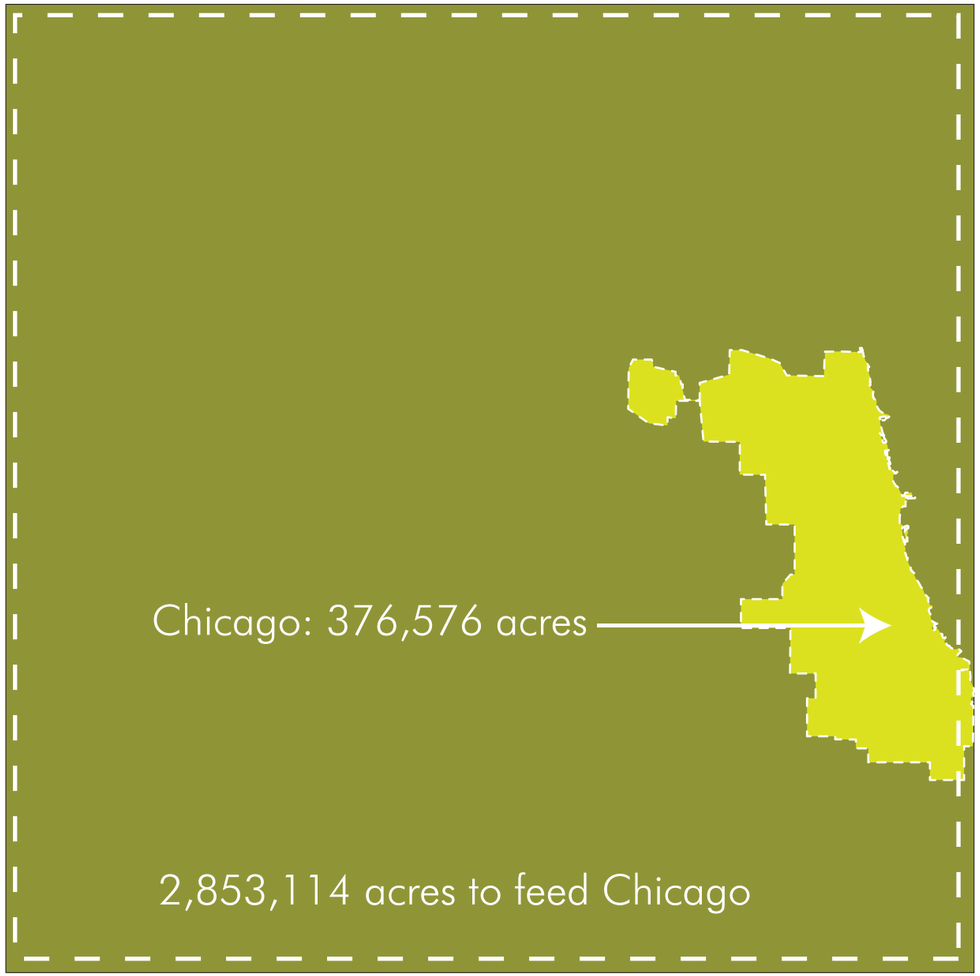


AEROPONIC AGRICULTURE IN CHICAGO

Charles Maceachen, Spring 2010

CURRENT PRACTICES

OTHER EXAMPLES

AEROPONIC EXAMPLES

PROGRAM

EXISTING SITE

DESIGN PROPOSAL

EXPANSION MODEL

RESOURCES

IRRIGATION CIRCLES
FINNEY COUNTY,
KANSAS

PHOTO VIA TEXAS A&M
DEPT OF GEOSCIENCES

why urban agriculture?

water use:

98% of all water used for industrial agricultural irrigation is lost to evaporation and ground absorption.

WATER USE
AND
FOOD MILES

transportation:

More than 80% of the US population now lives in cities.

US produce travels an average of 1500 miles from rural farm to urban consumer, mostly by truck.

why urban agriculture?

pollution:

agricultural runoff is a significant source of
water pollution

pesticides seep into groundwater and run
into streams and rivers contaminating drinking water and killing wildlife (e.g. DDT)

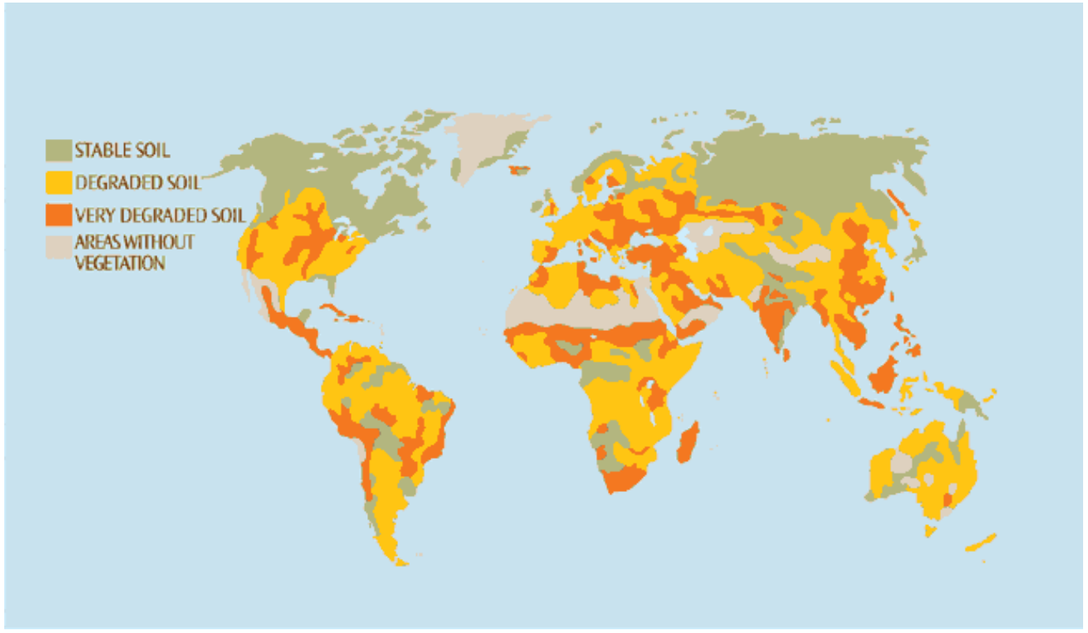
fertilizers run off into waterways causing massive algae blooms which deplete the water of oxygen and block out sunlight, killing other life.

why urban agriculture?

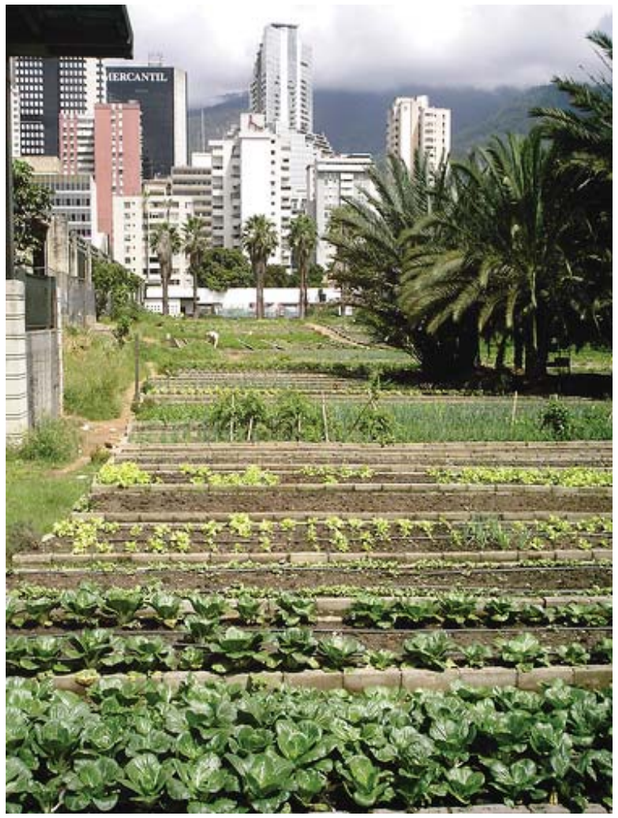
land use:

according to the UN FAO, 80% of the planet's arable land is already in use.

industrial farming techniques have seriously
degraded soil quality, resulting in ever increasing fertilizer use.



LAND USE



With the collapse of the Soviet Union in the early 90's, Cuba lost its main source of fuel and equipment, including farm machinery. Because it quickly became too expensive, or nearly impossible, to move produce from rural farms to the city of Havana, the city introduced a massive urban farming initiative which included free land for farmers and education on farming tecniques for the city's residents. Today, there are over 87,000 acres of farm land located within Havana itself. The city produces over half of the produce it consumes. This is all done using traditional soil farming by hand. And, because chemical fertilizers and pesticides are too expensive, everything is grown organically.

URBAN FARMING
IN CUBA

OE

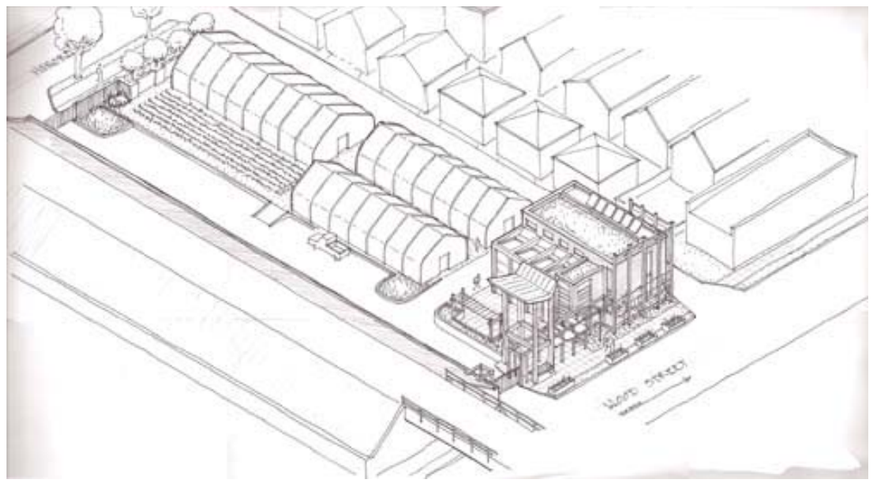
OTHER EXAMPLES

The South Central Community Garden in Los Angeles was a 14 acre vacant industrial site that the people of South LA took on as a community garden in 1994. It served 350 families until 1996 when the new owner of the site bulldozed the gardens. It was often called the largest urban farm in the United States.

SOUTH CENTRAL LA COMMUNITY GARDEN

TOP RIGHT:
BLACK VALLEY FILMS
BOTTOM RIGHT:
FLICKR USER
STILLTHEDUDEABIDES
BOTTOM LEFT: NASA

OE



Growing Home is an urban farm located in the South side of Chicago. They provide training and jobs for the homeless and low-income.

In 2008, their Wood Street site produced over 5,000 pounds of fresh vegetables. They expected to produce over 10,000 pounds in 2009.

