ERGS 451- Seminar: Engineering & Society

Lower Hackett Farm Revitalization

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LAFAYETTE COLLEGE

EASTON GARDEN WORKS

Introduction

For the Fall 2021 semester, our group has been working in collaboration with Lower Hackett Farm (Hackett) to address a variety of issues identified by both our group and the director of Hackett, Miranda Wilcha. We consider an array of contexts surrounding Hackett, ranging from national scale issues like the growing local food movement to the hyper-specific conditions Hackett is operating under. From there, we devised four projects which we felt would have the greatest impact on the productivity of the farm and help Ms. Wilcha in her goal of creating a thriving community in Easton.

Background

For millennia, the growth and consumption of food has relied on the organized practice we call farming. This practice has evolved and been shaped by new environments, new social and political structures, and the exponential growth of our populations. For much of its history, farming, much like child-rearing or construction, took ‘a village’ in order to distribute food, seeds, and farming resources, and was practiced by the vast majority of a population which ensured the generally efficient and equitable distribution of these necessary resources. This can be seen by the fact that from Ancient Greece to the 19th century US, 80 – 90% of populations directly participated in agriculture (Waterhouse)(Migeotte, 2009).

It is only in the past century or so that our modern industrialized farming practices have consolidated food production and distribution into the hands of an ever-shrinking and aging labor force, aided by the growth of a mechanized one. This mechanization and

automation has eliminated the need for a direct labor investment from much of the population. Particularly in the US, this consolidation has manifested in an inequitable distribution of food resources as evidenced by the 39.5 million Americans who live in supermarket redlined zones, areas where affordable and/or fresh food are largely inaccessible (USDA, 2019). As well, supermarket redlining tends to target minority Americans who live in these areas at a rate nearly six times that of white Americans (Dutko et al., 2012). With many beginning to recognize the systemic nature of how distribution affects different populations, farming practices are evolving once again to better serve the people.

Modern farming practices are primarily evolving through the adoption of older farming techniques and an increase in communally owned and operated farms. One might call this 'evolution through reversion.' Farms using minimal or no-tillage methods have increased over eight percent since 2012 (Dobberstein, 2019). No-till practices tend to be used by smaller, newer farmers aiming to counteract the negative impacts modern farming practices have on soil and climate health. No-till practices work with natural systems by building the soil microbiology and maintaining its structure, both of which tillage actively destroys.

One of the most direct ways farming is evolving to better serve people is through the proliferation of community gardens. The number of community gardens in the US has grown nearly sixty-six percent since 2012 (TPL, 2018). Essentially, community gardens are communal spaces where food is grown and distributed by community members for community members. For community gardens, labor, rather than capital, is the primary resource (though capital certainly continues to play a major role). Capital in a community

garden context is necessary for acquiring an initial set of tools, the yearly purchasing of seeds, and other assorted expenses but it doesn't compare to the millions spent on chemical fertilizers, soil conditioners, fuel, and equipment maintenance that larger farms use (USDA, 2019). Community gardens directly combat the supermarket redlining problem as "they're a [direct] source of low-cost, healthy food in neighborhoods where grocery stores are too few and far between" (TPL, 2018).

Hackett Farm

Easton, PA, is a prime example of how community gardens are being used to resist supermarket redlining and inequitable food distribution. Easton is home to six community gardens dispersed throughout the city. Lower Hackett Farm specifically is the newest and the largest of the six, only having started significant development in 2019. Since it is the largest of the six community gardens, Hackett is where the city wants to spend the most time, money, and focus on optimizations. The farm is located on less than an acre of fenced-in plot about two miles away from the campus of Lafayette College. It is next to Fisk Field and located directly off of Wood Avenue. The aerial image from Google Earth of Lower Hackett Farm is shown below in Figure 1. Although the farm has grown and changed since this photo was taken, the perimeter of the farm is currently the same. The complete current layout of the farm will be shown as an AutoCAD drawing in Figure 3.

Fig 1. Lower Hackett Farm Aerial View

Image shows Lower Hackett Farm from an aerial perspective; with the road to the right. Inside, raised growing beds and in-ground beds take up most of the space. Though the picture is slightly outdated, most features remain the same. Source: Google Earth.

Fig 2. Map of Easton Community Gardens

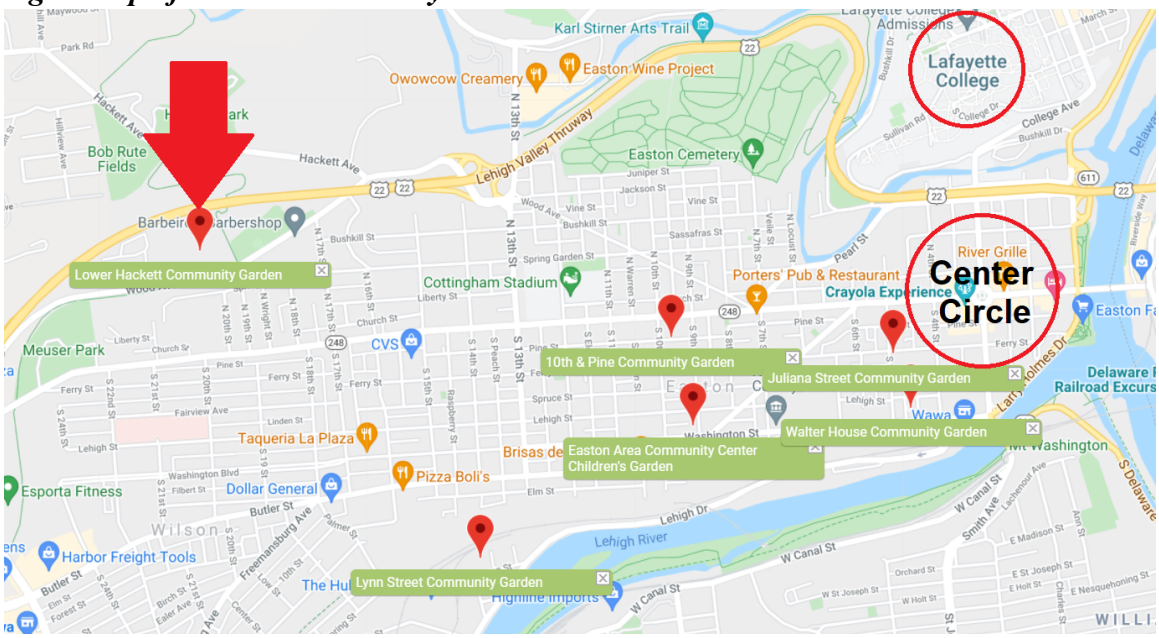


Figure shows the location of the six community gardens throughout Easton. Lower Hackett Farm is indicated by the red arrow, on the western side of Easton. Lafayette College and Center Circle are also circled in red for context. Map Source: West Ward Community Initiative.

Figure 2 is a map that highlights the location of Hackett Farm within the greater Easton Area, highlighting other reference points (in red) such as Lafayette College, Easton Center Circle, and the other community gardens. It is important to understand how the location of the farm, being both within the West Ward and it being on the edge of Easton, affects the accessibility of the space in order to fully understand the socio-technical system we're designing for. We must understand how its role as the hub farm shapes our socio-technical understanding of the Easton landscape in order to optimize the farm for it to have the greatest benefit to the community.

The overall goal of these community gardens and small urban farms is to "[provide] people with fresh fruits and vegetables", "[give] residents the opportunity to maintain their own plots of green space", and "[to foster] a community of individuals interested in sustainability and making Easton a greater city" (West Ward Community Initiative). Lower Hackett Farm is operated on land owned by the City of Easton but is managed by the Greater Easton Development Partnership (GEDP), which adopted all of Easton's community gardens in 2018. The Greater Easton Development Project is a volunteer-driven, non-profit entity focused on Easton's economic well-being, historical integrity, pragmatic development, vibrant culture, and urban hospitality. They developed Easton Garden Works as a branch of the GEDP that would manage and oversee all of the community gardens in Easton. Easton Garden Works uses these gardens to allow its residents to volunteer outside and enjoy communal green space.

