

Historic Waters: **Re-imagining Hoboken's** **Engineered Landscape**

by James J. Bykowski

Abstract

The purpose of this design project is to investigate and address the stormwater and open space problems in Hoboken, New Jersey. Researching the historical landscape change of Hoboken has shown the change from tidal marsh to a developed city and reasons why the city continues to flood. Continued development without new park expansion has led to an increase in population resulting in a lack appropriate open space requirements for residents.

The design explores different stormwater interventions within an open space network that incorporates stormwater infrastructure and the landscape. The focus of the design is creating a rain terrain where stormwater is absorbed and engaged by pedestrians, not forced into conduits to flow into the Hudson River. Spaces will be created through ideas established in Infrastructural Landscapes. These new multi-functional landscapes will improve the pedestrian experience in Hoboken, providing a better urban infrastructure for movement and management.

Historic Waters: Re-imaging Hoboken's Engineered Landscape

By James John Bykowski

Submitted in partial fulfillment of the requirements for the degree of Master of Landscape Architecture in the Department of Landscape Architecture at Rutgers University.

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For my mom, Linda Bykowski, who helped me through the past three years of my education. Thank you for being there and encouraging me to work hard.

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Introduction

Purpose of Research

Traditional stormwater management, increased impervious surfaces from development and climate change is causing more flooding in our urban landscapes. Stormwater issues in Hudson County, New Jersey, have resulted in major flooding fears and damages. This design project will look at significantly improving the quality of stormwater infrastructure while adding public spaces and creating multi-functional landscapes in Hudson County through ideas based in Infrastructural Landscapes.

My research and personal experience with the landscape has directed me towards Hoboken, New Jersey's landscape and stormwater issues for this graduate design project. In September 2011, during the third semester of my landscape architecture education, The Department of Landscape Architecture at Rutgers University had its annual fall field trip. This year, the department decided to venture out into the landscape of Manhattan, so I decided to stay at a friend's apartment in Hoboken the evening before to get an early start to New York the next day. That day Manhattan, New York and New Jersey received a pretty generous rain event, causing flooding in

Hoboken, where my car was parked. When I returned to my car, I realized from the sand bags lining the street that I parked in a flood prone zone. Luckily, the flood waters saturated the vehicle's interior, but fortunately, did not reach the engine. As my education proceeded, I learned more about Hoboken and our built environment. I discovered more about the pollutants in the water from Hoboken's combined sewer system that flooded my car. This personal experience influenced my exploration of why flooding occurs in Hoboken and if there were landscape design interventions that would help to prevent the overflow of Hoboken's combined sewer system. Landscape and infrastructural performance play an immense role in shaping our experiences in the built environment.

Urban infrastructure becomes "both site and system."(Belanger 2011) The urban landscape is dominated by infrastructural systems that create

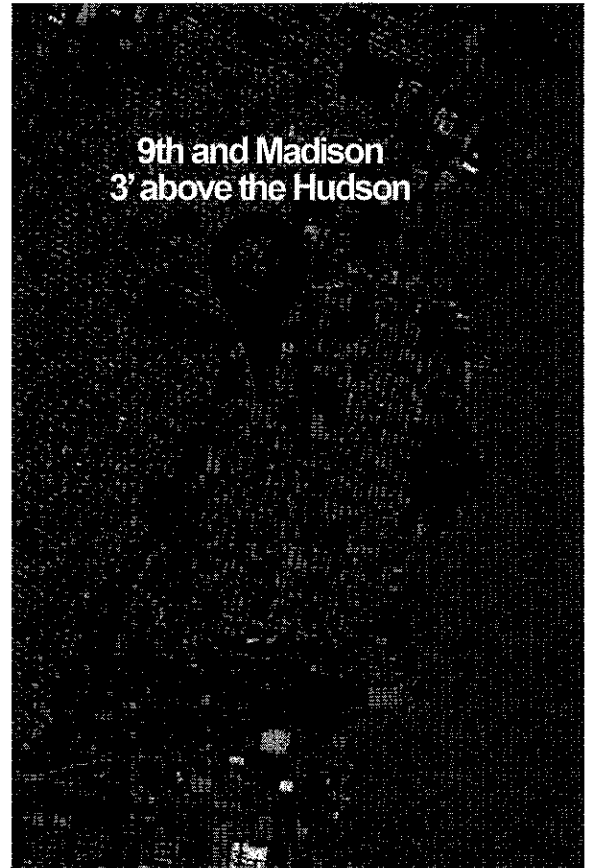


Figure 1.1 Location of my car in Hoboken, New Jersey.

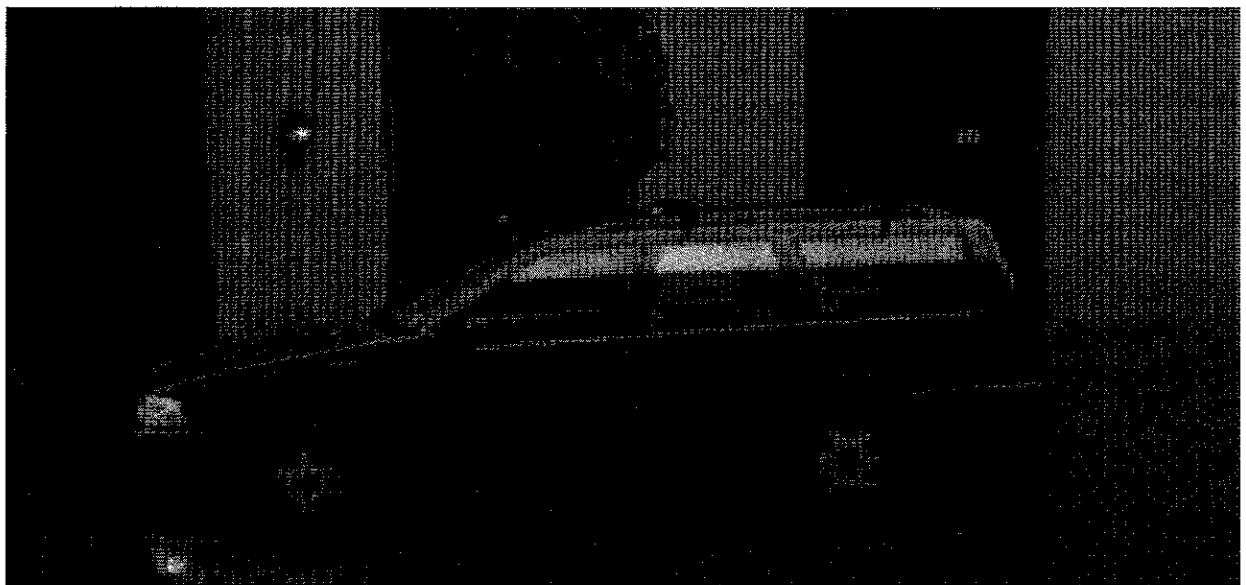


Figure 1.2 My car flooded in Hoboken.

movement of energy and materials that our cities need to function. These systems that make our cities function also create barriers for the people who inhabit cities. "In order to function, fit, and be acceptable infrastructure needs to enhance the quality of the landscape. Hence, conceiving infrastructure blends with generating architecture, building landscapes and producing urban settings and living environments." (Shannon 64) The barriers between infrastructure and landscape should be dissolved to create spaces that function socially and enhance the engineered functions of the city.

Imagining these innovative landscapes raises questions on how they will function in many different ways. Will these new multi-functional landscapes improve stormwater practices and the pedestrian experience in the county, providing a better urban infrastructure for movement and management? Can infrastructural landscapes bring the dynamic functions of the urban environment into the public space to bridge the gap between infrastructure and landscape? Can landscape architects change the public's thinking and help them to see the importance of these biodynamic systems? How will these potential public spaces help in connecting the residents of different communities with the waterfront and themselves? This design project will show the function and

possible benefit of an infrastructural system bound to urban ecology. Creating connectivity within these systematic landscapes for pedestrians, infrastructure, public transportation and vehicular movement is a potential way of designing the future of our urban fabric.

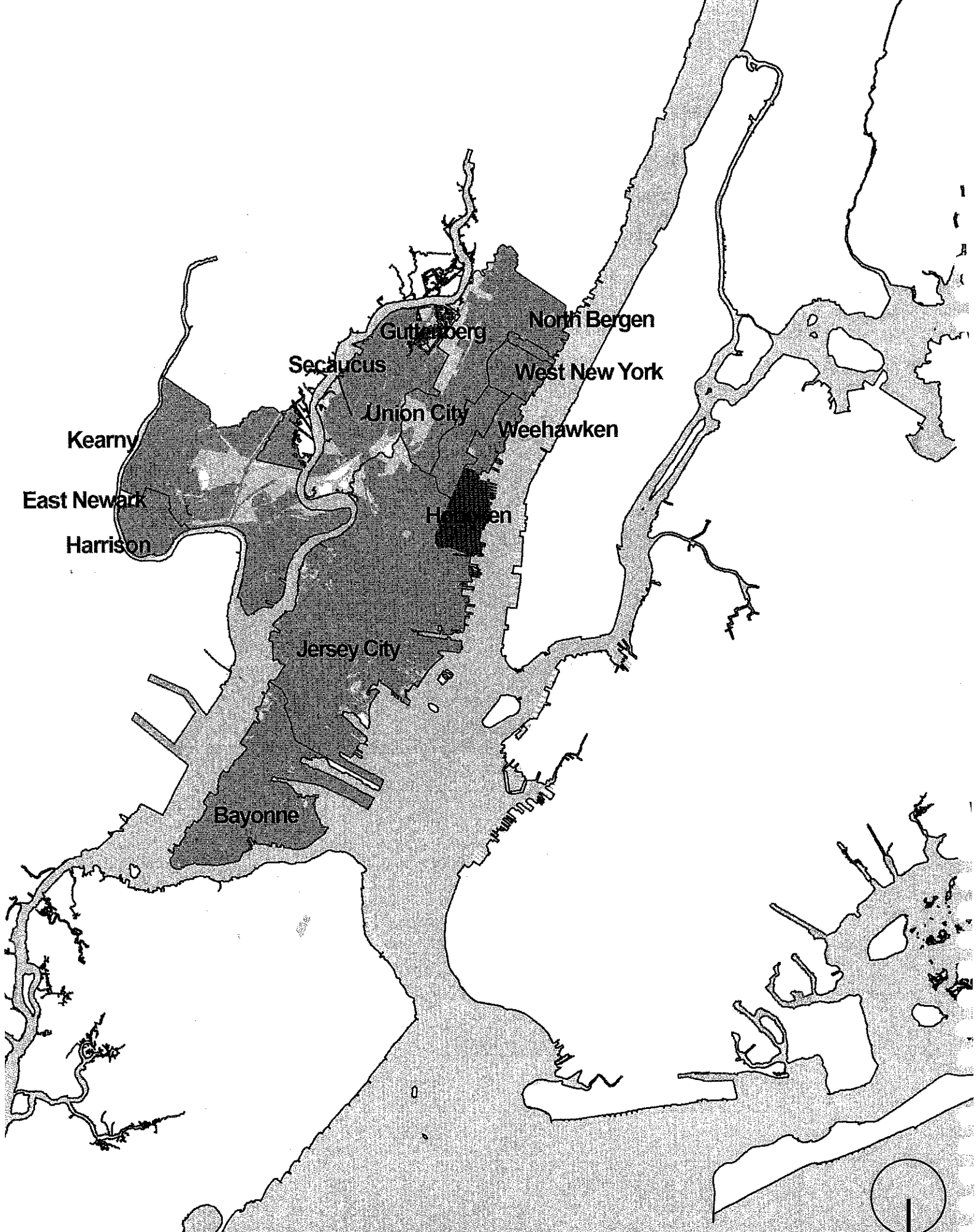


Figure 2.1 Cities and towns in Hudson County, NJ

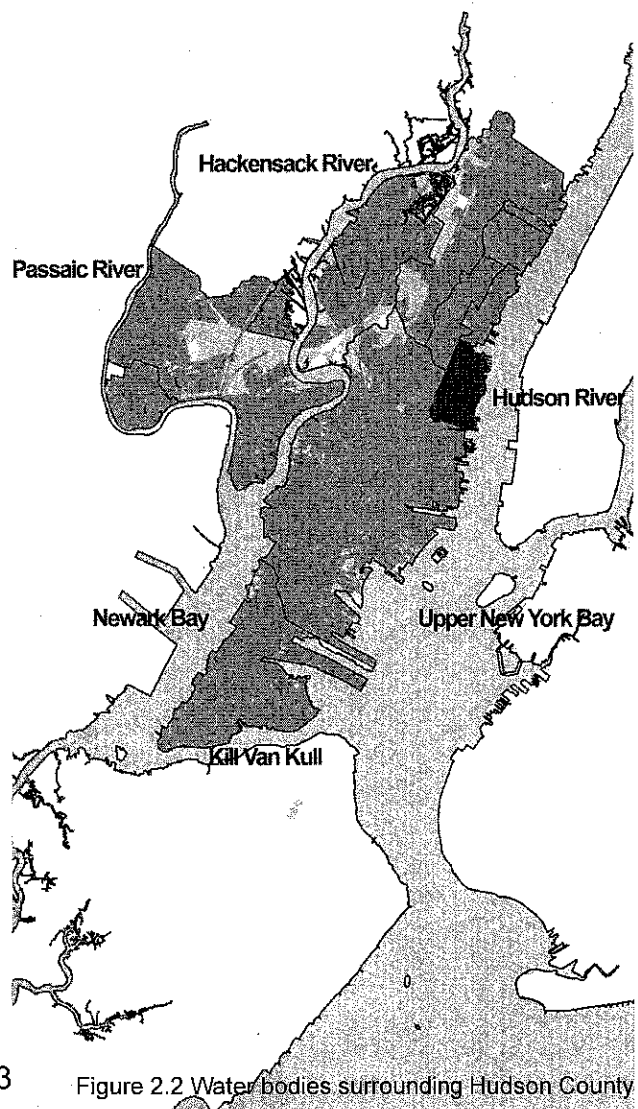
Source: NJDEP, NYDOT

Methods

Regional Background: Hudson County, New Jersey.

This design project is located in Hudson County, New Jersey. The county is comprised of twelve cities and municipalities: Bayonne, Jersey City, Hoboken, Weehawken, Union City, West New York, Guttenberg, Secaucus, Kearny, Harrison, East Newark, and North Bergen. The majority of the county is surrounded by different water bodies; to the west are the Hackensack and Passaic rivers and Newark Bay; to the east is the Hudson River and the Upper New York Bay, and to the south is the Kill Van Kull. The proximity of the county to these water bodies provides great opportunity for residents to experience their landscape in different ways. One can go from a dense urban environment to a tidal marsh to a developed river walk with views of Manhattan. These different spatial experiences provide for an exciting and attractive place to live.

Hudson County's close proximity to New York City, across the Hudson River, offers its residents easy accessibility to a remarkable transportation network for movement through the region. Within the county, residents have the opportunity to travel on a



number of different transportation systems. These public transportation systems include New Jersey Transit rail, light rail and bus, Path trains, and New York Waterway ferry.

With all these great advantages to living in

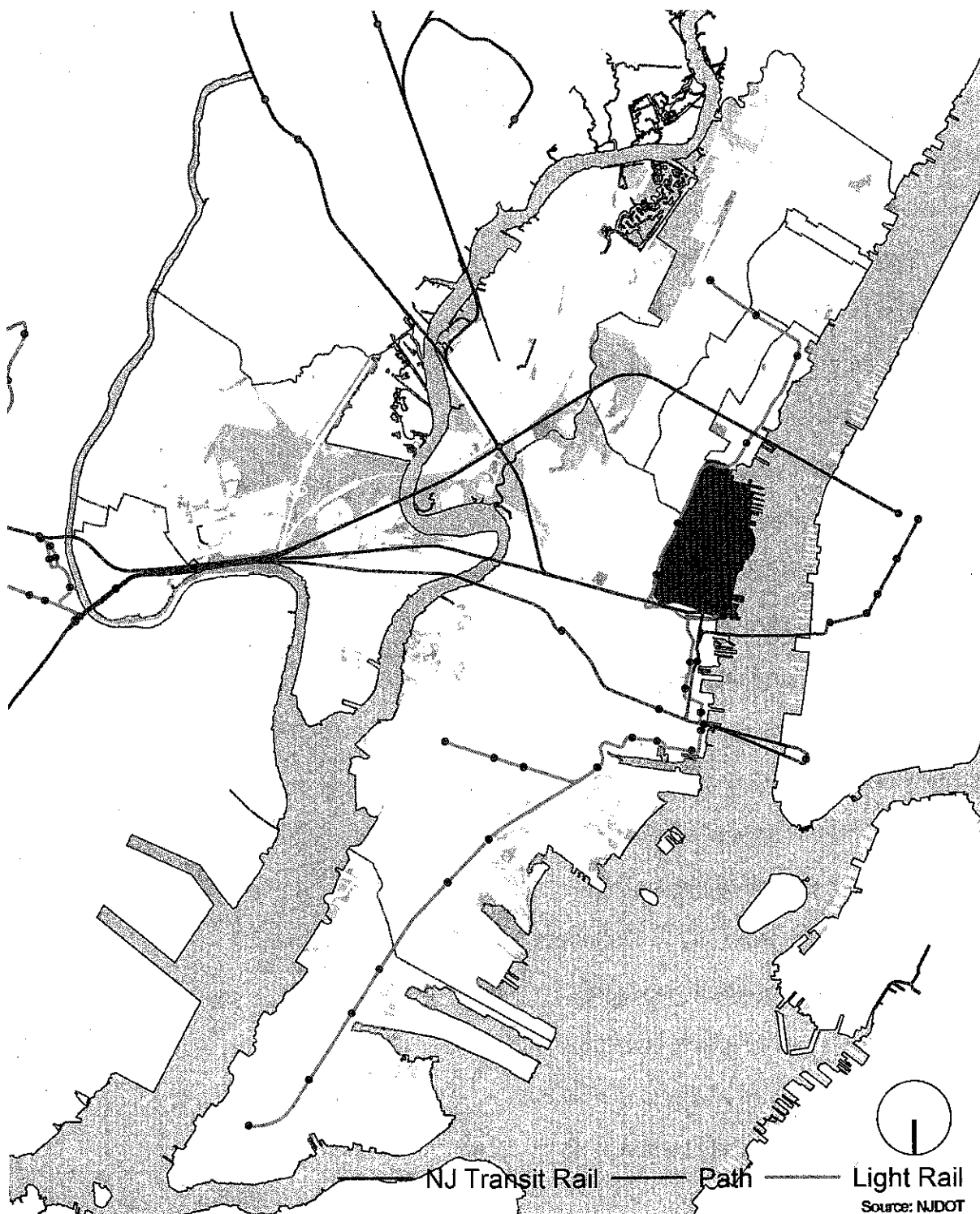


Figure 2.3 Public Transportation connecting with New York City

Hudson County, there are many important difficulties. One of the problems in the county is the continuous flooding from medium to heavy rain events. Urban stormwater runoff from the high amount of impervious surfaces is the main cause of the flooding in this densely populated area. The urban stormwater of the county is currently designed to flow into combined sewer systems that make up the entire county. This outdated infrastructure is causing environmental and human health risks. "The Hudson County Combined Sewer treats both the city's wastewater and its rain runoff equally well, and in the same combined facilities. But when high rates of storm runoff overload the system and exceed its treatment capacity, untreated water pours into the Hudson Bay or onto county and city streets." (Hudson County 2010)

