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Parks and W[rec]k: Ecosystem Services of Urban Parks

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Parks and W[rec]k:

Ecosystem Services of Urban Parks

Serena Iacoviello

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Abstract:

As the general population and specifically urban populations continue to grow, cities must become more sustainable. Unfortunately in New York, cherished green spaces and their respective ecosystem services have been gravely degraded. This is especially true for underserved urban neighborhoods that often have the highest levels of pollution. In restoring mixed-used parks and protecting their ecosystem services, city dwellers can reap the benefits of improved social fabric, quality of life, local environment and economy. In my exploration of this subject I reference natural science and social science quantitative data. This data describes the ecological degradation and climate change and the negative impact it specifically has on the health of the residents of East Harlem and the South Bronx. The data also addresses the ecosystem services of urban parks in New York concentrating on Randall's Island Park. Overall, I have shaped my research around three disciplines of environmental studies: Environmental History, Ecological Economics and Urban Design. I investigate the Environmental History of the Northeast, New York City and Randall’s Island. In regards to Ecological Economics, I explain the undervaluation of ecosystems and their services, their potential benefits, and the complexities of ecological valuation methods. As for Urban Design, I discuss various urban planning movements, the importance of neighborhood and park diversity and the role parks play in mitigating and adapting to climate change. I integrate the findings of these disciplines into park policy recommendations that address environmental justice, waste management, and the restoration and maintenance of native species.
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Introduction: Degraded Ecosystems: The Wrecking of Ecological and Human Well-Being

The ecosystem services that our cities' green spaces historically provided have been drastically degraded. The lack of healthy ecosystems negatively impacts human well-being. Without these ecosystems, city populations face serious risks. If the state of degradation of ecosystems is not addressed, these risks to human well-being will be further compounded by population growth and climate change. It has been estimated that by 2050, 66% of the world’s population will be living in cities¹. As days continue to grow hotter due to climate change, health risks of the growing city population will increase and “heat-related asthma, strokes, other illnesses, and mortality” will occur more frequently².

Ecosystem services are a fundamental aspect of creating healthy and sustainable cities. They provide supporting, regulating, provisioning and cultural services that are interconnected with every aspect of human well-being. Urban parks can be redesigned in ways that protect and promote ecosystem services by reintroducing and restoring native natural areas. The title of the thesis, Parks and W[rec]k, refers to the role urban parks must take on, not only as areas of recreation, but as areas of remediation. They must combat the state of wreckage we, and future generations, face. Poor health, ecological degradation and climate change are all contributing factors to this state of “wreck”.

In chapter 1 of this thesis, I describe the poor health prevalent in the populations of East Harlem and the South Bronx and how this problem can be improved through green spaces such as Randall’s Island Park. I concentrate on the ecosystem services that urban parks can provide, using Randall’s Island as a positive example. In chapters 2, 3 and 4, using the disciplines of Environmental History, Ecological Economics and Urban Design, I investigate the problems that contribute to our “wreck” and the benefits that can be reaped
by reversing them through urban green spaces. Chapter 2 focuses on Environmental History and the changing ecosystems of the Northeast, New York City and Randall’s Island. In Chapter 3, I explain the role Ecological Economics has in capturing the value of ecosystem services and their benefits. In traditional economics, ecosystems and their services have been severely undervalued. Throughout this chapter I explain the complexities of ecological valuation and potential sources of improper valuation. In Chapter 4, I use Urban Design to frame the benefits of integrating ecosystem services into the urban landscape. I discuss how urban planning movements influenced the design of cities. Additionally, I describe the role diversity plays in promoting neighborhood and park success. I highlight the expanded functional aspect of park design in mitigating and adapting to climate change. In the concluding chapter I recommend policies that emphasize the need for collaboration amongst various stakeholders to address issues of environmental justice, waste management, and the restoration and maintenance of native species in urban parks.

Chapter 1: Ecosystem Services and Our Health: Randall’s Island and its Proximate Communities

In the United States, as well as in countries around the globe, many cities have been constructed in a way that neglects the connection between the ecological environment and human well-being, “Over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, fresh water, timber, fiber, and fuel. This has resulted in a substantial and largely irreversible loss in the diversity of life on Earth”3. It has also led to the degradation of ecosystem services that were once provided in abundance, bringing us
to our current environmental state of “wreck”. Without ecosystem services, human well-being suffers. Ecosystem services directly provide benefits people can obtain from their surrounding ecosystems. Human dependence on ecosystem services can be clearly seen in the figure below.

![Diagram of ecosystem services and human well-being](image)

**Figure 1: Linkages Between Ecosystem Services & Human Well-Being**


There are four main categories of ecosystem services; these include provisioning services, regulating services, supporting services and cultural services. Provisioning services are “ecosystem services that describe the material outputs from ecosystems” including food, raw materials for construction and fuel, surface and ground water, and medicinal resources. Regulating services are provided by the “regulating of the quality of air and soil or by providing flood and disease control”. For example, trees can influence temperature and air quality by providing shade as well as removing pollutants from the atmosphere. Trees can improve air quality by effectively removing carbon dioxide from the
atmosphere. Another regulating aspect of ecosystems is that they provide buffers against “natural hazards such as floods, storms and landslides”\(^6\). Additionally, micro-organisms that exist in soil and wetlands can benefit the environment by directly decomposing “human and animal waste, as well as many pollutants”\(^7\). Other regulatory benefits of ecosystems include erosion prevention, pollination of crops, and regulation of pests and vector borne diseases\(^8\).

Habitat or supporting services provide the foundation for the majority of other services. Supporting services provide “living spaces for plants or animals and maintain a diversity of different breeds of plants and animals”\(^9\). Supporting services include “soil formation, photosynthesis, and nutrient cycling”\(^10\). A habitat provides everything that an animal or plant may need to survive, it is important for habitats to exist along migratory routes. In cities, this can be especially useful for migratory birds. Another supporting service is the maintenance of genetic diversity; “genetic diversity distinguishes different breeds or races, providing the basis for locally well-adapted cultivars and a gene pool for further developing commercial crops and livestock”\(^11\).

Cultural services include the “non-material benefits that people obtain from contact with ecosystems”\(^12\). Natural landscapes and urban green spaces improve mental and physical health by providing recreational spaces. These spaces can attract tourists from around the globe thus providing economic incentive to conserve them. Natural landscapes and green spaces can also foster “aesthetic appreciation and inspiration for culture, art and design”\(^13\). These spaces can also provide an arena for spiritual experiences, “nature is a common element of all major religions; natural landscapes also form local identity and sense of belonging”\(^14\).
In recent years, a growing number of Americans have been dealing with psychological disorders. One’s environment can have a lasting impact on an individual’s psychological state. A healthy environment can serve to benefit one’s psychological state, while a degraded one will make it worse. The improvement of one’s psychological state is a part of the cultural services of urban green spaces. It is not wise, therefore, to discount investment in the environment to mitigate mental health concerns. Medication for mental health disorders has been increasingly dispensed to children, “a 2003 survey in the journal of psychiatric services, found the rate at which American children are prescribed anti-depressants almost doubled in five years, the steepest increase—66 percent—was among preschool children”\textsuperscript{15}. Anti-depressants are not the only drugs that have seen an increase in their number, “between 2000 and 2003 there was a 49 percent increase in the use of psychotropic drugs- antipsychotics, benzodiazepines, and antidepressants. [...] New evidence suggests that the need for such medications is intensified by children’s disconnection with nature”\textsuperscript{16}.

The community surrounding Randall’s Island has been gravely impacted by the high rates of air pollution in the local area, causing adverse health outcomes. In East Harlem, the rate of childhood asthma hospitalization is one of the “highest in the United States, with one in four children suffering from asthma. With close proximity to the FDR Drive, Triborough Bridge, Wards Island Pollution Control Plant, and several bus depots in northern Manhattan, residents are constantly exposed to diesel exhaust and pollutants that irritate the lungs and can trigger asthma attacks”\textsuperscript{17}.

Asthma is not the only health problem that faces the East Harlem Community, “a considerable number of East Harlem residents also suffer from Type 2 diabetes. Recent city
health department surveys estimate between 16% and 20% of adults in the area are affected, and that hospitalizations, amputations, and deaths linked to diabetes are much higher in East Harlem than other parts of New York City.”\(^{18}\) It is clear that socioeconomic class plays a role in the health issues in New York, “some studies have shown that asthma rates in Bronx County and East Harlem is 21 times higher than in affluent parts of the city”\(^{19}\).

In the South Bronx, which borders the Northern portion of the Island, the “obesity rates are as high as 34%”\(^{20}\). Asthma rates in this population are also extremely high due to the high levels of pollutant exposure. In the South Bronx, pollutant exposure can be largely attributed to the concentration of major expressways in the area. There are five expressways that cut through and around the South Bronx: the Cross Bronx, Major Deegan, Bruckner, Sheridan and the Bronx River Parkway. This poses a problem not only for residents that live near these expressways but also for residents that send their children to schools that neighbor these expressways. The South Bronx Environmental Health and Policy Study established that “20% of pre-Kindergarten to 8th grade students attend schools within 150 meters (or two city blocks) of a major highway. The figure for New York City as a whole is less than 10%. About half of the pre-Kindergarten to 8th grade students in the South Bronx attend schools located within 150 meters (500 feet or less than two city blocks) of a highway or truck route”\(^{21}\).

The children of the South Bronx are also burdened by their proximity to industrially-zoned land, “about half of all pre-Kindergarten to 8th grade public elementary school students in the South Bronx attend schools close to industrially-zoned land (within 1/8 of a mile or two and a half city blocks) containing waste transfer stations and other
facilities associated with high diesel truck traffic and pollution emissions”\textsuperscript{22}. Approximately “one-third of New York City's trash is handled at waste transfer stations in the South Bronx, and then trucked or sent by rail to landfills across the region”\textsuperscript{23}. Additionally, 24% of NYC’s waste transfer stations are located in the South Bronx\textsuperscript{24}. This is vastly disproportionate to the South Bronx’s population percentage, which is “6.5% of NYC’s population”\textsuperscript{25}. Hunts Point is a section of the South Bronx that is particularly exposed to pollutants because, “in addition to waste transfer stations, Hunts Point is also home to the city’s wholesale food markets. The markets generate enormous truck traffic, an estimated 15,000 trips daily, according to the City. To get to their destination, trucks must drive around and through the Point’s community of 12,000 residents”\textsuperscript{26}.

Truck traffic as well as truck idling causes particulate matter 2.5 to be emitted. Particulate matter is the “generic term used for air pollution that consists of liquid and solid particles suspended in the air”\textsuperscript{27}. This form of pollution is particularly dangerous to human health due to the fact that the “fine particles are easily inhaled deeply into the lungs where they can be absorbed into the bloodstream or remain embedded for long periods of time”\textsuperscript{28}. In New York City, “17% of children 17 years and younger—300,000 children—have had asthma at some time in their lives,” this percentage increases to 20-30% in the South Bronx\textsuperscript{29}. This vulnerable and overburdened population suffers 43.5 asthma related deaths per million, which is three times higher than the national average\textsuperscript{30}. This number is drastically higher than the 13.1 asthma related deaths per million in New York State. The number of asthma related hospitalization in boys and girls under the age of 14 is 9.3 per 1,000 children\textsuperscript{31}. This number is five times higher than the national average\textsuperscript{32}.

Since environmental pollution and degradation is a determining factor for the
development of health risks, tackling environmental degradation is paramount. The demographics of the South Bronx consist of low-income minorities thus making it a prime candidate for federally funded environmental justice initiatives. The Environmental Protection Agency (EPA) defines environmental justice as the “fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies”33. In order for the EPA’s goal of environmental justice to be achieved, “all communities and persons across this nation [must receive] the same degree of protection from environmental and health hazards, and equal access to the decision-making process to have a healthy environment in which to live, learn, and work”34.

Greenways and Green Buffers are examples of urban planning tools that can be utilized to reduce the impact of air pollution on the residents of urban areas such as the South Bronx. One recent sustainability improvement that has been created in the area is the greenway that connects the South Bronx to Randall’s Island. The community was previously isolated from Randall’s Island as it was very difficult to get to without a car. Today, Randall’s Island offers many important cultural services that provide its proximate communities with common ground that also help to mitigate their health risks. There are “approximately eight miles of dedicated bicycle and pedestrian pathways [that] now run throughout the Park and along its waterfront, providing comprehensive non-vehicular access [...] These meandering pathways – free from cars, trucks, and buses – have radically enhanced the Park experience for strollers, runners, bicyclists and anyone traveling to and from the Island’s new fields and facilities”35. The park offers a vast variety of different sports fields, there are more than “70 fields accommodating a range of sports, including
soccer, softball, baseball, football, lacrosse, field hockey, rugby, and cricket. All fields [are] either fully irrigated sod or artificial surface, and many [are] lit for evening use”. On the Island, there are also tennis courts, a dance studio, a golf range and an outdoor track and field venue, Icahn Stadium, which is designed to host local, national, and international competitions. Some of the sports fields are structured in such a way that when they are not being utilized for sports, they can be transformed into an outdoor entertainment venue. Past events that were held in this area include Governors Ball, Electric Zoo, Frieze Art Fair and Cirque du Soleil touring shows. On average, Randall’s Island attracts “3 million visitors [...] per year, many of whom are local children and families who participate in [the Island’s] free public programming”. Randall’s Island also provides the local community with natural areas to be enjoyed. In 2011, the Wetlands Stewardship Program on Randall’s Island brought over “1500 students to the wetlands”. The value derived from the program can easily be seen by its success. In 2012, it was predicted that the program would serve up to “2000 students; even with bus shortages and cancellations related to Hurricane Sandy, which disabled nearly the entire fall semester, [...] 1300 students were brought to the Park.

Other than cultural services, the natural areas in the park also provide supporting services and regulating services. For example, the Randall’s Island Sports Foundation restored “9 acres of salt marsh and freshwater wetlands at the Little Hell Gate Inlet and the Bronx Kill. These sites are now filtering nonpoint source pollution and serving as habitat for fish, birds and other wildlife”. The wetlands’ filtration of pollutants, a regulating service, is particularly important because the “Harlem River, an outlet for the Lower Hudson River, is directly affected by the larger river’s water quality problems.
Polychlorinated Biphenyl (PCB) contamination of fish is a primary concern for both water bodies. The acres of restored marsh provide habitat, a supporting service, for many migratory and resident “wading birds, shorebirds, and waterfowl, in particular providing foraging grounds for the great and snowy egrets and black-crowned and yellow-crowned night herons that nest on South Brother Island, nearby. The marsh also provides habitat for “blue crabs, fiddler crabs and ribbed mussels as well as nursery grounds and feeding habitat for finfish and shellfish. Additionally, a habitat for “butterflies, dragonflies and damselflies, that require slow-moving water, and birds such as red-winged black-birds, marsh wrens, common yellow throats, swamp sparrows and green herons” is provided by the restored fresh water wetlands. The Park also provides a habitat for “pheasants, wild geese, raccoons, red-tailed hawks and rabbits. Randall’s Island also “offers a variety of planted and themed gardens and landscaped areas, all created using native species and sustainable practices.

As a part of the NYC MillionTrees project, “a citywide [...] program with [the] ambitious goal [of planting and caring] for one million new trees across the City’s five boroughs over the next decade”, a plot of land on Randall’s Island that was formerly a Christmas tree dumpsite, has been transformed into an urban forest. This forest contains native species such as Celtis occidentalis, Juniperus virginiana, Liriodendron tulipifera, Prunus serotina, Quercus alba, and Quercus coccinea. These trees provide regulating services for the surrounding area as they remove pollutants and Carbon Dioxide from the air, improving the surrounding air quality. On the Island there is also an “urban farm that offers guided visits for school groups in partnership with GrowNYC.” While maintaining and visiting the farm provides volunteers with a cultural service, the food resources that
the farm provides, is a provisioning service.

Chapter 2: An Environmental History: The Northeast, New York City and Randall’s Island

As climate changes, the ecology of an area changes as well, inviting new life to flourish and causing some to perish. By looking at the environmental history of a region, we can see how climate and humanity influenced proximate ecology. For thousands of years the Northeastern United States existed as thick sheets of ice, void of human life. It was not until 11,000 years ago that temperatures became hospitable for human life. With warming temperatures came “large open forests of spruce, fir, pine, and other tree species [that] expanded across the Northeast, interspersed with open meadows and marshland. A wide variety of animal life could also be found, including large mammals such as mammoth, mastodon, caribou, musk ox, moose, as well as smaller mammals such as fox, beaver and hare”49. As temperatures continued to rise, new species of trees began to replace the old forests. These new forests were comprised of red and white pine, oak and beech50.

As the glaciers continued to melt, lakes and marshes began to appear. The new landscape allowed for animals such as the “rabbit, turkey, waterfowl, bear, turtle, and white-tailed deer” to inhabit the land while driving herds of larger animals further North, until they faced their ultimate extinction51. A variety of marine life was ushered in with the expanded watercourses, “including many varieties of fish, clams, oysters, scallops, seals, and porpoises”52. The changing ecology allowed the Paleo-Indians, later referred to as the Lenape Indians to live in the area. The Paleo-Indians were mobile hunters and gatherers, living mainly near water supplies, in groups of fewer than 50 individuals never staying in
one spot for long. They sustained themselves off of large mammals as well as smaller animals, fish and plants.

As the Archaic period developed, the environment became more conducive to human, animal and plant life, causing increases in their populations. As food resources became plentiful, the Native Americans no longer had to be nomadic and began to settle in areas on a permanent or semi-permanent basis. Throughout the Woodland period, the Native Americans had a settled agricultural lifestyle. They farmed crops such as “maize, beans, squash, and tobacco.” Their settled lifestyle led to cultural developments such as “elaborate human and canine burial sites [...] stone pipes [...] and pottery.” With the arrival of Europeans in the early 1500s, “guns, glass beads, copper kettles, and alcohol soon became incorporated into the Native American economy.” The European settlers also brought diseases with them that “brought about the demise of huge portions of the population.” As the European settler population began to grow more land was needed to maintain the settlers’ lifestyle. Being that the Dutch were “armed with far more guns than the natives, the Dutch quickly forced the Indians out of the region.”

As we walk through the bustling asphalt streets of New York City, it is hard to imagine that the City could have ever been void of skyscrapers and full of animal and plant life. Before Manhattan was the extravagant city we know it to be today, the Lenape name for the land was Mannahatta, the “island of many hills.” There were, in fact, 573 hills according to Eric Sanderson. Eric Sanderson, the founder of the Mannahatta Project, sought to understand what New York City looked like before Henry Hudson arrived in New York Harbor on September 12, 1609. Sanderson described the biodiversity of the time to be like the cultural diversity of today, “found in marvelous neighborhoods, each the result of
chance meetings, historical legacies, and an ever-changing—yet familiar—landscape of opportunity and disappointment. Fifty-five different kinds of neighborhoods, or ecological communities, were once found on Mannahatta. Sanderson reconstructed much of New York City’s ecological history by utilizing a very detailed and accurate map of New York City, the British Headquarters Map circa 1782-1783. The British Headquarters Map was created by British “military cartographers during the eight-year occupation of New York during the American Revolution.” At the time the British Headquarters Map was created, it showed “what to those hard-nosed military mapmakers were annoying tactical impediments, the same features which we would celebrate today as ecosystems: marshes, forests, beaches, rivers, ponds, streams, cliffs, coves, and bays.” Before New Yorkers began to manipulate their landscape, there were “salt grass fields the great green swords of salt marshes on the Lower East Side; [...] red maple swamps in Times Square, and precious bogs in Central Park; [...] sandy beaches on the Hudson River shore; and over the rest of the map nearly everywhere across the upland, [...] forests—deep, old, massive forests.” In order to reconstruct the landscape prior to 1782, Sanderson and his colleagues “strip from the map all the features that had been added by settlers and soldiers—such as roads, farms, and fortifications—until they’d reduced their digitized version of the map to the basic building blocks of the physical landscape: shorelines, hills, cliffs, land cover, streams, and ponds.”

By 1776, “New York was the second largest city in the American colonies, with more than 30,000 inhabitants (including black slaves and freemen), lagging just behind Philadelphia, and larger than Boston.” At that time, “the city proper occupied Manhattan Island to only just north of today’s City Hall Park, with scattered buildings and farms in the
Out Ward along the Bowery. Small settlements extended up the East Side to the small town of Harlem on the East River shore (located approximately where today’s East 124 Street meets the FDR Drive, under the on-ramp to the Triborough bridge)”\textsuperscript{67}. With the settlement of the Colonists, further change in the original ecosystems occurred. They cultivated “apple orchards, and planted wheat, barley, and rye along side cows, pigs, and chickens on productive smallholder farms”\textsuperscript{68}. Sanderson describes Greenwich Village circa 1776 as “just an intersection of two dusty country roads in a rolling landscape of fields and broken woods”\textsuperscript{69}. As New York City began to become the port that it is today, it became not only a hub and melting pot for people, but also for plants and animals. The introduction of different plant species caused an approximate doubling of the plant species that existed in 1609\textsuperscript{70}. Some invasive animal introductions into the port of New York City include “such local favorites as the Norway rat, European starling, English sparrow, rock dove (i.e., pigeon), wooly adelgid (a small mite like creature that sucks the life from hemlocks), and the chestnut blight (a fungus that has virtually wiped out the American chestnut)—all crimes to nature as far as local farmers, fishermen, foresters, and partisans of the native flora and fauna are concerned”\textsuperscript{71}. Manipulation of the Manhattan landscape to meet the needs of humans did not stop at agriculture; “by the time of Robert Moses in the early twentieth century factories had left for more suburban and rural locales, leaving space for new highways. For Moses, the waterfront was about transportation, and thus he encircled Manhattan Island with black asphalt belts”\textsuperscript{72}. This created many economic opportunities for New Yorkers, but these opportunities came at the cost of wrecking the natural environment and its services.

Randall’s Island is another site in New York City that has experienced heavy
alterations to its landscape in order to meet the desires of New York’s inhabitants. In the last stages of the glacial periods, long before the arrival of Native Americans and Europeans, when the ice finally retreated “the area was colonized by plants suited to artic tundra conditions which eventually gave way to a forest of conifers and deciduous trees”\(^73\). The floral and faunal communities eventually stabilized into a “landscape of oak, hemlock, beech, and chestnut trees”\(^74\). Originally, Randall’s Island had a roughly triangular shape and was “divided from the mainland Bronx by the Bronx Kill and from Wards Island by a strait known as Little Hell Gate. A narrow band of marshland ringed the entire island but at its northern corner and along its southeastern side were larger areas of marshy ground or meadow partially inundated at high tide. Natural, low-lying channels drained the marshes into the East River”\(^75\). The southern portion of the island had an “undulating landscape of low grouped hills”\(^76\). The northern portion of the island was more elevated than the rest of the island and was comprised of flat and dry terrain\(^77\). In the middle portion of the island, to the east there were “at least two large ponds which do not seem to have been connected to the shore by any stream or creek”\(^78\). There were also sections of meadows that extended through the central portion of the island and parts of the southern portion of the island between the hills\(^79\).

Over the course of the last 400 years, Randall’s Island has undergone many changes in ownership and function. The first transfer of ownership was in 1637 when “Dutch Director-General Wouter van Twiller, [...] purchased Randall’s and Wards Islands from the Native Americans”\(^80\). Although Native Americans most likely did not have permanent residence on Randall’s Island itself, it is likely that “Native American activity, possibly resources exploitation, hunting, or camping, took place on Randall’s Island, which was
known to the Native American as Minnahanonck. This is because there were “two large Native American villages [...] on the shores of Manhattan and the Bronx opposite Randall’s Island. These sites include Conykeekst, on the eastern shore of Manhattan in the vicinity of East 121st Street, and Aspetong, a village site on the southern shore of the Bronx immediately north of Randall’s Island. By 1639, Randall’s and Wards Islands were “occupied by a tenant farmer named Barent Jansen, for whom Wards and Randall’s Islands were later named Great and Little Barent or Barn Islands, respectively.” In 1664, Thomas Delavall, one of the first mayors of New York, was granted the two islands and “allowed the residents of the adjacent community of Harlem to use the islands as meadow land.”

By the eighteenth century, the islands had switched ownership various times but were consistently used for agriculture. Toward the end of the eighteenth century, with the Revolutionary War underway, “Randall’s Island was the site of a great deal of military activity, beginning with the establishment of a small pox hospital [...] in 1776.” The City of New York purchased Randall’s Island in the mid-19th century and “redeveloped it with municipal institutions such as the Alms House, hospitals, and a Potter’s Field.” In 1845, a complex of buildings was constructed on the northeastern portion of the Island in order to host “children who had been orphaned, were living on the streets, or whose families simply could not provide a home for them.” On the southern end of Randall’s Island, “the House of Refuge, a separate, private institution for juvenile delinquents, was built [...] on land granted to the organization by the City in 1851.” At this time, there were also orchards planted on the island’s eastern and northern shorelines.

In 1843, due to rising real estate prices on the island of Manhattan, the City of New York had chosen Randall’s Island as the new location for the Potter’s Field (a burial ground
for unclaimed bodies and those who could not afford a proper burial) that used to exist in Bryant Park. The Potter’s Field on Randall’s Island was located at the southern end of the island and was “an orchard partly insulated from the main island, and by its size, elevation, the character of the soil, and the facility of access, at all seasons of the year, admirably adapted to this purpose”. In contrast to this idyllic description of the site, is the harsh reality of what the municipal burial ground on Randall’s Island was really like. It was in fact considered to be a “great evil and an abomination. [...] The horrid stench invaded not only [...] the nostrils and the lungs of all...on the island, but...as far as Harlem”. The process of burying the bodies in the Potter’s Field by no means would meet today’s standards,

“A long pit is dug, of considerable width, but only about four feet deep, for that is the utmost extent that can be reached until the rock arrests the pickaxe. The coffins are piled in tiers upon this, till they are five or six feet above the surface, and then there is a little (very little) covering put on the top and on the south side, while the sides of the coffins facing the north are exposed from the top to the bottom of the pit. Never did we behold such a sight—never did we endure such a smell.”

Due to the improper burial process, rats became increasingly common on Randall’s Island. Because the bodies were not buried at a proper depth, they were easily accessible to thieves who would sell them to surgeons and medical professionals and were “allegedly packed off to other places like pickled pork on a regular basis”. By 1936, the Hell Gate Bridge was already constructed and most of the pre-existing hospitals were demolished in order to make way for the RFK-Triborough Bridge. A bridge was also constructed in the 1950s to connect Randall’s Island to Wards Island. This bridge was demolished in the 1980s when landfilling connected the Islands. In order to connect Randall’s Island to Wards Island, the marshes as well as the open water of Little Hell Gate were filled. Some of this filled land now exists as parking lots near Icahn Stadium. Landfilling did not only connect Randall’s Island to Wards Island but also to Sunken
Meadow, a marshy island to its east. Other landscape modifications included landfilling on the Island’s northern portion, which reduced the size of the Bronx Kill and its “hundreds of acres of salt marsh”\textsuperscript{97}. The various landfilling, which began in the 1930s, essentially destroyed “integral habitat and its ecosystem functions”\textsuperscript{98}. Unfortunately, the importance of these habitats has only recently been recognized. Because the value of these ecosystems was not recognized, they were not protected. In fact, marshy ecosystems were looked upon as “one of nature’s failures” and referred to as “malarious swamps”\textsuperscript{99}. In recent years, however, the stewards of Randall’s Island recognized the value of the Island’s original ecosystems and restored acres of salt and fresh water wetlands, planted urban forests composed of native species and planted wild flower meadows. In doing so, they have taken small but significant steps toward remediating some of the damage that Randall’s Island has incurred over time. These restoration projects will be explained in further detail in chapters 3 and 4.

Figure 2: Aerial satellite image of New York City and below it the 1782 British Headquarters Map
Figure 3: Depicting Randall's Island, Ward's Island and Sunken Meadow.
Viele, Topographical Map, 1874.

Figure 4: Depiction of Randall’s Island’s original and new shoreline.
U.S. Coast and Geodetic Survey of Blackwell’s, Ward’s, and Randall’s Island, E.Hergesheimer, 1886.
Chapter 3: Ecological Economics: Valuing the Invaluable

Much of the ecological degradation and wreckage that we are participating in and witnessing today is due to our undervaluing of natural ecosystems. In a world where, unfortunately, money indicates value, it has been a struggle to put an accurate monetary
value on ecosystems and the benefits of their services. Part of the complexity exists in the fact that some view ecosystems as priceless and integral parts of life while others will see them as just piles of dirt or as obstacles to their immediate financial well-being. If the importance of ecosystems is not recognized we will continue down the path of degradation, as “we don’t protect what we don’t value” 100.

The growing field of ecological economics aims to bridge this gap by improving and expanding economic theory to “integrate the earth’s natural systems, human values and human health and well-being”101. In contrast to traditional economics, ecological economics recognizes that “there are more things that contribute to human well-being than just the amount of stuff [one possesses], such as health and education (human capital), friends and family (social capital) and the contribution of the earth and its biological and physical systems (natural capital)” 102. In recognizing and shaping policies around human dependence on the environment, ecological economics could serve to shape a world that “is ecologically sustainable, has a fair distribution of resources (both between groups and generations of humans and between humans and other species), and [that] efficiently allocates scarce resources including ‘natural’ and ‘social’ capital”103. Natural capital includes natural products such as raw materials and also incorporates planetary and ecosystem functions. While the monetary value of some of these services can be calculated (albeit as an approximation) others are priceless as they are essential for life. Our interactions with others and the overarching structures of our society comprise our social capital and contribute to society’s collective well-being. Finally, human capital includes our “health, personal experiences, education, talents, skills and interests. Collective human capital (and social capital) cannot be maximized unless there is social justice, equivalent
access to the opportunities that our society provides”\textsuperscript{104}. Often times, our current economic system does not capture in its market price, the full cost of a good that depletes natural resources, damages ecosystems, or damages health. The damages that are not included in a good's price, “but are shouldered by a third party, outside the producer/seller and buyer/consumer” are called externalities\textsuperscript{105}. In order to move toward sustainability it is necessary to include these costs in the market price of a given good.

In order to categorize nature's services, the most common framework used is the one established in the Millennium Ecosystem Assessment, which separates ecological services into provisioning, regulating, cultural, and supporting services. As mentioned in chapter 1, provisioning services refer to material outputs of ecosystems such as food and water. Regulating services refer to regulation processes such as that of air and soil and moderation against weather events. Habitat and supporting services provide habitats and genetic diversity. Finally, cultural services provide the non-material benefits that people obtain from ecosystems such as aesthetic, spiritual and psychological benefits\textsuperscript{106}. Ecosystem services can also be divided into final and intermediate services. Final ecosystem services are the benefits that we “directly consume, enjoy, or use, while intermediate ecosystem services lead to the final service”\textsuperscript{107}. Final and intermediate services can also be expressed as direct and indirect use value. For example, “ecosystems generate direct use values by supporting the various types of birds we enjoy non-consumptively […] or consumptively. They generate indirect use values by supporting the life of various plants or insects that in turn enable birds to thrive”\textsuperscript{108}. In regards to consumptive direct use values, market prices are used to determine valuation, “when natural ecosystems provide a habitat for animals that are harvested and sold commercially,
the commercial market value provides a gauge of the value of the habitat services”\textsuperscript{109}. In other words, economists can look at a consumer’s willingness to pay as an indicator of marginal value, however, “in the context of commercial products of ecosystems, [...] market prices represent only the marginal value of these products [...] market sales understate the overall value of the commercially viable forms of life supported by ecosystems”\textsuperscript{110}.

There are also direct nonconsumptive use values of ecosystems. In such instances, market prices are not relevant because the market does not exist. For example, “there usually are no markets for the bird watching opportunities that ecosystems provide by offering suitable habitats”\textsuperscript{111}. In these cases inferential methods such as the travel cost method are used. This method requires “adding to the entry fee (if any) the transportation cost and time cost expanded to visit a particular site”\textsuperscript{112}. One can also use “survey methods such as the contingent valuation method, to determine how much value people place on the nonconsumptive uses”\textsuperscript{113}. While surveys can be useful and are sometimes the only method of understanding value, economists tend to be skeptical of the results that arise from the survey method. They claim: “individuals’ asserted preferences in the hypothetical circumstances posed by surveys bear no systematic relationship to their true preferences”\textsuperscript{114}. In the case of indirect use values, the utilitarian approach to value would not assign any value to lower forms of life “over and above the value that we attach to the higher life forms to which they contribute” because “to add their indirect use values to their direct use values would be double counting”\textsuperscript{115}.

There are two main types of non-use values, existence value and option value. Existence value is the “value that is derived from the sheer contemplation of the existence of ecosystems—apart from any direct or indirect uses of goods and services they
provide”\textsuperscript{116}. For example, one can experience awe and appreciation of the complex biodiversity of an ecosystem. Option value is the value that people are willing to pay to “preserve an environmental amenity, over and above the mean value (or expected value) of the use values anticipated from the amenity”\textsuperscript{117}.

When it comes to the urban environment, we tend to discount the existence of natural ecosystems and how they can serve to benefit urbanites. Ecosystems that exist in cities can include “street trees, lawns/parks, urban forests, cultivated land, wetlands, lakes, sea, and streams”\textsuperscript{118}. The services that these ecosystems contribute to can be defined on a local as well as a global scale. For example, urban forests and street trees contribute to local and global regulating services such as CO\textsubscript{2} sequestering. In the urban environment, the most important ecosystems services include, “air filtering (gas regulation), micro-climate regulation, noise reduction (disturbance regulation), rainwater drainage (water regulation), sewage treatment (waste treatment), and recreational/cultural values”\textsuperscript{119}.

Air pollution is a serious environmental and public health concern in cities, thus making regulating services of ecosystems in cities essential. Vegetation can serve to mitigate air pollution through filtration. The filtration capacity of a tree is dependent on its species. For example, the greater the area of a tree’s leaves, the greater potential it has for filtration. Coniferous trees, with large surface area of needles have a greater filtering capacity than trees with deciduous leaves\textsuperscript{120}. Part of the reason for this is that “the needles are not shed during the winter, when the air quality is usually the worst. However, coniferous trees are sensitive to air pollution and deciduous trees are better at absorbing gases”\textsuperscript{121}. The potential worth of urban forests can be seen in a study of San Diego’s urban forest, which “removes 4.3 million pounds of pollutants from the air each year, a benefit
worth $10.8 million annually"122. In the year 2000, New York City trees removed 67 metric tons of carbon monoxide, 364 metric tons of nitrogen oxide, 536 metric tons of ozone, 354 metric tons of particulate matter 10 and 199 metric tons of sulfur dioxide during nonprecipitation periods, a monetary value of $8,071,000123.

In addition to pollution filtration, urban trees and other urban ecosystems can counteract the urban heat island effect caused by the great amounts of heat absorbing surfaces and heavy energy expenditure in cities. For example, “a single large tree can transpire 450 l of water per day. This consumes 1000 MJ of heat energy to drive the evaporation process. In this way city trees can lower summer temperatures of the city markedly”124. One cultural service of urban ecosystems is their contribution to decreased levels of noise pollution, thus improving health and well-being. For example, a soft lawn as opposed to concrete pavement can buffer noise pollution and decrease it by 3dB, a shrubbery “at least 5m wide can reduce noise levels by 2 dB and a 50-m wide plantation can lower noise levels by 3 – 6 dB”125.

As the climate changes, some areas will experience heavier rainfall. Rainfall becomes “surface-water run off which results in increased peak flood discharges and degraded water quality through the pick up of urban street pollutants”. When an area has vegetation, most of the rainwater will either evaporate or be absorbed into the ground and only 5-15% of it will become run off. This percentage increases to about 60% in cities with little to no vegetation—this rainwater is led into storm drains rather than being absorbed into the ground126. Therefore, if a city is at high risk for flooding, it will benefit greatly from green infrastructure that absorbs rainwater. In New York City, street trees “intercept 890 million gallons of stormwater annually: 1,525 gallons per tree on average, with a total value
of over $35 million each year”\textsuperscript{127}.

Recreational spaces that offer city dwellers space to unwind and play provide cherished cultural services. On the psychological level, green spaces can serve to reduce stress. On the other hand, a built environment, devoid of green space, will cause stress levels to increase. Over one hundred studies have shown that “life’s stressful events appear not to cause as much psychological distress in children who live in high-nature conditions compared with children who live in low-nature conditions [...] and the protective impact of nearby nature is strongest for the most vulnerable children- those experiencing the highest levels of stressful life events”\textsuperscript{128}. Direct exposure to nature is especially beneficial to children with ADHD. Studies suggest that this exposure can “improve children’s cognitive abilities and resistance to negative stress and depression [...] [additionally], attention performance for un-medicated children clinically diagnosed with ADHD was better after a simple 20 minute walk in a park, with a natural setting, then it was after a walk through well-kept downtown and residential areas”\textsuperscript{129}. This has to do with the restorative properties that nature has which ultimately relieve people of directed-attention fatigue. This fatigue is “marked by impulsive behavior, agitation, irritation, and inability to concentrate [...] if you can find an environment where the attention is automatic you allow directed attention to rest. And that means an environment that’s strong on fascination”\textsuperscript{130}.

The physical and emotional benefits that we receive from nature are on the decline due to human alienation from nature. Nature-deficit disorder, although it is not a formal diagnosis, is a way of describing the costs of alienating ourselves from nature. Some of these costs include “diminished use of the senses, attention difficulties, and higher rates of physical and emotional illnesses”\textsuperscript{131}. This disorder affects individuals as well as
communities. Nature deficit is an especially relevant problem in cities as “long-standing studies show a relationship between the absence, or inaccessibility, of parks and open space with high crime rates, depression and other urban maladies”\textsuperscript{132}. The restorative properties of nature can also be seen in a study where patients in hospital rooms “facing a park had 10% faster recovery and needed 50% less strong pain-relieving medication compared to patients in rooms facing a building wall”\textsuperscript{133}. It is essential that health as well as other benefits of nature be incorporated in cost-benefit analysis when project planners are deciding whether to conserve, restore, or destroy nature.

In light of recent research on the ecological services that benefit city dwellers and the environment in general, the stewards of Randall’s Island have aimed to make the park not only a sports complex but also a recreational area that captures the benefits of ecological services by maintaining healthy ecosystems on the island. Randall’s Island is a beacon of hope for restoration projects around New York City. For example, the Randall’s Island Park Alliance (RIPA), “removed 30,000 cubic yards of rubble, rebar and fill; regraded with clean sand; and planted salt marsh grasses \textit{Spartina alterniflora} to create over three acres of low marsh and \textit{Spartina patens} and \textit{Panicum virgatum} to establish an acre of high marsh/transition habitat”\textsuperscript{134}. This marsh provides habitat services for birds, fish and invertebrates, which make it an excellent environmental educational tool and source of appreciation thus contributing to the Island’s cultural services. Species such as “snowy egrets, great blue herons, double-crested cormorants, yellow-crowned and black-crowned night herons, […] Carolina chickadees, buffleheads, Eastern phoebes, belted kingfishers, and song sparrows” can all be seen in this habitat\textsuperscript{135}. In order to help visitors and bird watchers identify these species, interpretive signage was installed on the boardwalk that
surrounds the habitat.

The marsh grasses provide regulating services by acting as a natural filtration system. They remove “sediment and soak up heavy metals and petroleum byproducts from the water column, which in turn improves water quality and reduces nonpoint source pollution and nitrogen inputs into the East River and Long Island Sound”\textsuperscript{136}. The salt marsh grasses also have the natural capability of sequestering “carbon from the atmosphere, removing \( \text{CO}_2 \) from the air and placing it in storage in marsh soils, helping to reduce greenhouse gases”\textsuperscript{137}. The restored salt marsh and the ferry dock are locations on the island where oyster monitoring occurs. At the ferry dock location, spat (baby oysters), were found which is a “good indicator that oyster larvae do exist in surrounding waters and that future shellfish restoration projects in the area may be successful”\textsuperscript{138}. This indicates that these waters are providing successful habitat services to support oyster health.

Although restoration projects have shown to be beneficial, the exact valuation of the ecosystems remains a challenge. Issues with valuation arise for various reasons. One reason is that “a high diversity system [usually of a larger size] is assigned the same total value as a low diversity system [of a smaller size] [...] because the probable added value of diversity remains poorly known”\textsuperscript{139}. While the total value of ecosystem services cannot truly have a price because they are integral for life, it is necessary to place a price on them in order to create proper conservation policies. In creating these policies one must determine the “costs of destroying [or the benefit of conserving] the next unit of relatively intact natural habitat”\textsuperscript{140}. Another issue that arises is due to the lack of homogeneous circumstances (geographical, cultural and temporal) that surround the context of the
ecosystem in play. For example, a wetland that is in an area that could be a potential flood zone and that ultimately protects against property damage would be of greater economic value than one in an uninhabited area, all else equal. Also, “future generations may impute different values to ecosystem services than does the current generation; such changes are difficult to forecast” which make valuations difficult\textsuperscript{141}. Another problem that arises is that “market prices [...] are distorted by externalities, subsidies, barriers to trade, etc., [and thus are] poor indicators of the value of ecosystem [...] services” being that they do not incorporate the social costs of unsustainable economic practices\textsuperscript{142}. Stability is another variable in valuations. For example, in the case of provisioning ecosystem services (i.e. agriculture), a farmer may choose to diversify crops in order to avoid a risky monoculture in which should something go wrong, the entire crop yield could potentially be destroyed. Finally, it is difficult to give the exact value of a specific service because of its ultimate interdependence with other services. For example, air pollutant filtration that is naturally conducted by trees would not be possible without healthy soil conditions—yet many would consider valuing the ecosystem services provided by healthy soil in addition to the ultimate service of air pollution filtration as double counting. Even though the valuation process of ecosystems is complex and imperfect, it should still be utilized as a means of creating a healthier and more sustainable world.

\textbf{Chapter 4: Urban Design: Reversing Wreck through Parks and Recreation}

As a result of the Industrial Revolution, many cities around the world had become centers of squalor and environmental wreckage. Wealthier urban dwellers felt that the state of the city was beyond repair and would be most efficiently dealt with by simply abandoning it and retreating to the suburbs. In 1922, Henry Ford expressed his
disenchantment with the city stating, “The modern city is probably the most unlovely and artificial site this planet affords. The ultimate solution is to abandon it... We shall solve this city problem by leaving the city”¹⁴³. In London, the city problem was perceived in a similar manner. Ebenezer Howard, the mind behind the Garden City movement, suggested that “crowded cities choking on soot and sewage” should be retreated from in exchange for semi-rural land that would offer Londoners “lungfuls of fresh air and conviviality”¹⁴⁴.

Although suburbia was meant to be an ecological haven, the suburbs became one of the most destructive forces on the environment. Suburbs “take up more space per person, [...] are expensive to build and operate, [...] require more roads for every resident, more water pipes, more sewers—more power cables, utility wiring, sidewalks, sign posts, and landscaping. [...] They pollute more and pour more carbon into the atmosphere. In short, the dispersed city is the most expensive, resource-intense, land-gobbling, polluting way of living ever built”¹⁴⁵. Additionally, suburbs became a symbol of social inequality, “it seemed that segregation was just the natural working of the free market, the result of the sum of countless individual choices about where to live. But the houses were single—and their residents white—because of the invisible hand of government”¹⁴⁶.

In the 1870s, prior to the desire to abandon cities for the suburbs, the playground movement was introduced. This movement valued “urban nature more than swing sets or baseball fields; nature was presented as a health benefit for working-class Americans, particularly their children”¹⁴⁷. It was out of this movement that urban parks similar to Olmstead’s Central Park were created. In the early twentieth century, the healthy cities movement, incorporated public health into urban design. Codes mandated “how many feet parks and schools should be from a home” in order to create healthier cities¹⁴⁸.
Unfortunately, the urban parks that were created post World War II were “increasingly less natural and more attuned to organized sports”\textsuperscript{149}. As the population of cities grew, playgrounds and parks did not keep up with this growth. Also, these public parks “have become increasingly domesticated lawyered, and boring—and designed without taking wildlife into consideration”\textsuperscript{150}.

In the eyes of Jane Jacobs, who published her most influential and controversial book \textit{The Death and Life of Great American Cities} in 1961, boring urban parks would only attract crime and further degradation. She believed that a successful park would attract “as many different kinds of people, with as many different schedules, interests, and purposes as possible”\textsuperscript{151}. In order to achieve diversity of park use, it is necessary that “diversified users be deliberately introduced into the park itself”\textsuperscript{152}. For example, Jacobs explains that swimming, fishing, boating, sports fields, carnivals, music and plays are all activities that can be directly experienced in a single park, drawing in visitors with varying interests. A beautiful view may serve to augment the visitors experience but it is not necessarily the demand good that attracts them to the park. The idea of a successful park being a diverse park can be extended to all aspects of cities. She states, “in cities, liveliness and variety attract more liveliness; deadness and monotony repel life”\textsuperscript{153}. City streets should reflect diversity of life not monotony, “the more successfully a city mingles everyday diversity of uses and users in its everyday streets, the more successfully, casually (and economically) its people thereby enliven and support well-located parks that can thus give back grace and delight to their neighborhoods instead of vacuity”\textsuperscript{154}. An ecosystem, be it natural or man-made, requires diversity to sustain itself, “In both cases, the diversity develops organically over time, and the varied components are interdependent in complex ways. The more
niches for diversity of life and livelihoods in either kind of ecosystem, the greater its carrying capacity for life”\textsuperscript{155}.

The ideas of Jane Jacobs influenced the New Urbanism movement that started in the 1960s and ultimately came to fruition in the 1980s. This movement was founded on ten major principles: walkability, connectivity, mixed-use and diversity, mixed housing, quality architecture and urban design, traditional neighborhood structure, increased density, smart transportation, sustainability, and quality of life\textsuperscript{156}. Jacob's ideas on the need for diversity in parks and cities are reflected in the mixed-use and diversity principle of New Urbanism, which states “neighborhoods, blocks, and buildings offer a mix of shops, offices, apartments, and homes. The neighborhoods welcome people of all ages, income levels, cultures and races”\textsuperscript{157}. If the principles of New Urbanism were to be fully integrated into the urban landscape, the desire to retreat from the city would dissipate. It is necessary to make the urban landscape an upgrade of the suburbs, “the sustainable city has [...] to be healthier, [...] more fun, and more resilient than the dispersed city. It has [...] to lure us closer together rather than pushing us apart. It has [...] to reward people for making efficient choices when they move around”\textsuperscript{158}. Additionally, nature should not only exist in parks, it should “be part of your daily habitat and routine. In order for New Yorkers to soak up the benefits of nature, it has to be integrated right into the urban fabric”\textsuperscript{159}. Parks should come in various sizes; small parks near businesses can serve as an easily accessible respite from hectic city life.

Creating sustainable cities increases residents’ health and happiness and is a necessary step in adapting and mitigating climate change. Climate change is a direct threat to the “stability and longevity of New York City’s infrastructure, buildings, and parks”\textsuperscript{160}. If
greenhouse gas emissions are not reversed, sea levels and temperature will rise and storms will be more frequent and intense. In order to create more sustainable cities, parks within them need “to expand their function beyond recreation— to store and clean water, filter air, help improve public health, and provide habitat and biotic connectivity to increase biodiversity, in essence to become organic infrastructure”\textsuperscript{161}. Parks should be constant works-in-progress, with a continuously growing capacity to improve the city's environment. When parks expand their function beyond the cultural services of recreation they can provide regulating services that protect the city from issues such as flooding and sewer overflows. For example, when parks are planted with inundation-tolerant species they can “serve as a buffer to inhabited areas, thus reducing the risk of flooding and storm damage”\textsuperscript{162}. The risk of flooding increases in areas with impervious surfaces. In the last century, New York City has lost over 90 percent of its wetland area and “three-fourths of the city's land area is [now] covered with impervious surfaces”\textsuperscript{163}.

Much of the impervious asphalt makeover New York City received was due to the works of Jane Jacob’s rival, Robert Moses. He was known for prioritizing expressways made for automobiles over subway and bus transit. With the construction of many expressways
in New York City, Moses ushered New York into the age of the automobile. One expressway Moses built was the Cross-Bronx Expressway. The route that was chosen for it caused many neighborhoods to be unnecessarily destroyed. In a one-mile stretch of the Cross-Bronx, 1,530 families’ homes were demolished when an alternative route would have only displaced 19 families. This expressway attracts over 160,000 cars per day, contributing to noise and air pollution along its route. The depth of the bitter sentiments that the Cross-Bronx incites due to excessive traffic can be understood through a quote by Jeff Saltzman: “If you have ever wondered if you’re in Hell, then you are experiencing a rather normal spiritual quandary that you share with many. If however, you know without the shadow of a doubt that you are in Hell, then you must be on the Cross Bronx Expressway!” The Cross-Bronx has negative health implications for its surrounding residents who would have benefitted more from investment in public transit than transit routes intended for low-occupancy vehicles. Another expressway Moses is responsible for is the Belt Parkway. In order for this parkway to be created “much of the Jamaica Bay area was infilled.” The filling of this marshland to create a parkway was the reason for “extensive flooding and damage during Hurricane Sandy, as waters sought to return to their natural coastline.” Had Moses recognized the value of the marshland as a flood buffer, much of the damage caused by Sandy could have been prevented. This lesson must be incorporated into urban park design.

Parks that contain organic infrastructure and natural landscaping which serve functional purposes such as storm damage prevention, could also double as recreational areas where children can experience unstructured play. When children do not rely on playgrounds or sports fields to organize their playtime, they form “intellectual connections
— they create, discover, imagine, and innovate. [...] [They] learn to understand and develop skills of invention, cooperation, and sharing.” 170. Playing in a natural environment can enhance biophilic connections. Biophilia, as defined by E.O. Wilson, is ‘the urge to affiliate with other forms of life’” 171. He argues “humans have an innate affinity for the natural world, probably a biologically based need integral to our development as individuals” 172.

When organized sports are the only option for play in a park, this innate need for the natural world is denied. Instead, a “chilling message is sent to our children that their free range play is unwelcome, that organized sports on manicured playing fields [are] the only officially sanctioned forms of outdoor recreation. [...] Some kids don’t want to be organized all the time. They want to let their imaginations run; they want to see where a stream of water takes them” 173. Time spent in parks with peers, whether it be playing a sport or playing in nature, creates social cohesion. Additionally, “access to public parks and recreational facilities has been strongly linked to reductions in crime and in particular to reduced juvenile delinquency” 174.

In 1935, Robert Moses, who was also New York City’s Park Commissioner, proposed a plan for developing Randall’s Island into a sports complex. Since then, the park has expanded its role to serve a diverse group of people and uses. Today, Randall’s Island offers areas of organized recreation as well as natural areas. This expanded role fulfills the ecological and social functions that New York City’s Parks Department expects each of its parks to meet. In order to adapt and mitigate climate change, the stewards of Randall’s Island have taken various measures to decrease the urban heat island effect and potential damage caused by storms. New York City’s Parks Department installed “16 different green roof systems at the Five Borough Administrative building on Randall’s Island, totaling over
15,000 square feet”\textsuperscript{175}. The diverse roofing systems are being monitored in order to determine their “suitability for various applications in New York City”\textsuperscript{176}. Green roofs provide regulating services such as “reducing stormwater runoff, mitigating the urban heat island effect, [...] [and] reducing air pollutants”\textsuperscript{177}. Additionally, green roofs provide wildlife habitats, a habitat service, while reducing waste by conserving energy and extending the “service life of the existing roofs”\textsuperscript{178}. They also serve as areas of passive recreation thus contributing to the cultural services aspect of ecosystems services. Depending on the type of green roof that is employed and its vegetation, depth and medium, “70-90\% of the precipitation that falls is retained on the green roofs” during the summer months\textsuperscript{179}. This helps to mitigate the effects of extreme weather events, a regulating service.

Randall’s Island Park Alliance is also providing regulating services by protecting against flooding through the restoration of the freshwater wetland. Much of the water that flows into this wetland is from a single pipe that collects stormwater runoff “from storm drains around the soccer fields just south of the wetland site”\textsuperscript{180}. Through the forces of gravity the water is pushed through “several compartments within the emergent wetland” thus absorbing and filtering nonpoint source pollution\textsuperscript{181}. If this piping system had not been installed, the stormwater runoff would have emptied directly into the Harlem and East Rivers through storm drains. The installation of a rain garden near the Little Hell Gate Salt Marsh was another landscape design aimed at avoiding stormwater runoff damage and erosion. During storms, the rain water from “the downspout pipe of the RFK Bridge was routinely causing erosion in the salt marsh”\textsuperscript{182}. The strategic placement of the garden ensures that the runoff from the RFK Bridge no longer erodes the nearby marsh, thus contributing to the erosion prevention aspect of regulating services. On the northern
perimeter of the island, the Bronx Kill salt marsh provides a “natural buffer to boat wakes and storm surges entering the Kill from the East River, which helps to prevent shoreline erosion”\(^{183}\).

In the wake of Hurricane Sandy in 2012, the shoreline of Randall’s Island, which is composed of seawall, riprap and natural edged sections, protected the Park against much of the damage that may have otherwise been sustained. In 2010, the Randall’s Island Park Alliance, completed “nearly $10M worth of repairs to the most crucial and damaged seawall and riprap areas [...] Along the Harlem River, the aging stacked stone seawall was repaired, and additional stone and filter fabric was installed behind the seawall to end what had been serious erosion of the upland areas”\(^{184}\). Because of the adaptation measures put in place, “the Park suffered no substantial erosion or undermining of the seawall in this section” despite the seawall being under “several feet of water during Sandy's storm surge”\(^{185}\).

During Hurricane Sandy, the Park’s wetlands served as organic infrastructure and soaked up much of the storm water, thus protecting the Park from flood damages. For example, “The Little Hell Gate salt marsh received and buffered a storm surge of over ten feet [...] protecting the adjacent pathways, track & field stadium and event lawn areas from erosion”\(^{186}\). Implementing preventative climate damage design in the Park proved to be worthwhile and effective. Such measures should be explored in parks throughout the city in order to create efficient organic infrastructure.

**Conclusion: Policy Recommendations: Parks for Progress**

In preparing for the increased population density of cities, it is important that cities’ green spaces are conscientiously and efficiently designed in order to safeguard and promote ecosystem services and human well-being. In designing a park, it is necessary to
incorporate as many different viewpoints and potential uses as possible. For a park to succeed, it should meet a series of goals shared among those who fund it, build it, maintain it, and use it. This should be done in a way that meets sustainability standards. In order to ensure this, it is necessary that different aspects of the park design and its ecological health be continuously evaluated. It is also crucial that the vegetation of the park be composed of native species in order to promote sustainable landscapes.

I recommend that the Parks Department create an active website where all parks must check in to log progress, problems they are facing, and ways problems were successfully eradicated. This website could serve to identify solutions to similar problems occurring across parks and to avoid design flaws. This site could also be a platform for maintaining ecosystem-monitoring logs that keep track of various ecosystems’ services. I recommend that the IT community in conjunction with ecologists, economists, and health professionals create a comprehensive computer application that can serve to valuate the park in ecological, monetary and health terms. With this data, parks can quantitatively show how they are benefitting their communities, which could procure them more funding.

In order to create more sustainable designs, in 2008, Mayor Bloomberg created The Green Codes Task Force. This team was tasked with “encouraging green building and removing policy and code barriers to green design”\textsuperscript{187}. Many of the legal codes that structure the world we live in, work in theory but not in reality. This causes economic inefficiencies as well as impediments to sustainability measures. Larger parks, such as Randall’s Island, have buildings within their parameters that could benefit from an update to green building codes. Changes in building codes could drastically decrease how much energy a building utilizes and how much waste it produces. Implementing green roofs or
white roofs (white painted roofs that reflect rather than absorb heat) in buildings can reduce the amount of energy the building spends on air-conditioning in the summer months. Additionally, water catchment systems can be installed and the water that is captured can be recycled and used for watering plants.

In order to keep larger parks safe and available for use after dark, they must have light fixtures dispersed throughout. To meet sustainability standards, these fixtures should be powered by alternative sources of energy such as solar panels. At key points such as specific sports fields, larger lights that can be turned on and off should be present. Additionally, recycling units should be placed near sports fields that generate the most traffic. In fact, parks could become hubs of recycling, “recycling programs for small scale items such as cell phone batteries, where collectors are compensated by recycling companies, might provide a small revenue stream for smaller parks. [...] The success of this initiative hinges on working with the Department of Sanitation to facilitate pick up and coordination”188. The potential recycling program within parks can be expanded to composting initiatives that collect “commercial food byproducts from restaurants, breweries, produce markets, and green markets, as well as locally collected yard waste”189.

Parks in New York’s five boroughs that are currently underdeveloped must be considered for design improvements. In accordance with PlaNYC, these parks’ should be accessible to all New Yorkers, and provide regulating services such as reducing carbon emissions and improving stormwater management as well as water and air quality. The process of redesigning and developing parks is necessary, however, it can cause the most vulnerable city residents to be displaced. This is because implementing sustainability measures “drives up land values. This may be good news for property owners and city
coffers, but it is a disaster for renters.”190. The High Line Park in New York City was a great environmental success as it allowed nature to reclaim abandoned train tracks. However, it also caused “lightning-fast gentrification: the cost of residential property within a five minute walk of the park more than doubled during the eight years straddling the park’s opening in 2009”191. Cities should not only serve those who can afford living in a healthy environment, they should serve everyone. For this reason, “wealthy cities must provide affordable housing and different kinds of housing in even the most favored neighborhoods [...] zoning that excludes apartments and affordable housing from neighborhoods [...] constitutes a form of segregation”192. I recommend real estate studies be conducted in order to understand how parks may contribute to gentrification. If the results show a positive correlation, I recommend that government “step in with subsidized social housing, rent controls, initiatives for housing cooperatives, or other policy measures” in order to ensure that these upgraded parks really do serve everyone193. Randall’s Island Park is an example of a previously degraded park that is being successfully upgraded to serve all New Yorkers.

The location of Randall’s Island, amidst populations with generally poor health, largely due to their environmental circumstances, marks it as a critical investment point for environmental justice initiatives. With the passing of Executive Order 12898 by President Clinton in 1994, it became possible for “federal agencies to make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high adverse human health or environmental effects of its activities on minority and low-income populations, especially when required by NEPA”194. The stated purpose of NEPA, the National Environmental Policy Act of 1969, is to “declare a national policy which will
encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation”. In order to meet NEPA’s public participation process standard, the communities of the South Bronx and East Harlem should be involved in the decision making process for investments in Randall’s Island as well as potential new parks that could improve their circumstances. I recommend that Randall’s Island continue to engage the surrounding communities and ensure their status as stakeholders of local green spaces. By improving and increasing the number of urban parks, cities can effectively create a healthier and more sustainable environment for all.


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Ibid.

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174 Ibid., 177.


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179 Ibid., 242.


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182 Ibid., 9.

183 Ibid., 5.

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