ABSTRACT

Title of Document:	MOWING TO GROWING: TRANSFORMING A MUNICIPAL GOLF COURSE TO URBAN AGRICULTURE IN BALTIMORE CITY
	Nathan Allen MLA 2016
Directed By:	Dr. Byoung-Suk Kweon, Department of Plant Sciences and Landscape Architecture

This thesis demonstrates how landscape architects can transform underused golf course facilities located within cities for urban agriculture (UA). In the last decade more than 1000 golf courses have closed in the United States. Municipal golf courses represent some of the largest pieces of open space in cities and because of their inherent infrastructure they can provide the ideal location to support large-scale UA. In Southwest Baltimore large food deserts are a serious health concern and represent a lack of access to healthy food options for residents. Carroll Urban Agriculture Park is a design response resulting from a detailed analysis of the existing Carroll Park Golf Course and the surrounding community of Southwest Baltimore. The design will create an urban farm in a park-like setting to provide readily accessible healthy food options and various educational opportunities, and to support current and future urban agriculture related businesses in Baltimore.

MOWING TO GROWING:

TRANSFORMING A MUNICIPAL GOLF COURSE TO URBAN AGRICULTURAL IN BALTIMORE CITY

By

Nathan Allen

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Advisory Committee:
Dr. Byoung-Suk Kweon, Chair
Dr. Christopher Ellis
Dr. Lorraine Clarke

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CHAPTER 1: INTRODUCTION

In the nearly 140 years since it was first introduced to the United States, the game of golf has gone through a series of growth periods, taking it from a "*gentleman's*" game played primarily by the elitist few in the early 1900's, to one that over 30 million people played at the sports height in popularity around the year 2000.

More recently though, the golf industry has been experiencing a steady decline that can be attributed to many different factors from economic downturns, decreasing interest and participation, to an oversaturated market of courses. As a result of these factors the golf industry, since the early 2000's, has seen nearly 1,400 golf course facilities permanently shut their doors for business (National Golf Foundation, 2014). If the average 18-hole course consumes 150 acres, these closures represent nearly 300 square miles of land sitting unused. The question now is what should be done with these properties? Because golf courses were often constructed in populated areas, these properties remain valuable and interest among developers has been to replace courses with homes. In an effort to preserve the large pieces of open space, a trend in repurposing has led landscape architects and planners alike, to explore repurposing golf courses for things such as parks and nature preserves, and less common as sites for urban agriculture production.

In Baltimore City growing concern over food accessibility in low-income neighborhoods has prompted a call from Mayor Stephanie Rawlings Blake to increase the amount of affordable, locally grown fresh produce. Urban agriculture has been recognized as a possible solution to this problem and with numerous initiatives, including tax incentives and lenient building codes, the city has been working to promote the growth of urban agriculture in Baltimore.

In an effort to help alleviate the food desert conditions in Southwest Baltimore, this design thesis explores how an underused municipal golf course can be transformed into an urban agriculture hub. A thorough investigation of local community demographics, environmental connections, and existing golf course infrastructure will be used to develop a design concept that will support large-scale urban agriculture in a park-like setting.

The History of American Golf Industry

Developed on nearly every type of landscape from deserts and swamps to mountains and plains and woven into the fabric of rural, suburban, and urban life, the game of golf has a long and rich history in the United States spanning over a century. The first documented golf course, known as St. Andrews, was located in Yonkers, New York. In 1888 a transplanted Scotsman, John Reid, gathered a group of friends and laid out the three-hole course covering cow pastures and an orchard (Wind, 1975).

Figure 2. First golf course in the U.S. St. Andrews Golf Course, Yonkers, N.Y. (Encyclopedia Britannica, n.d.)

With such humble beginnings it's unlikely that anyone could have imagined how popular the sport would become and how quickly it would spread. In a period of roughly 100 years golf would blossom from about 1000 courses and 125,000 golfers in 1900 to around 16,000 golf courses and nearly 30 million players at the turn of the

century (Hueber, 2009a). This represents a very significant land use in the U.S. with nearly 2,244,512 acres or an area roughly the size of Delaware and Rhode Island combined (Santiago, 2005). Since arriving in the U.S. golf has gone through a series of development booms that dramatically grew the sport. Napton and Laingen (2008) have grouped these booms into four epochs:

1. Epoch I 1878-1919 Urban Elite Beginnings
2. Epoch II 1920-1949 Growth and Stagnation During Turbulent Times
3. Epoch III 1950-1969 Increased Leisure Time and Affluence
4. Epoch IV 1970-Present Maturation & Saturation
   (Napton and Laingen, 2008).

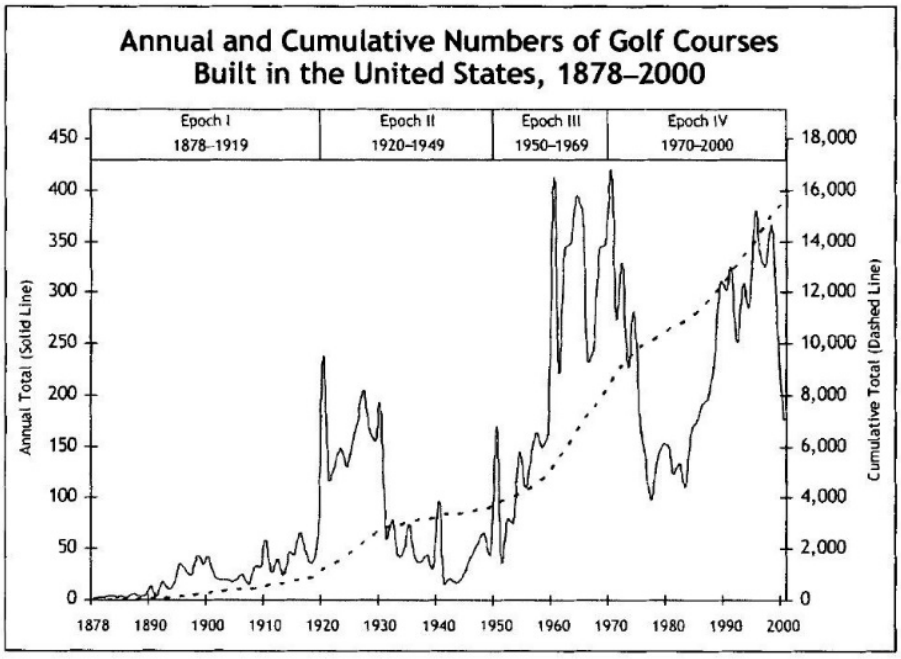


FIGURE 2. Annual and cumulative number of golf courses built in the United States, 1878-2000 (Napton & Laingen, 2008).

The first epoch of growth marked a time when golf was viewed as an elitists' sport. Many of the courses constructed in this period were located along the east coast in major financial districts. The vast majority of the near 1000 courses built during this period were very private country clubs with few public courses, a trend that continued

until closer to the 1960's (Adams and Rooney, 1985). The second epoch lasted from about 1920 and continued through 1949 and golf course growth was significant, especially during the period known as the *Roaring Twenties.* The great depression and World War II would strike a blow to construction boom but by 1950 nearly 1.1 million people played golf on over 5,600 courses, 80% of which were private clubs reserved for the upper class (Hueber, 2009). Epoch III lasted from 1950 to 1969 marking a period of increasing wealth and leisure time. Emerging from WWII the nation experienced a dramatic growth in both the economy and population. Longer life expectancies, the addition of 80 million baby boomers, and the automobile sparked an increased need for recreational land use and promoted the spread of golf courses out from the urban cores to the surrounding suburbs (Napton and Laingen, 2008). Epoch IV lasted from 1970 and continued through the turn of the century marking a period of maturation and saturation. 1985 the National Golf Foundation, after extensive research, put out a report titled "*Strategic Plan for the Growth of the Game*" which called for developers to build "A Course a Day" from 1990 to 2000 in an attempt to meet the likely demand. By the early 2000's around 30 million people played golf on 16,000 courses with an average of 400 courses constructed yearly from 1990-2000 (Hueber, 2009). The bulk of this growth was based off of the 80 million baby boomers that were expected to have more money, more time, and a desire to play more golf (National Golf Foundation, 2013). Another major factor during the 1990's was the role that real estate had on golf course construction. Golf popularity was exploding at the same time the housing market soared so it seemed like a match made in heaven to combine the two. Popular golf course architects were hired by developers to create large, beautiful golf courses that would help to sell homes along

them. In the 1990's around 60 percent of the 400 courses built annually were included with real estate development (Hueber, 2009). One of the biggest problems with this model was that developers never intended to maintain the courses after all the homes were sold and as a result communities were left with courses that were unsustainable and financially burdensome to continue operating.

Current State of Golf Industry

More recently the golf industry has taken some major blows and it has become evident that the industry is waning as the result of less people playing golf and even fewer people beginning to play the sport. This combination has led many golf courses across the country to shut down, leaving large pieces of once highly maintained landscapes, to become neglected and overgrown.

The Sports & Fitness Industry Association data showed that for the fifth year, overall participation in golf fell in 2014 as measured by the number of U.S. individuals

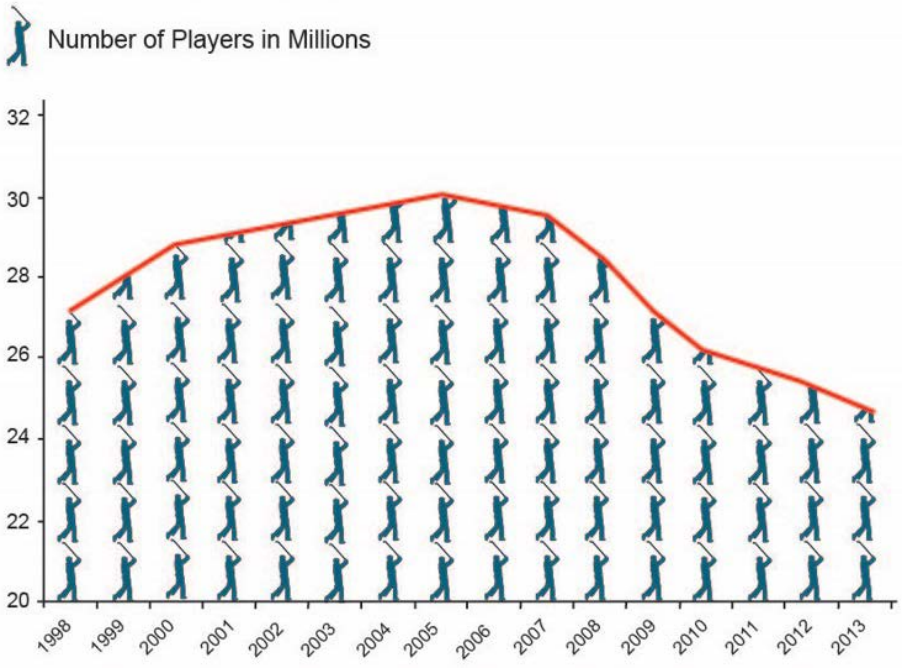


Figure 3. Number of golfers, in millions, in the United States 1998-2013

who reported playing on a course at least once (Germano, 2014). As figure 3 shows, the total decline in golfers has been around 5 million, from its peak of 30 million players in 2006 to 24.7 million in 2014 (*Golf Participation in the United States*, 2013). Speculative developers continued to build golf courses at staggering rates through the late 90's in anticipation of retirees buying homes on courses and playing lots of golf, but unfortunately this never came to fruition. The problem was outlined by attorney Steven D. Soto:

> Unlike the construction boom of the 1960s, the courses built during [the 1990s] did not have a corresponding growth in the middle class or even golfers, for that matter. These courses were built purely on speculation, as it was believed at the time that retiring baby boomers would dramatically increase the demand for golf. Unfortunately for the approximately 400 golf courses built each year during this period, this demand never materialized. Unlike their fathers, many baby boomers viewed golf as an old person's game, favoring more active recreation like jogging or tennis (as cited in Benfield, 2015).

Economic events in the first decade of the 2000's such as the dot-com crash, the recession following 9/11, and the Great Recession of 2008 can also take partial blame for golf's poor numbers. The recession of 2008 had arguably the greatest impact on those blue collar baby boomer workers the industry was relying on and who were on the verge of retirement. Market recover really only helped the already wealthy while others had to count their losses and begin to start saving again. The baby boomer generation, which was the basis for so much investment in golf, was turning out to be a failure. In 2013 the NGF stated "Golf courses and golf businesses should curb their expectations because this

generation of retirees may not be golfing as much as their predecessors" (NGF, 2013).

In addition to the loss of the baby boomer generation, another trend that has contributed to the decline in golf has been a slowly increasing lack of participation among younger generations, particularly those aged 18-34 (figure 4). Many factors can be attributed to this decline including the games high cost, difficulty, and the length of time it requires to play the game. What has often been recognized as a primary reason for playing golf, its slow and relaxing pace, may actually be contributing to the lack of younger people picking up the sport. An average round of golf can last 4+ hours and this pace of sport just doesn't seem to sit well with today's youth. Millennials, those who have grown up with the internet, tend to value speed and immediate results both of which are not reflected in a game that can take hundreds of hours to learn and years master. In the last decade participation among younger generations, especially

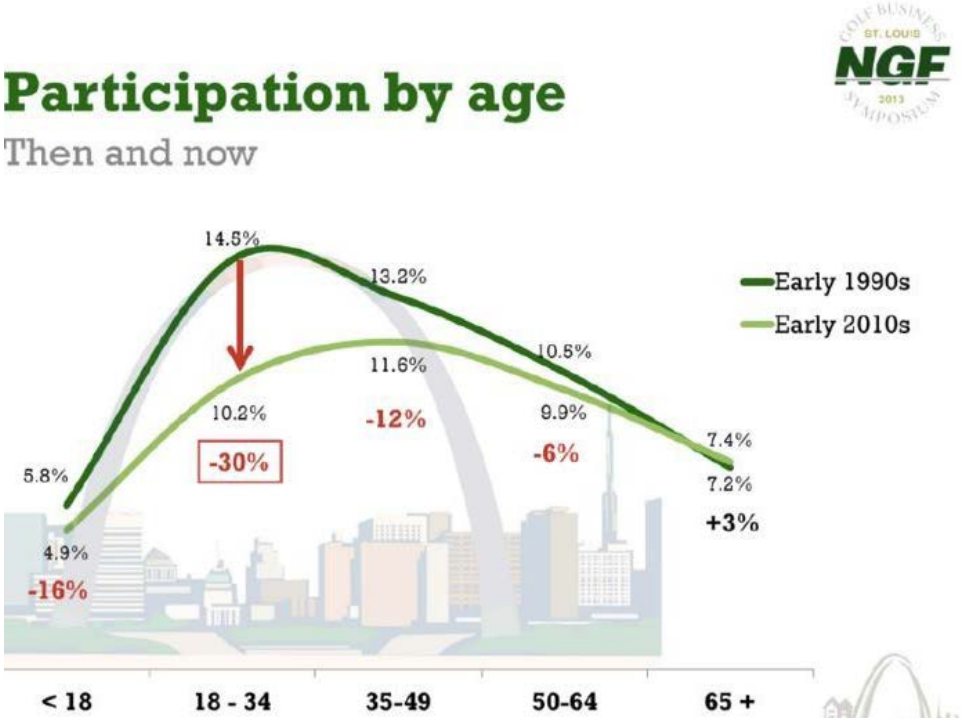


Figure 4. Decrease in percentage of golfers by age, 1990-2010 (NGF, 2013).

millennials in the 18 to 30 year range, has dropped nearly 35% (Harwell, 2015). Golf is also a very expensive sport to play. Aside for the initials costs of necessary equipment which can include clubs, balls. and even specific shoes, the fees to play on golf courses has also made it less popular among younger participants. According to the NGF the average 18-hole round of golf was around $52 while the average 9-hole round was $23 (National Golf Foundation, 2013). These expenses can be especially burdensome or even exclusionary for minority groups which make up nearly 5.7 million golfers or 21% of the golfing population. A 2010 study reported that African Americans earning less than $50,000 have a participation rate around 2.4% compared to the national average participation of 9% (NGF 2013).

Golf courses require a significant amount of overhead in order to remain operational. Golf course maintenance alone averages nearly $700,000 annually for an 18-hole course (Maintenance budget survey report, 2012). Add on to that the costs of clubhouse operations, golf professionals, and other amenities such as pools and tennis and it becomes evident that golf courses are a very expensive operation to sustain. While a couple of years in the negative can be overcome, continued revenue losses as the result of over a decade of less people playing golf have forced numerous courses to

Fig. 5 Golf course openings and closures (NGF, 2013)

go out of business. 2013 marked the eighth straight year that more courses closed than opened with 158 closing and 14 opening (NGF 2013). Of the nearly 1083 golf facilities that closed from 2000 to 20013 96 percent were public courses and 57 percent were 9-hole facilities (NGF 2013). A look into the near future does not hold any promise either, the NGF speculates that between 130-160 courses will continue to close annually over the next few years until the industry loses 1,500-2,000 courses.

A large majority of courses that have closed over the last 10-15 years have been those that were speculatively constructed as part of planned communities and when this proved to be wrong it was too late. Many of these properties carried too much debt, were unreasonable to keep maintained, and just not economically viable anymore (Hueber, 2009). However, many other golf course properties, such as municipally owned ones, have also experienced very difficult times. While privately owned community golf courses, which tend to charge significantly higher prices, have trouble affording to maintain these landscapes, it's not a far reach to assume that municipal golf courses are struggling even more so. Golf Course Industry (GCI) has reported that even though the number of municipal golf courses hasn't really changed over the last decade, they are financially struggling to stay alive (Walsh, 2010). Walsh also reported that many of these government-owned properties operate at a loss and are being forced to decide whether to continue losing money or to close them down and redevelop for another use. Many municipalities losing money have also resorted to leasing their golf courses to management companies who know the business of golf much better than city agencies. Baltimore City turned over the operation of its five courses to the non-profit Baltimore Municipal Golf Corporation in 1984, a time when the courses were costing tax payers $500,000 in annual subsidies. The move proved very beneficial as it pulled most of the

courses out of the red with the exception of Carroll Park golf course in Southwest Baltimore. Henry Miller said "this is the only course [Carroll Park] of the five we operate that hasn't made money…" (as cited in Steadman, 1993).

Environmental Impacts of Golf Courses

Carroll Park Golf Course is located in an environmentally sensitive area directly adjacent to the Gwynns Falls and is less than a mile from where the 66 square mile Gwynns Falls watershed empties into the Middle Branch of the Patapsco River. The watershed has been identified by Maryland's Integrated Report as impaired by nutrients, sediments, bacteria, and combination benthic/fishes bio-assessment (Maryland Department of the Environment, 2009). The operations required to maintain golf courses have the ability to contribute to further environmental degradation, especially when they are located along bodies of water.

In order to maintain golf courses with healthy stands of turf that can withstand the pressure created with hundreds of rounds of golf per day, significant nutrient supplementation is needed to maintain healthy plants. Excessive nutrient runoff from golf courses has the potential to negatively affect adjacent water bodies and contribute to other environmental concerns including algal blooms and eutrophication caused by excessive plant growth (Rice and Horgan, 2010). The average golf course applies around 152 pounds of Nitrogen for every acre of maintained turf and estimated total Nitrogen use on golf courses in 2006 was 101,096 tons. Improper applications from operator error and events such as irrigation and heavy rainfalls can all increase the chances for nutrient runoff. In Maryland especially, the declining health of the Chesapeake Bay has prompted legislature that would help to limit the amount of nutrients from fertilizer entering the Bay

from runoff. In 2011 Gov. Martin O'Malley signed into effect the Fertilizer Use Act that set restrictions on fertilizer use including one that stated fertilizers sold in Maryland may no longer contain Phosphorus. The average rate of Phosphate is 1.5 pounds per 1,000 ft^2 with an estimated total of 36,810 tons annually on golf courses (Golf Course Environmental Profile, 2009). A 2010 research report funded by the United States Golf Association (USGA) found that concentrations of Nitrogen in runoff samples were greater than levels associated with increased algal growth, while concentrations of Phosphorus where 7 and 14 times greater than USEPA water quality criteria to limit eutrophication in streams and ponds (Rice and Horgan, 2012).

Pesticide use on golf courses is very prevalent and can include insecticides, herbicides, and fungicides, all necessary to maintain the near perfect conditions expected at many courses. Many different insects and rodents present a big threat to golf courses if not controlled by insecticides/ rodenticides. Many herbicides are also used in order to keep courses weed-free, while fungicides are often used to prevent and cure fungal infections that can lead to plant death. In a comparison of acres of treated areas between golf courses and agriculture it was found that 52 golf courses in Long Island used an

Fig 6. Applying pesticides to golf course fairways (GCSAA environmental profile)

average of 18 pounds of pesticides per treated acre per year, or about seven times the rate that agriculture uses at 2.7 pounds per acre (Primi and Surgan 1994). When we multiply that number by the total of maintained turfgrass acres on golf courses in the U.S. we can estimate that nearly 27 million pounds of pesticides are applied to golf courses annually. Heavy use of pesticides, especially in urban and suburban settings where golf courses are often located, has been a topic of great concern for the health safety of humans and the environment. Most golf course insecticides contain neonicotinoids which have recently been suggested to contribute to the collapse of honey bee populations (Van der Sluijs et al., 2013).

