

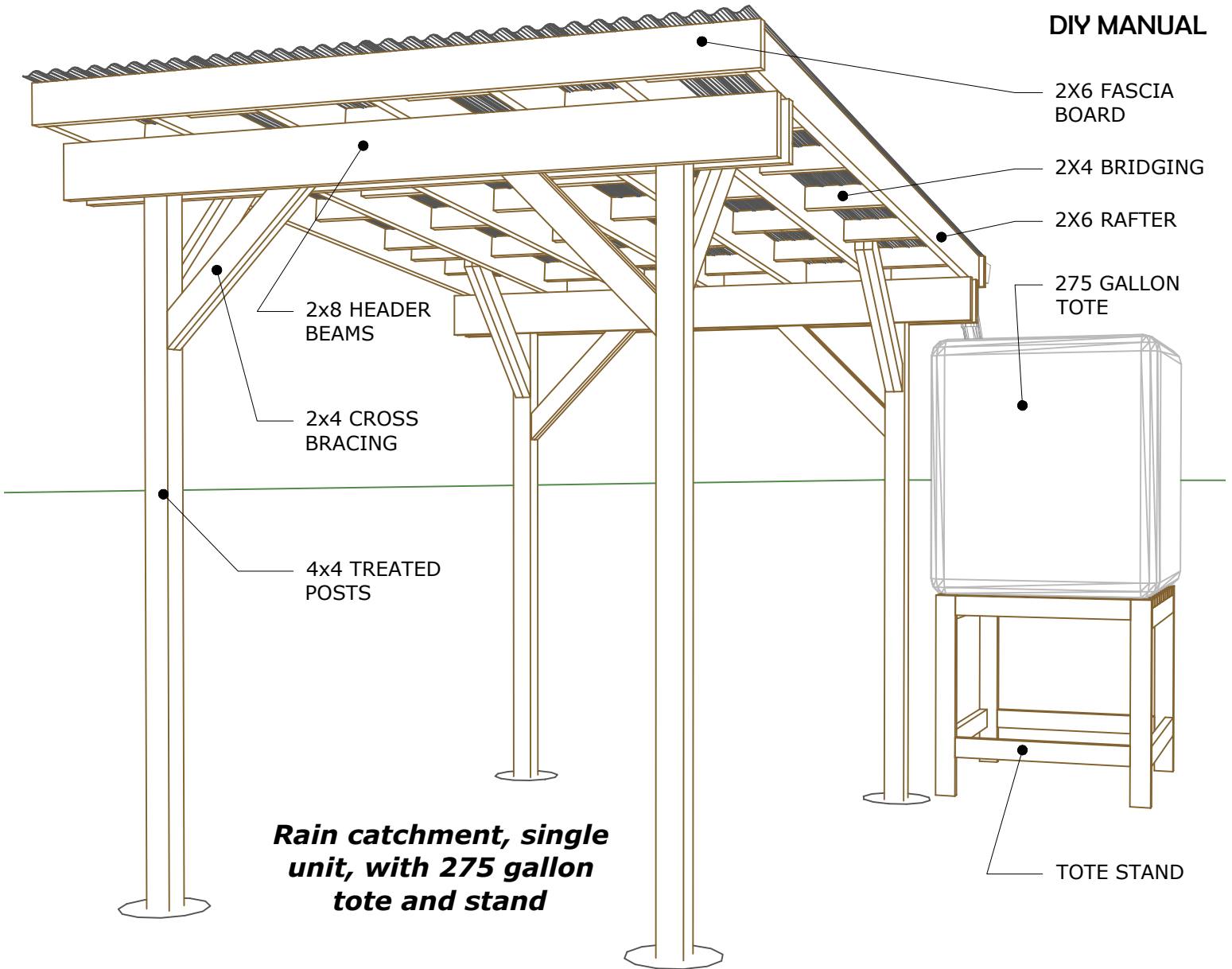


Keep Growing Detroit (KGD) exists to promote a food sovereign city where the majority of fruits and vegetables consumed by Detroiters are grown by residents within the city's limits. For more information about our work or this manual contact us at (313) 757-2635 or keepgrowingdetroit@gmail.com.

June 2017

IRRIGATION STATION

DIY MANUAL



Rain Catchment System

Design Guide:

Single Unit, Double Wide, Back to Back, or Customized Specifically for Your Site and Water Needs.

Do It Yourself, Utilize our Support Team, or Hire it Done.



IRRIGATION STATION

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Hello from Keep Growing Detroit,

Welcome to instructions to build an Irrigation Station. This freestanding unit was designed to be a simple structure to capture rainwater for use in gardens with limited access to water. The structure can be a stand-alone or multiple units based on your water capturing needs. The single unit roof is 8 foot by 12 foot and can capture about 60 gallons of water for every inch of rain. The structure can also double as a shaded seating area for gardeners. Under Michigan Building Code uninhabited free standing structures under 200 square feet do not require a building permit.

Rain Catchment Single Unit Preparation

There are a variety of factors to consider before beginning your project:

- Site Selection and Structure Placement, i.e. distance from garden
- Calculating Your Water Needs
- Choosing the Number of Modules and Orientation
- Preparation for Digging (Contact MISS DIG)
- Local Laws and Ordinances, State Building Codes, Property Line Offsets
- Manpower (In-House, In-House/KDG Partnership, Outsource)
- Materials Sourcing and Transportation
- Tools and Equipment Rent, Purchase, Borrow
- Assembly
- Delivery of Water to Garden
- Winter Maintenance
- Other Tips, Notes and Ideas

Choosing a Site to Build Your Irrigation Station

There are a few things to consider when choosing a site to build your irrigation station. The structure should be at least 5 feet from adjacent property lines and 20 feet from the sidewalk or consistent with frontages of adjacent buildings. It should be relatively close to the garden it is intended to water for ease of access. Avoid being under the shade of trees that would limit the amount of water being captured.

