Designing nature-based solutions and community-led resilience in Charlotte's urban landscape

Equitable Environments

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Abstract

This thesis explores strategies to address environmental injustice and enhance human wellbeing in minority-concentrated neighborhoods in Charlotte, North Carolina, impacted by rapid urbanization and limited access to greenspaces. Through a multi-scalar approach combining ecological restoration, sustainable urban design, and community-led placemaking, the project proposes integrated interventions such as expanding green corridors, restoring waterways, and promoting accessible transit to improve environmental quality and social equity. Central to the research is the Green Village of Charlotte, a nature-based educational and community hub designed to empower residents through environmental education and participatory initiatives focused on food sovereignty, biodiversity, and climate resilience. By combining scenario planning, design frameworks, softGIS surveys and community engagement, the project demonstrates how holistic, adaptive, and inclusive planning can foster healthier, more equitable urban environments while minimizing displacement risks. The findings contribute to advancing urban sustainability and environmental justice in growing metropolitan areas.

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01 Introduction

NORTH CAROLINA

recognized as the **birthplace** of the **environmental justice movement**

"Rolling back Environmental Justice programs leaves those with the fewest resources to suffer in silence."

On a HURRICANE-RAVAGED Appalachian Trail, vast damage and uncertainty

Repairs to the worst-hit sections of the famed trail are expected to be extraordinarily expensive and require substantial expertise. Months of work lie ahead.

ALMOST THREE YEARS AFTER

millions of gallons of gasoline leaked from an oil pipeline in Huntersville, officials are still trying to figure out how to clean it up safely.

Catch up quick: Two teenagers riding ATVs in the Oehler Nature Preserve discovered the leak. Colonial Pipeline has said it began 18 days before that.

Originally, officials said the spill discovered in August 2020 was 63,000 gallons. But last July, the company disclosed that figure was approximately **2 million gallons** — more than **30 times the original estimate.** As of the end of 2022, Colonial has recovered 85% of the gasoline, according to company spokesperson David Conti.

Why it matters: An environmental catastrophe took place in our back- and it has **mostly flown under the radar**. With the revised tes, it's the largest gasoline leak from a pipeline spill in the U.S. E&E News.

ENVIRONMENTAL HEALTH

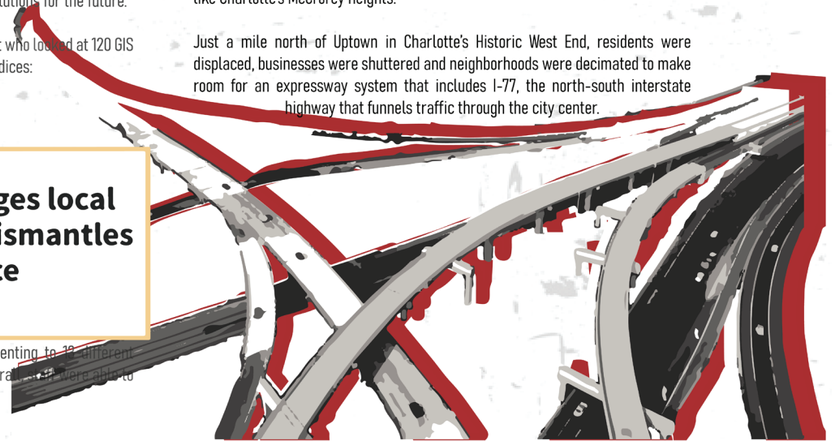
CHARLOTTE strives to tackle extreme heat, energy costs and increase sustainability in underserved communities

Uptown Charlotte and neighborhoods, including the Historic West End are hot zones, a heat mapping study reveals.

As president of the McCrorey Heights Neighborhood Association and a mer the Historic West End Association, Sean Langley is keenly aware of his ne hood's past, and of how the legacy of one of its darkest chapters has magn effects of climate change to raise temperatures and utility costs during t sifying summers.

The Federal Aid Highway Act of 1956 achieved its ambitious goal of buildi miles of roads to connect 90 percent of the nation's most populous cities by 1970s. The roadway expansion came at great cost to urban communities of color like Charlotte's McCrorey Heights.

Just a mile north of Uptown in Charlotte's Historic West End, residents were displaced, businesses were shuttered and neighborhoods were decimated to make room for an expressway system that includes I-77, the north-south interstate highway that funnels traffic through the city center.



"Helene caused nearly 500,000 gallons of raw sewage to spill into Rock Hill area waterways"

Local News

16,000 GALLONS OF SEWAGE SPILL INTO LITTLE SUGAR CREEK: CHARLOTTE WATER

About 16,000 gallons of sewage spilled into Little Sugar Creek on Friday because of a blockage in the Sugar Creek Wastewater Treatment Plant, Charlotte Water spokesman Cam Coley said.

LOCAL

Sustain Charlotte urges local investment as EPA dismantles environmental justice initiatives

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tive, community-led solutions for the future."

, city staff hired a consultant who looked at 120 GIS
tock groups to create three indices:

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second round of outreach with a different strategy: presenting to 12 different neighborhood associations, churches, and local groups. Overa were able to engage 500 residents in the EJ discussion.

Introduction

Charlotte's rapid urban expansion has intensified longstanding environmental injustices, disproportionately affecting minority communities through diminished access to greenspaces and increased exposure to climate risks (Martin, 2022). These negative effects trickle down through the network, affecting the city of Charlotte as a whole. This thesis looks into environmental injustice, urban ecology, and community-driven placemaking within Charlotte's evolving landscape. By exploring multi-scalar interventions like restoring green corridors and designing innovative educational hubs like the Green Village of Charlotte. This research highlights the potential of nature-based solutions to foster equitable liveability. Emphasizing community engagement and ecological resilience, my thesis reframes urban growth as an opportunity to empower marginalized neighborhoods and promote regenerative relationships between people and place. Through an integrated conceptual framework, this work charts a pathway toward a more inclusive and sustainable Charlotte, where environmental justice and ecological vitality coexist as foundational elements of urban design.

Figure 1.1. Collage of news articles

Motivation

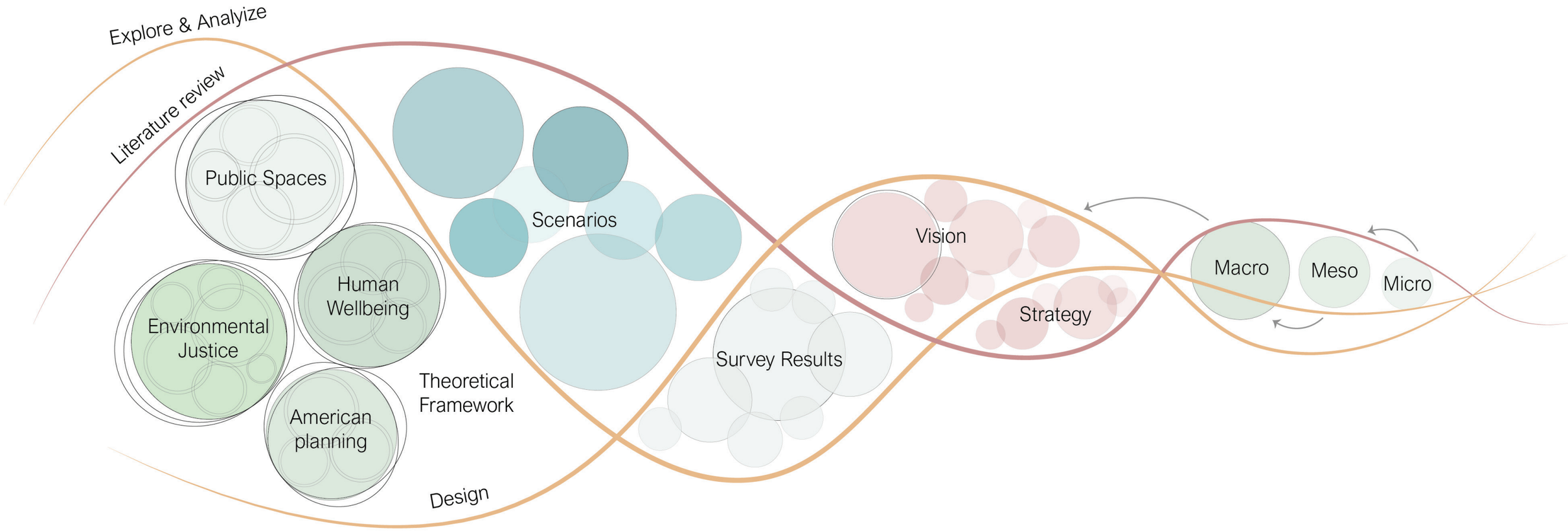
Over the past decade, I've gained a large network of American friends, of which most live along the East Coast. Through conversations I had throughout the years, this has made me familiar with the environment and its challenges. In 2023, I traveled through Colorado with some of these friends, gaining firsthand experience with the country's diverse landscapes and culture. This is why, when the Gambrell Foundation reached out to my tutor Nico in search of students interested in working on a project in the Charlotte area, I felt compelled to take on the challenge. Early on during the research process I encountered an article by A Martin, who was then a graduate student at UNC Charlotte, from 2022. The article explored Charlotte's complex history with environmental injustice. Her work immediately resonated with me and ultimately shaped the direction of my own thesis.

02

Methodology

Theoretical Framework

2.1. Methodology & Methods



This research was conducted using analysis and design. To get a grasp on the research location and its many perspectives, an extensive literature research was conducted exploring different themes that fed into the formation of a theoretical framework, which guided the project.

Once the theoretical and contextual foundation were established, the problem statement and research question were formulated to guide the project further. I traveled to Charlotte, North Carolina. There I conducted many site visits and spoke with local organizations, residents, developers and government officials. These meetings, along with further research, helped to contextualize the project upon returning back to Delft. They collectively contributed to the development of a comprehensive and grounded project vision. To develop this vision further, I experimented with designing different scenarios, each focused on one design element. Simultaneously, a survey was sent out throughout the city to collect local data. When the survey period was over, zoom-in locations were selected, and the scenarios and survey results led to my design strategy. This strategy was then tested across multiple scales and ultimately lead to a coherent multi-scalar design for Charlotte, North Carolina. Finally, I zoomed out to the state of North Carolina to evaluate the project's contribution. During this thesis, the main research methods used were mapping, theoretical analysis, historical evaluation, field trips, local conversations, survey data analysis and design.

Figure 2.1. Methodological Framework

2.2. Theoretical framework

Placemaking for human wellbeing

The theoretical framework is the foundation of this research. It takes the idea of placemaking from the Project for Public Spaces (PPS) model. A successful place has four different qualities: Uses & activity, comfort & image, access & linkage and sociability. The PPS framework also lists words that are commonly used to describe the quality of a place, and it lists intangible qualities that can be measured quantitatively for each of the quadrants (Project for Public Spaces, n.d.).

These qualities of a place each have an effect on the human wellbeing of those who experience the place. Human wellbeing is an ambiguous concept which has many different definitions, and can thus be seen as a multi-dimensional concept (LeBrasseur, 2022). The World Health Organization (WHO) has described human wellbeing as the following. *"To reach a state of complete physical, mental and social wellbeing, an individual or group must be able to realize aspirations, to satisfy needs, and to change or cope with the environment. Health is, therefore, seen as a resource for everyday life, not the objective of living. Health is a positive concept emphasizing social and personal resources as well as physical capacities".* For this research, the WHO definition of human wellbeing will be used. In short, human wellbeing exists out of social wellbeing, mental wellbeing and physical wellbeing. (World Health Organization, 2016).

As an example, one of the things access & linkage talks about is the walkability of a place (Project for Public Spaces, N.D.). Walkability has an effect on someone's physical wellbeing. The exact needs for human wellbeing are not uniform for every community, and depend on outside factors such as climate, culture, environment and demographic. A correct way to research how those factors work for local communities while gathering good data are community-based participatory research (CBPR) and integrated knowledge translation (IKT) (LaBrasseur, 2022). This research also considers that a place exists on the Dutch layer approach, which defines three different layers. Substratum, network and occupation. (Van Schaick et. al, 2010).

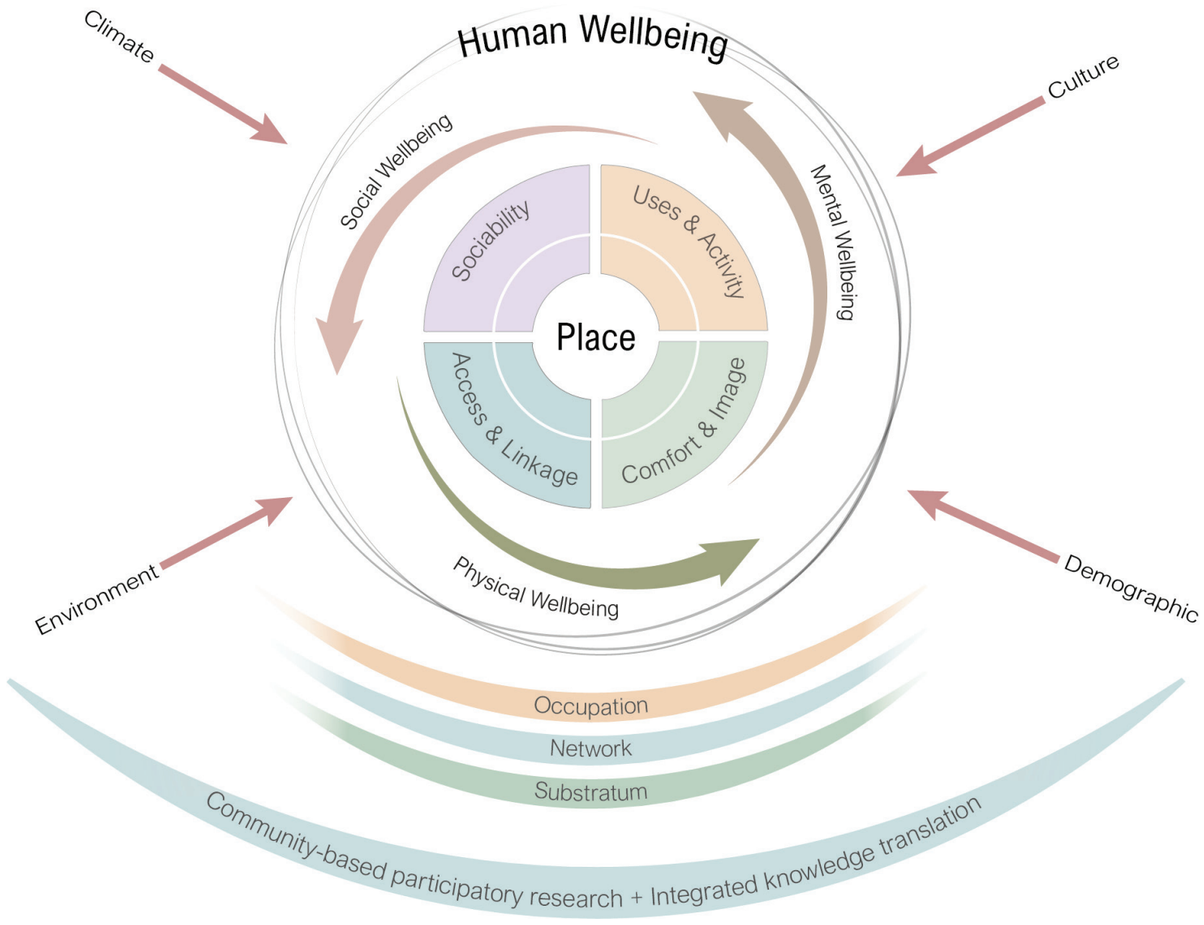


Figure 2.2. Theoretical framework
Adapted from (Van Schaick et. al, 2010; LeBrasseur, 2022; Project for Public Spaces, n.d.; World Health Organization, 2016)

2.3. Analytical frameworks

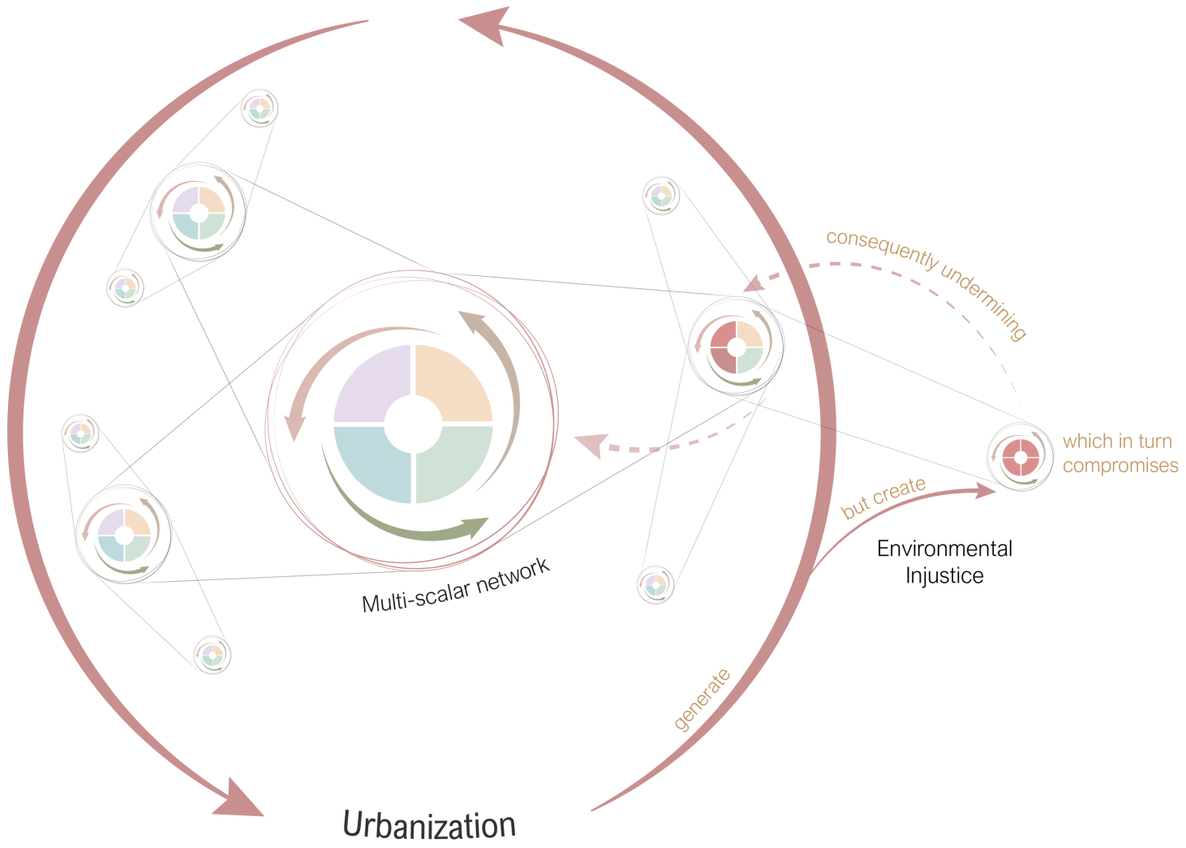


Figure 2.3. Analytical framework
Adapted from (Alfonso Piña, et. al., 2016; Project for Public Spaces, N.D.; World Health Organization, 2016)

Environmental injustice

The ideas present in the theoretical framework do not just exist on one scale, and should rather be seen as a multi-scalar network of places that all affect each other. (Project for Public Spaces, N.D. World Health Organization, 2010). When this network grows, it does so via the urbanization cycle. This cycle generates urban economic growth in the form of increased industrial activity, personal income, consumption and the expansion of urban area. This cycle, however, creates negative impacts, which in turn compromises the local community (Alfonso Piña, et. al., 2016). One of those impacts is minority-concentrated communities having less access to greenspaces, which creates major health- and safety issues. These issues include an increase in heat, the risk of floods, a decrease in air quality and an increase of pollution.

While these environmental hazards disproportionately affect minority-concentrated communities, it is important to note that environmental injustice consequently undermines the urban characteristics of the whole city, causing the urbanization cycle to generate with less effect (Alfonso Piña, et. al., 2016). When a place in the multi-scalar network is not meeting the qualities that benefit human wellbeing, this negative effect will seep through the whole network and affect the neighboring places, and thus the city as a whole. Environmental injustice is therefore a matter that concerns everyone in the system, not only those who are most affected.

The environmental justice movement seeks to minimize and equalize the effects of environmental hazards among the entire community regardless of income, ethnicity or race (City of Charlotte, 2020). When this is done successfully, the positive effects will trickle down through the network and lessen the effects for everyone involved in the system.

Greenspaces and human wellbeing

A plethora of literature describes the important link between greenspaces and human wellbeing (LeBrasseur, 2022). One interesting link I found is between the 3 - 30 - 300 rule (Konijnendijk, 2023) and the WHO definition (2010). The 3 - 30 - 300 rule is a simple rule of thumb that is based on an extensive research that states that, to live healthy, you should:
- have at least **3 trees** visible from your house.
- have at least **30% tree canopy** in your local area.
- live within **300 meters** of a public park.

When those numbers are met, research has shown that this will raise factors like the fatality rate and the livability of a place (Konijnendijk, 2023). Interestingly, each of these rules seem to link to a different type of wellbeing. This means that the 3 - 30 - 300 rule can be applied to test how a design affects the human wellbeing of a place. If for example the 30% canopy rule is not met, this will negatively impact the physical wellbeing of the users of a place.

Figure 2.4. Human wellbeing link
Adapted from (Konijnendijk, 2023; World Health Organization, 2016)

03

Charlotte

A city of tensions and transitions

3.1. Contextualizing Charlotte

This chapter introduces Charlotte, North Carolina. Situated in the southeastern United States, Charlotte makes an interesting location for researching environmental justice, urban development and socio-spatial inequality. The chapter outlines the city's historical development, its evolving urban form and the complex ecological and social dynamics that shape it today. Special attention is given to the structural challenges faced by marginalized communities and the environmental risks exacerbated by rapid urbanization. Simultaneously, the chapter identifies latent opportunities for sustainable, community-driven transformation, setting the stage for a critical investigation into how spatial design and planning can respond to these interconnected issues.

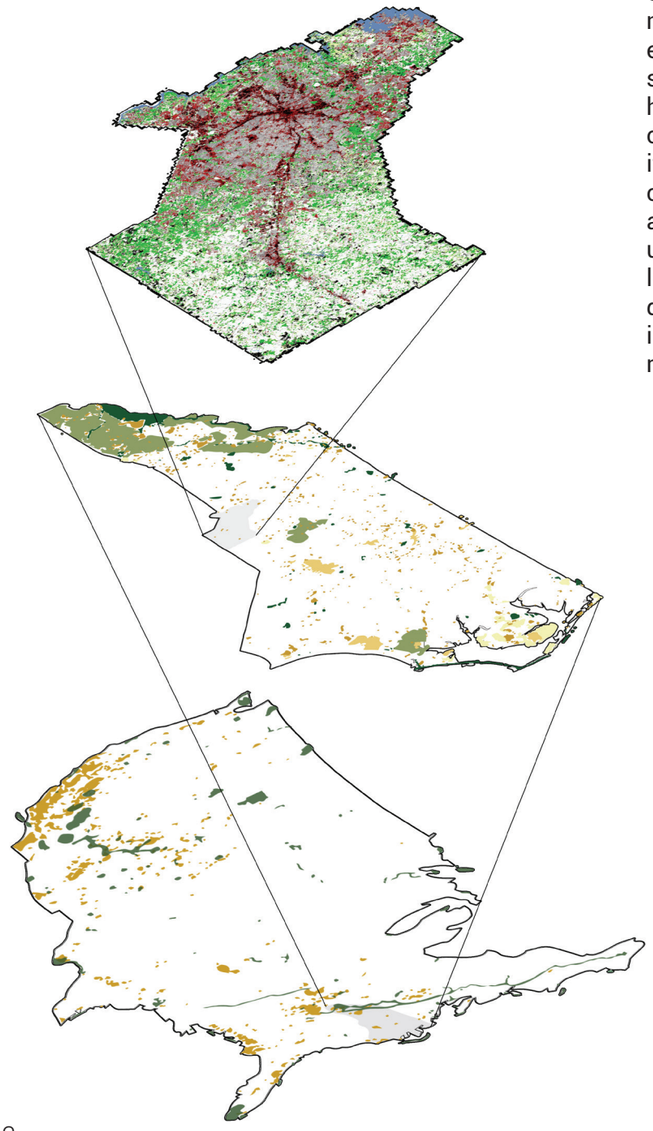
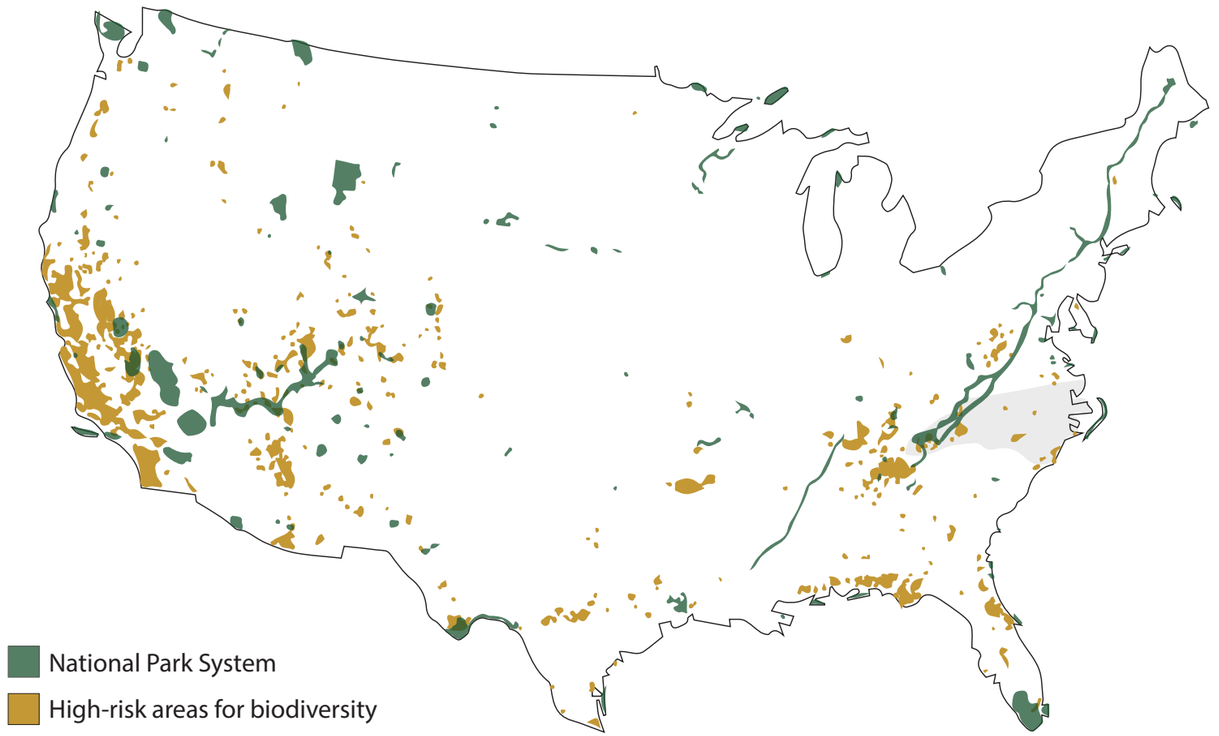


Figure 3.1. Charlotte, multi-scalar



North Carolina is situated on the East coast of the United States. It lies at the end point of the Appalachian mountain range, a large national park that spans across many states. The Appalachian trail, founded in 1937, is 2180 miles long, and the first national scenic trail by the national trails systems act of 1968 (National Park Foundation, n.d.). The Appalachian mountain range is an important ecological connection for North Carolina and a popular hiking location. (North Carolina Wildlife Federation, 2024).

Figure 3.2. Nation-wide ecological systems map

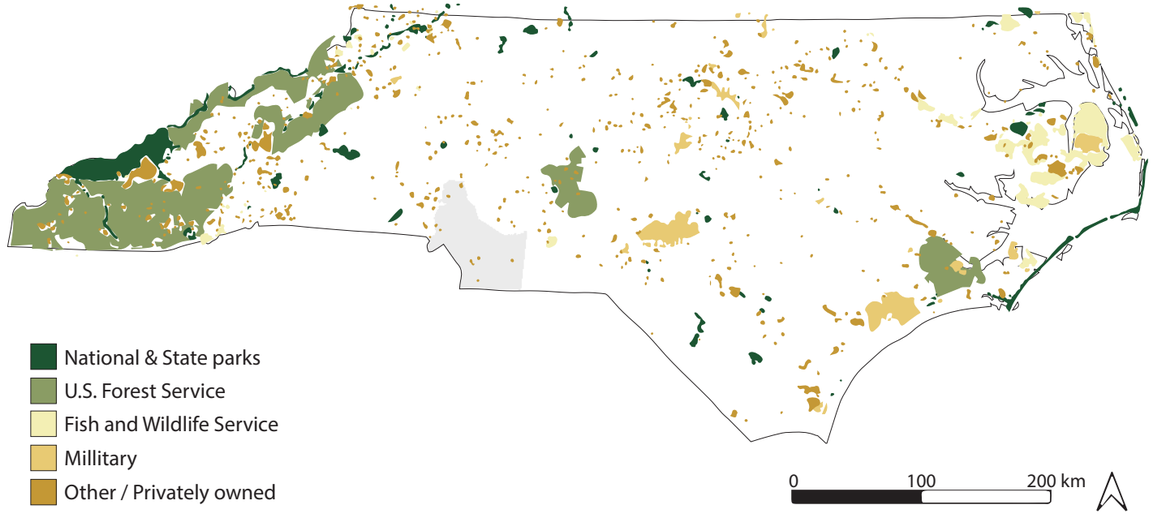


Figure 3.3. North Carolina, forest land ownership

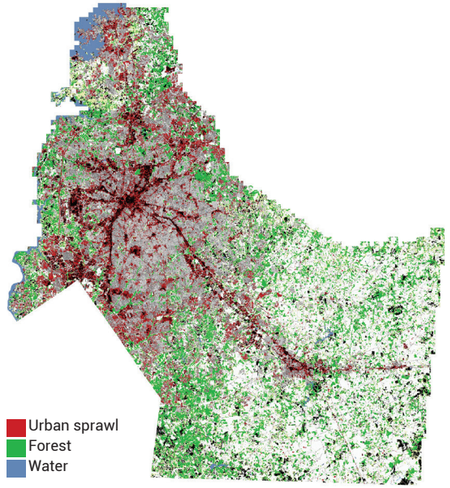


Figure 3.4. Mecklenburg & Union county, forests & urban sprawl map

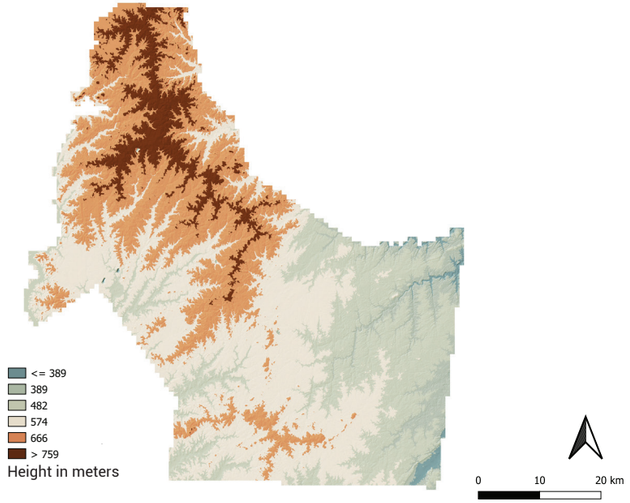


Figure 3.5. Mecklenburg & Union county, heightmap

North Carolina

The whole state of North Carolina can be seen as a transition from the Appalachian mountain range to the ocean. It therefore has a large variety in its ecology. In the western part of the state, the Appalachian mountain range encompasses 23 counties. Its varied topography fosters a home for thousands of species (North Carolina Wildlife Federation, 2024).

Charlotte

Situated in Mecklenburg county, Charlotte lies in the middle of this transition from mountains to ocean, at the border of South Carolina. While it is surrounded by large ecological systems, the city itself does not appear to have big connections to ecology. South of Mecklenburg county lies Union county, in which an arm of urbanization extends from the city. Mecklenburg county, faced by the growing city of Charlotte, does not have many natural areas left. As for the topography, the terrain goes down the further south you go. This means that the water streams in this area will always run from north to south.