Golf courses require substantial irrigation to maintain healthy turf throughout a growing season and the amount of water needed depends greatly on the region in which the course is located. In the United states there are an estimated 2,244,512 acres of land allocated for golf and water usage from 2003-2005 was estimated to be 2,312,701 acre-feet or roughly 752 billion gallons (Throssell, Lyman, Johnson, Brown and Stacey, 2008).

While the future of golf cannot be entirely predicted, it is quite apparent that the current situation is one that is proving to be unsustainable for many golf courses at different levels. Even in the best of situations with a fully recovered economy and the next wave of retirees begin playing more, the golf industry will continue to struggle as young golfers refuse to pick up the sport. Additionally, increasing concern over the impacts that golf courses have on the environment and the resources needed to keep them operating is beginning to make people reconsider their place in a community. The next question is, what should we be doing with these properties?

CHAPTER 2: PRECEDENT STUDIES

In the wake of golf's downturn we are left with hundreds of golf courses scattered throughout rural and urban America. With the average 18-hole facility taking up more than 150 acres the question now is, what do we do with these properties? Golf courses often become the target of concerned neighbors and environmentalists pointing at unnecessary use of water, pesticides, and fertilizers used to maintain a very unnatural environment of precisely manicured grasses. At the same time they can be valuable for the environmental benefits they are able provide in areas that may have otherwise been developed. Golf courses do provide some ecosystem services but because the courses must be maintained to support a sport, these services are often diminished. Current trends in repurposing courses include sustainable developments, plant and animal habitat restoration, ecosystem service restoration, and to a lesser degree urban agriculture. While individually the sites have specific goals, they all share the characteristic of creating multifunctional outdoor spaces for people to enjoy. The following precedent studies were examined in order to assist developing a design program for this project:

1. **Macatawa Greenspace** - Holland, Michigan
2. **Forest Beach Migratory preserve** - Port Washington, Wisconsin
3. **Bloom Montgomery Village** - Montgomery, Maryland
4. **Riverview Gardens** – Appleton, Wisconsin
5. **Grow Dat Youth Farm** – New Orleans, Louisiana

Macatawa Greenspace, Holland, MI

Because golf courses are often constructed along bodies of water and floodplains, environmentally sensitive areas that cannot be developed otherwise, they can also serve as ideal locations to restore local hydrologic conditions and incorporate stormwater management techniques. An example of this is seen in Holland Michigan where a former country club was sold to the parks department and converted into a restored wetland ecosystem and public greenspace. 53 of the 122 acre golf course were restored as wetlands ("Former Golf Course Transformed," 2014). The golf course was situated along the Macatawa River which was increasingly prone to flooding, causing erosion of the riverbanks and transporting high loads of sediment, pollution, and nutrients from the golf course. Besides the 53 acres of wetlands, this project stabilized 5,000 linear feet of streambank, added nearly 60,000 cubic yards of floodplain storage, and installed 8,400 new trees (Scholtz & Berry, 2012). Additional park amenities included the addition of an 18-hole disc golf course, a three- mile walking trail, park benches and a future visitor's

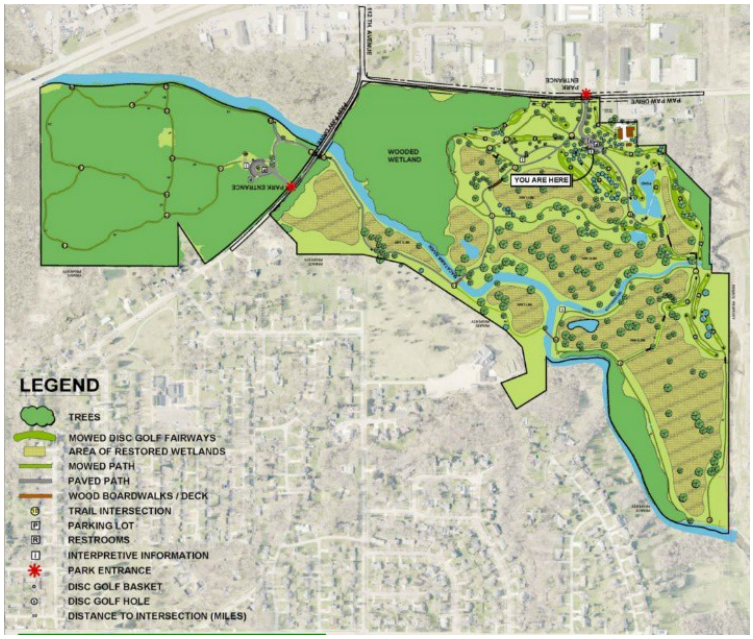


Fig 7. Proposed site plan for the Macatawa Greenspace in Holland, MI. ("Former Golf Course Transformed," 2014).

center. Since its completion in 2012 the park has seen a considerable increase in the amount of wetland waterfowl and most popular among residents of the area is wildlife watching, hiking, cross country skiing and disc golf. Designers of the park were able to take natural characteristics of the golf course and re-design them to provide increased environmental benefits.

Forest Beach Migratory Preserve, Port Washington, WI

Golf course properties can also be ideal for habitat restoration projects. Often containing multiple habitat niches such as waterways, grassland, and forest, golf courses already have a blueprint to be turned into valuable habitat areas. With some thoughtful design and management a golf course can be transformed to support a much larger population of wildlife. In Port Washington, WI along the shores of Lake Michigan, the Forest Beach Migratory Preserve was created out of a former 117 acre golf course. Due to its proximity to the lake and within the flight path of many migratory bird species, the Ozaukee- Washington County Land Trust (OWLT) saw the property as a great opportunity to restore wetlands and habitat that were vital to migratory birds passing through this area (Forest Beach Migratory Preserve, n.d.) The goal of this restoration, as stated by OWLT was four part:

1. Enhance the diversity and abundance of feeding and resting areas used by many migratory bird species, especially endangered or threatened species.
2. Create and enhance landforms and vegetative characteristics that facilitate groundwater recharge and help protect water quality in Lake Michigan.
3. Plant vegetation types that will enhance carbon sequestration.

4. Provide education and outdoor recreation opportunities to increase awareness and appreciation for migratory birds and natural resource conservation.

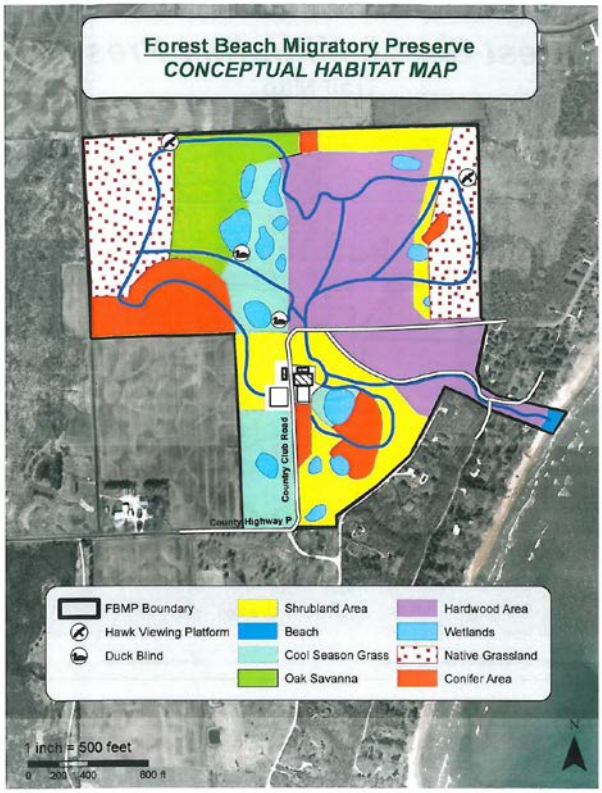


Fig 8. Conceptual habitat design for Forest Beach Migratory Preserve

Following herbicide applications to remove unwanted and invasive plant species, the property was planted according to the map in Figure 8. A network of trails and viewing platforms will lead visitors through the property and will use interpretive signage to explain the process of the restoration and the benefits it will have on the environment. When complete the preserve will include:

- 32 acres of mixed hardwood forest
- 12 acres of oak savannah
- 19 acres of shrub land
- 10 acres of conifer forest
- 22 acres of grasslands

- 17 acres of savannah
- 16 acres of wetlands
- 10 acres of mowed cool-season turf

Bloom Montgomery Village, Montgomery, MD

Golf courses across the country have also been finding new life in the form of a new style of sustainable community that utilizes a mix of higher density, diverse housing options and the preservation of valuable open space. As discussed earlier, many of the courses that are currently failing were part of planned communities. As these courses fail developers first reaction is to sell off the remaining land to develop new homes. Local residents are not excited to see the golf course go away, but more importantly they do not want to lose the open space adjacent to their homes. Some developers have started thinking of alternate ways to bring in new development while protecting and enhancing the natural environment of defunct golf courses. By imagining neighborhoods where residential areas are more condensed and not spread out like the typical suburban areas we know, more open space is able to be preserved for alternate uses and to provide neighbors with a valuable resource. An example of this is the redeveloping of the Montgomery Village Golf Course in the community of Montgomery Village, into what will be called *Bloom Montgomery Village*. A 147 acre golf course was purchased by Monument Realty with the intention to build a unique and more sustainable community on the property. The plan calls for 594 new homes and the preservation of over 80 acres of open space (Bloom Montgomery Village, 2014). The housing will be more densely concentrated with options for townhomes, condos and duplex units. Additional tree plantings, restored ponds and streams and native grass areas will all contribute to increased wildlife habitats

around the community and will provide ample outdoor activities to the residents. The 80 acres of preserved land will be converted from golf to include amenities such as:

- Trails
- Picnic areas
- Gardens
- Playgrounds
- Fishing
- XC skiing
- Dog park
- Exercise stations

Fig 9. Proposed site plan of Bloom Montgomery Village

Riverview Gardens, Appleton, Wisconsin

In 2011 the city of Appleton, WI teamed up with a non-profit organization COTS or the Community Outreach Temporary Services to purchase a $2.6 million, 72-acre golf course that had recently gone out of business. The goal was to establish a new and socially innovative non-profit organization called *Riverview Gardens*. Once completed the site will have 25 acres reserved for intense agricultural production and 45 acres for wildlife habitat, community recreation, and a community center (SeBlonka, 2013). The mission of Riverview Gardens is to create a financially self-sustaining social enterprise, focused on job training for people in need, using urban farming and a park setting in

Fig 10. Google Earth images of Riverview Gardens before and after

downtown Appleton, WI (Riverview Gardens, 2016). The main goal of the program is to

create innovative solutions to improve the conditions of poverty, homelessness, and unemployment in the surrounding Fox Chapel neighborhood. Riverview Gardens achieves its goal of being self-sustaining by relying on the involvement of community members and local organizations to sustain a large scale market garden, park space, and job training program (Riverview Gardens, 2016). When complete the 25 acres reserved for organic production will include 30 hoop houses, perennial orchards to grow fruits and nuts, field rows for vegetables, herbs and nuts. Hoop house production was located on more level areas of the golf course with access to main roads and an old golf maintenance facility and year-round production is made possible by composting practices in the hoop houses. Some fairways were transformed into fruit and nut orchards by planting a variety of trees including apple, pear, and hazelnut, while other fairways will slowly transition into native grassland areas with trail systems. The old golf irrigation system will also find new life on the course when retrofits are made that will supply water as drip irrigation rather than sprinklers (Pezenstadler, 2012). Hand-dug drainage swales were created to direct stormwater runoff from production areas into established wetlands in the lowest areas of the property. The latest addition to Riverview Gardens has been the re-purposing of the country club's pool into a 7,500 ft^2 state-of-the-art hydroponics greenhouse that is expected to generate $200,000 in sales annually (New state-of-the-art hydroponic greenhouse, 2015).

Fig 11. Repurposed pool for hydroponic lettuce production (Amerilux 2015).

Work on the farm is completed with the help of volunteers from local schools, the community, local organizations, and from Service Works, the driving force behind Riverview Gardens job training program. This program works to develop soft job skills to unemployed and underemployed adults and high school students. A certificate is awarded to those who complete the 90 hour program that includes planned tasks,

Fig 12. Job training opportunities at Riverview Gardens (Riverview, 2016).

progress meetings, and final evaluation that measures the persons work habits such as use of time, quality of work and relationships formed with co-workers and leaders. Participants in the program perform various tasks including building farm structures, preparing for planting, harvesting and cleaning produce, working at farmers markets, and even with event set-up and operation at the community center. Riverview Gardens

uses many different techniques to use the market garden as a way to generate income to support the many programs. Produce is distributed through multiple farmers markets in the surrounding community where members of the Wisconsin FoodShare are able to receive produce at half the cost when using their EBT. Riverview gardens also runs a community supported agriculture (CSA) program with 200 shares available each season. Each share includes roughly 9-12 items and lasts for 24 weeks starting in June. Those who cannot afford to pay for shares are eligible to sign up for WorkShares. With this program, participants are given a weekly share if they agree to provide work at Riverview Gardens at least 4-6 hours each week. The final income generator for Riverview Gardens is the wholesale of high quality, fresh produce to local restaurants, schools, and supermarkets.

Fig 13. Hydroponic lettuce produced at Riverview Gardens packaged for retail sale

It is the hopes of Riverview Gardens to create a replicable community-outreach model that changes the way we address the issues of poverty, homelessness and unemployment in our communities.

Grow Dat Youth Farm – New Orleans

Grow Dat Youth Farm was the concept of founder Johanna Gilligan and is a non-profit collaboration between Tulane University and City Park with a mission *to nurture a diverse group of young leaders through the meaningful work of growing food* (GrowDat Youth Farm, 2016). Local students, are educated in all facets of urban agriculture and

Fig 14. Illustrative rendering of Grow Dat Youth Farm (Grow Dat Youth Farm, 2015).

work together on the farm to produce healthy, sustainable fresh food that is distributed to needy residents of New Orleans. Through this process, the youth will also learn that they have the potential to positively change the social and environmental conditions of their local neighborhoods while improving themselves and preparing for their future. The farm location at City Park, part of a golf course that went out of business after hurricane Katrina, is centrally located in New Orleans among many economically disadvantaged communities and vast food deserts.

Grow Dat Youth Farm was made possible through the work of Tulane City Center (Tulane Universities School of Architecture) and the New Orleans Food and Farm Network, along with the help of several colleges at Tulane University and the Center for Public Service and New Orleans' City Park. The farms 6,000 ft² operations building is was designed by students of the School of Architecture and was built from seven recycled shipping containers and reclaimed steel trusses. The design includes office space, storage areas, conference rooms, a learning kitchen and a central open area that is used for events

Fig 15. Views of the Grow Dat Youth farm center designed by Tulane University architecture students.

(Grow Dat Youth Farm, 2016). Stormwater is harvested from the building and farm using bioswales where it is naturally filtered to recharge groundwater. The farm itself uses sustainable, bio-intensive farming practices to produce a 100% organically grown crop. Only two of the seven acres site are used for production. Each year the farm produces an average of 12,000 pounds of fresh produce, 70 percent of which is sold through farm stands, CSA programs, and farmers markets. 30 percent is donated through a Shared Harvest Program which provides low-income residents with free fresh food (Grow Dat Youth farm, 2015).

Grow Dat Youth Farm is a premier model on how an urban agriculture project can be made successful by combining the resources of higher education, local non-profit organizations, communities, and the youth. While working to help improve the food environments of surrounding communities, GDYF is also able to provide the opportunity for youth to develop valuable new skills that can lead to meaningful jobs in their future.

CHAPTER 3: URBAN AGRICULTURE

Food Security

The Great Recession of 2008 that so badly hurt the golf industry also had many other economic consequences that were felt throughout the United States and the rest of the world. Millions of Americans lost their jobs as giant banks failed, the automotive industry sank, and for the first time in history gas prices skyrocketed past four dollars a gallon across the country (Nordahl, 2009). The number of people living in poverty, which is defined as families of four earning less than $24,230 annually, has since then grown to over 46 million people in the U.S. or 14.8 percent of the population in 2014 (US Census, 2014). One of the most serious concerns facing those living in poverty is food security.

The United States Department of Agriculture (USDA) describes food security as an idea based on prevention that supports the development of sustainable, community based strategies based on these concepts:

- To improve access of low-income households to healthful nutritious food supplies.
- To increase the self-reliance of communities in providing for their own food needs.
- To promote comprehensive responses to local food, farm, and nutrition issues. (VerPloeg 2010)

Food insecure neighborhoods have been most prevalent in highly urbanized areas where we see the greatest populations of poor. Today over 50 percent of the world population lives in cities and that is expected to increase to 70 percent by 2050 (Koscica, 2014). As food production moves further and further from cities, fresh healthy produce becomes more difficult to acquire. Instead residents in these areas are forced to rely on an unhealthy diet of higher calorie, processed foods such as those found at corner stores and fast food chains which can lead to obesity and related negative health conditions. In

many of these neighborhoods supermarkets have moved out in search for better markets leaving behind what has been called "food deserts." A food desert has been defined by the USDA as an area that has limited access and economic means to acquire nutritious food, particularly neighborhoods of predominately lower incomes (Ver Ploeg, 2010).

In the city of Baltimore, 25 percent of residents live in a food desert and serious concerns over growing food deserts and limited access to healthy food led to the creation of the Baltimore Food Policy Initiative (Baltimore Food Policy Initiative, 2015). This was an intergovernmental collaboration between the Department of Planning and its Office of Sustainability, the Baltimore Health Department, and the Baltimore Development Corporation. Together these groups work to form strategies that will address food access in the city. The 2015 Food Environment Map (Figure 16) was the result of such a collaboration between the Office of Sustainability and the Johns Hopkins Center for a Livable Future (CLF). In the report for Baltimore City, a food desert is defined as "an area where distance to a supermarket is greater than ¼ mile, median household income is at or below 185% of the Federal Poverty Level, over 30 % of homes have no vehicle and the average Healthy Food Availability Index score for all food stores is low" (Baltimore Food Policy Initiative, 2015). The Food Environment Map recognized food deserts when all four variables are met:

1. Distance to a supermarket
2. 185% Poverty level
3. Access to a vehicle less than 30%
4. Supply and quality of healthy food

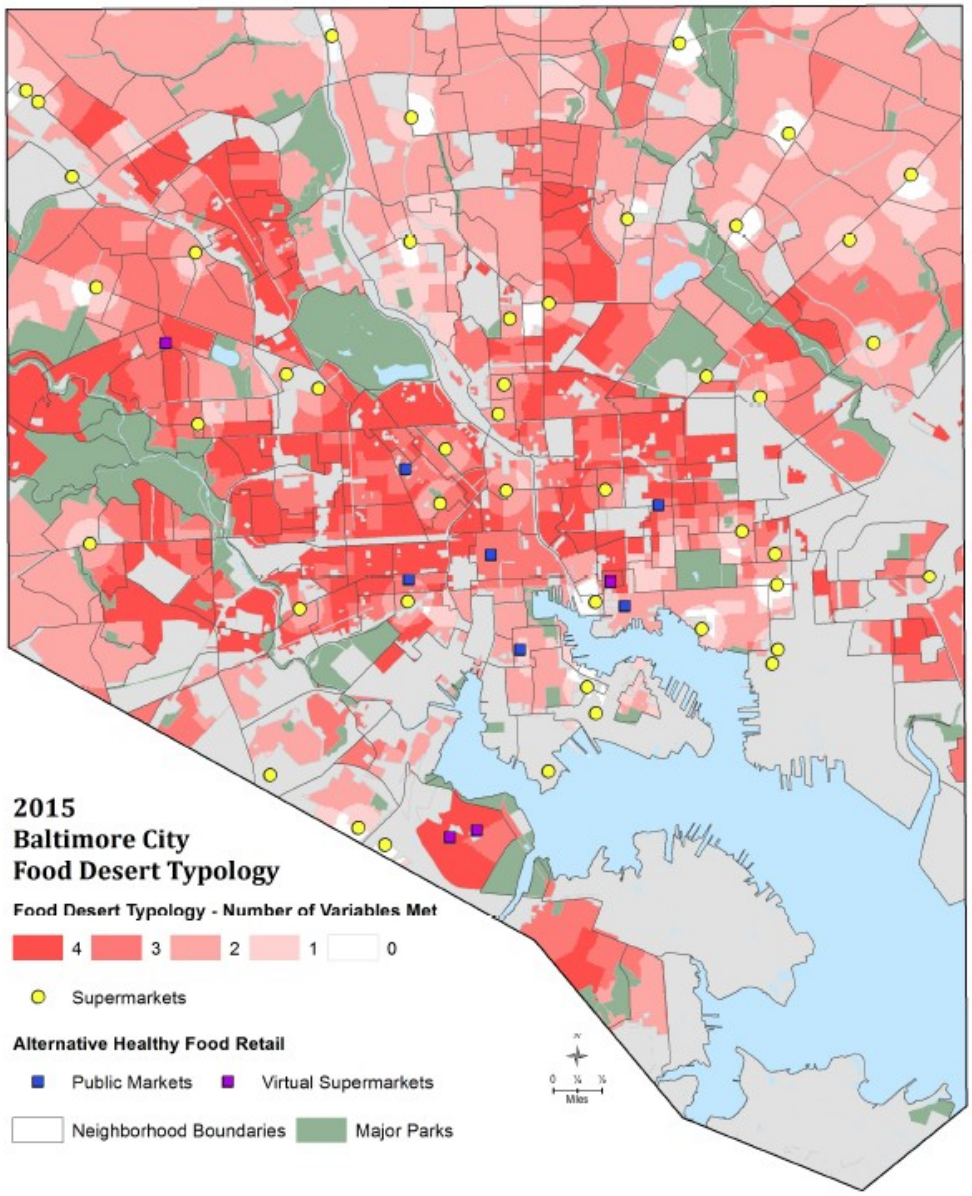


Figure 16. Baltimore City food desert map

Role of Urban Agriculture in Food Security

One option that has gained considerable traction recently as a way to promote food security within cities is Urban Agriculture (UA). UA has had many different definitions and on the most basic level it is defined as the production of food in urban areas. The Baltimore Office of Sustainability has adapted its own definition of urban agriculture in its Urban Agriculture Plan as:

> The cultivation, processing, and marketing of food, with a primary emphasis on operating as a business enterprise for income generation. It includes animal husbandry; aquaculture; agro-forestry; vineyards and wineries; and horticulture. It might involve the use of intensive production methods; structures for extended growing seasons; on-site sale of produce; and composting. A management plan is required for certain activities that addresses how the activities will be managed to mitigate impacts on surrounding land uses and natural systems. (Homegrown Baltimore, 2016)

Many different techniques are used in urban agriculture including in-soil or raised-bed cultivation, hoop house or greenhouse growing, hydroponics or aquaponics, permaculture, vertical farming, and orchards. Today UA accounts for nearly 15 percent of produce in the United States and is practiced by over 800 million people worldwide (Food and Agricultural Organization of the United Nations, 2016). UA, in most cases, utilizes bio-intensive growing methods that focus on producing greater yields of food in smaller areas, which can be very important in urban areas where access to land is often limited. At its most simple form, bio-intensive farming refers to maximizing crop yields from a minimum area of land while preserving and improving the quality of the soil (Fortier, 2014). Figure 17 provides an example of bio-intensive farming where rows are spaced closer in order to decrease the amount of land needed and condense practices needed to

Figure 17. Illustration comparing bio-intensive growing techniques versus traditional agriculture (Fortier, 2014).

grow. Not only can yields be increased but when these techniques are used with high-value crops, the economic impact can be significant. Urban garden plots have the potential to be up to 15 times more productive than traditional farming techniques, producing upwards of 40 pounds in one square meter annually ("Food and agricultural", 2016). Predicting yields in urban agriculture can be very difficult due to the many different growing conditions (region, soils, water, sunlight, etc.), techniques used to grow, and the experience of the grower. A study conducted in the City of Philadelphia found that an allotment garden of 5.2 acres, urban gardeners were able to produce1.34 pounds per square foot, totaling nearly 168,044 pounds of vegetables with an estimated value of $412,452 (Vitiello and Nairn, 2009). Figure 18 is the results of a study conducted by Urban Design Lab (2011) where they compared the yields in dollars of conventionally grown crops to bio intensive grown crops. Many of the most common market vegetables like leafy greens, tomatoes, squash, and cucumbers have a significantly higher return when grown using bio-intensive techniques.

