

## Guide for gray water treatment.

---

This is a guide for designing gray water evaporation fields and determining the size required to handle residential applications. These guide lines are based on information taken from several studies on evaporation rates. I have based my evaporation rates for Panama on a study done at the University of Miami. This study was the closest to the Panama climate we could find. Here is the basis of my formula for determining the size of evaporation fields.

1. The use of water is partly based on the flow rate of the pump. Most pumps are set at 40 lbs. of pressure. At that pressure the average shower will use a little over a gallon a min. At that rate you can figure a 15 min. shower will use 19 gallons.
2. The compost toilets only use water for the flush versions. Even those only use one pint per flush. Most of this should be evaporated in the compost system itself.
3. The average person should use only about a gallon a day to wash up.
4. Washing dishes should only take 2 gallons per day per person.
5. Laundry with a high efficiency front loading washing machine only uses 15 gallons per load. A normal top loader uses about 40 gallons and has less capacity. We can figure on the high efficiency machine, and two loads of laundry per person per week. That is 30 gallons per week, or about two gallons per day per person.

Total use per person, per day: 24 gallons.

### Determining the size of your evaporation field:

---

With these calculations, we can conclude the following use per month, per person, and determine our size of evaporation field needed. To determine our field size, we must first determine the amount of water that will be used in the dwelling per month. This will be based on how many people can sleep in the house, not the number of bathrooms.

Based on our calculations from our various studies, we estimate the evaporation rate in Panama to be 11.4 gallons per sq. foot per month. This is an average. The actual rate will vary based on the humidity level during that month.

If we conclude that each persons use is a minimum of 24 gallons per day, and we multiply that by 30 days, our total is 720 gallons per month.

If we divide that by our evaporation rate of 11.4 gallons per sq. ft, we get 63.15 sq. ft. per person. That means we need an evaporation field that has about 64 sq ft. surface area for each person living in the house.

With this we can estimate that a cottage with two people living full time, would need an evaporation field of about 130 sq. ft., or 10 x 13 feet in dimension. Keep in mind that guests will boost your demand on the system. You might want to increase your capacity to cover for long staying guests.

## How to boost your evaporation rates.

---

The evaporation rates we have used to calculate the field size is based on straight evaporation of water from the ground or an open pool. That rate can be boosted by the use of broad leaf plants. Some studies have shown that plants with large leaves can expel water into the air at a rate five times faster than an open pool of water.

What this means is that if you design your system to cover just the 2 people living in the house, by planting a full field of plants, you should be able to boost your capacity to evaporate water enough to accommodate any guests you may have.

You must take care to ensure that excessive rain water does not get into your field. The evaporation rates take into account normal rain fall. It does not account for run off on the ground draining into your field. Be sure to raise the ground around the field to prevent rain run off from flowing into fields built in the ground. Also, if you feel you are border line on your field being big enough, you could construct a plastic roof over the evaporation field. That will allow light for the plants and keep the rain water out of the field totally. Be sure not to allow rain run off from your roof to fall in the field.

## Design of the evaporation field:

---

The design of the evaporation field can vary depending on whether you are building over the land or over the sea. In most cases we are concerned with keeping the gray water from getting into the water table, or into the sea. Gray water will kill coral. To ensure that no gray water enters the sea we have designed these systems to be what we call closed loop systems. That means, no water leaves the system unless it evaporates into the air. The gray water enters the evaporation field. The plants drink all the water and thrive on the phosphates it provides, and expels the water back into the air. No contamination or pollution to the environment.

When building on dry land, we design systems that can be lined and constructed in the ground. The end result looks just like any other garden. It will look greener because it is being fed gray water.

The need to line the field depends on how close you are to sensitive areas. It is OK to perk the water if you have plenty of distance from any creeks, wet lands or waterfront. In the US it is required in most places to be at least 100 feet from any water with septic systems. I think that is a good rule to follow when deciding whether to line your field or not. Also, if the ground water is close to the surface you should line the system. If you don't, you will be pumping your gray water directly into the ground water. That could carry it quickly to the shore line.

If you do encounter water close to the surface, you will need to build a raised bed system. That can be done two ways. You can dig till you are close to the water table. Use the dirt taken out of the hole to build up the outside wall around the field. You would have to build it up till the inside depth is about 2 and ½ feet deep. You will need to line that field to prevent the gray water from getting into the ground water.

The other option is to pour a concrete slab and cement walls 2 feet high to form a planter box the size required. Either method will work. Whether it is in the ground, or in a concrete box, the design of the inside of the field is the same.

When building over the water, we can pipe the water to the land if the distance to the field is not too far. The drain pipe needs  $\frac{1}{4}$  inch of fall per foot to drain to the field. If it is 100 feet from house to field, it would need to drop about 2 feet.

If the house is too far off shore to reach a field or you don't have access to land for your system, then we construct a field over the water. In this case we must construct what would resemble a swimming pool on stilts. We make a concrete box on concrete stilts, that is 2 feet deep, and sized the dimensions required for the house. This can be any shape, square or rectangle, as long as it has the required sq. ft. exposure. It can even be designed as a long planter running along the walkway from the land to the house, and built into the structure of the dock. The reason it is built of concrete, is because we need to guarantee it will last forever and not leak or fall into the sea.

Grease traps and protecting and prolonging the life of your system:

---

To protect your evaporation field from being plugged up by soaps and what garbage goes down the drain, we use a grease trap. This can be built using a 50 gallon drum bought locally. Pipes can be fitted to the tanks using fittings bought locally. This tank should have a removable lid for servicing. The tank will allow the light soaps to rise and settle on top of the water, and the solid heavy waste like food scraps to settle to the bottom. The exit pipe will allow the clean water from the center of the tank to move on to the evaporation field.

This will prevent any waste from entering the evaporation field and plugging up the drain holes in the perforated pipe.

Use only biodegradable soaps and prevent putting garbage down the drain. Do not throw any chemicals down the drains.

Use of a weed screen is advised for the system. This will prevent the topsoil from filtering down into the gravel. You can always add more top soil, but if the top soil fills all the voids in the gravel, the field won't be able to hold as much gray water. It will lower its capacity to hold water. The weed screen will also prevent the roots from invading the pipes and plugging the drain holes.

Only use plants that don't have deep root systems. No trees. Tree roots can destroy your pipes. Use broad leaf plants when ever possible. The larger the leaves, the more water it can expel into the air.

Protect your field from heavy rain run off from hill sides and roofs. Mound the soil around the field to protect it. You can even build a plastic roof cover over it to eliminate rain storms from adding any water to your system.

If you find you have under sized your field, you can easily install an over flow line into an added field of whatever size you need.

Though we have been successful with our gray water designs, we do not guarantee our designs or claim that our designs carry any engineers stamp. Each project is different, and may require different solutions. The correct sizing of the field is what is important. These systems have been proven to work when sized properly. If a problem develops with the system being too small for the amount of use it is getting, an overflow pipe can be installed to connect the first evaporation field to an added field to take care of the problem.

#### CLEANWATER CONSTRUCTION

First street, Isla Colon, Bocas

Bocas del Toro, Panama

US phone: Dave Miner (303) 459-2518

Panama cell: Dave Miner (507) 6 640-2842

Panama office: Luis Georget (507) 6 561-8845

E-mail: [senddave2@comcast.net](mailto:senddave2@comcast.net)

[www.cwc-compost.com](http://www.cwc-compost.com)