The water coming from the 275 gallon tanks is gravity fed which means you will not have much water pressure unless you attach a pump to the tank to move the water to the garden. If you have electricity* you can get a transfer pump from the hardware store.

* If you don't have access to electricity, you can use a car battery and a 12-volt centrifugal pump or look into options for low-flow drip irrigation kits or just use watering cans.



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Calculating Monthly Water Needs

What is the square footage of your garden: $\text{LENGTH} \times \text{WIDTH} = \text{GARDEN SQUARE FOOTAGE}$

Example: $20 \text{ foot} \times 20 \text{ foot} = 400 \text{ square feet}$

Gardens need at least 4 inches per month (1 inch per week).

To calculate total gallons needed:

$\text{GARDEN SQUARE FOOTAGE} \times 0.623 \text{ (gallon conversion)} \times 4 \text{ weeks} = \text{GALLONS NEEDED PER MONTH}$

Example: $400 \times 0.623 \times 4 = 996.8 \text{ gallons per month}$

Detroit's average rainfall during the growing season is 2-3 inches. This is about 40-65% of our water needs (**we will use 50% as a rough estimate**).

Amount of water needed after average rainfall:

$\text{GALLONS NEEDED PER MONTH} \times 50\% (0.5) = \text{GALLONS WATER CATCHMENT GOAL}$

Example: $996.8 \times 0.5 = \mathbf{498.4 \text{ gallons}^*}$

*This example would require two Irrigation Station units for adequate water

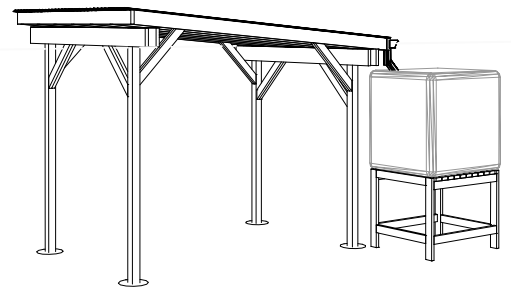
Guidelines for Using Captured Water for Food Crops

Because rainwater has not been treated like the water from the tap we recommend the following tips to avoid any foodborne illness:

- Do not drink the water from tanks
- Water crops at their roots, and wash crops thoroughly with municipal water before eating
- Periodically clean out tanks

Other Considerations

- Access to site for deliveries and getting materials in and out
- Security in the meantime
- Future development/expansion
- Permission from site owner
- Overhead lines
- Power source
- Distance from adjacent neighbor and sidewalks





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Rain Catchment Single Unit (Starter Unit) Materials List:

- (7) 2x6 rafters, each @ 12 feet minimum
- (2) 2x6 fascia boards (band joist), each @ 8 feet & 6 inches minimum
- (4) 2x8 beams, each @ 8 feet & 6 inches minimum
- (4) 4x4 treated posts, each @ 12 feet minimum
- (36) 2x4 bridging, ea @ 1 foot & 4 inches minimum
- (16) 2x4 cross bracing, ea @ 3 feet & 6 inches minimum
- (4) 2x4 temporary support bracing, ea @ 8 feet minimum
- (4) panels corrugated galvanized steel, 29 gauge, 2 feet wide (coverage area), 12 feet long
- (100) screws, 10-16 x 1.5 inches HWH self tap with washer
- (16) 50 pound bags of pea gravel (aggregate)
- (1) bucket of nails, 3-1/4 inch 16D coated sinker, or box of #8 x 3 inch exterior screws
- (8) carriage bolts, 8 inch long, $\frac{3}{8}$ - 16 carriage bolt
- (8) hex nuts, $\frac{3}{8}$ inch
- (8) cut washer, $\frac{3}{8}$ "
- (10) hurricane straps
- (1) 6 inch gutter, @ 8 feet & 6 inches minimum length
- (2) gutter end caps, (1) right, (1) left
- (1) downspout outlet
- (1) downspout adapter
- (1) flexible downspout
- (8) gutter hangers
- (4) drip edge lengths, (2) @ 12 feet minimum and (2) @ 8 feet minimum

Corrugated Metal:

Corrugated metal panels can be found at your local steel yard or roofing supplier.



HWH Screws:

HWH stands for Hex Washer Head. These screws should be available where you purchase the corrugated panels or your local hardware store.