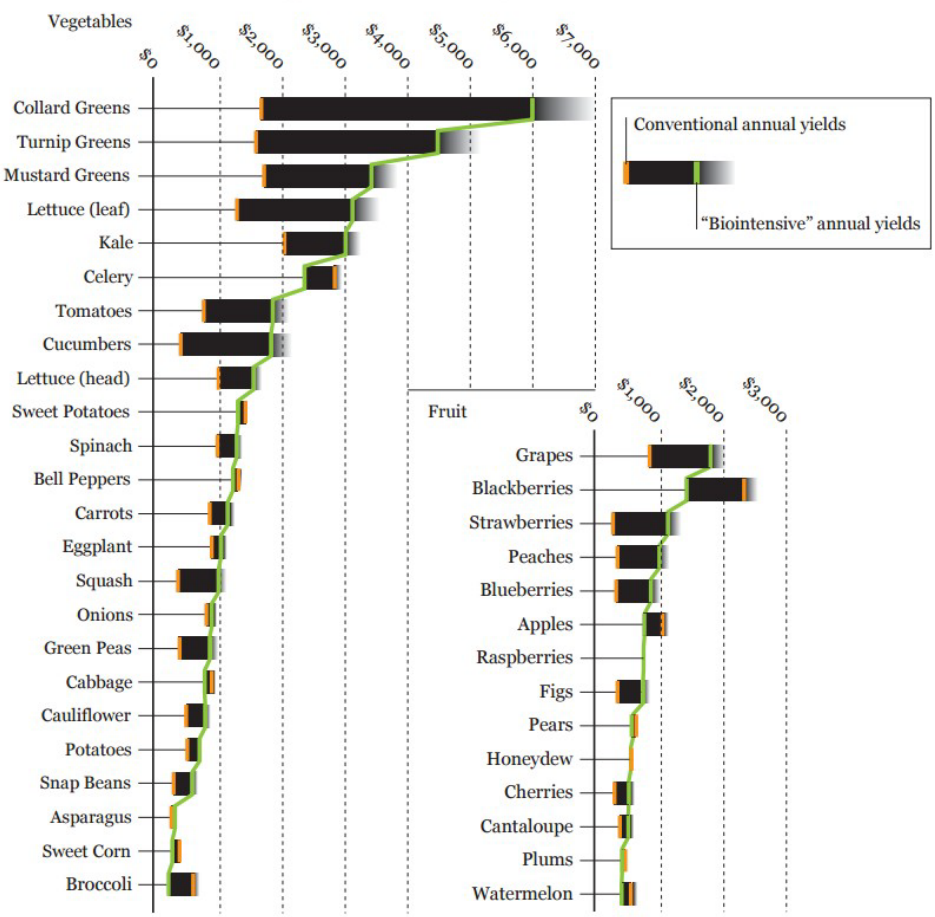


Figure 18. Graph displaying the difference in yield between conventional and bio-intensive growing techniques (Urban Design Lab, 2011).

While providing fresh food is the main goal there are many other benefits associated with UA. Studies today have shown that urban agriculture also has the ability to help improve the social, economic, environmental, and individual health issues that plague urban environments in the United States and around the world (Badami & Ramankutty, 2015). According to recent studies UA can increase access of heathy fruits and vegetables to low-income areas that have otherwise limited access (Nordahl, 2009). People who consume more fresh vegetables and fruits tend to lower their chances of chronic diseases associated with obesity (Hodgson, Campbell and Bailkey, 2011;

Gustafson, Cavello et al., 2007). At the same time it can help teach the public about nutrition and more healthy diet choices. The benefits of planting and growing in garden plots has shown to promote personal growth at an individualized level, encouraging better social and economic choices. Specifically, working together in garden plots and sharing between gardeners stimulates acceptance of cultural diversity and encourages community involvement amongst neighbors (Taylor and Lovell, 2013; Smit, Bailkey and Veenhuizen, 2006). Additionally, therapeutic benefits may come for those who work directly in urban agriculture. For example, "Renewal Farm…helps rehabilitate recovering drug addicts and alcoholics in New York City" (Hodgson, Campbell, and Bailkey, 2011). Greening projects in neighborhoods, especially ones like UA, can improve neighborhood resilience by learning to organize and adapt to changes while working toward a common goal (Tidball and Krasny, 2007). Social benefits arise from numerous opportunities for interaction among community, school, and small business involvement in the daily operation of UA sites. The growth of new friendships, partnerships, and trust amongst neighbors, local restaurateurs, and farmers, strengthens their investment in the community as a whole. UA can be a source for new jobs as well as new business attraction. It converts blighted, vacant properties in underserved communities to a source of easily accessible low-cost food and hands-on education. "A study in Vermont found that when comparing grocery store to farmer's market prices, buying organically at a farmer's market results in a lesser cost" (Boian, Hughes, and Deardorf, 2015). UA's effect on community value and growth has been accounted amongst its long-term advantages. "A recent study of New York City community gardens found that within five years of a community garden's opening, neighboring property values increase by as much as 9.4

percent and continued to increase over time. Disadvantaged neighborhoods experienced the greatest increase in property values." (Hodgson et al., 2001, Voicu and Been, 2008). Lastly, UA's vegetation and growth and environmentally conscious infrastructure leads to countless environmental benefits to the community as a whole. Polluted storm water is directed away from storm drains and into the land with individualized storm water management plans. UA on rooftops in cities has been shown to decrease stormwater runoff that contributes to combined sewer overflows (CSO). The Grange in New York City is a one acre urban farm on a roof top that is able to capture and filter one million gallons of stormwater per year (Cohen and Wijsman, 2012) "A study done in the Twin Cities of Minnesota found that a combination of tilling and the addition of compost allowed for three to six times higher infiltration rates than an untreated plot" (Boian et al., 2015). The foliage contributes to the urban neighborhood's biodiversity, serves as a habitat for its faunae while simultaneously reducing air pollution, and contributes to decreasing urban heat-island effect (Heather, 2012).

Urban Agriculture in Baltimore

Baltimore has recently emerged as one of the top 10 cities in the U.S. for urban agriculture. In 2009 the Baltimore City Office of Sustainability created the Sustainability Plan which listed urban agriculture as a way to develop a more sustainable city. The plans Greening Goal #2 states:

> Develop a plan that will promote healthy, local, and, where possible, organic food production and food professions and include multiple stakeholders currently involved in food production and job training. The plan should identify the predicted demand for urban-farmed food and recommend location and distribution of urban agricultural institutions. It could also identify the best distribution of existing food networks and identify gaps that need to be filled. (Baltimore City Planning Commission, 2009).

In 2013 the sustainability plan also introduced the cities *Homegrown Baltimore Initiative*, a plan to increase the production, distribution, sales, and consumption of locally grown food within the city (Homegrown Baltimore, 2013). The plan included three components: Grow local, Buy Local, Eat Local. *Grow Local* focusses on urban agriculture as a way to increase local food production. *Buy Local* calls for an increase in city farmers markets, csa programs, and farm-to- school programs as a means to increase sales and distribution of locally grown food. *Eat Local* aims to increase the desire and need to buy local, healthy foods. The Sustainability Office also released the Green Pattern Book in 2014 as a guide for options in greening and restoring the over 14,000 vacant lots and 16,000 vacant buildings in Baltimore City and urban agriculture has been identified as a possible option.

The city has taken additional steps to streamline the process for those who want to start UA businesses through changes in policy and zoning. In 2010 the city housing code was updated so that hoop houses are exempt from the need to acquire building permits prior to their erection (Homegrown Baltimore, 2013). The Homegrown Baltimore initiative also introduced a form of land leasing which allows people to obtain a five year lease at $100 per year to allow UA on city-owned vacant properties. The city will also provide potable water access for the entire year for a one-time fee of $120. In 2014 the Maryland General Assembly passed the Property Tax Credit-Urban Agricultural Property bill that would allow Maryland counties and Baltimore city to offer a property tax credit for any urban land used for agricultural production (House Bill 223, 2014). The bill identified UA property as any land larger than one eighth acre and less than five acres, located in priority funding areas and used for agricultural purposes. In May of 2015 Mayor Stephanie Rawlings-Blake signed a tax credit in Baltimore City that would grant

tax breaks to city urban farmers that grow and sell at least $5,000 worth of fruits and vegetables a year (Baltimore passes urban farm tax credit, n.d.). Other local organizations have also been created to help promote a vibrant UA scene in Baltimore

Figure 19. Farm Alliance Baltimore, Great Kids Farm, Baltimore Orchard Project

City. Farm Alliance Baltimore City is a network of various producers, both for profit and non-profit, working to increase the viability of urban farming in the city. A website, publications, and peer support is provided for those members who grow in the city, follow sustainable growing procedures, and meet a minimum sales quota. Farmers in the group work to pool resources to help one another in their efforts to become successful urban farmers. Great Kids Farm engages Baltimore City School students at all grade levels to support classroom learning, participate in every aspect of food preparation, and prepare students for success in 21st century colleges and careers (Great Kids Farm, 2015). The Baltimore Orchard Project is an organization that works to strengthen communities by planting and cultivating orchards, teaching environmental stewardship and sharing harvests with neighbors. In 2014 the organization worked with private property owners to harvest close to 5,000 pounds of fruit from existing trees and plant over 350 new fruit trees in Baltimore (Baltimore Orchard Project, 2015).

As of 2016 there are 17 urban farms in Baltimore city (for-profit and non- profit). There are also a total of 17 farmers markets in the city. Two of the most prominent and

successful UA businesses in Baltimore are Real Food Farm and Big City Farm.

Figure 20. Real Food Farms mobile market

Real Food Farm (RFF) is a not-for-profit farm located in and around Clifton Park, Baltimore. Their production, totaling around eight acres, consists primarily of orchards, field crops, hoop houses, and even bee hives. The mission of RFF is to work toward a just and sustainable food system by improving neighborhood access to healthy food, providing experienced-based education and developing an economically viable, environmentally responsible local agricultural sector (Real Food Farm, 2015). In order to help reach people who have limited or no access to a vehicle, RFF created a mobile food market truck which can make deliveries to neighborhoods or be staged at local farmers markets to distribute produce (figure 20).

Big City Farm (BCF) is one of the for-profit urban agriculture businesses in Baltimore city with the mission to build a network of urban farms in Baltimore, to create jobs, transform blighted, vacant property, and produce organically-grown fresh produce (Big City Farms, 2015). The operation currently has two separate locations in Middle Branch and Sandtown where they use two acres of hoop house production as their only growing technique. BCF produces primarily leafy greens and herbs to distribute to local grocers, institutions, restaurants, and individuals. Each half-acre site has produced

earnings of nearly $150,000 annually while providing full-time employment to 5 people (Meehan, 2013).

Figure 21. Hoop houses at the Middle Branch Location, Big City Farms

Both businesses represent the growing popularity of urban agriculture and the potential it can have to improve the livelihood of those both directly and indirectly involved. In order to support the growth and professionalism of similar ventures, a support system in the form of an urban agriculture hub would be beneficial.

Design Objectives

As previous research has indicated, the golf course industry is in a decline and current research does not suggest that it will return to the popularity levels that existed at its height. Cities especially need to re-consider how golf course properties, that are becoming less and less popular, can be put to a better use and provide more benefits to a larger population. The repurposing of Carroll Park Golf Course was based on how designers have started to convert unused golf courses to provide increasing environmental, economical, and social benefits using concepts of urban agriculture. The need to provide more healthy food options within impoverished areas is a priority for Baltimore and urban agriculture has been recognized as a reliable solution.

The objectives of this design are to:

1. Improve food desert conditions in Southwest Baltimore
2. Utilize the natural characteristics of a golf course and the existing infrastructure in order to support multiple types of urban agriculture production.
3. Create a park-like setting centered around agriculture, allowing for both active and passive experiences for visitors
4. Create an urban agriculture hub with a market and education center
5. Educate people on healthy food choices
6. Develop opportunities for new jobs in urban agriculture
7. Support growth of urban agricultural businesses

CHAPTER 4: METHODS

Site Selection

Carroll Park Golf Course is a 70 acre, nine-hole municipal golf course located in Southwest Baltimore, MD (figure 22). The golf course is bordered to the West and South by the Gwynns Falls and Interstate 95 respectively. To the North and East are the very dense industrial and residential areas of Southwest Baltimore. CSX train lines intersect the property to the North and East and between the course and Carroll Park sit the Montgomery Ward office park and a wood product processing warehouse. With direct access to I-95 this property offers ideal access and exposure to people traveling through Baltimore.

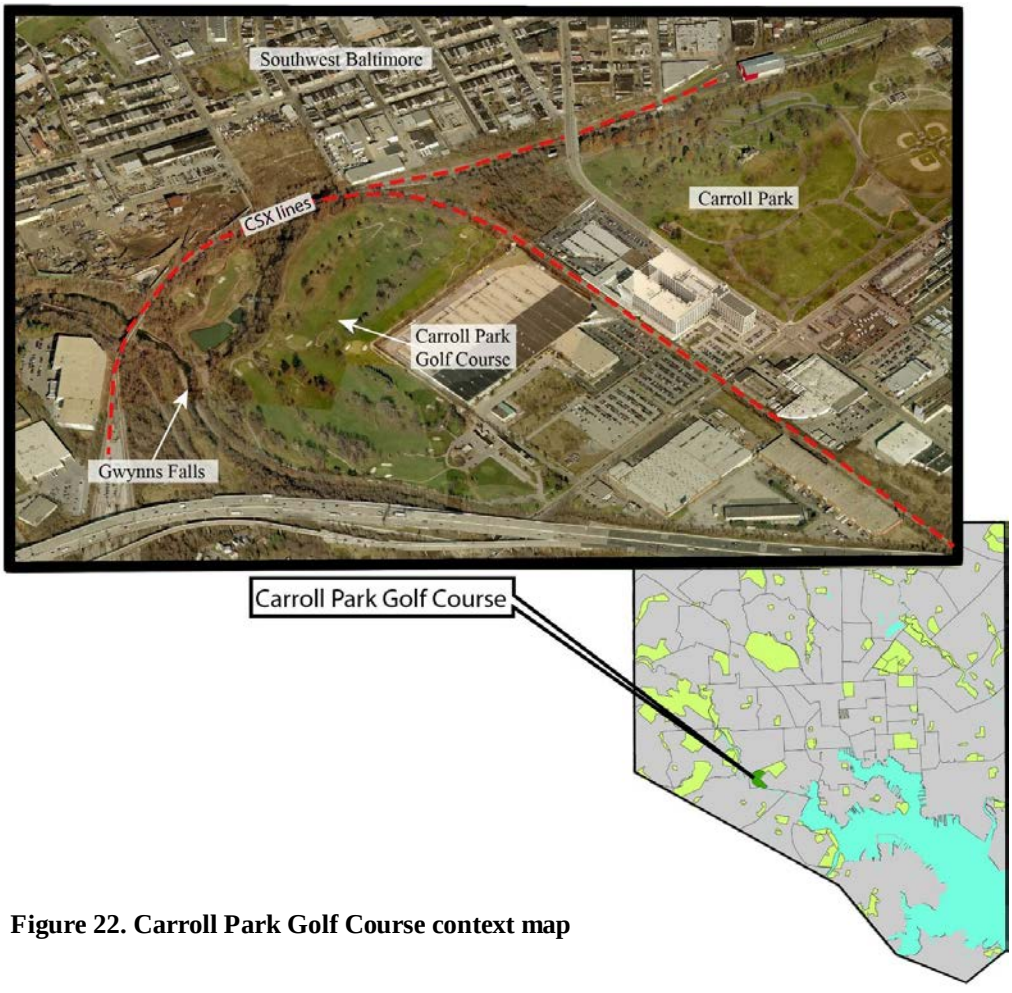


Figure 22. Carroll Park Golf Course context map

The proposed design will require the course to be no longer used for the purpose of golf and the following information will illustrate why Carroll Park Golf Course is the ideal location for such a design. Areas surrounding the site were also examined to ensure the final design will be well integrated and beneficial to the neighboring community of Southwest Baltimore.

Figure 23. Birds-eye-view of Carroll Park Golf Course (Google Earth).

Why Carroll Park Golf Course?

- Carroll Park Golf Course is one of the least used municipal golf courses in the city.
- The neighboring community of Southwest Baltimore has a high percentage of food deserts.
- The golf course's proximity to the Gwynns Falls offers stormwater management benefits.
- The course could provide additional connections to other parks, trails, and transportation.

The city of Baltimore owns five golf courses, four of the courses, Clifton Park, Forest Park, Mount Pleasant, and Carroll Park are located within the city limits while the fifth is located roughly 15 miles north of Baltimore along the Loch Raven Reservoir (figure 24). Carroll Park Golf Course is the only course of the five that does not have a full 18-hole layout. Only offering a 9-hole experience, this course is not suitable for outings and other events that tend to bring in more income. In conversations I had with the Superintendent of the course, Carroll Park has never really made any money and actually tends to lose money in most years. Because of these factors Carroll Park Golf Course is only open six months out of the year from April-October. With two other 18-hole courses within a five mile drive of Carroll Park it appears to be a likely candidate to be closed. Directly to the North of Carroll Park Golf Course is the neighborhood of

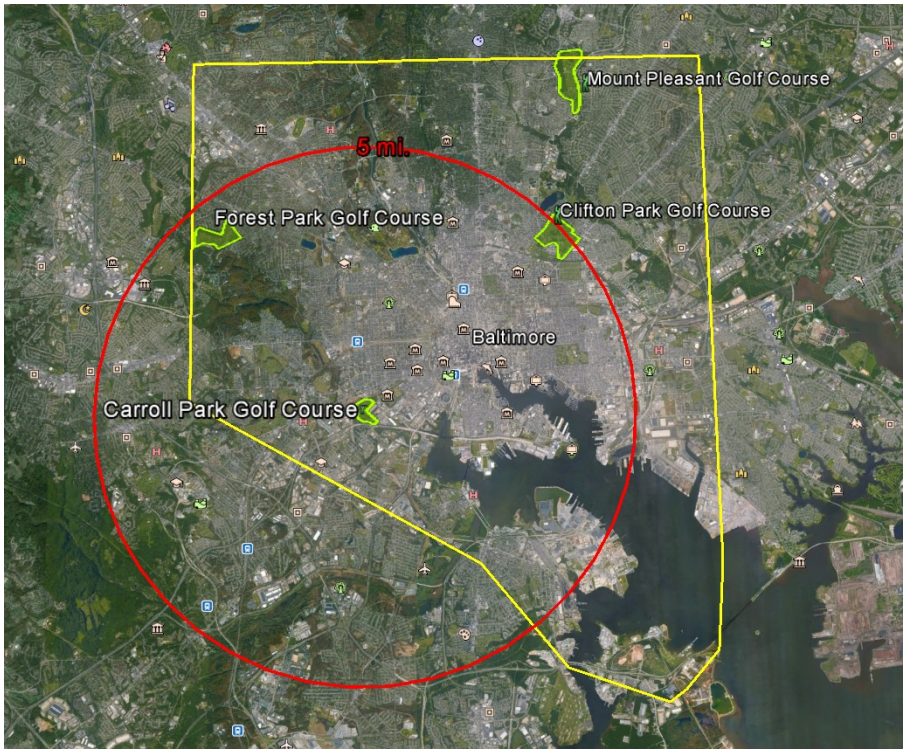


Figure 24. Google Earth image displaying proximity of other Baltimore municipal golf courses to Carroll Park Golf Course

Southwest Baltimore.

