NAMASKAAR

Welcome

CREATING SUSTAINABLE WATER AND SANITATION

TRAINING- CREATING SUSTAINABLE CITIES/TOWNS IN UTTARAKHAND

NAINITAL: 11 August 2021

Vijendra Vikramaditya

SUSTAINABLE DEVELOPMENT GOALS VISION 2030

GOAL No. 6

ENSURE AVAILABILITY AND SUSTAINABLE MANAGEMENT OF WATER AND SANITATION FOR ALL

TARGETS:

6.1 BY 2030, ACHIEVE UNIVERSAL AND EQUITABLE ACCESS TO SAFE AND AFFORDABLE DRINKING WATER FOR ALL

6.2 BY 2030, ACHIEVE ACCESS TO ADEQUATE AND EQUITABLE SANITATION AND HYGIENE FOR ALL AND END OPEN DEFECATION, PAYING SPECIAL ATTENTION TO THE NEEDS OF WOMEN AND GIRLS AND THOSE IN VULNERABLE SITUATIONS

6.3 By 2030, improve water quality

6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity

6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate

6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes

Continued .....

NATIONAL INDICATORS USED

SDG Global Target	Indicator selected for SDG for India Index	National Target Value for 2030
6.1 BY 2030, ACHIEVE UNIVERSAL AND EQUITABLE ACCESS TO SAFE AND AFFORDABLE DRINKING WATER FOR ALL	PERCENTAGE OF POPULATION HAVING SAFE AND ADEQUATE DRINKING WATER	100

NATIONAL INDICATORS USED

SDG Global Target	Indicator selected for SDG for India Index	National Target Value for 2030
6.2 BY 2030, ACHIEVE ACCESS TO ADEQUATE AND EQUITABLE SANITATION AND HYGIENE FOR ALL AND END OPEN DEFECATION, PAYING SPECIAL ATTENTION TO THE NEEDS OF WOMEN AND GIRLS AND THOSE IN VULNERABLE SITUATIONS	2. PERCENTAGE OF HOUSEHOLD WITH INDIVIDUAL HOUSEHOLD TOILET.	100
	3. PERCENTAGE OF DISTRICTS VERIFIED TO BE OPEN DEFECATION FREE	100
	3. INSTALLED SEWAGE TREATMENT CAPACITY AS A PROPOTION OF SEWAGE GENERATED IN URBAN AREAS	70

NATIONAL INDICATORS USED

SDG Global Target	Indicator selected for SDG for India Index	National Target Value for 2030
6.4 BY 2030, SUBSTANTIALLY INCREASE WATER-USE EFFICIENCY ACROSS ALL SECTORS AND ENSURE SUSTAINABLE WITHDRAWALS AND SUPPLY OF FRESHWATER TO ADDRESS WATER SCARCITY AND SUBSTANTIALLY REDUCE THE NUMBER OF PEOPLE SUFFERING FROM WATER SCARCITY	5. PERCENTAGE ANNUAL GROUND WATER WITHDRAWAL AGAINST NET ANNUAL AVAILABILITY	70

SUSTAINABLE WATER ??

IT MEANS AN AREA / TOWN / CITY/ STATE/ NATION THAT CAN BE WATER SELF-SUFFICIENT:

ENSURING THERE IS ENOUGH WATER TO MEET MULTIPLE NEEDS, FROM AGRICULTURE TO MUNICIPAL AND INDUSTRIAL.

IT ALSO MEANS WATER SUPPLY WILL REMAIN CONSISTENT, DESPITE CLIMATE CHANGE IMPACTS, SUCH AS A LACK OF RAINFALL AND DROUGHT, OR TOO MUCH RAIN AND BEING FLOOD RESILIENT.

APPROACHES FOR WATER MANAGEMENT CONSIDERING SUSTAINABILITY:

- TRADITIONAL ONGOING APPROACHES: RAIN WATER HARVESTING, REDUCING UAW, WATER CONSERVATION
- INTEGRATED URBAN WATER MANAGEMENT (IUWM)/WATER SENSITIVE CITIES

(TAKING CARE OF CLIMATE CHANGE IMPACTS)

- LATEST APPROACH

SUSTAINABLE WATER PLANNING:

WE HAVE TO INTEGRATE URBAN WATER PLANNING WITH SPATIAL PLANNING (Latest/ innovative idea adopted elsewhere)

- **TRADITIONAL URBAN WATER PLANNING:**

MANAGEMENT OF WATER SOURCES (E.G., GROUNDWATER, SURFACE WATER, AND REUSE), TRANSMISSION, WATER TREATMENT (E.G., QUALITY), DISTRIBUTION SYSTEM/S, WASTEWATER COLLECTION, WASTEWATER TREATMENT AND REUSE.

- SPATIAL PLANNING REFERS TO THE METHODS USED BY THE PUBLIC SECTOR TO INFLUENCE THE DISTRIBUTION OF PEOPLE AND ACTIVITIES IN SPACES OF VARIOUS SCALES.
- A SPATIAL PLANNING PERSPECTIVE ADDRESSES THE “ACTIVITIES OF ECONOMIC AND SERVICE SECTORS (SUCH AS HOUSING, ENERGY, ECONOMIC DEVELOPMENT, TRANSPORT, WATER, WASTE, SOCIAL WELFARE AND HEALTH) THAT HAVE SPATIAL OR LAND USE CONSEQUENCES IN THEIR WIDER SOCIAL AND ENVIRONMENTAL CONTEXT

THUS, CONSIDERING DEMAND AND AVAILABILITY OF WATER, AUTHORITIES OR AGENCIES MAY LIMIT CERTAIN ACTIVITIES.

Reducing Non Revenue Water (N R W)/ U A W

N R W is that quantity of water which does not yield revenue

High levels of NRW are detrimental to the financial viability, lead to higher tariffs and lower service level

Sources of N R W:

- Physical losses due to Leaks, Breaks, Theft (illegal connections), water usage in back washing and in flushing,

- Commercial losses due to Unmetered connection, inaccuracy in meters and readings, faulty billing on lower side and poor collection

NRW reduction approaches:

1. Isolation of zones: Divide entire net work in zones and sub zones and isolate them installing appropriate control valves and bulk meters.

2. Hydraulic analysis of net work to determine actual pressures versus calculated one. Require updated map of network.

3. Analysis of maintenance / repair records (What, where and there frequency. It may lead to decision repair vs. replacement.

4. Leak detection program and control

Locating leaks by direct observation: Wet spot, growing of grass/plants, abnormal pressure drop.

Finding the exact location of leaks in pipelines

i. By putting the sounding metallic rod
ii. By help of other advanced equipments

Monitoring consumptions with metering and billing

NRW percentage = {(Volume of Water produced- Billed Volume)/ produced volume of water} x 100

It must be kept less than 10% including back wash and flushing.

REUSE OF TREATED WASTE WATER

1. Reuse of treated waste water provides an alternative to fresh water where water is required for non-potable use. The water reclaimed from waste water can be used for toilet flushing, agriculture/horticulture, fire hydrants, industries, construction activities, power plants, etc.

Supply to power plants located within 50 Km of the city. As per directions of Ministry of Power, Tariff Policy Circular dated 28 January, 2016, it is mandatory that power plants within 50 kms from STPs have to develop a system for conveyance and use treated waste water. Copy of the Circular is available.

REUSE OF TREATED WASTE WATER

2. Provision of dual piping under Building Bye-Laws should be checked in all government (Central/State/UT/ULB) buildings, commercial complexes, public buildings like educational institutions, hospitals, and Group Housing Societies, whether the same is available, so that the treated waste water can be used for horticulture, toilet flushing and fire hydrants.

