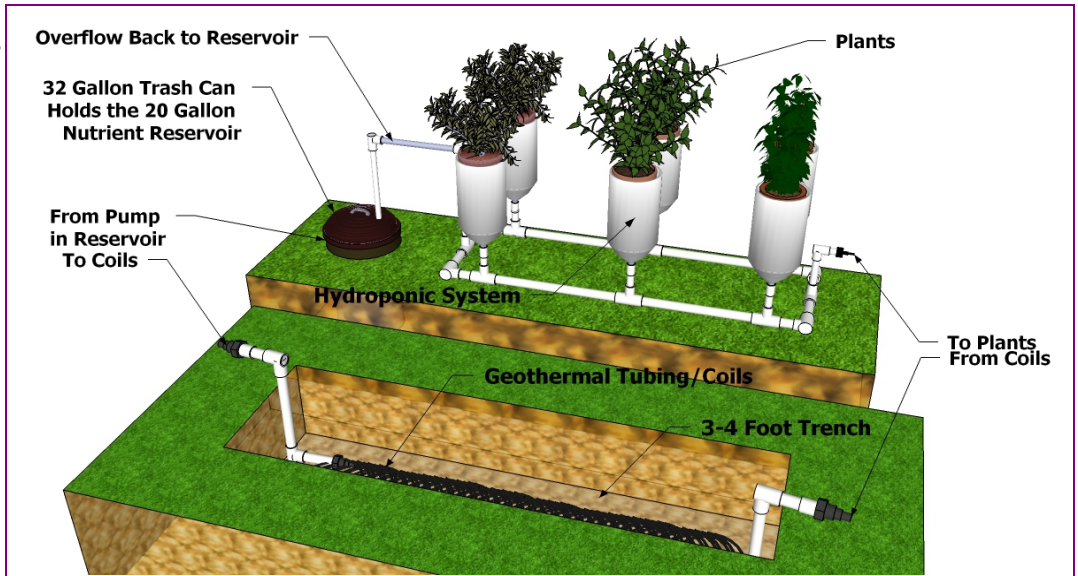


Home Hydro Systems

Geothermal Energy Nutrient Reservoir & Trench cooling System

The Reservoir and Trench portions of this design can be used separately but work better when combined. Geothermal Energy is free energy. Meaning the exchange of heat that's provided by the earth's soil, is free. In hydroponics it's common to keep the nutrient reservoir underground, and has been done for years to help keep the nutrients cool. In order to get the full effects of Geothermal Energy there are a few things to consider.

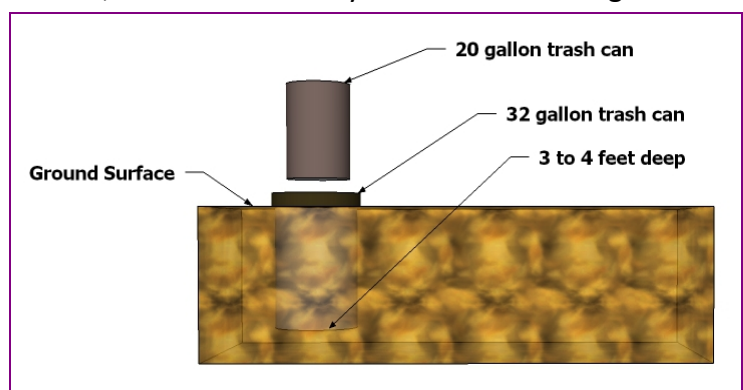


1. There should be no air between the sidewall of the reservoir and the ground. Air is an insulator and will insulate the reservoir from the ground therefore insulating it from the Geothermal Energy. Basically the heat won't be able to be extracted from the reservoir into the ground efficiently.
2. For best effects it should be at least 3 feet deep. The underground temperature of the earth remains constant throughout the year. The underground temperature is insulated from the above ground temperatures by the Earth's crust. Typically 3-5 feet is enough, although in places of permafrost, it should be placed deeper than the deepest permafrost.
3. Everything above ground should be insulated to prevent the absorption of heat when you pump the nutrient solution through the system. You don't want the above ground tubing/piping that the nutrients are flowing through to get hot and allowing the nutrients to heat up on its way to and from the plants. That would defeat the purpose of keeping them underground in the first place.

