Paths Less Paved: How Parks Boost Facility Distribution in the Chicago Lakefront Trail, the Atlanta Beltline, and the Hudson River Waterfront Walkway

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Abstract

Greenways have risen to prominence in recent decades as more cities begin to implement them into their urban planning. They increase access to green space, create a transportation corridor, and are easier to implement into existing space than traditional parks. This thesis explores the facility distribution of three prominent greenways: The Lakefront Trail, the Atlanta Beltline, and the Hudson River Waterfront Walkway. Through a historical analysis and geographic information mapping of the three greenways in which I compared and contrasted existing features and facilities such as comfort stations, transportation facilities, and access points, I found evidence to support the argument that parks that are directly connected to these greenways increase the number and frequency of facilities along the trails. Evidence was also found to support the argument that existing infrastructure decreases the number and frequency of facilities.

Introduction

Amid the hustle and bustle of the city sits a corridor that offers an escape to a world of possibilities that seems to move at a more leisurely pace. People exercise alongside cyclists, some on their commute to work and others for recreation. Along the way, they may come across playgrounds full of laughing children or scenic beaches with rolling dunes. Should they need to make a stop for food, relief, or relaxation, they are likely to find themselves passing a food vendor or a comfort station along their journey. This green oasis full of possibility sits in the middle of the city, offering a reprieve from congested streets and the concrete jungle just feet away. Formally known as a greenway, this concept has been implemented in dozens of cities across the United States since its introduction in the late 19th century to varying degrees of success.

Greenways as discussed in this paper are share-use, active-transportation corridors used for commuting and recreation that connect multiple neighborhoods together and maintain "ease of passage" and "continuity" as defined by the European Greenways Association.[1] They maintain a "low or zero gradient" and run continuously with the presence of circumventable barriers. Greenways are often known as active-transportation corridors as their length and ease of use and accessibility allow people to commute on them over long distances using non-motorized means. They may also link parks, nature reserves, cultural features, or historic areas, as defined by land conservation advocate Charles E. Little.[2] Greenways offered benefits for rapidly developing cities that made them an ideal choice for implementation as green space became a greater consideration in city planning.

[1] "Greenways | European Greenways Association."
[2] Little, C. E. (1990b). *Greenways for America*. http://ci.nii.ac.jp/ncid/BA12751128

This paper aims to explore the similarities and differences in amenities and facilities, with an emphasis on the distribution of facilities, across three separate greenways: the Lakefront Trail in Chicago, IL, the Beltline in Atlanta, GA, and the Hudson River Waterfront Walkway in Hudson County, NJ. In a comparative analysis of the greenways, I compared similar facilities as defined by a predetermined framework. These include comfort stations, transportation facilities, and access points. By comparing these across each greenway, I determined the frequency at which they are distributed and what factors of the physical environment, such as the presence of industrial infrastructure or parks, may cause a stretch of the greenway to exist with or without accessibility to these features. The Lakefront Trail and the Hudson River Waterfront Walkway, for example, are both waterfront greenways but they are very different in what amenities and facilities they offer. A factor I believe to be important to this distribution is the presence of parks. Though parks along greenways are usually smaller, they serve as distinct markers that provide room for the implementation of facilities. To conduct this analysis, I compiled historical information from literary sources as well as datasets from online data portals. I created three visuals in the form of maps to show the spread of the facilities and where distinctions can be found on the greenways. It is important to note that the terms “greenway” and “trail” will be used interchangeably throughout this paper.

By conducting this research, I aimed to address the broader question of what effects the physical environment can have on greenway development. This includes what the greenway may be constructed out of and why, what types of transportation facilities are offered and how often they are present, and what development has looked like in the context of each geographical area and given the nature of urban planning in existing cities. More specifically, I investigated the role that parks play within this conversation, given that they are established green space specifically

aimed at recreation. This required looking at historical accounts, such as literature written by people involved in the planning of these greenways, as well as development documentation, which can include planning and guidelines documents specific to each greenway. Green space access has been a necessity that cities have struggled to implement as they grow exponentially, and presently, the need for suitable solutions has become urgent.[3] With a growing understanding of the physical and mental health benefits that this type of access to green space offers residents, it is important to gain an understanding of the impacts that physical space has on the development of green space and what kind of features may be offered as a result. Because greenways offer much in the way of benefits and flexibility, they are ideal for city planners, and their growing popularity shows a need for more research into their design and development for optimal use during planning.

This paper argues that the physical environment that a greenway is situated in can play a positive or negative role in the number of facilities and amenities that are distributed along the Lakefront Trail in Chicago, Illinois, the Beltline in Atlanta, Georgia, and the Hudson River Waterfront Walkway in Hudson County, New Jersey. Existing infrastructure, such as factories, railroads, and other standing structures or buildings, requires greater consideration in development and diminishes the number of available amenities and facilities. While there are common buildings and features across the three greenways, I argue that the distribution of these amenities and facilities is diminished along areas that must consider existing infrastructure due to the physical difficulties of demolishing and rebuilding, as well as lowered priority due to the presence of such infrastructure. I also argue that parks increase the number of facilities available, given that they increase access to green space and are meant to address these needs for community members, so I

[3] Viniece Jennings et al., "Urban Green Space and the Pursuit of Health Equity in Parts of the United States," *International Journal of Environmental Research and Public Health (Online)* 14, no. 11 (November 22, 2017): 1432, https://doi.org/10.3390/ijerph14111432.

would expect to see more comfort stations and access points in the greenways with more parks located directly on the trail.

To address the arguments, I first provide background information regarding the historical development of the greenway itself, as well as the historical development of each individual greenway to provide the necessary context in which to place each case. This is followed by a literature review that provides further context on what the existing literature on greenways looks like as well as where gaps in this literature exist. This section will also briefly address social factors, such as economic and racial factors, that play an important role in development but that are not the focus of this paper. I then provide a framework that I use to identify each point of interest for each greenway, as well as necessary definitions for facilities and amenities. I proceed to explain the methodology behind the paper as well as data acquisition. Finally, I conclude with an analysis of the information and compiled data and a discussion of the results, as well as the implications of this paper.

Background and Context

Early History of Greenways

When the concept of a greenway was introduced by famed architect and urban planner Frederick Law Olmsted and his partner Calvert Vaux, they were referred to as “parkways” and were intended for use by carriages. Olmsted first conceived of the idea while working on a new park design in Brooklyn, New York. He supported the idea that parks created a “sense of enlarged freedom,” and taking into consideration the volume of expected visitors, he advocated for extended

passages that could connect many parks together, serving as an extension of the parks in Brooklyn.[4] His first official greenway would be Boston's Emerald Necklace, which stretches 15 miles and connects the city's 5 main parks.[5]

Though the term 'greenway' would not be introduced until the mid-20th century, the concept had started to become increasingly popular in cities across the world much earlier in the century. 'Greenway' was first used by William Whyte in his 1959 monograph *Securing Open Space for Urban America* and later more officially in his 1968 book *The Last Landscape*.[6] The term began to gain traction and in 1987, the President Reagan Commission on Americans Outdoors released a report endorsing and recommending greenways to cities.[7] This led to the "greenway movement", which was a rise in popularity and support for greenways in the late 20th century. Robert Searns introduced the concept of greenway generations in 1995. These generations change as greenways adapt to new challenges or changes and Searns notes three important shifts.[8] The first generation includes "axes, boulevards, and parkways" that are much older and have been in use for centuries. The second generation is the one where most well-known greenways today belong. Described as "trail-oriented recreational greenways that provide access to rivers, streams, ridgelines, railbeds and other corridors", these greenways are common and geared towards adapting to the environment and meeting the needs for recreation and beautification within cities. The third generation is one that is now emerging that addresses problems beyond human health

[4] "'Report to the Brooklyn Park Commissioners,' January 1871," n.d., https://rotunda.upress.virginia.edu/founders/default.xqy?keys=OLMS-print-01-06-02-0009-0013.
[5] Fábos, "Greenway Planning in the United States: Its Origins and Recent Case Studies," May 1, 2004.
[6] William H. Whyte, *The Last Landscape*, 1970, http://ci.nii.ac.jp/ncid/BA65772727.
[7] Anne A. Gharaibeh, "Enhancing the Historical Identity of Jerash by Introducing Greenway Culture," *Proceedings of the Fábos Conference on Landscape and Greenway Planning* 3, no. 1 (January 1, 2010): 50, https://scholarworks.umass.edu/cgi/viewcontent.cgi?article=1286&context=fabos.
[8] Robert M. Searns, "The Evolution of Greenways as an Adaptive Urban Landscape Form," *Landscape and Urban Planning* 33, no. 1–3 (October 1, 1995): 65–80, https://doi.org/10.1016/0169-2046(94)02014-7.

and aesthetics and integrates solutions related to issues such as wildlife protection, flood reduction, and water quality. The three greenways discussed in this paper fall under generation two due to the time in which they were planned and developed, as well as their primary purposes, which are to increase access to green space in their respective cities and provide a transportation corridor.

Development of the Atlanta Beltline

Once nicknamed "Terminus" because of its central role in the railway system in the American South, the city of Atlanta has a lot of unused railroads laying forgotten from its "Terminus" days.[9] Atlanta also holds a reputation for being the "city in a forest" and a study conducted in 2014 found that 47.9% of the land within the city limits was covered in a tree canopy.[10] This ideal mix of infrastructure and environment set the groundwork for masters' student Ryan Gravel.[11] He introduced the idea of a greenway that utilized the old railroads and turned them into a map for development. Because the railroads paved the path for clear, flat terrain, the land was set up for an ideal greenway. Classified as a rails-to-trails project, the project began development in 2005 following the formation of the Atlanta Beltline Partnership. The first paved segment of the greenway is constructed in 2008 and development escalates rapidly from there.[12] Built around the city of Atlanta, the Beltline features many notable stops and landmarks, as well as many art installations. Currently still in development, streetcars are planned to run alongside the railroads that outline the greenway, providing more transportation options for visitors. The greenway encircles the city of Atlanta, going along the outer edges of the city. Figure 1 provides a map for where the trail is situated.

