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The Breath of the Bronx: Limited Greenspace and Poor Respiratory Health

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The Breath of the Bronx: Limited Greenspace and Poor Respiratory Health in New York's Northern Borough



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Dedicated to Jennifer Beaugrand, Rhonda James, and Jose Rivera.

Thank you for your guidance, friendship, and for showing me how important a tree can be.

Abstract

Respiratory issues like asthma are common across the globe. So why does a borough in one of the most developed cities in the world have the worst asthma rates in the United States?

This paper looks at the disadvantages that the Bronx, New York faces due to its poor air quality, particularly the increased risk of respiratory illness and disease. It examines the benefit of green spaces and parks on human health. Tree coverage and increased oxygen outputs are proven to lessen the risk of respiratory issues. While it is the “greenest” borough in New York, much of the Bronx’s greenspace is allocated to affluent areas and away from the majority of its diverse, lower class population. By examining the variety of disparities between affluent, suburban neighborhoods and poorer, urban areas, the sources of many environmental and public health disadvantages are revealed. The paper focuses on the Bronx, but it employs research from a variety of other urban areas with similar conditions.

Keywords: Asthma, green space, Bronx, respiratory health, parks, equity

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Introduction

Right below the temperature, my iPhone's weather app alerts me of another piece of important information about what to expect outdoors. "Unhealthy Air Quality for Sensitive Groups," it reads. I luckily am not counted amongst those who may be most concerned with this message. Unlike my brother or sister, I was lucky enough to never develop asthma. Now that I've moved from a suburb of Boston to the congested streets of New York, I can see messages like this and know that I do not need to expect my day to be any harder than usual. I will not experience coughing fits, unusual shortness of breathe, or an asthma attack.

It is worth noting that I do not live between bustling city streets of Manhattan. I typically look at the city's magnificent skyscrapers from miles away. I live in the Bronx – a colorful, vibrant, and exciting borough – and I have loved this area since I moved here four years ago. There was one thing, however, that I felt like it lacked when I arrived: green space.

The Bronx, I assumed, did not have sprawling outdoor areas to take a walk, play sports, or relax. It was only when I began an internship at a local nonprofit that I realized how wrong my misconceptions were. The organization I worked for is dedicated to restoring and maintaining Bronx parks. Throughout my summer, I started to familiarize myself with the array of parks that can be found in the Northern borough. Though each is unique in their own way, there are a few similarities that are present in the majority of the ones I worked in. They are generally small, understaffed, and poorly maintained. While working at this organization, I often heard or read other facts about the Bronx regarding its environmental quality and public health. The most striking one that I heard was that the Bronx children have the highest prevalence of asthma among all other American children.¹ I was already aware that the Bronx was the poorest

¹ Karen Warman, Ellen Johnson Silver, and Pam R. Wood, "Modifiable Risk Factors for Asthma Morbidity in Bronx Versus Other Inner-City Children," *Journal of Asthma* 46, no. 10 (2009): pp. 995-1000, <https://doi.org/10.3109/02770900903350481>.

congressional district in the United States but it was disheartening to learn that it was also the leading area in the nation for another unfortunate fact.² I began to ask myself: what do these circumstances have in common? Do the financial struggles of Bronx citizens have any correlation with their poor breathing? Does the noticeable lack of outdoor recreational areas play into this as well?

This paper serves as an investigation into the intersection of these three harsh realities. The public health issues that citizens face in the borough are directly linked to its lack of maintained green space. The lack of green space is itself a byproduct of a history of economic neglect. In this paper, I will explore the junction of these issues and arrive at a holistic understanding of why the Bronx is the way it is today. In my first chapter, I will look into the medical causes for asthma and other respiratory illnesses. I will then examine statistical data regarding Bronx illness rates and compare it against other rates – both worldwide and nearby. In my second chapter, I will present the history of the Bronx. An understanding of how the borough developed into the busy urban center that it is today will help provide insight into how parks were implemented in the area. Chapter three will explore how race and disparities in economic status are involved in this reality. My fourth chapter will look at available green space today – its quality, abundance, funding, and how it compares to other areas. It will also examine studies that show the ability for plant coverage to combat pollution. Lastly, I will propose solutions that deal with public policy, community action, and urban planning. Whether they target the poor air quality directly or aim to improve it through the implementation of green space, the goal is to reduce the alarming asthma rates that the borough faces.

² Greg Giroux, “Rich, Poor, Young, Old: Congressional Districts at a Glance,” Bloomberg GOV, September 17, 2017, <https://about.bgov.com/news/rich-poor-young-old-congressional-districts-glance/>.

Chapter 1: Asthma in the Bronx (Public Health)

To understand the factors that have led to the problem of poor respiratory health in the Bronx, we must first understand the problem itself. What exactly is asthma? How do asthma and air quality relate to one another? How has an entire area of a city developed such bad respiratory health?

Asthma is a public health issue across New York City. The discipline of public health aims to “prevent disease and injury and to promote health through organized community effort.”³ The distinction of focusing on prevention rather than attempting to discover a cure is important. The organized efforts to combat asthma in the Bronx outlined here are concerned with determining factors that contribute to the critical health issue and finding ways to mitigate its harm. Community action, public policy, and institutional change are vehicles for improving a public health issue.

The Millennium Ecosystem Assessment is a publication that evaluates human interaction with the natural environment. In regards to the interplay between environmental wellbeing and public health, the assessment recognizes that many health issues that plague vulnerable populations are due to the failure for these populations to have certain ecosystem services properly provided and readily accessible.

Where a population is weighed down by disease related to poverty and lack of ‘entitlement’ — culturally or socially determined right of access to essential resources such as shelter, nutritious food or clean water — the provision of these resources should be the first priority for public health policy. Where ill-health is caused, directly or indirectly, by excessive consumption of ecosystem services (such as food and energy) substantial reductions in consumption would have major health benefits while simultaneously reducing pressure on life-support systems.⁴

³ Bruce F. Berg, *Healing Gotham: New York City's Public Health Policies for the Twenty-First Century* (Baltimore, MD: John Hopkins University Press, 2015), 2.

⁴ Corvalán Carlos, Anthony J. McMichael, and Simon Hales, *Ecosystems and Human Well-Being Health Synthesis* (Geneva: World health organization, 2005).

The asthma issue in the Bronx is intrinsically tied to the failure for Bronx residents to be provided with clean air, an element of the ecosystem that is tainted due to extreme pollution. In a less direct sense, the “excessive consumption” of certain ecosystem services contributes to the issue as well. Reliance on vehicles that burn fossil fuels, fuels that are provided by the natural environment, is a significant contributor to the Bronx’s poor air quality.

Asthma is just one of many respiratory illnesses, but it is the one that is most notably plaguing the borough in question. As stated by the American Academy of Allergy Asthma & Immunity, asthma is defined as “a chronic disease involving the airways in the lungs” that causes airways to be “always inflamed.”⁵ Since it is a “chronic” disease, those who develop asthma deal with it each day of their lives. Asthma cannot be cured, but those who have it can lead healthy lives if it is managed properly.

Asthma cannot clearly be defined as either a disease passed on by genetics or a disease developed due to environmental factors. In truth, it is influenced by both. According to a dissertation study done by a student at Walden University on the correlates of asthma in the South Bronx, researchers see asthma as a “complex disease in which the interaction between both genetic and environmental factors play a fundamental role both in the pathogenesis and in the development of the disease.”⁶

In humans, air enters the respiratory system through the nose and mouth. It travels down the trachea, often referred to as the “windpipe”, and branches at the bronchial tubes. These carry air into the lungs. In alveoli, small sacs in the lungs, an exchange of carbon dioxide and oxygen occurs. Capillaries carry oxygen-rich blood throughout the body and expel carbon dioxide

⁵ “Asthma | AAAAI,” The American Academy of Allergy, Asthma & Immunology, accessed May 10, 2019, <https://www.aaaai.org/conditions-and-treatments/conditions-dictionary/asthma>.

⁶ Veronica C Uwanaka, “Correlates of Asthma among the Minority Population in South Bronx, New York” (dissertation, Walden Dissertations and Doctoral Studies Collection, 2014), <https://scholarworks.waldenu.edu/dissertations/97/>.

through exhalation.⁷ The body's efficiency to perform these functions is compromised and breathing becomes more difficult. Symptoms that trigger asthma cause swelling and tightening of muscles around these airways. The presence of asthma triggers can vary depending on a wealth of factors. Many of these factors are beyond control, such as gender, weather, and natural allergies. Airborne irritants, such as cigarette smoke, air pollution due to smog, and other chemicals and particulates can "bother inflamed, sensitive airways".⁸ Mold, often found within homes, can have similar effects. It is important to note that people do not need to be *allergic* to these triggering factors.

The pressures of one's immediate environment that can exacerbate asthma can typically be linked to one's socioeconomic status. For instance, income levels can lead to differences in biomedical, behavioral, and psychosocial experiences. A low-income household and a higher-income household may have the same number of children at-risk for asthma living under one roof, but it is likely that the low-income household has a smaller living space with a variety of other environmental disadvantages. For instance, a Walden University study found that the absence of an extractor fan above a stovetop was present in many households where children in the Bronx suffer from Asthma.⁹ This is just one example in a multitude that shows that the Bronx suffers from high asthma rates not simply because of pollution and poor outdoor air quality, but because of the individual living situations of its residents. While poor indoor air quality contributes more significantly to the "development" of asthma, outdoor pollutants have been proven to contribute to "aggravation" of symptoms, including "increased bronchial

⁷ Kim Ann Zimmermann, "Respiratory System: Facts, Function and Diseases," LiveScience (Purch, February 12, 2018), <https://www.livescience.com/22616-respiratory-system.html>.

⁸ "AAFA," Cost of Asthma on Society | AAFA.org, accessed May 10, 2019, <https://www.aafa.org/cost-of-asthma-on-society/>.

⁹ Veronica C Uwanaka, "Correlates of Asthma among the Minority Population in South Bronx, New York" (dissertation, Walden Dissertations and Doctoral Studies Collection, 2014), <https://scholarworks.waldenu.edu/dissertations/97/>.

hypersensitivity, inflammatory changes, increased use of medication, and hospitalization.”¹⁰ The focus of this research is primarily concerned with outdoor factors for high asthma rates, but it is important to note that disadvantaged populations deal with a host of triggering environmental conditions.

Airborne pollutants such as sulfur dioxide, nitrogen dioxide, and carbon dioxide all lead to bronchial restriction, or the narrowing of airways, after inhalation. Even short-term exposure can trigger an asthma attack. SO₂ is released into the atmosphere through the combustion of fossil fuels containing sulfur, such as coal and diesel. NO₂ can be released similarly through coal, oil, gas, and wood.¹¹ The atmospheric levels for both of these compounds are highest in areas close to urban, industrial hubs.