Underground Reservoir

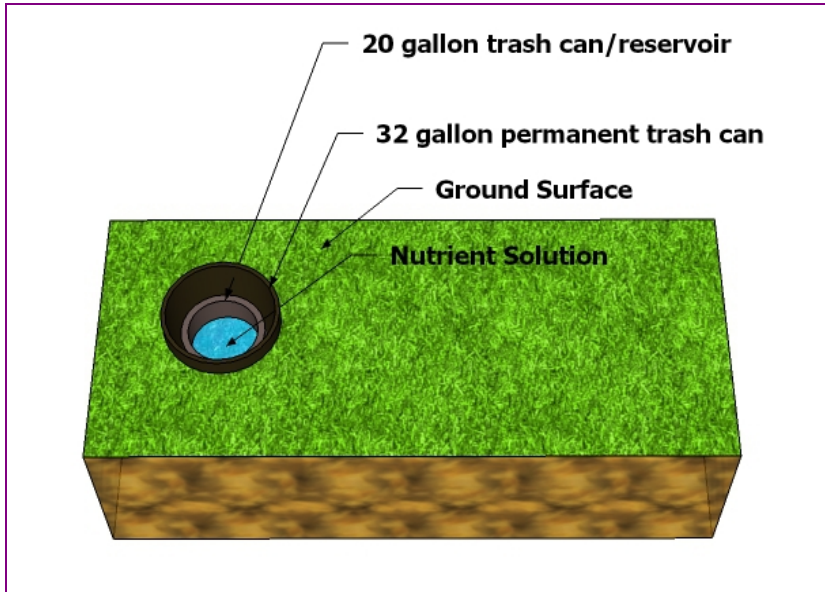
With hydroponics it is important to design things so they are easy to use and easy to clean when needed. This is one example of a nutrient reservoir that addresses the issues above, but allows for easy access and cleaning.

Dig a hole large enough to place a 32 gallon trash can in the ground at least 3 feet deep. Fill in the sides around the 32 gallon trash can with soil. This container/trash can will be permanently in the ground and makes direct contact with the earth (no air gaps). The 20 gallon (smaller) trash can will sit inside the larger one and will be the nutrient reservoir.



Home Hydro Systems

Geothermal Energy Nutrient Reservoir & Trench cooling System



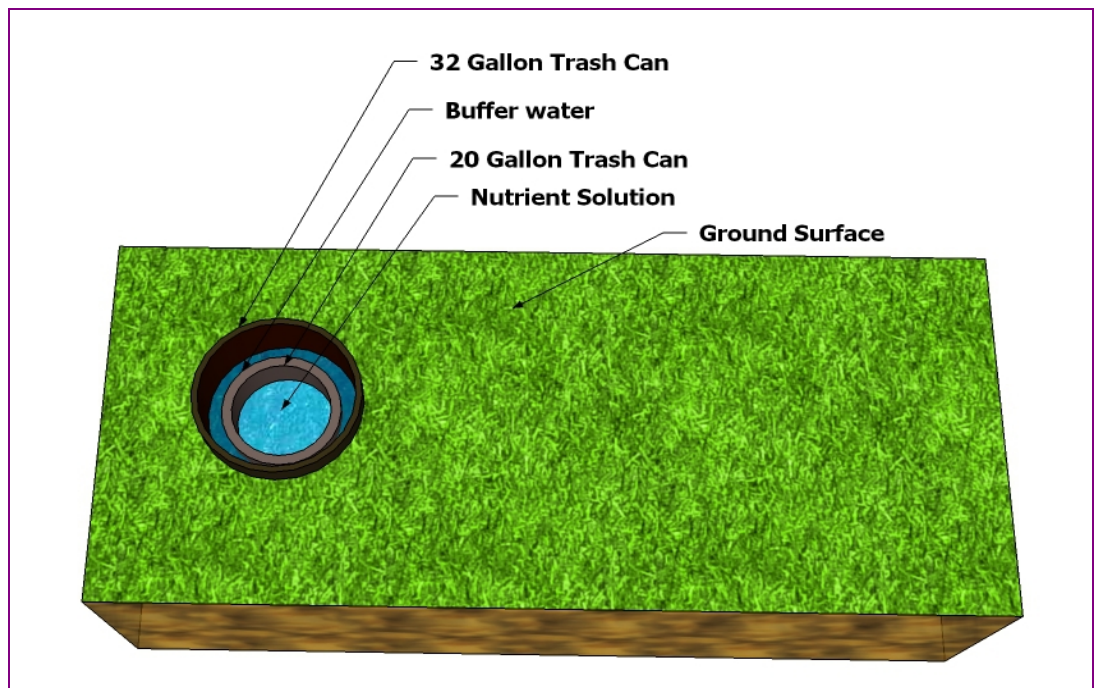
The smaller 20 gallon container/trash can will allow you to easily take it out for cleaning while leaving the larger container in direct contact with the ground.

(**Note:** these container sizes are not set in stone. The idea is to have one that is permanently in the ground, and another one that will fit inside of it that can be easily pulled out for maintenance.)

