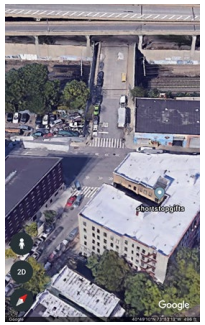
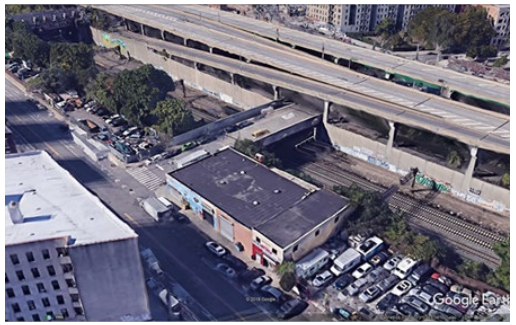
How can vertical gardens contribute to better air quality in Hunts Point New York?

By: Lofudu Tshumamboya
Capstone 18' Professor Famulari

Problem

When the sun's ultraviolet rays react with oxides of nitrogen (NOx) and volatile organic compounds (VOCs), ground-level ozone is formed. The main source of VOCs and NOx is mobile sources, including trucks, cars, construction equipment, buses and agricultural equipment. Ground-level ozone causes slight inflammation and can cause constriction of the airways, forcing the respiratory system to work harder to provide oxygen. A complex mixture of particulate matter (PM) contains dust, soot, nitrates, smoke, sulfates, water, tire rubber and metals. PM can be emitted, as smoke from a fire, or it can form in the atmosphere from nitrogen oxides. The Sacramento Metropolitan Air Quality Management District states "The size of particles is directly linked to their potential for causing health problems. Small particles (known as PM2.5 or fine particulate matter) pose the greatest problems because they bypass the body's natural defenses and can get deep into your lungs and potentially your bloodstream. Exposure to such particles can affect both your lungs and your heart."

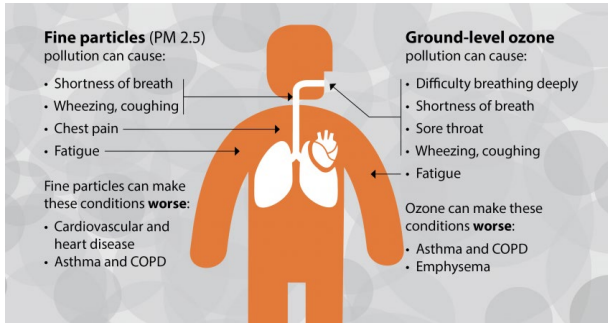




Capstone goals

The New York City Community Air Survey (NYCCAS) sites were measured four times a year, once every seasons. Seasonally adjusted street-level PM2.5 levels declined by an average of 0.4 micrograms per cubic meter (µg/m3) per year, and by 16% over the six-year period. According to a study (Assessing the Capacity of Plant Species to Accumulate Particulate Matter) done by several scientists in in Beijing, China, the average PM accumulation through plant material is 62.0 µg/cm3. It was then estimated that up to 50% of deposited particles may become re-suspended. My goal is to decrease the levels of PM 2.5 by 5.1 micrograms per cubic meter (µg/m3) per year.

Scope of design My research focuses on utilizing vertical gardens to improve air quality. This project incorporates vertical gardens into an urban landscape. The purpose of implementing vegetative designs is to improve air quality in Hunts point New York. Specific plants have been carefully chosen based, in part, on Dr. Wolverton's research recorded in his book called "How to Grow Fresh Air: 50 Houseplants that Purify Your Home Or Office." Upon conducting his research on, breathable lunar environments, Dr. Wolverton discovered that some houseplants the best at filtering common pollutants. This project utilizes his method for air purification and intends to lower PM 2.5 levels by 4% within a year.



