Greywater Planter Manual

For LA 410/510 - Design For Climate Action
University of Oregon

Project Completed by: Ben Brodka, Malaya Cansdale, Morgan Driggs, Orion Lawrenz, Raine Padawer, Luis Soria, & Lucy Stout

And guidance from: Audrey Rycewicz and Prof. Kory Russel

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Introduction:

The purpose of this greywater planter project is to create a sustainable water filtration system for the temporary housing community, Community Supported Shelters (CSS). Community-supported unhoused settlements in the U.S. frequently lack water infrastructure. Before the implementation of the greywater system, this transitional housing community would have trucks drive out gallons of used water every day from the community for disposal. These greywater planters will filtrate out used water (known as greywater) from sinks, showers, and laundry machines. The greywater system filtrates the used greywater water and creates usable water that plants can uptake. We are developing an alternative using modular planters to filter the greywater to a level of pathogens that is okay to release into the environment.

For this project, we are using clumping bamboo. Bamboo absorbs additional pollutants in the water and also provides a privacy wall, which is something residents wanted more of in their community. Clumping bamboo's roots don't grow very deep into the ground and it doesn't spread rapidly, as opposed to other types of bamboo. Clumping bamboo is beneficial for this project, because deep rooting plants could potentially break the inner piping system inside the tanks. This is important to keep in mind when planning the planting design for the project.