Hurricane Strap / Hurricane Tie



Carriage Bolt

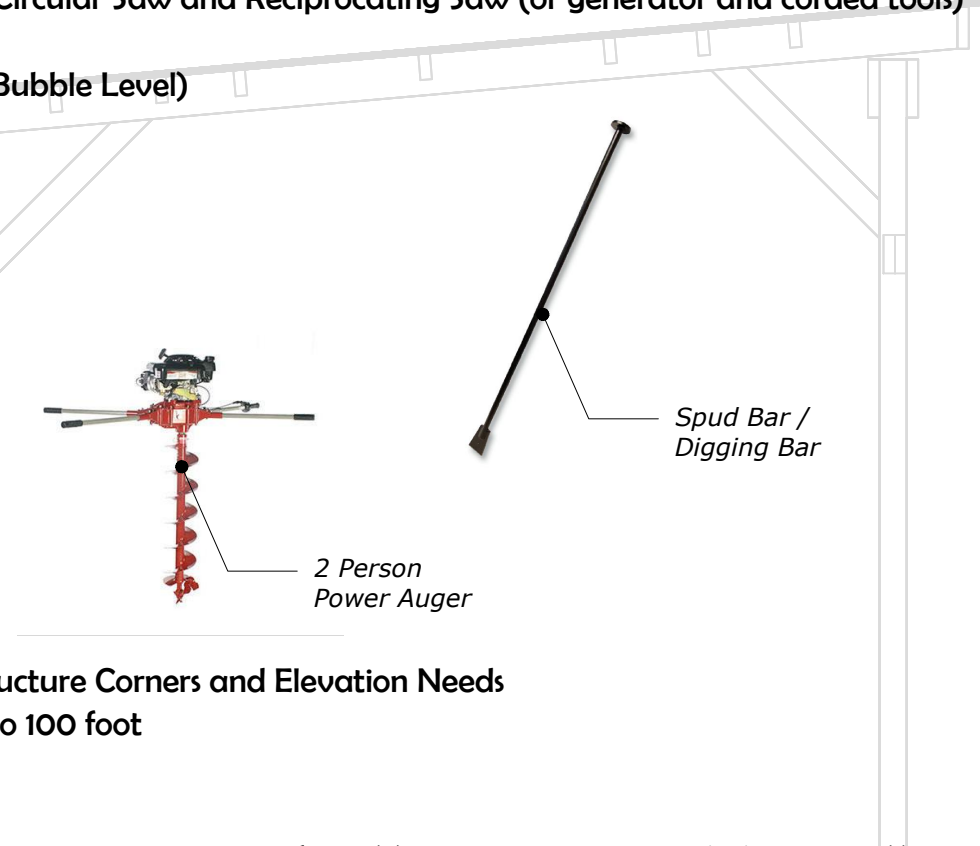
Lumber selection: We recommend that the 4x4 posts be treated lumber. While the remaining lumber needn't be treated, it should be sealed with a typical deck sealer, such as Thompson's. Choose reclaimed / salvaged lumber from your local reuse center, like ASWD, whenever available and cost effective!



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Rain Catchment Assembly and Installation Tools and Equipment List:

- Two Person Power Auger (available for rent)
 - Two to Three ladders, 6-12 foot
 - Battery Powered Impact Drivers, Circular Saw and Reciprocating Saw (or generator and corded tools)
 - Saw Horses for Cutting
 - Levels - 4 foot and shorter (Spirit/Bubble Level)
 - Line Level or Laser Level
 - Wheel Barrow
 - Spud Bar / Digging Bar
 - Post Hole Digger
 - Balling Spade Shovel
 - Hammers
 - Sledge Hammer (6-8 Pounds)
 - Speed Square
 - Framing Square
 - Drill Bits: Hex head and Philips
 - Utility Knife
 - Lumber Pencils
 - Plumb Bob
 - String or Cord for Determining Structure Corners and Elevation Needs
 - Measuring Tapes, 25 foot and 50 to 100 foot
 - Pliers, Channel Locks
 - Hand Saw
 - Wire Cutters
 - Quick Clamps - Qty 2
 - Short Stakes (2 to 3 feet) - Qty 4
- 
- The diagram shows a cross-section of a rain catchment structure. A red 2 Person Power Auger is positioned vertically, and a black Spud Bar / Digging Bar is shown at an angle. Labels with leader lines identify the '2 Person Power Auger' and the 'Spud Bar / Digging Bar'.
- Labor:** (3) People, Recommended at Least (1), preferably (2) skilled craftsmen
Time: 30 to 40 hours

DIY Budget: The estimated material costs for the Single Unit, Rain Catchment Structure:

\$750.00

This assumes materials only and excludes cost of tote, tote stand, tools, labor, transportation, and any other ancillary costs.



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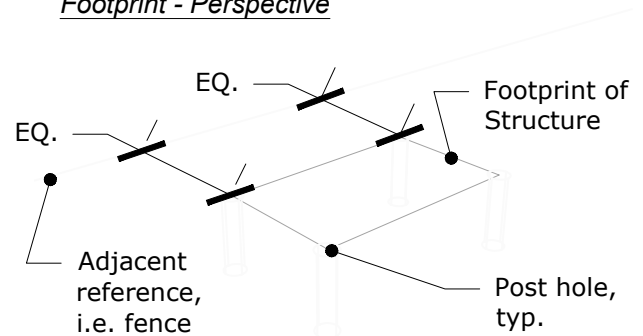
Rain Catchment Single Unit: Layout

Once you have the tools, materials and layout determined, and everything on site, the first step in the assembly process is to locate the structure on the site and layout the footprint.

Before doing any digging/augering on-site you should call MISS DIG, a free service that marks utilities to avoid damage. The phone number is (800) 482-7171.



Footprint - Perspective



A can of spray paint is a great tool to help visualize the footprint. Use it to mark the perimeter and post locations. Take care to orient the structure to an appropriate reference point, i.e. adjacent building, fence, sidewalk, road, or garden. Measuring from multiple points will help ensure that you have laid out the footprint properly, but the best test is visual - does it look right?

Once the footprint and post locations are mapped out, assuming MISS DIG has marked the locations of any underground hazards, and you have checked for any overhead hazards, you are ready to begin digging your post holes.

While these holes can be dug by hand with shovels, depending on your soil and site conditions, this may be extremely difficult. We have found that it is well worth the cost to rent a power auger. Bear in mind, that even with a power auger, very rocky soil, or debris from previous structures may still make this task difficult. Expect the process of preparing the holes to be the most time consuming step of the build, but it's also the most critical. Accurate placement with true and plumb posts will make the rest of the assembly run smoothly and ensure the durability and integrity of the structure.

