

Bellwether Innovations, LLC

Three Tower Kit for GroPockets

Building and setup Instructions

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Cindy
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Chapter 1 - Introduction & Shopping Lists

This document explains the process for building a GroTower mounting frame, adding the plumbing and the towers to make a vertical gardening system which will grow 42 plants. It assumes you have bought the three 5' tower kit which has the pump, pump harness, and the premium irrigation assemblies.

The frame structure will

- Support the irrigation system to the top of the towers
- Support the drain pipe
- Suspend the GroTowers above the water return

This frame is 7' 7-5/8" tall, 4' 7" wide, 7-3/8" deep. It holds 3 GroTowers with 14 pockets each.

We suggest that you build the frame and install the drain plumbing before drilling the holes in the towers and attaching the pockets.¹

¹ Why build the frame first? Once the pockets are attached to the outside of the pipe, the pockets are easily damaged, especially if the tower falls over. On the other hand, once the frame is complete, you can easily hang the tower with pockets keeping it out of harm's way.

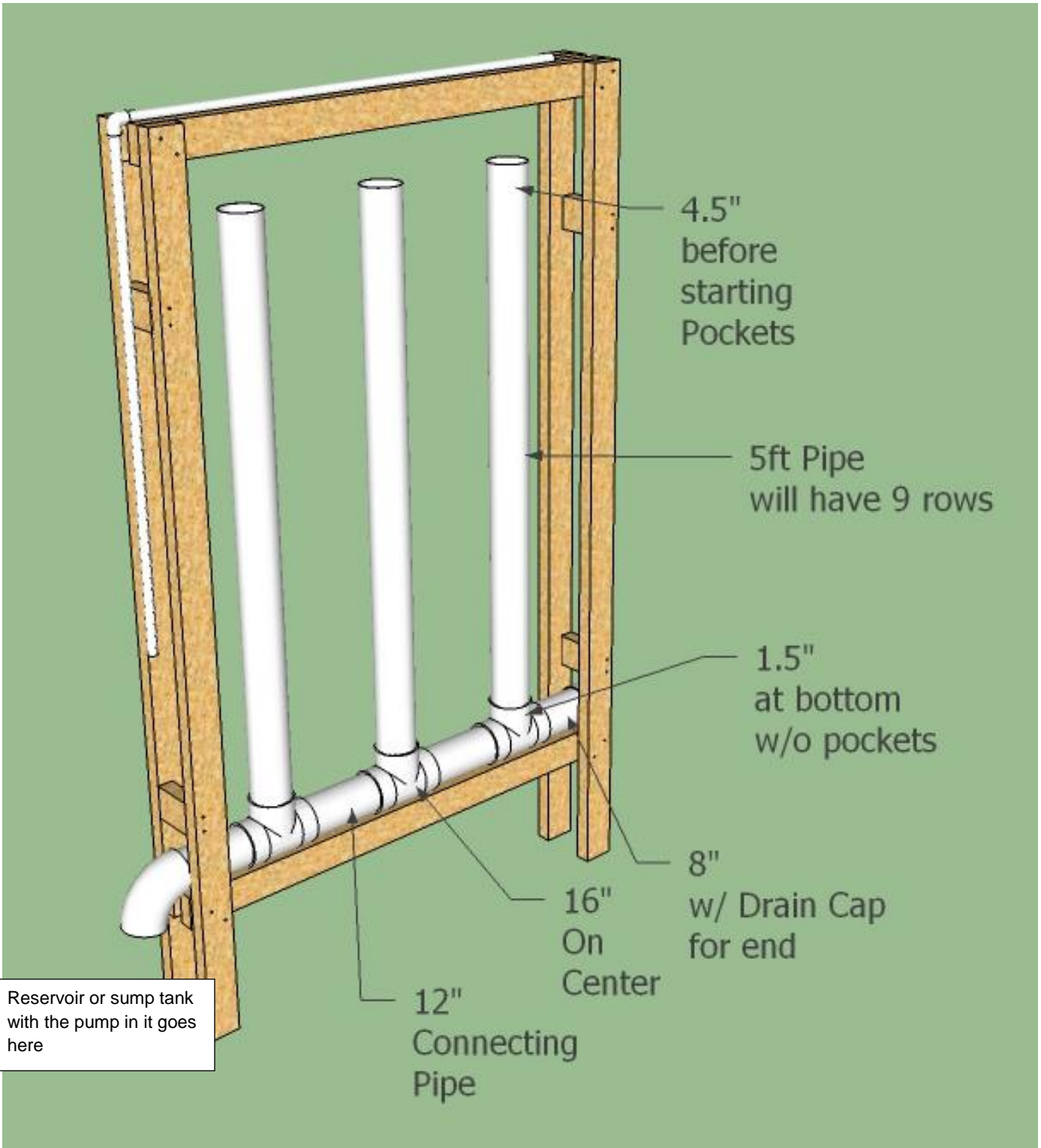


Figure 1- Drawing with Important Measurements

Here are two images of the completed system (this one happens to have 4 towers):



Figure 2- Top of similar 4 tower frame



Figure 3- Lower view of similar 4 tower frame

Considerations

Reservoir

Your system needs to include a reservoir. The reservoir can be a sump tank in an aquaponics system. Murray Hallam's videos on GroPockets show this approach. Or you can use a storage container like this one as a reservoir.

It is opaque, sturdy, and inexpensive. It holds about 17 gallons and is easily found at home improvement stores. The frame structure dimensions in this document are matched to this reservoir which is 12" tall. If you need to adjust the height for a different reservoir, see Appendix C.



Figure 4 - Storage Container as Reservoir

The submersible pump in the kit is situated in the sump tank or reservoir. The supply line in your kit routes the water from the pump in the bottom of the reservoir to the 1" pipe on the side and then to the top where the irrigation assemblies are incorporated. The water falls down through each tower and drains into the 4" pipe at the bottom of the GroTowers and is returned to the reservoir.

Reservoir considerations

- It must be aerated to at least 6 ppm of oxygen
- It needs to be opaque to prevent light – otherwise the nutrients will grow algae
- It needs to be pH neutral, for example no unlined cement
- It needs to be covered to prevent heavy rain infiltration which dilute the nutrients
- The covering needs to be removable for access to the pump, checking the water level, or retrieving fallen items, etc.

Construction Technique

The frame is built using 2 large identical rectangles made from 2x4's. On the next page are some drawings.

