मध्यप्रदेश शासन
नगरीय विकास एवं आवास विभाग
मंत्रालय, वल्लभ भवन, भोपाल

क्रमांक/एफ–4/18–2/2017/3336 भोपाल, दिनांक 30/03/2017

आदेश

मध्य प्रदेश शासन, नगरीय विकास एवं आवास विभाग द्वारा "Waste Water Recycle & Reuses and Feacal Sludge Management (FSM) " पॉलिसी प्रारूप लागू किया जा रहा है, जो कि भविष्य मे नगरीय निकायों द्वारा क्रियान्वित किये जाने वाली समस्त सीवरेज परियोजनाओं एवं ठोस अपशिष्ट प्रबंधन की परियोजनाओं पर लागू होगा।

इस पॉलिसी पर समस्त निकायों में विस्तृत विचार विमर्श किया जाकर इसे लागू करने की कार्ययोजना तैयार की जाए एवं यदि इसके सम्बंध में कोई सुझाव या संशोधन हो तो उन्हें एक माह की अवधि मे प्रमुख अभियंता, संचालनालय नगरीय प्रशासन एवं विकास को दिये जा सकते है।

संलग्न :– उपरोक्तानुसार

(विवेक अग्रवाल)
आयुक्त–सह–सचिव,
नगरीय विकास एवं आवास विभाग,
मध्यप्रदेश

पृ. क्रमांक/एफ–4/18–2/2017/3337 भोपाल, दिनांक 30/03/2017

प्रतिलिपि :–

1. प्रमुख सचिव, म.प्र. शासन नगरीय विकास एवं आवास विभाग मंत्रालय भोपाल.
2. निज सहायक, मां. मंत्रीजी नगरीय विकास एवं आवास विभाग म.प्र. भोपाल
3. समस्त संभागायुक्त मध्यप्रदेश ।
4. समस्त जिला कलेक्टर मध्य प्रदेश।
5. समस्त आयुक्त, नगरपालिक निगम मध्यप्रदेश।
6. समस्त संभागीय संयुक्त संचालक/कार्यपालन यंत्री नगरीय प्रशासन एवं विकास म.प्र.।
7. समस्त मुख्य नगर पालिका अधिकारी, नगर पालिका परिषद/नगर परिषद म.प्र.।
8. श्री अंशुम सिंह वेब कन्टेन्ट मैनेजर नगरीय प्रशासन एवं विकास भोपाल।

आयुक्त–सह–सचिव,
नगरीय विकास एवं आवास विभाग,
मध्यप्रदेश

Govt. of Madhya Pradesh State Level Policy (2017) for Waste Water Recycle & Reuse and Feacal Sludge Management (FSM)

Prepared by

Urban Development & Housing dept.

Govt. of Madhya Pradesh

Contents

Abbreviations:

BIS	Bureau of Indian Standards
BOD	Biochemical Oxygen Demand
BOO	Build Own Operate
BOT	Build Operate and Transfer
CER	Certified Emission Reduction
CGWA	Central Ground Water Authority
COD	Chemical Oxygen Demand
CPHEEO	Central Public Health and Environmental Engineering Organization
CPCB	Central Pollution Control Board
CSP	City Sanitation Plan
DBFOT	Design-Build-Finance-Operate-Transfer
DLB	Directorate of Local Bodies
GIS	Geographical Information System
GPR	Ground Penetrating Radar
GoI	Government of India
HUDCO	Housing &Urban Development Corporation Limited
lpcd	Litres per capita per day
LSG	Local Self Government Department, GoR
MOUD	Ministry of Urban Development, GoI
NCR	National Capital Region
NGO	Non-Government Organization
NMSA	National Mission for Sustainable Agriculture
OSS	On-Site Sanitation Systems
O&M	Operation & Maintenance
RBMC	Revenue Based Management Contract
REC	Renewable Energy Certificate
MPSPCB	Madhya Pradesh State Pollution Control Board
SLNA	State Level Nodal Agency
SS	Suspended Solids
SPS	Sewage Pumping Station
SPV	Special Purpose Vehicle
UDH	Urban Development & Housing Department
UIT	Urban Improvement Trust
VAT	Value Added Tax
WHO	World Health Organization

Foreword:

The Policy document has analysed a number of issues including urban trends, local practices, projected population, service delivery, institutional arrangements, municipal finances and innovation in financing that are of direct relevance to urban development in the State. The policy document also described status of JnNURM and recommended measures as well administrative actions to improve MP's urban areas.

The Department of Urban Development & Housing, Madhya Pradesh has prepared "Govt. of M.P. State Level Policy (2017) for Waste Water Recycle & Feacal Sludge Management (FSM)" to accomplish the objectives of 'The National Urban Sanitation Policy 2008' and 'Atal Mission for Rejuvenation and Urban Transformation Scheme'. The policy has been prepared in consultation with and contribution from various Government Departments and organisations, NGOs, experts from Engineering Colleges, etc.

UADD M.P. extends its heartfelt thanks to all the departments including Ministry of Urban Development, Government of India, State Finance, Agriculture and Industries Departments, experts from Engineering Colleges for giving valuable inputs and suggestions in the preparation of policy of its kind in the state of M.P.

The department also acknowledges direct or indirect contribution made by one and all associated with the preparation of this landmark policy.

It is also envisaged that coverage of sewerage and sanitation in Madhya Pradesh urban sectors is improved appropriately through a time bound action plan and all-round contribution from various funding agencies, untiring efforts by ULB machinery and NGO's and logical support from public representatives and public.

Commissioner

UADD, Madhya Pradesh

1. Context:

Sanitation is defined as safe management of human excreta, including its safe confinement treatment, disposal and associated hygiene-related practices. While this policy pertains to management of human excreta and associated public health and environmental impacts, it recognizes that the integral solutions need to take account of other elements of environmental sanitation, i.e. solid waste management, generation of industrial and other specialized/ hazardous waste, drainage, and also management of drinking water supply. The State of Madhya Pradesh has issued guidelines for State urban sanitation policy with a view that all cities & towns of Madhya Pradesh become totally sanitized, healthy and liveable so that all urban dwellers have access to and use safe and hygienic sanitation facilities. In order to achieve this goal, 100% human excreta and liquid wastes from all sanitation facilities, including toilets must be disposed off safely. Treated wastewater generated from existing wastewater treatment plants can be considered as an important component of water resources of Madhya Pradesh. Due to the terrain and the concentration of the urban population, the majority of treated wastewater is discharged into various rivers, nallas or on open land and only a part of it is used for irrigation.

On 2nd October 2014, the Government of India launched the Swachh Bharat Mission towards achieving a Clean and Open Defecation Free India by 2019. At present, the penetration of sewerage systems is low in Madhya Pradesh and more than 45% of urban MP households are dependent on On-Site Sanitation (OSS) systems. Thus, till the time the Government's vision of 100% sewerage universalization is achieved, it is felt that faecal sludge output needs to be managed in an environmentally safe and sustainable manner using complementary and alternative methods of treatment.

State shall be put into practice to achieve the goal of health and hygiene for citizens as enlisted below:

i. A Separate System: Sewerage system to carry domestic sewage while drainage system for storm water.
ii. Water reclamation centers to reclaim water after treatment of domestic sewage.
iii. Where water Reclamation centers are situated in the midst of residential area, these can be built under ground to avoid the problem of odour and parks can be maintained on the roof of treatment facility, in future where feasible.
iv. One of the schemes of treatment may be Grit chamber, Primary sedimentation tank, Reaction Tank, Secondary sedimentation tank, Chlorination Tank followed by sand filtration.
v. Reverse osmosis filtration may be used for tertiary treatment.
vi. Sludge may be dewatered, thickened and incinerated. Ashes remains may be used for landfill.
vii. 100% households should be covered by sewerage.
viii. Sewerage, Solid Waste Management and Water supply activity should be coordinated.
ix. Water tariff should be such as to discourage the people from wasteful use of water.
x. Policy is framed to resolve the following key issues:

A-Provision of adequate wastewater collection and treatment facilities for all the cities and towns in Madhya Pradesh.

B-Protection of the environment and public health in the areas affected by the proposed systems, especially, surface water and ground water.

C-Consideration of treated effluents as a source for reuse after achieving desired recycled effluent from Sewage Treatment Plants (for characteristics at end use, horticulture, agriculture industries, PWD, Rural Development Deptt).

D-Improvement of the socioeconomic conditions in the areas to be served by the proposed systems.

2. Vision, Goals and Purpose of the Policy Formulation:

The Policy, envisions, "All MP State cities and towns become totally sanitized, healthy and liveable 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".

State Level Policy (2017) for Waste Water Recycle & Feacal Sludge Management (FSM) is to ensure improved health status of urban population, specially the poor and under privileged, through the provision of sustainable sanitation services and protection of environment. The policy specifically endorses the following core principles:

i. To protect public health.
ii. To protect the environment and the State's water resources.
iii. To promote proper functioning of network based sewerage systems and ensure connections of household so as to prevent dry weather flow in drains & streets.
iv. Treatment of sewage and sludge is required prior to discharge into the environment.
v. Promote recycling & re-use of treated sewage for non-potable applications.
vi. To make Sewerage project economical and environmentally sustainable.
vii. Inclusive and participatory decision making with Experts & Focused Group discussions with stakeholder in the localities .
viii. Transparent decision making processes to achieve socio-environmental as well as economic & financial objectives.
ix. Capacity building for enhanced institutional ability to govern the sector effectively.
x. Ensuring, protecting and optimizing investments.
xi. Public Private Partnership (PPP) in the most appropriate manner
xii. Public outreach for environmental and health related outcomes.
xiii. Establishment of an efficient, effective, affordable and accountable system for managing urban sewerage and septage management.
xiv. Effective monitoring and evaluation of the initiatives intended to improve sewerage and septage management services.
xv. Coverage of all citizens in the urban areas for service provisioning.
xvi. Adequate sewerage and Septage facility provided to all urban customers
xvii. Equity across geographical as well as demographic fabric of the customer base.
xviii. Ensuring the system's financial sustainability in a progressive manner through improved efficiency, tariff rationalization and corporatized operations there by decreasing dependence on unsustainable resources.
xix. Improved service levels in a well-defined and phased manner by ensuring interventions in the spheres of infrastructure, institution, autonomy and management, monitoring mechanism and regulatory framework.

3. Need for Govt. of M.P.State Level Policy (2017) for Waste Water Recycle & Feacal Sludge Management(FSM):

Madhya Pradesh, the central state of the country, is geographically the second largest State of the country. It covers almost 9.5 per cent of the area (308,000 Sq. Km.) and 6 per cent (72.5 million) of country's total population. On the basis of the size of urban population, it ranks 8th and accounts for 5.58 per cent of the total urban population of India. According to the 2011Census, MP registered 20.30 % decadal growth in urban population against the national average of 17.64 %. In Madhya Pradesh, the decadal urban growth is much higher than (25.6 %) its rural counterpart (15.5 %). The 379 Urban Local Bodies of Madhya Pradesh accommodate 20.1 million urban population which accounts for 27.6 per cent of the total population of MP.

Table:1
Basic Information of Madhya Pradesh as of Census 2001, 2011 & as of 2017 Estimated

Indicators	**2001**	2011	2017 (Estimated)
Population	60,385,118	72,597,565	848,10,012
% of Population	26.70%	27.60%	28.95%
Sex Ratio	919	930	930
Literacy	63.70%	70.06%	72.00%
Districts	45	50	51
Towns(ULBs)	337	378	379

The 74th Constitution Amendment Act (CAA) came into force in June, 1993 which sought to improve strengthen urban governance and management of services. Present status in the services of Sewerage and Sanitation services is as given below.

Table:2 Percentage of Population as per Category of ULBs and Sewerage & Sanitation Coverage

Category of ULBs	**Numbers**	**Percentage of Urban Population**
Municipal Corporations **(Municipal Corporations are governed by M.P. Municipal Corporations Act, 1956)**	16	48.8%
Municipal Councils/Municipalities ***(Municipal Councils governed by M.P. Municipalities Act, 1961)***	98	30.3%
Nagar Parishad ***(Nagar Parishads are governed by M.P. Municipalities Act, 1961)***	265	20.9%
Total	379	100%

The Atal Mission for Rejuvenation and Urban Transformation (AMRUT) is a landmark initiative of Government of India for improving infrastructure and service delivery system in cities having one lakh and more population through better governance and financial management system. To achieve this the mission envisages implementation of a set of Reform agenda such as E-Governance , Constitution & professionalization of Municipal Cadre , Double Entry Accounting system , Urban Planning, Devolution of funds & Function , Review of Building Bye Laws, Set up Financial Intermediaries at States Level, Credit Rating of the Urban Local Bodies, Energy & Water Audit .Once these reforms are implemented it is expected to bring in improvement in service delivery, mobilization of resource and making municipal functioning more transparent and accountable . As per AMRUT Guidelines Para 12 on Urban Reforms 10% incentive shall be provided to the State / ULBs on the basis of self – assessment done by the States as per table 5.5 of AMRUT guidelines. The reforms achievements would be evaluated annually after the end of financial Year by allocating 10 marks for each Reforms milestone achieved during the year. The self – assessment is to be confirmed by the SHPSC and validated by the IRMAs.

Sr.No.	Year	No. of Milestones	Maximum Score
1	1st Year	28	280
2	2nd Year *	13	130
3	3rd Year *	10	100
4	4th Year *	3	30

Safe water supply and hygienic sanitation facilities are the two basic essential amenities the community needs on top priority for healthy living. While provision of safe drinking water takes precedence in the order of provision of basic amenities to community, the importance of hygienic sanitation facilities through low cost on – site sanitation, conventional sewerage and sewerage treatment can no longer be allowed to lag behind, as about 80% of water used by the community comes out of houses in the form of waste water which unless properly collected, conveyed, treated and safely disposed of may eventually pollute our precious water resources and cause environmental degradation. The provision of safe drinking water alone is not enough to break the chain of disease causing pathogens. Safe disposal of the waste is even more important. This can be at an individual property level or at group housing level like apartment, complexes or at community level.

In most cities and towns of M.P., only a minority of households are connected to a sewage system and only a small fraction of the sewerage from these households is treated effectively at primary or secondary sewage treatment plants. The rest of the urban population has either:

i. Some form of on-site sanitation like septic tank/soakage well for disposal of human excreta,
ii. Kitchen & bathroom waste disposing into road drains or directly on roads, thereby creating unhygienic conditions or,
iii. No sanitation facilities i.e. excrete in the open spaces around their homes.

About one fifth of urban India is dependent on on-site sanitation, or has no access to sanitation services. Therefore, it is imperative that urban authorities formulate effective policies and action plans for the planning and management of onsite sanitation services.

Two forms of Urban Sanitation Policy are relevant – the macro and the micro. The impact of the Urban Sanitation Service Infrastructure is well beyond the boundaries of individual municipalities. It has an impact on economy of a region, environment & social development. The need to manage the macro economy of the area and to protect the environment and manage the socio economic development, the State Government should set a macro policy, broad objectives and principles of which should be:

i. A frame work within which the municipalities are guided to work, and
ii. A benchmark against which municipalities are aware that they must measure up for approval of their projects for financing.

In accordance with the Constitution of India and its 12th amendment, prime responsibility for installing and operating a sanitation service lies with the individual Municipal Bodies. Each Municipal Government should determine its own policy for a sanitation service at the micro level within the frame work of the guidelines established in the macro policy formulated by the State Government.

4. Terms of Reference in the field of Waste Water & Sludge Management:

With fast growing economy and urban population, the waste generation is steeply increasing. Due to paucity of resources, the local bodies, which are responsible for management of wastes, are not able to provide this service effectively. Access to improved sanitation in urban has risen but the management of onsite sanitation systems such as septic tanks remains a neglected component of urban sanitation and wastewater management. Septage, which is a fluid mixture of untreated and partially treated sewage solids, liquids and sludge of human or domestic origin, flows out of septic tanks and enters waterways or is generally disposed into nearest water body or low lying areas. This leads to serious health and environmental implications.