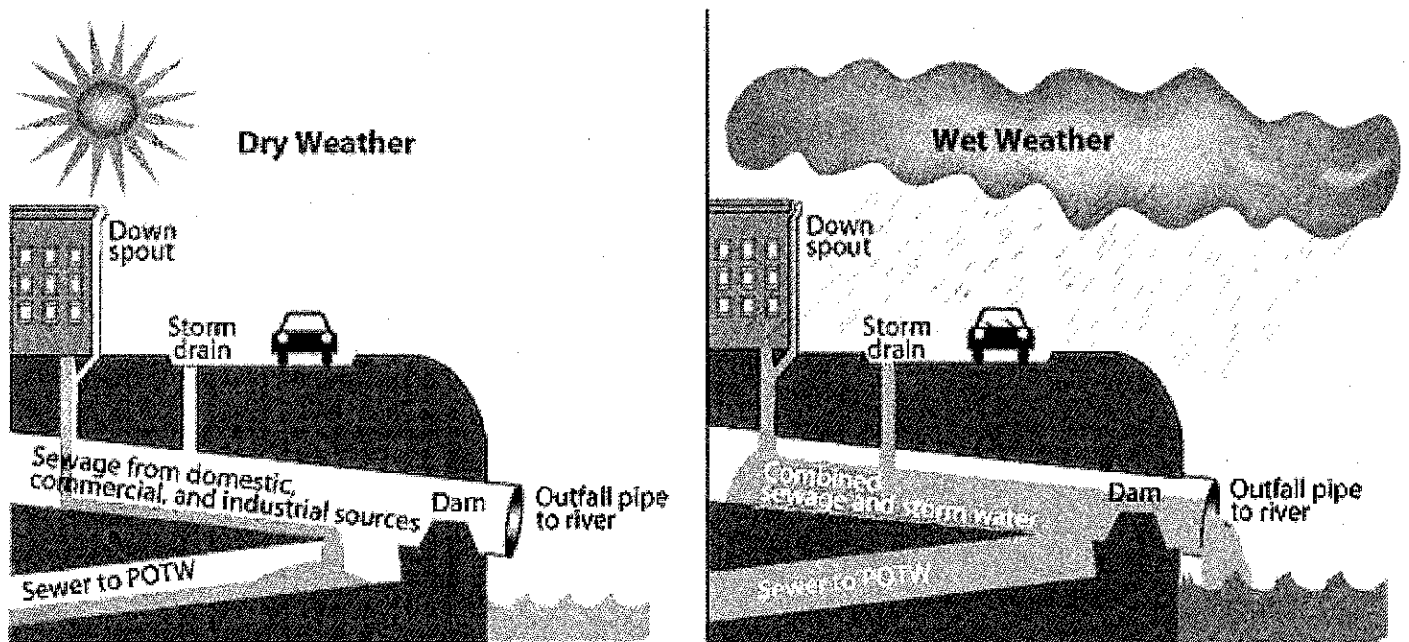


Figure 2.4 Diagram of combined sewer system. Source EPA

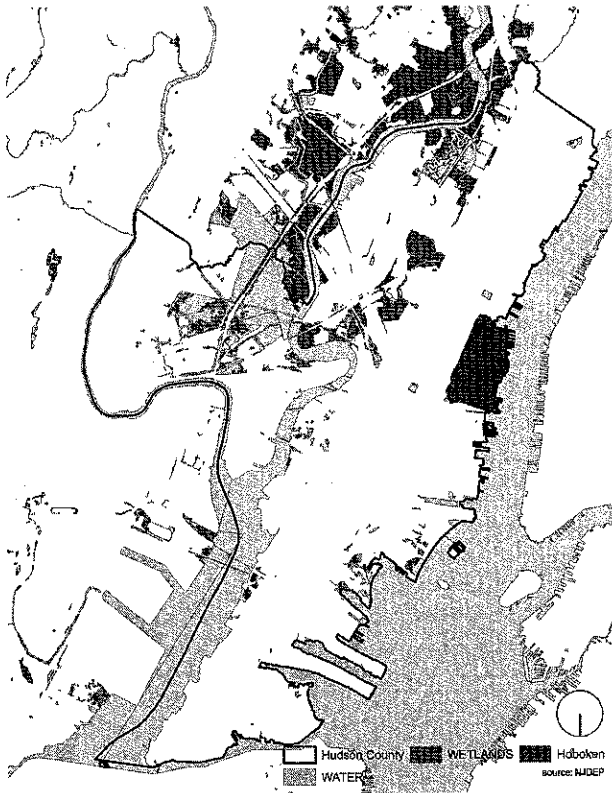


Figure 2.5 Existing Wetlands in Hudson County and surrounding area.

One of the influences on the flooding problems is the development that has been occurred in Hudson County from the time of the first settlers from Europe. The development included a great deal of filling of wetlands to “reclaim land.” “Another factor threatening to increase the incidence of flooding events in Hudson County is the continued loss of wetlands. According to the Land Use/Cover data from the New Jersey Department of Environmental Protection Agency, Hudson County had 3,897 acres of wetlands in 1986. This number decreased to a mere 1,540 acres by 2002, a decrease of over fifty percent.” (Hudson County 2010) These actions have continually caused problems in our built environments and preminent engineered solutions are not resolving the flooding issues.

Flooding issues are also influenced by the lack of open space and public space in the county. The 2010 population of Hudson County, the smallest in land size in the state, was 634,266 (Hudson County 2010). It is the most densely populated county in New Jersey (Hudson County 2010). The high population density of the region compared to the relatively low open space percentage provides great potential to improve current conditions of the county through brownfield and infrastructure revitalization. These improvements would not only attract new residents,

but also new business and help the county prepare for the 21st century.

Early Development of the City of Hoboken

Hoboken, New Jersey is located on the western shore of the Hudson River in Hudson County. Originally, Hoboken was part of the Township of North Bergen, until April 16, 1849 when the Township of Hoboken was established. As the city's population grew the township was renamed the City of Hoboken on March 28, 1855 with a population of around six thousand.

When the first Europeans sailed up the Hudson River, they viewed Hoboken, which appeared as an island. "The bold promontory of Castle Point, with its white and green cliff, extended out into the river and sloped gradually back to the marshes that separated it from what we now call West Hoboken and Jersey City Heights. Through this marsh ran the Hoboken Kill, that on the occasion of a high tide overflowed its banks and completely inundated the adjacent swamps, rendering Hoboken in appearance a perfect island." (Van Winkle 285) As seen in figure 2.6.

When the island was purchased by Colonel John Stevens in 1784 for about ninety thousand dollars, he planned to develop it as a resort. Before

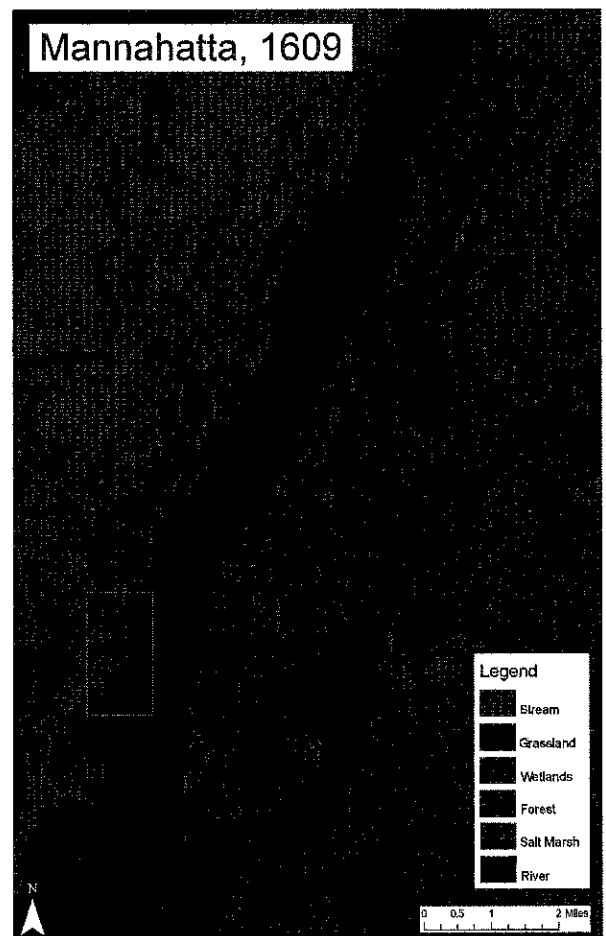


Figure 2.6 Illustration of Hoboken and Surrounding area before European settlement. Source: Mannahatta. Sanderson 2009

the factories and high rise residential towers of recent generations, Hoboken was known as a place of relaxation for the people of Manhattan. This resort came to be known as Elysian Fields. It was designed as an English style garden with walkways and shaded paths that rambled around hills with views of Manhattan. The Elysian Fields were built on the upland area of the land purchased by Stevens and the low lands remained undeveloped tidal marsh. The low land tidal marshes began to be filled as population and development grew in Hoboken.



Figure 2.7 Painting of Elysian Fields.
Source: Hoboken Historical Society

Historical Landscape Change

Through archival research, a number of historic maps and texts were accessed to study the history of Hudson County and Hoboken. These maps and texts have been invaluable in mapping the changes in the landscapes over time. They reveal the changes in the region from tidal marshes to developed urban land. Colonel Stevens created the original grid for Hoboken when the area was mostly tidal marsh. The tidal marsh lands were gradually filled in as development of the land progressed for buildings and infrastructure. The Hoboken Land and Improvement Company was responsible for the development of these lands. In 1838, the Hoboken Land and Improvement Company was incorporated by an act of legislature of the State of New Jersey. The company was responsible to “purchase, improve, mortgage and dispose of lands and other estates in and about Hoboken, for the purpose of grading and laying out the streets and squares, erecting wharves, and similar work.” (Wallace 288) As the city grew the western wetland edge slowly disappeared. This natural low land helped control flooding in the area, cutting it off from the Hudson River gave stormwater flow off the highlands nowhere to go.



Figure 2.9 Map of Hoboken 1882.

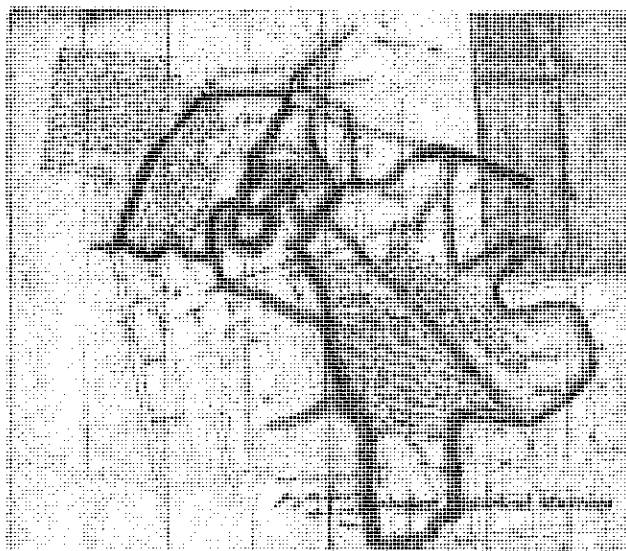


Figure 2.8 Map of Hoboken Creek.
Source: Hoboken Historical Society

Historic Landscape Change

Hudson County and Hoboken

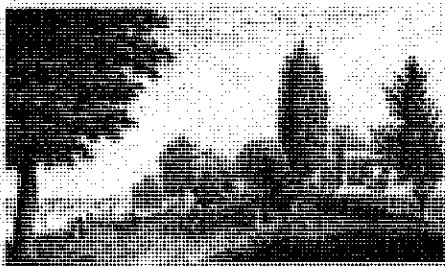


Map of Hudson County, New Jersey

Flooding

Hoboken Creek

Total Losses



1882 Hoboken Flood

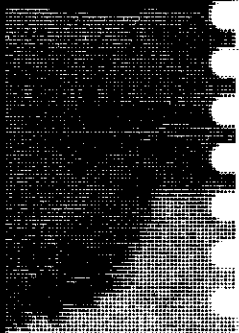
Lowest observation in 2 feet below high tide

Marsh land creates an 450 acres of losses

Main roads land creates up 3,400 acres of losses

Land was filled mostly with north but a considerable amount of oak were planted

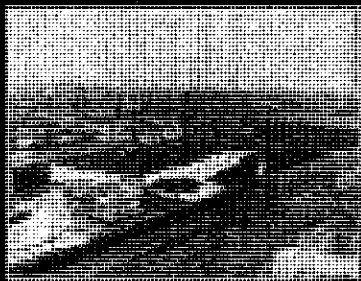
The general slope of trees is west by west





1971 10 10 10 10

1971 10 10 10 10



Mapping Historic Wetlands of Hoboken

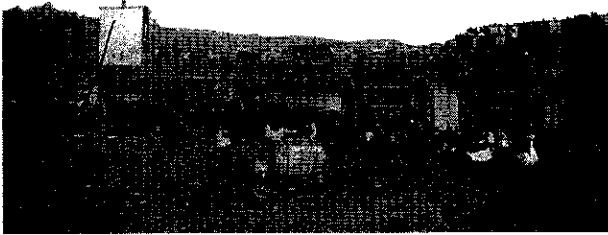


Figure 2.10 Photo of Hoboken Meadows. 1860
Source: Rutgers University Community Repository



Figure 2.11 Photo of Hoboken Meadows. 1903
Source: Rutgers University Community Repository



Figure 2.12 Photo of Hoboken Plank Roads. 1890
Source: Rutgers University Community Repository

Historical mapping and existing land use show how Hoboken's landscape has changed through time. When first discovered, Hoboken was mostly tidal wetlands of the Hudson River. These wetlands have been totally filled in for development, with no wetlands remaining. Also known as the Hoboken Meadows. (Figures 2.10 - 2.12) Residents of the meadows had to build plank roads to traverse the flood prone landscape. Filling of wetlands is the case for most of the New Jersey and New York region. "Tidal wetlands and shallow water flats that historically lined the coastlines of the New York/New Jersey (NY/NJ) Estuary have been impacted heavily since the arrival of European colonists." (Montalto 414) The now lost wetlands once provided a valuable ecological function for our environment. Stormwater, that was once stored, filtered, and infiltrated in the filled wetlands now runoff our built environments surfaces directly into adjacent water bodies.

The historical mapping study used maps between 1811 and 1910 to understand how the wetlands in Hoboken were filled in. "Beginning in the 17th century, huge portions of shoreline were modified, channels dredged, and wetlands disrupted or filled to accommodate increases in

trade, population growth, urbanization, and traffic. Dredge and fill activities associated with residential development were responsible for the greatest losses. However, filling also occurred during the construction of transportation infrastructure and as a means of mosquito control.” (Montalto 414) The “reclaiming of land” for development is the reason Hoboken’s wetlands have disappeared.

Developed land acreage in Hoboken went from 129 in 1811 to 793 today. This was achieved by building bulkheads on the Hudson River and filling the wetlands. Wetland acres went from 561 in 1811 to none existing today. This transformation of land is the major cause of flooding in Hoboken today.

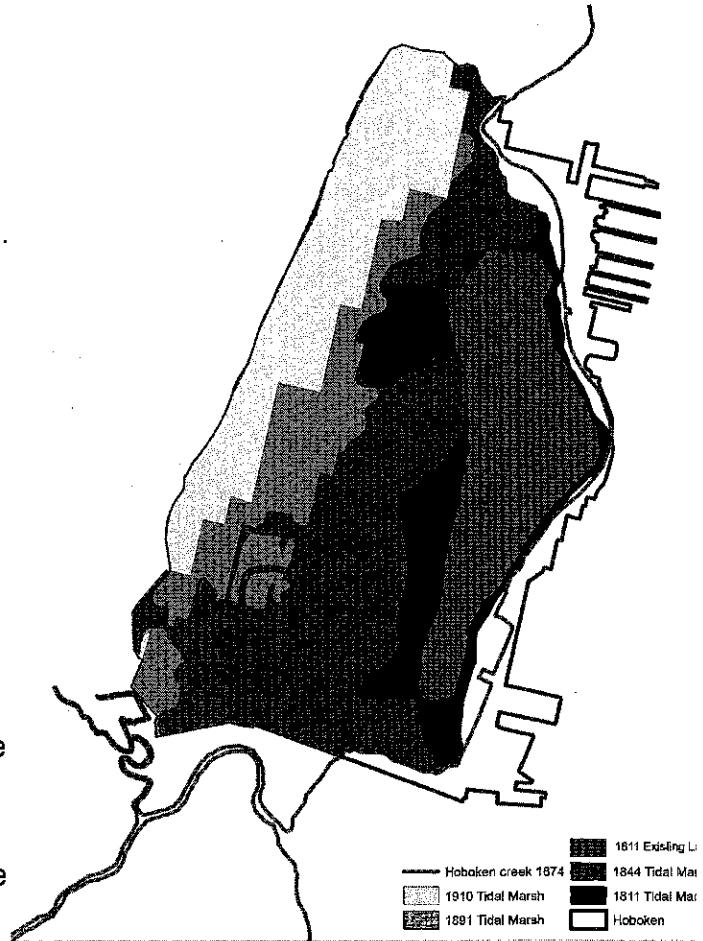


Figure 2.13 Mapping of Hoboken’s Wetlands
Sources: NJDEP, Hoboken Historical Museum

