MORE
Multimodal Optimisation of Roadspace in Europe

D5.4

Option generation and appraisal for future street conditions

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Version:	**1**
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1 Introduction

1.1 The MORE Project

The primary aim of MORE is to provide a comprehensive and objective approach to the planning, design, management and operation of road space on major urban corridors feeding the international TEN-T road networks (Figure 1).

This is so that limited road space and capacity can be optimised, through the development of new concepts, tools and processes (which is developed and tested in five cities). This takes into account the multi-modal functioning of the corridors and their links with major inter-modal interchanges (e.g., ports) to enable city authorities to optimally allocate limited available capacity, in space and time.

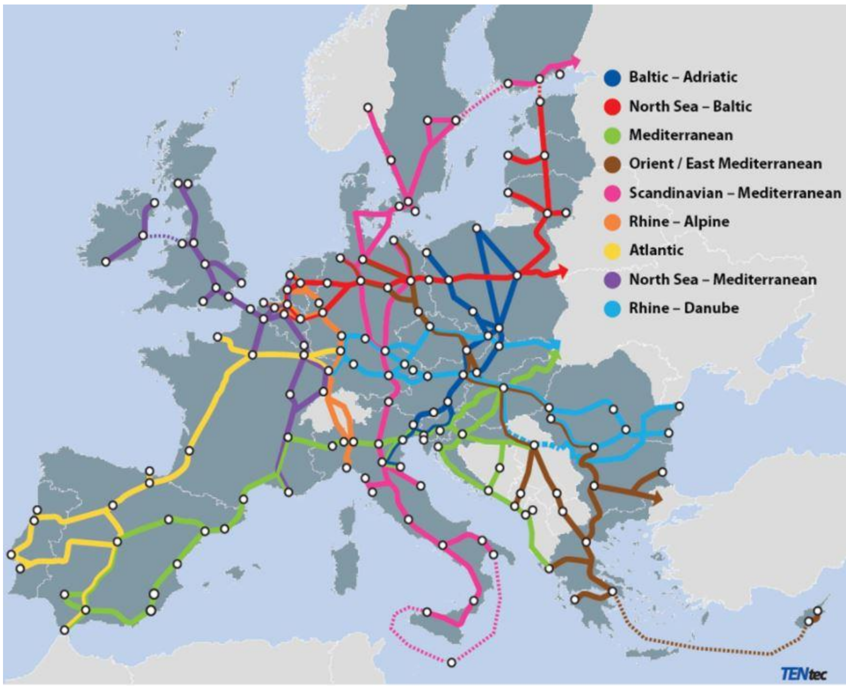


Figure 1. TEN-T Network (Source: European Commission)

The MORE ambition is to understand the current situation of the corridors in the partner cities, but also to understand how future trends may influence the way the roads are used.

1.2 Objective of Deliverable

This report presents the experiences of the five cities in following the MORE approach to developing optimal road-space management packages for their selected urban corridors. This focuses on sections that are expected to be under stress in the future.

This is due to growing multiple demands from different road users, mobility modes and land uses. These challenges present themselves in cities across Europe experiencing economic and demographic changes - as well as planned new housing, businesses and infrastructure – which might result in result in congestion, poor air quality and unreliable journey times.

This focus on “future conditions” translates to looking between 10 and 20 years henceforth.

The report presents how these road space management packages have been co-created with multiple stakeholders and the public; then modelled and appraised. The street designs which lead to the most positive impacts are highlighted, as are the resulting key performance indicators.

It takes the same form as D5.3 which addresses the current street conditions.

The aim is to enhance the ambition of street design and better accommodate new mobility modes in the future through an innovative process, making use of the four sets of MORE Tools:

- Generate street design options: Policy Interventions Tool and Street Designs Tool
- Stakeholder and public engagement and visualisation tools: Traffweb and Linemap
- Modelling tool to simulate operation of street design: enhanced Vissim
- Valuation of impacts of different street designs: Appraisal Framework Tool

This deliverable comprises one chapter for each of the five city MORE case studies and presents the step-by-step process they have followed in applying these tools.

This approach can now be replicated by other cities across Europe, drawing on the full range of outputs on the MORE website www.roadspace.eu.

2 Budapest

2.1 A brief summary of future conditions along the Stress Section

The topic of D5.4 deliverable is the future conditions of the Stress Section in Budapest. This deliverable is similar to the D5.3, which contains information on the current condition of the Budapest stress section. That deliverable contains the short recap of the Stress Section, the details of participative process, application of MORE tools in Budapest and general information about the design days.

2.2 Generating street design options in the stakeholder exercises

2.2.1 Design Days for Future Conditions

The Urban and Transport-focused design days workshops were organised by BKK in the summer of 2021. The aim of design days was to identify the present and the future conditions of the stress section of the MORE project and outer part of it (the whole Rákóczi road) in Budapest by transport, social, economic, technological and political aspects. BKK invited to the meetings the Mayor's office's departments and other companies, which have influence on transport, urbanistic or green aspects (Budapest Public Road company (road operator, Budapest transport company (PT provider), Budapest Urban Planning company, Chief Architect of Budapest, Chief Landscape Architect of Budapest, Budapest Public Space Maintenance company.

The 2 workshops held in personal at BKK HQ. Approximately 22 experts participated at each workshop. The 3-hour long events had a specific methodology to reflect and seek the current and future conditions of the whole Rákóczi axis. (Budapest stress section is part of Rákóczi axis).

The Urban aspect workshop held on 21st July 2021 with the following entities: BKK Centre for Budapest Transport (Strategic planning, Mobility Development, Project Implementation Depts.), Mayor Office, Chief Architect, Chief Landscape Architect, Budapest City Planning Ltd., Budapest Public Space Maintenance Ltd., Budapest Horticultural Ltd.

The Transport aspect workshop held on 26th July 2021 with the following entities: BKK Centre for Budapest Transport (Mobility Development, Mobility Management Depts.), Budapest Public Road, Budapest Transport Ltd., Budapest City Planning Ltd.

Figure 2. Design Days – Future Conditions

The participants of the workshop identified the technological, transport and urban vision of Rákóczi út (urban identity, public space function, humanization) through a multifaceted analysis based on dedicated methodologies (TfL movement and place matrix), questions and international good examples (existing public space reallocations). The whole Rákóczi road was analysed similar to the current condition at the design days.

- Technological vision:
    - Technology should be seen as a tool to achieve the goals set,
    - Systems should be designed so that everything has a function (not just an aesthetic one) and is people-centred,
    - When introducing new technologies, it is necessary to create a regulatory environment that can handle mixed systems properly,
    - In order to ensure equal opportunities, accessible stops and crossing points should be designed in the long term. Increasing the number of pedestrian surfaces and pedestrian crossing points is a priority for future planning by providing appropriate technology.
- Transport vision:
    - Reduction of the number of road lanes on Rákóczi road with a rethinking of the overall cross-section (cycle lane, central or edge public transport lane (bus, tram)) and its role in the transport network,

- Traffic mitigation measures need to be addressed at the city level, creating LEZ/ZEZ zones,
- Changing mobility needs and the proliferation of micro-mobility devices require the development of (micro)mobility points. Integrated applications are needed to facilitate the parking process,
- Last-mile deliveries by drones, the development of new concentrated loading points and the delivery of packages by environmentally friendly vehicles (electric vehicles, cargo bikes) are part of the logistics vision.

- Impersonation of Rákóczi road:
  - In its current state, Rákóczi road can be identified as a troubled person who has lived through better times, while in the future vision it is a young dynamic individual or even a family. This associates with the need to design such a defining and much used public space for women and children to be comfortable and accessible for all.
- Identifying the functional vision of Rákóczi road:
  - In its current state, Rákóczi road is in the highest mobility category on the axis of local importance and strategic importance and is more in the strategic category in terms of the importance of place. In its future vision, Rákóczi road is the inverse of its current situation, with reduced mobility needs and a focus on urban functions, functioning as a kind of sub-centre,
  - Rákóczi road can be divided into 3 or 4 different sections in terms of function (between Keleti Railway Station and Blaha Lujza square; between Blaha Lujza square and Astoria; between Astoria and Ferenciek square (Erzsébet bridge)). The environment of the terraces favours the development of heterogeneous functions,
  - The section between Blaha Lujza Square and Keleti Railway Station is expected to have a stronger traffic function in the future due to the station's closure. More pedestrian and green space could be provided by gradual traffic calming towards the city centre. This area could even be used to create thematic sections with a recurring cultural function, building on the catering or the remaining cult shops. These findings are particularly true for the innermost area, the Budapest stress section.

Technological vision in details

In the process of creating a technological vision, the experts at the workshop looked at what new technologies and other regulatory options could be used to develop the Rákóczi Road (the stress section of the MORE project) in the long term. And how the various negative impacts could be addressed. The workshops revealed a wide range of solutions and the wide spectrum of knowledge of the participants led to the discussion of different professional methods to address the problems. Technology should be seen as a means to an end, so the end is not the technology itself. In future developments, particular attention should be paid to people-centred elements and mindset building. Systems should be designed so that they all have an appropriate function (not just an aesthetic one), but care should be taken that they are not over-functional. When introducing new technologies, it is necessary to create a regulatory environment that can adequately handle mixed systems (conventional vehicles, micro-mobility devices, autonomous vehicles).

When introducing these devices, it is important to find the right means of communication to explain to society the use of innovative solutions and to reassure city dwellers about the safe use of these developments. In the spirit of sustainability and environmental protection, future planning should use innovative green technologies that can go hand in hand with transport development. An example is the SFR (Stockholm Tree Planting Scheme) technology, which serves the interests of city residents, plants and city operations at the same time. To solve existing drainage problems, water retention technologies or other innovative solutions (e.g., permeable pavement) are needed. Examples of ways to increase green space include green walls and green facades. In order to ensure equal opportunities, accessible public transport stops, and pedestrian crossing points should be designed in the long term. Increasing the number of pedestrian surfaces and pedestrian crossing points is a priority for future planning.

Transportation vision in details

One of the key elements of the Rákóczi axis (the stress section of the MORE project) transport vision is lane reduction. This can only be achieved by rethinking the whole intersection and defining its role in the transport network. Traffic calming measures need to be addressed at the urban level and their impact will be felt on the Rákóczi axis. The priority in the area will be to develop a cycle lane and a public transport lane (bus lane - central/inter-urban; tram). Particular attention should be paid in the design to ensure protection against traffic-induced vibration. As part of the logistical vision, drones should definitely be mentioned for last-mile deliveries, which can be used to reduce the number of lanes, as vehicles used for small parcel deliveries do not occupy road infrastructure. In the planning process, it may be useful to include the Danube in the transport process, thus also relieving congestion on the road. Other elements should include concentrated loading points, consolidation centres and LEZ/ZEZ zones. Delivery should be carried out by environmentally friendly vehicles (electric vehicles, cargo bicycles). An important issue is to develop a vision for parking measures. The spread of micro-mobility devices requires the development of mobility points/micro-mobility points in the city. To facilitate the parking process, integrated applications are needed to manage the occupancy of parking spaces, reservations, payment of fees and other parking functions.

The importance of Place

Both workshops brought up nostalgic thoughts about the beautiful memories of the past, and the built heritage that bears them - the iconic shops and restaurants from the heyday of the Rákóczi út - Kossuth Lajos axis (the stress section of the MORE project), and both workshops raised or at least raised the question of whether the axis is the main street of the city, whether it has such a role. Clearly both emerging and prominent features are catering, shopping, shops and cultural services. Participants in the urban focus workshop tended to look at the site from the point of view of the residents and local users, while the transport focus workshop also strongly emphasised the role of each section for tourists.

Recurring phrases and ideas **from both workshops**:

- the main street of the city
- built heritage
- community, community space
- catering, catering focus
- bridge the viewpoint/viewpoints cross-section of the bridge
- thematic sections, thematic shops

Among the terms used at the **urban-focused workshop**, the following stand out, which were less or not at all used among transport professionals:

- humanisation, human scale
- public space without consumption constraints
- public space is not just a terrace
- squatting, multi-cultural
- atmospheres

The terms and ideas that were used in the **transport-focused workshop**, which were not highlighted in the urban focus:

- hostels, tourism
- transversal connections
- instead of separating, collecting, distributing, connecting

The two tables below show the results of the urban focus workshop and the transport focus workshop.

Table 1. Workshop 1 - sections and related brainstorming ideas/thoughts

Main street, the main street of the city	Alter main street	Divergent characters on the axis	Making the built heritage visible	Lottery store, Rákóczi bakery	The atmosphere of side streets
century-old houses, built heritage	Shopping, bookshop	Arcades as a resource	Rákóczi út as advertising	Large shop window	More pedestrians inside the Grand boulvard
Clothing stores and shops too	Hospitality focus	Traffic load	Shopping, shopping street	Traffic calming increases attractiveness	Walking, strolling
Oxford Street is a good example	Let walking be the goal	Representative	Avenue	Traffic calming	Book Palace
The whole Rákóczi road - Kossuth Lajos street axis (stress section)	Cross-section quietening towards the south	Piac street, Debrecen	Culture: Pushkin, Klotild, Uránia	Thematic sections	Thematic markets
	Falling in love	Talking, walking to the Danube	Not just a terrace in the public space	Public space without forcing the consumption	Humanisation, on a human scale
Keleti railway station	Railway + Plaza terminal	Ice cream, walk, talk	Level up, airport lounge quality		
intermediate section	Gate	More of a transport role	External section more traffic	Local, neighbourhood features	Shops with higher delivery needs
Blaha Lujza square	More pedestrians inside the Grand boulvard	Old department stores: Corvin, Úttörő			
intermediate section	Community spaces	Bustling life, Multi-cultural	Gasztro-tengely	Controlled sitting-out function	Terraces, seating
	Little squares	Palotaquarter, Rókus Hospital	pedestrians do not only use the ped. crossing	Street furnitures	
Astoria	Bustling life, Multi-cultural	Terraces, seating			
intermediate section	Civilised, high culture	More pedestrians inside the Grand boulvard			
Ferenciek square	Strengthening the Danube link	Civilised, high culture	Fixed functions	Crossaxis	
intermediate section	Crossaxis	Váci street	Built heritage	Gastro axis	
Danube	Gate	View of Gellért hill	Meeting of sights		

Table 2. Workshop 2 - sections and related brainstorming ideas/thoughts

Section					
Use of landmarks	Let the street show its old face	Cross-link connections	Instead of separation, connecting function	The main street of the city?	Historical values
Stores' light	Role in the urban structure	prestige	Local trade	Hospitality & catering	Similar to Grand Boulvard
The whole Rákóczi road - Kossuth Lajos street axis (stress section)	Comparing Váci street and Rákóczi road	Relations between buildings and transport	Transit	Outstanding architectural values	Driveway as a beauty spot
Keleti railway station	Incoming tourist walks down to the Danube	Tourist falls in love with the city	First impression of the city	Keleti railway station's building	
intermediate section	Hotels, non-residential	Not terraced	Hostels for Tourists	Office buildings	Appearing the II. János Pál pápa square, Rózsák square
	Culture, Erkel theatre				
Blaha Lujza square	Old Grand Boulvard	Market	Corvin, and Úttörő Store		
intermediate section	Let it be mixed!	Stores, Shoping malls	Christmas market	Grand Boulvard's feeling	Shoping windows
	Tourists walking	Kazinczy street, Vas street			
Astoria	Community arena	Social area	Restaurants		
intermediate section	Tourists walking	Terrace, hospitality			
Ferenciek square	Thematic	Heart of Budapest	Klotild palace		
intermediate section	Strolling, walking	Café, baguette, French	Bartók Béla road		
Danube	Bridge to the lookout	Make the bridge environment attractive	Tourist route across the Danube		

Personalization

To further explore the specificities of the Rákóczi út - Kossuth Lajos utca axis, the participants of the workshops were also given a metaphorical task to give human qualities to the Rákóczi út of today and its desirable future version in 2030 (in line with SUMP timelines). The results of the two workshops on this topic are shown together in the two-word clouds below.

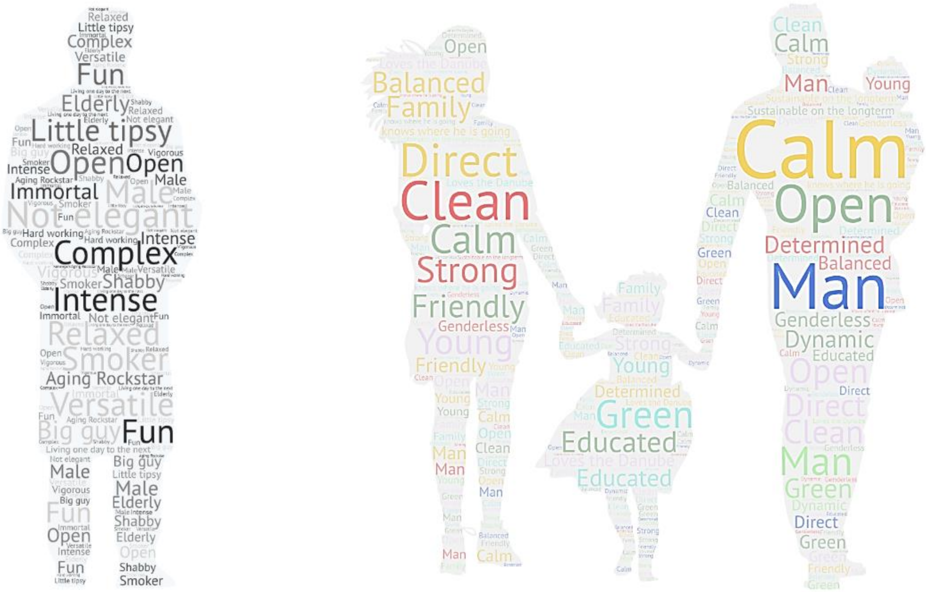


Figure 3. Human qualities assigned to the current conditions (left) and future desired conditions (right)

The former portrays the current state of an older man with health problems who has seen better times, who has the good qualities of being open, cheerful and versatile, but who is poorly dressed, shabby and an outdated rock star.

Until then, the future desirable condition is not a person, but a whole family, as suggested in the transport-focused workshop, because if the professionals design public spaces for children and women, it will be more comfortable and safer for all users. This individual or family, young, dynamic, but also calm and direct, green, sustainable in the long term.

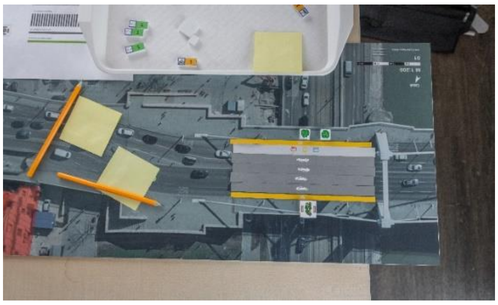
Using blocks and acetates to design future conditions

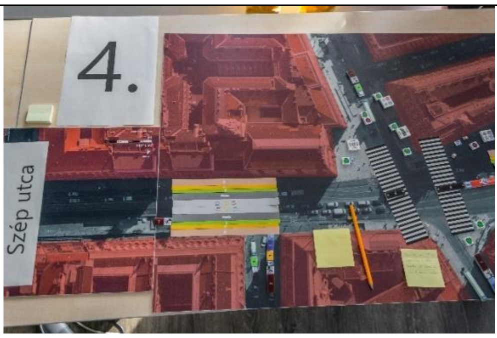
After examining the Stress section and the entire Rákóczi road, participants used the blocks and acetates measures available in the MORE project to express the use of public space. Using the blocks and acetate, the participants of the design days were able to create an ideal cross-sectional design of the Stress Section and the entire Rákóczi Road. During the process, the guests were able to consider the available cross-section, an urbanistic and traffic point of view, for the present (near future 1-2 years) and the medium term (2030). Participants in the workshop formed small groups to propose a design for each section. The versions produced were commented on by the other participants during the workshop, so that a consensus design for the stress section and the whole section could be achieved. The outputs (raw results) are presented in the following table.

Once the outputs (raw results) were ready, the experts involved in the MORE project aligned them and looked at how they fit with existing strategic policies (parking, taxis) in several respects and came up with an optimal, good solution. (e.g. parking, taxi, micro-mobility, etc.). Based on these and previous inputs, we gained the outcomes of the design days with 3 alternative designs developed for the present and 3 designs for future (2030) conditions, these were presented after the raw results of the Design Days workshop.

Results of the design days - Future Conditions

Table 3. Results of the design days Future Conditions

Section	Design Day for Transport aspect	Design Day for Urban aspect
From Erzsébet bridge to Astoria (surrounds of Ferenciek square	Pictures: Erzsébet-bridge:  Junction of Váci street at Kossuth Lajos Street (start point of the Stress section)  Ferenciek square:  Between Városház street and Szép street:	Pictures: Erzsébet-bridge:  Junction of Váci street at Kossuth Lajos Street (start point of the Stress section)  Ferenciek square:  Between Városház street and Szép street:

		
	Outputs: Erzsébet bridge • K+R at the corner of Erzsébet híd Váci utca next to the right turn lane from Buda Junction of Váci street at Kossuth Lajos Street (start point of the Stress section) • keeping the existing pedestrian crossings • loading area in the northern part of Váci street, catering terraces, point greenery Ferenciek square: • public transport lanes at the middle of the street • one car lane at each direction • green lane • cycle lane at each direction • terracing with fountain, point greenery, benches, clock, terraces • replacement of underpass with surface pedestrian crossing • replacement of the surface pedestrian crossing on the Danube side of Petőfi Sándor Street • at Károlyi street: retail area, mobility point, terraces, green area, drinking fountain and fountain	Outputs: Erzsébet bridge • pedestrian connection into Danube Junction of Váci street at Kossuth Lajos Street (start point of the Stress section) • Erzsébet bridge not touched • Japanese Shibuya-type diagonal (higher capacity) pedestrian crossing at the intersection of Váci utca - Kossuth Lajos utca • Wide cycle lane Ferenciek square: • Bus lanes at the middle of the street • one carriage lane in each direction • wide cycle lane • new pedestrian crossing (where pedestrian underpass available) • green lane between the pedestrian and cycle lane • public space features: goods loading, shared parking, cycle storage, disabled parking • provision of recreational benches, shelters Between Városház street and Szép street:

	Between Városház street and Szép street: • public transport lanes at the middle of the street • one car lane at each direction • green lane • wide sidewalk • place for loading goods • at Városház street: disabled parking, mobility point, double goods bays, bicycle racks	• Public transport lanes next to the kerbside (its not fitting to the “general concept: putting bus lanes at the middle of the street”) • car lanes at middle of the street(its not fitting to the “general concept: putting bus lanes at the middle of the street”) • one carlane in each direction • Mobility point in crossing small street (Városház street) • -Packing and loading points (city logistic) location • green areas
Surrounds of Astoria	Pictures: Astoria junction:  Between Astoria and Puskin street (endpoint of the Stress section) 	Pictures: Astoria junction:  Between Astoria and Puskin street (endpoint of the Stress section) 
	Outputs: Astoria junction • standard surface pedestrian crossings intead of shibuya-type pedestrian crossing	Outputs: Astoria junction: • Pedestrian crossings (where missing) • one car lane in each direction

	• drinking fountains, wells, greens, trees, Rákóczi road: • new pedestrian crossings • public transport lanes at the middle of the street, separating the directions with green lanes • one car lane and another one at the right turns • green lanes • cycle lanes • sidewalk • double loading points for goods and disabled parking at the south side of the junction • micro mobility points and recreation place at the north side of the junction • fountains, wells, green areas with bushes and trees. Between Astoria and Puskin street (endpoint of the Stress section) • public transport lanes at the middle of the street, separating the directions with green lanes and trees • one car lane at each direction • green lanes • cycle lanes • wider sidewalks • terraces, micro mobility points, place for recreation	• wide cycle lane • landscaping in front of East-West office building • landscaping in front of MTA palace, trees, seating areas • Loading and packing points (city logistic) • bicycle storage • mobility point (car-sharing parking) Rákóczi road: • Bus lanes at the middle of the street • one car lane in each direction • separate micro mobility lane • double green lane on one side • extra pedestrian crossing to access bus stops • loading space, shared transport parking • mobility point • dispersed catering facilities Between Astoria and Puskin street (endpoint of the Stress section) • bus lanes at the middle of the street • one car lane at each direction • cycle lane at each direction • wide green lanes with trees • fountains • micro mobility points

2.2.2 Fine tuning of the outcomes of Design Days

After the Design Days, a number of discussions were held with BKK experts on the possible design of the Stress Section. Discussions focused on existing strategies and plans, and public space design plans were considered. These included: planned cross-sectional design of Budapest bridges in the short and medium term, parking, taxi, city-logistics strategy, public transport network in the short and medium term, traffic calming in the city centre, reduction of road lanes, new cycle lanes, new public space functions in Kossuth Lajos Street and Rákóczi Street (Stress Section), possible design of micro-mobility points, mobility points and mobility stations, strategy for shared vehicle storage.

To take these aspects into account, the primary results of the design days were refined to link them to current and future conditions. The options identified for future conditions were:

- Scenario 0: Current layout at the Stress section with the future (2030) traffic demand
- Scenario 1: Conservative approach (Mixed version of Transport and Urbanistic approach)
- Scenario 2: Transport approach
- Scenario 3: Urbanistic approach

In the future scenarios, the location of the kerb changed at the road, which was one of the main differences from current scenarios. Changing the kerb allowed more extensive interventions. However, the tubular design of the stress section only allowed changes to be made at major intersections.

Short descriptions of the scenarios are as follows

- **Scenario 0: Current layout at the Stress section** with the future (2030) traffic demand
    - The version has a current layout (No change in the version compared to the current design), considering the public space, numbers and functions of the lanes, width of sidewalks. The traffic signal optimized due to the future traffic demand. Every pedestrian crossing has a traffic signal.
    - Public Transport service (lines and stops) is not changed from current state.
    - The future traffic and public transport demand were modelled with the BKK macroscopic model. The future possible changes at the road network of Budapest were taken into account at the modelling process, i.e., traffic calming measures at the neighborhood level street networks, reducing traffic lanes at the main road of Budapest's downtown. Pedestrian traffic is changed, the surveyed data multiplied by 1.1.

- **Scenario 1: Conservative approach (Mixed version of Transport and Urbanistic approach**)
    - The location of the kerb changed.
    - This scenario is the mix of Transport and Urbanistic approach scenarios, and the base of the scenario is the former plan on Rákóczi road.

- Some changes to the design, but no changes to the current kerbside.
- 1 car lane per direction, 1 cycle lane per direction, 1 bus lane per direction.
- Redesigning signal plans at intersections and pedestrian crossings for optimal traffic flow. Every pedestrian crossing is designed with traffic signal at Kossuth Lajos street-Rákóczi road (Stress section)
- New kerbside activities, parking facilities
- At junctions (Váci street - Kossuth Lajos Street; Ferenciek square, Astoria (Kossuth Lajos street - Rákóczi road - Múzeum boulvard - Károly boulvard) ensuring existing intersection turns
- In the BKK macroscopic model, the transport approach to public space design was modelled for analysis and synthesised for the road traffic counts carried out in the MORE project in autumn 2019. This methodology has ensured that future traffic data is available for smaller streets (where the strategic macroscopic model does not yield results). Pedestrian traffic is changed, the surveyed data multiplied by 1.2.

- **Scenario 2: Transport approach**
  - The location of the kerb changed.
  - Some changes to the design resulting from the Design Days.
  - 1 car lane per direction, 1 cycle lane per direction, 1 bus lane per direction, the bus lanes at the middle of the street.
  - The traffic lane for cars is narrow (less than 3m), due to this, the speed limit is 30km/h.
  - Redesigning signal plans at intersections and pedestrian crossings for optimal traffic flow. Every pedestrian crossing is designed with traffic signal at Kossuth Lajos street-Rákóczi road (Stress section)
  - New micro-mobility points have been designated (bike storage and e-scooter storage for private and share mobility), city logistics points designated.
  - Expansion of the public space function with parklets and extension of the pavement.
  - At junctions (Váci street - Kossuth Lajos Street; Ferenciek square, Astoria (Kossuth Lajos street - Rákóczi road - Múzeum boulvard - Károly boulvard) ensuring existing intersection turns
  - In the BKK macroscopic model, the urbanistic approach to public space design was modelled for analysis and synthesised for the road traffic counts carried out in the MORE project in autumn 2019. This methodology has ensured that future traffic data is available for smaller streets (where the strategic macroscopic model does not yield results). Pedestrian traffic is changed, the surveyed data multiplied by 1.2.

- Public Transport service (lines and stops) is not changed from current state.

- **Scenario 3: Urbanistic approach**
  - The location of the kerb changed.
  - The transport-oriented design differs only slightly from the urbanistic approach.
  - Some changes to the design, but no changes to the current kerbside.
  - 1 car lane per direction, 1 cycle lane per direction, 1 bus lane per direction.
  - The traffic lane for cars is narrow (less than 3m), due to this, the speed limit is 30km/h.
  - Redesigning signal plans at intersections and pedestrian crossings for optimal traffic flow. Every pedestrian crossing is designed with traffic signal at Kossuth Lajos street-Rákóczi road (Stress section)
  - New micro-mobility points have been designated (bike storage and e-scooter storage for private and share mobility), city logistics points designated.
  - Expansion of the public space function with parklets and extension of the pavement.
  - At junctions (Váci street - Kossuth Lajos Street; Ferenciek square, Astoria (Kossuth Lajos street - Rákóczi road - Múzeum boulvard - Károly boulvard) ensuring existing intersection turns
  - In the BKK macroscopic model, the transport approach to public space design was modelled for analysis and synthesized for the road traffic counts carried out in the MORE project in autumn 2019. This methodology has ensured that future traffic data is available for smaller streets (where the strategic macroscopic model does not yield results). Pedestrian traffic is changed, the surveyed data multiplied by 1.3.
  - Public Transport service (lines and stops) is not changed from current state.

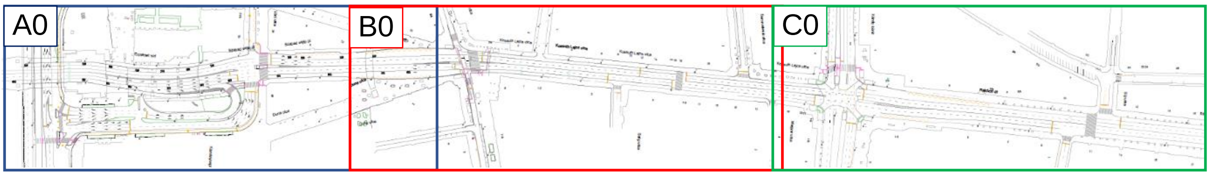
The most significant differences between the variants are:

- In the modified design versions, there is 1 road lane per direction in the Stress Section, however, in the Erzsébet Bridge (Entry area for the stress section from West), the location of bus stops, bus lane locations and the number and location of road lanes are different.
- All the new designs have cycle lanes, but their location, especially at junctions, varies.
- Number and location of pedestrian crossings.
- In the Transport and Urbanistic versions, the design of the peripheral areas is varied and heterogeneous (green area, benches, sitting, kerbside activities, loading points, etc.). The conservative version has a homogeneous design.

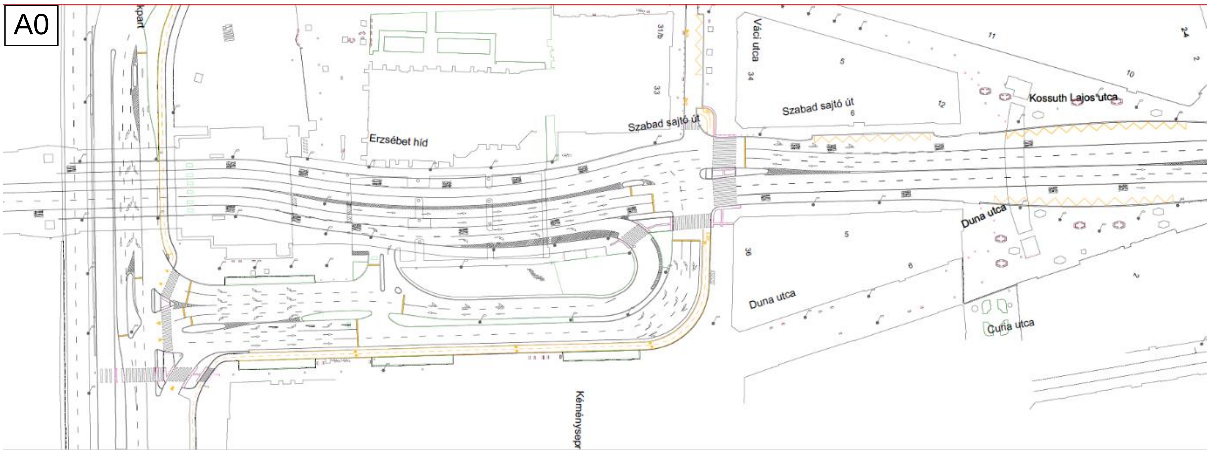
- Estimating pedestrian traffic is difficult, for the Urbanistic design we have assumed a higher pedestrian traffic than in the other cases.
- There are differences in the design of major junctions (Váci utca-Kossuth Lajos utca (Bridgehead of Erzsébet bridge), Astoria.

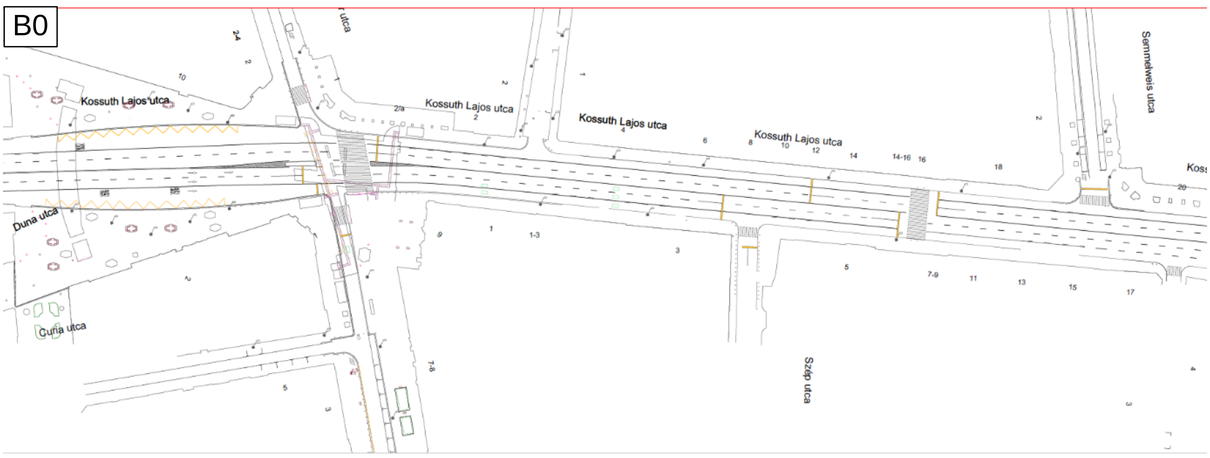
Layouts of the futures conditions

The current layout in the future and 3 alternative scenarios at the long-term time period by 2030.



Parts of the section:





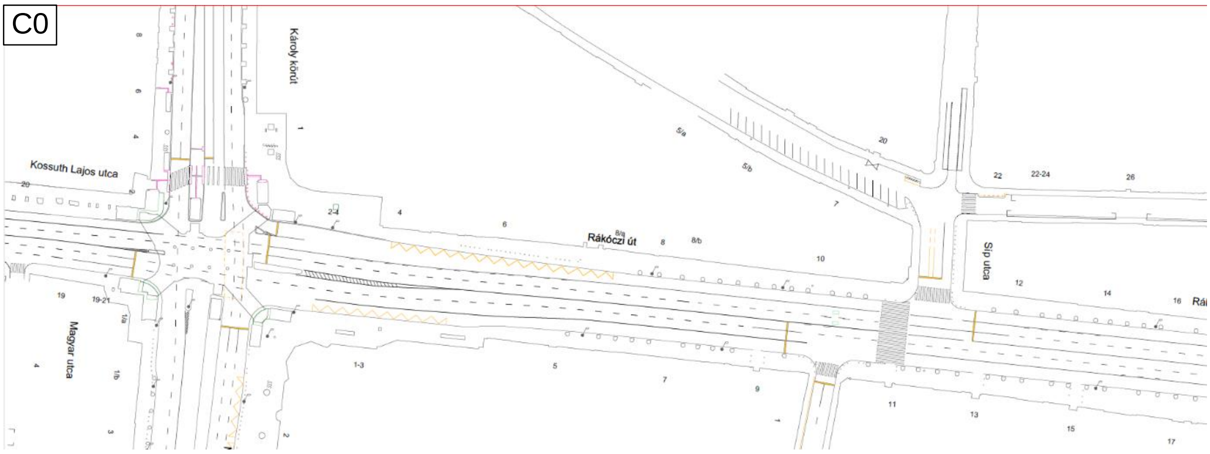
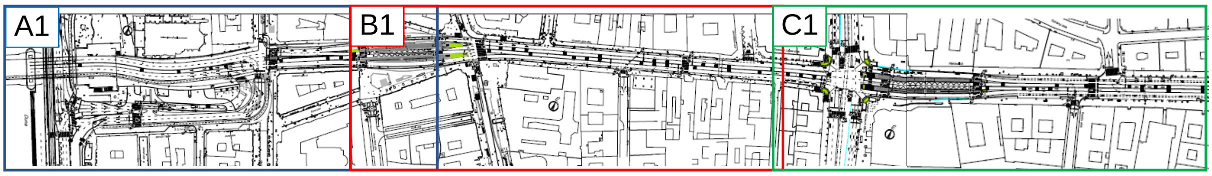
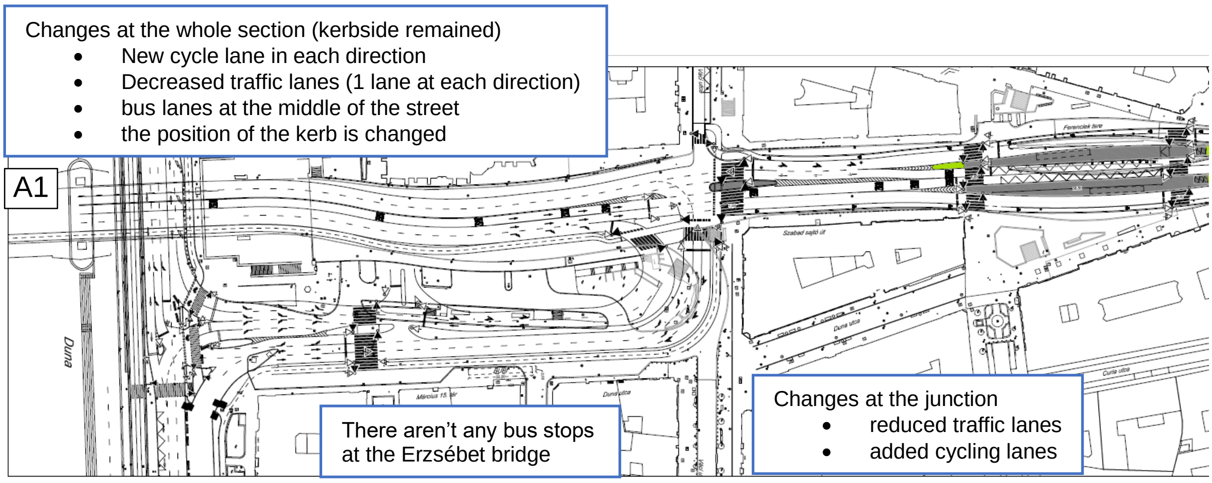
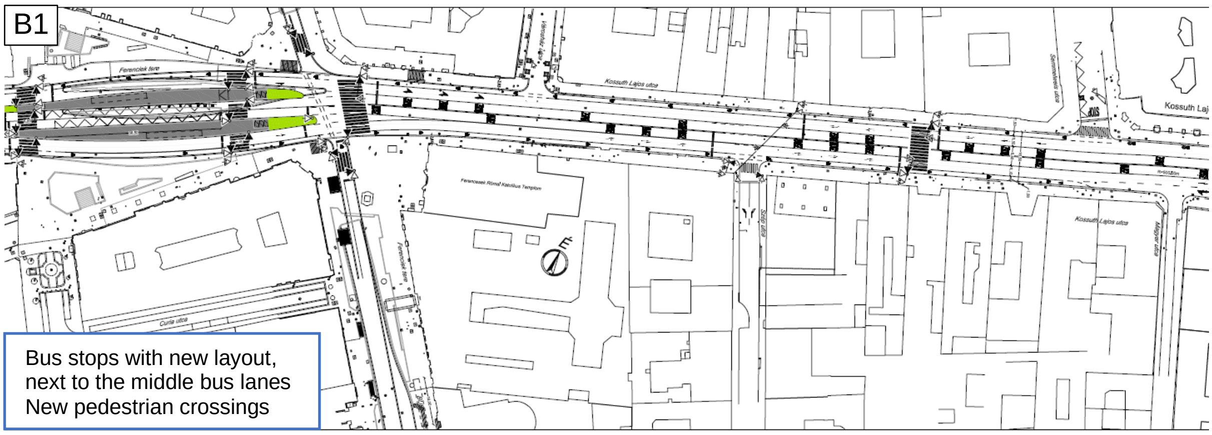


Figure 4. Scenario 0: Current layout at the Stress section with the future (2030) traffic demand







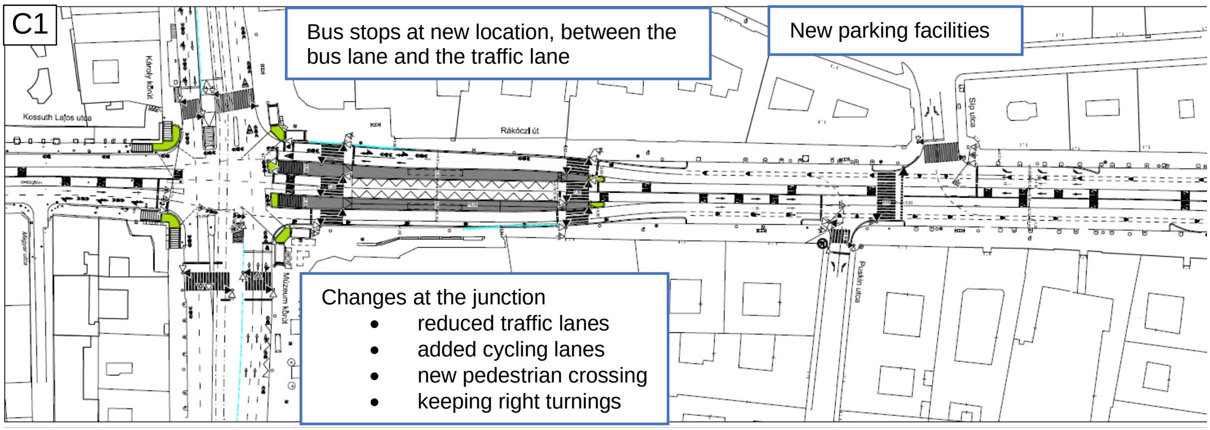
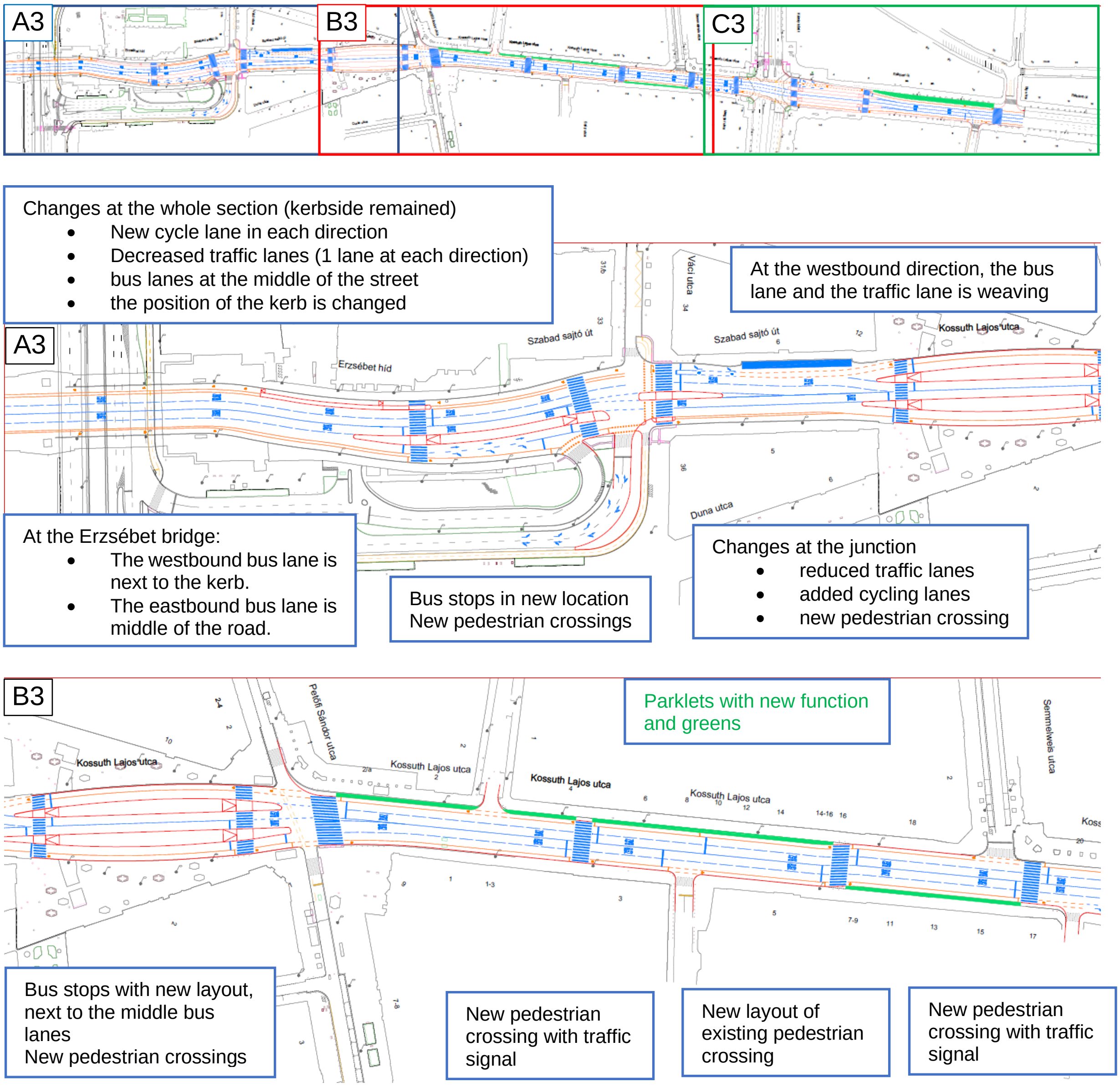


Figure 5. Scenario 1: Conservative approach (Mixed version of Transport and Urbanistic approach)



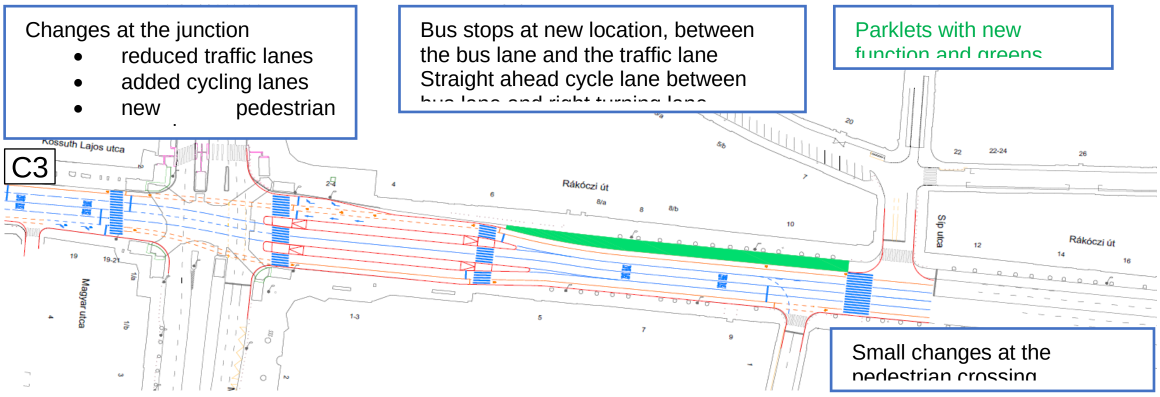
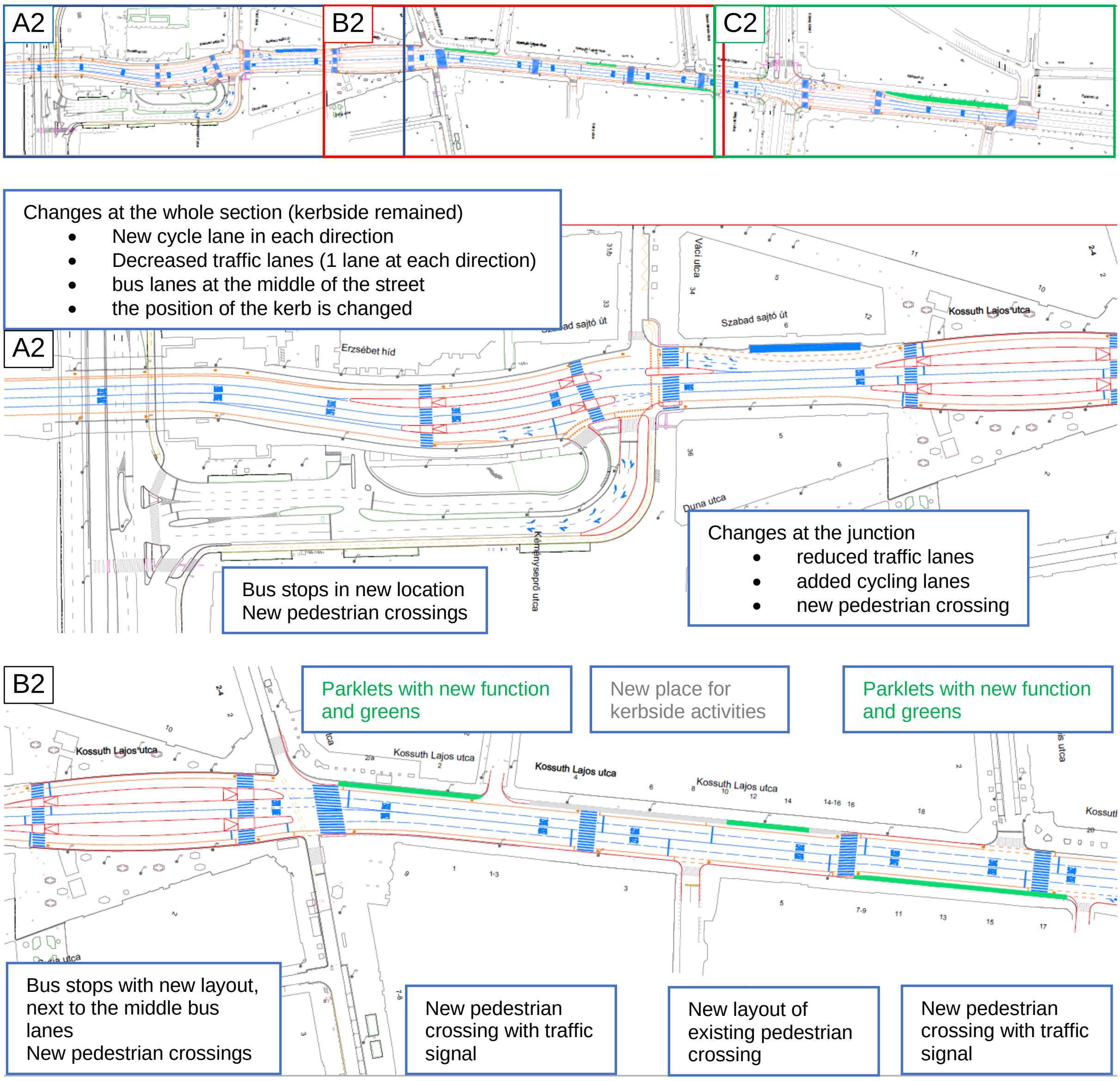


Figure 6. Scenario 2: Transport approach



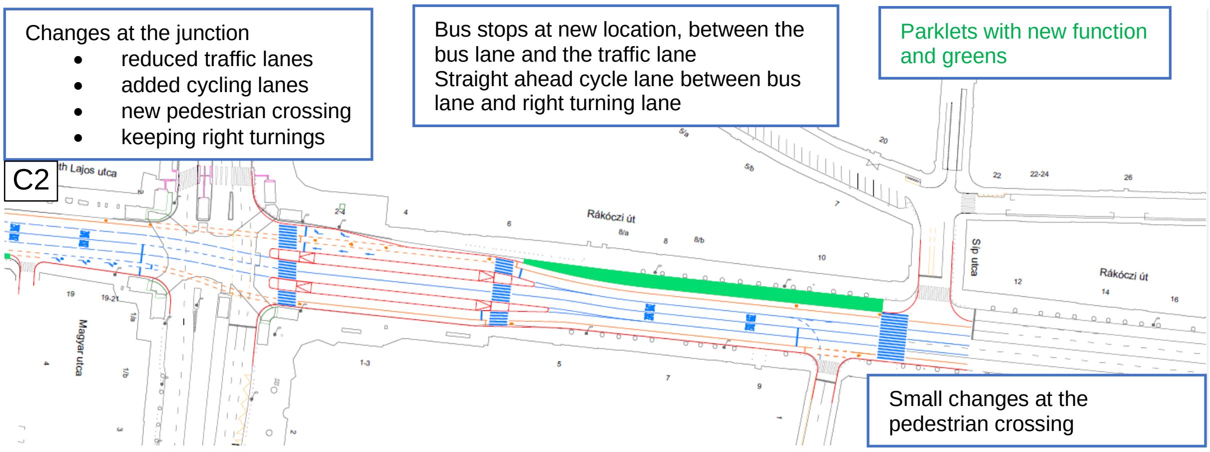


Figure 7. Scenario 3: Urbanistic approach

2.3 Building and applying the Vissim model

2.3.1 General description of the modelling phase

The modeling exercise started after the variation generation. As part of the modeling exercise, the road, pedestrian traffic survey and public space analysis data from November 2019 were first processed and refined for the modeling environment. The data available after processing provided the traffic data for modeling. The cross-sectional pedestrian traffic count data was processed with the public transport stop passenger data for refining pedestrian data.

For road traffic, the data processing involved the use of a quarter-hourly traffic input per vehicle category, complemented by the use of quarter-hourly resolution interchange destination matrices, also separated by vehicle category. As for pedestrian and passenger traffic - where no directionality data were available - the cross-sectional, stop-station passenger traffic was converted into directional concepts using the gravity method, which is widely used in analytical traffic modelling. Here, again retaining the same resolution, this produced a 45 x 45 cell pedestrian destination matrix every quarter hour, which gave both the inbound traffic and its directionality over the whole area.

The floating car measures were used to calibrate the road modeling results. The public transport network and passengers (boarding and alighting) were derived from the 2019 survey. The modelling tasks were performed by a contractor selected through a procurement process. BKK experts consulted with the contractor's experts on a weekly basis.

The Vissim models were created after the preparation of the input data. The modelling exercise was completed for all 4 versions, i.e:

- **Scenario 0** Current condition at the stress section with the future (2030) traffic demand
- **Scenario 1** Conservative (mixed version of Transport and Urbanistic versions)
- **Scenario 2** Transport approach
- **Scenario 3** Urbanistic approach

In each case, modelling was carried out for 4 periods:

- morning peak hours: 6AM-9AM;
- during the day (interpeak): 11AM-2PM;
- afternoon peak hours: 4PM-7PM,
- evening: 7PM-10PM

Based on the available data, traffic data was modelled and evaluated on a quarter-hourly (900s) basis. The following picture shows the whole modelled area for the base version - current condition at the stress section in Vissim simulation. The base network built in the modelling is larger than the area under study to obtain more accurate modelling results. The traffic signals in the base version (0th version) are the current design with optimalisation of green time, in the other three cases they are optimized for traffic, which optimization is done for all road junctions and new pedestrian crossings.

The urbanistic approach version, transport approach version and the conservative version have major differences with the reduced traffic lanes and new cycle lanes. Taking into account the future street network elements (traffic calming at the local streets and reducing traffic lane at the downtown of Budapest in general) also had have a sort of effects to the traffic flow of the stress section. These modifications were modelled with the Budapest macroscopic model and the traffic inputs for Vissim modelling were refined. These ones have better environment for placing and living in the streets, the pedestrian traffic increased in all of the scenarios with different parameters. The Urbanistic approach (Sc 3) has the highest estimation of pedestrian traffic, and the Scenario 0 has the lowest estimation of pedestrian traffic. The following table summarises the main inputs of the Vissim models.

Table 4. Main inputs of the Vissim Models

Version	Road traffic	Public transport	Pedestrian traffic	Signal control
Scenario 0 current condition at the stress section with the future (2030) traffic demand	modelled with the Budapest Macroscopic model, changes at traffic capacity at city roads and demand by 2030 taken into account	current PT lines; passenger from 2030 modelled results	surveyed data multiplied by 1.1	optimized signal control based on the traffic
Scenario 1 Conservative version	modelled with the Budapest Macroscopic model, changes at traffic capacity at city	current PT lines; passenger from 2030 modelled results	surveyed data multiplied by 1.2	optimized signal control based on the traffic

	roads and demand by 2030 taken into account			
Scenario 2 Transport approach	modelled with the Budapest Macroscopic model, changes at traffic capacity at city roads and demand by 2030 taken into account	current PT lines; passenger from 2030 modelled results	surveyed data multiplied by 1.2	optimized signal control based on the traffic
Scenario 3 Urbanistic approach	modelled with the Budapest Macroscopic model, changes at traffic capacity at city roads and demand by 2030 taken into account	current PT lines; passenger from 2030 modelled results	surveyed data multiplied by 1.3	optimized signal control based on the traffic

During the simulation process 8 vehicle categories were considered (Car, 3 type of lorries; motorcycle, bicycle, other micromobility devices).

The volume of traffic between the traffic generating and attracting points in the area was distributed on a quarter-hourly basis over the 8 vehicle categories. For this purpose, the data available at the individual nodes were distributed over the entire network and the quarter-hourly network traffic distribution rate was defined for each vehicle category.

For the pedestrian traffic data, only cross-sectional traffic count data were available (area entry and exit points, pedestrian crossings, underpass entrances) and data on the drop-off and pick-up of public transport vehicles. In the modelling, the distribution of pedestrians on the pedestrian network was weighted in the vicinity of Ferenciek Square and Astoria, with the crossing between the two areas being the control point in Kossuth Lajos Street between them.

2.3.2 Methodology

The simulation model was built using PTV AG Vissim 22 software. The geometric specification of the model space was aided by the cadastral dataset in EOV projection of Hungary and vector site drawings showing the planned design.

To reduce simulation errors caused by measurement errors and real fluctuations, the value of traffic inputs and the proportions of route choices for each vehicle category were determined from the counting data series by calculating the rolling average of the previous one hour every quarter hour. In the last case, categories that were extremely rare or very similar in nature were grouped together to eliminate errors in the value assignments due to low quantification. The categories used in the model:

Table 5. Categories used in the model

ID	description
SZGK	personal car
J1T	lorry with 2 axis, <3,5t
J2T	lorry with 2 axis, 3,5t-7,5t
J3T_J4T	lorry with 3 or 4 axes
KP	bicycle
MOT	motorbike
RR_SW	scooter, Segway
TX	taxi
BUSZ	bus

Several specific considerations had to be taken into account when building the model. First, although the reduction in passenger vehicle throughput in the project cases was accompanied by a reduction in traffic demand, this effect only affected the Rákóczi road axis and not the vehicles coming from the intersecting Múzeum boulevard, leading to widespread congestion from the Astoria junction.

In order not to create an insurmountable obstacle to further intensification of the already intense traffic situation, it became necessary to deal with vehicle-pedestrian conflicts in a specific way. This has been done with a view to ensuring that the right-of-way is not compromised, but that both vehicles stuck in pedestrian crossings can be crossed by pedestrians and long, random crossing surfaces (e.g., cycle path on the outside of the platform without a designated pedestrian crossing) operate according to a realistic mechanism.

Narrow passenger bus stop platforms, congested in many periods, also required specific modelling procedures. The need for all this can be explained by the fact that the microsimulation software is not specifically designed to study long-standing congested conditions, which are not a fundamental transport planning objective.

Thus, once congestion has already developed in the model, in many cases it is not worth further investigating the scenario in question, but rather its modification, or the modification of the traffic volume, is necessary. However, the above-mentioned procedures also allow a comparative analysis of these congested conditions, while reducing the gap between simulated and real processes.

Traffic volumes for the project cases and future conditions were determined using the load results from the Budapest Macroscopic model. Here, not the numerical values of the traffic volumes on the network segment, but their ratio to each other was used to determine the change in traffic volumes. The following factors are values per inbound cross-section, multiplied by the vehicle and pedestrian traffic volumes from a given direction, the neighborhood and extension of the section taken into account. Road traffic multipliers based on Budapest Macroscopic Model results.

Table 6. Values per inbound cross section

Road	Cross-section	Scenario 0	Scenario 1

			Scenario 2 Scenario 3
Rákóczi road	Erzsébet bridge	113%	70%
Rákóczi road	Ferenciek square	107%	59%
Rákóczi road	Astoria	115%	61%
Rákóczi road	Blaha Lujza square	111%	53%
Károly boulevard	Deák Frenc square	64%	94%
Múzeum boulevard	Kálvin square	89%	115%

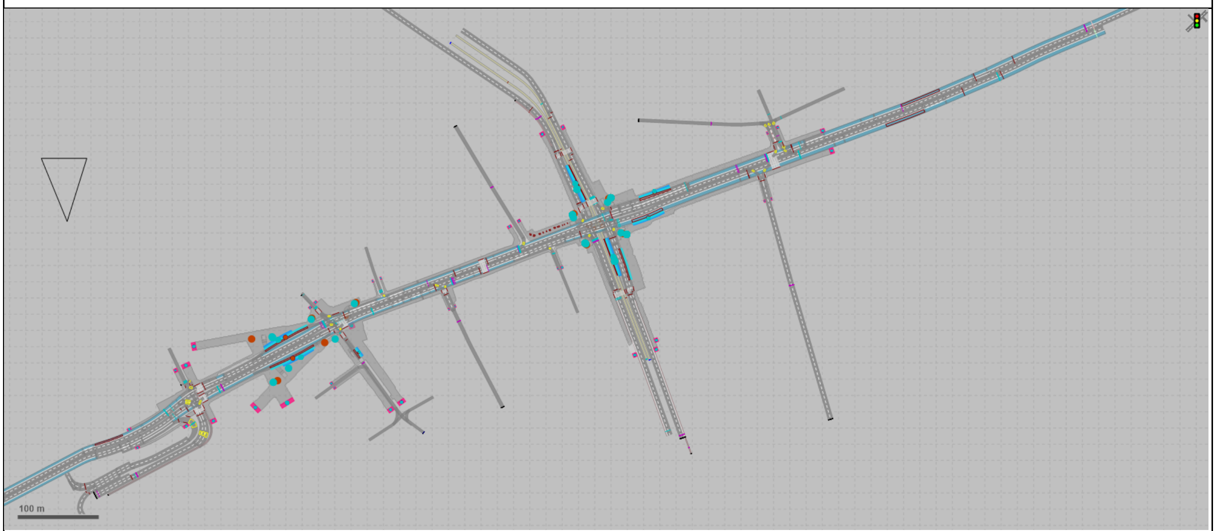
During the Vissim modelling building and calibrating, several actions were managed to develop a realistic model environment. These were the most important ones:

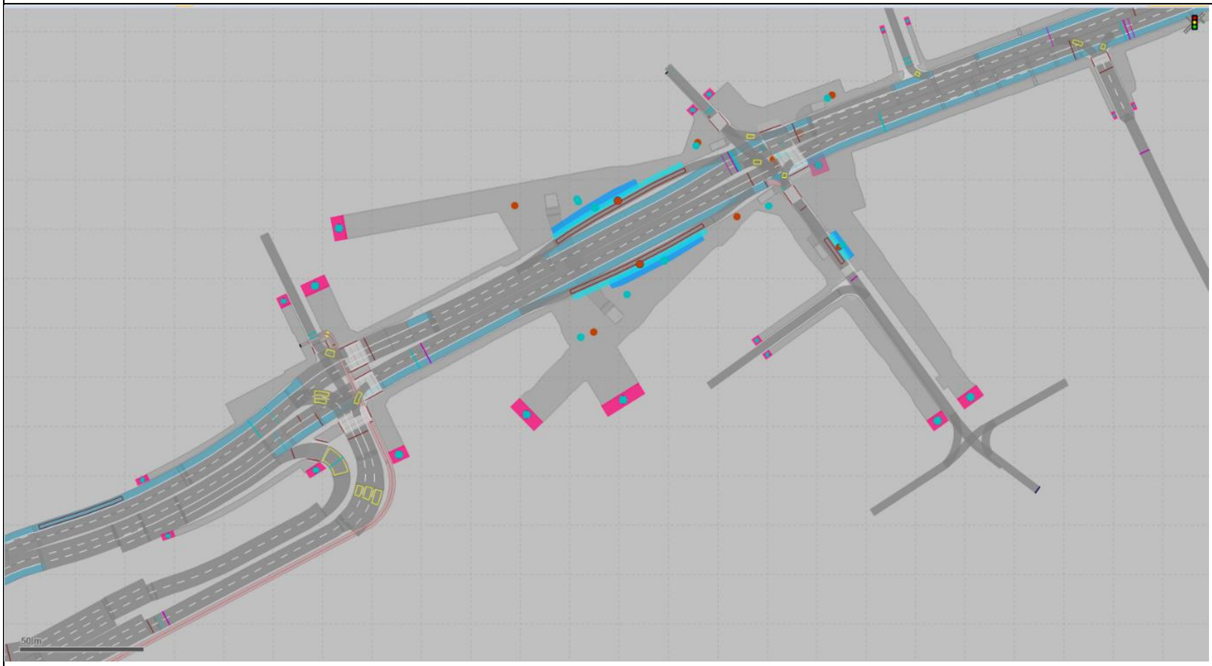
- modelling bike sharing points
- modelling pedestrian crossing at the saturated (confectioned) traffic network
- bus stops with heavy boarding and alighting
- handling a great number of pedestrians at the model, using different levels to speed up the simulation runtime
- using script for input data

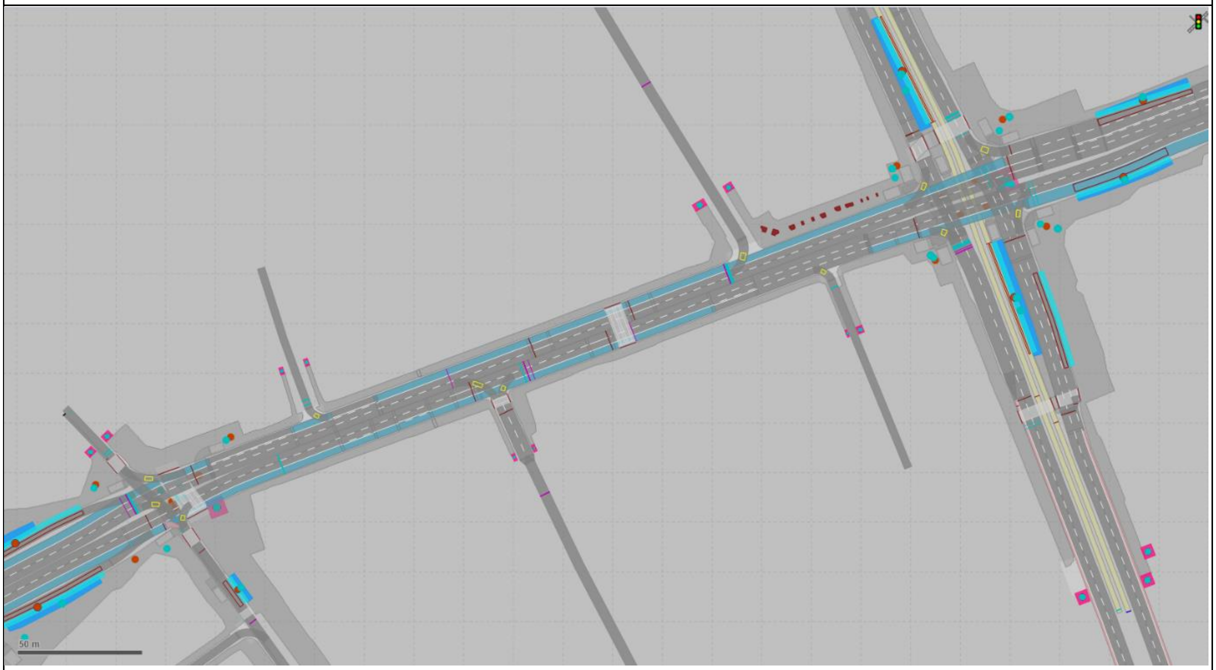
VISSIM networks

The following pictures contain the Scenario 0 Vissim network. The Appendix contains the rest of the Vissim networks.

The entire VISSIM network of **Scenario 0**



Scenario 0 : Surrounds of Váci street – Kossuth Lajos utca junction and Ferenciek square


Scenario 0 : Surrounds of Kossuth Lajos Street


Scenario 0 : Surrounds of Astoria

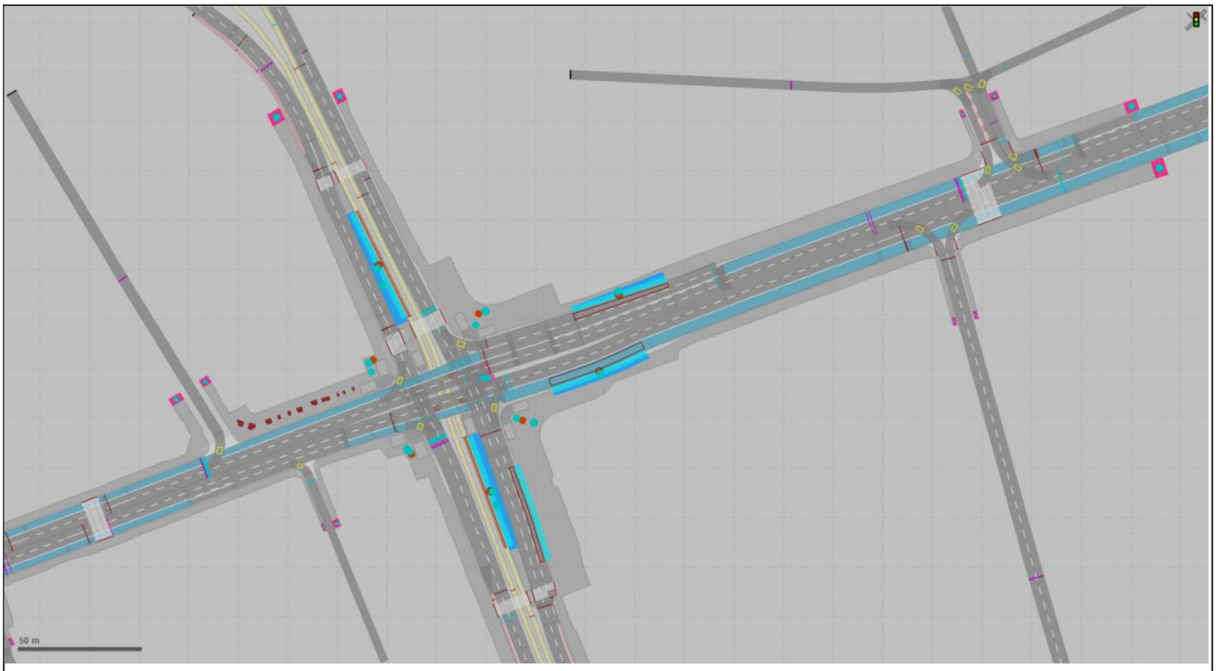


Figure 8. Scenario 0 Vissim network

2.4 Modelling Results

This chapter presents the results of the micro-simulation runs for each of the cases under consideration. This deliverable contains the results of future conditions. For the current condition please visit D5.3 deliverable.

Modelling results at the current conditions have for 4 analyzed scenarios at 4 different times of day. This provides 16 different scenarios managed at the simulation task.

t the evaluation phase the following abbreviations meaning:

- nn: Current condition at the stress section with the future (2030) traffic demand (**Scenario 0**)
- CC: Conservative approach (**Scenario 1)**
- AA: Transport approach (**Scenario 2**)
- BB: Urbanistic approach (**Scenario 3**)

Regarding KPIs, the following statistic parameters were calculated:

- output data based on 900s inputs (None)
- 95% percentile for the time of a day
- Average for the time of a day
- Maximum for the time of a day

- Minimum for the time of a day
- Standard deviation for the time of a day
- Summarized values (Total)

The following Figure contains the delays at the network compering with the base version from the variants for the current condition. This methodology ensured to compare the results not just among the future conditions but also consider the base version of the modelling process.

ver	time	Average of VEHS(ALL)	Average of VEHDELAY(ALL)	Average of STOPS(ALL)	Average of STOPDELAY(ALL)	Átlag / VEHS(30)	Átlag / VEHDELAY(30)	Átlag / STOPS(30)	Átlag / STOPDELAY(30)
AA									
AA	06-09h	33,31%	521%	944%	505%	110,18%	124,93%	150,38%	182,45%
AA	11-14h	19,73%	415%	526%	469%	100,00%	108,40%	121,25%	144,96%
AA	16-19h	19,21%	463%	686%	484%	98,74%	112,58%	135,31%	148,73%
AA	19-22h	23,80%	844%	1353%	897%	99,59%	121,89%	151,80%	176,31%
BB									
BB	06-09h	43,14%	311%	512%	302%	109,90%	126,46%	144,60%	196,31%
BB	11-14h	24,60%	278%	340%	308%	100,00%	106,27%	110,80%	147,14%
BB	16-19h	27,23%	317%	467%	320%	107,67%	112,91%	125,84%	157,20%
BB	19-22h	30,23%	570%	861%	595%	99,59%	119,95%	133,31%	185,72%
CC									
CC	06-09h	42,98%	326%	508%	322%	110,59%	102,50%	118,09%	159,07%
CC	11-14h	26,76%	280%	336%	308%	100,19%	85,01%	90,83%	115,54%
CC	16-19h	32,63%	306%	449%	306%	107,39%	87,35%	104,16%	114,89%
CC	19-22h	33,57%	520%	788%	532%	99,59%	96,44%	111,52%	143,41%
null									
null	06-09h	100,00%	100%	100%	100%	100,00%	100,00%	100,00%	100,00%
null	11-14h	100,00%	100%	100%	100%	100,00%	100,00%	100,00%	100,00%
null	16-19h	100,00%	100%	100%	100%	100,00%	100,00%	100,00%	100,00%
null	19-22h	100,00%	100%	100%	100%	100,00%	100,00%	100,00%	100,00%
nn									
nn	06-09h	120,32%	84,49%	93,59%	76,84%	110,73%	103,51%	103,02%	108,58%
nn	11-14h	106,53%	113,30%	114,69%	112,64%	99,43%	104,43%	102,35%	108,57%
nn	16-19h	106,44%	102,27%	105,64%	99,38%	107,11%	101,74%	104,08%	104,72%
nn	19-22h	111,38%	111,10%	109,74%	111,54%	98,98%	99,62%	95,77%	99,00%

Figure 9. Network delays for each scenario

This shows how the traffic performance of the other scenarios varies with delay compared to the baseline null at current condition. The table also shows the differences between the current condition baseline and future condition baseline.

The macro modelling results show the impact of increased traffic on the network in 2030 compared to the current traffic situation. The results show that the projected traffic can be accommodated comfortably with the current road cross-section design (Scenario_0_nn), while the other scenarios show a significant network traffic reduction. In the alternative scenarios, both the bus lane is centered, and the road traffic lane is reduced to 1 lane per direction. Despite the fact that the traffic calming interventions expected in the wider environment of the stress section are included in the modelling results, the network performance does not reach the current condition Transport and Urban approach versions.

In each case, the section under study is saturated and congested, taking into account the peak period. It can be seen that the design days result in designs that are applied with minimal deviations. The traffic performance of the Scenario2_AA_Transport approach between Ferenciek square and Elisabeth square is lower than the Scenario3_BB_Urbanistic approach due to the interlacing of the bus lane and the road lane. This small difference, which did not seem to have a significant impact during the design of the variants, nevertheless reduces the traffic performance of the network by around 10%.

The congestion in the centre bus lane is lower for future versions than for the current condition edge bus lane designs. The result confirms that the centre-guided bus lane has more favourable parameters for the transport network. In the Scenario1_CC_Conservative case, there is no bus stop on the Elizabeth Bridge. This is more favourable for bus traffic than in the other cases, but less favourable for uats because they cannot use an important transfer point.

Density values are used here to characterise the traffic in the whole area. The figures presented below show the 95th percentile values of the five-minute time-segment measurements during the busiest three-hour period in the afternoon (16:00-19:00). Explanations of the colour scales for road traffic and for pedestrians:

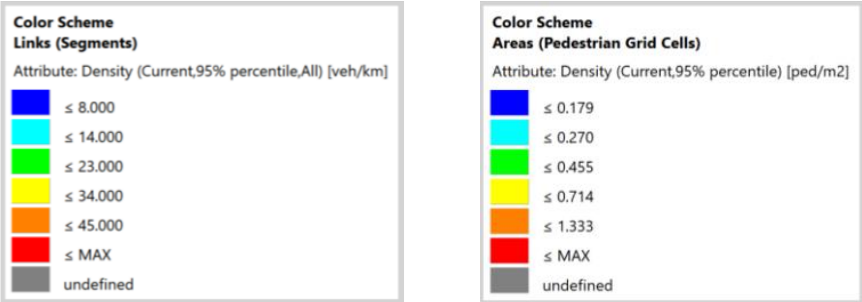


Figure 10. Density values at 95th percentile during 1600-1900

Scenario 0 Current condition at the stress section with the future (2030) traffic demand

This version describes the current layout with future traffic situation. The results are very similar to the current condition Scenario 0 at D5.3, just a little but more car and pedestrian traffic appear at the simulation. The worst congestion occurs around the Astoria junction. In addition, the traffic figures show that there is also significant congestion on other sections of the stress section. The Vissim study confirms that pedestrian traffic is most significant in the vicinity of the public transport stops, while the rest of the stress section does not encounter any obstacles to pedestrian movement.

Figure 11. Scenario 0 Current condition at the stress section with the future (2030) traffic demand

Scenario 1 Conservative (mixed version of Transport and Urbanistic versions)

The redistribution of the traffic area (bus lanes in the middle, with platforms inside) will radically change the flow of traffic. The location of the public transport lane has a significant impact on traffic flow at the macro level. This variant allows fewer surface pedestrian crossings than the Transport (Sc 2) and Urbanistic (Sc 3) variants but provides a link between the existing Astoria and Ferenciek Square underpasses and the new internal platforms. As expected, this design is less disadvantageous for road users and individual users than the alternative design.

Figure 12. Scenario 1 Conservative (mixed version of Transport and Urbanistic versions)

Scenario 2 Transport approach

The centrally routed bus lanes and appropriately sized platforms in the 2022 design will provide better opportunities for smooth passenger transfers. The flow of traffic through the Astoria interchange continues to be hampered by the relatively high traffic volume on the Museum Boulevard, which is a major constraint on the Rákóczi Road section of the study. However, the location of the eastern pedestrian crossing of the Astoria junction, which is very close to the M2 metro on-ramp, is a problem for this option, making it difficult to use the crossing.

The planned weaving lane change for bus traffic continuing west from Ferenciek square is slightly unfavourable, but its significance does not appear to be significant in view of the reduced permeability of the Astoria junction mentioned above. However, this could become a bigger problem if traffic on the Museum Boulevard is reduced to a point where it no longer impedes the passage of traffic on the Rákóczi axis. This can only be moderately addressed with traffic signal control (preference) because the intense bus traffic requires frequent departures of vehicles.

Figure 13. Scenario 2 Transport approach

Scenario 3 Urbanistic approach

The results of the study are significantly similar to the Transport scenario, as the design differs only slightly. The major change is that in this variant the platforms are also located at the road axis at the Elizabeth bridge end, next to the centrally routed bus lane at the middle of the road. Therefore, the phenomenon of weaving does not occur. The other differences are in the minimal location of the pedestrian crossings.

Figure 14. Scenario 3 Urbanistic approach

The Appendix contains the rest of the results and tables.

2.5 Conclusions

As it was difficult to evaluate the performance of the Rákóczi road against the adverse influence of the traffic on the Museum Boulevard. An attempt was made to evaluate the performance of this road section with a similar reduction in traffic to the Rákóczi axis, in addition to the required studies. In the process, we observed a reduction or disappearance of congestion phenomena. **Thus, we can state that the congestion at the Astoria junction clearly shows that the reallocation of street space away from general traffic can only provide a stable, acceptable level of service if it is combined with a network-oriented traffic reduction strategy.**

It is worth taking careful note of the potential problem lurking in the 'A - Transport' option for the planned bus and traffic lane interlacing west of Ferenciek Square, which, in the case of the network traffic management just mentioned, once it removes the congestion at the Astoria junction, could surface with the increased traffic on the Rákóczi axis.

On the pedestrian side, ensuring the width and accessibility of the platforms seems to be an important issue, without which passenger interchange will very quickly become impossible. In the same way.

The provision of space for pedestrian crossings on the sidewalk surfaces of arrivals can also be neglected. Adequate space for access is particularly important in view of the high volume of passenger traffic.

Based on the results, Scenario 3 - Urbanistic approach is the most appropriate design for 2030. The capacity of the public network is adequate, while at the same time the green spaces promote a good climate in the inner-city environment. However, it is of paramount importance to involve society, refine the options, gather advantages and disadvantages, and involve local residents in the decision.

Figure 15. Bird's eye view of Scenario 0: Current condition at the stress section with the future (2030)

Figure 16. Bird's eye view of Scenario 1: Conservative approach from Astoria

Figure 17. Bird’s eye view of Scenario 2 Transport approach from Astoria

Figure 18. Bird’s eye view of Scenario 3: Urbanistic approach from Astoria

3 Constanta

3.1 A brief summary of future conditions along the Stress Section

3.1.1 Introduction

The Future Stress Section is similar to the one for the Current Section due to the fact that this is the most used area along the Feeder Route in present times and also due to the fact that future land developments and modernisations are planned in this area. This is shown in the figure below.

For the moment around 4,000 people live inside the Stress Section, around 40 business are accommodated here, and a new neighbourhood is about to appear in the proximity, this will increase the number of inhabitants in the area significantly and of course the number of other attraction points (e.g. businesses, education and health facilities etc.).

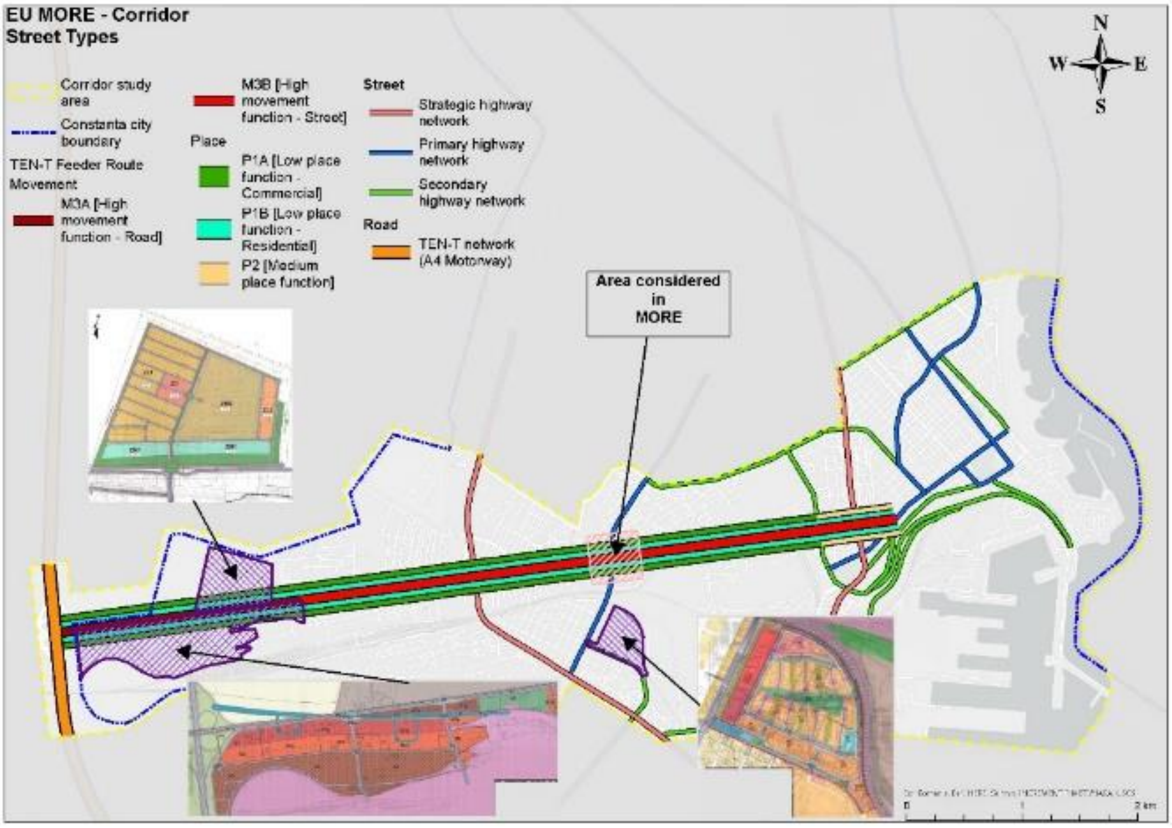


Figure 19. Future Stress Section planned developments

Regarding the new land use developments, a new neighbourhood is planned to emerge near the Stress Section on a surface of around 17 ha. In this new built up area there will be new collective housing buildings, commercial and services business, and education and leisure facilities.

