The Practical Preppers Guide to Rain Harvesting

Scott Hunt M.Eng

Owner of Practical Preppers LLC

Introduction

My obsession with developing water supplies for both residential and agricultural needs led me to every source of water other than rain water for many years. My main focus was on wells and springs and I believed that if they were properly managed then there would be no need to catch rain water.   I was trusting in a water supply that historically had always been there in my region of the south eastern United States.   There were several factors that led me to start looking into rain harvesting techniques but the main one was because of my experience in seeing the static water level or water table dropping in wells. For the past 4 years I have been installing backup hand pumps in hundreds of wells and the unique thing about that is that knowing the static water level was the number one factor I used in sizing a pump for the homeowner, prepper, survivalist or farmer.   I ran into wells that were once sitting at a 40ft level and were now at 80 or more. The unsuspecting homeowner didn't know or care as their submersible pumps were installed hundreds of feet below the static and they seem to never run out but all the while the water table was dropping.

"We never know the worth of water till the well is dry." Thomas Fuller

Though the well is not dry yet my on the job case study led me to do my own research and design and installation of rain catchment systems. My motive at first was to use rain harvesting as a backup to my other developed sources but then I also realized that the captured water could also be used to recharge the groundwater supply that inevitably was tied to my wells and springs being "charged".   At a minimum, the use of rain water would put less strain on my well. On a larger scale I am seeing a growing population, declining quality of surface water and groundwater and an aging water infrastructure, so the need to explore alternatives to our current water supply system is clear. By collecting rainfall that would normally become runoff and instead using it to meet water needs, rainwater harvesting provides an alternative that both lessens the strain on our current water supply system and helps protect the quality of surface waters.

As a solutions oriented engineer I see rain water helping is so many areas. There is growing enthusiasm about green, sustainable living systems and practices that save water, energy and money, while preserving and improving our natural environment. Rainwater harvesting supplies alternative water for such non-potable uses as irrigation, toilet flushing, laundry, vehicle and facility cleaning, fire suppression systems, HVAC cooling towers and agriculture. Potable rainwater harvesting systems can be used for drinking water, as well as showers/baths, dishwashing, swimming pools and food processing. Rainwater harvesting is a powerful solution to a range of water problems.

When you take a look at our overall uses of water and start to break them down into specific needs that rain water could meet in our country, rain water looks more and more attractive.

Uses of Harvested Rainwater

Rainwater harvesting is suitable for all building types ranging from residential to commercial and industrial and can be retro-fitted to existing buildings or integrated into new building designs. Collected rooftop water is typically used for non-potable (non-drinking water) demands, but can be treated to drinking water standards and used for potable (drinking water) demands.

While many common water uses are non-potable (see list below), water supplied from the municipal system and wells is generally potable water. Utilizing potable water for non-potable needs wastes resources and can place unneeded strain on local water treatment plants. One thing that is typically not factored into all these needs is the amount of electricity needed to create all that potable water.

Non-potable demands include:

- Building washing/power washing
- Cooling towers
- Fire suppression
- Household cleaning
- Industrial processing
- Landscape irrigation
- Laundry washing
- Pool/pond filling
- Toilet flushing
- Vehicle washing

Potable demands include:

- Drinking water
- Cooking
- Bathing
- Dish washing

Rain Water's inherent quality.

As I focused on well and spring water I was overlooking the inherent quality of rainwater and the proven history of using rain water. Rainwater harvesting is an ancient technique enjoying a revival in popularity due to the inherent quality of rainwater and interest in reducing consumption of treated water. I have been in communities where the well water contains high levels of sulfur and Iron. So much money is being spent on water purifications systems to treat the well water there. If that money was put into sustainable rain catchment systems the savings would be evident the first year of use. Rainwater is valued for its purity and softness. It has a nearly neutral pH, and is free from disinfection by-products, salts, minerals, and other natural and man-made contaminants. Plants thrive under irrigation with stored rainwater. I have watered my gardens with city water, rain water, and well water and I have to believe that rain water is the best based on production observations. Appliances last longer when free from the corrosive or scale effects of hard water. Users with potable systems prefer the superior taste and cleansing properties of rainwater.

Archeological evidence attests to the capture of rainwater as far back as 4,000 years ago, and the concept of rainwater harvesting in China may date back 6,000 years. On 2 trips to Israel I saw firsthand cisterns built as early as 2000 B.C. for storing runoff from hillsides for agricultural and domestic purposes are still standing.

Advantages and benefits of rainwater harvesting:

- The water is free; the only cost is for collection and use.
- The end use of harvested water is located close to the source, eliminating the need for complex and costly distribution systems.
- Rainwater provides a water source when groundwater is unacceptable or unavailable, or it can augment limited groundwater supplies.
- The zero hardness of rainwater helps prevent scale on appliances, extending their use; rainwater eliminates the need for a water softener and the salts added during the softening process.
- Rainwater is sodium-free, important for persons on low-sodium diets.
- Rainwater is superior for landscape irrigation.
- Reduces the damage to our creeks, water habitats and organisms caused by storm water runoff.
- Rainwater harvesting helps utilities reduce the summer demand peak and delay expansion of existing water treatment plants.
- Rainwater harvesting reduces consumers' utility bills.

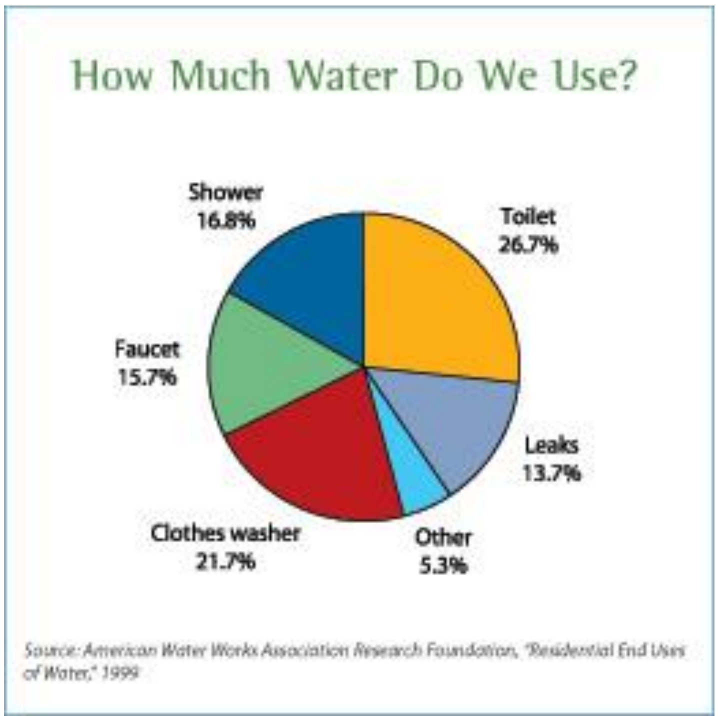
So whether it is out of necessity (survival), or to save money, or for health and environmental reasons rain harvesting is something I believe we should all consider implementing in our communities.