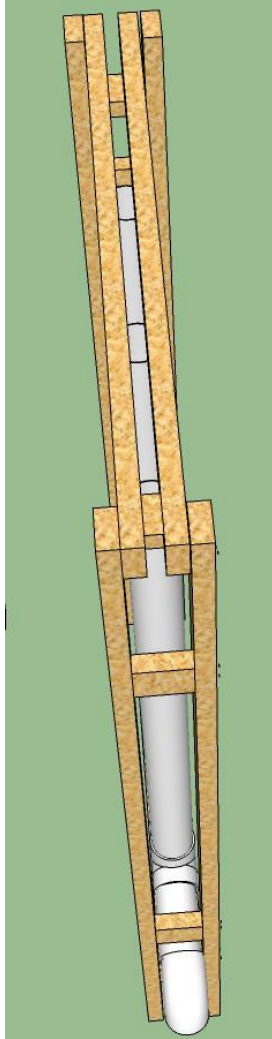


Figure 5- Angled Front View of Frame

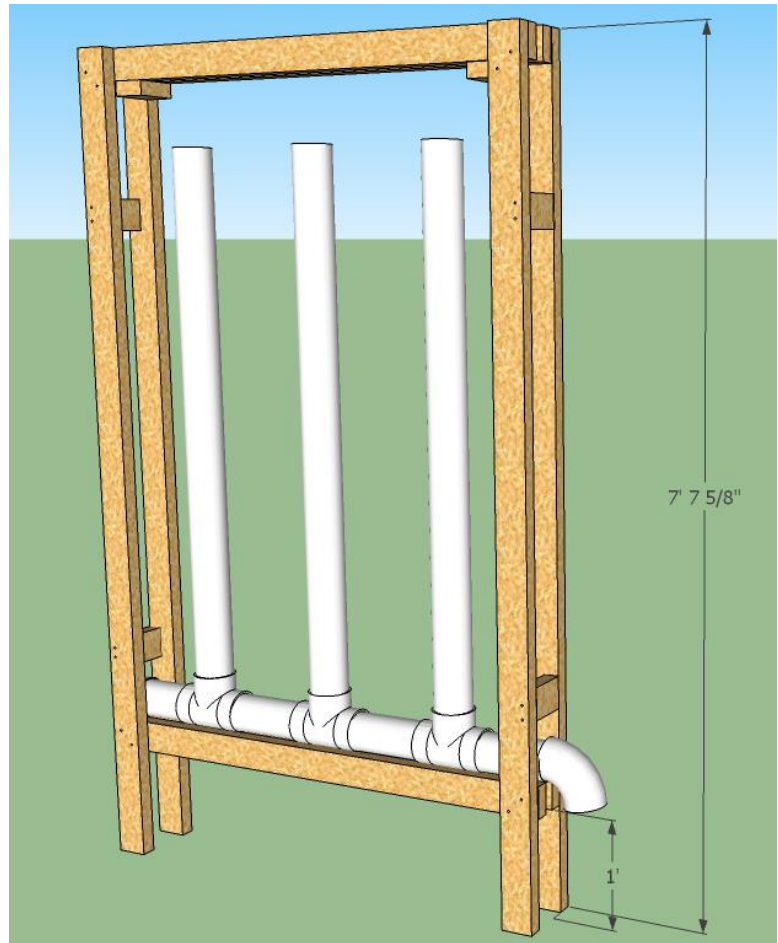


Figure 6-Frame overview drawing

Lumber Used to build the Frame

2x4s - These are the most common size of framing lumber you can find.² The easiest to find and transport are 8 feet (96") long. They are also available in 10' lengths. The spacer blocks, parts C, and D, can usually be made from cut-offs from the Part A's and Part B's.

2x4 lumber is available in at least 3 ways:

- Untreated white wood (pine, fir, unspecified)
- Untreated cedar – more expensive, but looks nicer
- Pressure treated "white wood" which makes it rot resistant

² 2x4's are actually 1-5/8 x 3 1/2" instead of 2" x 4".

Building for outdoors

If your GroTower frame structure will spend time outside without a cover, you should do one of the following.

- Paint the untreated wood
- Buy cedar or wood that is naturally rot resistant (exterior oils help with longevity & looks)
- Buy pressure treated lumber

Connecting the Frames

In this image, you can see they are connected by joining/spacer blocks. Employ finishing washers with each screw to prevent overdriving the screw into the lumber.

These washers look like this:



Figure 7 - Finishing Washer

1" Schedule 40 Pipe

The supply line which is connected to the pump in the reservoir will be slightly pressurized from the pump. Consequently, it needs to be schedule 40 pipe and fittings. The irrigation assemblies that come with your kit provide most of the fittings. You only need to buy the 1" pipe, an elbow, and a cap for the end.

4" PVC Pipe & Hub Fittings

The GroTowers and the pipe for the bottom of the frame (accepts the drips from all the towers and routes it back to the reservoir) are made from 4" PVC pipe. None of these is under pressure, so use the thin-walled S&D³. It usually comes in a 10' "stick" with a 4" bell on one end for connecting a run of pipe. The bell is shown in Figure 9.

³ S&D stands for sewer and drain. It has a rating of D2729. It is less than half the price of 4" schedule 40 pipe. The schedule 40 pipe and fittings would work, but they are way more expensive and you don't need the extra strength.



Figure 8 – Side View of Frame



Figure 9– 4" S&D Belled End

If you have a choice, avoid the belled pipe. The bell can be used as the top of the towers where the splash guard goes. Otherwise, for our purposes, it is waste. If only belled pipe is available to you and you want all 3 towers to look the same, you will have to buy 3 sticks of 10' pipe. You will need some pipe to use in between the tees so it is not a complete waste.

The fittings for the S&D pipe are the least expensive for this purpose. To hold the bottom of each GroTower, you will need a tee similar to one shown in figure 10.



Figure 11 - 4" S&D Cap

You will need one 4" S&D cap for the end of the drain pipe which doesn't return to the reservoir.

To return the water to the reservoir, you may need a 90° elbow at one end. There are two choices for hub elbows. The longer sweep elbow might suit your situation better but they will cost around 50%.

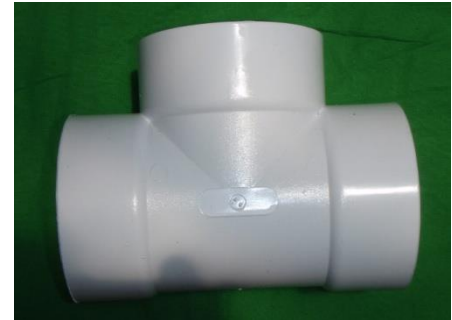


Figure 10 - 4" Tee



Figure 12 - 90 Elbow

Shopping List

It is best if you can transport 10' pieces from the home improvement store. Pipe is available in 10' "sticks" and you can buy fewer pieces of lumber if you can buy some 10' pieces.

This list will also need to have other items to suit any special situations, such as fasteners for attaching the frame structure to something else (wall, fence, IBC tote, etc.).

Lumber

If you can transport 10' pieces:

- Four 2x4 x 8' long for Part A's (vertical legs)
- Two 2x4 x 10' long for (4) Part B's

If you can only transport 8' pieces:

- Eight 2x4 x 8' long

Hardware

- #10 Wood Screws (3 or 3½" long)⁴
- Finishing Washers for #10 screws to keep the screw heads from penetrating into the 2x4s
- One pipe hanger for a ¾" pipe
- 3 short wood screws or hooks from which to hang the towers.
- Three ¾" or 1" split rings (one for each tower)
- 4 Corner Braces to make a stand alone frame structure (with appropriate fasteners)
- Optional – 4 steel mending plates with fasteners (if you want to use them instead of spacer blocks)

1" Pipe & Fittings

- Two 10' (or one 20') sticks of 1" Schedule 40 pipe
- 1" Elbow slip x slip
- 1" cap (slip)

4" S&D Pipe & Fittings

- Two (or three) 10' sticks of 4" S&D pipe
- 3 Hub Tees
- 1 Cap
- 1 90° elbow (optional if you need to route the drain to the reservoir)

⁴ Coated deck screws or stainless steel screws (more expensive). They need to be resistant to moisture, and if you are using pressure treated wood, the screw must be rated for pressure treated wood.

Tools

- Tape Measure
- Level
- Pencil for marking
- Straight edge for marking lumber
- Large square for aligning corners of frame
- Electric drill (two would be nice)
- Twist bit approximately the same size as pilot bit in hole saw (optional)
- A 2½" hole saw with pilot bit for drilling holes in 4" S&D pipe
- A ½" hole saw to cut a hole in the reservoir for the pump wire
- Screwdriver with bits to match the screws being used to build frame
- Saw to cut 2x4 lumber (Miter saw or crosscut handsaw)
- Saw to cut PVC pipe (Miter saw, reciprocating saw, or hacksaw)
- Saw to cut opening in reservoir lid for return water & flexible PVC pipe (electric jigsaw is first choice for this)
- Rubber mallet to force 1" PVC connections together
- A 2" net pot for aligning the GroPocket to the drilled hole in the pipe

Supplies

- With City water, treatment method for chlorine or chloramine⁵
- Paint or stain (if applicable)
- PVC Cement^{6 7}
- Nitrile or latex gloves to wear while applying PVC cement
- Nylon zip ties to hold GroPockets in place while the cement dries⁸
- Silicon caulk to fill any gaps caused by insufficient PVC cement
- Sandpaper or rasp to clean up holes drilled in the pipe
- Paracord or string for hanging the GroTowers from the Frame Structure

⁵ This is discussed in more detail toward the end of the document.