A considerable number of people will be attracted to this new built area and considering the proposed designs we assume the new neighbourhood will have an additional 3000 inhabitants. This development will create a supplementary pressure on the street network especially in peak hours even if we will consider only the number of new inhabitants and not taking into account the number of travels resulted from the other activities in the area.

The City has also plans for the modernisation of I.C. Bratianu Boulevard (the Feeder Route) and to transform it completely into a sustainable street with bus lanes, cycle paths and improved sidewalks. The public lighting and green spaces will also be modernized and the Feeder route will be equipped with SMART bus stations and urban furniture, including the infrastructure for EV charging.

Considering all future developments and the current and future economical, social and cultural conditions around the Stress Area, the streets width can't be considerably increased. Therefore these changes will have to be accomodated by the existing built environment.

3.1.2 Future condition scenarios

Starting with the City's overall development and sustainable mobility visons, and after analyzing the transactional environment that can influence these desired visions, we identified 4 possible future scenarios built by considering the economic growth and the environment.

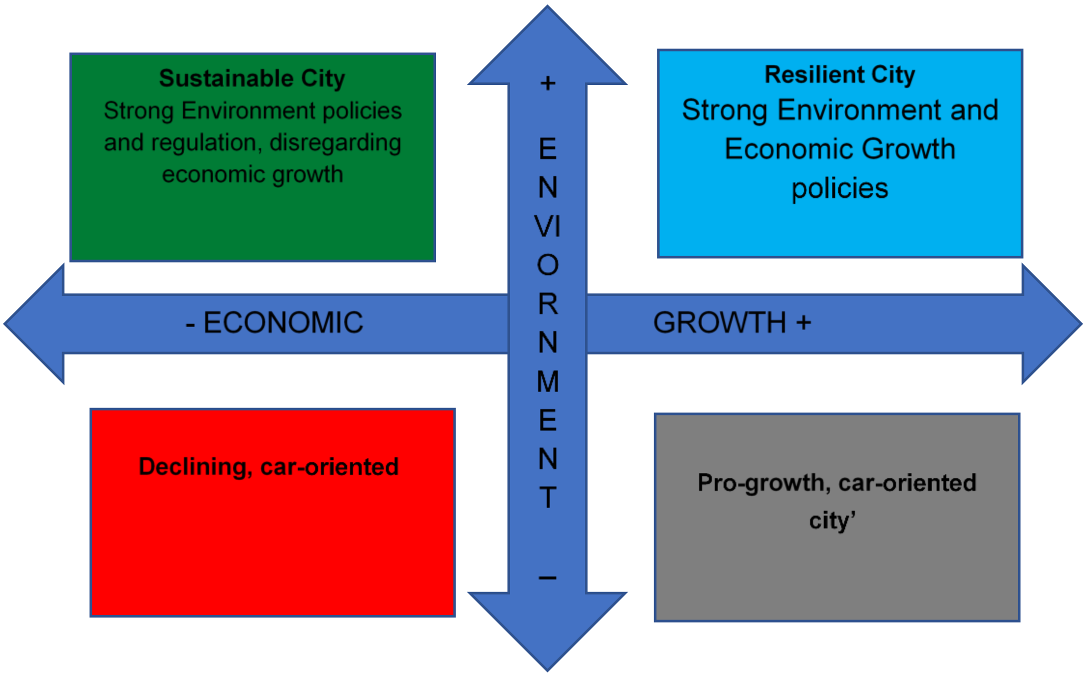


Figure 20. Future scenarios

3.1.3 Scenario no. 1 – Declining, car-oriented

In this scenario the City will suffer from bad environment and negative economic growth. The population will decrease and will follow the actual trend of ageing and migration, especially to the neighbouring localities.

The European, National and local policies will disregard both the environment and the economic growth. Thus, the economy will suffer and the GDP per capita will decrease leading to less business and jobs.

People will not change their social behaviour, especially regarding the use of personal vehicles, they will have a car centric behaviour, leading to an increase in the car ownership and a waste of public space.

There will be an increase in the GHG and CO_2 emissions leading to a bad environment and slowly the City will lose its attractiveness as a tourism destination.

In this case, we can envisage that the current trend of using private cars will continue. The total traffic volume will increase by 27%. The private car share is foreseen to grow from 49.81% (in the year 2020) to 58.79% (in the year 2030), while the public transport will decrease from 32,91% to 26,04%, in this respect the modal share will change as presented in the figure below.

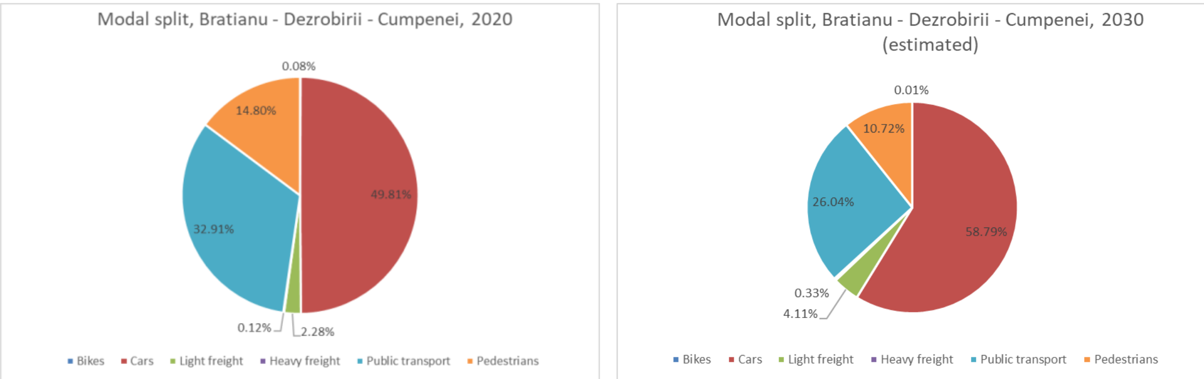


Figure 21. Projected changes to modal split Scenario 1

3.1.4 Scenario no. 2 – Sustainable City

In this scenario we considered that the City will have a good quality of the environment but will not support economic growth.

Demographic change will follow the foreseen trend, due to good environment people will be healthier and live longer. Clean environment will also attract more old people to come and live in the City. These factors will then lead to an ageing population.

Tourism will increase and will attract more people from the elder generation and due to its seasonality will not support the economy of the City.

Environmental policies will be largely introduced and enforced in the City but will affect the local business that cannot adapt to the new rules imposed.

The City will succeed in providing the infrastructure for alternative travel modes and due to the taxation on pollution (differentiated parking prices, vehicle access regulation, pollution taxes on cars etc.) people will tend to use more sustainable travel modes (public transport, bicycle, walking) that will lead to a decrease in car ownership and a supplementary pressure on the public transport service.

In scenario no. 2 we can envisage that the modal split will shift towards public transport. The total traffic volume will increase by 22%, to accommodate the new travel demand. Considering that the public transport will increase in attractiveness, the total traffic increase will not be the same as for Scenario no. 1 (having in mind the capacity of public transport vehicles). The private car share is foreseen to shrink from 49.81% (in the year 2020) to 46.59% (in the year 2030), while the public transport will increase from 32.91% to 37.24%. The modal share will change as presented in the figure below.

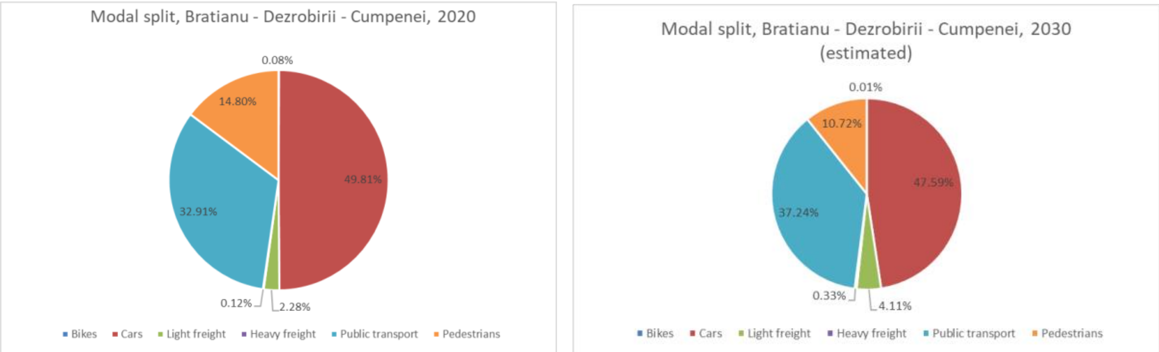


Figure 22. Projected changes to modal split Scenario 2

3.1.5 Scenario no. 3 – Pro-growth, car-oriented city

In this scenario the City will support the economic growth disregarding the environmental policies. The economy of the City will improve thus leading to more business and jobs, this will attract more people in the City, which will lead to an increase in population due to the new opportunities arisen.

Digitalisation will be embedded in all the economic activities, including in the public sector and will support the economic growth.

More economic opportunities will lead to an increase in people income and due to the lack of taxation of polluting vehicles the number of cars will continue to grow.

People will not change their mobility behaviour and will continue to have a car centric behaviour.

Scenario no. 3 foresees an increase in economic activity, hence an increase in mobility needs. The increase will be seen in freight vehicles, but also in private car usage, as there will be no restrictions for these. However, the junction that we analyse will probably reach its maximum capacity, hence forcing some travellers to reconsider the transport mode (or route choice). Also, the municipality will have to implement some measures to address the congestion in the area. Therefore, we foresee an increase in total traffic volume, but somehow limited to the capacity of the area, thus the estimated increase will be by 29%. The private car share is foreseen to grow from 49.81% (in the year 2020) to 56.97% (in the year 2030), the freight vehicles will increase from 0.09% to 7.46%, while the public transport will decrease from 32.91% to 27.31%. The modal share will change as presented in the figure below.

Figure 23. Projected changes to modal split Scenario 3

3.1.6 Scenario no. 4 – Resilient City

In this scenario the City promotes both environmental and economic growth policies, with special focus on innovation and digital transformation. The business sector is very diverse and dynamic providing the necessary framework for people to have good access to jobs, education and training and preformat services.

The population is thriving and the City is capable of attracting young people due to the improved educational system and due to the increased number of jobs.

The social and cultural behaviour of people will be completely changed and focused on economic and energy efficiency and more aware of the benefices of a clean environment. Thus people will have a sharing mentality and will use more clean transport modes.

The need for travel in order to obtain different goods or services will decrease due to good internet connectivity and Digitalisation. Teleworking will be fully implemented in the proper sectors of economy.

In scenario no. 4, we can envisage that the modal split will shift towards public transport. The total traffic volume will increase by 20%. The private car share is foreseen to shrink from 49.81% (in the year 2020) to 44.39% (in the year 2030), while the public transport will increase from 32.91% to 40.21%. There will also be an increase in bikes usage. The modal share will change like this:

Figure 24. Projected changes to modal split Scenario 4

3.2 Preparations for the street design exercises

3.2.1 Future Vision

Considering the development goals of the City and the SUMP objectives, including the emergence of new technologies the vision for developing the Stress Section is to create a clean and SMART area for people, where everybody can feel safe and secure, with multiple opportunities for businesses and leisure with good connection to public transport.

In order to achieve this vision multiple issue must be approached and several questions should be answered, for example:

- How can we create a clean area with less pollution and noise?
- How can we adapt the area for the new emerging technologies?
- How can we make the area safer and induce the sentiment of security to its users?
- How can we increase the attractiveness of the area both for people and business?

3.2.2 Design exercise

The approach for preparation of the design exercises for the future conditions went hand in hand with the one for current conditions. The main reason for doing so was represented by the fact that on all discussion with the stakeholders regarding the future no clear vision and no concrete proposal emerged. Most of the participants were connected to actual issues around the Stress Area and tried to find solutions for how the current situation can be improved. Even though in the online meetings with the stakeholders we provided information about future demography, future technologies, future services etc. we could not obtain many recommendations or suggestions on how they see the development of the area in the next 20 to 30 years.

In this respect, the local implementation team has to adapt to this situation and find another approach in order to identify the designs for future conditions of the Stress Area. Thus, the approach was to analyse the results of the simulation of the 10 design options for the current conditions and after comparing them to propose two of them for further analyses considering the 4 scenarios identified for the future, respectively: 1. Declining, car-oriented; 2. Sustainable City; 3. Pro-growth, car-oriented city; 4. Resilient City.

3.2.3 Future Designs Options

After building and applying the Vissim model and after comparing the result for the simulated scenarios, we identified two designs that presented the best results in the simulation, as presented below.

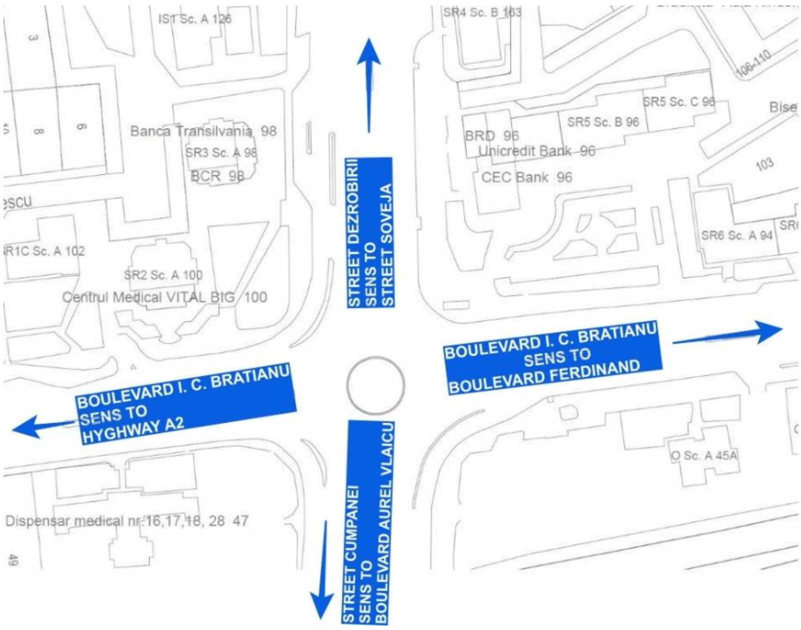


Figure 25. Layout of Section under Stress

Table 7. Future Design option 1

FUTURE DESIGN OPTION NO. 1	
I. C. BRATIANU BOULEVARD, WEST TOWARDS EAST, SENSE TO BOULEVARD FERDINAND	
THE CURRENT SITUATION	**PROPOSED SITUATION**
- 3 lanes for one-way traffic with a width of 3.5 m. - The pedestrian crossing is built 96.4 meters away from the junction. - On the right side in the direction to Ferdinand Blvd., after the pedestrian crossing we find a 27.1 m long Bus bay station and afterwards parking spaces. - On the left side in the direction to Bd. Ferdinand we find after the pedestrian crossing angled parking spaces.	- 2 lanes for one-way traffic, with a width between 3 m and 3.5 m. - The pedestrian crossing is located on the initial position. - On the left side in the direction to Blvd. Ferdinand we have until the pedestrian crossing a 2.5 m double bicycle track with a 2 m safety space and parking spaces with 5.20 m long and 2.5 m wide. - The cycle path passes from two-way to one-way at the pedestrian crossing. - On the right side in the direction to Ferdinand Blvd., after the pedestrian crossing we find a one-way cyclists lane

	with a width of 1.25 m with, segregated by a space of 0.5 m and a safety space of 1.5 m, the Bus bay station remain on position and afterwards parking spaces with 5.20 m long and 2.5 m wide. - The first lane for vehicles is transformed into a dedicated lane for public transport with a width of 4 m. - The sidewalk is two meters wide, according to the law and is found on both sides of the street.
I. C. BRATIANU BOULEVARD, EAST TOWARDS WEST, SENSE TO HYGHWAY A2	
THE CURRENT SITUATION	**PROPOSED SITUATION**
- 3 lanes for one-way traffic with a width of 3.5 m. - The pedestrian crossing is built 91.2 meters away from the junction. - On the right side in the direction to A2, after the pedestrian crossing we find a 24.3 m long Bus bay station. - On the left side of the road in the direction to A2 there are no parking spaces for vehicles.	- 2 lanes with 3.5 m for each direction. - The pedestrian crossing is located on the initial position. - On the right side in the direction to highway, we find a until the pedestrian crossing, there is a 2.5 m double bicycle track and a 2 m safety space and parking spaces with 5.20 m long and 2.5 m wide. - The cycle path passes from two-way to one-way at the pedestrian crossing. - On the left side in the direction to highway there are no parking spaces, there is a one-way lane for cyclists with a width of 1.25 m, segregated by a space of 0.5 m and a safety space of 1.5 m. - The first lane for vehicles is transformed into a dedicated lane for public transport with a 4 m width. - The sidewalk is two meters wide, according to the law and is found on both sides of the road.
DEZROBIRII STREET, SOUTH TOWARDS NORTH, SENS TO SOVEJA STREET	
THE CURRENT SITUATION	**PROPOSED SITUATION**
- On the right side in the direction to Soveja Street there are 3 lanes with a 3.5 m width for vehicles - The pedestrian crossing is built 86.7 meters away from the junction - After the pedestrian crossing on the right side, there is a 23.5 m long Bus bay station, followed by a taxi station with 5 parking places, afterwards angled parking places.	- 3 lanes with a width between 3 m and 3.5 m. - Pedestrian crossings are located in the same positions as in the base scenario and until the pedestrian crossing there is a 2.5 m width double bicycle track protected by a 2 m safety space. - The cycle path passes from two-way to one-way at the pedestrian crossing.

- On the left side in the direction to Soveja Street there are 4 traffic lanes, near the intersection a lane is dedicated for turning right. Subsequently, after the pedestrian crossing, we move to 3 lanes per direction. - Near the intersection we find a 29.1 m long Bus bay station and after the pedestrian crossing to Soveja Street there are angled parking.	- After the crossing we have 3 lanes per direction with a width between 3 m and 3.5 m. - The sidewalk is two meters wide on both sides of the road.
DEZROBIRII STREET, NORTH TOWARDS SOUTH	
THE CURRENT SITUATION	**PROPOSED SITUATION**
- 3 lanes per direction for vehicles with 3.5 m width. - On the right side of the direction to Blvd. Aurel Vlaicu there is a right turning brace that comes from Blvd. I.C. Bratianu. - On the left side of the direction to Aurel Vlaicu Blvd., there is a right turning brace that stings in I.C. Blvd. Bratianu.	- The road is on 3 lanes with a width between 3 m and 3.5 m. - After the intersection crossing, we have 3 lanes per direction with a width between 3 m and 3.5 m. - The sidewalk is two meters wide, according to the law and is found on both sides of the road.

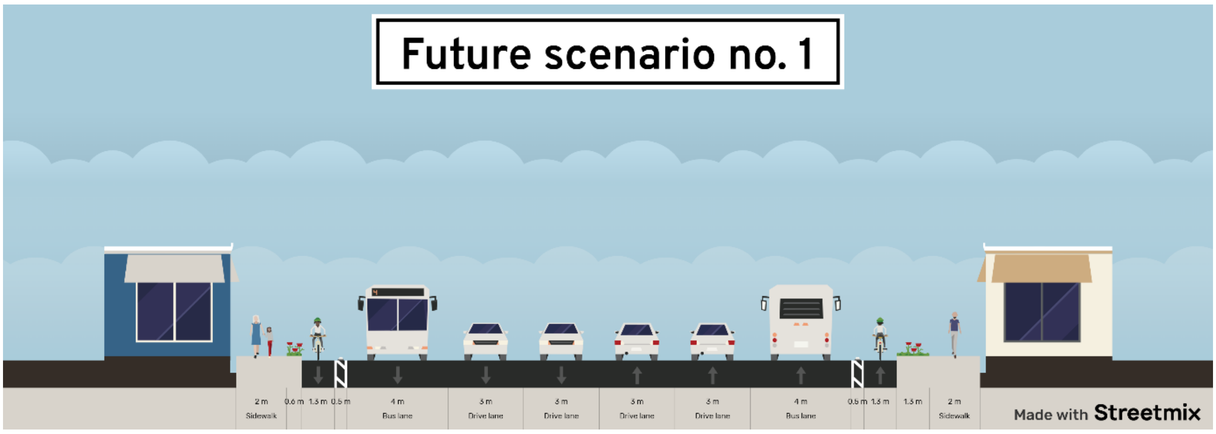


Figure 26. Future Design option 1 cross section street allocation

Table 8. Future Design option 2

FUTURE SCENARIO NO. 2	
I. C. BRATIANU BOULEVARD, WEST TOWARDS EAST	
THE CURRENT SITUATION	**PROPOSED SITUATION**

- 3 lanes for one-way traffic with a width of 3.5 m. - The pedestrian crossing is built 96.4 meters away from the junction. - On the right side in the direction to Ferdinand Blvd., after the pedestrian crossing we find a 27.1 m long Bus bay station and afterwards parking spaces. - On the left side in the direction to Bd. Ferdinand we find after the pedestrian crossing angled parking spaces.	- 2 lanes for one-way traffic, with a width between 3 m and 3.5 m. - The pedestrian crossing is located on the initial position, the one in current situation. - On the left side of the direction to Blvd. Ferdinand we have until the pedestrian crossing a 2.5 m width double bicycle track with 2 m safety space and parking spaces, each having 5.20 m long and 2.5 m wide. - The cycle path passes from two-way to one-way at the pedestrian crossing. - On the right side in the direction to Ferdinand Blvd., after the pedestrian crossing we find a one-way lane for cyclists with a width of 1.25 m, a buffer zone with a width of 0.5 m and a safety space with a width of 1.5 m, a Bus bay station and parking spaces, each space is 5.20 m long and 2.5 m wide. - The first lane for vehicles is transformed into a dedicated lane for public transport with a width 4 m. - The sidewalk is two meters wide, according to the law and is found on both sides of the road.
I. C. BRATIANU BOULEVARD, EAST TOWARDS WEST	
THE CURRENT SITUATION	**PROPOSED SITUATION**
- 3 lanes for one-way traffic with a width of 3.5 m. - The pedestrian crossing is built 91.2 meters away from the junction. - On the right side in the direction to A2, after the pedestrian crossing we find a 24.3 m long Bus bay station. - On the left side of the road in the direction to A2 there are no parking spaces for vehicles.	- 2 lanes with a width of 3.5 m for each direction. - The pedestrian crossing is located on the initial position, the one in current situation. - On the right side in the direction to the highway, we find until the pedestrian crossing a 2.5 m double bicycle track with a 2 m safety space and parking spaces, each having 5.20 m long and 2.5 m wide. - The cycle path passes from two-way to one-way at the pedestrian crossing. - On the left side in the direction to the highway there are no parking spaces, is only a one-way lane for cyclists with a width of 1.25 m, a buffer zone with a width of 0.5 m and a safety space of 1.5 m. - The first lane for vehicles is transformed into a 4 m width dedicated lane for public transport. - The sidewalk is two meters wide, according to the law and is found on both sides of the road.
DEZROBIRII STREET, SOUTH TOWARDS NORTH	
THE CURRENT SITUATION	**PROPOSED SITUATION**

- On the right side in the direction to Soveja Street there are 3 lanes with a 3.5 m width for vehicles - The pedestrian crossing is built 86.7 meters away from the junction - After the pedestrian crossing on the right side, there is a 23.5 m long Bus bay station, followed by a taxi station with 5 parking places, afterwards angled parking places. - On the left side in the direction to Soveja Street there are 4 traffic lanes, near the intersection a lane is dedicated for turning right. Subsequently, after the pedestrian crossing, we move to 3 lanes per direction. - Near the intersection we find a 29.1 m long Bus bay station and after the pedestrian crossing to Soveja Street there are angled parking.	- Across the junction is a bridge that connects Dezrobirii Street and Cumpenei Street with two lanes in each direction. The junction can also be crossed under the bridge because the roundabout remains in place. - The road has 3 lanes with a width between 3 m and 3.5 m and at the meeting of the bridge it is possible to go on the bridge or under the bridge. The first lane is for the right turn. - Pedestrian crossings are located under the bridge in the same positions as in the base scenario and until the pedestrian crossing, there is a 2.5 m wide double bicycle track with a 2 m wide safety space. - The cycle path passes from two-way to one-way at the pedestrian crossing. - After the pedestrian crossing we have 3 lanes per direction with a width between 3 m and 3.5 m. - The sidewalk is two meters wide, according to the law and is found on both sides of the road.
DEZROBIRII STREET, NORTH TOWARDS SOUTH	
THE CURRENT SITUATION	**PROPOSED SITUATION**
- 3 lanes per direction for vehicles with 3.5 m width. - On the right side of the direction to Blvd. Aurel Vlaicu there is a right turning brace that comes from Blvd. I.C. Bratianu. - On the left side of the direction to Aurel Vlaicu Blvd., there is a right turning brace that stings in I.C. Blvd. Bratianu.	- Across the junction is a bridge that connects Cumpenei Street and Dezrobirii Street with 2 lanes in each direction, with a width between 3 m and 3.5 m. - The intersection can also be crossed under this bridge because the roundabout remains in place. - The road has 3 lanes for each direction with a width between 3 m and 3.5 m and at the meeting of the bridge it is possible to go on the bridge or under the bridge. The third lane is for the right turn. - After the pedestrian crossing we have 3 lanes per direction with a width between 3 m and 3.5 m. - The sidewalk is two meters wide, according to the law and is found on both sides of the road.

3.3 Building and applying the Vissim model

3.3.1 Building the model

With the designs already established and the Linemap drawings done, the next step was to start building the transport model for running the simulations. Briefly, the model was developed following next steps:

- Data gathering for road junction design, vehicles, pedestrians, parking places/parking manoeuvres, bus stops etc.;
- Defining all the possible scenarios based on the stakeholders' engagement activities carried out in the project and on the experts' opinion;
- Selecting the scenarios to be tested;
- Drawing the maps for each scenario using LineMap tool to include the design options required;
- Importing the maps from LineMap in Vissim tools and setting up the final details, according to the rules governing the field;
- Including the traffic volumes in Vissim for each period of time (AM / PM);
- Running and calibrating the model;
- Extracting traffic parameters.

For each scenario, including the baseline, which was tested the inputs were the following:

- Data related to the geometrical details of the junction;
- Desired speed distribution;
- Vehicle volumes;
- Pedestrian volumes.

The outputs of the VISSIM model were the following:

- Average travel time [s/veh];
- Average delay [s/veh];
- Average delay stopped [s/veh];
- Average speed [km/h].

3.3.2 Applying the Vissim model

For each scenario identified, future condition scenarios were introduced to the designs options to start the simulation for the AM and PM peaks. The input data and the results of the simulations are presented here.

Table 9. Baseline scenario AM – 2030 – input data

Code	Description	Data
OM_in1	Unique Identifier for option	CON_S4_0010_2030_BS

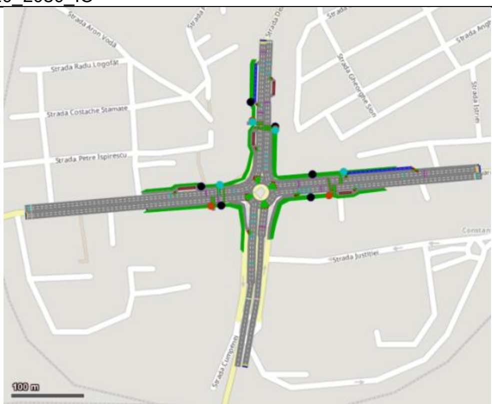
OM_in2	Screenshot of the modelled network (including all network objects and scale bar)	
OM_in3	Desired speed distribution (name of standard distribution or values of individual distributions)	50 km/h
OM_in4	Entering vehicle input volumes	
OM_in5	Pedestrian input volumes	
OM_in6	Pedestrian distancing values (modelling parameters e.g. due to COVID-19 social distancing)	Not used

Table 10. Baseline scenario AM – 2030 – output data

Code	Description	Data
OM_out1	Unique Identifier for option	CON_S4_0010_2030_BS

OM_out9	Average travel time [s/veh] = Total of travel times / number of vehicles - at **network level** - for motorised vehicles and bicycles - average across simulation runs	73.76
OM_out10	Variance and 95% percentile of average travel times across simulation runs - at **network level** - for motorised vehicles and bicycles	
OM_out11	Average travel time [s/veh] = Total of travel times / number of vehicles [for the **stress section**] - for motorised vehicles and bicycles - average across simulation runs	Not applicable
OM_out12	Variance and 95% percentile of average travel times across simulation runs [for the **stress section**] - for motorised vehicles and bicycles	Not applicable
OM_out13	Average delay [s/veh] = Total of delay / number of vehicles - at **network level** - for motorised vehicles and bicycles - average across simulation runs	35.21
OM_out14	Variance and 95% percentile of average delay across simulation runs - at **network level** - for motorised vehicles and bicycles	
OM_out15	Average delay [s/veh] = Total of delay / number of vehicles [for the **stress section**] - for motorised vehicles and bicycles - average across simulation runs	Not applicable
OM_out16	Variance and 95% percentile of average delay across simulation runs [for the **stress section**] - for motorised vehicles and bicycles	Not applicable
OM_out17	Average delay stopped [s] - at **network level** - for motorised vehicles and bicycles - average across simulation runs	13.36
OM_out18	Variance and 95% percentile of delay stopped across simulation runs - at **network level** - for motorised vehicles and bicycles	
OM_out19	Average delay stopped [s] [for the **stress section**] - for motorised vehicles and bicycles - average across simulation runs	Not applicable
OM_out20	Variance and 95% percentile of delay stopped across simulation runs [for the **stress section**] - for motorised vehicles and bicycles	Not applicable
OM_out21	Average speed [km/h] or [mph] = total distance / total travel time - at **network level** - for motorised vehicles and bicycles - average across simulation runs	24.05
OM_out22	Variance and 85% percentile of average travel speeds across simulation runs - at **network level** - for motorised vehicles and bicycles	
OM_out23	Average speed [km/h] or [mph] = total distance / total travel time [for the **stress section**] - for motorised vehicles and bicycles - average across simulation runs	Not applicable
OM_out24	Variance and 85% percentile of average travel speeds across simulation runs [for the **stress section**] - for motorised vehicles and bicycles	Not applicable
OM_out36	Environmental impact (CO, NOx; VOC, Fuel Consumption by node evaluation) - on **network level** - average across simulation runs	N/A

Table 11. Infrastructure change – 2030 – AM – input data

Code	Description	Data
OM_in1	Unique Identifier for option	CON_S4_0010_2030_IC
OM_in2	Screenshot of the modelled network (including all network objects and scale bar)	
OM_in3	Desired speed distribution (name of standard distribution or values of individual distributions)	50 km/h

OM_in4	Entering vehicle input volumes	
OM_in5	Pedestrian input volumes	
OM_in6	Pedestrian distancing values (modelling parameters e.g. due to COVID-19 social distancing)	Not used

Table 12. Infrastructure change – 2030 – AM – output data

Code	Description	Data
OM_out1	Unique Identifier for option	CON_S4_0010_2030_IC
OM_out9	Average travel time [s/veh] = Total of travel times / number of vehicles - at **network level** - for motorised vehicles and bicycles - average across simulation runs	116.47
OM_out10	Variance and 95% percentile of average travel times across simulation runs - at **network level** - for motorised vehicles and bicycles	
OM_out11	Average travel time [s/veh] = Total of travel times / number of vehicles [for the **stress section**] - for motorised vehicles and bicycles - average across simulation runs	Not applicable
OM_out12	Variance and 95% percentile of average travel times across simulation runs [for the **stress section**] - for motorised vehicles and bicycles	Not applicable
OM_out13	Average delay [s/veh] = Total of delay / number of vehicles - at **network level** - for motorised vehicles and bicycles - average across simulation runs	78.02
OM_out14	Variance and 95% percentile of average delay across simulation runs - at **network level** - for motorised vehicles and bicycles	
OM_out15	Average delay [s/veh] = Total of delay / number of vehicles [for the **stress section**] - for motorised vehicles and bicycles - average across simulation runs	Not applicable
OM_out16	Variance and 95% percentile of average delay across simulation runs [for the **stress section**] - for motorised vehicles and bicycles	Not applicable
OM_out17	Average delay stopped [s] - at **network level** - for motorised vehicles and bicycles - average across simulation runs	47.62
OM_out18	Variance and 95% percentile of delay stopped across simulation runs - at **network level** - for motorised vehicles and bicycles	
OM_out19	Average delay stopped [s] [for the **stress section**] - for motorised vehicles and bicycles - average across simulation runs	Not applicable

OM_out20	Variance and 95% percentile of delay stopped across simulation runs [for the **stress section**] - for motorised vehicles and bicycles	Not applicable
OM_out21	Average speed [km/h] or [mph] = total distance / total travel time - at **network level** - for motorised vehicles and bicycles - average across simulation runs	13.51
OM_out22	Variance and 85% percentile of average travel speeds across simulation runs - at **network level** - for motorised vehicles and bicycles	
OM_out23	Average speed [km/h] or [mph] = total distance / total travel time [for the **stress section**] - for motorised vehicles and bicycles - average across simulation runs	Not applicable
OM_out24	Variance and 85% percentile of average travel speeds across simulation runs [for the **stress section**] - for motorised vehicles and bicycles	Not applicable
OM_out36	Environmental impact (CO, NOx; VOC, Fuel Consumption by node evaluation) - on **network level** - average across simulation runs	N/A

Table 13. Overground passage for vehicles – 2030 – AM – input data

Code	Description	Data
OM_in1	Unique Identifier for option	CON_S4_0010_2030_OP
OM_in2	Screenshot of the modelled network (including all network objects and scale bar)	
OM_in3	Desired speed distribution (name of standard distribution or values of individual distributions)	50 km/h
OM_in4	Entering vehicle input volumes	

OM_in5	Pedestrian input volumes	
OM_in6	Pedestrian distancing values (modelling parameters e.g. due to COVID-19 social distancing)	Not used

Table 14. Overground passage for vehicles – 2030 – AM – output data

Code	Description	Data
OM_out1	Unique Identifier for option	CON_S4_0010_2030_OP
OM_out9	Average travel time [s/veh] = Total of travel times / number of vehicles - at **network level** - for motorised vehicles and bicycles - average across simulation runs	79.82
OM_out10	Variance and 95% percentile of average travel times across simulation runs - at **network level** - for motorised vehicles and bicycles	
OM_out11	Average travel time [s/veh] = Total of travel times / number of vehicles [for the **stress section**] - for motorised vehicles and bicycles - average across simulation runs	Not applicable
OM_out12	Variance and 95% percentile of average travel times across simulation runs [for the **stress section**] - for motorised vehicles and bicycles	Not applicable
OM_out13	Average delay [s/veh] = Total of delay / number of vehicles - at **network level** - for motorised vehicles and bicycles - average across simulation runs	37.19
OM_out14	Variance and 95% percentile of average delay across simulation runs - at **network level** - for motorised vehicles and bicycles	
OM_out15	Average delay [s/veh] = Total of delay / number of vehicles [for the **stress section**] - for motorised vehicles and bicycles - average across simulation runs	Not applicable
OM_out16	Variance and 95% percentile of average delay across simulation runs [for the **stress section**] - for motorised vehicles and bicycles	Not applicable
OM_out17	Average delay stopped [s] - at **network level** - for motorised vehicles and bicycles - average across simulation runs	21.26
OM_out18	Variance and 95% percentile of delay stopped across simulation runs - at **network level** - for motorised vehicles and bicycles	
OM_out19	Average delay stopped [s] [for the **stress section**] - for motorised vehicles and bicycles - average across simulation runs	Not applicable
OM_out20	Variance and 95% percentile of delay stopped across simulation runs [for the **stress section**] - for motorised vehicles and bicycles	Not applicable
OM_out21	Average speed [km/h] or [mph] = total distance / total travel time - at **network level** - for motorised vehicles and bicycles - average across simulation runs	21.05
OM_out22	Variance and 85% percentile of average travel speeds across simulation runs - at **network level** - for motorised vehicles and bicycles	
OM_out23	Average speed [km/h] or [mph] = total distance / total travel time [for the **stress section**] - for motorised vehicles and bicycles - average across simulation runs	Not applicable
OM_out24	Variance and 85% percentile of average travel speeds across simulation runs [for the **stress section**] - for motorised vehicles and bicycles	Not applicable
OM_out36	Environmental impact (CO, NOx; VOC, Fuel Consumption by node evaluation) - on **network level** - average across simulation runs	N/A

When comparing the results of the simulations we can observe that the design with the best results on all the features is the base line scenario. The reason for these results is that the results obtained are looking mostly at the indicators related to the movement function of the street, respectively how fast a car can run through the simulated network and how many obstacles it can encounter and how long it will take it to run over them. So the results are not considering any of the place functions of the street, like how pleasant it is to be on the street, how many option you have on it for shopping, leisure and other purposes, or any other social needs people have.

In this respect, the results of the simulation must not be taken for granted but they need to be interpreted in a larger way, considering also the needs of other users and the development objectives of the cities.

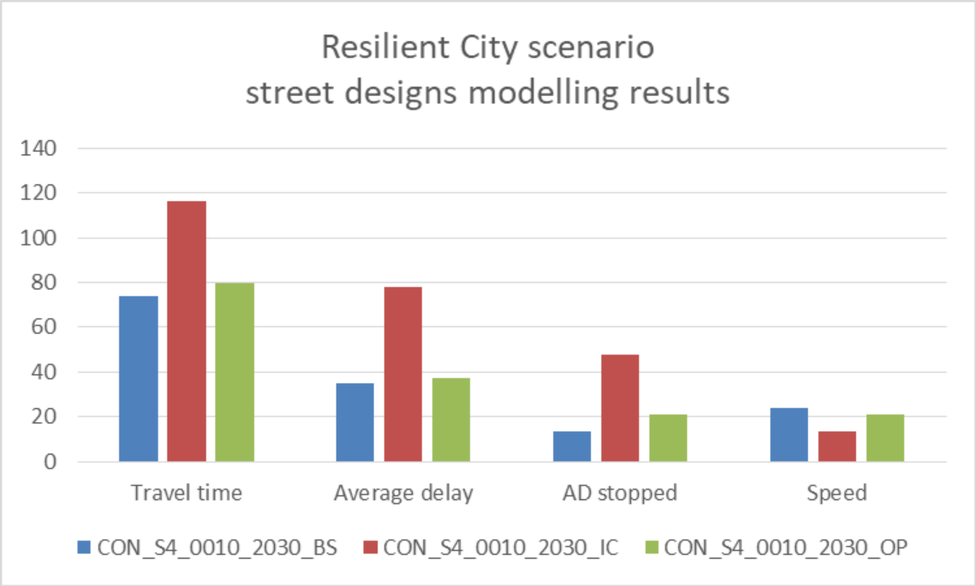


Figure 27. Resilient City scenario street design modelling results

3.4 Appraisal of design options

In order to have a better view on the result of the Vissim simulation, we undertook the design option appraisal using the tool developed in MORE.

Having in mind that in Romania there are no standard costs provided for new investments objective, these costs were obtained according to the national legislation only after concluding some technical and economic studies (e.g. technical inspections, topological and geotechnical studies, feasibility studies and technical designs). We understood that we will not be able to use the cost benefit analyses or the multi- criteria analyses. In this respect, we came to the conclusion that, according to the data that we have, we can only conduct the technical/political assessment.

The technical political assessment exercise consisted in completing the excel files with the data that we had regarding some predefined indicators related to:

- The street design (e.g. allocated street space for different road users, types of pedestrian crossings, bus stops etc.);

- Movement function (e.g. volumes of traffic per type of users, speed, travel time, speed etc.);
- Place function (vehicle based activities and people based activities);
- Wider impacts (economic, social and environmental).

Unfortunately the Municipality did not have to many extra data that could be inserted as input for the tool, due to the general issue in Romania and of course in Constanta regarding the lack of consistent traffic data. For example we did not have consistent data related to the Place function and wider impact specific for the Stress Section. Thus, we could not use the tool to its maximum potential.

Another issue that we encountered when using the tool, having in mind that the main difference between the two future designs proposed for further analyses is the over ground vehicle bridge, was that the results obtained were similar. We couldn’t introduce any information regarding the over ground passage for vehicles. These was useful feedback delivered to the tool designers.

4 Lisbon

4.1 A brief summary of future conditions along the Stress Section

4.1.1 Current conditions along the Feeder Route

The map on the side shows the section under analysis, some points of interest around its influence area as well as where the movements that use Rua Morais Soares can be distributed, assuming the importance of this street to spread many movement flows.

Rua Morais Soares is one of the most important roads that connect the east part of the city, and the movements that come from the TEN-T network to the city centre, namely the business and historic centre. Besides its importance in the road network, it is also a very dense commercial and service zone. It generates high levels of demand, attracting large flows of people throughout the day on different transport modes, causing several double-parking problems, and with a high pedestrian flow pressure, despite the lack of comfortable and appealing conditions to walk.

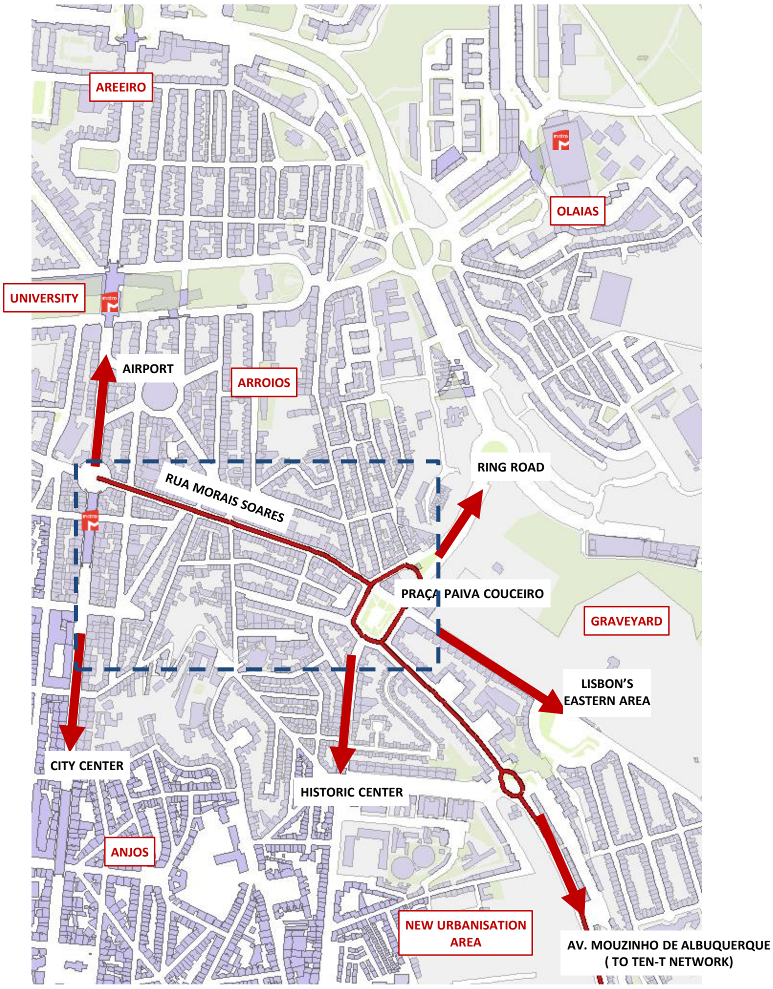


Figure 28. Location of the stress section under study and its surroundings

4.1.2 Future conditions in the Wider Impact Area

This chapter shows the expected conditions within the section under study in the following 20 years. This analysis is based on the four scenarios developed in D5.2 for the section, each one with their own characteristics and impacts' level on demography, local economy and mobility, but also on the land developments that are expected to occur as well as in some technological advances that will lead to new mobility patterns and public space uses.

The evolution of each scenario, and its mobility consequences, will be used for testing the new designs developed in D5.3, considering each transport mode foreseen OD matrices, which will support the analysis of the proposed solutions in the future.

In summary, the section's future conditions are based on:

- Development of scenarios
- New land uses
- Additional transport modes

4.1.3 Scenario Development

To forecast what future patterns of demand along the section under stress are going to be, four scenarios were developed. Each scenario is a picture of one possible future set of circumstances to which the proposed set of measures for the section has to consider. The scenarios describe possible futures which contextual environment are significant different leading to different impacts and consequences on mobility that should be taken into account.

The developed scenarios pretended to create 4 different community visions, based on the type of population or zone users and in generational characteristics in which the technology and some imposed restrictions may perform a central role.

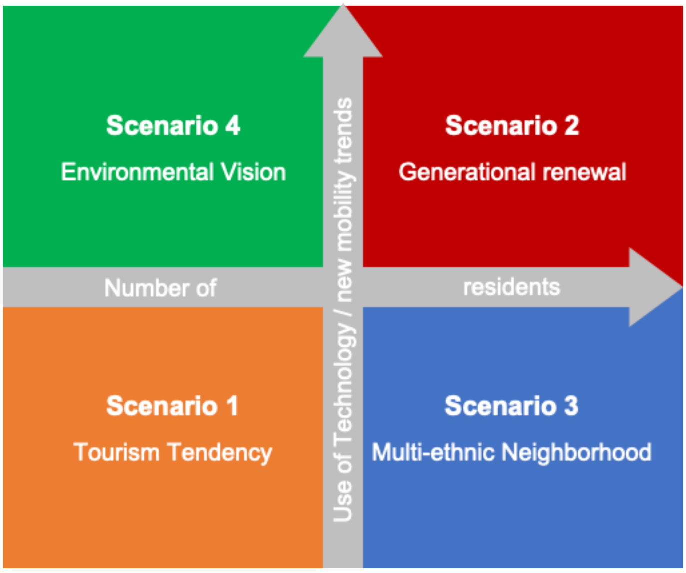


Figure 29. Considered scenarios for the section under study

- **Scenario 1** is based on tourism growth, which will help to redefine existing commerce and services in the section and its impacts on demography and economy.

- **Scenario 2** relies on success of some housing policies and the emergence of some clusters of technologic start-up companies in the zone's area of influence, which will attract a younger generation to live in the section.

- **Scenario 3** assumes a similar composition that has happened in surrounding neighbourhoods, with a significant immigrant population moving to this section, changing the type of commerce and rejuvenating the area.

- **Scenario 4** considers the hypothesis of large restrictions to ICE vehicles circulating in the city centre and its surroundings and the progressive transformation that can occur in the economy and demography in this area.

To work on the above-referred scenarios' development, was foreseen the evolution of each one of the following drivers of change since those were considered as the most likely to generate higher impacts on the section:

- Demographic and population aging

- Tourism
- Social habits or behaviours
- Commerce
- Technological developments
- Employment
- Cost of living

Below, each scenario is described, through the association of each driver of change with their expected evolution.

Scenario 1 – Tourism Tendency

- Lack of capacity to attract young population and, simultaneously, AirBnb grows and consequently cost of living too. This effect will, in a medium term, decrease population as long as there isn't any demographic renovation.
- Airport increases capacity in 50% - tourism grows as well as Airbnb;
- Due to Covid-19, real estate prices reduce. These reducing will be exploited for foreign investment, without intention to live in the area but to build hotels, guest houses or high-income resident houses. In a medium term this type of investment will increase the living costs, becoming inaccessible to younger generations and families;
- The neighbourhood becomes trendy or hipster, due to tourism demand, which will attract also visitors on weekends. Some expensive stores open.
- Cost of living, especially rent prices, increases leading to a gentrification of the zone. Due to this, some low income and traditional stores will close, and some house rents may become unaffordable to most habitants. In this context, the sense of identity with the neighborhood may be lost.
- Lower traffic in the rush hours but higher traffic volume in off peak periods. Some touristic and traditionally disorganized transport modes like tuk tuks grow. Tourism buses become common.
- Due to ride sharing and taxis use increase, and lower demographic levels, parking residents demand will reduce. In contrast, some hotels as well as some exclusive stores will open, demanding space to park around them to their customers.

Scenario 2 – Generational renewal

- Low rents program is a success, which allows to attract young people to live in the area, taking advantage of the universities and companies hubs are created in the surroundings.
- Creation of employment hubs near the section besides continuously support to create start-up companies in the city.
- Rise of teleworking. Number of travels, especially during rush hours will decrease. However, younger generations, which are traditionally more able to do teleworking, rather live outside the city due to the cost of living and to avoid daily mess.
- Home deliveries users have a high increase, demanding increasingly faster deliveries, which the existing traditional stores may not be able to follow, leading to their decline;

- Younger generations with lower average income, which won't be attractive to some expensive stores;
- Parking demand for residents will reduce, since younger generations don't appear to attach as much importance to car owning. However, for families, the perception of the need to own at least one car by household will remain which will still make pressure on parking demand. On the other hand, the increasing use of transport modes sharing will increase the demand for parking of those transport modes (car, scooters, bicycles, etc.)
- Parking for customers and load/unload demand will reduce since some traditional stores will close.
- Taking advantage of the price reducing of rents as well as income, several vacant building spaces will be recovered and modernized, increasing zone's attractiveness for younger generations;
- Automated driving increases, which reduce parking needs and, consequently, space for pedestrian and active modes becomes available. However, autonomous vehicles tend to move instead of parking which may increase traffic volume. However, it is expected that safety for vulnerable users increase.
- Use of drones to deliver freight or even 3D printing may have a positive impact in the number of load/unload operations and use of public space.

Scenario 3 – Multi-ethnic neighborhood

- Number of immigrants grows in the area, slowly substituting older residents, leading to new socio-demographics and types of street commerce;
- The zone becomes multi-cultural and multi-ethnic;
- Commerce is more focused in local supply, at weekends, the neighborhood has capacity to attract visitors to its stores and restaurants;
- Car ownership might fall, so parking pressure for residents will reduce. However, parking demand for customers and load/unload operations increases;
- The use of public transport increases;
- Demographic changes likely to boost sustainable travel behaviour such as use of active modes, like walking and riding bicycle, the use of public space to live in community.

Scenario 4 – Environmental Vision

- Several restrictions for combustion vehicles are imposed in the city center and its surroundings (inclusively in the street under study), in conjunction with a strong public transport reinforcement;
- The zone becomes more attractive for a population from upper and upper-medium class, not relying on car;
- Cost of living, especially rent prices, increases leading to a gentrification of the zone which conducts to the closing of some cheap and traditional stores and some house rents may become unaffordable to most habitants.
- The zone becomes less attractive to families whom, most likely, will live in other zones.

- The type of commerce slowly changes for a mixture of stores for daily local supply, and also some art galleries and expensive stores will also open, being able to attract weekend visitors. However, the sense of neighborhood's authenticity will disappear.
- Hotels or Hostels will arise.
- Some stores and hotels will demand parking space for costumers and load/unload operations. Possibly parking pressure on weekends will be higher.
- The use of ride sharing increase significantly, as well as active modes. Parking demand for ride sharing, car sharing, bicycles or other micro-mobility systems will rise. The use of public transport may reduce.
- The use and own of electric vehicles will increase significantly, since circulation and parking of electric vehicles is usually much less restricted. If, in a short term, residents parking pressure reduces, in a medium term it will possibly grow again and with another type of requirements as public chargers.
- Automated driving increases, which reduce parking needs and, consequently, space for pedestrian and active modes becomes available. However, autonomous vehicles tend to move instead of parking which may increase traffic volume. However, it is expected that safety for vulnerable users increase.
- Creation of parking slots, or intelligent kerbside management, especially for load/unload operations, which may allow to increase public space using those parking spots, during some time-of-day periods. This may allow to increase the place's attractivity, inviting street users to use those places (restaurants, stores, rest places)
- Use of drones to deliver freight or even 3D printing may have a positive impact in the number of load/unload operations and use of public space.

The table below provides a summary of the contextual environment to which the scenario relates, considering demography, economy and social behaviors, and a list of the foreseen consequences for parking and mobility within the section, that results from the changes in each scenario.

Table 15. Summary of scenarios and its consequences in parking and mobility

Scenario 1 Tourism Tendency	Scenario 2 Generational renewal	Scenario 3 Multi-ethnic neighborhood	Scenario 4 Environmental Vision
CONTEXTUAL ENVIRONMENT			
Demography Low number of residents No generational renewal Economy Capacity to attract weekend visitors New hotels and expensive stores Social Behaviors Neighborhood's identity is lost Sense of community doesn't exist	Demography Number of residents increase Mixture between younger residents and existing and older residents Economy Lack of capacity to attract daily visitors Street is not attractive for some high income and/or traditional stores Social Behaviors Rise of teleworking and online commerce The neighborhood will be seen as passage than as a local to stay and live	Demography Number of residents increase significantly Generation renewal and number of families and children increase Economy Traditional and oldest stores will be replaced by a mixture of conveniency and ethnic products stores New stores won't be attractive for daily visitors but will be used by the community Social Behaviors Neighborhood will be seen as place to be used by the community	Demography Number of residents reduce Zone become attractive for a very specific type of population Economy Hotels, and mixture of daily consumption and exclusive stores will arise Weekend attractivity will be high Social Behaviors Neighborhood's identity is lost Residents use local stores for daily needs, but a sense of community is not created.
MOBILITY AND PARKING CONSEQUENCES			
Parking Low pressure for residents parking High parking demand for costumers and load/unload processes Ride sharing parking places should be needed Mobility Road traffic becomes more congested, due to the rise of some touristic transport modes like tuk-tuk but also mini and larger buses. Pedestrian mobility is not so demanding. Demand for active modes and new transport modes is low. Buses, as public transport, aren't attractive.	Parking Medium pressure for residents parking Low parking demand for costumers and load/unload processes Ride sharing parking places should be needed as well as parking for motorcycles and active modes (sharing and personal vehicle) Mobility Low road traffic in short term, increasing in the medium term due to ride sharing systems and new transport modes like autonomous vehicles Pedestrian mobility reduce its importance due to the street's lower ability to attract Demand for active modes and new transport modes is very high. Buses, will be progressively substituted by alternative and new transport modes	Parking Low pressure for residents parking High parking demand for costumers and load/unload processes Medium parking demand for active modes (sharing and personal vehicle) Mobility Low road traffic. Pedestrian mobility is very important since local commerce and the use of public space will be the heart of the community. Demand for active modes is high. Buses and public transport have a very significant demand.	Parking Low pressure for residents parking, which may increase over time due to electric vehicles. High parking demand for costumers and load/unload processes Ride sharing parking places should be needed. Mobility Low road traffic, although it should rise due to increase of electric vehicles use Pedestrian mobility has a higher importance in weekend than on weekdays. Demand for active modes is medium. Buses and public transport may have a high demand in a short term that could be replaced progressively by alternative and new transport modes.

4.1.4 Land Use changes

Besides demographic evolution, some changes will occur that will influence mobility patterns and flows and will eventually cause a change in the area's demographic characteristics. Among the considered changes are an urbanization and requalification of several land plots, interventions in the subway line and also a creation of several restrictions in the vehicle access to the city centre, which may have a significant impact in the section under study.

In the following, a detailed explanation of each one of the measures is made.

Table 16. Interventions and consequences of new housing and business developments

<table>
<tr><th colspan="2">Interventions – housing and business developments</th></tr>
<tr><td>
</td><td><u>Braço de Prata:</u>
Construction of a residential area with nearly 500 flats, associated with public space requalification.

<u>Vale de Santo Antonio's Urbanisation Plan:</u>

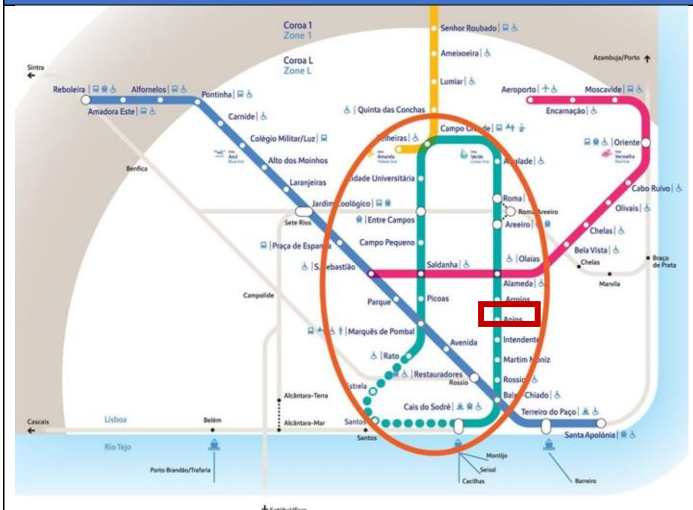
477.000 m2 intervention area, to urbanize and construct a new residential (3150 flats) and new shopping areas; Most of these new flats will be integrated in Lisbon municipality' Low Rents program.

<u>Hub Criativo do Beato:</u>

Reconversion of a former army factory complex, with 35.000 m^2, aiming to develop a new business centre related to technology, innovation and creative industries</td></tr>
<tr><th colspan="2">Consequences</th></tr>
</table>

<u>Demography</u> It is expected that Vale de Santo Antonio will significantly increase the population (between 6.000 and 9.000 habitants), attracting several families and youngsters to the area encouraging a generational turnover. The proximity with Hub Creativo do Beato which is being built to be an innovative and ecological business center focused in the development of start-up companies, may help to attract an younger generation to the zone. Braço de Prata shouldn't have a major impact in the section's demography. <u>Economic vitality</u> Both Vale de Santo António, with new shopping areas, as well as Hub Criativo do Beato should contribute for a renewal of commerce and businesses. The created services and commerce should be more oriented for daily and proximity consumption than other type of activities that could attract people from other parts of the city. <u>Mobility</u> According with the foreseen values, the total implementation these three plots will be responsible for a huge traffic increase, from 1.800 vehicles to around 3.300 vehicles (afternoon peak hour). However, public transport should be reinforced and the demand for other active modes, as well as new transport modes, may increase significantly due to younger generations that are expected to live and use these zones.

Table 17. Interventions and consequences of public transport changes

<table>
<tr><th colspan="2">Interventions – public transport</th></tr>
<tr><td>
</td>
<td><u>Change in the subway lines</u>
Creation of a circular service in the city's center. This will increase the number of services and the headway and will allow a better connection between the city and its surroundings.
<u>Arroios subway station reopening</u>
This station that serves directly the stress section is closed for works to extend its platform. It is planned to reopen in 2021.</td></tr>
<tr><th colspan="2">Consequences</th></tr>
</table>

Demography

It is not expected the interventions in the subway network have significant influence in demographic changes since it is not a new station but a renovated one.

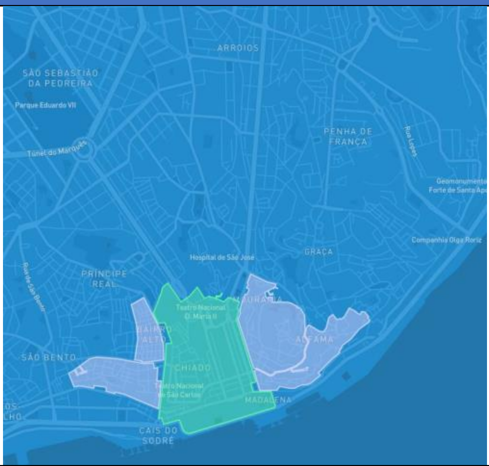
Economic vitality

With the subway network's longer and faster range, some economic activities near the station may suffer a positive impact. However, since this is not a new station and the area is covered by a good bus network it is not expected to provide a major impact by itself.

Mobility

The station's reopening will change current pedestrian flows, since several people that, nowadays, cross the section in direction to Alameda's station will move to Arroios. In terms of modal split, a significant number of bus users should be transferred for the subway. Car and ride sharing modes should reduce slightly.

Table 18. Interventions and consequences of access restrictions

<table>
<tr><th colspan="2">Interventions – access restrictions</th></tr>
<tr><td>
</td><td>Downtown restrictions
It was announced in the beginning of 2020, that the historic downtown area of Baixa-Chiado would have restricted vehicle access until August 2020. This measure had the intention of reducing 40% of the daily vehicles in the downtown given priority to public transport, pedestrians and active modes.
However, due to Covid 19, this measure had to be postponed but it still remains as a priority for a near future.</td></tr>
<tr><th colspan="2">Consequences</th></tr>
<tr><td colspan="2">Demography
The implementation of this measures shouldn't have any significant impact on the street's demography.
Economic vitality
It is not expected that the implementation of this measures would have any significant impact on the street's economic vitality. However, in the medium term, this intervention may boost a new vision of mobility, encourage the use of other active modes, having positive impacts on the street's activity.
Mobility
It is hard to forecast the impacts on section's traffic due to the implementation of these restrictions. However, since the restriction in the city center is more focused in the crossing traffic, Rua Morais Soares and Praça Paiva Couceiro may suffer a significant road traffic increase since they are alternatives axis for the movements between the center and the eastern side of the city.</td></tr>
</table>

Besides, the above referred measures there are some intentions to implement directly in the section under study, but which are not yet clearly defined and, for that reason, are not detailed:

- Creation of a parking lot in Praça Paiva Couceiro's underground, that could solve some lack of offer for customers but mainly for residents;
- Elimination of road traffic on the west side of Praça Paiva Couceiro, transforming it in a continuous pedestrian road. The road on the east side, which is currently a one way road, has to be transformed in a two way one. The implementation of this intervention could reduce traffic's speed, improve safety's feeling for pedestrian and create a continuous space between the square and the sidewalk, in contrast with the current situation that gives the feeling of being on an island.

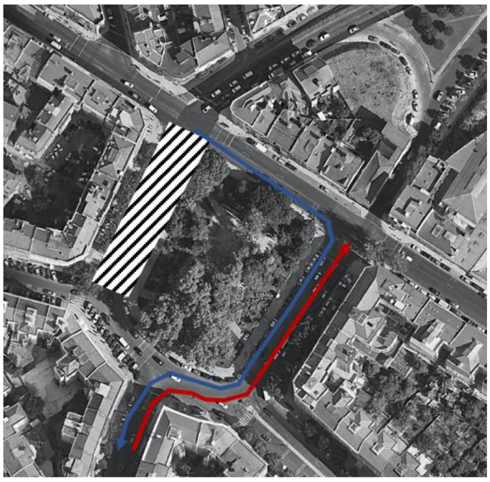


Figure 30. Possible plans to eliminate traffic on west side of Praça Paiva Couceiro

4.1.5 Additional Transport Modes

Besides evaluating future mobility patterns based on demographic and economic factors, it will also be evaluated the impacts of new type of transport modes that currently don't exist or, at least, aren't broadly used. Among several new transport modes that may appear in the near future, the following five may be the ones that may cause a major impact on mobility in a short and medium term.

- <u>Automated driving increases</u> – this will reduce parking needs which will allow to create more space for pedestrians and other transport modes. However, probably will increase congestion reduce public transport use. Safety for vulnerable users improve.
- <u>Electrification of vehicles</u> - use of electrical vehicles increase which, being cheaper than combustion vehicles, may invite people to use car which may increase congestion. Noise levels reduce.
- <u>Use of drones to deliver freight or even 3D printing</u> - may have a positive impact in the number of load/unload operations and use of public space.
- <u>Use of smart traffic optimization (UTOPIA)</u> - increase public transport attraction by giving priority at intersections
- <u>Creation of parking slots, or intelligent kerbside management</u> – Efficient use of parking, especially for load/unload operations, which may allow to increase public space using those parking spots, during some time-of-day periods. This may allow to increase the place's attractiveness, inviting street users to use those places (restaurants, stores, rest places).

In the next chapters, it will be analyzed how the new technologies can be accommodated in different scenarios and their impacts on mobility patterns.

4.1.6 Impacts of future condition in the mobility patterns and use of public space

Considering the model's development, the demand's evolution for each transport mode was foreseen according with the expected scenarios' results. So, for each scenario, some place characteristics were forecasted, as the population evolution by age group and the number of stores, which were then combined with the expected transport modes' demand evolution and walking values.

The following figure shows the methodology to define the future patterns of movements and place activities and how the variables are correlated between them.

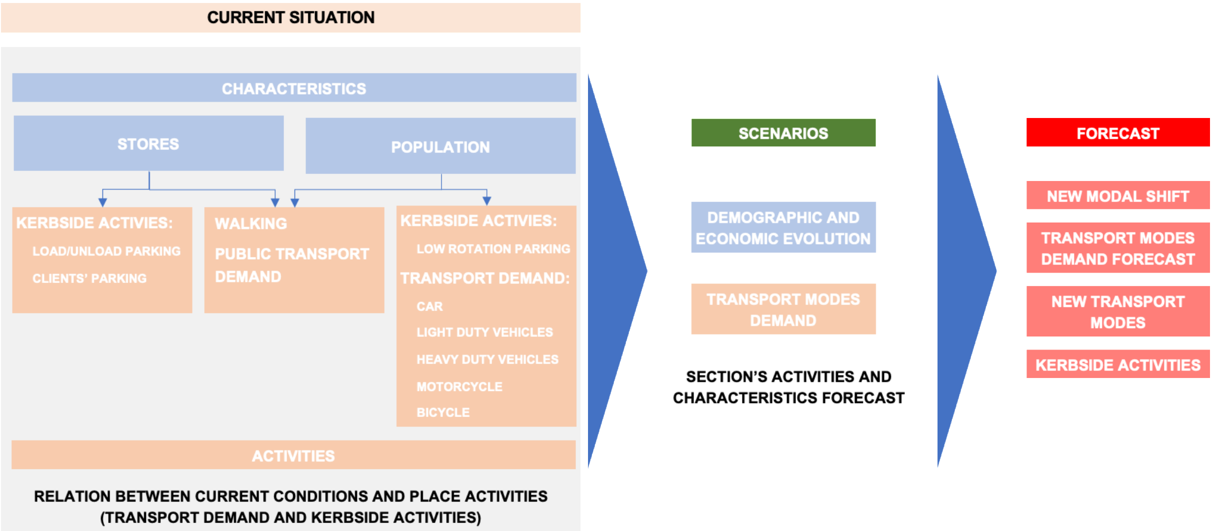


Figure 31. Model's methodology

To forecast the population for the following years, the current population's age structure around the section was used, being then considered the Eurostat projections to forecast the population's evolution. Afterwards, according with the scenarios' characteristics, the values were changed in order to result in a new age structure in the project's horizon year with implication in the street's mobility and place activities.

A similar process was adopted to calculate future demand patterns for the transport modes. After identifying the relation between the section's current demographic and economic characteristics and transport modes' use, a demand evolution was defined for each transport mode as well as for the kerbside activities, namely parking patterns by number of stores and residents. In D5.2, a more detailed analysis is provided.

The adopted methodology allowed to forecast and relate demographic and economic characteristics with the demand for transport mode. In the following figures, is shown a global vision about these variables in the section, in the afternoon peak period in 2040 for the four scenarios.

However, considering that scenarios 2 and 3 are the most likely to occur, only these two were considered for micros-simulation effects.

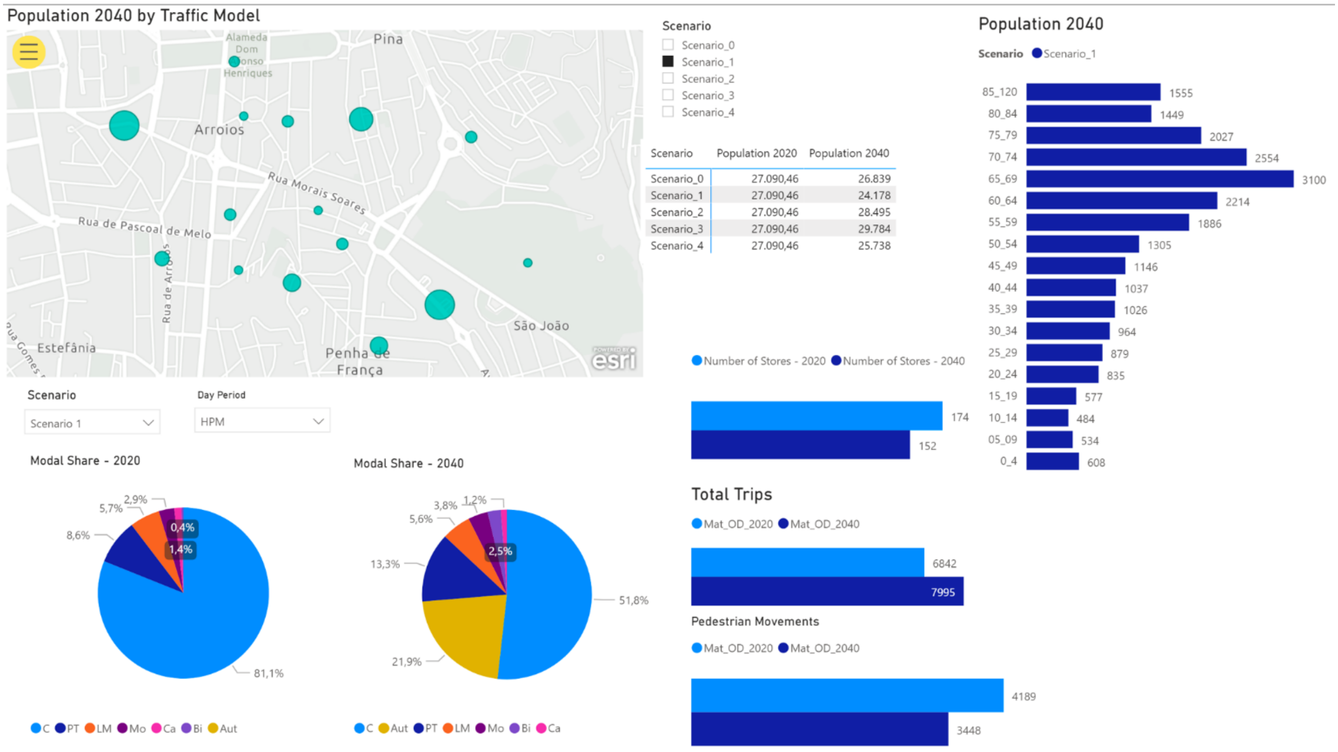


Figure 32. Demand model results, morning peak period, scenario 1

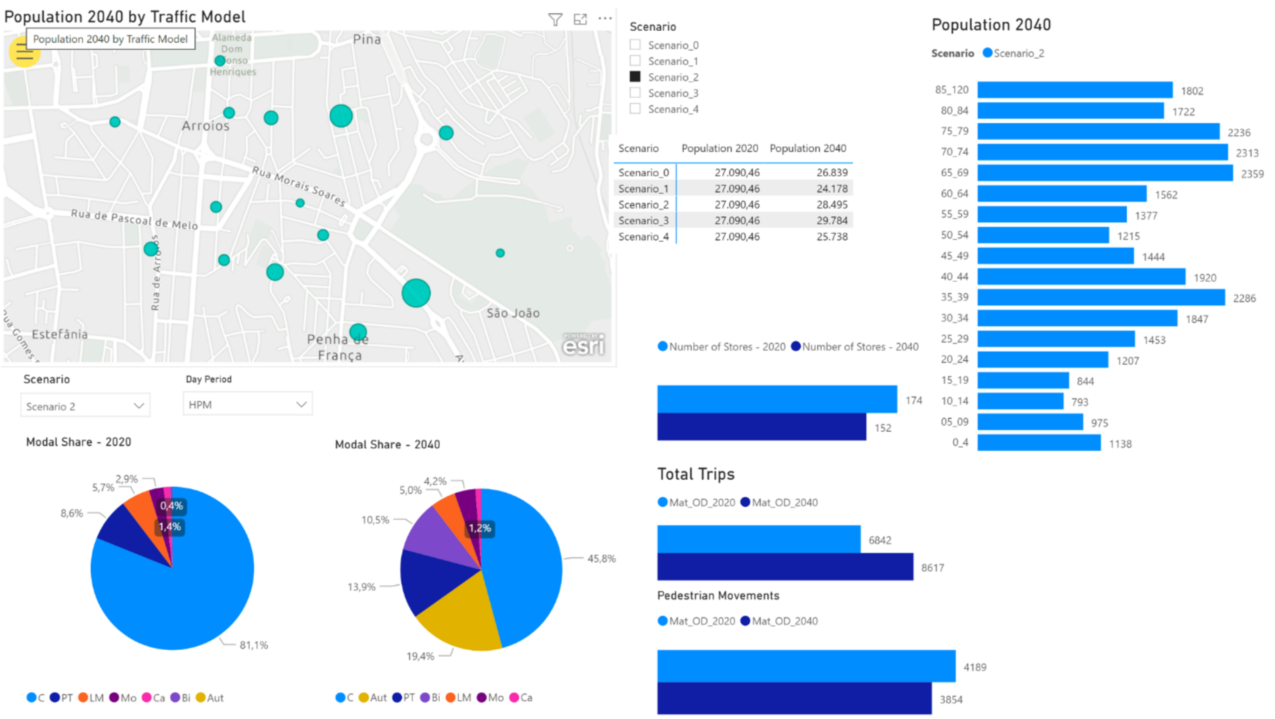


Figure 33. Demand model results, morning peak period, scenario 2

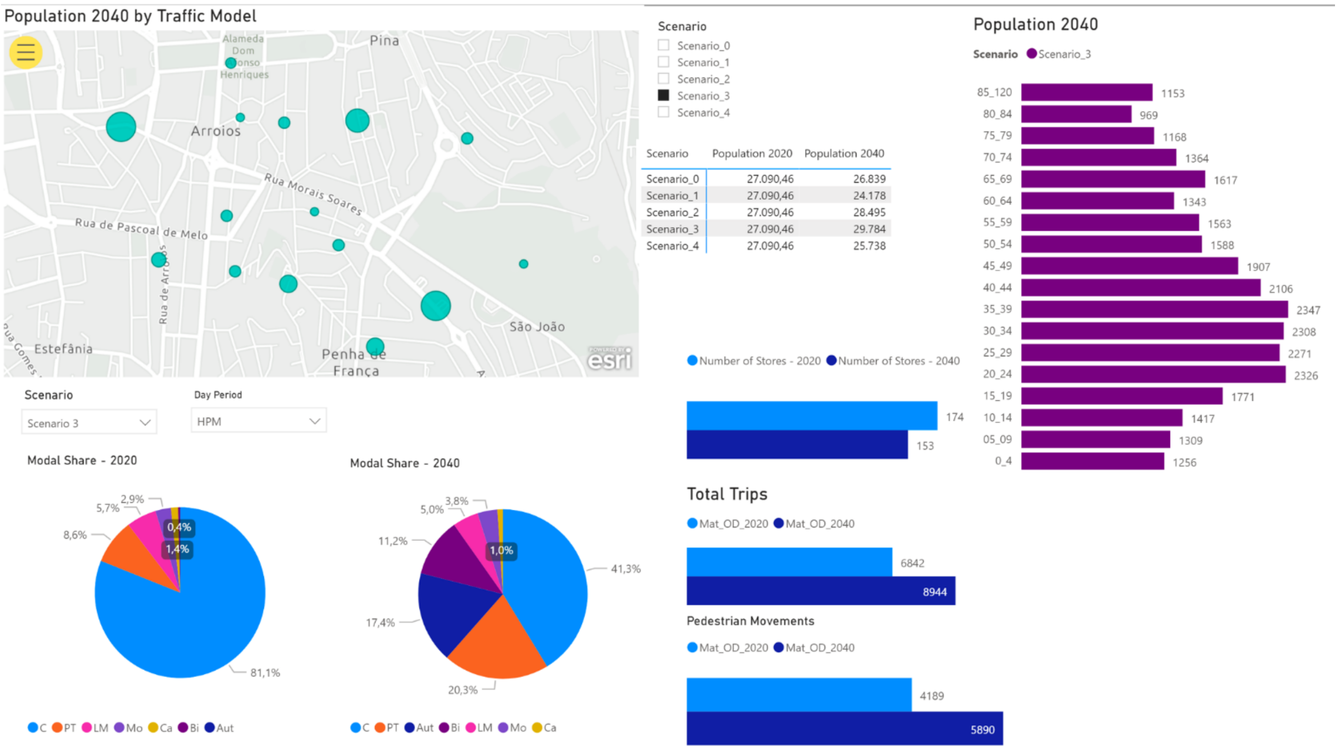


Figure 34. Demand model results, morning peak period, scenario 3

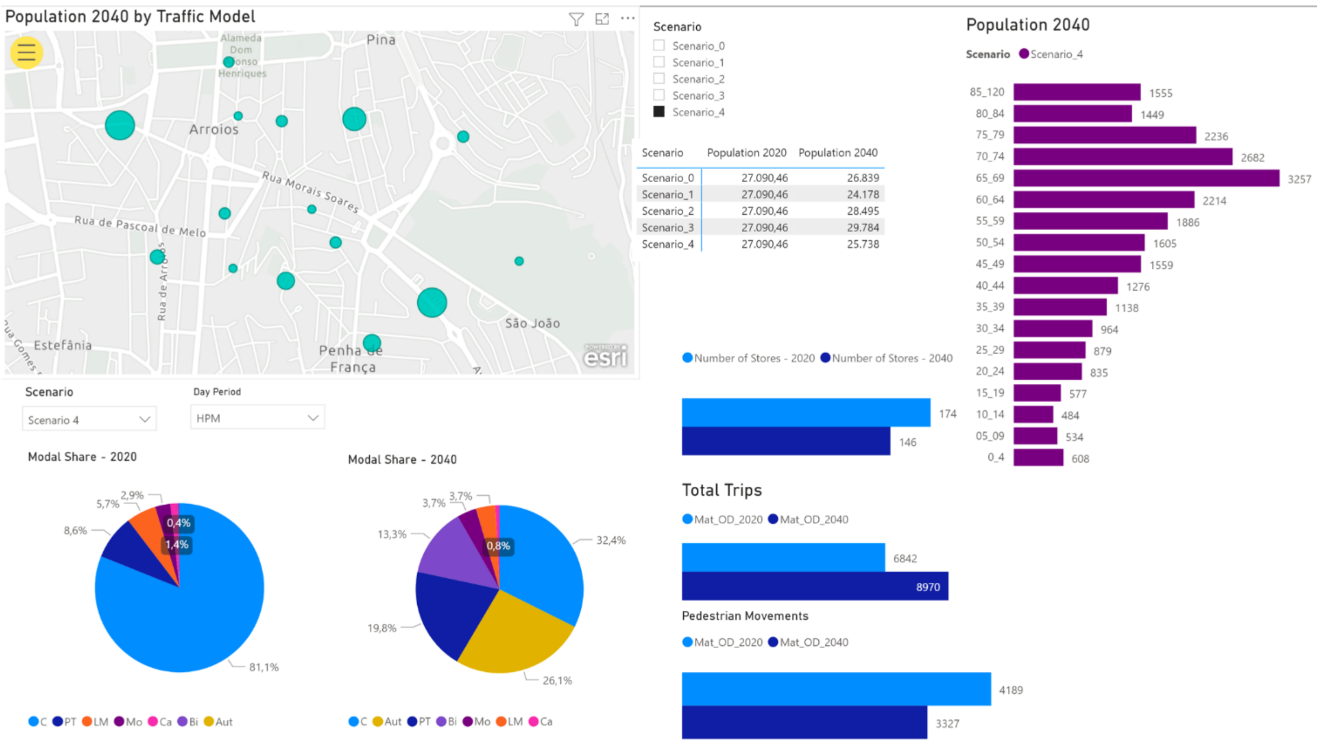


Figure 35. Demand model results, morning peak period, scenario 4

4.2 Generating street design options in the stakeholder exercises

To discuss future designs for the street, was important to have different views of the problem and to recognize what the priorities should be regarding street use. This demanded a discussion on the project and its different constraints, regarding the section under analysis, to understand the most significant problems from other perspectives and which possible solutions could be adopted to improve space quality.

With this objective, three virtual design sessions were organized in May 2021, which involved the participation of several representants of municipal departments from different public space areas of activity as well as representants of external entities, all related with the place or with the street users. The following table shows the represented entities in the design days session:

Table 19. Represented entities in the virtual design days

Sessions	Entities
Session 1	- Mobility Strategy and Planning Department
Session 2	- Public Space Department - Urbanism Department - Traffic Management Department - Pedestrian Accessibility Department
Session 3	- International Federation of Pedestrians - Disabled Association (CVI – Centro de Vida Independente) - Parish Council of Penha de França

The sessions had and estimated time of one hour and a half but all of them took a longer time than expected. The sessions had the following agenda:

1. Presentation of the project
2. Brief summary of the work done
3. Presentation of the elements gathered from Traffweb and street survey
4. Presentation of the scenarios for the future
5. Discussion about the street's design.

However, despite been informed that the objective of the workshops was to identify future tendencies and how they should be integrated and complemented with the other common transport modes and street uses, the discussion had always concentrated in the current conditions, proposing new designs to solve current problems, giving their perspective of what the priorities should be nowadays. In fact, we found very difficulties to discuss future issues and the correspondent solutions, without discussing first current conditions in such a pressure section that presents so many problems, nowadays. The suggestions resultant from these workshops were complemented with the proposals coming from public participation.

In this way, the same designs used in D5.3 are used to analyse the future conditions in order to measure the impacts of each scenario in the new designs, through the modelling process.

The results from the modelling will be assessed, using the appraisal tool, which allow to compare current situation's results with the future scenarios.

As well as in D5.3, the most relevant new designs are shown in the following images, as well as a comparison between the final solution and the current situation.

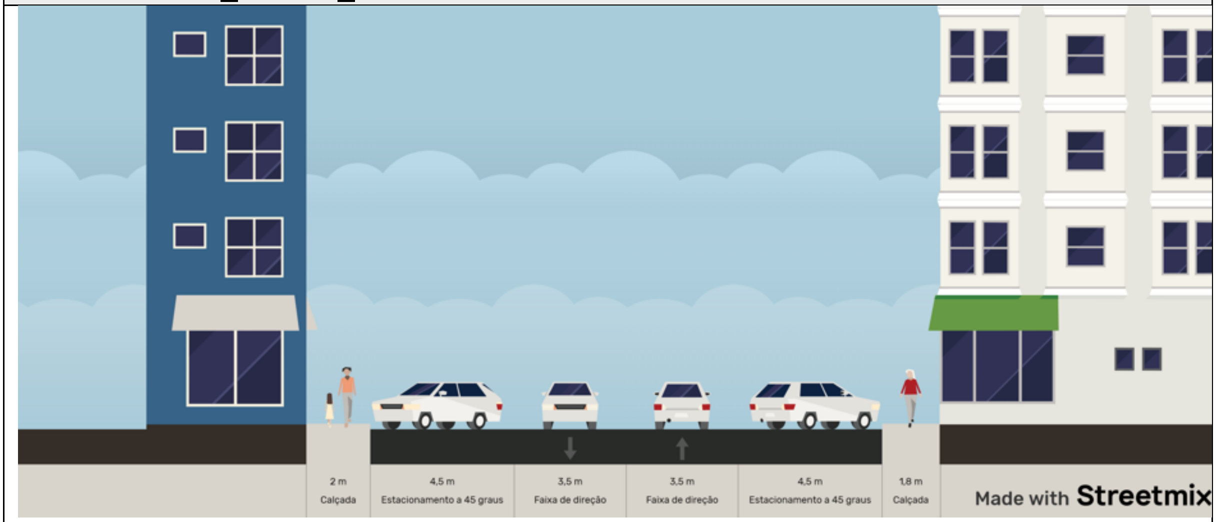
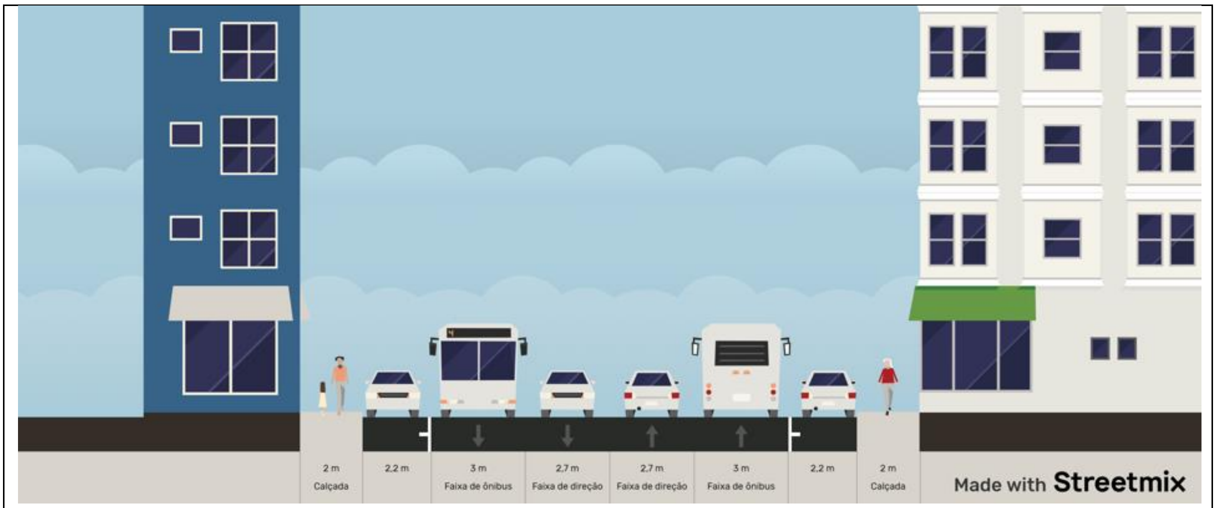
<table>
<tr><th colspan="2">Scenario 1: Precedence to parking</th></tr>
<tr><td colspan="2">ID Number: LIS_S14010_AMR00000</td></tr>
<tr><td colspan="2">
</td></tr>
<tr><td>Proposals:
Reduce one lean in each way;
Change parallel parking to diagonal parking
Slight sidewalks' widening</td><td>Expected negative impacts:
Maybe one lane in each way won't be enough to have an efficient traffic flow and will produce traffic jams.
Bus flow should have a significant negative impact.
The sidewalks should enlarge about 30 cm in each way, which it is not significative to enhance good conditions to walk or use the street.
The number of parking places will increase significantly, which can be seen as an invitation to go to the street using private transport.</td></tr>
</table>

Figure 36. Scenario 1 street design cross section

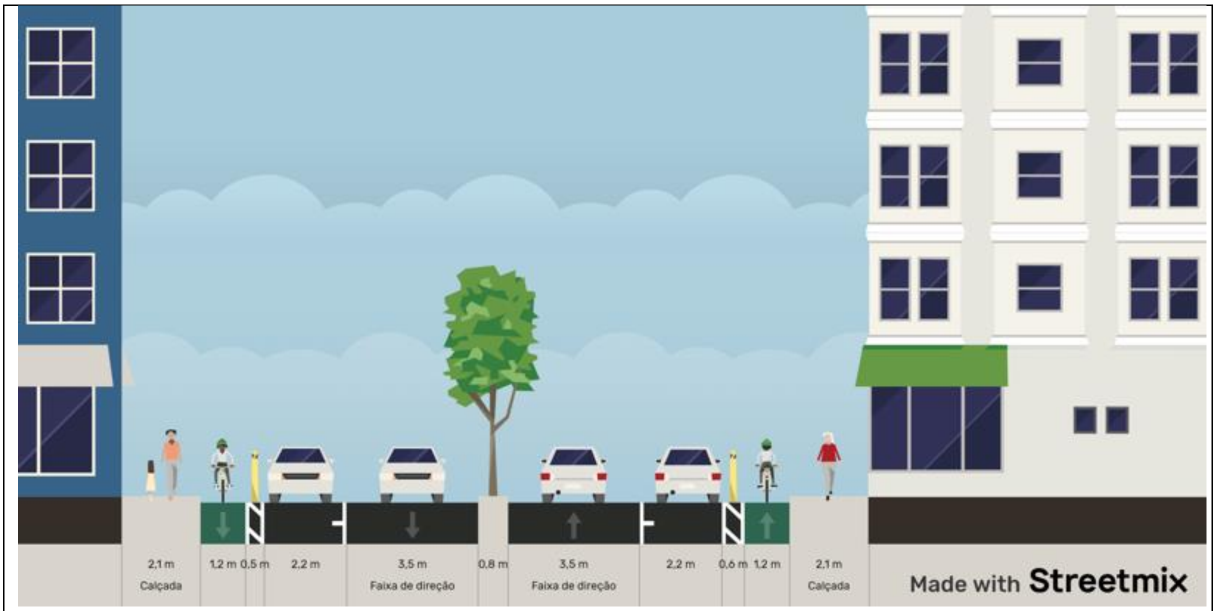
Scenario 2: Precedence to public transport
ID Number: LIS_S14010_JKLS0000



Proposals:	Expected negative impacts:
• Transform the right lane in a bus dedicated lane • Maintain current parking spaces • Reduce the parking places width	• Maybe one lane in each way won't be enough to have an efficient traffic flow and will produce traffic jams. • The buses will have a positive impact, although there are several right turns, so those spaces may be occupied by other vehicles. • Since current parking situation remains, the right lanes would be used by cars to park in the parking places and besides, double parking should remain. • The introducing of a bus lane will oblige to reduce parking width. 2,2 meters may not be enough, in some load/unload operations. • The situation for pedestrians remains the same.