Dig holes so that the post are set below the frost line as required by code. Consult your local codes for requirements in your region. In Detroit, our holes are dug to 42". We recommend setting the posts in aggregate, but concrete is suitable as well.



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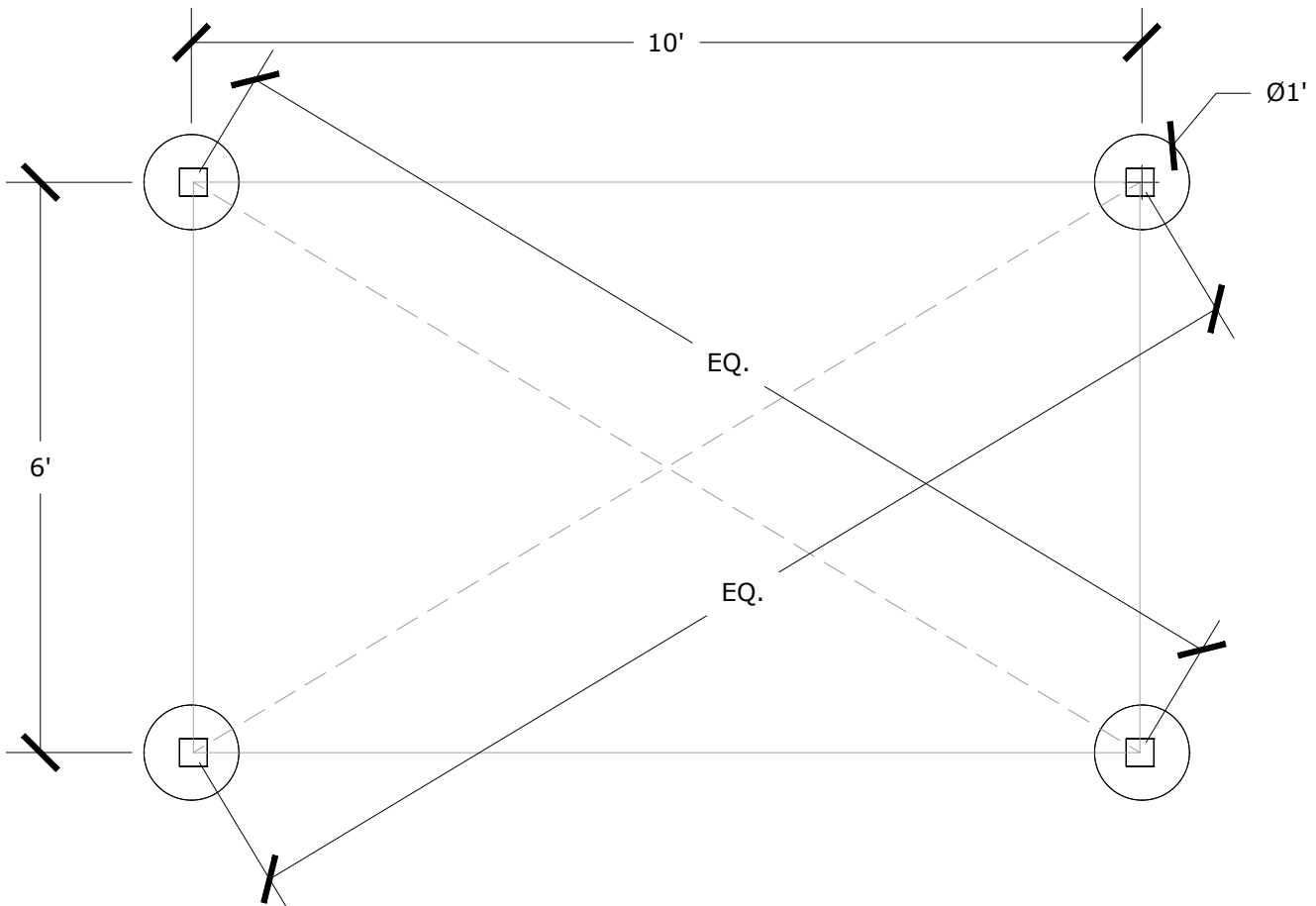
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Rain Catchment Single Unit: Layout

See layout diagram below, this is a top view of the footprint of the structure. To ensure that the footprint is square, you can measure diagonally, corner to corner, and if the measurements are equal, then you are square. If not, one of your sides or corners is out of square, and needs to be shifted.

Locating the footprint:

In addition to measuring from multiple points, taking diagonal measurements can also help to ensure that your footprint is square to the adjacent reference, i.e. fence, sidewalk, etc.



TOP VIEW - LAYOUT

SCALE: 1/2" = 1'

