Trees for greener streets:

A spatial case study of four street greening developments in Toulouse

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Trees for greener streets: A spatial case study of four street greening developments in Toulouse

Stadsträd för grönare gator: En rumslig fallstudie av fyra gröna gatuprojekt i Toulouse

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Abstract

Urban greening has become a central strategy for addressing the challenges of urbanisation and climate change. In dense historic city centres, where space is limited, urban greening initiatives require careful planning and spatial sensitivity. While the ecological benefits of street trees are well documented, their spatial and perceptual impacts within contemporary streetscapes remain less explored. This master's thesis aims to deepen the understanding of how contemporary street greening, with a focus on street trees, influences the spatial perception and experience of streetscapes. The study focuses on four recent street transformations in the historic city centre of Toulouse, France.

The research adopts a qualitative, empirical case study approach, examining four recently redeveloped streets. The methodology combines literature review, document studies, and structured site observations. Spatial analysis is guided by Gordon Cullen's framework of visual perception and serial vision, complemented by Arne Branzell's notation method to document perceived spatiality. Observations focus on the interaction between trees, built form, and street structure, considering both current conditions and projected future development as trees mature.

The findings illustrate that street trees play a significant role as spatial elements within contemporary streetscapes, influencing enclosure, scale, rhythm, and movement. Tree placement, species characteristics, and canopy development contribute to varying spatial experiences across different street morphologies. The results also indicate that the spatial impact of street trees is dynamic, with their influence on streetscapes expected to increase over time as the trees grow and their canopies expand. Although young trees initially have a complementary role to building façades, their spatial influence increases as they mature, gradually contributing to stronger enclosure, clearer boundaries, and more socially inviting streetscapes.

Keywords: urban environment, street greening, trees, spatial elements, spatial perception & spatial experience.

Sammandrag

Stadsgrönska har blivit en central strategi för att hantera utmaningarna med urbanisering och klimatförändringar. I täta historiska stadskärnor, där utrymmet är begränsat, kräver initiativ för stadsgrönska noggrann planering och rumslig känslighet. Medan de ekologiska fördelarna med gatuträd är väl dokumenterade, är deras rumsliga och perceptuella effekter i dagens gatubild fortfarande mindre utforskade. Denna masteruppsats syftar till att fördjupa förståelsen för hur dagens stadsgrönska, med fokus på gatuträd, påverkar den rumsliga uppfattningen och upplevelsen av gatumiljön. Studien fokuserar på fyra nyligen genomförda gatumiljöförändringar i den historiska stadskärnan i Toulouse, Frankrike.

Forskningen använder sig av en kvalitativ, empirisk fallstudie och undersöker fyra nyligen ombyggda gator. Metoden kombinerar litteraturgenomgång, dokumentstudier och strukturerade platsobservationer. Den rumsliga analysen styrs av Gordon Cullens ramverk för visuell perception och *serial vision*, kompletterat med Arne Branzells notationsmetod för att dokumentera upplevd rumslighet. Observationerna fokuserar på interaktionen mellan träd, bebyggelse och gatustruktur, med hänsyn till både nuvarande förhållanden och förväntad framtida utveckling när träden växt.

Resultaten visar att gatuträd spelar en viktig roll som rumsliga element i dagens gatubild och påverkar avskärmning, skala, rytm och rörelse. Trädens placering, artens egenskaper och kronans utveckling bidrar till varierande rumsliga upplevelser i olika gatumorfologier. Resultaten visar också att gatuträdens rumsliga påverkan är dynamisk, och att deras inflytande på gatubilden förväntas öka med tiden när träden växer och deras kronor expanderar. Även om unga träd inledningsvis har en kompletterande roll till byggnadernas fasader, ökar deras rumsliga inflytande när de mognar och bidrar gradvis till starkare inneslutning, tydligare gränser och mer socialt inbjudande gatubilder.

Nyckeord: stadsmiljö, gröna gator, urbana träd, rumsliga element, rumslig perception & rumslig upplevelse.

Preface

The subject of this master's thesis, the spatial characteristics of contemporary urban street greening, was chosen because of my interest in how urban vegetation, especially urban trees, influences the spatial characteristics of urban environments. Urban greening has become a significant trend in contemporary city development. Through my studies in landscape architecture, its importance has become increasingly apparent, driven by the belief that it is crucial to creating livable, resilient urban environments. Living and travelling to different cities has allowed me to observe how vegetation is present and increasingly incorporated into urban environments and streetscapes. The approaches have varied both between cities and across different climatic conditions.

This master's thesis is set in Toulouse, France, where I have lived for the past two years. The city has undergone and continues to experience significant urban transformation, reflected in the daily life and movements of its residents. As part of efforts to create a more liveable and resilient urban environment, streets have been transformed to prioritise urban greening and soft mobility. Coming from a Nordic background, I have found it particularly interesting to observe how streets and public spaces are shaped, both in everyday street life in another cultural context and in the role of sun and shade during the summer heat.

The research process has been long, at times difficult, and more demanding than I initially expected. I am relieved that it is now finished and glad to conclude my studies in landscape architecture. I want to thank my supervisor, Tomas Eriksson, for taking me on midway through the semester and for the rewarding, motivating discussions that have helped advance my master's thesis. I would also like to thank my friends, boyfriend, and family for their support, for giving me uninterrupted time to write, and for their company when needed.

Table of contents

1. Trees for greener streetscapes

Sustainability has become a fundamental value in contemporary urban development, as cities face growing pressures to serve more functions within limited space (Mofidi-Shemirani & Hodjati 2013). When cities have frequently reduced green spaces for urbanisation, this has increased their vulnerability to extreme weather events such as heatwaves, floods, and droughts, and intensified the urban heat island effect (UN Environmental Programme n.d.). These changes have profoundly reshaped the physical and social fabric of urban environments, with nearly two-thirds of the world's population projected to live in cities by 2050 (United Nations 2018; UN Environment Programme n.d.). Urban greening has emerged as a strategy for addressing the dual challenges of urbanisation and climate change. It is increasingly essential for creating sustainable, livable, and resilient cities. Within this context, urban greening has emerged as a central strategy for sustainable urban development (Goodwin 2017). It involves creating interconnected networks of green areas, such as parks and green streets, which provide ecological, social, and economic benefits while addressing urbanisation pressures (Goodwin 2017; Monteiro et al. 2020). Streets are vital components of urban infrastructure, making up 20-30% of the environment and therefore have the potential and responsibility to address the effects of urbanisation and climate change (Stavroulaki & Berghauser Pont 2020). They are evolving from traffic corridors into multifunctional public spaces that prioritise pedestrians over cars, enhancing livability, social interaction, and sustainability, and contributing to the creation of sustainable environments (Alamoush et al. 2021; Stavroulaki & Berghauser Pont 2020). By enhancing livability and providing environmental benefits, streets play a critical role in shaping public life, fostering interactions and social encounters in everyday settings (Sádaba et al. 2024).

Good street design is essential for delivering economic, social, and environmental benefits while maintaining local character (Alamoush et al. 2021). Achieving this requires attention to both functional and visual aspects to create inclusive, attractive, and resilient urban spaces. The COVID-19 pandemic further highlighted the role of streets and pavements as vital public spaces, reinforcing the need to transform car-oriented, high-traffic environments into accessible, safe, and open areas that enhance urban life (Day 2024). Such transformations include pedestrian-only zones, clearly marked and secure cycling infrastructure, adaptable seating that encourages social interaction, and features that support a range of activities (Day 2024). However, implementing these interventions is often constrained by limited space, competing land uses, and ongoing maintenance demands, particularly in dense urban contexts (Fachrudin et al. 2023). When interventions are poorly planned or fragmented, their capacity to deliver social, environmental, and economic benefits may be reduced. Ensuring long-term functionality, therefore depends on supportive policies and continuous management across multiple levels of governance, from national strategies to local urban design frameworks. From a planning perspective, this requires urban greening to be conceived as an interconnected system rather than isolated interventions. Planning plays a central role in establishing spatial priorities, land-use regulations, and the allocation of public space,

thereby shaping how cities grow, adapt, and respond to environmental, social, and economic challenges (Bush & Doyon 2019). To avoid fragmentation and maintain ecological effectiveness, planning frameworks must support connectivity, multifunctionality, and integration across scales, from citywide strategies to street-level (Goodwin 2017; Monteiro et al. 2020; Fachrudin et al. 2023).

Toulouse, a city in southwestern France, exemplifies the use of street greening as a central strategy to address the challenges of urbanisation and climate change while improving livability and environmental conditions (AUAT 2019). As part of the 2019 master plan, introducing street trees and vegetation alongside improvements to soft mobility, transforming streets into multifunctional, convivial, and people-oriented public spaces (AUAT 2019; AUAT 2023). In the city centre, including the historic centre and surrounding streets, greening is shaped by limited space and the need to preserve architectural and cultural heritage. This requires careful consideration of the street and how trees adapt to tight conditions while contributing to spatial quality. These initiatives show how street trees can promote soft mobility, honour heritage, and increase the versatility and conviviality of historic streets. This master's thesis examines the spatial features of four streetscapes in Toulouse's historic centre, in the context of contemporary street greening, see Figure 1.1.

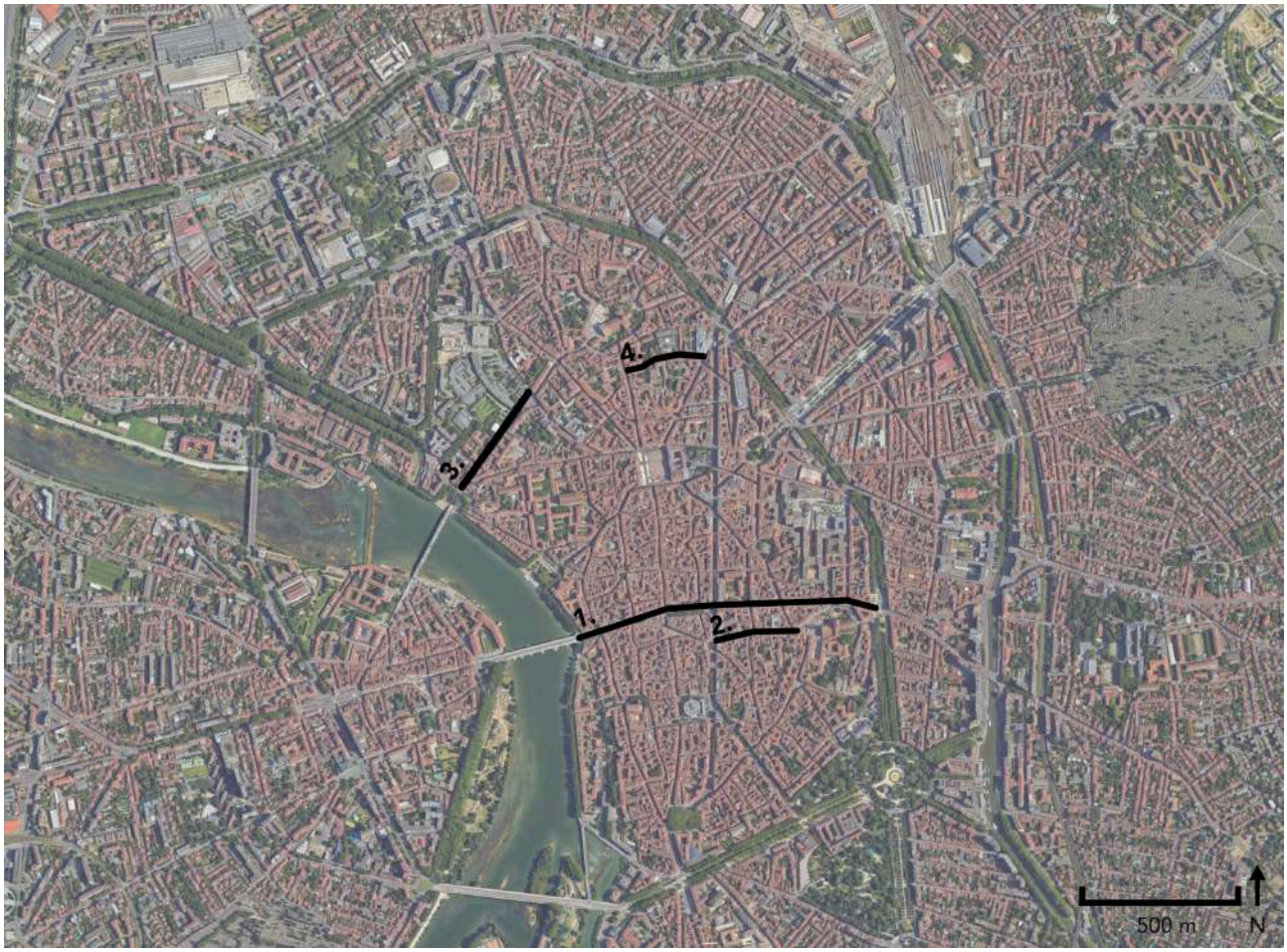


FIGURE 1.1. The selected streets are situated within the urban core of Toulouse: 1. Rue de Metz, 2. Rue Croix Baragnon, 3. Rue Valade and 4. Rue du Périgord. (Google Earth & Kettunen. 2025)

1.1. Aim and goals of the study

The main aim of this master's thesis is to provide a more comprehensive understanding of how contemporary street greening influences the spatial perception of streetscapes, offering insights for landscape architects, urban planners, and municipalities involved in climate-adaptive urban planning.

This master's thesis explores how cities become greener through street greening, focusing specifically on the recent transformation of streets in Toulouse, where trees are central elements. These streetscapes illustrate a response to ongoing urbanisation and climate change. As trees are increasingly included in streetscapes, it is important to consider not only their climate benefits but also their spatial and visual impacts. This master's thesis addresses a gap in the current literature, as the ecological advantages of street trees are well recognised. Still, their spatial and perceptual influences, particularly in dense historic neighbourhoods, are less examined. Therefore, this thesis explores the spatial characteristics of street greening in Toulouse, focusing on how street trees influence the spatial structure and qualities of four recent projects. It considers both their current conditions and their development over time, within a context where limited space, preserved heritage, and the interaction between built and natural elements significantly define the city's identity.

1.2. Research questions

The research presented in this thesis centres on the role of street trees as living elements that contribute to the spatial perception and experience within contemporary street greening developments. It is guided by a primary research question, which investigates how street trees shape the spatial characteristics of four selected contemporary streetscapes as part of recent street greening initiatives in the dense, historic city centre of Toulouse. This main question is divided into two subquestions. The first examines how the spatial traits of urban street trees influence the perception and experience of the streetscapes, while the second explores the temporal aspect, considering how the spatial properties and impacts of the trees change between current conditions and projected future states as the trees mature. The study emphasises both the perceptual and structural roles of street trees. Collectively, these questions aim to reveal the immediate and long-term spatial effects of street trees, offering insights into their contribution to urban design, spatial quality, and the overall experience of contemporary streetscapes in historic city centres. The research questions are as follows:

Primary research question:
How are contemporary street greening developments designed, and how do they influence the perceived and experienced spatial qualities of streetscapes?

Subquestion 1:
In what ways do trees, as spatial elements, influence the perceived and experienced spatiality of the streetscapes?

Subquestion 2:
How do the spatial impacts of the street trees develop as the trees mature?

1.3. Limitations of the study

This master's thesis focuses on Toulouse, specifically its dense, historic city centre. This area was chosen due to its extensive recent urban transformations, many of which have occurred at the street scale. While urban environments are complex systems and streets cannot be entirely detached from their broader urban context, this master's thesis concentrates on the street scale as its primary level of observation.

The observation of contemporary street greening focuses on the spatial perception and experience of streetscapes. While many factors could be explored, the research is limited by its chosen theoretical and methodological frameworks. It uses two levels of analysis: a broad spatial view of streets based on Branzell's principles and a more detailed examination of specific sections, guided by Cullen and his concept of serial vision and the visual perception, together with notations by Branzell. This master's thesis is therefore limited to spatial characteristics that are primarily visual. Spatial characteristics that are not mainly visual, such as sound, temperature, or social interaction, are not considered, as they would have required several observations for the results to be meaningful.

As the observations were conducted in June, the analysis of the spatial characteristics of urban trees is limited to the summer season, when trees are fully leafed. Seasonal variations and spatial experiences during spring, autumn, and winter are therefore not considered. The observations were limited to daytime conditions, as nighttime observations were not seen as beneficial for observing the streetscape.

2. Theoretical overview

This chapter provides a theoretical overview and a framework for understanding the spatial perception of contemporary street greening. It begins by defining spatial perception, then presents the central approach this master's thesis draws on: Gordon Cullen's perspective on visual perception. It describes the framework and how it is used to explore how people perceive streetscapes and the trees within them. The chapter also presents the spatial characteristics of trees to establish a more comprehensive framework for examining them as living elements of streetscapes.

2.1. Spatial perception of streetscapes

In urban planning, architecture, and landscape architecture, spatiality refers to the characteristics of a space and relationships between them, the structure and organisation of spaces, and how they are perceived and experienced through movement (Ching 2007). Spatiality encompasses both the physical form and the spaces of the interior and exterior, as well as the perception and recognition of the physical elements through sequential experience over time (Ching 2007). The relationships recognised in this master's thesis are between the streets, buildings, and trees, which are organised within the street structure of sidewalks, bike lanes, car lanes, and planting strips, creating places as one walks through the streets. Spatial perception, by contrast, relates to how individuals experience and interpret space (Green & Schellenberg 2017). It involves understanding size, shape, distance, scale, and organisation, reflecting how people navigate and interact with their surroundings (Green & Schellenberg 2017). In this master's thesis, the core components shaping the spatial perception are streets, buildings and vegetation, which define the structure and character of the city, influencing how people experience and engage with it.

2.1.1. Cullen's framework for human perception

Gordon Cullen, a British architect, emphasised the importance of visual and spatial sequences in shaping the experience of the city, advocating for human-centred urban environments (Cullen 1971). He describes the urban environment as a composition of buildings and the spaces between them. Cullen (1971) highlights *the art of relationships*, focusing on how elements such as streets, façades, and vegetation interact to create dynamic and emotionally engaging surroundings. His work emphasises that spatiality is not static but is continuously perceived and reinterpreted through movement and shifting viewpoints. Cullen (1971) divides visual perception into four categories: *serial vision, place, content*, and *the functional tradition*. Serial vision describes the city as a series of changing views, where contrasts and shifting perspectives create dynamic visual experiences. It is employed as a methodological approach in this master's thesis, where the streets are interpreted through serial vision, reimagined as a series of sections, and further discussed in chapter three. Place emphasises human scale and the relationship between people and their surroundings, focusing on how places feel and function. In this thesis, this perspective is applied to examine human scale

through the relationship between the observer and the surroundings. The observations are therefore based on the subjective experience of the observer and how the streetscapes feel and functions. Content refers to the physical elements of the urban scene, including walls, floors, trees, and other structures, that define, enrich, and give character to space. These elements, such as buildings, trees, and amenities, are analysed in relation to the streetscape. Lastly, the functional tradition highlights that streets and public spaces must serve practical purposes, such as movement, access, and daily life, while maintaining visual coherence and spatial quality. Although daily life is not observed, visual coherence and spatial quality are inherently considered in the analysis of the streetscapes.

Furthermore, Cullen (1971) states that outdoor spaces become meaningful places when they are inhabited and treated like interior rooms, where the floorscape and wallscape form the foundation for experiencing the defined space. Floorscape contributes to continuity through footpaths and walkways that link areas seamlessly, while enclosures, focal points, small open spaces, narrow passages, and varied textures, materials, patterns, and levels create intimacy and rhythm within streetscapes. Wallscape provides boundaries and opportunities for expression, with light, shade, texture, and construction reinforcing architectural character, framing spaces, and enhancing visual character. Elements, such as trees and furniture, interact with floors and walls to define space, establish identity, and create a sense of here and there and of place. Together, the floorscape, wallscape, and other elements blur the boundary between indoor and outdoor, transforming streets, squares, and courtyards into inhabitable, human-scaled places where movement, perception, and social life are seamlessly intertwined.

This thesis uses Cullen's framework to examine the selected streetscapes and their spatial characteristics. It examines the streetscapes are as outdoor room, with the floorscape and wallscape defining space. Trees are examined as elements that interact with the floorscape and wallscape, shaping perceptions and experiences of streetscapes by defining space and influencing the sense of place and identity. Aspects such as their proportions and influence on the human scale, their role in guiding movement, their contribution to the rhythm of the street, and their use as focal points are observed on the streetscapes. In this way, Cullen's perspective provides a framework for understanding how these elements function visually and perceptually.

2.2. Street trees as spatial elements

A tree's spatial characteristics depend on its structure, which is influenced by species-specific growth patterns, age, and environmental conditions (Sjöman och Slagstedt 2016). Trees add vertical presence and create a visual rhythm on the street, with trunk diameter determining the tree's visual prominence and whether it serves as a landmark or a less prominent feature. The number of stems is a central spatial characteristic of trees, with single-stem trees reinforcing the street line, while multi-stem trees add variety. Stem height and canopy influence perceptions of space and the sense of enclosure. Branching patterns and canopy form define the canopy's horizontal extent and vary from upright, spreading, symmetrical, and irregular. Spreading crowns create lateral enclosure, while

upright forms emphasise verticality. The canopy acts as a spatial ceiling, influencing perceived height, enclosure, and intimacy. Its density, foliage density, layering, and shape regulate light and overhead coverage. In this way, the structural and canopy features of street trees emphasise their ability to shape urban environments in the long term (Sjöman och Slagstedt 2016). Therefore, the selection of species is as much a spatial decision as an ecological one.

These spatial characteristics are dynamic and change over time rather than remaining constant. Trees continuously change in form and presence throughout their lifespan and across seasons, gradually modifying the spatial environment they occupy, the shade they offer, and how they frame the surrounding space (Sjöman och Slagstedt 2016). Deciduous trees show distinct seasonal changes that greatly affect the spatial qualities of streetscapes. In spring, emerging foliage softens street edges, increasing visual permeability while gradually providing shade and a sense of enclosure. During summer, trees have fully developed canopies, creating dense, volumetric overhead coverage that forms shaded corridors, offers relief from heat, and establishes intimate, human-scaled spaces. In autumn, the changing colours of leaves enhance the street's visual character, emphasise seasonal variation, and add depth and texture to the urban environment. During winter, leaf loss reopens views, increases solar access, and restores long sightlines along the street, resulting in a brighter, more open spatial experience.

Tree placement along streets is essential for defining boundaries, directing movement, and shaping the visual and functional aspects of streetscapes. It creates a sense of enclosure, frames views, and reinforces rhythm and continuity, thereby enhancing legibility and strengthening urban identity. Placement also influences shade provision, a vital element that enhances thermal comfort and street usability (Chen & Ng 2012). Shade significantly affects our perception, experience, and use of streets (Sjöman & Slagstedt 2016). Pruning supports these functions by ensuring safe passage, preserving visual clarity, and maintaining coherent relationships between trees, pathways, and surrounding urban features.

3. Methodological approach

This chapter outlines the methodological approach used to examine contemporary street greening as part of the urban transformation in Toulouse. It begins by presenting the selection criteria for selecting the examined streets before describing the methodological steps of this master's thesis. It then continues by discussing the reflective process and the master's thesis's subjective perspective. The chapter also addresses the use of AI as a support tool.

