Streets for All

Navigating Equity in the Built Environment of Montreal

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Policy Brief

THE ISSUE

Streets are the most prevalent type of public space in cities. They play an important role in shaping urban landscapes and sustaining city life. Through streetscape design, cities can foster vibrant and inclusive neighbourhoods that cater to the diverse needs of their residents. However, for cities to prosper with high-quality neighbourhoods, urban planners, designers, and policymakers must consider broader social and spatial equity in streetscape planning. Microscale features of the streets such as trees, benches, and sidewalks can significantly enhance streetscapes' enjoyability, making built environments more attractive for pedestrians, cyclists, and residents (Carlson et al., 2019).

In Montreal, an articulated goal to improve the built environment exists in the Montreal equity plan. Our research aimed to determine whether variations at the microscale level exist among streets of similar typologies across diverse socioeconomic neighbourhoods in Montreal. The guiding question is: ***Are all streets created equal?***

The short version of the Microscale Audit of Pedestrian Streetscapes (MAPS-Mini) tool was used to assess microscale features essential for creating high-quality built environments (Cain et al., 2015). Assessments were conducted using Google Street View and in person site visits to ensure a comprehensive analysis of the tool's effectiveness across different methodologies and urban contexts.

FINDINGS

Significant disparities in the quality of streets' built environment across various socioeconomic neighbourhoods exist. **Despite having identical typologies and characteristics, streets in lower-income areas generally exhibit poorer built environment quality, highlighting that streets are not always created equal in Montreal.** This trend is particularly evident in medium and high-density neighbourhoods.

At the same time, the overall assessment indicates that most streets in Montreal require more attention for improvements. More urban design features are needed across the island, as less than a third of the audited streets are deemed to have high-quality built environments.

Montreal Street' Built Environment MAPS-Mini Scores Accross Different Socioeconomic Neighborhoods

RECOMMENDATIONS

Addressing disparities in the built environment is essential for creating equitable, healthy, and livable communities. In Montreal, particular attention should be paid to improving the quality of streets in low-income neighbourhoods. As such, design recommendations include:

***1.* Developing Equity Frameworks Including Community Engagement**

- Increasing participatory planning processes to ensure that the needs, priorities, and concerns of diverse residents are adequately addressed in urban design decisions.

2. Enhancing Active Transportation Amenities

- Enhance pedestrian and cyclist infrastructure through multiple measures such as wider sidewalks, protected bicycle lanes, and improved lighting to enhance safety and accessibility, particularly in low-income neighbourhoods.
- Include multiple traffic calming measures on local streets for more effective reduction of car speeds.
- Increase greenery on streets and in adjacent public parks to enhance aesthetic appeal, create stimulating spaces, that can foster a sense of belonging for residents.

3. Ensuring Ongoing Assessments and Maintenance

- Periodically verify the quality of streets and ensure their maintenance for continuous upkeep.

Note d’orientation

PROBLÉMATIQUE

Les rues sont le type d’espace public le plus répandu dans les villes. Elles jouent un rôle important dans la formation des paysages urbains et le maintien de la vie urbaine. Grâce à la conception de rues, les villes peuvent soutenir des quartiers dynamiques et inclusifs qui répondent aux divers besoins de leurs résidents. Cependant, pour que les villes prospèrent avec des quartiers de haute qualité, les urbanistes, les designeurs urbains et les politiciens doivent tenir compte d’une plus grande équité sociale et spatiale dans la planification du paysage des rues. Les caractéristiques de petite échelle des rues telles que les arbres, les bancs et les trottoirs peuvent considérablement améliorer l’attrait des paysages urbains, rendant les environnements bâtis plus agréables pour les piétons, les cyclistes et les résidents (Carlson et al., 2019).

À Montréal, malgré un objectif articulé visant à l’amélioration de l’environnement bâti, il manque des interventions spécifiques dans les rues pour promouvoir l’équité à travers la conception urbaine. Notre recherche vise à déterminer si des variations à petite échelle existent parmi les rues de typologies similaires dans divers quartiers socio-économiques de Montréal. La question directrice est: ***Toutes les rues sont-elles créées équitablement?***

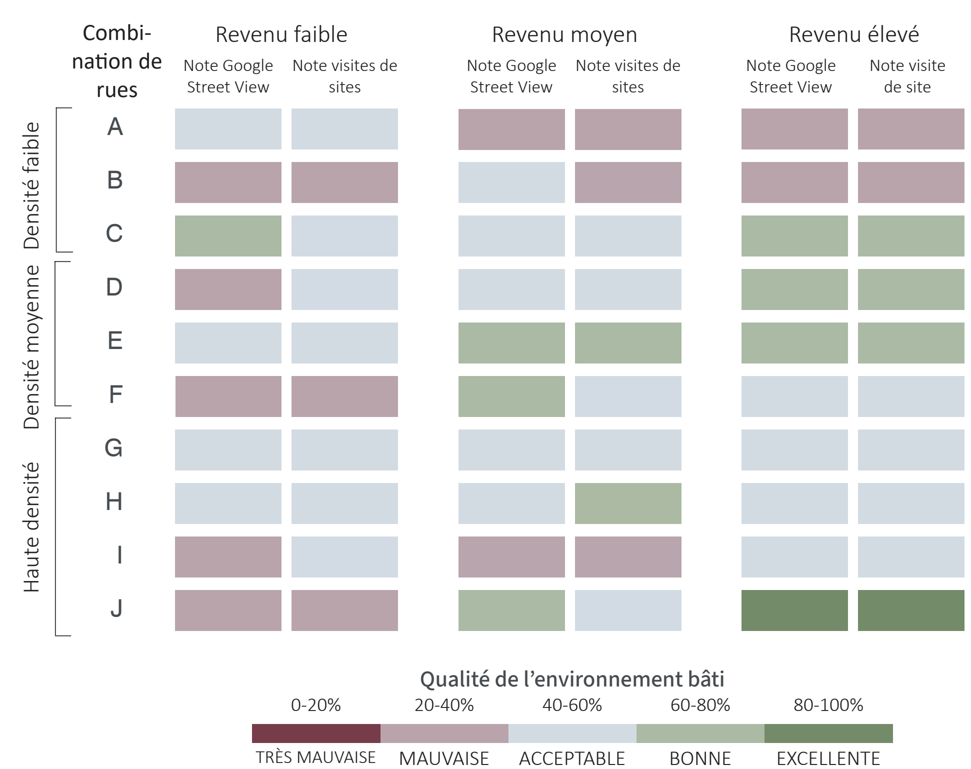
La version abrégée de l’outil Microscale Audit of Pedestrian Streetscapes (MAPS-Mini) a été utilisée pour examiner ces caractéristiques essentielles à la création d’environnements bâtis de haute qualité (Cain et al., 2015). Les évaluations ont été réalisées en utilisant Google Street View et des visites de sites en personne pour assurer une analyse exhaustive et valider l’efficacité de l’outil à travers différentes méthodologies et contextes urbains.

CONSTATS

Des disparités significatives existent dans la qualité de l’environnement bâti des rues de divers quartiers socio-économiques. **Malgré des typologies et des caractéristiques identiques, les rues des quartiers à faible revenu présentent généralement une mauvaise qualité environnementale, soulignant que toutes les rues ne sont pas toujours créées égales à Montréal.** Cette tendance est particulièrement évidente dans les quartiers de densité moyenne et élevée.

En même temps, l’évaluation globale indique que la plupart des rues à Montréal nécessitent plus d’attention pour des améliorations. Des éléments de design urbain supplémentaires sont nécessaires sur toutes l’île, car moins d’un tiers des rues évaluées sont considérées comme ayant des environnements bâtis de haute qualité.

La qualité de l’environnement bâti de rues de Montréal à travers différents quartiers socioéconomiques



RECOMMANDATIONS

Aborder les disparités dans l’environnement bâti est essentiel pour créer des communautés équitables, saines et vivables. À Montréal, une attention particulière devrait être portée à l’amélioration de la qualité des rues, notamment dans les quartiers à faible revenu. Ainsi, des recommandations de design incluent :

1. Développer des cadres d’équité incluant l’engagement communautaire

- Accroître les processus de planification participative pour garantir que les besoins, les préférences et les préoccupations de divers habitants sont adéquatement pris en compte dans les décisions de conception urbaine.

2. Améliorer les commodités de transport actif

- Améliorer l’infrastructure piétonne et cycliste à travers différentes mesures telles que des trottoirs élargis, des pistes cyclables protégées et un meilleur éclairage de rue pour renforcer la sécurité et l’accessibilité, surtout dans les quartiers à faible revenu.
- Inclure plusieurs mesures d’apaisement de la circulation sur les rues locales pour réduire efficacement la vitesse des voitures.
- Augmenter la verdure dans les rues et les parcs publics adjacents pour créer des espaces plus esthétiques et stimulants qui peuvent favoriser un sentiment d’appartenance pour les résidents.

3. Assurer des évaluations et un entretien des rues continus

- Vérifier périodiquement la qualité des rues et assurer leur entretien régulier pour un maintien continu.

Acknowledgements

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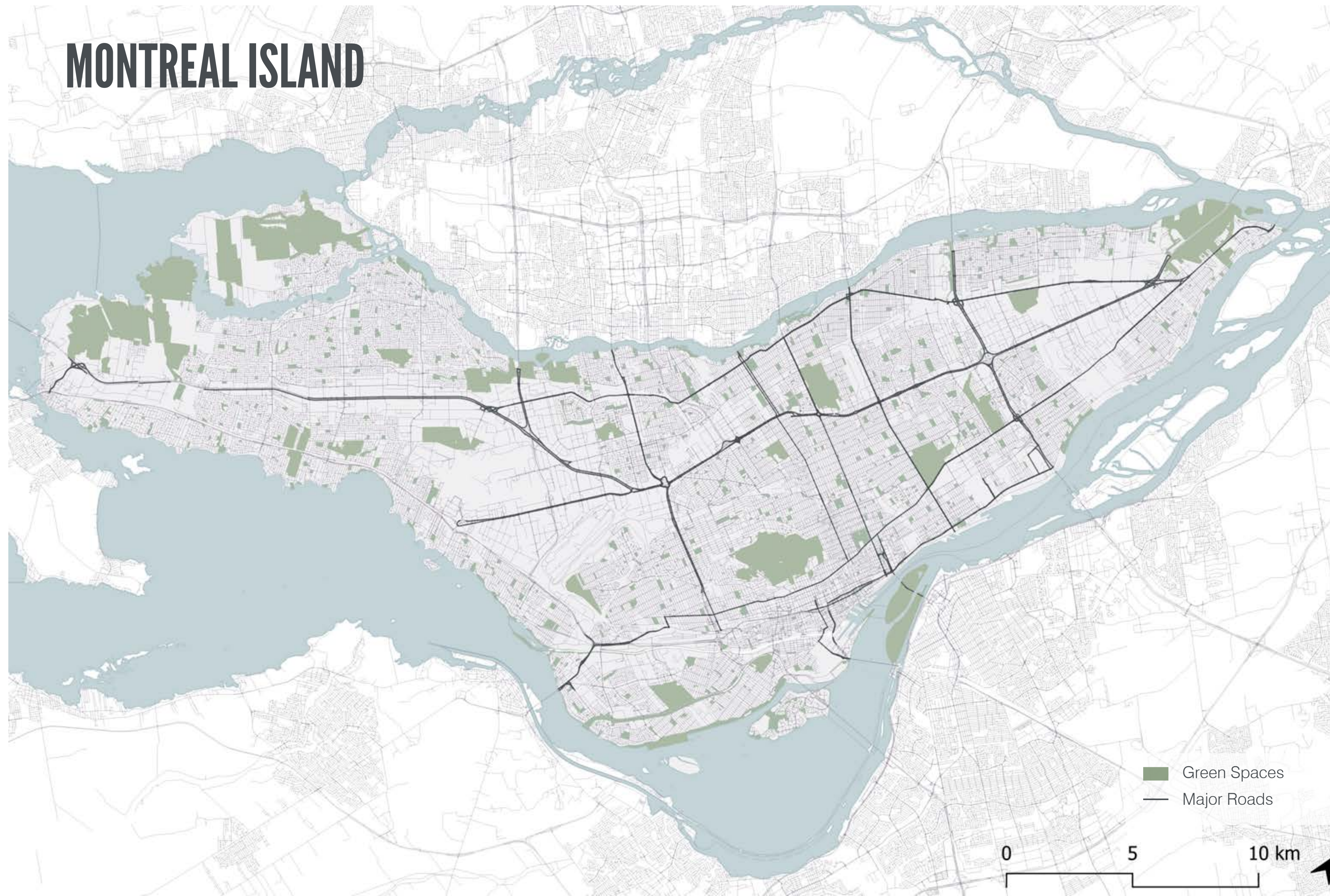
1. Introduction

Streets, as the most prevalent type of public space in cities, play an important role in shaping urban landscapes and sustaining city life. Their built environment can encourage interactions among residents, promote alternative modes of transport such as walking and cycling, support local economic activities, and enhance the livability of urban areas (Whyte, 1980; Gehl, 2011). Through streetscape design, cities can foster vibrant and inclusive neighbourhoods that cater to the diverse needs of their residents and improve their overall quality of life (UN-Habitat, 2013).

Given the importance of streets, it becomes imperative to consider how their design intersects with broader social equity goals. Planning for equity strives to ensure equal access to opportunities for all residents (APA, n.d.). Centered around the improvement of citizens' quality of life, it involves developing safe and attractive neighbourhoods that support the physical and mental well-being of their population (APA, n.d.). The integration of social and spatial equity considerations entails identifying areas for improvement in the built environment, especially in areas inhabited by more vulnerable populations (i.e., lower income households).

While streets have the potential to foster a sense of community, certain typologies and built environment elements can inadvertently discourage such interactions, particularly in more car-centric and poorly maintained urban areas (Agyeman, 2021). Street designs that prioritize automobile circulation over pedestrian accessibility can fail to provide inviting environments conducive to community interaction (Agyeman, 2021). Thus, exploring social equity within streetscapes is essential for creating thriving cities.

Montreal, one of Canada's most multicultural metropolitan cities, comprises a mosaic of neighbourhoods with diverse characteristics encompassing culture, history, population demographics, and urban fabrics. This diversity makes Montreal an ideal case study for examining equity in urban streetscapes. The city's *Solidarity, Equity, and Inclusion Plan* guides efforts to improve the quality of life of the city's diverse populations, with a particular focus on vulnerable groups (Montréal, 2021). Drawing on Montreal's Charter of Rights and Responsibilities,



which mandates that: “The city is both a territory and a living space in which values of human dignity, tolerance, peace, inclusion and equality must be promoted among all citizens”, the plan outlines 71 actions to create secure and inclusive urban environments (Montréal, 2021). However, despite an articulate goal to improve the built environment, the plan lacks specific street design interventions.

This research aims to evaluate the built environment of streets with similar characteristics, including population density, across different socioeconomic neighbourhoods within Montreal. By examining the attributes of theoretically identical streets, the study seeks to identify any potentially overlooked disparities. As such, the guiding question is: ***Are all streets created equal?***

Microscale features of the streets such as trees, benches, and sidewalks can significantly enhance streetscapes’ enjoyability, making environments more attractive for pedestrians, cyclists, and residents (Carlson et al., 2019). These elements are also quicker and cheaper to adjust than larger-scale urban planning efforts (Carlson et al., 2019). Thus, this research concentrates on microscale elements to provide actionable insights for the streets of Montreal.

In this study, the short version of the Microscale Audit of Pedestrian Streetscapes (MAPS-Mini) tool was used to assess microscale features essential for creating high-quality built environments (Cain et al., 2015). The assessments were conducted both through Google Street View and through in-person site visits to ensure a comprehensive analysis and validate the tool’s effectiveness across different methodologies and urban contexts.

The study provides important evidence-based guidance for street design and revitalization projects, offering invaluable insights to urban planners, designers, and policymakers. By identifying streets in Montreal where the built environment requires improvement due to lacking, inadequate, or insufficient quality street infrastructure and/or amenities, the research highlights areas in need of urban transformation. The findings can inform interventions, investments, and resource allocation decisions, ultimately assisting professionals in ensuring spatial equity in Montreal.

Boulevard Décarie, Montreal

2. Literature Review

2.1. The Social and Spatial Equity of Streets

Assessing and designing urban environments through the lens of spatial and social equity is a recognized strategy for creating sustainable cities (Agyeman, 2021). UN-Habitat (2013) highlights street connectivity and multifunctionality as key indicators of urban prosperity, reflecting thriving and healthy communities. Central to this prosperity is equity and social inclusion, ensuring that all residents, especially those from marginalized groups, benefit from the city's success and development (UN-Habitat, 2013).

One effective way to promote equity in urban streets is by considering the allocation of spatial rights, which involves addressing the needs of different users (Agyeman, 2021). Thoughtful and inclusive space allocation should cater to all users, including pedestrians, cyclists, and public transport users. Unfortunately, current urban planning in North America tends to prioritize vehicle circulation at the expense of other modes of transport (Elokda, 2017; UN-Habitat, 2013). However, cities are now progressively moving away from historical car-centric approaches to planning and towards implementing more active transport infrastructures and opportunities, particularly in the post-pandemic context (Cleckley, 2021). Achieving equity involves ensuring accessibility for diverse users, especially those in lower-income areas (Dasgupta, 2021). Integrating pedestrian and cycling amenities, along with greenery, into street design can support these goals by enhancing comfort, safety, and attractiveness, particularly for children, women, and the elderly (Agyeman, 2021; UN-Habitat, 2013).

Agyeman (2021) illustrates how the organization and design of streets can dramatically impact their functionality and inclusivity. The comparison of Gothenburg, Sweden's shared street Södra Vägen, which accommodates various transport modes to the car-centric Massachusetts Avenue in Cambridge (Massachusetts USA) highlights stark differences in streetscapes that influence user experiences (Agyeman, 2016). Despite having the exact same width, these streets offer vastly different environments, with Södra Vägen demonstrating a more democratized and just approach to street design (Agyeman, 2016).

Furthermore, research indicates that democratizing street usage reduces traffic levels, fostering increased social interactions (Agyeman, 2021). Aligned with *contact theory*, these heightened interactions can enhance relationships among social groups, contributing to a more cohesive and inclusive society with a heightened sense of belonging (Agyeman, 2021). Streets that are well-designed support these interactions, nurturing stronger community bonds and enhancing the well-being, behavior, and happiness of residents (Mehta, 2007; Talen et al., 2023; Elokda, 2017). Additionally, investments in active transportation enhance quality of life by promoting sustainability and reducing greenhouse gas emissions (Dasgupta, 2021).

Examining and comparing streets offers valuable insights into both the successes and shortcomings of urban design. Comparing streets, as illustrated by the *Södra Vägen vs. Massachusetts Avenue* example, can reveal significant differences in urban environments, particularly in terms of their level of democratization. However, the location of the streets being compared matters. Conducting comparative assessments within the same context

Södra Vägen,Gothenburg, Sweden

Massachusetts Avenue, Cambridge, Massachusetts, United States could yield more useful results than comparing across differ-ent cities or countries, as in Agyeman's example.

Observing streets across various neighbourhoods within the same city can facilitate the identification of necessary interventions, particularly when carried out by the same political entity, such as the city of Montreal in this current study. The characteristics and demographics of the neighbourhoods where these streets are located can offer a nuanced understanding of spatial justice by providing further insight into the distribution of the benefits of urban design within a city. Additionally, streets need to be carefully matched based on specific criteria to ensure a valid comparison.

2.2. Indicators of High-Quality Streets

Streets, when well designed, can become dynamic places that serve not only as thoroughfares but as vibrant spaces for social interactions and diverse activities (Park & Garcia, 2020). Urban planners should recognize streets as essential social public spaces that fulfill the human need for interactions beyond home and work (Mehta, 2007; Mehta & Bosson, 2021). To foster livable streets, a shift away from car-centric designs is imperative, requiring a generous allocation of space for pedestrian amenities (Whyte, 1980). The careful design of public spaces, including streets, holds the potential to significantly enhance urban vibrancy and encourage greater overall use (Whyte, 1980).

Public spaces can help increase social interactions, preventing social isolation and exclusion and improving overall quality of life (Gehl, 2011; UN-Habitat, 2013). Humans have an inherent need for social interactions, and the mere presence of people in public spaces attracts more users (Whyte, 1980; Gehl, 2011). These interactions can be of low intensity and effort, such as seeing and hearing people without direct communication (Gehl, 2011). Moreover, public spaces like parks and plazas offer bystanders the opportunity to derive joy from observing and engaging vicariously through the activities of others (Whyte, 1980).

Designing spaces that accommodate a variety of social activities, including unforeseen ones, is essential for creating lively streets, especially in North America, which lacks the historic old plazas and squares found in medieval European and Asian cities (Mehta, 2007). Streets should support a range of activities, including walking, cycling, standing, lingering, gardening, sitting, observing others, etc. (Whyte, 1980, Gehl, 2011). Street activities can be categorized into three categories: necessary (related to transport), optional (recreational), and social (involving interactions between two or more people) (Gehl, 2011). People naturally stop and linger for conversations at curbs, intersections, and near traffic circulations, especially when adjacent to public spaces, parks, stores, and restaurants (Whyte, 1980). They also tend to seek out sitting spots wherever available, even informal ones like ledges and steps (Whyte, 1980).

The built environment can influence behavior in public spaces, with optional activities being particularly susceptible to its quality (Gehl, 2011). Indeed, walking for leisure places emphasis on aesthetics and infrastructure, while walking as a mode of transport relies more on land-use (Rodrigue et al., 2022).

Therefore, the ability of streets to accommodate effectively the diverse social needs, activities, and modes of transport within communities serves as a crucial measure of success in urban design. The aim is to develop cities where streets are designed, maintained, or revitalized to support these activities through planning and ongoing assessment. Ensuring that the built environment of streets is successful is an iterative process. In instances where existing amenities prove insufficient, urban transformation becomes necessary. It is essential to continually evaluate streets in cities post-construction to ensure they are evolving along with community needs and patterns. It is important to also ensure that well-designed streets are equitably distributed in cities, so that all residents can benefit from the advantages of enhanced social interactions. By verifying the quality of streets, this research can contribute to improving Montreal's inclusivity, vibrancy, and social cohesion.

2.3. The Built Environment of Streets

Over the years, urban planning has evolved to place a greater emphasis on creating high-quality public spaces that enhance people's daily activities (Gehl, 2011). This modern approach prioritizes pedestrian-friendly and human-scaled infrastructure, with controlled motorized traffic and lower speeds typically resulting in busier and livelier streets for residents (Gehl, 2011).

The built environment of streets can be analyzed at multiple scales: macroscale, mesoscale, and microscale. The macroscale focuses on aspects such as land use, transportation networks, block lengths, intersection density, building density, as well as street connectivity (Koo et al., 2023). The mesoscale, which zooms in on the neighbourhood level, examines similar elements to the macroscale (Kim, Park & Lee, 2014). At the microscale, streetscape elements and amenities are assessed. These features influence the attractiveness and safety (both from traffic and crime) of streets and, consequently, the experiences of pedestrians and cyclists (Carlson et al., 2019). All these scales are important and influence one another. Urban transformations at the microscale can have a ripple effect, enhancing entire neighborhoods, and vice versa.

Microscale elements, usually the quickest and easiest to modify, can significantly promote active transportation among residents of varying ages and physical health statuses (Koo et al., 2023; Cain et al., 2015). Research shows that improving the microscale of streets by incorporating numerous high-quality public amenities (parks, urban furniture, bicycle racks, street trees, mixed land uses, etc.), enhances their vibrancy and supports diverse social activities (Miranda et al., 2021, Mehta, 2007).

Environmental elements largely contribute to the attractiveness of streets (Whyte, 1980). Greenery provides respite from urban monotony, and reinforces the fundamental relationship between humans and nature (Appleyard, 1978). Additionally, walking infrastructure, along with traffic calming measures (e.g., pedestrian crossings) can provide a sense of comfort and safety to users, particularly children, the elderly, disabled individuals, and parents with strollers, as well as pedestrians who may not always be attentive to their surroundings (Gehl, 2011; Whyte, 1980). Elevated sitting places such as benches, chairs, and bus stop seats encourage public space usage by providing convenient

Rue Masson, Montreal

Well-maintained streets that appeal to pedestrians and cyclists of all ages, are essential for supporting social interactions, and physical activity (Appleyard, 1978; Cain et al., 2015). Residents may associate the presence of graffiti and litter with unsafe environments (Tabatabaie et al., 2023). A study evaluating the perceptions of streetscapes among experts and non-experts found that streets perceived as having the highest quality and attractiveness prioritized pedestrian infrastructure emphasizing comfort, safety, and visual attractiveness (Talen et al., 2023). People's willingness to walk on streets, especially during after-dark hours, is correlated to street conditions (Park & Garcia, 2020). Adequate lighting that enhances visibility is a key factor in instilling a sense of safety for pedestrians at night (Park & Garcia, 2020). Additionally, the presence of a variety of mixed-use establishments, including stores, restaurants, and bars, allows for increased amounts of eyes on the street, thereby enhancing the overall sense of safety of residents (Jacobs, 1961). This aligns with the *broken window theory* that suggests that the presence of litter and obstructions on the streets leads people to perceive places as unsafe (Talen et al., 2023). Thus, higher maintenance contributes to a reduced fear of crime (Park & Garcia, 2020).

Overall, the built environment of streets plays a role in shaping people's perceptions and walking behavior, prompting deviations from their primary trip trajectory to engage with desirable elements (Miranda et al., 2021). This dynamic interaction creates opportunities for spontaneity, and active participation in city life (Miranda et al., 2021).

It is important to note that all streets have the potential to be lively if designed properly, even arterials and major roads that sustain heavy traffic flows (McAndrews & Marshall, 2018). Arterial roads are typically characterized by high car speeds, high vehicle volumes, and unpleasant noise, making them uncomfortable and dangerous for pedestrians (McAndrews & Marshall, 2018). However, just like other street typologies, redesigning these arterials to incorporate more mixed-use buildings and protected pedestrian and cycling infrastructure, including sidewalks, bicycle lanes, public transit stops, and trees can transform them into more livable spaces, though this remains more challenging (McAndrews & Marshall, 2018).

The growing recognition of social, economic, and functional importance of streets is reflected in the creation and adoption of design guidelines aimed at enhancing the safety and inclusivity of streets (NACTO, 2013). These guidelines provide detailed recommendations for the appearance, orientation, dimensions, and positioning of pedestrian, cyclist, and public transportation infrastructure (NACTO, 2013). They encompass design propositions for features like buffer zones, curb extensions, bus stops, speed bumps, and more (NACTO, 2013). The intent of these designs is to promote the adoption of active transportation while mitigating the high volumes and speeds of vehicular traffic (NACTO, 2013).

Ultimately, all types of streets, including arterial roads, have the potential to be well-designed, offering enhanced safety and appeal to all users. While assessing the quality of streets, focusing on specific microscale features of the built environment allows for a comprehensive understanding of which streets are adequately designed for alternative modes of transportation. The essential features include:

- Traffic calming measures: This encompasses the presence of pedestrian crossings, effective separation of street uses with protected buffer zones, speed bumps, curb extensions, etc.
- Universally accessible designs: Considerations of users with disabilities or with wheeled items (i.e., strollers) involves evaluating the presence of slopes and curbs that facilitate easy access for all.
- Walking and cycling infrastructure: Examining the width of sidewalks and the existence of dedicated bicycle lanes is essential to identify pedestrian-friendly environments.
- Public Amenities: Features such as transit stops and urban furniture (e.g., benches) enhance pedestrian experience.
- Land Use: Considering the variety of land uses, including parks, stores, restaurants, and public spaces, is also important to determine if streets are desirable and support diverse activities.
- Environmental Factors: The presence of trees and greenery contributes to the overall quality and aesthetic of streets.
- Maintenance and litter: Regular upkeep, including cleanliness and removal of litter and graffiti creates more inviting environments for pedestrians and cyclists who can perceive them as safer.

Observing these features can determine the quality of the built environment of different streets. Streets can then be compared among each other to determine if there are any variations across socioeconomic neighbourhoods in Montreal. Policy and design recommendations for future interventions are based on these comparisons and the literature.

2.4. Street Improvements and the Fear of Gentrification

Street improvements have the potential to significantly enhance neighbourhood quality of life by increasing their safety, attractiveness, as well as the level of physical activity among residents. However, such well-intentioned enhancements frequently raise apprehensions among longstanding residents about the possibility of gentrification and displacement (Serrano et al., 2023; Goossens et al., 2020). Initiatives like street revitalizations, neighbourhood greening initiatives, and public transportation expansions tend to result in rising property values, placing financial strain on low-income residents who experience escalating rents and service costs (Miller, 2019). Local businesses in these areas also face the risk of being gradually displaced (Serrano et al., 2023). Therefore, it is essential that investment and revitalization efforts in low-income neighbourhoods prioritize ensuring that all residents, especially the vulnerable ones, can enjoy the benefits.

While fear of gentrification may lead some to reject street improvement projects, prolonged disinvestment in low-income areas, along with neglect of streets and public spaces, can lead to urban decay and entrenched poverty (Miller, 2019). Consequently, while these apprehensions are valid, inaction is not the solution. Instead, urban planners and decision-makers should adopt equity-focused frameworks for interventions in these neighbourhoods, ensuring a better quality of life for all their population. This approach involves adopting a variety of strategies to mitigate the effects of gentrification and maintain affordable housing (Serrano et al., 2023; Van Tol, 2019). These can include policies regarding preservation and protection of affordable housing (e.g., legal protection), expanding affordable housing options (e.g., inclusionary zoning practices), stabilization initiatives (e.g., providing resources for more residents to become homeowners), and community engagement initiatives (e.g., involving citizens in decision-making) (Serrano et al., 2023).

In the Montreal context, initiatives like *Quartiers verts, actifs et en santé* (QVAS), and *Réseau quartier verts du Canada* (RQV) promote the development of sustainable and inclusive neighbourhoods that encourage active transportation (RQV, 2017; Rochette, 2015). These initiatives prioritize participatory planning, ensuring that marginalized and low-income communities have a voice in decision-making processes and advocating for policies to mitigate gentrification (RQV, 2017; Rochette, 2015). In that way, the city can improve streets while also creating policies to keep long-term residents in their neighbourhoods and maintain affordable housing.

As this study evaluates the built environment of streets across various socioeconomic neighbourhoods in Montreal, it recognizes the complex relationship between street enhancements and concerns regarding gentrification. To address these challenges, enhancing streets in Montreal requires planners and policymakers to adopt proactive strategies, such as equitable development frameworks, inclusive policymaking, and community engagement initiatives, as exemplified by programs like QVAS and RQV.

2.5. Tools for Measuring the Quality of Streets' Built Environment

Different tools and methodologies for assessing the quality of the built environment of streets have emerged in the literature, primarily involving observational audit surveys. One notable tool is the Microscale Audit of Pedestrian Streetscapes (MAPS), designed to evaluate the walkability of urban areas with a focus on elements conducive to physical activity (Cain et al., 2015). MAPS-Mini is derived from the broader 120-items MAPS tool and specifically targets microscale features related to pedestrian and cyclist experiences, facilitating the identification of easily modifiable attributes (Cain et al., 2015). It comprises an on-site auditing survey of 15 built environment features, including sidewalks, trees, crosswalks, benches, bicycle paths, etc., which can significantly enhance active transportation (Cain et al., 2015). By concentrating on the microscale of neighbourhoods, MAPS-Mini allows for the identification of features that are easy to modify and cost-effective, potentially leading to significant improvements when implemented extensively (Cain et al., 2015; Daley et al., 2022).