4.1. On-Site Sanitation

The collection and treatment of waste is done where it is deposited. Examples are the use of pit latrines, septic tanks, and imhoff tanks. This is being adopted by almost 80% of urban town in MP consisting of some form of toilet that passes waste to leach pits, pits with mechanical removal options and septic tanks. The second on site disposal option being exercised is defecation in open space. This causes passing of the chemical and pathogenic infections to the ground waters, to the drains and water bodies, outside resulting in severe risk to human health. Therefore, followings points has to be considered in this matter:

i. The options of the onsite system will depend on the substrata, space availability and social acceptability. These also are dependent upon the water absorption capacity of the soil. Rocky areas and high water table areas are not suitable for this at all as they do not provide any protection against the pathogens. It is generally suggested that the risk factor for pollution is related to the traverse time between polluting point and the water table. A traverse time of 50 days is considered low risk, 25-50 days is to be considered as medium risk area and less than 25 days is considered as high risk areas with the point of view of pollution of the ground water. Finer soils with high clay content have low

permeability and thus greater risk reduction in lesser depths whereas coarse sands and rocky fissures provide high permeability and lower reduction. Generally, a minimum distance of 2 to 3 m is required for risk reduction.

ii. The on-site option for solids removal combined with carriage of the sewage through conduits to the general sewerage system can also be considered as a good option in critical areas. Such options could be a combination of small bore/shallow sewers for sewage collected after settling of solids in a tank (e.g. septic tank effluent) and in site disposal systems.

iii. All in site options must be adopted after full involvement of the local users who know all the feasible options and must have a say in the choice. Assistance of NGOs and dedicated organizations for this option should be encouraged.

iv. On Site technologies represent viable and affordable options if collection, transport, treatment and safe end use or disposal is managed properly.

v. Bio digester, Pydroid technology based on site solution accompanied by root zone treatment can be suitably used for onsite sanitation. Reed Bed filters, horizontal or vertical, can be deployed before final disposal / Re-use.

vi. The ULB through its suction machines shall facilitate the clearance of sludge on payment basis. Municipality can also authorize any private person/Agency for clearance of sludge through mechanical means.

4.2. Off – Site Sanitation

The ideal mode for sanitation is an off-site system which collects all the waste from within the city and transfers it to a treatment facility outside the city which treats it to acceptable levels of effluent and sludge which is then disposed /reused. The essential pre-requisite to a sustained functioning of the offsite facilities are:

i. Adequate sewerage flow (approximately 108 lpcd minimum) which is possible only in town/areas with a minimum supply of 135 lpcd and 100% connectivity.

ii. Availability of Land for Sewage Treatment Plant and Pumping Stations will be ensured while preparing the master plan of sewerage for town. Town planning department shall mandatorily earmark land for Sewerage Treatment Plant and other facilities.

iii. Where possible, gravity flow shall command the collection and conveyance lines.

iv. Treatment plants shall be located away from any potential population growth. Location selection shall be coordinated and approved with the concerned governmental agencies. Due consideration shall be given to interact with landowners and adjacent communities.

v. It is mandatory to construct decentralized Sewage Treatment Plants (STPs) for the treatment of waste water in high rise buildings, so that sewerage system in that area may function properly and the treated waste water may be utilized in the nearby area. It will also reduce the investment requirement of sewerage system.

vi. The use of advanced wastewater treatment technologies shall be endorsed and encouraged. However, appropriate wastewater treatment technologies shall be selected with due consideration to operation and maintenance costs and energy savings, in addition to their efficiency in attaining and sustaining quality standards.

vii. Innovative approaches to wastewater treatment, particularly for the small municipal systems have to be considered. Design criteria, performance specifications and guidelines for such systems shall be adopted and generalized.

viii. Design and performance specifications of wastewater treatment plants shall be as per guidelines given in the manual on sewerage treatment systems published by CPHEEO. Sufficient room in tendering for the construction of new plants shall be provided for competition to take place in both technologies and costs.

4.3. Need for Septage Management

Inadequate sanitation has a great environmental economic and health impacts. In order to minimize these impacts, several measures including increased investment in sanitation, policy initiatives, regulations, and public campaigns to improve sanitary conditions are required.

In the absence of any consolidated septage management practices, all these improved sanitation facilities will continue to degrade surface water bodies and groundwater resources. Therefore, there is a need to invest in septage management as a complement to sewerage development, till than sewerage system comes in place.

4.4. Understanding Septage

"Septage" is septic tank sludge that is a combination of raw primary sludge and anaerobically produced raw sludge. It has an offensive odour, appearance and contains significant levels of grease, grit, hair, debris and pathogenic microorganisms. There are broadly three categories of septage namely:

Domestic Septage, Industrial Septage and Grease Septage. This document focuses on management of domestic septage (household, non-commercial and non-industrial sewage) in a responsible, safe and consistent manner.

Generally, septage has three main components as follows:

Scum - floats on the top and is generally where the bacteria live that treat the waste

Effluent - the semi-treated liquid that comprises the majority of the material in the septic tank

Sludge- solids which collect at the bottom of the tank

The physical and chemical characteristics of these components and the whole septage can vary depending on the septage characters (like size, design, pumping frequency and climatic conditions of the place where it is located), the quality of water supplied and type of the waste from the household which is user specific.

Source of Septage

Septic tanks are the primary source of septage generation. A septic tank is a horizontal continuous flow type of a sedimentation tank (with a detention period of 12-36 hours), directly admitting raw sewage, and removing about 60-70% of the dissolved matter from it. Septic tanks receive black and/or grey water and separate the liquid from the solid components. A septic tank is generally followed by a soak-pit to dispose off the effluent into the ground. The sludge settled at the bottom and the scum at the top surface of the sewage is allowed to remain in the tank for several months during which they are decomposed by bacteria through anaerobic digestion. Septic tanks are generally provided in areas where sewerage system is not present and for catering to the sanitary disposal of sewage produced from isolated communities, schools, hospitals and other public institutions.

Why is septage a problem?

The indiscriminate disposal of domestic wastewater is the main reason for degradation of water quality in urban areas, with negative impacts on health, the economy and the environment. Discharging wastewater to the land or to surface waters is a menace to public health and is a violation of the fundamental right guaranteed by The Constitution of India (Right to Clean Environment). The unmanaged septage can pose direct and indirect socio economic impacts.

Septic tanks require de-sludging at regular intervals in accordance with its design and capacity. Often only when a tank gets clogged and filled beyond its holding capacity that de-sludging is done. The overflow from the tank finds it way into any nearest waterways or land surface and pollutes it. The

effluent and sludge from septic tanks are often rich in phosphates and nitrates. The effluents lead to saturation of surface soil and water bodies with nutrients posing a threat of eutrophication to the surface waters. People and animals in contact with these contaminated areas are susceptible to infections. It also pollutes the groundwater, when the sludge percolates. The leachate from the unmanaged septage virtually disposed on the subsurface can pollute the ground water. Communities coming in contact with these contaminated soil or water become susceptible to infections and water borne diseases.

Is septage only a menace or can be a resource?

Though septage is problem it can be harnessed into a useful resource. Domestic septage can be a resource rather than a waste when properly managed. Septage contains plant nutrients such as nitrogen, phosphorus, and in some cases varying amounts of micro nutrients such as boron, copper, iron, manganese, molybdenum, and zinc. Septage can reduce reliance on chemical fertilizers and when combined with fertilizers can provide the required nutrients for crop production.

4.5. Septic Tanks

Septic tanks are one of the most common forms of urban sanitation facilities in MP. Major part of MP has not been connected to municipal sewer system which makes people dependent on the conventional individual septic tanks.

Technical Advisory on Construction of Septic Tanks

A. General:

The septic tank is originated in France during the early 1800s where it was developed to deal with human wastes generated in the new towns that expanded rapidly to support the industrial revolution following the regime of Napoleon Bonaparte. Until that time, the wealthy used buckets in an ablution room within their house and the staff emptied the contents when necessary into the same cesspit latrine adjoining the house that they used themselves.

A septic tank has three main functions:

- Separation of sewage solids from liquid (the faecal solids float to form a scum);
- Reduction of scum (stools) and dissolved COD (mostly urine) by anaerobic bacteria (in both chambers); and
- Storage of inorganic solids and minerals (septage) as a fine silt on the floor (to be removed by spade or suction periodically - usually every 1-3 years).
- Natural anaerobic bacteria and associated microorganisms living within the septic tank adapt to degrade human sewage to simple biomasses, water and inorganic radicals (for example, trace minerals in food).

Septic tank is a combination of sedimentation and digestion tank having a detention period of 24 to 48 hours on an average daily flow of sewage, where sewage is detained for some time when the suspended solids settle down to the bottom of tank and this is accompanied by anaerobic digestion of sludge and liquid, resulting in appreciable reduction in the volume of sludge and release of gases like carbon dioxide, methane and hydrogen sulphide. But the effluent of the septic tank is very septic and malodorous and it is more objectionable than the liquid that goes into the tank. It is therefore requiring a secondary treatment by disposing the effluent through soak pit (seepage pit), leach pit or dispersion trenches or ST effluent to connect in to public sewers.

B. LOCATION

- Septic tank should be located in the area, which is having porous soil for the subsurface disposal of effluent as for as possible.
- Big STs should be located away from the residential buildings, to avoid public health hazard and nuisance.
- It should not be located in the swampy area or area prone to flooding.

C. DESIGN CRITERIA

i. Sedimentation

To remove the maximum possible number of suspended solids from the sewage, a minimum depth of 30 cm is necessary, which requires a surface area of 0.92 m2 per 10 lpm of peak flow rate.

ii. Sludge digestion

Sewage is detained in the tank to undergo anaerobic digestion for destroying the organic matter and converting it into innocuous sludge, which becomes suitable for dewatering and drying. The volume required for digestion of sludge is 0.032 m3/capita.

iii. Sludge and scum storage

Adequate provision should be made for the storage of digested sludge and scum in the tank. The volume required for sludge and scum storage is 0.0002 m3/capita/day.

iv. Freeboard

A minimum free board of 30 cm is required in the tank including the provision for seed sludge.

v. Sewage Flow

The maximum flow (peak flow) to the tank is calculated on the basis of number of plumbing fixtures discharging simultaneously and not only the number of users or per capita wastewater flow expected to reach the tank. A table showing fixture equivalents is given below: -

Facility	Equivalent fixture unit
Water closet	1
Bath	½
Wash basin/Kitchen sink	½
Urinal (with auto flush)	1
Urinal (with auto flush)	½
Slope sink	1
Laboratory sinks	2
Combination fixture	1
Shower bath	1
Bath tub	2
Drinking fountain	½
Ablution tap	½
Dishwasher	½

vi. RECOMMENDED CAPACITIES OF SEPTIC TANKS

In view of the unsatisfactory quality of the effluent and the difficulty in providing a large area for the final disposal of effluent through sub-soil dispersion system, septic tanks are

constructed only for the individual homes and small communities having a total contributory population of 300 persons. For larger communities, provision of septic tanks should be avoided as far as possible, but it may be extended to a population of 500 in the undulating topography.

vii. CONSTRUCTION DETAILS

i. Length of the tank (L) should be 2 to 4 times the width (B).
ii. Inlet and outlet should be located as far away as possible (on opposite sides) from each other and at different levels.
iii. Both inlet and outlet should dip 25 to 30 cm into the liquid and project 15 cm above the liquid.
iv. First baffle should be placed at a distance one-fifth of the length (L/5) from the mouth of the inlet pipe (For Large ST having designed for population more than 50 persons)
v. Second baffle should be placed at a distance of 2/3 L from the outlet pipe. (For Large ST having designed for population more than 50 persons)
vi. The invert level of the outlet pipe should be placed at a level, 5 to 7 cm below the invert level of inlet pipe.
vii. A bottom slope of 10% (0.10) or more, from all the corners of the tank towards the outlet of desludging chamber should be provided.
viii. Septic tank should be provided with a ventilating pipe. The height of the ventilating pipe should extend at least 2 m above the top of the highest building within a radius of 20 m.
ix. Septic tank should be provided with a watertight cover of adequate strength, Access manhole of adequate size should also be provided for the purpose of inspection and desludging of tank.

viii. SECONDARY TREATMENT OF EFFLUENT

Satisfactory disposal of effluent depends to a great extent on the porosity and percolation characteristic of the soil, level of sub-soil water table and the concentration of suspended solids in the effluent. The disposal of effluent may be either under-ground or over ground. Normally underground disposal either in the form of soak-pit (seepage pit) of dispersion trenches is practiced.

Soak-pit (seepage pit)

Soak pit can be adopted in all type of porous soils where percolation rate is below 25 minutes per cm and the water table is 180 cm or more from the ground level. Soak pits are cheap to construct and are extensively used. They are filled up with rubble or brickbats. The depth of soak pit is usually kept 1 m below the invert level of outlet pipe. The pit is covered and the top is raised above the adjacent ground level to prevent the damage by flooding.

PROPOSED SEPTIC TANKS for various Population Load of 5, 10, 50 & 250 (Type-1-2-3-4) are suggested to be constructed as per the drawing enclosed in Annexure 1A & 1B:

- Length 'L' should be 2 to 4 times the width 'B'.
- First baffle should be placed at a distance one-fifth of the length (L/5) from the mouth of the inlet pipe.
- Second Baffle should be at 2L/3 from the outlet pipe.

- Invert level of outlet pipe should be 5 to 7 cm below the invert level of inlet pipe.
- Both inlet and outlet pipes should be provided with a 90^{o} bend which should dip in the liquid. Inlet should project at least 15 cm above the liquid.
- Bottom slope from all the corners towards the desludging chamber should be at least 1 in 10.
- The length of ventilating pipe should be 2 m more than the highest building within a radius of 20 m.
- In the case of large installations, the depth of septic tank for desludging interval of 1,2 and 3 years should not be less than 1.1, 1.4 and 1.75m.

Construction

- Concrete structures are preferred.
- They should be water tight and multichambered.
- Bottomless septic tanks should be prohibited.
- Must be sized so that the volume is at least 1.6 times the daily flow but preferably 2 or 2.5 times the daily flow.
- The bigger the tank, the less frequently it will need to be desludged. Multiple chamber septic tanks should be designed for new installations.
- Must also be accessible (have a removable cover and not be located directly under the house) to pump sludge when sludge level becomes too high.
- Small housing blocks may share a community septic tank to reduce per household costs.

Maintenance

- When the septage occupies two-thirds of the depth of the tank, it needs to be removed; otherwise there is a risk that excreta will pass directly through the tank and overflow into the disposal system.
- Septage should be taken to an approved sludge treatment and disposal site by means of a vacuum tanker.
- Households should be encouraged to minimize their use of water and be careful about what they put into their septic tanks.
- The septic tank should be desludged every 2 to 3 years depending on the capacity and design.
- The desludging schedule should be prepared (preferably computerized) and should be notified to the household about their due date.

4.6. Present Status of Septage Management

The adequate facilities and services for collection, transportation, treatment and disposal of urban domestic septage do not exist in most of the cities. Most on-site sanitation systems (OSS) are emptied manually in absence of suitable facilities. Ideally a septic tank system should be desludged every 2-5 years. But ignorance towards maintenance and operational conditions often results in accumulation of organic sludge, reduction in effective volume and hydraulic overloading which ultimately causes the system failure and release of partially treated or untreated septage from the septic tank. Private

operators often do not transport and dispose of septage several kilometres away from human settlements and instead dump it in drains, waterways, open land, and agricultural fields.

Technological Options for Septage Management

The septage treatment required depends on the types and sources of domestic wastewater and faecal sludge. The domestic wastewater and faecal sludge often contains high concentration of organic matter and pathogens. Hence it is important to provide environmentally suitable technological options for collection, transport, treatment and disposal/reuse of faecal sludge/ septage.

4.7. Current Practices

In MP towns/cities, municipalities/local government bodies are mainly responsible for ensuring the safe handling and disposal of septage generated within its boundaries. They also establish local ordinances or regulations to govern septage handling and to meet all requirements and standards.. In most of the cities, only crude and unhygienic septage handling practices exist and there is no proper municipality infrastructure that performs the task of septage management. Most of the septic systems are not well maintained in the country and if they are maintained by individual home owners, many of them do not have the technical know-how for its operation and maintenance. For example, the household garbage disposals and pouring of grease into domestic drains can reduce the effectiveness of the septic tank in the long run. In terms of system operation, as many as 75 percent of all system failures have been attributed to hydraulic overloading.

Desludging of septic tanks is an over burden for many home owners that they postpone until the tanks have reached its capacity and they start overflowing. Untreated septage is often disposed in low lying areas or agriculture farms or even in a water body, which poses serious health and environmental problems.

4.8. Stages of Septage Management

The septage management basically consist of collection, treatment and proper disposal of septage.

