

ABSTRACT

Title of Document: URBAN AGRICULTURE: EXAMINING THE
INTERSECTION BETWEEN AGRICULTURE
AND HIGH-RISE LIVING

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Traditionally, agriculture and the urban environment have been separated; however, new thought and experimentation reveal there exists a symbiotic relationship between the two. The implementation of agriculture into our public and private spaces can provide urbanites with a series of benefits that foster new communities. This thesis examines how urban agriculture can be utilized within the Hudson Yards Development in New York City. The focus of the thesis is the design of an experimental high-rise apartment building that utilizes common architectural elements as a means to produce food. The complex seeks to provide for itself by taking advantage of the natural symbiotic relationship between plants and people. Ultimately, the thesis argues that the act of growing food in urban areas can transform our approach to urban development and enable people to become self-sufficient by using urban and architectural design as teaching tools about food.

URBAN AGRICULTURE: EXAMINING THE INTERSECTION BETWEEN
AGRICULTURE AND HIGH-RISE LIVING

By

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Chapter 1: Introduction

Agriculture and the Urban Environment

Modern technology has allowed for a further separation of agriculture and the city; however, new thought and experimentation has shown a symbiotic relationship between the two. Vertical farming and urban agriculture are new movements that seek to reduce human impact on the Earth and enable cities to become more resistant to environmental collapse by moving farms into urban areas. Theoretically, by incorporating agronomy into our cities, vertical farming and urban agriculture can transform our approach to urban development and enable people to become self-sufficient by using urban and architectural design as teaching tools about food.

Agriculture and urbanism are no longer considered mutually exclusive, but rather, their juxtaposition provides opportunities to sponsor the growth of cities. In *Global City Blues*, Daniel Solomon states that, “Food and urbanism are both fundamental to the human experience”¹. Yet the act of growing food and the urban experience have been held separate. By inserting the agrarian landscape into the urban environment, community and collaboration are fostered within the public realm through this productive amenity. Recently acknowledged through contemporary theory, urban agriculture activates urban space. *The Social Life of Small Urban*

¹ Solomon, *Global City Blues*, 17.

Spaces concludes that, “if you want to seed a place with activity, put out food”². With the growing popularity of community gardens and the Slow Food Movement, urban agriculture can be a communal unifier within the city.

Vertical Farming is the manifestation of agriculture in a dense area that services and provides for a surrounding population. Revered for its technological advancement of stacking greenhouses, vertical farming allows for the production of a variety of crops while eliminating much of the waste and pollution. It advocates for a closed-loop city that produces its own resources rather than relying on outside means. With very few, large-scale built vertical farming precedents, vertical farms still have the opportunity to be defined in terms of programs that provide more than just sustenance. The inclusion of these high-tech farms within cities can help to sponsor the growth and amenities, while providing valuable resources to its inhabitants.

It is anticipated that the human species will likely face a series of both environmental and economic difficulties resulting from our current lack of concern for the environment. We burn oil for transportation and harm ecosystems to create arable land all to feed our own needs. Vertical farming and urban agriculture are tools that can allow us to work symbiotically with natural processes of growing food. Dr. Dickson Despommier states, “what is most required at this point in our history is not yet another quick techno-fix, but rather a permanent overhaul in the way we behave as a species”³. Urban agriculture is the next step towards this attitude. With the inclusion of agriculture in the urban environment, urban agriculture can reshape the public realm and enable people to become more self-reliant.

² Whyte, *The Social Life of Small Urban Spaces*, 50.

³ Despommier, *The Vertical Farm*, 142.

Urban Agriculture Timeline: History and Theories

Urban agriculture is grounded in recent urban theories and modern precedents, which utilize it as a program to enhance public space. Pre-dating modern times, this conversation begins with ancient civilizations. Monuments and cities such as the Hanging Gardens of Babylon and Machu Picchu begin the conversation by juxtaposing agriculture and the built form. Machu Picchu incorporated many stepped agricultural terraces in close proximity to the urban fabric. While the Incans didn't blur the lines between public space and agricultural field, the correlation between proximity of agriculture and city is undeniable. Having agricultural space close to the city walls was vital to sustain the activities of the Incan population, and without it, the city would not have been able to survive.⁴ This need for local food and sustenance became a driver for the creation of their unique stepped urbanism.

With the industrial revolution, the harmonious relationship between agriculture and urban environment became severed. Cities harbored new industries, and populations flocked from the countryside to these new occupations. Cities quickly became overcrowded and as a result, architects and urban planners reimagined what a city should be. Since cities were expanding, agriculture was pushed further and further away from the city edge⁵.

Ebenezer Howard reimagined the overcrowded, industrial city and published his vision for the urban environment in *Garden Cities of To-morrow*. In 1898, Howard began the Garden City Movement, which was focused on the creation of

⁴ Viljoen, *CPULs: Continuous Productive Urban Landscapes*.

⁵ Nordahl, *Public Produce*, 3.


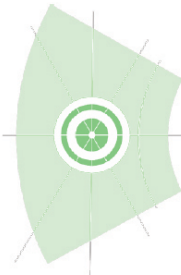

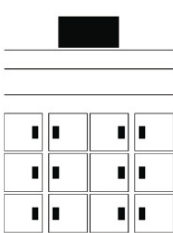




CONTEMPORARY URBAN AGRICULTURE THEORY			
GARDEN CITY MOVEMENT 1902 C.E.	EBENEZER HOWARD	 Bring City to Farm	 Public Space as Left Over
BROADACRE CITY 1932 C.E.	FRANK LLOYD WRIGHT	 Bring Farm to Suburbs	 Individualism
CONTINUOUS PRODUCTIVE URBAN LANDSCAPES 2004 C.E.	ANDRE VILJOEN	 Bring Farm to City	 Interconnected Public Green Space
AGRARIAN URBANISM 2011 C.E.	ANDRES DUANY + ELIZABETH PLATER-ZYBERK	 Bring Farm to City	 Sectional Relationship Between Agriculture + Urbanism

Figure 1: Contemporary Urban Agriculture Theory Visually Explained
Credit: Author

public space in the form of public gardens. At its essence, the urban theory focused on bringing the city to the farm by utilizing agricultural land as the site for his garden cities. Each city was planned to have six boulevards with non-productive, public green space anchoring the center of the city⁶. By allowing large swaths of public space to be incorporated into the city, Howard creates a more healthful environment by allowing light and air into the urban context. Even though agriculture is highlighted within the diagrams for Howard's theory, agriculture still remains outside of the Garden City. Five-sixths of the agriculture surrounding the garden city is kept intact and functioning to support the metropolis. Dairy farms, fruit farms and allotment gardens are all incorporated and in close proximity to the garden city, which support the city's health and welfare. Although agriculture serves an important function to the garden city, the focus of the theory becomes the relationship between buildings and open space⁷.

With Howard's Garden City Movement focusing on public health through public space, Frank Lloyd Wright rethinks the American suburbs and cities by integrating agricultural practices. *Broadacre City* moves the population away from the unhealthy, overbuilt city and implants people into the countryside. With one acre per family, Wright's ideal city focuses on the individual instead of the collective need. "Whatever a man did would be done – obviously and directly – mostly by himself in his own interest under the most valuable inspiration and direction: under training, certainly if necessary."⁸ Consequently, each acre is cultivated and managed

⁶ Howard, *Garden Cities of To-Morrow*, 51.

⁷ Ibid., 52–54.

⁸ Wright, "Broadacre City: A New Community Plan."

by the family residing on the land that participates in both manual and industrial practices. In addition to the family plots, a multitude of amenities are planned for the Broadacre City, including factories, schools, markets, and office buildings, all of which support the inhabitants. The primary focus of each Broadacre community is the farm. By placing the farm at the crux of the scheme, Wright puts great emphasis on the importance of the city's food supply. In his scheme, "architecture becomes landscape and landscape takes on the character of architecture by the simple process of cultivation."⁹ Broadacre City suggests the heavy integration of agriculture into the daily lives of American citizens; however, it favors a low density, suburban model over a high-density, urban model. Wright's principle of integrating agriculture into the daily lives of people was never realized, and as a result, our cities have continued to distance themselves from agriculture.

In the contemporary era, our civilization has achieved a high degree of separation between agriculture and the population. With the aid of technology, we have taken many large strides away from our ancient precedents and can now indulge in cuisines that come from thousands of miles away. Industrialization, zoning regulations and suburban sprawl has pushed agriculture further away from the city limits, and as a consequence, we have lost an aspect of life that was once deeply rooted in our culture.¹⁰ Inspired by the green movement, two theories reconsider agriculture as a program that can be integrated into cities.

Continuous Productive Urban Landscapes (CPUL) promotes the integration of agriculture into our public spaces and streets. At its essence, the theory improves

⁹ Ibid.

¹⁰ Nordahl, *Public Produce*, 3.

upon Howard's Garden City Movement by programming the green boulevards and gardens of the city. Instead of separating the functions of the city and the functions of the farm, the two are integrated providing the city residents with healthful food. In turn, CPULs begin to address the environmental impact that the food industry causes¹¹. Comparatively, *Agrarian Urbanism* takes a limited stance on urban agriculture and presents it as an after thought to traditional urbanism. In their manifesto, *Agrarian Urbanism*, Duany argues that urban agriculture can be recycled onto the transect of the New Urbanist city through a kit of parts. Farms remain farms, while balconies and rooftops are transformed to harbor agriculture.¹²

Regardless of the scale of implementation, both theories begin to integrate the productive landscape into the urban context. Agrarianism and urbanism are no longer seen as mutually exclusive, but rather seen as mutually beneficial. By bringing the farm into the city, architects are given a unique opportunity to shape public space, while providing a local productive amenity. Urban agriculture theory supports urban agriculture can be a productive program that enriches the urban fabric.

Contemporary Agricultural Difficulties + Urban Agriculture Benefits

As we approach the Peak Oil and Post-Oil world, global problems are re-emerging and surfacing, which will undoubtedly affect how we consider our infrastructure. Climate change, a growing population, and world health are all approaching difficulties that could be potentially harmful to our current means of living. By acknowledging these imminent difficulties, our society can take steps to

¹¹ Bohn and Viljoen, "The Edible Landscape: Envisioning the Continuous Productive Urban Landscape (CPUL)."

¹² Duany, *Garden Cities*.

becoming more resistant by employing new sustainable infrastructure. Even though the implementation of urban agriculture cannot solve these problems, it is possible that urban agriculture could help to mitigate these challenges by changing the process of how we grow food.

Population

With the world continuing to develop through industrialization, access to essential resources and rising levels of standards of living will push the boundaries of the Earth's carrying capacity. As we approach the end of the 21st century, the world population is expected to reach eleven billion people¹³. To feed the current human population of about 7 billion people, we farm a combined landmass the size of South America. In *The Vertical Farm: Feeding the World in the 21st Century*, Despommier cites that to feed just three billion of the five billion new mouths, we will need to farm an additional landmass the size Brazil.¹⁴ This amount of arable land does not exist and in fact, farms are being razed to build suburban developments. Despommier illustrates that the advantages of vertical farming in an urban context are unparalleled for both economic and environmental stability.

Vertical farming provides a viable solution for the production of more food on less land. With typical farms being pushed further away from the city center, vertical farming reestablishes the proximity of agriculture to the city. In fact, these food laboratories would allow food to be produced within the city limits. This food could be pesticide-free and organically grown. Vertical farming could potentially save vast quantities of water now used for irrigation and produce little or no waste because it

¹³ "World Population to Reach 9.7 Billion by 2050 New Study Predicts."