3.2. Charlotte's formation

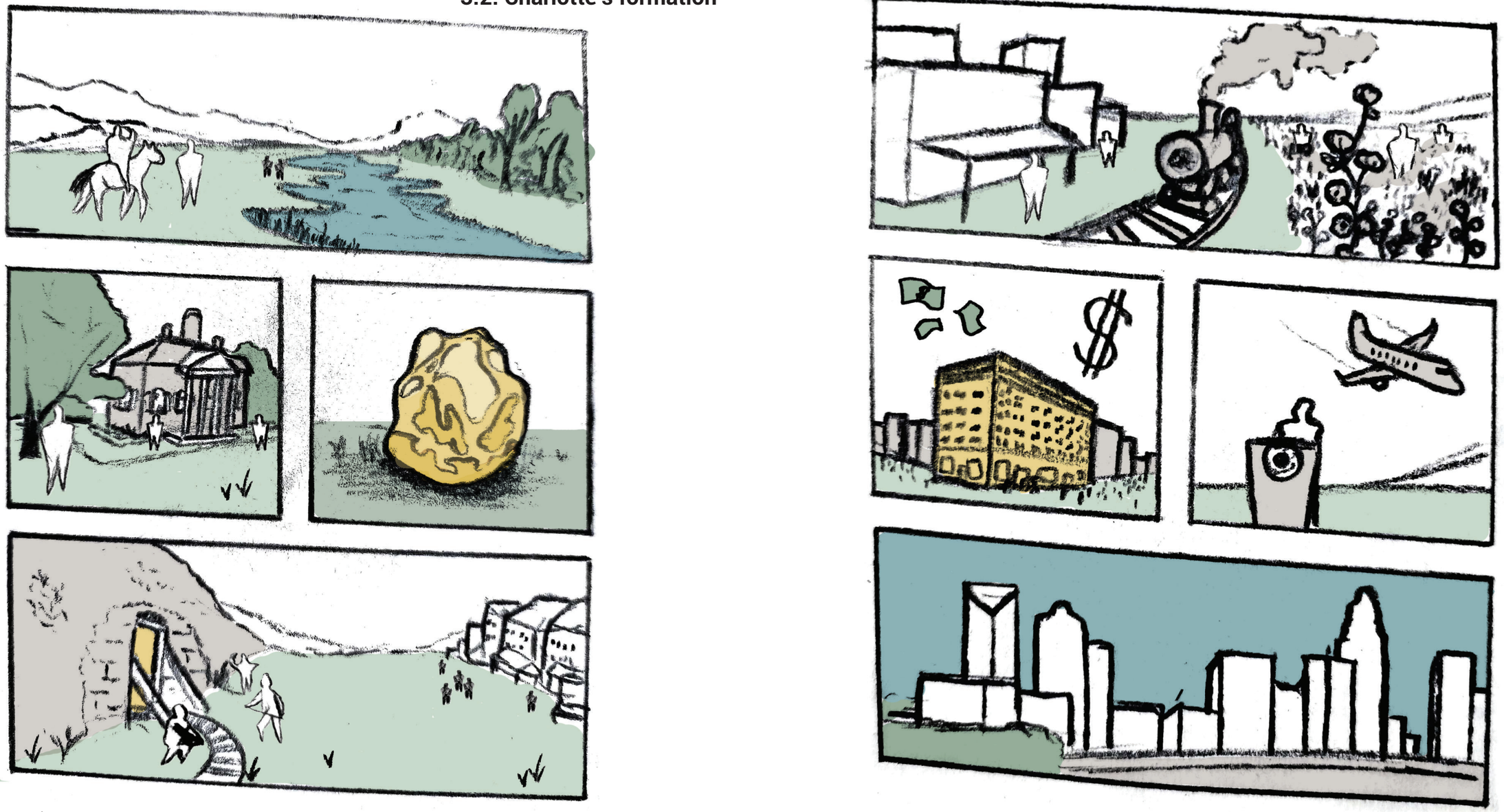


Figure 3.6. Simplistic history panels

The first inhabitants
The area where Charlotte now lies used to be a native crossroad. Catawba and Siouan-speaking people used to occupy the river until the Europeans flooded into the Catawba homelands around the 1750s. The Europeans brought enslaved people with them and the African American population grew following the American Revolution.

Many descendants of these first American Indian, European and African American inhabitants still live in the greater Charlotte area today (Levine Museum of the New South, 2025).

Figure 3.7. Mecklenburg county historic map - before

1768
The city of Charlotte got formed on the 3rd of December, 1768. It was a small town created with the purpose to hold a courthouse and prison. (North Carolina General Assembly, 1768). The city is named after Charlotte of Mecklenburg-Strelitz, the queen of British King George III. Mecklenburg-county is named after her hometown. (City of Charlotte, 2023).

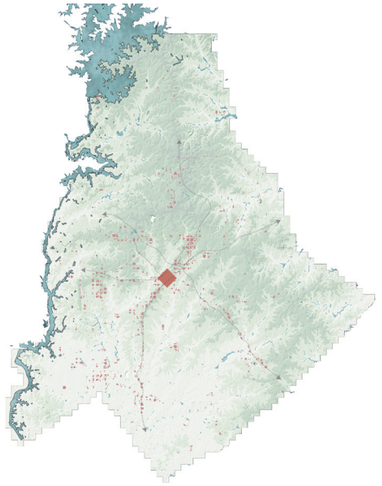
Figure 3.8. Mecklenburg county historic maps - 1768

1840
Gold was discovered in the area in 1799, which started the first gold rush of the United States. This turned Charlotte into a center of trade. By 1840 there were over fifty gold mines in the area, largely run by slaves. The two largest mines were underground near West Morehead and South Trion. The city's first banks opened to handle the gold trade (Levine Museum of the New South, 2025).

Figure 3.9. Mecklenburg county historic maps - 1840

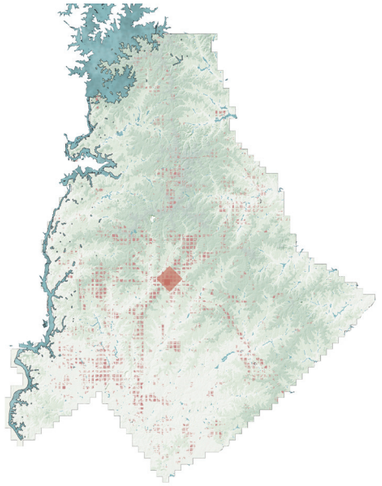
1880
The gold rush moved away to California in 1849. Instead, the city started growing by cotton and railroads (History South, n.d.). In 1880, decades after the Civil War, a new generation of business leaders embraced the New South ethos, promoted by figures like Henry Grady. While it sought to bring investment and industry towards the South, it coincided with the collapse of the political will for reconstruction. This led to the marginalization of many people, erasing the gains of African Americans (Ayers, 2007., Levine Museum of the New South, 2025). As Charlotte was growing into a rails and textile hub, it was in need of local banks (Kurzeja, 2023).

Figure 3.10. Mecklenburg county historic maps - 1880



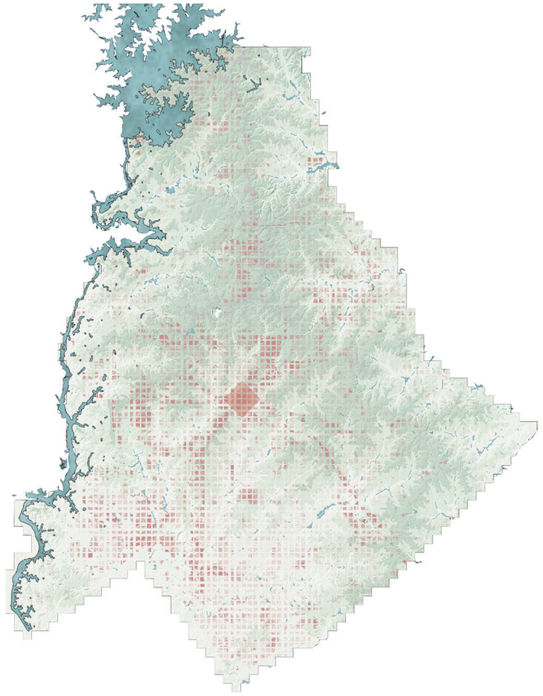
1920
By 1920, Charlotte became the largest cotton manufacturer in the nation. (History South, n.d.) Many banks were founded as the city's industry kept growing (Kurzeja, 2023). This is why the city is still often referred to as the banking city of America.

Figure 3.11. Mecklenburg county historic maps - 1920



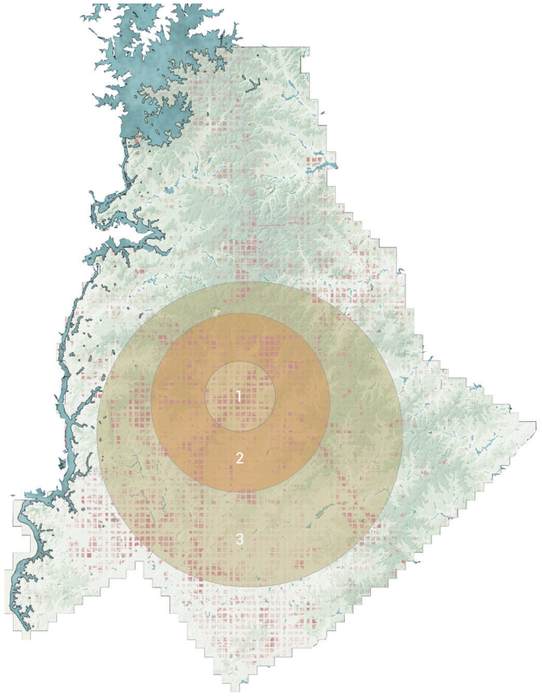
1965
During the 60s, Brooklyn became one of the first examples of “urban renewal". This neighborhood used to house mostly African Americans, and was home to many businesses, residencies and churches. As part of this urban renewal plan, the neighborhood got demolished and is now part of the Second Ward. (Brooklyn Village, 2016).
The nationality act of 1965 meant the start of an increase in immigration, which meant that the city had to expand fast (Levine Museum of the New South, 2025).

Figure 3.12. Mecklenburg county historic maps - 1965



2025
The city kept expanding into the landscape that we see today. When looking at the city from above, a few patterns have formed in the rapid expansion that followed the nationality act of 1965.

Figure 3.13. Mecklenburg county historic maps - 2025

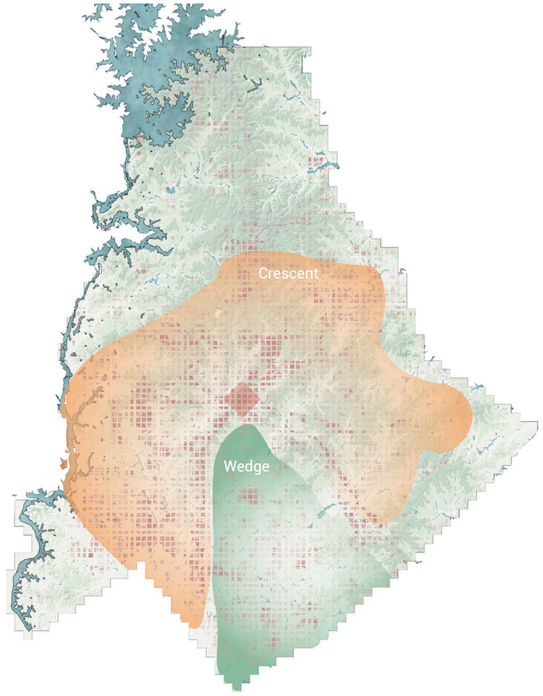


Three rings
When looking at the city parks, there are three rings that can be made out. When the city first formed, there was a lot of thought put into the public parks mixed within the urban sprawl. This is why today the city center has a lot of small parks spread all around. This is the first ring.

When the city suddenly had to expand, there was no time to think about parks, and as a result, a large area of the city consists of only urban sprawl with no parks. This is the second ring.

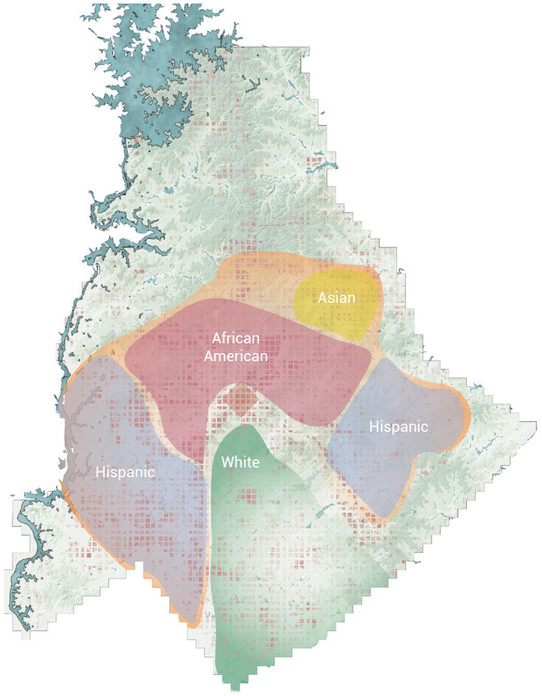
Only in recent years did people realize the need for parks. Large parks can now be seen at the edges of the city. This is the third ring (Landess, personal communication , 2025).

Figure 3.14. Mecklenburg county historic maps - three rings



Crescent & Wedge
Many different maps show a pattern that resembles a crescent and a wedge. This pattern can be observed in maps showing for example income, schooling, food deserts, voting patterns, race and even COVID infection rates (CLT Public Relations, 2020). This divide grew as highways and zoning patterns segregated neighborhoods from one another (Landess, personal communication, 2025, Fant, personal communication, 2025).

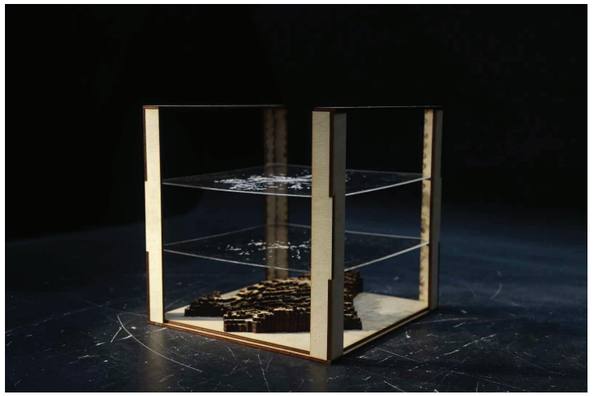
Figure 3.15. Mecklenburg county historic maps - crescent & wedge



Ethnic distribution
The crescent and wedge can be divided further when looking into the ethnic distribution of the city. In general, the Hispanic communities reside at the west and east side of the city. The black communities live north of the city center, the Asian communities are located North/East and most white people live South of the city center (Levine Museum of the New South, 2025).

Figure 3.16. Mecklenburg county historic maps - ethnic distribution

Figure 3.17. Model representing Charlotte's topography and the urban development of the last 100 years



3.3. Charlotte's urbanization

Ecology

Charlotte has continued to expand rapidly to this day. This urbanization comes with many challenges. For one, Charlotte has long been proud of its large tree canopy spanning over the city, but this canopy has been declining in size for many years now. A lot of efforts have been made to stop this decline, but this has yielded no result so far as the canopy keeps shrinking each year. This shrinking canopy is representative of the loss of greenspaces that is happening all throughout the city (O'Neil-Dunne et al, 2019).

This loss is putting a strain on the local ecology. As the greenspaces become less connected, the habitats of the local ecosystems shrink. Charlotte is losing over three football fields a day worth of trees. This reduces the area's capacity to support food sources and sustain populations of the same species, which naturally leads to a decline in biodiversity (Shoemaker et al, 2020).

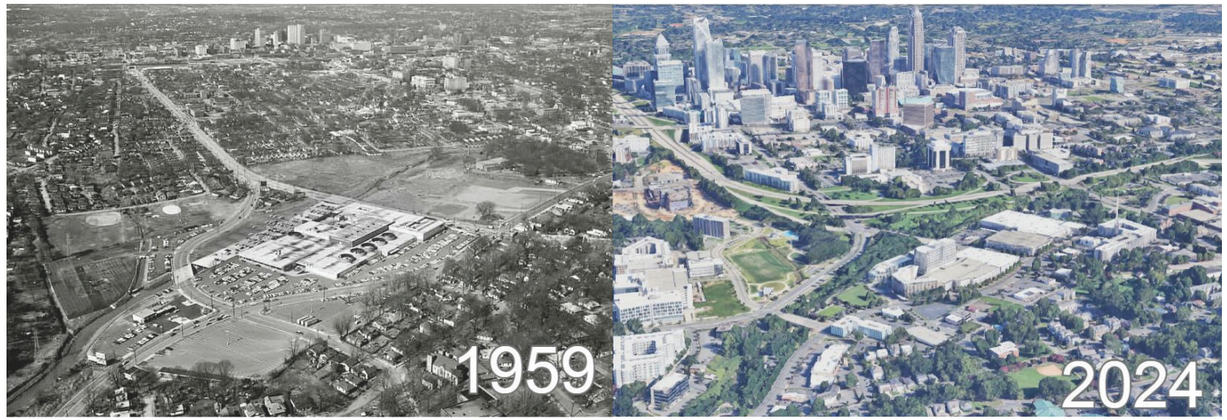


Figure 3.18. Charlotte's urbanization before and after photos - birdseye

Figure 3.19. Photo of Charlotte urbanizing

Environmental hazards
The loss of greenspaces does not only negatively affect the ecology. It creates major health and safety risks for the people of Charlotte. The greenspaces often get replaced by impermeable surfaces, causing the rain water to no longer be able to seep into the ground, rising the risk of floods. The air quality goes down as there is less vegetation to clean the air, while the newly constructed urban sprawl starts to pollute the area more. The removal of greenspaces also leads to the city warming up more. The effects of this can not be understated, as it has a proven direct correlation with the fatality rate of an area (Konijnendijk, 2025., Grubbs et al. 2021., Landess, 2025).

Environmental injustice
Greenspaces are not distributed equally. Worldwide trends show that minority-concentrated communities have the least access to greenspaces. Industry often gets built next to these communities and as a consequence suffer the most from the environmental hazards that follow. Environmental racism is the expression of environmental injustice. Environmental justice is the name of the social movement that seeks to minimize and equalize effects of environmental hazards among the entire community regardless of income, ethnicity or race (City of Charlotte, 2020., Grubbs et al. 2021).

Why Charlotte?
Charlotte has long ranked last in economic mobility among the 50 largest U.S. cities. Recently it has shown significant progress, now ranking as the third most improved city, rising from 50th to 38th place (Chetty et al., 2014. Chetty et al., 2024). This means that children born into low-income families in Charlotte now have better chances of climbing the income ladder compared to previous generations. The study attributes this progress to several factors, including increased economic connectedness, the interactions between individuals from different socioeconomic backgrounds, and public-private partnerships aimed at addressing systemic issues. Despite these successes there is still has a long way to go. The city has a large divide between communities that is visible on a range of demographic and environmental maps. This, paired with the major environmental risks in the area, makes Charlotte the birthplace of the environmental justice movement. The term environmental racism was first coined by Dr. Benjamin Chavis in 1982 during protests against toxic waste dumping in a black North Carolina community. (Commission for Environmental Cooperation, n.d., Hilton Williams, 2025).

Figure 3.20. Charlotte's urbanization before and after photos - local

Figure 3.21. Map of Sugar Creek

3.4. Sugar Creek

Sugar Creek is a neighborhood located north/east of the city center and serves as a clear example of environmental injustice. The neighborhood was once called Sugaw Creek, named after the Sugaree Indians (Blythe, 1961). Originally a white neighborhood, it faced demographic shifts as African American families moved in, leading to a predominantly black culture. In recent years the community has become increasingly diverse with a growing Latino population (Israel, 2024).

Nowadays Sugar Creek is a neighborhood with a residential area at the east side, and industry towards the west. The industry area used to be forest long ago. Today, there is only a small border of trees left dividing these two zones. Most of this tree border is not accessible as park, and most of the industry is parking lots for mobile vehicles. The close proximity of this area is negatively impacting the residential area. A lot of the neighborhood does not have sidewalks which makes it not a walkable area, and the creek which the neighborhood is named after can only be observed from two locations, none of which are easy to reach nor places you want to stay at.

Gentrification

And yet, the neighborhood is suffering from gentrification. This is an issue that is seen all throughout the city, and it brings an important topic to this research.

With how tax laws work in the United States, it is very difficult to improve the livability of an area without pushing out the original residents as a result. If a new person moves into a street and builds a house that is more expensive than the other houses, everyone in that street needs to pay higher taxes from then on. This quickly makes it unaffordable for the original residents to keep living in their house and they will inevitably be forced to move out. A displacement of the original residents is something that must be avoided if we do not want to repeat the same mistakes as Brooklyn's urban renewal plans. Addressing this challenge is imperative to safeguard the local identity of the place (Fant, personal communication, 2025., Grubbs et al. 2021., Charlotte i-team, personal communication, 2025).






Figure 3.22. Photos of a stroll through Sugar Creek, January 2025

3.5. Conclusion

Charlotte, North Carolina, lays in the middle of large vastly different ecological systems. The structure of the city that we see today can be traced back to the developments around the old train tracks, which in turn were laid out following the topography of the landscape.

The city has a long history of marginalizing its minority-concentrated communities. Today, we find ourselves in a situation with an unequal distribution of greenspaces, creating major health and safety risks. While improving the livability in those communities is crucial, we must put our focus on preventing the displacement of the current residents in order to safeguard the local identity. This conflict between improving livability and preventing displacement makes the project a delicate matter.

04

Problem Statement

Research Questions

4.1. Problem statement

Urbanization is a leading cause in minority-concentrated communities having less access to greenspaces, which leads to major health and safety issues. This, paired with the major environmental risks around Charlotte, makes the city the birthplace of the environmental justice movement. While it is important to improve the livability, it is imperative to safeguard the local identity, and so we must not end up indirectly displacing the original residents.

The disappearance of greenspaces has consequently led to a decline of ecology, which in turn trickles down impacting the ecosystems on a broader scale.

While some communities bear the brunt of environmental injustice, no part of the city is immune from its consequences. What starts as localized harm trickles down and becomes a city-wide vulnerability, though the burden is not evenly distributed. This makes it a matter that concerns everyone. Finding justice is not charity, but a search for structural integrity.

4.2. Research questions

What **ecological spatial approach** can improve environmental justice for human and non-human life in Charlotte?

Mapping injustice

Where do historical and current spatial patterns of environmental injustice show up, and what issues arise from these?

Ecology

Which existing ecosystem services can be restored, reconnected, or expanded to improve environmental conditions and quality of life?

Community-driven

What strategies can enable community-driven, justice-centered urban planning that integrates environmental equity into Charlotte's design framework?

Measuring

How can long-term social and ecological benefits of environmental justice interventions be modeled and measured?

05

Glossary

3-30-300 rule
A guideline that recommends people should see 3 trees from their home, live in a neighborhood with 30% tree canopy and be within 300 meters from a park.

Biodiversity
The measure for how densely an area is populated by different fauna and flora species.

Bioswale
A vegetated shallow part in a landscape designed to capture and infiltrate rainwater during peaks, removing pollution, improving the water quality.

Charlotte
The capital of North Carolina, existing of the main core and the surrounding urban sprawl.

Community Based Participatory Research (CBPR)
A collaborative research approach that involves community members in the research process.

Crescent and wedge
The description of the urban structure of the city center in which the most livable neighborhoods are located inside of the wedge, surrounded by the crescent of neighborhoods with a lower livability rate.

Displacement
The forced movement of residents from their homes or communities due to rising costs or redevelopment.

Ecosystem services
The direct and indirect contribution of ecosystems to human wellbeing. Think of clean air, water, food production, etc.

Environmental injustice
Urbanization causes minority-concentrated communities to have less access to greenspaces. This creates major health and safety issues.

Environmental Justice
The social movement that seeks to minimize and equalize effects of environmental hazards among the entire community regardless of income, ethnicity or race.

Environmental racism
The expression of environmental injustice.

Food desert
An area with limited access to affordable and nutritious food, often correlated with inequities.

Gentrification
A process in which neighborhoods transform due to economic growth, displacing the original residents.

Greenspace
An area where people and nature meet. Permeable surfaces and vegetation raise the livability and resilience of the surrounding areas. When done right, it benefits the wellbeing of human- and non-human life. Think of parks, forests and greenways.

Human wellbeing
As defined by the World Health Organization, human wellbeing consistent of physical wellbeing, mental wellbeing and social wellbeing. Greenspaces can benefit all three of those types of wellbeing.

Impermeable surface
A hard surface like asphalt or pavement that does not allow the infiltration of rainwater, increasing the risk of floods. The opposite of permeable surfaces.

Integrated Knowledge Translation (IKT)
A research approach that emphasizes the co-production of knowledge with local stakeholders.

Minority-concentrated community
Communities / neighborhoods in which there is a large share of minorities in the population.

Multi-scalar design
A design approach that considers the impacts across multiple scales, from small parks to the entire region.

Permeable surface
A soft surface like soil or grass that allows the infiltration of rainwater into the ground, preventing floods. The opposite of an impermeable surface.

Placemaking
A design approach that focuses on creating quality public spaces that contribute to people's health, happiness and wellbeing.

PPS framework
A model developed by Project for Public Spaces identifying four qualities of a successful place: Uses & Activities, Comfort & Image, Access & Linkage and Sociability.

Pumptrack
A looped track designed for wheeled sports such as BMX, skateboarding and scooters, where riders keep generating momentum without kicking themselves forward. They are low barrier inclusive public places that promote physical activity and social interaction.

Scenario planning
A design method that explores different possible futures or outcomes to better understand the impacts of specific design interventions.

SoftGIS
A mapping method that combines spatial data with the experiences and opinions of the users of those spaces.

Tree canopy cover
The layer of trees that cover the ground when viewed from above. Charlotte is proud of its large tree canopy spanning over the city. However, this canopy has been declining in the face of urbanization.

Urban heat effect
Urban areas experience higher temperatures than their surrounding rural areas, due to human activities and infrastructures.

Urbanization
The act of making an area denser with human infrastructures like buildings, roads and parking lots.

Walkability
How friendly an area is to walking, based on sidewalk availability, safety and destinations.

06

Conceptual Framework

6.1. Conceptual framework

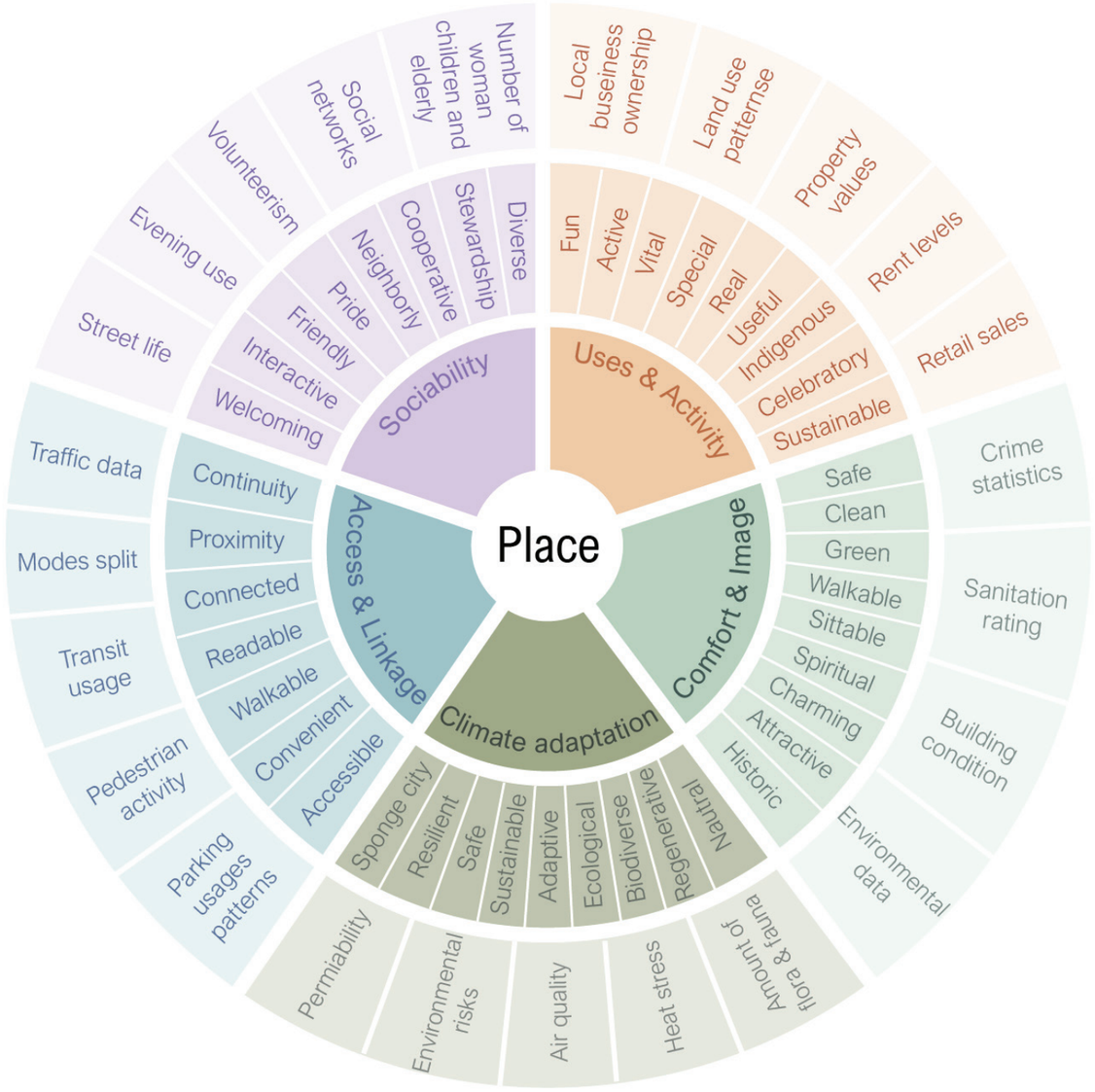


Figure 6.1. Conceptual framework
Adapted from (Project for Public Spaces, N.D.)

The fifth quadrant

My conceptual framework exists of the PPS model and its four quarters. As an addition, I added my own quarter named Climate Adaptation. This is what I consider to be another important aspect of placemaking.

The inner ring in the model represents the core qualities. The middle ring holds intangible words people often use to describe a place. The outer ring represents quantitative ways to measure these intangibles (Project for Public Spaces, N.D.). I based the words that I put in my model on my experiences I gained during my master's at the Technical University of Delft.

This adapted framework showcases my view on placemaking, and it functioned as my guideline while designing. I used it as a way of testing if my designs were meeting the criteria I was giving myself.

6.2. Why climate adaptation?

Besides the often discussed benefits of climate adaptation, like the benefits for the climate and ecology, there are very important health and economic reasons. Ecosystem services are the direct and indirect benefits people receive from their environment. Examples of those contributions are food, raw materials, clean water, clean air and beauty (Landess, 2025).