Avenue Greene Montreal

Although observational auditing tools for the built environment were originally designed for in-person field observations, recent studies have increasingly adapted them for virtual completion (Kurka et al., 2016; Steinmetz-Wood et al., 2019; Philips et al., 2017, McAndrews & Marshall, 2018; Miranda et al., 2021, Talen et al., 2023). These online audits utilize modified versions of the MAPS tools or other virtual auditing tools such as Virtual-STEPS, which draws inspiration from MAPS (Kurka et al., 2016; Steinmetz-Wood et al., 2019; Philips et al., 2017). Leveraging Google Earth's Aerial and Street View functions, online audits combine high-resolution imagery for comprehensive assessments (Kurka et al., 2016; Steinmetz-Wood et al., 2019; Philips et al., 2017). Research comparing in-person and online audit results consistently demonstrates extremely high levels of agreement between the two methods, indicating that virtual audits are reliable and valid (Kurka et al., 2016; Steinmetz-Wood et al., 2019; Philips et al., 2017). However, online assessments may exhibit slightly lower reliability when evaluating elements related to aesthetics, maintenance, and conditions due to temporal variation in the built environment (Steinmetz-Wood et al., 2019; Philips et al., 2017). Additionally, Google imagery provides distorted images of reality, as the images are captured with a wider angle than human vision and are not taken at human eye-level. Despite this, overall, online observation auditing tools are advantageous to use, as they present almost identical results to in-person ones, and they reduce costs, eliminate travel times, and enhance auditors' safety (Kurka et al., 2016; Steinmetz-Wood et al., 2019; Philips et al., 2017).

This study uses the MAPS-Mini tool due to its high relevance and systematic approach in evaluating the built environment of streets (See Appendix 1 for details). MAPS-Mini is useful in identifying elements that can be improved throughout the island of Montreal. Observational audit surveys can be conducted twice: once virtually, using Google Street View, and once through in-person site visits. A dual-method approach allows for a comprehensive analysis and comparison of the reliability of virtual versus in-person audits. Insightful commentary on the strengths and potential limitations of MAPS-Mini can highlight any discrepancies and nuances in the results. Ultimately, the study aims to present the most accurate evaluation of the quality of the built environment of streets.

3. Methodology

To address the research question, a mixed-methods approach, encompassing both quantitative and qualitative data collection and analysis, was employed. Data sources included the 2021 Census, Geographic Information System (GIS) files, Google Street View, Google Maps, and in-person site visits. A presence-based methodology using the MAPS-Mini tool was implemented to evaluate the built environment of various streets in Montreal. The results were then analyzed to assess the equity of street design across the different neighbourhoods in the city.

3.1. Selection of Streets to Study

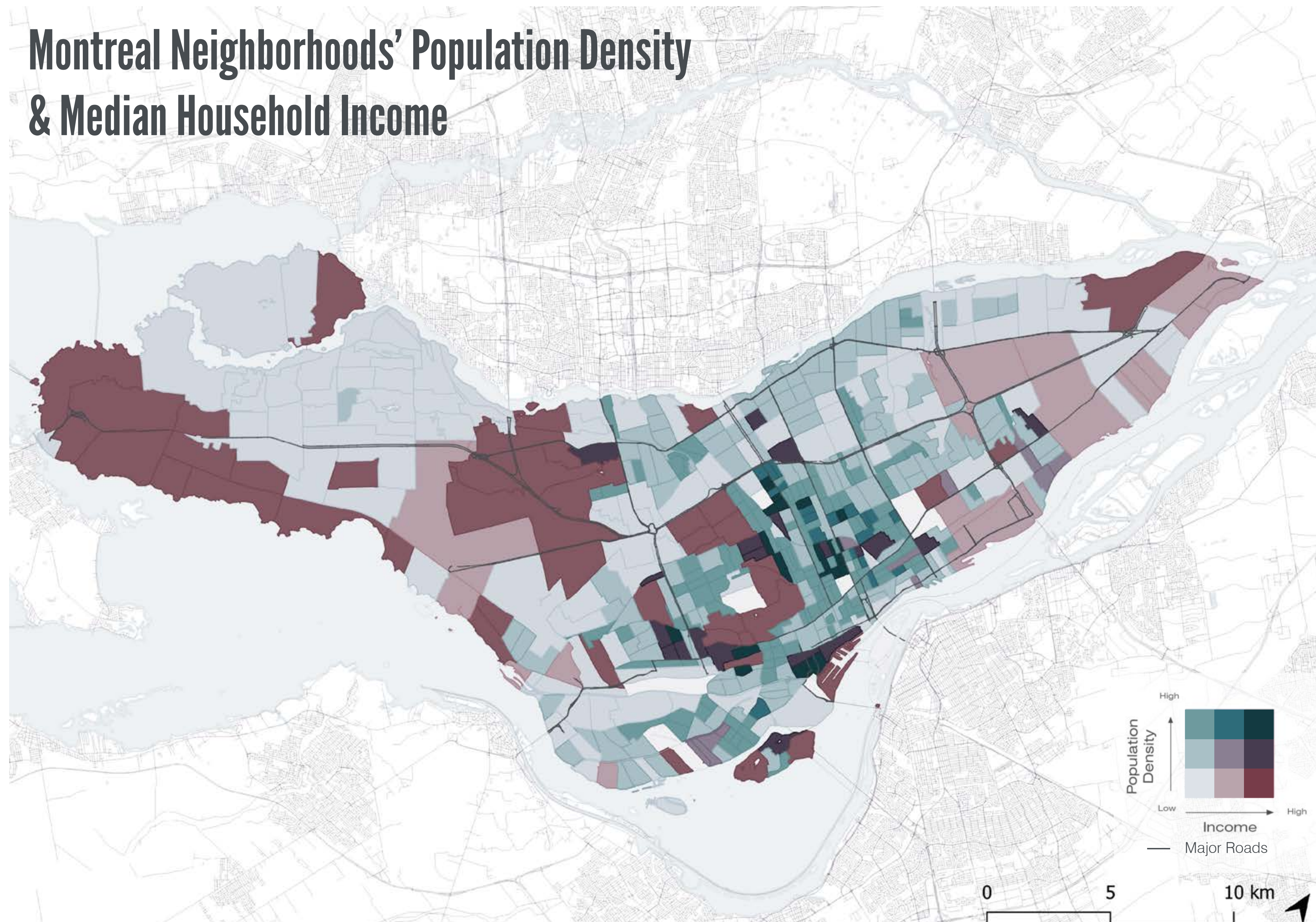
3.1.1. Selection of Neighbourhoods to Study

The selection of Montreal neighbourhoods for the study began with categorizing neighbourhoods into low, middle, or high-income groups using 2021 census data. In this context, neighbourhoods were defined as Montreal island's census tracts. Median household income categories were established as follows:

- Low income: Below 30,000$
  (including population without income)
- Middle income: Between 30,000-60,000$
- High income: Above 60,000$

The percentages of low, middle, and high-income households for each census tract were taken into consideration. Different income thresholds were tested to avoid disproportionate results. For instance, setting the low-income cut-off at 20,000$ only covered 22% of the population and skewed the higher income categories in an excessive manner. Ultimately, the distribution was as follows:

- Low income: 38%
- Middle income: 33%
- High income: 29%



Then, population density was calculated in GIS by dividing the total population of each census tract by its land area, and categorizing this information into three categories: low, medium, and high population density.

A bivariate map was created to cross-reference population density with income levels of each census tract, enabling the identification of neighbourhoods with similar population densities but varying income levels (See map on previous page). This method facilitated the selection of streets for comparative analysis.

3.1.2. Selection of Streets to Study

A GIS shapefile of streets in Montreal was juxtaposed with the bivariate map of the neighbourhoods. A total of 30 streets were selected for assessment and organized into sets of three streets each: one in a low-income neighbourhood, one in a middle-income neighbourhood and one in a high-income neighbourhood, all with the same population density. Streets in each combination were matched based on specific criteria to ensure comparability, including:

- Segment length: minimum 150 meters
- Street width: ± 2 meters
- Speed limit: Below 50km/h

The segment location was important, as it represented only a portion of certain very long streets that sometimes traverse multiple neighbourhoods with varying characteristics. When a combination of streets appeared to match on GIS, they were cross-referenced on Google Street View to ensure visual similarity in terms of composition and building density. Once selected, their locations were pinpointed in Google My Maps, and then exported to GIS for easier location.

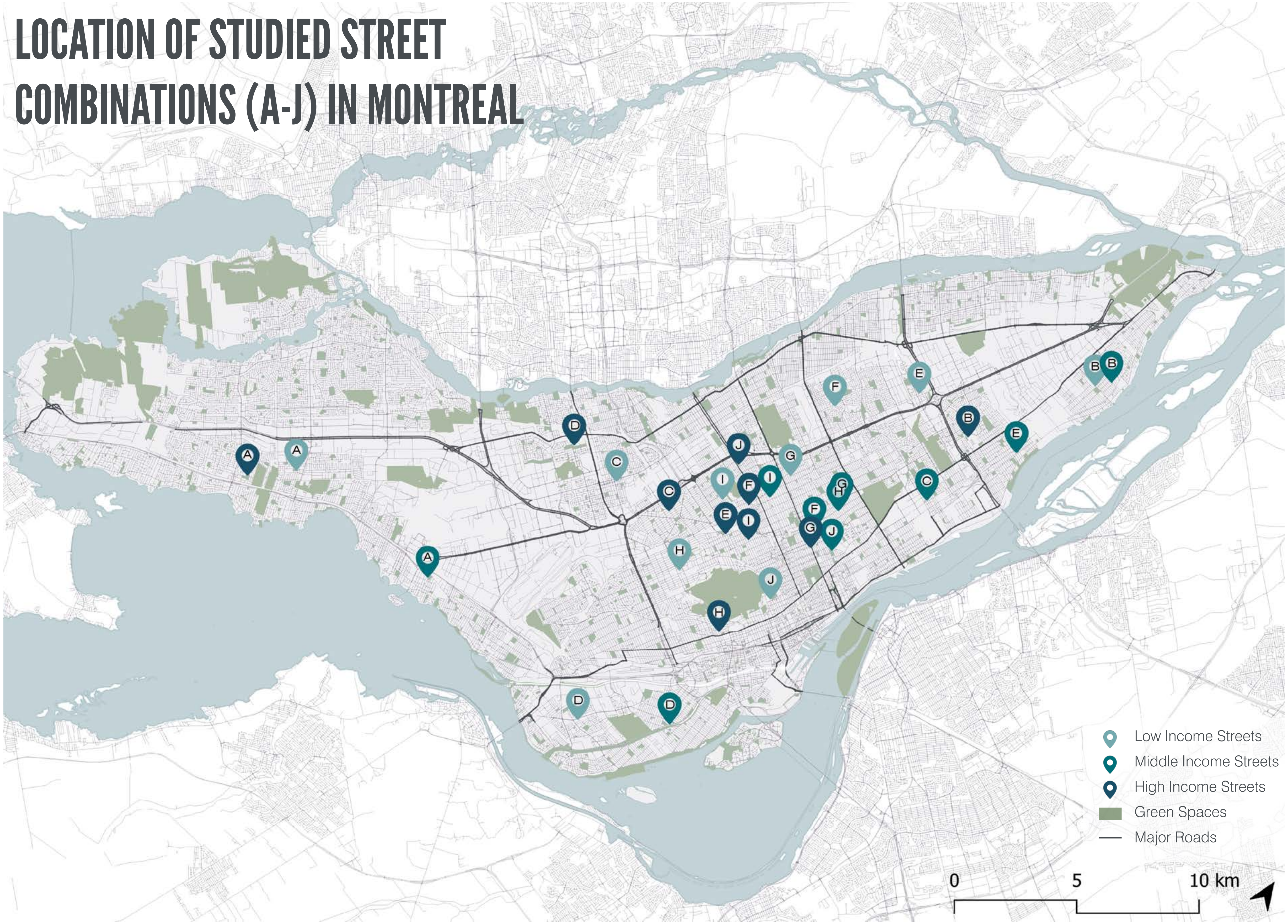
The selection process was iterative to identify the most suitable streets for each combination and ensure representation in every type of population density neighbourhoods. Each of the 10 combinations was assigned a letter (A-J) as an identifier.

The final street combinations included:

- 3 street combinations in neighbourhoods with low population density
- 3 street combinations in neighbourhoods with medium population density
- 4 street combinations in neighbourhoods with high population density

Rue Prince Arthur, Montreal

LOCATION OF STUDIED STREET COMBINATIONS (A-J) IN MONTREAL



Low density

A. Avenue Aurora
Avenue Tulip
Hardwood Gate

B. 8e Avenue
16e Avenue
Rue Honoré-Beaugrand

C. Boulevard Décarie
Rue Dickson
Boulevard Graham

Medium density

D. Boulevard Shevchenko
Avenue Brown
Boulevard Alexis Nihon

E. Boulevard des Galeries D'Anjou
Boulevard Pierre Bernard
Avenue Van Horne

F. Rue de Cluny
Avenue de Lorimier
Rue Clarke

High density

G. Rue Jean-Talon E
Boulevard St-Michel
Avenue Mont-Royal E

H. Chemin de la Côte-des-Neiges
Rue Masson
Avenue Greene

I. Avenue Bloomfield
Rue St-André
Avenue Durocher

J. Rue Prince Arthur
Rue Fullum
Rue Drolet

3.2. Study Design & Data Collection

3.2.1. Observational Audit Survey Review

The MAPS-Mini tool was selected as the observational audit survey to guide the assessment of the selected streets. Data was manually collected twice: once virtually using Google Street View, and once in person through site visits. The original MAPS-Mini tool's survey question list (Sallis, n.d.), available online, was used in this study. However, certain questions were modified to better align with the purpose and accuracy of this study (See Appendix 1 for details). The survey consisted of 15 questions, with scoring aligned with the original tool. This scoring system yielded a total score out of 21. The score was then converted out of a 100 and expressed as a percentage, which corresponded to a category indicating the quality of the built environment.

In the original MAPS-Mini, there were separate questions for the presence/absence of pedestrian walk signals and of marked crosswalks at street intersections. Given that some of the streets in this study were highly residential, one-way streets with low car speed limits, the presence of a walk signal seemed unnecessary. Thus, the MAPS-Mini question was modified to include any type of traffic-calming measure located on the street or at the intersections, such as stop signs, narrowed walkways, and speed bumps.

Additionally, the question regarding the presence or absence of public transit stops on the street segment was extended to also consider BIXI stations, given the context of Montreal. BIXI is a bike-sharing system that is available to Montreal residents as a popular alternative to other modes of transit such as the metro, commuter rails, the REM (Réseau express métropolitain), and buses.

3.2.2. Data Collection Using Google Street View

Virtual data collection took place at the end of March 2024 and throughout April 2024. The MAPS-Mini survey was conducted by navigating through Google Street View from the first to last intersection, as well as in the reverse direction. While some survey questions were straightforward to answer, others required careful judgement. In cases where evaluated street segments had more than two intersections, proportions were calculated to determine the presence of certain elements at 'one' or 'both' intersections. If over 50% of intersections featured the elements, they were classified as 'both' intersections, scoring more points. Google Maps aerial view aided in identifying transit stops along the studied streets. It is worth noting that public transportation stops on streets intersecting with the evaluated streets were excluded from the count, since they were not officially located 'on' the studied street. Aerial satellite imagery was also used to estimate the density of the tree canopy providing shade to active transportation users.

Regarding streetlights, up to 2 points could be allocated depending on whether there were 'some' or 'ample' lighting. In this study, it was interpreted as streetlights being present on both sides of the streets to illuminate the sidewalks or on only one side of the street. Moreover, parks located solely at the end of the studied streets, rather than along the pedestrian pathways, were disregarded. Finally, streets with minimal buffers, such as irregularly spaced small trees, were still considered as buffers despite offering limited additional safety from traffic.

3.2.3. Data Collection Using In-Person Site Visits

The in-person site visits took place from the end of April 2024 to the beginning of May 2024. These visits occurred during daylight hours (between 11am and 7pm) on days with similar sunny spring weather conditions. The site visits were conducted in an arbitrary order, not following specific street combinations, but rather focusing on visiting streets in relative proximity to each other. Thus, different areas of the island of Montreal containing the assessed streets were visited on different days.

In addition to conducting the MAPS-Mini survey, photographs were taken at pedestrian eye-level, representing a perspective more aligned with active transportation viewpoints compared to Google Street View imagery, which is captured from a vehicle and above human eye-level.

The decision-making process for answering survey questions during these site visits mirrored the one described for the Google Street View section. In addition, assessing the presence of marked crosswalks, faded paint was still considered if a clear indication of a painted crosswalk existed. This approach was reinforced by observing Montreal employees repainting crosswalks during travel to the site points. Furthermore, sidewalk maintenance concerning tripping hazards was evaluated based on the potential for individuals, including small children and those with limited mobility, to trip over cracks or experience difficulties navigating the environment.

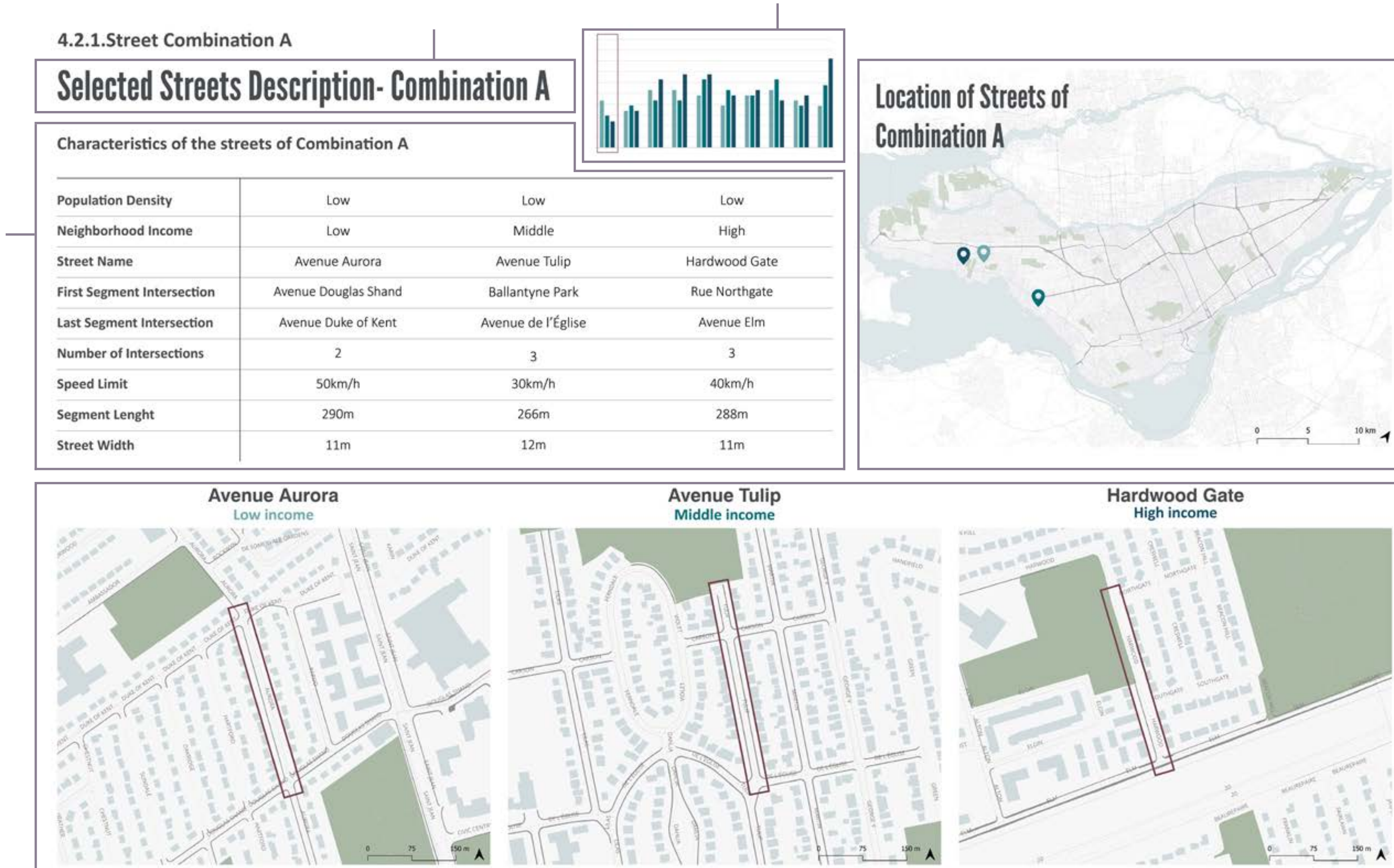
3.3. Mapping and Interpreting Results (Sample Page)

The findings from the observational audit surveys were aggregated and converted into percentages reflecting the quality of the built environment of streets from a microscale perspective. Maps depicting the context of the street segments and graphics displaying the survey results were generated and structured into descriptive sheets as outlined below:

The studied streets are divided into 10 combinations, each consisting of 3 streets that are directly compared. Each combination is assigned a letter for identification, ranging from A to J.

The table describes key characteristics of the selected streets within one combination:

-Population Density: Number of people living per km^2 within the neighborhood.
-Neighbourhood Income: Overall median household income of the neighborhood.
-Street Name: Street's proper designation.
-First and Last Segment Intersection: Names of the streets bounding the the studied streets.
-Number of Intersections: Number of streets crossing the studied streets. This number sometimes varies to ensure segments of similar length are compared.
-Speed Limit: Maximum car speed limited on the studied streets (between 30km/h and 50km/h).
-Segment Length: Length of studied streets (150 meters of more)
-Street Width: Width of the street, measured from one edge of the sidewalk to the other edge (± 2 meters).



Population Density	Low	Low	Low
Neighborhood Income	Low	Middle	High
Street Name	Avenue Aurora	Avenue Tulip	Hardwood Gate
First Segment Intersection	Avenue Douglas Shand	Ballantyne Park	Rue Northgate
Last Segment Intersection	Avenue Duke of Kent	Avenue de l'Église	Avenue Elm
Number of Intersections	2	3	3
Speed Limit	50km/h	30km/h	40km/h
Segment Lenght	290m	266m	288m
Street Width	11m	12m	11m

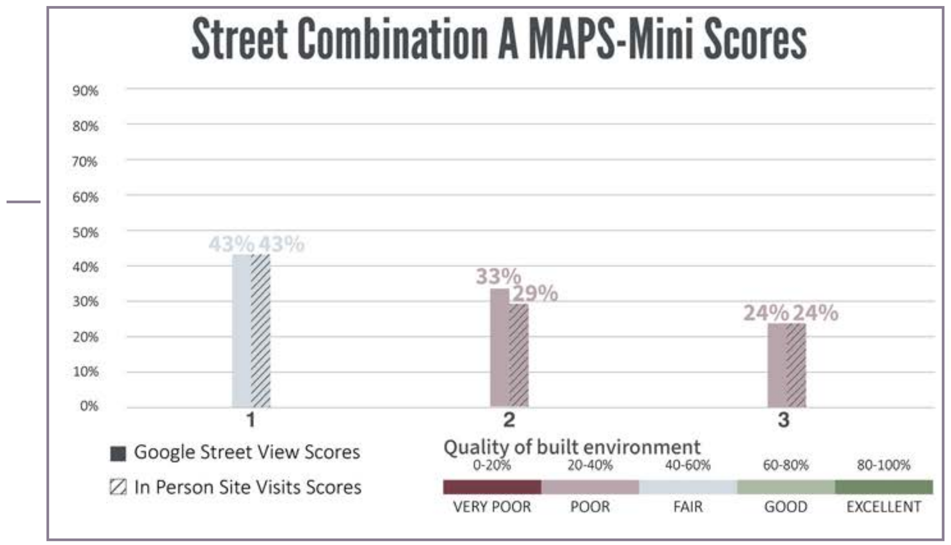
Evaluation of the street combination within the overall results.

The location of the streets in each combinaion situated within the island of Montreal. The pins are color-coded to match the neighbourhood income levels.

The local context and specific segment boundaries of the studied streets.

The results of the observational audit surveys are graphed out twice for each street within the combination, one being scores obtained from Google Street View and one from In-person site visits. Streets are referenced with numbers ranging from 1 to 3, following the order in which the streets are displayed in the pictures below and the increasing neighbourhood income-levels.

Reminder Map: The location of the streets in each combination situated within the Island of Montreal. The pins each represent a street within a combination and are color-coded to match the neighbourhood income levels.



The pictures show the streets that were observed.

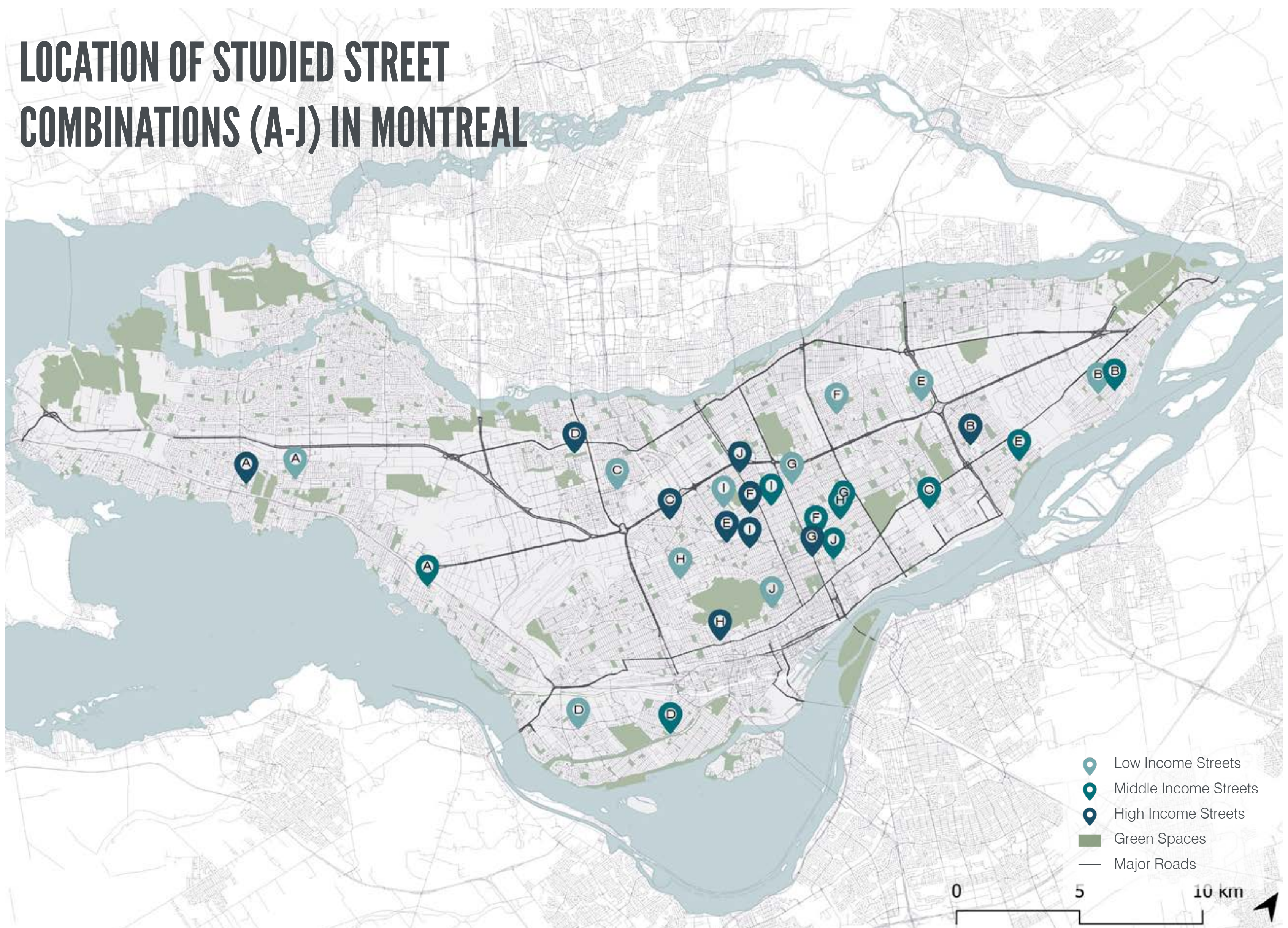
4. Results

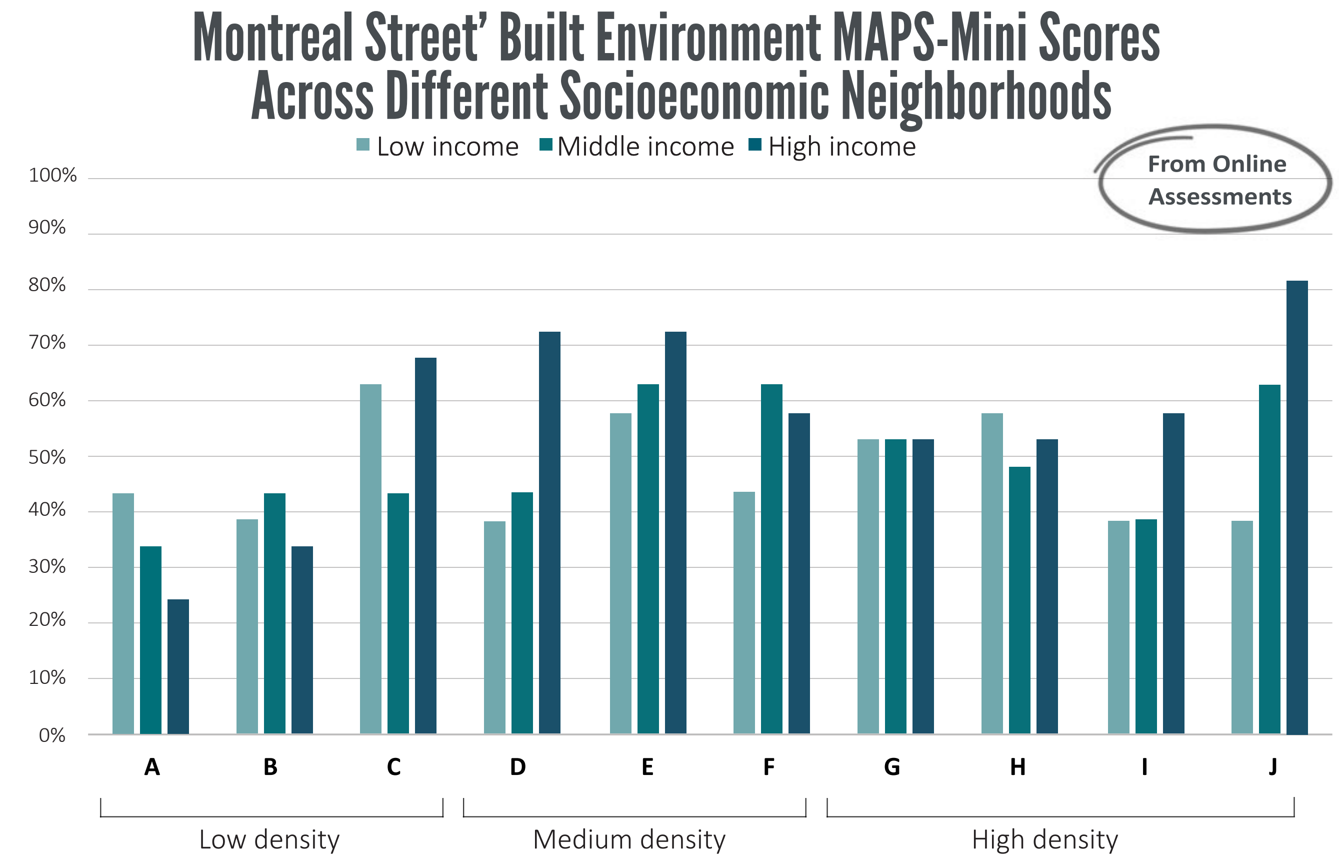
4.1. Results from the MAPS-Mini Street Assessment