TABLE: Types and sources of domestic wastewater and faecal sludge

Type	**Source**	
Faecal sludge	Pit latrines and leach pits	Decreasing concentration of pollutants and pathogens (top to bottom)
Septage	Septic tanks	
Blackwater	Water closets	
Domestic sewage	Sullage and black water mixed together	
Sullage (grey water)	Personal washing, laundary cooking and cleaning	

Source: WSP, 2008

Septage Collection

An important feature of septage which has to be considered for septage collection is the septage generation rate and sludge withdrawal.

Septage generation rate

Septage generation rates vary widely from place to place depending on practices of septic tank use, number of users, water used for flushing, efficient functioning of the tank and level of contamination control. It can be considered that the volume of sludge evacuated from a septic tank corresponds more

or less to the volume of the septic tank, plus some cleansing and rinsing water. The size of a septic tank in individual houses in MP ranges from 1 to 4 m^3, the size of a septic tank in office or apartment buildings from 10 to 100 m^3.

Desludging of Septic Tanks

In most of the cases the septic tanks are desludged manually. This is considered as unpleasant and repulsive job since the sludge (including fresh excreta) generally gets spilled around the tank during emptying, and poses a risk of transmission of diseases of faecal origin. Given the safety and health risks of manual desludging, it is critical for cities to take measures to stop this common practice. The most satisfactory method of sludge removal is by vacuum tankers. The faecal sludge needs to be correctly disposed and further treated. For this, the faecal sludge should be separated from the liquid in drying beds or by settling. The separated effluents from these systems should be treated in Waste Stabilization Ponds (WSP) or constructed wetlands.

4.8.1 Septage Transportation

The septage transportation is one of the most important components of septage management. Recognizing a standard method of collection, handling and transportation of septage is an important requirement. Desludging trucks act as a "mobile sewer network" for onsite sanitation systems be used.

4.8.2 Septage Treatment and Disposal

Septage can be treated in a variety of ways, and there is no single best option considering the widely varying conditions of urban areas in MP. The selection of treatment depends upon characteristics of septage to be handled.

4.8.3 Septage characteristics

The quality and quantity of septage coming out of the tank depends largely on the type of treatment adopted, the frequency of desludging, climate, soil conditions, water usage and household chemicals going in the septic tank. The physical and biological characteristics of septage are highly variable. The anaerobic nature of septage results in the presence of odorous compounds such as hydrogen sulfide, mercaptans, and other organic sulfur compounds. Septage contains constituents that may result in unpleasant odours, risk to public health and serious environmental hazards. Since septage is highly concentrated, if it is discharged into a water body it may cause immediate depletion of oxygen, increased nutrients leading to eutrophication and increased pathogens leading to a risk of health hazards. Knowledge of septage characteristics and variability is important in determining acceptable disposal methods.

TABLE: Characteristics of Septage in tropical countries

Parameter	Type "A" high strength	Type "B" low
Example	Public toilet or bucket latrine sludge	Septage
Characterisation	Highly concentrated, mostly fresh FS; stored for days or weeks only	FS of low concentration;
COD mg/l	20 - 50,000	< 15,000
COD/BOD	5: 1 to 10 : 1	5: 1 to 10 : 1
NH4-N mg/l	2 - 5,000	<1,000
TS mg/l	≥ 3.5 %	< 3 %
SS mg/l	≥ 30,000	7,000 (approx.)
Helm. eggs no./l	20 - 60,000	4,000 (approx.)

Source: Strauss ,1996

4.9. Septage Treatment Options

The treatment and disposal methods of septage can be conventional or non-conventional. The conventional methods are the most widely used and they serve the purpose of treatment of sludge and effluent.

Pre-treatment of septage

Pre-treatment/stabilization includes physical, chemical, or biological processes. Stabilization is a pre-treatment method that decreases odours, the levels of pathogens and further decay of septage. Stabilization options include lime stabilization, aerobic digestion, anaerobic digestion, and composting.

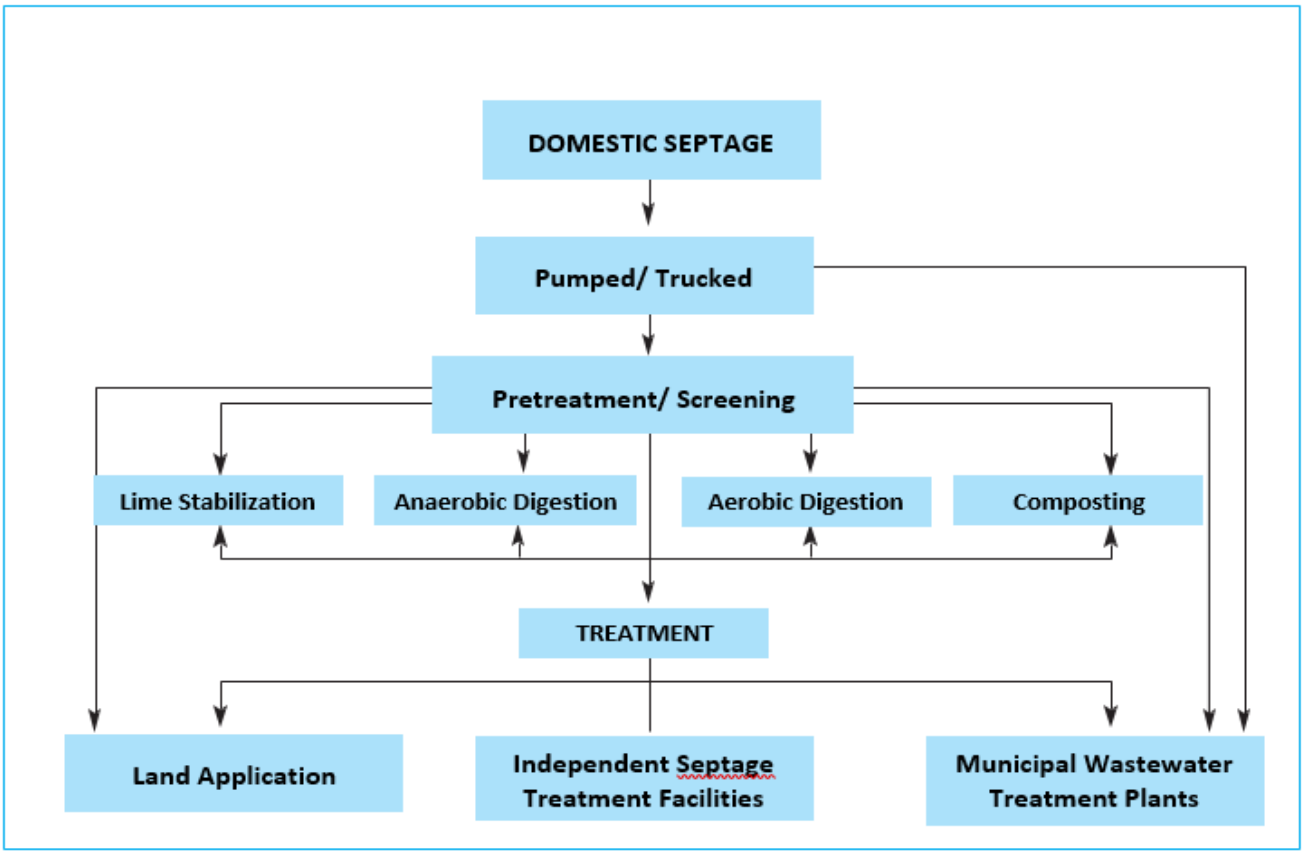
Alkali (Lime) Stabilization

Lime or other alkaline material is added to liquid septage to raise the pH to 12.0 for a minimum of 30 minutes. Although there is a lot of variation in septage characteristics and lime requirements, mixing is not very difficult, and approximately 20 to 25 pounds of lime is used for every 4,000 litres of septage. Lime addition could be done at any of these three points:

a. To the hauler truck before the septage is pumped,
b. To the hauler truck while the septage is being pumped, or
c. To a septage storage tank where septage is discharged from a pumper truck.

Although there is a lot of variation in septage characteristics and lime requirements, mixing is not very difficult, and approximately 10 kg to 12 kg of lime is used for every 1,000 gallons of septage. Lime addition could be done at any of these three points:

a. To the hauler truck before the septage is pumped,
b. To the hauler truck while the septage is being pumped, or
c. To a septage storage tank where septage is discharged from a pumper truck.



Methods of Septage Treatment and Disposal

Aerobic Digestion

In this method, septage is aerated for 15 to 20 days in an open tank to achieve biological reduction in organic solids and odour potential. The time requirements increase with lower temperatures. Normally, this is not a cost- effective option.

Anaerobic Digestion

Septage is retained for 15 to 30 days in an enclosed vessel under anaerobic conditions to achieve biological reduction of organic solids. Anaerobic digestion is generally not suggested except for co-treatment with sludge. However, one advantage is that anaerobic digestion produces methane gas, which can be used as fuel.

Composting

Liquid septage or septage solids are mixed with a bulking agent (e.g., wood chips, sawdust) and aerated mechanically or by turning. Biological activity generates temperatures that are high enough to destroy pathogens. The composting process converts septage into a stable, humus material that can be used as a soil amendment. However, there is a possibility of odours. After the septage is stabilized, it can then be sent for further treatment or disposal.

Land Application

Land application is the most commonly used method to manage the septage after stabilization. There are various application methods to dispose off septage on the land viz. Surface application, sub-surface application and burial (USEPA, 1984).

a. Surface application

It is relatively simple and cost effective, uses low energy, and recycles organic material and nutrients to the land. However, it has high odour potential during application and possibility of pathogen dispersal if not lime stabilized. Surface application includes spreading septage from septage hauler trucks, specially designed land application vehicles, or tank wagons onto sites, or using spray irrigation, ridge and furrow irrigation, and overland flow (USEPA 1984). Septage can also be applied to the land as a fertilizer and soil conditioner. Application rates depend on the slope, soil type, depth of application, drainage class and hydraulic loading. Septage must not be applied before or during rainfall or in the areas where water table is shallow. Thus, an interim storage facility is needed. The various surface application methods are as follows:

- *Spray irrigation*- Pre-treated septage is pumped at 80 to 100 psi through nozzles and sprayed directly onto

the land. Spray irrigation can be used on steep or rough land and minimizes disturbances to the soil by trucks.

- *Ridge and furrow irrigation*- In this disposal method, pre-treated septage is applied directly to furrows or to row crops that will not be directly consumed by humans. This is used for relatively level land, usually for slopes in the range of 0.5 to 1.5%.

- Hauler truck spreading- Septage is applied to the soil directly from a hauler truck that uses a splash plate to improve distribution. The same truck that pumps out the septic tank can be used for transporting and disposing the septage.

- Farm tractor and wagon spreading -Liquid septage or septage solids are transferred to farm equipment for spreading. This allows for application of liquid or solid septage. The septage must be incorporated into the soil within 6 hours, if lime stabilisation has not been done.

b. Subsurface incorporation

In this method, untreated septage is placed just below the soil surface, reducing odour and health risks while fertilizing and conditioning the soil. Subsurface incorporation allows better odor control than surface spreading and reduce the risk of pathogen dispersal. Septage can only be applied to slopes less than 8%, and the soil depth to seasonal high water table must be at least 20 inches (or as mandated by local regulations). A holding facility is required during periods of rainfall or wet ground. To prevent soil compaction and allow sufficient infiltration, equipment must not be driven over the site until 1 to 2 weeks after application. There are two ways for subsurface application:

- Plough and Furrow Cover— Liquid septage is discharged from a tank into a narrow furrow about 15 to 20 cm deep and is then covered by a second plough.

- Subsurface Injection— Liquid septage is injected in a narrow cavity created by a tillage tool with an opening of about 10 to 15 cm below the surface.

c. Burial

Major form of septage burial includes disposal in holding lagoons, trenches, and sanitary landfills. High odour potential during septage application is inherent until a final cover is placed on the top. Appropriate site selection is important not only to control odour, but also to minimize potential groundwater pollution.

- Holding lagoons- These lagoons are a maximum of 6 feet deep and do not allow any soil infiltration. The septage is placed in small incremental lifts of 15 to 30 cm and with multiple lagoons loaded in sequential order for optimum drying. To decrease odours, the lagoon inlet pipe can be placed below liquid level.

- Trenches- Septage is filled sequentially in multiple chambers in small lifts of 15 to 20 cm for optimum drying.

Each trench is then covered with soil (2 feet) as a final covering and new trenches are opened. An alternate option is to leave a filled trench uncovered to permit maximum solids to settle and liquids to evaporate and leach out. The solids, as well as some bottom and side wall material, are then removed and the trench can be reused.

- Sanitary landfills- Production of leachate, treatment, and odour are the primary problems to be considered when septage is added to sanitary landfills. As such, septage must not be added in landfills in areas that have over 90 cm of rainfall, landfills that do not have leachate prevention and control facilities, or those not having isolated underlying rock. A 15 cm of soil cover needs to be applied each day in the landfills where septage is added and 2 feet of final cover within 1 week after the placement of the final lift. In general, sanitary landfills are not cost-effective disposal options for septage.

4.10. Treatment at sewage treatment plants

Co-treatment of septage along with domestic sewage at a sewage treatment plant (STP) is a feasible and acceptable alternative for septage treatment. Though septage is much concentrated in its strength than the domestic sewage, its constituents are similar to municipal wastewater. Sewage treatment plant should have an adequate capacity in order to accept the septage without hampering the normal functioning of other processes.

- *Septage addition to nearest sewer manhole*- Septage could be added to a sewer upstream of the sewage treatment plant, and substantial dilution of septage occurs prior to it reaching the sewage treatment plant, depending on the volume of sewage flowing in the sewer.

- *Septage addition to STP*- Septage could be added to sewage immediately upstream of the screening and grit removal processes. It is economical because of the very simple receiving station design and also allows the wastewater treatment plant staff to have control of the septage discharge

4.11. Constructed Wetlands (CW)

A septic tank provides only primary treatment and should always be followed by a soakage pit. In the areas where water table is shallow, the effluent from the septic tank/improved septic tank could be connected to constructed wetlands to prevent ground water contamination. Constructed Wetlands (CW) are a biological wastewater treatment technology designed to mimic processes found in natural wetland ecosystems. These systems use wetland plants, soils and their associated micro-organisms to remove contaminants from wastewater. They act as a filter removing sediments and pollutants such as nutrients and other heavy metals from waste water and septage. The bed is filled with porous media and vegetation is planted in the media. These systems require land but offer very effective biological treatment response in a passive manner so that mechanical equipment, energy and skilled operator attention are minimized. Vegetation in a wetland provides a substrate (roots, stems, and leaves) upon which micro-organisms can grow as they break down organic materials. Constructed wetlands are of two basic types: horizontal flow constructed wetlands and vertical flow constructed wetlands.

Horizontal flow constructed wetlands

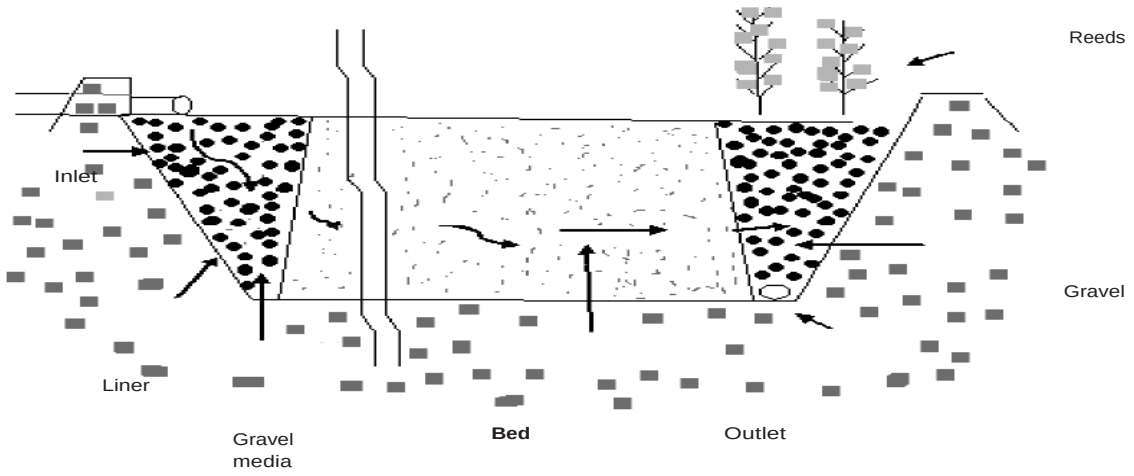


FIGURE: **Reed bed systems with horizontal filter**

Horizontal flow constructed wetland is suited for secondary treatment of wastewater or liquid component of the septage coming out of improved septic tank/anaerobic baffled reactor. The flow pattern is horizontal in the filter bed. A horizontal planted gravel filter acts through the combined effect of the filter material and plants growing on the filter media (see Figure below). The effluent is odour free. As wastewater flows from one end to the other end through the planted gravel filter, it is resupplied with oxygen. A depth of 30-60cm is maintained in the bed with a slope of 1%. The advantage of this system is that it can achieve high treatment efficiency at low-cost and since the flow is sub-surface, there is no odour problem.