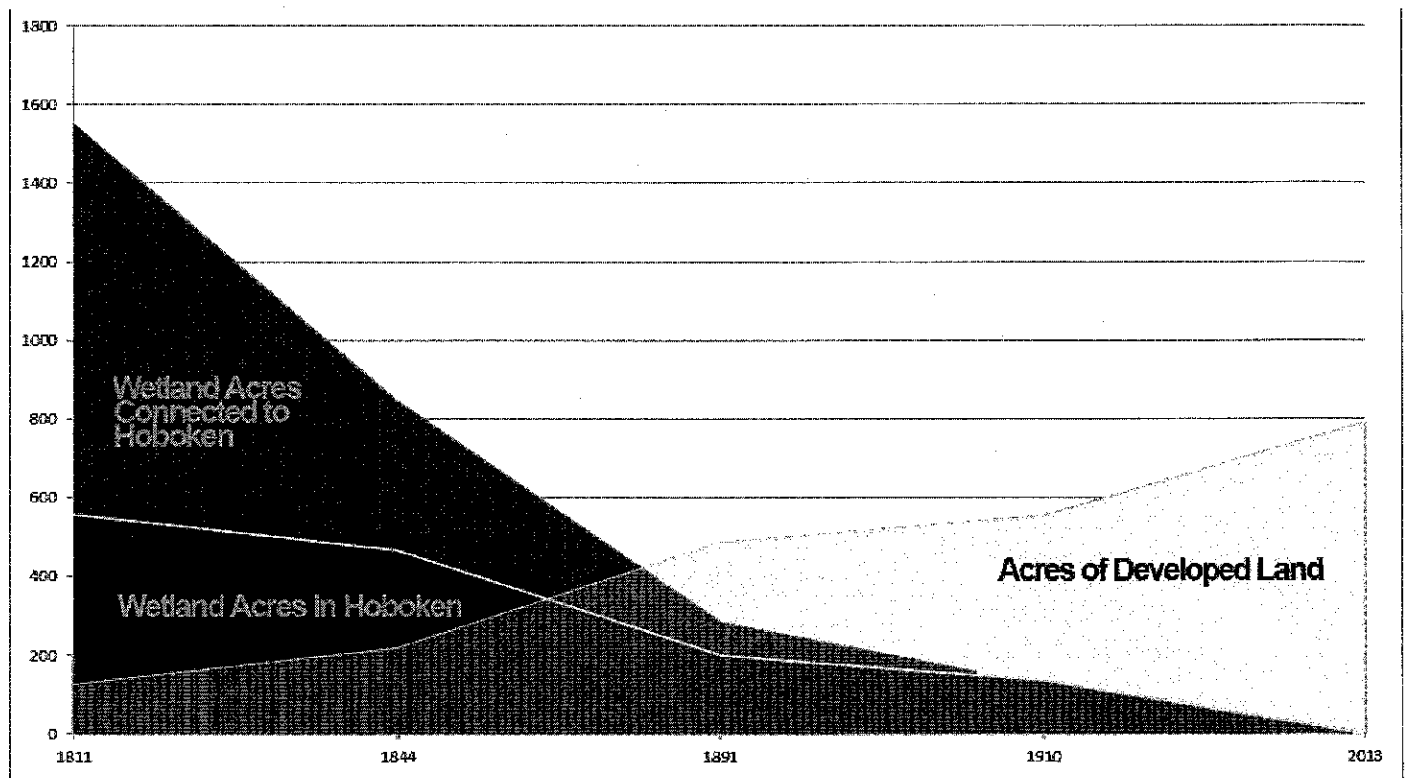


Figure 2.14 Wetland loss to development

wetland loss over time



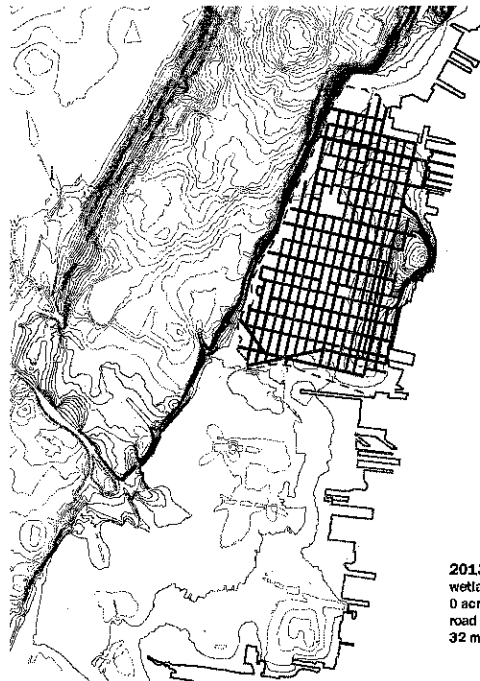
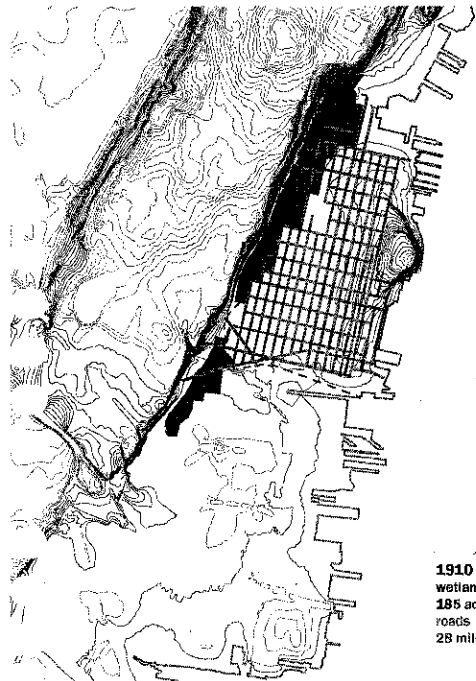
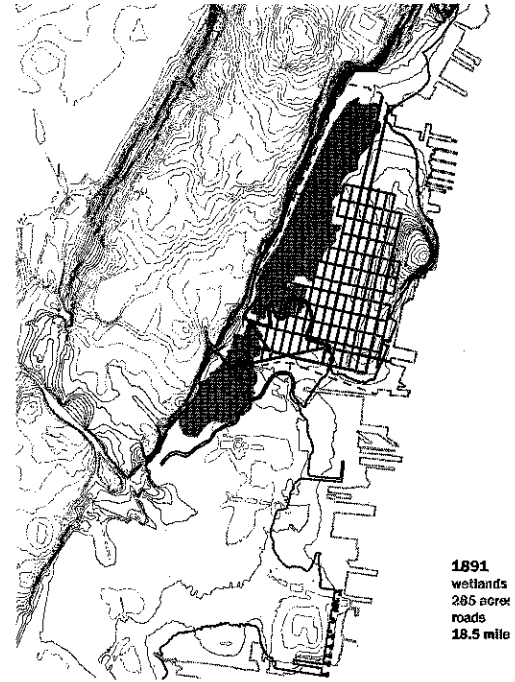
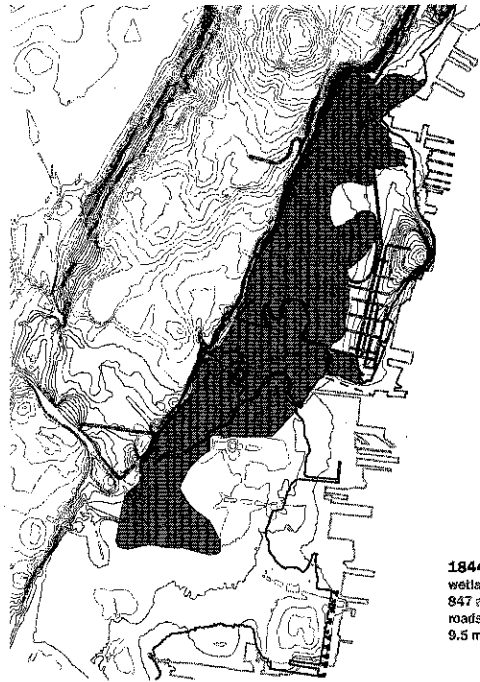
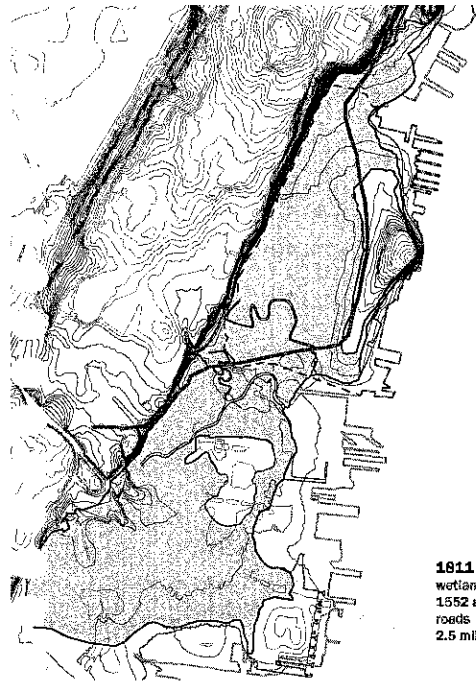


Figure 2.15 Wetland loss to development

Existing Conditions of the City of Hoboken

Existing Land Use

Hoboken is currently a highly developed urban landscape. To better understand this landscape a mapping of its current land use was very important. Using Arc GIS, a mapping study of existing residential and industrial buildings, vacant land, off street parking, open space, roads and utility areas was conducted. Private backyards and driveways were not included in the study. Some areas were included because of the close proximity to the Hoboken City boundary. The results of the mapping are presented in figures 2.16 and 2.17.

"The city of Hoboken is 90% impervious, meaning that 90% of rainwater enters the collection system almost immediately." (EmNet 11) The mapping goals were to better understand the amount of impervious surface broken into different categories. This data will help guide design interventions dealing with urban flooding.

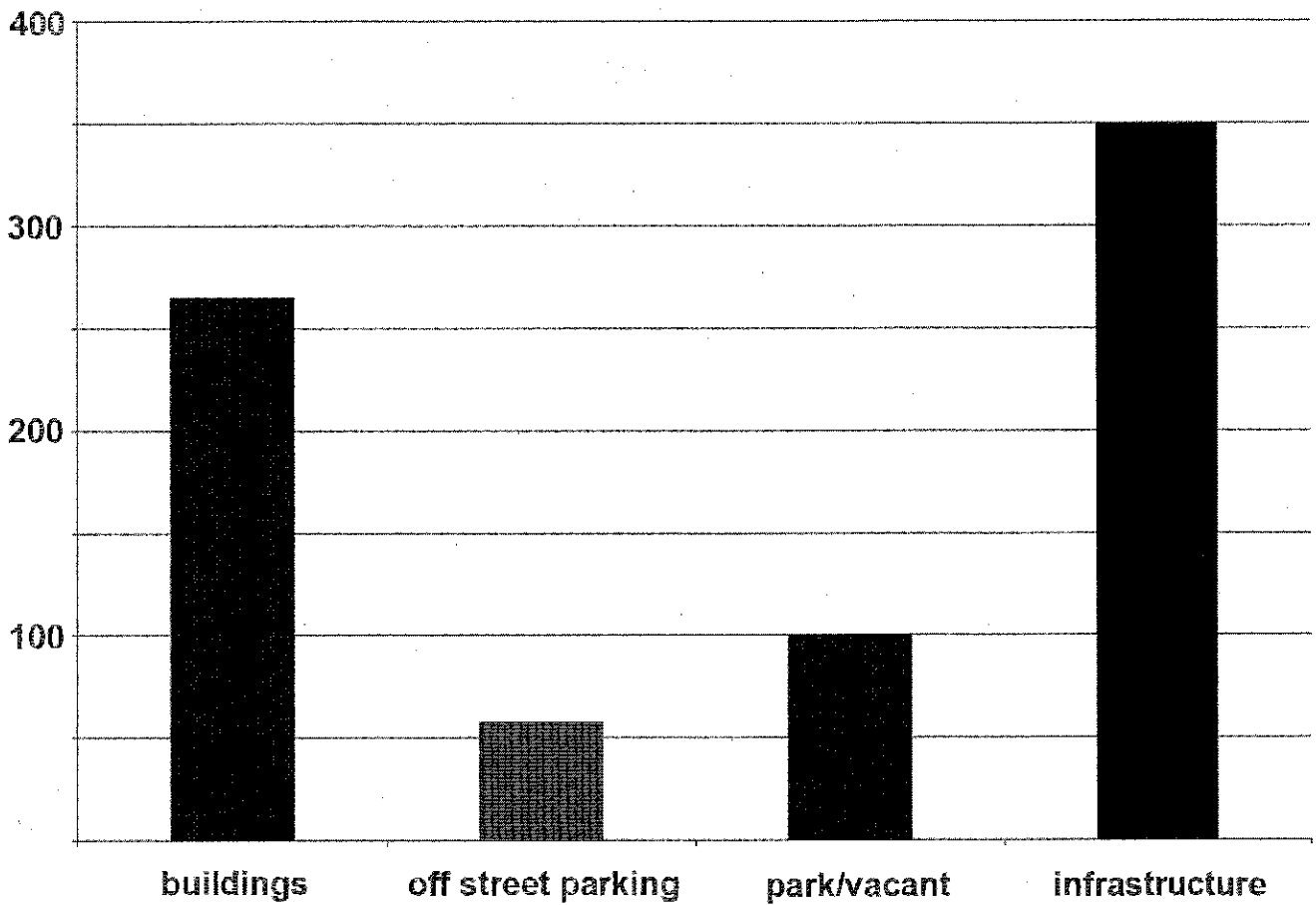


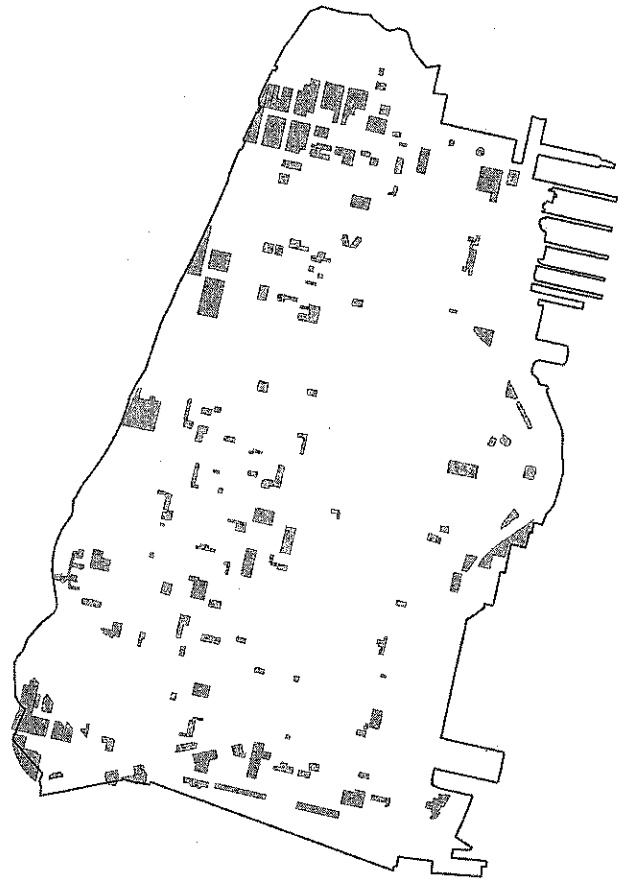
Figure 2.16 Existing land use



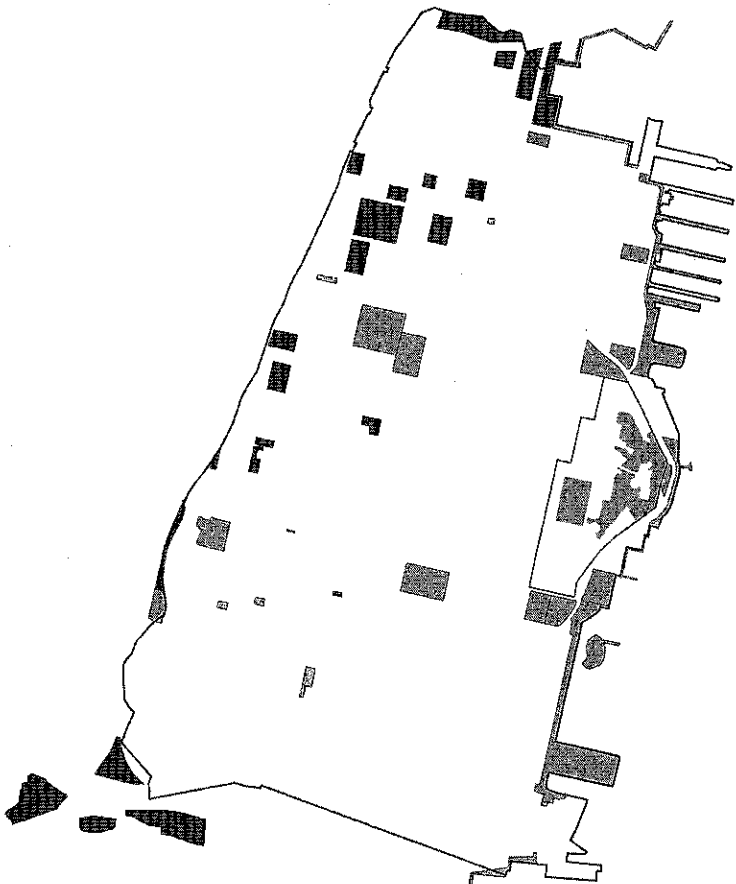
Figure 2.16 Existing land use



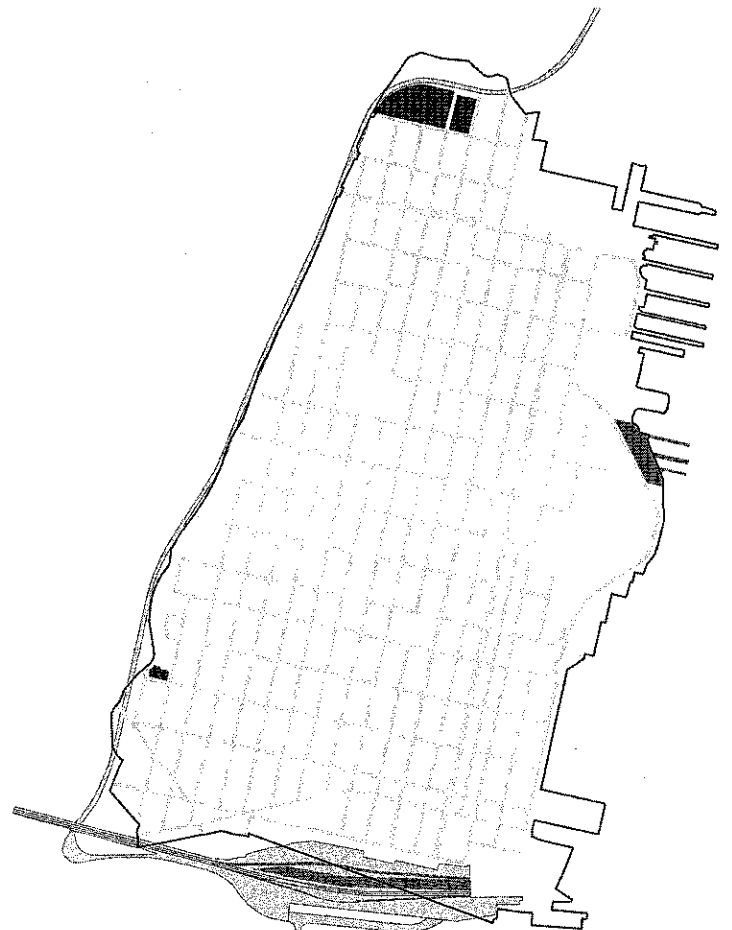
buildings 265 acres



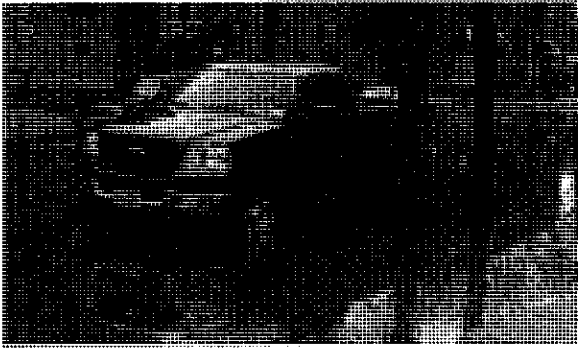
off-street parking 58 acres



park and vacant land 100 acres

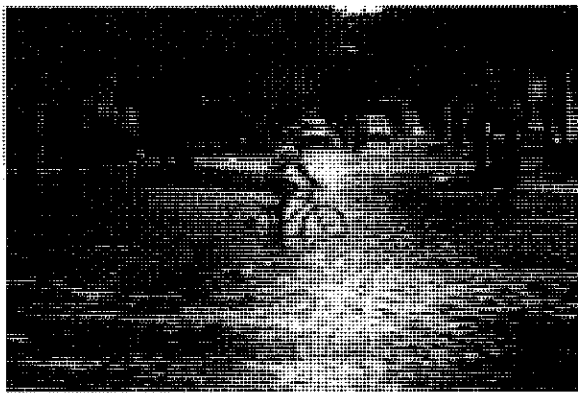
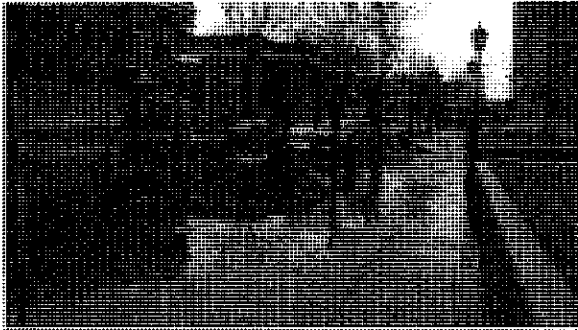


infrastructure 350 acres



Flooding in Hoboken

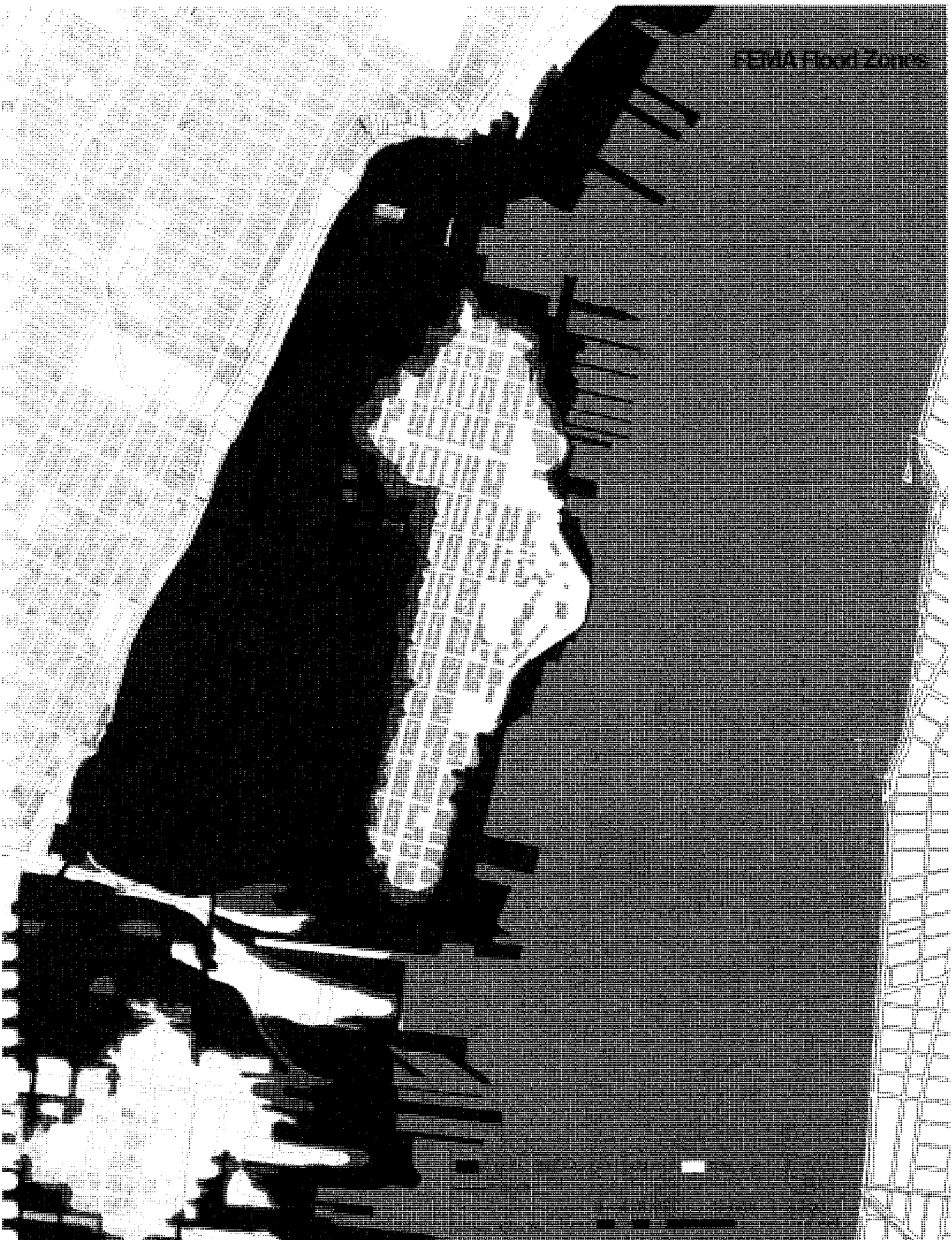
Since September 2011 when my car was flooded in Hoboken, I have been interested in exploring the reasons why the City of Hoboken has such major flooding issues. The development and use of impervious surfaces has clearly contributed to the flooding issues in this urban environment. However, the location of Hoboken has contributed significantly to its flooding. One of the major issues is that most of Hoboken was developed in a flood plain. The city of Hoboken is roughly 793 acres, located directly adjacent to a major body of water, the Hudson River. Much of Hoboken is in flood zones defined by the Federal Emergency Management Agency (FEMA).



The term "100-year flood plain line" is a commonly misunderstood concept. A "100-year flood can happen two years in a row." (USGS) "The term "100-year flood" is used in an attempt to simplify the definition of a flood that statistically has a one percent chance of occurring in any given year. Likewise, the term "100-year storm" is used to define a rainfall event that statistically has this same one percent chance of occurring." (USGS) The first zone in Hoboken labeled by FEMA is called, "Zone AE". Zone AE is a parcel of land that has a one percent chance of flooding



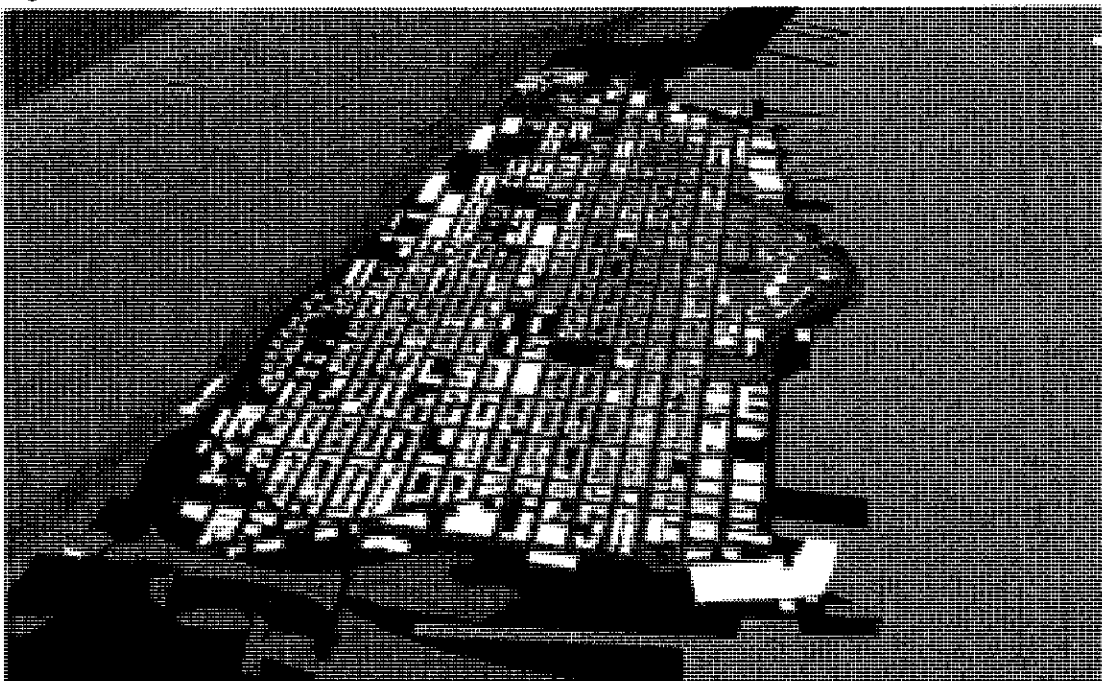
Figures 2.17 - 20 Flooding in Hoboken.



annually, also known as the 100 year flood plain. This zone has the potential to flood during many different rain events. The second area of the flood plain in Hoboken that rarely floods is known as the "0.2 percent chance of flooding" zone. As the name states, it has a 0.2 percent chance of flooding each year, this area is in the 100 to 500 year flood zone. The third zone in Hoboken is called "Zone X" and this area has an elevation above the 500 year flood plain resulting in a nominal chance of flooding. (FEMA) Of Hoboken's 793 acres, 66% of the total land area or 529 acres fall in zone AE, an area that is under constant threat of flood. Six percent falls in "zone 0.2" which comprises 45 acres. The total land area of both zone AE and Zone 0.2 combined is 574 acres, 72 percent of the City of Hoboken.

This is a landscape that has gone through constant change, from tidal wetlands to a major city.

Figure 2.22 FEMA flood map.



2001 01 18 10:00 AM

Hoboken's future changes need to address their flooding problems and possibly look to the past to guide their future development and design issues.

FEMA flood zones in Hoboken

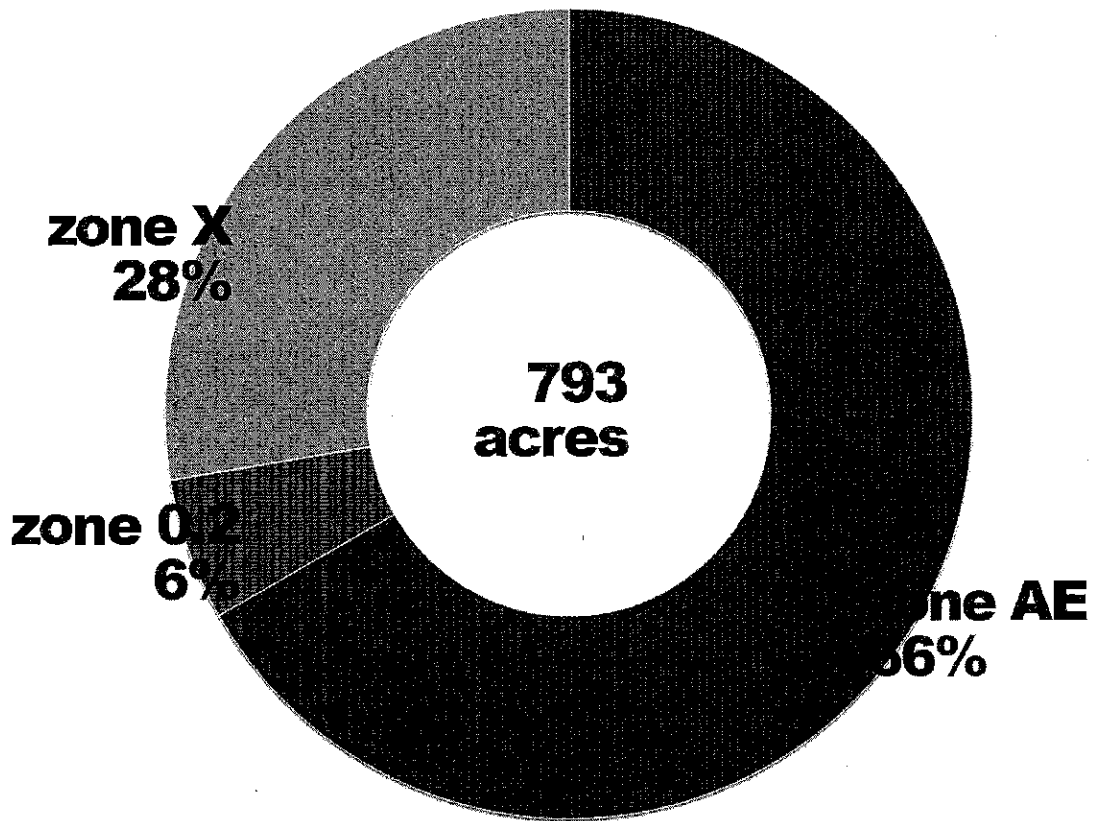


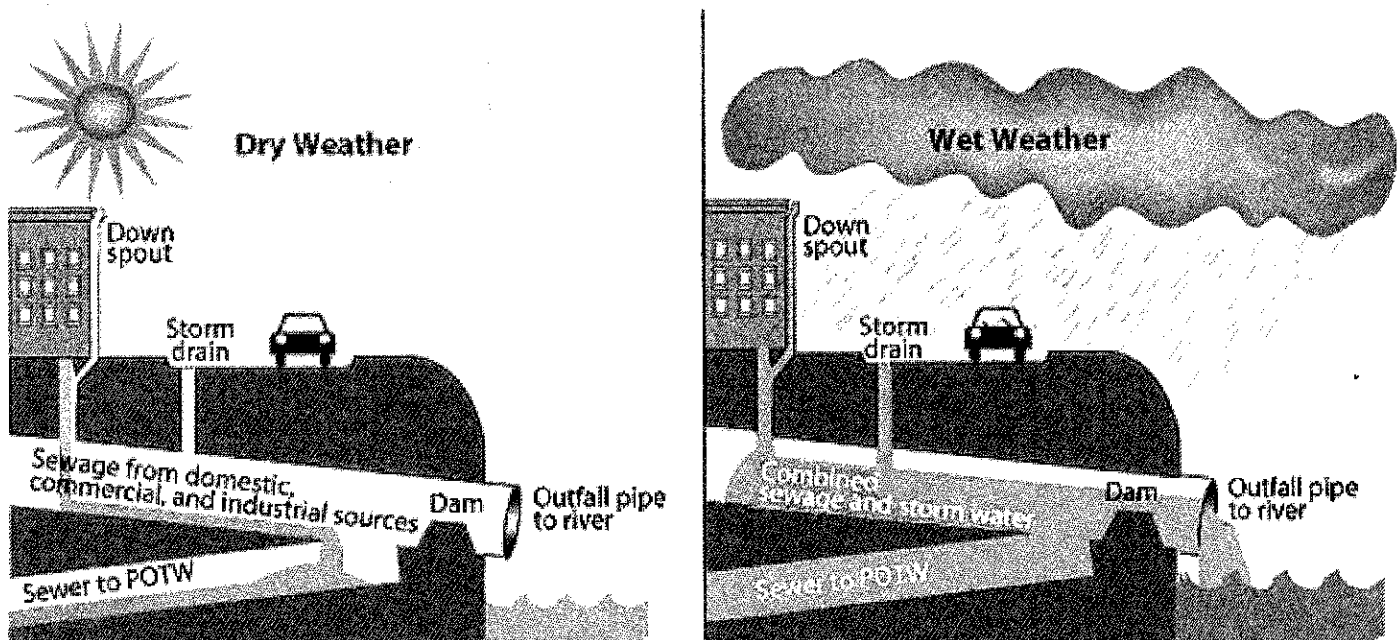
Figure 2.23 FEMA flood data.

Combined Sewer System

Flooding in Hoboken becomes a major public health concern because of the combined sewer system that exists there. "Combined Sewer Overflow (CSOs) discharge toxic materials and bacterial and viral pathogens at potentially harmful levels on the receiving water bodies. CSO's are a major pollution concern for approximately 772 cities in the U.S. that have combined sewer systems." (Delleur 568) Combined sewer systems developed in European and American cities in the early 1800s.

These systems were designed to collect and combine stormwater, raw sewage and industrial wastewater into the same pipe. The collected wastewater is then directed to a water treatment plant, where it is cleaned and discharged into a











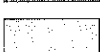


Figure 2.24 Diagram of combined sewer system.
Source EPA



nearby body of water. In Hoboken, this water body is the Hudson River. Problems arise during episodes of heavy rainfall and the combined sewer system is overwhelmed with wastewater. This wastewater will then be discharged directly into the water body without being treated, causing pollution. (Delleur 568)

Another problem with the combined sewer system in Hoboken is when the Hudson River is at high tide, six of the seven combined sewer outfall points are submerged by the river. When the outfall points are submerged the wastewater cannot discharge and the wastewater backs up into the streets causing flooding.

Keeping stormwater from entering the combined sewer system will help reduce the flooding in Hoboken. This can be done through different sustainable methods and will be discussed in Best Management Practices, page 48.

-  Hoboken
-  14VO
-  18PS
-  H
-  H1
-  H2
-  H3
-  H4
-  H5
-  H6
-  H7
-  HSI
-  HWF

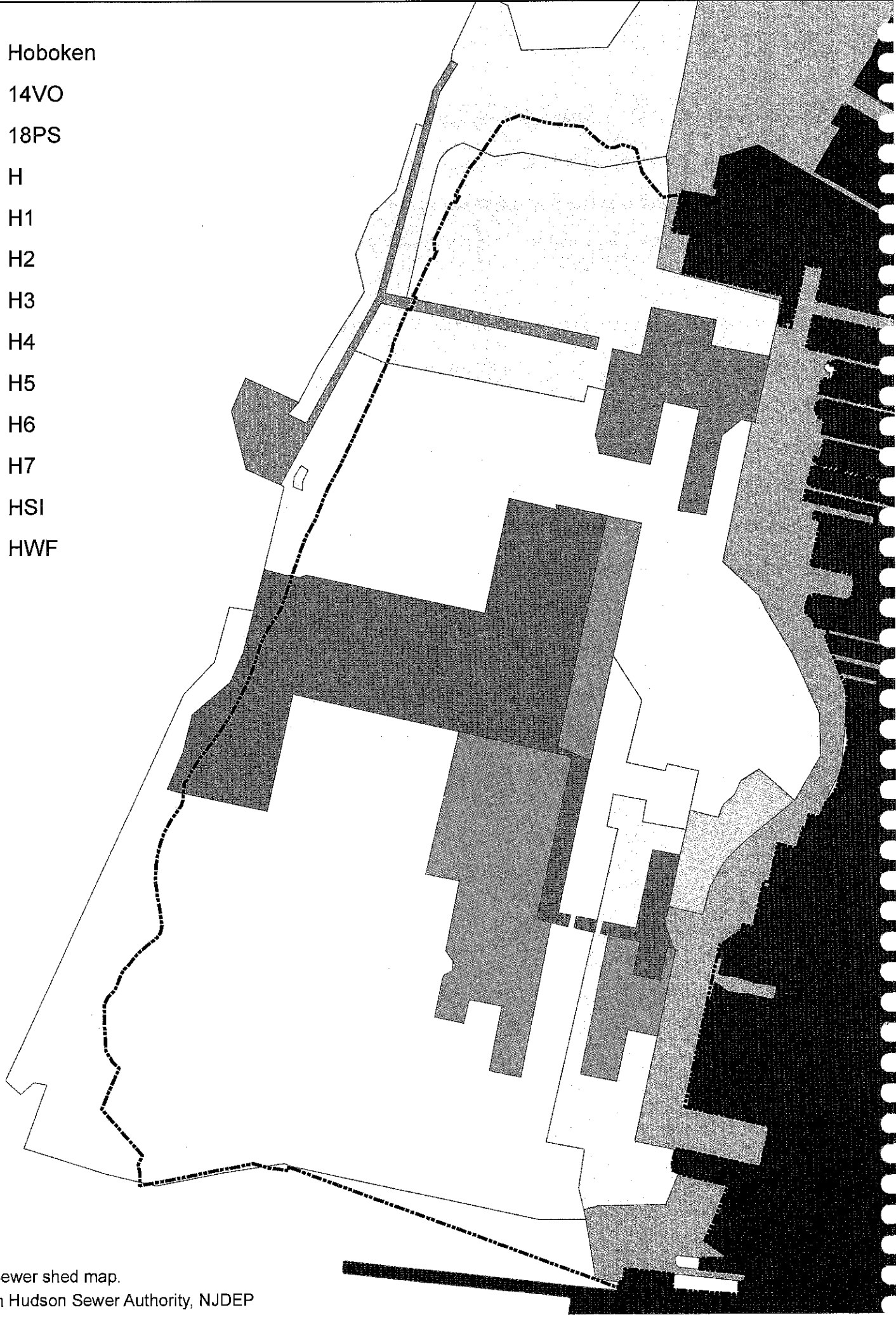


Figure 2.25 Sewer shed map.
 Source: North Hudson Sewer Authority, NJDEP

Trunk Lines

Sewer System

TYPE

Force Main

Gravity

Interceptor

Inverted Siphon

Outfall

SS

SSFm

ST

UNK

Hoboken

Road Edge

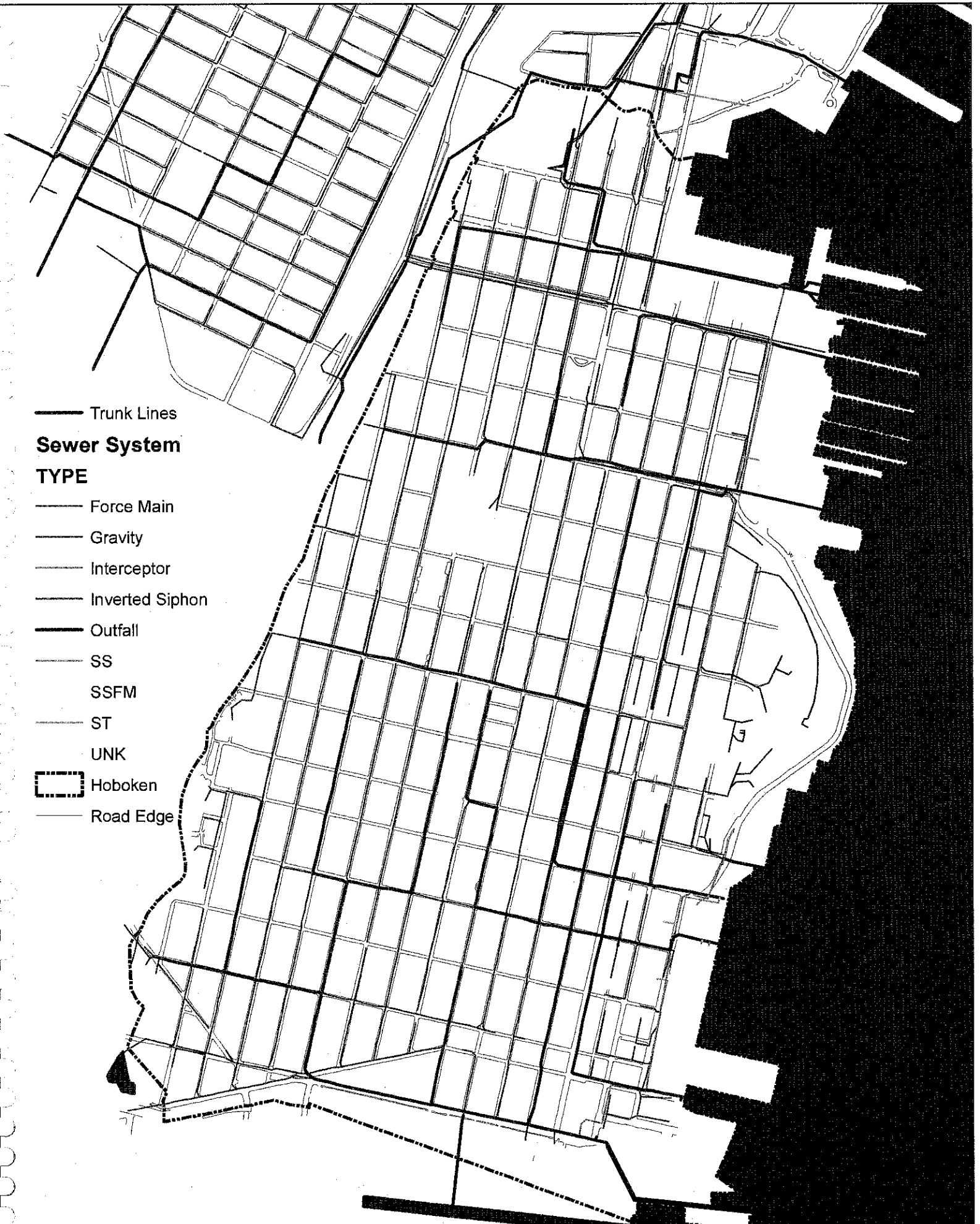


Figure 2.26 Sewer line map.

Source: North Hudson Sewer Authority, NJDEP

Hoboken Sub Watershed

A watershed analysis study was performed using a digital elevation model of the city and Arc GIS. This analysis shows how the topography of Hoboken influences the stormwater flow. The majority of Hoboken slopes east to west. At the western edge the landform rises back up to Bergen Hill. The low point of Hoboken is in the southwest section. The most frequent flooding occurs in this section because of the natural water flow into it seen in the watershed map.

Figure 2.27 Topography.

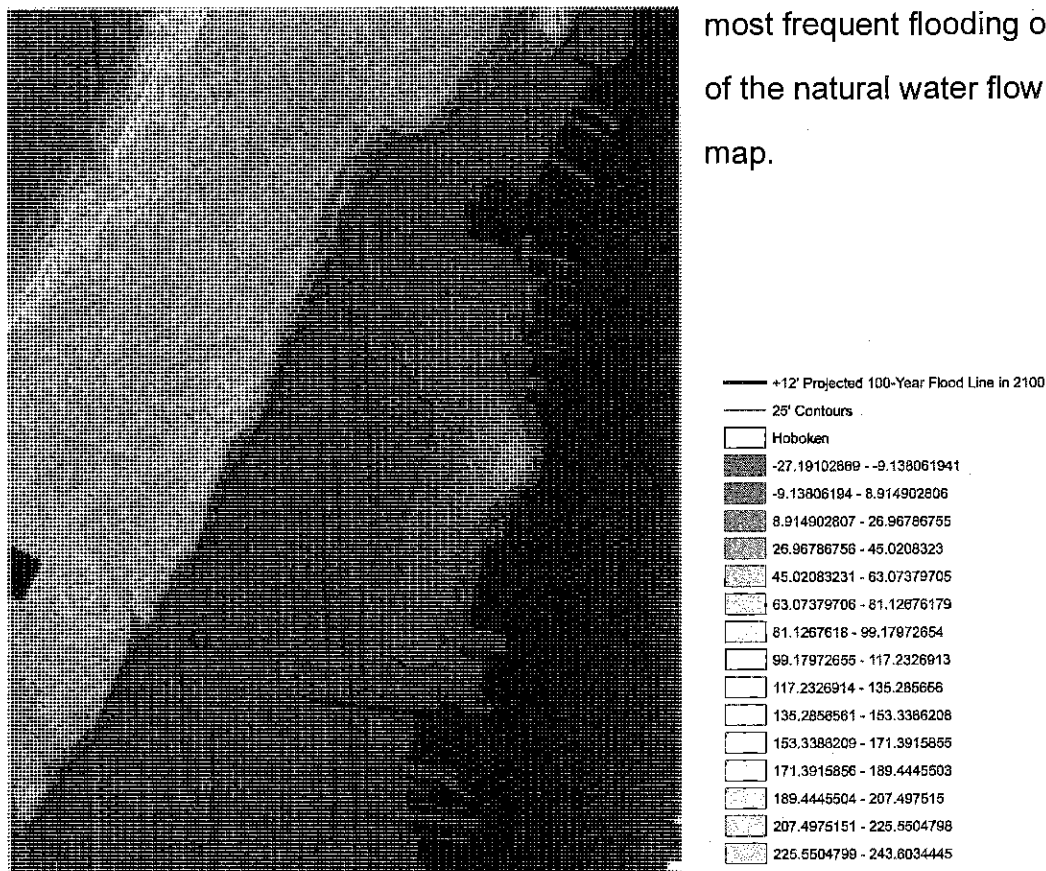
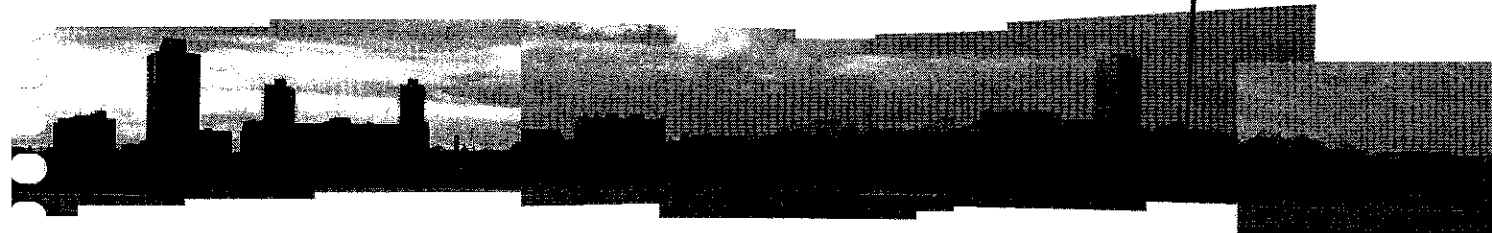


Figure 2.29 View of Hoboken from New York City.



Figure 2.28 Stormwater flow.

castle point



Design Theories and Literature Review

Infrastructural Landscapes: Methodology to Design

“Infrastructure: the basic physical and organizational structures and facilities (e.g. buildings, roads, and power supplies) needed for the operation of a society or enterprise.” (Oxford Dictionary)

Infrastructural landscape, “proposes an expanded operating system for contemporary cities where the full complexity of biodynamic processes and resources are visualized and deployed across the full footprint of urbanism and the life cycles of infrastructure.” (Belanger 2011) These working landscapes have relatively few boundaries and



Figure 3.1 View of Light rail, Vacant and Residential

contain systems which work together to provide functions for the urban environment and public space to experience the urban landscape. Thinking about definition of infrastructure one sees how ecological functions and open space can also fall into the category of infrastructure because of society's need for these to function correctly within our cities for healthy living.

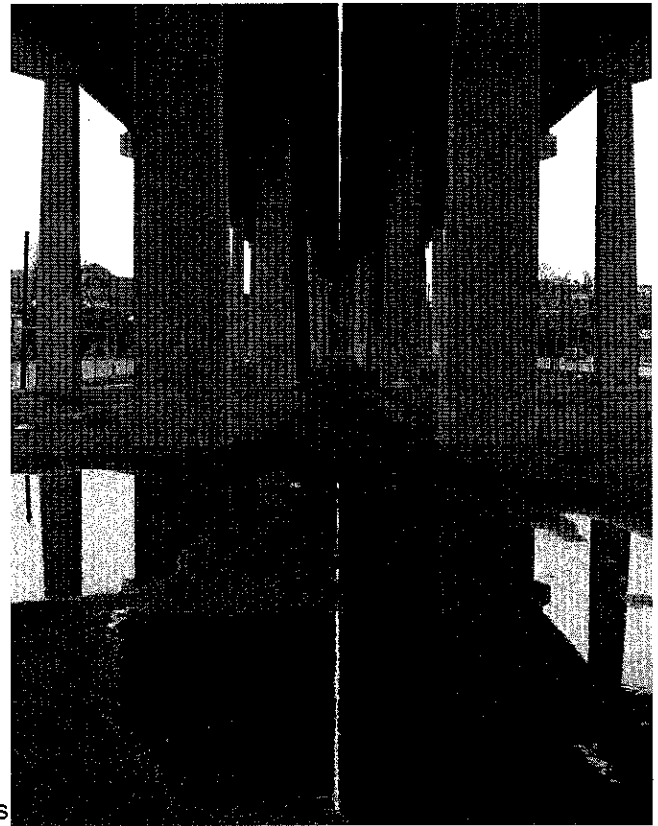


Figure 3.2 Overpass

Figure 3.3 Infrastructures





Figure 3.4 Washington Street, Hoboken.



Figure 3.5 Pier A Park, Hoboken.



Figure 3.6 Light Rail Station, Hoboken.

Our cities are planned by design professionals to function in a clear and orderly way. Downtown sections contain stores and businesses for commerce; parks and open space are used for recreation; roads and train corridors are used for transportation. “Building the city that is intended to be efficient with clearly designated and segregated usually results in many leftover spaces without planned uses, including areas near or under highways, bridges and overpasses. Also, as industries move out of cities, land becomes vacant.” (Hauck 117) Reclaimed spaces on the fringe of existing infrastructure or the spaces in-between are areas with potential of becoming more than prosaic landscapes and becoming landscape with value to the community they serve. “These reclaimed spaces, however, are more than just stop gap measures resulting from a lack of better places. Users have discovered aesthetic and functional potential in these condemned spaces, which they continue to activate for their own purposes. Such spaces are attractive for their users because the user defines what these spaces are good for.” (Hauck 15) The spaces created by infrastructure offer a different urban experience than the traditional urban park. These space need the correct program assigned to them to succeed in the city or neighborhood they exist in.

Urban Stormwater and Flooding

Urban Condition



Figure 4.1 1950 Flooding Hoboken.
Source: Hoboken Historical Museum.

The urban environment and development of impervious landscapes create challenges for stormwater management. The natural water cycle has been devastated by development and hard engineered solutions such as Hoboken's combined sewer systems. Stormwater no longer flows through natural surfaces, absorbed and slowed by plants and soils. Instead it is designed to flow as fast as possible off a surface, into a drain, then a pipe and outfall downstream into a river or ocean to become somebody else's problem. "The displacement of open land by impervious surface of streets, driveways and buildings will intensify rainfall runoff. This will not only increase the risk of flooding but will also threaten water resources through pollutants transported from impervious surfaces." (Hermly 224)

Flexible or softer stormwater systems offer an ecological based framework that reproduces the natural process of the area before urbanization. A softer system of plants and soil slows and treats stormwater before entering the sewer system and pipe and rapidly discharged into an end of pipe solution, usually a river.

The overall surface condition of Hoboken's

urban landscape places pressure on the combined sewer system by the connectivity of impervious surface to it. During any rain event, 90-95% of the stormwater reaching Hoboken will be directed into the sewer system then into the Hudson River. (EmNet Report 2011) There is not enough green or pervious space to absorb the stormwater. “The effect of disconnecting impervious areas from a combined sewer in favour of a new open rainfall management (including open channels, ponds and green roofs) found that it not only improved stormwater management in the area, but also the performance of the combined sewer system that serves the surrounding area.” (Hermy 224)

Best Management Practices

Best Management Practices (BMPs) are way alternative ways of dealing with stormwater off of a developed site. “Schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the United States, BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.” (EPA) BMPs for stormwater management are designed to improve water quality by reducing stormwater flow during large storm events.

Figure 4.2 Constructed wetland. Philadelphia, Pa



Stormwater System Interventions : Green Infrastructure

Collection – stormwater can be collected in tanks from a roof or another impervious surface and stored for later use.

Bio-swale – is designed to slow, absorb and infiltrate stormwater from minor floods through the use of different plants and soils. Can be used along streets and parking lots to prevent stormwater from entering the sewer system.

Constructed Wetlands – are large shallow areas where stormwater collects and is temporarily stored. These systems are heavily planted with wetland species and allow sediment and pollutants to settle at the bottom, filtering the water. These areas offer high aesthetic values to the surrounding community.

Green Roofs – are installed on the top of a building and consist of different layers. A green or planted layer and a drainage layer. Water is absorbed by designed soils and plants; the excess will flow off. Street trees with soil volume channel – help slow and store stormwater from the adjacent street. Keeps stormwater from entering the sewer and reduces

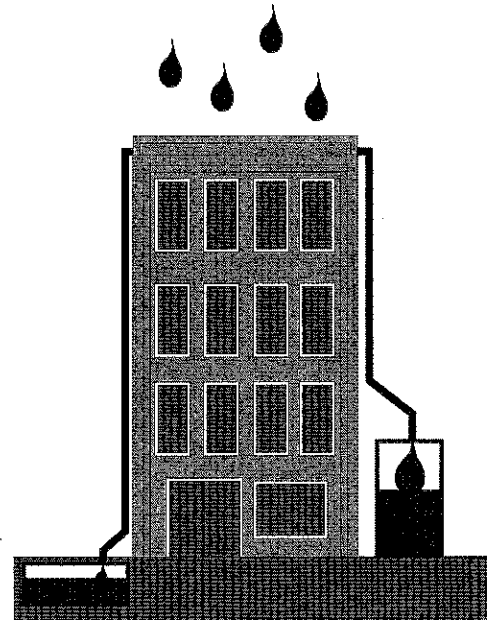


Figure 4.3 Stormwater collection

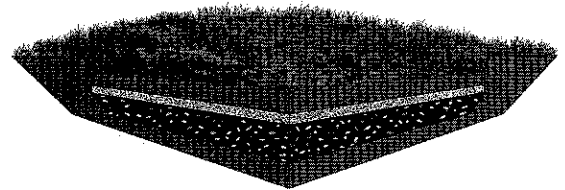


Figure 4.4 Bio-swale



47 Figure 4.5 ASLA Green Roof

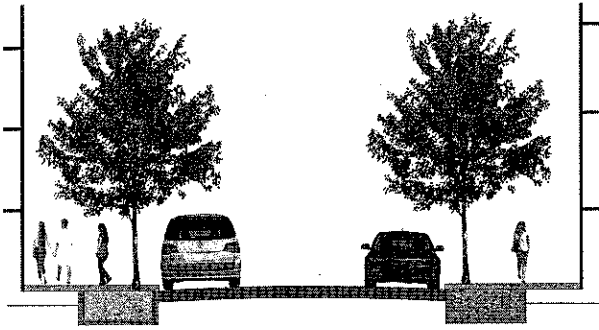


Figure 4.6 Street trees with permeable paving

pressure on a sewer system.

Vertical green walls or planters – Slows stormwater that is coming off a roof on its way down to street level.

Permeable Paving - Allows stormwater to infiltrate through a paved surface and help recharge ground water

Polder – a low lying parcel of land that is surrounded by dykes or walls for temporary stormwater storage. After the rain event has stopped, stormwater can slowly be released back into the environment

Soft shore line – Used instead of a bulkhead or wall to slow storm surge from entering a city.

Oysters – These creatures naturally create reefs that help protect land from oncoming storm surge.

Waterfront Parks – Usually provide ample impervious surface and plants to help slow, absorb and infiltrate stormwater.

Surge walls - are designed to keep ocean or river water from a large

Pumps – Use electricity to pump excess surface stormwater to an adjacent water body or storage facility.

Sewer – Traditional stormwater management where water runs off a surface into a pipe. The stormwater is then delivered to the nearest water body (river, stream, lake or ocean) as fast as possible to avoid back up from other locations.

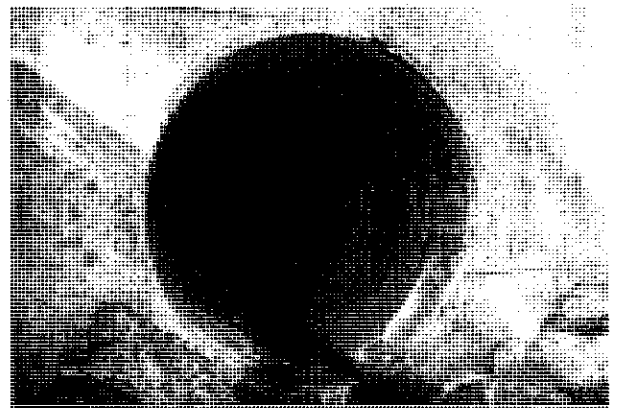


Figure 4.3 Sewer Outfall.

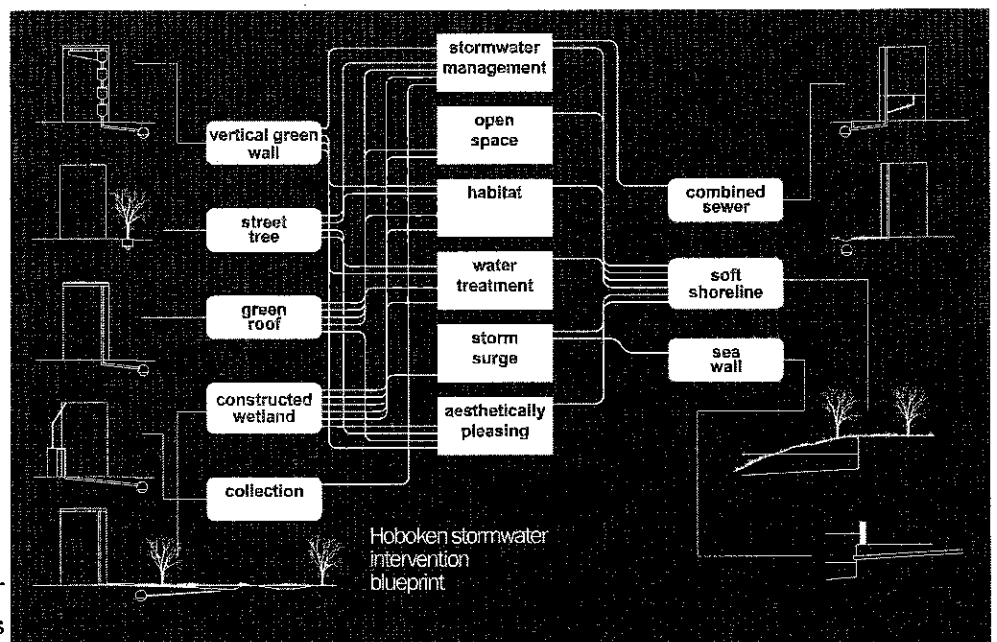


Figure 4.3 Stormwater Interventions

Design Research

Site Description

The design proposal will focus on the areas located on the western edge of Hoboken. Stormwater flooding occurs most frequently in this area of the city. Development is on the rise in this part of town and no valuable open space has been created to offset the development. Existing conditions show a very urban landscape; mostly off-street parking, vacant land and industrialized. Stormwater interventions and open space will reduce the flooding frequency and take pressure off the aging sewer infrastructure. This design proposal investigates ways to protect Hoboken from flooding from medium to large rain events, not from storm surge due to large hurricanes.

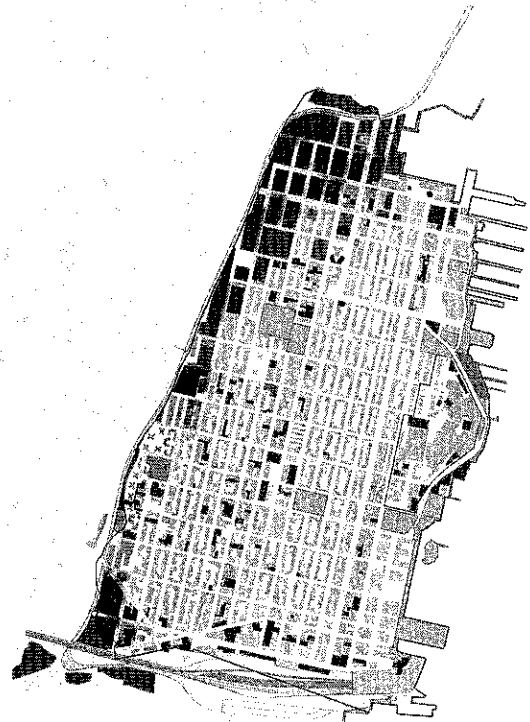
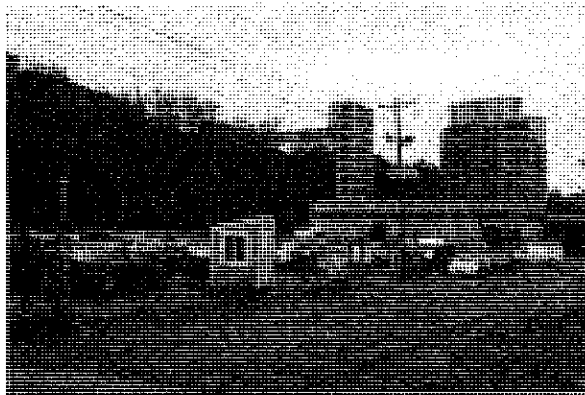
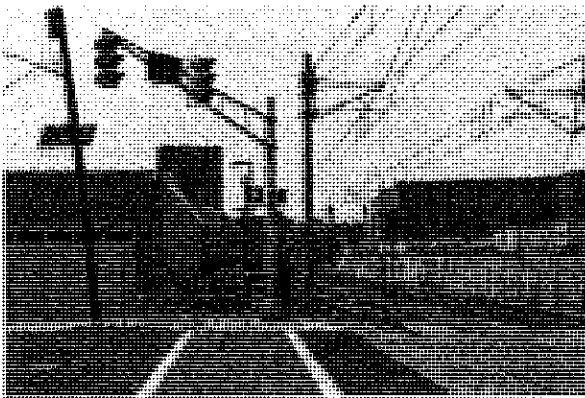
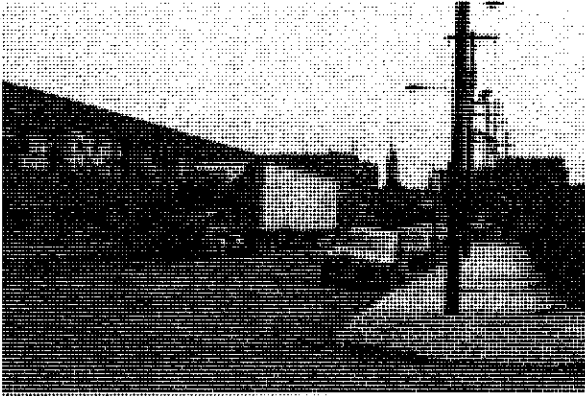
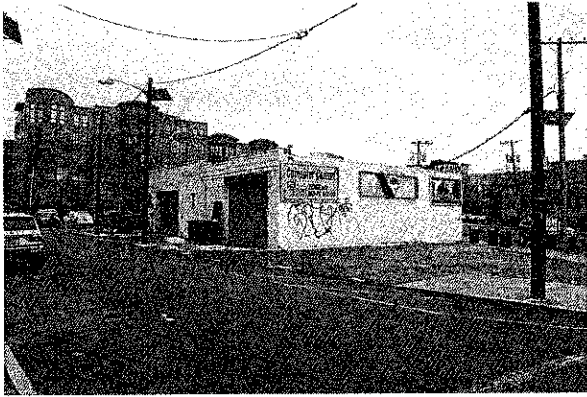




Figure 5.2 Western edge, Hoboken. Source: Google Maps



Design Proposal

The design interventions use the spaces in-between or left over spaces created by past urban planning and changing land use to create a framework for stormwater infrastructure and a pedestrian circulation system that incorporates historical wetland traces of the city. The historical research and existing conditions has shown why Hoboken has a significant flooding problem. This research can be applied to help frame the future design interventions in an attempt to relieve the flooding problems of the western edge. The stormwater interventions will be based on the research from urban stormwater BMPs.



West Hoboken Design Goals:

- Reclaim space for ecological stormwater management
- Disconnect impervious surface
- Reduce the time it takes for stormwater to enter the existing combined sewer system
- Create an open space network/linear park system for future development of Hoboken's landscape
- Use plant species for their phytoremediation abilities
- Increase public engagement with the landscape and natural processes, mainly flooding



- Create a richer experience for commuters in western Hoboken

The reclamation of land on the western edge of Hoboken is an important design facilitation to make space for stormwater interventions. The existing land use analysis has shown that this part of the city offers the largest available parcels of land. These large parcels are important in reducing the amount of impervious surface that dominates the urban landscape of Hoboken. “The creation of more green areas is also an answer to the recent calls for a more ecological and greener urbanization.” (Hermly 218) Redevelopment of the spaces in-between for future stormwater interventions that allow public access will be important in mitigating the flooding issues in the western section of Hoboken.

The disconnection of impervious surfaces by adding spaces which allow for stormwater infiltration or collection will have a significant impact on slowing stormwater from entering Hoboken’s combined sewer system. This can be done through small or large scale stormwater interventions.

Reducing the amount of stormwater entering a sewer system will reduce the frequency of flooding. Using different ecological stormwater interventions will slow and absorb stormwater, reducing the time

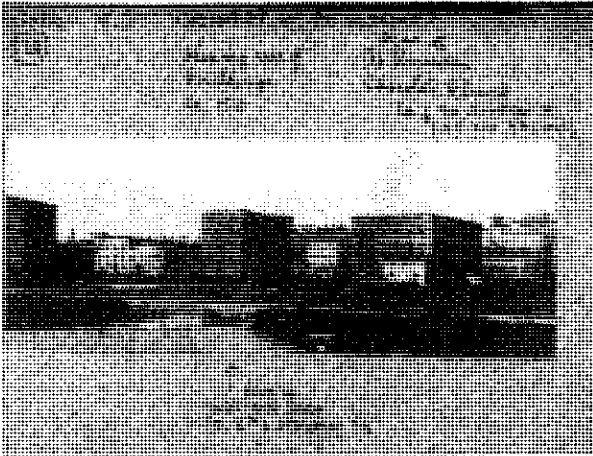


Figure 5.3 Western Edge, Hoboken. 1909
Source: Rutgers University Community Repository



Figure 5.4 Western Edge, Hoboken. 1908
Source: Rutgers University Community Repository

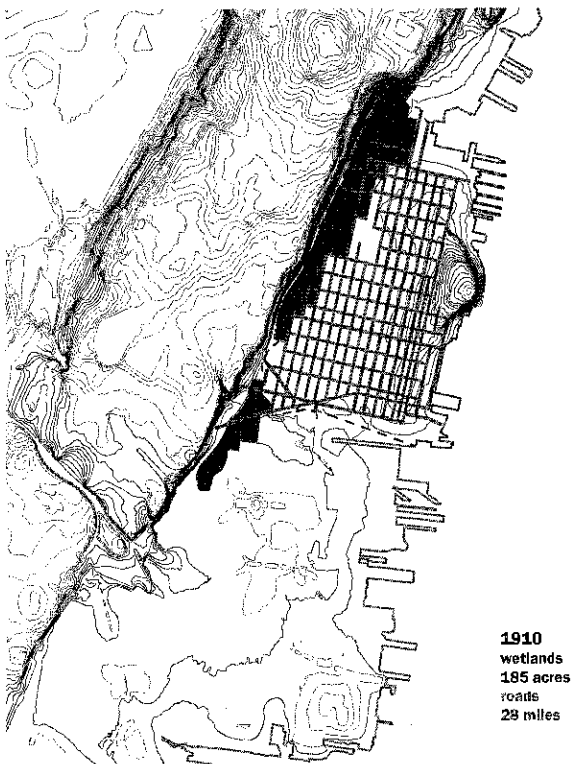


Figure 5.5 1910 Wetlands

of concentration which in turn reduces runoff. This design approach will be important for shaping the overall concept for the western edge of Hoboken.

An open space network with different areas of stormwater intervention will create a linear network that will slow and absorb stormwater comparable to a massive planted sponge. This linear network of drainage solutions will be analogous of the historic Hoboken creek that once flowed over the western edge of Hoboken.

Increasing public engagement with the urban landscape will create value and a sense of place. The stormwater interventions proposed serve to reconnect the people with the water which once flowed through this landscape and is now buried beneath the city. Enhancing the public's understanding of stormwater management can help to promote civic motivation to develop stormwater improvement strategies.

Conceptual Plan

The conceptual plan evaluates the existing land use and begins to reclaim spaces for the stormwater interventions most appropriate to the City of Hoboken. The conceptual form and linear spatial planning are influenced by the historical analysis and assessment of the land "reclaimed" from wetlands before the 1900's. The concept and the space on the western

edge will once again reclaim landscape but this time it is for creating a rain terrain not land to develop. The plan for the space on the western edge of Hoboken will reclaim landscape that was wetlands around 1910 and reform the land to be used for water management to prevent flooding and promote pedestrian access. The proposed green space runs the length of the western edge of Hoboken and is connected to the existing waterfront park system at both the north and south edges of Hoboken. The largest spaces will be used for stormwater flood plains. These spaces are designed to flood and will have the greatest impact on preventing the flow of stormwater into the combined sewer system, reducing pressure and allowing stormwater from highly developed areas to enter the sewer system.

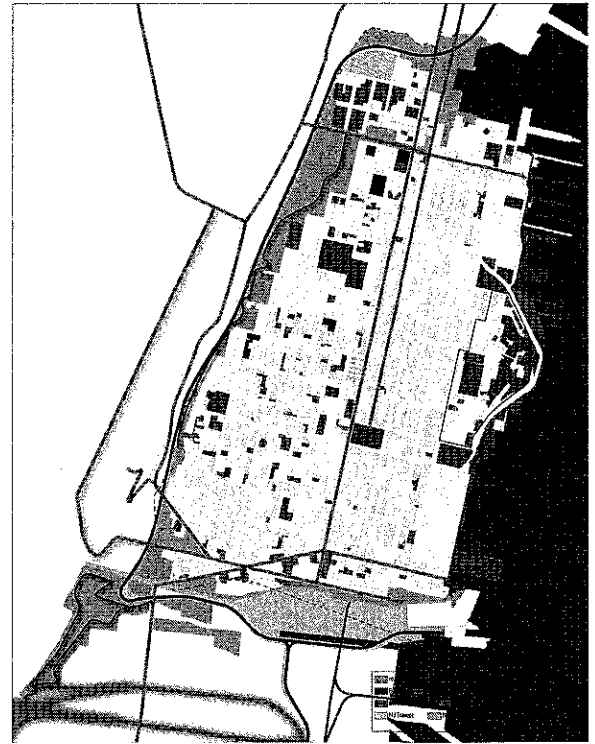


Figure 5.6 Reclaimed land

Park Typologies: Creating a Rain Terrain

The different park typologies are based on creating different ecologies within the space but connected to the overall network. Topography and the urban fabric of Hoboken influence where the different typologies are proposed within the reclaimed land.

Urban Forest: Trees play an important role in improving water quality. Their leaves slow rain water from reaching the ground and their roots absorb stormwater. The proposed urban forests will be developed on the western edge and connect to the existing forest on Bergen Hill.

Urban Park: Primary these parks will be used as social spaces for the residents of Hoboken. Design with BMPs they help in reducing overall stormwater volumes.

Wetland Park: These spaces will inhabit the lowest areas of Hoboken where flooding issues are the worst. They will primarily be planted with different species of grasses for maximum water uptake and habitat creation. Wetland parks will offer the residents of Hoboken a places to stroll and interact with an urban ecology.

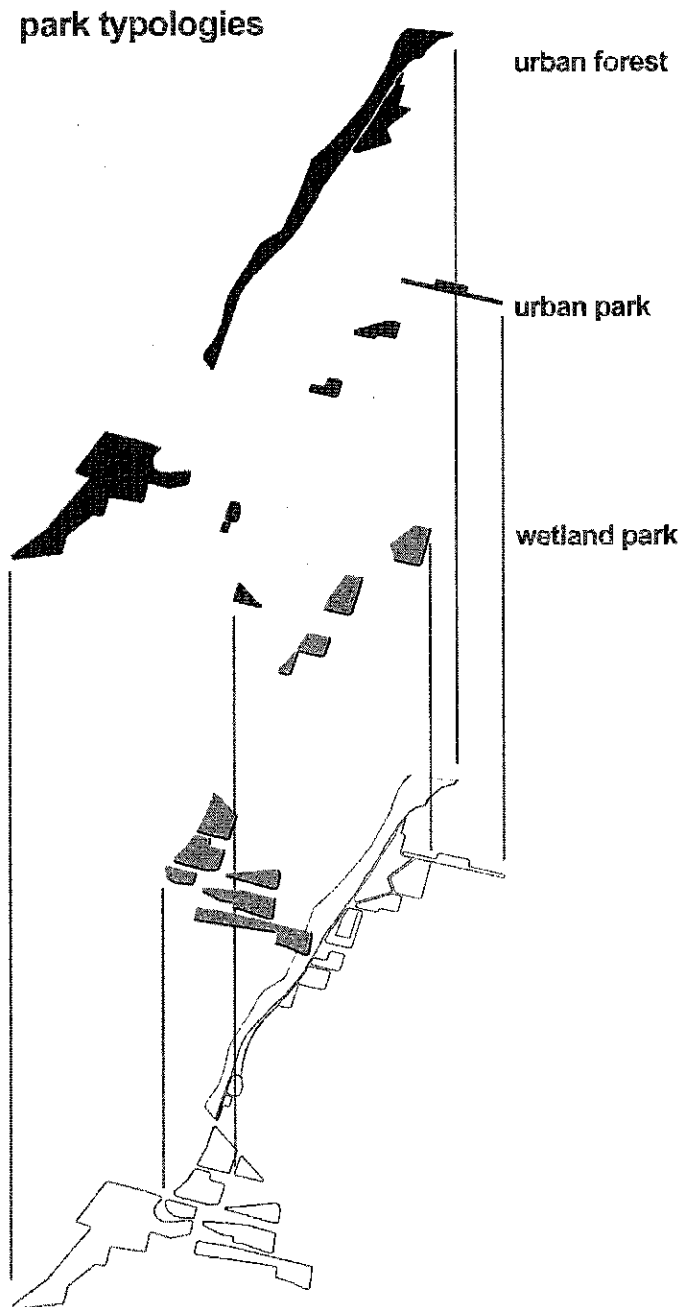


Figure 5.6 Park typologies

Figure 5.7 Conceptual Plan

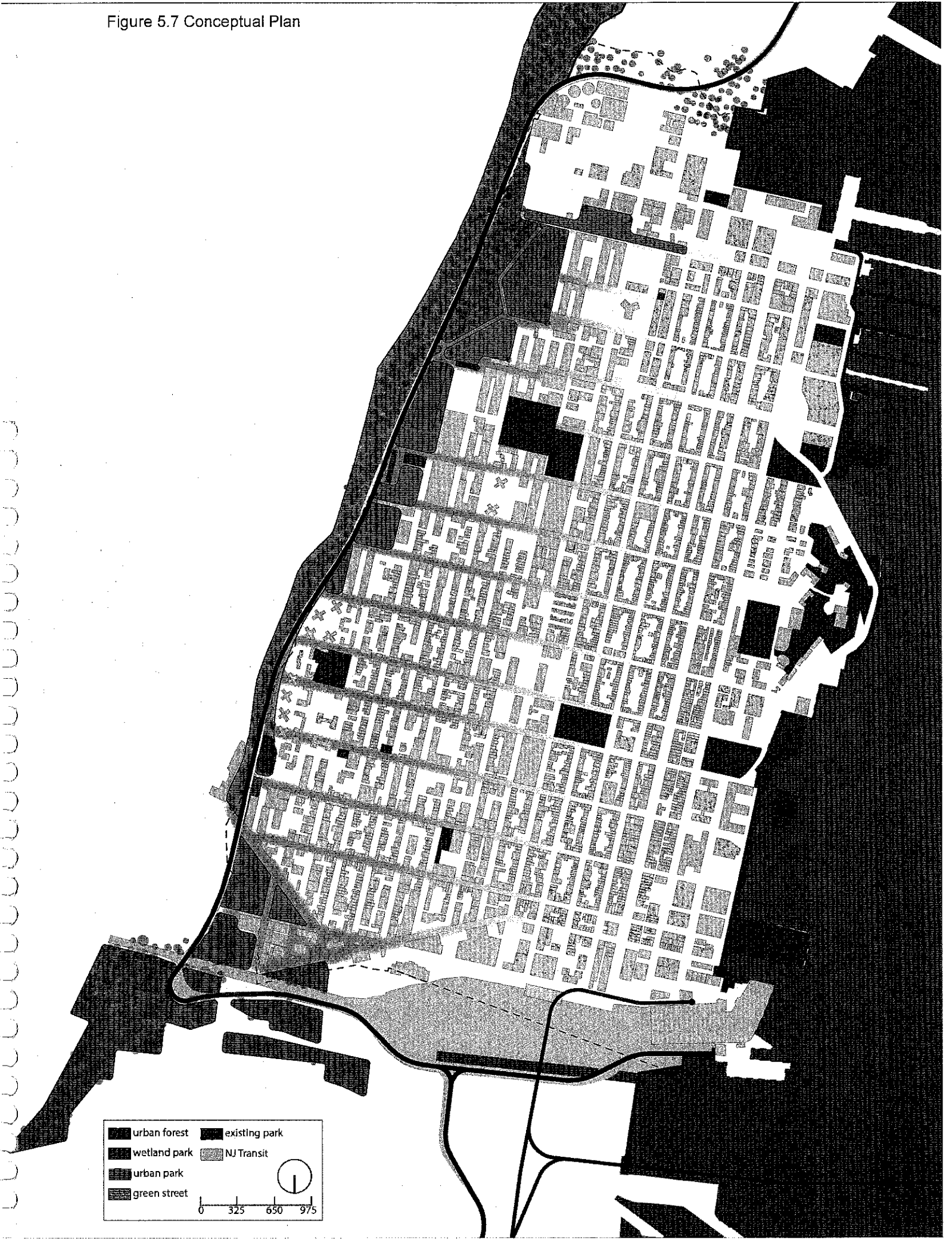
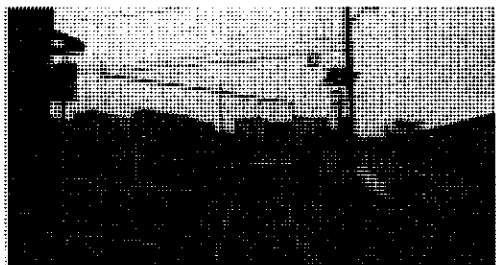
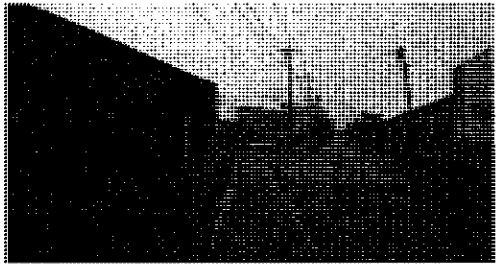
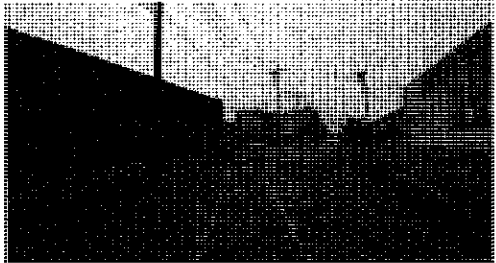
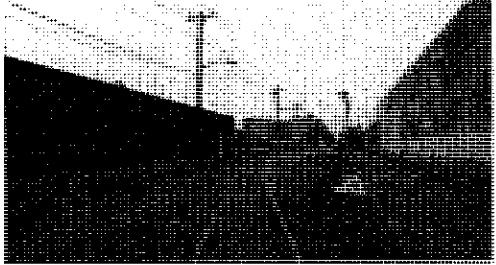
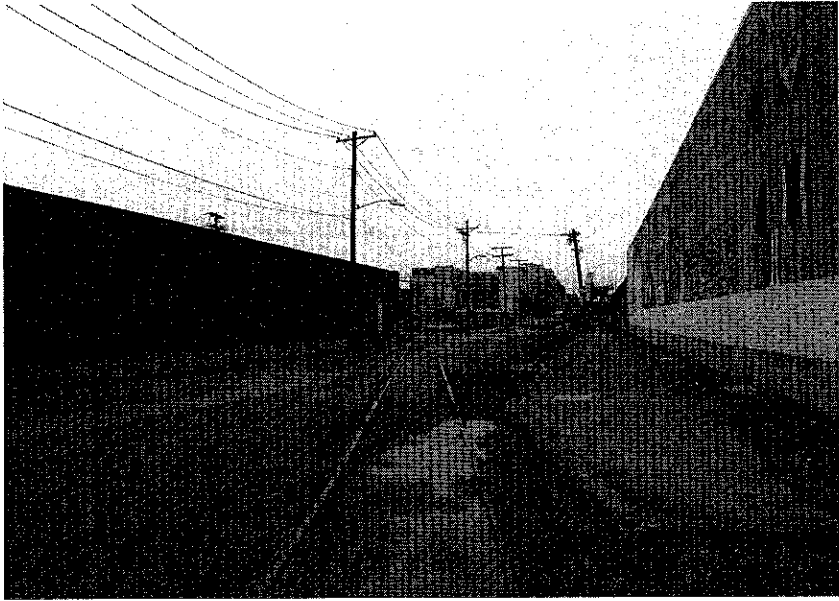


Figure 5.8 Reclaimed street.

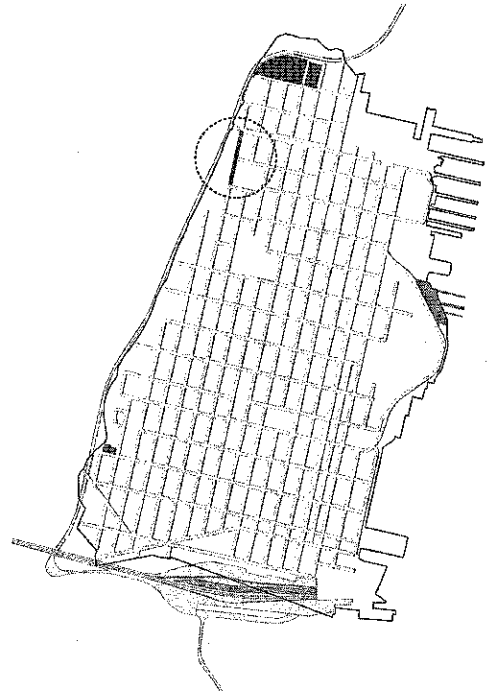


**new public
access**

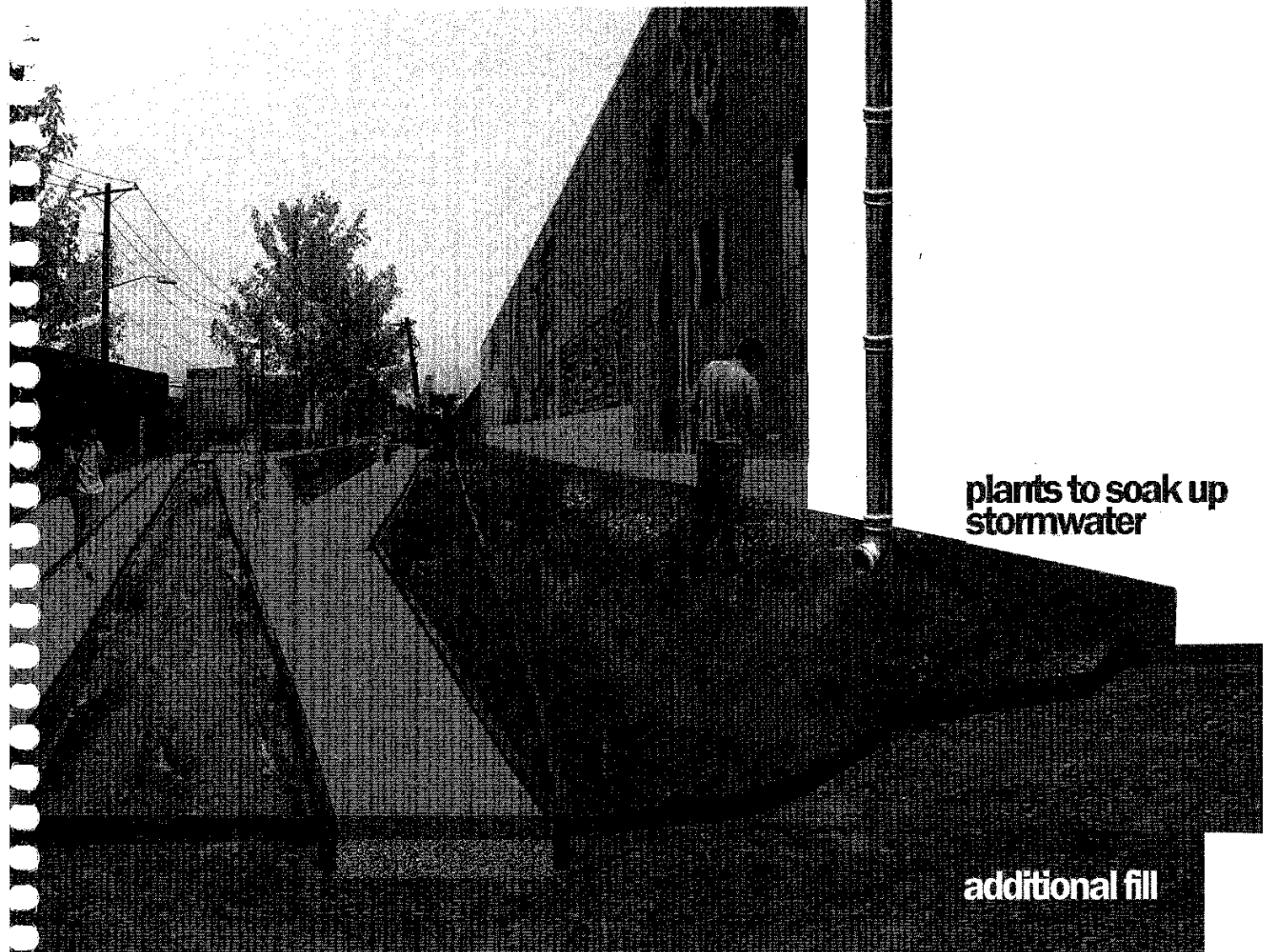
Proposed Interventions

Madison between 12th and 14th

Reclaiming Madison Street between 12th and 14th allows a deteriorating street to continue the open space network in the western portion of Hoboken without purchasing private property. Designed soils are added to the edges of streets and planted to soak up stormwater from adjacent buildings. The existing buildings act as retaining walls for the added soil.



reclaimed street



**plants to soak up
stormwater**

additional fill

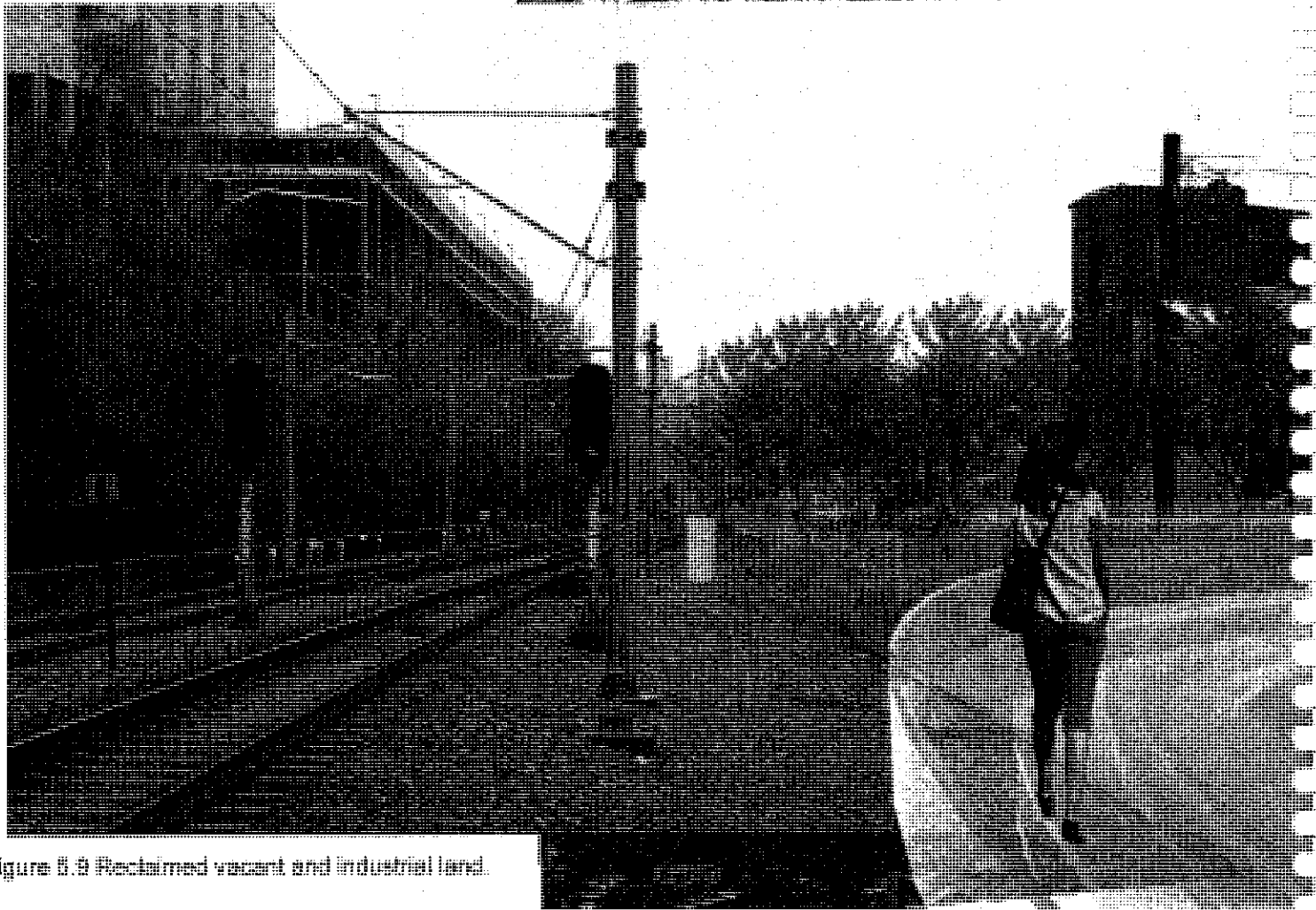
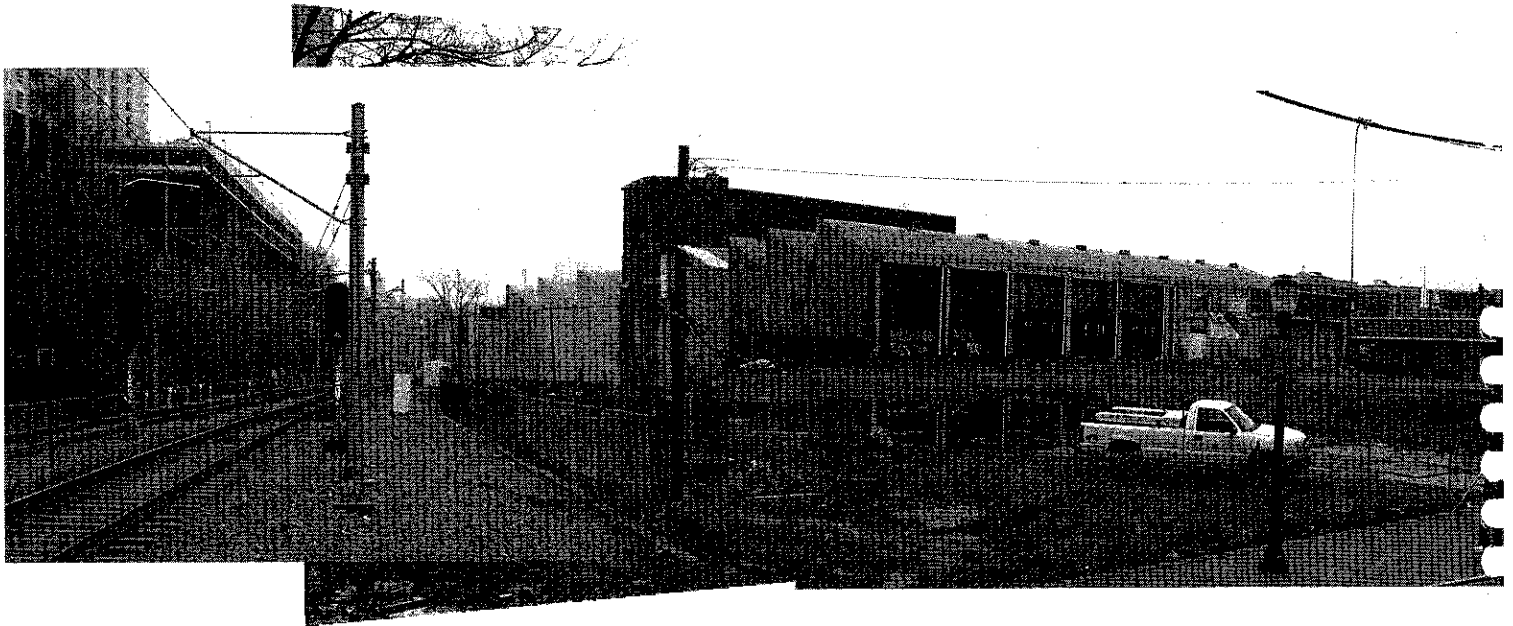
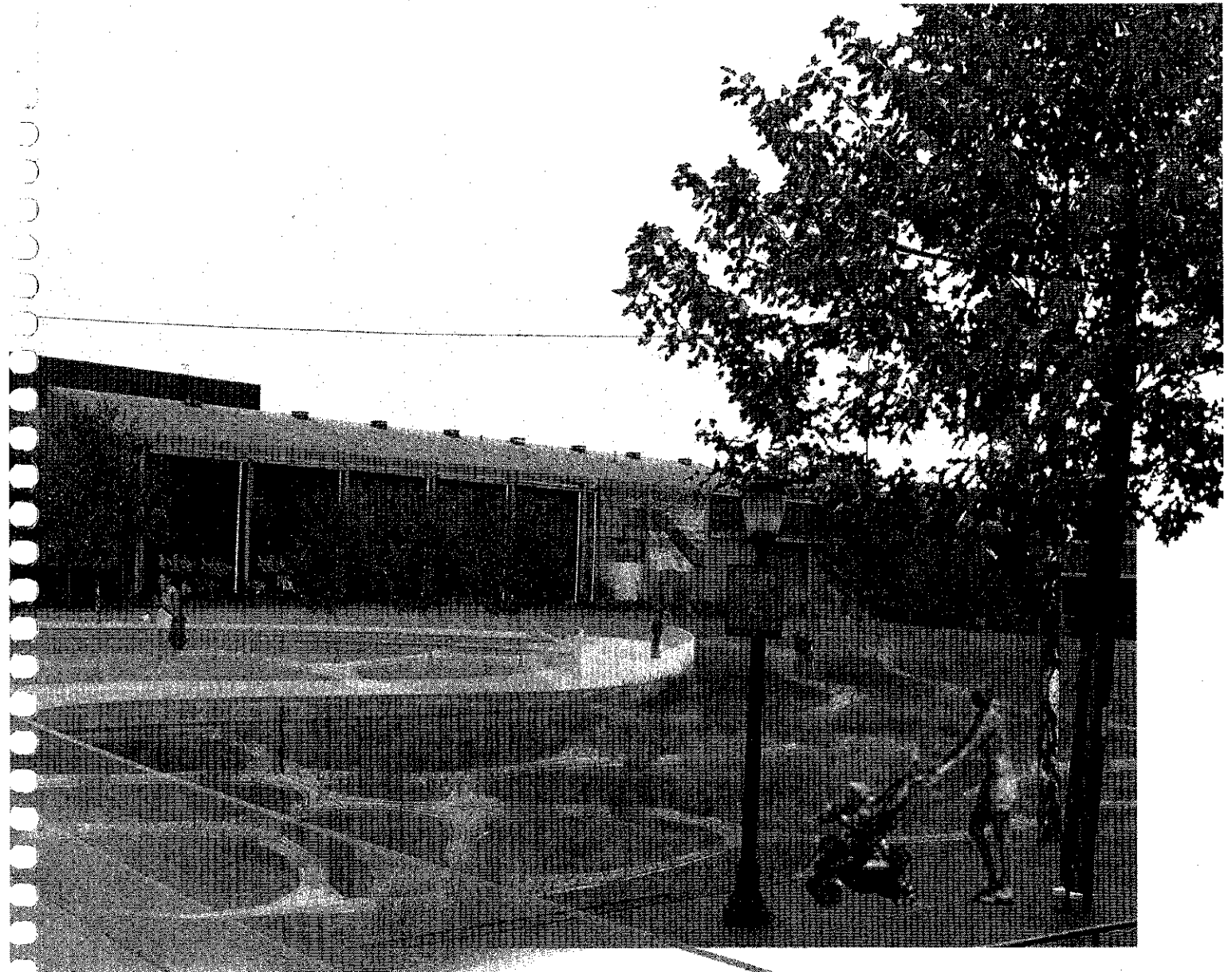
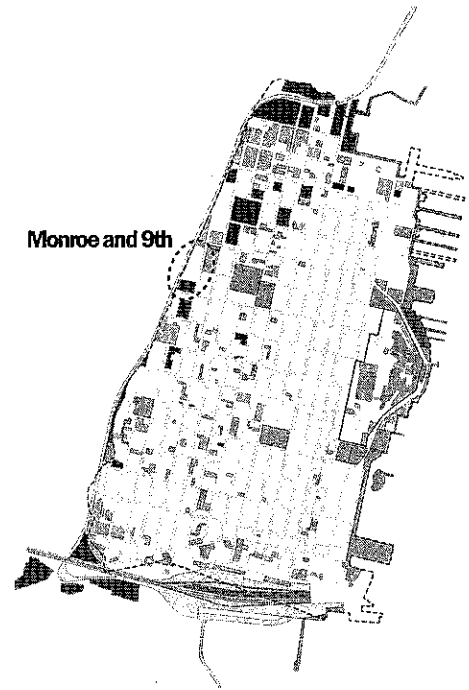


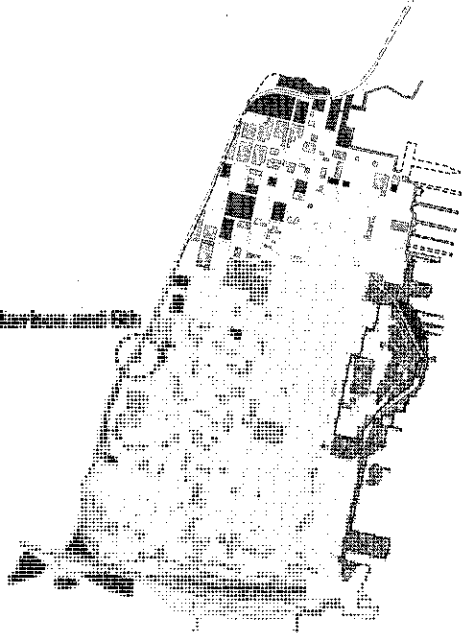
Figure 6.9 Reclaimed vacant and industrial land.

Monroe and 9th

Using vacant land on the western edge, the intervention allows reclaimed land to become a surface to absorb and slow stormwater. The boardwalk running through the space connects to the 9th street Light Rail Station. The board walk is influenced by the plank roads that ran through this section of Hoboken before the tidal marshes were filled in.



Harrison and 6th

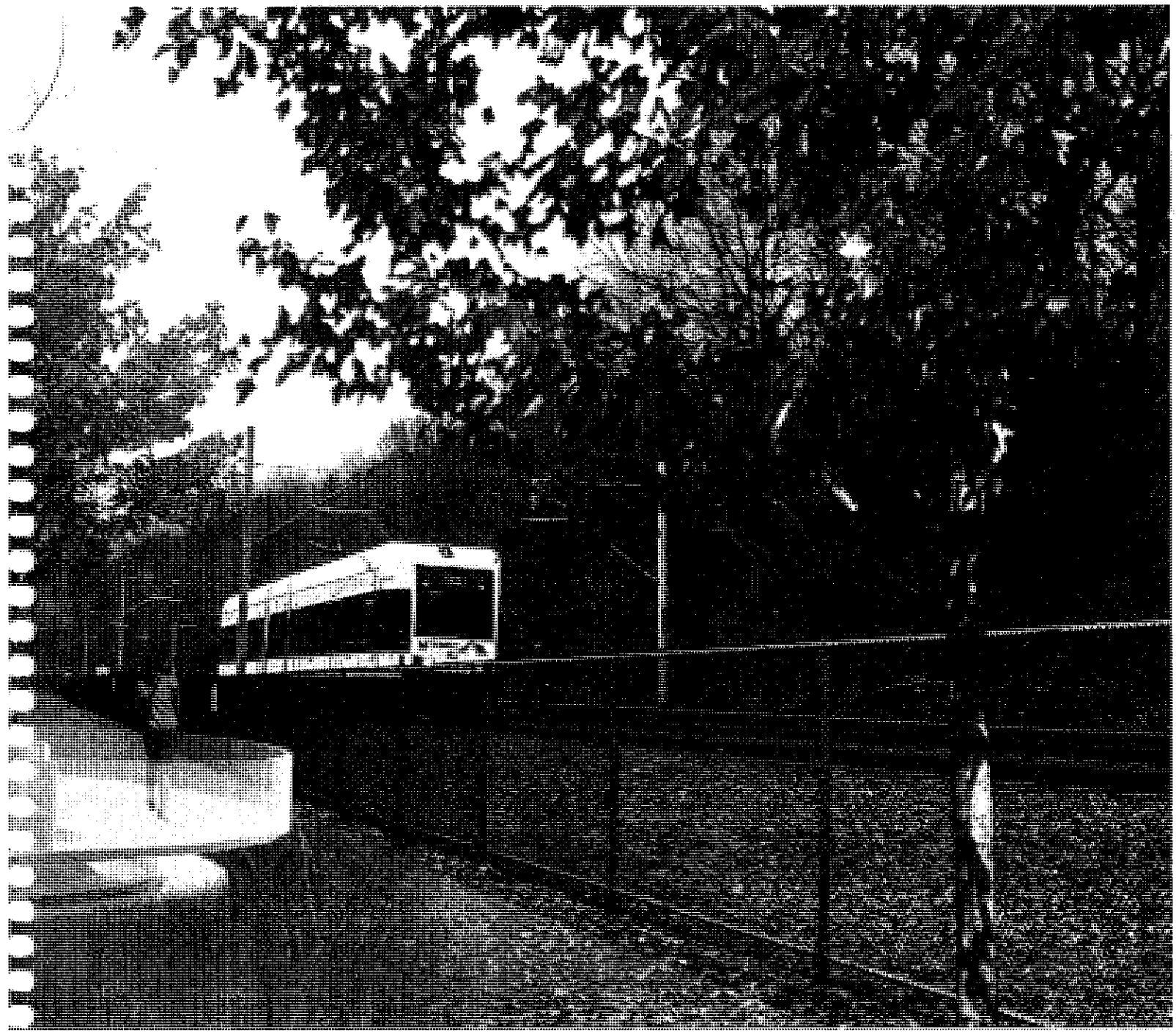


Harrison and 6th

This area offers a vacant space next to residential housing for stormwater concentration. To help with reducing impervious surface runoff, Harrison street has been reclaimed allowing the area to have a more significant role in stormwater absorption.

Figure 5.10 Reclaimed vacant land.





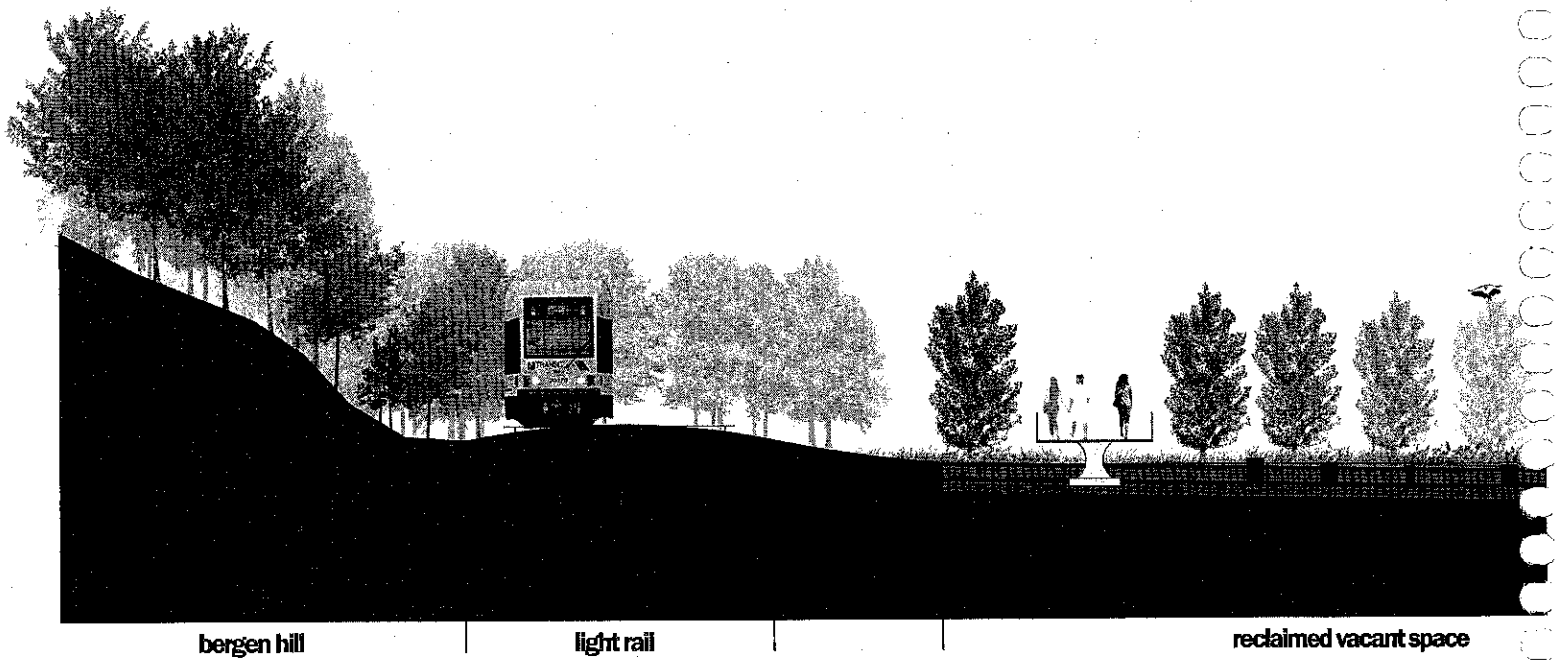
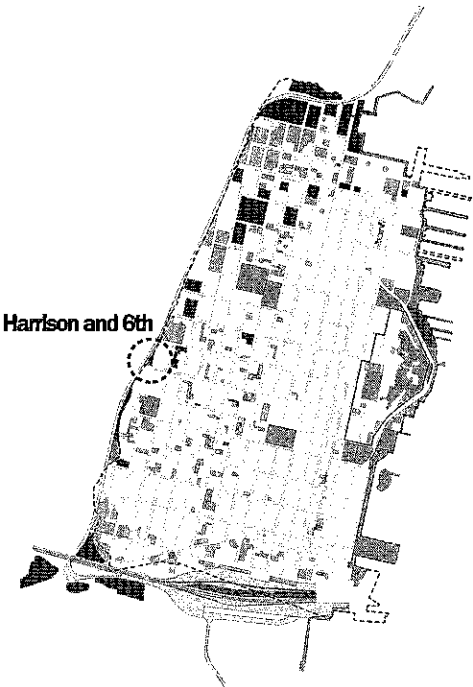
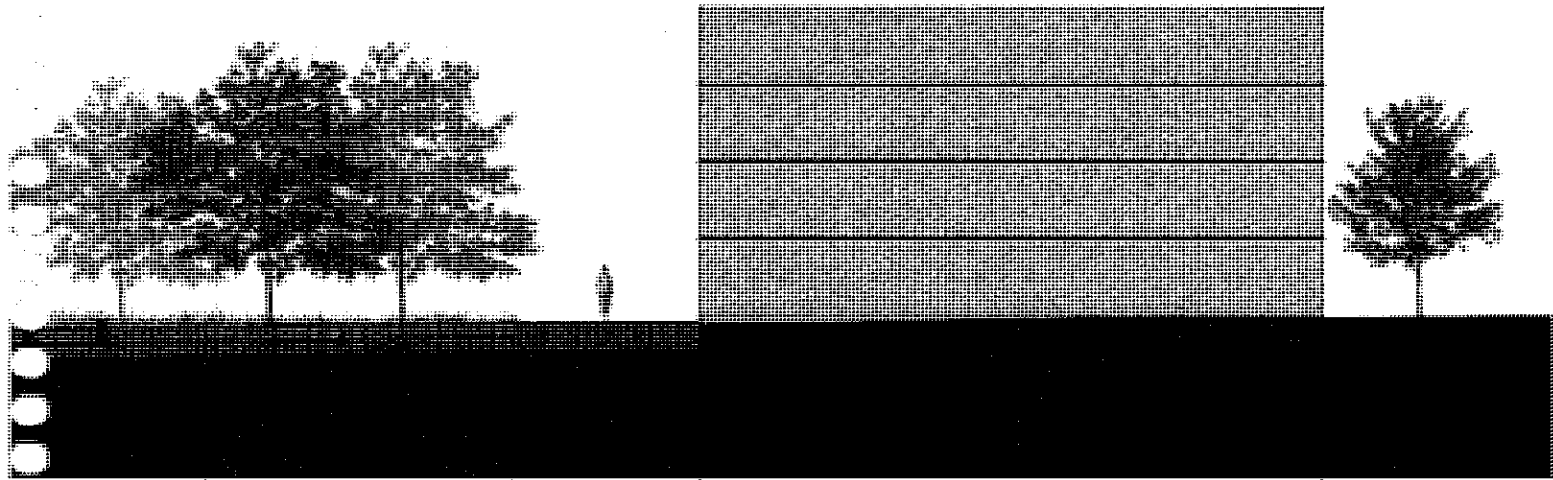


Figure 5.11 Reclaimed vacant land.



Harrison and 6th



reclaimed side street

existing sidewalk

residential building

Conclusion

As the environment changes and rain events come more frequently, urban flooding will continue to increase. Design has given us a palette of different stormwater interventions to work with that show potential for decreasing volume of stormwater flows. Now is the time to release these interventions on the full scale of the urban environment. Designing these different interventions within the landscape that allows the human experience to be heightened and engage the water, not pipe the water under our feet and out of sight.

These different design interventions offer a wide range of different user experience while moving through the urban landscape. From large urban forests where stormwater is absorbed by many different plants to small urban parks that focus on collection and reuse of water. Stormwater management and public space working together have a lot to offer Hoboken's built environment.

Addendum

Rebuilding after Sandy: A Call to “Design with Nature”

Hurricane Sandy ravaged New Jersey and New York on October 29, 2012. The vast devastation will be extremely hard for people to forget. Even so, we are very resilient; we will rebuild and move on with our lives. I am one of the millions affected by Sandy, luckily there was no damage to my home but I was without power for more than ten days and forced to relocate. Some of my closest friends weren't as lucky and I want them to really think about how and where they rebuild.

Year after year the storms on the east coast get larger and cause more damage with longer periods of restoration required. People lose power, water, heat, and property but, we rebuild. Towns and cities lose infrastructure, but we rebuild and move on with our lives just to face another devastating storm. Is this the proper course of action? I am suggesting we step back and really thinking before we rebuild the same way. After “Super-Storm Sandy” we have to re-imagine the way we engineer our infrastructure and use our land. Traditional methods (end of pipe engineering) are not standing up to sea level rise and larger storm systems.

Landscape architects have been thinking about this for years. My hope is that Sandy will be the event that changes the way we actually develop and re-develop our land. The New Jersey coastline was almost completely destroyed by Sandy. Landscape architects, architects, engineers and planners should be looking back to resources that may have forgotten and draw influence from them when considering re-development of our built environments following this extremely destructive storm.

In Ian McHarg's “Design with Nature,” one appreciates a way to design with nature and use natural processes as part of our infrastructures, not over engineer a simple process. “Emphasis

is not on either design or nature by itself, but upon the preposition with, which implies human cooperation and biological partnership.” (McHarg viii) Green infrastructure in today’s built environment is attempting to use this partnership. Instead of draining storm water from our paved surfaces directly into a pipes and sending it down stream to become someone else’s problem, let’s use infiltration and get that water back into our ground water supply.

One of the chapters in, “Design with Nature,” deals with a study about the New Jersey Shore, completed by graduate students in landscape architecture at the University of Pennsylvania. This study uncovered the importance of the barrier islands that run along the coast and protect the New Jersey bays from the Atlantic Ocean. These islands were designed by nature to control storm surges with a series of dunes. This series of dunes, primary (front), secondary (middle) and back dunes offer a remarkable defense system to our larger east coast storms. Unfortunately, it was a storm similar to Sandy that hit our coast a little over fifty years ago, “The Storm of 1962,” that lead to the study being conducted. The winter storm took a comparable path and caused similar damage as Sandy. During the storm of 62, houses built high on primary dunes had the sand washed out from beneath them. The same happened during Sandy, to residents of Long Beach Island, creating an uncomfortable view of a residential area next to the ocean. The barrier islands were breached by the ocean during the storm of 62, this also happened during Sandy in Mantoloking, New Jersey causing immense flooding problems and major damage to homes and infrastructure. Flooding from storm surge also occurred further up the New Jersey coast in Hoboken. The majority of the city was covered with six feet of water that flowed in from the Hudson River.

As New Jersey prepares to rebuild, we should consider stepping back and looking at alternatives to the status quo of development along the shore. The native landscape before development started would be the appropriate starting point for influence into new design ideas. Landscape architects, architects, engineers, planners and public officials should step forward and put proper

plans into action. It is possible to re-develop the New Jersey coast and save the important tourism business while new regulations are put into place allowing housing and natural processes to coexist protecting our investments.

Ian McHarg said, "let us accept the proposition that nature is process, that it is interacting, that it responds to laws, representing values and opportunities for human use with certain limitations and even prohibitions to certain of these." (McHarg 7) So, in this time of sorrow and despair, we find the strength to help our neighbors and friends; let's also find the strength to re-thinking the places we develop and how we develop, so we have less of a chance of seeing the devastation of Hurricane Sandy happen again. Rebuilding smarter and more resourceful should be the goal of all New Jersey residents.

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