Southwest Baltimore has a population of 17,800 and covers around 870 acres, 63 percent of which is considered a food desert (figure 25). An urban agriculture site here could bring relief to much of Southwest Baltimore in the form of jobs, education, and a reliable source of fresh, local food.

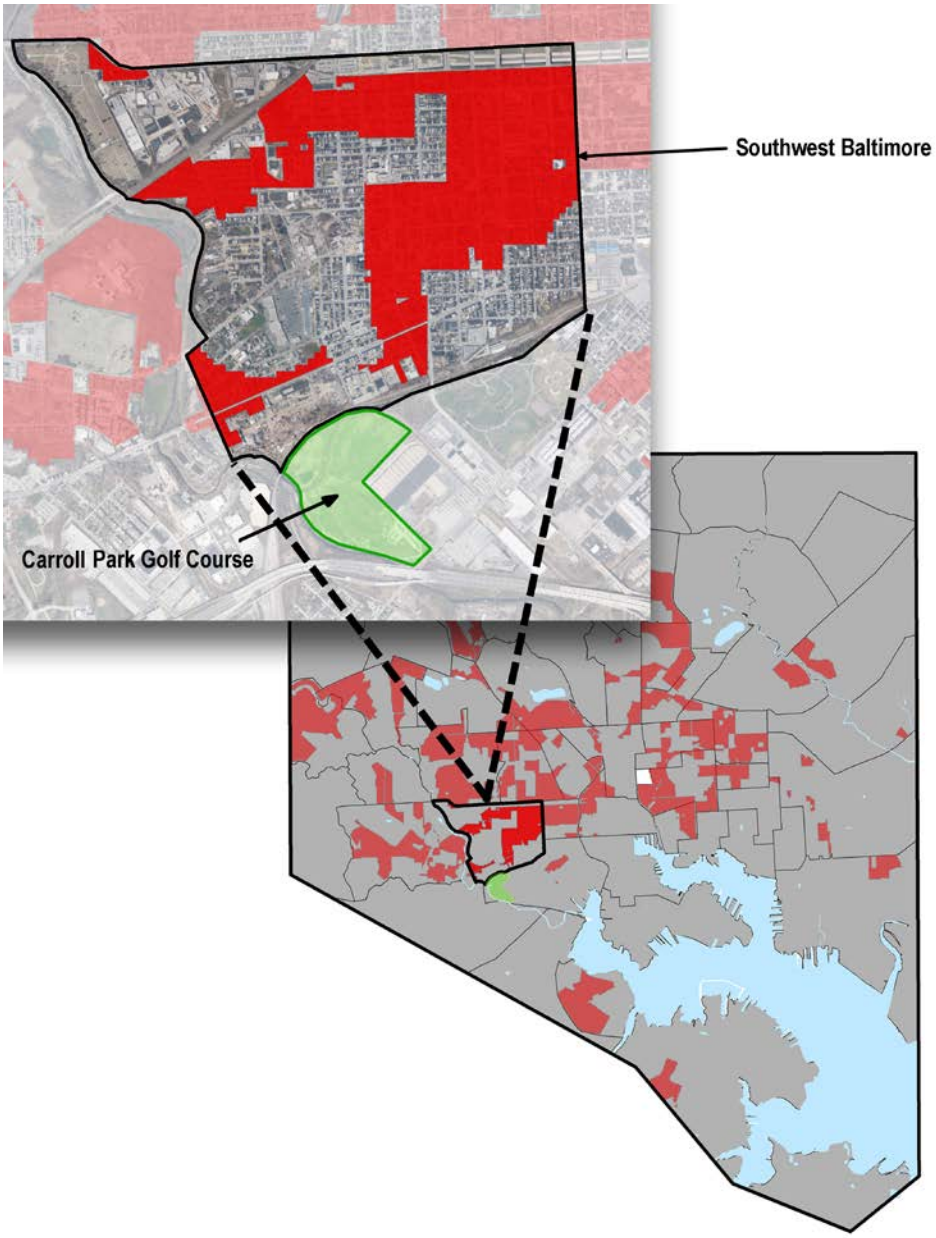


Figure 25. GIS map displaying food deserts in Baltimore City and zoomed into Southwest Baltimore

Access to Healthy Foods

Figure 26. GIS map displaying the proximity of supermarkets, corner stores, and fast food restaurants in Southwest Baltimore

S.W. Baltimore has very poor access to healthy food options (figure 26). There is only one supermarket while there are numerous corner stores and fast food chains. There are also no nearby city or farmers markets.

Vehicle Availability

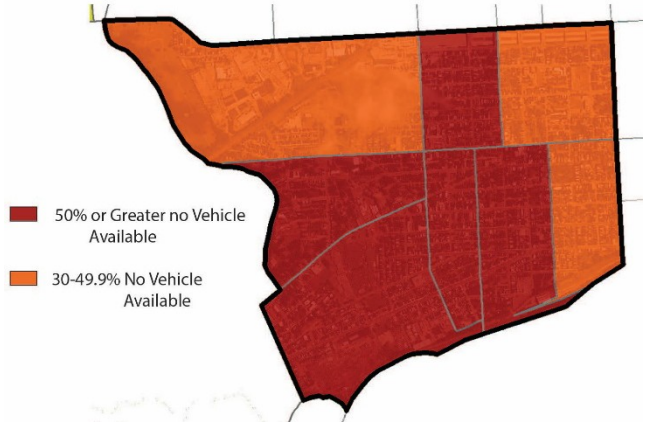


Figure 27. GIS map of vehicle availability in Southwest Baltimore

With limited, and in many cases no access to a vehicle (Figure 27), residents rely on their food supply from places like fast food and corner stores where the nutritional value is

poor. This effect can lead to increased cases of obesity and other serious health problems associated with a poor diet.

Low Income Neighborhood

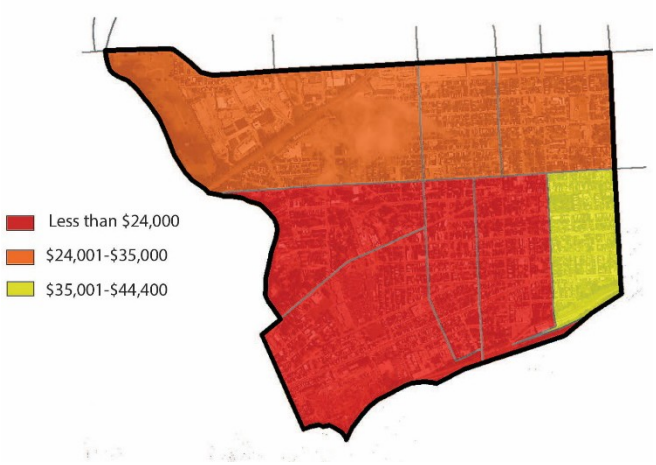


Figure 28. GIS map displaying income levels for a family of four in Southwest Baltimore

All of S.W. Baltimore is in the 185 percent poverty level meaning a family of four is earning an annual total of $44,400 (Figure 28). However, a large majority of the neighborhood earns far below that and half the community earns less than $24,000 a year.

Historical Influence

The property on which Carroll Park Golf Course sits was once part of the 800 acre Georgia Tract plantation developed by Dr. Charles Carroll in the early 1700's. Over time the property has gone through multiple transitions from a plantation, an industrial area with mills and steel works, to a public park as it is today. During the Public Park/ Olmsted Era 1890-1926, the Baltimore City Park Commission began to buy up pieces of the property to be developed into a city park. The first two sections A and B in Figure 29 would be designed by the Olmsted Brothers as Carroll Park. Parcel C was not included in the park design but the Olmsteds did weigh in on the property and would decide for it to

be left as open space.

> "They did [the Olmsteds] recommend the thinning of massive thickets, the clearing of areas for grassy openings, the building up of the embankment between the railroad and the park, improvements for proper site drainage, and a pedestrian tunnel underneath the railroad." (Landscapes, 2001).

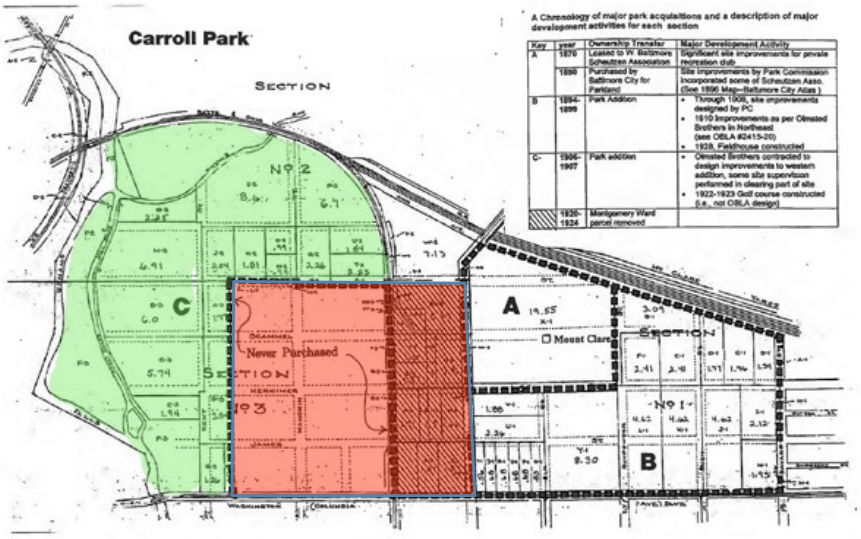


Figure 29. Map of property purchased by Baltimore City that eventually became Carroll Park and Carroll Park Golf Course

The space between the two properties in red was sold in 1920 to the Montgomery Ward company where an eight story art deco office building was constructed and remains open today. Parcel C was left untouched until 1923 when the Director of Parks and Recreation, Charles "Gus" Hook, laid out a 9-hole golf course (Landscapes, 2001).

The Carroll Park Masterplan contained some additional historical information that has been influential on some of the design concepts included in the new urban agriculture park. Structures that were on the property previously included an octagonal bandstand used as a gathering space in the park and multiple greenhouses that would be

used to propagate plants that were eventually distributed throughout the park system of Baltimore (Landscapes, 2001).

Figure 30. Photographs of bandstand c. 1880 and greenhouses c.1927 located in Carroll Park (Landscapes, 2001)

In the new agriculture park plan, the visitor's center and gathering spaces in the property have adopted this octagonal architecture as a tribute to the park's early days. A portion of the new design will also incorporate greenhouse and nursery production in order to plant public spaces in Baltimore with edible plant material.

With a closer look at the Olmsted plan for Carroll Park (Figure 31) it can be seen that there were also designs that included tunnels or paths that would be used to cross the CSX lines that divide the golf course property from the rest of the park. This information will be used to create new entry ways to the urban farm park that will be important to provide better connections to surrounding neighborhoods and parks which are currently divided by S. Monroe St. and the CSX lines.

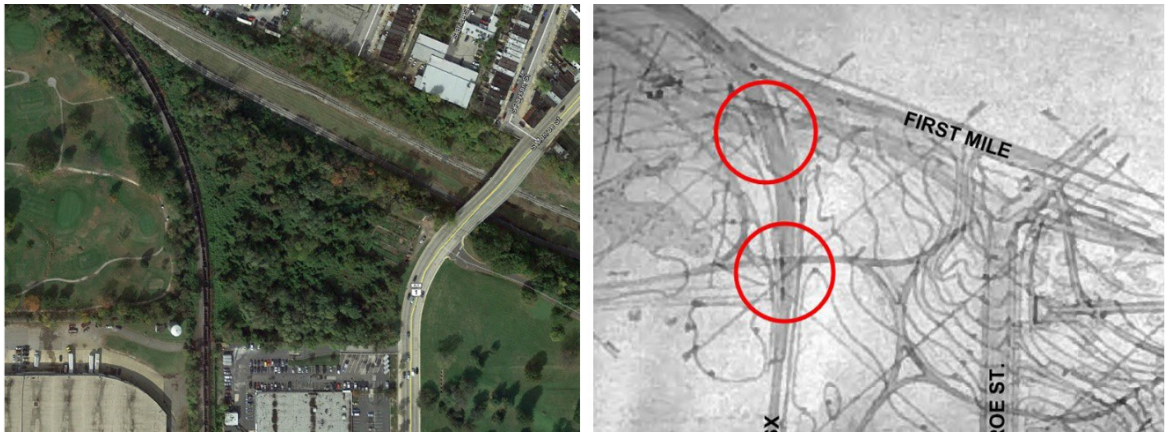


Figure 31. Present day Google Earth image compared to Carroll Park Master Plan by the Olmsted Bros. (Landscapes, 2001).

There has also been discussion in Baltimore on the future of the rail corridor between Carroll Park and S.W. Baltimore. Figure 32 shows the "First Mile", a plan that has been pitched that would rehabilitate the poor transition between the neighborhood and Carroll Park by incorporating new housing, street cars, and trail systems that would link the neighborhoods to the parks and even allow the Gwynns Falls trail to wander through the golf course.

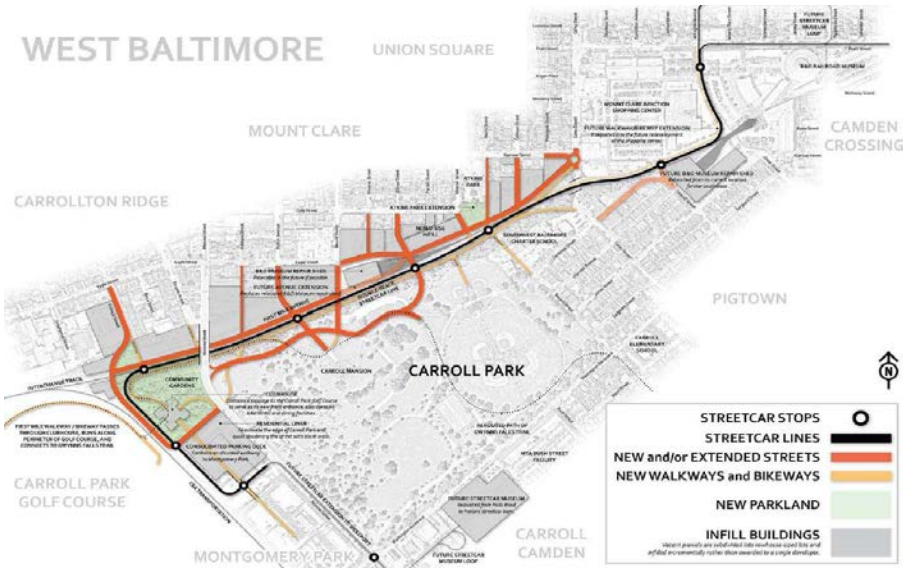


Fig 32. Conceptual drawing of the proposed "first mile" corridor connecting Southwest Baltimore to Carroll Park (Szarkowski & Neily, 2014).

Demographics

When compared to Baltimore City and Maryland as a whole, Southwest Baltimore is significantly below average socio-economically. Southwest Baltimore is comprised of 76% African Americans, 17% white, and 4 % Hispanic (figure 33). Baltimore city is similarly comprised of 63% African Americans, 28% White, and 4% Hispanic. The state of Maryland, on the other hand, is 55% white, 29% African American, and 8% Hispanic. Unemployment in Southwest Baltimore in 2010 was more than double that of Baltimore City and almost four times that of Maryland as a whole (figure 33). The median household income of the study area, on the other hand, is more than ten thousand dollars less than the city-wide income and more than twenty thousand dollars less than the state-wide income.

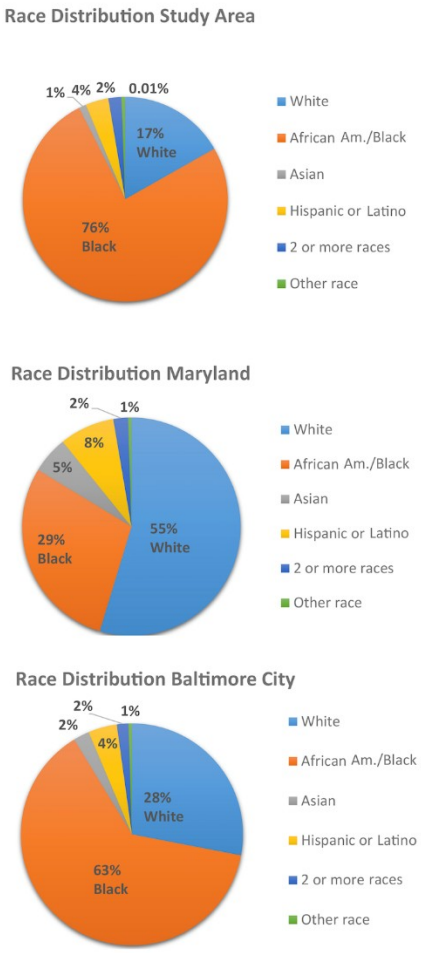


Figure 33. Demographic data for SW Baltimore, Baltimore City, and Maryland

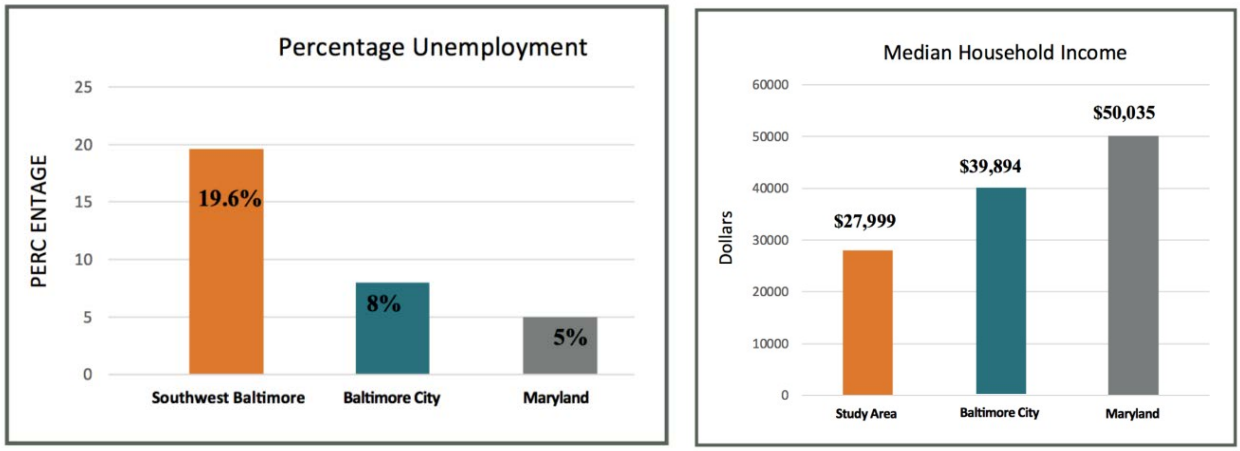


Fig 34. Unemployment and income for Southwest Baltimore, Baltimore City, and Maryland

Soils

One of the most significant factors in any agricultural production is soil quality. The ability to which a certain type of soil can support healthy crop production depends greatly on the physical, chemical and biological character of the soil. The Cornell Soil Health Assessment Training Manual states that healthy soils should have these 10 characteristics:

- Good soil tilth
- Sufficient depth
- Sufficient but not excess nutrient supply
- Small population of pathogens and pests
- Good soil drainage
- Resistant to degradation
- Free of chemicals and toxins that may harm the crop
- Resilience when unfavorable conditions occur
- Large population of beneficial organisms

The site proposed at Carroll Park Golf Course is comprised of various types of soils with a range of physical and chemical traits that will help when deciding what types of crops can be grown and where. Soil type is a term typically used to explain the physical

Figure 35. Hydrologic Soils

composition and properties of soil. With the help of the Web Soil Survey tool offered by the USDA it was determined that on the roughly 66 acres of property there are nine types of soil classes (Figure 35). The nine soils have also been grouped into three hydrologic soil groups ranked from A through D and from the lowest threat of runoff to the highest respectively. Infiltration rates can be thought of as the soils ability to absorb rainfall, while runoff is the opposite where soils that display lower infiltration rates have a greater chance to cause sheet flow of storm water runoff. The following chart represents the percentage of hydrologic soils at the site. B soils tend to have moderate infiltration rates from .15-.30" per hour. C soils have lower infiltration rates and sometimes a layer that may obstruct drainage and rates of .05-.15" per hour. Group D soils are usually the worst draining soils with a high runoff potential. Higher clay contents create slow infiltration rates of 0-.05"per hour. Flooding of the Gwynns Falls over time has contributed to loamy-sandy soils that are often associated with high sediment creating fertile soils. Although, it must be noted that floodplains tend to flood almost once a year and activities

Figure 36. Total acres of hydrologic soil groups

that occur here should be carefully considered. While the USDA Soil Survey is a good source to get a base-line understanding of the general soil conditions, it is necessary to perform core sampling in order to more accurately understand the condition of the site's soils. At a glance it is positive to see that a large majority of the site is loam to sandy-loam soils and are desirable soils for the production of high quality vegetables.