GROWING HOME CHICAGO

VERTICAL
FARMING
EXAMPLES

Mithun's entry for the GBG Living Building Challenge

Blake Kurasek's "The Living Skyskraper"

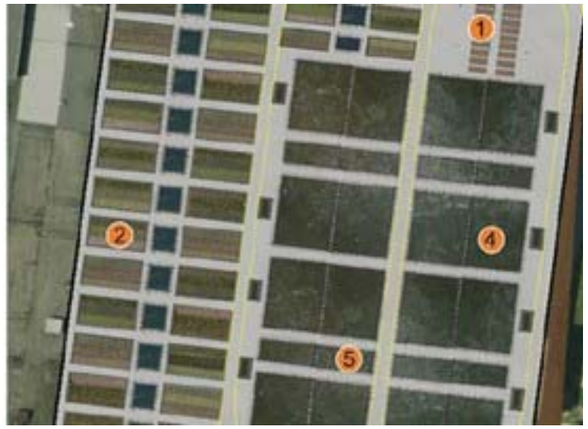
SOA Architects "The Living Tower"

PROPOSED BUILDING LAYOUT
LORAIN, OHIO

1 **Vermiculture & Composting (22 EA, 30 Yard Bins)**

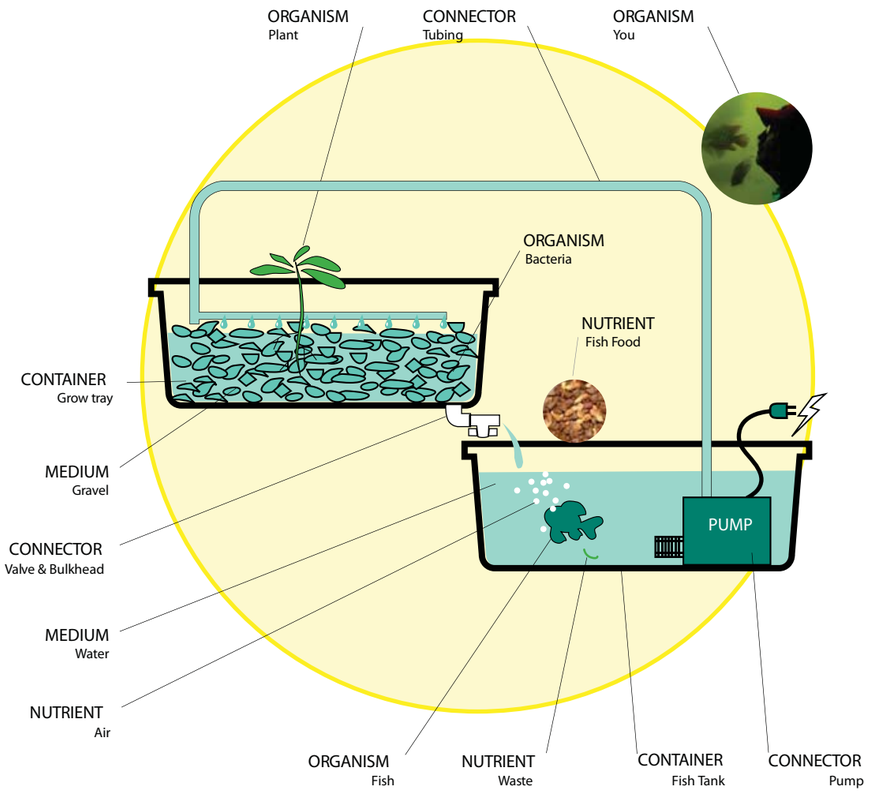
2 **Aquaponics Planting Beds (86,000 SF)**

3 **Aquaponics Fish Production (303,743 Gallons)**

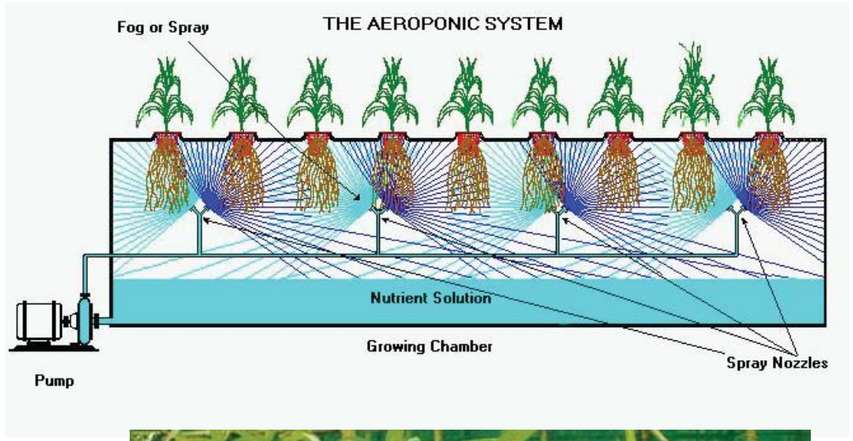


Bevan Suits of Sustainable Design Group and Access to Aquaponics is teaming up with others to convert an industrial site in Lorain, Ohio to an Aquaponics facility. There are further plans to open a new 55,000 aquaponics greenhouse near Boulder, Colorado.

The process of aquaponics involves growing fish and vegetable in a recirculating, self contained loop. Each fertilizes and feeds the other creating a low-imput, high-output system.



AQUAPONICS IN OHIO



Aeroponics is a system for growing plants which utilizes a method of spraying the roots with a fine solution of water and nutrient. The roots are left to freely hang within the mist, providing access for oxygen and the nutrient solution.

This method is different from hydroponics in that the roots are free, rather than being submerged in water and gravel or some other medium.

Advantages:

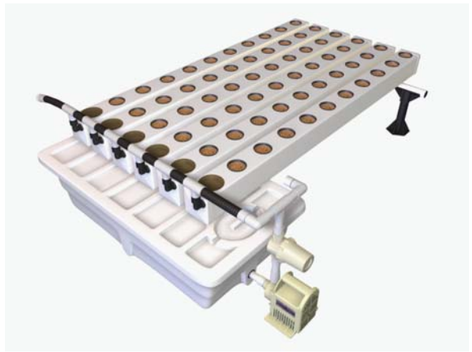
-Up to 95% reduction in water usage
-Closed loop and controlled environment

AE

AEROPONIC
EXAMPLES

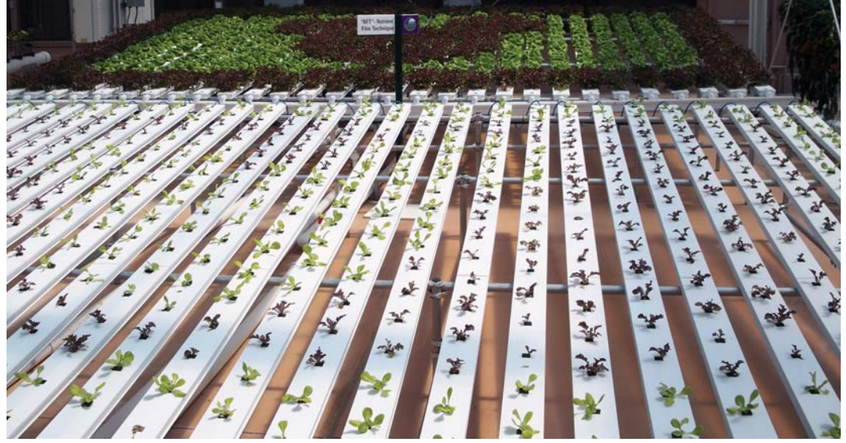
In 1997 NASA and AgriHouse, inc. began looking at aeroponic technology as a possible way to feed astronauts on long missions or even future colonies. Together, they developed a light, inflatable aeroponic device that could be easily set up during a mission and required minimal space in transit. Experiments undertaken on the MIR space station proved the project a success and it is still ongoing.

AgriHouse, inc. has gone on to become the largest manufacturer of aeroponic systems. Complete systems like the aeroflo2 are modular and can be combined at any scale.



NASA AND
AGRIHOUSE
INITIAL DESIGNS

AE



The Epcot Center at Walt Disney World has an exhibition of current aeroponic agriculture technology. The food grown here is used in Disney World restaurants.

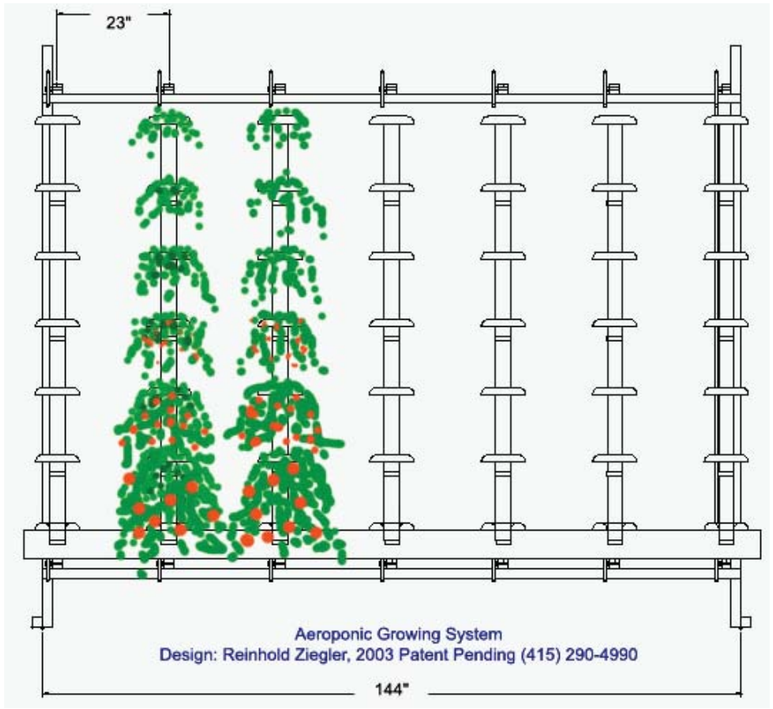
AEROPONIC
EXAMPLES
AE

EPCOT CENTER
AEROPONIC
DEMONSTRATION

AE
03

A company out of Sausalito, CA is currently seeking investment for a system they are calling the Bioshelter. This is essentially a greenhouse enclosing a modular aeroponic system. It is designed to be placed on vacant sites in an orientation where sun access is maximized.

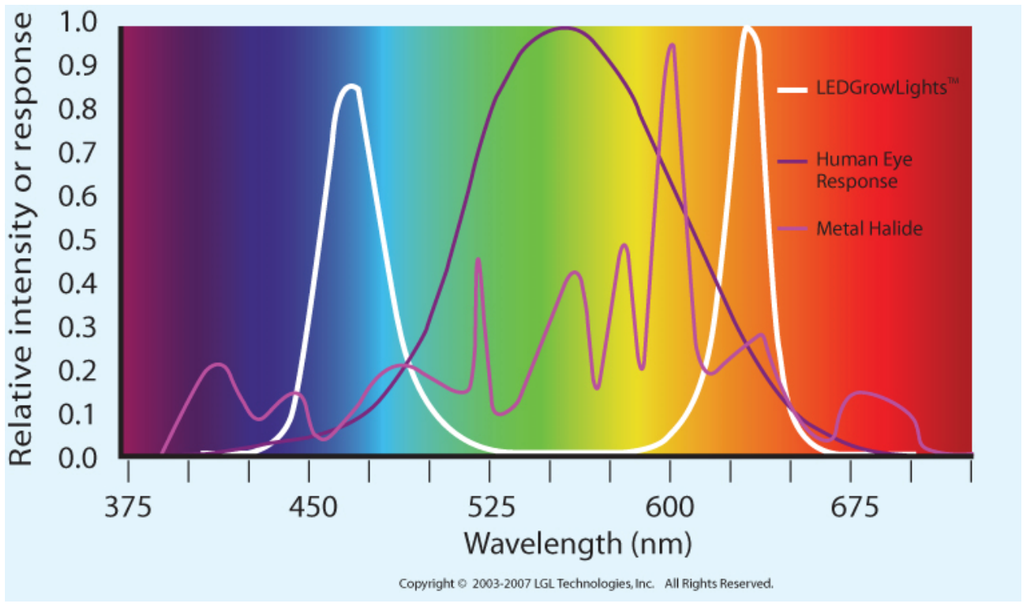
There are 6 growing levels that are rotated throughout the growing cycle for ease of harvesting and to provide more light for younger plants.