¹⁴ Despommier, *The Vertical Farm*, 96.

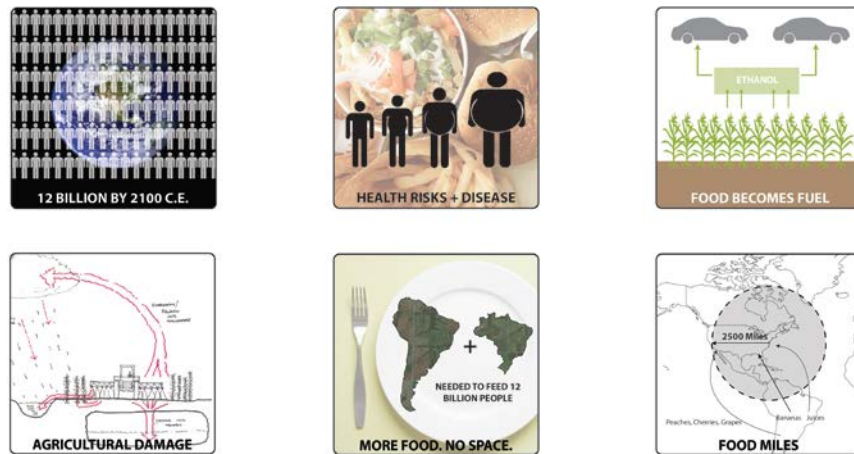


Figure 2: Potential Future Threats
Credit: Author



Figure 3: Urban Agriculture Benefits
Credit: Author

utilizes cutting edge technology to produce food. By becoming less reliant on external resources, the average American city can become more self-reliant.

Health

In today's society, people are disconnected from their food source and often don't realize how our food is grown directly affect our health and well-being. Fruits and vegetables are often picked unripe and frozen, which prematurely stops the conversion of sugars and nutrients. This food is then processed, chemically ripened, and processed again creating a variety of different products. The by-product of this agricultural process compromises on taste and nutrition and supports organisms with long shelf lives. To get the desired flavors, these foodstuffs are often artificially sweetened with corn syrups and salts deteriorating the health of the general public¹⁵.

By utilizing state-of-the-art growing techniques, urban agriculture can better connect people with how their food is grown, while providing healthier foods. By utilizing vertical farms or community gardens, we now have the ability to produce our sustenance without the use of harmful hormones, pesticides or fertilizers. Furthermore, it decreases the amount our food is processed and cuts down on food miles, which results in a tastier and more healthful product¹⁶. Urban agriculture seeks to become a tool that can positively affect the health of our population.

Agriculture

Contemporary agricultural practices produce an abundance of food that allows us to thrive; however, the process can be considered wasteful of limited resources

¹⁵ Woolf, *King Corn*.

¹⁶ Despommier, *The Vertical Farm*, 161.

such as fuels. Farming consumes almost 20% of the fossil fuels used annually in the United States, and uses almost 70% of all available freshwater on the Earth.¹⁷ In addition, our food is coming from further and further away with the average American meal being sourced more than 1500 miles away¹⁸. By utilizing more sustainable farming practices and incorporating urban farming into our cities, byproducts of the agriculture industry can be mitigated and reduced.

Urban farming drastically reduces the proximity of the food source to the city, and consequently diminishes carbon output and oil consumption. It also begins to heal the landscape from deforestation and agricultural runoff. Over time, a natural ecosystem that has been disrupted due to traditional farming practices will be able to be restored by being left alone.¹⁹ When trees and brush return to an area, wildlife and biodiversity flourish. This restoration of the natural environment will actively reduce the amount of carbon in the atmosphere and ease the impact of climate change.²⁰ Theoretically, urban agriculture can help reduce our environmental impact, while becoming a productive amenity to the urban environment.

Urban Agriculture Timeline: Modern Precedents

Within the last few decades, the conversation about urban agriculture and vertical farming has diversified with many contemporary architects joining the conversation. These precedents study agriculture at different scales ranging from the scale of the city to the scale of a pavilion. A mix of programs are also analyzed and

¹⁷ Ibid., 162–168.

¹⁸ Nordahl, *Public Produce*, 6.

¹⁹ Despommier, *The Vertical Farm*, 154–155.

²⁰ Ibid., 159.

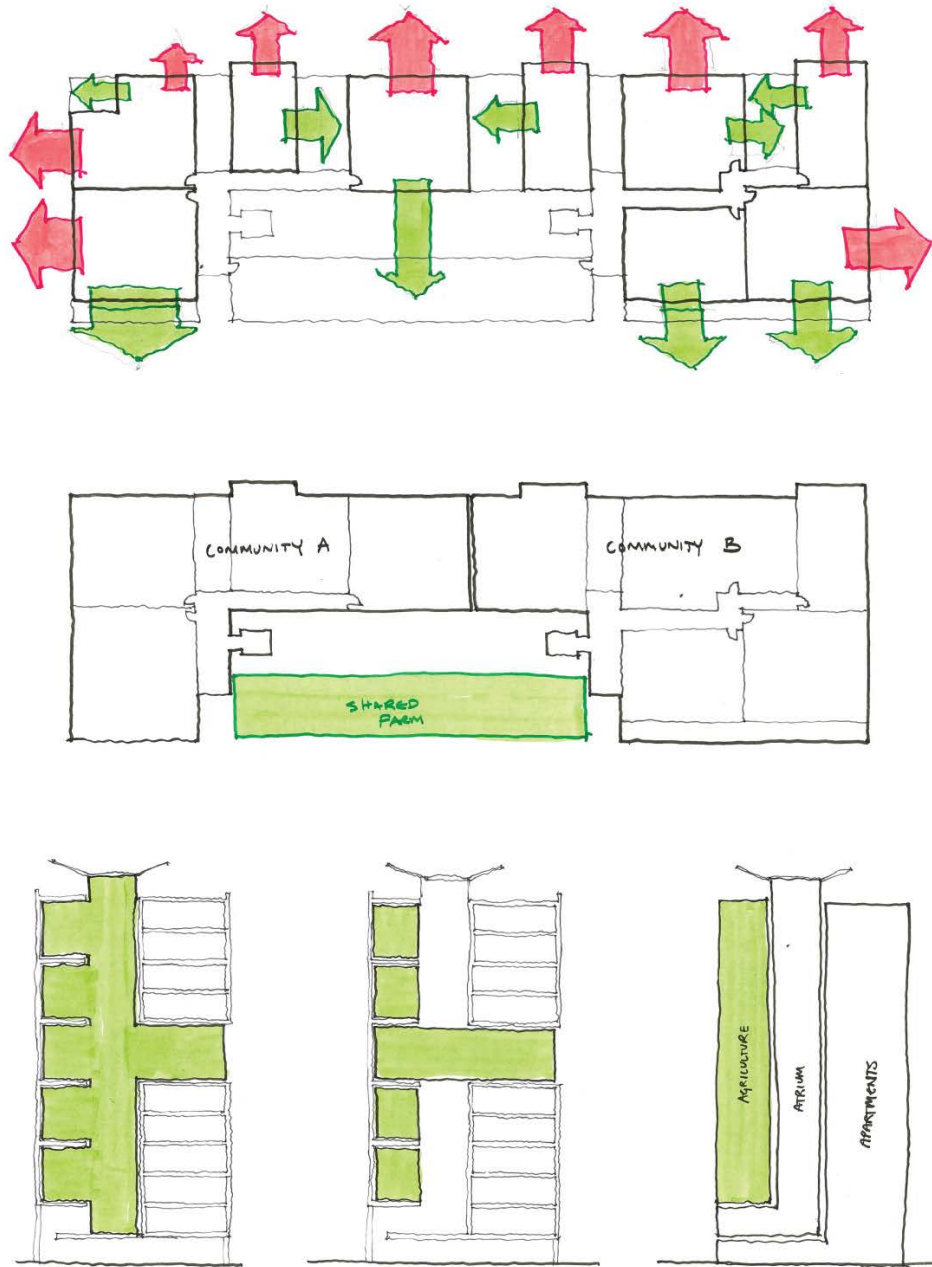


Figure 4: Diagrammatic Analysis of Agro-Housing
 Credit: Author

considered; however, the precedents always include an agricultural component as the main programmatic consideration. Even though there are other precedents, these examples serve as a study to showcase how urban agriculture has been recently investigated and employed.

Agro-Housing: Wuhan, China

Vertical farming and urban agriculture have been explored as potential solutions to an authorized schism occurring between rural and urban communities in China. By 2025, the Chinese government has mandated the displacement of 250 million farmers and peasants from the countryside into the cities. Billions of dollars are being spent on infrastructure and developmental projects that are rapidly urbanizing farmlands and other small-scale towns. Existing Chinese cities are being strained by the rapid urbanization and mass exodus from the Chinese countryside as peasants move into slums and ghettos searching for work. This displacement creates many complications ranging from housing shortages to forced lifestyle and culture shifts.²¹

Proposed by Knafo Kilmore Architects, Agro-Housing is an experimental housing project that eases rural families' transitions into an urban lifestyle by integrating food production into the apartment design. This development project utilizes residents' agrarian skill sets while promoting community collaboration. By taking advantage of their agricultural knowledge, family members can provide sustenance to their community and create a source of income for themselves. Agro-

²¹ Johnson, "China's Great Uprooting: Moving 250 Million Into Cities."

Housing begins to address the social issues that China faces while redesigning the home to utilize agriculture as a communal unifier.²²

Agro-Housing serves as a significant case study that seeks to blend the agrarian lifestyle with the urbane routine. The design of the apartment complex juxtaposes two major programmatic elements: apartment-style housing and a multi-floor greenhouse. Apartment blocks are accessible by two separate elevator towers that split the complex into two separate communities. These communities are unified by equal access to the productive green house spaces, which allow for family interaction and congregation. The agricultural components are developed to promote a sense of community and openness by acting as spatial bridges, while the private apartments promote a sense of individualism. Even though the individual apartments are inwardly focused, each residence has both an urban and an agricultural view that allows the inhabitants to look towards their future as urbanites while preserving their agrarian knowledge. Ultimately, the design implements technology and vertical farming to improve the assimilation into an urban lifestyle by building on the past culture of the residents.

The Edible Schoolyard: Brooklyn, New York

Educational institutions and schools provide an opportunity to expose the youth to a changing culture towards agriculture. Engaging children in the production and cultivation of food sows a seed of interest in nutrition and health. This precedent brings the topics of good health and nutrition to the fore by building off of the lessons of the Edible Schoolyard movement. This project aims to teach the next generation

²² Gorgolewski, *Carrot City*, 140–143.