Health

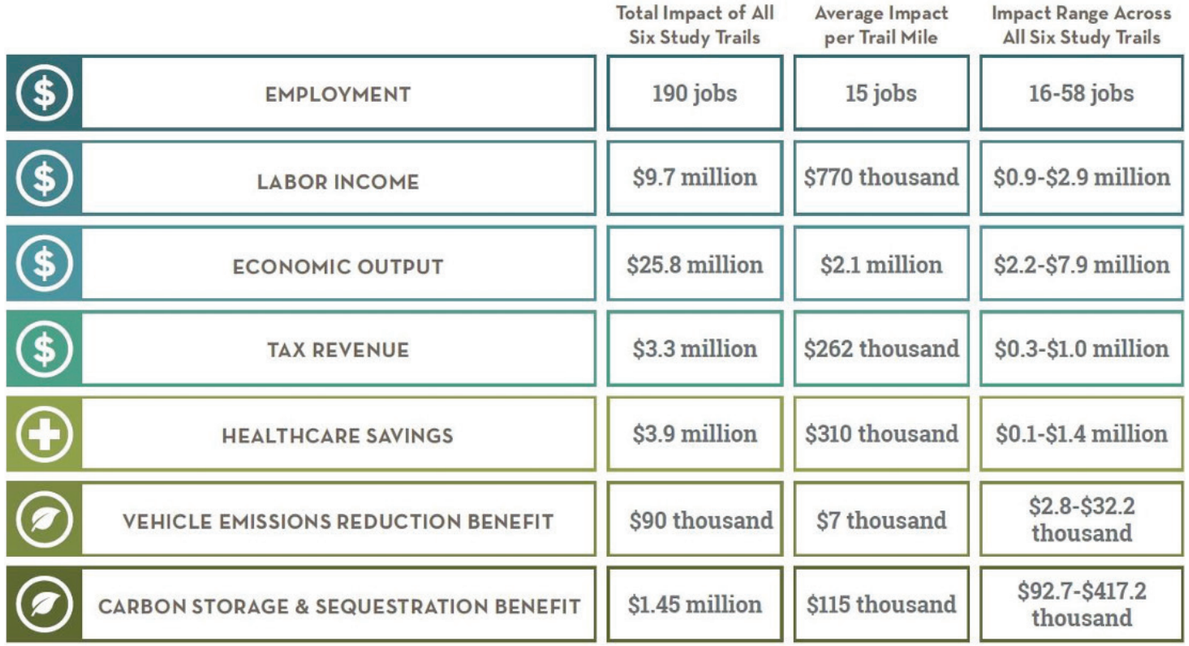
As summarized by Browning et al. (2024), *"...access to greenery is associated with reduced risk of all-cause mortality, heart disease, obesity, mental disorders, low birth weight, physical inactivity, and sleep disorders, among dozens of other diseases, illnesses, and conditions."*

Study has shown that increasing tree canopy coverage to 30% could have prevented the deaths of 2644 people in 93 European cities during 2015 (Iungman et al., 2023). In Philadelphia PA, 403 deaths could be prevented every year by following this measure (Kondo et al., 2020). Living within 300 meters from greenspaces is associated with fewer mental and behavioral problems in Spain, Munich and Sweden. (Pérez-del-Pulgar et al., 2021; Markevych et al., 2014; Annerstedt et al., 2012). Having three trees visible from your house has been associated with a reduced need for medication and psychologist visits in Spain (Nieuwenhuijsen et al., 2022). In a virtual reality simulation, greater numbers of trees have been shown to enhance recovery from acute stressors in the U.S. (Jiang et al., 2016). Studies like these and more are the foundation of the 3-30-300 rule, and they show the necessity of greenspaces for our health (Browning et al., 2024; Konijnendijk, 2021).

Economy

Climate adaptation can aid in business development, job creation, increased property value and income from user & tourist spending. Local data from the Carolina Thread Trail (CTT) and the Catawba Lands Conservancy (CLC) shows that their efforts over six study trails have already resulted annually in 190 jobs, $3.9 million healthcare savings and $90 thousand vehicle emission benefit. In total, their findings are that the economic impact of their trails save $3.5 million per mile per year. Their existing 400 miles thus earn back $1.4 billion per year right now, and when their 1600 planned miles are constructed the trails will earn back $5.6 billion per year.

This proves with local data that climate adaptation is not just a money sink, and that greenspace solutions will quickly earn their costs back, continuing to result in a growing net profit from then on (Landess, 2025).



	Total Impact of All Six Study Trails	Average Impact per Trail Mile	Impact Range Across All Six Study Trails
EMPLOYMENT	190 jobs	15 jobs	16-58 jobs
LABOR INCOME	$9.7 million	$770 thousand	$0.9-$2.9 million
ECONOMIC OUTPUT	$25.8 million	$2.1 million	$2.2-$7.9 million
TAX REVENUE	$3.3 million	$262 thousand	$0.3-$1.0 million
HEALTHCARE SAVINGS	$3.9 million	$310 thousand	$0.1-$1.4 million
VEHICLE EMISSIONS REDUCTION BENEFIT	$90 thousand	$7 thousand	$2.8-$32.2 thousand
CARBON STORAGE & SEQUESTRATION BENEFIT	$1.45 million	$115 thousand	$92.7-$417.2 thousand

Figure 6.2. Annual economic, health, and environmental impsacts facilitated (From Catawba Lands Conservancy and Carolina Thread Trail)

07

Scenarios Planning

Figure 7.1. A part of Charlotte's skyline

What are scenarios?
To get a clear picture which interventions will result in which outcomes, many scenarios have been developed. The scenarios are designs focusing on one specific design element each. They are experiments and do not necessarily represent a good design, as they will likely be lacking in other important qualities that were not considered for the scenario. Nevertheless, they are interesting studies to take inspiration from when making final designs. It allows me to pick and choose between design elements once I know what they will gain me and what the communities need. For these experiments, multiple zoom-ins of the Sugar Creek neighborhood have been used.

7.1. Framework based scenarios

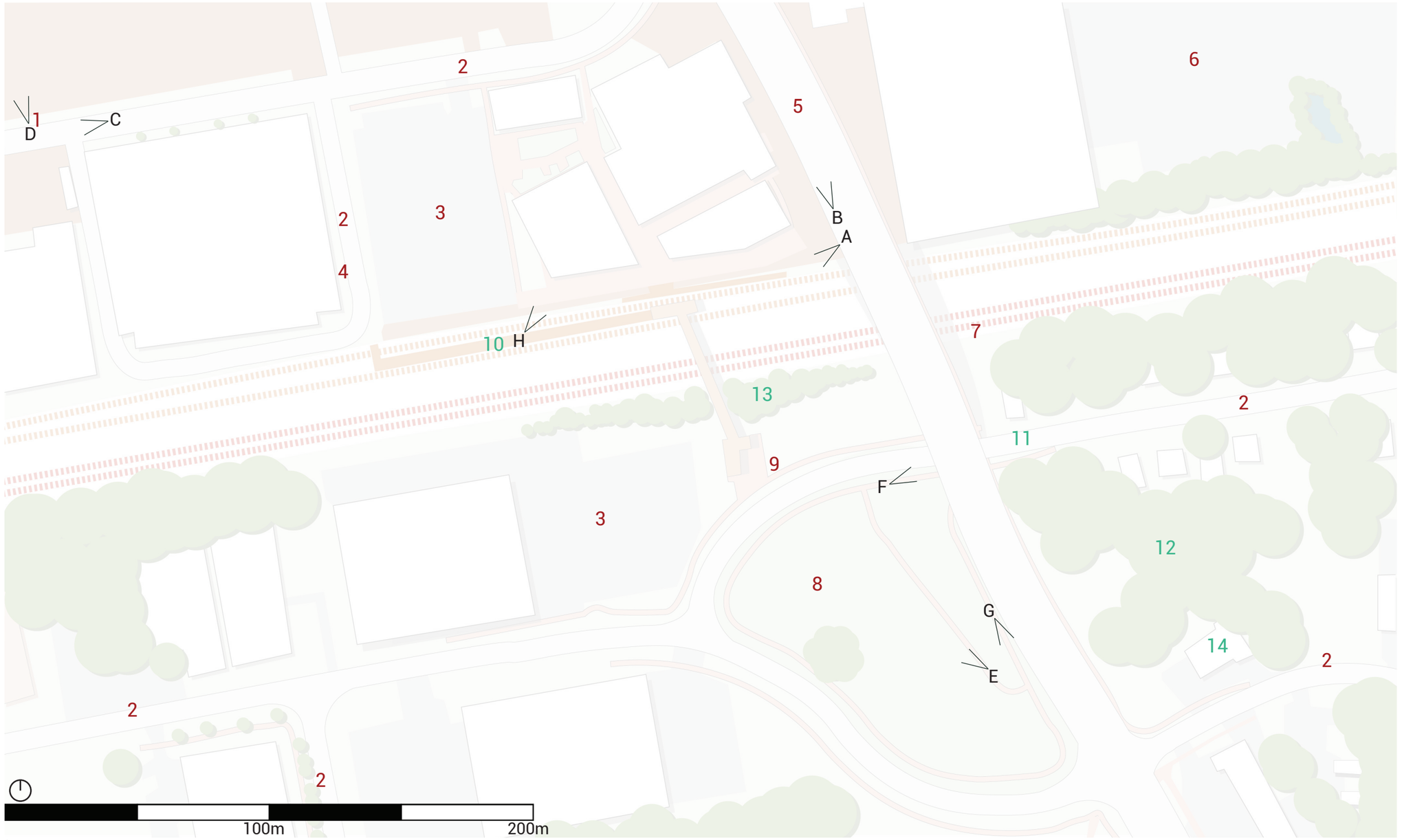
The first group of scenarios is based on the conceptual framework. Each design is focused solely on one of the five qualities that this framework provides. They are each tested on the area surrounding Sugar Creek Station.

Existing situation

Based on my own experience visiting this location, the area is very easy to get to from the city center via a train connection. The issues, however, arise once you arrive. My attempts to walk towards the residential area of Sugar Creek, north of this station, were soon met by a lack of sidewalks, large parking lots, no clear routings, construction sites I needed to cross and busy roads with few pedestrian crossings. The neighborhood appears to follow a car-centric design. You are expected to have your car parked at the station so you can drive to your home from there. Although there is a residential area towards the east, most of Sugar Creek's houses lie north of the station. A strong connection towards the north is thus important. On this map, the north is currently a construction site. I will regard it as empty space in my scenarios that I can still give any purpose.

The south entrance of the station leads into a large open grass field with a single tree. This area provides a large opportunity when designing improvements. In general, the station is surrounded by a lot of parking lots and large buildings. This does not leave a lot of space for greenspaces.

Figure 7.2. Sugar Creek station - existing situation



These findings are based on my personal experience walking through the area

Identified issues

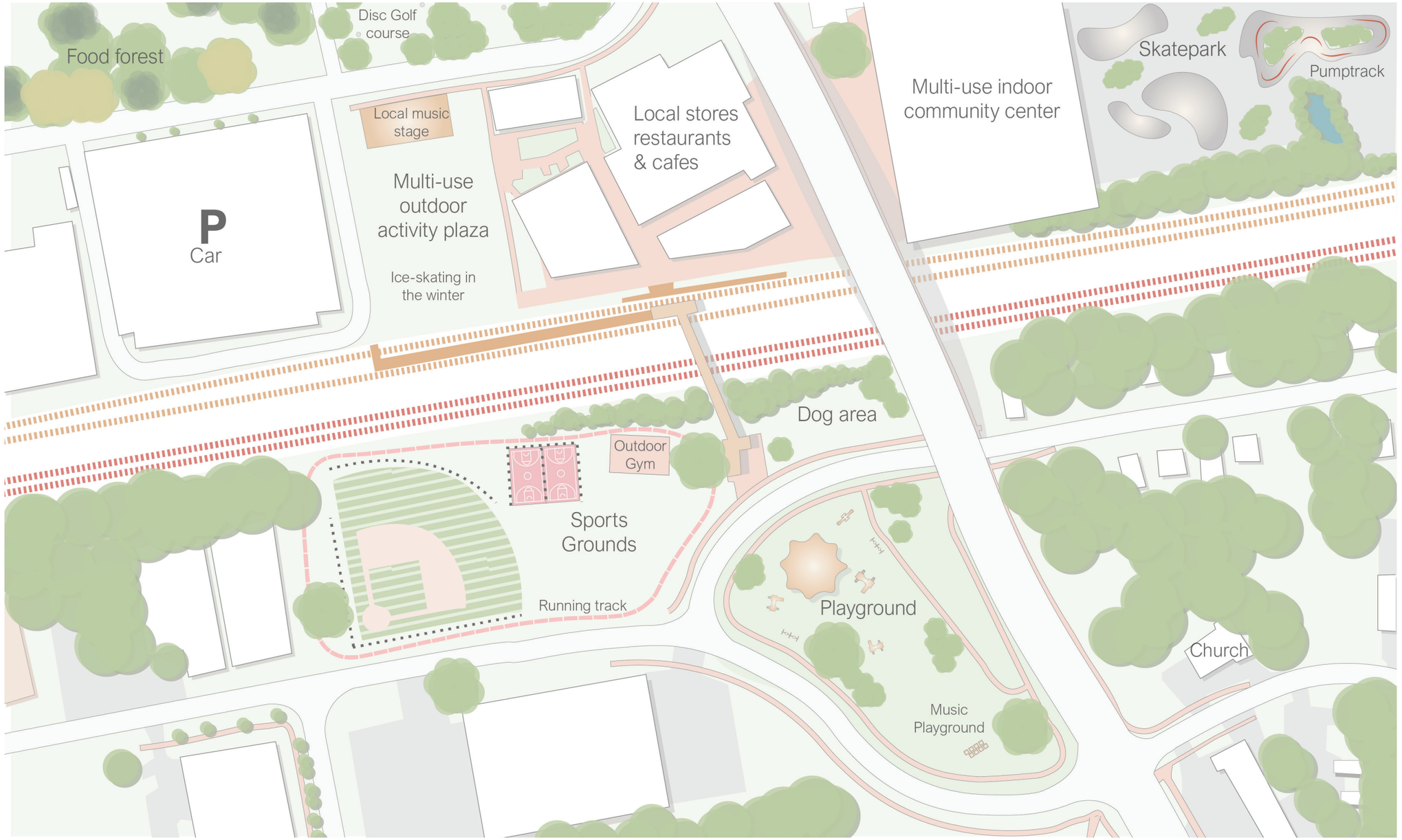
1. Active construction site, no route around
2. No sidewalks, surrounded by parking lots
3. Parking lot with impermeable surface, no trees
4. Existing bus stop feels unsafe
5. Bridge sidewalk feels very unsafe, very loud
6. Large industrial parking with no trees
7. No fence to train tracks
8. Large unused grass field in front of train station with just one lone tree, missed opportunity to develop greenspace.
9. No bus stops

Identified strengths

10. Clean well maintained train platform, easy affordable connection to the rest of the city.
11. Bridge acts as separation to create a private feeling to the residential area despite the close proximity to train station
12. Many trees
13. Start of a green corridor along the tracks, should be expanded on further
14. Church can act as a community hub

Figure 7.2. Sugar Creek station - existing situation

Figure 7.3. Photos taken inside of this location, January 2025



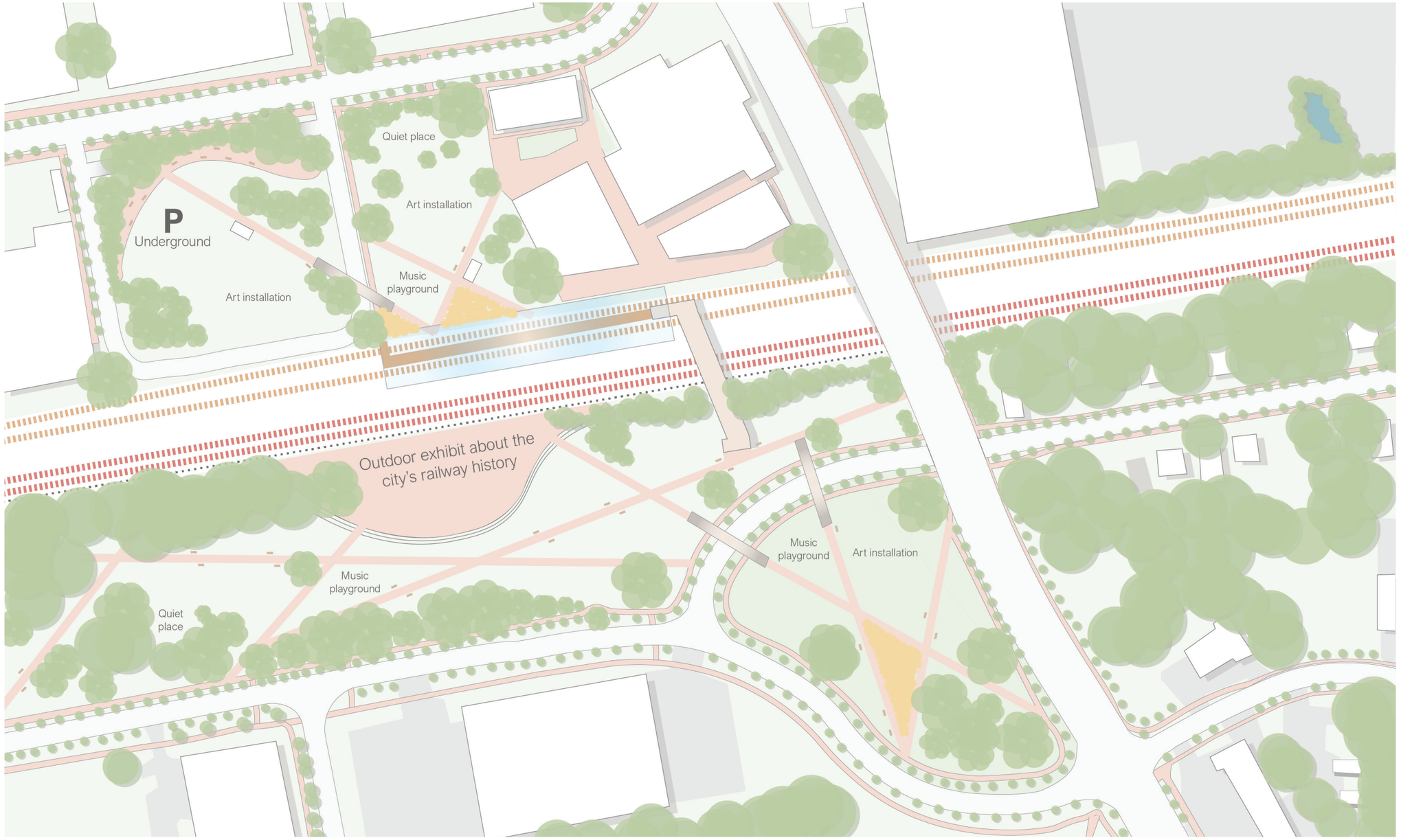
Uses & activity

Some of the important values of this part of the framework are fun, active, indigenous and useful. I tried to get as much variety of uses into this experiment as possible. For example, a large parking lot has been turned into a skatepark with a pump track. The existing local stores and restaurants north of the city will get more life via an outdoor multi-use plaza. This can be used for ice-skating during winters. You can also find a new disc golf course, a food forest, playground, community center and a sports ground with multiple activities like baseball, basketball, a running track and an outdoor gym.

This experiment helped me gain perspectives of what different functions could be possible in this area.

A shortcoming of this design is that this very dense area with a large variety of uses could quickly cause gentrification. Considering sociability is vital when designing uses & activities in a location.

Figure 7.4. Sugar Creek station - uses & activity

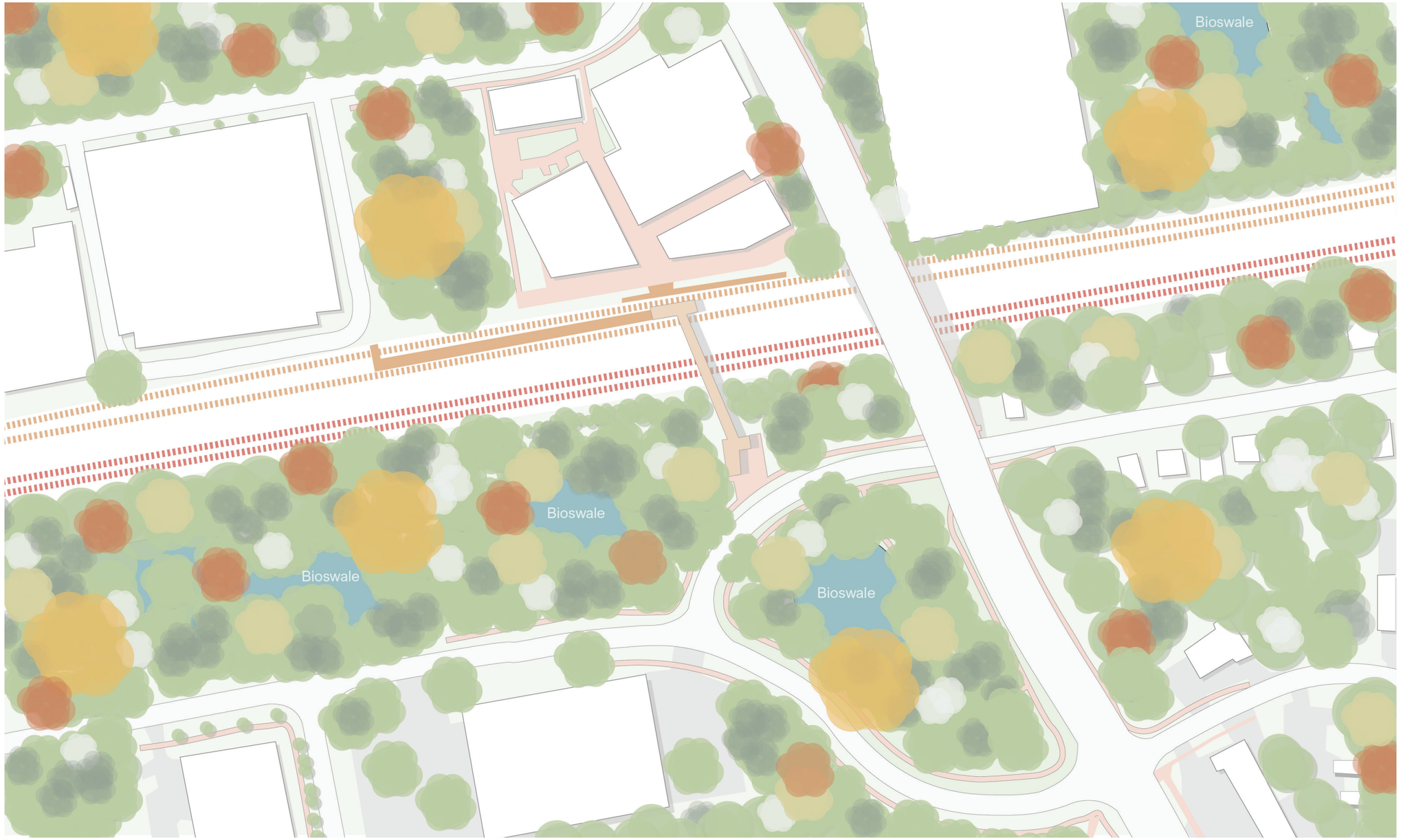


Comfort & image

This part of the framework values safe, clean, charming and historic designs. It is important to have a lot of sitting places and to make the area walkable.

For this experiment I focused on sightlines, creating straight paths that connect areas along those lines. I wanted to make sure that all the important areas were visible from most angles. There are trees in-between sidewalks and roads to create a safer atmosphere when you're walking through the area. The park is intended to extend further west and will eventually connect up with the tree border of Sugar Creek, creating a safe and charming walkable route towards the residential area. For the historic quality, I created an outdoor exhibition next to the train tracks, which explains Charlotte's railway history. There are three spots for art installations and there are musical playgrounds spread throughout the area. These are inspired by my visit to Estes Park, Colorado in 2023. From my experience, sound plays a large role in comfort and image that often gets overlooked. A weakness of this design is that there is not a lot of variety in activities. There is not a lot of incentive to visit the park itself.

Figure 7.5. Sugar Creek station - comfort & image



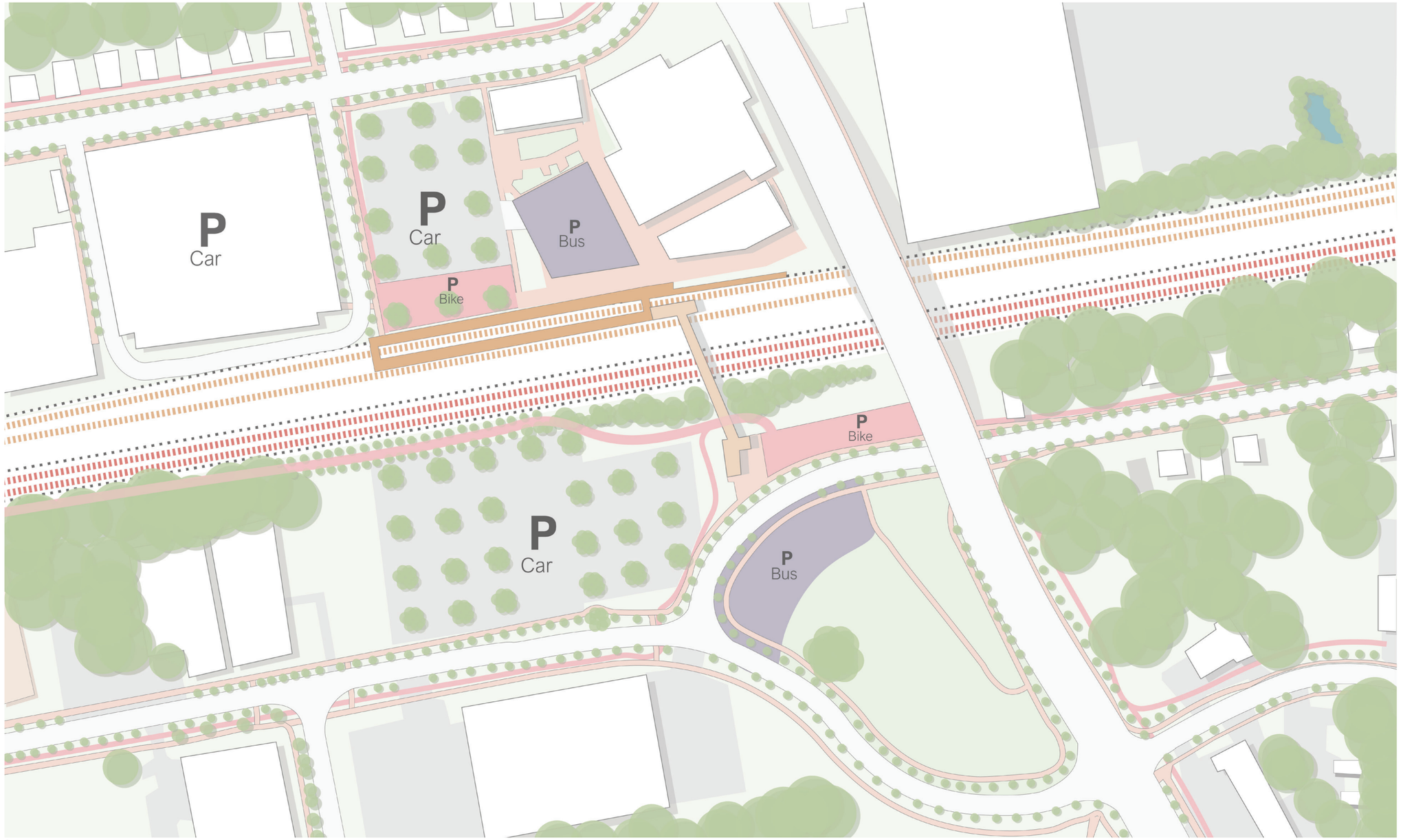
Climate adaptation

This experiment is an extreme case in which all focus is put on climate adaptation. A lot of native species have been re-introduced to the area, and bioswales are made to catch the rainwater runoff and protect the city from flash floods. This experiment shows where all the possible areas for greenspaces are.

What this design lacks is the human element, as for the purpose of this experiment all focus has been put on the ecological and nature-based aspects. This makes it not the most realistic of the designs, but certainly one worth experimenting with.

Ulmus americana
Pinus strobus
Platanus occidentalis
Fagus grandifolia
Quercus phellos
Sassafras albidum

Figure 7.6. Sugar Creek station - climate adaptation

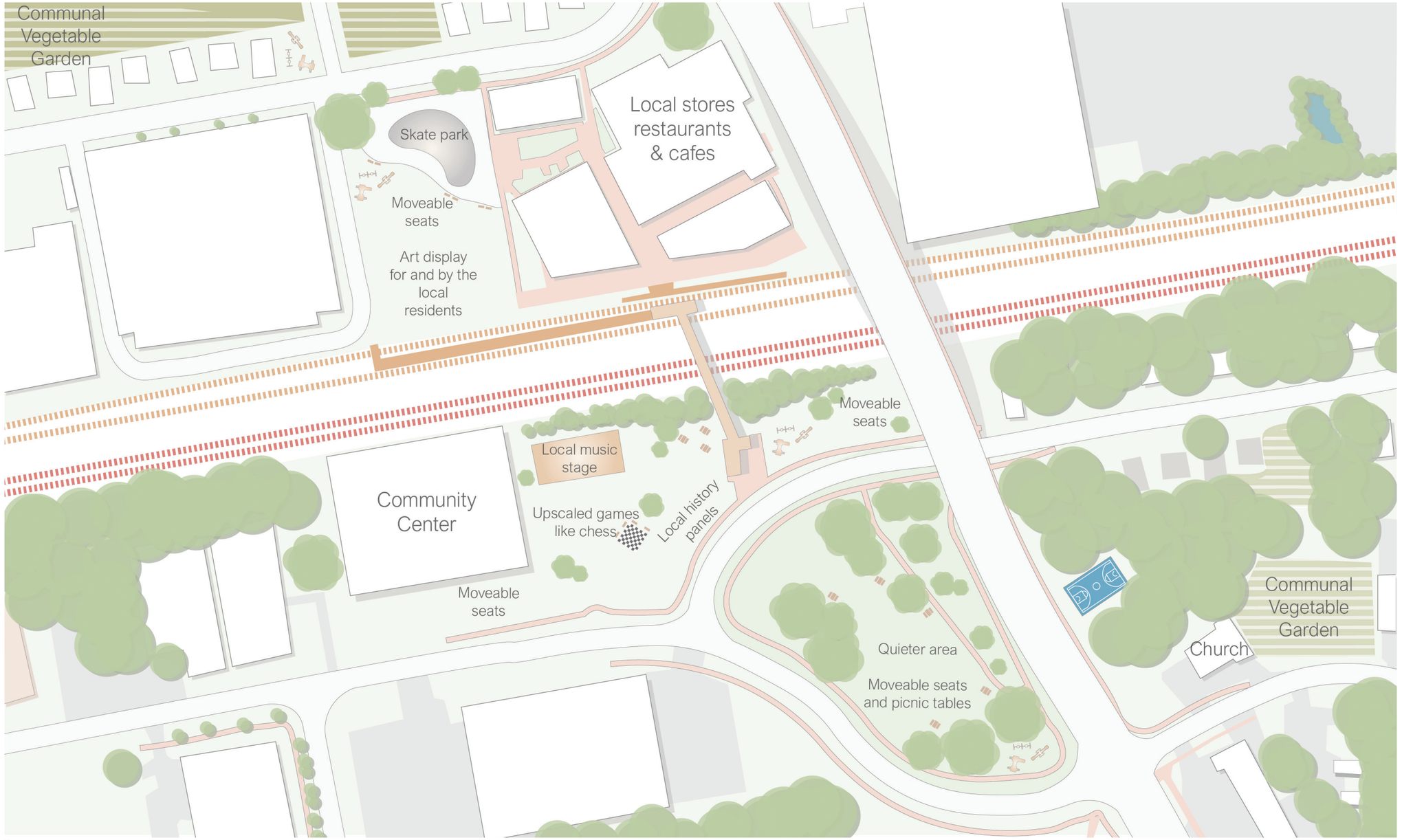


Access & linkage

For this experiment I tried to focus on diversifying the modes of transport. There are bike parking areas outside of the train station with bike lanes that can quickly bring you to your home. There are also bus hubs and a lot of public parking spaces. I added trees on those parking lots to help against the urban heat effect. New sidewalks create a more accessible atmosphere, with trees that visually separate the sidewalks from the car roads.

This design is clearly lacking the other qualities needed for placemaking, and the focus on transport might be a bit overblown. Nevertheless, it is an interesting experiment to design an extreme case like this.

Figure 7.7. Sugar Creek station - access & linkage



Sociability

This was the most difficult quality to make a design for, as sociability is something that happens naturally between people, and it is not something spatial. After some extensive research into the PPS model I came to the conclusion that sociability is not about the activities, but rather the areas in between the private and the public spaces. This is where people tend to meet naturally. The public areas with activities need to feel inviting to the people outside of them. There also needs to be an emphasis on especially welcoming the minority groups (Project for Public Spaces, n.d.).

In this experiment, I created a public center around the train station where people will naturally pass through and more private spaces around the houses. There are a lot of elements in-between those spaces that invite community-based interactions. For example during summer nights, local people might go on stage and make music without a high entry barrier. Moveable seats are used all throughout the design, and activities are placed next to each other which commonly aren't, like a local art display next to a skate park. Lastly, the private spaces have shared vegetable gardens.

Figure 7.8. Sugar Creek station - sociability

7.2. No interventions?

This scenario is based further north in Sugar Creek, at a crossing through the trees bordering the residential area from the industrial area. The experiment is a prediction of what will happen over the next 100 years if we keep following the trends that are currently happening in the city, without any design interventions.

In the first 50 years we see a gradual decline in trees. The border keeps shrinking as the land gets taken over by industry. By 2075 there will only be a thin strip of trees left. At some point in the future, a large developer will likely buy up the industrial land and start developing a mall there, turning the whole area into the next commercial hub of the city. This does not seem too unlikely, as the land will be relatively cheap. It is mostly parking lots for mobile vehicles such as trucks, vans and forklifts. By 2125, the area remains unrecognizable and the local identity of the place will be gone.

