPP
4	SWM	NPP	NPP/PPP	NPP/PPP	-
5	Storm Water Drainage	PHED	PHED	NPP	NPP

8.6 Capacity building

A Detailed Training Needs Assessment is required to ascertain and validate the training requirements. NPP should set aside a Training Budget annually as part of its budgetary exercise, based on the Training Needs identified .It should implement a phased time-bound program to impart training as per the areas and level of instruction required in collaboration with GoUP.

8.6.1 Training

The Training needs assessment should cover all classes of employees with the recognition that the nature and type of training requirements could be very different. The table below provides an illustrative set of training needs across select sanitation components –

Table 51 Training needs across Sanitation plan Components

Sanitation Component	Senior Officials	Technicians / Operating Staff / Workers
All Departments	• Powers and Duties • Citizen Charter and commitments • Urban Reforms and JNNURM • Service Level Benchmarking • Procurement and PPPs • Use of Computers for Information system Improvement	• Rights and Responsibilities • Health and Safety • Citizen Charter and commitments
Water Supply	• CPHEEO Manual and norms	• Water Quality Testing

Sanitation Component	Senior Officials	Technicians / Operating Staff / Workers
	• Developing a Water Supply DPR • Conducting a Water Loss Audit • Metered Supply • SLB Reporting	methods • Installation of Meters/Reading • Repairing water leakages • Handling pipe breaks • Field Inspections and reporting • Use of equipment and safe work practices
Sewerage	• CPHEEO Manual and norms • Developing a Sewerage DPR • Treatment systems including decentralized /centralized options • Reuse of grey water after primary treatment and Methane Generation • Monitoring Onsite Sewage Treatment • SLB Reporting	• Waste Water Quality Testing • Guidelines for providing connections • Repairing pipe breaks and choking • Field inspections and reporting • Use of equipment and safe work practices
Solid Waste Management	• Implementing Door-to-Door collection and source segregation • Waste collection routing • Awareness generation and Community mobilization • PPPs and Contracting • Waste recovery and Landfill technologies	• Collection efficiency • Segregation techniques • Complaints Redresses • Cost Recovery • Safe work practices
Finance and Accounts	• Budget preparation and Reporting • Financial Management • MIS and Information Management • Auditing and follow up	• National Municipal Accounting Manual and local accounting rules • Accrual Accounting • Accounting software

8.6.2 Personnel Management and Occupational Health

Sanitation operations especially waste management essentially involve significant role of manpower especially sanitation workers and safai karamcharis with most of them working on

contract (temporary basis). Majority of these workers are unskilled and poorly educated. Further, the problems of low level of awareness, poor commitment, and discipline; resource diversion; absenteeism; alcoholism; drug addiction; etc. have also been commonly observed among these workers.

Further, due to the very nature of their occupation, the sanitation workers are exposed to a plethora of disease vectors at various stages of handling waste. As a result of this high exposure, typically, morbidity rate is found to be high among them, resulting in poor productivity as well as in generally high mortality.

In order to address these issues, it is recommended that NPP, Unnao allocate adequate resources to ensure appropriate interventions for management of personnel and their health and safety. These interventions will comprise of a range of short-term training courses round the year on a regular basis for all grades of sanitation workers on the significance and importance of their work to the city to enhance self-esteem, on handling the issues of alcoholism and drug addiction and occupational health and safety aspects, personal health protection, etc.

NPP should arrange to conduct regular medical check-up of all MSW/sanitation workers with the provision of appropriate and commensurate support for curative treatment for those found to have chronic ailments.

Arrangement to provide uniforms, caps with NPP, Unnao logos, and personal protective equipment on a regular basis to impart a sense of identity.

Further the institutional set up and capacity for effective sanitation can be enhanced by NPP, Unnao by participatory approach:

- Engaging a group of NGOs and social workers with good communication skills to commence a sustainable campaign on effective sanitation practices all across the city;
- Involving civil society/ community-based organizations such as resident welfare associations, mohalla committees, market/traders associations, women's groups, and rag-pickers' groups in various municipal services & evolving a participatory monitoring system for sanitation services.
- Adopt a system of organizing regular consultations with stakeholders on the issues of, environmental sanitation, MSW management, public health and hygiene, quality of life and urban governance/development in general.

8.6.3 Information Management

Updation of baseline information on sanitation indicators at a household level is critical for NPP planning, analysis and decision making with respect to sanitation services. A possible periodic approach is suggested below

- Information when compiled should be recorded in the property tax database.
- Updation through a self-declaration while residents pay their property taxes
- Ensuring Accuracy through sample Inspection of say 1-2% households and fines on false information will ensure information validity.