3. National Urban Sanitation Policy 2008 mandates reuse of at least 20% of treated waste water.

CASE STUDY- SINGAPORE

NEWater- Reuse of reclaimed/treated waste water

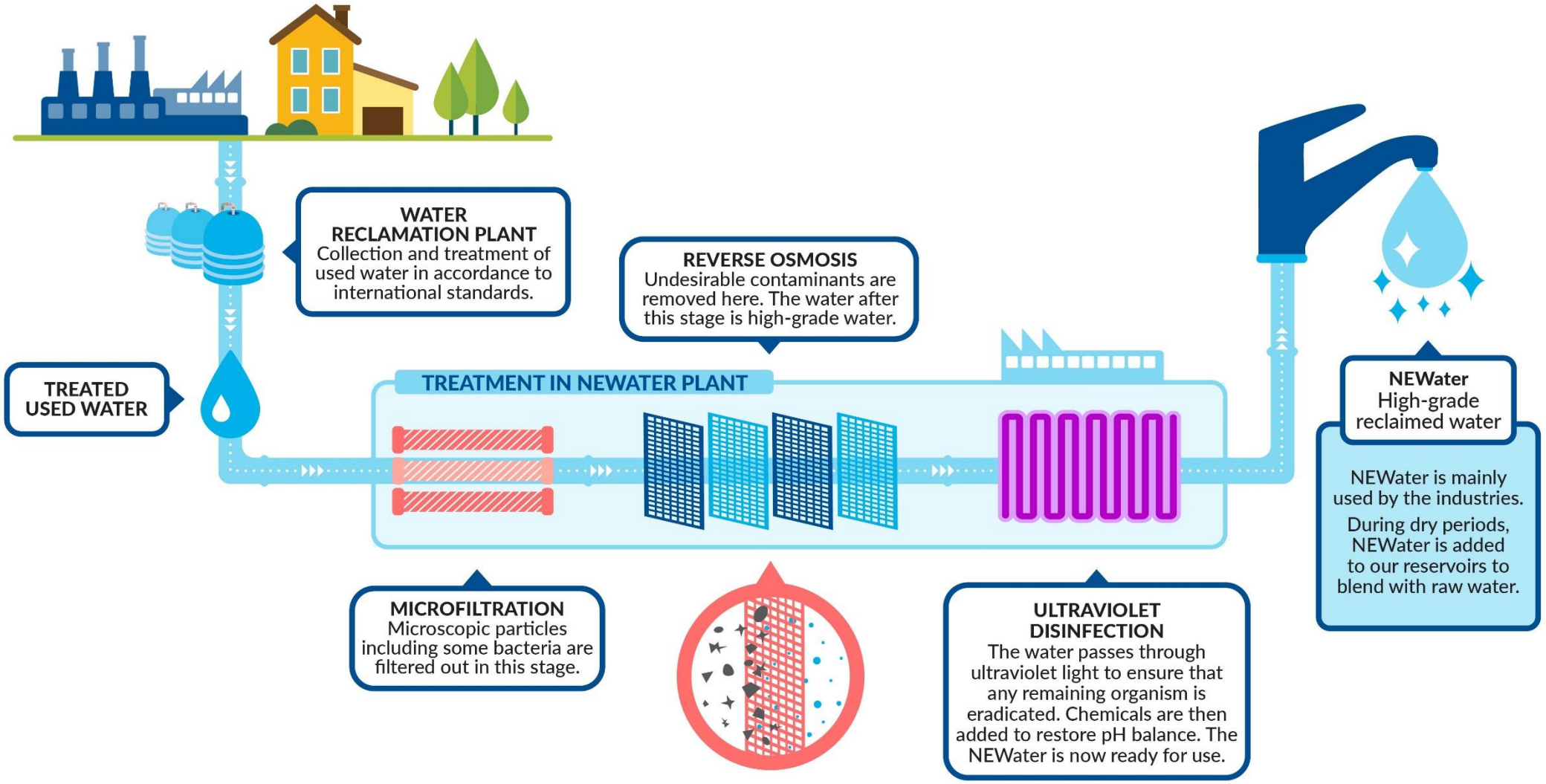
- During 1970s, Feasibility study to determine technical possibility to use reclaimed water
- In 2000 a plant 10000 cubic metre per day capacity commissioned.
- After many tests and audits it was proved that it is safe and sustainable.
- Then it was named NEWater

- **INTERNATIONAL GROUP OF EXPERTS IN ENGINEERING, BIOMEDICAL SCIENCES, CHEMISTRY/BIO CHEMISTRY AND WATER TECHNOLOGY FOUND THAT NEWATER'S QUALITY WAS CONSISTENTLY SAFE AND WELL WITHIN WHO/US-EPA REQUIREMENTS FOR DRINKING.**
- **At present 40% of Singapore's water demand is met with NEWater**

TREATMENT

- Microfiltration
- Reverse Osmosis
- Ultra-violet disinfection
- Chemical added to restore pH

NEWater ready to Use


WATER RECLAMATION PLANT
Collection and treatment of used water in accordance to international standards.
REVERSE OSMOSIS
Undesirable contaminants are removed here. The water after this stage is high-grade water.
TREATED USED WATER
TREATMENT IN NEWATER PLANT
NEWater
High-grade reclaimed water
NEWater is mainly used by the industries.
During dry periods, NEWater is added to our reservoirs to blend with raw water.
MICROFILTRATION
Microscopic particles including some bacteria are filtered out in this stage.
ULTRAVIOLET DISINFECTION
The water passes through ultraviolet light to ensure that any remaining organism is eradicated. Chemicals are then added to restore pH balance. The NEWater is now ready for use.

Rain Water Harvesting (RWH)

RWH is collection and storage of rainwater from roof tops, roadside, open areas, etc. which can be stored for further usage or recharged into ground water to augment water resources.

NEED OF R.W.H. & BENEFITS

- TO SUSTAIN THE RESOURCES FOR NEXT GENERATIONS AS WE GOT IT FROM OUR ANCESTORS
- TO BALANCE THE HYDROLOGICAL CYCLE
- TO IMPROVE THE QUALITY OF WATER
- TO CHECK SOIL EROSION
- TO AVOID DRAUGHT
- TO AVOID FLOOD
- TO SAVE ENERGY IN WITHDRAWAL WATER FROM DEEPER SOURCE
- TO INCREASE VEGETATION COVER FOR ECOLOGICAL BALANCE
- TO SAVE ENVIRONMENT

A RAIN WATER HARVESTING SYSTEM COMPRISES OF:

1. A system or catchment from where water is captured for storage;

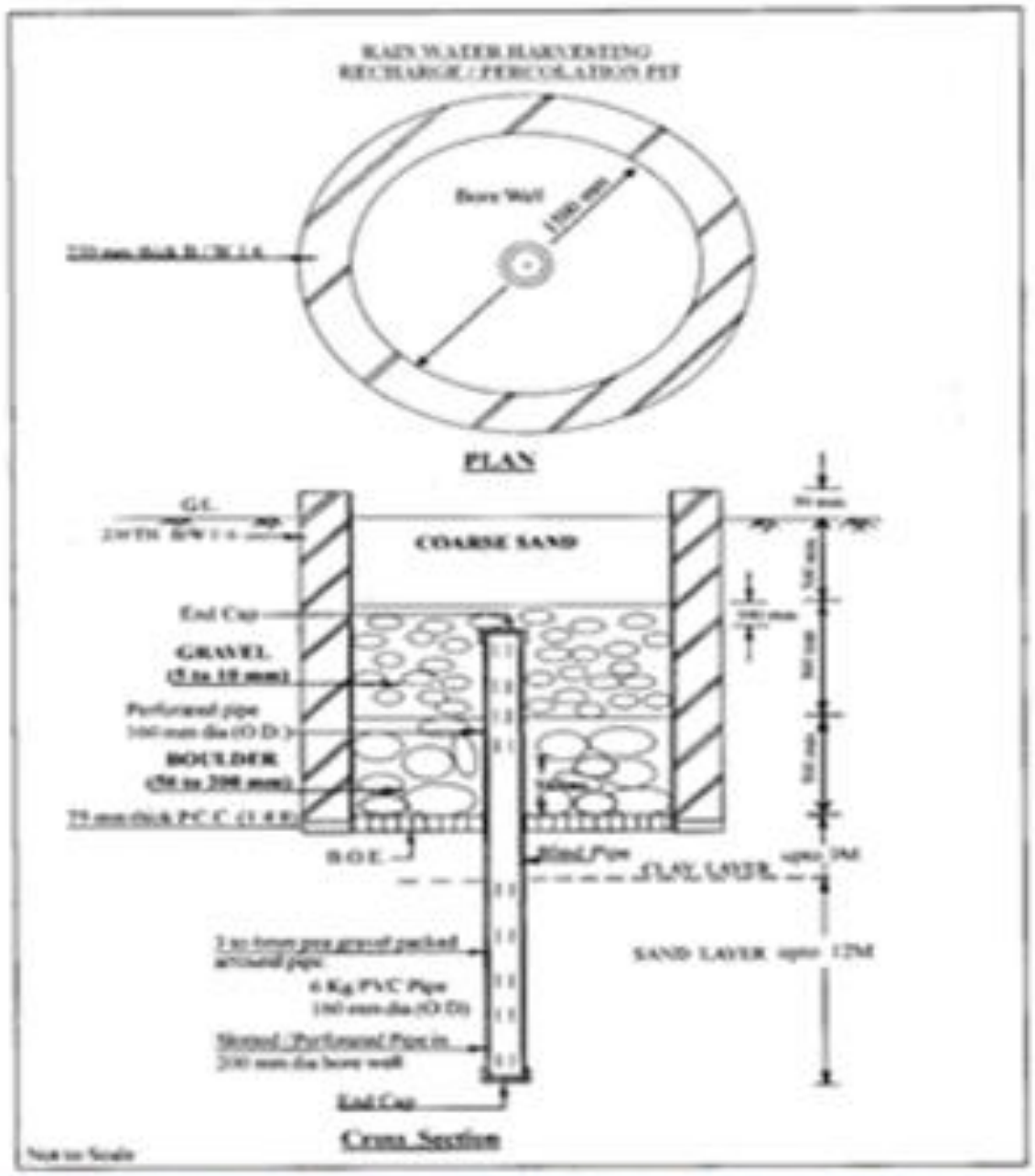
2. A system of pipes/ducts to carry the harvested water to the storage facility;

3. Filter unit for removal of dirt that comes with rain water; and

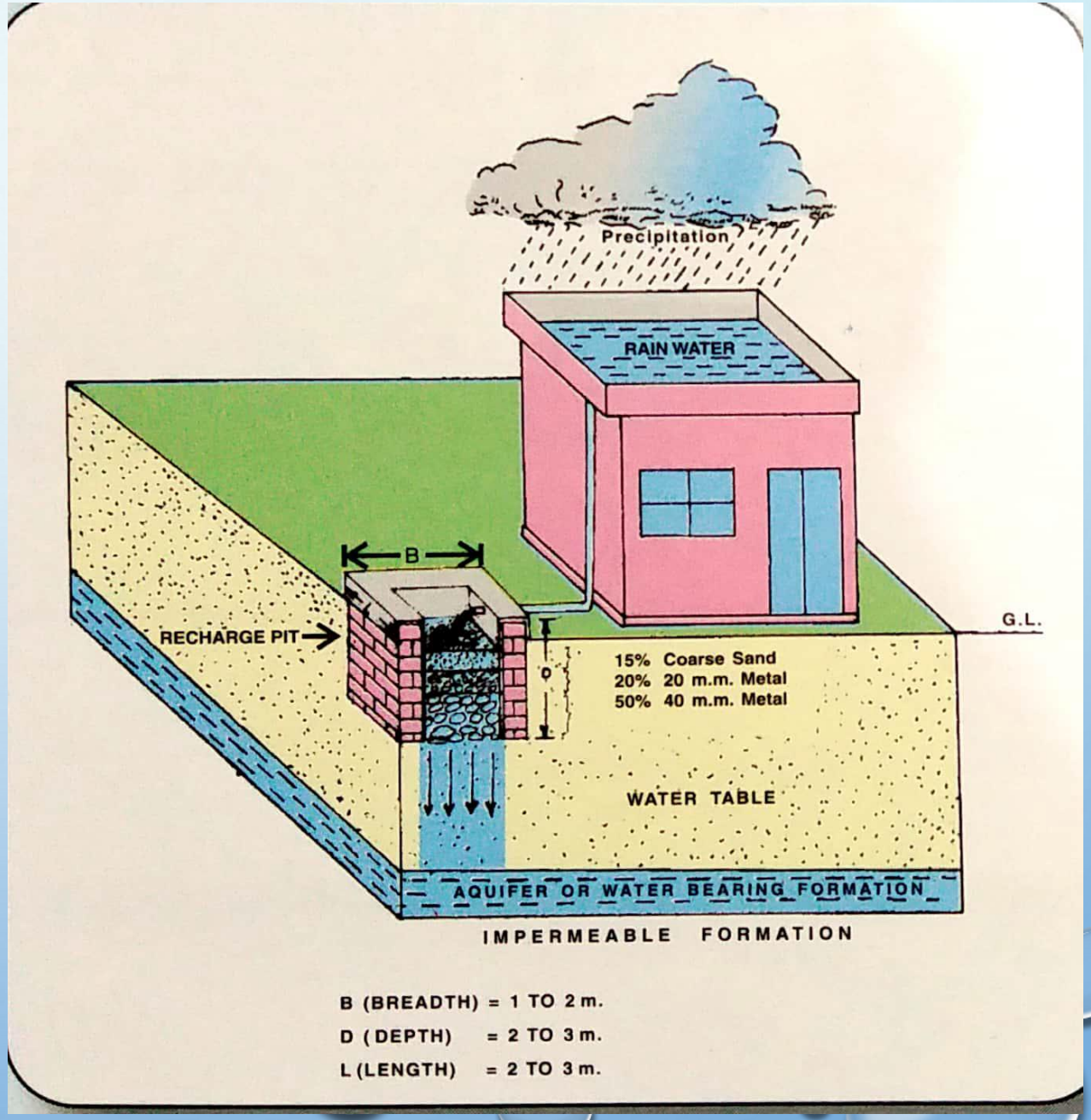
4. Storage tank or ground water recharging structures.