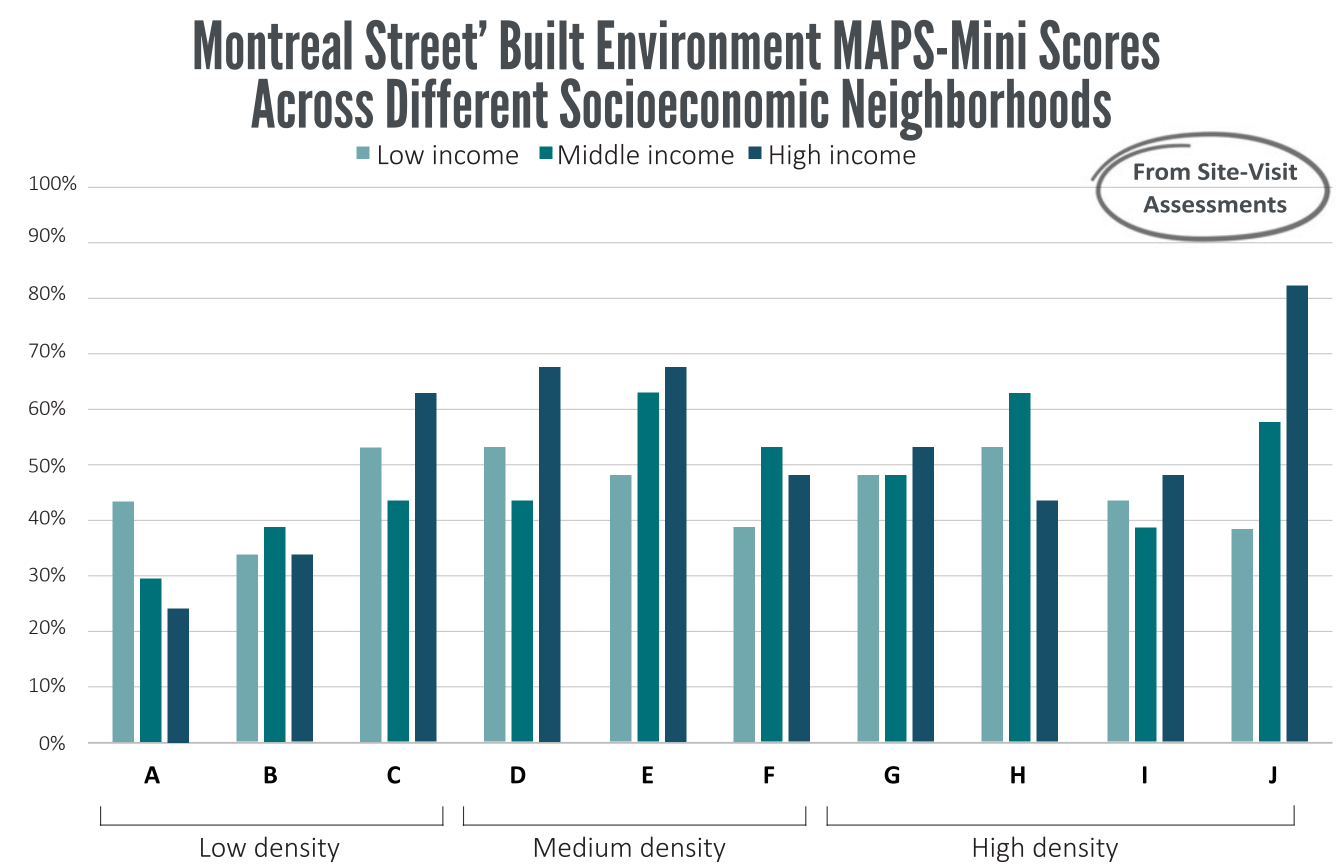
Using the MAPS-Mini tool, each evaluated street was assigned a score reflecting the quality of its built environment, ranging from 0% (very poor quality) to 100% (excellent quality). These individual scores were analysed among street combinations.

4.1.1. Street Combination Scores Comparison

Across online and in-person assessment, comparative analysis of scores for low, middle, and high-income streets revealed notable variations. Generally, low-income streets had built environments that scored equal to or lower than their counterparts. The only







exceptions to this trend were street combination A (both through Google Street View and site visits) and street combination H (only through Google Street View). Overall, most scores tended to decrease with in-person site visits. A lot of scores remained the same through both assessments. However, there were three instances where scores increased from online assessments to in-person assessments: low-income Boulevard Shevchenko (street combination D) and Avenue Bloomfield (street combination I), as well as middle-income Rue Masson (street combination H).

4.2. Individual Street Combinations Results

In the next section, the findings for each street combination are presented and showcase variations in scores for same street typologies across different socioeconomic neighbourhoods.

Boulevard Shevchenko, Google Street View

Boulevard Shevchenko, Site Visit

Avenue Bloomfield, Google Street View

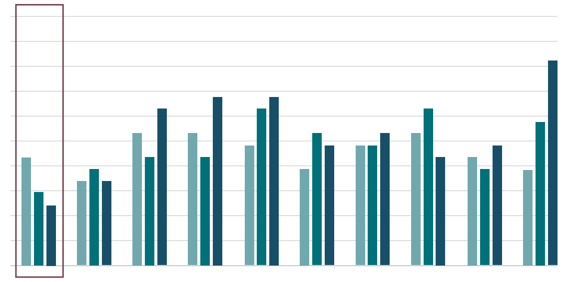
Avenue Bloomfield, Site Visit

Rue Masson, Google Street View

Rue Masson, Site Visit

4.2.1.Street Combination A

Selected Streets Description- Combination A

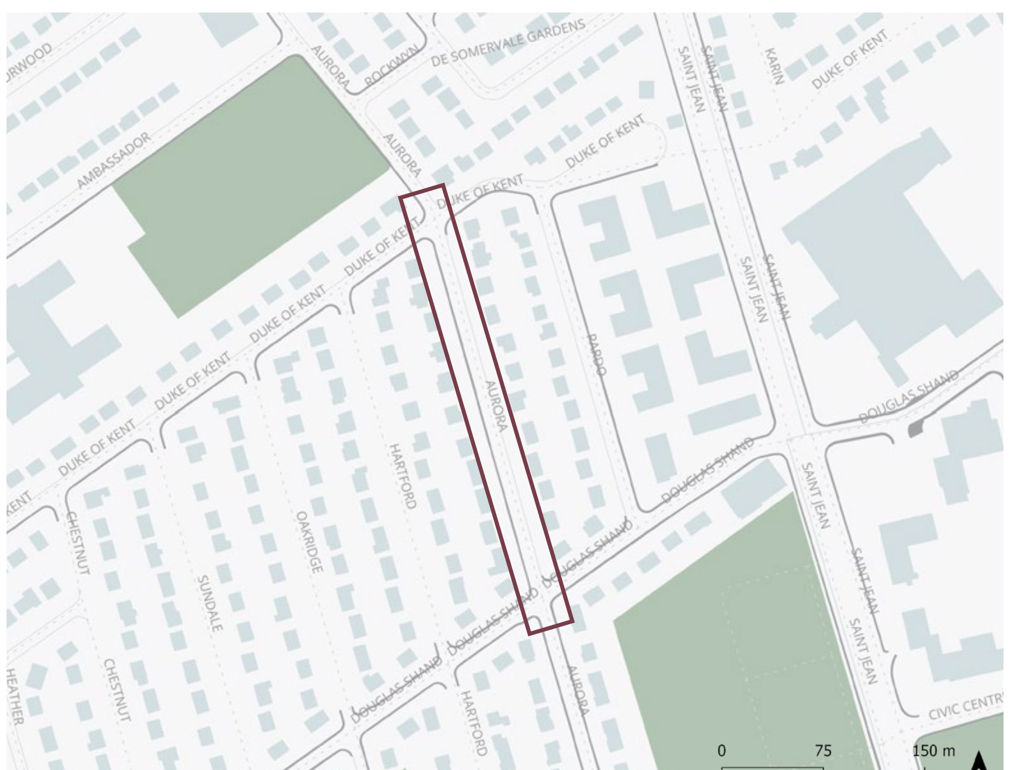


Characteristics of the streets of Combination A

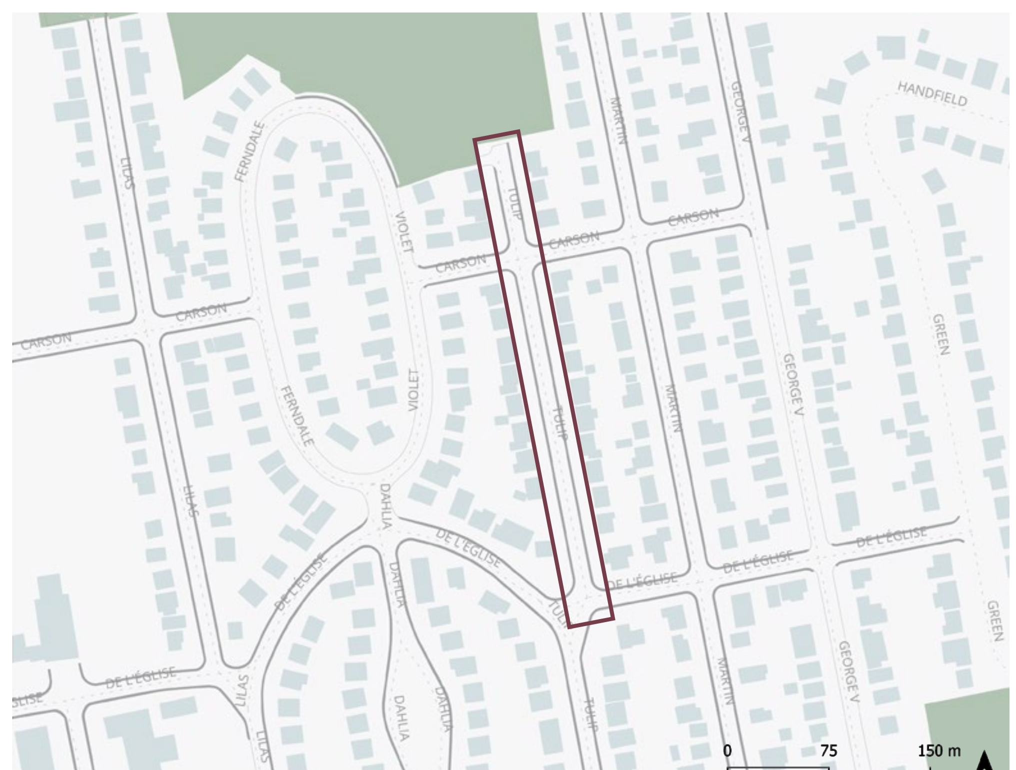
Population Density	Low	Low	Low
Neighborhood Income	Low	Middle	High
Street Name	Avenue Aurora	Avenue Tulip	Hardwood Gate
First Segment Intersection	Avenue Douglas Shand	Ballantyne Park	Rue Northgate
Last Segment Intersection	Avenue Duke of Kent	Avenue de l'Église	Avenue Elm
Number of Intersections	2	3	3
Speed Limit	50km/h	30km/h	40km/h
Segment Lenght	290m	266m	288m
Street Width	11m	12m	11m

Location of Streets of Combination A

Avenue Aurora
Low income



Avenue Tulip
Middle income



Hardwood Gate
High income

Street Combination A MAPS-Mini Scores

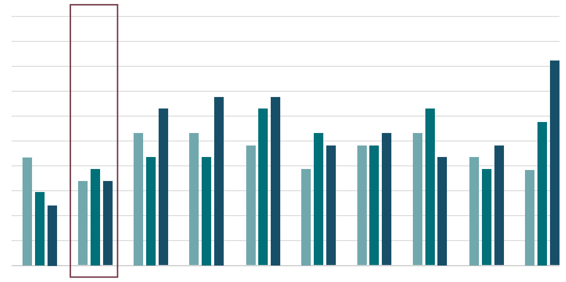
1.Avenue Aurora
Low income

2.Avenue Tulip
Middle income

3.Hardwood Gate
High income

4.2.2.Street Combination B

Selected Streets Description- Combination B



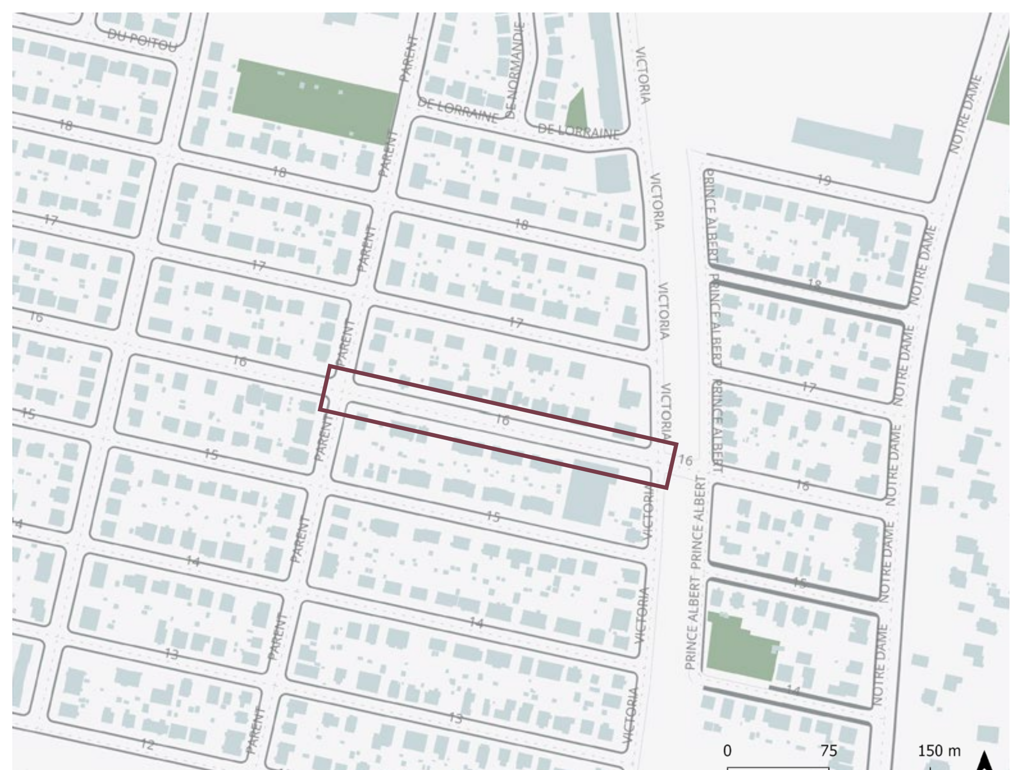
Characteristics of the streets of Combination B

Population Density	Low	Low	Low
Neighborhood Income	Low	Middle	High
Street Name	8e Avenue	16e Avenue	Rue Honoré-Beaugrand
First Segment Intersection	Rue René-Levesque	Rue Parent	Place Honoré-Beaugrand (1)
Last Segment Intersection	Rue de la Gauchetière	Rue Victoria	Place Honoré-Beaugrand (2)
Number of Intersections	2	2	2
Speed Limit	30km/h	50km/h	50km/h
Segment Lenght	240m	239m	221m
Street Width	15m	15m	14m

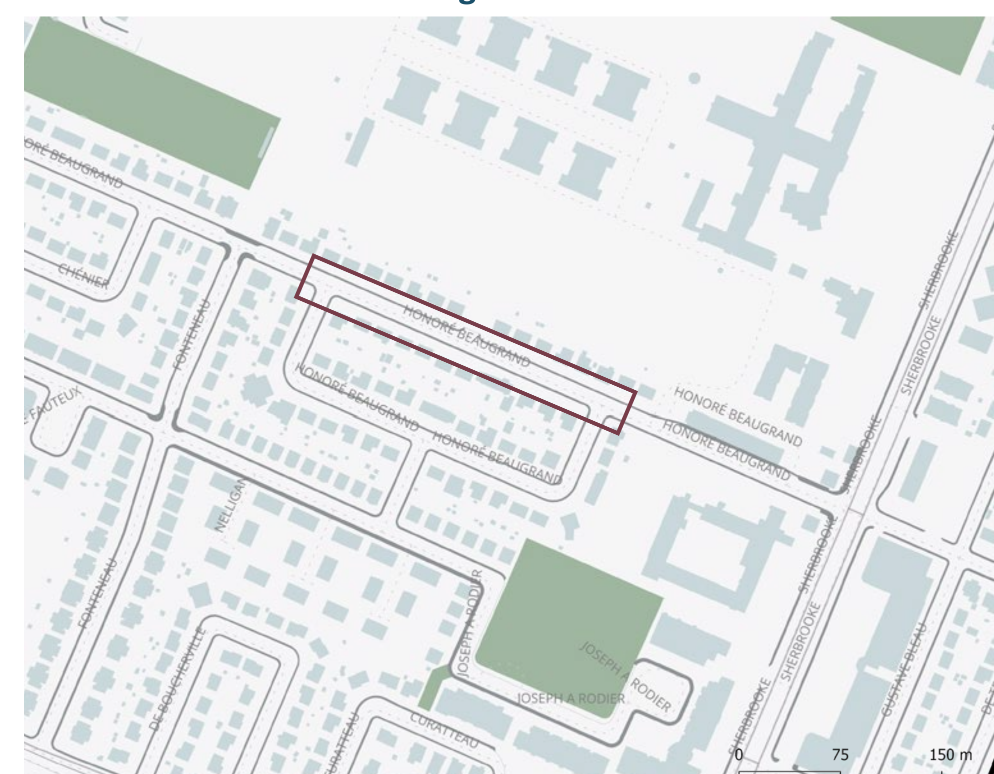
Location of Streets of Combination B

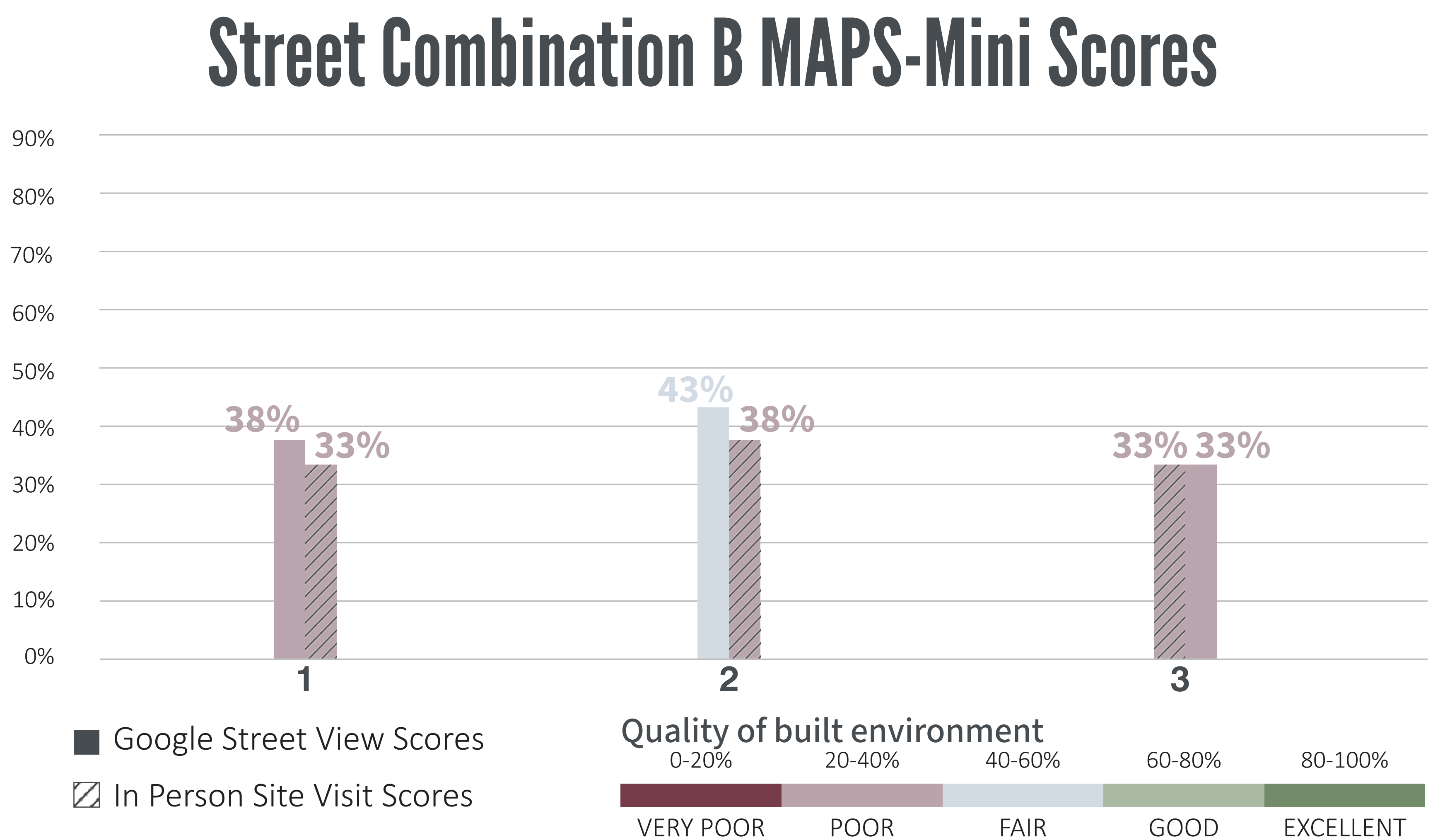
8e Avenue
Low income

16e Avenue
Middle income



Rue Honoré-Beaugrand
High income

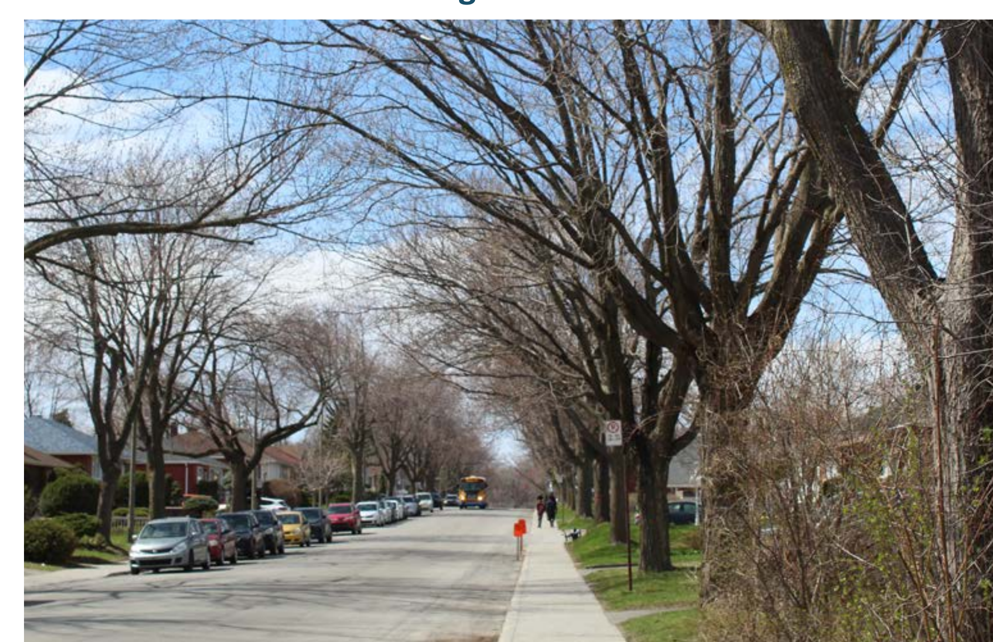




1.8e Avenue
Low income

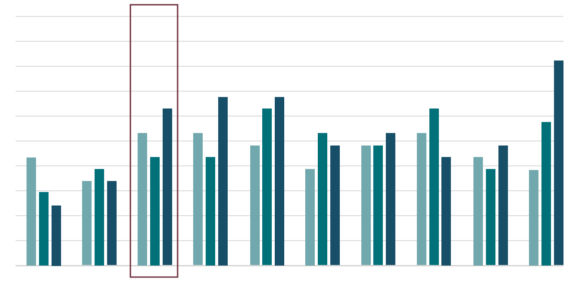
2.16e Avenue
Middle income

3.Rue Honoré-Beaugrand
High income



4.2.3.Street Combination C

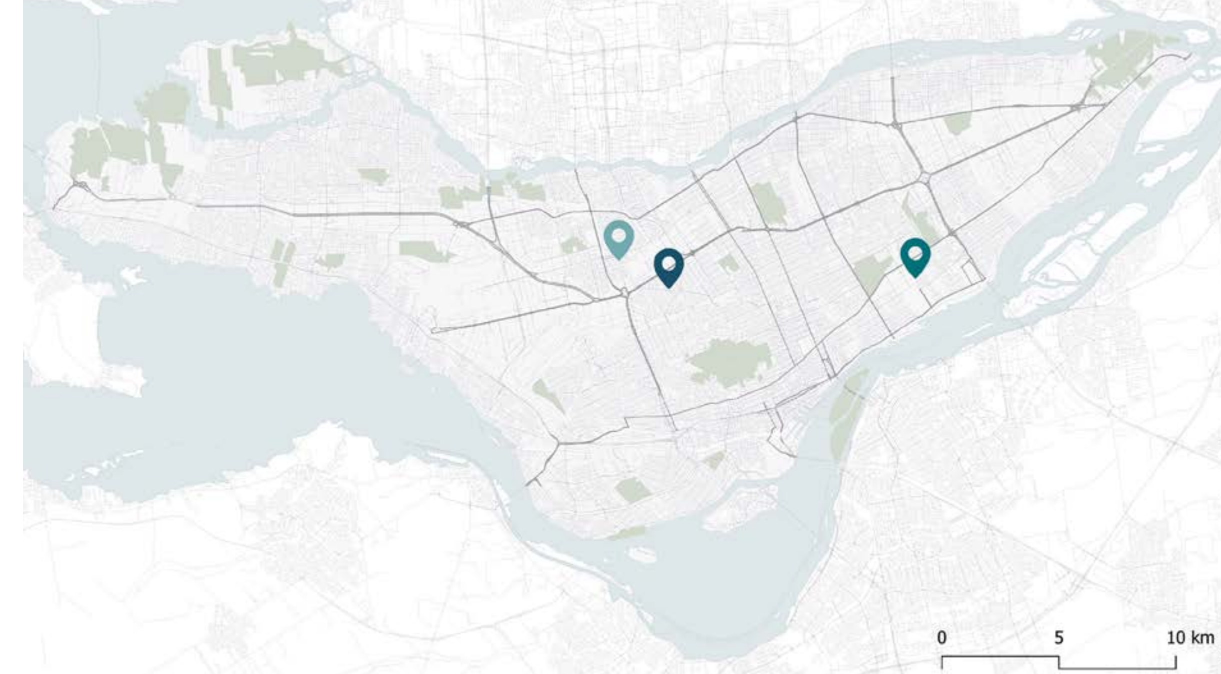
Selected Streets Description- Combination C



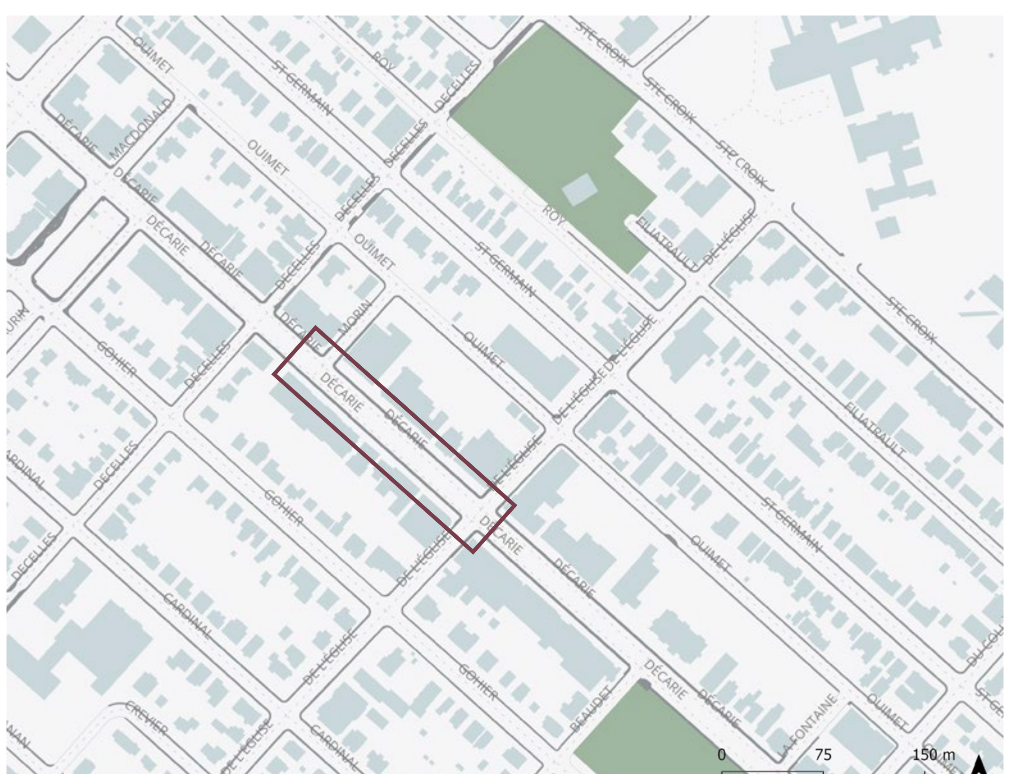
Characteristics of the streets of Combination C

Population Density	Low	Low	Low
Neighborhood Income	Low	Middle	High
Street Name	Boulevard Décarie	Rue Dickson	Boulevard Graham
First Segment Intersection	Rue Morin	Rue Desaulniers	Avenue Kindersley
Last Segment Intersection	Rue de l'Église	Rue Hochelaga	Croissant Lombard
Number of Intersections	2	2	2
Speed Limit	50km/h	40km/h	30km/h
Segment Lenght	158m	172m	185m
Street Width	22m	21m	23m