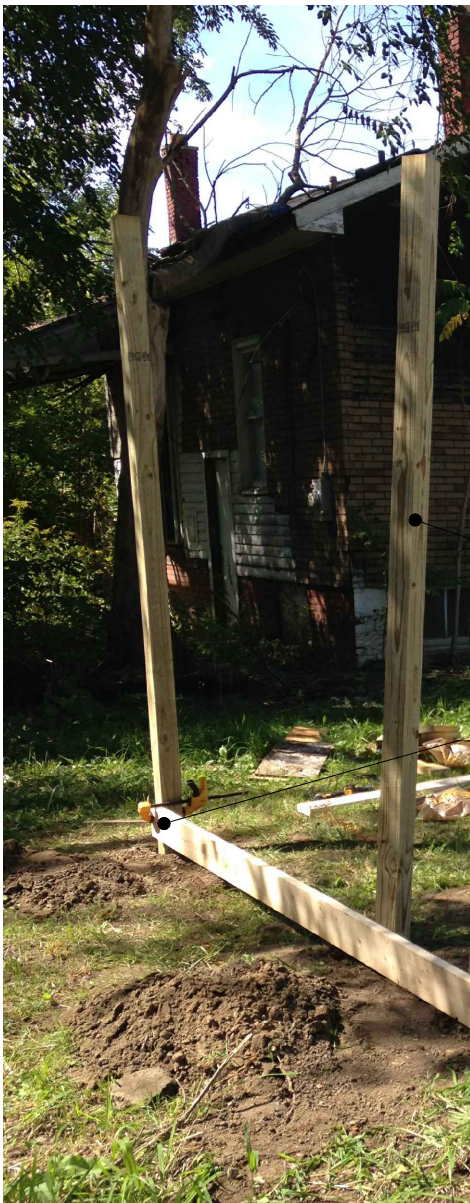


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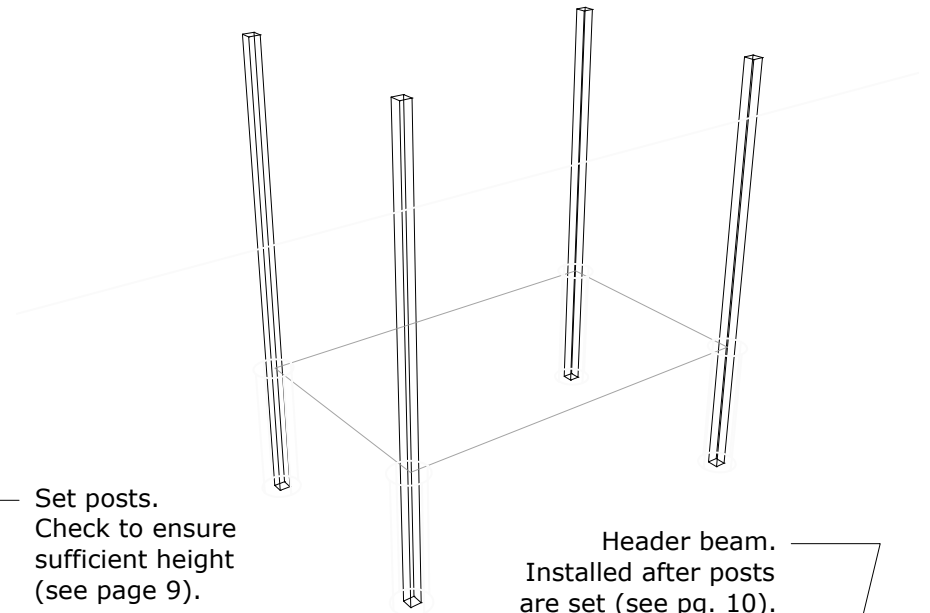
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Rain Catchment Single Unit: Setting the Posts

Now that your irrigation station is laid out and holes are dug, it's time to set the posts. It is critical that the posts are all set square, plumb and aligned to each other. In this step you will want to utilize string, a line level, and temporary bracing to set the posts and secure them in place while the aggregate is poured into the hole and around each post. Use 4 foot level on front and side of posts to set plumb and true.



Setting Posts - Perspective

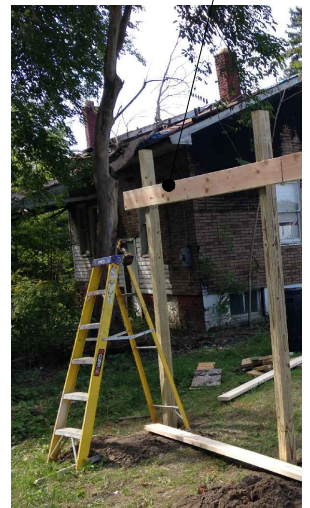


Set posts. Check to ensure sufficient height (see page 9).

Header beam. Installed after posts are set (see pg. 10).

Quick clamps and temporary lumber to keep things in place.