Once you have placed the reservoir inside the larger container, fill the reservoir with nutrient solution (or water to pre-test the setup). Then fill the larger 32 gallon container with water (buffer water) at least half way or just past where the

water level in the reservoir (20 gallon trash can) is. You may need to place a heavy rock in the reservoir (20 gallon trash can), because if the water level is higher in the 32 gallon trash can the 20 gallon one might want to float a little.

The water in the 32 gallon trash can (buffer water) takes up the air space between the two containers, effectively continuing direct contact between the ground and the nutrient reservoir. This will allow the heat from the nutrient reservoir to be absorbed into the ground cooling the nutrients. Now, to clean the reservoir all you need to do is simply empty some of the nutrient solution out, then lift it out to clean it.



(**Note:** It would be advisable to add some bleach or chlorine to the buffer water to keep anything from growing in it and keep it clean.)

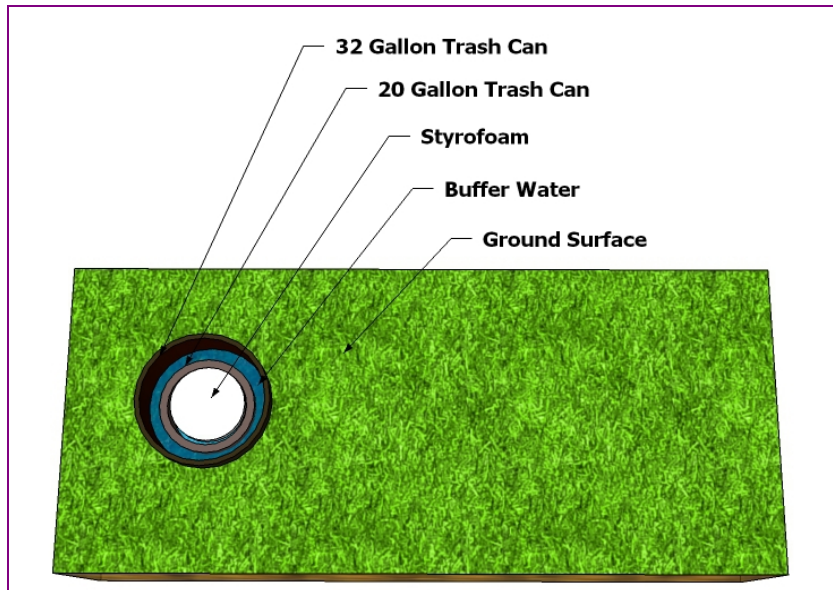
Home Hydro Systems

Insulating the top with Styrofoam inserts

Insulating the top with Styrofoam inserts is quite simple. Cut a circle in a 1 ½ to 2 inch thick sheet of Styrofoam to tightly fit in the 20 gallon reservoir. Then cut a hole or notch to run the cord and tube for the pump and cord.

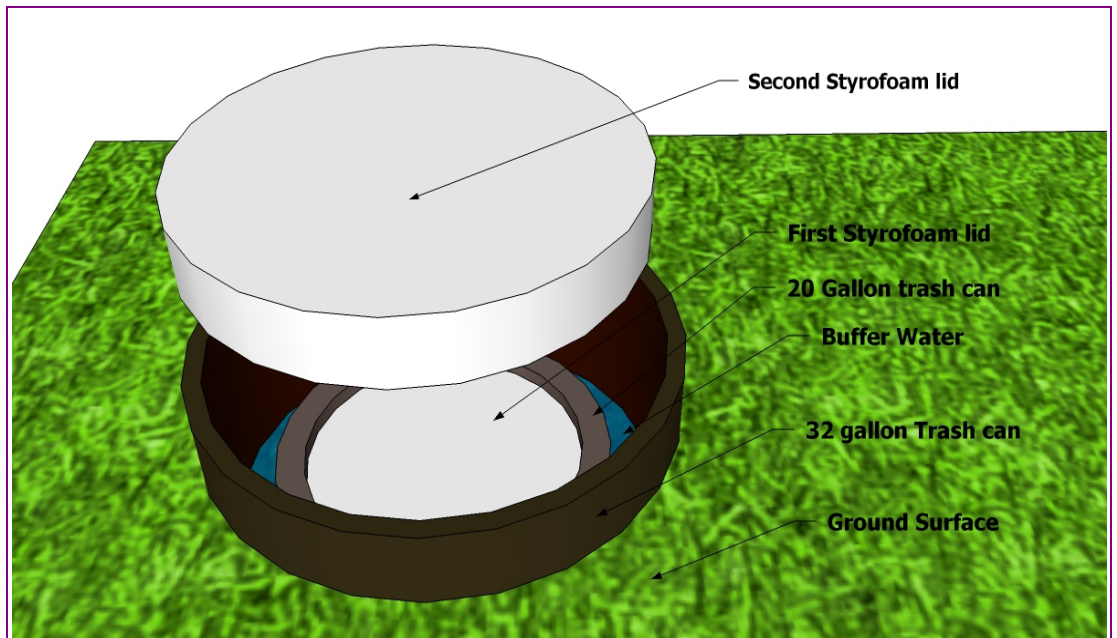
(Note: You can find Styrofoam sheets of different thicknesses in any home improvement store with the home insulation products.)