BIOSHELTER

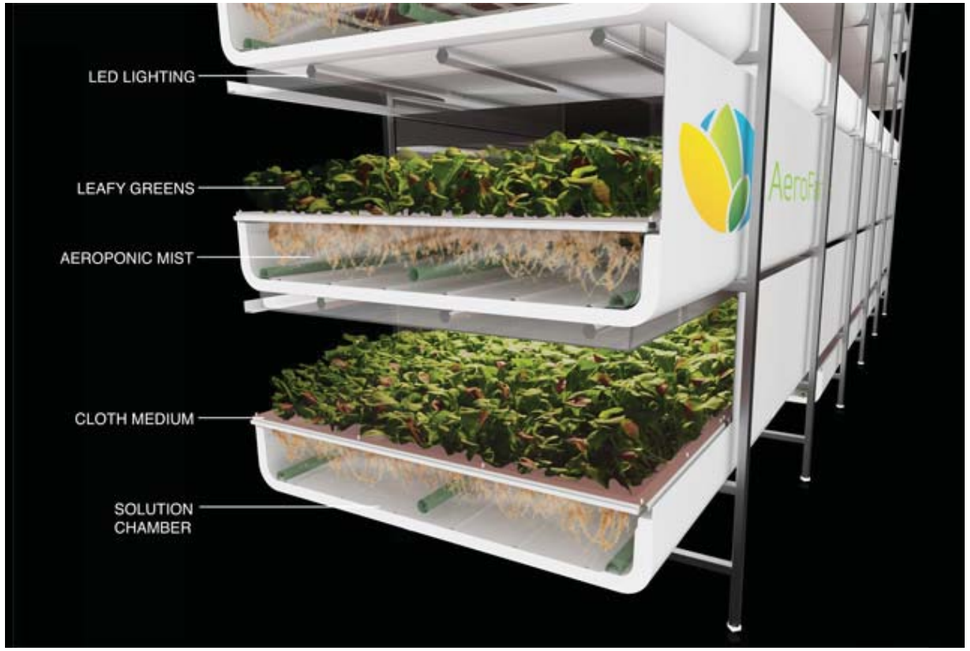
ALL IMAGES:
REINHOLD ZIEGLER

LED Testing Array



LEDs can be tuned to the specific wavelengths to which Chlorophyll is most receptive.

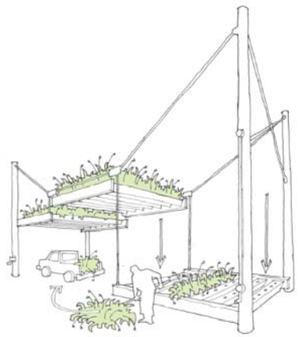
AeroFarms is a relatively new company that just received $500,000 in venture funding. Their aim is to provide startup services including consultation, clients, equipment, and installation of Aeroponic equipment. Their focus is the conversion of existing industrial and warehouse spaces into aeroponic farms. They have conducted extensive testing and development of new types of aeroponic growers as well as LED lighting to mitigate the cost of conventional grow lights.



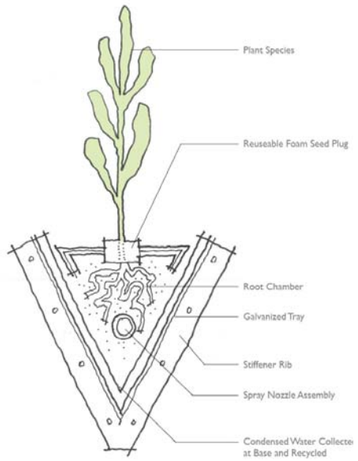
AEROFARMS

AE AEROPONIC EXAMPLES

For the Reburbia 2008 competition, architecture firm Miller Hull proposed covering existing parking lots in strip malls and big-box retail with a suspended aeroponic system. The proposal included a system for raising and lowering individual sections for harvest and maintenance as well as using wind mills to pump the water / nutrient solution throughout the site.



AERIAL FARM
Even in the harsh Arizona desert, bumper crops of corn, flax, and cotton will thrive by utilizing aeroponics. A method of growing plants without soil and utilizing a vapor mist to deliver water and nutrients into a sealed root chamber, aeroponics require only a fraction of the amount of water required for traditional farming. Because the system does not require soil, it can be very lightweight and even elevated. Windmills on select poles pump water and pressurize the system for low wind periods.



CROP TRAY DETAIL
Galvanized sheet metal growing chambers span between structural supports using their distinctive "V" shape. The chambers are sealed to contain the nutrient mist that sustains the plants. The mist system is constructed through commercially available off-the-shelf equipment.

AEROPONICS ELEVATED PLANTS WITHOUT SOIL

MILLER HULL'S 2008 REBURBIA COMPETITION ENTRY

ALL IMAGES: MILLER HULL PARTNERSHIP

The project will reuse an existing and currently vacant light Industrial / warehouse space. This space must provide a confortable working environment for those who spend their days here as well as provide ample work space for aeroponic agriculture. In addition to those who work here, community outreach and teaching program will invite members of the community into both the workshop rooms as well as the grow rooms. An outdoor area suitable for, or able to be made suitable for, traditional soil-based farming would be ideal as it would provide an external identity for the project. This is, however, not necessary. If a prospective building meets the essential requirements for the program, but lacks an external gardening area, the building should still be considered. This is especially true on the North side of Chicago where exterior areas of this nature are much more rare.

Due to the tight connection with the community, it is imperitive that any building chosen for this project be near a residential neighborhood. Density, however, is not necessarily a defining characteristic since density is constantly changing and one of the hopes for this project is that it will help bring back some life to languishing neighborhoods.

SUPPORT SPACES

ELECTRICAL	1 @ 2000 SF total of 2000 SF	

must accomodate posible solar / wind electical generation

MECHANICAL	1 @ 2000 SF total of 2000 SF	

must accomodate posible solar thermal, etc.

SEED STORAGE	1 @ 200 SF total of 200 SF	

stable, cool temperature, low humidity, low light

PRODUCE STORAGE	1 @ 800 SF total of 800 SF	

stable, cool temperature, low humidity, low light

LAUNDRY	1 @ 150 SF total of 150 SF	

space for a couple clothes washers / dryers

MISC STORAGE	1 @ 600 SF total of 600 SF	

long-term janitorial, other equipment

SECTION TOTAL: 5750 SF
+10 % GROSS: 6325 SF

MAIN LEVEL SPACES

1 @ 1000 SF
total of 1000 SF

LOBBY / OUTREACH

lobby area with display / info

5 @ 200 SF
total of 1000 SF

OFFICES

office space for admin

2 @ 800 SF
total of 1600 SF

CLASSROOMS

multi-use rooms for a variety of kinds of instruction

1 @ 1200 SF
total of 1200 SF

CONFERENCE ROOM

large, central table, able to seat 12 with projection screen

1 @ 500 SF
total of 500 SF

LIBRARY

small storage and study space for books and other media

1 @ 250 SF
total of 250 SF

KITCHEN

for preparing in-house-grown produce for events as well as instruction
also for employee use

MAIN LEVEL SPACES

BREAK ROOM — 1 @ 300 SF, total of 300 SF

room for employees, adjacent to kitchen and offices

PUBLIC REST ROOM — 2 @ 400 SF, total of 800 SF

mainly for visitor use

PRIVATE REST ROOM — 2 @ 100 SF, total of 200 SF

mainly for employee use

SHOWERS — 2 @ 200 SF, total of 400 SF

private showers allowing employees to bike to work and for use after working in the garden

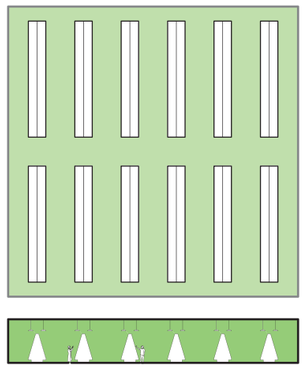
---

STORAGE — 1 @ 300 SF, total of 300 SF

janitorial and other storage, includes janitorial sink

SECTION TOTAL: 7550 SF
+10 % GROSS: 8305 SF

PRODUCTION SPACES



GROW ROOM — 3 @ 10000 SF, total of 30000 SF

large rooms for aeroponic equipment
overall area and layout of these rooms is extrememly flexible
but 30,000 SF overall is the least amount of space needed

STORAGE — 3 @ 500 SF, total of 1500 SF

equipment storage directly related to aeroponics
one storage room accessible from each grow room