⁶ Primer is not required.

⁷ Buy at least a 1 quart container. Clear is better cosmetically. For example, Weld-on 795.

⁸ 18" will fit around the pipe with the pocket. You can buy 18 long ones or buy 9" ones and link them together. This is what is shown in Murray's video. Two 9-10" zip ties are cheaper than one 18" zip tie.

Chapter 2 – Build the Frame Structure

Identifying the Parts

For clarity's sake, we use this identity convention:

- Part A is the vertical leg of each of the 2 frames which are attached together.
- Part B is the horizontal cross piece which connects the two vertical legs.
- Part C is the spacer/connector block connecting the 2 frames to each other. You will need 2 for each side and 2 at the top to keep the 1" pipe from falling down between the 2 frames
- Part D is one short piece to which the flexible PVC of the plumbing harness can be attached.

Lumber Cut List:

Here is a list of the quantity and lengths of 2x4's needed by Part ID. Use whatever available method to make these cuts.

- Four 2x4 cut to 91 5/8"
- Four 2x4 cut to 55"
- Six 2x4 cut to 4-5/8"
- One 2x4 x 6 1/2" long for attaching supply line

Mark all Part A's

Now, we need to mark all of the Parts A so that the 2 frames are built identically. We will draw three lines to locate:

- Bottom of the lower Part B⁹
- Bottom of the lower side spacer Part C
- Bottom of the upper side spacer Part C

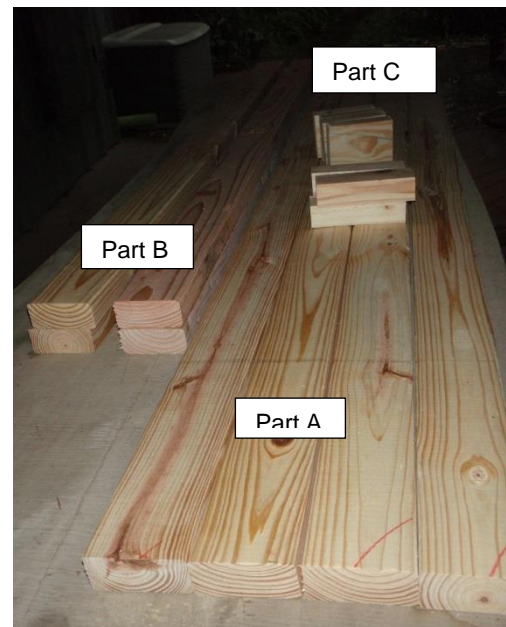


Figure 13 - Parts A, B, C ready to build

⁹ The upper Part B is aligned with the tops of Part A

1. Find a level spot which is big enough to support all the Part As laying down.
2. Lay all four Part A's parallel to each other.
3. Measure up from the bottom by 12". (or the height of your sump tank). Mark this with a ruler or square across the width of all four pieces. This is illustrated in Figure 14- Marking Part A.
4. Measure up from that line by 11" and make another mark across the width of all 4 pieces. This will provide approximately 7" clearance above the drain pipe before the spacer board is inserted.
5. Measure 15" down from the top of Part A and draw a line across all boards.

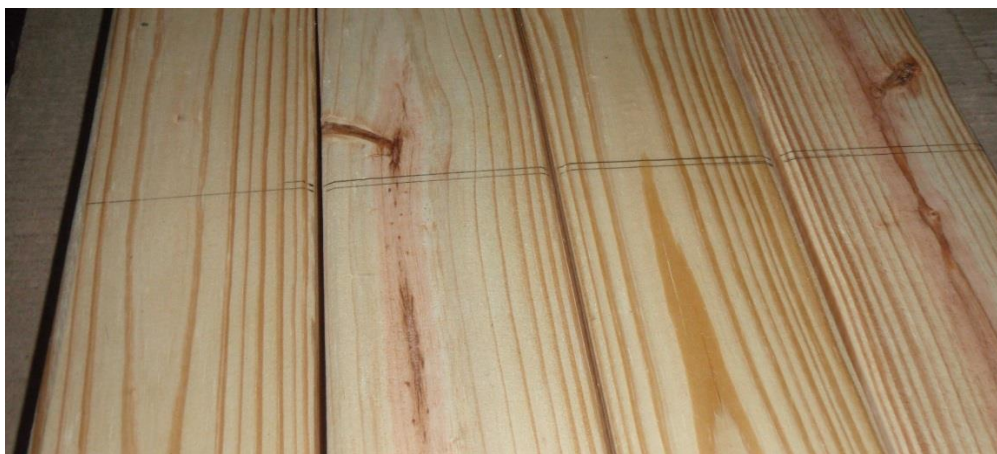


Figure 14- Marking Part A

Build Each Half Frame

Assembly of each rectangle using two Part As and two Part Bs is next. This is easily done on the ground. Use finishing washers to keep the screws from going too deep into the 2x4s.

Notes

Pre-Drill if the pieces are not tight - If you find the two pieces you are screwing together don't meet closely, remove the screw and pre-drill **only** the side from which the screw enters. Make the hole larger than the threads on the screw so that it falls completely thru the hole and grabs the other piece of lumber.

If you are going to wall mount the frame - When attaching the horizontal part B, decide on a diagonal pattern of 2 screws. On the 2nd frame use an opposite diagonal pattern of 2 screws so that the screws don't encounter each other in the Part B.



Figure 15 Diagonal Screw Placement

Pattern

Here is one frame standing up:

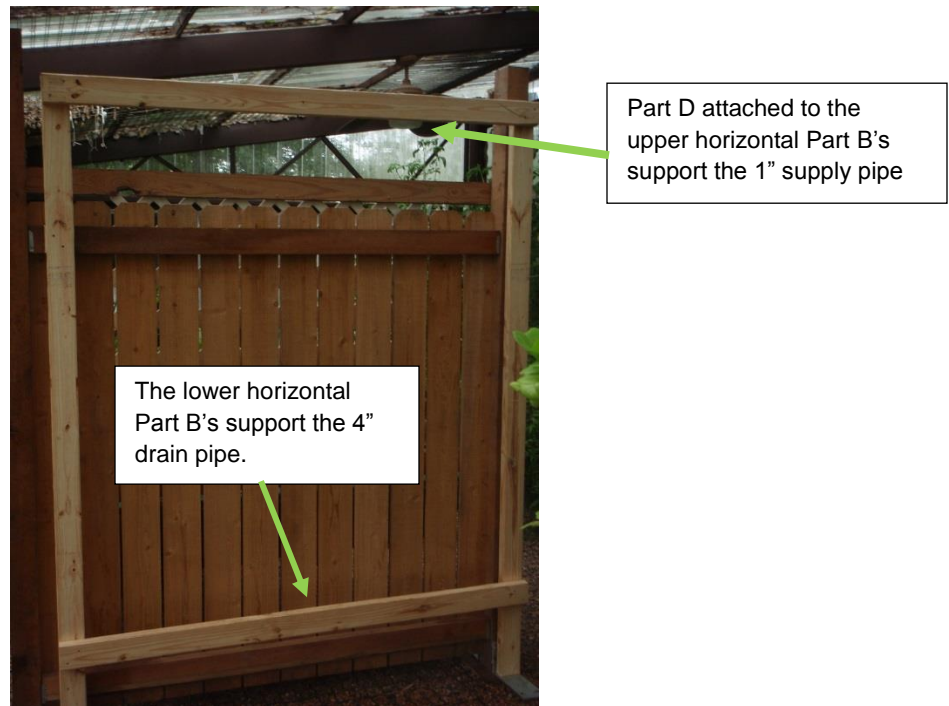


Figure 16- One-half of Frame Structure

6. Spread out the two Part A's the width of Part B's length.
7. Align Part B with the top of the Part A's and put one wood screw in each corner.
8. Place the other Part B on the line drawn in Step 3.
9. Drive in one wood screw at each end.
10. Use a square to make sure the Part B's are at a 90° angle to the Part A's.
11. Once you're sure the frame is square, drive in the second screw in each of the four connection points.