[9] "History | Atlanta, GA."
[10] "Urban Tree Canopy Study | Trees Atlanta."
[11] Atlanta BeltLine, "History on the Atlanta BeltLine – Piedmont Park // Atlanta Beltline."
[12] Atlanta BeltLine, "Atlanta BeltLine Timeline // Atlanta Beltline."

Figure 1. A map of the Atlanta Beltline Trail, stretching 18.7 miles. Taken from the Atlanta Beltline official website (2024).

Development of the Chicago Lakefront Trail

The Lakefront Trail paints a picturesque painting as it meanders along the shoreline of Michigan Lake. Built on a landfill meant to fill in along the coastline, remnants of Chicago's Great Fire sit amongst the landfill.[13] The greenway was officially established in 1963 as a bicycle path by Mayor Richard Daley.[14] The greenway has always been meant primarily for cyclists, dating as far back as the late 1890s, where the mayor at the time encouraged the city to bike more, especially after "safety bicycles" were introduced. A trail separation project to provide pedestrians and cyclists their own designated trails alongside each other was completed in 2018 following decades of overcrowding on the single available trail.[15] Multiple museums, centers, and beaches line the shoreline that the greenway follows and Chicago's historical designation as a prairie is apparent when passing the Burnham Wildlife Corridor or the Montrose Point Bird Sanctuary.[16]

[13] Patty Wetli, "Grant Park, Chicago's 'Front Yard,' Rose From the Trash of the Great Fire," *WTTW News*, October 11, 2021, https://news.wttw.com/2021/10/08/grant-park-chicago-s-front-yard-rose-trash-great-fire.
[14] "Biking and Chicago's Lakefront Trail."
[15] District, "Lakefront Trail | Chicago Park District."
[16] District, "Burnham Wildlife Corridor | Chicago Park District."

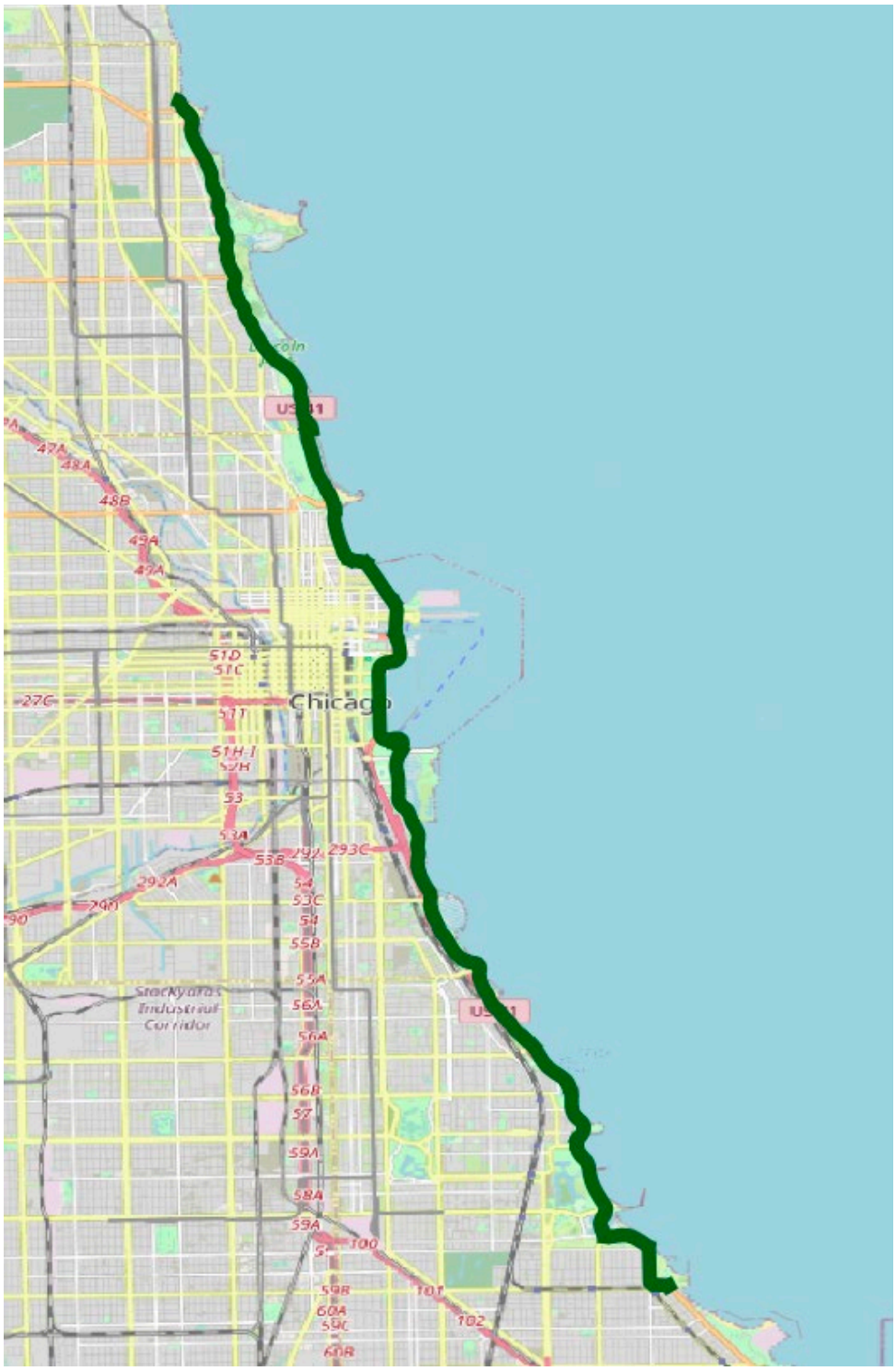

Figure 2. A map of Chicago's Lakefront Trail, stretching 18.5 miles. Created by Kimberly Carrillo Rivera using data from the Chicago Data Portal, February 9, 2024.

Development of the New Jersey Hudson River Waterfront Walkway

The Hudson River Waterfront Walkway, or the Hudson River Walkway, was created as industrial activity declined along the shoreline in the late 20th century, with the goal being to increase public access to the waterfront.[17] Detailed plan and design guidelines were released by the Hudson River Waterfront Conservancy in 1984 for municipalities to follow.[18] Unfortunately, the greenway has run into various issues throughout its development given that it crosses multiple municipalities and jurisdictions.[19] It is only mandated that any construction near the shoreline leaves 30 feet of space for building, but this decree, along with existing homes and industrial infrastructure that had been present prior to the establishment of the greenway, makes it difficult to develop the trail or even access it along certain parts, which slowed down progress significantly.[20] According to the plan and design guidelines, a number of factories had agreed to provide "direct access to water" for the Walkway when its initial plans were released in 1984.[21] The design guidelines help maintain uniformity along developed sections of the greenway, helping create an illusion of continuity, but there are several areas of the greenway that are still being developed today, particularly along the areas of the walkway where industrial infrastructure still exists.

[17] The Associated Press, "Judge Upholds Law on Waterfront Access," *The New York Times*, August 19, 1999, https://www.nytimes.com/1999/08/19/nyregion/judge-upholds-law-on-waterfront-access.html.
[18] Administrator (n.d.)
[19] Applebome, "A Promenade and a Trail, Ready to Meet a Greenway."
[20] The Associated Press, "Judge Upholds Law on Waterfront Access."
[21]Hudson River Waterfront Conservancy. 1984. "The Walkway Plan." *Hudson River Waterfront*. New Jersey Department of Environmental Protection. Accessed April 1, 2024. https://hudsonriverwaterfront.org/index.php?option=com_content&view=article&id=20:reference-documents&catid=5:consvcat&Itemid=19.

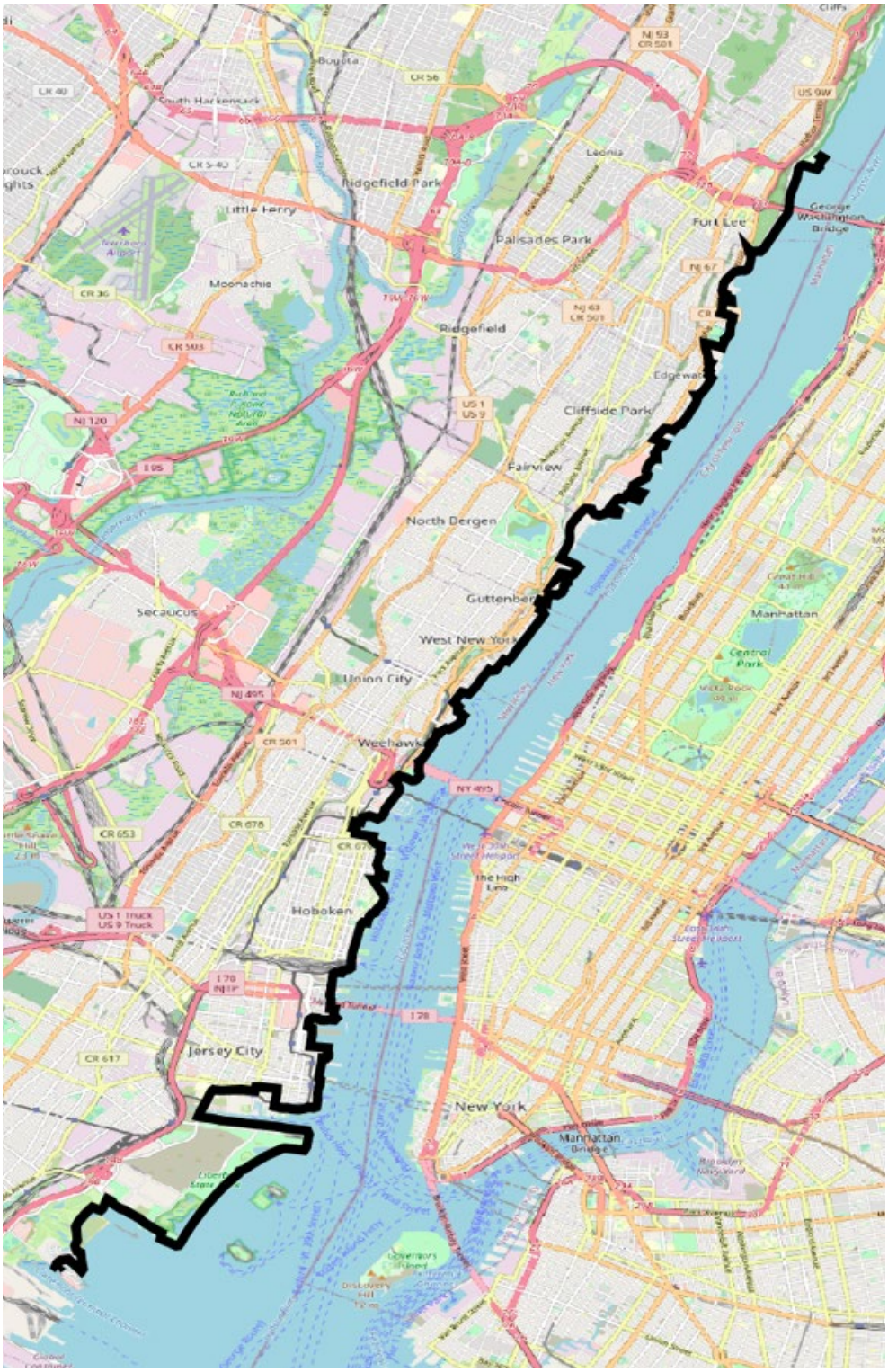

Figure 3. A map of the Hudson River Waterfront Walkway, stretching 18.5 miles. Created by Kimberly Carrillo Rivera using data from the Hudson River Waterfront Walkway reference documents, February 27, 2024.

