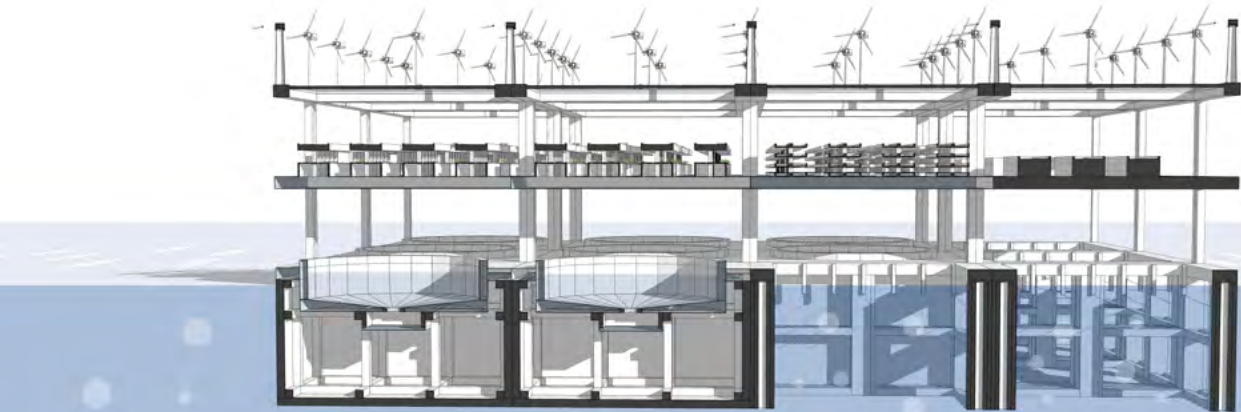


REGIONAL FOOD SELF SUFFICIENCY

NEW VISIONS FOR PRODUCTIVE LANDSCAPES

Yiling Wang
MLA Landscape Architecture, RISD



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REGIONAL FOOD SELF SUFFICIENCY

A thesis submitted in partial fulfillment of the requirements for the Master of Landscape Architecture
Degree in the Department of Landscape Architecture of the Rhode Island School of Design,
Providence, Rhode Island.

By Yiling Wang

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Approved by Masters Examination Committee:

Johanna Barthmaier-Payne, Department Head, Landscape Architecture

Emily Vogler, Primary Thesis Advisor

Johanna Barthmaier-Payne, Secondary Advisor



fig 1. "Cart and Balloons" food art by Carl Warner. artist, director and photographer

ABSTRACT

Food is an important resource for the survival and development of civilization. Its potential is so huge that it affects physical and mental health in an individual sense, and it affects landscapes and even public relations in a social sense. For most people, having food is never a problem that the importance of food is overlooked. However, the right to food is not equal. There are still a considerable number of people have low food access, which means..., and they may also be forced to be in an unbalanced diet leading to health problems such as obesity. A large amount of food and the resources used to produce food are wasted, and unsustainable production methods cause the deterioration of the production environment are problems that need to be solved urgently.

I believe it's time to reimagine the role of food in our daily lives in terms of new ways of people participating in productive landscapes. Those landscapes can have a primary function as food production as well as secondary and even tertiary functions for example being places for public activities and education. Productive landscapes have way more possibilities as long as we can give full play to our creativity.

In the thesis I'm going to explore the possibility of food self-sufficiency in order to shift people's visions and engagements with productive landscapes using New Bedford region as the test ground. During the design process, there will be new transformations of land based on calculated data. Those types of land will be multi-functional combining food production, environmental justice and human engagement together.

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LEXICON / KEY TERMS

FOOD SECURITY

A measure of the availability of food and individuals' ability to access it¹.

FOODSHED

A region of food flows, from the area where it is produced, to the place where it is consumed, including: the land it grows on, the route it travels, the markets it passes through, and the tables it ends up on².

FOOD SELF SUFFICIENCY

A region relies partially or totally on food produced within the region to meet its basic food needs.

FOOD ACCESS

People's ability to find and afford food.

PRODUCTIVE LANDSCAPE

A type of food-production-based landscape that will integrate the local people, therefore increase interest agriculture and bring social welfare to the society³.

FOODPRINT

The environmental impact, or footprint, of food, including the amount of land required to sustain a diet, the amount of carbon dioxide produced, if the food is organic, and if it is local.

FOOD DESERT

An area that has limited access to affordable and nutritious food¹, where grocery stores are scarce or missing⁴.

FOREST FARMING

The cultivation of understory crops within an established forest. It is a form of forest land management system known as agroforestry. It may take place in a natural forest or in a timber planting⁵.

URBAN AGRICULTURE

The practice of cultivating, processing, and distributing food in or around urban areas⁶.

ENVIRONMENTAL SUSTAINABILITY

The rates of renewable resource harvest, pollution creation, and non-renewable resource depletion that can be continued indefinitely.

COMMUNITY GARDEN

A single piece of land gardened collectively by a group of people which utilize either individual or shared plots on private or public land while producing fruit, vegetables, and/or plants grown for their attractive appearance⁷.

AGRITOURISM

Any agriculturally based operation or activity that brings visitors to engage with.

MONOCULTURE

The agricultural practice of growing a single crop, plant, or livestock species, variety, or breed in a field or farming system at a time.⁸

POLYCULTURE

A form of agriculture in which more than one species is grown at the same time and place in imitation of the diversity of natural ecosystems⁹.

WORKING WATERFRONT

An area or structure on, over, or adjacent to navigable waters that provides access to the water and is used for water-dependent commercial, industrial, or governmental activities¹⁰.

PERMACULTURE

A system of assembling conceptual, material, and strategic components in a pattern which functions to benefit life in all its forms. It seeks to provide a sustainable and secure place for living things on this earth¹¹.

CHAPTER I: WHY FOOD SELF SUFFICIENCY

Food is something that everyone needs every day on this planet. Its indispensability determines that it is one of the most important resources for survival and development.

Today since the majority of the food energy required by the ever-increasing population of the world is supplied by the industrial food industry, it becomes one of the major contributors to climate change¹², and also has significant impacts on a wide range of other social and political issues including ecology, economics, population growth, water supply, landscape, cities social issues, an so on.

The food system is the world's largest industry and is supporting the life of all the people on the earth. The current state of the globalized food system is strikingly fragile, built on an unsustainable base of industrial-scale monoculture and environmental degradation.¹³ Maintaining food self sufficiency in terms of daily diet needs within a certain region of territory can largely increase the living security. This chapter will explore why regional food self sufficiency is important and how practices of improving food sufficiency abilities are taking out around the world.

fig 2. "An Inside Look of The Restaurant Depot"
Background image courtesy of Malarie Zaunbrecher (photographer).

FOOD, HUMAN, CITY AND ECOLOGY

FOOD CRISIS IS SEVERE

The food crisis is much more severe than we usually imagine. There are one in seven households in United States are food insecure¹⁴, which means they don't have enough food or they can't afford healthy diet leading them to obesity and other health problems.

The number of people living in poverty in the U.S. in 2012 (46.5 million) was the largest number seen in the 54 years for which poverty estimates have been published.¹⁵ This number translates to a national poverty rate of 15%. As ranked by Poverty USA, Massachusetts was 11th in the country for poverty in 2011, with an overall state poverty level of 11.9% in that year.¹⁶ By 2012, the state poverty rate had fallen slightly to 11.0%.¹⁷ This level of analysis masks pockets of much greater poverty in the region, especially in the cities of New Bedford in Bristol County, which had poverty rates of 21.2%, respectively, in 2012.¹⁸ Childhood poverty rates are even higher, with New Bedford showing a startling childhood poverty rate of 28.3%.¹⁹

Taken together, the high poverty, unemployment, and relatively low income levels even for those who are employed contribute to a high level of food insecurity.

The USDA defines food insecurity as a situation where "Food intake of one or more household members was reduced and their eating patterns were disrupted at times during the year because the household lacked money and other resources for food."²⁰ Feeding America, a national hunger-relief organization, utilizes a different methodology through indicators such as poverty, unemployment, and median income.²¹ Showing by Feeding America's 2012

food insecurity rates for the three-county region (the three counties which are closest to the test ground, New Bedford), Bristol County greatly exceeds both the other two counties and the statewide average, with overall and childhood food insecurity rates of 12.3% and 18.2% respectively. This means that nearly 1 in 5 children in Bristol County experiences food insecurity. Only about half of these children are likely eligible for federal nutrition assistance, due to income eligibility limits for these federal programs.²²

FOOD INSECURITY IS AFFECTING EVERYONE

Food insecurity is also affecting a wider range of people. During the epidemic, the panic of seeing empty food shelves in supermarkets raised awareness about how precarious our food system is. By getting more people involved in the food production or processing system instead of just being consumers, it can bring the society with more social, economic and humanity values. For the people who use their leisure time to spend with crop growing, it can be a great time to refresh the mind and body by doing some simple farm work. For those who want to join the food system as their jobs, that can be great job opportunities.

Increasing food self-sufficient rate requires to rethink the current food system of which current trend is not putting us on the track to feed people in the future. If not, people may suffer from chronic malnutrition, obesity, or hunger. And the environment may crash due to running out of certain resources.

FOOD WASTE ISSUES SHOULD BE ADDRESSED

Food waste is a major part of the impact of agriculture on climate change and other environmental issues. The Food and Agricultural Organization estimated in 2014 that food waste lost causes a global economic, environmental and



Top to bottom
"Grocery store manager on coronavirus: This feels different". from Metrowest Daily News.
"Food Waste Worsens Amid COVID-19 Pandemic". by Hobson, Jeremy, and Hagan, Allison. May 27, 2020.

social cost of \$2.6 trillion a year and is responsible for 8 percent of global greenhouse gas emissions.²³ Moreover, food waste that is not handled or reclaimed properly, i.e. through composting, can have many negative environmental consequences. For example, landfill gas from anaerobic digestion of organic matter is a major source of the greenhouse gas methane, and un-reclaimed phosphorus in food waste, leads to further phosphate mining. Moreover reducing food waste in all parts of the food system is an important part of reducing the environmental impact of agriculture, by reducing the total amount of water, land and other resources needed to feed the global community.²⁴

Estimates of food waste in the United States range from 35 million tons to 103 million tons.²⁵ In a study done by National Geographic in 2014, Elizabeth Royte indicated more than 30 percent of food in the United States, valued at \$162 billion annually, isn't eaten.²⁶ The University of Arizona conducted a study in 2004, which indicated that 14 to 15% of United States edible food is untouched or unopened, amounting to \$43 billion worth of discarded, but edible, food.²⁷ In 2010, the United States Department of Agriculture has come forth with estimations from the Economic Research Service that approximates food waste in the United States to be equivalent to 141 trillion calories.²⁸

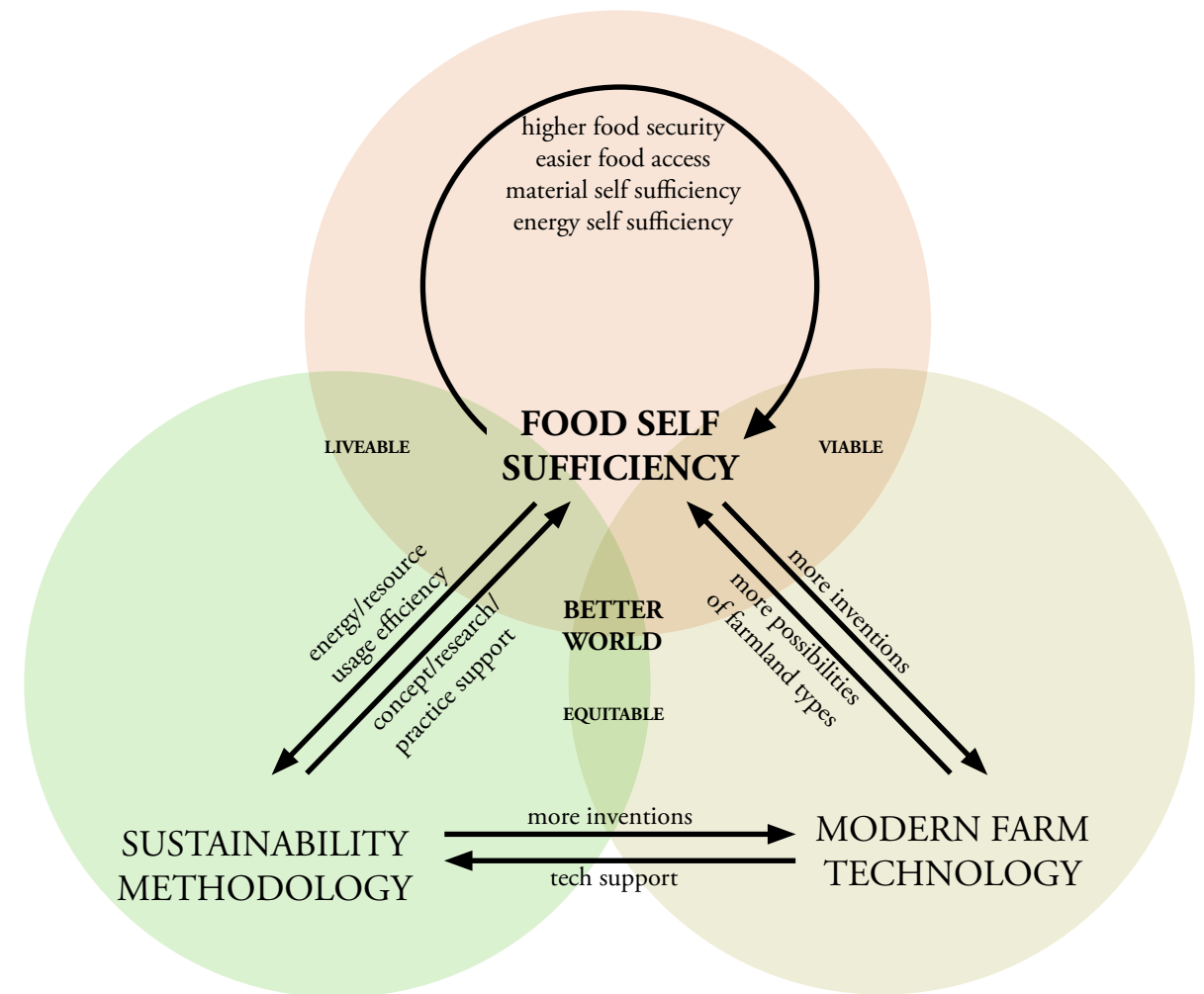


THE MEANING OF FOOD SELF SUFFICIENCY

FOOD SELFSUFFICIENCY:

HIGHER FOOD SECURITY BASED ON PEOPLE 'S DAILY HEALTHY DIET IN A SUSTAINABLE MANNER

So food self sufficiency in my thesis, does not mean all the food should be produced and consumed in one single area. But means to give higher food security in terms of people's basic daily diet in a sustainable manner. And in this process, knowledge from sustainability and modern technology supports the idea.



"Relationships between food sufficiency, sustainability and modern technology"
diagram by the author.



**CHAPTER II: PRACTICES OF
FOOD SELF SUFFICIENCY**

MODERN PRODUCTIVE LANDSCAPE PRACTICES

CUBA'S URBAN FARMING REVOLUTION²⁹

"Cuba's urban farming revolution: how to create self-sufficient cities". Clouse, Carey. 17 March 2014.

DATE: Since 1989

LOCATION: Havana, Cuba

SCALE: Whole city agricultural revolution

TYPE: Semi-sustainable urban agriculture

CORE IDEOLOGY: Prioritising organic farming methods, the production of useful edible crops and the use of peasant labor to restore the domestic food supply system

In 1989, Cuba fell into punishing trade sanctions following the fall of the USSR. Cuba became, almost overnight, a country detached from the rest of the world. This was the beginning of Cuba's food crisis, a period in which residents lost, on average, access to one third of their daily calories, and most Cubans experienced widespread, inescapable hunger.

