LOCAL FOOD SYSTEMS

Finding potential in Lakewood, Colorado

Studio 2 (LDAR 5502)
Spring 2016

Landscape Architecture Program
College of Architecture and Planning
University of Colorado Denver

University of Colorado Denver

City of Lakewood

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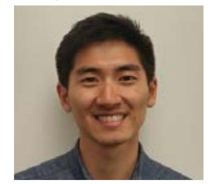
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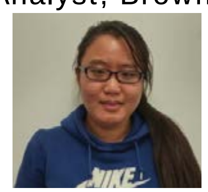
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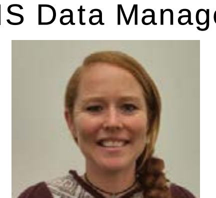
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INTRODUCTION

This food systems study and report is the result of a unique partnership between graduate students in the Landscape Architecture Program at the University of Colorado Denver (UCD) and the City of Lakewood, Colorado. This collaboration was precipitated by the 'Hometown Colorado' initiative, which pairs faculty and students with city staff to help solve real-world municipal problems. In support of its mission to ensure a more resilient, self-reliant future, the Sustainability Division and the Comprehensive Planning and Research Division of the City of Lakewood requested a food systems study that would include collaboration with community partners, inventory of existing resources and analysis of potential deployment sites for food production and distribution facilities throughout the city. The instructors of Studio 2, which is the second of a six-studio course of study at UCD, took up this challenge and began coordination with city officials in the Fall of 2015.

Pedagogically, this partnership was also a good fit with the educational goals for this course, while providing the research and insights needed by the City of Lakewood. Studio 2 is a landscape architecture studio in the core graduate sequence focused on the investigation and understanding of complex urban systems. Urban agriculture and food systems provided an appropriate lens through which to examine urban systems, as they intersect with concerns for ecology, community, economy and infrastructure, as well as aesthetic considerations. The students who have prepared this proposal were in some ways primed for this work beginning in the Fall semester of 2015. At that time, they were students in an Introduction to Geographic Information Systems course that involved working with Lakewood GIS data to complete a walkability study under the auspices of the same Hometown Colorado program. As such, the students came to this challenge already familiar with the geography of Lakewood as well as the GIS data they would be relying on so heavily for this project.

This study consists of two distinct parts, each of which occupied roughly half of the semester. The work in the first half was dedicated to familiarizing the students with issues surrounding local food production, urban agriculture and food systems. This was accomplished through an intensive site design process in which teams of three students were paired with a community organization and asked to propose a prototype of food production that was specific to a given parcel of land. The sites and partners were as follows:

- Southern Gables Sustainable Neighborhood in cooperation with Green Gables Elementary School
- an Xcel Energy right-of-way, with Xcel and the City of Lakewood
- Everitt Farms, with Derek and Kamise Mullen
- A brownfield site at 700 Depew Street, with the City of Lakewood, along with the adjacent Lakewood Gulch floodplain, in cooperation with Randy and Maddie Nichols
- Mountair Park Community Farm, with Sprout City Farms

The designs proposed by the students for this portion of the study included a variety of agricultural methods and value-added processing. These designs can be seen in the section titled 'Lakewood Site Designs.'

The second portion of this study looked at the extrapolation of the prototype designs developed in the first half across the entire City of Lakewood in order to determine the total potential agricultural output and economic value of this system, if seen through to its ideal conclusion. For this more analytical portion of the study, the students were divided into three groups: writers, who were responsible for explanatory text about agricultural production methods, site typologies and precedent gathering; geospatial analysts, responsible for analyzing land availability city-wide for this program; and 'accountants,' responsible for determining expected agricultural yields and economic value for each of the food production methods. By working in a coordinated manner, the students have brought all of these factors together and accomplished the extraordinary task of making sense of a very complex and oftentimes convoluted set of information.

The information found herein is entirely student-generated, under the guidance of the studio instructors and City of Lakewood staff. The report is divided into three principal sections: Food Production Methods, Land Use Typologies and Lakewood Site Design Studies. Each examines a different facet of this project and includes related analytical maps and spreadsheets that help to further clarify and illuminate the information being presented. The Appendices contain additional supporting information and summaries of raw data that were used in the preparation of this report.

We welcome you to contact the course instructors at the University of Colorado Denver for more information about this report or to discuss its contents. We are most grateful for this opportunity to have collaborated with the talented and dedicated staff of the City of Lakewood and earnestly hope that it becomes a useful catalyst in the city's quest to become more sustainable and resilient through a robust development of local food systems.

Schnell Family Farm of Lakewood, Colorado, circa 1896
Image credit: www.barthworks.com

FOOD PRODUCTION METHODS

In-ground agriculture is the most typical of farming types. However, this typology is not always the most suitable for urban farming. When food is grown in the ground, there are many considerations that need to be taken into account. Some basics include the quality of soil, amount of sunlight the land receives, and whether or not there is irrigation access.

Food grown in this style is most typically seen planted in rows to facilitate efficient planting and harvesting. Monocropping is commonly seen among industrial scale farms. However, in smaller scale urban farms up to larger community supported agriculture (CSA), a variety of crops are planted in one land area and are rotated seasonally. Both methods are intended to achieve as high a crop yield as possible, with those yields being converted into shares for members or profits. Some of the easiest crops grown in Colorado's climate include beans, tomatoes, basil, root crops, and leafy greens (including micro greens, chard, kale, mustard, etc.). On the other hand, Brussels sprouts, watermelon, sweet corn, and potatoes are some of the hardest crops to grow in this climate.

In-ground agriculture, otherwise thought of as traditional farming, historically has gone through many identity crises. Here in the United States in just over 200 years we went from having 90% of our working class population as farmers to 2.6% (USDA). There has also been a coinciding physical change in the farming structure over many of those years. Since WWII, we have witnessed millions of farms close or go out of business. At the same time, the average size of farms was drastically changing from small family-owned operations to more large commercial-operated industrial crop productions. Now with a growing population, and with millions of acres over the past decades being sold off for development or production of fossil fuels, we are beginning to see those trends reverse.

Henry's Farm, Illinois, with 650+ varieties of vegetables in each year's seed order
Image credit: http://www.brockmanfamilyfarming.com/henrys-farm

In general, the population's awareness of the necessity of healthier food is increasing. People are becoming more willing to pay a little extra for food they know is grown sustainably. In addition, they are more diligent about knowing the sources of their food. The idea that a farm is somewhere in a rural, distant place, is no longer the norm. Due to this increased demand for local, healthier options, and with the majority of the population living in cities, we have seen the emergence of small urban farms.

These farming operations are usually run commercially, or by a non-profit organization. Although the non-profit farms typically include more community education aspects within their operations, they both may be geared toward CSAs, or market access sales. Another difference is that non-profits generally donate any extra food that hasn't been purchased, whereas commercial operations may first provide to local restaurants or other processing companies and sell extras at farm stands. Either organization running the greenfield turned urban farm should have plenty of opportunities to sell their produce.

Early sproutings in a field of crops
Image credit: http://www.ceso.pt/detail/HMFDL4Za

Yield and Value Analysis: In-Ground Agriculture

The data for the in-ground farming method was gathered from four sources, including “Sprout City Farms” (Lakewood, CO), “Re:Vision International” (Denver, CO), “Colorado Agricultural Statistics 2014” (Reilly, 2014) and “Analyzing Agricultural Potential Within Denver” (Carman et al, 2015). While we received this data in various formats, we ultimately aggregated it to find a low, average, and high value for several types of crops (detailed tabulations can be viewed on B-2 of the Appendix). We chose to report on the crops which appeared most frequently across the data sources, which indicated they are the most common types of crops grown in this region.

For this farming method and all following, we found our economic values in the same way. We used current organic produce retail prices for the economic value predictions, as we assume most small scale, local farmers will be growing using mostly organic standards. Wholesale values were determined by deducting 25% from the retail price as there is typically a 75% markup in retail prices (Bowers, 2013). CSA values were calculated based on results from a study comparing grocery store produce prices to prices of CSA shares (Hawthorne Valley Farmscapes Ecology Program, 2013).

				Gross Distribution Value Estimates (USD/Lb.)*								
	Outcomes (lb/sf)			**Retail**			**Wholesale**			**CSA**		
Crop	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High
Tomatoes	0.41	1.83	3.15	$1.00	$4.46	$7.65	$0.75	$3.34	$5.73	$0.57	$2.57	$4.41
Greens	0.38	0.90	1.18	$0.78	$1.85	$2.43	$0.59	$1.40	$1.83	$0.45	$1.07	$1.40
Root Vegetables	0.64	1.76	2.81	$1.31	$3.58	$5.73	$0.98	$2.69	$4.30	$0.76	$2.07	$3.32
Alliums	0.01	0.81	1.79	$0.06	$4.56	$10.08	$0.04	$3.42	$7.55	$0.03	$2.62	$5.78
Peppers/Eggplant	0.37	0.96	1.41	$1.84	$4.76	$7.02	$0.86	$2.22	$3.27	$0.66	$1.70	$2.51
Cucurbits	1.45	2.01	3.13	$3.00	$4.16	$6.48	$2.25	$3.12	$4.85	$1.64	$2.27	$3.54
Tomatillos	0.14	0.29	0.43	$0.16	$0.34	$0.50	$0.12	$0.26	$0.38	$0.10	$0.20	$0.29
Green Beans/Peas	0.2	0.72	1.3	$1.00	$3.59	$6.47	$0.75	$2.69	$4.86	$0.57	$2.07	$3.73
Broccoli/Cauliflower	0.06	0.21	0.44	$0.12	$0.43	$0.90	$0.09	$0.31	$0.65	$0.07	$0.25	$0.52
Cabbage	0.06	0.64	1.03	$0.07	$0.79	$1.28	$0.06	$0.60	$0.96	$0.04	$0.46	$0.74
Corn	0.01	0.88	2.27	$0.00	$0.17	$0.43	$0.00	$0.12	$0.32	$0.00	$0.10	$0.25
Cantalope	0.02	0.31	0.46	$0.02	$0.30	$0.45	$0.01	$0.23	$0.34	$0.01	$0.18	$0.26
Overall Average		0.94			$2.42			$1.70			$1.30	
Overall Average in Acres		**16431.8**			**$42,104.81** /acre			**$29,590.5** /acre			**$22,576.86** /acre	
	Assumes 40% of each acre is productive.											

An apple orchard in west Australia
Image credit: www.agric.wa.gov.au

Orchards are groups of trees or shrubs grown together with intentional placement for the production of fruits, nuts, and seeds. The layout of an orchard varies on what is being planted, and usually consist of more than 10 acres of trees to be harvested for food production. Orchards are notably planted in rows, with a direct line creating a path through the middle for harvesting. It is a highly labor-intensive style of farming that requires extensive knowledge and training with tree grafting, pruning, training, and harvesting. Trees can be standard or dwarf types, with first harvest taking place several years after planting.

Different methods for harvesting include traditional labor or pick-your-own models. Farms will entertain and provide other value-added items for sale such as cider, canned goods, honey, and cheese. Labor is reduced through pick-your-own strategies, however others often must be hired to help draw in harvesters to remain profitable.

Common examples of American orchards are apples from Washington, cherries from Michigan, almonds from California, and peaches from Georgia. Many orchards are found in Colorado, with apples, peaches, pears, plums, and apricot orchards mainly found in the Western Slope. Delta, Mesa, Montrose, and Montezuma counties are the largest producers in the state for orchard crops. Many parts of Colorado have a climate that is great for production, with long hot days and cool nights. This climate is especially suitable for stone crops.

The history of orchard production in western Colorado closely paralleled the introduction of irrigation systems due to the low amount of precipitation the region receives. Water was pumped via gravity from the Colorado River, which was a relatively inexpensive system to water these crops. Today, the land use remains much the same, and production is highly successful. Many visitors come to the region for festivals, farmstays, and pick-your-own harvesting.

Harvest in apple orchard
Image credit: www.iawlight.com

First olive orchard in Texas
Image credit: www.thetexasiantravels.com

Yield and Value Analysis: Orchard Production

The production numbers for Orchards were gathered from two texts on edible forests (Meyer & Sharapova 2015 and Jacke & Toensmeier 2005), “Colorado Agricultural Statistics 2014” (Reilly, 2014), and “Analyzing Agricultural Potential Within Denver” (Carman et al, 2015). Fruit trees that are known to grow well on the Front Range were chosen as the four representative crops. The retail, wholesale, CSA, and Open Access economic value estimates were all generated based on the previously mentioned methodologies. For the purposes of this study, the ‘Open Access’ management model refers to an unrestricted production typology that is open to the public for harvesting, free of charge. Open Access models are typically volunteer run and intended to benefit food-insecure communities.

				Distribution Value Estimates (USD/Lb.)*											
	Outcomes (lbs/sf)			Retail			Wholesale			CSA			Open Access		
Crop	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High
Peach	0.13	0.41	0.84	$0.36	$1.13	$2.31	$0.46	$1.44	$2.94	$0.21	$0.65	$1.33	$0.18	$0.56	$1.16
Pear	0.53	0.63	0.73	$1.08	$1.28	$1.48	$0.81	$0.96	$1.11	$0.62	$0.74	$0.85	$0.54	$0.64	$0.74
Plum	0.4	0.41	0.41	$1.00	$1.02	$1.02	$0.75	$0.77	$0.77	$0.58	$0.59	$0.59	$0.50	$0.51	$0.51
Apple	0.27	0.77	1.04	$0.70	$1.99	$2.69	$0.52	$1.49	$2.02	$0.41	$1.16	$1.56	$0.35	$1.00	$1.35
Overall Average		0.56			$1.36			$1.16			$0.78			$0.68	
Overall Average in Acre		**12087.9**			**$29,520.61** /acre			**$25,336.13** /acre			**$17,044.48** /acre			**$14,760.31** /acre	
	Assumes 50% per acre is productive														

Palisade plum orchard, western slope of Colorado
Image credit: www.redslipperdiary.wordpress.com

The first greenhouses were recorded in Rome in 30 AD. Legend has it that physicians of Emperor Tiberius told him that it was necessary to eat one cucumber a day for his health, leading Roman scientists and engineers to figure out how to grow these plants year round. The first American greenhouse was constructed in 1737. Despite this long history, greenhouse production has not been particularly widespread until the past few decades, as technology has improved and startup costs decreased.

Consumer demand for local foods is strong and continuously increasing. Greenhouse growing is an intensive form of agriculture, offering the opportunity for year-round food production. Protected crops are less apt to be damaged by wind, rain, and hail, so the percentage of marketable products is higher. Yield is often higher as well, if you can provide optimum growing conditions for each crop. Greenhouses protect crops from many diseases, particularly those that are soil-borne, which can splash onto plants in the rain. Greenhouse crops may be protected from common field pests as well. Greenhouses are also appropriate for a contaminated site that may not have been previously considered for food production, thus allowing access to food in previously unsuitable areas (Springer, n.d.).

Hydroponic Greenhouses
Image credit: www.gothicarchgreenhouses.com

Image Credit: www.wired.com

Vertical Greenhouses
Image credit: Modernfarmer.com

Vertical Greenhouses
Image credit: 10mile-farms.com

There are several different types of production greenhouses. Hydroponic greenhouses grow plants without soil, using inert substances to support the roots and deliver water and nutrients. The benefits of growing hydroponically include increased plant productivity, providing a high yield per plant per square foot (RIMOL Greenhouse systems, 2016). This method is very clean, with no organic material present. In addition, it offers the grower complete control over the crops' nutritional needs. This allows for maximum growth and fruit production (George E. Boyhan, 2009).

Aquaponics is a bio-integrated system that links hydroponics with aquaculture. This is a first step towards long-term sustainable food production. The waste products of one system (fish) serves as nutrients for a second biological system (plants). This is also good for the fish because the plant roots remove nutrients from the water which would otherwise become toxic if left in the fish tank (Diver, Aquaponics Integration of Hydroponics with Aquaculture, 2006).

Vertical greenhouses grow leafy greens in stacked rows that reach to the ceiling without natural sunlight or soil, in half the time it takes on a traditional farm. These high-tech grow houses are typically seen in urban areas. They utilize artificial lighting, climate control and in many cases hydroponics and aeroponics, which use a nutrient mist on plants sitting under specialized LED lights that generate photosynthesis. The main advantage of indoor vertical farming is that it has less of an impact on the environment, growing a large crop yield on a small footprint (Morgan Brennan, 2015). Depending on the size of the towers, large plant sites can be between 125,000 to 250,000 plants per acre (Future Growing LLC, n.d.). In addition, vertical farming can use up to 95% less water than traditional methods (Weller, 2015). More traditional greenhouses grow crops in long rows, carefully monitoring heat, ventilation, and carbon monoxide levels to maintain a controlled environment for the plants to grow in. According to research, every 4,000 square feet of greenhouse space requires an estimated 25-30 hours of crop care and upkeep (George E. Boyhan, 2009).

Greenhouses are generally covered with glass, fiberglass, or plastic that allows heat to build up inside the building. Freestanding greenhouses should be oriented east-west, with the longest sides facing north-south for greatest solar exposure. Existing site conditions such as high trees and buildings have to be considered with regard to shade effects and windbreaking. Ideally, sites should be located near utilities for irrigation and electricity usage, and roadways for distribution and access purposes. The topography of the site should ideally have a 1-2% slope for drainage, and not include any slopes greater than 5% (Investintech.com, n.d.). Standard greenhouse sizes range from 10,000 square feet to over 10 acres, so the size of the site is an important consideration (Diver, 2000). Vertical greenhouses range in size from a greenhouse as small as 1,500 square feet (Aero Farm Company in Lakewood) on 6,000 square feet of land to 90,000 square feet (FarmedHere in Chicago), the largest vertical farm in North America (Weller, 2015). Greenhouses can also be operated under a variety of financial models, including non-profit uses, for-profit uses, and community CSAs.

Greenhouses would ideally be used in the city of Lakewood to increase food access to residents as well as be placed in areas defined as a food desert by the USDA (American Nutrition Association, 2015). There are several areas of Lakewood where residents are further than one mile from a supermarket or grocery store, and greenhouses providing on-site produce sales would be ideal in these locations. Across the US, tomatoes are the leading greenhouse vegetable crop, followed by European cucumbers, lettuce, peppers, and culinary herbs such as basil, sage, and rosemary.

Yield and Value Analysis: Greenhouse Production

Greenhouse numbers were gathered predominantly from four sources including Growhaus (Denver, CO), Rocky Mountain Fresh (Lyons, CO), Nevada Naturals (Reno, NV), and AeroFarms Co / Future Growing (Lakewood, CO). While the original goal was to capture numbers for around 5 most commonly grown greenhouse crops, we ultimately found that the majority of production in greenhouses comes in the form of greens (such as bibb and butter lettuce, chard, kale, choy, and arugula) or tomatoes. We aggregated these crops into one "greens" category, as their production numbers are very similar (refer to Appendix page B-3 for detailed tables). These numbers included both horizontal and vertical production, as well as aeroponics, hydroponics, and aquaponics for each.

				Distribution Value Estimates (USD/Lb.)*								
	Outcomes (lbs/sf)			Retail			Wholesale			CSA		
Crop	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High
Tomatoes	3.2	10.76	22.4	$7.78	$26.15	$54.43	$5.82	$19.58	$40.77	$4.48	$15.06	$31.36
Greens	7.79	64.27	120.75	$16.05	$132.40	$248.75	$12.07	$99.62	$187.16	$9.27	$76.48	$143.69
Overall Average		37.52			$79.27			$59.60			$45.77	
Overall Average in Acres		**163415.34**			**$345,306.65**	/acre		**$259,621.30**	/acre		**$199,385.66**	/acre
	Assumes 10% of each acre is productive.											


Traditional Greenhouses
Image credit: www.diygreenhouseplan.info


Traditional Greenhouses
Image credit: lightdepgreenhouse.com

A raised bed is an open-topped box constructed to contain the growing medium above grade. This allows crops to have improved drainage, permits remediation of the growing medium, and helps to separate it from existing soils. As an urban agricultural method, raised beds are a way to essentially eliminate contamination of crops by toxic and harmful residues that may be present in urban soils and introduce improved accessibility to gardens.