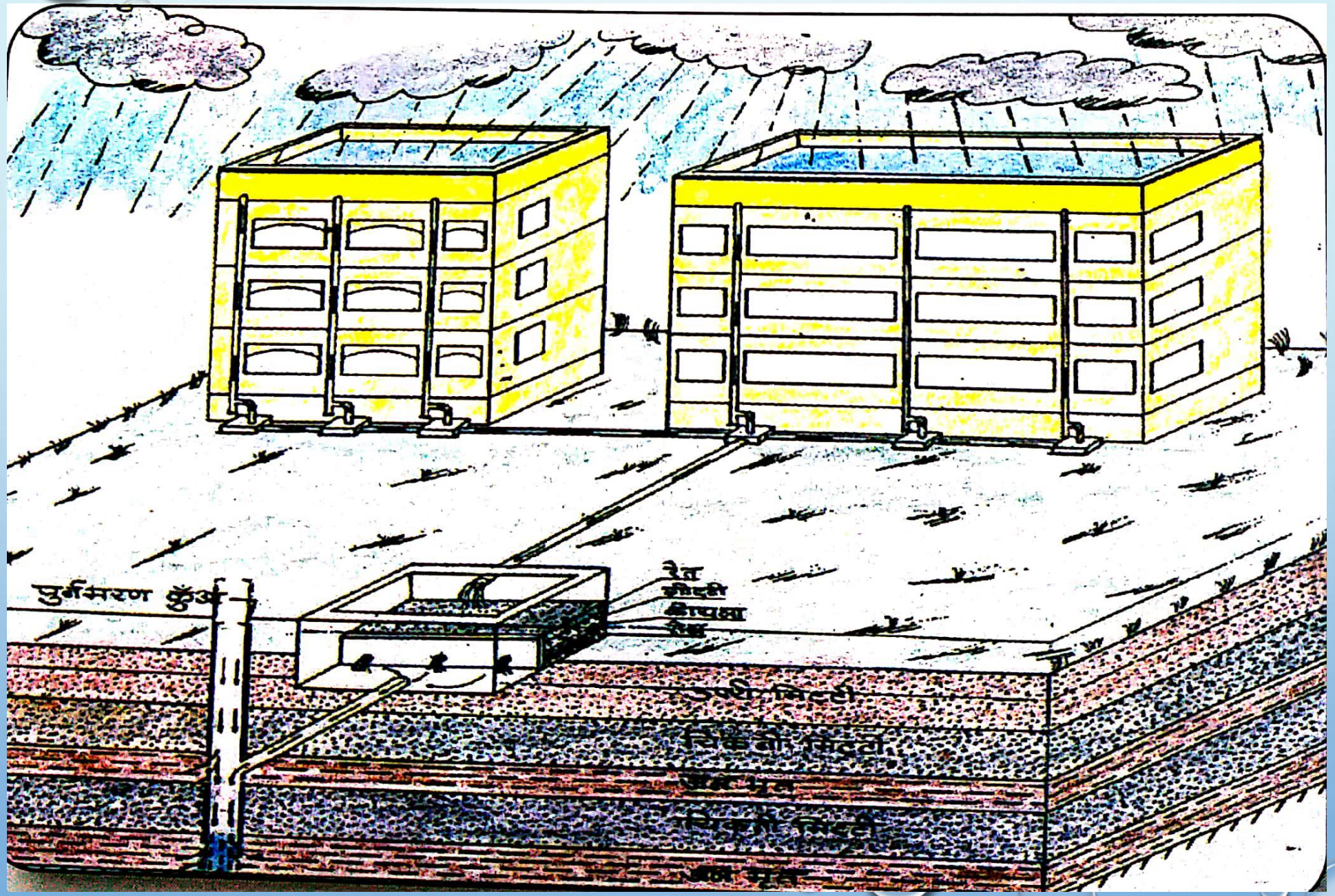
RAIN WATER HARVESTING TECHNIQUES

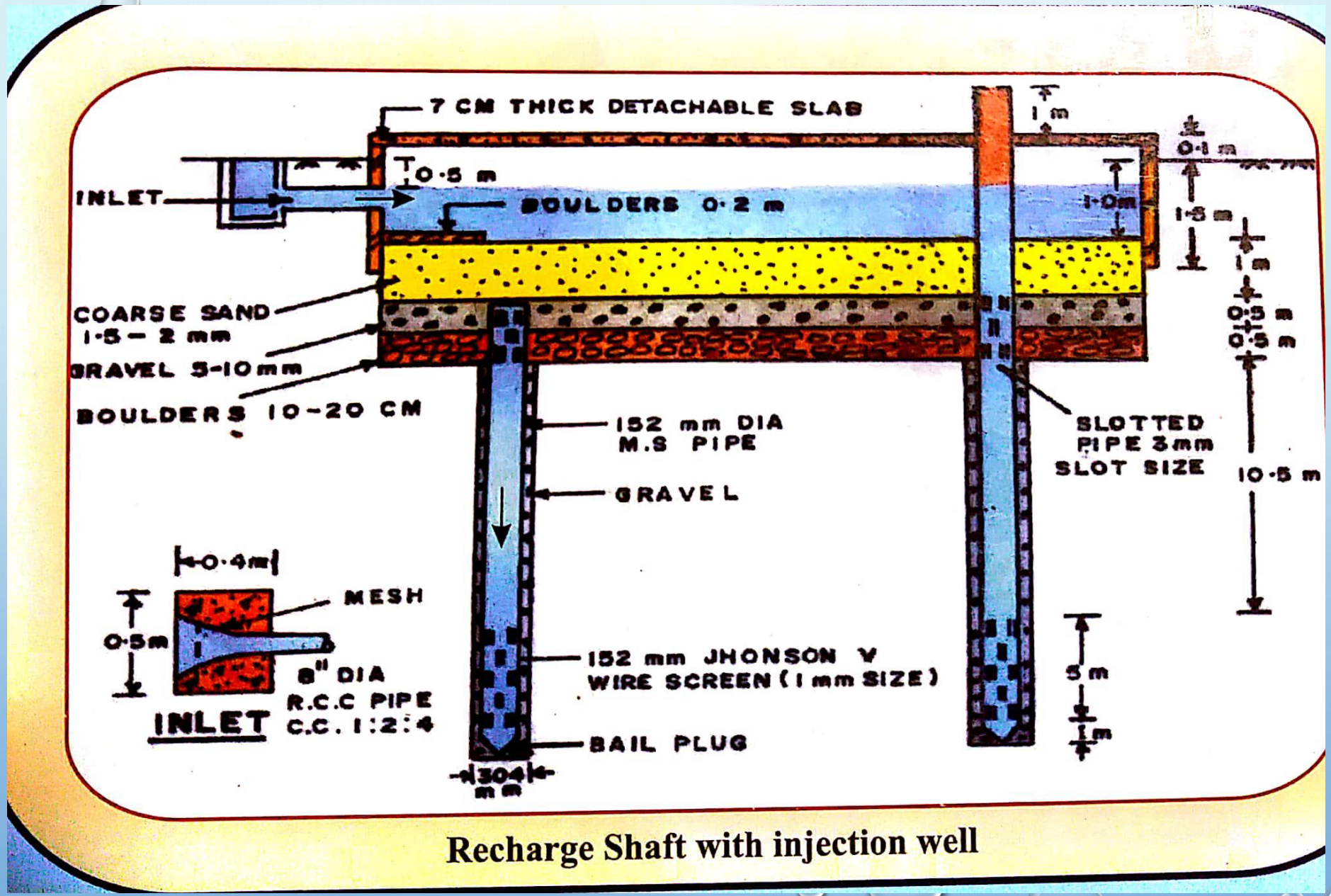
- RECHARGE/PERCOLATION PIT
- RECHARGE/PERCOLATION PIT WITH BORE WELL
- RECHARGE TRENCH WITH or WITHOUT BORE WELL
- GREEN STRUCTURES