Climate

The weather patterns experienced in Baltimore are largely dictated by its geographic location. Situated on the Fall Line, partially in the Coastal Plain and Piedmont Plateau, Baltimore is protected from the Appalachian Mountains to the West and the Chesapeake Bay to the East. The climate in Baltimore is considered humid sub-tropical with mild winters and hot, humid summers. Temperature varies with the warm season from May 29 to September 16 where the average temperature is about 78°F. The warmest day is usually around July 14 at 88° F. The cold season generally last from December to March where the average daily temp is around 50°F with the coolest days occurring around mid-January where the average low temperature is around 25°F.

When growing crops, frost can play a major role in the timing of spring planting and fall harvest. For crops that are being started inside greenhouses during frigid months,

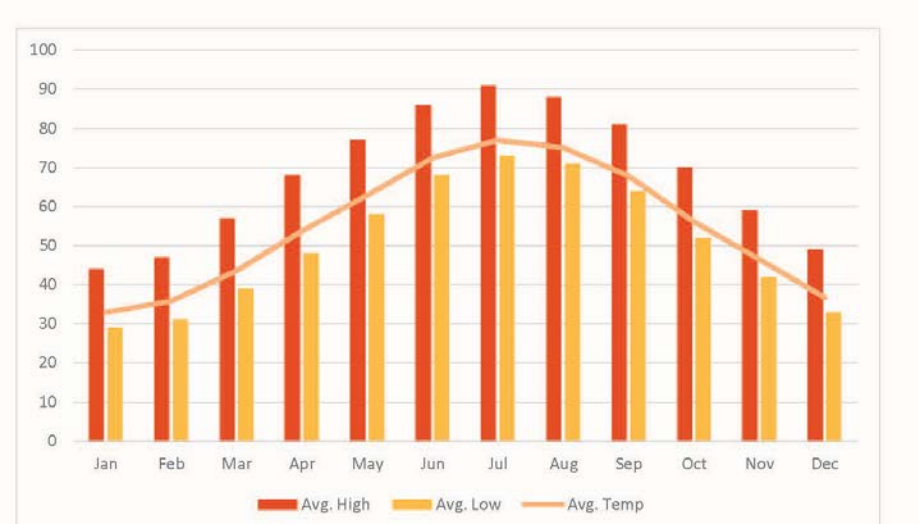


Figure 37. Average annual temperature Baltimore Maryland

Baltimore City Frost Probability

Percent Probability of Temperature 32 Degrees F. Or Lower, On Or Before

10% 1 yr. in 10	33% 1 yr. in 3	50% 1 yr. in 2	67% 2 yrs. in 3	90% 9 yrs. in 10
Oct. 30	Nov. 8	Nov. 13	Nov. 18	Nov. 28

Percent Probability of Last 32 Degree F. Temperature Occurring On/Or After Date In Spring

10% 1 yr. in 10	33% 1 yr. in 3	50% 1 yr. in 2	67% 2 yrs. in 3	90% 9 yrs. in 10
April 11	April 1	March 26	March 20	March 10

Table 1. Frost probability for Baltimore Maryland

knowing the optimum time to plant them is crucial. During the fall it is equally important to understand these times. Many crops like tomato, pepper, and cucumber can be killed by freezing temperatures. Table 1 gives accurate probability of the likelihood of frost in fall and spring.

Again due to its geographic location and local topography, Baltimore, much like Maryland, experiences many extremes in weather. Precipitation averages from 40-45" a

year and about 20” of snow per year. Summer can bring with it very high temperatures mixed with high levels of humidity. These factors, when combined with moisture supplied from the Chesapeake Bay, can lead to very strong thunderstorms that can produce locally heavy rainfalls. Nearly 20% of these storms happen in spring and early summer when the air is unstable (Mogil & Seaman, 2009). Because Baltimore is such a heavily urbanized area with varying terrain and proximity to the bay, localized flash flooding is a very common occurrence.

Hydrology

The topography of the site is undulating with two main ridges that define where water either drains into a smaller stream, the Gwynns Run, to the Northwest or the larger Gwynns Falls along the south. Slopes on the site range from rather flat from 3-5 percent to a maximum of 15-20 percent slopes on the northern section of the site. Studying the catchment areas will reveal where design features such as irrigation ponds and

Figure 39. Topography and drainage map

bioretention cells can be located. As many golf courses were, Carroll Park Golf Course was constructed partially within a floodplain. These areas posed many problems for development so they were often devoted to open space in the form of parks and golf courses. The map in Fig 40 displays the Flood Hazard Zones as defined by the Federal

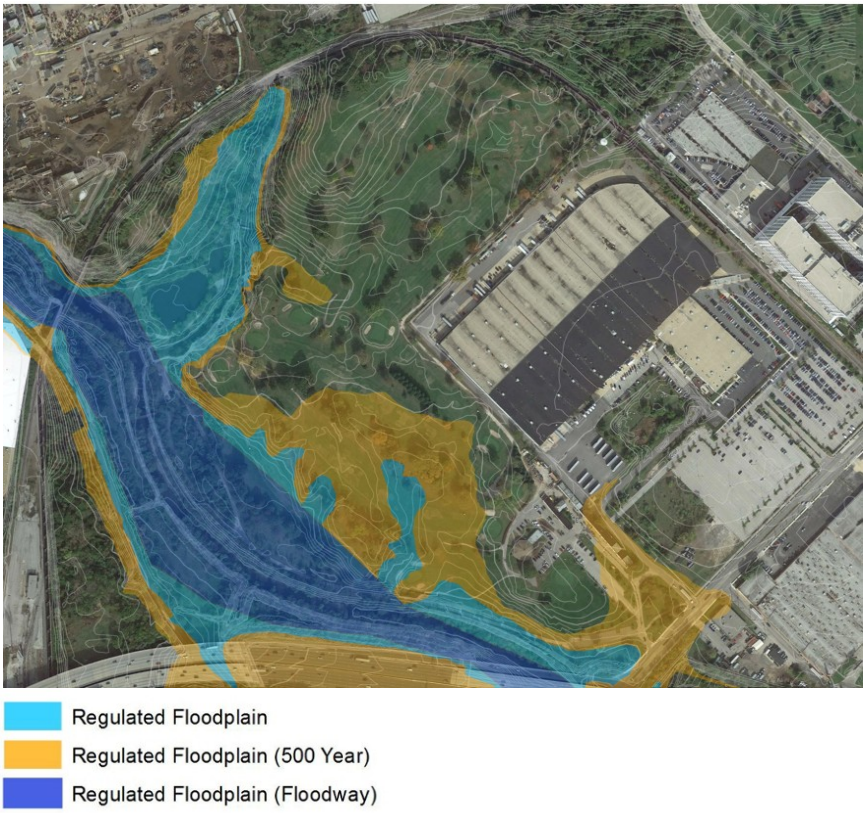


Figure 40. Google Earth image displaying proximity of other Baltimore municipal golf courses to Carroll Park Golf Course

Emergency Management Association (FEMA). The dark blue area is the Regulatory Floodway. This is the channel of a stream plus any adjacent floodplain areas that must remain free of any encroachment so that the 1% flood discharge can be conveyed without increasing the base flood elevation. The areas in light blue, which cover roughly 20 acres of the site, are the 1% flood zone also known as the 100 year floodplain. These areas are at risk of being inundated by floods that have a 1% chance of being equaled or

exceeded in any year. The areas in orange represent the 0.2% flood zone which represents the 500 year flood.

Existing Infrastructure

Golf courses have infrastructure that can potentially be repurposed in order to support urban agriculture practices. Figure 41 is a map that represents the existing golf cart paths, irrigation system, and structures that are presently located in Carroll Park Golf Course. Often golf cart paths have been established throughout the property in order to transport golfers during inclement weather. These paths, made from gravel, asphalt, and concrete could serve as transportation routes for farm equipment and even pedestrian trails. Many courses these days were built with wall-to-wall water management systems (irrigation). Irrigation systems could be used as-is with pop-up and impact sprinklers but for more accurate irrigation and to reduce waste, retrofitting existing irrigation would be necessary. Potable water lines are often placed throughout courses and these could be used to provide drinking water or water needed for public restrooms. Existing structures like restrooms, clubhouses, maintenance facilities and shelters offer more opportunity for re-use as other purposes. As mentioned in the earlier case studies, clubhouses were turned into community centers and kitchens, and maintenance facilities were used for storage and farm operations. In some cases golf courses that have gone bankrupt also agreed to sell the golf course maintenance equipment along with the course. In these cases tractors, hand tools, and even golf carts could be used for other purposes.

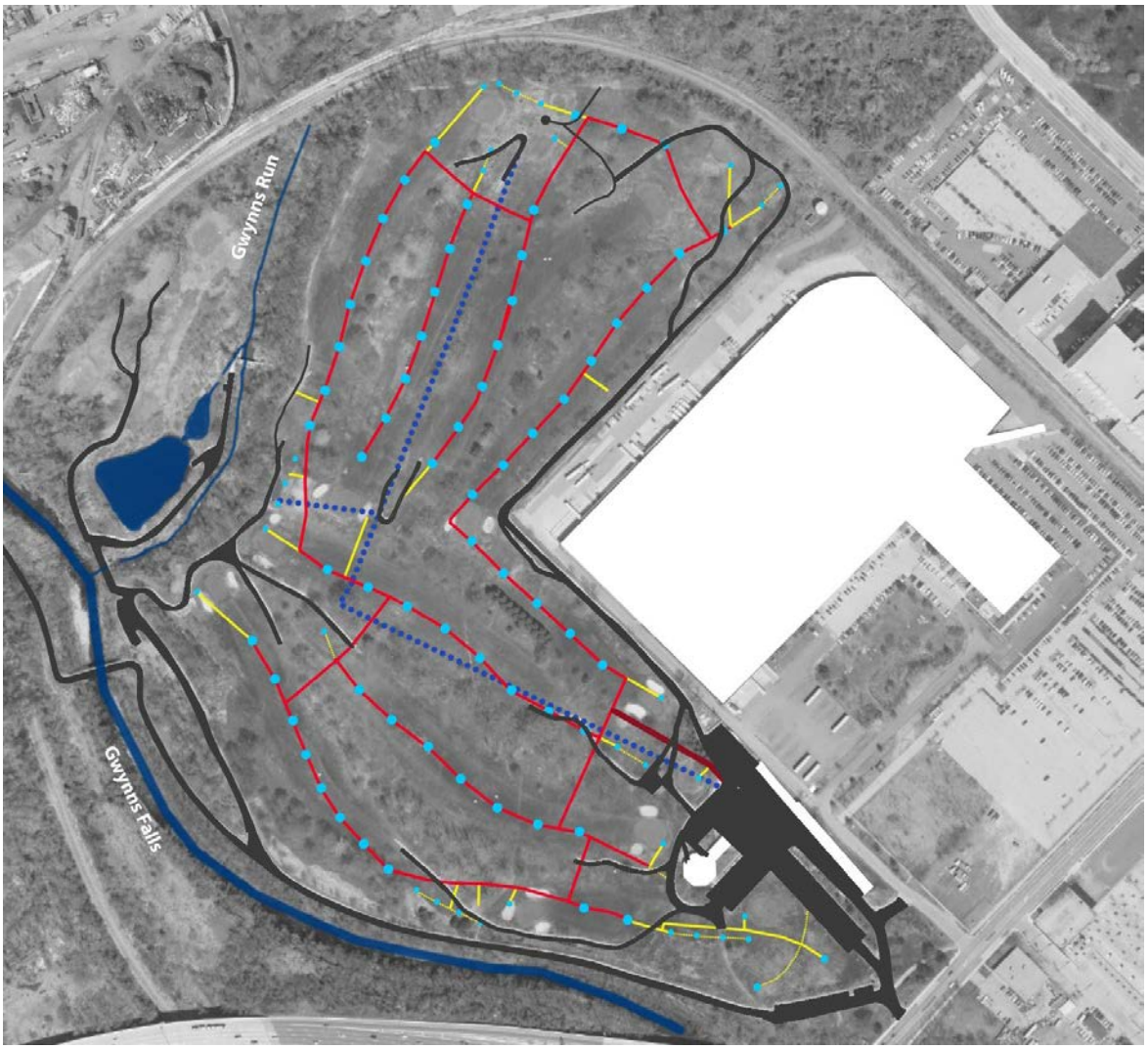


Figure 41. Existing Infrastructure of Carroll Park Golf Course (irrigation, paths, buildings)

Preliminary Program

The proposed design response is to take an underused golf course that is currently only serving a very small population of Baltimore golfers and create a new type of urban agriculture park that not only improves the accessibility of locally grown produce, but also improves the social, environmental, and economic conditions of Southwest Baltimore. In order to accomplish these goals the following elements will be addressed throughout the design.

1. Vibrant farmer's market space for growers to distribute fresh produce to the community and a welcoming place for neighbors to gather
2. Opportunities to educate people on where their food comes and the importance of eating flesh, healthy food
3. Year-round growing opportunities using various combinations of urban agriculture growing techniques
4. An urban agriculture farm in a park-like setting to allow active and passive experiences in agricultural production
5. Establish a city tree nursery that can be used to propagate and distribute fruit and nut producing trees throughout Baltimore's system of public open spaces and parks
6. Restore and protect valuable floodplain habitat to improve the health of local waterways

CHAPTER 5: DESIGN RESPONSE

Site Plan: Carroll Urban Agriculture Park

Figure 42. Site plan of Carroll Urban Agriculture Park

The design of Carroll Urban Agriculture Park can be broken down into five major areas including the main entrance, public garden spaces, a naturalized area, the working farm area, and the orchard and tree nursery (Figure 43).

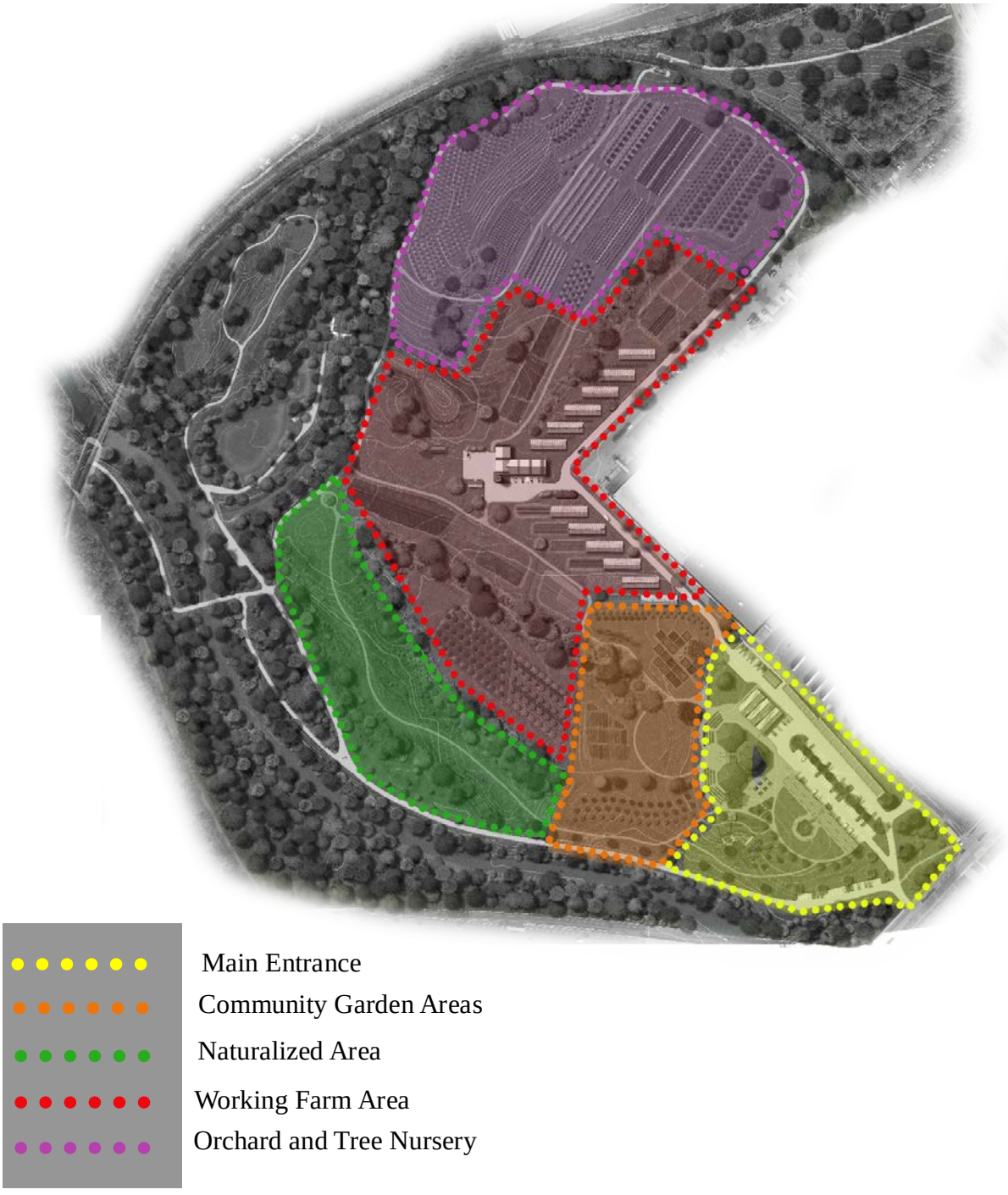


Figure 43. Map of the five main areas of the proposed design

Existing road and trail infrastructure on the golf course was used to help define the circulation routes of both farm equipment and pedestrians. The main loop, which is the primary road for farm equipment, is highlighted red in Figure 44. In sections, pedestrians and equipment alike will need to share the road. This 10-12 foot gravel road will provide easier access for employees and visitors to most parts of the farm. Various other paths include paved pedestrian trails and less formal gravel or mulch pathways. Because this is a working farm and a park, appropriate signs and markers will help direct visitors around the site and ensure their safety.