Tiri's Garden, Denver
Image credit: MSU Denver Rotaract Club

Celebration Community Garden, Denver
Image credit: UrbiCulture Community Farms, ucfarms.org

Raised beds may be made from wood, brick, stone, concrete, or a variety of other materials. They can be prefabricated or built in place on location. They are simple and inexpensive to construct, although they require the importation of large quantities of soil. The method can limit the amount of growing space relative to necessary pathways, but simultaneously allow for increased gardening opportunities for individuals with limited mobility. The use of raised beds give the opportunity for agricultural production on land with poor soils, and they can be temporary (for short-term use of a space) or more permanent fixtures.

Yield and Value Analysis: Raised Beds

The Raised Bed production numbers are almost identical to that of in-ground production, with the exception being the removal of corn, as it cannot easily be grown in raised beds. The same sources were used for these numbers as well, except the Colorado agricultural statistics data was also removed, since the production scale is so much smaller for raised beds. Otherwise, it is assumed that with either production method, the soil would be amended, and become homogeneous across both growing methods, yielding very similar numbers in terms of output.

				Distribution Value Estimates (USD/Lb.)*								
	Outcomes (lbs/sf)			Retail			Wholesale			CSA		
Crop	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High
Tomatoes	0.41	1.83	3.15	$1.00	$4.46	$7.65	$0.75	$3.34	$5.73	$0.57	$2.57	$4.41
Greens	0.38	0.90	1.18	$0.59	$1.40	$1.83	$0.59	$1.40	$1.83	$0.45	$1.07	$1.40
Root Vegetables	0.64	1.76	2.81	$0.98	$2.69	$4.30	$0.98	$2.69	$4.30	$0.76	$2.07	$3.32
Alliums	0.01	0.81	1.79	$0.06	$4.56	$10.08	$0.04	$3.42	$7.55	$0.03	$2.62	$5.78
Peppers/Eggplant	0.37	0.96	1.41	$1.14	$2.96	$4.36	$0.86	$2.22	$3.27	$0.66	$1.70	$2.51
Cucurbits	1.45	2.01	3.13	$3.00	$4.16	$6.48	$2.25	$3.12	$4.85	$1.64	$2.27	$3.54
Tomatillos	0.14	0.29	0.43	$0.16	$0.34	$0.50	$0.12	$0.26	$0.38	$0.10	$0.20	$0.29
Green Beans/Peas	0.20	0.72	1.30	$0.80	$2.87	$5.17	$0.75	$2.69	$4.86	$0.57	$2.07	$3.73
Broccoli/Cauliflower	0.06	0.21	0.44	$0.12	$0.43	$0.90	$0.09	$0.32	$0.68	$0.07	$0.25	$0.52
Cabbage	0.06	0.45	0.83	$0.07	$0.56	$1.03	$0.06	$0.42	$0.77	$0.04	$0.32	$0.60
Cantalope	0.02	0.24	0.45	$0.02	$0.24	$0.44	$0.01	$0.18	$0.33	$0.01	$0.14	$0.26
Overall Average		0.93			$2.24			$1.82			$1.39	
Overall Average in Acres		**20149.8**			**$48,793.93**	/acre		**$39,679.27**	/acre		**$30,245.09**	/acre
	Assumes 50% per acre is productive											

Metro Caring Community Garden, Denver
Image credit: Denver Urban Gardens, dug.org

Gabrielle's Garden, Denver
Image credit: UrbiCulture Community Farms, ucfarms.org

Food forests represent a low maintenance gardening practice that imitates a healthy woodland ecosystem, combining edible trees, bushes, perennial vegetables, herbs, and vines with other non-food producing woodland species. Food forests do not typically provide a significant financial benefit, as they tend to be free to access and are intended for public consumption; however, they notably provide a useful yield for human consumption.

There are many benefits for the local habitat, ecology, and local community that may be realized as a result of creating a food forest:

- Food forests have no size limitations and can simply be placed into the smallest of lots.
- Food forests are versatile and can be built around an existing tree or landscape.
- Food forests help create a balanced ecology by providing species diversity.
- Food forests are capable of very high yields, producing high quantities of fruits, nuts, flowers, and herbs.
- Food forests are very simple to create and maintain.
- Given their species diversity, food forests typically provide a habitat for pollinators and other wildlife, promoting natural fertilization and pest management.

Photo of a food forest
Photo credit: appropedia.org

Typical crops found in a Colorado food forest are:

- American Persimmon
- Apple trees
- Pear trees
- Apricot
- Assorted cherry trees
- Assorted berries
- Assorted nut trees
- Grape vines
- Cold hardy kiwis
- Gourds

(A more extensive and detailed list of the specific food forest crops can be found at http://coloradofoodforest.com/)

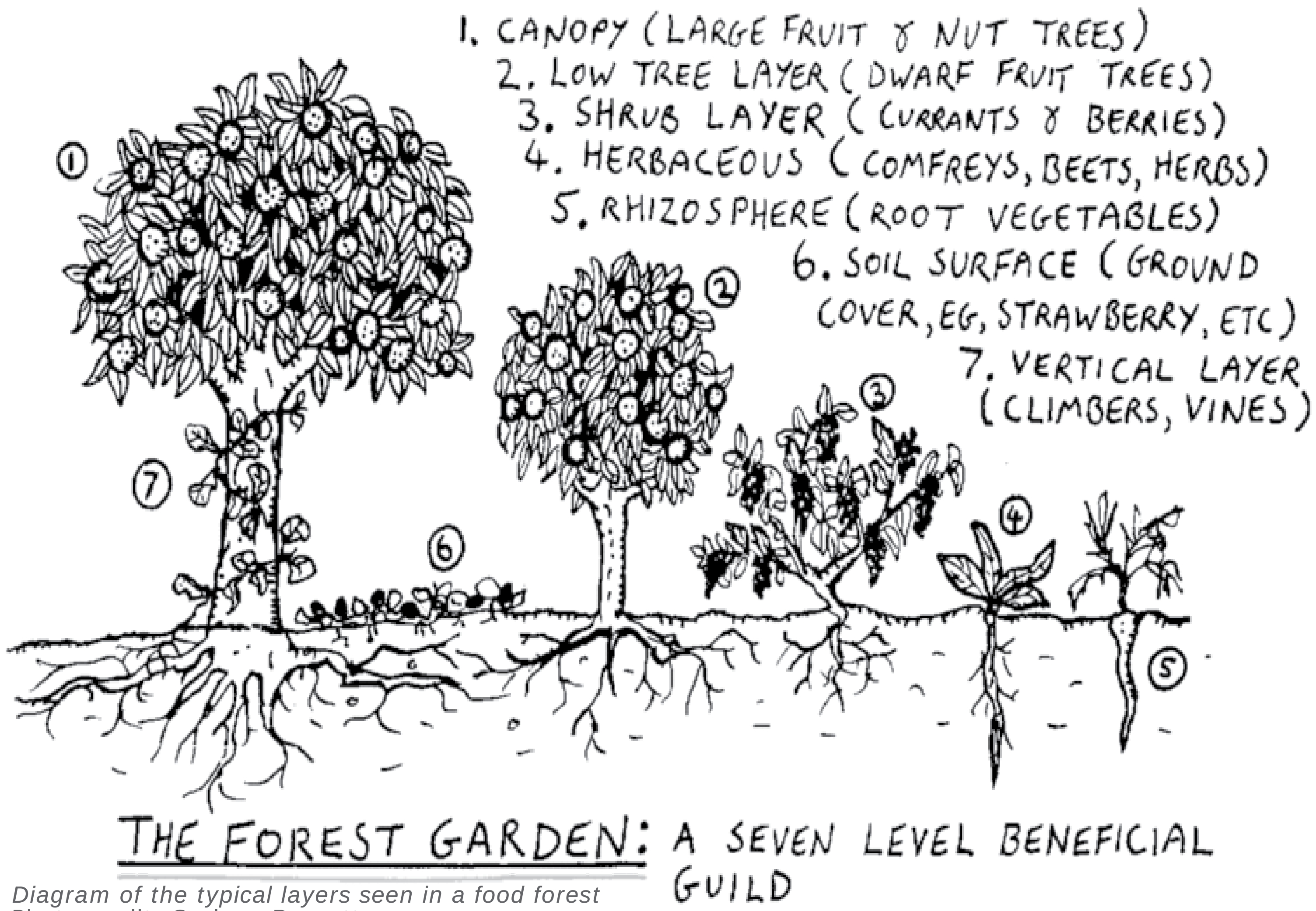


Diagram of the typical layers seen in a food forest
Photo credit: Graham Burnett

				Distribution Value Estimates (USD/Lb.)*											
	Outcomes (lbs/sf)			Retail			Wholesale			CSA			Open Access		
Crop	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High
Raspberries/Blackberries	0.2	0.95	2.28	$2.22	$10.56	$25.35	$1.67	$7.92	$19.02	$1.32	$6.25	$15.00	$1.11	$5.28	$12.68
Strawberries	0.06	0.43	1.08	$0.28	$2.04	$5.12	$0.21	$1.53	$3.83	$0.16	$1.17	$2.95	$0.14	$1.02	$2.56
Rhubarb	0.1	0.13	0.16	$0.20	$0.27	$0.33	$0.90	$1.17	$1.44	$0.69	$0.90	$1.11	$0.10	$0.13	$0.16
Asparagus	0.06	0.36	0.65	$0.33	$1.98	$3.57	$0.25	$1.48	$2.67	$0.19	$1.14	$2.05	$0.16	$0.99	$1.78
Fruit Trees	0.64	1.91	3.02	$1.58	$4.72	$7.46	$1.41	$4.22	$6.67	$0.91	$2.71	$4.29	$0.79	$2.36	$3.73
Currants/Gooseberries	0.3	0.3	0.3	$1.98	$1.98	$1.98	$1.49	$1.49	$1.49	$1.14	$1.14	$1.14	$0.99	$0.99	$0.99
Overall Average		0.68			$3.59			$2.97			$2.22			$1.80	
Overall Average in Acre		**14810.4**			**$78,206.54** /acre			**$64,628.16** /acre			**$48,337.08** /acre			**$39,103.27** /acre	
	Assumes 50% per acre is productive														

A food forest that has been created in Seattle's Beacon Hill neighborhood
Photo credit: gaiahealthblog.com

Yield and Value Analysis: Food Forest Cultivation

Food Forest production numbers were gathered from four sources including Hoot and Howl Berry Farm (Boulder, CO), the previously mentioned texts on edible forests, and “Analyzing Agricultural Potential Within Denver” (Carman et al, 2015). Because there are very few precedents for food forests in Colorado, this information had to be estimated based on food forests in other climates (specifically Iowa and Massachusetts). In order to make these estimates accurate, we used rainfall totals as a way to determine the difference in production from one climate to the other (see Appendix B-3 for detailed tables). We gathered numbers for crops that would commonly be seen in a food forest (including various berries and fruit trees), as well as those that we know can grow on the Front Range.

For economic estimates, we used the same process for retail, wholesale, and CSA values as the previous farming methods, but included open access (see page 9 for description) for this typology. These numbers were estimated by reducing the retail price by 50% to account for unharvested or spoiled produce due to the unmanaged nature of an open access model.

“Value-added processing” is a broad term encompassing different practices that increase the value of farm products. Value-added processing entails changing a raw agricultural product into something new through packaging, processing, cooling, drying, extracting or any other type of process that differentiates the product from the original raw commodity. Processing is subject to a variety of rules and regulations for the final product marketed. While these regulations can vary according to the specific crop marketed, a major determining factor is whether the final product will be intended for a food or a nonfood purpose (University of Kentucky, 2011).

The concept of value-added processing has gained currency in the small farm policy debate in response to the concern that the farm value of the consumer food dollar continues to decrease (University of Minnesota, 2000). Value-added processing might be a means for farmers to capture a larger share of the consumer food dollar.

Important questions are raised when small farms decide to include a value-added processing component on their land, including:

- What is unique about your product that will attract customers?
- Who will buy your product? Consumers? Restaurants? Grocery stores or specialty food shops?
- If you sell direct, how many customers will regularly purchase your product?
- If you sell to shops and stores, how will your product reach those locales?
- Is your sales site conveniently located for shoppers?
- What are your costs, including overhead, ingredients, and labor?
- How much will your product cost?
- How much will the consumer pay for the product?
- How will you attract consumers to your product?
- How will you demonstrate the quality of the product?

(University of Minnesota, 2000).

Typical value added food in Colorado includes spices, teas, dehydrated produce, nuts, seeds, honey, jams, jellies, preserves, fruit butter, and baked goods (including candies, fruit empanadas and tortillas). Another value-added product in Colorado are pickled vegetables that have an equilibrium pH value of 4.6 or lower (Colorado Farm to Market, 2016).

Canning is considered a form of value-added processing
Image Credit: semaponline.org

Value-added processing in action
Image Credit: oregonstate.edu

Image Credit: www.cutgana.it

Yield and Value Analysis: Value-Added Processing

Our analysis of Value-Added Processing as a production method necessitated a unique approach, but ultimately we were able to achieve comparable outcomes for land use and economic values, as well as a recommended number of kitchens to serve the city of Lakewood. It should be noted that Value-Added Processing can take many forms, and the outcomes of this analysis are based on sources looking specifically at kitchen incubators. Kitchen incubators are a type of Value Added Processing that not only have shared kitchen facilities, but also offer cold and dry storage, food business consulting services, and packaging. The top products processed in kitchen incubators nationally are, baked goods, catered foods, food truck items, prepared meals and sauces/spreads. The majority of distribution of kitchen incubator products happens at farmer's markets, community events, small grocers/retailers and online (Wodka, 2016).

Our primary source for this analysis was U.S. Kitchen Incubators: An Industry Update, an analysis of national survey data from the Kitchen Incubator Industry (Econsult Solutions, 2013). For our purposes we used the median number of tenants per facility, the median number of shared users, and the median rent ($/hour) nationally from this study. In the absence of reliable production data for this typology, we also used the operating model and rental frequency of Colorado Kitchen Share (locations throughout Colorado) as an assumed standard to determine an estimated gross economic value in the form of rent for each kitchen.

To determine the number of kitchens needed to accommodate Lakewood, we found the percent of Colorado's population that is serviced by the estimated number of kitchens currently available in the state. We then applied that percentage (4%) to the population of Lakewood to determine the number of residents requiring a kitchen incubator facility every week. This was based on the aforementioned median figures, and the number of kitchen incubators that contributed to the U.S. Kitchen Incubators study. The number of residents divided by the number of shifts available per week for one kitchen (from the information given to us by Colorado Kitchen Share) revealed the number of kitchens needed to accommodate the weekly need of 4% of Lakewood residents.

			Median Rate Rent/Hour/Kitchen
			$22
Day Open p/week	80% Booking/hours open/kitchen	Median Hours/Shift	Est.Gross Rent Value /shift
7	19	4	$86
Median # of Tenants/Facility	Median # Kitchens per Facility	Shifts/day/kitchen	Est. Gross Rent Value/day/kitchen
24	2	5	$413
Median # of Tenants/Kitchen		Shifts available/week/kitchen	Est. Gross Rent Value/week/kitchen
12		34	$2,890
			Est. Value/Annually/Kitchen
			$150,259

Population of Colorado	Number of Facilities/CO	population/ facility	% population/facility
5,456,574	13	419,736	8%
	Est. # of Kitchens/CO	population/kitchen	% population/kitchen
	26	209,868	4%

Population Lakewood			
149,643			
Population Requiring Kitchens	# of shifts needed/population/week	% pop. requireing facilities (based on % pop./kitchen/CO)	
5756	480	4%	
	# of kitchens needed/shifts/week	Recomended # of kitchens to Serve 4% of the population of Lakewood Weekly	
	14	14	
		Estimated value all shifts/week	Estimated value all shifts/month
		$41,248	$164,991
		Estimated Gross Rent Value annually for all kitchens	
		$2,144,883	

LAND USE TYPOLOGIES AND PRECEDENTS

EVALUATION OF POTENTIAL IMPLEMENTATION SITES IN LAKEWOOD

Greenfields encompass a fairly large range of parcels. As their name implies, greenfields are typically a parcel or a portion thereof that is either undeveloped, or at least uncontaminated. This land type requires that the land be undeveloped and clear of rubble. Greenfields provide opportunities to implement production agriculture at scales commensurate with site type, size, and location.

In Lakewood, urban greenfields are typically small plots of land; however, they may also be relatively large compared to the density of the surrounding urban environment. Plots are usually no smaller than a quarter acre, and may go up to nearly any size. For the City of

Detroit urban farm
Image credit: http://www.dailydetroit.com/2015/07/06/10-detroit-urban-farms-rooting-goodness-into-the-city/

Brother Nature Produce
Image credit: http://www.dailydetroit.com/2015/07/06/10-detroit-urban-farms-rooting-goodness-into-the-city/

Lakewood's purposes, lot sizes of a quarter acre or more are being considered for this typology. Not only does the amount of land matter, but the current vegetation on the site may be a concern, as is the immediate surrounding urban environment, and most importantly the soil quality. Although conditions may vary considerably, these sites generally should not require a considerable amount of work to start production. As such, sites with contaminated soil, excessive shade, or otherwise inappropriate conditions for growing edible plants would likely be considered unsuitable for this type of production.

Vacant greenfield near affordable housing
Image credit: http://affordablehousinginstitute.org/blogs/us/2010/09/urban-fallow-part-1-letting-go-of-the-past.html

ACRE Community Farm
Image credit: http://www.dailydetroit.com/2015/07/06/10-detroit-urban-farms-rooting-goodness-into-the-city/

Vacant greenfield in Detroit, MI
Image credit: http://smartgrowth.org/webinar-adapting-urban-vacant-land/

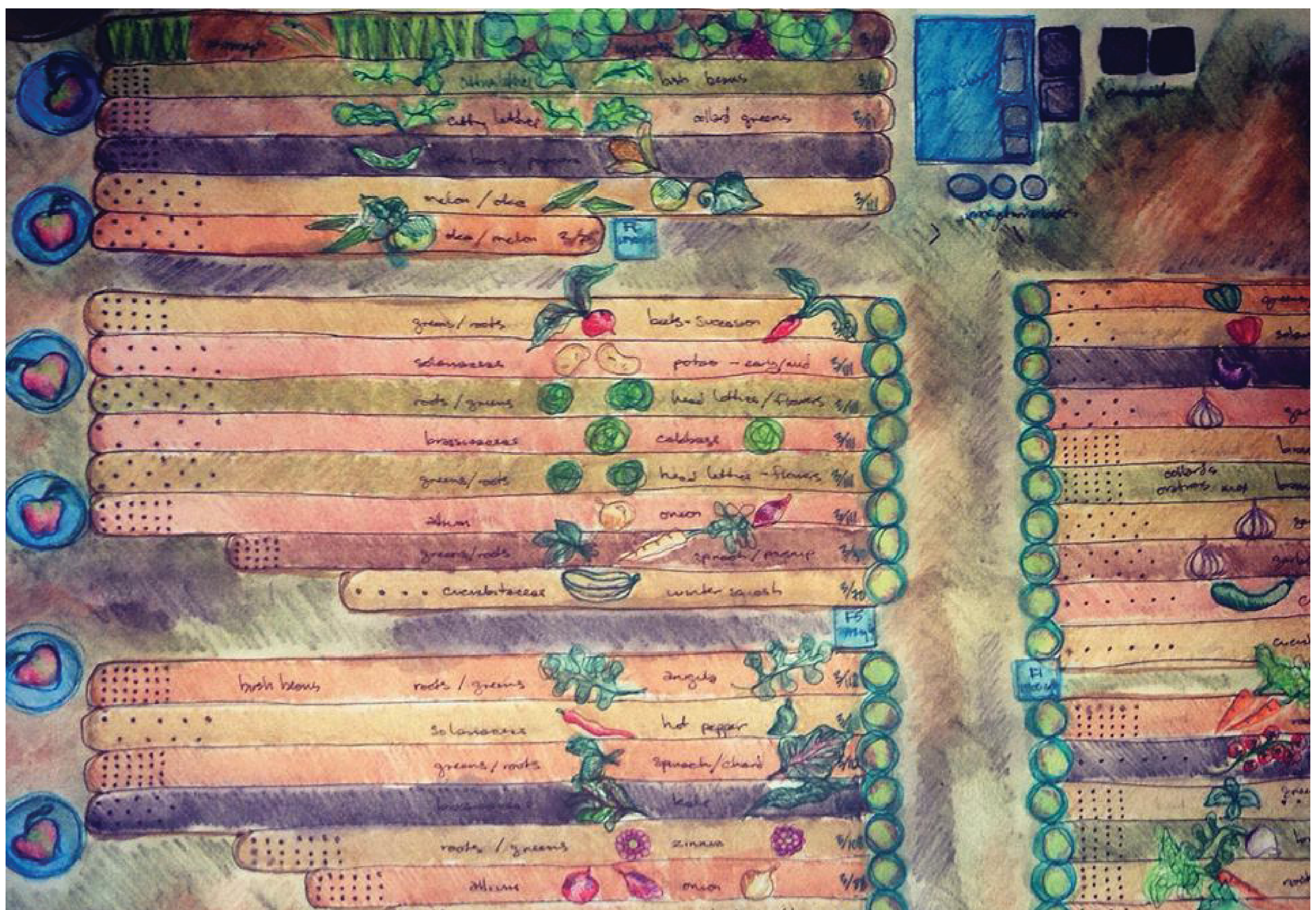
Examples of urban production agriculture sprouting up on greenfield parcels across a city can be seen throughout Detroit, Michigan. Although the city has depopulated, it can be looked to for inspiration as a city taking advantage of its many acres of greenfields. Urban agriculture has infiltrated both vacant lots and fields across the city, where approximately 70 urban gardeners oversee and operate over 1,400 urban gardens.