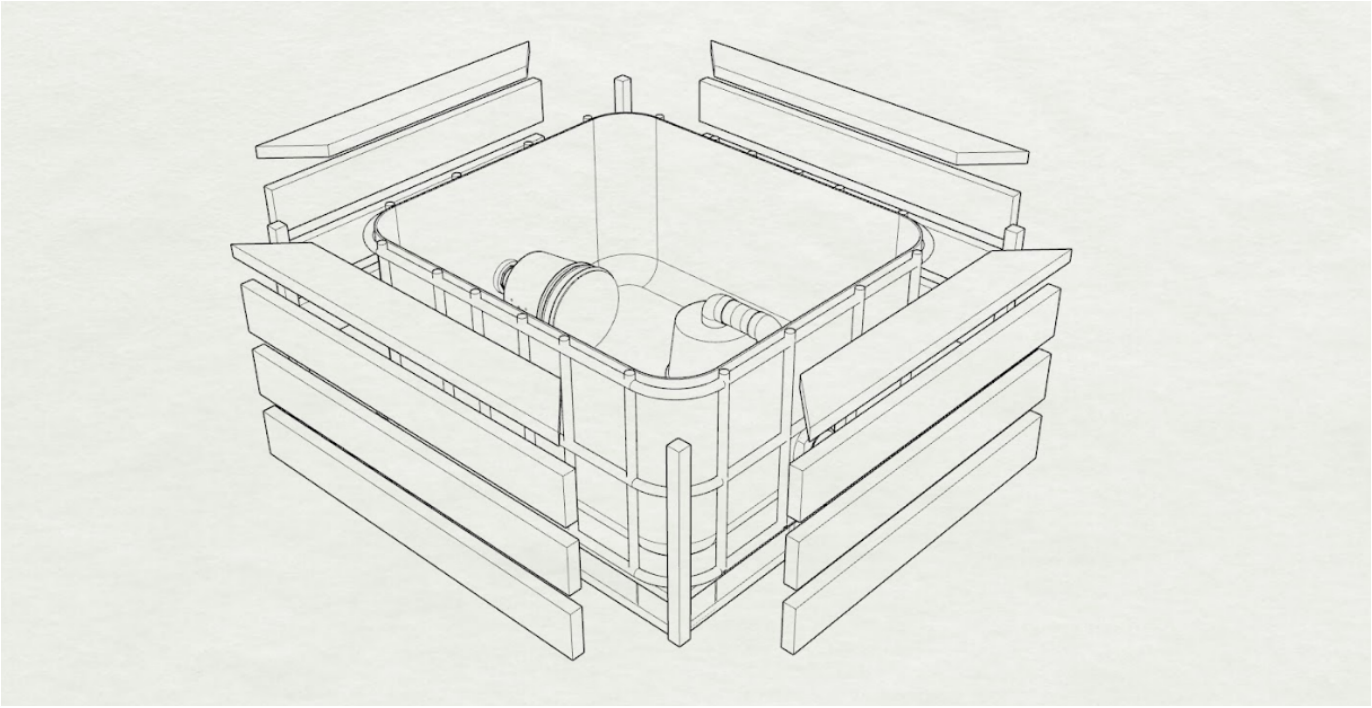


Fig. 1

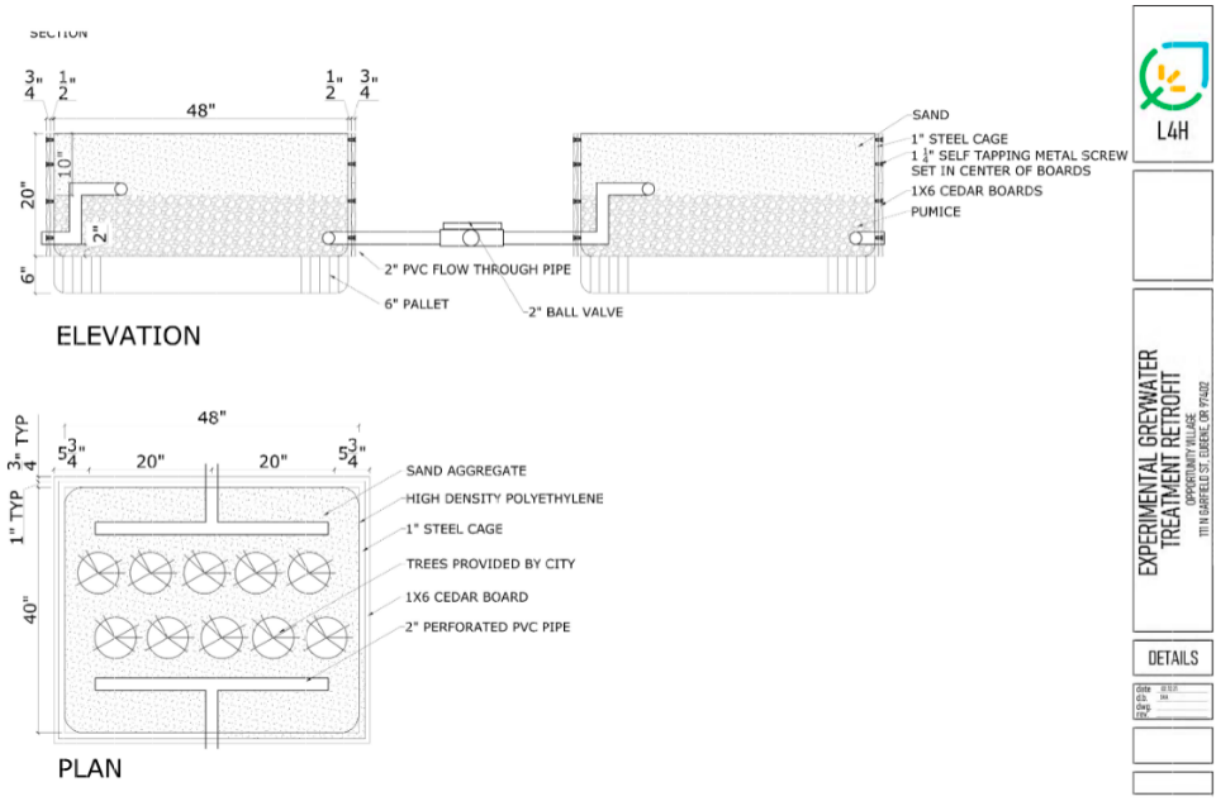

SECTION
3/4" 1/2"
48"
1/2" 3/4"
10"
20"
2"
6"
SAND
1" STEEL CAGE
1 1/4" SELF TAPPING METAL SCREW SET IN CENTER OF BOARDS
1X6 CEDAR BOARDS
PUMICE
2" PVC FLOW THROUGH PIPE
6" PALLET
2" BALL VALVE
ELEVATION
48"
3/4" TYP
5 3/4"
20"
20"
5 3/4"
1" TYP
40"
SAND AGGREGATE
HIGH DENSITY POLYETHYLENE
1" STEEL CAGE
TREES PROVIDED BY CITY
1X6 CEDAR BOARD
2" PERFORATED PVC PIPE
PLAN
L4H
EXPERIMENTAL GREYWATER TREATMENT RETROFIT
OPPORTUNITY VILLAGE
111 N GARFIELD ST, EUGENE, OR 97402
DETAILS