RAIN WATER HARVESTING
RECHARGE / PERCOLATION PIT
Bore Well
PLAN
G.L.
COARSE SAND
End Cap
GRAVEL
(5 to 10 mm)
Perforated pipe
BOULDER
(50 to 200 mm)
S.O.E.
Blind Pipe
SAND LAYER
6 Kg PVC Pipe
Slotted / Perforated Pipe in
End Cap
Cross Section
Not to Scale

Roof top Rain Water Harvesting

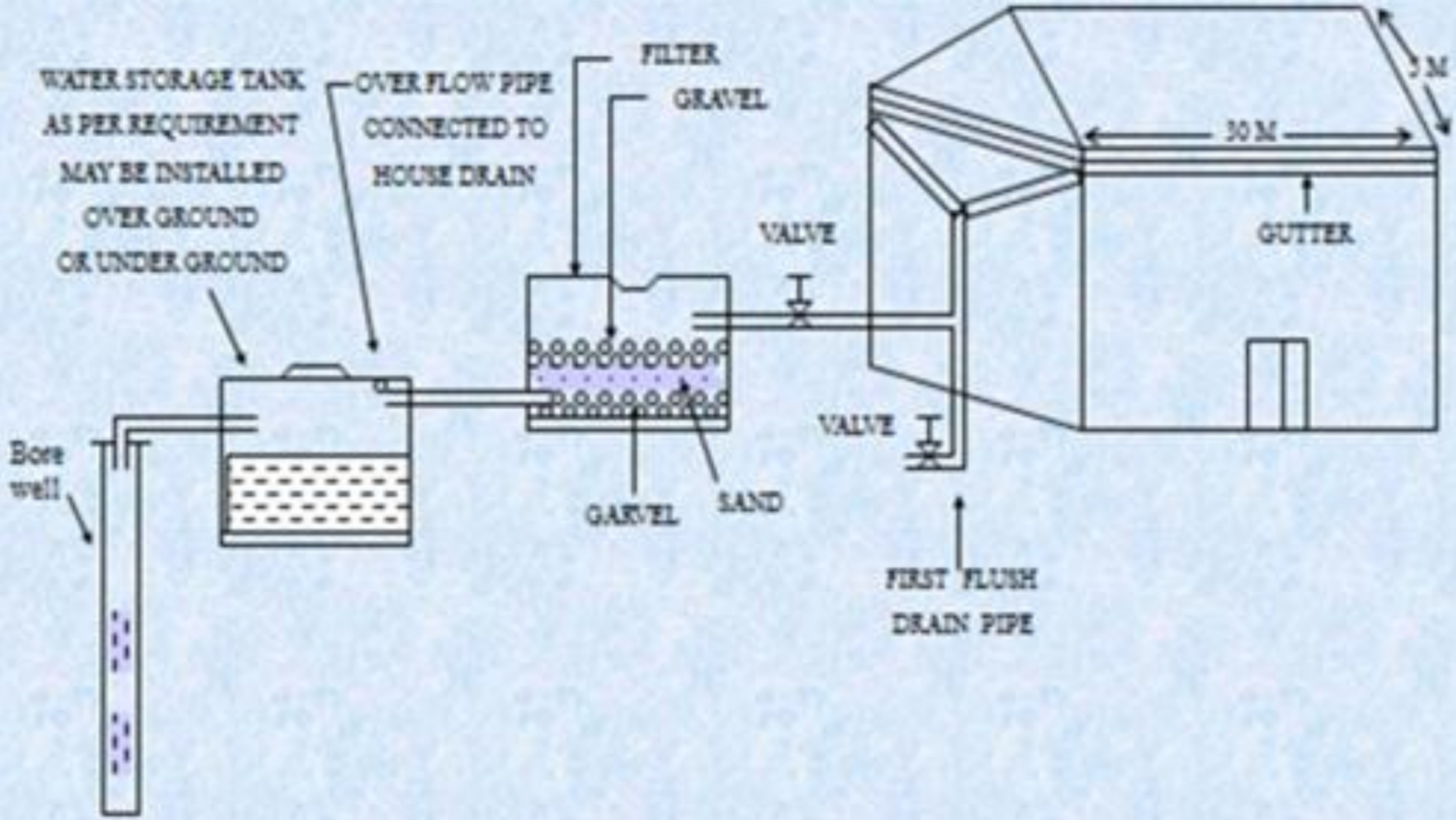



पुर्नभरण कुँआ
रेत
गिट्टी
कोयला
रेत



Recharge Shaft with injection well

RAIN WATER HARVESTING – AN - ILLUSTRATION



The following formulae is used for the estimation of quantity of water available from rain :

$$Q = C\,R\,A$$

Where,

Q = Quantity/volume of water in litres

C = Run-off Coefficient

R = Average Rain fall in mm.

A = Area of Catchment in m^2

Table:-I Runoff Coefficients

Sl. No.	Types of surface/catchments	Coefficient
1	2	3
1.	Pucca / Cement concrete Roof	0.80
2.	Pucca / Brick tiles Roof	0.75
3.	Corrugated / Plain G.I./ Plastic Sheets Roof	0.85
4.	Asbestos Sheets Roof	0.85
5.	Ground Surface- Cement, Concrete	0.70
6.	Ground surface - Bricks	0.60

Table 4 - Availability of Rain Water through Roof Top Rain Water Harvesting

Rainfall(mm)	100	200	300	400	500	600	800	1000	1200	1400	1600	1800	2000
Roof top area (sqm)	Harvested water from Roof top (cum)												
20	1.6	3.2	4.8	6.4	8	9.6	12.8	16	19.2	22.4	25.6	28.8	32
30	2.4	4.8	7.2	9.6	12	14.4	19.2	24	28.8	33.6	38.4	43.2	48
40	3.2	6.4	9.6	12.8	16	19.2	25.6	32	38.4	44.8	51.2	57.6	64
50	4	8	12	16	20	24	32	40	48	56	64	72	80
60	4.8	9.6	14.4	19.2	24	28.8	38.4	48	57.6	67.2	76.8	86.4	96
70	5.6	11.2	16.8	22.4	28	33.6	44.8	56	67.2	78.4	89.6	100.8	112
80	6.4	12.8	19.2	25.6	32	38.4	51.2	64	76.8	89.6	102.4	115.2	128
90	7.2	14.4	21.6	28.8	36	43.2	57.6	72	86.4	100.8	115.2	129.6	144
100	8	16	24	32	40	48	64	80	96	112	128	144	160
150	12	24	36	48	60	72	96	120	144	168	192	216	240
200	16	32	48	64	80	96	128	160	192	224	256	288	320
250	20	40	60	80	100	120	160	200	240	280	320	360	400
300	24	48	72	96	120	144	192	240	288	336	384	432	480
400	32	64	96	128	160	192	256	320	384	448	512	576	640
500	40	80	120	160	200	240	320	400	480	560	640	720	800
1000	80	160	240	320	400	480	640	800	960	1120	1280	1440	1600
2000	160	320	480	640	800	960	1280	1600	1920	2240	2560	2880	3200
3000	240	460	720	960	1200	1440	1920	2400	2880	3360	3840	4320	4800

Table:-II Availability of Rain water through Roof Top

Area of Roof in Square meter	Annual Rainfall in mm.				
	400	500	600	800	1000
	Quantity of harvested water from Roof (Cu meter)				
80	25.6	32	38.4	51.2	64
100	32	40	48	64	80
150	48	60	72	96	120
200	64	80	96	128	160
250	80	100	120	160	200

Volume of Tank required

$$V = t \times n \times q + et$$

where,

V = Volume of Tank (liters)

t = length of dry season (days)

n = number of persons using tank

q = demand per capaita per day per person (liters)

et = Evaporation loss during the dry period of t days.

e = Evaporation rate.