As seen on the preceding page, Brother Nature Produce is an urban farm in the Corktown neighborhood of Detroit. They have been pushing the limits on farming for over ten years, last year specializing in edible weeds, and are well-known for their spicy salad mix. In partnership with Brother Nature is ACRE Community Farm, also based in Corktown. They focus on bringing healthy, local food to Detroiters, specializing in high-quality heirloom produce. Lastly represented below, the Michigan Urban Farming Initiative is a 501(c)3 non-profit organization that bases itself on education, sustainability, and community within Detroit. They offer a CSA, engage the community in their own sustainable agriculture through education, and help reduce socioeconomic disparity to food availability (Held, 2015). Although Detroit has depopulated, which has directly instigated the emergence of some of these urban farms, other cities have their own unique opportunities to increase food security for their residents with local production.

The Michigan Urban Farming Initiative - 734 Bush St.
Image credit: http://www.dailydetroit.com/2015/07/06/10-detroit-urban-farms-rooting-goodness-into-the-city/

Moondog Farms is a commercial operation that has been in existence since 2011, and is roughly 1/4 acre (Shunk, 2011). They currently offer 30 CSA shares, sell wholesale to three nearby businesses, and sell additional goods at their farm stand. The shares sell for $675 each, and provide 18 - 20 weeks of fresh harvest (Mehrmanesh, 2015). They provide the fresh produce for the Mercury Café, Queen Anne's B&B, and Five Points Fermentation (Shunk, 2011). Their farm stand is located on site, and is open every Saturday at 10:00 AM during the months of July through October. The growing season is from May through October, and they offer a variety of vegetables, herbs, flowers, and fruits. Their growing methods are chemical free, biologically intensive, organic and sustainable. These practices focused around the soil offer a higher quality, nutrient dense product as compared to industrial crop production.

Repurposed door as a sign for MoonDog Farms,
Image credit:http://www.westword.com/restaurants/mercury-cafe-plants-and-harvests-produce-from-its-very-own-moon-dog-farms-5728077



Planting Plan of MoonDog Farms
Image credit: http://www.placestogoindenver.com/places/888235-MoonDog-Community-Farm/

Profile picture for MoonDog Farms
Image credit: https://www.facebook.com/MoondogFarmdenver/photos/a.553395808087027.1073741825.553395204753754/781441675282438/?-type=3&theater

English Peas at MoonDog Farms
Image credit: https://denverfeasting.wordpress.com/2012/06/18/moon-dog-farms-farming-for-community/

MoonDog Farms produce
Image credit: https://www.facebook.com/MoondogFarmdenver/photos/a.760316090728330.1073741830.553395204753754/760316054061667/?-type=3&theater

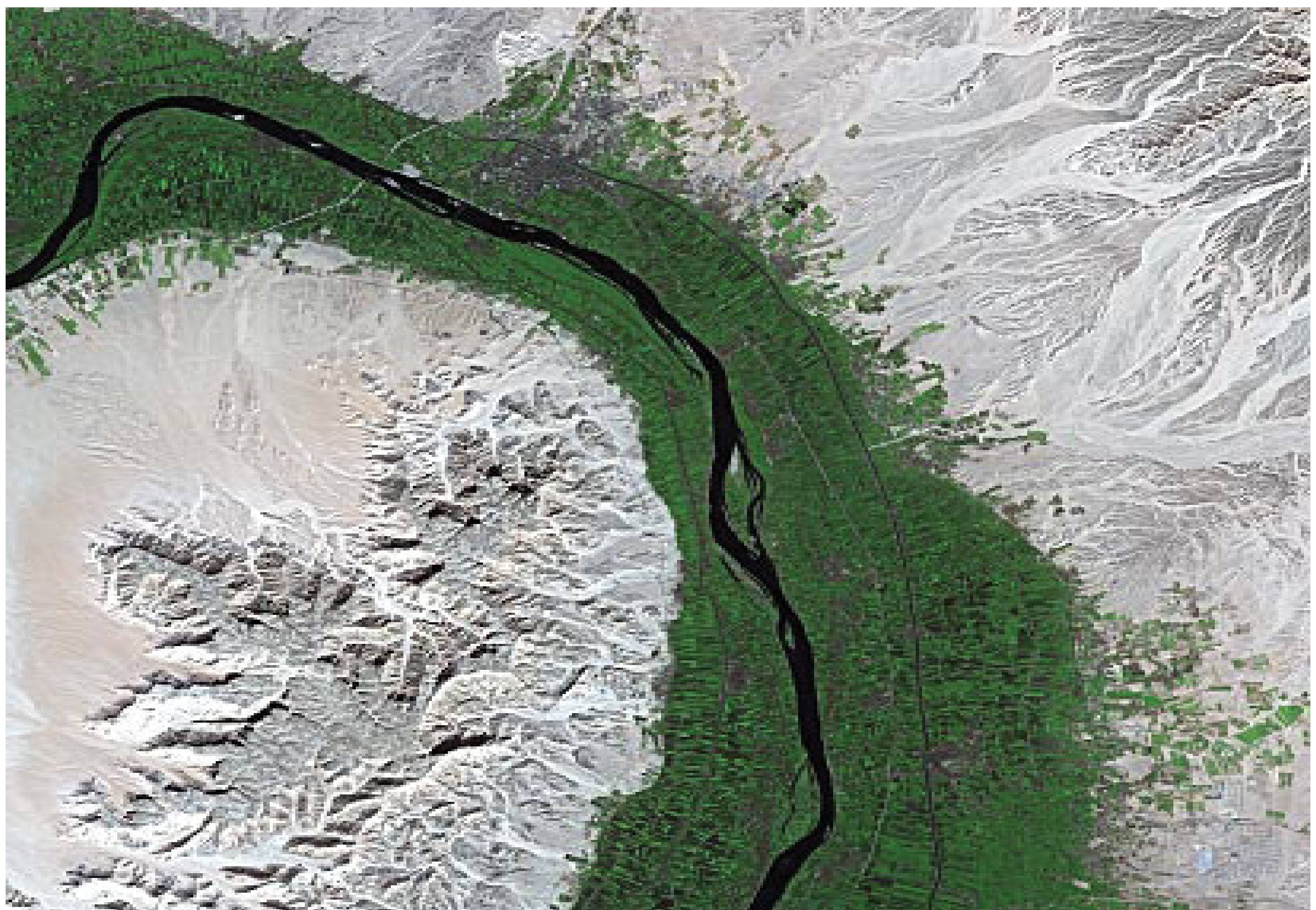
MoonDog Farms came from two business owners' collaboration towards providing healthy, local foods for their customers. Milan Doshi, owner of the Queen Anne Bed & Breakfast and Five Points Fermentation, and Marilyn Megenity, proprietor of the Mercury Cafe, along with the help of Nick Gruber, from Produce Denver, established the farm in early summer 2011 (Shunk, 2011). They have been improving the site at 333 22nd Street in Denver, Colorado, and have noted improvements in crop yields after incorporating irrigation into the farm, which also allowed for a change in their planting schedule for the upcoming year (Shunk, 2011). The farm does not allow volunteers, as Marilyn believes that people ought to be paid for their work (Shunk, 2011). Likewise, the CSA shares are work-free (Mehrmanesh, 2015).

The farm is located within a couple blocks of its wholesalers, who also happen to own the farm. Therefore, it's apparent that the goal of providing local, organic food to their customers is met with ease. The Mercury Cafe even freezes all the produce they can, in an attempt to make locally-sourced food available throughout the winter months, rather than having it shipped in from another state (Shunk, 2011). There is no doubt that MoonDog Farms is meeting its stated mission, which is, "to increase access to local fresh organic food in Denver."

View from MoonDog Farms, looking SouthWest towards Benedict Fountain Park.
Image credit: http://www.localharvest.org/moondog-community-farm-M65262

Farms in a floodplain adjacent to a city
Image credit: Intervale.org

Farms set within a floodplain
Image credit: cpat.org.uk



The Nile River floodplain
Image credit : Floodplains.wikispaces.com

Floodplain agriculture has been a widely utilized farming approach for thousands of years as farmers have successfully reaped the nutritional benefits of sediment deposition from flood events. On average, rivers flood nearly every two years. As they flood, they push their water out onto the floodplain, bringing a high volume of silt, clay, and organic matter along with it. A study in 2003 estimated that 80% of organic carbon from leaf litter on floodplains comes from rivers, which in turn contributes to the high fertility of floodplain soils, making them ideal places to grow crops and graze cattle.

The benefits of farming in a floodplain are not solely limited to highly productive crops, but farming these nutrient rich lands also provide ecological benefits as well. According to the Federal Emergency Management Agency (FEMA), farming on floodplains provides beneficial functions such as: reducing flood velocities downstream, improving water quality with vegetation coverage, and acting as recharge areas for ground water while also providing habitats for flora and fauna.

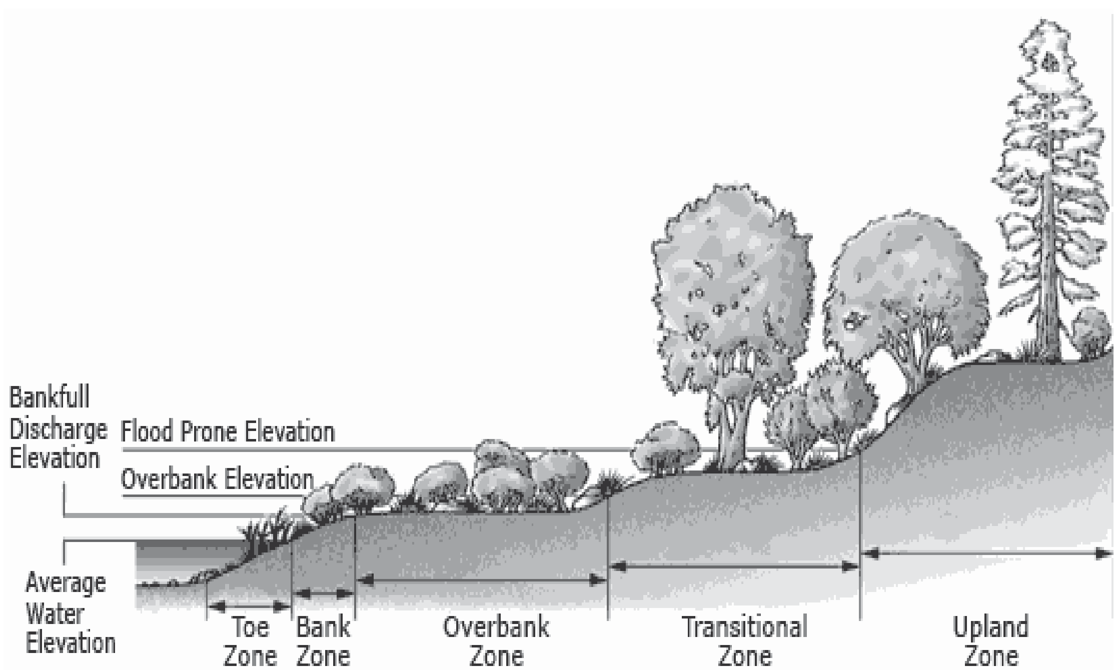
When contemplating the feasibility of floodplain agriculture within a specific site, it is important to consider the elements of the site to determine the most appropriate application (Coburn, 2015).

Criteria to Consider:

- Available lot size will directly impact the type and scale of production that is possible in a given floodplain; i.e., a commercial production farm and a “pick-your-own” farm have differing minimum and maximum lot size recommendations. Since soils are typically highly fertile and productive in floodplains, it is often possible to produce an increased quantity of food compared to a lot of equal size located outside the floodplain.

Photo of the variation in farm plots along a floodplain
Image Credit: Intervale.org

Stand of cottonwoods that are typically found along rivers in the west
Image Credit: timberlinetrails.net



An elevation diagram of the different zones located in a floodplain
Image credit: nrcs.usda.gov

- Floodplains will periodically be inundated during storm events. Determining the average elevation above mean water level is a significant factor in placing fields to prevent certain crops from being submerged for extended periods of time. Other crops thrive in inundated conditions and can be planted at or below the mean water level.

- Oftentimes, floodplains are undeveloped; therefore, access to the sites can be a limiting factor, and additional road development to access the site can be costly. However, floodplains have the added benefit of greater land availability for cultivation, since construction in floodplains is typically avoided.

- Characteristically, floodplains host a myriad of flora and fauna, which often include large trees, such as the cottonwood, in Colorado. Large trees present potential obstacles to a production site, rendering it less desirable given the increased amount of shade and potential obstructions to cultivations of a site (Verhoeven).

Floodplains are capable of hosting any production typology that would benefit from the nutrient rich and fertile soils. For example, the Intervale Center, located on the Winooski River in Burlington, Vermont, sits on a 900-acre floodplain. The Intervale Center hosts 11 farms on approximately 135 acres and is dedicated to organic practices. The Center's programs have expanded over the years to include on-site farming, a farm incubator program, business planning support for farms, a number of CSA programs, and a food gleaning program.

The concept to create a farm on the Intervale floodplain was conceived in 1987 by Will Raap when he purchased the fertile soils with the idea of creating a community food system. Prior to the purchase, the land was used as a dumping ground. Prior to creating the farm, nearly 1,000 tires were removed from the site, along with 350 junked cars.

Currently, The Intervale Center is owned by the CSA members through a consumer co-op model and is a lively, environmentally conscious, and financially viable example that is recognized nationally as a successful model for sustainably farming on a floodplain. Below is a photo of the community gathering that Intervale hosts in order to celebrate their community asset, local food (Intervale.org).

Thursday night festivities at The Intervale Center
Image credit: Intervale.org

Chickens are used at Elmer Farm as a form of permaculture
Image Credit: Elmerfarm.com

The Intervale Farm program has assisted in the success of over 40 farms since its inception. For example, Elmer Farm, Intervale's bean and grain farmer, was part of the farm incubator program from 2004-2006 with the goal to grow dry beans and experiment with grain production. In 2005 the farm started a small market garden, selling produce to the local wholesale accounts. By 2006 the farm was growing 32 acres of beans, grains, and vegetables for three seasons in the Intervale Valley.

Eventually, after the assistance from the Intervale Center's incubator program, Elmer Farm was able to purchase farmland from the Vermont Land Trust and establish their own farm, where they continue to grow crops on 25 acres, manage a small CSA, and support local farm-to-school and gleaning efforts (Intervale.org, 2016).

Aerial image of the Rio Grande Healthy Living Park on the Rio Grand River
Image Credit: healthylivingpark.org

Community gathering at the Rio Grande Healthy Living Park
Image Credit: healthylivingpark.org

Set along the floodplain of the Rio Grande River in Alamosa, Colorado lies the Rio Grande Healthy Living Park. As a subsidiary of The San Luis Valley Local Foods Coalition, formed in 2008, the 38-acre park was recently acquired and secured by the Trust for Public Land, San Luis Valley Foods Coalition, and Colorado Open Lands in order to preserve the land and support the local agricultural heritage (healthylivingpark.org, 2015).

The Rio Grande Healthy Living Park is planned to feature the following entities:

- A working farm, which will serve for education and research opportunities for individuals families, and children to grow their own food
- A local food market that will be supplied by greenhouses, providing fresh food to local schools
- A botanical garden
- A commercial kitchen that can host local food makers and caterers
- Live events such as concerts, parties, weddings, and other gatherings
- Walking trails for the community

Volunteers set up irrigation in a canal at the farm
Image Credit: healthylivingpark.org

Kitchen gardens have been a component of institutions of various kinds throughout history. Whether religious, secular, academic, medical, or any combination thereof, there often can be found some form of agricultural activity. Early monasteries, the monastery at St. Gall being a prime example, served spiritual, educational, and medicinal roles – St. Gall is regarded as perhaps the model for the modern university – and, food holding the central role that it has in life, were a fount of agricultural production and research. Nutrition is such a basic part of health that such a pairing seems natural, even obvious. Even Frederick Law Olmsted's design for Central Park originally included an onsite dairy: the health benefits from improved nutrition were understood to be important enough to provide milk production within public space as a gesture to increase food access.

The food system we now find ourselves under has resulted in widespread issues of food access and food education, and has separated institutions from agricultural production. Nutrition-related helath problems are considered to be among the leading health risks; for example, obesity rates are at epidemic levels. However, opportunities abound to address the issues surrounding our food system and to reintegrate our institutions with agriculture. Interactive by nature, educational, healthcare, community service, and religious institutions create a community relationship and the sense that they, in some way, are a part of the public realm. As such, a collaborative, cooperative effort can readily bring forth positive methods to address and remedy issues related to nutrition and health – a perfect example and model being found in the recent school/community garden movement.

Significant potential for urban agriculture lies on the land of the various kinds of institutions found in cities. When searching for spaces for agricultural production, institutional land makes for one of the largest sets of parcel types, with an especially wide range of agricultural production and distribution methods possible. In addition, the inputs required to pursue the typology of institution-based agriculture tend to be small, with the vital factor being a cooperative effort by the institutions and community organizations.

Aria Sister Gardens, Denver
Image credit: UrbiCulture Community Farms, ucfarms.org

Generally, by way of the temporary donation of unused land belonging to an institution, space can be provided for food production efforts by the local community. In return, a portion of what is produced can be retained by the institution for its own programs, such as food banks or cafeterias. Institutions able to participate in such a model could include public schools, churches, hospitals, recreation centers, colleges and universities, childcare centers, and community centers. These institutions can be roughly sorted into three categories, based on function: education, healthcare, and community service.

The development of an institutional/community garden can be relatively inexpensive, with necessary design elements including community gathering/educational space, garden bed or plot space, and tool storage. Operations and management are generally overseen by a community organization and done on a volunteer basis. Production space can be divided up in a traditional allotment garden fashion or cultivated communally, depending on the institution and the production aims of the garden.

Modes of food production that are possible within this typology include temporary raised beds, in-ground plots, row cropping, food forests/gleaning fields, and greenhouse production. Since the focus of this typology, depending on the situation, could be access and education rather than volume of production or economic efficiency, the usable land area required is potentially relatively small; however, with an expansive view, a wide variety of models are possible, and institution-based agriculture has the potential to function at a larger, production-centered scale.

Carrot Harvest, Gabrielle's Garden, Denver
Image credit: UrbiCulture Community Farms, ucfarms.org

Pay-what-you-can Farmstand, Celebration Community Garden, Denver
Image credit: UrbiCulture Community Farms, ucfarms.org

A precendent example found in Denver, Colorado is the work done by UrbiCulture Community Farms, which has collaborated with various institutions to create community gardens on institutional Land. One of these is Celebration Community Garden. A partnership between UrbiCulture Community Farms, a Denver nonprofit organization, and Celebration Community Church allowed for a portion of church land to be used for a community garden that would serve the residents of the neighboring assisted housing; with the church matching fundraising donations, the garden was built for just over six thousand dollars. In addition to providing food access to the local community, ample space is provided to enable the garden to host beekeeping and gardening classes.