How much water do we use?

EPA – "The average American family of four uses 400 gallons of water per day. On average, approximately 70 percent of that water is used indoors, with the bathroom being the largest consumer (toilets alone can use 27 percent!)." The amount of water available in the world today is the same amount of water that was available 100 years ago but only 2.5% of the world's water is freshwater. An adequate water supply does not just depend on the total quantity of water available, but also depends on the quality of this available water.

The strain on our water supply is evident:

- In less than 20 years, 1.8 billion people will be living in areas with water scarcity.
- Worldwide, water consumption is rising at double the rate of population growth.
- Even without drought, areas in at least 36 states in the U.S. are expected to have water shortages.



How much water can we harvest? Since the quantity of potable water is decreasing and the demand for it is increasing let's figure out what we can do to capture, store and use as much free rain water as possible. Here is a simple formula used to calculate how much water you can capture of your home or any structure on your property.

$$V = A * d_{rain}(.62)$$

V : Volume of rain to tank [gallons]

A : Area of house/ collection [ft^2]

d_{rain} : Depth of rain fallen [in.]

So if we take a 2000 sq/ft home and one inch of rain we get 1240 gallon of rain water. Here is a chart based on different rainfall amounts using the same formula.

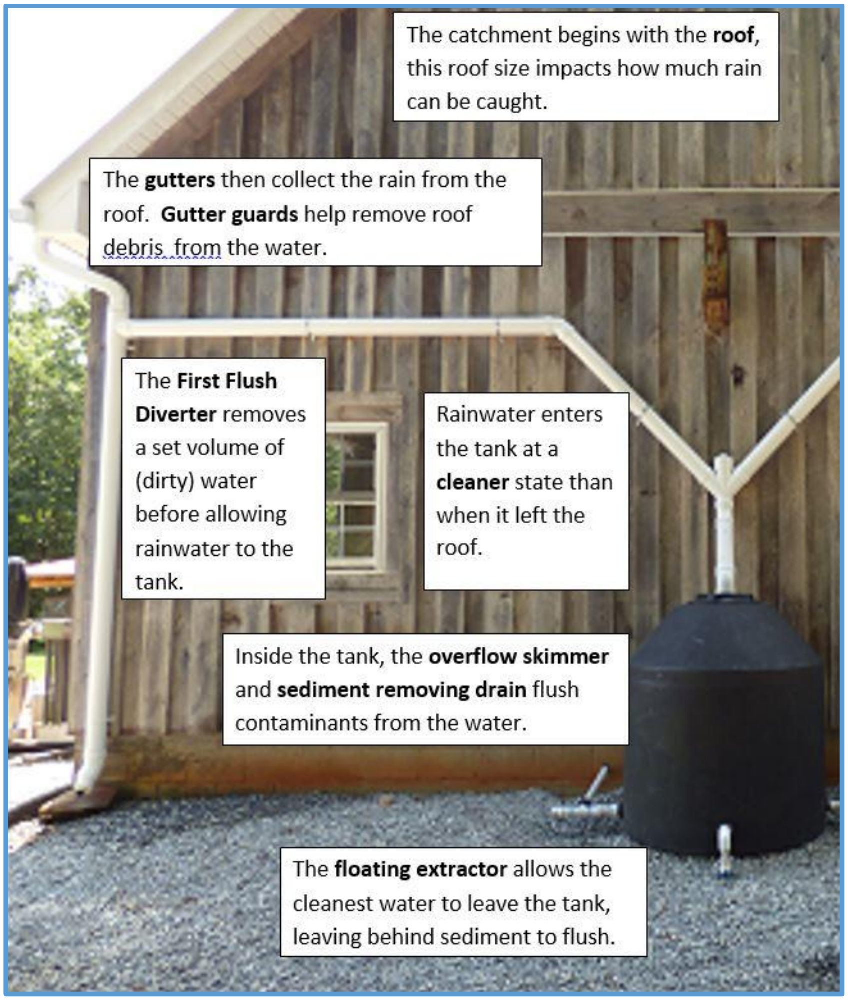
		Based on 2,000 ft^2 collection area		
	Yearly rain [in.]	Yearly [Gallons]	Weekly [Gallons]	Daily [Gallons]
Arizona	7"	8,680	167	24
Mississippi	52"	64,480	1,240	177
Virginia	45"	55,800	1,073	153
Louisiana	59"	73,160	1,406	201

So it is important to design your storage capability to take into account how much it rains, the timing of your dry seasons, and your usage.

What surprises most people when they begin to look at rain harvesting is the huge amount of water they can capture off of modest sized structures. I will admit that when I put my first system in place to capture water to top off my swimming pool I was amazed how fast the level came up. Ever since that day I have not had to add water to my pool due to evaporation/use. That system only used 400 square feet of roof space.

The Components of Rain harvesting

Perhaps one of the most interesting aspects of rainwater harvesting is learning about the methods of capture, storage, and use of this natural resource at the place it occurs. Though you can make some of the components, many are found at places specializing in rain harvesting. I use North American Rain Harvesting http://www.raincollectionsupplies.com/ and Carolina Water Tanks http://www.carolinawatertank.com/ for my supplies. A general overview of a system I installed on my shop is below. Let's look at each major component in a rain harvesting system in detail. We will touch on at least eight components that have an effect on the rain that hits the roof. Rainwater harvesting systems can be as simple as a rain barrel for garden irrigation at the end of a downspout, or as complex as a domestic potable system or a multiple end-use system at a large corporate campus. For this article I will be focusing on how to create a domestic potable system.



The Roof

The roof type, climatic conditions and the surrounding environment will all have an effect on the quality of the rain water you collect. Of course the roof size determines how much water you can collect. Most rain collection systems are retrofitted to a structure so you are stuck with the roofing material in place unless you make a huge investment to change it. Some people build separate structures just to capture rain and then place tanks and pumps under that roof.