Repeat steps # 6 through 10 for the other frame structure.

Now, you have two identical rectangular frames which need to be tied together.

Add Spacer Blocks to one Rectangular Frame

Then, one of the frames gets all of the Part C's. Choose one of the frames to work with.

12. Attach one Part C to the upper horizontal Part B on the inside of one of the frames at each end. This piece supports the 1" pipe with the proper spacing for the valves to hang below the 2x4.

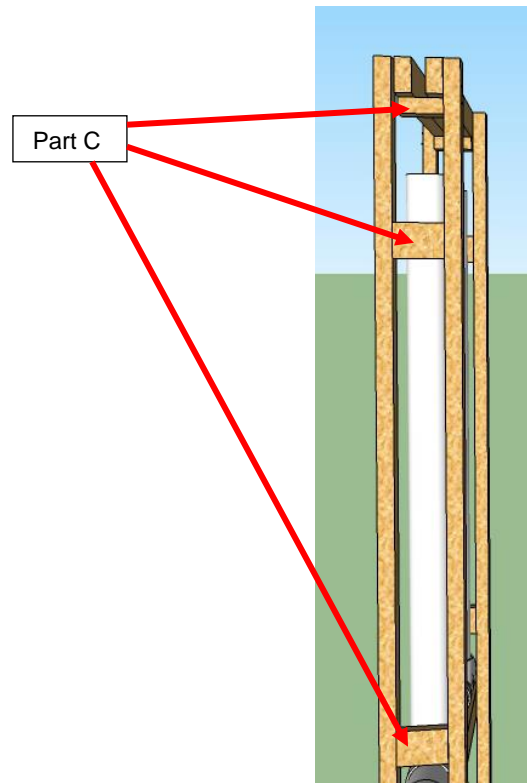


Figure 17- Orientation of Part C

13. On the same side of the frame, find the markings made on the inside of the Part A's in Steps 4 and 5. Figure 17 shows the orientation of the top Part C on one side.
14. Pre-drill two holes for each of the four Part C's
15. Attach each Part C using wood screws and finishing washers. By necessity, you are drilling into the end grain of Part C on the sides, so don't over drive the screws.

Final Steps

Free Standing Unit

16. Add the corner braces to the bottom of the Part A legs so that one side of the corner is attached to the leg and the other is flush with the ground.
17. Attach the two frames together by fastening from one frame into the Part C blocks already attached to the other. Both of the Part B's go on the inside, as shown in Figure 17 **Error! Reference source not found..**
18. The unit should be able to stand on its own at this point.

Anchored Unit

If it is being anchored, make sure you will have access to the anchor point before you assemble the two frames together following Step 15.

Anchor the frame structure to an IBC Tote or Grow Bed in an aquaponics system. Make sure the frame structure is able to stand up.

Unit Attached to Fence or Wall

Attach the frame to which the spacer blocks are attached to the fence or wall. It may require additional spacer blocks to keep the Frame structure parallel to the structure to which it is being attached as show below in Figure 18.

As you can see Part B and the spacer blocks should be towards the outside. Once it is attached to the wall, you will not have access to the outside of the frame.

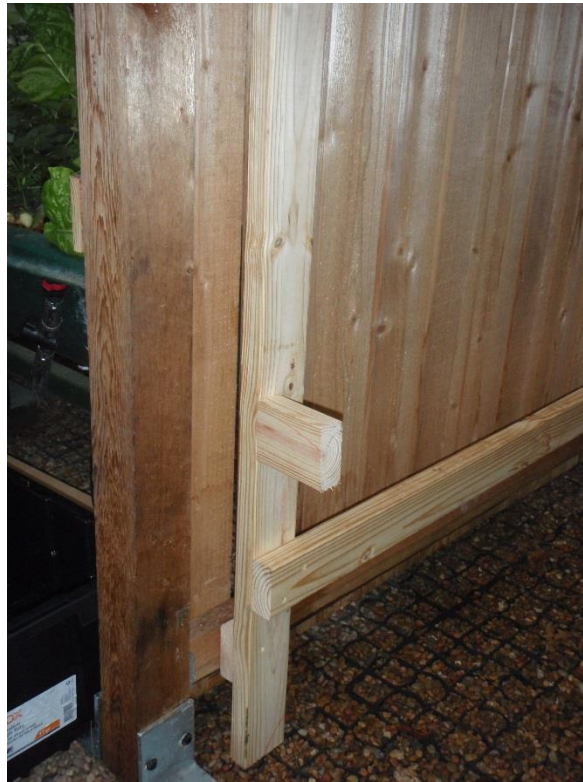


Figure 18 - Attaching One Frame to Fence

Use appropriate fasteners to attach this side to the fence or wall.

19. Attach the two frames together by fastening from one frame into the Part C blocks already attached to the other. Both of the Part B's go on the inside, as shown in Figure 16 & 18.

Chapter 3 – Setting up the Plumbing

Note: Run water through all the pieces of cut pipe to flush out the PVC shavings. Otherwise, they will end up floating in your reservoir and clogging your pump.

Frame and Reservoir in place

After the frame is built, it should be put into its place, if this hasn't been done already. Then, establish the location for the reservoir at one end of the frame. This location determines how the pump harness and supply line are routed and how the 4" drain pipe will feed into the reservoir.

Put the pump into the reservoir and arrange the flexible PVC portion so that it comes out of the reservoir and onto the side of the frame. Part E is intended to hold the top of the flexible PVC pipe in place below the 3/4" union. The picture to the right is an idea of what it should look like.

You might need another person to hold the flexible PVC pipe at the correct level while you mark that level on the side of the frame structure. We can't tell you the correct height of Part E because that depends on your individual situation.

20. Use Part D and the flexible PVC to mark the height Part D should be. The pump should be in the bottom of the reservoir while determining this height.

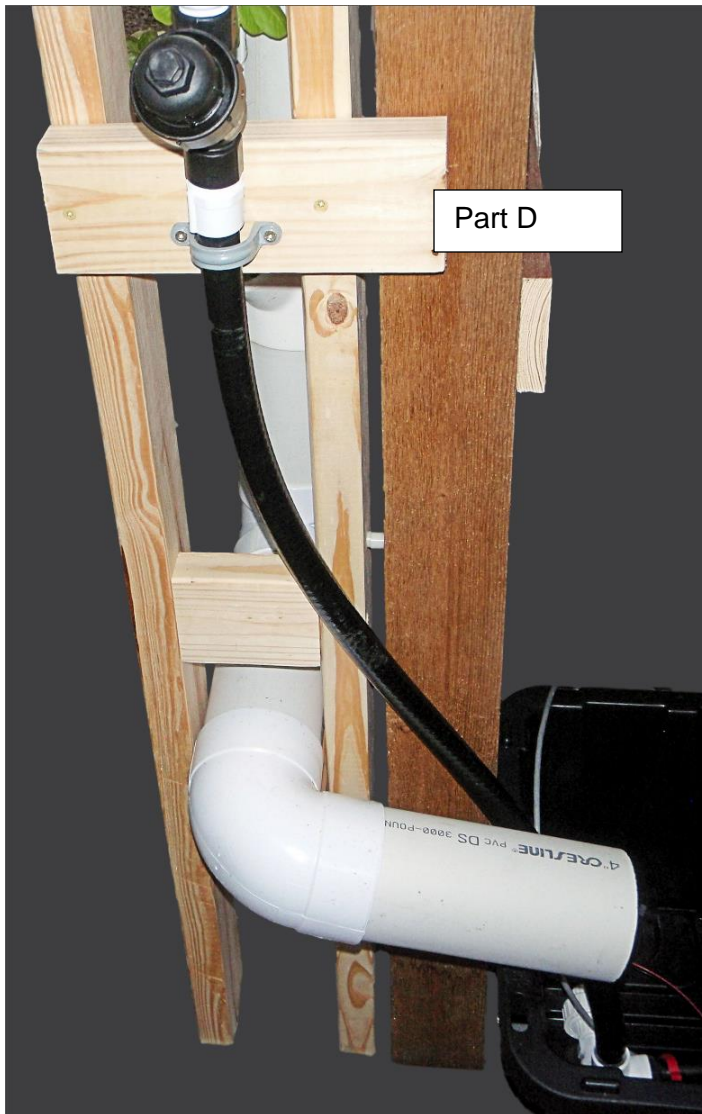


Figure 19 – Flexible PVC supported on the end of Frame

21. Use a short level to align Part D and fasten it to the side of the Frame Structure.
22. Attach a pipe support hanger and use it to capture the flexible PVC pipe.

