

# Lisbon

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Mobility On Demand Urban Implementation Case Study

Claire Abrahamse



Historic Lisbon

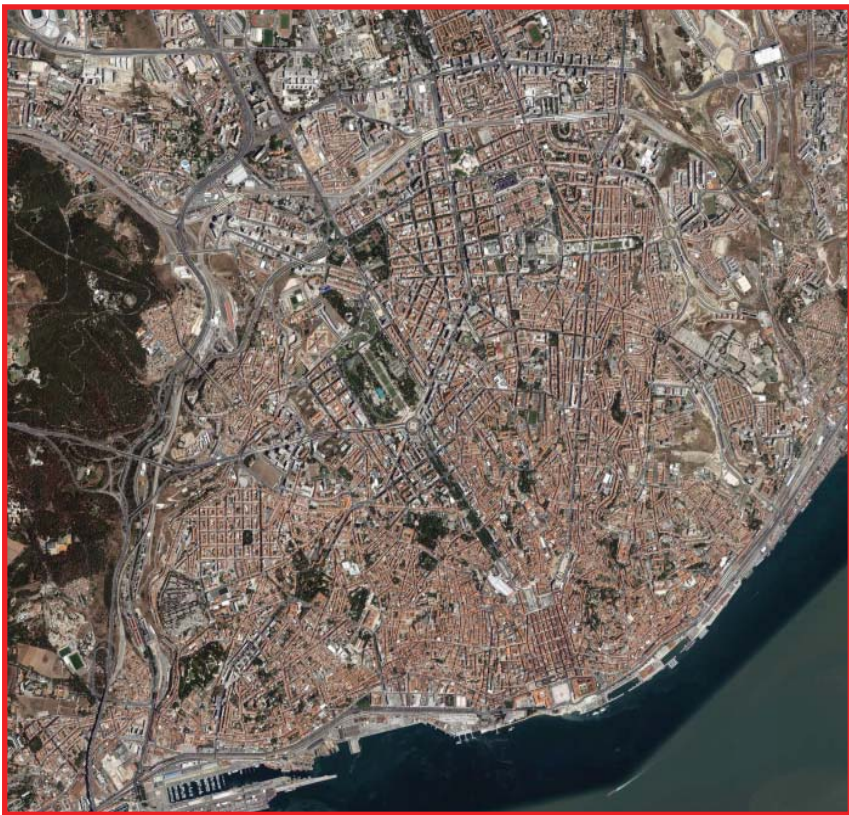
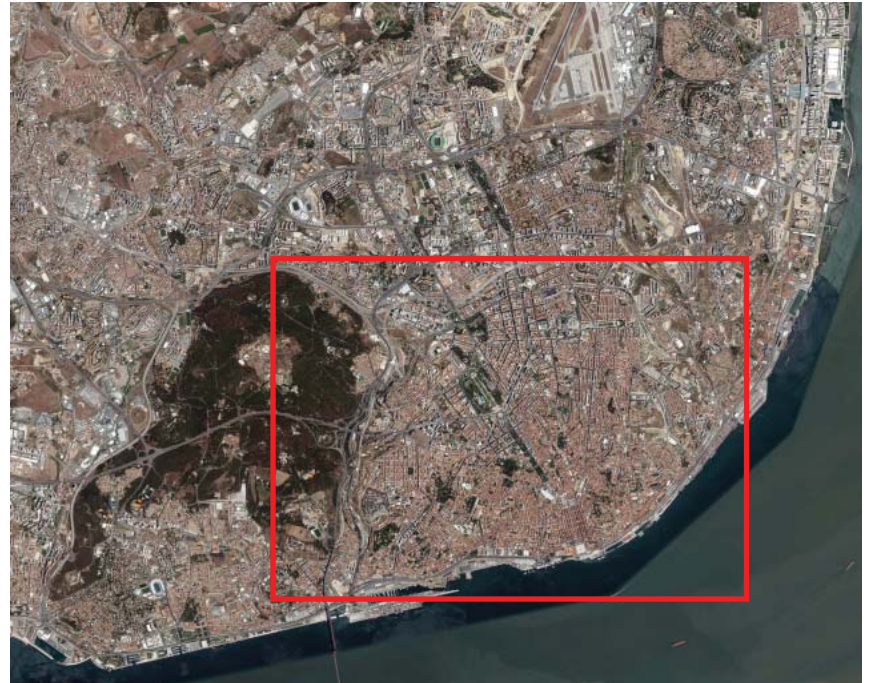
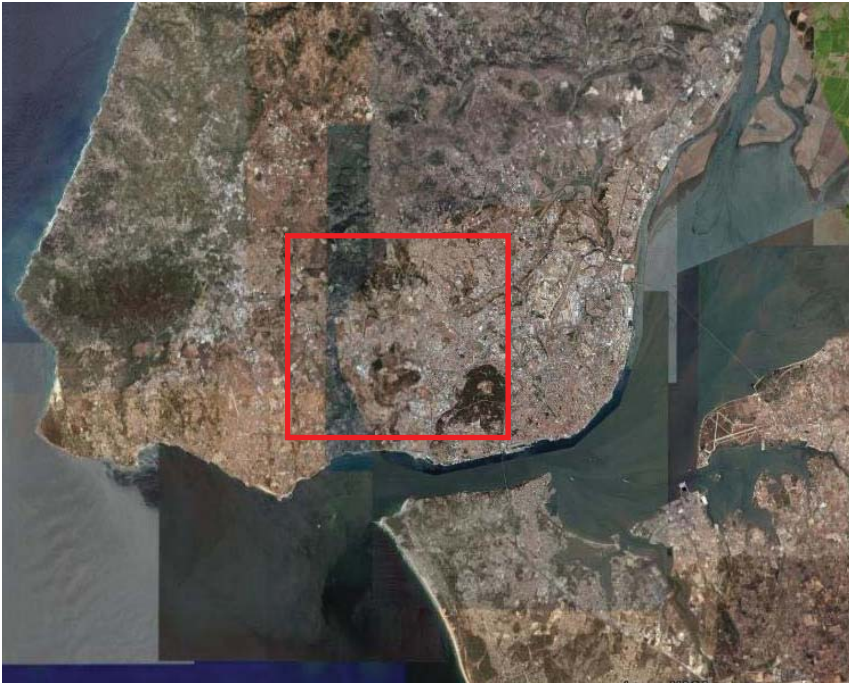








## Location and Context





Lisbon is a city centred on its connection to the Tagus River. Its primary urban square, the Praça do Comercio, is enclosed on three sides by the Pombaline buildings of the old city centre – reconstructed in a narrow grid formation by the Marques de Pombal after the city was devastated by an earthquake in 1755 – with the Tagus River on the fourth. The built fabric that extends radially inland from this square is structured by two primary avenues and a series of secondary urban squares, with the urban “stratigraphy” clearly showing the successive planned urban extensions over the centuries, each of which now make up distinct neighbourhoods. In this way, the medieval fabric is at the city centre, whilst the 19th Century and Modernist urban extensions are located towards the northern city limits. The fabric, block sizes and street widths thus become markedly larger and less dense as one moves away from the old urban core, with all of the implications for accessibility and “walkability” these changes imply.



> Panoramic view of Lisbon from the Park at the top of Avenida da Liberdade (19th century expansion), looking southwards towards the old city and the River Tagus. Castelo Sao Jorge (the old Moorish and medieval fortress) can be seen on the hill to the left, with the Alfama district clinging on below.

The urban centre of Lisbon, whilst consisting of a very dense built fabric with narrow, steep streets – many of them pedestrianised – is comprehensively served by the existing public transportation system, particularly as railway and tramlines were introduced during the 19th Century and were seen primarily as a means of connecting the city's prominent families, who had helped in funding their installation, to their coastal houses on the western seaboard. For this reason, the western side of the city, long associated with the wealthier families in Lisbon, is far more accessible by public transportation than the north-eastern quarter.

Despite this, it should be noted that the narrowness and steepness of the streets, combined with the high level of protection of the old building fabric and the resultant lack of accommodation of cars and parking structures, has made this area increasingly unattractive to young Lisbonites as a place to live. Thus the city centre is largely uninhabited after working hours, making the promotion of this area as a live/work, 24 hour urban

neighbourhood a priority for local authorities, particularly as the area is set to be proclaimed a UNESCO World Heritage Site, with all the accompanying issues of authenticity and museification this implies. The introduction of a new mode of highly flexible, personal but public mobility in this historic core could thus prove to be a draw-card in attracting a new residential community and maintaining urban authenticity in the historic core.

An entirely different public transport and accessibility issue arises within the northern and north-eastern extents of the city. Although the industry located along the eastern banks of the Tagus is well connected by rail, it is largely segregated from the urban fabric. The location of the EXPO '98 grounds along the eastern riverbank did serve to forge better public transport links with the rest of the city to the periphery, most notably with the extension of a new subway line into this urban quarter and the construction of a new primary railway station, the Oriente, to the north-eastern city edge. However, there are still many “blank areas” where public transport

does not serve many neighbourhoods within reasonable walking distances, particularly within the Salazar-era Modernist social housing projects. The airport is also situated within this isolated north-east quarter, and has no rail linkages to the city centre.

Thus the northern periphery of Lisbon presents an entirely different mobility problem to the historic core, as it represents a captive residential community who must either rely on private motor vehicles (which are expensive and inconvenient in a city where roads are narrow and parking is not easily accommodated, to say nothing of gasoline prices) or walk long distances along 120m long perimeter blocks to reach public transport stations and bus stops. Because of their sprawling, low-density design, buses are less frequent and serve fewer streets within these neighbourhoods, and subway stops are often located on wide, highly-trafficked roads. The challenge here is thus to “liberate” and “connect” these communities into the older city fabric and the existing transport network.



## Historical Development of Lisboa



The city of Lisbon started as a Moorish city, huddling against its fortress on the Alfama hill, and surrounded by a defensive wall. It remained within these bounds for almost four centuries, after which it was taken by the Christian forces from the northern Iberian kingdoms.

The fabric of the Alfama is very distinct, with narrow, twisting streets and steep gradients – streets often end in staircases, and thus vehicular access is problematic.

The area was structured around its primary civic buildings, all centred on the fortress (depicted in purple), the Mosque – drastically-altered and converted into the Cathedral of Lisbon after the Christian “Reconquest” (depicted in red), and the old gates of the city, between which the primary neighbourhood streets still run.



At the height of its empire, Lisbon, as its epicentre, was a sizable city organised around two primary powers – the monarchy and the church. The palace, storehouses, ship-building yards, arsenal and defences fronted the river to receive the spoils of empire (depicted in purple), and a primary urban space developed on the riverfront, adjacent to the palace.

The area behind this civic spine was largely structured around several churches (in red), the the Franciscan monastery to the south-west of the city, with the Dominican convent and city hospital to the north, adjacent to another primary public space.

The fabric of the city is dense and irregular, yet a primary spine of movement is discernable between the two primary public open spaces.