Figure 37. Scenario 2 street design cross section

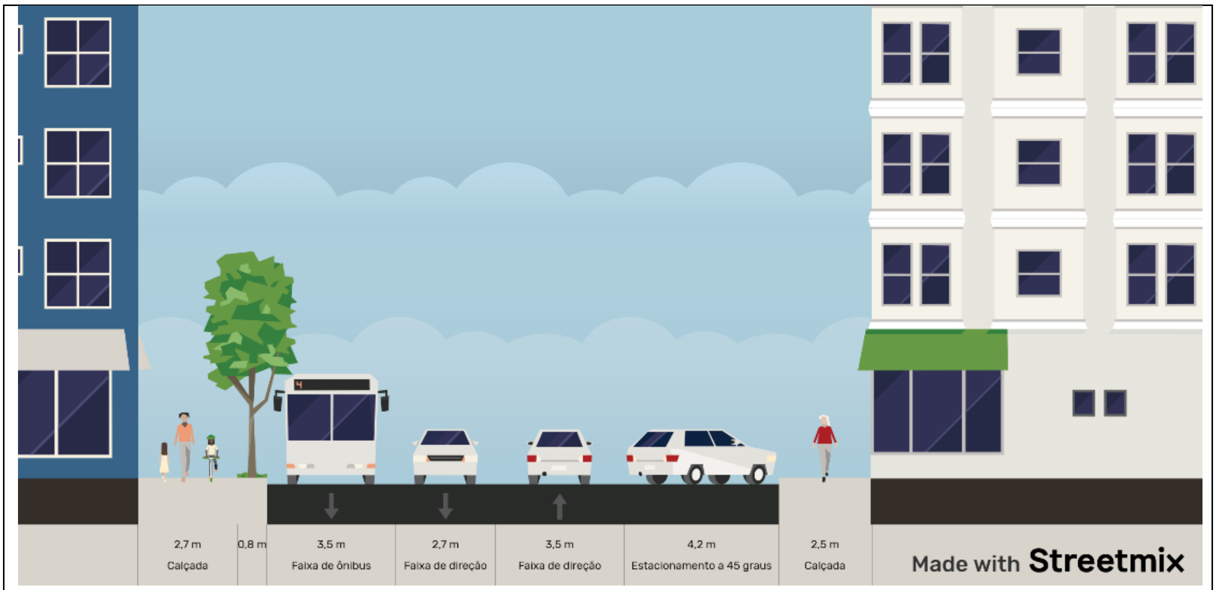
Scenario 3: Precedence to cycle lanes
ID Number: LIS_S14010_ABCFH000



Proposals:	Expected negative impacts:
• Introduction of a one way cycle lane on each side of the road between sidewalks and parking. • Slight sidewalks' enlargement • Narrowing the parking places • Introduction of pedestrian refuges with trees	• Maybe one lane in each way won't be enough to have an efficient traffic flow and will produce traffic jams. • Bus flow may have a significant negative impact. • Right turns should be a problem for the safety of using the cycle lane. • Parking width will reduce from 2,5 meters to 2,2 meters which may not be enough, in some load/unload operations. • The situation for pedestrians is slightly the same. • Current number of bicycles doesn't seem to justify a cycle lane. However, it may induce the number of active modes there.

Figure 38. Scenario 3 street design cross section

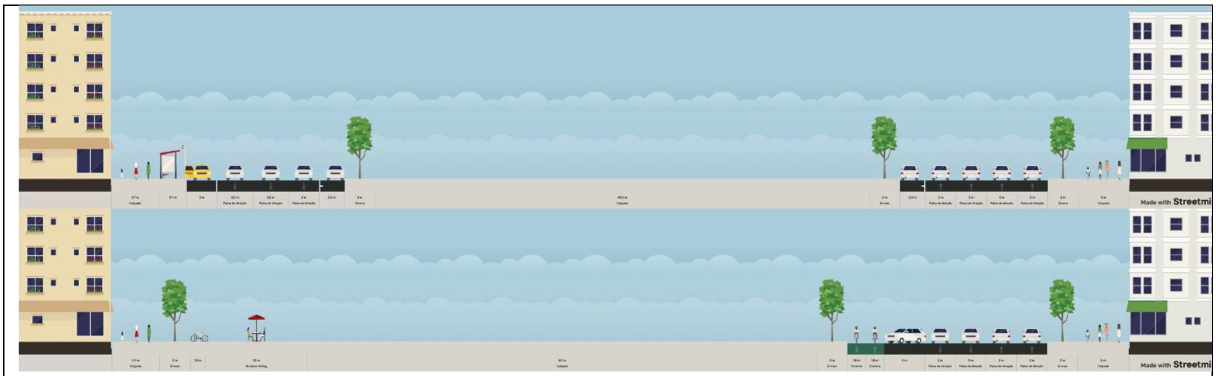
Scenario 4: Precedence to pedestrians, bus and greenery
ID Number: LIS_S10000_ABCDEJK0



Proposals:	Expected negative impacts:
• Transform right lane in the east to west side in a bus lane. • Remove one lane in the west to east side • Significant sidewalks' enlargement and plantation of trees in one side • Remove parking from one side and transform parallel parking in diagonal parking in the other side,	• The road capacity should be enough to have an efficient traffic flow in both ways in the morning peak hour, but maybe is not enough at afternoon peak hour. • Parking would remain in the side with lower traffic volume, which may induce traffic volume in neighbouring streets, due to parking finding and to use the streets to inverse direction to find a place in the other direction. • Diagonal parking may lead to some accidents. • The buses will have a positive impact, although there are several right turns, so those spaces may be occupied by other vehicles.

Figure 39. Scenario 4 street design cross section

Scenario Paiva Couceiro
ID Number: LIS_S14010_ABCD0000

<table>
<tr><td colspan="2"></td></tr>
<tr><td>Proposals:

• Remove of traffic from one side and make a continuous space between the square and its west side.
• Create two-way direction on the east side of the square
• Transformation of the current parking lot into a diagonal parking in the inverse direction.</td><td>Expected negative impacts:

• The number of lanes may not be enough to have a fluid traffic flow.
• This solution will oblige to create some left turns, since current situation worked as a roundabout.
• Need of installing more traffic lights, having an impact in the traffic flow.
• Maybe there will be a need to install signalized crossings to pedestrians, since two-way lanes in each direction may increase the risk of being hit.
• The removal of traffic from that side will remove some routes, which may induce traffic in adjacent streets
• Several movements would concentrate in the same roads, leading to some traffic disorganization.</td></tr>
</table>

Figure 40. Scenario Paiva Couceiro street design cross section

4.3 Building and applying the Vissim model

4.3.1 Methodology

As referred above, on the previous chapter, the scenarios for the future, namely the resultant OD matrices, are assigned to the designs generated from both public participation and design days sessions.

This methodology will compare the outputs from the model, under current and future circumstances, allowing to identify which design suits better to different situations.

For future situation assignment only two scenarios, in afternoon peak period, were simulated, as they should be the most likely to occur:

- Scenario 2 – Generational renewal
- Scenario 3 – Multi-ethnic neighborhood.

More details on locations of nodes and sections are found in the Appendix. The methodology followed for the future conditions is similar to the one presented in D5.3, which will facilitate the comparison between scenarios.

In the following chapters, the outputs of the assignment of Scenario 2 and Scenario 3 OD matrices to each suggested design are shown.

4.3.2 Scenario 2 – Generational Renewal

The figure below shows the evolution of the movements in a 20 year long perspective, comparing with the current situation. It is expected that the total number of trips will increase, but with a much more balanced use of transport modes. Comparing with the reference values of the year 2020, the number of car users should reduce, being replaced by other transport modes as autonomous vehicles, bicycle and public transport users. The higher number of public transport users will, consequently, demand to increase the number of buses circulation, which may have a significant impact on general traffic circulation.

Considering the demographic and socio-economic context around Scenario 2, the number of pedestrian movement is expected to reduce 10%.

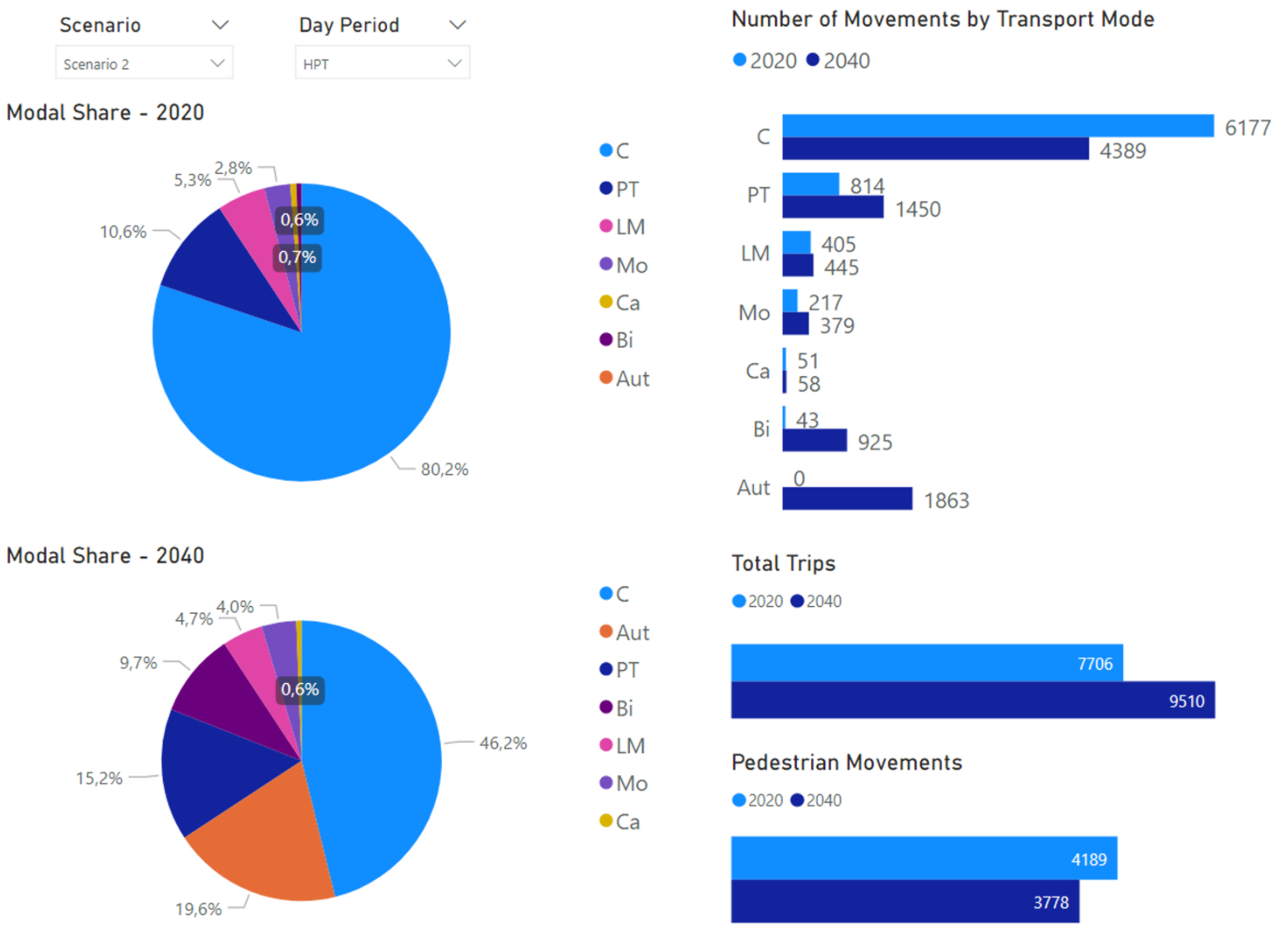


Figure 41. Movement characteristics, Scenario 2, PM Peak

In the following chapters some modeling outputs are shown, which will allow to compare how traffic and pedestrians would behave according with each scenario. The identified outputs are the following:

- Vehicles:
  - Number of vehicles
  - Number of stops
  - Stops and vehicles delay
  - Queue length
  - Overall traffic level of service
- Pedestrians;
  - Number of pedestrians
  - Maximum density
  - Average speed

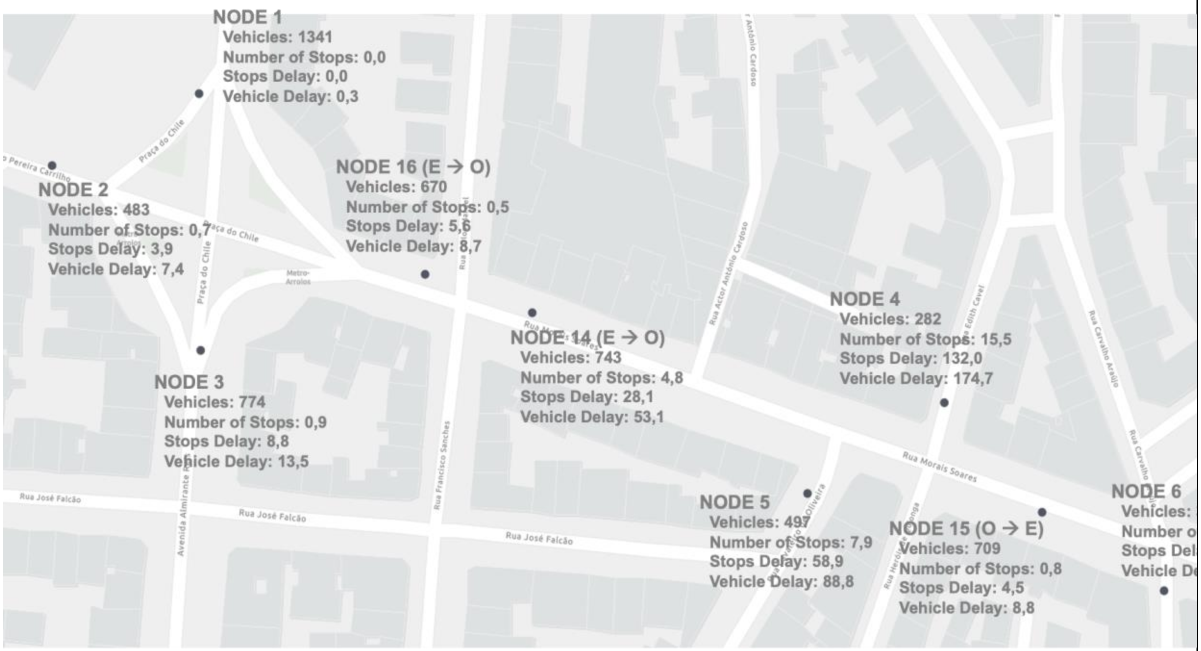
- Level of service

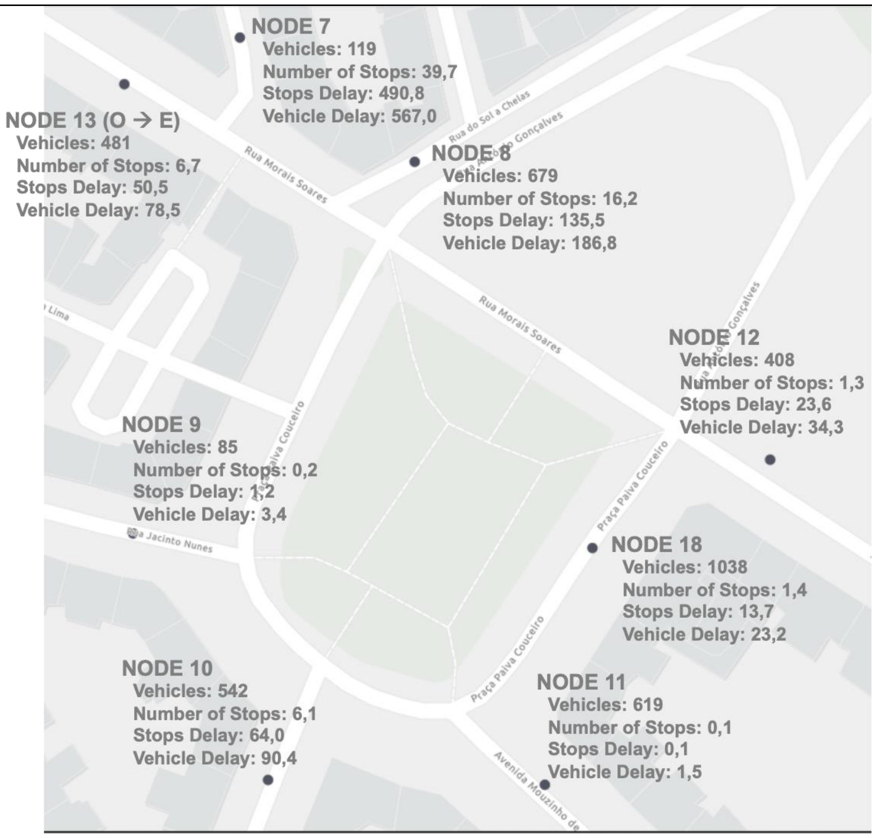
After showing the results for each design, a comparison between the obtained results will be made.

Design 0

The following table shows the number of vehicles, as well as some traffic characteristics, as delays, queue length and level of service, that pass through each node, considering all transport modes, assigned to street's design 0, that corresponds to the current situation.

Nodes results – Design 0





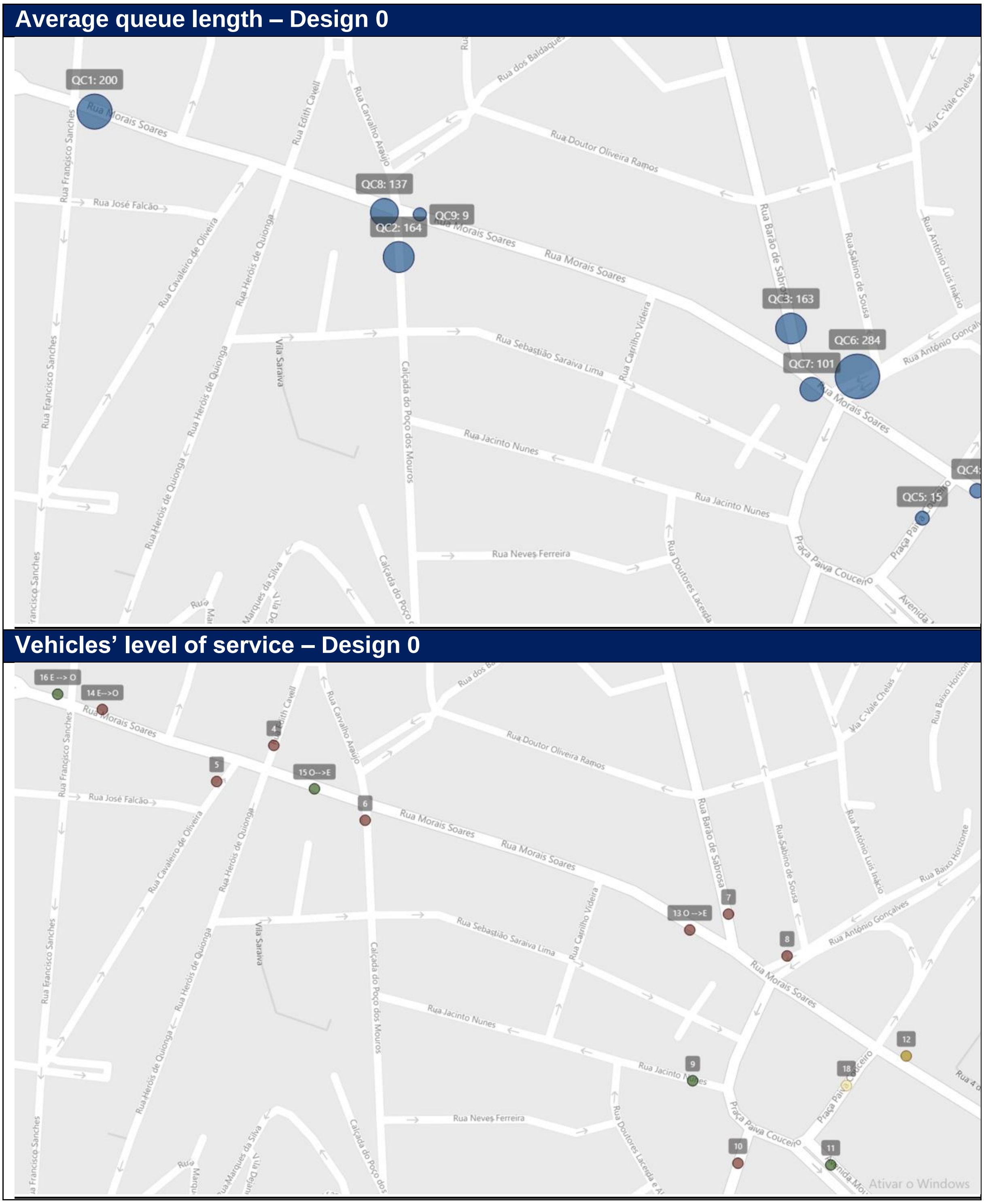


Figure 42. Modelling outputs – Scenario 2, Design 0, PM peak period

Considering pedestrian movements, the figure below shows some characteristics regarding pedestrian movement resulted from Vissim simulation, as the number of pedestrian per hour, average speed and maximum density as well as the current level of service.

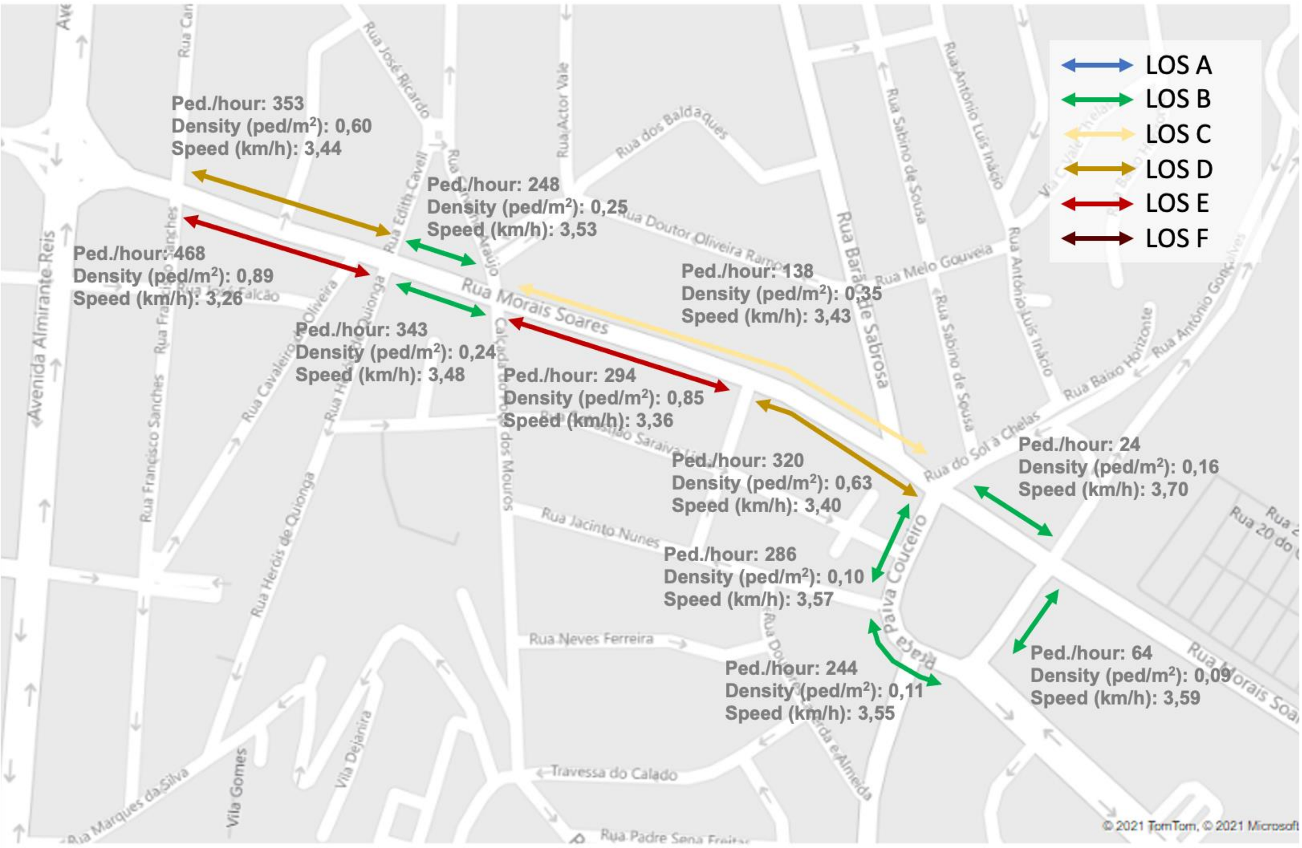
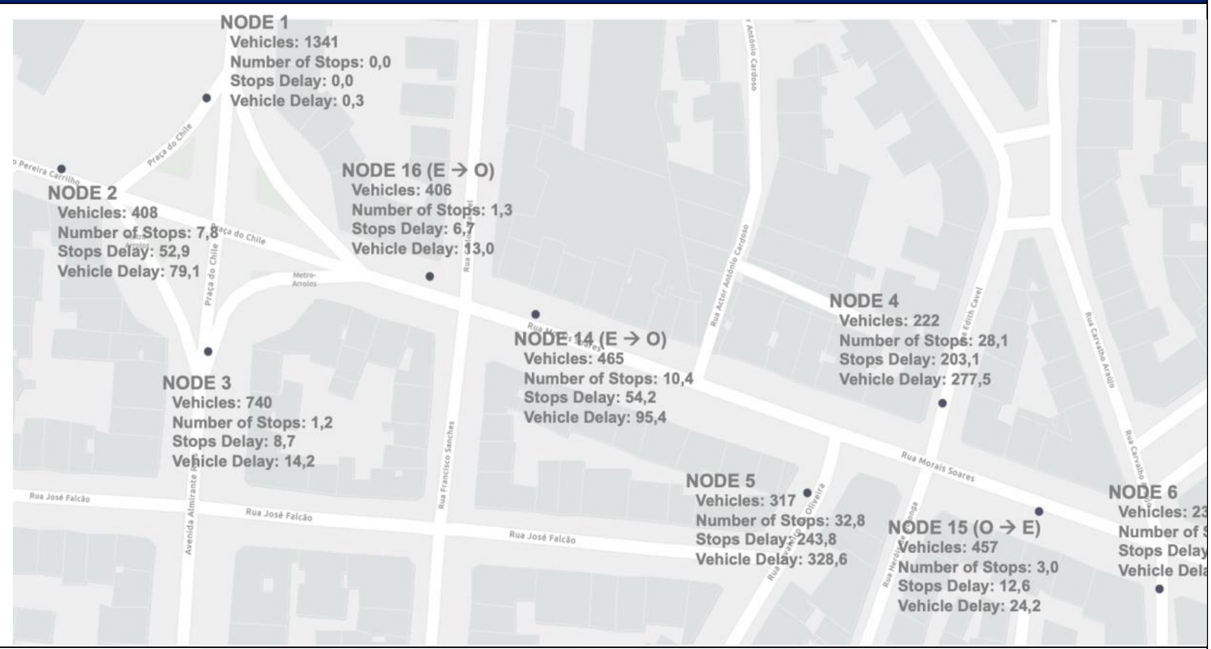


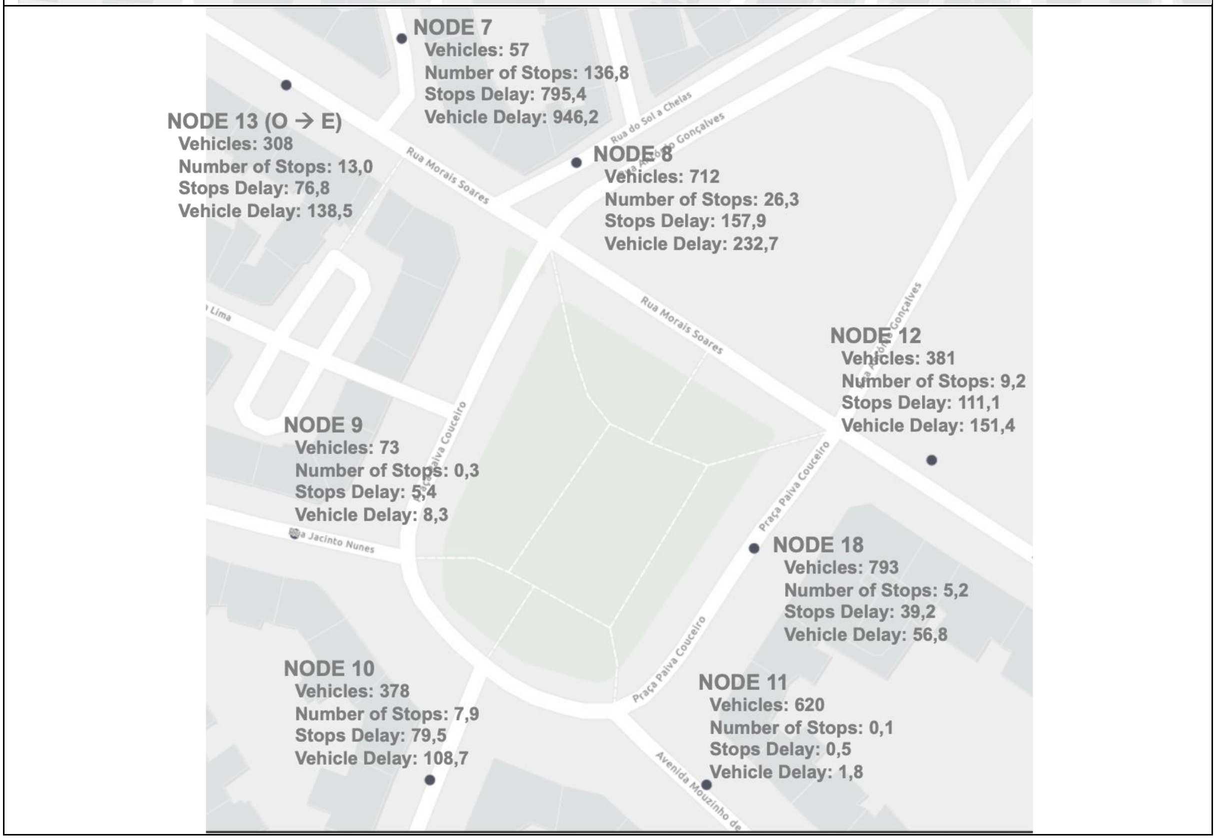
Figure 43. Pedestrian's characteristics and level of service, Scenario 2, Design 0, PM peak period

Design 1

The following table shows the number of vehicles, as well as some traffic characteristics, as delays, queue length and level of service, that pass through each node, considering all transport modes, assigned to street's design 1, that foresees an increase on the number of parking places, through the replacement of current existing parking spaces into diagonal parking, leading to the removal of a general traffic lane in each way. This design considers a slight increase of sidewalks' width.

Nodes results – Design 1





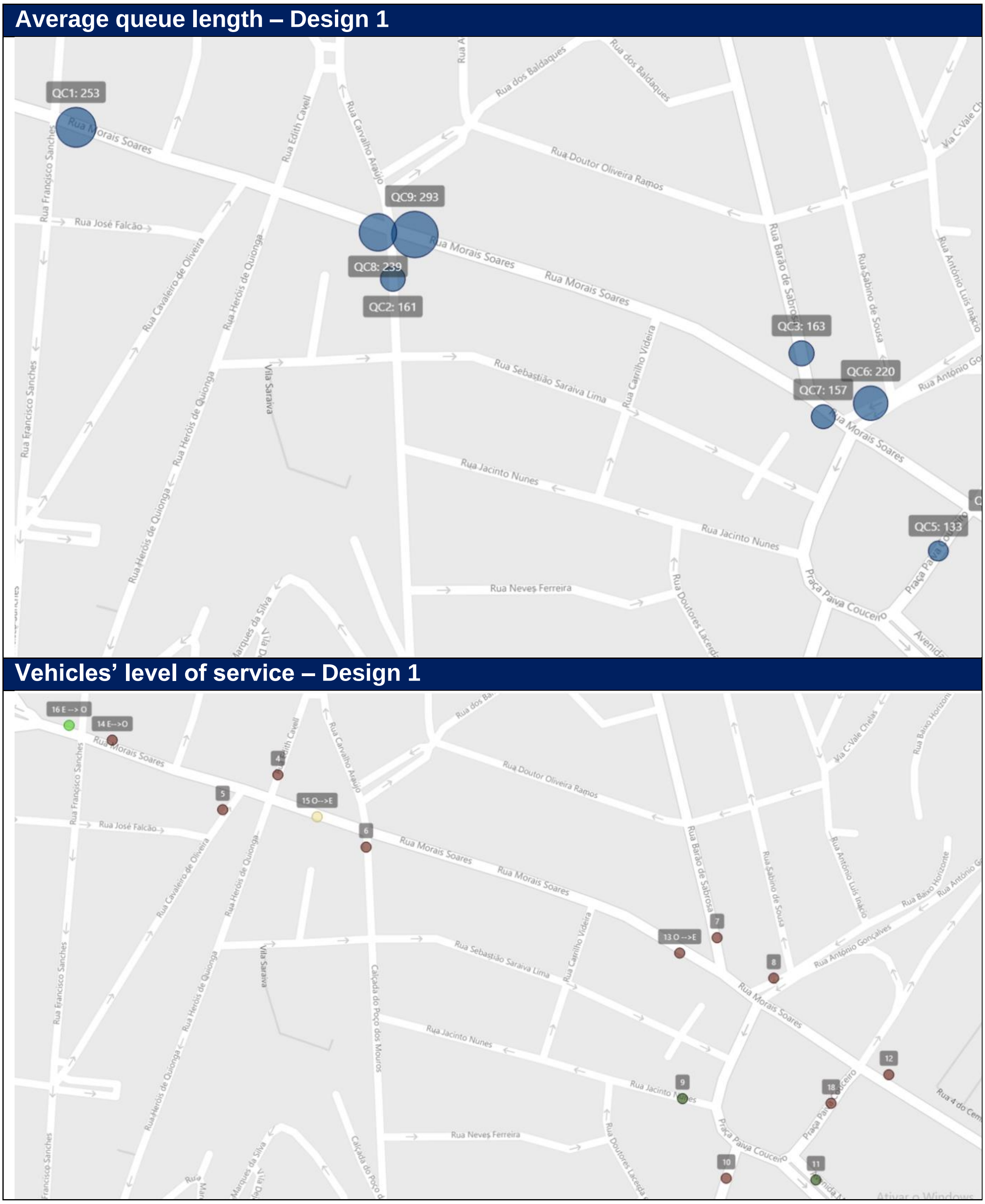


Figure 44. Modelling outputs – Scenario 2, Design 1, PM peak period

1, PM peak period

Considering pedestrian movements, the figure below shows some characteristics regarding pedestrian movement resulted from Vissim simulation, as the number of pedestrian per hour, average speed and maximum density as well as the current level of service.

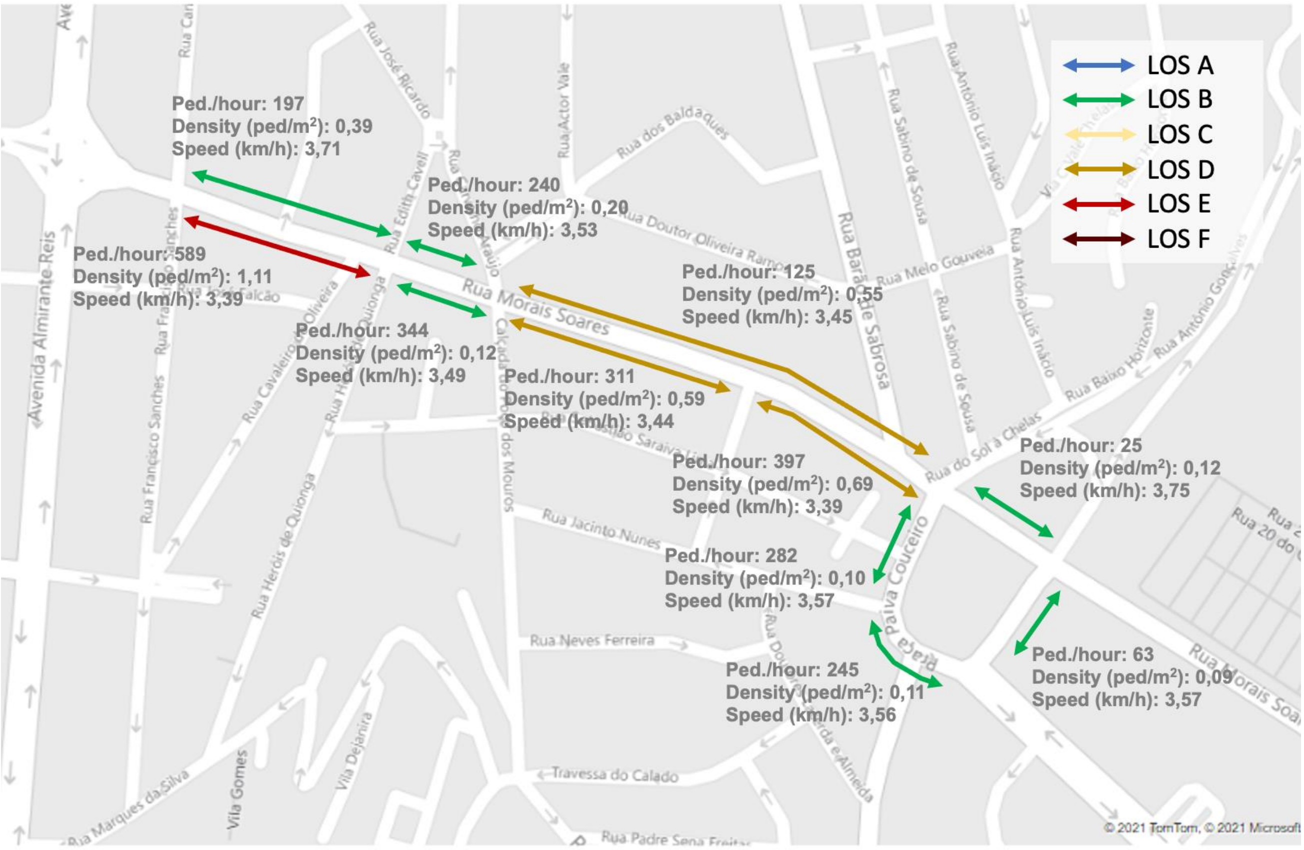
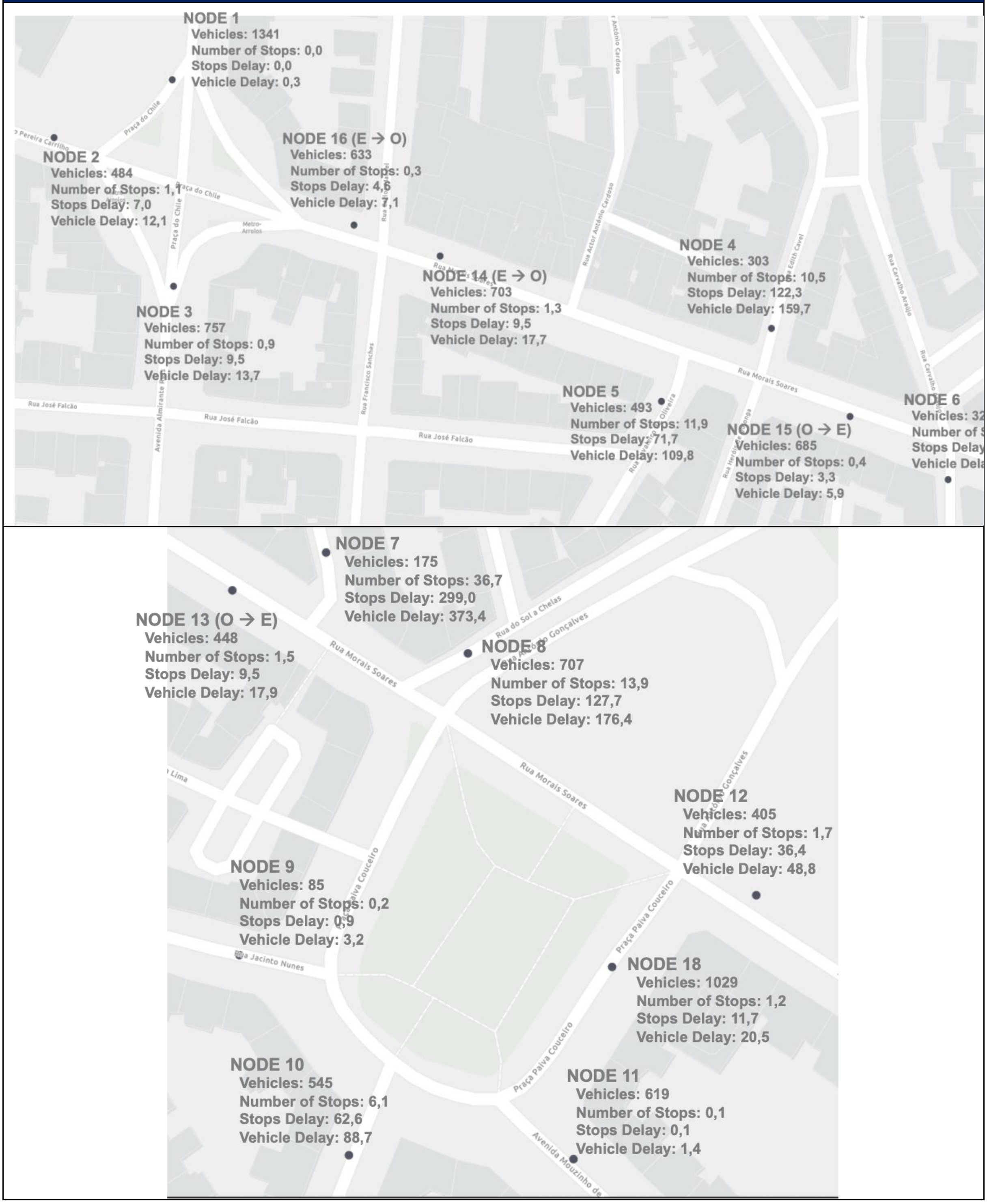


Figure 45. Pedestrian's characteristics and level of service, PM Peak, Scenario 2, Design 1

Design 2

The following table shows the number of vehicles, as well as some traffic characteristics, as delays, queue length and level of service, that pass through each node, considering all transport modes, assigned to street's design 2, that considers changing the right lane into a public transport lane. This design aims to contribute to the reduction of second lane parking occurrences, despite right turns and access to parking spaces are still allowed which may hinder the circulation of buses.

Nodes results – Design 2



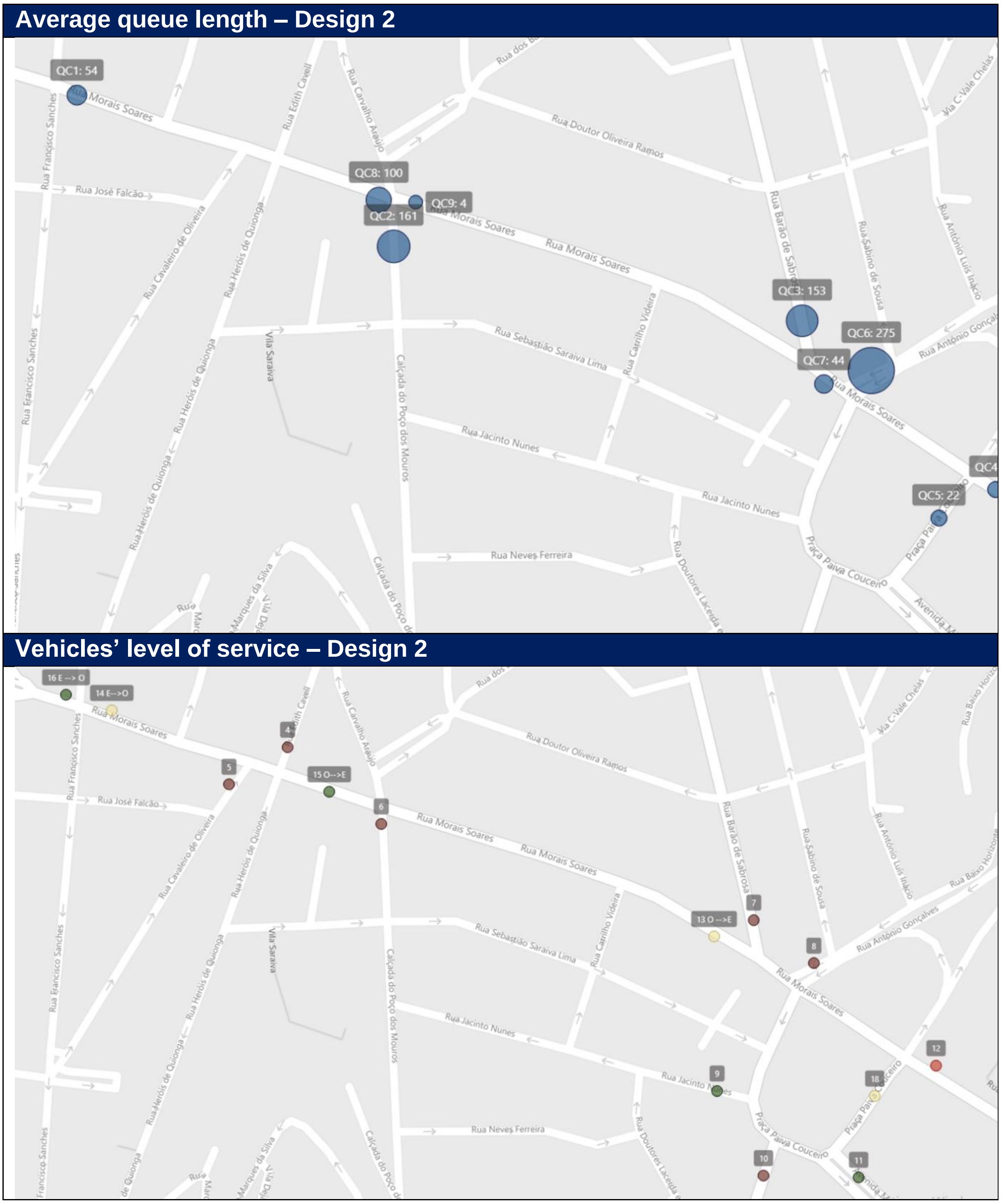


Figure 46. Modelling outputs – Scenario 2, Design 2, PM peak period

Considering pedestrian movements, the figure below shows some characteristics regarding pedestrian movement resulted from Vissim simulation, as the number of pedestrian per hour, average speed and maximum density as well as the current level of service.

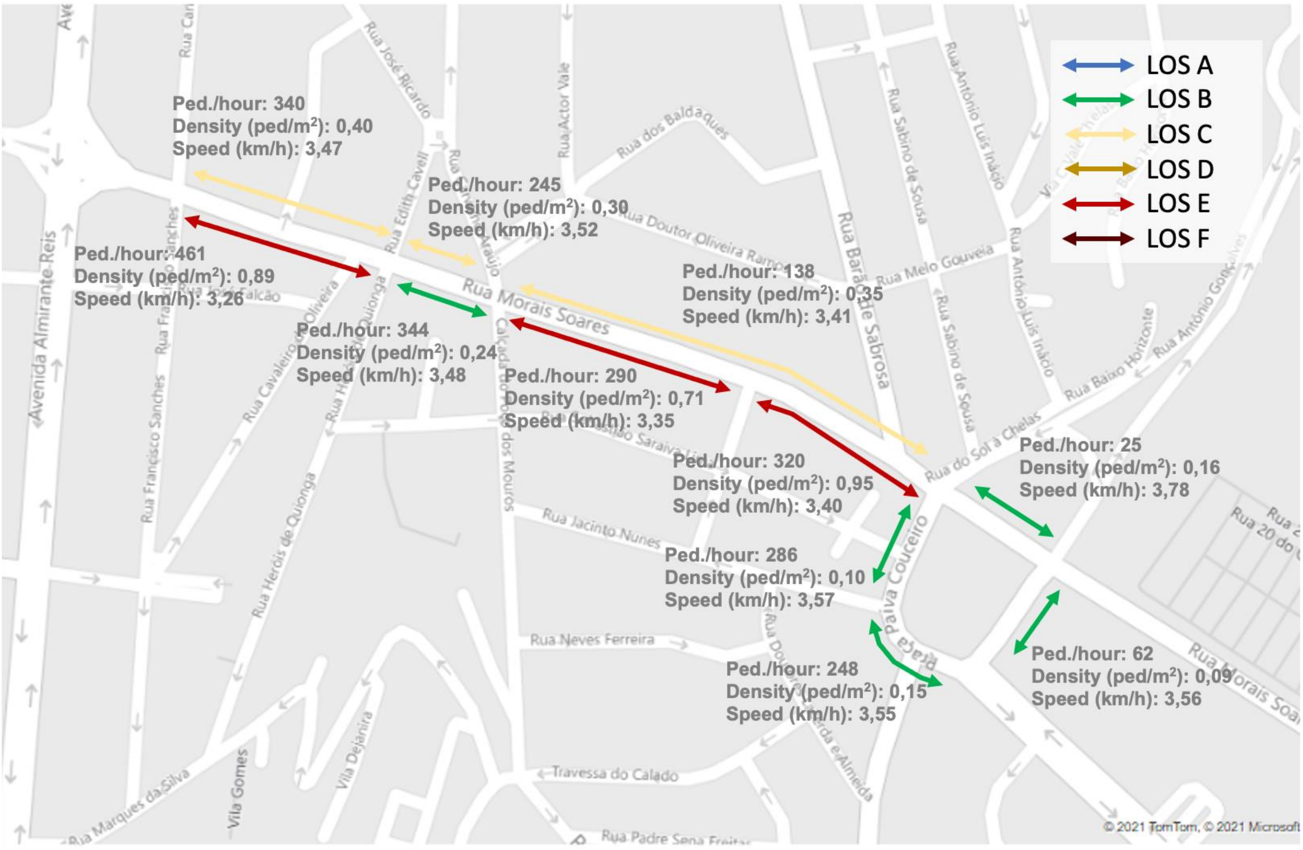
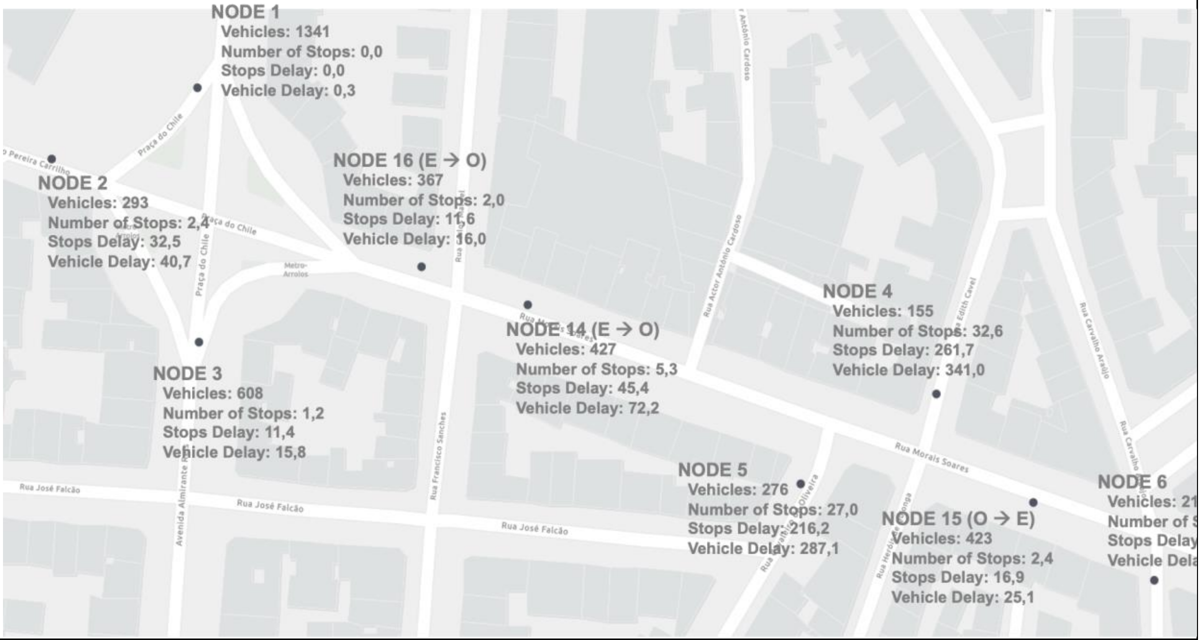


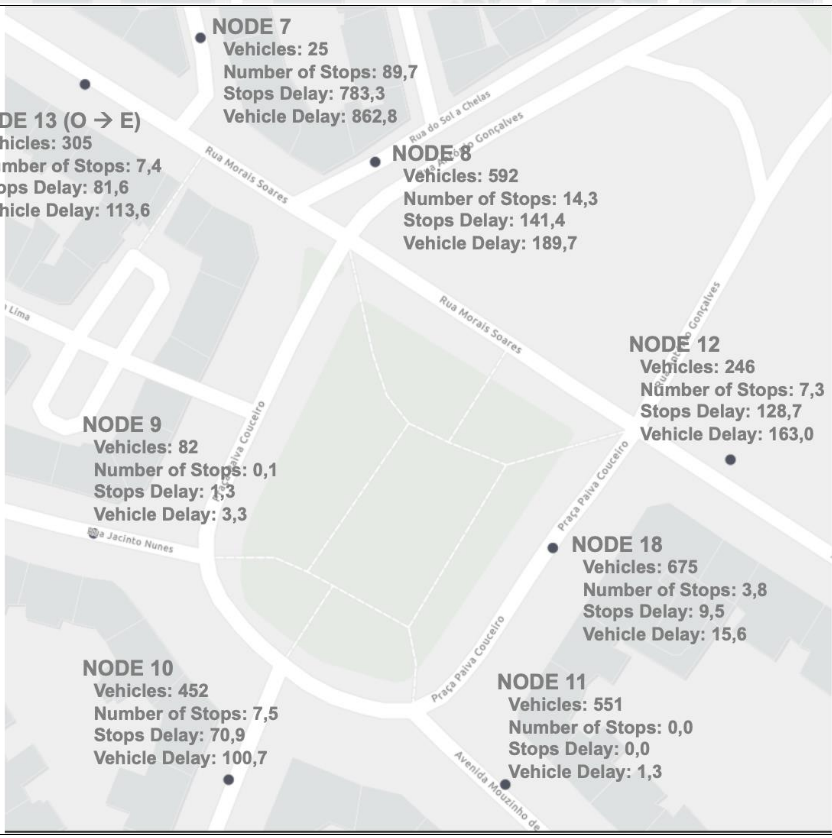
Figure 47. Pedestrian's characteristics and level of service, PM Peak, Scenario 2, Design 2

Design 3

The following table shows the number of vehicles, as well as some traffic characteristics, as delays, queue length and level of service, which pass through each node, considering all transport modes, assigned to street's design 3, that considers the installation of a one way cycle lane in each street's side. This design will consider the reduction of one general traffic lane in each way, and larger sidewalks. Besides these changes, a green corridor with trees along the middle of the road will be implemented.

Nodes results – Design 3





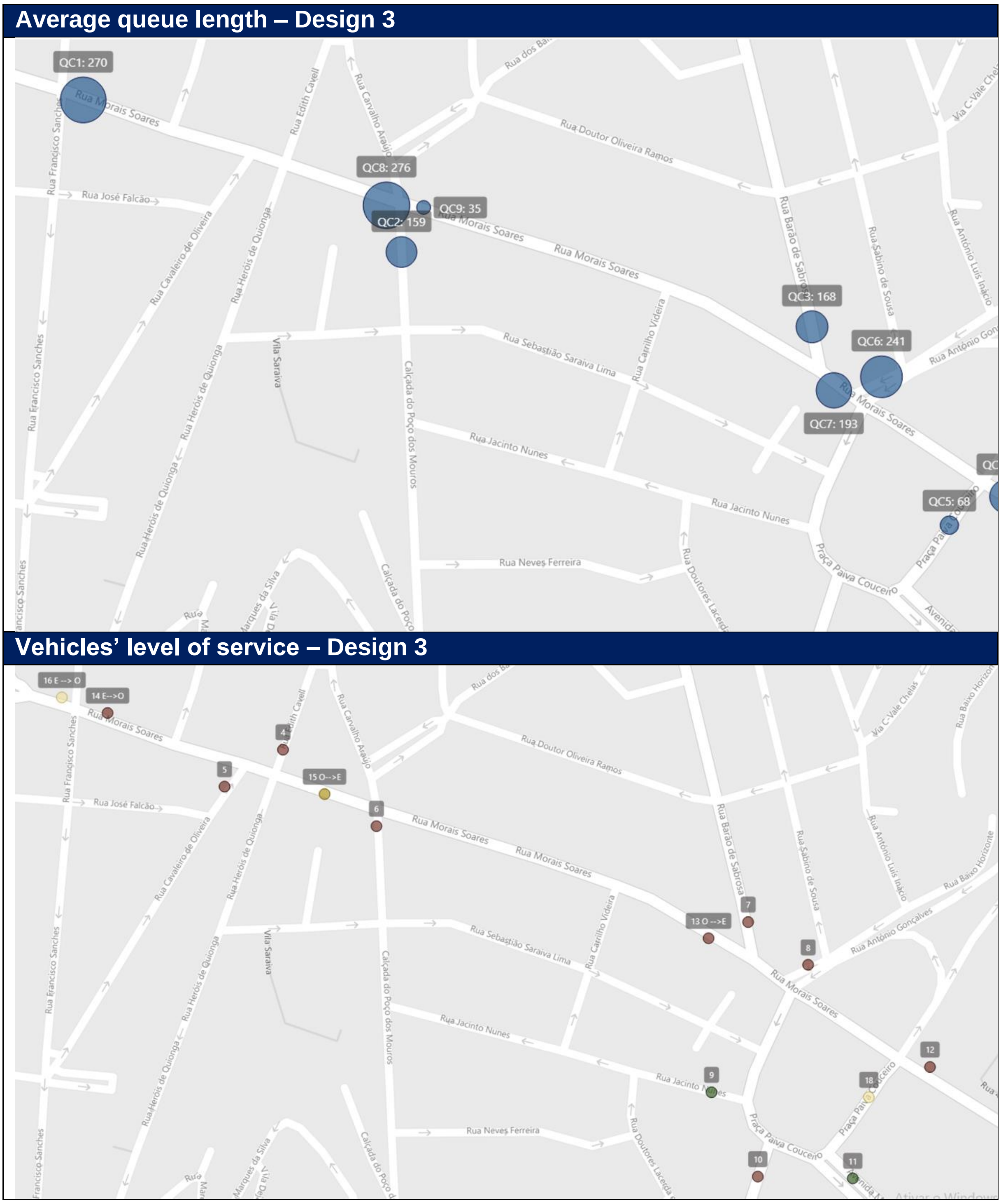


Figure 48. Modelling outputs – Scenario 2, Design 3, PM peak period

Considering pedestrian movements, the figure below shows some characteristics regarding pedestrian movement resulted from Vissim simulation, as the number of pedestrian per hour, average speed and maximum density as well as the current level of service.

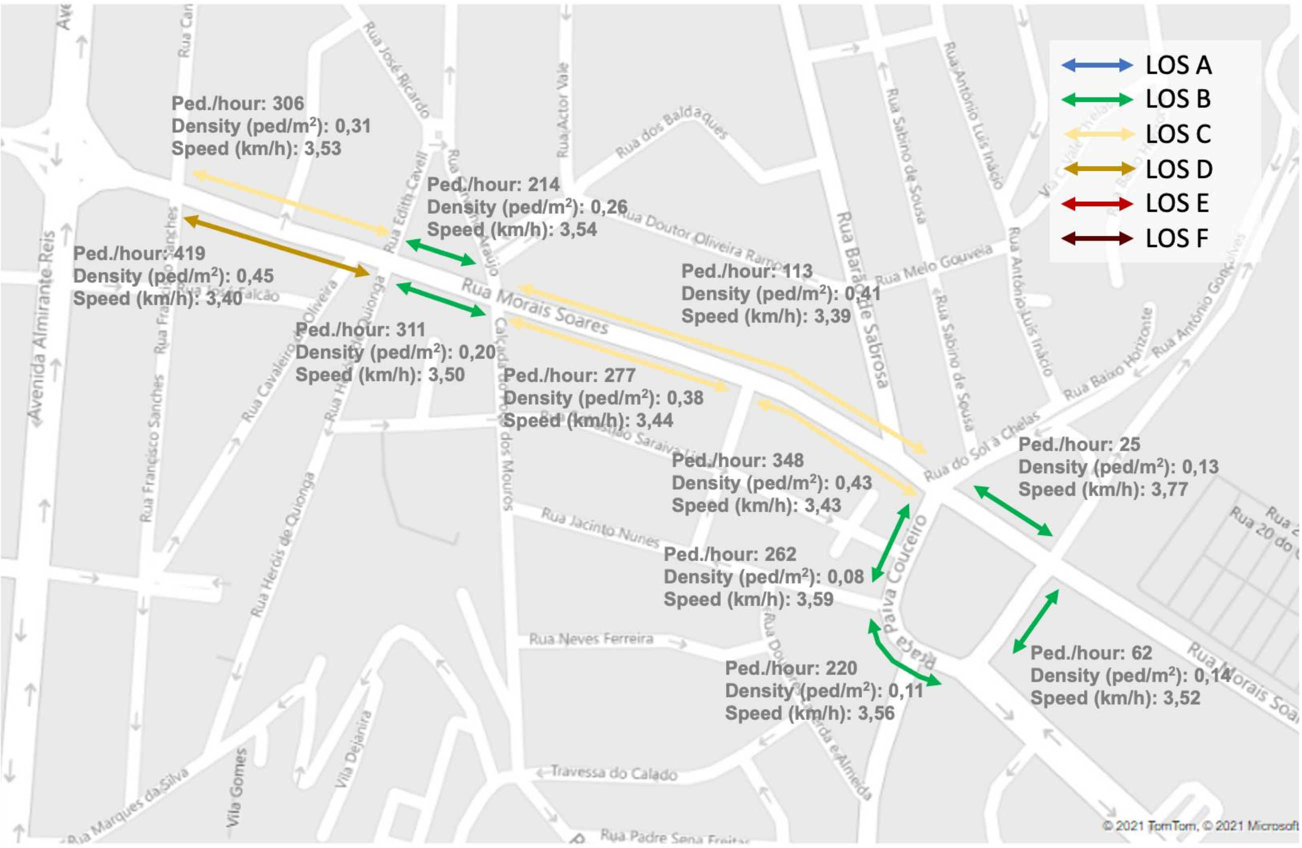
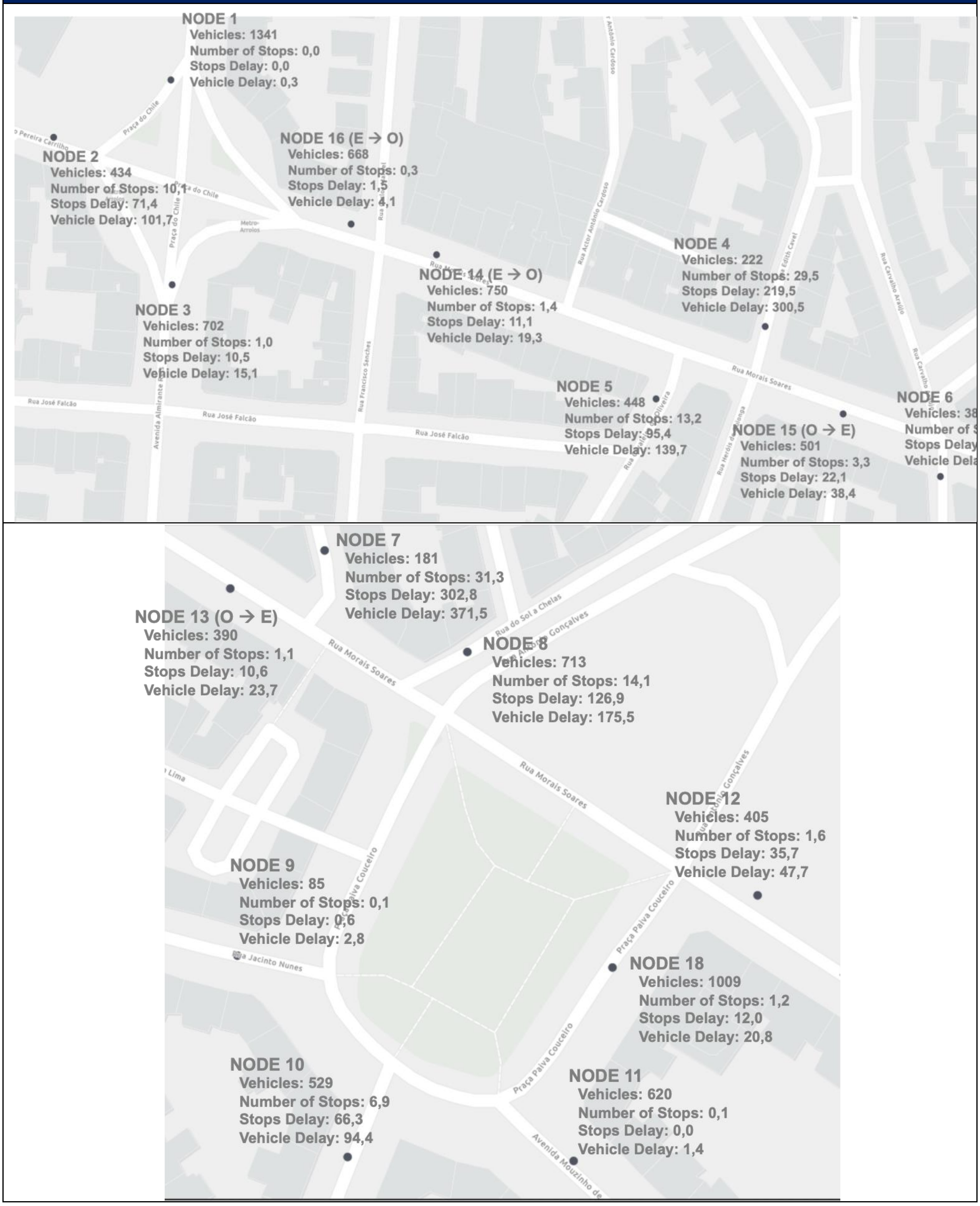


Figure 49. Pedestrian's characteristics and level of service, PM Peak, Scenario 2, Design 3

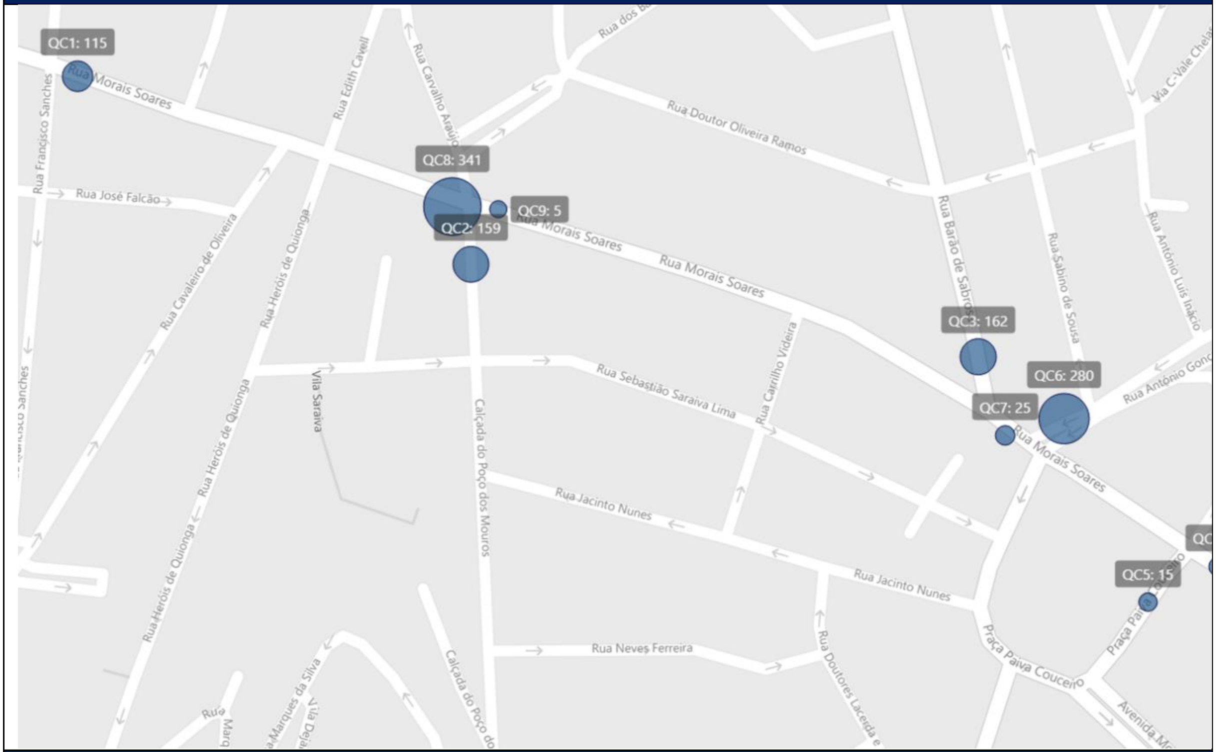
Design 4

The following table shows the number of vehicles, as well as some traffic characteristics, as delays, queue length and level of service, which pass through each node, considering all transport modes, assigned to street's design 4, that considers the reduction of a general lane in the west to east direction, and the transformation of the right lane on the opposite side into a bus lane. The existing perpendicular parking will be transformed into diagonal parking and some the current parking space will be converted into pedestrian area, which additionally to sidewalks' enlargement, renders this scenario into the one that offers more space to public space activities.

Nodes results – Design 4



Average queue length – Design 4



Vehicles' level of service – Design 4

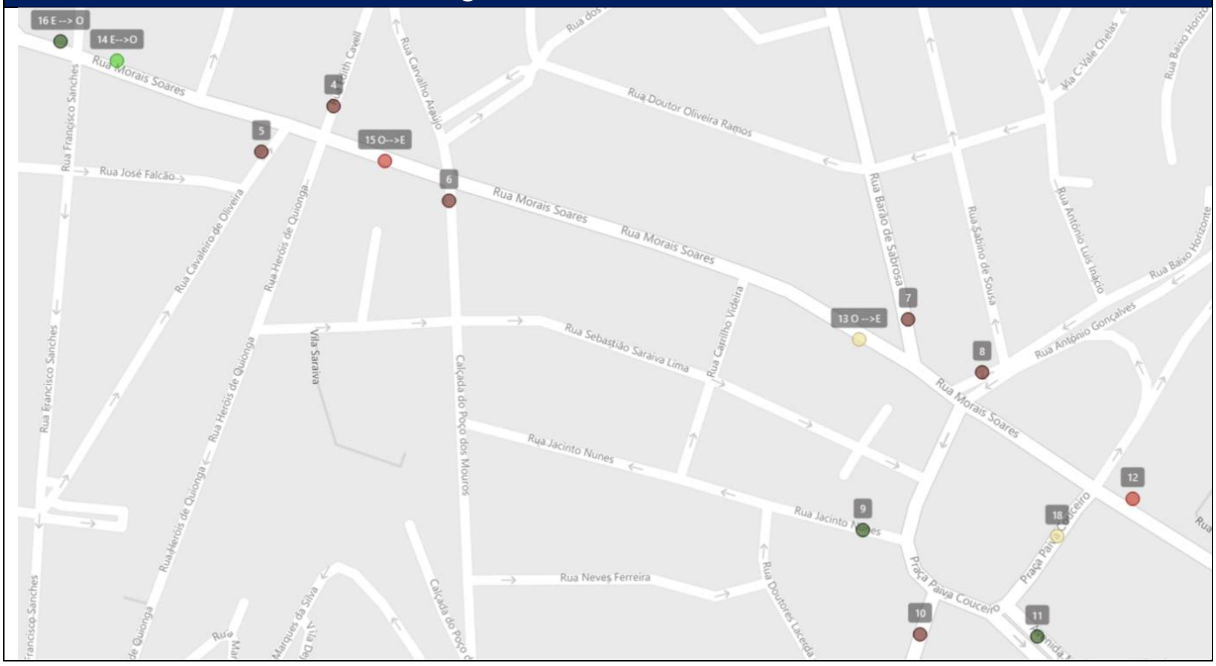


Figure 50. Modelling outputs – Scenario 2, Design 4, PM peak period

Considering pedestrian movements, the figure below shows some characteristics regarding pedestrian movement resulted from Vissim simulation, as the number of pedestrians per hour, average speed and maximum density as well as the current level of service.

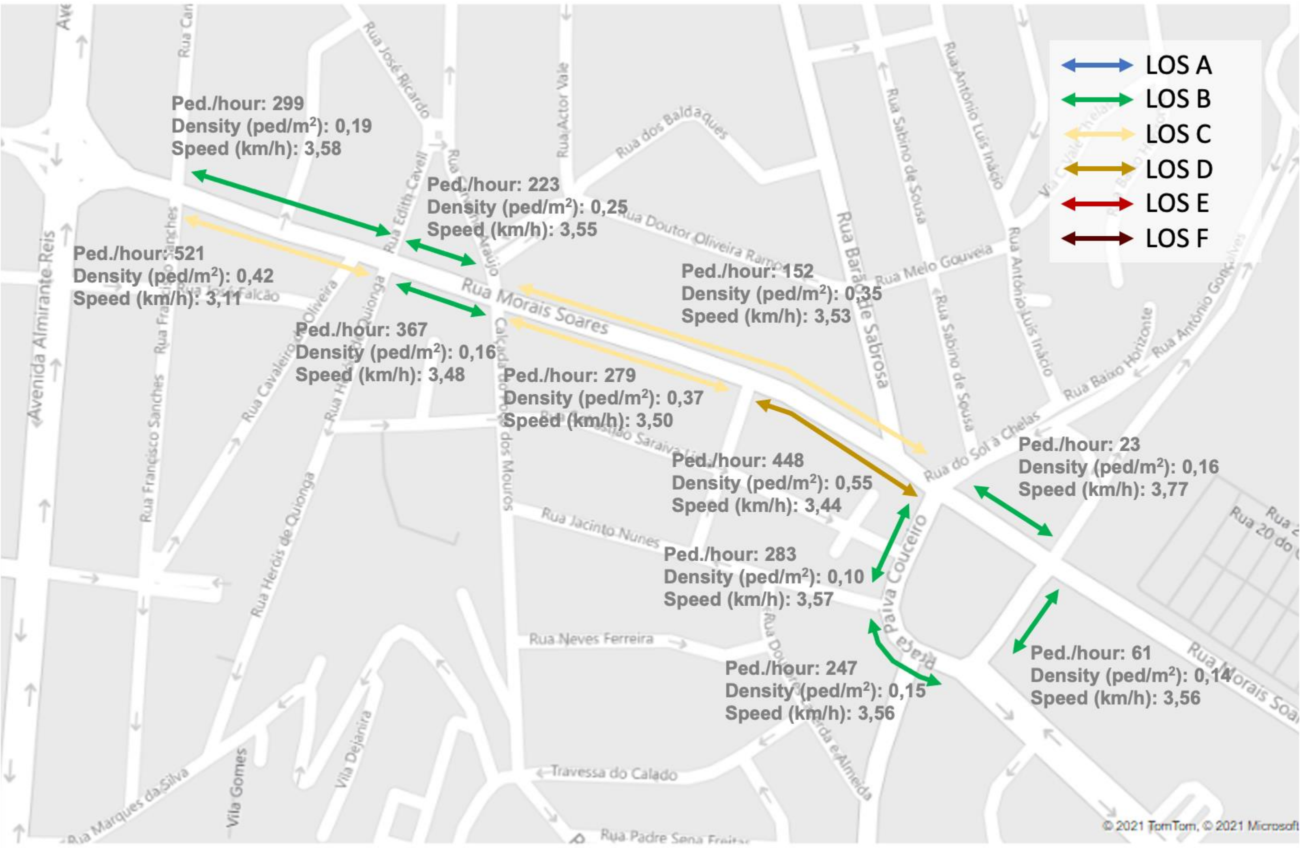


Figure 51. Pedestrian's characteristics and level of service, PM Peak, Scenario 2, Design 4

4.4 Scenario 3 – Multi-ethnic neighbourhood

The figure below shows the evolution of the movements, according with the admitted assumptions for this scenario in a 20 year long perspective, when compared with the current situation.

As in scenario 2, the total number of trips should increase but the modal share shall be more heterogeneous, with higher use percentages for other transport modes instead of cars, considering also the inclusion of autonomous vehicles. In this scenario the car use will suffer a great reduction but that loss will be hugely compensated by a very significant increase of public transport use, as well as use of bicycles. Autonomous vehicles will also signify a very large percentage of the movements in this section. However, in contrast with scenario 2, the pedestrian movements will increase around 35%, which will be explained by the foreseen demographic and economic evolution in a medium-term perspective.

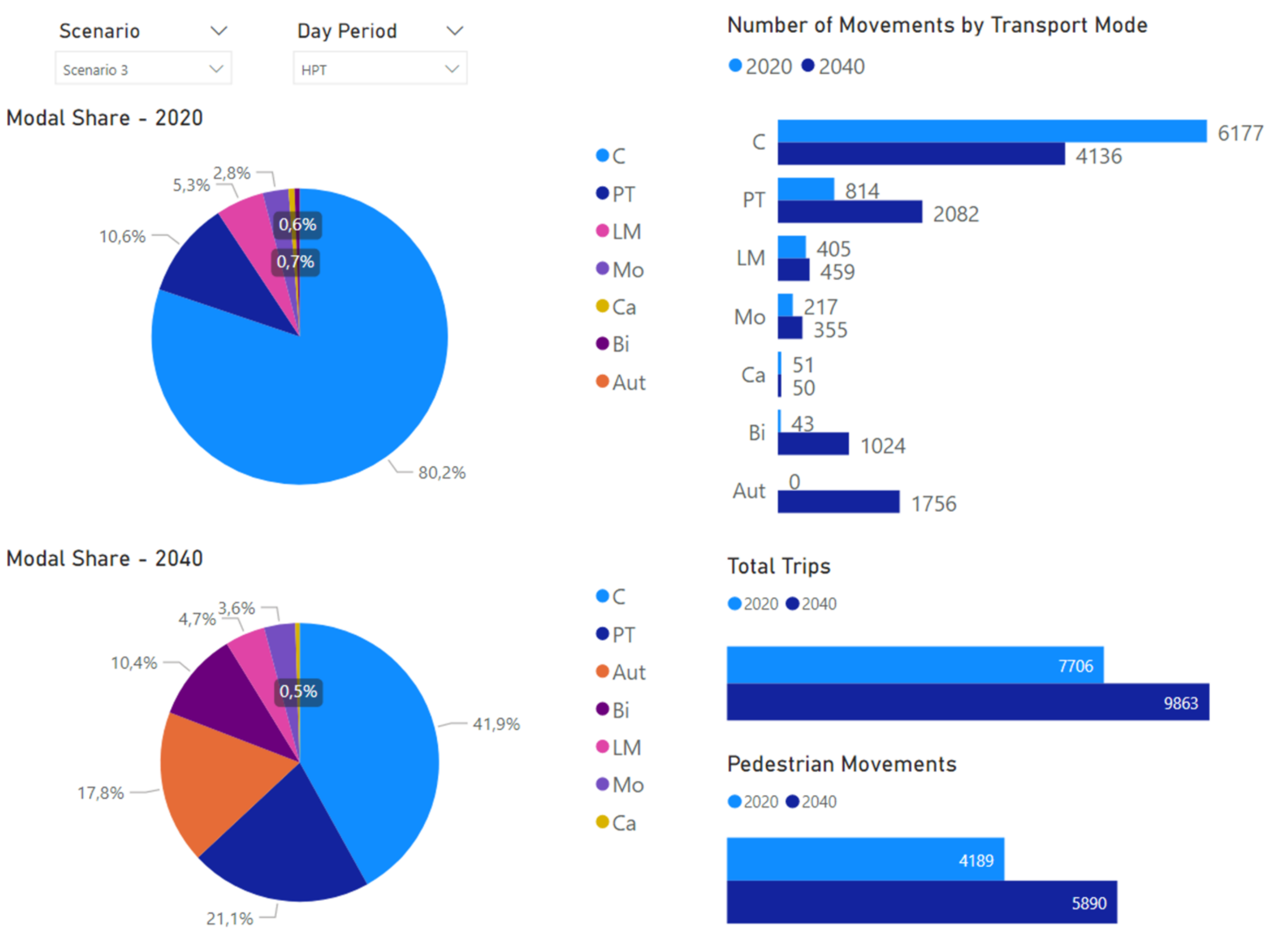
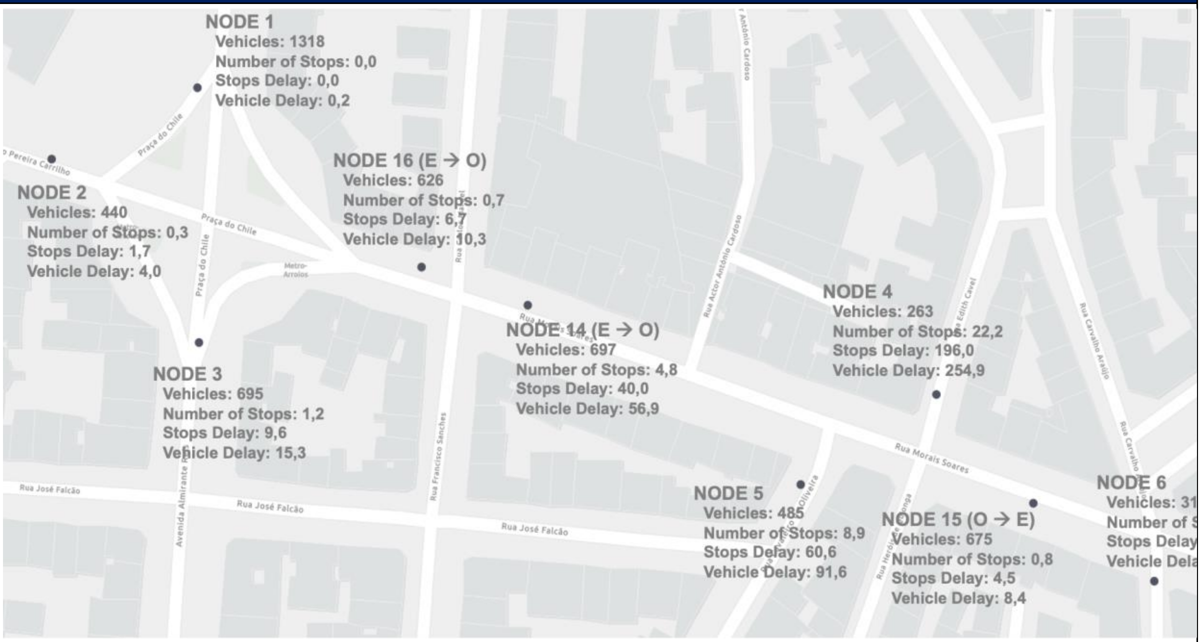


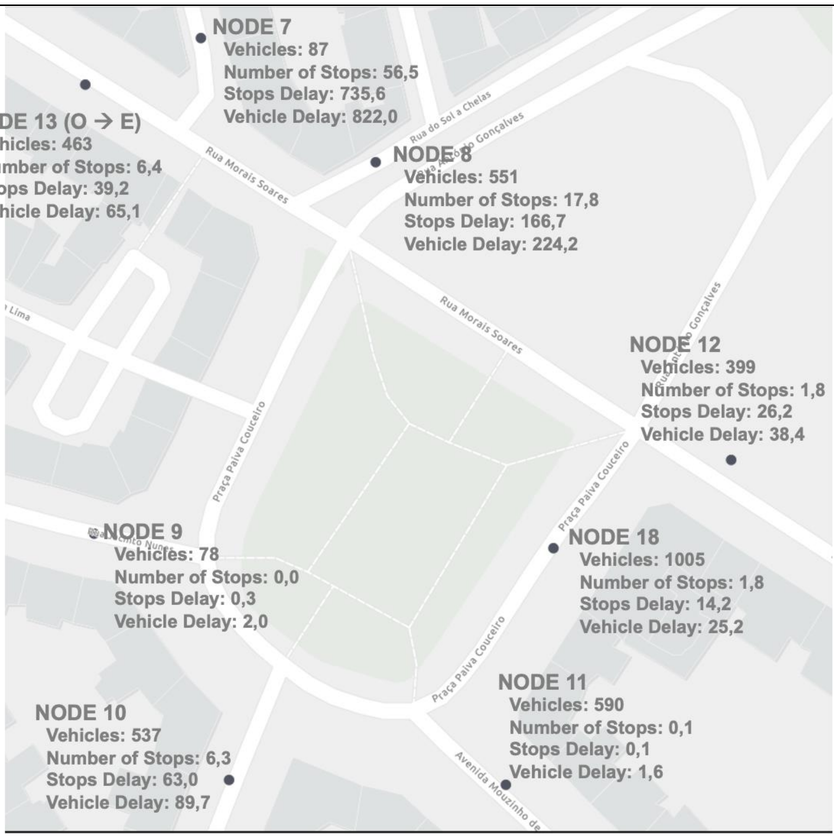
Figure 52. Movement characteristics, Scenario 3, PM Peak

Design 0

The following table shows the number of vehicles, as well as some traffic characteristics, as delays, queue length and level of service, which pass through each node, considering all transport modes, assigned to street's design 0, that corresponds to the current situation.

