# GNG1103 - Deliverable C - Design Criteria

Team: D1 - Hydroponics 1

The Barriere Lake community has expressed their needs for a self sufficient year-round farming solution. Based on the needs of the client, a set of design criteria must be developed. The design criteria will help to select possible solutions and will give a set of benchmarks that the team will need in the selection for a suitable system. By examining, benchmarking and ranking solutions, we can begin to test what the market has available and set goals for ourselves to accomplish.

The current hydroponic solutions available that meet an abundance of the requirements are listed below in the benchmarking table. Based on the values we assigned to the different criteria, the nutrient film technique appeared to be the best option, this is due to its low cost and solutions to lack of soil and self-sufficiency.

## 2.0 Translating Needs into Design Criteria:

| # | Need | Design Criteria |
|---|---|---|
| **1** | Climate Control | Temperature (C) |
| **2** | Cost Efficient | Cost ($) |
| **3** | Self-contained | Solar Power (Watts) |
| **4** | Modular | Weight (lbs) |
| **5** | Water Supply | Volume (liters)<br>Rainwater storage tank (liters) |
| **6** | Easy to use | Simple to maintain and use |

## 2.1 Benchmarking Data:

| Specifications | Hydroponic Site Grow Kit Garden Vegetable Planting System Kit (6-pipe 3-layer) | Viagrow (Deep Water Culture) | AeroGarden Farm Plus Hydroponic Garden |
|---|---|---|---|
| **Cost ($CAD)** | $129 | $281.59 | $899.95 |
| **Weight (lbs)** | 7.7 kg | 20.5 kg | 21.6 kg |
| **Size (m)** | 100 cm x 50 cm x 100 cm | 30.5 x 30.5 x 38.1 (cm) | 91.4 x 30.5 x 86.4 cm |
| **Reservoir Size (liters)** | 15-20 L | 144 L | N/A |
| **Plant Slots** | 54 | 8 | 24 |
| **Style** | Nutrient Film Technique | Deep water culture | Aeroponic |
| **Modularity** | Very portable | Very portable | Not portable |

## 2.2 Target Specification Benchmarking:

| Specifications | Importance | Hydroponic Site Grow Kit Garden Vegetable Planting System Kit (6-pipe 3-layer) | Viagrow (Deep Water Culture) | AeroGarden Farm Plus Hydroponic Garden |
|---|---|---|---|---|
| **Cost ($ CAD)** | 4 | 3 | 2 | 1 |
| **Weight (lbs)** | 2 | 3 | 1 | 3 |
| **Size (m)** | 2 | 1 | 3 | 1 |

| | | | | |
|---|---|---|---|---|
| **Reservoir Size (liters)** | 5 | 3 | 1 | |
| **Plant Slots** | 5 | 3 | 1 | 2 |
| **Style** | 3 | 3 | 2 | 2 |
| **Modularity** | 4 | 3 | 3 | 1 |
| **Total** | | 71 | 44 | |

## 2.3 Engineering Design Specifications:

| **#** | **Design Specifications** | **Relation (=, < or >)** | **Value** | **Units** | **Verification Method** |
|---|---|---|---|---|---|
| | ***Functional Requirements*** | | | | |
| **1** | Reservoir | | | Liters | Test |
| **2** | Water | > | 20 | Liters | Rainwater harvesting |
| **3** | Climate Control | | 0 | C | Test |
| **4** | Power | > | | Watts | Solar Panels |
| **5** | Submersible fountain pump | = | yes | N/A | Test |
| **6** | Channel for plants to grow | = | yes | N/A | Test |
| **7** | Starter cubes/small baskets to start seedlings | = | yes | N/A | Test |
| **8** | Return System | = | yes | N/A | Test |
| | ***Constraints*** | | | | |
| **1** | Weight | > | | lbs | Analysis |

| | | | | | |
|---|---|---|---|---|---|
| **2** | Cost | < | 100 | $ | Budget |
| **3** | Size | = | 6x6 | m | Analysis |
| **4** | Weather | = | Year round | C | Analysis |
| **5** | Animals | = | Yes | N/A | Analysis |
| **6** | Electricity | = | No | Watts | Analysis |
| **7** | Clean water | = | No | Liters | Analysis |
| | ***Non-Functional Requirements*** | | | | |
| **1** | Easy to use | = | yes | N/A | Analysis |
| **2** | Variety of plants | = | yes | N/A | Test |
| **3** | Product life | > | 5 | Years | Test |
| **4** | Safety: Minimum Pinch Points | = | yes | N/A | Test |

## Functional Requirements:

1. Reservoir
2. Water
3. Climate/Animal Control
4. Power
5. Submersible fountain pump
   - Water wheel (spiral pump)
   - Hydraulic ram pump
6. Channel for plants to grow
7. Starter cubes/small baskets to start seedlings
8. Return system to lead nutrient solution back to reservoir

## Constraints:

1. Weight
2. Cost
3. Size
4. Weather

5. Animals
6. Electricity
7. Clean water

## Non-Functional Requirements:

1. Easy to use
2. Variety of plants
3. Product life
4. Safety: Minimal Pinch Points

## Conclusion:

In the end, it was decided that the preferred style of system was a nutrient film technique(NFT). This technique has many advantages over other systems, including its:

- High modularibility
- Ability to support many plants
- Simple design

In addition to these, NFT is also a very robust system. Unlike wick-based hydroponics and deep-water culture, NFT does not carry a high risk of either drowning or underwatering plants. And unlike drip systems, NFT systems operate on a mass scale, meaning that the user must only monitor 1 dataset regarding factors such as pH levels, mineral concentration, and flow rate. However, this system has some disadvantages, such as:

- Danger of pump failure

    Pump failure in NFT usually means a quick death of all plants in the system

- High Flow Rate

    NFT typically involves a constant flow of water, which must be accommodated for by the piping system

- High Power Usage

    NFT's high flow rate means that a lot of power must be used to pump the water continuously. In addition, a secondary pump must also be used to oxygenate the water. This is because the plants are not contained in soil, which typically provides them with dissolved oxygen.