After acquiring the fairly developed plot from the since-dissolved West Ward Neighborhood Partnership, the GEDP were limited in the changes they could make. In an effort to both maintain community-supported aspects and quickly expand and develop the

community garden initiative, the Lower Hackett project proceeded with the intention of immediate returns on production rather than planned longevity. Irrigation planning, plot sizing and positioning, supporting infrastructure installment, and mapping of the space were unable to be developed as might have been desired with a new, 'blank slate' piece of land. Even with the lack of upfront planning, the farm has been effective in its goal of getting a foothold in the community. Hackett has been a productive farm and community space for two years, but there are still numerous ways in which the farm can grow and be improved to greatly benefit the Easton community.

Miranda Wilcha, the Community Garden and Compost Coordinator for the GEDP and sole full-time employee of the community gardens, was our primary contact informing our knowledge of the farm and its services and voiced some of her primary concerns. Some of these concerns included the efficiency and longevity of the space given its size, labor force, and how a general lack of cohesion and planning in the space is stunting its potential growth and production. Due to a reliance on volunteer labor, Ms. Wilcha is often overwhelmed with the wide variety of tasks and responsibilities that operating a farm requires. As a solution, Ms. Wilcha and our group believe that the space needs a significant overhaul with a thoughtful layout to its infrastructure and daily operations to reduce the amount of time spent on any specific task or responsibility. We all agreed that the appropriate first step would be to generate a to-scale model of the space to analyze how the space currently fits together and use it as a canvas to propose an alternative model. We went to Hackett Farm with a measuring wheel and took note of the general dimensions of the main sections of the farm and converted these dimensions into the AutoCAD drawing seen below.

Fig 3. AutoCAD model of current farm layout

Area 1	In-Ground Beds
Area 2	Raised Beds
Area 3	Proposed Greenhouse Space
Area 4	Farm Storage and Cool Bot
Area 5	Wash Station and Spigot
Area 6	Beekeeping

Figure shows the current layout of Lower Hackett Farm, with the adjoining table detailing the use for various sections of the farm.

Proposed Projects

Through our discussions with Ms. Wilcha, our group is targeting four main projects in our effort to overhaul and revitalize the space. Our report will provide a framework for how each of the projects should proceed with supporting socio-technical research. The first point that Ms. Wilcha emphasized is the need to design an in-depth map plotting the various additions and modifications. Much of her funding comes from the City of Easton, and the more detail provided supporting the need and usefulness of any modifications increases not only the probability of receiving funding but the speed at which the project may get approved. We must make the case to Dave Hopkins, the City's Director of Public Works, that this project is worth funding and will be beneficial to the community. These plans could also be provided in grant proposals, one of the main ways the GEDP currently receives funding. Constructing a concise and in-depth plan is necessary for Ms. Wilcha to have a conceptual view of the whole farm and a definite

proposed idea of what the space will look like for the future. She said that this will be the most important aspect of our project because this is what will have the greatest material effect on the progression of the farm. The remaining four projects are what will be within the plan. They are as follows:

Redesign the vegetable wash station. When dealing with food, cleanliness and sanitation are of the utmost importance. There is currently a wash station that has done Ms. Wilcha well, but with the recent installation of a walk-in cooler on the premises which expands the kinds of crops which can be grown, there is a desire for a wash station to accommodate those new crops. This expansion would necessitate a high-pressure system as the primary washing source, and a soaking system for rinsing off various greens. This project was spearheaded by Konstantinos Voiklis.

Expand and rearrange bed space within the farm to optimize the efficiency and the crop yield of the farm. As of now, many of the raised beds are relics from before Ms. Wilcha was involved with the farm, and their footprint occupies an unusual amount of space. Here, we will design a more optimal orientation with two main considerations. First, Ms. Wilcha would like a driveway running the length of the farm, from the door to the back fence wall. As of now, several beds are in the way. Second, Ms. Wilcha wants to expand the number of raised beds to accommodate additional community members. Optimizing their spacing and positioning for ease of maneuverability within the space will be primarily how that's decided. This project was spearheaded by Steven Stillianos.

Improve and add to the irrigation system. There is currently one spigot, and everything is watered by hand. We are proposing to add another spigot so that members of the

community can use water for the community gardens without interfering with any of the attachments that others may be using. Also, this will make it easier to run drip tape to inground beds, saving lots of time wasted watering by hand and going to fill up the watering can every time that it runs out of water. This project was spearheaded by Casey McCollum.

Write-up of a final plan proposal. The final part of this project includes creating one final plan that is drawn to scale to maximize the usage of space and to make the farm operate more efficiently. These plans will also be drawn to scale to ensure that the dimensions of the different appliances and workspaces are accurate, which not only helps with this project but can be referenced for future projects to properly plan out spatially where new features may go. This plan will also make it easier to visualize the changes we are proposing (since we have made a scale model of the current layout of the farm) and make the proposal make more sense by presenting multiple changes at the same time, which makes it more cohesive. This project was spearheaded by Casey McCollum.

As engineers, when designing and implementing any project, a variety of factors and contexts have to be considered if the project is to have an efficient and effective implementation and a long and sustainable lifespan. In this project, the considered contexts can be broken up into three main groups: socio-political, technical, and economic. Because the socio-political contexts exist outside of the specific projects, it will get its own section addressing the farm at large. The technical and economic contexts will be within the specific project section, as each project has different constraints and requires a unique approach.

Socio-Political Contexts

Introduction

When looking at the contexts that have come to shape and define an institution, there are several orders of magnitude to consider, ranging from the hyper-local to the national. Hackett Farm is our focal point, but it exists within a larger network of trends in food sourcing and distribution, inequality, and agricultural legislation. As well, contexts can often be defined and contained in discrete categories, including social contexts, political contexts, geographical contexts, technical contexts, etc. However, one of the intentions of the Engineering Studies major is to not only be able to identify and define these discrete categories but understand how they overlap and work together. For this reason, this section is titled "Socio-Political Context" to more completely address the variety of contexts affecting Hackett Farm through an Engineering Studies lens.

On a national scale, we will look at how community gardens are able to combat supermarket redlining and food insecurity, the increasing public interest in locally sourced foods, and national food safety standards. On a state level, we will look at how community gardens are being supported and what that means for their future growth, and how the state control of water access dictates the options for improving Hackett's irrigation system. Finally, we will look at several local contexts specific to Hackett, including its storage and distribution system, how it collaborates with the five other community gardens, and what it means for an individual to run a community garden.

National Guidelines, Trends, and Supermarket Redlining

Supermarket redlining, also known as food apartheid or food deserts, is “a term used to describe a phenomenon when major chain supermarkets are disinclined to locate their stores in inner cities or low-income neighborhoods and usually pull their existing stores out and relocate them to suburbs” (Eisenhauer, 2001). Specifically, supermarket redlined zones (SRZs) tend to have a poverty rate greater than twenty percent and a third of the population must be living more than one mile from a grocery store. As of 2017, nearly 39.5 million Americans live in SRZs, up from 23.5 million in 2009 (USDA, 2009)(USDA, 2017). SRZs have severe negative effects on the health outcomes of the communities they encompass, manifesting as "increased risk for obesity and heart disease" (Lu, 2020). Because "community gardens provide a place where members of [a] community can have sustainable and reliable food sources and an immediate connection to their food", the number of community gardens has grown by sixty-six percent between 2012 and 2018 as communities attempt to address these problems (BCTV, 2020)(TPL, 2018).

The West Ward, one of the four neighborhoods Easton encompasses, is a supermarket redlined zone itself. Hackett Farm aims to alleviate local food insecurity through both the distribution of their fresh produce and the access they provide to their raised bed growing spaces. As SRZs tend to be poor areas and grocery stores have little incentive to develop a location, community gardens present a cheap alternative solution allowing for low-cost growth and distribution. Designing our projects such that Hackett

can operate at a low cost with minimal labor input is important to facilitating its growth and combating SRZs.