The easiest way to cut the Styrofoam is to burn it. I like to use a inexpensive Soldering iron. You can also heat on end of a metal coat hanger. The Styrofoam will cut like butter and the heat will leave a sealed clean edge on the Styrofoam all at the same time.



Now cut a second piece of the same 1 ½ to 2 inch sheet of Styrofoam in a circle. This time cut it to tightly fit the larger 32 gallon trash can. This will help insulate the nutrient solution, but more importantly insulate the buffer water from surface heat.

(Note: cutting a notch at the edge of the Styrofoam inserts instead of a hole will make maintenance easier)

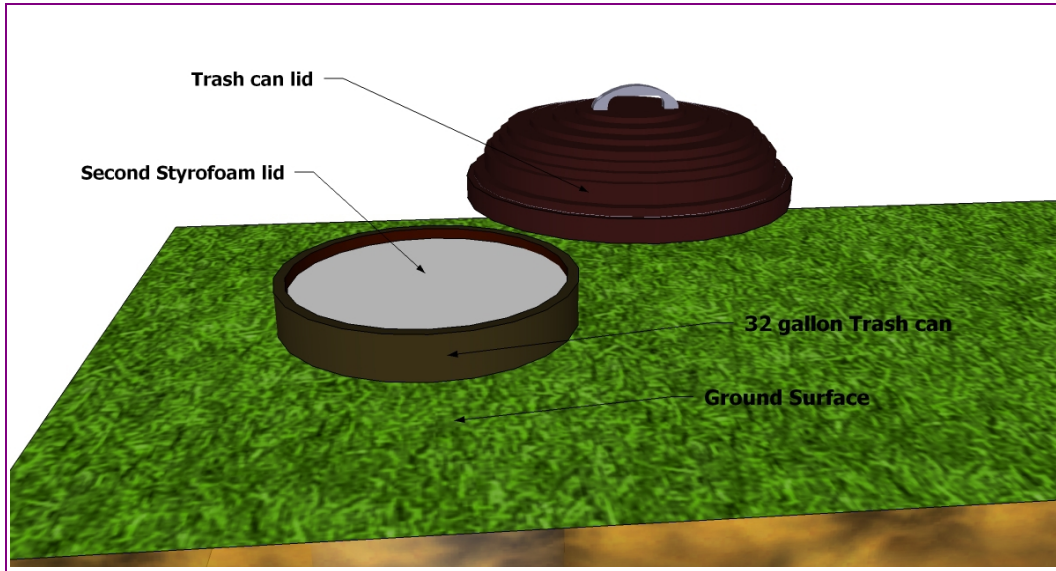


Now, cut a hole or notch for the pump tube and cord in the second Styrofoam insert. Place the second Styrofoam insert in and push it all the way down to the top of the 20 gallon trash can.

(Note: You may also want to add a handle to the Styrofoam inserts to make taking them out easier.)

Home Hydro Systems

Geothermal Energy Nutrient Reservoir & Trench cooling System



Now that you have the Styrofoam inserts in place you can mark then cut where you want to place the nutrient solution return line/tube. Then mark and make the necessary feed and return line holes/notches in the 32 gallon trash can lid. Place the trash can lid on top and run the feed and return lines to your Hydroponic system.

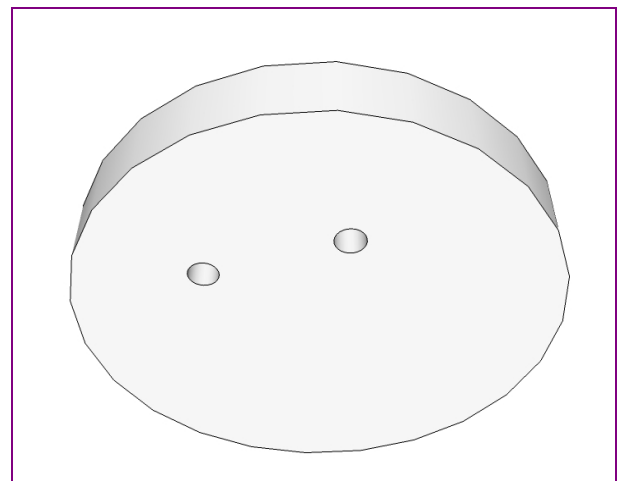
(Note: Make sure you insulate all tubes and hoses that are above ground to keep them from getting hot and heating your nutrient solution as it flows through them. If at all possible you should insulate the growing chambers (plants root zone) to keep them from heating up also.)