Fig. 2

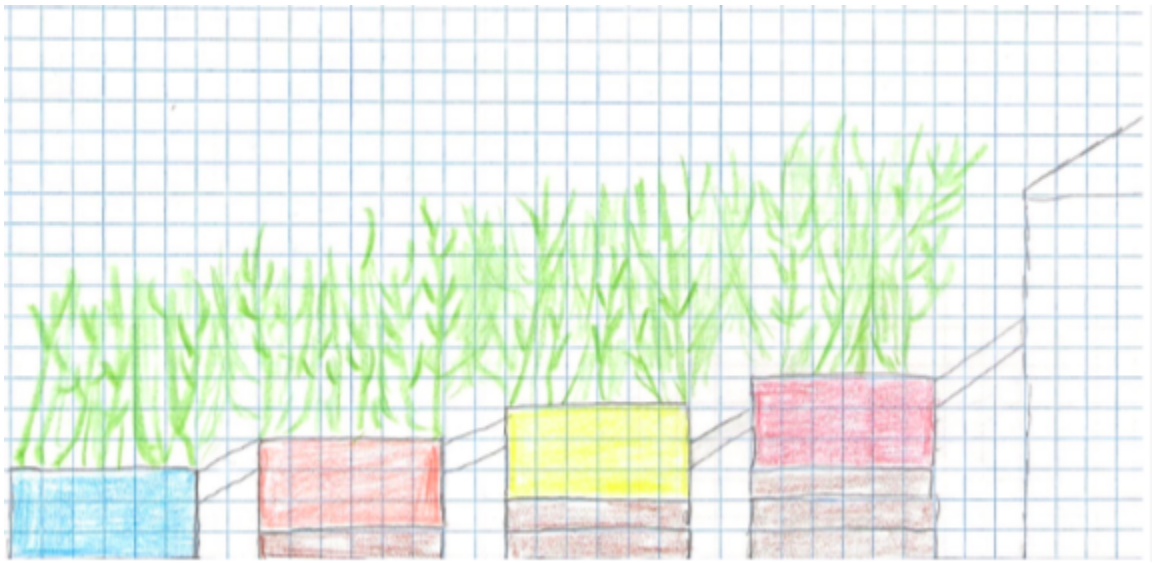


Fig 3.

Materials needed:

Tools List:

- Measuring tape
- Markers and pencils
- Safety glasses
- Work gloves
- Angle grinder and cut off wheel attachment
- Sawzall
- Power drill and hole saw attachments
- Shovel, hoes, wheelbarrow, hose, sponges (for cleaning honey out of IBC totes)
- Buckets
- Chop (Miter) saw
- Brad nailer (nail gun) and compressor
- Dolly
- Truck

Supplies List:

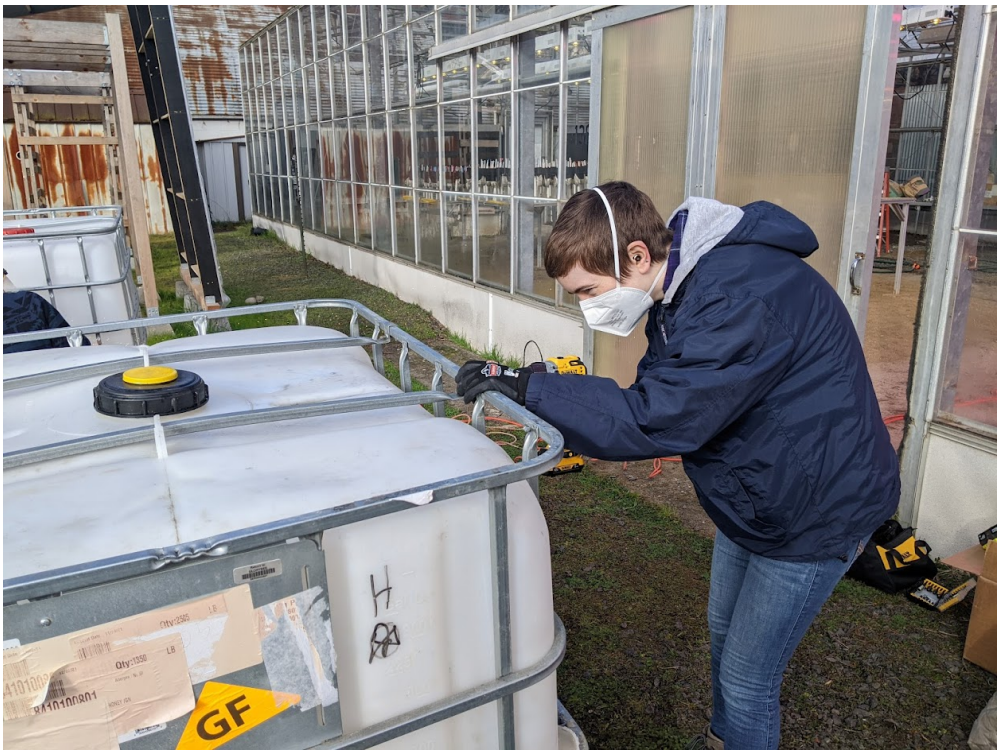
- IBC totes x2
- 2in PVC elbow 90-degree Schedule 40 Slip x Slip x12
- Oatey Purple Primer 1oz x1
- Red Hot Blue Glue ½pint x1
- Clear RTV Silicone sealant
- Disposable nitrile gloves x1 box
- 2½in deck screws
- 1½in brad nails
- 2in FIP poly tank adapter x7
- 10 plastic pallets (for the planters to sit on)
- 2x1½in PVC adapter Schedule 40 MIP x Slip x7
- 2x1½in PVC reducer bushing (Spigot x Slip) x4 (potentially 8 based on outlet design)
- 2x1½in PVC Schedule 40 bushing (Spigot x Slip) x8
- 1½in Schedule 40 PVC pipe 8ft (did not use all)
- 2in Schedule 40 PVC pipe 8ft (did not use all)
- 2x2x8 Douglas fir utility & btr x8
- 1x6x6 Western Red Cedar quality flat top fence pickets x53 *use 1x6x8 boards if available to create less scrap/waste
- 2-gallon buckets w/ lids x4
- 2-gallon buckets w/o lids x4