ROOF LEVEL GREENHOUSE — 1 @ 2000 SF, total of 2000 SF, or as available

multi-use rooms for a variety of kinds of instruction

SECTION TOTAL: 33500 SF
+5 % GROSS: 35175 SF

BUILDING TOTAL: 49,805 SF

EXTERIOR SPACES

TRASH / RECYCLING PICKUP — 1 @ 1000 SF
RECYCLING DROPOFF — total of 1000 SF
COMPOST DROPOFF

adjacent to driveway or parking lot

GREENHOUSE — 2 @ 400 SF, total of 800 SF

a non-critical component which may be removed
if space does not allow

PLANTING BEDS — as available

for traditional growing, a non-critical component

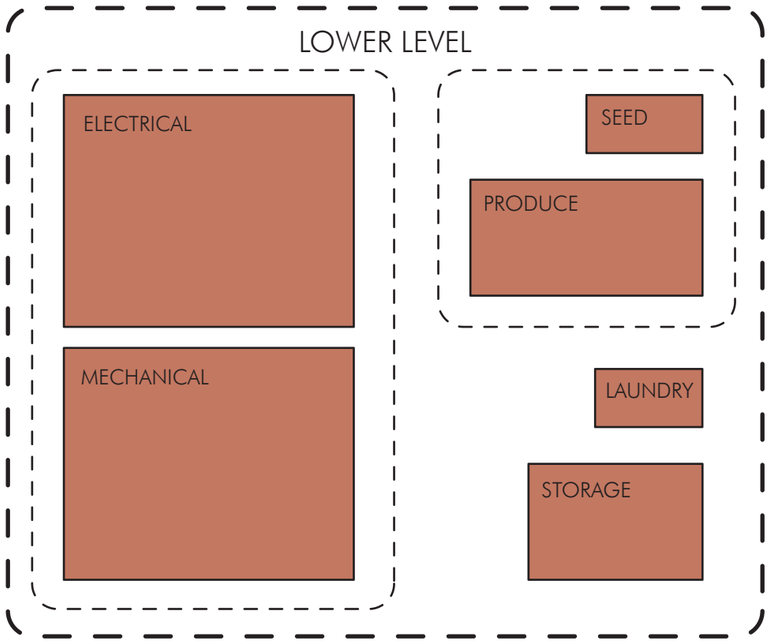
PARKING — as available

a non-critical component

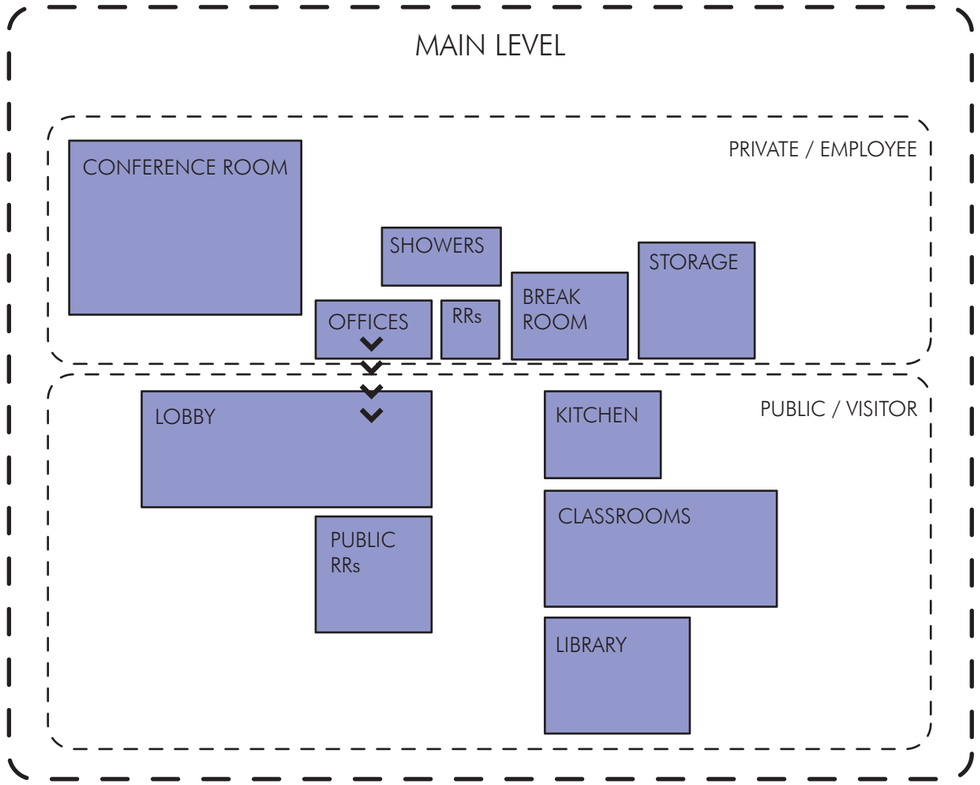
EQUIPMENT STORAGE — 1 @ 500 SF, total of 500 SF

storage related to exterior building upkeep and exterior
farming if those components exist

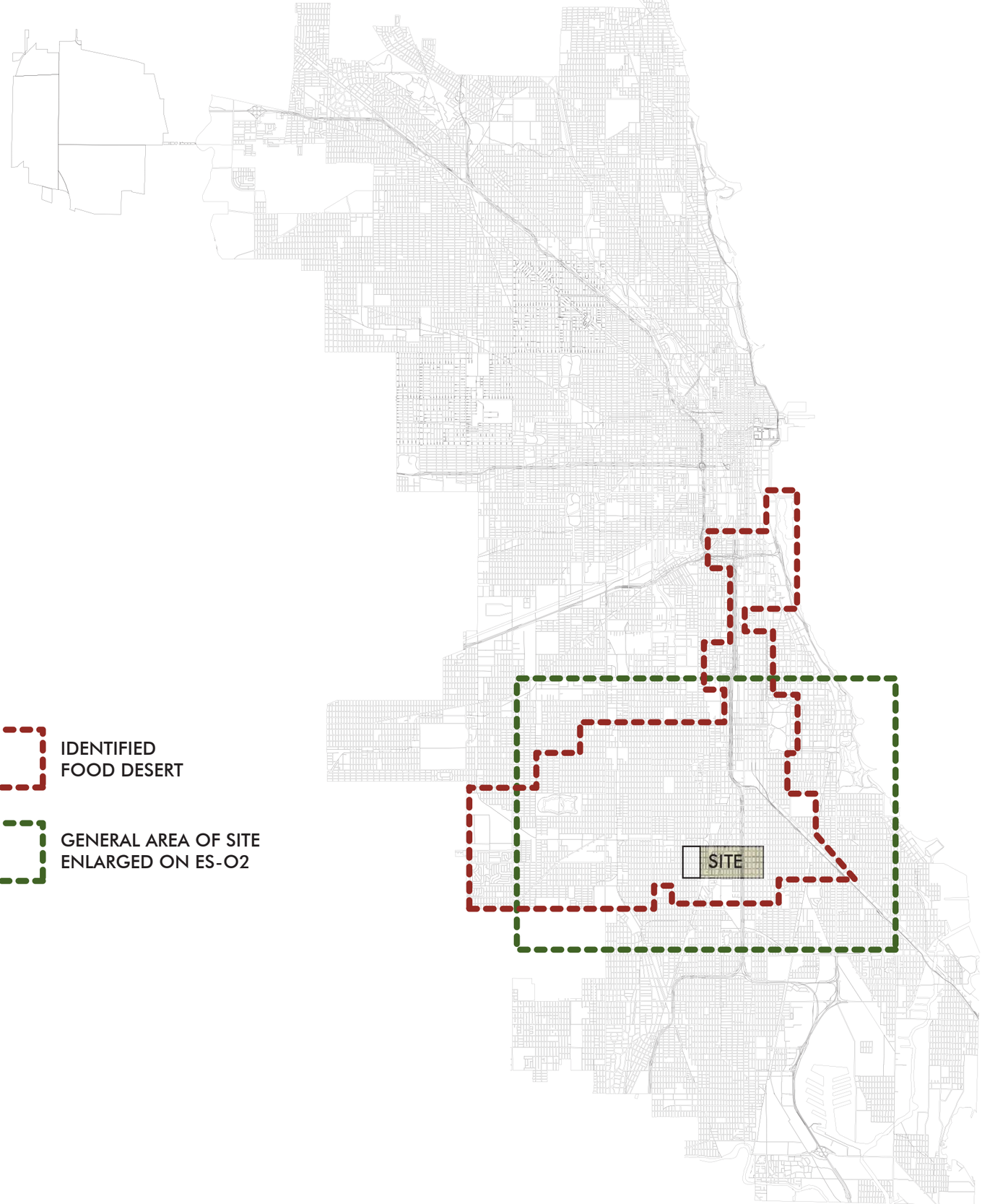
These spaces are rarely used or accessed. They may be placed in a basement level or other back-of-house situation.



These spaces are used on a daily basis and should have near direct access to the main entrance. Offices should be close enough to the lobby to remain in control.



EXPECTED PROGRAM REQUIREMENTS



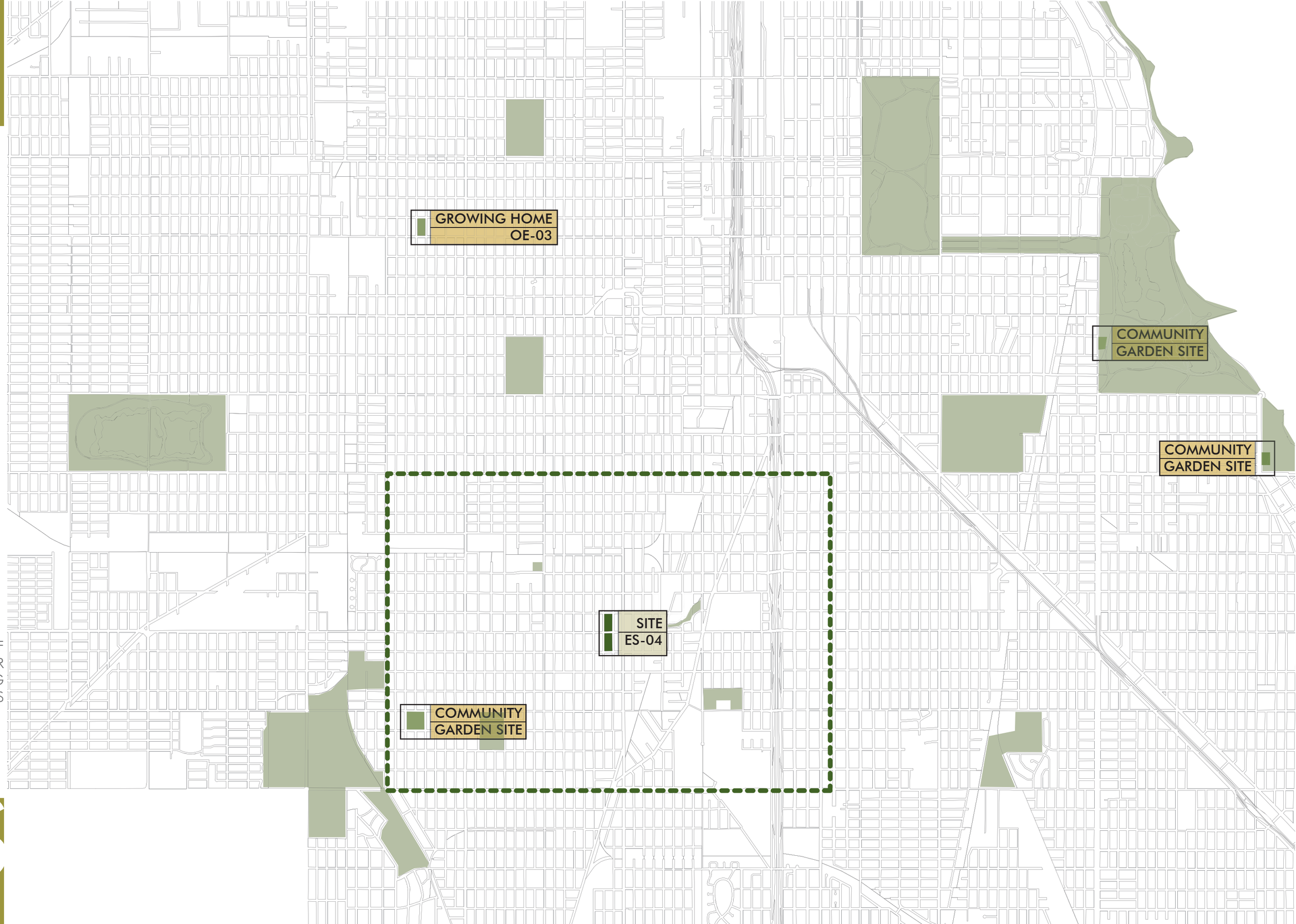
IDENTIFIED FOOD DESERT

GENERAL AREA OF SITE ENLARGED ON ES-02

LOCATION OF SITE WITHIN ONE OF CHICAGO'S FOOD DESERTS

ES

EXISTING SITE



LOCATION OF SITE AND OTHER URBAN FARMING EFFORTS

ES

S ASHLAND AVE
S RACINE AVE
S HALSTED ST
S VINCENNES AVE
DAN RYAN EXPRESSWAY
W 76TH ST
W 79TH ST
W 83RD ST
1/2 MILE
WALGREENS
EMPLOYMENT CENTER
PRESCHOOL
INDUSTRIAL ART SCHOOL
LEO HIGH SCHOOL
CVS
SITE
ES-04
CHURCH
POLICE DEPT.
CHURCH
AIDA FOOD MARKET.
FAMILY DOLLAR
cta 44
cta 08
cta 79
cta RED LINE