Research done for *The International Journal of Health Planning and Management* examined the effects of certain air pollutants on the length of hospital visits for patients hospitalized for asthma-related reasons. The study concluded that environments heavily polluted with PM 2.5 and NO₂ significantly lengthened these visits for the tested group.¹²

Amrita Dosanjh, a California-based pediatric pulmonologist, points out the parallel between the evident increase in CO₂ emissions and worldwide childhood asthma rates in a 2011 article featured in *The Journal of Asthma and Allergy*.¹³ 75% of these emissions come from the burning of fossil fuels – a practice that has become commonplace across the globe over the past century. In a developed nation like the United States, people burn fossil fuels each time they

¹⁰ Bruce F. Berg, *Healing Gotham: New York City's Public Health Policies for the Twenty-First Century* (Baltimore, MD: John Hopkins University Press, 2015), 74.

¹¹ David J. Nowak, Pamela Barclay, and Laura Jackson, *EnviroAtlas: Asthma Exacerbation Avoided Due to NO₂ Removed*, United States, Environmental Protection Agency, August 2015.

¹² Li Luo et al., “The Effects of Air Pollution on Length of Hospital Stay for Adult Patients with Asthma,” *The International Journal of Health Planning and Management* 33, no. 3 (2018), <https://doi.org/10.1002/hpm.2532>.

¹³ Amrita Dosanjh, “Childhood Asthma and Anthropogenic CO₂ Emissions,” *Journal of Asthma and Allergy*, 2011, p. 103, <https://doi.org/10.2147/jaa.s24565>.

drive a car, truck, or van. Areas that experience regular traffic congestion are likely to have poor air quality due to CO₂ emissions from automobile use.

The Bronx is intersected by several highways such as the Cross Bronx Expressway, Pelham Parkway, Mosholu Parkway, Throgg's Neck, Grand Concourse, and more. These roadways provide transportation routes to many New York state residents. As a result, pollutants in auto emissions irritate asthmatic individuals. Plenty of the drivers that access these roadways come from Westchester county and other areas north of the Bronx. As they pass through the Bronx on their daily commute, they pollute a community that they are not even a part of. 184,000 cars are said to drive on the Cross Bronx Expressway every day, making it one of the busiest roadways in the United States of America.¹⁴ The Cross Bronx Expressway can be linked not only to today's poor air quality, but to countless other disadvantages set in motion by its construction that will be discussed later in this paper.

The National Institute of Environmental Health Science published research surrounding the link between traffic-related air pollution and poor respiratory function among children with asthma in its *Environmental Health Perspectives Journal* in 2011. The study was conducted at four schools within the South Bronx. It concluded that children at the school-site with the most direct exposure to elemental carbon emissions from vehicular traffic had an "increased risk of cough, wheeze, and other symptoms" associated with the disease.¹⁵ The presence of carbon is a

¹⁴ Patrick Ploschnitzki, "Robert Moses, the Construction of the Cross-Bronx Expressway and Its Impact on the Bronx," Academia.edu, accessed May 9, 2019, https://www.academia.edu/8799288/Robert_Moses_the_construction_of_the_Cross-Bronx_Expressway_and_its_impact_on_the_Bronx_.

¹⁵ Ariel Spira-Cohen et al., "Personal Exposures to Traffic-Related Air Pollution and Acute Respiratory Health among Bronx Schoolchildren with Asthma," *Environmental Health Perspectives* 119, no. 4 (2011): pp. 559-565, <https://doi.org/10.1289/ehp.1002653>.

reasonable indicator of pollution sourced from traffic, as the contributors for the study “found evidence that > 90% of the Bronx [elemental carbon] can come from diesel exhaust.”¹⁶

In southern Bronx neighborhoods like Mott Haven, more stationary sources of pollutants, like factories and industrial buildings, line the waterfront. People who spend the bulk of their lives in close proximity to these high-risk areas are most prone to develop asthma. Sulfur dioxide and nitrogen dioxide are released in high volumes as a result of this industrial activity. Mott Haven itself has been dubbed by some as “Asthma Alley” due to its concentration of noxious facilities, including printing presses for the Wall Street Journal, a sewage treatment center, a parcel depot, and a warehouse for the food distributor Fresh Direct.¹⁷

The United States Environmental Protection Agency has a database that graphically provides data regarding the removal of these pollutants due to trees. While EnviroAtlas’ range does not span the entire country, it does have data regarding New York City. It accounts for fluctuating yearly tree cover due to a variety of coniferous trees, trees that maintain their canopy all year round, and deciduous trees, trees that lose their leaves seasonally. An estimate of the annual improvement in air quality based on the removal of a certain pollutant per year is calculated from atmospheric levels of certain compounds and hourly absorption rates.

A quick glimpse at the database’s map reveals that most of the Bronx is shown to be “yellow” when filtering information regarding amounts of Sulfur Dioxide removed annually by tree cover.¹⁸ The Bronx is broken up “block groups”, varying in size but ranging from roughly the size of four to ten street blocks. Yellow block groups indicate that less than 10 kilograms of

¹⁶ Ariel Spira-Cohen et al., “Personal Exposures to Traffic-Related Air Pollution and Acute Respiratory Health among Bronx Schoolchildren with Asthma,” *Environmental Health Perspectives* 119, no. 4 (2011): pp. 559-565, <https://doi.org/10.1289/ehp.1002653>.

¹⁷ Marcia G. Yerman, “South Bronx Fights Air Pollution in ‘Asthma Alley,’” Moms Clean Air Force, April 24, 2019, <https://www.momscleanairforce.org/bronx-air-pollution/>.

¹⁸ David J. Nowak, Pamela Barclay, Leah Yngve, Laura Jackson, *EnviroAtlas: Asthma Exacerbation Avoided Due to SO₂ Removed*, United States, Environmental Protection Agency, February 2016.

SO₂ are removed from the air per year by tree coverage. Many areas in the Bronx appear gray, indicating that 0 kg / year are removed. Areas that appear green or even blue are areas where plentiful tree coverage leads to a massive amount of absorption of SO₂. Unfortunately, green and blue areas are limited to non-residential areas of the Bronx. Crotona Park removes 211 kg of SO₂ per year, Inwood Park removes 404 kg / year, and Pelham Bay Park, New York's largest park, removes 2384 kg / yr. Despite disparities in overall area, conclusions about the effectiveness to combat pollution can still be drawn from comparisons. An area like Fordham University provides apt analysis of an area with significant greenery. Fordham is as large or slightly larger than most other block groups, but removes 98 kg of SO₂ per year. Nearby, The Bronx Zoo removes 2384 kg / year. These areas share the same, heavily trafficked roadways are these tree-lacking, neighboring block groups. The difference, it seems, is that these productive areas are simply covered in trees.

Toggling the displayable layers to show “Carbon sequestered by tree cover” lets the user see how other pollutants are stored in trees. One can see that many of these areas are a deep blue or green, showing that they sequester high amounts of metric tons of carbon per year. Crotona Park sequesters 58 metric tons of carbon in a year.¹⁹ One can understand the effectiveness of a spot like Crotona when it is compared against a less-green area of similar size. Crotona is approximately 0.20 square miles. A group of bordered areas in the nearby Fleetwood neighborhood make up a space of a similar size, sequestering less than 10 metric tons combined. The importance of highly-green areas with strong, full-bodied tree coverage is evident thanks to this program. EnviroAtlas shows data regarding the sequestration of two specific pollutants, but later chapters will expand on the ability of trees to improve air quality.

¹⁹ “EnviroAtlas Interactive Map,” EPA (Environmental Protection Agency), accessed May 10, 2019, <https://enviroatlas.epa.gov/enviroatlas/interactivemap/>.

The New York Environmental State Department of Environmental Conservation, or the DEC, is the city government body responsible for reporting the quality of the Bronx air to its residents. The abundance of the particulates responsible for poor air quality and respiratory health should be accurate and available to the public. However, a 2004 report on South Bronx air quality information recognized an oversight in the calculated data: the monitoring stations were located 15 meters above the ground. To more accurately accrue data regarding the air, a coalition of individuals at New York University measured air quality from a mobile station 4 meters above the ground.²⁰ Starting in 2001, it travelled around the South Bronx confirming or finding errors in the government's readings. The NO₂ concentrations recorded at ground level "were over twice as high as those recorded by the DEC."²¹ CO concentrations tended to be "60-90% higher than those recorded by DEC monitoring stations."²² Throughout this paper, it will become apparent that the Bronx is rarely prioritized by larger government groups. The inability to measure air quality correctly in the borough is just one example.

Healing Gotham: New York City's Public Health Policies for the Twenty-First Century outlines many factors that lead to high asthma rates in low-income areas like the Bronx. A factor that contributes to asthma exacerbation that is arguably the most surprising is stress. It notes that families of lower socio-economic status typically experience high stress. "Stress," it says, "has pro-oxidant effects that increase airway inflammation" and "also increase vulnerability to antigens through direct effects on the endocrine system, autonomic control of airways and

²⁰ Carlos Restrepo et al., "A Comparison of Ground-Level Air Quality Data with New York State Department of Environmental Conservation Monitoring Stations Data in South Bronx, New York," *Atmospheric Environment* 38, no. 31 (2004): pp. 5295-5304, <https://doi.org/10.1016/j.atmosenv.2004.06.004>.

²¹ Carlos Restrepo et al., "A Comparison of Ground-Level Air Quality Data with New York State Department of Environmental Conservation Monitoring Stations Data in South Bronx, New York," *Atmospheric Environment* 38, no. 31 (2004): pp. 5295-5304, <https://doi.org/10.1016/j.atmosenv.2004.06.004>.

²² Carlos Restrepo et al., "A Comparison of Ground-Level Air Quality Data with New York State Department of Environmental Conservation Monitoring Stations Data in South Bronx, New York," *Atmospheric Environment* 38, no. 31 (2004): pp. 5295-5304, <https://doi.org/10.1016/j.atmosenv.2004.06.004>.

immune function.”²³ Psychological stress and ozone (O₃) both affect oxidative stress pathways, so their relationship is not exactly biologically unusual.²⁴

A 2007 study identified another factor for high asthma rates that is mostly present in low-income, urban communities. The study, titled “Synergistic Effects of Traffic-Related Air Pollution and Exposure to Violence on Urban Asthma Etiology,” notes that exposure to violence, or “ETV”, also leads to an increase in asthma in an area. “Urban caregivers, for example, restrict children’s behavior, keeping them indoors due to fear of violence, making children more sedentary, increasing indoor exposures, and decreasing spatial autonomy that is important to development.”²⁵ Exposure to violence would also likely increase the stress levels of an asthma-sensitive individual. The publication eventually concludes that there is an association between the emission of NO₂ from traffic and asthma diagnoses among children who experience urban stressors such as exposure to violence. On top of generally poor air quality, these factors that affect one’s social environment as certainly at play in a community such as the Bronx.