Another thing that is happening has to do with the houses. Note how the houses in the residential area keep growing. They are all slowly getting replaced, from modest brick-built houses to large mansions. This is the result of gentrification. If there are no safeguards put in place for the original residents, none of the original families that settled in this area will remain. This scenario acts as a warning as to why design interventions are needed. It is admittedly an extreme outcome and just a prediction, however it must be understood that cities can change drastically in 100 years. When we look 100 years back the city will be just as, if not more unrecognizable than this future scenario.

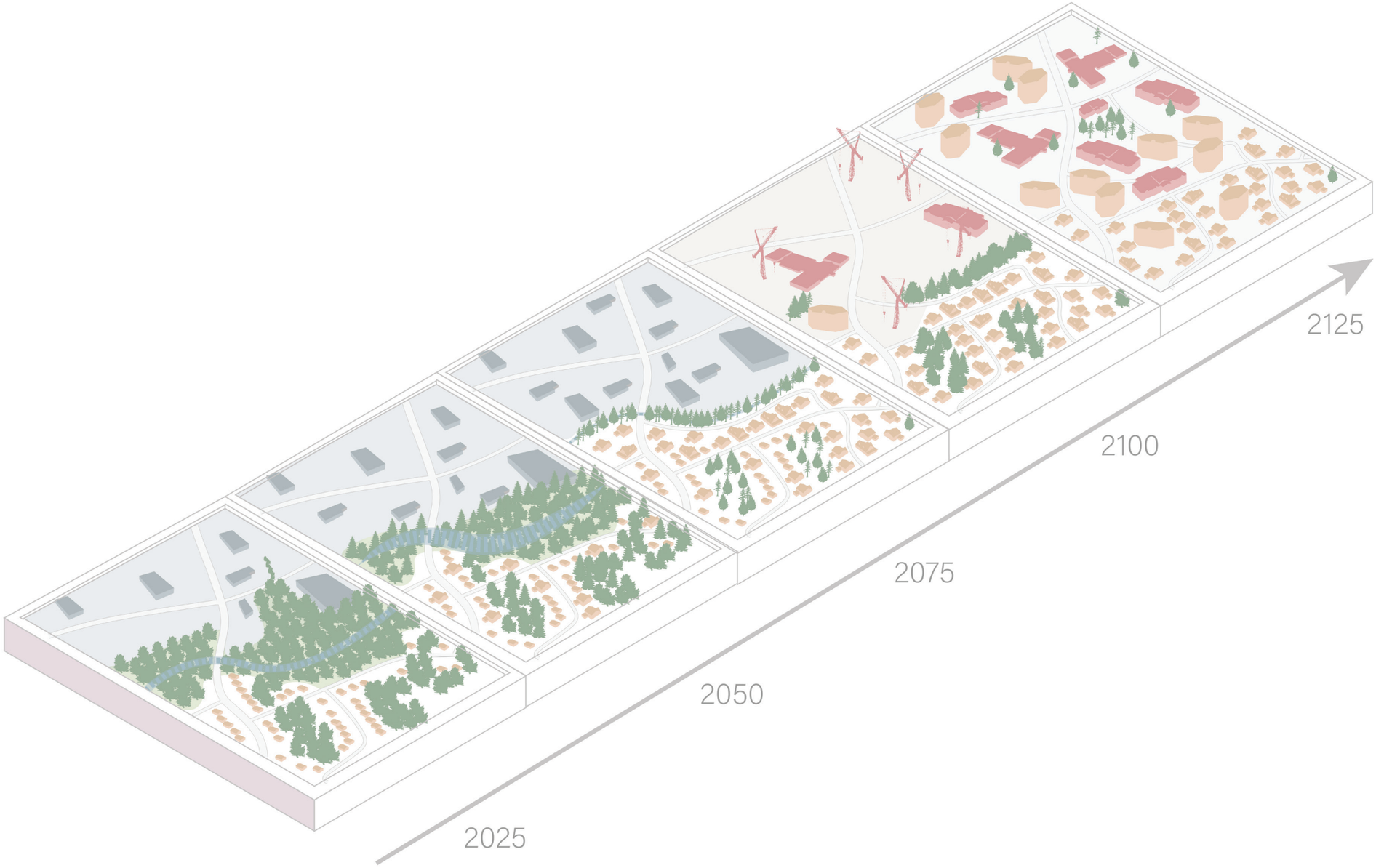
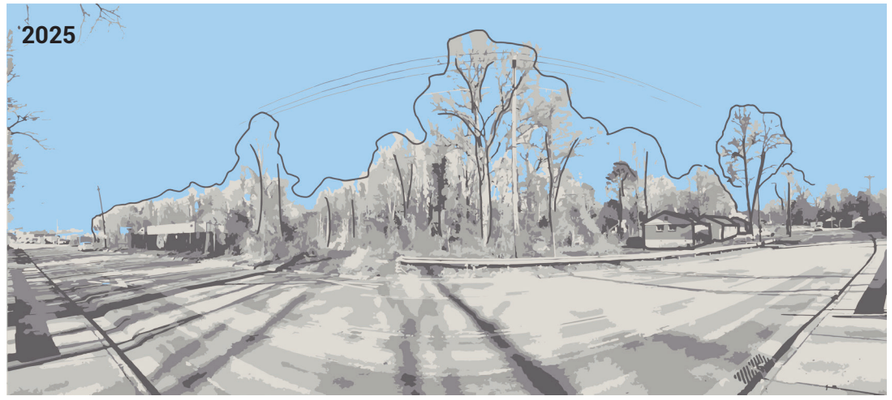
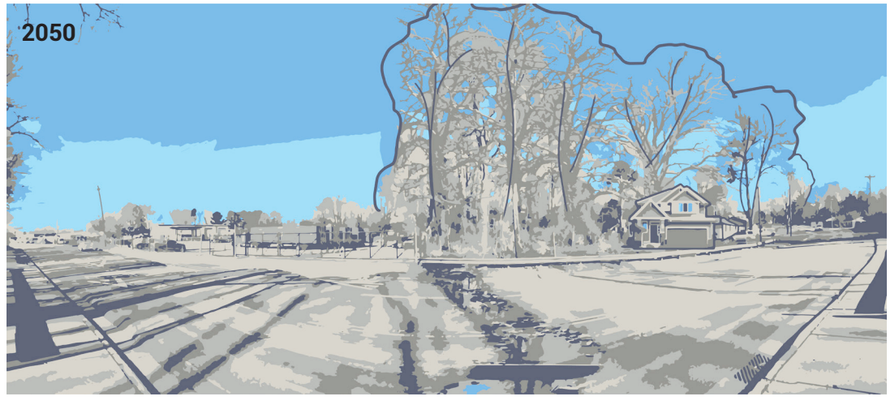


Figure 7.9. No interventions axonometric drawings





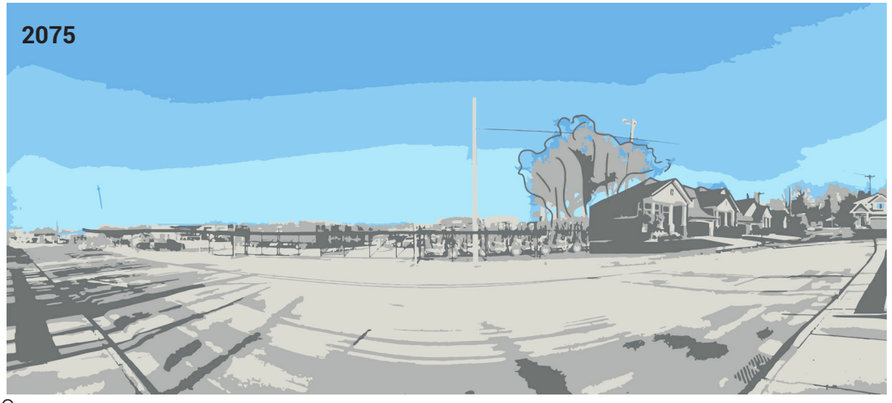
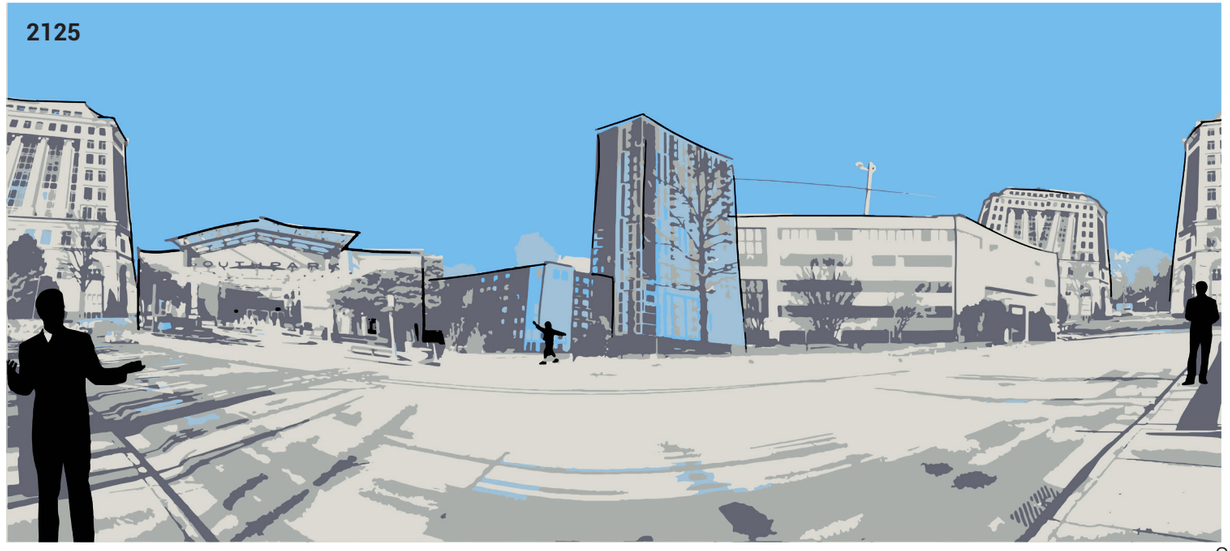


Figure 7.10. No interventions collages



7.3. Designing with time

For this scenario I developed a design method that plays with time. A design never exists in one moment. For a design to have a lasting impact, it must be aware of the way it will get perceived at any moment in time. Design drawings typically showcase a design in its best possible form, a moment that will never exist exactly as showcased. This is of course done to sell designs and to make them look more appealing. For this experiment I tried to break out of that design philosophy and develop an area that undergoes heavy changes over the course of 75 years.

By acquiring new land that borders the existing greenspaces, the park can be expanded and new trees can be planted. This part with new trees will feel very different compared to the older parts of the existing greenspace. Over time, those trees will grow and age. The old trees will inevitably die, creating room for new trees. At this point we will be in a new situation, opposite to the start of the design. Buildings in the park could be built in such a way that they can easily be moved as the layout of the park keeps changing.

This design approach risks designs becoming too chaotic. If there are no safeguards in place, the initial structure of the park will get lost over time, with no guarantee that it is replaced by a good new structure. To prevent this from happening, path layouts, sightlines and zone plans can be implemented. Some areas will never have trees for example. The paths keep the structure of the park intact while the feeling and activities of the spaces keeps moving around the park.

This approach has been tested at the same location as the previous scenario, although zoomed in even further. I reintroduced native tree species into the park which will help elevate the feeling throughout the seasons, as well as through time.

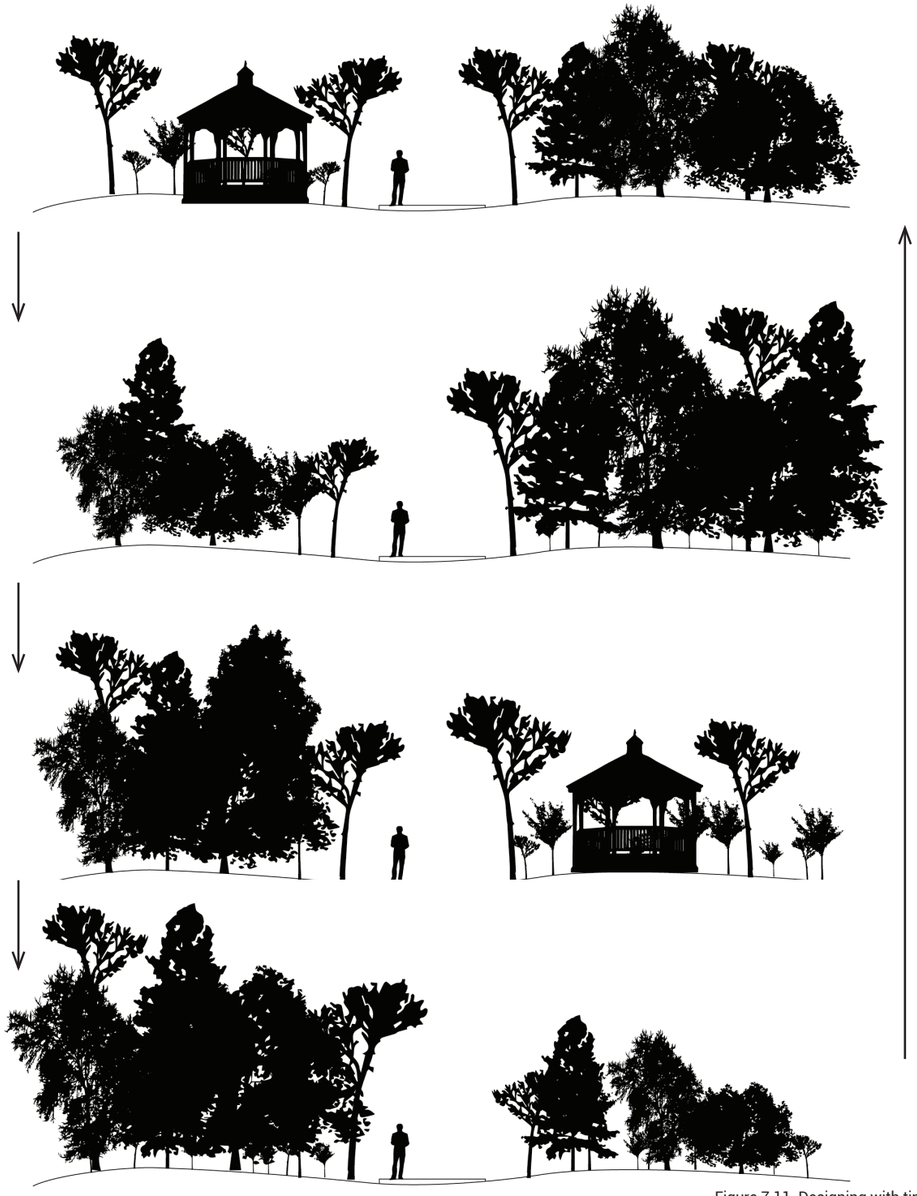


Figure 7.11. Designing with time concept drawings

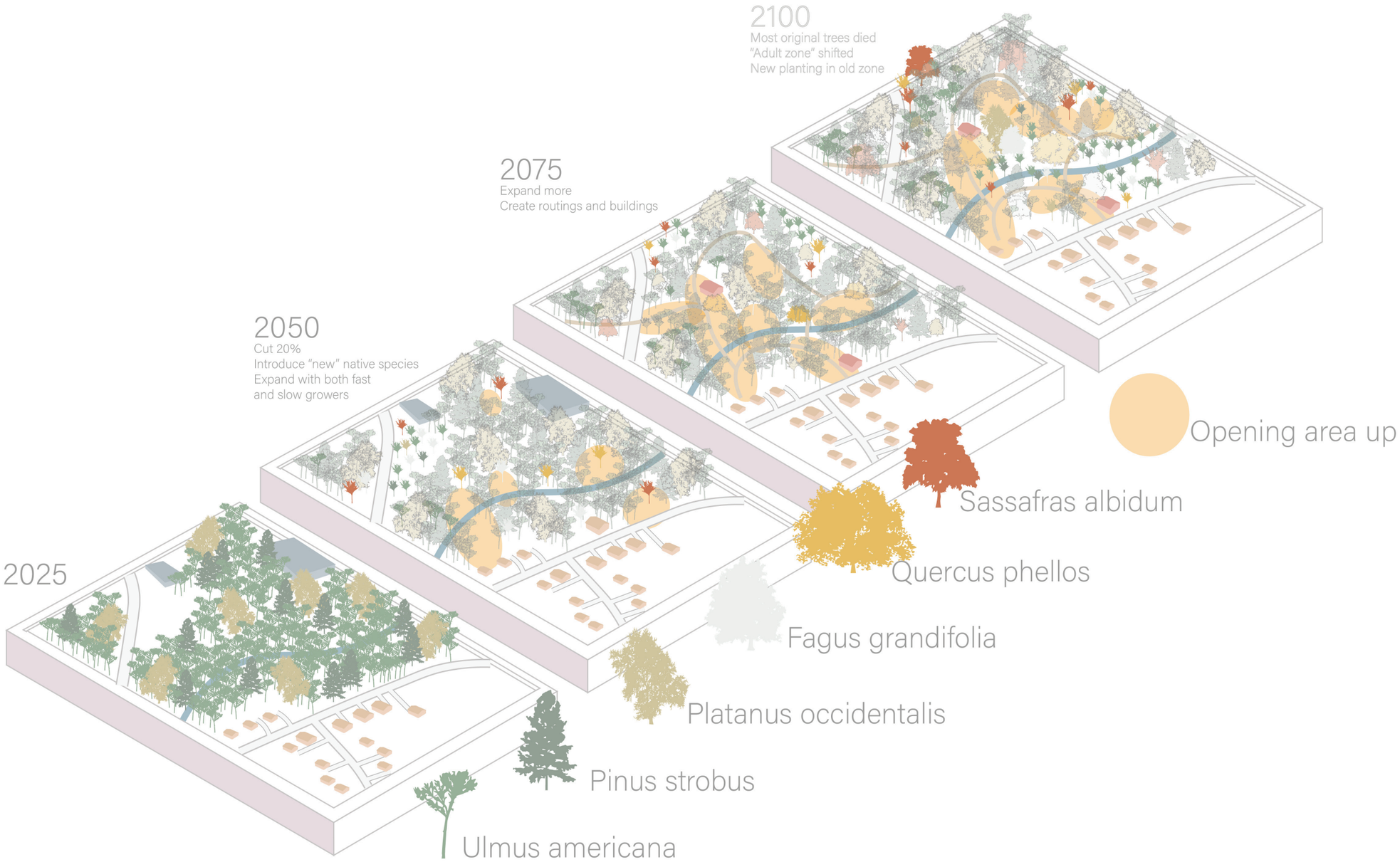


Figure 7.12. Designing with time axonometric drawings

08

Survey Results

9.1. Greenspaces around charlotte

For my project, a survey was spread out in five different parts of the city. Uptown/South, North/East, Ballantyne, West, and the Airport area. Each survey was identical yet collected a different data pool, so the results could be compared per area. The airport area resulted in no responses, so for this research four areas were considered instead.

The survey was divided into three sections. In the first, participants were asked to provide basic demographic information in the form of age, ethnicity and household composition. The second part presented participants with an interactive map. They could zoom in and out, drag the map around and change the view between simplistic and satellite. They were asked to place a marker at their two most important greenspaces. They were then asked to select which activities they most often do there and how much time they spend there on average per week. The third and final part of the survey asked some additional questions about how the participants felt about their surroundings, most of these questions were optional.

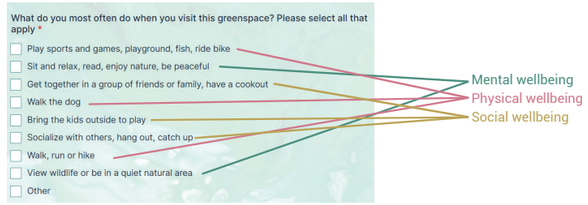
What's interesting is that despite my limited data pool, four of the selected locations were different parts of the Little Sugar Creek Greenway and three people chose the old Ballantyne golf course that got turned into a public park. This shows that these greenspaces are very important to those communities. The Little Sugar Creek Greenway has often been chosen by people who do not even live in that part of town.

Disclaimer

Despite many efforts to spread the survey around with the help of various organizations, the surveys only resulted in 15 responses; 30 locations. This means that there is not enough data to make scientifically correct assessments using this data. The data has been analyzed regardless as a personal practice, and to showcase how the project would have gone in case there was enough data, in the hope that future research might still learn from the methods used. The following data analysis can thus be considered as a "what if" scenario and must not be taken as conclusive evidence.

Human wellbeing

Participants were asked to select which activities they most often do while visiting their selected greenspace. They were given a lot of options like "Walk the dog" and "Take the kids outside". They were also able to fill in their own text. While this many options might not seem like useful data at first, all these options had been divided beforehand into the three types of wellbeing, adapted from LeBrasseur's research. This means that each greenspace has data of the types of wellbeing it benefits.



Data collection

The survey was available from the 1st of April until the 13th of May 2025 to anyone over the age of 13. Data collection occurred through the digital webpage, of which the URL was shared via email and social media distribution with the help of local organizations. The survey was estimated to take five minutes to complete.

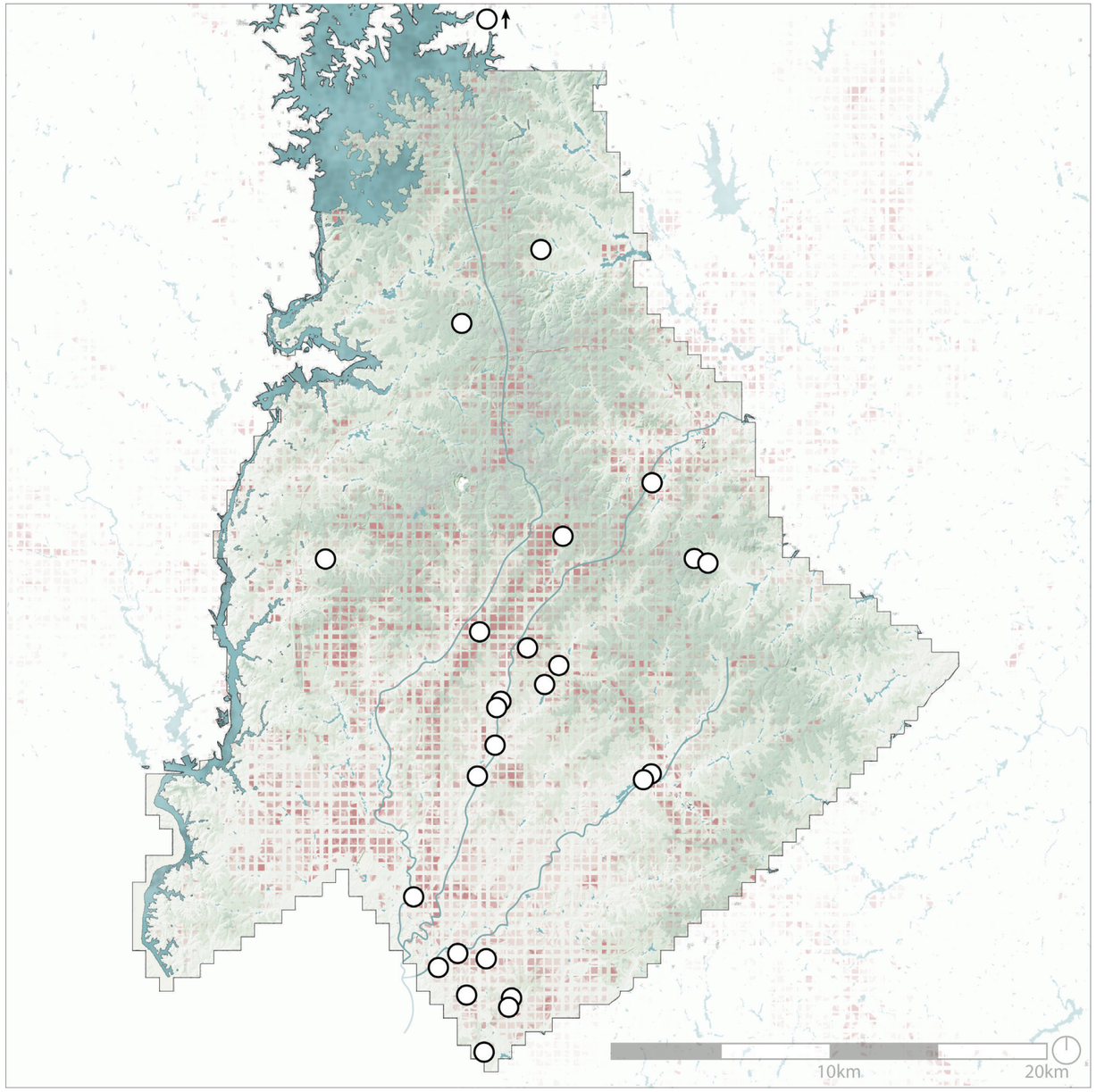


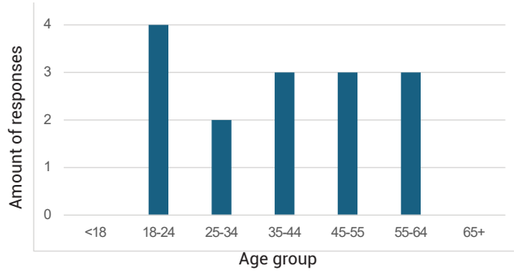
Figure 8.1. Most visited greenspaces around Charlotte

9.2. Data analysis

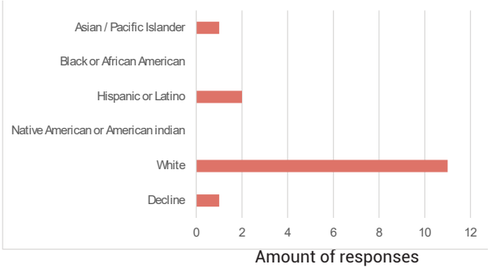
Demographic info

The results show that, while the age groups are an even distribution, most responses are from white individuals with partners and kids. This severely limits the relevancy of the results. Notably, I got zero responses from black people. Considering the topic of my research, it is unfortunate that the African American community and other marginalized groups are not represented.

Age



Ethnicity



Household composition

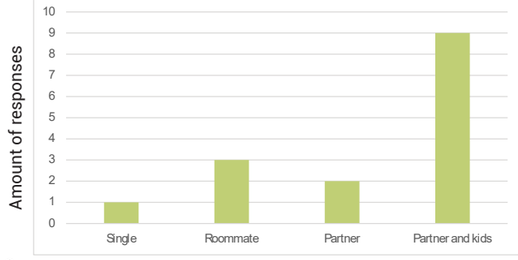
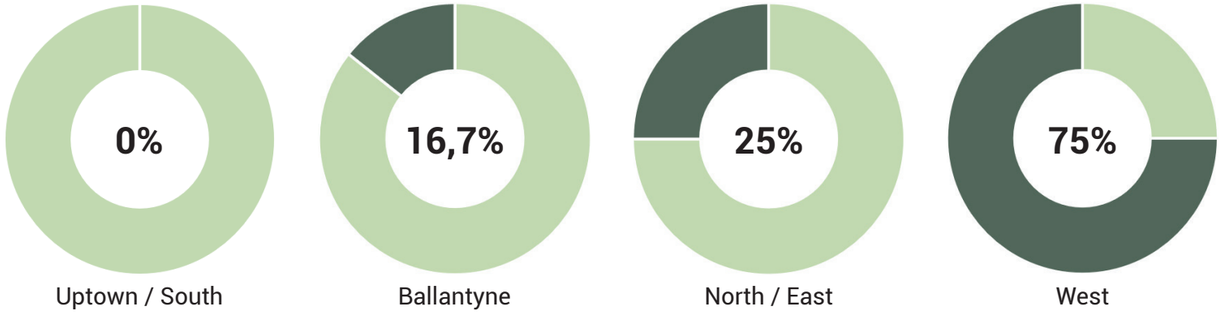


Figure 8.2. Age groups
Figure 8.3. Ethnicity
Figure 8.4. Household composition
Figure 8.5. How many greenspaces require further travel?
Figure 8.6. Effect of wellbeing benefits on time spent

How many important greenspaces require travel outside of the research area?



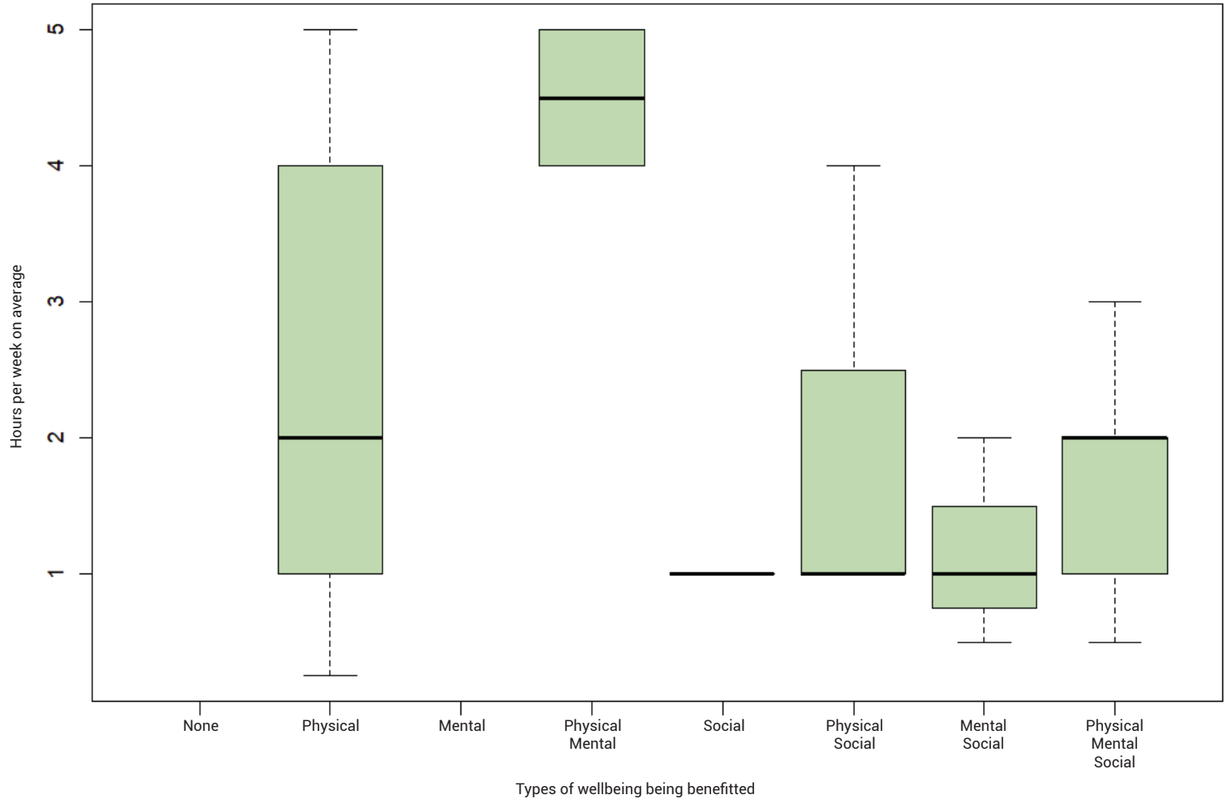
While the survey collected different data pools for each area of the city, not everyone who responded to the survey chose greenspaces inside of the data pool they live. Notably, only 25% of the responses from the west side of Charlotte picked a location that lays on the west side of town, meaning that they need to travel far to visit their most important greenspaces. Another thing of note is that, while Ballantyne is the smallest research area, most of the important greenspaces still lay inside of Ballantyne.