Literature Review

Overview

In this section, I review existing literature relating to greenways and their development, specifically greenways located in key areas that I will be researching. I discuss literature relating to specific greenways and their development, as well as literature that discusses related topics, including gentrification and accessibility and equity. These topics offer insight into the reasons behind the development of certain facilities and amenities, as well as the frequency of their placement, which makes them an important aspect of research. Greenway design has seen many changes through the decades since the concept was introduced, and prior research shows the necessity for understanding the needs and concerns of the present community and the space they occupy. I will first discuss greenway design as it has been discussed primarily by two major existing texts, followed by a discussion on literature on the Atlanta Beltline, the Chicago Lakefront, and the Hudson River Walkway. After this, I will look at literature relating to social factors that are relevant to greenway design, in particular gentrification and accessibility and equity. I will then discuss how my research fits within the scope of the existing literature.

Greenway Design

Much of the current literature on physical characteristics of greenways exists in relation to greenway design and development. Well-known literature such as *Greenways* by Flink and Searns provides valuable information on the history of greenways and insight into the process behind designing these trails.[22] The authors address the lower costs associated with building greenways

[22] Charles Flink and Robert M. Searns, *Greenways: A Guide to Planning Design and Development*, 1993, https://trid.trb.org/view/405299.

as well as the benefits that come from their development. In terms of facility distribution, the book does not directly address these aspects of greenways, but rather discusses logistics for ensuring the greenway is implemented successfully. Identifying recreation resources is named as a necessary step to ensuring the success of the greenway, and this includes identifying how the local parks and recreation department has handled and implemented community needs. This helps identify existing spaces for recreation, including areas designated as parks. Long term responsibilities are also named as necessary considerations for greenway success, under which maintenance of trail facilities and infrastructure falls. *Greenways for America* is a well-known publication that discusses greenways in the United States and provides an overview on why they rose in popularity and their relation to the green movement. Existing literature emphasizes the importance of factors such as the presence of nature and the practicality of trails. The importance of spatial planning is emphasized as well, as designs without proper planning yield less benefits than those that consider and integrate the space around them.[23] Other factors that tend to be considered are ecological aspects and ease of integration. Because greenways tend to be larger green spaces, they are best implemented when designed with the existing space in mind. As mentioned previously, this is a reason for why they are good candidates for increasing green space access in urban settings. Though there is quite a lot of literature on the process of designing greenways, there is less available that focus primarily on urban greenways, which might look very different to suburban or rural corridors.

The Atlanta Beltline

[23] Little, C. E. (1990b). *Greenways for America*.

There is a large amount of literature relating to greenways in Atlanta, Georgia, with much of the literature focusing on or referencing the Atlanta Beltline. Much of the existing literature focuses on the social and financial aspects that greenways have on residents. A 2017 study by Palardy, Boley, and Gaither shows that residents generally find the addition of the Beltline to have a positive impact on their happiness and well-being. An aspect mentioned in the study is social empowerment, which promotes neighborhood cohesion through the utilization of green space.[24] Because greenways are meant to serve as connecting paths, it is understandable that residents would find a sense of empowerment in having access to a larger part of their community. This is a topic within green space discussion that relates to social factors behind development decisions. As discussed in Flink and Searn's *Greenways*, greenways should consider what their human goals are and think about who is using the greenway and why.[25] The Beltline's message according to their website is to "break down barriers and connect people, communities, and cultures that have been intentionally segregated for generations."[26] While many social factors drive the development of the Beltline, the focus for this paper is on the physical environment that impacts decisions.

However, the Beltline is still the subject of controversy. While it plays a role in connecting the city and increasing the health and well-being of residents along the trail, it also plays a significant role in the gentrification of parts of the city that drive out residents currently living there.[27] Research conducted by Immergluck and Balan showed that while provisions were put in place to attempt to assist with affordable housing for new residents, none were placed to help existing residents, which has been the subject of much literature and debate. While research on

[24] Palardy, Boley, and Gaither, "Residents and Urban Greenways: Modeling Support for the Atlanta BeltLine."
[25] Flink and Searns, *Greenways: A Guide to Planning Design and Development*.
[26] Atlanta BeltLine, "Equity and Inclusion // Atlanta Beltline."
[27] Immergluck and Balan, "Sustainable for Whom? Green Urban Development, Environmental Gentrification, and the Atlanta Beltline," August 4, 2017.

Atlanta's Beltline is more abundant than other greenways, there is still a distinct lack of research focusing on the physical aspects of the trail and the design choices as a result of where it is situated.

The Chicago Lakefront

The Chicago Lakefront is often discussed in relation to Chicago green space and its planned layout. The city of Chicago is unique in that its planning has followed guidelines set out by Daniel Burnham in what is known as the Burnham Plan of Chicago, which was released in 1909.[28] Though the plan never fully came into fruition, there are aspects of the plan that can be seen today. Burnham wanted to emphasize beautification in the plan, and he was a staunch supporter of protecting the lakefront for public use.[29] Among the literature that has been written on the greenway are articles that focus on green space accessibility and how the greenway may operate as a potential cause of gentrification in Chicago. The presence of green space has historically increased land value and house prices in urban spaces, which can lead to the exodus of existing community members as they are unable to afford rising prices.[30] According to Stuhlmacher, this trend exists in Chicago as green space has become a predictor for gentrification more recently.[31] Much of the available research in particular focuses on the social impacts that the Lakefront Trail has had.[32] More recently, a thesis published in 2015 by Kellie Radnis looks specifically at how the Burnham Plan

[28] Samuel Kling, "Wide Boulevards, Narrow Visions," *Journal of Planning History* 12, no. 3 (February 20, 2013): 245–68, https://doi.org/10.1177/1538513213476709.
[29] "Plan of Chicago Prepared Under the Direction of the Commercial Club During the Years 1906, 1907, and 1908," The Library of Congress, n.d., https://www.loc.gov/item/09017454/.
[30] M. Bočkarjova et al., "Property Price Effects of Green Interventions in Cities: A Meta-analysis and Implications for Gentrification," *Environmental Science & Policy* 112 (October 1, 2020): 293–304, https://doi.org/10.1016/j.envsci.2020.06.024.
[31] Michelle Stuhlmacher, Yushim Kim, and Ji Eun Kim, "The Role of Green Space in Chicago's Gentrification," *Urban Forestry & Urban Greening* 71 (May 1, 2022): 127569, https://doi.org/10.1016/j.ufug.2022.127569.
[32] Jaeyoung Ha and Hyung Jin Kim, "Urban Green Space Alone Is Not Enough: A Landscape Analysis Linking the Spatial Distribution of Urban Green Space to Mental Health in the City of Chicago," *Landscape and Urban Planning* 218 (February 1, 2022): 104309, https://doi.org/10.1016/j.landurbplan.2021.104309.

was implemented into the Lakefront Park System.[33] The case study the author conducted provided valuable information on features and attractions, grouping them by parks and designating them into various types of features. This appears to be one of the more recent comprehensive studies that focuses solely on the Lakefront Trail. As mentioned previously, much of the discussion around the Lakefront Trail happens in conjunction with green space throughout the city.

The Hudson River Waterfront Walkway

While literature on the Walkway is sparse, there are reports and guidelines available that add to the existing literature. Reports conducted by the state of New Jersey have revealed extensive planning and policy recommendations. The state has released several documents that show their support and commitment to expanding public access to the coastline in the form of parks and the greenway. A Public Trust Doctrine was released by the state of New Jersey in 2019 that names the Waterfront as a protected area and cites the *Hudson River waterfront area rule (N.J.A.C. 7:7E-3.48)* as the rule that governs the area the greenway occupies.[34] Amongst the official state and municipal documents available, there is a limited number of papers and reports that look at the history and development on the Walkway. Strauss and Wang's article "New Jersey's Gold Coast: Revisiting Public Access and the Hudson River Waterfront Walkway" presents an early overview into the perception of the project and redevelopment efforts in 1992, offering insight into how the greenway began to impact public access.[35] Of great interest is a research paper published in 1998 that conducted a survey to determine possible uses and their demand from visitors. Since its

[33] Kellie Marie Radnis, "Chicago's Lakefront Park System: A Study of the Burnham Plan and Its Implementation," *Columbia University Libraries/Information Services*, January 1, 2015, https://doi.org/10.7916/d86w998k.
[34] "PUBLIC ACCESS IN NEW JERSEY: The Public Trust Doctrine and Practical Steps to Enhance Public Access," *NJ.Gov* (New Jersey Department of Environmental Protection, 2018), https://www.nj.gov/dep/cmp/access/public_access_handbook.pdf.
[35] Strauss, Andrew L., and Geraldine Wang. "New Jersey's Gold Coast: Revisiting Public Access and the Hudson River Waterfront Walkway." *Carolina Planning Journal* 18, no. 1 (1992): 26-32.

publication however, there has been little in the relation to research done on current features of the greenway, as well as how they might have come into fruition. While greenways such as the Beltline and the Lakeshore Trail have been the subjects of extensive research, the Hudson River Waterfront Walkway has remained a limited subject in research despite its location in one of the most populated centers in the United States.