Install Drain Line

In this design, the drain line tees support the GroTowers. Consequently, it is important to make sure all the tees are perfectly aligned with each other and plumb.

4" S&D PVC Pipe Cut List

Cut the pipe, cutting the largest pieces 1st. Three of the pieces on the cut list are for the GroTowers and need to be cut first. If you have 2 pieces of pipe, cut one of them in half to make 2 towers. One of the towers will have a belled end. Then, cut the bottom 60" off of the other piece of 4" pipe for the 3rd GroTower. Next, cut the 2 11 3/4" pieces, followed by one 8". The final piece you will need to measure according to how your connection to the reservoir is made. It will typically be 10-12".

- 1 with belled end 60" long for one GroTower
- 2 @ 60" for two GroTowers
- 2 @ 11 3/4" for between the tees
- 1 @ 8" for ends of the drain line
- 1 @ to be determined according to reservoir location

The three 60" pieces used to build the towers will be covered in the next chapter.

Note about Gluing the Drain line

It may be possible to construct the drain line without PVC cement. However, you may have small leaks which will be visible because of an algae buildup. You could try it and glue the drain line later, if necessary.

If you do glue up the drain line, you will have to be careful to get the sides of the tees lined up with each other so that the towers go straight up. You can use a short piece of 4" pipe in the tee laying your drain line on its side to make sure all tees are at the same angle. .

The cap can be glued on without worrying about alignment.

Assemble Drain Line

For this part, gather up the S&D hub tees, elbow and the cap.

23. Place the pieces in this order, starting at the end away from the reservoir:
 - a. Drain Cap
 - b. 8" piece of pipe
 - c. 4" hub tee
 - d. 11 3/4" piece of pipe
 - e. 4" hub tee
 - f. 11 3/4" piece of pipe
 - g. 4" hub tee
 - h. (10-12" as you determined according to your reservoir/sump location)

- i. 4" Elbow and optional pipe into reservoir

24. Use a rubber mallet with a board to spread the impact to knock the 4" PVC into a close fit.

Install Supply Line

This set of plumbing routes the water from the pump in the reservoir to the irrigation heads in each assembly. You have already set up the pump and a line which temporarily terminates on the side of the Frame Structure.

This part of the instructions explains how to construct the 1" part of the line and integrate the irrigation assemblies. Once the line is complete, it doesn't show from the ground except for the valves and ½" lines of the irrigation assemblies hanging down into the towers.



Figure 20-Top Portion of Supply Line without splashguards

Alignment Issues for the Supply Assembly

In summary:

- **The 1" elbow and the ¾" side of the tees in the irrigation assembly all need to be pointed in the same direction, aligned with each other as closely as possible.**
- **The center of the irrigation assemblies must be in the center of the 4" pipe.**

So, it is important that you establish the distance between the hub tees in your system in order to cut the 1" pipe to the length which will make the irrigation assemblies fall into the center of the GroTowers.

If there were slight errors in cutting or gluing, such that the lower drain assembly is not the planned 16" on center, now is when we need to adjust the upper irrigation assembly to accommodate these errors in building.

1" PVC Schedule 40 Cut List

The measurements in this cut list are for a perfect world. Before cutting, see Suggested Approach.

- 1 @ Elbow to 1st irrigation assembly – 11" (check this with rough fit)
- 2 @ Between assemblies – 14½"
- 1 @ the end of the overhead run – 8" (check this with rough fit)
- 1 @ the distance between the elbow at the top and the pipe on the side

The length of the last piece has to be determined by each user because it is influenced by the location of the reservoir.

Suggested Approach

25. Detach the 3 tees with the valves from the lower irrigation assemblies.

Here is an image of the premium irrigation assembly:

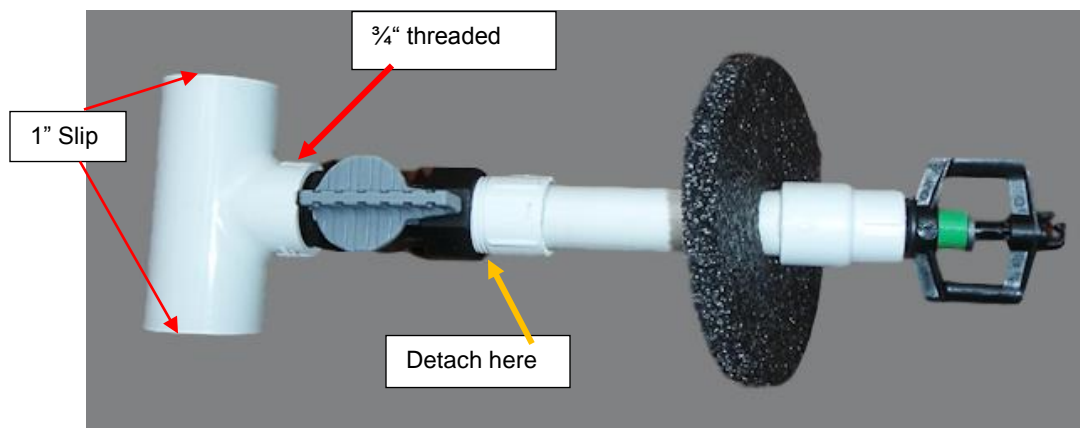


Figure 21- Premium Irrigation Assembly

If you can establish the center of the 4" hub tee¹⁰, measure from one center of one tee to the center of the next tee. It should be 16". The length of the 1" pieces need to be adjusted by whatever amount the distance is off.

For example, if the center to center measurement for one set is 16½", then the 1" pipe should be 15" instead of 14½".

¹⁰ Some hub tees have a discernible molding line in the center of the side of the hub that is helpful to use when measuring.

Cut these pieces one at a time in order and rough fit without a gluing to get the spacing right. Be sure to fit the pipe all the way into the tee slips. This is hard without the glue. It is equally difficult to pull apart.

26. Measure for one of the pieces which goes between the irrigation assemblies.
27. Cut it and check the length against the drain line. Keep in mind the socket on the 1" tees.¹¹ Adjust if necessary.
28. Repeat for the other piece which goes between the irrigation assemblies
29. Measure for the 1" pipe which goes to the 1" elbow from an irrigation assembly
30. Cut it and make sure it lines up with the plumbing on the end with the reservoir.
31. Cut a piece for the end with the cap.

Work in a place with enough length for the entire assembly (at least 6' long). Place brown paper or newspaper under your work location to catch the drips of PVC Cement.

Once the two pieces (with glue on them) meet, you won't have very long before they bond and you can't move them. So, work quickly to align each tee to the others. Having the valve still attached will make it easier to see when they are all pointed in the same direction and all lay equally flat on the work surface.

32. Find the 1" elbow and 1" cap.
33. Place the pieces in this order:
 - a. 1" elbow
 - b. 11" piece (or whatever you determined) between elbow and first assembly
 - c. One of the tees from the irrigation assembly
 - d. A 14½" piece of 1" pipe
 - e. 2nd tee
 - f. A 14½" piece of 1" pipe
 - g. The 3rd tee
 - h. 8" piece of pipe
 - i. 1" cap

34. Glue the entire line together. Liberally apply PVC cement to the outside of the pipe and the inside of the fitting for each piece.

35. Align the elbow to face the same direction as the ¾" side of the tees.

Now you have one long piece which goes across the top of the Frame structure and supplies water and nutrients to your plants.

Determining Length of side piece

At this point, the end of the pump fittings supplied by GroPockets is at a known height. What needs to happen next is that a piece of 1" PVC pipe be cut to match the length between this point and an elbow at the top of the frame structure.