In 1755, an earthquake, followed by a series of tidal waves, followed by a massive fire, destroyed Lisbon, leaving many dead and obliterating the central part of the city, which is located in the valley.

The Alfama area, hugging the hill for defensive purposes, and the Chiado neighbourhood on the opposite hill to the west were largely spared, but the royal palace and all of the buildings situated along the waterfront and associated with trade, ship-building and empire were destroyed.

The adjacent drawing is derived from a comparison between the last mapping of the city undertaken before the earthquake, and the plans for the reconstruction, where the buildings that were either unaffected or restored from the medieval fabric area shown.



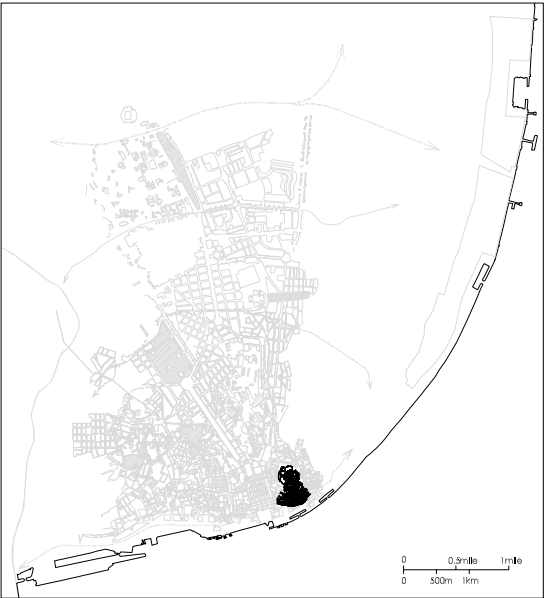
The Marquis Pombal started reconstruction immediately after the earthquake, and created a new, geometric centre for Lisbon, which formalised the public spaces of the older city in their approximate positions, but replaced the palace structures of the old city with government buildings.

Whilst the new structures, all of a similar architectural language, were meant to be earthquake resistant and had larger streets between them in order to allow for easier evacuation, the resultant fabric is still very fine and close-grained, with implications for the accommodation of private motor vehicles, among other aspects of contemporary life, in the central city today.

This seriously decreases its "liveability," and as urban designers, the challenge is to develop a both/and solution, where the historical integrity of the cityscape and its buildings is maintained, but where creative thinking and invention allows for an unobtrusive layering of contemporary life and its services onto the old city.



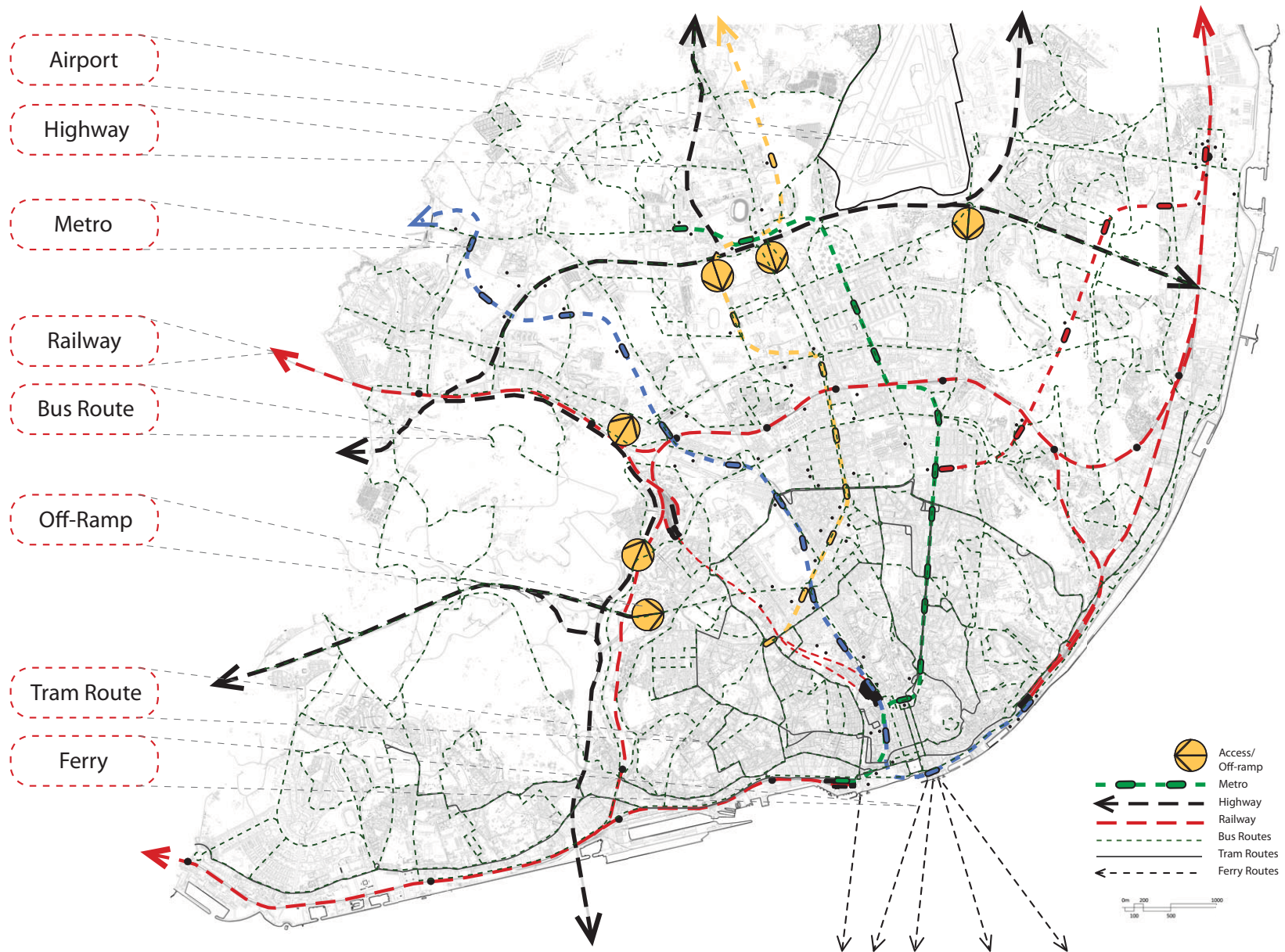
Morphological Development of Lisboa



< Development of the primary built extensions of the city over time showing (from top left) the Moorish village (700 - 1152 AD), the medieval westward expansion and destruction of the centre (1152 - 1755 AD), the construction of the Pombaline plan in the Baixa area (1755 - 1800 AD), the nineteenth century expansion along the Avenidas Novas (1800 - 1926 AD) and Salazar's modernist extensions to northern edges of the city (1926 - 1874).