Gentrification by Greenways

Gentrification has had a central role in literature focusing on the effects of greenways, and green spaces in general. Because I have been researching different factors that greenways affect and vice versa, it is important to acknowledge the consequences that gentrification can have on neighborhoods and communities. Though increasing green space accessibility for all communities is an important goal for many cities, the implementation of these spaces without proper planning and adjustment of city policies can lead to the displacement of some communities.[36] Without adjustment to current policies, research has found that neighborhood rent prices can go up significantly with the construction of new green space, leading to the exodus of existing tenants, which renders attempts to increase accessibility for every resident in the city moot.[37] Thus, the negative effects of greenways must be acknowledged and discussed in conversations about the implementation of greenways. While they may provide a lot of benefits, their implementation, particularly along areas that do not see the greatest access to greenspace and its facilities, may be more detrimental to the community.

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[36] Immergluck and Balan, "Sustainable for Whom? Green Urban Development, Environmental Gentrification, and the Atlanta Beltline," August 4, 2017.
[37] Cole and Immergluck, "Reshaping Legacies of Green and Transit Justice through the Atlanta Beltline," 2021.

Accessibility and Equity in the Socio-Economic Space

Accessibility has also played an important role among discussions related to the physical environment. Studies have found that some communities have less access to green spaces, particularly those at a greater economic disadvantage.[38] This is a problem that greenways are meant to address by increasing access points to green spaces, but the issue stems from the implementation of these spaces. Because space in urban areas is limited and many economically disadvantaged neighborhoods are located near industrial zones, it is difficult to plan green spaces that utilize their space to the best of their ability.[39] This discussion ties directly into how the physical space is used. Spaces used as active transportation have also been found to be detrimental to communities that are already disadvantaged. Because greenways are long, multi-use spaces typically designed with walkers and bikers in mind, people who can afford the rising costs of living near these greenways often move in for access to a commuting path, taking up residences that were previously accessible to families with lower incomes.[40] This conversation works in tandem with the previously mentioned discussion around gentrification. This continuous cycle results in issues with green space accessibility that continues to leave disadvantaged communities across many cities without access to nature, a fact that is detrimental to the mental and physical health of residents in these areas.

Addressing the Literature Gap

[38] Jung, "Green Spaces for Whom? A Latent Profile Analysis of Park-Rich or -Deprived Neighborhoods in New York City," September 1, 2023.
[39] Liu, Kwan, and Kan, "Analysis of Urban Green Space Accessibility and Distribution Inequity in the City of Chicago," April 1, 2021.
[40] Kim and Wu, "Do the Characteristics of New Green Space Contribute to Gentrification?," February 11, 2021.

Much of the recent literature available focuses more so on the socio-economic aspects of greenways. By bringing focus back to the physical environment, I hoped to contribute to the existing literature which examines the physical environment of greenways and its impact on greenway features. There was a distinct lack of literature available on the physical environment for the three greenways I discussed, so this research aims to bridge that gap and provide further reading on this important aspect of green space design.[41] There is a significant gap in literature based on green space in Hudson County, with very little available on the Hudson River Waterfront Walkway in particular. As such, I aimed to add and hopefully encourage more research on significant greenways. The physical environment of a green space plays an important role in design and making these spaces the most efficient and accessible possible, so it is important to discuss the space and how goals such as increasing accessibility and space efficiency can be accomplished.[42] The existence and placement of parks, for example, shapes the landscape of a greenway and determines the availability of space along the trail, which may impact facility distribution. Urban parks in particular are important given their location in areas that already struggle with a lack of space, and their presence can provide opportunities to implement structures for enjoyment and recreation. Other such features that may have the same effect include existing infrastructure, such as the presence of highways or industrial facilities. Without discussing and analyzing factors such as facility frequency and the geography of urban spaces in relation to one another, it is difficult to come to conclusions about the best way to adjust urban planning so that planners can utilize the existing space to the method best suited for the unique environment that the city is situated in.

[41] Rigolon et al., "Green Space and Health Equity: A Systematic Review on the Potential of Green Space to Reduce Health Disparities," March 4, 2021.
[42] Lee et al., "The Relationship between User Perception and Preference of Greenway Trail Characteristics in Urban Areas," August 16, 2019.

Overview of Research & Conceptual Framework

Overview

My thesis argues that the physical environment that a greenway is situated in plays an important role in the facilities and amenities that are distributed along the Lakefront Trail in Chicago, Illinois, the Beltline in Atlanta, Georgia, and the Hudson River Waterfront Walkway in Hudson County, New Jersey. Existing infrastructure in particular requires greater consideration in development. While there are common buildings and features across the three greenways, I argued that the distribution of facilities is diminished along areas that much consider existing infrastructure. Existing infrastructure is defined as infrastructure that was present prior to the development of a particular segment along the greenways. I also argued that the presence of parks increases facilities and accessibility to the trails due to an increase in available space for these facilities.

Conceptual Framework

In this paper, I looked to Robert Searns' "The Evolution of Greenways as an Adaptive Urban Landscape Form" for a framework on greenway definitions and guidelines. Released in 1995, Searns provides definitions for three generations of greenways: generation 1, generation 2, and generation 3. As mentioned previously, the three greenways I investigated in this paper are considered generation two greenways. These greenways were typically developed between in the latter half of the 20th century and place an emphasis on "non-motorized" travel, with Searns' stating that "it is the hike-bike path that fully defined the character of Generation 2 greenways".[43] These

[43] Searns, "The Evolution of Greenways as an Adaptive Urban Landscape Form."

greenways are also known as “trail-oriented recreational greenways”, typically aiming to bring nature into the urban environment and separate motorized and non-motorized methods of travel. It is mentioned in Searns’ paper that many urban greenways follow waterways, as the Lakefront Trail and the Waterfront Walkway do, but the introduction of another type of project was introduced by the rail-to-trails movement in the 1960s. Searns’ says the following of these greenway trails

“The urban greenway trail represents a special, more accessible, adaptation, a combination of the off-street bikeway concept, which first emerged in Europe, wilderness hiking trails, and Olmstead’s park walkways.”

Searns’ work with Flink in *Greenways* was also focal point of my analysis, as the recommendations made in their book will serve as a basis for what constitutes productive greenway development.[44] In their book, they outline ways to begin developing greenways and these suggestions helped support the ideas I discussed in this paper and develop my hypotheses. These recommendations include identifying recreation resources and long-term responsibilities when developing greenways. Identifying recreation resources includes considering existing options for recreation such the presence of parks, biking trails, and beaches. According to Searns and Flink, figuring out long term responsibilities includes considering management services, which is often dealt with by parks and recreation. As such, it could be argued that it is easier to manage and maintain facilities when there is a park involved given that there exists an assignment of responsibility for installation and maintenance, which could potentially boost the number of facilities available. Other aspects to consider include access and transportation. Searns and Flink

[44] Flink and Searns, *Greenways: A Guide to Planning Design and Development*.

assert that it is important to acknowledge the presence of any existing transportation corridors, such as highways, that may pose an obstacle to the greenway. Because consideration for existing infrastructure is important in greenway development, I hypothesized that facility frequency would decrease with an increase in this type of infrastructure. I defined each of these terms further below.

For this analysis, I defined an amenity as a feature or service used for recreational purposes that increases the appeal of the space. These are not necessary, but they are meant to increase enjoyment for visitors. A facility is defined as something that is designed for ease of use or to alleviate a specific need.[45] Specific facility designation will be included in the methodology section, while amenities will be grouped together to reduce possible issues or conflicts with designation. Existing infrastructure was defined as infrastructure that had been in place when the greenway was developed. More specifically, this includes industrial complexes, factories, and highways. Parks were defined as public areas of land that incorporate nature, as defined by Taylor et. al.[46] This information will be presented through maps designed in QGIS with a set of criteria that each will follow to ensure that they are all equal in presentation.

Methodology

Introduction

To address how and why certain physical similarities and differences developed across the three chosen greenways, I conducted a case study comparing three different cases. I used a combination of historical analysis and Geographic Information System (GIS) mapping analysis to

[45] Merriam-Webster, "Dictionary by Merriam-Webster."
[46] Lucy Taylor et al., "What Visitors Want From Urban Parks: Diversity, Utility, Serendipity," *Frontiers in Environmental Science* 8 (December 14, 2020), https://doi.org/10.3389/fenvs.2020.595620.

accomplish this. I first discussed how historical analysis was used to assist in the discussion and I provided an overview of the sources and documentation that will be utilized as well as how they will be incorporated into the discussion. An explanation on how the GIS mapping will be done will follow.

Historical Analysis

The historical analysis is an important aspect of my research given that there is relevant information on development and planning for these greenways in literature, particularly literature released in the mid- to late-20th century, and official design plans for the development of these greenways. Much of the information used for this analysis comes from primary sources in the form of existing literature in books and scholarly articles. Existing literature provides an overview of greenways, including how they have been defined and what separates them from other forms of green space. This is important for understanding why certain features may have been included or omitted in the design process for the cases I investigated. I also used design plans and other existing documents from the cities or governing bodies, as well as place-specific literature if available. For the Walkway, for example, I looked at the 1984 Plan and Design Guidelines, which provide information on the development of the greenway as well as how they chose to incorporate existing infrastructure. Released by the Hudson River Waterfront Conservancy and the Hudson Waterfront Walkway Technical Design Committee, these documents provide vital details on the requirements for the construction of the greenway.[47] I also looked at the official park district websites for background information as they typically provide an overview of their histories and groups

[47] Hudson River Waterfront Conservancy. 1984. "The Walkway Plan." *Hudson River Waterfront*. New Jersey Department of Environmental Protection. Accessed April 1, 2024. https://hudsonriverwaterfront.org/index.php?option=com_content&view=article&id=20:reference-documents&catid=5:consvcat&Itemid=19.

involved in the development of the greenway. The Atlanta Beltline maintains a comprehensive, up-to-date website that provides a lot of information, including datasets, construction projects, and transit planning.[48] These types of sources are important for understanding why greenways chose to incorporate certain features as well as the current status of these features and as they are typically maintained by a governmental body or organization, they can provide the most up-to-date information.