My roof material preference is a metal roof but asphalt shingles do not stop me from catching rain. Many folks are concerned about the quality of rain water from an asphalt roof to which I tell them that No water is bad. Bad water I can clean. In a crisis situation I am not worried about the shingles compared to how worried I would be if I had no water. That being said for retro-fit situations with an asphalt roof, preliminary water quality sampling of runoff from the roof is likely the best way to determine appropriate end uses of the water. For new construction, roofing materials other than asphalt shingle are generally preferable.

Each type of roof will need a different level of washing in order to begin the process of rain collection for potable water. The following chart gives the amount of water that should be rejected or diverted at first to make sure the roof has been properly rinsed during rainfall.

Level of Roof Contamination	Rejection Amount
High Contamination Environment - Organic waste from animals, birds or adjacent trees - Areas of high airborne contamination(close to roads, pulp mills, open wood burning) - Rough roof surfaces such as asphalt shingles	First 0.04 in (1.0 mm)
Medium Contamination Environment - Normal levels of organic waste collection - Medium expectation of airborne contamination - Rough roof surfaces such as clay shingles	First 0.03 in (0.75 mm)
Low Contamination Environment - Relatively clear site - Low expectation of airborne contamination - Smooth roof surface such as metal	First 0.02 in (0.05 mm)

Once you have determined what level of rejection water (diverted) you will use for your system then we need to determine the volume required to hold/ divert this amount of water. This amount will be held by the first flush diverter system. We will cover that after we discuss gutters.

Gutters, Downspouts and Gutter Guards

Gutters and downspouts channel water from the roof to the tank. Gutters are installed to capture rainwater running off the eaves of a building. Some gutter installers can provide continuous or seamless gutters. For potable water systems, lead cannot be used as gutter solder, as is sometimes the case in older metal gutters. The slightly acidic quality of rain could dissolve lead and thus contaminate the water supply. The most common materials for gutters and downspouts are half-round PVC, vinyl, pipe, seamless aluminum, and galvanized steel. Seamless aluminum gutters are usually installed by professionals, and, therefore, are more expensive than other options. Regardless of material, other necessary components in addition to the horizontal gutters are the drop outlet, which routes water from the gutters downward and at least two 45-degree elbows which allow the downspout pipe to snug to the side of the house. Additional components include the hardware, brackets, and straps to fasten the gutters and downspout to the fascia and the wall.

When using the roof of a house as a catchment surface, it is important to consider that many roofs consist of one or more roof “valleys.” A roof valley occurs where two roof planes meet. This is most common and easy to visualize when considering a house plan with an “L” or “T” configuration. A roof valley concentrates rainfall runoff from two roof planes before the collected rain reaches a gutter. Depending on the size of roof areas terminating in a roof valley, the slope of the roofs, and the intensity of rainfall, the portion of gutter located where the valley water leaves the eave of the roof may not be able to capture all the water at that point, resulting in spillage or overrunning.

Besides the presence of one or more roof valleys, other factors that may result in overrunning of gutters include an inadequate number of downspouts, excessively long roof distances from ridge to eave, steep roof slopes, and inadequate gutter maintenance. Variables such as these make any gutter sizing rules of thumb difficult to apply. Consult your gutter supplier about your situation with special attention to determine where gutter overrunning areas may occur. At these points along an eave, apply strategies to minimize possible overrunning to improve catchment efficiency. Preventative strategies may include modifications to the size and configuration of gutters and addition of gutter boxes with downspouts and roof diverters near the eave edge. Gutters should be installed with slope towards the downspout; also the outside face of the gutter should be lower than the inside face to encourage drainage away from the building wall.

Gutter Guards

To remove debris that gathers on the catchment surface, and ensure high quality water for either potable use or to work well without clogging irrigation emitters, a series of filters are necessary. Essentially, mesh screens remove debris both before and after the storage tank.

The defense in keeping debris out of a rainwater harvesting system is some type of leaf screen along the gutter or in the downspout. Depending upon the amount and type of tree litter and dust accumulation, the homeowner may have to experiment to find the method that works best. Leaf screens must be regularly cleaned to be effective. If not maintained, leaf screens can become clogged and prevent rainwater from flowing into a tank. Built-up debris can also harbor bacteria and the products of leaf decay. There are many products and designs to choose from. I chose the Leaf Relief for my seemless gutters for several reasons. It handles the high speed flows off of my 12/12 pitch metal roof, it makes a strong box out of my gutter system and it works great for getting rid of all those Oak tree leaves next to my buildings. Here is a short section of seamless gutter with Leaf Relief installed.

First Flush Diverters

Now that we have captured the rain water off the roof and into the gutters it is looking for a place to go! We want to catch that dirty or rejection water for our potable system in what is called a first flush diverter. A roof can be a natural collection surface for dust, leaves, blooms, twigs, insect bodies, animal feces, pesticides, and other airborne residues. The first flush diverter routes the first flow of water from the catchment surface away from the storage tank. The flushed water can be routed to a garden or planted area. While gutter guards remove the larger debris, such as leaves, twigs, and blooms that fall on the roof, the first-flush diverter gives the system a chance to rid itself of the smaller contaminants, such as dust, pollen, and bird and rodent feces. The simplest first-flush diverter is a PVC standpipe. The standpipe fills with water first during a rainfall event; the balance of water is routed to the tank. The standpipe is drained continuously via a pinhole or by leaving the screw closure slightly loose. In any case, cleaning of the standpipe is accomplished by removing the PVC cover with a wrench and removing collected debris after each rainfall event. After your first cleaning of the diverter you will be glad you installed them. I pull handfuls of black sludgy gook out of my first flush diverters each month.

Though there are several types of FFDs (First Flush Diverters) I like the ball valve type that consist of a floating ball that seals off the top of the diverter pipe when the pipe files with water. The Volume of water goes back to the level of roof contamination chart mentioned before. If you don't want to use the fancy formula below based on the contamination chart above then one rule of thumb is to divert a minimum of 10 gallons for every 1,000 square feet of collection surface. However, first-flush volumes vary with the amount of dust on the roof surface, which is a function of the number of dry days, the amount and type of debris, tree overhang, and season. When the pollen is out am glad erred on the larger FFD.

Using the recommendation for high contamination environments to flush the first 0.04 in. of rain, this equation can be used to calculate how tall your first flush diverter needs to be.

