

Rural Garden in a Food Desert

Innovative Farming Solutions

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BAEN 480 - Capstone Project



TEXAS A&M UNIVERSITY

Department of Biological and Agricultural Engineering

Introduction



South Texas Advancement Resource (STAR) presented us with a project to provide a design for vegetable production on a pilot plot of their 200-acre farm located on the East Slator Ranch.

The pilot plot is a 5-acre development on the farm designated to create a rural garden. The rural garden includes high tunnels and a 4.5-acre traditionally irrigated garden area.

The project consists of three main parts: crop selection, the design of an irrigation system, and the design of the garden layout.

Design Objectives

- ❖ Crop Selection: select suitable plants based on soil type and extreme weather conditions (semi-arid region), and create a rotation plan to take advantage of the growing seasons and maximize production.
- ❖ Garden Layout: consider wind and weather data to determine the best place to plant the crops, and incorporate the use of high tunnels.
- ❖ Irrigation System: create a system that maximizes efficiency and reduces evaporation and runoff.

Costs & Benefits

The project is feasible

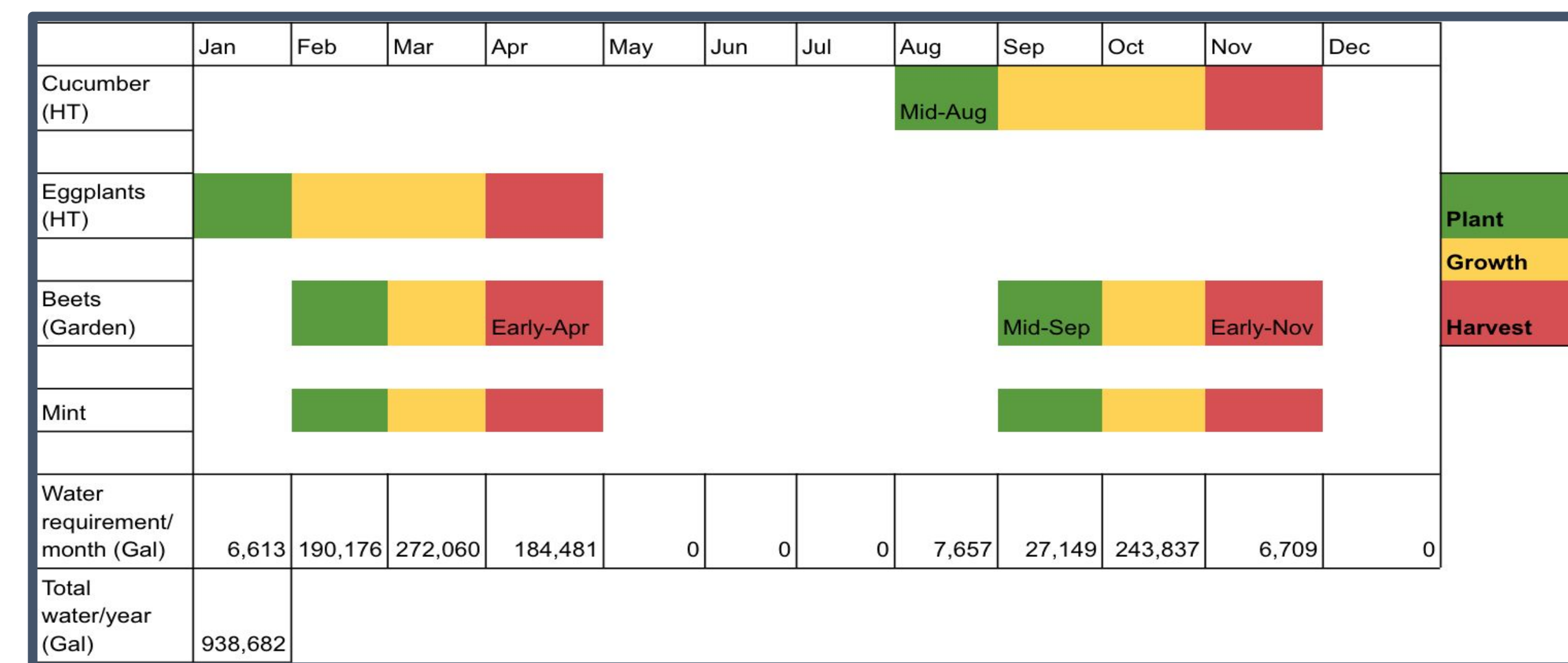
| Costs & Benefits | | | | | |
|-------------------|--------------|-----------------------------------|-------------|------------------|--------------|
| Section | Capital Cost | Operating, Fixed & Variable Costs | Total Costs | Possible Revenue | Balance |
| Crop Management | \$221.44 | \$11,290.00 | \$11,511.44 | \$224,981.15 | \$213,691.15 |
| Garden Layout | \$37,178.68 | \$0.00 | \$37,178.68 | \$21,935.00 | \$21,935.00 |
| Irrigation System | \$16,013.57 | \$29,480.00 | \$45,493.57 | \$0.00 | -\$29,480.00 |
| Total | \$53,413.69 | \$11,290.00 | \$94,183.69 | \$246,916.15 | \$152,732.46 |