Use 4 foot level





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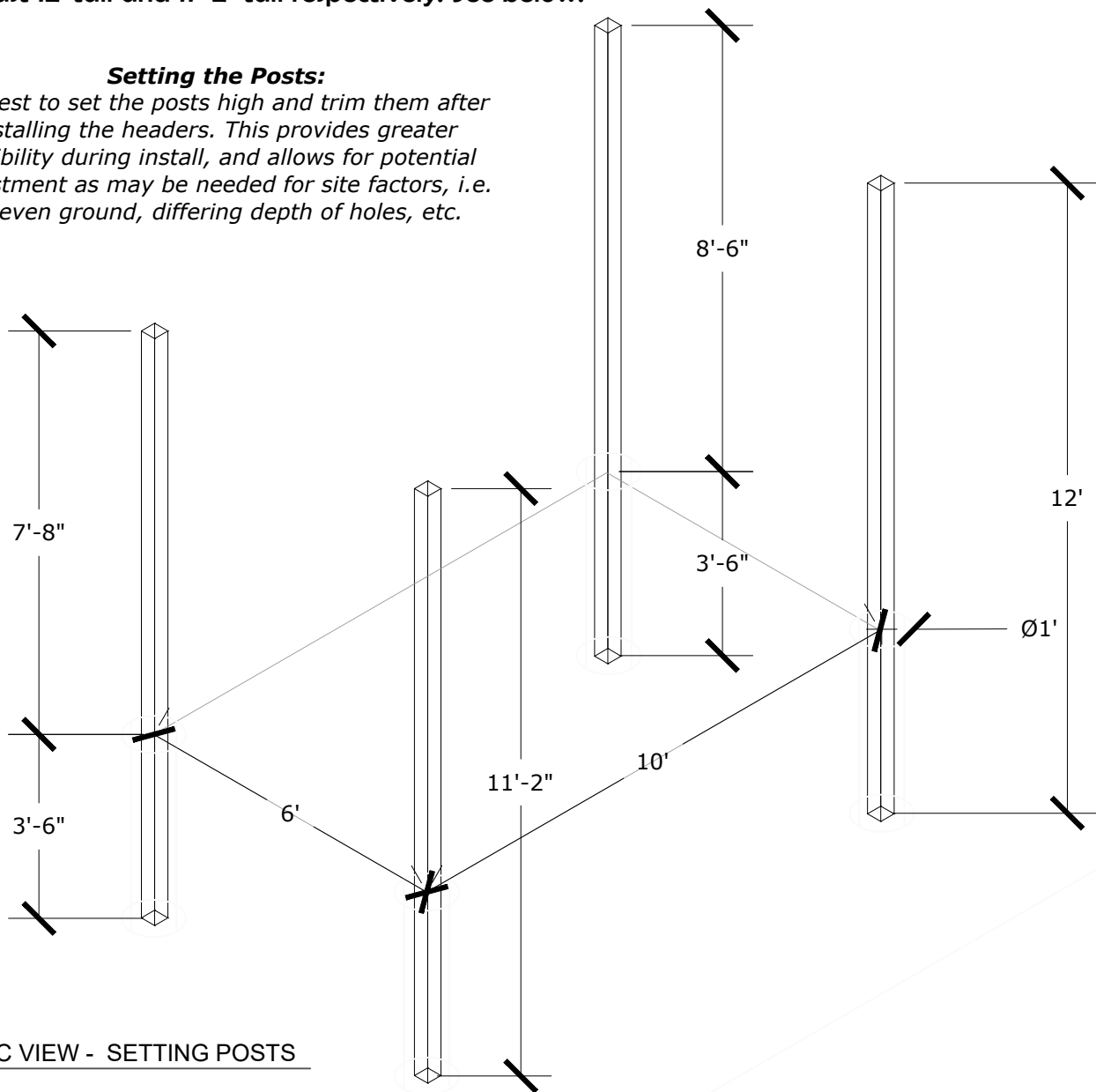
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Rain Catchment Single Unit: Setting the Posts

See the post installation layout diagram below. Note that (2) of the 4x4 posts (the "front" posts / high side posts) should be set with at least 8'-6" above ground level and the other (2) (the "back" posts / low side posts) should be set with at least 7'-8" above ground level. With a 3'-6" deep hole, these posts need to be at least 12' tall and 11'-2" tall respectively. See below.

Setting the Posts:

It's best to set the posts high and trim them after installing the headers. This provides greater flexibility during install, and allows for potential adjustment as may be needed for site factors, i.e. uneven ground, differing depth of holes, etc.



ISOMETRIC VIEW - SETTING POSTS

SCALE: NTS



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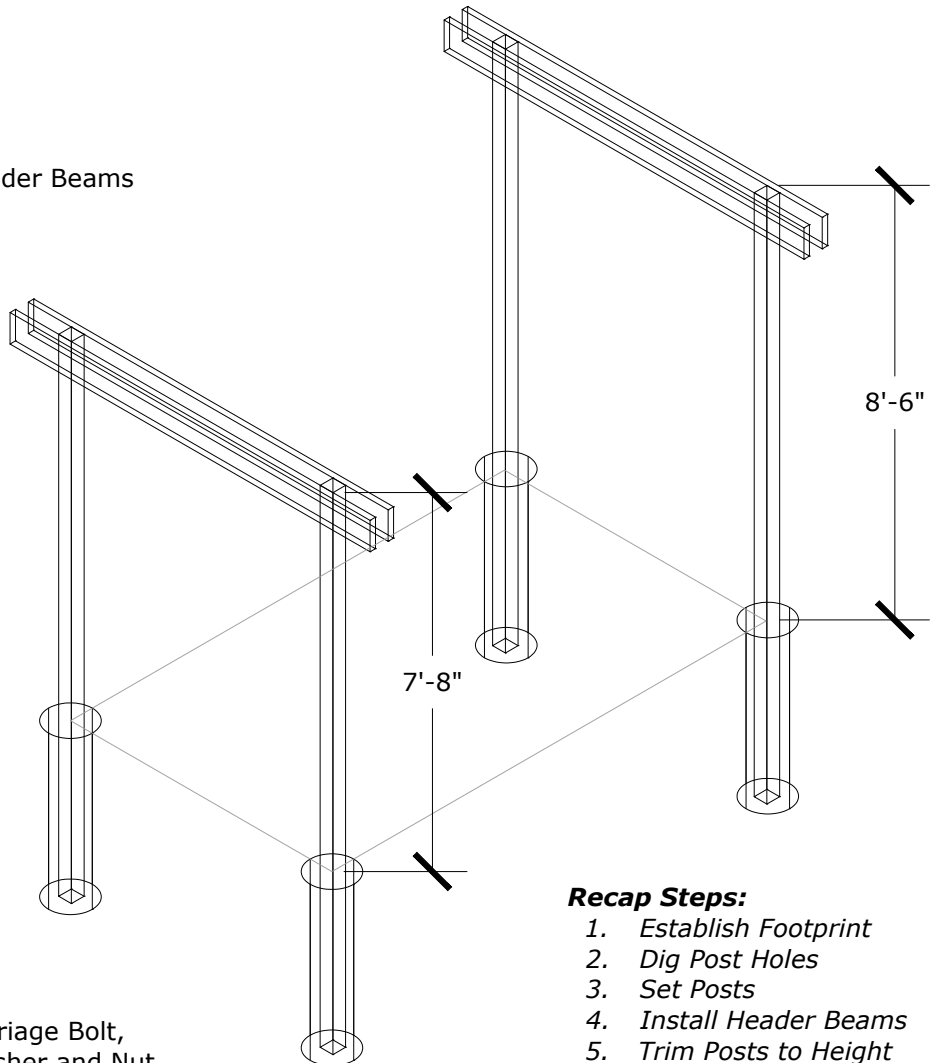
Rain Catchment Single Unit: Header Beams

As the posts are being set, the header beams and roof structure can be pre-cut, laid out and pre-assembled on the ground. First cut and install headers. You can tack the headers into place with nails or screws, leveling the headers as you go. Once in place, pre drill your carriage bolt holes and install. Use (2) bolts, high and low, at each post/header intersection (as seen in the images). Washer and nut should be located toward the interior of the structure. After headers are in place, trim posts to top of header.