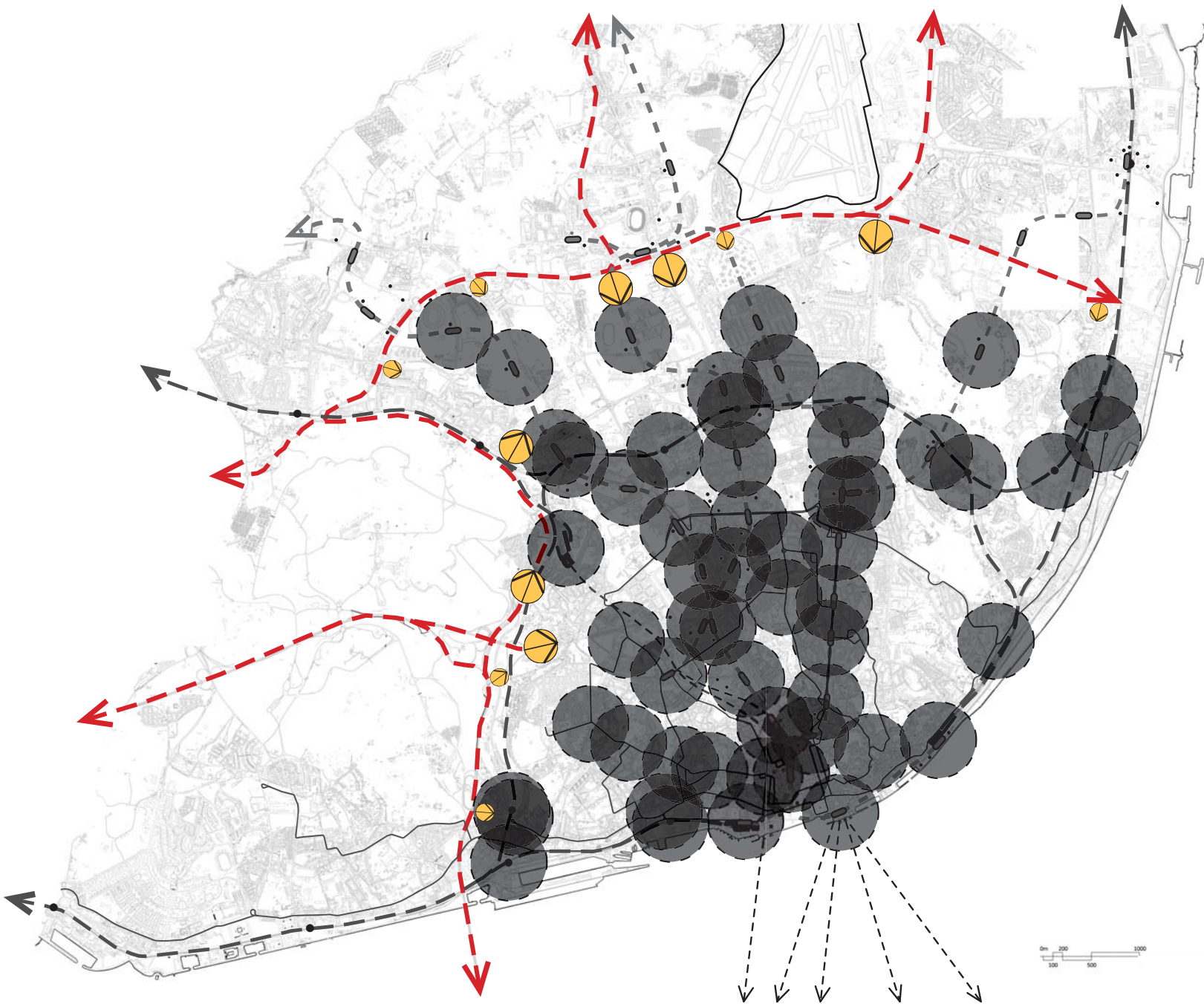




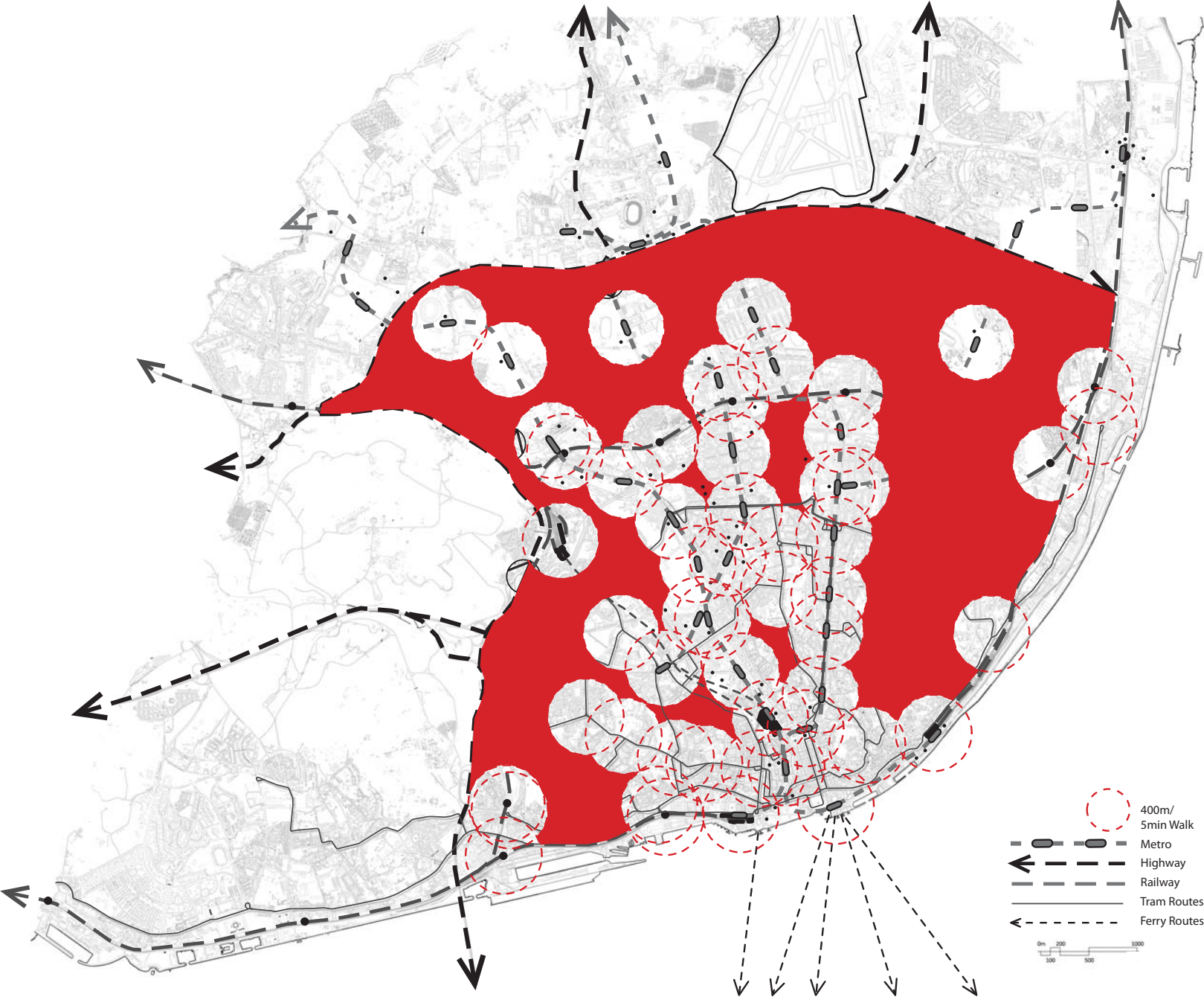




5 minute walking circle around existing transport nodes

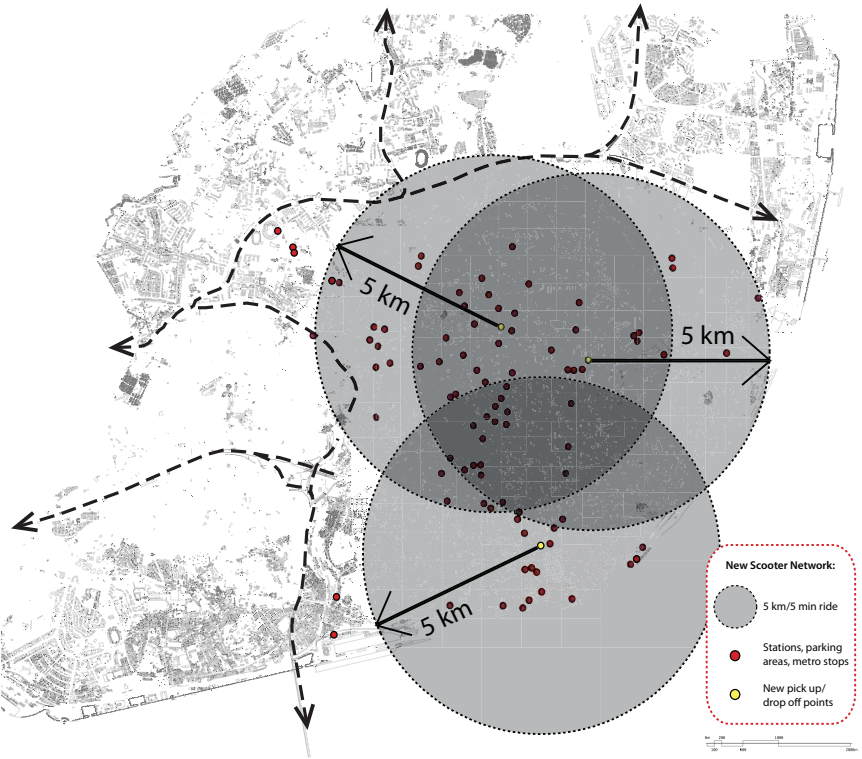
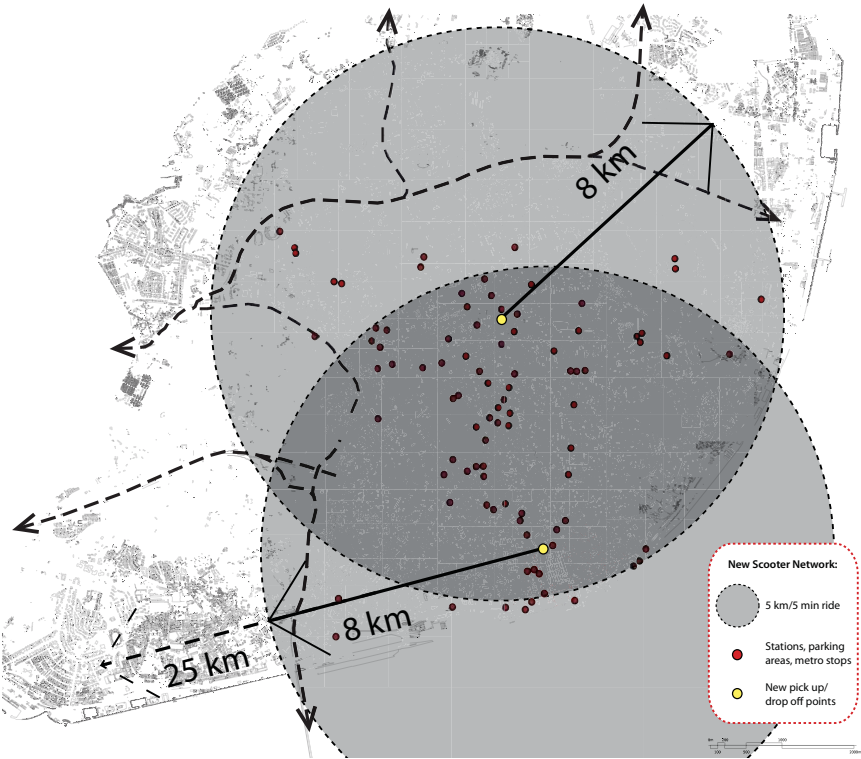