Table:-III Storage Capacity of Tank

Normal rainfall in mm.	Storage capacity in Kilo litres as per Area of Roof		
	100 Sqm.	200 Sqm.	300 Sqm.
600	2.2	4.4	6.6
800	2.9	5.8	8.7
900	3.2	6.4	9.6

Table:-IV Sizing of Rain Water Pipes for roof drainage

Sl. No.	Dia meter (internal) of pipe (in mm.)	Average Rain Fall (mm. per hour)			
		50	75	100	125
		Roof Area in Sqm.			
1.	65	24.1	16.0	12.0	9.6
2.	80	40.8	27.0	20.4	16.3
3.	100	85.4	57.0	42.7	34.2
4.	125	-	-	80.5	64.3

ULBS MAY UNDERTAKE THE FOLLOWING MEASURES:

1. Enforcement of Building Bye-Laws

2. Establishment of Rain Water Harvesting Cell

3. Specific measures during JSA

a. ULBs should ensure that all government buildings (Central/State/ULB) must have RWH structures.

b. ULBs should check that all public buildings like educational institutions, commercial establishments, hospitals, etc have got RWH structures

ULBS SHOULD UNDERTAKE THE FOLLOWING MEASURES:

c. ULBs should check Group Housing Societies whether they have RWH structures available or not.

d. ULBs should ensure that in future all building permissions granted must have RWH structures incorporated, as per BBLs, and same should be checked before issuing Occupancy-cum-Completion Certificate (OCC).

e. ULBs should undertake de-concretizing of pavements around trees. ULBs should lay perforated paver blocks which allow water to percolate into the ground along tree roots.

RWH structures taken from Model Building Bye-Laws 2016 (MBBL 2016)

CONSERVATION OF WATER

Need for conservation of water

- Increase in Water demand
- Water sources are depleting
- Saving money on utility bill,
- Conserving water can also extend the life of your septic system/soak pits by reducing soil saturation and reducing pollution due to leaks.
- Overloading municipal sewer systems can also cause untreated sewage to flow to lakes and rivers.
- The smaller the amount of water flowing through these systems, the lower the cost of these systems.
- Costly sewage system expansion has been avoided by community-wide household water conservation.

Household tips for conservation

- Keep a bucket near utensil washing sink, pour left out water in that after guest has used it. Use this water for washing machine, for watering plants
- Give only half glass of water first, then give on demand
- Put Plastic Bottles in Your Toilet cistern
- Install Low or Dual Flush Models
- Use Clothes Washer for Only Full Loads
- Consider a High Efficiency Washing Machine
- Install Water-Saving Showerheads, Shower Timers, and Low-Flow Faucet Aerators
- Take Shorter Showers
- Keep a tub, standing or sitting below shower

WATER CONSERVATION AT HOME

SHOWER

WET DOWN, TAP OFF, SOAP UP, RINSE OFF …….……. 30 Lts.

SHOWER FOR TEN MINUTES …….. …….. 90 Lts

THUS BY TURNING THE TAP OFF WHILE SOAPING UP WE CAN SAVE …. 60 Lts.

BATHING (IN TUB)

QUICK SHOWER …… 30 Lts.

BATH TUB ……..…….....…… 110 Lts.