How different wellbeing types affect time spent in greenspaces

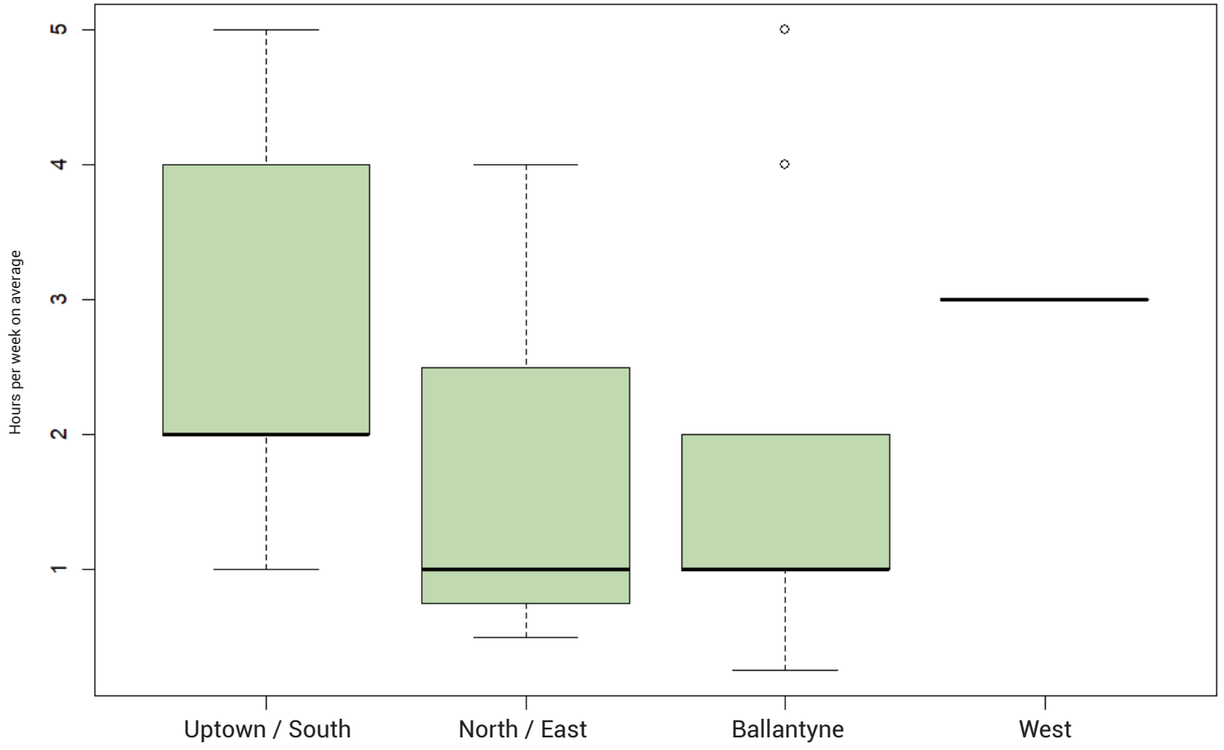
One interesting observation is the effect that physical wellbeing seems to have on the average time spent in greenspaces. Data suggests that people tend to spend much longer in greenspaces when there are physical wellbeing activities. The opposite seems to be the case for social wellbeing activities and mental wellbeing activities. When those are present, people tend to spend less time in greenspaces. This is a strange observation that could be explained by the small sample size. Further research is needed to show that if this pattern holds up.

Correlation between what wellbeing types are affected

Another pattern that shows up in the data is that mental wellbeing and social wellbeing almost always come in pairs. If one type of wellbeing exists, the other very likely exists as well. This is not the case with physical wellbeing which tends to exist on its own. This is an interesting pattern as participants were only asked to list their general activities with no mention of wellbeing types. Multiple wellbeing types must mean that multiple different activities were listed. It could be the case that this is the result of the small sample size, so further research is needed.



How much time does each community spend in greenspaces?

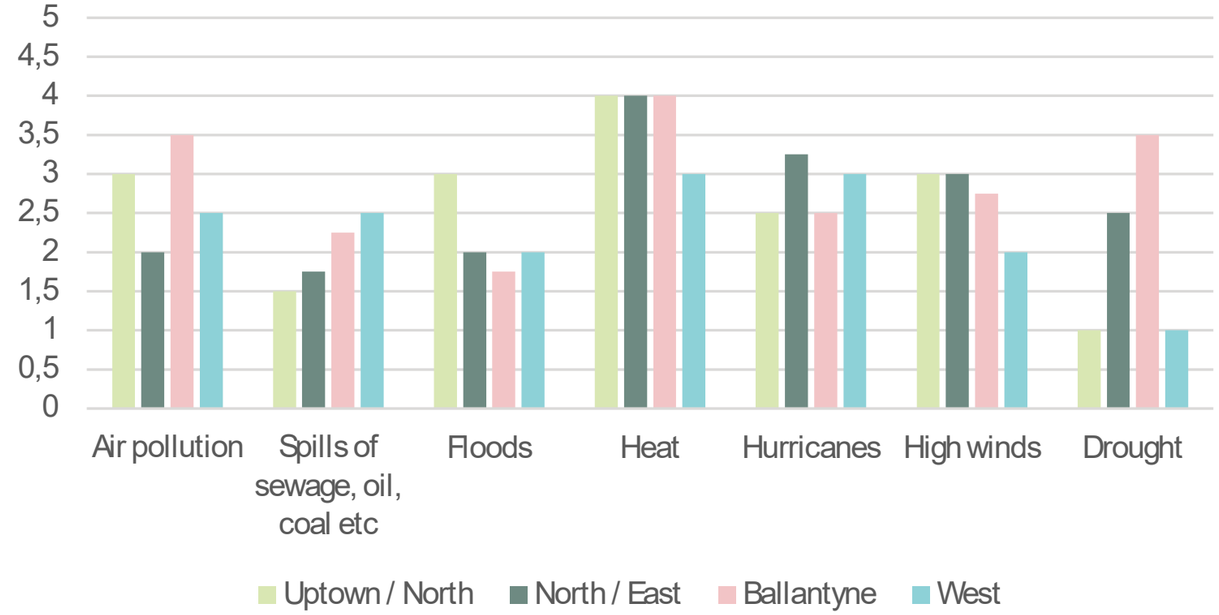


On average, most time spent in greenspaces is in Uptown / South Charlotte. It is notable that Ballantyne has the least amount of time spent on average, although it does have the highest outliers. The small sample size must be considered, which is especially noticeable in West Charlotte, which only has one location. More research is required.

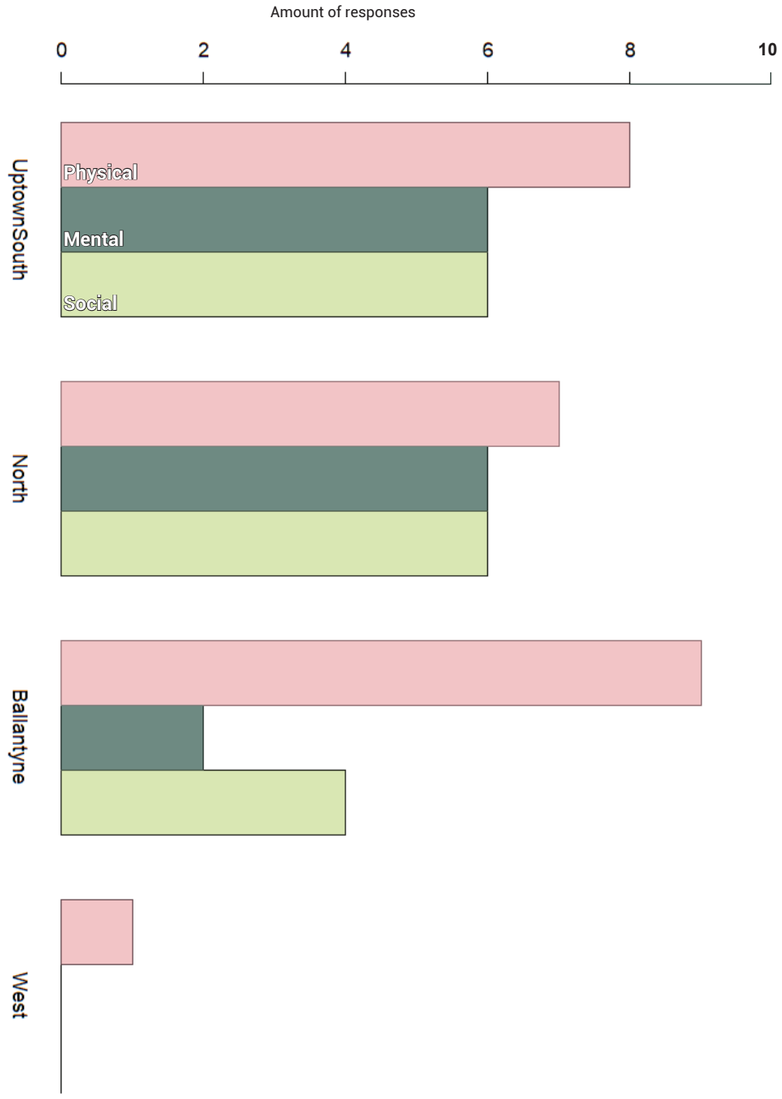
Figure 8.7. Correlation between what wellbeings are affected
Figure 8.8. How much time does each community spend in greenspaces?

How vulnerable do participants feel to environmental hazards on a scale of 1/5?

Even though this was an optional question, almost every participant decided to fill it in. This shows that environmental hazards are of importance to the participants. The results show that most communities feel equally vulnerable to the different environmental hazards, most of them being rated around 2.5 out of 5. There are some exceptions, with droughts being barely perceived as a vulnerability in Uptown/North and West, while its among the highest vulnerabilities in Ballantyne. It could be that this has to do with a difference in maintaining lawns, causing the people in Ballantyne to be faced with the effects of droughts more often. Heat is the highest rated vulnerability across the board, scoring the highest for every community.



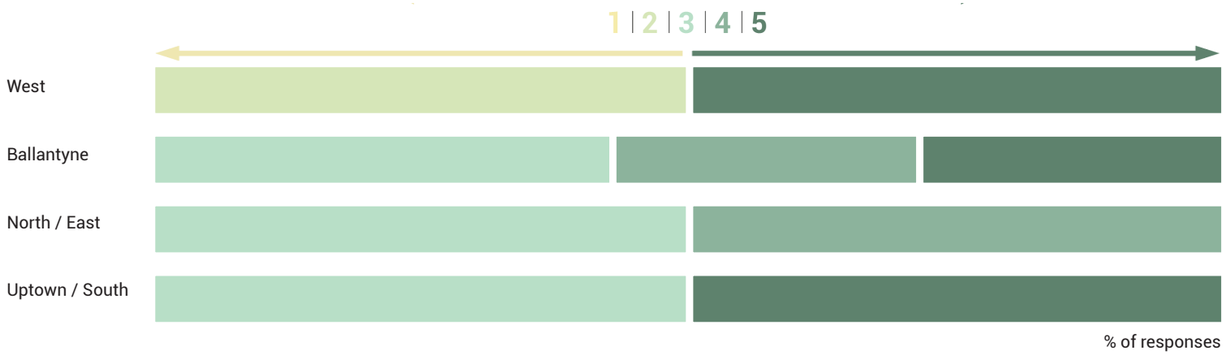
Wellbeing types per community



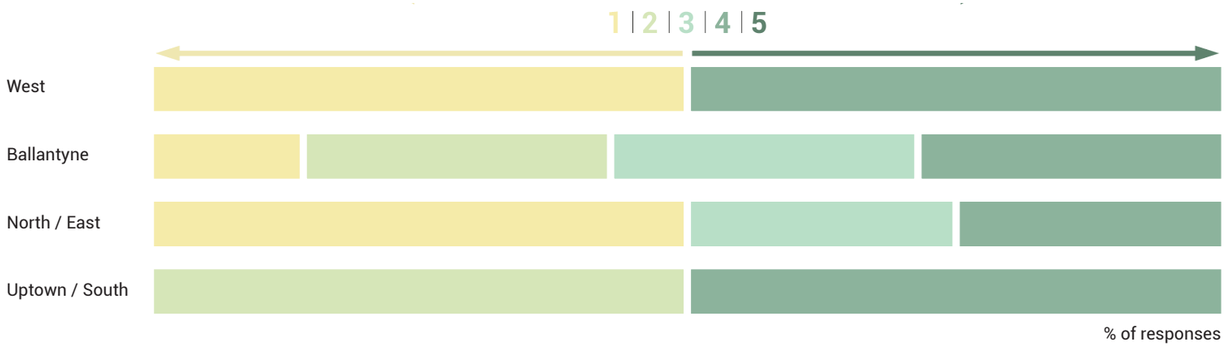
When we analyze the different types of wellbeing being benefitted per community, Uptown / South Charlotte and North/East Charlotte show near-identical patterns, in which physical wellbeing is slightly better represented than mental and social wellbeing. Not much can be said about Charlotte West as it has only one response in total. Ballantyne is an interesting outlier which shows a much higher representation of physical wellbeing with almost no representation of mental wellbeing. This matches the prediction made by both myself and Whitney Feld, president of the Bissel Ballantyne foundation (personal communication, 2025).

Figure 8.9. Vulnerability to environmental hazards
Figure 8.10. Wellbeing types per community

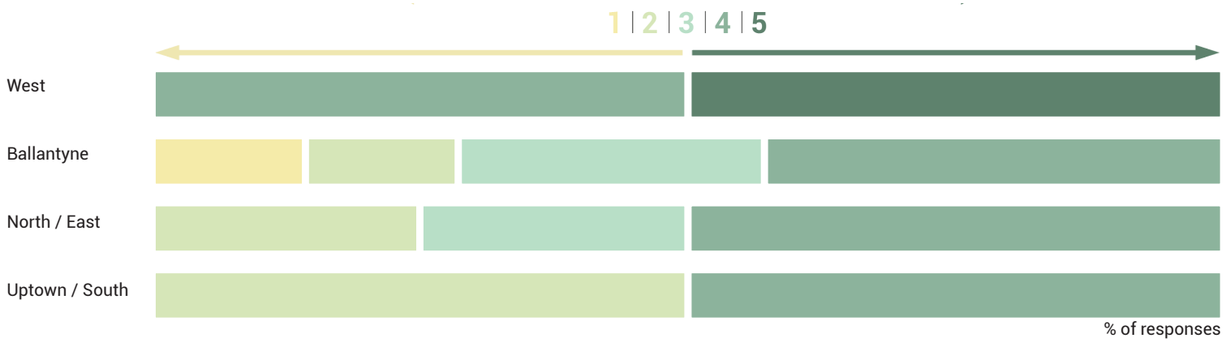
How happy are participants with the quality of their greenspaces? (scale 1-5)



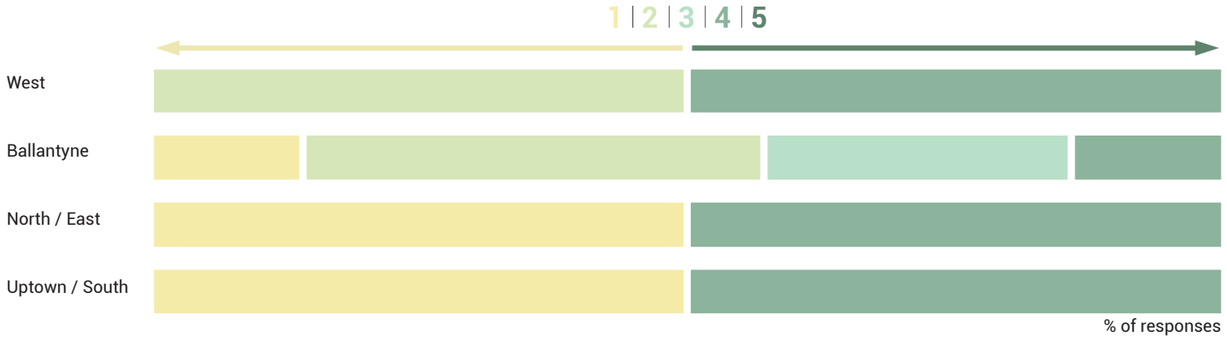
How well do participants feel connected to their local community? (scale 1-5)



How happy are participants with the quantity of their greenspaces (scale 1-5)



How well do participants feel connected to the city of Charlotte? (scale 1-5)



Participants were asked to leave a 1 to 5 rating on how happy they are with the quality and quantity of their greenspaces; and how well they feel connected to their local community and the city of Charlotte. The results show a few interesting patterns. For example. Charlotte West has a good quantity of greenspaces, while struggling in their quality. This can be attributed to the term greenspace being left intentionally ambiguous. Participants might have a different personal definition of greenspaces, resulting in different communities counting different locations as greenspaces. For example, a similar research done in Nova Scotia found that unmaintained spaces next to roads were seen as greenspaces by the local community (LeBrasseur, 2022). Ultimately, there are not enough responses to draw conclusive evidence and more research is required.

Figure 8.11. Quality of greenspaces
Figure 8.12. Quantity of greenspaces
Figure 8.13. Connection to the local community
Figure 8.14. Connection to the city of Charlotte

9.3. Anecdotal insights

Personal greenspace insights

As an optional question, participants were asked if they had any personal story, comment or feedback about their chosen greenspaces. Responses included:

"I like seeing the gardens on UNCC campus and seeing all of the wildlife there." -North / East

"My kids go to the Elon Park fields to play soccer or we play frisbee golf. We also like to take walks with our dog on the walking path off of Marvin road close to Elon Park." -Ballantyne

"Learning to ride horses" -North / East

"This place has a pretty dope mountain bike/mixed use trail" -Ballantyne

"We love to bike ride on these paths with our kids and also take walks with friends" -Ballantyne

All participants responded by stating their activities in more detail. This implies that, for those greenspaces, people are passionate about the things that they do. These personal anecdotes serve as evidence of the types of activities that people will cherish, which could be implemented in designs. Almost all responses describe activities that benefit physical wellbeing. This fits the patterns found during the data analysis.

Meets that are not met

During the third part of the survey, participants were asked optionally if there are any activities / needs that the greenspaces in their environment currently do not provide. This question was more general and not about any specific greenspaces that they chose. Responses included:

"Pickleball courts!"

"It would be great to have areas where families or groups could gather and enjoy each other's company"

"Better connectivity for non-car transportation. The greenways are working to get there but I still need to drive in many cases"

All of the responses came from Ballantyne and sketch a picture of the things residents want and the things that still need to be improved in Ballantyne's greenspaces.

Greenspaces that no longer exist

As an optional 4th part of the survey, participants were asked if there are any greenspaces that they used to go to, but no longer exist. This resulted in three responses. Two of these were the same location, the Ballantyne Golf Course. The golf course closed down permanently in 2021 and got turned into a public park (WBTV, 2021). People seem to miss the golf course, however, this new park got picked by three other participants as their most important greenspace, so it seems like this renovation has been a loss for some people, while its a win for others. The target audience for the new park is larger than the golf course, so the net-profit seems to pay off. The other location that got picked was the "4-mile creek". This greenway seems to still exist around Ballantyne, and I have not been able to find out which part exactly got lost. Regardless, a loss of a part of this greenway has likely led to people no longer having easy access to the larger greenway network, which is a loss for the residents of that neighborhood.

Community colors

At the end of the survey, participants were asked to pick a color that they most associate with their surrounding environment. Two thirds of the responses decided to answer. If I had more responses, this would have been used to make a visual map of colors throughout charlotte. I was curious to see if there would be different colors per community. The result shows that most people picked a different shade of green, but three people decided to go for a more bold choice, going for blue, yellow and brown.

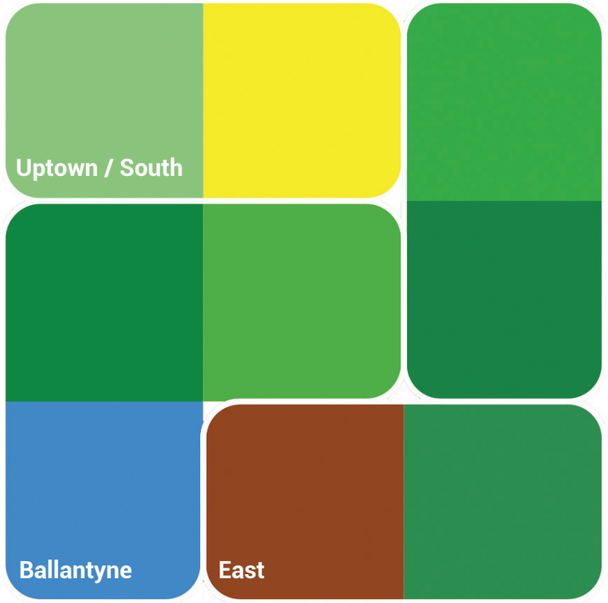


Figure 8.15. Color distribution

Final comments

As the final question, participants were asked if there were any final thoughts they wanted to share. The responses were:

"*I am lucky to be able to use greenways and residential streets to safely bike around my corner of Charlotte"* -Uptown / South

"There's are tons of awesome greenspaces around the area, I like what is being done here!" -North / East

"Time in Charlotte: 3 years" -Ballantyne

"I would love to see more greenspace. It seems that all of the greenspace in Ballantyne is disappearing and turning into housing. It is concerning not only for loss of greenspace but it doesn't seem that our infrastructure is set up to handle all of the extra people. Thanks for your work!" -Ballantyne

This final comment shows that the disappearance of greenspaces, while disproportionately affecting the minority concentrated communities, is happening everywhere. It is not an isolated issue and it is of concern to everyone. The proposed greenspace solutions will thus be of benefit to everyone in the city.

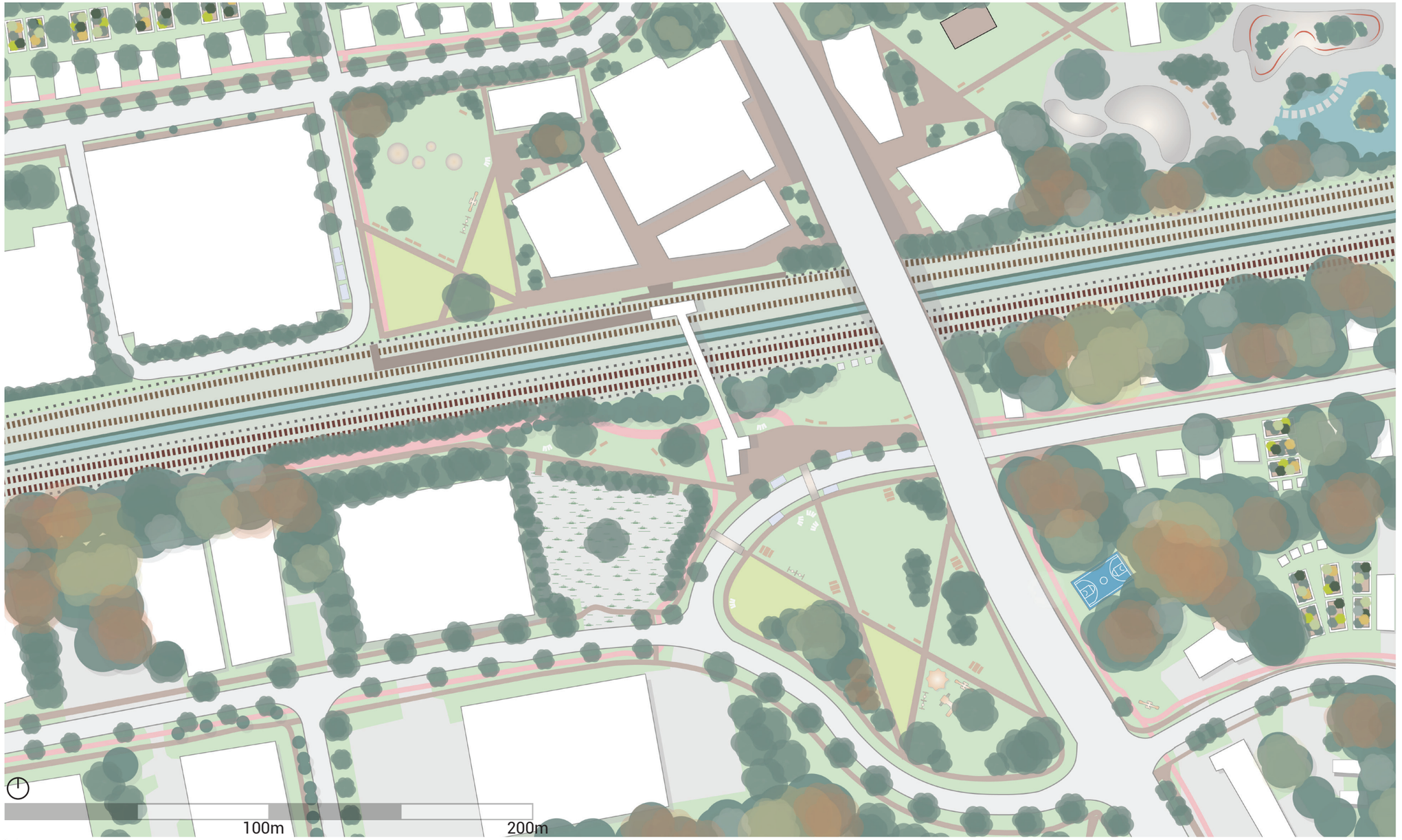
9.4. Conclusion

While the data shows a few interesting patterns, there is unfortunately not enough data to suggest real evidence and more research is required. The survey remains as a showcase of what direction future research could take, and how surveys could aid design based research.

The anecdotal insights serve as interesting stories from local people and their experiences with greenspaces in their surrounding.

09

Community-based Design

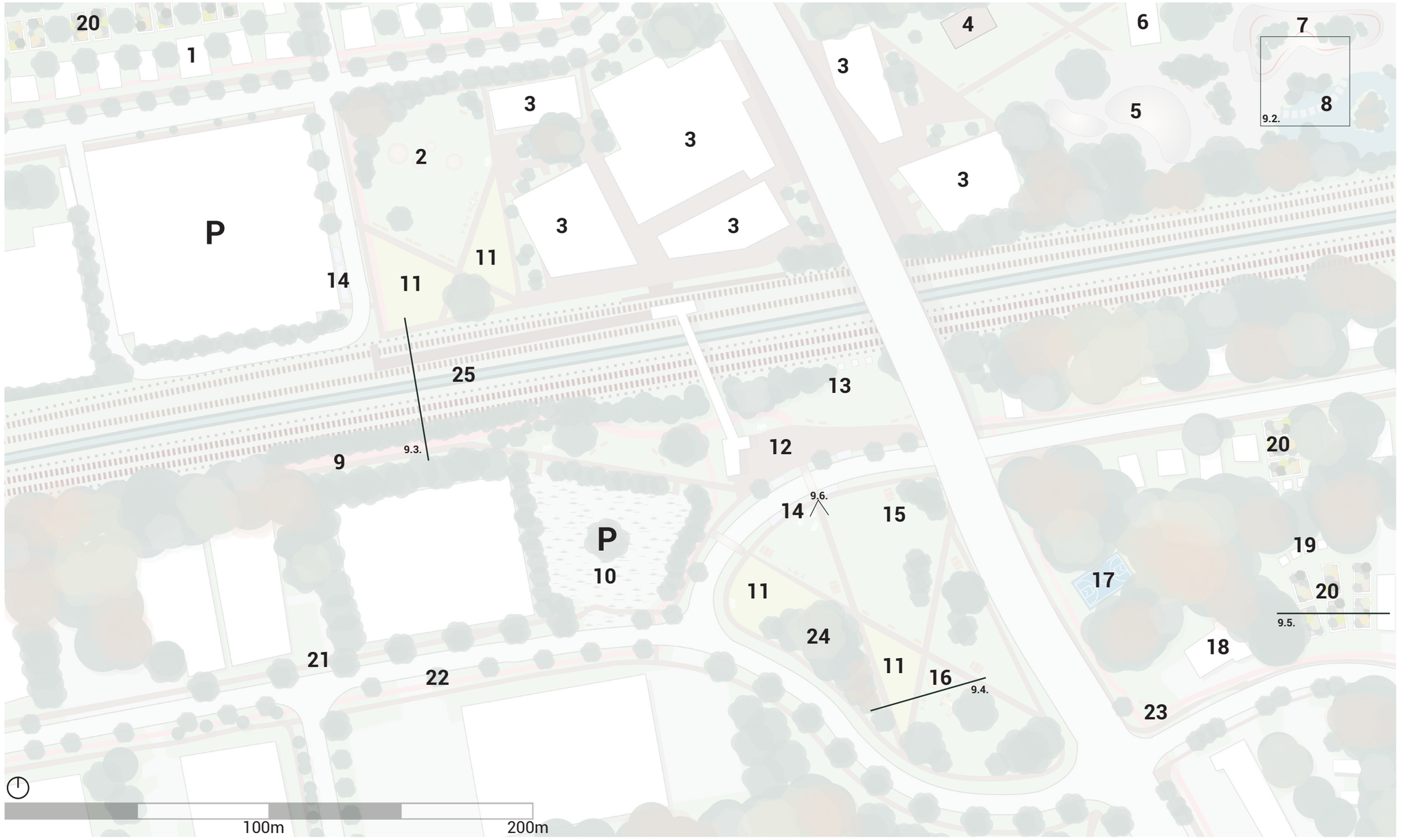


9.1. Sugar Creek Train Station

This design of the train station of Sugar Creek combines everything learned during the scenarios and the survey results into one coherent final design that incorporates all forms of human wellbeing. Community-led designs are key here, to prevent the displacement of the current residents. As I can not truly design community-led initiatives, I've taken inspiration from projects happening elsewhere in the city. For example, last year a new local retail development in West Charlotte by the Whitaker Group came with the first privately black-owned skatepark in the country. This project was a response to an issue brought to light by the local skateboarding community (Clinton, 2024. Metts, 2024). Another concept that I take inspiration from is the People's Porch in Charlotte's Enderly Park neighborhood. This is a multi-purpose community space developed in 2022 that can house meetings, events, workshops and more (SILO, 2022).

The residential areas got new communal vegetable gardens. Growing crops is something that not many residents know how to do, but it is something that the community members are interested in learning (Fant, personal communication, 2025). A first step to achieving a design like this is to teach the residents about the inequity they are facing, and the tools that they have to combat it. A design for a place that benefits this idea will be explored in chapter 10. This design is the result of successfully encouraging both the current residents and developers to cooperate.