Table 52 List of Information from HH Survey

Property Tax Identification Code	
Toilet Access	Yes/No
Type	Toilet within Property / Shared facility
No. of people using the Toilet	
Primary Water Source	
Other Water Sources	
Toilet connected to	Septic Tank/Sewer/local treatment system/open drain/others
If Septic Tank, last cleaned on	Date
If Sewered, is grey water outlets also connected	Yes / No
Covered under SWM Door-to-door collection	Yes/No
Practicing source segregation	Yes/No

Whenever there will be increase in sanitation facilities coverage NPP should install bulk meters at intake and discharge points in water supply and sewerage system.

Also NPP should track and report progress with respect to cost recovery and collection efficiency targets on a quarterly basis. (Recording financial performance)

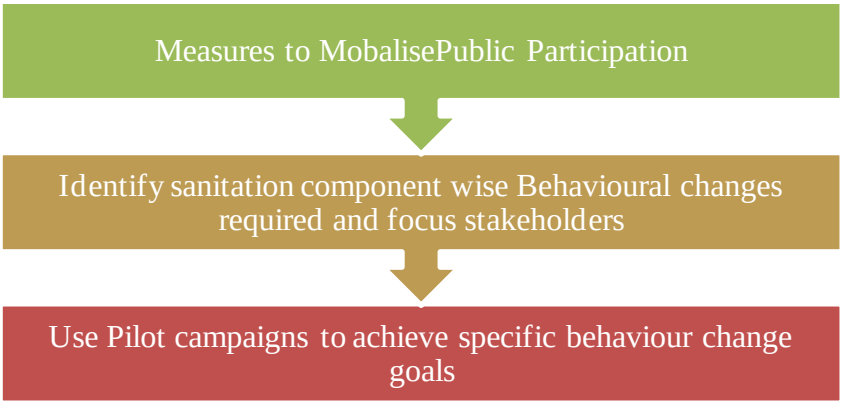
8.6.4 Implementation Strategy

- For the capacity building and increase of awareness levels in the public, it is recommended that a third party is hired by NPP, Unnao which is competent enough to prepare a detailed IEC plan & implement it in a phased manner.

- Citizen participation and involvement is crucial to achieving service delivery goals in sanitation.

Open defecation and open urination which is rampant in parts of the city should be prohibited. Therefore at the level of an individual sanitation component, there are a number of behavioral aspects that need to be focused on through awareness generation and communication campaigns to effect positive behaviour need to achieve specific sanitation outcomes.

Figure 35 Approach to Address Awareness Generation



8.7 Recommendations

Table 53 Below Provides an Overall Accountability

Roles	Public/Community Toilets	SWM	On Site Sanitation	Sewerage	Water Supply
Guidance	MoUD AND CPHEEO				
Planning	NPP, W &S Department			PHED + NPP & W & S Dept.	
Asset Creation/Capital Investment	NPP, W &S Department		HH	PHED + NPP & W & S Dept.	
O and M	NPP, W &S Department		HH	NPP, W &S Department	
Monitoring	NPP, Ward Committees(if exists),Independent (third party)				
Regulation & Tariff Setting	Elected Body				
Clarity on Land Titles	NPP and Revenue Department, GOAP				

The above framework attempts to fix accountability for various components of Sanitation with respect to various roles namely, Guidance, Planning, Asset creation, O&M, Monitoring and Regulation/Tariff Setting. The framework recognizes that

- NPP clearly has single point accountability for Shared Toilet Access, Solid Waste Management and planning and monitoring of Onsite sanitation
- A three tier monitoring approach is recommended for oversight of delivery of water and sanitation services.
- There will continue to be overlaps between PHED in sewerage and water supply, particularly in planning and asset creation, with O&M being the responsibility of NPP.

REFERENCES

- National Urban Sanitation Policy
- Uttar Pradesh State Sanitation Policy
- Urban Infrastructure Development Small and Medium Towns
- Municipal Solid Waste Management Scheme for Unnao (U.P) under UIDSSMT Programme Year 2006-2007
- Unnao Water Supply Re-organization Scheme (UNDER UIDSSMT)
- Unnao Sewerage Scheme under UIDSSMT – District Ghaziabad
- Nagar Palika Parishad, Unnao–Statistical Summary Report
- Service Level Benchmarking –General Information of City

ANNEXURE-1

MINUTES OF MEETING OF STAKEHOLDERS CONSULTATION

Date : 29th September 2015

Time : 1:00 p.m. – 3:00 p.m.

Venue : Nagar Palika Conference Hall,

The E.O welcomed all the CSTF members and introduced the consultants and briefly explained the process of City Sanitation Plan and asked Mr. Jawed to give the presentation on situation analysis based on the survey results and analysis, conducted by the survey team and explained the prioritization setting exercise as proposed to be carried out at the conclusion of the meeting. The points discussed are as follows:

I. Participants highlighted the problems faced by them in their respective wards. Mostly, it was related to Collection, Disposal & Proper Management of Solid Waste.