3.1. Selection criteria for selecting streets

Four streets were selected based on four criteria: 1. their location within the city centre, 2. recent redevelopment efforts, 3. prioritisation of pedestrians and cyclists, 4. and their role in Toulouse's urban greening initiatives. All streets are located in the Sector Centre on the east bank of the Garonne River and form part of the historic urban fabric. Each has undergone significant transformation within the past five years and therefore represents a contemporary example of street greening. They have all been transformed to prioritise soft mobility. Each have been planted with trees as part of the development.

Several streets meet the criteria, but only four have been selected as case studies. The selected streets differ in width, length, and character, providing a diverse foundation for analysing the spatial characteristics of the streetscapes. The first street is a boulevard, long and wide, with several trees planted in a line, together with lower vegetation. The second street is parallel to the first, shorter and narrower, winding, and with an important focal point that influences the single trees that are planted. The first and second streets are both part of the Busquet development, which is described in chapter five. The third street is selected because of its openness on one side, creating different boundaries that influence the trees and lower vegetation. It is partly part of the Busquet development, while the fourth street is not part of the Busquet development. The fourth street was chosen because of its narrowness, still opening up in the middle, together with its extensive planting of trees and vegetation. In contrast to the other streets, it has only been partly transformed, while the others have been more completely redone. The different morphologies and planting strategies allow for varying street characteristics and spatial experiences to be discussed.

3.2. Methodological steps and the process

This master's thesis employs a qualitative and empirical research approach, conducted as a case study. It aims to explore, observe, and present the spatial characteristics of four contemporary street greening projects in Toulouse. The research was carried out through five main methodological steps: a literature review, document studies, a preliminary site analysis, a broader site visit with an observation study, and lastly, the structured site visits with observation studies. The findings were then compiled into plans, sections and text to present a comprehensive result.

The process for this master's thesis followed a linear structure: the literature review, document analysis, and preliminary site analysis were conducted during spring 2025, while the broader site visit and the structured site visits were conducted during summer 2025. The reflective process was essential in shaping both the overall direction and the research questions of this master's thesis. Several themes were considered before the final subject was defined, centred on contemporary street greening within the context of recent street development, with a focus on the spatial structure and perceived spatiality. The methodological approach, grounded in qualitative and empirical research, was chosen to enable a thorough exploration of the spatial characteristics that urban trees contribute to the streetscape.

It is essential to acknowledge that observational research is inherently shaped by the observer; in this master's thesis, I, a landscape architecture student in the final year of my studies, serve as the observer. The thesis builds on an academic background, including a bachelor's degree in landscape architecture from SLU, the Swedish University of Agricultural Sciences in Uppsala, and an exchange year at ENSA Toulouse, École Nationale Supérieure d'Architecture de Toulouse. The landscape architect's perspective offers insight into form and function, with an understanding of how built environments are designed and conceived, where trees are regarded as essential design elements. Additionally, my upbringing in Helsinki, my studies in Uppsala, and two years of living in Toulouse have also shaped my interpretation of urban space, particularly in terms of differences in the everyday use of public spaces, cultural differences and variations in climate. Although the subjective perspective is inevitable, grounding the study in theoretical and methodological frameworks ensures both transparency and an analytical perspective.

3.2.1. Literature review

A literature review was conducted to examine previous research on contemporary street greening. It focused on articles in the fields of landscape architecture, urban planning, and urban forestry. The databases Scopus and Google Scholar were utilised, and the primary search keywords included urban environment, streets, and trees. The themes examined included urban planning, streetscapes, and street trees. These were reviewed to establish a broad understanding of the selected subject and to identify knowledge gaps regarding the spatial characteristics of contemporary street greening. Relevant theories, concepts, and frameworks for interpreting urban space, streetscapes, and their spatial characteristics were then selected to enable a structured approach to examine how urban space is perceived, with a focus on the spatial perception of streetscapes. These were developed into the theoretical overview, see chapter two, and provided a foundation for the methodological approach. Gordon Cullen's book, *The Concise Townscape* (1971), contributed to shaping both the theoretical overview, see chapter two, and the methodological approach, which is further described in section 3.2.5. For the methodological approach, Arne Branzell's *Att notera rumsupplevelser* (1976) provided inspiration for a method for documenting spatial experiences, which is further described in section 3.2.5.

3.2.2. Document studies

To contextualise the recent urban transformations in Toulouse, a document study of the central planning frameworks was conducted. Central to this thesis were two strategic documents provided by the Toulouse Urban Project, which include the *Toulouse City Master Plan* from 2019 and the *Sector Centre Master Plan* from 2023. These documents were reviewed to provide a comprehensive overview of the current and future urban transformation in the city, see chapter two. The planning frameworks lay the groundwork for the street transformations analysed in this thesis by outlining how Toulouse aims to balance necessary adaptation to urbanisation and climate change with the preservation of its heritage. The purpose of studying these documents was to clarify the broader urban transformation that shaped the selected streets and outline the transformation of Toulouse, focusing on integrating and enhancing nature within the urban environment, both at the citywide level and within individual sectors (AUAT 2019; AUAT 2023).

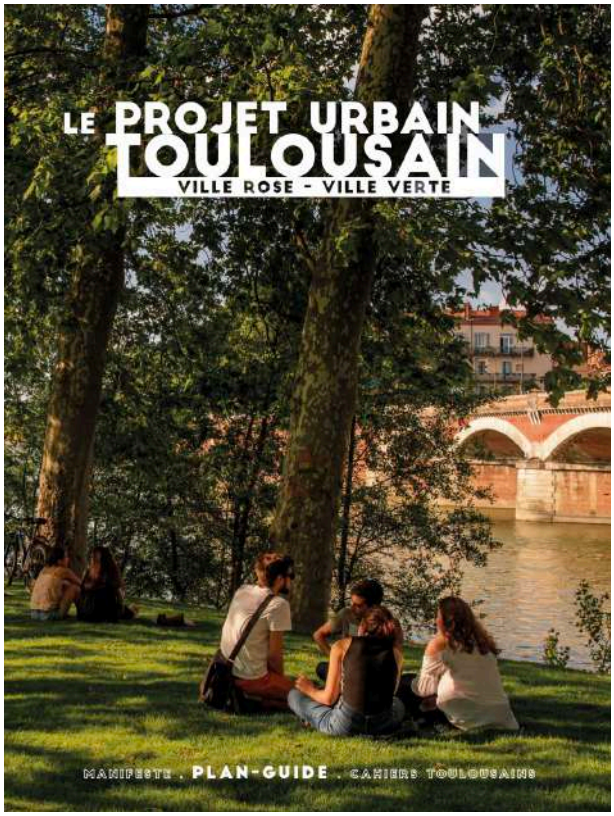


FIGURE 3.1. *The Toulouse City Master Plan.* (AUAT 2019)

FIGURE 3.2. *The Sector Centre Master Plan.* ([redacted] 2023)

The Toulouse City Master Plan

The Toulouse City Master Plan outlines the city's planned development with a timeline extending to 2040 (AUAT 2019). This development is divided into five themes, with the first theme, "Environnement, Développer la nature en ville" or "Environment, Develop the nature in the city" being essential to this thesis. It outlines three primary objectives for this theme, with the objective "Renforcer les liaisons végétales et paysagères" or "Strengthening vegetation and landscape links" being particularly of interest, see chapter four.

The Sector Centre Master Plan

The sector centre master plan defines the sector's identity and outlines its development in line with *the Toulouse City Master Plan* (AUAT 2023). The document has the same structure as *the Toulouse City Master Plan* and is divided into five themes to illustrate the overall development of the sector. The first theme, "Environnement, Développer la nature en ville" or "Environment, Develop the nature in the city", and the objective, "Renforcer les liaisons végétales et paysagères" or "Strengthening vegetation and landscape links", have been reviewed, see chapter four.

3.2.3. Preliminary site analysis

The preliminary site analysis provided an overview of the selected streets, within their broader context, identifying their location, connections, focal points, and overall use. This included general background information from maps and other sources, such as planning documents from the city, the city websites and newspaper articles. The lengths and widths of the streets were measured using mapping tools such as Google Earth. The historical development of each street was briefly examined to provide a broader understanding of the factors that have shaped it over time. This included an overview of their earlier state, supported by available photographs showing their condition before the urban transformation. The available photographs from before the transformation of each street are found in chapter six, where they were edited into black and white to distinguish them from photographs from the present. Before-and-after material was presented to provide a thorough understanding and a clear overview of the street transformations.

3.2.4. A broader site visit and observation study

The site visits and observation studies were conducted during the summer and can be divided into two parts: a broader site visit and observation study, followed by the structured site visits and observation studies. During this broader site visit, each street was walked through, and the observations focused on the broader context, how the streets connect to their surroundings and on the general features of the selected streets. The sense of continuity and enclosure created by the buildings, along with their heights, was observed to provide a solid foundation for each street. The recent street transformation was examined, with particular attention given to the chosen materials, including trees, as well as other street furniture and amenities. The broader site visit and observation study provided a foundational understanding of the spatial context and characteristics of the selected streets, complementing the preliminary site analysis. Notes and photographs were taken of the observed buildings and vegetation, while the heights and flow of movement along the street were recorded. The collected material was primarily used for personal reference during the development of plans, sections, and text.

3.2.5. Structured site visits and observation studies

The structured site visits and observation studies were developed based on a foundation of several theoretical frameworks, as discussed in chapter two. The methodological approach for the

structured site visits was influenced by Gordon Cullen's *The Concise Townscape* (1971) and inspired by Arne Branzell's *Att notera rumsupplevelser* (1976).

Cullen's (1976) influence on the methodological approach for the observation studies is primarily his concept of serial vision, where he emphasises how spatial perception changes through movement, which forms the conceptual basis for examining the streets. Rather than reproducing Cullen's photographic sequences, this thesis translates serial vision into a series of sections of each street. Each street is shown through three sections spanning from façade to façade across the street, illustrating how the spatial structure changes along the width rather than along its length. This provides a representation of the spatial characters encountered as one moves through the street. The sections have been notated with the notation framework of Branzell, which presents the perceived spatiality, and is thoroughly described in the next section. The trees are seen as elements, and the ground is describes as floorscape, and the facades as wallscapes. Naturally, the sections illustrate how vegetation interacts with the surrounding built environment to shape the perceived and experienced spatiality, both in the present and in 50 years. This comparison between present and potential future conditions allows an examination of how increased canopy cover might influence the overall spatial experience of the street. The sections are complemented by a principal plan drawing of a part of the street showing tree placement, and a plan drawing inspired by Branzell, described below.

In addition, the methodological approach for the observation studies draws inspiration from the Swedish architect Arne Branzell, who developed a systematic method for documenting spatial experiences using pen-and-paper notation (1976). In this thesis, Branzell's approach is adapted to digital tools, using a tablet and pen to record observations. Branzell's method emphasises increasing awareness of spatial qualities by identifying the dynamic character of space and recognising how perception shapes spatial understanding. He developed the method to describe urban space, although the approach can be applied to all types of spaces. His method uses a notation framework based on symbols that represent different spatial limitations. Different line types indicate different forms of spatial boundaires, see Figure 3.3. These lines can be combined with various markings to clarify the sense of the space, see Figure 3.3. They can also be complemented with different markings, dots and arrows, to clarify the direction within the space, see Figure 3.4. The strength of the line indicates whether a boundary has a strong or weak influence on the spatial experience. This includes assessing whether a space feels directed or concentrated, solitary or overlapping, strongly or weakly defined, and how degrees of spatial enclosure vary along a route, see Figure 3.4. According to Branzell (1976), intuitive spatial impressions can be made conscious and analytical through structured notation, providing a framework for observing and articulating subjective spatial experiences. Branzell's framework has therefore been used in this master's thesis to enable a structured notation of the perceived and experienced spatiality on the streetscapes. This thesis applies Branzell's principles in a plan drawing for each street, where the above-mentioned aspects are illustrated to provide an overview of the dynamic experience of moving along the street in plan.

Additionally, his framework is further integrated into the series of sections by adding spatial notations to highlight the degrees of openness and enclosure. The notations use the different line types described above, and in Figure 3.3.

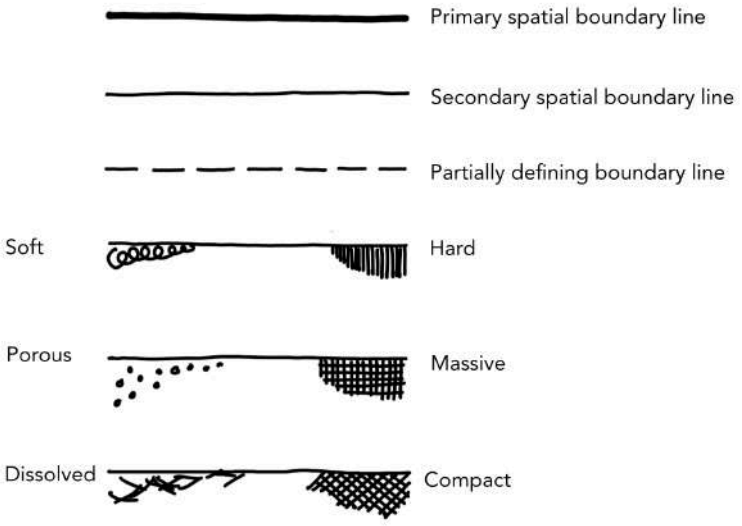


FIGURE 3.3. The line types by Branzell indicate different spatial boundaries. (Kettunen. 2026)

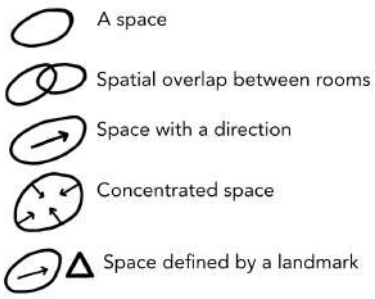


FIGURE 3.4. The different space-defining notations by Branzell. (Kettunen. 2026)

The structured site visits and observation studies involved four structured visits, where each street was visited during each structured visit.. Because the distance between the streets was short, all site visits were conducted as part of a single, continuous walk. On two occasions, the walk began at the first street, continued through the second and third streets, and ended at the fourth. On the other two occasions, the route was reversed, starting at the fourth street and ending at the first. These were conducted on June 10th, 2025, between 13:00 and 15:00; June 11th, between 11:00 and 13:00; June 13th, between 07:00 and 09:00; and the final visit on June 16th, between 11:00 and 13:00. Each visit took place in sunny weather, with temperatures around 30 °C for the midday visits and approximately 20 °C for the morning visit. Most visits occurred around midday when the sun is at its highest, enabling clear observation of shading patterns during the warmest part of the day. Sunny conditions were deliberately chosen to observe the street's sun and shading dynamics. Additionally, a morning visit was conducted to assess the streets in cooler, more comfortable conditions.

The streets were walked slowly, from end to end, in both directions, to view them from multiple perspectives. Extended observations for a detailed assessment of street dimensions and trees were conducted in shaded areas, away from the sun, providing some relief. During the walk, photographs were systematically taken of the street environment and trees. The trees were recognised, as elements, along with their height and width, and the perceived microclimate was noted. The photographic material was primarily used for personal reference during the development of plans, sections, and accompanying text. Several photographs are included in chapter six, presenting the

transformation of the streetscapes. Despite efforts to maintain consistency, the before and after photographs were captured from differing viewpoints due to limitations in the available sources, preventing precise one-to-one comparisons. To help with orientation, the intended viewing angles for each photograph are marked on the first overview map of each street, see figures 6.1.1, 6.2.1, 6.3.1, and 6.4.1.

The results of this study are primarily based on observations from site visits and aim to capture the spatial characteristics of each street through various documentation and representation methods. The empirical data were compiled to create a comprehensive analysis of each street, with each form of representation serving a specific purpose and highlighting different aspects of the street. The analysis was completed, with additional information from Google Earth and photographic material, primarily from news articles, to verify elements that were not fully documented during the site visits. Additional visualisations were included to illustrate the intended future condition of the first three streets, while none were available for the fourth.

3.3. Artificial intelligence as a support tool

Artificial intelligence (AI) was used during the writing process of this master's thesis as a supporting tool for language and structure. DeepL was used for translating documents and words between Swedish, French, and English. Grammarly was utilised to improve grammar, clarity and style in the written text throughout the entire writing process. ChatGPT served both as a reflective tool to discuss the content, structure, and coherence of the text and as a language support tool to refine formulations, review synonyms, and terminology. It was mainly used during the early stages of the writing process to explore the theme, research questions, and the general thesis structure. At a later stage, ChatGPT was used to support the organisation of the results for the four streets in order to ensure coherence. All content was compiled by the author, and the tool was used to propose an initial structure for consistently handling the extensive material. While AI can be used in many ways, its main advantage in this context was as a provider of reformulations and suggestions. These suggestions were often imperfect, but in some cases helped to clarify ideas. All text was written by the author, with AI-generated suggestions carefully considered, adapted, and reformulated multiple times throughout the writing process. The tools were used critically, helping with giving propositions and not answers. The author maintains full responsibility for the content, research, and conclusions of the master's thesis.

4. The Pink City becomes the Green City

This chapter introduces Toulouse and discusses briefly its history, as well as recent and ongoing urban transformation. It highlights the Toulouse Urban Project, comprising the *Toulouse City Master Plan* and the *Sector Centre Master Plan*, and offers an overview of planned development in the city, with urban greening as a central objective of the transformation. These plans include initiatives to promote soft mobility, such as walking and cycling, as a central part of the greening strategy, together with tree planting.

4.1. Toulouse, *La Ville Rose*

Toulouse is situated in south-west France, as shown in Figure 4.1, between the Atlantic Ocean, the Pyrenees, and the Mediterranean Sea. The Garonne River flows from the Pyrenees to the Atlantic through Toulouse, and the Canal du Midi links the Garonne to the Mediterranean Sea. The city has an ancient history, with origins dating back to antiquity, and over time, the old city on the right bank became surrounded by medieval suburbs that developed on both banks of the river (Britannica 2025). The Great Fire of 1463 destroyed half the city, which was primarily built out of wood, leading to a shift towards Roman-inspired brick buildings and Renaissance-inspired houses. The city centre expanded toward the Canal du Midi, which was completed in 1693 (Canal du Midi n.d.).

FIGURE 4.1. Toulouse is marked as the red dot in southwest France, with Paris shown as the black dot for reference. (Kettunen. 2025)

Today, the city expands along the river and is surrounded by the Périphérique, the Ring Road, which separates the city from the suburbs, as shown in Figure 4.2. Toulouse is the fourth-largest city in France, with a population of 500,000 (Le Figaro 2024), including over 120,000 students (Toulouse Team n.d.), making it a major university city in the country (AUAT 2019). Over the past decade, the population has increased by an average of 5,000 inhabitants per year (European Union n.d.), and is projected to surpass Lyon as the country's third-largest city (Le Figaro 2024).

FIGURE 4.2. The city of Toulouse is surrounded by suburbs, the airport to the west and agricultural land to the east. (Google Earth & Kettunen. 2025)

4.2. The redevelopment of Toulouse

In response to Toulouse's urban growth, it has been essential to rethink the urban environment. The city announced *the Toulouse Urban Project*, which led to a master plan in 2019 (AUAT 2019). The Toulouse Urban Project was led by the *Prospective et Stratégie Territoriale, the Urban Prospective and Strategy Department*, supported by architects, urban planners, and landscape architects from

AUAT, *L'agence d'urbanisme et d'aménagement de Toulouse*, *the Toulouse urban planning agency* (European Union n.d.). The total budget allocated by the city for the urban project was € 1,200,000 (European Union n.d.). The urban project, with a long-term perspective extending to 2040, aims to balance urban growth with biodiversity, comfort, and climate resilience in the city (AUAT 2019).

The master plan considers the various scales of Toulouse and addresses five themes: the environment, conviviality, mobility, urban form, and activity (AUAT 2019). The environmental dimension focuses on integrating nature into the city, while the conviviality dimension concerns the development of public spaces. The mobility dimension involves promoting soft mobility. The dimension of urban forms concerns enhancing the city's overall structure, whereas the economic dimension supports economic growth (AUAT 2019). The master plan divides Toulouse into six sectors, each with its own sector-specific master plan, see the sector divisions in Figure 4.3 (AUAT 2019). The Sector Centre, Sector 1, see Figure 4.3, is situated in the centre of Toulouse and is of particular interest in this master's thesis as it comprises several historic neighbourhoods with diverse typologies, from the Roman city to old suburbs, former villages, and former military and industrial sites (AUAT 2023). The Sector Centre covers an area of 518 hectares and extends along the Canal du Midi in a south-east direction, with Allées Jules Guesde and Pont Saint-Michel to the south, and Allée Charles de Fitte and the banks of the Garonne to the west, see the shown area in Figure 4.4. (BAU-B Arquitectura I Urbanisme n.d.).

FIGURE 4.3. The city is divided into six sectors. (AUAT 2019:10)

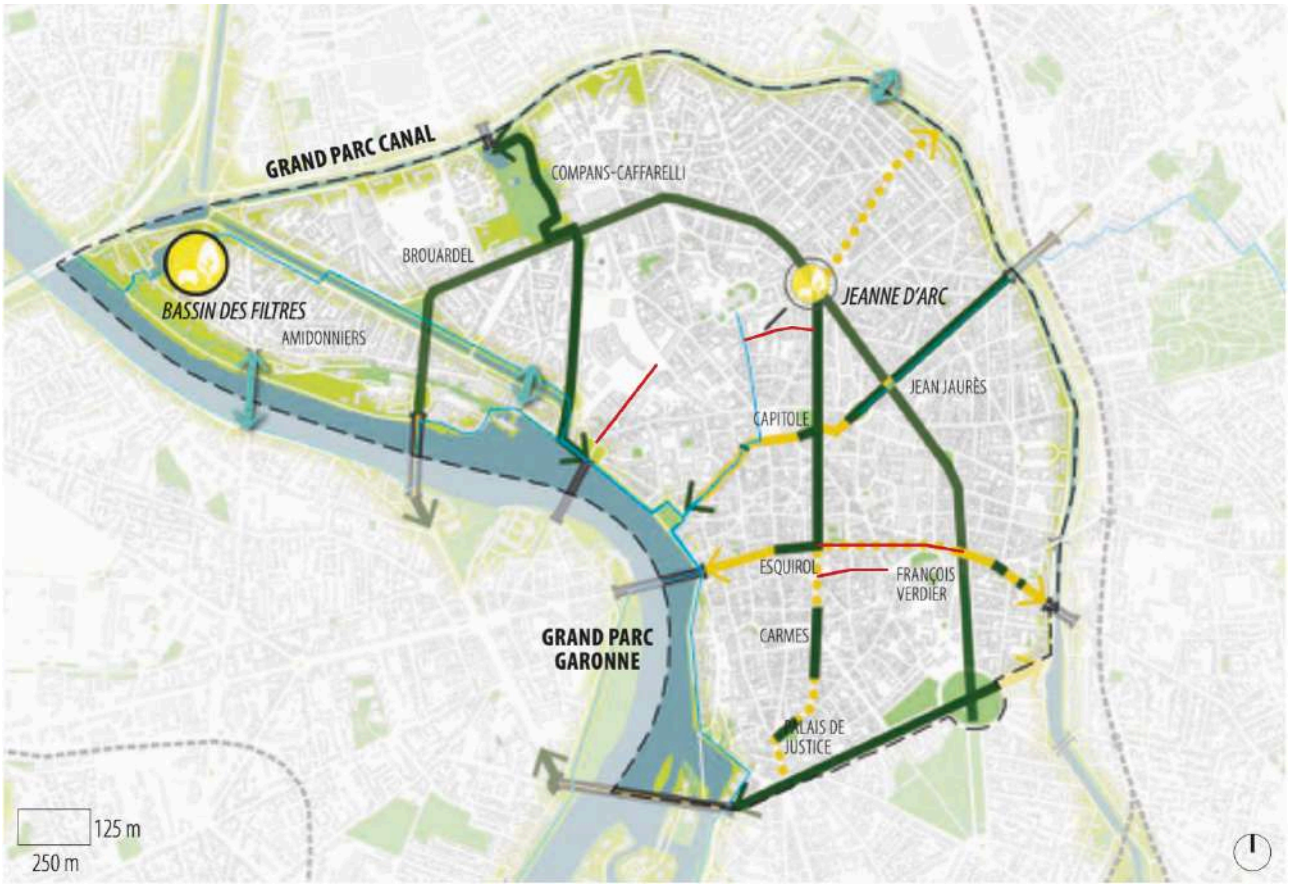


FIGURE 4.4. Landscape links in the Sector Centre with the big city parks, following the waterways: Grand Parc Garonne along the Garonne and Grand Parc Canal along the Canal du Midi. (AUAT 2023:43)

The sector centre is influenced by geographical and historical factors, with the ancient city, the Garonne River, and the Canal du Midi being defining elements (MDP Michel Desvigne Paysagiste n.d.). The city's existing water and vegetation corridors follow a north-south orientation, see Figure 4.4, highlighting the need to strengthen east-west connections (AUAT 2019). Five city parks are being developed to serve as connections between the city and the centre, two of which, the *Grand Parc Garonne* and the *Grand Parc Canal*, are part of the Sector Centre, see Figure 2.4. The Grand Parc Garonne project, stretching 32 kilometres, has been ongoing since 2015 (Toulouse Mairie - Métropole n.d.b), while the Grand Parc Canal project, spanning 30 kilometres, began in 2021 (Toulouse Mairie - Métropole n.d.a). Both are planned for completion by 2030 and aim to enhance the natural heritage and landscape by creating green networks and developing paths for soft mobility (Toulouse Mairie - Métropole n.d.a; Toulouse Mairie - Métropole n.d.b). To connect the city parks across the city, the master plan has identified and established a transversal network of landscape links connected to major infrastructure (AUAT 2019). Existing landscape links to be preserved or strengthened are marked as solid green lines, and links to be further developed are indicated by yellow lines, see Figure 2.5 (AUAT 2019; AUAT 2023). The selected streets examined in this master's thesis are marked in red and are connected to the identified landscape links, see Figure 4.4. The enhanced network includes street trees forming a continuous city canopy by linking green spaces, landscaped sidewalks on major roads, pedestrian paths in urban districts, and streets prioritised for soft mobility (AUAT 2023).