UrbiCulture has also worked with local communities and land-finding organizations to create gardens at Columbian Elementary School in Denver as well as a large garden founded in collaboration with Regis University, known as the Aria Sisters' Garden. Efforts at Columbian Elementary include a farm-to-cafeteria program and a summer educational program for elementary school students.

At the Aria Sisters' Garden, classes are taught about Permaculture principles and food production to both community members and to university students; the university has launched a program about urban agriculture, with classes hosted cooperatively by urban farming organizations and faculty.

Celebration Community Church, Denver
Image credit: Wieland Construction, wielandbuilds.com

Celebration Community Farm, Site Plan
Image credit: UrbiCulture Community Farms, ucfarms.org

Another local precedent is Eiber Community Garden at Eiber Elementary School in Lakewood, Colorado. An initiative by the Eiber Garden Committee, in partnership with Denver Urban Gardens and the elementary school, the project was awarded a grant from the city of Lakewood and began construction on the garden in 2013. The garden is operated jointly by residents of the neighborhood and by the school's garden club, and, in addition to providing garden plots to local residents, gives educational opportunities to both residents and to students of the school. Thus, a fundamental education about where food comes from is made available to the youth of this low-income community as well as to neighborhood residents.

Celebration Community Garden, Denver
Image credit: UrbiCulture Community Farms, ucfarms.org

Eiber Community Garden, Lakewood
Image credit: Eiber Neighborhood Association, eiberhood.org

When expanded, the typology of the institutional/community garden has the potential not only to shift culture and cultural perspectives on food and nutrition, but also to increase local resilience and self-reliance and to address food access issues in a direct, fundamental way. In return for minimal inputs and collaboration between organizations, available and otherwise unused space can be directed towards the fulfillment of institutional and community needs, and the basis for a strong and reasonable local food culture can be built.

Eiber Community Garden, Lakewood
Image credit: Eiber Neighborhood Association

The Environmental Protection Agency (EPA) developed the brownfield program in 1995 to help states, communities, and other stakeholders work together in a timely manner to prevent, assess, safely clean up, and sustainably reuse contaminated land. Since its inception, the program has helped to change the way contaminated property is perceived, addressed, and managed.

There are an estimated 450,000 brownfields in the U.S. According to the EPA, a brownfield is a property whose expansion, redevelopment, or reuse may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant (EPA, 2006). Cleaning up and reinvesting in brownfields provides numerous benefits, including increasing local tax bases, facilitating job growth, utilizing existing infrastructure, eliminating blighted areas, and helping to improve and protect the environment.

There are several challenges in the cleanup and redevelopment of brownfields, including: environmental liability, financial barriers, cleanup considerations, and reuse planning. Despite these challenges, many opportunities exist for brownfield redevelopment, helping with infill in densifying areas as well as creating a complete development plan for cities and rural areas alike.

Urban soil contamination does not prevent the land from being used for food production. In cases where remediation is not possible, farmers have used greenhouses or hydroponic and aeroponic systems to grow food above ground on formerly abandoned brownfields. Urban projects that are being built upon contaminated sites have been encouraged to retain and manage their stormwater on-site, to conserve energy and water, to install more efficient insulation, and to plant trees (Edwards, 2008).

Raised beds could also be used on brownfields, allowing gardening in a variety of lengths and shapes. The beds contain imported, clean soils and are raised up, reducing contact with contaminated soil on site. Raised garden beds are great for growing small plots of vegetables and flowers, keeping pathway weeds from garden soil, preventing soil compaction, providing good drainage, and serving as a barrier to pests such as slugs and snails.

Traditional Greenhouse
Image Credit: www.chicagobusiness.com

Raised beds are just one production typology that is appropriate on brownfield sites.
Image credit: tucsonraisedgardenbeds.com

Greenhouses are ideal for brownfield sites since all food can be grown in different or no soil.
Image credit: agratech.com


Brownfield site, Pennsylvania
Image credit: www.cmu.edu


Brownfield site, New Jersey
Image credit: www.jmsorge.com

Brownfield redevelopment example, Tulsa Oklahoma
Image credit: www.manhattanconstructiongroup.org


Brownfield site that would be perfect for a greenhouse or raised bed agriculture - Portland, Oregon.
Image credit: www.opd.org

Aero Farms is a small vertical farm practicing aeroponic techniques in an industrial area in Lakewood, Colorado (Grant, 2014). The vertical Tower Gardens are sourced from Well Nourished Worldwide, and allow up to 20 vegetables, herbs, fruits, and flowers to be grown in less than 3 square feet. The owner of Well Nourished Worldwide, Jeff Olsen, claims that leafy green crops, such as kale, Swiss chard, and spinach can grow more efficiently in urban greenhouses than on large rural farms. Olsen claims an urban farmer growing leafy greens vertically in a greenhouse can earn a quarter of a million dollars in revenue per acre (Grant, 2014).

Aero Farms provides produce to many Denver restaurants, including Linger and Root Down, through approximately 12 harvest event per year. The greenhouse is approximately 1,500 square feet and the total site is approximately 6,000 square feet.


Tower Gardens
Image Credit: www.theneweconomy.com

The Greensgrow Project is housed on an abandoned brownfield site in Philadelphia, Pennsylvania, which formerly hosted a galvanized steel plant. After the EPA remediated the site through the brownfields program, it sat abandoned for years until the Greensgrow Project took over. The Project now encompasses a greenhouse, three drained, irrigated raised beds with high tunnels, a 4,000 square foot hydroponic system for growing greens, a nursery hoop-house, flower beds, bee hives, a farm market, and a retail nursery. The Project uses community input to make production decisions, allows residents to sell various value-added goods at the farm market, and offers discounted CSAs for low-income community members. Farm operations are run by a cooperative of fifteen farmers (Loria, 2011).

The Greensgrow Project's mission, to carry out "an environmentally friendly and entrepreneur based re-use of blighted land that will bring fresh produce and other farm products to city neighborhoods", is a perfect example of the existing potential of urban brownfield land, utilizing ingenuity and an available site with existing site contamination issues.

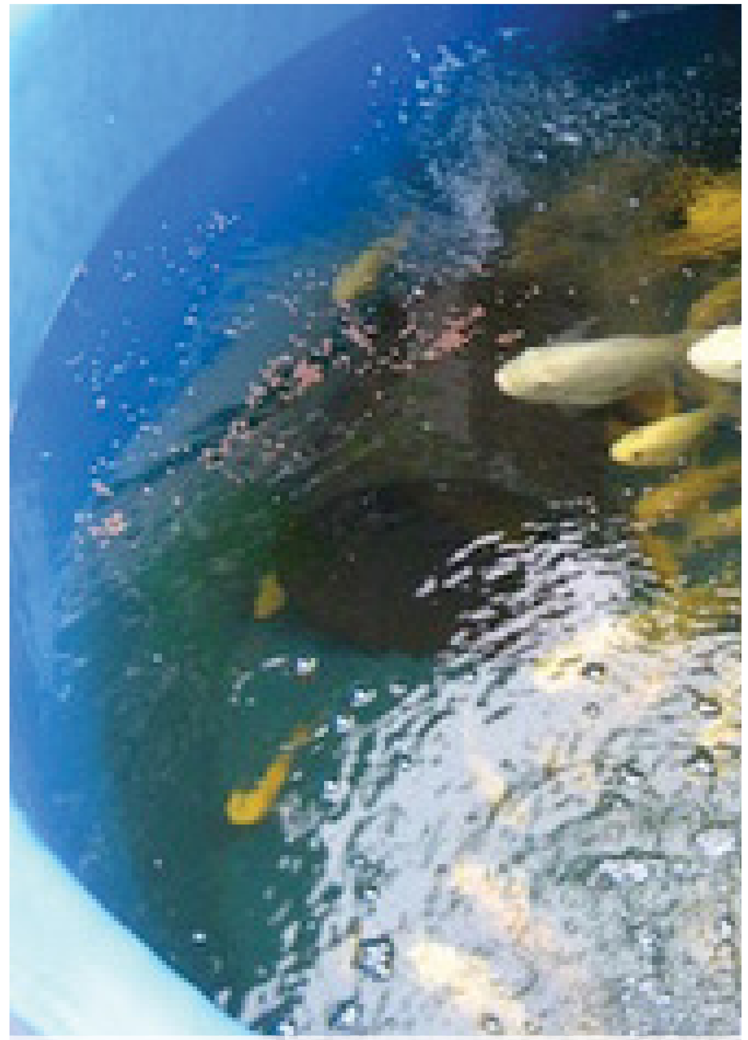

Vertical Lettuce Farm
Image Credit: thegreenhorns.net


Lettuce growing
Image Credit: www.greensgrow.org

The GrowHaus is a nonprofit organizations located in a primarily industrial and contaminated area in northern Denver, Colorado that utilizes both hydroponic and aquaponics farming. The total land area GrowHaus sits on is approximately 20,000 square feet.

The indoor hydroponics farm is 5,000 square-feet and provides fresh produce for residents of the Elyria-Swansea and Globeville neighborhoods while generating income through sales to restaurants and markets. It utilizes a number of state-of-the-art features to minimize inputs and maximize yields. The primary crop grown is bibb lettuce, but other crops including chard, kale, arugula, spinach, and cilantro are also grown on site. The hydroponics farm is able to generate up to 1,200 plants per week while conserving up to 90% of the water used in typical commercial farming.

The aquaponics farm uses 3,250 square feet of space at The GrowHaus, renovated using a grant from the Colorado Health Foundation. It includes: 300 sq. ft. of media beds that grow squash, zucchini, cucumbers, several varieties of tomatoes and peppers, eggplant, broccoli, brussel sprouts, beans, and strawberries, all companion planted with nasturtiums, cilantro and marigolds to help with pest control; 1,200 square feet of deep water culture raft beds which every week produce roughly 800-1000 heads of lettuce, kale, tatsoi, chard, mizuna, mint and basil and a wide variety of other salad and cooking greens; and vertical towers which grow the majority of the culinary herbs in the system– thyme, basil, dill, cilantro, parsley, sage, stevia, rosemary, mint, and lots of the standard greens (GrowHaus, n.d.).



The most common aquaponic farming occurs with the interaction between fish and plants.
Image credit: www.aquaponicstrainingcenter.com

Hydroponic farm at the Grow Haus Denver
Image Credit: www.thegrowhaus.org/

The Garden, located in the Park Hill neighborhood of Denver, is a facilitator of value-added processing associated with urban agriculture. The Garden is a community food and events center, managed and supported by the members that use it and the community it serves. The renovated Victorian house, known as the Robinson House listed on the National Historic Registry, includes a commercial kitchen that can be rented hourly for producers of jams, juices, pastries, pies, and any other product required to be produced in a kitchen certified through the Colorado Department of Public Health and Environment.

The Garden also provides a Youth Farm Internship Program, funded through the City and County of Denver's Office of Economic Development. Through the Program, students of all ages learn how to garden, compost, juice, cook, and more. The products grown and manufactured through the Program are sold from weekly farmers markets and pay-what-you-can Sunshine Veggie Mobile (mobile farmers market).

Beverly Grant of Mo' Betta Green farmers market pours orange Thai basil juice made by youth worker, Tori Wasko, at The Garden.
Image credit: Brent Lewis

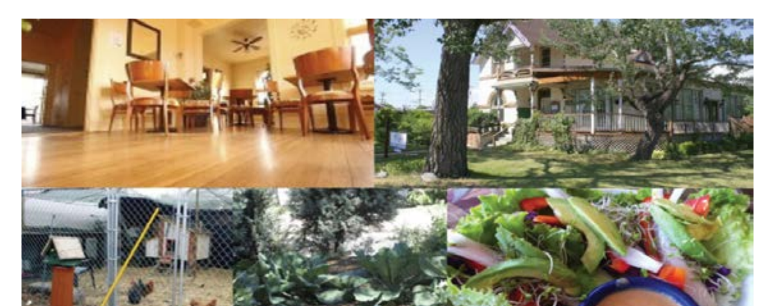


Image credit: http://www.thegarden-parkhill.com

ROW Community Garden in Huntington Beach, CA
Image credit: www.californiaagriculture.ucanr.edu

In urban areas, vacant land and fresh produce can be hard to come by, resulting in the need to travel long distances to obtain fresh produce, or be left without. Innovation is necessary to find space, and right-of-ways (ROWs) are vacant spaces that can be used for many non-traditional practices. Some ROWs can be set aside for the utility companies to maintain their equipment, while others are city-owned spaces such as medians, sidewalk strips, and traffic circles. Some of these spaces are large enough to support an individual's personal garden, while others are large enough to maintain agriculture for entire communities. Although received by many in a positive light, some communities have encountered issues with regulations in regards to these areas, and have had to rally and fight to win the support of the governing bodies in their neighborhood to uses these areas for agricultural purposes.

In South Central Los Angeles, which is a food desert, Robert Finley saw the potential of the 150-foot by 10-foot wide patch of soil between the sidewalk and road and made an edible garden to feed himself and the many underserved people of his community. South Central LA has been immortalized in films and TV as notoriously dangerous and impoverished, but Robert sees it differently. He says that "the drive-thrus are killing more people than drive-bys", adding that "gardening is the most therapeutic and defiant act you can do, especially in the inner-city" (Nordahl, 15). As a city law, Robert is required to maintain this patch of space, although it is not his personal property. He was confronted by city officials and issued a ticket because it wasn't up to the standards of the city, which forced him and others to act. He was able to gather 900 plus signatures and petition to the city councilman, ultimately leading to the approval to continue farming in the space.

ROW Farming in Brooklyn, NY
Image credit: Eric E. Anderson

Robert Finley's "Guerilla Garden"
Image credit: Robert Finley

Electrical transmission ROWs are much larger and accessible to a wider range of people. Networks of electrical transmission lines transect more than 450,000 miles of land, providing power to large regions through what's known as "the grid". The lines, substations, and power stations in the United States are divided into 3 smaller networks, the Western, Texas, and Eastern Interconnections, which then carry electricity to customers through the electric power distribution system. The energy structure is then divided amongst companies that deal directly with the consumers.

Underneath these lines are ROWs owned or maintained by an electric utility company and are in many cases kept vacant to ensure the upkeep of the lines, towers, and stations. These long swaths of land have been deemed by many to be an optimal space to use for nontraditional


Sao Paolo Community Farm
Image credit: Marlene Bergamo/Folhapress

purposes. Agriculture, biofuel farming, wind and solar power, and vegetation and forest management are examples of nontraditional developments that could take place on this open land.

During the Great Depression, land under the lines was dedicated to employees of the utility companies to farm for free to help supplement food availability. To this day, people have continued to use these areas for farming. Some have been sanctioned by a local entity, while others hope to go undetected and are referred to as “guerilla gardens.”

Sanctioned community gardens can be found in communities of varying sizes, including Des Moines, Iowa and Des Plaines, Illinois, to the metro areas of Los Angeles and San Francisco, California. The land is typically untilled, which makes the soil suitable for farming. However, people must be aware of any pollution or contamination present, and many of these sites have been sprayed with herbicides to keep vegetation at bay. Other challenges include topographies that cut through rocky hilly terrain, where accessibility is an issue.

Regulations vary amongst utility companies, but are implemented to maintain the equipment and to ensure consistent, reliable power to their customers. In Colorado, Xcel Energy and Tri-State Generation and Transmission Association, Inc. are the utility companies that produce energy for the state. Xcel Energy allows planting in the ROWs, but there must be a clearance height above 25 feet for anything under the lines, a 10-foot clearing on either side of the lines, and permanent structures are forbidden. In addition, farmers must be aware that Xcel owns the easement, so anything growing can still be cleared for Xcel’s work needs.


ROW Through Hilly Terrain
Image credit: powertransmission.blogspot.com


California Community Garden
Image credit: Scott Smeltzer

California Farmland
Image credit: Alanna Face

This is the case in Des Plaines, IL, where the park district has a program for organic community farming underneath Commonwealth Edison's power lines. For 30 years, these gardens have provided families with a supplemental source of food. In 2010, Commonweath Edison decided to disallow any nontraditional use under these lines, and shut down all the ROW gardens throughout the Chicago metro area. However, after extensive petitioning, the Des Plaines program was allowed to continue through a lease agreement (Krishnamurthy, web).

This type of gardening can be found throughout California and has received the support of the state and the University system. Urban centers, beach towns, and inland cities are host to these gardens under the power lines, through lease agreements with the local utility company. There are over 90 community gardens in Los Angeles County, most of which are located under power lines. The University of California Cooperative Extension has recognized the need to feed the large populations, especially those who live in the inner-cities. The UCCE has partnered with the Los Angeles Food Policy Council to increase resources to help with the startup and maintenance of these gardens. Included is a Master Gardener training program, whose graduates are encouraged to volunteer at local community gardens and work a hotline for those who have questions and would like tips on techniques (Meadows, web).

In Huntington Beach, a southern California beach town, the community garden has been in operation since 2010, with 110 plots and continuous demand. The mission of the Huntington Beach Community Garden (HBCG) is to donate at least 10% of food grown to local charities, which members are thrilled to do. The HBCG members also reach out to the community to educate children and adults about organic gardening via social media (Huntington, web).

Due to the growing population, unsustainable food system, and shrinking supply of fresh, local food to communities, the use of ROW land for farming is very appealing. ROWs are a resource that can host a variety of farming styles such as food forests, individual gardens, production farms, and community gardens. In cities, these areas are a great resource, especially to those that reside in "food deserts". Local populations benefit from the interaction with each other, learning new skills and sharing gardening tips, and enjoyment of outdoor activity that benefits all. With the cooperation of legislators, utility companies, and local residents, a national standard to ROW regulations could be enacted that will allow for farming in these prime lands.

12th Avenue, Bicycle Accessibility
Image credit: Carolyn Hagele

LAKEWOOD SITE DESIGN STUDIES

Final proposed plan for Everitt Farms
Landscape plan by Erin Wooden, Ruxue Wei, Stefan McElroy

Everitt Farms

Originally established on 1,000 acres in the 1870's as a cattle operation, Everitt Farms is now a 7.8-acre urban farm located at the corner of Alameda and Garrison in Lakewood, Colorado. The site currently produces hay as the primary commodity, and a myriad of vegetables are grown on one-acre on-site and sold at a farmer's market, also on site.

Everitt Farms is currently considering development options for the site, with the intention to preserve the remaining 7.8-acres and as an international precedent of a business model that can be reproduced worldwide. The business model is intended for small scale farms dealing with the constant struggles of assuring that small sites can be financially equitable while also providing a future for the local communities and economy.

Photo of the owners of Everitt Farms working at the farm
Image credit: Everittfarms.com

Proposed community garden in the West Village of Everitt Farms
Image Credit: Ruxue Wei

Within Everitt Farms there are multiple production methods that are either currently in place, or that have been proposed to incorporate into the new development, including:

- Community gardens
- Production farm
- Food forest
- Greenhouse production
- CSA / Farmers market

In order to maximize production space on the 7.8-acre site and involve the community as much as possible, community gardens have been proposed to provide edible plants within the community setting. This typology allows for community members that live on-site to provide a contribution of labor to the farm, and manage their own cultivation plots. As the photo above demonstrates, the proposed community garden surrounds an outdoor seating area located within a plaza, where the option to cook outdoors can bring "farm to table to life.

Currently, Everitt Farms manages a small scale farmer's market as a means of distributing produce grown seasonally on one-acre of land on-site. With future plans to develop a mixed-use, agriculture-centered community, including space for commercial and residential structures on the 7.8-acre site, the residents will be provided the ability to obtain fresh produce directly from an on-site farmer's market, and also the opportunity to sell their own produce to the public realm.

Proposed seating area surrounded by an herb garden
Image credit: Stefan McElroy

Proposed community grow space with an open green plaza behind
Image credit: Stefan McElroy

The proposed greenhouses will serve as the location for year round food production, and accommodate other gatherings with a community meeting space. In addition to utilizing the greenhouses for production, Everitt Farms seeks to use the spaces as an opportunity to teach traditional production based skills through an education center.

Everitt Farms is also seeking to develop a series of rooftop gardens to maximize their production space, and as a means to provide environmental benefits such as: reducing storm water runoff; filtration of pollutants; and, reduction in heating and cooling costs during seasonal extremes. Additionally, Everitt Farms is seeking to construct greenhouses on a number of residential and commercial structures, which would also serve in maximizing grow space and provide seasonal fruits and vegetables.