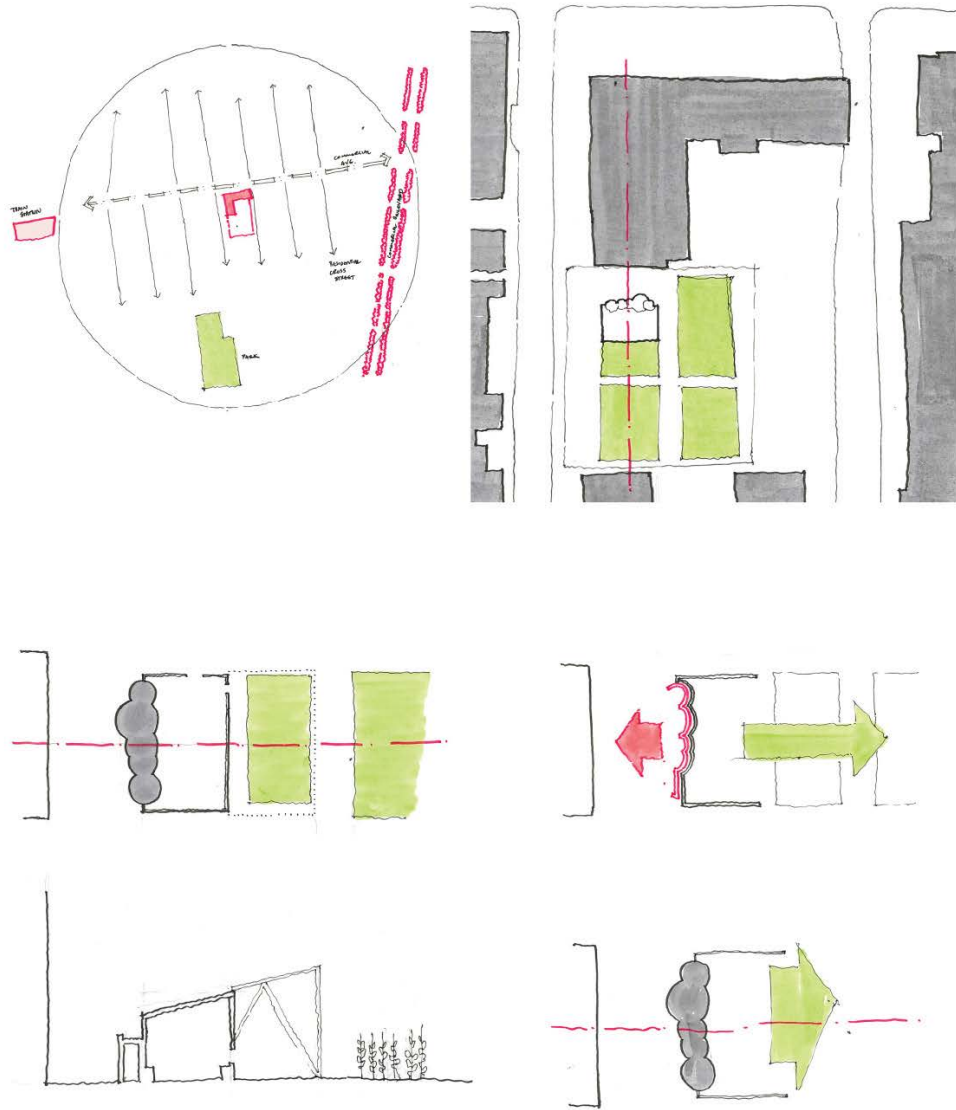


Figure 5: Diagrammatic Analysis of P.S. 216 Edible Schoolyard
Credit: Author

about the benefits of locally grown produce, while giving them the experience they need to grow their own food. By imparting the tools and mindset to allow the next generation to produce their own food, our society is promoting self-sufficiency, good health, and nutrition.

The Edible Schoolyard, designed by WORK Architecture Company, seeks to educate schoolchildren about growing and harvesting food and promotes self-sufficiency as one of its core tenants. The project transforms an existing parking lot at P.S. 216 in Brooklyn, New York into a living laboratory that supplements the students' education and nutrition. The simplistic design incorporates three major spaces, all which support the overarching theme of urban agriculture. The Systems Wall provides the support utilities that allow the project to function while acting as a buffer and threshold towards the school. The Kitchen Classroom serves as a space for food preparation with constant views towards the green house and outdoor gardens. Formally, the project is inward facing with visibility towards the function of agriculture rather than the school. The Mobile Green House offers the elementary school with a year-round growing space and curriculum centered on health and nutrition. The green house space is retractable during the summertime opening up a greater land area to cultivate crops.²³ By placing visual emphasis on the act of growing and by utilizing the Systems Wall as a functional threshold, the project immerses schoolchildren in the process of growing food while teaching them valuable lessons in health and nutrition.

²³ Ibid., 90–91.

Elephant and Castle Eco Tower: London, England

Designed by Ken Yeang, the Elephant and Castle Eco Tower can be seen as a microcosm, where multiple programs symbiotically interact. The eco tower is 35 stories high, and is part of a larger master plan of other towers built nearby. The tower utilizes the “city-in-the-sky” concept, where the programs of vegetation, retail and subsidized housing come together and support each other. Urban agriculture and vegetation are included in a continuous park that spatially links the apartments and floors together. Because the circulation spaces are conceived of as a continuous park, these vegetative spaces become public. As one ascends up the tower, vegetation and agriculture are presented to the observer as a visual and physical threshold. Because the vegetation is so visible, the eco tower begins to define a certain urban agriculture aesthetic. The visibility of the agriculture and the concept of the microcosm strengthen the notion that urban agriculture can be utilized as a public program that unites people and unlike programs.

Through the analysis of these precedents, urban agriculture has the potential to be utilized as a public program, with both formal and aesthetic qualities. The utilization of urban agriculture as a physical and visual threshold is seen as common themes throughout these case studies. In Agro-Housing, the vertical farm was employed as a shared, public amenity and is visible on the façade of the housing complex. In both the Edible Schoolyard and the Elephant and Castle Eco Tower, the agricultural program is used as a physical threshold that helps to give an immersive experience into urban agriculture. The visual nature of this program suggests that an urban agriculture aesthetic needs to be further defined. These precedents expand upon

the role of urban agriculture in the city and aim to improve the connections between public space and people.

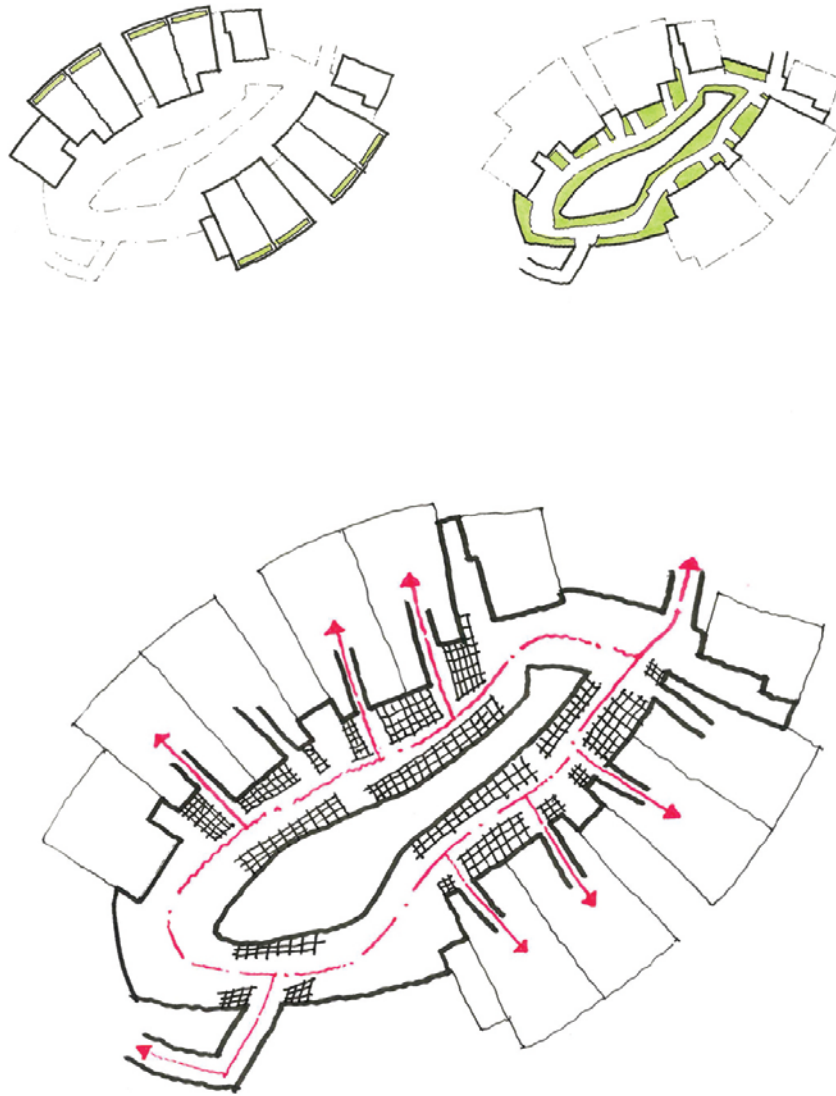


Figure 6: Diagrammatic Analysis of Elephant and Castle Eco Tower Floor Plan
Credit: Author

Chapter 2: Method

Kit of Parts

The utilization of a kit of parts is necessary to demonstrate the potential for inhabit, the design will be able to take on different forms depending on site. When determining the kit of parts, it was important to look at different scales of urban agriculture to begin identify different strategies associated with each element. The kit of parts includes elements at the building and urban scales. From a single potted plant to cultivating crops in a large public park, the design will be able to adapt to site pressures and needs based off of an extensive kit of parts.

The kit of parts will include building and urban scale elements to determine unique strategies when intervening in a broad range of cities. At the building scale, potted plants, planters, hanging window gardens, balconies, facades and rooftops show different potential for urban agriculture. In the city, rooftops and facades show the most underutilized potential for growing larger amounts of food. At the urban scale, lawns, yards, vacant lots, streetscapes, plazas and parks all show potential to grow food. Since urban agriculture can be thought of as a public program, many of these spaces are currently in the public realm; however, they are not currently thought of as productive amenities. For instance, by planting fruit-bearing trees on our streets, we will be able to transform the streetscape into a producer rather than just a bystander. By using parts of public parks to plant small orchards, the park is then allowed to provide more than just refuge from the city. Not all elements in this kit of

parts make sense in all cities, but it begins to identify the potential for urban agriculture in many scenarios.

City Type Potentials

The benefits of urban agriculture are far reaching, and different contexts can benefit differently by implementing urban agriculture. Urban agriculture can be seen as a program that can be employed regardless of context; however, in each city there are different opportunities to maximize its impact. In dense cities, rooftop gardens and large-scale vertical farms have the most potential because land is very valuable. In sprawling or abandoned cities, community gardens and low-rise greenhouses are more probable because space is abundant. In each city, urban agriculture can be implemented but in drastically different forms. By looking at a broad range of cities, different strategies for utilizing the kit of parts will be able to be identified.