Each greenway was chosen based on specific criteria. To conduct a comparative analysis between each greenway, they needed to be the same or similar lengths, as well as see a relatively high volume of visitors each year. This allowed for a fairer comparison given that each greenway receives high volume traffic, which helps reduce bias towards any trends that may arise from a lack of or surplus of visitors. If a greenway sees a larger volume of visitors, for example, there may be more frequent facilities targeted towards servicing these visitors. Planners for less urban greenways may deem it unnecessary to have certain facilities or plan to reduce the quantity of the facilities as they would not be accessed as frequently. They also needed to have similar purposes. All three greenways meet each of the criteria. The Lakefront Trail is 18.5 miles long and sees over a million visitors a year.[49] The Hudson River Waterfront Walkway also stretches 18.5 miles with hundreds of thousands of visitors a year, though the specific number is unknown.[50] The Atlanta Beltline, which is slightly longer at 22 miles, also sees over a million visitors a year.[51] All three greenways are classified as generation two greenways as defined by Charles Flink and Robert Searns, as their primary uses are recreation and beautification, as well as the revitalization of the

[48] Atlanta BeltLine, "The Project // Atlanta Beltline."
[49] "Chicago Park District Lakefront Trail Count" (PDF). Chicago Park District
[50] Dennis Hevesi, "A River Walk's Piecemeal Birth," *The New York Times*, August 15, 1999, https://www.nytimes.com/1999/08/15/realestate/a-river-walk-s-piecemeal-birth.html?src=pm.
[51] "Atlanta BeltLine - Trust for Public Land."

land and existing infrastructure that they sit on.[52] More generally, however, these greenways were the most accessible for purposes of this investigation due to proximity and familiarity, which allowed me to visit in person and observe some of what I had researched. This provided a chance to verify some of the data I had found through my research and get an understanding of the context these greenways are in within their environments.

Geographic Information System Mapping

As I aimed to complete a comparative analysis of the three cases, I created several visual aids that will be useful in discussion when comparing the greenways using the mapping software Geographic Information System (QGIS). I chose this software due to my familiarity and experience using it in the past, as well as its ease of access and its number of robust features. It allowed me to import data easily in the form of shapefiles and csv files, which were the most common file types that I was working with. For each greenway, I created two maps that highlight several common factors. These are: the location and length of each greenway, as well as every operating comfort station, transportation facility, and access point. I separated the aspects I want to look at into their own maps to prevent overcrowding in a single image. In total, I created six comprehensive maps specifically for comparison, with one that displays the length and location of each and one that shows the comfort stations, transportation stations, and access points. I looked at what physical barriers may cause lower or higher frequency in certain areas, as well as what features of their surrounding area have influenced the placement of unique features.

Amenities and facilities have been previously defined in the overview sections, but I will further designate each specific feature here. Among the category of facilities, I included comfort

[52] Flink and Searns, *Greenways: A Guide to Planning Design and Development*.

stations, more traditionally known as restrooms. In order to determine whether each of these stations could be considered accessible on the trail according to the available data, I created buffer zones around each comfort station. If it fell within .1 km of the boundary of any part of the trail, then it could be considered part of the trail and added to the total count for that trail. This metric was chosen based on hiking guidelines that rule people walking on a trail without an available restroom should move a minimum of 200 feet away from the trail before finding a spot to go.[53] While this rule applies to hikers on nature trails, it was still implemented with accessibility in mind. Because greenways are meant to emulate these types of trails in an urban environment, this rule was chosen to be a reasonable distance for walkers. As comfort stations require much more space, this metric was expanded to .1 km, or about 328 feet. This leaves the comfort station within the expected walkable distance typically set for hikers while allowing room for the structure. I also defined a transportation facility as one which helps facilitate transportation along the greenway or with access beyond the greenway. For the purposes of this paper, this included bike stations such as Divvy, Lime, and Citi, as well as access points that include bus, train, or streetcar stops. This also included bike rental shops. Access points are points that facilitate access to the greenway and are accessible by car or pedestrians. Amenities included features that are not necessary, such as viewing stations and beaches. I noted if these appear across greenways, but I expected these types of features to be more unique and tailored to the specific environment that the greenways are in. I also counted the number of parks that are connected by each trail, meaning they had to be directly linked or physically on the greenway to count. I also tracked existing infrastructure, which included industrial complexes, factories, or highways that were present within the .1 km buffer I had set for comfort stations. The final totals for each feature per trail were combined into a table

[53] "Backpacking 101: On the Trail," Washington Trails Association, n.d., https://www.wta.org/go-outside/new-to-hiking/backpacking-101/backpacking-101-on-the-trail.

for better readability and shown in Table 1. I also looked at the frequency at which facilities appeared on the trails. This was done by calculating the number of each facility per mile for each trail. This was done for comfort stations, access points, transportation stations, existing infrastructure, and parks. The reason I chose to focus on facilities for this is that they are seen as necessary and provide a baseline for enjoyment in recreation. As they alleviate needs, I deemed them more important for the purposes of this paper. I also included existing infrastructure, counting factories or yards that appear within 0.1 km of the trail, or highways that go directly through the trail. By comparing the average frequency for each against existing infrastructure, I was able to see if the frequency of facilities lessened with the presence of more infrastructure or not. Similarly, I was able to see if a larger frequency of parks indicated more comfort stations, access points, or transportation stations.

The information for each of these data points was sourced from Google Maps, which provides comprehensive data from a variety of sources including satellite imagery and aerial photography, as well as ground views of large portions of the greenways. This allowed me to create datasets based on the most current imagery available. I also searched through data portals such as the Chicago Data Portal, Atlanta's Open Data Hub, and the New Jersey Geographic Information Network. I have utilized several datasets in the final maps, with those being used to map the greenway onto a base map in QGIS.[54][55][56]

Results and Analysis

Introduction

[54] "Parks - Chicago Park District Buildings (Current) | City of Chicago | Data Portal."
[55] "Atlanta_BeltLine (FeatureServer)."
[56] "Hudson River Waterfront Walkway."

To support the hypothesis that the frequency of amenities and facilities is diminished along areas on greenways that are impeded by existing infrastructure, as well as the hypothesis that this frequency is increased with the presence of parks, I looked at multiple datasets and literary sources to understand the frequency at which these additional features make appearances on each greenway. For the results, I have divided this section by each greenway followed by an analysis at the end. All pertinent data and information about comfort stations, access points, transportation stations, amenities, and length is included for each greenway and divided as such. The final totals for each feature per trail were combined into a table for better readability and shown in Table 1. What follows is a summary of the results followed by a table showing specific counts and a map visualizing these results.

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Table 1. A table displaying the total counts for trail length, comfort stations, transportation stations, and access points for each of the three greenways. The data was compiled from multiple sources. 2024.

	The Lakefront Trail	The Atlanta Beltline	The Waterfront Walkway
Trail length (mi)	18.5 miles	22 miles	18.7 miles
Comfort Stations	29	3	11
Comfort Stations per mile	1.56	0.13	0.58
Transportation Stations	25	3	24
Transportation Stations per mile	1.35	0.13	1.28
Access Points	53	58	13
Access Points per mile	2.86	2.63	0.69
Parks	13	11	5
Parks per mile	0.70	0.5	0.26
Existing Infrastructure	0	13	5
Existing Infrastructure per mile	0	0.59	0.26

Features that are lacking development across the three greenways are comfort stations and transportation stations. Though the Lakefront Trail has much higher counts for both, it may be argued that it might not be enough given the volume of visitors each day, and the counts for Hudson River Waterfront Walkway and the Atlanta Beltline are a lot lower despite similar visitor volumes, which is a discrepancy that will be discussed further in the analysis.

The Atlanta Beltline

The Atlanta Beltline currently stretches 18.7 miles, with a planned expansion to 22 miles by the completion of the project in 2030.[57] The greenway is divided into segments based on their geographical position, ranging in length from less than a mile to over three miles long. In total, the trail is divided into nine distinct segments: Westside Trail, Eastside Trail, Northeast Trail, Southside Trail, Southwest Connector Trail, West End Trail, Westside Trail, Westside Beltline Connector, and the Westside Trail Extension.[58] The road varies in construction, with a mix of paved and compacted fine gravel paths, and every segment is between ten and fourteen feet wide.[59] The trail features three comfort stations located across two parks along the trail and three transportation stations, with all three designated as bike rental shops.[60] Bike sharing services such as Lime have ceased to operate in recent years, leaving the trail with little in terms of transportation stations. The trail offers 58 access points across its segments alongside eleven parks. It also has thirteen structures counted as existing infrastructure, the most out of the three greenways. I encountered

[57] Atlanta BeltLine, "Atlanta BeltLine Timeline // Atlanta Beltline."
[58] "Places to Go," Atlanta Beltline, n.d., https://beltline.org/places-to-go/.
[59] Sinclairjr, "Sinclairjr," July 1, 2021, https://www.traillink.com/trail/atlanta-beltline-(overview)/.
[60] "Southside Trail -Seg. 1 Northeast Trail," November 2023, https://beltline.org/wp-content/uploads/2020/06/ABL-Trail-Maps-Rack-Card-FINAL-11-2023_website.pdf.

difficulties accessing the data set for the access points from the Atlanta Beltline website, so the visualization for access points is separate and pulled from the organization's own map.