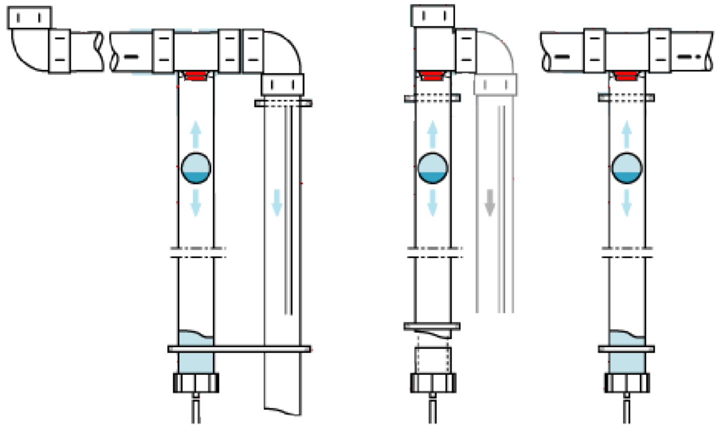
$$h = \frac{A}{D^2}(.611)$$

h: height of first flush diversion needed [ft].
A: Square footage of house/collection area [ft^2]
D: Diameter of the First Flush Diverter [in.]

This equation can be used to build a FFD to recommended height. Sometimes, multiple standpipes, are needed to meet the volume required for FFD. They can be plumbed in series before the storage tank. Here is a video of an installation where I needed 2 FFDs in series…
https://www.youtube.com/watch?v=4Q9g_gyKI0g&list=UUpDl4WPpgvvOeZFpw4ewycA

Again, I prefer the ball valve type FFDs as it prevents water/debris that went into the FFD from being sucked out of the FFD and into the storage tanks. See below..

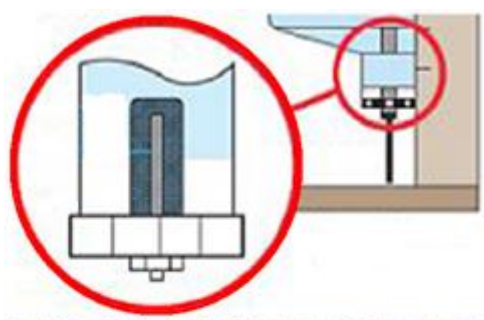
The seal for the ball must be installed correctly to seat fully when the ball floats. If this does not seal, water that should have been diverted makes it to the holding tank. The seal functions the same way in all three setups. It's highlighted in red.



The Outlet Valve

The outlet valve, located at the bottom of the FFD standpipe is adjusted to let a very slow trickle of water out to drain the volume between rain events. Most have a filter to help it work correctly, but it requires cleaning and frequent checks to make sure the diverter drains properly. I like to tip the outlet valve away from the building at 45 degrees making it easier for the water to drain away from the building and to attach a hose to the drain tip.

The plastic filters from this model clean up great with just a little water. A minute of care is the only difference between these two:



The Storage Tank

Key considerations

- Above ground tanks should be opaque to prevent algae growth, UV resistant to prevent tank failure, and piping should be protected against freezing or drained in the winter.
- Belowground tanks must be appropriately load-rated for the site (i.e. under a pedestrian area or a parking lot).
- Tanks should be installed according to manufacturers' instructions.
- Tanks should be sized according to the roof area and the anticipated demand
- Manway sized accesses all for easier maintenance and access to critical piping and fittings.
- Tanks should be located as close to supply and demand points as possible to reduce the distance water is delivered.
- To ease the load on the pump, tanks should be placed as high as practicable.
- Due to their extreme weight when full, tanks should be placed on a stable, level pad.
- Due to space constraints, sometimes multiple smaller diameter tanks are manifold together

Tank Materials

Storage tanks can be made of wood, metal, cement, fiberglass and polypropylene. For most folks the polypropylene tanks are the easiest to find and install.

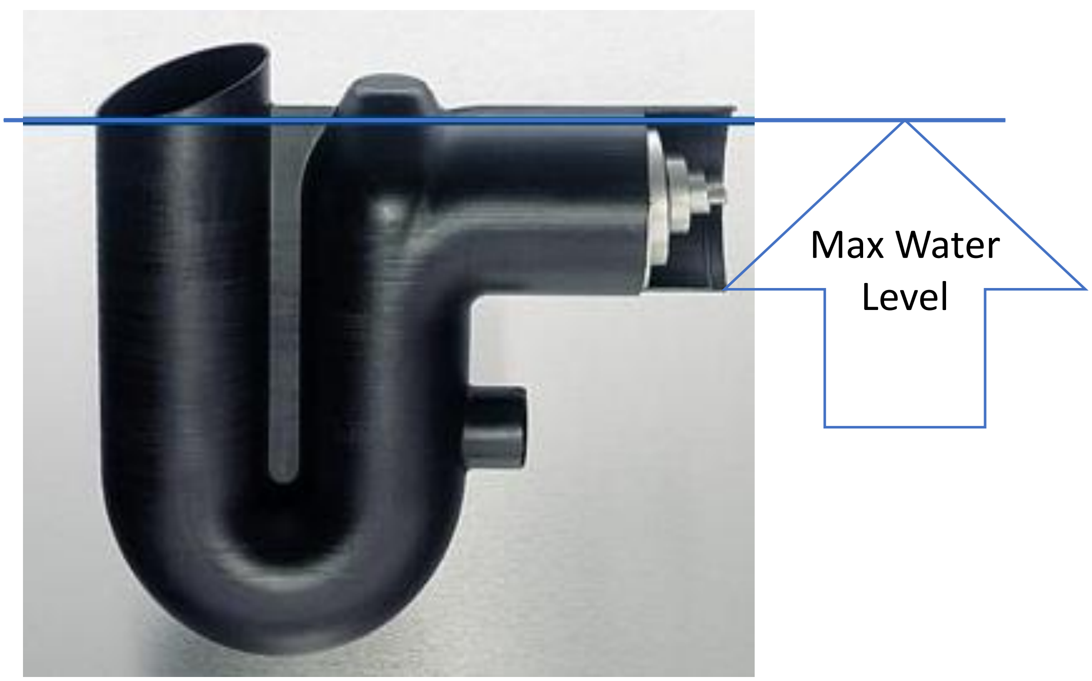
Tank installation

Tanks must be properly installed to prevent damage. In aboveground systems, piping and small storage tanks must be either drained or protected against freezing during the winter. Aboveground tanks should also be opaque to discourage bacterial growth and UV protected to prevent deterioration of the tank. Commercially available aboveground and belowground tanks should always be installed in compliance with manufacturers' recommendations. Again, aboveground tanks must on stable soil or a concrete pad and belowground tanks must be designed to support the weight of the soil above and any anticipated traffic loads. All tanks (aboveground and below ground) must have a vent to expel air as rainwater enters the tank and draw air in as rainwater is pumped out of the tank. If the tank overflow does not have a water trap, air can be displaced through the overflow as rainwater enters the tank. In these cases, the vent only needs to be as big in diameter as the water supply line leaving the tank. If air cannot leave the tank through the overflow, the vent diameter should be 1 ½ times the diameter of the inlet pipe. Most Polypropylene tanks with manway covers have lids with built in vents.   The inlets and outlets for the tanks should be the same size and free of restrictions.