Mega City: Manhattan, NYC, NY

Manhattan provides a unique opportunity for urban agriculture because of its high density and limited space. In the thriving megacity, urban agriculture has a chance to be retrofitted onto existing infrastructure, such as large rooftops and piers near the edge of the island. Since there are very few abandoned and surface parking lots, vertical farming can be employed to provide food to the population. The megacity has the density necessary to make vertical farming feasible, and is thus a prime candidate to for this new technology to be employed on a large scale. Unlike other city types, the mega city could utilize vertical farming to recycle waste from other program types. Since space is very limited, the implementation of urban

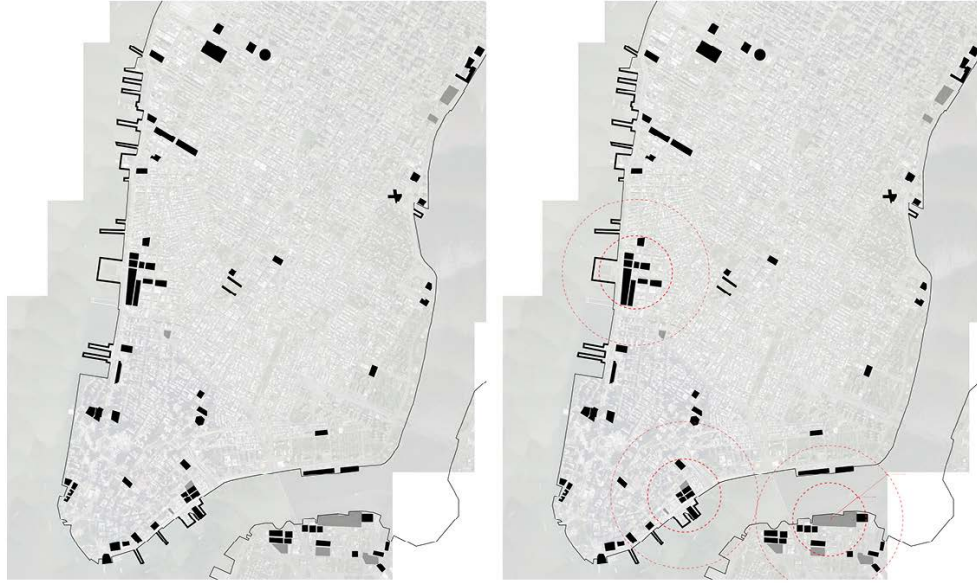


Figure 7: (Left) NYC Congregation of Metrics, (Right) NYC Potential Urban Agriculture Communities
Credit: Author



Figure 8: (Left) L.A. Congregation of Metrics, (Right) L.A. Potential Urban Agriculture Communities
Credit: Author

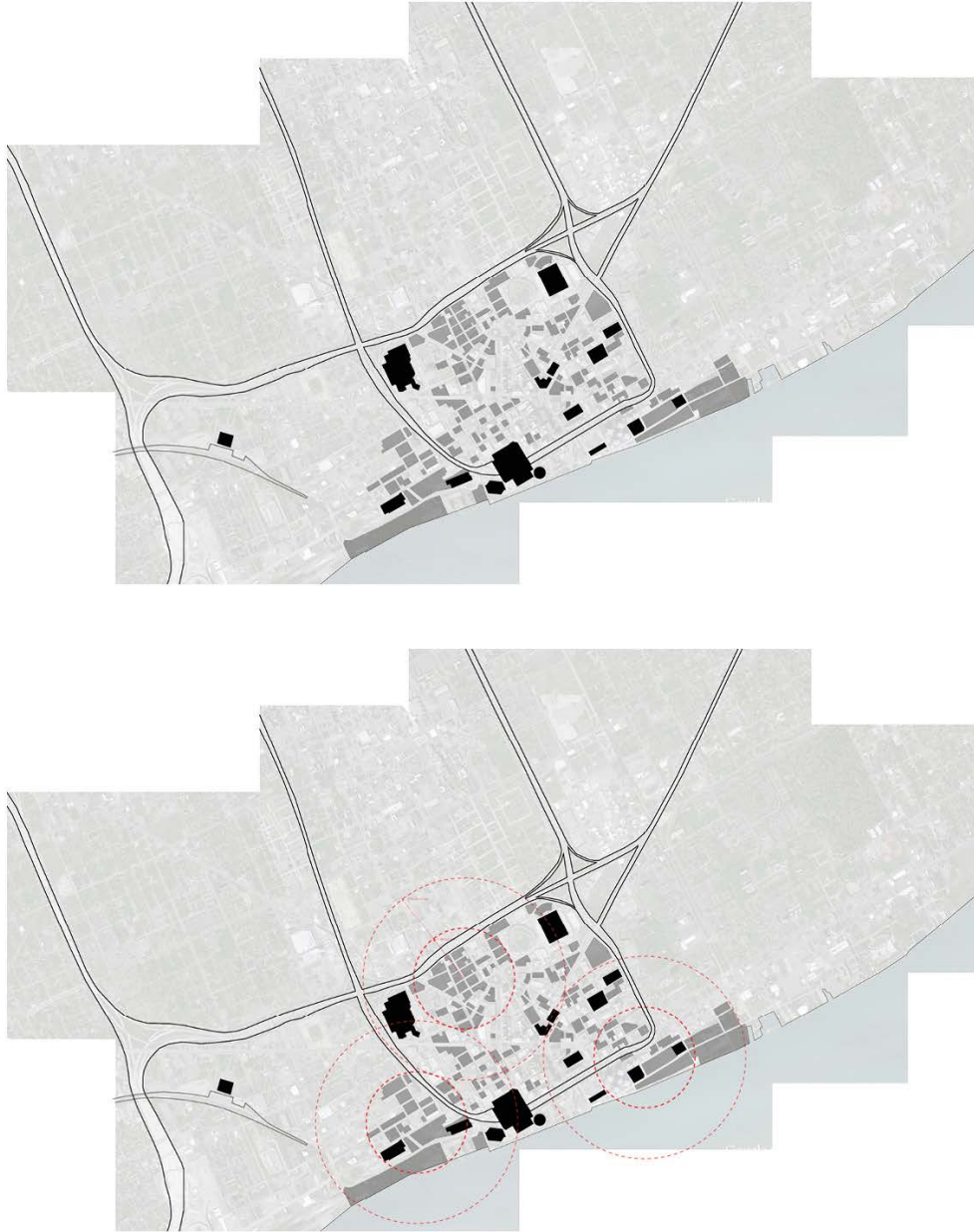


Figure 9: (Top) Detroit Congregation of Metrics, (Bottom) Detroit Potential Urban Agriculture Communities
Credit: Author

agriculture has the potential to create valuable public space. By utilizing these strategies, urban agriculture is able to provide necessary amenities to the city and have a symbiotic relationship with its context.

Sprawling City: Los Angeles, CA

Los Angeles's sprawling edges and low-rise infrastructure allow for the implementation of urban agriculture at a different scale. The city is defined by its immense highway infrastructure, which allows the residents to move around the city via private automobile. By utilizing urban agriculture to create public space, new urban centers can be created for people to gather and pause from the regular movement of their daily lives. The immense highway network could also be utilized to transport food created by these urban agriculture centers to the surrounding suburbs.

Since the transit system sponsors the use of the automobile, large parking lots near the core of Los Angeles can be transformed into urban farms. Large rooftops and warehouses can be utilized as areas to grow food. In the suburbs, private yards and other green spaces can also be transformed into productive amenities.

Collapsed City: Detroit, MI

Urban agriculture has the most potential to impact the urbanism of collapsed cities, which have become less populous due to the shrinking local economy. By including urban agriculture in the planning of these cities, urban agriculture can attract new inhabitants by providing new jobs and positively impacting the local economy. This could potentially allow for urban renewal and give new life to these decrepit cities.

With a failing economy, Detroit can be seen as a prime candidate to test the theory that urban agriculture is able to sponsoring urban renewal. Currently, there are several urban agriculture experiments occurring outside of the main core of the city. Charles Waldheim, professor and chair of the Landscape Architecture department at the Harvard Graduate School of Design, suggests that landscape urbanism can be employed to alleviate Detroit's failing state. Since the vacant plots of land are not being utilized nor being allowed to return to nature, Waldheim states that, "landscape is the only medium capable of dealing with the simultaneous decreasing densities and indeterminate futures."²⁴ Urban agriculture might be able to act as this landscape. This program will utilize these urban vacancies and simultaneously attract people by stimulating the economy.

Because of the large amount of parking lots and vacant land, Detroit can employ agriculture at a large scale. Horizontal farming and low-rise greenhouses can act as the catalyst for urban agriculture to take root, and for the first phases, urban agriculture can act as a placeholder for future development. As the city densifies and urban agriculture becomes more profitable, public space can be planned around vertical farms that provide food to the city and surrounding region.

²⁴ *Shaping the City*, 106.

Chapter 3: Initial Urban Agriculture Design

Program Analysis

After conducting the analysis of both theory and precedents, it became apparent that urban agriculture could have a symbiotic relationship with different program types. In the Elephant and Castle Eco Tower, the tower was conceived of as a microcosm that provided the diversity of program that was contained in a standard city block. This precedent revealed that urban agriculture could have a mutually beneficial relationship with other programs, such as retail, educational space, living spaces and recreation spaces. The potential flows of resources between the programs suggest that the waste from one program could be used as a resource for another. This symbiotic relationship between programs could sponsor a diverse set of experiences associated with urban agriculture.

The following probes into the initial design incorporate six different categories of programs: residences, recreation spaces, commerce spaces, educational spaces, workspaces, and service spaces. The growing and educational spaces provide knowledge and raw resources to the markets and living spaces. The commerce is able to process the raw resources into processed food. Wastes will be collected in the service areas, which include constructed wetlands, a food digester and a black water treatment system. Waste will be able to be reprocessed and used a resource providing energy and grey water to the surrounding programs. Each scheme will utilize this