Concept plan/Existing site

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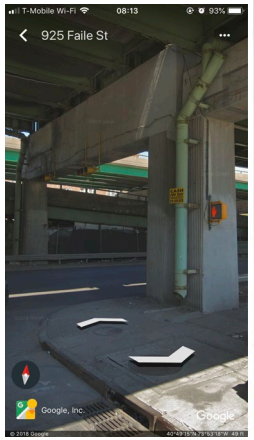
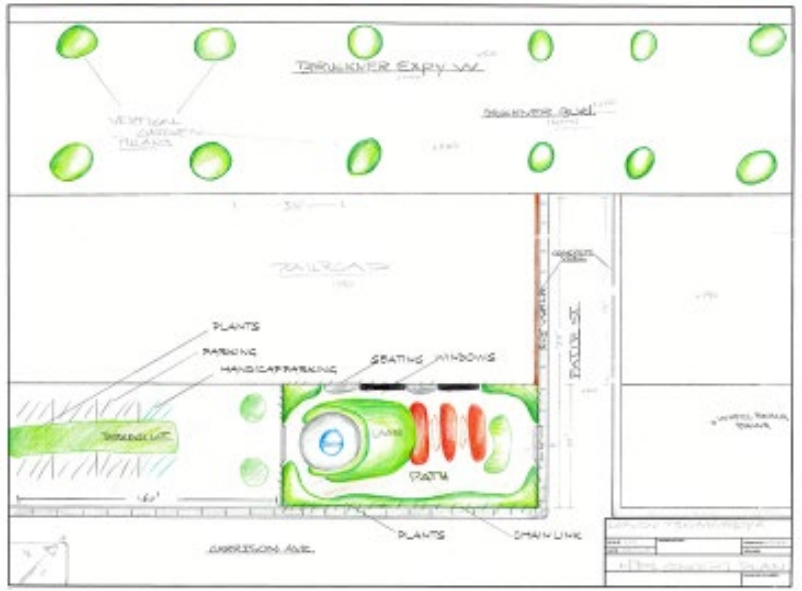
Site Information
Location:
1163 Garrison Ave.
Bronx, New York 10474
Hunts Point
(Between Faile Street & Garrison Avenue)

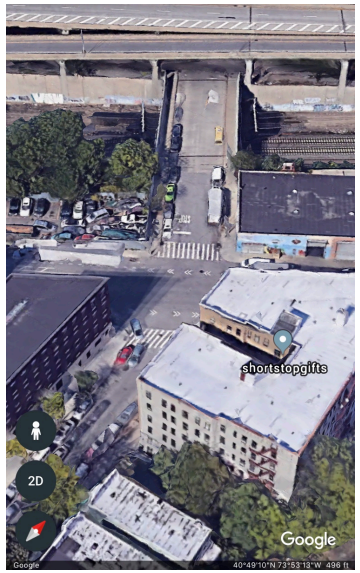
Bridge: I-278, Bronx, N

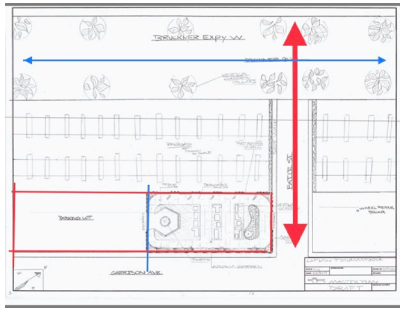


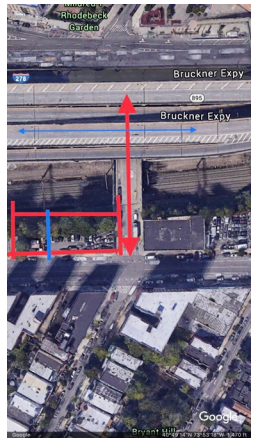


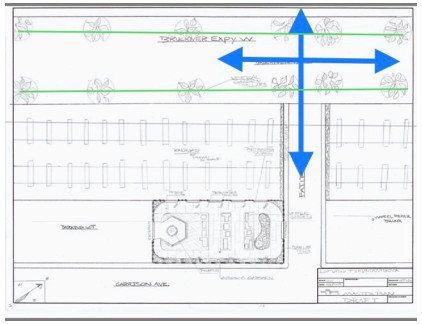
The project site is a 8,505 sq. ft parking lot located on 1163 Garrison Avenue. The property is within a mile radius of three public schools. It is also within a mile radius of the 6, 2 and 5 trains located in multiple areas. According to NY Latin culture magazine, the Bronx is known as the heart of Latin culture in New York City. The New York Yankees, the Bronx Zoo, the NY Botanical garden, the quaint maritime village of City Island, the cultural attractions of Fordham and the "real little Italy" are all located in Bronx, New York.