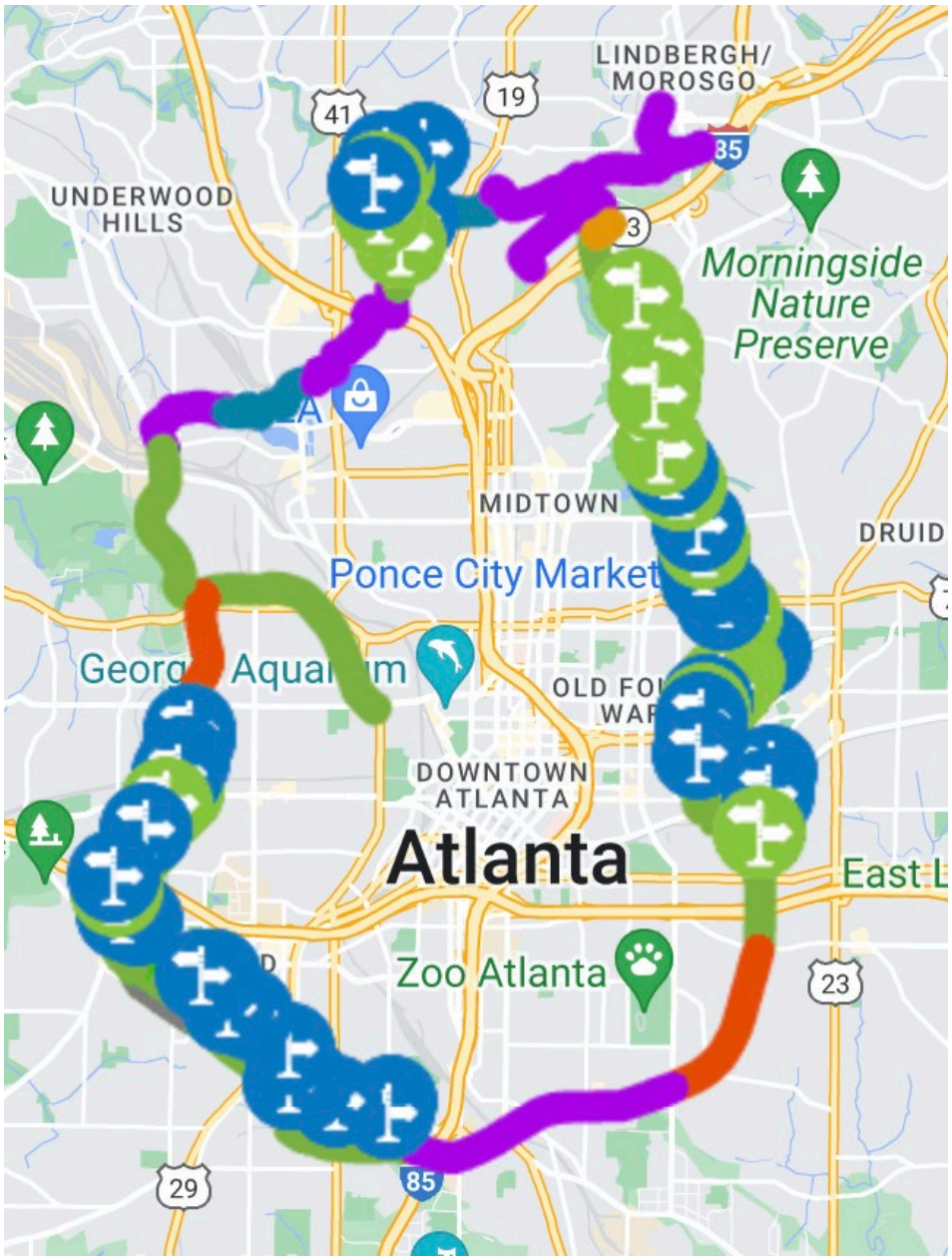

Figure 4. Map of Atlanta Beltline's access points. Taken from beltline.org (2024).[61]

[61] "Atlanta Beltline // Interactive Map." n.d. https://beltline.org/map/.

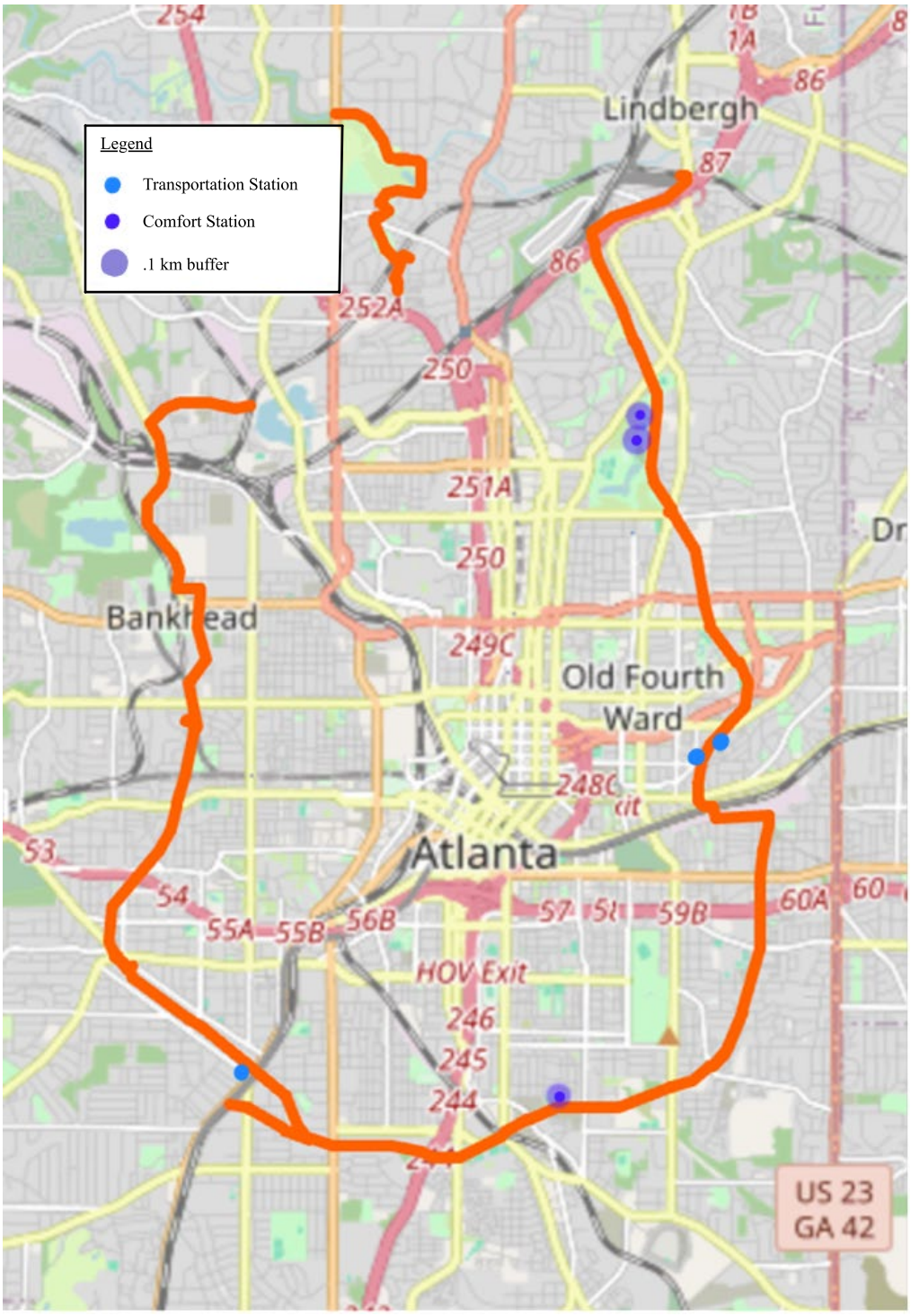

Figure 5. Map of the Atlanta Beltline featuring transportation stations and comfort stations. Created by Kimberly Carrillo Rivera using data from the Atlanta Beltline official website. April 1, 2024.

The Hudson River Waterfront Walkway

The Hudson River Waterfront Walkway stretches 18.5 miles along New Jersey's Gold Coast, originating in Bayonne and ending past Fort Lee, New Jersey.[62] The trail goes through nine municipalities.[63] According to the *Hudson River Waterfront Walkway Plan and Design Guidelines*, any development along the waterfront must follow the instructions set out by the design standards.[64] These guidelines are intended to regulate the construction of the pathway to ensure uniformity and equal accessibility all along the waterfront. The completed sections of the path are a minimum of 30 feet wide and the entire path is paved. According to the greenway site, it can be accessed anywhere along the route, making it difficult to assign a quantity to access points.[65] To ensure data remains consistent, however, access points were deemed as such at park entrances given that these are the clearest points along the greenway to access the trail. With this criterion, there are thirteen access points. There are eleven comfort stations located in parks that are on the trail. Public restroom access beyond those located in parks is non-existent along this trail.[66] In terms of transportation stations, there are eight Port Imperial bike stations.[67] Sixteen Citi bike stations operate along the trail, though these are concentrated around Hoboken and Jersey City.[68]

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[62] "Hudson River Waterfront Walkway," Hudson County, accessed February 14, 2024, https://www.visithudson.org/things-to-do/attractions/hudson-river-waterfront-walkway-2/#:~:text=Hudson%20County%20offers%20unparalleled%20views%20of%20the%20New.
[63] White, Henry, III. 2011. "The Walkway: Its Role and Requirements." Slide show. Hudson River Waterfront. 2011. https://hudsonriverwaterfront.org/index.php?option=com_content&view=article&id=20:reference-documents&catid=5:consvcat&Itemid=19.
[64] "Reference Documents," hudsonriverwaterfront.org, accessed February 14, 2024, https://hudsonriverwaterfront.org/index.php?option=com_content&view=article&id=20:reference-documents&catid=5:consvcat&Itemid=19.
[65] "Walkway_map," hudsonriverwaterfront.org, accessed February 14, 2024, https://hudsonriverwaterfront.org/index.php?option=com_content&view=article&id=6&Itemid=23.
[66] OpenStreetMap, "OpenStreetMap," OpenStreetMap, 2010, https://www.openstreetmap.org/copyright.
[67] "Hudson Bike Share," Hudson County, accessed February 14, 2024, https://www.visithudson.org/abouthc/transportationmap/hudson-bike-share/.
[68] "Bike Share Map: New York City (Citi Bike)," Bike Share Map: New York City (Citi Bike), accessed February 14, 2024, https://bikesharemap.com/newyork/#/13.510820668899765/-74.0347/40.7288/.