EXISTING SITE ES

NEARBY BUSINESSES SEVICES, AND TRANSIT ROUTES

ES 03

ES EXISTING SITE

SATELLITE VIEW OF SITE

ES

LOCATION
849 W 79th ST

SIZE
55,890 SF

PREVIOUS USE
offices for Chicago Department of Human Resources

CURRENT STATUS
vacant, for sale by CB Richard Ellis

ASKING PRICE
$1,300,000

STRUCTURE
concrete beam and column

OTHER
fully sprinklered
freight elevator

ALLEY

S PEORIA ST

COMMUNITY GARDEN SPACE

S GREEN ST

W 79TH ST

COMPOST &
RECYCLING DROPOFF

ALLEY

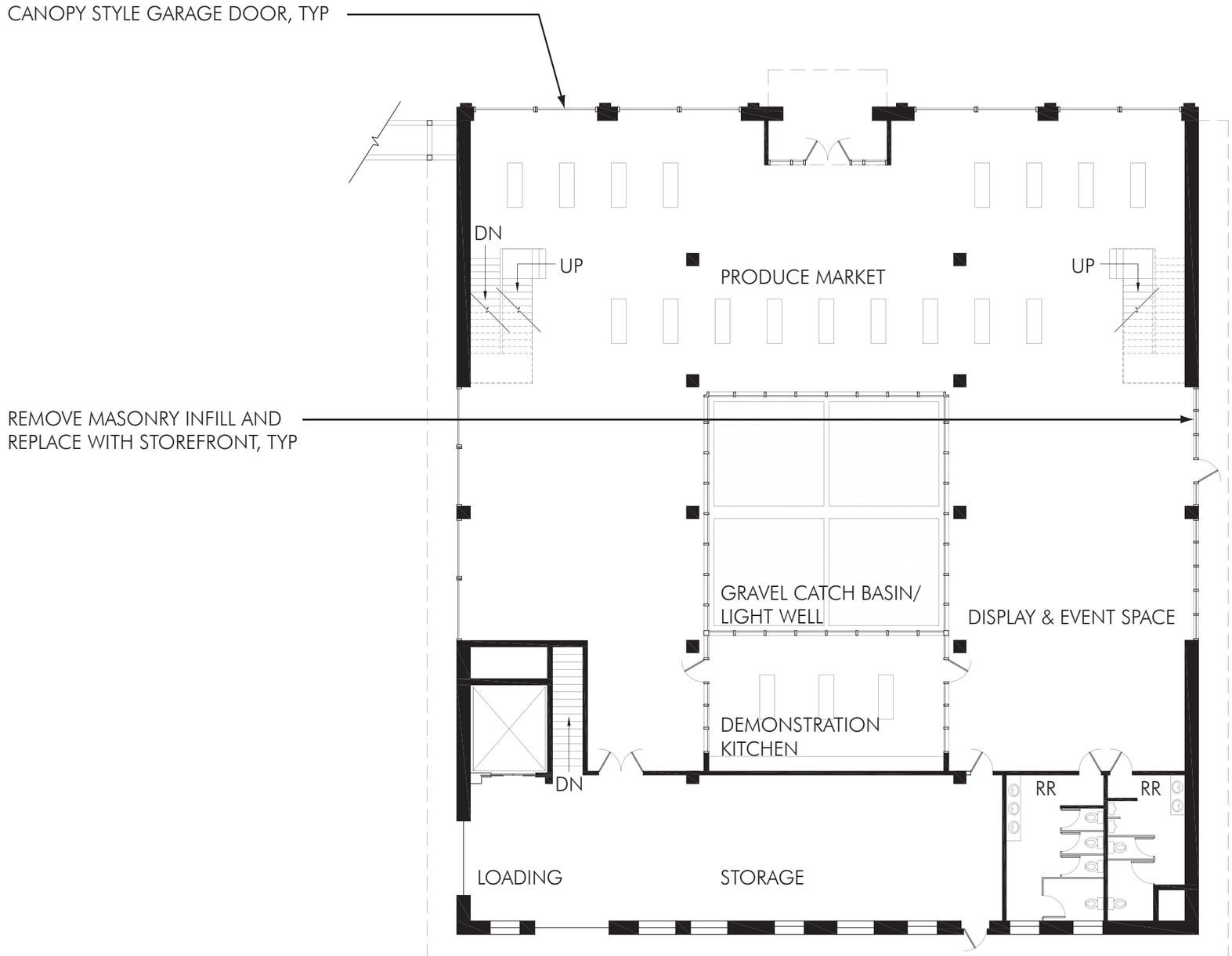
08 32

16 64 FEET

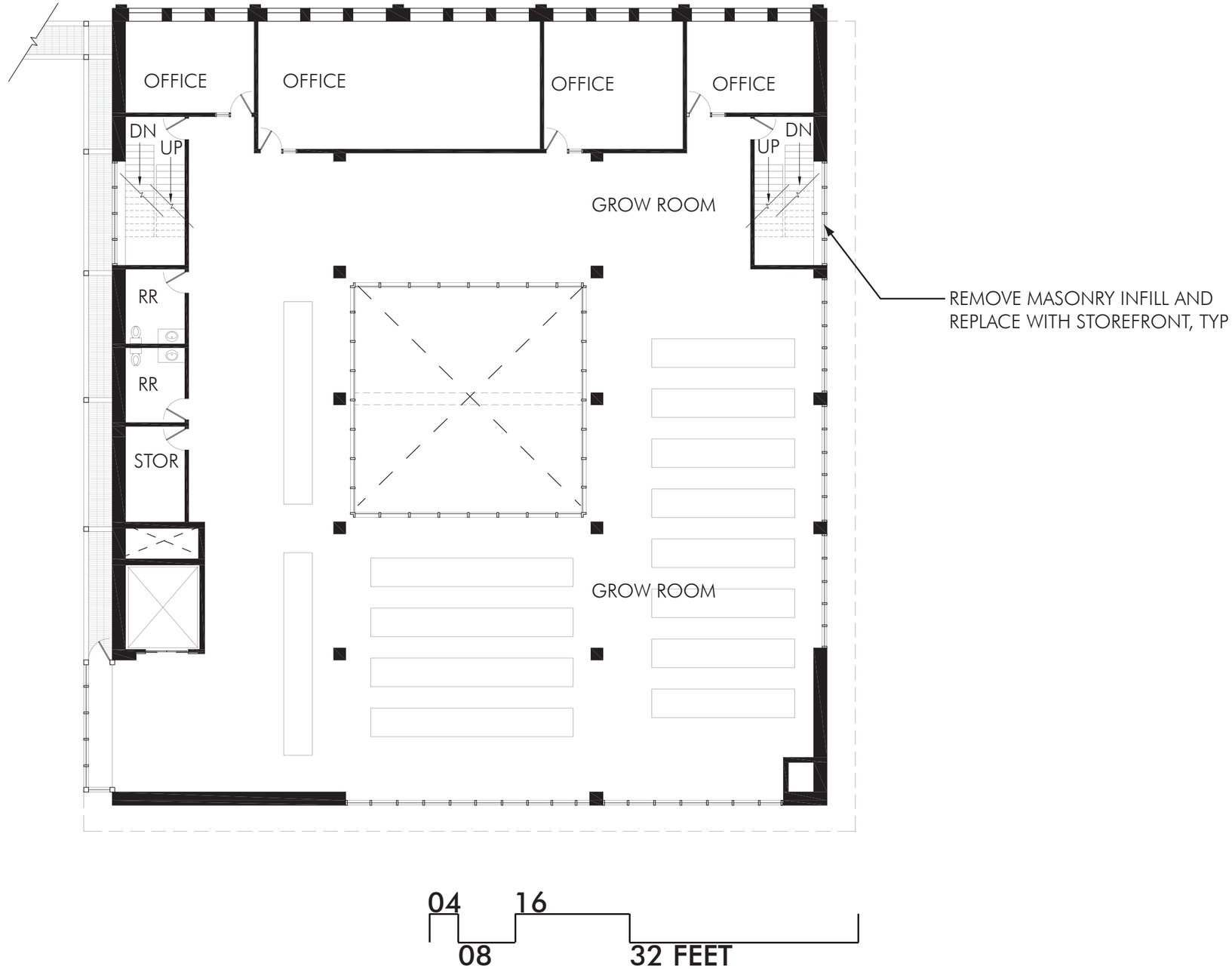
DESIGN
PROPOSAL DP

SITE PLAN

DP 01

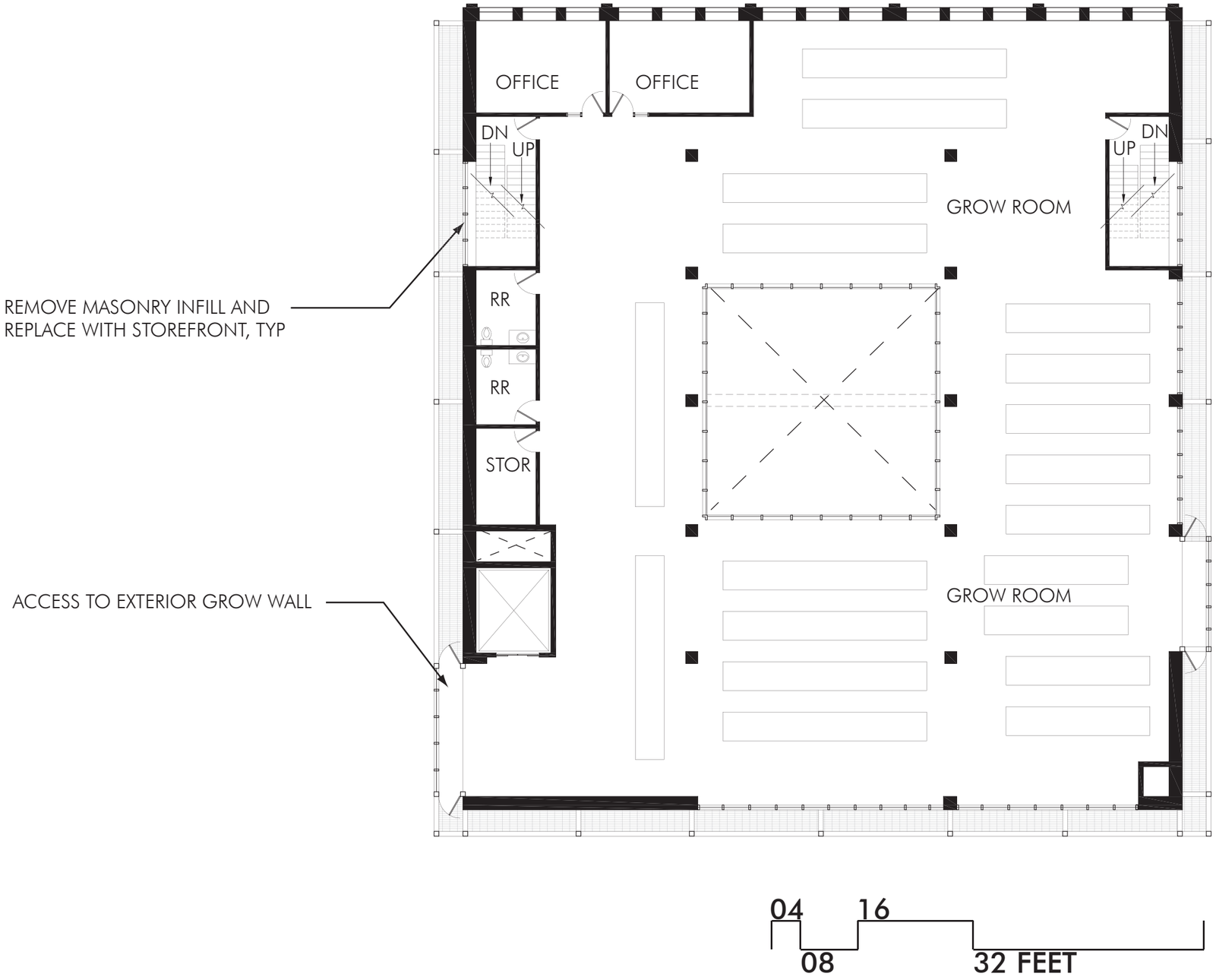


FIRST FLOOR PLAN

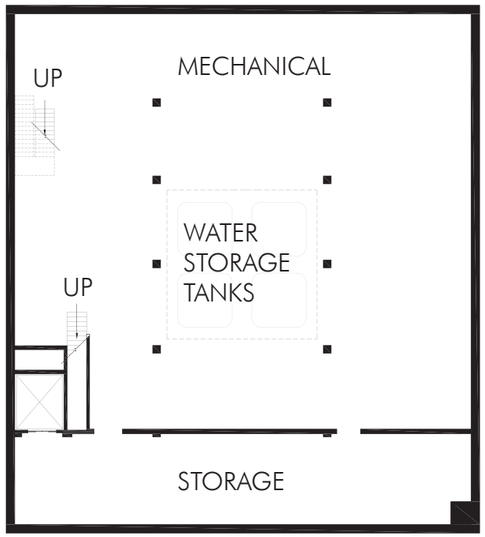


SECOND FLOOR
PLAN

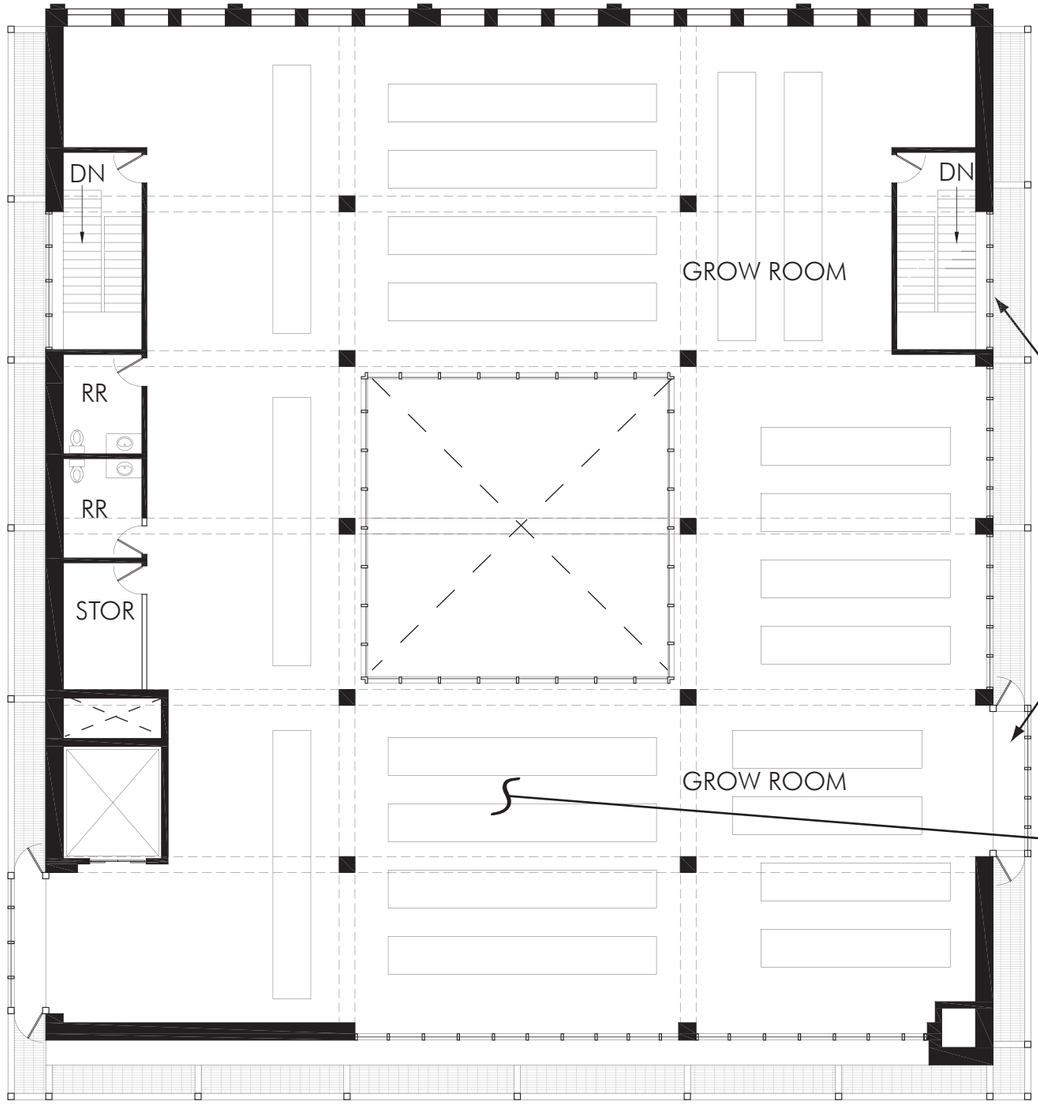
DESIGN
PROPOSAL



THIRD FLOOR
PLAN



08 32 FEET
16



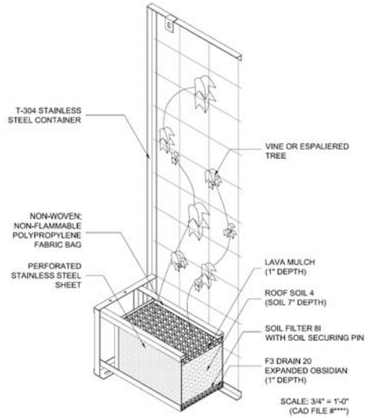
REMOVE MASONRY INFILL AND
REPLACE WITH STOREFRONT, TYP

ACCESS TO EXTERIOR GROW WALL

REMOVE ENTIRE ROOF AND
REPLACE WITH OPERABLE