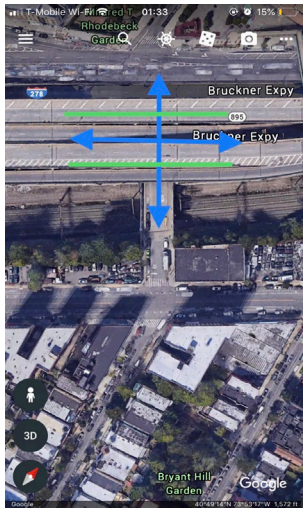
- Public transportation is available
- Family owned businesses are easily accessible (community)
- Commute to location from other areas of the Bronx is possible (short commute for Bronx residents)
- The location is placed in a culturally diverse neighborhood (diverse food, culture, interests etc.)
- The city never sleeps- There will always be people around this location. The city is energetic
- This location is a relatively residential area











Panting plan/ Plant list/ Planting materials

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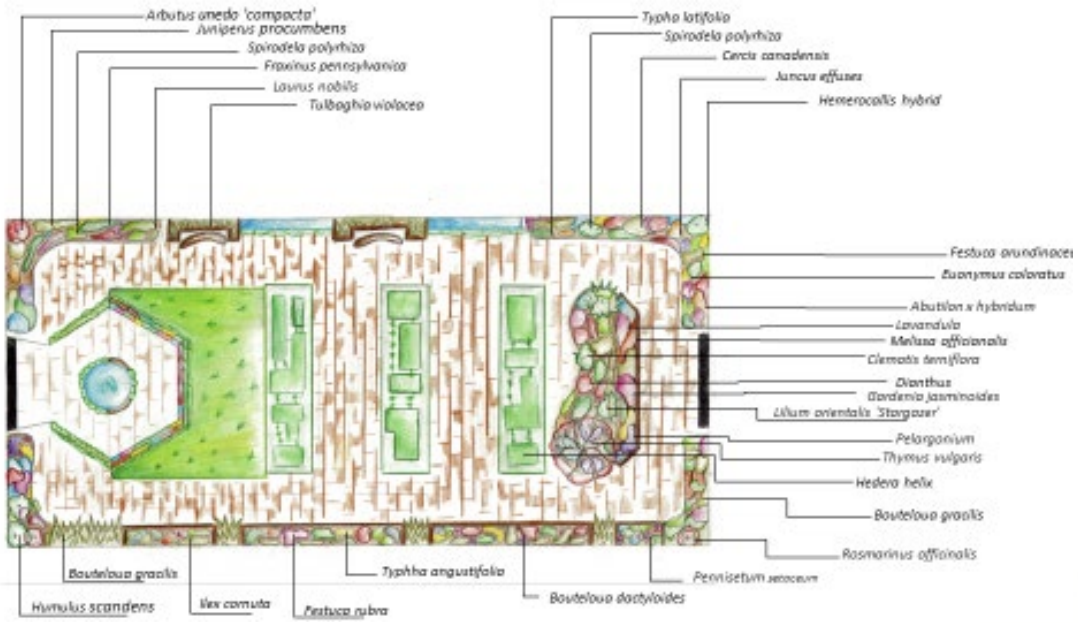
Botanical Name	Common Name
Arbutus unedo 'compacta'	Compact Strawberry Bush
Bouteloua dactyloides	*Buffalo Grass*
Bouteloua gracilis	Blue Gamma Grass
Cercis canadensis	*Eastern RedBud*
Euonymus coloratus	Purple Leaf Wintercreeper
Festuca arundinacea	Tall Fescue
Festuca rubra	Red Fescue
Fraxinus pennsylvanica	Green Ash
Hedera helix	*English Ivy*
Hemerocallis hybrid	Daylily
Ilex cornuta	Carisa Holly
Juniperus procumbens	Juniper
Tulbaghia violacea	Society Garlic
Nitrate	
Juncus effuses	Soft Rush
Spirodela polyrhiza	Giant duckweed
Typha latifolia	Broad-Leaved Cattail
Typhha angustifolia	Narrow Leaved Cattail
Sodium	
Eucalyptus camaldulensis	River Red Gum Eucalyptus Tre