Location of Streets of Combination C

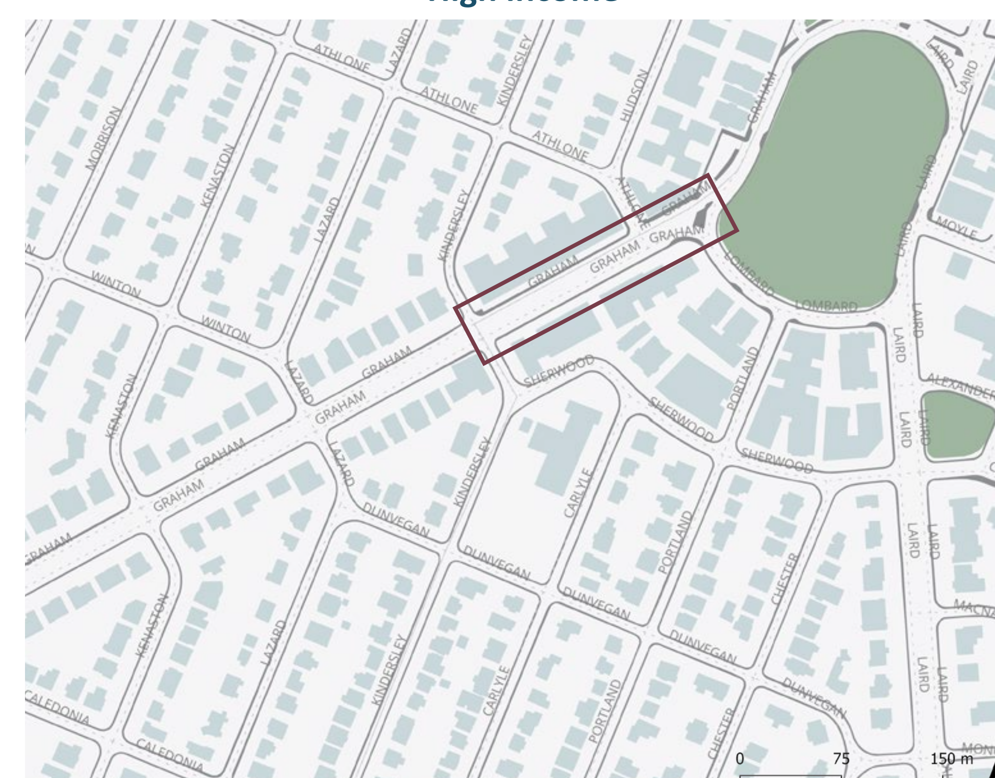


Boulevard Décarie
Low income

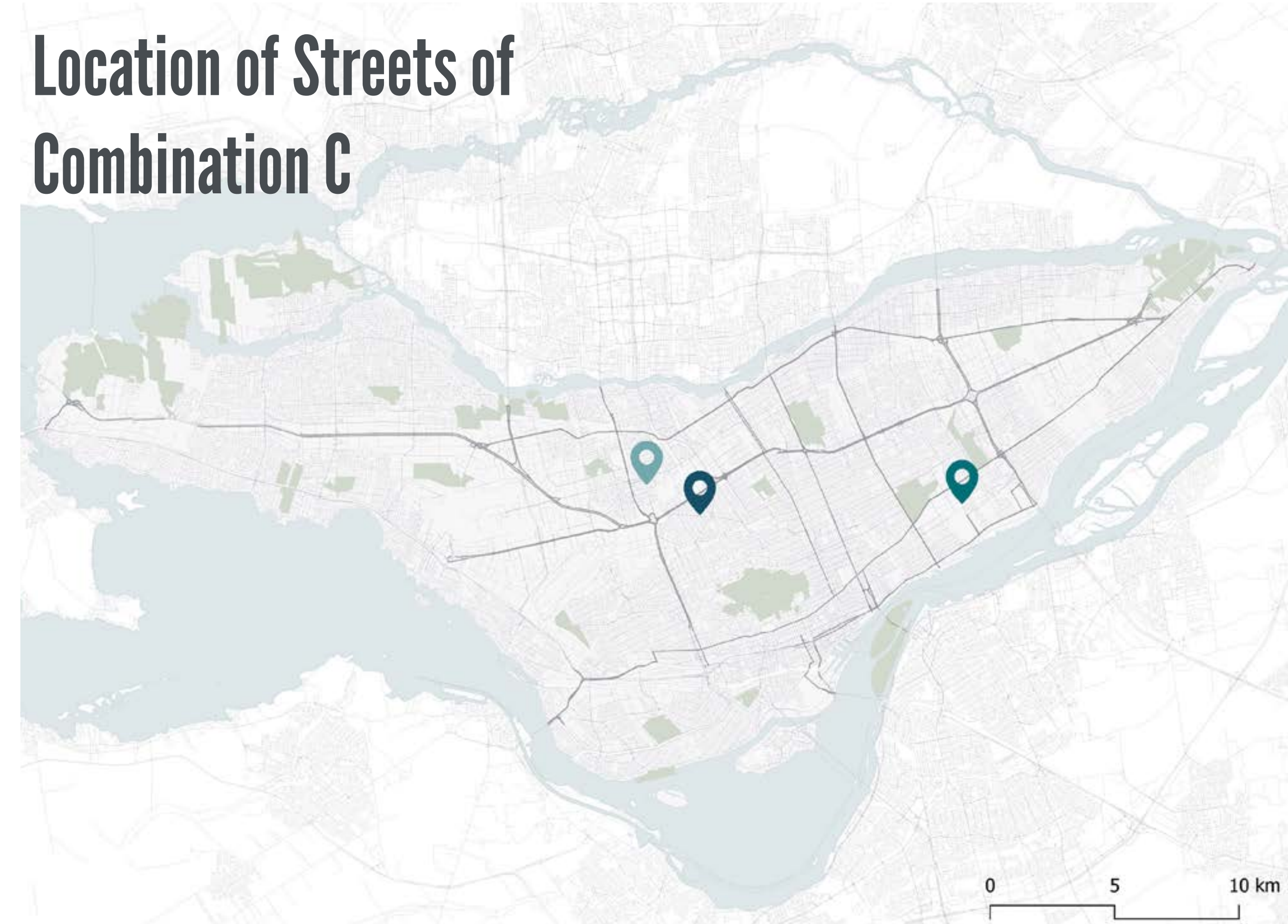


Rue Dickson
Middle income

Boulevard Graham
High income



Street Combination C MAPS-Mini Scores



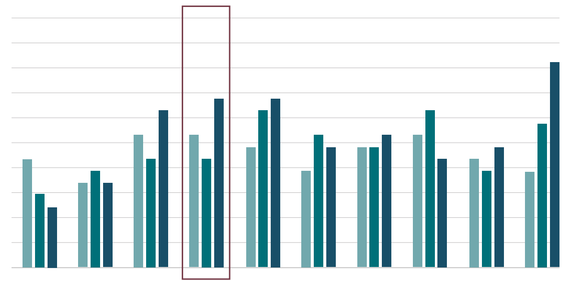
1.Boulevard Décarie
Low income

2.Rue Dickson
Middle income

3.Boulevard Graham
High income

4.2.4.Street Combination D

Selected Streets Description- Combination D

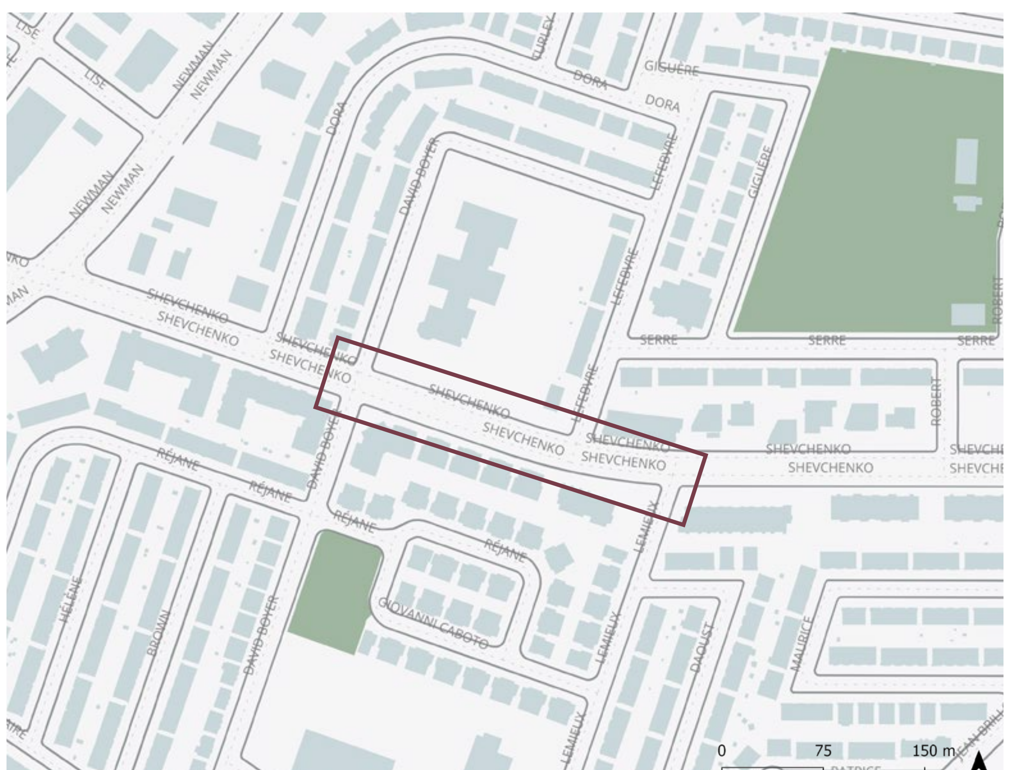


Characteristics of the streets of Combination D

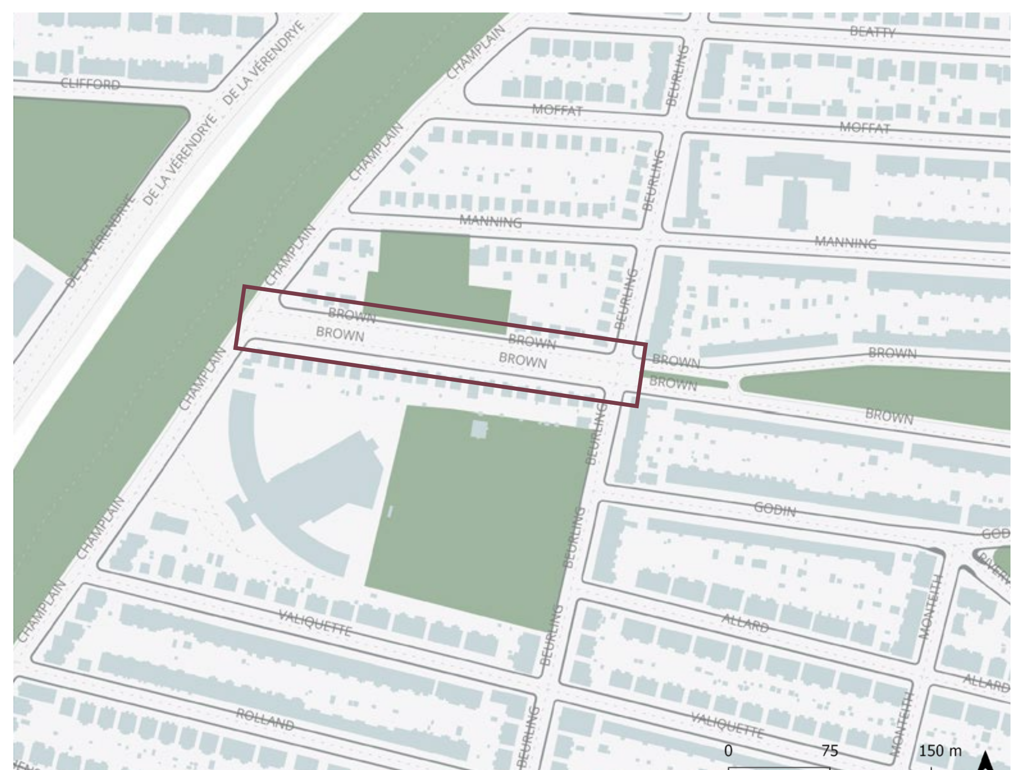
Population Density	Medium	Medium	Medium
Neighborhood Income	Low	Middle	High
Street Name	Boulevard Shevchenko	Avenue Brown	Boulevard Alexis Nihon
First Segment Intersection	Rue Lemieux	Rue Beurling	Rue des Nations
Last Segment Intersection	Rue David-Boyer	Boulevard Champlain	Rue Charles Darwin
Number of Intersections	2	3	4
Speed Limit	30km/h	30km/h	40km/h
Segment Lenght	246m	269m	273m
Street Width	28m	27m	28m

Location of Streets of Combination D

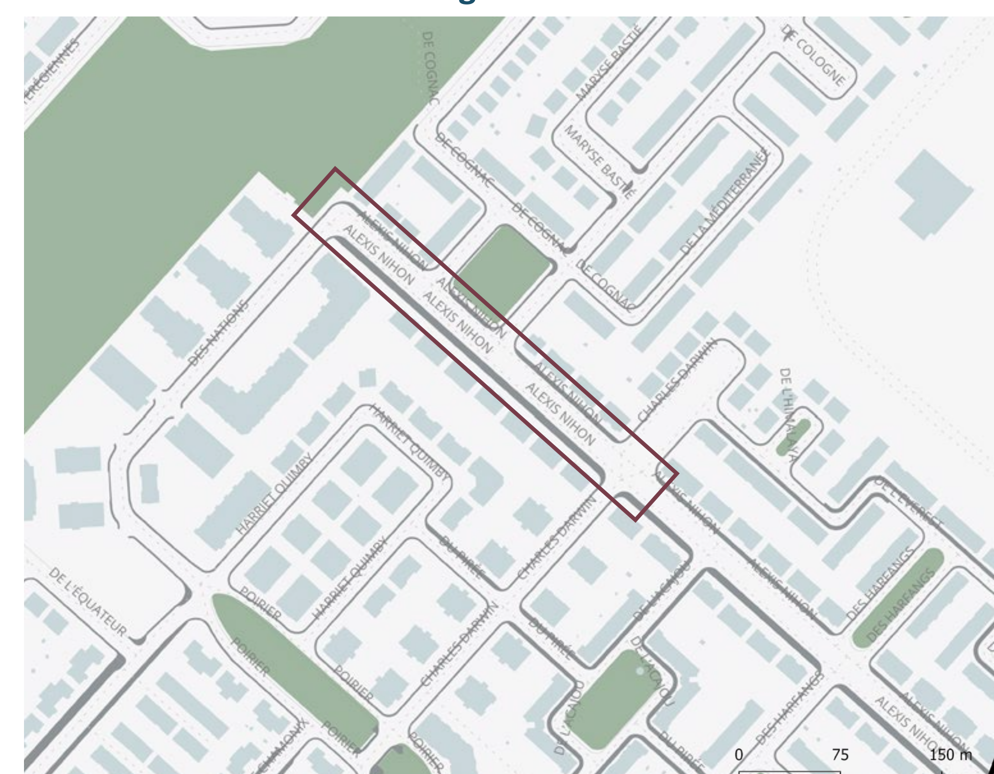
Boulevard Shevchenko
Low income



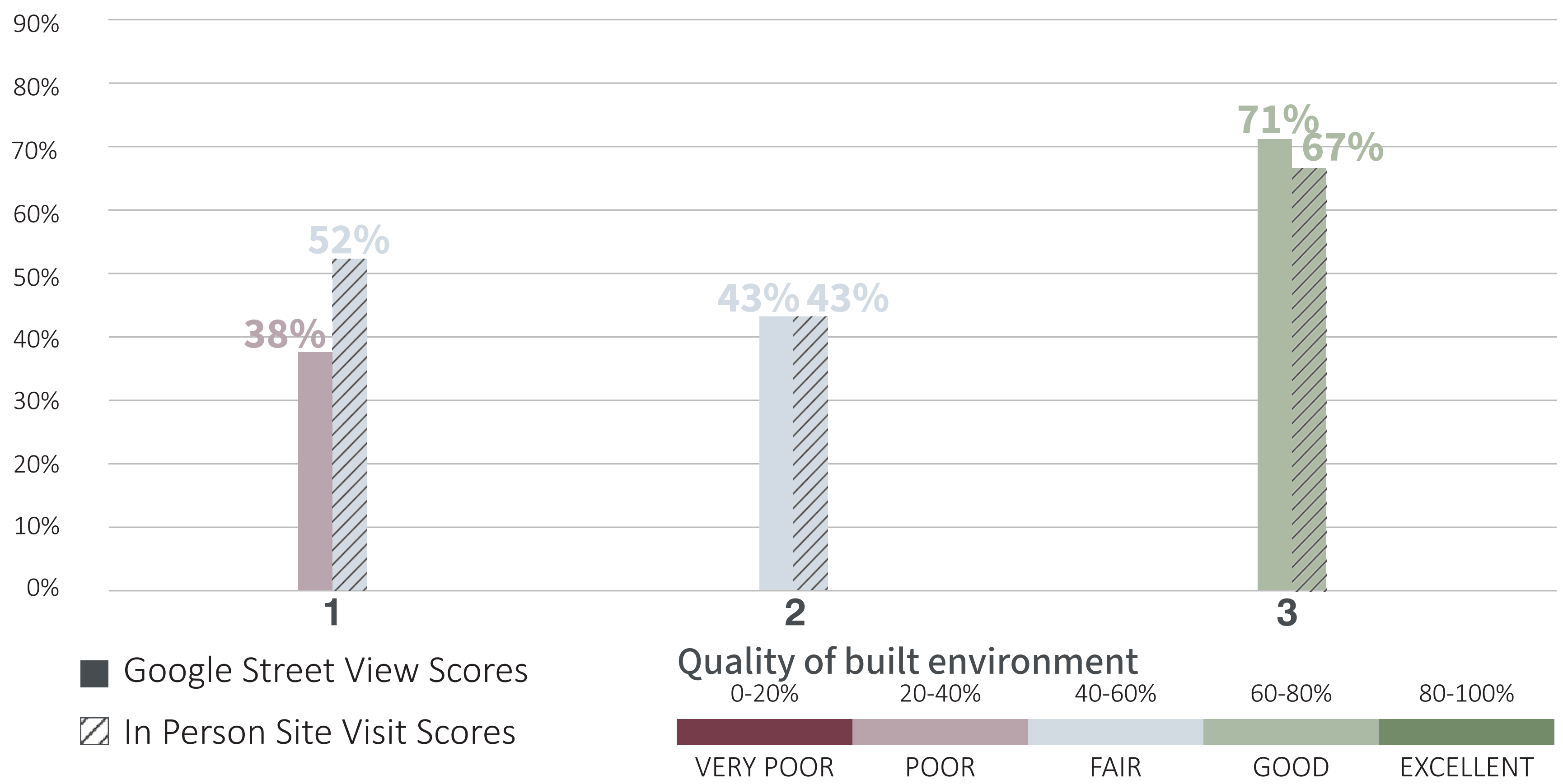
Avenue Brown
Middle income



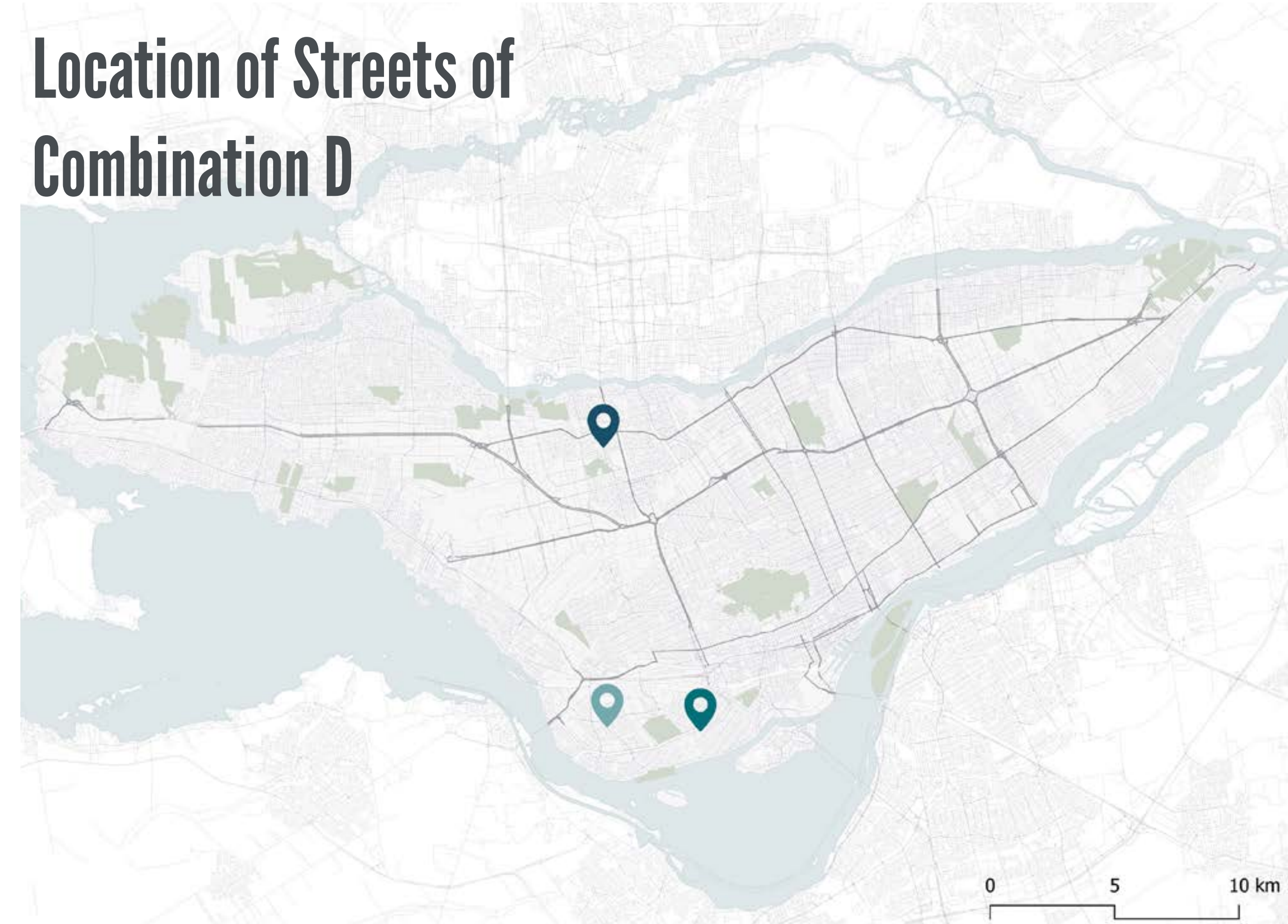
Boulevard Alexis Nihon
High income



Street Combination D MAPS-Mini Scores



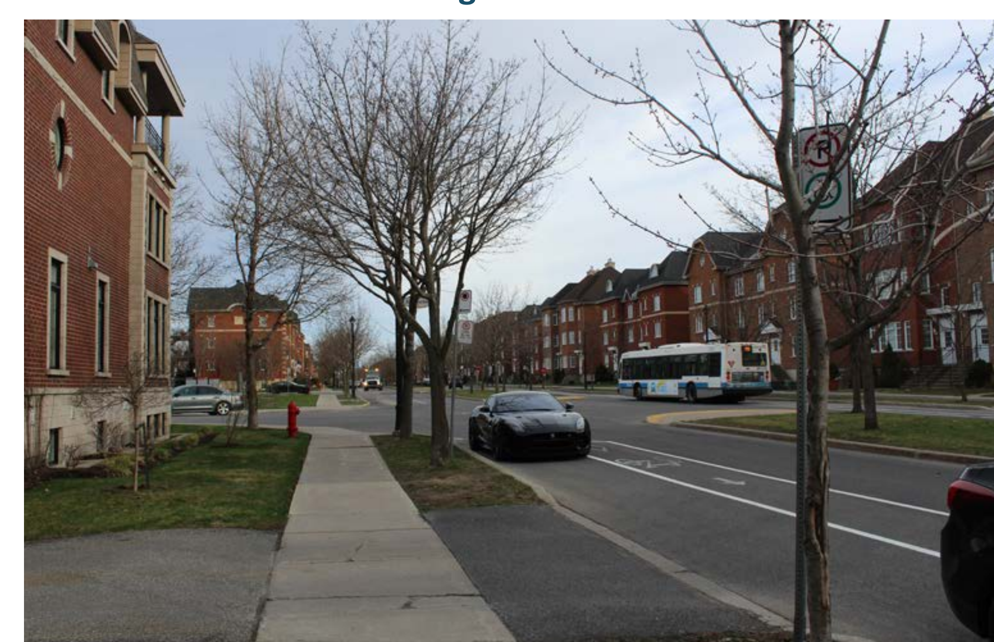
Location of Streets of Combination D



1.Boulevard Shevchenko
Low income

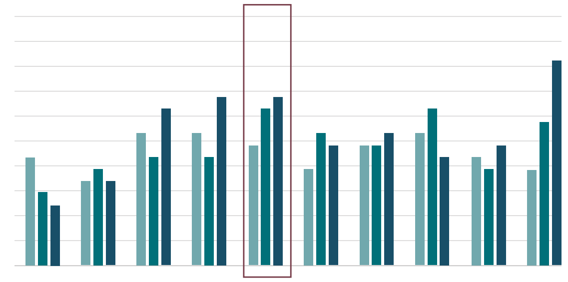
2.Avenue Brown
Middle income

3.Boulevard Alexis Nihon
High income



4.2.5.Street Combination E

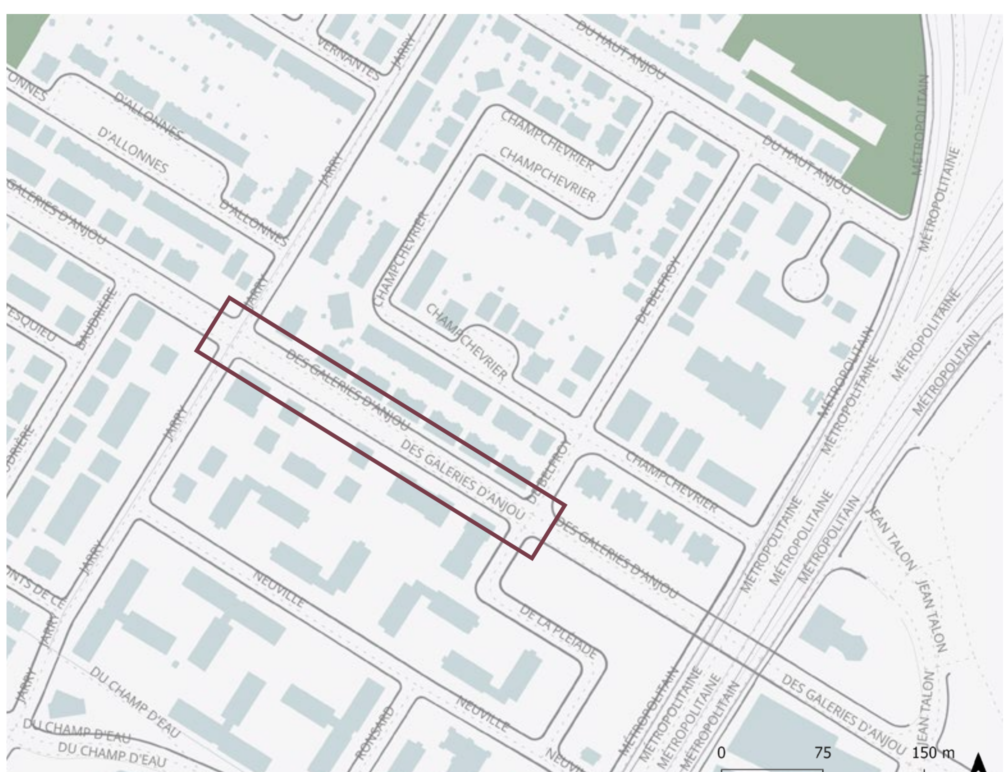
Selected Streets Description- Combination E



Characteristics of the streets of Combination E

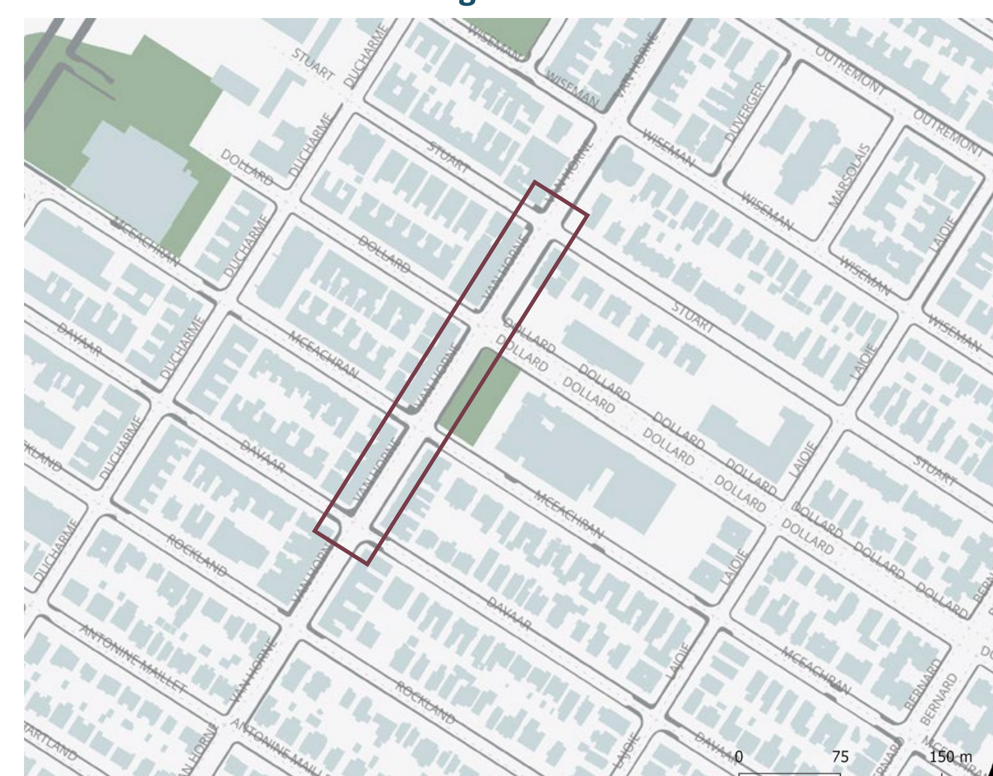
Population Density	Medium	Medium	Medium
Neighborhood Income	Low	Middle	High
Street Name	Boulevard des Galeries d'Anjou	Boulevard Pierre Bernard	Avenue Van Horne
First Segment Intersection	Rue Jarry	Rue Notre-Dame E	Avenue Stuart
Last Segment Intersection	Avenue de Belfroy	Avenue Dubuisson	Avenue Davaar
Number of Intersections	2	2	4
Speed Limit	50km/h	50km/h	50km/h
Segment Lenght	254m	272m	258m
Street Width	21m	21m	20m