A study from 2009 published by the National Center for Biotechnology Information compared Bronx asthma rates and living conditions to those in other areas of the United States. It concluded that Bronx children were at a higher rate of risk to asthma than anywhere else in the country. The chronic illness is “the leading cause of hospitalization and of school absence for children” in the borough.²⁶ As a result, children in the Bronx are also “twice as likely to die”²⁷ from asthma than the average American child. Among Bronx children between the ages 4-5,

²³ Bruce F. Berg, *Healing Gotham: New York City's Public Health Policies for the Twenty-First Century* (Baltimore, MD: John Hopkins University Press, 2015), 75.

²⁴ Carlos Restrepo et al., “A Comparison of Ground-Level Air Quality Data with New York State Department of Environmental Conservation Monitoring Stations Data in South Bronx, New York,” *Atmospheric Environment* 38, no. 31 (2004): pp. 5295-5304, <https://doi.org/10.1016/j.atmosenv.2004.06.004>.

²⁵ Carlos Restrepo et al., “A Comparison of Ground-Level Air Quality Data with New York State Department of Environmental Conservation Monitoring Stations Data in South Bronx, New York,” *Atmospheric Environment* 38, no. 31 (2004): pp. 5295-5304, <https://doi.org/10.1016/j.atmosenv.2004.06.004>.

²⁶ Warman, Johnson Silver, Wood, “Modifiable Risk Factors for Asthma Morbidity in Bronx,” 995-1000.

²⁷ Warman, Johnson Silver, Wood, “Modifiable Risk Factors for Asthma Morbidity in Bronx,” 995-1000.

15.5% had asthma. The average for all of New York city was 9.2%. The average rate for all US children is 8.9%.²⁸ In 2000, black children had an asthma rate that was 44% higher than that of white non-Hispanic children.²⁹ In the 1980s, the rate for black children was 15% higher than non-Hispanic white children. Asthma is becoming more treatable as time goes on, but the ability to properly treat it seemingly does not extend into poor, urban, non-white communities.

This inability to treat asthma in areas like the Bronx is in part due to the lack of access to medical care. Primary health care options in low-income areas are scarce. High asthma rates are typically in areas of New York City where “higher percentages of those who lack health insurance live.”³⁰ Statistics involving high hospitalization rates due to asthma do indeed point to a severe asthma problem, but more candidly point to an institutional healthcare problem. Emergency room visits are often the only treatment option for a family that relies on Medicaid or has no insurance at all. In 2004, 10.7 of every 1000 hospitalization cases in the Bronx was related to asthma, with 12.8 out of every 1000 being asthma-related in the Mott Haven / Hunt’s Point neighborhood. In Brooklyn, Manhattan, Queens, and Staten Island, 6.1 of every 1000 hospitalizations or less were asthma-related.³¹

The asthma epidemic in the Bronx is caused by poor living conditions – namely poor air quality. Insights into its historical development can help explain what led to this reality in the borough. This look into the past reveals consistent environmental neglect and the placement of the city’s most severe environmental burdens on the Bronx’s population.

²⁸ Warman, Johnson Silver, Wood, “Modifiable Risk Factors for Asthma Morbidity in Bronx,” 995-1000.

²⁹ Berg, *Healing Gotham: New York City's Public Health Policies for the Twenty-First Century*, 76.

³⁰ Berg, *Healing Gotham: New York City's Public Health Policies for the Twenty-First Century*, 77.

³¹ Berg, *Healing Gotham: New York City's Public Health Policies for the Twenty-First Century*, 79.

Chapter 2: Environmental History of the Bronx (Environmental History)

The history of the Bronx is filled with numerous events that led it to be an area where asthma could become a serious issue. Past missteps in urban planning and environmental neglect allowed the borough to become one with several sources of air pollution. Additionally, its failure to implement green spaces with abundant tree coverage has prevented it from being able to naturally regulate its air quality.

The Bronx is the northernmost borough of New York City. It is also the only borough of the five that is part of the mainland, as Queens and Brooklyn make up the western end of Long Island and Staten Island and Manhattan are islands themselves. This distinction is a crucial factor in its development. Many features of the Bronx today can be traced back to its initial geography.

While its geography historically made the Bronx disadvantaged when it came to water commerce, trading and transportation by boat were not impossible. Many streams ran through the borough, like Tibbett's Brook, a system that continues to run through Van Cortlandt Park today. The Bronx River has always been the major waterway in the Bronx. Today, it remains the only major river to run through New York City.

The geology of the Bronx is equally as important to its development. The soil is of a clay loam surface, perfectly suitable for planting and cultivation. It is the terrain, however, that presents a challenge. Rocky ridges running from north to south lie on the western half of the Bronx. The winter freeze brings loose rocks up from deep underground. These had to be removed before plowing could start each year. This same rock, Fordham gneiss³² was key in the development of Manhattan, as it served as the bedrock for the foundation of the city. For anyone hoping to engage in agriculture, however, they presented a problem.

³² Lloyd Ultan, *The Northern Borough: a History of the Bronx* (Bronx, NY: Bronx County Historical Society, 2009), 3

The entire environmental history of the area may not seem crucial to understanding the issue of asthma or limited green space in the Bronx. It is, however, important to develop a clear understanding of the development of parkland and the emergence of rampant pollution. To do this, the interaction between the Bronx and New York City as a whole must be examined. In late 1874, New York City annexed areas outside of Manhattan into the city for the first time. This included the West Bronx, and the area became known as the “Annexed District.”³³

For a borough with such poor park quality, it is surprising to learn that the fate of the Bronx as we know it has been historically tied to the idea of parks. When New York City acquired mainland towns that compose the modern day Bronx from Westchester County, they “doubled the geographical size of New York City.”³⁴ The area was mostly either rural or suburban, contrasting the busy urban center that city-dwellers were accustomed to. It was evident that a different approach would be necessary for city planning in the Annexed District. When deciding who would oversee the development of the area, many suggested the Department of Public Works. Due to the minimal urbanization present in the area, the authority ended up being granted to the Department of Public Parks, as insisted by Governor John A. Dix.³⁵

To the majority of New York City residents, the Bronx was an afterthought. The fact that it’s nickname became “The Annexed District” speaks volumes about the role it played within the larger city. The Bronx was known for being new and separated from the bustling urban centers of Manhattan. All it needed was a series of locations attractive enough to convince New Yorkers it was worth travelling to.

In 1875, the Board of Park Commissioners within the Department of Public Parks chose Frederick Law Olmsted, a chief designer of Central Park, to draw up a plan for the Annexed

³³ Ultan, *The Northern Borough: A History of the Bronx* 173.

³⁴ Ultan, *The Northern Borough: A History of the Bronx* 173.

³⁵ Ultan, *The Northern Borough: A History of the Bronx* 173.

district. As time went on, many of these commissioners were replaced. The new appointments were made for patronage reasons alone and had “no interest in planning streets for the mainland.”³⁶ With no street plan to be seriously considered, the placement and range of several public improvements could not be considered. The Bronx remained a land where sewers and proper streets did not exist. This can be seen as a starting point for a history of urban planning and public health faults in the area.

When an economic depression hit in 1873, funding was immediately cut to the Board of Park Commissioners. With no funding, The Annexed District *could not* be improved, even if the initiative was there. This was perhaps the first step in a history of government neglect and lack of funding for the Bronx. The Melrose neighborhood had no sidewalks. The borough had no paved streets. There was no sewer system or water mains. From an urban planning standpoint, The Bronx was a nightmare.

The district was failing to thrive in the late 19th century, causing the land prices to remain low. John Mullaly, born in Belfast, Ireland in 1835, had travelled to New York to pursue journalism at first, saw the West Bronx as a location of untapped potential. At the time, not many residents lived in the area. Mullaly imagined an extensive park system in the Bronx – one that would eventually influence a great migration of people from the city. He sought to buy the parkland before real estate prices rose and got to work creating parks that could be “ready for the people of the future.”³⁷ Because of the strips of rock that line the west, Mullaly imagined that many of the parks could retain their natural terrain. This can be seen today in places like Crotona Park, Franz Sigel Park, St. Mary’s Park, and more. This gave the proposed Bronx parks an advantage over Central Park, for instance, as they would not have to pay for excavation costs.

³⁶ Ultan, *The Northern Borough: A History of the Bronx* 174.

³⁷ Ultan, *The Northern Borough: A History of the Bronx*, 175.

Mullaly was met with his fair share of opposition and criticism. Teddy Roosevelt, American President and renowned champion of the outdoors, even opposed the idea, claiming New Yorkers would never make trips to parks in the Bronx. Luckily, the New York State government passed legislation in 1884 that established a committee to “buy parks on the mainland for the city.”³⁸ John Mullaly was appointed to serve as secretary of this new committee. By 1888, he had led the city to purchase what are now Van Cortlandt Park, Bronx Park, Pelham Bay Park, Crotona Park, Claremont Park, and St. Mary’s Park.³⁹ Additionally, the city acquired the routes of Mosholu Parkway, Pelham Parkway, and Crotona Parkway.

While the official public parks that were created were new, many of these areas had been serving as functional green spaces for years prior. Augustus Van Cortlandt was a wealthy and influential member of the New York elite of the time. He regularly let citizens use his land for recreation and leisure. Mullaly was happy to acquire the land from Van Cortlandt, as he was enamored by the trees, shrubs, and songbirds there. He also imagined that the trout in Tibbett’s Brook would attract anglers to the new park.

Other locations, like Bronx Park, were favorites of Mullaly’s due to their unparalleled vistas. These, he thought, could bring painters to the park. It was even considered to be a location for a botanical garden, a feature of cities like Philadelphia and Paris that New York City lacked. Mullaly’s had long-term visions for a borough centered around the implementation of parkland.

Crotona Park, formerly known as “the Bathgate Woods”, had a variety of tree species within it that caught the committee secretary’s attention. Like the Van Cortlandts, the Bathgate family was also keen on letting the public use their land as a public recreation space or picnic ground. Mullaly foresaw the likelihood of dense settlement around the area, predicting that may would rely on Crotona to serve as their local green space.

³⁸ Ultan, *The Northern Borough: A History of the Bronx*, 175.

³⁹ Ultan, *The Northern Borough: A History of the Bronx*, 175.

St. Mary's Park was the smallest Bronx park commissioned at the time. Located in Mott Haven, it was already located in the most densely populated part of the Bronx. The people had settled here for its proximity to the budding industrial hub⁴⁰. This was all occurring years before the air quality problems brought on by rampant industry made green space such an important commodity.