As a means to further provide community involvement at Everitt Farms and increase the production of fruit on-site for sale at the farmer's market, a half-acre food forest is proposed that will serve as a garden and seating space. The food forest, much like the other production methods on site, has the ability to further serve the commercial entities, such as the baker and brewer directly located on-site. Anticipated fruit trees include apples and plums, with the option to also plant fruit producing shrubs.

Proposed central seating area
Image credit: Stefan McElroy

Proposed main entrance garden from Alameda Ave.
Image credit: Stefan McElroy

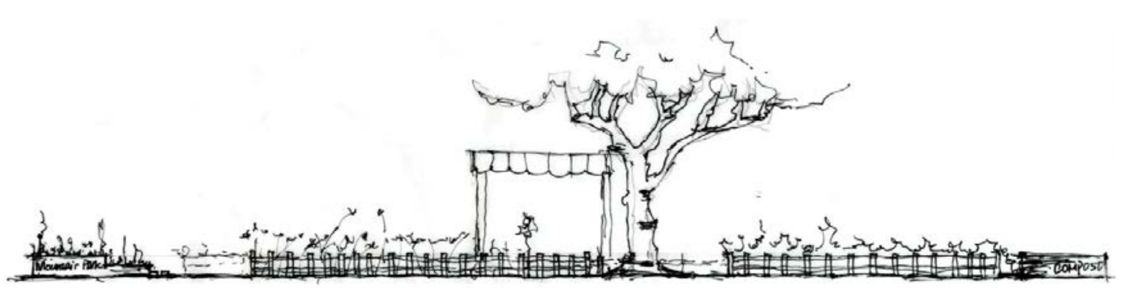
Central to Everitt Farms is the existing production farm. At approximately one acre in size, the production farm has historically been used to provide for the Everitt family, while also supporting the on-site CSA. During the fall, the Farm supports itself through the sale of a large quantity of pumpkins grown on-site. With the proposed development at Everitt Farms, the production farm is proposed to remain at the same scale and be leased to a local farmer. Going forward, the produce grown at the production farm will have the ability to sustain the proposed residences and businesses on-site, while also supporting a larger scale CSA.

Student proposed phase II design of Mountair Park Community Farm
Image credit: Yuchen Jiang & Nick Piche

Aerial perspective of Mountair Park, looking North. Elevation: 5381 ft.
Image credit: GoogleEarthPro


Proposed elevation of outdoor musical instrument rooms
Image credit: Yuchen Jiang


Example devices for outdoor musical instrument rooms
Image credit: Leah LeMasters


Elevation of Southern fence with "Mountair Park Community Farm" sign on left
Image credit: Yuchen Jiang

Mountair Park Community Farm (MPCF) is run by the local non-profit organization Sprout City Farms (SCF). The stated goal of the organization is to "truly serve the communities in which they are located." To do so, SCF focuses on "healthy food access," "education, participation, and awareness," and "ecological stewardship." Their belief is that in order to be a healthy community, family, or individual, all should have the access to fresh, locally grown organic foods. With this access they are then able to educate the participants and make them more aware and likely to use the strategies that are modeled on-site. Those strategies in turn support ecological stewardship, resulting in long-term sustainability, food security, and balance with the local ecosystem.

Phase I of MPCF has been producing food for the Two Creeks Neighborhood since 2014. In 2015, they produced 4,600+ lbs. of organic produce on just over ¼ acre of allocated production land. This food was sold through CSA shares and farm stands. There are 20 paid CSA shares, 5 work shares (where 50% of the share fee is reimbursed after 34 hours of work), and 5 free shares for those who qualify based on income. Although the farm stand is donation-based and community members are only expected to "pay what they can," market value donations are suggested. SCF also donated food to the Mountair Christian Church and Molhom Elementary School food pantries.

Phase II of the community farm is currently under construction. With that, education is a critical aspect for meeting the farm's goals, and this area is more focused on community gardens, educational programs, and gathering spaces. The design created by the students of the University of Colorado Denver focuses on this community need, while also increasing production agriculture by 63%. This proposed Phase II design features centrally located community/educational raised beds, and educational gathering spaces surrounding the various farm features (such as compost, apiaries, and numerous

Sign upon entering Mountair Park Community Farm
Image credit: Nick Piche

	SPRING	SUMMER	FALL
Arugula	✓		✓
Beans		✓	✓
Beets		✓	✓
Bok Choy			✓
Carrots		✓	✓
Chard	✓	✓	✓
Cucumbers		✓	✓
Eggplant		✓	✓
Escarole	✓		✓
Garlic			✓
Green Onions		✓	✓
Kale	✓	✓	✓
Leeks			✓
Lettuce, head		✓	✓
Lettuce, mix	✓	✓	✓
Melons		✓	✓
Onions			✓
Peas	✓		✓
Peppers		✓	✓
Potatoes			✓
Radishes	✓	✓	✓
Rutabagas			✓
Scallions		✓	✓
Spinach			✓
Summer Squash		✓	✓
Sun Chokes			✓
Sun Chokes			✓
Winter Squash			✓
Tomatoes		✓	✓

2016 seasonal CSA list
Image credit: http://sproutcityfarms.org/

Path encouraging a walk through the community urban park farm.
Image credit: Yuchen Jiang

Aerial view featuring community gathering areas, the shaded picnic area, and raised beds.
Image credit: Yuchen Jiang

butterfly gardens). Community spaces surround the raspberry patch, shaded picnic area, and terraced “outdoor musical instrument rooms.” The design addresses the desires of community members as reported by city outreach, the operators of Mountair Park Community Farm, Sprout City Farms, as well as within the City of Lakewood’s Sheridan Station 20-Minute Neighborhood plan and 40W Place-making and Implementation plan.

View from within the raspberry patch, looking towards the center of MPCF-II.
Image credit: Yuchen Jiang

View as imagined traveling West on RTD's light rail W Line.
Image credit: Nick Piche

Looking North from within the center of the raised-beds
Image credit: Nick Piche

Perspective looking East on the pedestrian path, approaching the South entrance.
Image credit: Nick Piche

Green Gables Community Garden, site plan
Image credit: Leah LeMasters, Gregory Allan Davidson, Katya Reyna

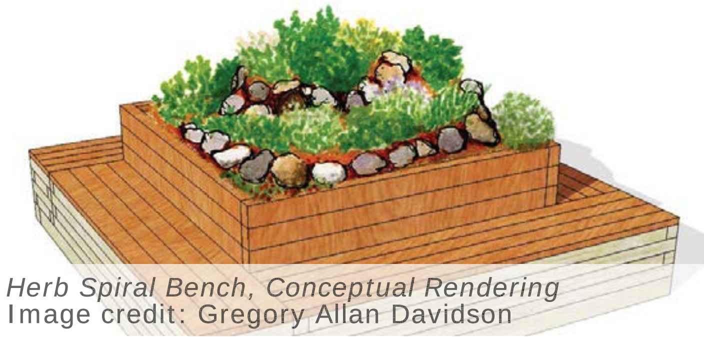
In cooperation with Green Gables Elementary School, the Jefferson County School District, the City of Lakewood, Denver Urban Gardens, and graduate students from the University of Colorado Denver, the Southern Gables Sustainable Neighborhood successfully applied for a participation grant to construct a community garden on the schools grounds. Under the direction of two community volunteers, conceptual plans were developed for a multi-stage community garden that would provide for production and community gathering space as well as both ecological and horticultural educational opportunities.

Southern Gables Sustainable Neighborhood Network
Image credit: Leah LeMasters

The design features a wide variety of possible elements, including an orchard, food forest, outdoor classroom / community gathering space, greenhouse, passive rainwater harvesting system, meadow, and play grove.

Annual crops and food forest, perspective rendering
Image credit: Gregory Allan Davidson

The design aims to meet the needs of the community and the school through providing spaces accessible and usable by both groups for education and food production. The proposed gathering space is multi-functional, capable of serving as outdoor classroom, market area, and social gathering space. A key component of the concept is the collection of stormwater runoff from the school building and grounds, filtered through rain gardens with butterfly and pollinator attractant plantings, redirected to provide passive irrigation for fruit trees and other food-producing plants.



Herb Spiral Bench, Conceptual Rendering
Image credit: Gregory Allan Davidson

The meadow and play grove seek to bridge the divide between the experience of nature and playground / recreation areas for children. By echoing native ecologies, these zones require little to no maintenance and provide students and the community with the educational experiences offered by a guided interaction with the natural world.

Raingarden and community gathering space, perspective rendering
Image credit: Gregory Allan Davidson

Meadow and play grove, perspective rendering
Image credit: Gregory Allan Davidson

This model of partnership allows for vibrant possibilities to build community, increase local resilience, and move forward collectively with the collaborative use of institutionally-owned land for the production of food. Given that many of the spaces with potential for this typology are completely or essentially unused, and given that educational, healthcare, and community service institutions are already attempting to address these needs and serve the public, urban agriculture seems like an obvious step forward.

Final proposed plan for the Excel ROW site
Image credit: Zhiguang Hu, Carolyn Hagele, Lisa Warren

The potential for urban farming in utility right-of-ways (ROWs) are wide-ranging, with communities throughout the United States benefiting from food production in spaces that would be otherwise vacant. To help sustain a healthy population, these areas can provide local, fresh food to people who otherwise may travel a long distance or opt for fast, easy, less nutritional choices. Oftentimes, ROWS also provide a direct link from outlying suburbs to the central metro area, providing a transit corridor for commuters. This connection can invite a sense of cohesion amongst different communities, bringing people together to celebrate food.

In Lakewood, ROWs are utilized and maintained by a wide variety of entities, including Xcel Energy (the local electric utility company), local water and sewer districts, transportation authorities and others. With little competition to procure this land, adequate accessibility, and the absence of heavy vegetation, many ROWs may have potential for urban agriculture.

The vacant site at 12th Avenue and Gray Street in Lakewood was chosen as a case study to design a concept for an urban agriculture prototype. As the team for this site worked together with the City of Lakewood, the needs and expectations of the city were addressed, capitalizing on the value and facing the challenges of this particular site. Ultimately, a plan was designed that would be feasible, beneficial to the community, and aesthetically pleasing as a neighborhood park.

A multi-family development has been proposed in a location adjacent to this site, and the design of the site was created with that in mind, as well as the current residents of the surrounding neighborhood. The team worked to create a design that would complement the agricultural history of the Two Creeks/Molholm neighborhood in which it is situated, while aligning the vision with Lakewood's 20-minute neighborhood strategy, as the site is located adjacent to RTD's Sheridan Light Rail Station.

Xcel ROW at Gray Street and 12th Avenue
Image credit: Carolyn Hagele

Sheridan Station at Xcel ROW site
Image credit: Carolyn Hagele

The typologies proposed in this plan adhere to the constraints set forth by Xcel's vegetation management policies. Vegetation must be kept below 25-feet in height directly underneath the power lines, and taller vegetation must be at least 10-feet away from the lines on either side. Furthermore, no permanent structures are allowed within the ROW. Ultimately, it was felt that a production farm, food forest, and community garden would be the ideal typologies for the site.

The site plan shows the concept for the site as well as the future development directly to the south of the site. A production farm is located in the southwest area of the site, which is intended to be contracted to a vendor who can sell the produce to local restaurants, institutions, or markets. To the north and east of the production farm is a pavilion where visitors can relax, play, work, and educate.


Dry Gulch adjacent to the site
Image credit: Carolyn Hagele

To the east and northeast of the production farm, in areas outside of the ROW, a food forest was envisioned. The food forest is intended to mimic the functions of a woodland ecosystem, each plant to benefit each other. The food forest will produce bounties of edibles from the fruit trees, berry shrubs, and other vegetation below the canopy. Apples, pears, quince, raspberries, grapes, and gooseberries will be plentiful. Locals and commuters alike would be invited to forage and learn about the benefits and management of food forests. A partnership with local non-profits and volunteers would be encouraged to participate.

Located along the meandering path in the northwest section of the site, raised beds will serve as a community garden. This will provide the residents of the new development a source of fresh produce as well a sense of pride in their neighborhood. Some raised beds will also be provided for the local elementary schools to supplement school lunches.

In the center of the site at the Depew Street extension, another area welcomes visitors and encourages gathering or sightseeing. Along 11th Avenue and around the western edge of the site, a living wall screens the park and farm, providing vining edibles for enjoyment. A detention pond will provide stormwater management during rain events, and a kickball field and recreation space when dry. Serviceberry and quince have been proposed in the detention pond as well, as these species are able to withstand periodic inundation.

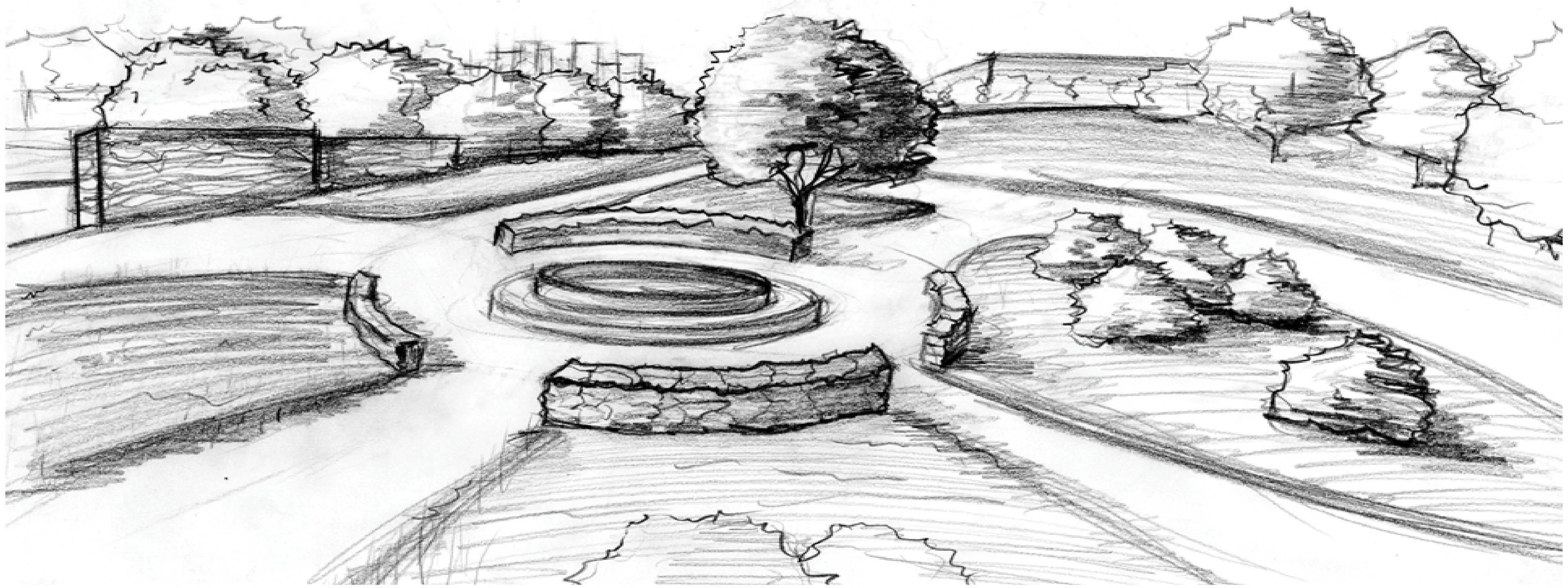
To attract pollinators to this site and beyond, we have imagined an area at the east end of the site that will be host to native perennials such as Echinacea, globe thistle, lavender, and clematis, with complementing


Pollinator Garden at the East Entrance
Illustration credit: Carolyn Hagele


View from the East Entrance
Image credit: Carolyn Hagele

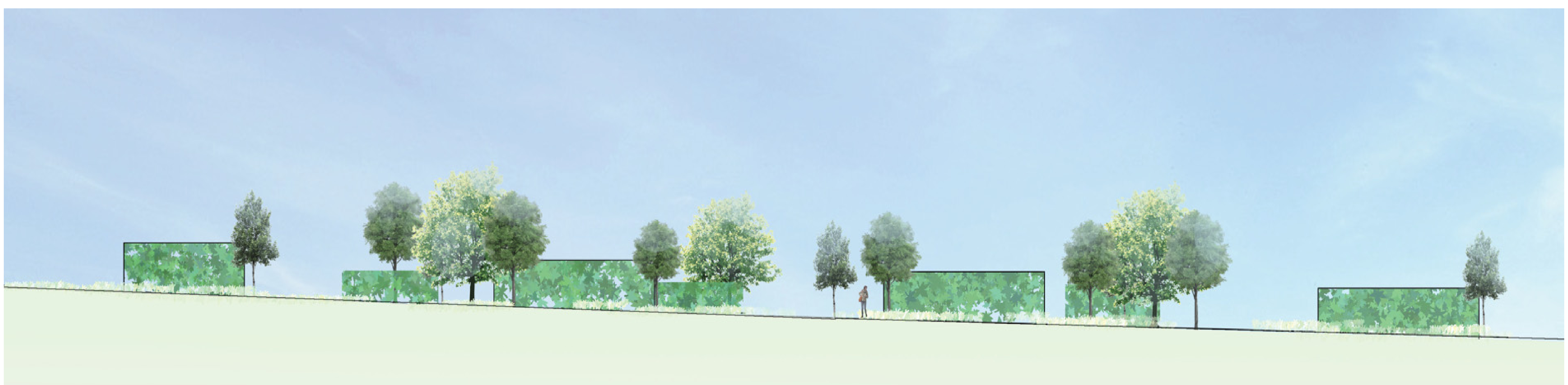
native grasses. This area is intended to resemble a meadow, with a walking trail to experience the smells and sights.

To address the need for long-term agriculture in an area that is classified as a “food desert”, an urban farm with varying degrees of management strategies was designed. This team envisions a neighborhood that will congregate and learn from each other, and educate future generations of the importance of local gardening. Along with the potential to serve the community, this team hopes to set precedents for farming in utility ROWs throughout Colorado.



The welcome Garden at the North Entrance
Illustration credit: Zhiguang Hu

Hummingbird pollinating a Columbine
Image credit: www.blog.gardenharvestsupply.com



Living Green Wall
Image credit: Zhiguang Hu

The parcel type for 700 Depew Street is a brownfield site, previously having been used as a sewage treatment plant and a storage site for the Lakewood public works department. Due to these restrictions, all food that is grown on this site would need to be separated from the existing soil. The soil has not been tested, but contamination can be assumed, given the site's history. The team responsible for 700 Depew decided on the majority of food production occurring in vertical greenhouses, which utilized 57,200 square feet of the site. Raised beds were also considered and allotted 16,500 square feet of the site. The raised beds will grow a variety of vegetables and fruits, including blackberry bushes and hops to be used in an on-site brewery and restaurant. This is a good example of one of the value-added processing techniques used on this site. Berries that are grown outside the brewery would be used to flavor some of the beer, and the on-site hops garden would be harvested and used in the brewing process. The site also includes a commercial kitchen and a food business incubator, both of which would utilize food grown on site, either in raised beds or from the greenhouses, to prepare the food into a new product to be sold. The business incubator would be available to businesses with a food focus, such as a caramel apple shop or a pie shop. These businesses then would rent out the commercial kitchen and use some of the food grown on site to produce their final products. The site includes 11,800 square feet of distribution warehouse space, where food from the greenhouses, products from the business incubator, and beer from the brewery could be temporarily stored until ready for distribution.

A regional food hub is the final element to be included in the design at 700 Depew Street, with driving on the perimeter of the site providing access for those from outside the local area, and a pedestrian walkway running through the center of the site. Three sculptural carrots are located along the length of the pedestrian walkway, showing the life cycle of a carrot and adding a "destination" element.

The parcel type for the Lakewood Gulch site is a floodplain, which that immediately imposes restrictions on what can be done with the site. The team responsible for this site decided to connect this site with the 700 Depew Street site with a bridge for cars and pedestrians alike. Since 700 Depew Street was mainly an agricultural production, processing, and distribution center, with some neighborhood features, the Lakewood Gulch half of the site became an area for the local neighborhood to use. A colorful sculpture serves as a playground for neighborhood children, which is flanked on both sides by community gardens consisting of raised beds. The community gardens take up 17,500 square feet of the site, and the playscape uses another 8,800 square feet.