Figure 22 gives you an idea of what it should look like

1" pipe to supply line. This is the piece which needs to be cut to match your system.

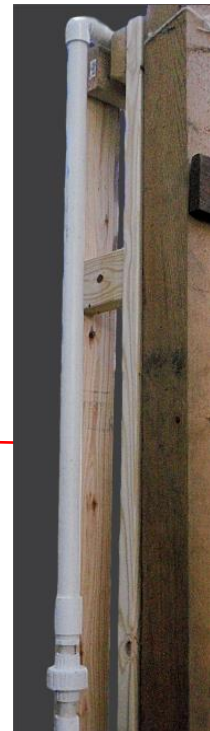


Figure 22 - Nutrient Supply line on side of frame

¹¹ The socket is supposed to be 1-1/8" on a 1" fitting.

Lay the long piece (with irrigation assemblies) you just made in its place at the top of the Frame Structure.

36. Use a tape measure or rule to measure the distance between the elbow and the 1" coupling at the end of the GroPockets plumbing harness. Take into account that pipe and fittings go together much closer when PVC cement is applied.
37. Cut a piece of 1" pipe to this length.
38. Flush out the inside of the pipe with water to remove PVC shavings.
39. Detach the $\frac{3}{4}$ " union to make it easier to make this connection.
40. Apply PVC cement to the pipe and 1" coupling and glue them together.

Chapter 4 – Adding Pockets to Make GroTowers

Finally, you are ready to add the GroPockets to the towers and hang them in place. This is the most time-consuming portion of the project. If you have a group, have some of your group work on this while the others are assembling the frame and the plumbing.

You already have 3 pieces of 4" S&D pipe cut to 60". Now we need to mark it for the holes, drill them, and add the GroPockets. Murray Hallam of Practical Aquaponics made a video of this process which you can find on our website at this URL.

http://www.gropockets.com/How-to-make-a-Garden-Tower_c_37.html

Mark the Towers

The kit you purchased includes enough pockets for 9 rows of the Tic-Tac-Toe pattern for each GroTower. This is 2 pockets in one row, 1 in the next, then 2 pockets and so forth. The markings on the template for this pattern are green. A cross mark and a filled in circle needs to be made for each pocket. As you learn in the video, the circle shows where to drill and the cross is an alignment mark which matches the notch in the pocket itself.

You can mark 4 rows of pockets before the template has to be moved.

You will need a pencil, measuring tape, and the template for this.

41. Start by marking one end as the top with a center line
42. Mark another line 4½" down.¹²
43. Tape the top of the template on that line.
44. Wrap the template around the pipe
45. Mark the top and bottom of the template at the center mark.
46. Mark each pocket labeled with Tic Tac Toe in the 4 rows of the template with two marks: a cross at the top of the dotted line and a filled in circle at the bottom of the dotted line
47. Move the template down to the bottom mark and repeat marking for 4 more rows.
48. Move it one more time for 1 more row of pockets. This is a total of 9 rows.
49. Repeat Steps 34 through 41 for the other 2 towers.

Drill the Holes

Take a look at the pilot bit in your hole saw. Is it long enough that you can see the marked circle easily so that the bit goes right in? If not, use a twist bit to pre-drill the pilot holes at all the marked circles.

¹² Murray's video advises 6", but he is working with a 68" pipe instead of a 60" pipe.

For example, this hole saw has a very short pilot bit, so we have pre-drilled the holes.



Figure 23 - Hole Saw with Short Pilot Bit

We recommend a larger hole saw than Murray discusses in his video. One reason for this is that his net pots are smaller than the ones which are the usual in the U.S.

50. Use your hole saw to drill out the holes for the GroPockets.
51. Drill a small hole for the paracord or string at the mark for the center top of each tower.
52. Clean up the filings around the holes for the pockets using a rasp and/or sandpaper.

Keep in mind that your fingers may make contact with these holes when you put plants in and out, so smooth is better.

Glue on the Pockets

Murray Hallam's video also covers this process in detail. We recommend that you add PVC cement around each hole in addition to the PVC cement on the pocket.



Figure 24 - Put Glue on Pipe

Glue the pockets in columns so that you don't have to rotate the pipe as you glue on the GroPockets. One of the columns is all the pockets on the left in the rows of doubles. The other column is the pockets on the right in the rows of doubles + the singles.

53. Prepare the nylon ties to fasten the pockets in place.
54. Glue the pockets on one column of all 3 towers.
55. Wait a while (½ hour).
56. Remove the nylon ties.
57. Rotate the pipes and do the other column.
58. After those pockets are set, tie a knot in one end of the string/paracord and pass the loose end through the hole so that the tower is ready to hang.

Chapter 5 - Hanging GroTowers & Finishing Touches

Now the GroTowers are ready to put into place. To make it easier to line them up and hang them, leave the sprinkler head detached from the irrigation assembly. See Figure 21- Premium Irrigation Assembly.

Hang GroTowers

Follow this procedure for each tower:

59. Insert the GroTower into the hub tee so that the center point is directly below the Part B above it.
60. Drive a short wood screw directly above the center point.
61. The tower needs to be firmly seated in the hub tee.
62. Attach the split ring to the end of the string/paracord.
63. Use the split ring to hook the string onto the screw above as a failsafe hanger for the GroTower.

Once all the towers are hung, start filling the reservoir with plain water for testing and flushing the system. Five gallons should be enough for this purpose.

64. Add the rigid PVC sections with splashguards and sprinkler heads to the irrigation assemblies. This piece looks like this:



Figure 25 lower irrigation assembly

Reservoir Plumbing Check

65. Check that the reservoir plumbing is all connected. The vortex aerator should be rotated to face inside the reservoir as shown in the 2nd picture. Notice that the pump is connected via a half-inch union for easy removal