Overflow Skimmer

An overflow skimmer is a great benefit in a rain harvesting system. It reduces bacteria greatly by-removing layers that develop on the water surface

- An overflow siphon will keep your tank from overfilling and at the same time remove any surface contaminants from your tank.
- It removes the lightest pollutants by drawing from surface water only. This leaves a cleaner upper water zone overall, and nicer intake for the floating extractor.



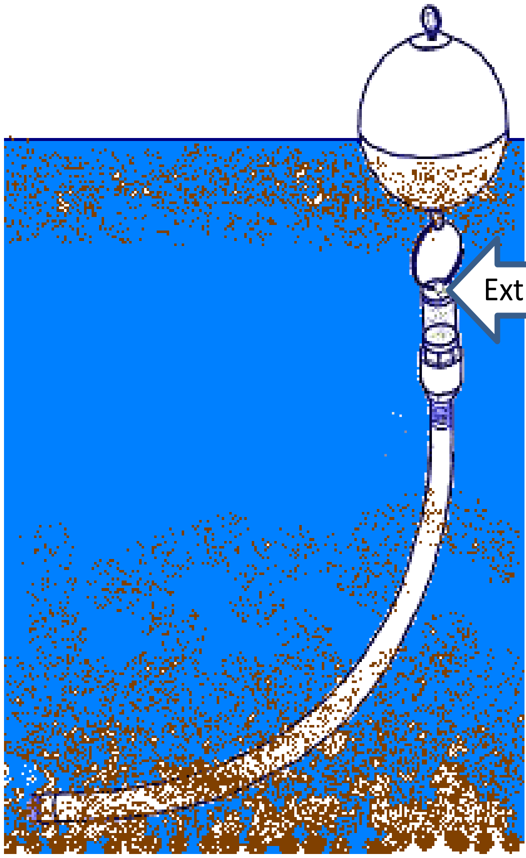
This model features a rodent guard built in, but they can also be added at the end of an overflow pipe, or where needed. A large variety are available.

The Overflow Skimmer in Action

What in the world is a floating extractor?

According to ARCSA (American Rain Catchment Systems Association) the cleanest zone of rain water in your storage tank is about four inches from the top of the water in the tank.   That is where the “extractor” comes into play. Sometimes called a “Floating Intake” or a “Floating arm draw-off valve”, these take many forms as well. There is common agreement that water from the bottom of the tank is much lower quality than the rest of the tank. Raised ports are sometimes used, but the floating extractor self-regulates well.

Floating Extractor



Light Sediment floats on the surface

Extraction Depth ≈ 4 in. below the water surface

- Research has shown this to be the cleanest area of a water tank
- Far superior to drawing heavy sediment from the bottom, and avoids skimming floating particles from the top

Heavier Sediment sits on the tank bottom

Piping to the tank, pipe sizing, and overflow sizing

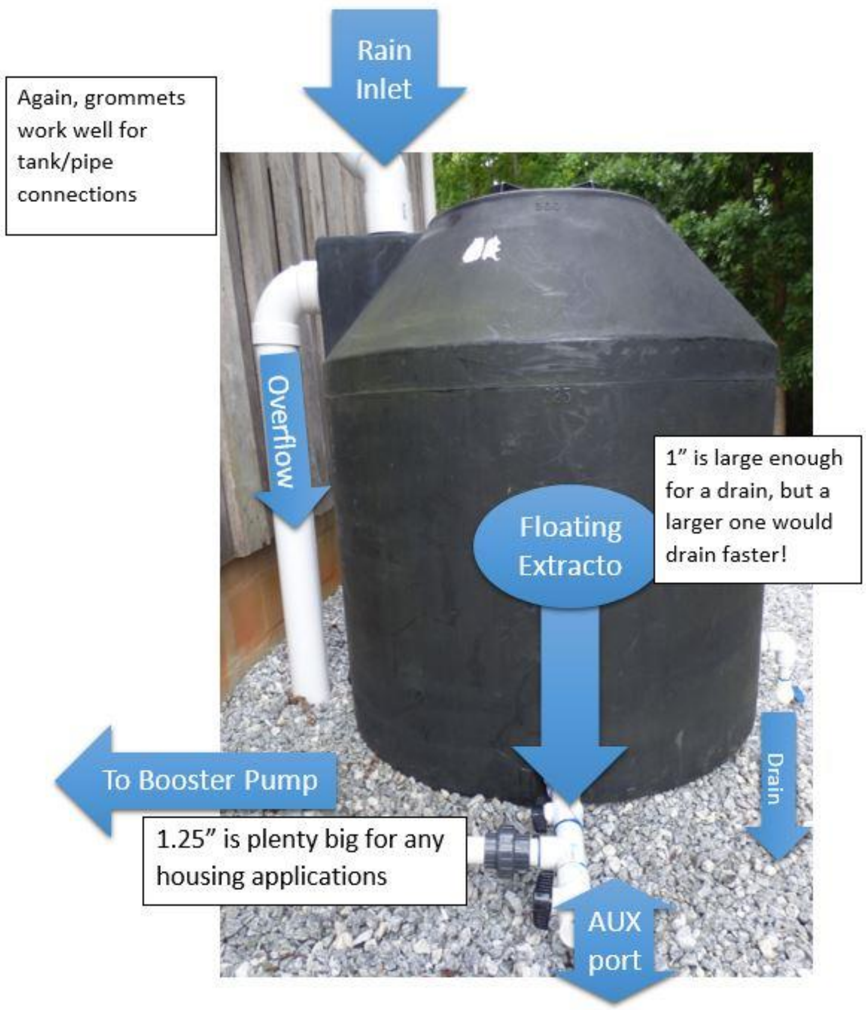
The overall downhill run to the tank prevents standing water in piping. Standing water is a good place for bacteria or insects to take over between rain events. The piping needs to be large enough to handle heaviest storms. Rubber tank grommets allow you to install various size pipes into your polypropylene tanks.

Bulkhead fittings are great for smaller connections to the tank.

They must be used in a flat surface of the tank, and require getting into the tank, or a specially made tool.

Piping out of the tank.

The main storage tank can get busy with all the possible connections. That is why I like to add a tank that I would call the calm tank. A tank from which to extract the rain water.