Vertical flow constructed wetlands

Vertical-flow operation is normally used to treat sludge or septage having high solid contents. To operate in a vertical-flow mode, the septage is uniformly distributed on the surface of the CW units. Vertical flow constructed wetland are usually preceded by some form of primary treatment, although some are built to receive raw sewage/septage. Each bed resembles a trickling filter, except that it has a layer of sand on top where aquatic plants are grown, usually the common reed (*Cana indica*). The septage is introduced to the surface of the bed and it percolates down through the sand and gravel media to the base. Intermittent dosing of the bed by a pump or flushing device improves distribution and improves the aeration given below.

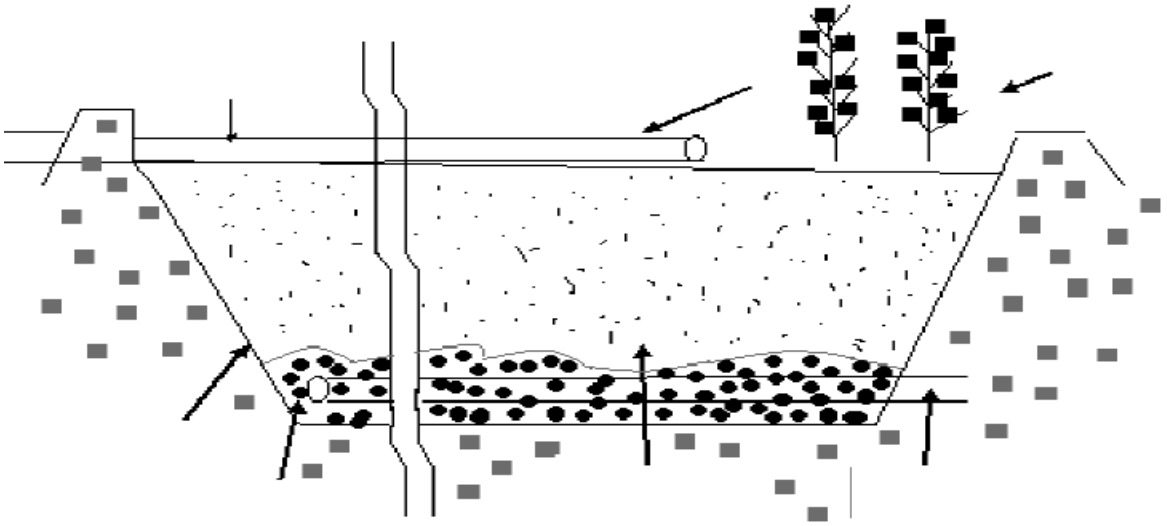


FIGURE: Reed bed systems with vertical filter

4.12. Sludge Disposal/Reuse:

The sludge which is generated after the treatment of septage should be disposed appropriately. Even after the sludge is stabilised in the lagoons, additional stabilization or treatment measures may be required to generate final product of acceptable quality.

4.12.1 Septage Management System

The septage management system includes designing, operation and maintenance, desludging, institutional mechanism, monitoring, financial arrangements, legal provisions and administrative procedures.

In MP, out of 379 towns, in most of the towns due to absence of organised sewerage scheme, sewerage system is managed on ad-hoc basis in which mostly on-site sanitation facilities like septic tanks are constructed without understanding the efficient mechanism to get waste water treated onsite that to techno-economically. Since the concept of simple mechanism of primary treatment of waste water inside the campus of households or nearby in the form of septic tank is very common practice, perhaps the simplest and longest surviving example of an anaerobic process is septic tank, normally provide 24 hours' detention time and are often built as horizontal flow units with 1 or 2 baffle arrangements between the inlet and outlet. Simultaneously very simplicity in construction and use lead to imperfections in operation, first in the form of short- circuiting and secondly in the form of disturbance to anaerobic activity by some dissolved oxygen always coming in with the inflow. Septic tank effluent has to be soaked, as surface discharge is not allowed. This is done by providing either soak pit or soak trenches. But in MP effluent of septic tank is usually discharged conveniently in nearby roadside storm water drain

Here in the policy MP Govt. emphasis to have construction of septic tanks with technological concept.

4.12.2 Desludging Procedure

There is a widespread promotion of OSS. However, all the programmes and city agencies still do not address adequately the issue of septage that accumulates inside septic tank/ OSS. Due to lack or inadequate public services, private service providers have emerged to empty OSS by hand or with vacuum trucks. Operators with mechanized equipment often transport and dispose of septage several kilometres from people's homes in drains, waterways, open land, and agricultural fields. Manual desludging is also done in low-income areas and squatter settlements. They are often inaccessible by truck and hence deposit the septage within the household, into nearby lanes, drains, open land or waterways. Thus, the poorest have the highest health risk both because they are the most likely to provide manual desludging services, and because their homes are closest to the actual dumping grounds.

In carrying out manual desludging all the precautions should be taken to protect the workers as provided under Municipal Solid Waste Rules. The sludge after removal should be transported in a controlled manner to avoid leakages or spillage en-route.

Before desludging, if the liquid level in the tank is higher than the outlet pipe, this may indicate clogging in the outlet pipe or in the drain field. The sludge then may be collected through safe containers or pumping. Before pumping, the scum mat is manually broken up to facilitate pumping. Before this is done, the liquid level in the septic tank first is lowered below the invert of the outlet, which prevents grease and scum from being washed into the drain field. After the scum mat is broken up, the contents of the tank are removed. Normally, the vacuum/suction hose draws air at a point where 1 to 2 in. (2.5 to 5 cm) of sludge remains over the tank bottom; this material should be left in the tank. Washing down the inside of the tank is not required unless leakage is suspected and the inside must be inspected for cracks, if internal inspection is warranted, fresh air should be continuously blown into the tank for at least 10 minutes.

4.12.3 Septage Transportation

The sludge after collection should be transported through trucks to the treatment or disposal sites, with proper regulation. In MP there is a comprehensive regulation on transport of solid wastes (municipal solid wastes, biomedical wastes and hazardous wastes), however similar regulation is not existing for transport of septage. The septage transport should be regulated in the same manner as provided under Municipal Wastes (Handling and Management) Rules 2000.

4.12.4 Septage Treatment Facilities

There are number of treatment options available. Treatment using natural processes, including waste stabilization ponds, unplanted sludge drying beds, constructed wetlands, and composting, are considerably cost-effective solutions. Anaerobic digestion (with biogas generation), lime treatment, and mechanized systems, such as activated sludge process, are also widely used technologies in treating septage. Important considerations include the cost of land, the capacity of staff to operate and maintain the system, and the location of the treatment facility with respect to OSS. Digested sludge from OSS is 100 times more concentrated than domestic wastewater flowing in the sewer systems, and therefore should not be treated with wastewater in sewage treatment plants. If the dried sludge meets established standards, it can be used as a soil amendment for reclaimed land, landfill cover, landscaping compost, or fertilizer for non-edible plantations. For use as compost for edible crops, treatment facilities need to ensure that the end product attains standards for agricultural reuse.

4.12.5 Decentralizing Physical Infrastructure

In all the large cities there is difficulty of collecting septage and hauling it across cities to designated disposal and treatment sites. It is important to consider decentralized treatment and reuse of wastewater and nutrients may be the best option. This may significantly reduce collection and haulage costs. Capital, operating and maintenance costs decrease with increasing plant size. However, since larger treatment plants require longer haulage distances between pits and disposal sites, costs escalate for collection companies, which in turn increase the risk of indiscriminate and illegal dumping. The optimum plant size has to be determined on a case-by-case basis as it depends on the local context (e.g., labor cost, land price, treatment plant scale, haulage distance, and site conditions).

4.12.6 Costs and Cost Recovery

Neither local authorities nor water supply authorities in MP have adequate capital or leverage to finance expensive sewer networks or sewage/septage collection and treatment facilities. Thus, major sanitation improvements are dependent on a mix of government funding, external assistance and increased user charges. Project design should incorporate institutional building and financial viability. Obtaining funds and enacting necessary reforms (e.g., linking revenues with expenditures) requires careful negotiation and cooperation between local stakeholders, especially when elected officials are sensitive to popular concerns regarding tariffs. Multi-sourcing of funds can be used to effectively reduce the funding requirements of ULBs by encouraging project investment and O&M costs.

Operation and maintenance (O&M) expenses for septage management programs typically include the following:

a) labor
b) overhead (e.g., benefits, employment taxes)
c) utilities
d) transportation for processed and incoming materials
e) vehicles and other equipment maintenance
f) taxes
g) disposal costs for dried cake
h) licenses and permits; insurance
i) testing and other monitoring and
j) miscellaneous supplies

Revenue Generation Plan

1. Political approval and effective administration of such taxes and charges have proven to be too difficult. Many cities in the country are increasingly realizing the importance of septage management and trying to introduce the taxes to recover at least the part of the cost with water bill. Charges can be linked to water consumption; disconnection of water supply provides an effective sanction against non-payment.
2. The disadvantages are that the water service provider is not always willing (or able) to collect sanitation charges, and, while there are strong synergies in financial management, sanitation services require different skills and resources to those needed for water supply.
3. Government funding is also essential, notably for the provision of sanitation services to the urban poor who remain excluded from public sanitation services and unable to develop private alternatives.
4. Some cities charge a flat rate (or zero) tariffs, collect revenues lower than their O&M costs and, are dependent on subsidies.
5. The other part of the arrangement is between the Sewage Treatment Facilities and ULBs (or the contractor collecting the septage). The tipping fee is perhaps the only variable of the facility's financial system. Calculating the desired tipping fee requires "working backwards." The cost to process the septage is determined by the facility's monthly operating expenses.
6. The tipping fee (per unit basis) is determined by dividing the total tipping revenue by cubic meters of incoming septage. Therefore, to determine the tipping fee, the tipping revenue must first be calculated using the following equation: Tipping Revenues = Operating Expenses + Profit Margin – Material Revenues.
7. In most cities, desludging is done only when requested by households and usually when the septic tank overflows. Costs are paid by the household directly to a private desludging company. To implement a city- wide septage management program, there is a need for the ULB and/or water supply authority to develop a system to ensure that all septic tanks are desludged regularly and that the septage removed is treated. Each ULB should develop a system that works for them. ULB/water supply authority could collect fees from the households and pay the contractor for each truck-full of septage brought to the treatment facility. This would give the contractor an incentive not to simply dump the septage, as is currently being done. This can be a source of revenue generation.

8. In case sewage, septage, or sludge is collected, transported, treated & disposed by a third party, the final disposal of the treated sewage, septage or sludge shall comply with relevant MINAS Standards notified under Environment (Protection) Act, 1986.
9. Reuse of treated sludge for agriculture application should comply with the standards notified for compost under EPA. A more detailed guideline in this regard is proposed in the next chapter.

4.13. Public Participation

Public awareness and interest on the issues related to the conservation of natural resources have steadily increased and their participation needs to be promoted in the septage management programmes. The effective management of septage is of concern to a broad segment of the population as it affects the day-to-day life of individuals and communities. Communities should become involved in decisions concerning the development and siting of septage disposal point and desludging procedures, handling, transport and treatment methods and possible adverse effects including health effects of septage mis-management. Hence a strong public awareness programme is very important to implement the septgae management policy. The ultimate aim of the public awareness programme is to shape human behavior of all concerns including septic tank users, desludging staff. An education system is to be established in order to achieve effective awareness generation programme and to promote responsible citizenship behaviour. Following four areas need to be focused:

a. *Sensitivity:* to help citizens and social groups gain a variety of experiences in, and acquire a basic understanding of septage and associated problems.
b. *Attitude:* to help citizens and social groups acquire a set of values and feelings of concern for septage and motivation for actively participating in septage management.
c. *Skill:* to help citizens and social groups acquire skills for identifying and solving septage related problems.
d. *Motivation:* There should be a system to motivate the citizens through various incentives e.g. image boosting for better work and rebate in charges on septage collection and disposal.

4.14. Awareness generation

The ULBs may consider creating a Mass Awareness Cell. This cell will be responsible for creating awareness programmes on septage management. The cell should constitute committees at various levels and involve various stakeholders including representatives of citizens, RWAs, ULBs authorities, NGOs, transporters and others. In organizational aspect, the cell should-

- Assess current practices
- Identify the role of key community members
- Identify the resources available from the authorities and resources to be contributed from the citizens, businessmen, industrial units, dairies etc.
- Highlight personal responsibilities and obligations in keeping septic tanks clean as per schedule
- Inform people about the duties and responsibilities of both individuals and community in cooperating with municipality in septage management
- Inform people about advantages of desludging septic tanks regularly
- Inform people about need of septage treatment before disposal in terms of health and environmental impacts

- Inform people about the need to pay for septage collection and its disposal
- Development of monitoring mechanism for effective implementation of awareness programme

4.15. Mechanism of communication

All the above information will help define a proper strategy for communicating with different stakeholders. To reach out to the community media, group campaigns, video forums, pamphlets, home visits and other outreach formats can be prepared. The various means of public contacts-

- Print media, hoardings, posters, leaflets, publicity materials, radio, TV
- Open forum, signature campaign
- Direct communication, through RWAs, seminars, meetings
- Door-to-door awareness and motivation programme
- School programme
- Involvement of National Cadet Corps, National Social Service, scouts
- Involvement of religious leaders
- Involvement of mahila mandal and women associations

5 Reuse of Recycled Waste Water/ Effluent

Recycling of wastewater is essentially, reusing treated waste water for beneficial purposes such as agricultural and landscape irrigation, industrial processes, toilet flushing, and replenishing a ground water basin (referred to as ground water recharge). Recycling and reusing are both aimed at conservation and waste reduction, but they are not the same thing. Recycling is a process, while reusing is a practice.

Recycled wastewater may be adhered to be used for sewerage schemes based on design years-

- about 15% of the sewage generation for base design year,
- 40% for intermediate design year (after 15 years) and
- 60% for ultimate design year (after 30 years).

Benefits of Reuse of wastewater

- Helps save water, since it reduce the demand for freshwater for various uses, thus it helps to supplement potable water for non-potable uses
- Helps reduce pollution in the water bodies, since water is being recycled and treated
- Recharges ground water and replenishes surface water bodies
- Provision to develop and use a reliable in-house water source availability
- Reduction in fresh water cost and reduction in disposal cess-pools
- An approach towards zero liquid discharge
- A low-cost method for sanitary disposal of municipal wastewater
- Reduces pollution of rivers and other surface water bodies
- Conserves nutrients, thereby reducing the need for artificial fertilizer
- Provides a reliable water supply to farmers
- Protection of environment and effectively combat the water scarcity

5.1. Quality Concerns

Despite a long history of sewage/septage reuse in India, the quality issues linked with safety of sewage/septage reuse still remains an enigma. Public health concern is the most important issue in any type of reuse of sewage/septage, be it for irrigation or non-irrigation use. There is always a difficulty in delineating acceptable health risks and wastewater reuse is a serious debate all over the world. The fundamental precondition for water reuse is that its application should not cause unacceptable public health risks. Untreated wastewater poses a serious risk of water-borne diseases, such as cholera, typhoid, dysentery, plague and helminthiasis. Use of untreated wastewater for irrigation should be discontinued and replaced with irrigation using treated wastewater that meets public health guidelines in order to minimize the exposure of farm workers and consumers. For agricultural applications, the WHO has published guidelines for wastewater for restricted and unrestricted irrigation (WHO 2006). Governments have also developed more stringent criteria for agricultural applications. For non-agricultural applications, no global water quality standards exist, and various governments have issued their own standards. Some of the key pathogens that are found in raw wastewater are summarized in Table given below.