II. One of the participant highlighted that there should be an individual center in every ward to look after sanitation problems.

III. There should be a multipurpose community center in each ward with having facilities like dispensary and community toilets.

IV. E.O assured that they will organize a meeting with all the representatives of nursing homes and hospitals to understand the issue in detail and propose an appropriate solution. He also mentioned that the GIS based satellite mapping and e- governance initiative has been carried out and GIS map was being shown to all participants.

V. NGO and RWA should be used for awareness generation in the people, particularly for improved sanitation.

VI. One of the CSTF member highlighted problems of road and slum and laid more emphasis on sanitation and also expressed their feeling on quality of water supplied, water related health problems and told that quality of ground water is not too good for drinking purposes in Unnao.

VII. One of the CSTF member expressed his views on operation and maintenance that how to make city clean. Installation of a centralized sewerage system and provision of clean

drinking water forms the need of the hour. He mentioned that the process should not stop at planning stage but implementation should also be given importance.

VIII. Unsystematic disposal of solid waste and waste water from industries in low lying areas will lead to contamination of ground water and the same should be checked immediately.

IX. EO assured that the problems of city will be resolved as soon as possible specially for improved sanitation and water supply systems in the city with the positive cooperation from public.

X. The E.O thanked to all stakeholders for their participation and assured that problems raised by participants will be resolved.

ANNEXURE-2

SURVEY QUESTIONNAIRE

Personal information

Name: _____ H. No.:_____ No. of members in the household:_____

Ward No.:_____ Employment Type: _____ Zone: ___ Income Category: _____

Q. No.	Questions	Responses	Count
I.	**Sanitation System**		
1.	Is there toilet facility available in house?	Yes	
		No	
		Total	
	Type of Toilet (Wet-Flush/dry- soak pit)		
2	If yes. a. How many members of household use it? b. Is the toilet shared by houses OR Individuals?		
3	If No, do you use a public/community toilet OR defecate openly?		
4.	Are there community toilets/ Urinals in your locality?	Yes	
		No	
		Total	
4a	**If Yes:**		
	What is the condition of the public toilet?		
	Who is responsible for maintenance of the public toilet?		
	Are there any user fee/charges for the usage of public toilet?		
	If yes, what are the charges?		

	How many people use the public toilet (average daily number of visitors)		
	Any toilet for physically disabled persons in your community		
4b.	**If Not**, are you willing to contribute to such facilities?	Yes	
		No	
		Total	
6.	Will you also contribute to O&M of such facilities?	Yes	
		No	
		Total	
7.	What type of toilet do you use and where the waste is disposed?	Open drains	
		Manual Scavenging	
		Septic Tank (if yes, go to section …)	
		Connected to sewerage system (if yes, go to section II)	
II.	**Sewerage System**		
1.	Do you have sewer connection?	Yes	
		No	
2.	If yes, what is the cost of the connection you paid?		
	Any monthly fee?		
3.	If no, are you willing to pay for sewerage connection and how much?	Yes	
		No	
4.	Do you face any problem with your sewer connection?	Chocking	
		Frequent leakage/rupture	
		Foul smell	
		Overflowing in rainy	

		season	
5.	Who is responsible for cleaning the sewerage system of your locality?	Pvt./ Municipality/any other agency	
6.	How often the corporation people visit you for health/sewerage purpose	Quarterly	
		Half yearly	
		Annually	
		Need base	
		When complaint is made	
	Where does the sewage go from your place	STP/open drains/storm drain/river/any other	
III.	**Septic Tanks**		
1.	Are you connected to individual septic tank or community septic tank?		
2.	Who manages the septic tanks?	Municipal corporations	
		Community initiatives	
		Individuals	
		No One	
3.	How often do you get the septic tank cleaned?	Once in a year	
		Once in two years	
		Once in three years	
		Not yet done	
4.	How much do you pay for septic tank cleaning to MC or community initiatives?		
5.	Where is septic tank waste disposed of?	STP	
		Open drain/ open	

		space	
		Don't know	
IV.	**Water Supply**		
1	What is the source of water supply?	Nagar Palika	
		Bore –well	
		Private tankers	
		others	
2	What is the frequency of water supply?	< 2 hours	
		2-4 hours	
		4-8 hours	
		>8 hours	
3	What is the quality of water supplied?	Always poor	
		Occasionally poor	
		Good	
4	Do you have your own house water connection?	Yes	
		No	
5	What is the adequacy of water supply?	Sufficient	
		Not sufficient	
	V. **Solid Waste Management**		
1	Where do you dispose your household solid waste?	In drain	
		In open	
		To nominated agency/ scheduled collection	
		Waste containers/ community bins	
2	How far is the place, where Solid waste is dumped?	< 100 mts	
		100-200 mts	
		200-500 mts	
		>500 mts	