Along with the evaporation of food imports, Cuba lost access to the animal feed, fertilisers and fuel that had sustained the island's agricultural efforts. Oil scarcity became so pervasive that it curbed pesticide and fertiliser production, limited the use of tractors and industrial farming equipment, and ultimately seized the transport and refrigeration network that was needed to deliver vegetables, meat and fruit to the tables throughout the region.

the Cuban government responded with an overhaul of agriculture on the island, prioritising organic farming methods, the production of useful edible crops and the use of peasant labour. In urban areas, guerrilla gardening initiatives blossomed into new state-supported urban farming programmes, with widespread voluntary participation.

Havana, the capital city of Cuba, has become an exempla-

ry model of this new self-provisioning, a precedent that demonstrates both the opportunities and obstacles for the transference of urban agriculture to other regions. Havana provides an example of a systematic approach to rethinking urban landscapes for more productive means: food production infrastructure has been woven into the city fabric, with interventions that range in size from backyard gardens to large peri-urban farms. Many of these gardens have emerged somewhat opportunistically from vacant and blighted properties within the city, exploiting usufruct rights (free land provided by the government) to seize available space.



"Nearly 8000 parcels, or small lot gardens, are found in Havana today". Photo: Cook, Andy.

The urban agriculture practised in Havana provides an important model for any city transitioning towards food independence. As climate change intensifies and energy, land and water reserves diminish, many see the value in a return to local economies and the development of more resilient food systems. Cuba's model could be particularly instructive for other nations seeking improved food security.

REFLECTION OF CUBA'S MODEL

Cuba's agricultural reform model has turned a lot of under-used urban land into an efficient and productive landscape. This production model has dramatically improved urban space utilization and reduced the dependence of the food supply system on the transportation network. Urban planting participants use their buildings' roof and backyard space for planting or breeding and providing these products to nearby restaurants. At the same time, waste from



"This urban farmer also has chickens, turkeys, guinea pigs, and vegetable production on his rooftop". Photo: Cook, Andy.

nearby markets is also an effective fertilizer source, for it can be collected and composted in a short time. In such small-scale food circulation, food realizes efficient circulation following closed-loop permaculture principles, which are essential to maintain resource utilization in this resource-limited world.

Varying levels and scales of urban farms provide opportunities for surplus labor. Due to the constraints of the urban environment and farmland size, it is difficult for large-scale

production machinery to intervene in urban agricultural production, which also means injecting more human labor resources. In Cuba, urban planting participants took up hoes and replaced tractors with oxen teams, making production more sustainable and secure, relying less on fossil fuels.

In Cuba, this production model with a large amount of human participation is to respond to the food crisis that has spread throughout the country. It will be different when this model is applied to the productive landscape of the United States. In the United States, where basic food supplies can be guaranteed, this model will be different. It does not mean that everyone is required to participate in farming. People can choose whether to participate in agriculture and how they participate in agriculture according to their interests and needs. For low-income people who have low accessibility to food, they can use their labor to obtain food. For others, they may choose to plant to enrich their lives. For the former, the low-tech, high-efficiency planting tools independently invented by Cuban planting participants can be highly informative. For the latter, productive landscapes can be conceived more enjoyably, allowing multiple family or social activities for them to participate with or even just stay in.

THE FENWAY VICTORY GARDENS³⁰

"https://fenwayvictorygardens.org/". Home page of The Fenway Victory Gardens.
"https://www.nationalgeographic.org/article/fenway-victory-gardens/"

DATE: Founded in 1942 and remaining continuously-operating until today

LOCATION: Frederick Law Olmsted's famed Emerald Necklace, 1200 Boylston St, Boston, MA 02215

SCALE: 7.5 acres, about 30350 square meters

TYPE: Community garden

CORE IDEOLOGY: Inheriting the function of productive landscapes in order to maintain and encourage urban gardening in the Victory Gardens for the benefit of all the people of the City of Boston, as well as to provide a chance to work outdoors, enjoy green space, and work with nature



"Location of The Fenway Victory Garden".
Diagram by the author.

The Fenway Victory Gardens were founded during World War II. During that time, commercially grown crops and transportation resources were shifted to support military operations. With this shift and the rationing of canned fruits and vegetables in early 1943, civilians were encouraged to begin growing fruits and vegetables themselves. The White House, and in neighborhood and com-



"During World War II, government and industry supported community gardening as patriotic". Photograph courtesy the national archives.

munity plots including the Fenway Victory Gardens.

The Fenway Victory Gardens is comprised of over 500 gardens spanning 7.5 acres. The gardens are tended by a community of more than 475 members from every neighborhood in Boston, reflecting the diversity of our city and its rich history and culture. The Fenway Victory Gardens is one of the two remaining continuously-operating World War II Victory Gardens in the United States and the only garden to have continued its operation in the same location as it was during the War.

FENWAY GARDENS TODAY

The meaning of Victory Gardens will change over time, but the saying in the poster. "Your victory garden counts more than ever", is still meaningful today. As the role of heightened war efforts and food rationing to victory gardens diminishes with the changing times, victory gardens are now producing fresh products for families. At the same time, those gardens are endowed more recreational, educational, and social values.

Fenway Victory Gardens is divided into 500 fenced plots. A gardener must be a Boston resident in order to have a victory garden plot. It used to be whoever showed up got a space. But the neighborhood is currently experiencing a renaissance. There's a wait-list now. A gardener must first volunteer and do community service with the Fenway Garden Society before they receive a victory garden plot.

About 25 percent of the plots grow vegetables. There are leisure gardens, flower, fruit, and herb gardens, and perennial gardens. For the gardeners who grow vegetables, popular crops are tomatoes and salad greens, such as kale, lettuce, and arugula.



"Making a Teaching Garden". Photograph courtesy Mike Mennonno, The Fenway Victory Gardens.

For educational values, Fenway Gardens are great places to study biology, ecology, geography, human geography and physical geography for students in grades from five to twelve. Fenway Gardens also have teaching gardens, which are designed to help experienced and novice gardeners to better understand cultivation methods. The "Green Team" of the Emerald Necklace Conservancy helped construct the plots for the teaching gardens.

The Fenway Garden Society holds several "Community Participation Days" every year. Members of the society and other volunteers come together to maintain the gardens. According to the society, tasks "can be as varied as repairs of the irrigation system and turning compost to building gates and mending fences.

REFLECTION OF FENWAY VICTORY GARDENS

This garden is fascinating in the way of distributing the land and community participations. Being surrounded by dense urban residences, it functions smoothly by throwing series of daily and seasonal activities including volunteer work, gardening tutorial, and the best garden competition. It is a great example of how an urban productive landscape weaves social activities, property management and food production together.



“The first commercial rooftop greenhouse of Lufa Farms as well as in the world”
 Year built: 2011
 Size: 31000 square feet
 Production: Herbs, microgreens, cucumbers, and peppers

LUFA FARMS³¹

“<https://montreal.lufa.com/en/>”. Home page of Lufa Farms.

DATE: Started in 2011
LOCATION: Montreal, Quebec, Canada
SCALE: Four farms totaling 300800 square feet
TYPE: Commercial rooftop green house farm
RELATED COMPANIES: Luda Farms
CORE IDEOLOGY: Creating a better food system to reconnect people with where their food comes from by growing veggies right here in the city on rooftops, partnering up with hundreds of farmers and food makers, and providing it all to people through their online farmer’s market.

Lufa Farms is the name of an urban agricultural company as well as the series of commercial rooftop farms they established. The company was founded in 2009, of which CEO and founder Mohamed Hage was born in Lebanon and grew up surrounded by rooftop gardens. Upon moving to Canada, he was surprised to find that vegetables often travel over 2,000 km before being eaten. It was this knowledge combined with the simplicity and accessibility of rooftop farms that led him to bring together a team to tackle the mission to encourage cities to eat locally and responsibly.³⁰

ROOFTOP FARMS

Lufa Farms has established four rooftop farms. Their first and also the world’s first commercial rooftop farm was built between 2010 and 2011 on an existing industrial building in Montreal’s Ahuntsic-Cartierville borough. It is the most diverse of their greenhouses, with several different types of vertical and horizontal growing systems and dozens of varieties of herbs, microgreens, cucumbers, and peppers.

Following the Ahuntsic farm, the second (Laval farm) and

third (Anjou farm) farms were built in 2013 and 2017, occupying 43000 square feet and 63000 square feet respectively. Laval greenhouse demonstrates what large-scale rooftop agriculture is capable of. The greenhouse maximizes energy savings and creates an optimal environment for crops to thrive. It was designed and constructed especially for and at the same time as the building below. It houses tomato and eggplant production, and it may also be adapted for other crops. Anjou Farm was designed to optimize space for green productions without skimping on quality. Hortiplan’s partially-automated hydroponic growing chan-

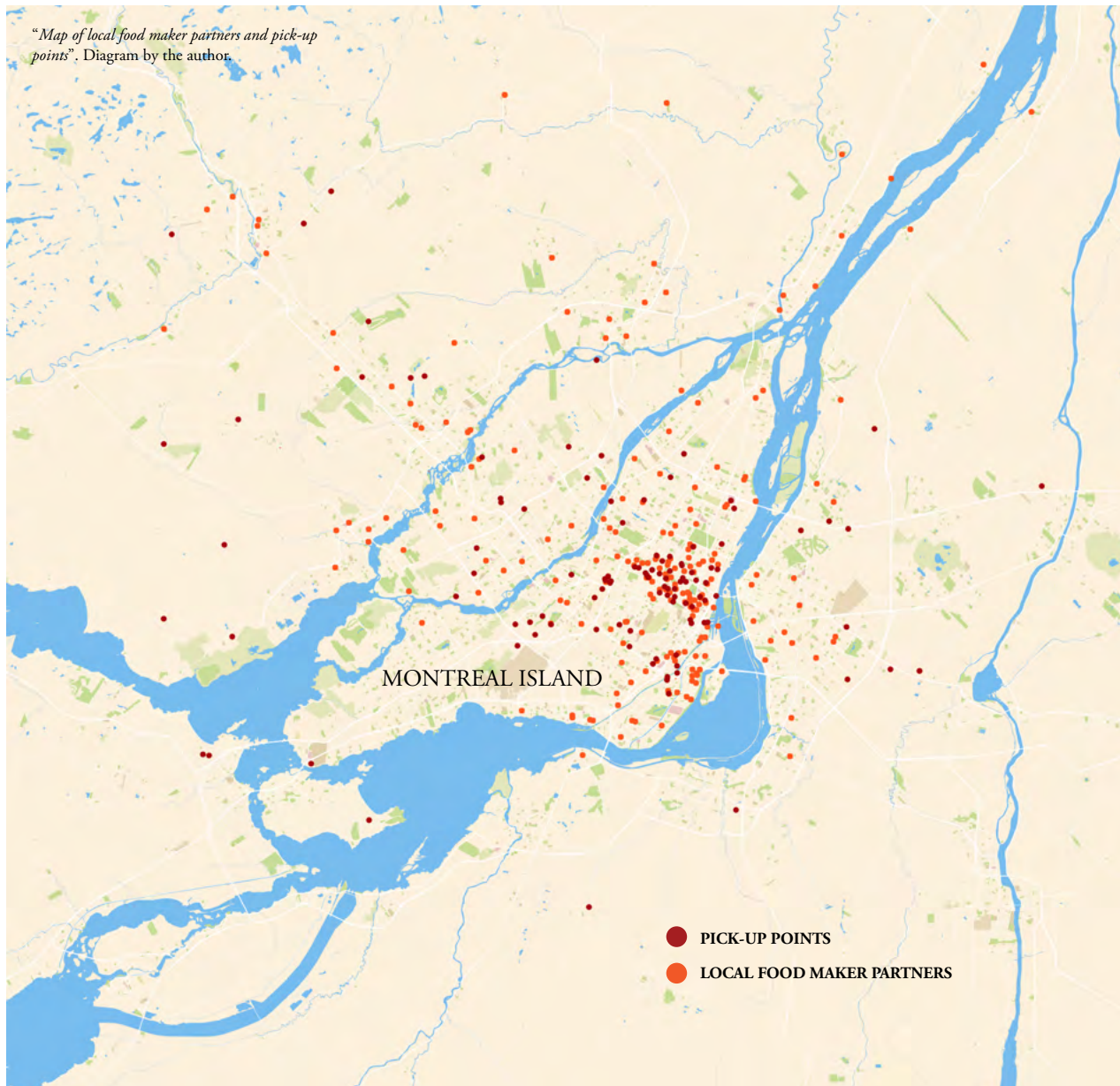
nels move gradually, every day, from the planting end of the greenhouse to the harvesting end of the greenhouse. As they do so, they also move away from one another, creating space for the plants to grow. It houses leaf greens production, outputting hundreds of thousands of lettuce, greens, and herbs of dozens of varieties each year.

The latest rooftop greenhouse was established in Ville Saint-Laurent in 2020 with an area of 163800 square feet. It’s also the the largest urban farm in the world. It captures rain and meltwater which are used to supplement our

closed loop irrigation system. With a double glass glazing and two sets of thermal curtains to improve insulation. In order to tackle the waste problem, Luca Farms installed an internal composting system, selling the excess on the online Marketplace.

A NETWORK COMBINING ROOFTOP FARM WITH LOCAL FOOD MAKERS

Rooftop farms aren’t meant to replace local farms and food makers. Not everything can be grown on rooftops after all.



Altogether, they're building a healthier, more sustainable local food system. They seek out partners who share their values of transparency and sustainability and work closely with those farmer partners for their online farmer's market to offer locals a full selection of products.

They also developed a community of hundreds of neighborhood pick-up points to get food from their rooftops and partners to their customers as directly as possible. The idea is efficiency, convenience, and community-building.

Ranging from locally-owned yoga studios to neighborhood cafes, their pick-up points help counteract the food desert problematic. They also serve as an efficient means of delivering all those baskets collectively to customers, and promote local neighborhood economy and vitality.

REFLECTION OF FENWAY VICTORY GARDENS

This type of urban farm use the potential urban land very smartly. Developing the farm on the rooftop of large supermarkets doesn't occupy extra spaces. And the network established by Lufa Farms with local food producers is also helpful to maintain a more stable local food system.

However, there is still problems with the material circulations. Although greenhouse style farms are using less water than general farmlands, there is still a considerable amount of waste food being produced. Where dose those water go? How will those be treated?





CHAPTER III: NEW BEDFORD REGION AS THE TEST GROUND

New Bedford is a city in Bristol County, Massachusetts, United States. As of the 2010 census, the city had a total population of 95,072, making it the sixth-largest city in Massachusetts.

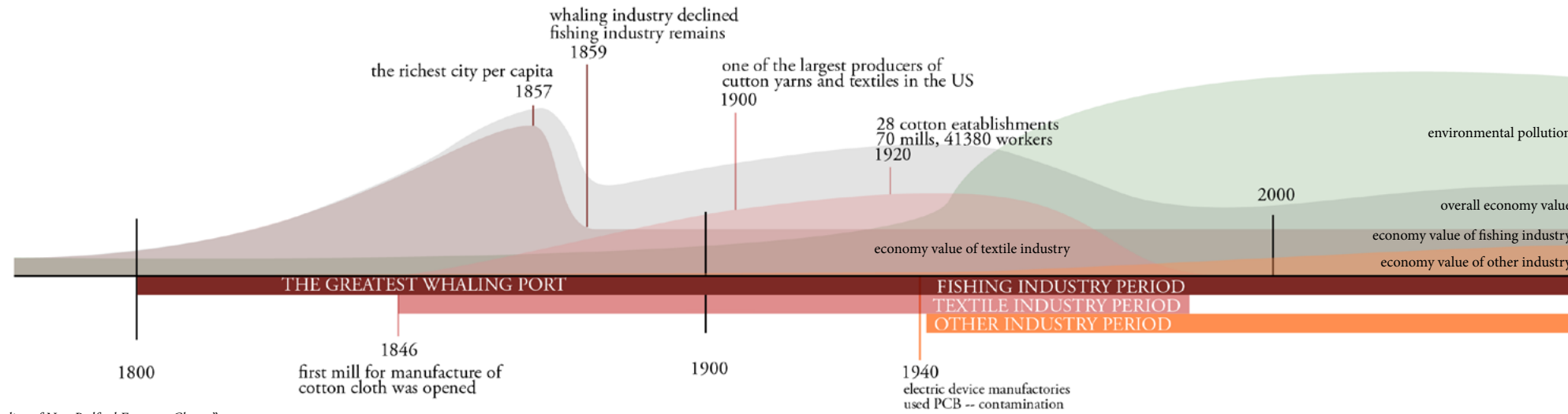
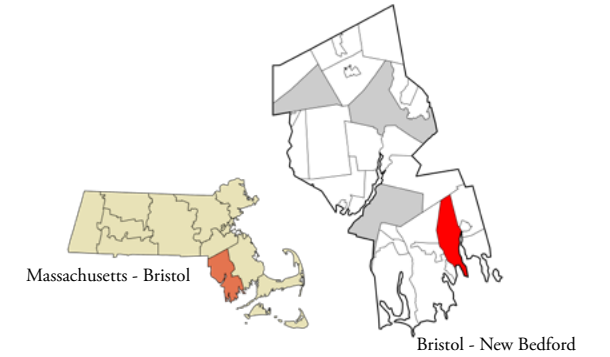
New Bedford can be called a land of opportunity as well as challenge.