WASTAGE …… …….. ……... 80 Lts


Avoid shower &
swimming pool bath

WASTAGE DUE TO LEAK OR TAP OPEN

ONE DROP / SEC. 5 L /DAY

TWO DROPS / SEC. 10 L/DAY

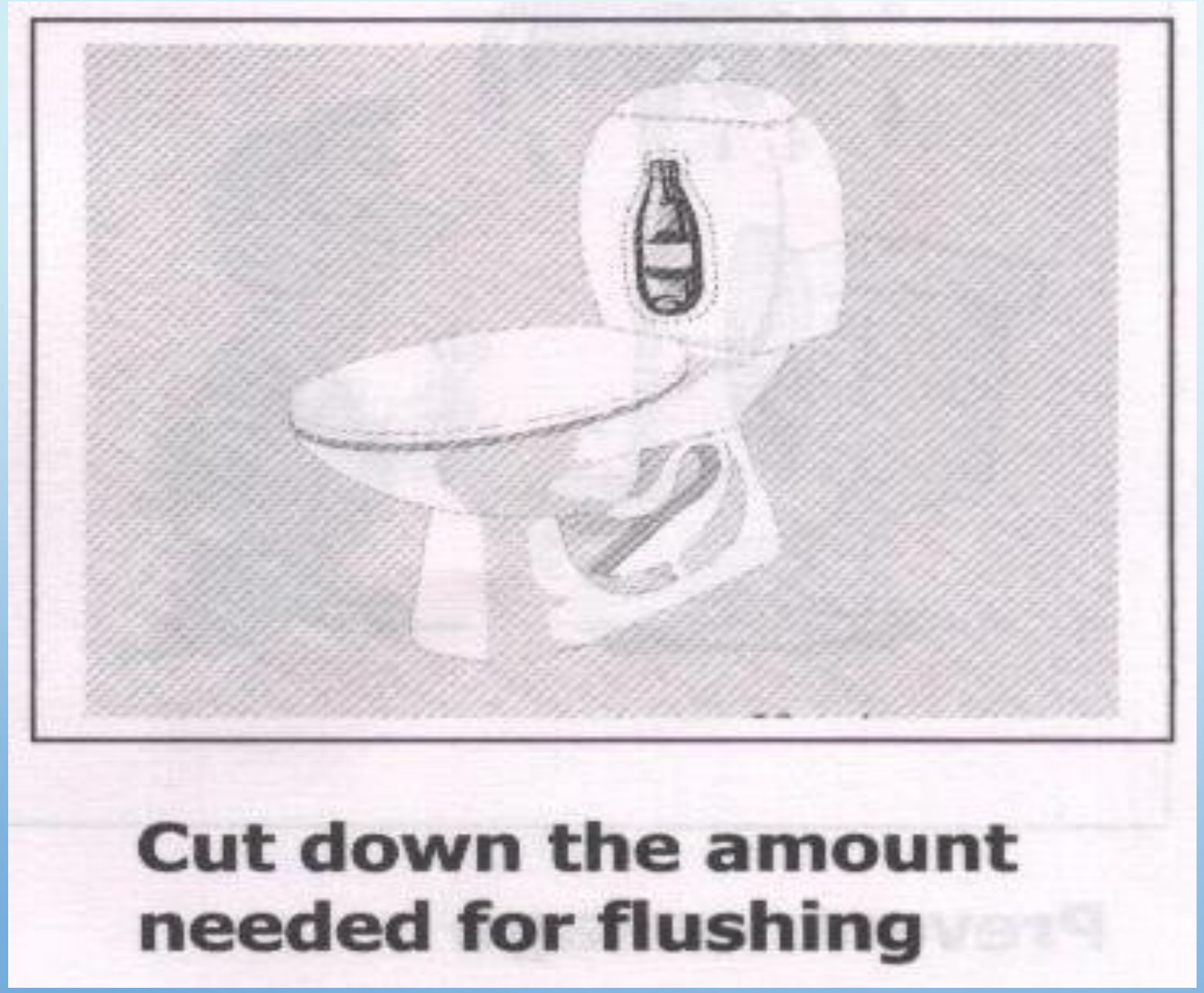
DROPS BREAKINGS TO STREAM 100 L/DAY

HALF SOOT STREAM 300 L/DAY

ONE SOOT STREAM 1250 L/DAY

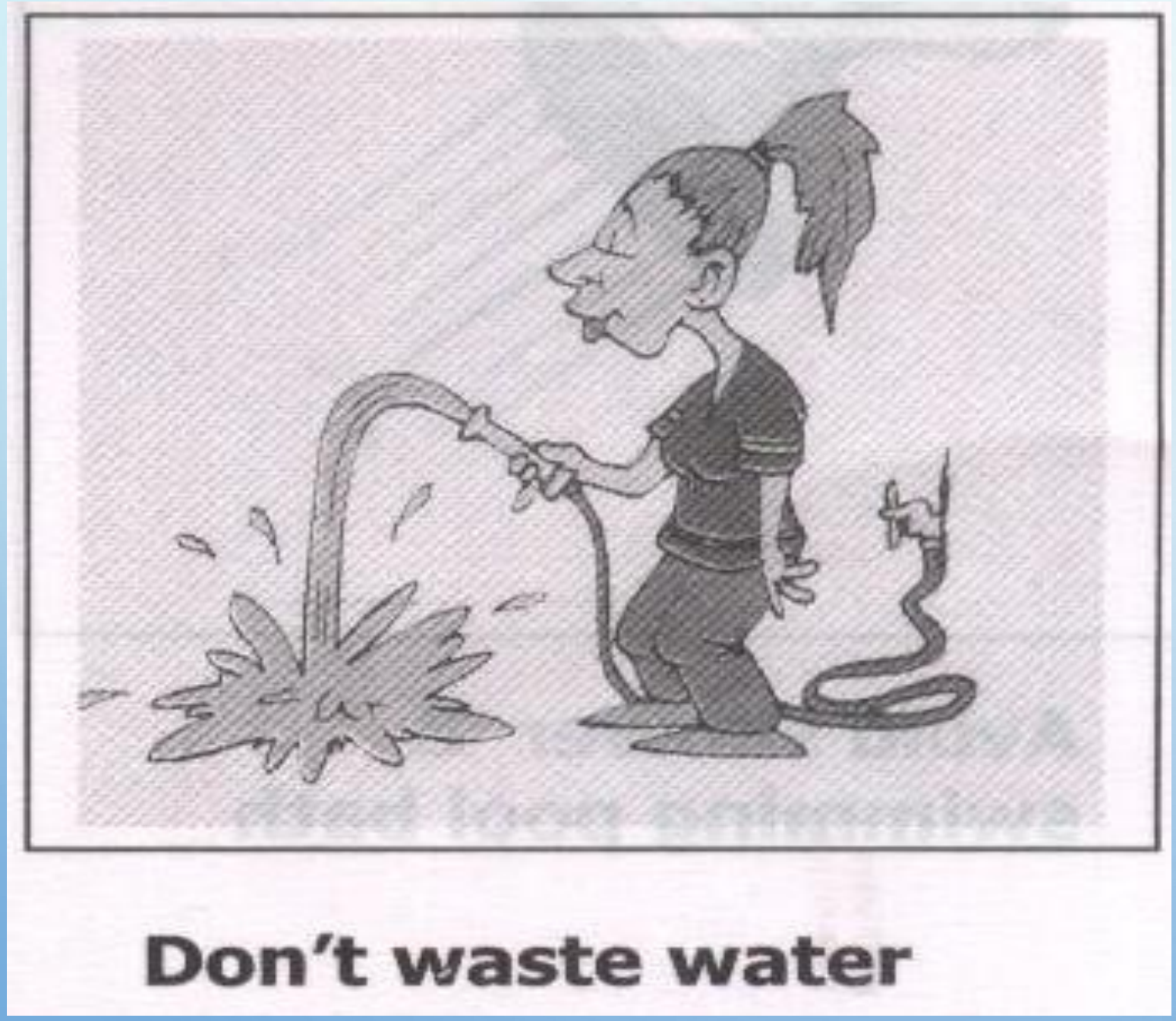
Don’t keep tap open while brushing teeth, washing face or shaving

Clean vegetables, utensils & clothes in a pan instead of running water



FULL FLUSH ……
INSTEAD 9 Lts. USE 6 Lts.

HALF FLUSH ……
INSTEAD 4.5 Lts. USE 3 Lts.



WASHING CAR

BUCKETS …… 18 Lts.

HOSE (10 MIN.)… 300 Lts.

Avoid floor & driveways washing daily

Avoid vehicle washing with potable water

Don't contaminate water by adding colour or other pollutants

Storm Water Management

Causes of Flooding

- The ponds, lake or bawaries , the sources of run-off collection are diminishing day by day.
- Unplanned urbanization is causing considerable increase in impervious areas.
- Global climate change 1°C of temperature increase cause increased intensity of rainfall.

Storm Water Management contd.....

Causes of Flooding contd.....

- The illegal disposal of construction & demolition waste/ municipal solid waste coupled with poor maintenance of existing drainage system

- Absence of systematic approach to implemental holistic storm water drainage scheme (Not planning in totality).

How to Avoid Flooding

- **Proper assessment of storm water runoff.**

Ref. : Manual on Storm Water Drainage Systems – 2019,

Volume-1, Part-A CPHEEO web site

- **Properly designed drainage system should be provided considering the disposal point.**

Ref. : Manual on Storm Water Drainage Systems – 2019,

Volume-1, Part-A CPHEEO web site

- **Maintain the existing ponds or create new ponds/ basins, inside or near the habitations.**

How to Avoid Flooding contd....

- **Properly Maintained and Operated Drainage system**

  Ref.: Manual on Storm Water Drainage Systems – 2019, Volume-2, Part-B CPHEEO web site

- **Following Standard Operating Procedures**

  Ref.: NIUA's Standard Operating Procedures for drainage

How to Avoid Flooding contd....

- **Providing Green Structures and RWH systems**

Ref.: Manual on Storm Water Drainage Systems – 2019, Volume-2, Part-C CPHEEO web site