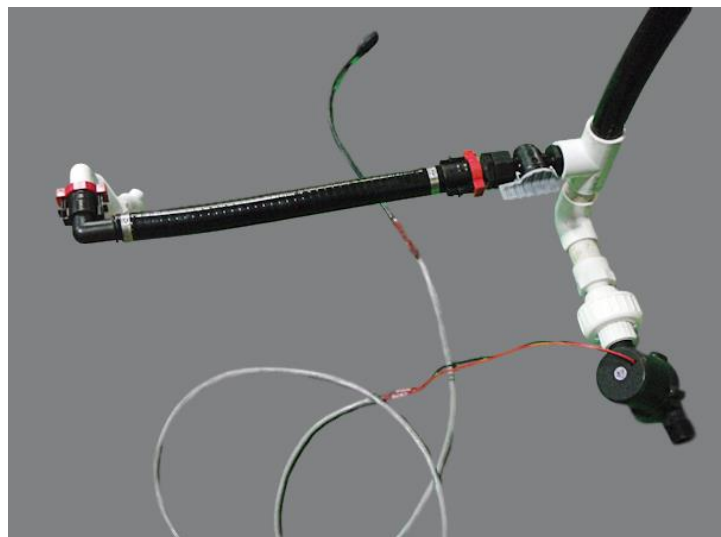


Figure 26 Pump harness with venturi aerator

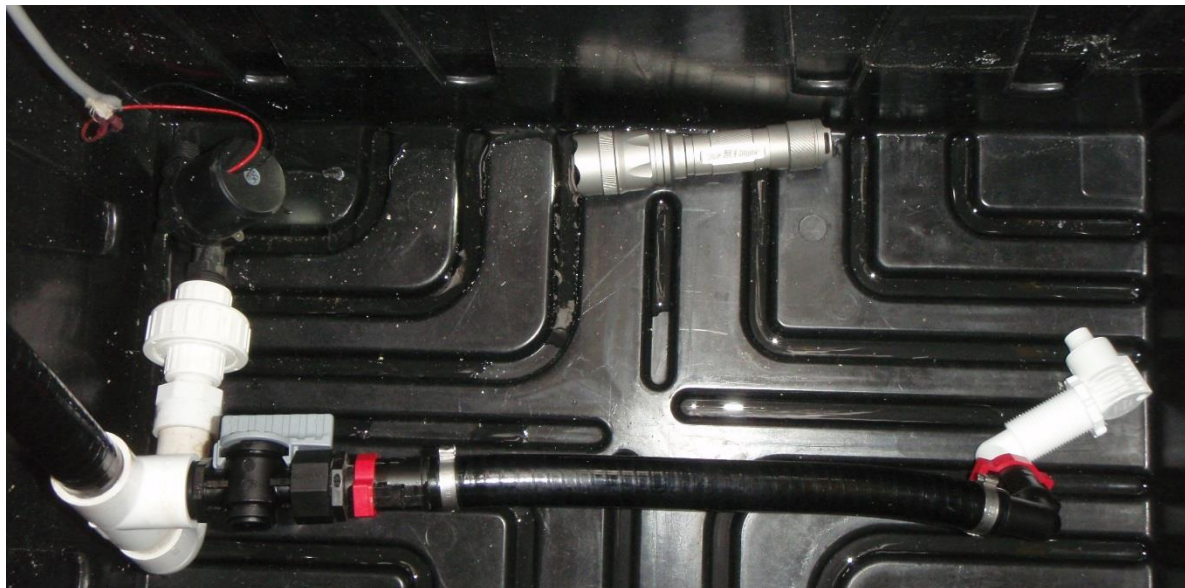


Figure 27 - Pump harness w aerator installed in reservoir

Aeration Leg

The aeration leg is connected to the side of a 3/4" tee in the reservoir. It looks like this:

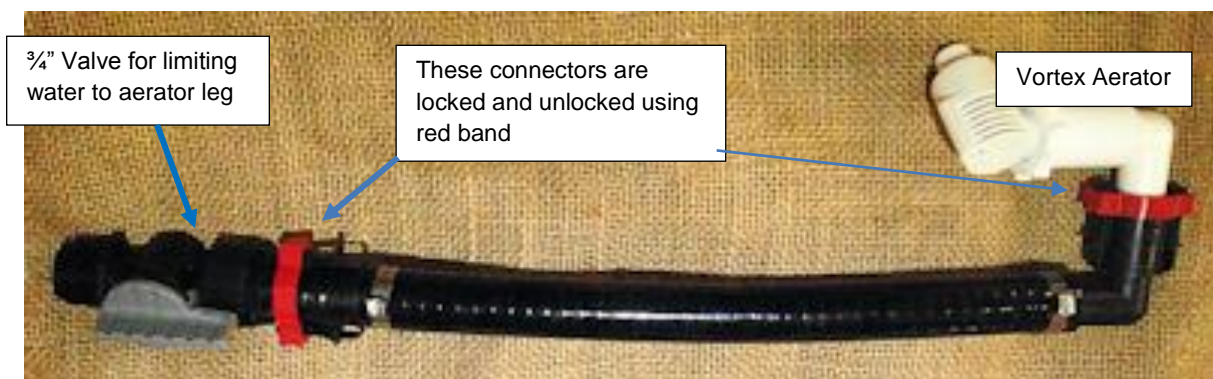


Figure 28- Aeration Leg for Reservoir

It is shipped to you already assembled. To install it, disconnect the threaded male adapter by sliding the red band down. Then, you can easily screw the male adapter into the female side of the valve. Once the valve is installed reattach the adapter.



Figure 29 Aeration Leg Attached to Valve

The vortex aerator needs to be suspended from the reservoir so that it keeps the water in the reservoir stirred up. This is easily done.

66. Drill one small hole in the top of the reservoir.

67. Then, thread a nylon tie through the hole around the nozzle and over the top edge of the reservoir.

Here is an image of the goal:



Figure 30- Aeration Nozzle Attached to Reservoir

Balance Aeration Leg & Water to Sprinkler Heads

68. Provide power to the reservoir pump.

69. Turn the nozzle so that the water from the nozzle hits the water in the reservoir at an angle to induce a circular movement in the water. The nozzle has a venturi element which introduces air into the water as it comes out.

70. Use the valve on the aeration leg to adjust the amount of water going to the sprinkler heads in the GroTowers. The faster the sprinkler heads go, the less water is fed to the vortex aerator. Pick a good compromise rate.

GroPocket Leak Check

71. Look at all the GroPockets individually and see if any of them have drips coming out of the sides or bottoms.

72. If you see drips, look for their origin. Take down that tower and use silicone to fill the gap from which the leak is coming.

Cut Openings in the Reservoir Lid

Now that the plumbing is all connected, the lid needs to be fitted. In order to do that you will need to cut openings for:

- Electrical wire to pump (a ½" hole is sufficient)
- Flexible PVC from pump to side of Frame Structure (1¼" hole)
- Area for return water from the drain

One hole roughly 4"x4" will be enough.



Figure 31 Reservoir Lid showing Return Water & PVC Holes

Here is the same area from a different angle:



Figure 32 - Reservoir Lid with Square Opening

We have tucked our reservoir in back of the frame structure to which the towers are connected to keep it out of the footpath in the greenhouse. It would have also been possible to put it

directly under the 4" 90° elbow. In that case, the short piece of pipe in the picture would not have been necessary.

In this image, you can see an extra hole was drilled to the side for the pump wiring. This is not necessarily needed. It makes the lid slightly more difficult to remove.



Figure 33 Reservoir Lid in use

Add Fresh Water and Compost Tea

After circulating the 5 gallons of water for the testing, you may find that it has picked up some PVC shavings or other detritus. So, pour that water out and start over with a batch of compost tea and enough water to fill the reservoir.

If you are using Municipal water...

First choice would be to substitute rain water whenever you can.

Chlorine and Chloramine are frequently used in city water these days. Be aware of this issue. Find out what your city water department is adding to the water system which feeds your house.

Chlorine

Chlorine will dissipate from a body of water within a day

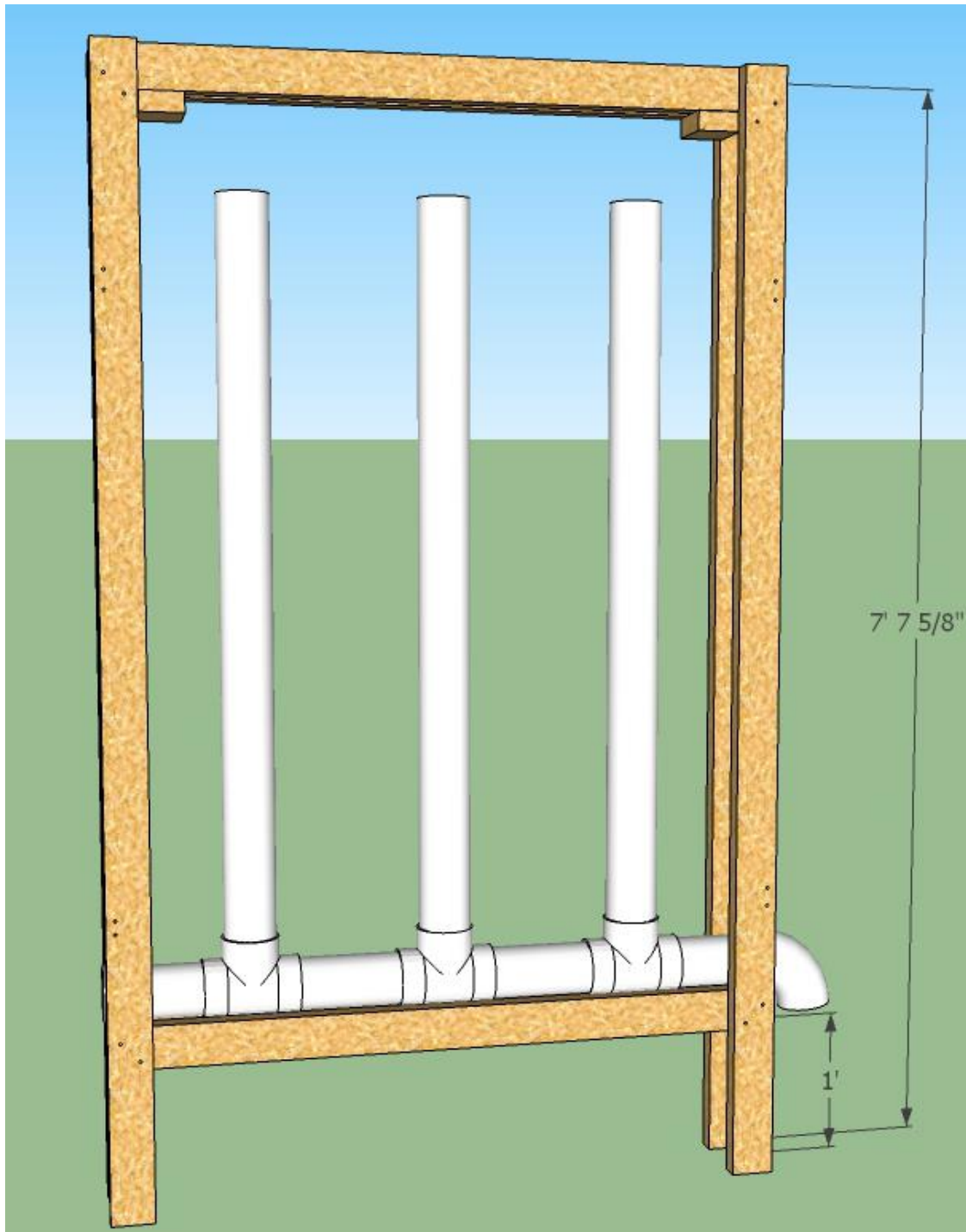
Another option is to add a filter to the hose you use to replenish the water in your system.