Under an even broader context, "the public's attention on food production has significantly shifted over the past 25 years," focusing more on "locally sourced and organic foods over those from factory farms" (Catlin and Sholtz, 2020). Catlin and Sholtz, two Lafayette Engineering Studies graduates, attribute this shift to a growing negative attitude to the traditional factory and industrial farming methods. This attribution is supported by the fact that a 2017 United States Department of Agriculture report on local agriculture found that "the number of farmer's markets has increased by 395%, from 1,755 to 8,700, over the past 25 years" (Ibid)(Woods et al., 2017).

This increase in broad support is incredibly important for Hackett. Hackett is intended to operate as a hub farm for all of the Easton Garden Works-operated community gardens. These gardens exist across the city of Easton, not just in the West Ward neighborhood, meaning a wide array of communities encompassing a variety of socio-economic statuses are being served by these gardens. Understanding that this means the community gardens will likely see some degree of increased interest and involvement is an important context for why continuing to develop Hackett is important for the Easton community at large.

The passage of the Food Safety Modernization Act (FSMA) in 2011 was an effort by Congress to "ensure the U.S. food supply is safe by shifting the focus to preventing contamination of the food supply, rather than responding to it" (FDA, 2021). This is done through a variety of new requirements, including "a written food safety plan, hazard

analysis, preventive controls, monitoring, corrective actions and corrections, verification, supply-chain program, recall plan, and associated records" (Safe Food Alliance). These regulations apply to all "domestic and foreign food facilities that are required to register with" the Food and Drug Administration, or the FDA (FDA, 2020).

While Hackett is a community garden and is exempt from direct enforcement of the FSMA, it would be in their best interest to follow many of these guidelines to keep the community safe. Given the goal of these guidelines is to prevent food contamination, designing with food safety in mind is paramount to protecting the Easton community. This is particularly important to the wash station modifications which directly deal with food contamination. Because Ms. Wilcha hopes to expand the variety of vegetables being grown, ensuring that each of them can be cleaned appropriately will dictate the kinds of modifications made.

State Support and Bureaucracy

As noted above, there has been a growing trend across the United States of cities adopting community gardens (sixty-six percent growth in six years). Specifically in Pennsylvania, the passing of the Plan For Pennsylvania in 2019 provided funding for twenty-eight urban farms and community gardens across the state (BCTV, 2020). As well, Pennsylvania Agriculture Secretary Russell Redding expressed his appreciation for community gardens saying that they play an important role in Pennsylvania's food system and that they "feed communities in need, breaking down walls that block opportunity and bringing communities together" (ibid). This wholehearted support for the kind of work the GEDP is undertaking helps inform us that the farm will likely be of great importance

in five or ten years, and designing with that in mind will help us to create and implement sustainable solutions.

Hackett, and all the GEDP operated community gardens for that matter, use city water, which is provided by the Easton Suburban Water Authority (ESWA) and regulated by the Pennsylvania State Department of Environmental Protection. The water source for the City of Easton and surrounding service areas is the Delaware River (ESWA). From the river, the water is processed for contaminants at the Easton Water Treatment Plant and is then piped directly to Hackett Farm or stored in holding tanks located nearby. Because the farm is using piped city water rather than an on-site well, the ESWA must do any maintenance or make any modifications to the irrigation infrastructure. Because there are a variety of both state and local regulations that must be navigated in terms of how and when these pipes can be accessed, who can do maintenance to these pipes, and a number of different water quality standards, making sure that any of our desired irrigation modifications are fully compliant is an important step in providing appropriate recommendations.

Hackett Specific

Although Hackett is where the vegetables are grown, it is not where they're distributed. This is left to the Vegetables in the Community program (ViC) . ViC is a program started by Lafayette College where “students and faculty work cooperatively with neighborhood residents to deliver the produce, advertise, share food knowledge, collect and distribute recipes, and cook samples” (Lafayette College, 2019). Understanding the relationship Hackett has with Lafayette and the way our project is a

continuation of that relationship is important for Hackett's maintenance and growth. Specifically for the wash station, it informs some of our location and orientation choices, as they will dictate how quickly food is able to be stored and remain the freshest for its future distribution.

As has been mentioned, Hackett is one of the six community gardens that Ms. Wilcha manages. Hackett is the largest of them and the goal is for it to act as a hub where the other gardens are able to get their seedlings in the spring and drop their harvests off throughout the growing season. This is an important context for understanding why Hackett's efficiency and development are paramount for Ms. Wilcha and her goal of expanding the reach of all the gardens. It also informs our project designs in terms of the spacing and freedom of movement necessary for Hackett to efficiently act as a hub. The combination of limited space and high maneuverability dictates how a project like the bed rearrangement should be approached.

Because Hackett is the largest community garden, it is often host to a variety of social events which contribute to the social cohesion of the neighborhood. In this past fall 2021 season, events like a bonfire with food and drink and a pumpkin carving event find a home at Hackett. Understanding that this space will not only be a home to vegetables but to people as well must inform our design philosophy. Safe and attractive designs are best when accounting for socialization.

Hackett is an almost entirely volunteer-run operation (Easton Garden Works). This must inform how the space is designed in terms of ease of use for people of a variety of backgrounds to be able to quickly and easily get involved. There will certainly be a

select group who are more involved than others and learn to manage the space in a particular way. However, the design of the space must have obvious components to allow any layperson to walk on the farm and contribute. Complex irrigation systems, confusing washing and storage protocols, and varied bed spacing or sizing may be better suited to a farm operated by an individual, but not to a volunteer program like at Hackett.

Given our project revolves around infrastructure renovation projects, the issue of who finances those projects is relevant to shaping the scale of projects we can tackle, what materials we can use, and how those projects are approached. Hackett is owned the GEDP, an organization operating under the City of Easton, meaning it is publicly funded and relies on a yearly budget for all expenses. Ms. Wilcha has detailed to us that this budget is highly flexible based on her needs in a given year and on community involvement in the farm's offerings. As well, because the irrigation on the farm, likely the most costly of our recommendations, is also controlled by the city, it's likely that Easton can offer direct funding for that specific project rather than it being taken out of Hackett's general budget. For the projects or project components Easton won't be able to directly cover but that are still too costly given any budget limitations, grant funding is another good option. A variety of non-profits including the American Public Gardens Association detail stipends to community gardens wanting to complete certain projects with funding ranging from $4,000 all the way to $20,000 (American Public Gardens Association). With these funding options in mind, we can better plan our projects to take advantage of the various funding avenues.

Finally, farm layout, infrastructure, and systems tend to be highly individualized and personal to the individuals involved. Although much of the labor at Hackett comes from volunteers who must be accounted for when designing, the space is ultimately Ms. Wilchas, or whomever else may one day run the farm. It is paramount that the space functions such that she is able to get the most out of it. Not only does this mean our initial design suggestions must consider her specific desires and workflow needs, but that the space should ultimately be flexible and moveable so that personalized adjustments can be made as necessary. This will manifest in modular systems which can easily be moved around or switched out. Ultimately, both flexibility and precision are important principles for us to follow, though flexibility overtakes precision as a guiding ethos in our design recommendations.

Wash Station

Overview

Our first project was the washing station. This space will be used to clean a wide variety of vegetables and pack them for either storage or distribution.

Fig 4. Current Wash Station

Image shows the current washing station at Hacket, with a section for packing and drying next to the sinks and spigot. Image taken by Konstantinos Voiklis.