Styrofoam insert handle

From my own experience making a handle for the Styrofoam inserts will make taking them out much easier, in turn making the maintenance of your hydroponic systems much easier. Styrofoam is a weak material so you wont be able to screw a handle into it, and gluing one to it wont last long either. I wanted to add this page about adding a handle to your Styrofoam inserts to give you some ideas on how to do this.

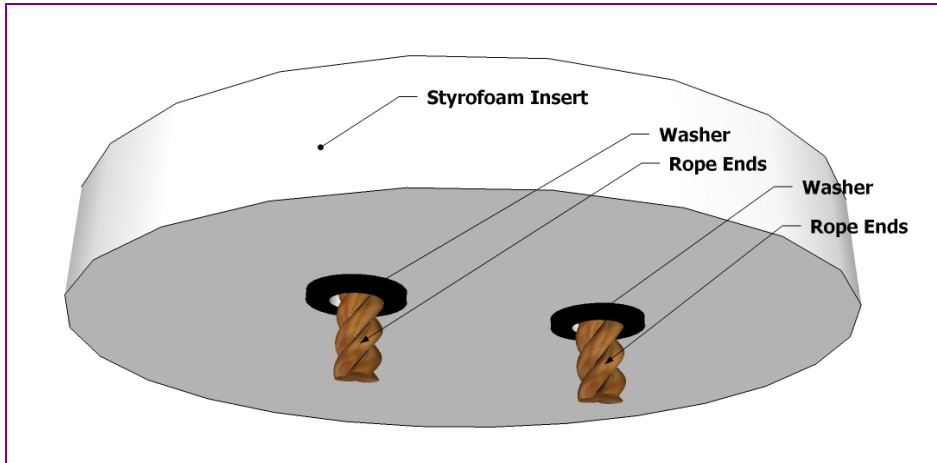
Because the Styrofoam is a weak material you should not try to attach anything to the top of it, because it will just tear off and not last. The best way to attach the handle is through the Styrofoam inserts and from the bottom. This way the piece is lifted from the thickest part of the Styrofoam all at the same time.

First find a piece of rope to use as the handle then make 2 holes in the Styrofoam inserts, barley large enough to fit the rope through. Once the rope is through the holes you will need a support for the rope or it will just tear through the Styrofoam as you pull it up.



Home Hydro Systems

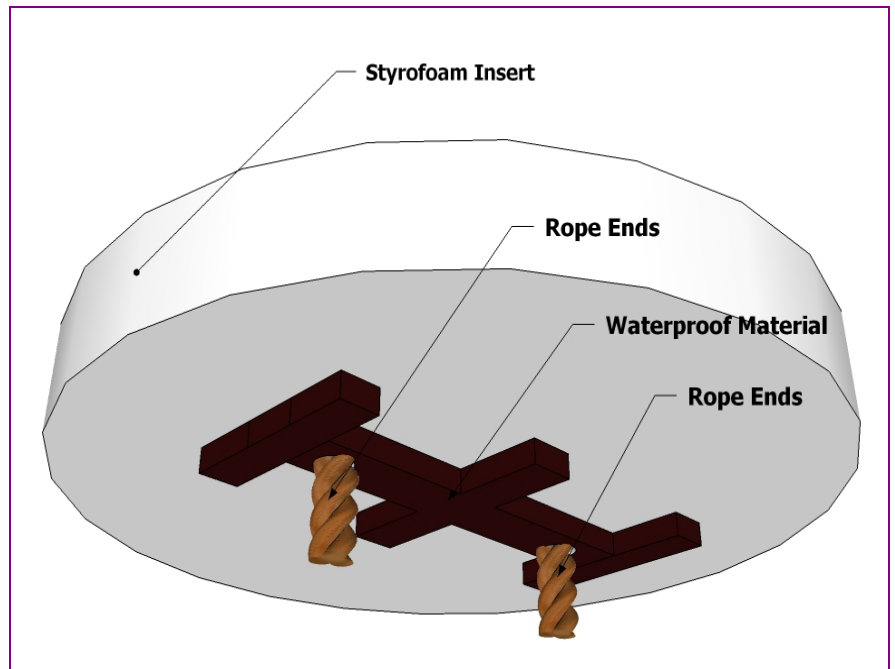
Styrofoam insert handle



One way to create the support for the rope is to use large washers (the larger the more support). Simply place the washers in place over the holes and glue to the Styrofoam using a waterproof glue, then thread one end of the rope through each hole and tie both ends of the rope in a knot to keep it from coming back out. If the holes in the Styrofoam are not tight agents the rope fill the space with silicone or waterproof glue to make it stronger and keep any air from going through the open space.