Cutting IBC Totes in Half:

Tools Needed:

- Safety glasses
- Work gloves
- Markers
- Angle grinder w/ grinding wheel and cut-off wheel attachment
- Power drill
- Possibly hose, sponges, shovels, hoes, buckets, and wheelbarrow

We created the base of this structure by utilizing two food grade Intermediate Bulk Containers, commonly referred to as IBC totes. We made a total of four greywater planter systems from these two totes. In order to accomplish this, they need to be cut in half. To begin this process, start by measuring the halfway point between the top and bottom of the plastic portion of the IBC tote. Then, mark where to cut all around the two containers. Use an angle grinder with a cut-off wheel attachment to cut through the cage portion of the IBC tote. Next, using a power drill, remove the bars on the top portion of the metal cage so you can safely cut through the plastic portion of the IBC tote.



Using a Sawzall, cut through the marked-off halfway plastic portion until they are cut in half. Once the top portion is cut, reinstall the metal cage and set the top halves on the ground upside down. Depending on what the IBC totes previously housed, you may have to clean out the remaining contents. The IBC totes we had used contained honey, so we utilized shovels, hoes, buckets, and a wheelbarrow to scoop the honey out. Then using a hose and sponges, we cleaned out the honey remnants and then cleaned off the tools we used to extract the honey from the IBC totes.

After we had both IBC totes cut in half, the edges were left serrated. This is a safety hazard and the edges have to be smoothed down. Inorder to do this, switch out the cut-off wheel for the grinding wheel on the angle grinder. The angle grinder will smooth out the metal that was previously cut, so there won't be any sharp pieces. This process will create sparks. Make sure to wear proactive gear, check that there isn't anyone in the line of sparks, and be mindful of any flammable materials nearby.

Creating the Intake and Outtake Holes:

<u>Tools and supplies needed:</u>

- 2in FIP poly tank adapters
- Power drill
- Hole saw attachments
- Tape measure

- Disposable nitrile gloves
- Clear RTV Silicone sealant

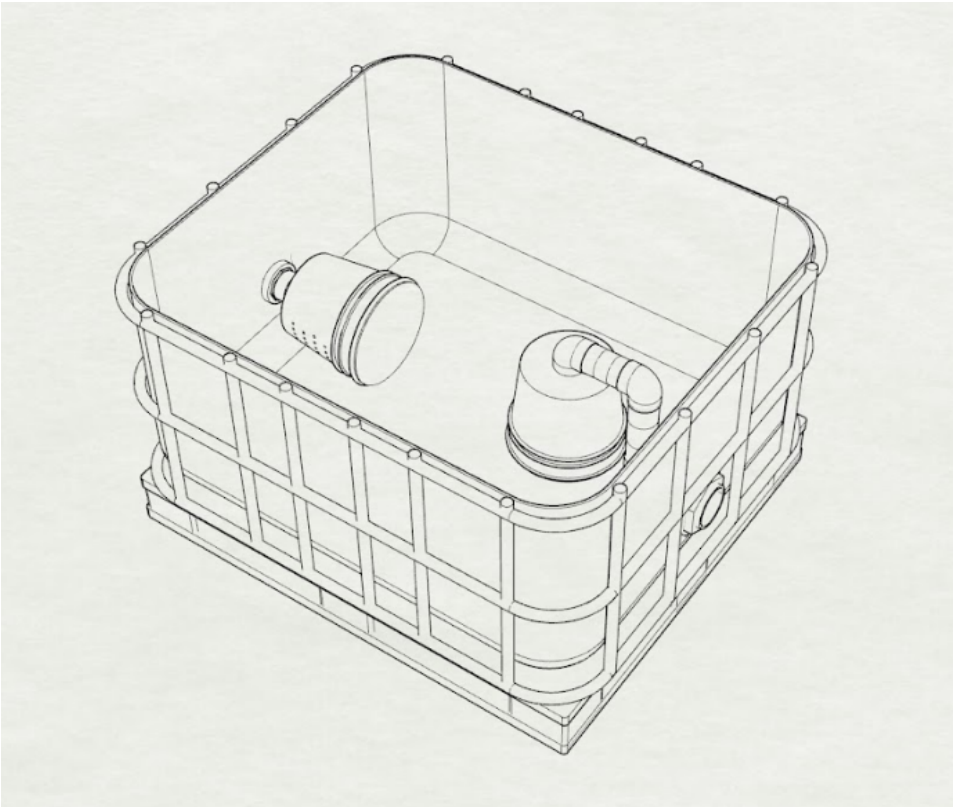


Fig. 4

The two bottom totes should come with valves already installed. Make sure the 2in Schedule 40 PVC pipe fits in the interior part of the valve inside the tote. If it does not, you will need to drill a hole for a 2in FIP poly tank adapter on that side. To create the hole in the plastic part of the IBC tote, find the hole saw attachment size most similar to the size of the threading on the 2in FIP poly tank adapters. Using the hole saw attachment on a power drill, cut holes on two opposite sides in the center-bottom of the curved plastic (about 1in up from the bottom). Make sure there is enough space from the bottom for 2in Schedule 40 PVC pipe with an elbow attached to fit through the hole without touching the bottom of the tote. If one or both of the existing valves do not fit 2in Schedule 40 PVC pipe, drill a hole for another 2in FIP poly tank adapter on the same side as the valve. Make sure to drill the hole on a flat and not curved part of the plastic.

Using Clear RTV Silicone sealant (use disposable nitrile gloves when handling the sealant), spread the sealant around one thread of the 2in FIP poly tank adapter so when the 2in FIP poly tank adapter is pushed through the hole, the sealant seals it against the plastic of the IBC tote. Apply sealant where the 2in FIP poly tank adapter meets the plastic of the tote on the other side as well. Repeat for each 2in FIP poly tank adapter you install.

Assembling Internal Piping System:

Inlet piping materials needed:

- 1½in Schedule 40 PVC pipe
- 2in Schedule 40 PVC pipe
- 2in PVC elbow 90-degree Schedule 40 Slip x Slip x12
- 2x1½in PVC reducer bushing (Spigot x Slip)
- 2x1½in PVC adapter Schedule 40 MIP x Slip
- 2x1½in PVC Schedule 40 bushing (Spigot x Slip)
- 2-gallon buckets w/o lids x4
- Power drill
- Hole saw attachments
- Chop saw
- Measuring tape
- Markers
- Safety glasses
- Work gloves
- Disposable nitrile gloves
- Oatey Purple Primer and Red Hot Blue Glue (used to attach PVC pipe materials together)
- Clear RTV Silicone sealant

Figure 4 diagram shows the outlet piping set on the left, and the inlet piping set on the right. To create the inlet piping, cut four 3½in pieces of 1½in Schedule 40 PVC pipe and four 9in and 3in pieces of 2in Schedule 40 PVC pipe using the chop saw. Use the Oatey Purple Primer first and Red Hot Blue Glue on top and assemble quickly (be sure to wear the disposable nitrile gloves when handling this glue) to connect one of the 3in pieces of PVC to two 2in PVC elbow 90-degree Schedule 40 Slip x Slip creating a U-shape. Afterwards, glue one of the 9in pieces of PVC to one of the elbows already glued to the 3in piece of PVC. Next, glue another 2in PVC elbow 90-degree Schedule 40 Slip x Slip to the bottom of the 9in piece of PVC pipe. Then glue a 2x1½in PVC reducer bushing (Spigot x Slip) to the elbow. Glue one of the 3½in pieces of 1½in Schedule 40 PVC pipe to the 2x1½in PVC reducer bushing (Spigot x Slip) so the entire connected piece creates an S-shape. Then use the Oatey Purple Primer and Red Hot Blue Glue to glue one of the S-shaped inlet pipes directly into the pre-existing valve. If the Clear RTV Silicone sealant is set on the intake holes, you can then install the 2x1½in PVC adapter Schedule 40 MIP x Slip in the 2in FIP poly tank adapters and glue the inlet piping to the 2x1½in PVC adapter Schedule 40 MIP x Slip using the Oatey Purple Primer and Red Hot Blue Glue. Once the glue is set, use the Clear RTV Silicone sealant to ensure the connection is watertight.