Assuming 50% of the crops make it to the market with a 50% margin on price

Crop Selection

Beets - Mint - Eggplants - Cucumber

Selected based on chance of survival in the area's extreme weather conditions and soil type (USDA Hardiness Zone 9). Crop coefficients ≈ 1 to reduce evapotranspiration losses.



Crop Rotation Plan and Water Requirements

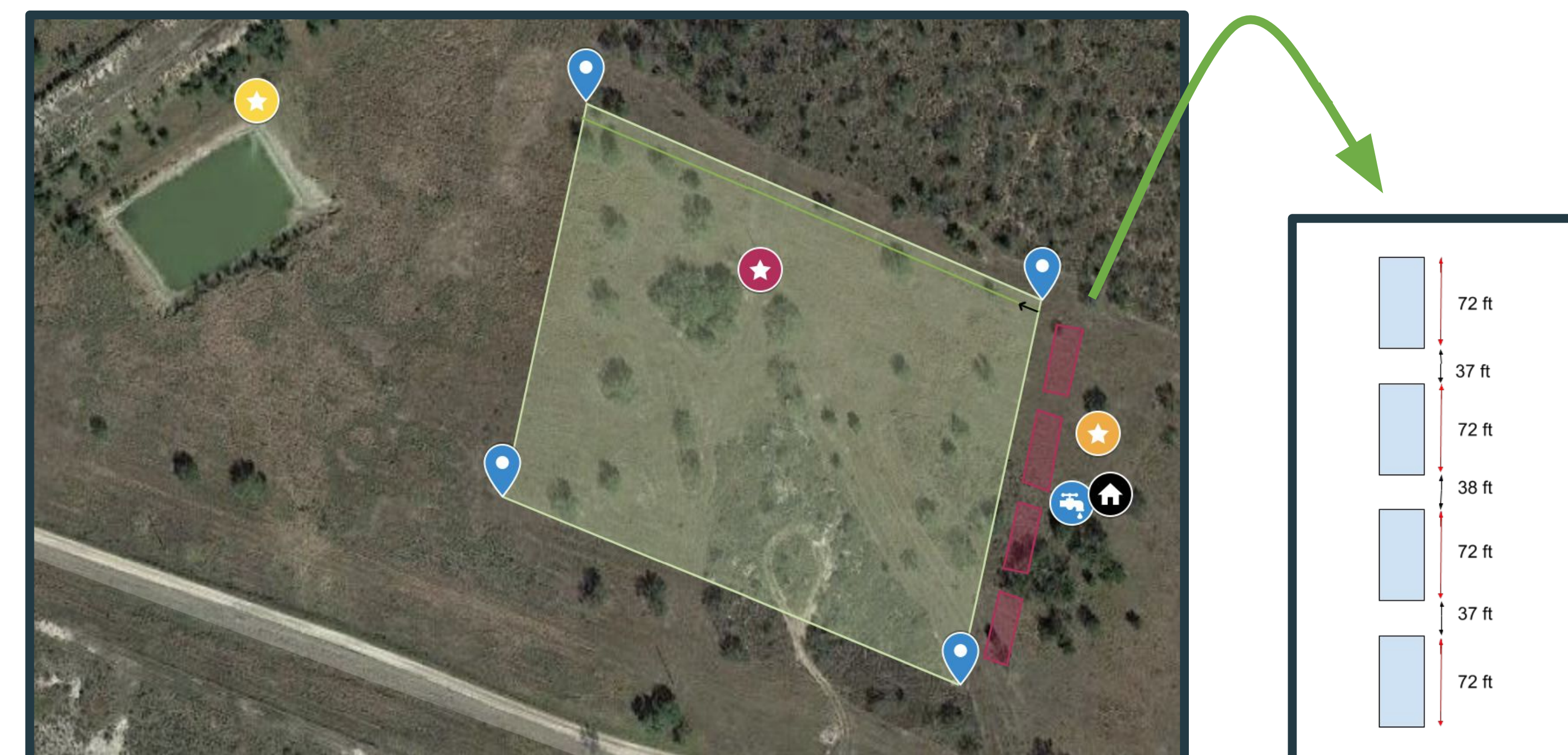
Garden Layout

High Tunnel Garden: (4) - 30 ft x 72 ft x 14 ft High Tunnels

Traditional Garden: 400 ft x 500 ft

