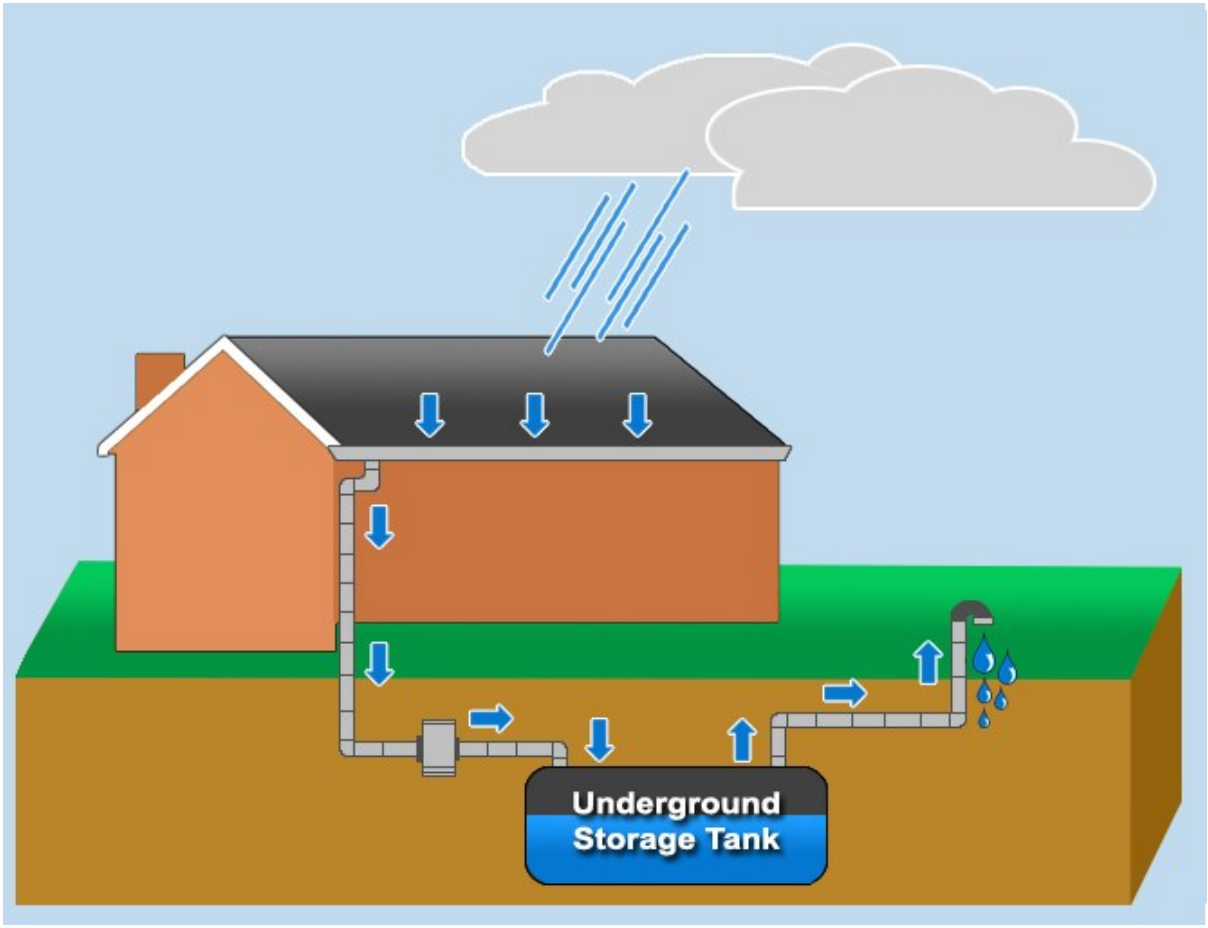
Rainwater Harvesting



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Introduction

Rainwater harvesting is collecting the run-off from a structure or other impervious surface in order to store it for later use. Traditionally, this involves harvesting the rain from a roof. The rain will collect in gutters that channel the water into downspouts and then into some sort of storage vessel. Rainwater collection systems can be as simple as collecting rain in a rain barrel or as elaborate as harvesting rainwater into large cisterns to supply your entire household demand.

The idea of rainwater harvesting usually conjures up images of an old farm cistern or thoughts of developing countries. The reality is that rainwater harvesting is becoming a viable alternative for supplying our households and businesses with water. It's not just for the farm anymore! There are many countries such as Germany and Australia where rainwater harvesting is a norm. Due to the green building movement, you will be seeing rainwater harvesting systems become more popular here in America.

The collection of rainwater is known by many names throughout the world. It ranges from rainwater collection to rainwater harvesting to rainwater catchment. In addition, terms such as roof water collection or rooftop water collection is also used in other countries.

We believe that rainwater harvesting is a viable technology in an urban setting. All that is necessary to take advantage of this resource is to capture the free water falling on your roof and direct it to a rainwater storage tank. By doing this, you can take control of your water supply and replace all or at least a substantial portion of your water needs. Rainwater harvesting systems can be configured to supply your whole house and/or your landscape needs.

What Are the Benefits of Rainwater Collection?

- Rainwater is a relatively clean and absolutely free source of water.

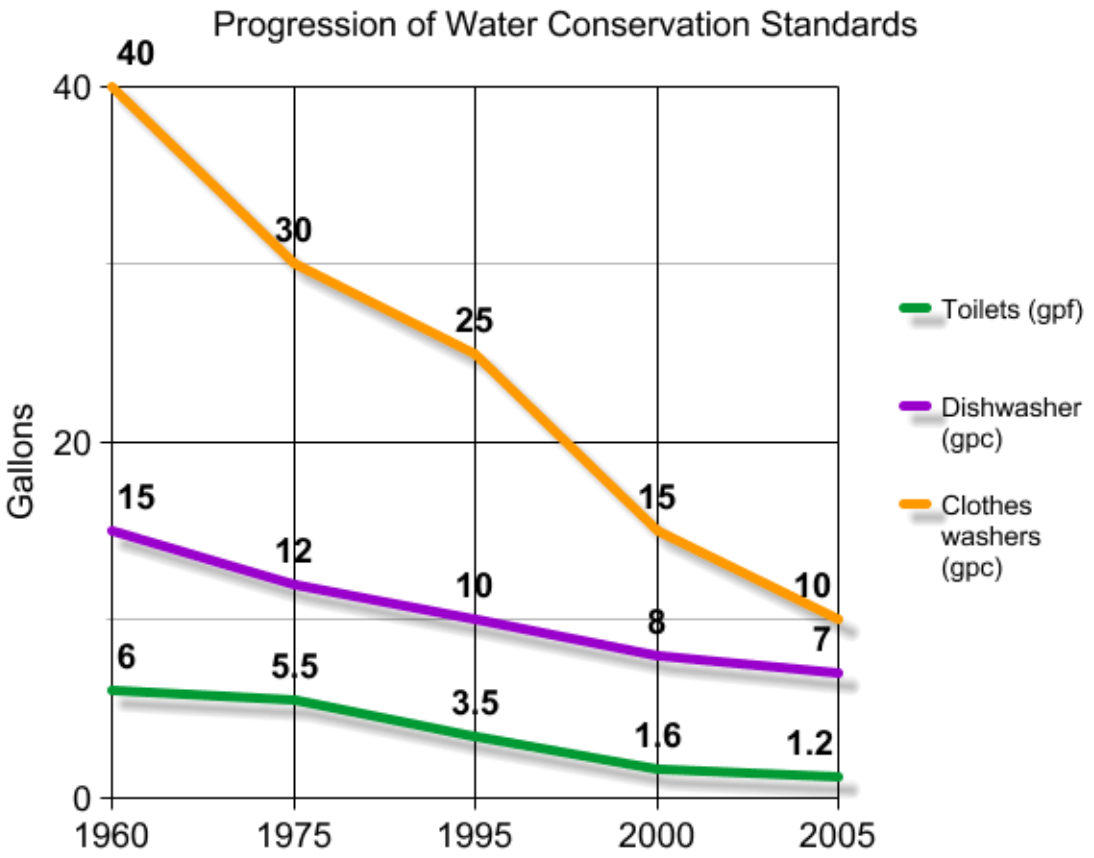
- You have total control over your water supply (ideal for cities with water restrictions).
- It is socially acceptable and environmentally responsible.
- It promotes self-sufficiency and helps conserve water.
- Rainwater is better for landscape plants and gardens because it is not chlorinated.
- It reduces storm water runoff from homes and businesses.
- It can solve the drainage problems on your property while providing you with free water.
- It uses simple technologies that are inexpensive and easy to maintain.
- It can be used as a main source of water or as a backup source to wells and municipal water.
- The system can be easily retrofitted to an existing structure or built during new home construction.
- System are very flexible and can be modular in nature, allowing expansion, reconfiguration, or relocation, if necessary.
- It can provide an excellent back-up source of water for emergencies.

Why Is Rainwater Harvesting Important?

Rainwater harvesting is important for several reasons but one of the biggest is the fact that we are tapping out water conservation gains inside our homes so we need to start looking outdoors for more opportunities.