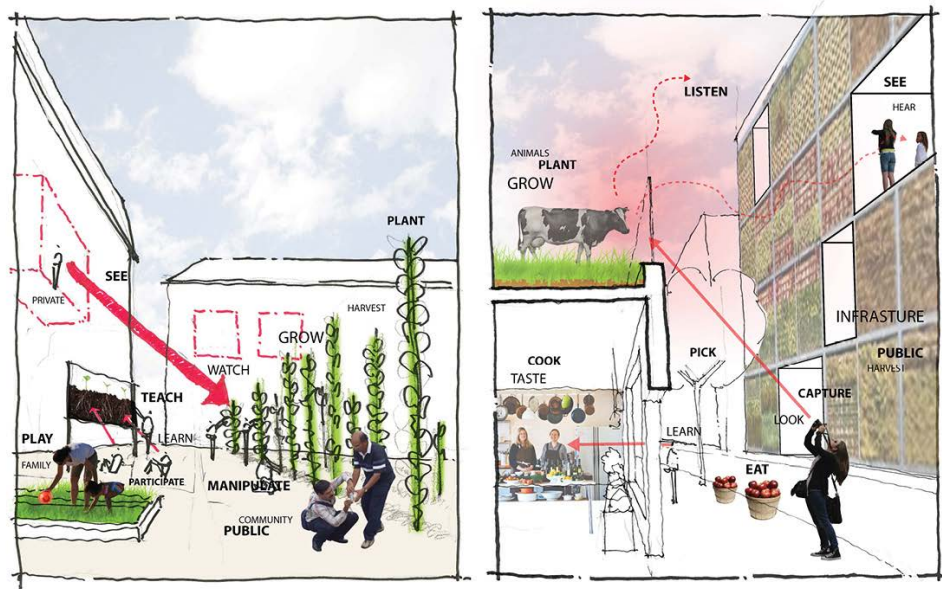


Figure 10: Programmatic Photocollage
Credit: Author

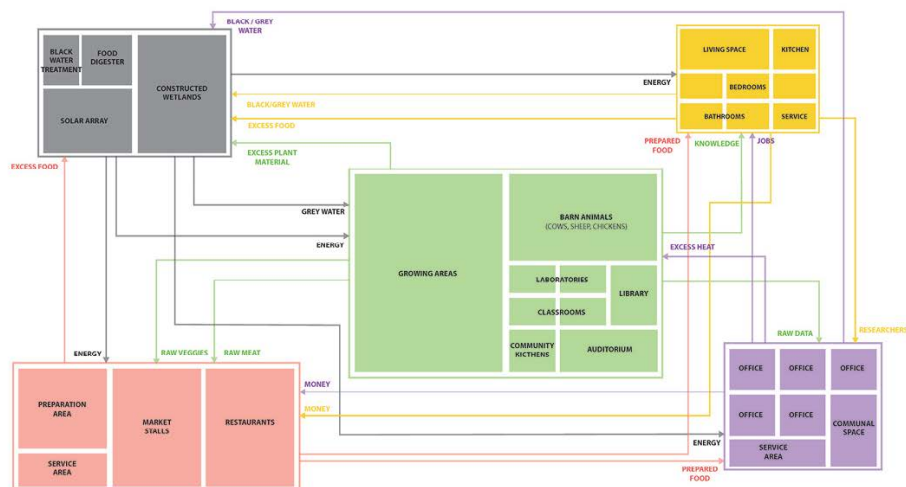


Figure 11: Programmatic Inputs + Outputs
Credit: Author

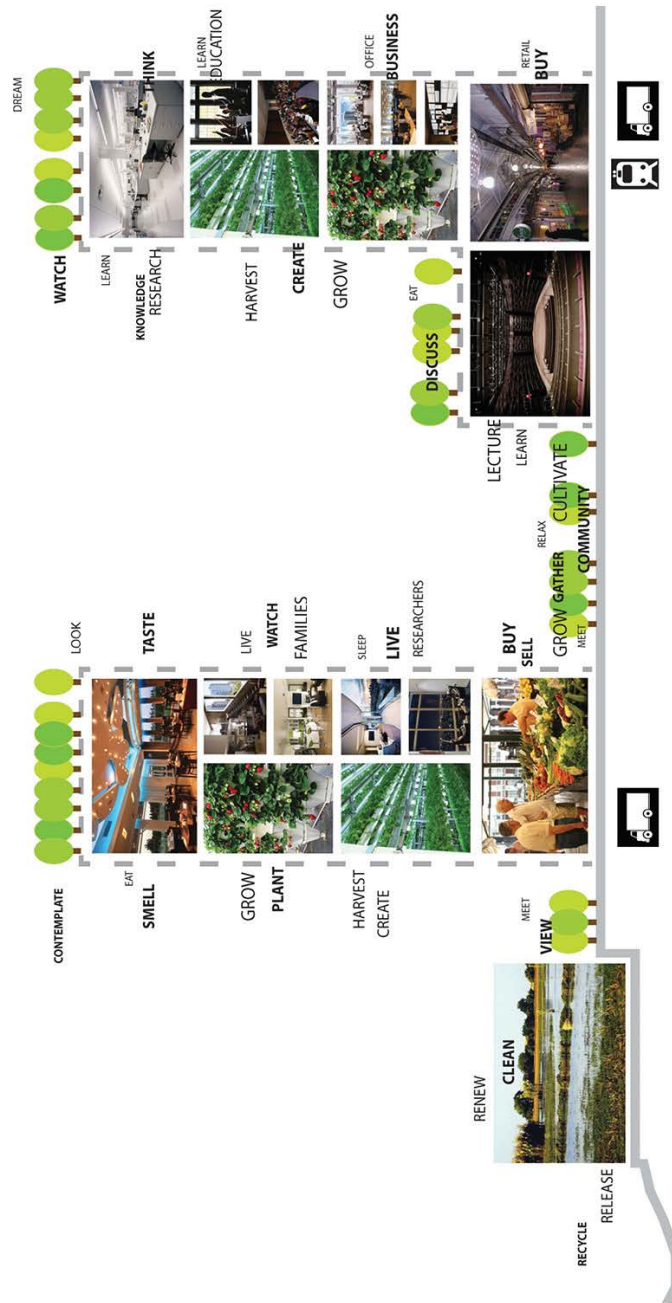


Figure 12: Theoretical Programmatic Sectional Study
Credit: Author

diverse set of program, and will benefit from the symbiotic relationship between them.

Initial Design Probes

To begin understanding where urban agriculture could best prosper, each of the different city types were dissected and analyzed. When beginning to determine different sites within each city, it was important to begin to look at each city at the same scale to read the subtleties and differences in the urban fabric. This thesis examined and analyzed each city type at 1" = 500' scale. The analysis of each city was conducted using the same metrics to draw comparisons and differences between the selected cities. In the design probes, the following metrics were used to determine sites within the city: edges, highways, railroads, vacant/parking lots, and large rooftops. These metrics were identified as having the most potential to locate sites for urban agriculture. After plotting each metric for a city, the diagrams were overlaid to identify sites where the metrics congregated and overlapped. These areas were identified as having high potential to sponsor urban agriculture.

Manhattan, NYC, NY

The site determined to have the most potential for urban agriculture is Pier 40 on the West Side Highway in Manhattan. The pier is on the Hudson River with significant views to the surrounding financial district and Midtown. Because of its large rooftop, the adjacent warehouse has also been incorporated in the scope of this site. The highway and other streets, which run perpendicular to the site, are seen as site constraints because they currently limit the visibility to the site.

Because the size of the intervention is limited by space, vertical farming and rooftop gardens are employed from the kit of parts, while public space is created at the street level. The scheme builds on the idea of visibility and creates porosity at the ground level to invite people into the communal gardens, which serve as a public gathering space and productive amenities. The vertical farm is oriented to capture the maximum amount of sunlight, which coincidentally optimizes views to the financial district.

Los Angeles, CA

In Los Angeles, the site determined to have the most potential is between E 1st street and E 4th Street, at the location of a train station. The scope of the site is bound by these streets and includes the parking lots to the west of the train station. This site was determined because of its connection to regional transit and its close proximity to a food distribution center, which could be used as amenities to export food to the surrounding suburbs. Because of new construction and its position in the Arts District of Los Angeles, the site in a prime position to add to the urban fabric through urban agriculture.

The scheme utilizes the infrastructure of the train station by adaptively reusing the structure and adding a vertical farming element. The parking lots are also transformed, and new edges are created through the implementation of liner buildings. These buildings help to rationalize and contain the space, which has been reprogrammed to create community gardens. These community gardens are at the heart of the scheme, and allow for a productive landscape to inhabit the public realm.

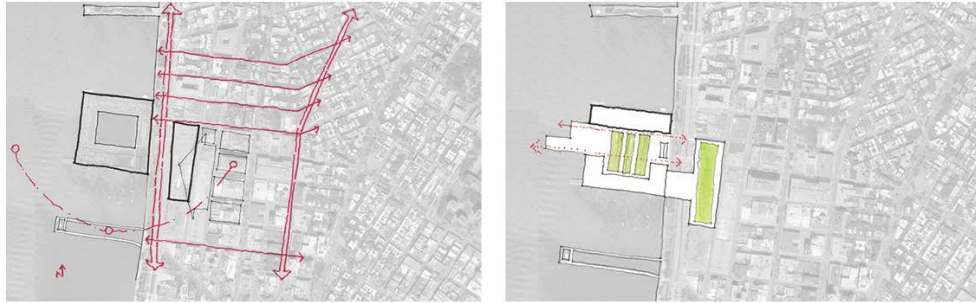


Figure 13: Initial NYC Scheme
Credit: Author

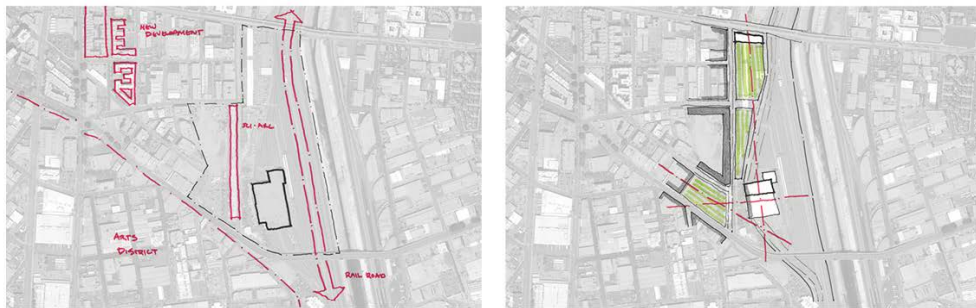


Figure 14: Initial L.A. Scheme
Credit: Author



Figure 15: Initial Detroit Scheme
Credit: Author

Detroit, MI

Due to the expansive vacancies in the city, Detroit presents an opportunity for urban agriculture to sponsor new types of urbanism. The West Side Industrial district presented the most potential for urban agriculture because it was located near several amenities. At this site, there are several large rooftops, an abundance of empty lots, and potential to rejuvenate the waterfront. There is also a potential to utilize the rail line that runs underneath the site as a method to transport food to Canada and the surrounding suburbs. The site includes access to several highways, which can serve this purpose as well. Ultimately, the vacant lots and transit connections present an opportunity to use urban agriculture as a catalyst for urban renewal.

The scheme utilizes the transit amenities, while filling in the vacant lots with new development. The waterfront is redeveloped to make it a hub for urban agriculture, and eventually vertical farming. Since there is an abundance of space, agriculture can place horizontally, but as the city becomes denser, traditional agriculture will be able to be replaced by vertical farming.

Initial Design Findings

In each city, agriculture has the ability to manifest itself in different ways, which respond to specific city opportunities. Each probe utilizes the most relevant amenities and site potentials to foster and create a community for urban agriculture. Vertical farming presents itself as a viable solution to grow food in Manhattan, while horizontal urban agriculture can be utilized to revitalize the collapsed city of Detroit. Developing a kit of parts became necessary to complete each probe because of its ability to adapt to each city context. Ultimately, this thesis dives deeper into the context of the mega city. Because of the limited vacancy and valuable land of Manhattan, this thesis intersects how living in the city can foster and support urban agriculture.

Chapter 4: Site Analysis

Manhattan, NYC

This thesis delves deeper into Manhattan and examines the agricultural potential of the mega city. Since Manhattan is one of the densest cities in the United States and space is valued at a premium, agriculture and the mega city might seem to be at odds. However, this study seeks to show that the two aren't necessarily mutually exclusive. Manhattan is utilized as an extreme example to show how agriculture can permeate even the densest cities.

New York City is already participating in the conversation about fresh, healthful food. Enacted as a mayoral initiative, the Food Retail Expansion to Support Health (FRESH) program is aimed at providing the residents of New York City with fresh, healthful food by giving development incentives to people looking to develop or renovate existing grocery stores. This is aimed at combating health risks and disease by providing healthy food options throughout the city²⁵. By looking toward large underdeveloped areas of Manhattan within the boundaries of this program, the Hudson Rail Yards stand out as a prime site to demonstrate how agriculture can be implemented within the city.

²⁵ "Food Retail Expansion to Support Health."



Figure 16: Context of Manhattan with Site Highlighted
Credit: Author



Figure 17: Hudson Rail Yards Figure-Ground with Site Highlighted
Credit: Author



Figure 18: Hudson Rail Yards - Investment Areas
Credit: Author

The Hudson Yards Development

Currently, the Hudson Rail Yards are located in the Clinton Neighborhood of Manhattan and act as a storage and maintenance facility for the subway and the Long Island Rail Road trains. The Hudson Rail Yards are bound by the West Side Highway to the West, W 33rd street to the North, W 30th street to the South and 10th Avenue to

the East and encompass an area of almost 26 acres. In an effort to develop above this under utilized land, the Hudson Rail Yards were rezoned for residential, retail and other mixed uses. Because of this site's importance within the transit system, the rail yards are to stay open and operational during construction and only the air rights can be developed. The challenge of the site for architects and developers alike is the change in topography. On the Western Rail Yard, the train tracks are at the same topographic grade as the West Side Highway; however, the Eastern Rail Yards are partially sunken below street level at 10th Avenue. This change in topography has posed a very expensive challenge to developers seeking to turn a profit by building above the rail yards. Because of this topographic change and the requirement that the tracks must be kept operational, developers only have the option to build skyscrapers.