Header Beams

Carriage Bolt,
Washer and Nut,
Interior View



Recap Steps:

1. Establish Footprint
2. Dig Post Holes
3. Set Posts
4. Install Header Beams
5. Trim Posts to Height



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Rain Catchment Single Unit: Temporary Bracing

During the installation process, it is important to continue to keep your posts square and plumb. The best way ensure this is to install plenty of temporary bracing. Install bracing before working at height (Especially with option B).



Temporary cross bracing, attached at the top of one post and the bottom of another, keeps the structure from racking during the construction process



Temporary post bracing, attached at the top of one post and staked to the ground, keeps the posts true and in place during the construction process



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Rain Catchment Single Unit: Roof Structure

Whenever possible, it's best to minimize ladder work, working overhead, and working at heights. These activities are more difficult and carry greater risks of injury. That being said, these tasks are unavoidable in construction projects. Exercise all appropriate caution, use personal protective equipment, and never perform work that you are not comfortable performing. In this project these tasks can be minimized by performing the majority of the roof construction and assembly on the ground before raising it into place. Use a level surface to build the roof structure.

If your manpower (or size of structure) makes lifting the roof into place implausible, then you can certainly build it in place. Below see steps and images of both approaches.

Option A: Build Roof Structure on Ground and Raise into place.

- Safer Working Conditions
- Easier and Faster Construction
- Need 4+ people to raise into place

Option B: Build Roof Structure In Place

- Exercise caution when working on ladders and atop roof
- Working overhead is more time consuming and physically exerting
- Can be accomplished with 2 skilled workers



Step 1: For both Option A and Option B, the first step is to layout and assemble the perimeter, mark and pre-cut the joists.

Perimeter Band Joists and Fascia Boards

Standard Joists

Perimeter Band Joists and Fascia Boards





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Rain Catchment Single Unit: Roof Structure



Mark both fascia boards at increments of 16 inches on center (see diagram, page 13). Mark both at the same time.

Pre-cut and align joist with marks (Whether using Option A or Option B).



Layout roof structure



Attach joists to fascia boards, using screws or nails at each intersection, through the fascia and into the joist