The following graph shows the gains that have been achieved with our indoor water fixtures through the combination of governmental standards and innovation by fixture companies. As you can see, we don't have much more room to go in terms of achieving more efficiency gains with our indoor fixtures. What's next… the ٠.٢ gallon per flush toilet? Probably not!

This phenomenon is known as the law of diminishing returns. So where will the next revolution in water conservation take place? We believe we offer services in the areas where this revolution will take place.



What Are the Uses of Collected Rainwater?

You can essentially use rainwater anywhere you use tap water. The idea of using drinking water to flush our toilets and water our lawns is wasteful and irresponsible, especially in light of population growth and water shortages across the country. Rainwater collection is a technique to green your home and to lessen your environmental footprint.

There are basically three areas where rainwater can be used:

١-Irrigation use

٢-Indoor, non-potable use

٣-Whole house, potable use

Here are some ideas for specific uses of rainwater:

- Hand water your lawn and garden.
- Connect rainwater collection system to irrigation/sprinkler system.
- Wash your vehicles.
- Wash your pets.
- Refill your fountains and fish ponds.
- Refill your swimming pool.
- Replace the use of tap water with rainwater to wash your driveways and sidewalks (if you don't use a broom).
- Use it for all indoor non-potable fixtures (toilets and clothes washer).
- Use it for all potable needs when properly filtered and disinfected.
- Use it for industrial processes instead of municipally treated water.

So Just How Much Rain Can I Collect?

The amount of rainfall that you can collect is governed by the following formula:

١″ of rain x ١ sq. ft. = ٠.٦٢٣ gallons

Easy to Remember Formula: ١″ of rainfall over ١,٠٠٠ sf will yield ٦٢٣ gallons

To calculate the amount of rainwater you can collect, you need to know your annual average precipitation for your area. You can use the precipitation map below to find an approximate amount for your area.

How to Harvest Rainwater

So you're convinced that you want to start collecting rainwater at your house. Below you will find the resources to educate yourself on the best method for harvesting rainwater in your situation. You will also find information about the basic components of a rainwater collection system. Even though rainwater catchment is an old technology, there have been many improvements over time through product innovations.

The only thing that differs in the following methods is the scale of the system. They all follow the same principles but differ on aesthetics and actual water conservation effectiveness. Click the pictures for a closer look.

Rain barrels can get you started

RAIN BARRELS

This method is the most common and one that many people are familiar with. This involves installing a barrel at a gutter downspout to collect rainwater. The actual barrel may be a recycled barrel or a new commercially available rain barrel.

Pros:

- Easily implemented by anyone at any residence
- Barrels are readily available in your community or at various stores & websites
- Barrels don't take up much space so they can fit into any situation

Cons:

- Capacity is generally only ٥٠ to ١٠٠ gallons

“DRY” SYSTEM

This method is a variation of a rain barrel set-up, but it involves a larger storage volume. Essentially, the collection pipe “drys” after each rain event since it empties directly into the top of the tank.

Pros:

- Can store a large amount of rainwater.
- Great for climates where rainfall happens with infrequent, larger storm events.
- Can be inexpensive to implement.
- Less complicated system so maintenance is easier.

Cons:

- The storage tank must be located next to your house.

“WET” SYSTEM

This method involves locating the collection pipes underground in order to connect multiple downspouts from different gutters. The rainwater will fill the underground piping and the water will rise in the vertical pipes until it spills into the tank. The downspouts and underground collection piping must have water-

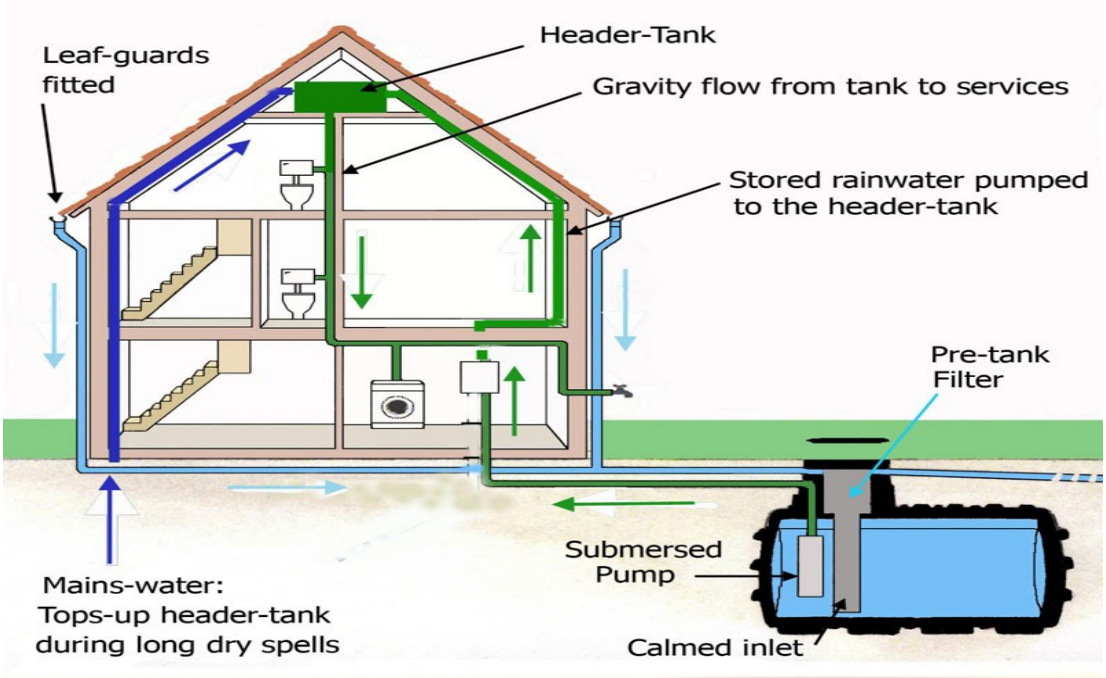
tight connections. The elevation of the tank inlet must be below the lowest gutter on the house.

Pros:

- The ability to collect from your entire collection surface
- The ability to collect from multiple gutters and downspouts
- The tank can be located away from your house

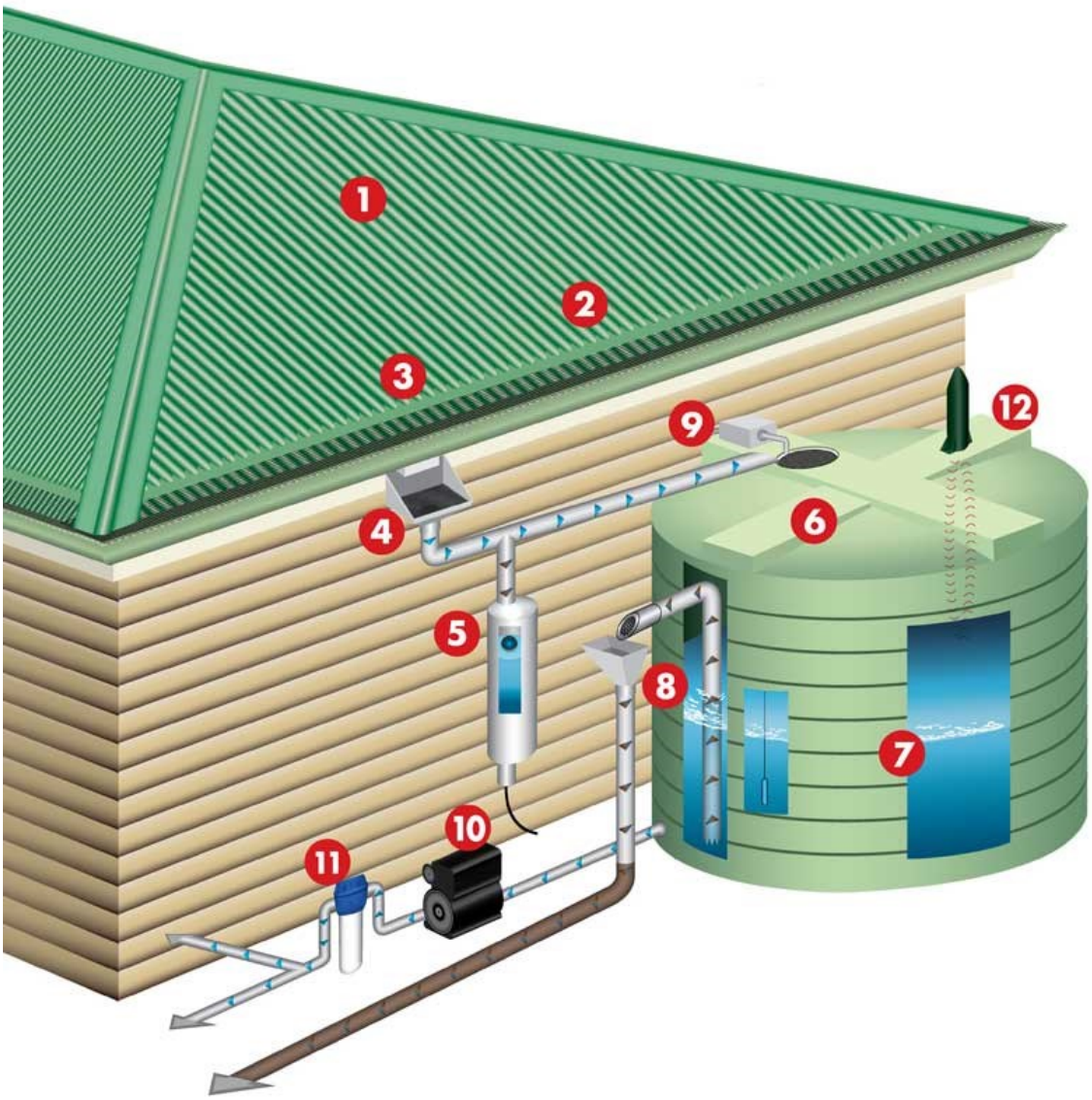
Cons:

- More expensive to implement due to underground piping
- Sufficient difference between gutters and tank inlet must be available



How Do I Create A Complete Rainwater Collection System?