Fig 5. Footprint of Current Wash Station

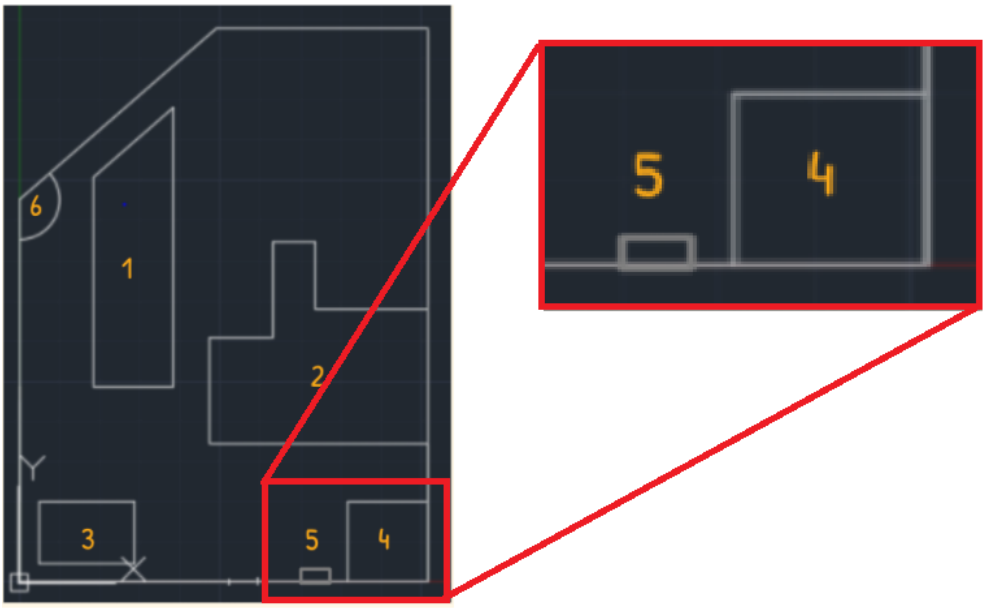


Image shows the location and footprint of the current wash station (labeled 5) next to the larger storage area (labeled 4) within Lower Hackett Farm on the lower right corner of the property.

Above is a picture of the current wash station and storage area. It's currently placed approximately sixteen feet to the right of the entrance and eight feet left from the coolbot. It occupies a ten-foot by four-foot footprint. From right to left, there is the loading zone directly next to the table where freshly picked vegetables are dropped off, the washing tank where the vegetables are individually cleaned, the drying rack where the wet vegetables are able to drip dry sitting on a wire table, and the packing station where the vegetables are loaded into storage bins. From there, they move into the coolbot to be stored until distribution.

Ms. Wilcha expressed two primary technical desires for our update: that the station repurposes components of the existing wash station, and that the new wash station should occupy a similar footprint to the existing one. In addition, due to the variety of vegetables grown, the wash station needed to accommodate the variety of ways different vegetables will need to be washed. Because of the nature of small community gardens, the solution needed to require relatively low-tech solutions.

With these primary constraints in mind, research as to the most effective solution began. Penn State states that the primary intentions of an effective wash station are to reduce the chances of foodborne illnesses harming a consumer or bacteria spoiling food, resulting in waste (Gorgo-Gourovitch et al., 2021). The University of Arizona outlines the best way to achieve these goals is by “using vigorous [washing] methods without brushes,” as they increase the chances of blights and bacterias being transferred from one infected vegetable to another (Mpanga et al., 2020). There are a number of ways of producing vigor when washing, and with the need to accommodate a variety of vegetables, a couple of different methods would need to be utilized. Generally speaking,

there are two broad washing categories which vegetables can be classified into: scrub vegetables and soak vegetables. Scrub vegetables include all root vegetables like carrots, radishes, beets, and scallions, but also vegetables like tomatoes, peppers, and cucumbers which are cleaned more effectively via scrubbing rather than soaking. Soak vegetables on the other hand consist of loose-leaf greens like lettuce, kale, and chard. These vegetables are “grown close to the ground [and are exposed to] a variety of systems,” meaning they have a high risk of contamination (Chamberlin, 2021). Root vegetables with caked-on soil require high-pressure agitation while leaf vegetables require a gentler, less targeted cleanse. To this end, two primary systems are necessary.

This proposed system is easily transferable to Hackett's current setup. The scrub station can be mounted on the post sitting directly behind the current sink, providing a place for the water to drain. The soak station is small enough that it can fit to the right of the current table in front of where the hose is wrapped. It avoids being in the way of the hose as when not in use, it can easily be broken down into its primary components and be stored underneath the table. As desired by Ms. Wilcha, the vast majority of the current station is maintained. The untouched table sections serve the drying and packing needs very well, and modifications to those systems aren't needed.

Scrub Station

Technical Breakdown

The scrub station is composed of a variety of cheap and accessible hardware components. The design takes direct inspiration from longtime farmer Jesse Frost of Rough Draft Farm. Despite its name, there is no physical scrubbing occurring. Rather, the design consists of a wide-angle spray nozzle that produces a cascade which "scrubs" the vegetables with high-pressure water. The water is controlled via a foot pedal, allowing one's hands to remain free for vegetable handling. The nozzle provides a powerful directed spray capable of cleaning a wide variety of root vegetables very quickly. In all, the design consists of seven individual components, the vast majority of which are converting the hose threading to a pipe threading and directing the spray downward, perpendicular to the washing surface. This design was chosen for its simplicity and for its ease of implementation in the current system. This design calls for a grated table (table with holes), allowing one to rest the vegetables on the surface while allowing the water to escape without running across the other vegetables. The current wash station already has such a surface, and the nozzle can be mounted as needed, making it a simple yet effective solution.

Starting from the bottom of the structure and moving up, the scrub station consists of a foot-powered water valve with a ½" pipe threaded (NPT) inlets and outlets. In order to accommodate the standard ¾" hose threads (GHT, as compared to NPT), a ½" female NPT to ¾" female GHT is necessary. In order to move the water upwards to the nozzle, Hackett will need a length of cross-linked polyethylene (PEX), a high-strength tubing solution, connected via ½" female NPT to ¾" male PEX barb. As the water flows up approaching the nozzle, the PEX will be converted back into NPT via a ¾" male PEX barb to ½" female NPT 90° elbow. From there, the elbow leads out parallel to the ground

into ½" to ¼" male NPT Adapter, into a ¼" female NPT 90° elbow, and finally into the ¼" male NPT flat spray nozzle. A trade-off of opting for PEX is that it requires the use of clamps to ensure a water-tight seal and a specialty cutter to cut it to length. We believe this trade-off is justified by its durability. Ultimately, PEX can be substituted for ¾" irrigation tubing, but the adjoining fittings would need to be appropriately changed to suit the new tubing.

Fig 6a. Nozzle Portion of Scrub Station

Image shows a hose connected to a high-pressure nozzle that is spraying the root ends of scallions. Image source: No-Till Growers.

Fig 6b. Pedal Portion of Scrub Station

Image shows the pedal of the scrub station which is pressed by the farmers foot to control the water flow to the nozzle. Images source: No-Till Growers.

Economic Breakdown

As mentioned, the scrub station is composed almost entirely of relatively common hardware store fittings. Upkeep costs are of little concern as the parts are durable, but also cheap in case of failure. So long as the system is partially disassembled to allow water to drain from the system so as to not crack pieces since water expands when frozen, it should be more than durable to survive freezing temperatures. Below is a table outlining the line-item costs. They are accurate as of publication and are sourced primarily from McMaster-Carr, with the foot pedal being from Amazon and the tubing and its fittings being from Home Depot.

Table 1. Scrub Station Pricing

Hardware	**Price (USD)**
Foot Pedal Water Valve	$23.59
¾" F GHT to ½" F NPT	$8.78
¾" PEX Barb to ½" F NPT	$2.72
5' length ¾" PEX Tubing	$3.77
¾" Pex Clamp (10 pack)	$6.98
PEX Tubing Cutter	$7.85
¾" PEX Barb to ½" F NPT 90 degree	$7.76
½" to ¼" M NPT	$5.60
¼" F NPT 90 degree	$4.32
¼" M NPT to Nozzle	$5.62
Total	**$76.99**

Prices sourced from The Home Depot, Amazon, and McMaster-Carr. Accurate as of December 16, 2021.