The development and design of the Sector Centre were overseen by a team from Barcelona, led by *Joan Busquets* and his agency *BAU-B Arquitectura I Urbanisme* (AUAT 2019). The landscape architect responsible for the project was *Michel Desvigne,* and his agency, *MDP Michel Desvigne Paysagiste* (MDP Michel Desvigne Paysagiste n.d.). The urban environment and the boundaries between built and natural environments were being reconsidered as part of the transformation, opening up new opportunities for exploration (AUAT 2019). The redevelopment led by Busquets, primarily concerning streets, was completed in 2021 (MDP Michel Desvigne Paysagiste n.d.). The aims were to enhance the city's heritage and identity while emphasising soft mobility. This included coherent street paving and shared lanes for pedestrians, cyclists, and motor vehicles, along with tree planting. It aimed for a naturalistic character and reinforced the existing plant structure by identifying nine landscape elements forming a hierarchical network connecting the current vegetation: the Garonne River, the Canal du Midi, the boulevards forming an octagon, the parkways, the transversal and radial streets, the islands, as well as the gardens in squares and courtyards, see Figure 4.5. Although the redevelopment of Busquets is complete, the redevelopment continues on Sector Centre according to the sector-specific master plan from 2023 (AUAT 2023).

FIGURE 4.5. The hierarchical network of vegetation and the nine landscape elements that were identified and outlined by Busquet and his team. (BAU-B Arquitectura I Urbanisme n.d.)

5. Street greening

This chapter provides a foundation for understanding street greening and the importance of street trees in creating sustainable cities. It starts by redefining streets as multifunctional spaces where trees are significant elements. However, their spatial arrangement and layout still determine how trees can be incorporated into streets. The chapter then explores the role of trees within street environments, emphasising their significance in shaping spatial structure. Finally, it offers a brief overview of the history of trees in France.

5.1. Redefining streets

Urban planning has been prioritising motor vehicle traffic since the 1950s (Tsigdinos et al. 2024). Streets were primarily designed as mobility corridors, with limited regard for their social, ecological, or aesthetic potential. Currently, there is a growing emphasis on sustainable transport and soft mobility (Stavroulaki & Berghauser Pont 2020). Soft mobility includes non-motorised transport such as pedestrians and bicycles (La Rocca 2010). Contemporary streets are therefore no longer seen merely as traffic corridors but as multifunctional public spaces that support social, economic, and environmental activities (Alamoush et al. 2021; Stavroulaki & Berghauser Pont 2020; Sádaba et al. 2024). This redefinition aligns closely with green infrastructure principles, demonstrating how considerate urban design can influence mobility choices, foster social interaction, and promote sustainability goals while enhancing the resilience and inclusivity of streetscapes (Goodwin 2017). Streetscapes are the most extensive and interconnected parts of the urban fabric, shaping movement, social interaction, and ecological opportunities (Stavroulaki & Berghauser Pont 2020). Within these redefined multifunctional streets, trees stand out as one of the most effective methods of street greening (Goodwin 2017). They are widely recognised as a key part of green infrastructure (Goodwin 2017), offering ecological, social, and economic benefits. Most existing research on street greening has focused mainly on the environmental benefits of street trees, while more recent studies emphasise their role as spatial and structural components of the urban environment (Goodwin 2017; de Wit & van der Welde 2024). In contemporary street greening, street trees serve as multifunctional greening elements, dependent on the streets and how trees can be integrated into them.

Streets include alleys, avenues, boulevards, promenades, pedestrian streets, and squares. Each has features such as width, enclosure, and layout that shape how spaces are used and experienced. The physical shape of a street, including the public and private spaces, provides the foundation for potential greening and determines where trees can be placed and how their canopies can grow (Stavroulaki & Berghauser Pont 2020). Street orientation and the height-to-width ratio are essential in shaping the character and function of streetscapes. On narrower streets, while they can create human-scale spaces that promote intimacy and social interaction, they can also feel unsafe when space is too constrained. Trees have limited space to grow, with canopies having less room to spread, and the soil volume below ground is restricted. The limited width restricts larger plantings

but can accommodate smaller tree species and planters. Careful species selection is therefore essential to ensure functionality and ecological benefits without overcrowding the street. On wider streets, trees have more space to grow larger, taller, and wider; sidewalks and barriers can also support bigger bushes, trees, and green infrastructure. Wider streets facilitate linking central areas through urban vegetation, where trees act as visual corridors, frame landmarks, and integrate social, ecological, and mobility functions, thereby improving urban quality (Sjöman & Slagstedt 2015). Limiting or eliminating vehicle traffic enables the provision of trees and permeable surfaces. Pedestrianised streets enhance activity and recreation by transforming public spaces into places for leisure, flexible street use, and social encounters. These social and environmental benefits make pedestrianised streets essential to urban livability and resilience.

Overall, this move toward multifunctional streets highlights the growing importance of street greening, influencing movement, social interactions, and ecological possibilities. Different types of streets need to be assessed differently in greening efforts to optimise space use without causing excessive enclosure or shade. Therefore, understanding street morphology is vital, and understanding the relationships among streets, buildings, and trees is essential to designing vibrant, resilient, and multifunctional streets.

Street greening has been widely studied, especially regarding sustainability, climate resilience, ecosystem services, and human well-being. It has been implemented in various ways to balance mobility, social interaction, and ecological benefits. Much research has also focused on trees, primarily on their role in climate adaptation and their contributions to urban ecosystems. However, less focus has been given to the spatial features of street greening, and only a few studies have explored the spatial and functional roles of trees within streetscapes (de Wit & van der Velde 2024).

5.2. The role of trees in street environments

Trees have long played a vital role in shaping urban environments, and their presence has historically influenced both the physical and cultural development of cities. They often predate built structures, and they commonly served as natural starting points for the development of architecture and urban planning, creating a direct link between trees and the growth of cities. Historically, they have served as building materials, weather protection, and orientation markers (Sjöman & Slagstedt 2015). From the 17th century onwards, their role became more formalised as trees increasingly featured in urban greening initiatives (Sjöman & Slagstedt 2015).

Although street vegetation has existed in cities for centuries (Feng & Tan 2017; de Jonge 1986), the last two centuries have seen a move towards intentional, citywide greening strategies that recognise its broader value (Feng & Tan 2017). Within this context, street trees have become a particularly central element of urban greening, as they represent the type of vegetation most consistently encountered by residents in their daily lives (Coleman et al. 2022). Over time, their primary purpose shifted from ornamental beautification to providing ecological and environmental benefits

(Seamans 2013). Research done by landscape architects in the early 20th century showed that vegetation actively influences the spatial experience by framing views, guiding movement, establishing rhythm, and creating a sense of enclosure (de Wit & van der Welde 2024). This as they were examining the vspatial and visual impact of trees, by combining architectural ideas of form and enclosure with the emotional and perceptual aspects of the landscape.

Strategic planting along streets has been used in urban environments for various reasons. Trees strongly shape the perception, navigation, and use of streets (Sjöman & Slagstedt 2015). They serve as adaptable spatial elements that soften building edges, frame views, guide pedestrians, and enhance visual appeal through variations in form, colour, and texture (Goodwin 2017). Arrangements vary, including solitary trees, linear or double rows, clusters, or irregular groups, creating distinct spatial types that define, enclose, or open up urban environments. Rows provide linear guidance, double rows create vaulted or enclosed spaces, clusters establish intimate subspaces, and individual trees serve as focal points in larger areas. Trees also function as physical and visual buffers, shielding pedestrians from traffic and enhancing safety (Mullaney et al. 2015). Planting along streets and canals was historically used to provide shade and ease movement, demonstrating that trees were purposefully employed to improve comfort and navigation well before modern planning techniques emerged (Sjöman & Slagstedt 2015). Whether as remnants of rural landscapes or as intentionally designed avenues, their presence emphasises the enduring influence on urban character and identity (Feng & Tan 2017; de Jonge 1986; Coleman et al. 2022).

Trees face significant constraints that can limit their growth and long-term performance in urban environments (Sjöman & Slagstedt 2015). Urban areas contrast significantly with natural habitats and often create less favourable conditions for tree growth. Factors such as compacted soils, limited rooting space, elevated surface temperatures, irregular water supply, and artificial lighting exposure all impose additional stress on trees (Sjöman & Slagstedt 2015; Mullaney et al. 2015; Goodwin 2017; Jonge) 1984). As a result, although some species can live for centuries, few urban trees reach maturity due to these challenging growing conditions (Goodwin 2017; Mullaney et al. 2015). In addition to environmental constraints, trees require ongoing maintenance, can interfere with underground and above-ground infrastructure, and may pose safety hazards if not properly managed (de Jonge 1984; Goodwin 2017). While trees offer ecological, social, and economic benefits, these benefits are affected by tree growth and are vital in dense urban areas to create livability. Ecologically, they enhance ecosystem services (Doll et al. 2024; Martinez et al. 2025), support biodiversity (Doll et al. 2024; Von Thaden et al. 2021), sequester carbon, improve air quality (Schindler & Schindler 2025), and regulate microclimates through shading and evapotranspiration (Doll et al. 2024; Pataki et al. 2021). These cooling processes help reduce the urban heat island effect (Azmeer et al. 2024). Social benefits include improved well-being and health outcomes (Schindler & Schindler 2025; Pataki et al. 2021), while economic gains range from higher property values to lower energy costs (Mullaney et al. 2015; Roy et al. 2012). The extent of these benefits

depends on tree size, lifespan, species diversity, and planting density, with larger and longer-lived trees offering disproportionately greater value (Goodwin 2017; Mullaney et al. 2015).

The successful integration of street trees depends heavily on the surrounding urban environment. Factors such as urban morphology, street design, orientation, width-to-height ratio, local climate, and overall urban morphology influence both the feasibility of planting and the extent of the benefits trees provide (Stavroulaki & Berghauser Pont 2020). Species diversity and adaptive flexibility further enhance the resilience and long-term performance of urban tree populations (Martinez et al. 2025). Even as isolated individuals, they contribute to ecological connectivity and support broader green networks across the urban landscape (Nam et al. 2024).

5.2.1. Brief history of trees in France

Trees have been systematically integrated into French cities since the 17th century to improve urban livability, especially as the countryside and natural landscapes became less accessible to urban environments (Corvol 2023). In France, the tree became part of urban greening efforts after the French Revolution in 1789, serving as both a physical and symbolic foundation for the newly constituted First Republic. Trees symbolised a return to peace, though their symbolism varied across social groups, representing liberation for peasants and unity for elites. In the early 19th century, trees began to be planted as part of beautification policies, with Paris leading the way. Trees were appreciated for both their aesthetic and practical value, especially their ability to provide shade. However, difficulties caused by storms and the expansion of railway infrastructure led to conflicts with trees, resulting in their removal and eventual renewal during the 19th century. Following industrialisation, tree planting became more structured and started to shape entire cities, and the need for coordinated planning led to the emergence of urban planners and landscape architects. The tree-lined boulevards, emphasising the importance of greenery in urban environments, became popular among residents. Paris served as a model, and Haussmann's urban transformation programmes helped spread this approach to other French cities (Corvol 2023).

At the beginning of the 20th century, a significant shift in urban trees occurred with the introduction of the Cornudet Law, which created a national framework requiring cities with populations over 10,000 to include tree planting in their master plans (Corvol 2023). The goal was to integrate greenery into urban design from the beginning and to prevent unplanned urban sprawl. Although trees continued to serve traditional roles such as beautifying cities, during the interwar period, they were increasingly used to enhance city entrances, improve the appearance of suburban areas, and provide shade along traffic routes. After the Second World War, France experienced the retreat of its linear forests, diminishing at a rate of 45,000 kilometres annually between 1945 and 1970. This loss was mainly caused by national mobilisation and urban expansion. During this period, tree planting focused on smaller towns in response to rapid urban growth and the need for liveable public spaces (Corvol 2023).

The 1990s marked a turning point in how urban trees were perceived (Corvol 2023). Trees began to be seen as an essential part of the living environment, closely connected to human well-being. They featured prominently in public campaigns, including those led by the RATP “Régie Autonome des Transports Parisiens”, “the Paris public transport authority”. The appreciation for trees has continued, and trees are recognised for improving the quality of life in cities (Corvol 2023), and complementing the built environment, where architectural and plant heritage enrich one another (AUAT 2023).

Initiatives to increase urban tree numbers through planting programmes are being developed across various levels, including by international organisations, national governments, and local authorities (Pataki et al. 2021). The European Union, as part of its Biodiversity Strategy, plans to plant three billion trees by 2030 to enhance biodiversity and restore ecosystems (Lee et al. 2023), and France is committed to planting one billion trees by 2030 (European Commission 2024), Toulouse has launched a plan to plant 100,000 trees by 2030 (Mairie de Toulouse 2025). In Toulouse, the increased number of trees aims to adapt the city to climate change and mitigate urban heat islands by expanding urban green space and increasing tree canopy cover (Mairie de Toulouse 2025). The trees planted are arranged in various configurations adapted to the local urban environment, where grouped trees are prioritised to enhance biodiversity and urban cooling (AUAT 2019), while other configurations include isolated street trees, aligned trees, groves, urban forests, micro-forests, and fruit plantations (Mairie de Toulouse 2019). Trees are planted on streets to create comfortable routes throughout the city, encouraging walkability and prioritising soft mobility (AUAT 2019; AUAT 2023). The selected species are diverse and intended to improve local biodiversity (Mairie de Toulouse 2019), with non-allergenic, climate-change-adapted, low-maintenance, and water-efficient species favoured (AUAT 2019).

6. Spatial characteristics of street greening

This chapter presents the results and analysis of the case studies conducted on the four selected streets in central Toulouse. The observations are organised by street, with each case study structured into a preliminary site analysis and an examination of the spatial structure together with the perceived and experienced spatiality. The preliminary site analysis introduces each street and presents the transformation. The examination of the spatial structure and the perceived spatiality is presented as an overview of the spatial characteristics and illustrates the spaces along the street on a map inspired by Branzell. An additional diagram marks the placement of trees along the street, clarifying their location and the spatial structure they bring to the street. It then continues along the streets, shown through a series of sections, inspired by Cullen's approach and influenced by Branzell's, where the spatial characteristics are presented in their current state and in possible future conditions. The future conditions are envisioned by the author with support from the visualisations presented at the end of the street presentations.

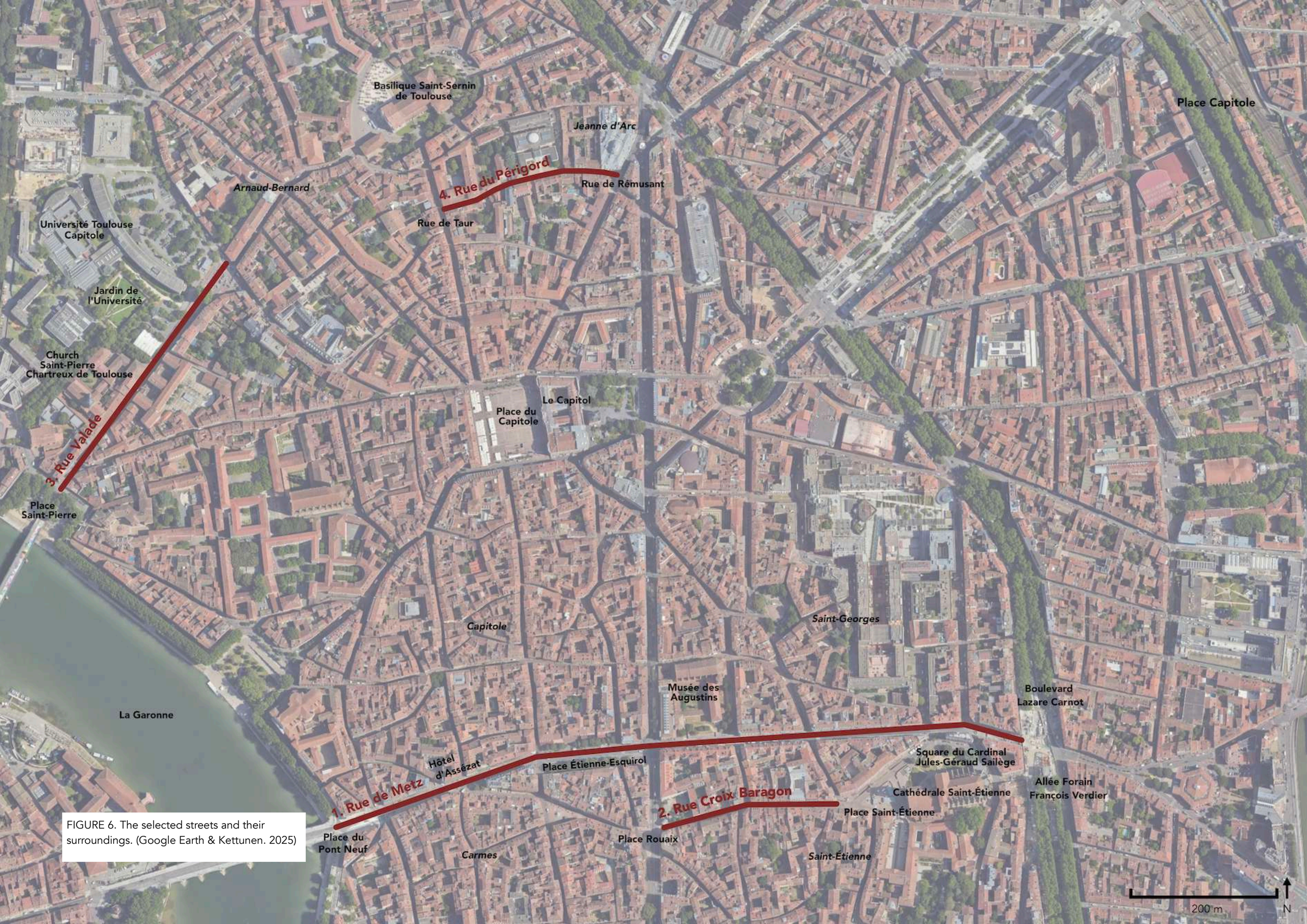


FIGURE 6. The selected streets and their surroundings. (Google Earth & Kettunen. 2025)

6.1. Streetscape 1: Rue de Metz

Rue de Metz is located between the Capitole and Saint-Georges neighbourhoods to the north, and the Carmes and Saint-Étienne districts to the south, as shown in Figure 6. It extends east-west and is crossed by several perpendicular and diagonal streets, most of which are one-way. It forms part of the city's historic east-west axis (AUAT 2023), connecting the Place du Pont Neuf in the west to the Boulevard Lazare Carnot and the Allée Forain François Verdier in the east, as shown in Figure 6. It is a major street connecting the city centre to the Garonne. The street is approximately 900 metres long and about 12 to 15 metres wide. It is lined on both sides with buildings four to five floors high, with uniform brick or washed limestone facades.

The street is defined by several central squares. To the west lies Place du Pont-Neuf, which connects Rue de Metz to the Garonne and to Pont-Neuf, the oldest bridge in Toulouse, completed in 1632 (Toulouse Mairie Métropole n.d.c.), as shown in Figure 6. Further east is Place Étienne-Esquirol, which accommodates the Esquirol metro station, an important point of connection in the city. Continuing eastwards, the street opens onto Square du Cardinal Jules-Géraud Sailège, which forms the forecourt of the Cathédrale Saint-Étienne, see Figure 6. On Rue de Metz are the Hôtel d'Assézat, which houses the fine art museum Foundation Bemberg, and the Musée des Augustins, a fine arts museum set in a former Augustinian convent, see Figure 6. Along Rue de Metz, the ground floors are characterised by a mix of flagship retail stores, smaller commercial units, interior design shops, and clothing boutiques, while the upper floors accommodate residential apartments and office spaces. A few outdoor cafés are located at each end of the street.

6.1.1. The transformation on Rue de Metz 2022-2025

The transformation is part of the Sector Centre master plan and the broader transformation initiative led by Busquet, introduced earlier in chapter four. It also forms part of the enhanced connection to the Grand Parc Garonne (AUAT 2023) and is limited to the section of Rue de Metz between Rue d'Alsace-Lorraine to the west and Boulevard Lazare Carnot and the Allée Forain François Verdier to the east, covering approximately 480 metres, see Figure 6.1.1. The project began in 2022 (La Dépêche 2021) and was completed in June 2025 (Mairie de Toulouse 2025).

Before the transformation, the street was primarily car-oriented, with three traffic lanes, two leading west and one leading east, as shown in Figures 6.1.2 and 6.1.3. Bikes were positioned on the right side of the traffic lanes without a dedicated cycling lane. The sidewalks were narrow and in some areas partially separated from the roadway by railings, see Figure 6.1.2. The street surface consisted of asphalt with white lane markings, with a raised curb and high-traffic signs. No trees or other greenery were present on the street.

The transformation turns Rue de Metz from a car-focused street into one that prioritises pedestrians and cyclists. The traffic flow has been adjusted, turning the original three-lane street into a one-way

eastbound street, as illustrated in Figure 6.1.4. A new two-way bike lane, marked with red paving (Toulouse Mairie Métropole 2025), accommodates cyclists. Both sides of the street feature widened sidewalks, with the curb slightly sloped towards the road. The pavement is made of porphyry paving, aligned with the Sector Centre, resulting in a cohesive streetscape throughout the city.