The image below shows a complete rainwater collection system. While some of the components shown are absolutely necessary, not all of the components listed are required. Although, all of these components will help create a harvesting system that is highly functional and nearly maintenance-free.



Water is our most precious natural resource and something that most of us take for granted. We are now increasingly becoming aware of the importance of water to our survival and its limited supply, especially in such a dry continent as Australia.

The harvesting of rainwater simply involves the collection of water from surfaces on which rain falls, and subsequently storing this water for later use. Normally water is collected from the roofs of buildings and stored in rainwater tanks. This is very common in rural Australia. Water can also be collected in dams from rain falling on the ground and producing runoff.

Either way, the water collected can be considered to be precious.

Rainwater harvesting techniques

The collection of rainwater from the roofs of buildings can easily take place within our cities and towns, not just in rural Australia. All that is necessary to capture this water is to direct the flow of rainwater from roof gutters to a rainwater storage tank. By doing this, water can be collected and used for various uses.

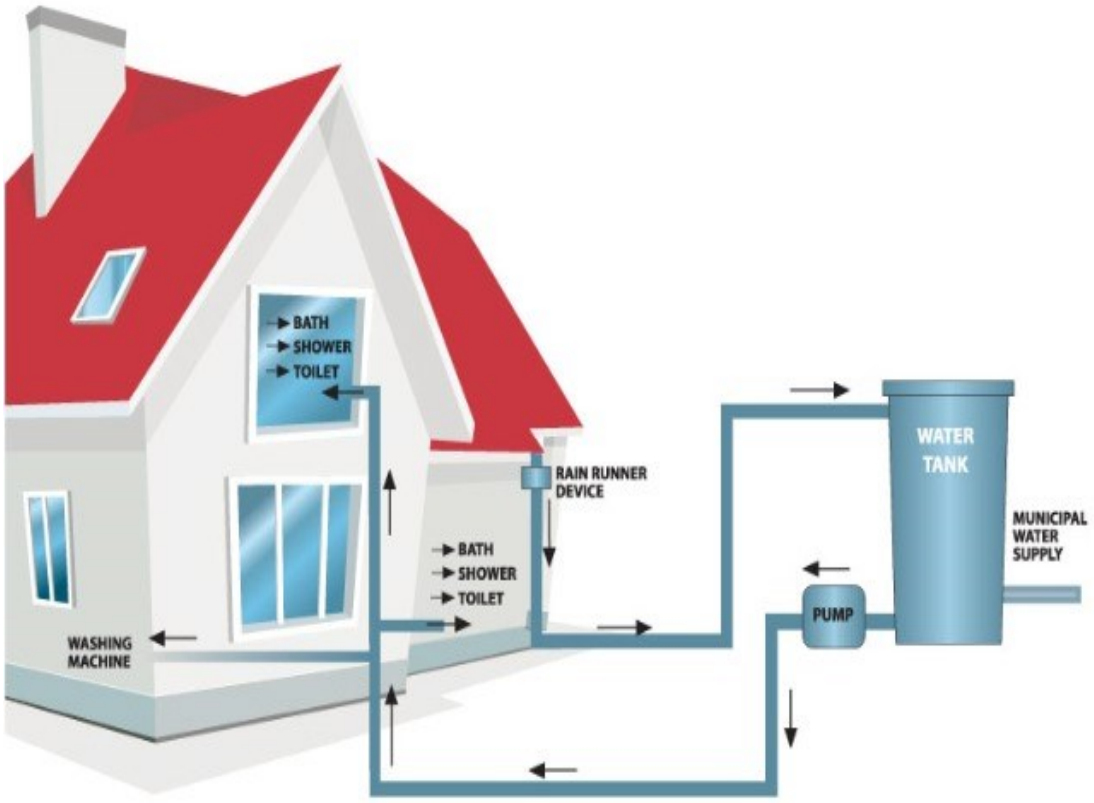
If you are reliant on collected rainwater and are not connected to a towns water supply, then the water collected will be especially important to you. If you are from the city, then it is possible to replace all or at least a substantial portion of your fresh water requirements by the capture and storage of rainwater from your roof. Being largely self-sufficient in water supply is possible for a vast majority of Australian households and buildings.

What are the Benefits in Rainwater Harvesting?

By capturing water directly, we can significantly reduce our reliance on water storage dams. This places less stress on these dams and can potentially reduce the need to expand these dams or build new ones.

Collecting and using your own water can also significantly reduce your water bills.

By capturing water, the flow of storm water is also reduced and this minimizes the likelihood of overloading the storm water systems in our neighborhoods.



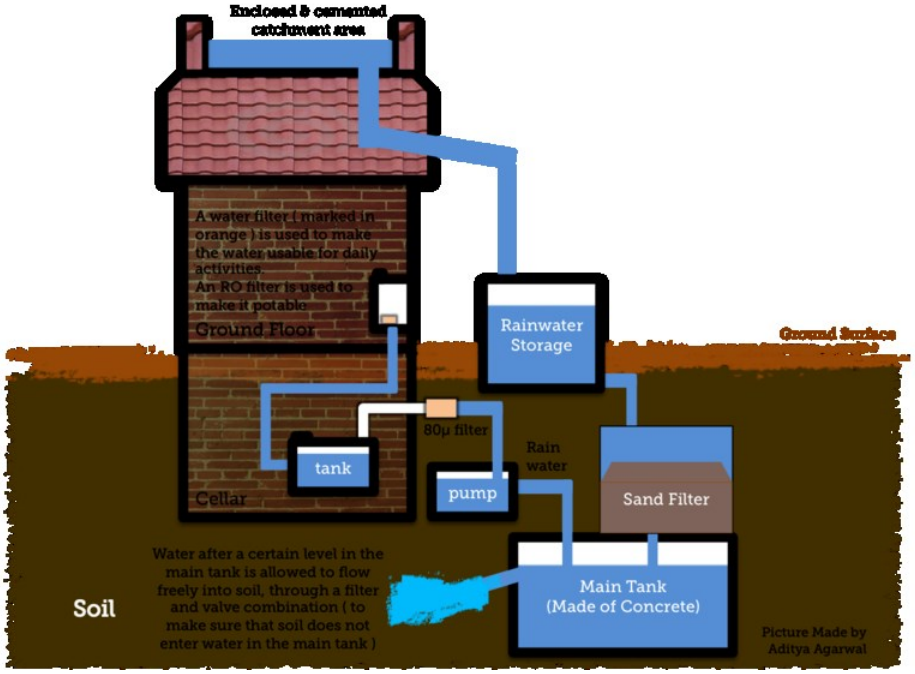
What About Dirty Roofs?

There are a number of devices (first flush devices) which allow for the first flow of water to the rainwater storage tank to be diverted from the tank. By doing this, any dirt on the roofs of buildings that has built up prior to the rain can be excluded from the tank.

Sizing of Rainwater Storage Tanks

The most appropriately sized rainwater storage can be chosen by quantitatively assessing the performance of various sized storage capacities. By assessing the performance of various sized storage capacities, it is possible to make an informed decision as to what would be the most suitably sized storage capacity for the given application. The input for the assessment is historical daily rainfall data, and the performance of a particular storage capacity can be judged by how much water is required to be supplied from other sources to make up for any

shortfall in demand.



Water Balance for Estimation of Rainwater Storage Capacity

The size of the area of capture or roof area must also be known when estimating the amount of rainfall that is able to be collected. The larger the roof area, the more rainfall that is able to be collected.

Assessing Performance of Different Sized Rainwater Storage Tanks

The performance assessment of various sized storages involves the calculation of the amount of water in storage for a given day. This calculation is based on the water balance shown above. This is a simple calculation, however, using a computer allows this calculation to be completed for many consecutive days of rainfall data. This is equivalent to trial sizing a storage tank size over the period of assessment (over many years).

The computer model completes daily water balance calculations, so that any roof runoff generated from rainfall in that day is calculated. The computer model also calculates the daily level status of the water storage used to hold this rainwater.

During any one day the storage could overflow depending on the amount of roof runoff generated. Likewise, the storage could also be emptied if the volume of

water used exceeds the amount of water available from the storage. In this case, water must be supplied from other sources in order to fulfil the water demand. The computer model calculates and sums the amount of water supplied from other sources over the period of assessment. This information can then be used for a comparative assessment of the different amounts of makeup needed with use of different size water storages.