Nodes results – Design 0





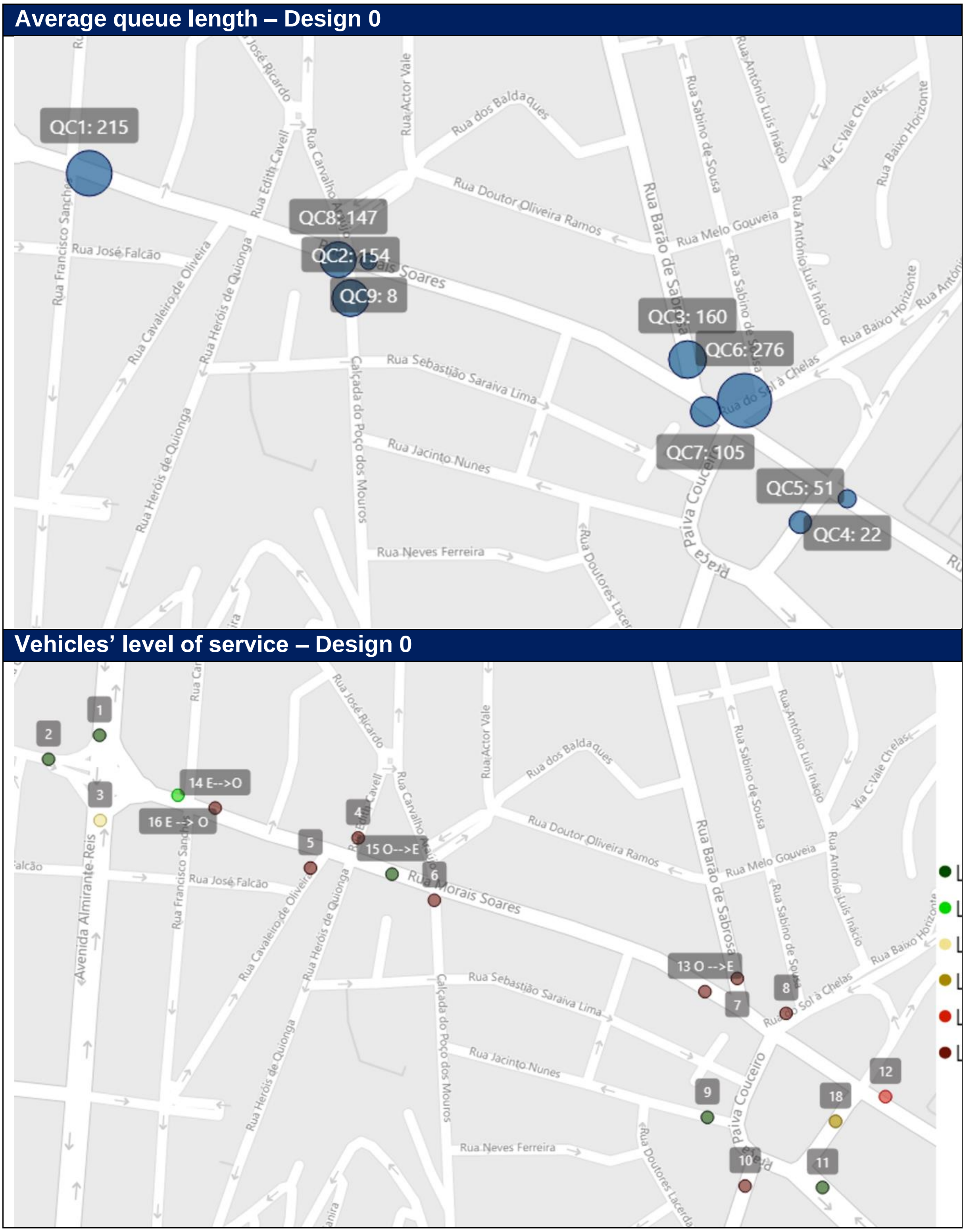


Figure 53. Modelling outputs – Scenario 3, Design 0, PM peak period

Considering pedestrian movements, the figure below shows some characteristics regarding pedestrian movement resulted from Vissim simulation, as the number of pedestrian per hour, average speed and maximum density as well as the current level of service.

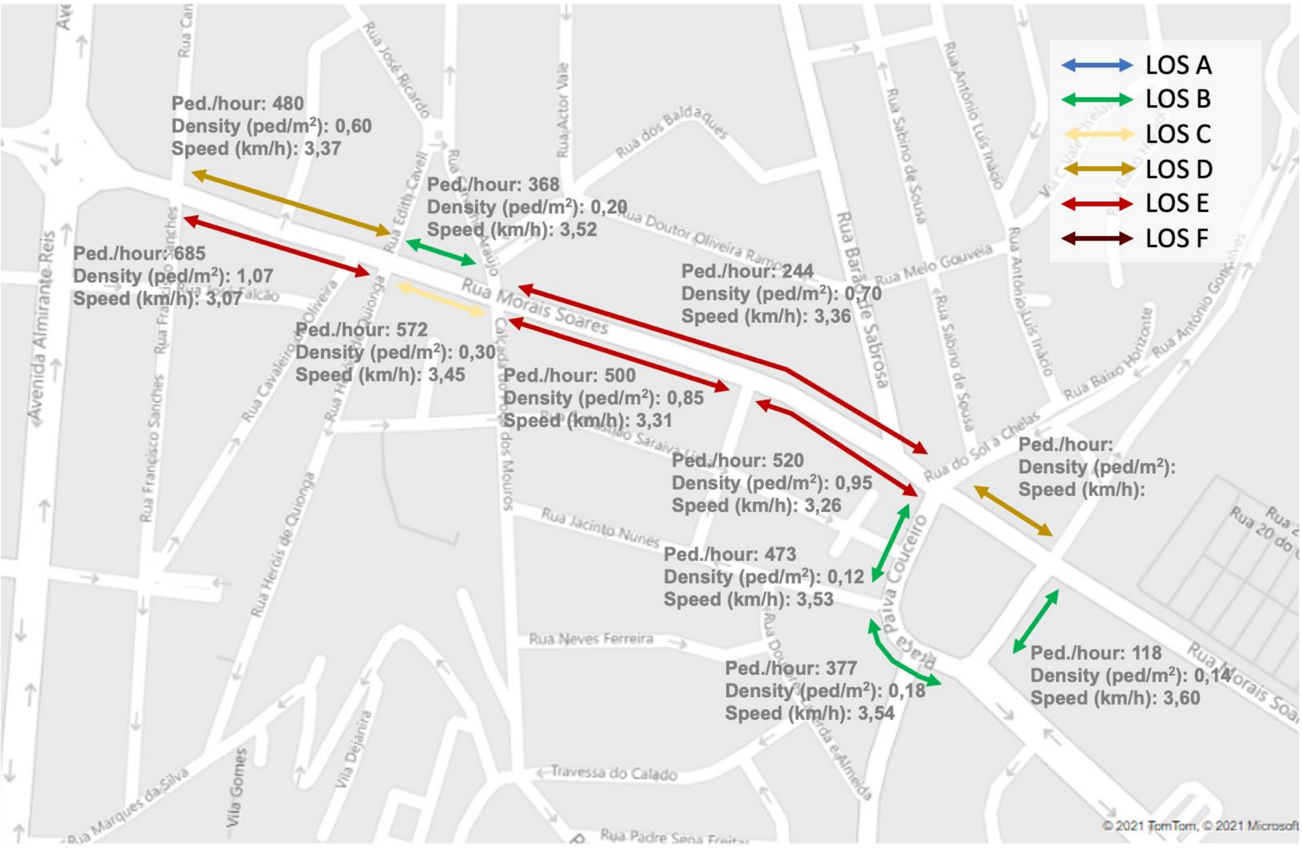
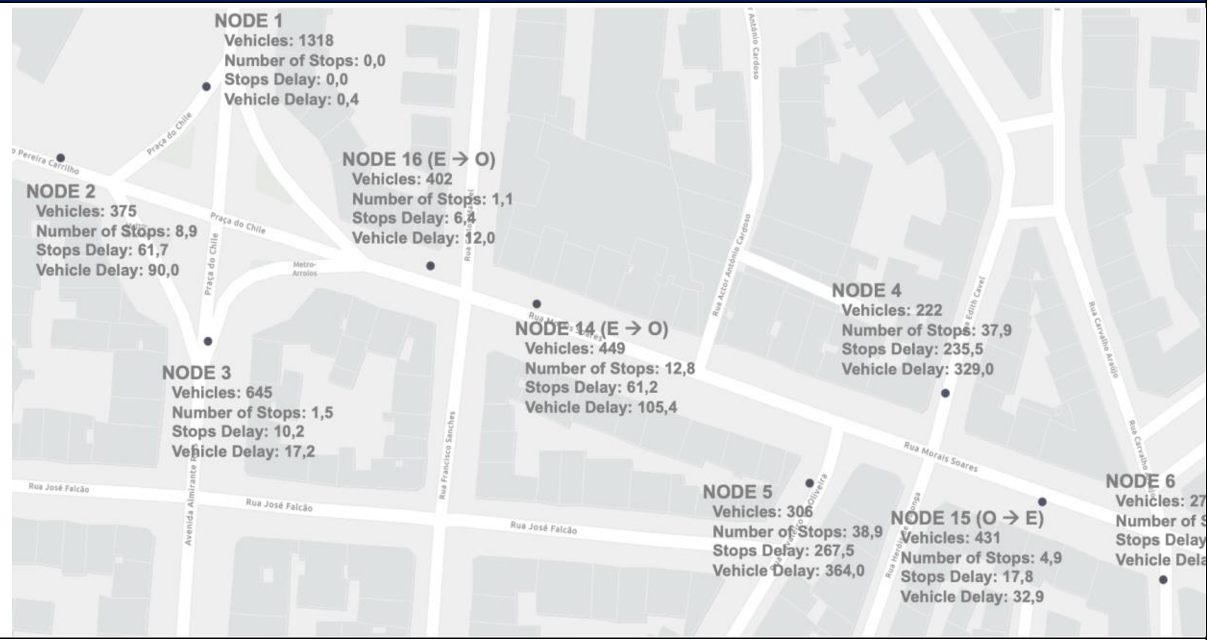


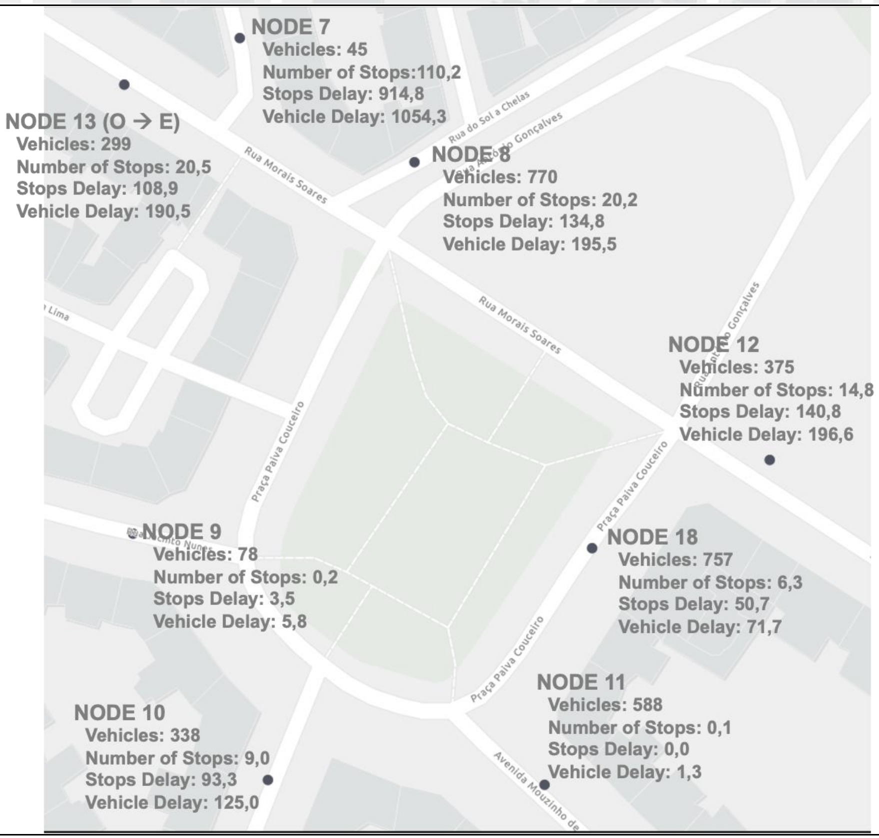
Figure 54. Pedestrian's characteristics and level of service, PM Peak, Scenario 3, Design 0

Design 1

The following table shows the number of vehicles, as well as some traffic characteristics, as delays, queue length and level of service, which pass through each node, considering all transport modes, assigned to street's design 1, that foresees an increase on the number of parking places, through the replacement of current existing parking spaces into diagonal parking, leading to the removal of a general traffic lane in each way. This design considers a slight increase of sidewalks' width.

Nodes results – Design 1





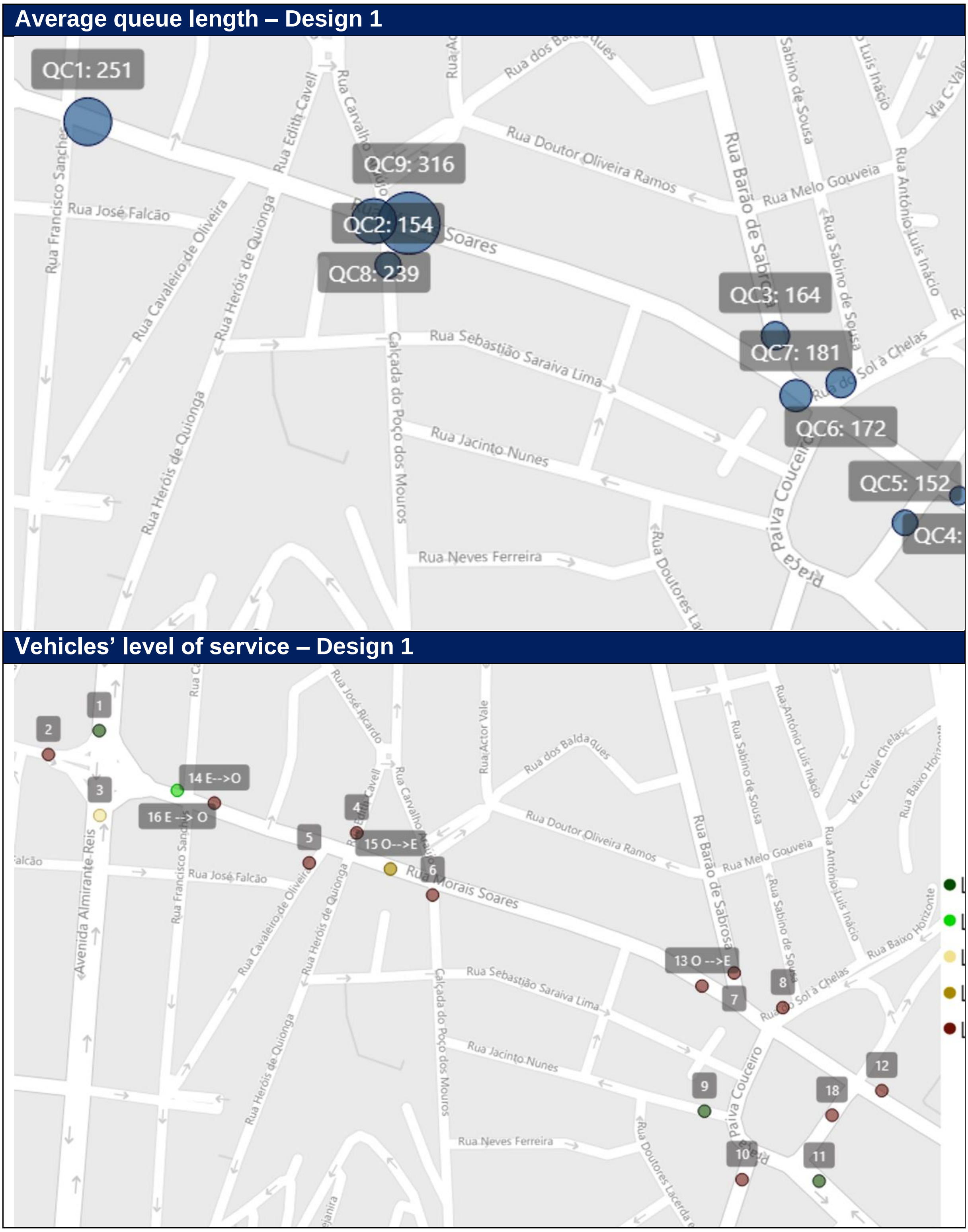


Figure 55. Modelling outputs – Scenario 3, Design 1, PM peak period

Considering pedestrian movements, the figure below shows some characteristics regarding pedestrian movement resulted from Vissim simulation, as the number of pedestrian per hour, average speed and maximum density as well as the current level of service.

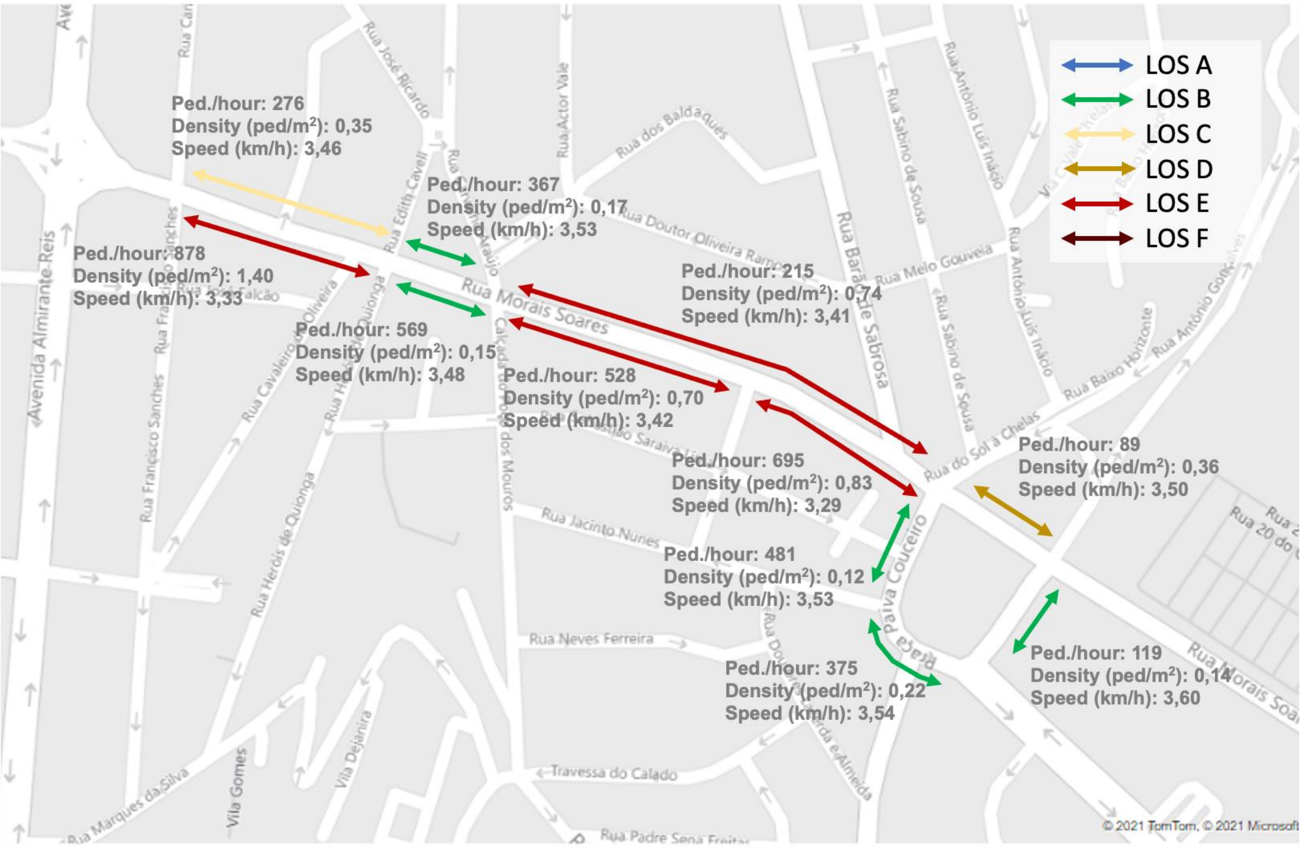
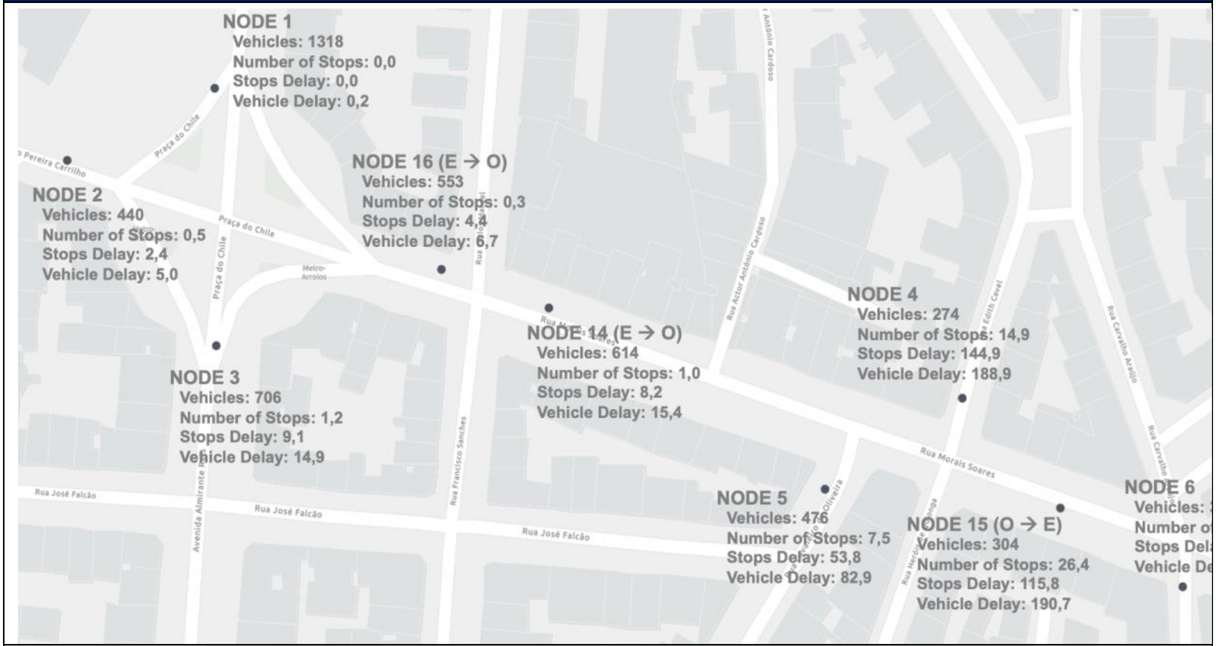


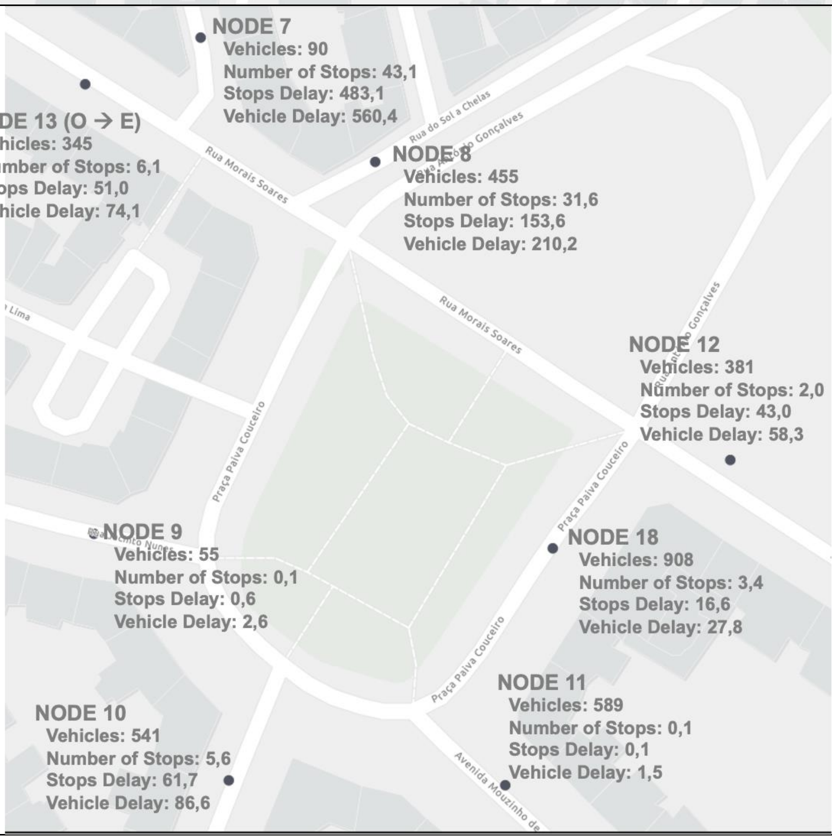
Figure 56. Pedestrian's characteristics and level of service, PM Peak, Scenario 3, Design 1

Design 2

The following table shows the number of vehicles, as well as some traffic characteristics, as delays, queue length and level of service, which pass through each node, considering all transport modes, assigned to street's design 2, that considers changing the right lane into a public transport lane. This design aims to contribute to the reduction of second lane parking occurrences, despite right turns and access to parking spaces are still allowed which may hinder the circulation of buses.

Nodes results – Design 2





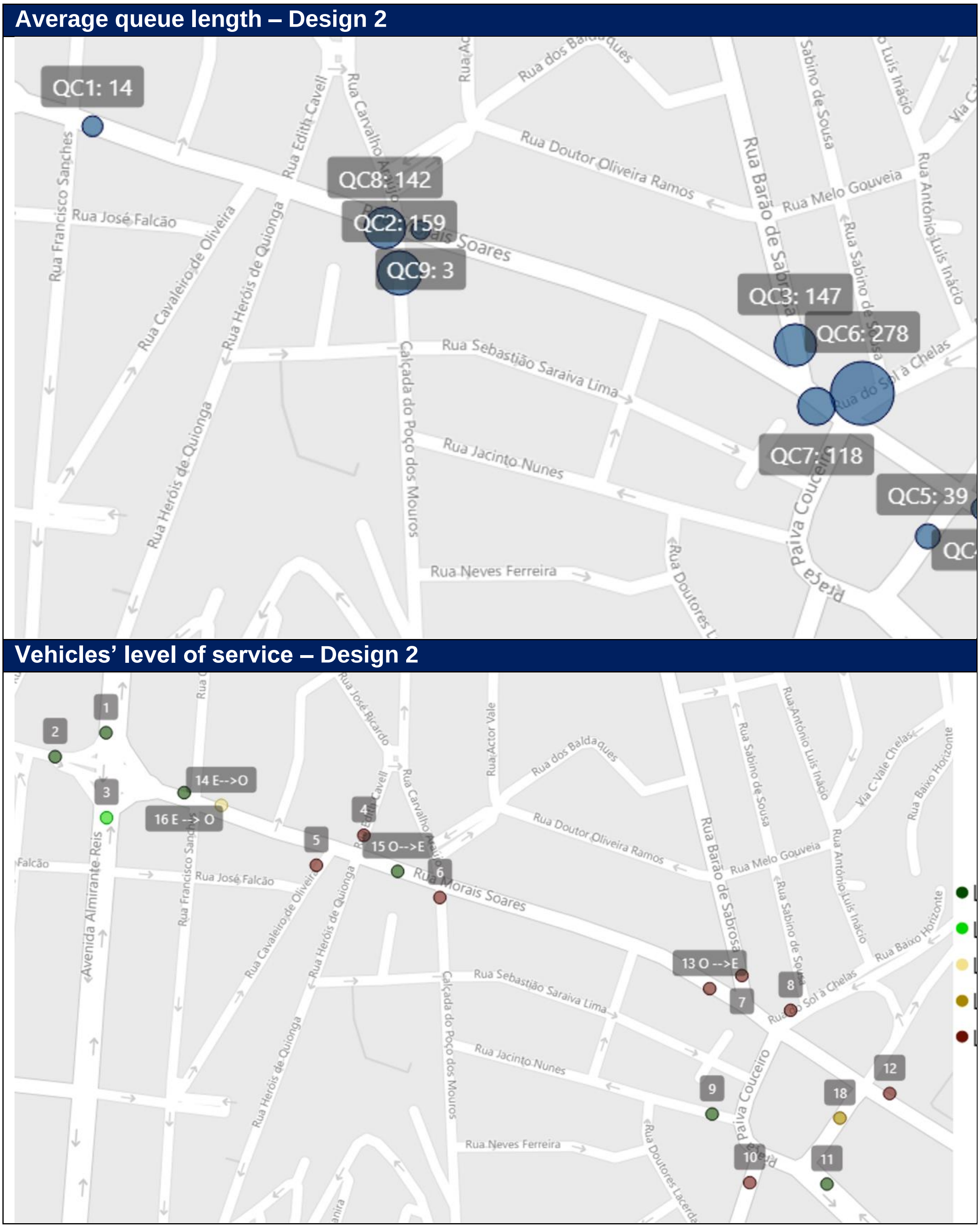


Figure 57. Modelling outputs – Scenario 3, Design 2, PM peak period

Considering pedestrian movements, the figure below shows some characteristics regarding pedestrian movement resulted from Vissim simulation, as the number of pedestrian per hour, average speed and maximum density as well as the current level of service.

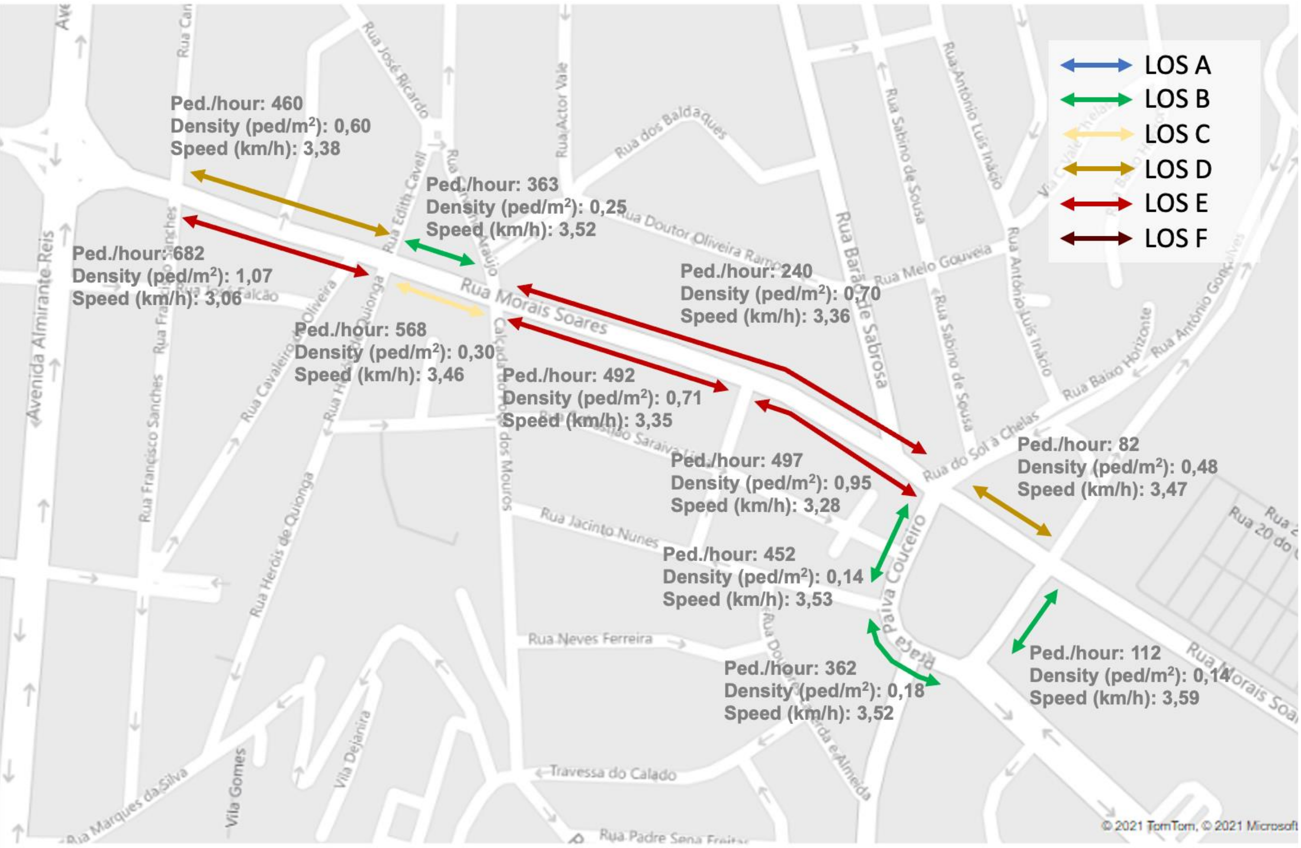
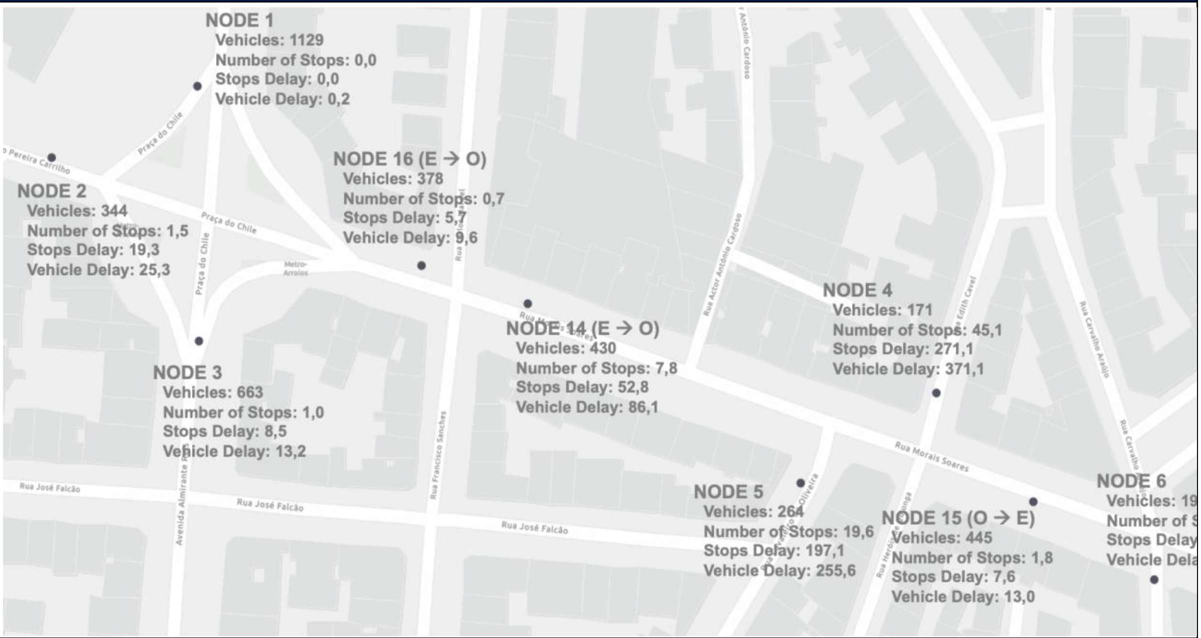


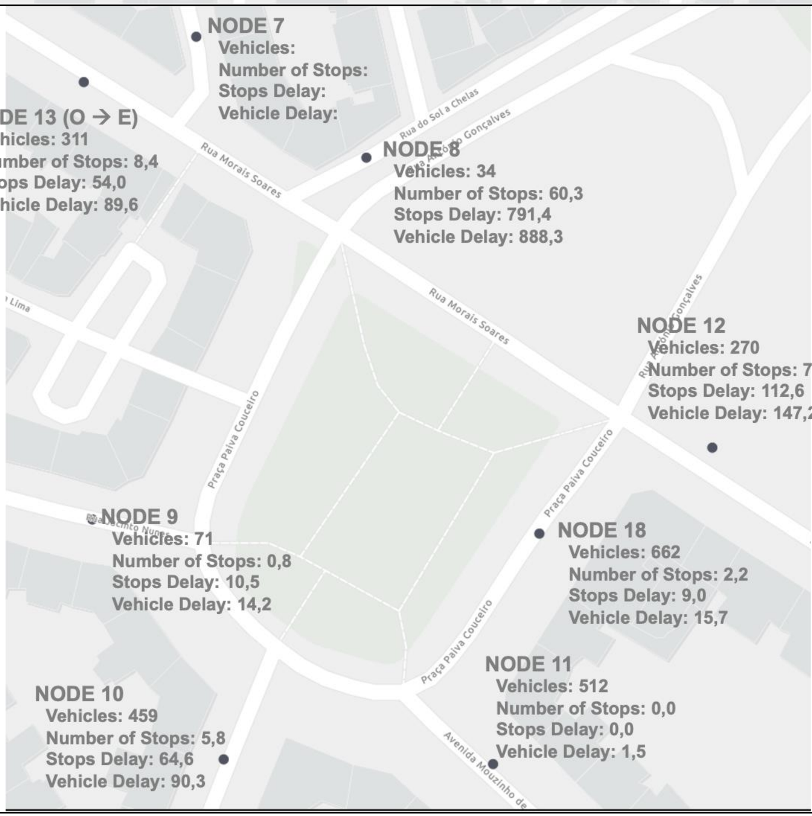
Figure 58. Pedestrian's characteristics and level of service, PM Peak, Scenario 3, Design 2

Design 3

The following table shows the number of vehicles, as well as some traffic characteristics, as delays, queue length and level of service, which pass through each node, considering all transport modes, assigned to street's design 3, that considers the installation of a one way cycle lane in each street's side. This design will consider the reduction of one general traffic lane in each way, and larger sidewalks. Besides these changes, a green corridor with trees along the middle of the road will be implemented.

Nodes results – Design 3





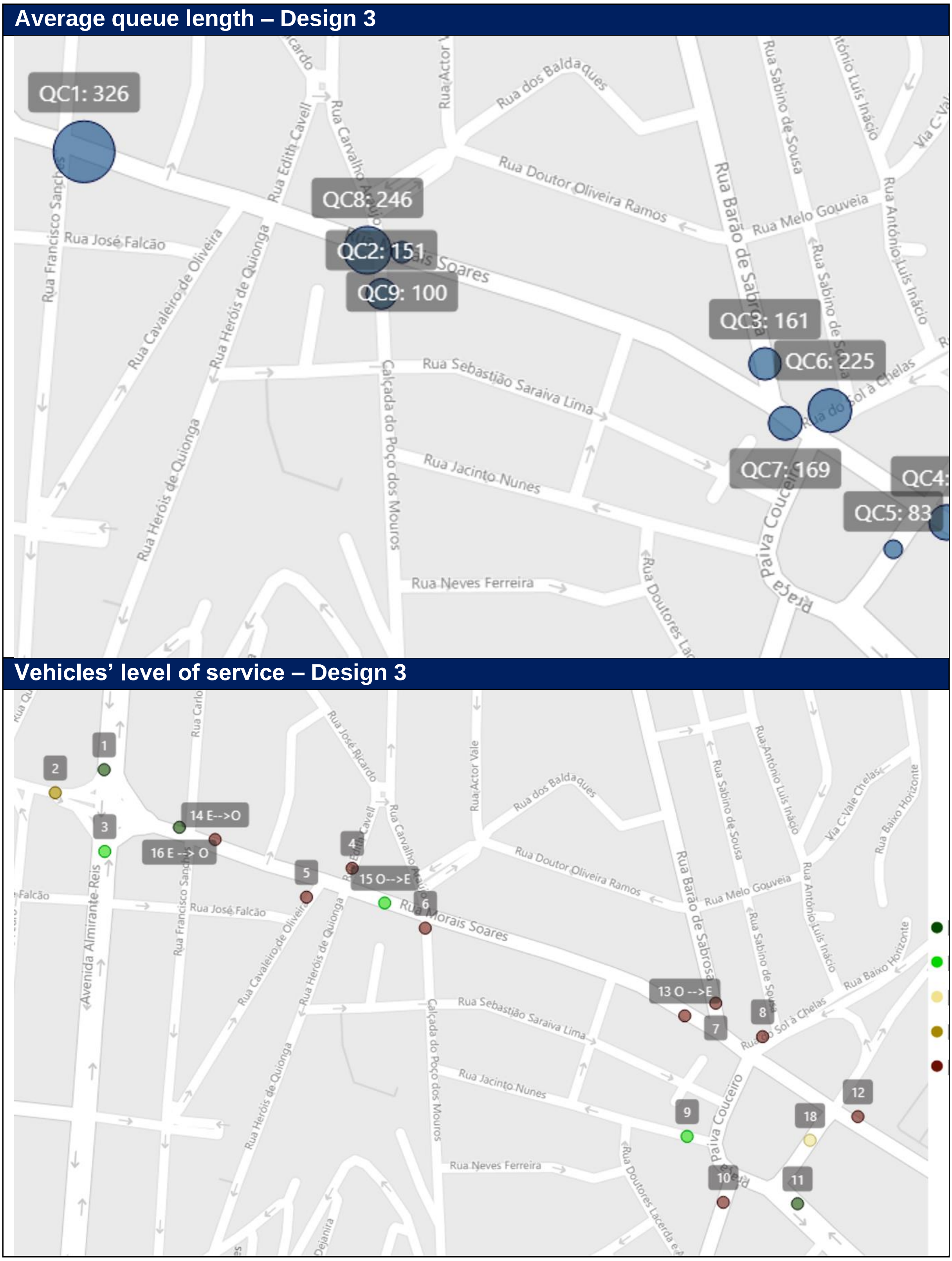


Figure 59. Modelling outputs – Scenario 3, Design 3, PM peak period

Considering pedestrian movements, the figure below shows some characteristics regarding pedestrian movement resulted from Vissim simulation, as the number of pedestrian per hour, average speed and maximum density as well as the current level of service.

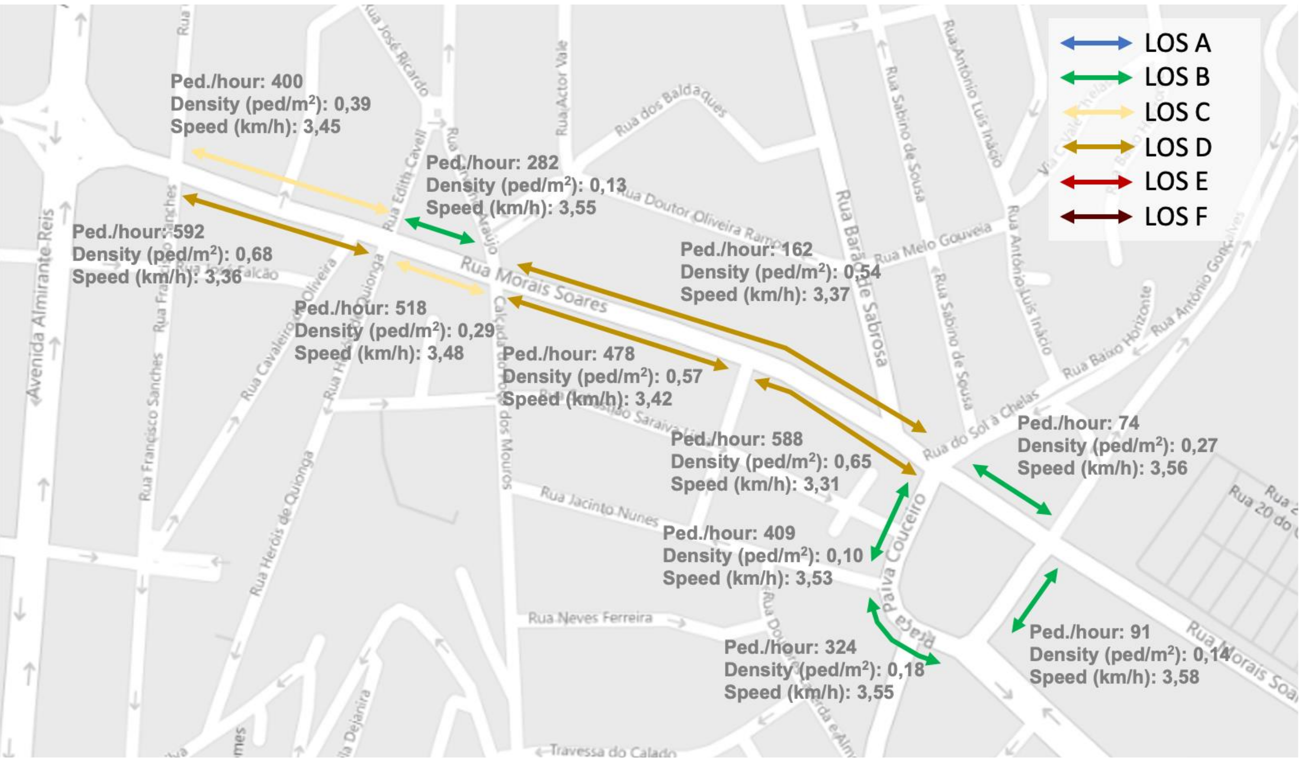
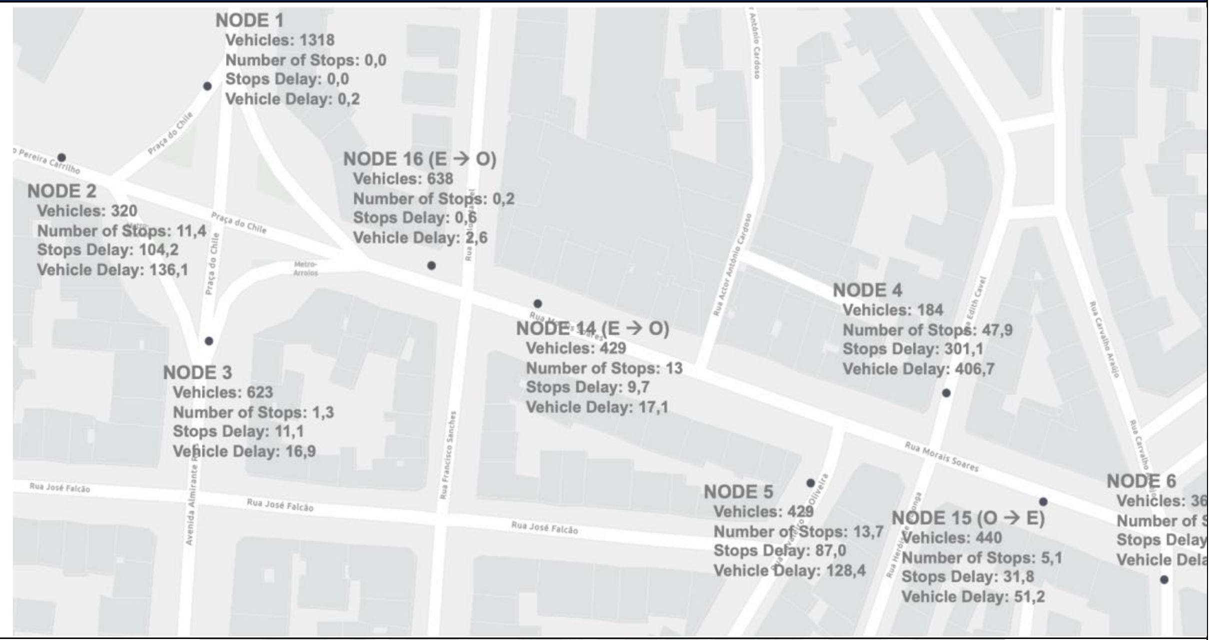


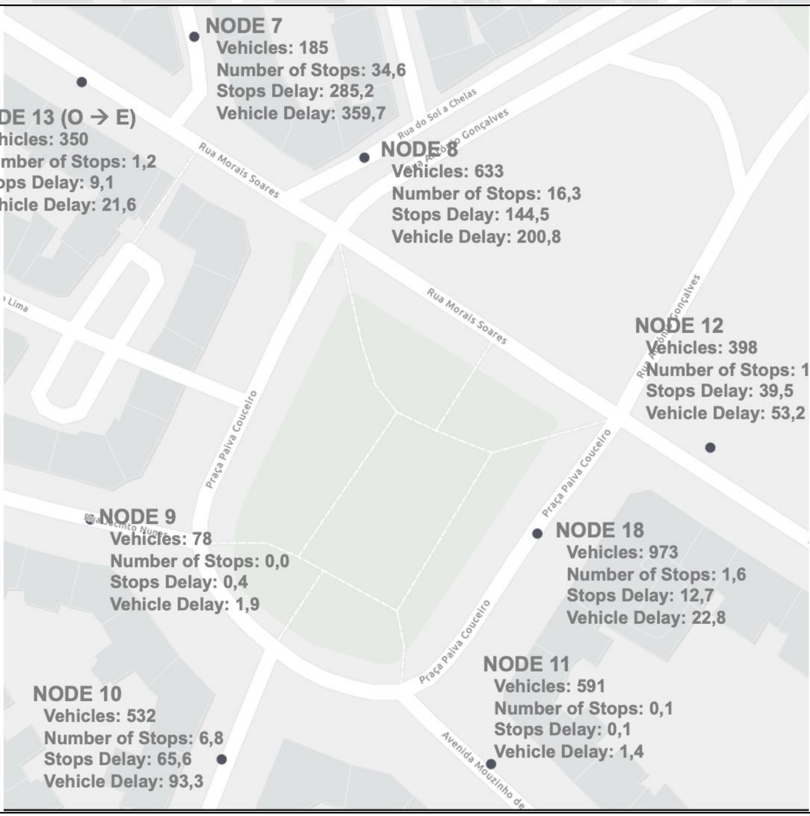
Figure 60. Pedestrian's characteristics and level of service, PM Peak, Scenario 3, Design 3

Design 4

The following table shows the number of vehicles, as well as some traffic characteristics, as delays, queue length and level of service, which pass through each node, considering all transport modes, assigned to street's design 4, that considers the reduction of a general lane in the west to east direction, and the transformation of the right lane on the opposite side into a bus lane. The existing perpendicular parking will be transformed into diagonal parking and some the current parking space will be converted into pedestrian area, which additionally to sidewalks' enlargement, renders this scenario into the one that offers more space to public space activities.

Nodes results – Design 4





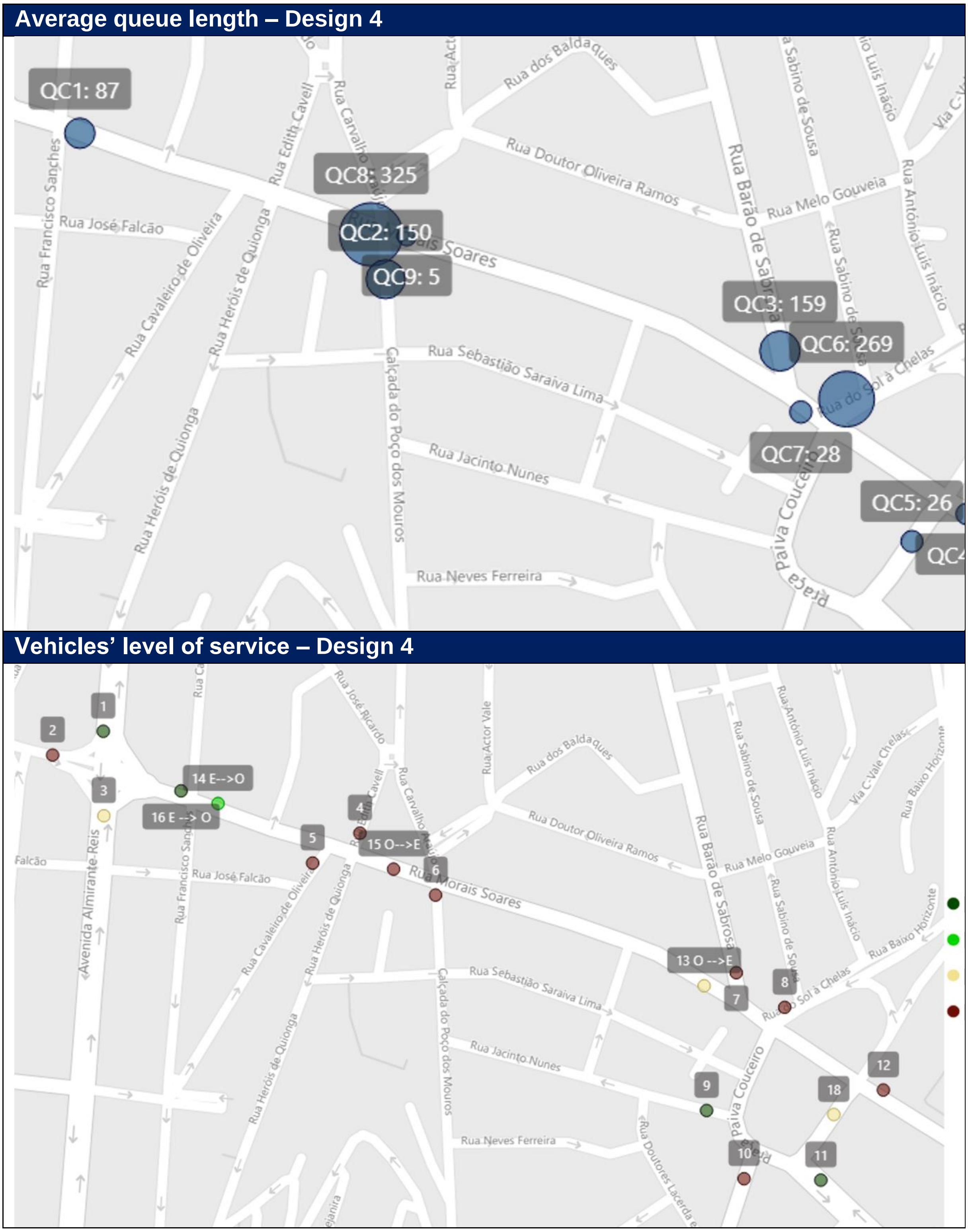


Figure 61. Modelling outputs – Scenario 3, Design 4, PM peak period

Considering pedestrian movements, the figure below shows some characteristics regarding pedestrian movement resulted from Vissim simulation, as the number of pedestrian per hour, average speed and maximum density as well as the current level of service.

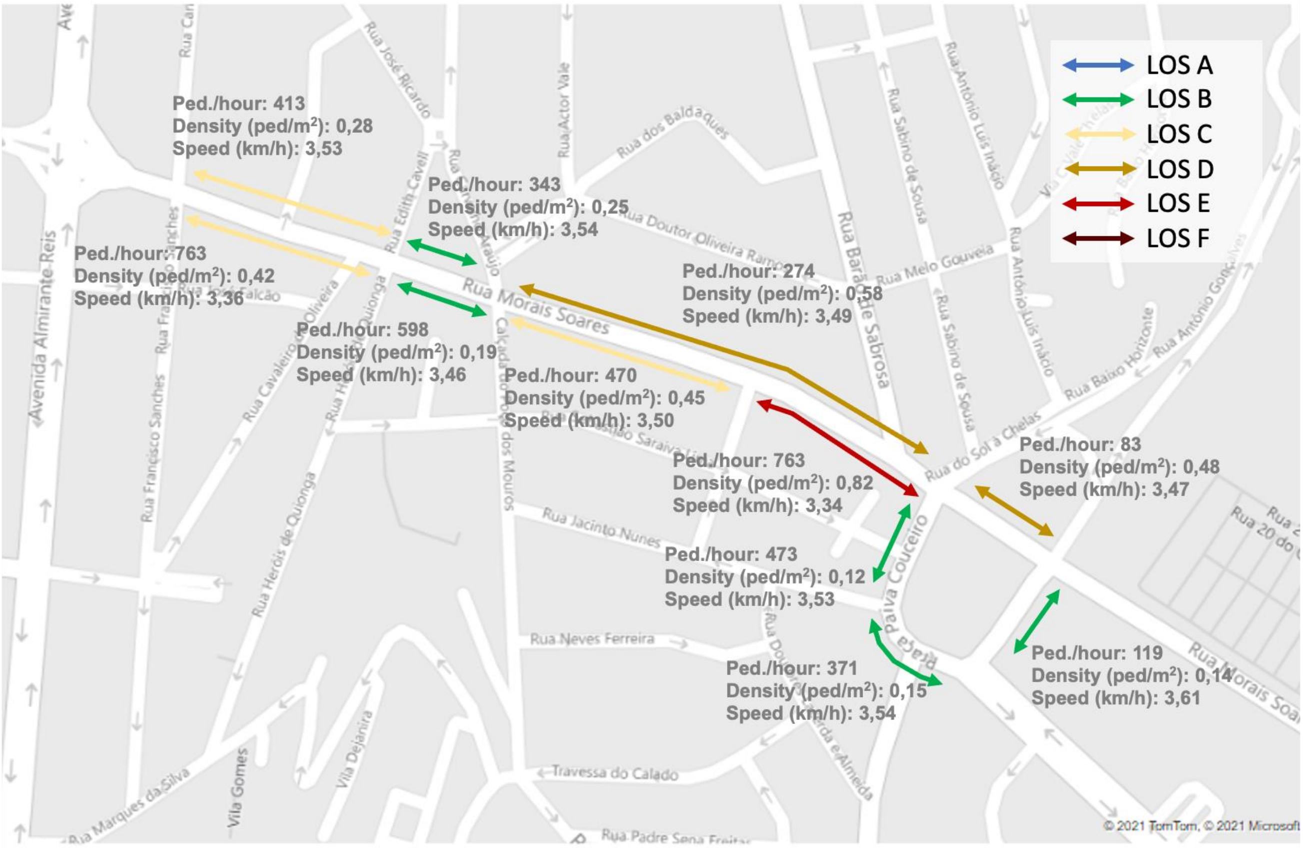


Figure 62. Pedestrian's characteristics and level of service, PM Peak, Scenario 3, Design 4

4.5 Conclusions

4.5.1 Scenario 2 – Conclusions

In this chapter, some traffic flow characteristics will be compared among designs, like travel time, queue lengths and provided level of service, both for traffic and pedestrians, considering the foreseen demand volume for scenario 2.

Figure 63 shows the sum of travel times by each transport mode. Design 2 tends to be the most efficient in almost all transport modes, which enhances the idea that a dedicated bus lane affects less the other transport modes flow than second lane parking. In scenario 2 both designs that consider the implementation of a bus lane (scenario 2 in both ways and scenario 4 in the west to east direction), have lower travel times than design 0, where the right lanes are constantly used by this abusive behaviour. Design 3 shows similar times to design 0, except for bicycle users, where is clearly more efficient and public transport users, where the travel times are substantially worse. Design 1 is, in overall, the alternative that presents worst circulation conditions.

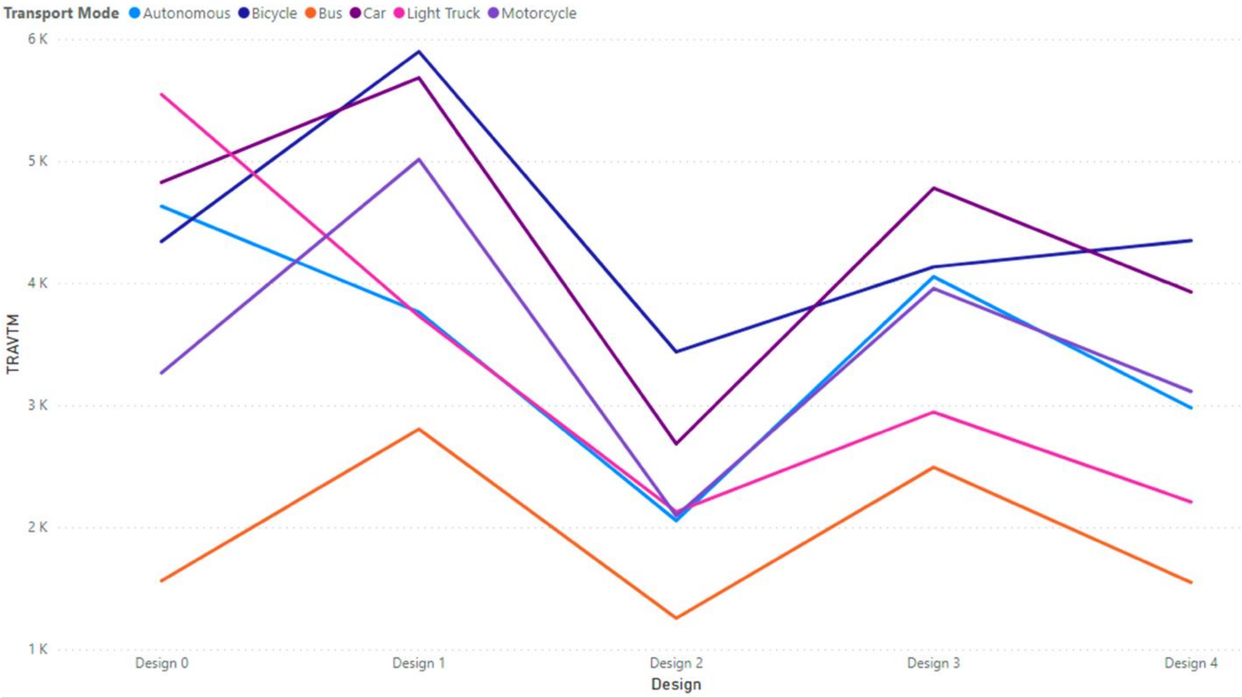


Figure 63. Travel time by transport mode and design, Scenario 2

Regarding queue lengths, in overall, design 1 and design 3 tend to be the ones that will longer lines, in contrast with design 2 and 4 that shows smaller lines, except in queue counter 6.

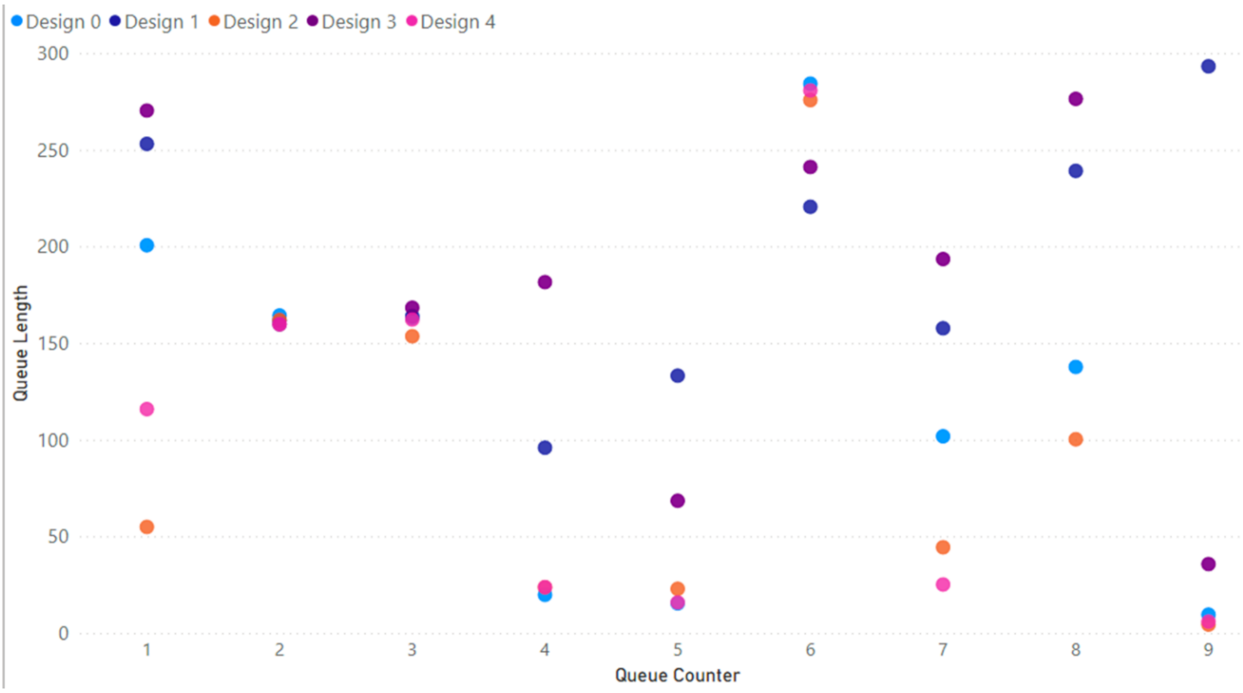


Figure 64. Average queue length by queue counter and design, Scenario 2

The following graphic considers the location of points that were used to observe the level of service identified from Table 3 to Table 7, counting the number of points with a defined level of service's type that were visualised in each scenario. This figure will allow to have a general idea of what kind of service should be offered by each scenario. According with the identified results, design 2 is the one that offers more level A situation and, at a same time less Level F situations. Except design 2, that shows better results and design 1 that is clearly worst, the other 3 design alternatives are very balanced between them.

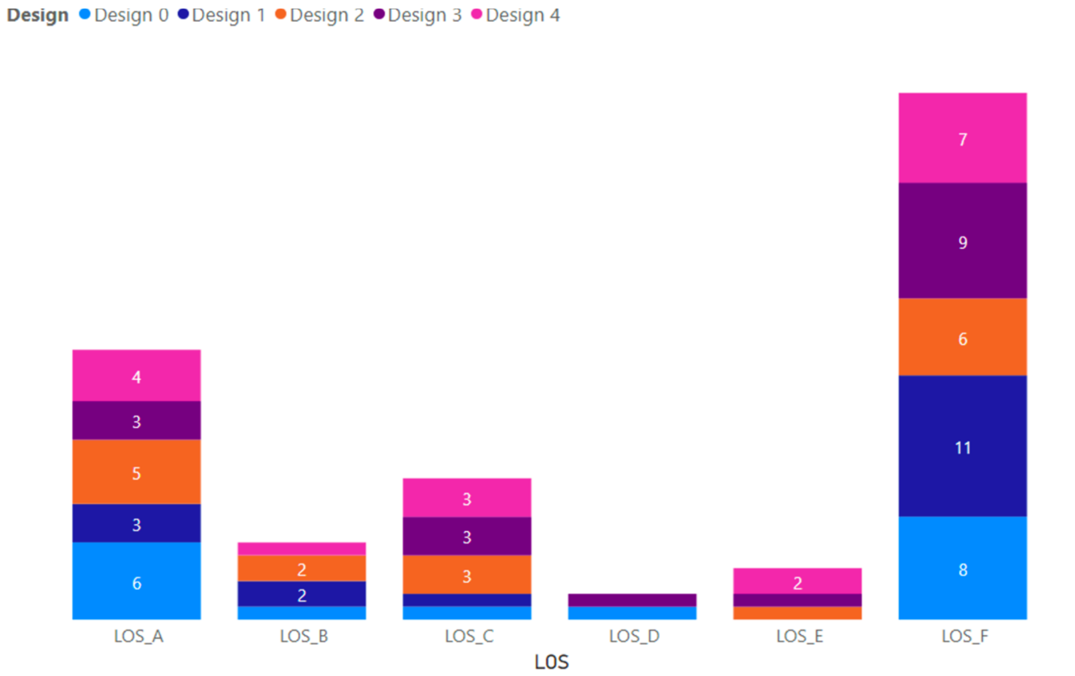


Figure 65. Number of points per traffic's level of service classification, Scenario 2

A homologous exercise was done with pedestrian level of service, i.e., similar to the traffic analysis, the number of locations per each level of service classification was identified. In the case of pedestrians, design 4, followed by design 3, have the best quality of service. In contrast, designs 0 and 2 have the most situations with poor quality of service provided.

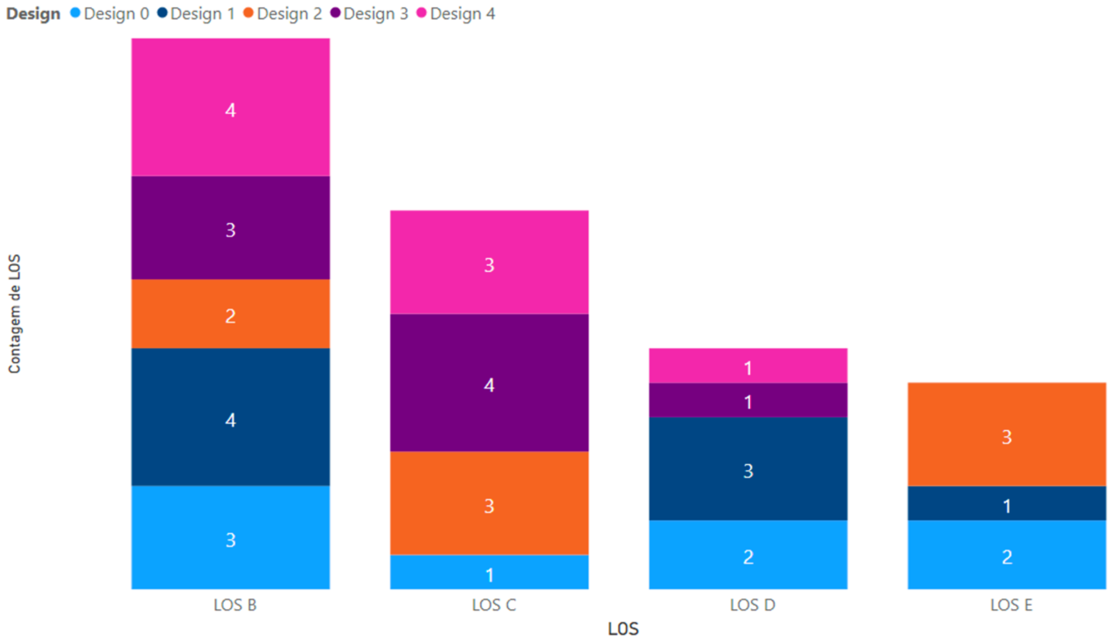


Figure 66. Number of points per pedestrians' level of service classification, Scenario 2

4.5.2 Scenario 3 – Conclusions

As well as proceeded in scenario 2, an evaluation of some traffic flow characteristics will be done, comparing some outputs provided by PTV Vissim travel time, queue lengths and provided level of service, both for traffic and pedestrians.

Besides the above-mentioned characteristics, for this scenario the modelling observation allows to conclude that, despite having less cars than current situation, the more balanced modal share imposes a poorer quality traffic circulation in design 3 and 4, which can be observed through the comparison between the number of vehicles circulation from west to east, which is significantly less that the number of vehicles circulating in the same direction on the other designs. The increase of other transport modes use seems to conduct to traffic overload and one lane doesn't seem enough to that kind of demand. One alternative that should be tested, considering that the car use reduction, being replaced by autonomous vehicles, for instance, will promote a lower pressure in parking demand, is the implementation of lay-by stops for public transport in some locations that are currently occupied by parking spaces. In this way, buses wouldn't need to stop on the carriageway leaving the space free for other transport modes, reducing the impact on queue lines and travel times.

Considering the expected bus frequency, the lay-by length should have the capacity to stop two buses, simultaneously. However, the implementation of this infrastructure would demand significant changes in the street's design, especially in design 3, where the implementation of the cycle lane could demand the use of existing pedestrian areas. This solution, despite improve traffic flow conditions, shall be thoroughly analysed to not hinder pedestrian conditions that are, nowadays, so poor.

Regarding the other indicators, design 2 seems the alternative, in overall, that presents better travel times performances, in contrast with design 1 that is the worst case in all transport modes.

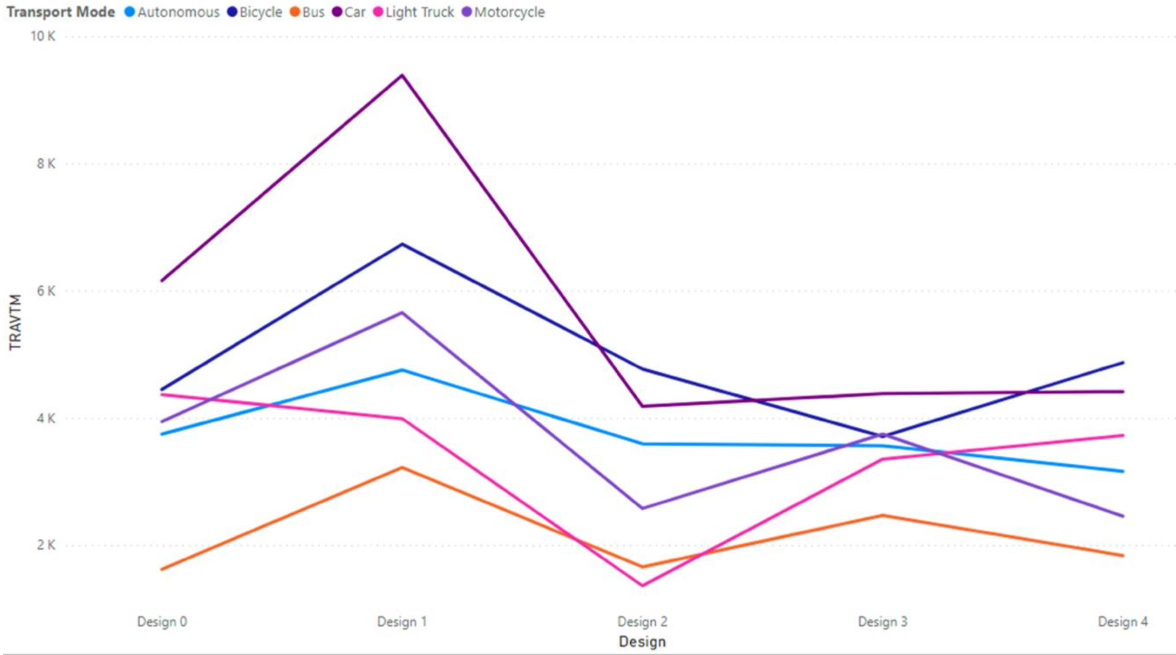


Figure 67. Travel time by transport mode and design, Scenario 3

Regarding average queue lengths, design 1 is the suggestion that should have smaller lines. Designs 1 and 3, in general, are the alternatives that show the longer queue lines in more intersections.

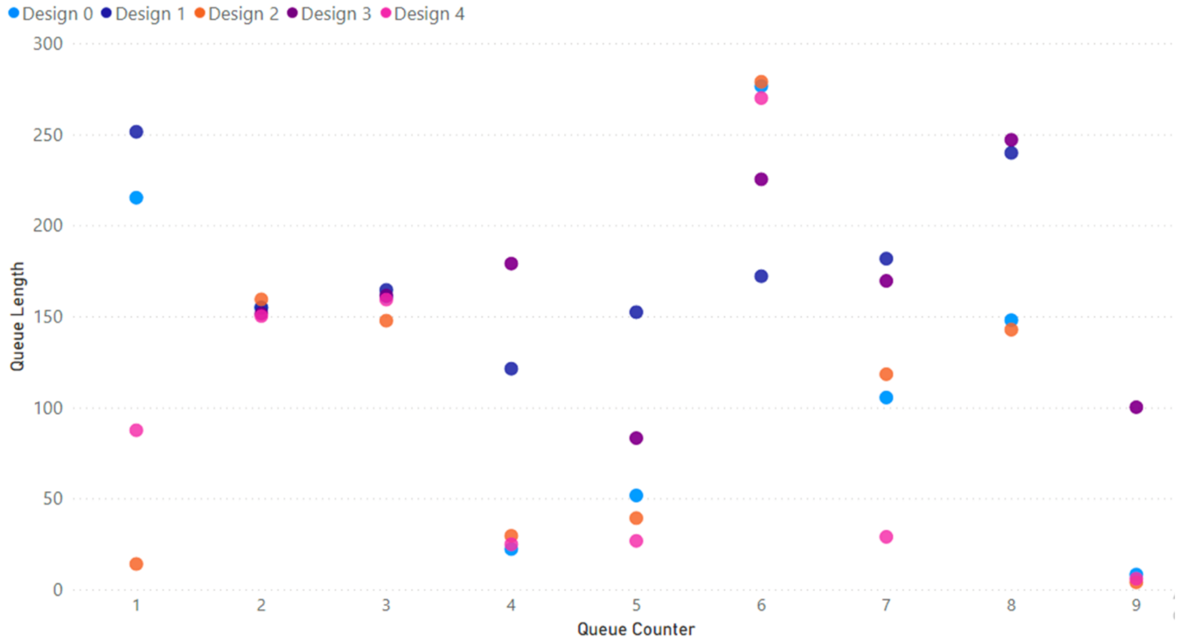


Figure 68. Average queue length by queue counter and design, Scenario 3

Looking at how many times a certain level of service classification repeats along the network, design 2 is the one with more level A classifications and less level F ex-aequo with design 0. In fact, except for design 1 that is clearly worse than the others, there aren't very significant differences about the level of service provided. However, as referred above, the number of vehicles in west to east direction in design 3 and 4 is much less than in the designs 0 and 2, which may be defined as a capacity failure.

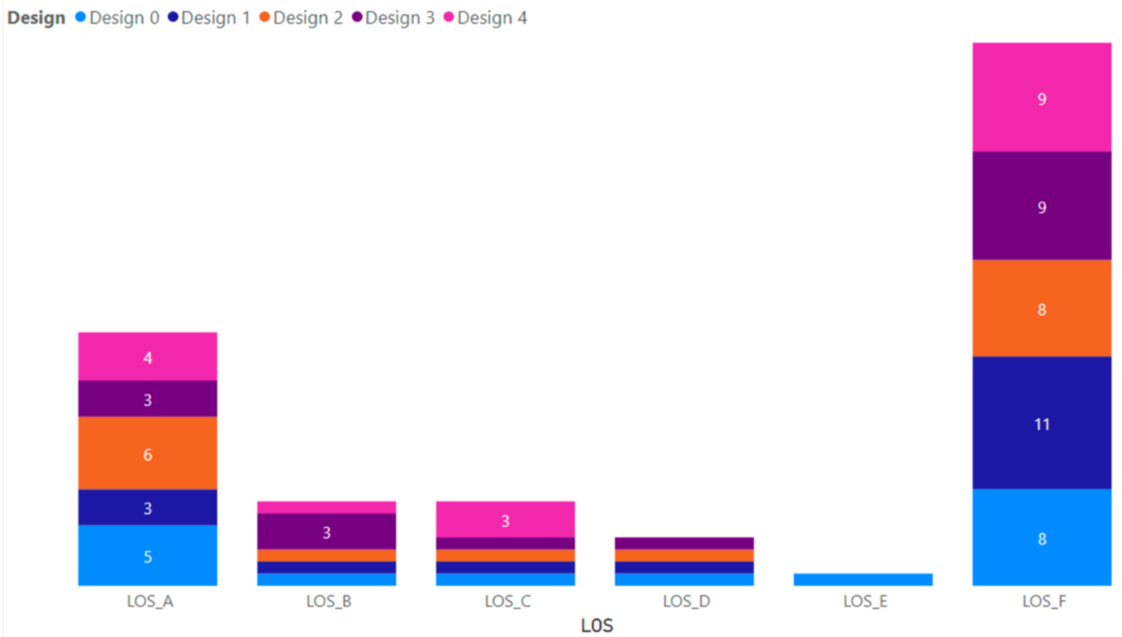


Figure 69. Number of points per traffic's level of service classification, Scenario 3

Looking at the pedestrian level of service, it is significantly worse in all designs than in the scenario 2 which is explained by the higher number of pedestrian movements in this simulation. Even so, designs 0,1 and 2 are clearly worse than the other two alternatives, showing that are not prepared to provide a good quality service to such a demand pattern. Designs 3 and 4, despite being slightly better, still have some situations that should be improved, maybe through the removal of some parking spaces taking advantage of a predictable demand reduction.

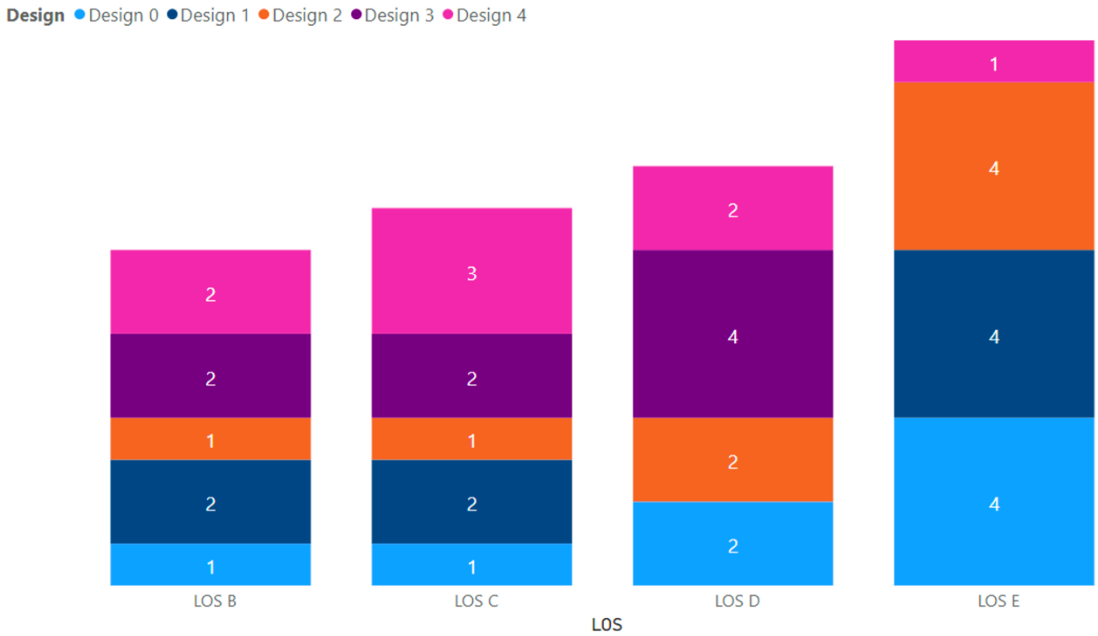


Figure 70. Number of points per pedestrians' level of service classification, Scenario 3

5 London

Please note that all modelled results contained in this report are indicative only, are pre-feasibility, non-audited designs of the highway and signal design and therefore should not be used or relied upon outside of the MORE project. A model used for supporting scheme development in London must be built according to the MAP, Modelling Guidelines and include a Scheme Impact Report.

The Vissim model outputs for these scheme designs are not representative of real-world functionality or operation on the highway network in this location as a supporting strategic modelling exercise has not been undertaken that reflects the changes in the network, as would often be undertaken to support the development of a real-world scheme.