As for opportunity, it is one of the most important joints of the New England food system for it's the leading seafood source of New England, or even America. Commercial fishing and the businesses that support it bring both economic and cultural vitality for the city.

However, the decline of other two major economic engines, the whaling and textile industry, caused a huge population loss due to the rapid rising unemployment rate. A larger group of people in New Bedford started to suffer from poverty in the mid 20th century.

Food access is an obvious indicator of economic conditions and residents' happiness in New Bedford. By calculating the production and consumption of food in the New Bedford foodshed, we can get clear evidence of "how many challenges people in New Bedford are facing". Along with the analysis of vacant land, a blueprint of future New Bedford productive landscapes is generally showing up.

PROSPERITY AND DECLINE OF NEW BEDFORD



"Timeline of New Bedford Economy Change" diagram by the author.

Thanks to natural geographical advantages, New Bedford gained worldwide reputation as the greatest whaling port and the richest city per capita in the world in the 19th Century³². Every part of the whale body was used. Whale oil was of the most importance which provided people with light. However, with the development of kerosene, petroleum and other fossil fuels which were more reliable, whale oil were eventually replaced and the industry plummeted.

The textile industry dominated the economy of New Bedford in the 20th century. New Bedford's first mill for the manufacture of cotton cloth was opened in 1846. After the turn of the century New Bedford became one of the largest producers of cotton yarns and textiles in the country, and led all centers in quality and quantity output of fine goods³³.

Nowadays, Fishing continues to be one of the largest businesses in the area. But the leftover marks of the declined industries are still standing in New Bedford. The bones of whales in the whaling museum make people hard to forget the period of history. The large volumes of vacant industrial buildings and their surrounding spaces are waiting to be rejuvenated.



Hunting a whale



The whaling museum in New Bedford



Textile factory open at night



Vacant industrial buildings

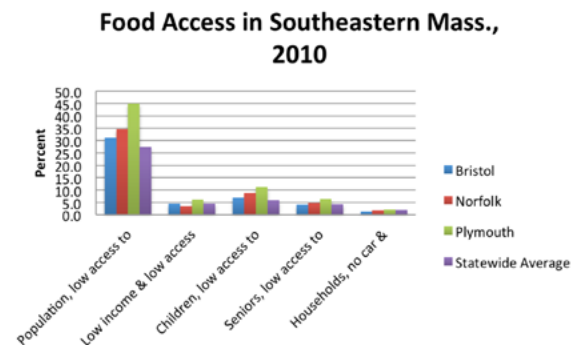
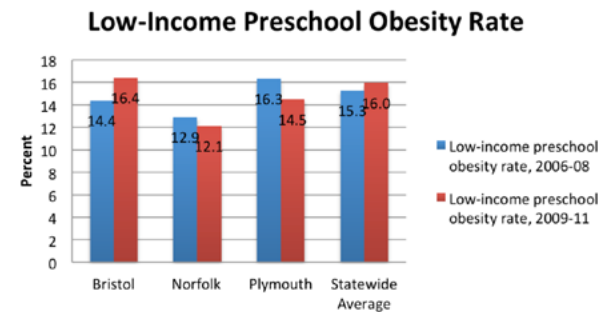
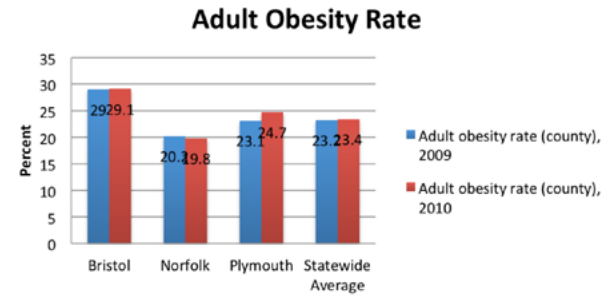
A LAND OF CHALLENGE

FOOD IS NEED³⁴

Bristol County had a 2012 poverty rate of 13.2%, for a regional average of 9.4%. However, as shown in the chart below, this level of analysis masks pockets of much greater poverty in the region, especially in the cities of New Bedford and Fall River in Bristol County, which had poverty rates of 21.2% and 26.3%, respectively, in 2012.⁶⁰ Childhood poverty rates are even higher, with Fall River showing a startling childhood poverty rate of 41.3% in 2012, New Bedford 28.3%, and the counties overall ranging from 8.7% to 17.8%. New Bedford adult obesity rate was 29%.

Using 2010 data collected by Massachusetts public schools, the project also examined older child obesity rates in the two cities. Though these numbers are not directly comparable to the percentages in the chart above, due to different data sources and years, they give a sense of the higher rates of childhood obesity in the two cities than in the county and region overall. The study found that 17.4% of children in Fall River and 19.2% of children in New Bedford were obese, compared with a statewide average of 16.3% from that study's data. Furthermore, the study noted that "As the children age, the weight disparities between New Bedford and Massachusetts populations increase. In first grade, 15.2% of New Bedford's children are obese, compared with 14.3% statewide, a difference of less than one percent. More than one-fifth (20.4%) of New Bedford's tenth graders are obese, compared with 15.2% statewide, a difference of more than five percent.

In recent years there has been much research and discussion on the idea of "food deserts," or areas where grocery stores are too few or too far apart to serve the residents. Despite critiques of this topic, the concept of food deserts is still worth examining as a component of food security in Southeastern Massachusetts.

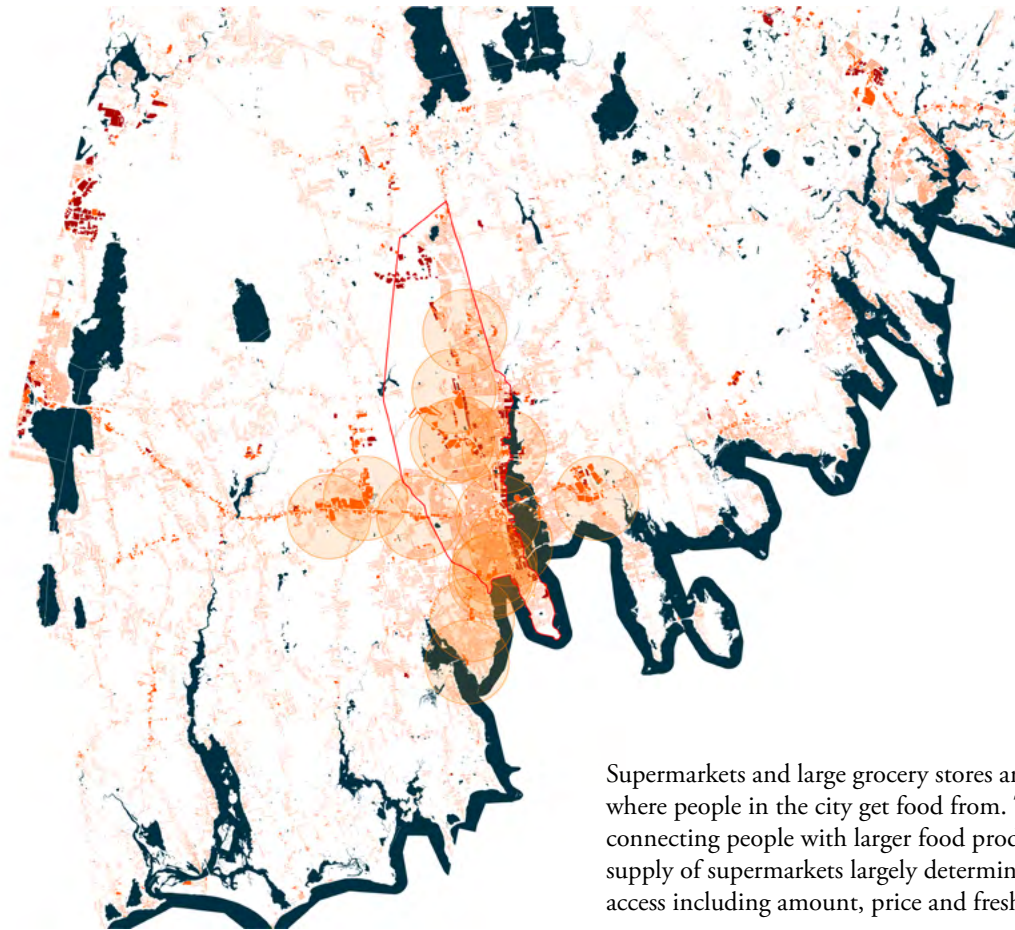


"Life is hard enough, eating healthy doesn't have to be."

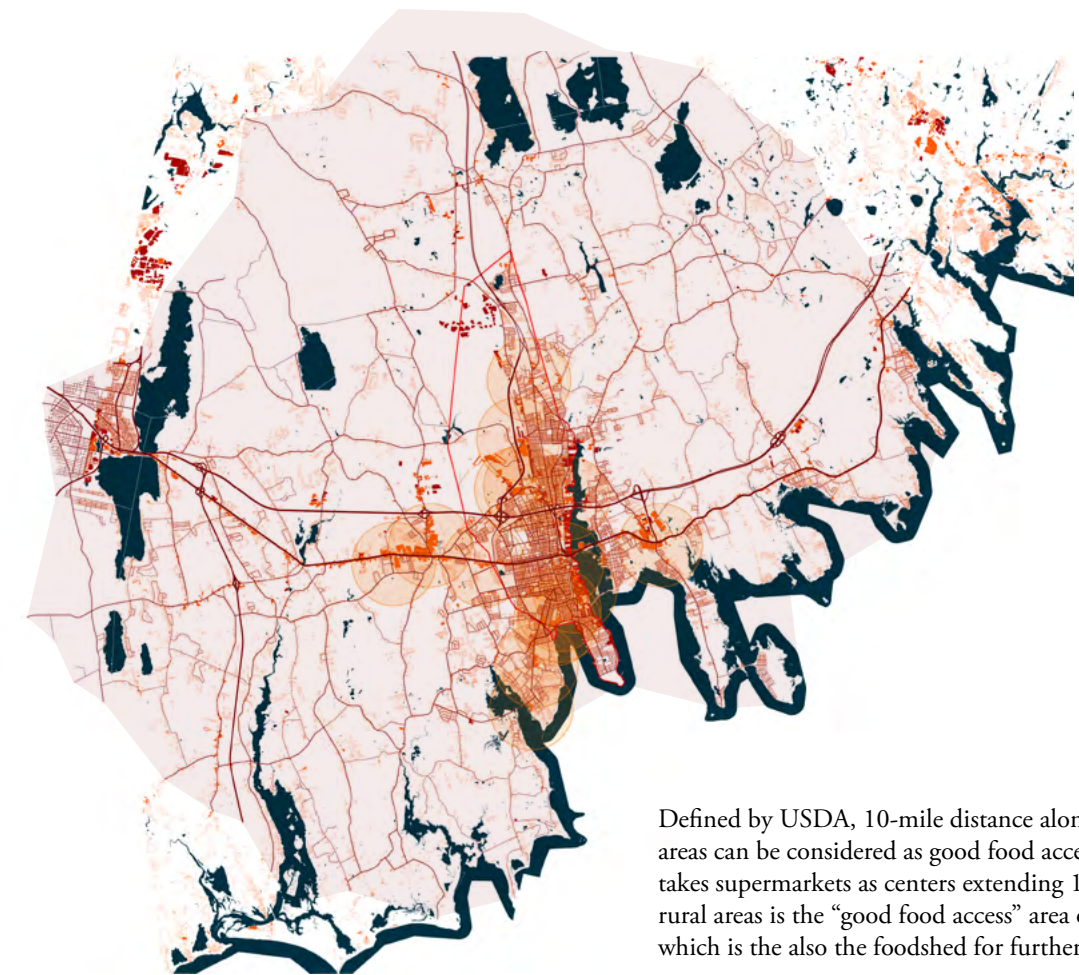
The USDA's Food Access Research Atlas also provides searchable maps that illustrate access to grocery stores within a region.⁸⁴ As shown below, these maps indicate pockets of food deserts within our region, especially within the cities of Fall River and New Bedford.

SNAP, the Supplemental Nutrition Assistance Program, is a federal nutrition program that provides nutrition assistance to eligible low-income individuals and families. SNAP benefits can be used to purchase food at grocery stores, convenience stores, and some farmers' markets. Formerly known as food stamps, SNAP benefits are now provided each month in the form of a plastic card called an EBT (electronic benefits transfer) card, which works like a debit card. Paper coupons are no longer used.⁷⁴ WIC stands for the Special Supplemental Nutrition Program for Women, Infants, and Children. This program provides federal grants to states for supplemental foods, health care referrals, and nutrition education for low-income pregnant, breastfeeding, and non-breastfeeding postpartum women, and to infants and children up to age five who are found to be at nutritional risk. The SNAP program has become increasingly important to families in Southeastern Massachusetts in recent years, as shown by the following table and charts.