	Total High yield	Total Avg Yield	Total Low Yield
Berries	$95,660.64	$17,168.21	$41,646.63
Vertical Greenhouses	$1,154,176.34	$895,776.25	$638,357.95
Raised Beds	$6,110.13	$4,915.26	$3,722.42
Total/Grow Season	$1,255,947.11	$917,859.72	$683,727.00
Property Value/No Buildings			
Sales Tax	$94,196.03		
Property Value Empty	$5,778,106		
Property Tax on original sale	$1,227		
Total Tax Revenue	$5,873,528.55		

Type	Employment Created
Restaurant/Brewery	35
Greenhouses	23
Warehouses	40
Business Incubators	300
Retail	30
Total	428

Berry Production						high	average	low				
Total Cropped Area (sq ft)	16613			Total Production (lbs)		9.99	2.25	3.29				
Crop Name	% of area	area of crop in	high yield	avg yield	low yield	lbs high	lbs avg	lbs low	$$/lb	Total High yield	Total Avg Yield	Total Low Yield
Blackberries	5%	831	1245.975	631.294	16.613	1.5	0.76	0.02	$6.74	$8,397.87	$4,254.92	$111.97
Cherry	5%	831	2026.786	1071.5385	116.291	2.44	1.29	0.14	$5.99	$12,140.45	$6,418.52	$696.58
Raspberries	15%	2492	7475.85	99.678	3787.764	3	0.04	1.52	$6.99	$52,256.19	$696.75	$26,476.47
Grapes	15%	2492	7475.85	274.1145	3887.442	3	0.11	1.56	$2.37	$17,717.76	$649.65	$9,213.24
Hops	60%	9968	498.39	498.39	498.39	0.05	0.05	0.05	$10.33	$5,148.37	$5,148.37	$5,148.37
Total Yield			**18722.851**	**2575.015**	**8306.5**				**Total**	**$95,660.64**	**$17,168.21**	**$41,646.63**

Raised Bed Production						high	average	low				
Total Cropped Area (sq ft)	1275			Total Production (lbs)		21.84	13.56	5.29				
Crop Name	% of area planted	area of crop in	high yield	avg yield	low yield	lbs high	lbs avg	lbs low	$$/lb	$$/High	$$/Avg	$$/Low
Beets	10%	128	306	216.75	127.5	2.4	1.7	1	$1.68	$514.08	$364.14	$214.20
Cabbage	2%	26	38.25	20.91	3.825	1.5	0.82	0.15	$0.45	$17.21	$9.41	$1.72
Carrots	5%	64	382.5	198.9	14.6625	6	3.12	0.23	$0.96	$367.20	$190.94	$14.08
Chives	1%	13	2.55	2.55	2.55	0.2	0.2	0.2	$4.66	$11.88	$11.88	$11.88
Eggplant	5%	64	57.375	31.875	6.375	0.9	0.5	0.1	$1.62	$92.95	$51.64	$10.33
Garlic	1%	13	6.63	4.59	2.55	0.52	0.36	0.2	$1.00	$6.63	$4.59	$2.55
Mint	1%	13	0.255	0.255	0.255	0.02	0.02	0.02	$1.93	$0.49	$0.49	$0.49
Radishes	20%	255	1581	805.8	33.15	6.2	3.16	0.13	$0.99	$1,565.19	$797.74	$32.82
Squash, Summer	5%	64	57.375	30.6	3.825	0.9	0.48	0.06	$1.87	$107.29	$57.22	$7.15
Tomatoes	50%	638	2040	2040	2040	3.2	3.2	3.2	$1.68	$3,427.20	$3,427.20	$3,427.20
Total Yield			**4471.935**	**3352.23**	**2234.6925**				**Total**	**$6,110.13**	**$4,915.26**	**$3,722.42**

Highest yield greenhouse crops: spinach, kale, tomatoes, and arugula

Other greenhouse crops: cabbage, cilantro, cucumbers, collards, mint, peas, summer squash, and Swiss chard

Highest yield raised bed crops: blackberries, tomatoes, radishes, beets, and hops

Other raised bed crops: cabbage, carrots, chives, eggplant, garlic, mint, summer squash, cherries, raspberries, and grapes

Before site conditions
Image Credit: Tyler Landry

Before site conditions
Image Credit: Tyler Landry

Lakewood Gulch site
Image Credit: Stacy Ester

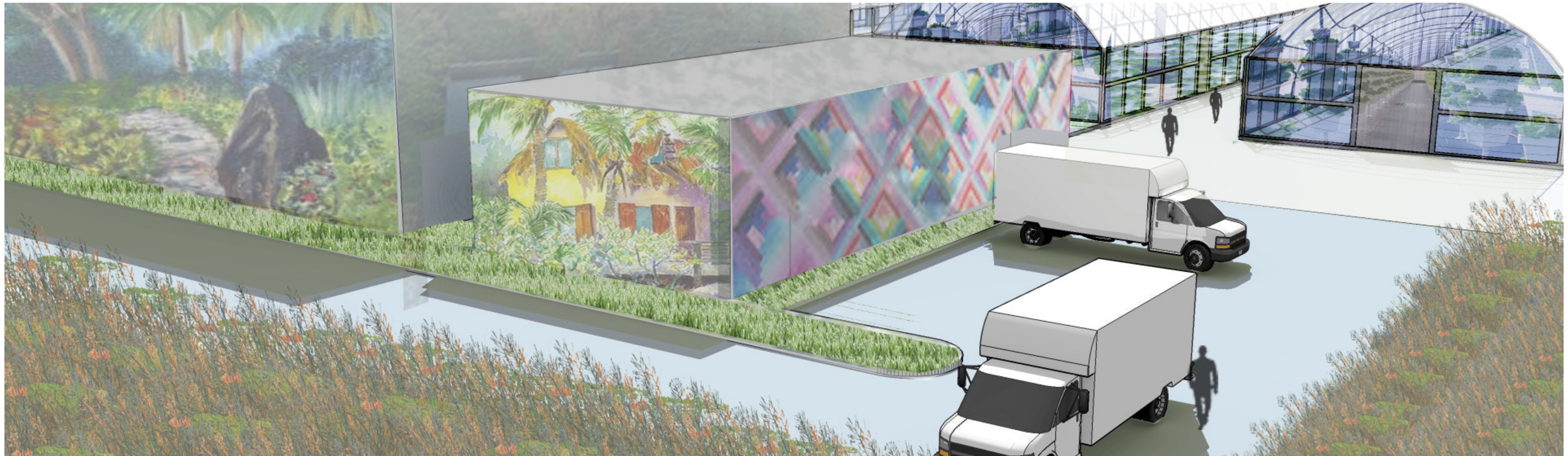
Final proposed site plan rendering
Image Credit: Stacy Ester, Tyler Landry, Heather Murphy

View through the business incubator to the plaza/ flexible space to enjoy in a variety of ways, such as a farmers market. Image Credit: Heather Murphy

View from the back of the brewery, looking at raised beds filled with vegetables, fruit, and hops. Image Credit: Tyler Landry

View down the pedestrian walkway through the middle of the site
Image Credit: Tyler Landry

Overview of the 700 Depew street site
Image Credit: Stacy Ester



View from outside the distribution warehouses.
Image Credit: Heather Murphy

View of front drop off area at 700 Depew Street.
Image Credit: Stacy Ester

CONCLUSION

Urban agriculture offers the promise of significantly improving the food security and resilience of urban populations without the need to meaningfully alter current economic development patterns. Indeed, as the research documented in these pages has shown, not only can the plant-based dietary needs of nearly the entire population of the City of Lakewood be met using existing available land, but the economic value of the food produced can be diverted to other uses that will help promote and sustain the city's growth. Additionally, there would doubtless be ancillary benefits accrued from a local food system, including jobs created and public health benefits, that were beyond the scope of this study but which are important to consider nonetheless. Regardless, the conclusions indicated by the work of this group of students are impressive in their own right, as detailed below.

While descriptions of the various land-use typologies and food production methods considered for this study are well-documented elsewhere in this report, perhaps the most salient information to emerge from this project are the estimates of agricultural yield and economic value that could result from a city-wide local food production system. These estimates were based upon a thorough and meticulous study of existing similar land use typologies and food production methods that are already in use and proven to be successful elsewhere. To be sure, urban agriculture is still a nascent and growing endeavor, so nearby precedents were not always available from which to derive highly accurate estimates. As such, precedents were prioritized according to region: the Denver metro area first, followed by the southwest US, the western US, and when necessary, elsewhere in the country. For some production methods, such as greenhouses, the growing conditions are carefully controlled, so regional proximity of precedents was less of a concern in these instances. That said, Colorado is one of the more progressive states in this movement and generally provided an adequate sampling of local precedents to work with. Nonetheless, these estimates are still just that: estimates. Many, if not most, organizations engaged in urban agriculture do not yet maintain accurate records of crop yields and economic value at a level of detail that would have allowed for a high level of precision in the yield predictions outlined in this study. Despite this difficulty, we have confidence in the numbers presented in this report.

Students present design ideas to community partners in Lakewood
Photo credit: Scott Carman

The landscape architecture students of Studio 2 at University of Colorado Denver
Photo credit: Scott Carman

Of course, any given production method can be used to grow a wide variety of fruits and vegetables, further complicating the task of forecasting the overall productivity of a given typology per unit of land area. In order to overcome this obstacle, the five most common crops were determined for each production typology and used as a stand-in to estimate productivity of all crops grown for each. Economic value was then derived from production estimates using averages of retail prices for the various crops at area grocery stores. Wholesale value of crops was determined using an average retail mark-up of 30%, again based on research of available nationwide data.

The final numbers are very encouraging and perhaps even shocking to some, but not at all out of line with similar research that has been done in the region in recent years, most notably a study of local food systems in Denver completed in the spring of 2015. Based upon a preliminary assessment of parcels across the City with potential for agricultural production, the system could be expected to produce about 91,366,000 pounds of fruits and vegetables annually (meats, dairy and other sources of nutrition were beyond the scope of this study). According to the USDA's food consumption data for 2015, the typical American eats about 2,000 pounds of food annually, of which about 688 pounds is fruit and vegetables (a depressingly small amount and well below the 50% of our diet recommended by the US Department of Health and Human Services, but that's a matter for another study). Based on this number, that amount of produce could meet the plant-based dietary needs of 132,800 people, or roughly 90% of Lakewood residents. Even using the more ideal number of 1,000 pounds of fruits and vegetables per person per year, the system could feed 91,366 people, or 62% of residents.

If we change the focus to look at only the most preferable sites, meaning those that meet all criteria for superior growing conditions, it could be expected that 21,278,000 pounds of fruits and vegetables could be grown annually. That translates into 30,927 people having their plant-based dietary needs met based on what Americans actually eat, or 21,278 residents being fed based upon the recommended amounts (or 21% and 14.5% of Lakewood residents respectively). It is worthwhile to note that according to city-data.com, approximately 18% of Lakewood residents live at or below the poverty line, meaning the proposed local food system could feed all of Lakewood's most food-insecure residents in three out of the four scenarios presented. Again, these results are based upon very conservative estimates of food production and take into consideration that a percentage of the food produced would spoil or otherwise not be consumed, meaning the actual yields of such a system could possibly be significantly higher than these estimates. Maps of the parcels identified and the criteria used for each of these scenarios can be found on the following pages.

These results are a promising start to an endeavor which has only begun with the publication of this report. As a next step, a deliberate and detailed GIS analysis of preferred sites for urban agriculture should be conducted in order to accurately identify potential sites for urban agriculture and establish guidelines for the development of a truly robust local food system. This is, of course, no small feat and will require a confluence of dedicated community organizations, policy shifts, political will and resources to bear fruit, but the groundwork is laid and efforts such as the one documented in this report are an important first step in bringing this movement to Lakewood.

REFERENCES

American Nutrition Association. USDA defines food desert . 2015. <http://americannutritionassociation.org/newsletter/us da-defines-food-deserts>.

"Before You Start an Apple Orchard." Fruit Research University of Minnesota. The Regents of the University of Minnesota. Web. 28 Apr. 2016.

Cobourn, John, and Steven R. Lewis. “Agriculture Is a Good Fit in Floodplains.” Reno, Nev.: U of Nevada Cooperative Exten sion, 2011. 2011. Web. 15 Apr. 2016.

Colorado Farm to Market. Cottage Foods. 5 April 2016. <http://co farmtomarket.com/value-added-products/cottage-foods/>.

"Community Gardens." University of California Cooperative Exten sion-Los Angeles County. University of California Division of Agriculture and Natural Resources, 2016. Web. 18 Apr. 2016.

Daly, Brian. "Floodplain." Springer Reference (n.d.): n. pag. Web. 15 Apr. 2016. Available online at: http://web.mit.edu/cron/class/nature/projects_12/pdfs/BrianDaly-Intervale.pdf.

Diver, Steve. “Aquaponics—Integration of Hydroponics with Aquacul ture.” 2006.

Econsult Solutions. “U. S. Kitchen Incubators: An Industry Snapshot.” 2013.

Edwards, Amy L. “When Brown Meets Green: Integrating Sustainable Development.” 16th Section Fall Meeting. Wash ington DC: Holland & Knight LLC, 2008.

EPA. Environmental Protection Agency . 2006. <https://www.epa.gov/sites/production/files/2015-09/documents/anat_bf_re dev_101106.pdf>.

Future Growing LLC. Aeroponics Technology. n.d. <https://future growing.wordpress.com/aeroponics-technology/>.

George E. Boyhan, Darbie Granberry and W. Terry Kelley. Green house Vegetable Production. April 2009. <http://www.caes.uga.edu/extension/thomas/anr/documents/greenhouseveg etableproduction_b1182.pdf>.

Grant, Elaine. Urban farms one solution for ailing food system, Colorado agriculture activist says - . 18 June 2014. <http://www.cpr.org/news/story/urban-farms-one-solution-ail ing-food-system-colorado-agriculture-activist-says#sthash.KxoNo8Xc.dpuf>.

GrowHaus. Reinventing Denver’s Food System. n.d. <http://www.thegrowhaus.org/>.

Held, Stephanie. “10 Detroit Urban Farm Rooting Goodness Into The City.” Daily Detroit. 6 July 2015. Available online at: http://www.dailydetroit.com/2015/07/06/10-detroit-ur ban-farms-rooting-goodness-into-the-city.

"Huntington Beach Community Garden." www.hbcommunitygarden.org. 2016. Web. 28 Apr. 2016.

Intervale Center. “Intervale Center.” N.p., n.d. Web. 29 Apr. 2016. Available online at: http://www.intervale.org.

Investintech.com. GUIDE TO GREENHOUSE TECHNOLOGY. n.d. <http://www.investintech.com/content/greenhousetech nology/>.

Krishnamurthy, Madhu. "ComEd Re-evaluating Fate of Des Plaines, Mount Prospect Garden Plots." Daily Herald. Paddock Publications, Inc., 2011. Web. 28 Apr. 2016.

Loria, Kristen. The Greenhorns . September 2011. <http://www.thegreenhorns.net/wp-content/files_mf/1335237608From_Bees_to_Brownfields.pdf>.

Meadows, Robin. "UC Cooperative Extension Helps Farming Sprout in the City." California Agriculture Online. University of California Agriculture, Oct. 2013. Web. 18 Apr. 2016.

Mehrmanesh, Faatma. “MoonDog Community Farm.” LocalHarvest. 12 March 2015. Available online at: http://www.localharvest.org/moondog-community-farm-M65262.

MoonDog Community Farm. Places to Go In Denver. 9 April 2016. Available online at: http://www.westword.com/restaurants/mercury-cafe-plants-and-harvests-produce-from-its-very-own-moon-dog-farms-5728077.

Morgan Brennan, Jodi Gralnick. Vertical farming: The next big thing for food—and tech. 24 June 2015. <http://www.cnbc.com/2015/06/24/vertical-farming-the-next-big-thing-for-food-and-tech.html>.

Nordahl, Darrin. Public Produce: Cultivating Our Parks, Plazas, and Streets for Healthier Cities. Washington D.C.: Island, 2014. Print.

"Orchard." Wikipedia. Wikimedia Foundation. Web. 28 Apr. 2016.
Pierce, Erin R. "Top 9 Things You Didn't Know About Ameri ca's Power Grid." Energy.gov. Energy Department, 2016. Web. 18 Apr. 2016.

Organic Greenhouse Vegetable Production. 2000. <https://attra.ncat.org/attra-pub/viewhtml.php?id=45>.

RIMOL Greenhouse systems. Growing Hydroponically. 2016. <https://www.rimolgreenhouses.com/greenhouse-series/hydroponic-systems>.

Rio Grande Healthy Living Park. “Rio Grande Healthy Living Park.” N.p., n.d. Web. 15 Apr. 2016. Available online at: https://healthylivingpark.org.

Shunk, Laura. “Mercury Café plants and harvests produce from its very own Moon Dog Farms.” Westword. 10 October 2011. Available online at: http://www.westword.com/restaurants/mercury-cafe-plants-and-harvests-produce-from-its-very-own-moon-dog-farms-5728077.

Springer. Design Criteria for Greenhouses. n.d. <http://dow load.springer.com/static/pdf/672/chp%253A10.1007%2 2F978-3-642-14582-7_4.pdf?originUrl=http%3A%2F%2Flink springer.com%2Fchapter%2F10.1007%2F978-3-642-14582-7 4&token2=exp=1459895585~acl=%2Fstatic%2Fp f%2F672%2Fchp%25253A10.1007%25252F978-3-642->.

Thulson, Maggie. “Moondog Farms-farming for community.” WordPress. 18 June 2012. Available online at: https://denverfeasting.word press.com/2012/06/18/moondog-farms-farming-for-community.

University of Arizona. Environmental Control Systems. n.d. <http://ag.arizona.edu/hydroponictomatoes/system.htm>.

University of Kentucky . Adding Value to Plant Production. June 2011. <http://www.uky.edu/Ag/CCD/vakyproducts.pdfeff>.

University of Minnesota. Univeristy of Minnesota. 2000. <http://www.misa.umn.edu/prod/groups/cfans/@pub/@cfans/@misa/documents/asset/cfans_asset_286378.pdf>.

Verhoeven, Jos T. A., and Tim L. Setter. "Agricultural Use of Wetlands: Opportunities and Limitations." Annals of Botany. Oxford Uni versity Press, n.d. Web. 12 Apr. 2016. Available online at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2794053.

Weller, Chris. The future of agriculture is an indoor vertical farm half the size of a Wal-Mart. 23 October 2015. <http://www.techi sider.io/indoor-vertical-farm-is-the-future-of-agricu ture-2015-10>.

Zak, Annie. "From Parking Lot, H.B. Community Garden Flourishes." From Parking Lot, H.B. Community Garden Flourishes. The Orange County Register, 12 Sept. 2013. Web. 15 Apr. 2016.