5.1 A brief summary of future conditions along the Stress Section

5.1.1 Stress Section

The map below shows the entire length of the A2 TEN-T corridor in London from Bricklayers Arms in Southwark to the M25 Boundary in Kent to the east. Old Kent Road (OKR) has been highlighted on this map for context as the stress section location for London's future conditions option generation and appraisal.

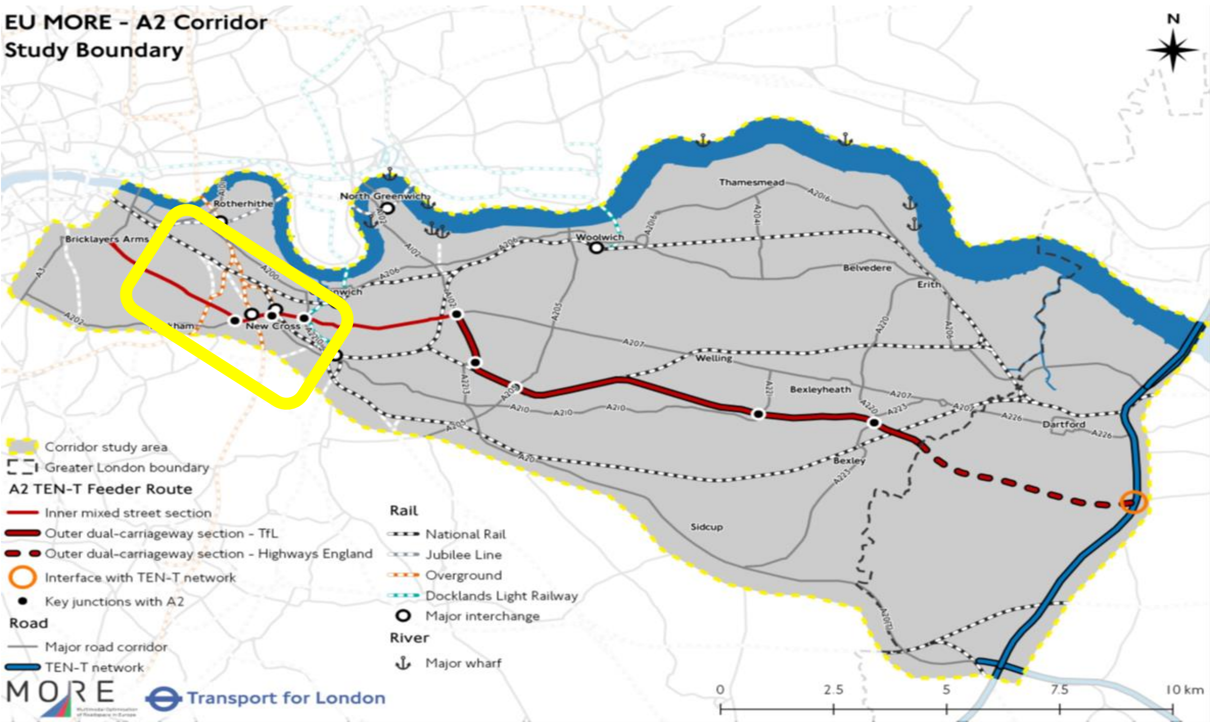


Figure 71. Stress section for future conditions – London

As previously referenced, in the D5.2 deliverable, OKR has been identified as an opportunity

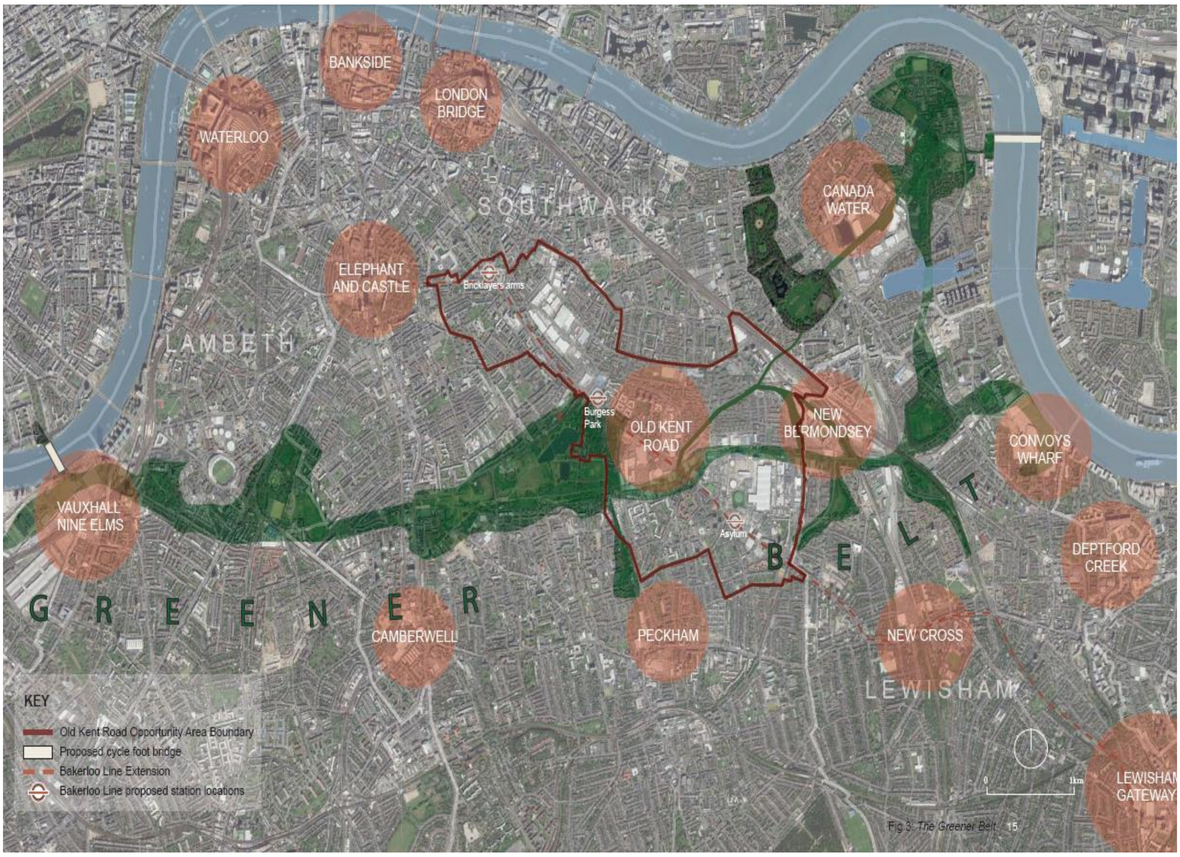


Figure 72. Old Kent Road Opportunity Area with A2 feeder route intersection. Source: OKR AAP

area (OA) in the London Plan which means it is one of limited places in London that is deemed to have capacity to accommodate large scale development. The figure below outlines the parameters of the OA and OKR in the context of south London and the A2 feeder route.

There is a Mayoral commitment to deliver the Bakerloo Line Underground Extension (BLUE), which could see two new underground stations serving the Old Kent Road and immediate vicinity, significantly increasing the public transport capacity in the area. However, funding is yet to be secured to deliver the scheme. There is a level of uncertainty around the scale of growth OKR OA could accommodate with and without enhanced public transport capacity.

Initial projections suggest, with BLUE, OKR OA could accommodate up to 20,000 homes and 10,000 jobs by 2037. Without BLUE, this is in the region of 8,000 homes and 4,000 jobs. It should be noted these plans are provisional and were consulted on in 2021. The outcome of the consultation is due to be published in 2022. Details of the consultation can be found on the London Borough of Southwark's website.[1]

Building on the proposed OKR spatial plans for development, the figure below illustrates the proposed changes to the existing land use. Of note is the relocation of the high street, expected to generate significant footfall and pedestrian activity, to the southern end of OKR where current land use it predominantly industrial.

Figure 73. OKR Proposed Town Centres and High Street. Source: OKR AAP

Up to 9,500 homes, commercial space and jobs are permitted to come forward as part of Phase 1 of the AAP in advance of BLUE. There is therefore a requirement to support this growth in the absence of delivery of significant public transport capacity, in the form of BLUE, through a Healthy Streets scheme which would also provide active travel measures after. TfL continue to look for third-party funding and work with potential development partners, which could help fund these public transport capacity improvements.

For the purposes of this design option and appraisal exercise, designs have been generated in the context of 2041 demand and using the TfL forecast demand scenarios.

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[1] https://www.southwark.gov.uk/planning-and-building-control/planning-policy-and-transport-policy/development-plan/area-action-plans-section/old-kent-road-aap/current-and-previous-versions-of-okr-aap.

5.1.2 Expected Movement and Place-related Demands

Information is provided in the figure below which details the range of expected movement demands by time of day interpreted from modelled origin and destination data for 2041. We have used TfL's strategic travel demand model, MoTiON, and supporting tools, to estimate how travel demand might change across the stress section and wider impact area, these are reported in zones, which is the most refined spatial level available with the strategic travel demand model.

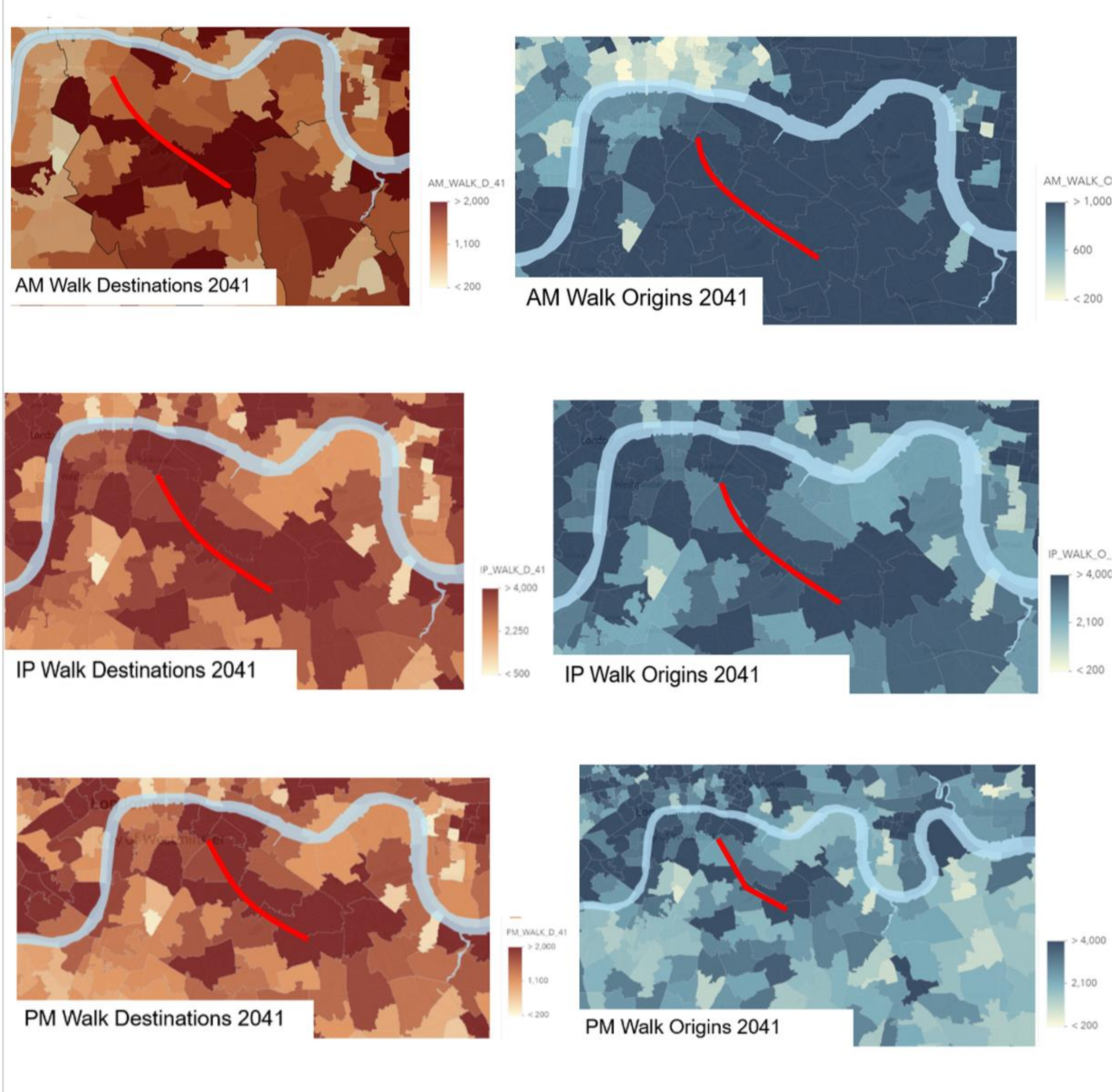


Figure 74. Modelled Origin and Destination outputs for Walking by time of day for the 2041 Reference Case Scenario. OKR Highlighted in Red

The figure above shows a concentration of over 2,000 walking trips ending at the southern end of OKR in the AM peak, highlighting the level of employment and jobs created on OKR attracting these trips. Similarly for origins, there is a high level, over 1,000 trips, originating in OKR and the wider impact area.

The Inter-Peak for destinations shows even higher concentrations than the AM peak with over 4,000 trips ending in most of the zones for OKR emphasising its location as a high street for essential services and leisure activities. Origins are similarly as high with up to 4,000 trips originating at the southern end of OKR and extending to Surrey Quays, with up to 2,000 originating trips along the entire length of the stress section.

Similar trends can also be seen replicated in the PM time period with up to 2,000 trips ending at the southern end of OKR and in various zones along the length of the Stress Section, not dropping below 1,000 for the entire length. A similar trend is seen for trips originating in the PM peak as a result of the high population growth anticipated and high density living.

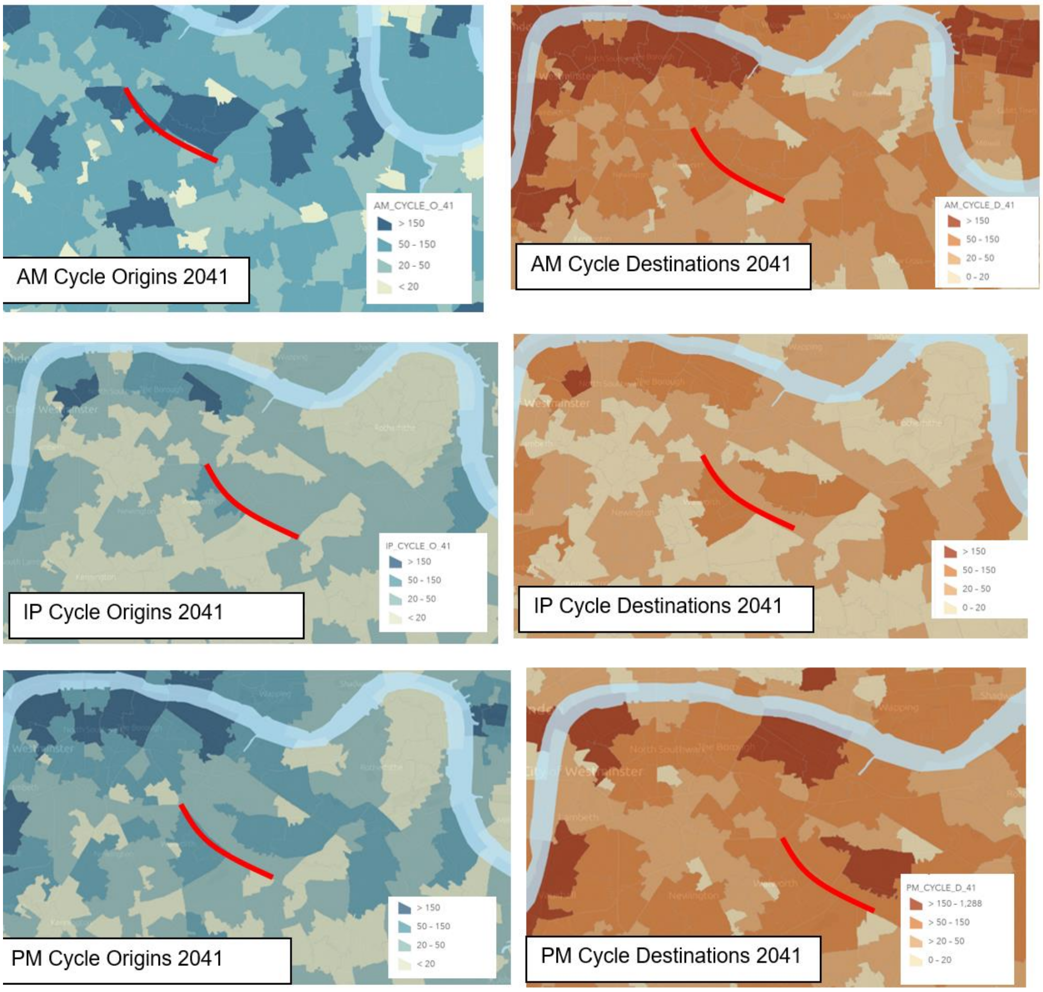


Figure 75. Modelled Origin and Destination outputs for cycling by time of day for the 2041 Reference Case Scenario. OKR Highlighted in Red

There are two clear and unsurprising origin and destination outputs that show the greatest trips, these are AM origins and PM destinations. Both show similar patterns with the greatest cycle trips originating and ending at the south western edge of the OKR in particular. For the AM period, over 150 cycle trips are also generated at the northern edge of OKR. For AM destinations there are more modest trips ending in OKR but the wider impact area, particularly towards Waterloo shows a concentration of destination trips that, given the proximity of OKR, could be used as a through route for these trips.

The Inter-peak period sees much reduced cycle output, particularly as origin with most of the zones surrounding OKR seeing less than 50 trips. For destinations, the trend is similar except for the Western side of OKR which sees 50-150 trips.

The PM period for origins is also modest at majority 50 trip output, the destination output as described above however is more intense with up to 150 trips in most of the zones within the OKR vicinity and up to 1,200 trips in zones adjacent to the OKR. Providing safe and consistent cycle routes, wayfinding and cycle parking facilities will therefore be a key priority to consider in the design exercise.

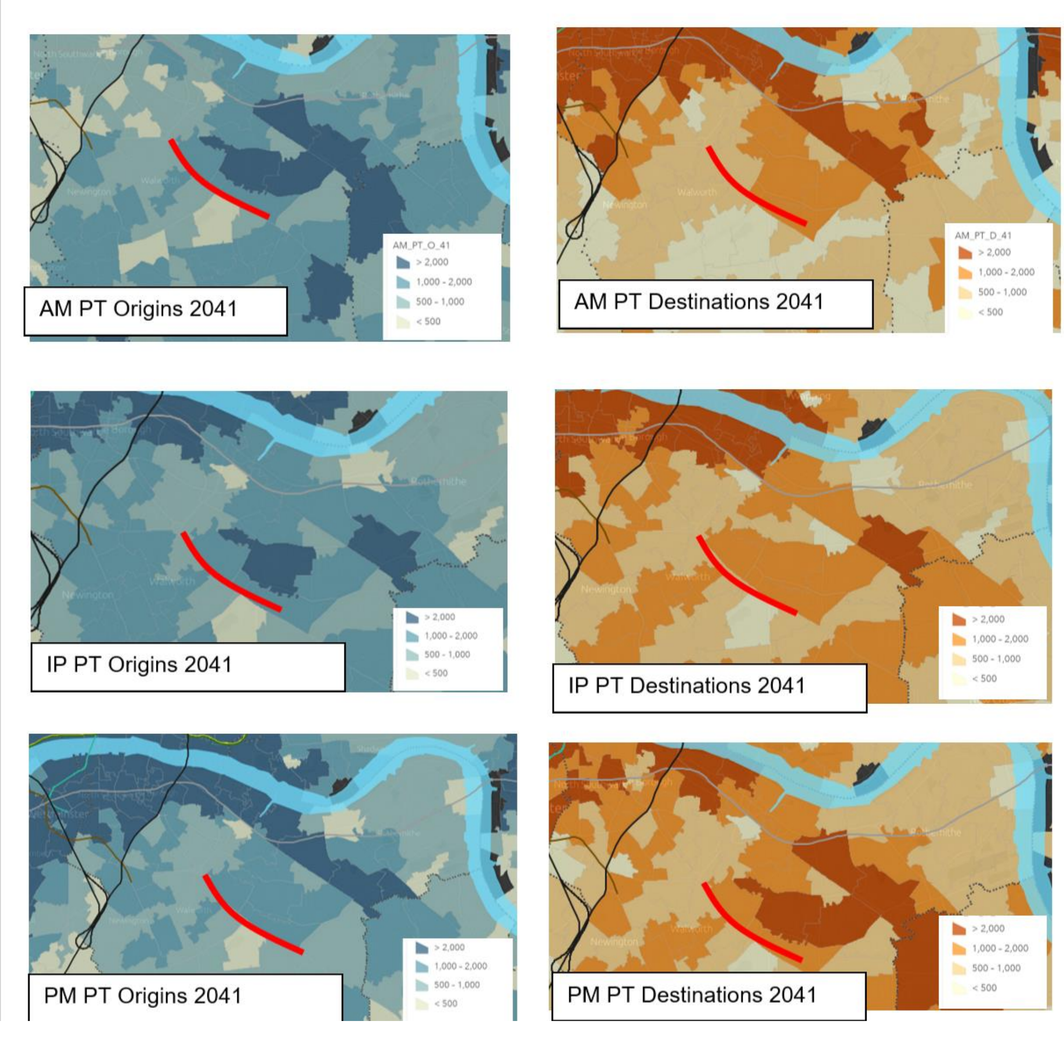


Figure 76. Modelled Origin and Destination outputs for Public Transport (RailPlan) by time of day for the 2041 Reference Case Scenario. OKR Highlighted in Red

A clear trend that public transport is fundamental for OKR is evident across all three time periods and origin and destination outputs. Similar to the cycling outputs, commuting patterns are illustrated as origin outputs in the AM period and PM destinations with over 2,000 trips. Throughout other time periods and function, outputs remain high, between 1,000-2,000 trips in most of the MoTiON zones within the vicinity of OKR. Again, concentration of trip outputs can be seen in both origin and destination towards the eastern side of OKR.

5.1.3 TfL future demand scenarios

In addition to the time of day variations in estimated origin and destination modelled outputs, modal demand has also been considered which takes into account the modelled TfL future demand scenarios. TfL conducted research in 2019 which investigated emerging trends and how these could develop into different futures. The output of this work was three scenarios, none of the three scenarios was to be considered more likely, desirable or plausible than others. Their main purpose was to better define the ‘envelope of uncertainty’ affecting our medium- to long-term plans. ‘Innovating London’, ‘Rebalancing London’ and ‘Accelerating London’ were the three scenarios that resulted and demonstrated three alternatives to the future assumed in our central case, with a nominal timeline of 2041.

- **Innovating London** is the story of London reinventing itself as a young, urban innovator, where technology changes how people live and work, but leaves some behind.
- **Rebalancing London** is the story of a more equal but ageing society with lower economic growth, which focuses on self-sufficiency and liveability as world power moves east.
- **Accelerating London** is the story of an ever-growing, expanding London which acts as the beating heart of the world financial system, but struggles to deliver a high quality of life for all.

It was also deemed necessary to conduct a fourth Scenario, titled **PT+,** due to the reference case not including the Bakerloo Line Upgrade and Extension (BLUE) to Lewisham, due to the scheme being currently unfunded in the TfL Business Plan. This scenario includes two proposed stations on Old Kent Road and Metro-isation of south London which is expected to have significant implications on travel demand and mode share along the stress section and wider impact area.

The demand scenarios provide travel outcomes linked to the preferences and assumptions of personal travel behaviour used to build each of the scenarios. The diagram below presents an indication of the travel outcomes for each scenario on sustainable mode share, as per the Mayoral target of 80% by 2041.

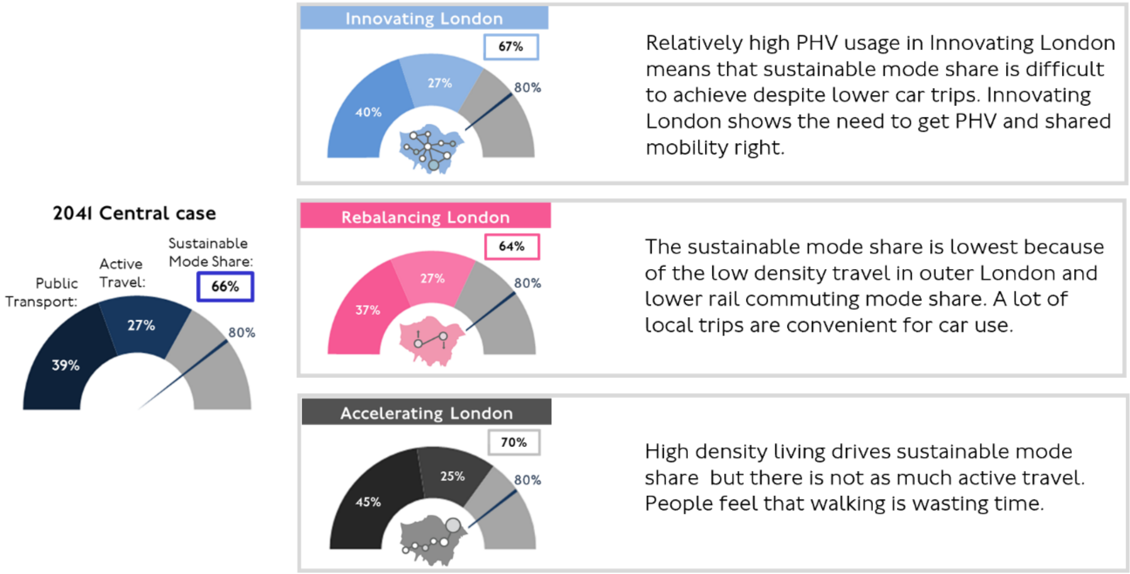


Figure 77. Indication of the travel outcomes for each scenario

5.1.4 Public Transport

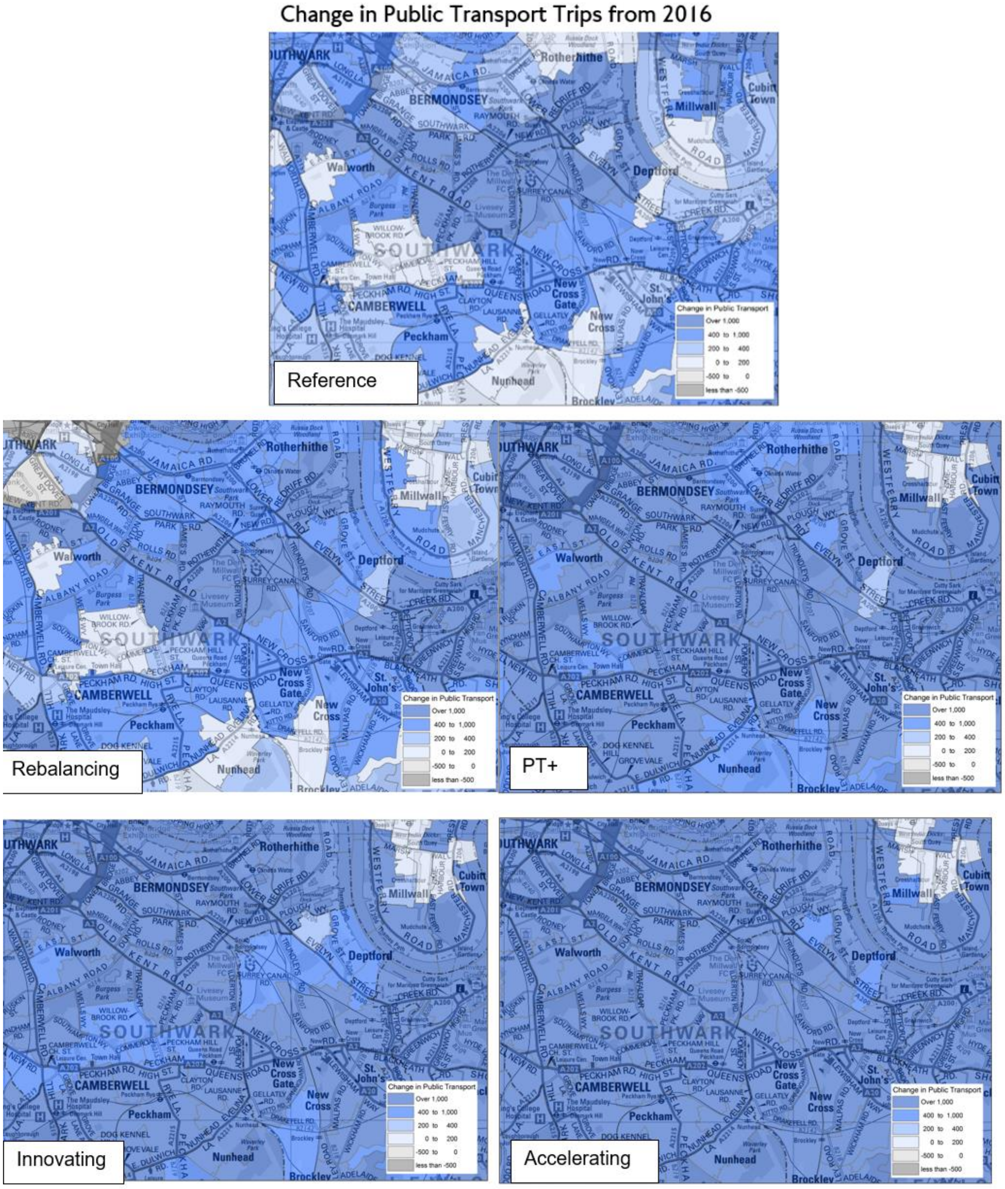


Figure 78. Change in Public transport trips from 2016 to 2041 for each scenario

The maps show a concentration of over 1,000 more public transport trips than in 2016 along the stress section of OKR and linked to the secondary Opportunity Area of Surrey Quays, north easterly from OKR. As the 2041 reference case model does not include the extension of the Bakerloo Line from Lambeth North, it should be noted that the majority change in these trips is anticipated to be made by Bus.

The wider study area sees similarly high change in Public Transport trips to the north western side of OKR around Walworth and to the southern extent of OKR in New Cross and Peckham. However, it is Accelerating London that appears to have the most impact on change in public transport trips with increases over 1000 along the length of the corridor and the wider impact area. This is due to population and employment levels soaring at a greater rate as forecast in this scenario which results in constant overcrowding on transport services as well the road network congestion worsening. The PT+ scenario then also has the second greatest increase in trips from 2016 along the corridor length and in the immediate vicinity.

5.1.5 Walking

Figure 79. Change in Walking trips from 2016 for each scenario

There is more selective growth in walking trips, compared to PT trips above in each of the scenarios, albeit for Accelerating London whereby there is significant growth of over 1000 more trips in most zones in the immediate vicinity and wider impact area of OKR. PT+ and Reference case scenarios show the most intense growth behind Accelerating with is particularly concentrated to OKR zones, again with over 1000 more trips emphasising the anticipated change in conditions from what currently exists.

The demand for other transport modes between each TfL scenario can be viewed in the D5.2 deliverable.

5.2 Preparations for the street design exercises

5.2.1 Design Brief

This section will outline the road uses and users considered as a priority for Old Kent Road stress section and the priorities for the design exercise.

The period to 2041 is the strategic focus of the Mayor's Transport Strategy (MTS) in achieving the 80% sustainable mode share. Therefore, the key policy priorities and road user priorities set out in this section are consistent with those outlined in the design brief for the current conditions of New Cross in London (Deliverable 5.1).

The overarching outcomes identified in the table below align to the MTS and also take into consideration the local borough vision set in the OKR Area Action Plan and OKR Social Regeneration Charter.

The Key priorities also consider the range of future conditions, as set out in the preceding chapters, of modal demand and supply factors that have implications for street design. The clear trend in all scenarios is the strategic importance of public transport on OKR, particularly in terms of efficient movement of people. However, this must also be balanced by the competing needs to accommodate significant population growth in terms of place-making and kerbside activities generated by a denser population. Walking, including interchanging between modes, will need careful consideration in the street design exercise; particularly, in the context of supply of new modes and the safety implications of these for pedestrians and other road users.

Table 20. Key Priorities for the street design exercises

Key Priorities	
Provide safe and consistent cycle provision	Introduce road danger reduction measures
Improve bus journey time	Improve air quality
Improve walking conditions	Improve access to public transport
Reduce severance for pedestrians	Improve interchange between modes
Reduce speed	Reduce private car trips and consolidate freight

In creating road space designs that deliver the above key priorities, road user requirements have been considered that will be used to evaluate success in achieving these outcomes. These include providing pedestrian crossing, provide safer cycling provision, reduce speeds, accessible bus stops, cleaner and greener vehicles, increased footway and clear and concise restrictions for parking and loading.

5.2.2 Design Options

Using the design brief provided for design priorities and road-user requirements, as outlined above, road space designs were specified to be created for the A2 Old Kent Road study area. Given the characteristics of the corridor and key priorities identified, this led us to two distinct thematic areas to consider in producing the road space designs of:

- Active travel modes or place priority (ATM)
- People moved, or public transport, priority (PT)

These two areas are considered to address each of the key priorities in **Error! Reference source not found.**, but recognise that there are clear competing elements of the road space that require compromise to the detriment of one or the other mode when prioritised. Therefore, it is deemed necessary to achieve the greatest benefits to allocate priority to each of these modes separately when developing designs.

Active travel modes priority refers to giving consideration to the stress section as a place, considering its high priority function and land-uses of shops, cafes, restaurants where people would like to spend time and enjoy activities on the street in itself. In terms of design considerations, this not only refers to more space allocated for pedestrian activities on the footway but also crossing facilities in places where pedestrian desire lines dictate as opposed to where the least impact to traffic occurs. Priority would also be provided for active travel modes such as cycling with the provision of cycle lanes on the carriageway and cycle parking facilities.

People moved priority aligns to the improved access to public transport, bus journey times and reducing private car trips indicators of the key priorities identified in the design brief. Specifically, on the corridor, Buses act as the most efficient mode to transport significant numbers of people at all times of day for which road space should be prioritised.

Time of day was an initial specification for the road space designs, focussing on morning, afternoon, and evening modal flows throughout the length of the corridor and how this varies throughout the day.

The table below summarises the designs to be generated, separated between people moved and active travel modes priority for each.

Table 21. Designs to be generated in the street design exercise for each segment of the stress section

People Moved Priority	Active Travel Modes Priority
Description	**Description**
OKR PT AM	OKR ATM AM
OKR PT IP	OKR ATM IP
OKR PT PM	OKR ATM PM

5.3 Generating ideas for design options

Due to the live discussions around the development proposals for OKR and the concept nature of the MORE project, as well as time pressures within the project, it wasn't deemed appropriate to co-create road space designs with members of the public. A revised method utilising virtual meeting tools, as a result of the COVID-19 pandemic, was employed to develop designs internally.

Similarly, given the future nature of the design options to 2041, it was decided the option generation and road space design tools would not take into account the variation in modal demand between each of the scenarios well so these were not generated for this task.

On further assessment of the stress section, and due to the time pressures mentioned above as a result of COVID-19 impact, the scope of the area for design options to be generated was reduced to the Northern Section of OKR, between Mandela Way and Albany Road on the grounds that this was expected to be the most congested and constrained location on OKR due to the re-development plans and re-location of the high-street, which also included the proposed Old Kent Road Underground Station as part of BLUE.

Below is a description of the design improvements made for each of the design options and illustrations of the main design option features where appropriate. The design improvements involved two scenarios for the three times periods during the day (AM peak, and Inter-Peak & PM peak.)

5.3.1 Public Transport Priority Design Option

The purpose of this design option was to allocate as much roadspace as possible to road-based public transport modes, based on the scenario that BLUE was unfunded by 2041 in the TfL scenarios of Innovating, Rebalancing and Accelerating London, and that priority would need to be given to road-based public transport modes to accommodate the growth in population and employment from OKR developments in 2041.

Please note: The TfL scenarios account for committed and funded schemes in TfL's Business Plan to the mid-2020s. However, it should be noted this is not limited to further external funding sources coming forward to support growth in the area within the time period of the current *business plan and beyond. TfL remain committed to delivering the Bakerloo Line Extension; however, this depends on a viable funding package being put together.*[2]

Specifically, the design option generated for this priority allocated:

- Addition of a continuous bus lane in both directions, this kept two lanes for general traffic in each direction of the road.
- Bus lanes operating in the AM and PM peaks up to the junction in front of building 276, after this junction the bus lanes will be operating for 24-hrs.
- The loading and parking bays permitted to be in operation in off-peak times only.
- Existing loading bays reallocated to areas where footways were much wider
- Existing loading bays shifted on footways where possible
- Relocation of pedestrian crossing where it was deemed necessary to ensure the smooth flow of buses in bus lanes, for example to the end of a bus lane at a junction.
- Signalized crossings were added where it made accessing public transport easier for pedestrians for more direct desire lines and areas that generate demand, i.e., the proposed Tesco site.
- The central median in front of the proposed Tesco site was reduced in width to give more space for the carriageway.

Figure 80. Public Transport Priority Design Option

[2] https://tfl.gov.uk/corporate/about-tfl/how-we-work/planning-for-the-future/bakerloo-line-extension

5.3.2 Place-based Priority Design Option

The purpose of this design option was to allocate as much roadspace to cyclists and give consideration to pedestrian desire lines and OKR as a ‘place’ for spending time and leisure activities whereby BLUE has been delivered and represents the greatest mode share for residents and employees of the OKR OA. The Old Kent Road Underground Station would generate mass daily numbers of entries and exits within the stress section design area that would need to be accommodated in 2041.

Figure 81. Place-based Priority Design Option overview

The design therefore incorporates elements of the following:

- Adding a continuous 2m-width cycle lane in each direction.
- All parking and loading shifted on to widened footways.
- Where footways were constrained, providing 3.0 m- bus boarder medians on both sides of the road to give passengers more space for waiting and pedestrians moving past more space.
- Zebra crossings have been added where pedestrian desire lines are expected.
-

Special provision has been made around the location of the proposed BLE station:

- The footway at the station side was widened to 5.0m.
- 3.0 m- bus boarder median was added in both sides of the road to give passengers moving through and waiting, wider space.
- Loading and parking bays were shifted to the extended footway and the existing loading bay provision retained but relocated in front of the cycle lane.
- At building 279 the footway is widened, and the traffic lane width is reduced.

At the junction where the road intersects with Albany Road at the southern end of the design section a number of changes were made:

- At the NE side the footway was widened
- The median was widened
- the cycle lane was extended to cross the other side of the junction.
- the median from all sides were slightly changed to make sure they align properly with the carriageway lanes from all sides.
- The cycle lane is extended to SE side up to the next junction
- Signalized crossing was added in both sides of the road in front of building 288
- At Humphrey Street the signalized crossing was relocated closer to the junction
- A signalized crossing was added to the SE bound arm
- The width of the central median was reduced to accommodate the new design elements.

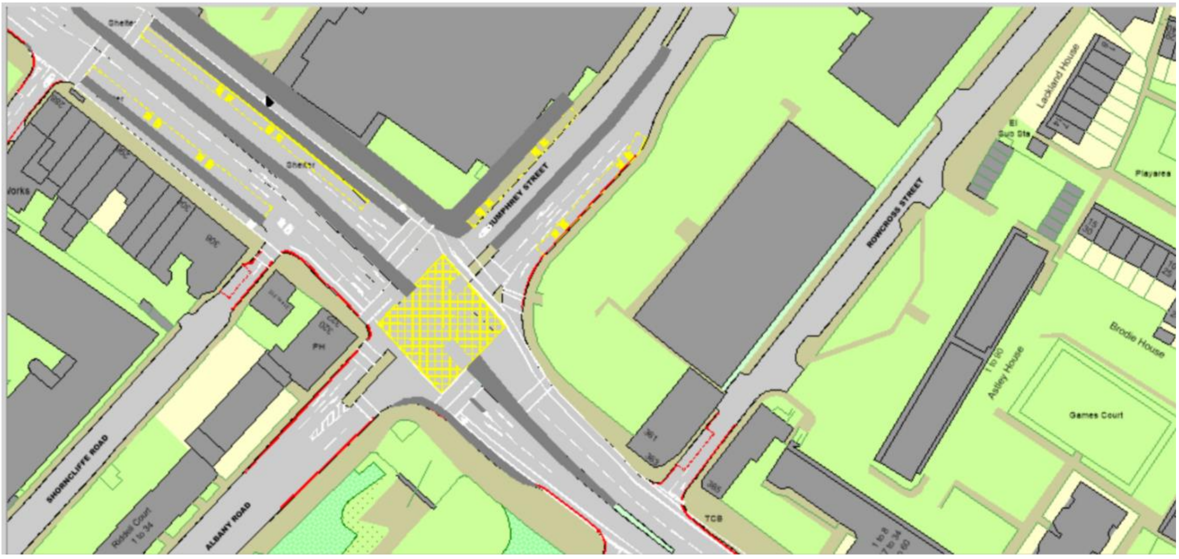


Figure 82. Place-based Priority Design Option – Albany Road

As a rule of thumb for time variations between all design options, the following approach was adopted:

1. If a parking or loading bay has been allocated or retained from the existing layout and it is on the footway, or a bus lane continues around it unimpeded, then it can operate during the peak periods (i.e., during the red route hours) and also through the inter-peak hours usually between 11:00-16:00.
2. If a parking or loading bay impedes bus flow or the footway- depending on priority, then it is removed in the appropriate peak period depending on traffic flow:
    A. AM Peak/inbound/south side of street
    B. PM Peak/outbound/north side of street

As the AM and PM peak design options included the same parking and loading restrictions for each time period, it was deemed only necessary to model one of these. On initial assessment of the data available, the PM peak period was chosen to take forward as this had the greatest level of competing demands and therefore impact to be made with the design options.

Table 22. Summary of design options sifted that will be taken forward for modelling and appraisal

Design Reference	Description	Demand Scenario to be modelled
OKR PT PM	Priority given to road based public transport modes	Accelerating London
		Innovating London
		Rebalancing London
OKR ATM PM	Priority given to pedestrians and active travel modes as a result of BLUE station demand.	PT+

5.4 Building and applying the Vissim model

Designs of the highway and signal design should not be used or relied upon outside of the MORE project. A model used for supporting scheme development in London must be built according to the MAP, Modelling Guidelines and include a Scheme Impact Report.

5.4.1 Base Model Origins

TfL Network Management commission, audit and develop Vissim models routinely to determine operational impacts of a schemes on London's road and bus network,

Transport for London have already calibrated and validated a 2019 Vissim model for the AM (08:00-10:00) and PM (16:00-18:00) for Old Kent Road. The model is a cordon of a much longer model that covers the A2 Corridor through South-East London to its Terminus in Central London.

The model time period used for the design options was PM peak.

The modelled vehicles are:

- Cars/Light Goods Vehicles,
- Taxis,
- Medium Goods Vehicles,
- Heavy Goods Vehicles,
- Motorcycles, and
- Pedal Cycles.

Pedestrians were not modelled as there was not sufficient data available to generate a representative demand for 2041 suitable for a pedestrian model.

The scope of the Vissim model is indicated in the diagram below:

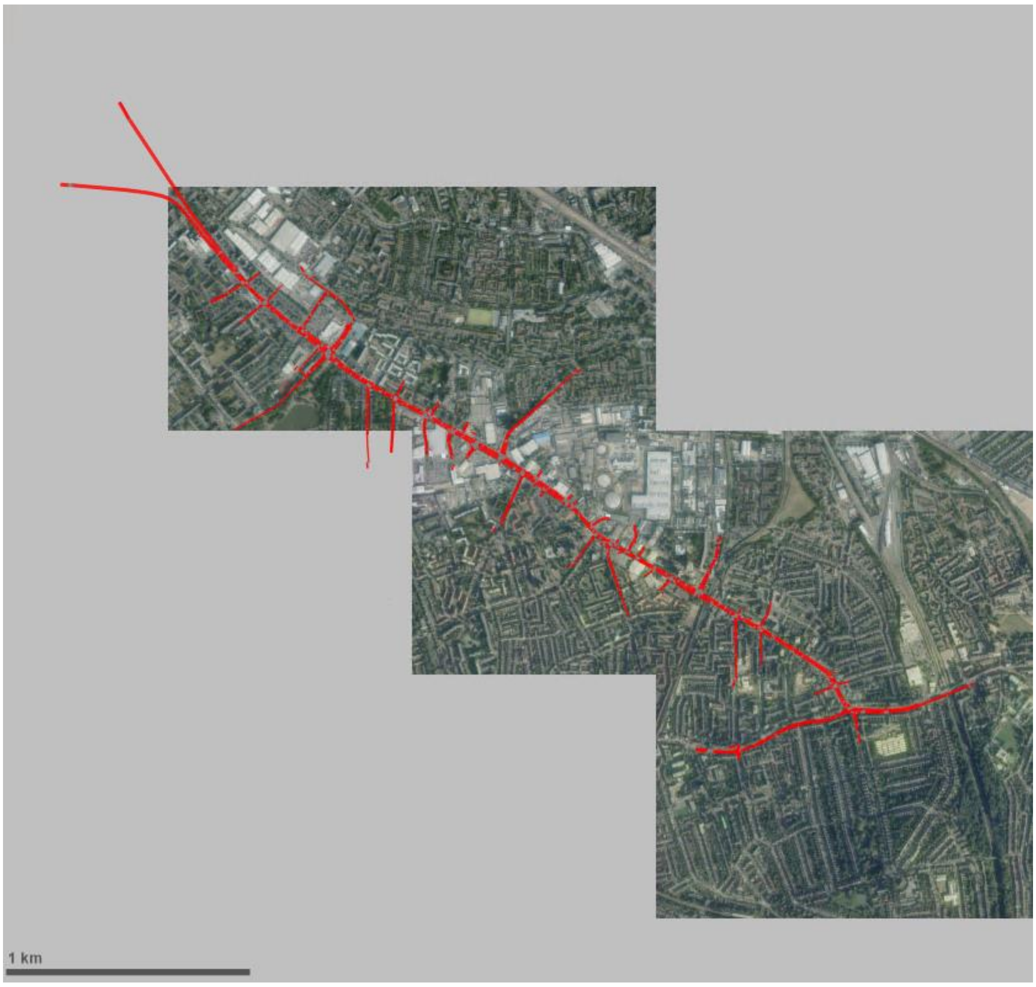


Figure 83. Scope of the Vissim model for section under stress

The traffic signals in the model are controlled by an emulation of London's Urban Traffic System (UTC) which holds the signal plans and controls the signals through the Split Cycle Offset Optimisation Technique (SCOOT). Speed distributions are those from the Department for Transport (UK) – *Vehicles Speeds in Great Britain (2005).* Diagrams showing vehicle inputs are given in the full model results spreadsheets. This highway network forms the basis of the MORE Vissim model.

5.4.2 Modelled Designs

Please note that all modelled results are indicative only, are pre-feasibility, non-audited designs of the highway and signal design and therefore should not be used or relied upon outside of the MORE project. A model used for supporting scheme development in London must be built according to the MAP, Modelling Guidelines and include a Scheme Impact Report.

The VISSIM model outputs for these scheme designs are not likely to be representative of real-world functionality or operation on the highway network in this location, as the strategic model *used does not have the detail of the scheme design, hence the outputs do not represent the detail normally needed for a local level model such as Viissim.* There are a total of three physical designs modelled, as indicated in the table below, using 5 TfL demand scenarios. Results will be reported and analysed below. The current road space design layout has been modelled for comparison to the new design options generated and demand scenarios.

Table 23. Physical designs modelled

Design	Demand Scenario
Current	Reference Case (2016)
OKR PT (PM)	Accelerating London
	Innovating London
	Rebalancing London
OKR ATM (PM)	PT-Plus

5.4.3 Design Scenarios

The main design changes from the Current design are at the Old Kent Road/Albany Road Junction.

Figure 84. Old Kent Road Public Transport – People movement - Layout

In this design scenario, bus services have a separate bus in both directions lane north of the junction.

Figure 85. OKR ATM (PM) Layout - Active travel modes or place priority

In this design, dedicated cycle provision is introduced on the corridor, pedestrian crossings additional crossings and reduction in road space allocated to general traffic and buses. A brand new method of control was required at the Albany Road/OKR junction in order to accommodate the cycles and changes to the pedestrian crossings. The full designs can be seen in the Appendix.

5.4.4 Demand Scenarios

As part of other work by Transport for London, three demand scenarios have been developed which reflect different broad visions of what the city could look like in 2041. A description of these three scenarios is shown below:

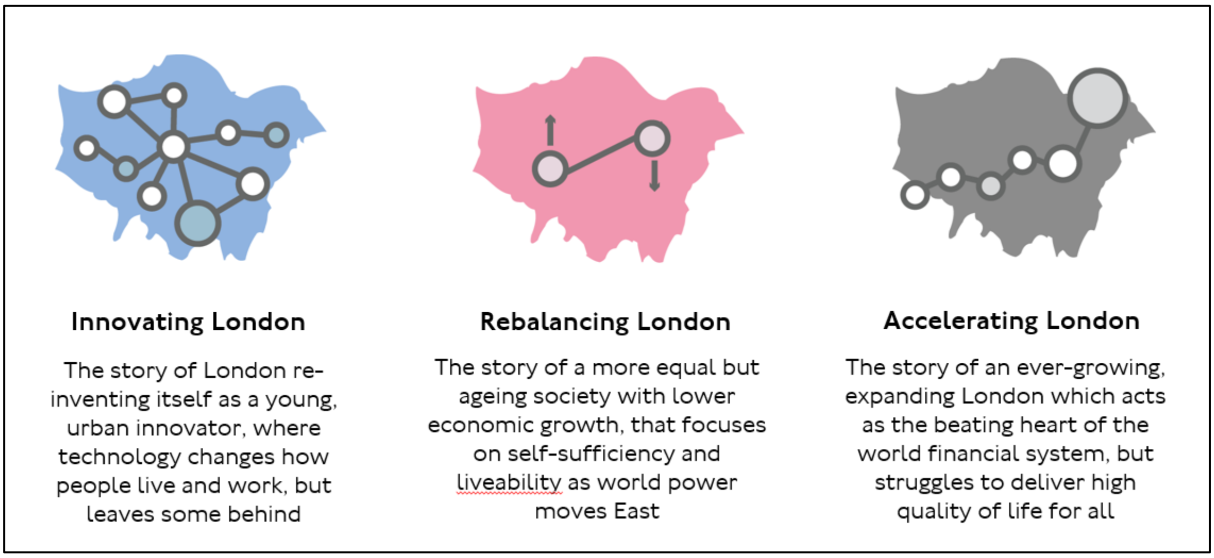


Figure 86. Three demand scenarios reflecting broad visions of what the city could look like in 2041

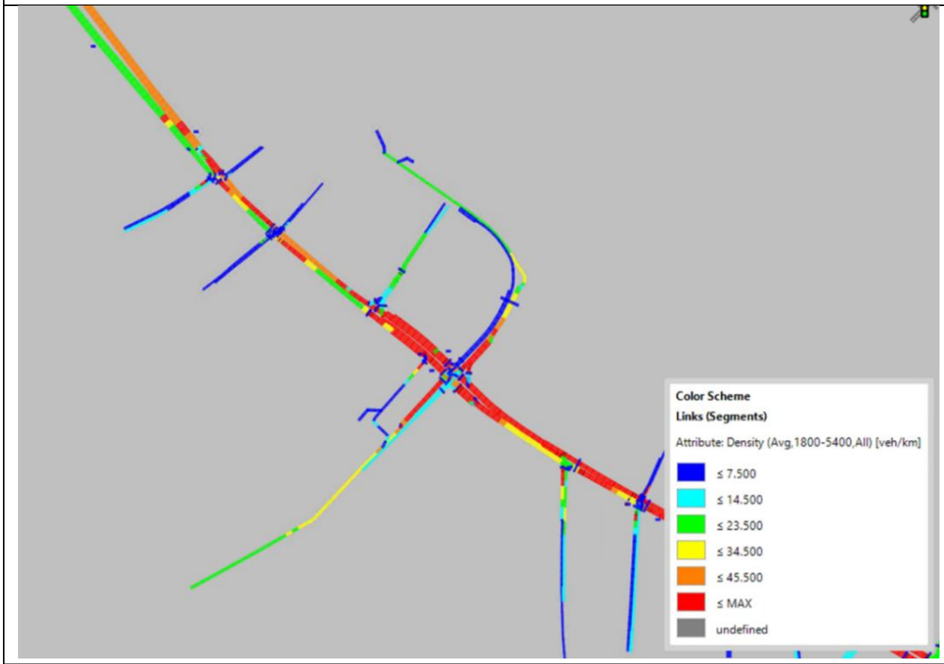
A fourth specific demand scenario has also been developed named 'PT-Plus' which reflects transport improvements in South-East London and the delivery of BLUE.

These visions have an impact on the level of demand for travel, modes and origins/destinations when modelled in MoTiON. The change highway demand in MoTiON is then transferred to the Vissim model on the specific input links.

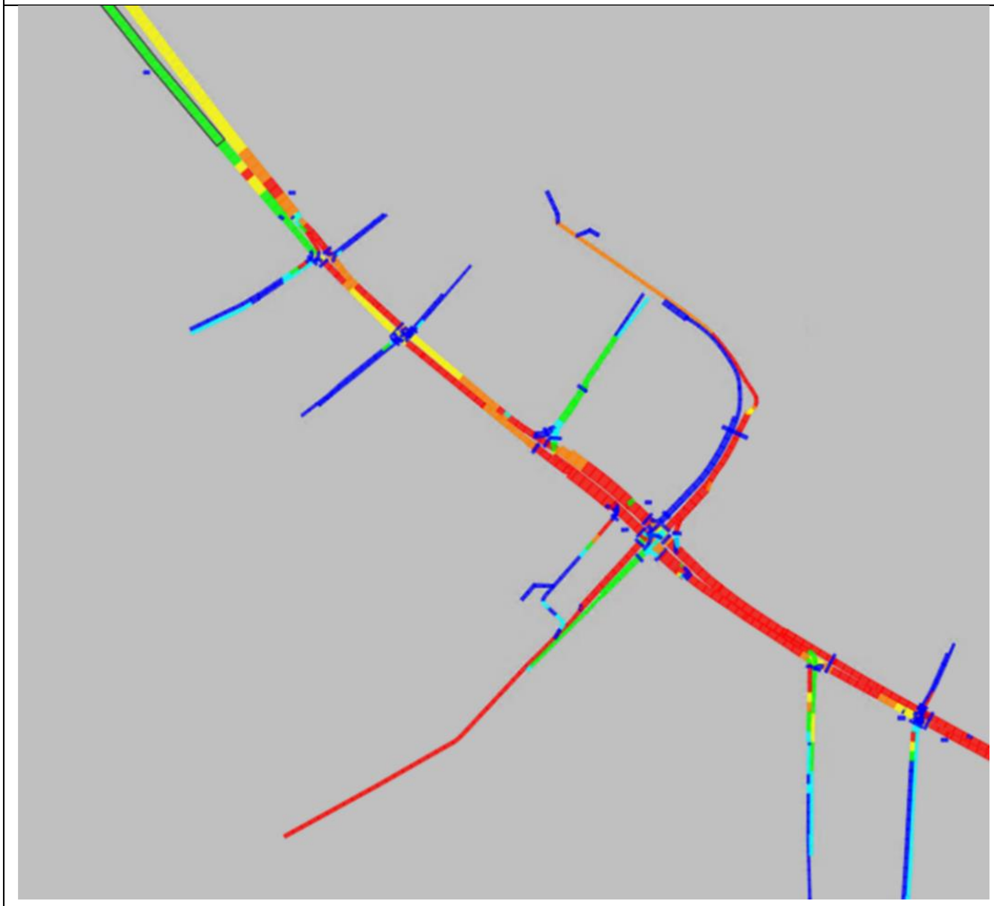
5.4.5 Modelled Densities

The following images show the modelled vehicle densities, which reflect the queuing, stationary and slow movement of vehicles, between the different options.

Current / Reference Case – Segment 1 - (1700-1800)



OKR PT (PM) / Accelerating London – Segment 1 - (1700-1800)



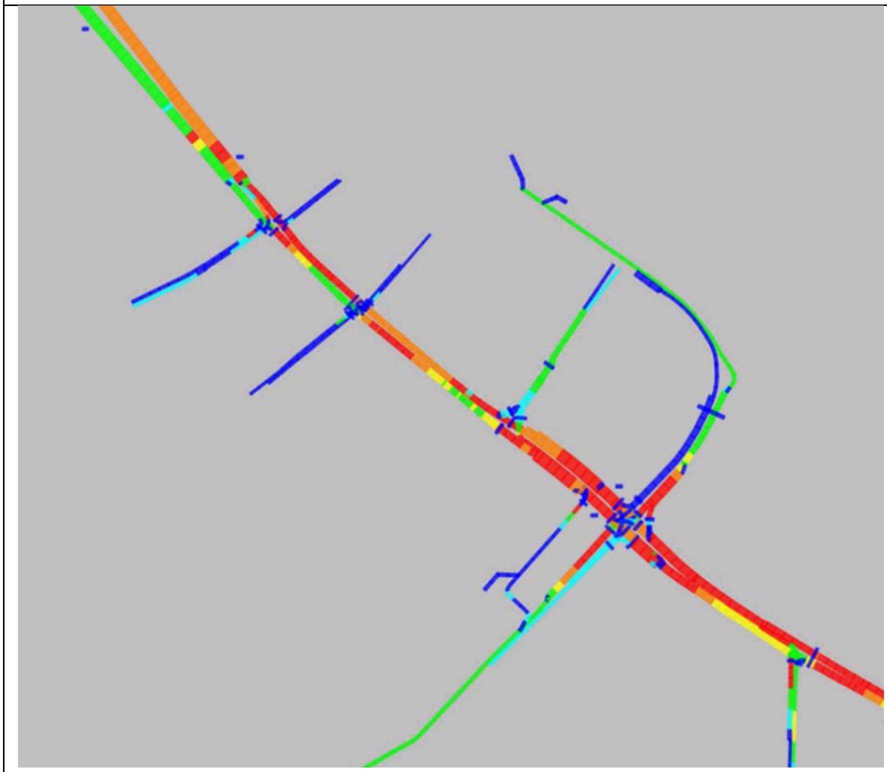
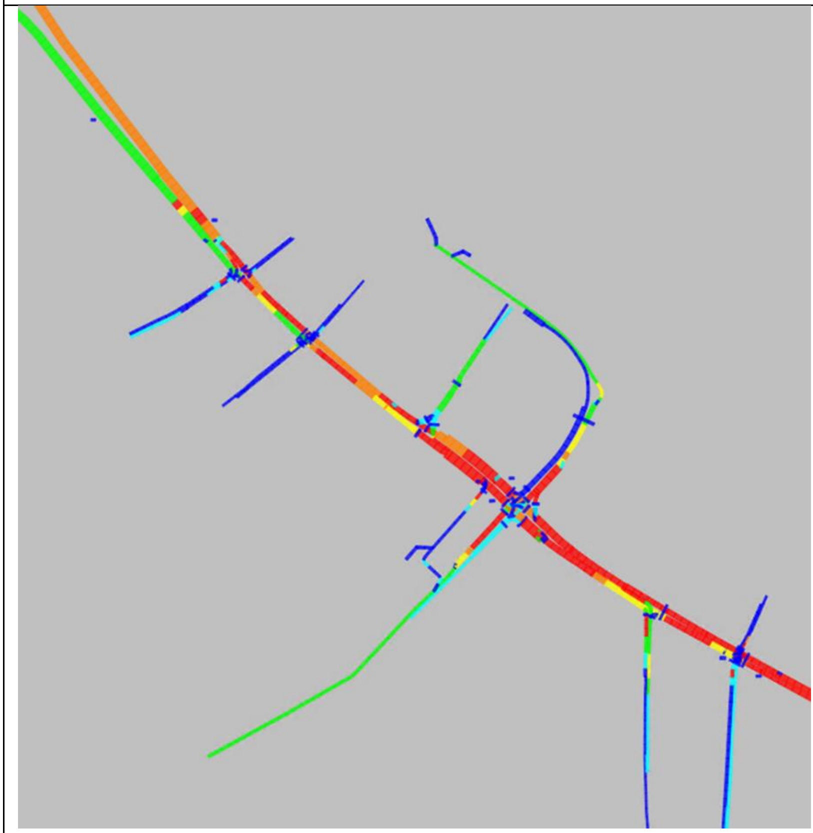
OKR PT (PM) / Innovating London – Segment 1 - (1700-1800)

OKR PT (PM) / Rebalancing London – Segment 1 - (1700-1800)

OKR ATM \ PT-Plus – Segment 1 - (1700-1800)

Figure 87. Model Comparisons (Base v Accelerating London v Innovating London v Rebalancing London and PT-Plus)

The density plots show that the Reference scenario has the lowest modelled vehicle density in general, due to the changes in design which restricts road space for general traffic.

In all scenarios the southbound A2 has a higher density than any other areas.

The Accelerating London and PT-Plus scenarios show high vehicle density on Albany Road and Humphrey Street. Innovating London and Rebalancing London scenarios show slightly lower densities on these arms.

5.4.6 Network Statistics

The VISSIM model outputs for these scheme designs are not representative of real-world functionality or operation on the highway network in this location due to the strategic model inputs that do not translate to the detail normally needed for a local level model such as VISSIM. Strategic model inputs have been used due to the forecast nature of the contextual designs to the year 2041. The results should not be used or relied upon outside of the MORE project.

A strategic modelling exercise, coupled with design iterations would produce more representative flows for the corridor that would feed in to the Vissim model. Due to the considerable uncertainty in later future scenarios and the sensitivity to input demand, a 2041 scenario is also unlikely to be usually modelled in Vissim.

The network statistics covers the whole of the modelled network, rather than the segment where the network changes have been modelled.

Table 24. Network statistics

	Average Speed (mph) - OUT_21				
	All	Motorised	Cyclists	Cars (exc Taxi)	Bus
Reference					
1700-1800	10.4	10.4	10.5	10.4	8.9
1800-1900	10.5	10.5	10.2	10.6	8.7
Accelerating London					
1700-1800	8.2	8.1	10.2	8.0	8.5
1800-1900	7.0	6.9	9.6	6.8	7.4
Innovating London					
1700-1800	11.8	11.9	10.7	12.1	9.3
1800-1900	11.3	11.4	10.5	11.5	9.0
Rebalancing London					
1700-1800	9.7	9.6	10.6	9.7	8.9
1800-1900	9.4	9.4	10.4	9.4	8.4
PT-Plus London					
1700-1800	7.0	6.8	9.7	6.8	7.0
1800-1900	5.5	5.2	8.9	5.2	6.6

Modelled speeds between the scenarios show that the Innovating London scenario has on average higher speeds for all vehicle types.

The slowest average speeds are modelled in the PT-Plus scenario. In all scenarios, apart from the Reference, the second hour is slower than the second. This indicates congestion from the first hour continues to build up through the second hour. This difference is seen the most in the PT-Plus scenario. This reflects a bottleneck for motorised traffic in the layout design in PT Plus in comparison to the other scenarios.

Table 25. Comparison of speeds

	Average Delay (s) - OUT_13				
	All	Motorised	Cyclists	Cars (exc Taxi)	Bus
Reference					
1700-1800	157	164	67	160	211
1800-1900	157	166	74	162	221
Accelerating					
1700-1800	232	248	79	246	208
1800-1900	233	250	83	251	193
Innovating					

1700-1800	123	128	63	124	194
1800-1900	137	145	65	141	205
Rebalancing					
1700-1800	177	186	65	182	211
1800-1900	189	201	69	198	236
Place T-Plus					
1700-1800	281	297	90	293	333
1800-1900	388	421	114	417	360

Modelled average delay is the lowest in the Reference Scenario and greatest in the PT-Plus Scenario, due to the layout changes.

Between the scenarios with the OKR PT design, the Innovating London Scenario has the lowest delay.

The Innovating London and Accelerating London Scenarios are different as the Bus delay is lower than the average for motorised vehicles illustrating the effectiveness of the Bus lane provision in improving speeds for buses as aligned to the design brief objectives.

The PT-Plus scenario shows the highest delays for all vehicle classes in the second hour.

Modelled Flows (All Vehs)		Ref'	Accel'	Innovating	Rebalance	PT-Plus
1700-1800	Segment 1 (2-way)	2154	2218	2114	2167	1886
1800-1900	Segment 1 (2-way)	2522	2386	2464	2466	2023

The number of modelled vehicles that go through the segment is greatest in the first hour in Accelerating London Scenario (2218) and greatest in the second hour in the Reference Scenario (2522).

In general, the OKR PT Design Scenarios show similar levels of modelled flow through the section. The reduction in lane capacity for motorised vehicles in the PT-Plus Scenario reflects in the lowest modelled flows.

Modelled Flows (All Motorised, Whole Network)		Ref'	Accel	Innovating	Rebalance	PT-Plus
1700-1800	Whole Network	9437	9628	8881	9496	8490
1800-1900	Whole Network	9663	9908	9089	9676	8317

When looking at the whole network, the total number of Active and Arrived shows the Modelled Flows in the network.

Accelerating London has the greatest modelled flows and increase in number of trips (PHV and otherwise) due to the extent of growth- in terms of overall population-on the corridor, with PT Plus the lowest. Innovating London has lowest modelled flow of the Scenarios using the common OKR PT Layout.

5.5 Conclusions

Due to the limited information available, uncertainty of indicators to 2041 and the concept nature of the design options generated using TfL's demand scenarios, it wasn't deemed appropriate to run the outputs from VISSIM in the MORE appraisal tools for the Future conditions design options.

The Current Design / Base scenario model, for 2016, has a very high number of modelled trips and also maintains the highest highway capacity.

The Accelerating London Scenario has the highest number of modelled trips, and highest growth on highway trips on new developments on the corridor itself. This combined with a reduction in highway capacity compared to the base explains the lowest highway performance for this design.

The Rebalancing London Scenario also has a relatively high number of modelled trips in the network. The modelled high number of trips is related to the less attractiveness of the public transport network in this scenario and lower take-up of sustainable travel in this scenario.

Innovating London has a moderate growth in the trips originating on the corridor, reflecting inner-London growth, however, has the lowest number of overall trips which therefore yields the best highway performance. This scenario has a preference for shared transport which may be reflected in the lowest number of overall trips. It can therefore be concluded, from the Vissum outputs, that the innovating London scenario performs best with the OKR public transport priority design option.

PT-Plus scenario has the greatest reduction in highway capacity, which is not sufficient for the demand which remains, particularly for buses, which leads to the degradation in performance for all modes on a network level, despite improvements to the provision in the design segment.

The results indicate that the designs, and in particular PT-Plus scenario, could benefit from a design iteration in order to improve the performance for all road users and reduce queuing.

Applying the MORE tools and approach to re-designing road-space, in the context of the future situation to the year 2041, using the demand forecasts to account for the potential uncertain futures, it is evident there is benefit in considering how to build a resilient highway network that could sustain the variety of uncertain futures presented in the demand scenarios to 2041.

The modelling exercise led us to consider some scenarios for further modelling that could be undertaken, related to policy goals and objectives. For example. Scenarios could be modelled to determine a local policy goal to be achieved in order that a scheme can be delivered.

The results for each of the demand scenarios have shown performance against changes in highway capacity that perform differently on the network depending on travel preferences, such as for shared transport in the Innovating London scenario, or population growth impacts combined with a reduction in highway capacity that negatively impacts the network. The conclusion to take away from applying the MORE approach is that traditional scheme design and appraisal does not effectively consider the resilience of road space designs to changing or uncertain demand beyond what they are initially designed to accommodate.

6 Malmo

6.1 A brief summary of future conditions along the Stress Section

6.1.1 Summary

The future stress section will have characteristics far from the current situation of Hans Michelsens gata. The structure of the buildings and blocks will be dense and high, enabling effective densification of a new and attractive urban area. However, this gives the section plenty of challenges. More traffic movements are to be expected due to the new urban area, impacting an already near-congested street during peak hours.

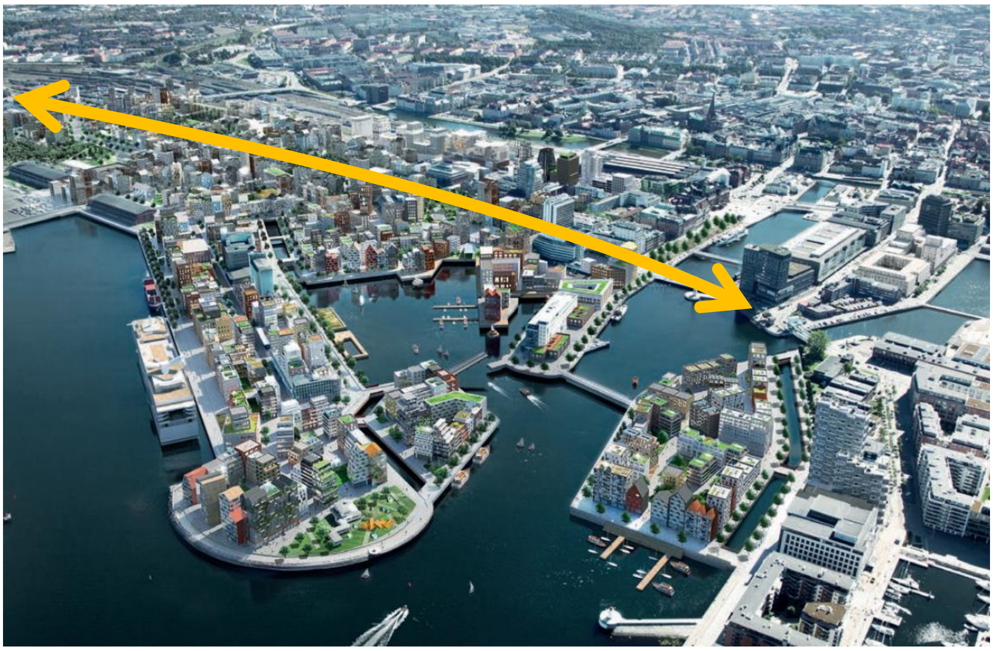


Figure 88. The area of Nyhamnen with future development. The area of study is represented by the yellow arrow. (Masterplan Nyhamnen, City of Malmö)

The stress section consists of the street Hans Michelsensgatan. The stress section consists of one segment.

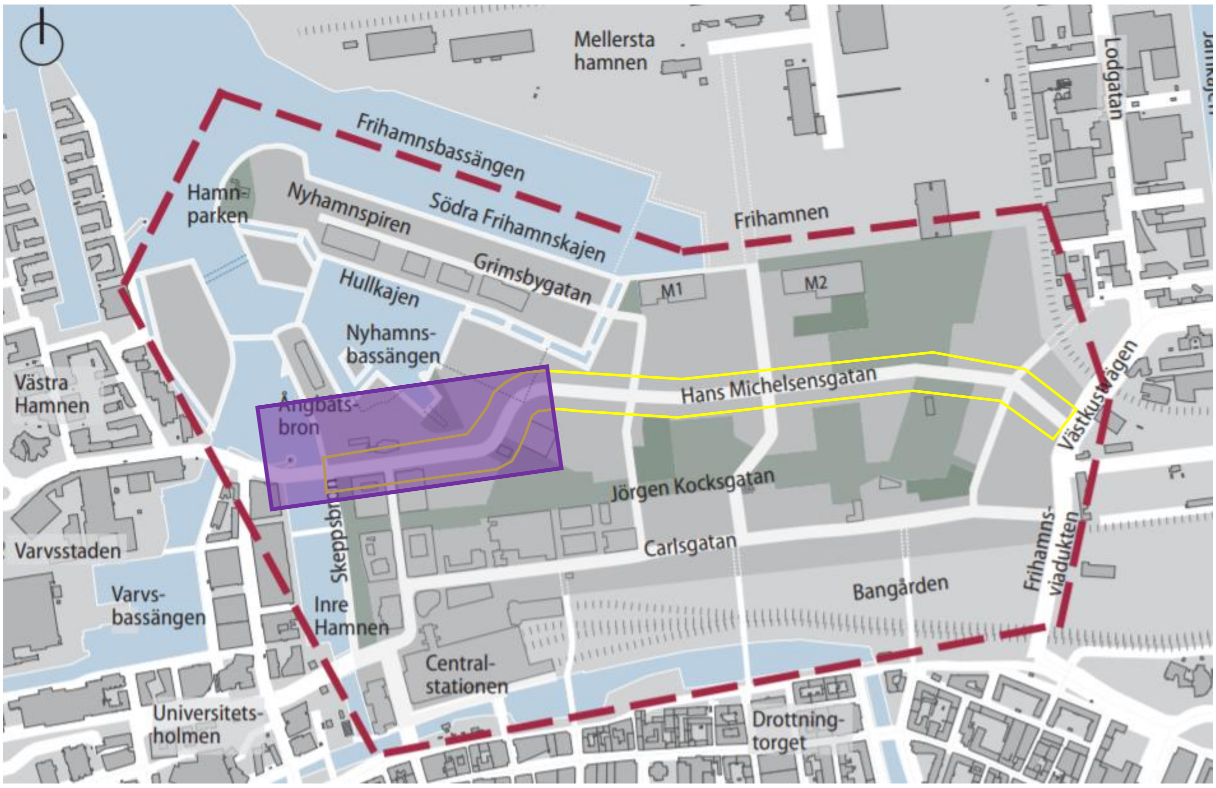


Figure 89. Stress section in focus during the design activities marked with a purple square

Malmö's objective approach for the design phase in MORE is based on three main *scenarios: Mobility, Sustainability and Liveability.*

Mobility "M"

In the Mobility scenario, traffic planning will continue to be car-favouring, extrapolating the current modal share and giving plenty of spaces for car and goods traffic hence coping with the increase of motorized flows. While increasing accessibility for some (including deliveries and parking), noise and barrier effects are to be expected. The future patterns of demand show increases in general traffic flow, also during peak hours where the current situation has problems with congestion and queues for through traffic.

To cope with the intense flows of traffic and create possibilities for on-street parking and bays for loading and unloading as well as two lanes in each direction for general traffic.

Sustainability "S"

Based on Sustainable Urban Mobility Plan (SUMP) modal objectives (among others), this scenario is all for promoting mobility in a sustainable, more carbon-efficient way. In the modelling of transport demand, this is evident with a large increase in PT users and bicycle flows along the streets. However, as the commuting traffic (both going to and through the

Nyhamnen streets) still has a high share of car traffic, flows risk continuing causing issues with e.g. congestion.

The area should be characterized by a constant vicinity to public transport as well as having a bicycle- and pedestrian-friendly structure. However, public transportation and bicycling having good prerequisites can be conflicting to both cars and pedestrians.

As primary elements for future design options, dedicated lanes for public transport as well as for cycling should be used.

The sustainability scenario is the most representative of the City of Malmö policies in urban and traffic planning. Apart from the SUMP, it is also the most in line with the masterplans of the entire Malmö and the Nyhamnen area.

Liveability "L"

This scenario focuses on the local urban life of the area and adjacent streets. The promoting of the city environment makes it possible to have people strolling along wider sidewalks, stopping by at a café or local store to make errands. However, great measures are needed to redirect through traffic efficiently and create incitements for residents and workers in the area to use other modes of transport.

The modelling of pedestrian flows is limited in terms of previous work, e.g. how it changes depending on available infrastructure and supply of street activities. However, the dialogue project supports that even though the flows are uncertain, the people along liveability streets *experience* the street as more pleasant thanks to certain elements.

As main elements to be used in the liveability design scenario are e.g. broad sidewalks, trees and cafés.

6.1.2 Movement forecasts

The focus of this sub-chapter is the traffic volumes predicted by Dynameq-modelling. These scenarios, or visions, represent different approaches to traffic and urban planning, including different traffic mode priorities and estimated modal shares. The estimated transport demands of the Mobility scenario are close to today's travel behaviour while the Sustainability scenario is based on goals for the future modal split. The Liveability scenario further assumes an even larger change in estimated modal share based on infrastructure with less available road space for cars together with travel behaviour changes.

The City of Malmö has developed a mesoscopic traffic simulation model using the software Dynameq. The model covering Malmö and its surroundings, shown in Figure 90, has been used to assess the impacts of these different scenarios and measures. The mesoscopic model is based on the same network as the macroscopic Sampers/EMME-model that Malmö has been using for a longer time. Sampers is originally a national demand model where route choice is modelled in the EMME software. Sampers is developed by the national road authority but used by Malmö municipality to make its forecast scenarios for travel demand.

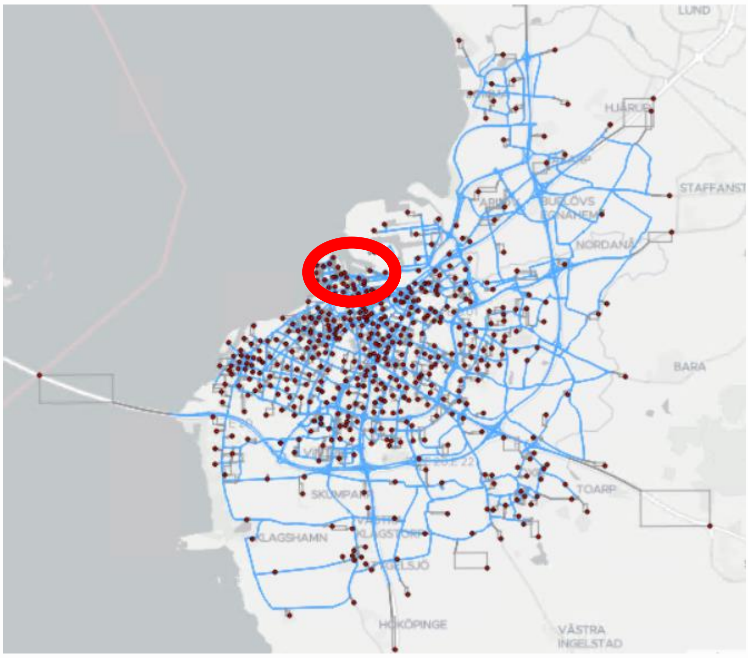


Figure 90. Mesoscopic model covering Malmö and its surroundings. Road network in blue, red dots are modelled origins and destinations. The Västra hamnen and Nyhamnen area in the red circle.

This subchapter aims to describe the assumptions used to model the different scenarios and further present results and some conclusions from the simulation study.

The modelling is based on different future infrastructural changes of the Nyhamnen area and surroundings. Along with the Liveability scenario, a selection of measures to create less car traffic in the area has also been identified:

- Introduction of mobility hubs. To make the hubs an attractive choice, the model includes a raise of parking fees in Nyhamnen and Västra hamnen by approx. €10 per day. Details of this have been covered in previous reports.
- Tighter space for motorized vehicles to instead prioritize sidewalks.
- A new bridge from Norra hamnen via Nyhamnen onwards to Västra hamnen, reducing the need for through traffic along the stress section. See estimated location in Figure 92.
- A penalty for using the corridor stress section to avoid through traffic.

Methodology and assumptions

The simulation was done using the Malmö meso model using Dynameq version 4.2. Travel demand matrices are based on scenarios from Sampers. The following Sampers scenarios were translated into the scenarios from MORE:

- Sampers RVU and Sampers Grund (Trafikverket baseline 2040 combined with City of Malmö demographics) were used for scenarios Mobility and Mobility+, the latter being an even more aggressive car favouring option.
- Sampers TROMP (including mode share objectives) was used for the Sustainability scenario.
- Sampers TROMP together with reduced car trips to and from work assuming more people work at home was used for the Liveability scenario.

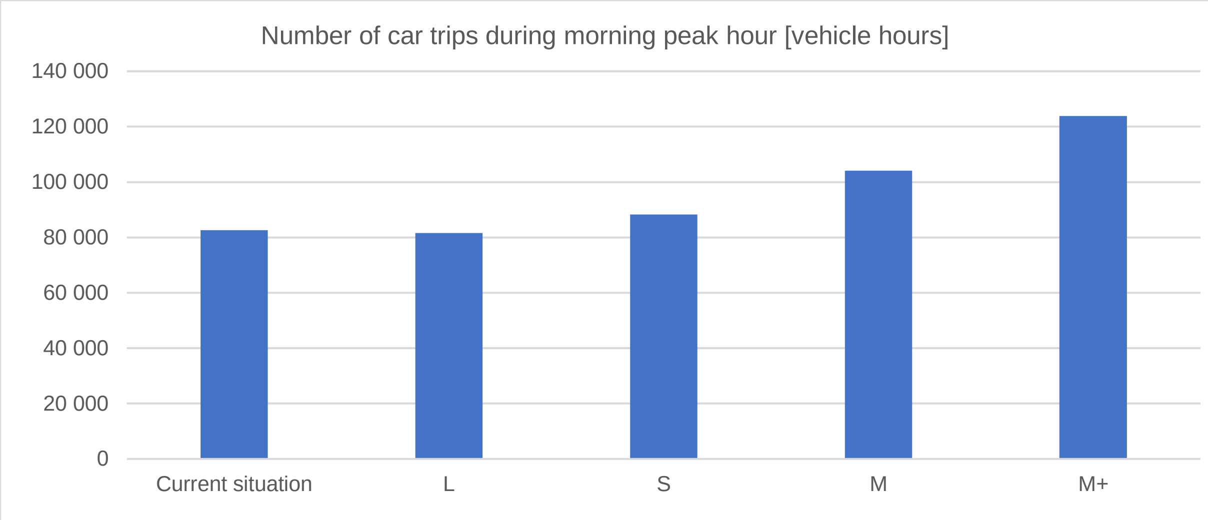


Figure 91. Number of car trips during the morning peak hour, presented by vehicle hours for the entire network.

Results - Morning peak hour

The following chapter presents a brief part of the simulation results. Presented results are showing vehicles passing east-west between Västra hamnen and Nyhamnen, delays due to congestion in the whole network and simulated average speed per link in comparison with speed limits. Results are presented for the morning peak hour for each scenario. The afternoon peak hour results can be found together with the full report in the appendices.

The number of vehicles passing east-west along the corridor between Västra hamnen and Nyhamnen is measured on Hans Michelsensgatan, Carlsgatan and the New Bridge which is included in some of the scenarios. The current Jörgen Kocksgatan is the future Hans Michelsensgatan in a slightly new alignment.

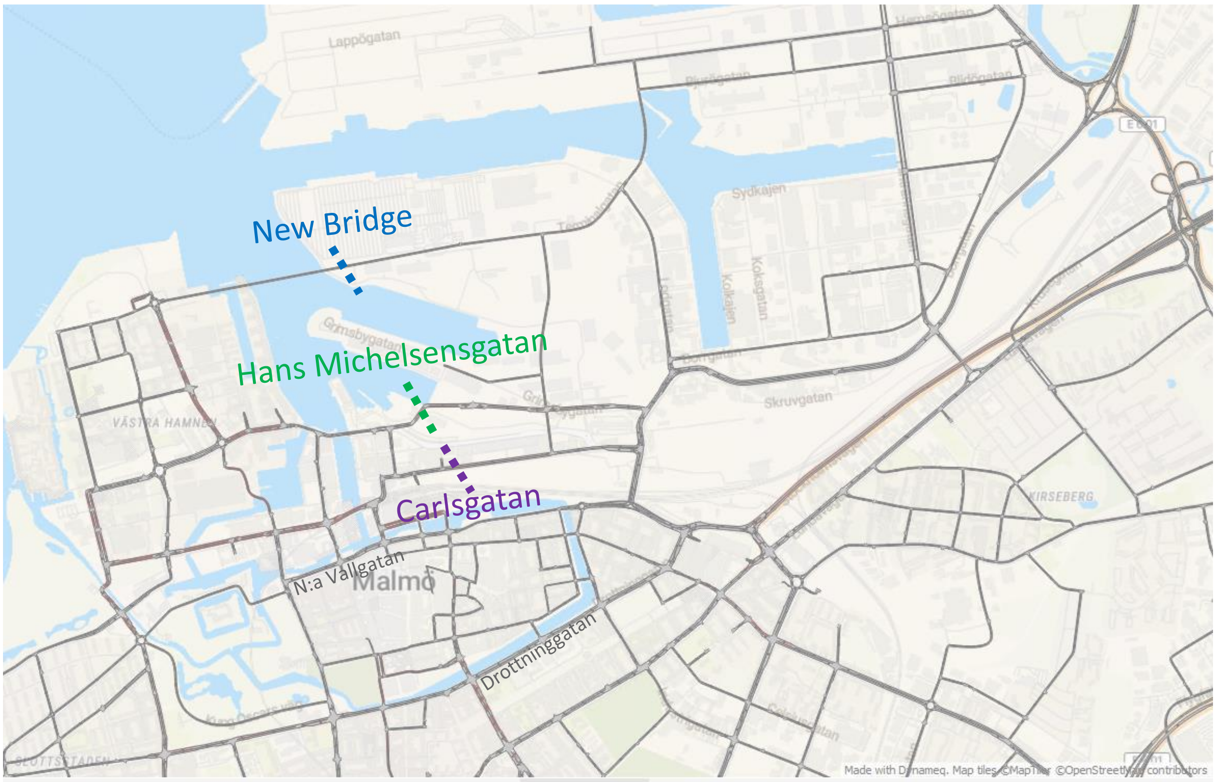


Figure 92. Road sections between Västra hamnen and Nyhamnen where the number of vehicles is presented from the simulation.

Traffic flows

Traffic flows during morning peak hour is presented below. It is important to note that simulated flow on a link in a congested situation can be lower despite a higher travel demand. For instance, the larger number of car trips in scenarios M and M+ is resulting in a situation where congestion in some cases makes total flow in the corridor lower than the L and S scenario which both has a lower demand for car trips.