DEFINING THE FOODSHED



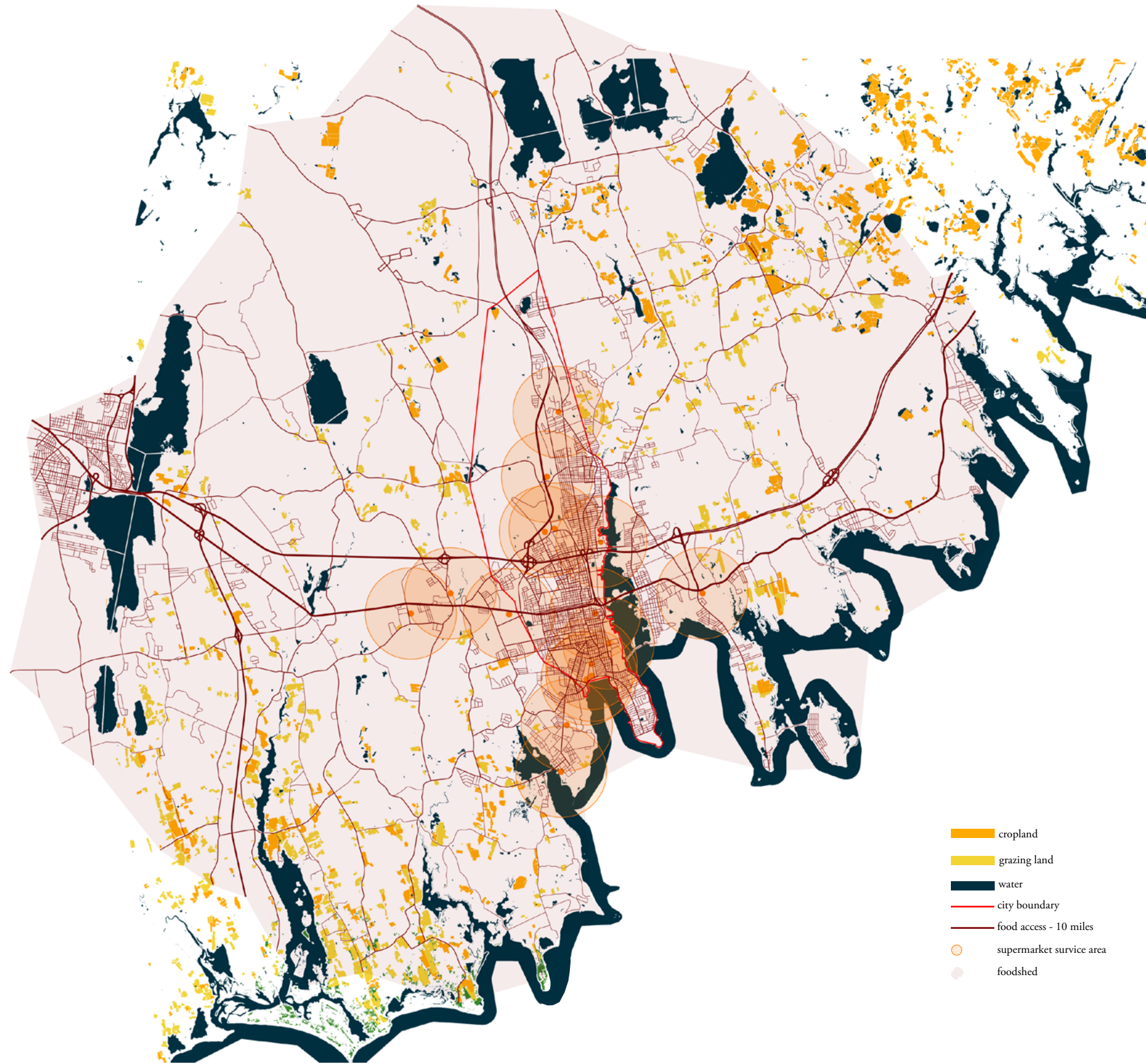
Supermarkets and large grocery stores are major places where people in the city get food from. There are the joints connecting people with larger food production areas. The supply of supermarkets largely determines people's food access including amount, price and freshness.



Defined by USDA, 10-mile distance along roads in rural areas can be considered as good food access. The area that takes supermarkets as centers extending 10 miles into the rural areas is the "good food access" area of New Bedford, which is also the foodshed for further calculations.

commercial industrial water city boundary supermarket service area

commercial industrial water city boundary supermarket service area
 food access - 10 miles foodshed

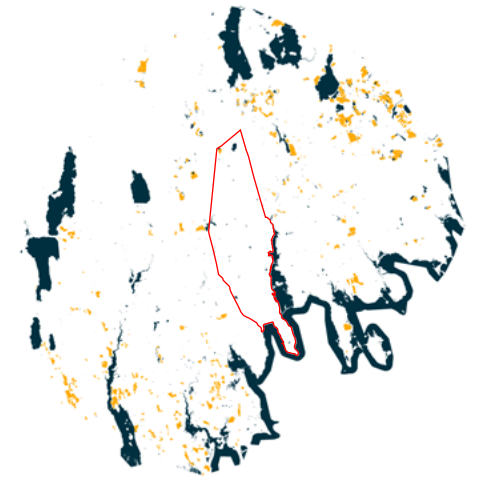


- cropland
- grazing land
- water
- city boundary
- food access - 10 miles
- supermarket service area
- foodshed

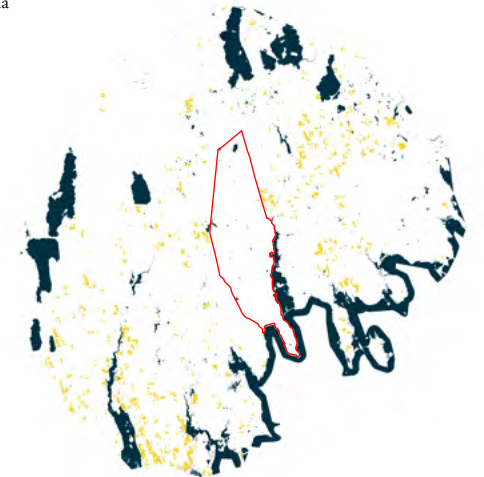
CURRENT PRODUCTION WITHIN THE FOODSHED

The area of agricultural land is a direct indicator of food production. Using the data from MassGIS, we can extract and calculate the total area of cropland and grazing land within the foodshed. The total area of cropland is 1738.5 hectares and grazing land 1593.73 hectares which respectively equal to 4295.9 acres and 3938.2 acres. So could the output of those lands really meet the needs of the population?

CROPLAND AREA:
1738.5 ha



GRAZING LAND AREA:
1593.73 ha



FOOD NEEDED BY THE POPULATION OF NEW BEDFORD



	SERVINGS	CALORIC INTAKE		SERVINGS	CALORIC INTAKE		SERVINGS	CALORIC INTAKE
1 Vegetables(mix)	1.6 cups	4%	1 Vegetables(mix)	3 cups	7%	1 Vegetables(mix)	3 cups	7%
2 Fruit-cool climate	0.4 cup	1%	2 Fruit-cool climate	1 cup	4%	2 Fruit-cool climate	2 cup	8%
3 Fruit-warm climate	0.3 cup	1%	3 Fruit-warm climate	1 cup	5%	3 Fruit-warm climate	0 cup	0%
4 Whole grains	0.7 oz	3%	4 Whole grains	3.75 oz	11%	4 Whole grains	3.75 oz	11%
5 Refined grains	6.9 oz	18%	5 Refined grains	3.75 oz	15%	5 Refined grains	3.75 oz	15%
6 Protein-rich plants	0.6 oz	3%	6 Protein-rich plants	1.6 oz	7%	6 Protein-rich plants	2.6 oz	11%
7 Meat, fish, eggs	7.1 oz	23%	7 Meat, fish, eggs	5.2 oz	15%	7 Meat, fish, eggs	3.3 oz	9%
8 Dairy	1.5 cups-eq	10%	8 Dairy	1.5 cups-eq	9%	8 Dairy	1.5 cups-eq	9%
9 Added fats	2.2 oz	19%	9 Added fats	1.1 oz	12%	9 Added fats	1.4 oz	15%
10 Discretionary calories	500 cal	18%	10 Discretionary calories	250 cal	15%	10 Discretionary calories	335 cal	15%

Data resource, "A New England Food Vision"

The data above shows the daily diet of a normal person. The diet on the left is the current diet that most Americans take which is not a balanced diet for there is too much meat intake and too little fruit intake. The middle is the

ideal diet visioned by Omnivore. Combining those two diets, a diet that is more suitable for New England people is generated in the report of *A New England Food Vision*. This diet is the basis for calculation of the food needed.

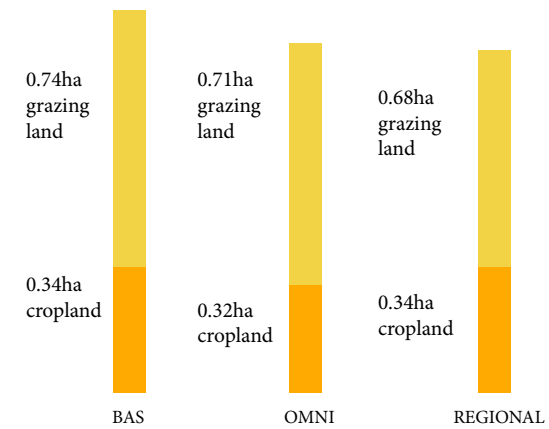
Based on regional diet, each person in New England region needs 0.68ha grazing land and cropland for food production. Combining with the population of New Bedford, we can get the number of how much land we actually need.

CROPLAND

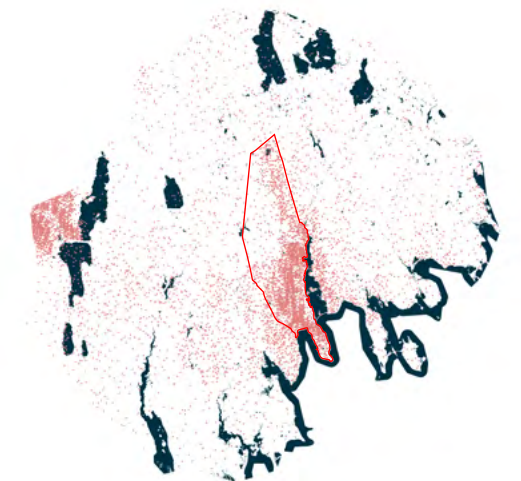
WE HAVE 1738.5 ha
WE NEED 32325.84 ha

GRAZING LAND

WE HAVE 1593.73 ha
WE NEED 64651.68 ha



AREA OF LAND NEEDED BASED ON DIETS



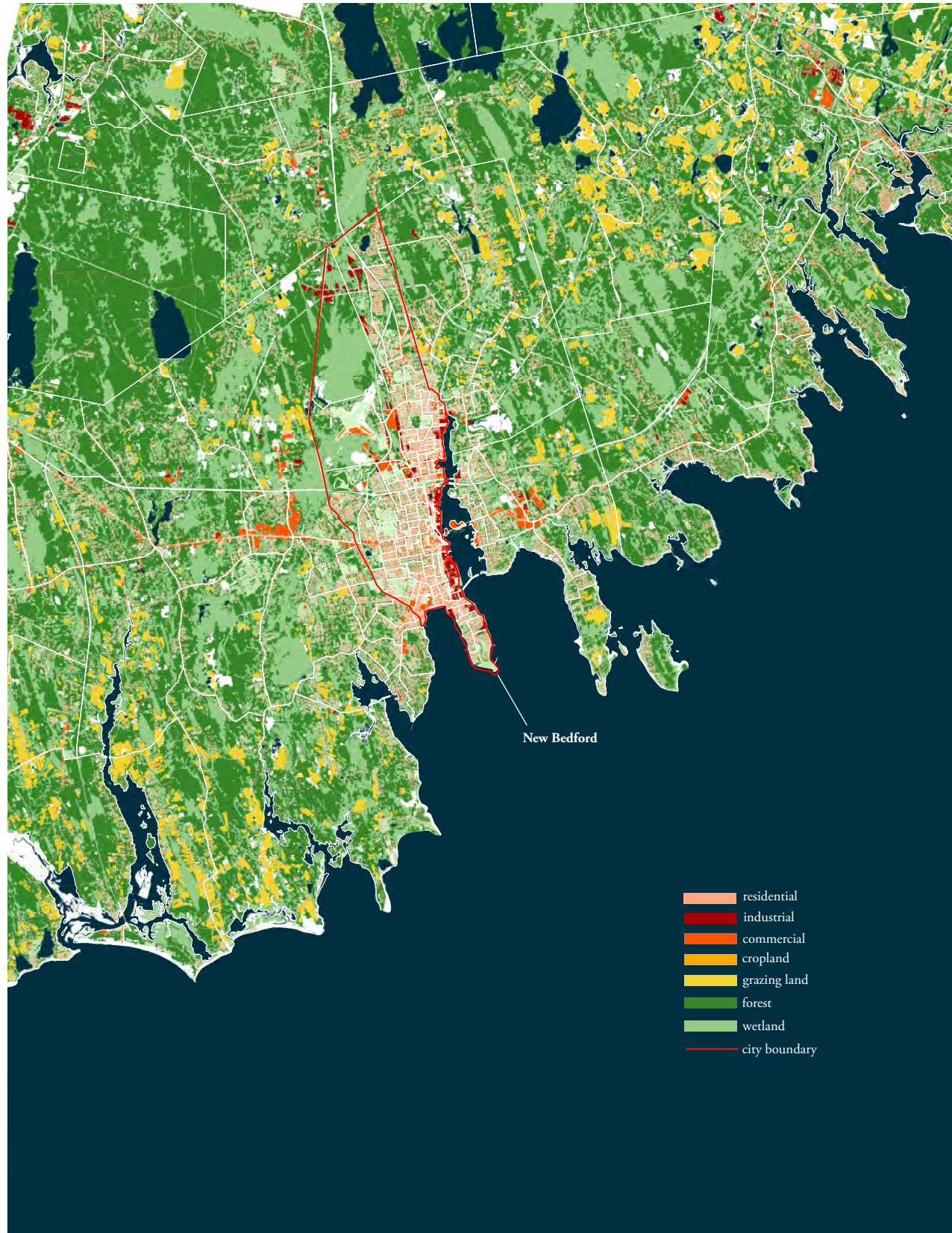
POPULATION OF NEW BEDFORD: 95076

Given the limited existing farmland, there is a need find new ways to achieve a more food self sufficient region.

-- Emily Vogler

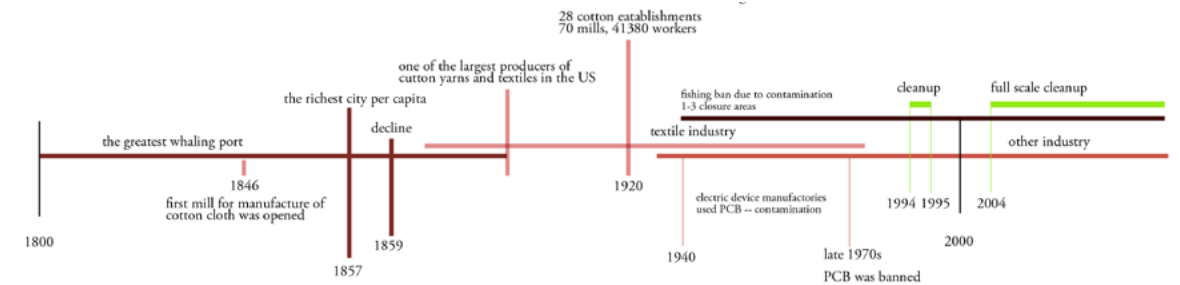


Background image from "A New England Food Vision"

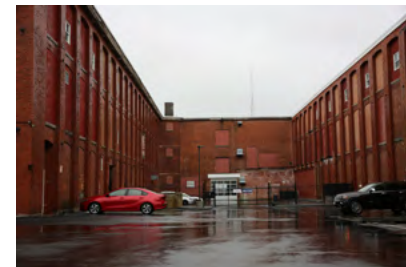


A LAND OF OPPORTUNITY

GEOLOGICAL AND HISTORICAL BENEFITS OF NEW BEDFORD



"Timeline of New Bedford Industrial Iteration" diagram by the author.



New Bedford has unparalleled opportunities due to its superior location and its own historical legacy.

As a port city, New Bedford not only has rich marine resources but also is surrounded by all types of natural resources. For the inland area, New Bedford is supported by a large amount of agricultural land which makes it possible for a better food system to be built on. And the natural wetland as well as the forest may bring unpredictable potential for new types of productive landscapes to be established.