Boulevard des Galeries d'Anjou
Low income



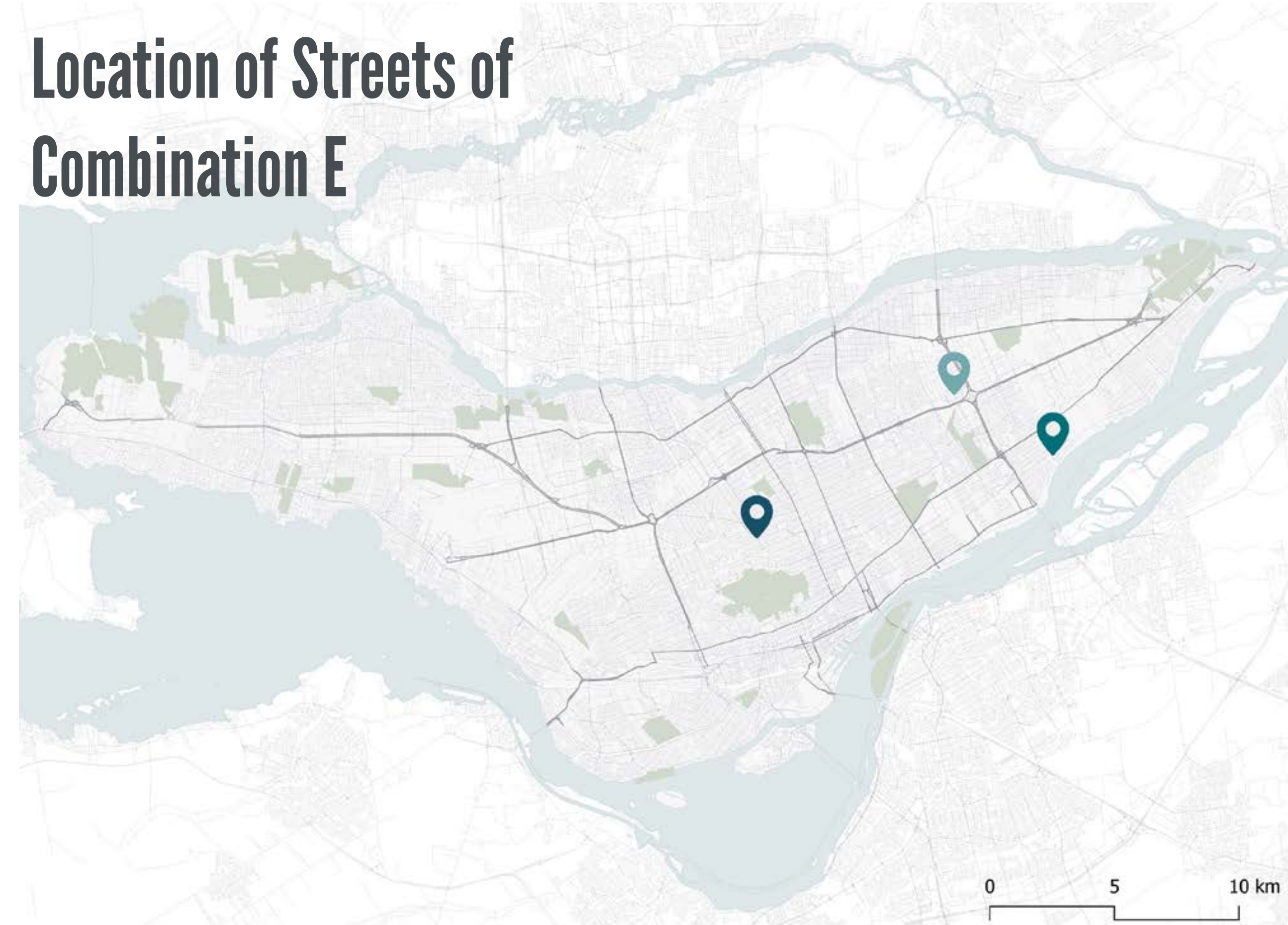
Boulevard Pierre Bernard
Middle income

Avenue Van Horne
High income



Street Combination E MAPS-Mini Scores

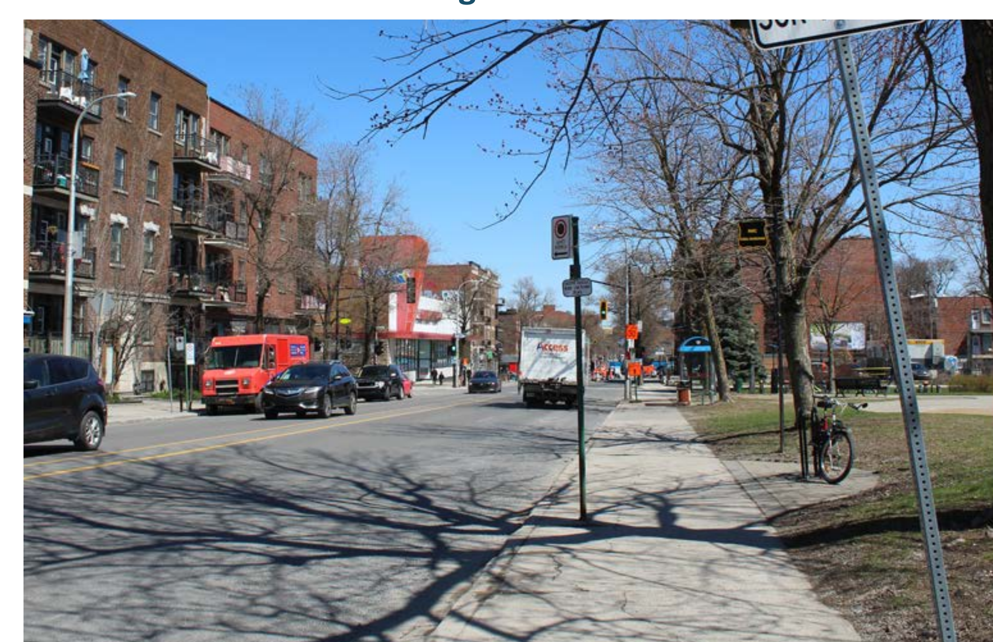
Location of Streets of Combination E



1.Boulevard des Galeries d'Anjou
Low income

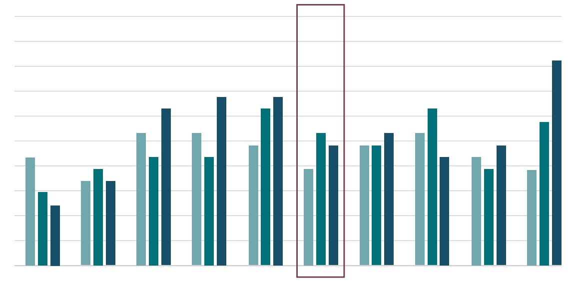
2.Boulevard Pierre Bernard
Middle income

3.Avenue Van Horne
High income



4.2.6.Street Combination F

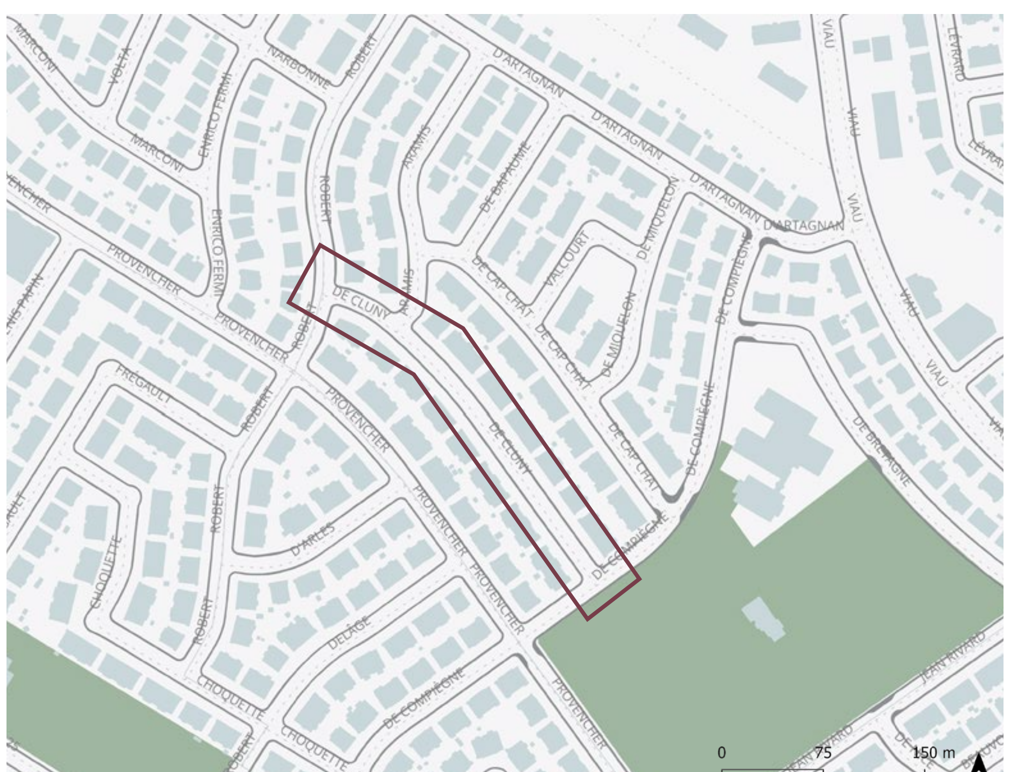
Selected Streets Description- Combination F



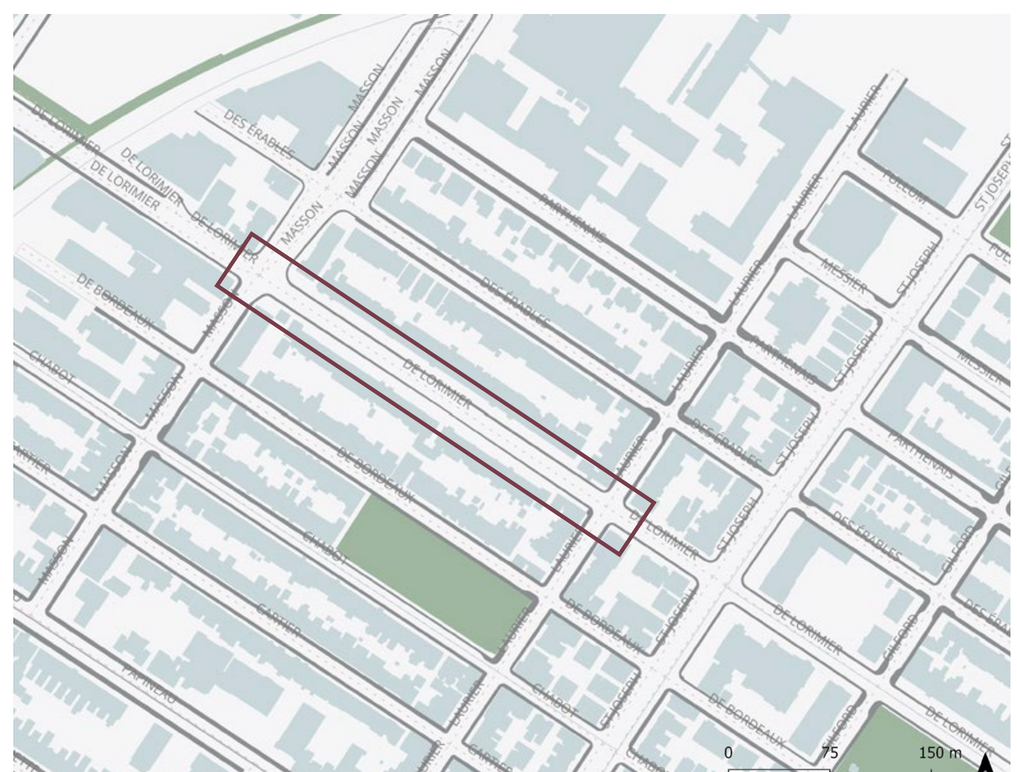
Characteristics of the streets of Combination F

Population Density	Medium	Medium	Medium
Neighborhood Income	Low	Middle	High
Street Name	Rue de Cluny	Avenue de Lorimier	Rue Clark
First Segment Intersection	Rue de Compiègne	Avenue Laurier E	Avenue Mozart O
Last Segment Intersection	Boulevard Robert	Rue Masson	Rue St-Zotique O
Number of Intersections	2	2	2
Speed Limit	50km/h	50km/h	50km/h
Segment Lenght	302m	308m	279m
Street Width	16m	16m	17m

Rue de Cluny
Low income

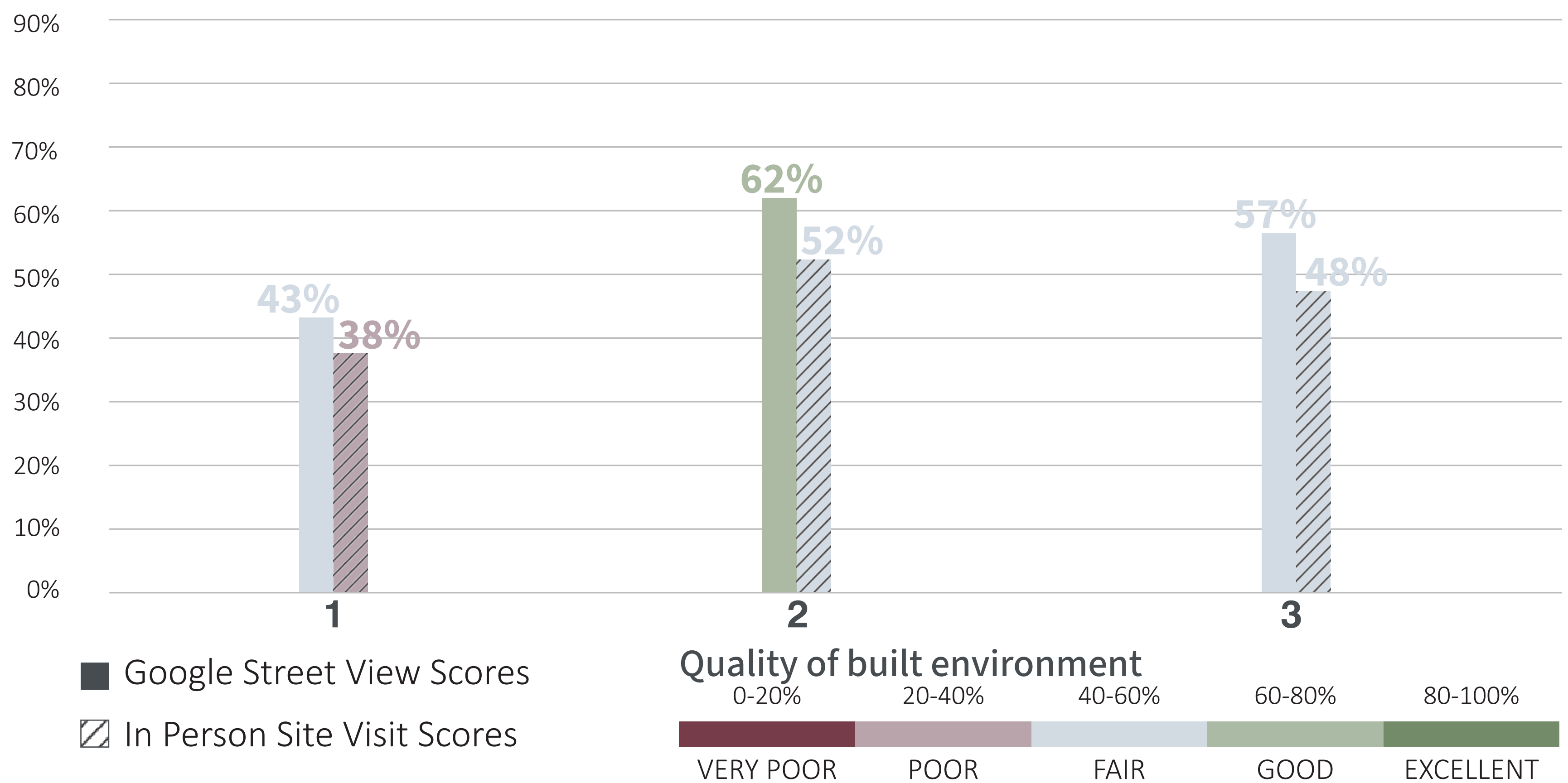


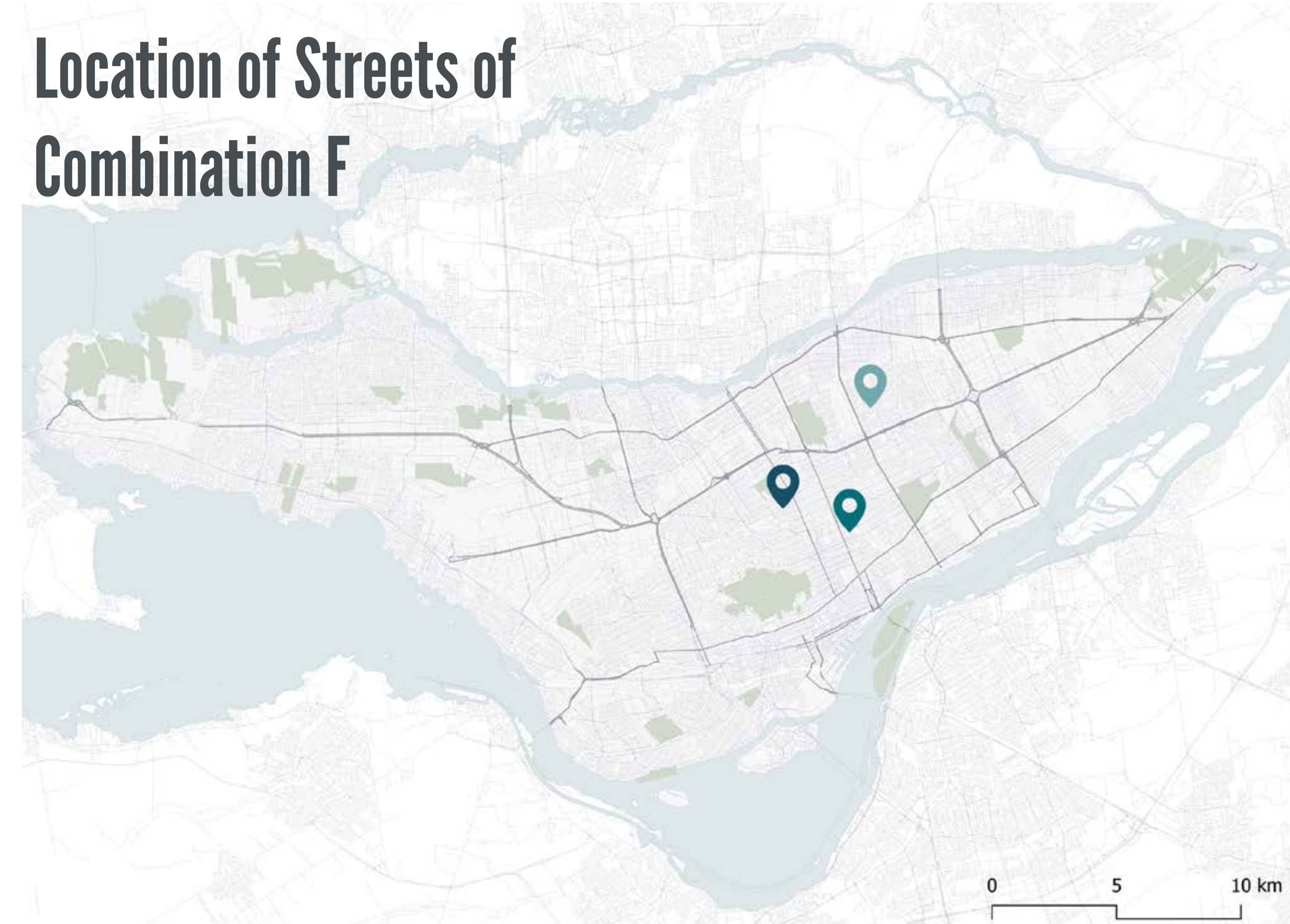
Avenue de Lorimier
Middle income



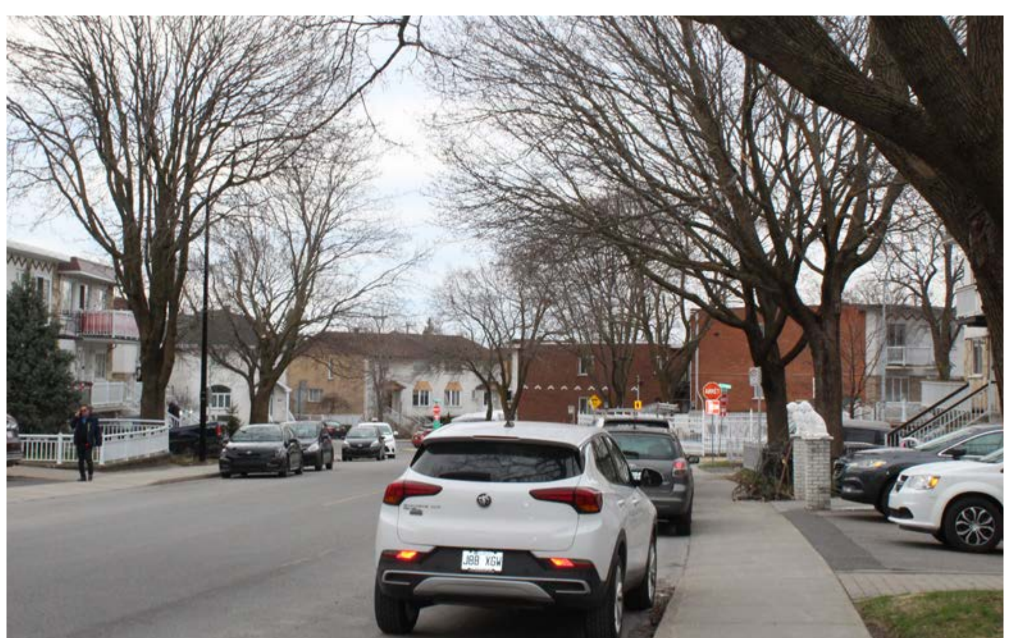
Rue Clark
High income

Street Combination F MAPS-Mini Scores



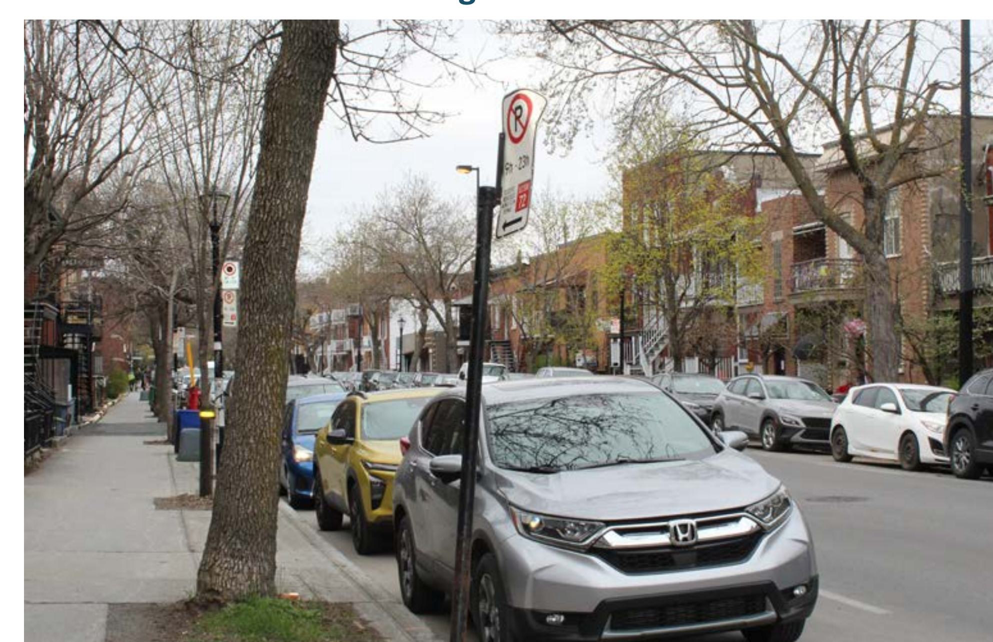


1.Rue de Cluny
Low income



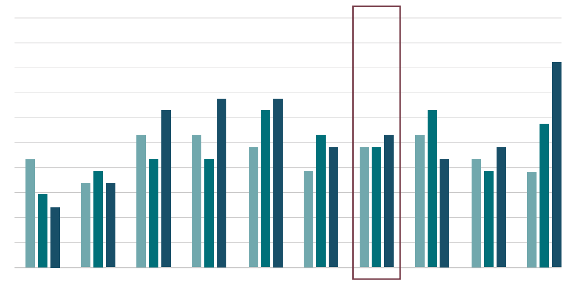
2.Avenue de Lorimier
Middle income

3.Rue Clark
High income



4.2.7.Street Combination G

Selected Streets Description- Combination G



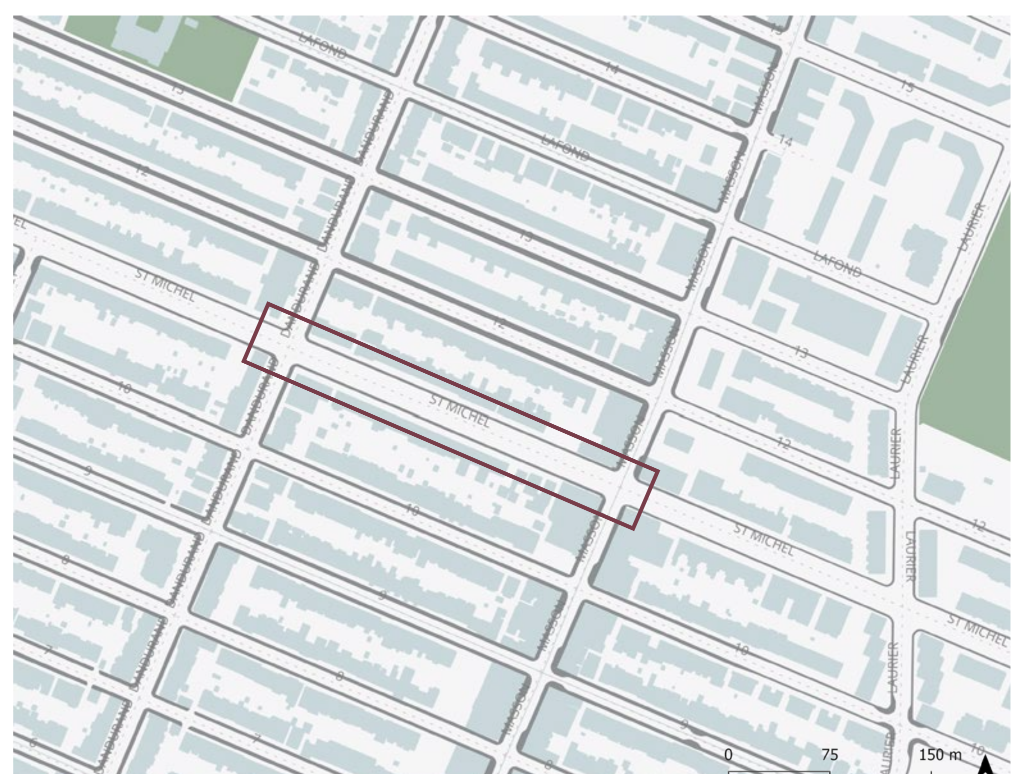
Characteristics of the streets of Combination G

Population Density	High	High	High
Neighborhood Income	Low	Middle	High
Street Name	Rue Jean-Talon E	Boulevard St-Michel	Avenue du Mont-Royal E
First Segment Intersection	Avenue des Érables	Rue Dandurand	Rue Papineau
Last Segment Intersection	Rue Cartier	Rue Masson	Rue Garnier
Number of Intersections	5	4	2
Speed Limit	50km/h	50km/h	50km/h
Segment Lenght	294m	266m	275m
Street Width	22m	22m	21m