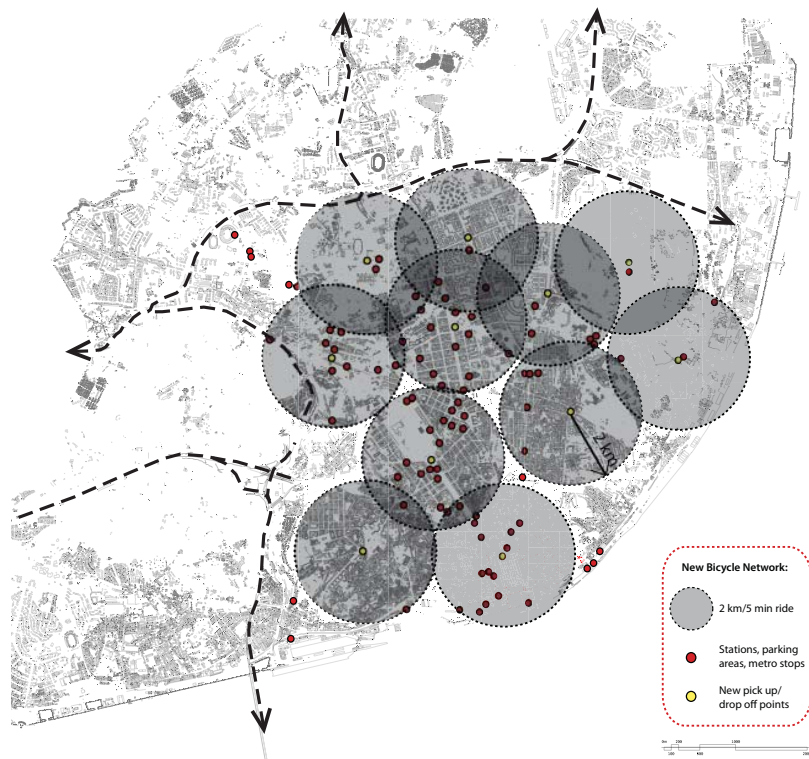




Mobility on Demand: range by mode of transport

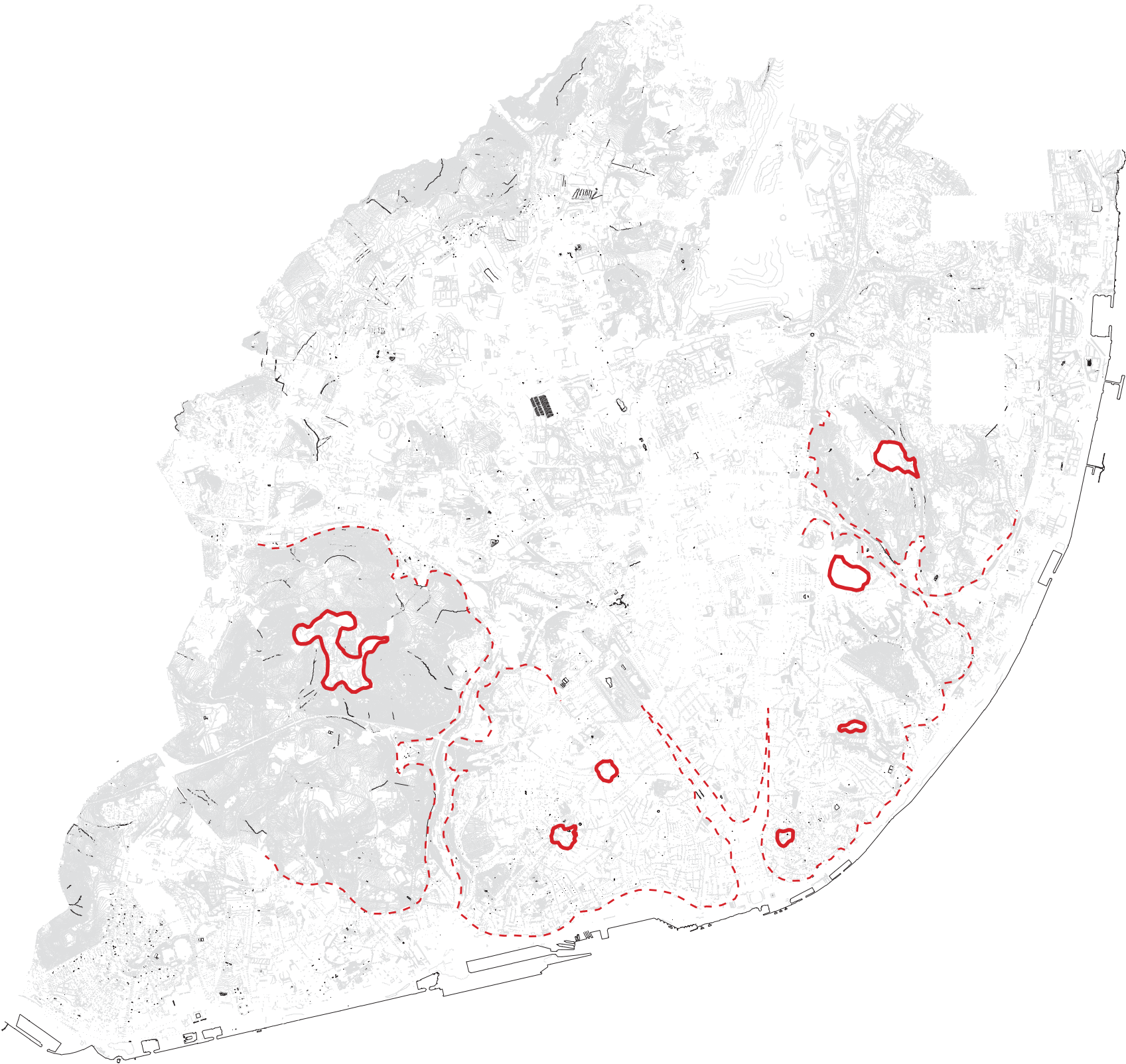




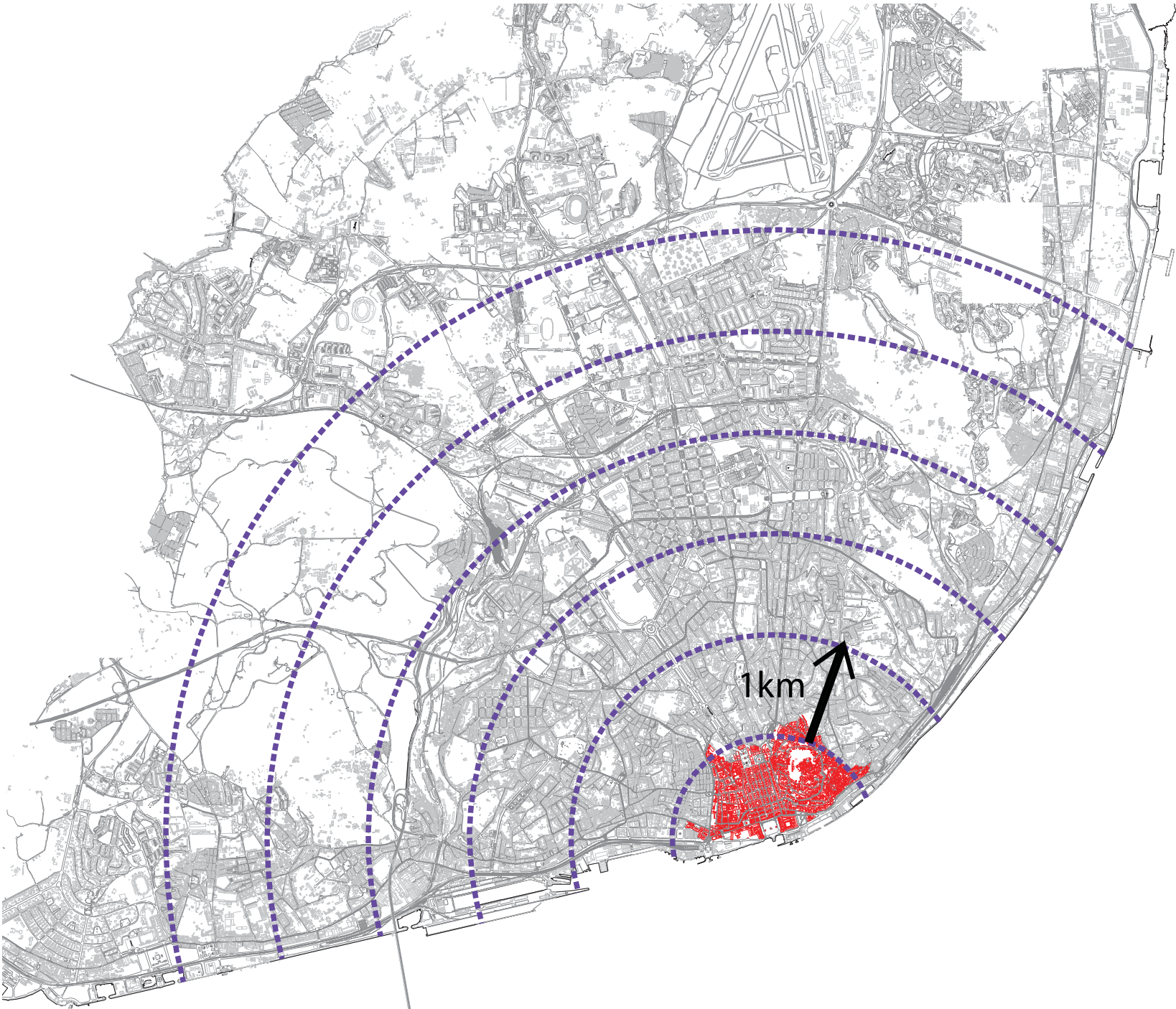




Topography of Lisbon Metropolitan Area

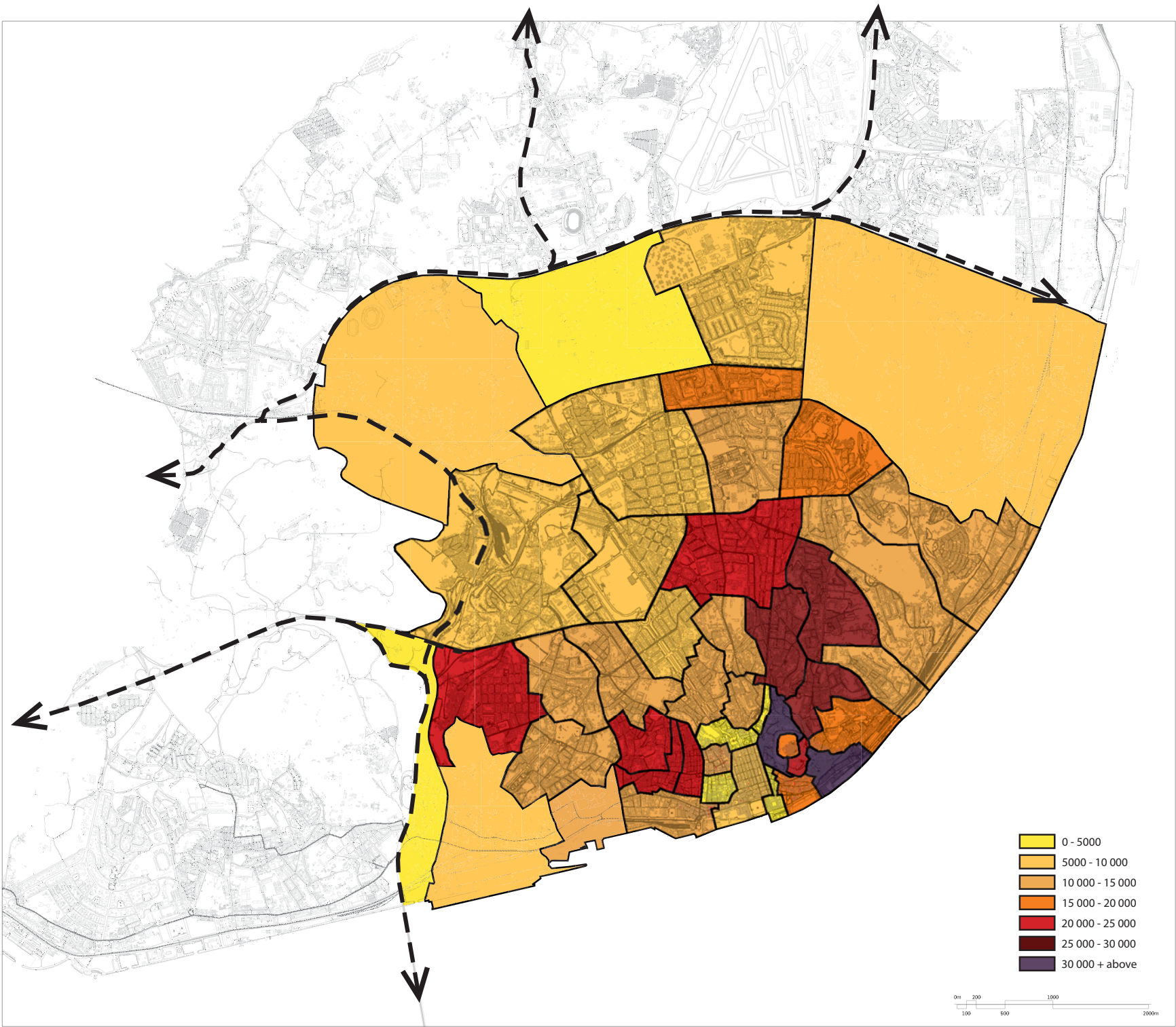






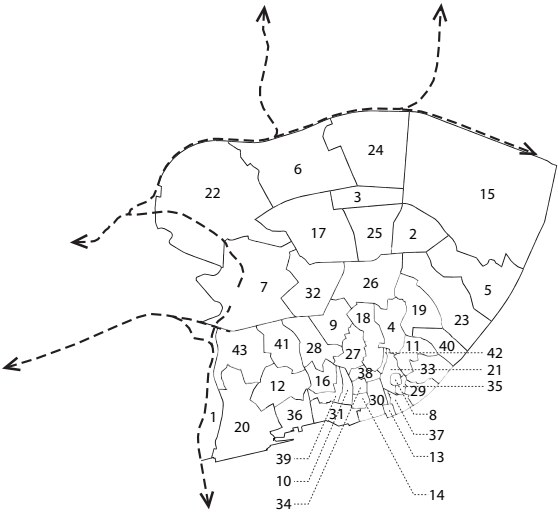


Population Density within Lisbon Metropolitan Area





City District/Parish		Population	Square Kilometres	Population/km <sup>2</sup>
1	Alcântara	18,510	4.39 km <sup>2</sup>	4,216
2	Alto do Pina	12,654	0.82 km <sup>2</sup>	15,431
3	Alvalade	10,996	0.58 km <sup>2</sup>	18,958
4	Anjos	12,490	0.48 km <sup>2</sup>	26,020
5	Beato	17,494	1.41 km <sup>2</sup>	12,407
6	CampoGrande	12,146	2.44 km <sup>2</sup>	4,977
7	Campolide	20,972	2.79 km <sup>2</sup>	7,516
8	Castelo	773	0.05 km <sup>2</sup>	15,460
9	Coração de Jesus	5,379	0.54 km <sup>2</sup>	9,961
10	Encarnação	3,072	0.15 km <sup>2</sup>	20,480
11	Graça	8,604	0.34 km <sup>2</sup>	25,305
12	Lapa	10,656	0.72 km <sup>2</sup>	14,800
13	Madalena	526	0.11 km <sup>2</sup>	4,781
14	Mártires	401	0.10 km <sup>2</sup>	4,010
15	Marvila	47,827	6.29 km <sup>2</sup>	7,603
16	Mercês	6,039	0.30 km <sup>2</sup>	20,130
17	Nossa Senhora de Fátima	18,611	1.87 km <sup>2</sup>	9,952
18	Pena	7,045	0.49 km <sup>2</sup>	14,377
19	Penha de França	17,885	0.66 km <sup>2</sup>	27,098