TABLE Some important pathogens associated with municipal wastewater

Pathogens	Examples
Waterborne bacteria	Salmonella sp, Vibrio cholerae, Legionellaceae
Protozoa	Giardia lamblia, Cryptosporidium sp
Helminths	Ascaris, Toxocara, Taenia (tapeworm), Ancylostoma (hookworm)
Viruses	Hepatitis A virus, Rotaviruses, Enteroviruses

Source: UNEP, 2004

5.1.1. Pathogen Survival

Public health concerns centre around pathogenic organisms that are or could be present in sewage/septage in great variety. Survival of pathogens in sewage/septage and in environmental conditions other than their host organisms (mainly humans) is highly variable. Table below presents the survival periods of various types of pathogenic organisms under various conditions.

Although sewage/septage reuse is risky due to associated health hazards, it is also important to understand the factors which reduce the risk. The factors include the level of sewage/septage treatment previously applied leading to settling, adsorption, desiccation of pathogens, as well as soil moisture, temperature, UV irradiation due to sunlight, pH, antibiotics, toxic substances, biological competition, available nutrient and organic matter, leading to pathogen die-off and/or removal from the sewage/septage source until final ingestion by humans to result in infection. The method and time of application of sewage/septage and the soil type will also have an influence. Another aspect of indirect pathogen contamination due to sewage/septage reuse has been the contamination of soil and subsequent entry of pathogen into groundwater. The principal methods of pathogen transport in soils include movement downwards with infiltration water, movement with surface runoff and transport on sediments and waste particles. One of

the important processes that control the contamination of groundwater is the adsorption or retention of organisms on soil particles. Another process assisting in the removal of bacteria and viruses from water percolating through the soil is filtration.

TABLE: Survival of pathogens in different environment

Type of pathogen	Survival time in days		
	In faeces and sludge	In sewage/septage and freshwater	In soil
Enteroviruses	<100 (<20)	<120 (<50)	<100 (<30)
Fecal coliforms <70 (<20)	<90 (<50)	<60 (<30)	<70 (<20)
Salmonella spp.	<60 (<30)	<60 (<30)	<70 (<20)
Shigella spp.	<30 (<10)	<30 (<10)	-
Vibrio cholerae	<30 (<5)	<30 (<10)	<20 (<10
Entamoebahystolytica cysts	<30 (<15)	<30 (<15)	<20 (<10)
Ascaris-lumbricoides eggs	many months	many months	many months

Note: Figures in bracket shows the normal survival time.

Source: Feachem et al 1983

5.1.2. Other Risk Factors

Other water quality parameters of concern in sewage/septage reuse are:

a. Toxic metal accumulation in soil
b. Salinity due to salt present in sewage/septage

The availability of heavy metals to plants, their uptake and their accumulation depend on a number of soil, plant and other factors. The soil factors include, soil pH, organic matter content, cation exchange capacity, moisture, temperature and evaporation. Major plant factors are the species and variety, plant parts used for consumption, plant age and seasonal effects. Dissolved salts causing salinity in sewage/septage exert an osmotic effect on plant growth. An increase in osmotic pressure of the soil solution increases the amount of energy which the plant must expand to take up water from the soil. As a result, respiration is increased and the growth and yield of plants decline. However, it has been found that not all plant species are susceptible. A wide variety of crops normally are tolerant to salinity. Salinity also affects the soil properties such as dispersion of particles, stability of aggregates, soil structure and permeability.

5.2. Sewage/Septage Quality Standards in Practice

Although, no specific standards exists for sewage/septage reuse, however General Effluent Standards notified under Environment (Protection) Act, 1986 (Schedule - VI, Part A, GSR 801(E) dt. 3 1.12.93) by Government of India for disposal on land for irrigation are applicable. These standards specify limits on suspended solids, pH, oil and grease, biochemical oxygen demand, arsenic; cyanide, radioactive substances and toxicity. Considering the wide-ranging potential for sewage/septage reuse, it may be difficult to set some common quality standards for all types of reuses.

TABLE: WHO guidelines for using treated wastewater in agriculture

Type of irrigation	Health-based target for helminth eggs	Required pathogen reduction by treatment (log units)	Verification monitoring level (E. coli	Notes
Unrestricted	≤1 per litre (arithmetic mean)b,c High-growing crops: d,e No recommendation Low-growing crops:d ≤1 per litre (arithmetic mean) E	4 3 2 4 6 or 7 ≤103	≤103 ≤104 ≤105 ≤103 ≤101 or ≤100	Root crops. Leaf crops. Drip irrigation of high- growing crops Drip irrigation of low-growing crops. Verification level depends on the requirements of the local regulatory agency.
Restricted:	F G H	3 2 0.5	≤104 ≤105 ≤106	Labour-intensive agriculture (protective of adults and children under 15) Highly mechanized agriculture. Pathogen removal in a septic

Source: WHO, 2006

5.3. Categories of Sewage/Septage Reuse

TABLE: **Categories of wastewater reuse**

Wastewater reuse categories	Issues/constraints
Agriculture irrigation Crop Irrigation Commercial Nurseries Landscape irrigation Parks School yards Free way medians Golf courses Cemeteries Greenbelts Residential	1. Surface and groundwater pollution if not managed properly 2. Marketability of crops and public acceptance 3. Effect of water quality, particularly salts, on soils and crops 4. Public health concerns related to pathogens (bacteria, viruses and parasites) 5. Use for control of area including buffer zone 6. May result in high user costs
Industrial recycling and reuse Cooling water Boiler feed Process water Heavy construction	1. Constituents in reclaimed wastewater related to scaling, corrosion, biological growth and fouling, 2. Public health concerns, particularly aerosol transmission of pathogens in cooling water
Groundwater recharge Groundwater replenishment Salt water intrusion control Subsidence control	1. Organic chemicals in reclaimed wastewater and their toxicological effects 2. Total Dissolved Solids, nitrates and pathogens in reclaimed wastewater
Recreational/environmental uses Habitat wetlands Lakes and ponds Boating Marsh enhancement Stream-flow augmentation Fisheries	1. Health concerns of bacteria and viruses, 2. Eutrophication due to nitrogen (N) and phosphorus (P) in receiving water, 3. Toxicity to aquatic life
Miscellaneous uses Fire protection Air conditioning Toilet flushing	1. Public health concerns on pathogens transmitted by aerosols, 2. Effects of water quality on scaling, corrosion, biological growth and fouling 3. Cross-connection
Aquaculture	1. Constituents in reclaimed wastewater, especially trace reservoir organic chemicals and their toxicological effects 2. Aesthetics and public acceptance 3. Health concerns about pathogen transmission, particularly viruses

Source: Tchobanoglous and Angelakis, 1996

5.3.1. Irrigation

Irrigation is the largest user of water in India. It is also estimated that nearly half of the domestic sewage/septage generated in India is used for irrigation. Irrigation reuse is also more advantageous, because of the possibility of decreasing the level of purification, and hence the savings in treatment costs, due to the role of soil and crops as biological treatment facilities. The choice is conventionally technical and economic one, though it is important that the community

as a whole should become more involved in the working of reuse systems. The major issues of this reuse are:

- surface and groundwater pollution, if poorly planned and managed;
- marketability of crops and public acceptance;
- effect of water quality on soil, and crops;
- public health concerns related to pathogens

Irrigation of Landscape and Recreational Area

In MP, sewage/septage is generally an urban problem and in urban areas the agricultural land is hardly available. Hence the scope for irrigation use is reduced. In such case, application of treated sewage/septage for landscape irrigation includes use in public parks, golf courses, urban green belts, freeway medians, cemeteries, and residential lawns. This type of application is one of the most common applications of sewage/septage reuse worldwide.

5.3.2. Domestic and Industrial Use

Reuse of wastewater for purposes other than irrigation may be either for:

- industrial reuse;
- non-potable purposes;
- indirect potable purposes; or
- direct potable purpose

a. Industrial Reuse

Industrial reuse of reclaimed wastewater represents major reuse next only to irrigation in both developed and developing countries. Reclaimed wastewater is ideal for many industrial purposes, which do not require water of high quality. Often industries are located near populated area where centralized treatment facilities already generate reclaimed water. Depending on the type of industry, reclaimed water can be utilized for cooling water make-up, boiler feed water, process water etc. Cooling water make-up in a majority of industrial operations represents the single largest water usage. According to former additional director of CPCB, in MP many industries located in water scarce areas have already adopted use of treated wastewater as a source of water.

TABLE: **Industrial water reuse: concerns, causes, and treatment options**

Concerns	Causes	Treatment options
Scaling	Inorganic compounds, salts	Scaling inhibitor, carbon adsorption, filtration, ion exchange, blowdown
Corrosion	Dissolved and suspended solids pH imbalance	Corrosion inhibitor, reverse osmosis
Biological growth	Residual organics, ammonia, phosphorous	Biocides, dispersants, filtration
Fouling	Microbial growth, phosphates, dissolved and suspended solids	Control of scaling, corrosion, microbial growth, filtration chemical and

Source: Asano and Levine, 1998

b. Non-potable Domestic Reuse

Adequately treated wastewater meeting strict quality criteria, can be planned for reuse for many non-potable purposes. Non-potable reuse leads to both: a reduction in water consumption and a reduction in wastewater flow rate. Therefore, non-potable reuse schemes can avoid adverse environmental consequences associated with conventional water sources and wastewater disposal systems. Non-potable domestic reuse can be planned either within single households/building, or on a larger-scale use through a reticulation system meant only for use for non-potable purpose.

Systems for individual households/buildings/facilities

In many parts of the world, it has become apparent that it may not be possible to provide a centralized sewage collection facility for all the households, due to both geographic and economic reasons. Wastewater from individual dwellings and community facilities in such locations without sewerage connectivity is usually managed by on-site treatment and disposal systems. Although a variety of onsite systems have been used, the most common system consists of a septic tank for the partial treatment of wastewater, and a subsurface disposal field for final treatment and disposal. By segregating the "grey" sullage from "black" toilet wastes, potential for reuse with minimal treatment within the household enhances manifold. There are several different schemes for reusing grey water at the household levels. In California, systems which use grey water treated to a primary level for subsurface irrigation of gardens have been in use for many years, and studies have shown no health problems associated with the use. When the grey water is not separated from toilet wastes, improvements in the quality of treated wastewater can be brought about by many alternative ways. One of the alternatives includes intermittent and recirculation granular-medium filters. The effluent from a recirculation filter has been found to be of such high quality, it can be used in a variety of applications, including drip irrigation.

Large-scale non-potable reuse through a dual reticulation system specially in corporation towns

A dual reticulation system is the wastewater reuse concept for urban areas where a centralized sewage collection system is in place, on a large scale. This system supplies treated wastewater to houses, and commercial/official/shopping complexes through a separate water supply network, to be used primarily for toilet flushing, and irrigation of lawns. Thus, households will have two water supply lines, one for potable and human-contact use purposes, and the second for non-potable, non-contact uses such as toilet flushing, use in the yards and gardens etc., hence the name "dual reticulation system." Such systems are in practice in Tokyo, Japan.

c. Indirect Potable Reuse

Deliberate (artificial) recharge of groundwater aquifers with treated wastewater can be carried out to achieve one or more of the following objectives:

- as storage during periods of low water demand;
- as an additional treatment method;
- as a measure to recharge depleting groundwater

- as a measure to improve the overall quality of groundwater by injecting reclaimed water of specific qualities.

5.3.3. Septage Sludge Reuse

Wastewater sludge is the solid/semi-solid substance, concentrated form of mainly organic, and some inorganic pollutants, generated because of treatment of wastewater. With the expansion of sewerage, system comes the ever-increasing problem of how best the sludge generated in wastewater treatment facilities can be disposed.

It is traditionally suggested that the sludge can be applied on land as soil conditioner and as fertilizer; however, there are concerns involved in its handling, transportation, and odour nuisance because open disposal of sludge poses threat to health and environment. Thus, the need of proper treatment of sludge is a prerequisite for its reuse. Properly treated sludge can be reused to reclaim parched land by application as soil conditioner, and as a fertilizer in agriculture. Deteriorated land areas, which cannot support the plant vegetation due to lack of nutrients, soil organic matter, low pH and low water holding capacity, can be reclaimed and improved by the application of sludge. Sewage sludge has a pH buffering capacity resulting from an alkalinity that is beneficial in the reclamation of acidic sites, like acid mine spoils, and acidic coal refuse materials.

For Recycling and Reuse of grey water in buildings modal Bylaws are already published in 2010 vide no. 294 M.P. Gazette Notification dated 26 may,2010 may also be considered in implementation of works. For reference copy of this document is given in **Annexure 2**

6 Legislation and Strategic document:

The Government Sewerage and Waste Water Policy should be read in accordance with the most current versions of the following, legislations and documents:

i. Latest CPHEEO Manual on Sewerage and Sewage Treatment Systems, 2013.
ii. Environmental (Protection) Act, 1986.
iii. The Environment (Protection) rules, 1986.
iv. The water (Prevention and control of pollution) Act, 1974.
v. The water (Prevention and control of pollution) cess Act, 1974.
vi. The water (Prevention and control of pollution) Amended rules, 2011.
vii. The water (Prevention and control of pollution) Cess rules, 1978.
viii. The water (Prevention and control of pollution) Rules, 1975.
ix. National Urban Sanitation Policy 2008.
x. National Water Policy 2012.
xi. Various Standards set by Bureau of Indian Standards (BIS).
xii. Effluent Quality guidelines for health protection measures in aquaculture use of waste water.
xiii. Quality guidelines for health protection in using human wastes for aquaculture.
xiv. Service Level Benchmarks Fixed By Ministry of Urban Development.
xv. M.P. Municipal Corporations Act, 1956 under which MP's all Municipal Corporations are governed.
xvi. M.P. Municipalities Act, 1961 under which all Municipal Councils and Nagar Parishad are governed.

xvii.Prevention & Control of Water (Prevention & Control of Pollution) Act-1974.

xviii.Policy Paper on Septage Management of Center for Science & Environment ,New Delhi

7 Govt. of M.P. State Level Policy (2017) for Waste Water Recycle & Feacal Sludge Management (FSM)" - Principles & Responsibility:

7.1. Resource Development

Wastewater is a perennial water source and shall form an integral part of renewable water resources and the State water budget. Each local body will consider it as a resource and make the plan for reuse as per the site conditions with the help of experts.

Collection and treatment of wastewater is a necessity to circumvent hazards to the public health and the environment. It becomes imperative when contamination of freshwater resources with wastewater is imminent. All local bodies will make city sanitation plan (CSP) for a period of 30 years considering future development and city development in line with city Master Plan to avoid any conflicts in developing the city in the future. The cities which do not have CSP may prepare a short term plan of 5 years from the base year for immediate implementation as per guidelines provided in Manual onSewage Treatment System, published in 2013 by the Ministry of Urban Development, Government of India to address the issues of utmost importance and then ULBs may prepare CSP for 30 years. The CSP should also be in line with the guidelines of Swachh Bharat Mission. Collection and treatment of wastewater is mandatory to protect public health against water borne diseases, and where epidemics may become a threat otherwise.

Existing levels of wastewater services shall be maintained and upgraded where necessary to enhance public health and the environment and separate plan is to be prepared by local body as per their requirement.

Treatment of wastewater shall be targeted towards producing an effluent fit for reuse in irrigation in accordance with WHO guidelines as a minimum requirement. Reuse of treated wastewater for other purposes shall be subject to appropriate specifications.

Coordination shall be maintained with the official bodies in charge of urban development to account for the treatment and disposal of their liquid wastes. Central treatment plants shall be built to serve semi-urban areas, and collection of wastewater can be made initially through trucking until collection systems are justified.

Specifications and minimum standards as stipulated by CPHEEO shall be applicable for the use of septic tanks in urban areas. Particular attention shall be paid to the protection of underlying aquifers.

7.2. Resource Management

It is highly imperative that Urban Local Body shall develop and manage wastewater systems as well as the treatment and reuse of the effluent.

A basic management approach shall be adopted where possible. The use of treated wastewater in irrigation and industrial application shall be given the highest priority and shall be pursued with care.

Effluent quality standards shall be defined based on the best attainable treatment technologies, and calibrated to support or improve ambient receiving conditions, and to meet public health standards for end users. Key factors will include the location of the discharge, its proximity to wells, the type of receiving water, and the nature and extent of end users. Wastewater intended for irrigated agriculture will be regulated based on the soil characteristics of the irrigated land, the type of crops grown, the irrigation schedule and methods, and whether other waters are mixed with the treated wastewater.