Capturing Ground Runoff

The concepts of rainwater harvesting are not only applied to roof catchments. Ground runoff can be modelled and used as input to overall water balance calculations. Additionally, the size and nature of water usage can be modelled. The computer model can also account for the way the water is handled. All of these factors can be incorporated into an overall water balance model so that the best strategy for capturing and managing this most precious of natural resources can be determined.

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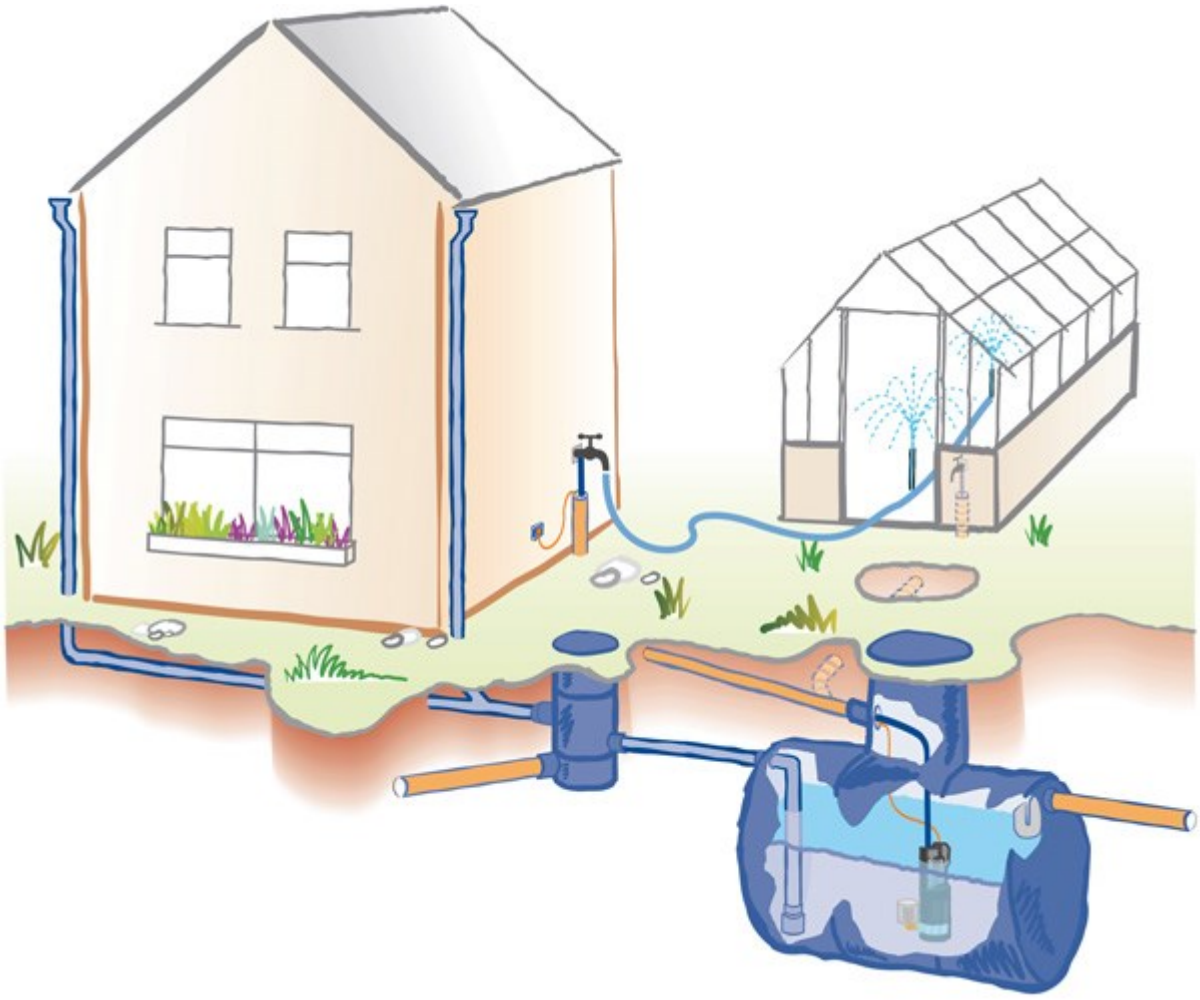
Rainwater Collection in Multistoried Roofs

Types of Rainwater Harvesting Systems



There are three main types of rainwater harvesting system: direct pumped, indirect pumped, and indirect gravity. In certain situations, it may be possible to have a purely gravity system; though such occasions are rare.

Water Butt

The most basic form of harvesting is the humble garden water butt. Water collects in the container from drain pipes and/or natural rainfall, and is mainly used for the watering of garden plants. Users with gardens of a decent size will see a reduction in the amount of mains water used. Pairing the water tank with a rainwater filter can further improve the quality of the harvested rainwater.

Direct-Pumped (Submersible)

qparticularly for domestic properties, and is generally the easiest to install. The pump is located within the underground tank and harvested water is simply pumped directly to the WCs or other appliances. If the tank should be in danger of running dry, a small amount of mains water is fed to it in order to maintain supply. For commercial projects, such systems tend to be dual pump arrangements (duty standby).

Direct-Pumped (Suction)

This system differs in that the pump is not inside the tank, but instead is located within a control unit within the house (e.g. utility room). The unit also deals with the backup from mains water supply, so there is no need to send mains water down to the tank.

Indirect Gravity

This type of system differs in that the harvested water is first pumped to a high level tank (header tank), then allowed to supply the outlets by gravity alone. With this arrangement, the pump only has to work when the header tank needs filling. Also the mains water is fed directly to the header tank, not into the main harvesting tank.

Indirect Pumped

This arrangement is similar to the above, except that the internal tank can be at any level in the building, as it does not rely on gravity to supply the outlets. Instead a booster pump set is used to provide a pressurized supply. This system employs the benefit of not having to feed mains back-up water to the underground tank, whilst also offering great flexibility as the booster pumps can be tailored to suit the flow and pressure requirements of the building.

Gravity Only

In some situations, it may be possible to have a system that functions purely through gravity, requiring no pump and therefore no energy use. With this arrangement, rainwater is collected from a part of the roof which has gutters above the filter and collection tank which are in turn above all the outlets. This

arrangement is ONLY ever possible where the storage tank can be located below the level of the gutters, yet higher that the outlets that it will supply. Only the power of gravity is needed to feed collected and filtered water to various parts of the home for use, so it is an ultra-energy efficient option.

Is Rainwater Treated?

Our rainwater harvesting systems filter water before it enters the storage tank. Debris such as moss, twigs and leaves are separated from the water before it enters the tank through a calmed inlet. Another filter, which is part of the pump assembly, rids the water of small particles before it is pumped to serviced appliances. The water harvested with these systems meets requirements for non-potable use.

Which System Is Best for Me?

Much depends on the individual situation. Where internal space is limited, or where it is not possible to fit a header tank, then the direct pumped systems are the best, particularly for domestic properties. Where it is possible to use a high level header tank, then the indirect gravity option can be preferable, especially where there is no requirement for the system to supply at high pressure. In large buildings or where high pressure is desired, then the indirect pumped system is the most appropriate.

Methods of Rainwater Harvesting - Components, Transport and Storage

Methods of Rainwater Harvesting

Broadly there are two ways of harvesting rainwater

١. Surface runoff harvesting
٢. Roof top rainwater harvesting

Rainwater harvesting is the collection and storage of rainwater for reuse on-site, rather than allowing it to run off. These stored waters are used for various purposes such as gardening, irrigation etc. Various methods of rainwater harvesting are described in this section.

١. Surface runoff harvesting

In urban area rainwater flows away as surface runoff. This runoff could be caught and used for recharging aquifers by adopting appropriate methods.

٢. Rooftop rainwater harvesting

It is a system of catching rainwater where it falls. In rooftop harvesting, the roof becomes the catchments, and the rainwater is collected from the roof of the house/building. It can either be stored in a tank or diverted to artificial recharge system. This method is less expensive and very effective and if implemented properly helps in augmenting the groundwater level of the area.

Rooftop Rainwater Harvesting System

Components of the Rooftop Rainwater Harvesting

The illustrative design of the basic components of roof top rainwater harvesting system is given in the typical schematic diagram shown in Fig ١.