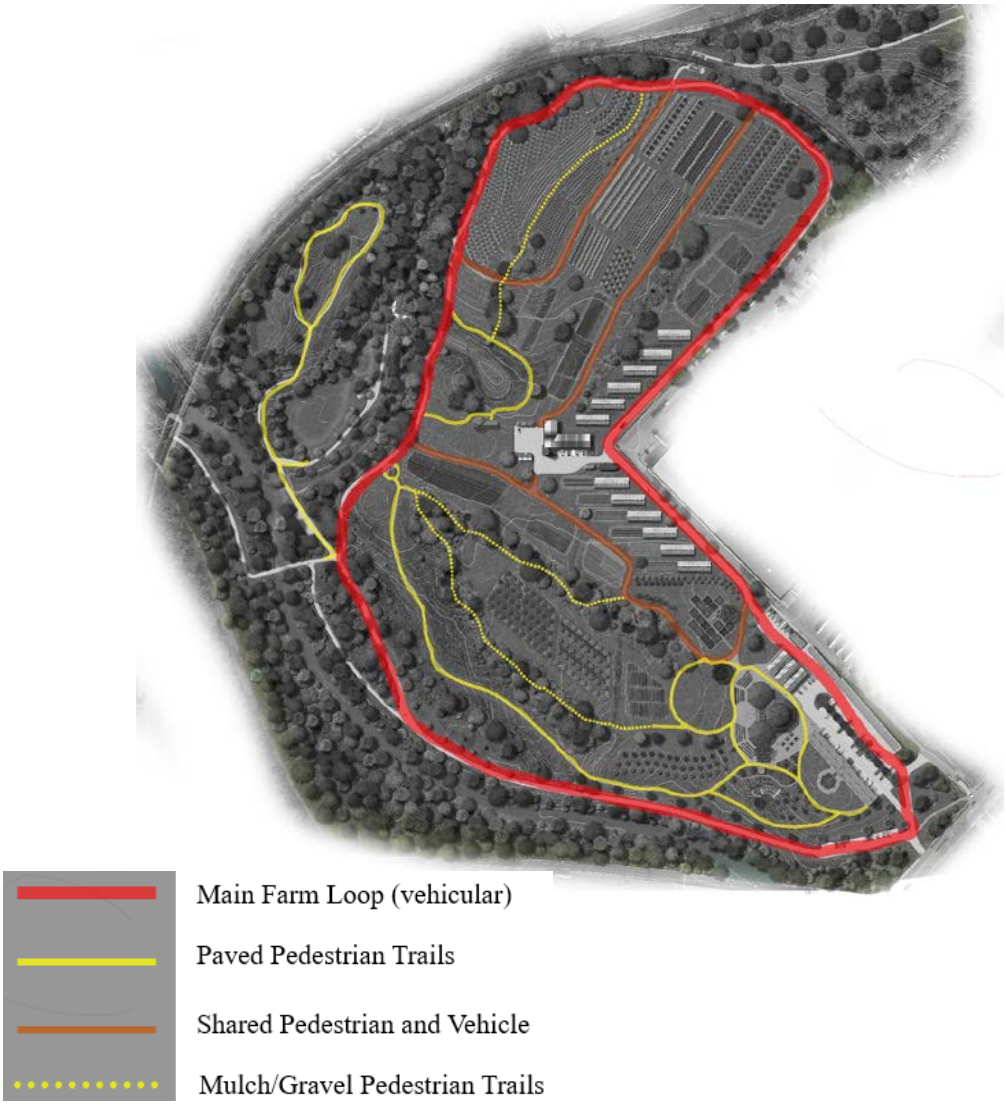


Figure 44. Farm transportation diagram

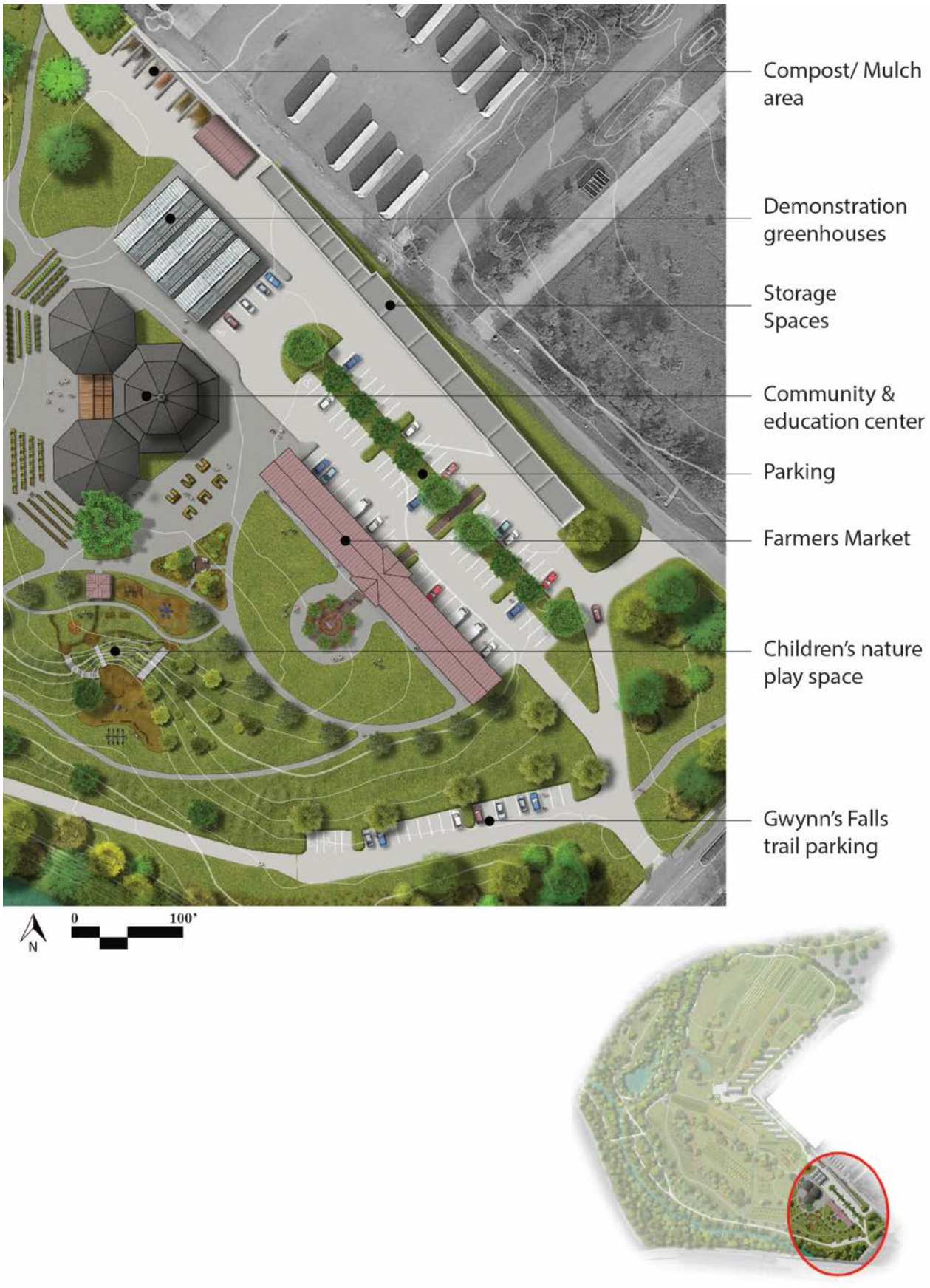
Main Entrance

The front entrance area of this design contains multiple spaces that are geared primarily toward public use and include:

- Parking area
- Farmers market
- Storage and rental space
- Community/ education center
- Children's nature play space
- Demonstration greenhouses
- Compost area

The main and only vehicular entrance to the site is off of Washington Boulevard just north of the I-95 overpass and direct access via on/off ramps to I-95 is also within 200 feet of the site. This area is currently occupied by the clubhouse, maintenance buildings and parking. Located on the southernmost end is the current parking area for the Gwynns Falls Trail. The new design uses roughly the same footprint of impervious area so as to not further increase stormwater runoff. The redesigned parking island not only provides an additional 25 spaces but also serves as a bioretention area for runoff associated with impervious areas around the market and community center. Existing concrete block garage areas have been repurposed and will serve as ideal storage and rental spaces for farm operations and market vendors alike. The existing area used for golf course supplies like soil and gravel has been updated to create an area for composting and supply storage.

Figure 45. Main Entrance



Farmers Market

The farmers market will serve as the permanent location for weekly farmers markets in Southwest Baltimore. The 10,000 square foot open-air structure was placed next to the existing parking area and provides 24 spaces for vendors to park and set up

Figure 46. Perspective of farmers market and parking area

their stands under the covered structure. A pedestrian walk way connects the visitor parking area and passes through the middle of the market, opening up to a large grassy gathering space with a circular planter and tree shaded seating area (Figure 46). This area will provide additional spill-over space for vendors and also serve as a communal area for people to relax and gather during farmers markets. Research has shown that farmers markets can have a positive impact on neighborhoods in the way they increase social interaction and help to promote stronger relationships among communities (Brown and Miller, 2008). With direct access to I-95, the location is easily accessible for local vendors and can provide the ideal location to distribute their produce.

Figure 47. Perspective of gathering space next to the farmers market

Community/ Education Center

Additions have been made to the existing clubhouse in order to provide more space for the new community and urban agriculture education center (Figure 47). The building itself will serve as a community center, event space, commercial kitchen, and also a job training center where under and unemployed members of the community can gain valuable job skills. A commercial kitchen inside the center will act as a job training area where workers can gain transferrable soft skills that can better prepare them for future employment opportunities. The kitchen will also serve the purpose of educating people on how to prepare and cook with fresh ingredients. Fresh food alone is not always the answer to food desert problems and studies have shown that simply placing new supermarkets and farmers markets in these areas does not change the buying habits of the residents (Heinonen et al., 2011; An and Sturm 2012).The

Figure 48. Perspective of urban agriculture community center

areas immediately surrounding the center have been reserved primarily as growing spaces for children to explore and for those with limited physical abilities. Everyone, despite their size, age, or physical condition, should have the opportunity to experience the joy and satisfaction that comes with growing your own food. Directly outside the main entrance are six wheel chair accessible planters that wrap around the gardener and provide easy access for tending their plots. On the back side of the center, facing the farm, are multiple raised beds for gardening. Irrigation for these areas is provided by a 10,000 gallon cistern that collects rain water from the roof of the center and with educational signage, visitors learn about the importance of reclaiming stormwater and how it can be recycled as irrigation for the garden.

Demonstration Greenhouses

The old golf maintenance building has been replaced by three year-round

demonstration greenhouses. These greenhouses will be a great opportunity to educate visitors on some of the more advanced growing techniques used today for greenhouse production such as aquaponics. Aquaponics is a system that combines aquaculture, the production of fish, and hydroponics, growing vegetables in a water medium (O'Hara, 2014). Farmers will raise fish, such as tilapia, inside of large tanks and pumps

Figure 49. Aquaponics greenhouse at UDC (Allen).

will recirculate the water in the tanks containing fish waste through vegetable planting beds. The plants will use the waste as fertilizer and will in turn filter the water before it is returned to the fish tanks. Systems such as those used at the University of the District of Columbia, Murkirk Research Farm, harvest the fish up to 4 times per year. This fish is then smoked in a commercial grade smoker where the fish can be preserved for much longer periods of time. According to UDC this system can expect to generate 500 pounds of fish and 5,000 pounds of produce (UDC, 2008). The other greenhouses contain

hydroponic systems for growing vegetables. These systems use a nutrient water instead of soil to grow vegetables such as leafy greens and herbs. Lettuce greens can be a sought after commodity for local restaurants during winter months and the income generated in these greenhouses can help cover operation costs of the farm during the off season. This area could help to create jobs specifically for running aquaponics and hydroponics greenhouses. As more urban agriculture businesses develop in the area, people trained at this site would be readily employable to manage these types of operations.

Children's Nature Playscape Area

Figure 50. Children's nature play area

Just south of the community center is the children's nature play area. This space was chosen because of its natural slope and proximity to the farmers market and community center. A playscape is an area that promotes play spaces that integrate physical, mental, and educational features (Gemmel, 2015). By cutting into the natural slope here, the design integrates two natural bank slides and a rock climb hill. Children can develop a better relationship with nature by allowing them to interact freely with loose features like natural tree logs and boulders. Fruit trees have been

Figure 51. Perspective of nature play area

established surrounding the area providing a small forest for kids to play in. Paved pathways that loop from the market area and the top of the hill provide wheelchair access to the playscape features at the bottom. The top section of this area just south of the community center has a gazebo, picnic tables and an sandy area for kids with some more traditional play structures such as swings and jungle gym. North of the area, between the market open space is an edible forest garden. Forest gardens apply principles of ecology to mimic natural forest ecosystems where plants form mutually beneficial relationships (Berenza, 2010). Just like in a forest, a forest garden is designed with a canopy layer, an understory, a shrub layer, and ground cover. Crops and plants are combined to help improve fertility and promote beneficial organisms.

Figure 52. Forest garden perspective

Public garden areas

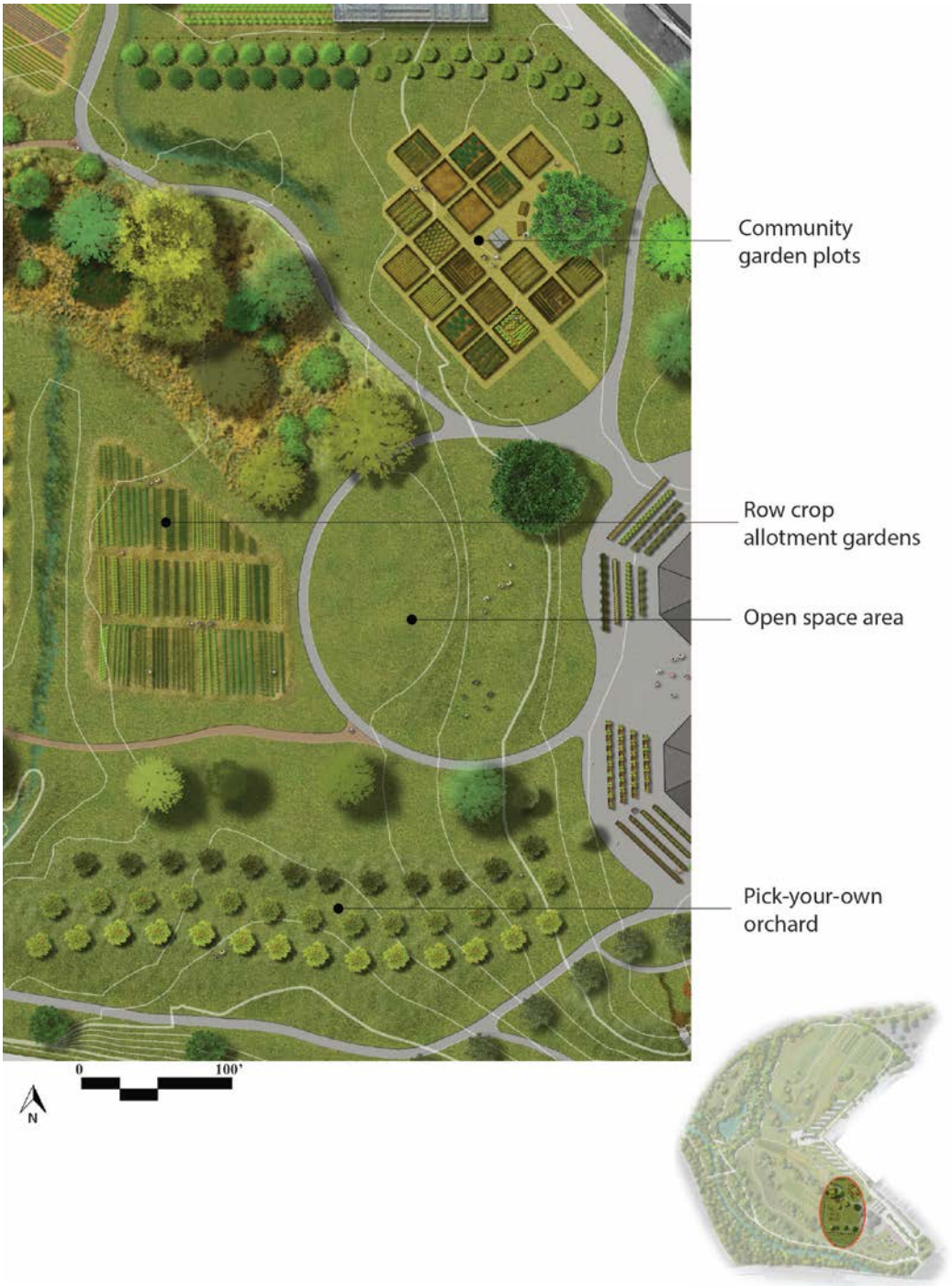


Figure 53. Public garden areas plan view

The public garden areas are located to the west of the community center. This area is intended to be used by members of the community who wish to rent spaces for

gardening and separate from the rest of the working farm, this area provides more convenient access located close to parking and the community center. To the north are the community garden plots. In this area are 20 foot by 20 foot raised-bed garden plots, a small fruit tree orchard, supply shed, and seating areas. Stormwater bioretention swales that will intercept runoff have been constructed down slope from the gardens and will direct water through the property to collection ponds.

Figure 54. Perspective of community garden plot area

Directly behind the community center is a large open space field that was the former location of the ninth green on the golf course. The roughly one acre circular space (Figure 55) provides a perfect setting for larger events like concerts in the park, weddings or just open recreation while visiting the farm. The area offers unobstructed views of the farm and a looping path with multiple spurs allowing visitors to explore the rest of the farm-park.

Figure 55. Birds-eye-view of open space lawn area in back of community center

Pick-your-own Orchard

Just south of the open space recreation field is a pick-your-own orchard. A mix of dwarf apple and pear trees wind down what was once the first hole par-3. Public would be allowed to freely collect fruit from the 1.5 acre orchard of over 50 trees. Because this area was partially within a floodway, it was decided that an orchard, rather than row crops would be appropriate here. Established trees would provide a strong root zone and also work as a filter for stormwater draining toward the Gwynns Falls.

Figure 56. Pick-your-own orchard (Epiphany School, 2015)

Naturalized Flood Plain Area

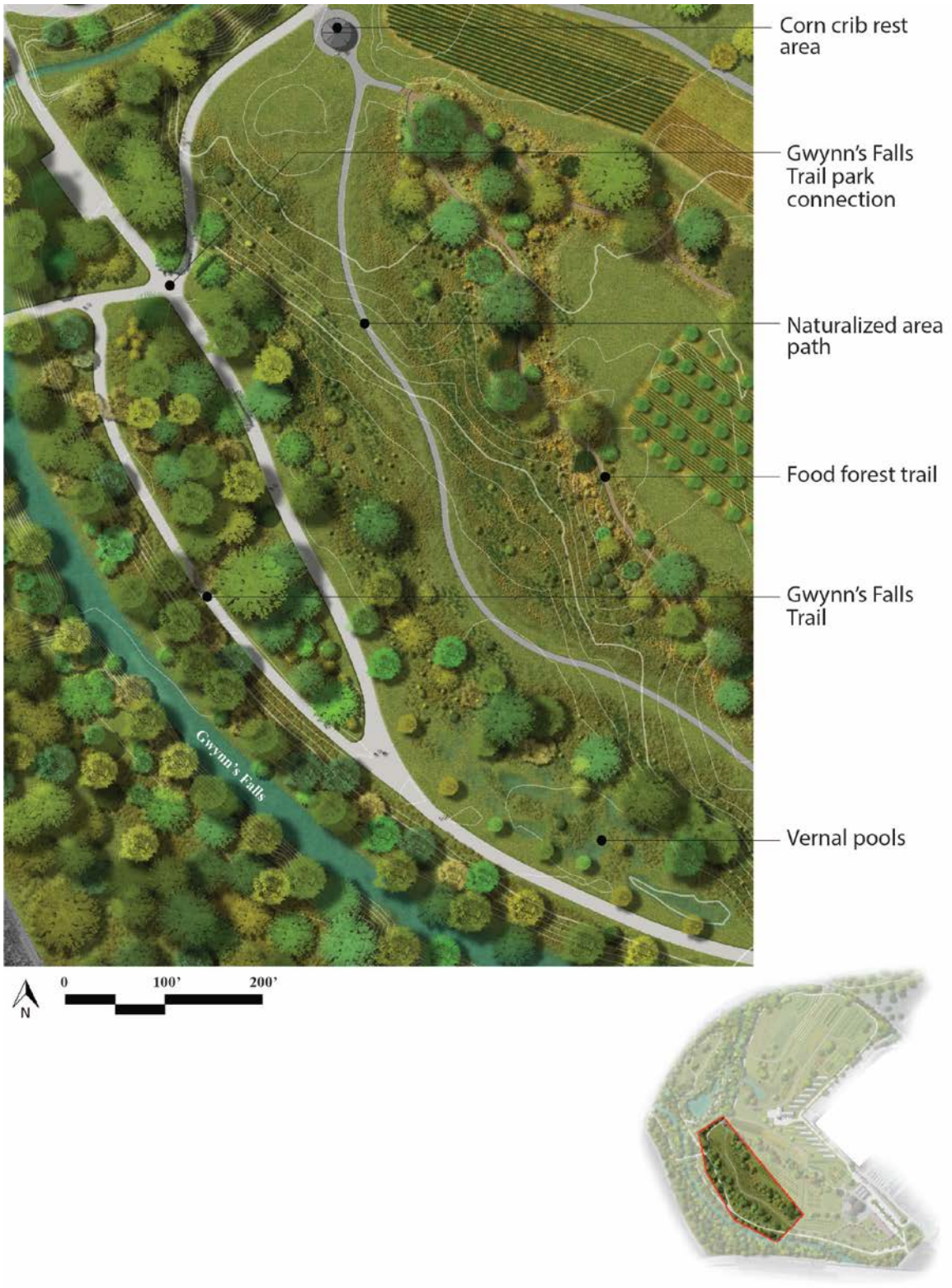


Figure 57. Plan view of naturalized area

The second hole of the golf course is almost entirely inside of the 100 year floodplain. Floodplains offer many ecosystem services from flood attenuation, erosion control, stormwater management, and water quality. Healthy floodplain habitats are difficult to come across, especially in highly urbanized areas like Baltimore. The properties current use as a golf course has limited the disturbance to this area but constant mowing, fertilizing and pesticide use here is preventing it from reaching its ecological potential. In order to protect and enhance the function of this area the design is to allow for natural succession of the vegetation. Research has shown that vegetated floodplains in the coastal plain region have the potential to remove a significant portion of nutrients found in stormwater runoff, including nitrogen and phosphorus (Yates & Sheridan, 1983). Maturing into a dense and biologically diverse riparian buffer, the flood plain will also act as a stormwater filter from farm operations runoff that has the potential to carry excess nutrients from fertilizers. Visitors can take the new path that travels through here and will see first-hand how, when left unmaintained, a golf course wants to naturally return to a forest condition. Maintenance would be limited to mow strips along the path

Figure 58. Example of a trail through a naturalized area, Fanno Creek Greenway trail, 2008)

and periodic removal of invasive plant species. Interpretive signs along the way will explain the history of the old golf course and also the importance of floodplain ecology. At the lowest point in the property, constructed depressions have been designed to create vernal pools or, more accurately for this setting, seasonal forest pools (figure 59). These are pools that can be isolated or clustered depressions in the landscape surrounded by upland deciduous or mixed-deciduous conifer forest (Brown and Jung, 2005). Periodic

Figure 59. Mid-Atlantic seasonal pools. (Brown & Jung, 2005)

flooding and rainfall will fill the depressions and provide ecological services and habitat for many species who thrive in these environments. These pools have four distinct features: surface water isolation, periodic drying, small size, and shallow depths. Because these areas dry regularly, predatory fish do not exist that would threaten amphibian and invertebrate species. Seasonal pools in the mid-Atlantic region are known to support nine species of amphibians including the spotted salamander (*Ambystoma maculatum*), wood frog (*Rana sylvatica*), and fairy shrimp (Order Anostraca) among others (Brown and Jung, 2005). On the west end of this area the Gwynns Falls Trail crosses the Gwynns Falls. Previously this trail only traveled along the water where it led to the parking area near the entrance. In the new design an additional connection has been made that will allow visitors using the trail to enter the urban agriculture park. This connection is

important because it will help provide access to the adjacent Carroll Park without having to travel along busy roads.