Figure 9.1. Sugar Creek station - final design



1. New affordable housing
2. Spring - fall: Art made by local people
   Winter: Ice skating
3. Local stores & restaurants
4. Public music stage, anyone can play
5. Skate park
6. People's Porch
7. Pumptrack
8. Bioswale with stepping stones / a sitting area inspired by the room for the river project (H+N+S Landscape Architects, early 2015).
9. Green walking & biking corridor
10. Permeable pavement
11. Native plant meadow
12. Bike parking
13. Charlotte's railway history explained
14. Bus stops
15. Moveable seating
16. Playground
17. Basketball field
18. Church
19. Small animal habitats / Bug hotels
20. Communal vegetable gardens
21. Extended sidewalks
22. Trees separating the sidewalks / bike lanes from the car road
23. Bike lanes
24. Native trees expansion
25. Bioswale along train tracks

Figure 9.1. Sugar Creek station - final design

Figure 9.2. Impression of the water retainment area and pumptrack

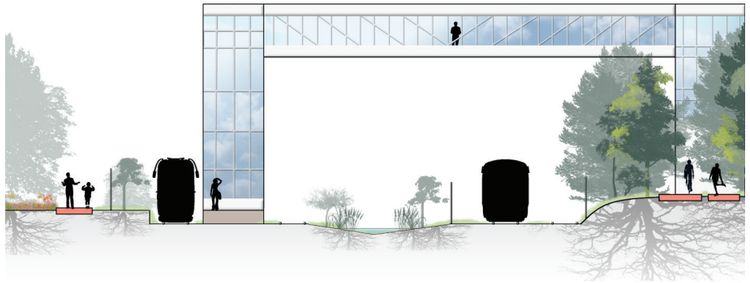
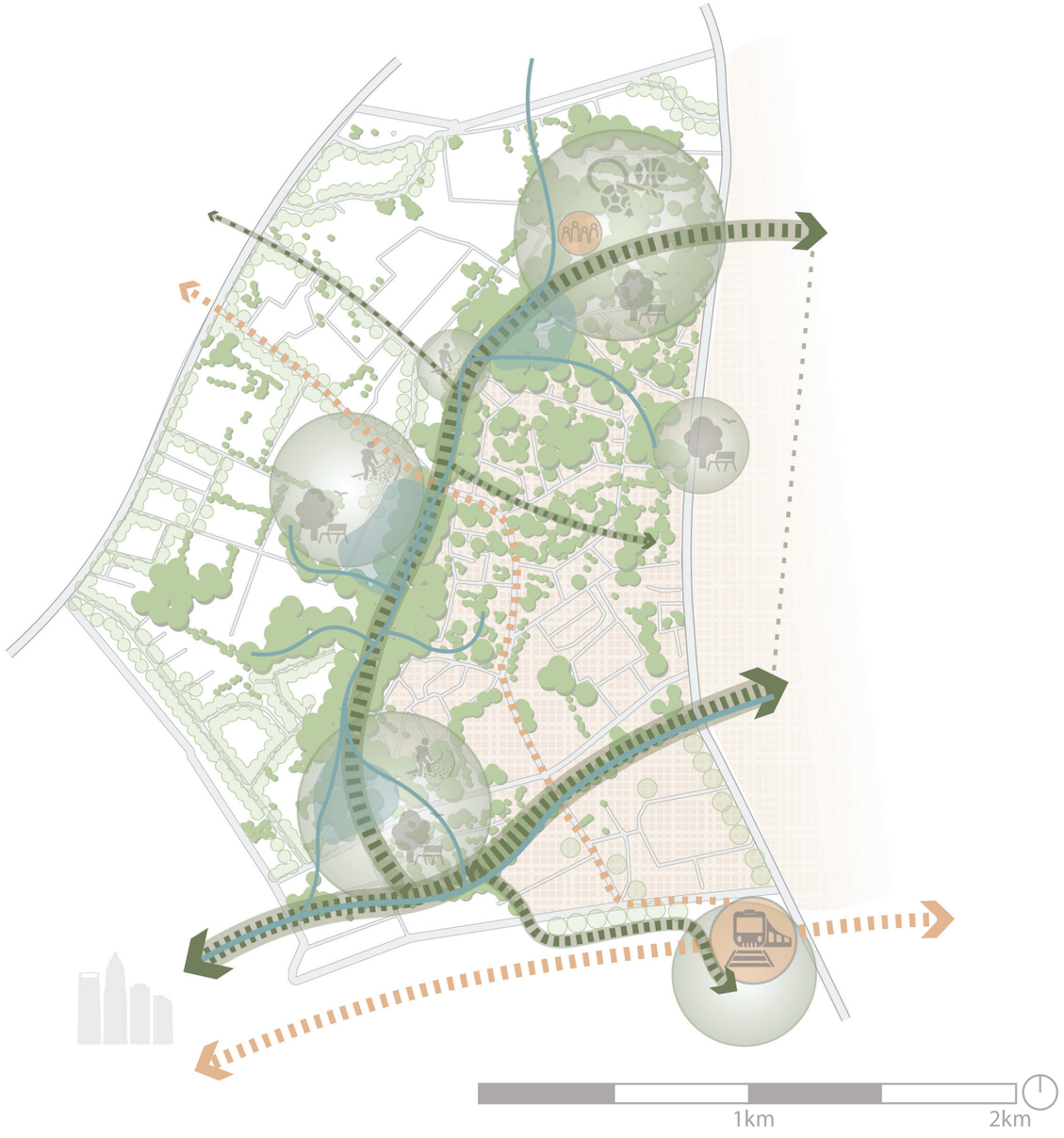


Figure 9.3. Section of the station, bioswale and green corridor

Figure 9.4. Section of the park south of the station

Figure 9.5. Section of the residential area with community vegetable gardens

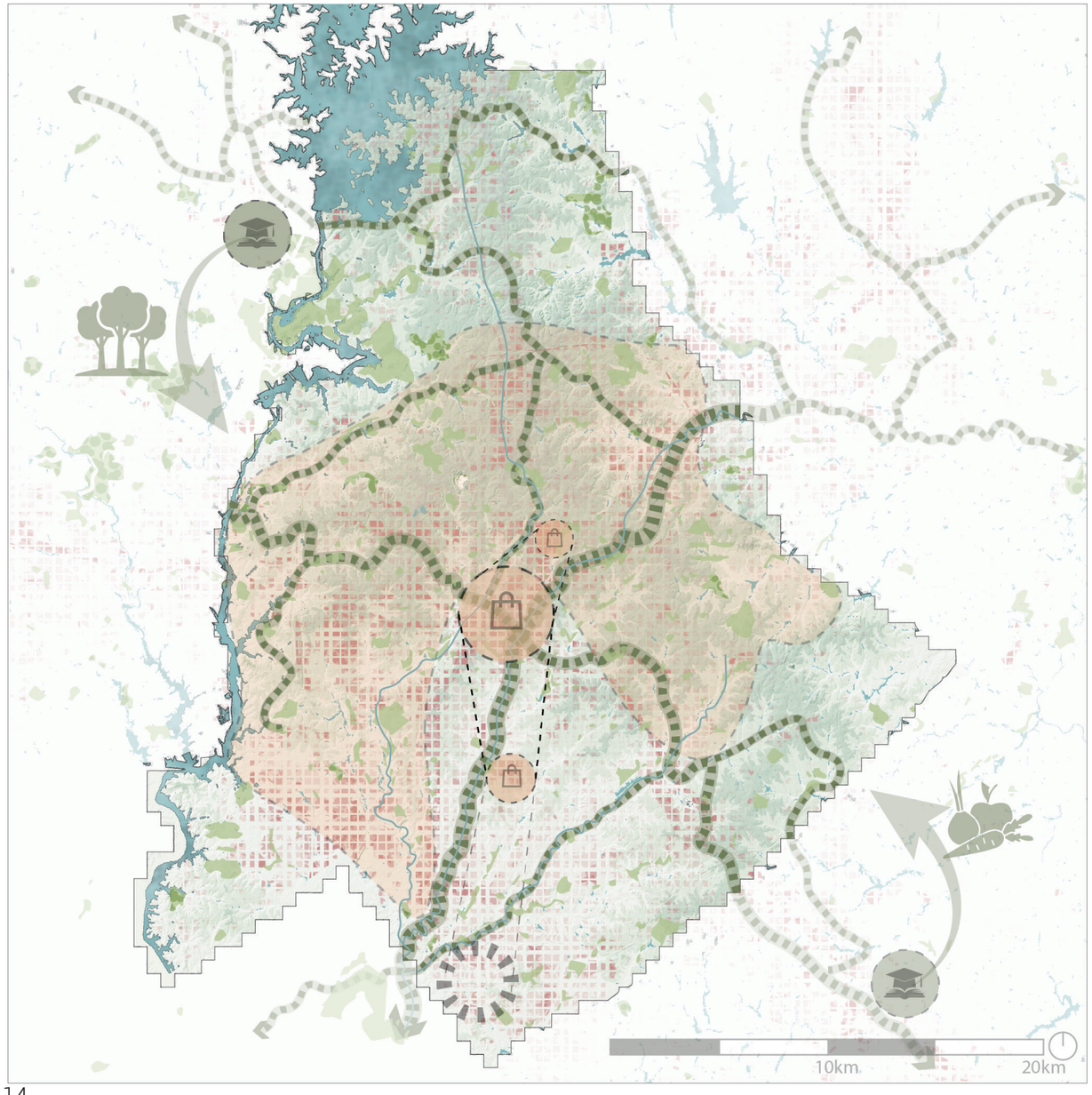
Figure 9.6. Perspective of the park south of the station



9.2. Sugar creek

The tree line that separates residential areas from the adjacent industrial zone has been reimagined as the backbone of this design. It creates a safe accessible network for pedestrians and cyclists, promoting active transportation through the neighborhood. Streams and creeks, previously obscured or underutilized, have been restored and integrated into a continuous green infrastructure, inspired by precedents such as the Little Sugar Creek Greenway (Carolina Thread Trail, n.d.). This structure is connected to the station, removing the need for cars when living in this neighborhood, resulting in cleaner air. The expanded parks will help cool down the surrounding and seep rainwater into the ground. Any access water can now more run through the creek system with more ease, reducing the overall risk of floods. A large water retainment area is developed in case of extreme scenarios where the standard measures are not enough. The green structures provide different uses in different areas, like an area for sports north, and an area for relaxing nature walks west. The green structures stretch further beyond this map, strongly connecting Sugar Creek with the rest of the city.

Figure 9.7. Sugar Creek - final design



9.3. Mecklenburg County

The green corridors spread through the entire city and beyond, as planned by the Carolina Thread Trail (Carolina Thread Trail, n.d.). Plans for a renovated South Park will make the place function as a new core of the city (Southpark Community Partners, personal communication, 2025., Chase et all, 2024). This will hopefully activate communities like Ballantyne to become more involved with the city of Charlotte. These communities are currently self-sufficient, with residents not commonly going outside of the neighborhood. South Park used to be this way, but young people moving in has caused this mentality to change roughly 10 years ago.

Outside of the city, two educational areas will be created. One of them is a tree nursery. This will provide older trees for the city, so whenever new trees are needed, they will no longer need to grow for a long time before they start to benefit the communities. School trips to this nursery could be held to educate residents on the benefits of trees. This is something that is necessary as many residents do not want trees as of right now. For example, they fear that a tree will fall on their roof and that they cannot afford the repairs. The second educational center will be the Green Village of Charlotte. This area will teach people what nature-based solutions exist, the importance of them and how they can apply them. The main focusses will be on food production and biodiversity. This green village will be further elaborated in chapter 10.

Figure 9.8. Mecklenburg county - final design

Before

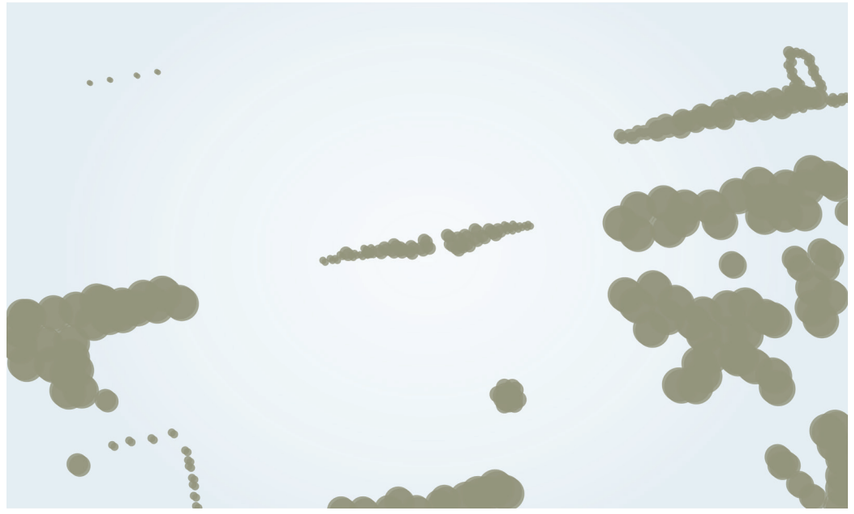


Figure 9.9. Zoom in - Tree canopy coverage - Before

Figure 9.11. Trees visible from homes - Before

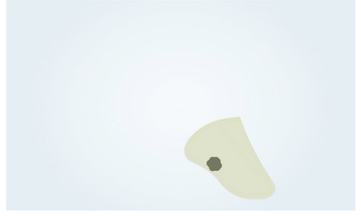


Figure 9.12. Parks - Before

After

Figure 9.10. Zoom in - Tree canopy coverage - After

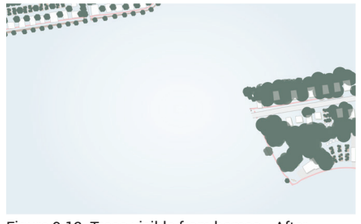


Figure 9.13. Trees visible from homes - After

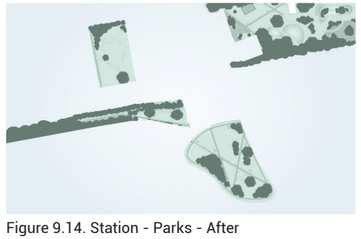


Figure 9.14. Station - Parks - After

9.4. Testing the design

As discussed in the analytical frameworks, the 3 - 30 - 300 rule can be used to check if a design fits the different types of human wellbeing. For this design, the existing situation has been compared with the new situation to see if the issues regarding human wellbeing have seen a significant positive impact after the design (Konijnendijk, 2023., World Health Organization, 2010). The 3 - 30 - 300 rule is designed to be tested on a small, local scale. For example, the 30% tree canopy coverage has to be tested in your direct surrounding, and cannot be tested for an entire neighborhood. This is because the impacts of a large greenspace relatively far away does not equate to the impacts of trees directly surrounding you, even though the community-wide percentage might look the same. This is seen when tested on the design for the Sugar Creek community. The existing situation already has 33,4% tree canopy coverage, even though large areas have a lack of trees when zoomed in. The new design has increased the number to 48,9% which is very close to the city's goal of a total 50%. This issue in scale also explains why the 45% total canopy cover of Charlotte is not representative for the 3 - 30 - 300 rule (shoemaker et al., 2020). This is why, in order to test my design, the 3 - 30 - 300 rule is tested on the smallest design scale, representing the design strategies used elsewhere throughout the whole design.

Figure 9.15. Sugar Creek - Trees canopy cover - Before & After

3 trees visible from homes - Mental wellbeing
The existing situation already passes the first rule, as all homes in this area have trees surrounding them. Therefore, not much has changed for this rule. The newly developed residential area has trees planted around the houses to make sure this new area fits the rule as well.

30% Tree canopy coverage - Physical wellbeing
The total area of this scale is around 177.000 m². The existing situation has a tree canopy coverage of 15,7%, roughly 27.800 m². This is far from enough, which has a serious impact on the physical wellbeing of the residents in this neighborhood. The new design has increased the tree canopy coverage to 31,3%, or roughly 55.500 m². This is just over the minimum set by the 3 - 30 - 300 rule. This is not a bad score, considering that this is the hardest rule to conform residential areas to, with many cities unable to reach it, or opting for a 30% grass coverage instead which does not fit the research that backs the guideline (Konijnendijk, personal communication, 2024).

300 meters away from park - Social wellbeing
The existing situation barely delivers on the 300 rule, offering one greenspace that only some homes can reach within 300 meters. The quality of this greenspace is very low, as it's nothing more than a large piece of grass with a single tree. Personal observations showed that it is not being actively used by the local residents. The new design offers more parks of higher quality, ensuring that there is always a park reachable within 300 meters of someone's home.

Conceptual framework

Another way to test the design is by following the guidance given by the conceptual framework. As the design is a delicate balance between the five design experiments, it follows all the aspects that are mentioned in the framework's idea of placemaking. More precisely, permeability and heat stress have gone up as a result of the new parks and trees. Pedestrian activity is promoted via the new sidewalks, which feel safer due to the trees planted in between the road and the sidewalks. There are more modes of travel promoted via the new bus stops and bike lanes. Social networks and street life are encouraged with the new community center and skatepark.

In summary, the most important parameters of the conceptual framework that guided my design were permeability, heat stress, pedestrian activity, safe environments, community networks and local business ownership. However, I was not limited to these aspects as all aspects from the framework were taken into consideration and there are more examples found in the final design than the aforementioned ones.

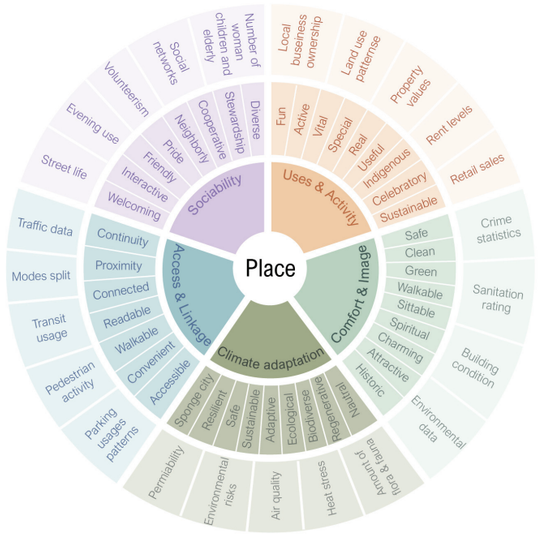


Figure 9.16. Conceptual framework

9.5. Conclusion

An important first step is educating people on the injustice that they are facing via concepts like the Green Village of Charlotte. Community-led designs that follow up on these nature based solutions are key to preventing the displacement of the residents who live there now. The following chapter will go in detail about a possible location that can provide those needs.

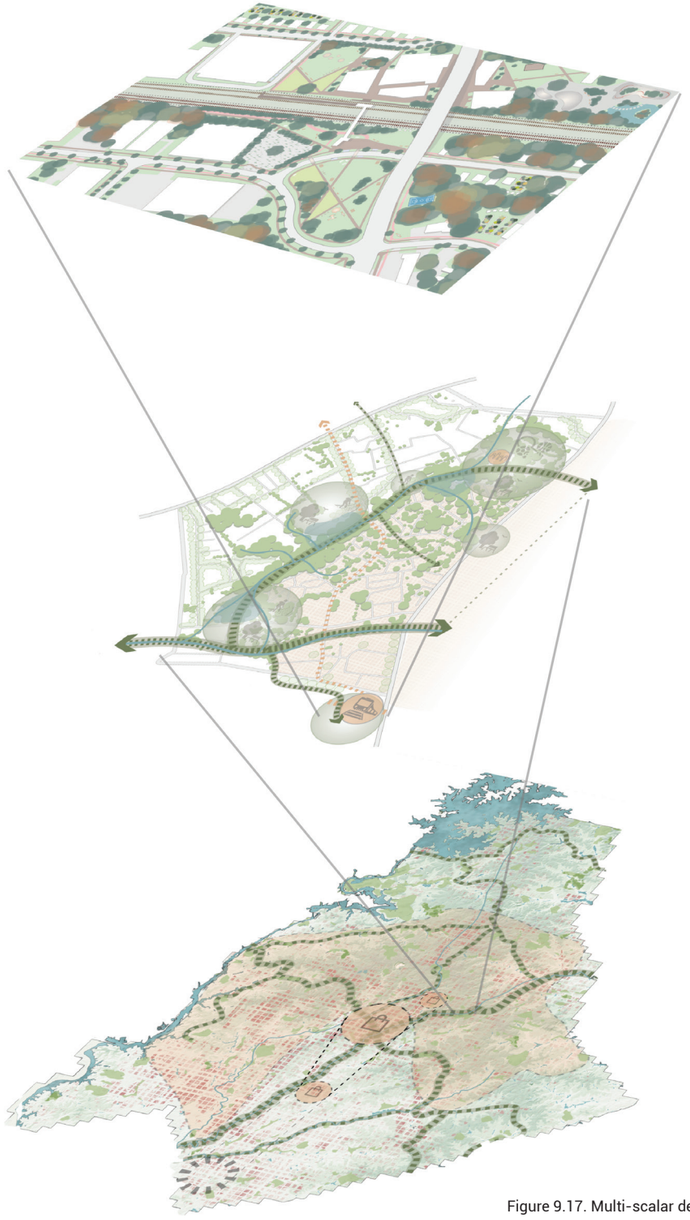


Figure 9.17. Multi-scalar designing

10

The Green Village of Charlotte

10.1. Existing situation

Figure 10.1. Existing situation

This piece of land is located in Union county at roughly half an hour drive from Charlotte's center. It is owned by the Gambrell Foundation and is currently being used as a farm for growing all sorts of vegetables, named the Basket Case farm. The produce is donated to communities in Charlotte who need it the most. Ideas exist to turn the farmland into a place of education and discussion, but this has never been developed further as of yet. A large portion of trees has been cut down to get an idea of the area, but most of the land remains untouched nature. The land has been in the owner's possession for generations. Despite many offers to sell the land to developers, they do not plan to sell their land. Most developers want to turn it into a new mall area. This is the opposite of the vision of the foundation. This chapter will explain my design for the land in detail. (Members of the Gambrell Foundation and Basket Case farm, personal communication, 2025).

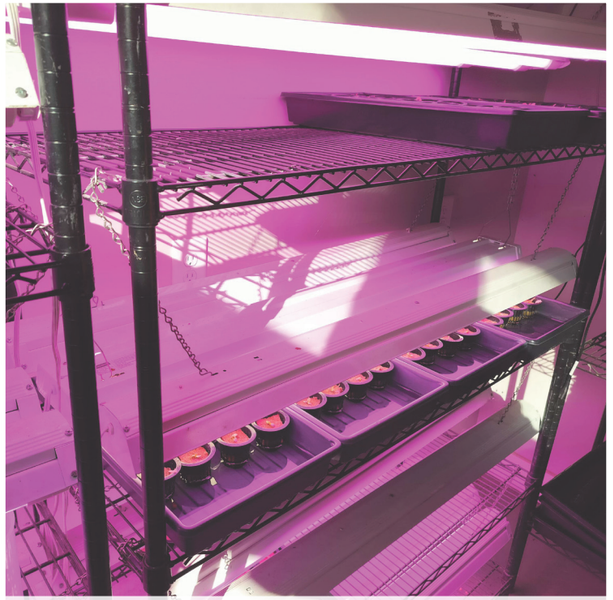


Figure 10.2. Photos of the existing situation

10.2. The Green Village of Charlotte

Figure 10.3. Large scale design

The existing farm remains private property for growing crops and experimenting behind the scenes. My new design fits within the mowed down area. It took inspiration from projects like the San Juan Capistrano ecological center, the Shelburne farms, the New Eden project and the green village of Delft. My design is a center for education, discussions and fun. Schools can plan trips to come over and learn about urban agriculture and the importance of ecology. Local communities can come over to learn what is possible to improve their livability, and they can have discussions for planning local initiatives. Having these discussion meetings away from their neighborhood in a space with a lot of inspirations might help to give the community members a fresh perspective during the discussions.

Arrival

The site is designed to be visited by school trips, communities and families. The parking lot is made out of a permeable pavement like gravel and has space for roughly 70 cars. Busses can also be parked here. The parking lot lies across the road from the main grounds. For special events that might attract more visitors, the parking spaces can extend into the grass surrounding the parking lot. The addition of a bus stop, while difficult to achieve, should be considered to make the site more accessible.

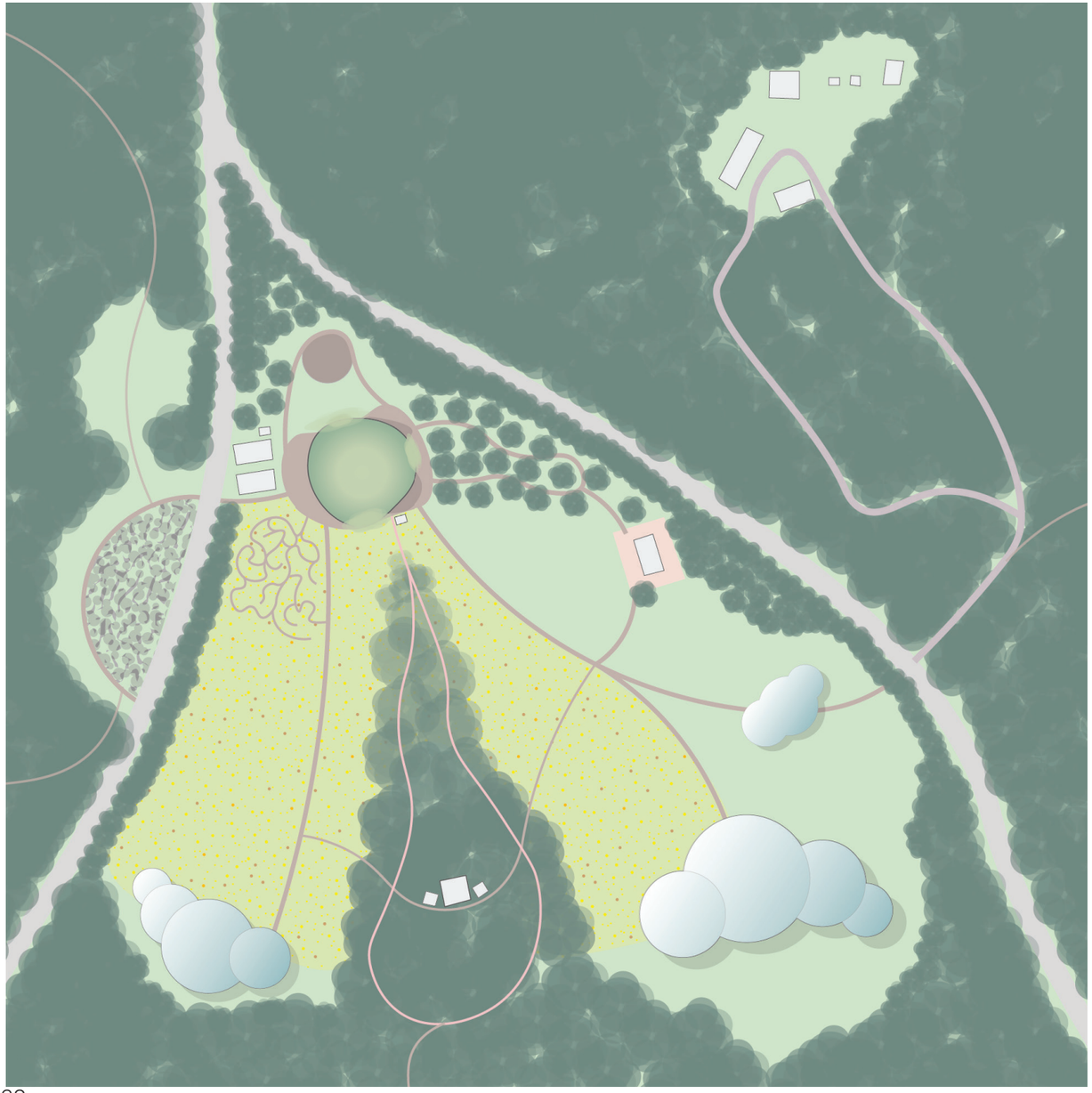
When visitors first enter the grounds, they will be greeted by small greenhouses that act as a teaser for what's to come. The path will then bring them towards the main plaza. Most of the activities are densely placed around here. The main building serves as a welcome area. There will be multi-purpose rooms, an office space and a restaurant. The offices are a more privatized space for the foundation which can be visited by other organizations who might want to develop something in the green village. The restaurant serves meals made using locally sourced crops and fruits. This means that the menu has seasonal availability. It will show not only how to grow crops themselves, but also how to use them. Cooking workshops will be held that teach people how to make those meals themselves. The roof of the main building is connected to the ground at certain areas. This makes it accessible to be walked on and used as an outlook point where you can sit down for a bit. The three main greenhouses are large and inspired by the New Eden project. Notice in the section how the ground declines towards the south. This means that you can look over the greenhouses when you're standing on the roof of the main building.

Ecological trail

There are many trails running through the area. One of these is the ecological trail. It sits in the middle of the main grounds. Vegetation of varying heights are used to create a transition upwards towards the forest. This can be observed well in the section. It is a short and easily accessible stroll that has a lot of signage, a watch tower and a microhabitat hunt.

The importance of educating

Many people in minority-concentrated communities are not aware of the way they are being marginalized. For example, organizations like Sol Nation still need to educate these groups on the use of solar energy (Fant, personal communication, 2025). In order to combat environmental injustice, people first need to be aware of the possibilities they have for a better livability. Only after this can community-led initiatives take shape. The green village of charlotte can act as both the place for education, and the place for developing those community initiatives.



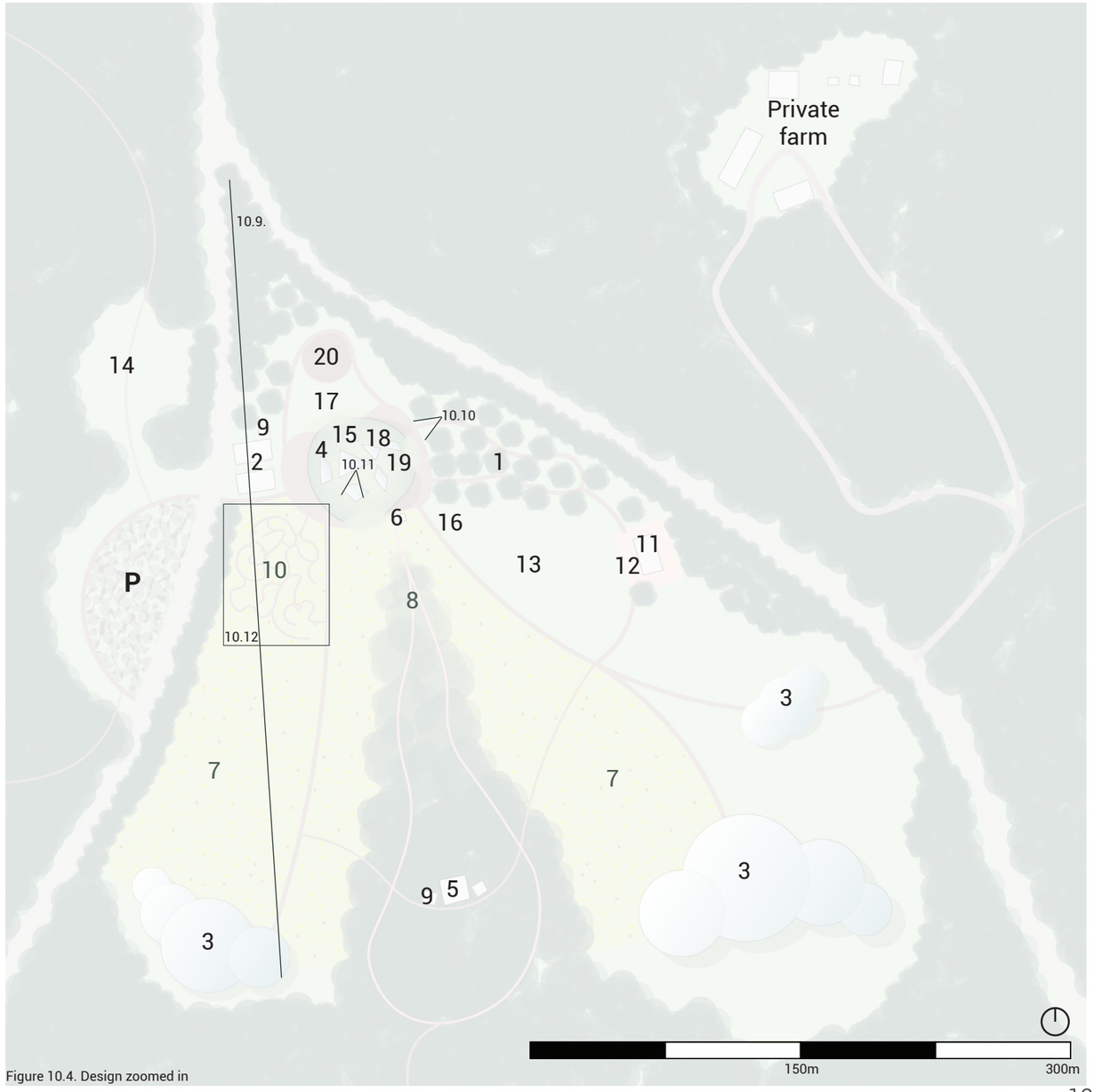
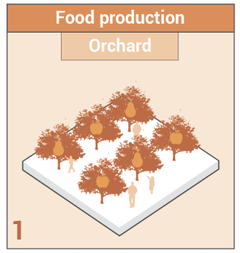
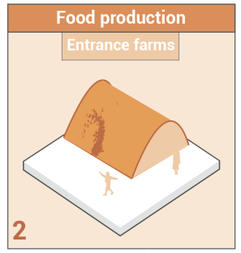


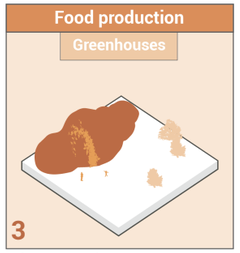
Figure 10.4. Design zoomed in



An orchard of varying fruit trees and bushes that showcases how a food forest could function within a community. It also creates fun activities during harvest seasons.

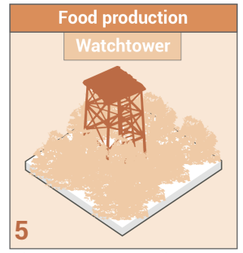


These small green houses are placed right at the entrance to immediately get people into the food production atmosphere. They are a small teaser of what's to come.

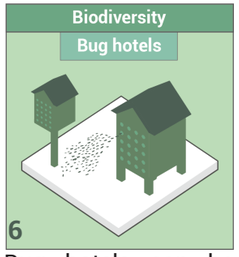


Three large green houses act as the main food production of this farm. People can get introduced to all sorts of crops that they can grow at home. They could plant a fast growing crop like a radish and come back later to harvest it.

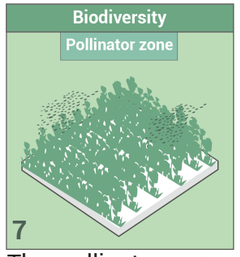
The restaurant will regularly host cooking workshops. These will teach people what they can make using the crops that get grown on-site. It will have varying menus depending on the season.



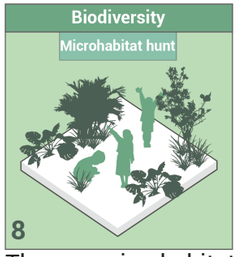
The watchtower provides a great view over the whole site. It will help people see the situation from a different perspective.



