

Site Selection and Considerations

- Determine your local climate and decide if you need a greenhouse to keep the fish warm or not, see "Climate's Effect on System Operation", in the course manual. If your location is warm, but you plan to have a greenhouse for a pest-sensitive crop such as tomatoes, consider getting a bit larger greenhouse to put the fish tanks inside also, as they will benefit from the additional warmth (unless you are in a very sunny and warm location, in which case that is not necessary). **If you are going to install a greenhouse on a sloped site, and intend to use the "sloped grading" method, you will need to tread carefully, as we do NOT YET have an example of a greenhouse for troughs installed on a sloped grading installation. Depending on the greenhouse type, we think it will PROBABLY work well. Just be careful, your building will be at the same angle from level that your finished ground is (doors will open REALLY EASILY one way and with more difficulty the other!).**
- **IMPORTANT: There are now TWO GOOD WAYS to grade your site, based on new information we developed in the last six months.** If your site is flat, you can mostly ignore this section. If your site is sloped, then you WILL need to do some kind of grading to prepare it for the fish tanks and troughs. While the fish tanks need a flat and level area, there are two ways to grade your site for the troughs for a large commercial aquaponics system, the "traditional" way of grading flat and level terraces with steep short sections between them; and the "new" way we'll call "sloped grading". Here are descriptions of the two to help you decide what's best for you:
 1. "Traditional" consists of grading terraces on a sloped site for your fish tanks and troughs that are LEVEL (which is different from FLAT) in both directions, lengthways to the troughs, and sideways to the troughs. This method of grading leaves you with large flat areas that are easy to put your installation on. It also has a couple of potential drawbacks: the first one is that you have relatively steep sloped areas between each flat and level terrace and the next terrace that are not useful for much of anything because of their steep slope, but upon which you DO need to install stairs or other methods of movement and transportation for people and up and down between terraces. The other drawback is that it involves a LOT of grading to turn a sloped piece of land into flat and level terraces. Grading costs money, and grading a sloped site level costs the most money. "Sloped grading", which we discuss next, can save you a tremendous amount of money if your site is "hard" or rocky, or even if it is soft dirt but sloped. We wish we knew about sloped grading almost four years ago when we graded for our farm; we would have done our WHOLE farm this way!!
 2. "Sloped grading" for "slant troughs" consists of grading your site level in the long direction of the troughs in the areas you will install hydroponics troughs, but grading it FLAT to match the existing slope in the sideways direction of the troughs (flat, NOT LEVEL, in this direction, they're different!). Yes, now your FLAT trough pad slopes significantly DOWNWARDS from the top trough to the bottom one, but is level in the lengthways direction of the troughs. How do you make your troughs now? You build the uphill side of the trough shorter and the downhill side of the trough taller, so that the trough is still LEVEL across the top of each individual trough, but the BOTTOM of the trough is sloped downhill (the top of the trough CAN'T slope unless you know a way to make the water in your trough slope). Each sloped trough is installed slightly lower than the previous one uphill from it.

You need to get the average measurement of the slope under the troughs, figure out how much difference that is over the 4 feet 6 inches of trough width, then divide that in half. Add half of this number to the downhill side of the trough and subtract half from the uphill side of the trough. Example: your sloped grading is done, and you've used a builder's level to "shoot" the pad, or a carpenter's level taped to a very straight 20-foot 2x6 and measured how far down the end of the 2x6 is off the ground when the other end is ON the ground and the 2x6 is level. However you did it, you've measured that the trough pad slopes downwards 17-3/4 inches in 20 feet of horizontal distance, or 0.8875" per foot. Over the 4-foot 6-inch width of the trough, this is 3.99" of slope. We'll round off to 4" to make this easy, and divide by half. That is 2 inches, and we subtract 2 inches from the uphill side of the trough (that would have been 12" tall for a traditional flat terrace), and build ALL our uphill sides 10" high. We ADD 2" to the downhill side of the trough (that also would have been 12"), and build ALL our downhill sides 14" tall. You might want to make a test "trough" from some plywood scraps first to check your math, before you cut all the plywood for a big system and find out there was a mistake.

When you install these, install the uphill side first, then the downhill side by leveling to the uphill side. Everything else works the same way as standard troughs described later in this manual. We installed a test sloped trough on a slope of 3.88 inches per foot (remember, our example was 0.8875" per foot!), and although it was quite odd-looking, it held water and functioned as a trough.



Sealing slant troughs to the Mirafi geotextile ground cloth with mortar and a trowel keeps mice, bugs, and dirt out from under your troughs.