Soak Station

Technical Breakdown

The soak station, as mentioned, required a different approach to producing the agitation needed to effectively clean this different group of vegetables. A concept that has been popularized within the small-scale farming community is the 'greens bubbler'. An air pump blows air into the bottom of a tub of water, producing bubbles that provide a general agitation. With the number of leaves greens provide, washing them individually would take hours. Bubblers provide a way to wash large quantities of greens very quickly. Agricultural Engineering technician Andrew Chamberlin of UVM outlines the basic components and composition of greens bubblers in his article Building a Better Greens Bubbler. There he breaks down the three primary components of a greens bubbler: the tank, the air distribution system, and the air pump. The air distribution system is generally constructed out of PVC tubing with holes drilled throughout its length, forming bubbles when air is passed through it while submerged, meaning the system is highly customizable to suit the size of the container and volume of produce you are working with. Chamberlin also provides case studies from different farms, breaking down their exact systems and farmer feedback on how those systems have worked. We have based our design specifications largely on that feedback. The soak station will consist of fewer individual parts than the scrub station, consisting of a tub, PVC tubing, and an air pump. Given the feedback Chamberlin received, a 100-gallon stock tank is a widely available size that would be more than adequate to sustain a farm of Hackett's size and output. To pump the air, a variety of blowers exist in the 1 horsepower, 120-volt

range, typical for a 100-gallon tank. The PVC distribution system can be designed to suit the tank, but will generally consist of basic shapes such as lengths, elbows, splitters, and caps of PVC depending on the orientation. We are hesitant to provide detailed specifications as the availability of specific tanks and blowers can fluctuate. Below is a short video showing a bubbler washing lettuce mid-process. It's meant to demonstrate the kind of agitation the system produces.

(Notice: Video has sound and may play loudly if volume is on.)

https://sites.lafayette.edu/egrs451-fa21/files/2021/12/IMG_9352.MOV.mp4?_=1

Video 1. Soak Station in Action

Video shows lettuce mix being washed in a similar soak station at Chanticleer Acres in Litchfield, CT. Video taken by Konstantinos Voiklis.

One necessary addition to the greens station which is more difficult to build is the spinner, which dries the greens after bubbling using centrifugal force (much like a home-sized salad-spinner, but larger). As such, a spinner will need to be purchased as well. Johnny's Seeds, one of the largest US seed and farm equipment distributors, offers a variety of spinner sizes on its website. For Hackett's output, a 2.5 gallon spinner should be suitable. The list price is $161.00 (Johnny's Seeds, 2021).

Fig 7. Assorted Soak Station Designs

Images show three examples of soak stations that employ the air pump/PVC combination in a large tub. Images from SARE, Keith Wilkes, and UVM respectively.

Fig 8. Johnny's Seeds 2.5 Gal Spinner

Image shows a greens spinner, with the outer spinning container next to the inner strainer container. Image from Johnny's Seeds.

The specific placement of the soak station and its accessories, although desired to remain in relatively the same place, is flexible to an extent. Wash stations require good drainage of the wastewater or you risk creating a patch of mud under your workplace, increasing both the mess of already dirty farm equipment and the chance of food contamination. The area surrounding the wash pack and adjoining storage is all covered in a substantial layer of gravel, making the specific placement flexible. As it stands, from a workflow perspective, placing it in front of the hose to the right of the wash station's

table is optimal due to its relative position to the beds and storage locations. We felt it necessary to mention that, due to the highly personalized nature of different farming systems and individual practices, that the final positioning is flexible within certain floorplan bounds and workflow perspectives.

Economic Breakdown

The soak station has fewer total parts than the scrub station but ultimately has a higher startup cost. Because we aren't making a precise recommendation of the PVC air distribution system and PVC comes in standardized lengths and segments, we are providing cost estimates using an approximate total parts list which should provide plenty of flexibility in terms of the final construction. The PVC tubing and stock tank are both very durable and the need to replace a component within a five-year window is exceedingly unlikely. The blower on the other hand is an electrical component and is exposed to the elements, meaning the probability that it breaks is much higher than its plastic counterparts. Although it is waterproof, exposure to water in freezing temperatures or long-term exposure to temperature fluctuations will significantly decrease its lifespan. With proper care and storage, it should last three-plus years.

Hardware	**Price (USD)**
100 Gallon Stock Tank	$99.99
1 ½" by 10' PVC Tubing	$12.54
1 ½" PVC Tee	$3.31
1 ½" PVC Elbow (x4)	$9.12
1 HP 120 Volt Blower	$88.95
Total	**$201.37**

Table 2. Soak Station Pricing

Prices sourced from The Home Depot and Amazon. Accurate as of December 16, 2021.

The total cost of the wash station updates comes to $439.36. Given the typical community garden operates on a yearly budget of "between $2,500 to $5,000," this is not an insignificant cost (Surls, 2001). However, two factors mitigate this concern. First, because our intention is to provide a final plan to Ms. Wilcha that she can then submit to the City of Easton for funding, the hope is that these projects can be covered outside of the general budget the farm will usually operate under. Second, because our project is intended to help increase the productivity and output of the farm, it's not unreasonable to assume that this increased output would lead to an increase in the farm's budget as more people would be benefitting from the program, spurring Easton legislators to fund the farm more.

Rearranging Beds within Hackett Farm

Overview

An additional emphasis for this project is rearranging the beds within the Hackett Farm to improve the functionality of the farm, maneuverability of the farm and overall crop yield. By doing this, Lower Hackett Farm will provide green space access to an increased number of Easton residents and increase locally sourced vegetables to help combat the food desert within the West Ward district of Easton. While this will be extremely helpful to the Easton Community, decisive planning is needed to optimize the space within Lower Hackett Farm so it can easily become a social hub for community gardeners and produce a significant crop yield.

Raised Beds Background

The current layout of the farm (Figure 3) includes raised beds for the community members to have their own personal garden plots. Currently at Lower Hackett, there are twenty seven wooden raised beds for members of the community to use as their personal garden plots. These twenty seven raised beds lay on a 2,949 square foot oddly shaped section within Lower Hackett Farm. The dimensions of each of these raised beds are 4 feet wide by 8 feet long by eight inches tall. Each of these plots are provided to the Easton community on a first come, first served basis. Each year, there is a signup for the community gardens on the Easton Garden Works website. Once someone signs up for a garden plot, it is theirs for the year. The picture below shows the raised beds before seeds are planted.

Fig. 9 : Photograph of Raised Beds

Image shows the raised beds section of Lower Hackett Farm which are used as community garden plots

There is an annual seed planting day where Easton Garden Works provides those who have signed up for a community garden plot with vegetable and flower seeds to choose from to plant within their personal garden plot. The gardeners also have the opportunity to bring their own seeds and grow whatever they want in their personal plot. While this is the main day the gardeners put seeds in their plots, it also offers a social setting for the gardens to gather and to meet each other to develop relationships.

Once the seeds are planted, it is up to the user of the plot to maintain their plot. Ms. Wilcha told us that some of the gardeners actively maintain their plots by harvesting their ripe vegetables, constantly watering and weeding their plot, while others begin to forget about their plot and let it grow out of control. Unfortunately, when members of the community do not tend to their plots they can get a bit messy. Figure 10 gives a nice illustration of how different plots are managed. The plots on the far left of the picture are neatly tended to while the ones in the middle are growing wildly out of control.

Fig. 10 : Photograph of Raised Beds

Image shows the difference management of the community garden plots Raised Beds when left to grow out of control

There are an additional five field plots which are similarly taken care of by community members; however, these people preferred to do their growing in the ground rather than in a raised bed. These plots are a bit larger, with dimensions of 11 feet by 8 feet.

In-Ground Beds Background

The other beds at Lower Hackett Farm are the in-ground beds. These beds are maintained by Ms. Wilcha and volunteers that come to Lower Hackett. These beds are the main area where vegetables, flowers and fruits are grown by Easton Garden Works. See Figure 3 on Page 8 for their current location within . There is currently 1,964 square feet of in-ground bed area at Hackett. While this may seem like a large plot for the in-ground beds, it is important to note that not all of this area is used for the in-ground beds. Since these beds are planted in rows, there are grass areas used to walk between beds that are not used for growing vegetables, fruits and flowers.

Figure 11 : In-ground Beds

Image shows the current six rows of in-ground beds at Hackett Farm

The crops that are grown in these in-ground beds are picked fresh from Hackett Farm and brought to the wash station on site. Once the vegetables have been washed and dried, they are stored in Hackett's walkin Coolbot until they are taken off to the Lafayette College run West Ward Veggie Stand. The West Ward Veggie Stand, a weekly pop up, donation only, farmers market put on at the 10th and Pine Street Community Garden during the summer months. The aforementioned Vegetables in the Community (VIC) program oversees these operations in hope to build community strength in the West Ward of Easton through the production and distribution of fresh, locally grown produce. By expanding and rearranging the current layout of the farm, there could be a great crop yield grown at Hackett leading to more vegetables for the community. This rearrangement will allow for Ms. Wilcha to more easily manage the Hackett Farm and help grow a greater sense of community through agriculture.