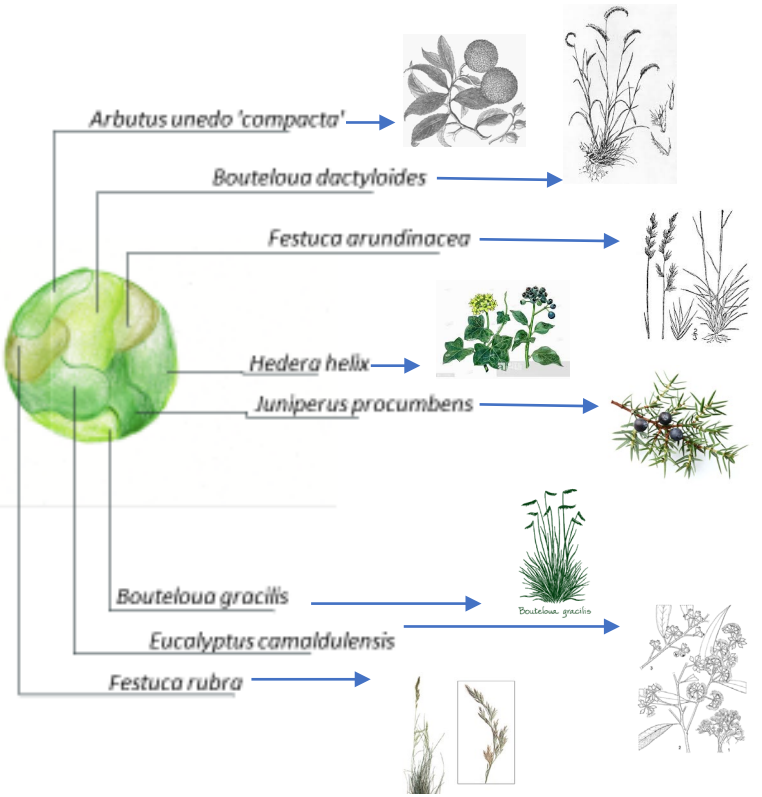
Entrance and boarders	
(Annual 3ft or more)	
Botanical Name	Commn Name
Abutilon x hybridum	Flowering maple
Pennisetum setaceum	Fountain Grass
Platanus occidentalis	American sycamore
C.sinensis	Tea plant
Quercus variabilis	Chinese cork oak
B. papyrifera	Paper birch
Ailanthus altissima	Tree of heaven
Sophora japonica	Japanese pagoda
Fraxinus mandschurica	Manchurian ash
Morus alba	White mulberry
Toona sinensis	Chinese mahogany



In this capstone project, plant material is selected based on its ability to filter toxins. Other plant material is selected based on aroma, and all by hardiness zones.

Aroma Garden list	
(Fragrant plants)	
Botanical Name	Common Name
Juniperus	Juniper
Melissa officianalis	Lemon balm
Matricaria chamomilla	Chamomile
Eucalyptus globulus	Eucalyptus
Laurus nobilis	Bay laurel
Thymus vulgaris	Thyme
Rosmarinus officinalis	Rosemary
Mentha	Mint
Ocimum basilicum	Basil
Origanum majorana	Marjoram
Gardenia jasminoides	Gardenia
Dianthus	Dianthus
Clematis terniflora	Sweet Autumn Clematis
Nicotiana tabacum	Nicotiana
Lilium orientalis 'Stargazer'	Oriental Lily
Calendula officinalis	Calendula
Lavandula	Lavender
Jasminum	Jasmine
Rosa	Roses
Pelargonium	Scented Geraniums

Fast growing		
(Annual Vines & woody plants)		
Botanical Name	Commn Name	Height
Asarina scandens	Climbing snapdragon	6-9'
Humulus scandens	Japanese hops	5-15'
Ipomoea purpurea	Common morning glory	To 10'
Ipomoea quamoclit	cypress vine	8-10'
Lathyrus odoratus	annual sweet pea	2-6'
ropaeolum majus	climbing nasturtium	4-6'



Master plan/ Perspectives

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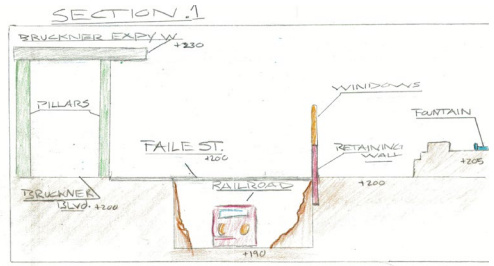