3	How often the garbage is collected by ULBs?	Once in a day	
		Once in two days	
		Once in three days	
		Never picked up	
4	Do you have domestic animals?	Yes	
		No	
5	Where do you dispose the animal waste?	In open	
		Use at home	
		Dispose with other waste	
		Outside the city	

ANNEXURE-3

WASTE WATER MANAGEMENT SYSTEMS

A typical wastewater management system comprises of three main components:

(i) **Wastewater collection system**, which could be based on any of the following systems:

- Micro scale conventional centralized system,
- settled sewage system,
- Small bore sewer system,
- Shallow sewer system,
- Twin drain system and
- Incremental sewerage system

(ii) Treatment system having following components:

a. Primary treatment system consists of screens, grit chambers and primary sedimentation tank;

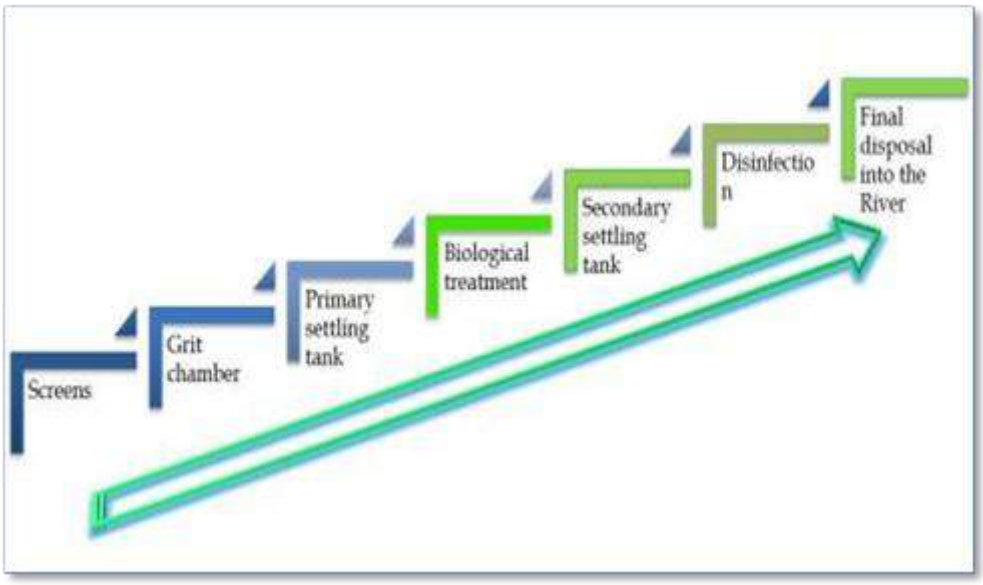
b. Secondary treatment system mainly consists of biological treatment systems.

c. Tertiary treatment is given to polish the treated wastewater coming out of secondary treatment unit to meet the reuse / recycle requirement. A tertiary treatment process normally consists of coagulation, solid/liquid separation and disinfection units for the removal of residual suspended solids (SS), colour, organic matter, offensive odour and microorganisms. Solid/liquid separation is normally achieved by filtration, floatation and adsorption. Disinfection of the pathogenic organisms is achieved by chlorination or Ozonation or UV disinfection or combination thereof.

(iii) Reuse / disposal systems could be

Septic tank: A septic tank is a wet technology. It is a watertight tank that collects wastewater from household utilities via a pipe. The wastewater flows through the tank and the solids will settle to the bottom of the tank. It functions as a storage tank for settled solids and floating materials with storage time of usually 2 to 4 days. About 50% removal of BOD and Suspended Solids is usually achieved in a properly operated septic tank. The clarified effluent flows out of the tank into a drainage field or a drainage system. The

solids that accumulate must be removed periodically, as in the case of pit latrine (UNEP/GPA, 2000; UNEP, undated).



- These are relatively low-tech, low-cost technologies which allow construction and operation by the local community, and they can reduce public health problems related to wastewater (UNEP/GPA, 2000). However, they provide only partial treatment and do not meet strict environmental standards, and very often are associated with environmental pollution (Wilderer and Schreff, 2000; Bakir, 2001).
- Nevertheless, recently, improved technologies are being developed to provide better solutions for decentralized treatment. Combining septic tanks with sand filters can
- upgrade septic tank's effluent to advanced secondary and even tertiary levels (Verhuizen, 1997) and various processes for on-site aerobic treatment systems have been developed and are available commercially (Bakir, 2001).