Chloramine

Chloramine in water does not dissipate like Chlorine. It needs to be counteracted by a treatment process before you use it in an organic system such as the compost tea brewer or GroTowers. There are multiple options to remove the Chloramine. One of them is a treatment sold by stores which sell fish or fish supplies.

Always treat the water in another container before adding it to reservoir

Appendix A - Drawings and Pictures of Frame Structure





Appendix B – Images of Plumbing Kit

Threaded Union

To make the pump easily accessible for maintenance or replacement, we started our plumbing run by attaching a ½” threaded union to the pump. A female adapter would also work, but the unions are easier to detach. Attach the side of the union with the male threads (inside threads, no nut) to the pump. The image shows which side of the union is connected to the pump. XXX needs a new image



Figure 34- Class B Pump with Threaded Union

When working with the unions, be aware that they rely on a gasket which is embedded in one of the pieces. This gasket can easily fall out and since it is black it can be hard to find. So, you might want to start by putting the gasket somewhere safe until you are ready to plug in the pump and run water through it. Then, LAST TASK, install the gasket.

On the other side of the union, a ½” male to ¾” slip male adapter (PVC code 436-074) connects to a short piece of ¾” pipe so that an elbow (to turn the plumbing vertical) can be next.

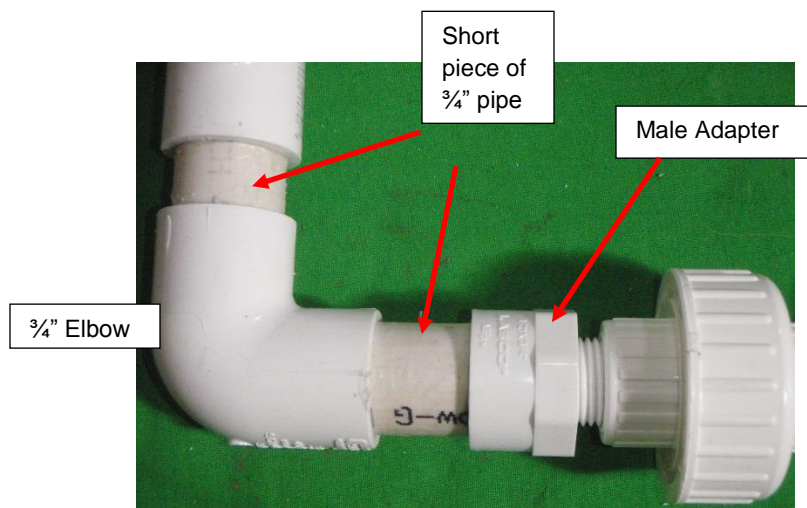


Figure 35- Class B Pump Requires Elbow

3/4" Tee

This fitting has a PVC code of 402-007. The side of the tee is threaded to accommodate one end of the Aeration Leg.

From the top of the tee is a 30" piece of 3/4" Flexible PVC which enables your supply line to easily thread out of the reservoir and onto one side of the Frame Structure.

Aeration Leg

The Aeration Leg is intended to be attached at the top of the reservoir so that the aeration nozzle is just above the water. It has a valve which you can use to adjust the flow so that water is flowing to all your irrigation heads. It looks like this:



After Flexible PVC

The Flexible PVC pipe is terminated by a 3/4" male adapter.

With Strainer

This adapter goes into a strainer, if you ordered one. On the other side of the strainer is one side of the 3/4" union. On the other side of the union is a 3/4" male adapter with a short piece of pipe connected to a reducing slip coupler which transitions to 1".

Without Strainer

The 3/4" male adapter at the end of the flexible PVC is attached to one side of a 3/4" threaded union. On the other side of the union is a 3/4" male adapter with a short piece of pipe connected to a reducing slip coupler which transitions to 1".

Appendix C - Adjust the Frame Height

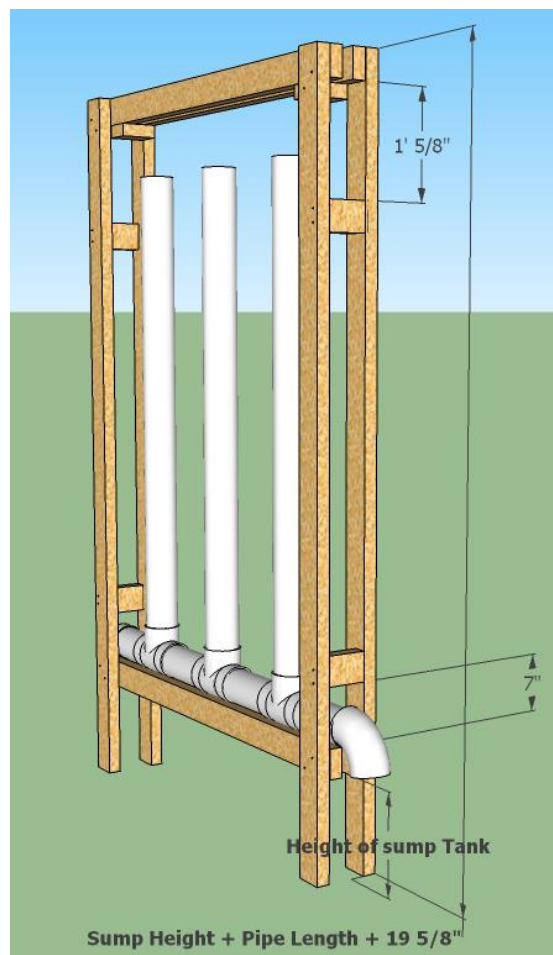
Frame Height (Part A)

Reservoir / Sump Tank Height

In order to determine the length of the vertical pieces for the frame, you need to know how tall your reservoir or sump tank is. Murray's videos on GroPockets show using a sump tank in an aquaponics system as the reservoir. The reservoir can also be a tank of any other size buried or not, including a five gallon bucket.

In this design, the 4" drain pipe has to be positioned over the rim of the reservoir. Consequently, the lower the top of the reservoir, the easier it will be to access the plants at the top of the GroTowers.

If some of the reservoir is buried, the whole frame can be lower making it easier to reach the top of the GroTowers and the plants growing in them. But, this may not fit the situation.



$$\text{Reservoir/Sump Height} + \text{GroTower Height} + 19\ 5/8'' = \text{Frame Height}$$