Ryegrass Driveway

One of the main concerns that Ms. Wilcha addressed to our group was the lack of maneuverability throughout the farm for her truck. She needs this to be improved to be able to bring loads of mulch, soil, compost or other things into different areas of the farm. Since the farm previously had a lack of original planning due to the quick turnover to Easton Garden Works, we are proposing a solution that will be able to significantly improve the current layout of the farm and make Ms. Wilcha's job is easier. The first step in the rearrangement of Lower Hackett Farm is to create a grass driveway that spans the length of the farm. This path will greatly help Ms. Wilcha reach all areas of the farm with her truck.

Fig 12. Proposed Ryegrass Path

The image shows an aerial view of Hackett Farm and where the Ryegrass Driveway will be located

A simple perennial ryegrass path will span from the 9 foot wide entrance gate for 150 feet in length totaling 1,350 square feet of ryegrass. Ms. Wilcha preferred a grass path over gravel because she wanted to limit the amount of rocks and impervious surface coverage within Hackett Farm. Having a grass path will help with stormwater collection and be significantly more cost effective than stone. Choosing a grass path over gravel also eliminated the need for further grading of the site to accommodate a more advanced engineered path. Ryegrass is a traffic tolerant grass and germinates quickly. This ensures that the creation of the path will be easy to make and be durable for daily use.

Nature's Seed is a website that offers gardening and planting tips. They give a deep dive into how perennial ryegrass should be grown and why it is a good choice for heavily

trafficked grass areas.. For proper establishment of the rye grass seed, there are two chances to plant: Once in the late summer (or early fall) and once again in the early spring. The path for which is the seedbed needs to be prepared at least six months before the expected planting date to make sure any soil amendments you add have time to react. Amendments should have organic fertilizer high in nitrogen content. Ryegrass flourishes in a soil pH of 5.5 to 7.5, though it will tolerate soils with a pH range between 4.5, up to 8.4. Like many other perennial cool-season grasses, the seeds of ryegrass go through several growing points of initiation and induction. Seeds use the time below-ground, for example, during the months of September to early March to gather and cultivate energy. Seeds should be sown at about one-fourth to half-an-inch deep within the soil using standard lawn spreader or even a grain drill. If using a spreader, you'll need to pack the soil to make sure there is adequate seed-to-soil contact. A grain drill, on the other hand, will accurately deposit seed into the soil's surface.

In order for this path to be implemented, some of the current raised community garden beds need to be relocated because they are currently in the way of where the proposed path will be. Once these beds are moved, we estimate that a two person volunteer crew can complete the maintenance needed to lay the path in one day. We advise on renting a sod cutter with an 18" cutting blade from Home Depot for the day to remove the current layer of grass. Someone will operate the sod cut to make the nine foot wide pathway for the 150 feet through the middle of the farm. See Figure 12.

Once the path is developed, we recommend renting a self-propelled TA18HD aerator from Home Depot to aerate over the path. We recommend aeration because grass roots need air, water and nutrients to grow thick, deep and strong. When soil becomes

compacted, even slightly, it inhibits the flow of the essentials that support thicker, healthier turf growth. A layer of compacted soil just 1/4 to 1/2 inches thick can make a significant difference in the health and beauty of your lawn. Aeration creates holes down into the soil to alleviate compaction so air, water and nutrients can reach grass roots (Harper).

Lastly, the grass seed needs to be poured. We recommend buying the 15,000 sq. ft. Turf Builder EdgeGuard DLX Broadcast Spreader for Seed, Fertilizer, and Ice Melt from Home Depot to spread the ryegrass seed. We estimated that the 25 pound bag of Pennington Annual Ryegrass Grass Seed will be enough seed for our path. Once the seeds are spread, wait a few weeks and the grass should germinate rather quickly. It is important to note that Ms. Wilcha must wait until the grass is fully germinated until the path experiences any type of vehicular traffic on it. Driving the truck over premature grass could cause this path to never reach its intended potential.

Moving Raised Beds

As shown below in Figure 13 , there is a large unused section of the farm directly behind the current location of the raised beds. In this space we propose moving the beds in the way of the path along with creating more raised beds to allow for more Easton community members to get involved with Hackett Farm.

Figure 13: Movement of Raised Beds

The raised beds in the way of the path will be relocated. Additional raised beds will be created in the back right corner of the farm.

The expansions of the raised beds area will allow for more community members to have access to having a personal plot at Hackett Farm. This increase of community engagement directly correlates with Easton Garden Works mission: "giving residents the opportunity to maintain their own plot of green space and fostering a community of individuals interested in sustainability and making Easton a greener city." We estimate that the Raised Beds area at Hackett Farm will expand to 4,300 square feet, a 45% increase in total space. In addition to relocating six beds due to the creation of the path, we calculate that there will be enough area for an additional 15 raised beds. the spacing between the beds will remain the same as it currently is and the plots will continue to be directly maintained by community members.

In order to build these beds and expand the raised beds area, mulch, lumber and soil need to be purchased. The area that the raised beds will be located on will need to be mulched. Palmer Nursery, a local mulch supplier, offers different options of mulch sold

by the cubic yard. They offer 100% pure bark mulch at a price of $36.50 per cubic yard. Bark mulches add aesthetic appeal and also help improve the health of a garden. This type of mulch is long-lasting and less likely to blow away. Bark offers an excellent form of weed control and is readily available and over time, it can help reduce soil compaction. Bark mulch decomposes more slowly than wood chips, so you don't have to replenish it as frequently. There are few disadvantages to this type of mulch and is recommended by our group. If we estimate a two inch thick base layer of mulch covering the 43 foot by 100 foot proposed raised bed space, 26.54 cubic yards of mulch will be needed. In this case, we recommend purchasing 27 cubic yards of mulch to ensure that their is a sufficient amount.

We will plan on reusing the lumber for all of the existing raised beds so we will only need to buy 2 in by 8 in by 16 feet pressure treated lumber for the new raised beds we will be constructing. Since the dimensions of the raised beds are 4 feet by 8 feet, each bed requires 24 feet of lumber. In order to have enough lumber for the 15 new raised beds there will need to be 360 feet of lumber purchased. Since Home Depot sells 2 in by 8 in pressure treated lumber as 16 feet long, at least 23 of these boards will need to be bought and the cut to be the dimensions of the beds.

Lastly, soil needs to be put into the beds for the community members to build their own personal garden plots. We are assuming that the existing plots will keep their same soil. The only soil that will be needed is for the 6 moved garden plots and 15 new garden plots. With bed dimensions of 4 feet by 8 feet by 8 inches, one bed can hold 0.79 cubic yards of soil. We recommend buying 17 cubic yards of soil to fill the 21 beds that

need soil. Palmer Nursery also sells soil and they recommend aged mushroom and compost soil for gardens. They charge $34.50 per cubic yard of soil.

Economic Estimation

The cost estimate of rearranging the beds of Hackett Farm is two fold. One main cost is the creation of the ryegrass path and the other is construction of new raised beds. While these costs are much larger compared to the other project, they will be upfront and long lasting. These costs will drastically improve how the farm operates and the improve the day to day

Table 3. Ryegrass Path Pricing

Hardware	**Price (USD)**
1 Day Sod Cutter Rental	$114.00
1 Day TA18HD Aerator Rental	$92.00
15,000 sq. ft. Turf Builder EdgeGuard DLX Broadcast Spreader for Seed, Fertilizer, and Ice Melt	$66.97
25 pound bag of Pennington Annual Ryegrass Grass Seed	$31.98
	Total Cost = $304.95

All costs directly from Home Depot's Website

Table 4. Construction of New Beds Pricing

Hardware	**Quantity**	**Individual Price**	**Price (USD)**
Cubic Yards of Pure Bark Mulch	27	$36.50	$985.50
2inx8inx16ft Pressure Treated Lumber	23	$24.88	$572.24
Cubic Yards of Soil	17	$34.50	$586.50
			Total Cost= $2,144.24

All costs directly from Home Depot's and Palmer Nurseries Website

Irrigation System

Overview

Figure 14: Current irrigation system

Image shows the only current spigot on Hackett Farm. Currently the hose and filling watering cans are the only ways water reaches other areas of the farm

Our third project is the irrigation system. The current water supply consists of a singular spigot where hoses and other attachments can be connected. This supplies the entire farm and it is quite inefficient. To make the farm run at a higher production rate, while lowering labor inputs a second spigot must be added. There are a few easy ways to add another spigot, but the easiest and most cost effective is to split a waterline off of the existing waterline feeding the first spigot and run an additional line off of it to the new desired location where a new spigot head can be installed.