Sustainable sanitation

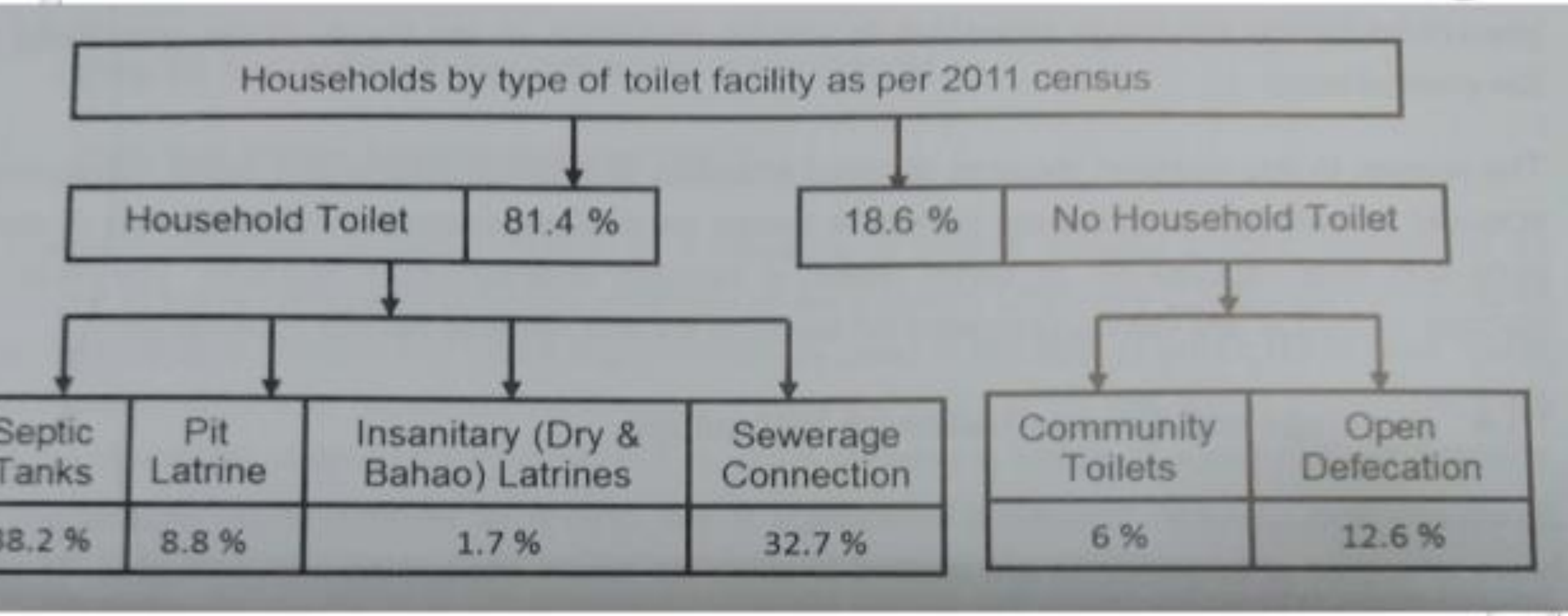
Resource Recovery

Energy- Biogas

Manure

DECENTRALIZED SANITATION SOLUTIONS FOR URBAN REGIONS OF HILLY AREAS

SANITATION is defined as safe management of human excreta including safe confined treatment, disposal and associated hygiene related practices


Households by type of toilet facility as per 2011 census
Household Toilet
81.4 %
18.6 %
No Household Toilet
Septic Tanks
Pit Latrine
Insanitary (Dry & Bahao) Latrines
Sewerage Connection
Community Toilets
Open Defecation
38.2 %
8.8 %
1.7 %
32.7 %
6 %
12.6 %

Out of 92 ULBs in the Uttarakhand state only 12-14% have partial sewerage system with partial treatment capacity that too is under utilised.

Reasons:

- **Huge financial requirement**
- **Skilled man power requirement**
- **Poor maintenance due to paucity of required finances.**

AS PER AN ESTIMATE IN 2015,

- **Sewage generation in India- 61,754 MLD**
- **Sewage Treatment Capacity- 22,963 MLD**

Thus 62% of untreated or partially treated Sewage was going into water bodies

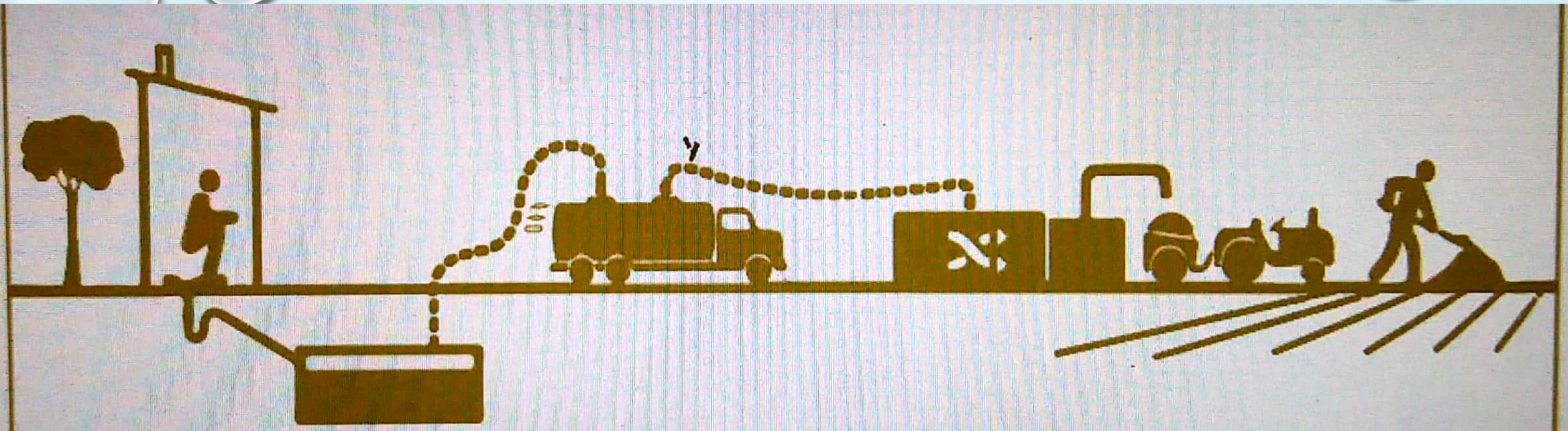
- **STPs in India are 920,**
- **615 STPs are operational**
- **80 STPs are non-operational**
- **154 STPs are under construction**
- **71 STPs are sanctioned**

Uttarakhand have only 24 STPs + 4 STPs, 225 MLD/ 103MLD

Uttarakhand:

Existing STP Capacity in MLD

- **Dehradun - 68+20 MLD**
- **Jagjeetpur Haridwar - 18 +27 MLD**
- **Sarai, Haridwar - 18 MLD**
- **Lakarghat, Rishikesh - 6MLD**
- **Swargashram - 3 MLD**
- **Tapovan - 3.5 MLD**
- **Devprayag - 1.4 MLD**
- **Srinagar - 3.5 MLD**
- **Uttarkashi - 2.0 MLD**
- **Gangotri - 1.0 MLD**



	Containment	Emptying and transport	Treatment	Disposal and end use
Definition	An onsite sanitation system into which a user interface discharges	Manual or motorized removal and transportation of faecal waste from the containment system	Process of converting faecal sludge into a product that is safe for end use	Disposal or utilization of output products derived from sanitation systems
Examples	Septic tanks, soakpits and cesspools	Vacuum trucks or carts	FSTPs, constructed wetlands and dewatering	Manure

Source: Compiled by CSE, 2016

REGULATORY FRAMEWORK

As per Constitution WATER and SANITATION are the responsibility of the STATE (Seventh Schedule, List II, Entries 6 & 17 respectively.

According to 74th C A act 1992, the Urban Service delivery including Sanitation is the responsibility of ULBs under local Municipal Laws

Article 252 of Constitution empowers Parliament to enact laws relating to Environment and Manual scavenging.

Water (Prevention and Control of Pollution) Act 1974 [WPCPA]

Environmental (Protection) Act, 1986 [EPR]

Policies, Administrative directions and Guidelines:

BIS Code of Practice for Installation of Septic Tanks- IS:2470 1985

CPHEEO's Manual on Sewerage and Sewage Treatment, 2013

Advisory on Septage Management, GoI. 2013 also provide the outline to prepare a septage management sub plan as a part of City sanitation plan.

Ministry of Urban Development (MoUD) now named as Ministry of Housing and Urban Affairs (MoHUA)

- **Missions such as SBM(Urban-2014)/AMRUT(2015) also specifies proper sanitation facilities and Faecal Sludge/ Septage Management in the ULBs.**

- **The Primer on Faecal sludge and Septage Management, 2016 stresses need for State-wide operative guidelines, City level tool kit, operation Manual etc.**

- **The MoHUA/ Ministry of Housing and Urban Affairs has come up with National Policy on Faecal Sludge and Septage Management, 2017.**

Thank you for your active participation
And patience listening