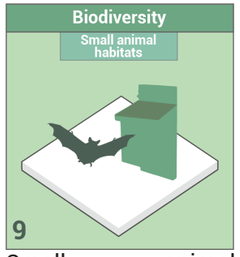
Bug hotels can be found all over the site. They will house a variety of insects like solitary bees, ladybugs, lacewings, worms and ants. Each hotel has signage that explains the ecological role of the insect it houses.



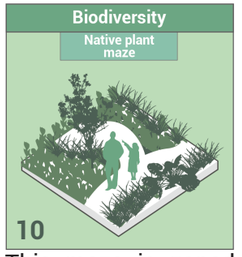
The pollinator zones are large fields with a variety of native flowers. They fill up the empty spaces in the design and showcase the importance of native plants in an ecologically robust system.



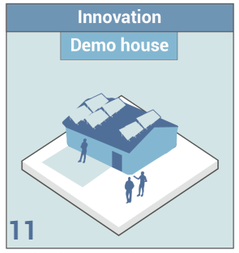
The microhabitat runs is a part of the ecological trail. There will be a QR code that leads to a website where you can upload photos of animals spotted during your visit. This way visitors can contribute to the collection of local ecological data in a fun way.



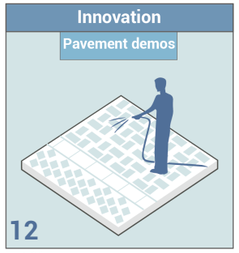
Small animal habitats showcase what people can do to help animal in their community. These habitats includes bat boxes, hedgehog shelters and bird nesting boxes.



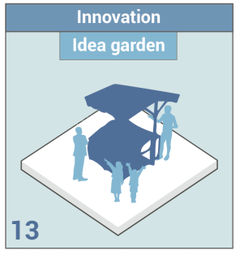
This maze is zoned into different sections that teach visitors about the important native plants in this region. The signage will not only go into detail on the ecological, but also the cultural value of these plants.



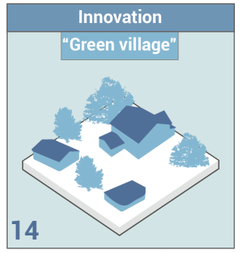
This house is created to look just like an ordinary house in Charlotte. It will be open to visitors and showcase what they can do to innovate their house. Think of solar panels, gray water systems and passive heating / cooling



Different pavement options in front of the demo house can be hosed by visitors to showcase what happens to rain water. Signage and flood maps can be placed with texts like “This surface absorbs X gallons per hour”.

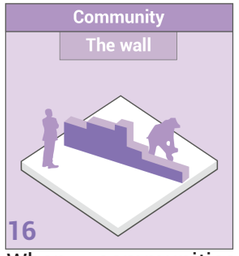


This is a place where during summers or special events people can get stalls or temporary installation to showcase innovative new ideas to visitors. The idea garden thus keeps cycling what's on show.



The green village is an area outside of the main grounds that acts similar to the green village of delft. Developers can test their ideas for new nature-based designs here and use it to showcase it to investors. The village will grow over time.

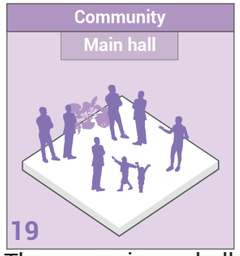
The makerspace is an indoor area where visitors can learn or experiment with making their own animal habitats, planters etc. They can take these home afterwards.



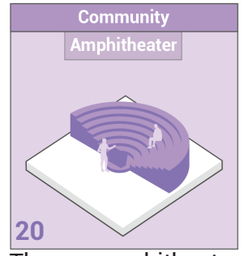
When communities gather here for discussions, they can place a brick with text written on both sides. People will be answering a question on both sides. “What is blocking your community?”. and “How do we tear this wall down?”.

A small section where people can leave seeds and take seeds with messages. This encourages both ecology and interaction.

These rooms can be used for multiple purposes depending on the audience. When schools come over, they can be used as classrooms. When communities have meetings here the rooms can be used to spark discussions.



The main hall functions as an entrance where people can sit down and meet others. It will have easy access to important utilities like bathrooms, info desks, the office area etc.



The amphitheater can be used during large events, school trips and community meetings as an outdoor version of the education / discussion rooms.

Figure 10.5. Explanatory tiles

Figure 10.6. Elephant house, Zurich zoo

Figure 10.7. museum of ethnography, Budapest

Main building

The main has a green roof that connects to the ground, making it flow into the landscape. Large glass frames pop out of the ground and act as both the entrance and daylight sources for the inside of the building. The overall shape takes inspiration from the elephant house of the Zurich zoo (Markus Schietsch Architekten, 2014) and the main building of the New Eden project. The roof is inspired by the museum of ethnography in Budapest (NAPUR Architect, 2016).

Figure 10.8. New eden project

Greenhouses

The greenhouses are very similar to those in the New Eden project, although smaller in scale (Grimshaw architects, 2001). Their round shapes will fit the main building, but the material usage is vastly different which makes them stand out in an elegant way in the landscape. The height difference in the terrain makes it so that when a visitor enters the site, they will look down towards the greenhouses, so they will not block the view of the trees too much.

Figure 10.9. Design section North to South

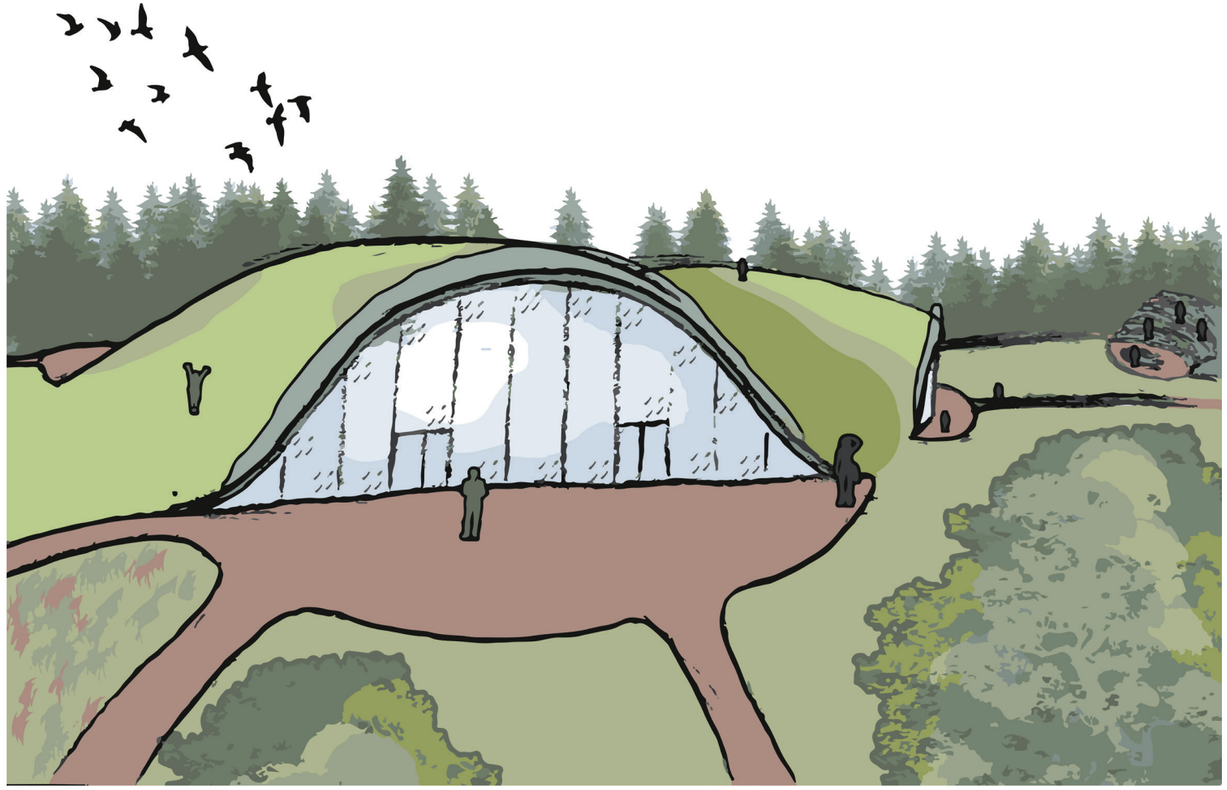


Figure 10.10. Birdseye perspective of the main building

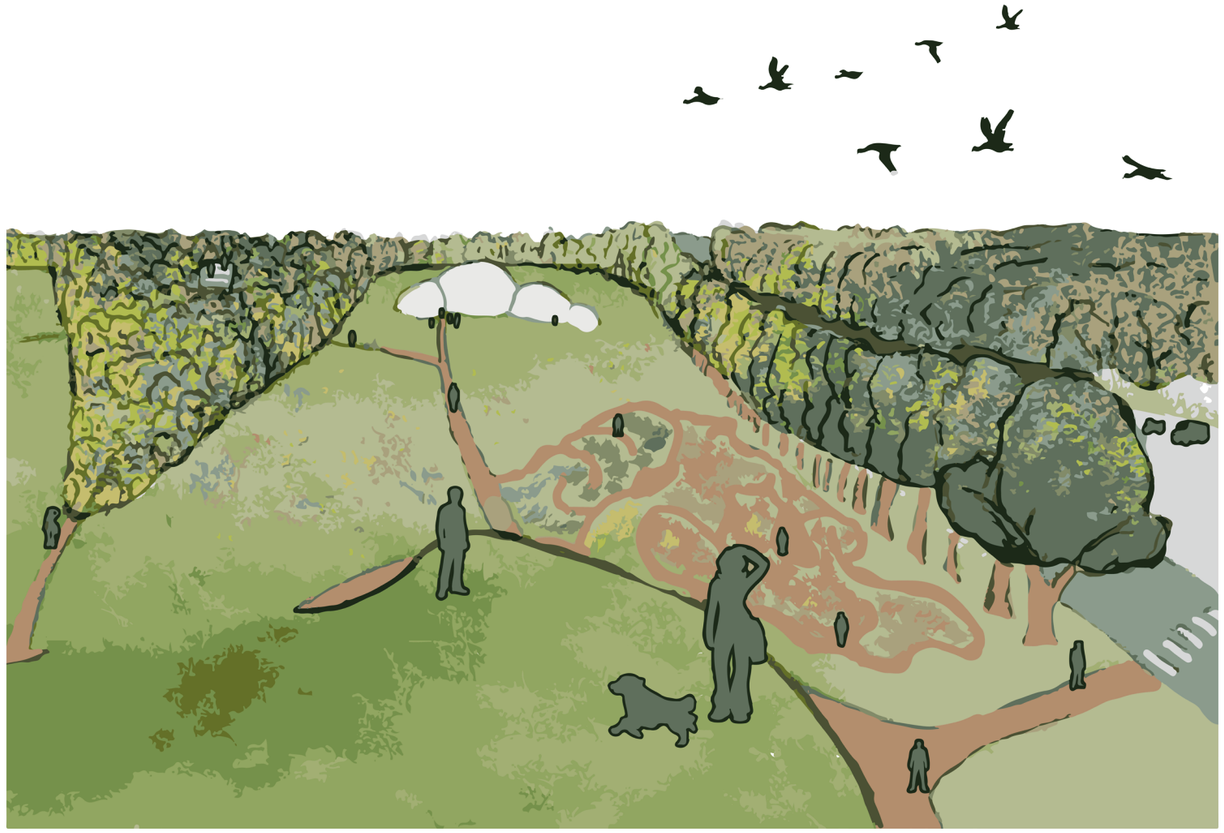


Figure 10.11. Birdseye perspective looking South

10.3. Native Meadow Maze

The native meadow maze is designed more as a fun area for education than to be a challenging maze. The paths will be somewhat easily visible as most plants don't grow very tall. Most paths connect together, and the dead ends will have information signage about the plants that surround you. This makes dead ends worthy of seeking out, rather than a wrong turn. This should stimulate exploration. There are three entrances to the maze. These also function as exits.

The maze is divided into eight zones. Each zone has a different planting scheme. They are designed in a way that there is always something going on at each moment in time. This means that, when one species stops blooming, a next one will come up. Most zones also have something going on in winter in terms of evergreens or other vegetation. The plants are also grouped together to have similar soil conditions. Some zones need to be watered while others do not. Each plant is also carefully picked for its visual beauty, its ecological value and its history. Some species hold stories about the native people who lived in the area long ago.

The zones are placed close together to form different areas. For example, all the zones with flowers that have strong scents are placed close together and border a scent garden hidden in the maze. The same is done to create a butterfly garden and a garden for picking berries.

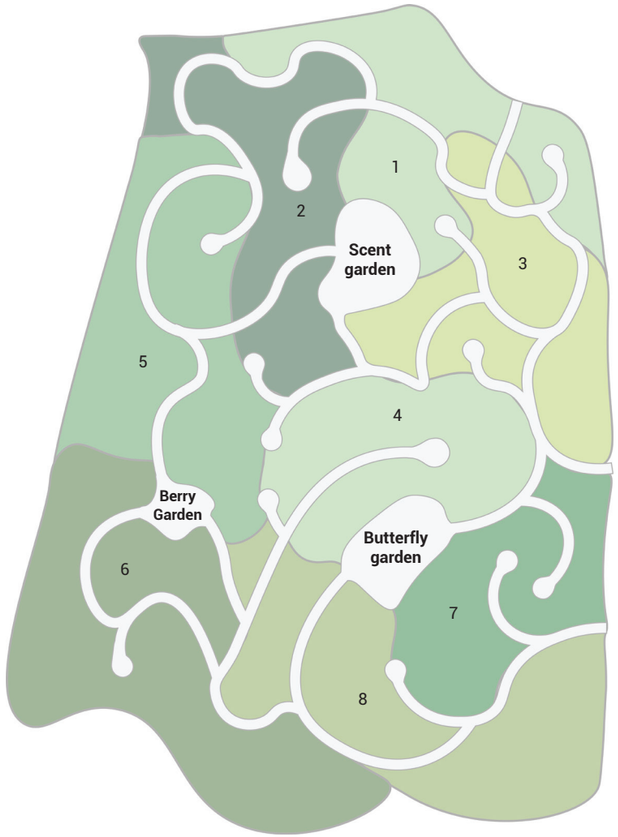


Figure 10.12. Inside of a greenhouse
Figure 10.13. Layout of the maze

Zone 1

Carolina Jessamine

Gelsemium sempervirens

Blooms January to May
Evergreen

The flowers bloom in January, providing an early nectar source. However, the flowers are toxic to people. It has a sweet candy-like scent and climbs up against structures.

(North Carolina Native Plant Society, n.d. Mooney, 2014)

Beepalm

Monarda didyma

Blooms May to September

This plant attracts hummingbirds for its nectar and spreads fast. It was known as Oswego tea, used by American colonists as a substitute for black tea. It smells like bergamot orange.

(North Carolina Native Plant Society, n.d. North Carolina State University, n.d. McAlpine, 2024.)

Soil condition:
Medium moisture, well drained loam

Zone 2

Blue Phlox

Phlox divaricata

Blooms March to May

The blue phlox is one of the first wild flowers to bloom in spring, making it vital for early nectar. It has a sweet, clove-like scent.

(North Carolina Native Plant Society, n.d. Gardenia, n.d.)

Garden Phlox

Phlox paniculata

Blooms July to September

The garden plox is known for its importance to butterflies and its strong scent. It has a strong, sweet, floral fragrance.

(North Carolina Native Plant Society, n.d. Gardenia, n.d.)

Soil condition:
Medium moisture

Zone 3

Tickseed

Coreopsis verticillata

Blooms March to August

Don't let this plant's name startle you, this plant has nothing to do with tick insects. If you look closely, you will see that the name actually comes from its whorled, circle-like arrangement of leaves.

(North Carolina Native Plant Society, n.d.)

Aster

Symphyotrichum oblongifolium

Blooms August to November

Asters bloom late into the fall, providing vital nectar for bees and butterflies. Its dense, mounding form make it ideal for pollinator gardens. The plant is drought-tolerant and requires low maintenance. The leaves have a spicy scent when crushed.

(North Carolina Native Plant Society, n.d., Praire Moon Nursery, n.d.,)

Anise Hyssop

Agastache foeniculum

Blooms June to September

Anise hyssop adds color, scent, and pollinator value to any garden. It's drought-tolerant, deer-resistant, and thrives in full sun. The plant has a sweet, light licorice / anise aroma.

(North Carolina Native Plant Society, n.d., Osorio, n.d. McAlpine, 2024.)

Soil condition:
Dry, well-drained, sandy loam to clay loam

Zone 4

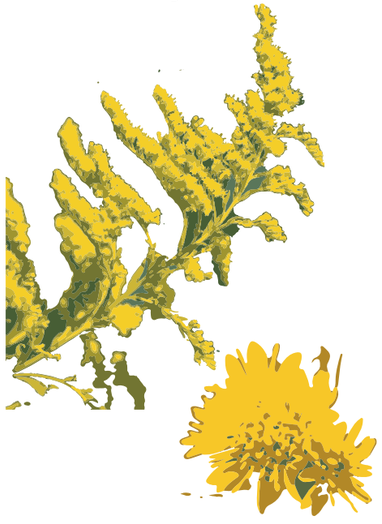
False indigo
Amorpha fabales

Blooms April to June

The false indigo is great at withstanding droughts and goes well with other drought-tolerant plants. This plant improves soil fertility via nitrogen-fixing, drawing nitrogen from the air and converting it into a form that benefits surrounding plants.

(North Carolina Native Plant Society, n.d.)

Golden rod
Solidago asterales



Blooms June to November

In this region, 102 species of butterflies and moths use this plant as a host for their caterpillars. It thus plays an important ecological role in the local ecosystem. The leaves smell like black licorice when crushed.

(National Wildlife Federation, n.d., Ernst Conservation Seeds, n.d., Readel, 2024)

Mountain mint
Pycnanthemum tenuifolium

Blooms July to September

Mountain mint supports over 100 species of native insects, offering abundant nectar in midsummer. Its strong minty aroma also helps deter deer and rabbits. All parts of the plant have a minty aroma when crushed.

(National Wildlife Federation, n.d., North Carolina State University, n.d., Kids Gardening, n.d.)

Soil condition:
Dry, well-drained, sandy loam to clay loam

Zone 5

Smooth Highbush Blueberry
Vaccinium corymbosum

Blooms February
Fruits mid-late summer
Red leaves in fall

Its berries are one of the few fruits native to NC that were cultivated by indigenous people, now grown worldwide. Its fruits feed birds, deer, small mammals and are edible by people.

(North Carolina Native Plant Society, n.d.)

Green and Gold
Chrysogonum virginianum

Blooms March to June
Evergreen

This plant is important for early-season insects, it was once called "woodland sunshine" and keeps its leaves during winter

(North Carolina Native Plant Society, n.d.)

Soil condition:
Medium moisture, well drained loam

Zone 6

Foamflower
Tiarella cordifolia

Blooms April to May
Evergreen

The leaves form a mat-like colony that covers all the soil, protecting and retaining it during heavy rainfall. The leaves stay during winter and create important winter habitats.

(North Carolina Native Plant Society, n.d.)

American Beautyberry
Callicarpa americana

Blooms May to July
Fruits in fall yellow leaves
- Berries stay during winter

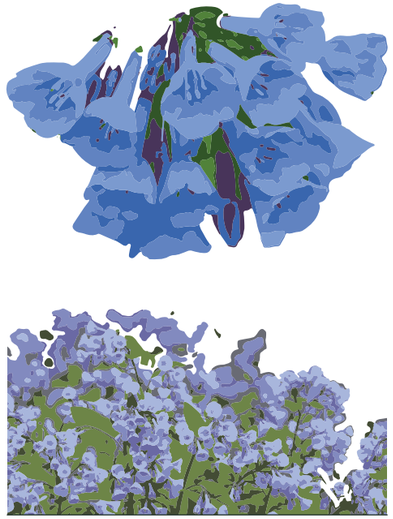
The leaves have a strong citronella-like lemon scent when crushed, and they help repel mosquitoes.

(North Carolina Native Plant Society, n.d., Ancient Roots Native Nursery, n.d.)

Soil condition:
Moist, well-drained

Zone 7

Virginia Bluebells
Mertensia virginica



Blooms April to May

The bells can shift their color from pink to blue to attract a wide variety of pollinators. The flowers have a light, sweet fragrance.

(North Carolina Native Plant Society, n.d. Heath, 2024.)

Joe-Pye Weed
Eupatorium asterales

Blooms August to September

Joe-pye weed has a legacy of indigenous medicinal knowledge. The plant is named after a 19th century Mohegan or Abenaki healer who helped cure a community of Indigenous People and European settlers from typhoid fever. It has a light, sweet scent.

(National Wildlife Federation, n.d., North Carolina State University, n.d. Butterfly Conservation, n.d.)

Blue Wood Sedge
Carex flaccosperma

Blooms late spring
Evergreen

This is not a grass, it's a wedge. You can tell because sedges have edges. Blue Wood Sedge blooms in late spring and keeps its leaves during winter.

(National Wildlife Federation n.d.)

Soil condition:
Medium moisture, moist loams or clay-loams

Zone 8

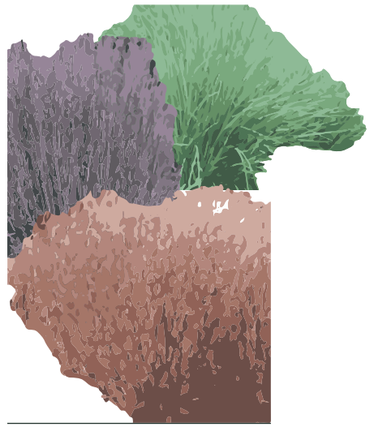
Eastern Purple
Echinacea purpurea

Blooms May to August
Seedheads stay during winter

The eastern purple coneflower blooms for a long time. After this the seedheads remain standing. During winters they will provide food for birds.

(North Carolina Native Plant Society, n.d., Missouri Botanical Garden. n.d.)

Little Bluestem
Schizachyrium scoparium



Green in spring & summer
Brown in Fall

This grass is one of the best native grasses in the region for attracting pollinators.

(North Carolina State University, n.d.)

Soil condition:
Average to dry soil

Spring

Figure 10.33. Native meadow maze - spring

Summer

Figure 10.34. Native meadow maze - summer

Fall

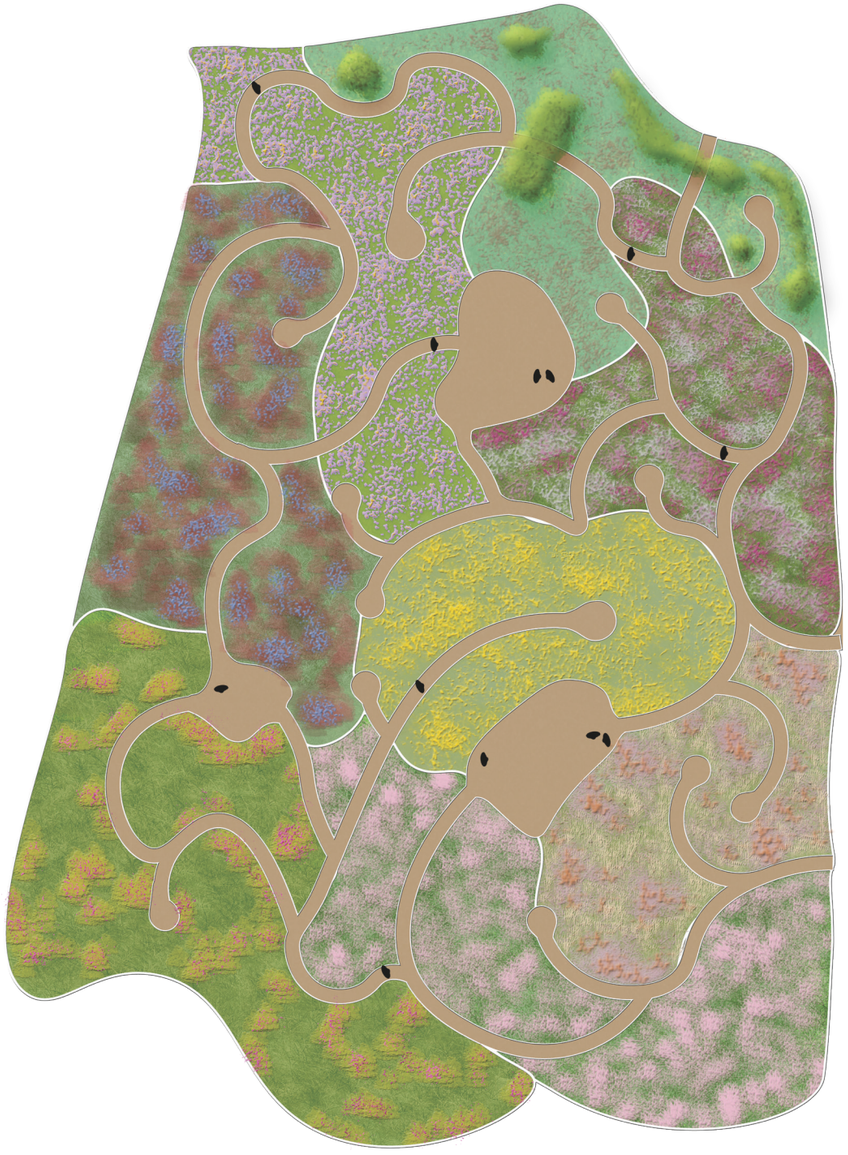


Figure 10.35. Native meadow maze - fall

Winter

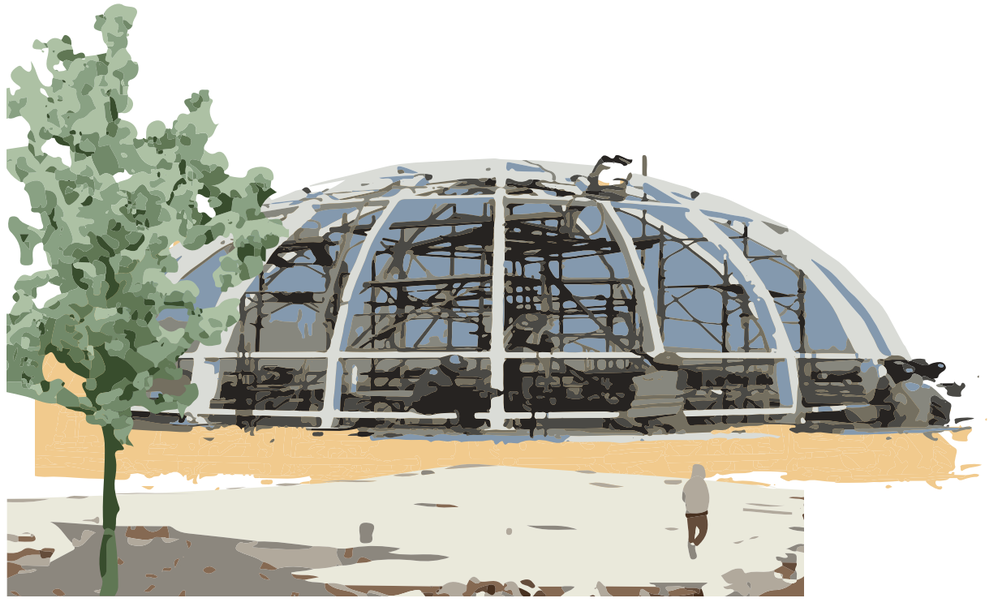
Figure 10.36. Native meadow maze - winter

11 Phasing

11.1. One year from now

The first step towards combating environmental injustice is to educate the people about the injustice that they are facing, and the tools that they have to make a change. This is why it is important to start by laying the foundation of the educational centers. In the first year of realizing this project, the focus should be on planting vegetation, as these take time to establish and grow. The trees and vegetation that needs to be placed back in the mowed-down area can be planted, the maze can be laid out with the native meadow plants planted, and the greenhouses can be built. The trees for the orchard should also get planted this year, as the trees might need a few years before they start producing fruits. The area for the parking lot can be cleared out, and the trees that get removed can potentially be moved on-site and be part of the new planting. This way, healthy established trees can be preserved, and the planting will not just exist out of young trees and shrubs. The permeable pavement of the parking lot can be laid out so the site can already be easily visited during the construction phase. By inviting communities over during construction, the communities can already get involved with the area and feel a connection to keep visiting it in years to come. The paths in and around the perimeter can be laid out, but the area around the main building should be kept free for construction work that will happen in year two.

Figure 11.1. One year from now



11.2. Two years from now

In the second year, communities can already be invited over for the first planting season, a large event where all the crops get planted in the greenhouses built the previous year. All the plants of the native meadow maze should be established by now, and construction of the main building is ongoing, potentially finished at the end of this year. The sample house can be built relatively quickly, and allow people to visit it during the harvesting season event. By starting the events early during construction, people will get to see the area develop further during each visit, creating a strong bond with the project. Once the main building is constructed, the rest of the terrain can be finished up, laying out the final paths, the amphitheater, the entrance greenhouses and the finishing touches of the other elements found around the perimeter. By inviting communities over early, the necessary conversations can start as soon as possible, resulting in the quickest positive effects back in their neighborhoods.

Figure 11.2. Two years from now

11.3. Five years from now

By year five, the green village of Charlotte will have existed for some years and will be thriving. A couple of years have gone by and the trees, vegetation, greenhouses, native meadow maze and orchard will have had time to settle in and grow, creating a lush atmosphere. With the right connections and advertising, schools, communities and families will regularly visit the location, learning about the injustices that they are facing, and more importantly the things that they can do about it. The restaurant will have been opened, offering regular cooking workshops. Meanwhile back in the city the trails will have kept expanding, improving the connections and livability of the city.

Figure 11.3. Five years from now

11.4. Ten years from now

Ten years from now, significant progress can be made on the expansion on the green trails that connect through the city. Meanwhile, the local initiatives that get sparked at the green village will have had time to develop. Everywhere throughout the city, these will become more frequent. The community-driven projects will be made for the people who live there now, minimizing the risk of gentrification. Urban agriculture will become a more common sight in the local communities, and more houses will be seen with solar panels and impermiable pavement. Local parks will form to create places to gather, exercise and relax. Back at the green village, the experimental area will have started to see some projects from local developers who want to test their ideas. This is when the green village will start to resemble the green village of the TU Delft.

Figure 11.4. Ten years from now

Figure 11.5. Ten years from now

11.5. Twenty years from now

In twenty years, the first kids who visited the green village will have grown up, and they are now the adults in charge of the communities and their surroundings. The inspiration they got as a kid will carry on in their decision making and they might have their own ideas that they now want to test at the green village, which has become a large thing by now. The trees that got planted twenty years ago have grown a lot, giving the site a rich and well established feeling for years to come. A large network of green corridors and trails has been made throughout Charlotte and is still expanding further, beyond the city, allowing Charlotte to play a key role in connecting the larger ecosystems of North Carolina.

Using the numbers from the Carolina Thread Trail (2025), the total shared economic savings as a result of this plan will be an estimated $50 billion. If the remaining 1200 miles of greenways get built, with the yearly gain increasing gradually each year, these will have made saved the economy $43,8 billion. The green village and tree nursery will provide an estimated additional 30 jobs, creating 1,5 million income yearly, resulting in 524 thousand tax revenue per year. If we include the estimated 4.2 million economic output per year, times twenty years, this will generate an additional 124 million. The impacts of the local initiatives are hard to estimate but cannot be neglected as they will be big. This is how the total number will get rounded up to an estimation of $50 billion over the course of the next 20 years. After this, the yearly economic saving will be estimated as $5 billion.