20	Prazeres	10,068	1.48 km <sup>2</sup>	6,802
21	São Cristóvão e São Lourenço	2,442	0.08 km <sup>2</sup>	30,525
22	São Domingosde Benfica	35,125	4.30 km <sup>2</sup>	8,168
23	São João	21,960	1.56 km <sup>2</sup>	14,076
24	São João de Brito	17,143	2.28 km <sup>2</sup>	7,518
25	São João de Deus	13,309	0.90 km <sup>2</sup>	14,787
26	São Jorge de Arroios	23,051	1.13 km <sup>2</sup>	20,399
27	São José	4,430	0.34 km <sup>2</sup>	13,029
28	São Mamede	7,072	0.60 km <sup>2</sup>	11,786
29	São Miguel	2,613	0.06 km <sup>2</sup>	43,550
30	São Nicolau	1,448	0.25 km <sup>2</sup>	5,792
31	São Paulo	4,676	0.41 km <sup>2</sup>	11,404
32	São Sebastião da Pedreira	7,842	1.05 km <sup>2</sup>	7,468
33	São Vicente de Fora	5,453	0.31 km <sup>2</sup>	17,590
34	Sacramento	1,167	0.08 km <sup>2</sup>	14,587
35	Santiago	1,226	0.06 km <sup>2</sup>	20,433
36	Santos o Velho	5,534	0.51 km <sup>2</sup>	10,850
37	Sé	1,926	0.12 km <sup>2</sup>	16,050
38	Socorro	4,309	0.11 km <sup>2</sup>	39,172
39	Santa Catarina	5,153	0.21 km <sup>2</sup>	24,538
40	Santa Engracia	7,626	0.57 km <sup>2</sup>	13,378
41	Santa Isabel	9,249	0.62 km <sup>2</sup>	14,917
42	Santa Justa	1,552	0.32 km <sup>2</sup>	4,800
43	Santo Condestável	29,186	1.33 km <sup>2</sup>	21,966

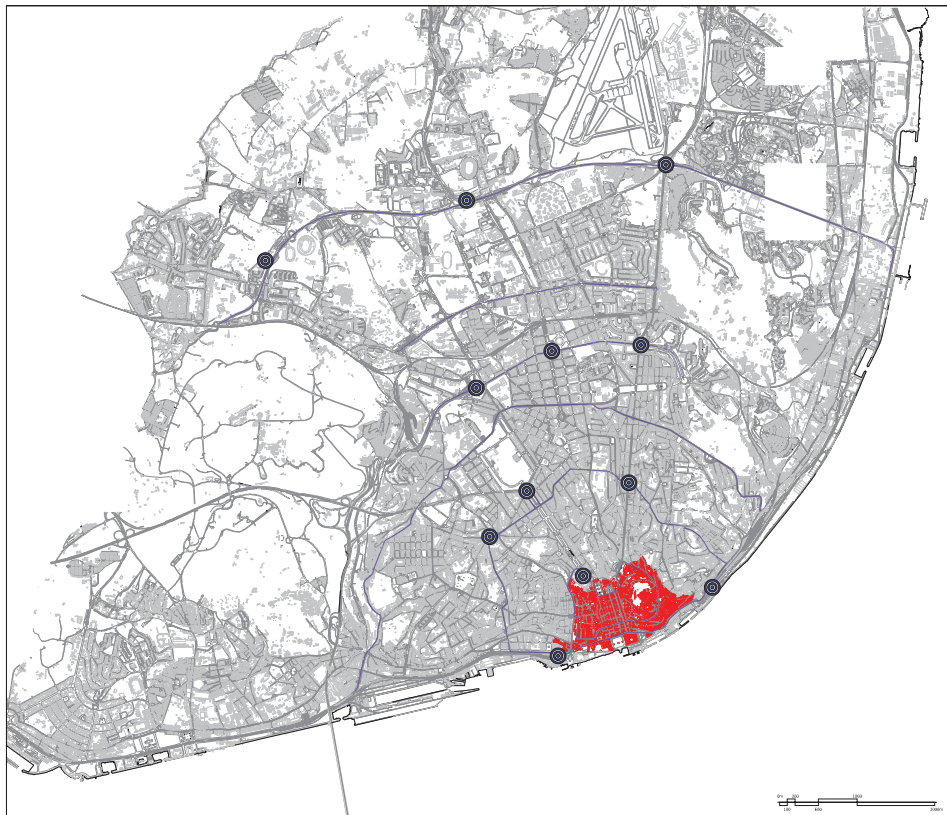
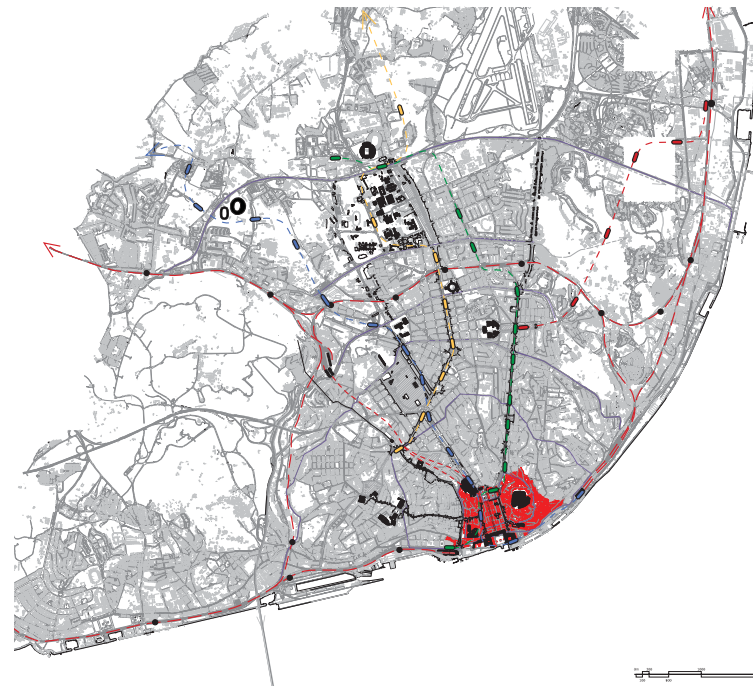
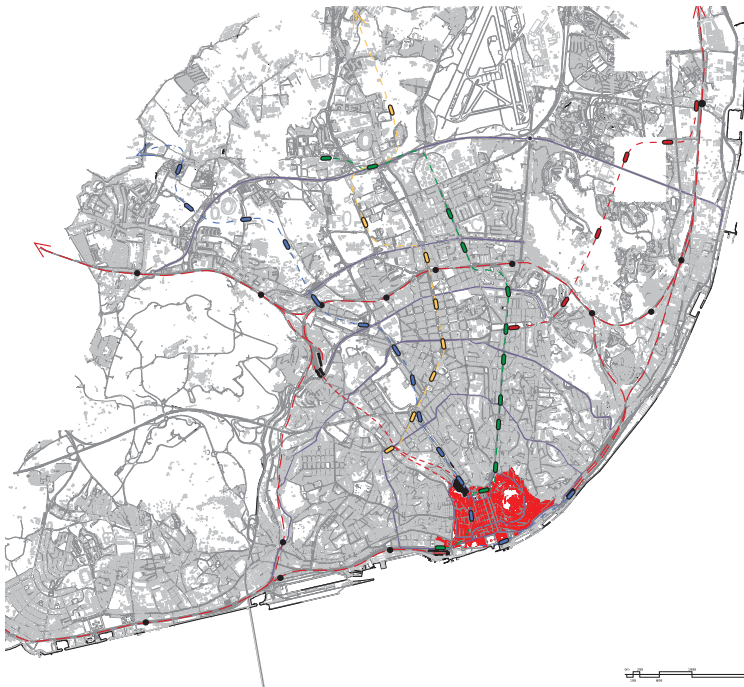