Industries shall be encouraged to recycle part of its wastewater and to treat the remainder to meet standards set for ultimate wastewater reuse or to meet the regulations set for its disposal through the collection systems and/or into the receiving environment.

Wastewater from industries with significant pollution should be treated separately to standards allowing its reuse for purposes other than irrigation or to allow its safe disposal.

7.3. Waste Water Collection & Treatment

Priority of Sanctioning Sewerage Projects:

Priority for the work of laying sewerage network & connectivity (mandatory) and construction of STPs would be taken in a phased manner to provide full 100% coverage of town. The priority for sanction of sewerage project will be:

i. Rivers, Major water bodies nearby town.
ii. Towns of religious and heritage importance
iii. Towns of major tourist importance
iv. Towns of revenue divisional HQ's
v. Towns of District HQ's
vi. Towns having population more than 50000
vii. Towns having population between 20000 to 50000
viii. Towns having population less than 20000
ix. Cities with water supply service level equal to or more than 135 lpcd. Full coverage is to be provided in these cities.
x. District Head Quarter not covered by Sewerage System.
xi. Heritage/Tourism/Water body town not connected by Sewerage System.
xii. Other cities not connected with Sewerage System having population more than 50,000.
xiii. Not fully connected on the basis of coverage.

7.4. Recycling, Reuse & of Treated Effluent and safe disposal of sludge

i. Treated wastewater effluent is considered a water resource and is added to the water stock for reuse.
ii. Priority shall be given to agricultural reuse of treated effluent for unrestricted irrigation. Blending of treated wastewater with fresh water shall be made to improve quality where possible. Crops to be irrigated by the treated effluent or blend thereof with freshwater resources shall be selected to suit the irrigation water, soil type and chemistry, and the economics of the reuse operations.
iii. Crop nutrient requirements shall be determined taking into consideration the prevailing effluent quality. Overuse of nutrients shall be avoided.
iv. Accumulation of heavy metals and salinity shall be monitored, managed and mitigated. Leaching of soils shall be advocated by the irrigation authorities.
v. Farmers shall be encouraged to determine the rate of water application needed for different crops, taking into consideration the value of nutrients in the treated water and other parameters.
vi. Farmers shall be encouraged to use modern and efficient irrigation technologies. Protection of on-farm workers and of crops against pollution with wastewater shall be ensured.

vii. Treated effluent quality should be monitored and users alerted to any emergency causing deterioration of the quality so that they will not use such water unless corrective measures are taken.

viii. Studies should be conducted and projects designed and implemented to store the excess treated wastewater in surface reservoirs but artificial recharge is not permitted . Due attention shall be given to the quality of treated and groundwater and the characteristics of the strata.

ix. Plans and studies for power generation from sludge, if proven technically, economically and financially feasible, shall be made with due attention to environment impacts.

x. Sludge produced from the treatment process would be processed so it may be used as fertilizer and soil conditioner. Care shall be taken to conform to the regulations of public health and environment protection norms.

xi. Industry: Industrial reuse of reclaimed wastewater represents major reuse next only to irrigation in both developed and developing countries. Reclaimed wastewater is ideal for many industrial purposes,. Where effluent is to be used in the industrial processes, it should be the responsibility of the industry to treat it to the quality standards required. Pilot scale feasibility studies carried out in Australia have concluded that it is possible to economically treat the domestic wastewater to achieve adequate quality for reuse as cooling water. Based on the conclusions of the feasibility study, a full-scale treatment plant employing cross-flow membrane microfiltration system may be installed. The membrane filtration system can remove all suspended solids, fecal coliforms, and giardia cysts. It could also significantly reduce human enteric viruses such as reovirusand enterovirus. The water reclamation plant at Eraring Power Station demonstrates the potential for reuse of wastewater in power generation and other industrial manufacturing facilities.

Industrial uses for reclaimed water include:

- Evaporative cooling water: -

a) Once-through cooling system.
b) Re-circulating cooling system.
c) Cooling water quality requirements.

- Boiler –Feed water- The use of reclaimed water differs little from use of conventional public supplies for boiler-feed water, as both require extensive additional treatment quality requirement for boiler feed make up water are dependent upon pressure at which boiler is operated.
- Industrial process water- Suitability of reclaimed water for use in industrial process depends upon particular use like-

a) Pulp and paper.
b) Chemical industry.
c) Textile industry.
d) Petroleum and coal.

xii. Whenever possible, other end uses of treated effluents; such as recycling, cooling, power generation, etc. shall be considered.

xiii. Re-use Options: The following options for re–use of effluent have been identified: In general, public health concern is the major issue in any type of reuse of wastewater, be it for irrigation or non-irrigation utilization, especially long term impact of reuse practices. It is difficult to delineate

acceptable health risks and is a matter that is still hotly debated. Potential reuse of wastewater depends on the hydraulic and biochemical characteristics of wastewater, which determine the methods and degree of treatment required. While agricultural irrigation reuses, in general, require lower quality levels of treatment, domestic reuse options (direct or indirect potable and non-potable) reuses need the highest treatment level. Level of treatment for other reuse options lie between these two extremes. The reuse options may be (artificial recharge of aquifers is not permitted):

- Irrigation

a) Agriculture and forestry

b) Landscaping

- Fish – farming
- Industry
- Non-potable Domestic Reuse.

The detailed project report should clearly define the best reuse option particular to town and strategy to obtain it. Action plan with clarity should be the part of Detailed Project Report (DPR), while preparing sewerage projects. Before deciding the reuse of treated waste water, authorities must full fill the water quality norms and its legal implications.

xiv. Governing local body can sell the treated waste water and digested sludge to generate the revenue.

7.5. Inflow & outflow of funds & Cost Analysis

1. In view of increasing marginal cost of wastewater collection and treatment, wastewater charges, connection fees, sewerage taxes and treatment fees shall be set to cover at least the operation and maintenance costs. It is also highly desirable that part of the capital cost of the services shall be recovered. The ultimate aim is for a full cost recovery.
2. Appropriate criteria in order to apply the "polluter pays" principle shall be established.
3. Different charges for different areas may be applied. This shall be assessed for each geographical area as a function of end users and effluent quality and will be subject to economic and social considerations.
4. Because of the limited financial resources available to Government of M.P., setting investment priorities in wastewater will be compatible with government investment plans.
5. Criteria for prioritizing investments in the wastewater sector shall take into account the current and future needs of the state, needs to expand wastewater systems in urban areas and to provide wastewater systems to smaller towns and villages.
6. Priorities of wastewater projects shall not be disconnected from water supply projects and urbanization in general. Decisions will be made concerning them to attain optimum solutions to the need for services, availability of finance and availability of trained manpower.
7. Treated effluent shall be priced and sold to end users at a price covering at least the operation and maintenance costs of delivery.
8. It is the intention of the Government, through private sector participation, to transfer management of infrastructure and services from the public to the private sector, in order to improve performance and upgrade the level of service.

9. The role of the private sector will expand with management contracts, concessions and other forms of private sector participation in wastewater management.
10. The concepts of BOO/BOT shall be entertained, and the impact of such concepts on the consumers shall be continually addressed and negative impacts mitigated.
11. The private sector role in reuse of treated effluent shall be encouraged and expanded.
12. As per urban reforms (under various schemes by MOUD) 100% cost of O&M of sewerage system shall be recovered from consumer. The costs will depend on the system/technology adopted for collection of sewerage and treatment and the administration costs. It is important that the full cost of the service is assessed for each urban area instead of adopting a typical cost assessment. The full cost shall cover the following:

- Institutional aspect of the sanitation service e.g. the management information systems, accountancy and finance management, billing and collection, customer services, etc. and oversight activities.
- Operating, maintaining (on a planned maintenance basis), repairing replacing and extending sanitation service physical infrastructure.
- Keeping updated infrastructure and customer data on a GIS base.
- Managers, staff, vehicles, equipment and consumables associated with the above.
- Consumable like chemicals etc.
- Power charges.
- Spare Parts.
- Any other O&M contract amount

7.6. Standards to be adhered, Regulations & Quality Assurances

1. Particular attention shall be focused on adopting and enforcing effluent and sludge standards for municipal and industrial wastewater treatment plants and for discharges from industries, laboratories, hospitals, slaughterhouses and other businesses.
2. Extensive and comprehensive monitoring programs shall be developed. Influent to and effluent from the plants and throughout watercourses shall be measured and monitored against all appropriate parameters to ensure that public health objectives and treatment efficiency goals are attained.
3. All crops irrigated with treated or mixed waters shall be analyzed and monitored periodically.
4. Observation wells shall be installed near the treatment plants to monitor groundwater quality where necessary, and to mitigate adverse impacts where and when needed.
5. Data collected from the monitoring process shall be entered and stored, processed and analyzed through computer software, and results published periodically.
6. Roof and storm water connections to public sewers shall be prohibited. Collection of storm water shall be done separately and will be the subject of water harvesting.
7. Effluent and sludge standards for the disposal of hazardous liquid wastes shall be defined to ensure the safe disposal of such wastes.
8. EPCO/MPPCB/ CPCB regulations for disposal norms shall be mandatory.
9. Industrial waste water is not allowed to disposed of in the sewer line. ULB can issue notification for penalties to be imposed on the such industrial units.
10. Laboratories shall be maintained and properly equipped to provide services and reliable data needed to ensure enforcement of and adherence to standards and regulations.

7.7. Legislation and Institutional Framework

1. Legislation and institutional arrangements for the development and management of wastewater shall be periodically reviewed. Gaps shall be filled, and updating of the institutional arrangements with parallel legislation shall be made periodically to cope with varying circumstances and for this government shall notify an agency giving full power to take necessary action in this matter.
2. The role of the Government shall be fine-tuned and its involvement reduced to be regulatory and supervisory. Involvement of the stakeholders in wastewater management and support shall be introduced and expanded.

7.8. Public Awareness and IEC & Priority Issues

i. The public shall be educated through various means about the risks associated with the exposure to untreated wastewater and the value of treated effluents for the different end uses.

ii. Programs for public and farmer's awareness shall be designed and conducted to promote the reuse of treated wastewater, methods of irrigation and handling of product. Such programs shall concentrate on methods of protection of farmers health, animal and bird health and the environment.

iii. Public awareness campaigns shall also be waged to educate the public on the importance of domestic hygiene, wastewater collection, treatment and disposal.

iv. It is observed that the system is dependent on the appreciation of the beneficiaries to the advantages and importance of the system to them and thereby working together towards making it successful. The co-operation is vital for following areas:

   a) Protecting the system from getting choked due to entry of extraneous material in the sewer system. A vigilant public will help prevent this.
   b) The sewerage system yields full benefits or disease protection when there is 100% connectivity.
   c) It is important that the beneficiaries appreciate the benefits and pay for their upkeep. The systems require proper upkeep and the cost associated with maintenance and upkeep should at least be recovered from the beneficiaries. The principle of the polluter pays will be adopted only by an enlightened and participating public.

v. A conscious campaign has to precede the planning and implementation of the sewerage systems. ULB, Non-Government Organizations and local neighborhood committees could give the process a thrust.

vi. A public participation process will not only aid in identifying potential consumers but also serve as a public education program. Potential users will be mainly concerned with the quality of reclaimed water, reliability of its delivery and the constraints in using reclaimed water. Also, connection costs or additional sewerage treatment cost might affect their ability to use the product. Consultations with various stake holders will aid in structuring of tariff and discounts for adopting reuse technologies, awareness on dual piping system, water conservation and safety issues.

vii. Municipal Bodies should decide and pass resolution regarding sewer connection charges. The provision should be widely publicized. Linkage of fixation & revision of user charges with other services need to be ensured from time to time. Implementation of user charges framework

addressing affordability considerations and progressively move to user charges with due consideration to Cost Recovery of O&M System for initial years and progressively to cover debt servicing.

viii. Series of 'Sewer connection camps' may be organized. The time and venue should be publicized widely to inform residents. The days, time and venue should suit the convenience of public.

ix. Ensure that all Government offices and schools are connected with Sewer Connections or Safe Sewage disposable facilities.

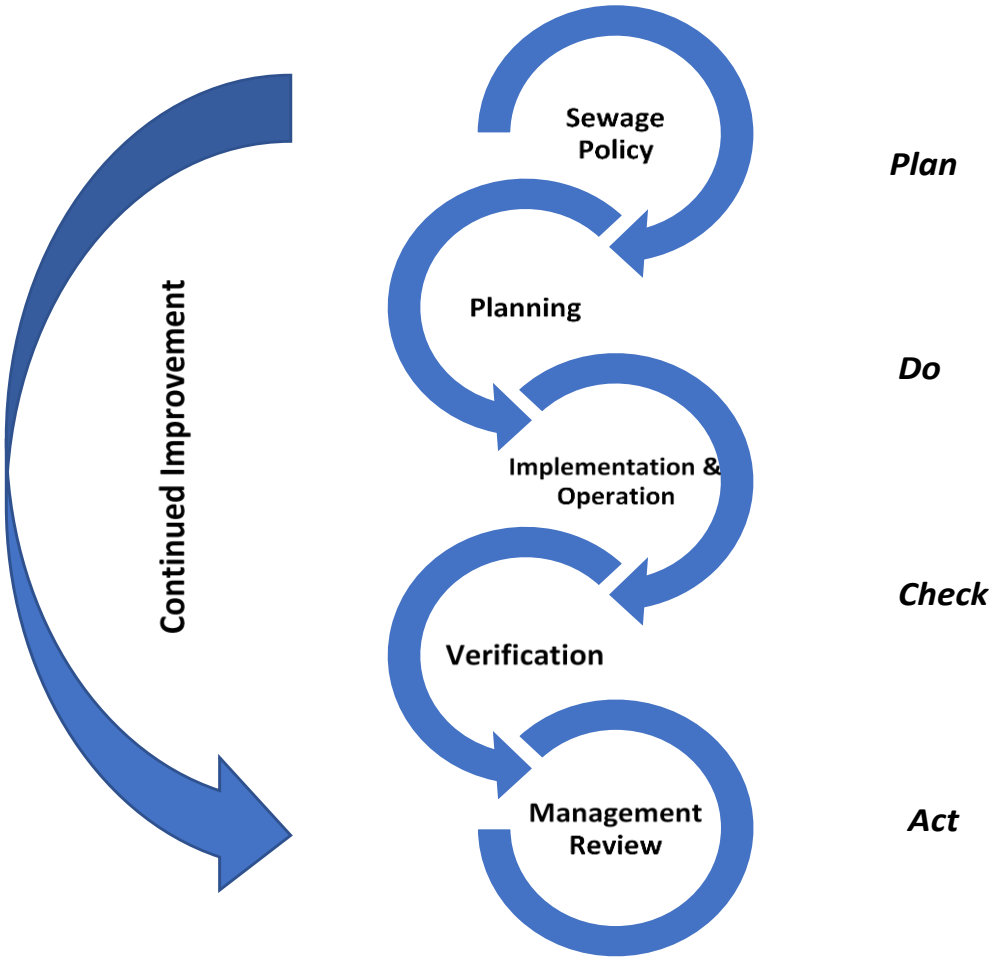
x. Implementation & Monitoring of Consumer Management & grievances redressal system in place with each ULB.

7.9. Human Resources & Continued R&D

i. Capabilities of human resources in the management of wastewater shall be enhanced through training and continuous education. Work environment shall be improved and incentives provided.

ii. Establishment of State Water & Waste water Training Center at state level. It will help in training of human resources in this sector.

iii. Human resources performance will be continually appraised in order to upgrade



capabilities, sustain excellence, provide job security and incentives to qualified individuals with excellent performance.

iv. Applied research on relevant wastewater management topics shall be adopted and promoted. Topics such as the transfer of wastewater treatment technologies, low cost

wastewater treatment technologies, reduction of energy consumption and others will receive adequate support.

v. Cooperation with specialized centers in the country and abroad shall be encouraged, and raising of funds for this purpose shall be supported.

vi. Transfer of appropriate technology suited for local conditions will be a primary target for the development activities and for adaptive research.

7.10. Service Level Benchmarking & Implementation Plan

Focus of improvements sewerage is on creation of new assets rather than management of existing assets. In order to bring about improvements in delivery of municipal services, a need has been felt to develop National Benchmarks in respect of basic services for sewerage are given below The Ministry of Urban Development has taken the initiative of bringing out a Handbook of Service Level Benchmarks, in 2008, which provides for standardized framework for performance monitoring in the four sectors. For Sewerage & Sanitation Services SLB are fixed.