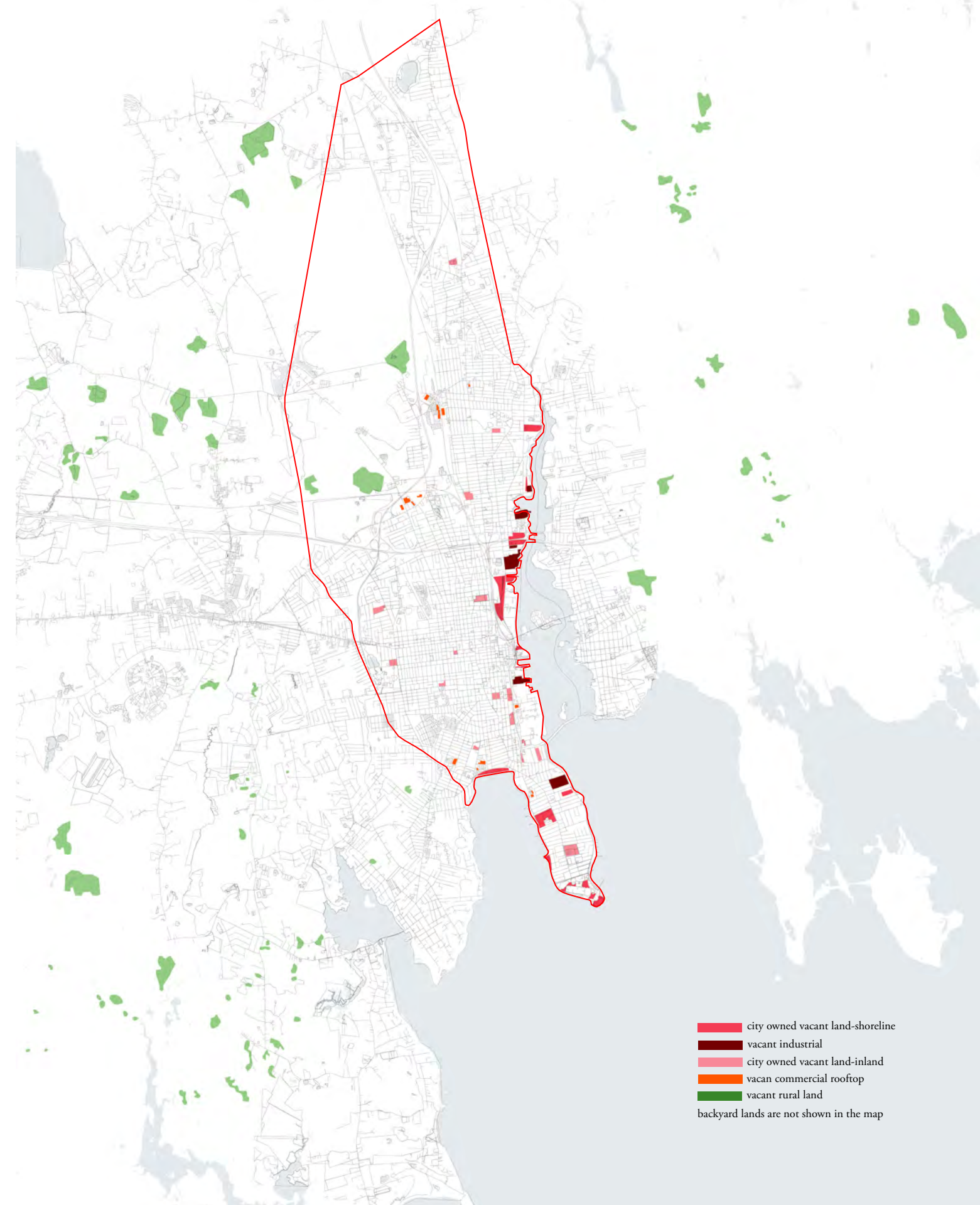
For the city itself, the "scars" that declined industries left on the other hand can also be the forgotten treasures. The huge buildings with beautiful brick facades left us with underused spaces for future programs. The unused lands near those industrial buildings can also be utilized along with the regeneration of the buildings. Also nowadays there are pieces of lands remaining vacant because of the change of the city land use.

MAPPING OF THE OPPORTUNITY LANDS

The map clearly shows a gradient of opportunity lands from rural to urban as well as from inland to seashore. Due to the obvious difference in geographic location, those lands are categorized into three large groups, waterfront underused lands, urban inland underused lands, and rural underused lands.

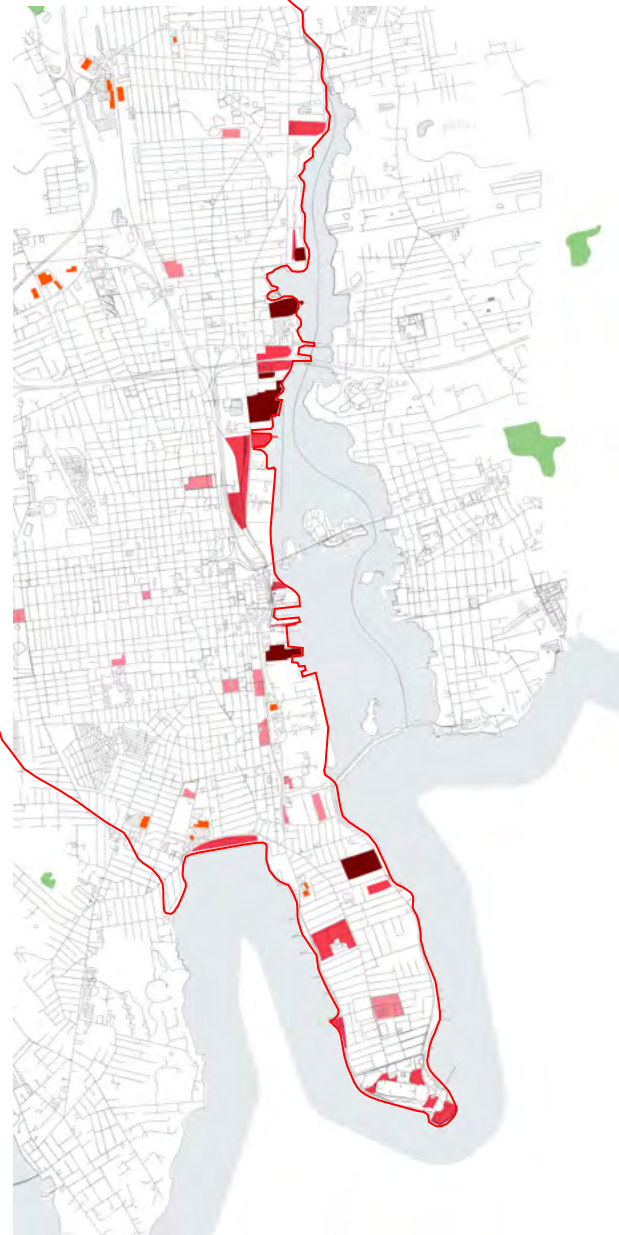
Those lands all have their distinct features. Rural lands are usually large scale and suitable for grazing or grain cultivating which can be connected with existing rural food production systems. The scale of urban inland underused lands varies, city owned vacant lands and vacant commercial rooftops are usually large scale, in the meanwhile private backyard are small. Supported by urban facilities, former lands can be developed into highly efficient commercial productive lands. The development of the latter is largely dependent on the owner's preferences which will mainly focus on feeding the family. Waterfront underused lands including city owned lands and vacant industries of which the ownerships have the potential to be transferred. The former is mostly open lands and the latter has building structures requiring more specific design methods.

The zoomed in aerial photos and visualizations are in the following pages.

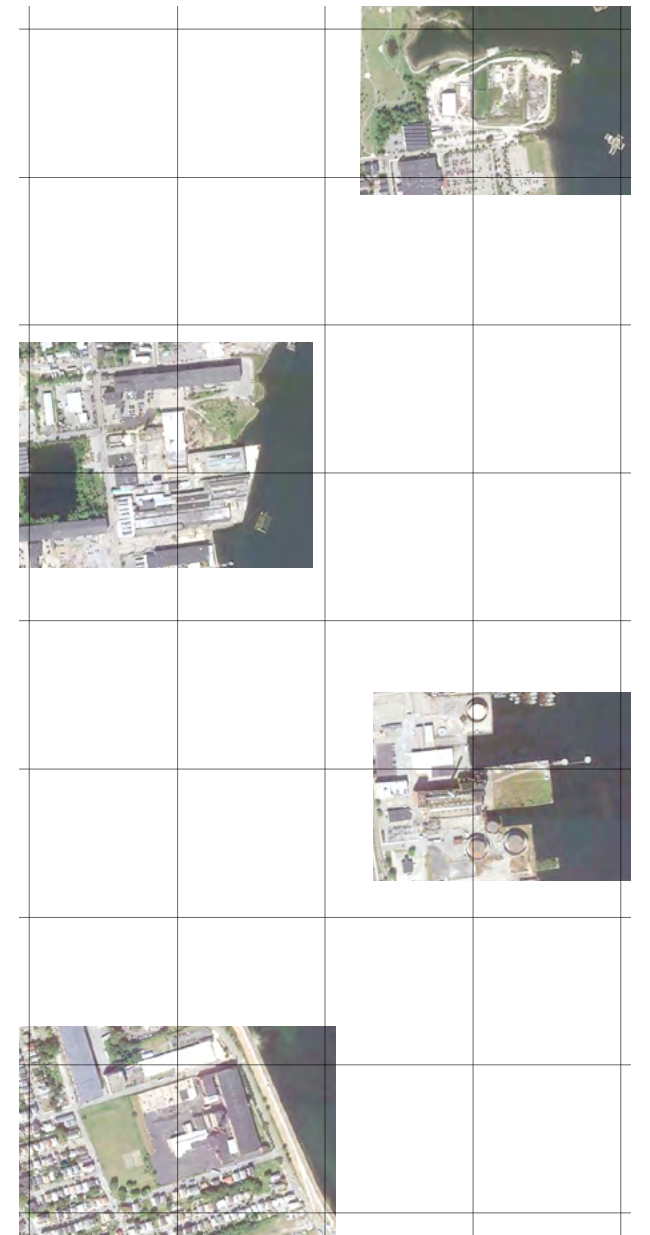
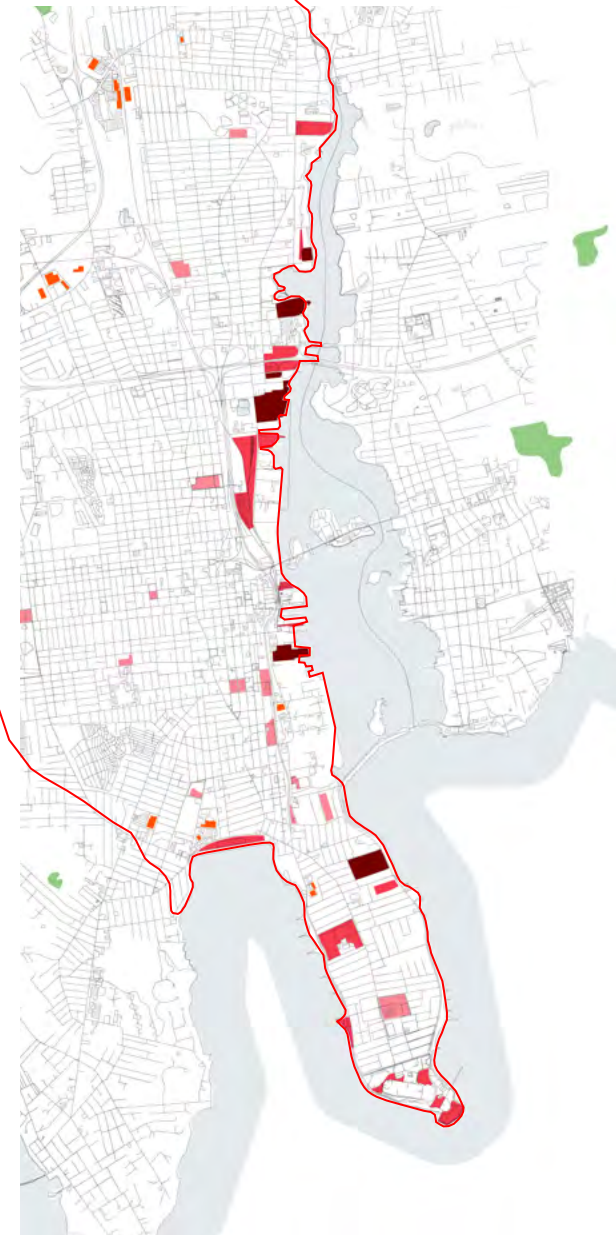