Mullaly likened Claremont Park to an area in the Catskill mountains, providing Bronx residents with the ability to tuck away in its natural contours and separate themselves from the urban lifestyle outside.

John Mullaly insisted that the Bronx should have a park that ran along Long Island Sound. The waterfront would draw crowds, making it "the Newport for the masses."⁴¹ Many of the ideas for parks seem to follow this trend: they were meant to be pristine, natural areas that provided an escape for the "masses" of New York City residents without having them commit to a longer journey outside the city. Mullaly's ambition seemingly had no end. He had concepts for zoos and aquariums by the water, observatories on elevated areas, and more.

The decision to maintain the natural contours of the Earth in these parks was made for a multitude of reasons. Along with providing a more authentic aesthetic appeal, it reduced costs for the creation of these parks by eliminating landscaping expenses.⁴²

While the creation of these parks was important to the Bronx's early development, it is important to note that many of these parks are not situated in areas that serve much of the borough's population. Van Cortlandt Park and Pelham Bay Park are the only two parks that are large enough serve as true "escapes" from urban life, and they are found far away from the dense

⁴⁰ Ultan, *The Northern Borough: A History of the Bronx*, 176

⁴¹ Ultan, *The Northern Borough: A History of the Bronx*, 176

⁴² Ultan, *The Northern Borough: A History of the Bronx*, 176

residential areas of the Bronx. Most other parks are small, grassy patches jammed between city blocks.

While public parkland was an issue, developing industrial centers never was. In its earliest days of development before talks of Annexation, the Bronx was always intended to be a suburban, residential borough. That would not prevent the likes of Jordan L. Mott, the namesake for Mott Haven, for setting aside a large portion of his holdings for industry. The entrepreneur “touted Mott Haven as the perfect site for factories of all kinds.”⁴³ These factories dotted the shoreline, creating a history of production and pollution from then forward. Between the years 1880 and 1898, “seventy factory plans were filed for the Mott Haven area.”⁴⁴ There was no limit to the types of goods being manufacturing in Mott Haven. Everything from pianos to refrigerators was, at some point, made in this southern section of the Bronx. However, “no definite boundary separated residences from these ‘important manufacturing plants’.”⁴⁵ Especially following the 1870s, people began to settle nearby these new, modern beacons of economic opportunity, situating themselves in the heart of their emissions. There were complaints about industrial pollution becoming an ordinary component of life in the area, but those with financial interests connected to the working population argued that juxtaposing these cheap tenement-style homes and factories made the neighborhood a busy “downtown” area for the Bronx – analogous to areas of Manhattan.⁴⁶

Prior to their annexation into New York City, the towns that lay west of the Bronx River faced massive problems regarding sewage disposal. These communities found “emptying into the Bronx river was the obvious and cheapest solution.”⁴⁷ As the waterway was shared with New

⁴³ Ultan, *The Northern Borough: A History of the Bronx*, 134

⁴⁴ Evelyn Diaz. Gonzalez, *The Bronx* (New York: Columbia University Press, 2006), 62.

⁴⁵ Gonzalez, *The Bronx*, 62.

⁴⁶ Gonzalez, *The Bronx*, 63.

⁴⁷ Ultan, *The Northern Borough: A History of the Bronx*, 189

York City, concerns about industrial pollution were raised. The small villages that were culpable, however, were not capable of fronting the cost for sewage lines that could extend to Long Island Sound. While pollution in the water does not directly impact air quality, this is one of the most obvious examples of Bronx residents being forced to choose unhealthy, polluting options due to lack of alternatives.

Just like noxious industrial facilities, the idea to construct polluting roadways was also more of a priority than providing Bronx residents with healthy, accessible green spaces. Its inception began in 1948 when Robert Moses was designated as the construction coordinator. He was already infamous in New York City for spearheading a variety of construction projects, many of them being expressways and parkways.⁴⁸ At the time, Moses was thought of as someone with an unwavering stubbornness and a “general disregard for the common man.”⁴⁹ Robert Caro, a well-known critic of Moses, remarked that he could manipulate New York City’s politics to his will despite never being elected to any position he had ever held.⁵⁰ Many see the construction of the Cross Bronx Expressway to be a symbol of the deterioration of the borough. Robert Moses exclusively spoke of the enormous benefits that the roadway would provide as it connected New Jersey, Long Island, Manhattan, and the Bronx. The displacement of residents from areas like East Tremont and the loss of thousands of jobs was an afterthought. Some estimates suggest that more than 1,500 were forced to leave their homes in order for the project to go ahead.⁵¹ Robert Caro claimed Moses was “the most racist human being [he] had ever really encountered.”⁵²

⁴⁸ Patrick Ploschnitzki, “Robert Moses, the Construction of the Cross-Bronx Expressway and Its Impact on the Bronx,” Academia.edu, accessed May 9, 2019, https://www.academia.edu/8799288/_Robert_Moses_the_construction_of_the_Cross-Bronx_Expressway_and_its_impact_on_the_Bronx .

⁴⁹ Ploschnitzki, “Robert Moses, the Construction of the Cross-Bronx Expressway and Its Impact on the Bronx”

⁵⁰ Ploschnitzki, “Robert Moses, the Construction of the Cross-Bronx Expressway and Its Impact on the Bronx”

⁵¹ Matt Sedensky, “NEIGHBORHOOD REPORT: BRONX UP CLOSE; Decades Later, Doing the Cross Bronx Expressway Right,” *The New York Times*, October 7, 2001.

⁵² Thomas J Campanella, “The True Measure of Robert Moses (and His Racist Bridges),” CityLab, July 9, 2017, <https://www.citylab.com/transportation/2017/07/how-low-did-he-go/533019/>.

Unsurprisingly, there are even claims that Moses designed bridges to be low enough to prevent poorer, often black New Yorkers, who often travelled in buses, from using the highway. His narrow-minded view of New York City's needs and racist tendency to prioritize affluent citizens contributed greatly to the Bronx's decline. The figure below shows the location of the Cross Bronx Expressway, along with other major roadways, in relation to the rest of the borough.



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Major Bronx Roadways

⁵³ New York State Department of Transportation

Rapid population growth in the 20th century also contributed to environmental issues that relate to the asthma problem today. While increased population density had its social advantages in creating tight-knit communities, it also gave way to a host of other concerns like “more congestion, competition, and environmental degradation.”⁵⁴

A number of factory employees lost their jobs in the 1930s, but World War II ignited a revival in manufacturing positions. In the 1940s, “milk plants, laundries, retail outlets, and the Con Ed power plant” remained in the Bronx and continued to expel industrial pollution.⁵⁵ But as the mid-20th century continued, the social fabric of the Bronx began to undergo change. As crime rose across New York City and the economy began to fail, sanitation services and the police force began to cut funding.

Those who could afford to move out of the area did.⁵⁶ Concentrations of minority populations began to grow. In 1950, 11% of the borough’s population was black, Puerto Rican, or Hispanic. By 1980, those same demographics made up 63.7% of the Bronx’s population.⁵⁷ As time went on, remaining white families “resented the imposition of different and often poorer peoples within their midst.”⁵⁸ Public housing developments were seen as the solution by New York City bureaucrats like Robert Moses. The social shifts of the century paved the way for the reality of the Bronx today – a low-income area scattered with busy roadways and facilities that condemn its residents to an environment of impure air. With no attention given to the areas that should serve as recreational escapes from these environmental injustice, it’s no wonder why the asthma problem is one that so many Bronx residents deal with.

⁵⁴ Gonzalez, *The Bronx*, 91

⁵⁵ Gonzalez, *The Bronx*, 103

⁵⁶ Gonzalez, *The Bronx*, 104

⁵⁷ Gonzalez, *The Bronx*, 113

⁵⁸ Gonzalez, *The Bronx*, 114

Chapter 3: Environmental Inequity in the Bronx (Environmental Inequality & Racism)

Every corner of the Earth deals with unique with environmental issues. No singular part of our planet has been immune to the ill-effects of human activity. Unfortunately, some locations are affected more than others. To make matters worse, this unequal distribution of environmental burdens is rarely random. The concept of “environmental justice” is fairly simple to understand. As put by Majora Carter, executive director of Sustainable South Bronx, the term means “no community should be saddled with more environmental burdens and less environmental benefits than any other.”⁵⁹ The term “environmental racism” expands on environmental justice. It can applied when it is apparent that people of certain races or ethnicities that are typically oppressed in society continue to be oppressed through these environment burdens. Environmental justice is said to “[maintain] a political commitment to the urgent conflicts over environmental resources, pollution, and exploitation in communities.”⁶⁰ In the 1980s, a variety of environmental struggles throughout the United States began to highlight the need for a convergence of goals and principles. Eventually, the First People of Color Environmental Leadership summit was held in Washington D.C. in 1991.⁶¹ There, involved parties conceived the “Principles of Environmental Justice.” The document contains 17 statements that recognize the disproportionate environmental disadvantages that minority ethnic groups are typically subject to. It called for public policies that are based on “mutual respect and justice for all peoples”, an idea that is absent in the historical patterns of urban planning in the Bronx.⁶² It continues to advocate for “universal protection” from the hazardous pollutants that “[threaten] the fundamental right to clear air, land,

⁵⁹ Majora Carter, “Sustainable Solutions: The Pursuit of Environmental Justice in the South Bronx ,” *Economic Development Journal*, 2006, pp. 24-29.

⁶⁰ Julie Sze, *Noxious New York: the Racial Politics of Urban Health and Environmental Justice* (Cambridge, MA: MIT Press, 2007).

⁶¹ Dana Alston, “The Summit: Transforming a Movement,” *The Summit: Transforming a Movement | Reimagine!*, 2010, <https://www.reimaginepe.org/20years/alston>.

⁶² Alston, *The Summit: Transforming a Movement*, 2010.

water, and food.”⁶³ The notion that these things are basic human rights had gained popularity and understanding thanks to the environmental movements of the 1970s, but it was not until the environmental justice movement was propelled into the public sphere that their unbalanced distribution between social groups was apparent to governments and regulating agencies.

The birth of the environmental justice movement showcased the disconnect between social classes in the United States. The mainstream environmental movement primarily concerned itself with the preservation of wilderness, focusing on maintaining “pristine green [spaces] devoid of people” as its central political battle. Although it certainly has spots of green areas, an urban environment like the Bronx would not see many benefits from a movement like this. Rooted in romantic, often unrealistic visions of the environment inspired by transcendentalism, the attention on these topics instead of fundamental rights to environmental wellbeing “reflected class and racial biases” in America.⁶⁴ The need for a movement that served those most harmed by environmental ills was hidden behind what historian Sylvia Hood Washington nicknamed “the environmental veil.”⁶⁵

There are seemingly innumerable examples of how the Bronx as a geographic area falls victim to environmental racism. American society is fueled by a culture of consumption – a culture that demands the intake of goods and the creation of “trash”. The pollution expelled from noxious facilities, “especially environmental or sanitary services” causes an increase in the concentration of harmful pollutants in the air.⁶⁶ In addition, the placement of waste processing facilities increases the number of waste-handling vehicles that arrive to and leave from communities, marginally emitting more pollution that builds up over time. The Bronx is home to several facilities that process sludge, sewage, water treatment, and garbage. In 2016, the New

⁶³ Alston, *The Summit: Transforming a Movement*, 2010.