Figure 60. Perspective of corn crib rest area

At the highest elevation in this section and where the second green is currently, a recycled corn crib structure is used as a rest area for trail users wishing to get out of the sun and take a break (Figure 60). The corn crib also plays an artistic function that serves as a reminder of the working farm. Less formal paths, possibly gravel or wood chips, travel through the existing patches of forested areas that are located between the holes of the golf course. These areas contain some beautiful specimen Elm, Oak, Cypress, and Black locust trees among others and currently these parts of the course are mowed weekly. For the design, these areas are no longer mowed and instead will be converted into large scale food forests by under planting the existing tree canopy with layers of fruit and nut producing trees, berry producing shrubs, and even herbs and mushrooms.

Orchards and Tree Nursery

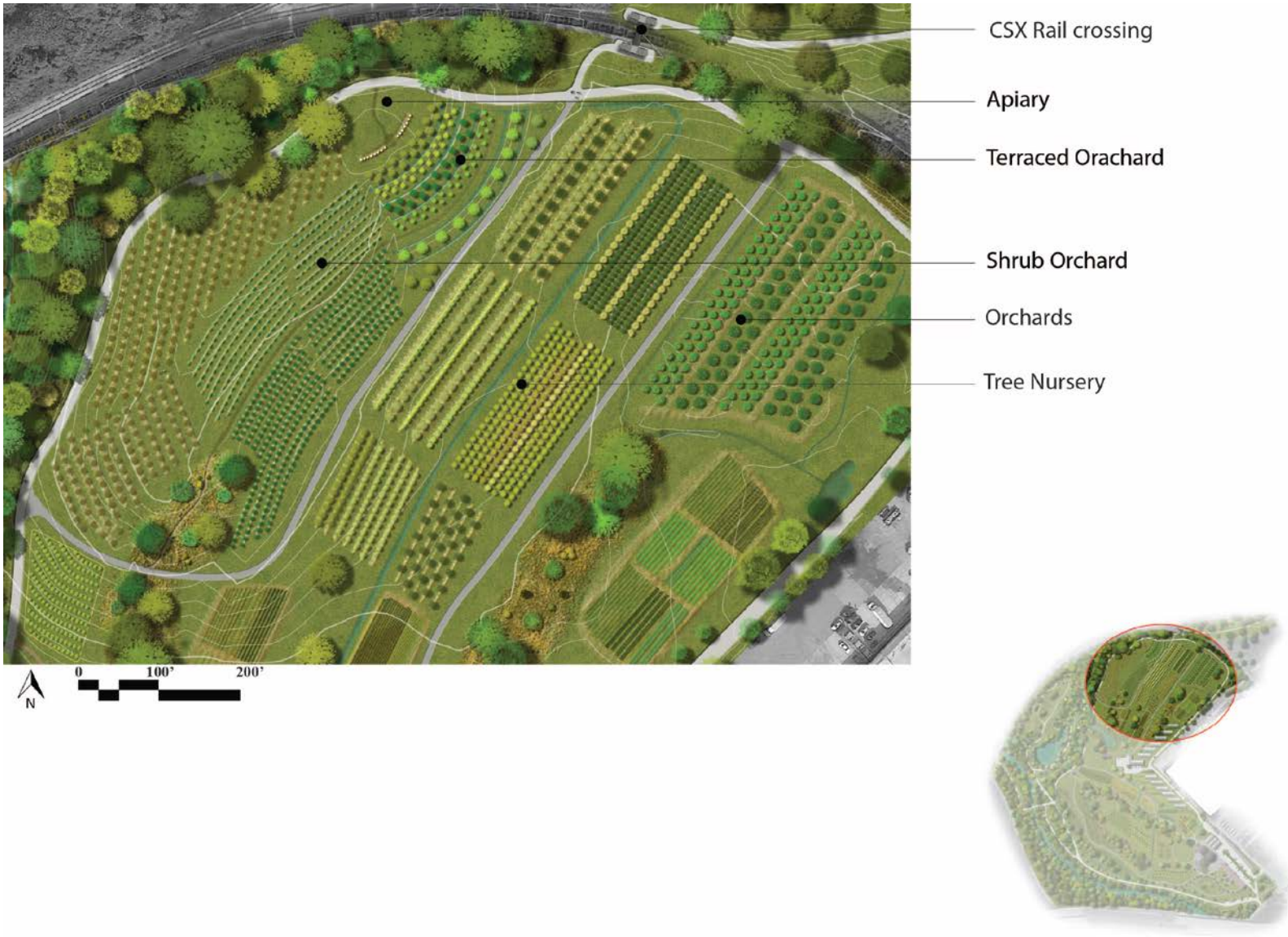


Figure 61. Plan view of orchard and nursery area

The north end of the farm is reserved for almost 10 acres of orchard and tree nursery production. Located in the Northwest corner, this section of the property offered a great location with southern exposure and better soils making it ideal for a variety of shrub and multi-stem fruit and nut trees. Some of the proposed plantings included, northern highbush blueberry, hybrid hazelnut, fig, and cherry. Planting these following the contours of this area will help to reduce the threat of erosion on the farm.

A terraced apple orchard was designed on the steepest section of the hill with up to 20 percent slopes. This technique uses alternating rows of trees and drainage swales that help to intercept stormwater runoff and trap it for the trees to absorb. Above the terraced orchard and the highest point of the property is the apiary. The original location of the third green on the golf course provides a level area to place bee hives. Not only can the hives produce honey for consumption, but they have a far greater value to the pollination

Figure 62. Birds-eye-view of the terraced orchard and apiary with views to the farm.

of various trees and crops (Heard, 1999). In Maryland alone honey bees have contributed to more than $26 million in pollination services to crops (Department of Legislative Services, 2015).

The middle portion of this section of the farm is reserved for a tree nursery. Much like the greenhouses on the property in the 1920's, the purpose of this nursery is to grow and eventually distribute fruit and nut trees throughout Baltimore's system of public open space and parks. Container grown ornamental tree production could also be considered here as another way to generate income for the farm.

Figure 63. Image displaying the density of the proposed city tree nursery (Rodney Burton, 2016)

Many cities around the country have begun to plant their public spaces with fruit trees and especially in low-income communities this can provide a free source of healthy food that can be easily accessed. Baltimore city landscape maintenance staff already work to maintain attractive ornamental plantings throughout the city so why not provide a planted landscape that has, not only aesthetic, but also societal health benefits such as fresh fruit.

In order to provide more convenient connections to the neighboring communities of Southwest Baltimore, and also to link the Gwynns Falls Trail to Carroll Park, the design suggests an at or below-grade railroad crossing (Figure 64). As mentioned previously, the 1906 Carroll Park Masterplan developed by the Olmsted Brothers suggested such as crossing in this general area of the golf course. The design will eliminate the need to direct trail users along busy roads and unsafe intersections and instead offer a scenic route through the farm in route to Carroll Park or the Inner Harbor.

Figure 64. Example of a below grade rail crossing as suggested by the Olmsted Brothers in the 1907 masterplan for Carroll Park

Working Farm Areas

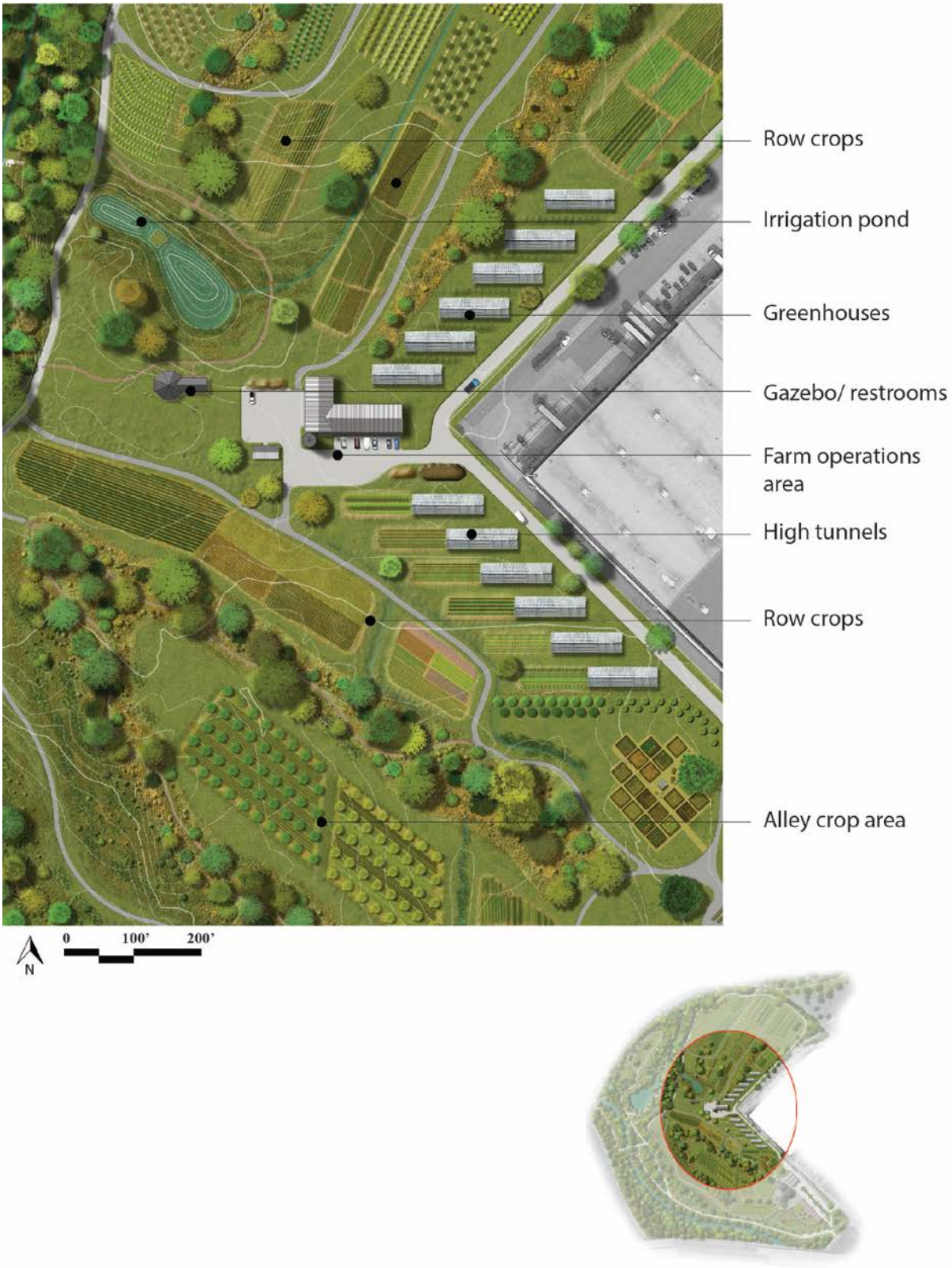


Figure 65. Plan view of the working farm areas

The heart of the farm is the actual working farm areas (Figure 65). This area includes the farm operation center, an irrigation pond, greenhouse and high tunnel production, multiple agricultural fields that employ both traditional, bio-intensive growing techniques, and alley cropping.

Centrally located is the farm operations center. The architecture of the structure resembles barns representative of those seen throughout rural Maryland and easily noticeable from I-95, the barn will serve as a landmark to any people traveling through Baltimore. The barn will house farm equipment, cleaning and storage areas for produce, break and restrooms for employees and even possibly living spaces for full time farmers.

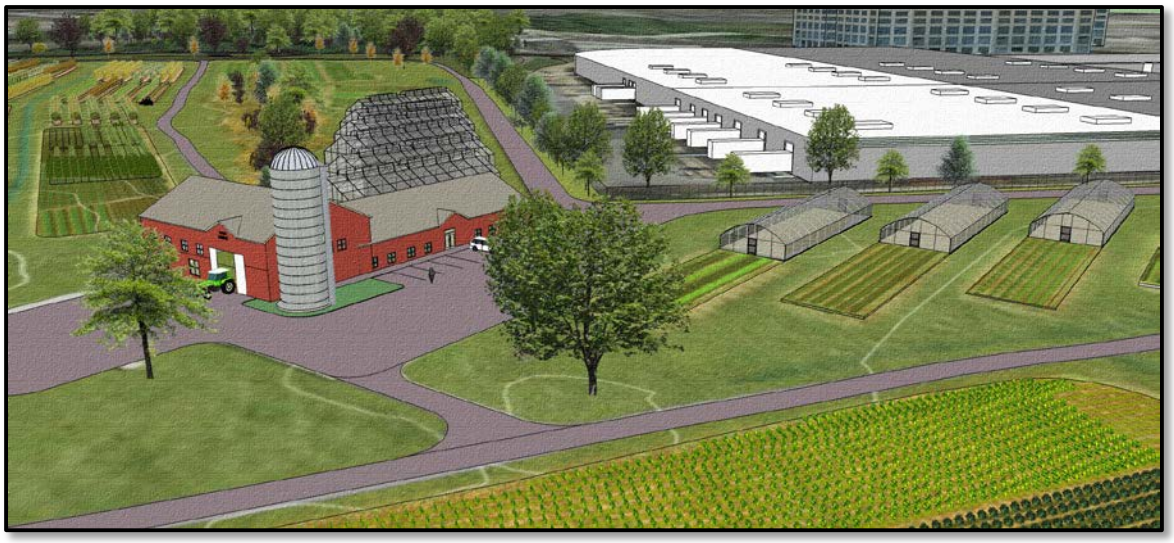


Figure 66. Birds-eye-view of the farm operation center, greenhouses, and crop fields

As previously mentioned, food safety is a major concern for any type of agricultural production. By using the site as a training center, the Carroll Urban Agriculture Park can play a key role in promoting food safety in urban agriculture operations throughout Baltimore while also generating jobs. The need to develop a food safety program is absolutely essential for an urban agriculture business. Threats can come

from almost any stage in the growing, harvesting, processing, storing, and distribution of food products and steps should be taken to prevent contamination and ensure consumer and employee safety. The FDA adopted a food safety program that was developed almost 40 years ago for the space program known as Hazard Analysis and Critical Control Point or HACCP (Jolly and Lewis, 2005). The program focusses on prevention of hazards used at critical stages in the food chain in order to prevent foodborne illness. The program involves seven basic principles.

1. Analyze hazards
2. Identify critical control points
3. Establish preventative measures
4. Establish procedures to monitor
5. Establish corrective actions
6. Establish procedures to verify
7. Establish effective record keeping

Table 2 identifies many of the most common food safety risks that occur at different stages of an agricultural production operation and the three hazard types. This chart can be used by an urban agriculture businesses to help organize a plan for ensuring food safety across the entire operation. Another example of a food safety management plans that could be incorporated are called Good Agricultural Practices or GAPS. Created by the Food and Drug Administration (FDA) and the United States Department of Agriculture (USDA), these are only voluntary guidelines but with pressure from consumers and the industry, an auditing program was developed that uses the GAP guidelines (Curtis, 2010).

Control Points Table

Potential Risks			
Hazard Phase	**Biological**	**Chemical**	**Physical**
Preproduction	Livestock, wild animals, improperly composted manure, natural soil organisms.	Residues from previous use history or current pesticide and fertilizer use.	Stones and sticks or "trash" from previous crops, syringes, other debris in compost.
Production	Same as above plus contaminated irrigation water.	Fertilizers and pesticides.	See above.
Harvest	Improper worker hygiene; dirty bins, containers, and harvest equipment; domestic and wild animals.	See above plus equipment leaks and cleanser residues.	See above plus poorly maintained or damaged/worn-out equipment, workers' personal articles (jewelry, pens, etc.).
Postharvest	Contaminated wash/rinse or cooling water, including ice; improper worker hygiene; dirty bins, containers, and sorting equipment; staging areas next to cull or compost piles or livestock areas.	Contaminated wash/rinse or cooling water, including ice; residues from pest control in and around packing shed/ buildings; residues in bins and containers.	See above.
Processing	Improper canning temperatures or pH, flies or other vermin around drying racks, employee hygiene.	Residues and water or other additives used in processing.	Damaged containers and equipment, including jars and packaging materials; fragments from walls or ceilings; employees' personal items.
Storage	Vermin such as mice or insects; improper temperatures or humidity; dirty bins and other types of cross-contamination.	Residues from cleansers and pesticides used to control vermin, residues or cross-contamination from other materials stored in the same facility.	Damaged bins, fragments from walls or ceilings, vermin nesting materials.
Transportation	See above.	See above plus residues from previous transport of chemical materials in vehicles.	Damaged pallets, bins, and containers; fragments from vehicles.
Marketing	Employee and consumer handling, improper sampling hygiene, improper temperature control.	Sanitizing and cleaning residues on display and sampling equipment.	Damaged display equipment; employees' or customers' personal items, including coins.
Preparation	Poor worker hygiene, dirty equipment, cross-contamination, improper cooking time or temperature, poor kitchen sanitation.	Residues on equipment, food additives.	Damaged equipment (both cooking and serving), fragments from walls or ceilings, employee's personal items.
Consumer	Inadequate or improper consumer education such as "refrigerate after opening" and "discard date" advisories.	Inadequate or improper consumer education such as "wash before consuming" advisories.	Inadequate or improper consumer education such as "may contain pits or shell fragments" warnings.

Table 2. Control point table from HACCP displaying potential risks for food safety at all stages of the food chain (Jolly and Lewis, 2005).

The USDA GAP guidelines include food safety risk controls for the following areas of food production:

- Crop and irrigation water
- Manure and municipal bio solids
- Worker health and hygiene
- Field and harvest sanitation
- Postharvest water during packing
- Transportation
- Storage and distribution

Other food safety management options could include implementing state and local certification programs. These programs can set standards and guidelines used by farms that assure consumers of a certain level of quality. Examples of such a program include USDA Organic and Fair Trade Coffee. This, in turn, becomes a branding technique that is not only identifiable to consumers but can also help to increase sales. As urban agriculture continues to grow within cities, the need for professionally trained food safety inspectors will also increase. The Carroll Urban Agriculture Park could become the official training center in the area to prepare people for careers in food safety.

Greenhouses and High Tunnels

Greenhouses and high tunnels are an important component to generating income and nearly every urban agriculture operation in Baltimore uses them in some form or another. With the added benefits such as extending the growing season, decreased weed and pest pressure, and controlling temperature and water, greenhouses and hoop houses or "high tunnels" can greatly increase the production and income for a farm. Greenhouses and high tunnels are very similar structure but the difference is that high tunnels are usually moveable, free standing structures that generally do not have heating or

electricity, instead relying on passive ventilation to control temperatures. Greenhouses on the other hand are more permanent structures with heating and electricity and are generally used for container pot growing. The six structures located north of the barn/head house are greenhouses intended for year-round production of high-value crops like hothouse tomato, cucumber, lettuce greens and even flowers. South of the barn/head house are six 110' by 30' sliding high tunnels. Crops are planted directly in the soil and a steel-tube frame is installed in the ground allowing the entire tunnel to be moved to

Figure 67. Sliding high tunnels at UDC Murkirk Research

another plot. With this system crops can be started early in the season when the chance for frost exists and once the threat is gone the tunnel can be moved where another plot is ready to start a new crop.