The transformation features 36 planted trees, with 24 on the street and 11 in the new square (Le Journal Toulousain 2025). Five trees were planted on the street in 2020 as part of the city's tree-planting initiative, while the remaining trees were planted during the redevelopment's final phase in spring 2025 (Mairie de Toulouse 2025).

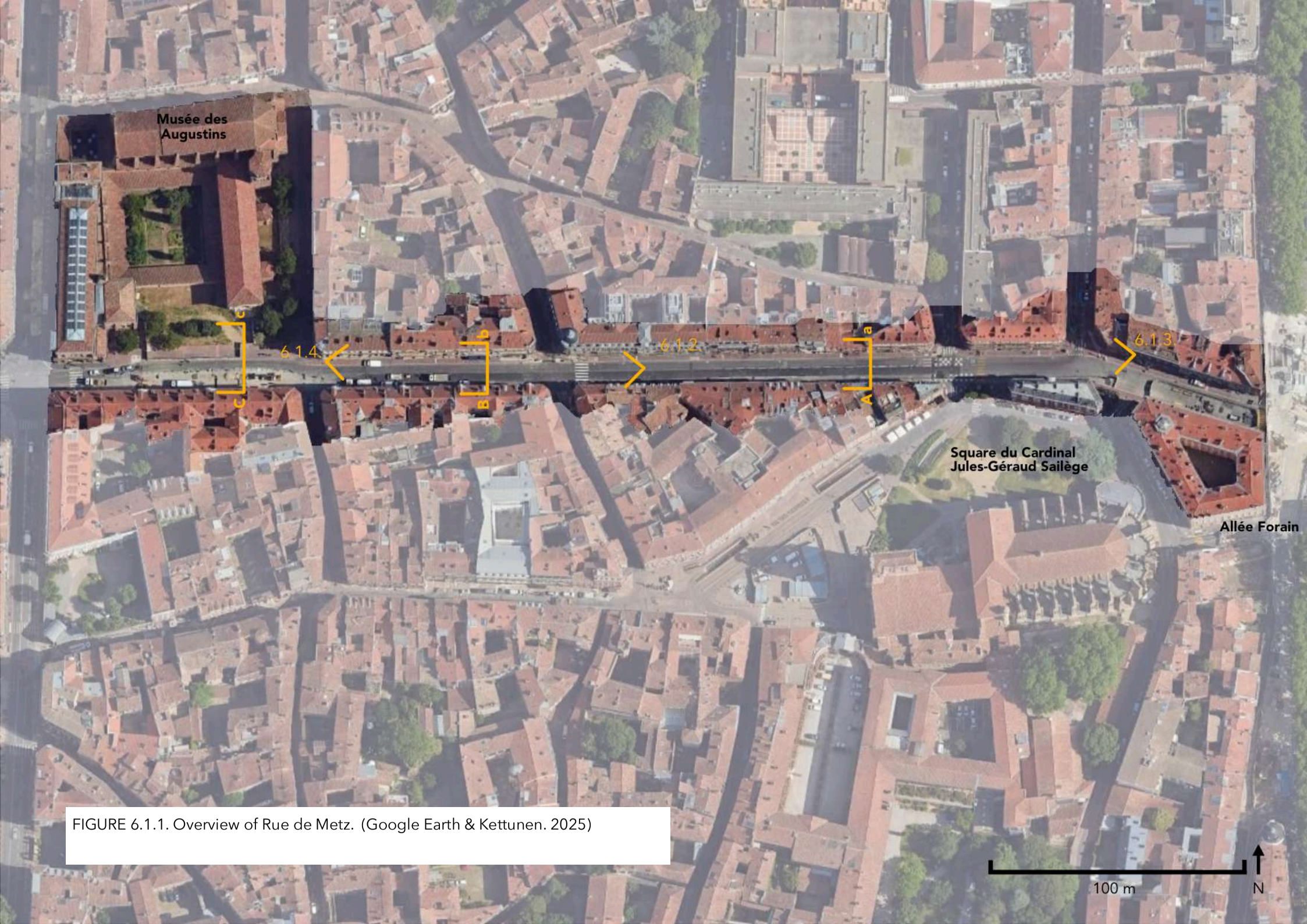


FIGURE 6.1.1. Overview of Rue de Metz. (Google Earth & Kettunen. 2025)

Rue de Metz before the transformation

FIGURE 6.1.2. Before the transformation, Rue de Metz had three carlanes, with bikes on the right-hand side of the carlanes and narrow sidewalks. For orientation, see Figure 6.1.1. (actuToulouse 2021c)

FIGURE 6.1.3. Rue de Metz features a long, continuous sightline with no greenery present along the street. For orientation, see Figure 6.1.1. (Le Journal Toulousain 2022)

Rue de Metz after the transformation

FIGURE 6.1.4. Rue de Metz has a cohesive wallscape and floorscape, together with the trees structured in line, which creates a defined streetscape. For orientation, see Figure 6.1.1. (Kettunen. 2025)

FIGURE 6.1.5. The newly planted trees, together with lower shrubs. (Kettunen. 2025)

FIGURE 6.1.6. The newly planted tree does not obstruct the view towards the sky. (Kettunen. 2025)

6.1.2. Spatial structure and perceived spatiality

Rue de Metz comprises a south-side sidewalk, a two-way bicycle lane, a roadway, and a north-side sidewalk with planting strips, see Figures 6.1.9–6.1.14. Pavement materials clearly delineate these parts. This floorscape establishes a clear spatial hierarchy, supporting legibility, separating movement functions, and maintaining visual coherence across the street. Both sidewalks provide generous pedestrian space, and the bicycle and vehicle lanes are equal in width, creating a balanced, orderly linear layout. The planting strips are arranged in a linear pattern with regular spacing, each containing one or two trees together with lower shrubs, see Figure 6.1.7. The selected species include oak, magnolia, and hackberry. The rhythm of the planting strips contributes to the aesthetic structure of the floorscape, reinforcing the street's formal character while introducing softness and variation at ground level. The street's height-to-width ratio creates a pronounced sense of enclosure, while the uniformity of building façades enhances visual cohesion and formality. This consistent wallscape frames the street as a clearly defined corridor, reinforcing directionality and guiding movement along its length. At the same time, long, uninterrupted sightlines introduce a contrasting sense of openness, providing clear orientation both westward and eastward.

Rue du Metz is compactly defined by surrounding buildings, but this definition dissolves where perpendicular streets intersect, creating overlapping spaces along the street, see Figure 6.1.8 Spatial variation is further enhanced by changing uses and intersections along the street. In the eastern section, outdoor restaurant seating extends onto the sidewalk, creating pockets of activity that interrupt the otherwise linear spatial rhythm. This strengthens the social dimension of the street, encouraging lingering, interaction, and informal occupation of space. The street opens up and becomes softer toward the church, forming a space with a clear direction toward the cathedral, see Figure 6.1.8. It also softens toward the existing green areas beside the museum, and becomes more porous near the museum due to the new square with trees, see Figure 6.1.8. Sightlines towards the cathedral and the museum act as visual and orienting focal points, reinforcing movement and offering framed views of adjacent green areas, see the blue triangles in Figure 6.1.8. At the western end, the square in front of the Musée des Augustins introduces a distinct spatial condition by breaking the continuity of the street corridor. Seating areas support social use and lingering, while visual connections to surrounding greenery soften the built edges. Subtle changes in elevation, descending towards the museum, further articulate the floorscape and enrich the perceptual and experiential quality of the space.

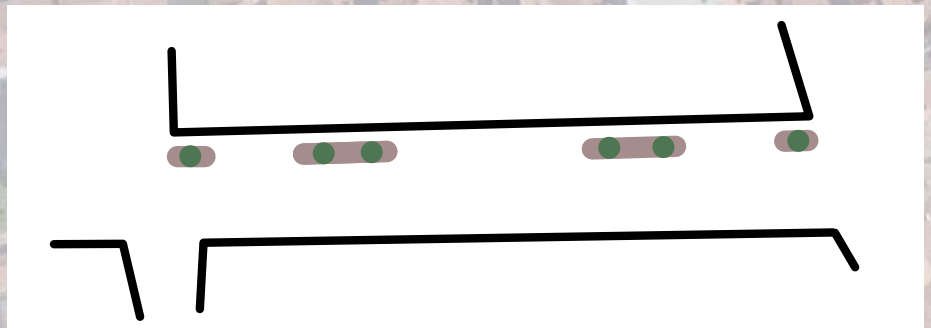
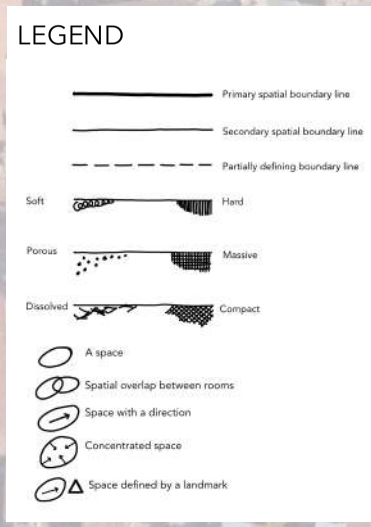


FIGURE 6.1.7. Tree placement on a part of Rue de Metz. (Kettunen. 2025)

FIGURE 6.1.8. Overview of the spatial structure of Rue de Metz, with spaces overlapping along the street defined by the dissolved boundaries. (Google Earth & Kettunen. 2025)



Series of section A-a:

FIGURE 6.1.9. Section A-a. Year 0: The tree structures the street into two spaces. For orientation, see Figure 6.1.1. 1/200 A4. (Kettunen. 2025)
FIGURE 6.1.10. Section A-a. Year 50: The mature tree creates a defined space along the sidewalk with overlapping canopies**.** For orientation, see Figure 6.1.1. 1/200 A4. (Kettunen. 2025)

The easternmost part of the street features a planting strip with trees and shrubs, as shown in Figure 6.1.9. It forms a physical barrier between the sidewalk and the car lane, creating a visually semi-enclosed edge along the north sidewalk while still allowing openness to the sky and maintaining visual connections to the rest of the street. The remainder of the street feels open, with building façades defining the street edges. In 50 years, the mature vegetation in the planting strip creates a more enclosed spatial character, as shown in Figure 6.1.10. The mature trees form a semi-enclosed space along the northern sidewalk, with a denser canopy cover creating a sense of a ceiling. The rest of the street remains open but feels more enclosed, as the canopy narrows the vertical openness

towards the sky. The south sidewalk and bike lane remain open, yet the overall space now feels more framed and contained compared to its earlier, more open state.

Series of section B-b:

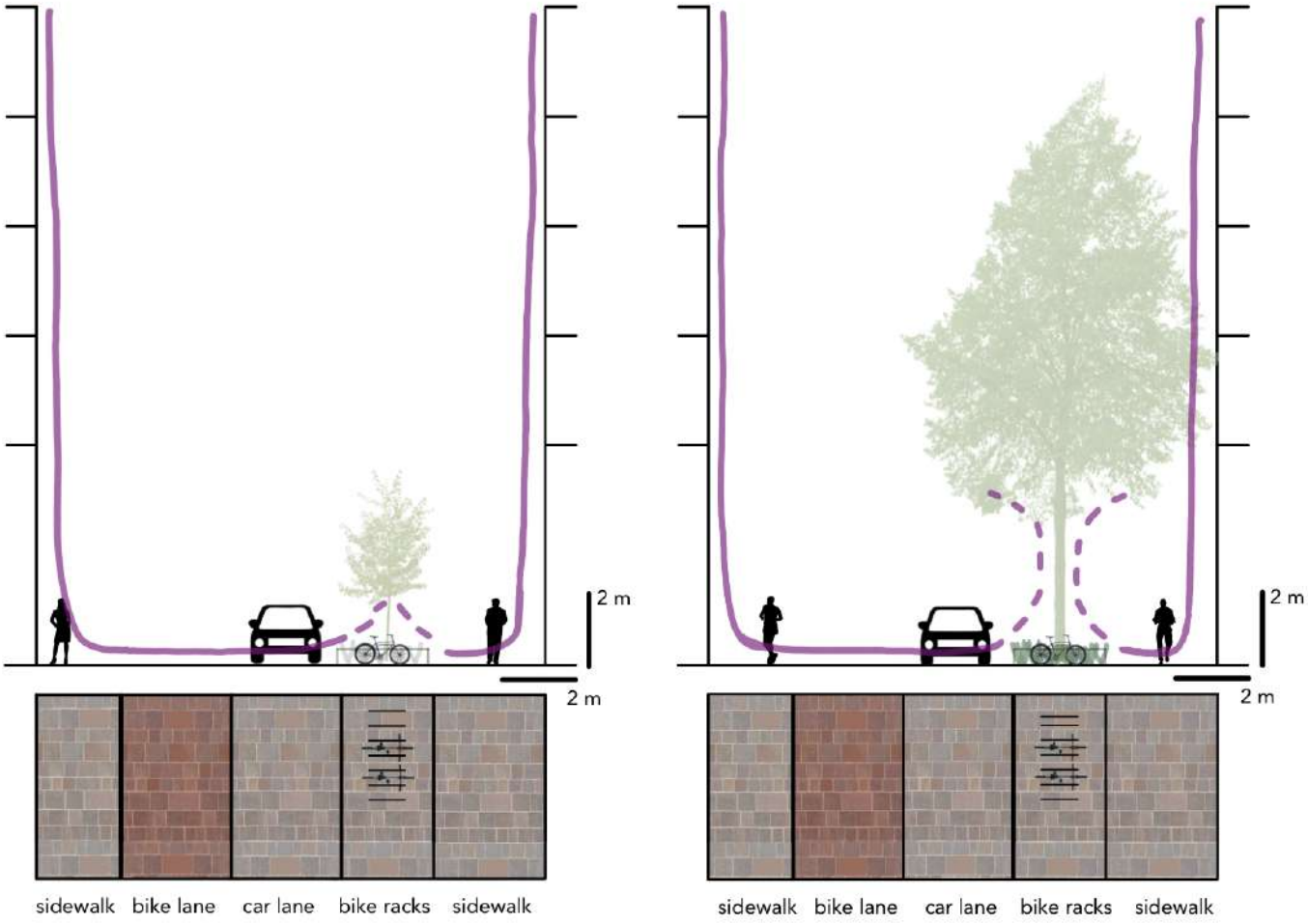


FIGURE 6.1.11. Elevation B-b. Year 0: The tree in the background does not affect the spatiality on this part of the street. For orientation, see Figure 6.1.1. 1/200 A4. (Kettunen. 2025)
FIGURE 6.1.12. Elevation B.b. Year 50: The mature tree creates a sense of a defined corridor along the sidewalk. For orientation, see Figure 6.1.1. 1/200 A4. (Kettunen. 2025)

A section in the middle of the street without a planting strip features bike racks instead, as shown in Figure 6.1.11. This section feels wider and more open because there are no physical barriers, and differences in pavement materials help define the space. Trees are visible in the background, primarily serving as visual focal points and guiding movement rather than creating an immediate spatial enclosure. In 50 years, the same section of the street will have mature trees visible in the background, influencing sightlines and creating a visual corridor between the north pavement and the building facade, as shown in Figure 6.1.12. This emphasises the street's directionality, enhancing orientation and guiding movement along the corridor.

Series of section C-c:

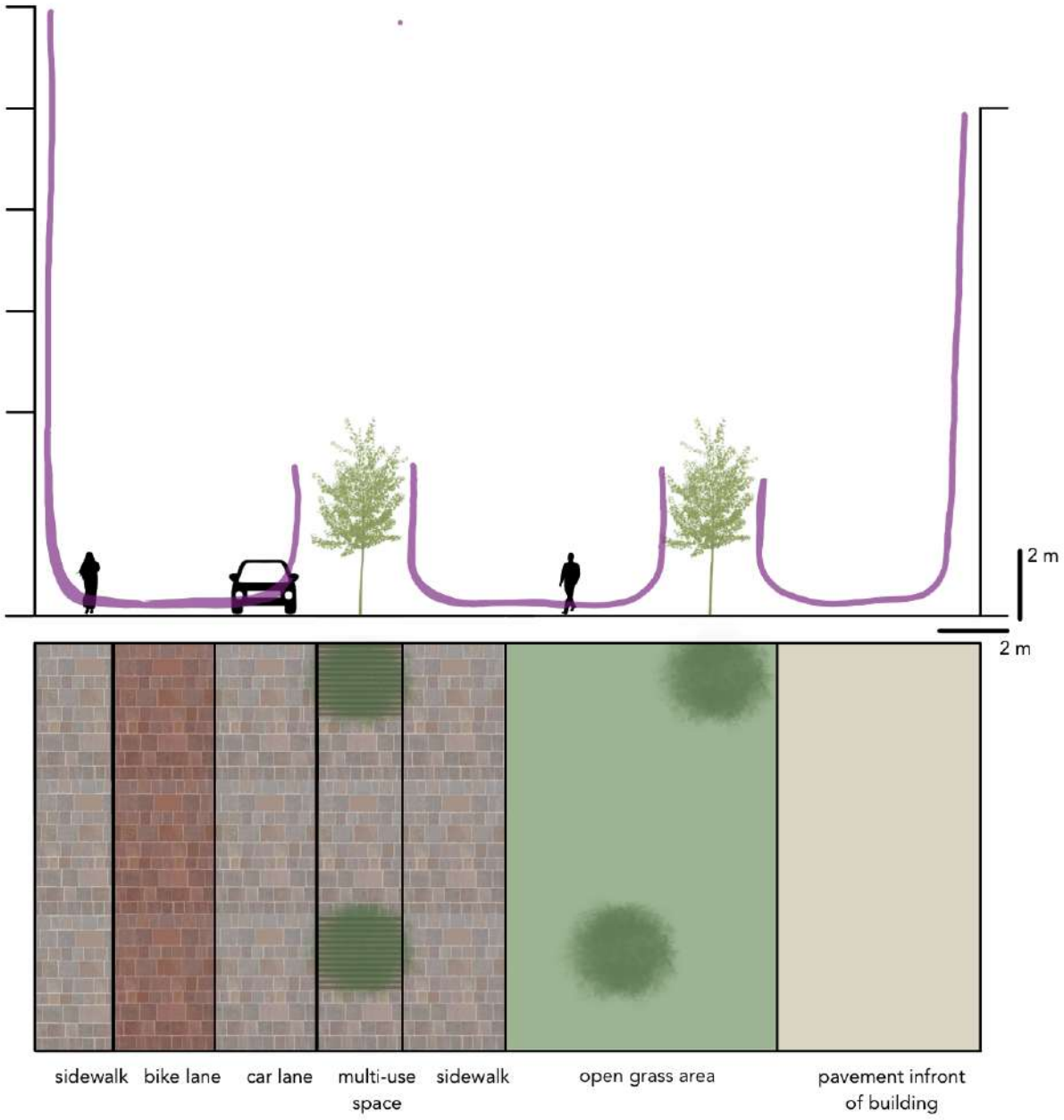


FIGURE 6.1.13. Section C-c. Year 0: The trees create a spatial structure along the street but do not yet define spaces. For orientation, see Figure 6.1.1. 1/200 A4. (Kettunen. 2025)

The part of the street in front of the museum appears open, due to the combined width of the street and the museum's front yard, with no visual barriers, as the trees are still young, see Figure 6.1.12. The space is framed by surrounding buildings, whose presence remains the primary focus within the overall composition. The planted trees help organise the street into distinct spaces, including a movement corridor between the south facade and the trees, a wider strolling area between the trees, and a smaller space adjacent to the museum. The north sidewalk, along with its planting strips, functions as a semi-visual buffer between pedestrians and vehicles, providing space for pedestrian movement and assisting visual orientation.

Series of section C-c:

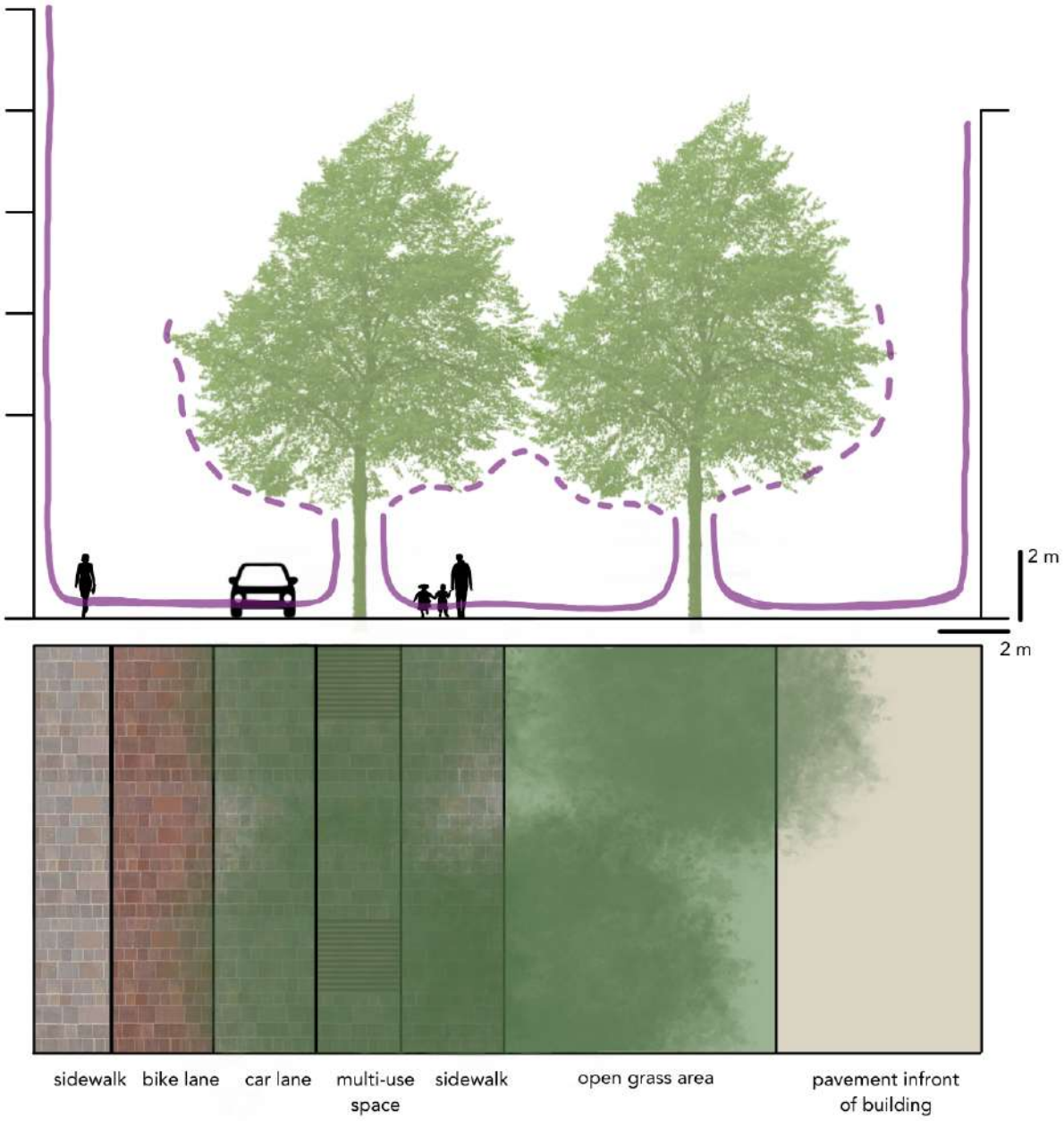


FIGURE 6.1.14. Section C-c. Year 50: A defined space is created between the trees, which function as the main edges when mature. For orientation, see Figure 6.1.1. 1/200 A4. (Kettunen. 2025)

In 50 years, the part of the street in front of the museum will have a more defined spatial arrangement, with the trees forming a semi-enclosed space beneath their canopies, see Figure 6.1.14. The trees dominate the vertical space, becoming the primary visual focus, while the surrounding buildings assume a secondary role. Spaces between the buildings and the trees remain partly open to the sky, but the canopy creates a more enclosed, intimate atmosphere.