Looking at the different measures the New Bridge, according to the simulation, is mostly an alternative to move traffic away from Hans Michelsensgatan and the stress section, while traffic along Carlsgatan is almost unaffected. The total flow in the measured corridor is increasing with the New Bridge suggesting that some traffic from parallel roads further south (for example Norra Vallgatan and Drottninggatan) is moved north passing through the area. A penalty that makes through traffic in the corridor unattractive seems to reduce the flow with roughly about 50-150 vehicles per hour in each direction.

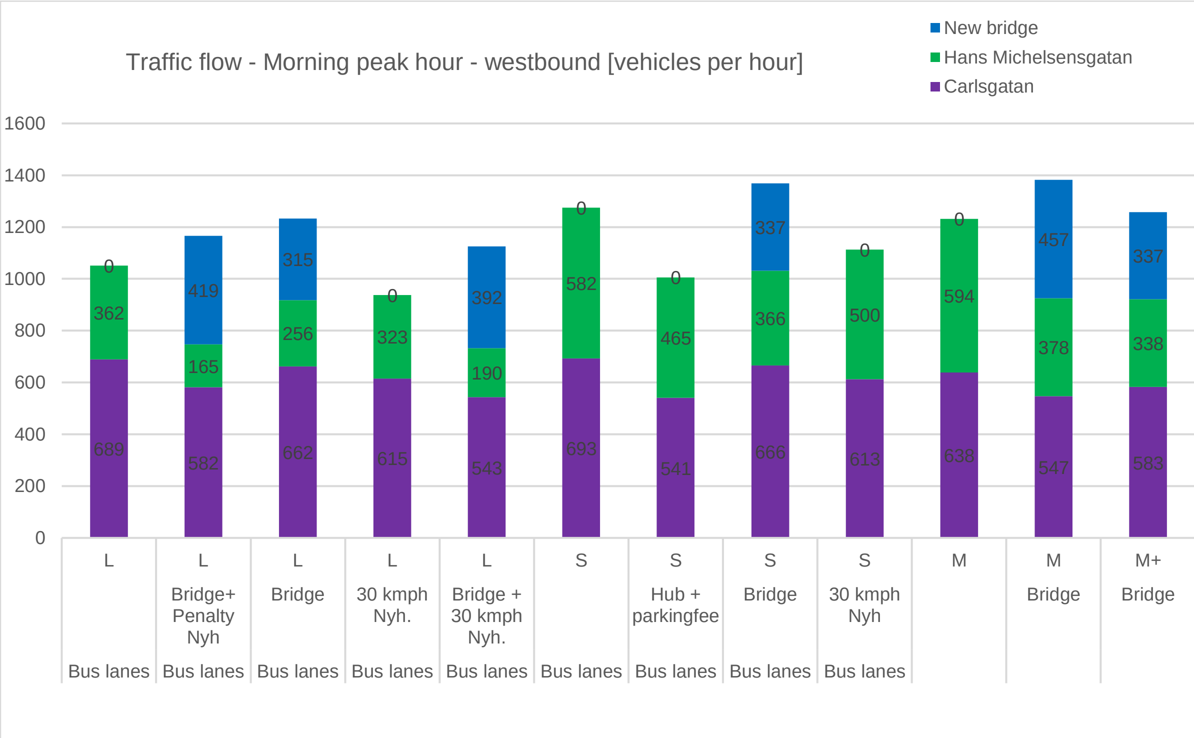


Figure 93. Traffic flow (vehicles per hour) during morning peak hour, westbound

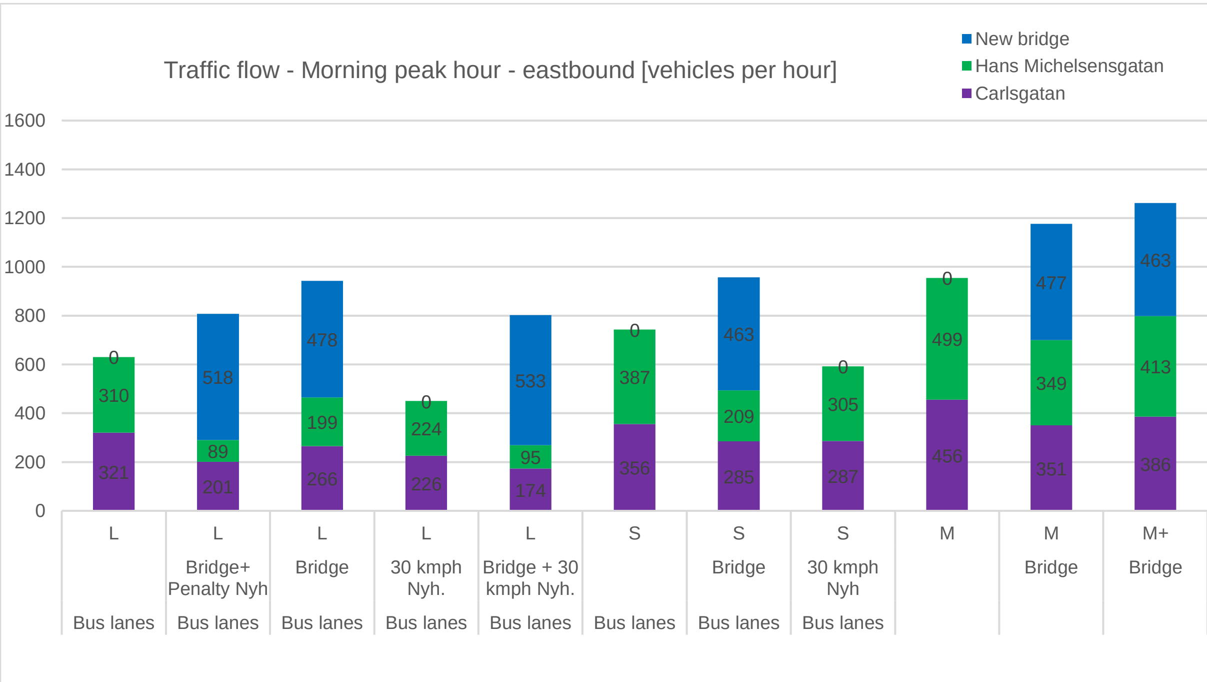


Figure 94. Traffic flow (vehicles per hour) during morning peak hour, eastbound. (The Hub-scenario is only modelled westbound during morning peak)

Delay due to congestion

Delay due to congestion in the whole network during the morning peak hour is presented below. The simulation shows roughly the same delay for all scenarios with traffic demand according to the L (Liveability) and S (Sustainability) scenarios where all alternatives have an increase of about 0-15% compared to the current situation. The different measures have a limited impact on the delay though it is affecting traffic only in the vicinity of Västra hamnen and Nyhamnen which is a small part of the total road network. The larger number of car trips in scenario M and M+ though is resulting in a much more congested situation where the simulated number of vehicles hour spent on delays are increasing by 50-100% compared to the current situation.

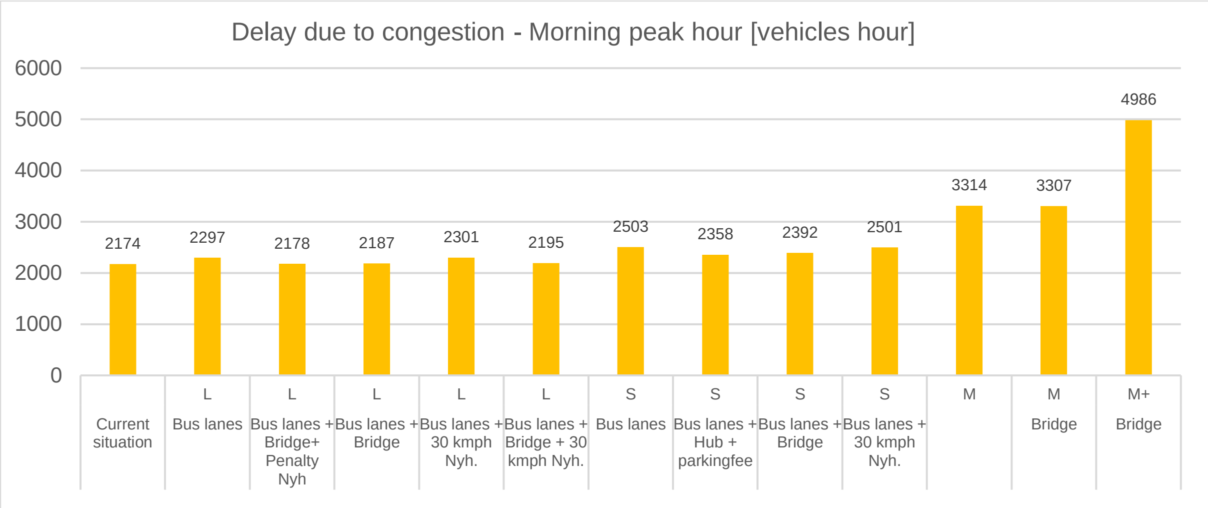


Figure 95. Total delay due to congestion in the whole road network.

6.1.3 Conclusions

An overall conclusion comparing the different scenarios is that there is a lack of capacity in the road network for the modelled number of car trips according to the simulation of the Mobility scenario. The congestion is on a level where gridlock occurs which significantly reduces capacity. The situation during the morning peak is more realistic with a large increase in delays but still without a complete gridlock. However, there are uncertainties about modelled traffic during the afternoon peak in the version of the forecast used here, a more recent forecast shows a lower number of trips.

The traffic situation in the Sustainability and the Liveability scenario is in general quite the same as the current situation.

Looking at the different measures the new bridge is according to the simulation mostly an alternative to move traffic away from Hans Michelsensgatan while traffic along Carlsgatan is almost unaffected. The total flow in the measured corridor between Västra hamnen and Nyhamnen is increasing with the new bridge suggesting that some traffic from parallel roads further south (for example Norra Vallgatan and Drottninggatan) is rerouting further north passing through the area.

The studied penalty to make through traffic in the corridor between Västra hamnen and Nyhamnen unattractive seems to reduce the flow with roughly about 50-150 vehicles per hour in each direction. To lower the speed limit to 30 km/h through Nyhamnen has about the same effect. This shows that the lower speeds might be effective enough to get rid of through traffic.

6.1.4 Future land use

The overview of place activities in the Nyhamnen area can be seen in Figure 96 below.

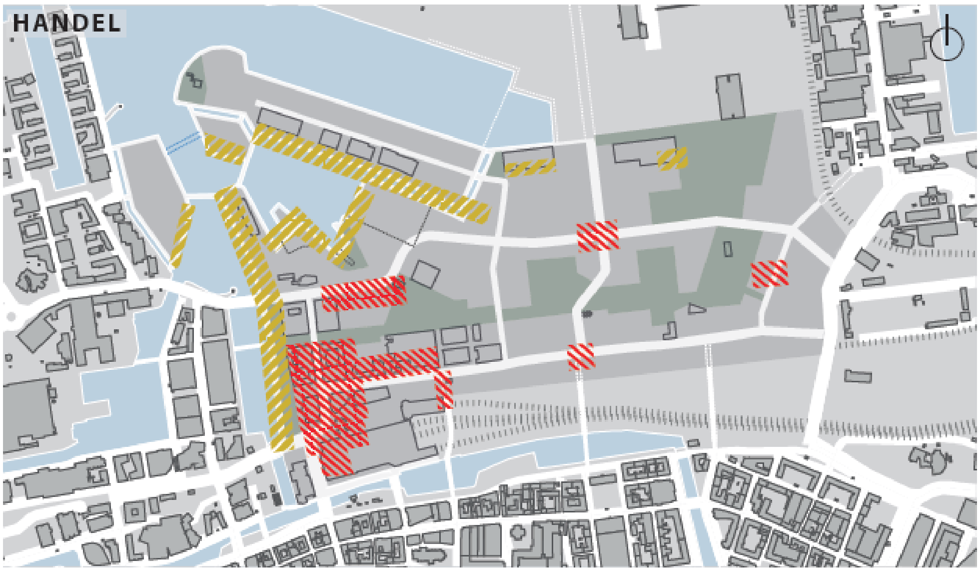


Figure 96. Overview of Nyhamnen shop locations (red) and tourism/leisure activities (yellow). The rest of the area will include mixed-use of offices, housing, schools, and other activities. (Masterplan Nyhamnen, City of Malmö)

For the street design workshops, a more detailed mapping of the stress section was taken forward together with the project leaders of the parallel planning process of the area. The results, which was a pre-requisite of the workshop, can be seen in Figure 97.

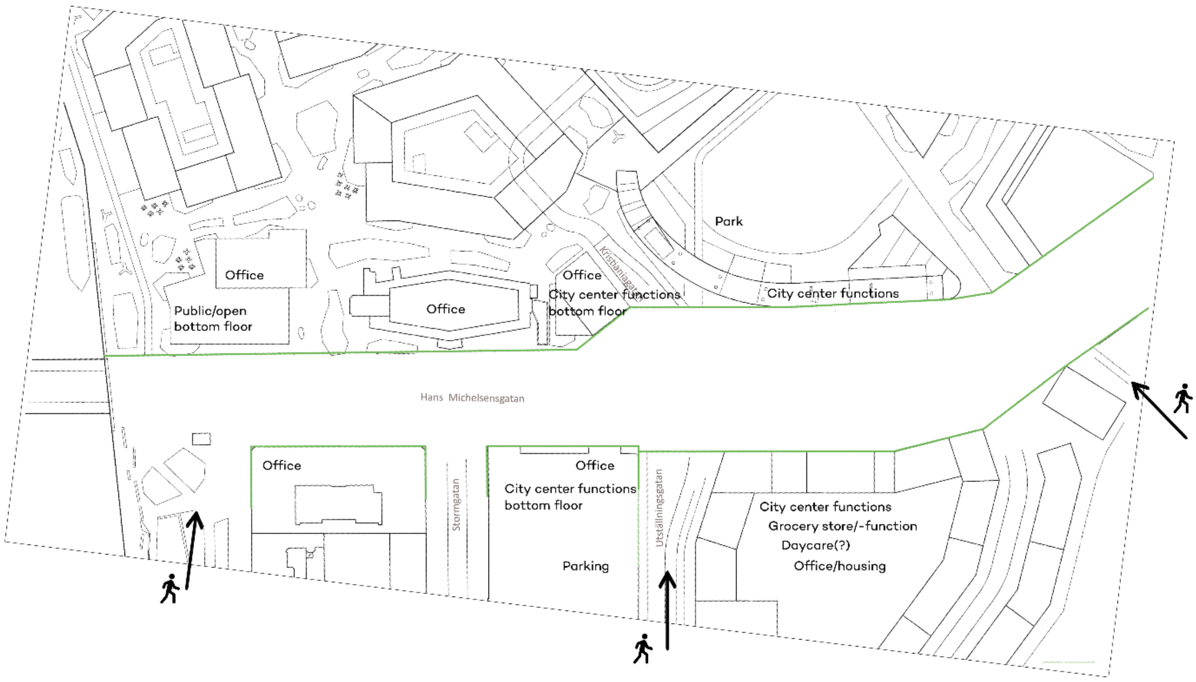


Figure 97. Detailed overview of expected shops, activities etc. in the stress section.

6.2 Preparations for the street design exercises

current pandemic. As an attempt to overcome these obstacles and include e.g. citizens in the exercises, both an extensive citizen participation project and a minor outdoor trial of the physical toolkit was conducted during the fall of 2020. The result of the activities, which has been covered in great length in the report of *D5.3*, have been beneficial as an input to the design exercises for future conditions:

- Citizen participation including Traffweb and assistance from TUD (Autumn 2020)
- Physical toolkit outdoor trial with citizens (Autumn 2020)

The street design exercises have had the main focus on generating design options by a series of workshops together with planners with various backgrounds. The specific preparation for the series considered the pandemic, as a physical and digital workshop series for the blocks and acetates tool was planned in parallel. Both forms of the tool had additions in elements compared to the original tool:

- The physical blocks and acetates were complemented with 3D-printed models of buses, bicyclists, and pedestrians of various ages. The thinking behind this addition was to put the street on a human scale.
- For the digital tool, opportunities arose to have different shapes and colours of the elements. The stress section included a curve, which makes the digital form of the tool easier to use.

The street design exercises are based on the scenarios *Mobility*, *Sustainability* and *Liveability*. The scenarios have been the foundation of the street use priority input when generating the unique identification codes for the designs.

To differ the different groups (and if it was LineMap or not), the field for the *segment* was used. Here, segment 1 meant the main design (which was taken through LineMap and onto simulations/analysis and appraisal. Segments 2 and 3 indicate the two groups from the blocks and acetates workshops.

Table 26. Overview of designs generated with Unique IDs

	Mobility	Sustainability	Liveability
Priori-ties	Car drivers/passengers - travelling Car drivers/passengers – parking Goods vehicles - travelling Goods vehicles - loading/unloading	Cyclists – cycling Micromobility users – travelling Bus/tram passengers - travelling Bus/tram passengers - waiting	Pedestrians - walking Pedestrians - crossing the road Street activities (e.g. strolling, sitting) Pedestrians with restricted mobility - walking
B&A 1	MAL_S2_0000_2040_B_0_LMQR0000	MAL_S2_0000_2040_B_0_FHJK0000	MAL_S2_0000_2040_B_0_ABCD0000
B&A 2	MAL_S3_0000_2040_B_0_LMQR0000	MAL_S3_0000_2040_B_0_FHJK0000	MAL_S3_0000_2040_B_0_ABCD0000
Line-Map	MAL_S1_0000_2040_B_0_LMQR0000	MAL_S1_0000_2040_B_0_FHJK0000	MAL_S1_0000_2040_B_0_ABCD0000

During the design workshops, the level of detail for the traffic conditions was on a general level. Additional IDs have been generated in the traffic analysis to show the various times of day that the traffic volume data is based on.

6.3 Generating ideas for design options in the stakeholder exercises

6.3.1 Background

One of the major opportunities of MORE is testing the use of blocks and acetates as an engaging activity, creating a base for discussions regarding the future streets of Malmö. During the earlier parts of 2020, the Malmö MORE group decided that the tool was to be used with various representatives from various parts of the City of Malmö planning process. Early on in the planning of the process, the purpose of the test was solidified:

- Primarily, testing and evaluating the tool and work method of Blocks and Acetates in the early stages of traffic and urban planning
- Secondly, identifying and trying to solve issues that have arisen in the parallel development project of the Nyhamnen area.

The test was planned mainly during the autumn and winter of 2020, having two scenarios in hand with regards to a pandemic: a) a workshop series that could be held in person and b), a digital solution. Due to the development of the virus, it was decided in January 2021 to continue with solely a digital workshop plan, where the meetings would be facilitated in Microsoft Teams.

6.3.2 Participants

The participants of the workshop series are shown in Table 27 below. The project group who planned the event consisted of seven people from the City of Malmö and the consultant company AFRY. Together the group represented different parts of urban and traffic planning. In addition to this group, 15 participants from the City of Malmö were invited, all connected in some way to the parallel work of the Nyhamnen area, where the future stress section is included.

Table 27. Workshop participants

Participant number	Organizational representatives		Private citizens		Workshop participation		
	Organization	Role in organization	Age	Gender	WS1	WS2	WS3
1	City of Malmö	Traffic planner	45	F	x	x	x
2	City of Malmö	Project leader	44	M	x	x	x
3	City of Malmö	Landscape Architect	46	F	x		
4	City of Malmö	Landscape Architect	38	F	x	x	x
5	City of Malmö	Traffic planner	40	M	x	x	x
6	City of Malmö	Landscape Architect	33	F	x	x	x
7	City of Malmö	Traffic planner, project leader	46	M	x	x	x
8	City of Malmö	Architect	61	F	x	x	x
9	City of Malmö	Traffic Planner	58	M	x		
10	City of Malmö	Architect	63	M			x
11	City of Malmö	MORE, traffic analyst	30	M	x	x	
12	City of Malmö	Project leader	31	F	x	x	x
13	City of Malmö	MORE, landscape engineer / Citizen participation	43	F	x	x	x
14	City of Malmö	MORE, project leader/ traffic planner	61	F	x	x	x

15	City of Malmö	MORE, traffic planner	45	M	x	x	x
16	AFRY	MORE, project leader	62	F	x	x	x
17	AFRY	MORE, strategist	62	M	x		x
18	AFRY	MORE, urban planner	32	M	x	x	
19	AFRY	MORE, traffic planner	26	M	x	x	x

6.3.3 Workshop 1

During the first workshop in the series, held on April 9th, the concept and purpose of the workshop series were introduced. The participants had previously gotten information via email as well. Further on, the dialogue project was introduced including the findings that have been well documented in deliverable D5.3 in the MORE report series. From there the tool (Blocks and Acetates via Powerpoint) was gone through and the stress section and its boundaries were presented. The project group informed the participants of the lessons learned from testing the tool internally, but also about e.g. London's trials during the winter of 2020.

In the afternoon, the participants and the MORE project group went out to physically meet and experience three of the reference streets from the project together with the future stress section. To enable the participants to reflect on their experience of the street, they got a survey to answer. The survey was a combination of the questionnaire from the MORE visit in Budapest and the TUD/City of Malmo-developed survey used in the citizen participation activities during the fall of 2020.

6.3.4 Workshop 2

The second workshop was held on the 20th of April. The focus was now on testing the Blocks and Acetates-tool and create different street designs for the future condition stress section based on the three scenarios. The participants were divided into two groups of circa 8 people per group. In each group, there was one *designer*, who shared the Powerpoint screen in the meeting and moved the design blocks and acetates on command. The group also included a *conversation leader*, who led the discussion, pointing the rest of the groups in a direction so that the designs progressed and did not stall due to other, broader discussions etc. The role of the conversation leader was identified as needed during the early tool trials.

Using the tool digitally meant some challenges for the team, however, some opportunities also arose. While the 3D-printed trees, pedestrian and bicyclists models couldn't be used, new acetates such as town squares could be incorporated into the tool.

Each group had an assignment to create 3 designs for the future stress section, each based on one of the scenarios *Mobility*, *Sustainability* and *Liveability*.

During the second workshop, time was limited: in addition to short instructions in the beginning and a short reflection at the end, there were about three hours left for each group to make three different designs. For the short time to focus on the design itself, rather than interpretation of what a certain scenario meant for the specific group, the project group for LineMap had previously developed a prioritization scheme consisting of nine different elements along the street. Depending on the scenario, the order of priority was changed. The elements were based on different types of movements along with street environments, as well as different types of activities that can be regulated by the city.

The different prioritization schemes that the participants had to start from were as follows:

Table 28. Priorities for each scenario.

Mobility	Sustainability	Liveability
1. General traffic (movement)	1. Bicycle (movement and parking)	1. Slow movements
2. Loading and parking	2. Public transport	2. Place-oriented street furniture
3. Public transport	3. General traffic (movement)	3. Trees and greenery
4. Bicycle (movement and parking)	4. Loading and parking	4. Parking and loading
5. Pedestrian movements	5. Pedestrian movements	5. Pedestrian movements
6. Trees and greenery	6. Trees and greenery	6. Outdoor seating and meeting places
7. Outdoor seating and meeting places	7. Place-oriented street furniture	7. Bicycle (movement and parking)
8. Place-oriented street furniture	8. Outdoor seating and meeting places	8. Public transport
9. Slow movements	9. Slow movements	9. General traffic (movement)

The prioritization schemes contributed to the groups having a common idea of what the design would entail, which made it easier in the next stage to compare and merge them into a common design per scenario. At the same time, the prioritization did not mean that the participants were guided in terms of, for example, whether a cycle path should have a certain width or whether it should be located in an exact location in a street section - this was still up to each group to decide.

In addition to prioritization schemes for each scenario, information was also provided on estimated traffic flows for each scenario. These forecasts helped to provide a certain understanding of what flows can be expected and were based on different assumptions about future infrastructure investments and traffic shares and increases in 2040.

A total of six different traffic solutions were the result of the workshop. Upon review of the material, it can be stated that both groups had developed designs for each scenario that resembled each other. It was clear that the different priorities that had been set had guided the participants to come up with completely different solutions with a completely different focus: In the mobility scenario, it was the cars that had the most space and where pedestrians and cyclists were treated rather harshly. In the sustainability scenario, space had been created for bus-prioritized lanes and bi-directional cycle paths on both sides of the street. In the liveability scenario, generous spaces for pedestrians and residents had been created, and trees had also been placed here on a generous scale.

6.3.5 Workshop 3

The third and final workshop was held on the afternoon of May 4. During this, the groups' results from workshop two were presented and discussed. Similarly, there were conversations, both in small groups and whole groups, about how they felt that the tool worked and whether the set-up for the workshop series was carried out optimally. The participants also had to answer an individual survey in conclusion to collect data that can be used in evaluating the tool. The result from this is reported below.

The digital tool

When the decision was made not to conduct physical workshops, the tool was reworked into the digital version of PowerPoint. This version had both pros and cons. The workshop was carried out in Microsoft Teams, where the introduction was made in the large group and where we were then divided into smaller groups to work.

Advantages:

- The digital version made it possible to adjust the blocks and strips in length, which made it somewhat possible to place a curved radius with several short blocks.
- The role of the conversation leader was to be clear, which meant that the group participants focused on the same issue. A risk with the physical version may be that the parts of the tool are so interesting to handle that several things can happen in different places on the playing field simultaneously, which can disjoin the conversation. This is, however, just speculation as the pandemic made it hindered a full test of the physical tool.

Disadvantages:

- The digital version is completely two-dimensional.
- The physical version makes it possible for all participants to actively move around and adjust the playing field, which is lost in the digital version.
- The interactive parts between the participants will be significantly more limited than if the workshop had been carried out physically. Even though the conversations went well, it took time for the designer to move around and adjust the design during the game.
- As the blocks and strips are statically rectangular, it was also the task of the designer to adjust them as far as possible to follow the turning radius of the street. This was a demanding job that took time.

Evaluation results

After the third workshop, the participants had to fill in a questionnaire to give their views on the working method, the tool and its usefulness. A total of 13 people responded to the survey. The results from the survey can be read below.

Overall, there was a positive response from the participants, where a majority gave the grades four and five (out of five) on all questions. Perhaps the most positive thing is that so many of the participants like to see a great potential to use the tool in future urban planning processes and that many also believe that the tool should be used in dialogue with citizens and laypeople.

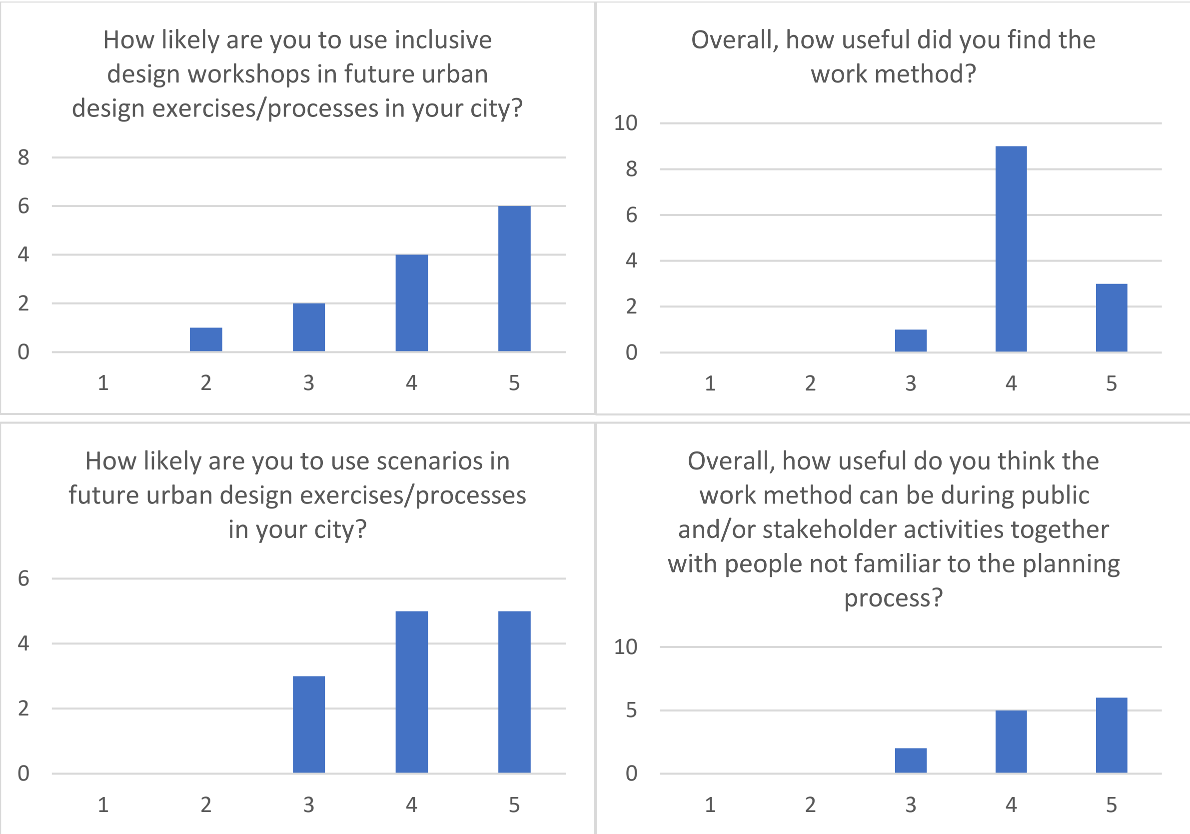


Figure 98. Evaluation results from workshop participants.

Among the free text answers, several suggestions for improvement were received:

- The tool should be able to handle radius
- Crossing design should be included
- The tool should be supplemented with refuges, green areas, elements for stays such as playgrounds, stop platforms, combined pedestrian and bicycle paths, cross-parking spaces, speed bumps and areas that represent the joint use of mobility functions.
- The game plan should be supplemented with more information about the properties along the street as the number of people/property, the design of the properties such as. balconies.

In the response, there were also suggestions on how the work process can be improved:

- Use an “easier” street to catch up on important discussions
- Review priorities and fixed conditions to get more reasonable results
- Focus more on thinking together and continuously include management and politicians. Especially in complex projects such as Nyhamnen

- Small groups for everyone to have a say
- Attention to which competence has an advantage in the subject
- The program was a bit tough, but get better when you can do the exercise for real and not on the computer

6.3.6 Transfer into LineMap

From the design output from workshop 2 (main designs) and workshop 3 (design evaluation), there were two designs for each scenario. With the limited time available for designing (maximum of one hour per design), the level of detail from the second workshop was rather general. The time limit also meant that there was no time available to look into crossing elements of the stress section in detail. While these matters were not the focus of the workshops, they needed to be dealt with to have a realistic evaluation of the designs.

When transferring the workshop designs into LineMap, the objectives were:

- Merging the two designs into one per scenario
- Dealing with crossing elements, number of lanes for turning etc.

6.4 Building and applying the Vissim model

For the VISSIM modelling, the three LineMap designs have each been the base infrastructure for the simulations. Each design has been simulated with different traffic volumes, described previously in the report.

The previous model of today's network has been re-modelled for the Nyhamnen area to suit the planned city structure and future street network. The base model for the future case is shown in Figure 99 below and covers the same base area as the previous model. Included in the model is the area of Nyhamnen and the two main approaches from the east, Västkustvägen and Stockholmsvägen. Along the two 4-lane main streets through the area in the East-West direction, Hans Michelsensgatan and Carlsgatan, the outer lanes in each direction are dedicated bus lanes. The overall network and design are then kept for all simulations regardless of the design within the stress section, consisting of three segments.

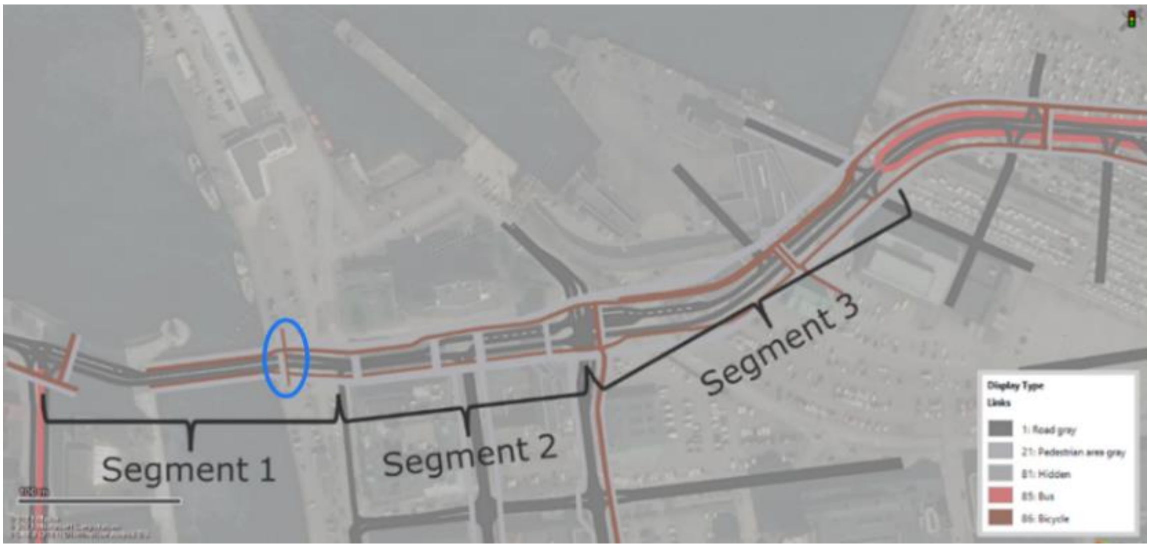


Figure 99. Stress section and segments. Signalized pedestrian crossing marked in blue.

6.4.1 Simulation analysis 1

Studied scenarios in the meso model (Dynameq)

Several combinations of infrastructure and measures have been studied in the meso modelling for Nyhamnen within the Malmoe city-wide model. The following scenarios have been calculated in the meso model to provide input regarding traffic volumes to the microsimulation:

- Liveability – No measures – “Working from home”: AM, PM
- Liveability – 30km/h – “Working from home”: AM, PM
- Liveability – Bridge and 30km/h – “Working from home”: AM, PM
- Sustainability – No measures – TROMP: AM, PM
- Sustainability – Mobility hub – TROMP: AM
- Sustainability – 30 km/h – TROMP: AM, PM
- Mobility – “JA” – RVU AM, LT, PM
- Mobility – “JA” and bridge – RVU AM, PM

6.4.2 Results and conclusion

Conclusions of first analysis

Three different outputs from the microsimulations are shown in figure 100 below for the studied scenarios for the morning peak (FM). In the figure, it can be seen that the differences between the studied scenarios are small in most cases and that the biggest differences are due to situations outside of the stress section (comparison of the orange and grey) bars. The scenario “85” (Mobility scenario) with the highest amount of traffic in the model also shows the longest average travel time and the average delay in the network. The average delay within the stress section is around 30s average per vehicle in all studied scenarios. Due to the difficulties to draw conclusions for the stress section in this approach a second analysis were made.

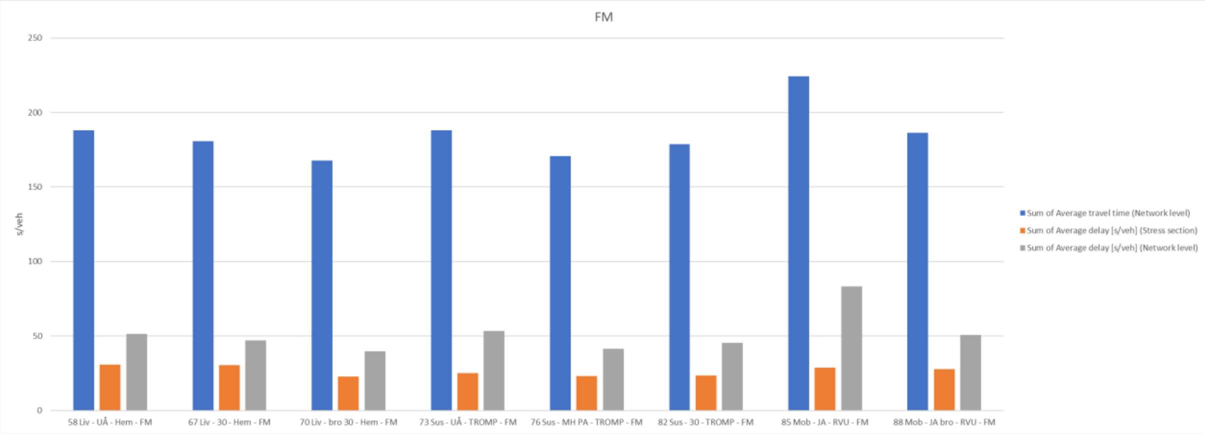


Figure 100. Result comparison during AM peak (FM). Avg. Travel time, Delay (Network) & Delay (Stress section)

The main conclusion for analysis 1 is that most of the resulting differences between studied scenarios are due to capacity-related issues outside of the stress section as a result of the varying overall traffic volumes in the different scenarios. Only smaller differences can be read out when it comes to the stress section results. A secondary conclusion is that the western parts of the studied model (outside of the stress section) can't fully cope with the increased traffic volumes described by the Mobility scenarios.

6.5 Appraisal of design options

To assess the design options and test the appraisal tool, a series of digital meetings were set up between traffic planners from the Malmo team that participated in the tool trial.

6.5.1 Methodology

<u>Simulation analysis 2</u>

The second round of analysis in the microsimulation model was conducted to, in a simplified way, determine the effects of the different studied road designs based on the same traffic volumes. The main traffic scenario to be studied in this part of the analysis is the Sustainability scenario based on the TROMP-predictions without any further measures since this is regarded as the baseline. Initial simulations are only carried out for the morning peak hour since this results in the highest demand for today's situation. Pedestrian volumes for crossing movements are also based on the predicted flows for the Sustainability design for all three designs. For the Liveability design where the pedestrian crossing flow is predicted to be higher, a sensitivity analysis is conducted to describe the eventual effects of increased pedestrian flows.

All simulations within this analysis are based on: Sustainability – No measures – TROMP: AM.

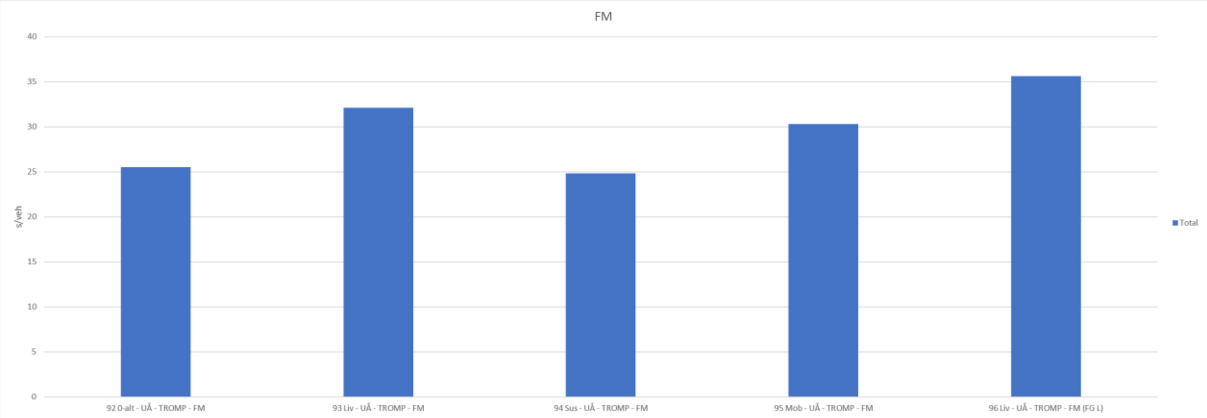


Figure 101. Result comparison during AM peak (FM). Avg Delay (Stress section)

Conclusions of analysis 2

The second analysis in the microsimulation model shows only small differences between the studied scenarios because the proposed designs are very similar when it comes to vehicular capacity at key intersections. The higher capacity within the Mobility scenario as an example might also not be showing any effect since a lower traffic volume scenario is used as the base for this comparison. Previous analysis for higher volumes also showed that capacity issues occurred in other parts of the network which then prevented the traffic from reaching the stress section.

Use of the tool

The unique ID needed to be generated differently than the previous ID:s described in the previous chapters, as the assessment scenarios had the same design, but used different scenario flows (i.e. the Liveability design had the Sustainability flow). Previously, a Liveability design could only have Liveability traffic flows. The segment column was used to assign new IDs to the. Most unique identifiers using S4 are assessment design/analysis options. S5 is used for one scenario, where the pedestrian flows crossing the street was increased as a sensitivity analysis.

To test the tool, two traffic planners worked together to get the correct data into the assessment tool during a series of digital meetings. Due to the nature of the Malmo approach with a non-existent current situation, some difficulties arose. A lot of the input data that was optional, such as land use and shops etc., was not possible to obtain from a current situation nor existing plans for areas. When looking at the reference streets, the problem persisted as the assumptions had to be too big when scaling it up to the stress section. When using the tool, the focus instead was on the usability of the tool and how to interpret the results.

Use of the tool - Input

The input in panes I1-I4, as well as PTAin, needed a certain number of assumptions for each scenario (including the baseline scenario, as this is not yet fully planned nor built). These are briefly described in the pane Malmo notes. For example, the implementation cost is only surface-based and is described as the difference between and the estimated cost of the baseline scenario and the specific design.

The majority of the appraisal tool work for Malmo revolved around the political and technical assessment (PTA). Here, the political priorities and objectives had to be put in. As the Malmo scenarios are based on a variation of priorities and the tool needed a constant priority – another option was needed. Instead, traffic planners based the priorities from the Malmo SUMP and the results from the public outreach (surveys and observations) as bases for both columns Road user and Objectives.

6.5.2 Results

Looking at the synthesis of the impact analysis in PTAout, the most complete design, according to the tool, is the **Liveability design** (first, the test with higher pedestrian flows, followed by the normal flows). The options had the most indicators for which the option was best and had the least number of political priorities violated. However, both violate planning standards (in both designs this was regarding available bus lane width, where neither of the designs had any).

Looking at the output from the PTAout pane, it is evident that the tool sees the available space for people-based activities as something valuable with regards to the priorities put in. Other functions, such as the number of cycle parking, favours the sustainability scenario instead. The mobility scenario is the cheapest but is the most frequent violator of both political priorities and standards.

As the input often is on a network level of detail, major differences cannot always be found in the simulation data as only the stress section is redesigned in the model. In some instances, it is possible, e.g., the mobility scenario, with the most available space for cars, to show the best performance for cars (average speed, travel time in the network etc.). The differences are not of greater magnitude though. Similar attributes are missing from the simulation as this was not built into the primary model. Having these, it is likely that the sustainability scenario would’ve seemed better according to the appraisal.

6.6 Data collection on reference streets

In addition to the work carried out with the street design for future conditions, the City of Malmö registered movements and patterns of the traffic (pedestrian, cycling, light and heavy vehicles) during the fall of 2020. The registrations were done both by automatic camera software as well as manual observations by student workers.

6.6.1 Background

Covered in previous report D5.3, the reference streets were objects in a dialogue project. Among the six streets, as shown in Figure 102 below, complete material has been gathered at all streets except Erik Dahlbergsgatan. In this shorter summary of the full report, a selection from the following streets is presented.

- Mariedalsvägen (Mobility)
- Stora Varvsgatan (Sustainability)
- Regementsgatan (Liveability)

Figure 102. Overview of reference areas and their scenario representation

The data collection includes the following aspect of traffic, parking and street life:

- Traffic flows
    - Flows for different modes of transport
    - Traces of movements through e.g. a. heatmaps
- Speeds
- Parking and kerbside
    - Parking space turnover
    - Type of use of the parking spaces
- Activities along the street

- What people move along the street
- How often / for how long people stay on the streets.

No data can lead to any extraction of details that can identify individuals and precautions have been taken to prevent any breaking of GDPR.

The data was collected during October and November 2020, where a second wave of the covid-19 virus was on the rise in Sweden, including Malmö. Several restrictions were introduced which most likely affected the mobility of everyday people, hence also the data analysed in this section of the report. However, some conclusions are might possible to draw on a street level.

Covered in previous report D5.3, the reference streets were objects in an extensive dialogue project conducted by Malmö as input in a co-creation process of future urban planning. In short, Figure 103 below show that the reference streets that were initially classed as mobility and sustainability streets were perceived as similar in terms of the scenarios. This indicates that even though the streets varied in available infrastructure (mobility tending to more general traffic space versus dedicated lanes for public transport and bikes on sustainability), the streets both felt disordered and sometimes dangerous due to the traffic situation.

The experiences of the Liveability-streets, Regementsgatan especially, differ vastly from M- and S-streets of the dialogue project. Here, the qualities bound to Liveability are frequently chosen by the respondents on site. The traffic flow on this site is lower both in regard to general and bicycle traffic and along the street are trees planted. The street of Regementsgatan is generally experienced as pleasant and inviting with plenty of street life.

Table 29. Key-value words and index

Mobility	Sustainability	Liveability
1. Convenient	5. Climate-smart	9. Pleasant
2. Dangerous	6. Smooth	10. Intimate
3. Fast	7. Ridesharing	11. Streetlife
4. Disordered	8. Accessible	12. Inviting

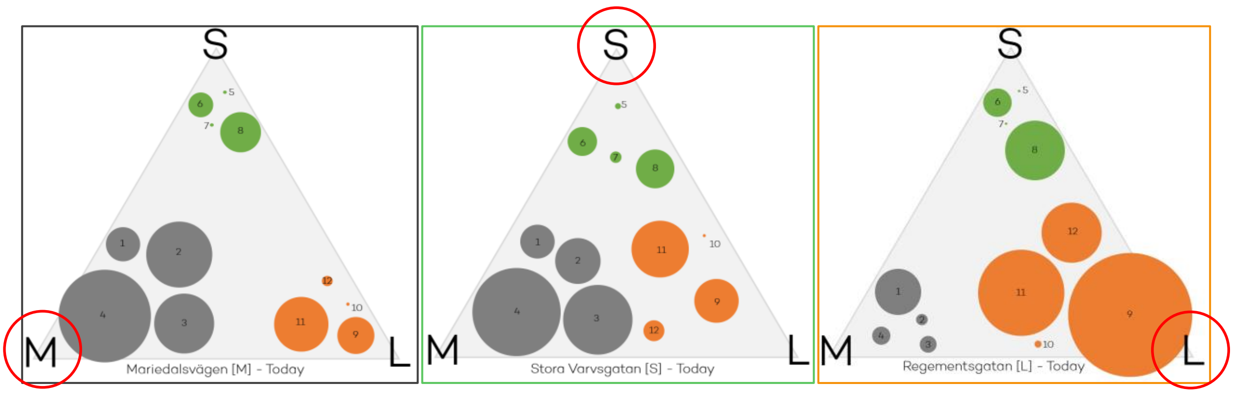


Figure 103. Examples of three present key-value word triangles of today's situation

Definitions

To supplement the material obtained through data collection, manual observations were made by student staff for two weeks in the autumn of 2020. These were made between 07:00 - 20:00 on weekdays. During weekends, observations took place over two hours during the period 09:30 - 16:30.

In this context, activities mean what happens on the sidewalks and who moves in the places. The report of the activities is divided into three parts: demographics, stationary events and occupancy rate.

Demography includes the gender and age distribution as well as the proportion of pedestrians who use a type and what type of aid. This data is collected through student observations at various locations.

Apart from speed and movement patterns on the reference streets, the focus of the data registration was also to find out how the streets were used and if any differences could be found between the streets:

Stationary events and **occupancy rates** have been compiled through data from Viscando's registrations. Stationary events mean how many people stop on average per hour. The definition of stationary events is when a person transitions from pedestrian to stationary by having a speed of less than 1 km/h for at least two seconds. The person is then counted as stationary until it has a speed of over two seconds again. Furthermore, the proportion of those standing still in groups is also reported. The definition of standing in a group is that there must be at least two people standing within two meters of each other. It is sufficient that a person is within two meters of someone in the defined group, i.e., the person does not have to meet the distance requirement for all group members. Stationary is reported partly as an average for the different zones and partly seen over the different hours of the day.

The occupancy rate defines how many pedestrians use the area in the different zones, i.e. the number of pedestrians per square meter. This has been recorded by five times per minute counting the number of pedestrians in the zone and then creating an average per minute. The number has since been divided by the area of the zone to get the number of pedestrians per square meter. In this report, the occupancy rate has been calculated up to an average per hour to be able to more easily be compared with a daily distribution. In the reported daily distribution, the number of pedestrians per square meter and per hour is reported.

Finally, it is not possible to distinguish whether cyclists use the cycle path or the footpath. The entire sidewalk next to the car lane has been classified as a shared space for bicyclists and pedestrians.

6.6.2 Mariedalsvägen (Mobility)

Mariedalsvägen has been selected with the theme Mobility as it is perceived as a car-oriented route that is mainly dimensioned to move people and goods. The street is wide, has a lot of traffic, has parking on both sides, the street has no bike lanes and the sidewalks are narrow.

In the western part of the measuring area, there is a restaurant and a grocery store with goods delivery. On the east side is the Crown Prince, where in addition to housing there are shops and other activities, such as a tennis hall.

The measurements on Mariedalsvägen were carried out during the weekend of 17–18 October and on Monday, 19 October 2020. The measurement area is bounded by Fågelbacksgatan in the south and at the height of Östra Kristinelundsvägen in the north.

Movement patterns and traffic flow

Movement patterns for each type of traffic during the everyday measurements have been plotted in Figure 104 below. For motor traffic, it is possible to see how the majority of vehicles stay in the centre of each lane. For pedestrians, it is possible to see that the movements take place more frequently on the eastern sidewalk compared with the western one - during the everyday survey, almost twice as many people choose the eastern sidewalk (1900). The pedestrian crossings in the north and south of the measuring area have been used most often, but it is also possible to see several informal intersections of the street. Of pedestrian crossings registered, about a quarter are made outside the pedestrian crossings, as shown in Figure 106.

For cyclists, the movement patterns are spread across the street section. A separate area for cyclists along the route is missing and they are instead referred to as the car lanes. However, a third of cyclists cycle on the pavement, the majority on the east side. It is possible to see how more cyclists are added from the smaller square area at the bottom right of the picture. Several cyclists have also been registered to cross the road in the middle of the stretch.

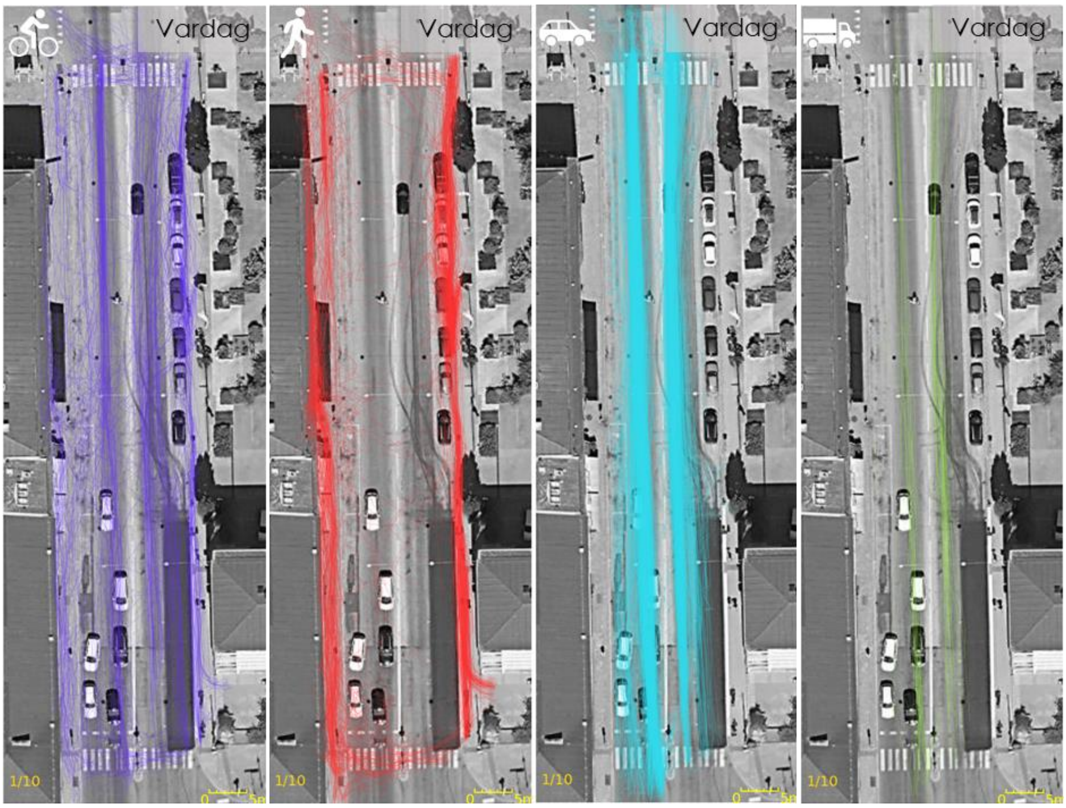


Figure 104. Movement patterns for each type of traffic during everyday measurements on Mariedalsvägen. Every 10th track is drawn. Viscando, 2021

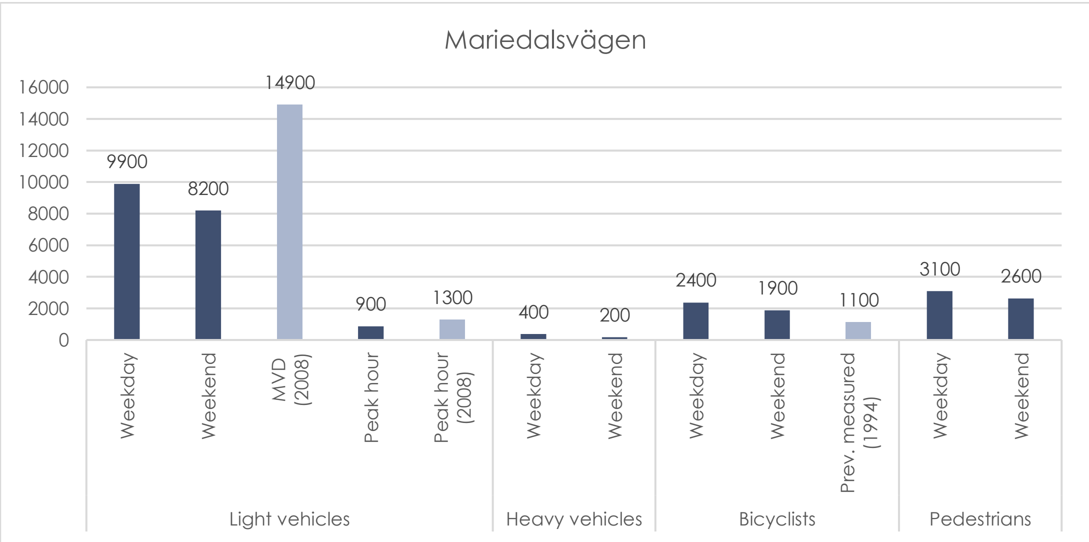
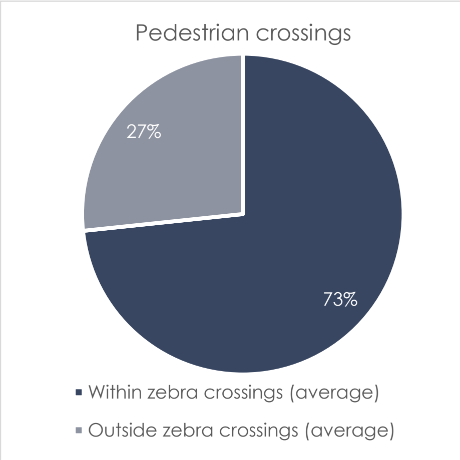


Figure 105. Traffic flows for light and heavy vehicles, cyclists and pedestrians on Mariedalsvägen



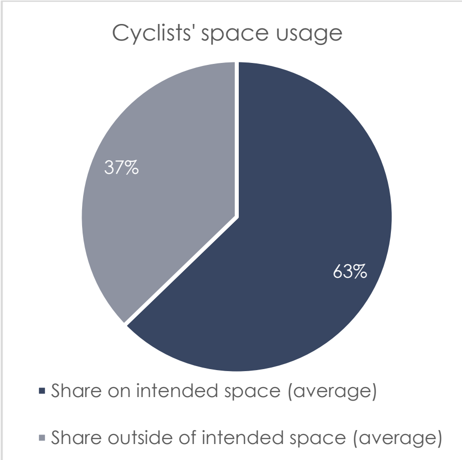


Figure 106. Share of road users who use/do not use the intended space. Pedestrians crossing the street (left) and cyclists cycling along the street (right). Average of everyday and weekend measurement

Speeds

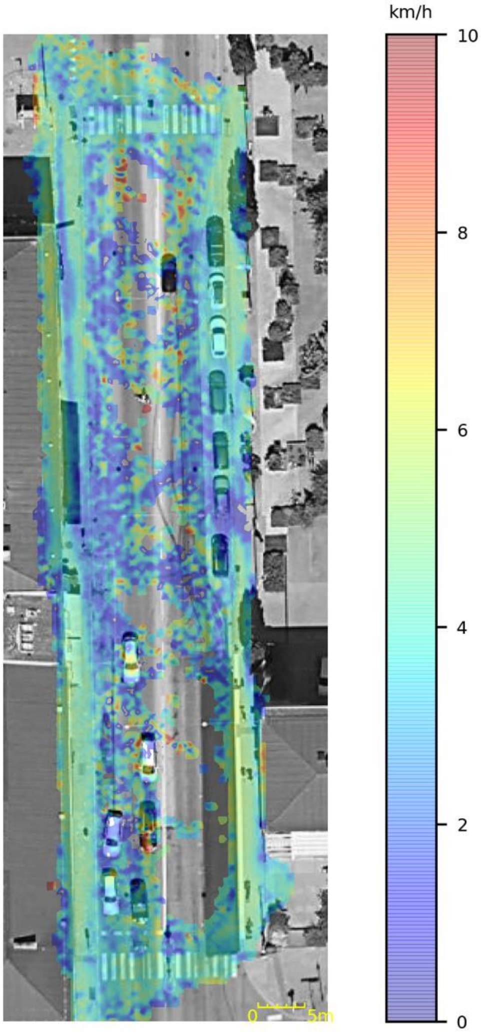


Figure 107. The average speed for pedestrians on Mariedalsvägen on October 19th, 2020

Pedestrians

The speed of pedestrians on the measured part of Mariedalsvägen is displayed in Figure 104. Slower movements can be found in the parking zones between car paths and sidewalks, likely due to people getting in and out of their cars, stopping for a brief time.

However, looking at the pedestrian movements across the car path, higher speeds (up to 10 km/h) can be seen in red. This is also confirmed in Table 30, with a higher 85-percentile across the street outside of zebra crossings (in other words, via an undefined crossing). Another pattern that can be seen is the southern part of the eastern sidewalk, where the average pedestrian speed seems to be higher. This could be caused by the short section being narrower.

Table 30. Pedestrian speeds on Mariedalsvägen (Mobility). October 19th, 2020.

Speed (km/h)	Western sidewalk	Eastern sidewalk	Northern crossing (unsign.)	Southern crossing (sign.)	Across the street (undefined crossing)
Median	5.8	5.6	5.0	4.8	5.6
Average	5.7	5.6	5.1	5.0	5.8
85-percentile	7.2	6.8	6.1	6.4	8.6

Cyclists

On Mariedalsvägen, there is no dedicated space for cyclists. Instead, they are referred to the car path. Speed distribution wise, this is shown on the car path in Figure 108 below. A majority have a speed over 21 km/h, with the 85-percentile being over 33 km/h. As cyclists have been detected on the sidewalks as well, data is presented per sidewalk in Figure 109 and Figure 110. According to the data, cyclists have lower speeds in these zones. The exact reason for this is unknown but can be speculated in either the cyclists being more careful or hindered by pedestrians (who is right to use the sidewalk, in contrast to cyclists over 8 years old). However, there are still plenty of speeds above 15 km/h which can cause safety issues or that pedestrians feel stressed or unsafe.

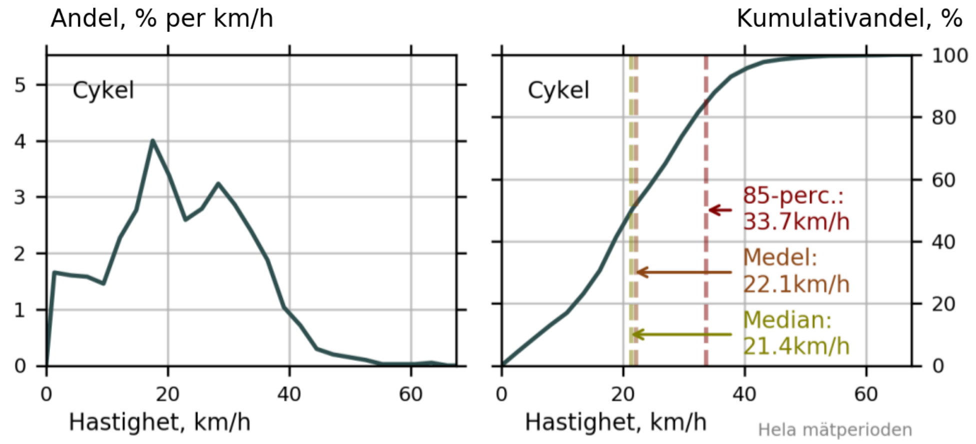


Figure 108. Speed distribution for cyclists on the road. Mariedalsvägen. October 19th, 2020. Viscando, 2021

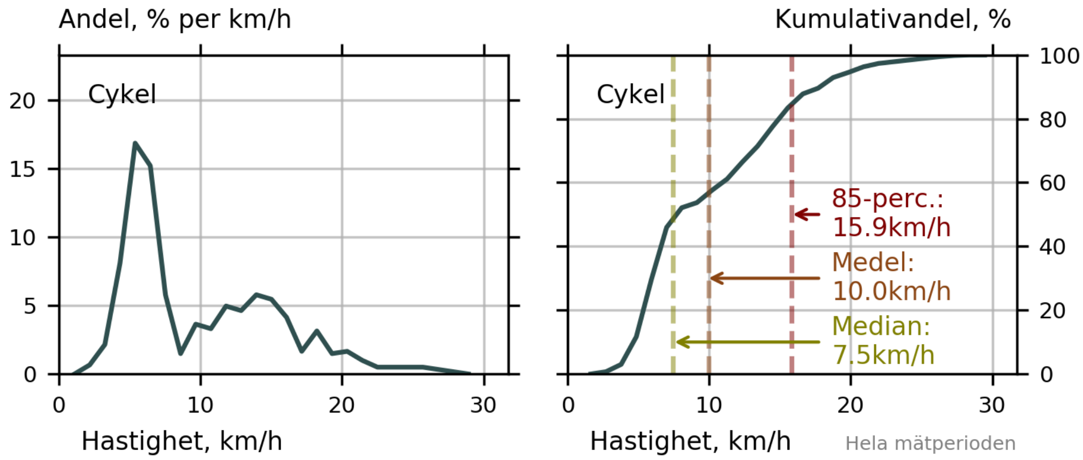


Figure 109. Speed distribution for cyclists on the eastern Sidewalk. Mariedalsvägen. October 19th, 2020. Viscando, 2021

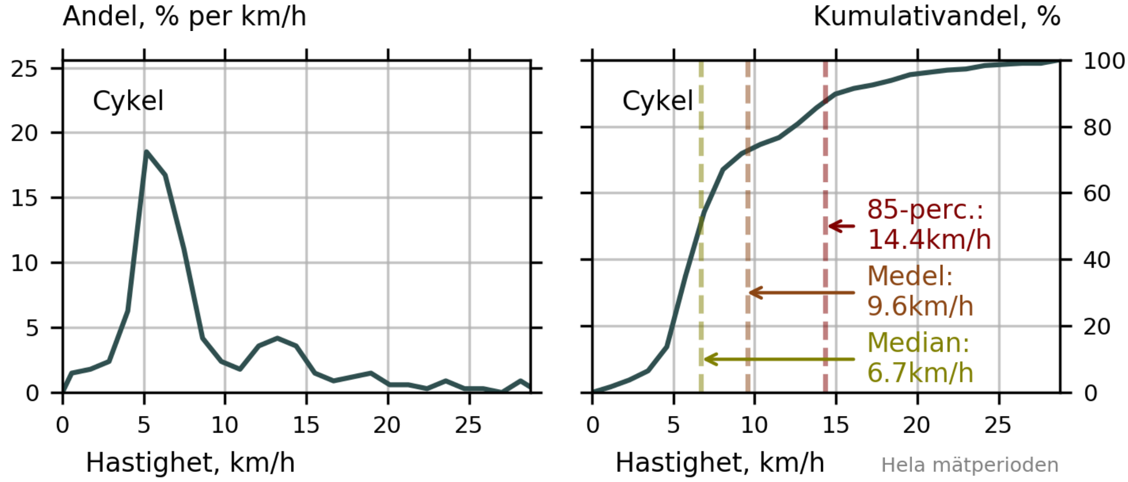


Figure 110. Speed distribution for cyclists on the western sidewalk. Mariedalsvägen. October 19th, 2020. Viscando, 2021

Motorized vehicles

The motorized vehicles speeds for the weekday measurement are shown below in Table 31. Speeds are quite similar along the measured segment of the street.

Table 31. Speed for motorized vehicles on Mariedalsvägen (Mobility). October 19th.

Speed (km/h)	Light vehicles	Heavy vehicles
Median	29.5	28.5
Average	28.6	27.6
85-percentile	38.1	37.2

Looking into the average speed per hour over a day, speeds are quite similar in both directions. Average speeds and 85-percentile are all below the speed limit of 40 km/h.

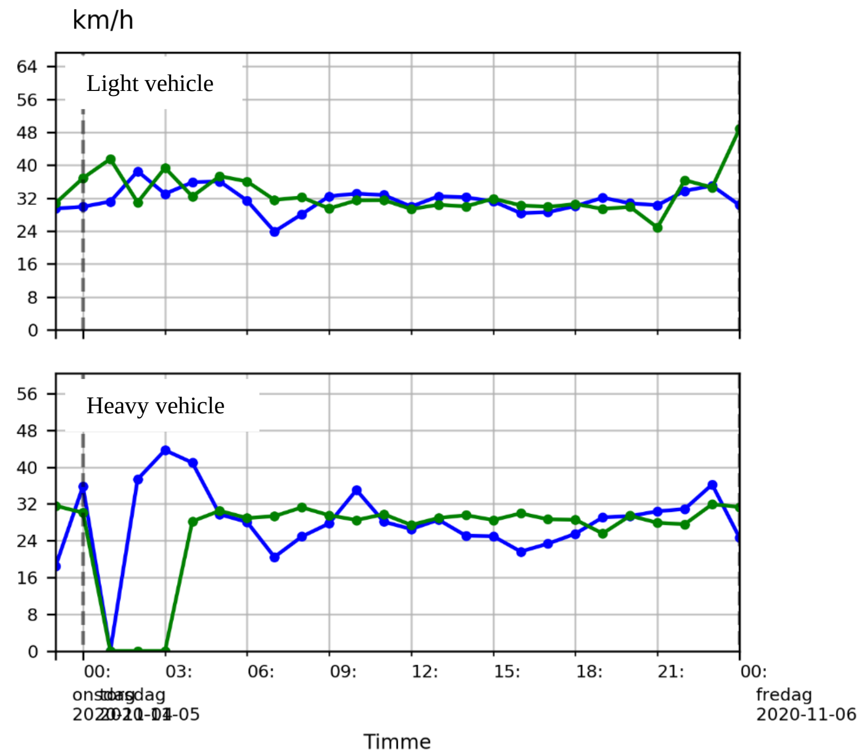


Figure 111. Average speed per hour for light and heavy vehicles on Sallerupsvägen on 5 November 2020. The blue line corresponds to the northwestern direction, green line corresponds to the southeastern direction. Viscando, 2021

<u>Activities</u>

Demographics

On Mariedalsvägen, the gender distribution shows that more females are walking along Mariedalsvägen. The age of the people are mostly young (19-34 years). Half of the pedestrians are below 34 years of age.

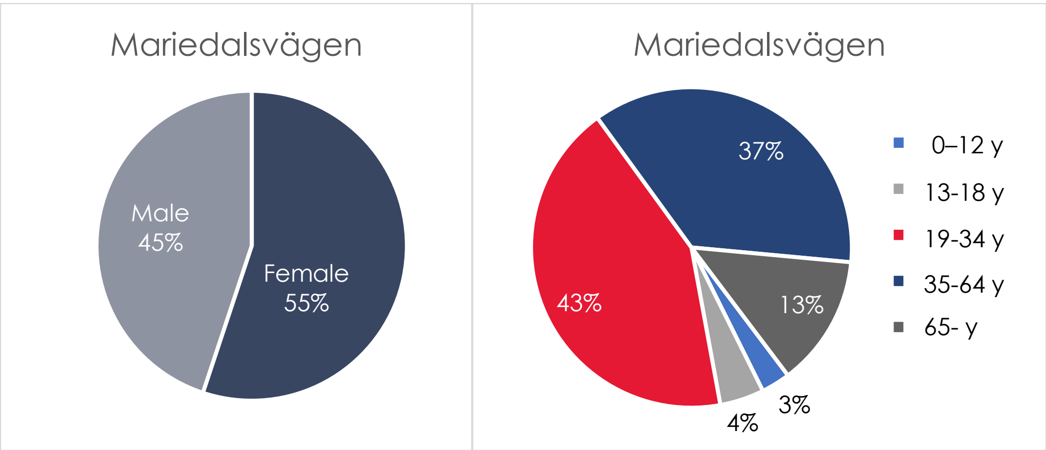


Figure 112. Gender and age distribution for pedestrians on Mariedalsvägen

The student observations also included if the pedestrians had any types of aids when they travelled along the streets. Here, running or rolling on a skateboard etc is also included. As can be seen in Figure 113, 13 per cent had some type of aid. Most of these had a stroller or a pet along with them.

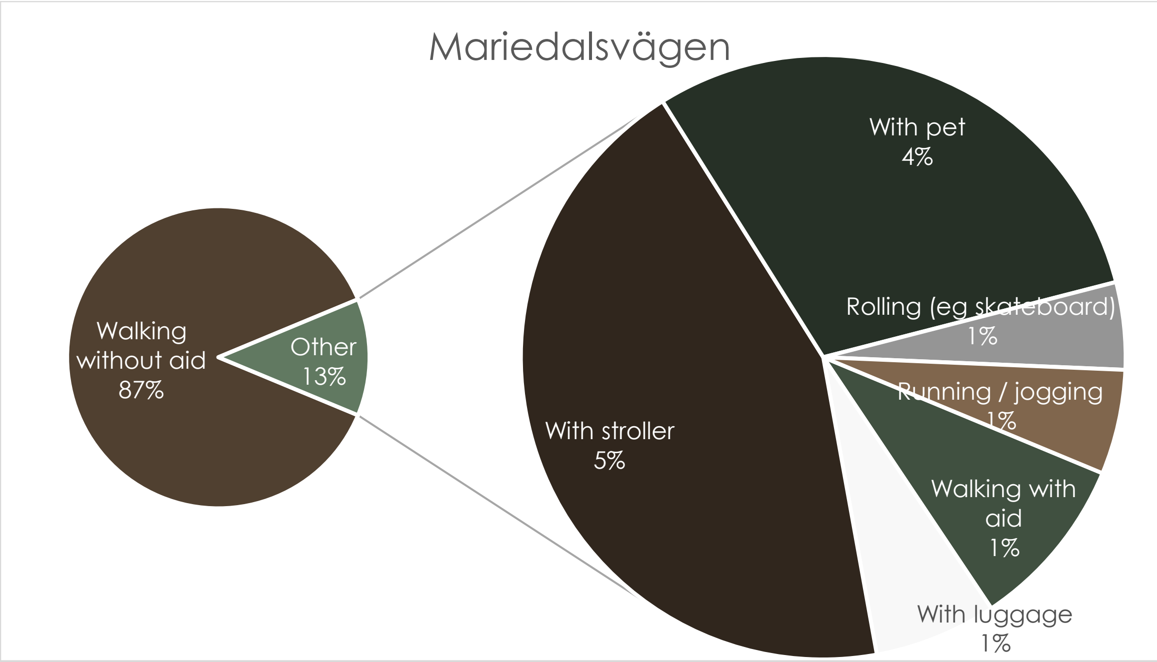


Figure 113. Proportion of pedestrians who use aids on Mariedalsvägen, and type of aid

Stationary events

The following chapters report who moves as a pedestrian along Mariedalsvägen, how many stops (stationary events) along the street and what degree of occupancy the street has during the different hours of the day.

Stationary events and occupancy rates are reported partly as an average for the entire Mariedalsvägen and partly for the different zones of the sidewalks listed in Table 32 below.

A higher share of group events is conducted on the western sidewalks (A2 and A3). This could be because of the restaurants and shops in these zones. The most stationary events per hour happen in A2 and B2, where B2 registers 61 stationary events per hour on average. As there are no benches, restaurants etc., this seems unlikely to be the actual case. However, the A2 28 events per hour show that the supply of activities has a demand.

Figure 114. Sidewalk zones along Mariedalsvägen

On average, Mariedalsvägen has 16 stationary events per hour, where 24% of these are done by two or more people. Of all pedestrians, 5% stop along the street.

Table 32. Stationary events on Mariedalsvägen in total and per zone

Zon	Average number of stationary events per hour	Share of stationary events of all pedestrians	Share of stationary events standing in a group
Mariedalsvägen	16	5%	24%
A1	2	16%	23%
A2	28	8%	30%
A3	8	6%	30%
B1	5	20%	26%
B2	61	5%	22%
B3	3	5%	23%
B4	6	5%	17%

As can be seen, by Figure 115 and Figure 116, the time of stationary events vary along the day. Looking at zone B2, the highest peak during the weekday measurement is around 11 o'clock, with the whole morning being busy. There is also a peak during the early morning, what causes this is uncertain.

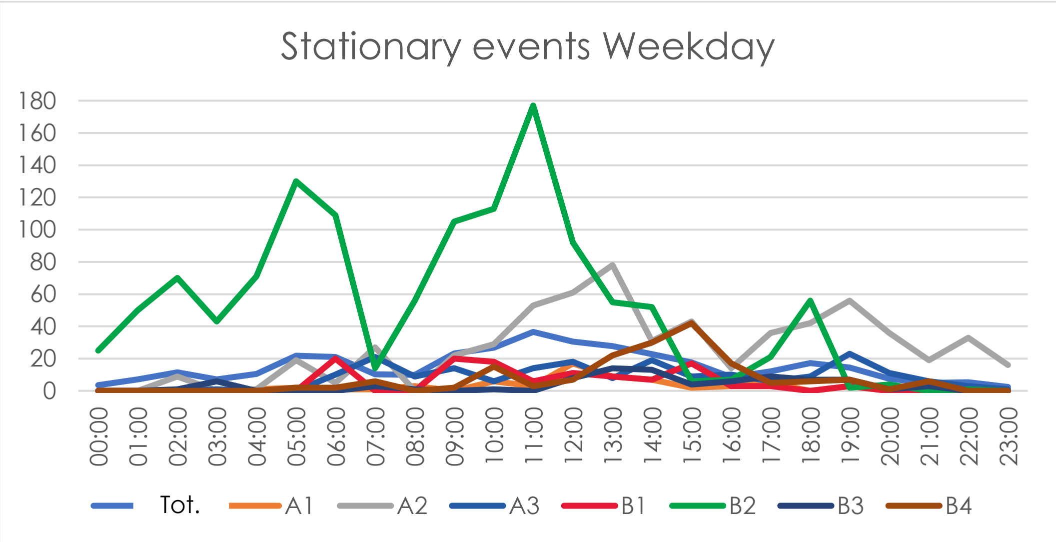


Figure 115. Average number of stationary events per hour during weekdays for Mariedalsvägen's different zones

During the weekend, the stationary events are more spread out over the 24 hours. Interestingly enough, there are a large number of events in B2 during the entire night, from midnight to 6 AM. Looking at the total average (blue line), the situation is more balanced. The morning peak from above is flatter and more events happen during the late afternoon/early evening.

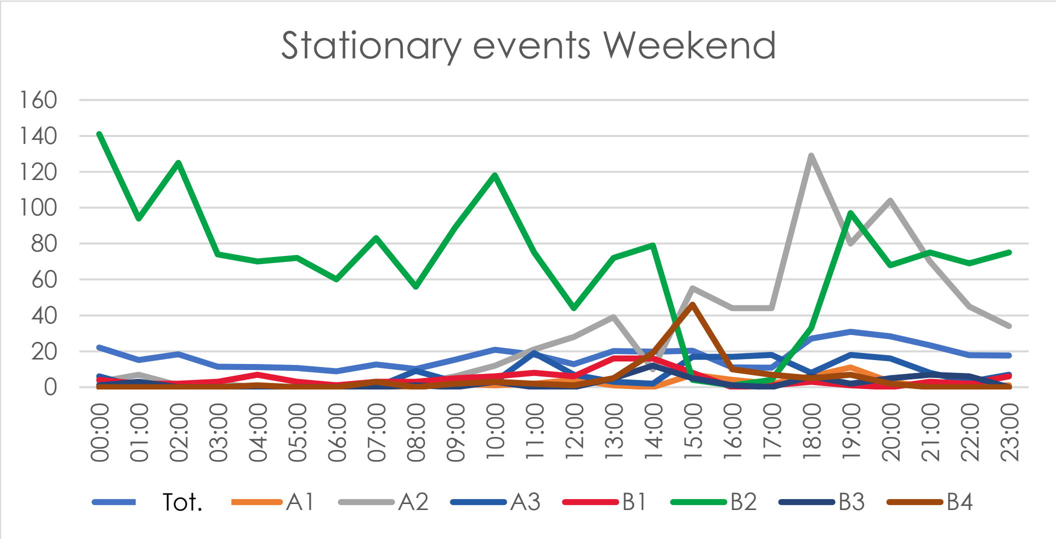


Figure 116. Average number of stationary events per hour during the weekend for Mariedalsvägen's different zones

<u>Degree of occupancy</u>

Degree of occupancy is defined as the number of pedestrians that are dwell per square meter in the different zones. This has been recorded by five times per minute counting the number of pedestrians in the zone and then creating an average per minute. The table below shows the occupancy rate in the different zones along Mariedalsvägen.

Table 33. Degree of occupancy for Mariedalsvägen in total and per zone

Zone	Average number of pedestrians per hour	Average number of pedestrians per hour per m2
Mariedalsvägen	31	0,30
A1	7	0,21
A2	56	0,30
A3	25	0,21
B1	10	0,20
B2	92	0,85
B3	10	0,12
B4	20	0,20

In summary, Mariedalsvägen has 31 pedestrians per hour on average, which is 0.3 pedestrians per hour per m2. The highest occupancy rate happens in zone B2, where 92 pedestrians are recorded per hour on average (0.85 per m2). Compared to the other zones B, this is an outlier (others ranging from 0.12 to 0.20). The reason could be some type of measurement error, seeing high figures during the night. However, the morning and lunch peak could indicate that this is a place where people slow down, waiting or looking into the shop windows.

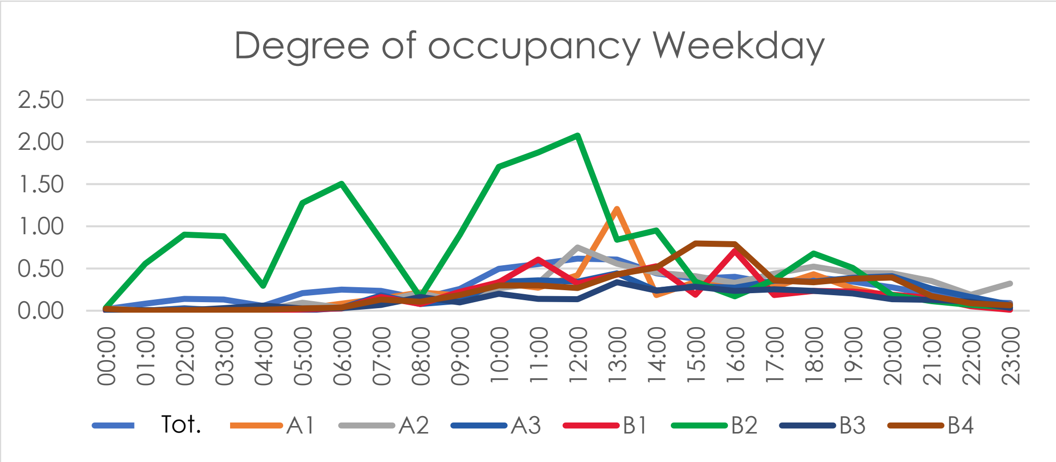


Figure 117. Average degree of occupancy per hour during weekdays for Mariedalsvägen's zones

During the weekend, the average occupancy per hour is more evenly during the day, with a peak in the afternoon rather than during the middle of the day.

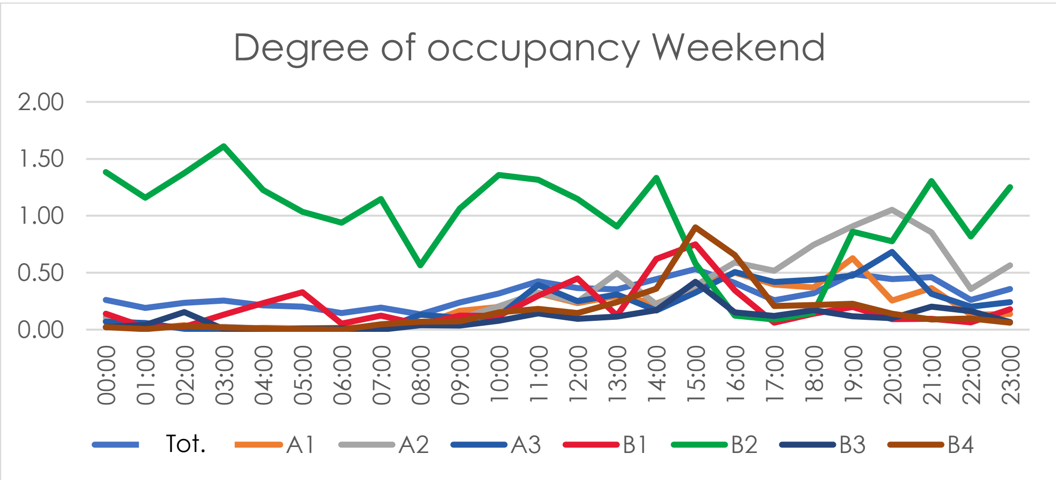


Figure 118. Average degree of occupancy per hour during the weekend for Mariedalsvägen's zones

6.6.3 Stora Varvsgatan (Sustainability)

Stora Varvsgatan is the eastern entrance to Västra Hamnen which has been selected as a reference place under the theme Sustainability, as it is a street where movements take place by car and bus as well as by bicycle and on foot. When it comes to activities in the form of activities along the street, few are open to the public compared to other reference places. However, there are plenty of workplaces along the street.

The measurements on Stora Varvsgatan took place on Thursday 12 November and Saturday 14 November 2020. The registrations took place from west of Hallenborgsgatan up to and including the intersection with Isbergs gata.

Movement patterns and traffic flow

Movement patterns for each type of traffic are shown below in Figure 119. For the light vehicles, few use the bus lanes at the far end of the carriageway. For heavy traffic, bus traffic is included, which means that the two lanes in each direction look relatively evenly utilized.

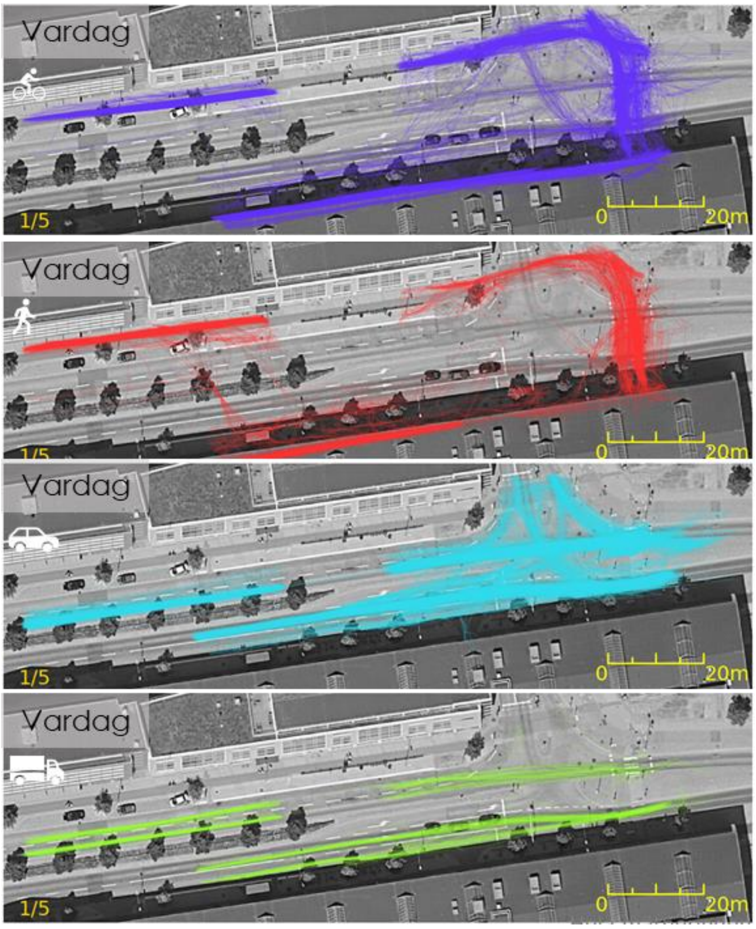


Figure 119. Movement patterns for each type of traffic during weekday measurement on Stora Varvsgatan. Every 5th track is drawn. Viscando, 2021

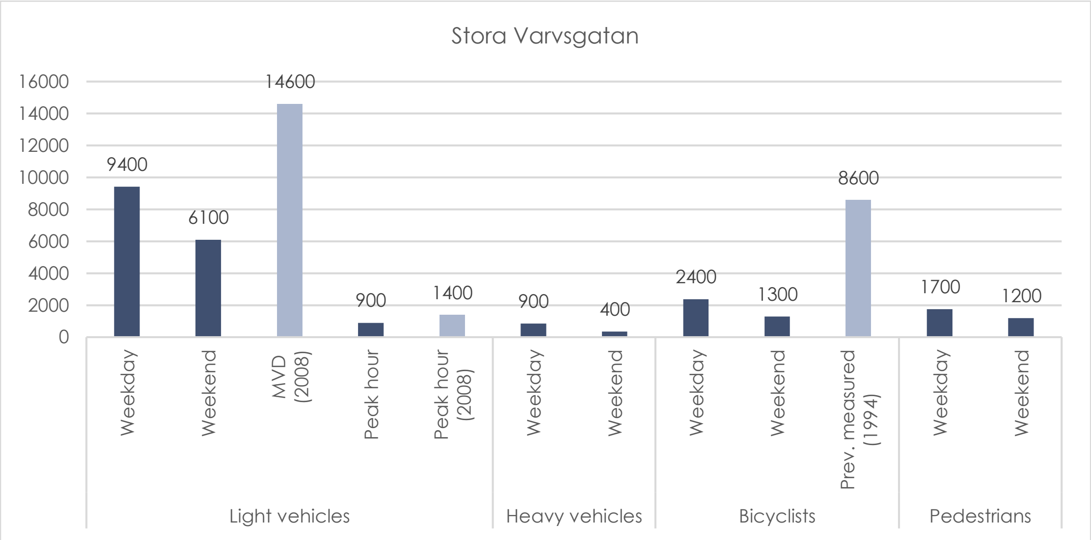


Figure 120. Traffic flows for light and heavy vehicles, cyclists and pedestrians on Stora Varvsgatan

Cyclists use the cycle paths on both sides of the road to a great extent - only 2 per cent of the registered cyclists cycle on the car path, which also can be seen in Figure 121. Compared to Mariedalsvägen, where only 63 per cent of cyclists use intended space, cyclists use cycle lanes when they are provided. In the measurements, it is not possible to make any difference between the cycle path and the parallel walkway.