To attach the 2-gallon buckets without the lids use a hole saw the same size as the 2x1½in PVC Schedule 40 bushing (Spigot x Slip) and cut a hole in the bottom of the bucket. Next, glue (using the Oatey Purple Primer first and Red Hot Blue Glue on top) the 2x1½in PVC Schedule

40 bushing (Spigot x Slip) to the hole in the bucket and then glue it to the 2in PVC elbow 90-degree Schedule 40 Slip x Slip so it hangs from the bottom of the S-shaped inlet piping.

Outlet piping materials needed:

- 1½in Schedule 40 PVC pipe
- 2in Schedule 40 PVC pipe
- 2x1½in PVC Schedule 40 bushing (Spigot x Slip)
- 2x1½in PVC adapter Schedule 40 MIP x Slip
- 2-gallon buckets w/ lids x4
- Power drill
- Hole saw attachments
- Chop saw
- Measuring tape
- Markers
- Safety glasses
- Work gloves
- Disposable nitrile gloves
- Oatey Purple Primer
- Red Hot Blue Glue
- Clear RTV Silicone sealant

Install the 2x1½in PVC adapter Schedule 40 MIP x Slip in the 2in FIP poly tank adapters using Clear RTV Silicone sealant to ensure a watertight fit. Cut 1½in Schedule 40 PVC pipe to 3½in in length using the chop saw. Glue one end of the 3½in piece of 1½in Schedule 40 PVC to the 2x1½in PVC adapter Schedule 40 MIP x Slip using the Oatey Purple Primer first and Red Hot Blue Glue on top, assemble quickly. Twist tight, and make sure there's enough glue that it seeps out the edges, to ensure there is no water leakage. Attach the other end of the 1½in Schedule 40 PVC to a bucket using the 2x1½in PVC Schedule 40 bushing (Spigot x Slip).

We drilled holes in one half of the length of the 2-gallon buckets with lids to allow water to flow out of the planter but keep plant roots out. Then using a hole saw the same size as the 2x1½in PVC Schedule 40 bushing (Spigot x Slip), we cut a hole in the bottom of the bucket. Next, we glued the 2x1½in PVC Schedule 40 bushing (Spigot x Slip) to the hole in the bucket and then glued (using the Oatey Purple Primer first and Red Hot Blue Glue on top) the 1½in Schedule 40 PVC to the 2x1½in PVC Schedule 40 bushing (Spigot x Slip) attached to the bucket. *This method of creating the outlet system had to be updated, because Prof Korey Russel felt that water may not be able to drain as well as it should this way.

Modifying Outlets:

Tools and supplies needed:

- 2x1½in PVC reducer bushing (Spigot x Slip)
- 1½in Schedule 40 PVC pipe
- 2in Schedule 40 PVC pipe
- 2-gallon buckets w lids x4
- Disposable nitrile gloves
- Oatey Purple Primer
- Red Hot Blue Glue
- Clear RTV Silicone sealant
- Gasket outlet attachment

