GNG1103 - Deliverable D - Conceptual Design

Team: D1 - Hydroponics 1

Introduction:

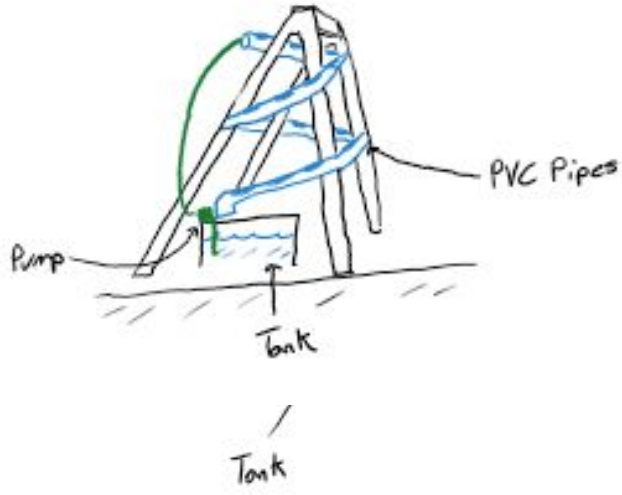
Based on our benchmarking and design criteria, each team member has developed three (3) conceptual designs for our hydroponics system. After analyzing and evaluating each member's conceptual designs, our team picked out attributes and aspects that were deemed most adequate from a select few and combined them to create three (3) global designs. These designs were then evaluated using a selection matrix, with the optimal design chosen as our final global design.

This document showcases all conceptual designs, all global designs, and the selection process used to determine our final optimal design.

Design Concepts:

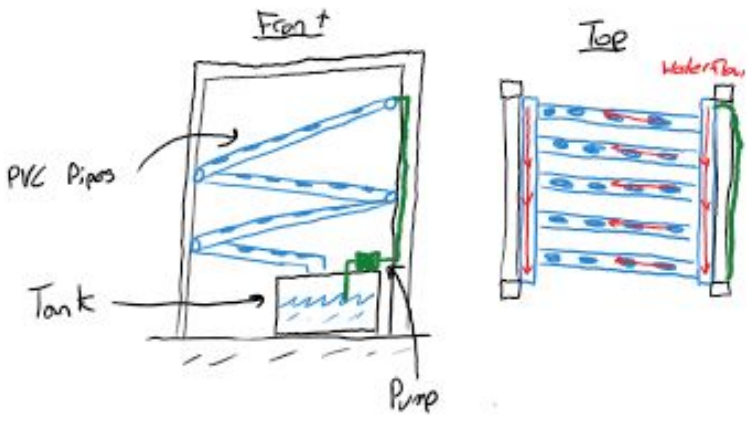
Gabe's Designs:

This execution of the nutrient film technique (NFT) involves the use of 2 sawhorse-like structures, with PVC piping sloping down and around both sawhorses. The advantage of this system is the minimal use and ability to reuse all water. On the other hand, due to minimal spacing available for piping on the sawhorses, the number of plant slots is quite limited. A pump in the water tank pumps the nutrient enriched water up to the top opening, and the water then flows down the gently sloped pipes back into the tank.