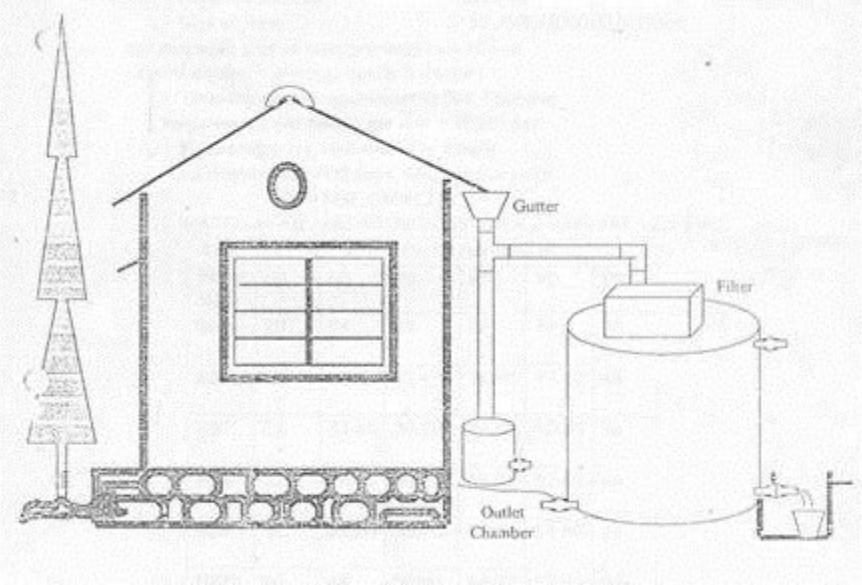


Fig ١: Components of Rainwater Harvesting

The system mainly constitutes of following sub components:

- Catchments
- Transportation
- First flush
- Filter

Catchments

The surface that receives rainfall directly is the catchment of rainwater harvesting system. It may be terrace, courtyard, or paved or unpaved open ground. The terrace may be flat RCC/stone roof or sloping roof. Therefore, the catchment is the area, which actually contributes rainwater to the harvesting system.

Transportation

Rainwater from rooftop should be carried through down take water pipes or drains to storage/harvesting system. Water pipes should be UV resistant (ISI HDPE/PVC pipes) of required capacity. Water from sloping roofs could be caught through gutters and down take pipe. At terraces, mouth of each drain should have wire mesh to restrict floating material.

First Flush

First flush is a device used to flush off the water received in first shower. The first shower of rains needs to be flushed-off to avoid contaminating storable/rechargeable water by the probable contaminants of the atmosphere and the catchment roof. It will also help in cleaning of silt and other material deposited on roof during dry seasons Provisions of first rain separator should be made at outlet of each drainpipe.

Filter

There is always some skepticism regarding Roof Top Rainwater Harvesting since doubts are raised that rainwater may contaminate groundwater. There is remote possibility of this fear coming true if proper filter mechanism is not adopted.

Secondly all care must be taken to see that underground sewer drains are not punctured and no leakage is taking place in close vicinity.

Filters are used for treatment of water to effectively remove turbidity, color and microorganisms. After first flushing of rainfall, water should pass through filters. A gravel, sand and 'netlon' mesh filter is designed and placed on top of the storage tank. This filter is very important in keeping the rainwater in the storage tank clean. It removes silt, dust, leaves and other organic matter from entering the storage tank.

The filter media should be cleaned daily after every rainfall event. Clogged filters prevent rainwater from easily entering the storage tank and the filter may overflow. The sand or gravel media should be taken out and washed before it is replaced in the filter.

A typical photograph of filter is shown in Fig ٢.

Fig ٢: Photograph of Typical Filter in Rainwater Harvesting

There are different types of filters in practice, but basic function is to purify water. Different types of filters are described.

Sand Gravel Filter

These are commonly used filters, constructed by brick masonry and filleted by pebbles, gravel, and sand as shown in the figure. Each layer should be

separated by wire mesh. A typical figure of Sand Gravel Filter is shown in Fig ٣.

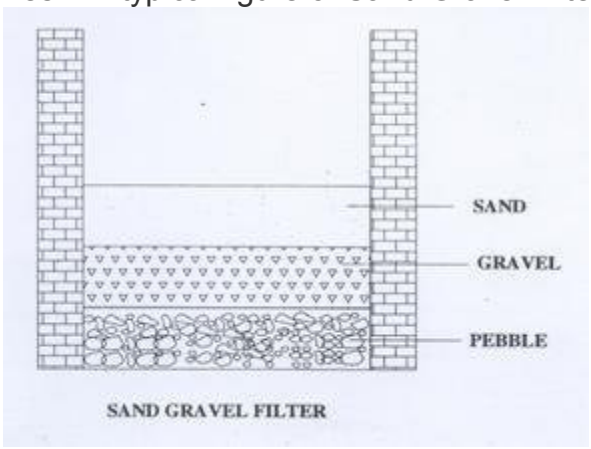


Fig ٣: Sand Gravel Filter

Charcoal Filter

Charcoal filter can be made in-situ or in a drum. Pebbles, gravel, sand and charcoal as shown in the figure should fill the drum or chamber. Each layer should be separated by wire mesh. Thin layer of charcoal is used to absorb odor if any. A schematic diagram of Charcoal filter is indicated in Fig ٤.

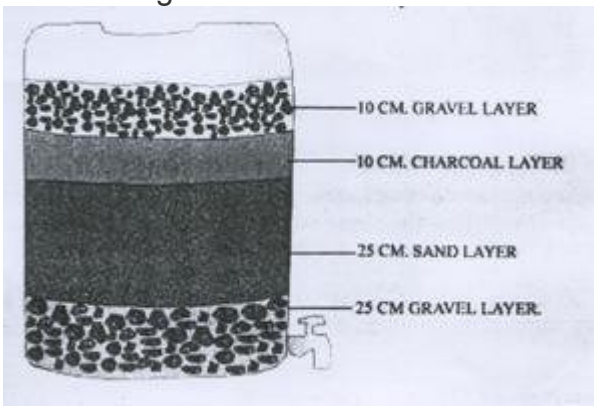


Fig ٤: Charcoal Filter

PVC –Pipe filter

This filter can be made by PVC pipe of ١ to ١.٢٠ m length; Diameter of pipe depends on the area of roof. Six inches dia. pipe is enough for a ١٥٠٠ Sq. Ft. roof and ٨ inches dia. pipe should be used for roofs more than ١٥٠٠ Sq. Ft. Pipe is divided into three compartments by wire mesh.

Each component should be filled with gravel and sand alternatively as shown in the figure. A layer of charcoal could also be inserted between two layers. Both ends of filter should have reduce of required size to connect inlet and outlet. This filter could be placed horizontally or vertically in the system. A schematic pipe filter is shown in Fig ٥.

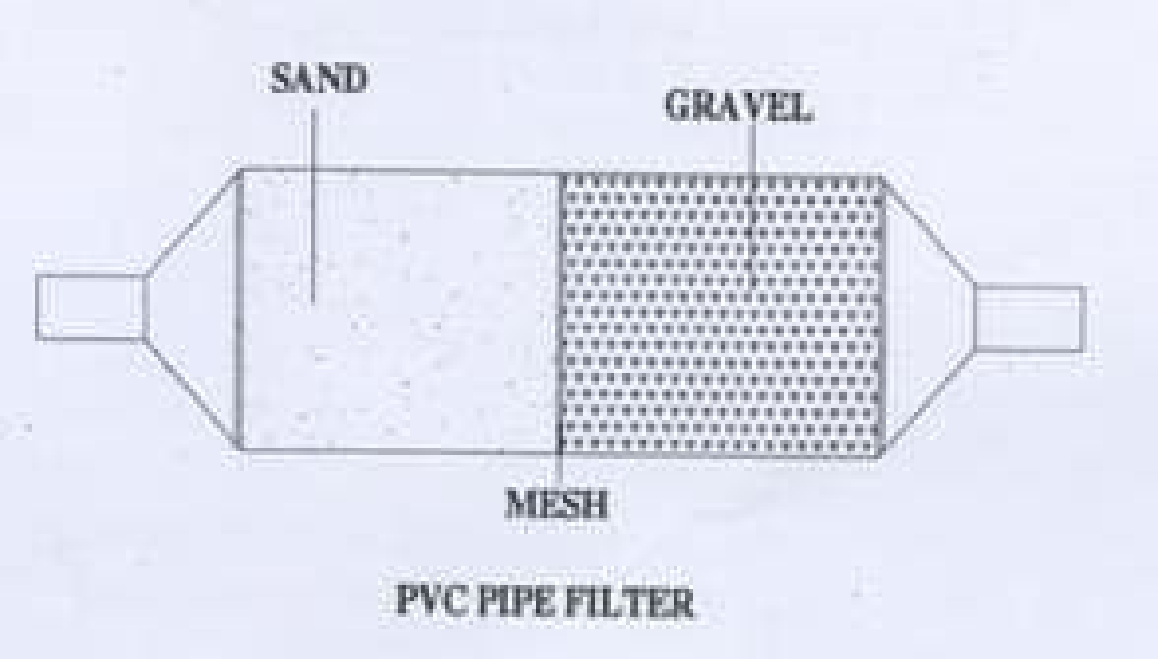


Fig ٥: PVC-Pipe filter

Sponge Filter

It is a simple filter made from PVC drum having a layer of sponge in the middle of drum. It is the easiest and cheapest form filter, suitable for residential units. A typical figure of sponge filter is shown in Fig ٦.