APPENDIX
ANALYTICAL DATA

Farming Method Data Aggregation

In ground Production

Data Source / Crop	Sprout City Farms	Re:Vision Internationa	Colorado Agricultural Statistics 201	UCD 2015 Denver Repor	Outcomes		
					Low	Avg.	High
Tomatoes	1.94	0.41		3.15	0.41	1.83	3.15
Greens	1.14	0.38		1.18	0.38	0.90	1.18
Root Vegetables	2.81	0.64		1.82	0.64	1.76	2.81
Alliums	1.79	0.01	0.97	0.47	0.01	0.81	1.79
Peppers/Eggplant	1.09	0.37		1.41	0.37	0.96	1.41
Cucurbits	3.13	1.45		1.45	1.45	2.01	3.13
Tomatillos	0.43	0.14			0.14	0.29	0.43
Green Beans/Peas	0.65	0.2		1.3	0.20	0.72	1.30
Broccoli/Cauliflower	0.14	0.06		0.44	0.06	0.21	0.44
Cabbage		0.06	1.03	0.83	0.06	0.64	1.03
Corn		0.01	0.36	2.27	0.01	0.88	2.27
Cantalope		0.02	0.46	0.45	0.02	0.31	0.46
						0.94	

Raised Bed Production

Data Source / Crop	Sprout City Farms	Re:Vision International	Analyzing Agricultural Potential Within Denver	Outcomes		
				Low	Avg.	High
Tomatoes	1.94	0.41	3.15	0.41	1.83	3.15
Greens	1.14	0.38	1.18	0.38	0.90	1.18
Root Vegetables	2.81	0.64	1.82	0.64	1.76	2.81
Alliums	1.79	0.01	0.47	0.01	0.76	1.79
Peppers/Eggplant	1.09	0.37	1.41	0.37	0.96	1.41
Cucurbits	3.13	1.45	1.45	1.45	2.01	3.13
Tomatillos	0.43	0.14		0.14	0.29	0.43
Green Beans/Peas	0.65	0.2	1.3	0.20	0.72	1.30
Broccoli/Cauliflower	0.14	0.06	0.44	0.06	0.21	0.44
Cabbage		0.06	0.83	0.06	0.45	0.83
Cantalope		0.02	0.45	0.02	0.24	0.45
					0.92	

Greenhouse Production

Data Source / Crop	Growhaus	Rocky Mtn Fresh	NevadaNaturals	AeroFarms	Outcomes Low	Outcomes Avg.	Outcomes High
Tomatoes		6.67	22.4	3.20	3.20	10.76	22.40
Greens	24.86		120.75	7.79	7.79	64.27	120.75
						37.51	

Orchard Production

Data Source / Crop	Iowa data	Mass data	CO Ag. Stats '14	Analyzing Agricultural Potential Within Denver	Outcomes Low	Outcomes Avg.	Outcomes High
Peach		0.13	0.26	0.84	0.13	0.41	0.84
Pear		0.53		0.73	0.53	0.63	0.73
Plum	0.26	0.4		0.41	0.40	0.41	0.41
Apple	0.3	1	0.27	1.04	0.27	0.77	1.04
						0.55	

Food Forest Production

Data Source / Crop	Hoot And Howl Farm	Mass Temperate Climate File	Iowa Info	Analyzing Agricultural Potential Within Denver	Outcomes Low	Outcomes Avg.	Outcomes High
Raspberries/Blackberries	0.2	0.36		2.28	0.20	0.95	2.28
Strawberries	0.5	0.06	0.07	1.08	0.06	0.43	1.08
Rhubarb		0.16	0.1		0.10	0.13	0.16
Asparagus		0.06		0.65	0.06	0.36	0.65
Fruit Trees		2.06	0.64	3.02	0.64	1.91	3.02
Currants/Gooseberries		0.3	0.3		0.30	0.30	0.30
						0.68	

Pricing Information

												Wholesale	CSA
						Retail							
Product	Albertsons	Safeway	Natural Grocers/ Vitamin Cottage	King Soopers	Sprouts	Park-Slope Food CoOp	2012 Berry Pricing Survey	Door to Door Organics	happy money saver. com [1]	https://attra.ncat.org/attra-pub/viewhtml.php?id=31#marketing	Average Retail	75% mark up, 25% margin from retail	42.33% savings fr
Alliums											$5.63	$4.22	$3.23
Onions						$1.03		$2.78			$1.91	$1.43	$1.10
Garlic						$5.13		$13.76			$9.44	$7.08	$5.45
Shallots						$3.12		$7.98			$5.55	$4.16	$3.20
Asparagus						$5.98		$4.99			$5.49	$4.11	$3.16
Broccoli/Cauliflower											$2.05	$1.54	$1.19
Broccoli	$1.99			$1.50	$0.98	$1.43 [2]		$3.99			$1.98	$1.48	$1.14
Cauliflower					$0.98	$1.43 [3]		$3.99			$2.13	$1.60	$1.23
Cabbage						$1.16		$1.33			$1.24	$0.93	$0.72
Cantalope							$0.98				$0.98	$0.74	$0.57
Corn										$0.19	$0.19	$0.14	$0.11
Cucurbits											$2.07	$1.55	$1.13
Cucumbers					$1.43	$2.25		$2.17			$1.95	$1.46	$0.84
Winter Squash						$1.52		$1.20			$1.36	$1.02	$0.78
Summer Squash						$1.88		$3.45			$2.66	$2.00	$1.54
Zucchini				$1.99		$2.00		$2.99			$2.33	$1.74	$1.34
Ribes(Currant and Goose											$6.61	$4.95	$3.81
Currants							$6.92				$6.92	$5.19	$3.99
Gooseberries							$6.29				$6.29	$4.72	$3.63

	Retail											Wholesale	CSA
Product	Albertsons	Safeway	Natural Grocers/ Vitamin Cottage	King Soopers	Sprouts	Park-Slope Food CoOp	2012 Berry Pricing Survey	Door to Door Organics	happy money saver. com [1]	https://attra.ncat.org/attra-pub/viewhtml.php?id=31#marketing	Average Retail	75% mark up, 25% margin from retail	42.33% savings fr
Fruit Trees											$2.47	$2.21	$1.42
Apple	$1.99				$1.88	$2.33		$4.17			$2.59	$1.94	$1.50
Peach					$1.98	$2.92		$3.34			$2.75	$3.50	$1.58
Pear	$1.99		$1.49		$1.48	$1.40		$3.80			$2.03	$1.52	$1.17
Plum						$2.49					$2.49	$1.87	$1.44
Green Beans/Peas											$4.98	$3.74	$2.87
Green Beans								$3.98			$3.98	$2.99	$2.30
Peas								$5.98			$5.98	$4.49	$3.45
Greens											$2.06	$1.55	$1.19
Chard						$1.67		$2.49			$2.08	$1.56	$1.20
Lettuce						$2.25		$2.49			$2.37	$1.78	$1.37
Kale	$1.50	$0.99			$0.88	$1.87		$2.49			$1.55	$1.16	$0.89
Choy						$2.25					$2.25	$1.69	$1.30
Peppers/Eggplant											$3.09	$2.32	$1.78
Peppers						$2.39		$4.99			$3.69	$2.77	$2.13
Eggplant						$2.49					$2.49	$1.87	$1.44
Raspberries/Blackberries											$11.12	$8.34	$6.58
Raspberries		$10.72		$9.28		$13.28		$15.97			$12.31	$9.23	$7.10
Blackberries		$10.72	$8.00	$9.28		$8.32		$13.31			$9.93	$7.44	$5.72
Rhubarb								$11.98			$11.98	$8.99	$6.91
Root Vegetables											$2.04	$1.53	$1.18
Carrots						$1.60		$1.49			$1.55	$1.16	$0.89
Potatoes				$1.50		$1.61		$2.50			$1.87	$1.40	$1.08
Radishes						$3.34		$2.49			$2.92	$2.19	$1.68
Beets				$1.99	$0.88	$1.45		$2.99			$1.83	$1.37	$1.05
Strawberries	$3.99			$3.50		$5.46		$5.99			$4.74	$3.55	$2.73
Tomatillos									$1.17		$1.17	$0.88	$0.68
Tomatoes			$1.29	$2.99		$2.79		$2.64			$2.43	$1.82	$1.40

GIS Identified Parcels				
	Land areas (acres)		Land areas (sf)	
Typology	Total	Preferred	Total	Preferred
Institutional/Comm	1032.64	697.91	44,981,798.40	30400959.60
Brownfield	573.41	20.60	24,977,739.60	897336.00
Greenfield	4240.14	288.37	1,088,030,336,	12561397.20
ROW	384.58	139.38	16,752,473.55	6071459.05
Floodplain Ag	1128.92	1117.57	49,175,755.20	48681349.20

Design Study Percentage Dictates			sq. ft.		sq.ft.	
Site	**Total Area**	**Total Grow Space (% of total area)**	In ground area	**In Ground %**	Raised Beds area	**Raised Beds %**
Green Gables (Institutional/Comm)	128046.22	24%	5449.68	4%	1203.13	1%
Depew	203425.20	48%	0	0%	17888	9%
Mountair	28509.00	69%	19896	50% [1]	512	2%
ROW (Xcel)	390360.00	14%	34832	9%	9406	2%
Floodplain		75%		50%		0%

Available Parcels

Available Inst/Comm	in ground	raised beds	greenhouse	food forest	orchard	
% total area per farming method	4%	1%	1%	14%	4%	
						Total Yield for Available Acres
area (acres)	41.31	10.33	10.33	144.57	41.31	247.83
yield lbs/acre	678725.36	208074.89	1687492.17	2141133.60	499297.96	5214723.99
	16431.80					
avg retail value /acre	$42,104.81	$48,793.93	$345,306.65	$78,206.54	$29,520.61	
avg wholesale value /acre	$29,590.50	$39,679.27	$259,621.30	$64,628.16	$25,336.13	
average CSA value /acre	$22,576.86	$30,245.09	$199,385.66	$48,337.08	$17,044.48	
						Total Gross Economic Value per Distribution Model for Available Acres
Retail Dist. (93%)	$1,617,422.76	$468,595.06	$3,316,170.41	$10,514,847.36	$1,134,010.93	$17,051,046.52
Wholesale Dist. (3.5%)	$42,778.87	$14,341.04	$93,833.37	$327,014.34	$36,628.34	$514,595.96
CSA Dist. (3.5%)	$32,639.27	$10,931.30	$72,062.76	$244,582.53	$24,641.14	$384,857.01
						Total Gross Economic Value
						$17,950,499.49

sq. ft.		sq.ft.		sq. ft.		sq.ft.	
Greenhouse area	**Greenhouse %**	Food Forest area	**Food Forest %**	Orchard area	**Orchard %**	Value Added area	**Value Added %**
924	1%	18065.64	14%	4725	4%	0	0%
57200	28%	0	0%	0	0%	23200	11%
0	0%	731	3%	4262	15%	0	0%
0	0%	11078	3%	0	0%	0	0%
	0%		25%		0%		0%

Brownfield	in ground	raised beds	greenhouse	food forest	orchard	Value Added Processing		
							2,747,551	sq.ft. available for all recommended Value Added Kitchens
% total area per farming method	0%	9%	28%	0%	0%	11%	192,479	Available for each Value Added Facility (parcel dependant)
								Facilities range in size from >3,000 sq.ft. to 50,000sq.ft. (Wodka, 2016)
							Total Yield for Available Acres	
area (acres)	0.00	51.61	160.55	0.00	0.00	63.08	212	
yield lbs/acre	0.00	1039868.71	26237117.23	0.00	0.00		27,276,985.94	
avg retail value /acre	$42,104.81	$48,793.93	$345,306.65	$78,206.54	$29,520.61			
avg wholesale value /acre	$29,590.50	$39,679.27	$259,621.30	$64,628.16	$25,336.13	$2,144,883.00		
average CSA value /acre	$22,576.86	$30,245.09	$199,385.66	$48,337.08	$17,044.48			
							Total Gross Economic Value per Distribution Model for Available Acres	
Retail Dist. (93%)	$0.00	$2,341,836.32	$51,559,795.92	$0.00	$0.00		$53,901,632.24	
Wholesale Dist. (3.5%)	$0.00	$71,670.34	$1,458,920.62	$0.00	$0.00		$1,530,590.96	
CSA Dist. (3.5%)	$0.00	$54,629.94	$1,120,431.39	$0.00	$0.00		$1,175,061.33	
Est. Gross Rent (Value Added Processing)						$2,144,883.00	$2,144,883.00	
							Total Gross Economic Value	
							$58,752,167.52	

Greenfield	in ground	raised beds	greenhouse	food forest	orchard		
% total area per farming method	50%	2%	0%	3%	15%		
							Total Yield for Available Acres
area	2120.07	5.77	0.00	127.20	636.02		2889.06
yield lbs/acres	34836566.23	116211.96	0.00	1883945.08	7688158.25		44524881.51
avg retail value /acre	$42,104.81	$48,793.93	$345,306.65	$78,206.54	$29,520.61		
avg wholesale value /acre	$29,590.50	$39,679.27	$259,621.30	$64,628.16	$25,336.13		
average CSA value /acre	$22,576.86	$30,245.09	$199,385.66	$48,337.08	$17,044.48		
							Total Gross Economic Value per Distribution Model for Available Acres
Retail Dist. (93%)	$83,016,575.74	$261,715.13	$0.00	$9,251,825.74	$17,461,428.12		$109,991,544.74
Wholesale Dist. (3.5%)	$2,195,687.72	$8,009.62	$0.00	$287,734.06	$564,000.86		$3,055,432.25
CSA Dist. (3.5%)	$1,675,258.15	$6,105.24	$0.00	$215,203.79	$379,422.73		$2,275,989.91
							Total Gross Economic Value
							$115,322,966.90

ROW	in ground	raised beds	greenhouse	food forest	orchard		
% total area per farming method	9%	2%	0%	3%	0%		
							Total Yield for Available Acres
area (acre)	34.61	7.69	0.00	11.54	0.00		53.84
yield lbs/acre	568746.48	154985.76	0.00	170875.23	0.00		894607.47
avg retail value /acre	$42,104.81	$48,793.93	$345,306.65	$78,206.54	$29,520.61		
avg wholesale value /acre	$29,590.50	$39,679.27	$259,621.30	$64,628.16	$25,336.13		
average CSA value /acre	$22,576.86	$30,245.09	$199,385.66	$48,337.08	$17,044.48		
							Total Gross Economic Value per Distribution Model for Available Acres
Retail Dist. (93%)	$1,355,339.81	$349,035.68	$0.00	$839,147.52	$0.00		$2,543,523.02
Wholesale Dist. (3.5%)	$35,847.09	$10,682.00	$0.00	$26,097.69	$0.00		$72,626.79
CSA Dist. (3.5%)	$27,350.49	$8,142.24	$0.00	$19,519.14	$0.00		$55,011.88
							Total Gross Economic Value
							$2,671,161.69

Floodplain	in ground	raised beds	greenhouse	food forest	orchard					
% total area per farming method	50%	0%	0%	25%	0%					
							Total Yield for Available Acres			
area (acre)	564.46	0.00	0.00	282.23	0.00		846.69			
yield lbs (acre)	9275093.83	0.00	0.00	4179939.19	0.00		13455033.02			
avg retail value /acre	$42,104.81	$48,793.93	$345,306.65	$78,206.54	$29,520.61					
avg wholesale value /acre	$29,590.50	$39,679.27	$259,621.30	$64,628.16	$25,336.13					
average CSA value /acre	$22,576.86	$30,245.09	$199,385.66	$48,337.08	$17,044.48					
							Total Gross Economic Value per Distribution Model for Available Acres			
Retail Dist. (93%)	$22,102,825.07	$0.00	$0.00	$20,527,174.25	$0.00		$42,629,999.32			
Wholesale Dist. (3.5%)	$584,592.91	$0.00	$0.00	$638,400.17	$0.00		$1,222,993.07			
CSA Dist. (3.5%)	$446,030.66	$0.00	$0.00	$477,476.09	$0.00		$923,506.75			
							Total Gross Economic Value			
							$44,776,499.14			

Preferred Parcels

Preferred Inst/Comm	in ground	raised beds	greenhouse	food forest	orchard					
% total area per farming method	4%	1%	1%	14%	4%					
							Total Yield for Preferred Acres			
area (acres)	27.92	6.98	6.98	97.71	27.92		167.50			
yield lbs/acre	458716.70	140627.47	1140492.00	1447085.68	337450.65		3524372.50			
avg retail value /acre	$42,104.81	$48,793.93	$345,306.65	$78,206.54	$29,520.61					
avg wholesale value /acre	$29,590.50	$39,679.27	$259,621.30	$64,628.16	$25,336.13					
average CSA value /acre	$22,576.86	$30,245.09	$199,385.66	$48,337.08	$17,044.48					
							Total Gross Economic Value per Distribution Model for Preferred Acres			
Retail Dist. (93%)	$1,093,135.57	$316,700.09	$2,241,234.59	$7,106,462.19	$766,421.57		$11,523,954.02			
Wholesale Dist. (3.5%)	$28,912.11	$9,692.39	$63,417.31	$221,012.72	$24,755.27		$347,789.81			
CSA Dist. (3.5%)	$22,059.26	$7,387.92	$48,703.64	$165,301.16	$16,653.72		$260,105.71			
							Total Gross Economic Value			
							$12,131,849.53			

Greenfield	in ground	raised beds	greenhouse	food forest	orchard					
% total area per farming method	50%	2%	0%	3%	15%					
							Total Yield for Preferred Acres			
area	144.19	5.77	0.00	8.65	43.26		201.86			
yield lbs/sf	2369219.08	116211.96	0.00	128126.25	522868.16		3136425.45			
avg retail value /acre	$42,104.81	$48,793.93	$345,306.65	$78,206.54	$29,520.61					
avg wholesale value /acre	$29,590.50	$39,679.27	$259,621.30	$64,628.16	$25,336.13					
average CSA value /acre	$22,576.86	$30,245.09	$199,385.66	$48,337.08	$17,044.48					
							Total Gross Economic Value per Distribution Model for Preferred Acres			
Retail Dist. (93%)	$5,645,919.70	$261,715.13	$0.00	$629,212.48	$1,187,543.81		$7,724,391.12			
Wholesale Dist. (3.5%)	$149,327.73	$8,009.62	$0.00	$19,568.66	$38,357.44		$215,263.45			
CSA Dist. (3.5%)	$113,933.55	$6,105.24	$0.00	$14,635.91	$25,804.37		$160,479.07			
						$2,144,883.00				
							Total Gross Economic Value			
							$8,100,133.64			

ROW	in ground	raised beds	greenhouse	food forest	orchard					
% total area per farming method	9%	2%	0%	3%	0%					
							Total Yield for Preferred Acres			
area (acres)	12.54	2.79	0.00	4.18	0.00		20	acres		
yield lbs/(acre)	206126.03	56170.20	0.00	61928.88	0.00		324,225			
avg retail value /acre	$42,104.81	$48,793.93	$345,306.65	$78,206.54	$29,520.61					
avg wholesale value /acre	$29,590.50	$39,679.27	$259,621.30	$64,628.16	$25,336.13					
average CSA value /acre	$22,576.86	$30,245.09	$199,385.66	$48,337.08	$17,044.48					
							Total Gross Economic Value per Distribution Model for Preferred Acres			
Retail Dist. (93%)	$491,204.49	$126,498.09	$0.00	$304,125.23	$0.00		$921,827.80			
Wholesale Dist. (3.5%)	$12,991.76	$3,871.39	$0.00	$9,458.37	$0.00		$26,321.52			
CSA Dist. (3.5%)	$9,912.41	$2,950.93	$0.00	$7,074.16	$0.00		$19,937.50			
							Total Gross Economic Value			
							$968,086.82			

ROW	in ground	raised beds	greenhouse	food forest	orchard			
% total area per farming method	9%	2%	0%	3%	0%			
							Total Yield for Preferred Acres	
area (acres)	12.54	2.79	0.00	4.18	0.00		20	acres
yield lbs/(acre)	206126.03	56170.20	0.00	61928.88	0.00		324,225	
avg retail value /acre	$42,104.81	$48,793.93	$345,306.65	$78,206.54	$29,520.61			
avg wholesale value /acre	$29,590.50	$39,679.27	$259,621.30	$64,628.16	$25,336.13			
average CSA value /acre	$22,576.86	$30,245.09	$199,385.66	$48,337.08	$17,044.48			
							Total Gross Economic Value per Distribution Model for Preferred Acres	
Retail Dist. (93%)	$491,204.49	$126,498.09	$0.00	$304,125.23	$0.00		$921,827.80	
Wholesale Dist. (3.5%)	$12,991.76	$3,871.39	$0.00	$9,458.37	$0.00		$26,321.52	
CSA Dist. (3.5%)	$9,912.41	$2,950.93	$0.00	$7,074.16	$0.00		$19,937.50	
							Total Gross Economic Value	
							$968,086.82	

Floodplain	in ground	raised beds	greenhouse	food forest	orchard			
% total area per farming method	50%	0%	0%	25%	0%			
							Total Yield for Preferred Acres	
area (acres)	558.79	0.00	0.00	279.39	0.00		838	acres
yield lbs/acre	9181843.36	0.00	0.00	4137914.68	0.00		13,319,758	
avg retail value /acre	$42,104.81	$48,793.93	$345,306.65	$78,206.54	$29,520.61			
avg wholesale value /acre	$29,590.50	$39,679.27	$259,621.30	$64,628.16	$25,336.13			
average CSA value /acre	$22,576.86	$30,245.09	$199,385.66	$48,337.08	$17,044.48			
							Total Gross Economic Value per Distribution Model for Preferred Acres	
Retail Dist. (93%)	$21,880,606.43	$0.00	$0.00	$20,320,796.98	$0.00		$42,201,403.41	
Wholesale Dist. (3.5%)	$578,715.50	$0.00	$0.00	$631,981.78	$0.00		$1,210,697.28	
CSA Dist. (3.5%)	$441,546.33	$0.00	$0.00	$472,675.62	$0.00		$914,221.94	
							Total Gross Economic Value	
							$44,326,322.63	