Biofilms

After a few months of having your fancy new rain harvesting system up and running you begin to notice a "slimy" film on the inside of the tank and pipes. At first I thought this was a bad thing and would pressure was and disinfect the insides of the tanks. I thought that if I had to do this all the time, how could this be sustainable? Then I found out that this Biofilm is actually a good thing. Biofilms are layers of bacteria attached to a solid surface with a protective binding often made of a chain of carbohydrates, occur throughout nature, on riverbeds and even on human teeth (plaque is a type of biofilm). While few people like to think about a bacteria layer in their water storage tank, biofilms are an important part of a healthy rainwater harvesting system. Research has shown that biofilms in rainwater systems typically develop from bacteria that are common in soil and the environment, accumulate metals and may remove bacteria from the stored rainwater.

The bacteria in biofilm use organic matter in the water as a food source. If the biofilm in the rainwater tank digests the available organic matter, the biofilm in the distribution system and any bacteria that may live in the water have a reduced food source which will minimize growth. Even with a stable and healthy biofilm, further treatment of the harvested rainwater is recommended if the water will have high contact with humans. This water should also be tested for harmful bacteria. The biofilm in a rainwater harvesting storage tank should be protected to ensure high water quality. The tank should never be emptied or cleaned as long as the rainwater passes through a pre-filtering first-flush filter system. Cleaning the tank will kill the biofilm layer. Likewise, no cleaning solutions should be introduced into the rainwater tank.

Water Quality check

We keep making progress in terms of making sure our captured rain water is clean. When I realized that roof-collected rainwater could be made safe and potable I wanted to keep going with the project. I found it amazing that in South Australia, 42% of residents mostly drink rainwater in preference to their mains water without any apparent effect on the incidence of gastrointestinal distress. To investigate the relationship between tank rainwater consumption and gastroenteritis in South Australia, a prevalence survey of 9,500 four year-old children was undertaken and this was followed up with a longitudinal cohort study of gastroenteritis among 1000 four to six-year-old children, selected on the basis of their tank rainwater consumption. This study found that in South Australia, children drinking tank rainwater were not at a greater risk of gastroenteritis than children drinking public mains.

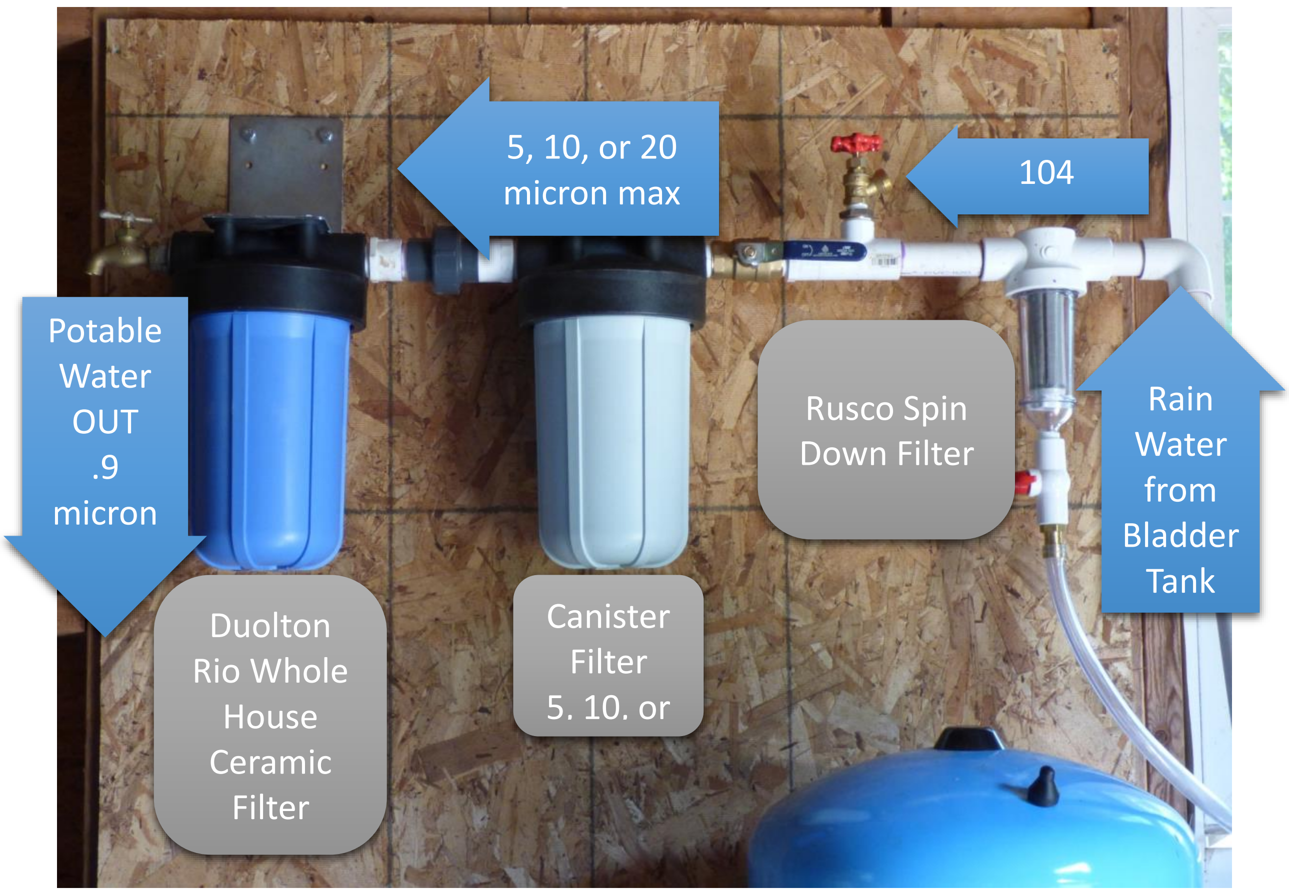
Pump, Filters and we are finally there!

Key considerations

- Pump systems should be designed to meet the expected peak demand of the end use of rainwater.
- All pumps should have automatically resetting dry-run protection.
- Submersible or jet/booster pumps can be used.
- Harvested rainwater should enter the pumping system through an elevated uptake point, such as a floating extractor.