FIGURE 6.1.15. Visualisation of the new street layout with planting strips, benches, and street trees is integrated along the street, contributing to a more pedestrian-friendly environment. For orientation, see Figure 6.1.1. (actuToulouse 2021b)

FIGURE 6.1.16. A visualisation of the eastern part of the transformation that included a new square and a new entrance to the Musée des Augustins. For orientation, see Figure 6.1.1. (La Dépêche 2021)

6.2. Streetscape 2: Rue Croix Baragon

Rue Croix Baragon is located in the neighbourhoods of Carmes and Saint-Étienne, see Figure 6. It runs parallel to Rue de Metz, and connects to it via Rue des Arts, Rue Boulbonne, and Place Saint-Étienne. The street links to Place Rouaix in the west and to Place Saint-Étienne in the east, see Figure 6. The street functions as a passage from the main road in the west to the church in the east. It is approximately 250 metres long and between five and eight metres wide. The street is lined with buildings on both sides, three to four floors high, with uniform brick facades and wooden details.

The street is a one-way eastbound street, lined with a variety of shops on the ground floor, including small independent stores, clothing boutiques, larger retail outlets, several jewellery shops, a pharmacy, restaurants, and cafes. The upper floors consist of offices and residential apartments. It is a significant local commercial street due to its proximity to Rue de Metz and its direct link to the Cathédrale Saint-Étienne de Toulouse at Place Saint-Étienne, which also serves as a visual focal point of the street, see Figure 6.2.3.

6.2.1. The transformation on Rue Croix Baragon 2023-2024

As part of a larger redevelopment initiative led by Busquets, the project aligns with the transformation of Rue de Metz. Before the transformation, it consisted of an asphalt roadway and stone-paved sidewalks of uneven width, mostly narrow, partly enclosed by railings and separated from the road by a high curb. The limited sidewalk forced pedestrians to walk on the roadway, as shown in Figures 6.2.2 and 6.2.3. In the wider parts of the street, some parking spaces were available.

The transformation of Rue Croix Baragnon began in 2023 and was completed at the end of 2024 (Toulouse Mairie Métropole 2025). The project prioritised pedestrians and transformed the street into a mixed-use space where pedestrians and cyclists are given priority, see Figures 6.2.4 and 6.2.7. The pavement was changed to porphyry paving, with a curb only slightly slanted towards the roadway. The sidewalks were widened, and the former parking spaces were transformed into seating areas, and bicycle racks were added (L'Opinion Indépendante 2021). This aesthetic decision strengthens the creation of a unified floorscape, contributing to a cohesive streetscape. At the same time, the multi-use lane and seating on the square encourage encounters and informal interactions. As part of the city's broader tree-planting initiative, six trees were planted in 2024 (Mairie de Toulouse 2025). These were positioned in areas previously occupied by parking spaces and strategically placed to enhance sightlines to the Cathédrale Saint-Étienne in the east.

FIGURE 6.2.1. Overview of Rue Croix Baragon. (Google Earth & Kettunen. 2025)

Rue Croix Baragon before the transformation

FIGURE 6.2.2. The westernmost part of Rue Croix Baragon shows the roadway taking up most of the space, with parking spaces at the widest section. For orientation, see Figure 6.2.1. (actuToulouse 2022)

FIGURE 6.2.3. The narrow and partially enclosed sidewalks at the easternmost end of the street. For orientation, see Figure 6.2.1. (actuToulouse 2022)

Rue Croix Baragon after the transformation

FIGURE 6.2.4. Seating is placed between the trees. (Kettunen. 2025)

FIGURE 6.2.5. The limited width of the street creates a narrow view of the sky. (Kettunen. 2025)

FIGURE 6.2.6. The square at the easternmost end has seating, leaving open space for events. (Kettunen. 2025)

FIGURE 6.2.7. Two trees define the square. (Kettunen. 2015)

6.2.1. Spatial structure and perceived spatiality

Rue Croix Baragnon has sidewalks of different widths and a central shared lane used by both vehicles and pedestrians, as illustrated in Figures 6.2.10–6.2.15. The pavements, featuring a uniform pattern across both sidewalks and the shared lane, visually unify the street and emphasise its multifunctionality, supporting movement, leisure, and informal activities simultaneously. Rue Croix Baragon feels compact due to the continuous façades and the narrow width of the street, but this definition dissolves at the intersecting streets and softens toward the ends where the street widens, see Figure 6.2.9. Intersections and the square at the eastern end introduce occasional moments of openness, structured by trees and seating, see Figure 6.2.6-6.2.7. Its winding layout and varying widths influence how space is perceived as one heads east toward the Cathédrale Saint-Étienne, which stands out as a prominent visual and orienting focal point. The narrow, winding layout of Rue Croix Baragnon, combined with continuous façades, fosters a strong sense of enclosure, frames movement through the street, and contributes to its intimate, human-scale character. The windingness creates broken sightlines. The varying street widths create several distinct spaces along the street, some of which overlap at the intersection, where the area is used by a restaurant with outdoor seating. These spaces are primarily directed toward the cathedral, which functions as a landmark, see the blue triangle in Figure 6.2.9

The vegetation consists solely of trees, with selected species including camellias, rowan, and cherry. Trees are planted along the north-side sidewalk, particularly in the wider eastern section of the street and within the square at its easternmost end, see Figure 6.2.8. A single tree is also present in the western section, see Figures 6.2.10 and 6.2.11. Together with the consistent floorscape and enclosing wallscape, the trees contribute to the street's aesthetic coherence while softening the built edges. Seating is placed alongside the street trees, with additional seating within the square at the eastern end, creating areas for rest and pause. These elements enhance the social dimension of the street by supporting informal encounters, short stays, and observation, reinforcing the role of Rue Croix Baragnon as both a movement corridor and a place for social interaction.

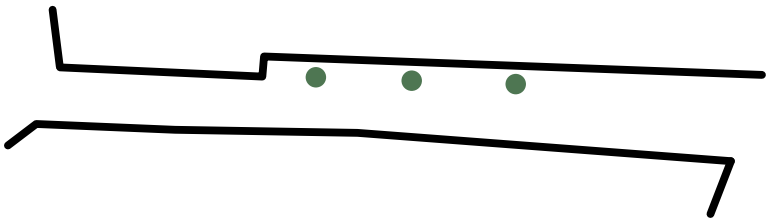


FIGURE 6.2.8. The trees are planted individually in line on Rue Croix Baragon. (Kettunen.2025)

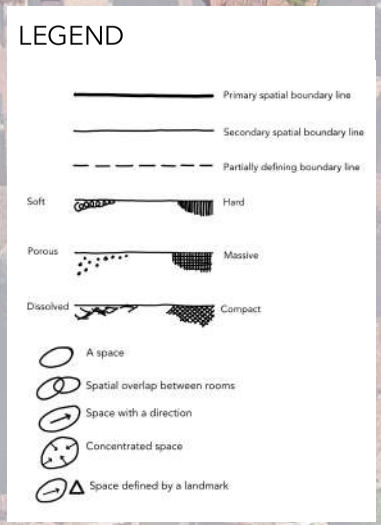


FIGURE 6.2.9. Spatial overview of Rue Vroix Baragon where the spaces are directed towards the cathedral. (Google Earth & Kettunen. 2025)

50 m

N

Series of section A-a:

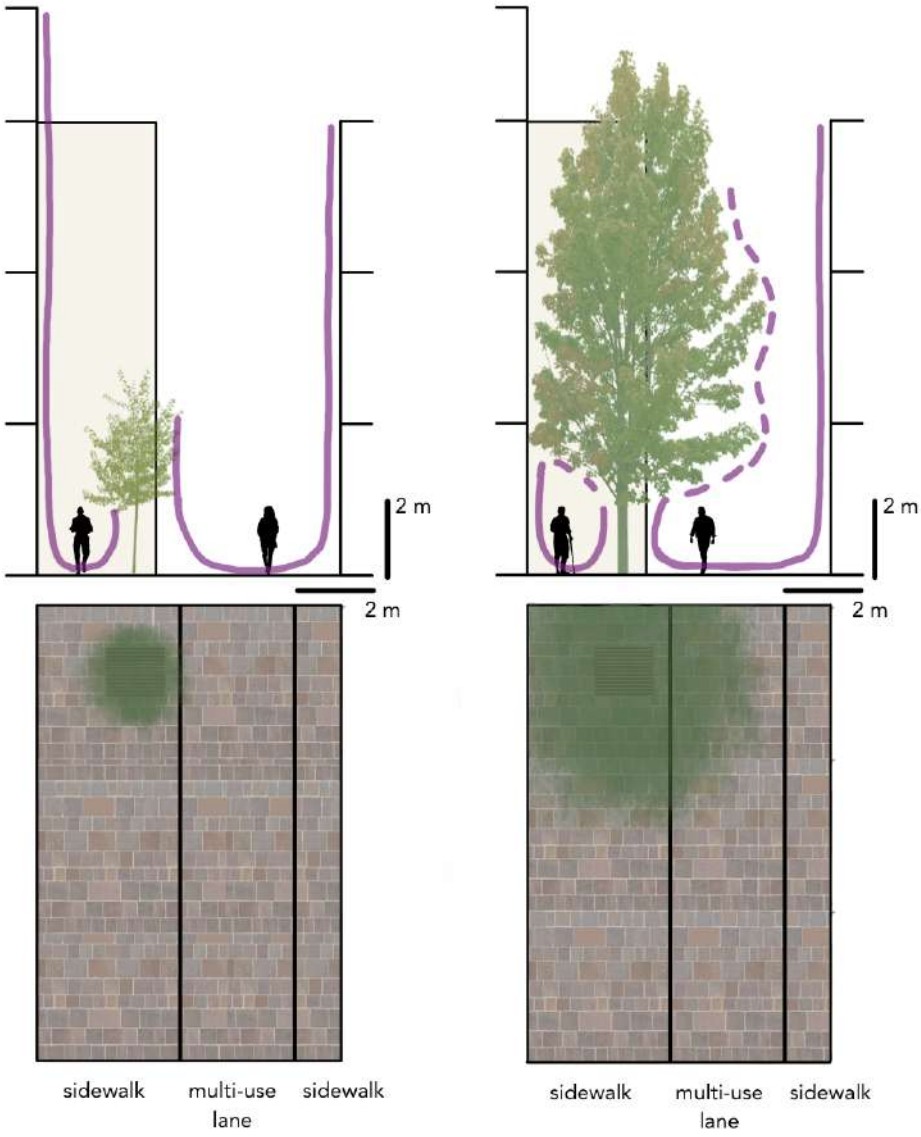


FIGURE 6.2.10. Elevation A-a. Year 0: The tree defines a bundary between the sidewalk and the multi-use lane. For orientation, see Figure 6.2.1. 1/200 A4. (Kettunen. 2025)
FIGURE 6.2.11. Elevation A-a. Year 50: The mature tree creates a defined space on the sidewalk between the facade and the tree. For orientation, see Figure 6.2.1. 1/200 A4. (Kettunen. 2025)

The westernmost part of the street features a wider northern sidewalk with a single newly planted tree in a former parking space, see Figure 6.2.10. The space between the north façade and the tree is enclosed primarily by the wall behind it, while the solitary tree introduces greenery and restructures the space. The street's remnants remain open and spacious thanks to the multi-use lane and unobstructed views of the sky. In 50 years, the mature tree creates an enclosed space between itself, the north facade and the wall behind, see Figure 6.2.11. The multi-use lane and southern sidewalk are also influenced by vertical branches, which obstruct views to the sky and reinforce the sense of enclosure. The tree may require pruning to prevent vehicle obstruction and to prevent it from encroaching too much on the street, which could also limit sunlight reaching the street.

Series of section B-b:

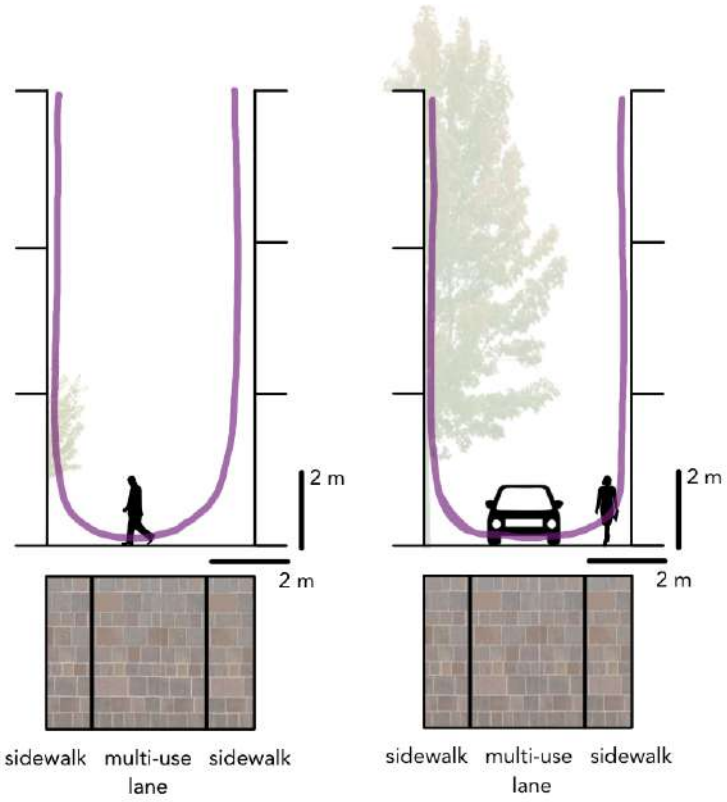


FIGURE 6.2.12. Section B-b. Year 0: The tree in the background does not contribute to the spatial experience on this narrow part of the street. For orientation, see Figure 6.2.1. 1/200 A4. (Kettunen. 2025)
FIGURE 6.2.13. Section B-b. Year 50: The mature tree does contribute to greenry in the background, forming a sightline towards the church. For orientation, see Figure 6.2.1. 1/200 A4. (Kettunen. 2025)

The narrowest part of the street lacks trees, as shown in Figure 6.2.12. Sightlines extend eastward towards the Cathédrale Saint-Étienne, where greenery is visible in the distance, but it has little impact on the immediate spatial experience. The street feels heavily enclosed, dominated by the height-to-width ratio of the façades and by the limited width, which restricts openness to the sky. As for now, there is no space for vegetation on this part of the street, and introducing greenery would require a fundamental restructuring, taking away the sidewalks and keeping only the multi-use lane. However, the street may also be too narrow for trees to thrive, as its narrow width significantly limits sunlight. In 50 years, the mature trees visible in the eastern sightlines will become a clearer visual element, subtly softening the sense of enclosure and enhancing a human-scaled experience while clarifying the direction towards the Cathédrale Saint-Étienne and guiding movement along the street, see Figure 6.2.13.

Series of section C-c:

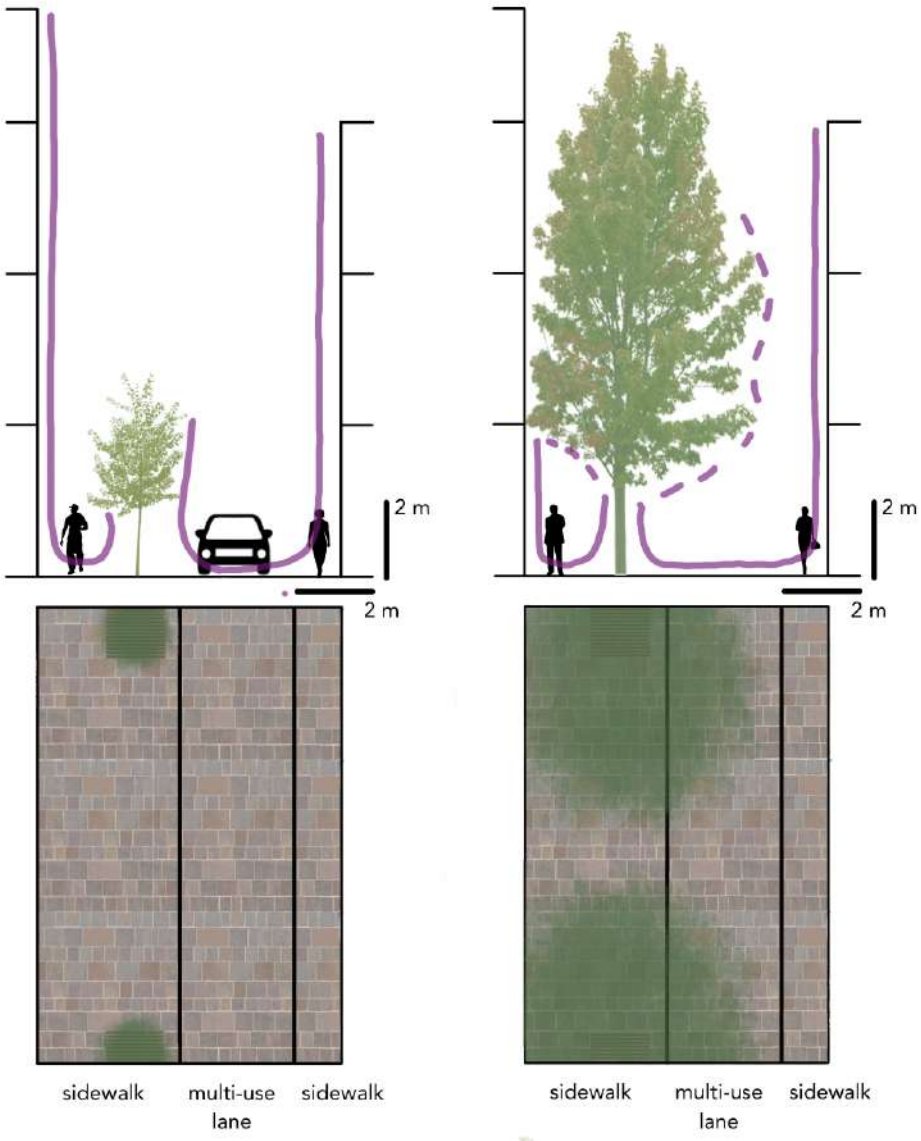


FIGURE 6.2.14. Section C-c. Year 0: The tree separates the sidewalk from the multi-use lane. For orientation, see Figure 6.2.1. 1/200 A4. (Kettunen. 2025)
FIGURE 6.2.15. Section C-c. Year 50: The mature tree creates a spatially defined room on the sidewalk under the tree canopies. For orientation, see Figure 6.2.1. 1/200 A4. (Kettunen. 2025)

In the easternmost part of the street, where it widens before the square, the newly planted trees are arranged in line along the northern sidewalk, reinforcing sightlines to the cathedral, see Figure 6.2.14. The north sidewalk feels spatially separated from the multi-use lane, whereas the multi-use lane and the southern sidewalk remain unaffected. The separation is primarily visual as the street remains physically open and pedestrian movement is not affected. In 50 years, the mature trees, with their canopies forming an overhead ceiling, will create an enclosed space between the north facade and the trees, see Figure 6.2.15. The street has a more reinforced spatial structure, and the sidewalk remains visually connected to the rest of the street. The canopies lower the perceived ceiling over the multi-use lane, framing the southern sidewalk between the façades and the trees.

FIGURE 6.2.16**.** A visualisation of the westernmost part, where an open, mixed-use street features a tree planted in place of a former parking spot. For orientation, see Figure 6.2.1. (actuToulouse 2022)

FIGURE 6.2.17. A visualisation of the easternmost part, where the trees enhance and reinforce the sightlines toward Cathédrale Saint-Étienne. For orientation, see Figure 6.2.1. (actuToulouse 2022)

6.3. Streetscape 3: Rue Valade

Rue Valade is situated in the Arnaud-Bernard neighbourhood, see Figure 6. It runs from the southwest to the northeast and is crossed by a single street. The street forms a central connection between the right bank of the Garonne and Place Saint-Pierre in the southwest, and the city centre and Rue des Puits Creuses in the northeast, see Figure 6. It is a one-way street approximately 350 metres long, with a width of ten to 12 metres. The street is defined by buildings lining its sides, except for the northern part of the western side, where a fence runs. The buildings range in height from two to four floors and are primarily constructed of brick or washed limestone.

Rue Valade is primarily a residential street, but it also features several restaurants, administrative spaces, a hotel, and the Church of Saint-Pierre des Chartreux de Toulouse. The University of Toulouse and the University Garden are located nearby, on the west side of Rue Valade, and the street is therefore frequently used by students. At the southwest end, the street opens onto a square, and at the northeast end, it opens onto parking spaces, see Figure 6.3.1.

6.3.1. The transformation on Rue Valade 2023-2024

The transformation of Rue Valade was carried out as part of the broader transformation and planting initiative in Toulouse. Before the transformation, the southwestern section of the street consisted of a roadway with sidewalks lining it, as shown in Figure 6.3.3. The sidewalks were separated from the roadway by a high curb and were partly enclosed by railings, while in some areas restaurants extended their outdoor seating onto the pedestrian space. In the eastern part of the street, the layout included the roadway, parking spaces, and narrow sidewalks, see Figure 6.3.2. The street surface was asphalt, and no greenery was present along the street itself, although vegetation was found at both ends.

The transformation on Rue Valade took place from July 2023 to February 2024 (Toulouse Mairie Métropole 2024). The project included the implementation of a one-way bike lane, the widening of sidewalks, and the creation of planted strips with trees and shrubs between the bike lane and the sidewalk on the western side of the street, see Figures 6.3.4 and 6.3.5. (Toulouse Mairie Métropole 2024). Additionally, an ancient plane tree at the northern end of the street was incorporated into the transformation, with added seating areas, see Figure 6.3.6. Seven trees were planted along Rue Valade as part of the city's tree-planting initiative, with one already planted in 2020 and the remaining six in 2024 (Mairie de Toulouse 2025). This reconfiguration of the floorscape introduces an aesthetic and social dimension by prioritising people over cars and creating opportunities for pause, interaction, and informal use. The design supports social interaction through seating areas, but the discontinuous pavement reduces spatial cohesion, while ecologically, the introduction of shrubs and trees enhances urban greenery. Following the transformation of Rue Valade, the next street to be redeveloped was Rue du Périgord (La Dépêche 2024), which is also included in this case study and is explored as the final street.

