BRIDGING THE DIVIDE:

CONNECTING NORTH JERSEY COMMUNITIES AND NATURE

THROUGH GREENWAY DESIGN

By,

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ABSTRACT OF THE THESIS

Bridging the Divide:

Connecting North Jersey communities and nature through greenway design

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Urban greenways are important to communities for their ability to provide important recreational space, transportation options, ecological services, social connections, and scenic beauty. However, in many urban environments, the process of planning and implementing greenways is difficult. Bergen County has had plans to increase access and recreation opportunities around the Hackensack River since the 1970s. However, none of the large visions have been achieved. Recently, local organizations have begun work on creating a greenway along the Hackensack River. This thesis is meant to give a vision to the greenway while considering common challenges and strategies for urban greenway design.

A suitability analysis was developed in order to identify parcels of land along the Hackensack River ideal for early-stage greenway intervention projects. Additionally, a visual assessment and regional GIS assessment were conducted to inform the route of the greenway. This resulted in a 9.38-mile path system from Overpeck County Park to Van Buskirk Island County Park. Hackensack River County Park was a specific location along the river that was identified as being particularly important to the success of the greenway because of it's proximity to existing open space along the river, county ownership of the land, important habitat for bald eagles, potential for connecting important places of interest along the river,

and the diversity of landscape elements found at the park. A site design was created using the guidelines set forth during the overall greenway design.

The process resulted in an overall 9.38-mile greenway route through 8 municipalities in North Jersey along the Hackensack River, a site design for Hackensack River County Park, and recommendations for moving forward with the Greenway Plan. The project should be organized on a regional level by the Bergen County Parks Department but carried out with the help of local municipalities. Partnerships with local businesses should also be pursued. Ultimately, the Hackensack Greenway has the potential to have long-lasting positive impacts on the local communities around the Hackensack River.

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1.1: Introduction

Greenways have become popular in open space planning and design for their ability to contribute functional and flexible open space to a broad group of people. Attempts to make cities greener and more resilient have made greenways popular in many urban environments. However, the process of planning, designing, and implementing greenway projects in cities across the United States is a difficult task.

One of the most difficult states for implementing greenways is New Jersey. New Jersey has high population density, little publicly owned land, and a difficult political atmosphere which all make greenway planning challenging. High population density causes tight landscape environments that make it difficult to design linear open spaces. Furthermore, the population density also increases the density of disruptive infrastructure such as highways. Highways such as interstate 80, the Garden State Parkway, and the New Jersey Turnpike all act as physical barriers preventing connections across the state. This is particularly evident in North Jersey where most of these highways meet. Additionally, New Jersey municipalities operate under Home Rule, which gives local power to the municipalities for many planning decisions. Since greenways, as linear corridors of public land, exist through many different municipalities, coordinating these local governments to achieve a cohesive project can be a challenge. At a smaller scale, most of the land in North Jersey has been developed or is privately owned making the availability of land for greenways scarce.

These were some of the challenges that a team of planners and politicians in the 1990s were faced with when creating a vision for the Hackensack River Greenway. This greenway design effort was supported by the Bergen County Parks Department and Bergen County Planning Board. However, the plan was shut down by public opposition and has been shelved for the past 25 years. Since then, more research has been done in the field of Landscape Architecture and Planning on challenges and strategies for greenway design and implementation.

Some of the outcomes of these studies show that greenways can improve community connections, provide flood and resiliency in the way of green infrastructure, and provide recreational opportunities for locations where open space is scarce. Given the uniquely dense and difficult situation North Jersey is faced with regarding green space, greenways should be considered as a solution. The Hackensack River Region is a good example of where this open space element can be implemented. Past greenway plans should be reevaluated and new greenway plans should be carried out.

The devastation of Hurricane Sandy, the need for resiliency and connectivity in communities in response to the prediction of increasing storm frequency, and local efforts to create greater access to the river by non-profit organizations has restarted the conversation around the Hackensack Greenway in 2018. These organizations have cited reasons such as connectivity between communities, access to the Hackensack River, recreation opportunities, and flood resilience as reasons to design a Hackensack River Greenway. Some of these reasons for returning to the greenway idea such as public access and recreation have historically been major topics for public use of the river (Bergen County, 1971). The recent energy for starting the discussion of the Hackensack River Greenway has been spearheaded by the Northern New Jersey Community Foundation; a non-profit organization focused on using collaboration between organizations and nonprofits in Northern New Jersey to help create a better, more cohesive community structure (*About Us*, 2020). With the collaboration of the Rutgers-based Center of Urban Environmental Sustainability (CUES), Bergen County Parks Department, The Hackensack Riverkeeper, and the municipal governments around the river, an initiative to re-open the discussion of a Hackensack River Greenway has begun.

I became involved in the project shortly after the Northern New Jersey Community Foundation solicited the help of CUES in organizing contacts and creating a rationale for why this vision should be pursued. Sparked by both the potential to explore a challenging topic interesting in its size and scope, and integrating both regional planning and site-scale design, I expanded on the work started by the organizations interested in the project.

This thesis uses the urban landscape of the Hackensack River Corridor in Bergen County, NJ to explore the difficult process of designing and implementing greenways. Specifically, the area of study is the stretch of Hackensack River that exists from Van Buskirk Island County Park in Oradell, to the intersection of Overpeck Creek in Little Ferry (see figure 1). This specific stretch of river was identified as the location for the greenway by the organizations currently working on the Greenway Project. The reason for this extent has to do with how the land is managed along the river. To the north of the study region, there is more preserved land in an effort to ensure the drinking water coming from the Oradell Reservoir is clean. To the south of the study region, the land is managed by the New Jersey Sports and Exposition Authority, one of three regional planning and zoning agencies in New Jersey (*Who Are We,* 2019). This leaves the chosen study region as the least managed section of the Hackensack River in North Jersey.

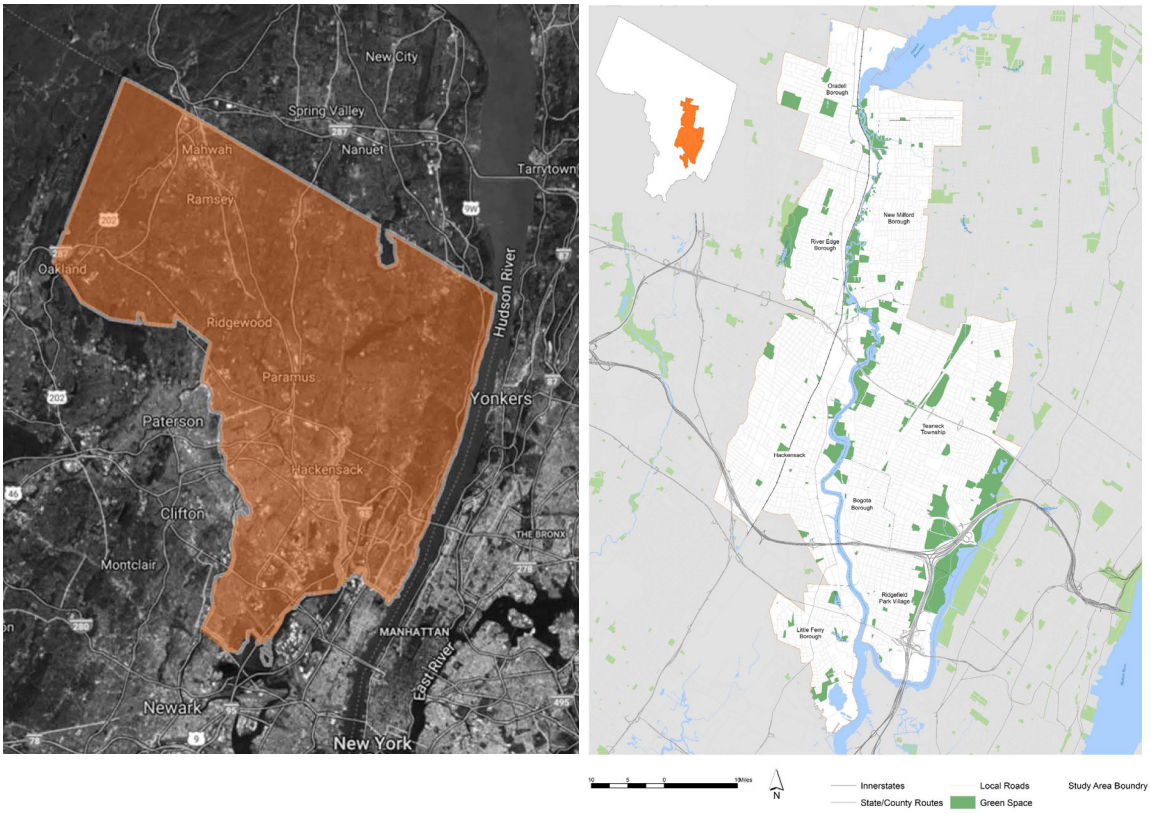


Figure 1. Study area location map.

In this thesis, first I explore the history of greenways in America and their urban applications. Then I explore the important factors that impact the implementation of greenways. Using the factors established in the theoretical review, I then design an approach to prioritize key locations for action at the beginning of the greenway design process along the Hackensack River. The goals for the overall proposed greenway in this thesis are informed by best practice greenway implementation strategies, past attempts at creating a Hackensack River Greenway, and current conditions along the Hackensack River corridor. The goals aim to make the landscape in the Hackensack region more connected, provide more access and public space along the river, and enhance opportunities for riverside wildlife habitat. The route of the greenway vision emerges from the application of these goals. Finally, Hackensack River County Park is explored in detail and designed to function as a component of the overall greenway vision. This multi-scale process ultimately shows the different levels of design needed in a greenway planning process.

1.2: Historical Background

It's important to look at the environmental and developmental history of the Hackensack River to understand how we have come to the point in the regions' history where the greenway is needed. Additionally, looking back on the ecological history will give insight to some of the specific native plant material that will be important to consider in the design phase. Over the years, the Hackensack River has played a major role in the growth and success of the surrounding communities. However, recently, access to the river is scarce despite the desire for riverside recreational activities.

Rivers have always been important to the human experience and have framed habitation patterns since the beginning of civilization (Forgaci, 2018). Early settlements would primarily use the rivers for transportation and agriculture. Since then, the tradition of river-use has persisted, and most of the world's major cities are located next to a river. (May, 2006). Urban rivers have been used for transportation, irrigation, defense, energy, waste removal, and potable and industrial water supply (Forgaci, 2018). With the dawn of the

industrial age, these uses began to grow in scale. The scale of these uses became unsustainable and eventually damaging to the river. Dredging and engineering of rivers controlled their flooding and prevented natural irrigation, while pollution made rivers dangerous to human contact which resulted environmental regulations that halted much of the industrial discharge. The result was the decline of the industrial era of river use and resurgence of communities using rivers for recreation and public space.

Northern New Jersey Rivers such as the Hackensack River were consistent with this global urban river development trend. Specifically, the Hackensack River went through the following phases: Native American river use, fur and early farm settlements, early road expansion, Industrial Revolution, suburban growth, decline of industrial use, and ecological awakening (Olsen, 2008).

To better understand the river landscape, it is important to look back to the creation of the Hackensack River before either the Native Americans or European Settlers came to the region. During the last ice age, approximately 18,000 years ago, a glacier cut across New York Bay (Olsen, 2008). A moraine, a location where debris is deposited from the flow of glacier streams, formed and acted as a dam. Behind the moraine, glacier lakes formed. The locations of the deepest parts of the lakes are reflected in the modern geography as the Great Swamp and the Meadowlands (Olsen, 2008). The resulting landscape was a flat expanse characterized by 21,000 acres of wetland and river (EPA, 2015).

The historic vegetation was made up of a combination of tidal wetland and woody wetland. Approximately 7,000 acres was believed to be dominated by *Chamaecyparis thyoides (*Atlantic White Cedar) (EPA, 2015). The dominant tidal wetland plant species included *Spartina alterniflora* (Smooth Cordgrass)*, Spartina patens (*Salt Hay Grass)*, Distichlis spicata* (Salt Grass)*, and Juncus gerardii* (Black Rush) (Tiner and Bergquist, 2007). The Native Americans would use the Atlantic White Cedar to make dugout canoes for transportation and fishing. The wetlands were an important source of food resources. The primary Native American peoples associated with the Hackensack River were the Lenni Lenape. It was the

Lenape who first gave the Hackensack River the name “Ackinsachys” which would later become “Hackensack.” (Olsen, 2008). Transportation and food resources were the main uses for the Hackensack River during the Native American dominated phase.

When the first Dutch settlers came to the region, the river was used in much the same way as it was under the Native Americans. Settlers and Native Americans traded food and fur with each other (Olsen, 2008). At this point, there were no substantial roads in what is now modern day Bergen County. The river was the quickest and most economical means of travel and trade.

Once Manhattan Island was purchased by the Dutch, settlements along the Hackensack River began to grow as trade between the regions increased. Some of the first and most notable of these settlement ports were Old Bridge Landing in New Milford, New Bridge Landing in River Edge, and Hackensack (Olsen, 2008). This period of trade can be defined from the mid-1700s until the development of railroads that replaced the river corridors as the fastest means of transportation. It is this economic connection with New York that allowed the region to grow during this period, and it was the Hackensack River that facilitated this growth.

As the demand for goods and materials produced along the Hackensack River increased, trains replaced ships as the primary method of transportation. Of Northern New Jersey Rivers, the Hackensack region was the last to be connected to the large network of railroads; preceded by both Newark (the Passaic River) and New Brunswick (the Raritan River) (Olsen, 2008). Simultaneously, diking and filling marshland in order to make room for expanding development occurred (EPA, 2015).

Industry used the river for power and waste removal as the railroads were used for the transportation of industrial goods. Chemical companies such as Standard Chlorine, Universal Oil Products, Ventron, and Scientific Chemical Processing all used the Hackensack River or tributaries in their production (EPA, 2015). The growth of these industries plus the growth of New York City provided jobs for many of the expanding communities along the

Hackensack.

The population continued to grow in the late 1800s and early 1900s and commuter railroad towns defined Northern Jersey's suburban landscape. This resulted in a dramatic change in the Hackensack River when the Oradell Dam and reservoir was constructed in 1922 to service potable water to the growing residential communities along the river. These historically farming communities shifted to suburban commuter towns. The historical Map of Hackensack from 1898 (see figure 2) illustrates the development of train lines and the activity of sail boats along the Hackensack River during this period. The large commercial shipping vessels were being replaced with canoeing, boating, and swimming clubs for the recreation of the growing commuter population.

However, the industrial use of the river conflicted with the recreational uses. The industry used the river not only for power, but also for waste disposal (Olsen, 2007). The

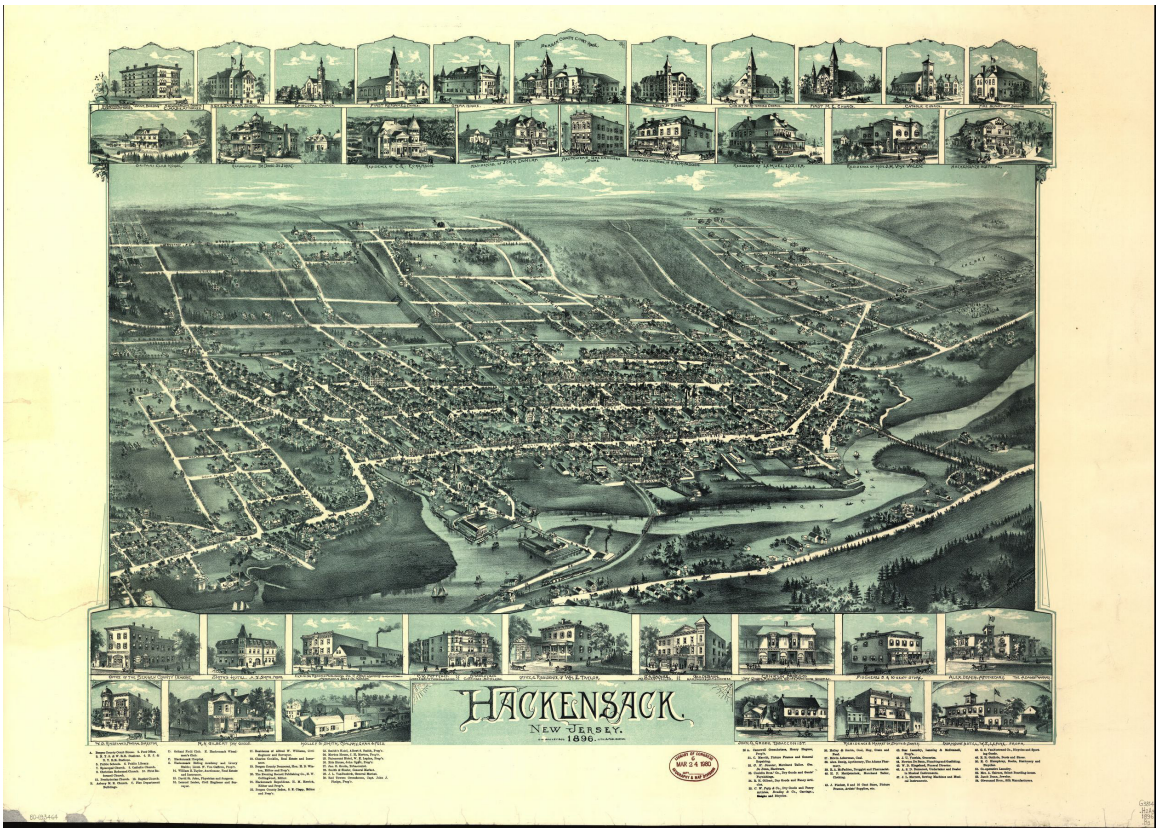


Figure 2. Historic 1896 Map of Hackensack. Trains and boats are still shown in the illustration as active parts of the transportation system. (O.H. Bailey and Co, 1896).

chemical companies disposed waste product into the river. Additionally, sewage plants in the region used the Hackensack for disposal and PJM landfill in the meadowlands was opened in order to service the solid waste from the growing population in Northern New Jersey and New York City. All these pollution sources lead to public health officials placing bans on swimming in the Hackensack River in 1920 (EPA, 2015).

The age of industrial decline began as tightening environmental regulations pushed much of the industry west or overseas. The flight of industry away from the Hackensack gave communities the opportunity to connect with the River again. Not only was there more room on the banks of the Hackensack, but the environmental cleanups began to investigate and address the pollution issues (EPA, 2015).

On the heels of the industrial decline, the most recent era of human activity on the Hackensack River can be called the ecological awakening (Olsen, 2007). Environmental groups such as the Hackensack Riverkeeper have educated the communities on the ecological importance of the river as a natural resource and have pushed for agencies such as the Environmental Protection Agency (EPA) and the New Jersey Department of Environmental Protection (NJ DEP) to make cleaning up and preserving the river a priority. After years of industrial and commercial river traffic, canoe groups and ecological tours have started to claim ground along the river for recreational and educational purposes.

In the wake of the environmental awakening and subsequent environmental protection legislation, many environmental advocacy and interest groups began to develop. National organizations such as the Sierra Club and the Audubon Society have regional chapters active in the North Jersey/ Hackensack Region (*Resources*, 2018). Additionally, there are numerous local environmental groups that have taken an interest in the ecology and nature of the area around the Hackensack River. A few of these organizations include: The Hackensack Riverkeeper, Friends of the Hackensack Greenway Through Teaneck, Bergen Save the Watershed Action Network, and Overpeck Preserve, inc (*Resources*, 2018). All these organizations were formed after the 1970s in response to greater environmental awareness.

The growing number of these organizations indicates a growing interest in the Hackensack River as a source of recreation and importance for the community.

1.3: Project History

Interest in the Hackensack River lead to an initiative lead by the Bergen County Planning Board in the 1960s that focused on open space and park development along the Hackensack River. A series of feasibility studies were conducted by the Planning Board and various engineering firms which became the Proposed Lake Hackensack Development Program of 1971. The plan was meant to explore the feasibility of the creation of a freshwater lake from midtown bridge to the waterworks in Oradell (See figure 3). The creation of the lake would "enhance the social, leisure, and cultural life of county residents" (Bergen County, 1971, pre-report letter para, 3). Specifically, it was looking to bring back recreational boating and fishing opportunities along the river. However, ultimately the plan was never acted on.

Figure 3. Extent of Proposed Lake Hackensack Plan (Bergen County, 1971).

Later, in the 1980s, a series of studies that built on the Lake Hackensack Plan began to explore the feasibility of a Greenway from the Oradell Waterworks to Johnson Park in Hackensack (see figure 3). The geographic extent and the social benefits of the plan were very similar to the Lake Hackensack Plan (Hakim, 1994). However, more emphasis was placed on the environmental conditions and the local ecologies. The proposed

greenway plan listed natural resource protection, recreational links, environmental education, open space preservation, connection to historical features, and economic potential as priorities for the project in the application for the New Jersey Department of Transportation Enhancement Program (Hakim, 1994). However, with these many goals, there were conflicting ideas on what should be the priority of the greenway.

The greenway plan was met with both a lot of support and resistance from different interest groups. There were local environmental groups that supported the plan because it would give the community more exposure to the beauty of the Hackensack River, but there were also environmental groups that opposed the plan because they didn't want the existing riverside ecology to be damaged by the construction of a pathway. Similarly, there were residents who supported the greenway proposal because it would increase the available open space to the communities, but there were also residents who opposed the plan because they didn't want the path to go near their property for privacy and safety reasons (Weitzman, 1994a).

The community was divided on the concept of a greenway along the Hackensack River. An article in The Record, a local Bergen County Paper, was published in 1993 titled *Seeking the Path of Least Resistance: Bergen Pushing River Walkway*. This article roughly outlined the plans for the greenway and the next steps that would be taken in the project. However, it also triggered public backlash for the project (Morley, 1993). Over the next year and a half, articles titled: *Neighbors Target Pathway, Hackensack River Pathway Hits Detour, Pathway Reaches Impasse*, and *Park Along the Hackensack is Dream Deferred* document the local opposition (Ahearn, 1994; Morley, 1994; Weitzman, 1994a; Weitzman, 1994b). Much of the opposition came from a handful of residents who were concerned about how the greenway would impact their privacy and safety (Weitzman, 1994a). Other concerns voiced about the project were the potential for crime, maintenance responsibility, park security, and parking (Morley, 1994). Additionally, the plans that were proposed by the Bergen County Planning Board at the public hearings did not have much flexibility (Morley, 1994a). If there

were a group of residents who didn't like the route of the path in the plans, there was no alternative to keep the discussion going. The grant that Bergen County got for this project went unused, and Freeholder Richard Mola lamented the loss of an opportunity by stating "We're losing 2.7 million for seven [opposing] home[owners]" (Morley, 1994, para. 17). Ultimately, the extent of the project was cut down to a single design of Hackensack River County Park. This park design was a compromise between the communities opposing the greenway project and the county.

1.4: Current Efforts to Activate the Hackensack River Greenway Project.

Discussion about a greenway along the Hackensack River has never dissipated, however it has died down significantly since the public opposition in 1994. Since then, there have been local efforts to fulfill the greenway vision. In 1995, one year after the greenway plan was abandoned by Bergen County, a local organization dedicated to the plan formed in Teaneck. That organization, Friends of the Hackensack River Greenway Through Teaneck, began organizing, building, and maintaining small foot-trails along the Hackensack River on the Teaneck riverbank. Today, signs along the River indicating access to these trails exist. Interpretive signage along these trails are focused on the avian wildlife of the Hackensack River. However, most of the trails are very narrow and are more akin to hiking trails (See figure 4). Additionally, the trails are broken by places where private property forces users to onto the street where there is not a strong visual connection to the trails.

Figure 4. Existing trail along the Hackensack River in Teaneck.

Furthermore, the City of Hackensack has required that all new development along the River

is to "include suitable provision for a pedestrian walkway along the bank of the Hackensack River" (Zoning Ordinance and Map, Chapter 175-5.6). This ordinance has resulted in several small stretches of walkways along the Hackensack River. Most of these walkways exist behind strip malls that contain shops such as Shop Rite and Taco Bell. A recent addition to this collection of pathways is behind the property of PSE&G. However, these paths are isolated and often don't have much pedestrian use.

Recently, several organizations have begun to look at the project more holistically, and at the time of publication, the conversation of a contiguous greenway connecting municipalities from Oradell to Little Ferry has been opened to local organizations, local municipal government bodies, and Bergen County Parks Department. Local organizations such as the Hackensack Riverkeeper and The Northern New Jersey Community Foundation have worked with CUES to discuss the project with mayors of municipalities involved. With the local municipalities on board, discussion to develop a greenway to connect these North Jersey communities to the river has begun.

Chapter 2: Theory

2.1 Greenway History in American Landscape Architecture

The American practice of landscape architecture and the design of greenways have long been intertwined. Fredrick Law Olmsted and Charles Eliot worked on some of the first examples of Greenways in America (Fabos, 2004). These projects included the Emerald Necklace design by Olmsted and the Boston Metropolitan Park System by Eliot (Fabos, 2004). Later, in the early 1990s, landscape architects such as Henry Wright, The Olmsted Brothers, and Charles Eliot II contributed to greenway planning. This occurred though Wright's Regional Plan for New York, the Olmsted Brother's "40-Mile loop" in Portland, Oregon and Eliot's open space plan for Massachusetts (Fabos, 2004; Little, 1990). In the 1960s and 1970, the concept of greenway planning was being taught in landscape architecture programs such as University of Wisconsin under Phil Lewis, University of Pennsylvania under Ian McHarg, and University of Massachusetts under Ervin Zube (Fabos, 2004). However, it wasn't until the 1970s and 1980 when the term greenway was used to describe these large regional planning projects. This period is known as the beginning of the Greenway Movement (Ahern, 2004).

There are two definitions of greenways that are most cited in greenway literature. The first is the President's Commission on Americans Outdoors in the USA (1987) which is often cited as the beginning of the Greenway Movement (Ahern, 2004; Fabos, 1995). The report called for an effort to "provide people with access to open spaces close to where they live, and to link together the rural and urban spaces in the American landscape threading through cities and countryside[s] like a giant circulation system." (The Presidents Commission on American Outdoors in the USA, 1987 as cited in Ahern, 2004, p. 34-35). This definition is a re-awakening of many of the values emphasized by Fredrick Law Olmsted and Charles Eliot in the late 1800s. In both Olmsted's Speech "Public Parks and the Enlargement of Towns" and Eliot's Speech "The Need for Parks," they argue for more connected park systems for public health, social unity, and open public access (Moga, 2009). Both Eliot and Olmsted

were specifically concerned with the importance of parks in the urban environment. By grounding greenway values in the roots of Landscape Architecture, it can be argued that Landscape Architects not only have the skill-set to implement greenways, but also have been working on these issues since the foundation of the profession in the United States.

The second definition important to greenway literature comes from Jack Ahern and Julius Fabos (1996). This definition states, "Greenways are networks of land that are planned, designed, and managed for multiple purposes including ecological, recreational, cultural, aesthetic, or other purposes compatible with sustainable use." (Ahern & Fabos, 1996 as cited in Ahern, 2004 p. 35). This definition was the result of a synthesis of greenway projects and literature.

Greenways often use existing man-made infrastructure such as roads, canals, railroads, or utility right-of-ways to use as the framework for the corridor. Additionally, natural landforms such as ridges, valleys, rivers, or coastlines can be used (Little, 1990). By building off exciting infrastructure or natural features conducive to contiguous open space, it makes the implementation of the greenways more successful.

The popularity and discussion around greenway design and implementation are a testament to the success of previous projects. Many benefits have been observed and documented as a result of Greenways. The most broadly recognized greenway benefits include ecological preservation, public health, transportation, recreation and tourism, historical and cultural heritage celebration, social connectivity, and access to aesthetic scenery.

Greenways are an excellent tool for increasing ecological function and services in urban areas (Ahern, 2013; Smith & Hellmund, 1993). Basic landscape ecology principles state that linking two previously isolated preserved tracts of open space will benefit the ecology. The very description of greenways, contiguous linear open space, satisfies this principle. In short, Smith and Hellmund (1993) claim, "Greenways can protect natural areas and diminish the isolating, disruptive effects of habitat fragmentation on wildlife and water resources" (p. 1)

A major use for greenways is recreation. Particularly, greenways are ideal for activities such as biking, walking, and jogging. Where a traditional city or town park might have a loop that a biker or jogger could use, a greenway can have miles of open space that creates a constantly changing environment for the user (Fabos, 1995). This experience is common in Rails to Trails (discontinued rail lines converted to recreational paths). An example of this is a trail through the Lehigh Gorge in Pennsylvania. Bikers travel to this location to enjoy a 25-mile bike ride on a scenic rail trail (*Bike Train*, 2020).

While some greenways may not draw tourism and recreation like some of the scenic rail trails, they still provide valuable transportation opportunities. This is especially important in urban communities where not everyone has a car or access to public transportation. A greenway can provide the route for people to safely get to work or go to the store.

By providing opportunities for recreation and transportation, greenways are also providing opportunities for improved public health. Connected green space accessible to the surrounding populations have been linked to improved community health and both physical and mental wellbeing (Larson, et al, 2016).

Local cultural history can be celebrated through greenway trails. Creating trails that link significant historical landmarks for the region, instill a deeper sense of community pride and unity. Most cultural features through cities are linked to rivers or shorelines due to their historical significance of development and transportation (Fabos, 1995). Examples of such historical river greenways include the Hudson River Walkway and the Montreal Heritage Corridor (Fabos, 1995).

Greenways that are miles long can also socially connect communities that are normally separated by geologic or man-made barriers. Social connectivity refers to the connections made between communities where there is exchange of economic, physical and cultural values (Keith et al, 2018; Kondolf & Pinto, 2017).

Greenways also provide public access to places of scenic and aesthetic beauty. The rivers, ridges, canals, valleys and coastal landscapes that often make up the framework for

greenways, are also landscapes that lend themselves to scenic views. The access to aesthetic beauty can provide relaxation and tourism attractions for local communities.

These benefits are some examples of what greenways can do to enhance communities. In many cases, a greenway might achieve more than one benefit. However, depending on the location and goals of the greenway project, not all of the benefits will necessarily be observed. As seen by the earlier Hackensack Greenway Plan, there were many different goals stated. For the greenway proposed in this thesis, the focus should be social connectivity, recreation, and access to scenic beauty.

2.2: Urban Greenway Challenges and Potential Solutions

Greenway planning and design has been notably challenging in the United States for several reasons. With the tradition of private land ownership in the United States, planning large scale contiguous projects becomes difficult. The development of the Highway System and railroad system in the United States had similar difficulties (Ryan et al, 2006). Taking advantage of existing infrastructure, organizations like Rails to Trails have been successful because the route of the greenway was developed previously. For this reason, greenways tend to occupy abandoned infrastructure or linear landscape features such as rivers.

Urban landscapes are particularly important in the discussion of greenway planning. Often, in these areas, greenways provide important benefits to communities (Keith et al, 2018), but they can be more difficult to implement. The difficulties that commonly plague greenway projects can be broken into three different categories: Management, Design, and Implementation.

Management

The benefits of long, contiguous open space come at a management cost. One of the major questions that arise in the developed of greenway projects is: Who will manage and maintain the land once it's been designed and built? This is a difficult question because greenway trails often ignore political and geographic boundaries (Ryan et al, 2006). Management at a local level can be difficult because the scale of greenway projects is often

regional. However, it is the local unit of government that has historically been most successful in open space planning in the United States (Erickson, 2006). Therefore, many greenway projects are managed at a county or state level or have a group of local organizations create an "alliance" management plan where the organizations meet regularly to discuss the state of the greenway (see figure 5).

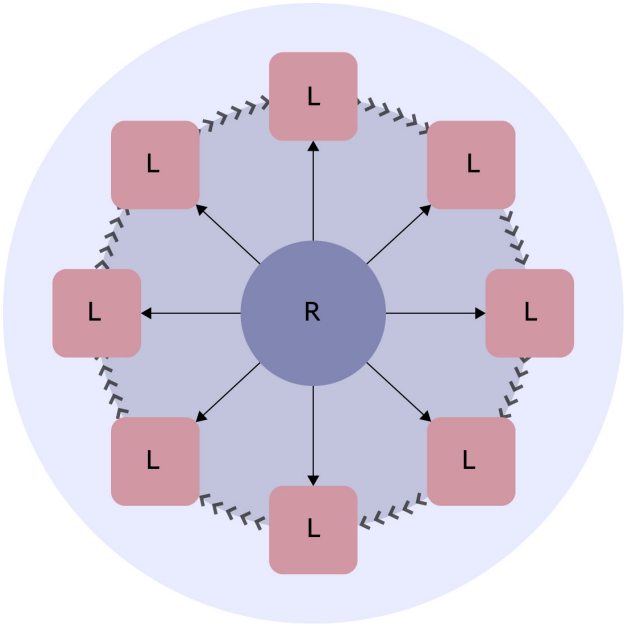


Figure 5. Greenway management graphic. The objects marked with an "L" represent local organizations. The object marked with an "R" represents the regional organization. In this case, the local organizations have the dominant role while the regional organization is providing support and acts as a moderator.(adapted from Erickson, 2006).

In the State of New Jersey, this management strategy would likely be the best option. With so many municipalities in such a small area operating under Home Rule, regional management is difficult. Home Rule is the government policy that gives local power to towns and municipalities to set up their own policies of self-governing to suit their own, local needs. However, having so many organizations involved in the management and decision making that goes into greenway implementation is also a challenge. Greenways are known for being a good tool to achieve multiple community goals, but these goals must be prioritized in order for the main greenway objectives to be realized. This can create a conflict when different organizations want to prioritize different goals (Erickson, 2006).

In order to avoid many of the management challenges that come with greenway planning, it is important to address them from the beginning of the process. The following include some of strategies that can address these challenges:

1. A clear and concise goal agreed on by all organizations involved.
2. Defining the roles of the participating organizations clearly from the start.

The Bergen County Parks Department should take the lead by organizing the Greenway project. With their oversight and support, the municipalities along the Hackensack River can locally implement the parts of the greenway that fall within their jurisdiction. With the management model described above and a clear understanding of organizational roles, the Hackensack Greenway will have a solid foundation to move into carrying out design elements.

Design

After some of the management challenges are addressed, there are design considerations that must be considered. One of the more important design challenges is the creation of safe spaces along the greenway. This not only refers to being safe physically, but also feeling safe while within the spaces. In a study conducted by Keith et al (2018), the most important factor influencing decisions to use greenways was "safety and security along the trail" (Keith et al, 2018, p. 52). Places that are secluded and don't attract much human interaction can become places of crime in the urban environment. There are three design criteria that can be used to make places feel safer:

1. Activate the spaces
2. Create clear site-lines
3. Design obvious and numerous access points

By providing opportunities for people to use the greenway, the number of people can deter from crime. The more eyes on the public space, the safer it becomes. Introducing an attractive landscape for recreation and use will increase the number of people who will use the space.

Increasing sight-lines in and out of the greenway will also contribute more eyes on the park. This is another way to reduce the likelihood of crime along the greenway. Not only will people be able to see out of the greenway, but it will also allow police to monitor the space more easily.

The more access points along the greenway, the more options people have to enter

and leave the space. This creates more freedom for the user. Additionally, it prevents the visitor from feeling constrained or trapped on the greenway. Design strategies that increase the visitor traffic, create clearer sight-lines, and provide more freedom to access or leave the greenway will make it a safer environment.

Implementation

Aside from management and design of greenways, carrying out the project through to the implementation phase can often be difficult. Two commonly cited challenges include land acquisition and public outreach and involvement (Ryan et al, 2006). Acquiring land in urban environments is extremely difficult because most of the land is owned privately or in use. Additionally, the value for urban land is higher making it more difficult to acquire lands for greenway projects even if the land was for sale (Ryan et al, 2006). By combining greenway objectives with green infrastructure in areas prone to flooding, more grant money will be available for land acquisition (Erickson, 2006). Conservation organizations such as the Nature Conservancy have criteria for acquiring land for natural preservation. These criteria overlap with some grant criteria for acquiring open space in New Jersey. A review of criteria from these grants and land conservation groups shows several criteria that are commonly found in organizations such as The Nature Conservancy, Rails to Trails Conservancy, Legacy Land Trust, Ojia Valley Land Conservancy, Peconic Land Trust, The Green Acres Program, and The Blue Acres Program (Green Acres, 2020):

1. Properties that include or abut important habitat or migration routes.
2. Land that is near existing open space or preserved land.
3. Land that would preserve or enhance scenic views of the landscape.
4. Land that has potential to mitigate impacts associated with climate change.
5. Property that has a history of flood damage.
6. Property that contributes to the sustainable use of water resources in the region.
7. Land that has potential for recreation and enjoyment of nature-based outdoor activities.

Three strategies for implementing greenways that address the challenges of land acquisition and public outreach include:

1. Building on small successes (Erickson, 2006): The scale of greenway projects makes them difficult to complete in short periods of time. These projects require persistence and momentum in the communities to achieve completion. By building on small, consistent successes along the way, the momentum and excitement of these public spaces can continue to move the projects forward.
2. Having a clear and effective public outreach strategy (Erickson, 2006; Ryan et al, 2006): Engaging the public early in the greenway planning process can prevent the derailment of the project later on. Additionally, hearing the desires and amenities the future greenway users want will help to "activate" the spaces in the design phase.
3. Target criteria to obtain funding for land acquisition: by targeting common land acquisition criteria, the success of applying for grants to obtain land and right-of-ways is increased. Grants and additional funding from partnerships will ease the financial load of the local organizations that are in the dominant role for managing the greenway system.

Together, the management, design, and implementation challenges that come with Urban greenway projects can be complex, but understanding the potential strategies for overcoming the challenges can help increase greenway project success.

2.3: Theory Applied: Hackensack River Greenway

The benefits and challenges of urban greenways can be used as a framework for discussing the goals and approaches that should be addressed in the design of a greenway along the Hackensack River. An approach that successfully addresses the past failures of the Hackensack Greenway project and employs proven strategies for greenway implementation is the best way to move forward.

First, it's important to note that Bergen County needs open space to support the

increasing population density of the region. The Bergen County Parks Master Plan study showed that many of the municipalities in the study region are under served in terms of open space (Bergen County Department of Parks, Recreation, Historic, and Cultural Affairs, 2019). The rapid growth is a sign that not only are there more people that would be using open spaces, but the existing open space and natural resources are under pressure from development. Second, the Bergen County Master Plan also identified the municipalities directly adjacent to this stretch of river as an area where a higher percentage of families do not have cars. In a car-dominated environment like North Jersey, a greenway can be an excellent alternative to using cars. Third, the Hackensack River is the ideal spot for such a greenway because the river valley landscape can be used as the greenway framework.

The goals for the Hackensack Greenway design should focus on benefits such as social connectivity and transportation, recreation, and ecological services as the main goals. By using a greenway to connect communities along rivers, it allows for alternatives to car transportation methods. The growing population coupled with the lack of open space requires more land for recreation. The preservation of the ecological services provided by the river will not only make the community more resilient, but also foster scenic beauty. The combination of these elements has the ability to make a more cohesive, healthy community environment for North Jersey.

The implementation strategy of the greenway should focus on a management strategy where the greenway is curated at the county scale, but individual projects are overseen by the municipalities. This would maintain the municipality's power under Home Rule, but the overall vision of the greenway would be managed and overseen by the Bergen County Parks Department.

Main design considerations should include ease of access, clear sight-lines and views, and naturalized riverbanks when possible. By providing ease of access and clear sight-lines to the greenway, some of the concerns about crime can be addressed. Furthermore, sight-lines to the greenway and Hackensack River could draw more attention to the scenic beauty of the

landscape recovering since the decline of industrialization.

Implementation strategies should focus on building on small successes that have already been realized and prioritizing projects that would be easy to acquire for the greenway. By doing this, the momentum needed to keep the Hackensack Greenway project moving forward to its eventual completion will begin.

Chapter 3: Regional Analysis and Concept Proposal for The Hackensack Greenway

Regional analysis of the Hackensack River Greenway Project was done in two parts. The first part was a suitability analysis focused on prioritizing locations ideal for greenway pilot projects. The second part of the analysis was a visual assessment of the river and the surrounding landscape. The visual analysis was also evaluated against GIS data of the Hackensack River Region to determine an overall route for the Hackensack River Greenway. There were two results of this analysis process. First, parcels of land that would be ideal for kick-starting a greenway project were identified. Second, an overall greenway route was developed along the Hackensack River.

Throughout the process, there were three guiding goals. These goals were informed by best practice greenway implementation strategies, past Hackensack River greenway attempts, and current conditions of the Hackensack Greenway Project. These overall goals exist in this order of priority:

1. Connect the communities along the Hackensack River in order to provide more open space for recreation and safer transportation.
2. Provide more access to the Hackensack River to utilize its potential as a scenic attraction.
3. Use the development of a greenway along the Hackensack River as an opportunity to enhance the local habitat.

These goals were chosen for several reasons. First, the landscape of North Jersey is fragmented by roads and railroads making it difficult to get from one place to another without a car. Second, these municipalities in Bergen County along the Hackensack River need more open space to support the growing population. Connecting these spaces through a greenway network can increase access. Third, the Hackensack River is a beautiful scenic resource for the community and is often hidden by vegetation and infrastructure. Giving more access to scenic natural environments will enhance the community. Lastly, there is a

lot of potential for migrating bird habitat along the Hackensack River. By restoring local ecologies to best support these birds, overall ecosystem diversity will improve. An added benefit to restoring wetland habitats is their ability to absorb storm water during storm events. This will protect the local communities from flood damage.

3.1: Suitability Analysis

A GIS suitability analysis was completed in order to identify properties that could be considered appropriate starting locations for the greenway project. One of the challenges of Urban Greenway implementation is how long the project can take to finish. In order to keep the project momentum going, it's important to build on small successes early on. The suitability analysis identifies properties that can be considered "low hanging fruit." By identifying this land in the beginning of the greenway process, they can serve as the momentum that will drive the of the overall success of the Hackensack Greenway.

The goal of this analysis was to identify properties that are connected to existing trails or open space, already owned by the public, unsuitable for other forms of development based on the risk of flooding, and contain important habitat that should be preserved. A table showing the criteria and ranking system can be found in Table 1.

The first factor used was property ownership (See figure 6 on page 26). Parcels that

Table 1

Suitability analysis criteria and ranking system for determining properties ideal for initial greenway interventions.

Criteria Layer	Category	Rank
Property Ownership	Property is already owned by the state, county or municipality	3
	Property is currently listed as "vacant"	2
	All other property	1
Proximity to Existing Paths	Property currently intersects with existing riverwalk paths	3
	Property is currently ajacent to existing riverwalk paths	2
	Properties does not intersect nor is ajacent to exisitng riverwalk paths	1
Flood Potential	Property intersects the 100-year flood zone	3
	Property intersects the 500-year flood zone	2
	All properties outside the flood zones	1
Important Habitat	"Industrial" land use	3
	Important habitat currently listed under "Recreational" or "Educational" land use	2
	Important habitat in all other land use types	1

were already owned by public institutions such as the municipality, the county, or the state (there are no federally owned lands in the study area) were ranked highly in the analysis. In order to start a greenway intervention on one of these properties, there would be no need for land acquisition. Vacant land that is not already in public ownership was ranked below publicly owned land. Land that is vacant may be easier to acquire than land owned and managed privately. Land within 100 feet of existing open space was given the lowest rank. In many land acquisition transactions for open space, two of the most important factors are cost and proximity to existing open space. Both for ecological and recreational purposes, larger areas of contiguous open space are generally considered to be better than smaller fragmented open space parcels.

The second factor in the analysis was existing paths (See figure 7 on page 26). Like open space, parcels that contained a river walk path already were given a high score. The easiest interventions to start working on would be the improvement of existing pathways. Parcels that were within 100 ft of existing paths were given a lower rank. They are possible properties that could be easily linked to existing river walks. The process of acquiring land or right-of-ways that connect to existing paths along the river will ultimately be the driving force in implementing the contiguous greenway.

The third factor is flood potential (See figure 8 on page 26). One of the key criteria for open space funding in New Jersey relates to the probability that a parcel of land could flood. The Blue Acres Program is a state funded organization that buys property that has been significantly damaged by flooding and will likely continue to flood in the future (*Green Acres*, 2020). FEMA flood hazard data was used to classify three different areas of flood potential. The highest potential (100-year flood zone) was given the highest weight. Although land within the 100-year flood zone is not suitable for building, paths and open space are more resilient to flood damage. The 500-year flood zone was given a lower weight, and the lowest weight was given to the areas with minimal risk of flooding.

Important habitat data was used as the fourth and final dataset in the analysis

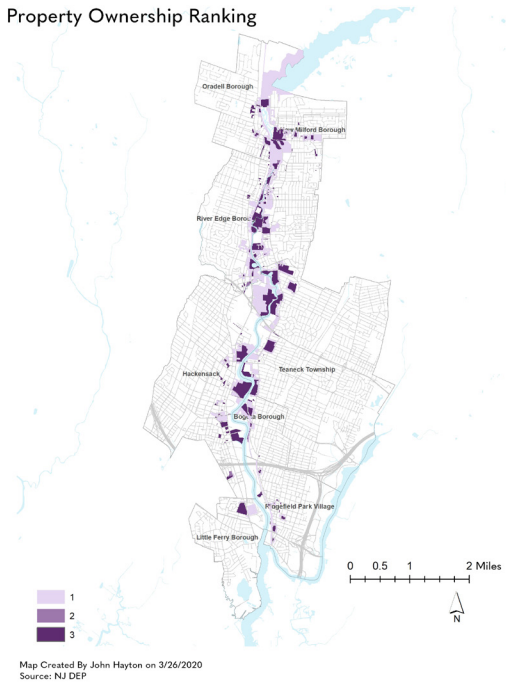


Figure 6. Property ownership ranking map.

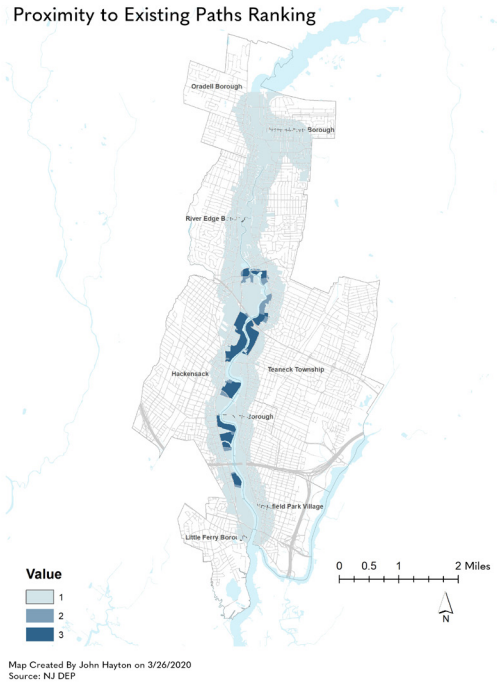


Figure 7. Proximity to existing paths ranking map

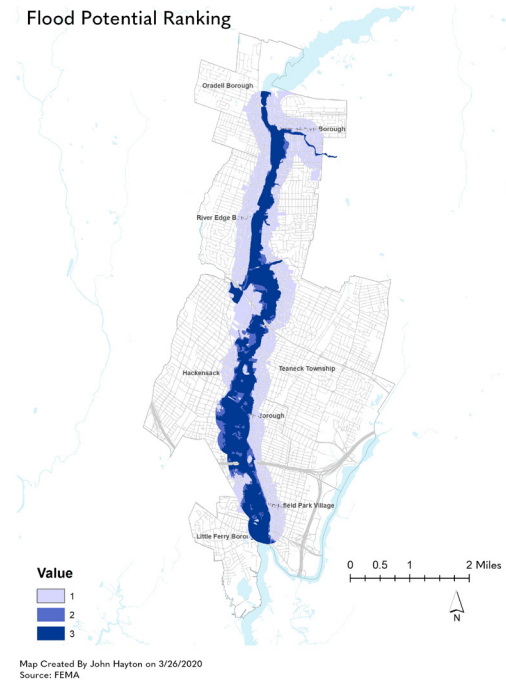


Figure 8. Flood potential ranking map

Figure 9. Important habitat ranking map

(See figure 9). The Landscape 3.3 dataset was put together by a joint effort between the New Jersey Department of Environmental Protection and Rutgers University. The dataset identifies important habitat for federally endangered, federally threatened, state endangered,

state threatened, and species of special concern in New Jersey. Within the study region, the Hackensack River contains habitat important to Bald Eagles, Black Skimmers, Black-Crowned Night Heron, Great Blue Heron, Glossy Ibis, and Snowy Egret.

One of the conflicts of greenway planning is the balance between habitat protection and recreation. This balance was taken into consideration in the ranking of the critical habitat areas. Areas with the highest ranking were critical habitat that occurred in land classified as industrial, commercial, or urban. Designing habitat suitable for the species identified can be incorporated into site-scale design. Ultimately, a linear green space would be a habitat improvement for the species of concern. Important habitat on recreational/school land was given a lower ranking. This is because generally, these areas have less hard-scape design elements and more habitat for important species. The last category included critical habitat in most other land use types, notably: residential and natural land. These were given the lowest rank because putting a greenway through a habitat mostly naturalized and providing a critical function for a species of concern in the State of New Jersey would likely degrade the environment further. To preserve these areas, greenway development should happen around, not through these landscapes.

The final suitability map shows a gradient from pale pink to dark red (See Figure 10 on page 28). Dark red indicates areas that are most suitable for greenway pilot project sites. In order to link these results back to parcels, the average rank for each parcel was calculated. The parcels ranged from having a score of 1 – 9.8 out of a possible 12 points. Raster weighted suitability analysis was performed in ArcGIS to get the result. A weighted suitability analysis takes the criteria layers (See table 1) and adds them together. Because each of the four layers had 3 ranked categories, the maximum (most suitable) rank was 12. A Zonal Statistics tool was used to calculate the average rank for each tax parcel. The result was a specific rank for each tax parcel, with a score out of a possible 12 points, indicating the parcels' suitability for initial greenway intervention. A table containing the parcel data and average score can be found in Appendix A.

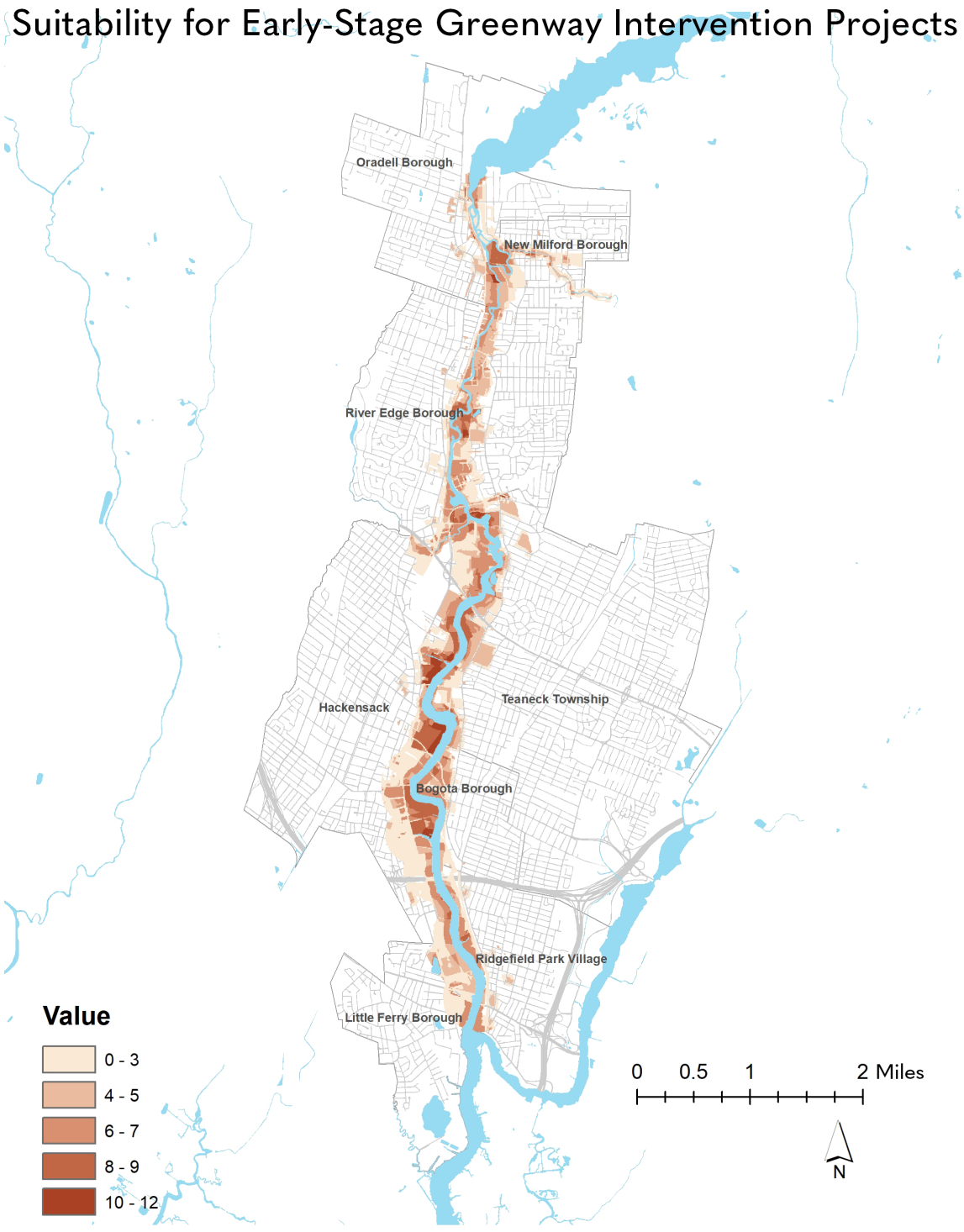


Figure 10. Early greenway project suitability map.

3.2: Visual Assessment of the River

The visual assessment of the river was done from the existing access points along the Hackensack Riverbanks and from a canoe. By approaching the river from two different perspectives, it allowed for a more holistic understanding of the Hackensack River Landscape. From these observations, different landscapes along the river were categorized into environmental typologies.

The New Jersey Department of Environmental Protection has mapped access points to major tidal waterbodies in the State. These locations were used to start the visual assessment from land. Each access point was visited and photo documented in August, 2019. Through the site visits, it became apparent that there were existing paths along the river. These paths were mapped using the ArcCollector Application. ArcCollector is a GPS based application that allows the user to collect spatial data in the field and enter it into GIS databases. Figure 11 shows a map with the existing river paths collected in the field and access point locations.

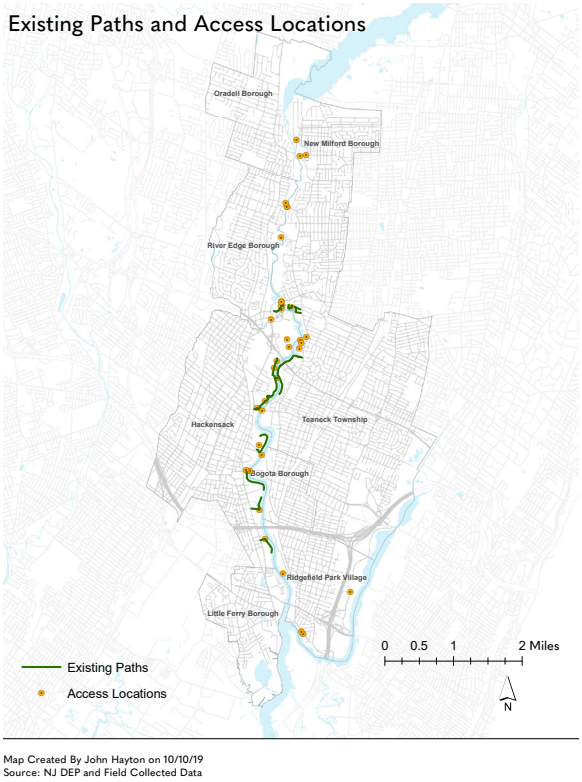


Figure 11. Existing Path and Access Point Locations

It was surprising to discover how many paths already existed along the river. However, most of the paths were difficult to find. Additionally, most of the paths are isolated and there are visual obstructions to the views of the river. For example, a path behind a ShopRite and a Taco Bell is only 1,200 feet long. During the site visit, I observed a woman jogging back and forth because the path did not lead anywhere. There were also benches along the path, but overgrown vegetation blocked any view of the river. Furthermore, the path faced the

backside of the strip mall where the trash dumpster is located. The collective experience of the space was unpleasant. This is only one example of this type of path experience along the Hackensack River.

Following the access point site visits, the canoe assessment took place in September 2019. The canoe was launched from the River Edge boat launch and taken out at a boat launch in Little Ferry for a total length of 6.75 miles. Most of the study area falls within this stretch of the river except for one mile of river in Oradell. The purpose of the canoe assessment was to document the river and the surrounding environments from the perspective of the river. A video camera was set up at the bow of the canoe to document the movement downstream. In addition to video, photographs were taken throughout the experience. Photos were taken in sets of three. One photo was taken toward the eastern bank, one photo was taken toward the western bank, and one photo was taken straight on downstream. This resulted in the photomap in figure 12 on page 31.

The photomap shows the transition of the Hackensack River from River Edge to Little Ferry. The outline of the river overlaps with images of bridges that cross the Hackensack. The photos are placed approximately where they were taken in relation to the river. Lines indicate the boundaries of the surrounding municipalities.

A clear change in the character of the river is evident when looking at the photomap. The northern part of the river is narrower and can be characterized by more overhanging trees. This part of the river was quiet except for the sound of cars or the occasional train. Further south, the river becomes wider and there are fewer overhanding trees. The man-made environment is much more obvious as strip malls, schools, industry and other buildings replace much of the vegetation found close to the riverbank further North. Wildlife such as egrets, great blue herons, and cormorants were observed in the more naturalized sections of the river. Generally, the environment around the river can be broken down into different observed typologies: the built environment, *Phragmites* wetland, woody wetland, and tidal mudflat.

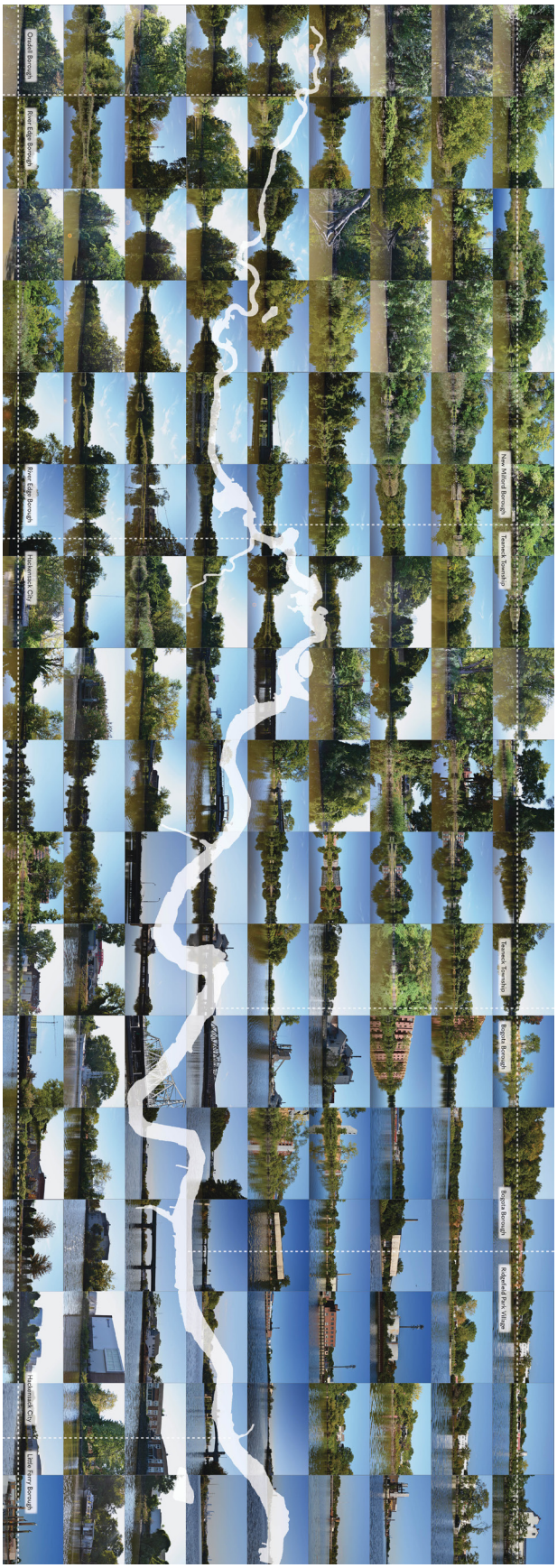


Figure 12. Photo Map of River Tour. This collection of photos illustrates the extent of the Hackensack River that was canoed by the author. The photos line up with their location relative to the river.

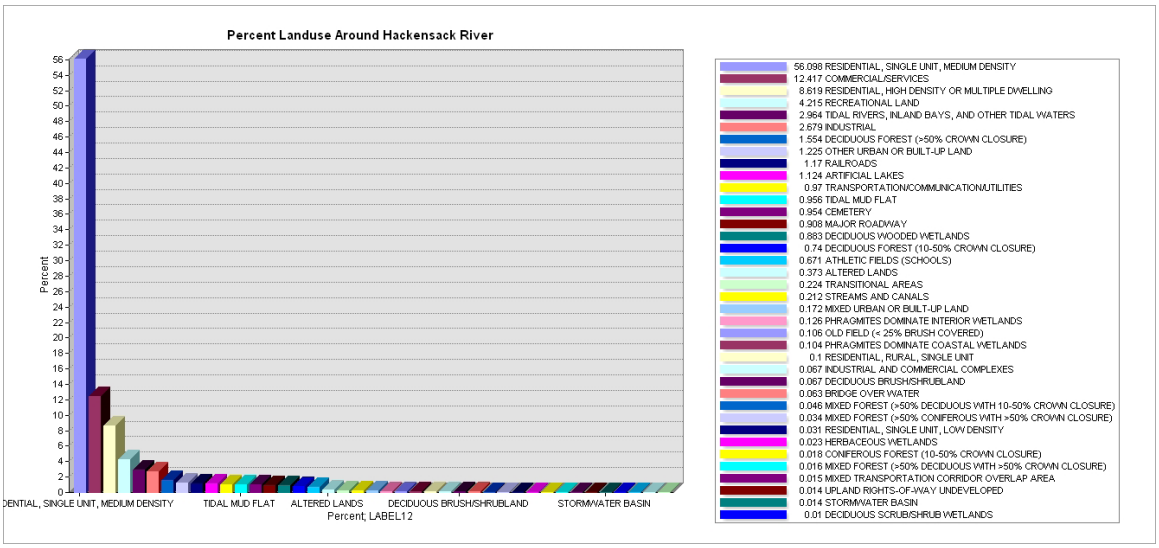


Figure 13. Percent land use chart for the Hackensack River study region.

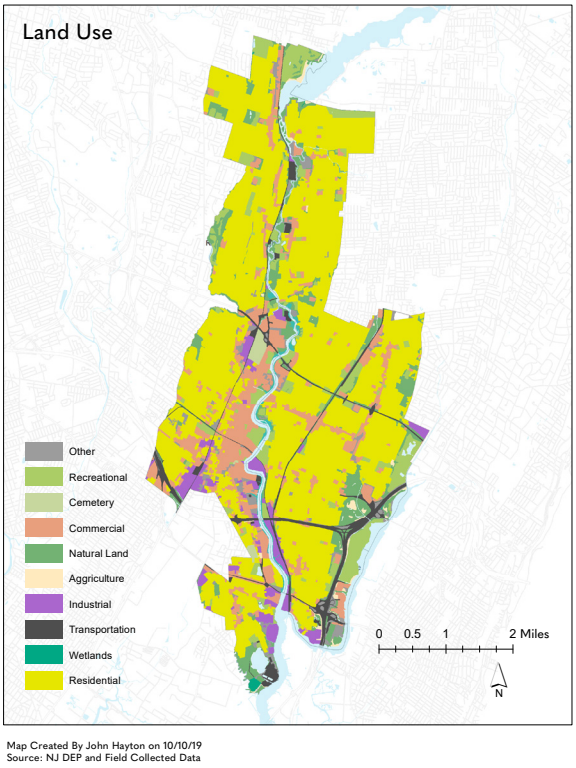


Figure 14. Land use map.

These observations were compared to a set of regional maps that were created using GIS data. These maps can be found in Appendix B. The most significant connection between the visual assessment and the GIS maps are most clear when looking at the land use map. The land use map shows four main land use types throughout the study region: residential, recreational, commercial, and industrial (see figure 13). The distribution of these land use types are displayed in figure 14. The whole study region is dominated primarily by residential land use. In the northern and eastern sections of the study region, the residential land use occurs directly along the river. The recreational land use occurs mostly toward the center of the study region. This is where most of the parks along the river are found. The largest parks are Johnson Park, Foschini Park, Hackensack River

County Park, Brett Park, Terhune Park, Oscar E. Olsen Park, and Andreas Park. There are no parks in the southern part of the study area. It's clear that most of the commercial land use occurs on the western side of the Hackensack River where the City of Hackensack is located. A large portion of this commercial land consists of strip malls along River Street. Most of the industrial land use occurs on the southeast side of the river in the municipality of Ridgefield Park. From the visual assessment, the change in the river landscape became most obvious when the commercial and industrial land use types were right next to the river.

From the visual assessment, there were several key outcomes that impacted design decisions. First, there are more existing riverside paths than originally expected. However, these paths are fragmented and lack connectivity to make the user experience more enjoyable. Second, the environment along the river can be divided into four main environmental typologies that collectively make up the Hackensack River experience: the build environment, *Phragmites* wetland, woody wetland, and mud flat. Lastly, the land use change from the North to the South is consistent with the observed quality of the river experience - more quiet and peaceful in the North opposed to busier and noisier in the south.

3.3: Proposed Greenway Path

The proposed greenway path was developed from the visual assessment of the river, evaluation of the past greenway plans, and current conditions along the Hackensack River. The process was guided by the goals of the greenway project:

1. Connect the communities along the Hackensack River in order to provide more open space for recreation and safer transportation.
2. Provide more access to the Hackensack River to utilize its potential as a scenic attraction.
3. Use the development of a greenway along the Hackensack River as an opportunity to enhance the local habitat.

The 1990s greenway project was smaller in scope than the greenway being proposed

Figure 15. Location of resident resistance to the 1990 greenway plan.

here. It was supposed to connect Johnson Park in Hackensack to Van Buskirk Island County Park in Oradell (4.1 miles). The greenway being proposed in this thesis connects Van Buskirk Island County Park to Lakeview Field in Little Ferry and Overpeck County Park in Ridgefield Park (a total of 9.38 Miles). The route for the 1990s plan was to be on both sides of the Hackensack River, with a large portion of the trail going along streets in New Milford. This was likely proposed because there is very little room between private property and the River in New Milford. To give access to the greenway path, it was necessary to use the roads as the greenway framework. However, some of the residents who lived along the river in New Milford and River Edge gave Bergen County enough opposition to stop the project from happening. Specifically, residents on Columbia Street in New Milford and Grove Ave in River Edge were quoted at public meetings (Morley, 1994). Figure 15 shows where the opposition for the greenway was most vocal. To avoid this problem in the future,

the proposed greenway route avoids the areas that were most against the greenway. The only part of the previous plan that has been carried over into the greenway design for this thesis is section along the railroad through River Edge.

Additionally, paths that currently exist along the river have been incorporated into the plan. Most of the existing paths are in Hackensack and Teaneck (See figure 16). Connecting these paths is an easy way to take advantage of existing infrastructure to make early successes along the greenway. Making larger sections of greenway will prevent visitors from pacing as observed in some spaces due to short path length. By using parts of the previously proposed greenway and the patchwork of existing river walk paths, a network of connections has been proposed that would create a contiguous path along the Hackensack River. Figure 16 shows the network of factors that make up the final proposed greenway. The final greenway route can be found in figure 17 on page 37.

Effort was made to allow for both sides of the River to have a path. This allows for loops throughout the greenway. By having loops, greenway users have the option to drive to locations where there is a parking provided to enjoy the greenway without having to go up and back on the same path. Additionally, when possible, links to the properties identified in the suitability analysis were made.

The proposed greenway route uses the framework of existing infrastructure as a guide when possible. For example, in Ridgefield park, there is a train line that runs along the river. Next to the train line is a small road (Industrial Ave) that is infrequently used. Making room next to the train line and potentially sharing the road for the greenway route could provide a simple solution to part of the southern greenway trail.

In places where private property or industry acts as a barrier to the greenway, the path can be cantilevered over the water. An example of where this solution might work is next to the Ice House. The Ice House is an ice skating rink that is built very close to the riverbank and leaves no room for a path. Sending the greenway out over the water can simultaneously respect the private property of the Ice House while giving people access to the Hackensack.

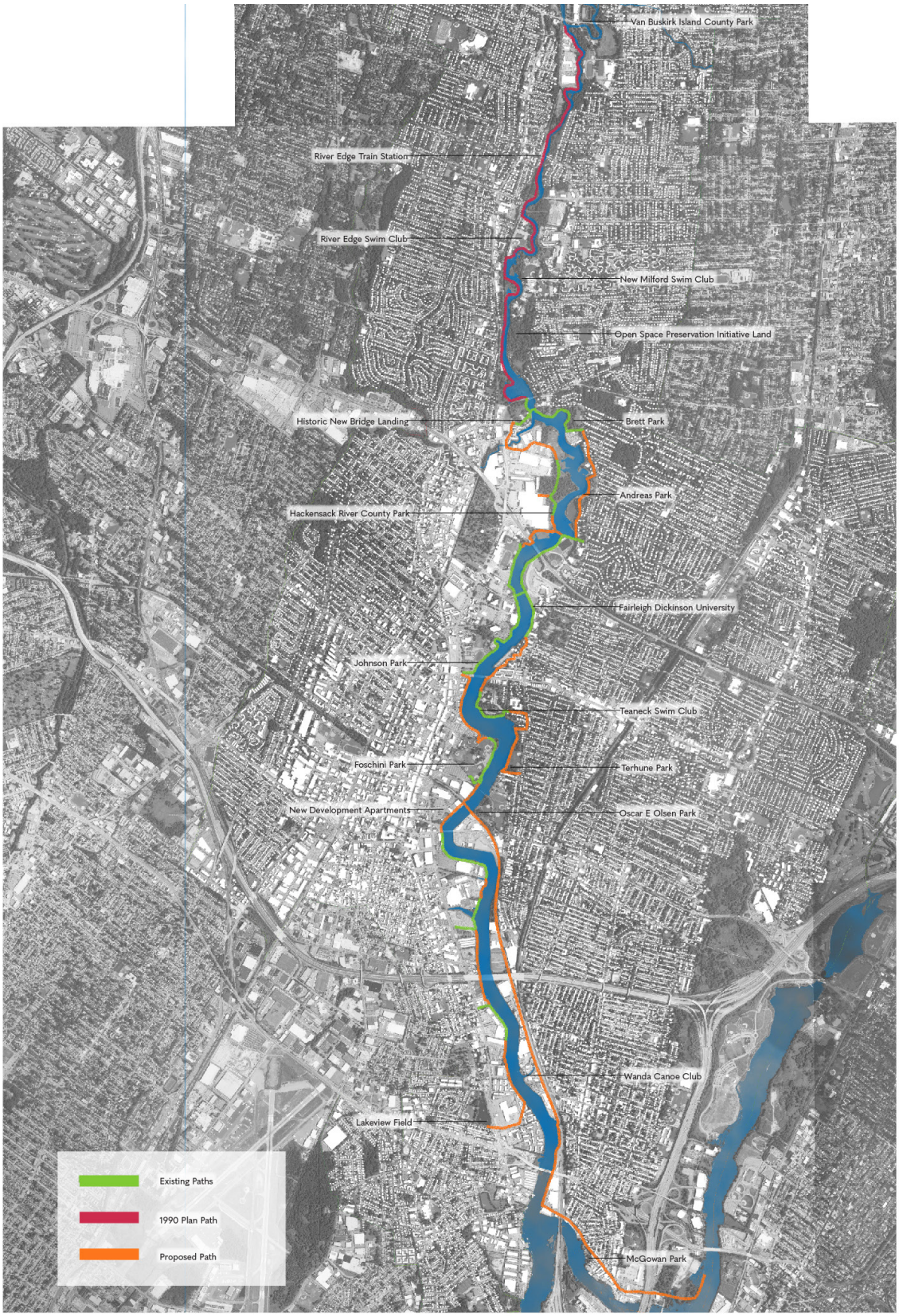


Figure 16. Important greenway locations and path types.

Figure 17. Conceptual greenway plan.

3.4: Path Typology Along the Hackensack River Greenway

The visual assessment and GIS land use mapping uncovered some typologies along the Hackensack River. The overall greenway plan goes through these areas. The greenway experience will change depending on the surrounding environment. The result is a set of six different greenway path typologies that respond to the changing environment along the Greenway: residential railroad, park, campus, road, cantilevered, and industrial railroad.

The Northern part of the proposed greenway in Oradell, River Edge, and New Milford is mostly residential. The greenway goes between the NJ Transit Train line and the river (See figure 18). The path is located between the train line and the river in order to distance the path from some of the communities that opposed the path in the 1990s. This will give the residents of these areas more privacy and can help to avoid future conflicts.

There are areas along the Greenway that have existing parks. Some examples of these parks are Johnson Park, Foschini Park, Brett Park, and Andreas Park. Most of the parks along the Hackensack River have open lawn or fields for sports. In locations like this, having a thin vegetated buffer between the park and the path would be needed to define the spaces (See Figure 19). A single row of planted trees could work well because it would separate the path from the activities in the park but allow a sight-line from the park to the greenway. A vegetated buffer between the path and the river would also be important. However, this buffer should be broken at specific places to give enough access to the river views.

Figure 18. Residential railroad typology.

Figure 19. Park path typology.

Parts of Hackensack and Teaneck have school and business campuses along the river. In these locations, there are already paths along the river. In general, these paths are some of the best maintained of the existing paths along the Hackensack River. However, more vegetation such as trees and planting beds could be added to enhance the experience by the water (See figure 20).

There are parts of the Greenway route that would have to parallel roads. In these cases, having a barrier between the road and the path is necessary in order to keep the greenway users safe (See figure 21). These barriers can also prevent noise and wind from impacting the greenway experience.

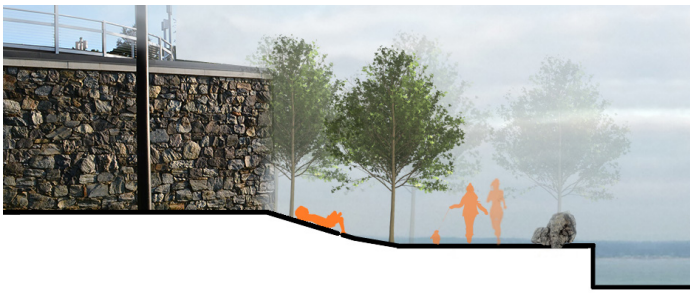


Figure 20. School or business campus path typology.

Figure 21. Roadside path typology.

In some places there is no room between the river and private property. Cantilevering the greenway over the river to get around the private property is a solution. The Hudson River Walkway in Hoboken uses this technique to maintain a contiguous path (See figure 22). The path is built over the water and is heavily used. Not only does this act functionally to maintain a contiguous greenway, but it also provides clear sight-lines across the river. An example of what this might

Figure 22. Example of cantilevered path to avoid private property. Photo taken at the Hudson River Walkway.

Figure 23. Cantilevered path typology.

Figure 24. Industrial rail path typology.

look like on the Hackensack River can be found in figure 23.

The southern part of the Greenway in Ridgefield Park is industrialized and major freight train lines parallel the Hackensack River. These train lines can be used as a framework for the greenway like in the northern part of the greenway. However, the experience will be very different. There would simultaneously be more existing infrastructure such as bridges and buildings while also containing fewer trees and vegetation. Just south of the Route 80 bridge, Industrial Avenue is an example of how the train corridor could be changed into a greenway route (See figure 24).

Overall, the greenway path typologies are a response to the landscape conditions observed along the Hackensack River. The six path typologies, residential railroad, park, campus, road, cantilevered, and industrial railroad, exist along the Greenway to create a diverse visitor experience though the communities of Bergen County.

Chapter 4: Hackensack River County Park Site Analysis

4.1: Location and Overview

Hackensack River County Park rated highly in the suitability analysis for determining good early-stage greenway projects. The highest ranked property was a 9.8 out of a possible 12. Hackensack River County Park rated a 6.4 out of 12. It is positioned in a key location for the success of the overall greenway. Independent from the analysis done for this project, the Hackensack River County Park was singled out in the greenway study in the 1990s as an important greenway location. After the project was stopped by public opposition, the compromise was a design for Hackensack River County Park (see figure 25).

There are five main reasons why this location was chosen for further study: its proximity to existing river walk paths, its location relative to existing places of interest, it's already owned by Bergen County, it contains important habitat for Bald Eagles, and has the main landscape elements found throughout the Hackensack River.

First, this site is located between multiple sections of existing riverside paths but is not connected to any of them. Linking existing paths together is one simple way greenway projects can gain momentum and service the community with the least amount of cost and input. Directly south of the site is the

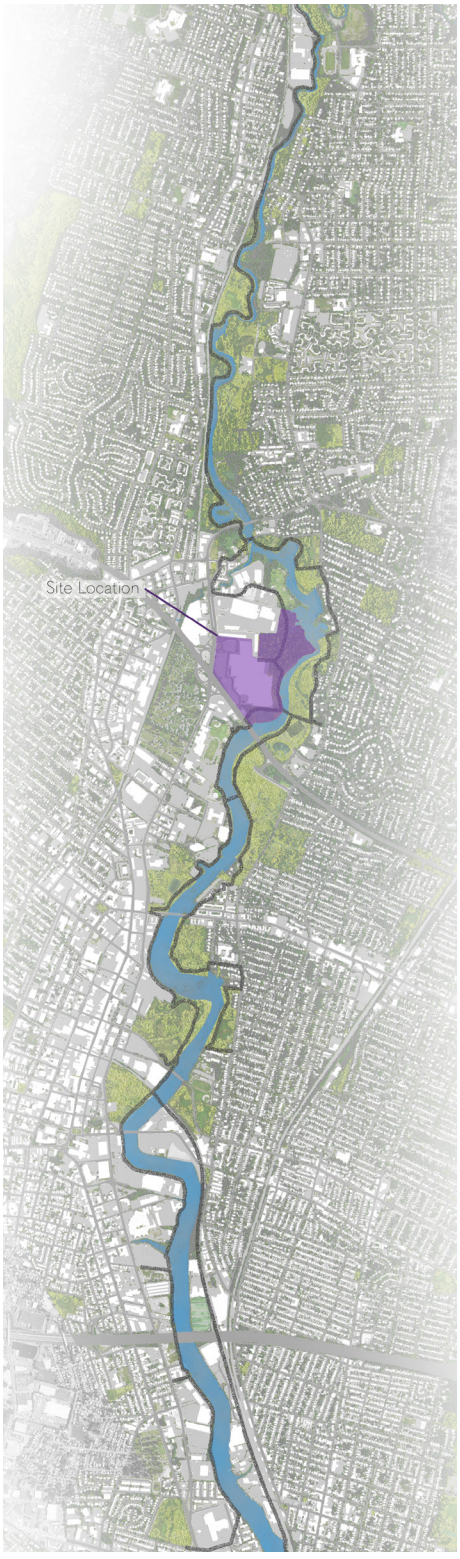


Figure 25. Site location map. Hackensack River County Park in the context of the proposed greenway.

Bergen County Academy Technical High School. A riverwalk path exists on their property and stretches one mile south to Johnson Park. Across the river, is the existing Hackensack Greenway through Teaneck which also runs through Fairleigh Dickinson University. Although there are sections of the Hackensack Greenway Through Teaneck that are not much more than a hiking trail, this section is paved and used by both pedestrians and bikers. The segment is approximately three-fourths of a mile in length.

Secondly, the park is located directly behind The Shops at Riverside Mall Complex and the Avalon Hackensack at Riverside apartment complex. Greenway sections that connect residential communities and commercial centers are typically more heavily used than other sections of greenway. Projects like these typically have higher success rates when applying for funding (Coutts, 2009).

Third, the Hackensack River County Park is owned by Bergen County and part of the Bergen County Parks Department. Given the management strategies and models described in Ericson's research, a county led model for Greenway implementation is recommended for the Hackensack River Greenway. The fact that this property is already owned by the county means that it doesn't need to be purchased before action is taken. This is important because land acquisition can be a long process that can delay subsequent design and construction phases.

Fourth, the park location is considered important habitat for Bald Eagles. Bald Eagles are a New Jersey Species of concern, and the habitat associated with the park offers not only nesting and breeding grounds, but also foraging sources.

Lastly, Hackensack River County Park contains all the landscape elements found throughout the whole Hackensack Study Region. The built environment, woody wetland, *Phragmites* marsh, and tidal mudflats all come together at this site. This makes Hackensack County Park an ideal location to set an example for what the Hackensack Greenway could look like through these different environments.

Given its ownership, proximity to existing greenway infrastructure, its habitat

potential, and it's suitable location for linking multiple land use types (residential, green space, educational, and commercial), The Hackensack River County Park is ideally located to begin the process of creating a single, contiguous greenway along the Hackensack River.

4.2: Potential Existing Park Users

The first and obvious factor impacting the Hackensack River County Park is the Shops at Riverside Mall. Customers at the mall are potential users to the park, however in its current state, the park is not visible to this audience. Besides having a physically overbearing presence on the park, the mall also blocks potential users. The only entrance to the park is through the mall and the mall parking lot which makes the park entrance uninviting.

Shopping trends in the past 30 years have seen a sharp decline in mall sales. However, the malls that are doing well diversify the experience of the mall visitor. Increasingly more people go to malls for activities other than shopping (Sanburn, 2007). For example, the American Dream Mall in East Rutherford, NJ offers a variety of entertainment options for visitors including mini golf, ice skating, skiing, and a water park (*American Dream,* 2020). Similarly, the Palisades Center in West Nyack, NY has diversified their visitor experience by adding a bowling alley, comedy club, and rope climbing course to their mall (Sanburn, 2007).

The Shops at Riverside Mall is owned by Simon and Company, the largest retail investor in the State of New Jersey (Simon Property Group). Even with the down-trending market for brick and mortar retail stores, Simon has recently invested heavily in renovations for the mall (Simon Property Group). It would make sense for the Mall to take advantage of the riverside experience to offer their visitors more than retail shopping. The mall has been upgraded and marketed as a top-of-the-line luxury retail center with many brand-name stores. The target group for the Mall, as described by Simon, is largely the upper-end of the income bracket of North Jersey and New York City (Simon Property Group). It's clear that the mall is not going away anytime soon, and given its location in proximity to the park, the users of the mall are potential park users.

In addition to the shoppers, a second important group of park users are the surrounding residential communities. The only community currently able to access the Park without a vehicle are residents at Avalon Hackensack at Riverside Apartments. However, across the river in Teaneck, there is a large community of single-family homes that could be within walking distance to the park if the right access was provided.

There are also two educational campuses and one office park within a half-mile of the park. Just south of Route 4 is the Bergen County Academies Technical High School. This campus holds 1,069 students and 95 teachers (*Bergen County Academies,* 2017). A riverwalk currently exists on the school campus, but it does not connect to Hackensack River County Park. Directly across the river is the Fairleigh Dickinson University Metropolitan Campus (*Metropolitan Campus Life*, 2020). This institution is home to almost 1,000 students. The part of campus directly across the river from the Park is where the athletic fields are for the School.

Additionally, the Hackensack River Greenway Through Teaneck is located across

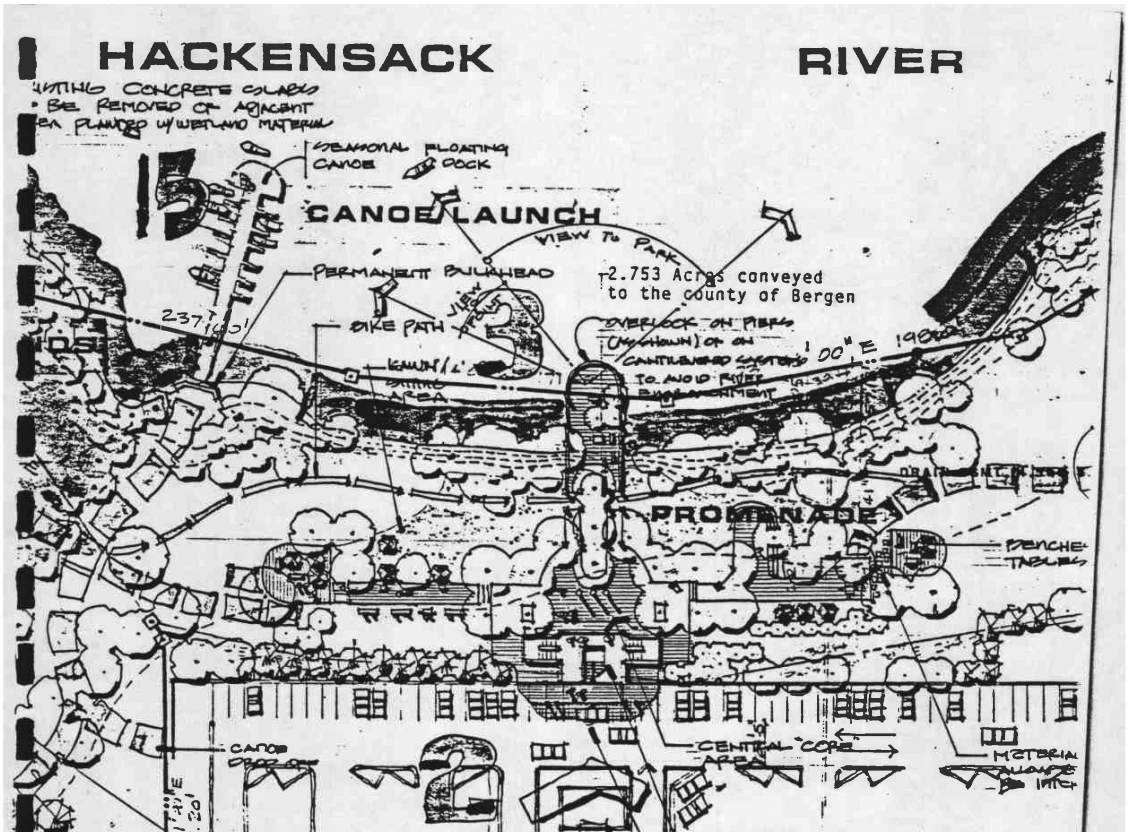


Figure 26. Historic 1994 design concept for Hackensack River County Park. Developed by Hakim Associates, 1994. (Hakim, 1994).

Figure 27. Site boundaries of Hackensack River County Park.

the river from the park. This trail system is supported by the organization Friends of the Hackensack River Greenway Through Teaneck. In most places, the it resembles a small hiking trail rather than a greenway. The trail particularly attracts birdwatchers, and there are plaques and interpretive signage about particular breeds of birds that can be observed along the river.

4.3: Existing Site Inventory

Hackensack River County Park has not been maintained or re-designed since it was constructed in 1994. Many of the benches are unusable or in various stages of disrepair (see figure 28a), the paths aren't clearly laid out and abruptly end in awkward places (see figure 28b), the overlook that is cantilevered over the river is sinking slowly into the sediment (see figure 28c), the cantilevered overlook has been patched where the wood as fallen through (see figure 28d). Generally, the site has been poorly kept and, in some places, has become dangerous to the public. Given that the last time the park was cared for was almost 30 years ago, it is time for an update.

Despite the unkempt state of the park, there is opportunity. Parking specific to the park exists in the parking garage. This allows for visitors to drive to the park if they are unable to walk or bike there. Additionally, there have been bird boxes placed around the park encouraging the nesting of bird species. Also, the way the river bends at this location allows for long views up or downstream increasing the aesthetic potential of the park. These features are also consistent with the greenway goals of encouraging access to the river, supporting wildlife, and offering scenic views of the river.

a) Benches

b) Incomplete Paths

c) Sinking overlook

d) Patched overlook boards

Figure 28. Existing park features. a) benches, b) incomplete paths, c) sinking overlook, d) patched overlook boards.

4.4: Circulation Diagrams

Flow and circulation are very important in the site analysis for this location. Access to Hackensack River County Park is confusing and unintuitive. There is only one entrance to the park, and it's concealed by the Shops at Riverside Mall and the parking garage. When trying to find the park, Google Maps takes you to a location where there is no access. The only other seemingly obvious entry point to the park is behind the adjacent strip mall. However, when trying to access it from this location, one is met with a chain link fence and a sign that says, "no park entry" (See figure 29). The first time I tried to access the park, I found this location, but could not find the formal park entrance. I had to return a different day to conduct the site observations.

In addition to the limited park access, the road system surrounding the park makes it particularly difficult to locate. The two roads adjacent to the park are NJ Route 4 and

Figure 29. False park entrance.

Hackensack Ave. Both roads are more than two lanes, require jug-handles for turning around, and are regularly backed up with traffic. When passing the park on either of these roads there is no visibility to the park. It is, for anyone who doesn't know it exists, invisible. This is particularly odd considering the amount of people who visit the mall each day and who drive past the park on route 4. The park has a very high potential for visitors given the high traffic area, but due to circulation issues, is left underutilized.

There are three relevant circulation patterns important to the use of the site: pedestrian circulation, vehicle circulation, and bus circulation. The circulation patterns need to be evaluated in three dimensions because the mall and garage are multiple levels. These are important to consider because when at the mall, there could be more than one possible way to reach the park entrance depending on what level you're on.

Pedestrian Circulation:

Most of the pedestrian circulation occurs on the sidewalks around the mall and within the mall itself (See figure 30). There are also several pedestrian trails existing in the park that loop around and create a meandering experience for visitors. However, the pedestrian access to the park is interrupted by the vehicular flow of the parking garage.

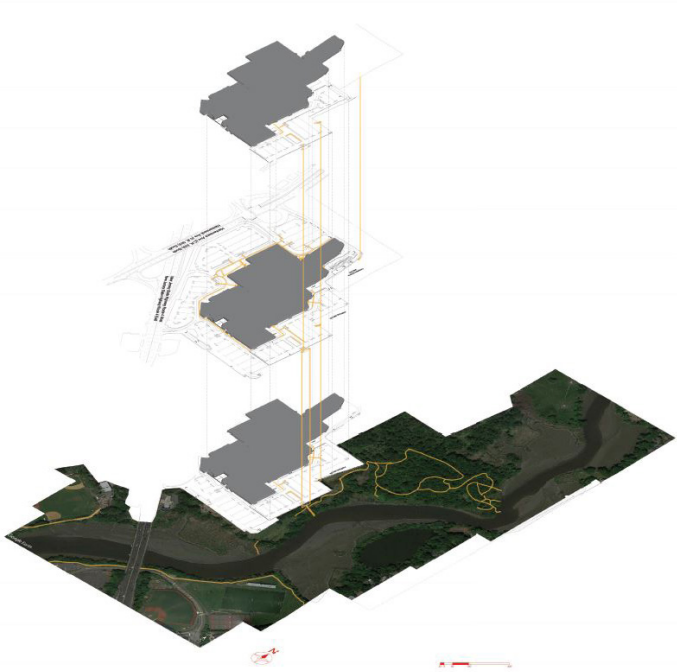


Figure 30. Pedestrian circulation diagram

Another reason for the disconnect could be that most of the pedestrian circulation associated with shopping occurs on level 1, while most of the pedestrian circulation associated with the park occurs on the ground level. These levels are connected only by a set of stairs. However, access to the stairs in unintuitive and requires users to cross the parking garage. This prevents shoppers from gaining easy access to the park while simultaneously prevents the shoppers from knowing of its existence. In addition to the restricted access for pedestrians from the mall to the park, figure 33 on page 51 shows the other locations where pedestrian access is physically blocked.

Vehicle Circulation:

Like much of New Jersey and the Hackensack River region, the space surrounding Hackensack River County Park is designed for cars. The mall is buffered by parking decks and the circulation is confusing. All the entrances to the space come from Hackensack Ave or Route 4. Most of the vehicle traffic occurs on level one (see figure 31) because that is the level where all the traffic arrives from the roads. Unless you enter the site with previous knowledge of the parking garage, it is likely you will only use level one. To get to the park entrance on the ground level, a ramp on the north side of the property and a ramp on the south east side of the property can be used, however, these are only for compact vehicles and easily missed in the frenzy of entering and exiting the busy mall parking lot.

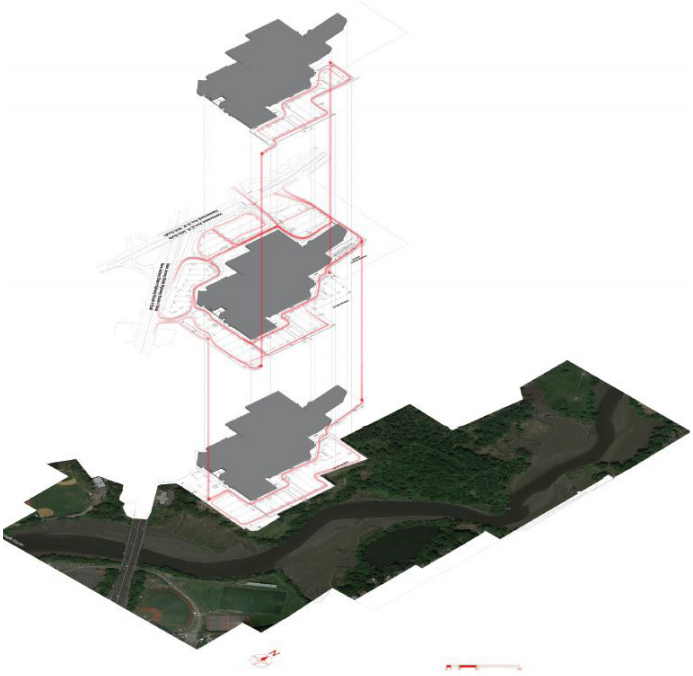


Figure 31. Vehicle circulation diagram

There are two major arteries of circulation used by vehicles in general. The first is directly between the mall and the parking spaces.

This lane is characterized by many stop signs and pedestrian cross walks to assist shoppers to their cars. The second is directly between the Hackensack River County Park and the parking spaces. There are no stop signs or pedestrian cross walks between the park entrance and the parking spaces. There are also no traffic calming tools to draw attention to the potential pedestrians walking to the park.

Bus Circulation:

There are two bus routes that stop at the Shoppes at Riverside Mall which also provide access to the Hackensack River County Park. NJ Transit Bus 756 travels from Englewood Cliffs NJ to the Bergen County Community College. NJ Transit Bus 572 travels from the Hackensack Terminal to Paramus Park. The bus stops are located at the front of the mall. These locations cannot be changed to the back of the mall (where the park entrance is) because of height restrictions of the parking garage. Currently, for bus travelers to access the park, they need to walk through the mall and parking garage.

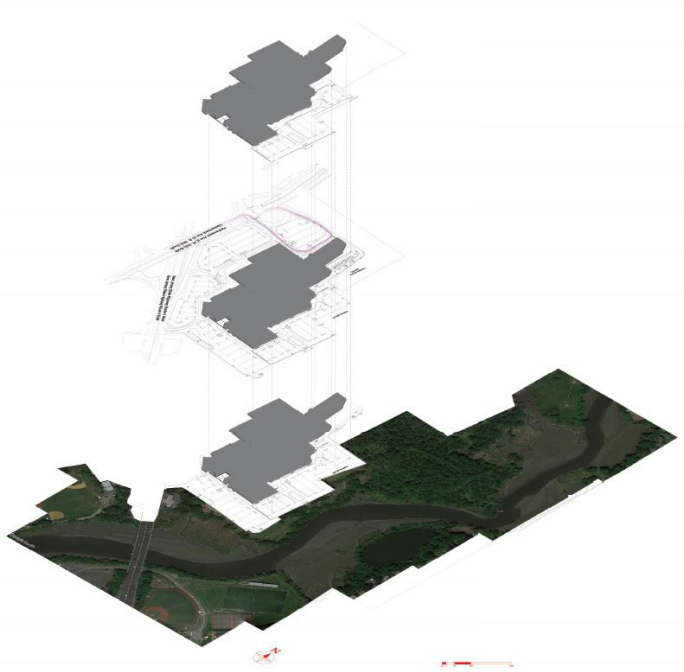


Figure 32. Bus circulation diagram

Circulation Barriers:

With the current circulation of the site, there are key places where pedestrian access is limited. Figure 33 illustrates where these barriers exist. First, there are two major vehicle lanes that pass between the back exit of the mall and the entrance to the park. This prevents a natural flow of pedestrians from the mall to the park and from the park to the mall. No sidewalks or crosswalks exist to make the connection.

The property to the south of the park, across from Route 4, is the Bergen County Academies Technical High School. There is an existing riverwalk path on this property, but it ends at route 4. This path has the potential to connect the park and the mall to the downtown section of Hackensack where there is currently a lot of investment in new apartment buildings. In this case, Route 4 is a major barrier as it is a four-lane thoroughfare.

The way the parking is set up, buses are unable to pull around to the back of the mall. There is a height limit to the vehicle access. Because of this, most people who take the bus to visit the mall don't go out to the back where the park is. Additionally, there are apartment complexes to the north of the mall that have no connection to the park despite being directly adjacent to it. The potential to combine an access point from the apartment complex and the bus stops to the park would benefit park use and make the site more pedestrian friendly.

The river itself acts as a barrier to the site. Directly across the river from the park is Fairleigh Dickinson University. The riverwalk along Fairleigh Dickinson University is part of the Hackensack Greenway Through Teaneck and continues north to New Bridge Landing Historical Site and south where it connects with River Rd. In addition to the campus, there are a lot of single-family homes that have access to this part of the greenway who would benefit from a connection to the park system across the River.

Figure 33. Circulation barriers diagram

Exploring different options for pedestrian flow will not only

make the overall greenway plan more cohesive, but it will also provide additional much needed access points to a county park. There is opportunity to make the park much more accessible to a larger population of Bergen County citizens.

4.5: Existing and Potential Viewsheds

Vista points and views are important to the site. The scenic beauty of the Hackensack River is historically significant and has been lost with the built-up development in the past 100 years. Hackensack River County Park is a good example of how high-speed roads run past the river and large buildings block any views of the river. The best way to see the scenic beauty of the Hackensack River now, is driving over one of the bridges during a high traffic time when the flow of vehicles is slow.

In addition to the historic significance, the views are important to help draw visitors to specific important locations within the landscape. The existing designed park and surrounding path system includes spaces where these vista points were placed. However, since their implementation, some of these vista points have been overgrown. Figure 35 shows where these designed vista points are located and if they are active. Active vista points are places where there are still undisrupted views of the landscape. Figure 34 shows the extent of the viewsheds from the active vista points. Inactive vista points are places where there is infrastructure, such as educational signage, that suggests a view, but has

Figure 34. Existing viewshed diagram

Figure 35. Vista points diagram

since been overgrown by vegetation (see figure 36).

Coinciding with existing points, figure 35 also points out potential vista locations. The potential locations are places that have been ground-truthed in order to determine their value for views. There are no formal access points to these locations currently, but they offer views of the river scenery.

Figure 36. Example of an overgrown vista point.

4.6: Habitat Types

There are five major habitat types that can be found at Hackensack River County Park. These habitat types are *Phragmites* Marsh, Mud flats, Woody Wetlands, Lawn, and Open Water. These habitat types reflect the overall Hackensack River Landscape. Specifically, *Phragmites* marsh, woody wetlands, and tidal mud flats are found throughout the study area.

Common Reed Grass, *Phragmites australis*, is an invasive species of grass that is found in disturbed marshes and coastal areas (Tiner & Berquist, 2007). *Phragmites* dominated marsh has become a major landscape feature at Hackensack River County Park (see figure 37). In the Hackensack River, it has taken over in marsh areas that have been disturbed by human development – replacing the natively existing salt marsh species *Spartina alterniflora* and *Spartina patens* along with other native, saline-tolerant marsh species (Tiner & Berquist, 2007). In general, while *Phragmites* provides useful functions such as stream bank stabilization and carbon sequestration, when compared to the native salt marshes, it provides less ecological function (Benoit & Askins, 1999). Generally, *Phragmites* dominated marshes have little biodiversity because of the dense and aggressive growth habits of the plant (Warren et al, 2001). Rather than providing an environment where a myriad of plants can thrive adding a diversity of ecological functions and habitats for local ecology, a *Phragmites* dominated marsh consists of one plant. Consequently, it has been linked to less productive

Figure 37. Location of *Phragmites* at Hackensack River County Park

environments for fish and bird species which historically have thrived and relied on native marsh environments for foraging and breeding (Benoit & Askins, 1999; Warren et al, 2001).

In addition to the ecological impacts, the patches of *Phragmites* marsh have a significant impact on the visitor experience of the park. *Phragmites* grows very densely and to a typical height of 6-12 feet (Silberhorn, 1976). For paths through Phragmites, it can be disorienting and confusing if there is no visual sight-line or exit. At Hackensack River County Park, there is a boardwalk that leads through a stand of *Phragmites* to a small observation deck with signage and information about the surrounding wildlife. However, in order to get to the deck, the path curves through the *Phragmites* in such a way that makes it impossible to see where you are going or where you have entered. Additionally, since this path is not a loop, when the visitor is on the observation deck, there is a sense of insecurity.

Along the Hackensack River, *Phragmites* environments are often coupled with mud flats. This is also true at Hackensack River County Park (see figure 38). Mud flats are generally located in tidal zones. They are exposed at low tide and submerged at high tide. Characterized by relatively flat topography with little to no vegetation, they form when

Figure 38. Location of mud flats at Hackensack River County Park

sediment travels downstream and enters a lower-energy area (*Intertidal mud flats*, 2020). With a decreased flow, the sediment is deposited to the bottom of the river and builds up over time.

The structural makeup of mud flats makes them vulnerable to change. Made of mostly sediment, when the flow intensity of the river changes or the flow volume of the river changes, the mud flat can shift accordingly. This can come from events such as large storms or development upriver. Mud flats are common along the Hackensack River and have been more prevalent in years since the construction of the Oradell Dam. Logs and other large forms of debris can accumulate in mud flats. The buildup of organic matter as a result can lead to rich environments for organisms to live (*Intertidal Mud Flats, 2020)*.

The unique environment the mud flats provide sanctuary for invertebrate such as worms and crustaceans such as clams. These organisms are an important food source for many fish and migratory birds. Birds such as piping plover and snowy egret use mud flats as important foraging grounds. Mud flats generally have little permanent vegetation due to dynamic shifts in the sediment. However, they do have different types of algae that thrive as

primary producers for this environment (*Intertidal Mud Flats*, 2020).

Mud flats, however, can prove to be a difficult design challenge for Landscape Architects. It is difficult to build on the mud flats and they do not hold vegetation because they are constantly shifting. However, they do provide some design opportunities for the Hackensack River. First, they provide no visual barrier because they do not hold vegetation or structure. This can be an advantage by placing vista points near their locations for long stretches of uninterrupted views. Secondly, their high ecological value attracts many migrating shorebirds. Some of these shorebirds are considered state threatened and are popular species to observe by birdwatchers. This provides educational opportunities to explain a naturally functioning tidal riverbed and the organisms that benefit from it.

Hackensack River County Park also contains important woody wetland habitat (see figure 39). Forested areas directly next to wetlands and bodies of water are significant habitat for bald eagles. Bald eagles use trees overlooking water for nesting. They also use the surrounding water and wetland for foraging (*Bald Eagle*, 2020). Much of the forested wetland along the Hackensack River has been removed for development. As the bald eagle

Figure 39. Location of woody wetlands at Hackensack River County Park.

populations in New Jersey are recovering from their decline in the 1900s due to harmful chemicals, these woodlands have high value and importance for the ecosystem. Hackensack River County Park is classified as habitat of significant importance for bald eagle populations by the NJ DEP. In addition to the habitat for bald eagles, woody wetlands provide habitat for smaller songbirds as well as a host of other organisms including turtles, frogs, raccoons, and fox.

Much of the land directly next to the mall consists of lawn (see figure 40)The lawn consists of all areas on the site that have been planted with turf grass and are mowed and maintained as low-ground cover. The Hackensack River County Park lawn exists directly next to the parking garage. Notably, these areas span from the parking structure almost all the way to the river with little riparian buffer. Nearby, other lawn locations are found on the Fairleigh Dickinson University Campus and the Bergen County Academies Technical High School.

These locations offer little ecological value but are important locations for site programing and human use. Currently the lawn at Hackensack River County Park makes it

Figure 40. Location of lawn at Hackensack River County Park.

possible to see from the parking garage to the tree-line along the river. Without obstructions, this can draw people from the parking garage into the Park. However, this also makes it possible to see the parking structure from various locations in the park. The visual oppression served by the parking deck is daunting considering the narrow geometry of the park itself.

The river itself is also a dominant feature at Hackensack River County Park (see figure 41). The river is extremely important ecologically as it flushes and circulates nutrients, provides habitat for fish and benthic invertebrates, and also foraging grounds for large birds of prey such as bald eagles (*Bald Eagle*, 2020). The light reflections from the water and the long, uninterrupted views allow for beautiful scenery for park visitors. Taking advantages of these sweeping views of the Hackensack River would be important in the design consideration.

Figure 41. The Hackensack River at Hackensack River County Park.

4.7: Tide diagrams

The Hackensack River is tidal through Hackensack River County Park. Because of this, the experience changes from hour to hour. The river has shallow slopping banks that provide a dramatic visual difference between high tide and low tide. At some points along Hackensack River County Park, the river can appear to more than double in width between high tide and low tide. At low tide, the mud flats are exposed, and a variety of birds can be observed foraging on the exposed crustaceans and worms.

The tidal change is due, in large part, to the positioning of the sun and the moon and the gravitational pulls they have on the oceans. When looking at the tide charts over the time frame of a month, a pattern is clear (see Figures 42 & 43). The vertical change in water level between high and low tide is approximately 4ft when there is no moon, and 8ft when there is a full moon (USGS, 2020). Therefore, the viewsheds that are so important to the success of the park and the experience of the park visitors are changing directly as a result of the moon cycle (see figure 43).

Overall, the site analysis of Hackensack River County Park shows a need for a re-design. It's been about 25 years since the last substantial maintenance or design has been done at the park. Additionally, it's in an important location for the success of the greenway. Directly adjacent to two existing river paths, making these connections would not only be a significant advancement of the greenway project, but it would also provide much needed access to the park itself. Access to the park is limited and scenic views of the Hackensack River could be improved. Furthermore, there is potential for improving the habitat quality for important bird species such as bald eagles. Hackensack River County Park could become a major attraction to the Hackensack Greenway plan.

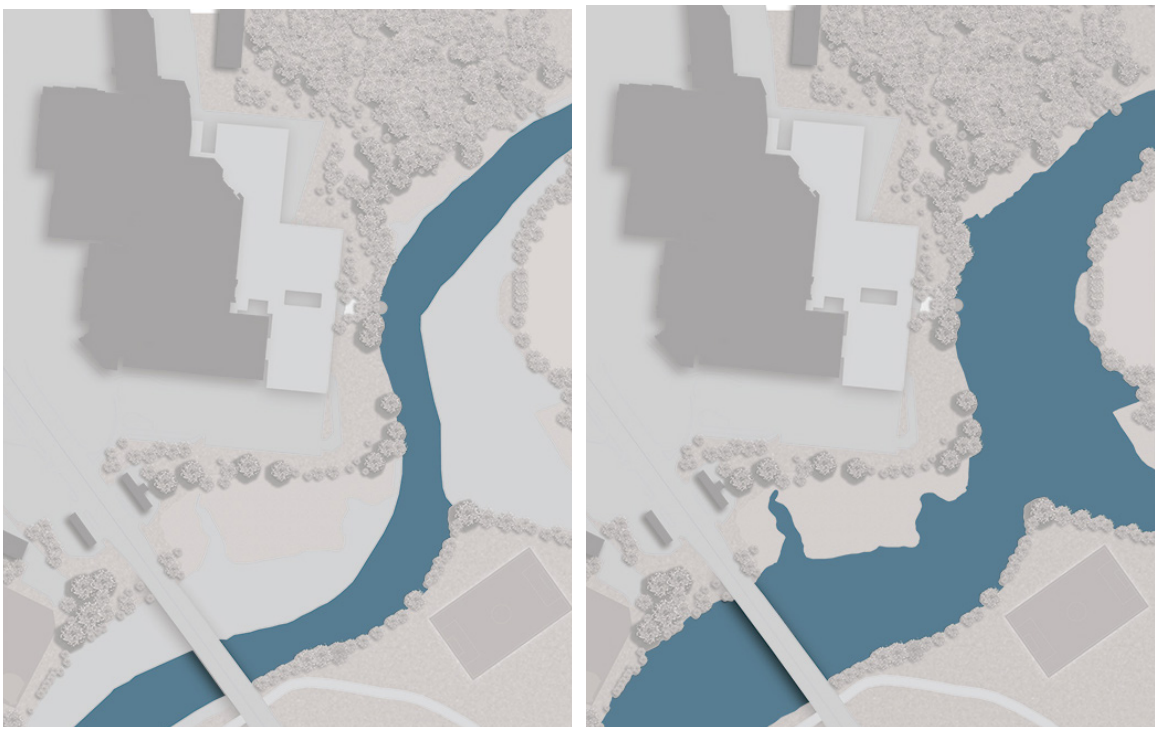


Figure 42. Tidal diagram showing the difference in river width depending on the tide.

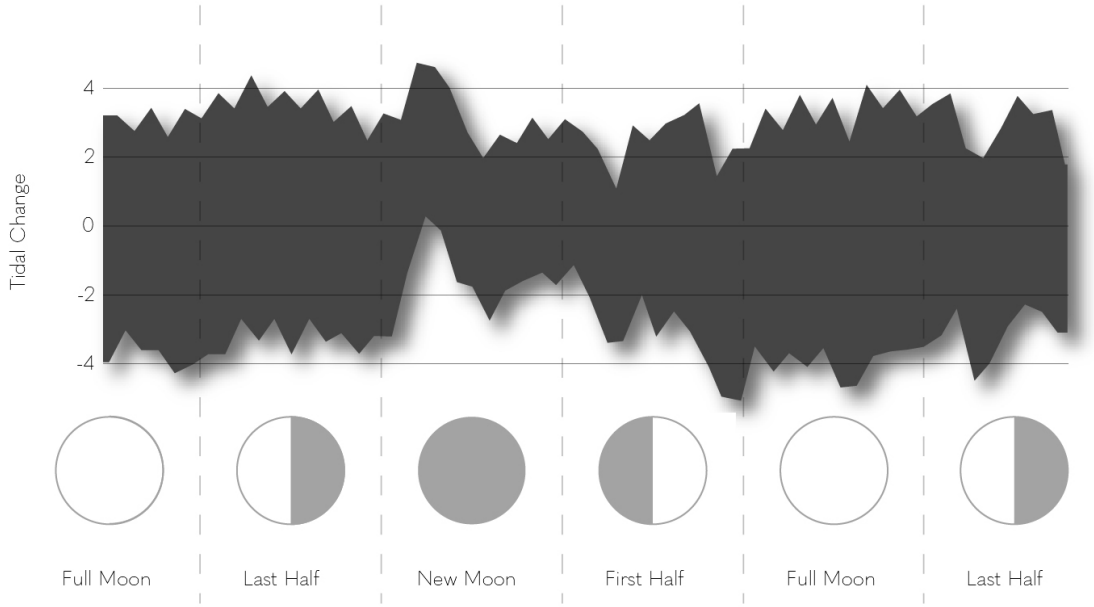


Figure 43. Example tide chart with moon phases.

Chapter 5: Hackensack River County Park Site Design

The process of site design must consider the overall greenway design as well as the site analysis. Based on the regional analysis done in Chapter 3, Hackensack River County Park was chosen as a significant first-step location for the greenway project because of its county ownership, close proximity to existing trails, potential links between commercial and residential spaces, the high habitat value potential, and the different environments found on the site that represent the overall landscape of the Hackensack River. The design will fit within the goals set forth for the Hackensack Greenway by connecting to communities along the Hackensack River for more recreation and transportation options, providing more access to the scenic views offered by the Hackensack River, and enhancing the local habitat. In order to successfully re-design Hackensack River County Park in the context of the overall greenway design, a morphological box method was used to come up with a conceptual plan using criterion developed from both the regional and site analysis phases. Then, once a sound conceptual plan was developed, section drawings and renderings were used to give an example of what specific design elements could look like to achieve the design goals.

5.1 Morphological Box Conceptual Design

The morphological box methodology uses inventory and analysis to identify site problems and develop design goals. These, in turn, inform specific design criteria. Each of the design criterion are isolated and explored in iterations. The conceptual design variations for each of the criterion are evaluated against the overall goals of the design. Weighing the positive and negative aspects of each iteration in relation to the design goals, one is chosen from each criterion and overlaid with the others. The selected elements are layered to produce a conceptual site plan. At this point, the plan can be evaluated against the goals of the design, and criteria can be modified for further layering. Once a robust conceptual plan has developed, the details of how the space is experienced can evolve in further detail.

For Hackensack River County Park, the site analysis revealed several challenges for greenway design. These challenges can be summarized with the following problem statement:

Hackensack River County Park has potential to be a key location for the success of the Hackensack River Greenway. However, problems such as limited access, hidden views, and incomplete trail connections make it all but invisible to those who are unaware of its location, thus leaving it underutilized as a public space.

This produced a goal statement aimed at creating a vision for Hackensack County Park that would resolve the issues in the problem statement:

The site will become a key location for the Hackensack Greenway by connecting existing trails, communities, and industries. The site will include amenities to activate the space to provide a more desirable user experience while providing essential framework for ecological systems to flourish. The site will give visitors the Hackensack River Experience by offering scenic views of typical environments that can be found along the entirety of the Hackensack River.

The goal statement gives a framework for a set of design criteria used in the Morphological Box design method. These criteria include park circulation, scenic views, ecological framework, and site activation amenities. Park circulation is important because it includes the connections to the surrounding riverwalk paths. These connections are the backbone of the overall Hackensack Greenway vision. By connecting the park to the mall, schools, and residential communities, the greenway can create a less fragmented environment. Scenic views of the Hackensack River will be a priority in order to provide access to the natural environment in this urbanized area. More visual access and connection is important as it was found to be lacking in both the regional and site analyses. Providing a strong framework for native ecologies to succeed is important to the site design as well as the greenway. Given the amount of disturbance and environmental degradation the Hackensack River has experienced, restoring some of the natural environments would improve the Hackensack River. One of the major design challenges in urban greenway design is the feeling of safety and security (Keith et al, 2018). By providing places in the park for people to gather and spend time, the less crime is likely to occur. Activating the space in this way will

also increase the recreational opportunities for greenway users. These four design criterion can be defined for the Hackensack River County Park below:

Park Circulation: Park circulation is currently limited to a few trails that have indistinct paths. There is a loop through the forested area, but getting there is unintuitive, so for the casual visitor, the park experience is limited to the observation deck directly adjacent to the parking garage. Furthermore, the access to the park is limited to a single entrance hidden behind the parking garage. The park circulation criteria focuses on integrating intuitive access to the park with the internal park circulation.

Scenic Views: Currently there is only one viewpoint available to the park user. Opportunities for more scenic views are available and can add to the experience of Hackensack River County Park as well as connect park visitors to the different environments the Hackensack River has to offer.

Ecological Framework: Currently, the site is identified as bald eagle habitat. Maintaining the balance of visitor access and use with the ecology of the site is essential. Additionally, all the wetland is dominated by *Phragmites* which provides poor habitat quality when compared to more diverse native wetlands. Establishing a framework where more plant diversity can be added to the design is essential.

Site Activation Amenities: Currently, Hackensack River County Park offers few park amenities for public use. The benches are in disrepair, trails are unclear, and the observation deck is sinking into the mud flat. The infrastructure for recreation is non-existent. Creating opportunities and activities for park users will provide the framework for a more desirable outdoor resource. These activation areas should consider mall shoppers, nearby schools, businesses, and residential neighborhoods as the potential park user population.

Each of these criteria were explored and resulted in a set of options. Each option independently addressed the criteria. The design criteria iterations for park circulation can be located in figure 44 on page 66. The iterations for scenic views can be found in figure 45 on page 67. The iterations for ecological framework can be found in figure 46 on page

68. Lastly, the iterations for site activation can be found in figure 47 on page 69. For each criterion, the bold box indicates which option was chosen for the layering process.

Status Quo: Currently the only connections on the site are directly off of the parking garage. The path leads to the river, but not anywhere else. There is also a small path through *Phragmites* that overlooks the river to the south.

Connection Over Route 4: A pedestrian bridge over route 4 would provide access to Hackensack River County Park. This option delivers the basic connection needed for the park to be integrated into a greenway network along the Hackensack River.

Basic Connection Under Route 4: This iteration sends the greenway path under route 4 to make the connection to Hackensack River County Park from the south. This option would also satisfy the basic requirements for connecting the park to a greater greenway network. However, by going under route 4, it replaces scenes of busy traffic with scenes of the river.

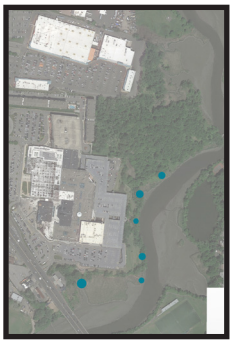
Apartment Connection: Building on the connection under route 4, this iteration also makes a connection to the local apartment complex north of the mall. This would give residents more direct access to the greenway.

Teaneck Loop Connection: This iteration makes the most connections to surrounding paths and potential park visitors. It connects Hackensack River County Park to the path south of Route 4, North to New Bridge Landing, the Apartment Complex North of the mall, and Fairleigh Dickinson University in Teaneck.

Figure 44. Connection morphological box iterations.

Status Quo: Currently, the only views of the river accessible from the park exist at the overlook and a platform surrounded by *Phragmites.* At present, neither of these places are particularly inviting. The viewing platform is hard to find because there's not a path leading to it.

Riverbank Reveal: This iteration would require opening up the whole riverbank for pedestrians and park visitors. Although this option would provide many vantage points for park visitors to view the surrounding scenery, it would require the removal of many existing trees along the river.



Pockets of Views: By providing specific pockets along the riverbank for access to scenery, the removal of many trees would be avoided. Additionally, these locations could be strategically placed to maximize a particular scene in the Landscape.

Overhead Boardwalk System: The most intrusive option, the boardwalk system would provide a meandering path over the mud flats along the Hackensack River. However, this may not be practical given the tendency of mud flats to shift during major storm events.

Figure 45. Scenic views morphological box iterations.

Status Quo: Currently, the ecological framework mainly consists of the forested area in the northern part of the park. Although there are a lot of wetlands in the park, all of them are damaged and dominated by *Phragmites*.

Woody Wetland Take-Over: This iteration proposes the removal of the parking garage between the mall and the park. Expanding the forested area to the entrance of the mall would create almost double the amount of forest habitat valuable for Bald Eagles. However, this would be very expensive and likely not possible because the mall owns the parking garage.

Major Wetland Re-Naturalization: Wetlands are important to the habitat value of the Hackensack River. Re-establishing native wetland species would improve the ecology of the area significantly. However, removing *Phragmites* is a very difficult and expensive process.

Selected Wetland Re-Naturalization: Targeting strategic locations to restore wetland and improve ecological function of the park would be the best solution. This iteration balances the value of the native wetland to the ecology with the experience and effort needed to make it happen.

Figure 46. Ecological framework morphological box iterations.

Status Quo: Currently there is nothing on the site that could actively draw people to the park.

Outdoor Plazas: Locating plazas outside some of the restaurant areas would draw people out toward the park. These locations could be programed to have events that link the park to the mall. However, due to the tight space on the site, this would have to take away from some of the major parking locations.

Bald Eagle Observation Deck: Instead of removing the existing parking, a bald eagle observation deck could be built on top of the parking garage. This would allow for site-lines over the trees as well as attract visitors from the mall.

Boardwalk Zip-line: Using the height of the parking garage, a zip-line could be connected to boardwalks at the rivers edge. Ultimately, although this would draw a lot of visitors to the park, it would damage the mudflats and wetlands by placing the boardwalks on them. It would also require the removal of trees along the trajectory of the zip-line.

Riverside Gathering Spaces: Providing gathering spaces on the ground-level of the park would give people a place to socialize outside of the mall. There is enough space for gathering spaces to include benches and other infrastructure to draw people outside.

Figure 47.
Site activation morphological box iterations.

The morphological box method resulted with a conceptual site plan (see figure 48). Connecting across the river to Teaneck, under Route 4, and to the apartment complex proved to be the option that most satisfied the design goals. By giving pockets of scenic views to the river, most of the riverbank ecology would remain unharmed while still providing access to the beautiful scenery at the river's edge. In order to keep the habitat goal realistic, only strategic locations of *Phragmites* dominated wetland would be restored to native wetland. Two site activation options were used because they did not conflict with each other. The first option is an observation deck on the parking garage. The second site activation strategy is to create gathering places along the river.

Figure 48.
Morphological box layered concept plan.

The overlaid morphological boxes were further developed into a site plan. The specific design features used to satisfy the goals can be found in figure 49. Enlargements of the parking garage and the proposed pedestrian bridge are found in figures 50 and 51 on page 72. The proposed design interventions to are labeled as follows:

1. Connection to the Bergen County Academy Technical High School
2. Connection across the river to Teaneck
3. Stronger connection to the Shops at Riverside Mall
4. Wetland garden
5. Bald eagle observation deck
6. Dock and canoe launch
7. Reconstructed native wetland
8. Exercise station

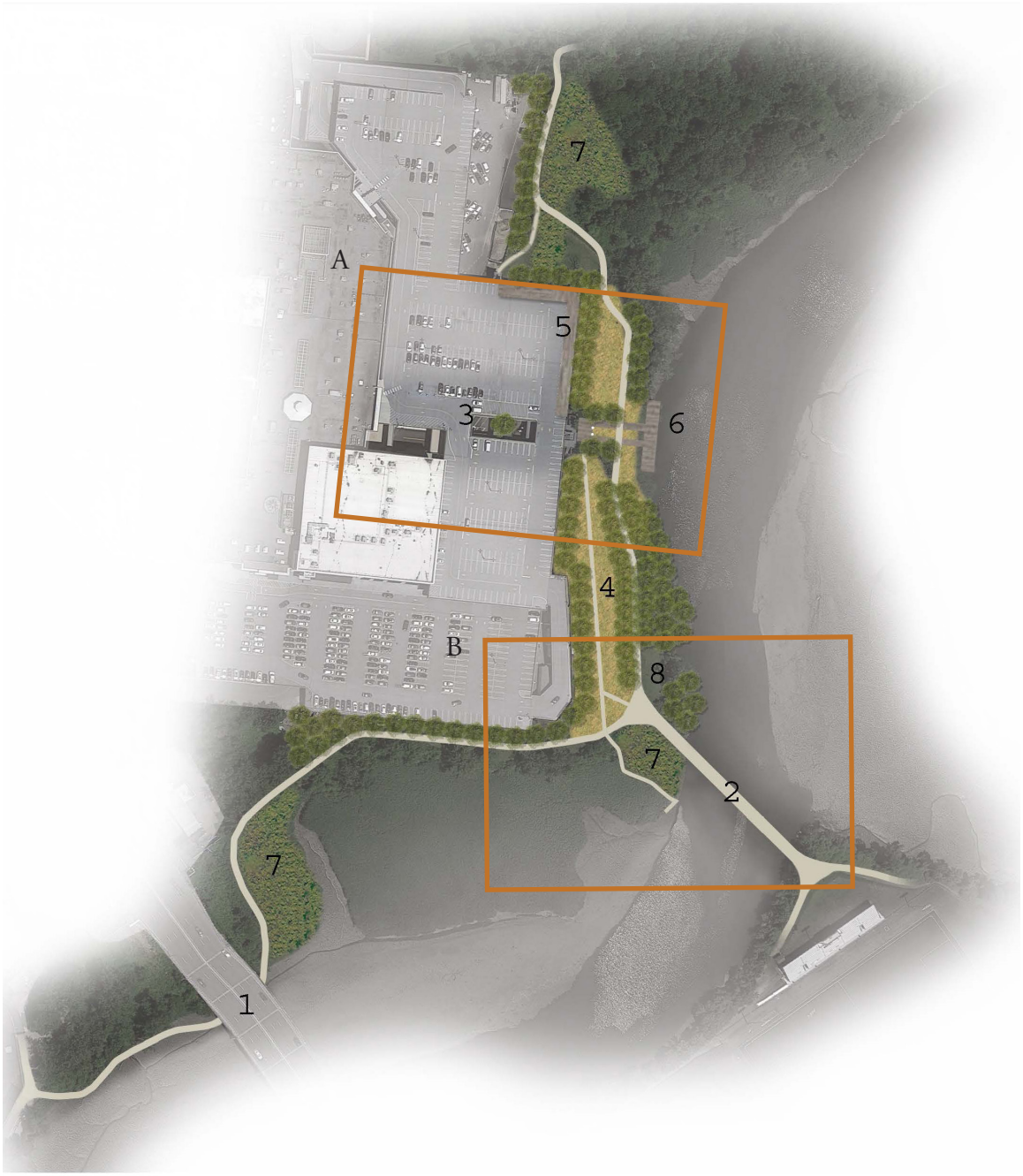


Figure 49. Site design

Figure 50. Enlargement A.

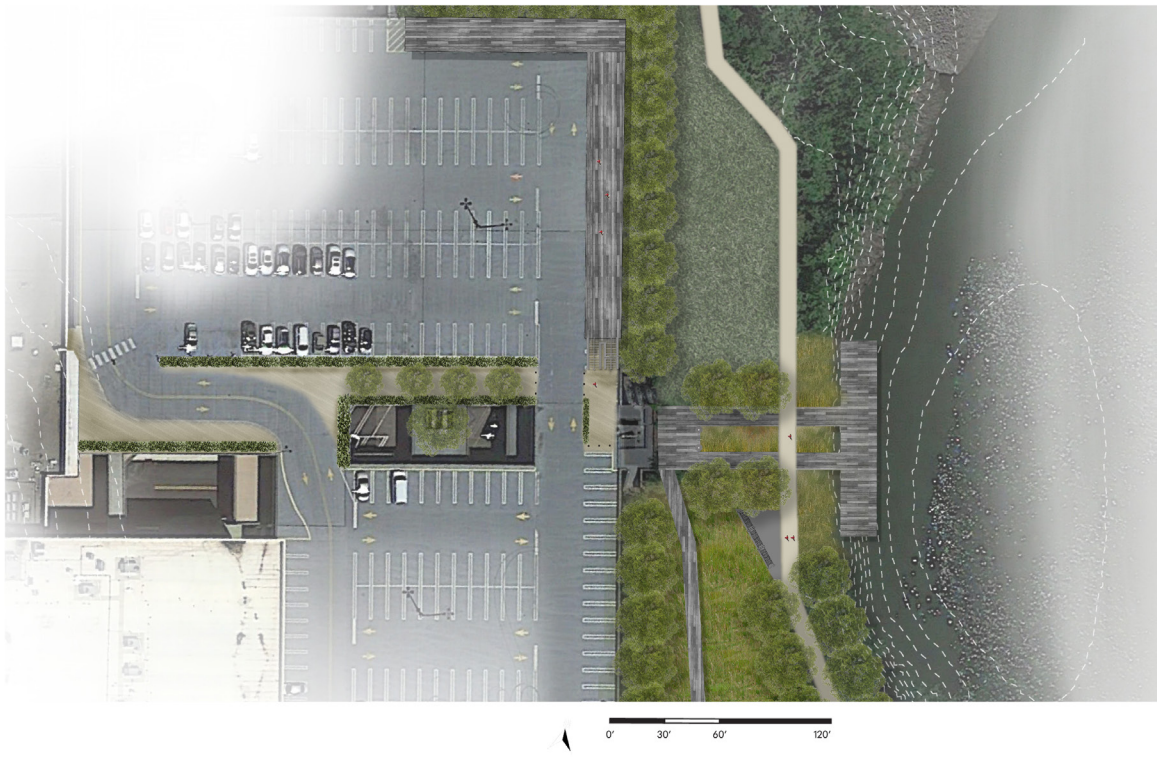


Figure 51. Enlargement B.

5.2 Design Details

There are eight specific design elements that will help fulfill the design goals of improving park access and circulation, capitalizing on scenic views of the river, providing an ecological framework for improved ecosystem function, and providing amenities that will activate the site. These elements are displayed in figure 49 on page 71. They include a connection to the Bergen County Academy Technical High School, a connection across the river to Teaneck, a stronger connection to the Shops at Riverside Mall, a wetland garden for stormwater management, a bald eagle observation deck, a dock and canoe launch, patches of reconstructed native wetland, and an exercise station.

Connection under Route 4 (1):

A connection to the existing path through the Bergen County Academy Technical High School will be necessary if the Hackensack River County Park is going to function as a piece of a larger greenway project. This connection would be most successful by going under the Route 4 bridge (see figure 52). There is 24 ft between the bottom of the bridge and the high-water mark. This leaves plenty of room for an elevated path under the bridge.

In addition to the practicality of connecting the two locations in this way, it would also add a unique experience for the park visitor. The greenway would be cantilevered over a mud flat. This means, at high tide the mud flat would be visible. During times when the mud flats are visible, snowy egrets can be observed foraging (see figure 53). Additionally, the changing tidal conditions will be visible from the greenway in this location. The tide will create a unique experience for the park visitor by providing a constantly changing view from the greenway path.

First and foremost, this element helps satisfy the goal of creating connections to the existing pathways. However, because the path is cantilevered over the mud flat, it also contributes to the goal of providing scenic views of the river.

Figure 52. Connection under route 4 section.

Figure 53. Low tide route 4 connection section.

Connection to Teaneck (2):

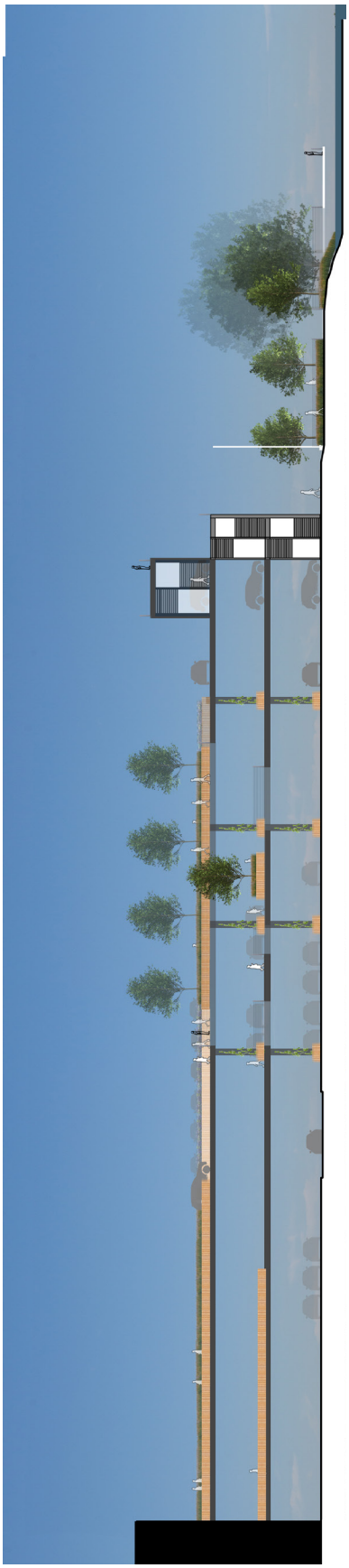
A pedestrian bridge connecting Hackensack River County Park to Fairleigh Dickinson University and the Township of Teaneck will open the park up to many more visitors. The bridge will serve as a much-needed park entrance (see figure 54). The bridge is located at a place where the river is narrow, but there is enough room on either side to welcome visitors without feeling rushed to either the right or the left path. Additionally,

Figure 54. Connection bridge from Teaneck and alternate park entrance.

at 15' wide, it will be wide enough for two bike lanes and one pedestrian lane. It would only have to be tall enough to allow the passage of a canoe or kayak because there is no commercial boating this far north on the river.

The bridge will also serve as an ideal spot to enjoy scenic views of the Hackensack River. With nothing to obstruct the views, platforms with viewing binoculars will be set up for visitors to use. From these locations, the visitor could see reconstructed wetlands, mud flats, and the flow of the river.

Connecting to the existing path at Fairleigh Dickinson University by the pedestrian bridge and Bergen County Academy Technical High School under Route 4, a 1.25-mile loop would be created along the Hackensack River. Park visitors will be able to park their cars at Hackensack River County Park and use the connections to enjoy a scenic loop along the Hackensack River. Additionally, the pedestrian bridge north of the park at New Bridge Landing can serve as a loop for the completed greenway. Centrally located between these two bridges, Hackensack River County Park would give greenway users the option of different recreational loops.



Connection to the Mall (3):

A more obvious connection from the mall to the park is needed. Without this connection, there is a group of potential park users who may not even be aware the park exists. By focusing on the axis from the mall to the park, this connection can be made stronger. The parking garage is located between the mall and the park. Since the parking garage structure has openings that allow light in from above, vegetation can be planted in the garage (see figure 55). Combining vegetation, trees, planting beds, and benches can draw visitors from the mall to the park. This greening of a parking garage adjacent to a park is something that can be done throughout New Jersey. Normally bland, harsh concrete structures, parking garages can be designed more beautifully by softening the infrastructure with planting material.

The plant material on the parking garage mirrors the form of the vegetation along the river. For most of the extent of the Hackensack River, the riverbanks have thin tree-lines that are often covered in vines. Using Virginia Creeper (*Parthenocissus quinquefolia*) to climb up the concrete supports of the parking garage, and geomorphic planting beds within the confinement of the garage openings, the design is meant to help blur the line between the concrete mall structure and the park. Additionally, wetland grasses are found throughout the Hackensack River region. By using

Figure 55. Section through the mall parking deck, dock, and canoe launch.

drought resistant grasses such as *Panicum*, the structure of the wetland grasses can be replicated. Wetland species would not work well on the parking garage because the planters needed to hold them would have to be watered often. The aesthetic of the wetland species can be achieved with less maintenance by using *Panicum*.

In addition to adding vegetation to the different layers of parking garage, painting the concrete to guide pedestrians to the park is important. Adding obvious crosswalks across the parking garage would be necessary to make it safer for pedestrians. It would also help draw interest toward the outside of the garage to the views of the river. Overall, increasing the number of eyes on the park will make it a safer place.

Wetland Garden (4):

The current lawn area in Hackensack River County Park is not only low in habitat value, but also extremely wet which makes it unsuitable for classic lawn activities common in public in parks. Creating a wetland garden (figure 56) in its place would both allow for aesthetic enjoyment of the space, and also allow for more effective stormwater management.

In order to capture stormwater, the topography would have to be adjusted. Essentially, the wetland garden would act as a large rain garden. Plants tolerant

Figure 56. Wetland garden section

of wet environments would be planted to absorb the stormwater that would normally build up in this space.

The main greenway path would be located between the garden and the river. At this point in the path, it would be wider to accommodate benches for relaxation. Behind these benches, trees frame the path and provide shade for the benches.

Closer to the garage, a smaller boardwalk takes park visitors through the wetland garden. This path is 6' wide and narrower than the main greenway path. This more intimate path would serve casual park users who may not be using the greenway for a thoroughfare. For example, shoppers from the mall might use this path as a quick escape to grab some fresh air.

The wetland garden provides attraction opportunities by allowing people to relax on the benches or stroll through the garden. It also provides more valuable foraging habitat for bird species and pollinators.

Bald Eagle Observation Deck (5):

The Bald Eagle Observation Deck takes advantage of the height of the parking garage to provide a long view across the treetops and over the River (see figure 57). This is an important viewing experience because it is different from all the other experiences in the park. Instead of being over the water, in the wetlands, or in the forest, this view gives you the

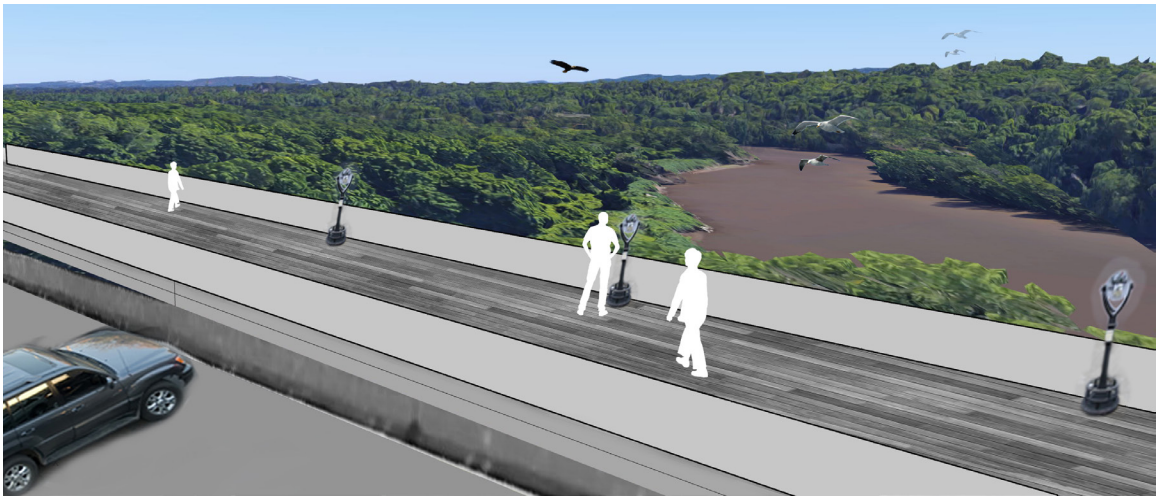


Figure 57. Observation deck perspective.

"Bald Eagle" experience. Specifically choosing nest locations in tall trees, bald eagles prefer to have wide-angle lookouts overlooking water and wetlands. To more accurately give the bald eagle experience, optical lookout lenses are available to use on the tower. These lenses replicate the extraordinary sight of bald eagles and give the viewer an immersive experience of the landscape from the perspective of a bald eagle.

The observation deck will also serve as an attraction and gateway into the park. Visible from the mall, shoppers would be drawn through the parking garage with plantings and arrive at the observation deck to get a beautiful view of the Hackensack River. Maybe after they use the observation deck, they will be encouraged to walk down into the park itself.

Additionally, just by adding more vantage points into the park, it will make the park safer. Having "eyes on the park" will discourage criminal activity which was raised as a concern for the greenway.

Dock and Canoe Launch (6):

The dock is located directly next to the entrance to the park from the mall. There is a platform that goes straight from the parking garage out to the river. In order to maintain the site-line to the river from the mall, trees are planted in an allee form. Instead of blocking the view, the trees frame it. The geometry of the parking garage is reflected in the plantings. The plantings on the parking deck line up with the plantings leading to the dock. This is done to guide the pedestrian flow to the park.

As the dock goes out over the water, the topography of the riverbank descends to the river. The center of the dock leading to the river will be cut out and planted with wetland grasses. This will reveal the transition from land to the river, and the tide will be visible going in and out at this location.

The boat launch is located at the north side of the dock. This is the best location for the canoe launch because Bergen County Parks has expressed interest in giving more access to the river from canoe and kayak as far north as Van Buskirk Island County Park. The Hackensack River County Park would be a good location to take out. The canoes and

kayaks would be approaching the boat launch from the north. The boat launch needs to be located at the end of the dock because during low tide, it may be difficult to get a canoe out of the river from a normal boat ramp. To solve this, the northern part of the dock will have a floating extension that rises and falls with the tide of the river.

Reconstructed Native Wetland (7):

Most of the wetlands currently located around Hackensack River County Park are dominated by *Phragmites australis*. Although this plant is known to have some valuable attributes such as phytoremediation and bank stabilization, it is undesirable for two main reasons. Ecologically, the *Phragmites* prevents a diverse environment for local ecology (Warren et al, 2001). Experientially, the height of the grass blocks visibility to the river.

Since there is approximately 616,298 sq. ft. of *Phragmites* on the site, it would be extremely disruptive, time consuming, and expensive to re-establish native marsh site-wide. Three smaller areas were strategically chosen to re-naturalize instead.

These areas were chosen for two major reasons. First, they can be isolated to make the re-establishment of *Phragmites* more difficult. This requires a barrier separating the re-established wetlands from stands of existing *Phragmites*. The barrier in some cases are natural landforms, but in other cases, they are proposed pathways and greenway connectors. Secondly, the restoration locations were chosen based on their proximity to park user experience. Areas where paths will be constructed will cause disruption to the immediately surrounding vegetation, so restoring the native marsh vegetation after the paths are constructed would be a good way to use the disturbance to elevate the local ecological potential. Additionally, replacing the 12 ft tall *Phragmites* with lower growing native grasses would make the park user experience more enjoyable by creating longer site-lines and less tightly confined spaces. Figure 58 shows an example of a section with *Phragmites* planted. Figure 59 shows what that section would look like with lower growing native plants instead of *Phragmites*.

The plants for the restoration were chosen for their height, habitat value, and their

tolerance to salinity. Both saltmarsh bulrush (*Bolboschoenus robustus*) and northern wild rice (*Zizania palustris*) would be good examples of plants that could be used in these locations (Silberhorn, 1976). Additionally, these species have geographic ranges that extend as far south as Virginia and North Carolina, thus making them resilient to the changing climate conditions (Silberhorn, 1976).

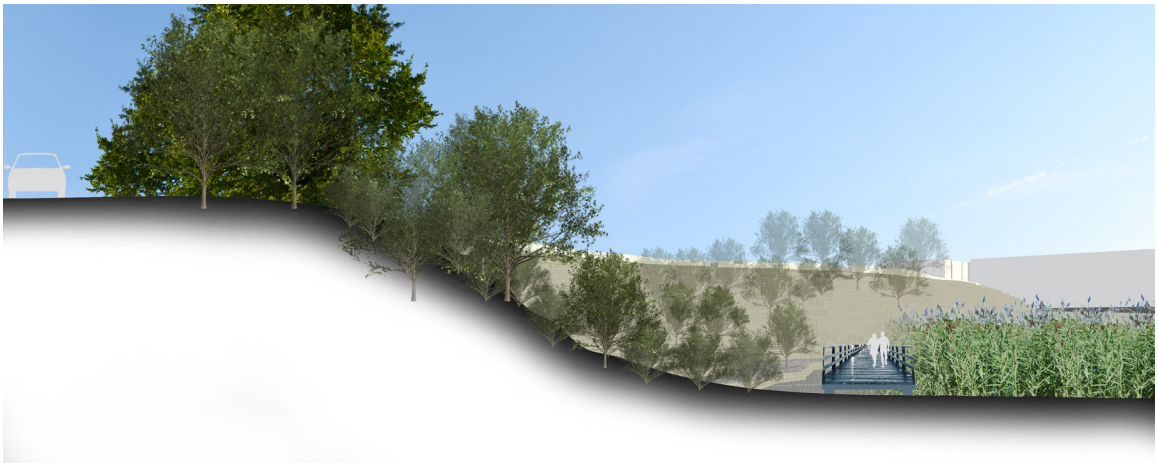


Figure 58. Greenway path adjacent to *Phragmites* dominated wetland

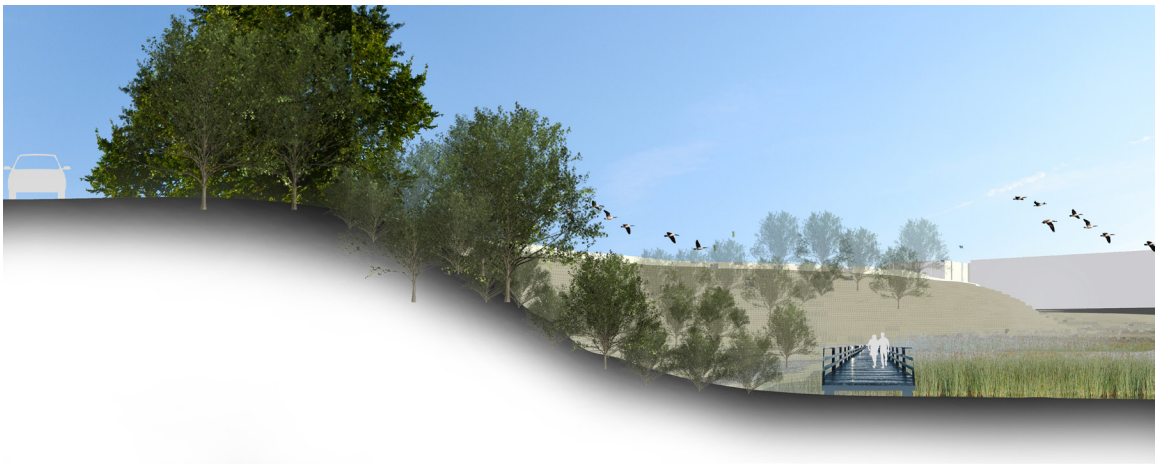


Figure 59. Greenway path adjacent to native wetland

Exercise Station (8):

With the connections made to both Fairleigh Dickinson University and The Bergen County Academy Technical High School, Hackensack River County Park is positioned between two sets of sport field facilities. This location, in addition to the loop created, puts

the park in a position to be used by the sports teams of the schools. An exercise station with benches for pushups, bars for pull ups, stretching stations, and other equipment that can be used for an outdoor workout could attract the use of the local schools. Additionally, the workout station would attract anyone looking to use the greenway for jogging or biking. This exercise station increases the recreation options of the park and the greenway.

Its location is placed close to the bridge so that people who want to use the greenway for the 1.25 mile loop will have it closely available. It is located out of the way of the main path and away from the primary gathering area by the dock and boat launch to avoid conflict with passive park users. However, its close proximity to the river will offer some view of the scenery for individuals working out. The location next to the river will give the exercise station morning sun. Starting around mid-day, the surrounding trees will create a more comfortable shaded environment in the summer. This is ideal because in the cooler mornings, the sun could warm the station while in the hotter afternoons, shade would provide relief from the heat.

5.3: How Will the Design Satisfy the Overall Greenway Design Criteria?

Not only were these site design features chosen because they satisfied the site design criteria, but they also help to satisfy the overall greenway vision. The criteria set for the Hackensack Greenway are:

1. Connect the communities along the Hackensack River in order to provide more open space for recreation and safer transportation.
2. Provide more access to the Hackensack River to utilize its potential as a scenic attraction.
3. Use the development of a greenway along the Hackensack River as an opportunity to enhance the local habitat.

By connecting Hackensack River County Park to existing pathways that lead south into downtown Hackensack and east into the Township of Teaneck, more opportunities for recreation and transportation will be available to these communities. The bald eagle

observation deck, the connecting bridge, and the dock all give the communities greater access to the river's scenic views. The re-establishment of native wetland species and the wetland garden offer opportunities for greater ecological value along the Hackensack River. Finally, the connections, the exercise station, and the gathering spaces within the design will draw more visitors to Hackensack River County Park and ultimately make it a safer place to be.

Chapter 6: Conclusions and Next Steps

This thesis started as an extension of projects being worked on by CUES and the Northern New Jersey Community Foundation. It was meant to be primarily a greenway design to complement the work they are doing. However, with the discovery of the previous greenway plans, it opened the project up as an opportunity to examine greenway strategies for difficult urban planning situations and how these strategies could inform design to overcome greenway challenges.

The result of this process is an example of how some of these greenway strategies can lead to design solutions. This has broader implications than just a greenway along the Hackensack River. These strategies and design elements can serve as an example of how similar situations across the United States can deal with greenway challenges. This is particularity important coming from Northern New Jersey. As communities in the US are becoming more densely populated, and highly populated suburbs are becoming more urbanized, landscapes like the Hackensack Region are likely to become more frequent. It can serve as an example of how a greenway project in a transitioning residential environment can use known strategies for urban greenway development to inform design solutions.

The whole process sheds light on political and administrative implications that I did not expect when starting the project. Through the examination of the previous greenway plan, public outreach was undervalued, and the importance of securing funds was overvalued. Even though the county received a grant for 2.7 million for the project in the 1990s, a handful of residents who opposed the plan prevented it from becoming a reality. Perhaps more focus on public meetings and providing flexible design plan options would yield a more favorable outcome.

The process of design lends itself to help in these public meeting situations. The goals stated for the greenway and the Hackensack River County Park were all aimed at the same objectives. These objectives were addressed differently based on the scale of the specific site being looked at. Goals that can be achieved in multiple ways can lead to discussions that

would provide more flexible framework which could reduce the chance of individuals halting the project.

Additionally, the use of path typologies to address different parts of the greenway can add flexibility. The typologies are a general template on how specific parts of the greenway can be addressed without getting into specific details that would make the plans seem definitive. This is a good place to open the discussion in public meetings: a general plan, design typologies to address specific conditions, and suggestions for locations to apply the design typologies. With a framework and a road map, the discussion of a greenway becomes less about a finalized plan being presented at a public meeting and more about a greenway plan being conceived by the public at a meeting.

Moving forward, the outreach to residents and businesses will be important to gain backing for the project. This thesis has been part of a larger effort to make the Hackensack River Greenway a reality. In order to bring the project together, partnerships between organizations and communication between interest groups needs to occur. Hackensack River County Park should be considered as the first project in the greenway effort. Public involvement will be important and will have to occur regularly with clear communication.

Corporate partnerships should be considered to help fund the project. The Hackensack Meridian Health Hospital system is in downtown Hackensack. This large network of health-based providers has hospitals throughout the state. Robert Garrett, the CEO of Hackensack Meridian Health states, “We need to dramatically improve preventative care” (Garrett, 2020, para. 2). By partnering with Bergen County Parks Department, The Northern New Jersey Community Foundation, and the Hackensack Riverkeeper to establish a greenway through their flagship city, Hackensack Meridian Health could directly act on their goal of improving preventative care. Having safe, accessible open space is one way to give the surrounding communities the option for a more active lifestyle potentially preventing chronic illness.

Additionally, the businesses located in strip malls along the river should be considered

for partnerships. A greenway next to their business would give customers easier access to their stores. Furthermore, by attracting visitors to the greenway, the businesses could generate new customers. There is a lot of commercial land along the west side of the Hackensack River. This part of the greenway could develop an "adopt a greenway" plan like the adopt a highway program. Contributing to the maintenance of the greenway will benefit both the greenway visitors and the businesses for improving the public spaces in the communities.

Hackensack River County Park is an example of a location along the Greenway that would be particularity suitable for this "adopt a greenway" program. Located next to a luxury mall, there is opportunity for the businesses to show they can be good corporate citizens by helping to improve the park for the public. Further, the park could be used for specific events hosted by local businesses. By encouraging partnerships with local businesses, the implementation of the Hackensack River Greenway could benefit.

However, for these partnerships to succeed, they need to be organized and curated by an organization. I propose this organization should be the Bergen County Parks Department. This is the best-suited organization to lead this project if it is to achieve long-term success. Identified as a key location of the Bergen County Parks Master Plan, the greenway would be a great place to for the Bergen County Parks Department to begin acting on the plan. Furthermore, many of the key parks that already exist along the Hackensack River are owned by the county. However, as was demonstrated by the design for the Hackensack River County Park, these parks are generally not well maintained. Nevertheless, given the scale of the greenway, the fact that it exists completely within the county boundaries, contains key locations already owned by the county, and a major component of the Bergen County Parks Master Plan, it is clear that Bergen County Parks should be the lead on this project.

Hackensack River County Park has proven to be an ideal place to start the Hackensack Greenway Project. By giving the park three main entrances that connect to existing paths along the river, improving sight-lines by using vegetation and existing buildings, developing gathering spaces and attractions to draw visitors to the park, and

improving the ecology of the damaged wetland marshes, Hackensack River County Park can be an example of a successful greenway intervention.

By starting the process of greenway development with successful design, the momentum of the greenway project will carry into the next step of the project. The connections made though the proposed site design will gradually start to build on the overall vision of the greenway. Rather than focusing on the main regional vision, the small site scale design successes are what will keep the project moving forward. Suggested locations for some of these early projects were identified in the suitability analysis and can be found in Appendix A. By strategically choosing locations that connect existing riverwalk paths, the Hackensack River Greenway can become a reality.

It is clear, as demonstrated by the greenway plan in the 1990s, that greenway planning and implementation can be difficult. However, I believe with the right partnerships, strategic public involvement, early success, and good design, that the time is right for the Hackensack River Greenway to be created. The Hackensack Region has the potential to be an example of how urban greenways can benefit communities that have high population density, underutilized riverside space, and a long history of industrial and commercial development.

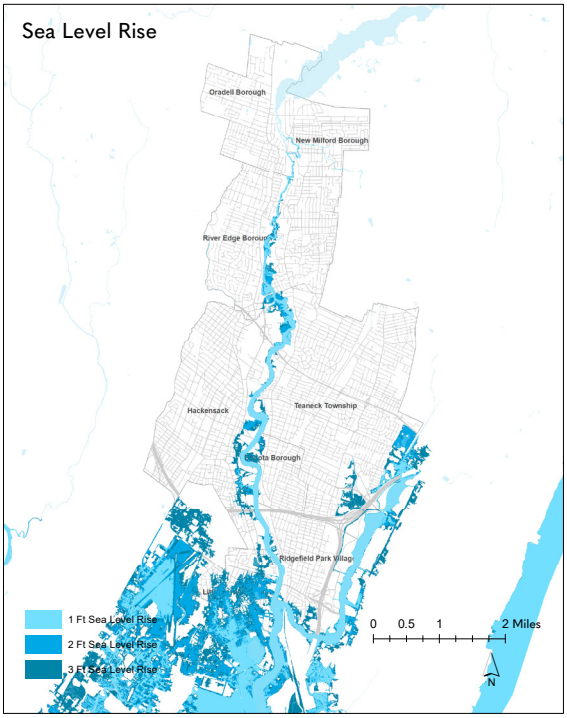
Appendix A: Suitability Analysis Score Chart

Table 2.
Suitability Analysis Property Score Chart

Number	PROP_LOC	OWNER_NAME	ST_ADDRESS	LAND_VAL	ALC_ACR	FAC_NAME	Property Rank
1	500 RIVER ST	CITY OF HACKENSACK	65 CENTRAL AVE	6430300	9.5	PARK	9.83
2	490 RIVER ST	CITY OF HACKENSACK	65 CENTRAL AVE	10739800	11.8	PARK	9.77
3	751 ROEMER AVE	TOWNSHIP OF TEANECK	MUNICIPAL BUILDING	224800	0.43	VACANT LAND	9.75
4	FT OF CAMDEN ST	CITY OF HACKENSACK	65 CENTRAL AVE	19457900	21.56	PARK	9.64
5	160 SO RIVER ST	COUNTY OF BERGEN	ADMINISTRATION BLDG	1469200	13	ADMINIS. BLDG	9.49
6	850-850A ROBERT CHESTER W	BOROUGH OF NEW MILFORD	930 RIVER ROAD	659900	2.2	MAINTENANCE BLDG.	9.33
7	55 CAMDEN ST	CITY OF HACKENSACK	65 CENTRAL AVE	4332000	4.8	PARK	9.26
8	460 HACKENSACK AV	COUNTY OF BERGEN	ADMINISTRATIVE BUILDING	71700	0.239	VACANT LAND	9.00
9							8.94
10	550 HACKENSACK AVENUE	COUNTY OF BERGEN	1 BERGEN COUNTY PLZ	598500	1.71	ADMINISTRATIVE BLDG.	8.84
11	ANDERSON ST	CITY OF HACKENSACK	65 CENTRAL AVE	316400	0.1763	SEWAGE	8.78
12	120 SO RIVER ST	COUNTY OF BERGEN	ONE BERGEN COUNTY PLAZA	589800	5	COMMERCIAL BLDG.	8.58
13	69-89 COURT ST	TSS REAL ESTATE LLC	32 GLENWOOD RD	1470600	2.58		8.57
14	100 ELM STREET	COUNTY OF BERGEN	ONE BERGEN COUNTY PLAZA	3327500	13.31	PARK	8.52
15	80 SO RIVER ST	PRICE COMPANY,THE EXCISE TAX #231	999 LAKE DR	8470800	14.8612		8.51
16	1660 RIVER RD	TOWNSHIP OF TEANECK	MUNICIPAL BUILDING	1422900	10.54	BRETT PARK	8.42
17	COURT ST	CITY OF HACKENSACK	65 CENTRAL AVE	248000	0.1423	SEWAGE	8.33
18	COURT ST	CITY OF HACKENSACK	65 CENTRAL AVE	81600	0.0728	VACANT LAND	8.25
19	PROSPECT AVE	BOROUGH OF NEW MILFORD	930 RIVER RD	47900	0.2755	VACANT LAND	8.25
20	MARGINAL ROAD	BOROUGH OF ORADELL	355 KINDERKAMACK ROAD	1352600	4.2	MUNICIPAL GARAGE	8.21
21	24 INDUSTRIAL AVE	VILLAGE OF RIDGEFIELD PARK	234 MAIN ST	1314400	2.286	DPW	8.17
22	MADISON ST	STATE OF NEW JERSEY-N.J. TRANSIT	PO BOX 10009	110800	0	VACANT LAND	8.00
23	UNIVERSITY PLAZA DR	FAIRLEIGH DICKINSON UNIVERSITY	1000 RIVER RD,MB#H-DH3-03	3300	0.0161	VACANT LAND	8.00
24	429 HACKENSACK AV	COUNTY OF BERGEN	ADMINISTRATIVE BUILDING	13200	0.0436	VACANT LAND	8.00
25	80 UNIVERSITY PLAZA DR	3 UNIV PLZASPE % NORMANDY RE PTRS	53 MAPLE AV ATTN J ADAMO	1194000	10.54		7.94
26	79 OLD NEW BRIDGE RD	PIGNATELLI, CAROL	79 OLD NEW BRIDGE RD	134800	0		7.82
27	178 PROSPECT AVE	BOROUGH OF NEW MILFORD	930 RIVER ROAD	167000	0	CLUB HOUSE	7.81
28	MIDTOWN BRIDGE APP	CITY OF HACKENSACK	65 CENTRAL AVENUE	3068500	3.4	PARKING AREA	7.78
29	105 OLD NEW BRIDGE RD	113 OLD NEW BRIDGE ROAD LLC	105 OLD NEW BRIDGE RD	219200	0		7.77
30	441 NEW MILFORD AVE	COUNTY OF BERGEN	1 BERGEN COUNTY PLAZA	808100	1.31	PARK	7.67
31	UNIVERSITY PLAZA	FAIRLEIGH DICKINSON UNIVERSITY	1000 RIVER ROAD	1350000	0	PARKING AREA	7.67
32	1201 & 1205 MAIN STREET	BERGEN CTY HISTORICAL SOCIETY INC	1209 MAIN ST	3528000	3.92	MUSEUMS	7.65
33	1209 MAIN STREET	STATE OF NJ CORP	P.O. BOX 404	900000	1	VON STEUBEN HOUSE	7.53
34	671 POMANDER WALK	TOWNSHIP OF TEANECK	671 POMANDER WALK	239200	0.4477	RESIDENCE	7.46
35							7.38
36	REAR 468 RIVER RD	BOROUGH OF BOGOTA	375 LARCH AVE	250000	1	SWIM CLUB	7.30
37	RIVER RD THRU LENOX AVES	BOROUGH OF NEW MILFORD	930 RIVER RD	89500	0.2525	VACANT LAND	7.28
38	1262 RIVER RD	TOWNSHIP OF TEANECK	MUNICIPAL BUILDING	46200	0.3419	RIGHT OF WAY	7.26
39	HENLEY AVE	BOROUGH OF NEW MILFORD	930 RIVER RD	56400	0	VACANT LAND	7.17
40	PETERS ROAD	LANDFRANK, LLC	278 RIVER ST	2964000	3.8		7.11
41	WEST OF NYS & WRR	PERRY, WILLIAM	432 PASSAIC AVE	18600	0.06		7.00
42	WEST OF NYS & WRR	BOROUGH OF BOGOTA	375 LARCH AVE	15800	0.06	VACANT LAND	7.00
43	WEST OF RR	BOROUGH OF BOGOTA	375 LARCH AVE	64400	0	VACANT LAND	7.00
44	432-40 SO RIVER ST	CREAMER,J.F. & CREAMER BROTHERS	101 E BROADWAY	547200	0.96		7.00
45	659 COLUMBIA ST	NJ ENVIRON PROTECTION % CANONICO, L	ML CD 501-01 P.O.BOX 420	128100	0	GREEN ACRES	7.00
46	87 OLD NEW BRIDGE RD	113 OLD NEW BRIDGE ROAD LLC	100 WEST FRANKLIN ST	130600	0		7.00
47	1210 MAIN ST	N.J.DEPT.OF ENVIRONMENTAL PROT.	JOHN FITCH PLAZA	1500	0.0474	VACANT LAND	7.00
48	45 KINDERKAMACK ROAD	NJ DEPT OF TRANSPORTATION	1035 PARKWAY AVE,CN616	5000	0	VACANT LAND	7.00
49	HACKENSACK RIVER	BOROUGH OF RIVER EDGE	705 KINDERKAMACK RD	1900	0.1455	VACANT LAND	7.00
50	COLUMBIA ST	BOROUGH OF NEW MILFORD	930 RIVER RD	132900	0.3142	VACANT LAND	7.00
51	STEUBEN AVE	BOROUGH OF NEW MILFORD	930 RIVER RD	260100	0	VACANT LAND	6.96
52	HACKENSACK RIVER	BOROUGH OF RIVER EDGE	705 KINDERKAMACK RD	18800	0.75	VACANT LAND	6.93
53	MAPLE AVE	BOROUGH OF NEW MILFORD	930 RIVER RD	293200	0.9183	VACANT LAND	6.91
54	HENLEY AVE	BOROUGH OF NEW MILFORD	930 RIVER ROAD	75700	0.768	VACANT LAND	6.90
55	164 WASHINGTON AVE	NJ ENVIRON PROTECTION % CANONICO,L	ML CD 501-01 P.O.BOX 420	134400	0	GREEN ACRES	6.89
56							6.89

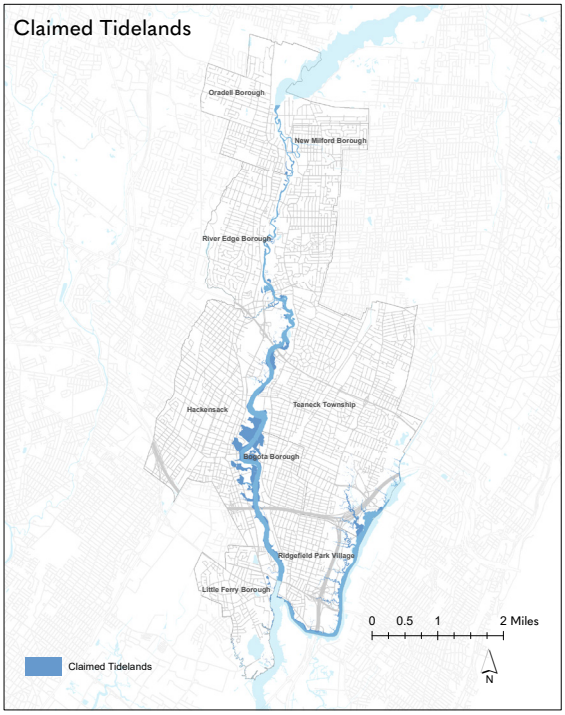
Number	PROP_LOC	OWNER_NAME	ST_ADDRESS	LAND_VAL	ALC_ACR	FAC_NAME	Property Rank
57	STEUBEN AVE	BOROUGH OF NEW MILFORD	930 RIVER RD	179900	0	VACANT LAND	6.85
58	NEW BRIDGE RD	COUNTY OF BERGEN	ONE BERGEN COUNTY PLAZA	56900	0.0735	VACANT LAND	6.83
59	MAPLE AVE	BOROUGH OF NEW MILFORD	930 RIVER RD	170000	0.2296	VACANT LAND	6.83
60	38 HACKENSACK AVE	SO.KENDALL PROP % BK CORP #524 RYAN	PO BOX 460189	175900	0.6992		6.83
61	15 COURT ST	COUNTY OF BERGEN	ADMINISTRATION BLDG	1045000	8.69	ADMINIS. BLDG.	6.82
62	540 COLUMBIA ST	NJ ENVIRON PROTECTION % CANONICO,L	ML CD 501-01 P.O.BOX 420	126800	0	GREEN ACRES	6.82
63	800 A-C COLUMBIA ST	BOROUGH OF NEW MILFORD	930 RIVER RD	2246300	13.8	MAIN DPW GAR.&OFFICE	6.82
64	1 OLD NEW BRIDGE RD	NJ ENVIRON PROTECTION % CANONICO,L	ML CD 501-01 P.O.BOX 420	159700	0	RIPARIAN GRANT	6.81
65							6.80
66	305 WEST FORT LEE RD	BERGEN ASPHALT CORP	16 TROY HILLS RD	1277500	3.65		6.78
67	AUDREY PL	BOROUGH OF NEW MILFORD	930 RIVER RD	209500	0	VACANT LAND	6.78
68	140 UNIVERSITY PLAZA DR	FAIRLEIGH DICKINSON UNIVERSITY	1000 RIVER RD,MS#H-DH3-03	686100	7.7	COLLEGE	6.76
69	161 WASHINGTON AVE	BOROUGH OF NEW MILFORD	930 RIVER RD	133400	0.1837	VACANT WETLAND	6.75
70	1 JOHN P. LYNCH WAY	BOROUGH OF RIVER EDGE	705 KINDERKAMACK RD	86300	2.66	D.P.W. BLDG	6.73
71	LYNWOOD AVE	BOROUGH OF NEW MILFORD	930 RIVER RD	176000	0.5785	VACANT LAND	6.73
72	674 HARVARD ST	NJ ENVIRON PROTECTION % CANONICO,L	ML CD 501-01 P.O.BOX 420	115700	0.1354	GREEN ACRES	6.67
73	COLUMBIA ST	BOROUGH OF NEW MILFORD	930 RIVER RD	1456600	4.18	COLUMBIA ST. PARK	6.66
74	MAIN & BOULEVARD	BOROUGH OF NEW MILFORD	930 RIVER RD	169800	1.1747	VACANT LAND	6.65
75	1400 RIVER RD	TOWNSHIP OF TEANECK	MUNICIPAL BUILDING	3156300	23.38	ANDREAS MEM. PARK	6.64
76	545 COLUMBIA ST	NJ ENVIRON PROTECTION %CANONICO, LN	ML CD 501-01 P.O.BOX 420	131800	0	GREEN ACRES	6.64
77	10 WOODRIDGE AVE.	FAIRLEIGH DICKINSON UNIVERSITY	1000 RIVER RD,MS#H-DH3-03	145900	0.484	OFFICE BLDG	6.63
78	1000 MAIN ST	CITY OF HACKENSACK	65 CENTRAL AVE	54900	0	COM/IND PURPOSE	6.63
79	COMMERCE WAY	CANAAN KOR COMM CHURCH INC	80 COMMERCE WAY	402900	1.85	CHURCH	6.62
80	120 E BROADWAY	CITY OF HACKENSACK	65 CENTRAL AVE	2916600	4.8612	GARAGE	6.60
81	423 HACKENSACK AVE	CITY OF HACKENSACK	65 CENTRAL AVE	137800	0	FORECLOSURE	6.59
82	KOTTE PL.	FAIRLEIGH DICKINSON UNIVERSITY	1000 RIVER RD,MS#H-DH3-03	728400	0	COLLEGE	6.58
83	WEST MAIN ST	BOROUGH OF BOGOTA	375 LARCH AVE	1785300	5	PARK	6.58
84	668 COLUMBIA ST	BOROUGH OF NEW MILFORD	930 RIVER RD	122900	0	VACANT LAND	6.56
85	668 HARVARD ST	BOROUGH OF NEW MILFORD	930 RIVER RD	112500	0.1148	VACANT WETLAND	6.50
86	489 HACKENSACK AV	COUNTY OF BERGEN	ADMINISTRATIVE BVUILDING	13500	0.045	VACANT LAND	6.50
87	VELDRAN AVENUE	BOROUGH OF ORADELL	355 KINDERKAMACK ROAD	1876800	0.9015	VELDRAN AVE PARK LOT	6.49
88	739 ROEMER AVE	TOWNSHIP OF TEANECK	MUNICIPAL BUILDING	310300	1.04	VACANT LAND	6.47
89	1020 RIVER RD	FAIRLEIGH DICKINSON UNIVERSITY	1000 RIVER RD MAIL STOP	9100000	28	COLLEGE	6.46
90	100 COMMERCE WAY	COMMERCE WAY VENTURES LLC	104 CHESTNUT ST SUITE 300	2850000	0		6.46
91	827 CEDAR LANE	BOARD OF FREEHOLDERS	ADMINISTRATION BLDG.	297300	0.2862	VACANT LAND	6.42
92	1600 RIVER RD	TOWNSHIP OF TEANECK	MUNICIPAL BUILDING	1023300	7.58	D.P.W. COMPLEX	6.40
93	UNIVERSITY PLAZA DR	3 UNIV PLZSPE % NORMANDY RE PTNRS	53 MAPLE AV ATTN J ADAMO	858800	2.29		6.40
94	10 RIVER EDGE RD	BOROUGH OF RIVER EDGE	705 KINDERKAMACK RD	293000	0.837	PARKING LOT & BLDG	6.40
95	HACKENSACK RIVER	COUNTY OF BERGEN	ADMINISTRATION BLDG.	2272000	26.5	VACANT LAND	6.35

Appendix B: Regional Maps



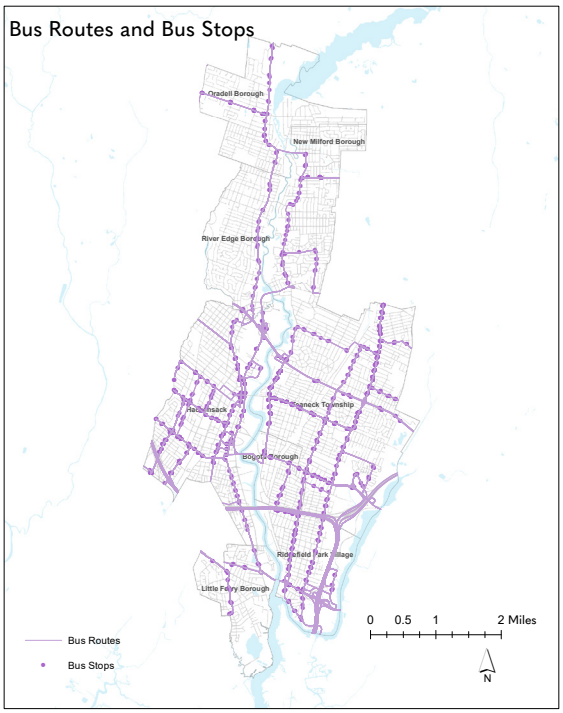
Map Created By John Hayton on 10/10/19
Source: NOAA

Figure 60. Projected sea level rise map.



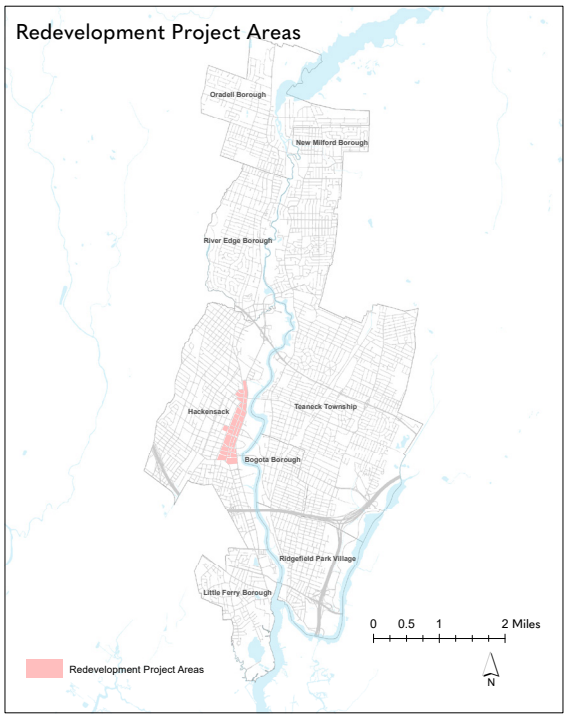
Map Created By John Hayton on 10/10/19
Source: NJ DEP and Field Collected Data

Figure 61. New Jersey claimed tidelands map.



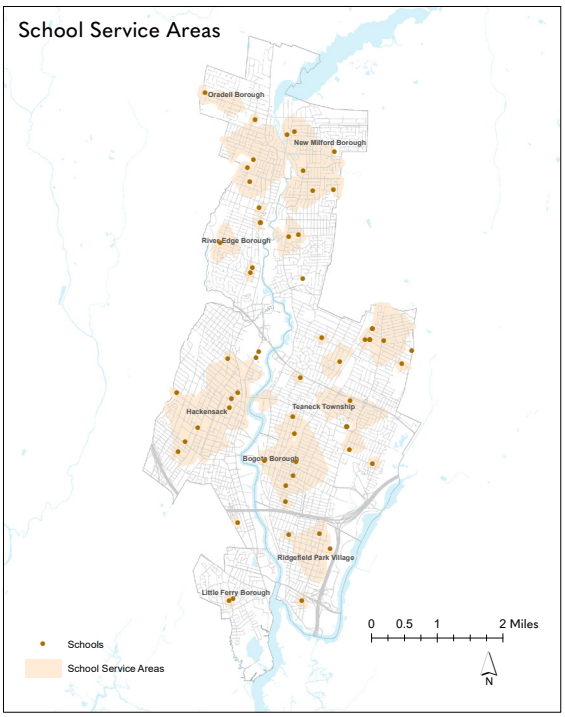
Map Created By John Hayton on 10/10/19
Source: NJ DEP and Field Collected Data

Figure 62. Bus routes and bus stops map.



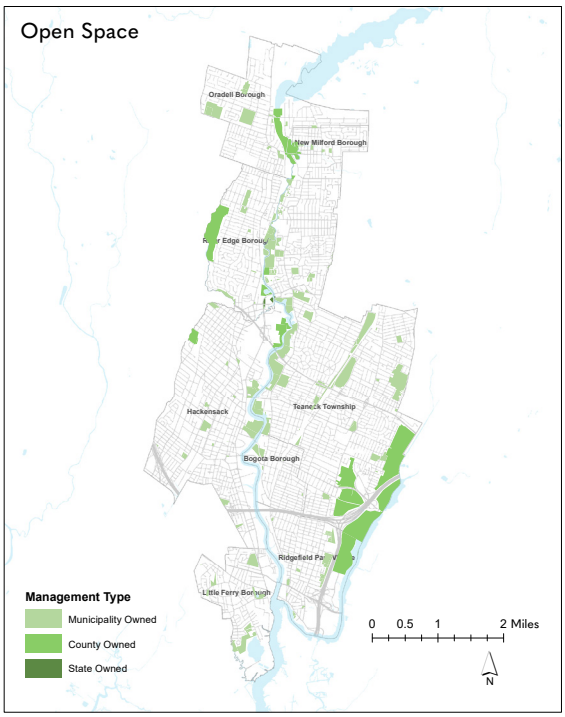
Map Created By John Hayton on 10/10/19
Source: NJ DEP and Field Collected Data

Figure 63. Hackensack redevelopment areas map.



Map Created By John Hayton on 10/10/19
Source: NJ DEP and Field Collected Data

Figure 64. School walking distance map.



Map Created By John Hayton on 10/10/19
Source: NJ DEP and Field Collected Data

Figure 65. Open space map.

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