Related Companies and Oxford Properties are currently developing and constructing the current master plan for the Hudson Rail Yards. The comprehensive master plan was designed by Kohn Pederson Fox (KPF) and situates a series of 16 separate skyscrapers onto the site. To solve the issue of topography, their scheme uses a series of caissons, which are placed in between the tracks and support a platform built above the tracks. At the West Side Highway, a hill is built up to this new ground plane successfully covering the tracks beneath. Mixes of retail, residential, office space, and educational and cultural programs are utilized to give this new neighborhood a sense of identity and to draw outside visitors to the area. A fourteen-acre park is at the heart of the scheme, which begins to provide a common public zone for visitors and residents alike. With a projected population of about 48,000

people, the neighborhood is expected to be active because of the different programmatic and functional amenities it provides to the city²⁶.

The critics of the master plan contest the scheme's communal park and believe the mega structures do not foster a neighborhood due to their scale. KPF has made this their focus by having the structures act as sculptures around the High Line Park that runs across the site. The skyscrapers and other buildings span, dance and situate themselves around the elevated greenway, which flows uninterrupted around the western and southern perimeter of the site. The buildings seemingly create a dialogue between the new neighborhood and the context of the city. This linkage hopes to create a series of interesting and unique experiences and hope to break down the gigantic massing of the structures²⁷.

Because of its size, the Hudson Yards Development presents a unique opportunity for the inclusion of urban agriculture within the dense city of Manhattan. By allowing agriculture to be included in the master plan, the critique of the proposal could be mitigated. As shown through the description and analysis of the precedents, urban agriculture could be used as a tool to foster community. By programming the large fourteen-acre park with communal gardens, the park could create a zone of activity during the spring, summer and fall months. This activity would showcase an active community and allow for the Hudson Yards to expand upon the current dialogue regarding urban agriculture. Smaller utility buildings, fruit-bearing trees, and rows of crops could potentially add a smaller scale to this park. With many residential

²⁶ "Strategic Investments Group - Hudson Yards."

²⁷ Bernstein, "Will Hudson Yards Be a Neighborhood?"

buildings planned for the site, the new neighborhood could be used as a staging area to explore the potentials of how people could live and grow food within the megacity.

Chapter 5: Final Design

The design of the thesis investigates how urban agriculture can be integrated into the site of the Hudson Yards at three separate scales. Both the urban scale and the building scale interventions use the master plan for the Hudson Yards as its context. However, the master plan for the Hudson Yards Development is transformed and amended to include urban agriculture. An experimental, residential apartment complex is designed to investigate how agriculture can be integrated into a vertical, high-rise community. A kit of parts is utilized, which allows the residents to participate in growing their own food and at the scale of their choosing. Ultimately, the design seeks to demonstrate how urban agriculture can be implemented at different scales to foster a community and give the inhabitants the tools they need to be producers of food within the city.

The Amended Hudson Yards Plan

At the urban scale, the design of the master plan for the Hudson Yards becomes a critical focus. Since the site is currently under construction and the master plan is being executed at the eastern rail yards, the thesis largely accepts the master plan for the area. The western rail yards are slightly amended by the incorporation of the Hudson Yards Gardens, a productive communal garden that replaces the fourteen-acre park. To allow for enough light exposure to make these gardens productive, the building plan for the western rail yards are also reconsidered. By transforming the

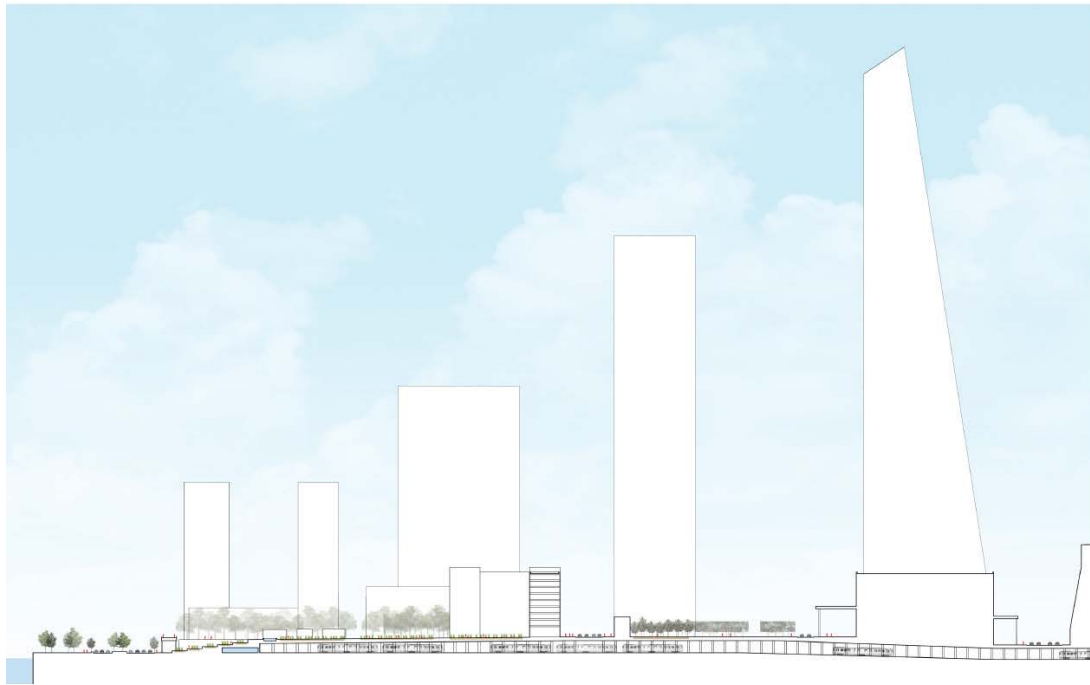
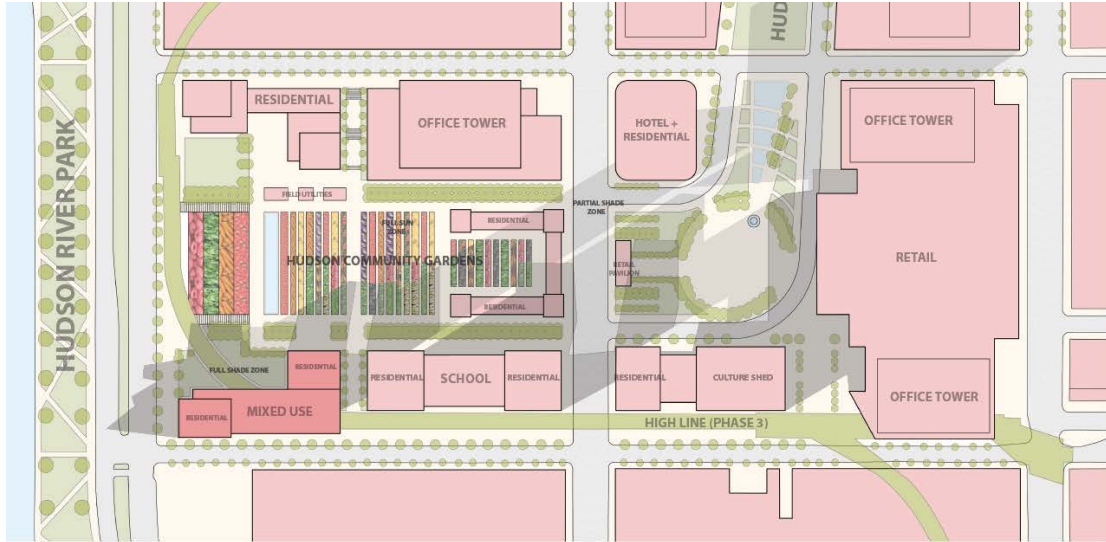


Figure 19: (Top) Amended Hudson Yards Master Plan, (Bottom) Amended Hudson Yards Master Plan Section
Credit: Author

western rail yards into a hub for urban agriculture, a greater sense of community is achieved by activating the new ground plane.

To include agricultural space within the master plan, the plan underwent a series of simplifications and transformations. First, the two central skyscrapers planned for the western rail yards were removed, and the population of these towers was moved to other sites within the master plan. These towers were removed to allow for deeper solar penetration into the central park. To accommodate this new population, a new massing was derived for the southern most skyscrapers by utilizing a typology frequently used in the master plan. Finally, low-rise housing is added to densify the plan and to recuperate some of the lost residential floor area. This low-rise housing breaks the scale of the development down, which helps to create a unique and identifiable place.

The gardens and agricultural elements are conceived to fill in the nooks and crannies left over in the master plan. The Hudson Yards Gardens inhabit the center portion of the site and act as a place for the community to gather and grow food together. Outside visitors may visit the site and rent portions of the gardens to grow their own food. These gardens would inspire several communities to come together and activate the ground plane through cultivation. The shadows on the gardens were analyzed, and they were used as design tools to figure out where different crops could grow. In addition to a formal, community garden, the residents and visitors of the Hudson Yards community would have the opportunity to forage in the area. New York City already allows several nontraditional fruit-bearing trees to be planted, such as Serviceberry trees or White Oaks. By utilizing only the tastiest of these legal trees,



Figure 20: View of Hudson Yards Gardens
Credit: Author



Figure 21: View from the High Line towards Apartment Complex
Credit: Author

visitors and residents, who do not participate in the garden, would be able to harvest food directly from the urban environment.

The design of the urban intervention helps to foster a community within the Hudson Yards Development by providing places where residents and visitors can unite through the act of cultivation. The addition of the Hudson Yards Gardens activates the public realm and allows for residents to directly profit from the urban environment. Unrelated visitors are asked to participate in the conversation of urban agriculture by being allowed to forage berries or nuts from the urban environment. Visitors will also benefit by being able to see the farming process at work, and thus will be able to heuristically learn about food. By utilizing urban agriculture as a means to foster a community, the urban environment is increasingly diversified and allows for people to participate in the discussion of urban agriculture directly.

Experimental Live-Grow Apartment Complex

The main focus of the design is an experimental living-growing apartment complex, which gives residents the opportunity to grow vast amounts of food through a double skin system. The complex is thought of as a microcosm that provides for itself through the symbiotic nature of living and growing spaces. The design of the building allows for the wastes from one program to be utilized as fuel for another program. The complex utilizes a comprehensive grey water system, which recycles grey water from the apartments for irrigation. The apartment complex provides energy for itself by utilizing a series of digesters, which process animal and plant wastes. The grey water system is stored within the stairwells and receives grey water from the floor above. Water is then recycled and utilized in irrigation on the floor

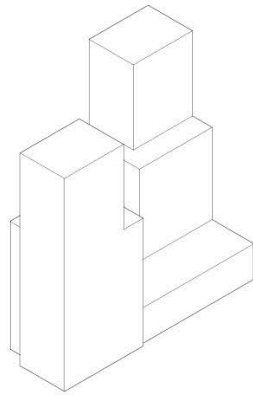
below. The typical unit is reimagined to include a new kit of parts that aid in the act of cultivating. The building seeks to be a replicable model that begins to change the way we think about agriculture and how we obtain our food.