It is intended to achieve the following bench marks in the cities as per priority as above:

Proposed Indicator	**Benchmark**
Coverage of toilets	100%
Coverage of sewage network services	100%
Collection efficiency of sewage network	100%
Adequacy of sewage treatment capacity	100%
Quality of sewage treatment	100%
Extent of reuse and recycling of sewage	20%
Efficiency of redressal of customer complaints	80%
Extent of cost recovery in sewage treatment	100%
Efficiency in collection of sewage charges	90%

It is envisaged to achieve service level benchmarks described above

A plan of action is given in Annexure 3 which shows work action plan for 55 towns where either partial sewerage works are done or in pipeline.

The physical Infrastructure required to be planned can be broadly classified as:

- **A Sewerage System:** Including the onsite disposals system, network of pipes that collect sewage from domestic, institutional, commercial and industrial premises, the collector and interceptor sewers and pumping stations that convey the sewage to treatment plant. Storm water and industrial waste water shall not be allowed in the Sewerage system. Heavy penalty is to be imposed on the industries discharging industrial waste water in the sewerage system. Industries should make separate arrangement for treatment of Industrial waste water.
- **Treatment Plant:** Where the quality of the sewerage is improved for its safe disposal or reuse. The sludge generated by the sewage treatment process is also normally processed at the plant for safe disposal and reuse. Treatment plants must have disinfection unit. The treated waste water shall not be allowed to discharge/ reuse without disinfection to eliminate the pathogens present in the treated waste water. In each STP (proposed and existing) about 100 m- 200 m distance shall be declared as exclusion zone and in this zone thick plantation is to be done and priority is to be given to indigenous plants.
- **Effluent Disposal Facilities:** For conveying the treated liquid effluents to the point at which they are either safely disposed of into the ground or to a body of water – a water course or lake

or to a point where they are directly reused in agriculture, fish farming, forestry, industry or planned reuse site. The disposal in the water body shall be taken up only when other options are not feasible /appropriate.

- **Sludge Disposal:** By means of which liquid, semi-solid or dried sludge are transported to the point where they are either safely disposed to sanitary landfill or recycled, principally for use in agriculture. It shall be ensured that there shall be no crude dumping of STP sludge as it may create unhygienic and un-aesthetic conditions. Adequate processing of sludge must be carried out before disposal.

1. The proposed systems should satisfy the following:

(i) Satisfy its purpose based upon appropriate technology.

(ii) Will respond to environment and social concerns.

(iii) Will generate a satisfactory rate of return.

(iv) Be both sustainable and affordable.

2. The sewerage system is designed for a sufficient design period (generally 30 years) consisting of one or more outfall sewers, trunk sewers and laterals generally operating by gravity, but with force mains and pumping stations where required. The systems are to be designed on separate system to accept the domestic waste including sludge but excluding any rain water and industrial waste as acceptable. The house collection system should be designed to achieve this. Households sludge connectivity should be ensured for smooth functioning of the STP. Awareness program should be planned for households sewer connection.

3. Both the alternatives (i) centralized system and (ii) decentralized system should be evaluated before deciding type of system. Where funds are restricted or for smaller towns based on possible re-use of treated waste- water, decentralized approach may be adopted.

4. The system is beneficial when all the premises are connected to the system and there is no waste water flowing in the drains. The service lines to connect the house connections to the sewer system should be laid along with the laying of the sewers up to the boundary of the premise and plugged so that it can be extended by the premise owner within his premise.

5. The surface drains should not be connected to the sewer systems as they also carry rain water, solid wastes and silt which tend to choke the sewers.

6. The program of construction of the sewerage systems especially in the existing inhabited colonies should be made very carefully. Any systems that are laid but not commissioned are prone to be filled up by dirt and solid waste. This is likely to make the commissioning very difficult at a later date.

7. It is desirable to start from the downstream end of the out fall and commission it. The trunk mains should be taken up after this and commissioned as the work progresses. The laterals that get connected to the commissioned sections of outfall/trunk sewers only should be laid.

8. The construction program for the STP and sewer network should be planned and executed in such a fashion so that both of these get commissioned at the same time.

9. It is generally not possible to take up work for the whole city at once and the work may have to be prioritized. A method of prioritizing can be:

a. Population of area.

b. Areas where lack of sewer system is creating unhygienic living conditions or unacceptable odor levels, e.g. areas with a high population density and no drainage system or found with low permeability adversely affecting septic tank soak ways.

c. Areas with high groundwater level requiring the use of cess-pools and where frequent emptying of the tanks is either impractical or extremely costly.

d. Area where the quality of the ground water is adversely affected by septic tank effluent and ground water is a source of drinking water or discharges in a polluted state to a water course.

e. City Centre, Commercial Centre etc.

10. In general pumping stations should be avoided on the sewerage systems to the extent possible because of the additional costs involved in construction and operation. They have to be installed if the design so requires. A properly designed and constructed pumping system can give trouble free service. The pumping stations can be suitably automated for better operation.

11. During construction, full care needs to be taken for diverting traffic and for fencing and safety of the excavation sites. The provisions for properly supporting the trenches should be taken. Special care should be taken for ensuring proper backfill and immediate repair of the roads after the work is completed.

12. The most common form of installing sewer is open excavation of trenches or open cut. This method has limitations on account of depth that can be handled, time taken and the disruption of the services of the concerned street for the work period. Usually this method is not feasible beyond 5-6 m depths. Alternative techniques of trench less technologies involving tunneling and micro tunneling are used for laying sewers where open cut is not feasible on any of the above counts. This procedure though prevalent in developed countries, is not common in MP, but should be considered as an alternative where the situations warrant. The techniques of thrusting pipes in ground can also be used in specific cases.

13. Laying sewer and water pipelines & road restoration

a. In case water supply line or sewerage is to be carried out in the same street, the work of water supply line or sewerage should be done first and the road work be done after they are completed to avoid damage to the road once constructed.

b. If both the work of sewerage and water supply pipelines is to be carried out in a street, it should be ensured that both the works are carried out at the same time to ensure that the road is not disturbed two times.

c. The issue of relative placement of the water line and sewer line in relation to possibilities of pollution should also be paid attention. For that horizontal and vertical separation should be followed with the provision in Manual.

d. Where the laying is being completed under a road, backfilling and compaction should be done as per specifications. If excavated area has a road pavement, it should be finished at top with a road pavement of the same standard and specifications as the existing pavement. It is desirable to use mechanical compaction devices for ensuring proper compaction and to avoid sinking of the repaired pavement.

14. Sewer network has not been utilized/remain under-utilized in the cities where sewerage facility is available. A large number of households are not connected to sewerage network resulting in prevalence of problems of sanitation, health and hygiene. Hence steps has to be taken at local level for utilization of network.

15. For more effective and quicker utilization of sewerage network created/under creation, greater participation of residents of the city is required. Following steps may be taken to connect every house hold with sewerage network:

a. Information, Education and communication (IEC) activities to be carried out to interact with citizens to convince them to take sewer connection. IEC activities may be taken up using newspapers, cinema slides, Nukkad Natak, Radio, SMS, Facebook, Twitter, Audio-Video clips, Films on local cable network etc.

b. NGOs working in this field and volunteers may be engaged to motivate people to take sewer connections. Children and Schools may provide excellent motivation tool. Competition at school/community level may be held to provide enthusiasm to carry out this activity.

c. The plumbers of the city may be enlisted. Workshop of Plumbers must be carried out to train them to carry out sewer connections, without doing any damage to sewer network and connecting waste water of Bathroom, Kitchen and Toilet in proper fashion to avoid any problem of choking.

d. A tentative estimate for joining the system of house to sewer line after categorization of houses in different categories such as A, B, C…. based on requirements should be prepared by Municipal Body and must be provided to residents so that there may not be overcharging incidences by the plumbers.
e. In order to have proper functioning of sewerage, residents should be educated so that solid waste must not find access to sewerage system. The kitchen and bathroom should be provided with mesh.

16. Operation & Maintenance of organised Sewerage System

i. Operation and maintenance should be carried out in accordance with the provisions of CPHEEO manual for O&M as amended time to time. It is important to plan for the proper operation and maintenance of the assets created for sewerage disposal. Operation and maintenance should be carried out in accordance with the provision of CPHEEO manual for O&M period of minimum 10 years. Dedicated fund should be provided/planned for proper operation and maintenance of sewerage system and STP.
ii. The important inputs for proper upkeep of the systems are a proper institutional arrangement for overseeing the work, appropriate technical back up, adequate funds, and active cooperation of an enlightened beneficiary public. A monitoring committee/vigilance committee should be constituted to monitor the waste water and storm surface water. A toll free number for helpline proposes should be created for public grievances.
iii. Most often, there will be lack of technical know-how and experience for operating the systems which are fairly sensitive and require professional attention. The O&M component of the contract can be for 10 years. The responsibilities should be clearly defined in the contract.
iv. Procurement of suitable equipment for ensuring proper maintenance like jetting machines, vacuum tankers, high powersuction machines, sewer rods, bucket cleaning machines, etc.
v. Possibilities may be explored for Operation and maintenance on basis of cluster approach of urban bodies for using the facilities jointly and saving on investment.
vi. Funds for O&M: The cost involved in running the plant, transportation of the raw sewage etc makes the system in loss. The present practice is that the sewage collected at STP is released in natural drains or rivers which make them highly polluted affecting the human health downstream of the point of sewage in river. This makes it necessary to treat the water to extent it can be utilized for irrigation, Industrial or other purpose. Treatment to tertiary level also involved additional cost. Local body will plan to generate funds for O &M.
vii. The tariff for domestic, industrial and irrigation water may be increased so that the reclaimed water becomes competitive or cheaper than the normal water. Local body may provide information on quarterly basis regarding quantum of treated wastewater available including long term availability especially in areas which have been declared notified/over-exploited by Central Ground Water Authority (CGWA) ,so that interested parties/Departments can make an application for reservation of treated waste water.

17. The Municipal Bodies should take into confidence all the stake holders and frame a suitable micro level policy for the sewerage disposal system within the guidelines stipulated in the State Policy and taking into account the local ground level realities. They should take advice from professionals for understanding the options. Such a Policy can include at municipal level:

a. Physical Targets for Sanitation Coverage with a view of assigning time schedule and setting priority for covering various parts of the city.
b. The standard of the service level that may be targeted and should be achieved by regular efforts.
c. Effluent disposal standards can be fixed earmarking sites for sewage treatment facilities. Identification of effluent disposal options and sites.

d. If more than one municipality can be gainfully combined for the system, identifying the options and working for such an agreement.
e. Identifying and laying down the targeted recycle/reuse option of the effluent and sludge.
f. Recognition of the principle of "the polluter pays" i.e. recovery of the financial liabilities being undertaken for the system.
g. User to involve in participation for creation of fund for capital work.

18. References for Design of Sewerage System

The sewerage system and its appurtenances will be designed and implemented as per the guidelines laid out in the "Manual on Sewerage and Sewerage Treatment" latest edition published by the Central Public Health and Environmental Engineering Organization (CPHEEO), Ministry of Urban Development, Government of India following the latest developments in the industry and good engineering practices and National Sanitation Policy by GoI. The details regarding the various Treatment Plant Process are available in the "Manual on Sewerage and Sewage Treatment (latest edition)" published by CPHEEO under direction of the Ministry of Urban Development, GoI.

PRICING OF SERVICES: KEY COMPONENTS OF TARIFF STRUCTURE: Waste Water/Sewerage

O & M Costs: Salaries and wages, electricity expenses, repairs, chemicals and other material purchases, Rents, Fuel, etc.

Capital Costs: Debt service charges, depreciation.

Major Drawbacks in the Existing *Tariff Structure System*:

- Recovery of Capital Cost-Nil, since in most of the towns in the state only partial and temporary Sanitation /Sewerage facilities available. Tariff determined as per existing practices are largely aimed at recovering the historical costs rather meeting the long-term incremental costs and increased investment needs of an expanding system.
- Tariff structure not strictly followed due to political interference.
- Missing attention on the affordability and willingness to pay.
- Not linked with the quality of service.
- Minimum life line rates not defined.

Policy : Suggestive Landmarks:

- Delinking of the service charges from the property tax net.
- Two-part tariff structure for -one for access and another for use or services rendered.
- Initially Tariff Structure should be based upon the average incremental costs and willingness to pay of different user groups. Allow for the lower charges to ensure life line rates. Cross subsidy mechanism should be introduced for Pro-Poor.
- Survey of quantity, quality and willingness to pay at regular intervals for various areas by Focused Group Discussions.
- Tariff Indexing keeping in view the rising cost of the service provision be done with reference to RBI WPI.
- Improved efficiency in delivery of service including in billing, collection, etc.

8 Inter- Departmental Co-ordination for use of recycled effluent:

It is necessary to recycle and reuse at least 20% of effluent after treatment. This resource should be judicially used after adhering to different requirements/ desired characteristics for end use of the product. Various departments may be given mandatory guidelines to use recycled water wherever possible with in the best usable characteristics achieved. Various department which may be considered for such uses are agriculture, horticulture, Industries, PWD, Rural Development and other which are using huge quantum of water in their day to day activities. For this purpose, it is necessary to have co-ordination between various departments of MP in their reachable activities in techno-economic, best use of available resources.

9 Annexures:

Annexure-1: Septic Tank Construction Drawing for Variable Population Load of 5, 10, 15,20,50 and 250

Annexure-2: Recycling and Reuse of grey water in buildings modal Bylaws- Gazette Notification

Annexure-3: Status of Sewerage & Sanitation Works done in MP - Gaps & Strategic Implementation Programme

Status of Sewerage & Sanitation Works done in MP - Gaps & Strategic Implementation Programme

S. No.	Name of ULB/Town	Name of District	Category of ULB-MC-M-NP*	Population			Name of the scheme in which Sewerage & Sanitation works Sanctioned/Proposed - Under-Programme-UIDSSMT/Amrut/ ADB/KFW/WB Etc.	Cost in Rs Crores	% Coverage of Sewerage /Sanitation after completion of proposed /Sanctioned Works			
				As per Census-2001	As per Census-2011	2017 (Estimated)			Existing Coverage (Population) % Under Sewerage & Sanitation	Brief if any	Total Population Covered including works in pipeline as shown in column-7	Left to be covered and its estimated Cost in Rs. Crores #
	1	2	3		4	5	6	7	8	9	10	11
1	Indore	Indore	MC	1597441	1992422	2387403	AMRUT	550	55%	Partial works done under NRCP & JnNURM	55%	45%
2	Bhopal	Bhopal	MC	1433875	1798218	2162561	AMRUT	343.09	65%	Partial works done under prevention of pollution of Upper Lake (PPoUL,BWL & ADB)	65%	35%
3	Gwalior	Gwalior	MC	826919	1054420	1281921	AMRUT	400	65%	Partial works done under NRCP & JnNURM	100%	Nil
4	Jabalpur	Jabalpur	MC	951469	1069292	1187115	AMRUT	350	50%	Partial works done under NRCP & JnNURM	100%	Nil
5	Ujjain	Ujjain	MC	429933	515215	600497	AMRUT	375	10%	Partial works done under NRCP	65%	35%
6	Dewas	Dewas	MC	230658	289550	348442	AMRUT	25	5%	only skeleton works for handling sewage/ sludge	100%	Nil
7	Satna	Satna	MC	225468	282977	340486	AMRUT	175.55	10%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil
8	Sagar	Sagar	MC	232321	274556	316791	AMRUT	302.74	45%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil
9	Ratlam	Ratlam	MC	233480	264914	296348	AMRUT	120.54	10%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil
10	Rewa	Rewa	MC	183232	235654	288076	AMRUT	176	10%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil
11	Murwara Katni	Katni	MC	186738	221883	257028	AMRUT	88.32	15%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil
12	Singrauli	Singrauli	MC	185580	220257	254934	AMRUT	102.55	60%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil

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#These works are proposed to be completed latest by year 2022 after getting appropriate funding from other sources