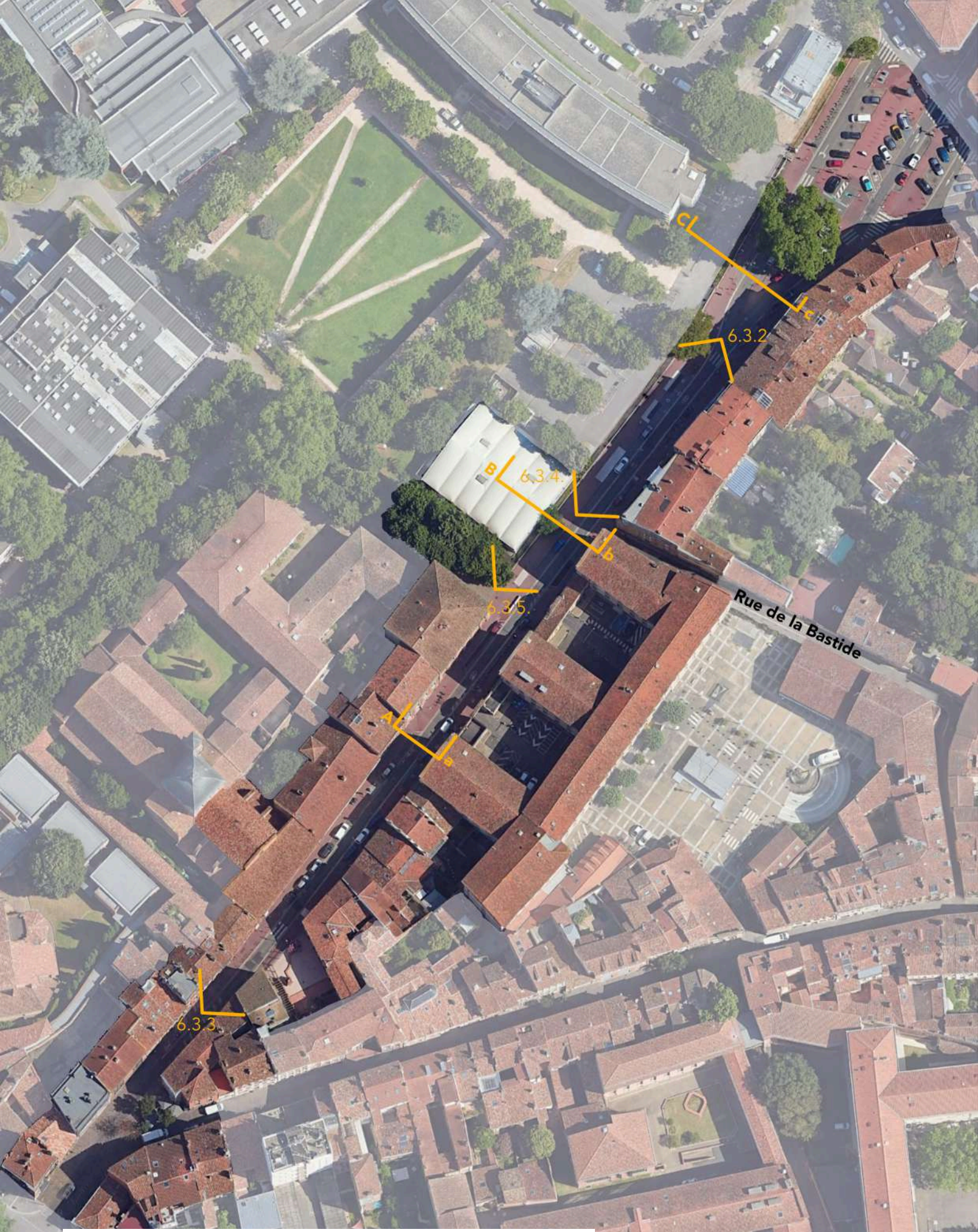


FIGURE 6.3.1. Overview of Rue Valade. (Google Earth & Kettunen. 2025)

Rue Valade before the transformation

FIGURE 6.3.2. Before the transformation, the one-way street was aligned with parking spaces on both sides of the roadway. For orientation, see Figure 6.3.1. (La Dépêche 2023)

FIGURE 6.3.3. The ancient plane tree functions as a visual focal point for the street. For orientation, see Figure 6.3.1. (actuToulouse 2021a)

Rue Valade after the transformation

FIGURE 6.3.4. An overview of the transformed street. For orientation, see Figure 6.3.1. (Kettunen. 2025)

FIGURE 6.3.5 Seating is placed along and at the end of the rain garden. For orientation, see Figure 6.3.1. (Kettunen. 2025)

FIGURE 6.3.6. The lower vegetation in the rain garden consists of different grasses and perennial plants widens under the plane tree. (Kettunen. 2025)

6.3.1. Spatial structure and perceived spatiality

The street is divided into two parts: the southern part is transformed into sidewalks and a multi-use lane with porphyry paving, while the northern part comprises a northern sidewalk, a planting strip, a one-way bike lane running north to south, a one-way roadway running south to north (speed limit 20 km/h), and a southern sidewalk, see Figures 6.3.9-6.3.14. These sections are clearly separated by curbs. The northern sidewalk widens towards the northeast, while the south sidewalk remains consistent in width. The pavement is asphalt, with benches placed along the street, concentrated at the northeastern end. Additional street furniture includes bike racks, recycling and waste-sorting stations, and shared bike parking on former parking spaces. At the northern end, a small public space beneath a large plane tree includes seating and limited parking, see Figures 6.3.13 and 6.3.1. Here, the floorscape expands to accommodate lingering and gathering, marking a transition from movement-oriented space to a place of rest. Narrower sections increase enclosure, while the central part opens to the north onto a courtyard enclosed by a 1.8-meter-high fence. The semi-permeable fence softens the enclosure and adds visual depth, making this segment feel more open.

Vegetation along Rue Valade is mainly in former parking areas, forming planting strips between the car lane and the north sidewalk, see Figure 6.3.7. These act as physical separators, guide pedestrians, and create protected zones. The strips establish a rhythm, visually and physically mediating traffic and pedestrians. Tree species include ash, apple, linden, and sophora. The mature plane tree at the north end, about 18 metres tall, provides shade, serves as a landmark, and acts as a focal point together with the small public space created under it for social interaction and orientation, balancing movement with pauses. Rue Valade is influenced by the surrounding buildings, which contribute to a compact spatial character. However, the openness on the other side of the fence increases the sense of openness and creates a softer edge, see Figure 6.3.8. The changing width and design of the street contribute to the formation of spaces that are primarily directed toward the plane tree, which functions as a landmark, see the blue triangle in Figure 6.3.8. Rue Valade's experience is shaped by movement, with spaces shifting between narrow, enclosed areas and wider, open segments, creating a dynamic rhythm. The northern planting strip and young trees guide pedestrians, while central lanes support flexible circulation for cars and cyclists. Continuous façades and variations in width and elevation reinforce a rhythm of enclosure and openness. Narrower southeastern sections feel more intimate, while wider eastern parts offer more open space. Buildings that line only one side introduce a greater sense of openness. Sightlines along Rue Valade direct views toward the riverfront and the historic city centre, extending the spatial experience beyond the street itself.

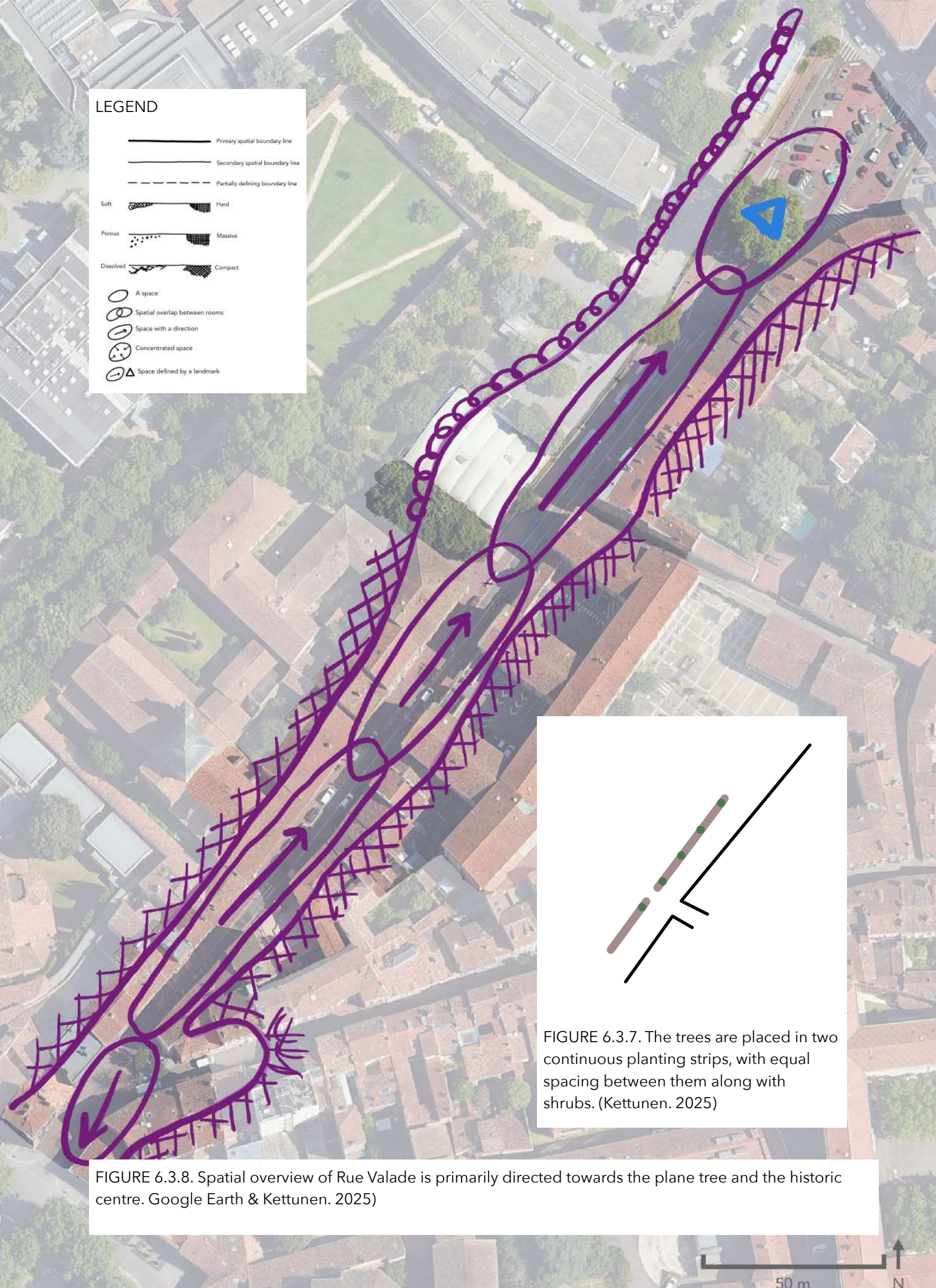


FIGURE 6.3.7. The trees are placed in two continuous planting strips, with equal spacing between them along with shrubs. (Kettunen. 2025)

FIGURE 6.3.8. Spatial overview of Rue Valade is primarily directed towards the plane tree and the historic centre. Google Earth & Kettunen. 2025)

Series of section A-a:

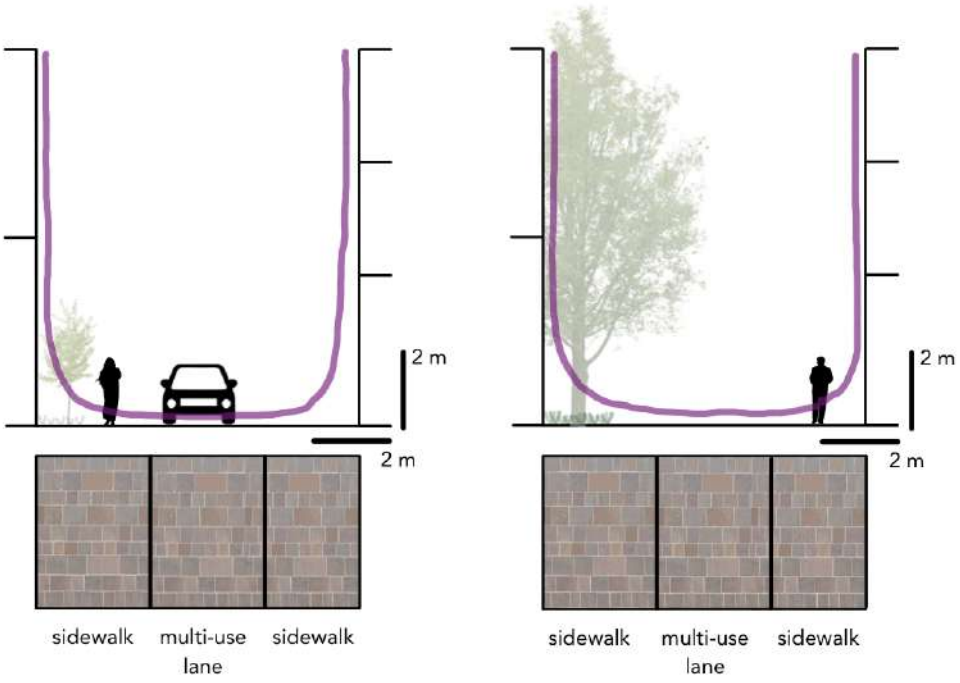


FIGURE 6.3.9. Elevation A-a. Year 0: tree The street remains open with the new tree in the background. For orientation, see Figure 6.3.1. 1/200 A4. (Kettunen. 2025)
FIGURE 6.3.10. Elevatio A-a. Year 50: The mature tree contributes to greenery in the background. For orientation, see Figure 6.3.1. 1/200 A4. (Kettunen. 2025)

The westernmost part of the street comprises sidewalks and a multi-use lane, see Figure 6.3.9. It feels like a single, open space because of the uniform pavement and the absence of curbs. The porphyry pavement is the same as on Rue de Metz and Rue Croix Baragon, connecting the street to the wider streetscape in the centre. Trees in the sightline primarily serve as a visual focal point rather than defining this part of the street. In 50 years, mature trees will become more prominent at a distance, emphasising their role as visual focal points and increasing the presence of greenery, see Figure 6.3.10. This change will not significantly affect the street's spatial character in this part.

Series of section B-b:

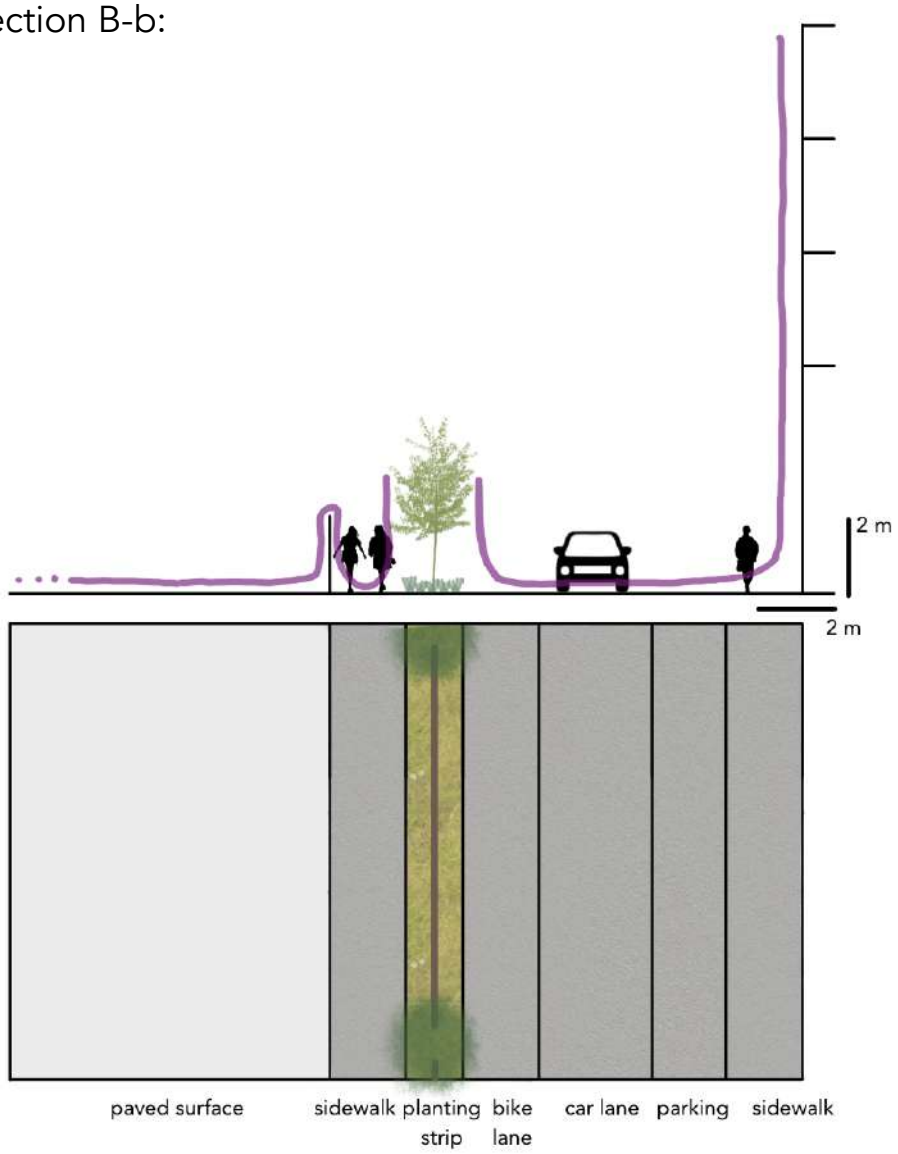


FIGURE 6.3.11. Section B-b. Year 0: The tree, together with the lower vegetation, creates a spatial division of the street, but the street lacks a clear spatial definition due to its width.For orientation, see Figure 6.3.1. 1/200 A4. (Kettunen. 2025)

The street widens, and the spatial structure extends to sidewalks, a planting strip, a bike lane, a roadway and parking, see Figure 6.3.11. It is defined by buildings on the northeast side and a fence on the northwest side, which extends to an open paved area. This encourages the street to feel more open, with the surrounding building height-to-width ratio emphasising openness over enclosure. The sidewalk between the fence and planting strip appears semi-enclosed, as it is physically enclosed but visually open.

Series of section B-b:

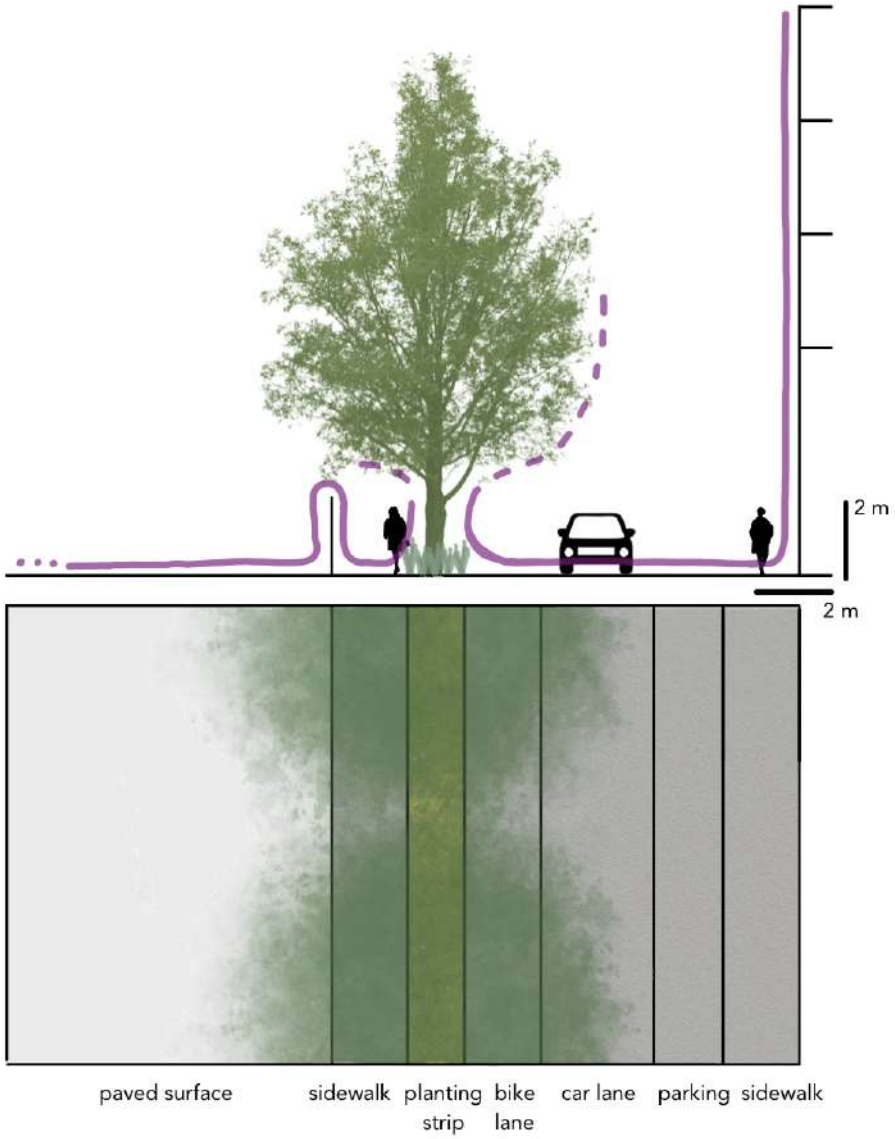


FIGURE 6.3.12. Section B-b. Year 50: The mature tree creates a defined space along the sidewalk and, together with the façade, functions as an edge that helps define the space along the rest of the street. For orientation, see Figure 6.3.1. 1/200 A4. (Kettunen. 2025)

In 50 years, the widened street part will feel more enclosed due to the mature trees, see Figure 6.3.12. The trees enclose the space between the fence and the planting strip, and their canopies cover the sidewalk, yet it is visually semi-open as the area is open on the other side of the fence. The cycle lane is partly framed by the overhead canopy, which becomes more intimate, while the remaining part of the street is partly open due to its generous width-to-height ratio.

Series of section C-c:

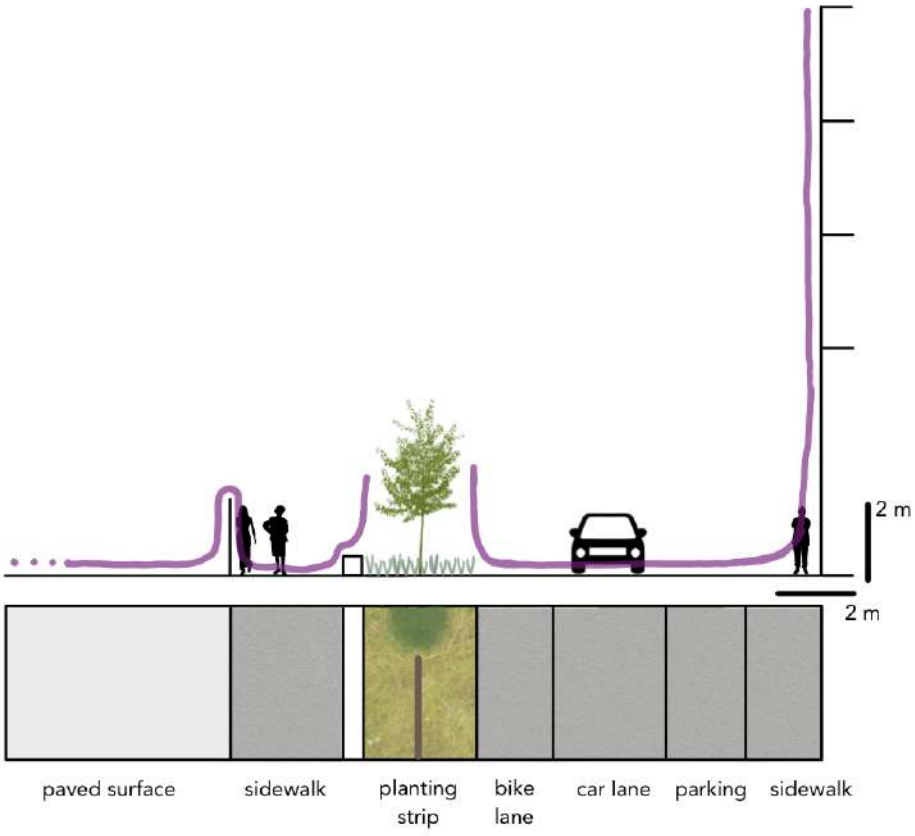


FIGURE 6.3.13. Section C-c. Year 0: The tree creates a spatial structure together with the lower vegetation, but does not create defined spaces on the street. For orientation, see Figure 6.3.1. 1/200 A4. (Kettunen. 2025)

The street is widening in the northeastern part, providing more space for the planting strip and the northern sidewalk, creating openness, see Figure 6.3.13. However, the wider planting strip provides spatial separation between pedestrians and traffic, making the sidewalk feel more enclosed and protected while maintaining visual openness. The current trees have minimal impact on the street's spatial character due to their small size and the street's wide height-to-width ratio. They do not act as vertical or spatial barriers but serve as focal points and connect to the other trees.