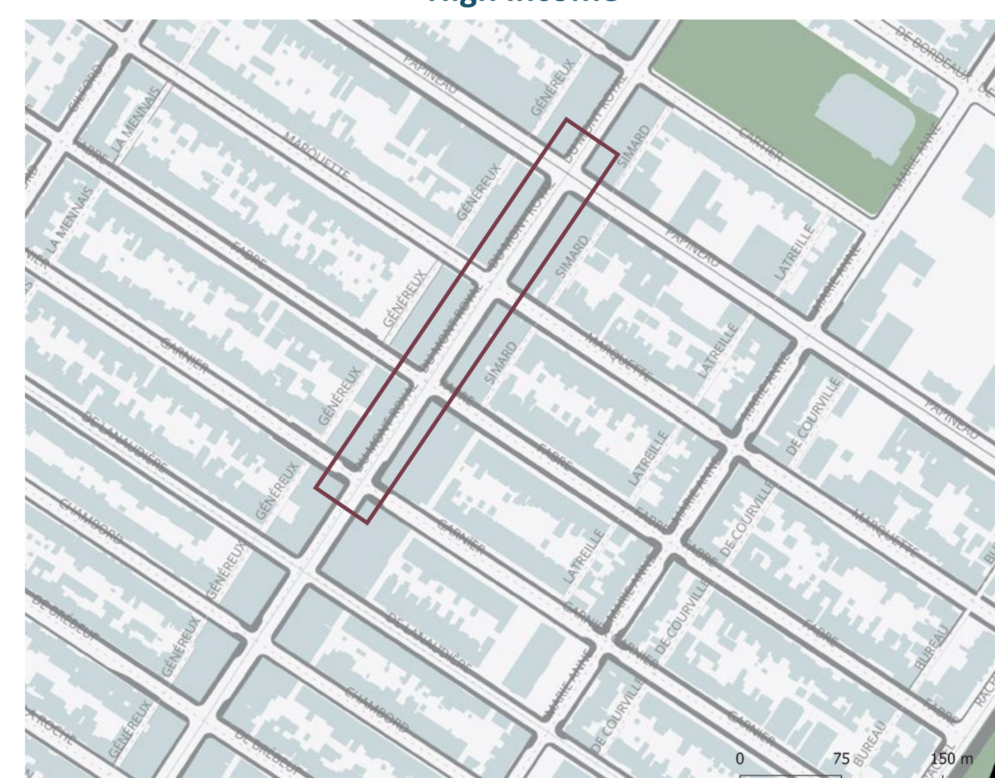
Location of Streets of Combination G

Rue Jean-Talon E
Low income

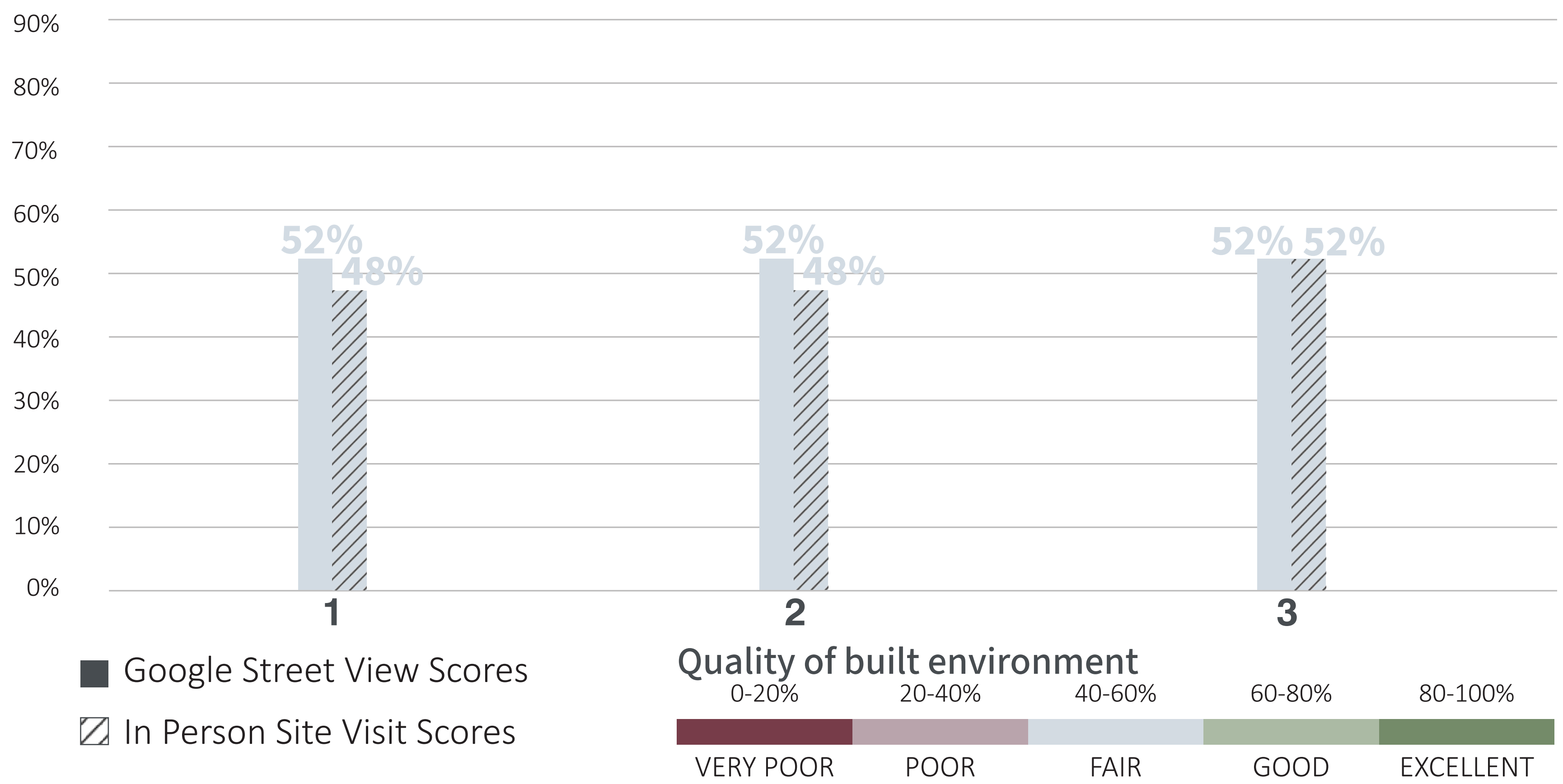
Boulevard St-Michel
Middle income



Avenue Mont-Royal E
High income



Street Combination G MAPS-Mini Scores



Location of Streets of Combination G

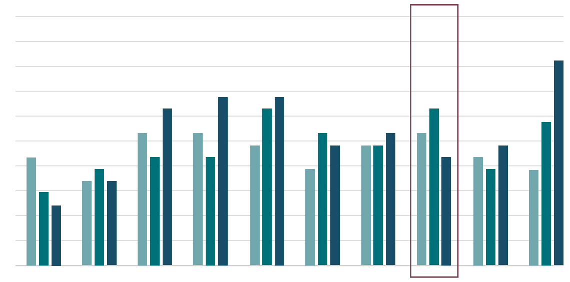
1.Rue Jean-Talon E
Low income

2.Boulevard St-Michel
Middle income

3.Avenue Mont-Royal E
High income

4.2.8.Street Combination H

Selected Streets Description- Combination H



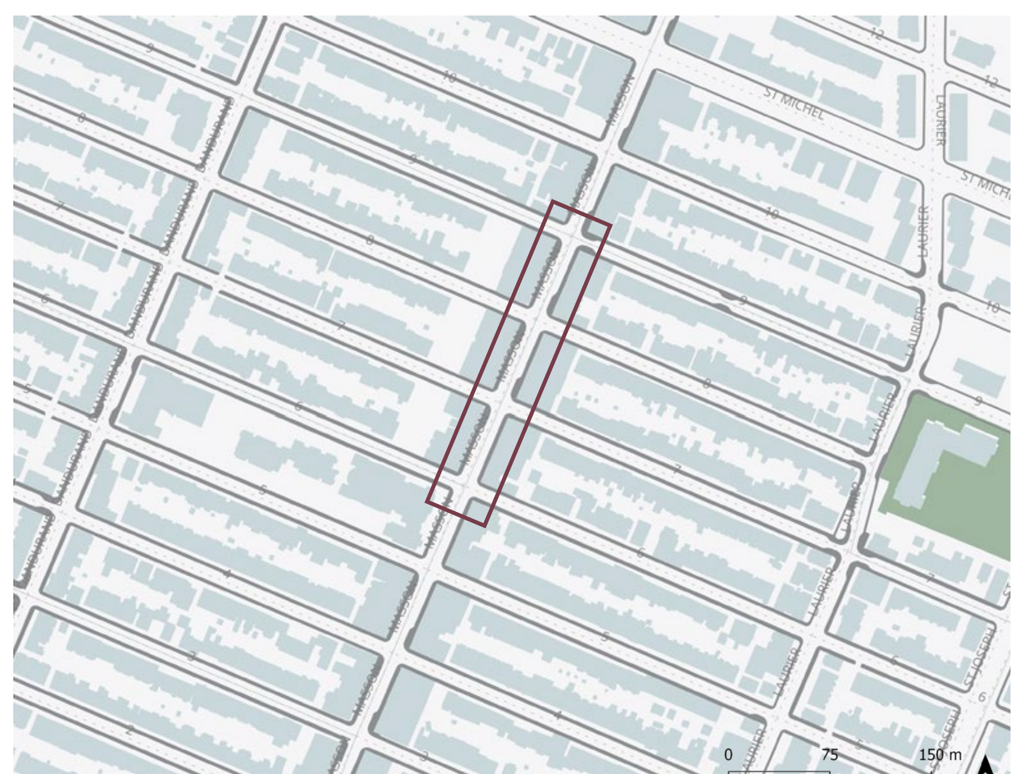
Characteristics of the streets of Combination H

Population Density	High	High	High
Neighborhood Income	Low	Middle	High
Street Name	Chemin de la Côte-des-Neiges	Rue Masson	Avenue Greene
First Segment Intersection	Chemin de la Côte-Ste-Catherine	6e Avenue	Boulevard de Maisonneuve O
Last Segment Intersection	Avenue St-Kevin	9e Avenue	Rue Sherbrooke O
Number of Intersections	3	4	2
Speed Limit	50km/h	50km/h	50km/h
Segment Lenght	204m	201m	214m
Street Width	21m	19m	19m

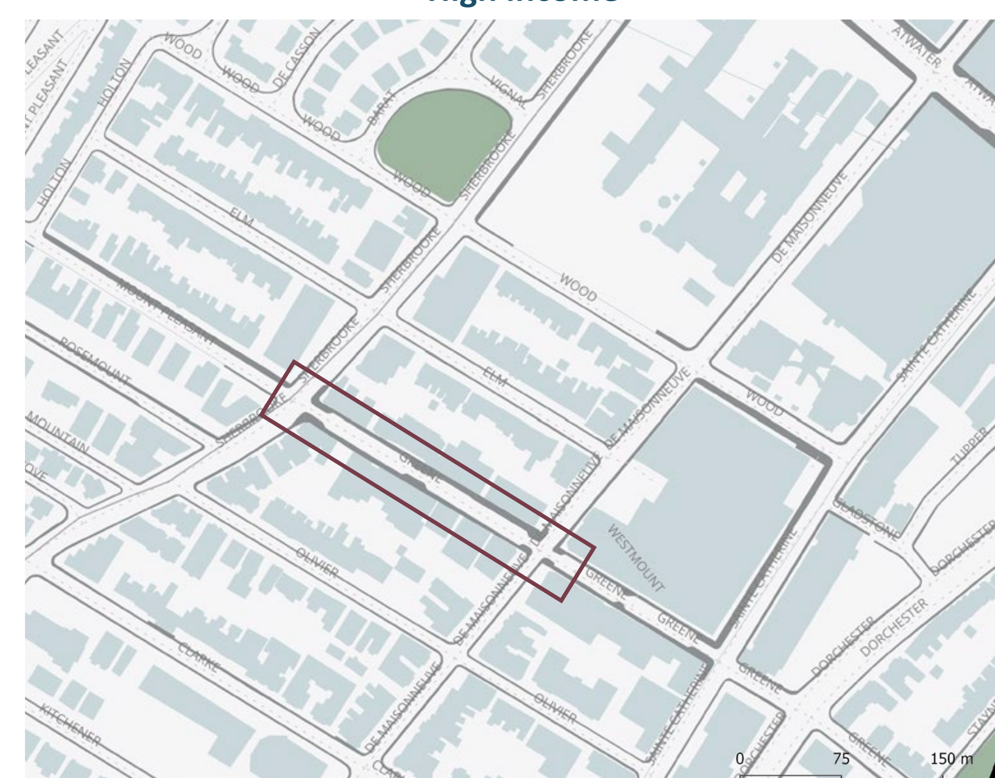
Location of Streets of Combination H

Chemin de la Côte-des-Neiges
Low income

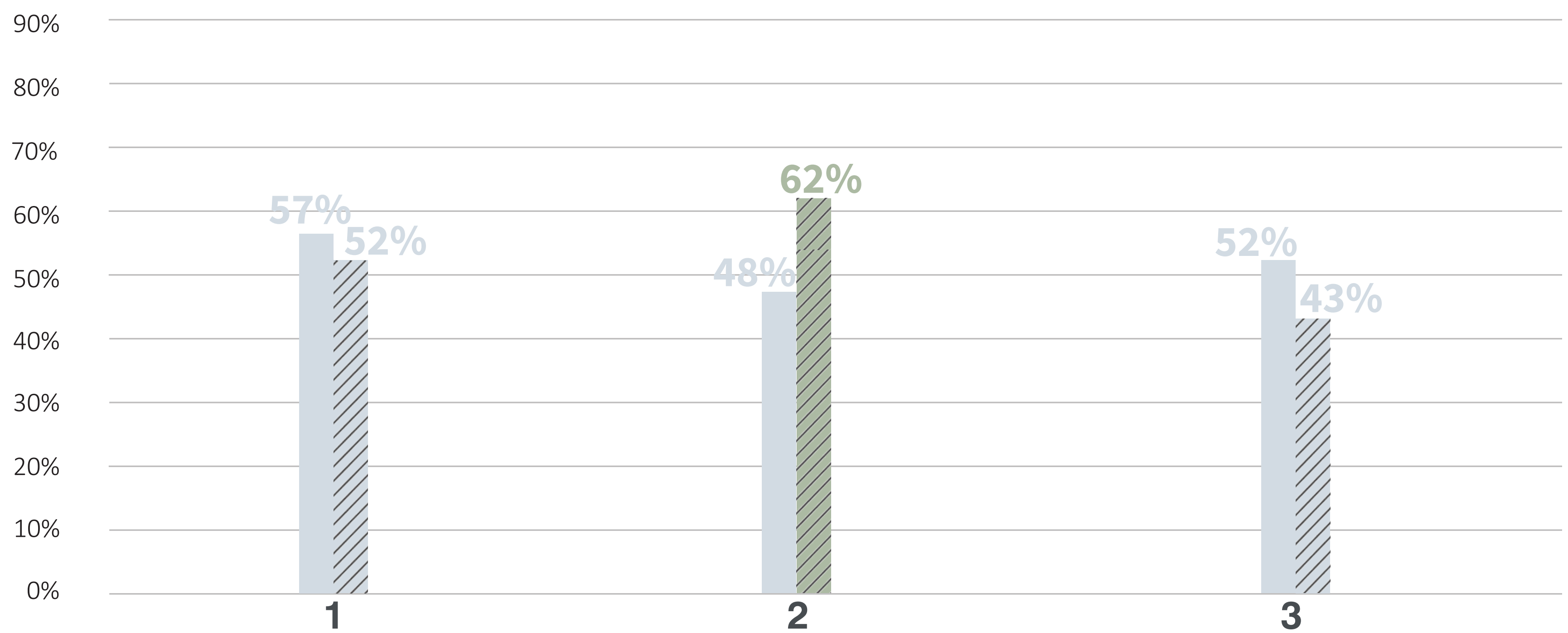
Rue Masson
Middle income



Avenue Greene
High income



Street Combination H MAPS-Mini Scores

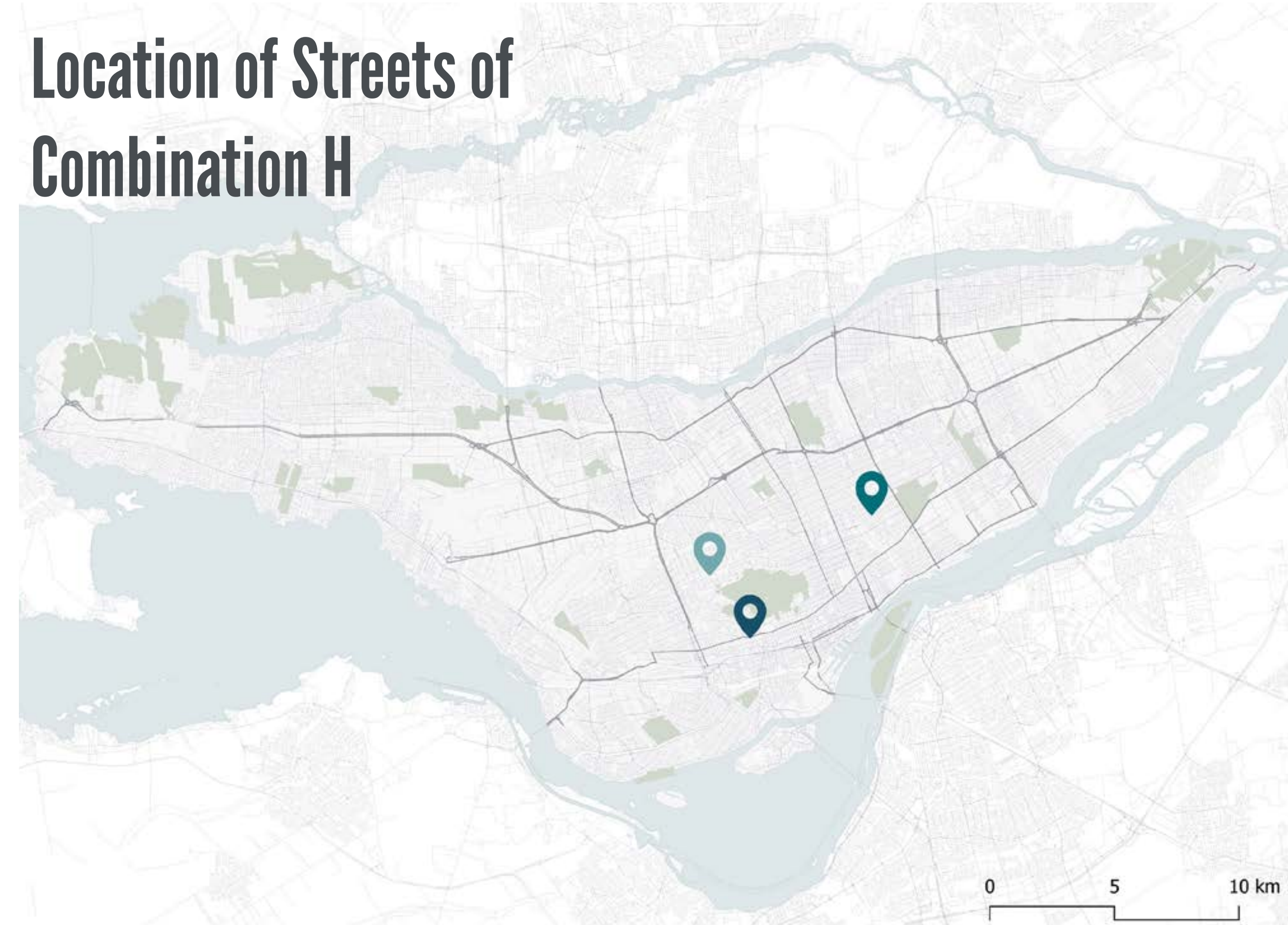


■ Google Street View Scores

▨ In Person Site Visit Scores

Quality of built environment

0-20%	20-40%	40-60%	60-80%	80-100%
VERY POOR	POOR	FAIR	GOOD	EXCELLENT



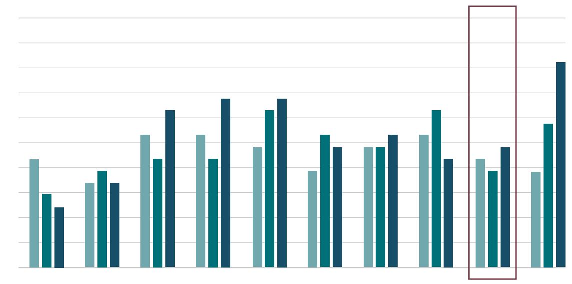
1.Chemin de la Côte-des-Neiges
Low income

2.Rue Masson
Middle income

3.Avenue Greene
High income

4.2.9.Street Combination I

Selected Streets Description- Combination I

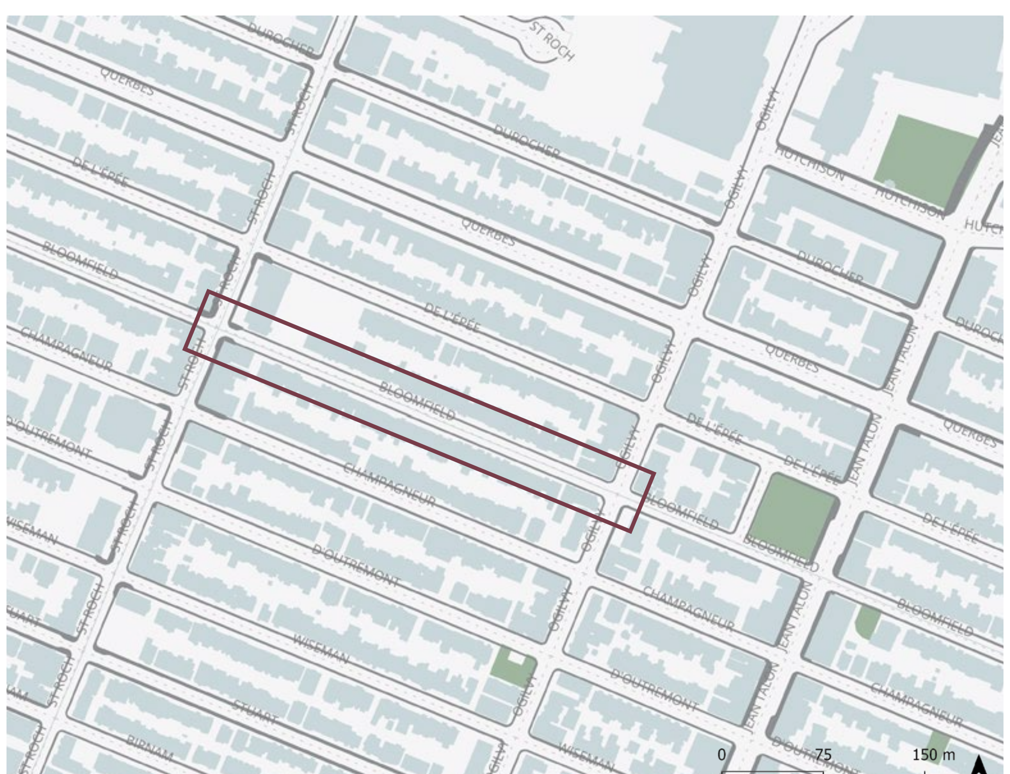


Characteristics of the streets of Combination I

Population Density	High	High	High
Neighborhood Income	Low	Middle	High
Street Name	Avenue Bloomfiled	Rue St-André	Avenue Durocher
First Segment Intersection	Avenue Ogilvy	Rue St-Zotique	Avenue St-Viateur
Last Segment Intersection	Rue St-Roch	Rue Bélanger	Avnue Bernard
Number of Intersections	2	2	2
Speed Limit	30km/h	30km/h	30km/h
Segment Lenght	322m	320m	306m
Street Width	13m	13m	13m