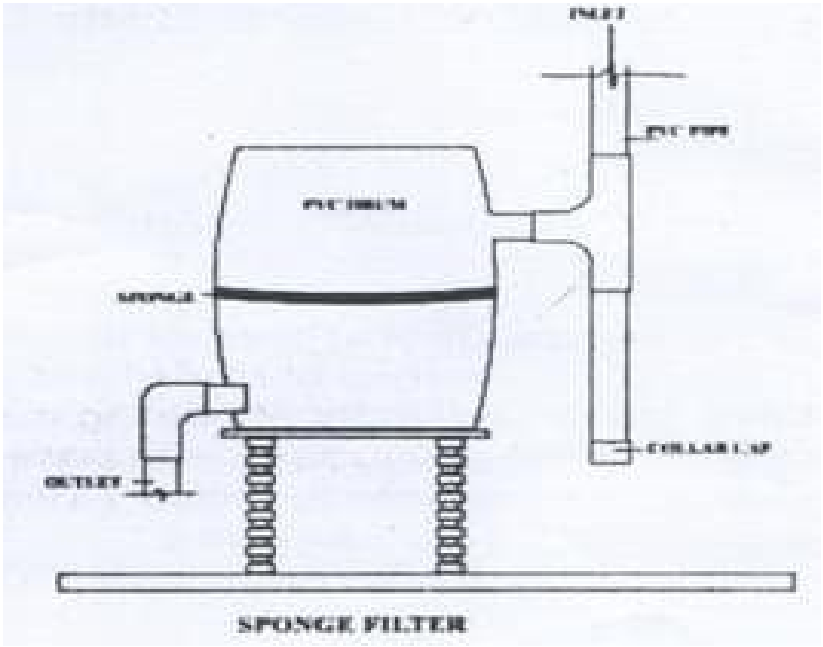


Fig ٦: Sponge Filter

Methods of Rooftop Rainwater Harvesting

Various methods of using roof top rainwater harvesting are illustrated in this section.

a) Storage of Direct Use

In this method rainwater collected from the roof of the building is diverted to a storage tank. The storage tank has to be designed according to the water requirements, rainfall and catchment availability.

Each drainpipe should have mesh filter at mouth and first flush device followed by filtration system before connecting to the storage tank. It is advisable that each tank should have excess water over flow system.

Excess water could be diverted to recharge system. Water from storage tank can be used for secondary purposes such as washing and gardening etc. This is the most cost effective way of rainwater harvesting.

The main advantage of collecting and using the rainwater during rainy season is not only to save water from conventional sources, but also to save energy incurred on transportation and distribution of water at the doorstep. This also conserves groundwater, if it is being extracted to meet the demand when rains are on. A typical fig of storage tank is shown in Fig ٧.

Fig ٧: A storage tank on a platform painted white

b) Recharging groundwater aquifers

Groundwater aquifers can be recharged by various kinds of structures to ensure percolation of rainwater in the ground instead of draining away from the surface. Commonly used recharging methods are: -

a) Recharging of bore wells

b) Recharging of dug wells.

c) Recharge pits

d) Recharge Trenches

e) Soak ways or Recharge Shafts

f) Percolation Tanks

c) Recharging of bore wells

Rainwater collected from rooftop of the building is diverted through drainpipes to settlement or filtration tank. After settlement filtered water is diverted to bore wells to recharge deep aquifers. Abandoned bore wells can also be used for recharge.

Optimum capacity of settlement tank/filtration tank can be designed on the basis of area of catchment, intensity of rainfall and recharge rate. While recharging, entry of floating matter and silt should be restricted because it may clog the recharge structure.

First one or two shower should be flushed out through rain separator to avoid contamination. A schematic diagram of filtration tank recharging to bore well is indicated in Fig ٨

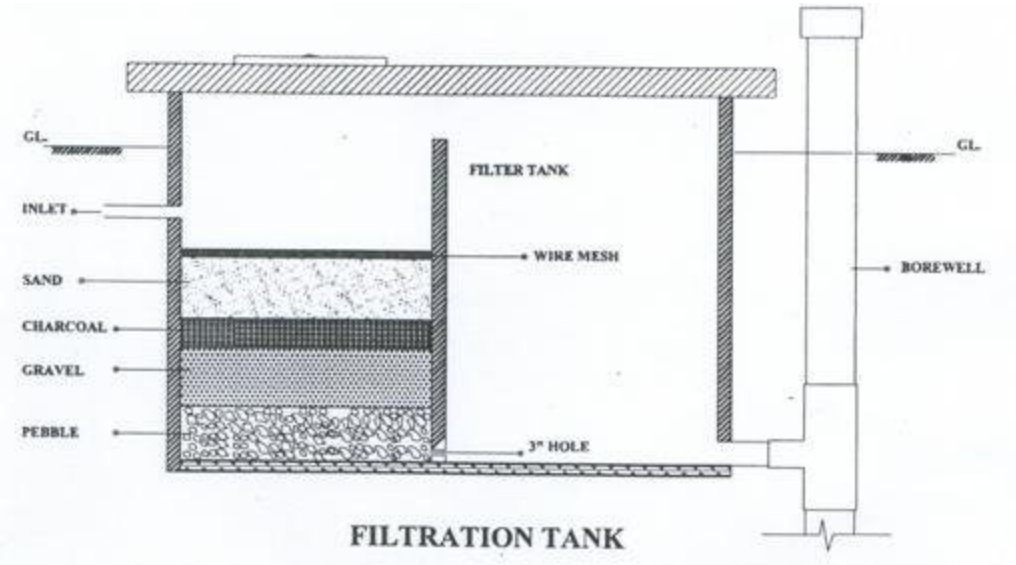


Fig ٨ :Filtration tank recharging to bore well

d) Recharge pits

Recharge pits are small pits of any shape rectangular, square or circular, contracted with brick or stone masonry wall with weep hole at regular intervals. Top of pit can be covered with perforated covers. Bottom of pit should be filled with filter media.

The capacity of the pit can be designed on the basis of catchment area, rainfall intensity and recharge rate of soil. Usually the dimensions of the pit may be of ١ to ٢ m width and ٢ to ٣ m deep depending on the depth of pervious strata.

These pits are suitable for recharging of shallow aquifers, and small houses. A schematic diagram of recharge pit is shown in Fig ٩.

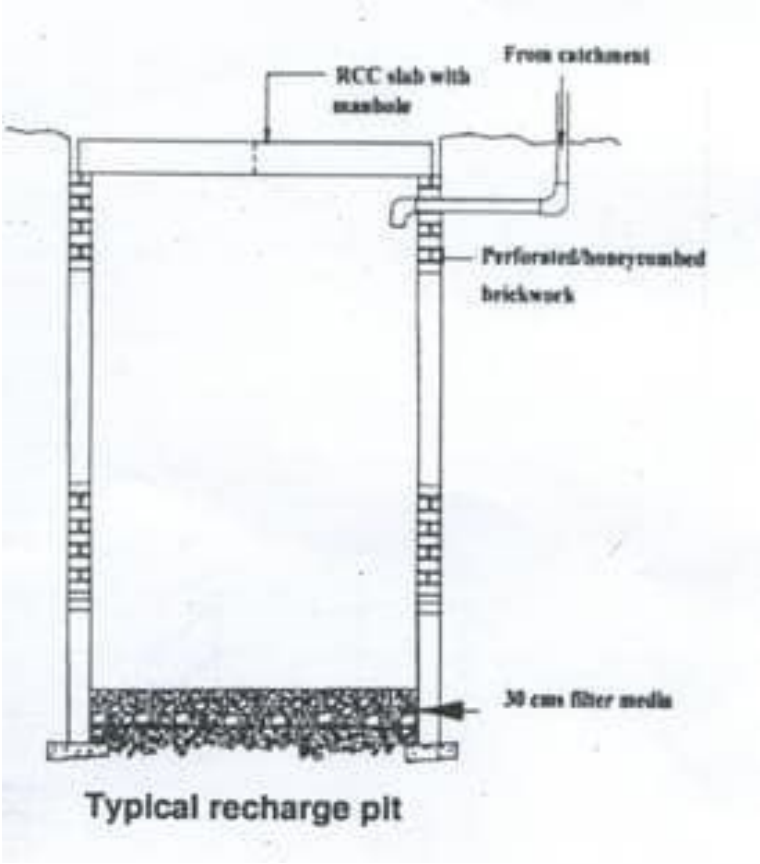


Fig ٩: Recharge pit

e) Soakway or Recharge shafts

Soak away or recharge shafts are provided where upper layer of soil is alluvial or less pervious. These are bored hole of ٣٠ cm dia. up to ١٠ to ١٥ m deep, depending on depth of pervious layer. Bore should be lined with slotted/perforated PVC/MS pipe to prevent collapse of the vertical sides.

At the top of soak away required size sump is constructed to retain runoff before the filters through soak away. Sump should be filled with filter media. A schematic diagram of recharge shaft is shown in Fig ١٠.