Building Site + Transformation

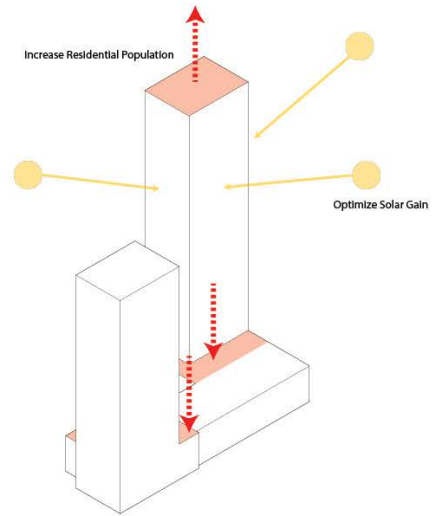
The site for the building is located within the amended master plan for the Hudson Yards. The site is located northeast of the intersection between W 30th Street and the West Side Highway. With no large buildings directly to the south of the site, this site was chosen because of its unlimited access to southern solar light. Within the context of the amended master plan, the building's massing currently mimics one of the typologies already seen within the plan. To optimize the amount of solar radiation the building receives, the massing is simplified and an operable, double skin system is applied to the building. This double skin system acts as a place for growing, and each unit have access to their own growing zone. The high line is allowed to puncture the base of the building and continue the public right of way through the building, acting as a threshold into the new Hudson Yards Development.

The base of the building is comprised of two levels: the ground floor and the High Line floor. At the ground floor, the organic digesters occupy the visible floor space. Areas for food separation and waste processing are utilized before the digestion takes place. The digesters are visible from the street, so passersby can see the digesters in action. Unloading zones below the High Line allow the building to be serviced and excess waste can be brought to this location to supplement the building's electrical need. At the High Line floor, the public is given access to the High Line market, which supports the residents above. Along with electricity for building

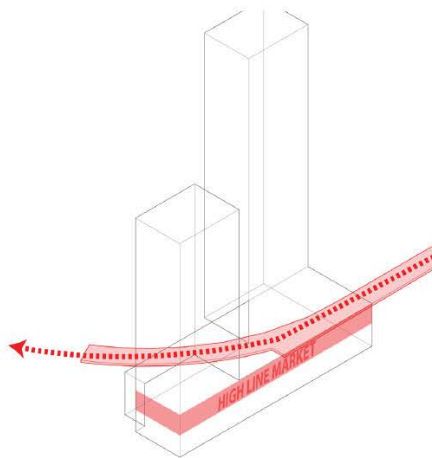
TRANSFORMATION:



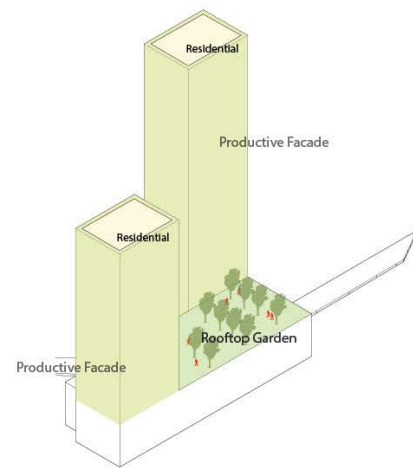
Contextual Form



Simplify Form



Capture High Line Amenity



Creation of Growing Spaces

Figure 22: Building Transformation from Contextual form to Urban Agriculture Complex
Credit: Author

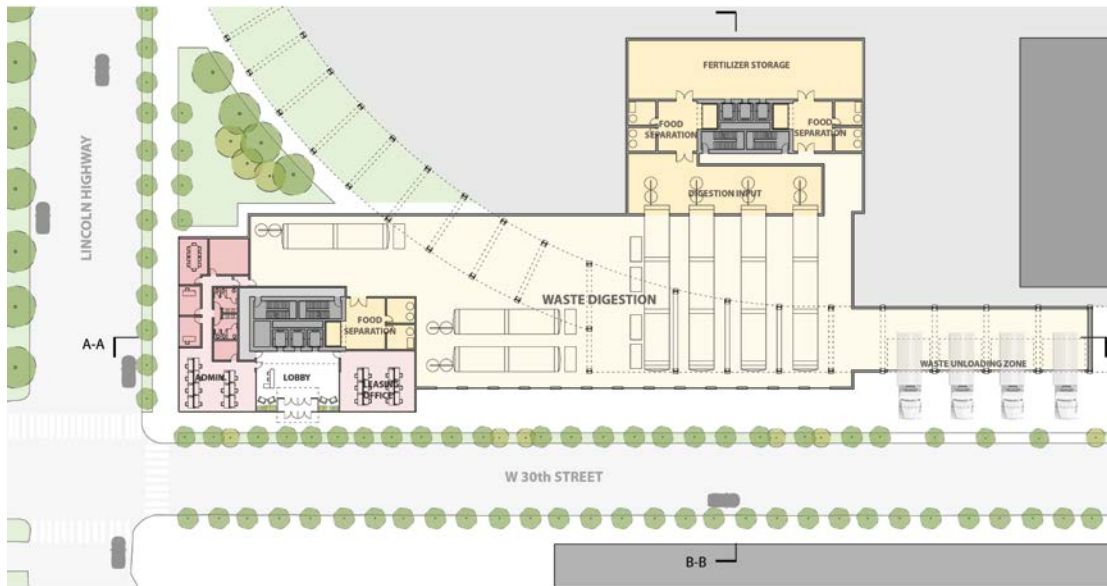


Figure 23: Ground Floor Plan of Apartment Complex
Credit: Author

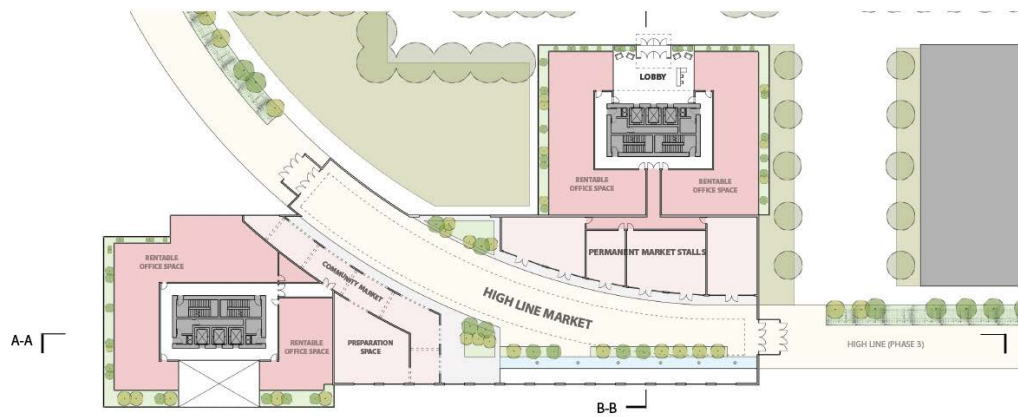


Figure 24: High Line Floor Plan of Apartment Complex
Credit: Author

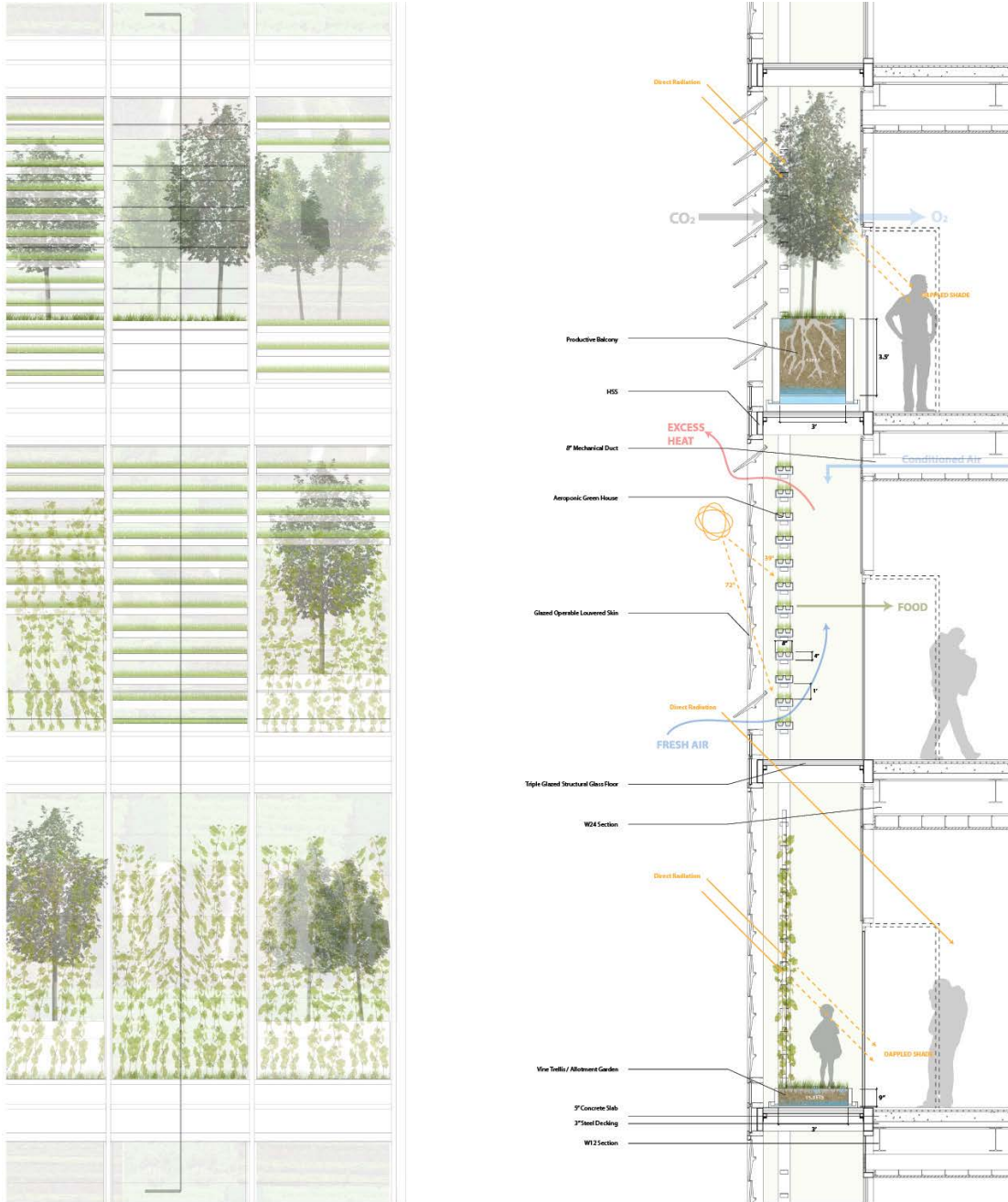


Figure 25: (Left) Elevation Displaying Kit of Parts, (Right) Kit of Parts Detailed Wall Section
Credit: Author

consumption, the digesters produce a fertilizer that could be sold in the market space. Community space for the residents to sell excess food grown in their apartment is allotted at this level as well. The residence are located above, and from the High Line, visitors can see the growing skin in action as the inhabitants grow, cultivate, trim, and harvest their plants.

Kit of Parts

Much like the design probes, the final design utilizes a kit of parts to enable the residents to cultivate their own food in the dense megacity of Manhattan. The kit of parts draws from precedents and utilizes an array of different growing methods. Each part can be thought of as temporary and can be replaced based off of the residents' needs. Each piece of the kit of parts would be located within the double-skinned façade of the towers and would allow each resident to participate in cultivating fruits and vegetables.