Location of Streets of Combination I

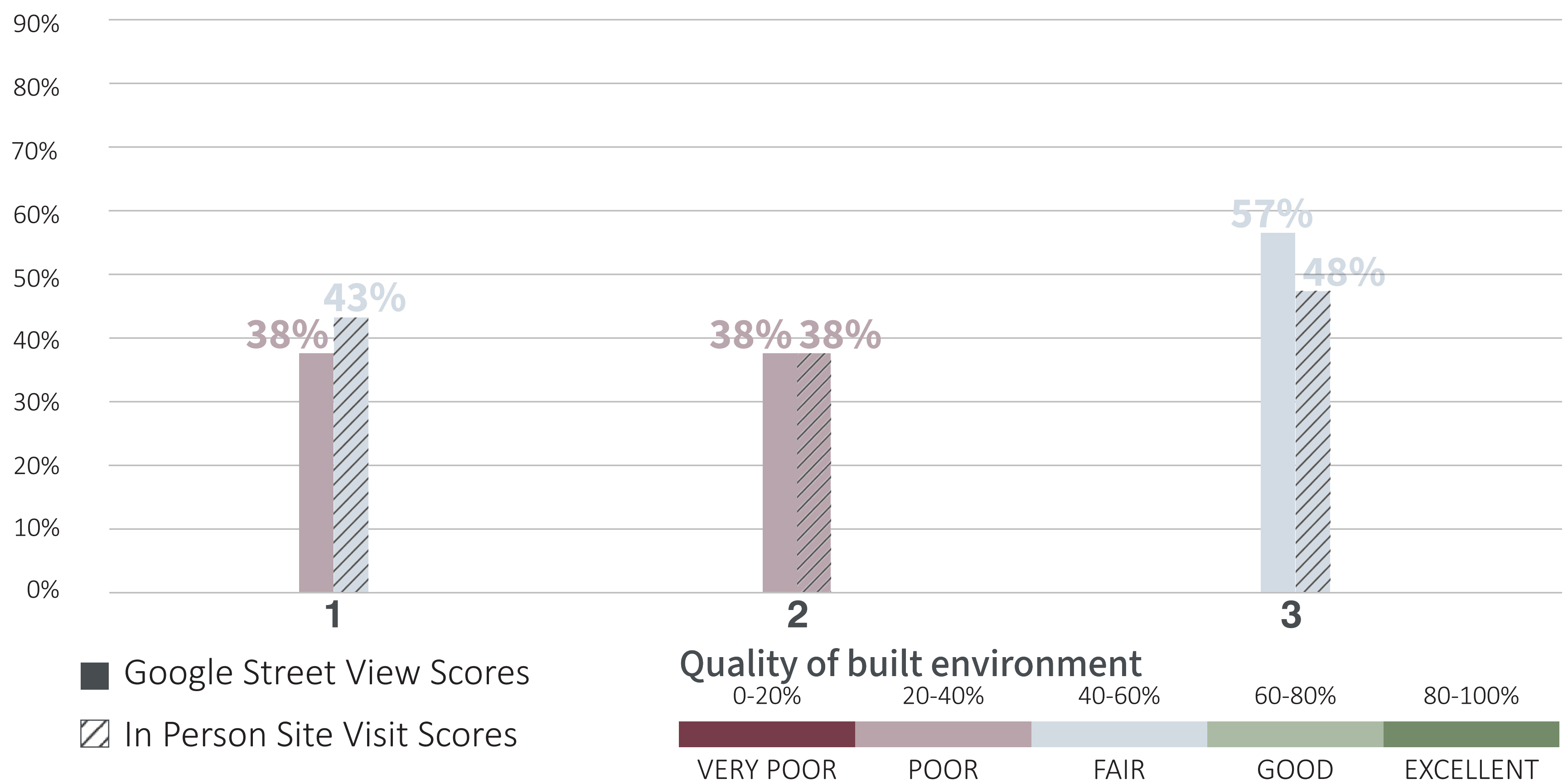
Avenue Bloomfield
Low income



Rue St-André
Middle income

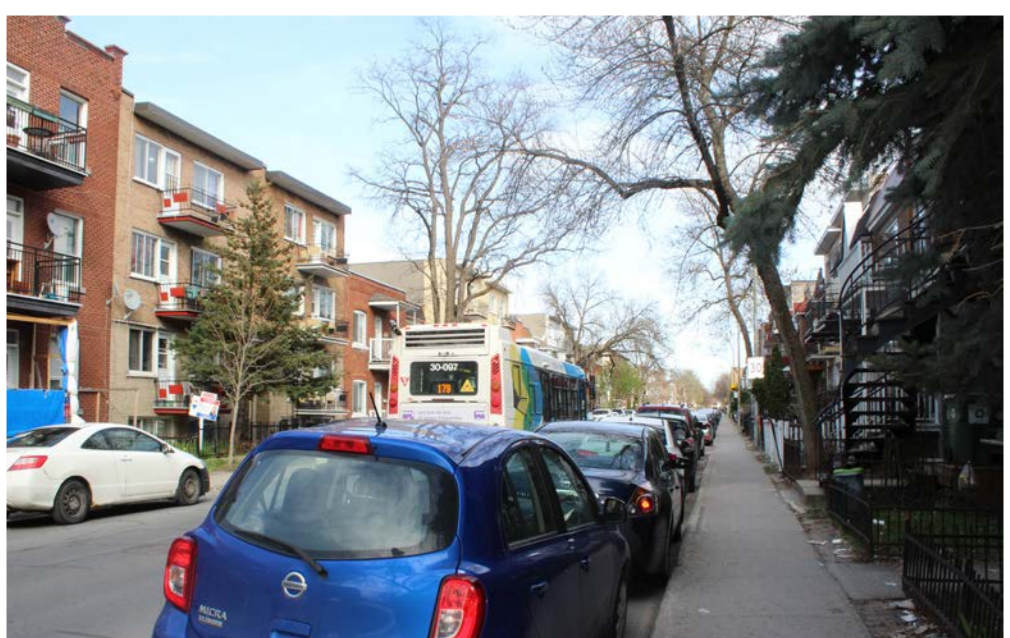
Avenue Durocher
High income

Street Combination I MAPS-Mini Scores



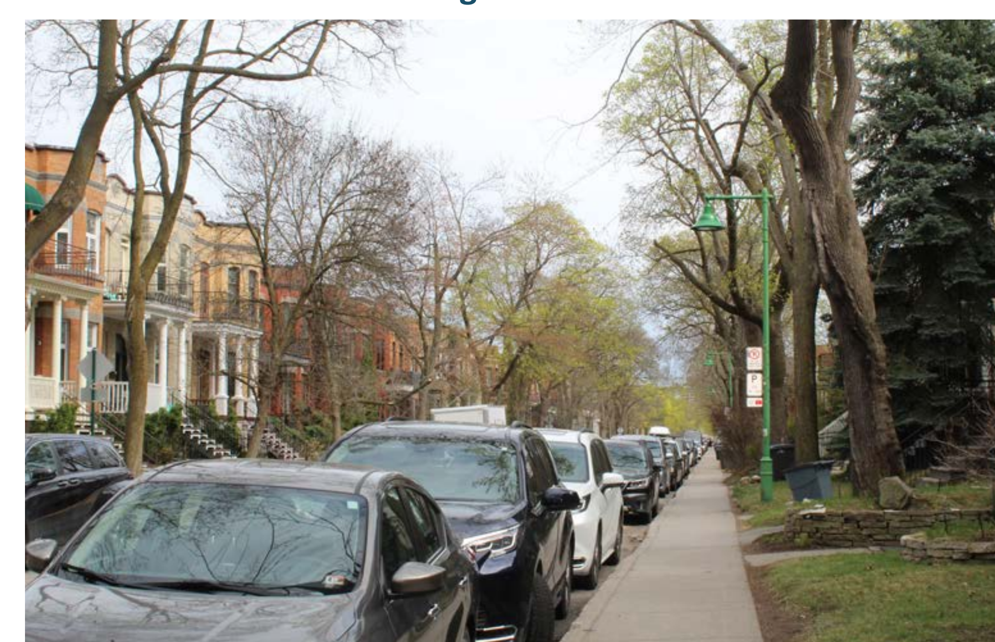
Location of Streets of Combination I

1.Avenue Bloomfield
Low income



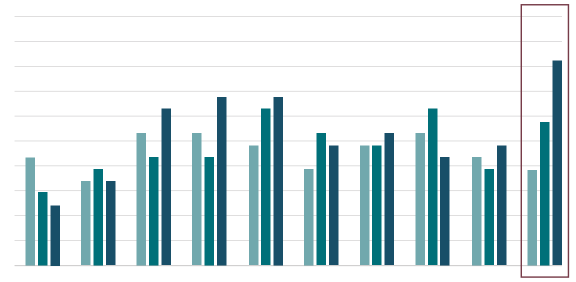
2.Rue St-André
Middle income

3.Avenue Durocher
High income



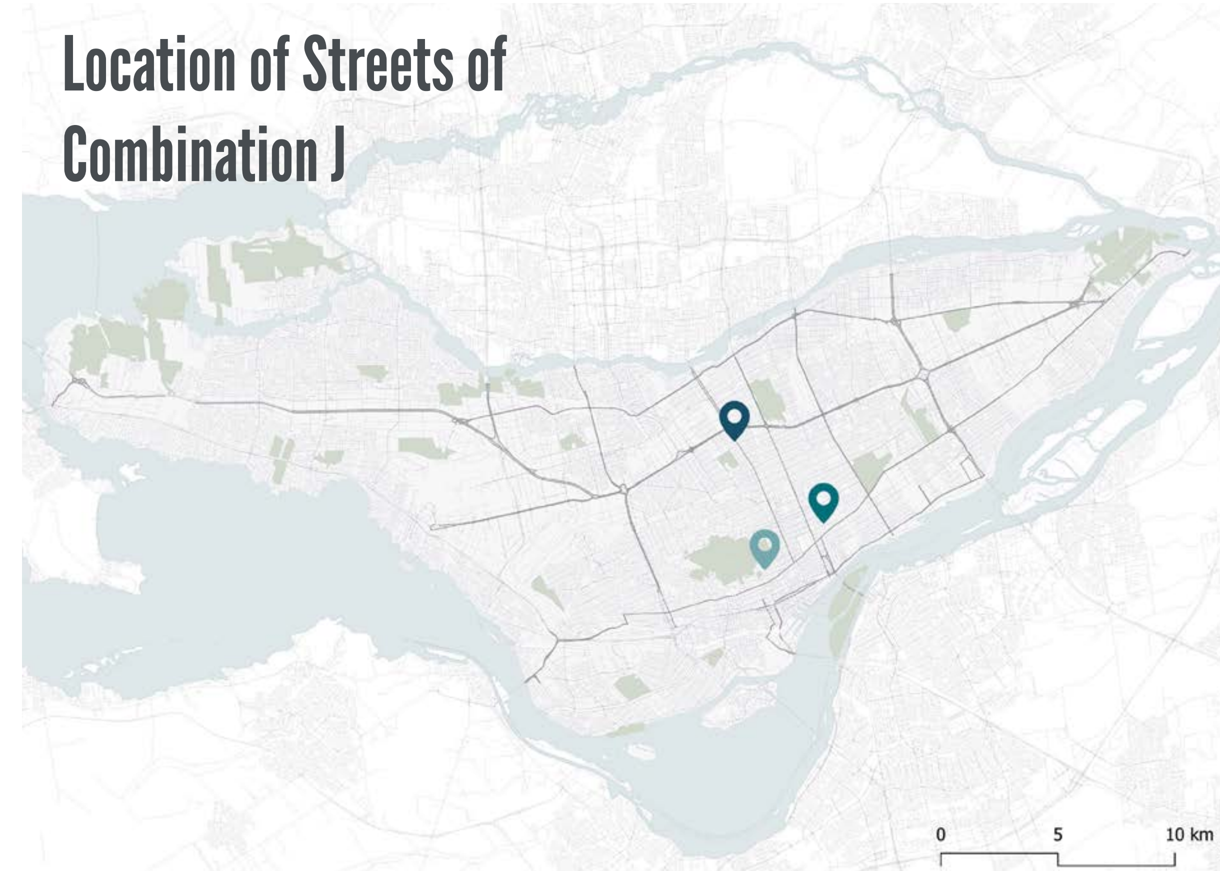
4.2.10.Street Combination J

Selected Streets Description- Combination J

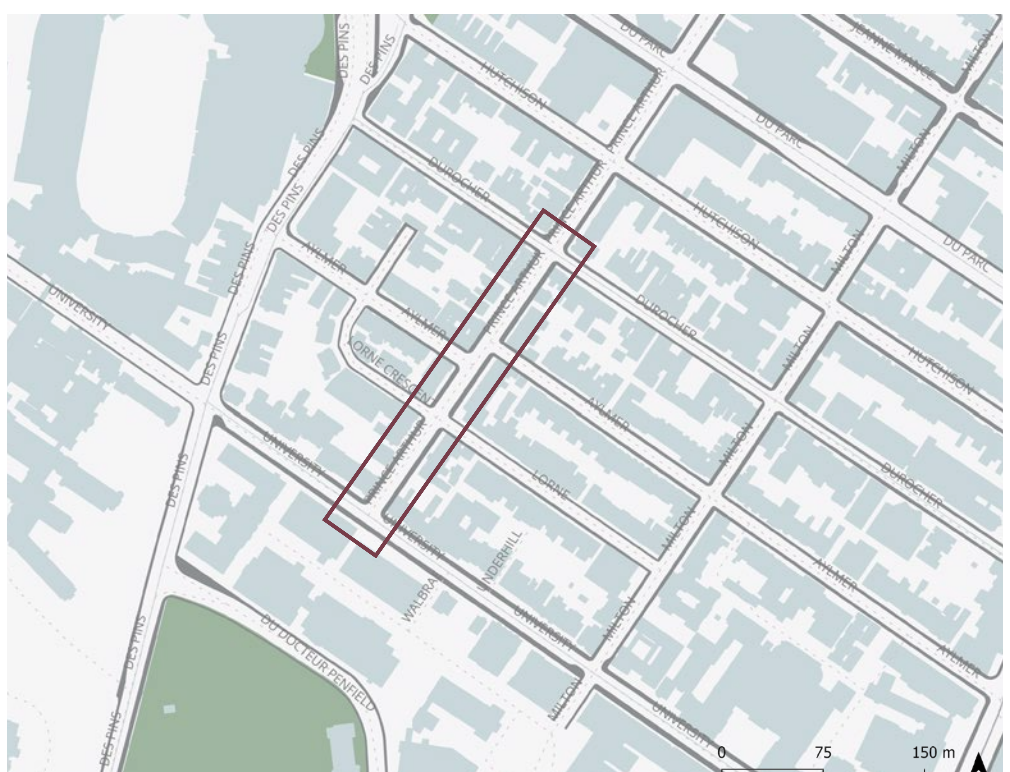


Characteristics of the streets of Combination J

Population Density	High	High	High
Neighborhood Income	Low	Middle	High
Street Name	Rue Prince Arthur	Rue Fullum	Rue Drolet
First Segment Intersection	Rue University	Rue Rachel	Rue Guizot E
Last Segment Intersection	Rue Durocher	Rue Marie Anne E	Rue Jarry
Number of Intersections	4	3	2
Speed Limit	30km/h	30km/h	50km/h
Segment Lenght	254m	255m	266m
Street Width	18m	17m	17m

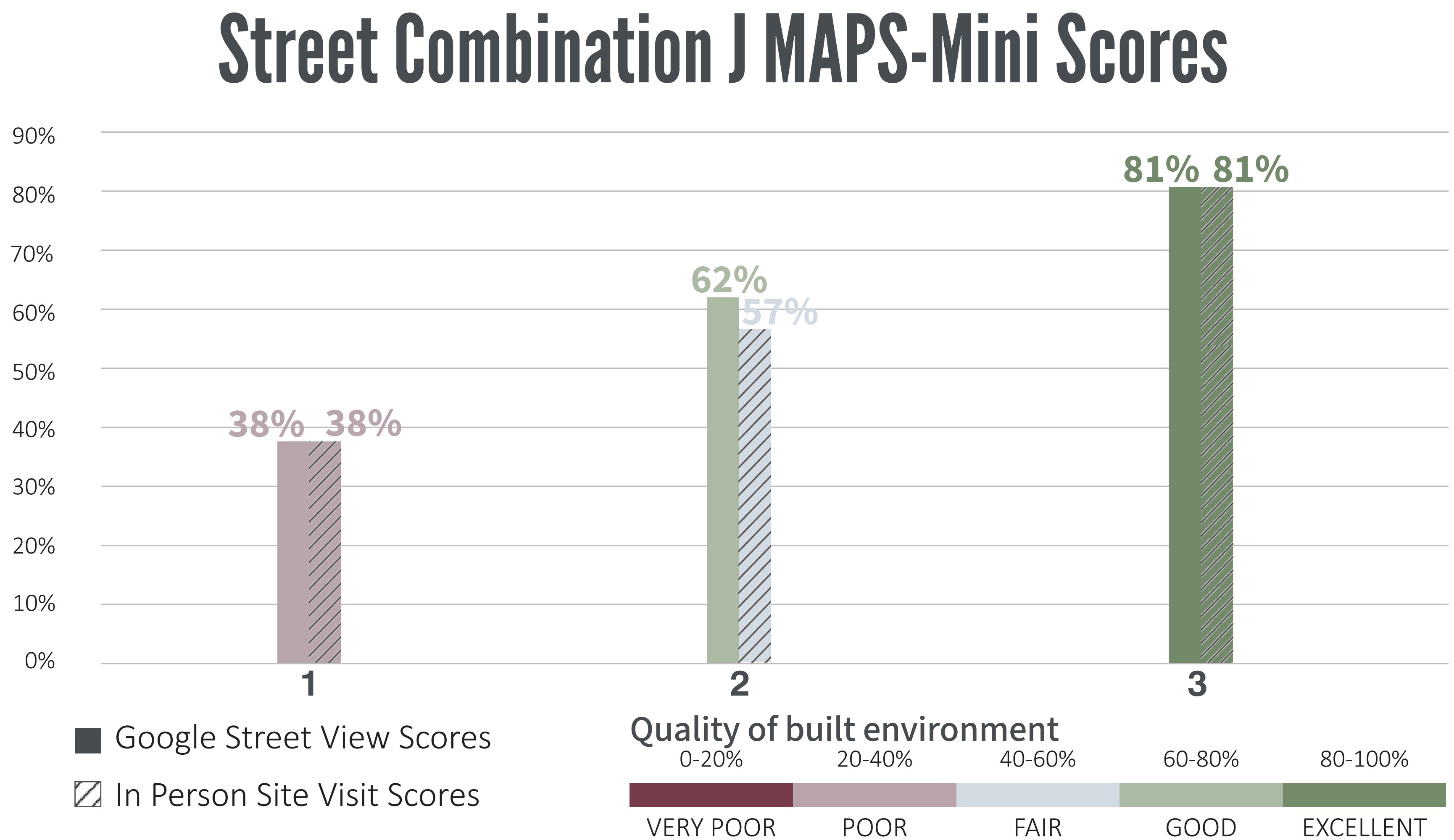


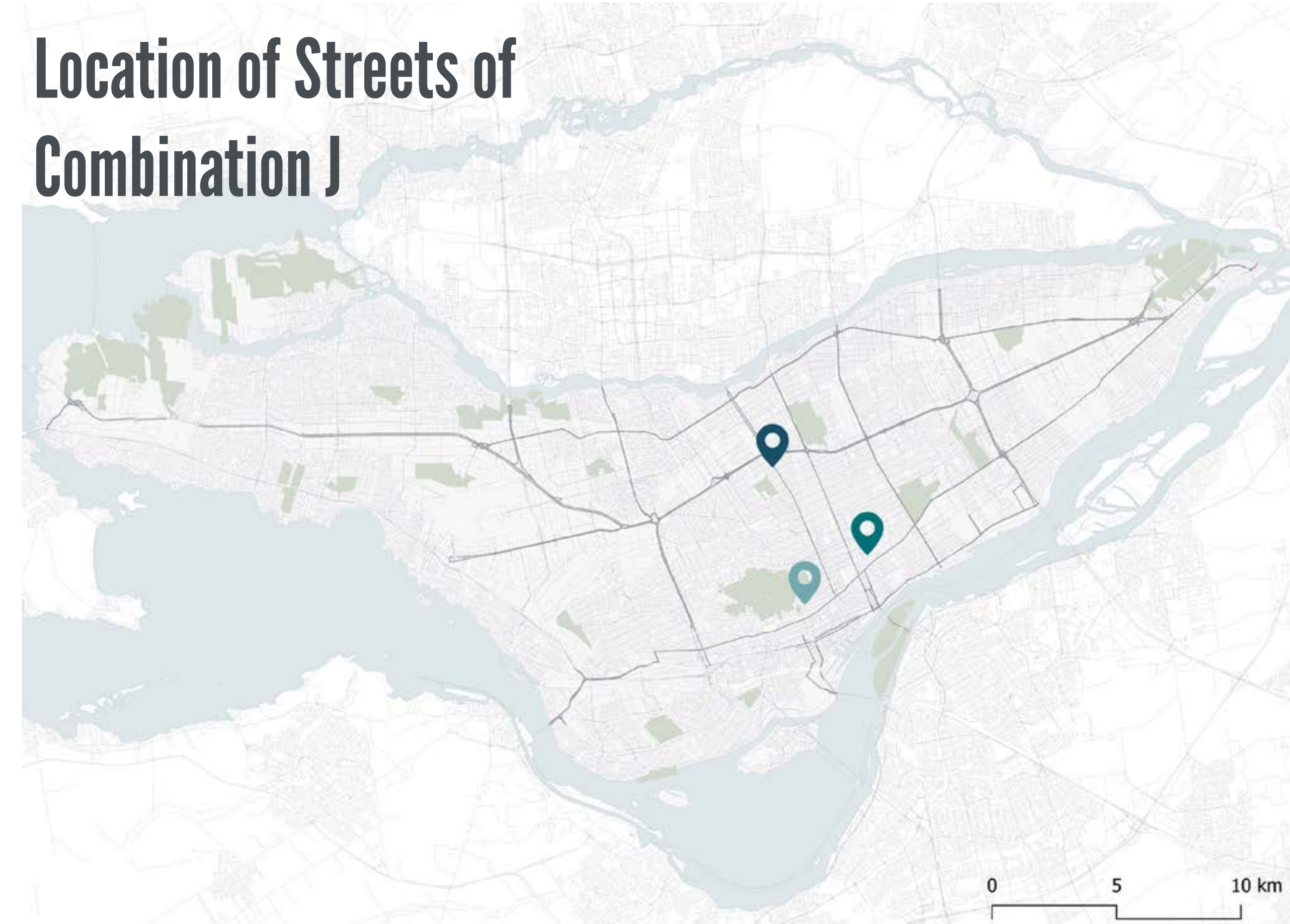
Rue Prince Arthur
Low income



Rue Fullum
Middle income

Rue Drolet
High income





1.Rue Prince Arthur
Low income

2.Rue Fullum
Middle income

3.Rue Drolet
High income

4.3. Overall Street Assessment and Results Using the MAPS-Mini Tool

The percentage scores of the assessed streets were categorized into 20% increments, each representing a different level of built environment quality. The first increment indicated the lowest quality, while the fifth and last increment represented the highest quality.

4.3.1. Google Street View Results

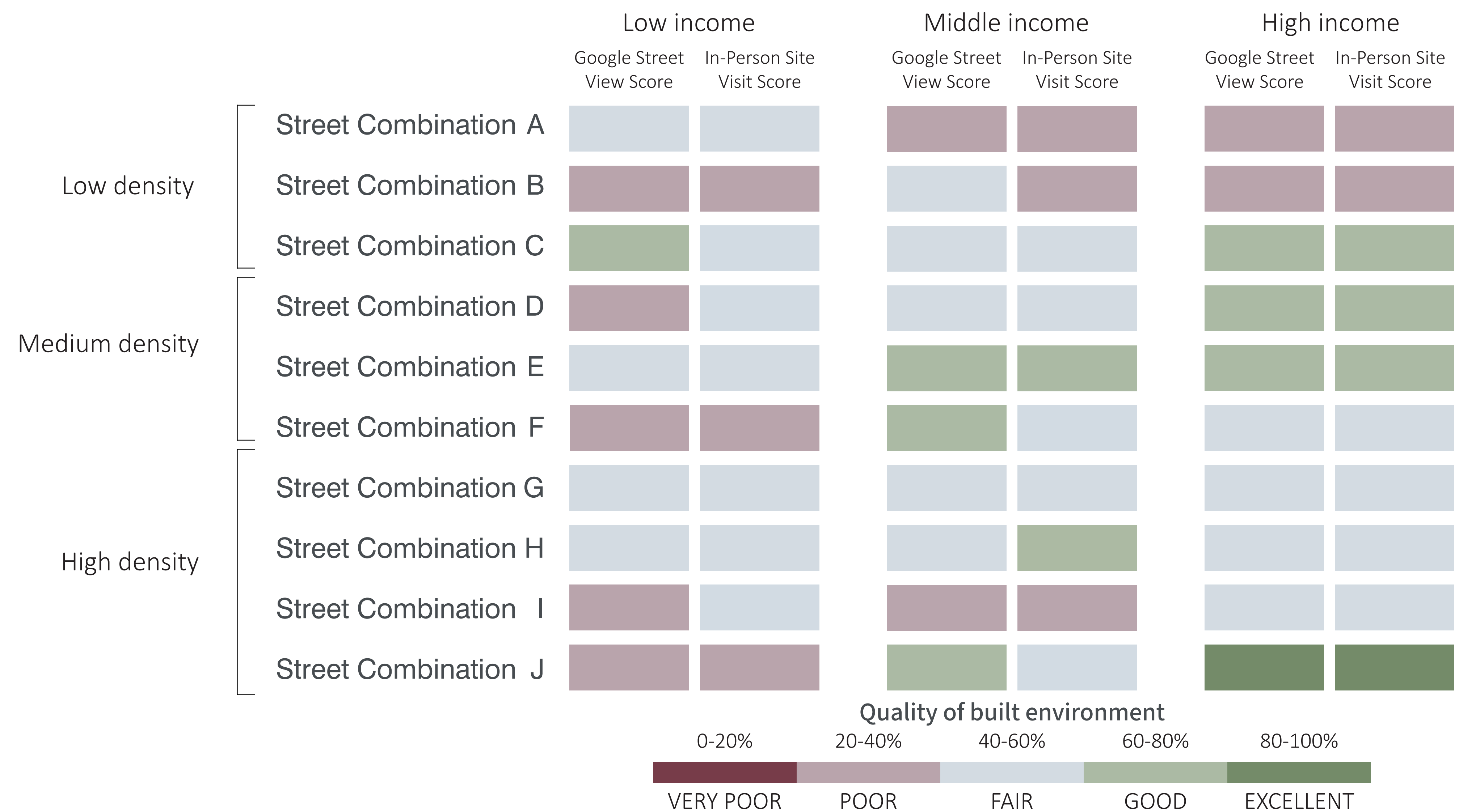
The Google Street View survey revealed that most streets were rated as having fair quality. Notably, low-income neighbourhoods had a higher prevalence of streets whose built environment rated poorly, compared to middle and high-income neighbourhoods, which only had one or two streets in this category. Interestingly, the low-rated streets in middle and high-income neighbourhoods were also located in low-density areas. High-income neighbourhoods had a greater number of streets rated above 60%, indicating the good quality of their built environment. Overall, only one of the thirty streets (rue Drolet) rated as excellent and was located in a high-income area. None of the streets received a very poor rating (scoring between 0 and 20%) that would point to a very urgent need for improvement.

4.3.2. In-Person Site Visits Results

The in-person site visits yielded slightly different results. The majority of streets' scores lowered, but many of them did not change to the extent of making them switch categories. Overall, more streets were rated as having a fair environment through in-person site visit assessments. Both low and middle-income neighbourhoods had more streets rated as having a poor-quality built environment. However, middle-income neighbourhoods had two streets rated as having a good quality environment, unlike low-income neighbourhoods, which had none. High-income neighbourhoods had several streets rated as good and beyond. The lowest-rated streets were mostly in low-density neighbourhoods, however none of them had a very poor rating. Medium-density neighbourhoods exhibited the best scores.

4.3.3. Google Street View vs. Site Visits Results

Among the thirty streets assessed, eight showed significant score variations between the Google Street View and in-person site visits audit surveys, resulting in different "quality of the built environment" categories. These changes were only observed in low and middle-income streets, as high-income streets maintained similar scores, resulting in same built environment categories across both assessment methods.



Montreal Streets' Built Environment MAPS-Mini Scores Across Different Socioeconomic Neighborhoods

5. Conclusions

5.1. Built Environment Street Features

As demonstrated in the literature, microscale built environment features play a crucial role in the liveliness, appeal, and comfort of streets (Gehl, 2011; Miranda et al., 2021; Mehta, 2007). These features include small elements and amenities within streetscapes that directly influence and enhance the experiences of pedestrians and cyclists (Carlson et al., 2019). The MAPS-Mini tool was used to identify these features, encompassing elements such as traffic calming measures, curb ramps, marked crosswalks, mixed land uses, public parks, public transit stops, adequate street lighting, benches, bicycle paths, well-maintained buildings and sidewalks, buffers from traffic, and street trees (Cain et al., 2015). This tool facilitated the identification and evaluation of these elements, resulting in scores that determine the quality of the built environments.

Streets across various socioeconomic neighbourhoods of differing densities were evaluated. The findings revealed some disparities in the quality of built environments across different socioeconomic neighborhoods in Montreal. Despite having similar typologies and characteristics, streets in lower-income areas exhibited poorer built environment quality, overall, highlighting the inequality in street design in Montreal. These variations underscore the need to incorporate social and spatial equity considerations into urban planning. This trend was particularly evident in medium and high-density neighborhoods. Conversely, one low-income street, Avenue Aurora (A) displayed an atypical pattern, scoring higher than those in wealthier areas. These disparities are further highlighted when comparing individual street elements, suggesting a need for targeted microscale interventions to address inequities in amenity provision and distribution. Priority in revitalization projects should be given to lower-income neighborhoods with the poorest-quality environments.

Overall, the assessment indicates that most streets in Montreal require improvements. Urban design efforts are needed across the island, as less than a third of the studied streets were deemed to have a good quality environment. The overwhelming majority were categorized as having a fair quality environment, indicating room for improvement. Only one street, Rue Drolet (J), was rated as having an excellent built environment.

Frequency of High-Quality Built-Environment Features Across Evaluated Streets in Montreal

Built Environment Features	Neighbourhood Characteristics					
	Income Level			Population Density		
	Low (/10 streets)	Middle (/10 streets)	High (/10 streets)	Low (/9 streets)	Medium (/9 streets)	Low (/12 streets)
1.Presence of traffic calming measures	8	10	10	9	9	10
2. Presence of ramps at the curbs	10	10	9	8	9	12
3. Presence of marked crosswalks	4	7	5	3	5	8
4. Presence of commercial or mixed land uses	3	1	4	2	1	5
5. Presence of public parks	2	4	4	2	5	3
6. Presence of public transit stops	7	5	7	3	6	10
7. Presence of *ample* streetlights	5	3	6	2	5	7
8. Presence of benches	6	4	7	2	6	9
9. Presence of bicycle Paths	1	1	3	2	2	1
10. Presence of 100% well-maintained buildings	2	2	1	2	2	1
11. Presence of graffiti	7	5	3	2	5	8
12. Presence of sidewalk	9	10	10	8	9	12
13. Presence of well-maintained sidewalks	3	1	2	3	2	1
14. Presence of buffers from traffic	4	4	5	2	3	8
15. Presence of abundant tree coverage providing shade to sidewalk	3	5	8	3	8	5

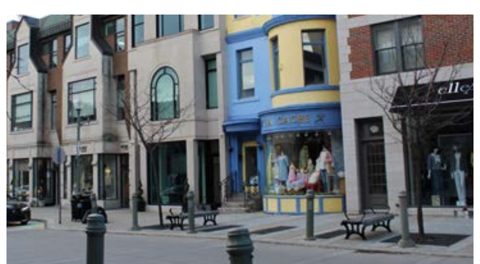
5.1.1. Traffic Calming Measures

Most streets incorporated at least one type of traffic calming measure. As the literature indicates, the presence of multiple measures enhances perceptions of traffic safety and prioritize pedestrians (Gehl, 2011; Whyte, 1980). Among all the studied streets, only Rue Jean-Talon E (G) and Rue Prince Arthur (J) lacked traffic calming measures entirely, and both were located in high-density and low-income neighborhoods.

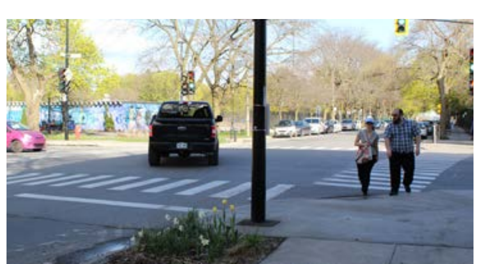
Some streets adopted intriguing approaches to calming traffic. For instance, Avenue Brown (D) featured shortened walkways made from bollards, which are easier to install than planted concrete curbs. Avenue Greene (H) had a narrowed paved walkway with urban furniture placed in the middle of the street, effectively slowing down cars throughout the street segment.


■ Avenue Brown (D)


■ 8e Avenue (B)


■ Avenue Greene (H)

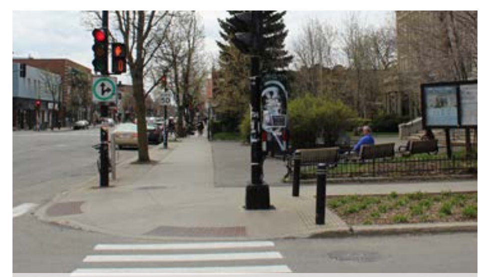
■ Boulevard Décarie (C)


■ Rue Fullum (J)

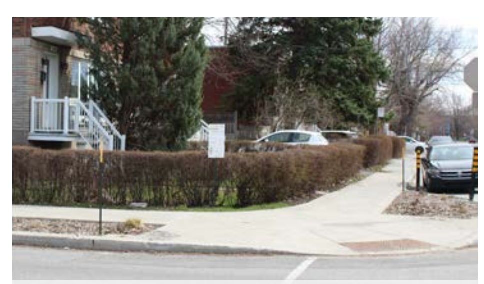

■ Boulevard Pierre Bernard

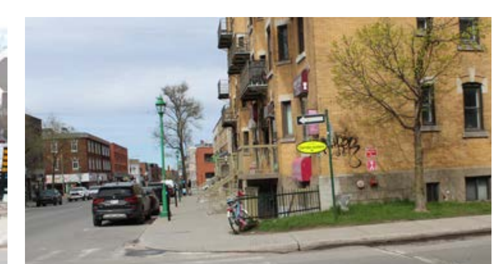
5.1.2. Ramps at the Curbs

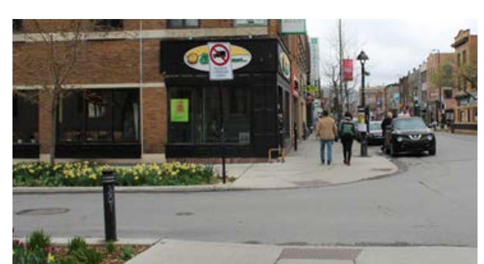
Nearly all of the streets evaluated had curb ramps, facilitating navigation for individuals with disabilities and parents with strollers. Among all the studied streets, only Hardwood Gate (A) lacked ramps entirely, as it did not have a sidewalk, making accessibility difficult for all residents. This street was located in a low-density, high-income neighbourhood. While most of these ramps were simple slopes on the sidewalks, some streets featured tactile surfaces to provide guidance for visually impaired people.


■ Rue Drolet (J)


■ Avenue Bloomfield (I)


■ 16e Avenue (B)


■ Avenue Durocher (I)


■ Avenue Mont-Royal E (G)


■ Rue Dickson (C)

5.1.3. Marked Crosswalks

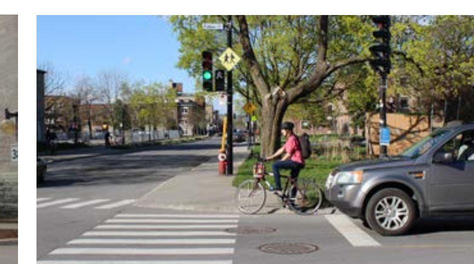
Marked crosswalks are an important type of pedestrian-oriented traffic calming measure, having their own question in the MAPS-Mini survey (Cain et al., 2015). The results from this study showed that low-income neighbourhoods seemed to be most lacking in marked crosswalks. Overall, many streets had faded crossings, while others, such as Rue Drolet (J) and Rue Fullum (J), had freshly repainted ones.

Many low-density neighbourhood streets were also missing marked crosswalks, even where they were needed. For example, Avenue Aurora (A) had a stop sign and pedestrian school corridor signaling, yet there was no visibly marked corridor for pedestrians.


■ 16e Avenue (B)


■ Avenue Bloomfiled (I)


■ Rue Drolet (J)


■ Rue Fullum (J)


■ Boulevard Shevchenko

■ Avenue Aurora (A)

( ) Street Combination ■ Low income ■ Middle income ■ High income

5.1.4. Land Uses

Land uses varied among the assessed streets, with the primary land use being residential. Only eight of the assessed streets were mixed-use, and these were mainly located in high-density areas. These streets had higher pedestrian activity, which the literature attributes to the appeal of window displays that enliven streets (Mehta, 2007). Notably, Avenue Mont-Royal E (G) attracted numerous people, despite the site visit occurring before its summer pedestrianization.

One street with a starkly contrasting and confusing land use was Rue St-André (I). This street consisted of the rear of the shops located on the adjacent Rue St-Hubert. Additionally, Rue St-André had multiple other land uses, including parking, residences, and parks, creating a very eclectic and confusing mix alongside the shops that did not face the street.


Chemin de la Côte-des-Neiges (H)


Rue St-André (I)


Avenue Mont-Royal E (G)

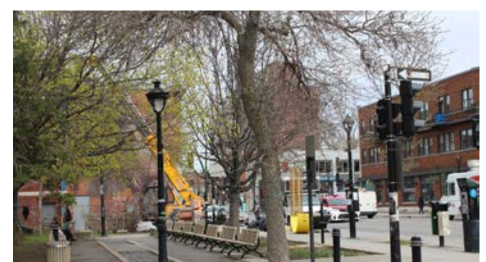

Rue St-André (I)

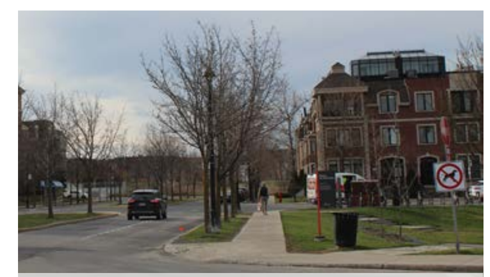

Rue Masson (H)


Rue St-André (I)

5.1.5. Public Parks

One third of the studied streets featured public parks of varying sizes and quality, with low-income neighborhoods having the least amount in the studied sample. Most parks were located in medium-density neighbourhoods. Some parks lacked greenery, while others were missing amenities. For example, Avenue Brown (D) featured a park that only had grass, trees, unpaved paths, and one trash can. Additionally, parks such as those located on Hardwood Gate (A) and Rue St-André (I) lacked connectivity with the streets; one had no paths/sidewalks connecting to the street, and the other was fenced off. The lower number of parks in lower-income neighbourhoods may perhaps be associated to the fear of green gentrification and displacement of long-term residents (Miller, 2019).

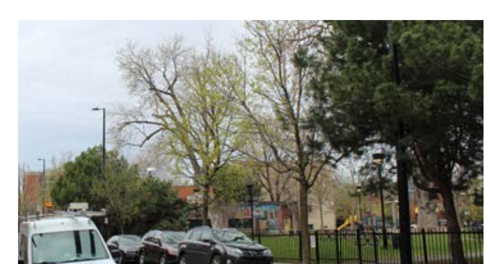

Rue Drolet (J)


Boulevard Alexis Nihon (D)


Avenue Brown (D)


Hardwood Gate (A)


8e Avenue (B)


Rue St-André (I)

5.1.6. Public Transit Stops

Nineteen of the studied streets featured public transit stops, including bicycle-sharing stations. These stops were well distributed across neighbourhoods of varying income levels but they were mainly located in medium and high-density areas.

Several of the evaluated street segments did not have bus stops directly on them; however, transit stops were present on adjacent streets, intersecting streets, or on the next segments of the same street. Following the MAPS-Mini tool, these nearby stops were not included in the microscale assessment, despite their proximity, which still provided residents with good accessibility to public transportation.