For intersecting movements, the existing passages east and north of the intersection with Isbergs gata (northbound) are well used. With pedestrians, however, it is possible to see that some people are passing along the refuge in the east. Several also cross the street at the height of the stops.

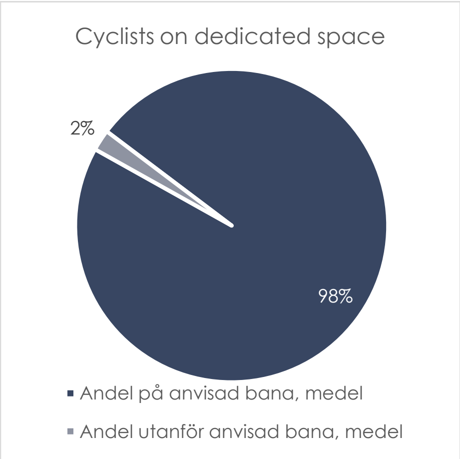


Figure 121. Share of cyclists who use/does not use the dedicated street space

<u>Speeds</u>

Pedestrians

The speed of pedestrians on the measured part of Stora Varvsgatan is displayed in Figure 122. The speeds are rather even along the pedestrian surfaces of the street. Some slower movements are identified in the crossing movements in the western part of the measured area. Here, it seems as if pedestrians slowdown in the bus lane for cars to pass in the car lane before they cross the road outside of a zebra crossing.

Red dots along the car lanes show speeds up to 10 km/h. That they are *along* car lanes indicate measurement errors.

In Table 34 below, numeric data regarding pedestrian speeds can be viewed. The southern sidewalk shows slighter higher speeds, while the zebra crossing (signalised) has lower median and average values. As in the case of Mariedalsvägen, the 85-percentile is higher, perhaps due to people running over when the light turns red.

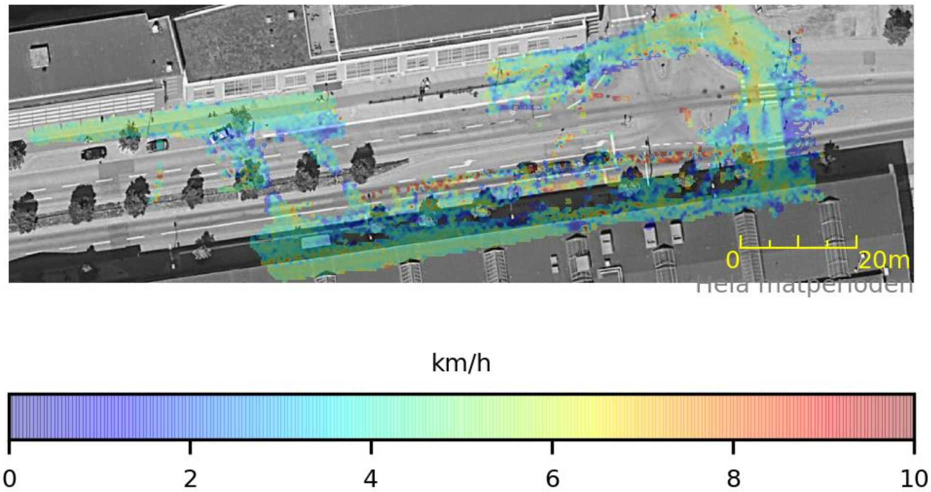


Figure 122. The average speed for pedestrians on Stora Varvsgatan on November 12th, 2020

Table 34. Pedestrian speeds on Stora Varvsgatan (Sustainability). November 12th

Speed (km/h)	Northern sidewalk	Southern sidewalk	Eastern crossing (sign.)
Median	5.1	5.3	4.8
Average	5.1	5.3	4.7
85-percentile	5.9	6.0	6.9

Cyclists

In Figure 123 below, the speed distribution on the northern sidewalk is presented. The distribution differs vastly from the Mariedalsvägen measurements (Figure 108 to Figure 110). On the Stora Varvsgatan northern sidewalk (including the cycle lane), the average and median values around 16 – 17 km/h are evident. There are also plenty of cyclists that cycle above 20 km/h.

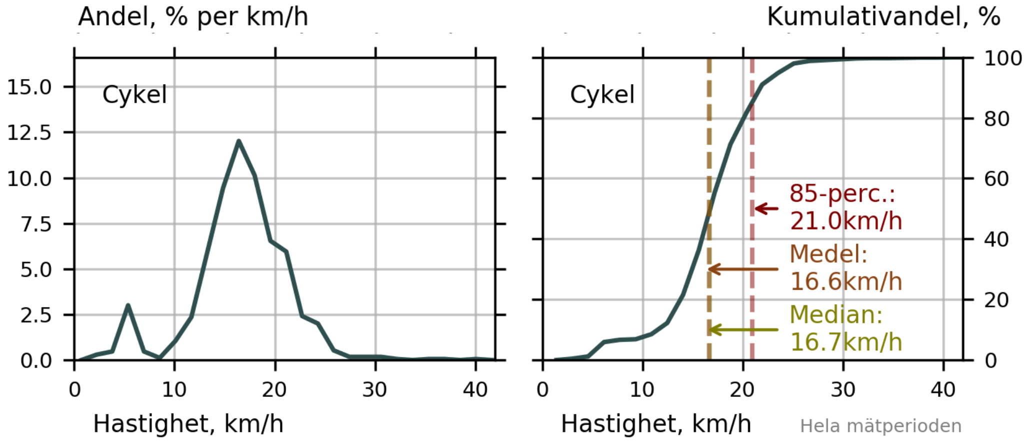


Figure 123. Speed distribution for cyclists on the northern sidewalk. Stora Varvsgatan. November 12th, 2020. Viscando, 2021

Motorized vehicles

Motorized vehicle speeds are presented in Table 35 below. Heavy vehicles have a significantly lower average and median speed than light vehicles. Compared to Mariedalsvägen, where the values were similar, the Stora Varvsgatan numbers are likely skewed by the buses trafficking the streets. There are bus stops on both sides of the street section observed, where the bus needs to deaccelerate and accelerate.

Table 35. Speed for motorized vehicles on Stora Varvsgatan (Sustainability). November 12th

Speed (km/h)	Light vehicles	Heavy vehicles
Median	31.2	20.6
Average	30.6	19.9
85-percentile	36.7	30.0

The average speeds per hour over a day are presented in Figure 124. The average speed for light vehicles is higher during the night, especially in the eastern direction.

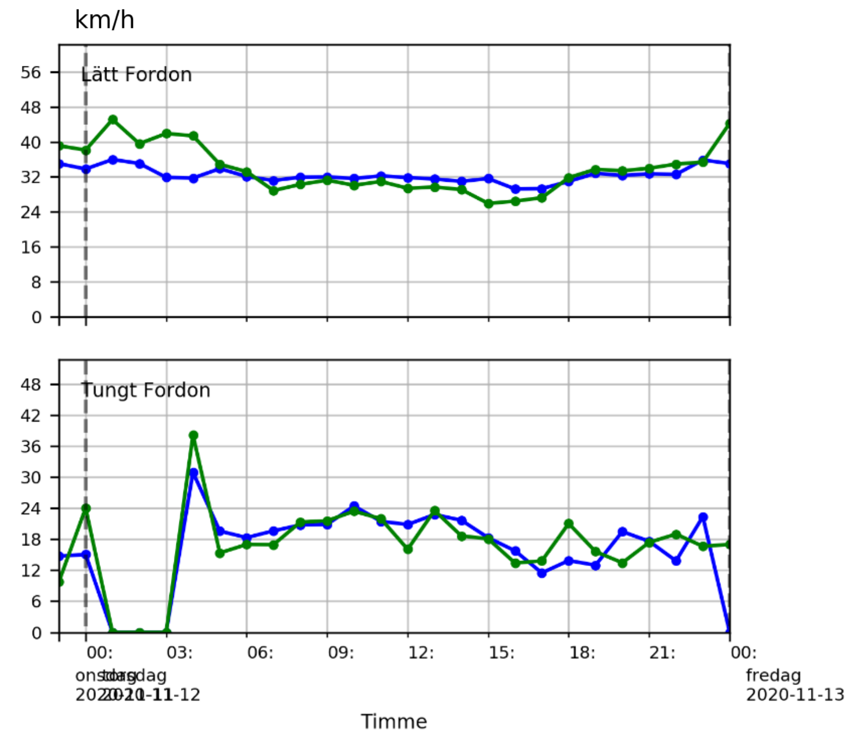


Figure 124. Average speed per hour for light and heavy vehicles on Stora Varvsgatan on November 12th, 2020. The blue line corresponds to the west direction, green line corresponds to the east direction. Viscando, 2021

<u>Activities</u>

Demographics

On Stora Varvsgatan, mainly men are the pedestrians. The largest age group is 19-34 years old, which combined with 35-64 years make up 92 per cent of the pedestrians when measured. The oldest age group is 9 units lower than on Mariedalsvägen.

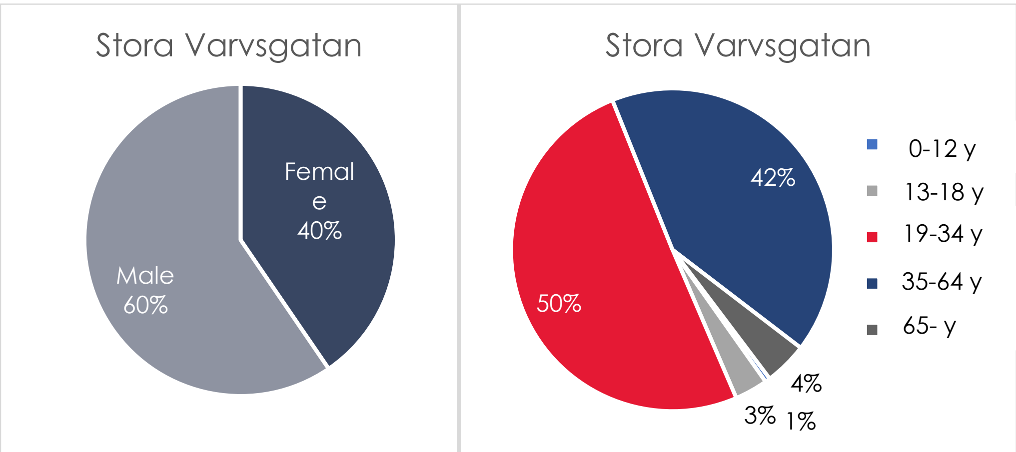


Figure 125. Gender and age distribution for pedestrians on Stora Varvsgatan

On Stora Varvsgatan, 13% of pedestrians use aids. Fewer have a stroller or a pet with them when walking. Instead, a larger share of the “pedestrians” run or roll along the street.

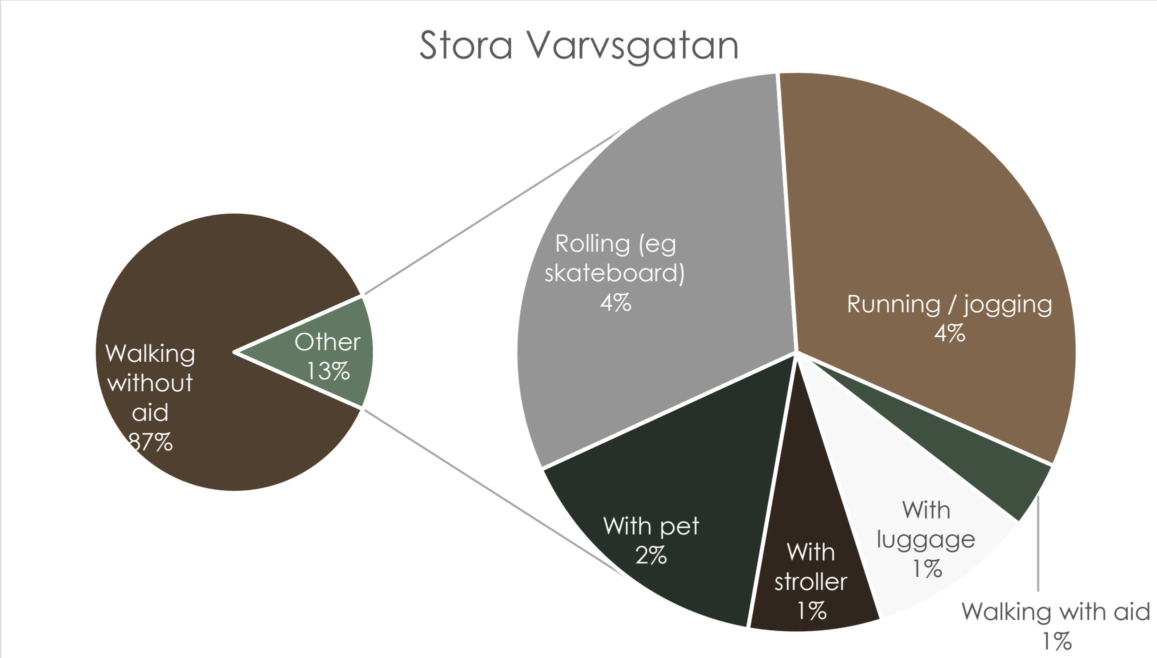


Figure 126. Proportion of pedestrians who use aids on Mariedalsvägen, and type of aid

Stationary events

The zones used when measuring stationary events are presented below.

Figure 127. Sidewalk zones along Stora Varvsgatan

Looking at the zones and in total, few stationary events occur along the measured part of Stora Varvsgatan. On average, 2 stationary events happen per hour in zone A2, B1 and B2 (and on the street in total). Larger shares of stationary events of all pedestrians happen in the B-zones. The direct vicinity of the bus stop has been sorted out, but this still could affect the numbers. The other thing happening along the façade around the B-zones is an official hotel.

Table 36. Stationary events on Stora Varvsgatan in total and per zone

Zone	Average number of stationary events per hour	Share of stationary events of all pedestrians	Share of stationary events standing in a group
Stora Varvsgatan	2 st	4%	13%
A1	0 st	0%	0%
A2	2 st	3%	9%
B1	2 st	8%	17%
B2	2 st	6%	11%

The stationary events on the weekday measurement on Stora Varvsgatan show two distinct peaks: morning and late afternoon. As the area around Stora Varvsgatan consists mainly of offices, this comes as no surprise.

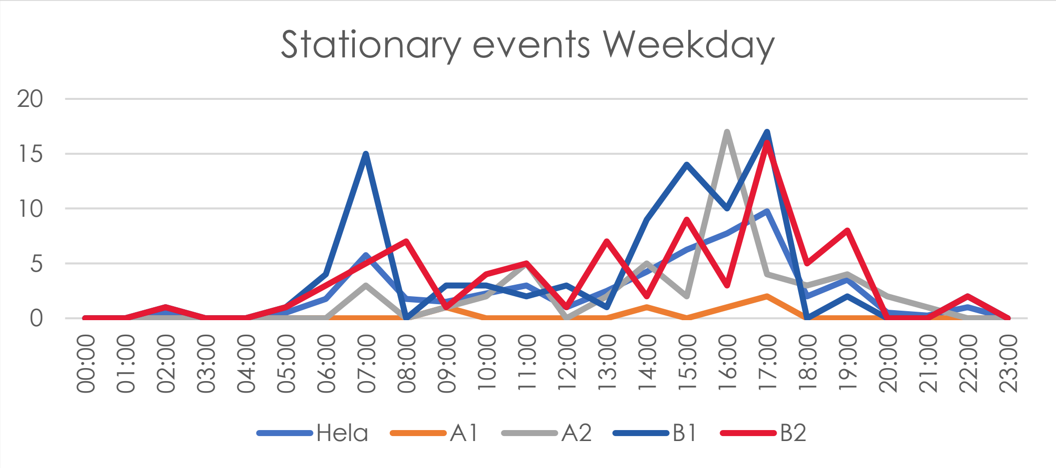


Figure 128. Average number of stationary events per hour during weekdays for Stora Varvsgatan's zones.

The office area factor is evident when looking at Figure 129 below. The stationary events are lower during almost all hours, and there are no united peaks as can be found in the figure above.

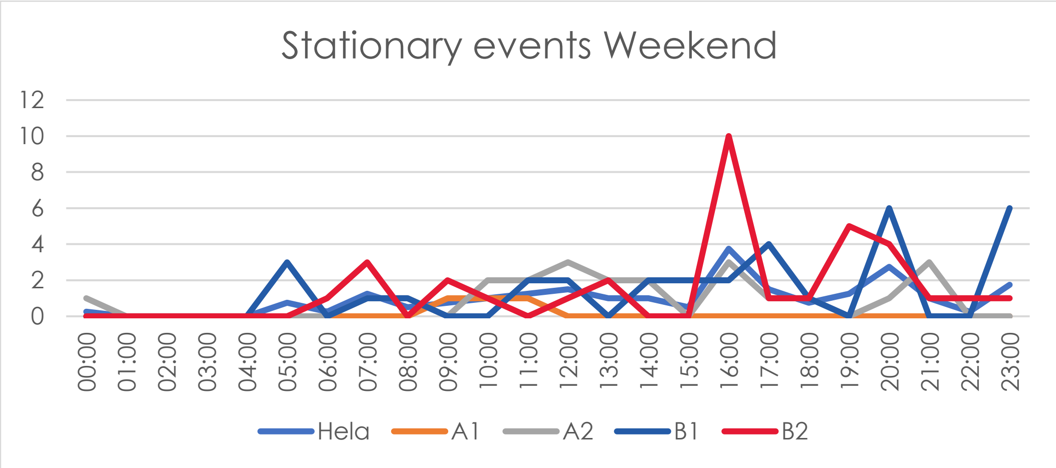


Figure 129. Average number of stationary events per hour during the weekend for Stora Varvsgatan's zones

Degree of occupancy

The degree of occupancy on Stora Varvsgatan are presented in Table 37 below. The figures per m2 are low, between 0,03 and 0,09. On average, 10 pedestrians in total are in the zones simultaneously on Stora Varvsgatan.

Table 37. Degree of occupancy for Stora Varvsgatan in total and per zone

Zone	Average number of pedestrians per hour	Average number of pedestrians per hour per m2
Stora Varvsgatan	10 st	0,06
A1	7 st	0,08
A2	13 st	0,09
B1	9 st	0,05
B2	11 st	0,03

During the weekday, the degree of occupancy is similar in all zones, apart from the 17 o'clock spike in A2. Otherwise, the two peaks in occupancy are around lunchtime and afternoon rush hour, where plenty of people are on the move in the area.

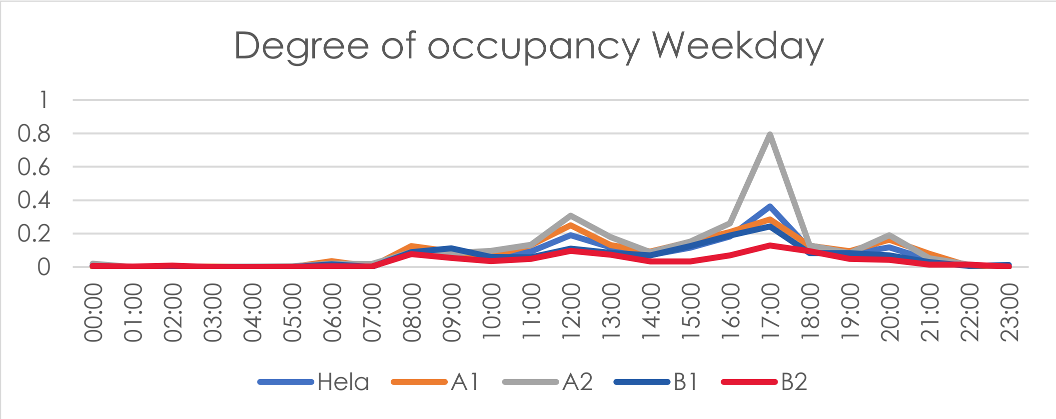


Figure 130. Average degree of occupancy per hour during weekdays for Stora Varvsgatan's zones

The weekend measurement shows a lower degree of occupancy. Often, both A zones have a higher degree of occupancy, even though both sides of the streets have little to no activity along the sidewalk. As with the stationary events, the weekend shows less peak and a more varied in the graphs.

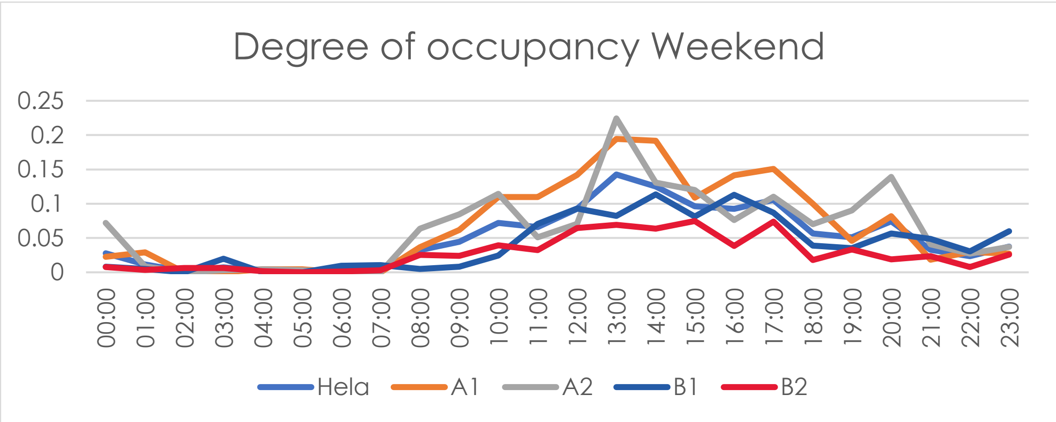


Figure 131. Average degree of occupancy per hour during the weekend for Stora Varvsgatan's zones

6.6.4 Regementsgatan (Liveability)

Regementsgatan is one of the main roads towards Malmö's western districts and has been chosen as a reference place under the theme **Liveability**. The street is a good example of a main road where cars, buses and bicycles pass but which at the same time have qualities with service, rows of trees on both sides and wide sidewalks that make the street pleasant to move along and stay at.

On Regementsgatan, two measurements were made to be able to capture all movements along the street. As the street is lined with large rows of trees, it was not possible to capture movements on the sidewalks while watching what was happening along the roadway. For pedestrian and bicycle lanes, the measurements took place on Friday 30 October and Saturday 31 October. For the carriageways, this was done on Saturday 21 November and Tuesday 24 November.

Movement patterns and traffic flow

The patterns for the registered movements are shown below in Figure 132. When measurements have been made during two periods, the patterns for cyclists and pedestrians are shown during two periods, divided by a yellow line. It is also possible to see a gap in the measurements where movements are not registered in the middle of the south side.

For cyclists, it can be seen that some use the carriageway, where they share space with motor traffic. Some also use the wide walkway on the north side of Regementsgatan where cyclists are not allowed. The majority, however, use the cycle path along the southern part of the street (87%). Here a distinction between the bike path and the pedestrian space can be seen.

Pedestrians along the route move mainly along facades, seemingly using the extra space available along the northern sidewalk. For pedestrians, few informal crossings of the road have been registered (7%). The measurements indicate that the majority use pedestrian crossings see Figure 133.

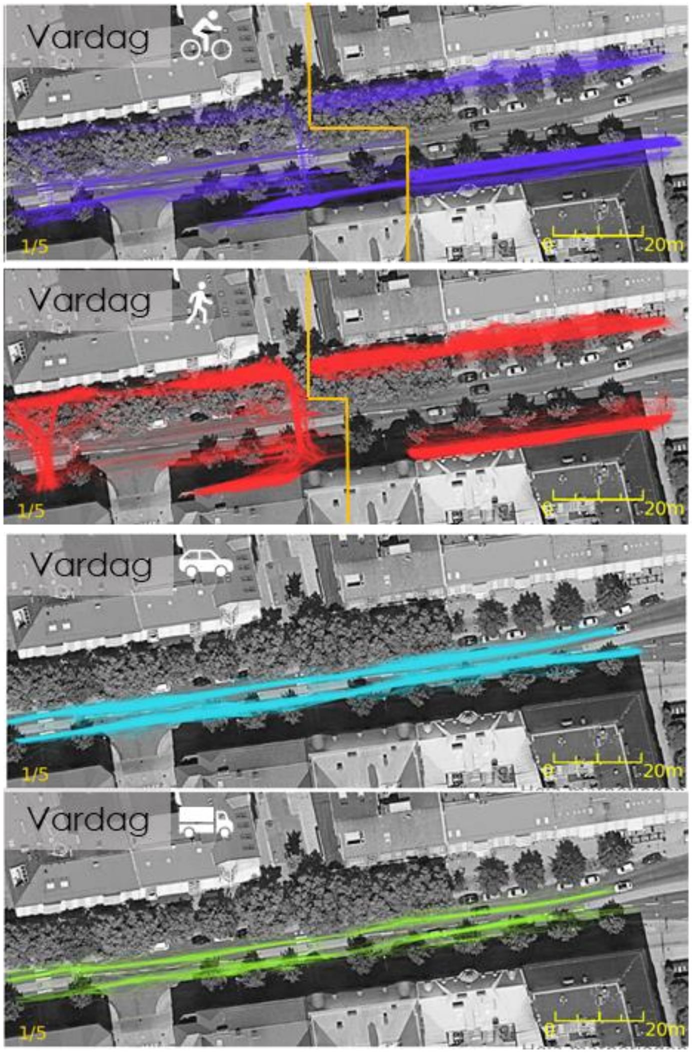


Figure 132. Movement patterns for each type of traffic during everyday measurements on Regementsgatan. Every 5th track is drawn. For cyclists and pedestrians, the picture to the left of the yellow line is from the measurement on Tuesday 24/11. To the right of the yellow line is from Friday 30/10. Viscando, 2021

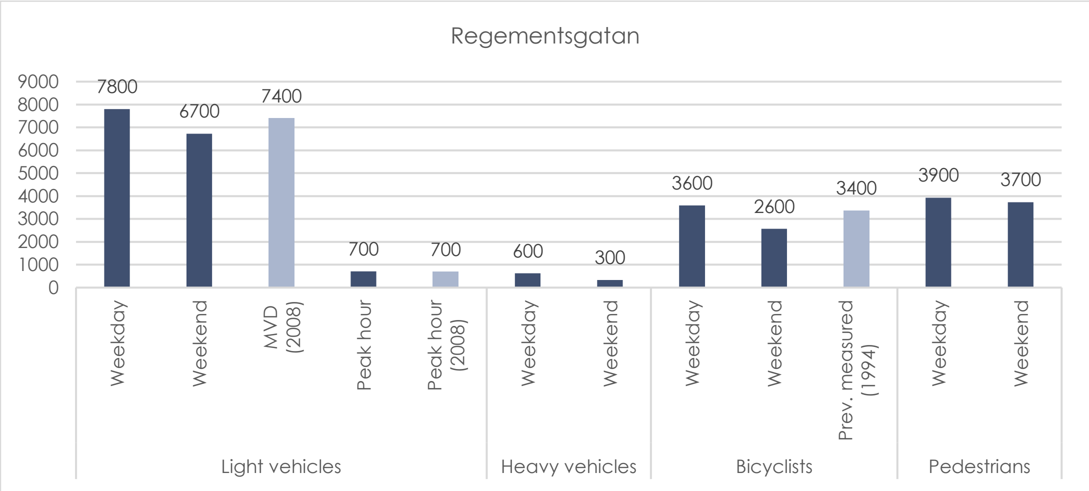


Figure 133. Traffic flows for light and heavy vehicles, cyclists and pedestrians on Regementsgatan

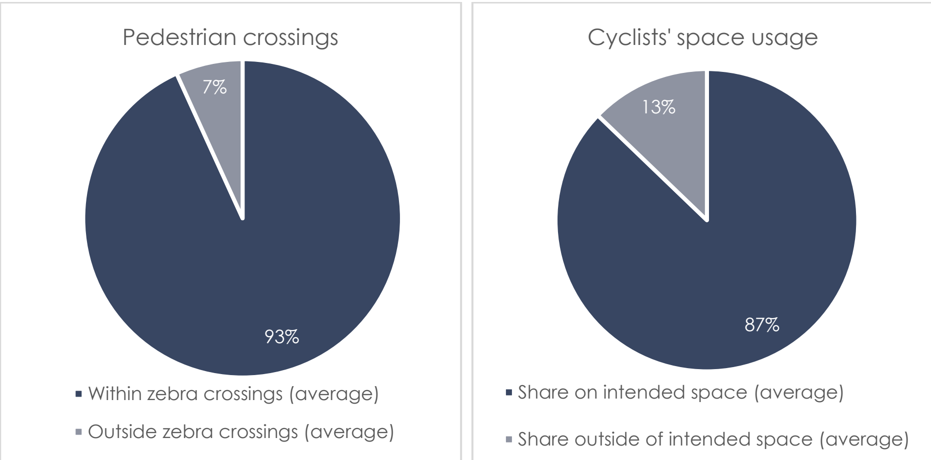


Figure 134. Share of road users who use/does not use the intended space. Pedestrians crossing the street (left) and cyclists cycling along the street (right). Average of everyday and weekend measurement

<u>Speeds</u>

Pedestrians

The travelling speed from the pedestrian measurements on Regementsgatan can be found in the figure below. Similar patterns as Mariedalsvägen and Stora Varvsgatan can be seen along the parking zones between the car lanes and sidewalks, where lower speeds occur from (presumably) people getting in and out of their car.

An interesting observation between the northern and southern sidewalk east of the gap is the difference in average pedestrian speed. Both sides of the street have smaller shops but look quite different due to the available space for pedestrians. On the southern sidewalk, space is limited (around 2.5 meters) and is just next to the cycle lane. On the northern sidewalk, the available space is over 5 meters, if the gravelled part under the trees is included, 8 meters.

According to the measurements, the northern sidewalk has lower speeds (more blue colours), indicating that more space and no cyclists could be a factor to walk at a slower tempo. It could also mean that people who walk slower choose this sidewalk to start with. However, looking at the table below, the average and median does not differ dramatically.

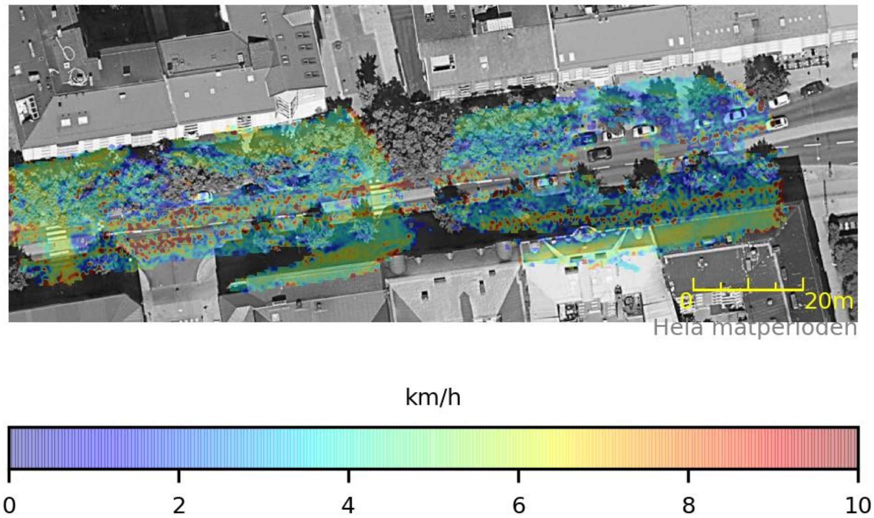


Figure 135. The average speed for pedestrians on Regementsgatan on November 12th, 2020

Table 38. Pedestrian speeds on Stora Varvsgatan (Sustainability). November 12th

Speed (km/h)	Northern Sidewalk	Southern Sidewalk	Western crossing	Eastern crossing	Across the street (undefined crossing)
Median	5.5	5.8	5.8	5.4	5.4
Average	5.4	5.8	6.1	6.0	8.0
85-percentile	6.5	7.0	7.2	7.3	11.4

Cyclists

The speed that cyclists maintain on Regementsgatan is shown below in Figure 136. It is clear to see the cycle path on the south side of the street.

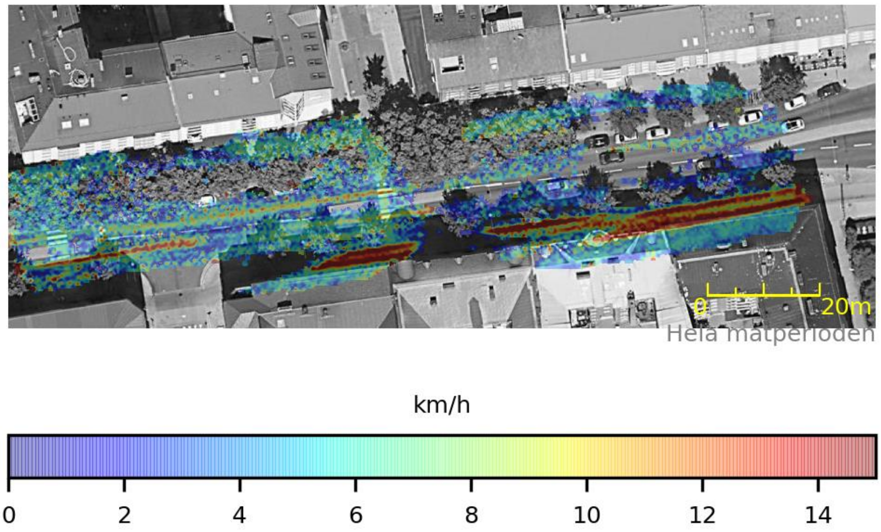


Figure 136. The average speed for cyclists on Regementsgatan on 24 November 2020. Viscando, 2021

On the north sidewalk, half of the cyclists have a speed below 6.5 km/h. The speeds are lower than on the south sidewalk, which is not surprising as there is no dedicated area for cyclists.

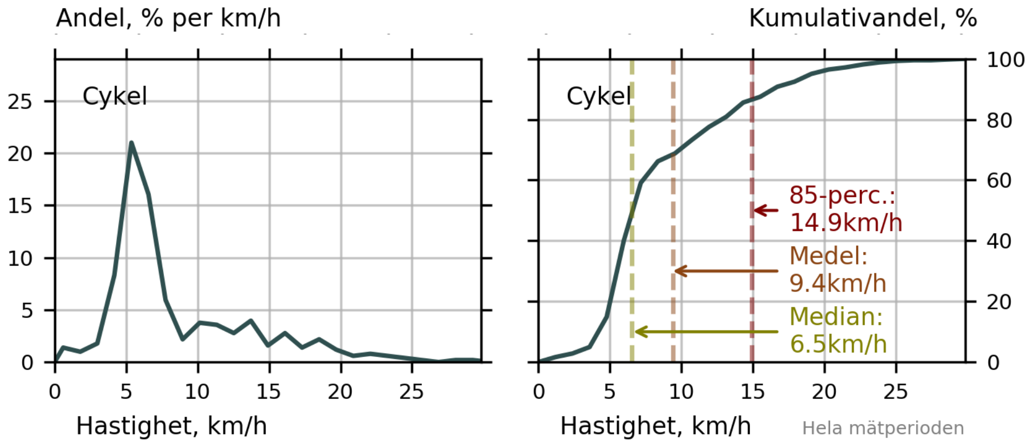


Figure 137. Speed distribution for cyclists on the northern sidewalk. Regementsgatan. October 30th, 2020. Viscando, 2021

The southern sidewalk has a significantly higher speed than the northern sidewalk, where half of the cyclists keep a speed above 18.2 km/h. The average speed is almost twice as high compared to the northern sidewalk.

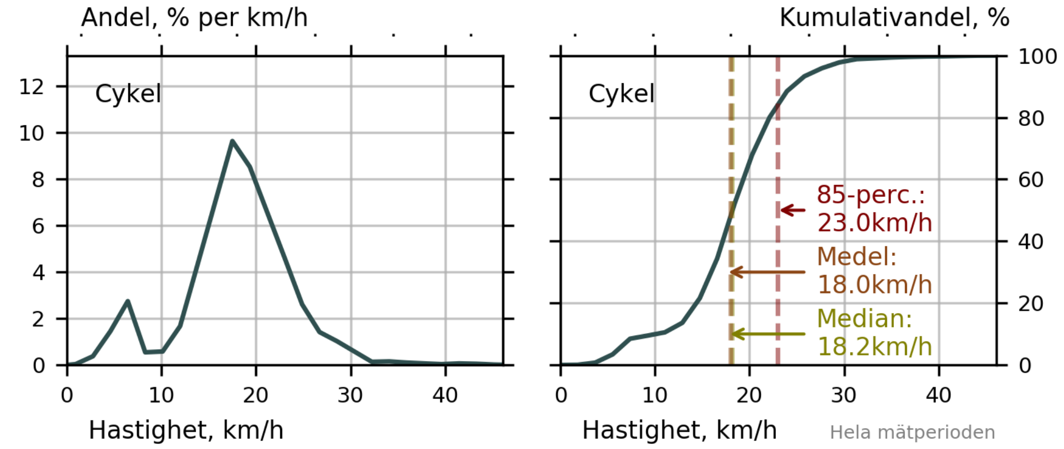


Figure 138. Speed distribution for cyclists on the southern sidewalk. Regementsgatan. October 30th, 2020. Viscando, 2021

Motorized vehicles

The motorized vehicle speed per hour during the weekday measurement is presented (divided into light (top) and heavy (bottom) vehicles) below. Light vehicles have a higher speed in general, especially during the night. The light vehicle speeds are the lowest during the afternoon. Heavy vehicle speeds vary more and are probably affected by e.g. bus intensity.

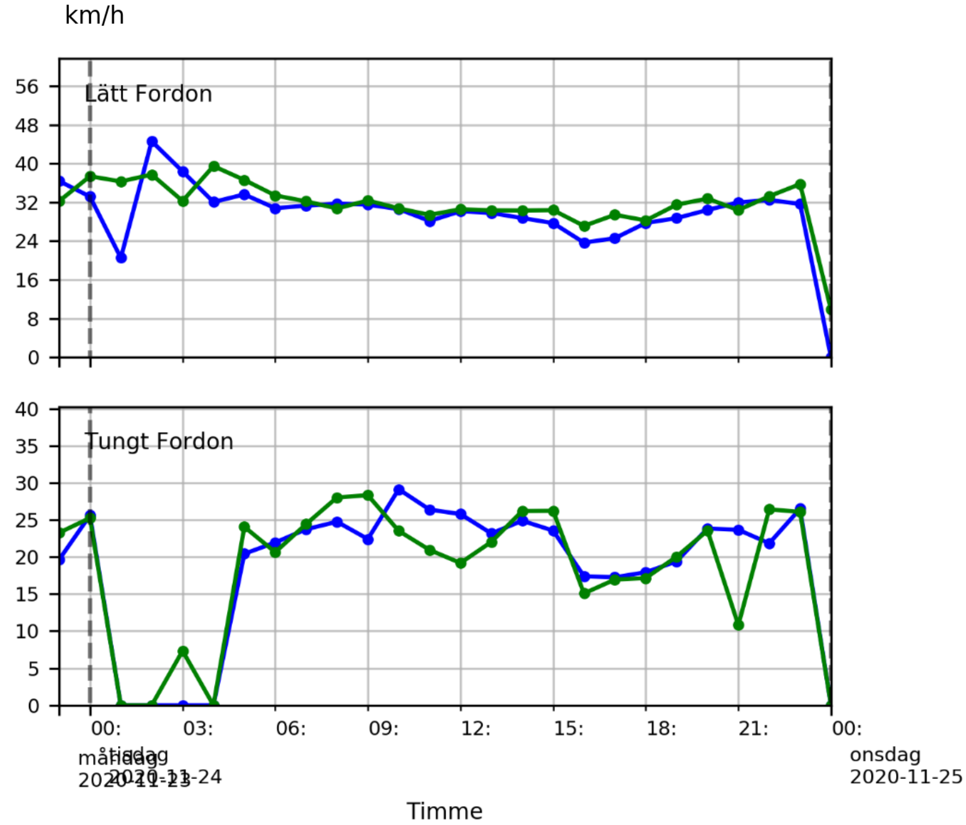


Figure 139. Motorized vehicle speed per hour during the weekday

As can be seen in the table below, neither light nor heavy vehicles have 85-percentiles above the speed limit (40 km/h).

Table 39. Speed for motorized vehicles on Regementsgatan (Liveability). 24 November

Speed (km/h)	Light vehicles	Heavy vehicles
Median	30.0	24.0
Average	29.6	22.2
85-percentile	36.7	30.8

Activities

Demographics

On Regementsgatan, mostly women were observed (59%), more than on any other of the streets. There is also a higher share of people over 65 years old.

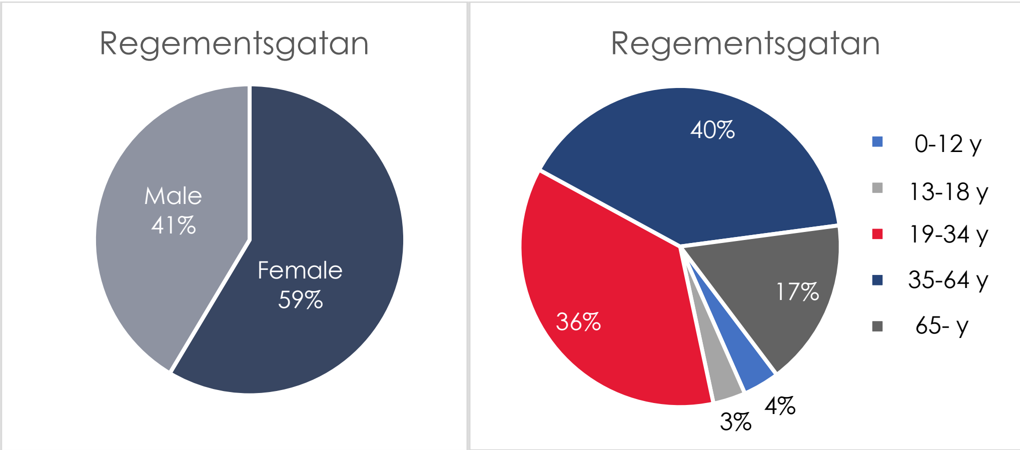


Figure 140. Gender and age distribution for pedestrians on Regementsgatan

Regarding walking with aids, 12 per cent of the observed pedestrians fell under that category. The share of aids resembles the Mariedalsvägen results, with most pedestrians having a pet or a stroller with them.

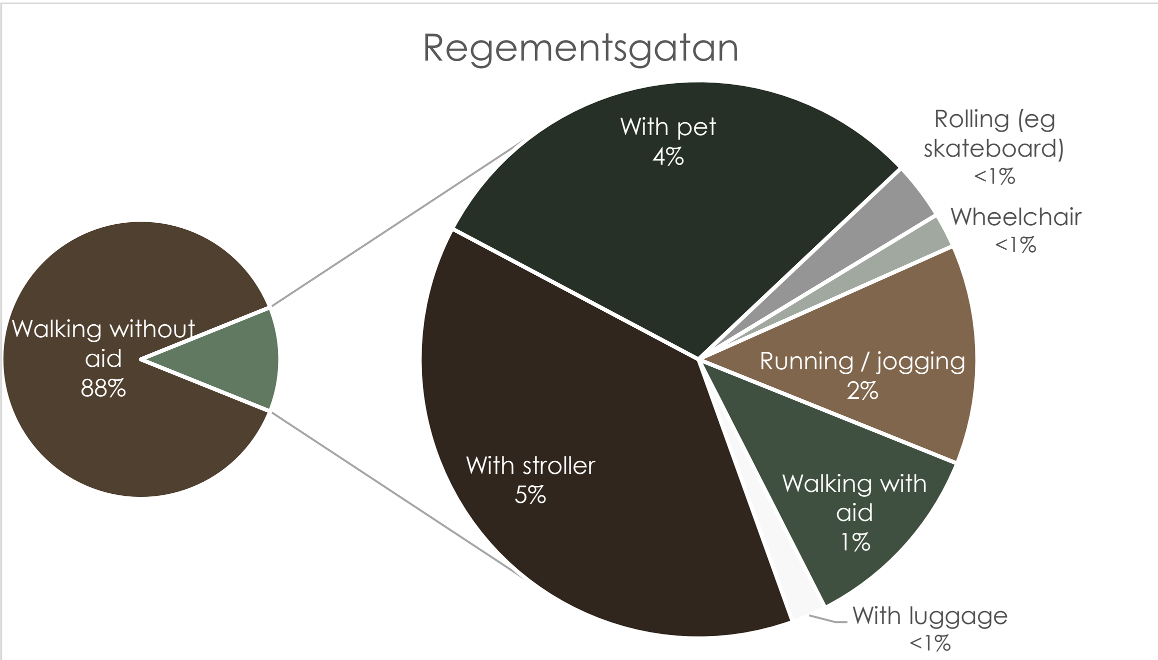


Figure 141. Proportion of pedestrians who use aids on Mariedalsvägen, and type of aid

Stationary events

Figure 142. Sidewalk zones along Regementsgatan

In Table 40 the number of stationary events per zone and all zones total is presented. On average, 9 per cent of all pedestrians passing through the zones stop (definition of a stationary event is when a person transitions from pedestrian to stationary by having a speed of less than 1 km/h for at least 2 seconds). Of all these events, every 5th event is made in a group of at least 2 people. Looking at the individual zones, it is A2 (17% of all pedestrians) followed by A1 (11%), which are the most popular. Both zones have restaurants/cafés on the bottom floors.

Table 40. Stationary events on Regementsgatan in total and per zone

Zone	Average number of stationary events per hour	Share of stationary events of all pedestrians	Share of stationary events standing in group
Regementsgatan	**8 st**	**9%**	**21%**
A1	9 st	11%	24%
A2	11 st	17%	19%
A3	4 st	6%	23%
B1	9 st	6%	17%
B2	8 st	6%	25%

Looking at when the stationary events occur, there are almost no stationary events during the night on the weekday measurement. After a calmer morning, plenty of stationary events happen from lunch and onwards, varying between what zone is the most popular.

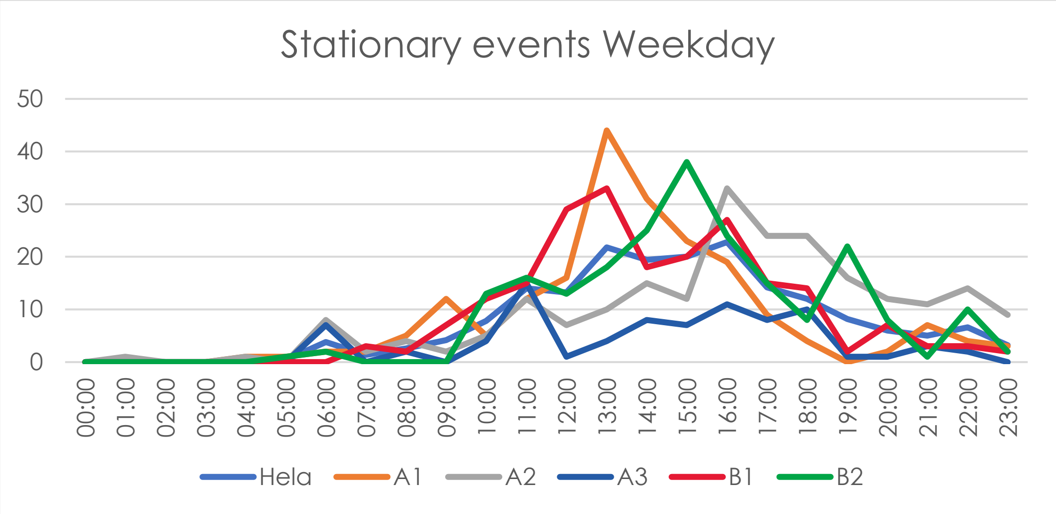


Figure 143. Average number of stationary events per hour during weekdays for Regementsgatan's different zones

During the weekend, stationary events look rather similar, but with some exceptions. Firstly, there are more events during night-time (with zone A2 registering over 20 stationary events over one hour). Secondly, a large spike can be seen at A2 at 6 PM, and a smaller by 10 PM in A2.

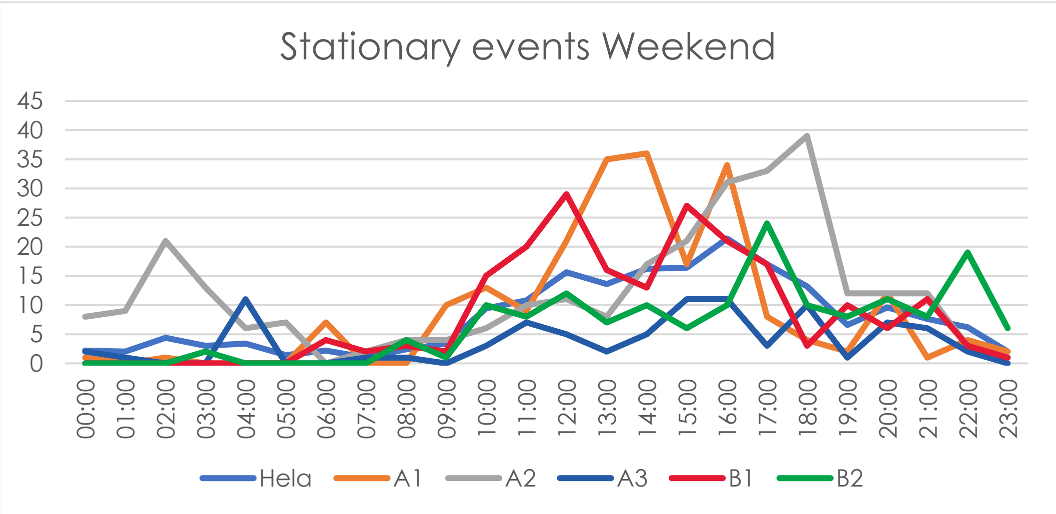


Figure 144. Average number of stationary events per hour during the weekend for Regementsgatan's different zones

Degree of occupancy

The degree of occupancy varies between the different zones, ranging from 0.06 in A3 to 0.15 in B2, resulting in 27 pedestrians per hour in all zones (0.11 per m2) on average. It seems more likely that the B-zones have a higher pedestrian flow in total on a smaller surface.

Table 41. Degree of occupancy of Regementsgatan in total and per zone

Zone	Average number of pedestrians per hour	Average number of pedestrians per hour per m2
Regementsgatan	27 st	0,11
A1	25 st	0,09
A2	29 st	0,10
A3	14 st	0,06
B1	30 st	0,14
B2	38 st	0,15

Looking at the distribution over the weekday, Figure 145, the B zones have the shape of a flatter but even hill, starting at 10 in the morning and ending at 20. The A zones have two individual but steeper curves, A1 reaching its peak at lunch followed by a slow decline, A2 peaking around 17.

During the weekend measurement, see Figure 146, the peak of occupancy reaches the same average number of pedestrians per square meter as the weekday, here during the lunch hour, followed by a slower decline until midnight.

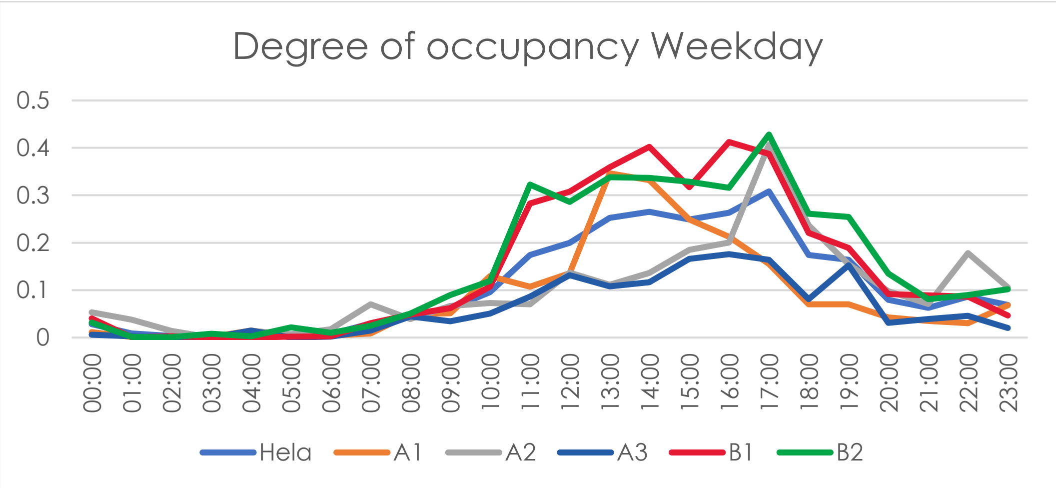


Figure 145. Average degree of occupancy per hour during weekdays for Regementsgatan's zones

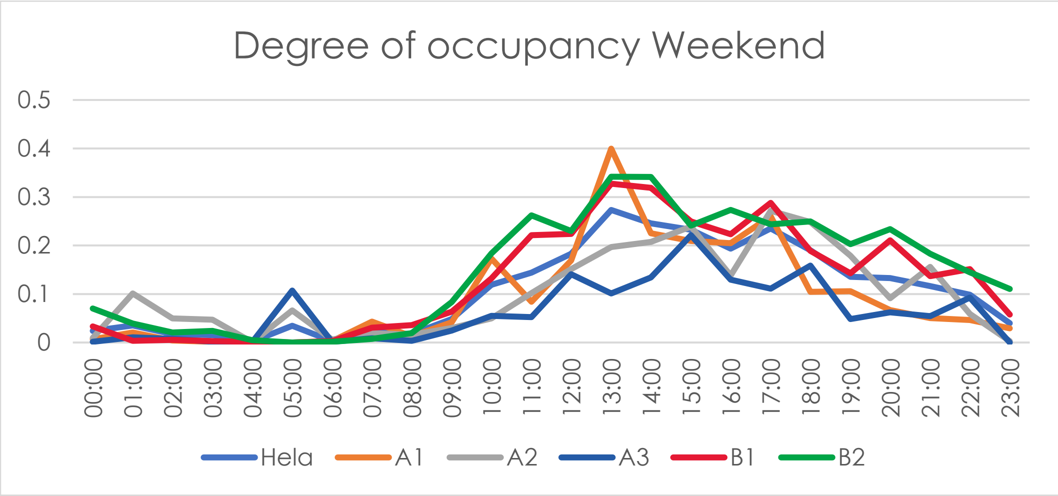


Figure 146. Average degree of occupancy per hour during the weekend for Regementsgatan's zones

6.6.5 Discussion

An overview with comparing data from the streets are presented below.

Table 42. Comparison of the streets. *Cyclists speeds on Mariedalsvägen are measured on the road, not the sidewalks

Comparison		MDV (M)	SVG (S)	RG (L)
Pedestrian speed (median)	km/h	5.7	5.2	5.7
Pedestrian speed (85-perc)		7.0	6.0	6.8
Cyclist speed (median)		21.4*	16.7	18.2
Cyclist speed (85-perc)		33.7*	21.0	23.0
Light veh speed (median)		29.5	31.2	30.0
Light veh speed (85-perc)		38.5	36.7	36.7
Stationary events (avg)	Events per hour (share of ped. flow)	16 (5%)	2 (4%)	8 (9%)
Stationary events (max)		61 (5%)	2 (8%)	11 (17%)
Degree of occupancy (avg)	Ped. per hour (per m2)	31 (0.30)	10 (0.06)	27 (0.11)
Degree of occupancy (max)		92 (0.85)	13 (0.09)	38 (0.15)

The conclusion from the dialogue project was that the Mobility and Sustainability streets referred to in this section are perceived as similar in several aspects. Even though some participants thought of the streets as having street life, a lot of comments were about the traffic being disordered and fast.

An example of traffic experience is that both Mariedalsvägen and Stora Varvsgatan were perceived as “fast” – indicating high speeds in the general traffic. Looking at Table 42, the light vehicle speeds does not differ compared to Regementsgatan, where traffic speed was mentioned seldom. On Mariedalsvägen however, the 85-percentile is higher which could indicate that speeding occurs by some (it is still below the speed limit of 40 km/h though).

On Mariedalsvägen, people didn’t think everyone had enough space on the street, which is correct when looking at how cyclists use the street. Every third cycle uses the footway, not the car lanes where they have been referred to. This stands in starch contrast to the other two streets with dedicated cycle lanes with a higher share on the intended space: 98% on Stora Varvsgatan (cycle lanes on both sides of the street) and 87% on Regementsgatan (cycle lane on one side of the street).

Looking at the pedestrian speeds on the streets, people do not change their walking tempo significantly depending on the type of street they’re on. Stora Varvsgatan shows a lower median speed, however, this could also depend on *where* the measurements are made: plenty of the measured pedestrians are passing signalised crossings where they slow down or wait briefly before passing, which could affect the total median values.

Looking at the pedestrian group and the characteristics. As the observations could not be made by the algorithm from the videos, manual on-site observation had to be made during other occasions, which does not last a full 24 hour period however they are considered to be reliant. Findings regarding age and gender differ somewhat, where Regementsgatan and Mariedalsvägen have more women moving along the street by foot. The streets are in the same neighbourhood. Regementsgatan has registered a higher share of the oldest age group (65 years and older, 17%), while Stora Varvsgatan only has 4%. As the area around Stora Varvsgatan mainly consists of offices, this perhaps come as no surprise.

The number of people using *aids* along the streets is constant around 13 per cent. This group of people can be seen as a *complex pedestrian*. They can be expected to be limited in their attention to the environment. This requires proper surfaces, a well-adapted speed of motorized vehicles and an even higher responsibility for the safety and security of those who move at a higher speed than walking speed. How to cope with this in future design is something that needs to be discussed further.

Looking at the data from the Activities chapters for each street, the results show variation between the streets. Stationary events could indicate *how* the streets invite people to stop along the street. This could be people sitting on a bench, conversating on the sidewalk with a friend or simply waiting for something. If a street has plenty of stationary events, this could be a place where people want to stop or make an appointment with a friend as it is a nice place. It could also be that a café or shop makes a person stop by. The exact reason for the registered stationary event is however unknown.

Comparing the stationary events, Mariedalsvägen shows the most events per hour, with a maximum of 61 events *on average* in zone B2. This means that a stationary event happens every minute in that specific zone, while B1 and B3 have 5 and 3 events per hour on average, respectively. The reason for the B2 zone to have a high number is the shop/postal service that exists in the building next to the zone. With covid restrictions, perhaps the queue for e.g. picking up a package had to be placed outside, hence the stationary events.

For Stora Varvsgatan with few activities along the facades and lack of benches, the number of stationary events per hour is low on average. The figures are higher for Regementsgatan, classed as a Liveability street here, every 10th pedestrian stop by, registering as a stationary event. This can indicate that the experience of Regementsgatan being pleasant and having street life makes more people stop by on the street, whereas e.g. Stora Varvsgatan does not invite pedestrians to do the same.

In total, the zones that have the most stationary events are the ones with activities on the ground floor with restaurants, shops and cafés. The Stora Varvsgatan measurement is disregarded in this conclusion as activities open for the public is missing along the street.

Looking at the degree of occupancy, the results vary once again between the streets. The highest average number of pedestrians, both per hour and per hour *and* m2, is found on

Mariedalsvägen. Once again, the B2 zone is a great contributor to the average. Even with this outlier, Regementsgatan is similar to Mariedalsvägen looking at all zones combined. As the sidewalks are wider on Regementsgatan than Mariedalsvägen, the per m2-measure disfavour the Liveability-street.

Looking at the A-zones on Regementsgatan, some interesting facts could be interpreted. The A3 zone has around half of the pedestrians per hour of the A1 and A2 zones. This could indicate that people slow down because they are around the shops and cafés, or that the sidewalk gets wider and give possibilities for slower speeds. These assumptions cannot be verified, however.

Combining the findings from the dialogue project with the data collection is challenging as the projects were not initially meant to compare to each other. With this view, perhaps some questions or key-value words from the dialogue or indicators from the data collection would be designed differently.

Concluding, the findings from the data collection are not crystal clear. While the Liveability street (Regementsgatan) shows good performance in the defined activity indicators and the Sustainability street does not, Mariedalsvägen (Mobility) tell an unanticipated story. The high degree occupancy and stationary events are likely rather because of certain shops than the street itself.

7 Appendices

7.1 Budapest - Analysed KPIs at VISSIM modelling

7.1.1 Delay Results:

- SIMRUN: SimRun, Simulation run (Number of simulations run)
- TIMEINT: TimeInt, Time interval (Time interval)
- DELAYMEASUREMENT: DelayMeasurement, Delay measurement (Delay Measurement)
- STOPDELAY(ALL): StopDelay(All), Stopped delay (average) (All) (Average stopped delay per vehicle in seconds without stops at PT stops and in parking lots) [s]
- STOPS(ALL): Stops(All), Stops (All) (Average number of vehicles stops per vehicle without stops at PT stops and in parking lots)
- VEHDELAY(ALL): VehDelay(All), Vehicle delay (average) (All) (Average delay time of all vehicles. The delay of a vehicle in leaving a travel time measurement is obtained by subtracting the theoretical (ideal) travel time from the actual travel time. The theoretical travel time is the travel time which could be achieved if there were no other vehicles and/or no signal controls or other reasons for stops. Reduced speed areas are taken into account. The actual travel time does not include any passenger service times of PT vehicles at stops and no parking time in real parking lots. The delay due to braking before a PT stop and/or the subsequent acceleration after a PT stop are part of the delay.) [s]
- VEHS(ALL): Vehs(All), Vehicles (All) (Number of vehicles)
- STOPDELAY(30): STOPDELAY(ALL) for Public Transport
- STOPS(30): STOPS(ALL) for Public Transport
- VEHDELAY(30): VEHDELAY(ALL) for Public Transport
- VEHS(30): VEHS(ALL) for Public Transport

7.1.2 Pedestrian Network Performance Evaluation Results

- SIMRUN: SimRun, Simulation run (Number of simulations run)
- TIMEINT: TimeInt, Time interval (Time interval)

- PEDENT(ALL): PedEnt(All), Pedestrians (entered) (All) (Total number of pedestrians that have newly been inserted into the network in the evaluation interval.)

- PEDARR(ALL): PedArr(All), Pedestrians (arrived) (All) (Total number of pedestrians who have reached their destination during the evaluation interval and have been removed from the network.)

- PEDACT(ALL): PedAct(All), Pedestrians (active) (All) (During the evaluation interval: Total number of pedestrians which are currently in the network. After the end of the evaluation interval: Total number of pedestrians which were in the network at the end of the evaluation interval. The pedestrians which have arrived PedArr (Pedestrians (arrived)) and the pedestrians which have not yet been inserted are not accounted for. .)

- DENSAVG(ALL): DensAvg(All), Density (average) (All) (Average pedestrian density: Ratio of pedestrians in the network to walkable areas) [ped/m2]

- SPEEDAVG(ALL): SpeedAvg(All), Speed (average) (All) (Average speed: Total distance DistTot / Total travel time TravTmTot) [km/h]

- FLOWAVG(ALL): FlowAvg(All), Flow (average) (All) (Product of current speed, averaged over all pedestrians and the current density) [ped/m s]

- TRAVTMAVG(ALL): TravTmAvg(All), Travel time (average) (All) (Average travel time of pedestrians traveling within the network or who have already been removed from the network.) [s]

- FLOWTODESTAVG(ALL): FlowToDestAvg(All), Flow towards destination (average) (All) (Product of current speed, averaged over pedestrians and current density, accounting for static potential and position of each pedestrian) [ped/m s]

- SPEEDTODESTAVG(ALL): SpeedToDestAvg(All), Speed towards destination (average) (All) (Average speed Total distance DistTot / Total travel time TravTmTot accounting for the static potential and position of each pedestrian) [km/h]

- STOPSAVG(ALL): StopsAvg(All), Stops (average) (All) (Average number of stops per pedestrian during the evaluation interval. A pedestrian is counted as standing still when its walking speed is below 0.2 m/s. Total number of stops / (Number of ped in the network + number of ped that have arrived))

- STOPSAVG(ALL): StopsAvg(All), Stops (average) (All) (Average number of stops per pedestrian during the evaluation interval. A pedestrian is counted as standing still when its walking speed is below 0.2 m/s. Total number of stops / (Number of ped in the network + number of ped that have arrived))

- NORMSPEEDAVG(ALL): NormSpeedAvg(All), Normalized Speed (average) (All) (Ratio of actual speed over desired speed, averaged over pedestrians and time steps)

7.1.3 Vehicle Network Performance Evaluation Results

- SIMRUN: SimRun, Simulation run (Number of simulations run)
- TIMEINT: TimeInt, Time interval (Time interval)
- DELAYAVG(ALL): DelayAvg(All), Delay (average) (All) (Average delay per vehicle: Total delay / (Number of veh in the network + number of veh that have arrived)) [s]
- STOPSAVG(ALL): StopsAvg(All), Stops (average) (All) (Average number of stops per vehicle: Total number of stops / (Number of veh in the network + number of veh that have arrived))
- SPEEDAVG(ALL): SpeedAvg(All), Speed (average) (All) (Average speed: Total distance DistTot / Total travel time TravTmTot) [km/h]
- DELAYSTOPAVG(ALL): DelayStopAvg(All), Delay stopped (average) (All) (Average standstill time per vehicle. Total standstill time / (Number of veh in the network + number of veh that have arrived)) [s]
- DISTTOT(ALL): DistTot(All), Distance (total) (All) (Total distance of all vehicles that are in the network or have already left it.) [km]
- TRAVTMTOT(ALL): TravTmTot(All), Travel time (total) (All) (Total travel time of vehicles traveling within the network or that have already left the network.) [s]
- DELAYTOT(ALL): DelayTot(All), Delay (total) (All) (Total delay of all vehicles that are in the network or have already left it. The delay of a vehicle in a time step is the part of the time step that must also be used because the actual speed is less than the desired speed. For the calculation, the quotient is obtained by subtracting the actual distance traveled in this time step and desired speed from the duration of the time step. For example, stop times at stop signs are taken into account. The following times are not taken into account: Stop times of buses/trains at PT stops Passenger service times Parking times in parking lots) [s]
- STOPSTOT(ALL): StopsTot(All), Stops (total) (All) (Total number of stops of all vehicles that are in the network or have already arrived. The following ar not taken into account: (1) Scheduled stops at PT stops, (2) Stop in parking lots A stop is counted if the speed of the vehicle at the end of the previous time step was greater than 0 and is 0 at the end of the current time step.)
- DELAYSTOPTOT(ALL): DelayStopTot(All), Delay stopped (total) (All) (Total standstill time of all vehicles that are in the network or have already arrived. Standstill time = time in which the vehicle is stationary (speed = 0) The following are not taken into account: (1) Stop times of buses/trains at PT stops, (2) Parking times, regardless of parking lot type) [s]

- VEHACT(ALL): VehAct(All), Vehicles (active) (All) (Total number of vehicles in the network at the end of the simulation. The vehicles that have arrived VehArr (Vehicles (arrived) and the vehicles not deployed are not accounted for.)
- VEHARR(ALL): VehArr(All), Vehicles (arrived) (All) (Vehicles arrived: Total number of vehicles which have already reached their destination and have left the network before the end of the simulation.)
- DELAYLATENT: DelayLatent, Delay (latent) (Total delay of vehicles that cannot be used (immediately). Total waiting time of vehicles from input flows and parking lots that were not used at their actual start time in the network. This value may also include the waiting time of vehicles that enter the network before the end of the simulation.) [s]
- DEMANDLATENT: DemandLatent, Demand (latent) (Number of vehicles that could not be used from input flows and parking lots. Number of vehicles that were not allowed to enter the network from input flows and parking lots until the end of the simulation. These vehicles are not counted as vehicles in the VehAct network.)
- DELAYAVG(30): DELAYAVG(ALL) for Public Transport
- STOPSAVG(30): STOPSAVG(ALL) for Public Transport
- SPEEDAVG(30): SPEEDAVG(ALL) for Public Transport
- DELAYSTOPAVG(30): DELAYSTOPAVG(ALL) for Public Transport
- DISTTOT(30): DISTTOT(ALL) for Public Transport
- TRAVTMTOT(30): TRAVTMTOT(ALL) for Public Transport
- DELAYTOT(30): DELAYTOT(ALL) for Public Transport
- STOPSTOT(30): STOPSTOT(ALL) for Public Transport
- DELAYSTOPTOT(30): DELAYSTOPTOT(ALL) for Public Transport
- VEHACT(30): VEHACT(ALL) for Public Transport

7.1.4 Vehicle Travel Time Results

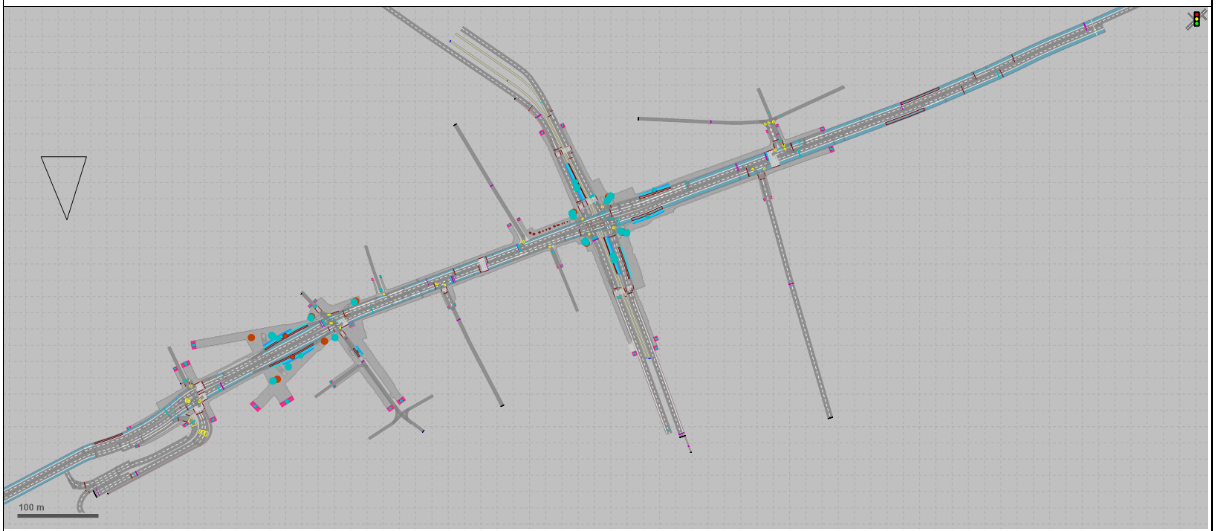
- SIMRUN: SimRun, Simulation run (Number of simulations run)
- TIMEINT: TimeInt, Time interval (Time interval)
- VEHICLETRAVELTIMEMEASUREMENT: VehicleTravelTimeMeasurement, Vehicle travel time evaluation (Vehicle Travel Time Measurement)

- VEHS(ALL): Vehs(All), Vehicles (All) (Number of vehicles recorded)
- TRAVTM(ALL): TravTm(All), Travel time (All) (Average travel time [s] of vehicles in the network) [s]
- DISTTRAV(ALL): DistTrav(All), Distance traveled (All) [m]
- DISTTRAV(30): DISTTRAV(All) for Public Transport
- TRAVTM(30): TRAVTM(All) for Public Transport
- VEHS(30): VEHS(All) for Public Transport

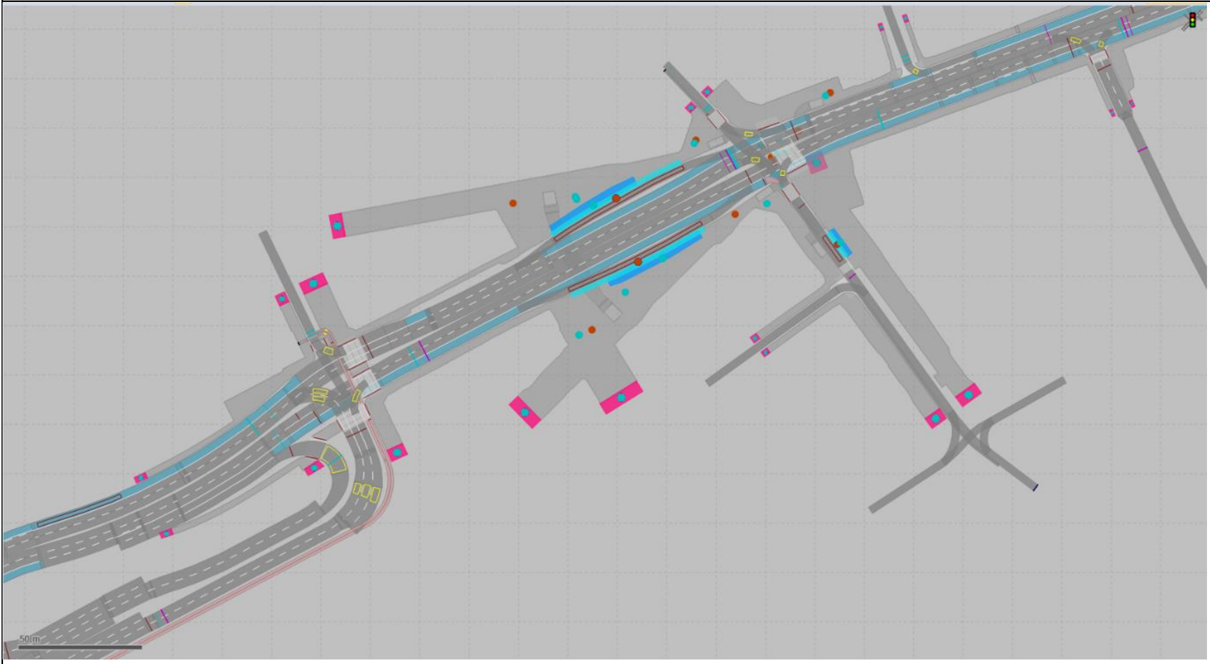
7.2 Budapest VISSIM networks

The following pictures show the modelling environment at the same size for all scenarios.