The first factor that was considered when siting these structures was ease of access. The golf course currently has a 10-15 foot maintenance path that runs along the east end of the property between the course and the neighboring commercial building and placing the greenhouses here is ideal. Not only would farmers be able to come and go

from the greenhouses easily but the structures themselves would serve as a good buffer between the farm and the commercial building next door. Slopes along this area were rather gradual from three to five percent and would require minimal earthwork to create level pads. The structures have been oriented with their ridgelines from east to west in order to provide the most sunlight during the cooler periods of the season. Because the greenhouses do increase the area of imperviousness, considerations must be taken on how to deal with stormwater runoff. One way to address this problem is through using cisterns, both above and below ground, to collect water from the greenhouse roofs. At the Big City Farm in Baltimore, MD, Biohabitats helped to design a 34,000 gallon cistern system made from recycled shipping containers to collect stormwater from their one acre urban farm of hoop houses ("Strength to love farm"). Another method, and the one used for the greenhouses and high tunnels at the Carroll Urban Agriculture Park, is vegetated

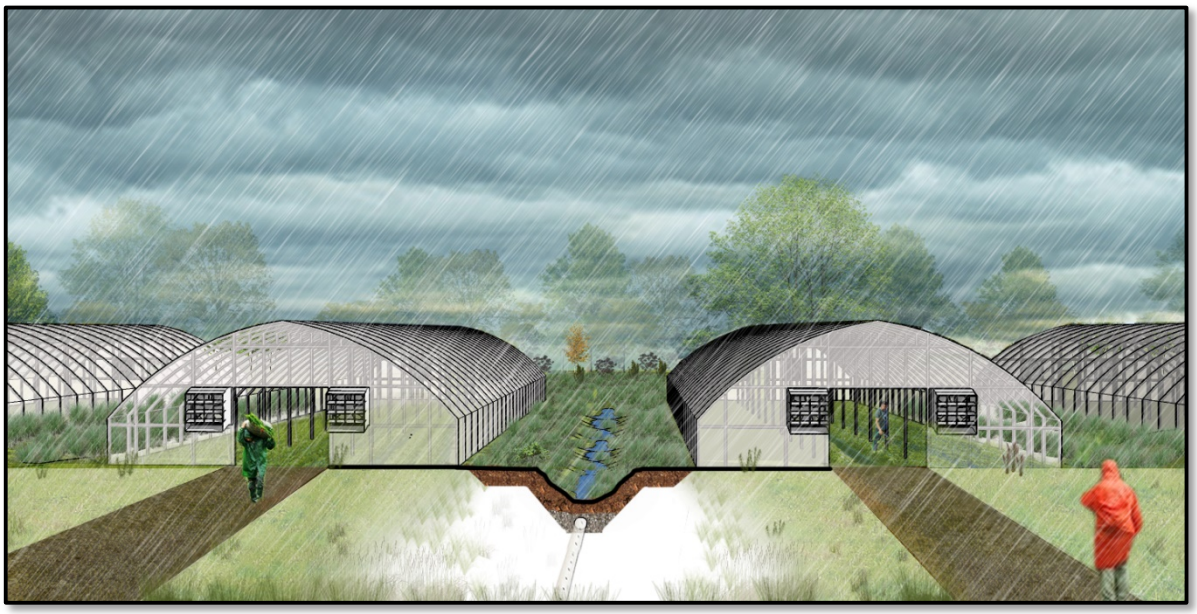


Figure 68. Perspective of greenhouses showing stormwater swale drainage system.

drainage swales. Stormwater sheds off the greenhouses and high tunnels and is collected in these swales, located between the structures, where plants transpire and help to filter the

water. Under drains are used to help transport excess water to the irrigation pond where it can be used later to water crops (Figure 68). During conversations with the superintendent it was revealed that Carroll Park Golf Course relies entirely on potable municipal water for irrigation, but unfortunately no records were available of how much water is used every year. A 2008 report in Applied Turfgrass Science measuring water usage on golf courses was used to develop a rough estimate of water usage for Carroll Park Golf Course (Throssell et al., 2008). In Table 3, a 9-hole golf course located in the

Facility type		US	Agronomic region[x]						
			NE	NC	Trans	SE	SW	UW/ Mtn	Pac
		Water use (acre-feet)							
9-hole	Avg. water use[y]	48.2	13.8	52.5	24.9	54.0	99.7	89.9	66.3
	Total water use	219,376	10,625	73,813	20,118	34,311	27,440	38,950	14,125
18-hole	Avg. water use	152.5	42.4f	76.7e	78.9e	241.8c	459.0a	300.4b	158.0d
	Total water use	1,518,070	74,733	181,900	152,750	521,093	352,950	175,827	58,816
27-hole	Avg. water use	386.2	84.4	164.2	164.9	580.9	988.9	394.5	325.7
	Total water use	575,255	17,223	57,324	33,961	245,701	173,052	26,826	21,174
	Total water use	2,312,701	102,581	313,037	206,829	801,105	553,442	241,603	94,115

Table 3. Water usage in Acre-feet for golf courses according to region (Throssell et al 2008).

transition zone uses an average of 24.9 acre-feet of water for irrigation per season. When we multiply the gallons per acre-foot (325,000gal) by how many acre-feet of irrigation is used annually (24.9 acre-ft.) we come up with 8,092,500 gallons of water annually. In a period when the availability of clean drinking water is becoming scarcer, it is hard to believe that we are using billions of gallons of clean drinking water to irrigate golf courses.

Irrigation Pond

To reduce the need to use clean drinking water for irrigation purposes an irrigation pond was constructed in the lowest area of the golf course. Using GIS it was determined that 20 acres of the farm would drain into the proposed pond area. Pond sizing was based off of stormwater runoff calculations for a 1-year rainfall event in Baltimore City

1 year storm event Baltimore City = 2.6 inches or .21 feet
1 acre = 43,560 square feet.
1 cubic foot = 7.48 gallons.
1 Acre-foot = 325,851 gal.
Average Depth of Pond = 7'
Average runoff curve for catchment area = .80

Catchment area = 20 acres

20 acres x 43,560 sq.ft. = 871,200 sq.ft.

871,200 sq.ft. x .21' = 188,760 cu.ft.

188,760 cu.ft. / 43,560 sq.ft. = 4.3 Acre-feet.

4.3 Acre-feet. x .80 (runoff curve) = 3.44 Acre-feet.

Pond area = .46 acres

.46 acres x 43,560 sq.ft. = 20,000 sq.ft.

20,000 sq.ft. x 7' = 140,000 cu.ft.

140,000 cu.ft / 43,560 sq.ft. = 3.21 Acre-feet.

Percentage of runoff irrigation pond can collect

$$\frac{\text{3.21 acre-feet (volume of pond)}}{\text{3.44 acre-feet (volume of runoff)}} = \textbf{.93 \%}$$

Figure 69. Irrigation pond capacity calculations to hold one-year storm event in Baltimore

which is 2.6 inches (Schuerler and Claytor, 2000). To get a very rough estimate of stormwater runoff volume, a runoff curve of .80 was used for the 20 acre catchment area. The calculations in Figure 69 reveal that the irrigation pond has the ability to capture 93 percent of a 1-year storm event of 2.6". This represents a significant decrease in the amount of stormwater runoff that would otherwise be entering the Gwynns Falls. To decrease the need to use city water on the farm a solar-powered pump (Figure 70) will be used in order to draw water from the irrigation pond into cisterns much like a system used by the University of the District of Columbia at their Murkirk Research Farm (Lakeou,

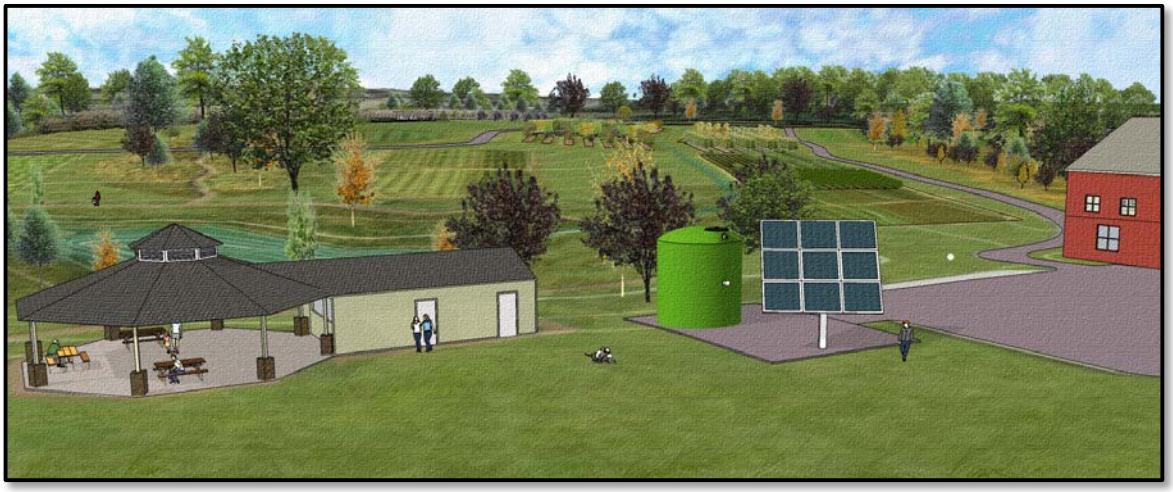


Figure 70. View of the solar-powered pumping station and park restrooms

,Ososanya, Laith, Quiroga, and Nunez, n.d.). In the case of the Carroll Urban Agriculture Farm, filtering would be necessary to remove any debris that could clog the drip irrigation lines that are often used in urban agriculture. Located adjacent to the irrigation pond and the pumping station is a gazebo with public restrooms. Visitors can rest here and enjoy views across the irrigation pond and interpretive signs will educate visitors on the stormwater harvesting techniques used on the farm.

Row Crops

In order to maintain efficiency around the farm most of the crop production areas are

located directly around the farm operations center and greenhouses. This was done in order to reduce the distance and thus the amount of time needed to get from the fields to the cleaning and processing areas. At the same time this layout will help to keep some of the busier operations consolidated, while reducing the disturbance of farming activities to park goers. Three acres have been designated for crop production including staple vegetables such as spinach, carrots, potato, cabbage, lettuce, broccoli, beans,pumpkins and melons. Specific crops could also be planted based on demographic data for the surrounding neighborhoods. Ethnic vegetable production is becoming increasingly popular and is a great way to help provide food more familiar to members of the community with diverse ethnic backgrounds.

Cut-Stem Flowers

A small area of production has been reserved for cut-flower production. This quarter acre field can be used to grow cut-stem flowers such as tulips and sunflowers, and woody-stem flowers such as hydrangea, dogwood, and willow. According to Lynn

Figure 71. Woody and cut-stem flowers for market (Virginia Cooperative Extension, 2014)

Byczynski, editor of *Growing for Market*, specialty cut flowers can be one of the most profitable field grown crops earning anywhere from $25,000 to $35,000 per acre (Byczynski, 2008).

Alley Crops

The last row crop production area is reserved for alley cropping. Alley cropping is a technique that involves growing agricultural or horticultural crops in wide rows between evenly spaced rows of trees (University of Missouri, 2015). Usually a high value

Figure 72. Rendering of the alley cropping fields at Carroll Urban Agriculture Park

hardwood tree is grown or smaller shrubs that produce nuts. While the trees are young crops are grown between the rows of trees while there is less competition for sunlight and nutrients. As the trees mature it may be necessary to switch the crops being grown to ones that require less sunlight and water. Eventually the trees mature and can be harvested. At Carroll Urban Agriculture Park it may be more beneficial to the park to avoid harvesting the trees as they mature. Instead they can become beautiful allées that

wind down what was once a fairway on the golf course.

Food Forest

A final area that could be explored for production is the proposed food forest areas that are highlighted in a yellow dashed line in (Figure 73). These areas on the current golf course include the sparsely wooded zones located between fairways. Food forests, or forest gardens as they are often referred, are agricultural plantings with multiple layers of plants that together create an ecosystem much like a mature forest. A forest garden consists of seven layers:

1. Canopy (large fruit and nut trees)
2. Low Tree Layer (dwarf fruit trees)
3. Shrub Layer (berries)
4. Herbaceous Layer
5. Rhizosphere (root crops)
6. Soil Surface (ground cover crops)
7. Vertical Layer (vines, climbers)

Figure 73. Plan view of the farm with food forest areas outlined

The idea is to create a self-sustaining environment where beneficial relationships are formed among the plant community (Jacke, 2008). By planting the current wooded areas the design will eliminate the need to mow nearly six acres of the property and instead provide a much more productive landscape capable of growing food and improving water quality and habitat for plants and animals alike. New paths that wind through these parts of the farm will allow people to forage fruits from native trees like paw paw, *Asimina triloba* and downey serviceberry, *Asimina triloba*, nuts from oaks and hazelnut, red and black raspberries, mushrooms and more.

Figure 74. Perspective of the food forest path

Farm Yields

Determining the yields for traditional agriculture has been studied for many years and has become fairly reliable for farmers to predict how much a crop will cost and what it could earn. However, small scale agriculture and urban agriculture are not as easy to measure and very little data is available to make accurate predictions. Varying scale, experience of growers, techniques used to grow, and the many different growing conditions (region, soils, water, sunlight, etc.) contribute to the difficulty of determining expected yields.

For this study a report from Rutgers New Jersey Agricultural Experiment Station (NJAES) was used to generate a very rough estimate of the production capabilities of the Carroll Urban Agriculture Park. The authors collected data from multiple studies which surveyed small home and public gardens and found that on average, market garden yields from small scale agriculture were between 0.25 lb/ft² and 1.25 lb/ft² (Rabin, Zinati, and

Nitzsche, 2012). As a general guideline, the report suggested that 0.5 lb/ft² was an acceptable value to use for determining average yield for small-scale, mixed stand agriculture. The masterplan for Carroll urban Agriculture Park did not go into the detail of exactly what crops and how much would be planted, rather it provided areas for crop production based off of farm layout and proximity to resources. Expected yields therefore, is a rough estimate that assumes a variety of vegetables and fruits would be planted based on the needs of the community and the potential income generation for the farm.

The farm design has reserved three acres for row crop production or roughly 130,000 ft². When multiplied by the average yield of 0.5 lb/ft² the farm could expect to produce 65,000 pounds of produce. Similarly the alley crop area and the rolling high tunnels have a combined area of 2.24 acres or 96,000 ft² and could produce 48,000 pounds. The rolling high tunnels cover an area of 36,000 ft² with production around 18,000 pounds. The total production for row crop areas including high tunnels is around 130,000 pounds of produce. This number reflects an annual production and does not represent the possibility of multiple harvests each season, so it is likely that this number could be even higher.

Greenhouse production has an even greater capacity to produce more than the 0.5 lb/ft² average. Research from Judson Reid and the Cornell Vegetable Program reported that greenhouse tomato and cucumber yields exceeded 5 lb/ft² with over 16,000 pounds of tomatoes and close to 6,500 cucumbers per 3,000 ft² greenhouse (Reid, n.d.). Similarly, greenhouse production of tomatoes in North Carolina recorded yields of 3.36 lb/ft² or 8,400 pounds per season using 2,500 ft² greenhouses (Estes and Peet, 1999).

Assuming yields similar to these studies could be achieved, the 18,000 ft² of greenhouses in this design could produce from 60,000 to 90,000 pounds of produce annually.

In order to determine yields for the orchard section of the design a study was referenced from the Urban Design Lab at the Earth Institute of Columbia University (2012) which compared USDA conventional average yields to bio-intensive average yields. The numbers represent an average across multiple sets of data where yields were measured in small scale agriculture in New York City. As Table 4 shows, tree fruit, including apple, cherry, figs, peaches, pears, and plums, had an average yield of 0.28-

	Food Group	USDA / Conventional Average Yields (lbs./s.f.)	"Bio-intensive Low" Average Yields (lbs./s.f.)	Estimated NYC annual retail (x 1,000,000 lbs.)	Estimated Land area needed for cultivation: USDA / Conventional Average Yields (acres)*	Estimated Land area needed for cultivation: "Bio-intensive Low" Average Yields (acres)*
Vegetables	**Dark Green** broccoli, collard greens, escarole, kale, lettuce (leaf), mustard greens, spinach, turnip greens	0.49	0.95	210	10,983	8,671
	Orange carrots, pumpkin, squash, sweet potatoes	0.43	0.70	193	10,321	6,323
	Dry Beans & Peas dry edible beans, dry peas and lentils, lima beans	0.03	0.07	62	46,804	34,490
	Starchy green peas, potatoes, sweet corn	0.35	0.47	731	35,672	33,525
	Other Artichokes, asparagus, bell peppers, brussel sprouts, cabbage, cauliflower, celery, cucumbers, eggplant, garlic, lettuce (head), okra, onions, radishes, snap beans, tomatoes, misc. vegetables	0.60	0.83	1,120	56,140	32,406
Fruit	**Tree Fruit** Apples, cherries, figs, peaches, pears, plums	0.28	0.32	470	27,132	24,311
	Grapes	0.20	0.45	102	11,761	5,227
	Berries Blackberries, blueberries, cranberries, raspberries, strawberries	0.20	0.23	94	25,940	7,635
	Melons Cantaloupe, honeydew, watermelon	0.52	0.50	208	9,462	9,551
	Warm weather / Citrus Apricots, avocados, bananas, dates, grapefruit, kiwi, lemons, limes, mangoes, olives, oranges, papaya, pineapple, tangerines	N/A	N/A	886	N/A	N/A
Total				**4,076**	**232,215**	**162,139**

Table 4. Food crop average yields with tree fruit highlighted in red (Urban Design Lab at the Earth Institute (2012).

0.32 lb/ft². Again, since the design of the orchard merely suggested the type of plants to be grown, it did not specify exactly what and how much should be planted. Therefore with five acres reserved for orchard production it can be assumed that between ~61,000 to 70,000 pounds of fruit could be produced at this site annually.

In total the farm has the potential to produce close to 270,000 pounds of vegetables and fruit. As previously stated these numbers represent only a rough estimate of the production capability of Carroll Urban Agriculture Park. Many factors can increase or decrease these numbers and the calculations are only to be referenced to understand the design's potential and not to be an accurate prediction of the economic capability of the farm.

CHAPTER 6: CONCLUSIONS

The theoretical design for Carroll Urban Agriculture Park is an attempt to demonstrate how golf courses, located within highly urbanized areas, could be transformed to support large-scale urban agriculture. As the earlier research showed, decreasing interest among youth participants, overbuilding, and financial burdens are forcing golf courses to close by the hundreds annually and the trend is likely to continue. These large pieces of open space, that only provide recreational benefits to a very small population of golfers, have far greater value than golf lends them and designers have started to exploit these underutilized spaces for the environmental, social, and economic potential they hold. Urban agriculture has been recognized as one way to help combat food insecure neighborhoods with low access to healthy food options by providing a readily available source of fresh produce. Additionally urban agriculture and associated activities can help improve the social, environmental, and economic conditions. Carroll Park Golf Course represents an underused municipal golf course in Baltimore and its proximity to spreading food deserts in Southwest Baltimore make it an ideal candidate to be transformed for urban agriculture. By thoroughly examining the natural and man-made infrastructure of the course, the design has transformed a 65 acre municipal golf course into and urban agriculture hub for the city of Baltimore, while at the same time creating a unique park where visitors can passively or actively experience urban agriculture.

Fairways that previously required routine mowing, watering, and fertilizing, have been replaced with over five acres of row crop production, six year-round greenhouses, and five acres of orchards. With an annual production capability of nearly 270,000 pounds of fresh vegetables and fruit, the design will improve food desert conditions in

Southwest Baltimore by providing a locally available source of food. Economic and social improvements will also be achieved through the work required to maintain the farm and park. Not only will the farm have the potential generate year-round and temporary employment opportunities, it will also foster collaboration among community members, non-profit organizations, volunteers, and business owners throughout Baltimore. By providing space and a supportive atmosphere for current and aspiring urban agriculture farmers, the design will promote the growth of urban agriculture in Baltimore. Having the option to rent growing space and the resources needed to grow, readily available in one consolidated area, new urban farmers, who otherwise would not be willing to take the risk, may be encouraged to start their own business.

One of the main advantages for transforming golf courses to urban agriculture is finding new life for the existing infrastructure. By repurposing old golf cart paths to biking and walking trails, the design has created an accessible park with improved connections to local parks via the Gwynns Falls Trail and a new crossing for the CSX railway has provided easier access to the farm for neighbors with limited access to vehicles. Re-purposing the irrigation system with a constructed stormwater pond will conserve nearly eight million gallons of potable drinking water while preventing nutrients and sediments in runoff to enter local waterways. The clubhouse, maintenance structures, and existing parking areas have provided valuable space to design a visitor's education center and a large open-air market. The new market will provide people living in the surrounding community increased access to fresh, healthy food while also providing a central location for local farmers to distribute their produce. Repurposing the clubhouse as a community and urban agriculture education center promotes the advancement of

urban agriculture through educational opportunities and also enriches the social fabric of the community.

A design of this size would more than likely need to be implemented in phases where input from the city, surrounding community, and business owners would be necessary to ensure its success. In its early stages the Carroll Urban Agriculture Park may closer resemble some of the precedents studies that focused on habitat restoration and creation. Some of the first steps could be the elimination of maintenance practices in designated areas such as the 20 acres of the course currently in the 100 year floodplain and the forested areas between fairways. Fairways could be converted to native grass fields where minimal mowing could be used to eliminate the establishment of woody plants in areas that may eventually be used for agriculture. Temporary trails, established by routine mowing, could be created between existing cart paths and would allow exploration of the park. Because it would require less labor and daily inputs than agricultural crops, establishing the orchard and nursery would be beneficial in the early stages. Most fruiting trees can take three to five years to become productive so giving them a head start would be ideal. With the popularity of hoop house and greenhouse production in current urban agriculture businesses within Baltimore, this may be one of the first built components of the farm. With their potential to generate higher production and income, greenhouses could help provide the funds needed to further expand operations on the farm. Years ahead when collaboration with local organizations and volunteer support has been developed, and support from businesses has been proven, further investments could help bring the full design into fruition.

As populations continue to grow in our urban cores so too will the need to provide

convenient and equal access to healthy food options. Urban agriculture offers part of the solution to this and as this thesis has shown, golf courses, can provide an ideal location and a supportive environment for large scale urban agriculture production. By using this design as an example, professionals including landscape architects and city planners, may be able to find a more appropriate use of underused and vacant golf facilities. An urban agriculture park could be a new model for city parks that not only provides recreation and educational opportunities, but one that works to improve the health, social, economic, and environmental conditions that plague impoverished areas in cities.

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