Benches are located frequently throughout the greenway, given that they are required by the guidelines. Given the greenway's proximity to New York City, the trail has multiple viewing stations set up along the trail, with much of it functioning as a boardwalk. It goes through five parks and has five existing structures on it or nearby. However, there are sections of the walkway that are classified as "industrial waterfront" with no access as of right now.[69]

[69] "Walkway_map," hudsonriverwaterfront.org, accessed February 14, 2024, https://hudsonriverwaterfront.org/index.php?option=com_content&view=article&id=6&Itemid=23.

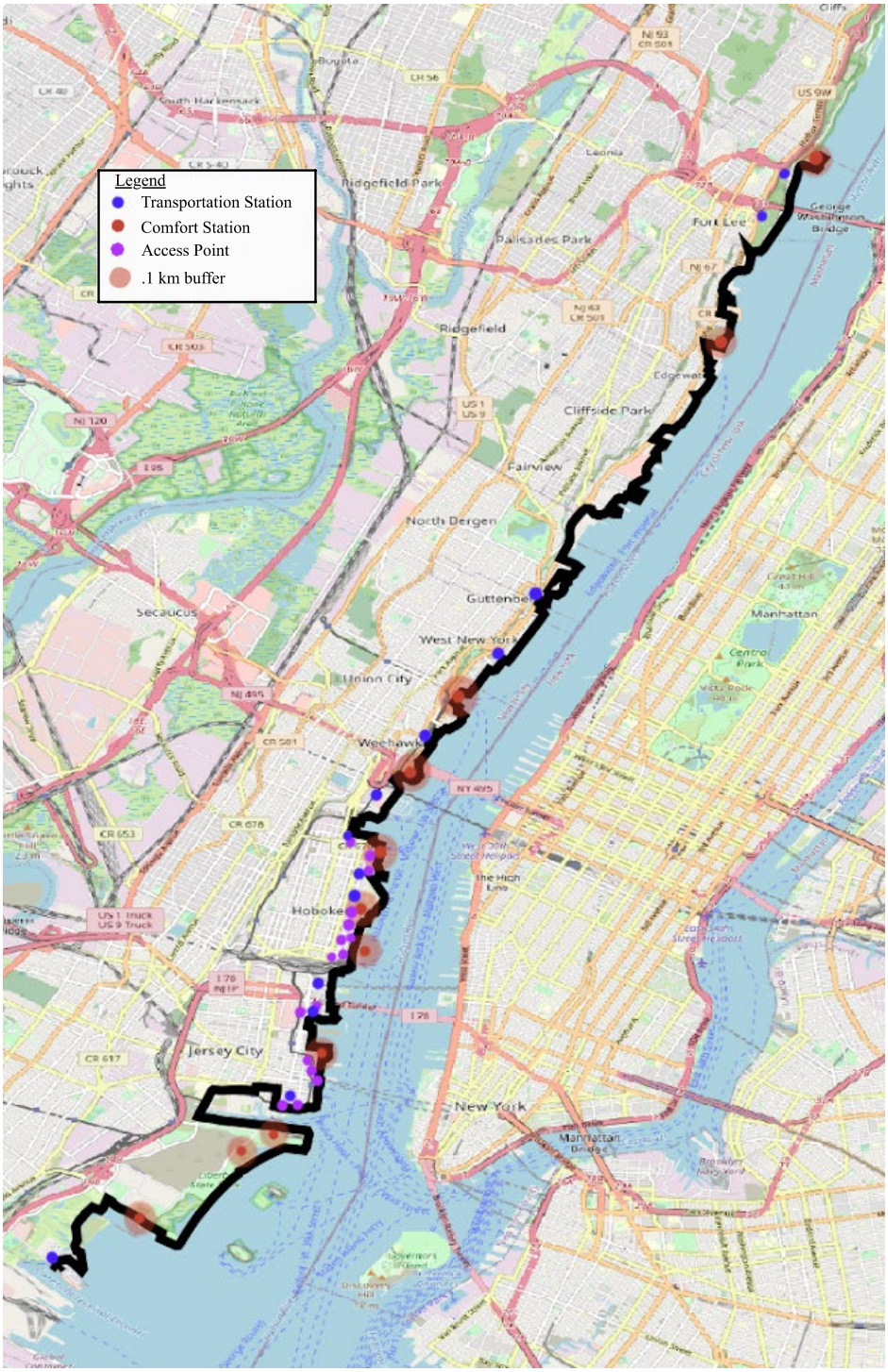

Figure 6. A map of the Hudson River Waterfront Walkway featuring transportation stations, comfort stations, and access points. Created by Kimberly Carrillo Rivera, March 27, 2024.

The Chicago Lakefront

At 18.5 miles, the Chicago Lakefront stretches along the coast of Chicago, separating the city from Lake Michigan.[70] Similar to the Atlanta Beltline, the trail is divided into eleven segments which go through different parks on the trail.[71] The Chicago Lakefront boasts the highest number of comfort stations of the three trails, with 29 operating comfort stations across the greenway.[72] It also has twenty-two Divvy bike stations located at intervals all along the length of the trail and three bike rental shops further north on the trail.[73] The trail has 53 access points, beginning in Jackson Park on the Southside of Chicago and ending in Lincoln Park. The entire trail is paved and has a bike path that runs concurrent with the pedestrian path at times, though they merge in areas where there is less space. The Lakefront is human engineered, built up in the 20th century using the existing coastline as a basis and expanding outward.[74] Beaches are located at intervals along the trail, and the trail goes directly through thirteen unique parks, with no existing infrastructure apparent along the greenway.

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[70] "Chicago Park District Lakefront Trail Counts," accessed February 14, 2024, https://assets.chicagoparkdistrict.com/s3fs-public/documents/page/The_Lakefront_Trail_User_Study.pdf.
[71] "Lakefront Trail | Chicago Park District," www.chicagoparkdistrict.com, n.d., https://www.chicagoparkdistrict.com/parks-facilities/lakefront-trail.
[72] "Lakefront Trail Map," Google My Maps, accessed February 14, 2024, https://www.google.com/maps/d/u/0/viewer?mid=1nf_f2CvxlB8ac42Uu50JET2Ju5efvVDa&ll=41.790213760121 45%2C-87.57684970304983&z=14.
[73] "Divvy Bicycle Stations | City of Chicago | Data Portal," Chicago, accessed February 14, 2024, https://data.cityofchicago.org/Transportation/Divvy-Bicycle-Stations/bbyy-e7gq/data.
[74] "Chicago's Lakefront Park System Comes up Short at Both Ends. Is It Time to Revive the 'Last 4 Miles' Plan?," WTTW News, n.d., https://news.wttw.com/2022/06/20/chicago-s-lakefront-park-system-comes-short-both-ends-it-time-revive-last-4-miles-plan.

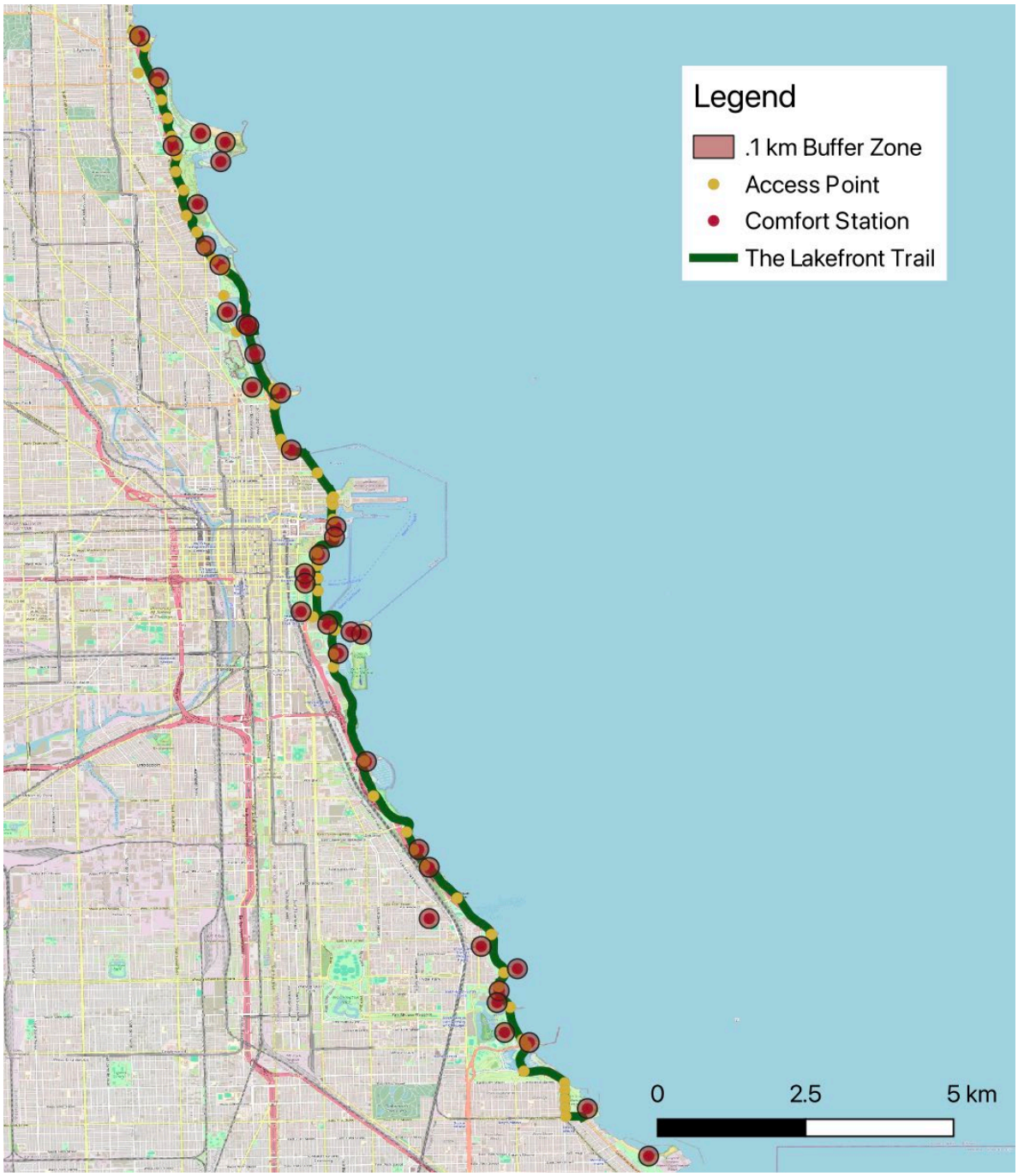

Figure 7. Map of the Chicago Lakefront Trail showing comfort stations and access points. Created by Kimberly Carrillo Rivera using data from multiple sources. 2024.