Series of section C-c:

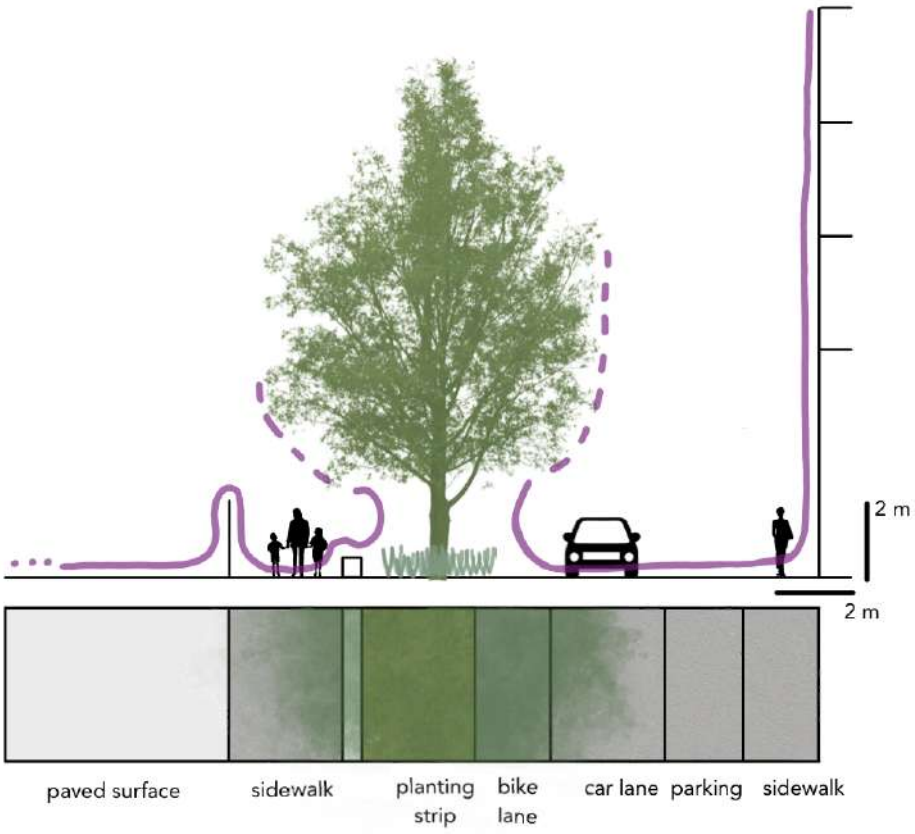


FIGURE 6.3.14. Section C-c. Year 50: The mature tree creates a spatial division on the street, reinforced by lower vegetation and seating. This results in one space forming along the sidewalk and another between the tree and the façade. For orientation, see Figure 6.3.1. 1/200 A4. (Kettunen. 2025)

In 50 years, the northeast part of the street will be characterised by mature trees occupying more space, see Figure 6.3.14. The northern sidewalk will feel more visually enclosed under the expanding canopy, with a semi-enclosed, open feel from the sidewalk's width and planting strip, and from the openness on the other side of the fence. The bike lane feels more enclosed under the tree canopy, lowering the perceived ceiling, and the remaining street appears tighter than before.

FIGURE 6.3.15. A visualisation of the street, with the planting strips placed on earlier parking spaces. For orientation, see Figure 6.3.1. (actuToulouse 2021a)

FIGURE 6.3.16. A visualisation where the plane tree is integrated into the transformation as a part of the new planting beds, together with lower bushes. For orientation, see Figure 6.3.1. (Le Journal Toulousain 2023)

6.4. Streetscape 4: Rue du Périgord

Rue du Périgord is located in the Jeanne d'Arc neighbourhood, connecting Rue du Taur in the west to Rue de Rémusant in the east, as shown in Figure 6. It is situated near La Basilique Saint-Sernin de Toulouse, a major church in Toulouse, and close to Place du Capitole and Le Capitole, the main square and the Town Hall, see Figure 6. The street is a one-way, slightly winding east-west street approximately 260 metres long, with a width of four to eight metres.

The street is primarily residential, located between roads offering a wider range of services and amenities. Several buildings designated as historical monuments line it, including the Chapelle des Carmélites de Toulouse, a Sistine Chapel, and La Bibliothèque d'études et du Patrimoine, a library and popular tourist attraction, see Figure 6. While these destinations draw visitors to the street, it also serves as a passage. Additionally, the street hosts the Lycée Sainte-Marie de Nevers, a secondary school, along with a barber's shop and a real estate agency.

6.4.1. The transformation on Rue du Périgord 2023-2024

The urban transformation was part of efforts to make the city greener. Before the urban transformation, the street consisted of a roadway, sidewalks and parking spaces, see Figure 6.4.2. and 6.4.3. The sidewalk is divided from the roadway by high curbs and partially enclosed on the north-side sidewalk by railings and on the south-side sidewalk by parking spaces, as shown in Figure 6.4.2. and 6.4.3.

The urban transformation on Rue du Périgord took place from December 2023 to March 2024 (La Dépêche 2024). The project involved resurfacing the pavement and creating four planted strips with trees and shrubs, established in former parking spaces along the southern side of the street, see Figures 6.4.4-6.4.6. Thirteen trees were planted as part of the city's tree planting initiative (Mairie de Toulouse 2025).

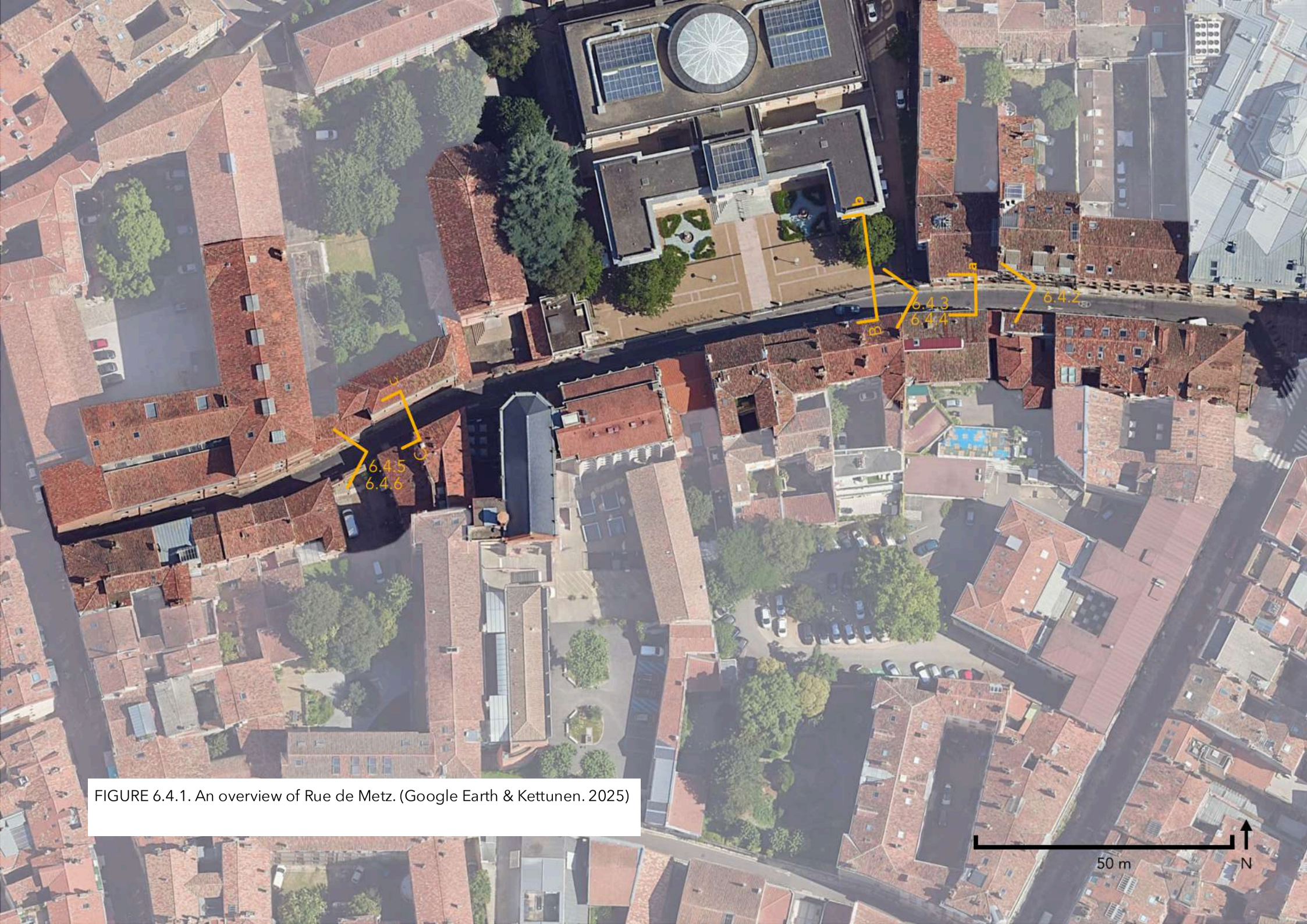


FIGURE 6.4.1. An overview of Rue de Metz. (Google Earth & Kettunen. 2025)

Rue du Périgord before the transformation

FIGURE 6.4.2. The sidewalks on the street are narrow and enclosed. For orientation, see Figure 6.4.1. (Google Earth 2025)

FIGURE 6.4.3 Rue du Périgord opens up towards the library. For orientation, see Figure 6.4.1. (Google Earth 2025)

Rue du Périgord after the urban transformation

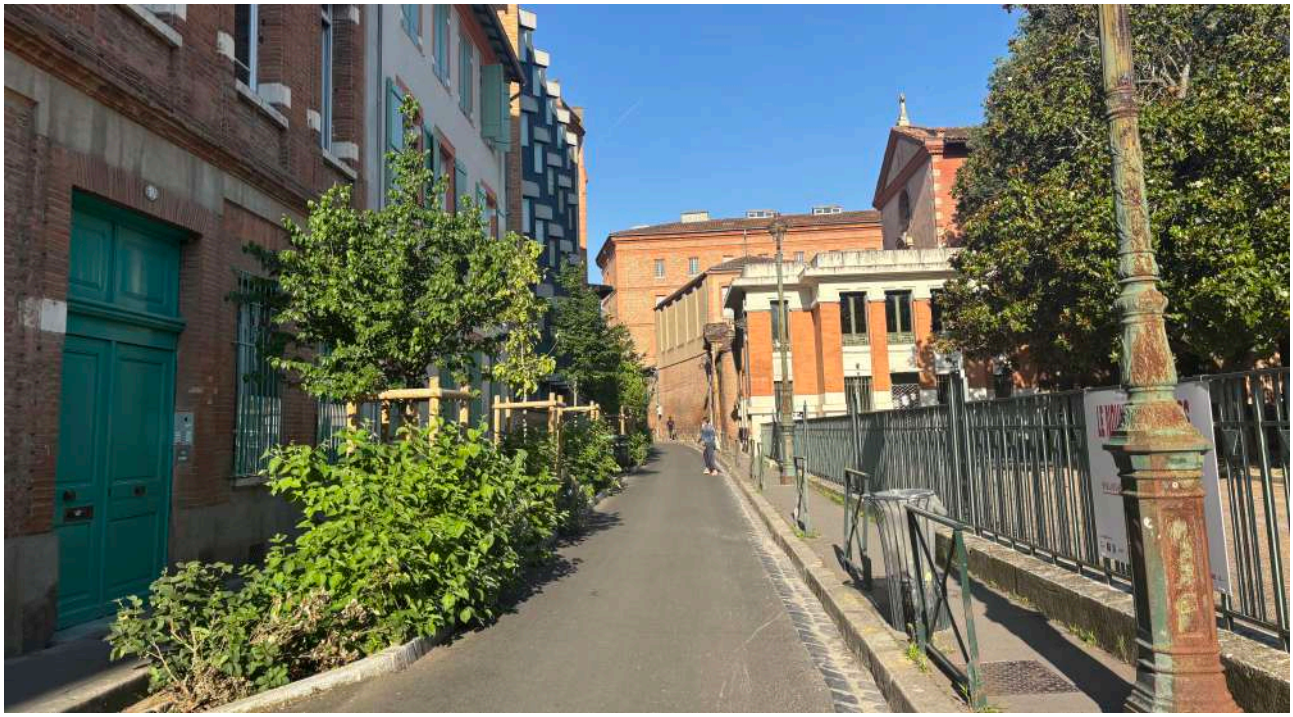


FIGURE 6.4.4. The vegetation comprises of trees and bushes. For orientation, see Figure 6.4.1. (Kettunen. 2025)

FIGURE 6.4.5. The westernmost part, where the vegetation creates an enclosed sidewalk. For orientation, see Figure 6.4.1. (Kettunen. 2025)

FIGURE 6.4.6. The vegetation creates a barrier, while the rest of the street is open. For orientation, see Figure 6.4.1. (Kettunen. 2025)

6.4.2. Spatial structure and perceived spatiality

The street features sidewalks on both sides, with planting strips separating the southern sidewalk from the east-west one-way car lane, see Figures 6.4.9-6.4.14. Few parking spaces remain between these strips. High curbs define the edges between the sidewalks and the roadway, creating a clear functional separation that also restricts flexibility, especially for pedestrians. The sidewalks are narrow and vary in width along the street, with the westernmost section being the narrowest, see Figure 6.4.13 and Figure 6.4.14.

Vegetation includes planting strips with trees such as magnolia and hazel, along with various shrubs. These are arranged in two or three rows within the strips and act as physical and visual barriers between the southern sidewalk and the roadway, see Figure 6.4.7. The planting strips help structure the space and enhance safety, but the narrow sidewalks often lead pedestrians and cyclists to use the car lane, which diminishes clarity of movement hierarchy and social comfort.

The street is divided into several segments with distinct spatial features, as shown in Figure 6.4.8. The street is divided into several rooms, influenced by the differenct character, but all with a direction towards the library. The easternmost segment lacks greenery and is tightly enclosed by buildings, serving mainly as a passageway with few opportunities to stop. Here, a continuous wall and a narrow floorscape emphasise a transit-oriented character, with limited aesthetic or social engagement. The middle segment, home to the library, is more open and acts as the street's main focal point, guiding spatial awareness towards it, see Figure 6.4.8. The library serves as a visual focal point, breaking the enclosure and offering a moment of spatial relief, where the openness of the floorscape enhances the sense of arrival. The space is directed towards the library, see Figure 6.4.8. Conversely, the westernmost segment, which is vegetated, has a different feel. It resembles an alley, with brick walls and blank facades, devoid of windows. This inward-facing wallscape increases enclosure and diminishes social interaction. The street's winding layout further narrows sightlines, emphasising varied spatial conditions along its length. The alternating zones of enclosure and openness generate a dynamic but disjointed spatial experience, with focal points or their absence, shaping both aesthetic impressions and social activity.

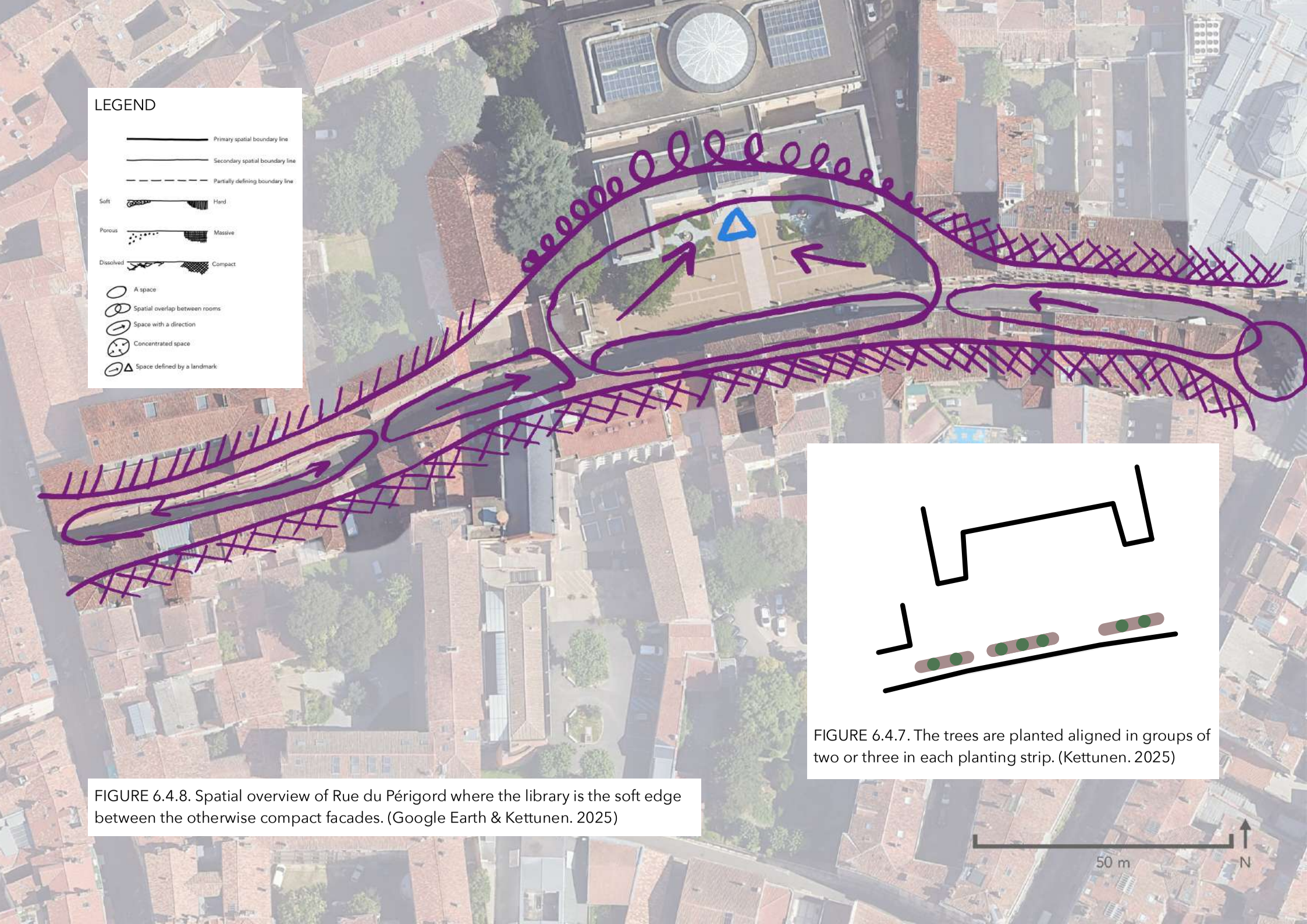


FIGURE 6.4.7. The trees are planted aligned in groups of two or three in each planting strip. (Kettunen. 2025)

FIGURE 6.4.8. Spatial overview of Rue du Périgord where the library is the soft edge between the otherwise compact facades. (Google Earth & Kettunen. 2025)

Series of section A-a:

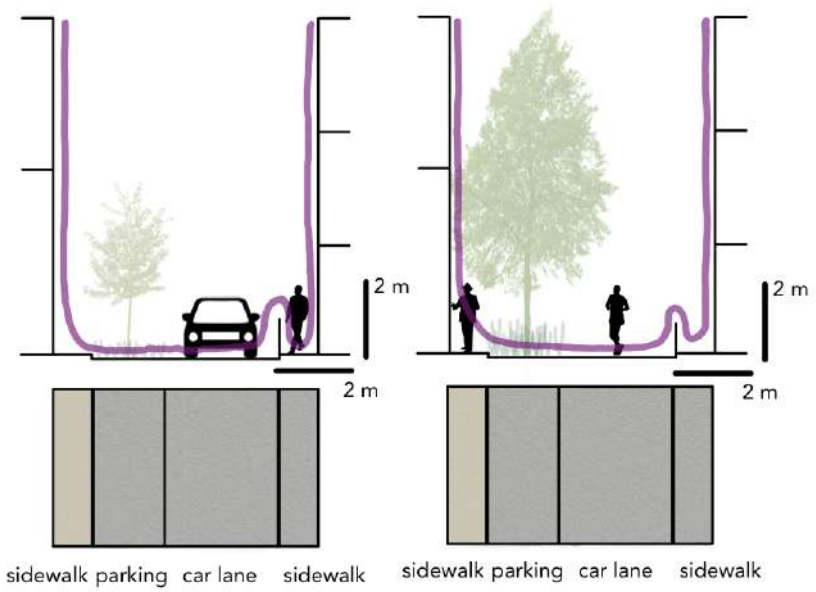


FIGURE 6.4.9. Elevation A-a. Year 0: The tree in the background does not contribute to the spatial structure on the street. For orientation, see Figure 6.4.1. 1/200 A4. (Kettunen. 2025)
FIGURE 6.4.10. Elevation A-a. Year 50: The mature tree in the background contributes to greenery on the street. For orientation, see Figure 6.4.1. 1/200 A4. (Kettunen. 2025)

In the easternmost part of the street, which is currently unaffected by the transformation, the high height-to-width ratio creates a strong sense of enclosure, even though the space remains visually open to the sky, as shown in Figure 6.4.9. Narrow sidewalks and high curbs intensify this enclosed feeling beyond what the building proportions alone suggest. A distant tree appears in the sightlines, introducing greenery and visual interest without significantly influencing the street's immediate spatial definition. In 50 years, as trees grow and their canopies expand, greenery will increasingly shape the spatial experience, as shown in Figure 6.4.10. The distant tree will become a stronger visual anchor, framing views and reinforcing orientation, while the spreading canopies will gradually transform visual perception.