  Further developments include combination of hi-tech components such Membrane Bioreactor (MBR) with the aerobic systems. The advanced aerobic systems, however, require power for aeration and possibly pumping. These improved technologies can meet high environmental standards and can indeed be considered as viable alternatives for wastewater treatment. In this case smaller flows of wastewater will be collected and treated in several small treatment facilities in the community (Bakir, 2001).

ANNEXURE-4

DETAILS OF VARIOUS SCHEMES FORIMPLEMENTATION OF CITY SANITATION PROJECTS

Valmiki Ambedkar Awas Yojana's component - Nirmal Bharat Abhiyan

Though the National Slum Policy was never finalized, yet on 15 August 2001 the Prime Minister of India announced a new Centrally Sponsored Scheme called the Valmiki Ambedkar Awas Yojana (VAMBAY), to ameliorate the conditions of the urban slum dwellers living below the poverty line. The main objective being to provide shelter or upgrade the existing shelter for people living below the poverty line in urban slums in a march towards the goal of slum less cities with a healthy and enabling urban environment. The guidelines of the scheme say: "Another very important basic amenity for slum dwellers especially in congested metropolitan cities is the lack of rudimentary toilet facilities. A new National City Sanitation Project under the title of 'Nirmal Bharat Abhiyan' is an integral sub component of VAMBAY. 20% of the total allocation under VAMBAY will be used for the same. The State Governments/ Local Bodies will be free to supplement the Government of India subsidy with their own grant.

Integrated Low Cost Sanitation (ILCS) Scheme, 2008

The Centrally Sponsored Scheme of Low Cost Sanitation for Liberation of Scavengers started from 1980-81 initially through the Ministry of Home Affairs and later on through the Ministry of Welfare. From 1989-90, it was operated through the Ministry of Urban Development and later on through Ministry of Urban Employment and Poverty Alleviation now titled Ministry of Housing & Urban Poverty Alleviation. A revised set of guidelines were released in January 2008. (The scheme is now called the "Integrated Low Cost Sanitation" Scheme)

The main objectives of the Scheme are to convert the existing dry latrines into low cost pour flush latrines and to construct new ones where EWS (Economically Weaker Section) households have no latrines and follow open defecation practices.

The scheme is on an 'All Town' coverage basis. The proposal can be submitted by the urban local body duly authorized by the State Government to the State Urban Development Authority for undertaking the programme. The concerned urban local body/ organisation has to give an undertaking prohibiting dry latrines in the towns thereafter.

The programme can be implemented by any state selected local NGO having adequate experience in this field , with the maximum funding of 15% over and above the total project cost to be borne by the Centre and States based on the ratio of 5:1 at different stages of implementation.

Further, the NGO shall be given the responsibility to look after operation and maintenance of the converted units, and organise training/ seminars for preparation of project reports and estimates by the ULBs/Development Authorities (DAs) after ensuring willingness of identified beneficiaries.

S. No.	Projects proposed	Schemes/ Plans	Funding agency
1	Waste water management system (laying of sewers and development of STP)	Water for Asian Cities programme, 2006 of UN-HABITAT: Water and Sanitation trust Fund	Asian Development Bank (ADB)
		Small scale finance for water and sanitation (WATSEN) scheme	Department for International Development (DFID), UK
		Sewerage PPPs: PPPs on urban infrastructure under AusAID-WB partnership project scheme for South Asia	AusAID –World Bank
		Integrated Low Cost Sanitation (ILCS) Scheme, 2008, under NUSP	Ministry of Housing & Urban Poverty Alleviation (HUPA), Govt. of India
		UIDSSMT started in 2005-6, under JNNURM of MoUD	Ministry of Urban development, Govt. of India

S. No.	Projects proposed	Schemes/ Plans	Funding agency
		UP Urban Sanitation policy,	State Govt. U.P.
		Total sanitation Campaign (TSC) Budget	U.P. state Govt. funds
		PPP initiatives scheme	Central/ State govt. of India
2.	Solid waste management system including collection, transportation, treatment (composting plant) and disposal system	UIDSSMT started in 2005-6, under JNNURM of MoUD	Ministry of Urban Development (MoUD), Govt. of India
		Under MSW (management and handling) rules, 2000	CPCB, MoEF, Govt. of India
		PPP initiatives scheme/support to NGOs	Ministry of Finance, Govt. of India
		Under District/city planning scheme, 2008	Planning Commission, Govt. of India
		Federal grant schemes for SWM	EPA'S Indian Health Service, U.S. Department of Interior Bureau of Indian Affairs (BIA)
3	Water supply system for the city including development of source i.e basic treatment of groundwater, reservoirs, pump houses and laying of supply pipelines,	Revised National Water Policy, 2002	Ministry of Water Resources (MoWR), Govt. of India
		Urban Water Supply Programme (AUWSP), 1994, currently merged under UIDSSMT of JNNURM	Ministry of Urban Development (MoUD), Govt. of India
		Water for Asian Cities	Asian Development