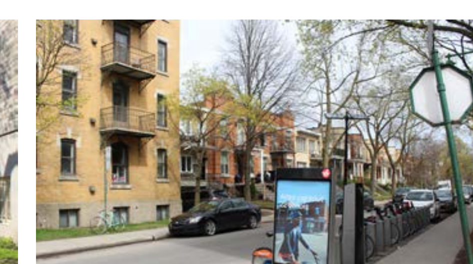

Rue Clarke (F)


Avenue de Lorimier (F)


Boulevard Graham (C)


Boulevard Shevchenko (D)


Rue Fullum(J)


Avenue Durocher (I)

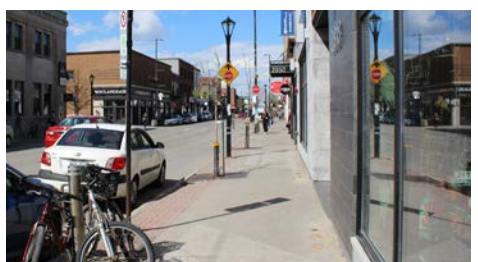
( ) Street Combination ■ Low income ■ Middle income ■ High income

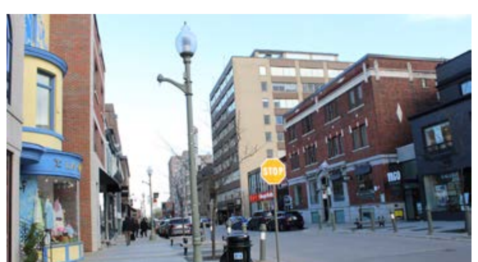
5.1.7. Streetlights

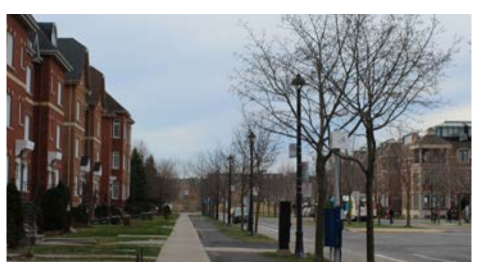
The MAPS-Mini tool assessed only the presence or absence of street lighting, defined as lights on one or both sides of the sidewalks to prioritize pedestrian safety. Approximately half of the evaluated streets lacked sufficient lighting, with streetlamps often positioned in the middle of the street (on a median strip) or on only one side of the street instead of both. These deficiencies were observed across neighbourhoods of varying income levels but were particularly common in low-density areas.

An interesting observation during site visits was the diversity in lamppost designs. These unique shapes enhanced the appeal of certain streets, such as Boulevard Graham (C), Rue Masson (H), and Avenue Greene (H). Since pedestrians move at slower speeds than cars, they have more opportunity to appreciate these aesthetic details.


■Boulevard Graham (C)


■Rue Masson (H)


■Avenue Greene (H)


■Boulevard Alexis Nihon (D)


■Boulevard Shevchenko (D)

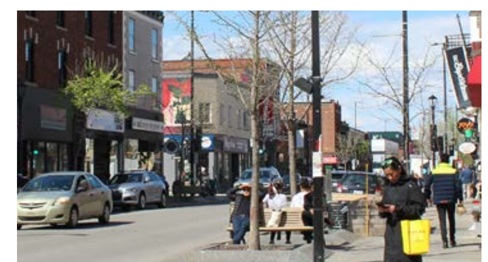

■Rue Honoré-Beaugrand (B)

5.1.8. Benches

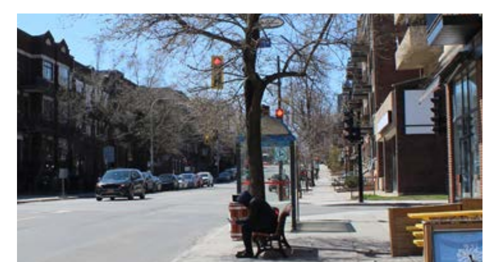
Numerous benches were observed along the streets, primarily in medium and high-density neighbourhoods. Interestingly, both low-income and high-income neighbourhoods had a similar number of seating areas.

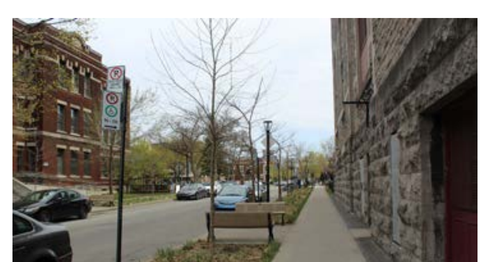
The design, orientation, and placement of benches varied across the studied streets. Some were perpendicular to the streets, occasionally facing each other in pairs, others faced the streets directly, while some had their backs to the street. Despite these variations, most people observed sitting on these benches were either waiting for the bus or located on streets with mixed land uses, such as Rue Masson (H) and Avenue Van Horne (E).

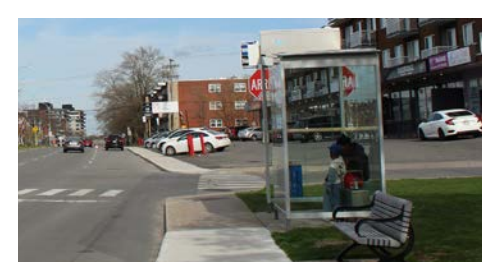

■Avenue Greene (H)


■Rue Masson (H)


■Rue Fullum (J)


■Avenue Van Horne (E)


■Rue Drolet (J)


■Boulevard Shevchenko (D)

5.1.9. Bicycle Paths

Only five of the evaluated streets had bicycle paths, all of which were unprotected painted bicycle lanes. These lanes were distributed fairly evenly across areas with varying income and density areas. A few sharrows, like the one on Hardwood Gate (A), were also identified, but they were not included in the count as they do not provide a designated space for cyclists.

Notably, rue Aurora seemed to have new street infrastructure, including a bicycle lane. However, this lane was replacing a sidewalk, resulting in a configuration where one side of the street featured a bike lane while the other maintained a sidewalk. This design still prioritizes space for automobiles, highlighting the continued emphasis on car traffic (Elokda, 2017).


■ Avenue Aurora (A)


■Boulevard Alexis Nihon (D)


■Hardwood Gate (A)


■Boulevard Pierre Bernard (E)


■Rue Drolet (J)


■Rue Prince Arthur (J)

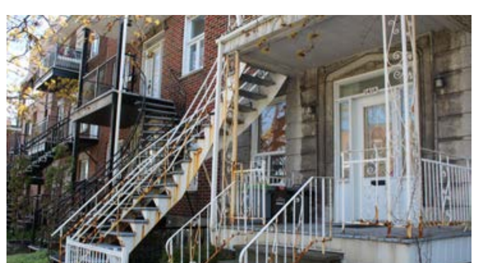
( ) Street Combination ■ Low income ■ Middle income ■ High income

5.1.10. Building Maintenance

The MAPS-Mini tool operated such that if even just one building on a street was damaged, the entire street's rating for building maintenance would suffer. Consequently, the majority of streets in neighbourhoods of all income levels and densities featured damaged buildings. These poor conditions manifested as rusty exteriors, boarded-up windows, cracks, material discoloration, chipped paint, and, notably on Rue Prince Arthur (J), an exposed wall. Often, these issues varied in severity, with some buildings starkly contrasting against others that were well-maintained, disrupting the visual harmony of the built environment. As a pedestrian, this discordance noticeably impacted the overall aesthetic appeal of the space.


Rue de Cluny (F)


Boulevard des Galeries d'Anjou (E)


Boulevard St-Michel (G)

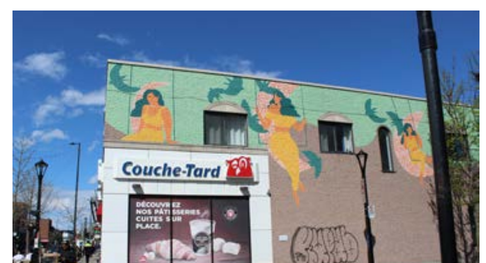

Rue Prince Arthur (J)


Avenue Durocher (I)

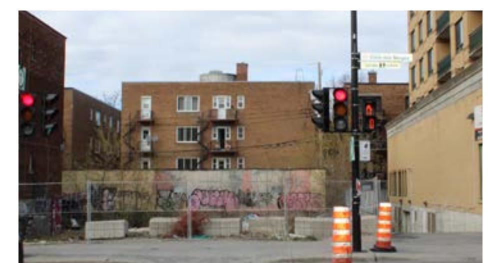

Rue St-André (I)

5.1.11. Graffiti versus Litter

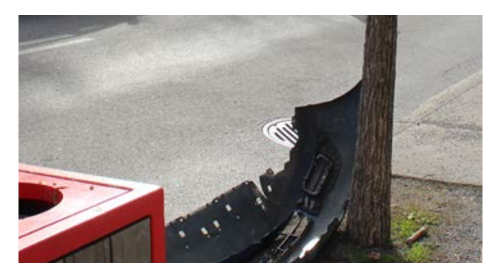
Graffiti or tagging was frequently observed across the studied streets, with the majority found in low-income and high-density neighbourhoods. While tagging and graffiti can be bothersome, they paled in comparison to the nuisance posed by litter during site visits, which often cluttered pedestrian pathways directly. The cleanliness of streets emerged as a bigger concern, especially considering that much of the graffiti was positioned out of direct sightlines for pedestrians. However, litter was not accounted for in the MAPS-Mini survey. On chemin de la Côte-des-Neiges (H), a missing car bumper left on the sidewalk hinted at potential safety concerns, suggesting a recent vehicle collision. Several streets littered with garbage lacked trashcans, a feature that could help alleviate the problem, as streets equipped with proper waste disposal were generally cleaner.



Rue Masson (H)


Chemin de la Côte-des-Neiges (H)


Avenue Mont-Royal E (G)


Chemin de la Côte-des-Neiges (H)


Rue Clarke (F)


Rue St-André (I)

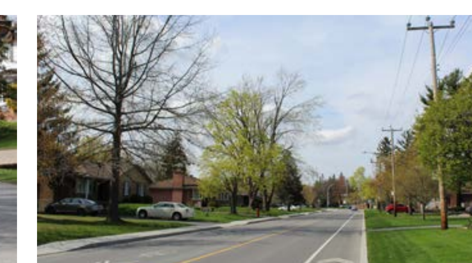
5.1.12. Sidewalks

All of the streets had sidewalks, except for a portion of Avenue Aurora (A), and Hardwood Gate (A), where the sidewalk abruptly ended. These streets were located in low-density neighbourhoods, with Hardwood Gate (A) in a high-income area and Avenue Aurora (A) in a middle-income area. The MAPS-Mini tool focused solely on the presence and upkeep of sidewalks. However, during site visits, it became evident that other factors such as sidewalks with diverse materials, colors, and designs, enhanced the walking experience by adding visual interest. Additionally, wider sidewalks provided a more comfortable and secure walking environment. This was particularly noticeable when comparing standard sidewalks with overlapping cedar fences and angled trees with protruding roots, causing uneven surfaces, as seen on Rue Fullum (J) and Avenue Tulip (A).


Rue Fullum (J)


Avenue Tulip (A)


Hardwood Gate (A)


Avenue Aurora (A)


Boulevard Décarie (C)


Avenue Greene (H)

( ) Street Combination ■ Low income ■ Middle income ■ High income

5.1.13. Sidewalk Maintenance

An overwhelming number of sidewalks across the evaluated streets exhibited severe neglect in maintenance. Only six streets, mainly located in low-density neighbourhoods, were in proper condition without any tripping hazards that can potentially endanger distracted pedestrians and those with limited mobility.

These issues were predominantly identified during site visits rather than through Google Street View, as parked cars and other obstructions often obscured the view of the sidewalk's condition. Since the site visits occurred at the beginning of spring, it is plausible that the observed damages could be associated with the aftermath of winter. While road construction activities for roadways were observed, there appeared to be little to no effort directed toward sidewalk repairs and improvements.


Rue Jean-Talon E (G)


Avenue de Lorimier (F)


Avenue Van Horne (E)


8e Avenue (B)


Avenue Bloomfield (I)


Chemin de la Côte-des-Neiges (H)

5.1.14. Buffer from Traffic

Thirteen assessed streets featured buffers from roadways, primarily in the form of street trees. However, their specific characteristics varied, including the trees' maturity and dimensions, their placement, and the spacing between them. These buffers were found in neighbourhoods with different socioeconomic levels, primarily in high-density areas.

The most comfortable buffer was observed on Boulevard Alexis Nihon (D), where there was a clear separation from the sidewalks. On other streets, trees serving as buffers punctuated the standard sidewalks, requiring pedestrians to sometimes alter their paths to navigate around tree protrusions. Rue Jean-Talon E (G) had a peculiar buffer that was situated in the middle of a wider sidewalk.


Rue Clarke (F)


Rue Dickson (C)


Avenue Van Horne (E)


Boulevard Alexis Nihon (D)

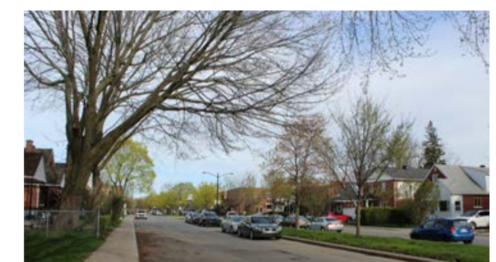

Rue Prince Arthur (J)

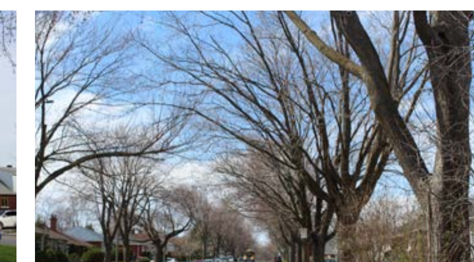

Rue Jean-Talon E (G)

5.1.15. Tree Coverage

Some of the streets exhibited greater tree coverage than others, enhancing the walking experience. Streets with the most trees were located in high-income and middle-density areas, while low-income and low-density neighbourhoods had very few. As the site visits were conducted in spring before the trees' foliage reached full bloom, the level of shading was deduced from the number and size of the street trees.

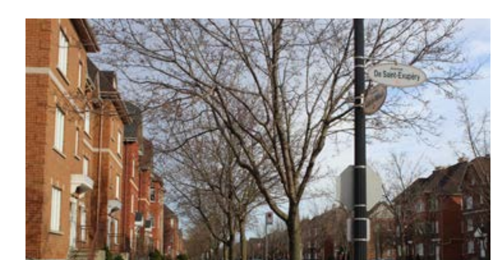
While the presence of trees was primarily evaluated for shade and comfort, their mere presence contributed to creating more inviting and aesthetically pleasing environments. Despite many trees on boulevard Pierre Bernard (E) and avenue Brown (D) being situated on median strips, they still significantly enhanced the streets' appeal, even though they provided limited shading.


Avenue Brown (D)


Rue Honoré-Beaugrand (B)


Rue de Cluny (F)


Boulevard Pierre Bernard (E)


Boulevard Alexis Nihon (D)


Avenue de Lorimier (F)

( ) Street Combination ■ Low income ■ Middle income ■ High income

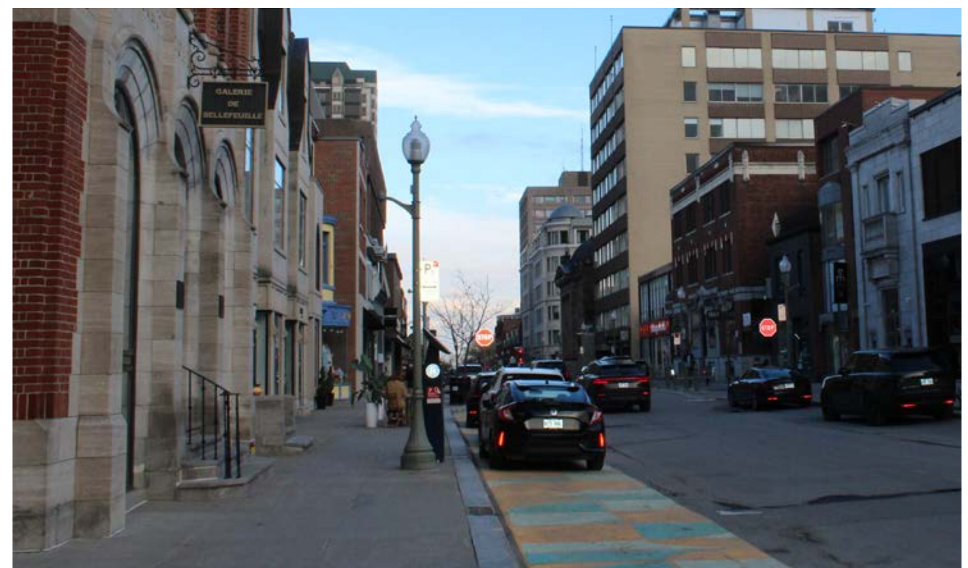
5.1.16. Public Art

One element enhancing the enjoyment and attractiveness of the built environment of streets, not accounted for in the MAPS-Mini auditing surveys, was the presence of public art. The observed art took various forms, from sidewalk art on boulevard Décarie (C) to murals adorning the sides of buildings on rue Masson (H), and even painted street parking lanes on avenue Greene (H). Despite some art being on parking lanes, pedestrians rather than car occupants were the ones appreciating it. No trend related to the income and density levels of neighbourhoods was observed, as these three streets were the only ones that had any public art.

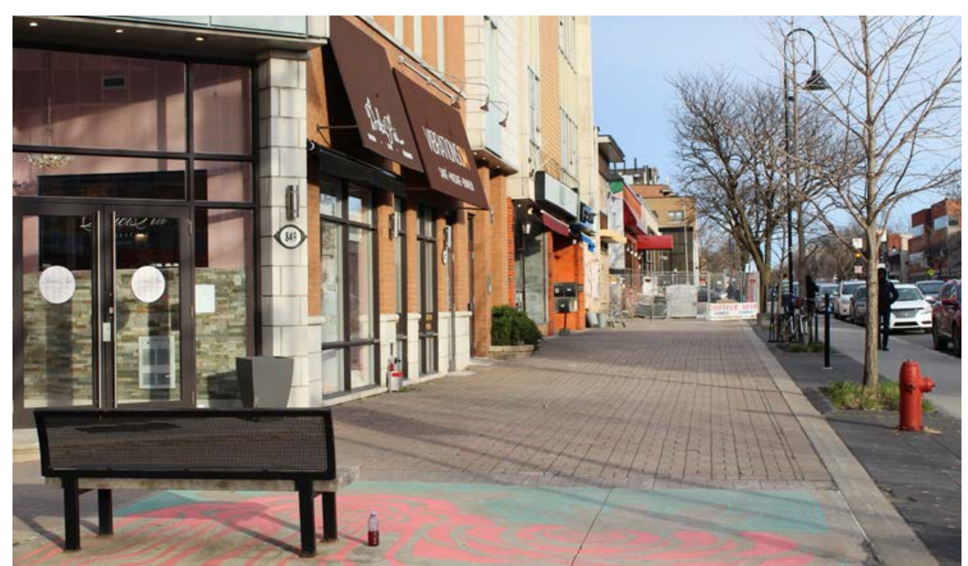
Public art transformed the walking experience, making the environment more engaging and stimulating, rather than solely convenient and comfortable. While it may not be practical or necessary to install public art on every street, particularly in low-density neighborhoods, it is beneficial for high-density streets with substantial pedestrian and cyclist traffic to consider incorporating public art to enhances livability and enjoyment.

Interestingly, certain streets had a lot of infrastructure and amenities but still lacked appeal, appearing mundane despite meeting functional criteria.

■ Rue Masson (H)



■ Avenue Greene (H)



■ Boulevard Décarie (C)

( ) Street Combination ■ Low income ■ Middle income ■ High income

5.2. Policy Design Recommendations

Addressing disparities in the built environment is essential for creating equitable, healthy, and livable communities. The results of this research suggest that greater focus and resources should be directed towards improving the quality of streets at the microscale in Montreal. In fact, most of the studied streets were rated as having poor to fair built environments, with only one street achieving an excellent rating. Additionally, particular focus should be directed towards lower-income neighbourhoods, which typically suffer from poorer street design.

Policy recommendations include investing in active transport infrastructure and prioritizing maintenance, especially in lower-income neighbourhoods. These efforts should be coupled with increased community engagement to address the diverse needs and concerns of residents. Leveraging established programs like *Quartiers verts, actifs et en santé* (QVAS) and *Réseau quartier verts du Canada* (RQV) can facilitate these inclusive approaches.

To mitigate gentrification and the displacement of long-term residents, initiatives to improve streetscapes should be complemented by equitable development policies. These policies include preserving affordable housing through legal protection, adopting inclusionary zoning practices, providing financial support to residents in need, etc. Such measures aim to secure that vulnerable populations benefit from improved public spaces.

Inclusive urban planning strategies can ensure that streets are accessible and welcoming to all residents, regardless of their neighbourhood socioeconomic level. Implications for urban design, transportation and land use planning include establishing clear equity guidelines to ensure equal access to amenities across different socioeconomic areas.

Targeted interventions include:

- Conducting ongoing assessments of street quality and maintenance to ensure the continuous upkeep of built environments. Special attention should be given to repairing damaged buildings across all neighborhoods and addressing issues such as graffiti and litter in low-income, high-density areas where these problems are most prevalent.
- Incorporating marked crosswalks in low-income and low-density neighbourhoods to prioritize pedestrian safety.
- Increasing the number of public parks, planted buffers and street trees in low-income areas to create more pleasant, and environmentally friendly urban spaces.
- Installing more street lighting and benches in low-density areas to enhance safety and comfort.
- Promoting mixed-use development to create vibrant and diverse streetscapes that cater to various activities and services, contributing to a more dynamic urban environment across the island.
- Increasing community engagement and participatory planning initiatives to ensure that the needs, priorities, and concerns of diverse residents are adequately addressed in urban planning decisions.

5.3. Limitations of Virtual Observational Audit Survey

While this study provides valuable insights into the built environment of streets, it is essential to highlight its limitations. The adaptation of the MAPS-Mini tool from an in-person assessment to one conducted via Google Street View, though convenient, presents challenges regarding the evaluation of certain built environment features. As the literature has warned, Google Street View imagery is captured from a car's perspective, often above human eye level, and can be obstructed by various elements. For example, the abundance of on-street parking adjacent to sidewalks frequently obstructs online views of sidewalk conditions and maintenance. Sidewalks and building conditions were the main microscale features causing discrepancies between the Google Street View and in-person site visit scores. In this study, such discrepancies were noted on streets like Boulevard Shevchenko, Boulevard Décarie, Boulevard Côte-des-Neiges, and Avenue Greene.

Although the site visits were conducted under consistent weather conditions, Google Street View images varied, showing sunny, rainy, and snowy conditions across different streets, which hindered some online evaluations. The imagery across Montreal was not captured uniformly throughout the year, leading to additional challenges when assessing street maintenance during winter.

Due to their more temporary nature, features such as graffiti and tripping hazards on sidewalks displayed variability between online and in-person evaluations. Even marked crosswalks showed differences, with many of them faded from the winter snow. The most drastic difference observed was the completely invisible crosswalk, missing signage and new walking signal on boulevard des Galeries d'Anjou.

Site Visit of boulevard des Galeries d'Anjou

This study demonstrates that conducting street assessments using Google Street View has more flaws than the literature suggests, as score changes were observed for the majority of streets, with some showing clear discrepancies in overall scoring.

Certain questions of the MAPS-Mini tool may also be further adapted. For instance, the original auditing survey accounts for the number of parks, rather than their size. However, the size and quality of parks can potentially increase their appeal. A recommendation for future adjustments to the tool is to provide options for answering this survey question similar to the tree coverage question, in terms of the percentage of park area adjacent to the street. Additionally, the MAPS-Mini tool should consider sidewalk widths and characteristics beyond mere presence and upkeep, as these factors that can influence pedestrian experience, comfort, and safety.

Google Street View of boulevard des Galeries d'Anjou

Despite these limitations, some advantages of virtual observations were noted. Google aerial and satellite imagery proved effective for specific assessments. For example, aerial views quickly identified transit stops and routes, providing a comprehensive overview of their distribution. Moreover, as the site visits occurred in spring, trees lacked foliage, complicating the assessment of tree canopy shading. Satellite imagery, combined with street view from site visits, offered a better evaluation of the percentage of sidewalk shaded from the sun.

Overall, combining virtual and in-person methods proved to be very useful and efficient, allowing for a thorough review of streets. Researchers using the MAPS-Mini tool should use both assessment approaches, but it is important to note that in-person assessments are more accurate and thorough. They offer a more natural and human perspective that aligns with pedestrian experiences.

5.4. Future Research Recommendations

Future research should explore incorporating subjective measures of street quality to the objective assessment of street quality. Ideally perspectives of everyday users could be collected through walk-along interviews. This approach can provide valuable insight into the lived experiences and instinctive perceptions of residents, complementing the objective assessments and offering a more holistic understanding of the built environment. Go-along interviews effectively combine interviewing and field observations, enabling researchers to gain deeper insights into individuals' experiences by observing their neighborhood contexts and reactions firsthand (Carpiano, 2009).

Even experiencing streets as an auditor during site visits differed significantly from evaluating them virtually or through photos. As a pedestrian, an auditor is directly confronted with tripping hazards, missing infrastructure, and stressful crossings. Additionally, in-person experiences can reveal new elements that influence the pedestrian experience, such as traffic noise. High levels of traffic noise can make streets very uncomfortable and unpleasant for pedestrians, even if they have amenities to support their activities.

Walk-along interviews are likely to enable researchers to identify residents' street element preferences more accurately than merely showing pictures and asking people to speculate about what it might be like to be a pedestrian or cyclist in those areas. These interviews can explore a range of questions, regarding the interviewees' perceptions, activities and inclinations to use the streets (See Appendix 7.2. for interview guide).

Combining subjective information from walk-along interviews with the objective data collected from the MAPS-Mini audits can offer a more holistic understanding of the factors influencing pedestrian and cyclist experiences. This integration could reveal which elements of the built environment truly attract people to certain streets and whether their usage is influenced by amenities, social factors –such as the presence of others– or both. Additionally, future research utilizing the MAPS-Mini tool should include assessments conducted through site visits at night. This approach can provide valuable insights into the adequacy of street lighting, as the strength and distribution of light can significantly vary after dark. Evaluating nighttime conditions will help determine whether the street lighting is sufficient to ensure safety and visibility for pedestrians and vehicles.

Moreover, future research could extend beyond microscale assessments of individual street segments to explore the mesoscale. This broader perspective would involve examining elements like transit stops, mixed-use and commercial areas, as well as bicycle lanes at the neighbourhood level. By doing so, researchers can gain a more nuanced understanding of the quality of streets within a neighbourhood. For example, not all street segments necessitate transit stops, if there are existing ones at a reasonable distance still providing residents with access to that service.

Finally, exploring the changes in the built environment of major streets traversing the island of Montreal across various socioeconomic neighbourhoods presents an intriguing avenue for future studies. These main streets sometimes undergo shifts in their typologies and characteristics, making it compelling to examine how their built environment changes alongside the neighborhoods they serve. For instance, Avenue Victoria intersects both the lower-income Côte-des-Neiges borough and the higher-income Westmount area, offering a compelling opportunity to explore how the built environment along this street (and other similar streets) changes across neighbourhoods with varying socioeconomic levels.

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7. Appendix

7.1. MAPS-Mini Questions

Intersection

1. Is a pedestrian walk signal present or traffic calming measures on the street/at the intersections (stop signs, speed bumps, narrowed walkways at intersection, pedestrian island)?

- ☐ No (0)
- ☐ Yes, at one intersection (1)
- ☐ Yes, at both intersections (1)

2. Is there a ramp at the curb(s)?

- ☐ No (0)
- ☐ Yes, at least at one curb at one intersection (1)
- ☐ Yes, at all curbs at one intersection (1)
- ☐ Yes, at both intersections but not at all curbs (1)
- ☐ Yes, at all curbs at both intersections (2)

3. Is there a visible marked crosswalk?

- ☐ No (0)
- ☐ Yes, at one intersection (1)
- ☐ Yes, at both intersections (1)

Land Use

4. What ain type of land use

- ☐ Industrial or vacant (0)
- ☐ Green space (parks, accessible forest) (0)
- ☐ Residential (0)
- ☐ Institutional (education, governmental) (1)
- ☐ Commercial (1)
- ☐ Mixed (1)

5. How many public parks are present?

- ☐ 0 (0)
- ☐ 1 (1)
- ☐ 2+ (2)

Amenities

6. How many public transit stops are present, including Bixi stations?

- ☐ 0 (0)
- ☐ 1 (1)
- ☐ 2+ (2)

7. Are streetlights installed? (e.g., are there streetlights on both sides of the street?)

- ☐ None (0)
- ☐ Some (1)
- ☐ Ample (2)

8. Are there any benches or places to sit? (including bus stop benches)

- ☐ No (0)
- ☐ Yes (1)

9. Is there a designated bike path?

- ☐ No (0)
- ☐ Sharrow (0)
- ☐ Painted line (1)
- ☐ Physical barrier-multiuse path (2)
- ☐ Physical barrier-bollard (2)
- ☐ Physical barrier-concrete/grass buffer (2)

Aesthetic

10. Are the buildings well maintained?

- ☐ 0-99% (0)
- ☐ 100% (1)

11. Is graffiti/tagging present? (do not include murals)

- ☐ No (1)
- ☐ Yes (0)

Sidewalks

12. Is a sidewalk present?

- ☐ No (0)
- ☐ Yes, on one side (1)
- ☐ Yes, on both sides (1)
- ☐ Pedestrian street (1)

13. Are there poorly maintain sections of the sidewalk that constitute major trip hazards? (e.g. heaves, misalignment, cracks, overgrowth, incomplete sidewalk)

- ☐ No sidewalk present (0)
- ☐ A lot (More than 25% of sidewalk) (0)
- ☐ Some (Less than 25% of sidewalk) (0)
- ☐ None (1)

14. Is a buffer present?

- ☐ No sidewalk present (0)
- ☐ No (0)
- ☐ Yes, on one side (1)
- ☐ Yes, on both sides (1)

15. What percentage of the length of the sidewalk/walkway is covered by trees, awnings or other overhead coverage?

- ☐ No sidewalk present (0)
- ☐ 0-25% (0)
- ☐ 26-75% (1)
- ☐ 76-100% (2)

7.2. Interview Guide for Future Research

Hello, today, we will discuss your perception of different streets. First, I would like to ask you about yourself, and your neighbourhood.

1. Can you tell me about the neighbourhood you live in?

2. What comes to mind when you hear the phrase 'streets for people'?

3. What activities do you engage in while using the streets?
    3.1. Do you engage in walking, cycling, sitting on urban furniture, gardening in your front yard, interacting with other people in the streets, linger or window-shop? At what frequency?
    3.2. Has your use of streets changed over your life? How has it changed? What influenced this change?

Next, I will ask you questions about your perception of each street we are visiting.

4. What characteristics attract you to this street?
    4.1. How would these characteristics encourage you to use this street?

5. What characteristics deter you from this street?
    5.1. How would these characteristics discourage you from using this street?

6. Would you feel safe using this street? At any time of the day? Throughout the year?

7. Which of the features and amenities would you actively seek out in this street? (This may encompass benches, street lighting, bike lanes, wide sidewalks, greenery, art, specific type of buildings, and so on.)
    7.1. What additional elements would enhance the experience of the street for you?

Finally, I will ask you questions about all the streets we visited to wrap up this interview.

8. Which of the visited streets would you be the most inclined to use?

9. Which of the visisted streets would you avoid the most?

10. How important is it for you to have streets with the compelling characteristics you mentioned in your own neighbourhood? Does one of the visisted streets come to mind?

Thank you for the time you spent accompanying me in this walk-along interview.