Lisbon Civic Structure and Concentric Development







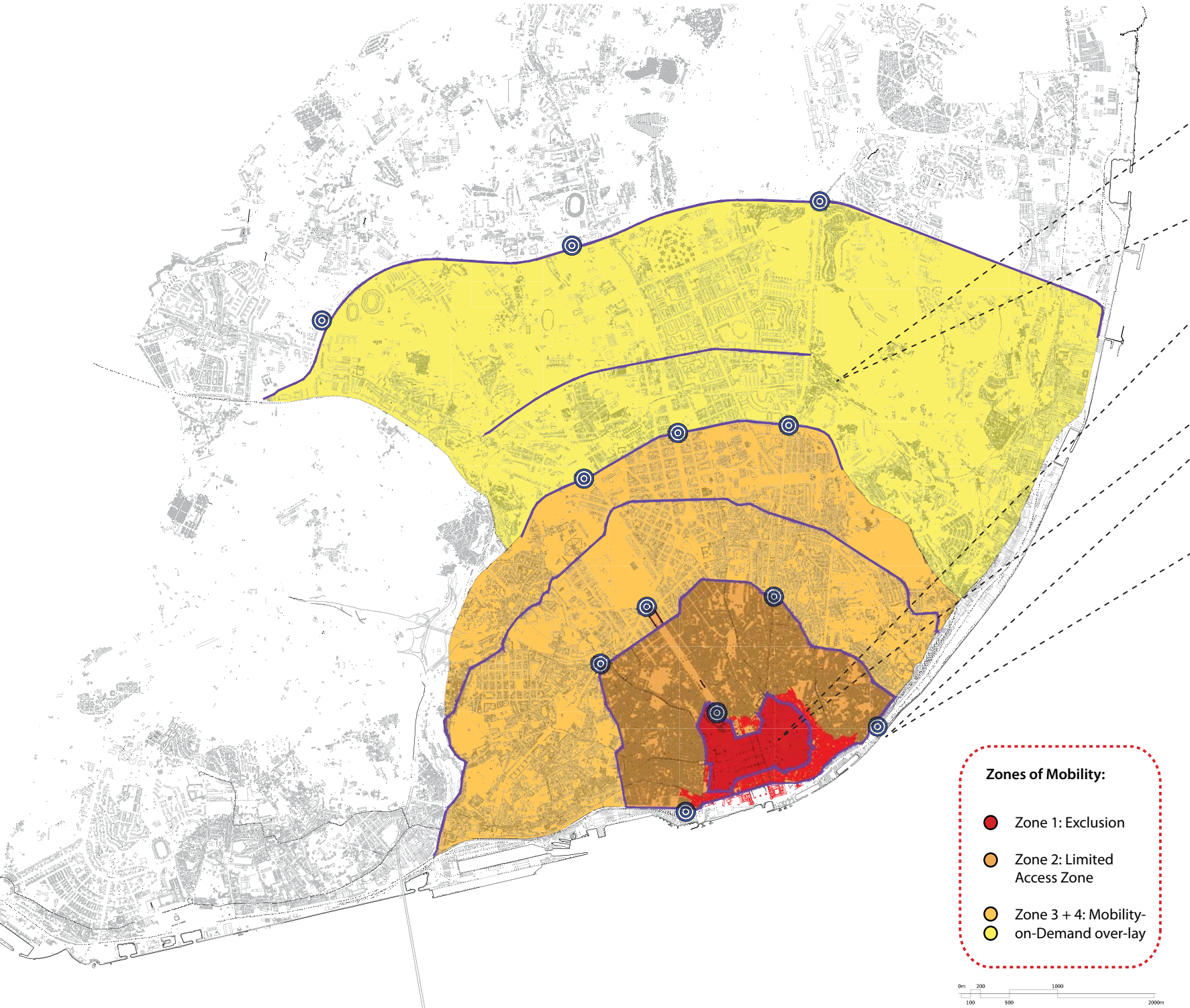
^< Civic structure system  
transposed over rings

^> Transport system (rail and  
underground) transposed over  
rings

< Mobility-on-demand primary  
nodes located at major public  
transport, civic fabric/structure  
and radial movement corridor  
junctions



Concentric Structure and Traffic Zones







The radial structure of Lisbon clearly shows the existence of several radial movement corridors, that all developed either in place of the demolished old city walls – which were erected during the medieval period – or between the planned extensions of the city after the fall of the monarchy at the turn of the nineteenth century.

In this way, the radial movement corridors clearly demarcate boundaries between very different types of urban fabric, with each ring becoming less dense and fine as they extend outwards from the old city core.

At the same time, the primary transport networks, especially the underground system, and the primary civic streets, squares, parks and public buildings (the civic structure of the city) create a 'V'-shaped or double-spine primary urban structure, which overlays and bisects each of the radial movement corridors as it travels outwards from the core.

The points where the civic, transport and radial systems intersect are also the urban spaces that form primary nodes within the city.

In the older quarters, these nodes developed because primary public spaces and buildings were located here, and thus the main movement corridors gravitated towards them; the in newer urban extensions these nodes often form due to the location of public transport stops and interchanges in space, and often lack the richness of the layering of civic structure seen in the older systems.

The location of mobility-on-demand systems here could begin to create and promote some of the richness, variety and complexity evident in the positive, habitable urban spaces within the older parts of the city.

**ZONE 1:**

**ZONE OF EXCLUSION**

Alfama and Baixa represent the oldest quarters of the city: Alfama having originated as a Moorish settlement with highly irregular an finely-grained urban fabric, and Baixa, whilst being highly geometric, having a similarly fine fabric. The Baixa and Alfama already have restricted private vehicle access (for residents only) and many of the streets have been pedestrianised, or always were due to their steep gradient.

The introduction of mobility-on-demand systems and exclusion of private cars here could serve to increase accessibility in this area, making it more attractive as a place to live, as well as reduce danger to the many pedestrians who wander the twisting streets. The exclusion of the private car, and thus the diesel/petrol combustion engine, will serve to reduce the corrosion of the protected built fabric through reducing emission-related pollution.

**ZONE 2:**

**LIMITED ACCESS ZONE**

Although the fabric in this area is fairly dense and finely-grained, the nineteenth century road building projects consolidated many of the primary roads leading out from the old city gates, as well as planning new primary streets as the city expanded. Thus the dense fabric within this zone is structured into distinctive quarters and neighbourhoods by a series of radial streets.

The mobility-on-demand transport system should be located at major nodes and public transport stops along these streets. Whilst private vehicles should be able to access the primary streets, there should be a transition to mobility-on-demand vehicles when the dense, residential quarters are accessed. Residents' cars should also be accommodated here.

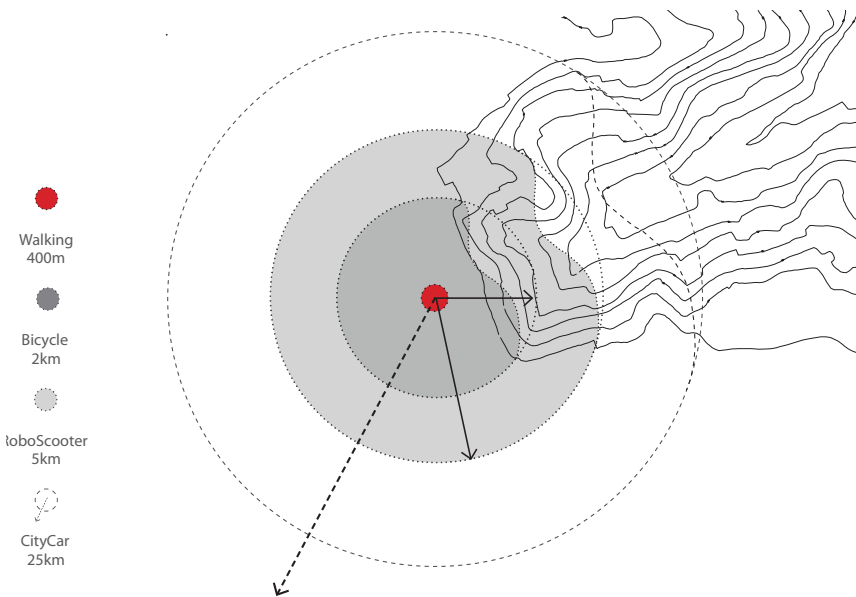
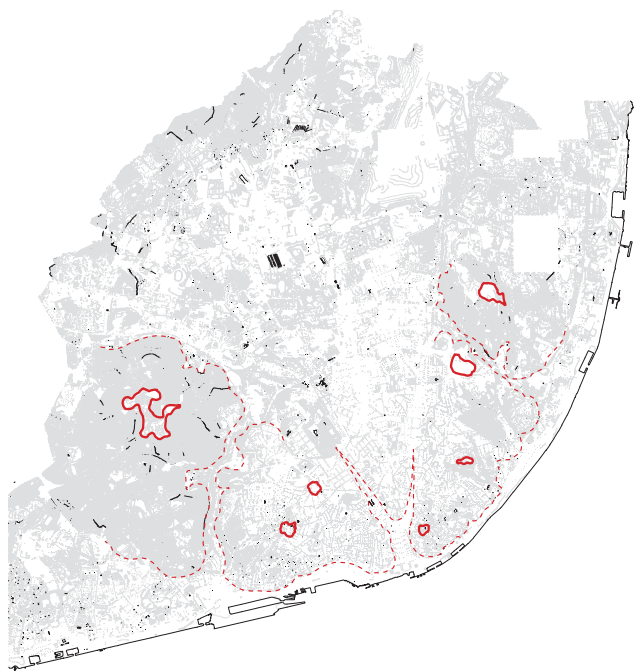
**ZONE 3 + 4:**

**MOBILITY-ON-DEMAND OVERLAY**

The Avenidas Novas, Alvalade and the University area all resulted from planned extensions to the city that occurred during the nineteenth and twentieth centuries. As such, they were all designed with wider roads and bigger blocks, creating a coarse urban grain - in short, they were all designed to accommodate the private automobile.

Because this area is so extensive, with the blocks and streets being less walk-able due to their scale and the public transport nodes thus also being more widely spaced, the mobility-on-demand system should be applied as an overlay onto the existing mobility system, not restricting private automobile use but facilitating and encouraging the use of public transportation by connecting the modes and stops more directly.

Lisbon City Centre



In inner city area of Lisbon – composed of the Baixa, Chiado and parts of the Alfama neighbourhoods, should undoubtedly be considered the most important area in Lisbon. It was the metropole to a vast sea-faring empire, it has buildings of significant architectural and historical importance (it is to be declared as a UNESCO World Heritage Site) and thus has touristic importance too. It also accommodates a community of residents and businesses, but is unfortunately in decline, due, in part, to the following:

1. Most of the existing commercial activity is in decline, unable to compete against the emerging shopping malls;
2. The area is busy and congested during the day; but quiet and deserted at night, deterring new residents from moving in, and encouraging existing ones to move due to safety concerns;

3. As the population of the area decreases, buildings become abandoned, or at least poorly maintained. Most of the inhabitants are old; and high rents, the lack of accessibility and facilities serve to deter new residents and companies from locating in the area;

4. As most people have a high car dependency and do not want to access the city centre, where parking is scarce, narrow roads make it difficult to drive, and congestion is a daily occurrence.