S. No.	Projects proposed	Schemes/ Plans	Funding agency
	household connections	programme, 2006 of UN-HABITAT: Water and Sanitation trust Fund	Bank (ADB)
		Small scale finance for water and sanitation (WATSEN) scheme	Department for International Development (DFID), UK
		Under District/city planning scheme, 2008	Planning Commission, Govt. of India
		Urban infrastructure PPPs under AusAID-WB partnership project scheme for South Asia	AusAID –World Bank

ANNEXURE-5

MUNICIPAL SOLID WASTE PROCESSING TECHNOLOGIES

THERMAL PROCESSING TECHNOLOGIES

Thermal processing technologies are mainly adopted to treat the hazardous waste with high calorific values. Thermal technologies are those technologies that operate at temperatures greater than 200°C and have higher reaction rates. They typically operate in a temperature range of 375°C to 5,500°C. Thermal technologies include advanced thermal recycling (a state-of-the-art form of waste to-energy facilities) and thermal conversion (a process that converts the organic carbon based portion of the MSW waste stream into a synthetic gas which is subsequently used to produce products such as electricity, chemicals, or green fuels). These technologies are briefly described below.

INCINERATION

Mass-burn systems are the predominant form of the MSW incineration. Mass-burn systems generally consist of either two or three incineration units ranging in capacity from 50 to 1,000 tons per day; thus, facility capacity ranges from about 100 to 3,000 tons per day. It involves combustion of unprocessed or minimally processed refuse. The major components of a mass burn facility include: (1) Refuse receiving, handling, and storage systems; (2) Combustion and steam generation system (a boiler); (3) Flue gas cleaning system; (4) Power generation equipment (steam turbine and generator); (5) Condenser cooling water system; and (6) Residue hauling and storage system. This technology is predominantly applicable for hazardous waste.

PYROLYSIS

In Pyrolysis**,** at high temperatures of 700°C to 1200 °C, thermal degradation of organic carbon-based materials is achieved through the use of an indirect, external source of heat, in the absence or almost complete absence of free oxygen. This thermally decomposes and drives off the volatile portions of the organic materials, resulting in a syngas composed primarily of hydrogen (H_2), carbon monoxide (CO), carbon dioxide (CO_2), and methane (CH_4). Some of the volatile components form tar and oil, which can be removed and reused as a fuel. Most Pyrolysis systems are closed systems and there are no waste gases or air emission sources (if the syngas is combusted to produce electricity, the power system will have air emissions through a stack and air emission control system). After cooling and cleaning in emission control systems, the syngas

can be utilized in boilers, gas turbines, or internal combustion engines to generate electricity or used as raw stock in chemical industries. The balance of the organic materials that are not volatile or liquid that is left as a char material, can be further processed or used for its adsorption properties (activated carbon). Inorganic materials form a bottom ash that requires disposal, although some pyrolysis ash can be used for manufacturing brick materials. Similar to incineration, Pyrolysis is also applicable for hazardous waste treatment.

GASIFICATION

In the Gasification process, thermal conversion of organic carbon based materials is achieved in the presence of internally produced heat, typically at temperatures of 660°C to 1800°C, and in a limited supply of air/oxygen (less than stoichiometric, or less than is needed for complete combustion) to produce a syngas composed primarily of H_2 and CO. Inorganic materials are converted either to bottom ash (low-temperature gasification) or to a solid, vitreous slag (high temperature gasification that operates above the melting temperature of inorganic components). Some of the oxygen injected into the system is used in reactions that produce heat, so that Pyrolysis (endothermic) gasification reactions can initiate; after which, the exothermic reactions control and cause the gasification process to be self-sustaining. Most gasification systems, like Pyrolysis, are closed systems and do not generate waste gases or air emission sources during the gasification phase. After cooling and cleaning in emission control systems, the syngas can be utilized in boilers, gas turbines, or internal combustion engines to generate electricity, or to make chemicals.

PLASMA ARC GASIFICATION

In Plasma Arc Gasification process, alternating current (AC) and/or direct current (DC) electricity is passed through graphite or carbon electrodes, with steam and/or oxygen/air injection (less than stoichiometric), to produce an electrically conducting gas (a plasma) typically at temperatures greater than 2,200°C. This system converts organic carbon-based materials, including tar, oil, and char, to syngas composed primarily of H2 and CO and inorganic materials to solid, vitreous slag. Like Pyrolysis and conventional Gasification, Plasma Arc Gasification is a closed system; therefore there are no waste gases and no emission sources in the Plasma Arc Gasification process. After cooling and cleaning in emission control systems, the syngas produced by plasma arc gasification can be utilized in boilers, gas turbines, or internal combustion engines to generate electricity or to make chemicals. The final emission products are

CO2 and water. The furans and dioxins in the emissions are extremely low and lower than the recommended USEPA or EU emission norms.