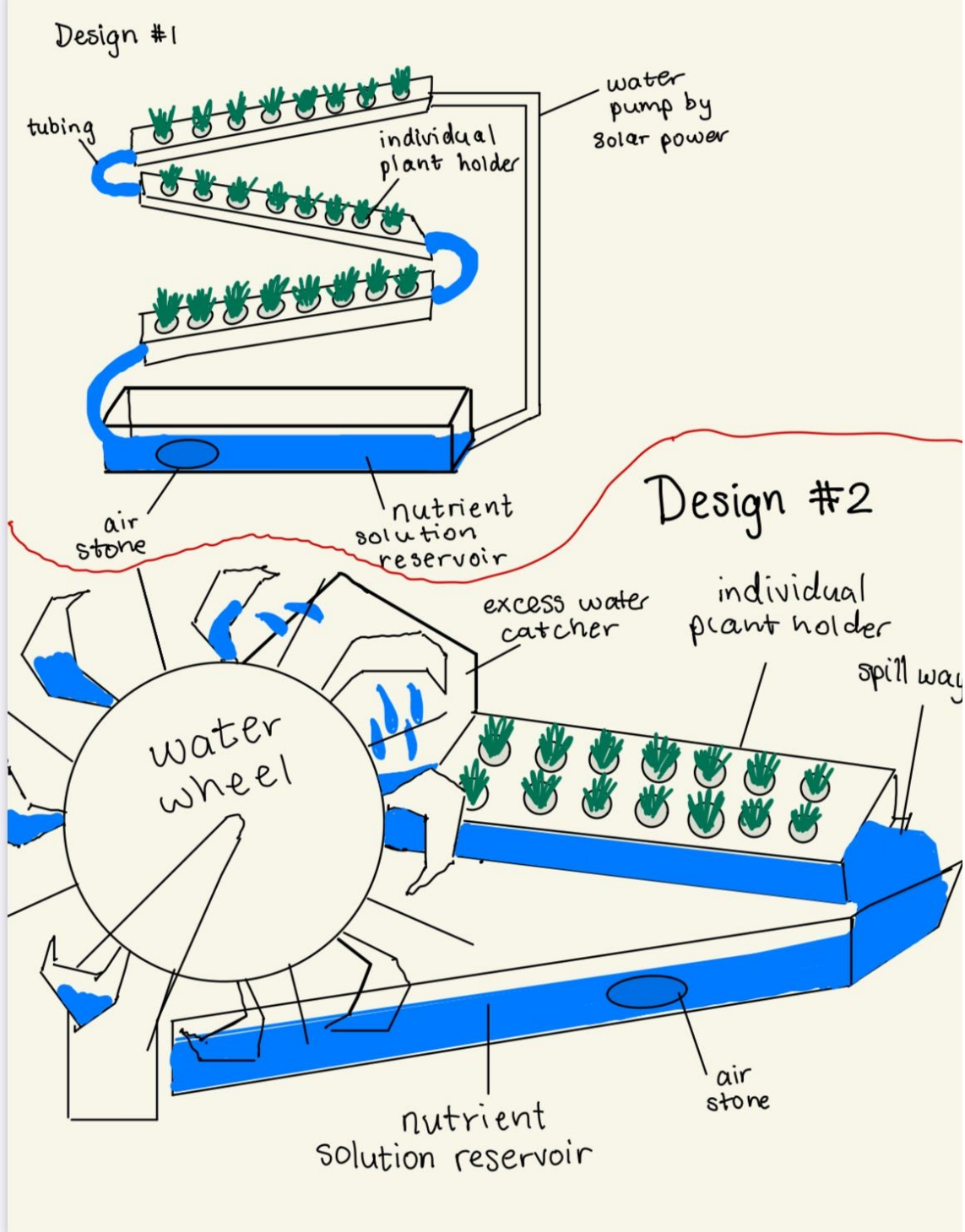


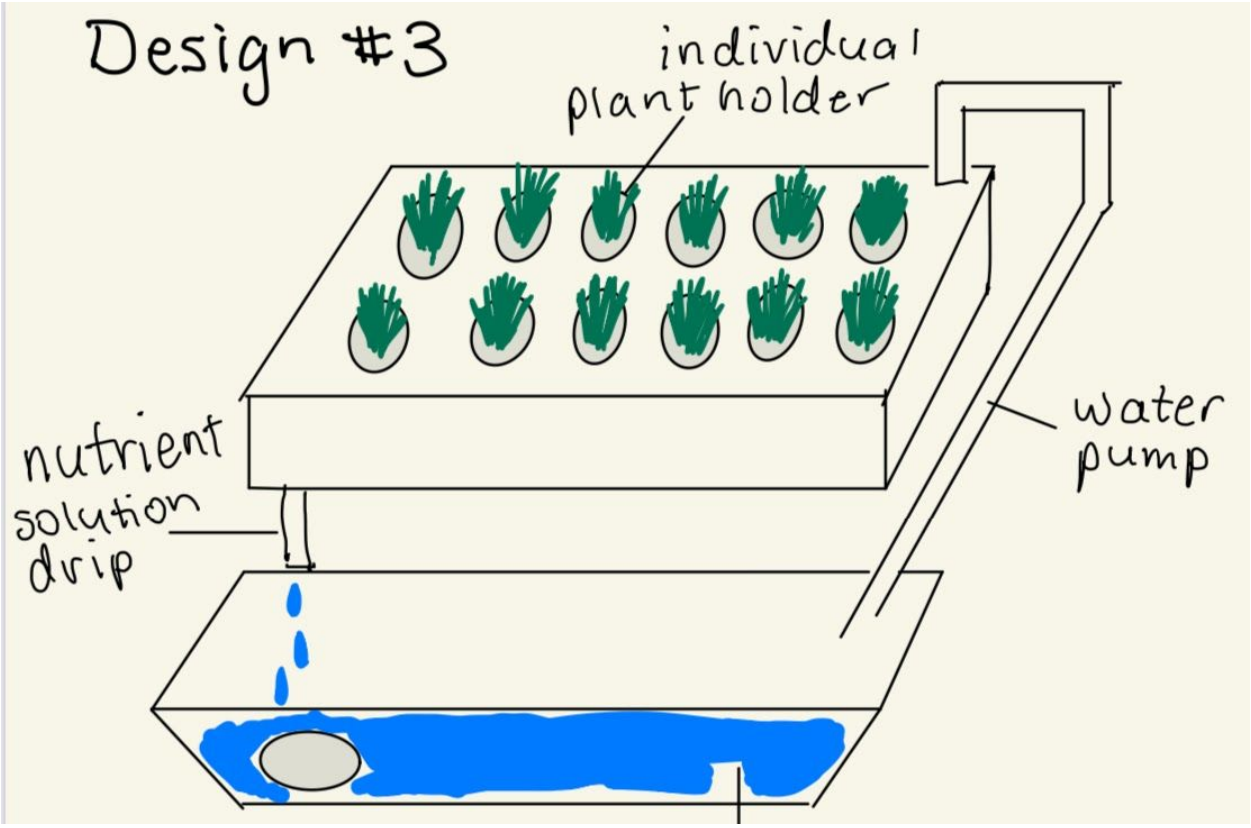
In this model of the NFT system, nutrient water is pumped from a tank up to a gently downward sloped PVC pipe which then flows into another pipe of similar nature. The pipes form a zig zag pattern as shown in the diagram. The advantages of this system include both minimal water use, and the ability to reuse all water. In addition to this, less lumber and PVC piping is needed, keeping costs lower. In turn, this model has very limited plant slots making it less ideal for our client.

This third model of the NFT system is very similar to the previous model, but instead of one pipe per level, multiple pipes are fed nutrient water on each level. This is accomplished through one perpendicular pipe running along the ends of each pipe in the level. The advantages to this system include the ability for all water to be reused, and the ability for a very large amount of plants to be planted. One major disadvantage is the large amount of water that would need to be pumped to feed the entire array of pipes.


Front
Top
Water flow
PVC Pipes
Tank
Pump

Alana’s Designs:

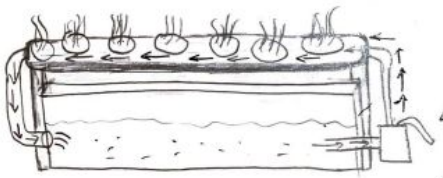



Design #3
individual plant holder
water pump
nutrient solution drip

Weeda's Designs:

Concept #1

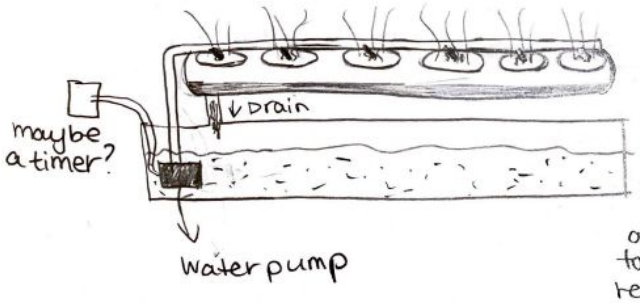
NFT



- water running through tubes on the sides
- A water reservoir that rests at the bottom and is full of the nutrients needed for the plants.
- A hand pump or maybe another type of pump is used to pump the water up into the pipe that holds the plants. The plants are placed in a pipe with holes, the bottom roots/stems of the plant in the pipe are touching the constant nutrient water solution passing by.
- The water is then re-entering the water reservoir from the other side, and the cycle continues.
- can create rows of plants and add more pipes connected to the water flow to grow even more plants.

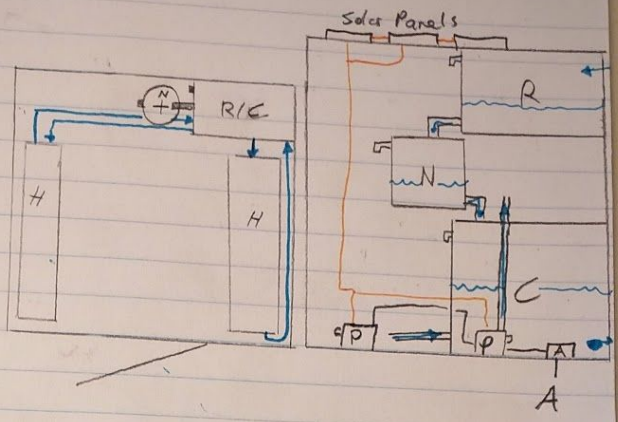
Concept 3

Drip System



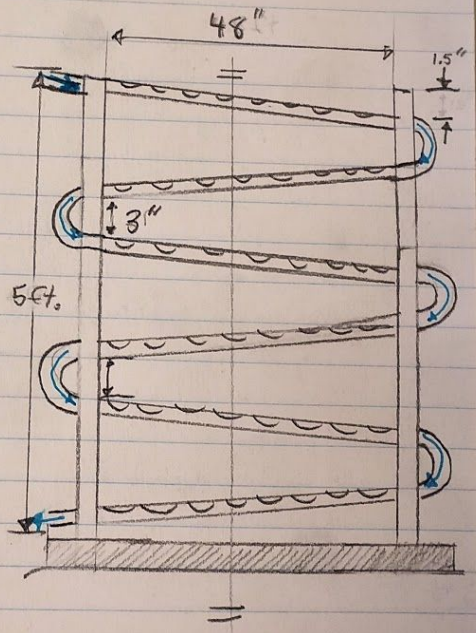
- a tube runs at the top of the pipe containing the plants and has a dripping spout at each plant
- the nutrient water solution is pumped using a water pump from its reservoir up to the plants and then drips into each one
- the pipe containing the plants and solution will then have another pipe working as a drain to avoid overflow → drain leads to reservoir
- may be a timer could be placed with the pump so that its pumping the solution at certain intervals...

#1



Notes:

- 2-module hydroponics system
- 'Nutrition' tank mixes water w/ compost to make nutrient solution
- 5-ft. height allows many plants
- 48" run on each module allows for many plants
- aeration achieved through use of a secondary pump and airstone(s)
- versatile build (NFT) allows for addition or reduction of modules, module height, run length, etc.
- Power achieved via solar panels
- water circulates through hydroponics system, reusing water