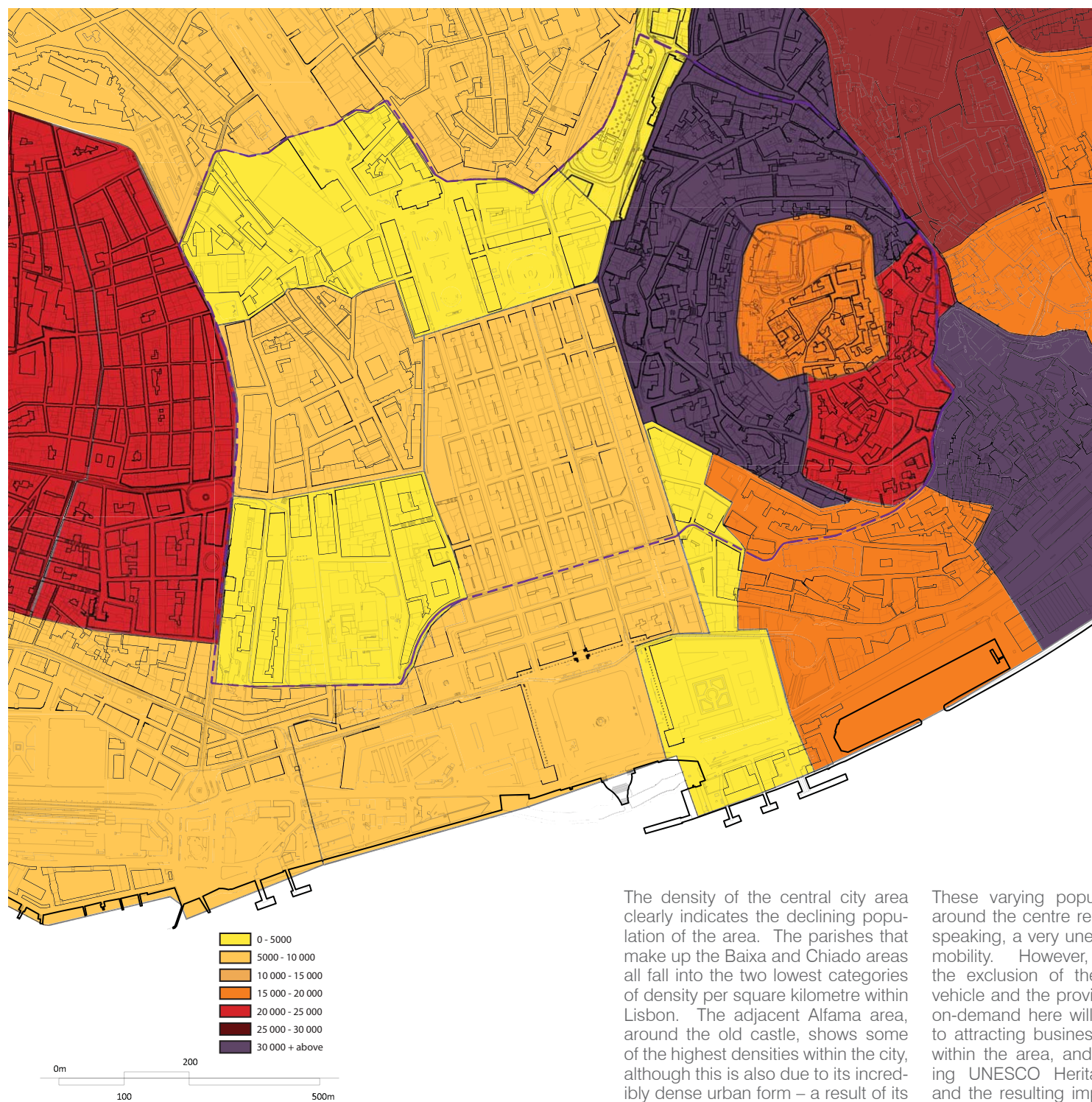
The traffic problems in the area also serve to hinder pedestrians and tourists in walking around the centre and accessing its cultural institutions.

As the Baixa lies within a valley, with fairly steep sides, the pedestrianisation of the area would not be feasible as it would limit people's access to many of those places located on the hillsides. The complete exclusion of the private motor vehicle and institution of mobility-on-demand vehicles in this area would go a long way to reversing some of these negative trends.

Again due to topography, the mobility-on-demand nodes would require a slightly denser distribution, as the distance that can be travelled in a certain time at an average speed reduces with an increase in gradient.



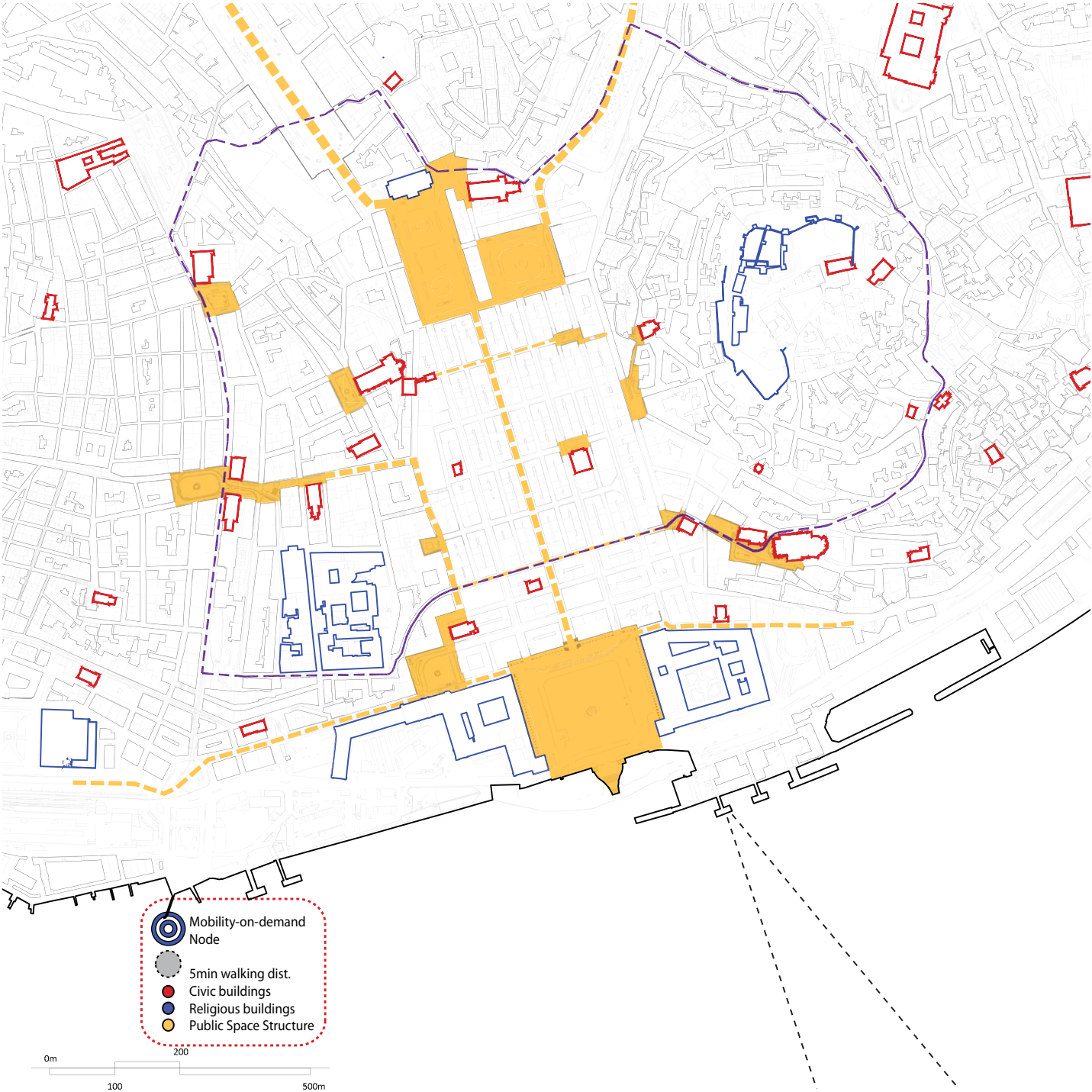




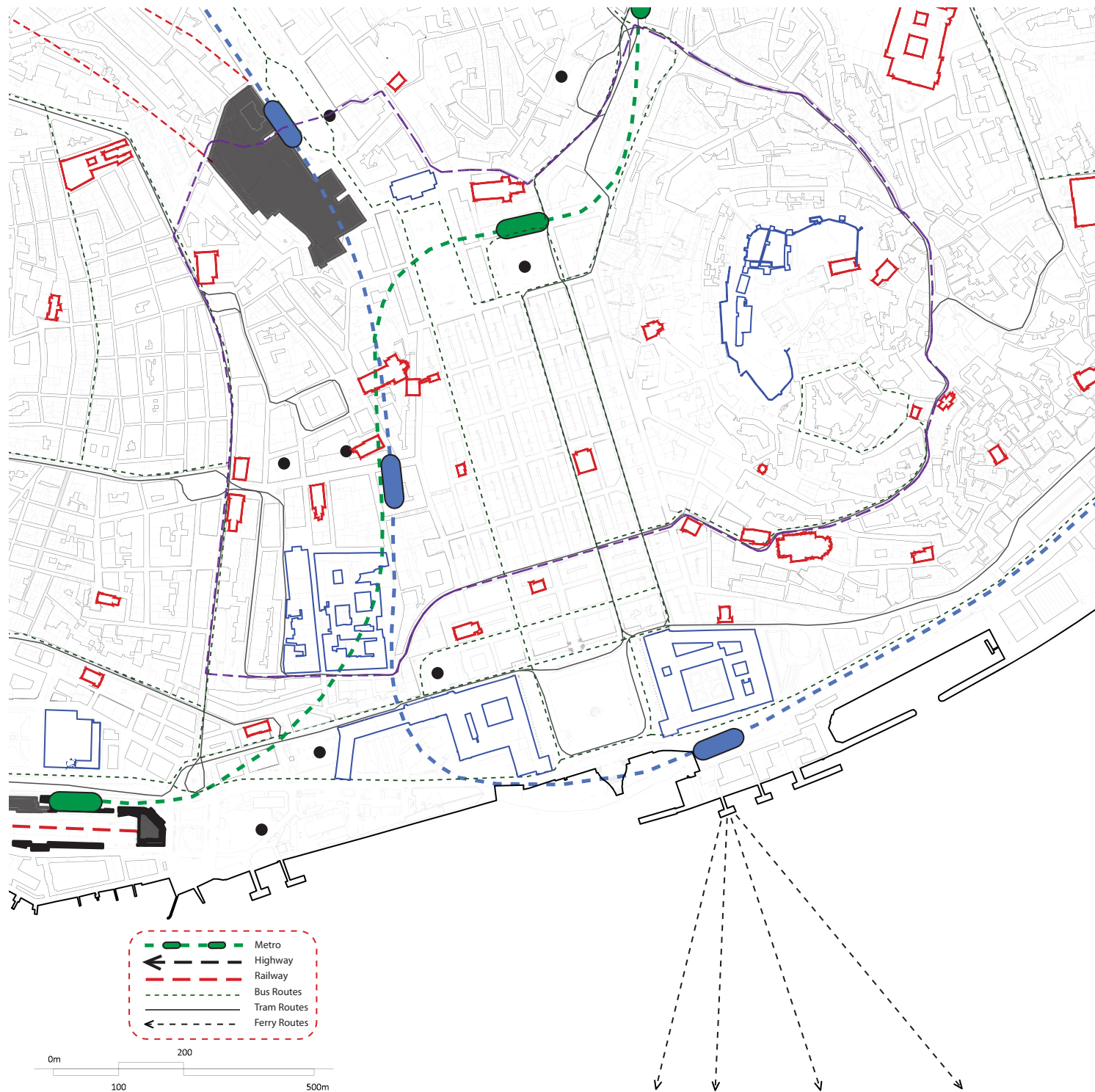
The density of the central city area clearly indicates the declining population of the area. The parishes that make up the Baixa and Chiado areas all fall into the two lowest categories of density per square kilometre within Lisbon. The adjacent Alfama area, around the old castle, shows some of the highest densities within the city, although this is also due to its incredibly dense urban form – a result of its development as a Moorish city from 700 AD to its “reconquest” in 1152 AD.