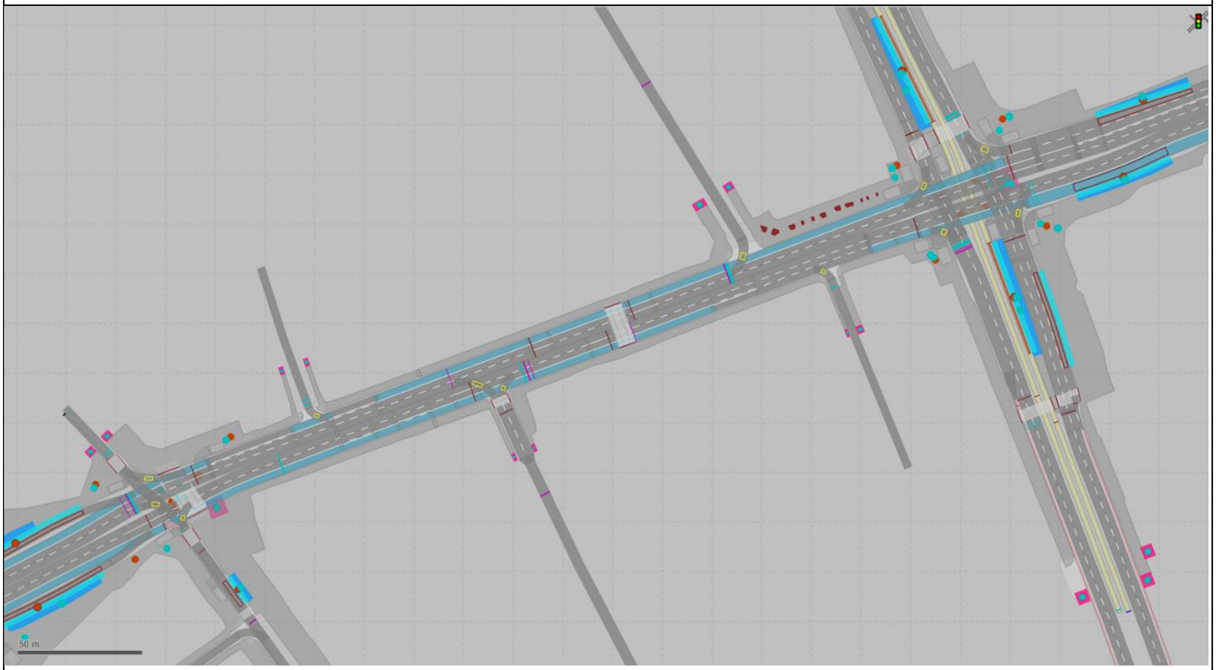
The entire VISSIM network of **Scenario 0**



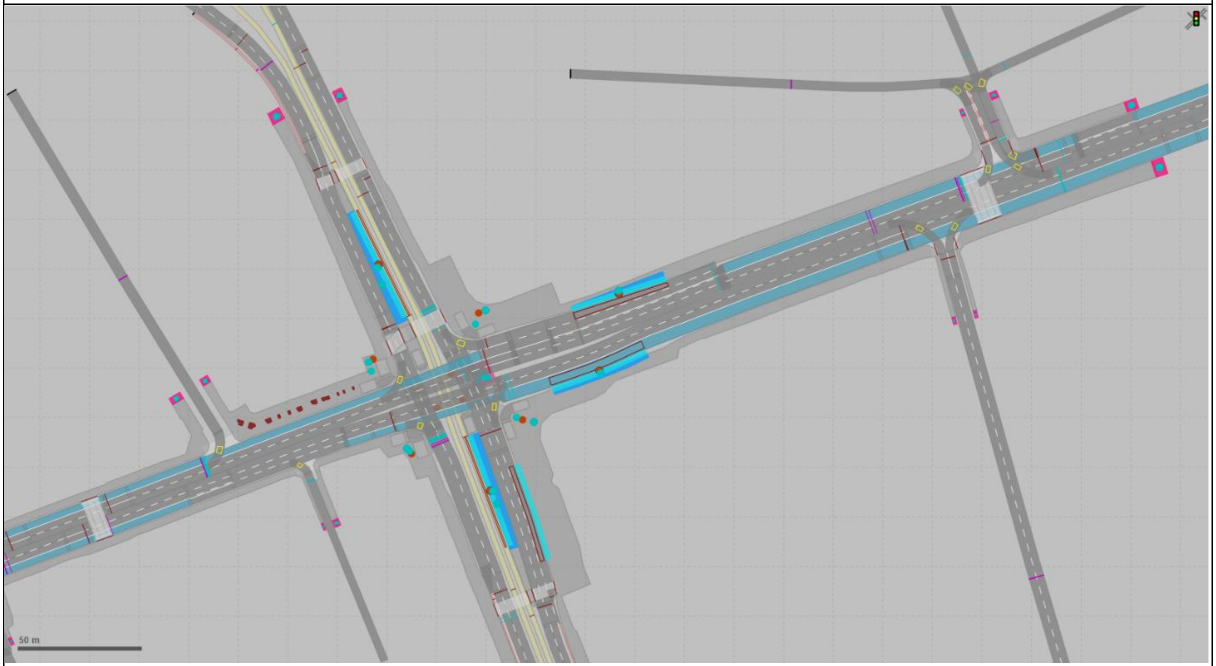
Scenario 0 : Surrounds of Váci street – Kossuth Lajos utca junction and Ferenciek square



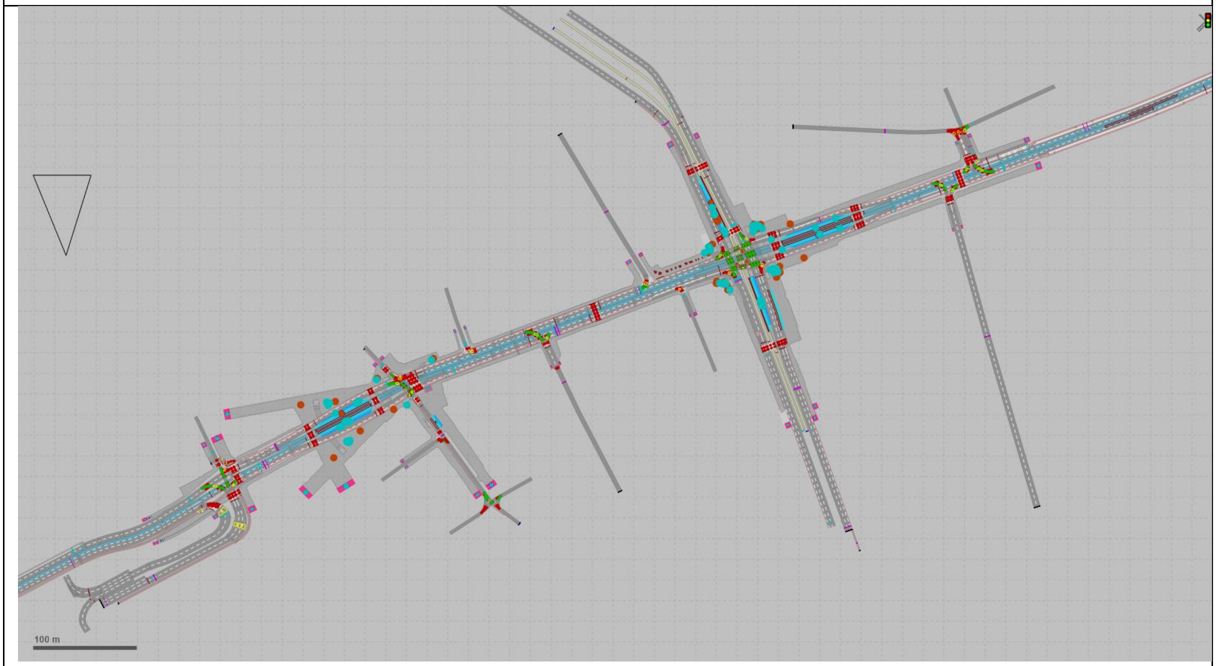
Scenario 0 : Surrounds of Kossuth Lajos Street



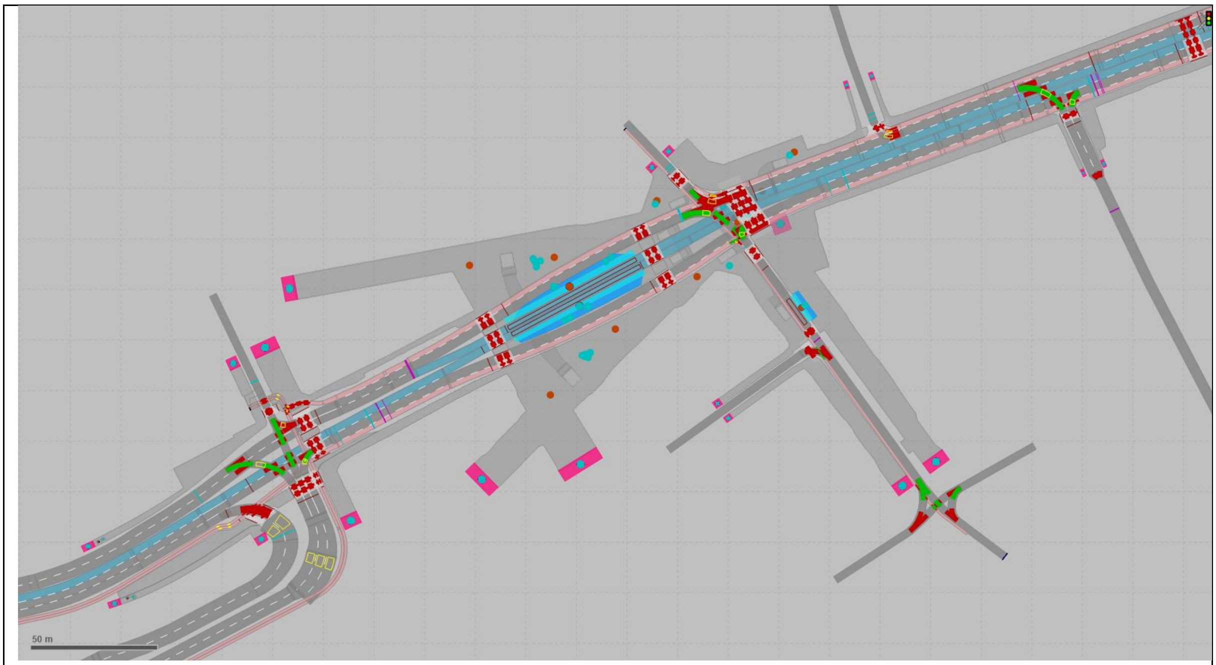
Scenario 0 : Surrounds of Astoria



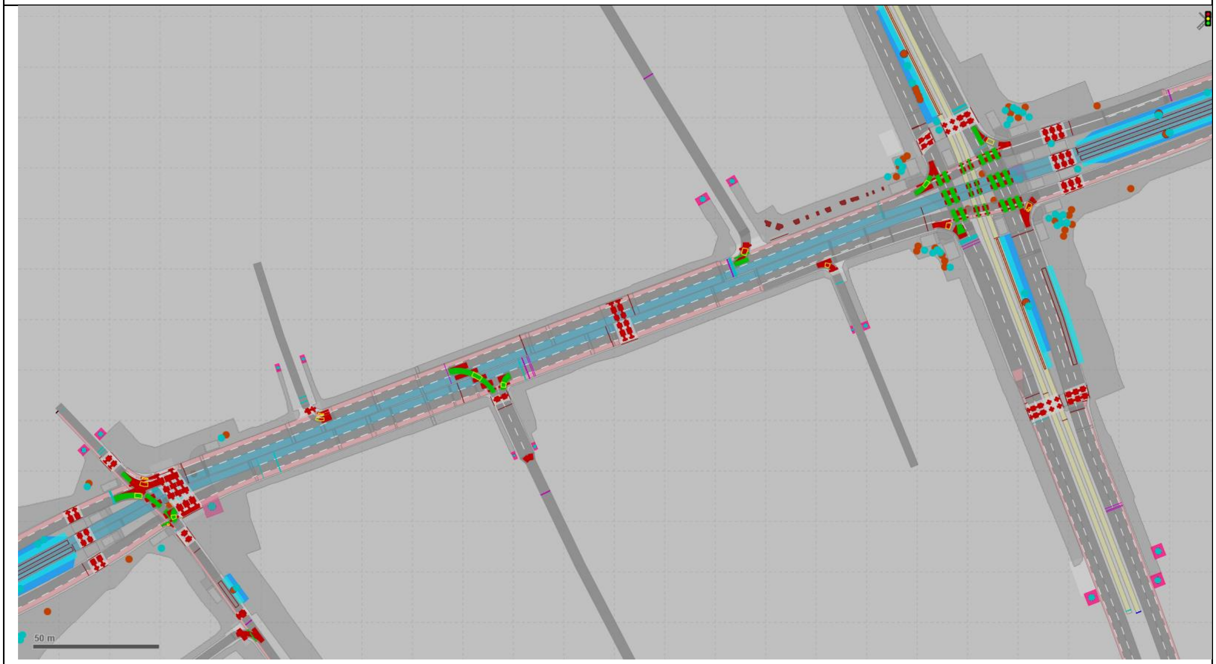
Scenario 1: The entire VISSIM network



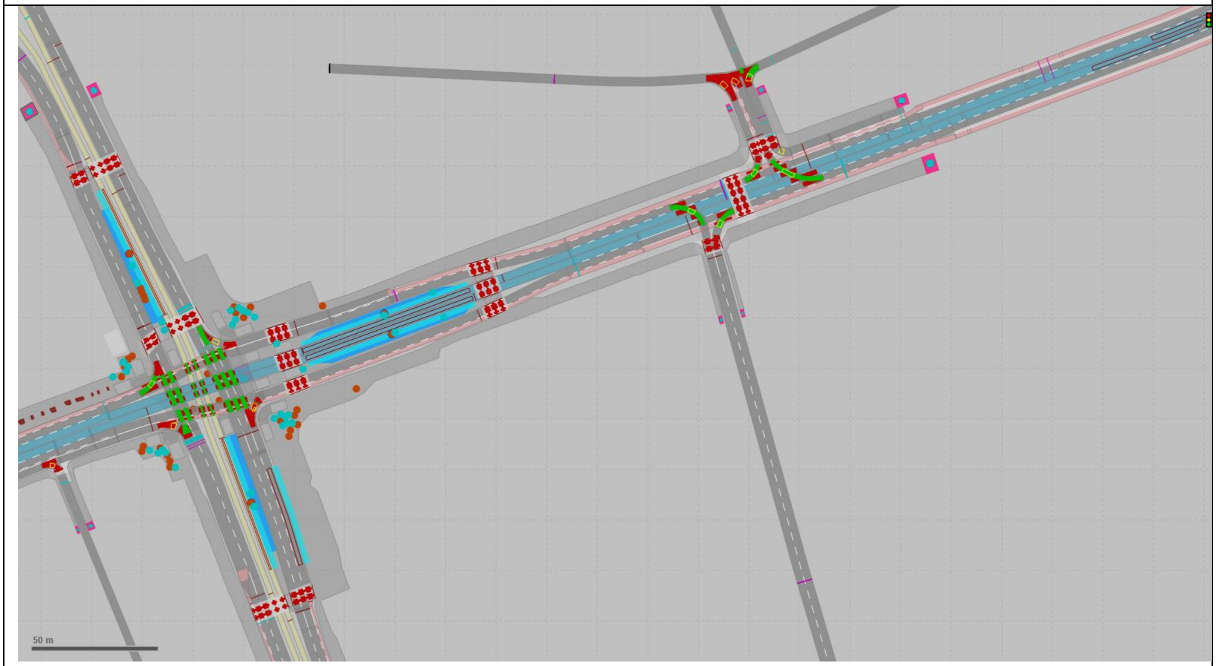
Scenario 1: Surrounds of Váci street – Kossuth Lajos utca junction and Ferenciek square



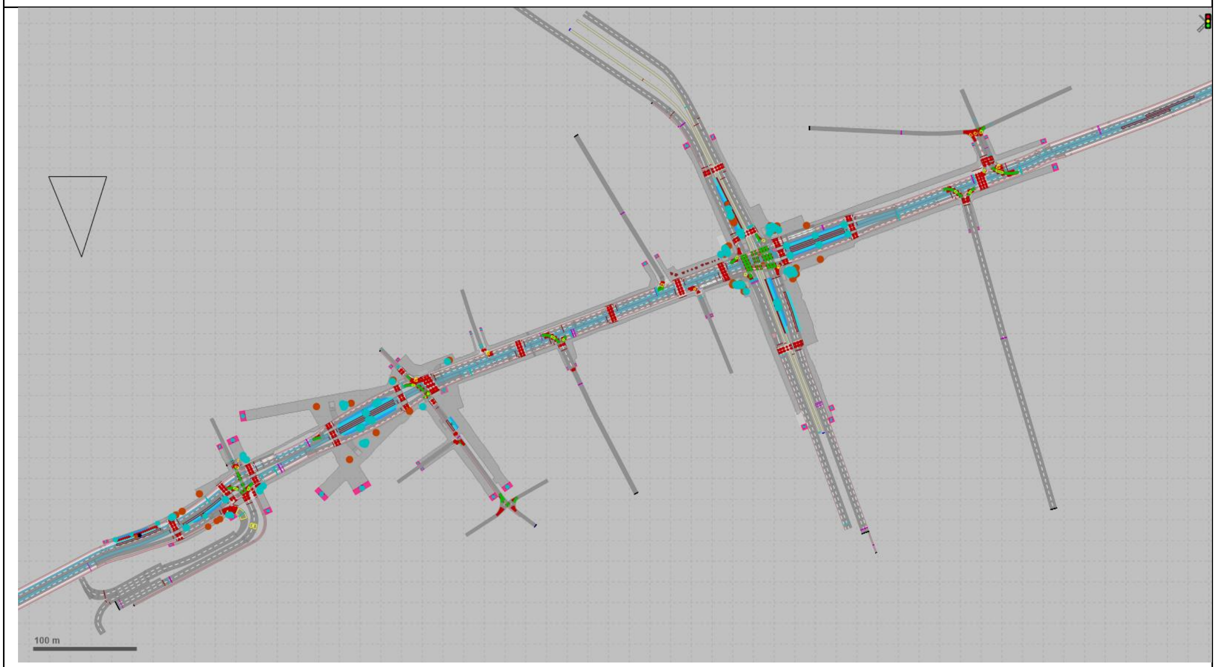
Scenario 1: Surrounds of Kossuth Lajos Street

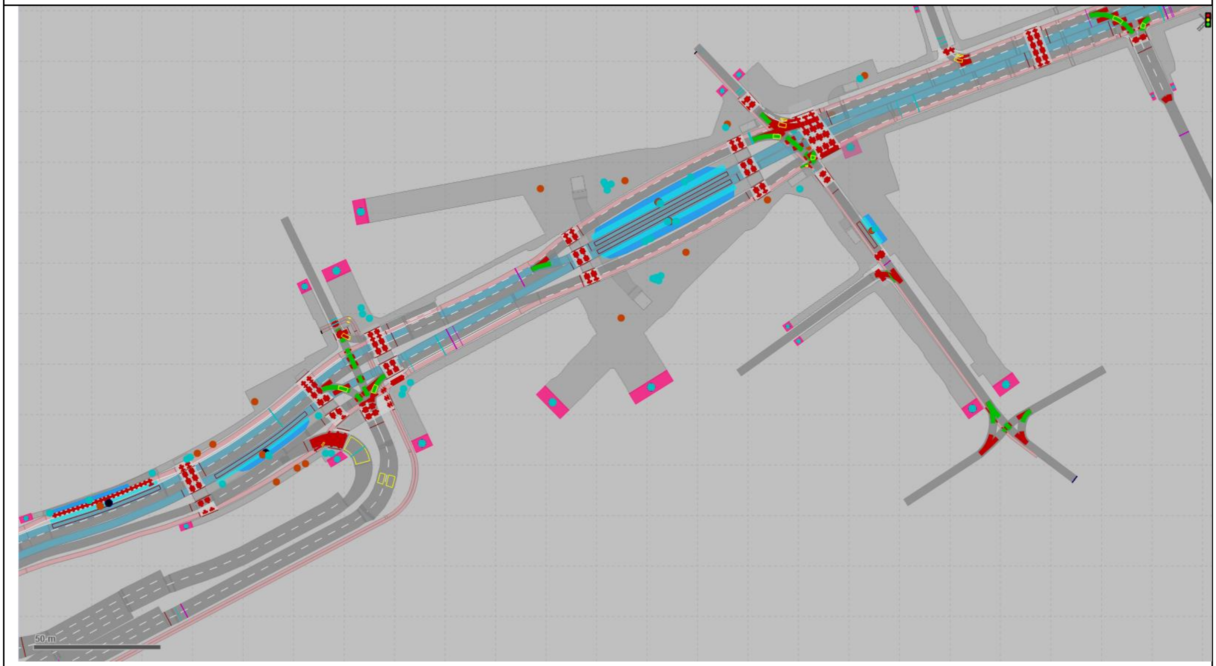


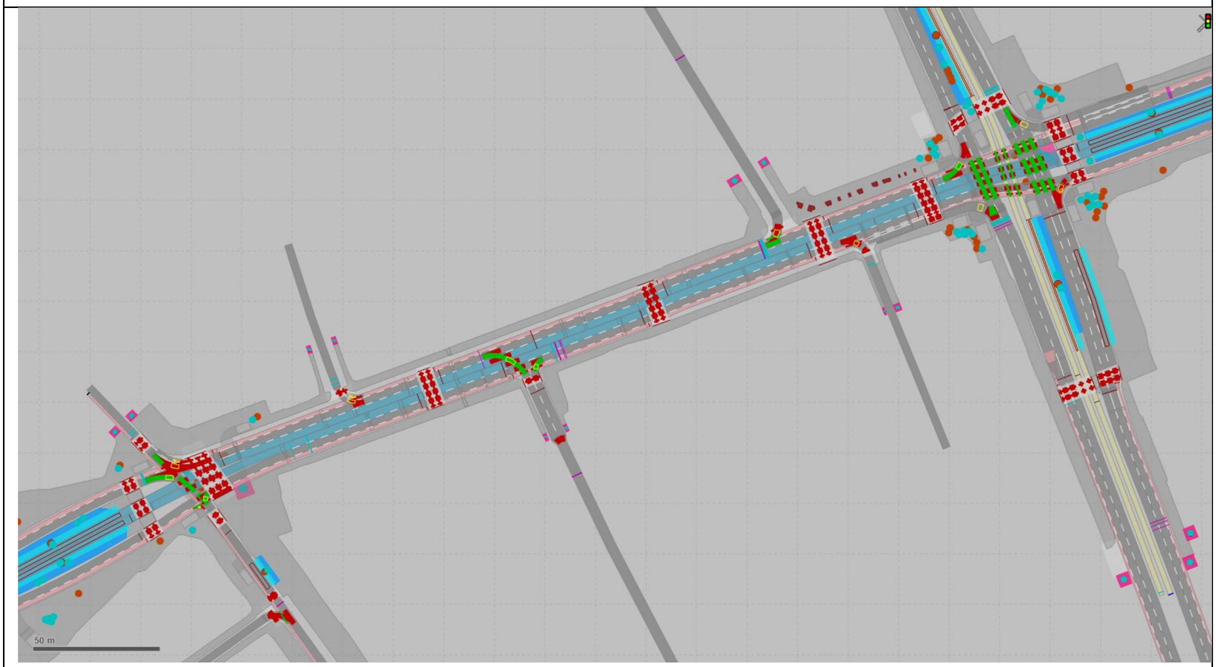
Scenario 1: Surrounds of Astoria

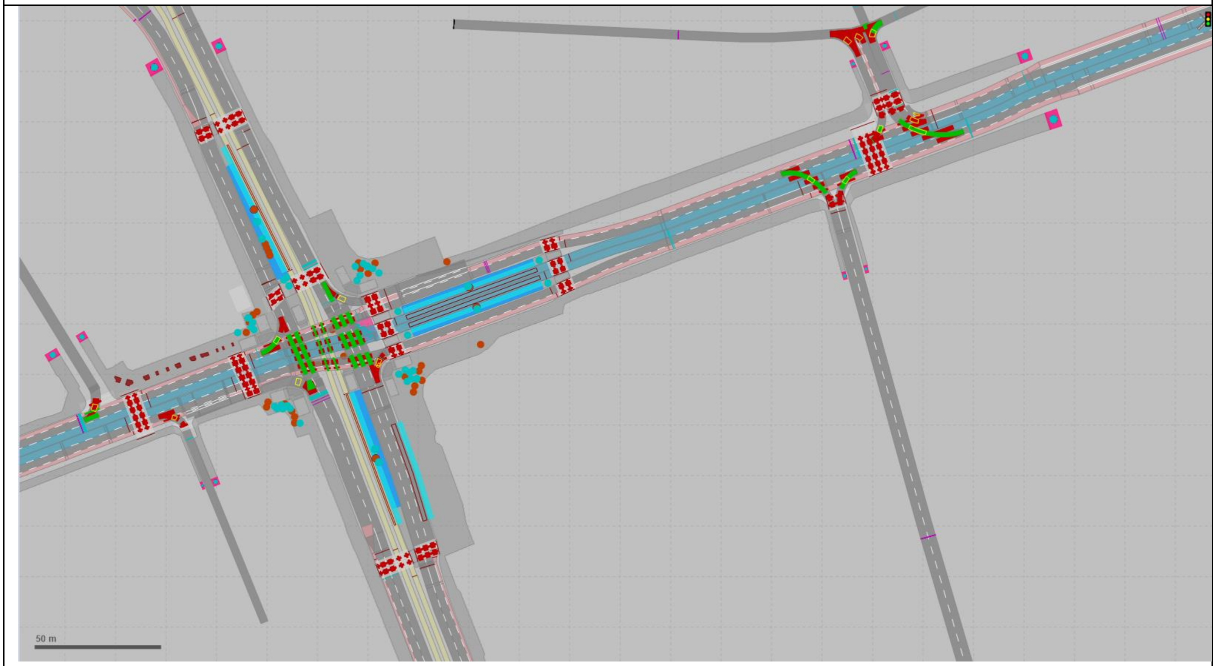


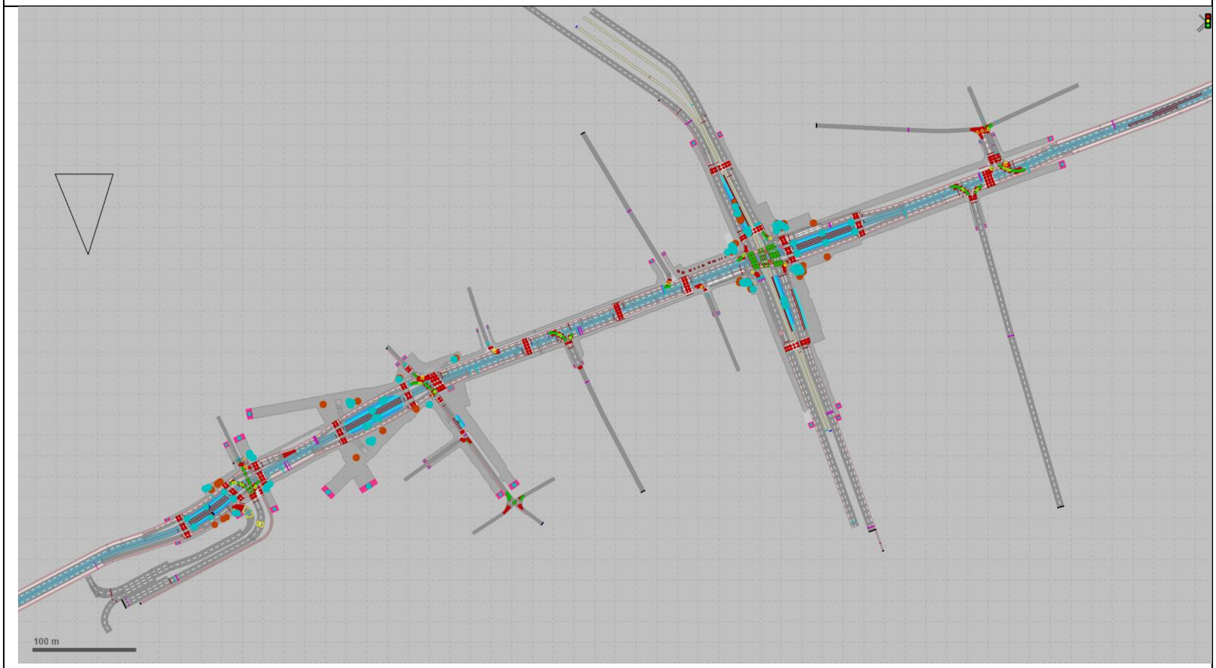
Scenario 2: The entire VISSIM network

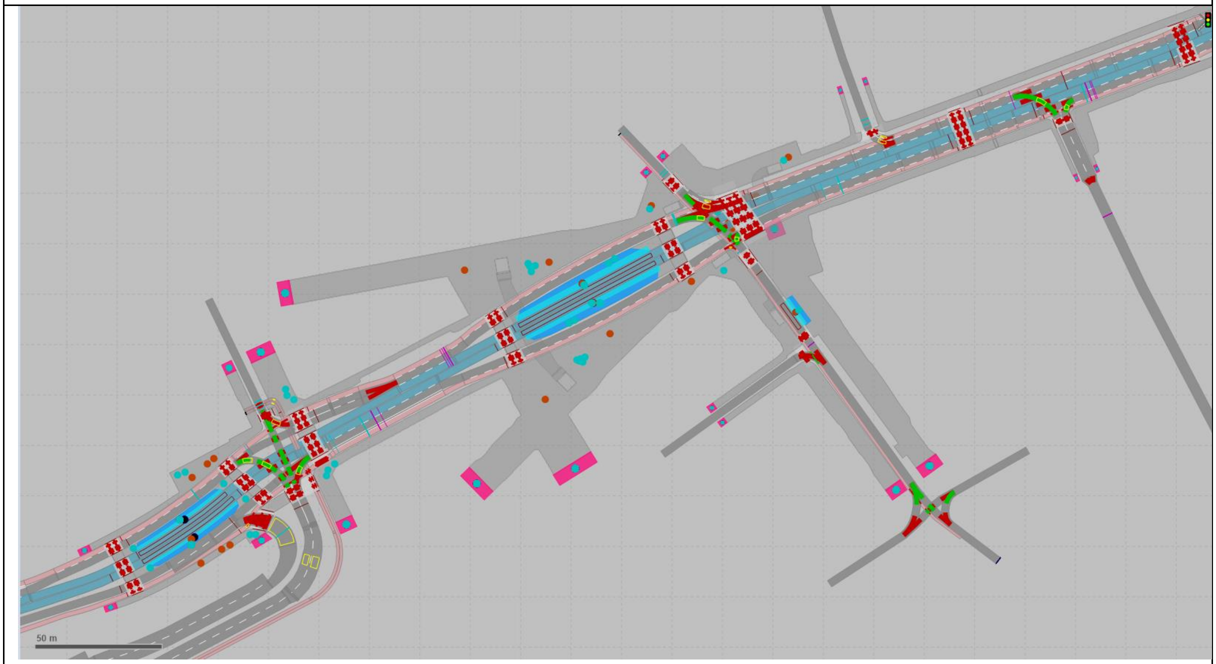


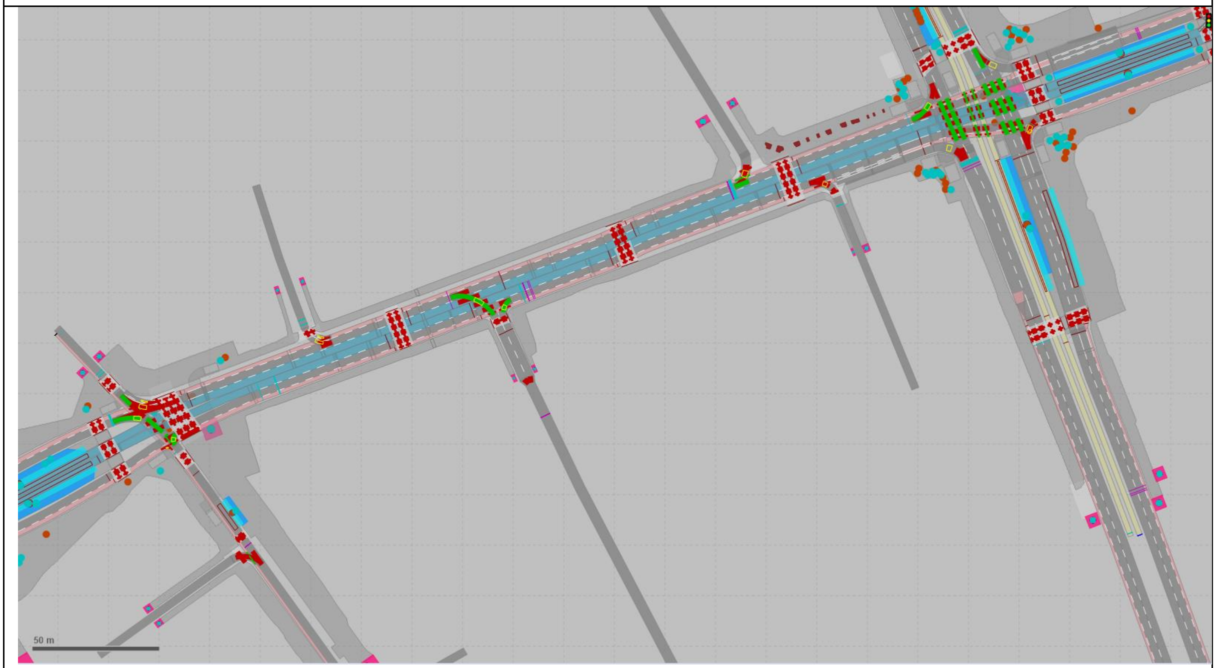
Scenario 2: Surrounds of Váci street – Kossuth Lajos utca junction and Ferenciek square


Scenario 2: Surrounds of Kossuth Lajos Street


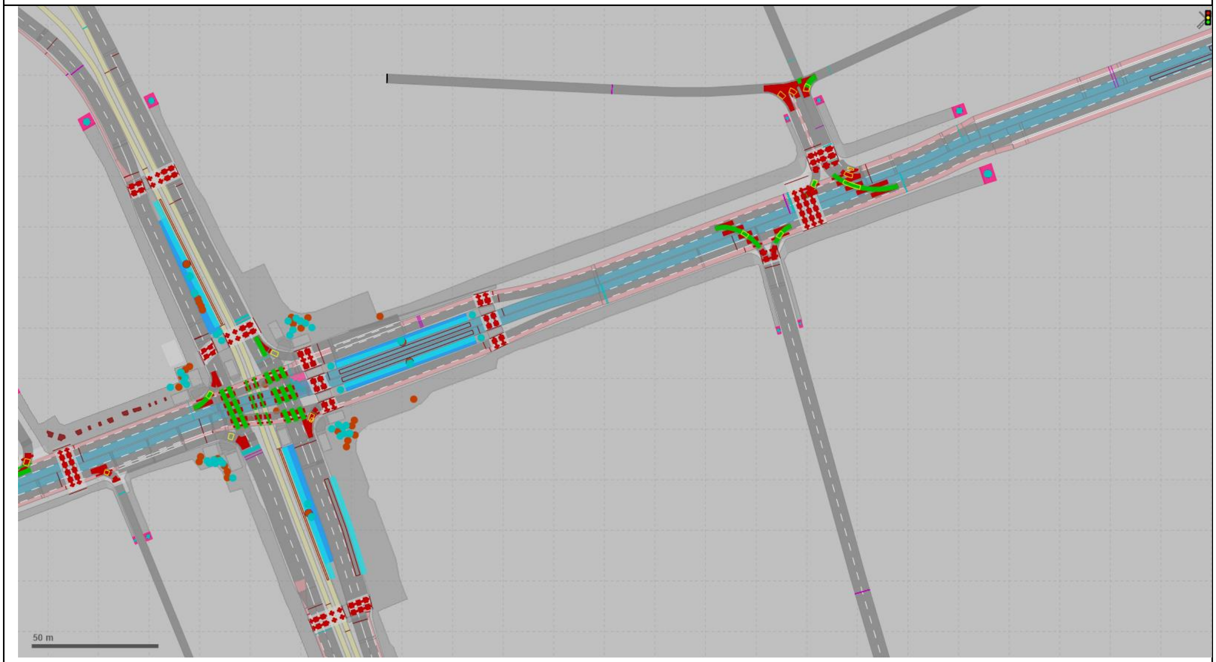
Scenario 2: Surrounds of Astoria


Scenario 3: The entire VISSIM network


Scenario 3: Surrounds of Váci street – Kossuth Lajos utca junction and Ferenciek square


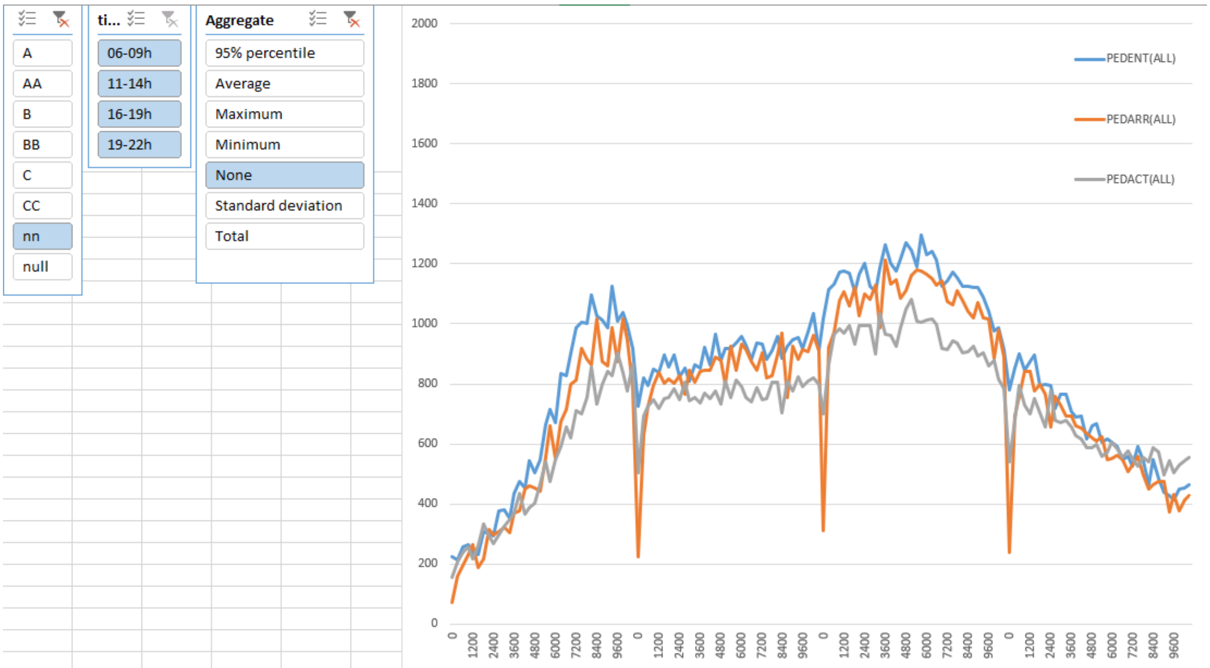
Scenario 3: Surrounds of Kossuth Lajos Street


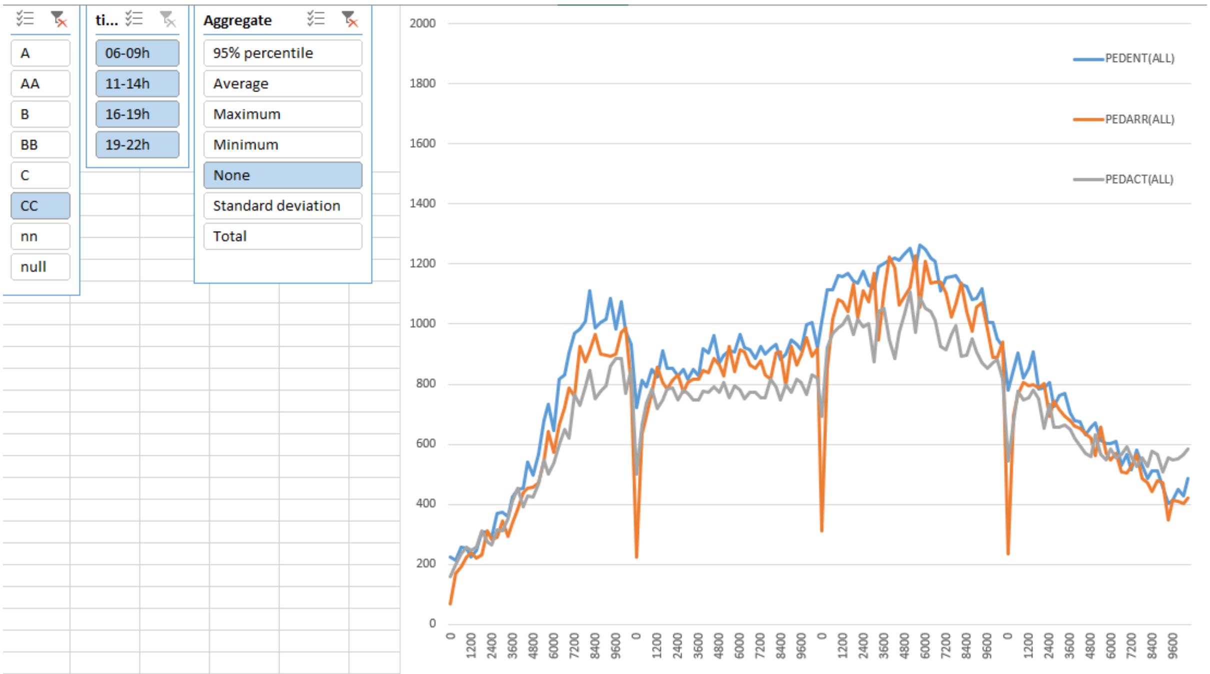
Scenario 3: Surrounds of Astoria

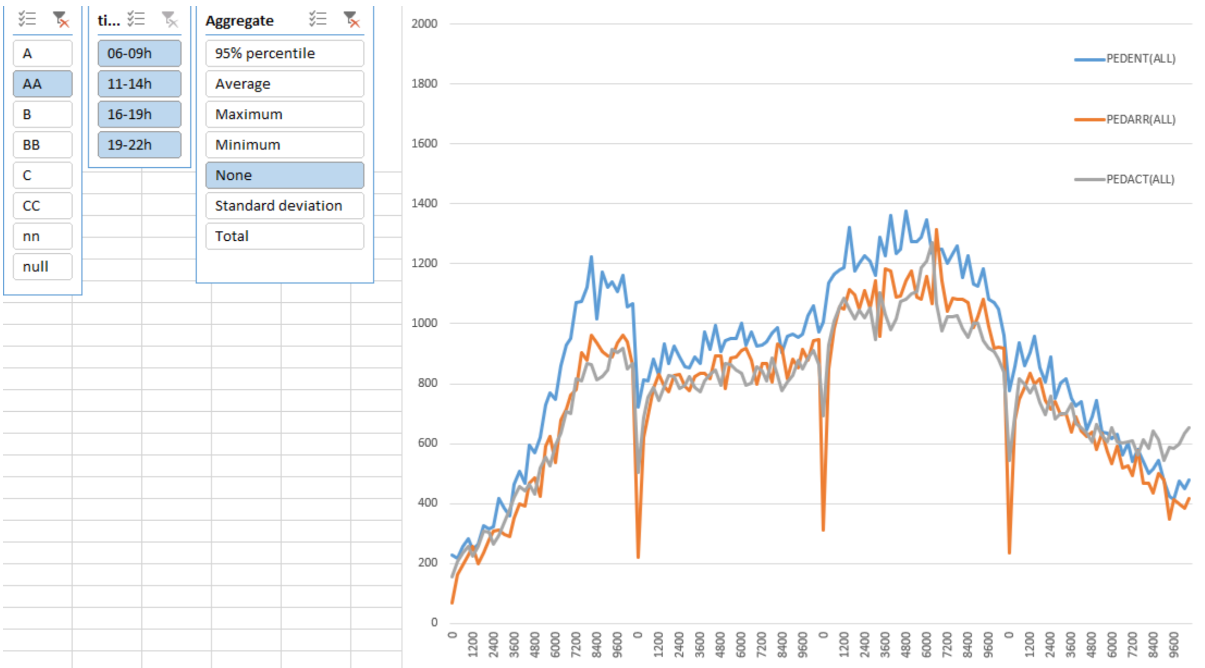


7.3 Budapest Results

7.3.1 Pedestrian Network Performance Evaluation Results




A
AA
B
BB
C
CC
nn
null
ti...
06-09h
11-14h
16-19h
19-22h
Aggregate
95% percentile
Average
Maximum
Minimum
None
Standard deviation
Total
PEDENT(ALL)
PEDARR(ALL)
PEDACT(ALL)


A
AA
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null
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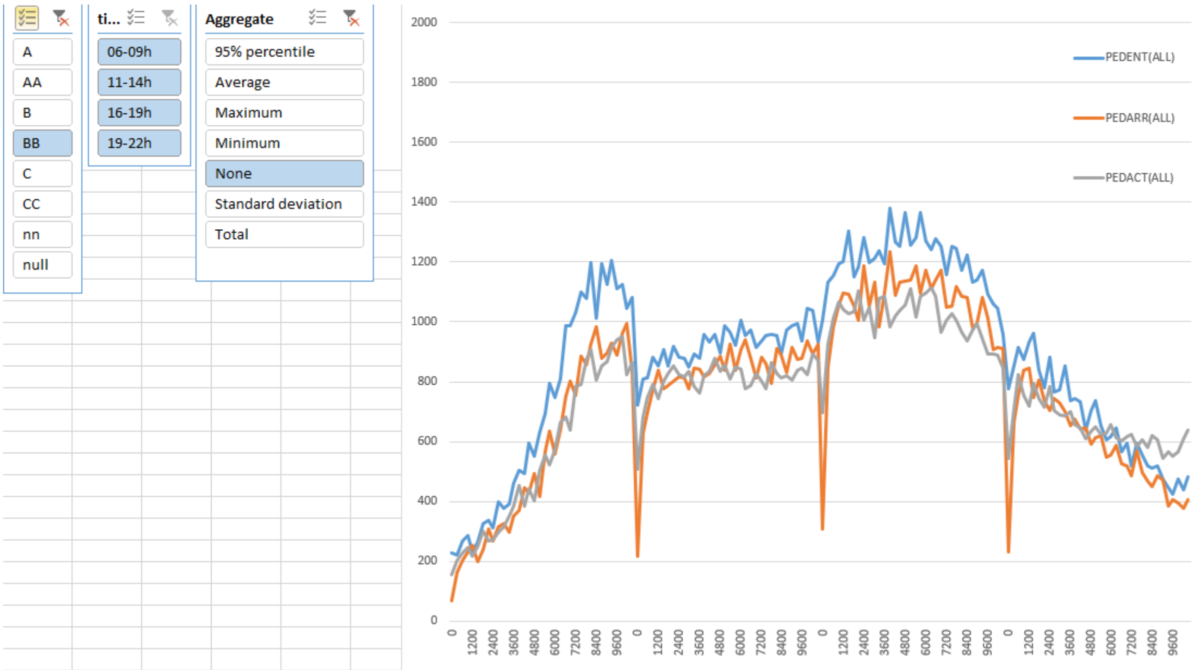
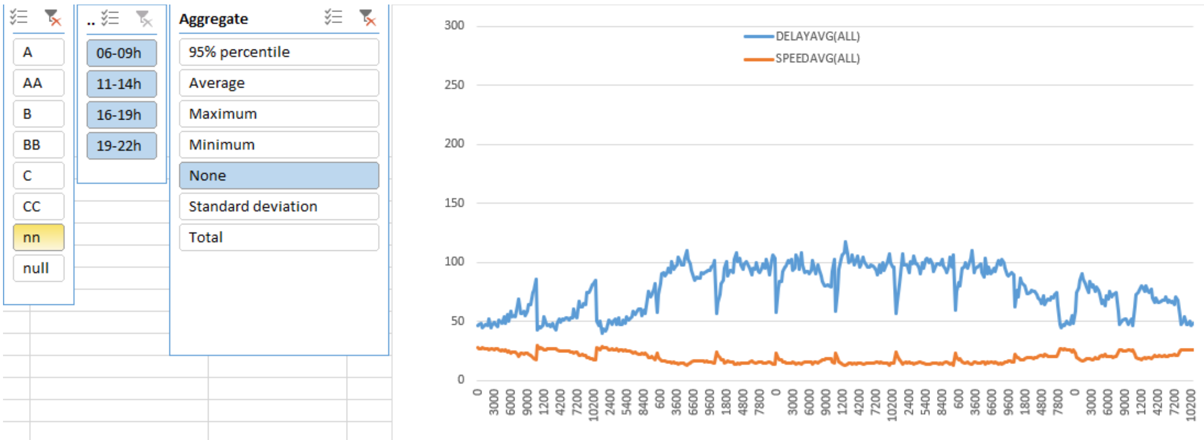
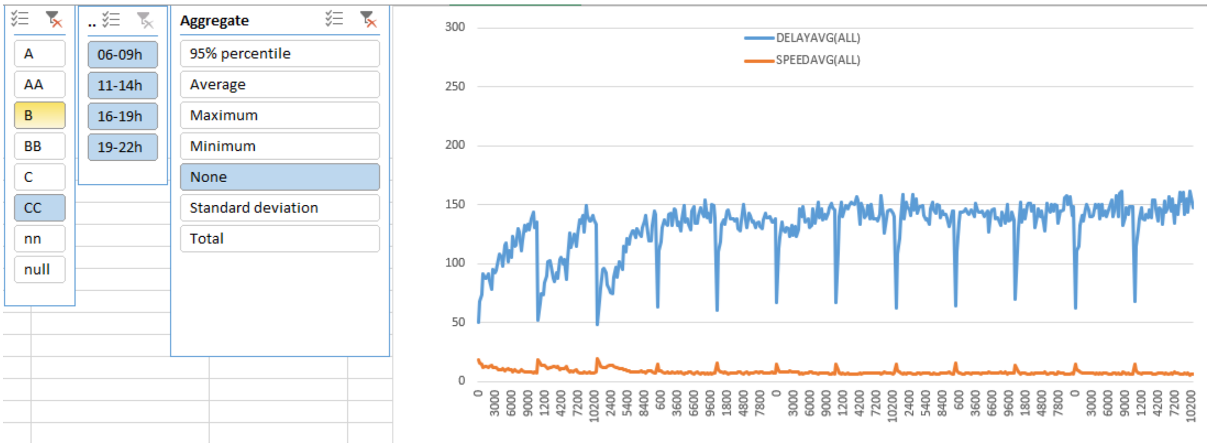
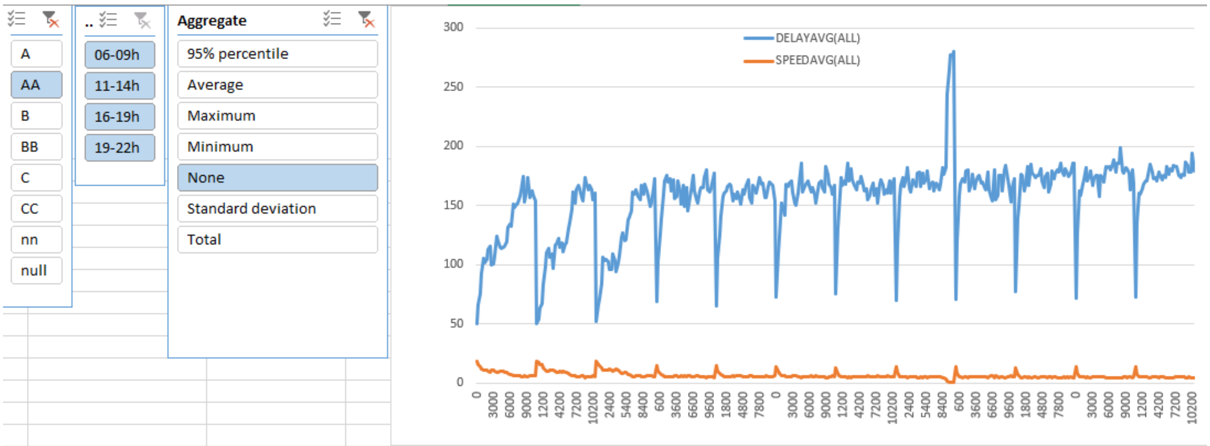
06-09h
11-14h
16-19h
19-22h
Aggregate
95% percentile
Average
Maximum
Minimum
None
Standard deviation
Total
PEDENT(ALL)
PEDARR(ALL)
PEDACT(ALL)



7.3.2 Vehicle Network Performance Evaluation Results Budapest




A
AA
B
BB
C
CC
nn
null
06-09h
11-14h
16-19h
19-22h
Aggregate
95% percentile
Average
Maximum
Minimum
None
Standard deviation
Total
DELAYAVG(ALL)
SPEEDAVG(ALL)
300
250
200
150
100
50
0


A
AA
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nn
null
06-09h
11-14h
16-19h
19-22h
Aggregate
95% percentile
Average
Maximum
Minimum
None
Standard deviation
Total
DELAYAVG(ALL)
SPEEDAVG(ALL)
300
250
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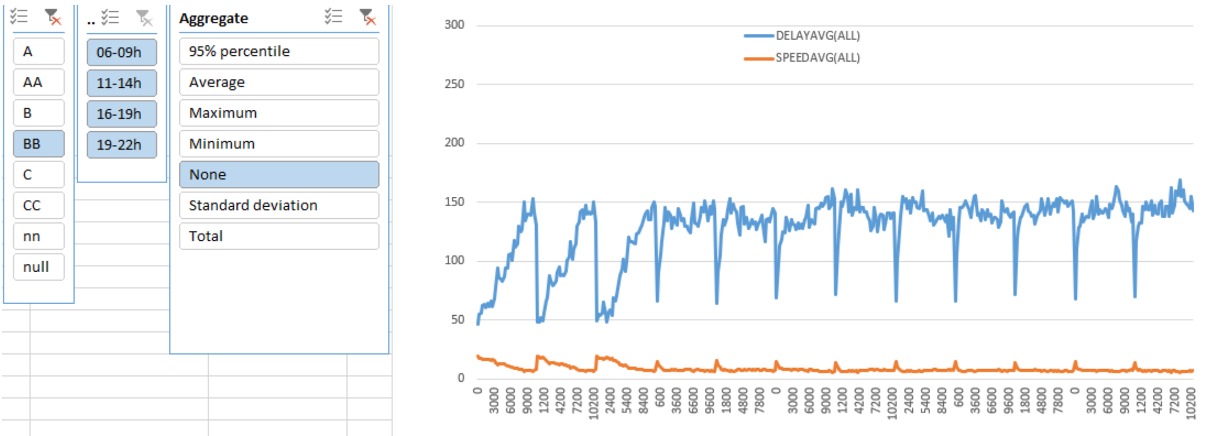
A
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06-09h
11-14h
16-19h
19-22h
Aggregate
95% percentile
Average
Maximum
Minimum
None
Standard deviation
Total
DELAYAVG(ALL)
SPEEDAVG(ALL)
300
250
200
150
100
50
0

7.4 Lisbon - Street Designs Taken Forward for Modelling & Appraisal

7.4.1 Design 0

Figure 147 and Figure 148 show some of the characteristics of the section, namely the number of lanes and kerbsides' width, which will allow to compare future street's design and will impact on the modelling results. Some of the general characteristics of the section are:

- Traffic lanes: Most of road along the section has two traffic lanes without segregation between traffic modes. The right lanes have a high frequency of bus stops and are commonly used for double parking. Praça Paiva Couceiro, is surrounded by one way roads with high capacity lanes (3 and 4 lanes), especially in the west and east corridors.
- Parking: There are around 130 parking places in all section, assigned to different typologies, like general traffic, load/unload, disabled and motorcycle. Normally the parking rotation is low, even in the load/unload parking places where the average parking time is around 30 minutes. There is a very high use of double parking along the section.
- Kerbside: The sidewalks' width is narrow, giving the number of pedestrians that circulate there, especially in the places with parking places and bus stops. In Morais Soares the sidewalks' width are between 1,70 and 1,90 meters in most of the section. In Praça Paiva Couceiro, sidewalks are very large, but there is a large discontinuity between the square and the sidewalks.

Figure 147. Section's characteristics, Design 0

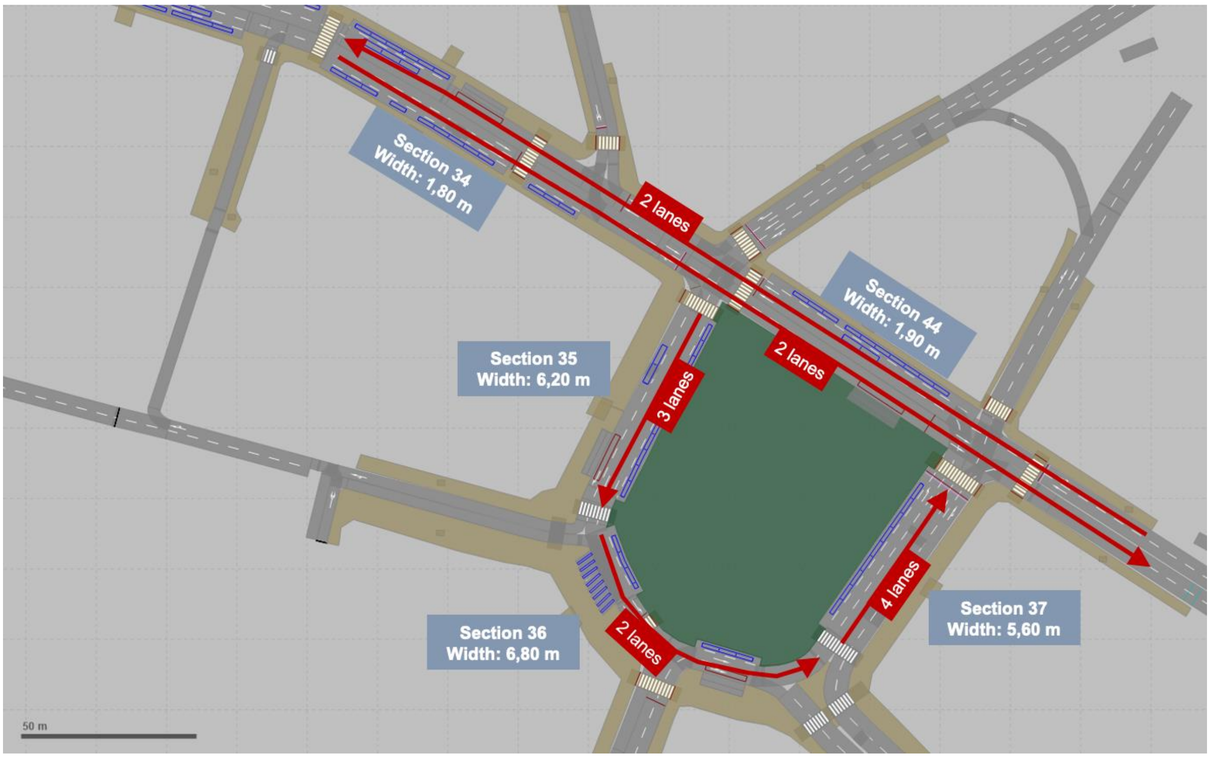

Figure 148. Section's characteristics, Design 0

7.4.2 Design 1

Design 1 provides essentially priority to parking above the other transport modes, since the existing parallel parking places will be transformed into diagonal parking to provide a higher number of parking places.

Figure 149 and Figure 150 show some of the characteristics of the section, namely the number of lanes and kerbsides' width, which will allow to compare future street's design and will impact on the modelling results. Some of the general characteristics of the section are:

- Traffic lanes: Most of road along the section has one traffic lane for each way without segregation between traffic modes. Considering the increase of parking places and the high capacity reduction, double parking is expected to disappear. Praça Paiva Couceiro, is surrounded by one-way roads with high-capacity lanes (3 and 4 lanes), especially in the west and east corridors.
- Parking: 173 parking places will be created in all section, assigned to different typologies, which correspond to an increase of 30% of the existing ones.
- Kerbside: The sidewalks' width increase, on average, 25 cm in each way, ie., in Morais Soares the sidewalks' width will have around 1,90 and 2,20 meters in most of the section. Praça Paiva Couceiro design remains the same.

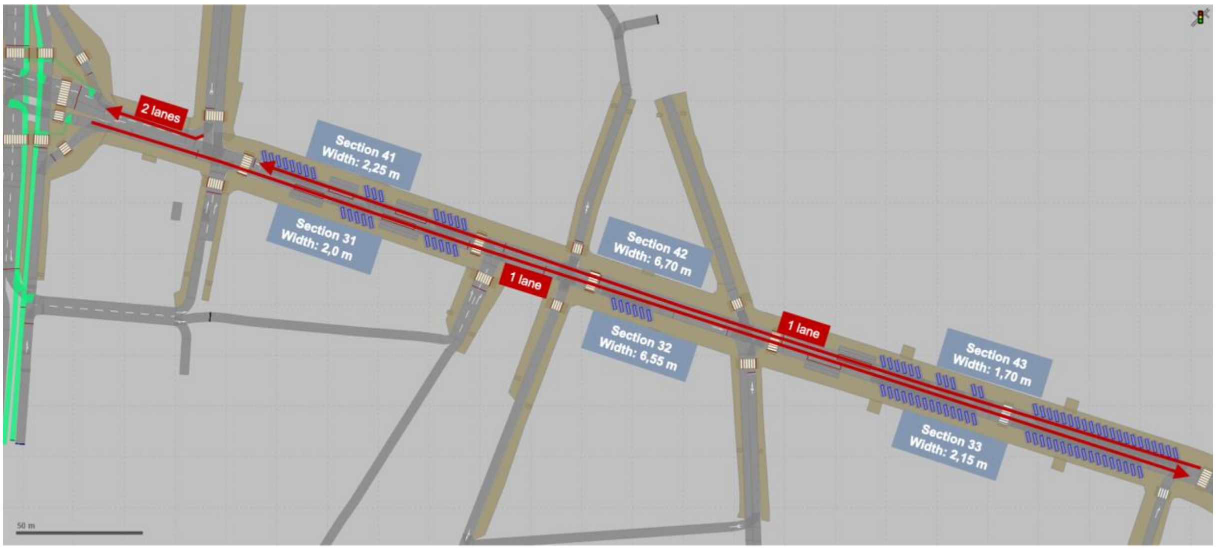

Figure 149. Section's characteristics, Design 1

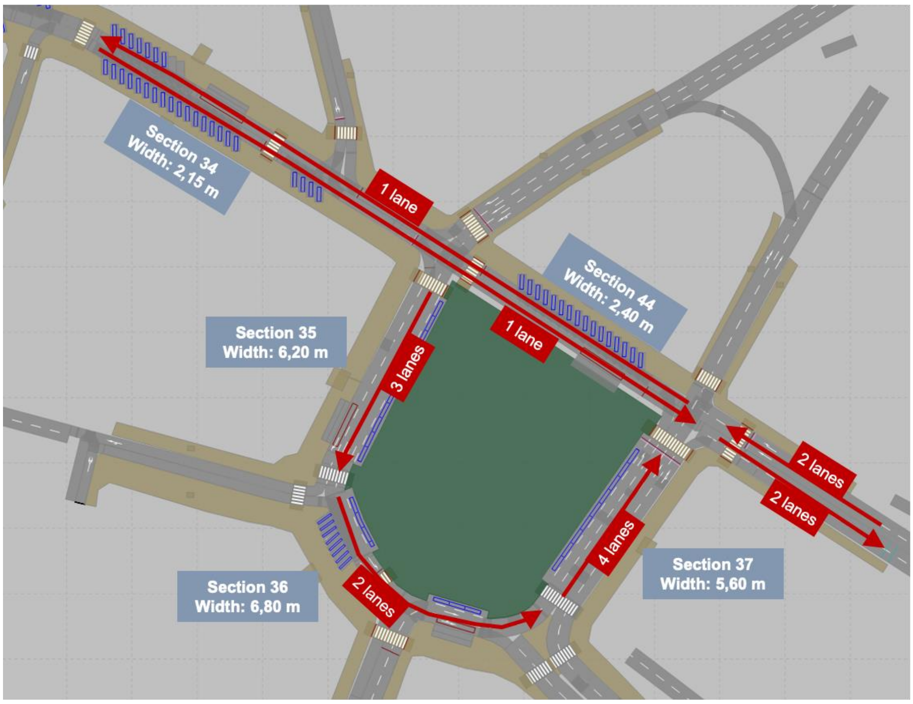

Figure 150. Section's characteristics, Design 1

7.4.3 Design 2

Design 2 clearly gives priority to bus movements above other transport modes, since two right lanes are transformed in to two bus dedicated lanes. However, right turns are still allowed as well as parking, so it is expected that both bus lanes will be occupied by other transport modes.

Figure 151 and Figure 152 show some of the characteristics of the section, namely the number and type of lanes and kerbsides' width, which will allow to compare future street's design and will impact on the modelling results. Some of the general characteristics of the section are:

- Traffic lanes: Most of road along the section has one traffic lane for general traffic and other dedicated to bus circulation, however with access to parking and right turns allowed. Considering the transformation of one of the lanes in both directions into a bus lane, double parking is expected to disappear. Praça Paiva Couceiro, is surrounded by one-way roads with high-capacity lanes (3 and 4 lanes), especially in the west and east corridors.
- Parking: The number and location of parking spaces will remain the same as the current situation.
- Kerbside: The sidewalks' width won't suffer any change, since the lanes width will remain the same as well as the number and location of parking bays.

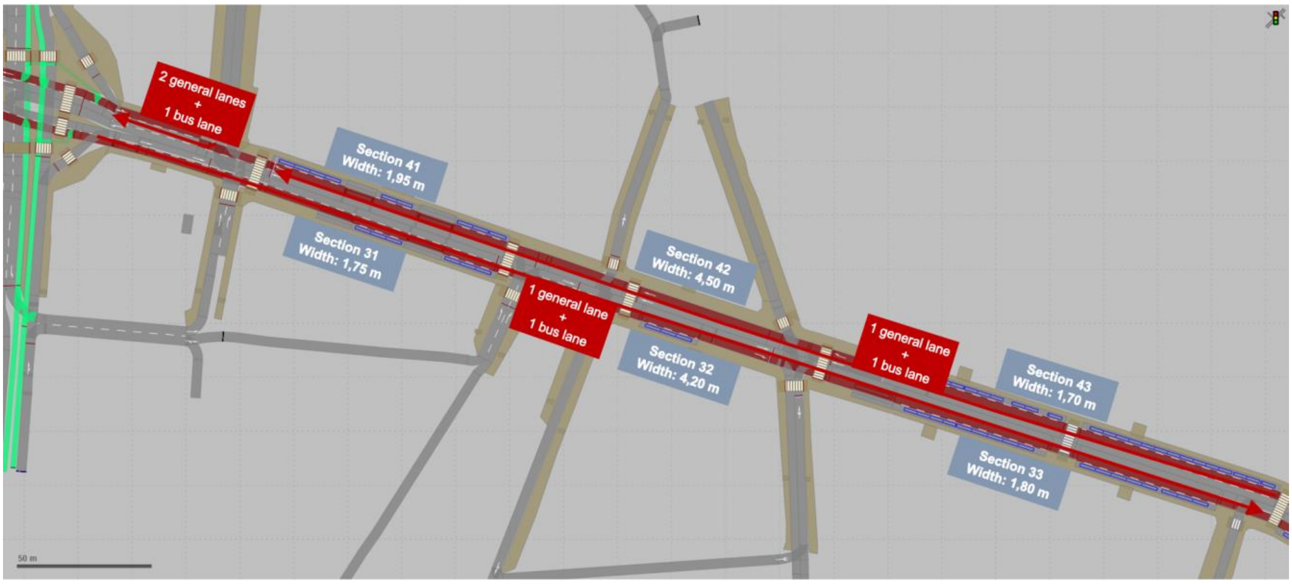

Figure 151. Section's characteristics, Design 2

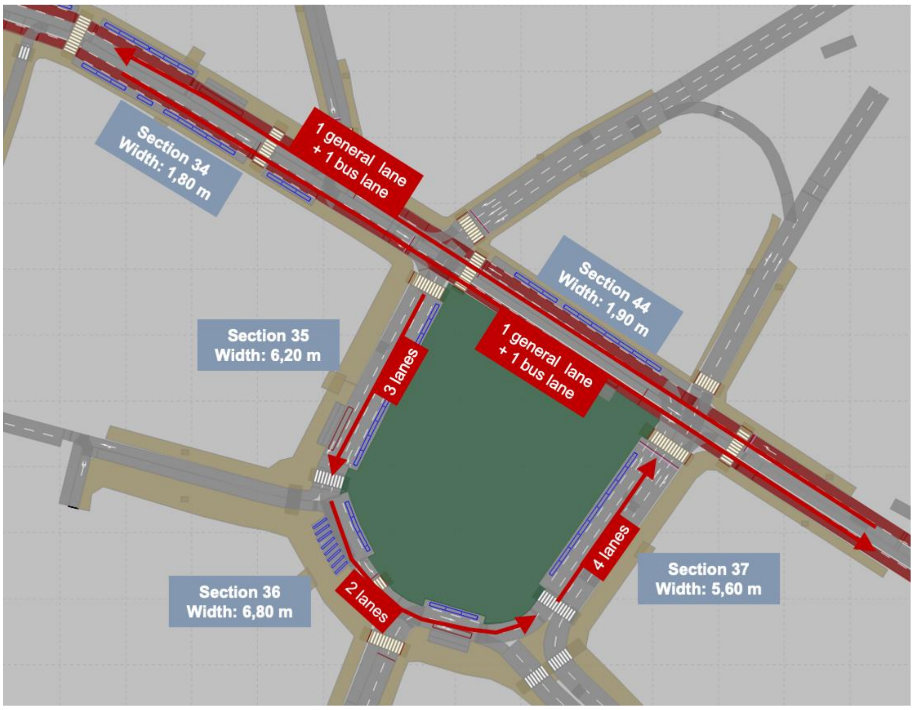

Figure 152. Section's characteristics, Design 2

7.4.4 Design 3

Design 3 considers the implementation of a cycle lane between parking and the sidewalk and the sidewalks' enlargement. To install this infrastructure was assumed the reduction of one lane in each direction and the installation of a pedestrian refuge between the two lanes. The rest of space will be used to maintain the existing number of parking spaces, implement the cycle lane and enlarge sidewalks. Since the right turns are still allowed, the implementation of the cycle lane should be made carefully in those intersections to avoid incidents.

Figure 153 and Figure 154 show some of the characteristics of the section, namely the number and type of lanes and kerbsides' width, which will allow to compare future street's design and will impact on the modelling results. Some of the general characteristics of the section are:

- Traffic lanes: Most of road along the section has one traffic lane for general traffic with right turns allowed. The parking bays are immediately adjacent to the general lanes and cycle lane is implemented at the parking's right side. Considering the reduction of one lane in both directions, double parking is expected to disappear. Praça Paiva Couceiro, is surrounded by one-way roads with high-capacity lanes (3 and 4 lanes), especially in the west and east corridors. The cycle lanes will be one way lane, following traffic direction with a width of 1,2 meters.
- Parking: The number of parking spaces remain the same but they have to be misplaced from the current location to an immediately position right aside the traffic lane.
- Kerbside: The sidewalks' width will increase and a pedestrian refuge could be implemented between both lanes, which, besides improving crossing street safety could be used to plant trees along the road.

Figure 153. Section's characteristics, Design 3

In the northern section of Praça Paiva Couceiro, the existing parking bay was transformed into a general lane, since one lane was not being enough to drain the traffic coming from Praça Paiva Couceiro to Rua Morais Soares, which was creating congestion situations in the west to east movements in Rua Morais Soares.

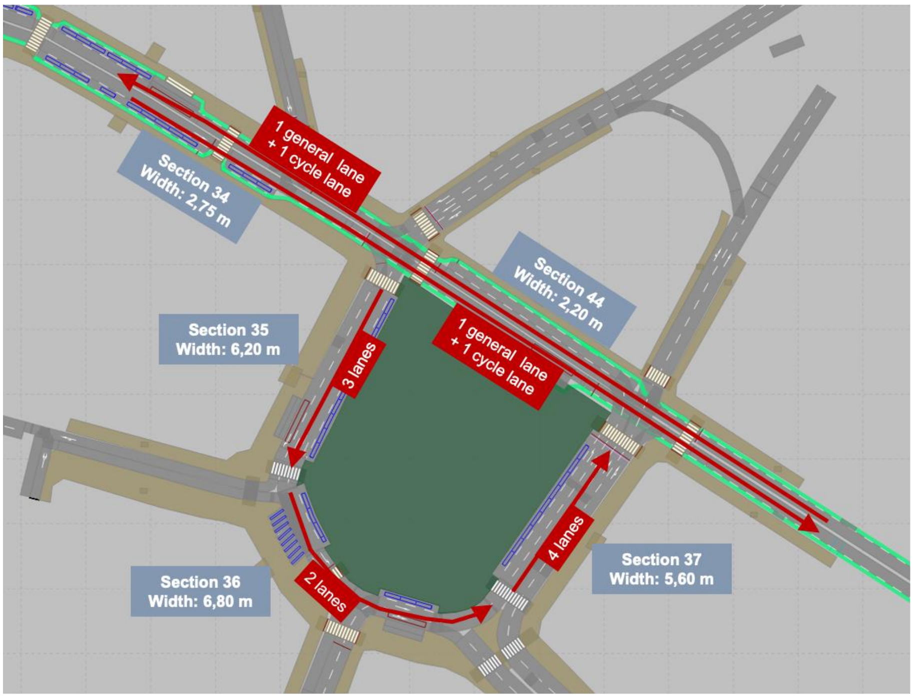

Figure 154. Section's characteristics, Design 3

7.4.5 Design 4

The design proposed for the design 4 has the intention of answering to the outputs from the previous scenarios. The new design aims to fit the section's capacity to the demand of the different transport modes, giving priority, essentially to public transport and pedestrians. The new design, through a new parking scheme, provides more space to implement greenery and some urban equipment, like terraces and benches.

- Traffic lanes: Most of the road will have one lane for general traffic in each way and a bus lane in the east to west direction. In the west section, near Praça do Chile (East to West) and in the east section, near Praça Paiva Couceiro (West to East) the number of lanes increase the help the traffic flow in both intersections.
- Parking: Parallel parking changed to diagonal parking and parking bays' location are interspersed along the road, which allows to provide parking in both sides, implement large sidewalks area and more places to install greenery or equipment. However, the number of parking spaces reduces 20% to 95 places.
- Kerbside: The sidewalks' width significantly increases and several areas along the section are created to increase places to use the street like terraces, benches, greenery.

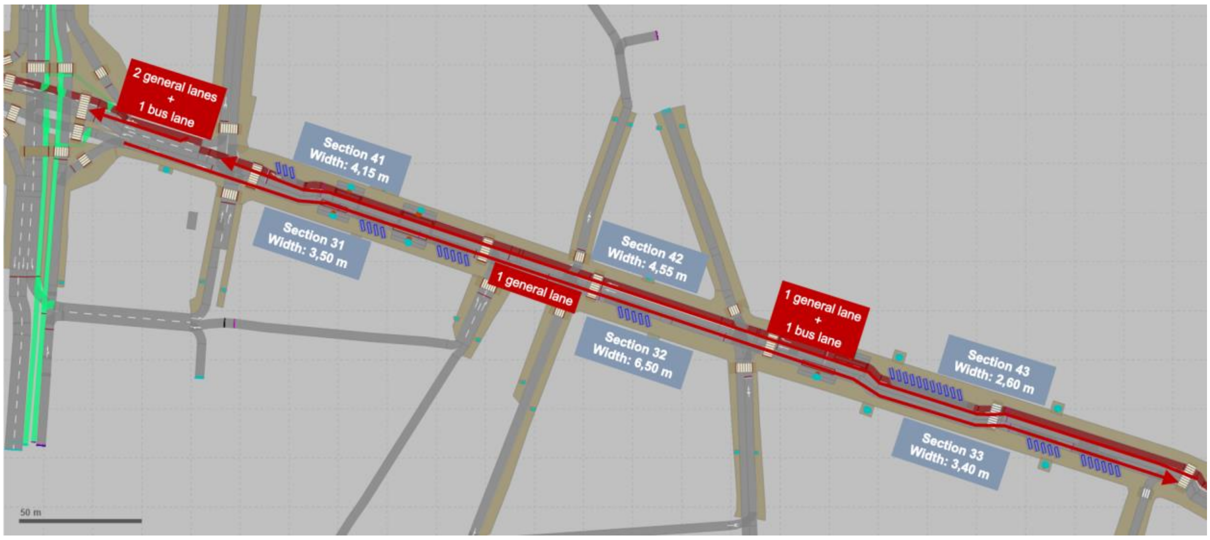

Figure 155. Section's characteristics, Design 4

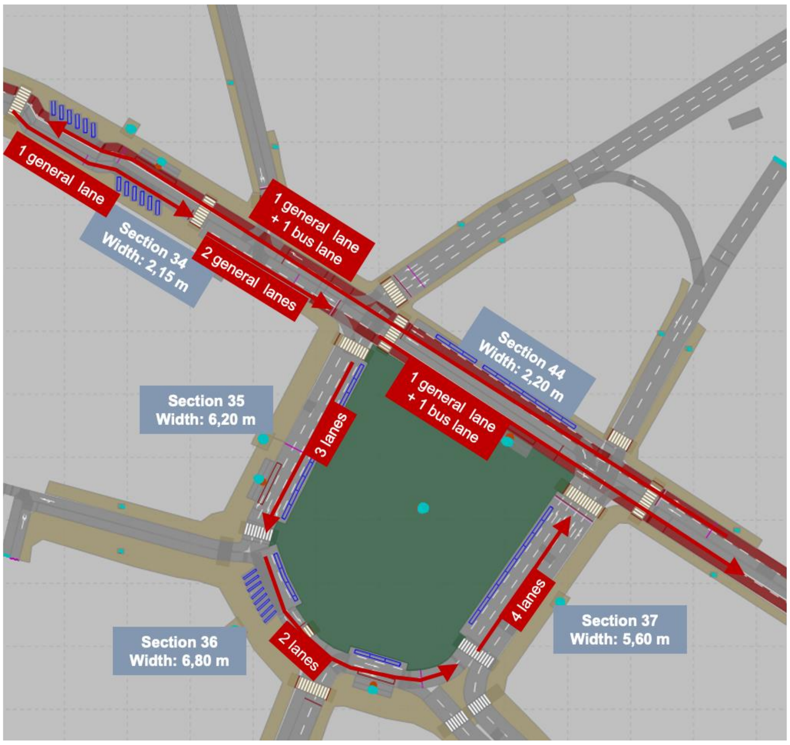

Figure 156. Section's characteristics, Design 4

7.5 Lisbon - Location of the nodes used for analysis purpose

The following images, show the entire street divided by sections. In each section's images, it is possible to see the modelling scheme and the locations where the nodes and sections, which will be used to analyse both vehicles and pedestrians, are identified.

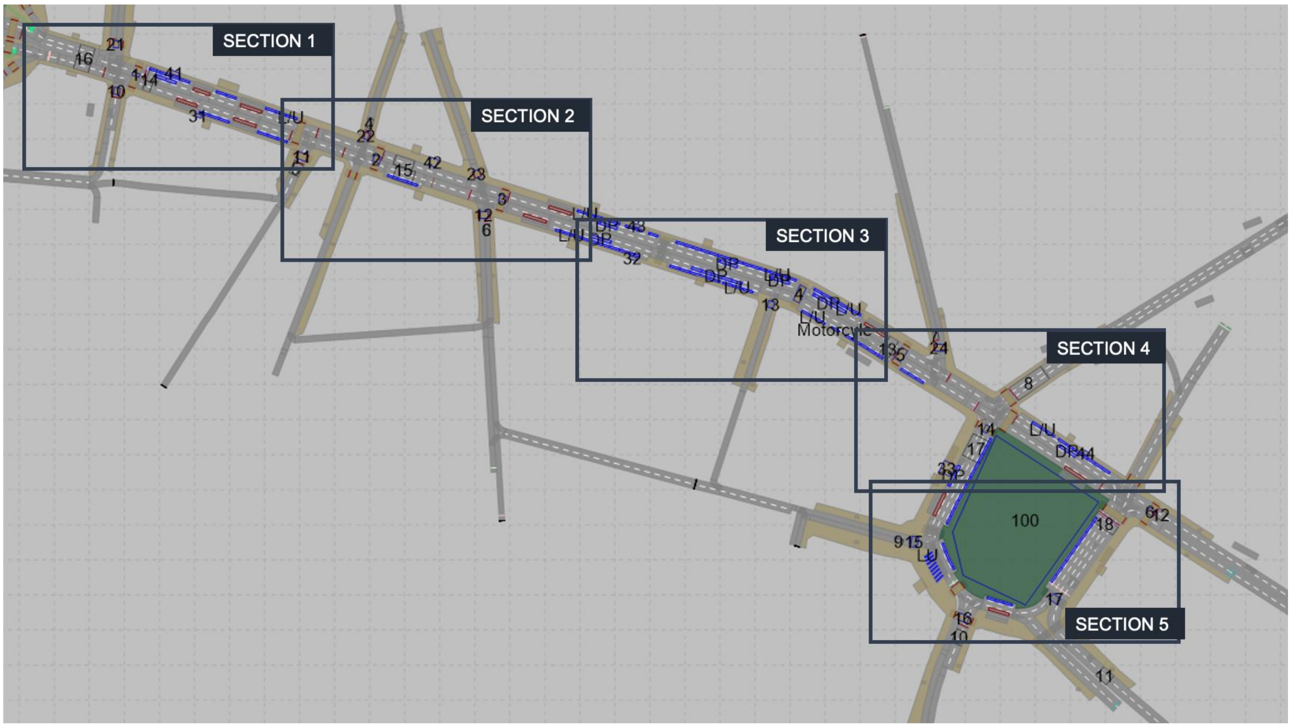

Figure 157. Map of the section under study

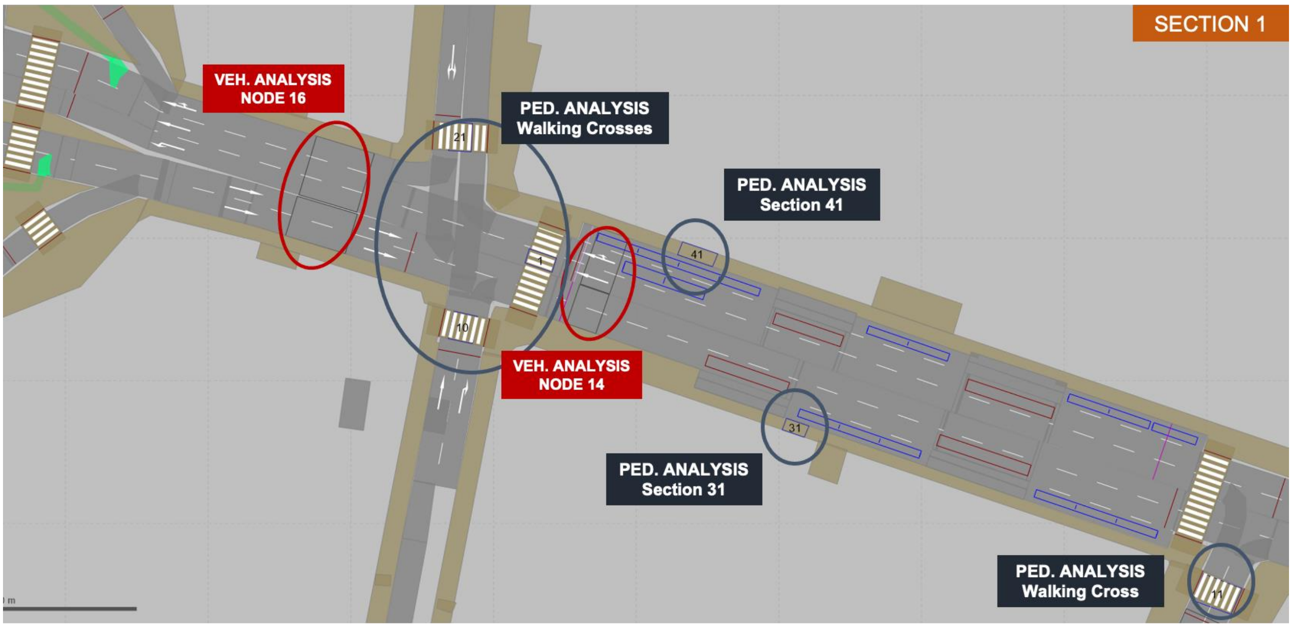

Figure 158. Location of the nodes and sections used for analysis purpose, section 1

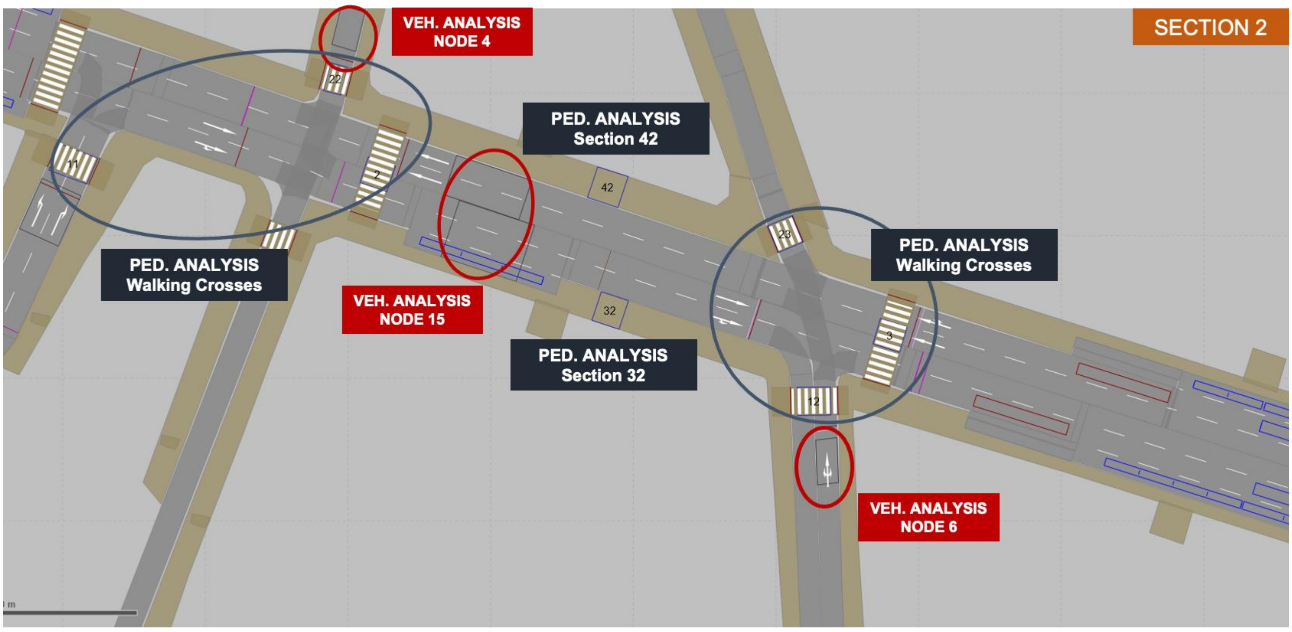

Figure 159. Location of the nodes and sections used for analysis purpose, section 2

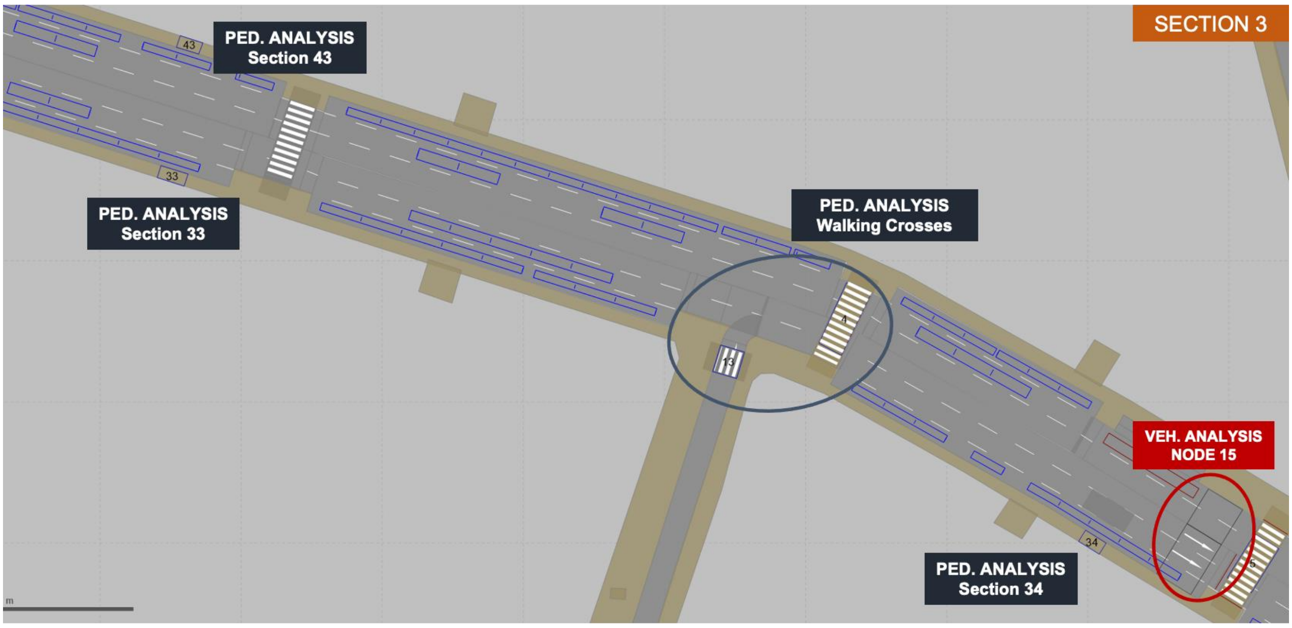

Figure 160. Location of the nodes and sections used for analysis purpose, section 3

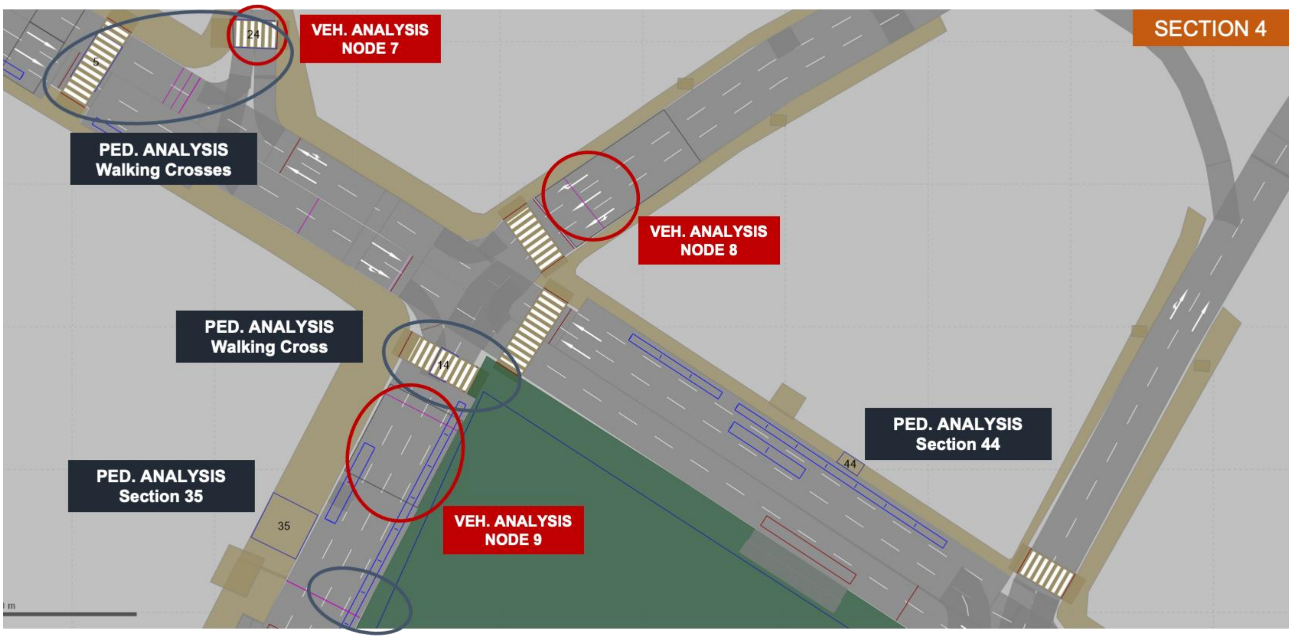

Figure 161. Location of the nodes and sections used for analysis purpose, section 4

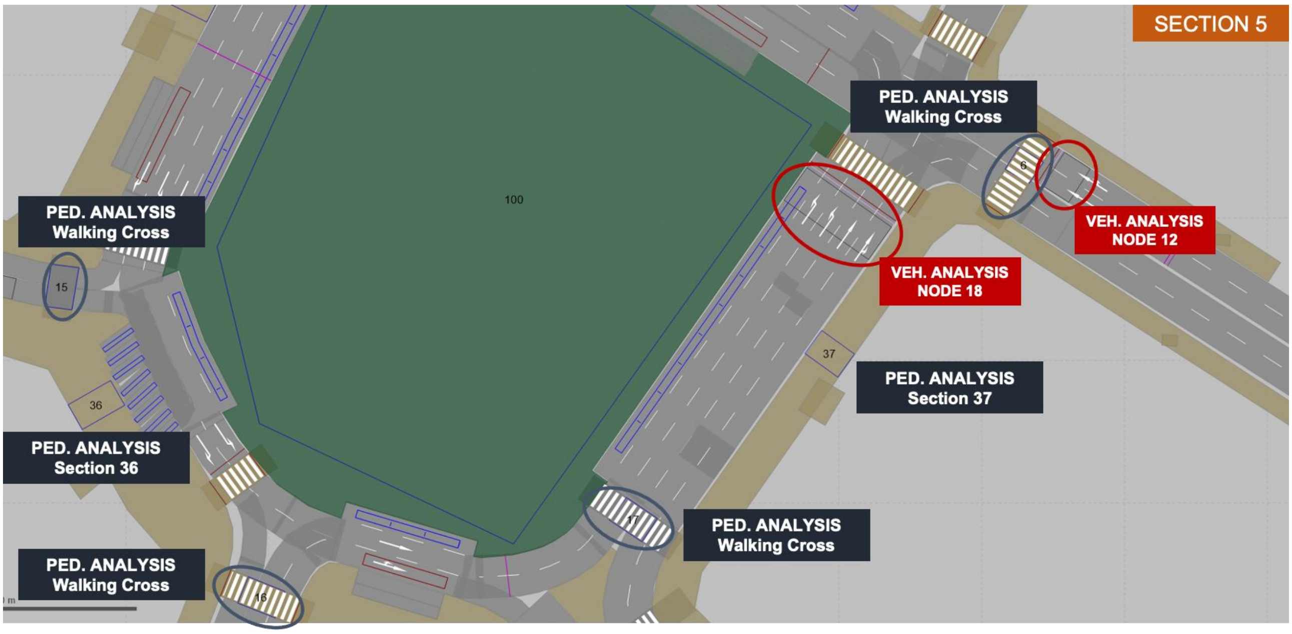

Figure 162. Location of the nodes and sections used for analysis purpose, section 5