Bridging

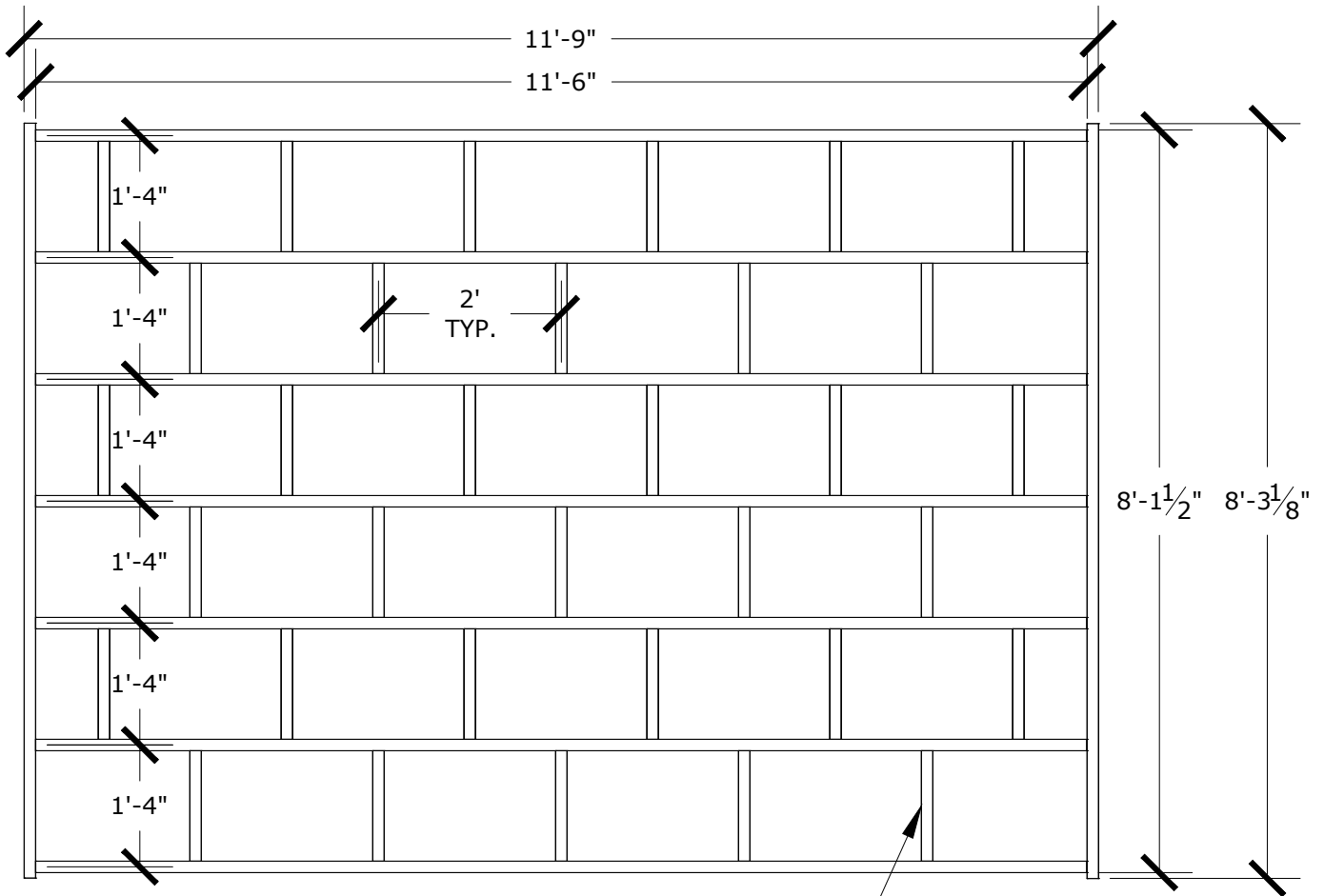


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Rain Catchment Single Unit: Roof Structure

See the roof deck layout below. Building the roof structure on the ground and raising it up makes the fabrication easier, but requires a bit of extra manpower to raise it up when your complete. After laying out the perimeter band joists and fascia boards, you'll secure the main joists and finally the bridging. Note that bridging may need to be adjusted or added to tie in cross bracing. Justify bridging to the top of the joists. After assembling the structure below, install drip edge and corrugated roofing. Corrugated roofing should overhang structure.



ADJUST OR ADD BRIDGING
AS NEEDED TO TIE INTO
CROSS BRACING

TOP VIEW - ROOF STRUCTURE

SCALE: 1/2" = 1'



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Rain Catchment Single Unit: Roof Structure



It is important when securing the corrugated material to align your drill holes with the joist below. Snapping a chalk line, or other indicator, is recommended.

Hurricane Strap
Note: that if you are building the structure in place, then you may attach the hurricane straps as you go, whereas, when building the structure on the ground, the straps will be installed after placing entire structure



Use care when working at heights to install corrugated panels (Option B)



Install drip edge before corrugated





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Rain Catchment Single Unit: Permanent Cross Bracing

With everything installed and securely braced, it's time to install the permanent cross bracing. These members are critical in keeping the entire structure rigid and stable. Once installed, the temporary bracing may be removed.



For the bracing that runs from post to between header beams, cut ends of 2x4's at 45 degree angle and double them up. Then attach to post as shown (from bracing member into post), and attach to header beam, through header into bracing



For the bracing that runs from post to roof bridging, cut one end at 45 degree angle and match the other to the roof slope (use bevel square to determine roof angle). Double up the 2x4's and then attach at post and roof. At roof, if the bridging does not exist at tie in point, add additional bridging as needed





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Rain Catchment Tote and Tote Stand Materials List:

- (7) 2x6 deck and frame, each @ 8 feet
- (2) 2x6 treated bracing, each @ 10 feet
- (1) 4x4 treated post, @ 8 feet
- (1) box of structural screws (100 count), #9 x 1.5 inches, hex-head
- (1) box of galvanized screws (5lb box), #10 x 3 inches, Phillips head
- (8) framing angles for 2x6
- (4) concrete deck blocks
- (1) gallon Thompson's Water Seal
- (1) 275 gallon tote

** Painting totes will minimize the water's exposure to sunlight and the growth of algae. Use paints that will adhere to plastic such as oil based exterior spray paint.*

DIY Budget: The estimated material costs a single Tote and Tote Stand is:

\$200.00.

This assumes materials only and excludes cost of tools, labor, transportation, and any other ancillary costs.



structural screws, available at Home Depot



framing angle, available at Home Depot



concrete deck block, available at Home Depot

275 gallon tote

tote stand





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Rain Catchment Tote Stand: Assembly



#1 Cut and assemble 4 feet by 4 feet perimeter with one joist cross member



#2 Cut and install decking, (8) pieces at 4 feet each. Install from top. Leave space between boards for drainage

#3 Cut (4) posts to 2 feet each. Cut (8) cross braces, (4) at 2.5 feet each and (4) at 2 feet each all with 45 degree angle on each end



#4 Notch one face of each post to receive cross brace as shown



#5 Attach posts using framing angles and structural screws. Attach cross bracing.

#6 Using two or more people, flip unit over



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Rain Catchment Tote Stand: Assembly

#8 Seal wood with Thomson's Water Seal (or other similar product) per manufacturers instructions.

#7 With help, move tote stand to appropriate location, at back of rain catchment structure and lift unit and set concrete deck blocks. Level as needed.



Rain Catchment Tote Stand: Set Tote

With the rain catchment structure and tote stand fully built and sealed, it's time to install the gutters, downspouts and place the tote.

Cut your gutter to length, capturing the full width of the structure. Assemble right and left end caps to gutter trough using zip screws or rivot tool. Use gutter seal! Install downspout adapter on gutter trough a few inches from end, keeping in mind where your water tote will be. Hang the gutter unit onto the fascia using gutter hangers every 2 feet. Attach the flexible downspout to the downspout adapter, and with tote set atop your tote stand, connect to hole in top of tote. Extend flex end down into the tote a few inches and your ready!



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You're done!

We hope that you have found this DIY guide helpful, and that you have great success with your irrigation station while helping to cultivate a food sovereign Detroit!



We would love to hear your success stories, plus any tips and tricks you learned along the way. Please share your stories and pictures with us and the community. We look forward to hearing from you.

**Thank you,
Keep Growing Detroit**

Design support provided by: