

© 2019

Sanja Martić

ALL RIGHTS RESERVED

REVEALING THE UNSEEN RIVER, A RIVERCENTRIC LANDSCAPE EXPLORATION

By

SANJA MARTIC

A thesis submitted to the

School of Graduate Studies

Rutgers, The State University of New Jersey

In partial fulfillment of the requirements

For the degree of

Master of Landscape Architecture

Graduate Program in Landscape Architecture

Written under the direction of

Holly Grace Nelson

And approved by

New Brunswick, New Jersey

October, 2019

ABSTRACT OF THE THESIS

Revealing the Unseen River, a Rivercentric Landscape Exploration

By SANJA MARTIC

Thesis Director:
Holly Grace Nelson

The thesis proposes a better understanding of what it takes to design a riverine landscape from a rivercentric perspective. The Raritan River in the City of New Brunswick is explored through this lens with two design goals in mind: improving the visibility of the Raritan riverscape in the city, and simultaneously, utilizing the Raritan riverscape to create green open space connectivity on a local as well as a regional scale.

This thesis looks to answer whether assuming rivercentric approach, that implies experiential as well as analytic site exploration and starts from the river as a core, best informs the river city's greenway design.

Upholding a rivercentric perspective requires looking at the city from its river and understanding how to design with the river as a core and not an edge. Furthermore, the river becomes the focus of every day, human scale experience captured in inventive ways. Finally, this information helps inform design ideas for enhancing the river's role in urban life.

At the same time, this thesis aims to capture the communities' attention using their river's aesthetic value. Next, it appropriates this value to forge and invigorate the relationship between people and nature. Finally, it is intended to spark a dialogue that would lead to a better understanding of the social and ecological importance of the river and to inspire citizen activism and governmental action.

ACKNOWLEDGMENTS

I would like to thank my thesis committee: Holly Grace Nelson, Dr. Frank Gallagher, Dr. Jean Marie Hartman, and Tobiah Horton, for sharing their expertise, for their guidance, and understanding. I also want to thank my fellow students at the Landscape Architecture Department for exchanging knowledge and compassion. Marcus Knowlton and Gail McKenzie were essential for the technical, administrative, and life support throughout my years of study.

I am lucky and grateful to have parents who understood and supported my journey. I am grateful to have had other great role models in my life who inspired me to go back to school and follow my own path and supported me when I did so.

Finally, I would like to thank Heather Fenyk and the Lower Raritan Watershed Partnership for playing a crucial role in my thesis development.

A big thank you to my friend and editor Karen Ellis.

Special thank you for discussing my thesis and providing information in conversations with John Loose from the Delaware and Raritan Canal Commission, Patricia Kallessen, Park Superintendent at the Delaware and Raritan Canal State Park and Eric Ekoue, Superintendent at the New Brunswick Water Treatment and Distribution Plant.

TABLE OF CONTENTS

ABSTRACT OF THE THESIS.....	ii
ACKNOWLEDGMENTS	iv
LIST OF ILLUSTRATIONS	viii
1. Introduction	1
1.1 Overview.....	1
1.2 Personal connection to the Raritan	5
2. River and the City - Analysis	7
2.1 The City of New Brunswick.....	8
Riverwalk.....	11
Waterfront.....	16
The City	24
2.2 Personal Analysis Methods Developed	28
2.3 Regional Perspectives	33
3. Rivercentric Framework.....	39
3.1. Historic Approach to River Basin Management	39
3.2. Rivercentric Approach to River Basin Design.....	40
3.2.1 Room for the River as Applied in the Netherlands.....	42
3.2.2 RfR as adopted to the Raritan in New Brunswick.....	48

In order to measure and assess the five sites' spatial quality before and after imagined design intervention, a.....	50
3.3.1 Emscher Landscape Park, Germany	54
3.3.2 Chouteau Greenway – St Louis, Mississippi by Stoss.....	61
4. Background.....	64
4.1 Raritan River - Change Over Time.....	66
4.2 New Brunswick and Transportation Infrastructure Development.....	70
Delaware and Raritan Canal (D&R Canal)	73
New Jersey Route 18.....	81
5. Design Intervention.....	84
5.1 The New Brunswick Greenway Masterplan Proposal	86
5.1.2 The Waterfront Access Points (Riverfront Connectors).....	93
5.1.3 The Green Streets	95
5.1.4 The Urban Streets	98
5.1.5 The Blue Corridors.....	99
5.2 Local/Regional Level Connection Possibilities.....	102
6. Expected Outcome and Applicability	105
7. Discussion	112
7.1 City Today and Greenway Future	112
7.2 Future Research.....	114

APPENDIX 1 – RIVERWALK FILM STRIP.....	116
APPENDIX 2 – PANORAMAS OF THE TWO RIVER SHORES.....	118
APPENDIX 3 – SITE EVALUATION CHARTS.....	120
BIBLIOGRAPHY	122

LIST OF ILLUSTRATIONS

Figure 1: Raritan River from Albany Street Bridge 2017-2018.....	6
Figure 2: The City of New Brunswick's Waterfront.	9
Figure 3: Riverwalk - Typical View.....	11
Figure 4: New Brunswick, 1985 River Dorms with Route 18.	12
Figure 5: Riverwalk or Trench?	13
Figure 6: Riverwalk Access from South-East - Boyd Park.	14
Figure 7: Riverwalk Access from North-East – Buccleuch Park.	15
Figure 8: D&R Canal and Raritan River at Spillway in New Brunswick 1830-1983.....	16
Figure 9: Water, City and Green Open Space.....	17
Figure 10: City and its River.....	19
Figure 11: Views of the Raritan River.....	20
Figure 12: New Brunswick Waterfront Parks.....	21
Figure 13: Difficult Access Along New Brunswick Riverfront.....	22
Figure 14: Population Context for New Jersey, Middlesex County, and New Brunswick ..	25
Figure 15: New Brunswick and Middlesex County Population.	26
Figure 16: Comparison by Race. (Source: U.S. Census Bureau, 2015).	26
Figure 17: New Brunswick, Population Density.	27
Figure 18: Riverwalk Typologies.	30
Figure 19: D&R Canal Typologies.	31
Figure 20: Regional Perspectives.....	35
Figure 21: Local East Coast Greenway Alignment.....	37
Figure 22: Rivercentric Approach Diagram.....	41
Figure 23: Map Rotation Diagram	42
Figure 24: Different types of measures in the RfR Program.	46
Figure 25: Adopted System of Landscape Layers.	51
Figure 26: City of New Brunswick Municipal Public Access Plan.	52
Figure 27: Rutgers University 2030 Master Plan.....	53
Figure 28: Emscher Landscape Park.....	55
Figure 29: Slinky Springs to Fame.....	57
Figure 30: Slinky Springs to Fame in Context.....	59
Figure 31: Slinky Springs to Fame.....	60
Figure 32: Chouteau Greenway – A loop and a Stitch.	62
Figure 33: Northern New Jersey, Indian Period Tribes, Trails, Villages.	65
Figure 34: The first know map of the Raritan.	67
Figure 35: Lower Raritan Land Use Change 1893-1995.	70
Figure 36: New Brunswick 1870.....	72
Figure 37: Delaware and Raritan Canal.....	74
Figure 38: Terminal Lock of the D & Raritan Canal.....	75
Figure 39: Johnson and Johnson building in New Brunswick.	77

Figure 40: Canal in front of the J&J Building Figure 41: Canal in front of the J&J Building
77

Figure 42: Three Characters of the Delaware and Raritan Canal.....	78
Figure 43: D&R Canal State Park Figure 44: D&R Canal State Park.....	79
Figure 45: NJDOT Route 18 Reconstruction Information.	83
Figure 46: Route 18 & Riverwalk.	84
Figure 47: Five Site Specific Typologies.....	87
Figure 48: Riverwalk Intervention Area.	88
Figure 49: Riverwalk Reimagined.	90
Figure 50: Broadened Pathway of the Riverwalk.....	91
Figure 51: Pathway and River	91
Figure 52: Outlook.	91
Figure 53: Floating Dock in Johnson Park.....	92
Figure 54: Riverwalk Reimagined 2.	93
Figure 55: Riverfront Connectors.	94
Figure 56: Proposed Access Improvement.....	95
Figure 57: Commercial Avenue Hardscape Intervention.....	96
Figure 58: Green Corridors.	97
Figure 59: Green Street Connects to Raritan at Boyd Park.	98
Figure 60: Urban Corridors.	99
Figure 61: Blue Corridors Intervention Area.	100
Figure 62: Blue Corridors and Key Connector Streets Matrix.....	100
Figure 63: Blue Corridor - Boardwalk 1.....	101
Figure 64: Blue Corridor - Boardwalk 2.....	101
Figure 65: Blue Corridor - Boardwalk 3.....	102
Figure 66: Pedestrian Overpass and Bridge Intervention.	103
Figure 67: Local and Regional Connection Intervention.	104
Figure 68: Base Layer Evaluation Charts Comparison.	106
Figure 69: Network Layer Evaluation Charts Comparison.	108
Figure 70: Potential for Use Evaluation Charts Comparison.....	109
Figure 71: Time Layer Evaluation Charts Comparison.....	111

1. Introduction

1.1 Overview

"Water in the city has the greatest potential to forge an emotional link between man and nature."

Anne Whiston Spirn, 1984, "The Granite Garden"¹

Rivers are considered essential elements of urbanization that traditionally determined siting of a city, and are the building blocks of its form, infrastructure and ecology. City development is a narrative of mutual adaptation between the city and its environment. Rivers shape and are shaped by the cities they cradle. The rapid rise and fall of industrialization in the United States left many city rivers polluted and disconnected from the communities that they were once an essential part of. In the last two decades, city rivers are getting considerable attention within the landscape architecture and urban planning fields. This is evident as an ongoing surge in waterfront development within metropolitan areas and advancement of new water management strategies concerned with climate change adaptation and the building of resilient, sustainable and livable cities.²

A renewed interest in urban rivers focuses mostly on the functionality of waterfronts or on ecosystem services of the river floodplain. Less effort is directed towards creating integrated masterplans with the goal of creating regional and local waterfront connections with the focus on the river as a central and starting point.

¹ Anne Whiston Spirn, *The Granite Garden: Urban Nature and Human Design* (New York: Basic Books, 1984), 142.

² Thäisa Way, *River Cities, City Rivers* (Washington, D.C: Dumbarton Oaks Research Library and Collection, 2018), 2.

This thesis looks to answer whether assuming rivercentric approach, that implies experiential as well as analytic site exploration and starts from the river as a core, best informs the river city's greenway design that integrates both, local and regional scale consequently.

It looks to answer the following questions: how can designers apply an integrated rivercentric planning approach in an urban riverscape design, and: what does it take to shift our thinking from the river as an edge to the river as an epicenter? The approach develops from a need to put the focus on the river landscape with all its cultural and ecological layers in order to imagine the city integrated within it. This requires a change of perspective from city-centric to river-centric; seeing the city from the river. Furthermore, assuming this perspective makes it much easier to see the possibilities for connections to other natural and manmade systems.

The importance of viewing the landscape as a system of physical layers as well as layers of meaning as an idea reverberated throughout the practice of Landscape Architecture. Landscape architect Thomas Woltz sees the layer analysis as "a process not only for uncovering and interpreting the history of these sites, but for building the consensus and support necessary to their survival. Landscapes designed through this research- based approach not only strengthen and deepen the public's bond with place, but also expand the role a contemporary park can play in the community"³.

³ Thomas Woltz, "Ecology and Culture in the Design of Urban Parks," *Landscape Journal: design, planning, and management of the land* 35, no. 2(2016): 252.

The site of this study is the Raritan River in the City of New Brunswick where Rutgers University already conducts substantial research and collects river data. This rapidly growing body of knowledge contains a lot of quantitative information; however, the river is still invisible in the everyday life of the city, and there is a lack of qualitative, experiential information and evaluation. The river and the city share a rich industrial, colonial and natural history. The goal of this thesis is, therefore, to improve the visibility of the Raritan riverscape in New Brunswick. The process is to capture the quality of every day, human scale experience in the riverine landscape, to explore ways to visualize and represent this experience, and finally, to enhance it. The intention is to bring attention to the river, to invigorate the relationship between people and nature and to inspire citizen activism and governmental action by promoting river ecology to wider audiences.

The methods framework for this thesis is a combination of experiential evaluation, analytical methods, ecology and historic artifacts. They all contribute to the final design that builds out from the river itself. This framework grew out of a personal connection to the river on one hand and the Dutch Room for The River (RfR) approach to integrated river basin management (originally conceived in the Netherlands in 2007⁴) on the other. The RfR approach, illustrated in chapter three, is an approach that favors an expandable river basin design that gives the river space and time to go through its natural cycles.

⁴ Rijkswaterstaat Ministerie van Infrastructuur en Waterstaat, "Room for the River Fact Sheet," Ruimtevoorderivier, 2018. Web. <https://www.ruimtevoorderivier.nl/english/>. (accessed January 20, 2019).

The methods used to capture and represent the quality of everyday experience are primarily field observations and documentation (measurements, photography, time-lapse photography and video, sketches, mapping, diagramming). Other methods are archival research, GIS data manipulation, case studies and interviews. The specific, personal tool developed for this study is a “film-strip” - time lapse photography taken with a GoPro camera attached to the bicycle helmet while bicycling, and long riverfront elevations taken while canoeing on the river. This method made it possible to collect a large amount of visual data that will later be analyzed, in one sweep. It was particularly effective in the areas that are difficult or hazardous to access.

The outcome of this study is a set of design recommendations that create a framework for an integrated, city-wide riverscape connection that is applicable to river cities in general as a “guide” for design thinking. I demonstrate how the opportunities for the river connections and place making occur within five distinct typologies, building out from the river itself, through river nodes, urban streets and green streets, and finally the river tributaries. These five typologies offer five distinct design opportunities and together form a continuous system of walking paths that unify the Raritan River and the city of New Brunswick. I further demonstrate how exploring multiple scales and perspectives led me to a more integrated design approach that also considers a regional scale.

Chapter two consists of a relevant site analysis, and it includes regional as well as site scale analysis. Chapter three explains the methodology of the rivercentric approach: where it stems from, how it was framed, and how it was adopted. Furthermore, it

summarizes inspirational site designs and masterplans most influential to the development of this thesis. Chapter four introduces the narrative of the Raritan River in New Brunswick. It starts with the history and focuses on the Industrial Revolution- the “Canal Building Era” and the industrial decline followed by the “Urban Renewal Era”, two of the most pivotal periods for the relationship between the Raritan River and the City of New Brunswick. In chapter five, I present the proposed design interventions that apply to each of the identified five typologies: the river walk, riverfront connectors, green corridors, urban corridors and the tributaries. The final chapter presents the expected outcome, the evaluation of the expected outcome, and its potential for applicability in other river cities.

1.2 Personal connection to the Raritan

“Not one of the valley-dwellers would think of claiming superiority or even uniqueness for their home landscape. They know there are a score of river basins along the Atlantic coast not unlike it. It is no new face of nature they have discovered, but an old beauty – the beauty of the commonplace. All the world is beautiful if we have but the eyes to see.”

John C. Van Dyke, 1915. *The Raritan Notes on the River and the Family*⁵

I have been a biking commuter ever since I started classes at Rutgers University in 2014. My bicycle has proven to be a great tool for city exploration. Every day I bike down the hill from Highland Park and across the Albany Street Bridge, crossing over the Raritan on my commute to Cook/Douglass Campus or downtown New Brunswick and back.

Checking the “pulse” of the river while gazing down from the bridge, at first

⁵ John C. Van Dyke, *The Raritan Notes on the River and the Family* (New Brunswick, New Jersey: Privately Printed, 1915), Viii.

unintentionally, became a part of my daily routine and the Raritan a part of my daily experience. Finding new biking and hiking connections and exploring urban wilderness in the areas surrounding the river became a favorite pastime. Even before that, water has been an important element in my life. Growing up on the Adriatic Coastline, the water's edge was always within my line of sight, and an awe-inspiring presence in the landscape. Later, living on a farm in between the Delaware and Raritan rivers allowed me to walk, hike, bike and canoe different parts of the Delaware and Raritan Canal State Park. In the summer, I would go tubing and swimming in the Delaware, I would kayak on the Raritan and its tributaries, and I witnessed the power of water when the seasons changed.



Figure 1: Raritan River from Albany Street Bridge 2017-2018.

Photographs taken while commuting to Cook/Douglass Campus. (Source: Photographs by author, Sanja Martić, 2017/2018).

While studying at Rutgers, I was lucky to have an opportunity to work on the Lower Raritan Watershed stream quality assessment over two summers in Dr. Hartman's Lab. This is where I discovered the unexpected presence of nature hidden in the urban streams and fragmented suburban wilderness. This is also where I discovered a calming serenity in floating on the peat carpet of saltwater marsh flats. This fascination and curiosity led to my own exploration and discovery of New Brunswick's urban wilderness. Ultimately, that is what initiated this thesis.

2. River and the City - Analysis

The current conditions of the Raritan waterfront in the City of New Brunswick are a result of its turbulent past determined in large part by its specific location in the landscape. Multiple scales are used to analyze the existing conditions. This chapter describes local conditions in the city and personal methods that are developed to study those conditions. Furthermore, this chapter offers a quick glance at the landscape of the entire East Coast of the United States in order to gain regional perspective. Both scales seem to be necessary in order to reveal how large- and small-scale natural and manmade systems connect and interact with each other, and what their interaction means for the city of New Brunswick.

2.1 The City of New Brunswick

In the beginning, the city had a close relationship with the Raritan River and the Delaware and Raritan Canal (D&R Canal) as a resource and a main transportation route. The surrounding farmland flourished as produce was shipped to the market, coal was shipped to New York and Philadelphia, and manufacturing industries lined the riverfront. Water was very much a part of everyday life, and the city radiated from its riverfront. Today, the city has moved away from the river that gave it life and lost the physical and emotional connection to the Raritan, as well as the surrounding landscape. Urban sprawl took away most of the farmland, making New Brunswick's connection to agricultural production invisible. The Raritan River became increasingly polluted and insignificant, and then finally, it got tucked away behind Rt 18 in the city that lost a big part of its identity and history. These are conditions that we find here today.

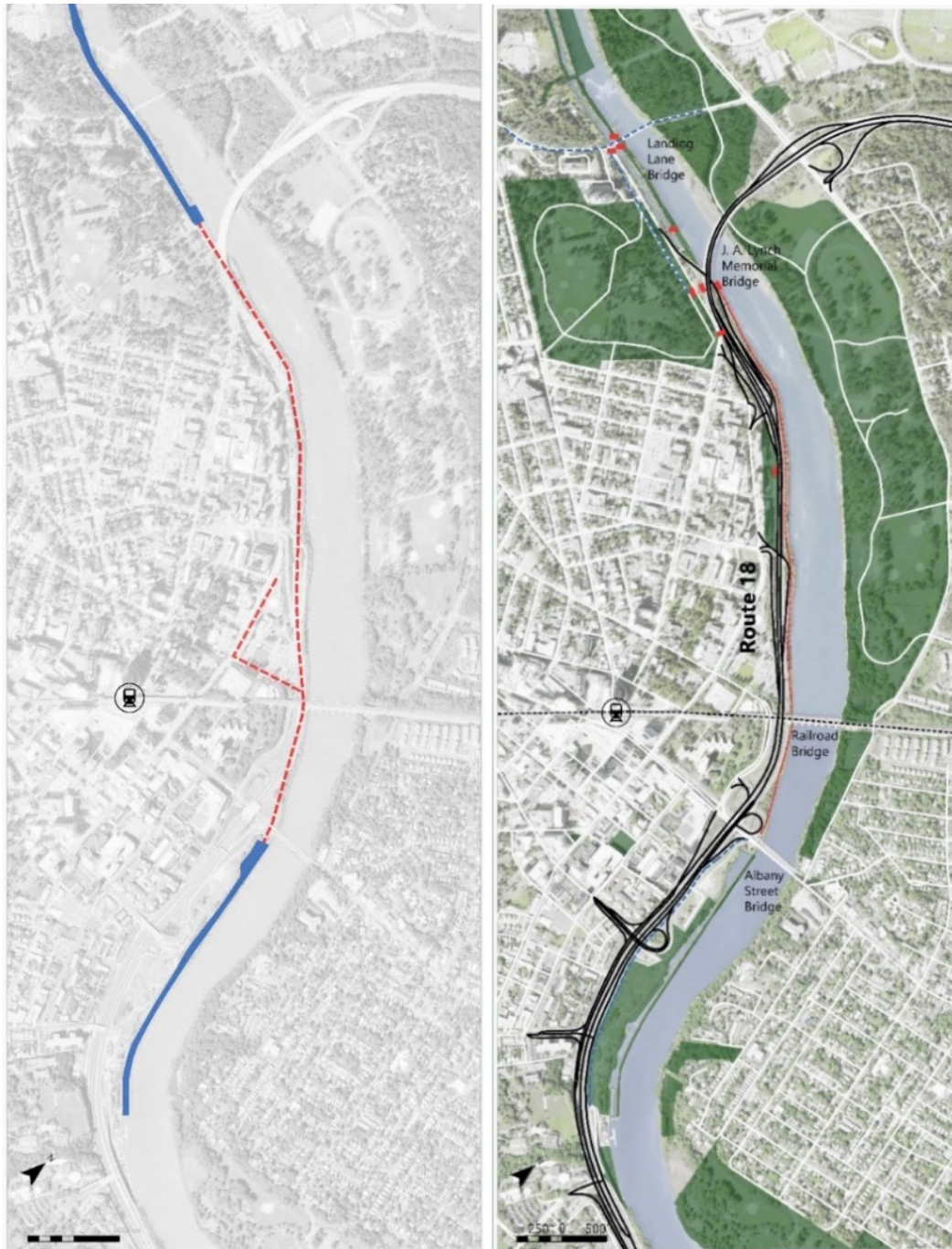


Figure 2: The City of New Brunswick's Waterfront.

Route 18 and the D&R Canal are two of the most prominent features of the New Brunswick's riverfront. (Source: Diagrams made by author, Sanja Martić, using ArcGIS⁶).

⁶ All maps and diagrams created by author were made using ArcGIS® software by Esri. ArcGIS® and ArcMap™ are the intellectual property of Esri and are used herein under license. Copyright © Esri. All rights reserved.

The image (Figure #2 left) uncovers the alignment of the D&R Canal in New Brunswick, partially buried under Route 18 (Figure #2 right). The highway construction turned the canal into a highway, and the canal's towpath into a walking and biking path. It bifurcated the canal, creating a spillway to divert one part of the canal flow into the Raritan, while the other part of the flow is piped and utilized by water utility companies. However, the terminal portion of the canal reappears at Boyd Park just below Raritan Avenue (Figure 2). The terminal portion has no canal water flow, but there is some tidal action because the final lock, at the end of the terminal portion, remains opened and the Raritan River water flows freely in and out of the Boyd Park portion of the canal.

The Riverwalk was designed and built by the New Jersey Department of Transportation (NJDOT) in 1983, and later forgotten and unmaintained, this path became locally known as "The Trench" or the "The Bum Trail." In this thesis it is renamed "The Riverwalk," through a process of rethinking its future use and with an intention of giving it a more positive image in people's minds.

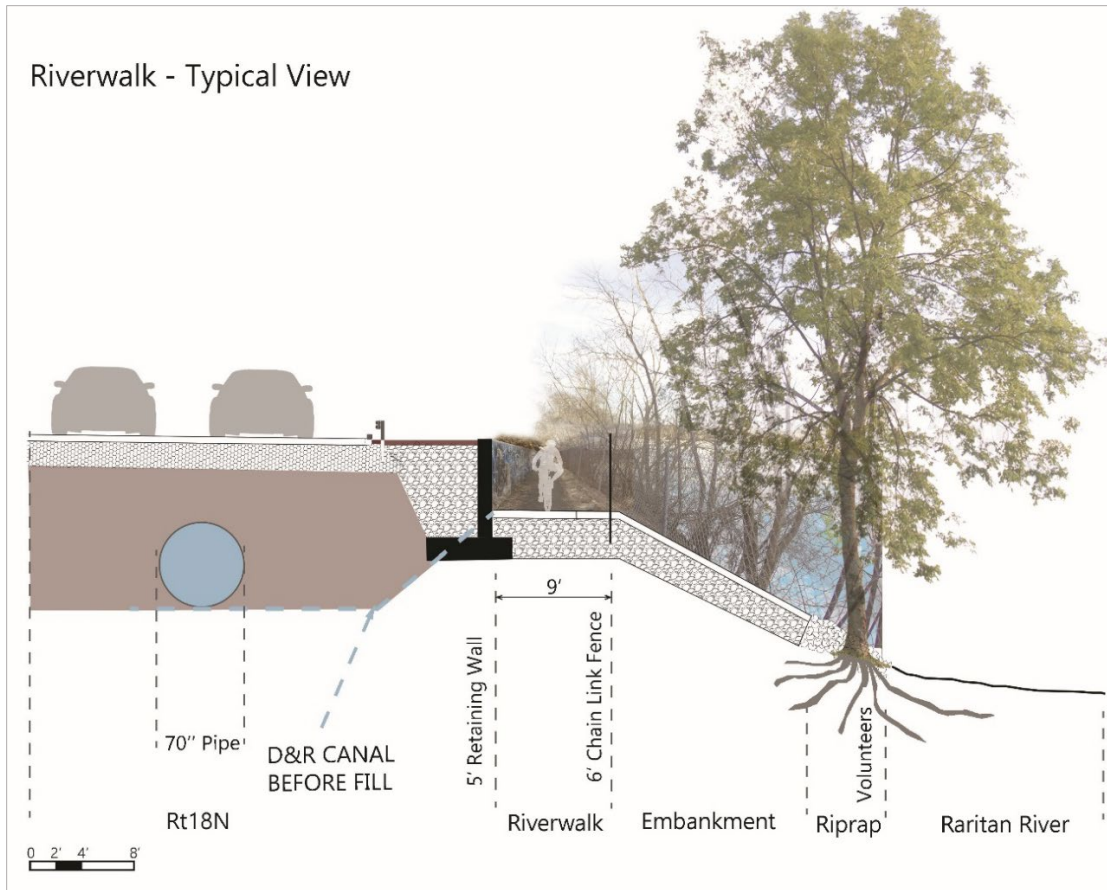


Figure 3: Riverwalk - Typical View.

Filled in canal with Route 18 on top, Riverwalk to the right, and portion of canal water piped. (Source: Diagram by author, Sanja Martic).

Riverwalk

One of the most exciting aspects of this research was an almost accidental discovery of the Riverwalk. At the elevation of 12 feet above sea level, this space is long and uncomfortably narrow, tunnel like, with no views to the outside world. One side is covered in trees, shrubs and vines with a 6' chain link fence running the entire length of the path. The other side is enclosed by a concrete retaining wall that is anywhere from 2' to 14' high (Figure 3). This 6,000 feet long, 9 feet wide walking path follows Route 18 on the riverside stretching between J. Lynch Sr. Bridge and Albany Street Bridge. It was

constructed to connect Boyd Park at the terminal lock of the canal with the rest of the D&R Canal State Park at the Landing Lane Bridge. When it was first constructed the path was entirely cleared of vegetation, resembling a scar in the riverine landscape with its hard, concrete edge completely exposed (Figure 4).



Figure 4: New Brunswick, 1985 River Dorms with Route 18.

Visible concrete revetment along the left bank of the Raritan.
(Source: Rutgers University Libraries. 1985. Special Collections).

The types of revetment used to prevent the erosion and give support to the Route 18 are a combination of concrete and rip rap revetments. Additionally, a six feet wide asphalt pavement is used as the walking surface for the pathway and bond between the load-bearing wall supporting the Route 18 and the concrete revetment. The concrete is further supported and anchored by the rip rap revetment at the point where the concrete shell reaches the river (Figure 3).

Over time, new vegetation started growing from the alluvial soil caught on the riprap in the course of the daily tides. Since the walkway was not used and maintained in many years it had built up leaf litter, vines, shrubs, bushes and trees on its concrete bank, giving it an illusion of a natural bank. Because the Riverwalk is so unique, it has an alluring yet eerie spatial quality. The tall wall on one side and masses of vegetation on the other form a long enclosure that feels very unsafe and confined. One wishes to enter this space yet feels trapped after a few feet of walking through this patchwork of concrete, asphalt and chain link hardscape softened by the green of the ragged vegetation. Surprising blotches of color jump out from the lively graffiti drawings covering the wall over the entire length of the Riverwalk. As a result, the walking path is widely perceived as uncomfortable and unsafe to a few people that are aware of its existence (Figure 5).

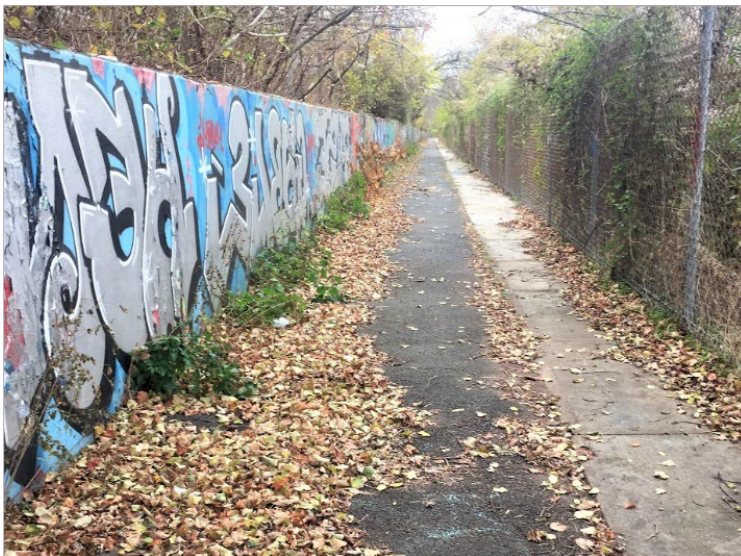


Figure 5: Riverwalk or Trench?

Pathway is simultaneously gloomy and captivating.
(Source: Photo by author, Sanja Martić, November 2018).

The Riverwalk is perfectly positioned to provide access to the waterfront, connect green open space and offer the best views of the river. However, access is difficult, with the longest disconnection from both the city and the river in the area adjacent to the Buccleuch Park. Currently, there are two entrances to the Riverwalk: the south-east one is concealed under an overpass at the Albany Street Bridge (Figure 6), and at the west terminus, one must cross the Route 18 exit ramp in order to access it from the Buccleuch Park and D&R Canal Park direction (Figure 7). Another access point, a set of stairs descending from Deiner Park directly to the Riverwalk is blocked by a bolted metal gate. It took almost a year before I traversed the 6,000 uncomfortable feet of the Riverwalk and completed the venture from one end to the other.



Figure 6: Riverwalk Access from South-East - Boyd Park.

Route 27 pedestrian underpass leading to the Riverwalk. (Source: Photo and diagram by author, Sanja Martic, September 2018).



Figure 7: Riverwalk Access from North-East – Buccleuch Park.

Pedestrian access compressed by two Route 18 ramps passes under John A. Lynch Senior Memorial Bridge. (Source: Photo and diagram by author, Sanja Martić, September 2018).

Changes in dominance of vegetative cover and hardscape have dramatically impacted the character of what used to be the Raritan River edge turned canal towpath, turned Riverwalk (Figure 8). The construction of a new road changed its character when it was first built, and again as the volunteer vegetation took over its edge. It is through this hybridization of the narrow edge condition that nature and city come together forming a condition called the fourth nature.

A landscape theorist John Dixon Hunt distinguishes three categories of landscape: 'first nature' the wilderness, 'second nature' the cultivated landscape, and 'third nature' being the garden, a combination of nature and culture. In recent years the fourth nature has been evolving as a new category characterized by blurring of boundaries between nature and culture, between constructed environments and wild nature. This unique character of the space is playing an important role in the design exploration that follows in chapter five.

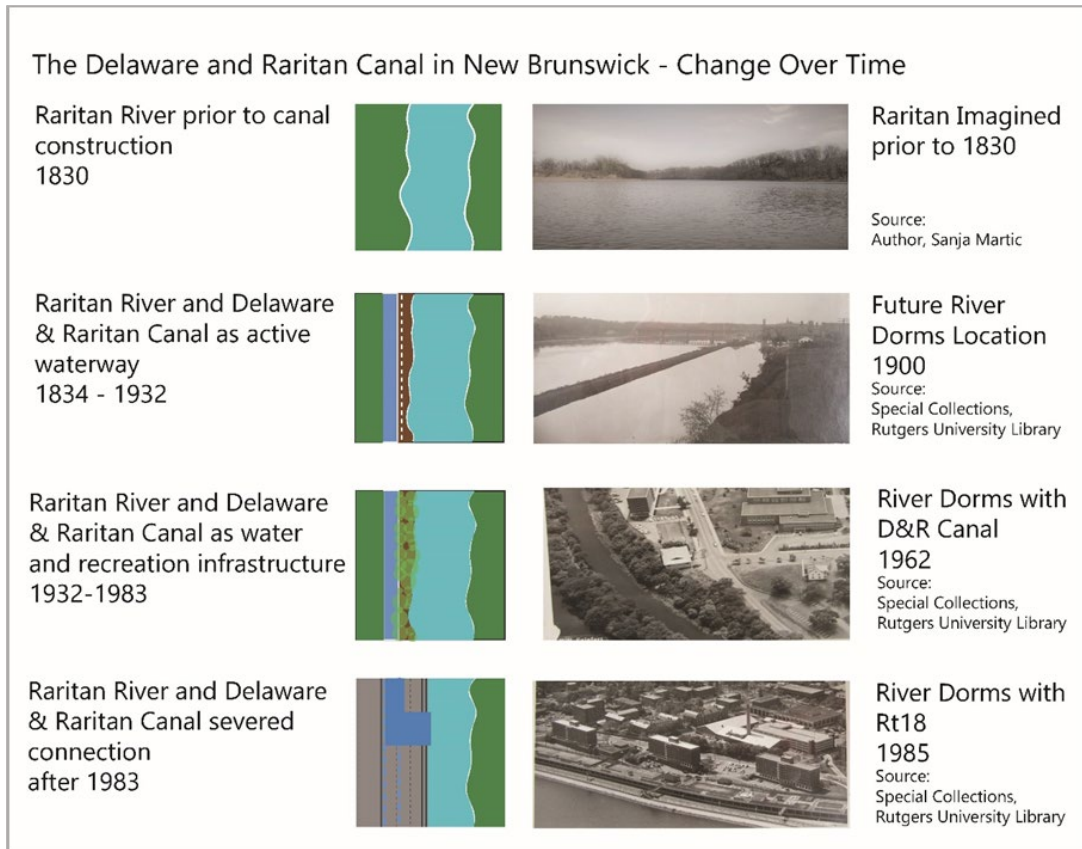


Figure 8: D&R Canal and Raritan River at Spillway in New Brunswick 1830-1983.

Change Over Time. Hardness of the river's edge changes through change in balance between vegetation and hardscape. (Source: Diagrams by author, Sanja Martic).

Waterfront

New Brunswick has a very long waterfront that extends beyond just the Raritan riverfront. Viewed from the riverine perspective, the city is reminiscent of a peninsula, or almost an island (Figure 9). New Brunswick is nesting within the bends of the Raritan River, surrounded by a network of blue and green stream corridors, yet all this water in the landscape goes utterly unseen. These underutilized, under-appreciated spaces, the invisible corridors, need to be brought out into the light and new places created from their fabric, as will be explored in the design intervention portion of this thesis.



Figure 9: Water, City and Green Open Space

City of New Brunswick surrounded by water.
(Source: Map created by author, Sanja Martić).

The Raritan River's city-front or the New Brunswick's waterfront is not a frequently visited place. The site visits and observations revealed very few waterfront users; therefore, it was extremely challenging to take a photograph of a person actively using this space. The main reason behind this strange void of people is the lack of connectivity caused by the structures and road infrastructure (Figure 13). Besides

blocking the access, the structure of Route 18 additionally blocks the views of the river, although it also acts as a levy (Figure 10), protecting the city in times of flooding. Furthermore, the streetscape design of Route 18 is characterized by heavy stone walls and thick metal fencing creating an unfriendly appearance that further obstructs enjoyment of the riverine landscape (Figure 11). Finally, the Raritan River is not wide enough to have a dominant, commanding presence in the landscape that we see in the bigger river cities. We could say that Route 18 is not the appropriate scale for the Raritan River and New Brunswick.

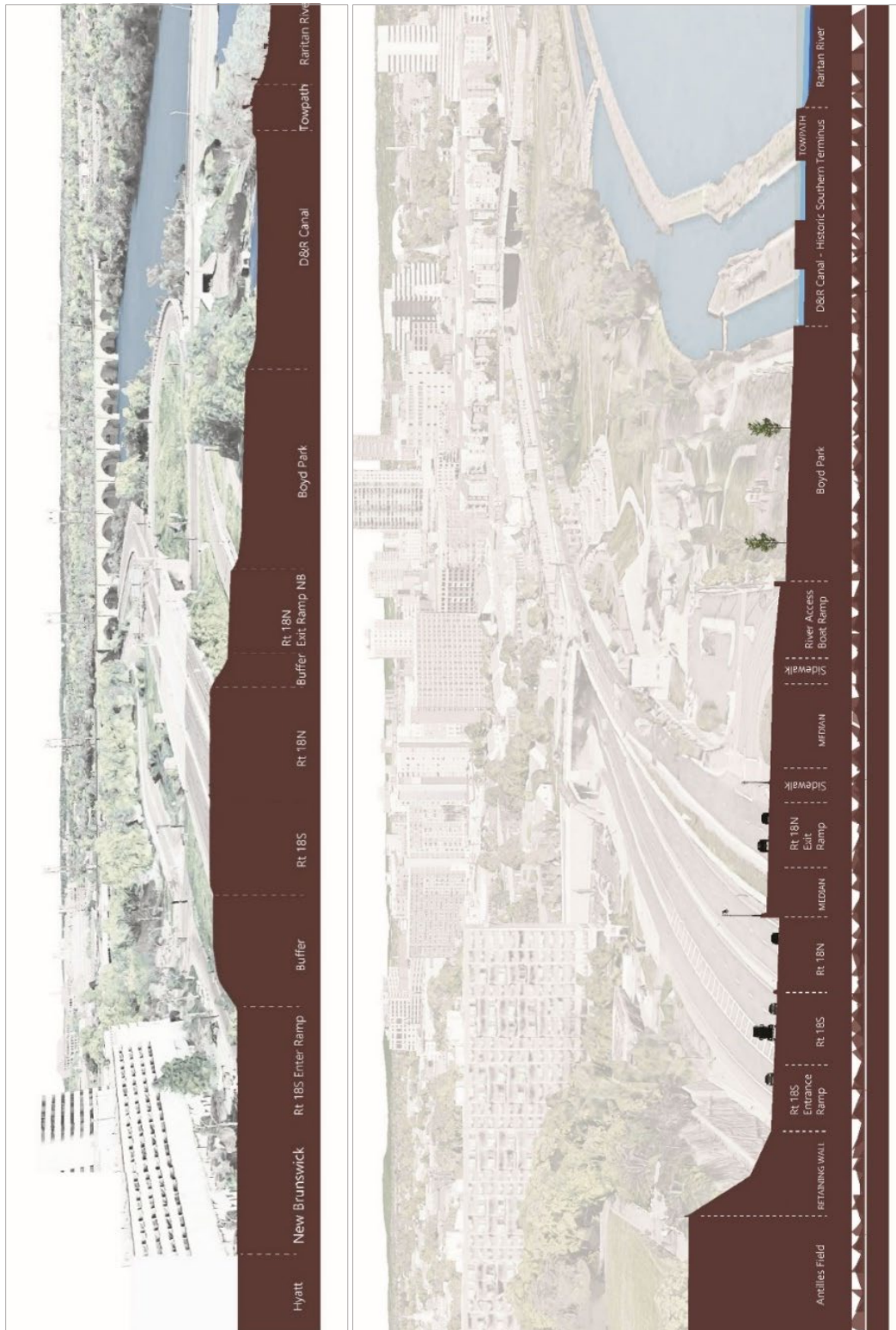


Figure 10: City and its River.

New Brunswick and the Raritan River Cross-section. (Source: Diagram by author, Sanja Martić).

Route 18 divides, but in places it also connects the waterfront. There is a 6' wide biking and walking lane that gets pedestrians and bicyclists from New Brunswick to Piscataway across the Raritan (Figure 11, top right), directly connecting Busch and Livingston Campuses to Johnson Park. Unfortunately, this is where the walkway ends. Using Route 18 as a connector will be further explored in the design portion of the thesis.



Figure 11: Views of the Raritan River.

Concrete and metal structures dominate views. (Source: Photos by author, Sanja Martić).

There are six parks within this section of the river: The D&R Canal State Park, Johnson, Boyd, Buccleuch, Deiner and Donaldson Park (Figure 12), that New Brunswick could also benefit from in terms of park connections. However, their connections to the river, each other and the surrounding community are not always utilized in the best



Figure 12: New Brunswick Waterfront Parks.

(Source: Diagram by author, Sanja Martić).

manner, leaving many missed opportunities when it comes to the park and river access. Boyd Park is on the river but lacks a more prominent and inviting pedestrian access from the city. Buccleuch Park has much better access from the city but lacks a connection to the river. Deiner Park could open an opportunity for connecting College Avenue Campus to the Riverwalk and indirectly to all other campuses via a continuous walking and biking path. Johnson Park is directly on the East Coast Greenway route and it acts as a green connection between Rutgers Campuses situated on two sides of the river. Donaldson Park has great amenities that could be an additional resource for the City of New Brunswick. They all lack a sense of cohesion that comes from seeing the river as a core that they all radiate from.



Figure 13: Difficult Access Along New Brunswick Riverfront.

(Source: Diagram and photos by author, Sanja Martić).

Major access impediments dominate the Riverwalk's northeast access points, while the existing access points need enhancement. The very first point on the map (Figure 13) is the entrance to the D&R Canal Park. Approaching it from the Johnson Park direction pedestrians and bicyclists have to share a five feet wide, cement wall enclosed path leading them over the Landing Lane Bridge. Approaching from the River Road direction there is another 5 feet wide path that turns into a recently constructed 5 feet sidewalk. In order to continue along the canal, pedestrians have to cross a wide intersection of Franklin Boulevard and River Road and continue on a two to three feet wide desire path shared with oncoming vehicular traffic, depicted under point three (Figure 13). If they were to cross into the next small portion of the canal's towpath that is left, they would have to negotiate substantial vehicular traffic as there is no pedestrian crosswalk, depicted by point two. The small portion of the towpath abruptly ends at the spillway, point 4 (Figure 13). The walking and biking path coming from Busch Campus ends at River Road with a curb and unsafe crossing, point 5 (Figure 13) towards the Buccleuch Park direction, point 7 (Figure 13). The Riverwalk comes to its NW terminus at the Roue 18 ramp, point 6 (Figure 13). Another path that leads to the College Avenue Campus narrows down until its completely gone point 8 (Figure 13). The pedestrian overpass allowing access from Deiner Park directly to the Riverwalk is bolted shut and appears abandoned and unsafe, point 9 (Figure 13).

In exploring local as well as regional connections, these points stood out as missed connections and opportunities (Figure 13). The Delaware and Raritan Canal Park with continuous walkable and bikable connection to Princeton, and further to Frenchtown

is at the city's doorstep, ending at the D&R Canal Spillway without any appropriate connection to New Brunswick. The Raritan River's navigational channel ends in Boyd Park making it a great opportunity for boating. The severed part of the D&R Canal towpath, the Riverwalk is hard to access, overgrown, underused, and at times dangerous. The city has a great potential to benefit from improving these connections, and it could do so by utilizing existing connections and by removing the impediments for river access.

The City

The City of New Brunswick houses two campuses of Rutgers University, the State University of New Jersey. It also accommodates the world headquarters of the Johnson and Johnson company. Finally, it has always been a home to immigrants from various backgrounds, living in ethnic neighborhoods. These are the factors determining the character of the city today.

Changes in the percentage of the population of Middlesex county living in the city of New Brunswick form 1800 until today tell a story of people following economic prosperity (Figure 14) that will be discussed in Chapter 4. The percentage of the Middlesex County population living in New Brunswick peaked in the canal era, while the biggest decline is seen in the 1950s. The total population percentage of the Middlesex County living in New Brunswick was the highest in 1870, at the height of the canal's operations, when 33.44% of Middlesex County's population lived here. Today only 6.8% of the Middlesex County's population lives in New Brunswick. After the 1990s there is a tendency of slow growth of this percentage.

Further analysis of New Brunswick demographics reveals a current makeup of the city that is younger than the rest of the county, less affluent (Figure 15), much less educated and with a much larger Hispanic population (Figure 16) compared to the rest of the county. Access to green open space and opportunities for interactions with nature are even more important for the financially vulnerable population.

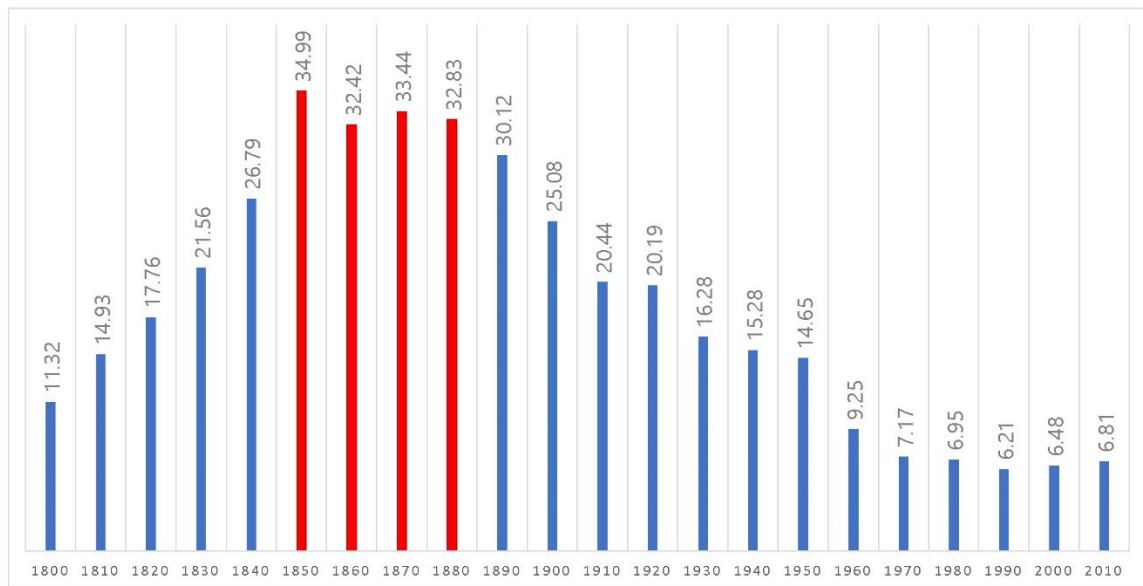


Figure 14: Population Context for New Jersey, Middlesex County, and New Brunswick

1800 – 2010. Percentage of Middlesex County population living in New Brunswick from 1800 to 2010. (Source: David Listokin, Dorothea Berkhout, and James W. Hughes. 2016. *New Brunswick, New Jersey: The Decline and Revitalization of Urban America*. New Brunswick: Rutgers University Press. P 38).

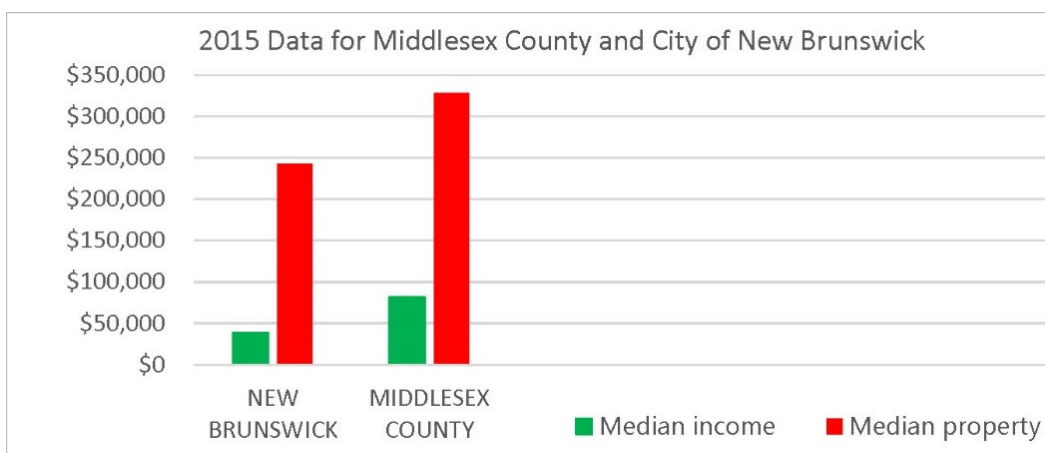


Figure 15: New Brunswick and Middlesex County Population.

Income and Property Value Comparison. (Source: U.S. Census Bureau, 2015).

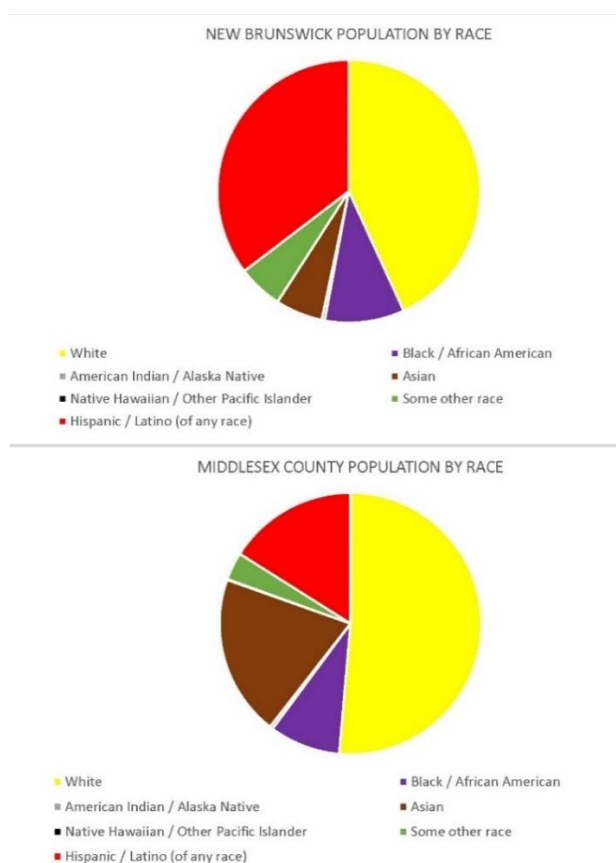


Figure 16: Comparison by Race. (Source: U.S. Census Bureau, 2015).

Population of New Brunswick and Population of Middlesex County, Income and Property Value Comparison. (Source: U.S. Census Bureau, 2015).

The most densely populated parts of the city are away from the river and lack adequate access to the surrounding green open space (Figure 17). City streets are dense with traffic, sidewalks are narrow and street design is not pedestrian friendly. There are many families with multiple children trying to navigate the neighbourhood streets. Combined with the heavy traffic at times, this creates unsafe conditions for pedestrians.



Figure 17: New Brunswick, Population Density.

Higher density shown in gray. (Source: The City of New Brunswick).

2.2 Personal Analysis Methods Developed

Field observations and documentation were primary research methods. The experience driven approach called for development of the personal exploration and evaluation methods. Exploring the everyday experience of the river in New Brunswick required primarily visual analysis while data analysis was secondary. Observations were conducted and the site was explored via a film strip and stop photography taken while walking, riding a bicycle and rowing in a canoe down the river.

Film-strip and Stop Photography

The nature of the riverfront, which is a long linear, filmlike strip, inspired the use of film as an exploration method (Appendix 1). A Go-Pro camera attached to the bike helmet was a recording tool that helped capture the rhythm and typologies of the riverfront. In addition, Riverwalk site visits were often uncomfortable since this particular area is not regularly maintained nor frequently used. Collecting a lot of visual information in one quick sweep helped survey this difficult to access site, with safety considerations. Visual information was later organized into site typologies and informed further design considerations (Figure 18).

Along the Riverwalk, the observed typologies are Typical View, Buffered Highway, Brutalist Connection, Highway Overlook and Brutalist Seclusion. They represent subcategories of the previously established Urban Wild part of the D&R Canal (Figure 19), that is covered in the Background Chapter. All Urban Wild typologies are constantly 9' wide with a 6' high chain link fence on the river side. The Typical View is the

predominant typology. It is enclosed by a 5' concrete wall, it offers some views of the highway and no views of the river. The Buffered Highway typology represents parts of the path that are further from the highway and contain areas covered in volunteer vegetation. The Brutalist Connection are areas where large concrete structures permeate the Riverwalk, such as at the railroad bridge, at the Deiner Park entrance and at the John A. Lynch Sr. Memorial Bridge. Highway Overlook areas are characterized by a lowered wall towards the highway (only 3') and an unusual opportunity to see the highway up and close, at almost the exact same elevation as the Riverwalk. Finally, the Brutalist Seclusion is a condition where Route 18 ramps are located and the supporting wall is up to 14' high, creating a sense of complete seclusion from the city. The analysis later translates into a design that will address each typology accordingly.

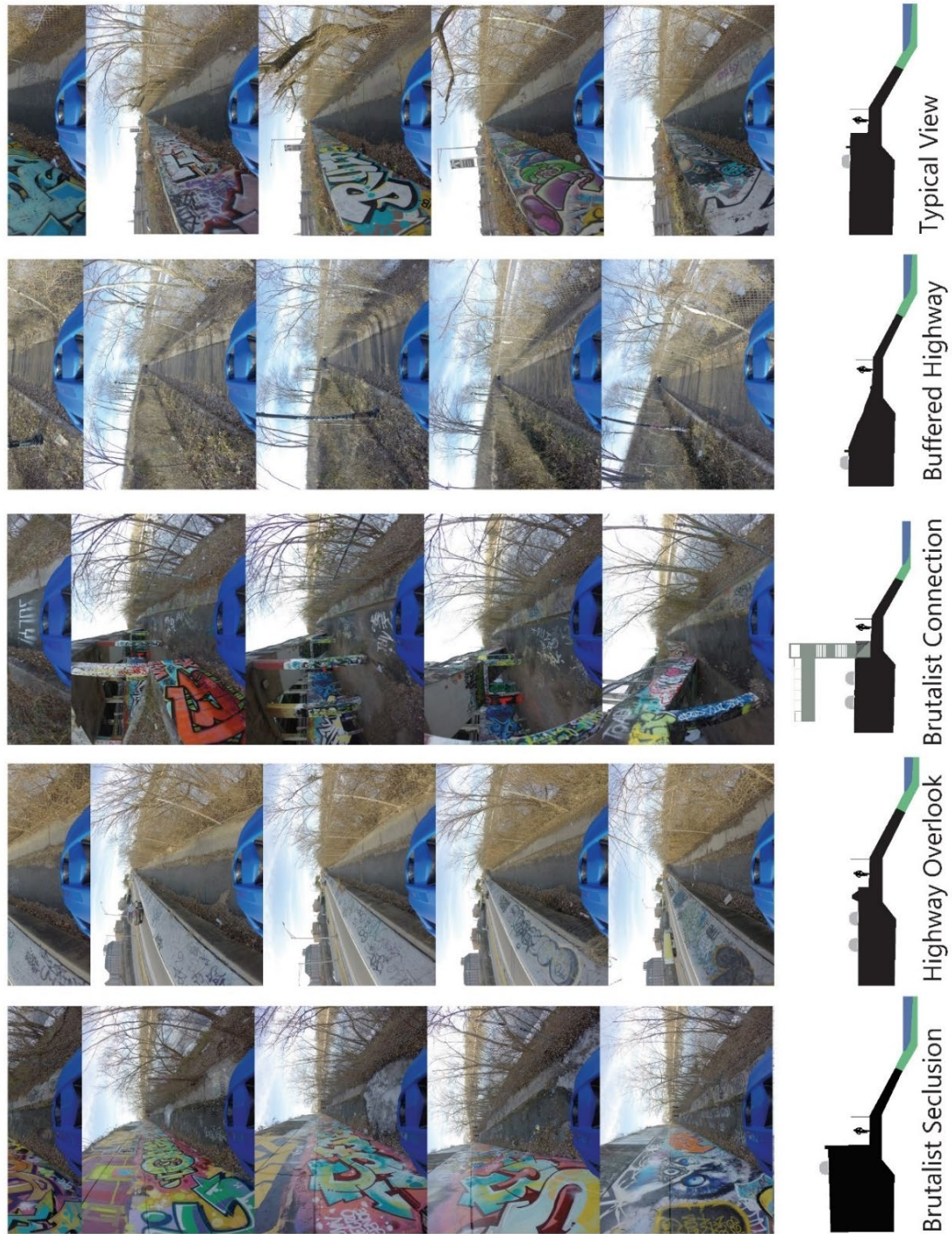


Figure 18: Riverwalk Typologies.

Five typologies determined by their spatial characteristics. (Source: Diagrams and photos by author, Sanja Martić).

River Shore - Panoramas

Presently, local residents are not using the river very much for boating or canoeing, with the exception of the Rutgers University rowing team. It is unusual to see a kayak, or a canoe transported on top of a car, and when it does happen it triggers a brief reminder that New Brunswick is a river city. Seeing the city from the river for the first time is an invigorating experience that could be easily enjoyed, providing there are opportunities for adequate access. This would open a possibility of having the river experience in everyday life.



Figure 19: D&R Canal Typologies.

Three canal typologies formed by combined work of people and nature. (Source: Photos by author, Sanja Martić).

To gain the experience of seeing the river from its viewpoint, thus assuming a rivercentric perspective, a canoe and a digital camera were used. The river's left and right banks were documented from a canoe in different seasons, times of the day and tidal stages, in order to truly secure the rivercentric vantage point. The result of this investigation is a long photographic panoramas series that run the length of New Brunswick and Highland Park/Piscataway waterfronts (Appendix 2). The panoramas bring attention to the stark differences in character between the left and right shores of the river. The soft shores of Johnson and Donaldson Parks are juxtaposed to the hardened edge of the New Brunswick bank. Soft and hard edges come together, creating the urban wilderness in places where the city and the river are attempting to converge.

Urban wilderness in this context, refers to spontaneous vegetation growth within an area of the city that has not been maintained for a long time. This condition can create unusual and intriguing environments where the beauty of lush plants or running river's water is in juxtaposition with cracked concrete, or a failing structure covered in graffiti (Figure 19, middle). This contrast is best witnessed within the Riverwalk's Brutalist Seclusion typology.

This way of documenting aims to inform future design by putting the main focus on the river and its ambiance, as well as to share documented experience with wider audiences in hopes of inspiring an emotional response and environmental action on the part of the New Brunswick residents. The long printouts are meant to enforce the idea of the river's beauty with the final goal of truly seeing the river.

2.3 Regional Perspectives

Large scale design requires identification of the large-scale network that is present within the landscape features. Analysis of the Raritan River context leads to discovery of several greenway networking opportunities and reveals connections through natural systems within the entire East Coast region. Two such systems dominating the East Coast are the Appalachian Mountains and the Atlantic coastline. These natural features are running in the north-south direction connecting the entire Eastern United States. They are also acting as a barrier for movement in the east-west direction. The only time these landscape barriers are penetrated is when large east coast rivers pierce through creating east-west connection.

Densely populated metropolitan areas stretching from New York City in the north, all the way to Washington D.C. in the south are framed by the Appalachian Mountains, the Atlantic coast line and the major East Coast rivers that bisect the Appalachians on their way to the Atlantic Ocean. The rivers create opportunities for the east-west connections with state and national parks such as The Hudson River Valley, the Delaware and Lehigh National Heritage Corridor, and the Chesapeake and Ohio Canal. The Appalachians are linked by an existing walking trail, the Appalachian Trail, while the idea of a continuous connection along the East Coast led to the formation of an aspiring East Coast Greenway Alliance. All the corridors together form a regional trail system matrix (Figure 20).

This blue and green matrix provides unique opportunities for cross connections between the corridors and interactions with nature and culture to one of the world's

densest contiguous urban populations. The Appalachian Trail and other trails are the green part of the matrix, while the East Coast Rivers and canals are the blue part. Together they form a fabric covering four different directions.

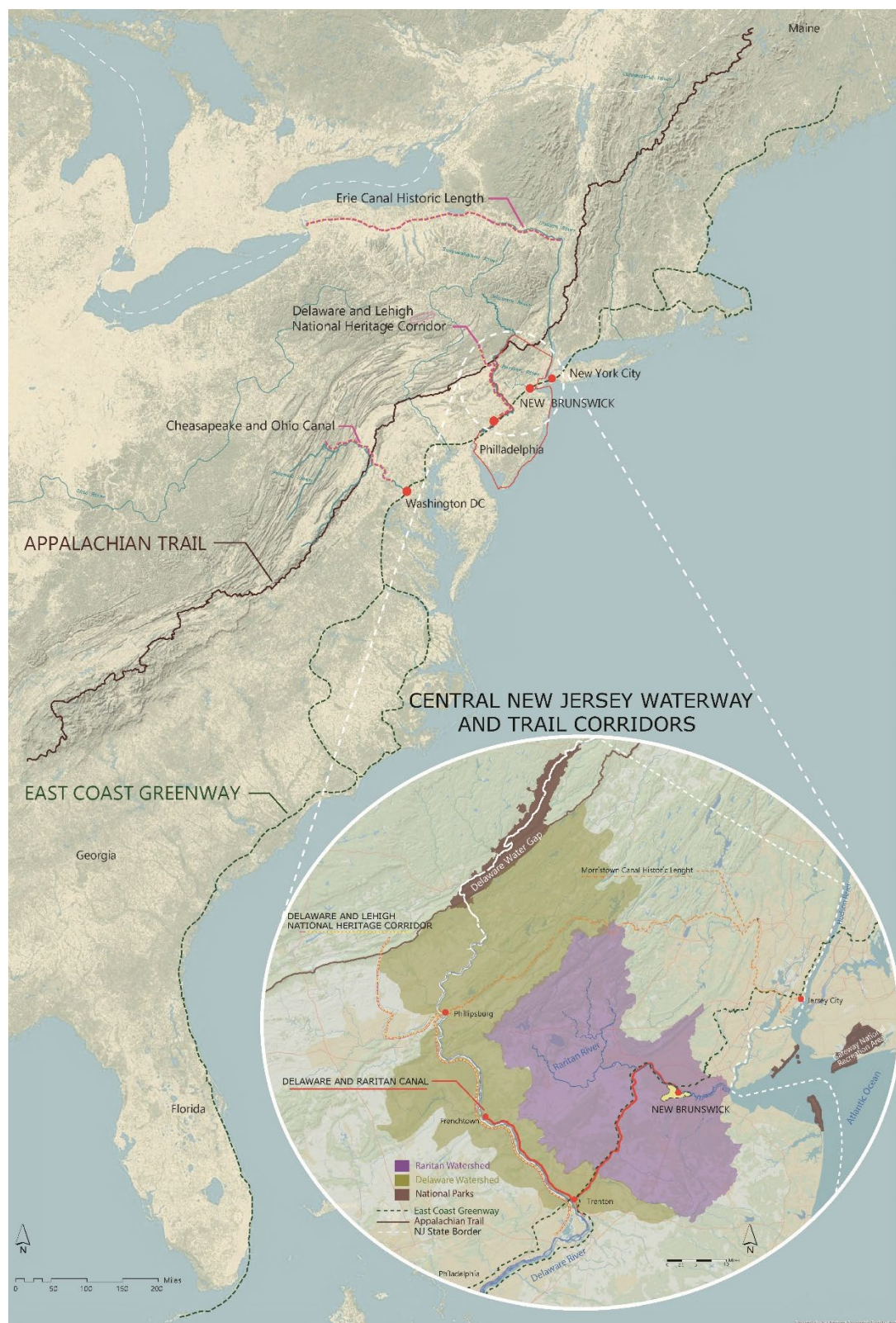


Figure 20: Regional Perspectives.

(Source: Maps created by author, Sanja Martić).

The Appalachian Mountain range, partially running along New Jersey's northern border, is home to world's longest hiking footpath, the Appalachian Trail, at 2,190 miles.⁷ It was first proposed by regional planner Benton MacKaye in a 1921 document titled "An Appalachian Trail: A Project in Regional Planning". MacKaye's vision initiated the idea of land preservation for the purposes of recreation and conservation. The idea started to materialize in 1925 and was actualized in 2014 when the last stretch of the Trail was formally acquired and protected. Today, the trail is visited by over 3 million visitors a year as it bisects fourteen US States from Georgia to Maine.⁸

The East Coast Greenway is an aspiring walking and biking route stretching the length of the US East Coast with a southern terminus in Key West, Florida and a northern terminus in Maine. Once actualized, the East Coast Greenway will be 3000 miles long and epitomize the bond between communities and nature by connecting the urban fabric to the existing green open space along its route into a unique linear corridor. Initiated in 1991, with the forming of the East Coast Greenway Alliance, the vision of Greenway designers, "represents a commitment to public health, environmental sustainability, economic development, and civic engagement."⁹

⁷ Appalachian Trail Conservancy, "About us," 2018, <http://www.appalachiantrail.org/home/about-us/media-room>. (accessed January 25, 2018).

⁸ Appalachian Trail Conservancy, "History," 2018, <http://www.appalachiantrail.org/home/about-us/history>. (accessed January 25, 2018).

⁹ East Coast Greenway Alliance, "About," 2018. <https://www.greenway.org/about/the-east-coast-greenway>. (accessed January 25, 2018).

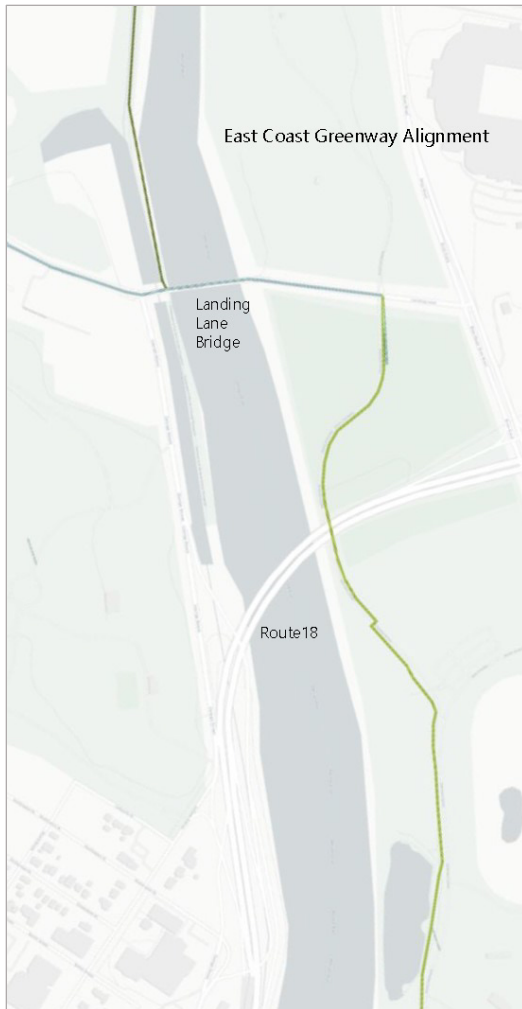


Figure 21: Local East Coast Greenway Alignment.

East Coast Greenway proposed alignment currently bypasses the Riverwalk and the City of New Brunswick. (Source: East Coast Greenway Alliance, "Route Map," 2019, <https://www.greenway.org/route-map>).

The East Coast Greenway's proposed alignment crosses the narrow waist of New Jersey using the D&R Canal Park as a major junction. The Canal Park's Masterplan recognizes the most important quality possessed by this linear park to be the role it can perform as a connector. The Canal Park no longer links New York City and Philadelphia, but it does join central New Jersey communities, different land forms and different kinds

of natural areas, and connects New Jersey with its heritage.¹⁰ Extending this connection back into the city of New Brunswick would be both, aligned with the Canal Commission's Masterplan and beneficial for the New Brunswick's future development. One of the alignments of the aspiring East Coast Greenway runs along the Raritan River, on the Johnson Park side (Figure 21). Unfortunately, this alignment overrides the city entirely and has no safe, continuous connection to the downtown.

The Delaware and Lehigh National Heritage Corridor runs along the Delaware River on the Pennsylvania side, parallel to the D&R Canal Park. It is an indirect connection between the proposed East Coast Greenway, through the D&R Canal Park to the Appalachian Trail. It is also an example of a linear park run by a nonprofit organization, while the Chesapeake and Ohio Canal is a linear park that is part of the National Park system. The Chesapeake and Ohio Canal is another significant connector between the Appalachian Trail and the East Coast Greenway close to a major metropolitan area of Washington DC.

The City of New Brunswick is uniquely positioned directly on the East Coast Greenway route connecting the Greenway to the Atlantic Ocean to the east and to the Appalachian Trail to the west. The city could benefit greatly from this position in the matrix of hiking paths and waterways, should access impediments to the D&R Canal Park and Raritan River be removed. There would be many mutual gains: the local community would have better access to nature, everyday recreation and day-hiking without having

¹⁰ Delaware and Raritan Canal State Park. Revised Masterplan. 1988, 32.

to drive to the trail. Local history would add to the richness of the trail's experience, while the local economy would benefit from hiking and biking traffic generated by the Greenway. Finally, being a part of the future East Coast Greenway vision is an invigorating driver of the nature stewardship and community development. These should be the most important goals for residents of the most densely populated state where land and water are the two most threatened natural resources, under constant threat from encroaching development and plagued by constant flooding.

3. Rivercentric Framework¹¹

"Man wants to take the river's natural storage reservoir and make no compensation for it. The river contends it is against Natural Law and cannot be done. The river is right."

James P. Kemper, New Orleans, 1927. ¹²

3.1. Historic Approach to River Basin Management

In river city landscapes around the world, the industrial revolution demanded capitalization of the river's territory and its water. As a result, many river basins were heavily engineered: rivers streamlined; river basins minimized; and creeks and small streams culverted or replaced by canals¹³. These practices, in combination with development over time, resulted in floodplains that restricted the river and required

¹¹ Parts of this chapter were published on the Lower Raritan Watershed Partnership Website. <http://lowerraritanwatershed.org/2019/02/>

¹² Ari Kelman. 2003. *A River and Its City: The Nature of Landscape in New Orleans* (Berkeley: University of California Press), 189.

¹³ Wiering, M. A., and B. J. M. Arts. 2006. "Discursive Shifts in Dutch River Management: 'Deep' Institutional Change or Adaptation Strategy?" *Hydrobiologia* 565 (1): 327–38. <https://doi.org/10.1007/s10750-005-5923-2>, 330.

repeated heightening of flood defenses¹⁴. There was no appreciation for the river ecosystems, and water was seen as a threat and as something that needed to be controlled. Over time, conflicts arose regarding use of the floodplain and its water.

The Industrial Revolution and subsequent development left behind a lasting pollution legacy: abandoned infrastructure and degraded water and soil quality. Meanwhile, the expanding population's need for potable water and space for safe habitation increased, causing a decline in the river basin permeable surface. In recent years, rising intensity and quantity of extreme precipitation events associated with a changing climate, coupled with increase of impervious surface cover, further complicate water management issues. A need for a new approach is becoming more evident.

3.2. Rivercentric Approach to River Basin Design

The rivercentric framework consists of two main components: a personal, daily experience with the river and the adopted Room for the River approach that together combine experiential evaluation, analytical methods, ecology and historic artifacts (Figure 2). All these factors contribute to the final design that builds out from the river itself. I will focus first on the original Room for the River (RfR) approach, as it was conceived and applied in the Netherlands in 2007, followed by an explanation of how it is adapted to

¹⁴ Jeroen Rijke, Sebastiaan van Herk, Chris Zevenbergen, and Richard Ashley. 2012. "Room for the River: Delivering Integrated River Basin Management in the Netherlands." *International Journal of River Basin Management* 10 (4): 369–82. <https://doi.org/10.1080/15715124.2012.739173>, 369.

the Raritan River. In the last part of this chapter I explain development of the personal exploration and analysis methods developed for the study.

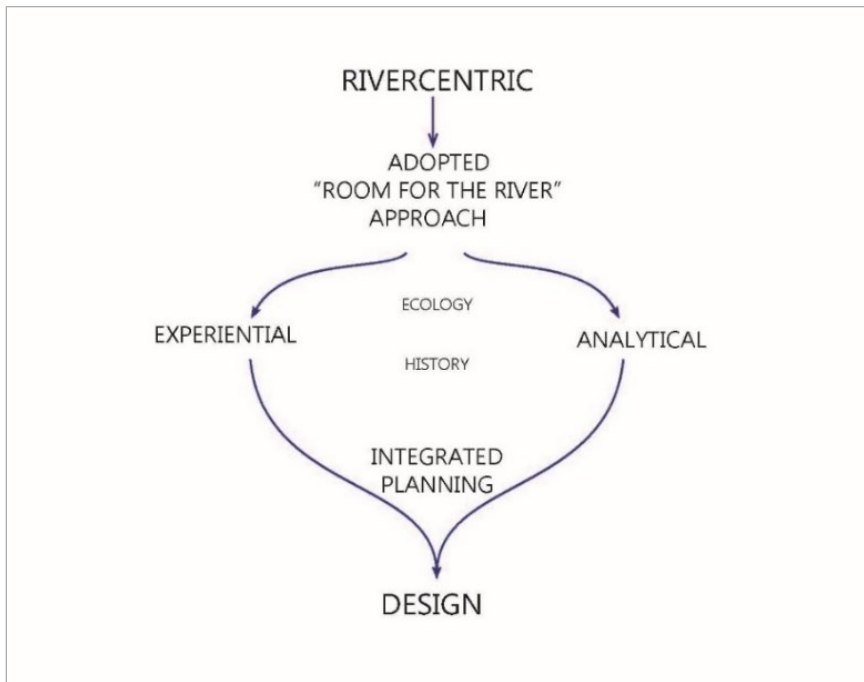


Figure 22: Rivercentric Approach Diagram.

Elements of Rivercentric approach. (Source: Diagram by author, Sanja Martić).

Understanding the rivercentric approach requires a literal and figurative change of perspective. To arrive at this viewpoint, in case of New Brunswick, literally rotating the map of the study area is required (Figure 23). The rotation gives the river graphic dominance on the map and triggers a new understanding. It shifts the perspective from a typical view where the focus is on the city with the river running along its edge, to the plan view dominated by the river's vertical axis and a city on its banks. This literal turn helped alter my reasoning and gave the river its own voice and power. Furthermore, it was a constant reminder of the temporal nature of the city in contrast to the longevity and endurance of the riverine landscape.

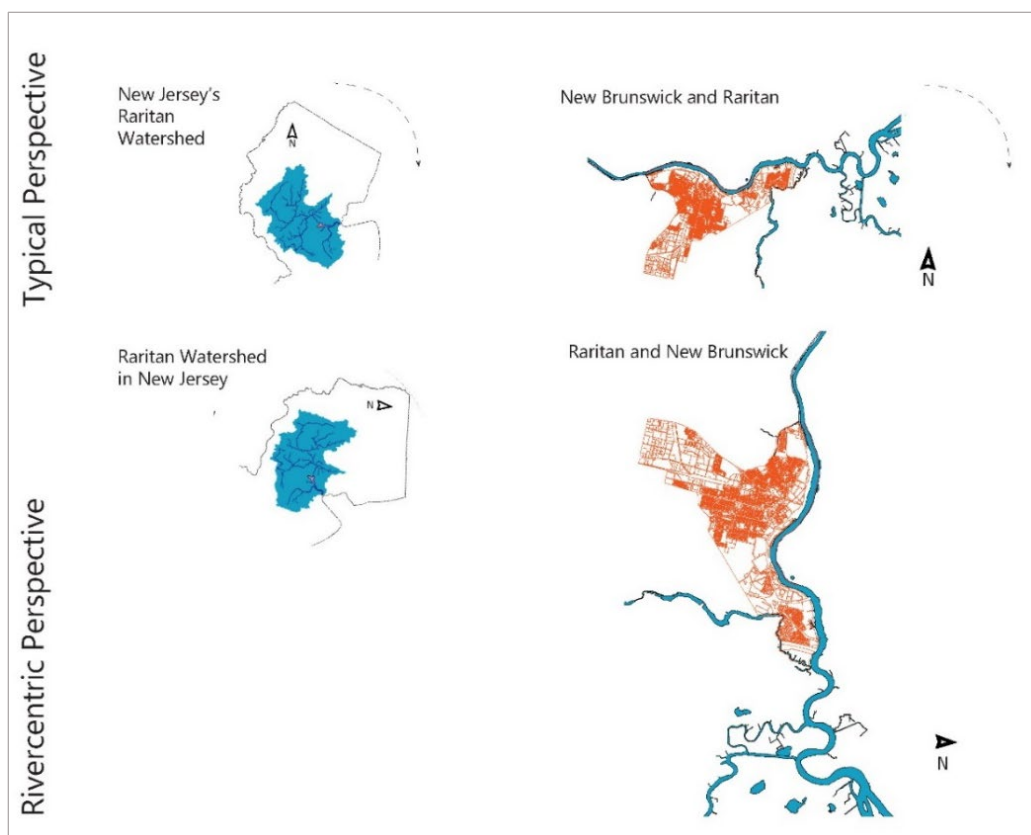


Figure 23: Map Rotation Diagram

Arriving at Rivercentric Perspective by rotating point of view.
(Source: Diagram by author, Sanja Martić)

3.2.1 Room for the River as Applied in the Netherlands

The Dutch Room for the River Program (RfR) was conceived in 2007 as an integrated river basin management strategy for the low-lying flood-prone and densely populated areas of the Netherlands. It is a top down, governmental program, meant to solve river flooding issues. As part of this program, water management is conducted via a specialized regional "Water Board," working in partnership with the Dutch National

Ministry and the Ministries for Transport, Public Works and Water Management¹⁵.

Through RfR, the Dutch Water Board takes a four-pronged approach to water management. The four key characteristics of the RfR approach include: large scale river region landscape architectural design thinking; a focus on collaboration, with landscape architecture playing a facilitating role; considering the landscape as a system of layers; and anticipating that natural processes will change and enhance the design over time.

Traditional water management methods were challenged in the Netherlands, following destructive floods in 1995, caused by record extreme precipitation events. It was clear that new flood levels required a different approach towards river management. Different approaches to water management call for different methods: many rely heavily on engineering while others emphasize a more natural approach. RfR finds a middle ground; instead of gradually reducing the area that rivers occupy, this approach allows the river to expand over a larger territory¹⁶. RfR brings together the worlds of water management and spatial planning, engineering and ecology. Tools are varied and include dredging at one extreme, and measuring spatial quality on the other, and they are put into the service of two main objectives: improving safety by reducing flooding of riverine areas, and "contributing to the improvement of spatial quality of the riverine

¹⁵ Jeroen Rijke, Sebastiaan van Herk, Chris Zevenbergen, and Richard Ashley. 2012. "Room for the River: Delivering Integrated River Basin Management in the Netherlands." *International Journal of River Basin Management* 10 (4): 369.

¹⁶ *Ibid*, p 369.

area”¹⁷. Although hard to quantify, this second goal is particularly interesting from the landscape architecture perspective as it considers the quality of the space.

Spatial Quality

Spatial quality within the RfR approach is defined as, “a property of the resulting landscape after a plan has been implemented”¹⁸. The attempt at qualitative evaluation at an institutional level is a novelty of the approach. A good design is further judged by three criteria: hydraulic effectiveness, ecological robustness and cultural meaning and aesthetics. Cultural meaning and aesthetics criteria call for enhancing the scenic beauty, tailored to a range of sites that could be classified as natural, urban or countryside. Ecological robustness endorses designs that are long lasting, self-sustained, build upon natural processes, and are low maintenance. This is achieved through combining natural hydrology with morphological and biotic processes to achieve stability in the riverbed and floodplain¹⁹. This means that plans have to be functional in the case of floods, but at other times must accommodate livability, wildlife habitats and areas usable for the public good. Design is informal and natural while providing maximum access for

¹⁷ Jeroen Rijke, Sebastiaan van Herk, Chris Zevenbergen, and Richard Ashley. 2012. “Room for the River: Delivering Integrated River Basin Management in the Netherlands.” *International Journal of River Basin Management* 10 (4): 369.

¹⁸ Frans Klijn, Dick de Bruin, Maurits C. de Hoog, Sjeff Jansen, and Dirk F. Sijmons. 2013. “Design Quality of Room-for-the-River Measures in the Netherlands: Role and Assessment of the Quality Team (Q-Team).” *International Journal of River Basin Management* 11 (3): 291.

¹⁹ Frans Klijn, Dick de Bruin, Maurits C. de Hoog, Sjeff Jansen, and Dirk F. Sijmons. 2013. “Design Quality of Room-for-the-River Measures in the Netherlands: Role and Assessment of the Quality Team (Q-Team).” *International Journal of River Basin Management* 11 (3): 292.

recreation, with spaces intended to reveal the spirit of each individual site of intervention.

The spatial quality assessment requires development of a special Q-team (quality team) composed of members from different but complimentary disciplinary backgrounds. The Q-team's role is to produce an independent recommendation on enhancing spatial quality through coaching designers and planners, peer review of the designs and plans, and regular communication to the Ministries of Transportation, Public Works and Water Management²⁰. This calls for significant transdisciplinary cooperation between planning and design, with an equal role for the landscape architect, urban planner, river engineer, ecologist and physical geographer. In addition to evaluating the project's outcome, the team also evaluates the quality of the integrative collaborative design process.

Practical Measures

Practical measures (Figure 24) are applicable at a large scale and fall into three categories ranked by the complexity of the integration of flood risk measures with spatial measures. These categories include technical measures: deepening the river bed, lowering groynes; strengthening dikes; measures within the banks; lowering the

²⁰ Frans Klijn, Dick de Bruin, Maurits C. de Hoog, Sjef Jansen, and Dirk F. Sijmons. 2013. "Design Quality of Room-for-the-River Measures in the Netherlands: Role and Assessment of the Quality Team (Q-Team)." *International Journal of River Basin Management* 11 (3): 289.

floodplains; removing obstacles; and measures beyond the banks: high-water channel building; dike relocation; water storage.

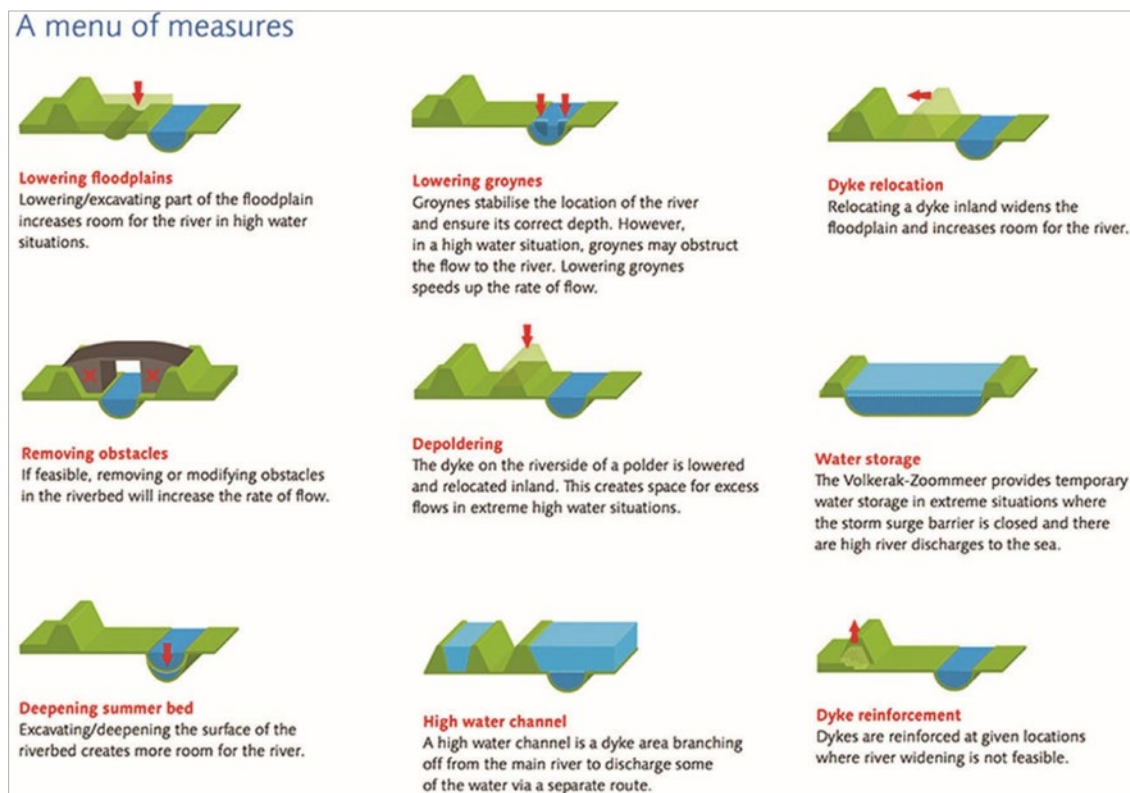


Figure 24: Different types of measures in the RfR Program.

(Source: Rijkswaterstaat, Ministerie van Infrastructuur en Waterstaat, Practical Measures, from Room for the River Fact Sheet, <https://www.ruimtevoorderivier.nl/english/>).

Methodology

The four elements that characterize Dutch RfR approach are:

1. Large-Scale of Design that considers the entire river region.

The large-scale landscape architectural design approach considers “not only detailing of small-scale elements, but also at the scale of the river system as a whole.”²¹

²¹ Thaisa Way. 2018. River Cities, City Rivers (Washington, D.C: Dumbarton Oaks Research Library and Collection), 376.

2. Collaboration.

The landscape architect plays a central role of coordinator between planners, architects and other partners. Fliervoet and Den Born studied and evaluated the RfR's collaborative process from a stakeholders' perspective. They concluded that the success of the approach is highly dependent on the cooperation and collaboration of multiple entities occupying the watershed with emphasis on the local knowledge. The biggest obstacles to collaboration stated by the participants, were the lack of an overarching, integrated maintenance vision and a lack of coordination between the authorities.²²

3. Considering the landscape as a system of layers.

Landscape is seen as a matrix of layers that interact and influence each other. Separating landscape into layers with subcategories organizes and focuses design thinking, making it easier to distinguish different functions and importance of each layer. These are the layers conceived in the RfR approach:

- o Basis of Landscape (soil, water, ecosystems)
- o Network Layer (roads, waterways, energy infrastructure)
- o Occupation and Land Use (living, working, recreation)
- o Time Layer -this layer encompasses all the other layers and it represents the time it takes for all other layers to develop together and form a certain character of the space that is understood by the viewer as the spatial quality. Time has always been an

²² Jan M. Fliervoet, Riyan J.G. van den Born, and Sander V. Meijerink. 2017. "A Stakeholder's Evaluation of Collaborative Processes for Maintaining Multi-Functional Floodplains: A Dutch Case Study." *International Journal of River Basin Management* 15 (2): 185.

important consideration in landscape design. The RfR approach simply emphasizes this element and attempts to measure it.

4. Creating conditions and responding to natural processes

Natural processes are expected to change and enhance design over time. It is the designers' job to foresee these changes and direct them as possible.

3.2.2 RfR as adopted to the Raritan in New Brunswick

As in the Netherlands, significant portions of New Jersey's Lower Raritan River are in low-lying densely populated areas. Flood protection is of paramount importance and a matter of human safety and economic security. However, the Home Rule focus of New Jersey's local governance limits the potential for thinking in a regional landscape context; no comparable "Water Board" serves as coordinating entity for water management, flood control prioritizes human land use layers, and engineering controls trump considerations of natural hydrological processes and flows. Collaboration and input from an NGO, Lower Raritan Watershed Partnership (LRWP), resulted in the following considerations for utilizing the RfR approach in New Brunswick portion of the Raritan River

1. Large scale of design aspect is manifested through systems thinking, that involves investigating different regional connectivity possibilities from the state scale to the North American East Coast scale. Chapter 2.3 reveals how these systems influence each other and what is their relationship to the Raritan River. Design thinking narrows in from this large scale and at the same time scales up from the site scale. Looking at the entire Raritan Watershed when considering design solutions for the Raritan waterfront in New Brunswick is a recommendation for the next step.

2. Landscape architect conducts collaboration between local, regional, national and state partners as well as coordination between the experts in the field. The experts may include a variety of professional partners. In addition to planners and architects, other professions to engage include social scientists, geographers, ecologists, river engineers, biologists, historians, archeologists and civil engineers.

At the federal level, the governing bodies to involve may include USACE, USCG and the Advisory Council on Historic Preservation. At a state level, governing bodies to involve may include NJDOT, NJDEP, the Land Use Regulations and Ecological Services Field Office. Regionally, the Delaware and Raritan Canal Commission and counties such as Middlesex, Somerset, Hunterdon, Mercer and others. At the local level, the municipalities along the Raritan River banks including New Brunswick, Piscataway, Franklin Township, Hillsborough, Montgomery, South Brunswick, Princeton etc., and NGOs such as Lower Raritan Watershed Partnership, NYNJ Baykeeper , D&R Canal Watch, The Canal Society of New Jersey, would all require representation.

Finally, the utility companies would need to be included, like water companies and PSE&G. The D&R Canal provides drinking water utilized by three water companies (Middlesex Water Company, New Jersey American Water Company, Elizabethtown Water Company) for over 300,000 people that include residential, commercial and industrial customers²³. The City of New Brunswick depends on this water for living, making this project especially challenging.

²³ Delaware and Raritan Canal Commission. 1977. Masterplan.

3. Considering the Raritan in New Brunswick as a system of layers.

The principle of layers from the RfR approach is applied to the select sites of intervention identified in New Brunswick. These areas were identified after completing the analysis of the river and the city (chapter 2). They are identified as having the best potential for creating connections between the city and the river and organized according to their distance from and connection to the Raritan. Water in the landscape, circulation, and existing infrastructure were the most relevant factors in envisioning the matrix of connections that could cover the city of New Brunswick. The sites identified and evaluated for the Greenway Masterplan fall into five categories, or five site typologies. The Riverwalk, Waterfront Access Points, Key Connector Streets (Green Streets and Urban Streets) and the Blue Corridors. Further discussion of the five identified site typologies follows under the Design Intervention (chapter 5).

In order to measure and assess the five sites' spatial quality before and after imagined design intervention, a development of an evaluation system was necessary (APPENDIX 3). In order to do so, I created a matrix of layers adopted from the RfR approach on one side and the five site typologies on the other. The matrix provided a basis for the site evaluation. Each site was evaluated through the lens of quality of its layers. The evaluation served as a guide for the design process. How does each design decision affect the matrix as whole, was the question? Further explanation, description of layers and the final assessment results follow in chapter 6.

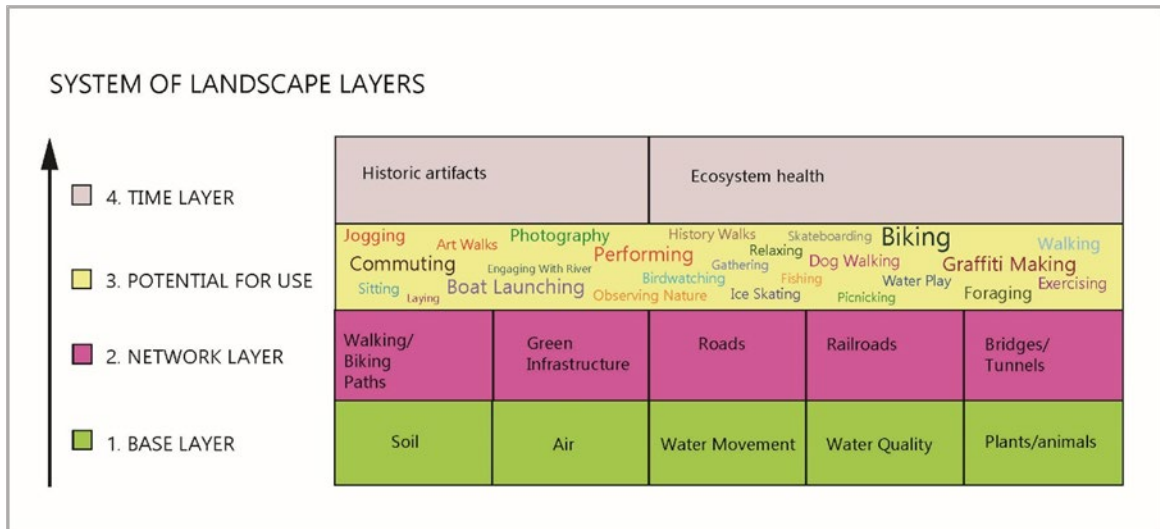


Figure 25: Adopted System of Landscape Layers.

(Source: Created by author, Sanja Martić).

3.3 Relevant Projects and Inspiration

Exploring case studies led to the discovery of many significant projects and designs. Besides the Room for the River example from Holland that provided the framework for this research, the City of New Brunswick Municipal Public Access Plan and Rutgers University Physical Masterplan Rutgers 2030 provided further insight into the existing conditions of the site as well as possibilities for their improvement. The D&R Canal State Park Masterplan further enforced the idea of long linear waterways being used as a corridor for connecting green open space.

A large-scale project in Germany that is aimed at renaturation of an industrial riverine landscape and creation of the Emscher Landscape Park is inspirational as it holds many similarities to the Raritan Watershed in New Jersey. Like New Jersey, the Emscher River region is a densely populated region burdened by an industrial heritage of pollution and fragmented by many local governing bodies. A visit to the Emscher

Landscape Park provided information on creating places that serve as connectors on both a regional and site scales. A Chouteau Greenway project in St Louis, Mississippi is an example of forming a matrix of corridors that connect diverse neighborhoods to natural and cultural resources and each other. All of the above-mentioned projects vary in scale, location, and scope but each one answers a particular design question relevant to the site. These are all examples of natural corridors used as a basis for the green open space connectors.

City of New Brunswick Municipal Public Access Plan

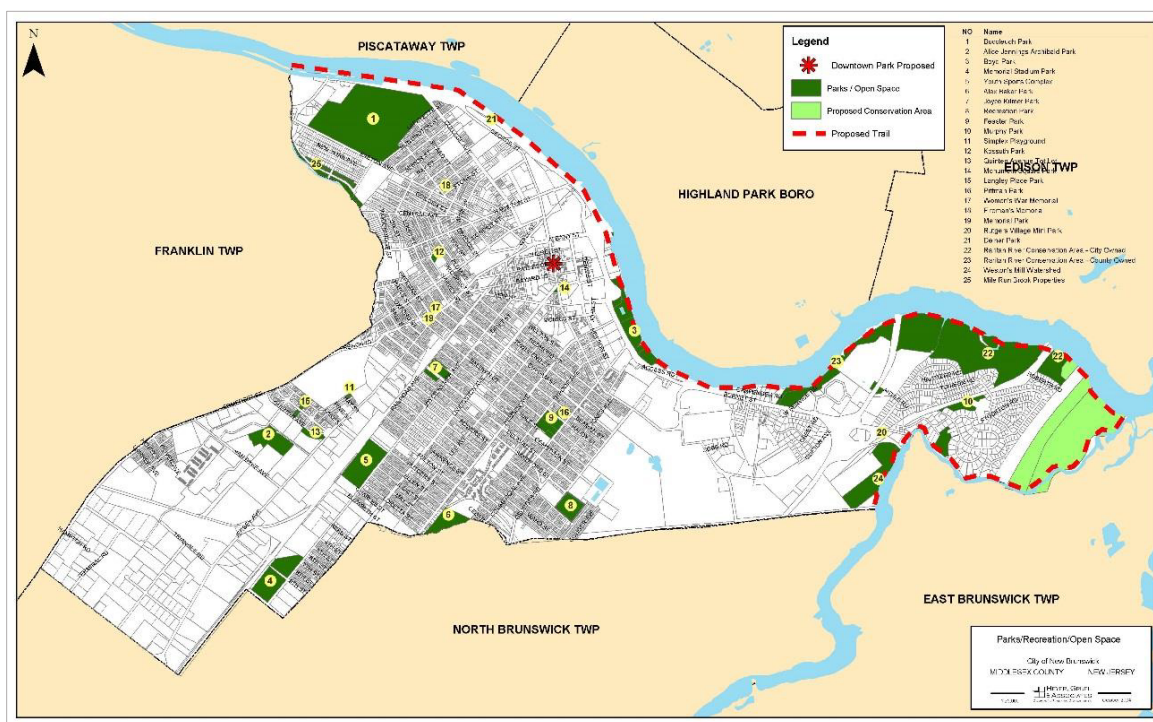


Figure 26: City of New Brunswick Municipal Public Access Plan.

Parks and open space map with proposed trail connecting the waterfront. (Source: Malone, S.J., (2017) The City of New Brunswick Municipal Public Access Plan, prepared for City of New Brunswick, NJ and NJDEP Coastal Management Program. pending adoption).

A 2017 municipal public access plan (Figure 27) identifies and describes in detail all the river access impediments and suggests access improvements, however, it is limited by the boundaries of the narrow edge of the waterfront. Site visits and experiential analysis uncover a lack of the physical and experiential connection between the waterfront and the green open space. Historical exploration uncovers loss of connection between communities and the river that unraveled over time. Reestablishing this relationship is identified as an area in need of improvement.

Rutgers University Physical Masterplan Rutgers 2030



Figure 27: Rutgers University 2030 Master Plan.

Proposed bridge connecting College Avenue Campus with the Livingston Campus via Rutgers University Ecological Preserve. (Source: Rutgers University Physical Master Plan Rutgers 2030 Volume 1: New Brunswick, June 18, 2015).

Rutgers University 2030 Master Plan (Figure 28) calls for a bridge and a boardwalk along the river, with a focus on the needs of the Rutgers University. The Master Plan limitation is in the lack of connection to the city and the D&R Canal State Park. In addition, construction of a new boardwalk would take away more of the river bed instead of lessening the environmental impact and giving the river more room. The design could be difficult to achieve given the nature of the Raritan River prone to flooding and large tidal fluctuations in conjunction with the expected sea level rise.

D&R Canal Commission Masterplan

The entire Raritan River watershed lies within the State of New Jersey, providing an opportunity to unite over the issue of water access and pursue a regional planning strategy as shown with the examples in Germany and Missouri. This is one of the important future development strategies stated in the D&R Canal State Park Masterplan from 1998. Its aspiration was connecting Central Jersey green open space, as well as cultural and historical sites through the D&R Canal as a main conjunction.

3.3.1 Emscher Landscape Park, Germany

There is a large variety of individual projects within the Emscher Landscape Park, with an underlining goal of the Emscher "conversion", or the Emscher River renaturation (Figure 29). This several decades long, ambitious project aims at transforming the entire length of the Emscher River (about 50 miles), back into a natural river from its industrial past historical use as a channeled, open sewer. As of today, some 140 miles of waste water channels have been constructed, and about 60 miles of waterways converted, with

an overall investment of 4.5 billion Euros in one of the largest infrastructure projects in Europe. The completion of the Emscher conversion is scheduled for 2020.²⁴

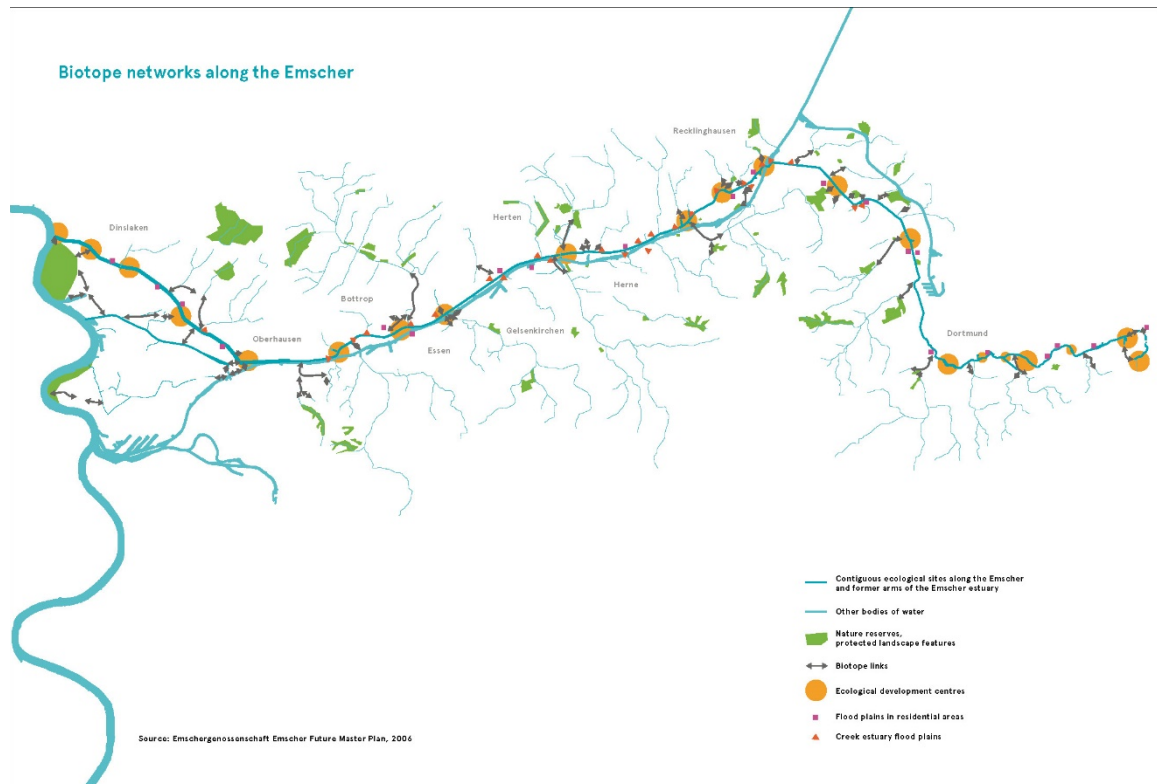


Figure 28: Emscher Landscape Park.

Scope of project is the entire Emscher River.
(Source: Emscher 3.0. 2006. From Grey to Blue).

Along with the infrastructure improvement and reconstruction, another big idea behind this 174 square miles regional park is creation of a new urban culturescapes: individual parks, industrial landscapes and artificial landmarks interconnected by hundreds of miles of trails. With over 200 projects that are already completed, this is the

²⁴ Ministerium für Kinder, Familie, Flüchtlinge und Integration des Landes Nordrhein-Westfalen, "Emscher Kunst," Emscher Landschaftspark, 2016. <http://www.emscherkunst.de/en/emsker-river/emsker-landschaftspark/>. (accessed January 25, 2019).

most developed regional park in Europe that has significantly improved the quality of life in the region and has become an international model for development.²⁵

Slinky Springs to Fame

Slinky Springs to Fame is one of the individual projects that caught my attention. This bridge sculpture connects Kaisergarten Park in the city of Oberhausen to the Emscher Landscape Park and its 40 miles of trails. Spanning over the Rhine-Herne-Canal, Slinky contributes to the urban culturlandscape, originally conceived as a part of the "EMSCHERKUNST 2010" exhibit. The bridge was designed by an artist, Tobias Rehberger, while construction was executed and completed in 2011 by an engineering company Schlaich Bergermann Partner, Madako (sbp).²⁶

²⁵ Stadt Oberhausen. Tourismus und Freizeit, "Slinky Springs to Fame," <http://www.oberhausen.de/de/index/tourismus-freizeit/stadtportrait/sehenswuerdigkeiten/slinky-springs-to-fame.php>. (accessed January 25, 2019).

²⁶ Ministerium für Kinder, Familie, Flüchtlinge und Integration des Landes Nordrhein-Westfalen, "Emscher Kunst," (accessed January 25, 2019).

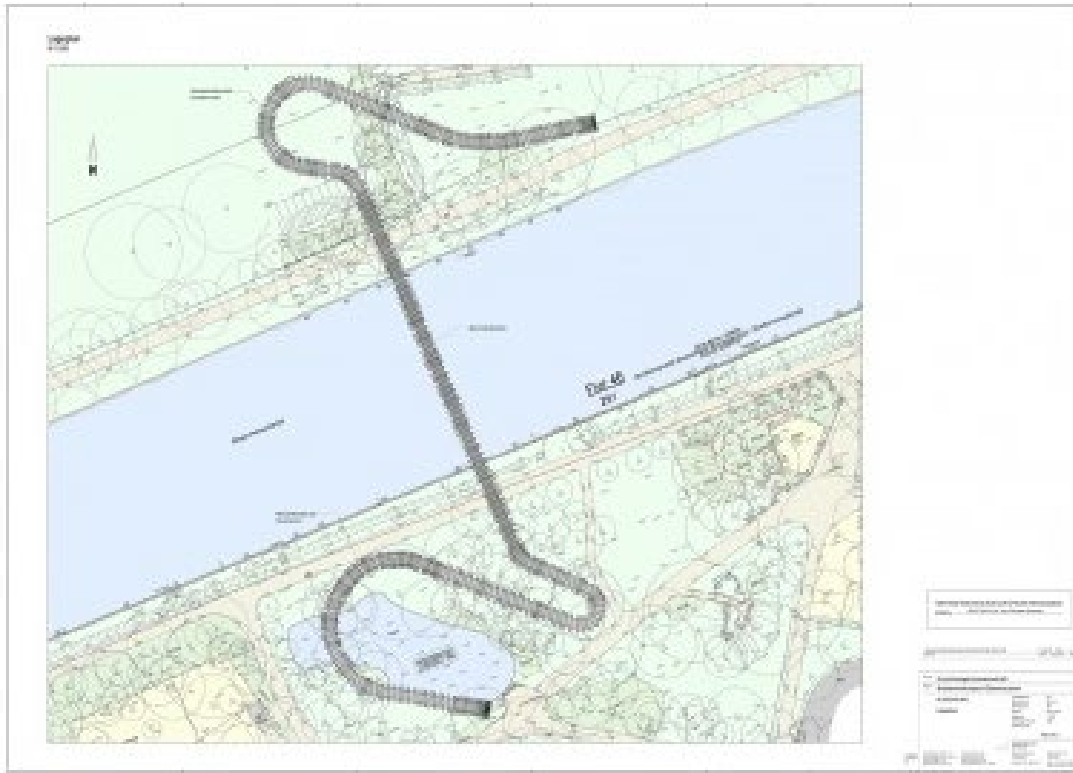


Figure 29: Slinky Springs to Fame.

Technical drawing of the Slinky Bridge reveals its structure. (Source: Sbp. Schlaich Bergmann Partner. 2018. Bridge Sculpture "Slinky springs to fame" Web. <https://www.sbp.de/en/project/bridge-sculpture-slinky-springs-to-fame/>).

The oscillating spiral bridge whose name comes from the spiral toy "Slinky"²⁷ is an instant attraction that provides joy to its users, particularly children (Figure 30). Strap ribbon bridge minimalist construction design allows for the lightness and liveliness of the bridge experience.²⁸ One can feel the bridge spring under one's feet, while experiencing the visual movement of the spiral at the same time. The bridge's meandering ramps offer

²⁷ Stadt Oberhausen. Tourismus und Freizeit, "Slinky Springs to Fame," <http://www.oberhausen.de/de/index/tourismus-freizeit/stadtportrait/sehenswuerdigkeiten/slinky-springs-to-fame.php>. (accessed January 25, 2019).

²⁸ Sbp. Schlaich Bergmann Partner, "Bridge Sculpture, Slinky Springs to Fame" Web. <https://www.sbp.de/en/project/bridge-sculpture-slinky-springs-to-fame/> (accessed June, 2018).

great views of the park, canal and of the bridge itself. Two ramps lead to the main 348 feet span, 33 feet above the canal that allow for undisturbed shipping below. The bridge is 8.2 feet wide and weighs only 115 tons. A total cost of 5 million Euros was covered 80% from the state through subsidies, and the remaining 20% from the Emschergenossenschaft, a public works company formed in 1899 as the first water management association in Germany with a mission to bring the Emscher back to its natural state.²⁹ Slinky is carefully placed in the landscape that was further enhanced by the addition of a new canal square with a water feature and a children's playground. The iconic bridge design won many awards and has become an Oberhausen city landmark.

The Slinky Springs to Fame bridge is a possible answer to a question of what an appropriate scale for a pedestrian bridge is. An additional discovery is that it is so engaging that it instantly activates its users and becomes a destination. A small-scale pedestrian bridge might be an appropriate connection from the Riverwalk's north-west end (Chapter 3.2) at the beginning of the D&R Canal at the Landing Lane Bridge. It would create an inviting and intriguing gateway to the D&R Canal State Park starting at the Landing Lane Bridge. An appropriate scale for the bridge and gateway into the D&R Canal Park could be a scale that would keep with the character of a local park but would be well known to global visitors alike. An activated bridge activates the river and brings us back to the rivercentric idea –using the river as the core that design builds outward from.

²⁹ Emscher Lippe Genossenschaft Verband. "The Emschergenossenschaft River basin management from the beginning," <https://www.eglv.de/en/emschergenossenschaft/>. (accessed June, 2018).

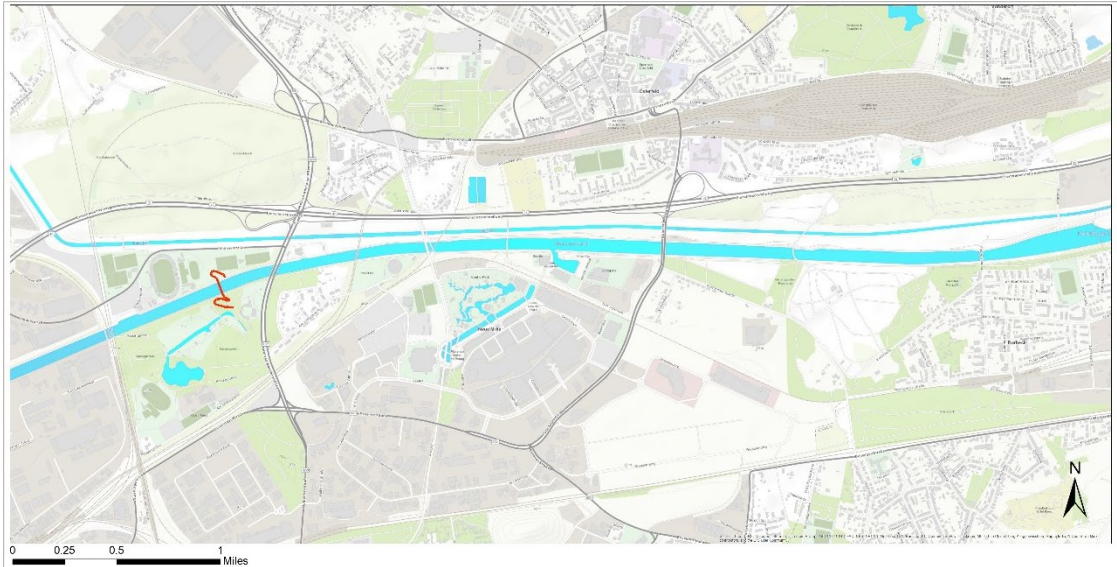


Figure 30: Slinky Springs to Fame in Context.

Slinky (shown in red) connects a local park in Oberhausen to the 40 miles of the Emscher Landscape Park. (Source: Diagram made by author, Sanja Martić).

The case study of the Slinky Springs to Fame bridge is revealing on two levels. It introduces a concept of a comprehensive watershed level planning initiative backed by state funding. On a much smaller scale, it tells a story of a small footprint bridge that makes a big impact on the region. Both scales are interesting to consider when thinking about New Brunswick and its connections to the Raritan River and the Delaware and Raritan Canal Park. While in the Ruhr Region case, large scale planning resulted in a site scale bridge design, perhaps a site scale bridge design in New Brunswick can spark conversations about large scale planning initiatives. One such initiative was started a long time ago when the D&R Canal State Park was first established with a vision of creating a corridor of connections to Central New Jersey historical, natural, and cultural sites.



Figure 31: Slinky Springs to Fame.

View from the south ramp. (Source: Photograph by author, Sanja Martic, June 2018).

North-west Germany's Ruhr Region is home to about 5.2 million people, compared to 3.4 million in Central New Jersey, and is one of Europe's largest metropolitan areas. It is situated in Germany's federal state of North Rhine-Westphalia. workers from all over the world. However, by the end of the industrialization era in 1960s production slowed down and industries that were once main economic drivers closed or moved. This brought on many environmental and socio-economic issues. In response to the need for regional revitalization, a Regional Association Ruhr (RVR) was formed. Today RVR consists of 20 municipalities, two counties, three government districts, the federal state North-Rhine Westphalia, and public companies Emschergenossenschaft and Lippeverband. A main goal of the association is transformation of the region into a service and culture-oriented metropolis, through a joint venture project, creation of the

Emscher Landscape Park.³⁰Emscher, Lippe and Ruhr are three rivers that run through the region. The Ruhr Region's development was initially driven by the coal and steel industries that once drafted

3.3.2 Chouteau Greenway – St Louis, Mississippi by Stoss

Chouteau Greenway project is a winning plan from the Stoss design firm in response to the Great Rivers Greenway's design competition in the spring of 2018. The goal was to create a connection between Forest Park in the city of St Louis and the refreshed Gateway Arch grounds on the Mississippi River originally designed by MVVA (Michael Van Valkenburg Associates). In a wider sense this case study shows that it is possible to generate public support for a large scale, long-term project in the United States, just like we learned from the Emscher Landscape Park example in Germany. On the other hand, this project also offers a way of solving socio-economic issues by landscape design intervention. New Brunswick, like St Louis, is facing similar issues of social and racial divides that will tend to increase as the planned city redevelopment progresses.

When completed, Chouteau Greenway will span a five-mile distance between Forest Park in western St. Louis to Gateway Arch National Park at the Mississippi River. This greenway will not be a park, but a landscape-driven development strategy for breaking the city's racial divide by attracting residents from all socioeconomic backgrounds towards this corridor that will connect parks, but that will also connect

³⁰ Regionalverband Ruhr, "Ruhr Metropolis Home," www.metropoleruhr.de/en/home/ruhr-metropolis/data-facts.html. (accessed June 2018).

important regional institutions³¹. In the words of another competition participant, James Corner, this project challenged participants to “think deeply about how a greenway can connect people and communities, contribute to what equitable cities can look like, and reflect and represent St. Louis’s values as a city”³². The greatest opportunity here is seen in unity, in connecting people by an ecological corridor that is also an economic generator, bringing vitality to the urban fabric³³.



Figure 32: Chouteau Greenway – A loop and a Stitch.

Greenway stitches through urban fabric creating connections to the riverfront and to the open space. (Source: Zach Mortice. 2018. “A “Loop and a Stitch” Across St. Louis’s Divide”. Landscape Architecture Magazine. 5/29/19).

³¹ Zach Mortice, “A “Loop and a Stitch” Across St. Louis’s Divide,” Landscape Architecture Magazine, 5/29/18.

³² James Corner in a letter to the Great Rivers Greenway competition, April 4, 2018.

³³ James Corner, Great Rivers Greenway Competition, 2018.

Another significance of this case study is the driving force behind it, a public agency. Great Rivers Greenways, an agency with a vision of connecting the city's three rivers with a regional network of greenway trails. The agency was created in 2000, after people of the St. Louis region voted for the introduction of a sales tax that would help fund building and maintenance of the greenways. The agency represents a vision of community that recognizes its parks and rivers as the region's best assets that need to be protected and connected in a system of parks, memorials, trails, and art spaces with a mission of strengthening the social, economic, and environmental well-being of the region. Great Rivers Greenways agency serves 2 million people in the 1,200 square mile district of St. Louis City, St. Louis County and St. Charles County. Operations of the agency also include and require collaboration on multiple levels including municipalities, public agencies, businesses, and nonprofit organizations. Master Plan, "River Ring" identifies 45 greenways that cover some 600 miles. Sixteen of them are currently in the works.³⁴

According to Stoss, although the Chouteau Greenway began as an east west proposition, connecting Arch to Park, it ended as a loop and a stitch because one line cannot effectively connect parts of the city that deserve equitable consideration in St Louis. Stoss's concept is one that recognizes St Louis's identity, both the iconic and nationally recognized, as well as its hidden stories of neighborhood erasures and racial tensions. Their proposal for Chouteau Greenway acknowledges and gives voice to all

³⁴ Great Rivers Greenways, "Great Rivers Greenways, About Us," <https://greatriversgreenway.org/about-us/>. (accessed November 12, 2018).

these stories³⁵. Chris Reed, Stoss's founding director, is looking to answer some ambitious questions such as "How can a landscape project sponsor a bigger conversation about the nature of race and class in a city?"³⁶

4. Background

*"This deeper understanding of natural and cultural history in cities can be the root of an authentic bond between people and the places they live—a bond formed through education that leads to greater stewardship of places and communities."*³⁷

Thomas Woltz, NBWLA, 2016.

Historically, human settlements were positioned on the river banks. In North America, the first communities established by the European settlers were arranged along the Atlantic Ocean coastline, and more specifically within the safety of its estuaries. St Augustine in Florida, settled in 1565 within the Mantanzas River estuary, is an example of the oldest continually inhabited city established by the Europeans in the United States.³⁸ Estuaries provided protection from the rough seas, their high production ecosystems were rich in food and other natural resources, while rivers offered drinking water and a gateway towards the inland. For the same reasons these areas were already inhabited by

³⁵ Stoss. Web. <http://www.stoss.net/projects/62/chouteau-greenway/>

³⁶ Zach Mortice. 2018. "A "Loop and a Stitch" Across St. Louis's Divide". Landscape Architecture Magazine. 5/29/19.

³⁷ Thomas Woltz, "Ecology and Culture in the Design of Urban Parks," Landscape Journal: Design, Planning, and Management of the Land 35, no. 2 (2016): 237.

³⁸ U.S. Department of the Interior, National Park Service, "Florida: St. Augustine Town Plan Historic District," June 6th, 2017
https://www.nps.gov/nr/travel/american_latino_heritage/st_augustine_town_plan_historic_district.

the Native Americans, who had long established trade and travel networks at the time of Europeans' arrival.

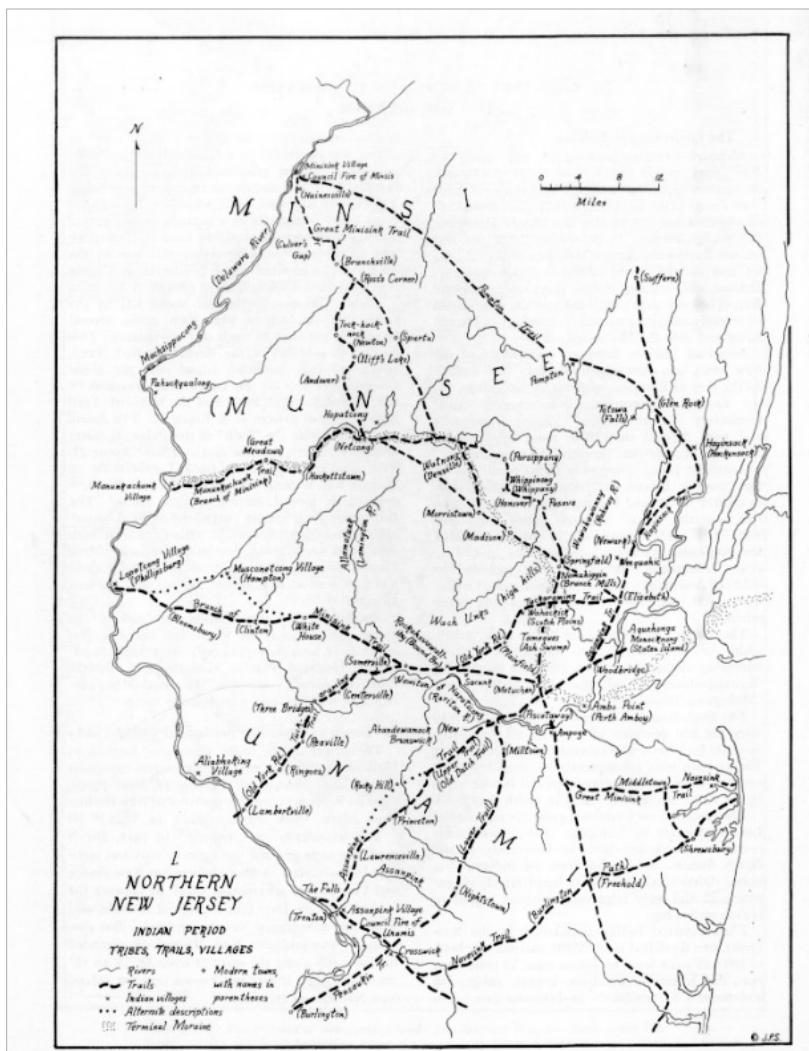


Figure 33: Northern New Jersey, Indian Period Tribes, Trails, Villages.

Many existing roads follow pathways of native inhabitants, Lenni Lenape. (Source: John Parr Snyder, *The Story of New Jersey's Civil Boundaries, 1606-1968* (1st ed. Trenton: Bureau of Geology and Topography, 1969), 2).

The Raritan Watershed, situated entirely at the heart of New Jersey, is another such example. The Raritan River's water reaches the Atlantic Ocean at the Raritan Bay, at the southern edge of the Lower New York Bay sharing its estuary with Hudson and

Passaic Rivers. The vast estuary was colonized by Europeans in the early 1600s, and over time became a densely populated midpoint between the cities of Philadelphia and New York. Many substantial changes impacted this area since precolonial times when Lenni Lenape natives inhabited the region (Figure 34). In order to best inform our understanding of the current Raritan River conditions that we find in New Brunswick and to explore possibilities for the access improvement we need to track back and explore changes that took place in the past. This chapter provides a closer examination of changes that occurred since the time of colonization, with focus on industrial revolution, industrial decline and the renewal.

4.1 Raritan River - Change Over Time

Colonial and industrial history of the Raritan is closely tied to the history of the Hudson River and New York Harbor, specifically Ellis Island, the main point of entry for European immigrants. Here, the Industrial Revolution was fueled by the labor of the constantly arriving immigrant body, by the river's water and other diverse natural resources that the estuary offered in abundance. The rivers were used by numerous industries as a source of water for power, cooling, and production, as well as waste disposal³⁹. Rapid industrialization soon formed one of the world's most densely populated areas, with the State of New Jersey becoming the most densely populated

³⁹ Tony Hiss and Christopher Meier, *H2O Highlands to Ocean: A First Close Look at the Outstanding Landscapes and Waterscapes of the New York/New Jersey Metropolitan Region: Water, Land, Air and the 14 Regional Indicators* (Morristown, N.J.: Geraldine R. Dodge Foundation, 2004), 12.

state of the Union to this day, anticipated to reach a full build out by the middle of this century.⁴⁰



Figure 34: The first known map of the Raritan.

The map orientation assumes the same direction as seen in Rivercentric perspective. (Source: Rutgers Special Collections).

As a result, the Raritan River landscape went through a dramatic change since European settlers first got to its banks. Prior to their arrival the native Lenape tribe called the river Rariton and used it as a source of food and a way of transporting goods and travelling that connected their inland pathways. The pattern of these old pathways bears

⁴⁰ New Jersey League of Conservation Voters, "Protecting Open Space," <https://www.njlc.org/issues/protecting-open-space>. (accessed January, 2019).

a similarity to the road pattern that we use today (Figure 34). Landscape has always dictated the best throughway alignments and settlement establishments. The Lenape seasonally used the fertile river bank plains for agricultural production and used the river to further transport their surplus produce for trade. They used the river's riparian forests as the hunting grounds and as a wood resource⁴¹. The Lenape's influence on the ecology and form of landscape was nominal. They considered natural cycles and used resources sustainably in order to work with the landscape that their lives depended on.

The new settlers superseded the Lenape in using the river and its banks as a resource and established their first post at the Raritan Landing in a small community that consisted of warehouses, shops, trade businesses and homes, all centered around a river port. The location is today known as the Piscataway side of the Landing Lane Bridge surrounded by Johnson Park. The second post, Inian's Ferry was established 1.5 miles down the river, on New Brunswick side at what is currently the Albany Street Bridge. John Inian established a ferry service here connecting the two sides of the river.⁴² Raritan Landing river port and the Inian's Ferry crossing were centrally located at the crossroads of the Lenape trade routes. This made Raritan Landing a transportation hub, an inheritance that granted New Brunswick its present nickname – the Hub City.⁴³

⁴¹ David Listokin, Dorothea Berkhout, and James W. Hughes, *New Brunswick, New Jersey: The Decline and Revitalization of Urban America*, (New Brunswick: Rutgers University Press, 2016), 4.

⁴² Listokin, Berkhout, and Hughes, *The Decline and Revitalization of Urban America*, 2016, 4.

⁴³ The Metlar/Bodine House Museum, Permanent Collection, "A Comprehensive Plan For: The Restoration, Interpretation and Rehabilitation of the Metlar/Bodine House", 2018.

When the boats would enter the mouth of the Raritan from the Atlantic Ocean, they could go no further than the Raritan Landing as this was the very end of the Raritan River's navigable channel and a natural terminal point for the exchange of cargo between the ships and ground transportation. Topography and change of elevation, a few miles further upstream from the Raritan Landing, define a Raritan that is no longer tidal and influenced by salinity of the Atlantic. The landscape determined the importance of the Raritan Landing, Inian's Ferry and later on New Brunswick. Their significance grew as more land routes started to get established as a continuation of the waterborne transportation system that allowed for the lowest cost of processing freight.

The pattern of the first land parcel divisions of the European settlers closely followed the banks of the Raritan River, as it was called at the time, and its tributaries (Figure 34). All the properties were attached at one end to a waterway to provide access to what was the main transportation route. This land division pattern, along with the orientation of this map indicate importance of the river to the settlers at that time. Their relationship to the river was forged through daily, direct contact with the river and its tides, floods and periods of drought. Note that the central axis of the river is vertically aligned, the same orientation as assumed in the rivercentric approach (Figure 23). This signals an attempt of the approach to recover the importance of the river by rebuilding people's affinity to it. The next few chapters illuminate how this relationship was severed.

4.2 New Brunswick and Transportation Infrastructure Development

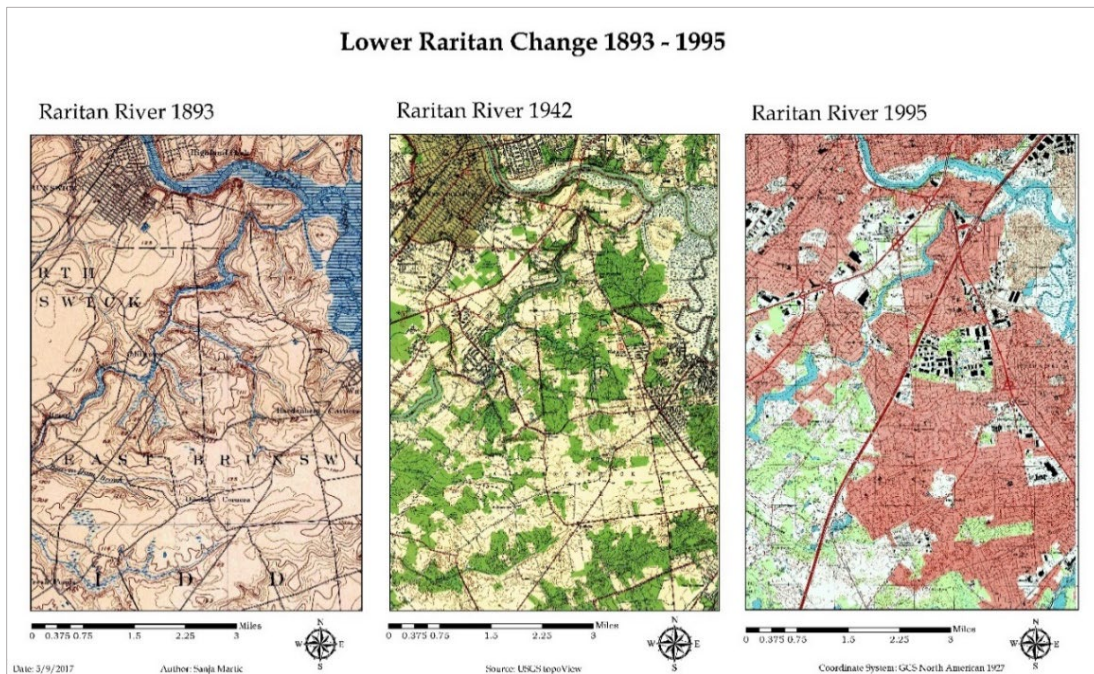


Figure 35: Lower Raritan Land Use Change 1893-1995.

Urban structures are taking over the landscape over time, while riverscape is disappearing. (Source: Maps assembled from the series of USGS historic maps, using the "topo view,"

<https://ngmdb.usgs.gov/maps/topoview/viewer/#4/39.98/-100.06> by author, Sanja Martic).

The urban structure of modern cities is shaped over time by changes in transportation and economic technology.⁴⁴ As the transportation infrastructure of New Brunswick developed it shaped its temporary form, and like most North American cities, it followed the same trajectory; from river port to suburban satellite city.⁴⁵ The city of New Brunswick was formally chartered in 1730, when the total population of Middlesex

⁴⁴ Listokin, Berkhout, and Hughes, *The Decline and Revitalization of Urban America*, 2016, 4.

⁴⁵ Alex Anas, Richard Arnott, and Kenneth A. Small, "Urban Spatial Structure, *Journal of Economic Literature*," 36(3) 1998: 1426-1464.

county was 15,956 people.⁴⁶ The city was a center of commerce, communication, government, and later, education with the establishment of the Queens College, future Rutgers University, in 1766. At this time, communities at Raritan Landing and Inian's Ferry were well established. With the introduction of a toll bridge built to replace the Inian's Ferry in 1790, a slow decline of the Raritan Landing started on one end, while the growth of New Brunswick's economic importance grew on the other⁴⁷.

Warehousing and processing of agricultural products took place in New Brunswick on the land closest to the river down and around the river bend from the Raritan Landing. Over time more land routes were getting established in the Turnpike Era and land away from the river started to become accessible (Figure 36). New Brunswick became a terminal point for a few of the main transportation routes like the Essex and Middlesex Turnpike (1806) and Georgetown and Franklin Turnpike (1815)⁴⁸ with a harbor located on the south bank of the Raritan. This was where the core of the manufacturing district was located, surrounded by the residences (Figure 37). The Raritan landscape in New Brunswick was an active, working landscape, full of people and life.

The improved transportation allowed for the expansion of the settlement to both sides of the river. The city's importance erupted with the opening of the Delaware and Raritan Canal in 1834. The Canal quickly became the city's lifeline and the main driver of its progress. This is evident from the late 19th century map (Figure 36, far left) where a

⁴⁶ US Census of Population and Housing 2015.

⁴⁷ Rebecca Yamin, *Rediscoverin Raritan Lending, An Adventure in New Jersey Archeology*, (Middlesex County, 2011).

⁴⁸ Listokin, Berkhout, and Hughes, *The Decline and Revitalization of Urban America*, 2016, 6.

recognizable primary street pattern of New Brunswick already started to emerge along with the first railroad line. The next transportation structure with such impact on the city will not come about until the building and extension of the Route 18 in 1980s.⁴⁹ It is therefore important to review the background of the two structures and their impact on the city and each other.



Figure 36: New Brunswick 1870.

At that time Riverfront was one of the most densely populated areas of the city. (Source: New Brunswick Public Library).

⁴⁹ The Metlar/Bodine House Museum. Permanent Collection, "From Indian Trail to Interstate," A Comprehensive Plan for the Restoration, Interpretation and Rehabilitation of the Metlar/Bodine House, 2013, <http://www.metlarbodinehousemuseum.org/permanentcollection>. (accessed April 15, 2018)

Delaware and Raritan Canal (D&R Canal)

The Delaware and Raritan Canal at first existed as William Penn's idea in 1676 at the time when ocean travel was dangerous and long, and a few existing roads were in a poor condition. It took almost 150 years before this idea was materialized and construction of the canal started in 1830. The canal, fed with water from the Delaware River in Frenchtown, runs to Trenton where the feeder canal ends, and the main canal breaks away from the Delaware River. The main canal runs from Trenton and terminates in New Brunswick, connecting the Delaware and Raritan watersheds. The canal opened in 1834 in order to connect Philadelphia and New York via water, cutting the time of travel between the two cities from two weeks to two days. During the height of the Industrial Revolution, between 1860 and 1870, the canal was in its prime, at one point used even more than the legendary Erie Canal.⁵⁰

⁵⁰ Department of Environmental Protection, New Jersey, Delaware and Raritan Canal State Park Master Plan (Delaware and Raritan Canal Commission: Stockton, NJ: May 1977), 1.

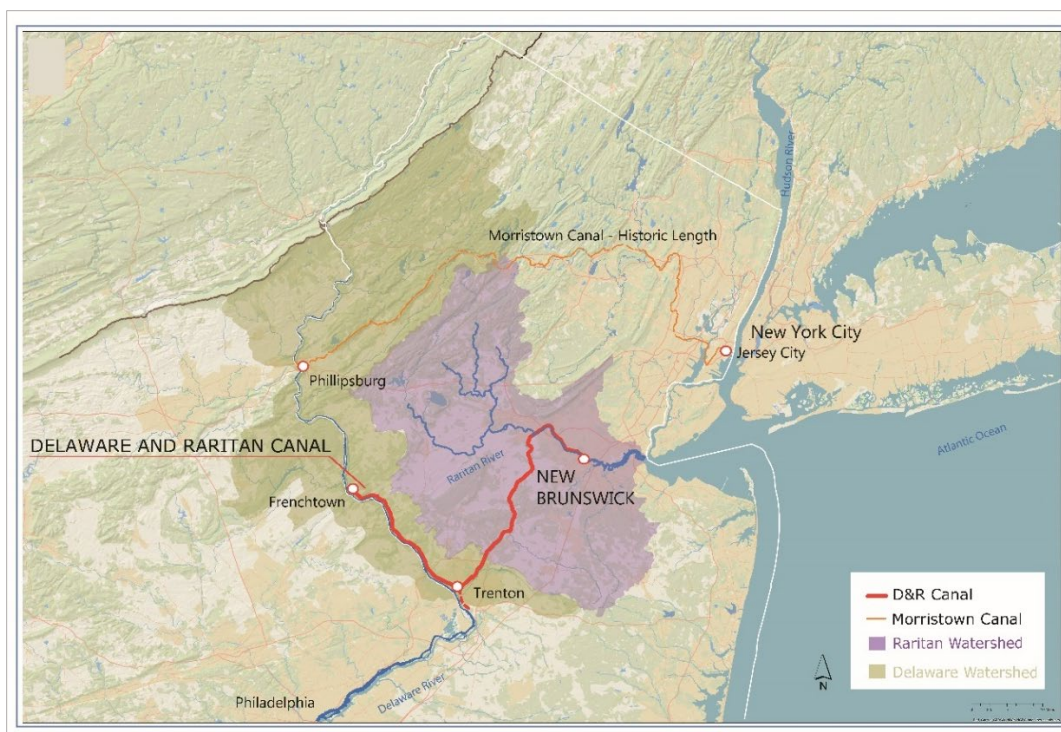


Figure 37: Delaware and Raritan Canal.

Delaware and Raritan Canal stretches from Frenchtown to New Brunswick (Source: Map created by author, Sanja Martic).

The D&R Canal is sixty miles long and it consists of a feeder and the main canal shaped as a wide letter "v" (Figure 38). The feeder canal starts near Frenchtown on the Delaware River at an elevation of 70 feet above sea level. The feeder is 6 feet deep and 60 feet wide. It enters the main canal in Trenton at the elevation of 56 feet. The main canal is 7 feet deep and 75 feet wide, 44 miles long. When first constructed the canal had a total of thirteen locks before reaching the sea level at the Raritan River and the terminal lock in New Brunswick⁵¹. This final and only double lock presented a pivotal point of the canal where barges with Pennsylvania coal and produce moved to the ocean

⁵¹ Betty B. Davison 1976. "The Delaware and Raritan Canal A Users Guide for hikers Canoeist, Fisherfolk, History Buffs, Bird Watchers, And Lovers of the Great Outdoors", The Delaware and Raritan Canal Coalition, p 8-9.

side while the barges with manufactured product moved into the canal.⁵² Today the remains of the Canal's terminal lock are contained within the Boyd Park, next to the Rutgers University's Boathouse (Figure 39).



Figure 38: Terminal Lock of the D & Raritan Canal.

Terminal Lock of the Delaware and Raritan Canal as Seen from the Rutgers Boathouse. (Source: Photo by author, Sanja Martic, December 2018).

The D&R Canal operated daily from April to December, from dawn till about 10pm. It was closed during the winter months and when temperatures would fall below freezing since the towpath would become too slippery for the mules to get traction. The mules were pulling barges with cargo from the towpath up and down the canal's locks⁵³. Besides transportation, the canal was also used for fishing and swimming, in the winter for ice-skating, people lived on the barges and the canal related activities were at the

⁵² Betty B. Davison, *The Delaware and Raritan Canal a User's Guide*, Delaware and Raritan Canal Coalition: 1976, 44.

⁵³ Richard F. Veit, *The Old Canals of New Jersey; a Historical Geography*, (Little Falls: New Jersey Geographical Press, 1963).

heart of community life. The earlier population percentage comparison (Figure 14) reveals the past canal's importance for the city's habitation.⁵⁴

The New Brunswick port benefitted and grew from the heavy traffic, however there were a few negative effects on shipping and wholesaling, since products could just sail right through the city to the next market and didn't need to be stored in warehouses or transported by land.⁵⁵ Still, at the end of the 19th century, the entire canal front in New Brunswick was dotted with densely concentrated industrial, manufacturing and warehouse structures (Figure 36) . When congestion due to the land constraints became overwhelming, industries started moving away from the waterfront and into the southern portions of the city.⁵⁶

Johnson and Johnson (J&J) was one of the companies that didn't follow this rule. J&J started to stand out as one of the most affluent companies in New Brunswick. Its influence grew over time and it eventually influenced the very fabric of the city in the years to follow. The J&J headquarters remained until this day within its historic property boundaries on the banks of the Raritan River under the stone railroad bridge. Today the canal portion is covered by a large parking lot and Rt18. When the canal was operational, J&J operated its own steamboat fleet under the name Middlesex Transportation Company and had a private dock on the waterfront property.⁵⁷

⁵⁴ Listokin, Berkhout, and Hughes, *The Decline and Revitalization of Urban America*, 2016, 38.

⁵⁵ Rebecca Yamin, *Rediscoverin Raritan Lending, An Adventure in New Jersey Archeology*, 2011. Middlesex County, NJ, 10.

⁵⁶ Department of Environmental Protection, New Jersey, Delaware and Raritan Canal State Park Master Plan (Delaware and Raritan Canal Commission: Stockton, NJ: May 1977), 7.

⁵⁷ Linda Barth, *The Delaware and Raritan Canal at Work*, San Francisco, CA. 2004, 57.



Figure 39: Johnson and Johnson building in New Brunswick.

(Source: Johnson and Johnson Museum)



Figure 40: Canal in front of the J&J Building Figure 41: Canal in front of the J&J Building

(Source: Linda J. Barth, *The Delaware and Raritan Canal at Work*, San Francisco, CA., 2004, 56, 57).

Over the next 100 years the canal was used primarily for transporting coal, before the railroads started taking over this task, eventually leading up to the canal's closing in 1933. Upon closing, the canal was handed over to the state and was left unattended for 10 years before it was dredged and rehabilitated as a potable water infrastructure in 1944.⁵⁸ Ever since, the canal had been supplying drinking water to New Brunswick and other parts of Middlesex County. As the canal's banks started to grow more vegetation, and the towpath was not used for pulling barges any longer, the canal slowly started to develop a new aesthetic character and was increasingly used for recreation. Closer

⁵⁸ Department of Environmental Protection, New Jersey, Delaware and Raritan Canal State Park Master Plan (Delaware and Raritan Canal Commission: Stockton, NJ: May 1977).

exploration reveals three distinct characters of the canal that we see today: Urban Nature, Urban Wild and Suburban Nature (Figure 43).

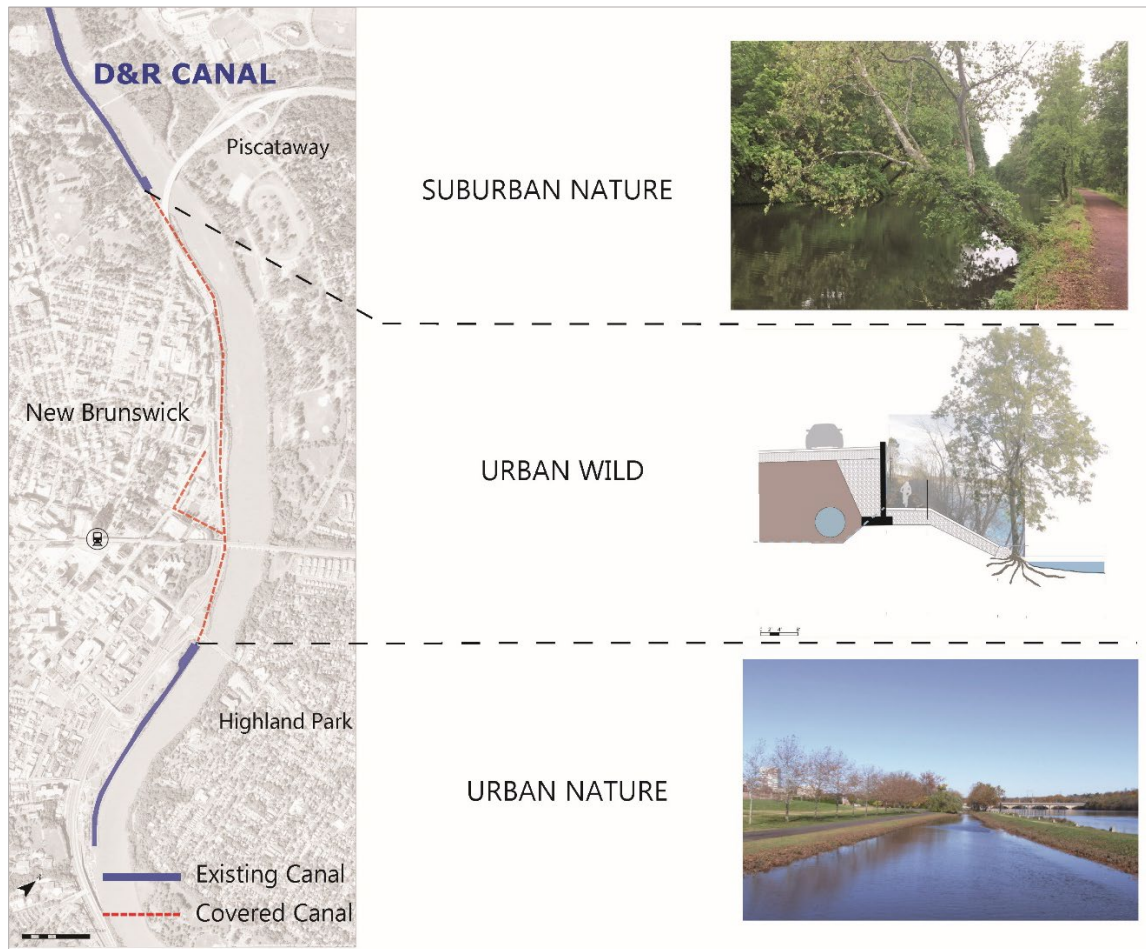


Figure 42: Three Characters of the Delaware and Raritan Canal.

The canal and its towpath go through a radical change, as they enter the City of New Brunswick. (Source: Map, images and diagram by author, Sanja Martić).

Vegetation started taking over the banks of the canal, resulting in an iconic landscape that gives Central New Jersey a distinct character (Figures 44 and 45) and its residents a sense of identity and connection to the outside world⁵⁹. It was this

⁵⁹ Listokin, Berkhout, and Hughes, *The Decline and Revitalization of Urban America*, 2016, 9.

connection to the place that sparked the community to organize and build strong public pressure to turn the old canal into the state park. In 1973, D&R Canal was included in the Register of Historic Places, and in 1974, the Delaware and Raritan Canal State Park was officially opened. Currently, the D&R Canal Park is very popular for biking, hiking, horseback riding and canoeing and is known as the second most visited state park in New Jersey with 1,245,193 visitors recorded in 2017.⁶⁰

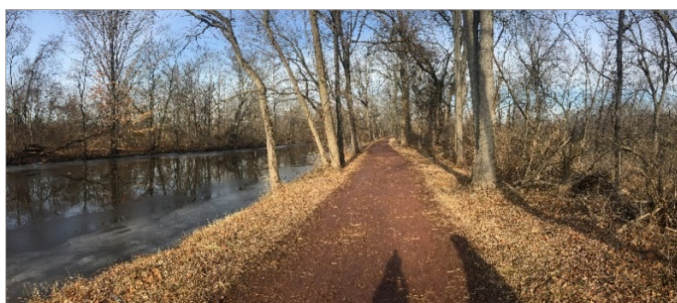


Figure 43: D&R Canal State Park



Figure 44: D&R Canal State Park

Typical views of the D&R Canal. (Source: Photo by author, Sanja Martic, December 2017).

However, there was another reason for the community outcry in 1973. At that time reconstruction and expansion of the State Route 18 and building of the John Lynch Bridge had threatened to sever the entirety of the D&R Canal and disconnect it from reaching the Raritan River at its last lock in today's Boyd Park. A long Environmental Impact Statement from 1976⁶¹ testifies of this struggle that involved experts from many organizations and fields including the Rutgers community. This long, politicized and

⁶⁰ State of New Jersey, Department of Environmental Protection, "Delaware and Raritan State Park, Facts" 2018, <https://www.state.nj.us/dep/parksandforests/parks/drcanal.html#faqs>.

⁶¹ United States Coast Guard, Washington, DC: Department of Transportation, "Final environmental impact/section 4f statement: Route 18 bridge across the Raritan River, New Brunswick-Piscataway, Middlesex County, New Jersey," (Washington, D.C: 1976).

drawn out battle⁶² resulted in a part of the D&R Canal being filled in and used as a base for the new throughway, thus indeed severing the end of the D&R Canal from the rest of the State Park (Figure 13).

The construction of a connection to the state park was mandated, and a narrow walking strip was carved into the concrete covered bank of the river leading pedestrians from the Canal's spillway at Buccleuch Park to the Albany Street Bridge. This path was meant to connect the last exposed part of the Canal in Boyd Park, New Brunswick to the rest of the D&R Canal Park. When it was first built the path stood out next to the river as a part of the concrete shell devoid of any vegetation and as a part of the support for a six-lane highway with Deiner Park built partially over its top (Figure 14). Over time, however, nature started taking over its concrete banks resulting in formation of an unusual landscape best described as aforementioned urban wilderness.

D&R Canal Park is recognized by its governing body, The Delaware and Raritan Canal Commission, to have an immense potential for green space connections within Central New Jersey. Potentials are listed and described in the D&R Canal Masterplan.⁶³ Further potential for connections towards even larger systems is explored in chapter 2.3 Regional Perspectives. The City of New Brunswick could benefit greatly from having a much better connection to this priceless asset. However, first the issue of access

⁶² Listokin, Berkhout, and Hughes, *The Decline and Revitalization of Urban America*, 2016.

⁶³ Department of Environmental Protection, New Jersey, Delaware and Raritan Canal State Park Master Plan, 2nd ed. (Delaware and Raritan Canal Commission: Trenton, NJ:1989).

explained in the following chapter and brought about by reconstruction of Route 18, needs to be addressed.

New Jersey Route 18

Around the time of the D&R Canal closing in the early 1930s the effects of the Industrial Revolution depleted resources locally, as well as nation wide. In addition, the big drought was evaporating agricultural fields of the mid-west and the great expansion was replaced by the Great Depression. In the postindustrial era that slowly followed, New Brunswick's economy slowed down. Next, World War II went by, proceeded by the G.I. Bill⁶⁴ that incentivized home building at around same time that automobiles became affordable. The Federal Aid Highway Act of 1956 authorizing funding for the new Interstate Highway System further encouraged massive movement of the people from cities to suburbs. Nationwide, city living fell out of favor, and by the 1960s, "New Brunswick was an aging industrial urban center"⁶⁵, like so many other river cities.

150 years after construction of the D&R Canal, at the tail end of the highway building era, New Brunswick's economic revitalization success depended largely on construction of a new transportation infrastructure, this time a highway that would provide access to the developing central business district (CBD). The resolution was a reconstruction of the state highway, New Jersey Route 18, that stretches from the Wall Township at New Jersey shore to Rt 287 in Piscataway. This route was reconstructed several times since it was first designated in 1939, with the most expensive, most

⁶⁴ Servicemen's Readjustment Act of 1944.

⁶⁵ Listokin, Berkhout, and Hughes, *The Decline and Revitalization of Urban America*, 2016, 1.

contested, and longest awaiting part of the reconstruction being the construction of the four lane, John A. Lynch Memorial Bridge over the Raritan River and parts of the Delaware and Raritan Canal.

The reconstruction and expansion started in 1960s and it didn't finish until 1983 for several reasons. On one hand, historians were afraid of losing the canal that did end up getting partially filled in. Citizens were concerned with the river access and esthetic value, and Rutgers students with the noise generated on the College Avenue Campus. On the other hand, developing the CBD needed access in order for its businesses to thrive in the new highway dependent economy. One of the companies crucial for New Brunswick's growth, Johnson and Johnson, insisted that the reconstruction was a condition for keeping their headquarters here.

By the time construction was completed, the resulting structure was indeed built on top of the filled in portion of the D&R Canal with several historic structures removed. The new structure formed a hard edge between the city and the river, it negatively impacted the ecology of the river bank, and ultimately impacted the access. Route 18 reconstruction was an economically motivated move that started to bring New Brunswick prosperity, but it took away a big part of its identity and history. Dissecting the city from the river was arguably the most radical change in the landscape of New Brunswick ever since the introduction of the D&R Canal. It marked changes in the land use, as well as a radical shift in people's perception of the river, that now became invisible to the city's residents. The River lost its importance as the city's lifeline and it started to literally and symbolically disappear from the city's landscape. At the same time large swaths of

neighbourhoods and landmarks were replaced inside the city in order to allow for the CBD developments, further impacting city's connection to its history and culture.



Figure 45: NJDOT Route 18 Reconstruction Information.

(Source: State of NJ, Department of Transportation, [Njcomuter.com](http://www.state.nj.us/transportation/commuter/roads/route18/faq.shtm#contract)
<http://www.state.nj.us/transportation/commuter/roads/route18/faq.shtm#contract>).

In 2005, a new reconstruction project was started that affected a portion of the Route 18 stretching south from the Albany Street Bridge to the junction with Route 1. The New Jersey Department of Transportation had stated goals that were supposed to mitigate some of the ecological, aesthetic and access impact of the prior construction (Figure 46). Some of the stated improvement goals that demonstrated needs of the local community were, "enhanced safety, operations, drainage and landscaping with noise

barriers and an aesthetic wall. Boyd Park will be enhanced, and a new boat ramp installed. An express section for through traffic and another for local traffic will be provided along with acceleration/deceleration lanes and shoulders. Multi-use paths, bicycle/pedestrian overpasses and bus stop pullouts will be provided and/or upgraded”⁶⁶. Today, ten years after construction was completed, the New Brunswick waterfront still feels disconnected from the downtown, underutilized, and with much room for improvement.



Figure 46: Route 18 & Riverwalk.

Route 18N with College Avenue Exit and Riverwalk on the right. (Source: Photograph by author, Sanja Martic, November 2018).

5. Design Intervention

Considering the relationship between the river and the city by assuming a rivercentric perspective resulted in a final design proposal that calls for two types of interventions. The first intervention is at the core of the design and it establishes a better access to the Riverwalk from the city. The second intervention is utilizing the river’s

⁶⁶ State of New Jersey, Department of Transportation, “Njcomuter.com” <http://www.njcommuter.com/>. (accessed December 20, 2019).

ravines to form access corridors from the city's neighborhoods to the river, thus enhancing visibility of the riverscape throughout the city. While improving the access to the Riverfront, the improved spatial quality of the Riverwalk is simultaneously considered. This implies paying respect to the history, local art and culture as well as the existing, postindustrial character of the space by building it into the design along with opening the views to the river along the Riverwalk's path.

The intervention in the ravine area is also somewhat subtle; it involves adding a boardwalk through the ravine that interacts directly with the street network making the ravine easily accessible. The current character of this space is one best described as a thrilling seclusion of being in the middle of the city yet surrounded by nature that not a lot of people see in their everyday life. Careful measures should be taken for this quality to remain incorporated in the future boardwalk design.

The riverine landscapes, the river and the ravines, are currently considered unsafe, they are rarely visited and often used for dumping. Designing a public space and bringing community in would change this perception and the use of space. Graffiti covered walls of the Riverwalk are already somewhat famous for being some of the longest graffiti art walls in the state. They could offer a canvas for more future mural and graffiti art that would express local culture as well as educate public about the riverine ecology. Finally, a small intervention is also suggested on the Johnson Park side of the Raritan in order to truly anchor the center of the design around the river. Collaboration between Middlesex county and New Brunswick would be required to realize this intervention.

5.1 The New Brunswick Greenway Masterplan Proposal

The design intervention on the city scale radiates from the river and the Riverwalk as a core and reaches out into the city's neighborhoods through Riverfront Connectors and Green and Urban Corridors. It brings the river into the city and pulls the city back to the river. The Tributary Connections complete a "back door" link, a full circle going back to the river. The Greenway Masterplan constitutes the main river artery, the Riverwalk, running in the north-south direction and the east-west oriented capillaries, corridors, running off from it. Each of the five design intervention typologies differ in character and level of intervention.

The Riverwalk, directly adjacent to the Raritan requires an intervention specific to its character. The Waterfront Access Points (Figure 55), are nodes that connect the waterfront to the city. They were constructed by the NJDOT in the process of the Route 18 construction but need to be redesigned in order to be more pedestrian friendly and offer a better experience of the riverine landscape. From these nodes, proposed intervention takes place on the Key Connector Streets that are Commercial Avenue⁶⁷, Joyce Kilmer Avenue and Delavan Street as a part of the future Green Streets network, while French and Hamilton Streets are a part of the proposed Urban Streets network. Finally, the Mile Run tributary becomes the fifth site of intervention as a future Blue

⁶⁷ Commercial Avenue was renamed Paul Robeson Boulevard. The change was recent and for timely reasons not reflected in writing, maps and diagrams of this thesis.

Corridor that has potential to be formed by enhancing access and redesigning the river's tributaries (Figure 47).

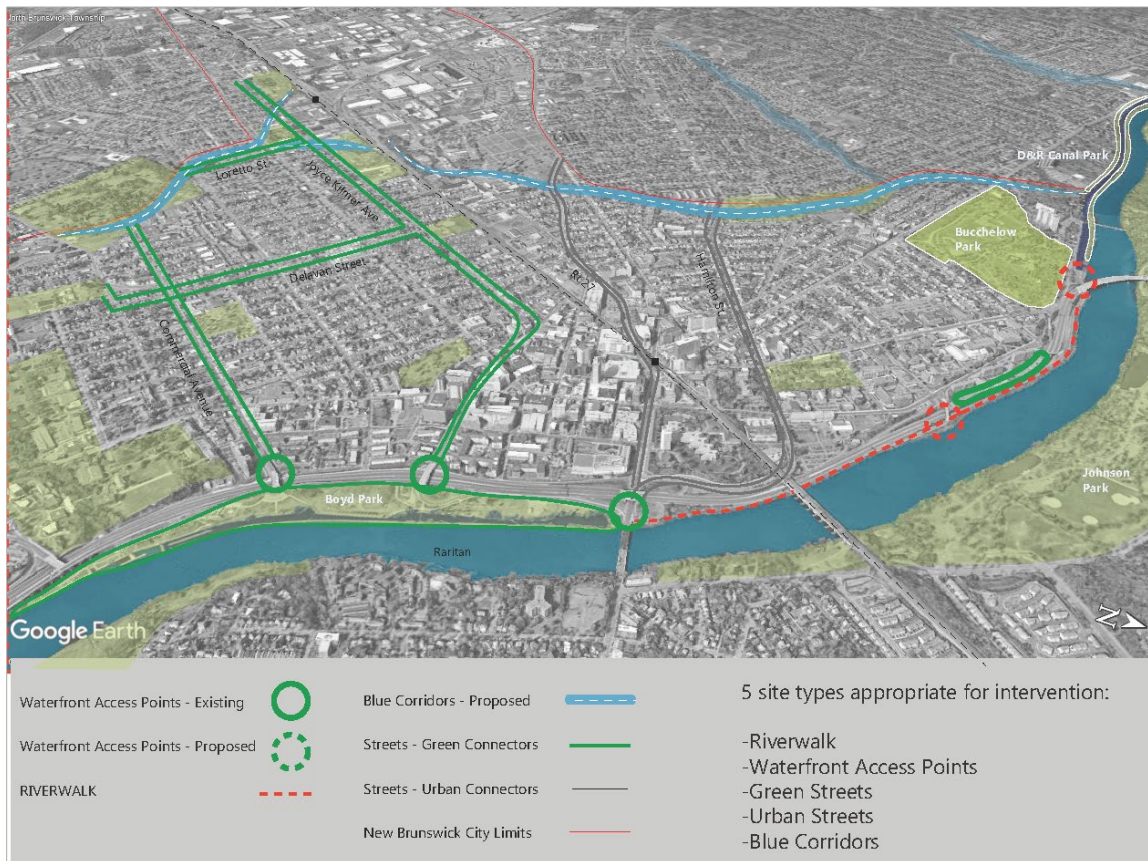


Figure 47: Five Site Specific Typologies.

(Source: Diagram created by author, Sanja Martić, background image from Google Earth 2018).

5.1.1 The Riverwalk

The "Bum Trail", haphazardly attached to the Route 18 as the main impediment to the river access becomes the gateway of its approach. The Riverwalk, as it is renamed in the process of redesign, is a narrow, concrete bank of the Raritan that becomes an axis from which design interventions permeate to the city and to the river. One of the more interesting aspects of this space is its ability to simultaneously capture

our attention in two ways by inspiring curiosity and signaling danger and uncertainty. The feelings of uncomfortable tension, coming from the enclosed space on one hand, are mixed with the feelings of curiosity about this peculiar place on the other. This ambiguity plays a crucial role in the final design as it gets translated into moments of compression and release, that become a part of the new Riverwalk's experience. The Riverwalk redesign is a conservative intervention that builds on the existing structure, using the urban wilderness and the river with its banks to create a unique experience.

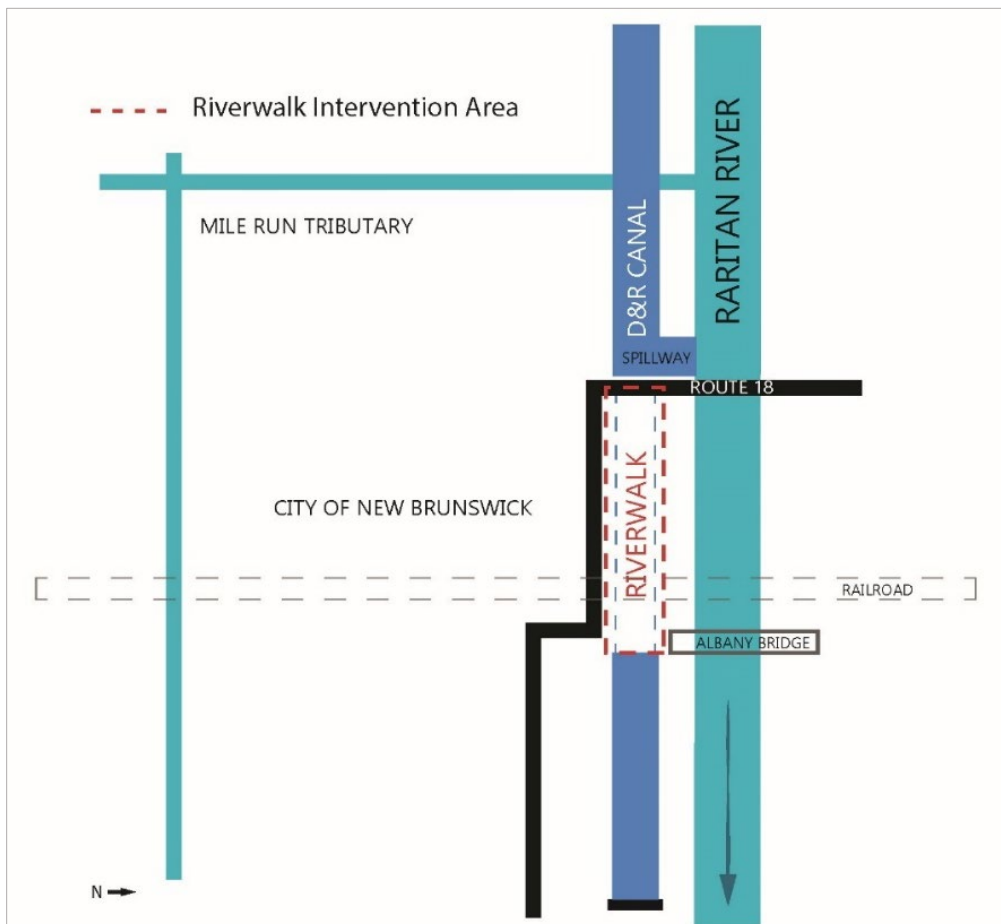


Figure 48: Riverwalk Intervention Area.

Intervention starts at the spillway and ends at Albany Street Bridge. (Source: Diagram by author, Sanja Martić).

The width of the path and the views from the path's vantage point are manipulated by the designer in order to maintain the experience of compression and release. After the 6 feet tall chain link fence is removed along the entire length of the Riverwalk it is replaced by a 42" railing (Figure 49). The pathway is widened to 12 feet in places where a sense of release of compression is needed and opened up to the river at the opportune moments (Figure 50). Openings on the riverside of the pathway are created by making cuts and removing vegetation within the cuts that are 28 feet in length. Some of the cuts additionally provide opportunities for a direct river access in the form of a series of platforms stepping down to the river (Figure 51).

All structures are built on the existing concrete covered bank, without any intervention within the riverbed. Broadened parts of the Riverwalk and the lookout areas are cantilevered off the existing structure (Figure 52). The two main lookouts correspond with the two existing lookouts in Johnson Park, creating spatial communication between the two and further enforcing the idea of the river as the epicenter. The Johnson Park side of the Raritan is further activated by addition of rotating floating docks that provide a possibility of viewing the river in high as well as low tides (Figure 53).

Two programmed lookouts communicate with the two existing lookouts directly across the river in Johnson Park. Some of the programming could include eco-art sculptures and citizen scientist river monitoring devices as suggested by the LRWP activists. They could also include remote communication with the Johnson Park (visual or auditory communication tools that bring attention to the other side). By attracting views, they also improve safety for people using the Riverwalk.

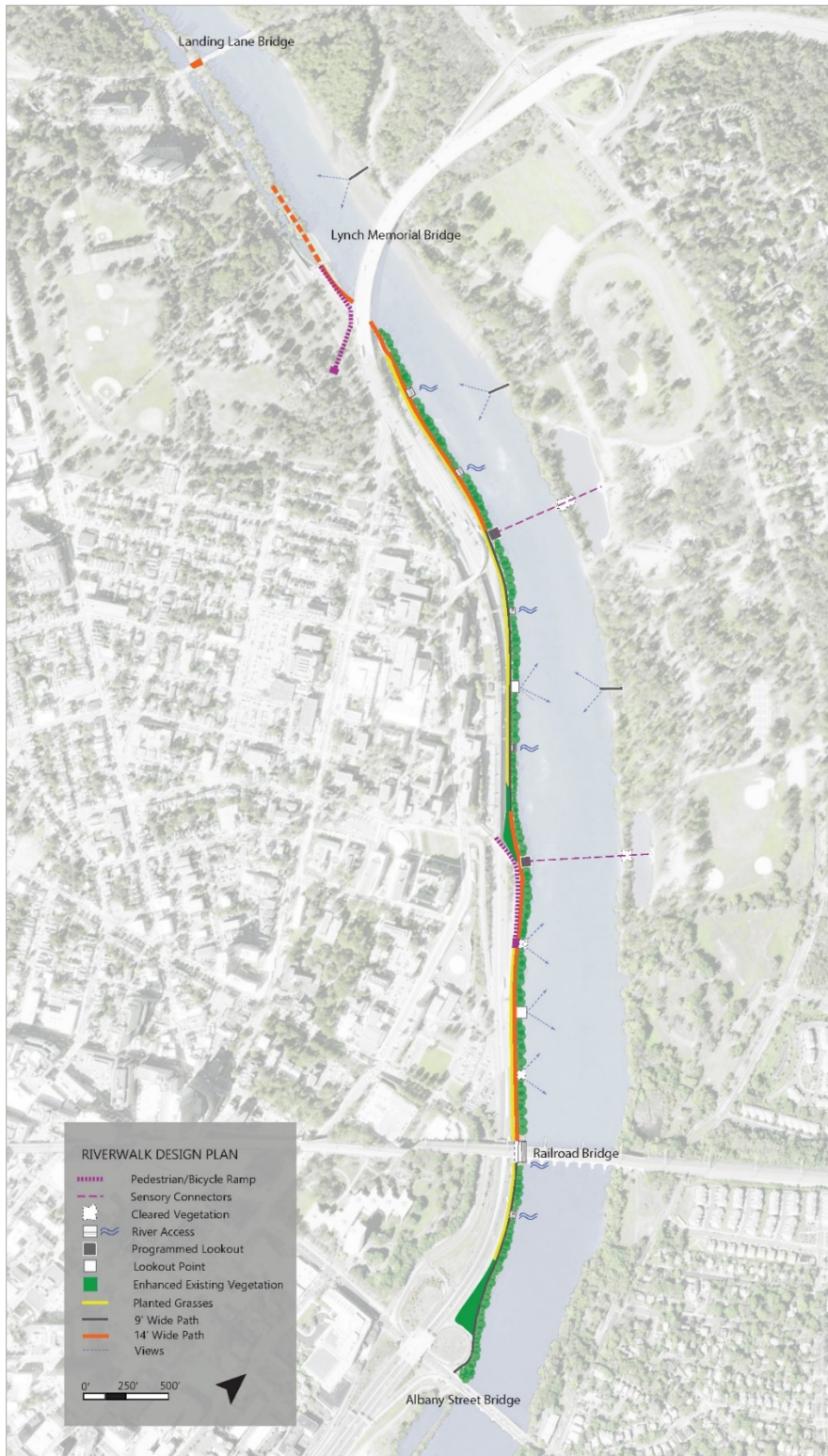


Figure 49: Riverwalk Reimagined.

(Source: Diagram by author, Sanja Martić)

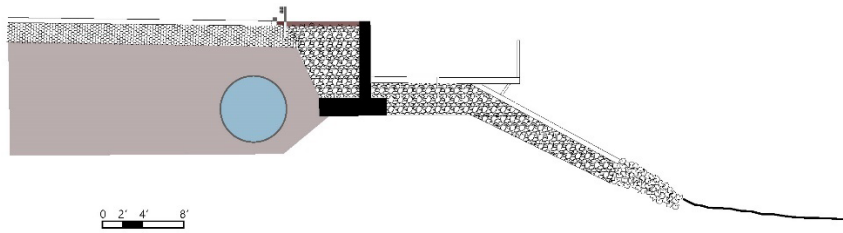


Figure 50: Broadened Pathway of the Riverwalk.

Pathway is now 12 feet wide, the fence is lowered to 42".
(Source: Section by author, Sanja Martić)

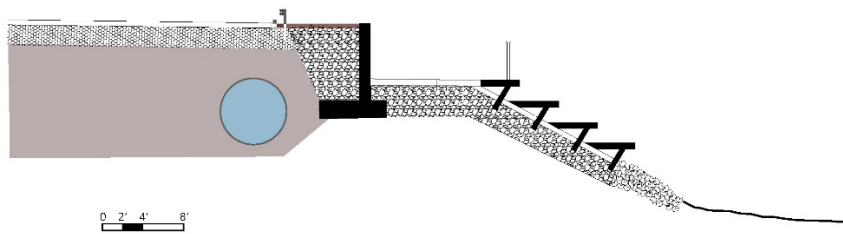


Figure 51: Pathway and River

Pathway provides opportunity for a direct engagement with the river.
(Source: Section by author, Sanja Martić)

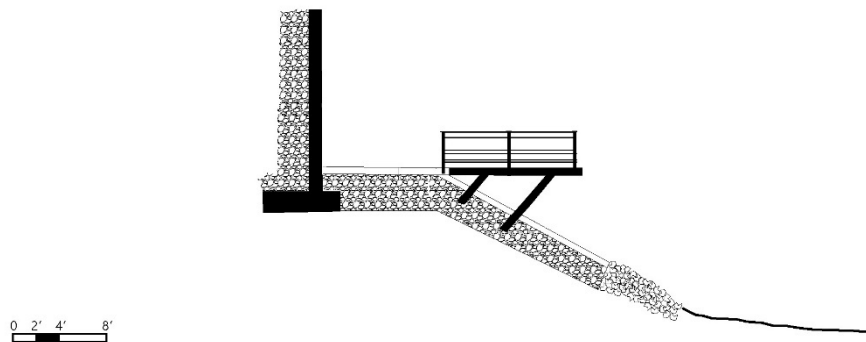


Figure 52: Outlook.

Outlooks communicate across the river. (Source: Section by author, Sanja Martić)



Figure 53: Floating Dock in Johnson Park

Floating and rotating dock adjusts to direction and height of the tide. It provides an opportunity to look at the river up close. (Source: Image by author, Sanja Martić).

The existing vegetation is enhanced wherever possible, additional native grasses are planted on the highway side of the pathway (Figure 54).

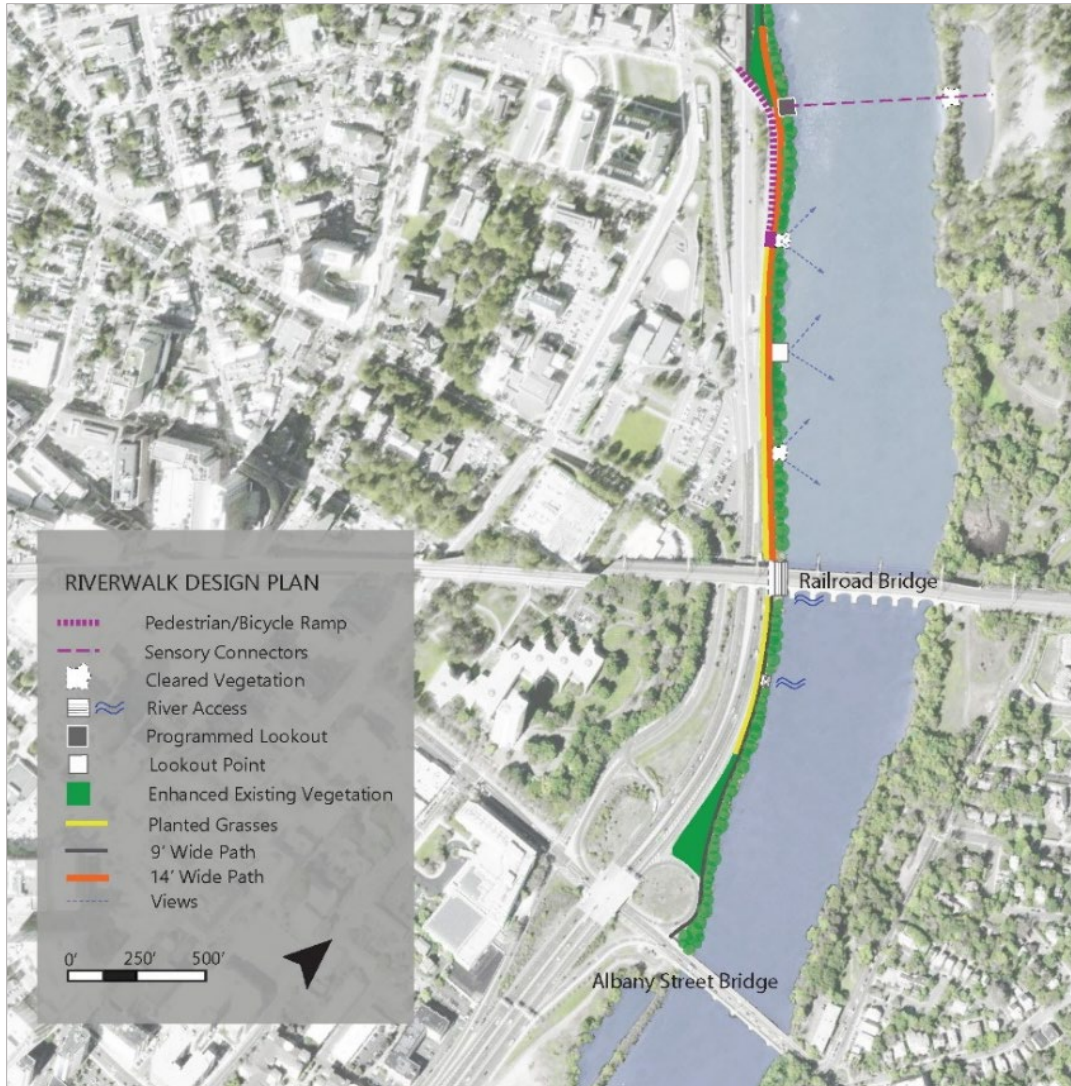


Figure 54: Riverwalk Reimagined 2.

Closer look at the plan. (Source: Plan by author, Sanja Martić)

5.1.2 The Waterfront Access Points (Riverfront Connectors)

The riverfront connectors permeate the river's edge and provide an opportunity for direct river access (Figure 55). Activating these areas by turning them into the nodes of activity through programming and a moderate design intervention is a first step towards opening the river to the city. The intervention takes place on three levels, some

existing riverfront connectors remain the same, some are enhanced by programming and design and two new access points are proposed (Figure 56).

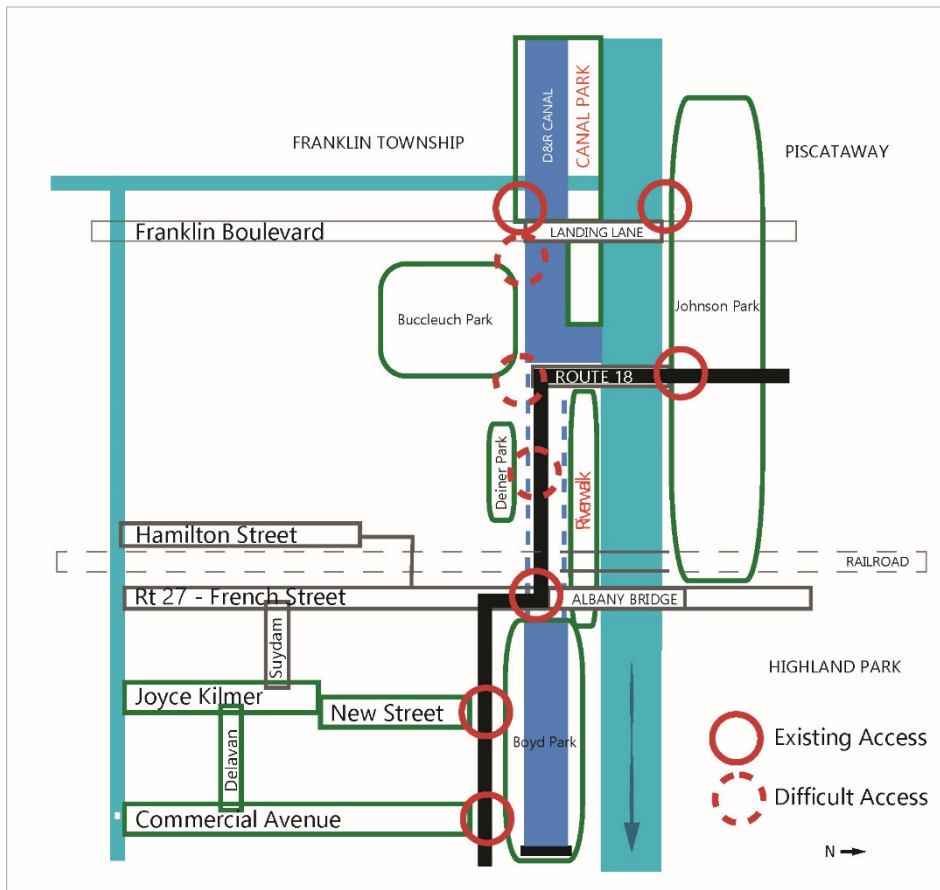


Figure 55: Riverfront Connectors.

Nodes that connect directly to the Riverwalk are depicted in red as Access. (Source: Diagram by author, Sanja Martić).

New access points are added utilizing Route 18 ramps, one at the south end of the Deiner Park and the other at Buccleuch Park (chapter 5.2). They act as gateways welcoming river to the city and people to the river. Their programming should include seasonal food trucks, popup markets, street performers etc. in order to attract people to the river edge and activate the place.

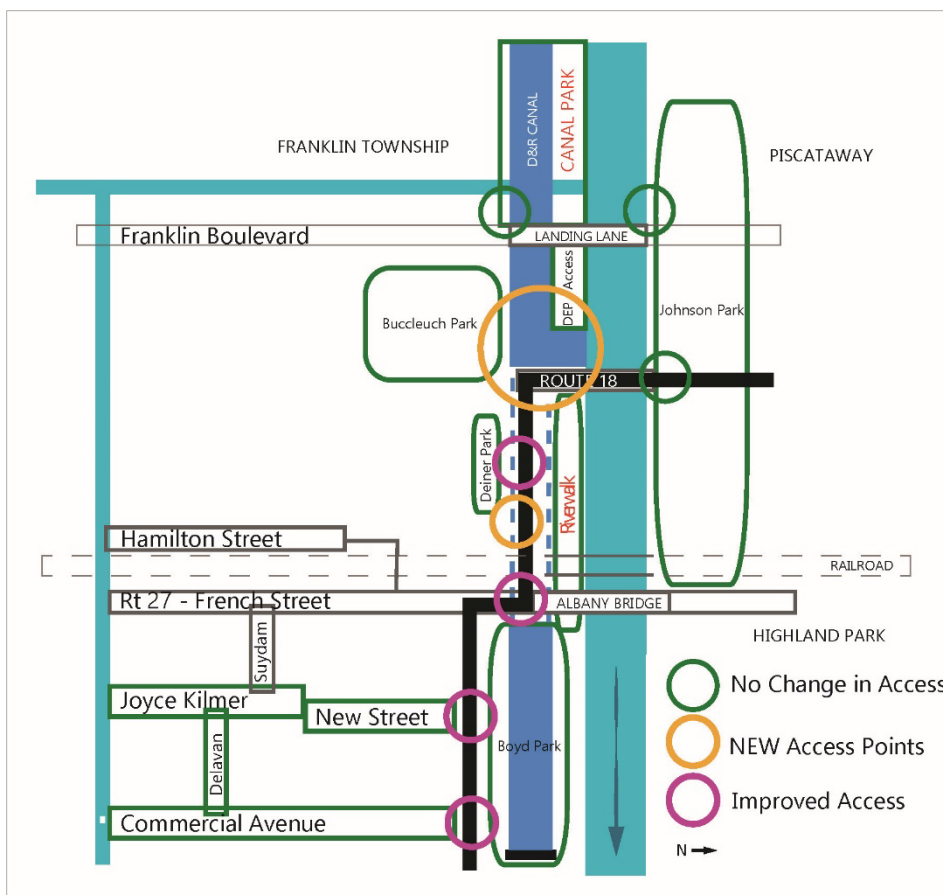


Figure 56: Proposed Access Improvement.

Two new access points are added, while the rest are enhanced.
(Source: Diagram by author, Sanja Martić).

5.1.3 The Green Streets

The redesign of the existing key connector streets within the City of New Brunswick enhances the biking and walking experience, while leading to the waterfront access points (Figure 57). Commercial⁶⁸ and Joyce Kilmer Avenues are green corridors, chosen for their proximity to the local schools, green open space, highest population density and wide traffic lanes (Figure 58). This neighborhood is also the most densely

⁶⁸ Commercial Avenue was renamed Paul Robson Boulevard in May 2019.

populated, underserved part of the city that has very little access to the green open space.



Figure 57: Commercial Avenue Hardscape Intervention.

Commercial Avenue facing the river. Proposed hardscape interventions would include lowering the curb in places and widening the sidewalk and the tree pits. (Source: Diagram by author, Sanja Martić).

The two thoroughfares, Commercial and Joyce Kilmer Avenues, have a great potential for “road diet”. This would mean a redesign of the street profile with the addition of traffic calming sidewalk extensions that would include bioswales with curb cuts for stormwater runoff capture, bike lane and wayfinding that signals river access. This intervention would further enhance pedestrian and bicyclists safety. The Green Streets would further create opportunities for bringing nature closer to the local communities by becoming way finders for the Raritan River as well as the green corridors with more pervious surface and vegetation (Figure 59).

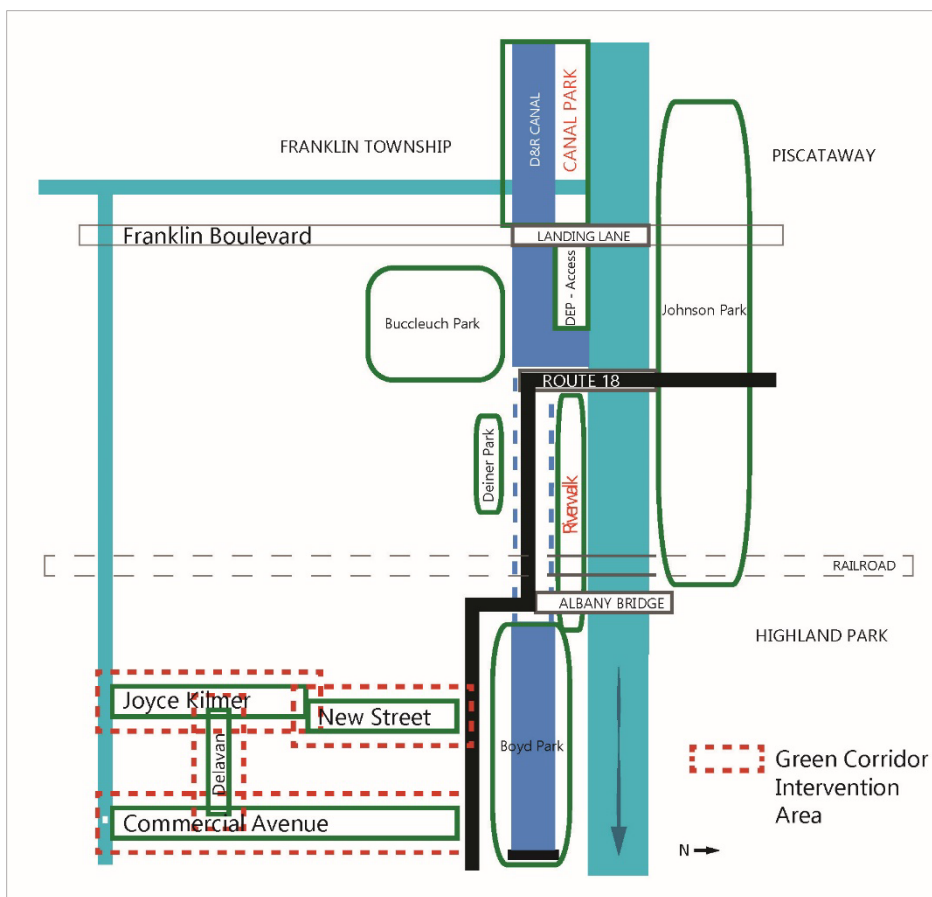


Figure 58: Green Corridors.

(Source: Diagram by author, Sanja Martić).

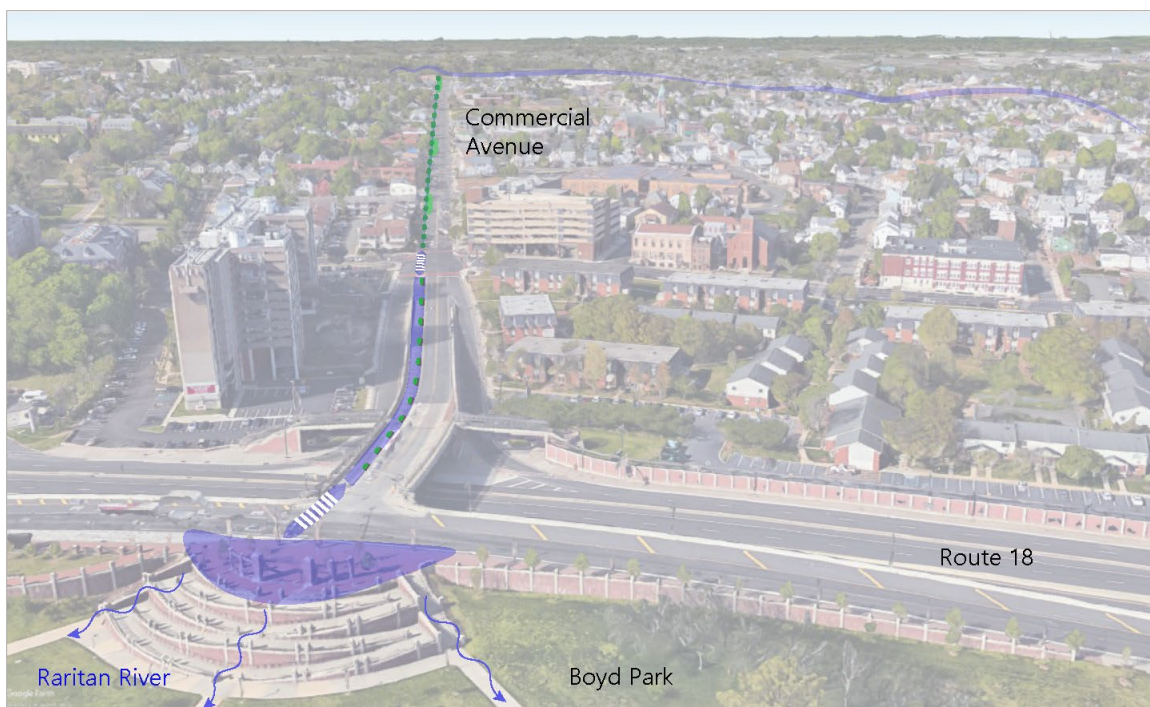


Figure 59: Green Street Connects to Raritan at Boyd Park.

(Source: Diagram by author, Sanja Martic).

5.1.4 The Urban Streets

Urban corridors (Figure 60), are the city streets of urban character, such as French and Hamilton Streets, where a larger intervention would not be reasonable. They are the main routes of access that carry most of the traffic in and out of the city and contain many store fronts. The design intervention within this area calls for enhancement of the existing street design by enhancing the existing sharrows bike lanes and improving the pedestrian experience by signaling the direction of the closest river access. Signage would also offer educational information regarding the river. Similar interventions could be applied outside of the immediate study area. Franklin Township's Franklin Boulevard is the next such opportunity.

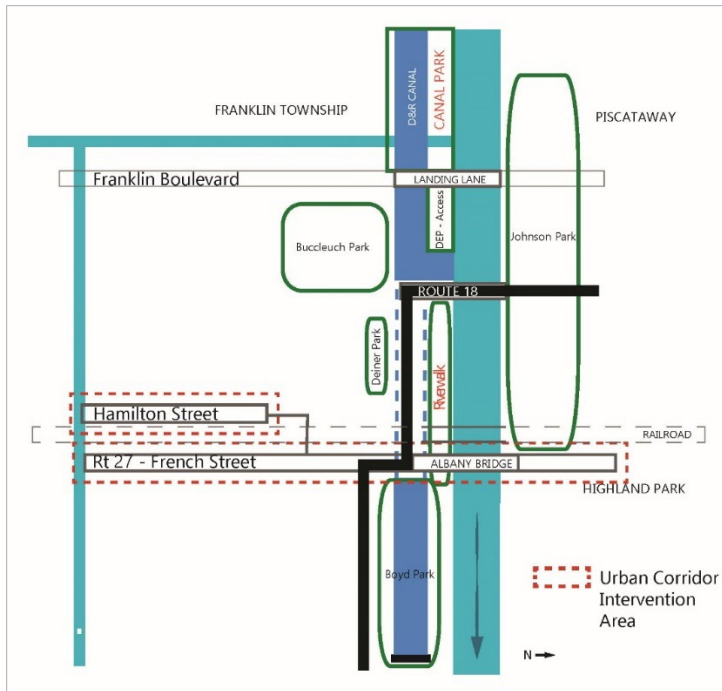


Figure 60: Urban Corridors.

(Source: Diagram by author, Sanja Martic).

5.1.5 The Blue Corridors

The City of New Brunswick, surrounded by the water on three sides, could take advantage of its ravines and their tree canopy covered buffer zones. In conjunction with the Green and Urban Streets, the ravine becomes a final part in the matrix of the river-city connection, acting as a “back door” to the river. (Figure 61). The existing Mile Run stream corridor, in conjunction with the key connector streets, forms a matrix of connections. The Mile Run stream corridor is now accessible and brings the community to the river through this matrix, offering further opportunities for engagement with the water and nature (Figure 62).

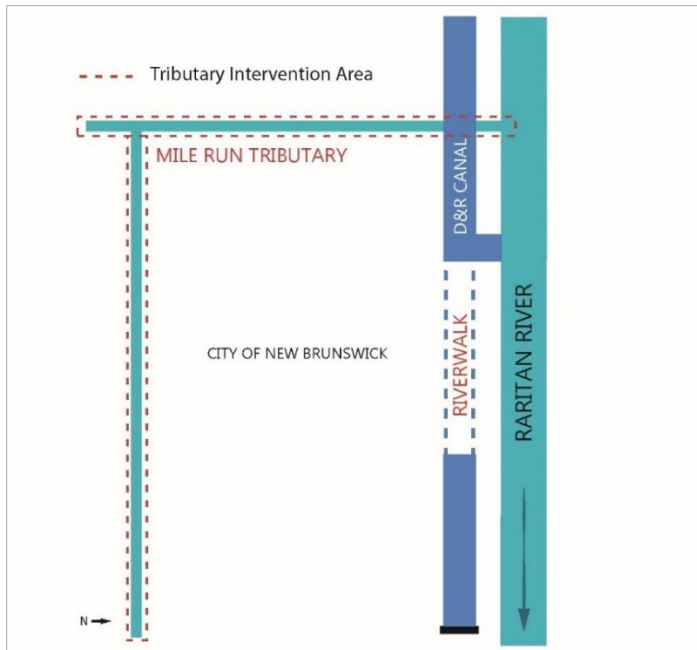


Figure 61: Blue Corridors Intervention Area.

Mile Run Tributary brings the river into the city.
(Source: Diagram by author, Sanja Martić).

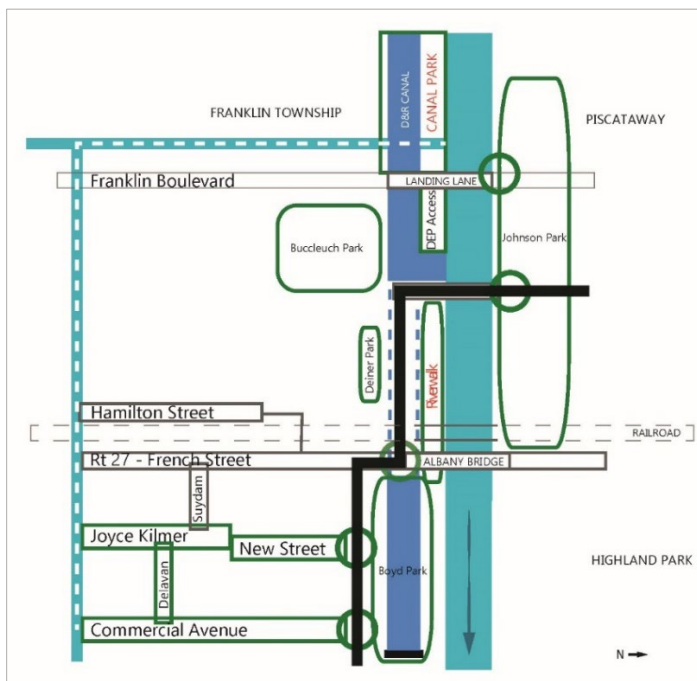


Figure 62: Blue Corridors and Key Connector Streets Matrix.

Mile Run tributary connects the streets back to the river.
(Source: Diagram by author, Sanja Martić).

The level of the design intervention within the tributary corridors depends on their scale, and varies in complexity from a simple, floating, wood plank walkway (Figure 63), to the elevated and railed boardwalk (Figure 65).



Figure 63: Blue Corridor - Boardwalk 1

Floating wood plank walkway. (Source: Image by author, Sanja Martić).



Figure 64: Blue Corridor - Boardwalk 2

Simple dirt pathway. (Source: Image by author, Sanja Martić).



Figure 65: Blue Corridor - Boardwalk 3

Tributaries grow larger as they near the river. (Source: Image by author, Sanja Martić).

5.2 Local/Regional Level Connection Possibilities

The area identified as having the largest number of access impediments (Figure 13) is addressed by designing a pedestrian overpass that starts at Buccleuch Park, overpasses River Road, utilizes the existing pedestrian walkway and ramp connection to the Busch Campus and brings pedestrians down to the spillway where it meets the extended and cantilevered Riverwalk path (Figure 66). From here, another bridge takes pedestrians over the spillway and into the Delaware and Raritan Canal State Park. This intervention creates connectivity on the river side of the River Road, ties in multiple directions and provides a local as well as regional missing link. D&R Canal Park becomes easily accessible from Rutgers Campuses, Buccleuch Park and the City of New Brunswick.

The East Coast Greenway proposed alignment could be realigned accordingly, so that it can utilize New Brunswick's resources.



Figure 66: Pedestrian Overpass and Bridge Intervention.

Route 18 pedestrian overpass (in white) meets the Riverwalk that is cantilevered as it reaches the area directly under Route 18 (in green). As the two join at spillway they bounce across it on the way towards the D&R Canal Park. (Source: Diagram by author, Sanja Martić).

The construction in this area might be difficult because of its impact on the vital infrastructure, environment and historical landmarks present in the Buccleuch Park.

However, the proposed design would utilize the existing infrastructure like the John A Lynch Sr Memorial Bridge to the maximum, thus minimizing the environmental impact of the new structure. Furthermore, the positive impact of the new structure on the future of the City of New Brunswick and the wider region should be seriously considered. Future recommendation is to further explore possibilities for the design of such structure.

Recommendation is for the design to be playful and local in scale with impact on regional audiences.



Figure 67: Local and Regional Connection Intervention.

Riverwalk (in orange) meets pedestrian overpass and bridge intervention (in purple) coming down from Buccleuch Park and Route 18 ramp. (Source: Diagram by author, Sanja Martić).

6. Expected Outcome and Applicability

Witnessing everyday life in the watershed and sharing a vision of what it could be is the aspiration of this thesis. Evaluating this vision is its final step. While going through the research process, my own perception of the river has changed and my relationship with the river has deepened with my understanding. How would design intervention change the existing conditions? How do we measure the feeling of a place, its spatial quality? The intent of the evaluation was to have a general direction that could inform the design thinking. However, in the end in every design there is a dose of serendipity and of nature acting in its own, unforeseen ways. These are both unintentional but welcomed byproducts of the entirety of the design process, that continues far beyond our project deadline.

Each site is evaluated through the layer point system. When the scores are looked at, the lower the score for specific site, the better the opportunity for enhancing it is, since there is more room for growth. The adopted layer system consists of a base layer, network layer, potential for use layer and time layer (Figure 25). Each of four layers is further subdivided into sublayers and given a value of 25 points in order to evaluate the site before and after the proposed intervention. What follows is a brief description of how each of the sites is seen through the layer system and what it means for the design.

Base Layer:

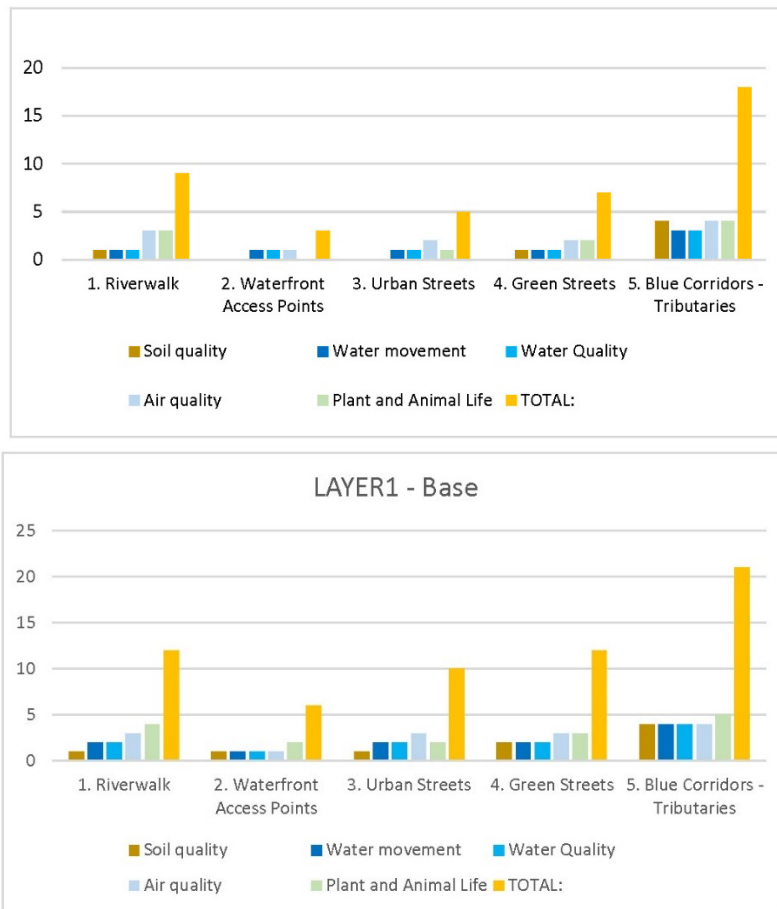


Figure 68: Base Layer Evaluation Charts Comparison.

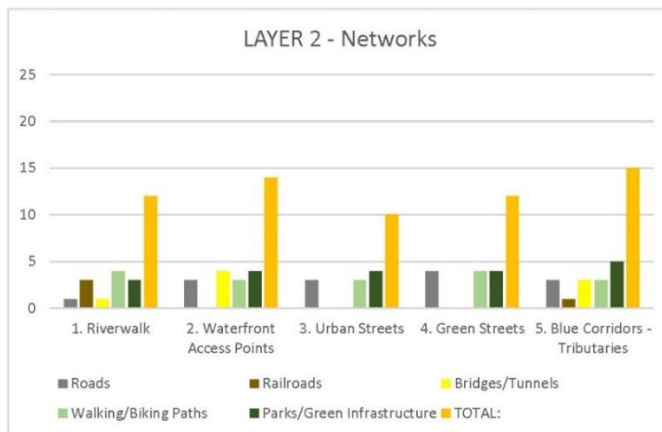
The top chart represents the evaluation of existing conditions. The bottom chart is projecting conditions after design implementation. (Source: Charts by author, Sanja Martić).

The objectives of the base layer are improving soil and air quality, water movement and water quality, as well as improving its potential for sustaining plant and animal life. Enhancing the Base Layer increases spatial quality of all the spaces, but the biggest increase is seen within the Urban and Green Streets. Within some sites these objectives are much easier to influence by design than the others. The ravine is an example of a space that already contains plant and animal life in a much larger

percentage than the rest of the sites, therefore potential for improvement within the base layer is low for the ravine, but much higher for the Urban and Green Streets that have very little plant and animal life. With the introduction of more plant species and pervious surfaces this area has a lot of potential for growth.

By introducing a pathway system into the ravine there is a potential to negatively influence the site ecology. However, this intervention would bring people into this space, which would enforce the maintenance of the stream corridors that currently suffer a littering problem and require frequent interventions by NGOs such as LRWP that organize volunteer cleanups.

Network Layer:



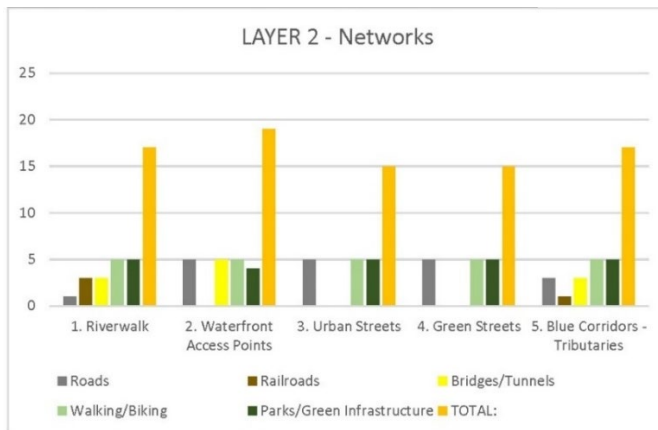


Figure 69: Network Layer Evaluation Charts Comparison.

The top chart represents the evaluation of existing conditions. The bottom chart is projecting conditions after design implementation. (Source: Charts by author, Sanja Martić).

The Network Layer forces us to think of the existing infrastructure networks, their current connectivity, and ways to utilize them in order to improve connectivity and spatial quality. For the sites studied the existing infrastructure includes existing roads, railroads, bridges and tunnels, walking and biking paths and green networks. The Network Layer evaluates the existing networks' presence and connectivity. Points (0-5) are given for the presence of the networks within the site and more points for their current connectivity. All the sites have a presence of at least one network; however, in some cases those networks are enhancing (and in others reducing) walking and biking connectivity. Using existing networks to increase connectivity is the goal for the network layer.

The comparison of charts before and after intervention shows an increase in walking and biking path network connectivity. Largest increase is shown in places with

the most existing networks that used to be an impediment for access that are now turned into opportunities for connection through design.

Potential for Use Layer:

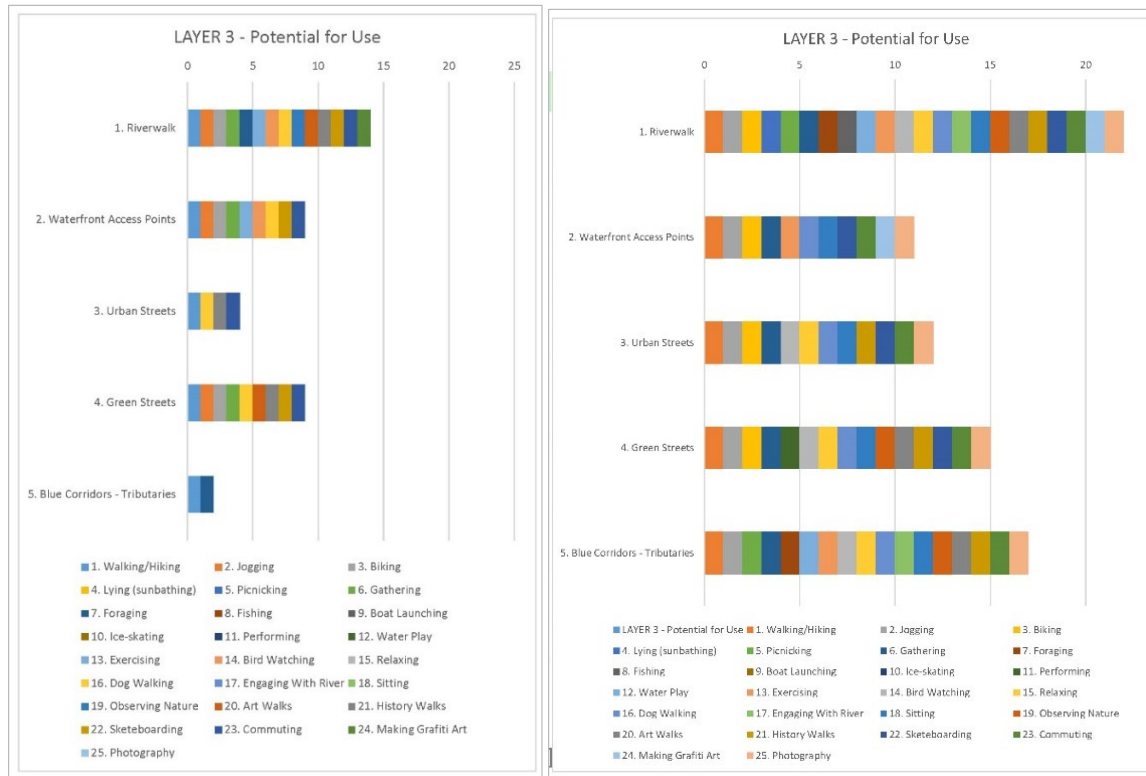


Figure 70: Potential for Use Evaluation Charts Comparison.

The chart to the left represents the evaluation of existing conditions. The chart to the right is projecting conditions after design implementation. (Source: Charts by author, Sanja Martić).

The Potential for Use layer was the most playful layer to work with, since it requires the designer to think about all of the different intended and unintended ways that people will use the space. This is true particularly in the case of Riverwalk that is already of somewhat unusual character. The Potential for Use Layer is also a layer that we

can influence the most by design. Activities are also increased simply by having people in spaces that they never frequented before. This is why the biggest increase for this layer is seen within ravine site that currently has no access.

In my matrix the Potential for Use layer replaces the Occupation and Land Use layer from the Dutch approach. Each of the five sites are evaluated for their potential to support any of 25 different activities that could take place within the area once it is redesigned: walking and hiking, jogging, biking, lying, picnicking, gathering, foraging, fishing, boat launching, ice-skating, performing, water play, exercising, bird watching, relaxing, dog walking, engaging with the river, sitting, observing nature, art walks, history walks, skateboarding, commuting, making graffiti and murals and photography.

The activities in this layer are chosen based on activities typically associated with the river landscape, a city park, some are based on observed existing use, and some based on the input from the LRWP. No-action evaluation, prior to intervention, allocates one point for each activity that can currently take place within the area. The goal for this layer becomes increasing the number of activities that could take place in the future or improving potential uses of different spaces in five typologies.

Time Layer:

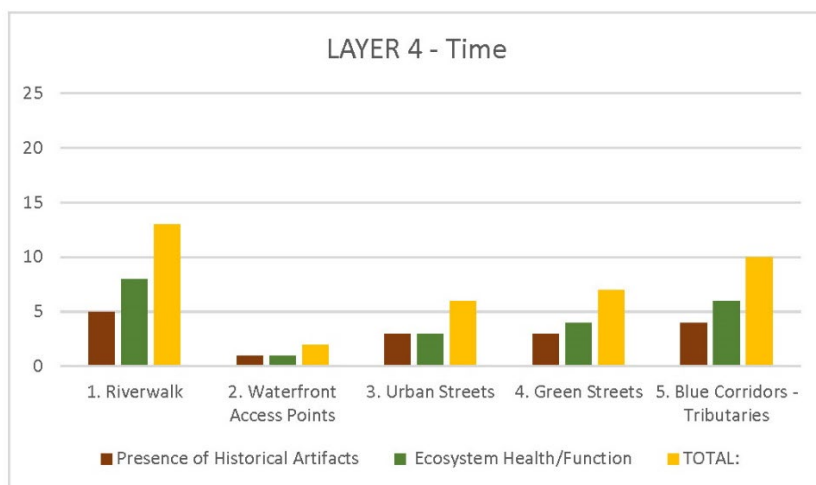
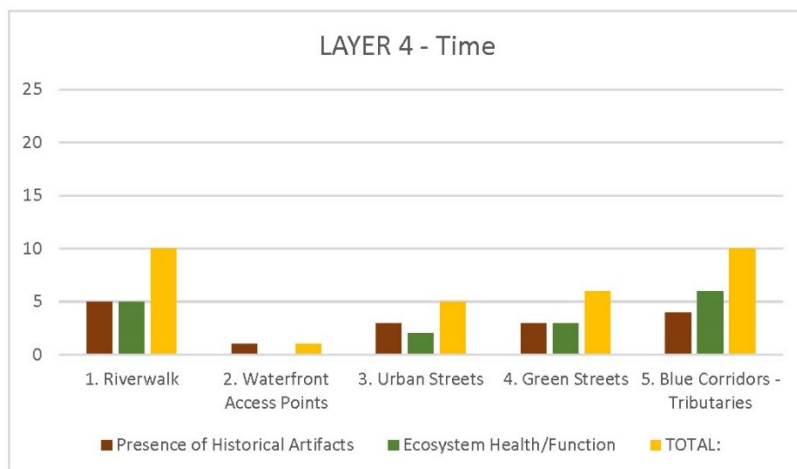


Figure 71: Time Layer Evaluation Charts Comparison.

The chart on top represents the evaluation of the existing conditions. The chart on the bottom is projecting conditions after design implementation. (Source: Charts by author, Sanja Martic).

Finally, the Time layer evaluates the presence of historic and cultural artifacts on one end and a potential for future ecosystem health improvement on the other. Sites that contain historic and cultural artifacts are rated higher, as well as the sites that will be able to, over time, enhance the ecosystem health. Ecosystem health is prioritized over

the existence of historic and cultural artifact since we live in times of extreme ecosystem vulnerability with threats posed by consequences of the global climate change.

Within this layer the Riverwalk shows the most potential for improvement since it contains the most history that can be exposed and has the most potential for ecosystem health improvement through the redesign of the waterfront. The tributaries have the least potential for improvement since they are already scoring high for the existing conditions.

7. Discussion

"This deeper understanding of natural and cultural history in cities can be the root of an authentic bond between people and the places they live - a bond formed through education that leads to greater stewardship of places and communities."

Thomas Bird Woltz, 2016, Ecology and Culture in the Design of Urban Parks⁶⁹

7.1 City Today and Greenway Future

There are many initiatives in the form of partnerships and alliances on a local and global scale today that are working towards creating continuous active transportation networks. We could say that we live in an era of greenway connections in city planning and landscape architecture. Walkable and bikeable cities are becoming increasingly popular places to live and work. Active transportation networks are not only desirable but are progressively becoming a necessity. They are helping lower our carbon footprint

⁶⁹ Thomas Woltz. 2016. "Ecology and Culture in the Design of Urban Parks." *Landscape Journal: design, planning, and management of the land* 35, no. 2 (2016): 237-253. <https://muse.jhu.edu/> (accessed May 1, 2019).

and the fossil fuel dependency, they are encouraging active living and pledge improving health of the communities. In making them accessible and equitable we prepare for uncertain planetary ecology future and negative consequences of global climate change.

Waterfront parks revitalize cities and, trigger dialogs regarding continuous, uninterrupted public access to the shorelines. Today, this idea is an important part of many riverfront municipalities' Master Plans, designing cities that are walkable and bikeable, cities that take advantage of their ecological systems and geographic location. Employers are looking to locate their office buildings near the areas that offer walkable and bikeable neighborhoods with good connections to parks and public transit, good access to quality food and personal services, and minimal need for driving and parking.

What opportunities does this new active transportation technology hold for the city of New Brunswick? In the past, changes in transportation technology have brought economic prosperity to the city. It seems that today, when the quality of life is becoming a priority in modern city design, New Brunswick has another chance for a new revival. Its scale and location hold a great potential and not only for its prominent placement on the Raritan River, but also for its potential to connect to emerging and existing greenways. The future recommendation is for the city to orient its future development towards this goal, making the vibrant layers of New Brunswick's cultural landscape visible again in a newly formed bond between the river and its city.

7.2 Future Research

The following are the issues that are outside of the scope of this thesis but are crucial for the future research within the field of Landscape Architecture.

This thesis is an outcry for the development of environmental stewardship in the local community; however, stewardship is also a vehicle for social cohesion, advocacy, and engagement. The next step in the natural progress of research would be working with the community. Listening and validating voices from the community, from people who share a lived experience with the river. This could include offering a platform for local art and cultural heritage and involving community in visualizing their river.

Possible negative impacts of this design intervention are displacement of the community that it is looking to serve. Careful steps should be taken to minimize the gentrification effect. Therefore, a separate inquiry should be made into the effect of the design on the future of the fragmented social groups within the city, especially the vulnerable low-income population and immigrant population.

Another group within the New Brunswick community that would be affected and potentially displaced is the homeless population. This issue could possibly be addressed by allocating parts of the design area to be used for the self-organized living spaces for homeless,⁷⁰ an experimental method that was started in Oregon in 2018.

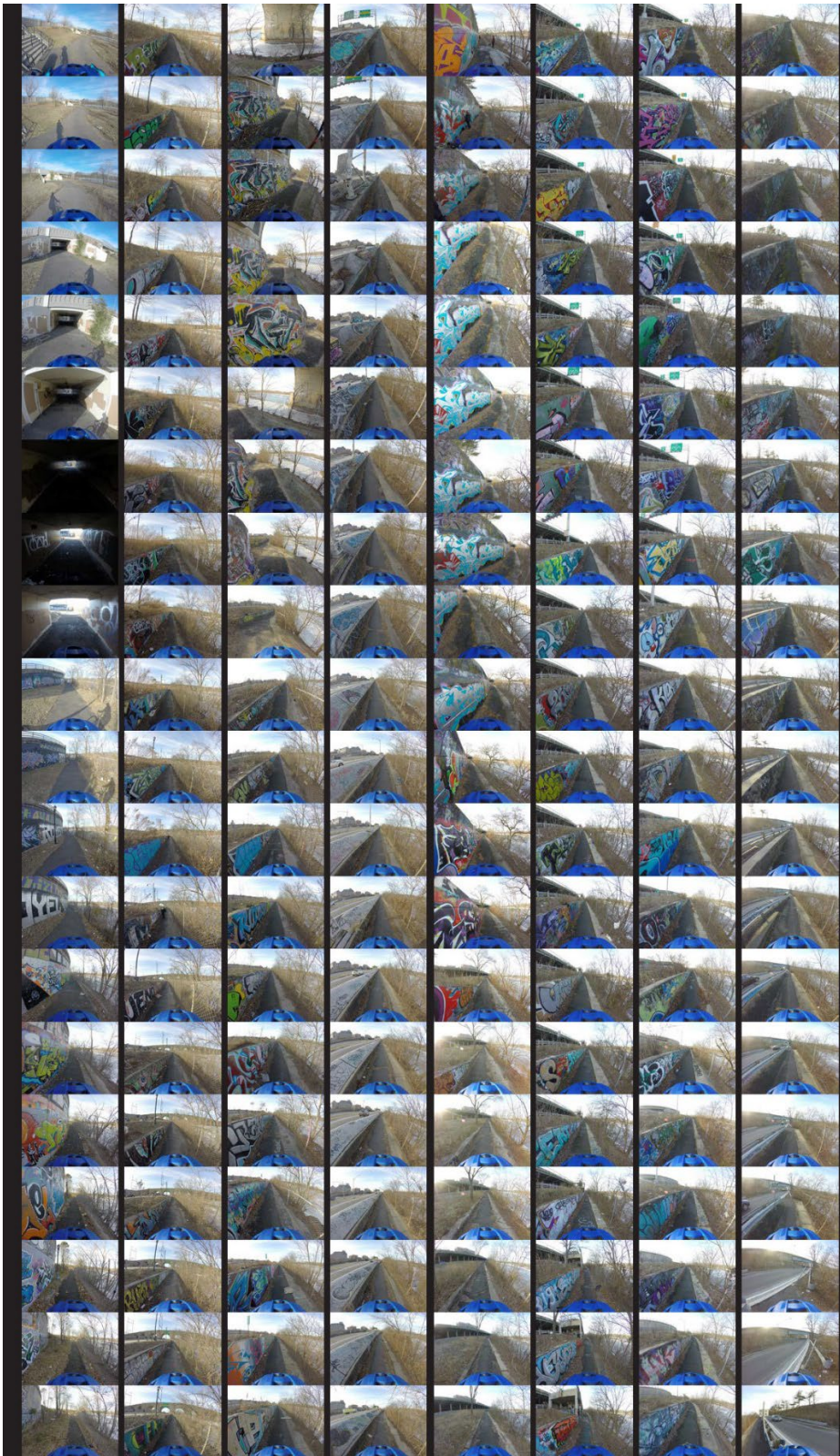
⁷⁰ Robert Molinar. 2018. Self-Organization as a Response to Homelessness: Negotiating Autonomy and Transitional Living in a "Village" Community. Web. <http://hdl.handle.net/1794/23826>

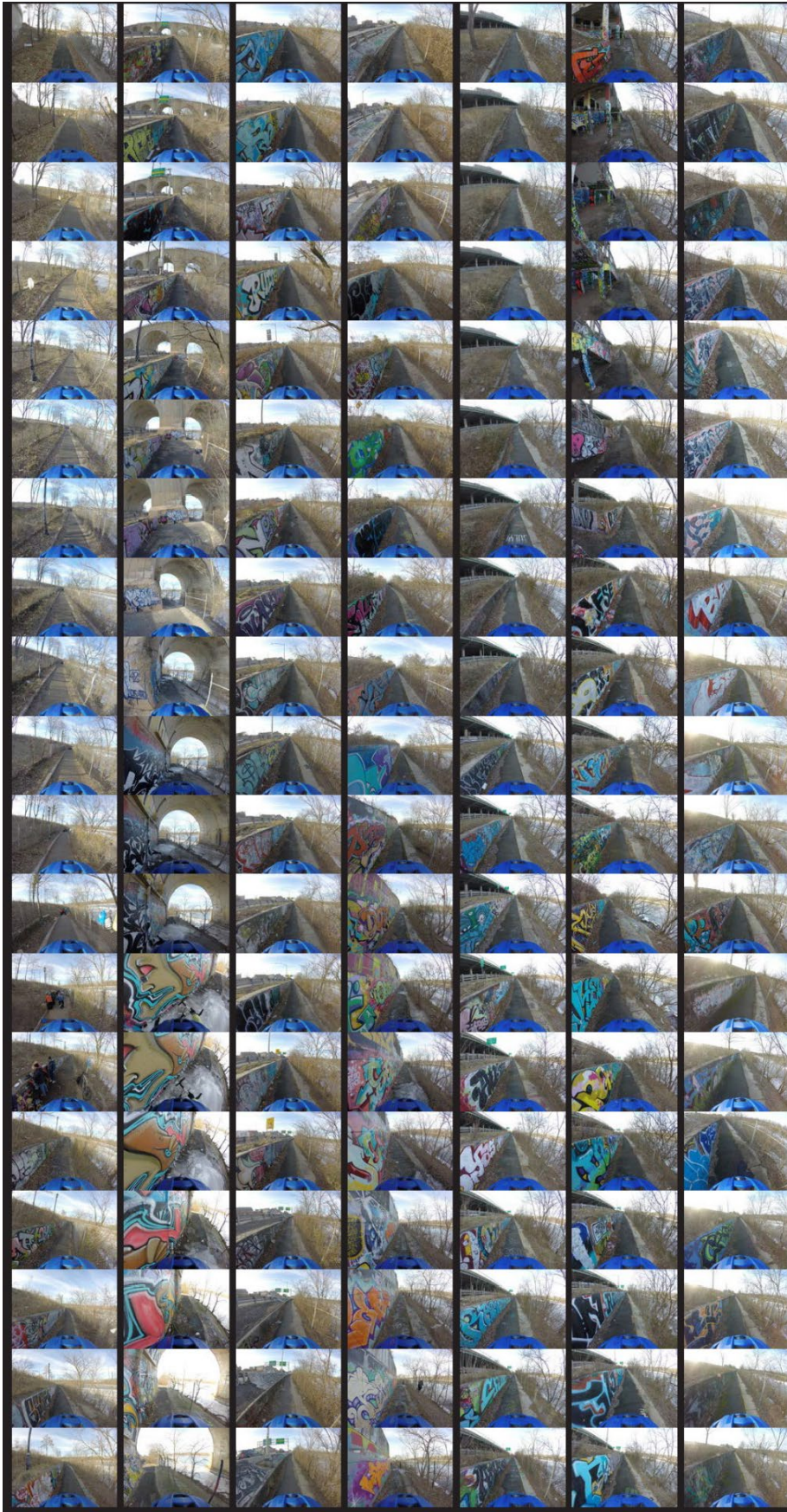
It would be interesting to explore through design, ways to generate financial benefits and create jobs for the local community. In this way communities could benefit from the project in multiple ways, not only through improved access to the green open space, but also in improved financial wellbeing.

NJDOT policies and rules regarding building road infrastructure are constantly changing and evolving. Revisions to the Standard Specifications for Road and Bridge Design within the riparian zone would be the ultimate goal as we work towards influencing the policy change.

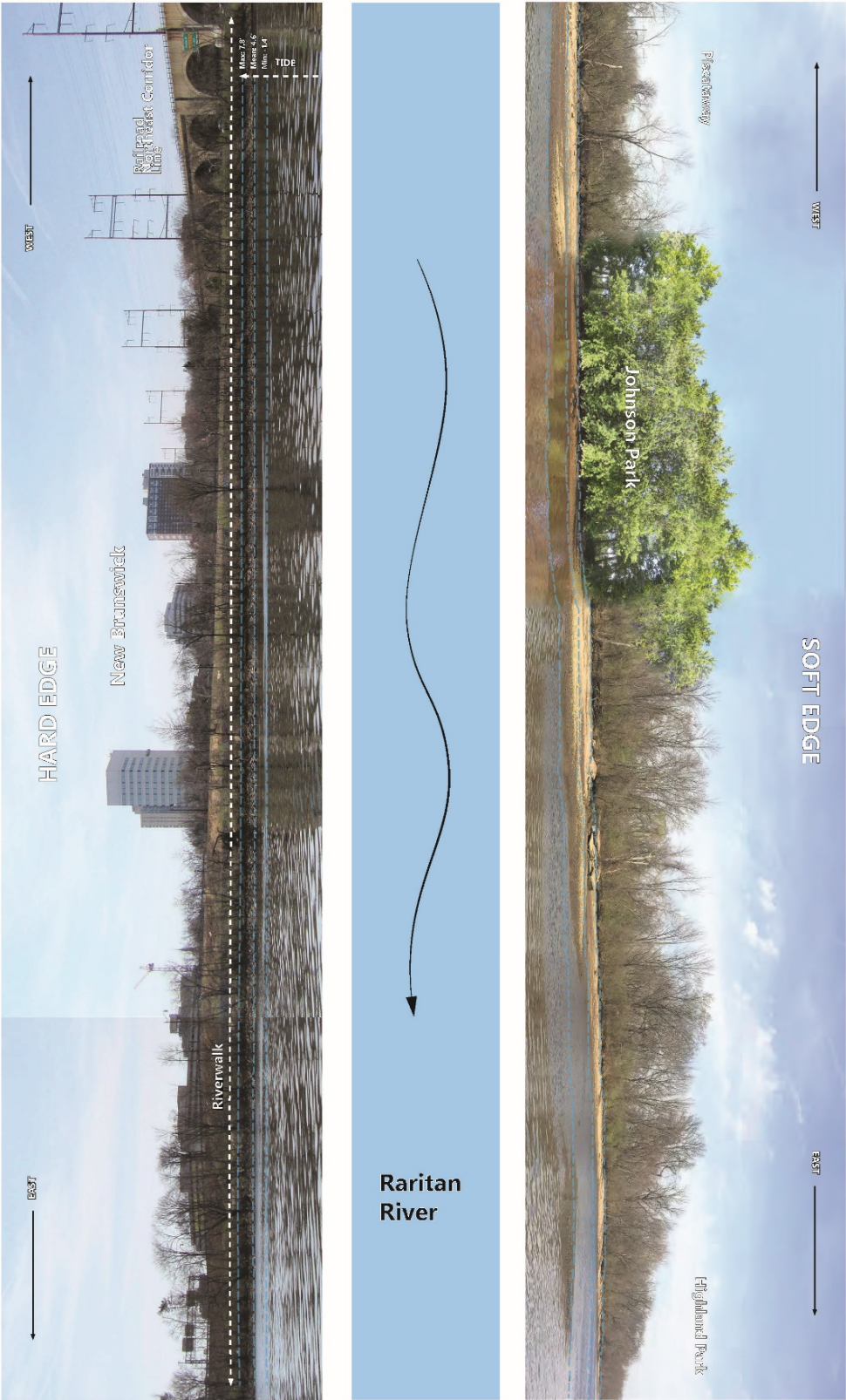
Finally, this thesis could inform further development of a network of green open spaces along the Raritan River and the Delaware and Raritan Canal outside of the City of New Brunswick. This network could prove a direct access for an array of recreational activities for densely populated Central New Jersey communities. Direct, walkable access to such network provides opportunities for urban hiking, lowers the amount of traffic on the road and time spent traveling to the nearest walkable pathway, thus improving health of people and their environment.

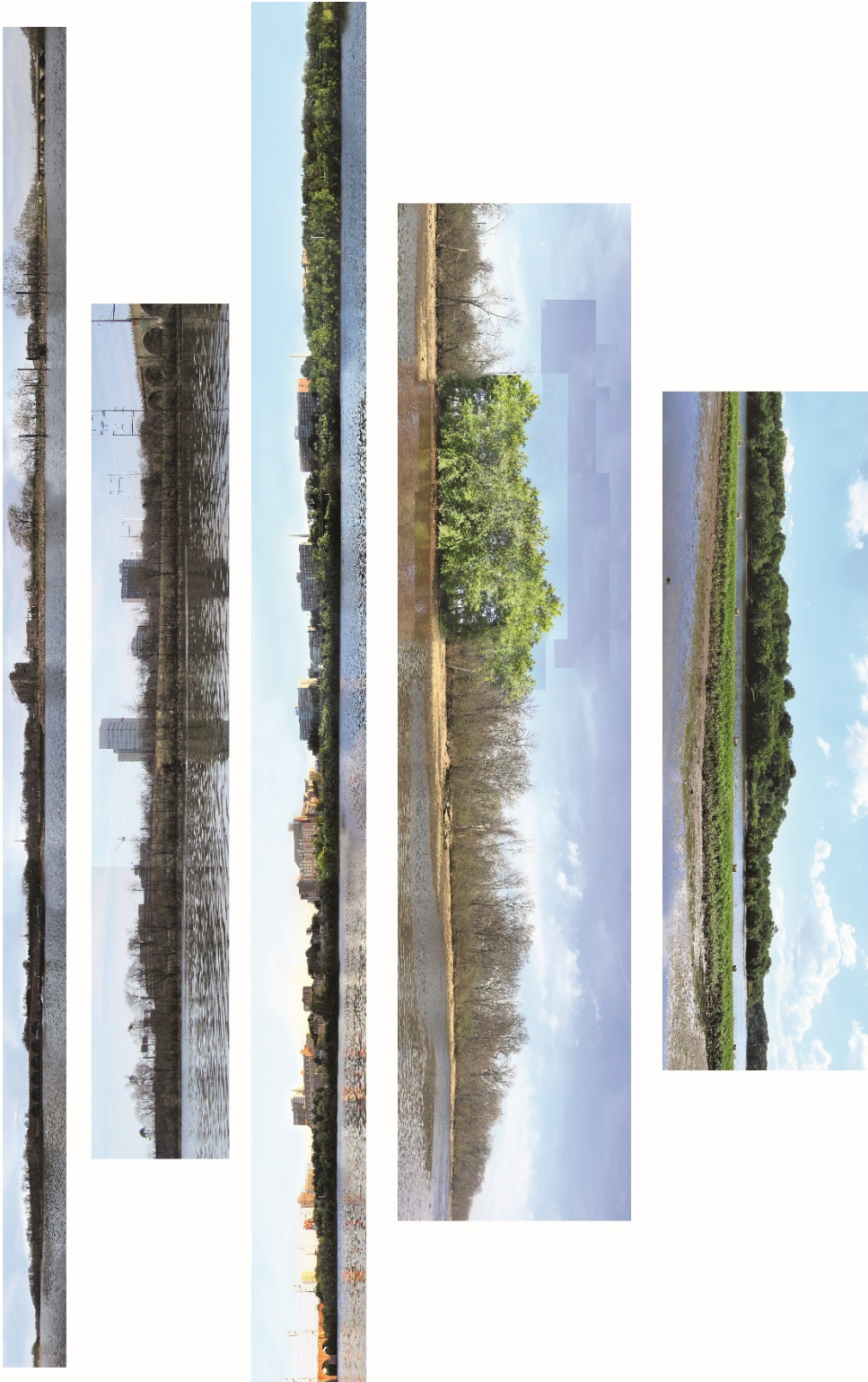
APPENDIX 1 – RIVERWALK FILM STRIP





APPENDIX 2 – PANORAMAS OF THE TWO RIVER SHORES





APPENDIX 3 – SITE EVALUATION CHARTS

BEFORE intervention	1. Riverwalk	2. Waterfront Access Points	3. Urban Streets	4. Green Streets	5. Blue Corridors - Tributaries	Max Possible Points	
LAYER1 - Base							
Soil quality	1	0	0	1	4	Max 5	
Water movement	1	1	1	1	3	Max 5	
Water Quality	1	1	1	1	3	Max 5	
Air quality	3	1	2	2	4	Max 5	
Plant and Animal Life	3	0	1	2	4	Max 5	
TOTAL:	9	3	5	7	18	MAX 25	
LAYER 2 - Networks							
Roads	1	3	3	4	3	Max 5	
Railroads	3	0	0	0	1	Max 5	
Bridges/Tunnels	1	4	0	0	3	Max 5	
Walking/Biking Paths	4	3	3	4	3	Max 5	
Parks/Green Infrastructure	3	4	4	4	5	Max 5	
TOTAL:	12	14	10	12	15	MAX 25	
LAYER 3 - Potential for Use							
1. Walking/Hiking	1	1	1	1	1	Max 1	
2. Jogging	1	1	0	1	0	Max 1	
3. Biking	1	1	0	1	0	Max 1	
4. Lying (sunbathing)	0	0	0	0	0	Max 1	
5. Picnicking	0	0	0	0	0	Max 1	
6. Gathering	1	1	0	1	0	Max 1	
7. Foraging	1	0	0	0	1	Max 1	
8. Fishing	0	0	0	0	0	Max 1	
9. Boat Launching	0	0	0	0	0	Max 1	
10. Ice-skating	0	0	0	0	0	Max 1	
11. Performing	0	0	0	0	0	Max 1	
12. Water Play	0	0	0	0	0	Max 1	
13. Exercising	1	1	0	0	0	Max 1	
14. Bird Watching	1	1	0	0	0	Max 1	
15. Relaxing	0	0	0	0	0	Max 1	
16. Dog Walking	1	1	1	1	0	Max 1	
17. Engaging With River	0	0	0	0	0	Max 1	
18. Sitting	0	0	0	0	0	Max 1	
19. Observing Nature	1	0	0	0	0	Max 1	
20. Art Walks	1	0	0	1	0	Max 1	
21. History Walks	1	0	1	1	0	Max 1	
22. Skateboarding	1	1	0	1	0	Max 1	
23. Commuting	1	1	1	1	0	Max 1	
24. Making Graffiti Art	1	0	0	0	0	Max 1	
25. Photography	0	0	0	0	0	Max 1	
TOTAL:	14	9	4	9	2	MAX 25	
LAYER 4 - Time							
Presence of Historical Artifacts	5	1	3	3	4	Max 10	
Ecosystem Health/Function	5	0	2	3	6	Max 15	
TOTAL:	10	1	5	6	10	MAX 25	
FINAL TOTAL:	45	27	24	34	45	TOTAL 100	

AFTER intervention	1. Riverwalk	2. Waterfront Access Points	3. Urban Streets	4. Green Streets	5. Blue Corridors - Tributaries	Max Possible Points
LAYER1 - Base						
Soil quality	1	1	1	2	4	Max 5
Water movement	2	1	2	2	4	Max 5
Water Quality	2	1	2	2	4	Max 5
Air quality	3	1	3	3	4	Max 5
Plant and Animal Life	4	2	2	3	5	Max 5
TOTAL:	12	6	10	12	21	MAX TOTAL 25
LAYER 2 - Networks						
Roads	1	5	5	5	3	Max 5
Railroads	3	0	0	0	1	Max 5
Bridges/Tunnels	3	5	0	0	3	Max 5
Walking/Biking	5	5	5	5	5	Max 5
Parks/Green Infrastructure	5	4	5	5	5	Max 5
TOTAL:	17	19	15	15	17	MAX TOTAL 25
LAYER 3 - Potential for Use						
1. Walking/Hiking	1	1	1	1	1	Max 1
2. Jogging	1	1	1	1	1	Max 1
3. Biking	1	1	1	1	0	Max 1
4. Lying (sunbathing)	1	0	0	0	0	Max 1
5. Picnicking	1	0	0	0	1	Max 1
6. Gathering	1	1	1	1	1	Max 1
7. Foraging	1	0	0	0	1	Max 1
8. Fishing	1	0	0	0	0	Max 1
9. Boat Launching	0	0	0	0	0	Max 1
10. Ice-skating	0	0	0	0	0	Max 1
11. Performing	0	0	0	1	0	Max 1
12. Water Play	1	0	0	0	1	Max 1
13. Exercising	1	1	0	0	1	Max 1
14. Bird Watching	1	0	1	1	1	Max 1
15. Relaxing	1	0	1	1	1	Max 1
16. Dog Walking	1	1	1	1	1	Max 1
17. Engaging With River	1	0	0	0	1	Max 1
18. Sitting	1	1	1	1	1	Max 1
19. Observing Nature	1	0	0	1	1	Max 1
20. Art Walks	1	0	0	1	1	Max 1
21. History Walks	1	0	1	1	1	Max 1
22. Sketeboarding	1	1	1	1	0	Max 1
23. Commuting	1	1	1	1	1	Max 1
24. Making Grafiti Art	1	1	0	0	0	Max 1
25. Photography	1	1	1	1	1	Max 1
TOTAL:	22	11	12	15	17	MAX TOTAL 25
LAYER 4 - Time						
Presence of Historical Artifacts	5	1	3	3	4	Max 10
Ecosystem Health/Function	8	1	3	4	6	Max15
TOTAL:	13	2	6	7	10	MAX TOTAL 25
FINAL TOTAL:	64	38	43	49	65	TOTAL 100

BIBLIOGRAPHY

- Acciavatti, Anthony. 2015. *Ganges Water Machine: Designing New India's Ancient River*. San Francisco: Applied Research & Design, 2015.
- Anas, Alex, Richard Arnott, and Kenneth A. Small. "Urban Spatial Structure," *Journal of Economic Literature*, 36(3) 1998: 1426-1464.
- Appalachian Trail Conservancy. "About us." 2018.
<http://www.appalachiantrail.org/home/about-us/history>.
- Ash, Caroline, Barbara R. Jasny, Leslie Roberts, Richard Stone, and Andrew M. Sugden. "Reimagining Cities." *Science* 319, no. 5864 (February 8, 2008): 739.
<https://doi.org/10.1126/science.319.5864.739>.
- Barth, Linda J. *The Delaware and Raritan Canal*. Reprint Edition. Charleston, SC: Arcadia Publishing, 2002.
- Barth, Linda J. *Delaware and Raritan Canal at Work, The*. Charleston, SC: Arcadia Publishing, 2004.
- Busscher, T., M. van den Brink, and S. Verweij. "Strategies for Integrating Water Management and Spatial Planning: Organising for Spatial Quality in the Dutch 'Room for the River' Program." *Journal of Flood Risk Management*, May, e12448.
<https://doi.org/10.1111/jfr3.12448>. 2018.
- Carman, Alan E. 2013. *Footprints in Time: A History and Ethnology of the Lenape-Delaware Indian Culture*. Place of publication not identified: Trafford Publishing.
- Davison, B. Betty. "The Delaware and Raritan Canal A Users Guide for hikers Canoeist, Fisherfolk, History Buffs, Bird Watchers, And Lovers of the Great Outdoors", The Delaware and Raritan Canal Coalition, 1976.
- Department of Environmental Protection. New Jersey. Delaware and Raritan Canal State Park Master Plan. Delaware and Raritan Canal Commission: Stockton, NJ: May 1977.
- Department of Environmental Protection. New Jersey. Delaware and Raritan Canal State Park Master Plan, 2nd ed. Delaware and Raritan Canal Commission: Trenton, NJ: 1989.

East Coast Greenway Alliance. "About" 2018. Web. <https://www.greenway.org/about/the-east-coast-greenway>.

Emscher Lippe Genossenschaft Verband. "The Emscher Genossenschaft River basin management from the beginning"
<https://www.eglv.de/en/emschergenossenschaft/>.

Fliervoet, Jan M., Riyan J.G. van den Born, and Sander V. Meijerink. "A Stakeholder's Evaluation of Collaborative Processes for Maintaining Multi-Functional Floodplains: A Dutch Case Study." *International Journal of River Basin Management* 15 (2) 2017: 175–86.
<https://doi.org/10.1080/15715124.2017.1295384>.

Great Rivers Greenways. "Great Rivers Greenways, About Us."
<https://greatriversgreenway.org/about-us/>.

GreenInfo-Network. "East Coast Greenway Map." Accessed February 11, 2019.
<https://map.greenway.org>.

Hiss, Tony and Meier, Christopher. *Highlands To Ocean: A First Close Look at the Outstanding Landscapes and Waterscapes of the New York/New Jersey Metropolitan Region*. First Edition edition. Morristown, N.J.: Geraldine R. Dodge Foundation, 2004.

Kelman, Ari. *A River and Its City*. First Edition, Berkeley: University of California Press, 2006.

Klijn, Frans, Dick de Bruin, Maurits C. de Hoog, Sjef Jansen, and Dirk F. Sijmons. "Design Quality of Room-for-the-River Measures in the Netherlands: Role and Assessment of the Quality Team (Q-Team)." *International Journal of River Basin Management* 11 (3) 2013: 287–99.
<https://doi.org/10.1080/15715124.2013.811418>.

Lawlor, Julia. "History and Nature on Delaware and Raritan Canal." *The New York Times*, July 29, 2010. <http://www.nytimes.com/2010/07/30/nyregion/30canal.html>.

Lippard, Lucy R. *The Lure of the Local: Senses of Place in a Multicentered Society*. New York: The New Press, 1998.

Listokin David, Dorothea Berkhout, and James W. Hughes. *New Brunswick, New Jersey: The Decline and Revitalization of Urban America*. New Brunswick: Rutgers University Press, 2016.

- Mathur, Anuradha, and Dilip Da Cunha. *Deccan Traverses: The Making of Bangalore's Terrain*. New Delhi: Rupa & Co, 2006.
- Mathur, Anuradha, and Professor Dilip da Cunha. *Mississippi Floods: Designing a Shifting Landscape*. New Haven: Yale University Press, 2001.
- The Metlar/Bodine House Museum. Permanent Collection. A Comprehensive Plan For: The Restoration, Interpretation and Rehabilitation of the Metlar/Bodine House. From Indian Trail to Interstate. 2013. Web
<http://www.metlarbodinehousemuseum.org/permanentcollection>.
- Middlesex County Cultural and Heritage Commission. "Raritan Landing." n.d. Accessed March 31, 2017.
<http://www.middlesexcountynj.gov/Government/Departments/BDE/Pages/Raritan-Landing.aspx>.
- Ministerium für Kinder, Familie, Flüchtlinge und Integration des Landes Nordrhein-Westfalen, "Emscher Kunst," Emscher Landschaftspark, 2016.
<http://www.emscherkunst.de/en/emscher-river/emscher-landschaftspark/>.
- Molinar Robert. "Self-Organization as a Response to Homelessness: Negotiating Autonomy and Transitional Living in a "Village" Community." 2018.
<http://hdl.handle.net/1794/23826>.
- Mortice, Zach. "A "Loop and a Stitch" Across St. Louis's Divide." *Landscape Architecture Magazine*, 5/29/18.
- New Jersey League of Conservation Voters. Protecting Open Space. 2019.
<https://www.njlc.org/issues/protecting-open-space>
- New York Times*. "Permit for Route 18 Bridge Over Raritan River Signed," *New York Times*, August 20, 1976.
- Regionalverband Ruhr. "Ruhr Metropolis Home." 2018.
www.metropoleruhr.de/en/home/ruhr-metropolis/data-facts.html.
- New Jersey Department of Transportation. "Route 18 straight line diagram." New Jersey Department of Transportation. August 2016. Retrieved September 9, 2019.
- Rijke, Jeroen, Sebastiaan van Herk, Chris Zevenbergen, and Richard Ashley. "Room for the River: Delivering Integrated River Basin Management in the Netherlands." *International Journal of River Basin Management* 10 (4) 2012: 369–82.
<https://doi.org/10.1080/15715124.2012.739173>.

Rijkswaterstaat Ministerie van Infrastructuur en Waterstaat. "Room for the River Fact Sheet." Ruimtevoorderivier 2018. <https://www.ruimtevoorderivier.nl/english/>.

Sbp. Schlaich Bergmann Partner. "Bridge Sculpture, Slinky Springs to Fame." 2018. <https://www.sbp.de/en/project/bridge-sculpture-slinky-springs-to-fame/>.

Slesinski, Jason J. *Along the Raritan River: South Amboy to New Brunswick*. Charleston, South Carolina: Arcadia Publishing, 2014.

Snyder, John Parr. *The Story of New Jersey's Civil Boundaries, 1606-1968*. 1st ed. Trenton: Bureau of Geology and Topography, 1969.

Spirn, Anne Whiston, *The Granite Garden: Urban Nature and Human Design*. New York: Basic Books, 1984.

Stadt Oberhausen. Tourismus and Freizeit. "Slinky Springs to Fame." 2018. <http://www.oberhausen.de/de/index/tourismus-freizeit/stadtportrait/sehenswuerdigkeiten/slinky-springs-to-fame.php>.

State of New Jersey, Department of Environmental Protection. "Delaware and Raritan State Park, Facts." 2018. <https://www.state.nj.us/dep/parksandforests/parks/drcanal.html#faqs>.

State of New Jersey, Department of Transportation. "Njcomuter.com." 2018. <http://www.njcommuter.com/>.

Stoss. Web. <http://www.stoss.net/projects/62/chouteau-greenway/>

United States Census Bureau. Census of Population and Housing. 2015.

United States Coast Guard. "Final environmental impact/section 4f statement: Route 18 bridge across the Raritan River, New Brunswick-Piscataway, Middlesex County, New Jersey." Department of Transportation, Washington, D.C: 1976.

United States Department of the Interior, National Park Service. "Florida: St. Augustine Town Plan Historic District." June 6th, 2017. https://www.nps.gov/nr/travel/american_latino_heritage/st_augustine_town_plan_historic_district.html.

Van Dyke, John Charles. *The Raritan Notes on the River and the Family*. New Brunswick, New Jersey: Privately Printed, 1915.

- Veit, F. Richard. *The Old Canals of New Jersey; a Historical Geography*. Little Falls: New Jersey Geographical Press, 1963.
- Vuren, Saskia van, Andries Paarlberg, and Hendrik Havinga. "The Aftermath of 'Room for the River' and Restoration Works: Coping with Excessive Maintenance Dredging." *Journal of Hydro-Environment Research* 9 (2) 2015: 172–86.
<https://doi.org/10.1016/j.jher.2015.02.001>.
- Walmsley, Anthony. "Greenways and the Making of Urban Form." *Landscape and Urban Planning*, Greenways, 33, no. 1 (October 1, 1995): 81–127.
[https://doi.org/10.1016/0169-2046\(95\)02015-L](https://doi.org/10.1016/0169-2046(95)02015-L).
- Warner, Jeroen, and Arwin van Buuren. "Implementing Room for the River: Narratives of Success and Failure in Kampen, the Netherlands." *International Review of Administrative Sciences* 77 (4) 2011: 779–801.
<https://doi.org/10.1177/0020852311419387>.
- Way, Thaïsa. *River Cities, City Rivers*. Washington, D.C: Dumbarton Oaks Research Library and Collection, 2018.
- White, Richard. *The Organic Machine: The Remaking of the Columbia River*. Fifteenth Printing edition. New York: Hill and Wang, 1996.
- Wiering, M. A., and B. J. M. Arts. "Discursive Shifts in Dutch River Management: 'Deep' Institutional Change or Adaptation Strategy?" *Hydrobiologia* 565 (1) 2006: 327–38. <https://doi.org/10.1007/s10750-005-5923-2>.
- Woltz, Thomas. "Ecology and Culture in the Design of Urban Parks." *Landscape Journal: design, planning, and management of the land* 35, (2) 2016: 237–253.
- Yamin, Rebecca. *Rediscoverin Raritan Lending, An Adventure in New Jersey Archeology*. Middlesex County, 2011.