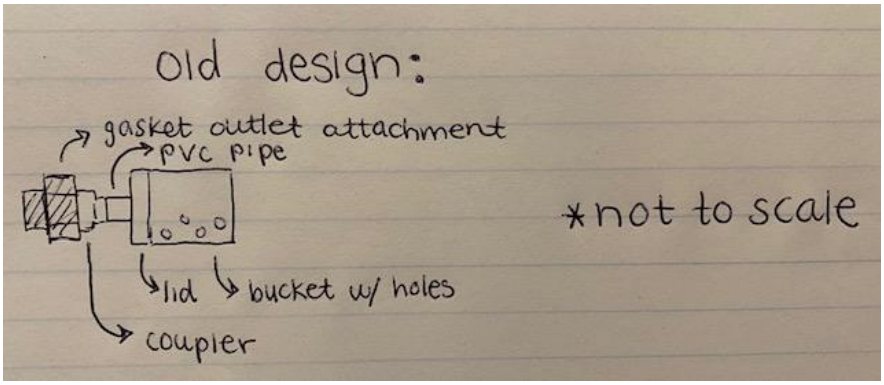


Fig. 5

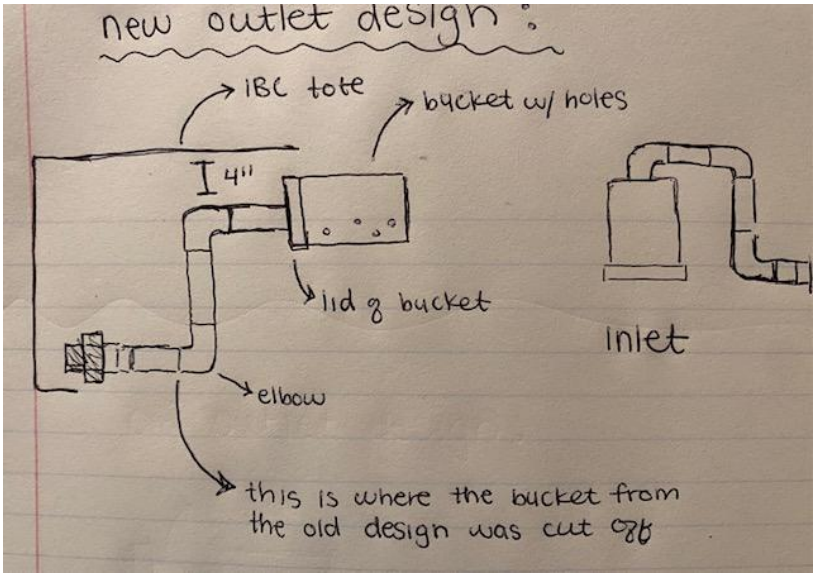


Fig. 6

We began adapting the outlet design by cutting the bucket off of the pipe. We then added more PVC attachments. First, measure and mark PVC and cut it using a chop saw. Cut 1½in Schedule 40 PVC pipe to 3½in in length. Cut 2in Schedule 40 PVC pipe to around 4in in length. This piece has to be around 4in below the top of the IBC tote, so measure accordingly. Then dry-fit the 1½in by 3½in PVC pipe to a 2x1½in PVC reducer bushing (Spigot x Slip), then to a PVC elbow piece. Then, connect one of the 2in by 4in PVC to a 2in PVC elbow, and attach the other end of the 2in PVC elbow to another 2in in diameter by 3in in length PVC piece. Then attach each piece of PVC together using the Oatey Purple Primer first and Red Hot Blue Glue on top and assemble quickly. Glue the other end of the 2in by 3in PVC to a bucket. This last step isn't solidified into the plan, because this portion of the project is still being reviewed by Prof. Kory Russel.

Installing Wood Framing:

<u>Tools and supplies needed:</u>

- Pencils
- Measuring tape
- Work gloves
- Safety glasses
- Power drill
- 2½in deck screws (and included torx bit)
- 1½in brad nails
- Brad nailer and compressor
- Chop saw
- 2x2x8 Douglas fir utility & btr x8
- 1x6x6 Western Red Cedar quality flat top fence pickets x53 *use 1x6x8 boards if available to create less scrap/waste