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	1	2	3		4	5	6	7	8	9	10	11
13	Morena	Morena	MC	150890	200482	250074	AMRUT	125	35%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil
14	Bhind	Bhind	M	153768	197585	241402	AMRUT	70.8	55%	Partial works done by ULB's. Presently cleaning of drains being done by Safai Kramchari. De-sludging of septic tanks and sake disposal of sludge being done	100%	Nil
15	Khandwa	East Nimar	MC	171976	200738	229500	AMRUT	10	10%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil
16	Chhindwara	Chhindwara	MC	122309	175052	227795	WB	150	20%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil
17	Burhanpur	Burhanpur	MC	194360	210886	227412	AMRUT	82.62	40%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	40%	60%
18	Guna	Guna	M	137132	180935	224738	AMRUT	77.2	35%	Partial works done by ULB's. Presently cleaning of drains being done by Safai Kramchari. De-sludging of septic tanks and sake disposal of sludge being done	100%	Nil
19	Shivpuri	Shivpuri	M	146859	179977	213095	AMRUT	25	35%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil
20	Vidisha	Vidisha	M	125457	155951	186445	AMRUT	91	10%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil

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	1	2	3		4	5	6	7	8	9	10	11
21	Chhatarpur	Chhatarpur	M	99519	142128	184737	AMRUT	0	10%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil
22	Pithampur	Dhar	M	68051	126200	184349	AMRUT	0	5%	only skeleton works for handling sewage/ sludge	5%	95.0%
23	Damoh	Damoh	M	112160	139561	166962	AMRUT	50	10%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil
24	Mandsaur	Mandsaur	M	116483	141667	166851	AMRUT	183	10%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil
25	Khargone	West Nimar	M	86443	116150	145857	AMRUT	50	50%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	50%	50.0%
26	Hoshangabad	Hoshangabad	M	97357	117988	138619	kFW	200	5%	only skeleton works for handling sewage/ sludge	100%	Nil
27	Neemuch	Neemuch	M	100240	119222	138204	AMRUT	60.25	80%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	80%	20.0%
28	Sehore	Sehore	M	90930	109118	127306	AMRUT	45.82	10%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil
29	Betul	Betul	M	83287	103330	123373	AMRUT	0	10%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	10%	90.0%
30	Datia	Datia	M	82742	100284	117826	AMRUT	54.16	25%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil

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	1	2	3		4	5	6	7	8	9	10	11
31	Seoni	Seoni	M	89799	102343	114887	AMRUT	35	10%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil
32	Nagda	Ujjain	M	96525	100039	103553	WB	25	35%	Work done Under administration of Grasim	100%	Nil
33	Shahdol	Shahdol	M	78583	86681	94779	WB	80	10%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil
34	Shajapur	Shajapur	M	50086	69263	88440	WB	77.45	10%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil
35	Narsimhapur	Narsimhapur	M	46120	59966	73812	kFW	70	5%	only skeleton works for handling sewage/ sludge	100%	Nil
36	Sendhwa	Barwani	M	43222	56485	69748	kFW	30	5%	only skeleton works for handling sewage/ sludge	100%	Nil
37	Dabra	Gwalior	M	56665	61277	65889	AMRUT	400	10%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil
38	Mandla	Mandla	M	45907	55133	64359	kFW	70	10%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil
39	Barwani	Barwani	M	48941	55504	62067	kFW	60	5%	only skeleton works for handling sewage/ sludge	100%	Nil
40	Maihar	Satna	NP	34347	40192	46037	ADB	50	15%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil
41	Sanawad	West Nimar	M	34131	38740	43349	kFW	70	5%	only skeleton works for handling sewage/ sludge	100%	Nil
42	Khajuraho	Chhatarpur	NP	19282	24481	29680	ADB	35	5%	only skeleton works for handling sewage/ sludge	100%	Nil
43	Dindori	Dindori	NP	17413	21323	25233	WB	30	5%	only skeleton works for handling sewage/ sludge	100%	Nil

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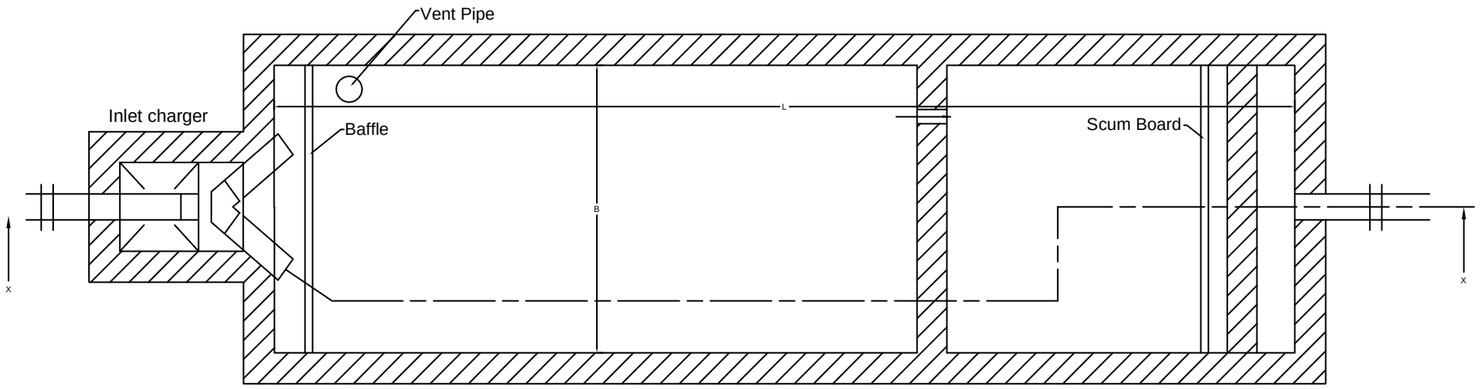
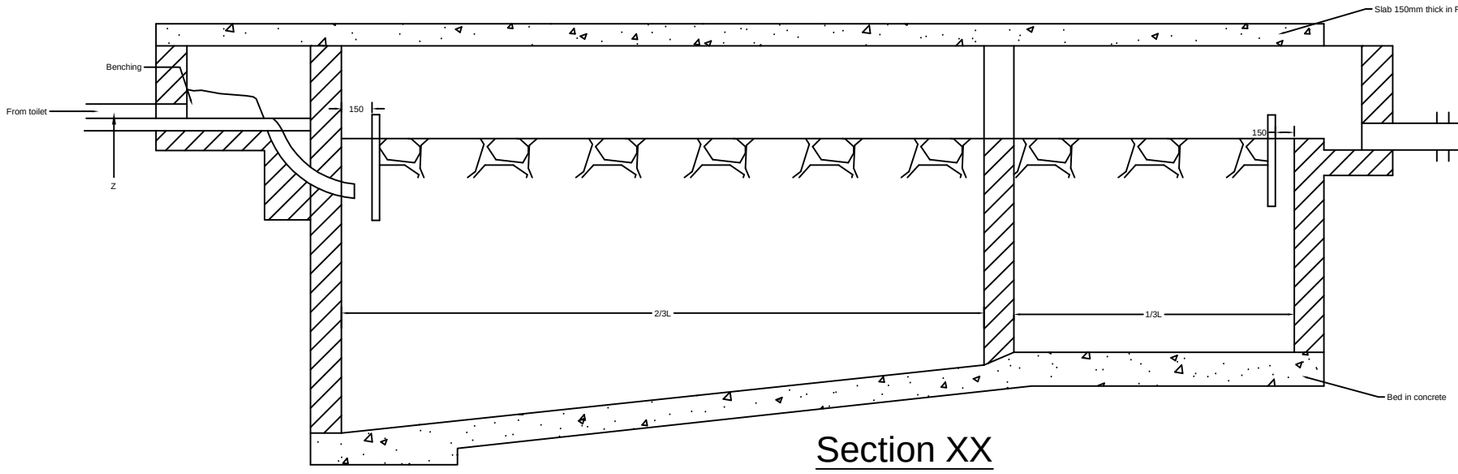
	1	2	3		4	5	6	7	8	9	10	11
44	Chitrakoot	Satna	NP	22294	23316	24338	WB	40	5%	only skeleton works for handling sewage/ sludge	100%	Nil
45	Budni	Sehore	NP	13862	16808	19754	ADB	40	5%	only skeleton works for handling sewage/ sludge	100%	Nil
46	Dharampuri	Dhar	NP	13229	16363	19497	WB	20	10%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil
47	Rajnagar	Chhatarpur	NP	12442	14253	16064	ADB	20	5%	only skeleton works for handling sewage/ sludge	100%	Nil
48	Omkareshwar	East Nimar	NP	6616	10063	13510	WB	30	5%	only skeleton works for handling sewage/ sludge	100%	Nil
49	Mandleshwar	West Nimar	NP	11345	12343	13341	WB	30	10%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil
50	Bhedaghat	Jabalpur	NP	1840	6657	11474	WB	25	10%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil
51	Sanchi	Raisen	NP	6785	8401	10017	ADB	25	5%	only skeleton works for handling sewage/ sludge	100%	Nil
52	Amarkantak	Anuppur	NP	7074	8416	9758	WB	15	5%	only skeleton works for handling sewage/ sludge	100%	Nil
53	Shahganj	Sehore	NP	7386	8510	9634	WB	35	5%	only skeleton works for handling sewage/ sludge	100%	Nil
54	Nemawar	Dewas	NP	5016	5978	6940	WB	20	10%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil
55	Maheshwar	West Nimar	NP	19646	24411	29176	WB	65	10%	Partial works done for cleaning of sludge from drain and de-sludging of septic tanks by mechanical means	100%	Nil

***MC= Municipal Corporation, M= Municipility or Municipal Council, NP= Nagar Parishad Town**
#These works are proposed to be completed latest by year 2022 after getting appropriate funding from other sources

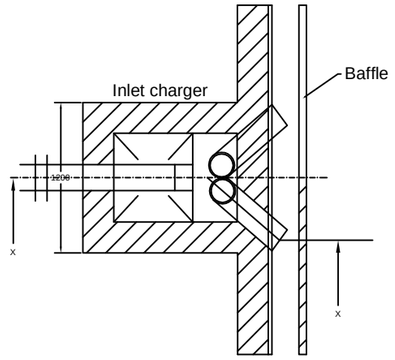
SEPTIC TANK CONSTRUCTION DRAWING FOR VARIABLE POPULATION LOAD OF 50 OR 250

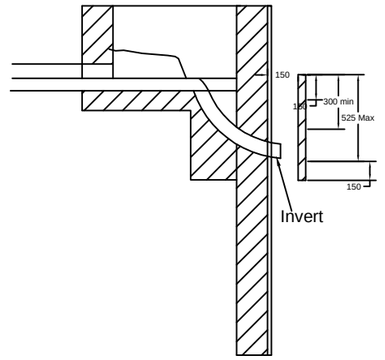


Sectional Plan ZZ



Section XX



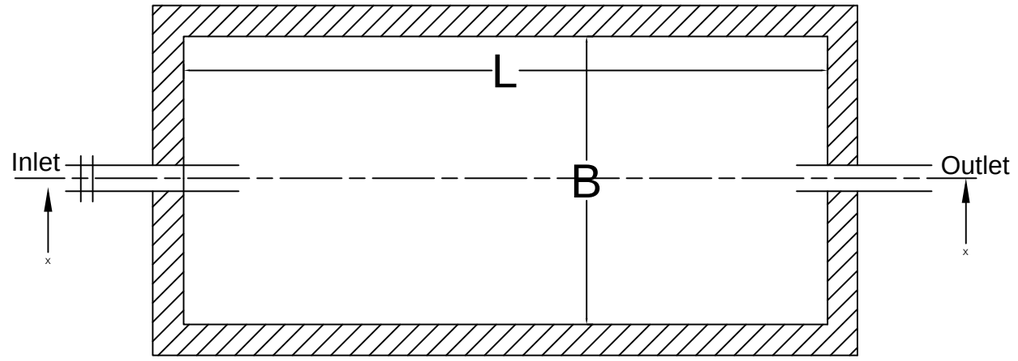


Section XX

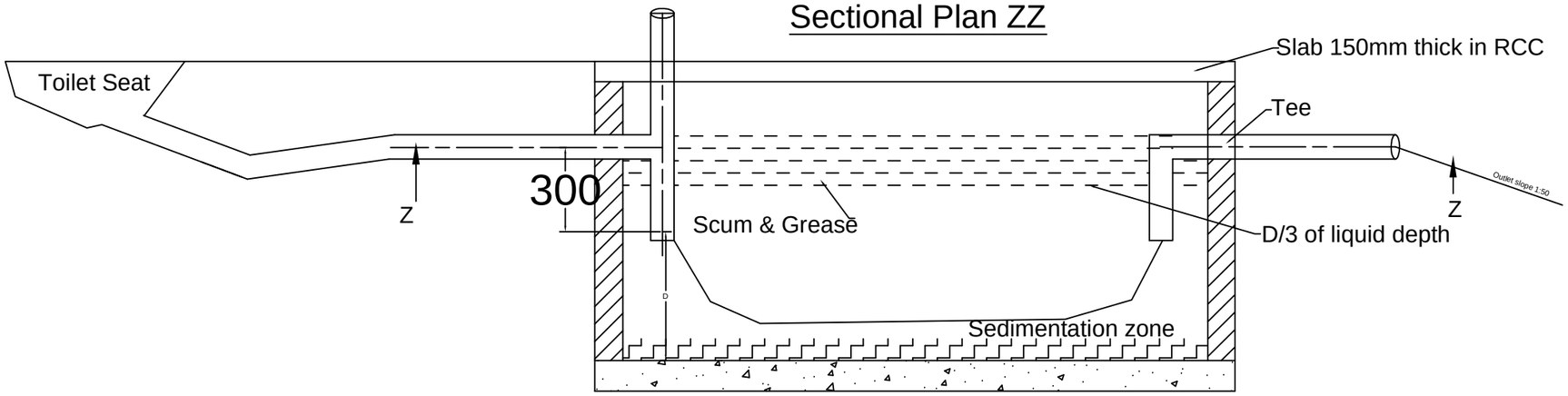
The detail of septic tanks construction, recommended based on designs for various muncipal / domestic population load envisaged: Table "B"

S.No.	Type of septic tank (refer drawings for respective areas & depth 'D' as per frequency of cleaning in coloumn-6	No. of users upto	Length 'L' in meters	Width 'B' in meter	Septic tank total depth ('D') for stated interval of sludge withdrawal total depth (D)= Depth of liquid (D1)+Depth of free (Df) + Space above free board (Ds) type of construction is recommended based in frequency of cleaning in years envisaged			Remarks
					Year 1	Year 2	Year 3	
1	Septic tank for cluster of houses of hostels of population load of 50 (Drg.B)	50	6	2	Type B1 1.1+0.3+0.3=1.70	Type B2 1.4+0.3+0.3=2	Type B3 1.7+0.3+0.3=2.30	Designed as per standard procedure and construction recommended as per above advisory
2	Septic tank for cluster of houses of hostels of population load of 250 (Drg. B)	250	12.90	4.30	Type F1 1.1+0.3+0.3=1.70	Type F2 1.4+0.3+0.3=2	Type F3 1.7+0.3+0.3=2.30	

SEPTIC TANK CONSTRUCTION DRAWING FOR VARIABLE POPULATION LOAD OF 5, 10, 15, or 20



Sectional Plan ZZ



Section XX

The detail of septic tanks construction, recommended based on designs for various muncipal / domestic population load envisaged: Table "A"

S.No.	Type of septic tank (refer drawings for respective areas & depth 'D' as per frequency of cleaning in coloumn-6	No. of users upto	Length 'L' in meters	Width 'B' in meter	Septic tank total depth ('D') for stated interval of sludge withdrawal total depth (D)= Depth of liquid (D1)+Depth of free (Df) + Space above free board (Ds) type of construction is recommended based in frequency of cleaning in years envisaged			Remarks
1	2	3	4	5	6			7
					Year 1	Year 2	Year 3	Designed as per standard procedure and construction recommended as per advisory
1	Septic tank of house hold of population of 5 (Drg.A)	5	2.25	0.75	Type A1 1.1+0.3+0.3=1.70	Type A2 1.4+0.3+0.3=2	Type A3 1.7+0.3+0.3=2.30	
2	Septic tank of house hold of population of 10 (Drg.A)	10	2.58	0.86	Type A4 1.1+0.3+0.3=1.70	Type A5 1.4+0.3+0.3=2	Type A6 1.7+0.3+0.3=2.30	
3	Septic tank of house hold of population of 15 (Drg.A)	15	3.30	1.10	Type A7 1.1+0.3+0.3=1.70	Type A8 1.4+0.3+0.3=2	Type A9 1.7+0.3+0.3=2.30	
3	Septic tank of house hold of population of 15 (Drg.A)	20	3.75	1.25	Type A10 1.1+0.3+0.3=1.70	Type A11 1.4+0.3+0.3=2	Type A12 1.7+0.3+0.3=2.30	