GREENHOUSE ROOF

04 16
08 32 FEET

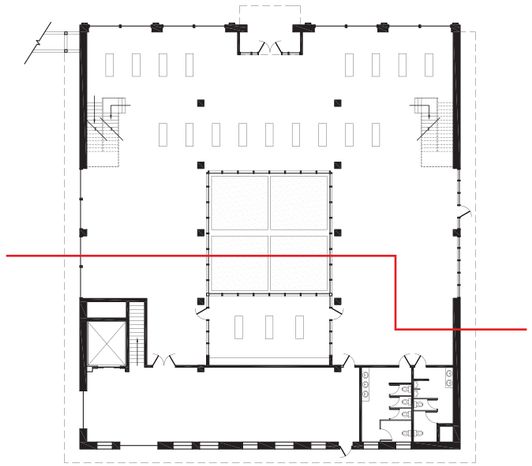
FOURTH FLOOR
AND BASEMENT
PLAN

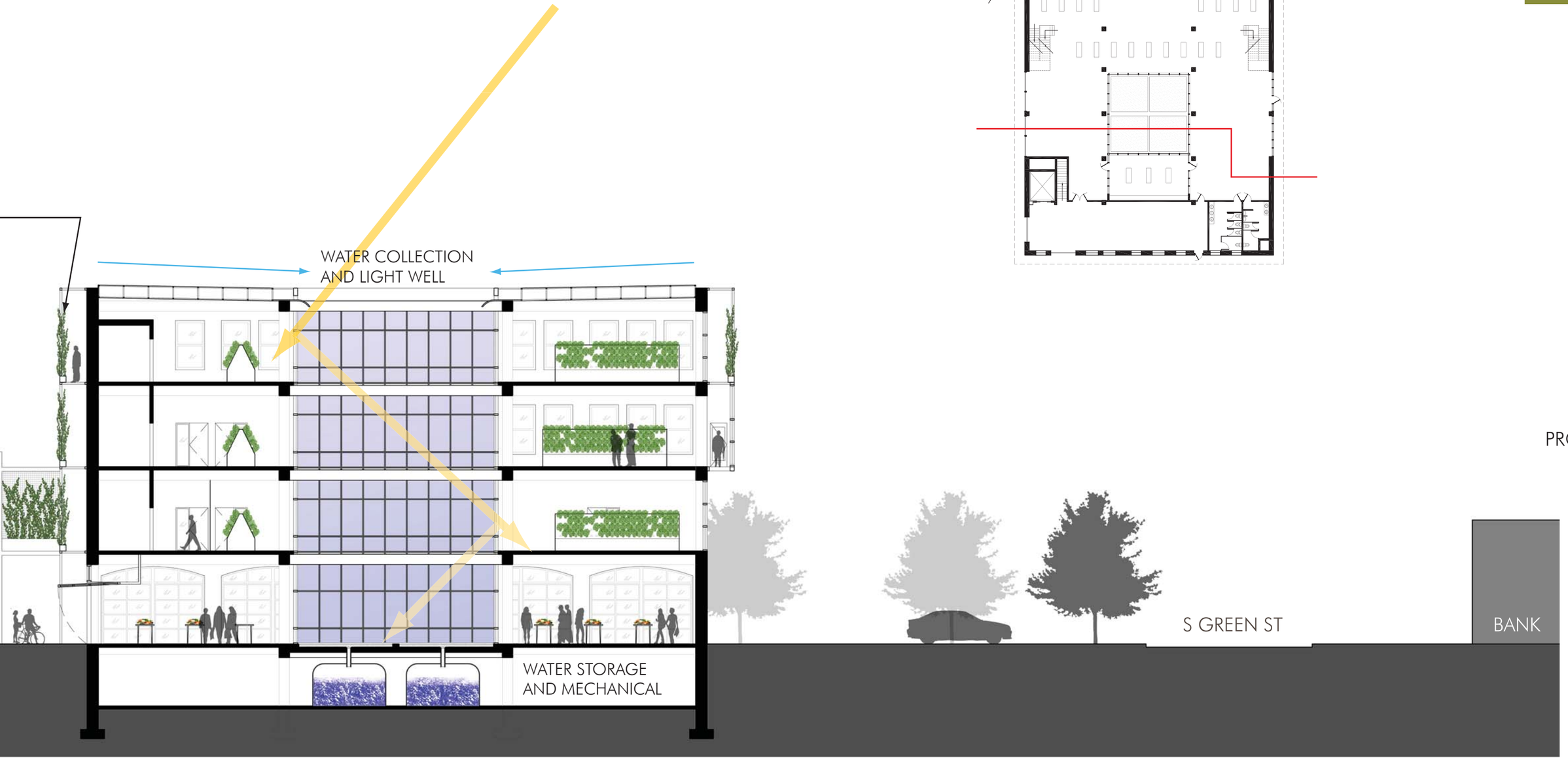


EXTERIOR VERTICAL GROWING SURFACES SIMILAR TO PARABIENTA GREEN WALL FROM SHIMIZU

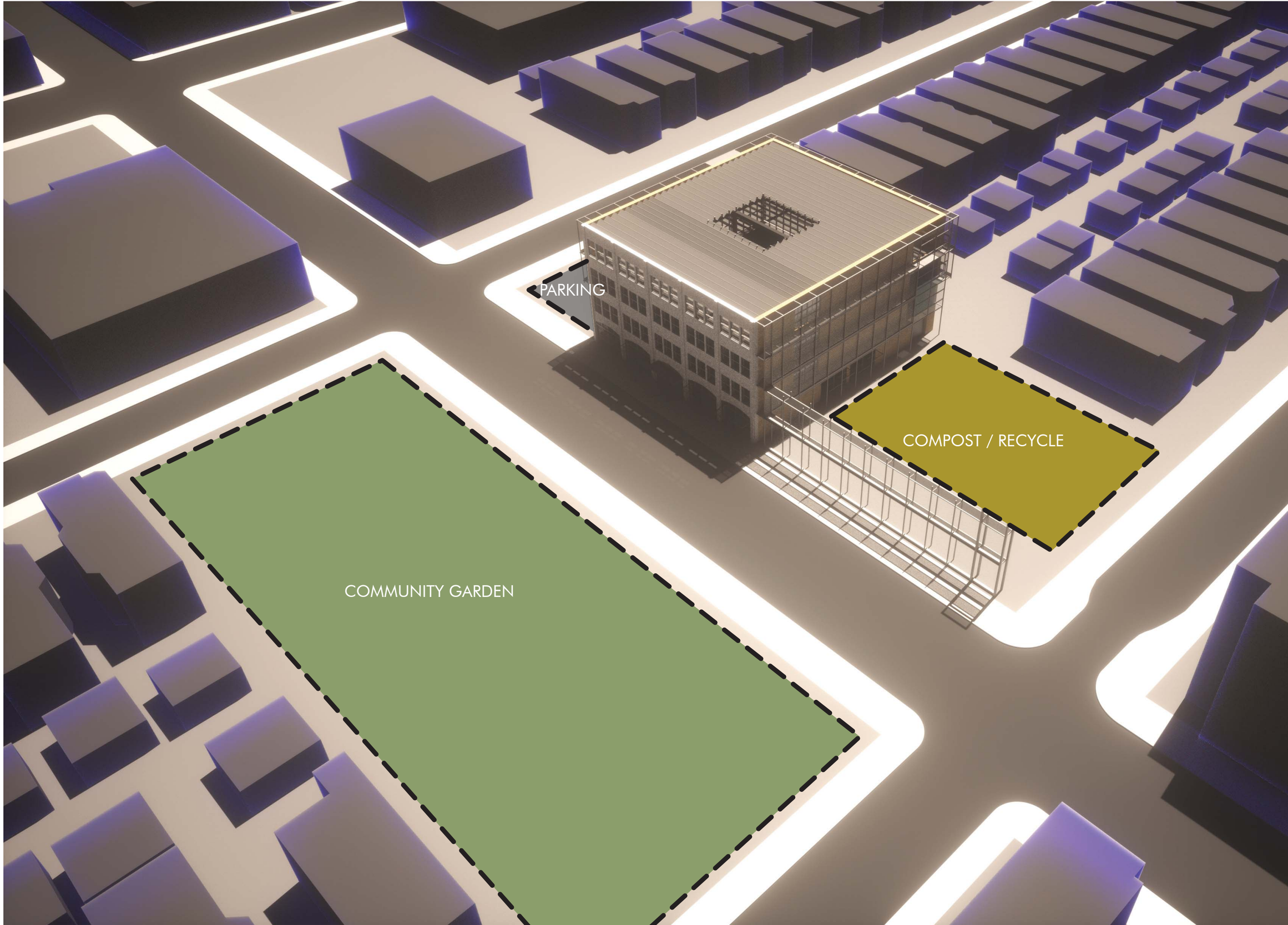
COMPOST MIXING

SECTION

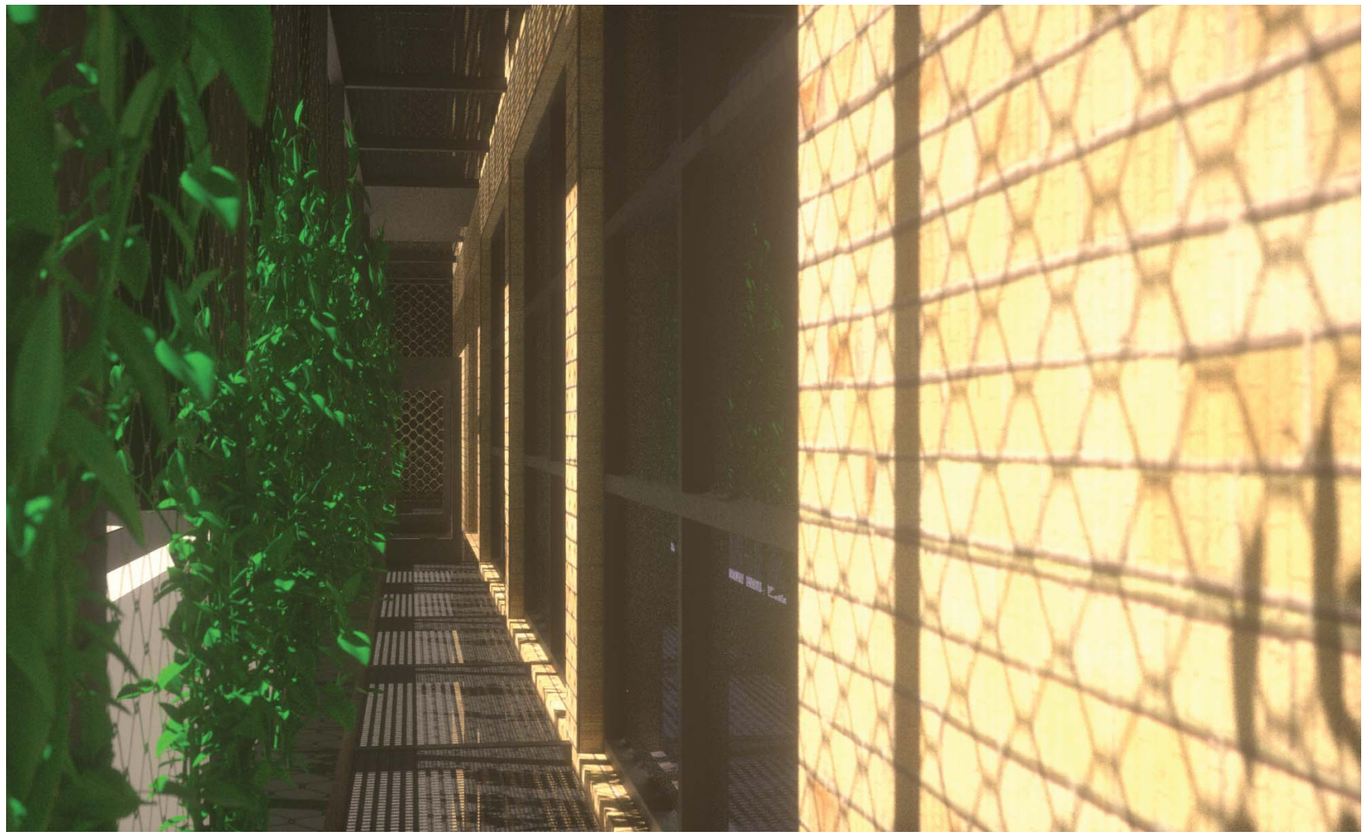




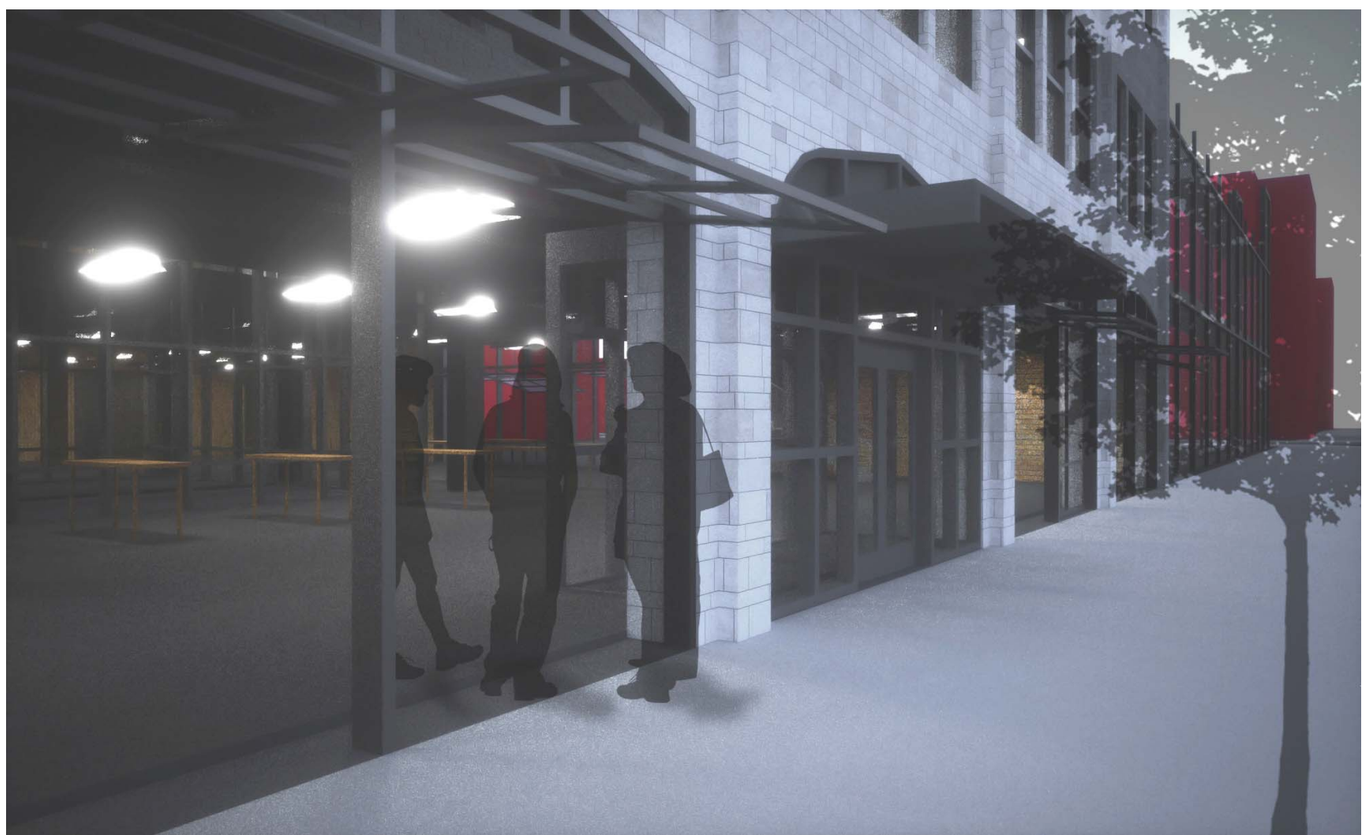
04 16
08 32 FEET



SITE LAYOUT



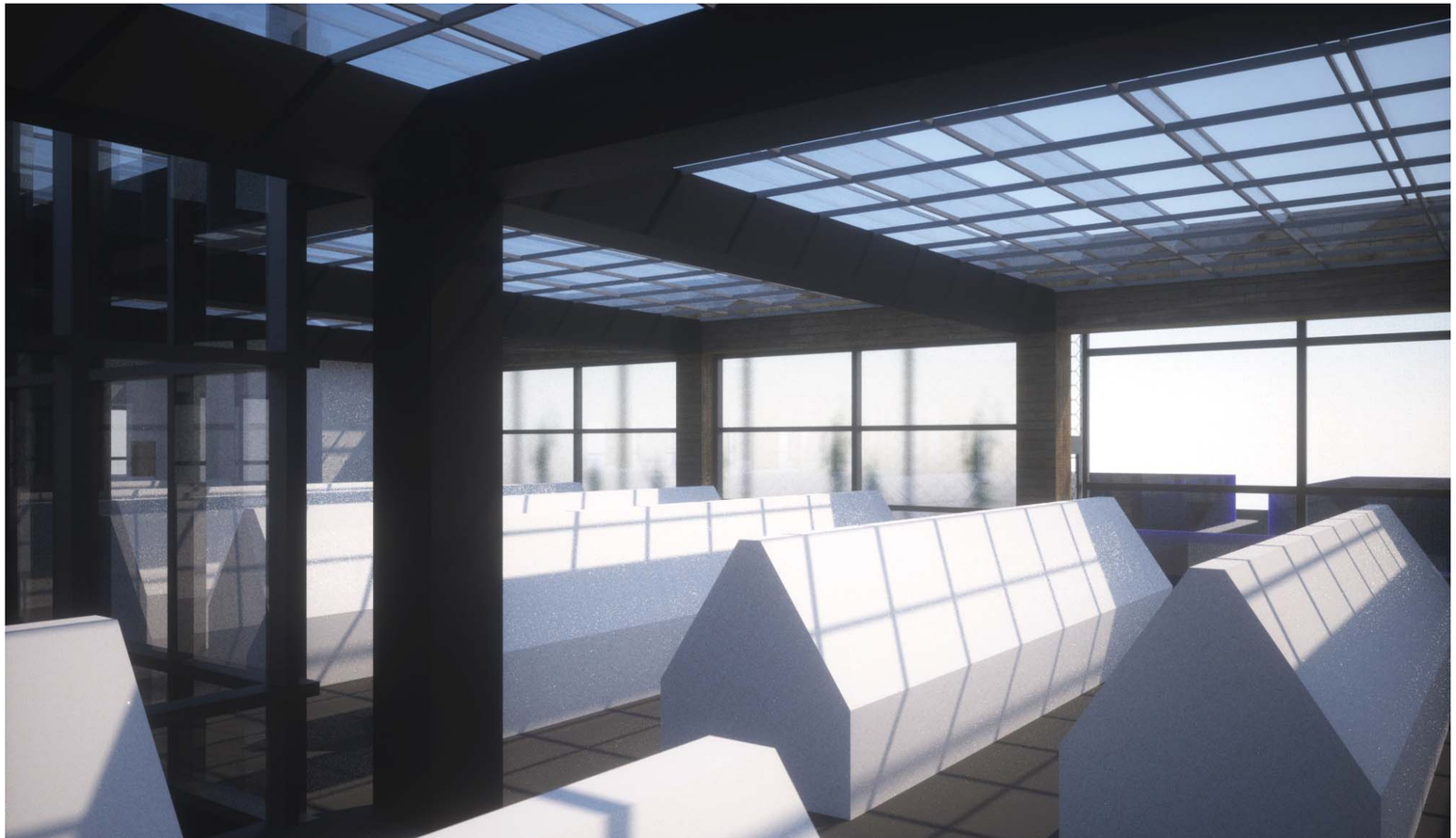
GROW WALL AT EAST FACADE



NORTH FACADE / ENTRY

GROW WALL
AND ENTRY

SECTION AND TOP FLOOR INTERIOR



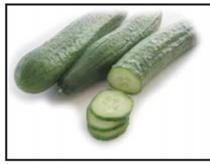
EAST FACADE
AND GROW
WALL

HOW MUCH FOOD COULD BE PRODUCED IN A GIVEN CROP?

35.1 LBS/SF/YEAR
180,343.8 LBS/YEAR
@ $2 / LB = $360687.60

8.6 LBS/SF/YEAR
44,186.8 LBS/YEAR
@ $3.50 / LB = $154,653.80

16.9 LBS/SF/YEAR
86,832.2 LBS/YEAR
@ $2.50 / LB = $217,080.50



47.9 LBS/SF/YEAR
246,110.2 LBS/YEAR
@ $2.125 / LB = $522,984.18

8.6 LBS/SF/YEAR
44,186.8 LBS/YEAR
@ $1.75 / LB = $77,326.90

ASSUMPTIONS:

yields based on “The Vertical Aeroponic Growing System”, see resources section

area based on a conservative 5138 SF of growing table area

prices based on average of typical wholesale and market costs

HOW MUCH ENERGY IS REQUIRED?

3168 SF OF ARTIFICIALLY LIT GROW TABLE
X 10 W SF
31.68 KW
X 12 HRS/DAY

380.16 KWH/DAY
138,758.4 KWH/YEAR

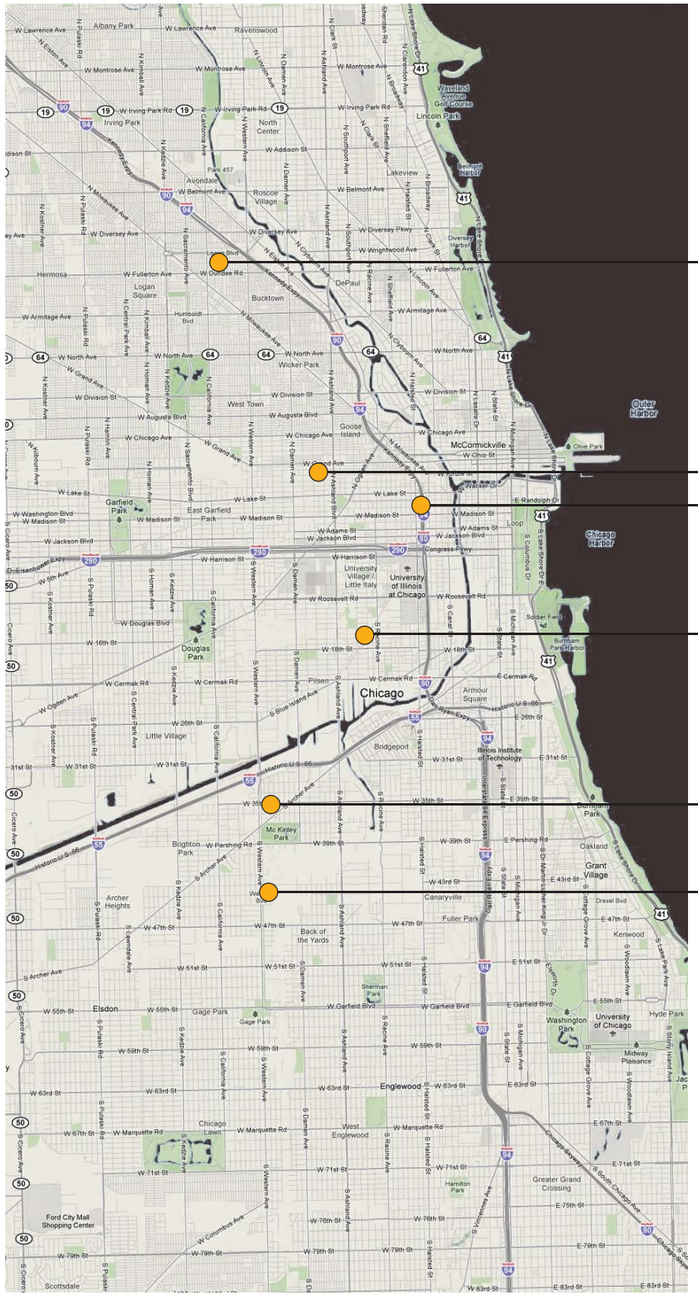
X $0.14 ELECTRICITY COST

$19,426.18 / YEAR

ASSUMPTIONS:

4th floor will be naturally lit

10 W/SF of LED grow lamps represent about 1/5th of the necessary wattage for HID lighting



3700 N. Talman
96,000 SF
100 Parking Spaces
18′ Clear Ceiling
$4,200,000

1821 W. Hubbard
67,785 SF
30 Parking Spaces
13′ Clear Ceiling
$4,890,000 + TIF

113 N. Green
90,730 SF
No Parking Spaces
12′ Clear Ceiling
$6,800,000

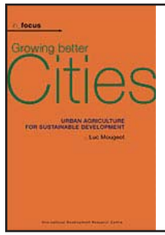
1337 W. 15th
66,000 SF
No Parking Spaces
21′ Clear Ceiling
$2,400,000

3510 South Western
51,000 SF
20 Parking Spaces
Unspecified Clear Ceiling
$1,950,000

4425 South Western
92,600 SF