Another even more sturdy support is pictured to the right. It consists of the same basic idea, but offers more surface area contact with the Styrofoam for more support while lifting it. Like with the example pictured above glue the support to the Styrofoam using a waterproof glue. Then thread one end of the rope through one hole, and the other end through the other hole, then tie a knot in both the ends of the rope.

If the holes in the Styrofoam are not tight agents the rope fill the space with silicone or waterproof glue to make it stronger and keep any air from going through the open space.



Home Hydro Systems

Building the Trench and Coil portion of the system

First you will want to select a place to dig your trench and you'll want it to be 3 to 4 feet deep. The length of the trench really depends on many factors such as the type of tubing used, size of tubing ($\frac{1}{2}$ in, $\frac{3}{4}$ in etc.), how thick the wall of the tubing is, how densely you pack the coils into the trench and the type of soil. Even how big (gallons of solution) the reservoir is, and the temperature of the solution to begin with, are big factors. Though a trench from 10 to 15 feet long should do nicely.

(Note: The trench can be as wide as you want and can even have multiple rows of coils in it)

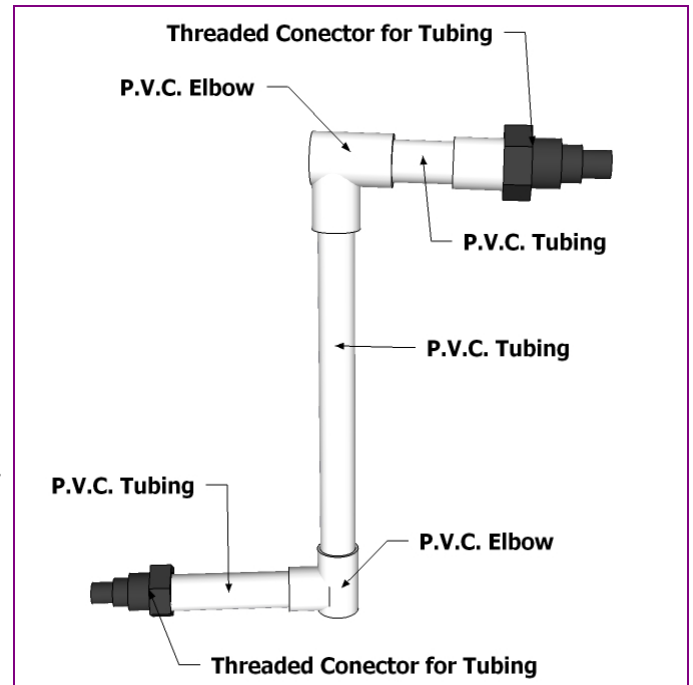
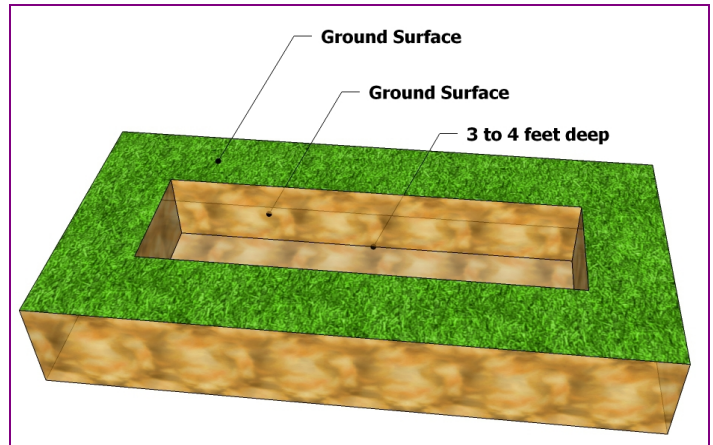


Polyethylene tubing can be found in any local hardware store with the drip irrigation supply's. Of course you want to use the solid tubing and not the tubing with pre-drilled holes or the soaker tubing, those will leak your nutrient solution into the ground. The smaller the tubing the better the heat transfer will be.

I would probably use the $\frac{1}{2}$ in tubing because that is the outlet size of most of my pumps. Although you can also use a reducing "T" connector, to go from the $\frac{1}{2}$ inch tubing to 2, $\frac{1}{4}$ inch lines. Then use another "T" connector at the return end to bring it back up to the $\frac{1}{2}$ inch tubing again. Also the more coils of this tubing in the ground the more cooling effect you will be able to achieve. There are just too many possibility's of connectors, adapters and fittings for me to list, but just ask about these at your local home improvement store in the drip irrigation and gardening sections.

(Note: Keep in mind the longer the tubing and the larger the diameter of the tubing the more fluid the tubing will hold, and will add to the amount of nutrient solution need to run the system without running your pump dry)

You can connect the tubing inline with your pump system a few ways, I like using P.V.C. myself so that is what I have shown here. It's inexpensive and is easy to connect and disconnects from the system. It's quite simple, basically you just cut and glue together a few pieces of P.V.C. (after measuring of course). The threaded connectors for the tubing can be found with the drip irrigation supply's and the P.V.C. connectors that they thread into, can be found with the P.V.C. connectors. This way you can quickly disconnect the vinyl tubing from hydroponic system for any maintenance, as well as if you decide to use it for a different hydroponic system. **(Note:** you need 2 of these, one for each end of the geothermal tubing/coils)



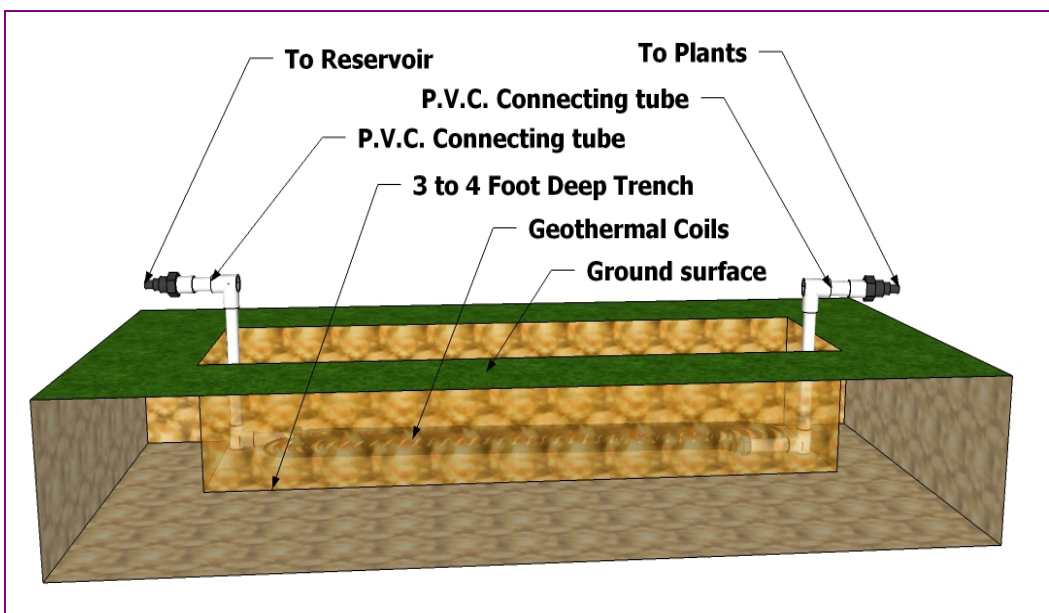
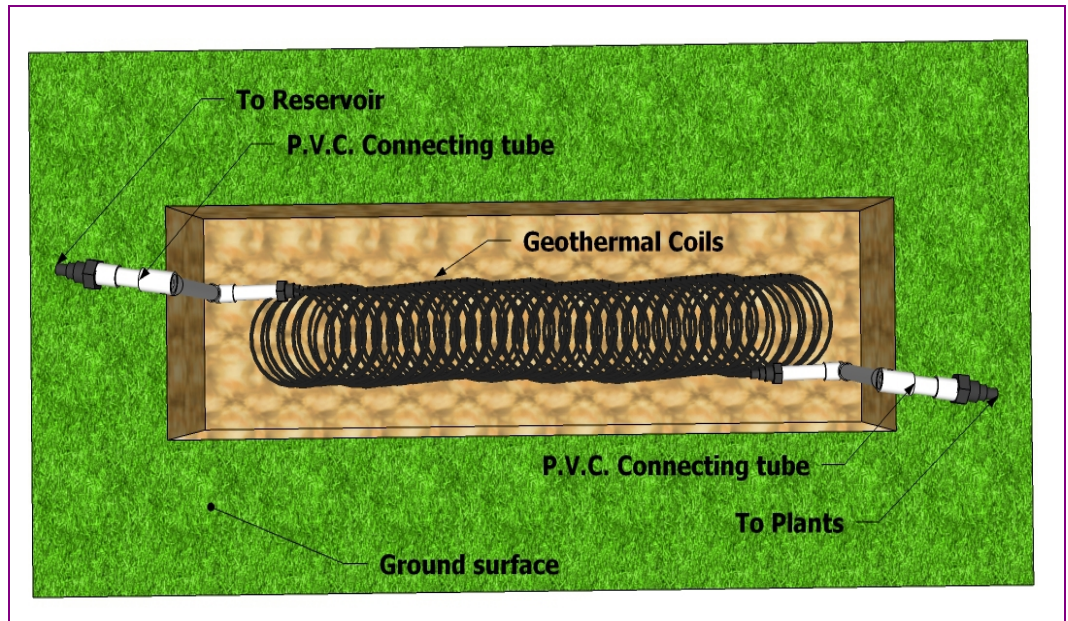
Home Hydro Systems