	Institutional	Brownfield	Greenfield	ROW	Floodplain
Total Estimated Yield (lbs) for **Available** Parcels (acres)	5,214,724	27,276,986	44,524,882	894,607	13,455,033
sq.ft. available for all recommended kitchens		2,747,551			
Total Estimated Gross Economic ValueFor **Available** Parcels	$17,950,499	$58,752,168	$115,322,967	$2,671,162	$44,776,499

	Institutional	Brownfield	Greenfield	ROW	Floodplain
Total Estimated Yield (lbs) for **Preferred** Parcels (acres)	3,524,372	973,044	3,136,425	324,225	13,319,758
sq.ft. available for all recommended kitchens		98,707			
Total Estimated Gross Economic Value for **Preferred** Parcels	$12,131,850	$4,165,838	$8,100,134	$968,087	$44,326,323

Raw Data

Sprout City Farms

2015 | 57 beds | Total Acerage: 0.17
65x2ft
7410sf

Month

Crop	June Total	July1	July2	July3	July5	JulyTot	August1	August2	August3	August4	August5	August Total	Sept1	Sept2	Sept3	Sept4	SeptTotal	Oct1	Oct2	Oct3	OctTotal
baby beet greens																					
beet				5	12	17	22	15	10	13	16	76	11		22		33	35	36	18	89
broccoli		11				11															
carrots								6	7	10	6	29	33		33	28	94	50	45	64	159
cauliflower							13		8			21									
chard				11	7	18	8	8		5		21	4				4				
cucumbers							51	2	60	71	84	268	69	49	75	9	202	37	28		65
eggplant								1	2	1	3	7	8	10	10	3	31	7	5	12	24
garlic				86		86															
green beans								7	18	4		29		39	36	43	118	27	11		38
kale	18	15	17	13	13	58	13	11		17		41	12				12				
leeks															32		32				
lettuce	26	28	16	24	6	74		8				8									
melons																					
onions								3				3	28	33	38	29	128	131			131
peas	61	53	5			58										5	5	10	13	7	30
Peppers								3	6	6	21	36	33	48	22	18	121	36	40	30	106
potatoes														29	36		65			33	33
radishes		15	21	10	14	60	17	7				24				29	29	39		22	61
rutabaga																54	54		25	30	55
scallions																					
shallots														19		23	42				
squash							10	18	31	29	53	141	29	23	90	3	145	84	9	48	141
tomatillos							8	11	19	40	8	86	24	13	17	12	66	12	3		15
Tomatoes								10	21	33	33	97	54	69	93	60	276	100	30	56	186
Zucchini				9		9															

352sf/crop

Crop	June	July	August	Sept	Oct	Annual Totals	Lbs/sf
Tomatoes			97	276	186	559	**1.59**
Greens	44	150	70	16		280	**0.8**
Root Vegetables		77	129	275	397	878	**2.49**
Aliums		86	3	202	131	422	**1.19**
Peppers/Eggplant			43	151	130	324	**0.92**
Cucurbits		9	409	347	206	971	**2.76**
Tomatillos			86	66	15	167	**0.47**
Green Beans/Peas	61	58	29	123	68	339	**0.96**
Broccoli/Cauliflower		11	21			32	**0.09**

2014 and 2015 combined Averages

Crop	2014	2015	Average
Tomatoes	2.29	1.59	**1.94**
Greens	1.48	0.8	**1.14**
Root Vegetables	3.13	2.49	**2.81**
Aliums	2.39	1.19	**1.79**
Peppers/Eggplant	1.26	0.92	**1.09**
Cucurbits	3.5	2.76	**3.13**
Tomatillos	0.39	0.47	**0.43**
Green Beans/Peas	0.33	0.96	**0.645**
Broccoli/Cauliflower	0.18	0.09	**0.135**

Sprout City Farms

2014 | 57 beds | 65x2ft | Total Acerag 0.17

21 crops | 352 sf/crop

Month | 7410sf

Crop	JuneTotal	July1	July2	July3	July4	July5	JulyTotal	August1	August2	August3	August4	August Tota	Sept1	Sept2	Sept3	Sept4	SeptTotal	Oct1	Oct2	Oct3	Oct4	OctTotal
baby beet greens	6						6															
beet				18	36	21	75	15	20	4	9	48		17			17		6		7	13
broccoli	16				9		25	13		9		22										
carrots				21	34	26	81	36	33	29	39	137	33	35		32	100	26	36	4	10	76
chard		16	14	9	14	9	62	18	14	8	8	48	5	3		3	11		1			1
cucumbers						35	35	9	70	29	22	130	37	71	2	20	130	10				10
eggplant										9	20	29	9	54			63	16		35		51
green beans													3	37	8	10	58	7				7
hot peppers						1	1															
kale		14	10	11	9	7	51	15	14	11	14	54	10	11		12	33		10		2	12
lettuce	59	44	27	16	12		158	20				20										
melons															136		136					
onions					15	10	25			8		8	14	460	13	9	496	12	6	67	2	87
peas		2	13	20	14		49														2	2
Peppers								5	8	12	12	37	26	163	7	21	217	35		10		45
potatoes															42	82	124		80	51	33	164
radishes	54	33					87								17	16	33	18	13	3	4	38
rutabaga																		21	14		18	53
scallions								23				23										
shallots														168	4	10	182	20				20
squash			16	88	66	43	213	58	39	18	49	164	158	31	117		306		35		73	108
tomatillos								18	17	17	13	65	15	20			35	22	14			36
Tomatoes								29	18	37	74	158	94	319		84	497	125	19	6		150

7410

352

Crop	June	July	August	Sept	Oct	Annual Totals	Lbs/SF
Tomatoes			158	497	150	805	**2.29**
Greens	65	277	122	44	13	521	**1.48**
Root Vegetables	54	243	185	274	344	1100	**3.13**
Aliums		25	31	678	107	841	**2.39**
Peppers/Eggplant			66	280	96	442	**1.26**
Cucurbits		248	294	572	118	1232	**3.5**
Tomatillos			65	35	36	136	**0.39**
Green Beans/Peas		49		58	9	116	**0.33**
Broccoli/Cauliflower	16	25	22			63	**0.18**

Raw data of crop production from 2014 and 2015 was received from Sprout City Farms. This data was broken down by harvest date (sometimes several within a month), and reported by crop in pounds (lbs) of production. A total for each crop was found for each date, aggregated by month, and then for the entire growing season. Crop totals were then placed into groupings we assigned (ex: aliums were onions, garlic, scallions), and a total poundage reported for each. Sprout City Farms reported that their growing area was .17 acres, or 7,410sf, and that they grow 21 different crops. Assuming an equal area of land is designated for each crop, that would mean they assign 352sf per crop. Using this number and the annual pounds of production for each crop category, we arrived at the lbs/sf for each.

Nevada Naturals

1,800sf	60'x30'	combined hydro/aero	reported 7lbs/sf total	200 sf/crop

Product(all varieties)	System Type	Number of Plan	Monthly Yield (pounds)	6 month Total (pou	Annual Totals (lbs	lb/sf	
Tomatoes	Aeroponic	64	1,120	2,240	4480	**22.4**	
Peppers	Aeroponic	64	1,055	2,110	4220	21.1	
Strawberries	Hydro Stacker	600	1,057	2,115	4230	21.15	
Greens (ground level)	Hydro Float	31,600	6,990 (40 days)	7,705	15410	77.05	**greens total: 120.75**
Greens (on tables)	Hydro Float	18,400	3,933 (40 days)	4,370	8740	43.7	
Peas	Hydro Flood	230	968 (64 days)	1,840	3680	18.4	
Beans	Hydro Flood	230	726 (64 days)	1,495	2990	14.95	
Cucumbers, Lemon	Hydro Vertical	100	60 (64 days)	122	244	1.22	
Eggplant, Japanese	Hydro Vertical	50	33 (64 days)	76	152	0.76	
Squash, Crookneck	Hydro Vertical	50	26 (64 days)	55	110	0.55	
		51388					

Nevada Naturals reported crop yields for a 6 month period from their 1,800sf greenhouse. We simply doubled these values, to find annual production, and then divided that by the square footage of the facility for the lbs/sf numbers.

GrowHaus

	5,000sf building	2,500sf grow space	1,350 heads/week
	weekly	monthly	annually
Butter head lettuce (90%)	1215	4860	58320
Red lettuce (3%)	40	160	1920
Choi (3%)	40	160	1920
Cilantro (3%)	40	160	1920
(Total)	1335	5340	**64,080**

greens=	62160
@2,500sf	**24.86 lb/sf**
@5,000sf	12 lb/sf

GrowHaus reported that they have a 5,000sf facility, with 2,500sf of growing channels, which produce 1,350 heads of lettuce per week. They also reported percentages of total grow space. Using these percentages, and total weekly production, we found the weekly production for each reported crop type. We then converted these numbers to annual yields, and combined all the relevant figures for greens, to come up with the total annual production of greens for the year. Finally, using 2,500sf of grow space and the total green production, found the annual lbs/sf.

Rocky Mountain Fresh

Greenhouse	Hydroponics	30,000sf	200,000lbs/yr
	lbs/sf		
Tomatoes	**6.67**		

Rocky Mountain Fresh has a 30,000sf facility which grows only tomatoes, and produces 200,000lbs/yr. We took this number and divided it by the square footage of the building to find lbs/sf.

Hoot and Howl Farm

	Area								
		5 acres total		1lb=15 strawberries		1lb=125 raspberries/blackberries			
Raspberries/ Blackberries	3 acres (130,680 sf)		Berries (rows 12" apart, 50 berries/linear ft per season)	65,000sf plante	3,240,000 berries	@ 400ftx325ft	26,000lbs	**.2lb/sf**
Strawberries	.33 acres	8 berries/sf	**.5 lb/sf**					
						24.79 berries/sf		

Hoot and Howl farm reported that they have 3 acres of growing area for blackberries and raspberries, and that they plant in rows 1' apart, which yields 50 berries per lineal foot. We started with a set of hypothetical dimensions (325x400) that equaled near 130,000sf (3 acres) to figure out yield for the entire plot of land. Assuming they plant rows 1' apart, that would mean that half of the 325' wide growing area is in the form of paths between plants and half is the plants themselves. So dividing 325/2, we get approximately 162 rows. If each of these rows are 400 feet long, and they get 50 berries per lineal foot (400x50), they get 20,000 berries per row, and multiplying that times the number of rows gives us the total number of berries (3,240,000). Assuming 1 pound = 125 berries, they produce 25,920 (approximately 26,000lbs) of berries a season. With 130,680 sf of grow space, that would mean .2 lbs/sf. The calculation of the strawberries was much more simple, as they reported getting 8 berries/sf, and based on their report of 1/3 of an acre of strawberries, we found the lbs/sf.

Facts About Future Growing's Aeroponic Tower Garden Technology

Total sf: 57200

	% of area planted (enter as decimal)	area of crop in s.f.	high yield (enter number from table)	avg yield	low yield	lbs high	lbs avg	lbs low
Arugula	10%	5,720	11,440	11,440	11,440	2	2	2
Cabbage	3%	1,716	2,574	1,407	257	1.5	0.82	0.15
Cilantro	1%	572	1,150	1,150	1,150	2.01	2.01	2.01
Cucmbers	3%	1,716	4,462	2,488	515	2.6	1.45	0.3
Collards	1%	572	383	297	206	0.67	0.52	0.36
Kale	15%	8,580	12,012	6,607	1,201	1.4	0.77	0.14
Mint	1%	572	11	11	11	0.02	0.02	0.02
Peas	1%	572	378	217	57	0.66	0.38	0.1
Spinach	35%	20,020	90,090	46,046	2,202	4.5	2.3	0.11
Squash, Summer	5%	2,860	2,574	1,373	172	0.9	0.48	0.06
Swiss Chard	5%	2,860	6,292	6,292	6,292	2.2	2.2	2.2
Tomatoes	20%	11,440	36,608	36,608	36,608	3.2	**3.2**	3.2

Tomatoes	**3.2**
Greens	**7.79**

Edible Agroforestry Design Templates (Meyer & Sharapova, 2015)

	rainfall/yr	
Iowa	34.7	
CO	15.6	0.45

	lb/plant	Plant diameter (ft)	Plant sf	lb/sf		
Raspberries	-	-	-	-		
Blackberries	-	-	-	-		
Strawberries	1	2.5	6.25	0.16		
Rhubarb	3.5	4	16	0.22		
Asparagus	0.4					
Apple (dwarf)	48	8	64	0.75	Fruit trees:	1.42
Currants (black)	10	5	25	0.4	currants/goose:	0.76
Gooseberries	9	5	25	0.36		
Plum (American)	122	15	225	0.54		
Plum (Dwarf)	8	8	64	0.13		
Pear	-	15	225			

	100%
Raspberries/Blackberries	
Strawberries	0.16
Rhubarb	0.22
Asparagus	
Fruit Trees	1.42
Currants/Gooseberries	0.76

plum	0.67
apple	0.75

	45%
Raspberries/Blackberries	
Strawberries	**0.07**
Rhubarb	**0.1**
Asparagus	
Fruit Trees	**0.64**
Currants/Gooseberries	**0.3**

The data gathered was from a region in Iowa. To make up for the difference in climate, we made the assumption that because Iowa receives 45% more rainfall a year than Colorado, our yield would be 55% less than the reported values.

CSA Info (Hawthorne Valley Farmscapes Ecology Program, 2013)

http://hvfarmscape.org/sites/default/files/csa_price_comparison_study.pdf

Avg. lbs per Share	Avg. weekly price/share	avg. price/lb CSA produce
14.55	$22.28	$1.87

Percent of price for the same produce at :

Supermarket	Nat. Food Store	Farm Stand	Farmer's Market	Average overall	Average Savings
49.67%	49.67%	62.67%	68.67%	57.67%	42.33%

Edible Forest Gardens: Ecological Vision, Theory for Temperate Climate Permaculture (Jacke & Toensmeier, 2005)

	rainfall in/yr	
MA	43	
CO	15.6	0.4

	lb/plant	Plant diameter (ft)	Plant sf	lb/sf			median	lbs per acre	lbs per sq ft
Raspberries	1.5	2.5	6.25	0.24		0.91			
Blackberries	6	3	9	0.67					
Strawberries	1	2.5	6.25	0.16					
Rhubarb					6-12 tons/acre		9	18,000	0.41
Asparagus	30				2,600-9,500 lb/acre		6050		0.14
Apple	160	8	64	2.5					
Currants	10	5	25	0.4	currants/goose:		0.76		
Gooseberries	9	5	25	0.36	fruit trees:		5.16		
Peach	130	20	400	0.33					
Plum (European, American and Japanese)	100	10	100	1					
Pear (Asian & European)	300	15	225	1.33					

		40%
peach	0.33	**0.13**
pear	1.33	**0.53**
plum	1.00	**0.4**
apple	2.50	**1**

	100%
Raspberries/Blackberries	0.91
Strawberries	0.16
Rhubarb	0.41
Asparagus	0.14
Fruit Trees	5.16
Currants/Gooseberries	0.76

	40%
Raspberries/Blackberries	**0.36**
Strawberries	**0.06**
Rhubarb	**0.16**
Asparagus	**0.06**
Fruit Trees	**2.06**
Currants/Gooseberries	**0.3**

The data gathered was from a region in Massachusettes. To make up for the difference in climate, we made the assumption that because MA receives 40% more rainfall a year than Colorado, our yield would be 60% less than the reported values.

yeild per acre

crop	apples	peaches	onions	cantalope	cabbage	sweet corn
year			lbs			
2004	17,500.00	13000.00	50000.00	16000.00	48000.00	15000.00
2005	20,700.00	11420.00	44000.00	19000.00	48000.00	15000.00
2006	10,000.00	12180.00	40000.00	17000.00	43000.00	15000.00
2007	8,130.00	11300.00	41000.00	19000.00	38000.00	14000.00
2008	12,900.00	12180.00	38000.00	21000.00	40000.00	17000.00
2009	10,700.00	11300.00	41500.00	27000.00	47000.00	16000.00
2010	10,000.00	11660.00	40000.00	19000.00	46000.00	15000.00
2011	6,920.00	10000.00	41500.00	19000.00	46000.00	18000.00
2012	14,200.00	13600.00	42000.00	25000.00	45000.00	15000.00
2013	4,670.00	5860.00	42500.00	20000.00	47000.00	16000.00
average	11,572.00	11250.00	42050.00	20200.00	44800.00	15600.00
avg/43,560=						
yeild per sq. foot	0.27	0.26	0.97	0.46	1.03	0.36

$ per pound

	$0.15	$0.47	$0.12	$0.15	$0.10	$0.12
	$0.17	$0.54	$0.18	$0.14	$0.10	$0.14
	$0.27	$0.66	$0.18	$0.18	$0.10	$0.15
	$0.22	$0.78	$0.10	$0.15	$0.11	$0.12
	$0.23	$0.72	$0.18	$0.20	$0.11	$0.16
	$0.26	$0.83	$0.13	$0.22	$0.11	$0.14
	$0.22	$0.94	$0.18	$0.19	$0.12	$0.15
	$0.29	$1.00	$0.14	$0.23	$0.14	$0.17
	$0.30	$0.79	$0.17	$0.32	$0.15	$0.17
	$0.36	$0.94	$0.19	$0.40	$0.16	$0.19
Average	$0.25	$0.76	$0.16	$0.22	$0.12	$0.15

Analyzing Agricultural Potential Within Denver (Carman et al, 2015)

CROP	min	max	average	pounds / square foot		
Apples	0.58	1.5	1.04			
Arugula	2	2	2			
Asparagus	0.09	1.2	0.65			
Beans	0.01	7	3.51			
Beets	1	2.4	1.7			
Blackberry	0.02	1.5	0.76			
Broccoli	0.04	1	0.52			
Cabbage	0.15	1.5	0.83			
Cantaloupe	0.45	0.45	0.45		numbers averaged from all varieties of each type from averages listed to the left.	
Carrots	0.23	6	3.12		Tomatoes	3.15
Cauliflower	0.8	0.8	0.8		Greens	1.18
Cherry	0.14	2.44	1.29		Root Vegetables	1.82
Collards	0.36	0.67	0.52		Alliums	0.47
Corn	0.03	4.5	2.27		Peppers/Eggplant	1.41
Cucumbers	0.3	2.6	1.45		Cucurbits	1.45
Eggplant	0.1	0.9	0.5		Tomatillos	
Garlic	0.2	0.52	0.36		Green Beans/Peas	1.30
Grape	0.11	3	1.56		Broccoli/Cauliflower	0.44
Kale	0.14	1.4	0.77		Cabbage	0.83
Lettuce (leaf types)	0.05	0.9	0.48		Corn	2.27
Okra	0.33	0.33	0.33		Cantalope	0.45
Onion, green	0.33	0.33	0.33			
Onions	0.07	2.3	1.19			
Peach	0.57	1.1	0.84			
Pear	0.51	0.95	0.73			
Peas	0.1	0.66	0.38		Strawberries	1.08
Peppers	0.11	4.5	2.31		Plums	0.41
Plums	0.23	0.58	0.41		Raspberries	1.52
Potatoes	0.4	1.5	0.95		Blackberries	0.76
Pumpkin	1.5	6.2	3.85		Apples	1.04
Radish	0.13	6.2	3.17		Asparagus	0.65
Raspberries	0.04	3	1.52		Peach	0.84
Spinach	0.11	4.5	2.31		Pear	0.73
Squash, Summer	0.06	0.9	0.48			
Strawberries	0.17	2	1.08			
Swiss Chard	2.2	2.2	2.2			
Tomatoes	0.3	6	3.15			
Turnips	0.6	3.4	2			
Watermelons	0.68	0.68	0.68			