⁶⁴ Sze, *Noxious New York*, 28

⁶⁵ Sze, *Noxious New York*, 28

⁶⁶ Sze, *Noxious New York*, 28

York City Council confirmed that “80 percent of the city’s waste [was] processed at stations in the South Bronx, north Brooklyn, and southeast Queens.”⁶⁷

In 2014, a bill was proposed to ensure that New York neighborhoods that process an overwhelming percentage of the city’s garbage do not exceed their processing capacity. The legislation, titled “Int. 0495-2014: Reducing permitted capacity at putrescible and non-putrescible solid waste transfer stations in overburdened districts,” aimed to amend the city’s administrative code and correct the fact that the city’s garbage is handled in areas occupied mostly by ethnic minorities.⁶⁸

The New York City Environmental Justice Alliance is a non-profit founded in 1991 that campaigns for legislation like Int. 0495-2014. It’s director, Eddie Bautista, said that he saw the bill as the “first tangible, real attempt to address...the clustering and over-concentration [of waste infrastructure] in a handful of environmentally overburdened communities of color.”⁶⁹ At the time of the bill’s proposal, New York City mayor Bill de Blasio and his administration did not support it. According to New York City legislation records, the bill was filed in December 2017. Under the name Intro 157-C, a bill regarding waste equity was signed into law by Mayor de Blasio in August of 2018. The Bronx, Queens, and Brooklyn, the boroughs that handle most of the city’s waste, will be relieved of the disproportionate burdens of waste management as a result. Additionally, the creation of new waste management facilities in individual neighborhoods that handle 10% or more of the city’s waste will be prohibited.⁷⁰ Not only will

⁶⁷ “A New Report Finds That the South Bronx Is Overrun with Garbage Trucks, and Emissions Are Hurting Residents,” Brick Underground, December 18, 2017, <https://www.brickunderground.com/live/south-bronx-air-quality>.

⁶⁸ The New York City Council, *Int. 0157-2018*.

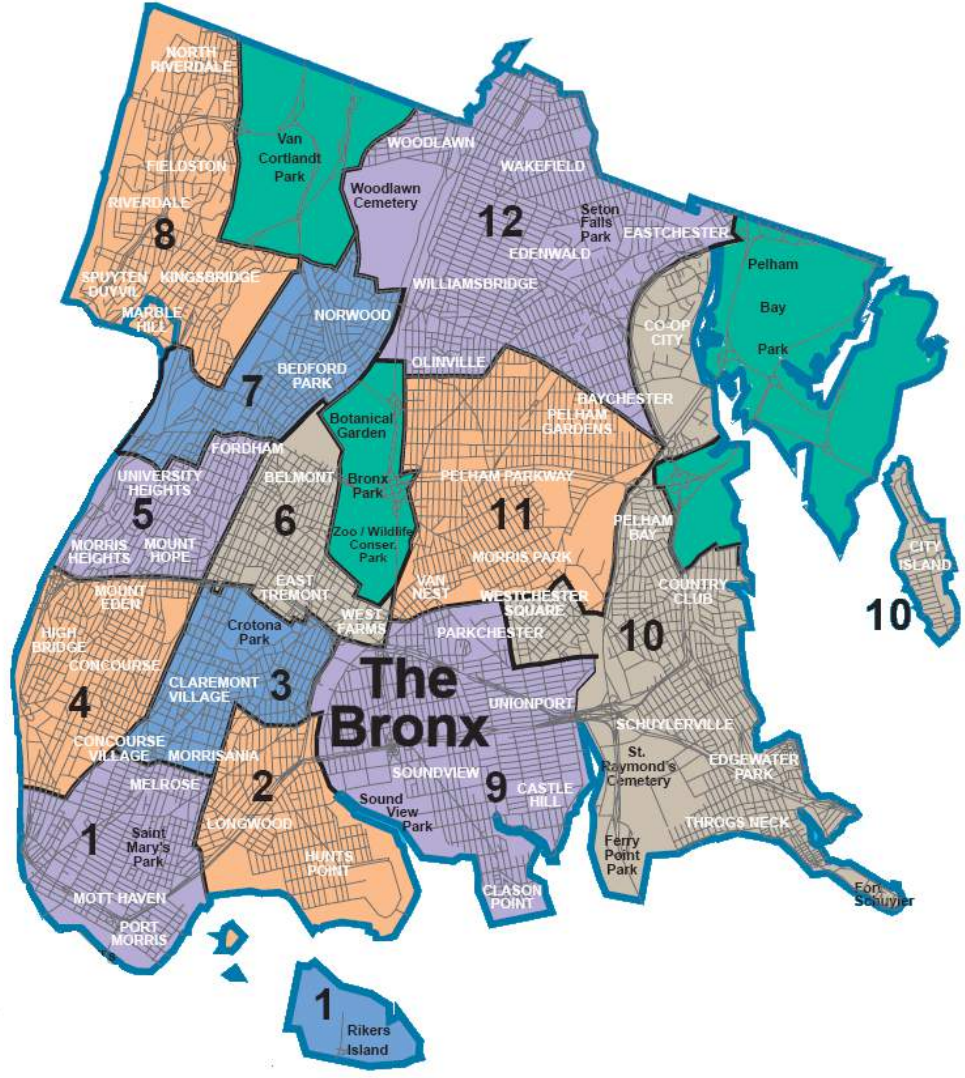
⁶⁹ Sarah Crean, “The Bronx Is Breathing,” New York Environment Report, March 2, 2015, <https://www.nyenvironmentreport.com/the-bronx-is-breathing/>.

⁷⁰ “Mayor De Blasio and Speaker Johnson Celebrate Signing of Waste Equity Legislation,” The official website of the City of New York, August 16, 2018, <https://www1.nyc.gov/office-of-the-mayor/news/417-18/mayor-de-blasio-speaker-johnson-celebrate-signing-waste-equity-legislation>.

direct emissions from these facilities be reduced, but emissions from vehicles involved in waste management operations will be less concentrated in certain areas. Estimates by the city government say that the South Bronx alone will see a 33% decrease in the amount of waste accepted to private sanitation facilities. Prior to the enactment of this legislation, Bronx district BX01 received 3,824 tons of waste per day. BX02 received 2,537 tons daily.⁷¹ The “capacity reductions” will begin on October 1, 2019.⁷² The figure below gives context to the geographic locations of these districts within the Bronx. Over the next few years, New Yorkers can hopefully expect to see the pay-off of this action.

⁷¹ “Mayor De Blasio and Speaker Johnson Celebrate Signing of Waste Equity Legislation”

⁷² “Mayor De Blasio and Speaker Johnson Celebrate Signing of Waste Equity Legislation”



Bronx Community Board Districts

Municipal facilities are not the only buildings that can be blamed for the heavy pollution in the Bronx. Plenty of buildings involved in other sectors of industry expel similar levels of pollution. Robert Bullard, a sociologist deemed the “father of environmental justice,” speaks extensively on disproportionate pollution levels in low-income neighborhoods of ethnic minorities, specifically African-Americans, in his publication “The Politics of Pollution: Implications for the Black Community”. With such large portions of these communities working

⁷³ Baruch College, NYCDATA, New York City (NYC) Maps – Boroughs with Community Districts

blue collar jobs, they become “economically dependent upon the very industry that pollute their neighborhoods.”⁷⁴

Zoning laws are behind the decisions to create these harmful facilities in high concentrations in certain areas. Laws created in 1916 by the New York City Zoning Ordinance created three categories of zoning districts, each controlling regulations regarding to height, area, and what the spaces could be used for. The “use” districts created three different categories of land use purposes: residence, business, and “unrestricted.”⁷⁵ As one can conclude by simply reading their names, each one of these categories is subject to different severities of regulation. Unrestricted areas were most commonly used for industrial developments. Ironically, the emergence of zoning as a discipline was championed by progressive politicians who “believed that the urban environment could be improved by technical expertise, scientific knowledge, and rational city planning.”⁷⁶ Soon, it became a tool to create larger class divides and segregate populations. By picking and choosing the designation of an area, zoning laws could artificially protect property values. Due to the income inequality between white and non-white communities in the United States throughout the 20th century, this helped control “the population that inhabited a particular area.”⁷⁷ The Bronx, Queens, and Brooklyn were delegated as neighborhoods with high concentrations of “unrestricted” areas. This led to rampant industrial development, far away from the wealthier residents of Manhattan. Thanks to the property value ripple-effects of zoning laws, the working-class, largely non-white populations of these outer boroughs were essentially condemned to live in areas where industrial facilities would pump emissions into the air they breathe.

⁷⁴ Robert D. Bullard and Beverly Hendrix Wright, “The Politics of Pollution: Implications for the Black Community,” *Phylon* (1960-) 47, no. 1 (1986): p. 71, <https://doi.org/10.2307/274696>.

⁷⁵ Sze, *Noxious New York*, 41

⁷⁶ Sze, *Noxious New York*, 41

⁷⁷ Sze, *Noxious New York*, 41

Fights against these large, polluting industrial centers continue today. Bronx residents have and continue to lead demonstrations against companies that contribute to the issue of poor air quality and asthma. In 2015, residents of the Mott Haven and Port Morris neighborhoods of the Bronx protested against FreshDirect, a food service company that had broken ground for a massive 500,000 square foot facility⁷⁸. The air quality in these areas is already impacted by the presence of “A Federal Express hub, aforementioned printing locations for newspapers, a waste transfer station and sewage treatment operation.”⁷⁹

Discussions about environmental justice and racism in the Bronx extend from air to land. St. Mary’s Park, for example, sits in the South Bronx by the Mott Haven neighborhood. The New York Parks Department hails it as the “largest park in the South Bronx” at 25 acres. Still, it is dwarfed by larger parks in the North like Van Cortlandt and Bronx Park. The facilities at St. Mary’s are in need of renovation, and the park itself cannot be the perfect escape to greenery that a park should be. Surveys with US residents showed that this neglect for smaller, inner-city parks is common, finding that “high poverty and majority-minority neighborhoods in urban regions have parks in closer proximity, but they also have a lower percentage of green space than wealthier and White neighborhoods.”⁸⁰ Disparities continue in park acreage and quality of facilities. Results of this study also found that “cities with relatively high black populations may have lower quality park systems and poorer walking access to parks than other cities.”⁸¹

⁷⁸ Hazar Kilani, “‘Asthma Alley’: Why Minorities Bear Burden of Pollution Inequity Caused by White People,” *The Guardian* (Guardian News and Media, April 4, 2019), <https://www.theguardian.com/us-news/2019/apr/04/new-york-south-bronx-minorities-pollution-inequity>.

⁷⁹ Yerman, “South Bronx Fights Air Pollution in ‘Asthma Alley,’” Moms Clean Air Force

⁸⁰ Alessandro Rigolon, Matthew Browning, and Viniece Jennings, “Inequities in the Quality of Urban Park Systems: An Environmental Justice Investigation of Cities in the United States,” *Landscape and Urban Planning* 178 (2018): pp. 156-169, <https://doi.org/10.1016/j.landurbplan.2018.05.026>.

⁸¹ Alessandro Rigolon, Matthew Browning, and Viniece Jennings, “Inequities in the Quality of Urban Park Systems: An Environmental Justice Investigation of Cities in the United States,” *Landscape and Urban Planning* 178 (2018): pp. 156-169, <https://doi.org/10.1016/j.landurbplan.2018.05.026>.

The largest parks in the Bronx are notably distant from the majority of Bronx residents. A comparison of census data shows how people of higher socio-economic status benefit more from access to parkland. The large, northern parks in the Bronx are easily accessed by citizens of Westchester county – arguably more so than Bronx county.

Westchester has a population estimate of 980,244 while the Bronx county has a population of 1,471,160.⁸² Westchester, however, has an area of 430.5 square miles while The Bronx has 42.1 square miles. Immediately, one can recognize that The Bronx has more residents squeezed into a smaller space. Dense living conditions can be a contributor to poor respiratory health. Westchester county has 2,204.7 people living within each square mile. The Bronx has 32,903.6 people in a space of the same size. 10% of Westchester county residents live in poverty, while 28.6% of Bronx residents face the same reality. The median household income for a Westchester county individual is \$86,226.⁸³ For the Bronx, the median income is \$35,302.⁸⁴ With a disparity greater than \$50,000 in average earnings, one can imagine that the Bronx and Westchester, despite being geographically close, are in some ways worlds apart.

The Bronx demographic is primarily African American or Hispanic. Census data says 43.7% of Bronx are African American alone and 35.7% are non-white Hispanic. In Westchester county, African Americans make up only 16.5% of the population. Non-white Hispanic individuals make up 20.1% of the population.

As outlined in Majora Carter’s article “Sustainable Solutions” for the Economic Development Journal in 2006, “low-income citizens often use emergency room visits as primary care. This comes at a high cost to taxpayers and produces no proportional benefits: poor people

⁸² "U.S. Census Bureau QuickFacts: Bronx County (Bronx Borough), New York," Census Bureau QuickFacts, accessed December 19, 2018,

⁸³ "U.S. Census Bureau QuickFacts: Westchester County, New York," Census Bureau QuickFacts, accessed April 9, 2019, <https://www.census.gov/quickfacts/westchestercountynyork>.

⁸⁴ "U.S. Census Bureau QuickFacts: Bronx County (Bronx Borough), New York," Census Bureau QuickFacts, accessed December 19, 2018,

are not only still poor, they are less healthy.”⁸⁵ The lack of information regarding medical facilities, or, more commonly, the lack of proper medical infrastructure to handle the needs of such a large population, leaves the Bronx depending on expensive treatments that benefit no one. Public health disparities play a massive part in environmental injustice and racism.

There are a wealth of disparities that contribute to the Bronx’s asthma rates being notably higher than the rest of the country’s. The disparity in public green space only exacerbates the issue. When all of the aforementioned disparities are considered, it is difficult to say that many are not rooted in intentional injustice against communities with less political representative, lower income, and vastly different qualities of life.

Chapter 4: Bronx Greenspace Area and Quality (Environmental Planning)

Functional, well-maintained green-spaces are necessary to promote healthy lifestyles and combat poor overall health, not just respiratory health. “Particulate matter” is the name of one class of pollutants that can have detrimental effects on the human respiratory system. Links have been found between increases in airborne particulate matter and “growing mortality and morbidity for major cardiovascular and respiratory diseases.”⁸⁶ Luckily, an abundance of trees and greenery has proven to be an effective solution to combat the issue. Particulate matter is categorized according to its size. For example, PM₁₀ and PM_{2.5} respectively refer to particulates with aerodynamic diameters of less than 10 micrometers and 2.5 micrometers. While the respiratory system functions as a filter for harmful particulates, ones of this size can penetrate the upper respiratory tract. Particulates finer than PM_{2.5} can “penetrate” through the upper respiratory

⁸⁵ Majora Carter, “Sustainable Solutions: The Pursuit of Environmental Justice in the South Bronx,” *Economic Development Journal*, 2006, pp. 24-29.

⁸⁶ V Silli, E Salvatori, and F Manes, “Removal of Airborne Particulate Matter by Vegetation in an Urban Park in the City of Rome (Italy): An Ecosystem Services Perspective,” *Annali De Botanica* 5 (April 15, 2015): pp. 53-62, <https://doi.org/10.4462/annbotrm-13077>.

tract and enter the lungs while “ultrafine” particulates, with diameters less than a single micrometer, are “capable of entering the bloodstream.”⁸⁷ They also may contain “carcinogenic compounds or heavy metals.”⁸⁸ Urban areas are, by their nature, densely populated and exposed to high amounts of airborne particulate matter. Green, foliar surfaces capture all sorts of pollutants. While they detoxify gaseous pollutants and release clean oxygen, particulate matter is instead “resuspended or washed away by a climatic event.”⁸⁹ The structure and morphology of a leaf or foliar organ contributes to its ability to capture particulate matter. The ecological classifications of trees provided through taxonomy can help determine which types of trees are most effective in this pursuit. The figure below shows the locations of parks in the Bronx. Although sparse, it can provide an idea about which areas experience the highest levels of pollutant removal by trees.

⁸⁷ “Removal of Airborne Particulate Matter by Vegetation in an Urban Park in the City of Rome (Italy): An Ecosystem Services Perspective,” *Annali De Botanica* 5

⁸⁸ “Removal of Airborne Particulate Matter by Vegetation in an Urban Park in the City of Rome (Italy): An Ecosystem Services Perspective,” *Annali De Botanica* 5

⁸⁹ “Removal of Airborne Particulate Matter by Vegetation in an Urban Park in the City of Rome (Italy): An Ecosystem Services Perspective,” *Annali De Botanica* 5



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Map of Bronx Parks

A study conducted in Villa Ada Park in Rome, Italy measured which trees absorbed the most particulate matter in a year. It concluded that the deposition of particulate matter was

⁹⁰ Maps-Bronx, Bronx Parks and Roads

highest in evergreen broadleaves, followed by conifers and deciduous broadleaves.⁹¹ Evergreens, of course, had the advantage of having full foliar coverage throughout the year. Deposition of these pollutants was understandably highest in the summer, when all trees maintained their canopies.

It can be difficult to quantify the benefit provided by an ecosystem, but certain studies have provided estimates on the value of the work that trees perform. Like the Villa Ada project, a study done by Ryerson University in Toronto, Canada aimed to understand the significance of the services provided by trees in an urban park. The focal point of the study, Toronto's Allan Gardens, used the "Street Tree Resource Assessments Tool for Urban Forest Managers," or STRATUM, to associate monetary amounts with these services. While aesthetic services to urban residents were considered, the results proved that environmental services are far more valuable. It noted an importance distinction in the way that trees combat pollution. They "alleviate poor air quality by absorbing gaseous pollutants" like O₃ and NO₂, "[intercept] particulate matter", and "moderating local air temperatures", preventing the formation of ground-level O₃.⁹²

Trees act as "carbon sinks" as well, "directly sequestering CO₂ to form woody and foliar biomass."⁹³ Nationwide, urban trees sequester 700 million tons of carbon deposits, providing \$460,000,000 of services annually.⁹⁴ If strategy is employed in the selection of planting locations, trees can even provide shading to the very buildings that emit CO₂ as a result of electric power production and natural gas consumption associated with home comfort energy

⁹¹ "Removal of Airborne Particulate Matter by Vegetation in an Urban Park in the City of Rome (Italy): An Ecosystem Services Perspective," *Annali De Botanica* 5

⁹² Andrew A. Millward and Senna Sabir, "Benefits of a Forested Urban Park: What Is the Value of Allan Gardens to the City of Toronto, Canada?," *Landscape and Urban Planning* 100, no. 3 (2011): pp. 177-188, <https://doi.org/10.1016/j.landurbplan.2010.11.013>, 178

⁹³ "Benefits of a Forested Urban Park: What Is the Value of Allan Gardens to the City of Toronto, Canada?," 178

⁹⁴ "Benefits of a Forested Urban Park: What Is the Value of Allan Gardens to the City of Toronto, Canada?," 178

use. STRATUM accounts for biomass, tree height, and DBH, or diameter at a tree's breast height, to determine the storage capabilities.⁹⁵ Practices involved with planting and maintain trees, often involving power-tools and vehicles, "accounted for" and said to make up "between 2 to 8% of annual CO₂ reductions achieved through sequestration and avoided emissions, assuming a large stature tree."⁹⁶

Tree canopy size is undoubtedly the most important factor in determining the effectiveness of air-quality mitigation and the provision of environmental services.⁹⁷

There is an immediate need in these city-environments to control and reduce its concentration of pollutants through natural means. In a borough like the Bronx where green space is so sparse, nature-based solutions that reduce pollution while provided needed greenery are ideal. Urban forestry and parkland have been proven to effectively mitigate both gaseous and particulate air pollutants.⁹⁸

A case study done in Faisalabad, Pakistan may seem like it has little to do with understanding the necessity for parks in the Bronx. In reality, "Attitudes of Citizens Towards Community Involvement for Development and Maintenance of Urban Green Spaces: A Faisalabad Case Study" is an ideal project to help understand what services green spaces offer within an urban area and why they are so important. Faisalabad is the "third mega city of Punjab province" and "the largest textile hub" in Pakistan.⁹⁹ Like The Bronx, it's recent history is defined by its industrial use and importance. As it's become a more industrial city, its population

⁹⁵ "Benefits of a Forested Urban Park: What Is the Value of Allan Gardens to the City of Toronto, Canada?", 180

⁹⁶ "Benefits of a Forested Urban Park: What Is the Value of Allan Gardens to the City of Toronto, Canada?", 180

⁹⁷ "Benefits of a Forested Urban Park: What Is the Value of Allan Gardens to the City of Toronto, Canada?", 179

⁹⁸ "Removal of Airborne Particulate Matter by Vegetation in an Urban Park in the City of Rome (Italy): An Ecosystem Services Perspective," *Annali De Botanica* 5

⁹⁹ Adnan Younis et al., "Attitudes of Citizens towards Community Involvement for Development and Maintenance of Urban Green Spaces: A Faisalabad Case Study," *Pakistan Journal of Agricultural Sciences* 55, no. 1 (2018): pp. 73-82, <https://doi.org/10.21162/PAKJAS/18.6539>.

has continued to grow, resulting in dense living situations that mimic the crowded populous of the northern borough.

“Urban green spaces support urban sustainability and improve the overall quality of life of urbanites,” notes the report.¹⁰⁰ In response to the population shift driving the transformation of the urban landscape, a coalition of researchers from a variety of universities in Pakistan conducted a questionnaire among Faisalabad residents. The goal was to analyze the role of the local government and community members in the maintenance of parks. Results revealed that an overwhelming 92.3% of respondents visit the park on a daily basis.

An interesting result to note is that 80% of respondents were completely unaware to the fact that urban green space development occurred with encouragement for community members to engage themselves in the collaborative decision making process. The local government alone does not dictate everything that goes into their creation and maintenance. Among the 85.3% respondents who claimed to be dissatisfied, 20.7% of those participants cited “daily maintenance problems” as the key reason for their response. Still, it speaks volumes that a population could use a park so often without knowing the role they could play in its development.

The Faisalabad scholars who conducted the study seem to be concerned with the same issues that a densely populated, highly polluted city on the other side of the world struggles with. Like the Bronx, Faisalabad needs urban green spaces for environmental sustainability, environmental diversity, and functional spaces. Most relevant to this paper, these spaces are crucial in playing a “recreational role” and enhancing “health of citizens” and “societal well-being.”¹⁰¹ An urban green spaces, defined here as “open, non-paved area having high vegetation

¹⁰⁰ Adnan Younis et al., “Attitudes of Citizens towards Community Involvement for Development and Maintenance of Urban Green Spaces: A Faisalabad Case Study,” *Pakistan Journal of Agricultural Sciences* 55, no. 1 (2018): pp. 73-82, <https://doi.org/10.21162/PAKJAS/18.6539>.

¹⁰¹ Adnan Younis et al., “Attitudes of Citizens towards Community Involvement for Development and Maintenance of Urban Green Spaces: A Faisalabad Case Study,” *Pakistan Journal of Agricultural Sciences* 55, no. 1 (2018): pp. 73-82, <https://doi.org/10.21162/PAKJAS/18.6539>.

proportions.”¹⁰² Like any industrial hub, these areas of high tree-cover are instrumental in “neutralizing the urban stresses e.g. stench, noise, heat, and air pollution.”¹⁰³

The Faisalabad study is helpful in understand why parks are necessary and how people respond if they are not well maintained. So how does the Bronx and the larger New York City area compare? An article published by AM New York certainly makes it seem as though New York City as a whole is performing well in terms of urban green spaces. The city has an estimated total of five million trees, according to the U.S. Forest Service’s iTree audit in 2016. While this includes trees that line urban streets, it is worth noting that many of these trees stand within the city’s “7,000 acres of forested parks.”¹⁰⁴ The ecosystem services provided by this vegetation is astounding. “Trees remove at least 1,300 tons of pollutants from the air which saves at least \$93 million from avoided sick days, doctor’s visits, and other health costs” according to data provided by Parks Department official Jennifer Greenfeld. Additionally, New York City trees absorb “1.9 billion gallons of water” each year that would otherwise become stormwater runoff that enters the city’s sewer system and bodies of water.¹⁰⁵ Shade from trees “reduce energy costs by at least \$17 million” every year.¹⁰⁶ 61,000 tons of carbon dioxide, an unhealthy air pollutant, are removed from the air per year thanks to tree – the equivalent to taking 12,000 cars in New York City off of the road.

So if New York City trees are doing such amazing work, why is the Bronx still the anomaly? Given attitudes about the ecological status of the Bronx, one can conclude that the

¹⁰² Adnan Younis et al., “Attitudes of Citizens towards Community Involvement for Development and Maintenance of Urban Green Spaces: A Faisalabad Case Study,” *Pakistan Journal of Agricultural Sciences* 55, no. 1 (2018): pp. 73-82, <https://doi.org/10.21162/PAKJAS/18.6539>.

¹⁰³ Adnan Younis et al., “Attitudes of Citizens towards Community Involvement for Development and Maintenance of Urban Green Spaces: A Faisalabad Case Study,” *Pakistan Journal of Agricultural Sciences* 55, no. 1 (2018): pp. 73-82, <https://doi.org/10.21162/PAKJAS/18.6539>.

¹⁰⁴ Ivan Pereira, “Arbor Day in New York: Parks Department Shares Data about Trees in NYC,” AM New York (AM New York, April 30, 2016), <https://www.amny.com/news/arbor-day-in-new-york-parks-department-shares-data-about-trees-in-nyc-1.11742012>.

¹⁰⁵ Pereira, “Arbor Day.”

¹⁰⁶ Pereira, “Arbor Day.”

trees are not exactly allocated equally through the city. This displeasure with the borough's ecological status is nothing new. In 1996, the New York Parks department's Bronx Parks Commissioner, William Castro, claimed that all Bronx parks were "clean and safe."¹⁰⁷ Bronx President Fernando Ferrer fired back, asking Castro if they were even looking at the same parks. Ferrer claimed Castro and the Parks Department were using "minimal repairs" to "obscure the overall problem of neglect."¹⁰⁸ Citing the continuous illegal dumping and drug use occurring in an array of Bronx Parks, Ferrer asserted "To tell the community that our parks are in good condition is wrong and insulting."¹⁰⁹ A year prior, Ferrer had compiled a list of 15 "problem parks" located in the Bronx: St. Mary's, Crotona, Aqueduct, University Heights, Richman, Devoe, Fort Four, Soundview, Haffen, and Rosewood. At the time of his 1996 statement, the quality and conditions of these parks had certainly not improved. Today, the aforementioned problems of illegal dumping and drug use are still prevalent in many. Additionally, they continue to be areas of environmental disregard. Poorly maintained facilities and flora are present in each park.

Two years prior, in 1994, the Parks Department issued a list to Borough President Ferrer of parks targeted for "Operation Clean Sweep". Through this initiative, thirteen parks were "slated for repairs and renovations"¹¹⁰. The following year, these renovations were either not complete or not maintained in eleven of these parks.

There are plenty examples of New York City seeing Bronx Parks as ripe locations for development – just not the typical development you may expect for a Park. Van Cortlandt Park, a recurring model for how the Bronx is environmentally neglected, has several busy roadways that cross through its wooded area. The park's map may tell you that the major "pathway" running

¹⁰⁷ "Ferrer Calls Bronx Parks the Worst in New York City," *New York Amsterdam News*, September 7, 1996

¹⁰⁸ "Ferrer Calls Bronx Parks the Worst in New York City."

¹⁰⁹ Ferrer Calls Bronx Parks the Worst in New York City."

¹¹⁰ Ferrer Calls Bronx Parks the Worst in New York City."

from Indian Field to Van Cortlandt Lake is entirely parkland. A visit would show you that Interstate 87, commonly known as Major Deegan, and Mosholu Parkway, are actually multi-lane highways that add noise and air pollution to the park with heavy vehicle traffic. Navigating throughout Van Cortlandt requires crossing over and under these roadways, so many nearby residents claim they avoid visiting the park altogether. The New York Times released an article in 2003 analyzing the “segmented character” of Van Cortlandt Park, blaming its poor design on “city and state policies that for decades considered the park’s land expendable for highways and other projects”¹¹¹. At the time of the article, New York City’s Department of Environmental Protection was under court order to select a location for a new water treatment facility to filter water from the Croton, the city’s oldest water source. For each day without a site selected, the department was fined. The bureaucracy of New York City made it clear that they valued Van Cortlandt Park less as a park and more as a mass of an area of development possibility. Robert Moses, who served as a parks commissioner for a period of time, “paved over one of the biggest freshwater marshes in New York City, in the park’s center, for the building of Mosholu Parkway,” setting the precedent that Bronx parkland could be treated as land for city development.¹¹²

Today, the water filtration center being discussed in this 2003 article exists operates, once again letting convenience take precedent over common-sense public urban planning. A park can be large and have plentiful tree coverage, but does that matter when its purpose is ignored and it is treated as land to freely strip from? As put by Johnson Kirk, author of the critical article, “When does a park cease to be a park at all? How many pieces must be cut off from public use without the fabric of the whole being lost? Who does the park belong to, the city or the residents

¹¹¹ Kirk Johnson, “In the Bronx, A Park Divided; First Split by Roads; Now, a Water Plant,” *The New York Times*, July 7, 2003.

¹¹² Kirk Johnson, "In the Bronx, A Park Divided."

who treat it as their backyard?”¹¹³ It is no wonder that Bronx residents fail to get the fresh air they need – when their parks are maintained, its only so they can be used for the interest of larger governing bodies.

Chapter 5: Maximizing Green Space & Minimizing Asthma (Environmental Policy)

To solve the issue of asthma in the Bronx and begin to reduce asthma rates, there needs to be a multi-faceted approach that incorporates solutions through public policy, healthcare initiatives, and more. Given the evidence provided regarding the role that urban green spaces can play in improving air quality, ecological and urban planning approaches could be particularly useful in a community with a severe lack of greenery. The immediate need to improve the population’s respiratory health could serve as a vehicle for change that has second-hand benefits. A newfound concern and care for green spaces would allow residents to relish in the additional services and benefits that urban green spaces can provide. Many parks that exist in the Bronx are in poor condition, and the 1,471,160 residents of the borough deserve areas that are funded, maintained, and appreciated.¹¹⁴

With that said, the public health issue needs to be dealt with in ways that are more direct and prompt. Many attempts to reduce asthma rates will happen within the walls of medical facilities and residential homes. A publication featured in the journal *Pediatrics Perspectives* titled “Solutions for Asthma Disparities” compares different steps that have been taken to reduce asthma in communities where rates are particularly high. It stresses the importance of intervention tactics that are “tailored to each child’s triggers and risk factors.”¹¹⁵ The “one-size-

¹¹³ Kirk Johnson, "In the Bronx, A Park Divided."

¹¹⁴ "U.S. Census Bureau QuickFacts: Bronx County (Bronx Borough), New York," Census Bureau QuickFacts, accessed December 19, 2018.

¹¹⁵ Anna Volerman, Marshall H. Chin, and Valerie G. Press, “Solutions for Asthma Disparities,” *Pediatrics Perspectives* 139, no. 3 (2017), <https://doi.org/10.1542/peds.2016-2546>, 4

fits-all” approach does not work when the nature of a public health crisis is so tied to the environmental and socio-economic realities of a certain area.

Because asthma-related issues make up such a significant amount of hospitalizations , it makes reasonable sense to address it separately. Specialty asthma clinics have been proven to be a cost-effective way to reduce related hospitalization rates.¹¹⁶ Ongoing case management, including regular communication and in-home visits, is a successful way to reduce asthma symptoms. It is most beneficial to recruit case-managers from the at-risk community in order to develop relationships built on trust and commonalities with patients.¹¹⁷ This role would ideally be one similar to that of a counselor, providing affected families with resources and advice to manage living with asthma.

With asthma being so prevalent among young children, schools are a sensible location to implement strategies to combat asthma. Asthma medication must be readily available in Bronx school systems. Supervision of the administration of daily asthma controller medication led to less missed school days and more frequent use of quick-relief inhalers in several schools in Alabama.¹¹⁸

According to the New York City Housing Authority’s 2018 Fact Sheet, the Bronx is home to 89 public housing developments.¹¹⁹ Collectively, they contain 44,292 apartments. With so many Bronx residents calling these buildings home, standards need to be set in order to ensure that these homes are properly ventilated, free of excessive dust, free of off-gassing, and smoke-

¹¹⁶ Anna Volerman, Marshall H. Chin, and Valerie G. Press, “Solutions for Asthma Disparities,” *Pediatrics Perspectives* 139, no. 3 (2017), <https://doi.org/10.1542/peds.2016-2546>, 4

¹¹⁷ Anna Volerman, Marshall H. Chin, and Valerie G. Press, “Solutions for Asthma Disparities,” *Pediatrics Perspectives* 139, no. 3 (2017), <https://doi.org/10.1542/peds.2016-2546>, 4

¹¹⁸ Anna Volerman, Marshall H. Chin, and Valerie G. Press, “Solutions for Asthma Disparities,” *Pediatrics Perspectives* 139, no. 3 (2017), <https://doi.org/10.1542/peds.2016-2546>, 5

¹¹⁹ NYCHA - About, accessed May 10, 2019, <https://www1.nyc.gov/site/nycha/about/about-nycha.page>.

free.¹²⁰ Public housing redevelopment with these goals in mind led to a significant increase in symptom-free days to asthma-sensitive individuals living in public housing in Seattle, Washington.

While shown to be effective in other American cities, these solutions are primarily centered around health-care. With this paper's strong focus on the environmental determinants that lead to poor air quality, it is fitting that this paper concludes with proposed solutions that involve improving the Bronx's environment as a whole. With such strong evidence supporting the link between increased tree coverage and decreased air pollution, it is crucial that parks and other areas that can support tree growth in the Bronx are developed and maintained.

One adequate solution to maximize green space in the area would be to implement "freeway cap parks". Otherwise known as "deck parks", this option uniquely utilizes existing infrastructure to create green areas. Urban areas of poverty often have low property values and heavy vehicle traffic. The Cross-Bronx expressway is an excellent example of a roadway suitable for a freeway cap park, as it sits below ground level – below the level that pedestrian residents would search for areas for recreation and leisure. *The American Journal of Public Health* published a research journal written by a team who use the Cross-Bronx Expressway as an example of a perfect location for a cost-effective series of cap parks. In "Cost-Effectiveness of Capping Freeways for Use as Parks: The New York Cross-Bronx Expressway Case Study", they cite a variety of health benefits that can come from the creation of these parks. The division created between human foot traffic and polluting vehicle traffic would be most key here – especially in removing asthma irritation caused by vehicle emissions.

These freeway cap parks do exactly what their title says: they cover major roadways with parks, creating a tunnel for cars to pass through and a green, flourishing bridge for residents to

¹²⁰ Anna Volerman, Marshall H. Chin, and Valerie G. Press, "Solutions for Asthma Disparities," *Pediatrics Perspectives* 139, no. 3 (2017), <https://doi.org/10.1542/peds.2016-2546>, 5

enjoy. The researchers who began the case study “built a microsimulation model that included increased exercise, fewer accidents, and less pollution as well as the cost of implementation and maintenance of the park.”¹²¹

The application of freeway cap parks is not always easy, however. Boston, Massachusetts completed an ambitious, multi-decade project known as the “Big Dig” that resulted in the creation of 5 new parks in urban areas. Unfortunately, the Big Dig was “plagued by problems such as leaking tunnels and ceiling collapses, and the initial investment may run well over \$20 billion by the time interest was paid”¹²².

Luckily, freeway cap parks built over the Cross Bronx Expressway likely wouldn’t run into the same type of problems. With the Expressway already below the pedestrian level, the potential for a “bridge” system is already there and wouldn’t need to be created. An estimation was calculated by the team responsible for the case study, claiming that within the 6.5 miles of road on the Expressway, 2.4 miles could be “more easily capped”¹²³. With a width of 0.02 miles, this means 36.8% of the road could not only be converted into parkland, but innovative parkland that makes the most out of unoccupied space. The simulation and research done claim “living close to a park may increase levels of physical activity by 37%”. Barriers separating car emissions from people will give them spaces for productive recreation and leisure in fresher air, minimizing the ill effects of pollution on asthma. Additionally, the implementation of this green space will have a positive effect on property values, helping the Bronx economy and rectifying the history of inequality and poverty that has been a continuous problem in the area. The

¹²¹ Sooyoung Kim et al., “Cost-Effectiveness of Capping Freeways for Use as Parks: The New York Cross-Bronx Expressway Case Study,” *American Journal of Public Health* 108, no. 3 (2018): pp. 379-384, <https://doi.org/10.2105/ajph.2017.304243>.

¹²² Sooyoung Kim et al., “Cost-Effectiveness of Capping Freeways for Use as Parks: The New York Cross-Bronx Expressway Case Study,” *American Journal of Public Health* 108, no. 3 (2018): pp. 379-384, <https://doi.org/10.2105/ajph.2017.304243>.

¹²³ Sooyoung Kim et al., “Cost-Effectiveness of Capping Freeways for Use as Parks: The New York Cross-Bronx Expressway Case Study,” *American Journal of Public Health* 108, no. 3 (2018): pp. 379-384, <https://doi.org/10.2105/ajph.2017.304243>.

Faisalabad study concluded that many urban communities are unaware of the roles they can play in the development of local parks. If the New York City Parks Department were to aim to create new parks in the Bronx, especially those that separate community members from traffic pollution, there should be a genuine effort to include the community in the planning process. The surrounding community would know what facilities and features are most necessary to their particular needs.

The existing Bronx parks should also be utilized in the pursuit of cleaner air. This can be done by increasing the number of planted, healthy trees in the borough. It is evident that the Parks Department employees present in the borough are understaffed.

Organizations like Sustainable South Bronx, founded in 2003¹²⁴, and The Bronx is Blooming, founded in 2011, are dedicated to educating Bronx youth on environmental stewardship practices and practical horticultural skills. The reverence for their environment instilled in these students may last their lifetime, but the maintenance they perform on trees and in parks is only temporary. Partnerships between organizations like these and New York City's Department of Parks and Recreation could prove to be fruitful in the effort to increase the volume of tree canopies. These groups are dedicated to urban ecological work. They possess the drive and skills necessary to plant trees, be stewards of trees, and ensure sustained and healthy growth over the years. With the backing of the city government, they could expand their operations, afford more equipment, and reach and engage with more members of their community.

Given the conclusions made by the Villa Ada Park study regarding the effectiveness of evergreen conifers in year-round pollution reduction, the city should prioritize the

¹²⁴ Viniece Jennings et al., "Urban Green Space and the Pursuit of Health Equity in Parts of the United States," *International Journal of Environmental Research and Public Health* 14, no. 11 (2017): p. 1432, <https://doi.org/10.3390/ijerph14111432>, 7

implementation of native conifer species. This tactic would ensure that trees in the Bronx maximize their potential to remove pollutants that serve as triggers for asthma.

Along with enacting plans to absorb pollutants out of the air, the Bronx must be given solutions that prevent pollutants from entering the air in the first place. The Bronx will continue to handle “40% of the city’s commercial waste” until late 2019. It is currently still home to “a sewage treatment plant, a sewage sludge pelletizing plant, [and] the world’s largest food distribution center.”¹²⁵ These, along with other industrial centers and factories, bring “55,000 diesel trucks to the area each week.”¹²⁶ While steps have been taken and legislation has been passed to have a more equitable distribution of pollution in New York City, the emissions from similar facilities will condemn Bronx residents to a life of poor air quality if public action is not continued.

The closing of the Bronx-Lebanon Medical Waste Incinerator is a shining example of how influential public action can be against these seemingly unstoppable institutions that poison the air. It is, perhaps, the most hopeful model that Bronx citizens can follow in order to achieve environmental equity.

When New York City required a location for an incinerator that would produce an overwhelming amount of air pollution, community action in Manhattan prevented its construction in the downtown borough. It was eventually approved to be built in the Bronx. The Bronx Lebanon Medical Waste Incinerator was built in 1991 under the assumption that Bronx citizens were not capable of fighting the same fight against a large institution. The South Bronx Clean Air Coalition, the North Bronx Clean Air Coalition, the Riverdale Committee for Clean

¹²⁵ Majora Carter, “Sustainable Solutions: The Pursuit of Environmental Justice in the South Bronx,” *Economic Development Journal*, 2006, pp. 24-29.

¹²⁶ Majora Carter, “Sustainable Solutions: The Pursuit of Environmental Justice in the South Bronx,” *Economic Development Journal*, 2006, pp. 24-29.

Air, and other activist groups put “relentless citizen pressure on elected officials and regulatory agencies,” pointing out attempts to hide realities about its threats to health.¹²⁷ Community members took the fight to the very streets that contribute to the poor quality of their air, demonstrating a sit-in on the Bruckner Expressway – the very roadway used to bring medical waste to the Bronx Lebanon Medical Waste Incinerator. In 1998, the fight was won. The incinerator was torn down a year later.¹²⁸

Public health policy can lead to changes in the way community’s handle a chronic disease like asthma. The construction of new parks and the proper maintenance of current parks can increase tree coverage, gradually reducing concentrations of pollution in the air. The most difficult step in these large-scale changes is having them occur. The most powerful way to instigate this change is through community action. Plenty of groups already aim to make these improvements in the Bronx. These groups need to be recognized in schools, government bodies, businesses and more. Their missions need to be known and understood by community members. Concrete steps can be made to provide disadvantaged populations with access to a beautiful park. Children will know what it is like to breathe a breath of fresh air. When focus is placed on those who are determined to make these institutional changes, the change will happen.

¹²⁷ Sze, *Noxious New York*, 64

¹²⁸ Sze, *Noxious New York*, 74

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