WATERFRONT UNDERUSED LANDS

city owned waterfront vacant lands

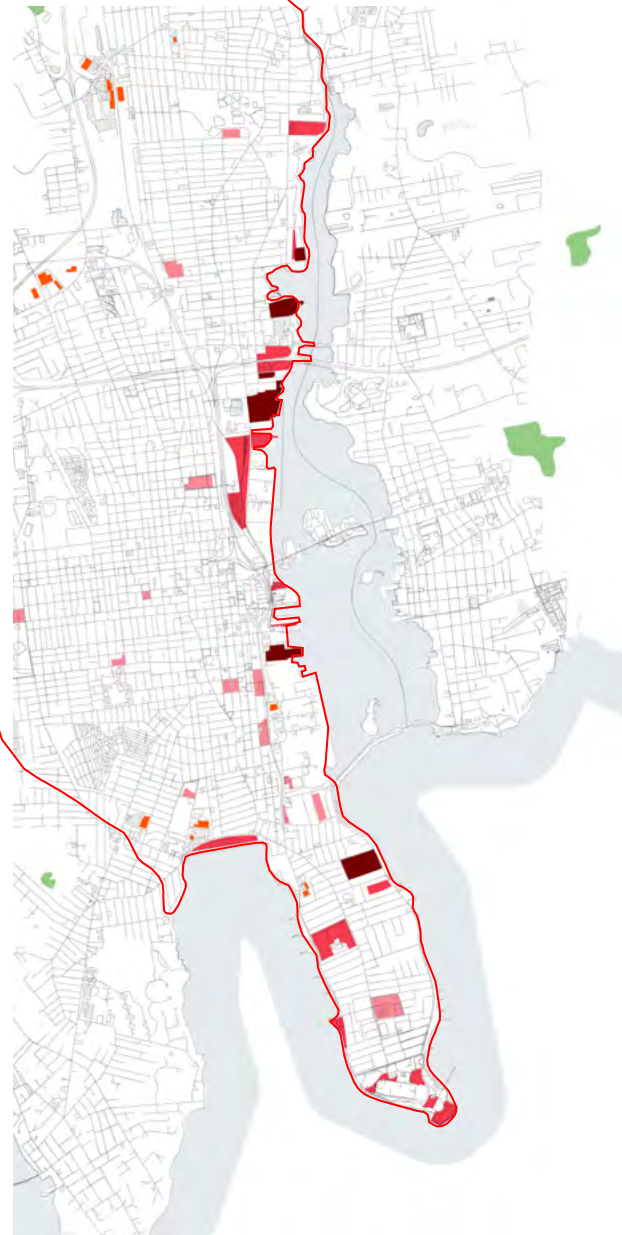


vacant industrial lands

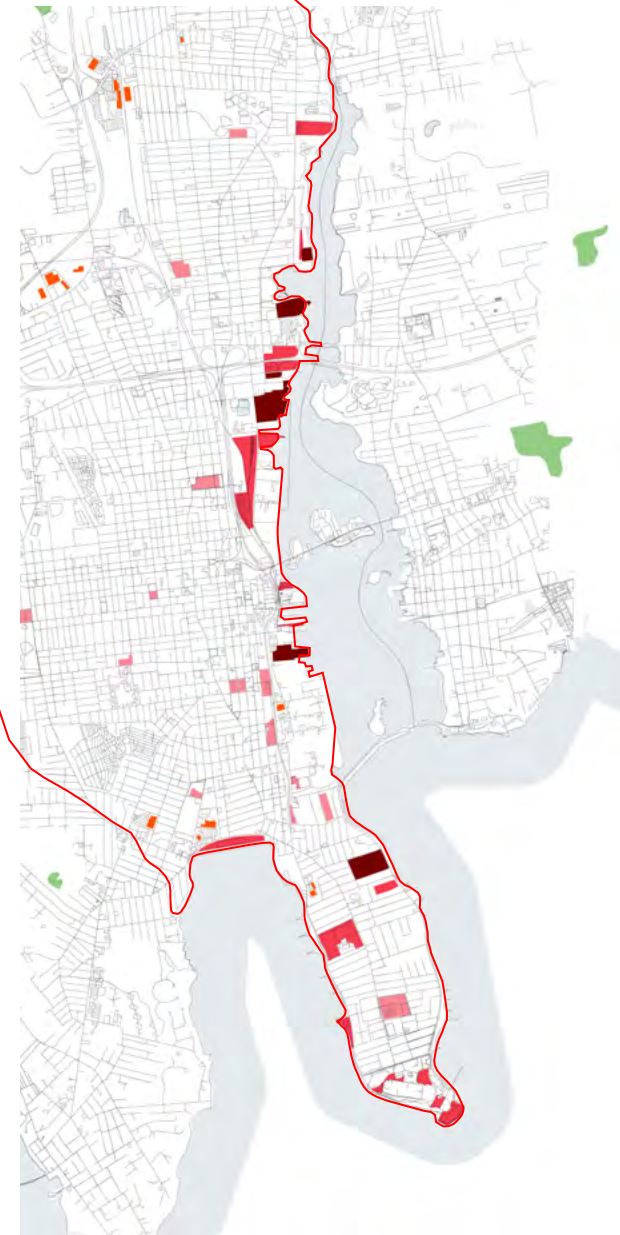


URBAN INLAND UNDERUSED LANDS

city owned underused lands

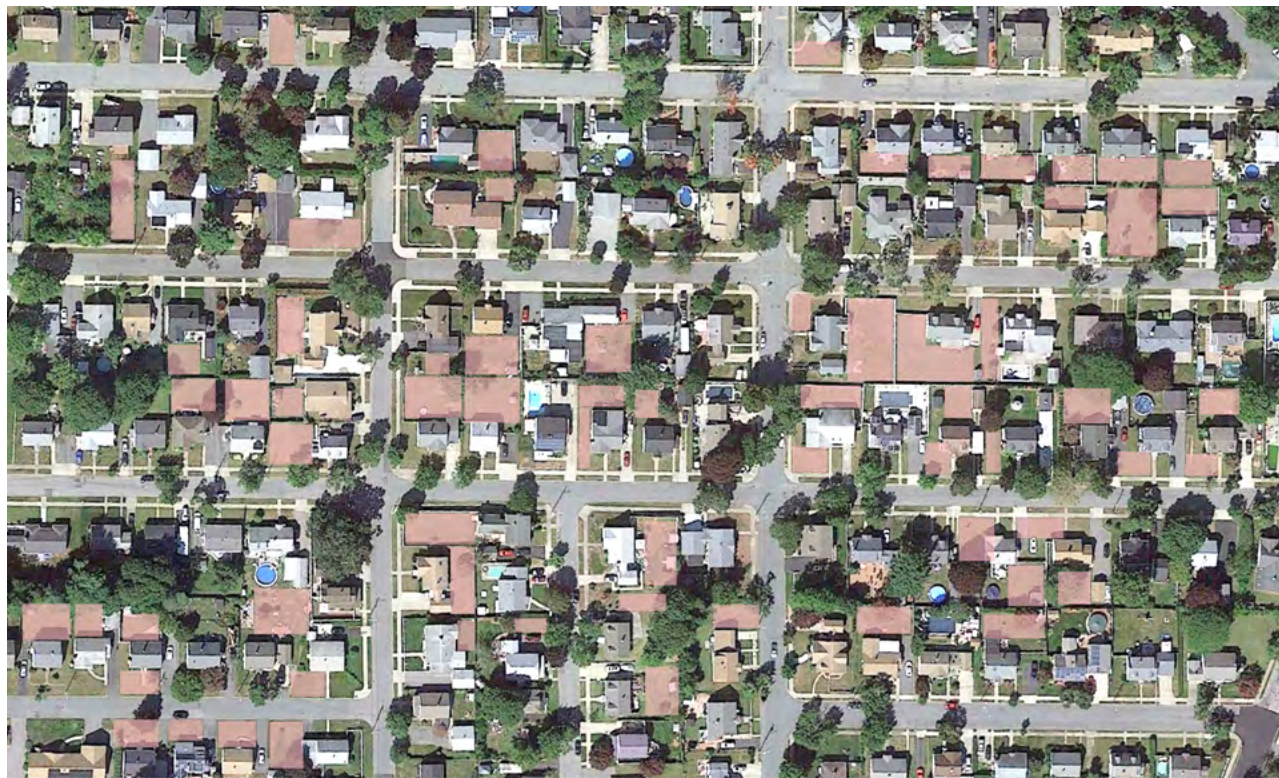
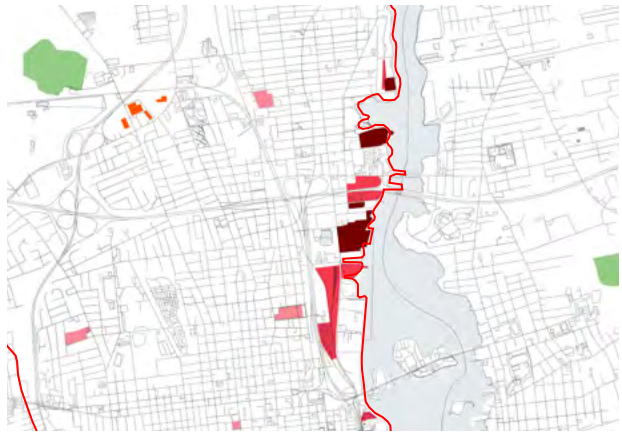


vacant industrial lands



URBAN INLAND UNDERUSED LANDS

vacant backyard lands



An underwater photograph showing a large, octagonal, wire-mesh cage suspended in the water. The cage is filled with many small fish. Several divers are visible around the cage, some appearing to be working on it. The water is clear and blue, with sunlight filtering through from above, creating a bright, shimmering effect. The overall scene suggests a marine aquaculture or research activity.

CHAPTER IV: WORKING WATER- FRONT PRODUCTIVE LANDSCAPE

Background image courtesy of Rick
Decker (photographer)

MARICULTURE AND AQUAPONICS

MARICULTURE AROUND THE WORLD

Mariculture is a specialized branch of aquaculture (which includes freshwater aquaculture) involving the cultivation of marine organisms (fish, shellfish, and aquatic plants) in saltwater. Marine aquaculture can take place in the ocean (in cages and netpens, on the seafloor, or suspended below the ocean surface) or on land in manmade systems, such as saltwater ponds or tanks³⁵.

Why mariculture? In 2016, the global population passed 7.4 billion, to feed this population traditional land-based agriculture consumes more than half of all developed

land and more than 70 percent of the world's freshwater resources. Despite this, more than 800 million people are chronically undernourished. The ocean covers more than 70 percent of the Earth's surface, yet capture fisheries and a small marine aquaculture sector produce only 2 percent of the global food supply.⁴ Mariculture is and will increasingly become an important producer of aquatic food in coastal areas, as well as a source of employment and income for many coastal communities³⁶.

However, the level of marine aquaculture in the United States is far behind the world average. China is the country with the largest production of mariculture, accounting for

half of the world's production. Mariculture production in U.S. only equals 0.3% of China's.

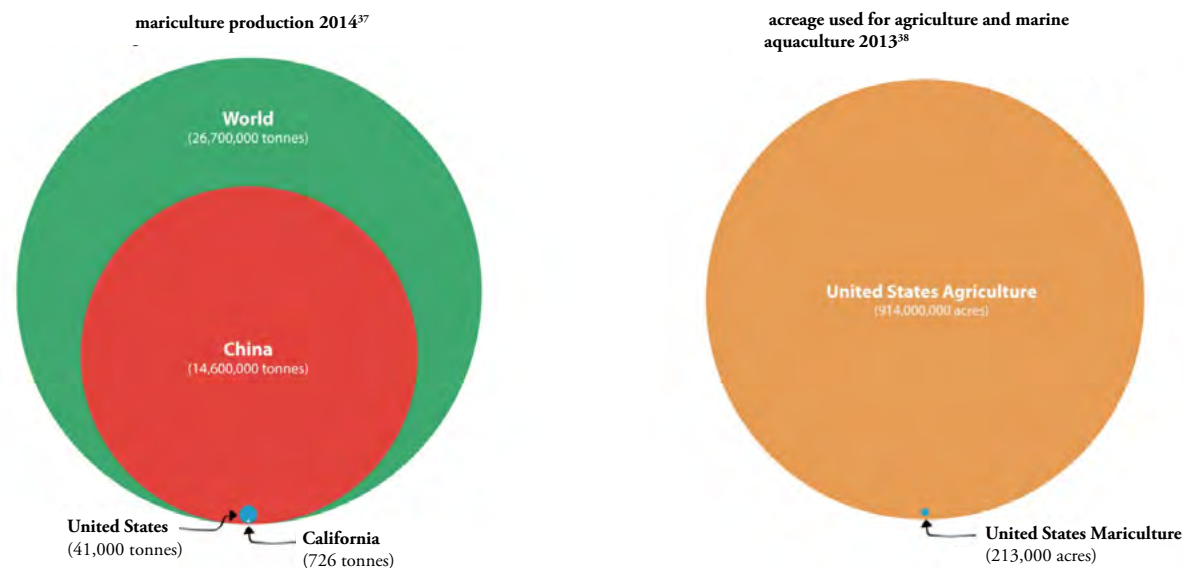
There are many reasons why the United States has not vigorously developed marine aquaculture. In terms of the ecological aspect, the ecological influences of the mariculture to ocean environment have not been determined. For example, the breeding of single species may lead to genetic pollution caused by the reduction of genetic diversity. For operators, mariculture costs more since exposed marine environments are far more technically challenging arenas⁶. That will reduce market competitiveness and have nothing to do with increasing food security. The seaside economy programs of China and the United States are also very different. There are many more leisure activities along the seashore in the U.S. than that in China which means mariculture may interrupt those activities and eventually lead to the decline of other economic formats. At the same time, the lack of understanding of fish nutrition and cooking techniques has led to people's general neutral or opposition attitude to mariculture.

Those are the challenges while trying to establish a mariculture-related project. Ecological influences, human engagements and social effects all need to be taken into consideration. It's also an opportunity to establish a well designed system as an example of those type of productive landscape as well as educating people of related knowledge.

Aquaponics has very superior characteristics in nutrient and material circulation. Using water as the medium, the waste produced by the fish becomes nutrients and will be absorbed by the plants. The water purified by the plants will be recycled back to the fish pond. Except for the nutrients that must be added in order to feed the fish and promote plant absorption, aquaponics is almost a self-sufficient system.

Combing mariculture with aquaponics is a possible solution to establish a environmental-friendly and high efficiency aquaculture system. Freshwater and saltwater production will be combined together to reach a better circulation system.

Diagram source, <https://www.arcgis.com/apps/Cascade/index.html?appid=e97ddd2cd9cf46218cefeed813e26c87>



AQUAPONICS

Aquaponics refers to a food production system that couples aquaculture (raising aquatic animals such as fish, crayfish, snails or prawns in tanks) with hydroponics (cultivating plants in water) whereby the nutrient rich aquaculture water is fed to hydroponic grown plant, involving nitrifying bacteria for converting ammonia into nitrates⁷.

MAPPING OF NEW BEDFORD HARBOR - OVERALL CONDITIONS

EXISTING FISHING INDUSTRY OF NEW BEDFORD HARBOR

New Bedford harbor is the highest value fishing port in the U.S. with a total harbor value of 431 million USD. In 2014 the Port handled 140 million pounds of domestic seafood and 250 million pounds of foreign seafood¹. From New Bedford harbor processor, the seafood can be trucked locally to wholesalers, go to a cold storage warehouse, trucked to an airport such as Boston's Logan International Airport where it is flown to various domestic and international destinations, or trucked to the Port of New

York New Jersey where it is put on container vessel to be shipped internationally. It can also be trucked from New Bedford to Worcester where it is railed out to the West Coast for export to Asia².

There is also a strong seafood processing system along New Bedford harbor with more than 30 processors and distributors and their own seafood auctions.

The support from existing fishing industries make New Bedford a perfect place to develop working waterfront productive landscapes.



ENVIRONMENTAL ISSUES OF NEW BEDFORD HARBOR

As mentioned earlier in, two electric device manufacturers used PCB and directly discharged it into the harbor during the 1940s to 1970s. That caused huge contamination to the seawater. Since then New Bedford has started its long way of environmental pollution clean up. Nowadays fishing for food is still prohibited in New Bedford harbor. There are several closure areas in the harbor. The inner harbor is the closure area 1 and is the most contaminated part. The outer harbor is the closure area 2 and the restriction of fishing there is a little looser than the inner harbor. The table below shows the safeness of seafood in those areas.

Closure Area 1

if you catch...	then...
Any shellfish, lobster, or fish, including bottom feeders	Do not eat it

Closure Area 2

if you catch...	then...
Black sea bass	Eat no more than one meal per month
All bottom-feeding fish including eel, flounder, scup, tautog	Do not eat it
Lobster	Do not eat it
Shellfish (clams, quahogs, mussels etc.)	Eat no more than one meal per month

The development of working waterfront productive landscape will also push forward the treatment of the water pollution and raise people's awareness of protecting the water environment.



[1] <https://portofnewbedford.org/commercial-fishing/>
 [2] 2018 Economic Impact Report

MAPPING OF NEW BEDFORD HARBOR - UPPER HARBOR

The upper harbor water channel is narrow and blocked by the highway bridges, there is no commercial fishing vessels and few fishing industries. If waterfront productive landscapes are developed here, they will have a more stable water environment without the disruption from large vessels. But since there is few supportive existing fishing industries, it requires more cost to build necessary facilities.



1. vacant concrete surface + industrial buildings



2. industrial buildings



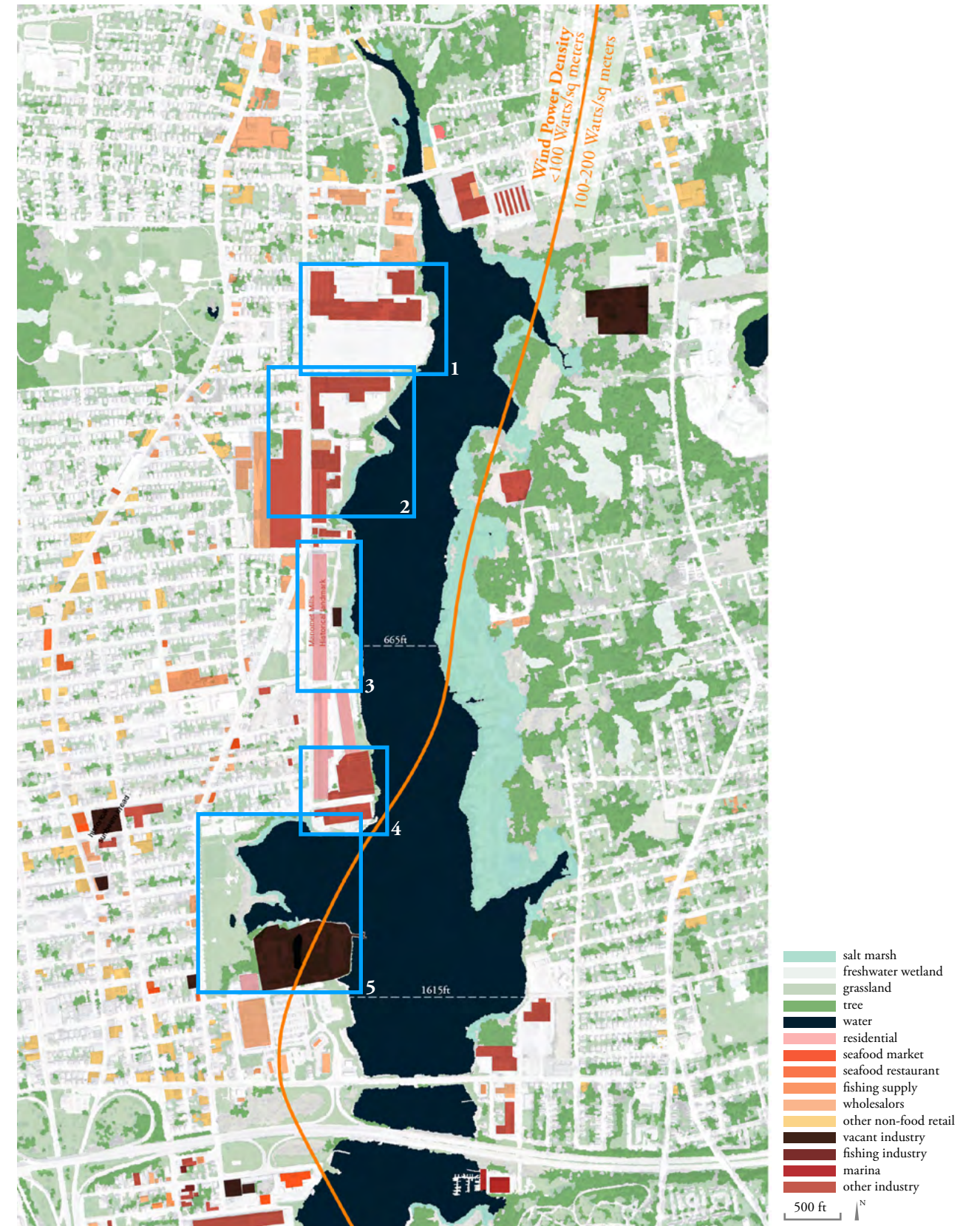
3. apartment + vacant waterfront



4. industrial buildings + vacant waterfront



5. underused industrial land



MAPPING OF NEW BEDFORD HARBOR - LOWER HARBOR

The lower harbor water channel much wider and most of the fishing industries locate along this part of the harbor. There are large commercial fishing vessels coming and going frequently bring more pollution and instability which requires protective solutions for proposed waterfront productive landscape program. Meanwhile, large-scale vacant industrial buildings and lands provide considerable potential.