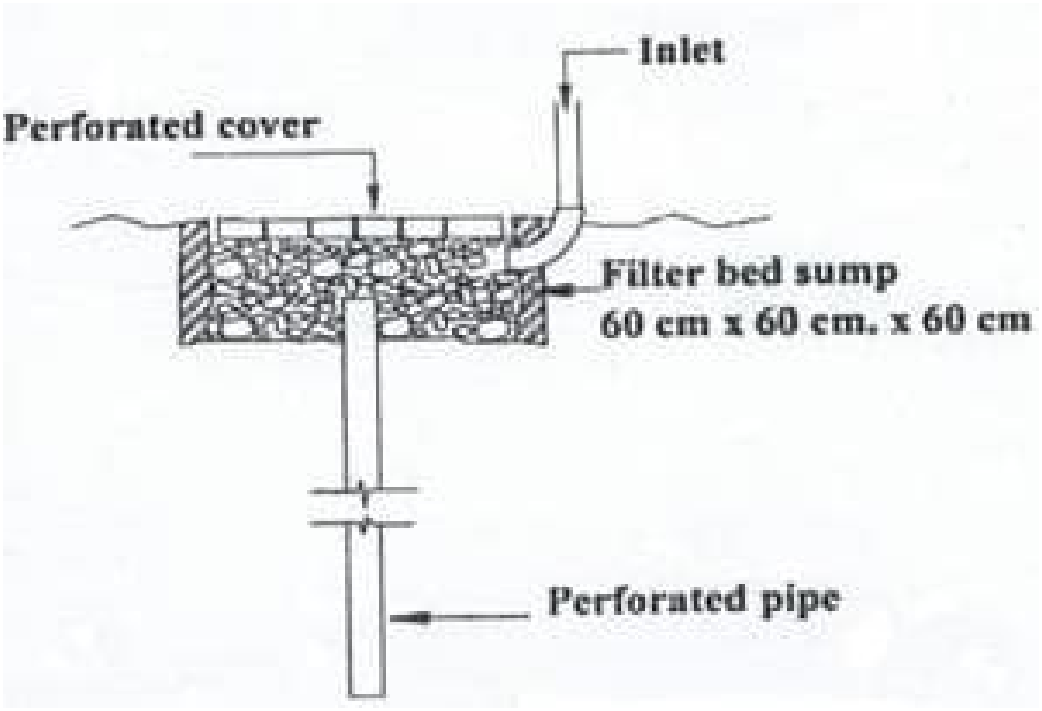


Fig ١٠ : Schematic Diagram of Recharge shaft

f) Recharging of dug wells

Dug well can be used as recharge structure. Rainwater from the rooftop is diverted to dug wells after passing it through filtration bed. Cleaning and desalting of dug well should be done regularly to enhance the recharge rate. The filtration method suggested for bore well recharging could be used. A schematic diagram of recharging into dug well is indicated in Fig ١١ shown below.

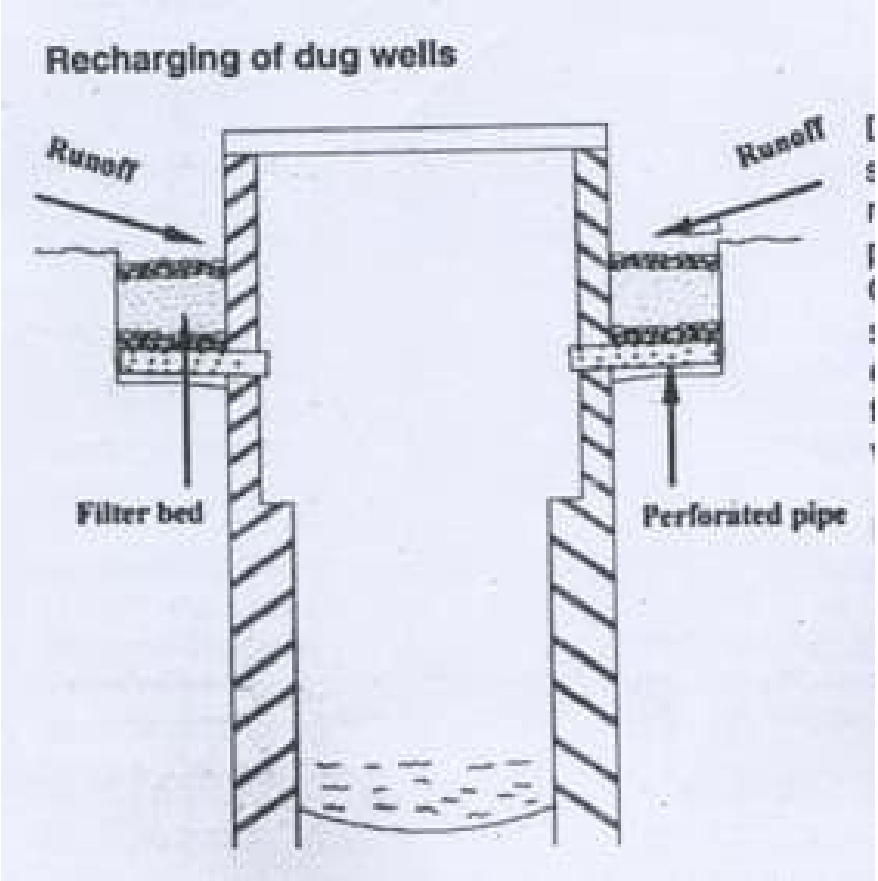


Fig ١١: Schematic diagram of recharging to dug well

g) Recharge trenches

Recharge trench in provided where upper impervious layer of soil is shallow. It is a trench excavated on the ground and refilled with porous media like pebbles, boulder or brickbats. it is usually made for harvesting the surface runoff. Bore wells can also be provided inside the trench as recharge shafts to enhance percolation. The length of the trench is decided as per the amount of runoff expected.

This method is suitable for small houses, playgrounds, parks and roadside drains. The recharge trench can be of size ٠.٥٠ to ١.٠ m wide and ١.٠ to ١.٥ m deep. A schematic diagram of recharging to trenches is shown in Fig below ١٢.