The garden was divided in two sections: high tunnels that will house eggplants or cucumbers depending on the season, and a traditional garden of beets with a companion plant of mint. Companion planting is beneficial for pollinators, wildlife, soil health, and crop nutrition.

The high tunnels are positioned in a single-bay configuration upwind and perpendicular to the wind direction to reduce wind speed and protect the traditional garden from wind erosion up to 480 ft downwind.



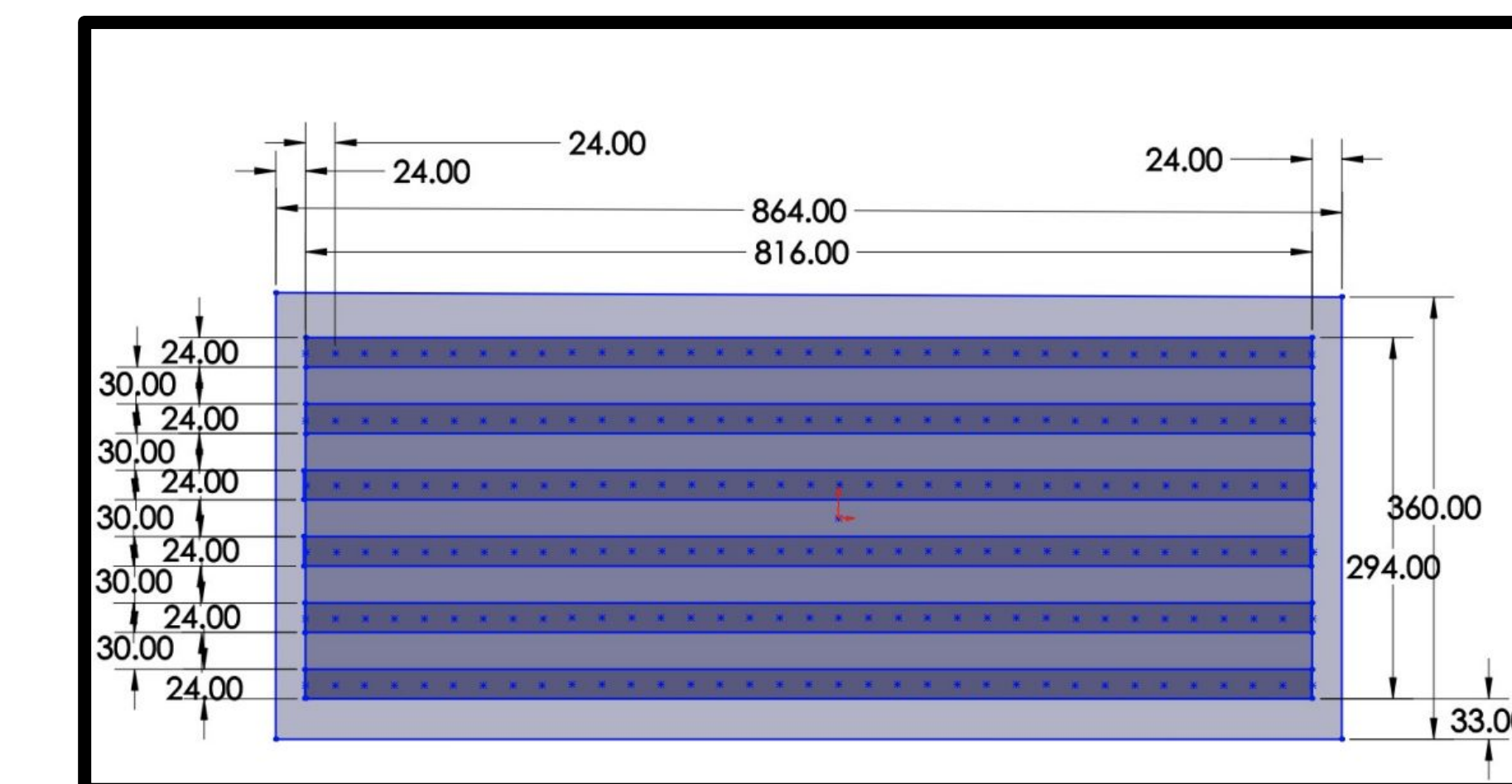
Project site: The large green rectangle is the traditional