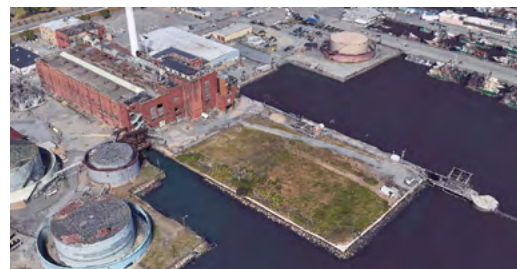
1. vacant waterfront + industrial buildings



2. fishing industrial buildings



3. underused fishing port



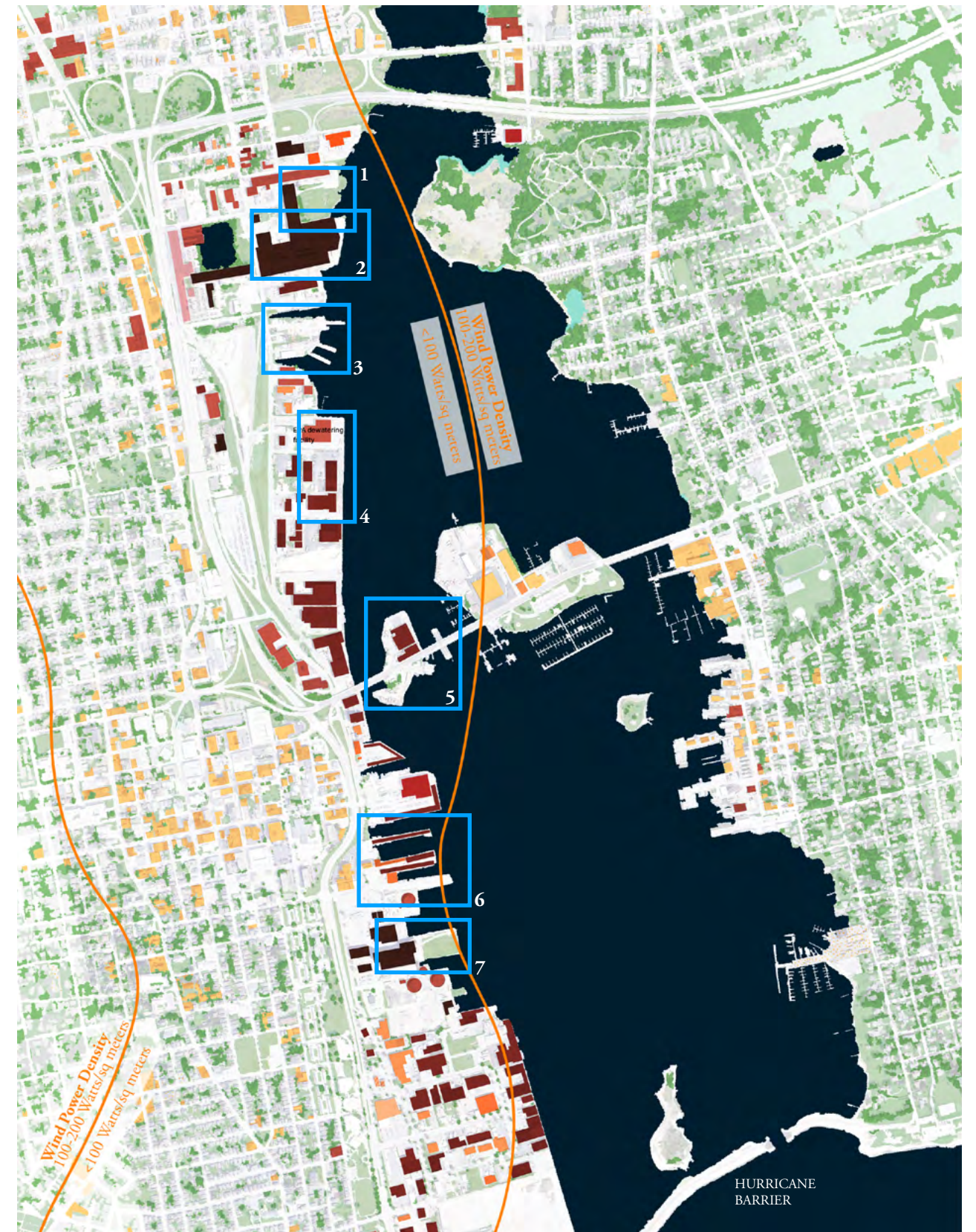
4. working waterfront + fishing industries



5. working waterfront of an island

6. working waterfront pier

7. vacant industrial building and waterfront



MAPPING OF NEW BEDFORD HARBOR - OUTER HARBOR

The outer harbor has very few industries. The water conditions of this area is the most unstable for it's open water without the protection from the hurricane barrier. The diversity of social programs are also limited. However the accessibility to the water front is very good and there are wonderful beaches which the former two parts do not have.



1. industrial buildings



2. industrial buildings



3. water treatment plant



4. vacant water front



5. beaches + public park



SITE SELECTION

In order to explore the possibility among fishing industry, social activities and productive landscapes, the site is selected in the lower harbor area where there is abundant fishing activities.

The site is an abandoned industrial land having not been used for half a decade. There is a major vacant building with the typical old-factory feature of red brick facades. This connects the “design for the future” with existing historical material reality. In terms of the waterfront side, the bare land has great potential to be developed into a fully functioning working waterfront as long as some sort of protection is added to protect the productive landscape from commercial vessels. As for the community (in-land) side, the impervious concrete surface and the poor connectivity with the surrounding neighborhood can be two major challenges. Soft landscape should be smartly designed without having to bring too much soil and new access should be provided to allow population flow in.



1. storage building



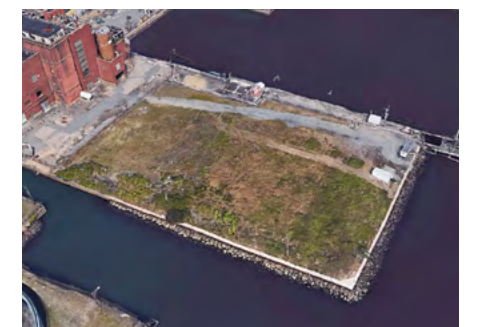
2. historical building



3. side building



4. major industrial building (vacant)



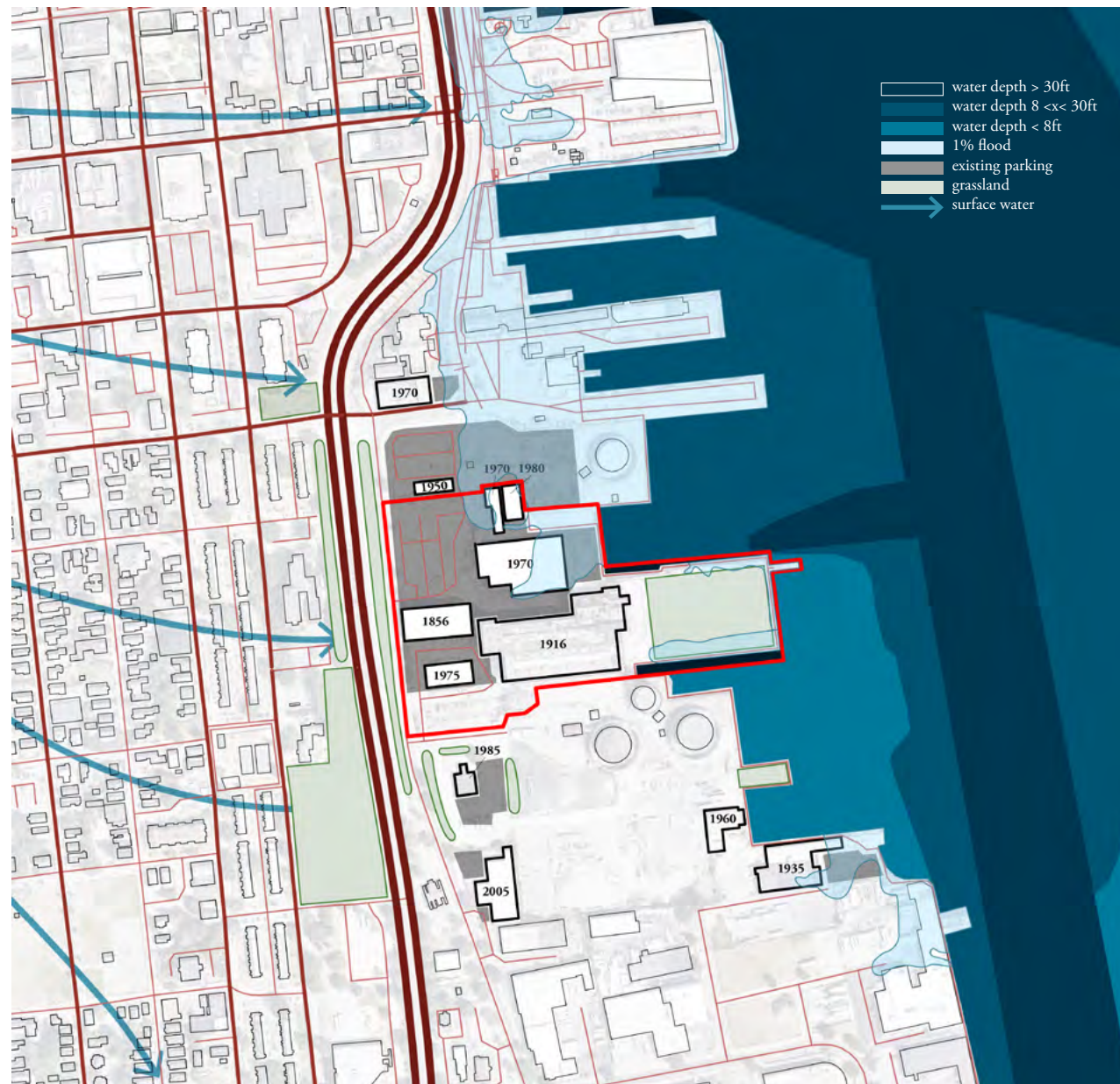
5. vacant land

SITE ANALYSIS

Advantages:
 abundant water resources
 space between the site and water channel

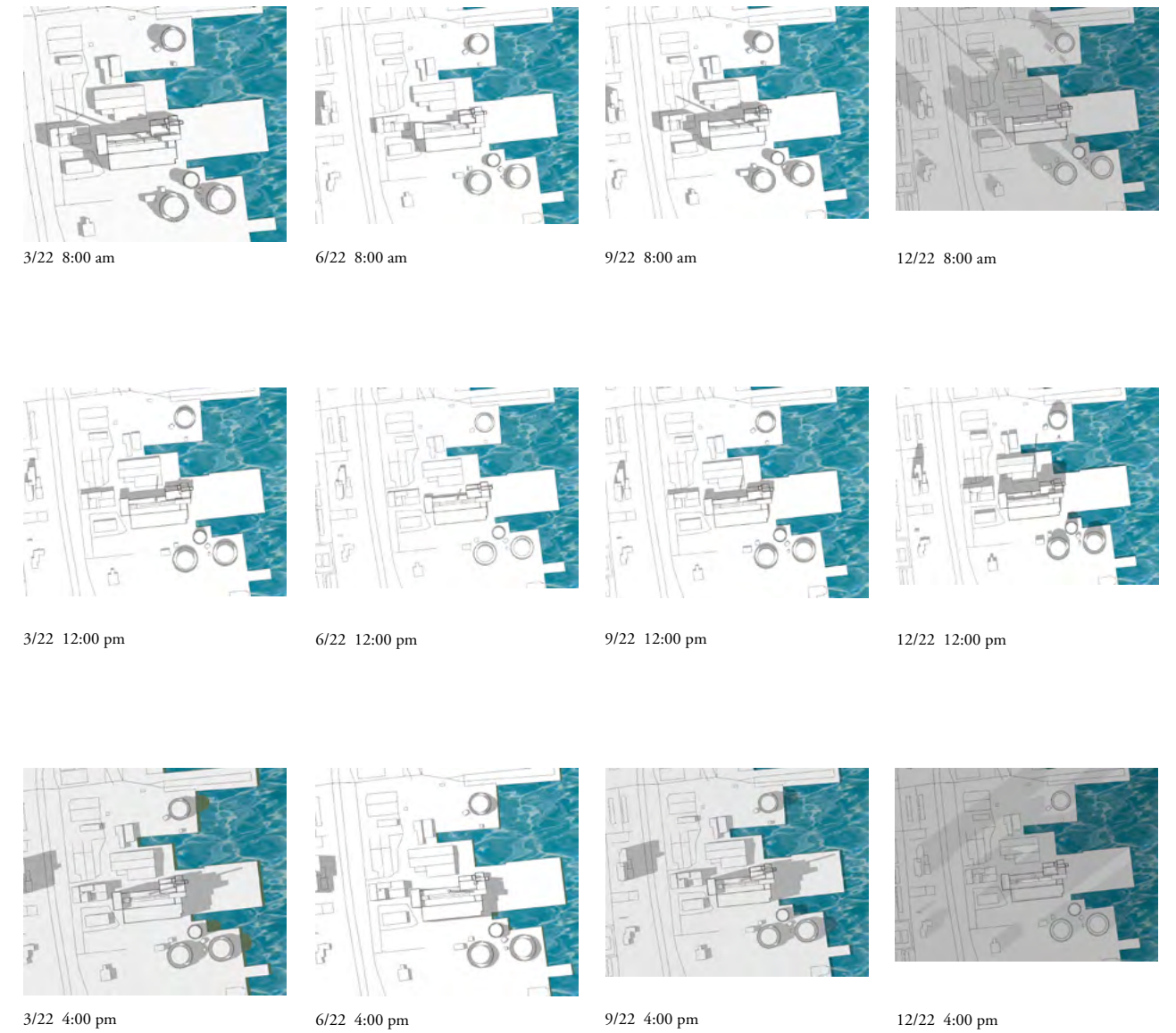
Disadvantages:
 disruption from busy water channel
 all impermeable surface on site
 1% flood challenge

mapping of water conditions



Advantages:
 sunlight-abundant areas are good for urban farming
 shade areas are good for social programs

mapping of sunlight

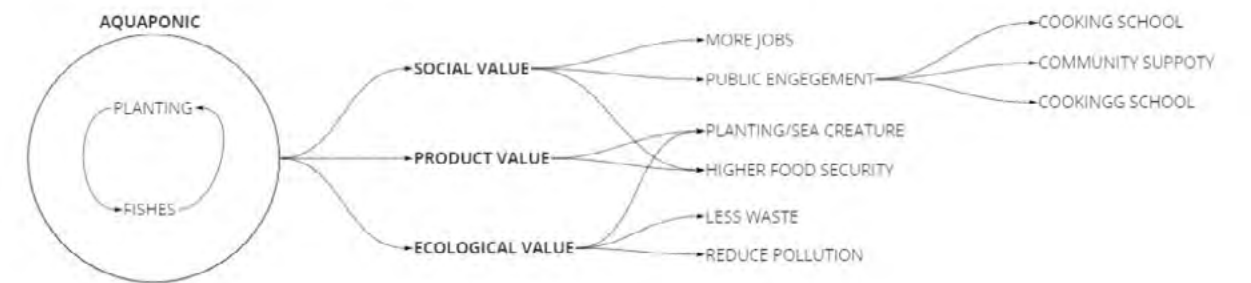


FRAMEWORK

SITE PROGRAMS

The industrial building in the center is the major feature of the site. By considering the building as the transition point, the whole site can be divided into two main sections including the community/social side which is close to the neighborhood and the production side on the waterfront. And the building offers both social programs and production programs. As they are separated by the building they will not interrupt with each other providing both the general population and the workers with an enjoyable environment and efficient working conditions.