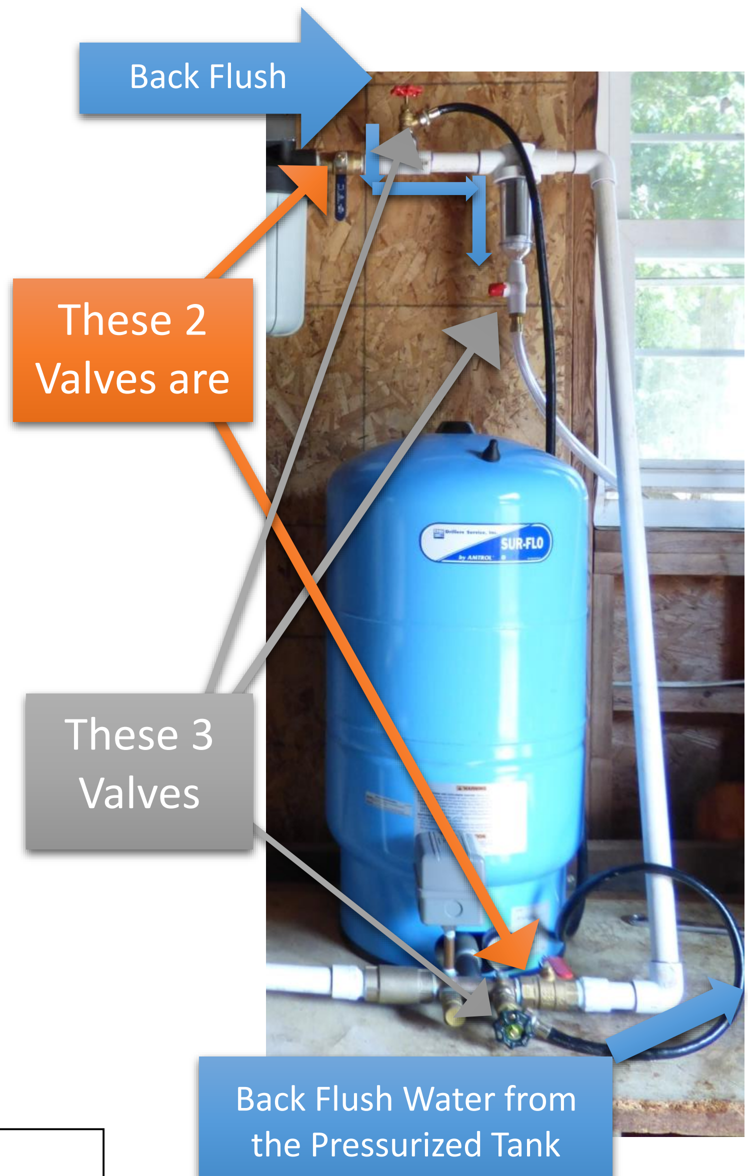
External booster or suction pumps are popular in rainwater harvesting applications. These pumps rely on lifting the water out of the tank and pushing it to the desired location. External pumps are louder than submersible pumps and must be protected from the weather. I chose to use a Dankoff piston pump that is a marriage of new and old technologies. It is an old school piston pump with great suction lift and not requiring pre-filtration. It uses a DC motor running off of solar charged batteries.

The Pump is controlled by a pressure switch that is coupled to a bladder tank. From the bladder tank the water is pumped through a series of filters to make the water potable. There are many ways to make water potable but I chose an off grid method and no chemicals. I use 2 levels of particle filtration and then finish it off with a Doulton whole house ceramic filter capable of removing any remaining bacteria.



Rusco spindown

I like to use filters that can be backflushed and used over and over.   These mechanical traps use the momentum of the water to “fling” particles out of the stream, leaving them in the bottom of the Rusco filter. The spin down gets easily rinsed through the bottom valve. Removing these particles before the canister filter makes the next particle filter and ultimately the ceramic filter last so much longer between replacements. The never need replacement filters, it only serves to increase the life of the filters after it.



To Back flush the spin down filter:

Water must be forced through the filter from the outlet side, and out the bottom valve

After the Rusco I use conventional whole house filter canisters and filters from 5, 10, and 20 microns

- Universal canisters fit a wide range of filters
- The filter medium does need to be changed regularly, this depends on filter size and input quality
- Filtering to 5 microns is a good goal with these canisters, it is also well enough filtered to enter the ceramic unit
- This helps the ceramic filter stay clean also
- These industry standard housings also can hold Doulton ceramic filters

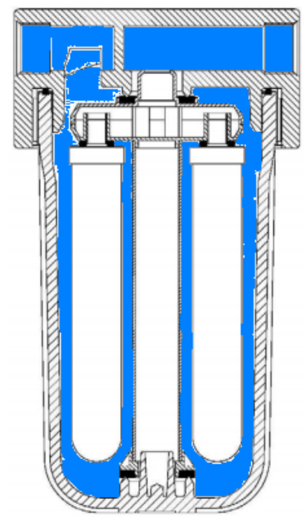
Another reason why I like the Dankoff piston pump is that is has no problem pushing the water through these series of filters. Here are some typical filter cannisters

Some folks opt for UV treatment but I have been using the Ceramic whole house filters for a few years now with great success.

Doulton Whole House Ceramic Filter

- The ceramic filter puts a great clean finish on our potable water setup.
- It should be filtered to 5 microns before entering to help this washable filter stay clean for longer.
- Less cleanings mean less chances to break the ceramic candles!

The Rio 2000 Multi Candle Filter Module requires 6 x Sterasyl™ Candles, Ø32mm (1.2") x 200mm (8") long. The module is designed to fit most industry standard 10" housings.



Product Performance

% Bacteria Removal	E. Coli	>99.99%
	Vibrio Cholerae (Cholera)	>99.99%
	Shigella	>99.999%
	Salmonella Typhi (Typhoid)	>99.999%
	Klebsiella Terrigena	>99.999%
% Cyst Removal	Cryptosporidium	>99.999%
	Giardia	>99.999%

Model	Rio 2000 Multi-Candle Filter Module
Typical output *	Up to 400 US Gallons (1500 litres) per hour
Filtration Rating (Absolute) Defined as >99.99%	0.9 microns
Filtration Rating (Nominal) Defined as >99.9%	0.5 to 0.8 microns
* Measured at 4 Bar. Output will alter dependant on pressure and condition of water.	