→ : Water Flow

→ : electricity flow

N : Nutrition Tank

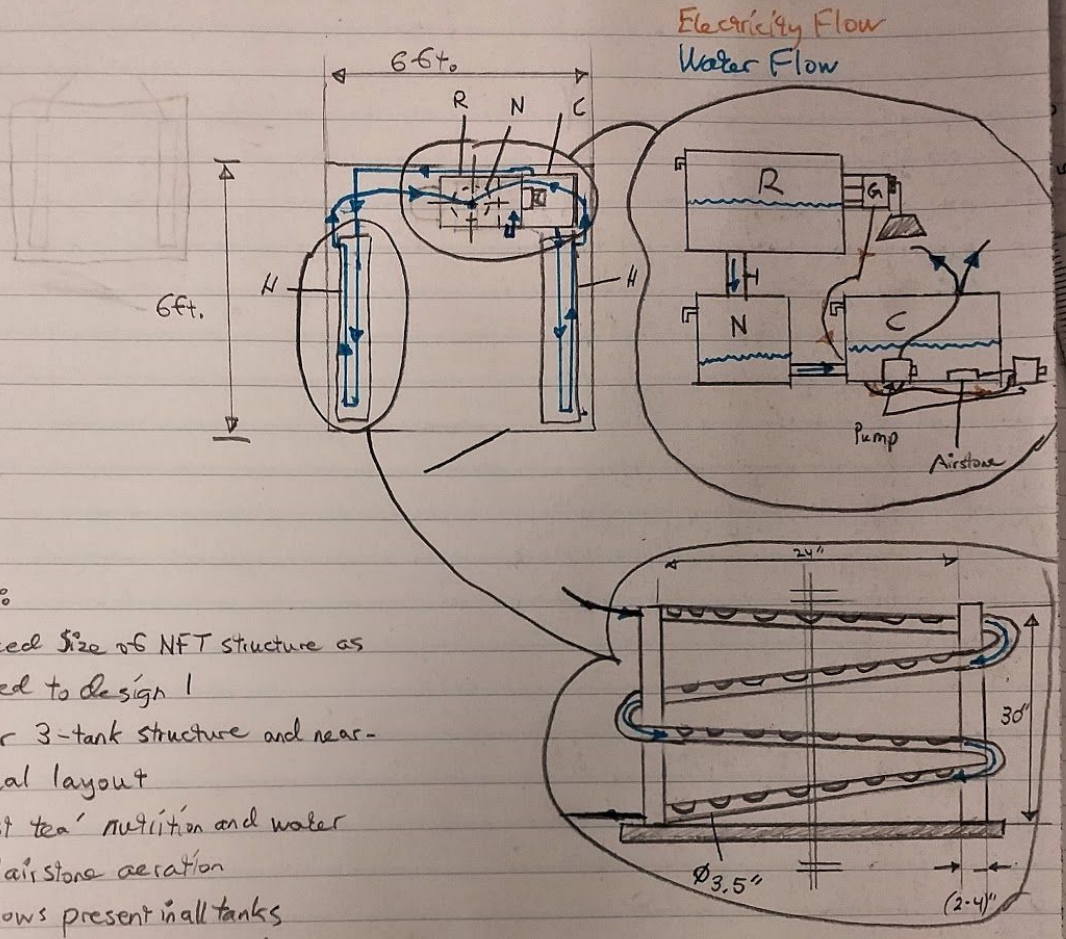
R : Rainfall tank

C : Circulation tank

P : Pump

A : Airstone

2.

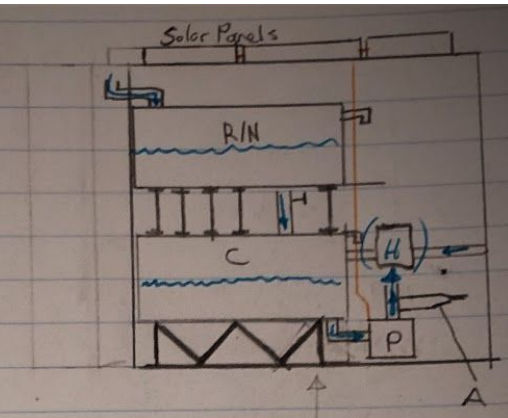


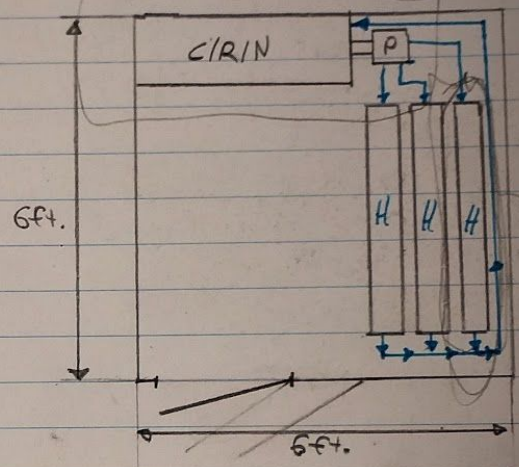
Notes:

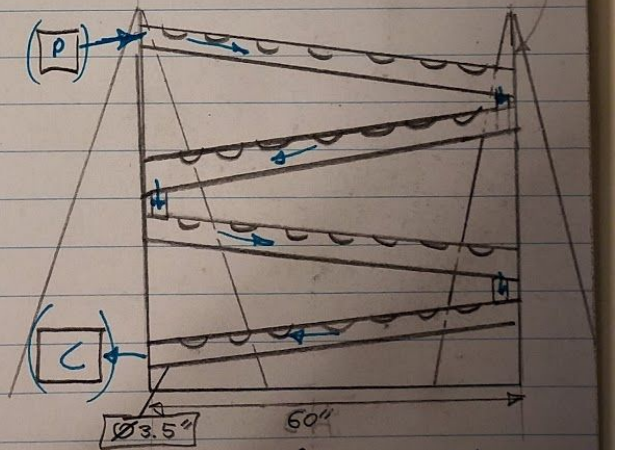
- Reduced size of NFT structure as compared to design 1
- similar 3-tank structure and near-identical layout
- 'compost tea' nutrition and water pump/airstone aeration
- over flows present in all tanks
- opaque tanks preserve solution + reduce growth of harmful bacteria
- powered via 'gravitylight' system
- 3.5" diameter PVC and 1" ID spaghetti piping

R - Rainfall Tank
N - Nutrition Tank
C - Circulation Tank
H - Hydroponics Structure
G - Gravity-Power System

#3.







Notes:

- Rainfall & ~~Circulation~~ Nutrient Tanks are combined; overflows
- Longer Hydroponics Structure
- Piping on Hydroponics Structure drops instead of wrapping around the supports
- Solar Powered
- Passive Aeration System attached to pump
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R/N - Rainfall & Nutrition Tank

C - Circulation Tank

P - Pump

H - Hydroponics Structure

A - Passive Aeration

Functional Designs:

The team voted on which designs they liked best and three final global conceptual designs were selected. These three are Joe's Design #1, Weeda's Gravity Design #2, and Gabe's Design #2. All three of these designs covered the client's needs and the set design criteria. All specifications for each of the three designs will be evaluated and benchmarked in order to select our final global design.

Benchmarking:

Specifications	Joe's Design 1	Weeda's Gravity Design 2	Gabe's Design 2
Cost ($CAD)	≈ $126.90	$195.99	$330
Weight (lbs)	≈ 28 lbs	≈ 33 lbs	≈ 25
Size (m)	1.5 x 1.2 x 0.25	6 x 6 x 4	1 x 0.5 x 1.2
Reservoir Size (liters)	≈ 18 L	≈ 20 L	≈ 19
Plant Slots	48	24	36
Style	NFT	Gravity fed	NFT
Modularity	Portable	No	Portable

Specifications	Importance	Joe's Design 1	Weeda's Gravity Design 2	Gabe's Design 2
Cost ($CAD)	4	3	2	1
Weight (lbs)	2	2	1	3
Size (m)	2	3	1	3
Reservoir Size (liters)	5	2	3	2

Plant Slots	5	3	1	2
Style	3	3	3	3
Modularity	4	3	1	3
Total		68	45	57

Conclusion:

The global design we have chosen based on the selection matrices is Joe's Design #1. The design elements that are of most value are the uses of compost for nutrient solution, it being the least costly, having the capacity to carry more plants, and a capability to insert more plant tubes. In addition to this, the 3-tank structure allows for both the use of rainwater collection and the ability to re-use all nutrient enriched water. The system is powered by solar panels which are functional to two water pumps and an airstone.