"Slant" troughs in a "sloped" grading installation. Note airlines with valves stubbed-out, pipes in VERY shallow trench to left (rocky ground!), Mirafi ground cloth ready to finish installation after trench is backfilled.



Fish tank in foreground, four 75-foot long slant troughs in background.

- If your site is dirt, you have more choices about where you want the aquaponics system to go because it is cheaper to move dirt than rocks. Follow the directions in the construction drawing. Make sure you read the previous bullet if you are dealing with a flat site. If you have a sloped site and decide to use the "traditional" grading method of terraces with slopes between, AND decide to use a sump tank (optional) the sump tank sits on a small flat pad that is four feet lower than the large pad for the tanks and troughs (you can usually hand-grade the sump tank pad with a pickax and rake). This gives you a gravity flow all the way from the high spot (the rearing tank) to the lowest spot (sump tank). Grade everything within 1" of level length-wise on the troughs. You can put a slight slope in crossways to the troughs, maybe 1" in four feet, so that your system finish ground drains runoff down slope in a rain instead of puddling around and between the troughs. This also makes it easy to get the subsequent troughs in the series working correctly: it's much harder to get water to flow uphill if you accidentally put the next trough two or three inches higher than the last one. Your grading contractor is responsible for getting this right, he should have a level and know how to use it. If he says it is level, then when you go to rake the sand out (covered next), and find your pad is 12" higher on one end than the other, you will wish you checked this before you paid him his final payment.
- If your site is dead flat, omit the sump tank, and install your pump connected to the aquaponics trough's outflow as shown in the CAD drawings.



Everybody needs a Siamese survey cat! Tim is laying out the grading with approximate levels. This optical instrument he's using costs about \$400 or so and saves tons of time laying out your aquaponics system and buildings. It allows you to double-check and confirm that your grading contractor REALLY got your pads level and flat before you pay him the last payment due. It's also a great tool to use to make sure your drainage slopes drain rather than clog.

- If your site is rock or otherwise very "hard", you want to carefully site your system to minimize grading costs. Also, read and re-read the previous section on "slant grading", and "slant troughs", because you can save a lot of money doing it that way. The cost of bringing in fill may be less than the cost of squashing what you have with a D9 until it's flat enough to build a system on. Also, it is very easy to get the fish tank and hydroponics trough areas flat and level. First, have your grading contractor do the best he can with whatever your substrate is.
- **IMPORTANT!** After the grading contractor is finished, dump a few cubic yards of sand (also known as pipe bedding, sometimes a LOT cheaper than sand) on your pad and hand-rake it out with rakes to make your finished level. If you have or can rent an optical level as shown in previous picture, use it first to get the pad as level as possible from end to end. It is easy then to check level in smaller areas (and knock down bumps and fill in holes) if you get a 16-foot 2x4 and duct tape a 6 foot builder's level to the top of it. Use the 2X4 to check level both ways on the pad if you have a pad that is level in both directions; and to check level and flat on the pad if you have a slope-graded pad, as you grade the sand with your rakes. After it is done, run a compactor or a bulldozer over it to compact it (if you have one), then go back and fill in any small areas that have settled with a rake, wheelbarrow full of sand, and your level on the 2X4.
- If your site is steep, you may need a larger water pump than specified if you end up with more head from your sump tank/last trough up to your rearing tank than 6 feet or so.

Grading and Site Preparation

- **IMPORTANT:** Get a good, experienced grading contractor. There are lots of people with an old D3, backhoe or skidsteer who will say they will "grade your site". You can easily spend more money on an inexperienced person with a too-small machine (and still end up with a mess) than if you did it right to begin with. Find



Our bulldozer is older than Tim - (she was made in 1948), and we love her! She's a piece of equipment that makes people ask "Does that thing even run?" But she starts up every time!

someone with two or three local references who is experienced with grading the type of ground you have. Some contractors are good in hard rock but don't do much dirt grading and don't have the right equipment for it. The smallest bulldozer you should hire for rock grading is a D6 or D7 with a ripper. Some contractors are very good in dirt but don't do much rock grading and don't have the right equipment for it. The smallest bulldozer you should hire for dirt grading is a D3 or D4. You don't need one with a ripper unless you have rock outcrops inside the area you plan to put the system, and there is nowhere else to move the system to.

- The cost of grading rock is going to be double or triple the cost of grading dirt. On the 1,024 square foot commercial system, expect maybe \$800 or so grading costs in dirt, and \$2,500 or so in light rock on a relatively flat site. Don't grade hard rock unless you have no other choice, it will cost a LOT to grade; instead, do a minimum of grading and level your site with trucked-in fill, and/or use the sloped grading method discussed previously. It will be cheaper, and your grading contractor should know and recommend this. It may be worth buying this trucked-in fill, because you can purchase a piece of rock for LESS than a piece of dirt.
- Grade according to the information in "General Site Considerations". If you have any questions about site layout or planning, we are available to design sites with specific grading plans for your grading contractor to follow. We can supply engineered plans if you need a city or county grading permit.
- **After grading is finished**, including hand-raking the layer of sand to get the pads exactly flat and level (in the direction they're supposed to be level), spread a layer of Diatomaceous Earth (DE, see the "Pest Control" section of this manual for more info on why), combined with Cream of Wheat or finely ground cornmeal. The ground should look rather white when you're done. (You're really wondering about us now, aren't you?). The cream of wheat or cornmeal will attract ants, cockroaches, and any other hard-bodied insects that may, in the future, wander down the holes the form stakes make in the weed mat, and then will **kill them**, in a completely organically certifiable and non-toxic manner.
- **Now, after the anti-bug stuff has been spread**, put down a layer of 6-mil black construction plastic. Use the plastic if you want to be absolutely sure you will have no weed problems (comes in 20-foot wide rolls at

Home Depot, Lowes, and other construction supply outlets), then lightly stake down a layer of Tencate Mirafi 180N weed mat (also known as geofabric or geotextile) on top of the plastic. Don't completely stake the plastic and weed mat down yet (just put in enough stakes so it doesn't blow away), as you still need to trench and install piping. The Tencate is a heavy non-woven black fabric that looks like thin felt (it's sometimes called geofabric or geotextile) and equivalents can be found at irrigation supply houses and contractor's supply houses.

- Prepare mini-pads (sand beds) for the tank locations that are 3-4" higher than the ground around each tank and cover them with the same weed mat. These higher tank mini-pads will drain water away from the tanks during rains and add to the tank's longevity.
- When you're doing your system layout, realize that you can make long troughs instead of breaking them up into shorter runs; HOWEVER, it is much more difficult to make 150' of trough level than it is to make 75' level, this is the reason for breaking it into two. It is much easier to get each succeeding trough level, but a LITTLE LOWER than the previous one, than it is to make a single long trough that is level. Also, the ONLY WAY you can get even 75' long troughs reasonably level is to use an optical level (like a builder's transit or laser level), which means you need to know how to use one, and either buy or rent one.
- You may not have funds to build a 4,096 square foot system now, but can afford to put in 1,024 square feet of the system. You do need to put in the correctly sized fish tank and other tanks (if you're using them) and the correctly sized piping for the 4,096 square foot system now, because it will be difficult and more expensive to change all this later. So, if you're not going to build all your troughs at once, hopefully you have realized that you need to put the piping for them in now so you don't have to dig the whole thing up later (good idea!). You have to think ahead and put in some stub outs that you will hook up to later when you expand. Stub out your pipe that returns to the sump tank at the far end of the troughs you ARE going to put in now, but put a "tee" in there instead of an elbow, with a cap on a 12" piece of pipe stuck into the tee. You can install "temporary" PVC fittings that can easily be removed later by using a cheap latex painter's calk and a stainless steel sheet metal screw. Squirt the calk onto the piece of pipe about 1" in from the end, push it into its fitting, then drill a small hole through both fitting and pipe and install the stainless steel screw in the hole with a little dab of latex calk under the screw head. Put the cap on this way also so it's watertight. Aim one side of the tee towards where your expansion troughs will be, and put the 12" temporary pipe with the cap into this side of the tee. Point the other side of the tee straight up to the surface of the ground, where you will hook it up to ANOTHER temporary pipe. This temporary pipe will run, on the surface of the ground, all the way back to your sump tank.
- DON'T glue any of these temporary pipes in now! ALL these temporary pipes are plugged into the fittings with some calking as described with a #8 stainless steel sheet metal screw. This holds them together, but when you undo the screw you can tap the pipe out of the fitting because the calking just sealed the pipe but DIDN'T glue it into the fitting. This way you can have a complete operating aquaponics system while you are earning the money for and building the next sets of troughs, and when you are ready you don't have to put another set of pipes and a pump in just to get water to the second set of expansion troughs. Just pop the temporary joints, scrape the painter's calk out of the joints, and this time glue them together with PVC glue.