Additional Spigot

The first step to installing the second spigot is to go to the first one and dig it up until the waterline itself is exposed. The normal material used for these types of water lines is PVC pipe. When the PVC is exposed there will be a 90 degree bend, commonly referred to as a 90 degree fitting. The pipe flowing into the fitting would need to be cut using a hand saw or an electric saw immediately before the pipe reaches the fitting. Then the entire spigot and vertical piece of the waterline can be pulled above ground. The 90 degree fitting will also have to be cut off of the vertical piece of the waterline. When the fitting has been removed from both ends, then the surface of the pipes can be cleaned and prepped. One they are cleaned PVC primer and glue will be used to put a new fitting in the same exact spot as before. The only difference with this fitting is that it has 3 ends to it instead of 2. It lets pipes be connected at 90 and 180 degrees instead of just 90. It is commonly referred to as a T or tee fitting in plumbing. This allows for another waterline to be run to a new location. When the new fitting is put into place, then a trench must be dug all the way to the area where the new spigot is being placed. Then pvc pipe and fittings can be used as needed to run the waterline over to the new area. Then a 90 degree fitting will be placed at the desired location and the new spigot can be attached. Splitting the spigots this way could cause a loss of pressure if both are turned on at the same time because of the nature of the splitting of the waterline. However, there is no concern of lowering the pressure since it has been reported that the existing spigot has a very high pressure for the tasks it will be used for. Also when installing the new lines it is very important that they are dug below the frost line to prevent the water lines from freezing and then cracking. The spigot we have chosen to use has an extra 4 feet of vertical piping

on the bottom to accommodate the depth needed to keep the water from freezing and cracking the lines.

The addition of a spigot could be completed in as little as a couple of hours up to about a full day depending on the amount of workers provided and if the trench for the waterline is dug with a machine or by hand. This is a common addition to many small scale farms and even personal gardens and there are many articles and instructions that are designed for a singular person with little experience in plumbing such as this one. The only difference is the large distance between the existing spigot and the new one, but this does not really change how it is installed, it just means that it will require a longer trench and more pvc piping. The material cost would be minimal for a farm of this size and production rate. The material cost for this job is $110.42 and the full material list is shown below. This upgrade will pay for itself in a very short time because of how much time is saved when watering the vegetables and the daily work and maintenance of the farm will be more time efficient as well, allowing for the farms production to be increased and allowing Ms. Wicha to still distribute her time among the six community gardens as she sees appropriate.

The labor is straightforward and could easily be completed by city employees. The addition of the second spigot eliminates the conflict between Ms. Wilcha and the community gardeners trying to use the same water source. It also makes the use of drip tape much easier. The spigot would be placed near the inground beds and drip tape would be run along those beds so that Ms. Wilcha does not have to water the beds manually with a watering can.

Drip Tape

Figure 15: Drip tape

Image shows what the proposed drip tape would look like in the in-ground beds

Drip tape is essentially hoses buried in the ground that have holes in them. When the water supply is turned on it supplies water directly to the roots. This is very important because almost no water is lost due to evaporation, and the water can be absorbed by the roots in a much faster manner. This irrigation method is very beneficial to the plants but it is also very beneficial to the farmer because she can simply turn the spigot on and come back to turn it off after a sufficient amount of time has passed. This may vary depending on the time of year or the types of plants that are growing there at the time. This method is also known as one of the best irrigation systems for a small scale farm or garden. It reduces damage and disease that can harm the plant and fertilizer can also be run through the water lines and mixed with the water, making the care taking of the crops even easier. This can be done by having a nipple and valve on the hose of the drip take that allows a container full of fertilizer or other nutrients to be connected to the hose. Then the contents

are slowly released into the water where it mixes in. The only part of this process that requires labor is filling up the container otherwise it is completely automatic. The installation would most likely be done by Ms. Wilcha because it is not very labor intensive and she has prior knowledge on the topic and may have certain preferences on the placement of the tape and the fittings.

There are many benefits and easy installation instructions included in this article. The cost can vary depending on the brands and fittings that you choose, but the most user-friendly way is to buy it as a complete kit. The kit that we chose is capable of irrigating 1000ft of crops (linear) and up to 15 rows of crops. The ground beds at hackett farm could reach up to 10 rows and 800-900 feet so this is plenty of material to work with. Also buying the kit assures that all of the parts will fit together and that enough of each part and fitting is included. Also, this can lower the price because of the larger amount of the products sold. The cost analysis is quite simple for the drip tape since the material comes in a kit and the Labor would be done by Ms. Wilcha and possibly volunteers. The only monetary cost is $246.37 for the kit.

Overall the irrigation system upgrades would be beneficial to not only the people who need to use the water but to the plants as well. This system would make taking care of the garden much more time efficient and less labor intensive. It does not produce these benefits at the expense of the health of the garden either, if anything this system is healthier and more effective for the plants as well. The only cost would be the money it would take to make these changes, which is quite small considering how large the benefits would be. These changes to infrastructure are not major and could be completed by the city or eastons workers in less than one day.

The cost estimate of the proposed drip tape irrigation system and additional spigots is largely influenced by the city of Easton since the water lines are owned by the city. Assuming that the city would be doing the labor and that the material is what we suspect, the material list can still be completed. For this part of the project we are assuming that 3/4 inch pvc piping was used when the first spigot was installed. If the material changes then the fittings and the other Items will remain the same the price will just have to be adjusted. The tools needed would be a saw, a measuring tape, and something to dig the trench with, preferably a mini backhoe. The likelihood that the city has these tools is extremely high, which would save even more money.

Cost Estimation

Table 5: Irrigation Cost Estimation

Item	Quantity	Cost x Quantity = Total Cost
90 degree fittings	3	1.41x3 = $4.23
T fitting	1	$1.72
Pipe	40 ft	$32.48
Glue and Primer	1	$12.34
Spigot	1	$71.85
Total		$122.62

This cost analysis is based off of current home depot prices since supply houses change prices and include bulk discounts as well as pricing that is consistent nationwide. Sometimes they also do not reveal prices until the customer places the order. Also large nationwide companies keep almost all products in stock and they receive the majority of

the suppliers products due to the fact that they are extremely large. This means that the suppliers have an incentive to keep Home Depot satisfied and keep the cost per unit as low as possible. However the city of Easton may use a different supplier and may have connections with them, but pricing would only be lower than the cost analysis that was conducted. The cost of the entire Irrigation system would then come out to $368.99 (adding both the new spigot and the drip tape).