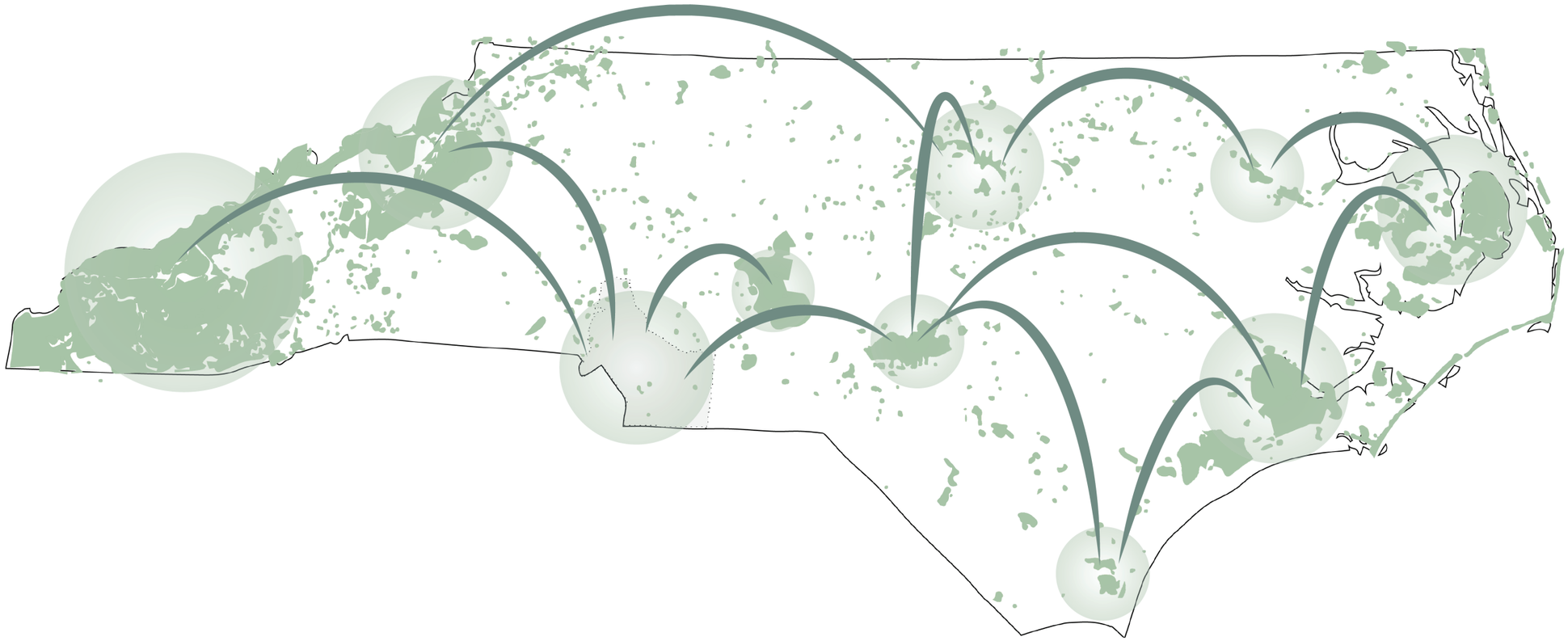
12 Conclusion

Conclusion

Charlotte's rapid urbanization has caused minority-concentrated communities to have less access to greenspaces, leading to major health and safety issues. A first step towards improving environmental justice is to educate people about the injustice that they are facing and the tools they have to combat it. Only then can community based design initiatives flourish. The sad reality is that American laws hinder large-scale improvements of livability, as such designs will indirectly force the existing residents out of their neighborhoods. This is why the focus on community driven initiatives is so important. The green village concept provides a space that will educate the people and enable communities to gather and brainstorm on new initiatives. While the neighborhood initiatives should be community driven, large scale city designs that do not risk displacement should still be encouraged, like restoring streams and creeks into a network of greenways. When everything is designed and checked using the conceptual framework model, this will lead to robust holistic interventions that raise the wellbeing of the current residents, benefit the ecology and trickle positive effects down through the multi-scalar networks, benefitting the city of Charlotte as a whole.

Figure 12.1 Little Sugar Creek greenwa

Scaling up
With this spatial approach applied through the whole state, Charlotte will become an important ecological connection for North Carolina. A network of small-scale connections to local ecosystems will allow migration routes all the way from the Appalachian mountains to the Atlantic ocean.



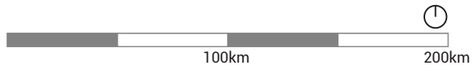


Figure 12.2 North Carolina vision

13 Reflection

How did the project go?
Overall, I can say that I have made a project that I can proudly finish my academic career on. It has taken a lot of work with many issues to work through, but in the end everything came together in a very satisfying way.

Early on during my research I planned to use a survey that collects SoftGIS data, which I could then use to ground my design in reality rather than just predictions. This was meant to elevate my project, but it turned out more difficult than planned to get the survey out. In hindsight, the time and effort that was put into the survey could have been placed elsewhere, and I should not have waited with designing until I got results. While showing a trend, 15 results is not enough to confidently ground the project in reality. The backup plan of making scenarios turned out to be a great method to bring my project forward; but it was started relatively late which resulted in some time related stress near the end of my project. The theoretical background and the meetings with local organizations, citizens, government officials and developers still grounds my project in reality. I ended up creating my frameworks relatively late, even though the theories used in them had been a part of my research for a long time,. The creation of them helped me make sense of things, as all the ideas I was having were now put together in a visually clear way. In future research I will try to make these frameworks earlier. Writing this thesis had a similar effect on me. It was really satisfying to see all the puzzle pieces I had floating around for a long time suddenly fall together into a coherent story.

In conclusion, this project was an exploration of combining different methods and approaches in an unfamiliar environment. The challenges I faced, from data limitations to the current political environments, ultimately led to a more integrated and holistic project. The methods proved to be fruitful and lay the groundwork for future research and a deeper engagement with the complex dynamics of environmental injustice.

What did I learn?
Working in a very different environment taught me a lot of valuable lessons, not only in the field of landscape architecture but a broader understanding of how the world is. I got to see very different ways of living in a culture that is very distinct from the Netherlands, with very different design approaches. This, combined with my experience working on a project in Hong Kong one year ago, has given me a very valuable portfolio of working in different environments, something I wish to continue doing in my upcoming carrier. Having been able to do a deep dive into a fascinating subject for a year taught me a lot. At first I found it difficult to see how much I learned because every step has gone gradual over a long time, but if I look back where I was one year ago, I suddenly see just how many steps I have made in my understanding of how to do research, the subject, the location and design.

Where do I position myself as a landscape architect?
In the future, I see myself working on design projects worldwide. I want to keep learning about different cultures to see how they design there, and to have that knowledge carry over to other projects. I do not want to stick to one scale. I enjoy working on multi-scalar projects so I can keep zooming in and out, working a large vision and then diving into the small details that make a place come to life. I do not rule it out, but as of now I do not see myself doing a PhD, as I do not see myself enjoying working theoretically. I want to start making real projects that get realized and start actually improving the lives of people directly. I can see myself sticking close to urbanism and architecture in my future work, as those fields have always interested me as well.

Figure 13.1 Collage of photos

14

Bibliography
& Figures

14.1. Bibliography

Alfini, M. (2025, February 13). *Sustain Charlotte urges local investment as EPA dismantles environmental justice initiatives.* WSOC-TV. Retrieved June 11, 2025 from https://www.wsoctv.com/news/local/sustain-charlotte-urges-local-investment-epa-dismantles-environmental-justice-initiatives/AEROSOT55ZDRBK7UIMJ4MOYHTA

Alfonso Piña, W. H., & Pardo Martínez, C. I. (2016). *Development and Urban Sustainability: An Analysis of Efficiency Using Data Envelopment Analysis.* Sustainability, 8(2), 148. https://doi.org/10.3390/su8020148

Ancient Roots Native Nursery. (n.d.). *Callicarpa americana - American beautyberry* [Web Page]. Retrieved June 13, 2025, from https://www.ancientrootsnativenursery.com/Plant-Name/Callicarpa-americana-American-Beautyberry

Annerstedt, M., Östergren, PO., Björk, J., Grahn, P., Skärbäck, E., & Währborg, P. (2012). *Green qualities in the neighbourhood and mental health – results from a longitudinal cohort study in Southern Sweden.* BMC Public Health, 12, Article 337. https://doi.org/10.1186/1471-2458-12-337

Atwater, W. (2022, August 26). *NC recognized as the birthplace of the environmental justice movement.* North Carolina Health News. https://www.northcarolinahealthnews.org/2022/08/26/nc-recognized-as-the-birthplace-of-the-environmental-justice-movement/

Atwater, W. (2024, December 27). *Charlotte strives to tackle extreme heat, energy costs and increase sustainability in underserved communities.* North Carolina Health News. https://www.northcarolinahealthnews.org/2024/12/27/in-underserved-communities

Ayers, E.L. (2007). *The promise of the New South: life after Reconstruction.* Oxford, New York, Oxford University Press.

Blythe, L., & Brockmann, C. R. (1961). *The hornet's nest: The story of Charlotte and Mecklenburg County.* Public Library of Charlotte and Mecklenburg County.

Brooklyn Village. (2016). *Brooklyn Village History.* Retrieved May 25, 2025 from https://brooklynvillage-clt.com/history/

Butterfly Conservancy. (n.d.). Gardening for butterflies [Web Page]. Retrieved June 13, 2025 from https://butterfly-conservation.org/how-you-can-help/get-involved/gardening/gardening-for-butterflies

Carolina Thread Trail. (n.d.). *Little Sugar Creek Greenway - Brandywine Road to 7th Street Segment.* Retrieved May 25, 2025 from https://www.carolinathreadtrailmap.org/trails/trail/little-sugar-creek-brandywine-to-7th

Charlotte: Moving Forward, Looking Back [Exhibition]. (2024-2025). Levine Museum of the New South, Charlotte, United States of America. https://www.museumofthenewsouth.org/exhibition/charlotte-moving-forward-looking-back/

Chase, M., Rhew, A., Sirkin, L., Clark, A., Copeland, K., Crocker, R., Doolittle, N., Holenko, A., Kennedy, J., Milam, L., Schilling, C., Sparks, A., Tooley, S., Weschler, M., Forinash, C., Oaksford, E. (2024). *Southpark Forward. 2023 Vision Plan.* executive summary. Charlotte, NC. SouthPark Community Partners.

Chemtob, D. (2023, March 21). *Millions of gallons of gasoline spilled from a pipeline in the Charlotte area, and it's still being cleaned up.* Axios Charlotte. https://www.axios.com/local/charlotte/2023/03/21/millions-of-gallons-of-gasoline-spilled-from-a-pipeline-in-the-charlotte-area-and-its-still-being-cleaned-up-323376

Chetty, R., Dobbie, W., Goldman, B., Porter, S. R., & Yang, C. S. (2024). *Changing opportunity: Sociological mechanisms underlying growing class gaps and shrinking race gaps in economic mobility. Opportunity Insights.* Retrieved May 25, 2025 from https://opportunityinsights.org/paper/changingopportunity/

Chetty, R., Hendren, N., Kline, P., & Saez, E. (2014). *Where is the land of opportunity? The geography of intergenerational mobility in the United States* (NBER Working Paper No. 19843). National Bureau of Economic Research. https://doi.org/10.3386/w19843
City of Charlotte. (2020). *Environmental Justice 2020.* Retrieved May 20, 2025 from https://data.charlottenc.gov/datasets/charlotte::environmental-justice-2020-2/about

City of Charlotte. (2023). *About Charlotte - The Queen City.* Retrieved May 20, 2025 from https://www.charlottenc.gov/Growth-and-Development/Economic-Development/About-Charlotte

Clinton, A. (June 26 2024). *Axios Charlotte. Black-owned skatepark opens in west Charlotte.* Retrieved May 23, 2025 from https://www.axios.com/local/charlotte/2024/06/26/black-owned-skatepark-west-charlotte

Commission for Environmental Cooperation. (n.d.). *About Dr. Benjamin Chavis.* Retrieved May 25, 2025 from https://www.cec.org/speaker/benjamin-chavis

Ernst Conservation Seeds. (n.d.). *Licorice scented goldenrod, PA ecotype* [Web page]. Retrieved June 13, 2025, from https://www.ernstseed.com/product/licorice-scented-goldenrod-pa-ecotype/

Gardenia. (n.d.). Phlox divaricata (Woodland Phlox) [Web Page]. Retrieved June 13, 2025 from https://www.gardenia.net/plant/phlox-divaricata-woodland-phlox

Gardenia. (n.d.). Phlox paniculata (Blue Phlox) [Web Page]. Retrieved June 13, 2025 from https://www.gardenia.net/genus/phlox-paniculata-garden-phlox

Grimshaw Architectrs. (2001). *New Eden Project Cornwall.* Eden Project. https://www.edenproject.com/mission/architecture

Grubbs, M., Glynn, H. (2021). *Pollution and Displacement: A Critical Look at Environmental Racism and Forced Migration in Charlotte's Historically Black Communities. Climate Inequality CLT.* Retrieved May 25, 2025 from https://climateinequalityclt.com/2021/03/01/pollution-and-displacement/

H+N+S+ Landscape Architecture. (2015). *Room for the River Nijmegen. Site visited March 1 2024.* Retrieved May 23, 2025 from https://hnsland.nl/en/projects/room-river-nijmegen/

Heath, S. (2024, June 23). *How to Grow and Care for Virginia Bluebells.* Retrieved June 13, 2025 from https://www.thespruce.com/virginia-bluebells-plant-profile-4797478

Hilton Williams, D. (2025). *The environmental injustice behind health disparities. Power is Giving.* Retrieved May 25, 2025 from https://www.powerisgiving.org/post/the-environmental-injustice-behind-health-disparities

History South. (n.d.). *Charlotte in the New South: Restless Re-Invention.* Retrieved May 25 2025 from https://www.historysouth.org/restless-re-invention/

Israel, M. (2024). *'A place of wholeness': West Sugar Creek Community's Plan to Unify. Urbancore.* Retrieved May 25, 2025 from https://urbancore.charlotte.edu/2024/09/26/a-place-of-wholeness-west-sugar-creek-communitys-plan-to-unify

Iungman, T., Cirach, M., Marando, F., Barboza, E. P., Khomenko, S., Masselot, P., Quijal-Zamorano, M., Mueller, N., Gasparrini, A., Urquiza, J., Heris, M., Thondoo, M., & Nieuwenhuijsen, M. (2023). *Cooling cities through urban green infrastructure: A health impact assessment of European cities.* The Lancet, 401(10376), 577–589. https://doi.org/10.1016/j.scitotenv.2023.167739

Jiang, B., Li, D., Larsen, L., & Sullivan, W. C. (2016). *A dose-response curve describing the relationship between urban tree cover density and self-reported stress recovery.* Environment and Behavior, 48(4), 607–629. https://doi.org/10.1177/0013916514552321

Kidsgardening. (n.d.). *Plant a Butterfly Garden* [Web Page]. Retrieved June 13, 2025 from https://kidsgardening.org/resources/garden-activities-plant-a-butterfly-garden/

Kondo, M. C., Mueller, N., Locke, D. H., Roman, L. A., Rojas-Rueda, D., Schinasi, L. H., Gascon, M., & Nieuwenhuijsen, M. J. (2020). *Health impact assessment of Philadelphia's 2025 tree canopy cover goals.* The Lancet Planetary Health, 4(4), e149–e157. https://doi.org/10.1016/S2542-5196(20)30058-9

Konijnendijk, C. (2025). [Conference presentation]. TU Delft, The Netherlands.

Konijnendijk. C. (2021). *'Threes for Trees' Introducing a new 3-30-300 rule for urban forestry & greener cities.* Retrieved May 20, 2025 from https://nbsi.eu/wp-content/uploads/2021/05/Web_Konijnendijk_AA_webinar_May_2021_330300-1.pdf

Kurzeja, P. (2023). *The History of Banking in Charlotte.* Charlotte Museum of History. Retrieved May 25, 2025 from https://charlottemuseum.org/learn/articles/the-history-of-banking-in-charlotte/

Landess, B. (2025). *Saving Land & Connecting Lives to Nature* [Conference presentation]. Catawba Lands Conservancy. Carolina Thread Trail. Charlotte, North Carolina, United States of America.

LeBrasseur, R. (2022). *Cultural Green spaces: Synthesizing Knowledge and Experience in Nova Scotia's African-Canadian Communities through Participatory Research and SoftGIS.* Social Sciences, 11(7). Retrieved May 20, 2025 from https://doi.org/10.3390/socsci11070281

M. Browning., D. Locke. (2024). *Measuring the 3-30-300 rule to help cities meet nature access thresholds.* Science of The Total Environment, volume 907. Retrieved May 20, 2025 from https://doi.org/10.1016/j.scitotenv.2023.167739

Markevych, I., Tiesler, C. M. T., Fuertes, E., Romanos, M., Dadvand, P., Nieuwenhuijsen, M. J., Berdel, D., Koletzko, S., & Heinrich, J. (2014). *Access to urban green spaces and behavioural problems in children: Results from the GINIplus and LISAplus studies.* Environment International, 71, 29–35. https://doi.org/10.1016/j.envint.2014.06.002

Markus Schietsch Architekten. (2014). *Elephant House Zoo Zürich.* Archdaily. https://www.archdaily.com/770772/elephant-house-zoo-zurich-markus-schietsch-architekten

Martin, A. (2022). *Charlotte's Checkered Environmental Justice History. Rachel Carson Counsil.* Retrieved May 20, 2025 from https://rachelcarsoncouncil.org/charlottes-checkered-environmental-justice-history/

McAlpine, L. (2024, May 14). *13 Colorful Nectar Plants for Pollinators*. Better Homes & Gardening. Retrieved June 13, 2025 from https://www.bhg.com/gardening/design/nature-lovers/nectar-plants-for-pollinators/

Metts, C. (June 21 2024). *A new retail development in west Charlotte comes with its very own skatepark.* The Charlotte Observer. retrieved May 23, 2025 from https://www.charlotteobserver.com/news/business/article289374224

Missouri Botanical Garden. (n.d.). *Echinacea purpurea 'Virgin'* [Web Page]. Retrieved June 13, 2025 from https://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?gen=Echinacea&isprofile=0&taxonid=272062

Mooney, P. (2014, March 7). *Carolina Jessamine.* Fragrant Earth. Retrieved June 13, 2025 from https://fragrantearth.wordpress.com/2014/03/07/carolina-jessamine/

NAPUR Architect. (2016). *Museum of Ethnography.* Archdaily. https://www.archdaily.com/788068/napur-architect-designs-a-bowed-building-for-the-ethnography-museum-in-budapest

National Park Foundation. (n.d.). *Appalachian National Scenic Trail.* Retrieved May 20, 2025 from https://www.nationalparks.org/explore/parks/appalachian-national-scenic-trail

National Wildlife Federation. (n.d.). *Native Plant Finder.* Retrieved June 13, 2025 from https://nativeplantfinder.nwf.org

Nieuwenhuijsen, M. J., Dadvand, P., Márquez, S., Bartoll, X., Barboza, E. P., Cirach, M., Borrell, C., & Zijlema, W. L. (2022). *The evaluation of the 3-30-300 green space rule and mental health.* Environmental Research, 215(Part 2), 114387. https://doi.org/10.1016/j.envres.2022.114387

North Carolina General Assembly. (1768). *Acts of the North Carolina General Assembly, 1768* (Vol. 23, pp. 759–783). In Charlotte chartered [Timeline exhibit]. Charlotte Mecklenburg Library. https://www.cmstory.org/exhibits/history-timeline-rural-beginnings-1730-1772/1768-charlotte-chartered

North Carolina Native Plant Society. (n.d.). *Native Wildflowers of NC.* [PDF]. NC Wildflower. Retrieved June 13, 2025 from https://ncwildflower.org/wp-content/uploads/favorites-1.pdf

North Carolina Native Plant Society. (n.d.). *NC Natives by Season and Color.* [PDF]. NC Wildflower. Retrieved June 13, 2025 from https://ncwildflower.org/wp-content/uploads/regions-color-1.pdf

North Carolina State University. (n.d.). *North Carolina Extension Gardener Plant Toolbox.* Retrieved June 13, 2025 from https://plants.ces.ncsu.edu/

North Carolina Wildlife Federation. (2024). *The North Carolina Mountains and Their Wildlife.* Retrieved May 20, 2025 from https://ncwf.org/blog/mountains

O'Neil-Dunne, J. (2019). *Tree Canopy Change Assesment. University of Vermont.* Retrieved May 25, 2025 from https://treescharlotte.org/wp-content/uploads/2020/07/Final-Charlotte-Tree-Canopy-Change-Assessment-2012-2018-Official.pdf

Osorio, L. (2021). *Native Spotlight: The sweet scent of anise hyssop. Laurelwood Arboretum.* Retrieved June 13, 2025 from https://laurelwoodarboretum.org/2021/04/28/native-spotlight-the-sweet-scent-of-anise-hyssop/

Prairie Moon Nursery. (n.d). *Symphyotrichum oblongifolium Aromatic Aster* [Web Page]. Retrieved June 13, 2025 from https://www.prairiemoon.com/symphiotrichum-oblongifolium-aromatic-aster

Project for Public Spaces. (n.d.). *What is placemaking?* Retrieved May 20, 2025 from https://www.pps.org/article/what-is-placemaking

Pérez-del-Pulgar, C., Anguelovski, I., Cole, H. V. S., de Bont, J., Connolly, J., Baró, F., Díaz, Y., Fontán-Vela, M., Duarte-Salles, T., & Triguero-Mas, M. (2021). *The relationship between residential proximity to outdoor play spaces and children's mental and behavioral health: The importance of neighborhood socio-economic characteristics*. Environmental Research, 200, 111326. https://doi.org/10.1016/j.envres.2021.111326

Readel, A. (2024, September 4). *How to Attract Butterflies to Your Garden: 6 Essential Elements to Provide.* Better Homes & Gardens. Retrieved June 13, 2025 from https://www.bhg.com/how-to-attract-butterflies-8703388

Shoemaker, D., Portillo, E. (2020). *State of the canopy: 45% canopy coverage. Trees Charlotte.* Retrieved May 25, 2025 from https://treescharlotte.org/news/treescharlotte-canopy-study-shows-sharp-decline/

SILO. (2022). *People's Porch*. Retrieved May 23, 2025 from https://www.siloard.com/peoples-porch

Sustain Charlotte. (2025, February 7). *Sustain Charlotte's statement on the elimination of the EPA's Office of Environmental Justice.* https://sustaincharlotte.org/sustain_charlotte_statement_on_the_elimination_of_the_epas_office_of_environmental_justice

Sustain Charlotte (2024, March 15). *Environmental Justice framework takes shape.* https://sustaincharlotte.org/environmental_stewardship_committee_march_2024_meeting_recap

Van Schaick, J., & Klaasen, I. (2010). *The Dutch layers approach to spatial planning and design: A fruitful planning tool or a temporary phenomenon?* European Planning Studies, 19(10), 1755–1796. https://doi.org/10.1080/09654313.2011.614387

WBTV. (2015, June 14). *16,000 gallons of sewage spill into Little Sugar Creek.* https://www.wbtv.com/story/29314009/16000-gallons-of-sewage-spill-into-little-sugar-creek/

World Health Organization. (2016). *Urban greenspaces and health. A review of evidence.* Retrieved May 25, 2025 from https://iris.who.int/bitstream/handle/10665/345751/WHO-EURO-2016-3352-43111-60341-eng.pdf

14.2. List of figures

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• Richard Saker/the Observer
• https://www.wunc.org/environment/2013-04-05/which-nc-roadside-has-the-best-wildflowers
• https://www.blackhawktreeinc.com/common-nc-trees
• https://www.istockphoto.com/search/2/image-film?phrase=child+magnifying+glass+bug
• https://www.siloard.com/peoples-porch/
• https://www.charlottesgotalot.com/things-to-do/arts-culture/symphony-park-at-southpark-mall
• ww
• https://pngtree.com/free-tree-png
• https://pngtree.com/so/vegetable-garden
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• Atwater, 2024
• Chemtob, 2023
• Grubbs et al., 2021
• Sustain Charlotte, 2024
• Sustain Charlote, 2025
• WBTV, 2015
• https://picryl.com/media/tall-buildings-charlotte-north-carolina
Figure 2.1. Figure by author
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Organization, 2016
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• https://databayou.com/northcarolina/parks.html
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• https://www.nconemap.gov/pages/elevation
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• https://www.nytimes.com/interactive/2022/03/03/climate/biodiversity-map.html
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• https://www.lib.ncsu.edu/gis/nlcd
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• https://www.lib.ncsu.edu/gis/nlcd
• Levine Museum of the New South, 2025
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• https://www.lib.ncsu.edu/gis/nlcd
• https://mapsofthepast.com/products/historic-county-map-mecklenburg-county-north-carolina-ross-1922-23-x-28-31-vintage-wall-art
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• https://www.nconemap.gov/pages/elevation
• https://www.lib.ncsu.edu/gis/nlcd
• https://mapsofthepast.com/products/historic-county-map-mecklenburg-county-north-carolina-ross-1922-23-x-28-31-vintage-wall-art
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• https://www.nconemap.gov/pages/elevation
• https://www.lib.ncsu.edu/gis/nlcd
• https://mapsofthepast.com/products/historic-county-map-mecklenburg-county-north-carolina-ross-1922-23-x-28-31-vintage-wall-art
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• https://www.nconemap.gov/pages/elevation
• https://www.lib.ncsu.edu/gis/nlcd
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• https://www.lib.ncsu.edu/gis/nlcd
Figure 3.15. Figure by author. Created with data from:
• https://www.nconemap.gov/pages/elevation
• https://www.lib.ncsu.edu/gis/nlcd
• CLT Public Relations, 2020
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• https://www.nconemap.gov/pages/elevation
• https://www.lib.ncsu.edu/gis/nlcd
• CLT Public Relations, 2020
• Levine Museum of the New South, 2025
Figure 3.17. Model built by author
Figure 3.18. Figure from https://www.reddit.com/r/OldPhotosInRealLife/comments/1cg23is/charlotte_nc_19592024/
Figure 3.19. Photo by Melissa Melvin-Rodriguez, The Observer
Figure 3.20. Photos taken by Google Streetview
Figure 3.21. Figure by author
Figure 3.22. Photos taken by author
Figure 6.1. Figure by author. Adapted from Project for Public Spaces, n.d.
Figure 6.2. Figure from Catawba Lands Conservancy and Carolina Thread Trail
Figure 7.1. Photo taken by author
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Figure 7.6. Figure by author
Figure 7.7. Figure by author
Figure 7.8. Figure by author
Figure 7.9. Figure by author
Figure 7.10. Collage made using photos taken by author, https://www.charlottesgotalot.com/things-to-do/shopping/southpark-mall, https://pngimg.com, https://www.freepik.com, https://www.istockphoto.com
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Figure 8.3. Figure by author. Created with data from own survey
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Figure 8.6. Figure by author. Created with data from own survey
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Figure 8.9. Figure by author. Created with data from own survey
Figure 8.10. Figure by author. Created with data from own survey
Figure 8.11. Figure by author. Created with data from own survey
Figure 8.12. Figure by author. Created with data from own survey
Figure 8.13. Figure by author. Created with data from own survey
Figure 8.14. Figure by author. Created with data from own survey
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Figure 9.4. Figure by author
Figure 9.5. Figure by author
Figure 9.6. Figure by author
Figure 9.7. Figure by author. https://www.shutterstock.com/nl/image-vector/education-icon-vector-sign-symbol-isolated-1507141088, https://www.istockphoto.com/search/2/image?mediatype=illustration&phrase=vegetable+icon, https://adioma.com/icons/trees
Figure 9.8. Figure by author. https://www.shutterstock.com/nl/image-vector/city-charlotte-state-north-carolina-line-1704237880, https://iconscout.com/icon/path-walking-1652470_1401846, https://www.shutterstock.com/nl/image-vector/education-icon-vector-sign-symbol-isolated-1507141088, https://www.istockphoto.com/search/2/image?mediatype=illustration&phrase=vegetable+icon, https://adioma.com/icons/trees
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• Google Earth (2025).
• https://www.istockphoto.com/photo/forest-and-tree-landscape-texture-background-aerial-top-view-forest-texture-of-gm1126410337-296536982
Figure 10.4. Figure by author
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• https://reflectionriding.org/nature-center-news-updates/ihdtwy2l4xfirudc32bj0wsoti5tlp
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• T.G. Barnes
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• https://blacksheepperennials.com/products/phlox-divaricata-blue-moon
• https://www.michlers.com/cdn/shop/products/Phloxdivaricata_closeup.jpg?v=1742058839
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• https://www.satvai.com/shop/phlox-flower-plant/
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• https://www.gardencrossings.com/product/coreopsis-designer-threads-golden-needles-perennial-tickseed/
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• https://www.prairiemoon.com/symphiotrichum-oblongifolium-aromatic-aster
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• https://northernwildflowers.ca/products/anise-hyssop
Figure 10.21. Figure by author, created with photos from:
• https://www.provenwinners.com/plants/baptisia/decadence-sparkling-sapphires-false-indigo-baptisia-hybrid
• https://northernwildflowers.ca/products/blue-wild-indigo
Figure 10.22. Figure by author, created with photos from:
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• https://www.gardeningknowhow.com/ornamental/flowers/goldenrod/goldenrod-care-information.htm
Figure 10.23. Figure by author, created with photos from:
• https://www.opnseed.com/products/pycnanthemum-tenuifolium-narrow-leaved-mountain-mint
• https://www.gardenia.net/plant/pycnanthemum-tenuifolium
Figure 10.24. Figure by author, created with photos from:
• https://gobotany.nativeplanttrust.org/species/vaccinium/corymbosum/
• https://raintreenursery.com/collections/highbush-blueberry-plants
• https://woodywarehouse.com/product/highbush-blueberry/
Figure 10.25. Figure by author, created with photos from:
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• https://esveld.nl/a/product/chrysogonum-virginianum/
Figure 10.26. Figure by author, created with photos from:
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• https://www.tuincentrumkoeman.nl/planten/schaduwplanten/schuimkaars-tiarella-cordifolia-6.html
• https://groeneparadijs.nl/tiarella-cordifolia-schuimbloem.html
Figure 10.27. Figure by author, created with photos from:
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• Ivo M. Vermeulen
• https://www.etsy.com/nl/listing/484644419/american-beauty-berry-50-berries-200
Figure 10.28. Figure by author, created with photos from:
• https://www.everwilde.com/store/Mertensia-virginica-WildFlower-Seed.html
• https://www.gardenista.com/posts/virginia-bluebells-edible/
Figure 10.29. Figure by author, created with photos from:
• https://www.longislandnatives.com/product/eupatorium-maculatum-spotted-joe-pye-weed/
• https://mulhalls.com/garden-home/blog/joe-pye-weed/
• https://www.shutterstock.com/nl/search/joe-pye-weed
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• https://prairieup.com/product/gardening-winter-interest/
• https://www.haagplanten.net/vaste-planten/echinacea/echinacea-purpurea-leuchtstern-pm0075031.html
Figure 10.32.
• https://www.gardenia.net/plant/schizachyrium-scoparium
• https://thegardenct.com/plant-name/Schizachyrium-scop-Prairie-Winds-Blue-Paradise
• https://kiefernursery.com/product/schizachyrium-scoparium-the-blues/
Figure 10.33. Figure by author
Figure 10.34. Figure by author
Figure 10.35. Figure by author
Figure 10.36. Figure by author
Figure 11.1. Figure by author, created with photos from:
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• https://arboretum.ucdavis.edu/events/volunteer-tree-planting-mar-2025
• Proven Winners
• https://www.vecteezy.com/png/49300854-winding-stone-path-through-lush-greenery
• https://prettywildseeds.co.uk/product/dwarf-wild-flower-meadow-seeds-pure-flower-100-pure-flower-seeds-2995
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• https://publichealth.tulane.edu/blog/benefits-of-community-gardens/
• https://www.cnxzlf.com/the-steel-structure-glass-dome-roof-of-togos-presidential-palace/
• https://www.tennessean.com/gcdn/presto/2021/02/10/PNAS/013a5413-3e0e-4c58-b9a3-3a912e7c48c6-IMG_2359.jpg
• https://www.sunrun.com/go-solar-center/solar-terms/definition/solar-module
• https://pi.movoto.com/p/411/4264745_0_aqVYM7_t.jpeg
• https://natureforward.org/program/woodend-field-trips/
• Proven Winners
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• https://www.calacademy.org/exhibits/living-roof
• https://homeli.co.uk/5-examples-of-living-green-roofs-grass-turf-and-succulent-sedums/
• https://pngtree.com/free-tree-png
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• https://www.dreamhus.nl/
• https://www.istockphoto.com
• https://pngtree.com/free-tree-png
Figure 11.5. Figure by author, created with photos from:
• The Whitaker Group
• https://www.cmlibrary.org/blog/get-know-west-boulevard-branch-community
• Richard Saker/the Observer
• https://www.wunc.org/environment/2013-04-05/which-nc-roadside-has-the-best-wildflowers
• https://www.blackhawktreeinc.com/common-nc-trees
• https://www.istockphoto.com/search/2/image-film?phrase=child+magnifying+glass+bug
• https://www.siloard.com/peoples-porch/
• https://www.charlottesgotalot.com/things-to-do/arts-culture/symphony-park-at-southpark-mall
• ww
• https://pngtree.com/free-tree-png
• https://pngtree.com/so/vegetable-garden
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