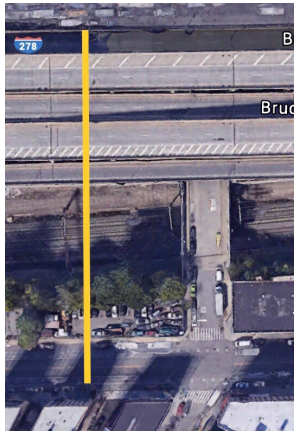

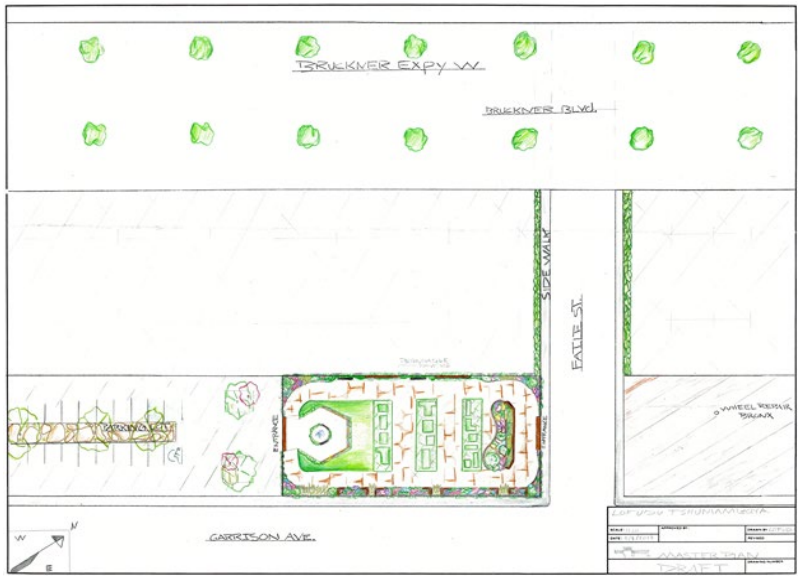

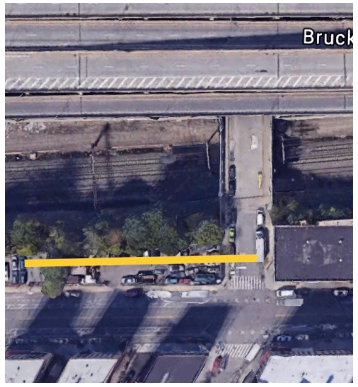

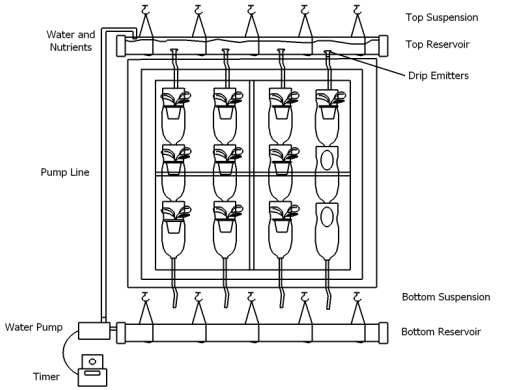

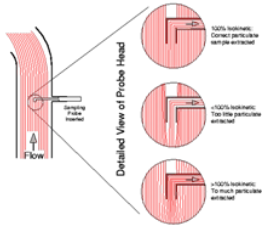

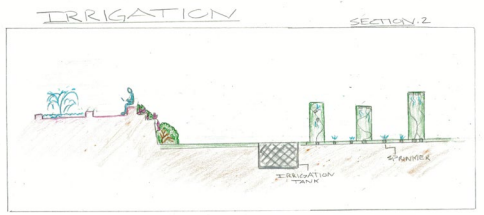

- The main design garden area consists of 3 rows of vertical garden.
- The design is made to replicate an urban landscape
- The large windows on the north side of the garden provide a view that allows visitors to gaze upon the vertical gardens placed on the bridges reinforcement pillars
- The west side of the garden is decorated with a fountain area, seating, and plant material
- The parking lot features large stones that accent the large and small greenery
- Faile Street is designed with vertical growth along parallel retaining walls which allow pedestrians to enjoy the site
- Underneath Bruckner express way features vertical gardens that contain pollution eating plants

Isokinetic extraction:

- Purpose is to capture particles that pass through a defined area for a defined time without disturbing their paths.
- The velocity of the air going into the sampling probe nozzle is equal to the velocity of the undisturbed air at that point.
- The air is disturbed as little as possible so that the same particles (no more and no less) go into the nozzle as would have passed the area of the nozzle had it not been there.

Piolet project

- Before construction and planting is done, % of pm 2.5 is measured using the Extech VPC300. The VPC300 is a Video Particle Counter with built-in Camera.It simultaneously measures and displays 6 channels of particle sizes (down to 0.3µm), Air Temperature, Humidity and Dew Point
- PM2.5 is measured by the principle of isokinetic extraction