Series of section B-b:

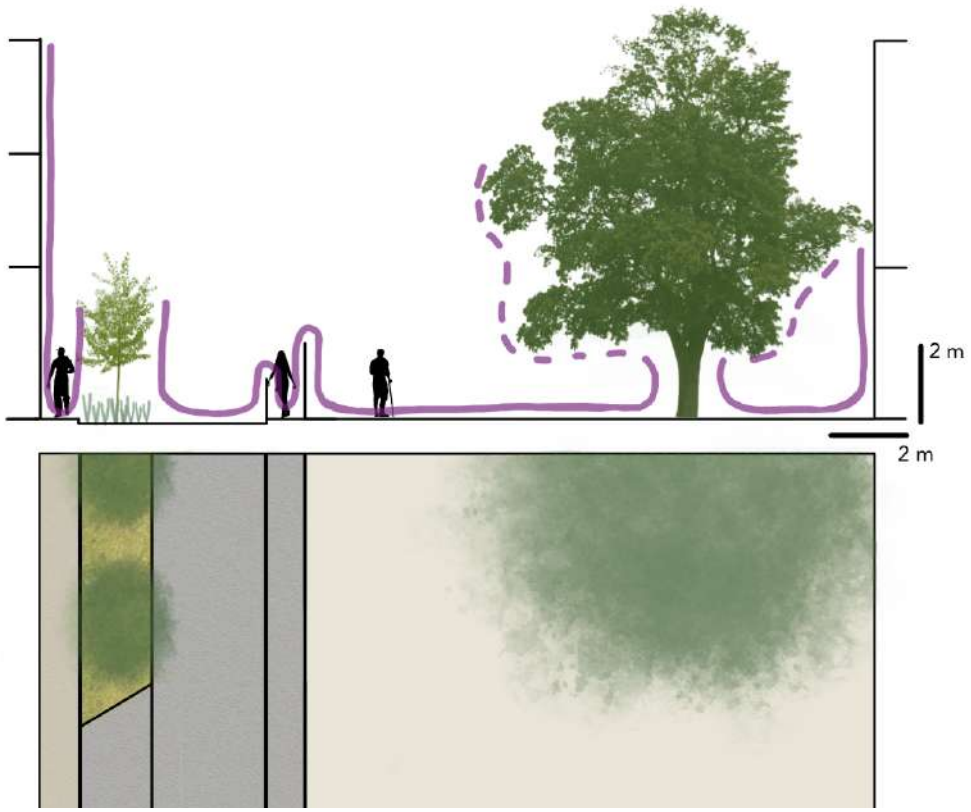


FIGURE 6.4.11. Section B-b. Year 0: The planted tree, together with the lower vegetation, creates a spatial definition on the street. For orientation, see Figure 6.4.1. 1/200 A4. (Kettunen. 2025)

In the central part of the street, views extend further toward the library, where wider gaps between buildings increase the sense of openness, as shown in Figure 6.4.11. The library's front yard enhances this spacious feeling with a large, mature tree. Newly planted trees and shrubs along the south sidewalk serve as a physical barrier for pedestrians from the street, remain visually open, and allow views to the sky. The existing tree in the library front yard functions as an edge, together with the building on the south side of the street, defining the streetscape.

Series of section B-b:

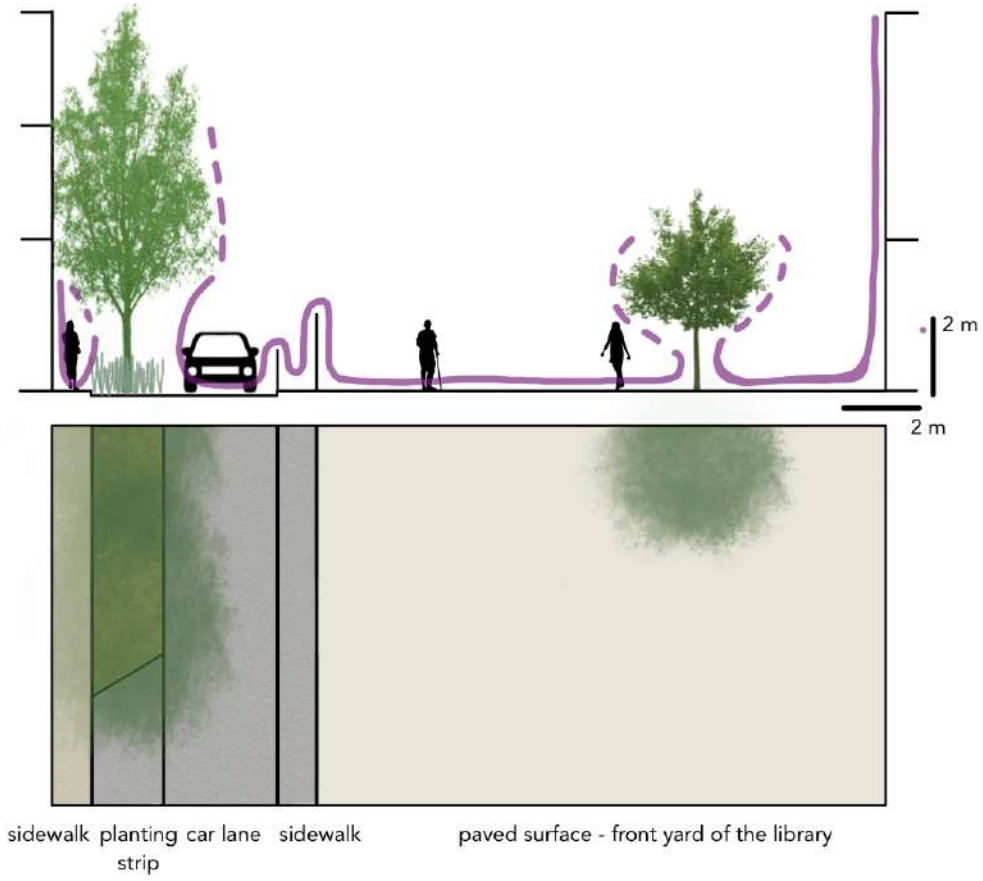


FIGURE 6.4.12. Section B-b. Year 50: The mature tree creates a defined space on the sidewalk, while the old tree in the library's front yard has been replaced with a new one. For orientation, see Figure 6.4.1. 1/200 A4. (Kettunen. 2025)

Over 50 years, as the trees grow, the street's spatial layout will become more layered and enclosed, as shown in Figure 6.4.12. The expanding canopies will act as both visual and physical barriers to the buildings, enhancing the definition of the street edge. The façades will benefit from this growth, with windows increasingly framed by greenery. As their branches extend, a ceiling-like canopy will form along the fronts of the buildings, creating a more enclosed, room-like atmosphere. The tree in the library front yard, have been replaced with a new one which changes the spatiality on the front yard. It is more open and the library facade is more space-defining than the new tree.

Series of section C-c:

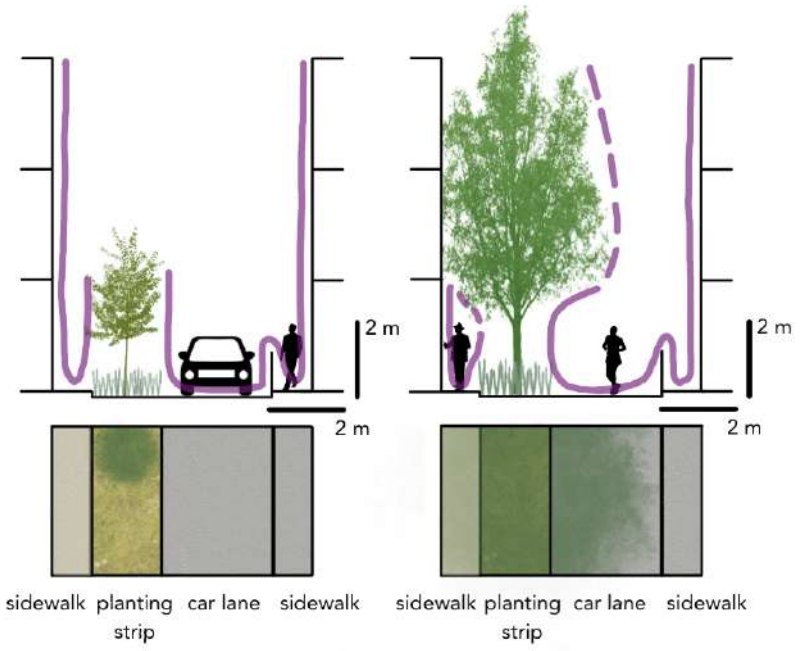


FIGURE 6.4.13. Section C-c. Year 0: The tree and the lower vegetation create a spatial division on the street. For orientation, see Figure 6.4.1. 1/200 A4. (Kettunen. 2025)
FIGURE 6.4.14. Section C-c. Year 50: The mature tree and the lower vegetation create a defined space on the sidewalk. For orientation, see Figure 6.4.1. 1/200 A4. (Kettunen. 2025)

The westernmost part of the street is the narrowest, resembling an alley, with a brick wall that mostly lacks window openings, as shown in Figure 6.4.13. This creates a strong sense of enclosure. Further west, the lack of vegetation and the winding layout enhance the feeling of passing through rather than being in a place. Newly planted trees introduce an initial spatial division, mainly serving as a physical barrier between pedestrians and vehicles while still allowing an open sky. The south sidewalk is separated from the street, and due to narrow sidewalks, the car lane also accommodates cyclists and pedestrians. Over 50 years, maturing trees will form dense canopies that lower the perceived height of the street, creating a more enclosed corridor between buildings and trees, see Figure 6.4.14. Areas not fully covered by the canopy will remain more open to the sky, creating a layered spatial experience with zones of enclosure and openness. The south sidewalk will become fully enclosed by shrubs and a denser canopy, and its narrowness will heighten the sense of visual and physical confinement. The rest of the street will feel like a single enclosed space, largely due to the trees' vertical growth.

FIGURE 6.4.15. The trees planted are of different species. (Kettunen. 2025)

FIGURE 6.4.16. The lower vegetation varies in height and form. (Kettunen. 2025)

FIGURE 6.4.17. The planting strips form a physical barrier from the sidewalk. (Kettunen. 2025)

FIGURE 6.4.18. A picture from under the tree on the library courtyard. (Kettunen. 2025)

7. Shaping streets through street trees

This chapter examines contemporary street greening through four case studies: Rue de Metz, Rue Croix Baragnon, Rue Valade, and Rue du Périgord. It discusses the results in relation to the research question and problem, addressing the spatial characteristics influenced by trees and how they shape perception and experience along each street. The chapter includes a reflection on the method, highlighting its strengths and weaknesses, and explores the future of street greening. The conclusion situates the findings within broader urban development, emphasising street trees as vital, dynamic elements of streetscapes.

7.1. Ever-changing streets and trees

Streets have always evolved to meet urban needs. Today, urban greening has become essential for creating sustainable, livable, and resilient cities, with green streets transforming urban spaces into multifunctional areas (Goodwin, 2017). Even historical neighbourhoods with limited space can integrate green infrastructure, enhancing environmental quality, livability, and resilience. While Fachrudin et al. (2023) note that interventions are often constrained by limited space, the results of this study demonstrate that effective urban greening is possible even in compact urban settings, provided that local strategies are carefully considered. Moreover, these interventions can maintain the local character, a factor considered essential for good urban design (Alamoush et al. 2021). As observed, streets have evolved into multifunctional spaces that include pedestrian-only zones, clearly marked and secure cycling infrastructure, adaptable seating that encourages social interaction, and features that support a variety of activities (Day 2024). These findings highlight that even modest interventions, when thoughtfully implemented, can significantly enhance the social, environmental, and functional value of urban streets, reflecting the broader goals of sustainable urban development.

In three out of four case-study streets, consistent pavement materials establish a shared visual language that unifies the streetscape and links the streets within the Sector Centre. Alongside the vertical rhythm created by aligned trees, these materials improve spatial clarity and flow. Developments like wider pavements, enhanced cycling infrastructure, and shaded seating prioritise pedestrians and cyclists, and promote daily street activity. The enhanced sightlines along the streets, together with trees carefully aligned with building façades and coherent material choices, reinforce the spatial and perceptual logic of the streetscape. These interventions preserve and highlight the historical character of the urban fabric, even within limited spaces, while simultaneously reclaiming the streets for pedestrians and restoring a sense of public life before the dominance of cars.

From a spatial perspective, these planting strategies directly respond to surrounding constraints and the architectural form. The case studies show that planting arrangements significantly influence spatial outcomes. On Rue de Metz, trees are planted in linear rows, together with shrubs, creating a clear, cohesive structure along the broad street, emphasising linearity and enhancing links to

broader green networks. Rue Croix Baragnon has single trees lining the street, reflecting limited space and continuous building facades, demonstrating how even a few trees can direct sightlines and soften the perception of space in a narrow street. Rue Valade features longer planting strips that define the pedestrian zone, with planting mainly defining the pedestrian area rather than the entire street segment, creating a partial enclosure. While Rue du Périgord includes extended planting areas with clusters of trees and shrubs, trees are concentrated near the library front yard, providing spatial relief without further narrowing the street. These differences influence the feeling of enclosure and spatial unity. Continuous, regular planting, most effective on wider streets, enhances legibility and flow, while more selective planting produces a weaker enclosure; however, narrow streets can still evoke a sense of enclosure. Overall, the combination of planting density, alignment, and street width sets the rhythm of enclosure and openness for each street, showing that street greening varies with planting density, placement, species, and long-term maintenance, with spatial qualities developing as the canopies grow.

Trees significantly influence whether streets are seen as movement corridors or welcoming places to linger. On Rue de Metz and parts of Rue Valade, trees and broader pavements with seating form spaces that invite lingering and social encounters. On Rue Croix Baragon and Rue du Périgord, the narrower streets are mostly experienced as corridors. However, destinations such as the square with trees and the library front yard provide opportunities for lingering and social interaction. This shows that vegetation alone rarely encourages social interaction; its effectiveness depends on factors such as space, surrounding uses, and supporting features. While trees help reshape streets by defining pathways, softening the environment, and adding colour, texture, and seasonal change. When combined with seating and pedestrian zones, they make streets feel lighter, sheltered, and welcoming, framing views and guiding movement. The results show that vegetation alone rarely encourages social interaction; its effectiveness depends on factors such as space, surrounding uses, and supporting features. The immediate benefits of young trees include enhanced climatic comfort, with shaded areas reducing heat and making walking more pleasant, particularly in narrow sections. Yet, as observed on Rue Valade, the mature plane tree demonstrates the added value of established vegetation, offering abundant shade and a pronounced sense of place.

Street trees significantly influence how streets connect with their built surroundings, affecting perceptions of space, daily experiences, and usage patterns. The interaction between streets, trees, and pedestrians is constantly changing and differs from one street to another, evolving as trees grow and user perceptions vary. Across the four case-study streets, the current influence of urban trees on space is limited because the trees are still young. At this stage, they are relatively small and mainly enhance the area through visual greenery, slight shade, and a softening of the streetscape. On Rue de Metz, Rue Valade, and Rue du Périgord, planting strips serve as physical barriers, but this effect is mainly due to the shrubs and planting strips rather than the trees themselves. As a result, the spatial role of the trees is still emerging. They do not yet create continuous enclosures, strong canopy cover, or well-defined spatial corridors. However, even young trees already impact the space: they act as green pockets within the streets, serve as visual focal points, and assist in

orienting movement and attention, subtly guiding circulation and enhancing connections to nearby streets.

Looking ahead, as the trees grow, their influence on the space will significantly increase. As canopies grow taller, wider, and more expansive in form, they will increasingly define the sense of enclosure, influence perceived scale, and organise the spatial arrangement along each street. On broader streets like Rue de Metz, continuous canopies can provide a protective overhead canopy, strengthening the sense of a connected space. On Rue Croix Baraagon, expanding canopies will soften building edges and foster a more intimate atmosphere, provided tree shape and canopy growth are carefully managed to preserve visibility and movement. However, there is a question of whether the street might feel overly confined. On Rue Valade, canopies are expected to form a connected ceiling, though it remains uncertain how this will integrate with the existing plane tree at the northern end. On Rue du Périgord, dense canopies may not encourage longer stays but could contribute to traffic calming by visually narrowing the street and reducing perceived speed.
Stem height, which can be adjusted, also impacts how spaces are experienced in the future. Most streets in this study are not built for large buses, allowing crowns to be set lower, which increases enclosure and fosters a human-scale environment. On wider streets like Rue de Metz, higher stem heights help keep façades, entrances, and shops visible, preserving the street's character. On narrower streets such as Rue Croix Baragnon and Rue Valade, slightly lower stems improve enclosure and provide shade while still maintaining clear sightlines and facilitating movement. In areas like Rue du Périgord, higher crown lifts may be needed to prevent too much enclosure and to ensure safety, visibility, and smooth movement.

Observations from this study show that buildings remain the main spatial boundaries across all four streets, with trees mainly serving as visual focal points and structural features. On Rue Croix Baragon, the individual trees are primarily an aesthetic choice, framing sightlines toward the cathedral and serving mainly as a complementary addition to the street. Conversely, on Rue de Metz, Rue Valade, and Rue du Périgord, the trees, together with additional vegetation, make the streets greener and create a more defined spatial structure, indicating that a more balanced relationship between building façades and greenery will develop as the trees mature.

These results are relevant for other historic city centres, where narrow streets are common, and space for greenery is limited. The study demonstrates how green interventions can be introduced without demolishing or significantly altering the built environment, instead functioning as complementary additions. Examples from Toulouse show different approaches to greening, including prioritising soft mobility and green spaces over vehicle traffic. Similarly, other historic city centres could adopt street greening and soft mobility strategies to create more space for street trees. Even narrow streets can accommodate green elements, and existing squares can be used to enhance greenery. Interventions do not necessarily require extensive planting; even a few carefully

placed trees can have a meaningful impact. Of course, all interventions must respond to the local context, and species should be selected accordingly.

7.2. Method discussion

This study relies mainly on qualitative spatial observation, an inherently subjective method. The lack of direct user involvement is a notable limitation, as no interviews, surveys, or behavioural mappings were conducted to document residents' or visitors' experiences. Consequently, social impacts are inferred rather than from personal accounts, limiting understanding of how different age groups, mobility needs, and seasonal changes influence everyday use. Additional uncertainties concern the accuracy of spatial data, some sourced from online maps such as Google Maps, which may not match on-site measurements but do not generally significantly affect the analysis. The approach focuses on sectional observation, supported by tools such as Branzell's method, which provides a structured and methodological way of recording observations through notations. This structured approach has been a strong aspect of the work, as each observation was carried out methodically and several times.

Drawing on Cullen's concept of serial vision, the analysis highlights the sequential, and in this study, the sectional experiences encountered while moving through the street, rather than considering it as a single, uninterrupted view. These sections function as simplified yet purposeful representations, capturing central spatial structures. Expanding Cullen's framework, the study considers not only the floorscape and wallscape but also the ceiling, which plays a crucial role in shaping enclosure, scale, and the overall perception of the streetscape. By integrating all three spatial planes, the method provides a more comprehensive understanding of the sense of spatiality.

The visual documentation of the streets and the results is limited, which makes the observations somewhat fragmentary. Fully understanding the spatial experience still requires on-site visits. The absence of photographs showing the streets before the changes is a weakness in capturing the context of the transformations. Although the documentation of the changes is adequate, it relies primarily on the author's photographs, often not taken from all angles, resulting in a fragmented perspective. Heights and widths were measured by the author, which may influence the perception of scale. While personal observations are inherently subjective and context-dependent, they provide a grounded, reality-based account of the street environments.

A weakness of this study concerns the temporal uncertainty surrounding assumptions about the recently planted urban trees. The trees studied across the four case-study streets are all in early growth stages, meaning their current spatial influence is limited and their long-term development uncertain. For this study, it has been assumed that the trees will grow and reach a reasonable height over the next 50 years. However, this assumption is inherently debatable, as tree growth is affected by numerous environmental, ecological, and human factors. Consequently, any projections of their

long-term spatial contributions are speculative, and the future scenarios presented in this thesis should be regarded as informed estimates rather than definitive predictions.

7.3. Future perspectives for the spatiality of streetscapes

Trees are likely to remain essential elements of streetscapes, with their structure and placement increasingly reimagined to shape future urban space. All streets studied here currently have trees planted in a line, but future propositions could consider more varied arrangements. Trees might be grouped, placed on each side of the street in varying distances, which could help slow vehicles, provide shade at different times, and create a more diverse streetscape. Larger tree crowns could develop if trees are given space to expand rather than being planted closely together. Planting trees in central lanes, especially on streets without vehicle traffic, might produce larger canopies and help separate cycling and pedestrian areas. Narrow streets could also benefit from individual trees adding greenery and complemented by seating to create spaces for social encounters. These options highlight the need for site-specific strategies, as what works on one street may not work on another.

Looking ahead, urban street greening must balance ecological goals with cultural, spatial, and infrastructural constraints, while accommodating each street's unique conditions. One-size-fits-all planting solutions are ineffective; instead, local, context-specific plans should be developed. Future approaches should emphasise canopy continuity, pedestrian comfort, climate resilience, and long-term spatial integration over short-term visual effects or simple planting quotas, as successfully implemented in cities like Toulouse. Strategic tree placement, careful species selection, and thoughtful integration of trees with the built environment will be more important than merely increasing tree numbers.

Future streetscapes are likely to become more lush, with increased greenery and less asphalt. Climate change will influence the selection of tree species, which, in turn, will affect the spatial character of streets. Careful planning of their placement can help ensure that trees enhance the visual and spatial qualities of streetscapes rather than merely increasing the number of trees planted. Regular spatial assessments and follow-up studies are therefore vital for understanding how streetscapes develop over time and whether desired spatial and environmental goals are met. While the spatial features are significant, other benefits provided by trees, such as biodiversity and microclimate regulation, also play a crucial role in shaping the future spatial quality of streetscapes, even if they were not the primary focus of this study.

7.4. Conclusion

This master's thesis examines how street trees, as living elements of current greening developments, influence the spatial characteristics of four streetscapes in Toulouse: Rue de Metz, Rue Croix Baragnon, Rue Valade, and Rue du Périgord. Contemporary street greening developments are designed with trees as central spatial elements, structured in relation to the specific conditions of

each street. Trees mediate between built structures, movement, and daily activities, rather than serving solely as decorative or ecological elements. This study shows that they shape enclosure, scale, continuity, and legibility, with their spatial and perceptual impacts varying according to street width, morphology, and planting arrangement. Trees contribute to the perceived and experienced spatial qualities by introducing a clearer spatial structure, often separating sidewalks from vehicular lanes. These designs frequently prioritise soft mobility through the inclusion of bicycle lanes and shared-use spaces. As a result, streetscapes become more legible, comfortable, and oriented toward pedestrians and cyclists. Individually, young or small trees have a limited spatial impact, primarily contributing to greenery and a subtle sense of structure, enclosure, and shade. This will change into an increased enclosure, continuity, intimacy, and spatial clarity as the canopies grow. However, when young trees are combined with lower vegetation, they help define boundaries within the street and strengthen spatial edges. Together with elements such as seating, trees support the creation of inviting environments that encourage social interaction and informal encounters, making streets feel more like destinations than pathways. At present, building façades remain the dominant hierarchical spatial edges, with trees acting as complementary elements. As trees mature, their spatial impact becomes more pronounced. Increased canopy size and visual presence allow trees to gain greater dominance within the streetscape, shaping spaces between and beneath them. Over time, mature trees are likely to form balanced spatial edges alongside building façades, contributing more strongly to enclosure, rhythm, and overall spatial definition. Overall, street trees shape urban streetscapes both instantly and over time. Their spatial, social, and climatic roles highlight their importance as dynamic, interconnected elements that support resilient, human-scaled, and socially vibrant streets within historic urban environments.

8. References and Figures

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Figure 6.2.14. Kettunen, A. (2025). *Section C-c.*[section].

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Figure 6.3.4. Kettunen, A. (2025). *Rue Valade from eye level.* [photo].

Figure 6.3.5. Kettunen, A. (2025). *The planting strip and seating along it.* [photo].

Figure 6.3.6. Kettunen, A. (2025). *The lush vegetation in the planting strip.* [photo].

Figure 6.3.7. Kettunen, A. (2025). *Tree plan of Rue Valade* [sketch].

Figure 6.3.8. Kettunen, A. (2025). *Plan of Rue Valade* [map].

Figure 6.3.9. Kettunen, A. (2025). *Elevation A-a.* [elevation].

Figure 6.3.10. Kettunen, A. (2025). *Elevation A-a.*[elevation].

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