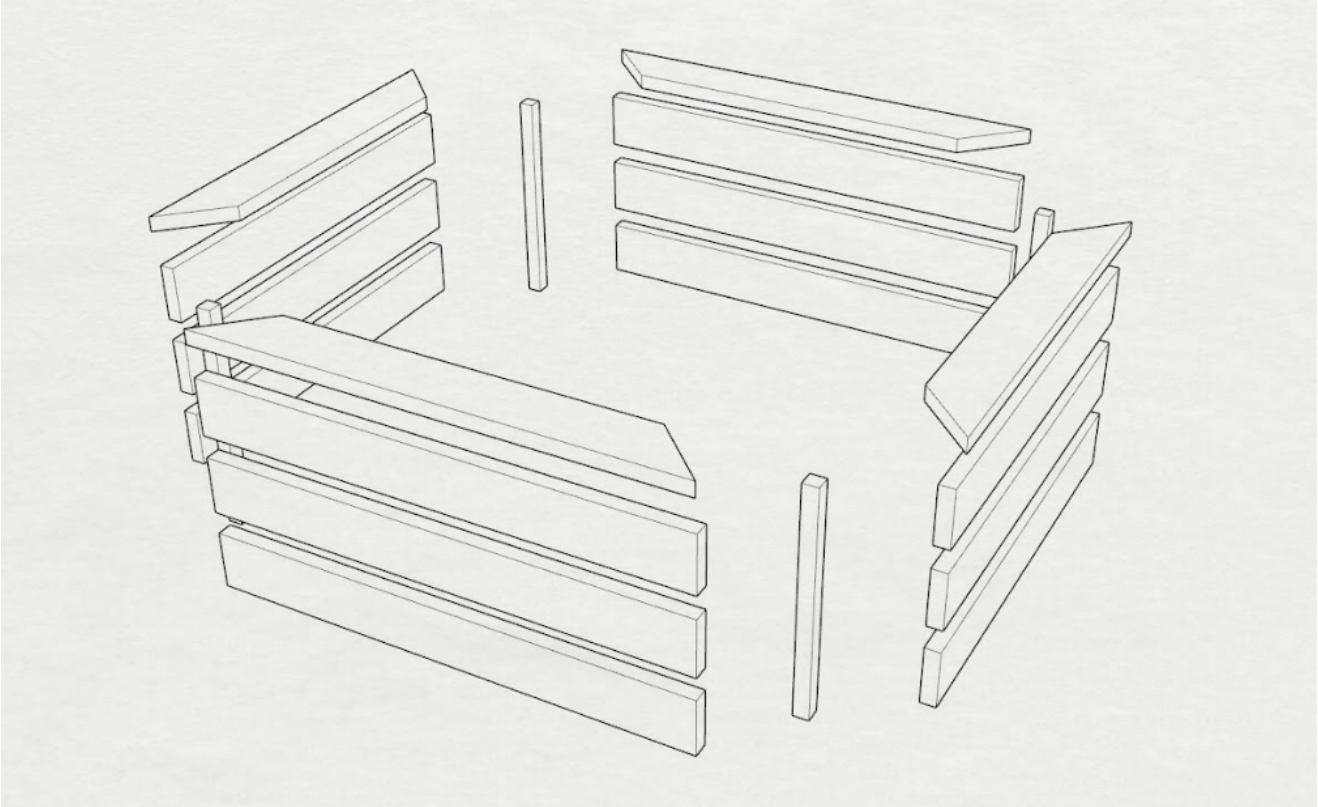


Fig. 7

For building the outer frame of the greywater tank, in order to conceal the industrial IBC tote, begin by measuring from the top to the bottom of the plastic of the IBC tote on each of the four corners. Mark out the measurements on the 2x2x8 Douglas fir utility & btr and use the chop saw to make the cuts. Repeat this for each of the four corners of the IBC tote halves. For this next part, you will need another pair of hands to assist. There should be two metal bars for you to attach the 2x2 to at each corner. Have one person hold one of the cut 2x2s to the correct corner of the IBC tote so the bottom of the wood lines up with the bottom of the plastic portion of the tote.

Using the power drill and a drill bit slightly smaller than the deck screw, make pilot holes that go through the wood and into the metal bar of the cage. Then using a torx bit (provided with the deck screws), screw the 2½in deck screws through the pilot holes, securing them to the metal bars. Repeat this process for the other 15 corners. Measure the distance on the side of the IBC tote between two corner 2x2s and mark the measurements using a pencil on the 1x6x6 (or 1x6x8 if they're available) Western Red Cedar quality flat top fence pickets. Cut Western Red Cedar wood accordingly, and then staple the sides to the Douglas fir posts. When creating the wooden frame around the inlets and outlets, measure a small piece of the 2x2x8 Douglas fir wood, and place it under the outlet and or inlet gasket(s). Next, measure two pieces of the flat Cedar wood

on either side of the inlet and outlet. There should be some space between the hole of the tank and the wood, as seen in the photos. Then, using a nail gun and air compressor attachment, nail the board edges flush to one another and nail the other end of the board, closest to the gasket, to the 2x2x8 Douglas fir piece. Repeat for all four sides of the IBC totes. Se photos below for reference.

As for the top portion of the frame, begin by measuring all four top side lengths of the tank, making sure measurements meet each outer edge of the wood. Measurements may vary from each of the four containers, so make sure to continue measuring each time. After lengths are determined, mark where you want to cut. Each wooden slat on the top portion of the frame will have a 45° angle on it. To cut the 45° angle, turn the chop saw to the 45° setting. Depending on the size of the chop saw, you may have to move and turn the Cedar wood slats suitably. Begin the assembly process by nailing down two opposite sides of the top frame. These pieces need to already be measured properly and have a 45° angle. Then, measure what other angles are needed for the other two opposite pieces, they will be close to 45°. We measured the angels again, because during the cutting process, the angles may slightly vary, and they need to be flush to one another.

Final Product:

*With the exception of the updated outlet design

Notes:

Unfortunately we ran out of time to fully complete the project. The inner piping outlet is still being constructed and the design isn't fully finalized. Prof. Kory Russel had mentioned that our previous design may not fill up as timely as we had wanted. The outer piping system connecting all four tanks will also need to be constructed. Additionally, the tanks will need to be filled with soil and or sand aggregate. This will also assist with the aesthetic appeal of the tanks, making the white portions showing in between the wooden slats, be darker and less noticeable. Moreover, the bamboo will be planted, completing the process. During this term we were unable to have the greywater planters put on site, so this project will have to be continued.

Acknowledgements:

Special thanks to Audrey Rycewicz, our grad student leader for the project, and Prof. Kory Russel, who gave us guidance for the alternative plumping system. Additional thanks to Prof. Yekang Ko for teaching our LA 410/510 class section. We want to acknowledge Community Supported Shelters (CSS) for working with our class and allowing us to place our greywater tanks at their facility. We also want to recognize Landscape for Humanity, and the University of Oregon Foundation, as well as the University of Oregon Resilience Initiative for funding support towards this project.