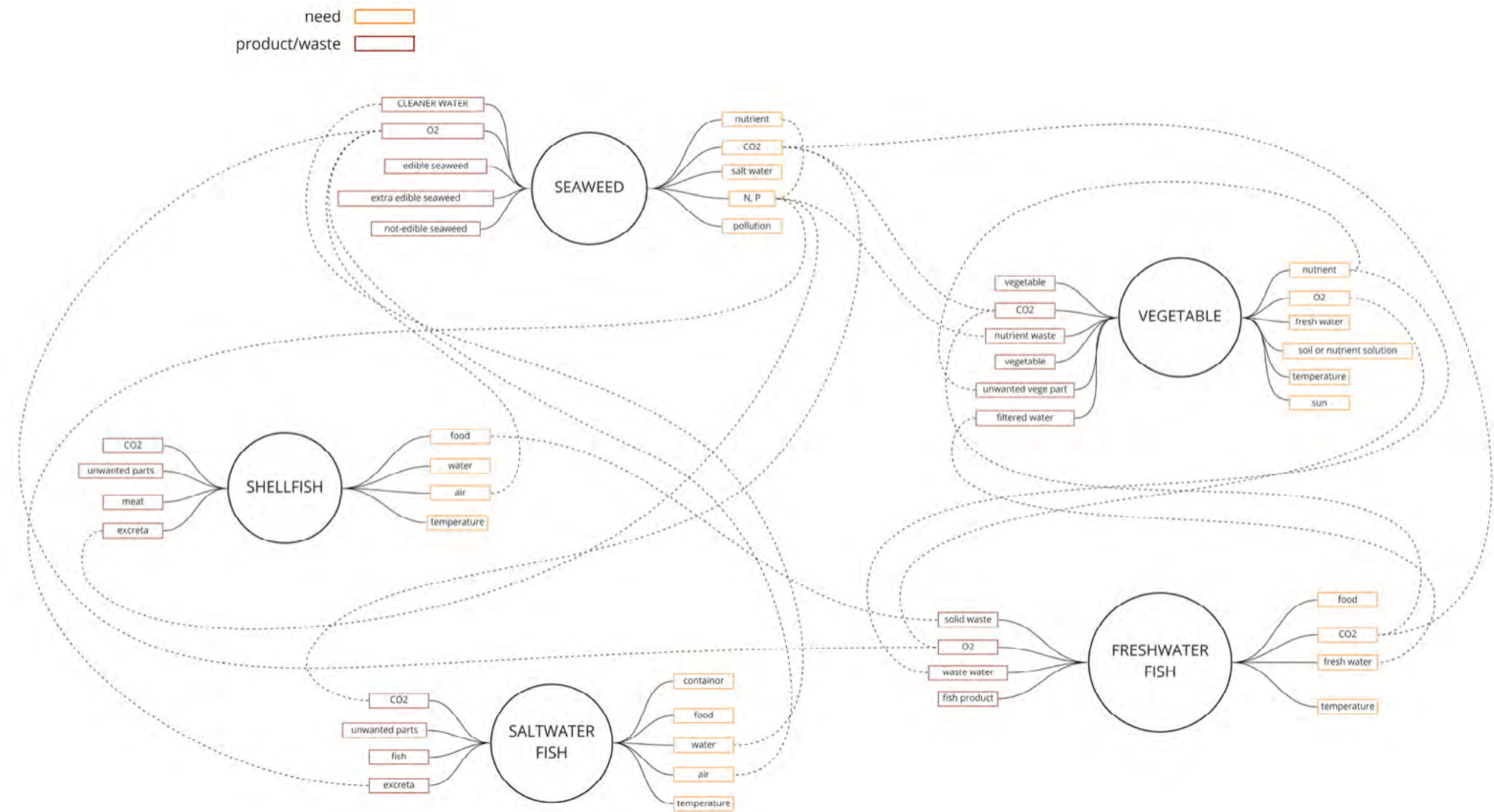
All the programs will be built up on the concept of aquaponics. On the social activity side, it will be used to bring water and greens to make the places unique and enjoyable without having to bring much soil in to build a garden. For example people will have a chance to eat in the green house with greens in the aquaponics system. That type of engagement will also be an attraction point for people to come on the site. On the waterfront side, aquaponics can offer a highly self-sufficient system saving resources and reducing environmental pollution.



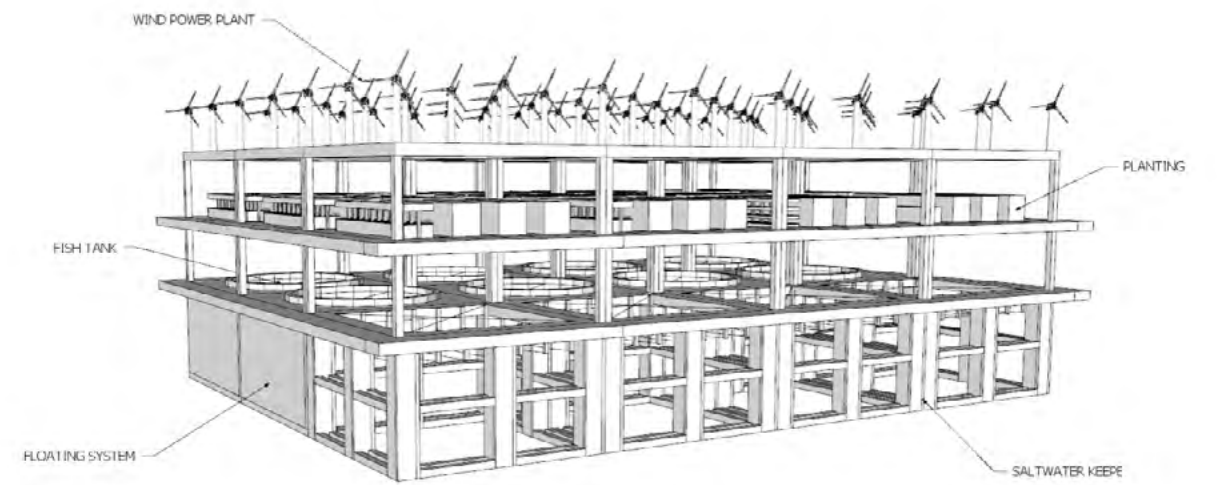
FRAMEWORK

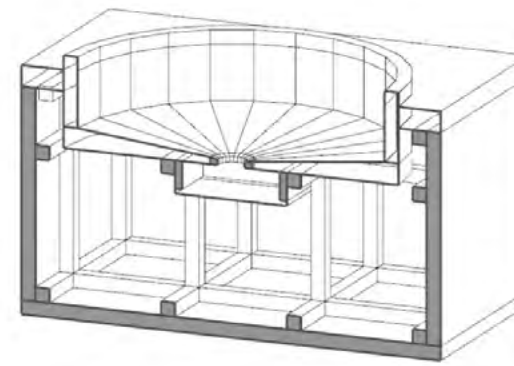
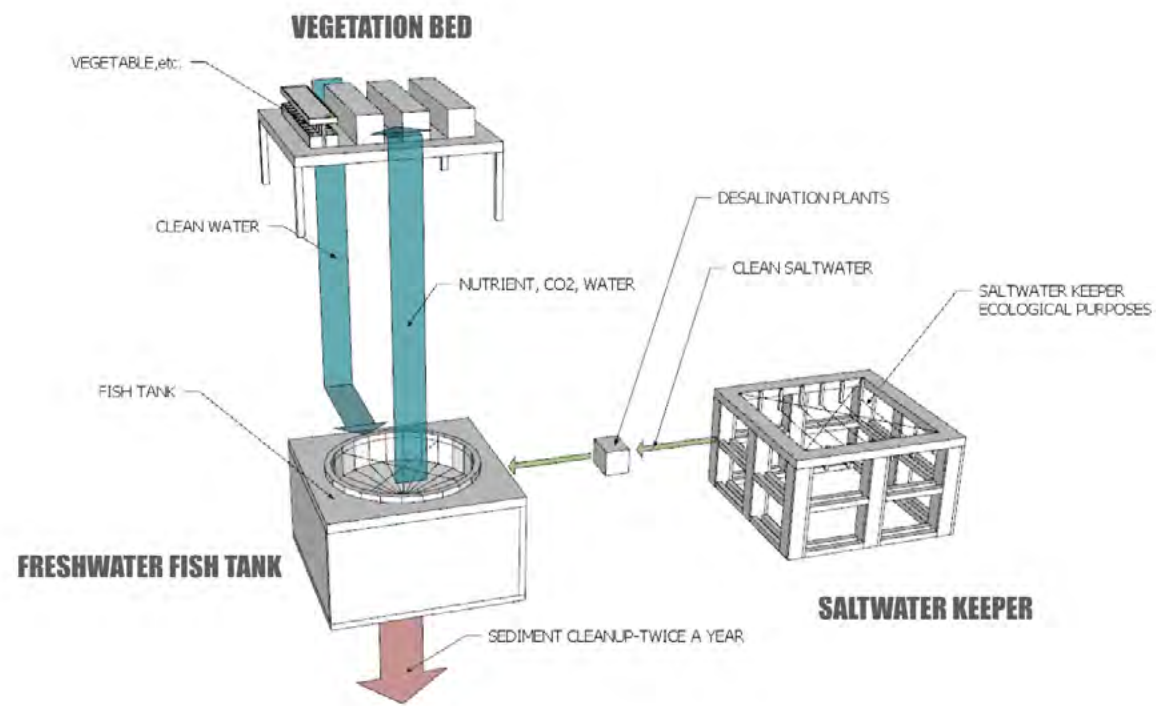
PRODUCTION SYSTEM

The diagram shows the resource circulation among the products by linking the “waste” and “production” together. The waste from fish can be nutrients for plants. Water can be self-cleaned for a long time within the system. Also by combining saltwater production into the system, it can benefit both the open sea environment and the system itself.

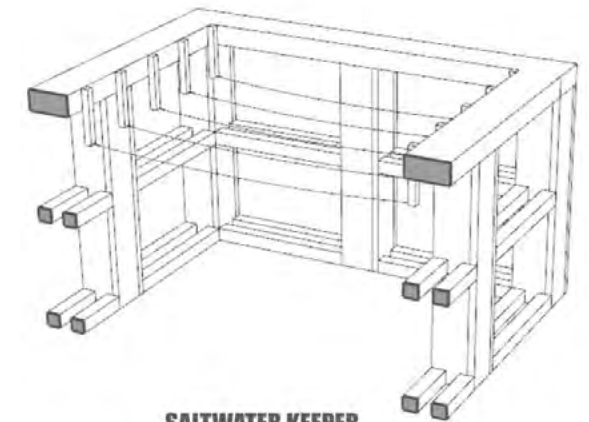


PRODUCTIVE PROGRAMS

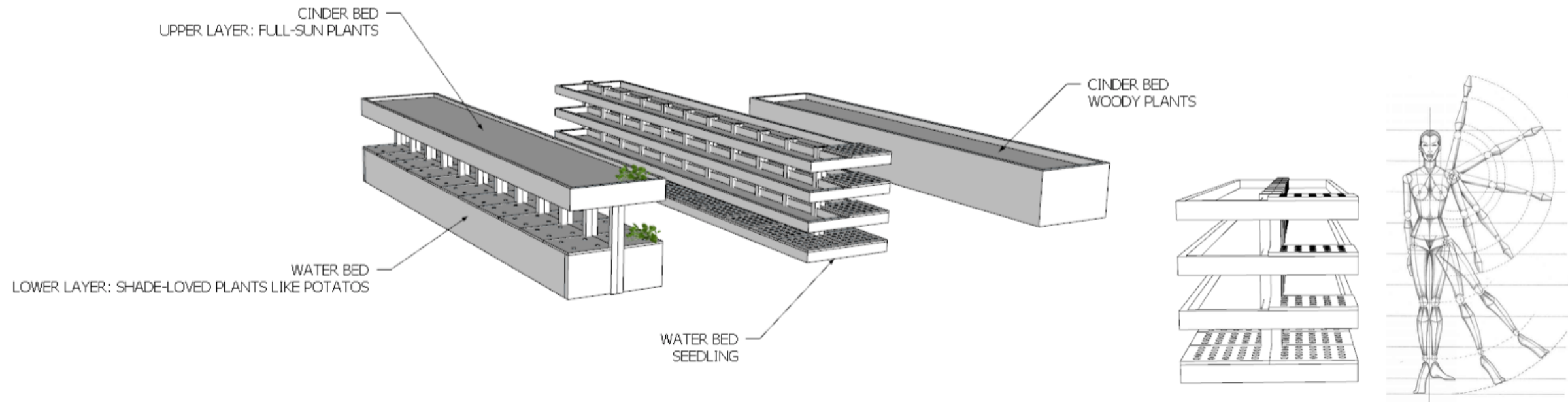




FRESHWATER FISH TANK



SALTWATER KEEPER



Coastal Southern California Planting Calendar

VEGETABLE	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Basil												
Beans, bush												
Beans, pole												
Beets												
Bok Choy												
Broccoli												
Brussels Sprouts												
Cabbage												
Carrots												
Cauliflower												
Celery												
Chard												
Chives												
Cilantro												
Collards												
Corn												
Cucumber												
Dill												
Eggplant												

Garlic												
Kale												
Leeks												
Lettuce or Mesclun												
Mustard Greens, Mizuna, Komatsuna												
Onions, bulb												
Onions, bunching (green onions, scallions)												
Parsley												
Peas, English, Snow, or Sugar Snap												
Peppers, Sweet or Hot												
Potato												
Pumpkin												
Radish												
Spinach												
Squash, Summer												
Squash, Winter												
Sweet Potato												
Sunflower												
Tomato												
Watermelon												

These months best for planting
 Plant in first or last half of month, as appropriate



REFLECTIONS

Throughout the process of working on the topic, the hardest part for me is to frame the topic. At the beginning, I was so ambitious about including a lot of aspects into the topic. And finally the food system became my focus. Actually the topic is still big and would not be possible for me to do designs. But as the analysis kept going and the picture of “a design for the future” is becoming more and more clear. But it was still late since the design was not even finished when it was time for final review. Thanks to Emily and all the other professors who cleared the way of this project of which it is going.

As for the topic itself, it makes me pay more attention to normal things and think about the bigger system behind it. With a certain level of understanding of the system, the designs can become more reasonable. Landscape architecture is a combination of science and imagination. Starting from utopia and then runs into data analysis and finally into space development, it's a hard but helpful process for me. It helps frame possible solutions to existing conditions. And that is not the end but the starting point for more scientific analysis and aesthetic imaginations. For example, to make the floating farm work, there is much research that needs to be done in terms of how much nutrients are really recycled and so on.

If this new landscape is really coming out, it's necessary to negotiate with engineers, aquaponics specialists, marine environment specialists, economists and the government. Engineers will figure out the structure of the physical farm. Aquaponics and marine specialists will be responsible for making the farm system work. The government and economists will determine how this new type of landscape can be linked with the local economy.

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