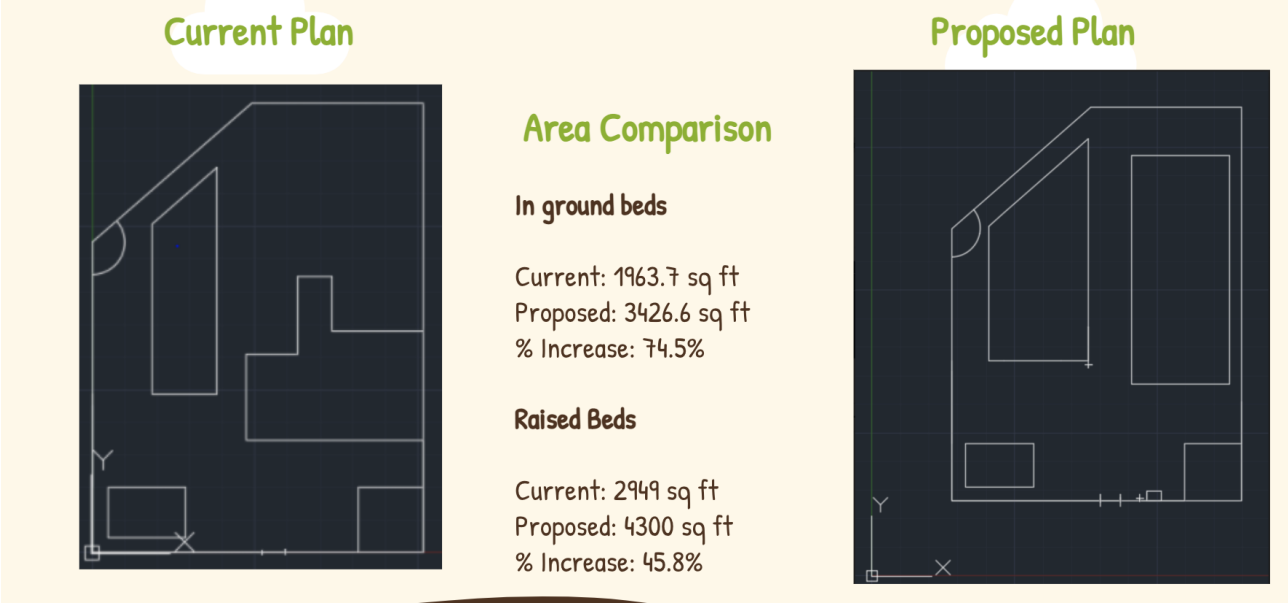
Final Proposed Plan

The last deliverable of our project is a final proposed plan of Lower Hackett Farm to give to Ms. Wilcha. This plan consists of an AutoCad drawing with our proposed changes to the farm. Currently, the farm appears as if it was slowly built and expanded haphazardly. The layout of the farm is very inefficient and so is the use of the land. These plans will show where each appliance of the farm will be. This plan was well thought out and will accommodate future growth, and make working on the farm more efficient by the location of different resources. Both the in ground beds and the raised beds will be expanded, allowing for more production and community involvement. The raised beds will also be cleared out of the center of the farm so if there is a need to drive into the farm, or when a decision is made for a path to be installed, it will accommodate that.

The plan will also show where the new additions to the farm are or will be such as the coolbot and the greenhouse, since these are very recent changes. The open community space, wash station, and other big resources will be shown on the plan, but so will the water supplies, the gate, and other smaller features, so the plan can show the full intention of cohesiveness, but also it will make it easy for someone to evaluate the site

without physically going there and taking measurements. This part of the project is key for organization and future upgrades or growth in general. As depicted in the AutoCad drawing of our proposed plan and Figure 16, there is a lot more space used, mainly by the raised and in ground beds, however it appears much neater and is not crammed. There is room for the ryegrass path, more space in the back is used, yet the area prone to flooding was still avoided. There also is at least five feet of space between all of the beds and the other resources, so there is enough room to work and there is some buffer space to keep it comfortable. The location of the wash station was kept the same because it is right next to the coolbot, which is where the produce goes after it is washed. Similarly the existing spigot will remain in the same area because it is located next to the wash station. All of these things will work together like an assembly line to optimize the efficiency of the farm and help Hackett improve in the future for expansion

Figure 16: Final Plan vs Original Layout



Conclusion

Hackett farm plays a vital role in the ongoing battle against supermarket redlined zones and increasing food accessibility. It's part of a growing trend in cities across the U.S. in reviving the ancient practice of communal agriculture and serves a crucial role in our ever changing agricultural landscape. As it stands, Hackett farm is in a prime position to make its impact felt across Easton and the Lehigh Valley at large. Our projects aim to build on its ongoing success and help it to grow to better meet the demand it hopes to meet.

The specific projects we took on were chosen based on conversations with the manager of the farm, Miranda Wilcha, currently used infrastructure at other community gardens and small farms, and the personal farming experiences of authors Konstantinos Voiklis and Casey McCollum. We chose projects that were likely to have the most significant impact now in addition to allowing for growth in the future. We approached these projects in specific ways, informed by community garden contexts at a local, state, and national level, involving factors like governmental support, the realities of the extent of food insecurity in the U.S., and Easton's unique political and social ecosystem.

Hackett's current wash station is unable to accommodate its growing output and workforce. The proposed wash station, composed of the scrub station and soak station, is a cheap and efficient rethinking of the way Hackett currently processes their vegetables and will better facilitate their growth in the community.

Hackett's current bed positioning and spacing is a limiting factor in terms of accessibility to the farm for equipment. It inhibits the expansions of the raised bed system, and is ultimately a holdover from before the farm was as large as it is today. Our proposed repositioning would allow for the construction of a grass pathway, facilitating trucks and other equipment to access more of the farm and aid in further growth. As well, this repositioning would allow for a logical expansion of the space, allowing more community members to participate.

Hackett's irrigation system consists of a single spigot, limiting the amount of bed space that can be watered at once and contributing to confusion and lost hose nozzles and attachments when community members visit. Our proposed updates would install two additional spigots, increasing the amount of space that could be watered at a given time. As well, it would allow Ms. Wilcha to assign spigots specifically to community members, increasing the sense of community ownership and reducing confusion as to where to return nozzles and attachments.

Future Potential Projects of Interest

Our contributions to the restructuring of Hackett Farm should be considered the first steps in the ongoing process of farm development within a community garden context. Because farms are highly personal, they tend to evolve as a farmer becomes more acquainted with their space and better defines their habits within that space. Our propositions, with the aid of Ms. Wilcha, aim to be a stepping stone that should help guide future additions, but not set them in stone.

As well, because these proposals were developed over the course of a single academic semester, the extent and variety of the modifications that could be made were certainly not exhausted. In the early stages of our work, we discussed a number of projects which should be further explored by future groups.

One of the primary projects Ms. Wilcha mentioned wanting to be developed was the construction of a propper community space. Community gardens are inherently community spaces that should help foster a sense of solidarity and be a space for gathering. As well, the space is largely volunteer-run, meaning new faces are not surprising and an effort should be made to accommodate the wide variety of people who might want to participate. The development of a space made for this express purpose should be a top priority in the ongoing development process. With the addition of a few tables and benches, a couple of large umbrellas to keep the sun and rain at bay, and a rearrangement of the current fireplace, the space could easily be transformed to help facilitate a greater sense of community.

Because the space is meant to be for a diverse community, accessibility should be of great focus. That may look like waist-high raised beds so that wheelchair users, the elderly. or people who otherwise can't bend over are better served by the farm's community plots.

The City of Easton has recently developed a 'micro forest,' a small space dense with a variety of native flora, directly across from the Hackett plot. Ms. Wilcha expressed a desire to implement that in some way to the farm, be it a children's field day, an

informative self-guided walking tour through the space, or the development of a food forest consisting of additional native, edible plants.

Hackett and the five other farms already have an ongoing relationship with Lafayette College via the ViC program and their partnership with Lafayette's school farm, LaFarm. Students are on campus for most of the busy spring planting season, fall harvest season, and winter preparatory season. A number of people volunteer at LaFarm each week, meaning there is a workforce likely willing and able to help at Hackett as well. Developing this relationship to the extent that formal volunteer hours can be established would be significant. Beyond that, proposing a formal, partial credit class would provide a consistent, knowledgeable workforce, as well as increase the relatively limited social relationship Lafayette students have with Easton.

Finally, and what may end up having the largest impact on the farm, is the development of a more comprehensive social media presence tied together with an event planning position. Outreach is essential for any farm trying to sell its goods but is especially important to a volunteer program. Being able to quickly and broadly advertise when volunteers are wanted would help increase the number of people visiting the farm. An event planner could then help organize large, community-attracting events to help increase awareness of the farm and increase its outreach. Events like spring planting and fall harvest, children's weekends or retiree evenings, or themed events like pumpkin carving or an easter egg hunt would certainly increase community involvement and awareness. Paired with social media outreach, Hackett would be set to become a dominant institution in Easton.

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