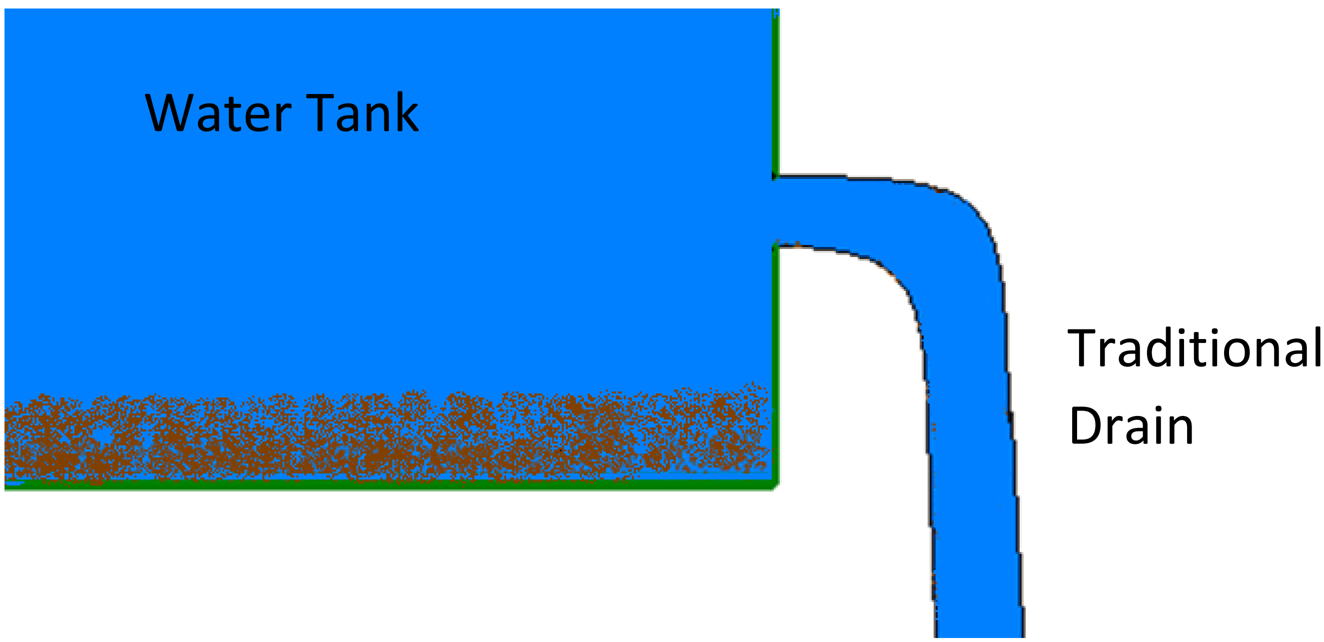
In Conclusion:

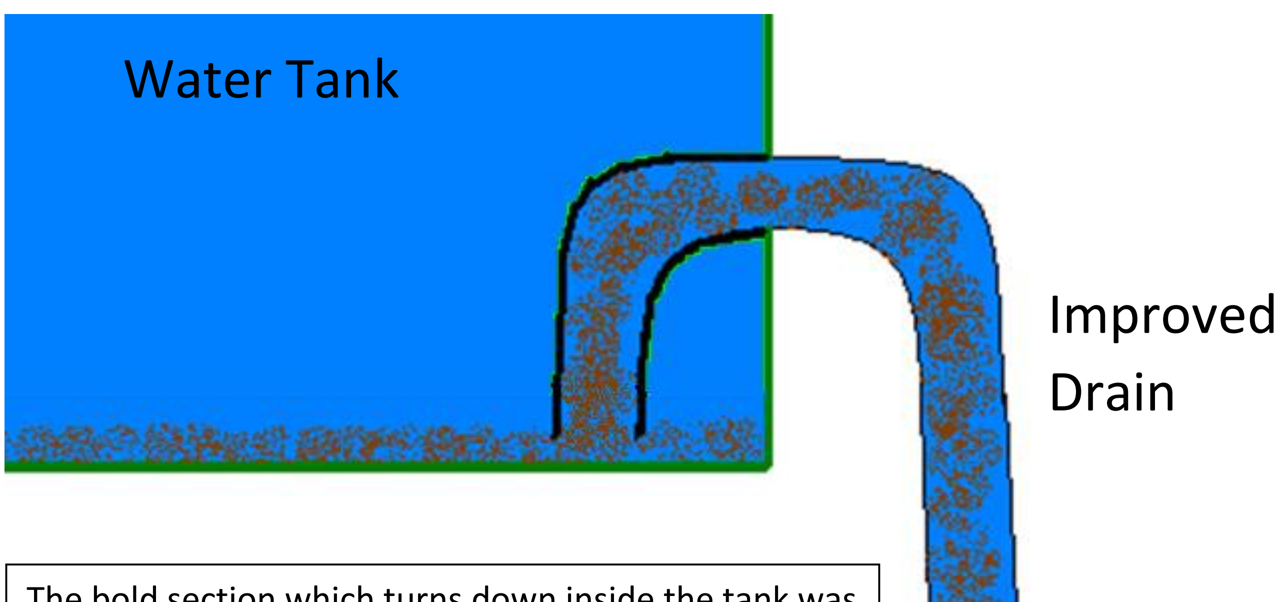
While rainwater harvesting is an ancient technology, modern rainwater harvesting has only recently gained a foothold in the United States. Modern rainwater harvesting is based on scientifically sound principles and research. As the popularity of rainwater harvesting grows, so will our understanding of the components necessary for a safe and sustainable water supply from rainwater. Though I overlooked rain harvesting when I first began to prepare a potable water supply I have greatly enjoyed the process of taking free water landing on my roof and turning it into something that could save my family and friends lives in a time of crisis.

Bonus features …

DRAIN UPGRADE TIP

In order to siphon heavy sediments off the bottom of the tank when it is drained we added turn down elbows to the traditional drain and made sure they were as close to the bottom of the tank as possible. We experimented until we achieved the maximum amount of water removal possible.





The bold section which turns down inside the tank was added to make the drain pull water from the bottom layer of the tank. This removes heavy sediment from the tank any time the drain is used

Bonus! A hot rain water shower!

A water heater can be added to any rain catchment system, allowing sanitizing and washing, even in an emergency.

We hooked our potable water tank up to a Geyser heat pump, this heater could be given enough power by just a couple solar panels.

Cold water enters the bottom of the tank, and it has a drain at the bottom and main outlet and pressure release valve at the top.

The tank is pressurized by the system shown previously, and doesn't need a separate pump.

The geyser takes cold water and returns hot water to the same tank fitting.

It uses a dip tube to effectively manage its water exchange.

The geysers temperature probe was installed on the inlet and insulated for accuracy. It tells the geyser when to turn on and off.

Below: The special dip tube allows the geyser to pull cold water from the bottom, while adding hot water at the same level, which naturally moves up in the tank, forcing more cold water down.