Analysis

Of the three greenways, Chicago's Lakefront is the most complete, with the other two projects still developing along some of the pathways. This impacted the total counts for each listed facility, but I discussed these given the available data and explored implications for the future of the trail given the current state. Because development, past and present, is relevant to the hypothesis, this is an avenue for discussion that should be explored.

In part due to the Lakefront Trail's planned design, it was easier to implement facilities such as comfort stations given that the trail had been designated as such early on. It was officially designated as an official bike path in 1963, the oldest to do so among the three trails, and this might explain why the greenway appears to cater to bike riders more than the others.[75] With a designated bike path all along the trail and operating bike stations and rental shops spread roughly equally across the greenway, the Lakefront Trail caters more to bike riders who intend to use the path as a commuter route. The seemingly more careful planning that went into the trail given its earlier designation has helped create greater overall numbers of facilities across the trails when compared to the Walkway and the Beltline. Alongside this, its protected nature meant that there could be no major disruptions to its connectivity, reducing the number of interferences in the form of existing infrastructure to zero. When compared to the Beltline, which has thirteen structures and an average of 0.59 structures per mile, the highest of the three, a pattern emerged. The Beltline ranked the lowest in frequency for comfort stations and transportation stations. The presence of existing infrastructure in Atlanta, much of which are industrial complexes and highways, means there is less space available for the implementation of these structures. Considering Searns and Flink in

[75] "Biking and Chicago's Lakefront Trail," www.architecture.org, n.d., https://www.architecture.org/news/chicagos-playscapes/biking-and-chicagos-lakefront-trail/.

this discussion, the concept of inventory analysis becomes important. Inventory analysis involves surveying existing structures and barriers to the implementation of greenways, as well as surveying all other aspects of the land and community.[76] When there are more structures that hinder access to parts of the trail and take up space, there is less space available to construct facilities. In urban greenways, narrow corridors often make it difficult to construct anything beyond the trail itself, so opportunities to increase enjoyment and recreation typically come through existing recreation resources.

I hypothesized that an increase in parks would increase the presence of facilities such as comfort stations and transportation stations. Looking at the available data, there are higher frequencies of these stations on Chicago's Lakefront. There are on average 0.7 parks per mile, the highest of the three greenways, and the trail boasts the highest frequency of comfort stations and transportation stations. However, the Beltline has a higher frequency of parks compared to the Walkway, but much lower numbers of comfort stations and transportation stations. This may be attributed to the frequency of existing infrastructure on the Beltline. Given that it has the highest frequency at 0.59 structures per mile, it is possible that the benefits of space that parks may provide are offset by the number of structures along the trail.

A surprising result was the low number of comfort stations that the Walkway offers. Despite its location in a metropolitan area, the number of publicly available comfort stations remains low, with all the facilities present in major parks, of which there are only five. The Walkway was planned and designed to only need thirty feet of space, suggesting a lack of space for the implementation of anything beyond established parks. Difficulties that the Hudson River

[76] Flink and Searns, *Greenways: A Guide to Planning Design and Development*.

Waterfront Walkway has encountered has much to do with the status and location of the trail. It is publicly accessible but privately-managed, which causes issues when it comes to the facilities and amenities the trail offers.[77] Because part of the waterfront is industrial, sections of the trail have little to no access to the waterfront and development along these areas has been slowed. There is no official count of access points, however, as it is stated that the trail can be accessed at any point in the route. This is unique to the Walkway, as the other two greenways can be difficult to access without an access point. However, given the need to maintain consistency throughout data collection, I specified access points in this paper through parks, bringing its total access points to thirteen. Given the Lakefront Trail's separation from the city by Lake Shore Drive, access points are important for public access. The Beltline makes good use of available space by utilizing existing railway corridors, which can make trail accessibility difficult in the Northwest and South parts of the trail. In certain mile stretches, however, there are as many as 22 access points. Many of the stretches of trail go through previously industrialized areas and highways, which can make continuity a challenge, but sections of the trial that go through residential areas offer higher frequencies of access points compared to other greenways. Access and transportation as Searns and Flink described it is therefore an important consideration for greenways. [78]

An important aspect of greenways to further consider is location and how their surroundings may impact these numbers. The Lakefront Trail is located along the waterfront and is bordered by Lake Michigan. This means infrastructure such as highways does not cut through the trail, so there is less space consideration for this mode of transportation. While the Waterfront

[77] Geraldine Wang and Andrew L Strauss, "New Jersey's Gold Coast: Revisiting Public Access and the Hudson River Waterfront Walkway," *Carolina Digital Repository (University of North Carolina at Chapel Hill)*, January 1, 1992, https://doi.org/10.17615/1q71-dq44.
[78] Flink and Searns, *Greenways: A Guide to Planning Design and Development*.

Walkway is also located along the waterfront of the Hudson River, Manhattan is located across the river and there are highways that connect the two land masses. As such, the Walkway had to consider these when developing the initial plans for the greenway. The Atlanta Beltline is unique in comparison due to its location around the city of Atlanta. It does not border a waterfront, but rather runs through different neighborhoods and zones, several of which include industrial zones that are located on the outskirts of the city. Because it began as a rails-to-trails project, these railroads were historically tied to industrial zones in order to ship things in and out of the city.[79] As such, it has a higher number of existing infrastructures due to their historical presence around the city.

This does not explain the lack of facilities such as transportation options or comfort stations. This may be due to public-private land ownership, as address by Searns and Flink.[80] As mentioned previously, this is also an issue with the Waterfront Walkway. In *Greenways*, the authors name requirements necessary for successful greenways. Constant maintenance that is typically provided by parks is named as one such necessity, and this helped develop the hypothesis that the presence of parks increases the frequency of facilities on a greenway. Debates over public land ownership vs. private ownership in the context of community projects such as these greenways have meant that finding a governing body to manage the construction and maintenance of facilities is difficult. Typically, parks managed by parks and recreation departments see more facility implementation due to a standard management procedure. However, without the presence of parks, the parties responsible for these facilities become less clear and progress to build these facilities stalls.

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[79] "Transportation Has Long Fueled Atlanta," Federal Reserve Bank of Atlanta, July 13, 2017, https://www.atlantafed.org/economy-matters/regional-economics/2017/07/13/transportation-has-long-fueled-atlanta.
[80] Flink and Searns, *Greenways: A Guide to Planning Design and Development*.

Overall, the Chicago Lakefront Trail and the Atlanta Beltline had similar numbers of connecting parks, which helped increase the number of access points. In places with more parks, there were generally more access points available, and looking further into specific mile stretches for each trail, the highest numbers of access points and comfort stations were typically found in conjunction with the presence of at least one park. Higher numbers of existing structures along the trails, as seen with the Beltline, did appear to have some effect on the frequency of comfort stations or transportation stations. The Beltline has the lowest amount of comfort stations and transportation stations, though the number of access points was the highest with this trail. There appears to be a conflict between the effects that the presence of parks and existing infrastructure may have. The evidence supports the hypothesis that parks do boost the number of facilities in regards to comfort stations and transportation stations, but it is difficult to assert that parks also increase the number of access points. On the hypothesis regarding the relationship between existing infrastructure and the frequency of facilities, a higher frequency of existing infrastructures does appear in conjunction with low numbers of comfort stations and transportation stations, but access points do not necessarily follow this trend.

Conclusion

Discussion

By using a comparative analysis to study the effects that the physical environment has on greenway development, the research found data that supported both of the initial hypotheses in this paper. I argued that existing infrastructure is important for determining the frequency and distribution of facilities along the Lakefront Trail, the Beltline, and the Hudson River Waterfront Walkway. I also argued that the presence of parks would help increase the frequency at which these

types of facilities and access points appeared in these cases. The data presented in this paper supports both hypotheses, though the claim is not strong, with the data reflecting a greater amount of facilities in sections of each trail where at least one park is present. While this project has limitations within this scope, it can serve as a starting point into further research on physical characteristics of greenways. The three presented cases play an important role in greenway access in their respective cities and as such, continuing to investigate and conduct research on these cases can be beneficial for the communities they reach and the overall understanding of greenway planning and design.

Limitations and Future Research

It is important to keep in mind the limitations that the data used in this paper has. A lot of the data is open-source data, particularly the data related to facilities and amenities, which technically means anyone can edit this data. While the data has often been verified, either by the department in charge of the greenway or by other members of the public, it is possible that some of the data may be outdated or incorrect. Research has shown that crowdsourced data may sometimes be even more accurate than data collected through conventional methods, however, so it is important to consider the validity and accuracy of all sources.[81] Another limitation this paper faces is that while it provides a steppingstone into further research into greenway development, it is limited in its generalizability. Because I focus on three greenways in the United States, further research is needed to be able to support broader claims about greenway development, both on a domestic and international level. This paper provides a starting point and an example framework that can be used in further research however, filling in the gap in literature on physical

[81] Shuili Du et al., "The Ethical, Societal, and Global Implications of Crowdsourcing Research," *Journal of Business Ethics*, January 24, 2024, https://doi.org/10.1007/s10551-023-05604-9.

characteristics on greenways. It also provides further reading and more information for the specific greenways. Given that they are major greenways in their areas, the compilation of information and data provided here can help researchers who are interested in studying these individual trails. Further research is necessary to fully understand the scope of the impact that the physical environment has on greenways, however, and there are several other factors that research can focus on, including social and environmental factors. It is important to note that while physical characteristics are an important factor in the development of greenways and the distribution of facilities and amenities along these trails, factors such as population density and economic factors likely contribute to the development of the greenways. Understanding and effectively utilizing greenway development in urban environments is important in providing green space accessibility for people who may not have access to these spaces, so it is important to continue to bridge these gaps in research.

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