garden, and the red squares are the high tunnel gardens.

Gardens Specifications

High Tunnel Garden

Produces 210 plants per high tunnel per season



- ❖ Row width: 24 in
- ❖ Space between rows: 30 in
- ❖ Plant spacing: 24 in
- ❖ 6 rows of main crop (eggplant or cucumber) per high tunnel

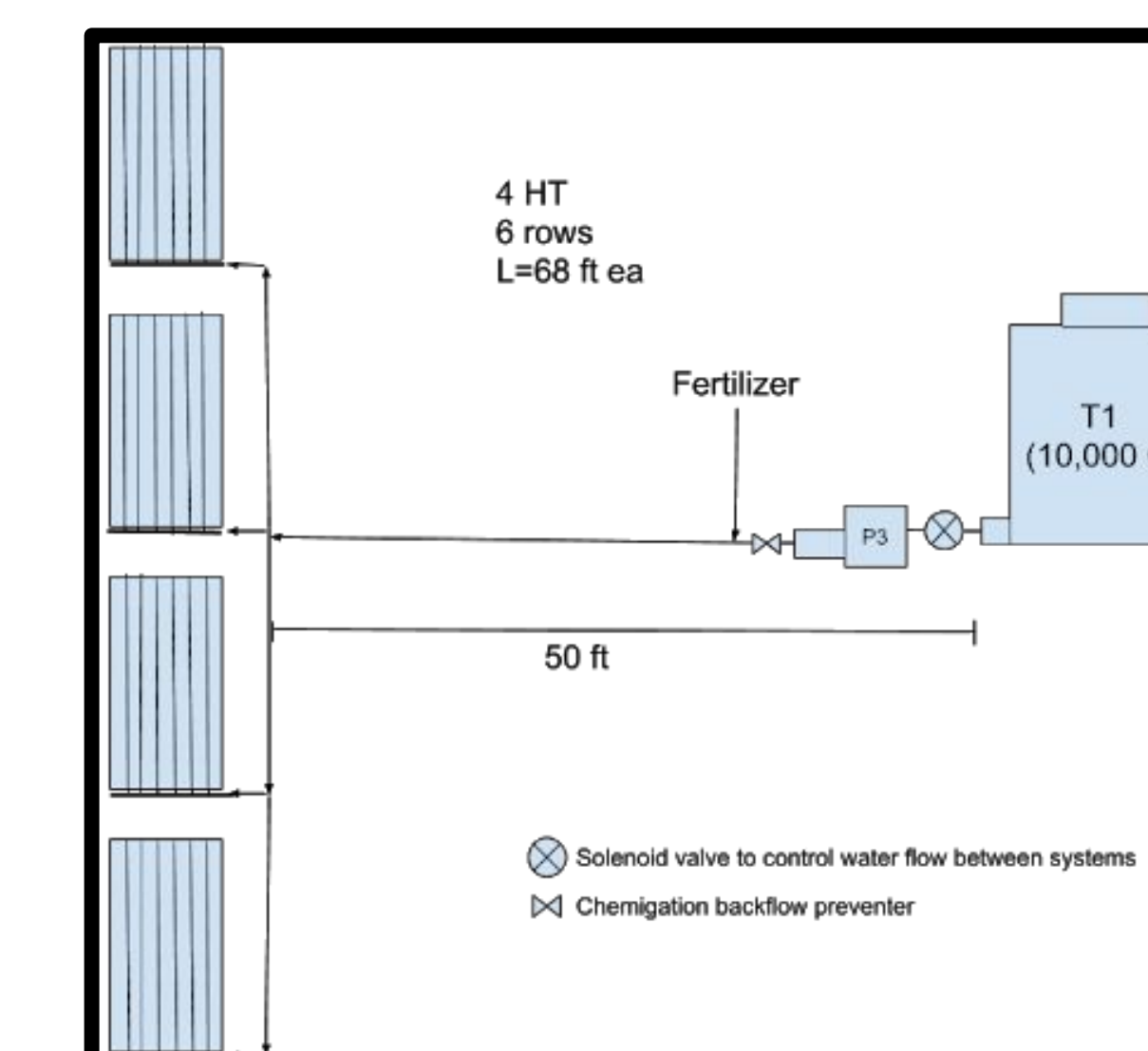
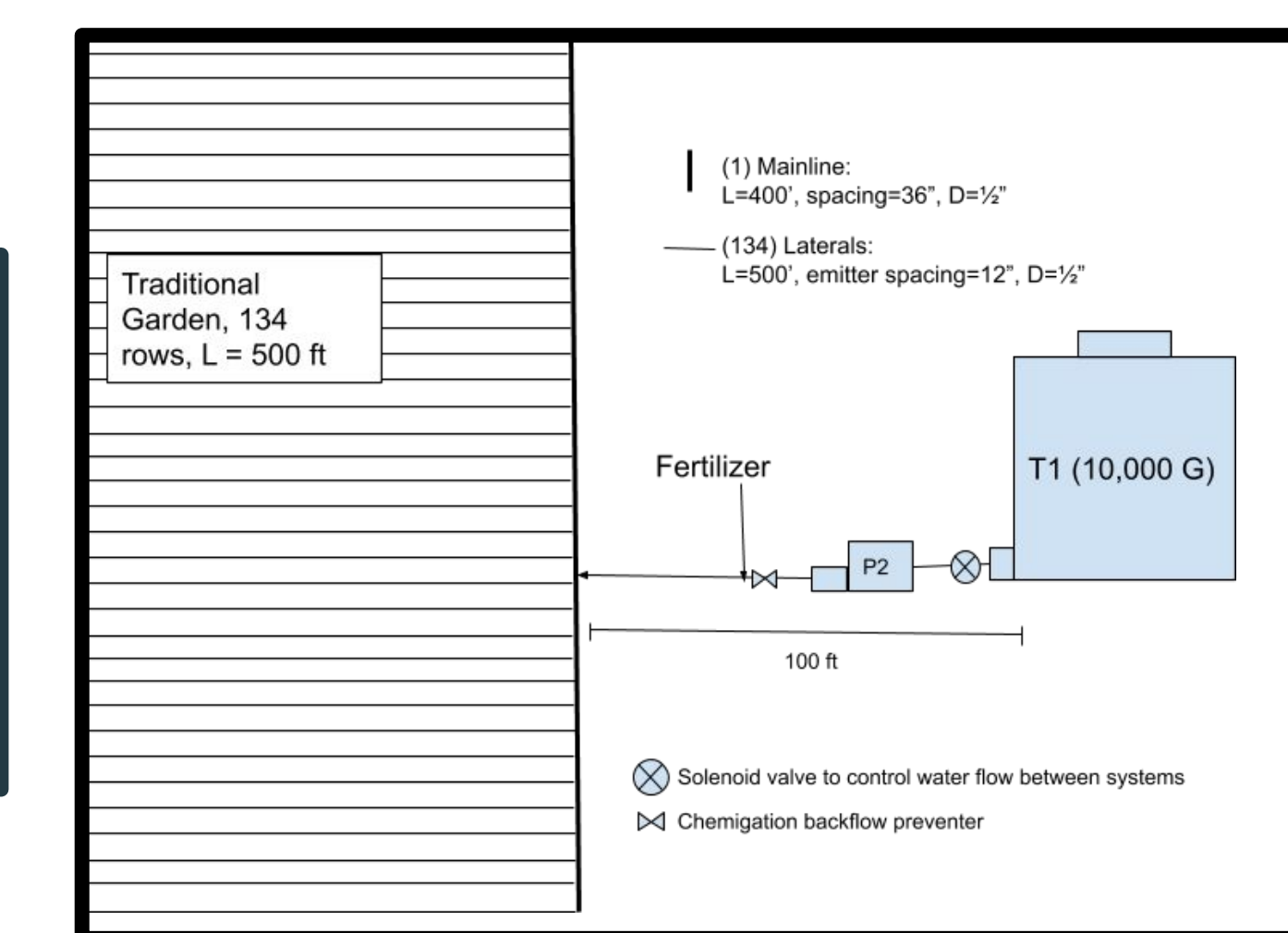
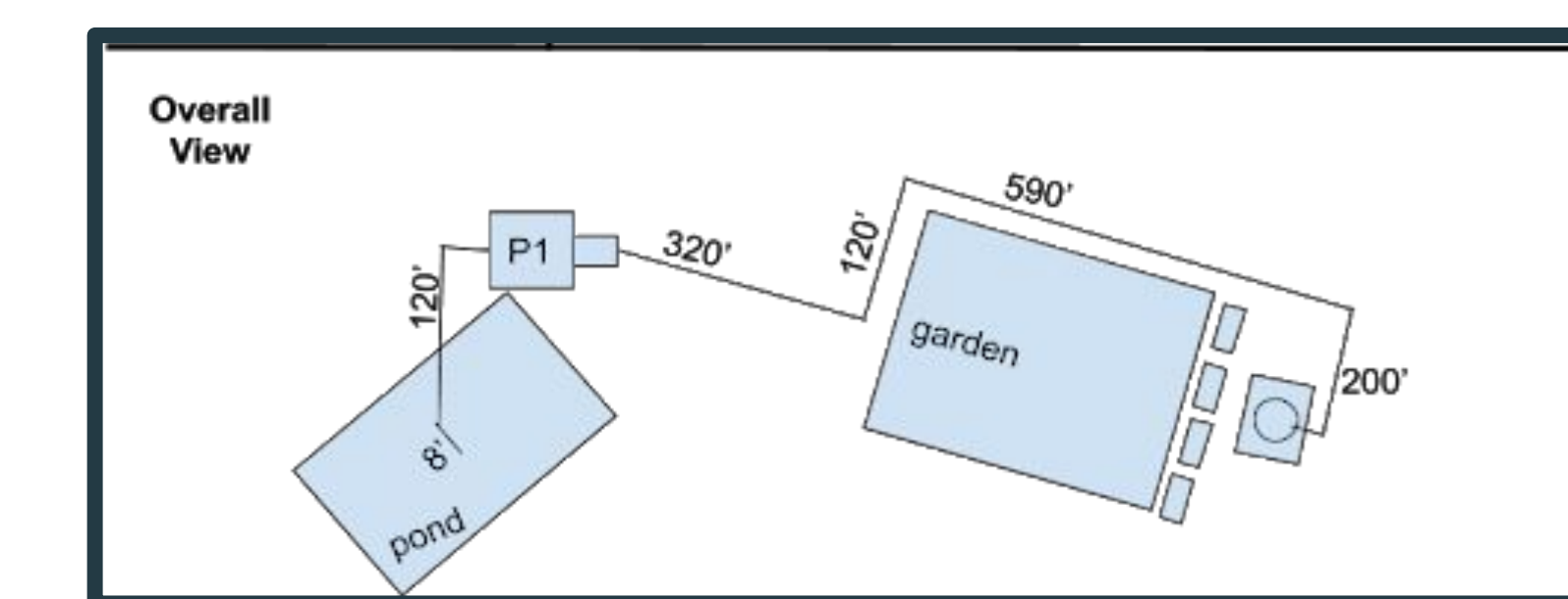
Traditional Garden

Produces 42,656 beets and 22,344 mint plants per season

- ❖ Row width: 1 ft
- ❖ 2:1 intercropping rate
- ❖ Space between rows: 2 ft
- ❖ 86 rows of beets total, 48 rows of mint total
- ❖ Plant spacing: 1 ft

Irrigation System

Drip Irrigation



- ❖ Drip irrigation selected to minimize evaporation and runoff
- ❖ Affordable & removable drip tape for design flexibility
- ❖ Smart control system to easily make changes to and monitor irrigation method
- ❖ Fertigation allows for precise control