BIOLOGICAL PROCESSING TECHNOLOGIES

Biological technologies are widely used to treat Municipal Solid Wastes (MSW) and are operated at lower temperatures with lower reaction rates. Biological processing technologies are essentially focused on the conversion of organics in the MSW consisting of dry matter and moisture. The dry matter further consists of organics (i.e., whose molecules are carbon-based), and minerals, also referred to as the ash fraction. The organics can be further subdivided into biodegradables or refractory organics, such as food waste, and non-biodegradables, such as plastic. Biological technologies can only convert biodegradables component of the MSW. Byproducts can vary, which include: electricity, compost and chemicals. Various biological processing technologies are briefly described below.

COMPOSTING

Composting is a natural micro-biological process where bacteria break down the organic fractions of the MSW stream under controlled conditions to produce a pathogen-free material called "Compost" that can be used for potting soil, soil amendments (for example, to lighten and improve the soil structure of clay soils), and mulch. The microbes, fungi, and macro-organisms that contribute to this biological decomposition are generally aerobic. A mixture of organic materials is placed into one or more piles (windrows), and the natural microbial action will cause the pile to heat up to 65-80°C, killing most pathogens and weed seeds. A properly designed compost heap will reach 70°C within 6 to10 days, and slowly cool off back to ambient temperatures as the biological decomposition is completed. Systematic turning of the material, which mixes the different components and aerates the mixture, generally accelerates the process of breaking down the organic fraction, and a proper carbon/nitrogen balance (carbon to nitrogen or C/N ratio of 20:1) in the feedstock insures complete and rapid composting. The composting process takes from 17 to 180 days. For composting process, the moisture content of the MSW should be ideally > 45%. There are two fundamental types of composting techniques: open or windrow composting, which is done out of doors with simple equipment and is a slower process, and enclosed system composting, where the composting is performed in some enclosure (e.g., a tank, a box, a container or a vessel).

ANAEROBIC DIGESTION

In anaerobic digestion (AD), biodegradable material is converted by a series of bacteria groups into methane and CO_2. A first group breaks down large organic molecules into small units like sugar. This step is referred to as hydrolysis. Another group of bacteria converts the resulting smaller molecules into volatile fatty acids, mainly acetate, but also hydrogen (H_2) and CO_2. This process is called acidification. The last group of bacteria, the methane producers or methanogens, produce biogas (methane and CO_2) from the acetate and hydrogen and CO_2. This biogas can be used to fuel boilers or reciprocating engines with minimal pretreatment. In addition to biogas, anaerobic bioconversion generates a residue consisting of inorganics, non-degradable organics, nondegraded biodegradables, and bacterial biomass. If the feedstock entering the process is sufficiently free of objectionable materials like colorful plastic, this residue can have market value as compost. AD process is also referred to as Biomethanation process.

BIOREACTOR LANDFILL

A bioreactor landfill is a wet landfill designed and operated with the objective of converting and stabilizing biodegradable organic components of the waste within a reasonable time frame by enhancing the microbiological decomposition processes. The technology significantly increases the extent of waste decomposition, conversion rates and process effectiveness over what would otherwise occur in a conventional wet landfill. Stabilization in this context means that landfill gas and leachate emissions are managed within one generation (twenty to thirty years) and that any failure of the containment system after this time would not result in environmental pollution. There is better energy recovery including increased total gas available for energy use and increased greenhouse reduction from reduced emissions and increase in fossil fuel offsets. These factors lead to increased community acceptance of this waste technology. Management of a bioreactor landfill requires a different operating protocol to conventional landfills. Liquid addition and recirculation is the single most important operational variable to enhance the microbiological decomposition processes. Other strategies can also be used to optimize the stabilization process, including waste shredding, pH adjustment, nutrient addition and temperature management.

PHYSICAL PROCESSING TECHNOLOGIES

Physical technologies involve altering the physical characteristics of the MSW feedstock. The MSW is subjected to various physical processes that reduce the quantity of total feedstock,

increase its heating value, and provide a feedstock. It may be densified or palletized into homogeneous fuel pellets and transported and combusted as a supplementary fuel in utility boilers. These technologies are briefly described below.

REFUSED DERIVED FUEL OR RDF

The RDF process typically includes thorough pre-separation of recyclables, shredding, drying, and densification to make a product that is easily handled. Glass and plastics are removed through manual picking and by commercially available separation devices. This is followed by shredding to reduce the size of the remaining feedstock to about eight inches or less, for further processing and handling. Magnetic separators are used to remove ferrous metals. Eddy-current separators are used for aluminum and other non-ferrous metals. The resulting material contains mostly food wastes, non-separated paper, some plastics (recyclable and non-recyclable), green wastes, wood, and other materials. Drying to less than 12% moisture is typically accomplished through the use of forced-draft air. Additional sieving and classification equipment may be utilized to increase the removal of contaminants. After drying, the material often undergoes densification processing such as pelletizing to produce a pellet that can be handled with typical conveying equipment and fed through bunkers and feeders. The RDF can be immediately combusted on-site or transported to another facility for burning alone, or with other fuels. The densification is even more important when RDF is transported off-site to another facility, in order to reduce volumes being transported. RDF is often used in waste to energy plants as the primary or supplemental feedstock, or co-fired with coal or other fuels in power plants, in kilns of cement plants, and with other fuels for industrial steam production.

MECHANICAL SEPARATION

Mechanical separation is utilized for removing specific materials or contaminants from the inlet MSW stream as a part of the pre-treatment process. Contaminants may include construction and demolition (C&D) debris, tires, dirt, wet paper, coarse materials, and fine materials. Generally, MSW reaching the dumping sites is unsegregated and mixed containing C&D debris and other contaminants. Therefore, it is essential to remove these contaminants from the incoming MSW by mechanical separation before processing the waste further by either biological, physical and thermal technologies (except Plasma Arc Technology).

However, in MBIR project source segregation will be adopted and the C&D debris (if generated) is expected to be reused for daily cover of the landfill. Therefore, the MSW reaching the dumping grounds may not require the elaborate mechanical separation process. This MSW has high organic content, fit to be directly used for various technologies after manual sorting only.

SIZE REDUCTION

Size reduction is often required to allow for more efficient and easier handling of materials, particularly when the feed stream is to be used in follow-on processes. Sizing processes include passive, moving, and vibrating screens and trommels. In order to reduce the size of the entire stream, or portions of it, mechanical equipment, such as shredders, is utilized. This allows for other physical processes, such as dryers, magnetic and eddy current separators, and densification equipment to work more efficiently. Magnetic and eddy current separators may be installed both up- and down-stream of shredders to increase the recovery of metals.

LANDFILLING

Landfilling means disposal of residual solid wastes on land in a facility designed with protective measures against pollution of ground water, surface water and air fugitive dust, wind-blown litter, bad odour, fire hazard, bird menace, pests or rodents, greenhouse gas emission, slope instability and erosion. Both for MSW and industrial hazardous waste landfilling is an essential component of solid waste management plan to accommodate the residue of treatment and the inert coming from the waste streams.

The technical requirement and design criteria for disposal of MSW and hazardous waste are different and is depends upon the quantity and characteristics of the waste. Therefore, in the solid waste management plan for MBIR two separate disposal strategy will be adopted for MSW and hazardous waste.

ABOUT COMPOSTING

Composting is a means of processing waste, which is a legal requirement, provided under the Municipal Solid Waste Management (MSW) Rules 2000 for all municipal bodies in the country. The MSW Rules 2000 requires that "biodegradable wastes shall be processed by composting, vermi-composting, anaerobic digestion or any other appropriate biological processing for the stabilization of wastes"

Aerobic composting is the process of degradation of biodegradable waste matter into simple organic compounds by certain microorganisms in the presence of air. The process begins at ambient temperature by the activity of mesophilic bacteria, which oxidize carbon to CO_2, thus liberating large amount of heat,

with the temperature reaching 50^0C within two days. At this point the process is taken over by thermophilic bacteria and the temperature continues to rise. Most of the thermophilic phase, which lasts for about two weeks, takes place in the temperature range of 55 – 65^0C. The process is dependent on the provision of adequate supplies of air and moisture for the bacteria, in addition to the nutrients provided by the wastes.

The complete composting process comprises of following activities:

- *Yard management system (windrow system)*: Fresh MSW will be stacked on the compost pad in the form of trapezoidal heaps (called windrows), inoculated and processed for correct composting & stabilised. *Due to heavy monsoons in the project location, entire compost pad would be covered.*

- *Coarse segregation system*: Automated screening system for segregation of lumpy and highly heterogeneous material.

- *Curing system*: Final curing for 15 days for further stabilisation and moisture control

- *Refinement system*: Removing of impurities such as glass, plastics, inert, etc. and maintaining the size below 4 mm as per compost quality norms.

- *Packing and storage system*: High quality compost will be stored in storage godown and packed in bags, as per the market requirements.

- *Testing laboratory*: Well-equipped laboratory will be set up to help in in-house testing of critical parameters such as temperature, moisture, C/N ratio, aerobic conditions etc.

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