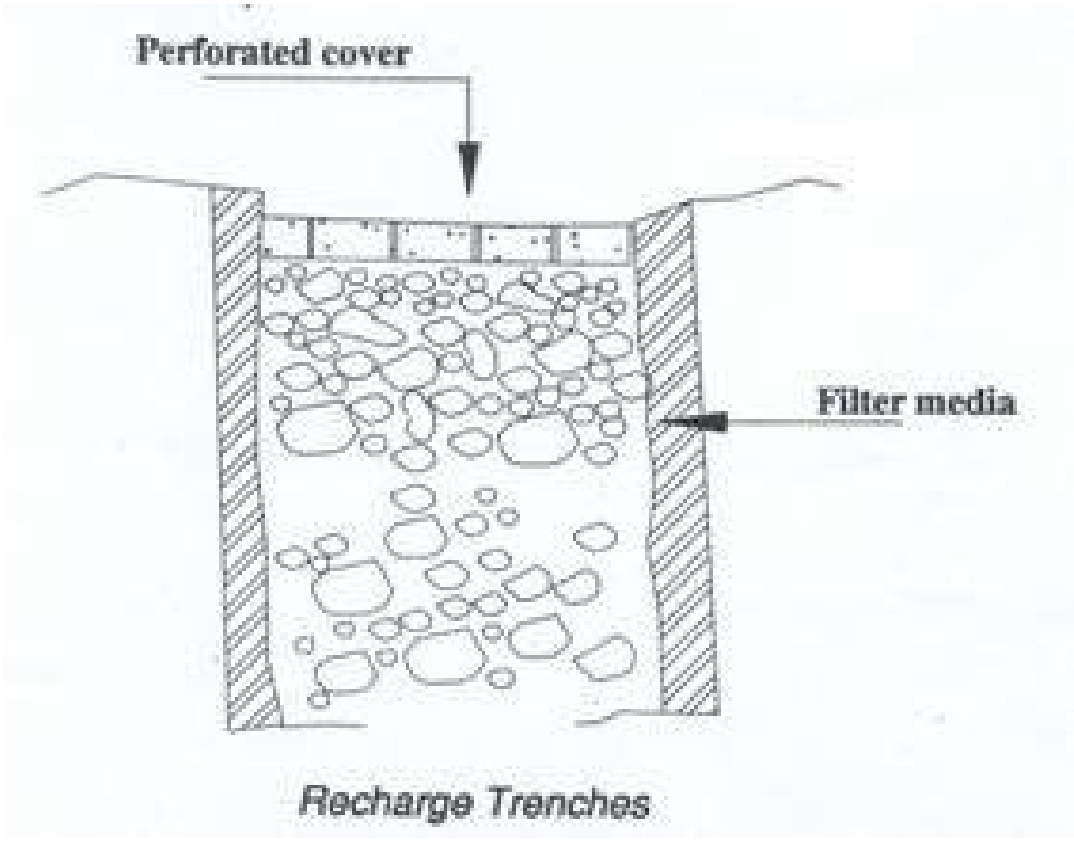


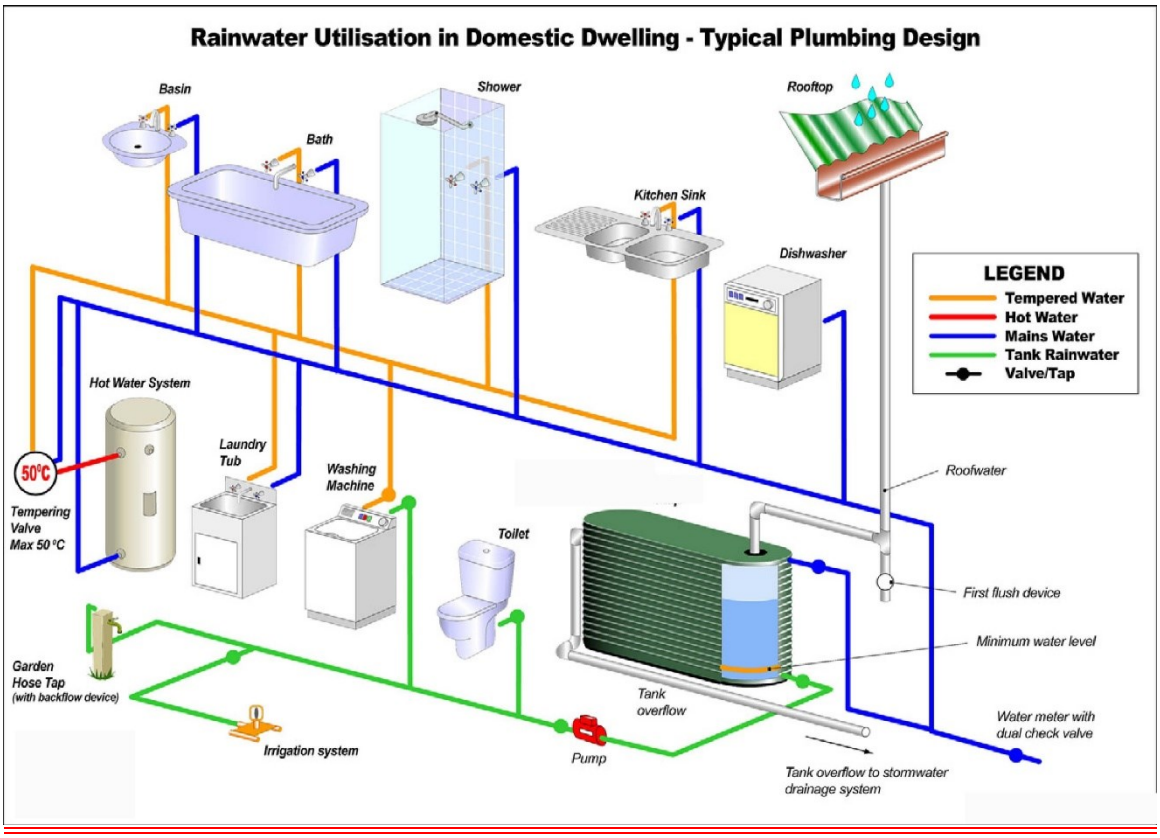
Fig ١٢: Recharging to trenches

h) Percolation tank

Percolation tanks are artificially created surface water bodies, submerging a land area with adequate permeability to facilitate sufficient percolation to recharge the groundwater. These can be built in big campuses where land is available and topography is suitable.

Surface runoff and roof top water can be diverted to this tank. Water accumulating in the tank percolates in the solid to augment the groundwater. The stored water can be used directly for gardening and raw use. Percolation tanks should be built in gardens, open spaces and roadside greenbelts of urban area.

Design Tips for Rainwater Harvesting Components



Design tips for rainwater harvesting components to collect and store the rainwater during rains in a overhead tank, or underground tank is discussed. Rainwater harvesting is natural in case of water collected in ponds in villages, but cities needs special methods to capture and store rainwater.

Design Tips for Collection of Rainwater

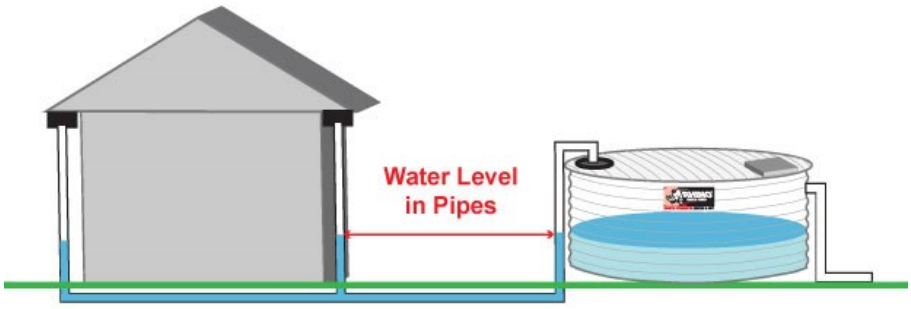
Water collected from roof can be a) stored for direct use b) allowed to infiltrate as groundwater recharge and c) combination of part storage and part recharge.

There are three structural components a) roof water collection system b) storage tank and c) recharge pit. The cost of the system will depends upon the cost of each of these components.

Water collected from the early showers are allowed to flow away since they contain some dirt. Once the roof top is washed clean by rainfall, the remaining water is collected. Nearly ٨٠٪ of the rain fall can be easily harvested.

It is much easy to collect water from a sloping roof top simply by placing lateral gutters (semi-circular collecting pipe) to bring the collected water at one common point. Flat, concrete roof tops sometimes offer more serious challenges for collection of rain water.

Usually flat concrete roof tops are provided with at least ٤ outlets (drain pipes) running along the four corners. This means the water collected from all the ٤ corners pipes are to be brought at the common storage site through a network of additional pipe lines. This may spoil the aesthetics and increase cost. Also, there is a need to keep the roof top clean to prevent pollution of rain water by preventing people to use the roof top for various purposes including storing of junk items.



Design Tips for Storage Tank

Storage tanks could be constructed a) underground b) half underground and half over ground and c) over-ground depending upon its size and availability of land area.

Storage tanks could be made of a) PVC (readymade Syntax type), b) Ferro-cement tanks and c) cement concrete tanks. Cost not being a consideration, a) for small storage (<> ٢٠,٠٠٠ L), cement concrete tanks would be ideal.

Ferro-cement tanks are of least cost. These are tanks made from pasting rich cement mortar over a tank structure made from bending, shaping and binding ٥ mm or so iron rods as reinforcement with an inside and out side layer of chicken mess (common wire net). Unlike cement concrete tanks, these are less prone to cracks/leakages and can be made in any shape (round, cylindrical etc.). Masons

having experience in working with ferro cement are required to undertake this job. Many NGOs have such masons.

Storage tank to be used for drinking water must have a filter system at the entry point, a water extraction system for taking out water (tap, hand pump) and a draining system for cleaning the tank (manhole, drain pipe etc.) periodically.

A diversion arrangement (T-joint with valve) is required at the outlet of roof collected water pipe line to allow the water to be either disposed off (dirty water after initial rain) or stored in the storage tank through the filter system for use as drinking water.

Rain water is generally deficient in dissolved minerals necessary for human body. Some scientists have suggested that on prolonged use, low Calcium (Ca) in rain water may absorb some Ca from our body making our bones weak (also applies to some RO purified water). However, so far there has been no report of any adverse effect of using rain water as drinking water.

Design Tips for Groundwater Recharge

Artificial groundwater recharge is professed when a) there is excess source water available at site and b) quality of source water is compatible with the groundwater to be recharged.

It is always safe and desirable to construct a RWH structure, where water is partly stored for direct use and partly allowed to percolate to recharge groundwater. This helps in maintaining quality control of the water used for recharge.

The recharge structure is usually a ١- ٢ cubic meter pit (could be larger when large quantity of water is to be recharged), filled with graded filter materials like cobbles, pebbles, gravel and sand in layers. The Objective is to let silt free good quality water to percolate.

Designing site specific filter beds are of critical importance. If the interstices of the filter are too small, water percolation will be slow. Conversely, filters with larger pores will allow faster percolation but water may not be free from suspended matters. For this reason, it is customary to have a pre-filter storage tank from where water is supplied to the pit as per its percolation capacity.

In hard rock areas (basalt and granite) where water occurs under water table condition in the weathered formation, there is no need to attach an extension pipe from the bottom of the recharge pit. Bur in areas where water occurs under water table condition at a deeper level (٢٠ – ١٠٠ m bgl), it would be necessary to attach an extension pipe.

The purpose of the pipe is to allow the source water to join directly to the aquifer (water table) without being lost in the over-lying unsaturated zone. Ideally, the length of the pipe should be such that it ends near the water table which however is known to fluctuate seasonally. It is necessary, that the bottom most part of the pipe be a slotted pipe. Similarly, if the pipe extends upwards to the ground level, the top most pipe should also be a slotted pipe.

An abandoned (dry but clean) dug well in hard rock area can be used as an effective recharge pit provided, a) water table is not too far below from the bottom of the well and b) formation near the well bottom is porous and permeable and c) the water diverted in to the well for recharge is of good quality. Such recharge practice should be best done in consultation with a geohydrologist and better be avoided if there is a risk of contaminated water entering in to the well and finally to the groundwater.

Artificial groundwater recharge through a number of such recharge structures will not only increase water availability (raised water table) but will also improve water quality. If properly constructed and managed, it is possible to use a bore well both as a recharge well during the monsoon period and supply (abstraction) well during summer months.

All RWH structure will require regular monitoring and periodical (at least annual) cleaning and maintenance of its various components. It is advisable to rather not construct these RWH structures, if regular maintenance cannot be assured.