Building the Trench and Coil portion of the system

Now that you have the trench dug and the P.V.C. connector tubes made for both ends of the Geothermal coils, the rest is simple. Just lay the tubing in the trench, and lay it down like a long flat row of coils. Then connect the connecting P.V.C. tubes, and make sure they are tight so they won't leak.

If there's a lot of rocks in the ground soil you should consider laying down a 3 to 4 inch thick layer of sand or sifted soil before laying down the coils. Also you

would want to put another 3 to 4 inch thick layer of this same sand or sifted soil on top of the coils before refilling the trench. You can use the same soil you dug out, just use a large screen to sift the rocks out. Or if you want to you can hand pick them out (but this might take a while). This will prevent the tubing from being punctured from rocks in the ground as the soil settles back down after you fill it back in. Now that you have everything in place all you need to do is fill the dirt back in the trench. Then connect lines from the nutrient reservoir and plants to the fittings that are above ground.

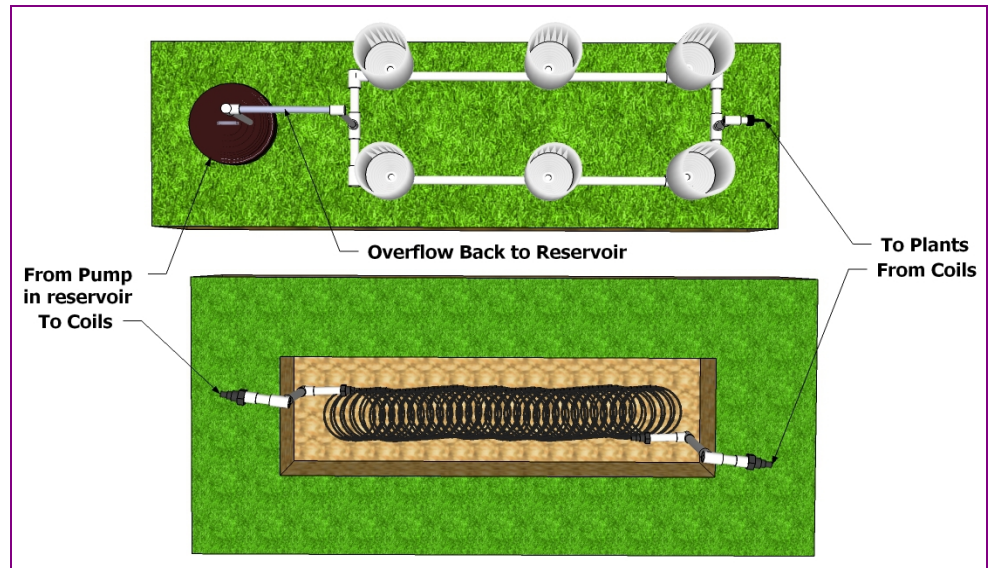


You will want to cover the above ground P.V.C. tubing and lines to both the reservoir and plants with pipe insulation, this to keep them from heating up your cooled nutrient solution. You can get pipe insulation at any home improvement store with the plumbing supply's. It usually comes in 6 or 8 foot lengths and in different diameters for different diameter pipe, and runs a buck or two each. This will go a long way to keeping your nutrients cool, especially if you need to run the lines for any length of distance.

Home Hydro Systems

Completed Geothermal Energy Cooling System

Now you're ready to take advantage of mother nature's free renewable energy source to cool your hydroponic nutrient solution. Just run the hose from the pump inside the reservoir to one end of the underground coils, then run a hose from the other end of the underground coils to your hydroponic system. The overflow from the hydroponic system goes directly back into the reservoir completing the nutrient solutions round trip.



You will want to make sure to that all the above ground tubing the nutrient solution flows through is insulated with pipe insulation, so the solution doesn't have the chance to warm up as it flows through these portions of the system. Also you will want to insulate the root zone of the plants. Not just the tubing but the part of the hydroponic system that holds the roots and growing medium, because the nutrient solution spends a lot of time in this area. Also when the solution is not flowing, the roots themselves are very vulnerable to heat. The nutrient solution and root zone should remain a constant 65 to 72 degrees, this mimics mother nature and will keep your plants happy.

HAPPY GUARDENING!!!