No Parking Spaces
28′ Clear Ceiling
$unknown

Chicago has no shortage of vacant industrial buildings and no shortage of neighborhoods in need of more fresh produce. By expanding on this prototype project, a network of aeroponic farms could be distributed throughout the city.

POSSIBLE EXPANSION SITES



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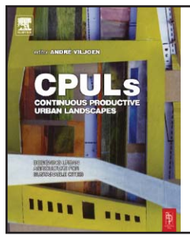

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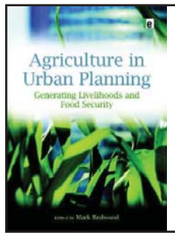

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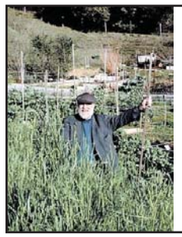

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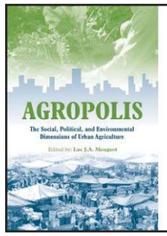

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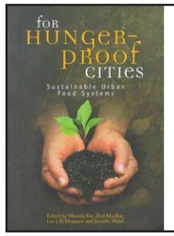

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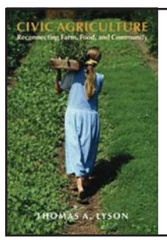

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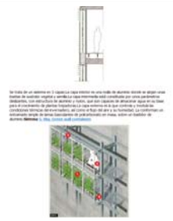

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