There are three moveable parts ranging in productivity: the Productive Balcony, the Vine/Allotment Garden, and the Greenhouse. The Productive Balcony allows the residents to grow small trees, shrubs and other grasses. It allows for the least amount of productivity; however, requires the least amount of work and allows for residents with a hectic lifestyle to participate in growing. The trees provide shade during the summertime and keep the interior apartment cool. The Vine/Allotment Garden permits for a medium level of cultivation, and allows residents to garden in the sky. Vines, vegetables and other small plants and shrubs can be grown. Privacy screens and other shading devices can be created by utilizing thick vines to shade and protect the interior of the apartment. The Greenhouse maximizes the growing potential of each unit by stacking miniature gardens on top of each other. Each row of the garden utilizes aeroponics to eliminate water waste and gives the plants direct exposure to nutrients. By creating a miniature vertical farm, the growing space is maximized and allows the residents to produce over an estimated 900 pounds of

vegetables a year. Much like the different units, the kit of parts enables different styles of cultivating food and gives choices to the residents regarding what they can grow and how they can grow it.

Unit Design

The residential program is located in the two towers in the scheme. Because the towers conform to the rotated New York City grid, each side of the towers receives some direct sunlight throughout the day. Since there will be no true facing north windows, each side of the building has the potential to grow food. During the process of the thesis, a solar radiation analysis reveals that the Southwest exposure of the building is receiving the greatest amount of light during the year. The Northwest and Southeast facades receive the second most, and the northeast is receiving the least. This radiation study directly affected where the different kinds of units were placed, and dictated the depth of the double skin façade. The space in between the two layers of glazing serves as a growing zone for each unit.

Located within each tower, there are four types of units: the Sky Garden Studio, the Herbal Flat, the Family Terrace Apartment, and the Agronomist Duplex. Depending on its exposure and the residents' lifestyles, each unit has different growing potentials. All units, except for the Sky Garden Studio, have dual exposure to maximize the variety of crops each unit can grow. The depth of the double skinned



Figure 27: Sky Garden Studio Unit Plan
Credit: Author



Figure 28: Family Terrace Apartment Unit Plan
Credit: Author

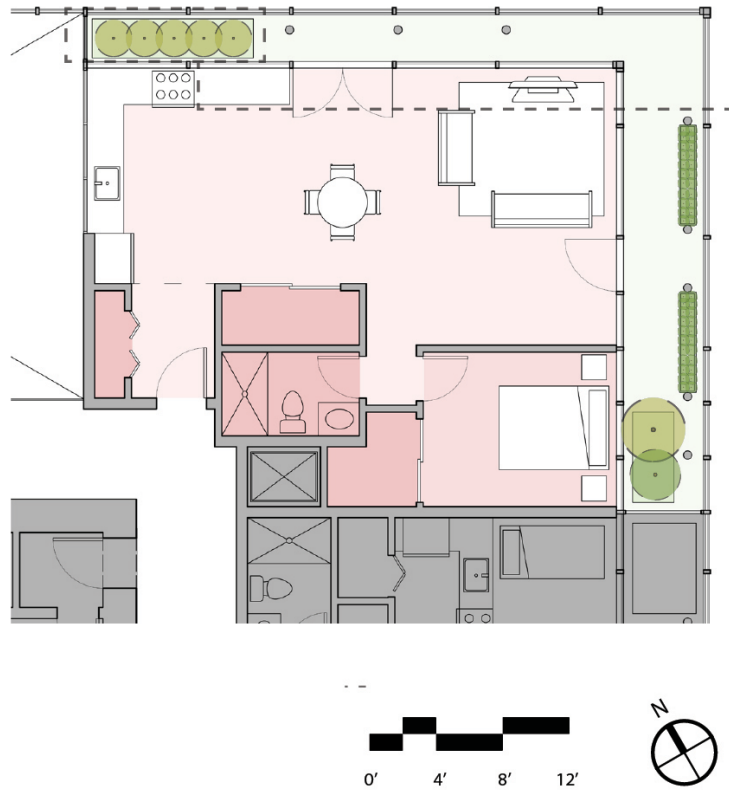
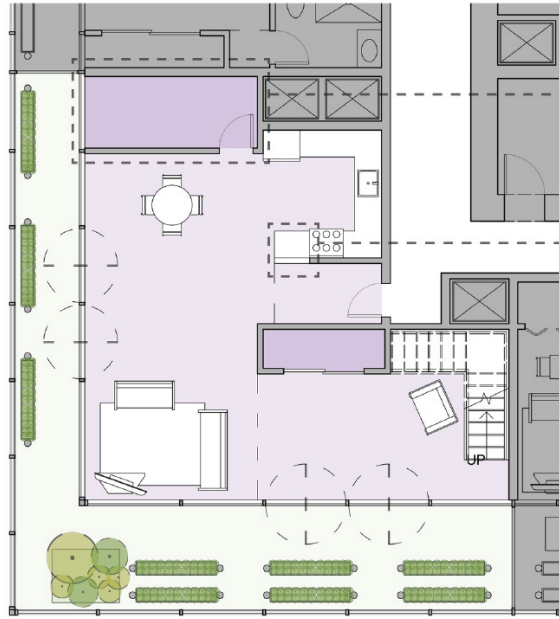
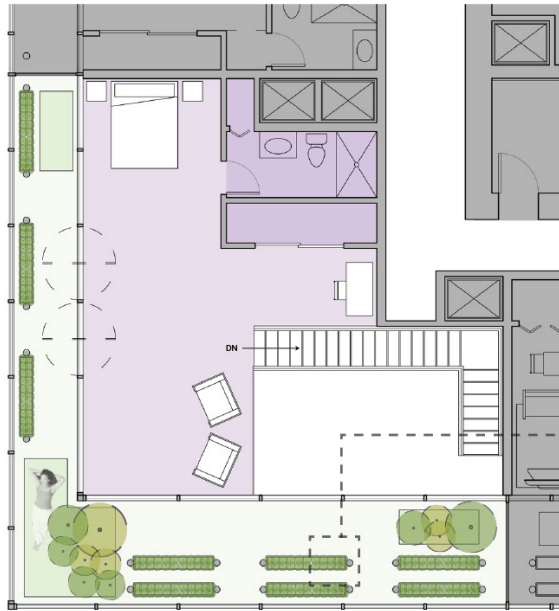


Figure 29: Herbal Flat Unit Plan
Credit: Author



Level 1



Level 2



Figure 30: Agronomist Duplex Unit Plan
Credit: Author

façade varies between three feet and eight feet depending on the solar exposure. The greater the solar exposure of the tower face, the greater the depth of the growing space, which maximizes the growing potential of the unit.

Even though each apartment is customizable and the kit of parts can be employed depending on the residents' interests, the size of the unit directly relates to how much you can grow. The Sky Garden Studio provides the smallest footprint to grow food; however, it can be maximized via the green house kit of part. The Herbal Flat features exposures to the Southeast and Northeast, which suggest only certain plants, such as herbs, can be grown in this unit. The Family Terrace apartment allows each bedroom to open up onto the growing space. This allows each family member to participate in growing and contributing to the family health and welfare. Even the littlest member of the family can heuristically learn about food by gardening. The Agronomist Duplex has the largest capacity to cultivate food. With a two-story apartment, the growing zone is maximized, and in some cases, has a one to one relationship with the amount of living space. The Agronomist Duplex always features a Southwest exposure, which allows for both traditional and nontraditional fruits and vegetables to be grown. The unit also features specific urban agriculture appliances and drying spaces that draw direct inspiration from corncribs. Because of its relationship with both the growing zone and the kit of parts, each unit enables the inhabitants both produce their own food and to heuristically learn about food by directly participating in urban agriculture.

Chapter 6: Conclusion

The discussion regarding how agriculture can be integrated into our cities will continue as we begin to face challenges in the future. By exploring urban agriculture as a viable option to produce some of our food, we are enabling the population to become more self-reliant. With our food sources closer to home, we are mitigating environmental damage by relying less on technology to preserve our food and more on ourselves. The product is healthier produce, a more diverse urban environment, and a better informed populous.

The design seeks to demonstrate how we can begin to integrate agriculture and the urban environment to enable people to grow their own food. Urban agriculture has the potential to foster communities and program public space. It can potentially be the driving link between seemingly disparate communities by giving the community a common goal to rally around. Ultimately, the experimental apartment complex seeks to show how we can begin to think about housing differently. By taking seemingly common architectural elements, such as the double-skinned façade, and transforming them into productive elements, designers are able to give people the means to grow their own food. By bringing our agricultural process closer to our cities and creating a symbiotic relationship between the two, we are able to create a more sustainable urban environment, challenge our current industrial agricultural system, and educate our population about food to create a generation of more self-reliant people.

Bibliography

- Bernstein, Fred A. "Will Hudson Yards Be a Neighborhood?" *Architectural Record*, May 3, 2013. http://archrecord.construction.com/news/2013/05/130503-Will-Hudson-Yards-Be-a-Neighborhood.asp?WT.mc_id=rss_archrecord.
- Bohn, Katrin, and Andre Viljoen. "The Edible Landscape: Envisioning the Continuous Productive Urban Landscape (CPUL)." *Field: A Free Journal for Architecture* 4, no. 1 (December 2010): 149–61.
- Despommier, Dickson D. *The Vertical Farm: Feeding the World in the 21st Century*. 1st ed. New York: Thomas Dunne Books/St. Martin's Press, 2010.
- Duany, Andres. *Garden Cities: Theory & Practice of Agrarian Urbanism*. U.K.: Duany Plater Zybrek & Co. : The Prince's Foundation for the Built Environment, 2011.
- "Food Retail Expansion to Support Health." The City of New York, 2013. <http://www.nyc.gov/html/misc/html/2009/fresh.shtml>.
- Gorgolewski, Mark. *Carrot City: Creating Places for Urban Agriculture*. 1st ed. New York: Monacelli Press, 2011.
- Howard, Ebenezer. *Garden Cities of To-Morrow*. Edited by F.J. Osborn. Cambridge, MA: The MIT Press, 1965.
- Johnson, Ian. "China's Great Uprooting: Moving 250 Million Into Cities." *The New York Times*. June 15, 2013, sec. Asia Pacific. http://www.nytimes.com/2013/06/16/world/asia/chinas-great-uprooting-moving-250-million-into-cities.html?_r=1&.
- Nordahl, Darrin. *Public Produce: The New Urban Agriculture*. Washington: Island Press, 2009.
- Shaping the City: Studies in History, Theory and Urban Design*. 2nd Edition. New York: Routledge, 2013.
- Solomon, Daniel. *Global City Blues*. Washington: Island Press, 2006.
- "Strategic Investments Group - Hudson Yards." New York City Economic Development Corporation, 2014. <http://www.nycedc.com/program/hudson-yards>.
- Viljoen, Andre. *CPULs: Continuous Productive Urban Landscapes*. Great Britain: Elsevier Ltd., 2005.

Whyte, William H. *The Social Life of Small Urban Spaces*. New York City, NY; Project for Public Spaces, 1980.

Woolf, Aaron. *King Corn*. Online Video, Documentary, 2007.

“World Population to Reach 9.7 Billion by 2050 New Study Predicts.” *The Telegraph*, October 2, 2013.
<http://www.telegraph.co.uk/earth/10348822/World-population-to-reach-9.7-billion-by-2050-new-study-predicts.html>.

Wright, Frank Lloyd. “Broadacre City: A New Community Plan.” *Architectural Record* 77 (April 1935): 243–54.