These varying population densities around the centre result in, spatially-speaking, a very uneven demand for mobility. However, assuming that the exclusion of the private motor vehicle and the provision of mobility-on-demand here will go a long way to attracting business and residents within the area, and with the pending UNESCO Heritage declaration and the resulting impact on population through increased tourism, much higher populations could be accommodated, and should be predicated, for the future.

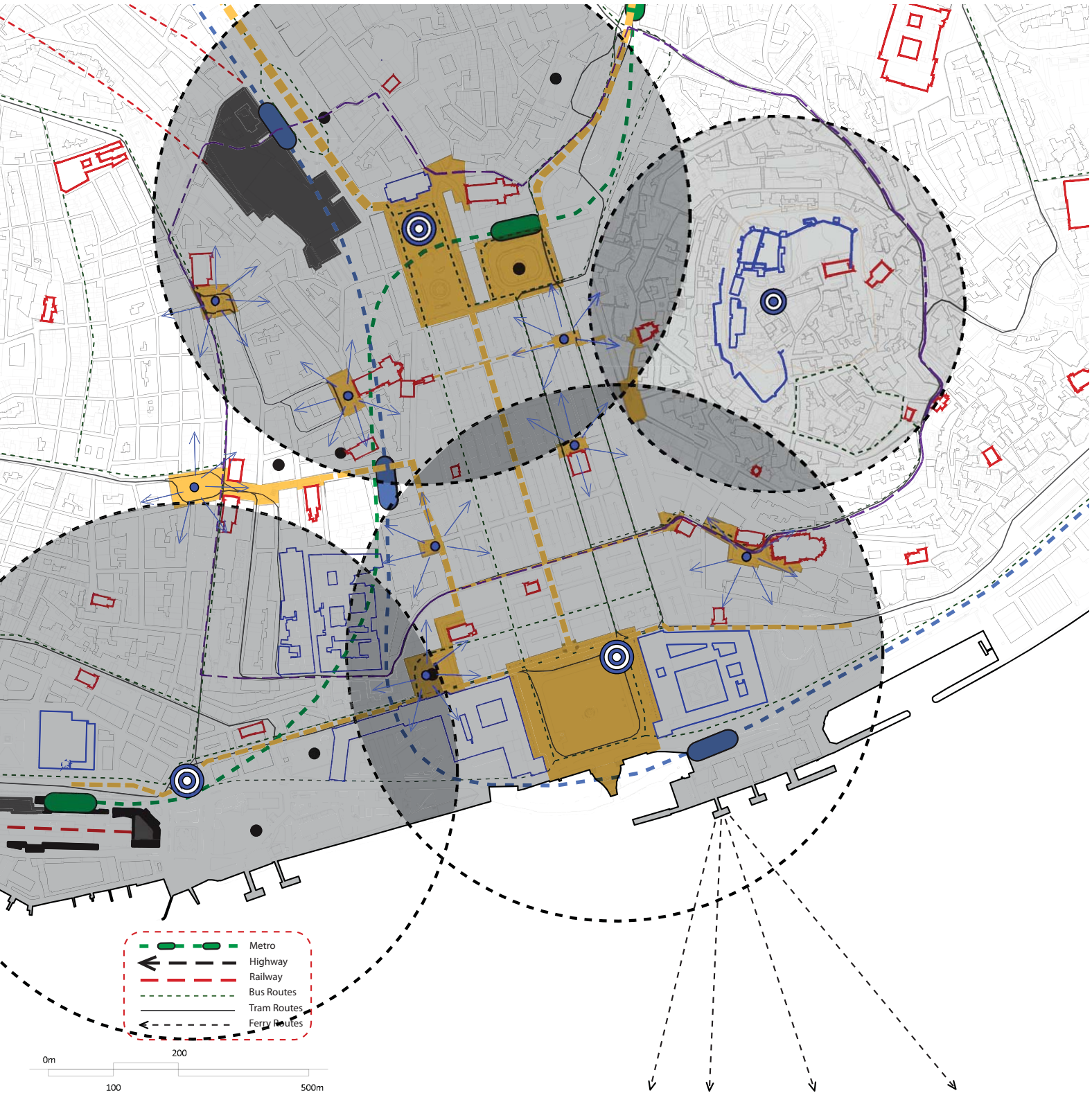
Civic Structure and Space: Lisbon City Centre



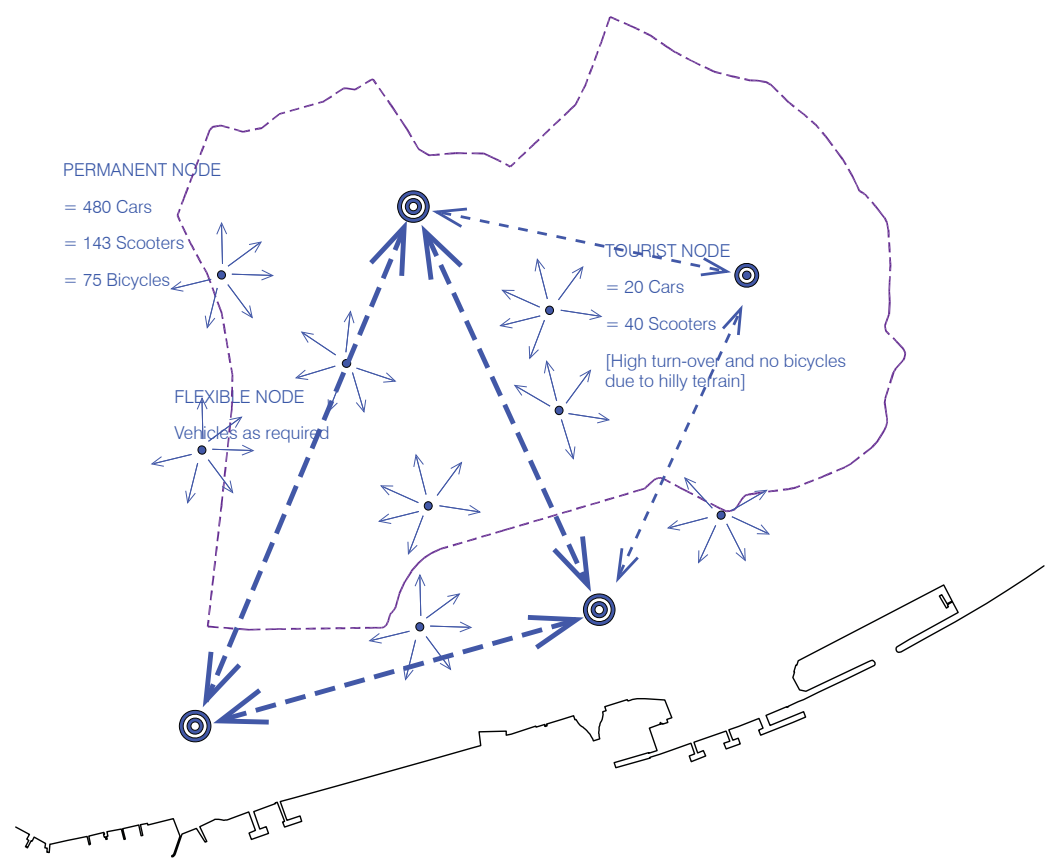




Nodes and Walking Distances: Lisbon City Centre







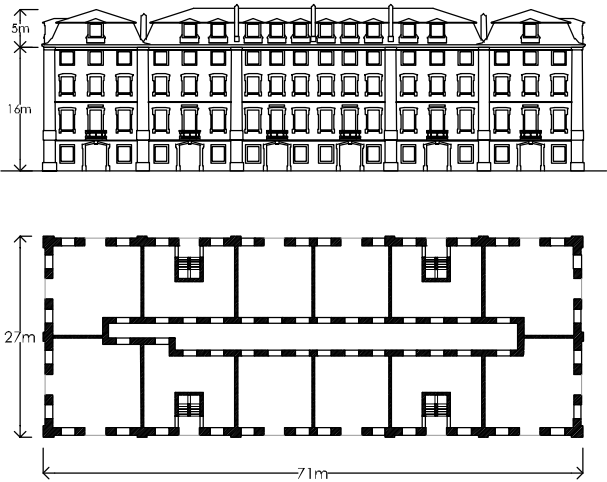
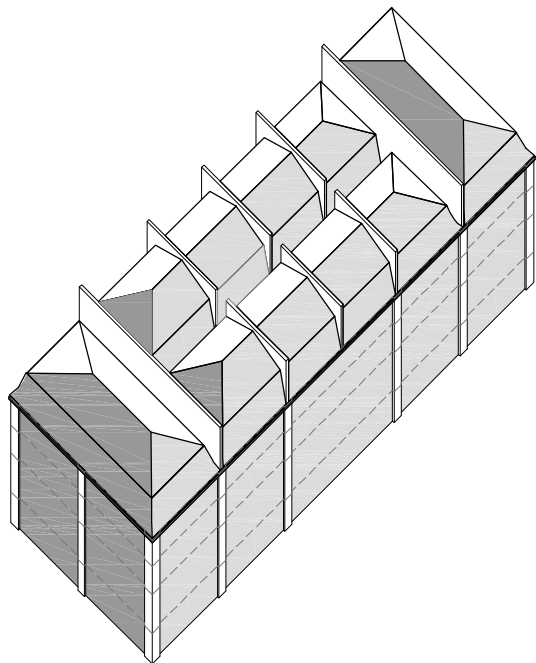
Sao Nicolau has a residential population of 1448 people (0.21% of Lisbon's population). By a conservative estimate, it welcomes 6 times as many trips into the city as it does out of the city in the morning.

Sao Nicolau		Mode	Trips
36.1%	Car	170	1020
3.8%	Passenger (Car)	18	108
18.5%	By foot	87	22
9.8%	Subway/Tram	46	526
1.8%	Train	9	304
27.7%	Bus	131	786
0.6%	Motorcycle/Bicycle	3	18
1%	Company/School Bus	5	30
0.7%	Other	3	18
TOTAL		472	2832

Assuming people who already use cars, motorcycles and bicycles will substitute them directly for the CityCar, RoboScooter and SmartBike directly, and of those using public transport, one-sixth will be dropped off close enough to their destination to walk there, one-sixth will take a SmartBike, one-third will use a RoboScooter to solve the last-mile problem, and one-third will take a CityCar.

	OUT	IN
CityCar	255	1696
RoboScooter	127	556
SmartBike	90	310

Block Types, Fabric and Mobility Issues: Baixa Pombalina





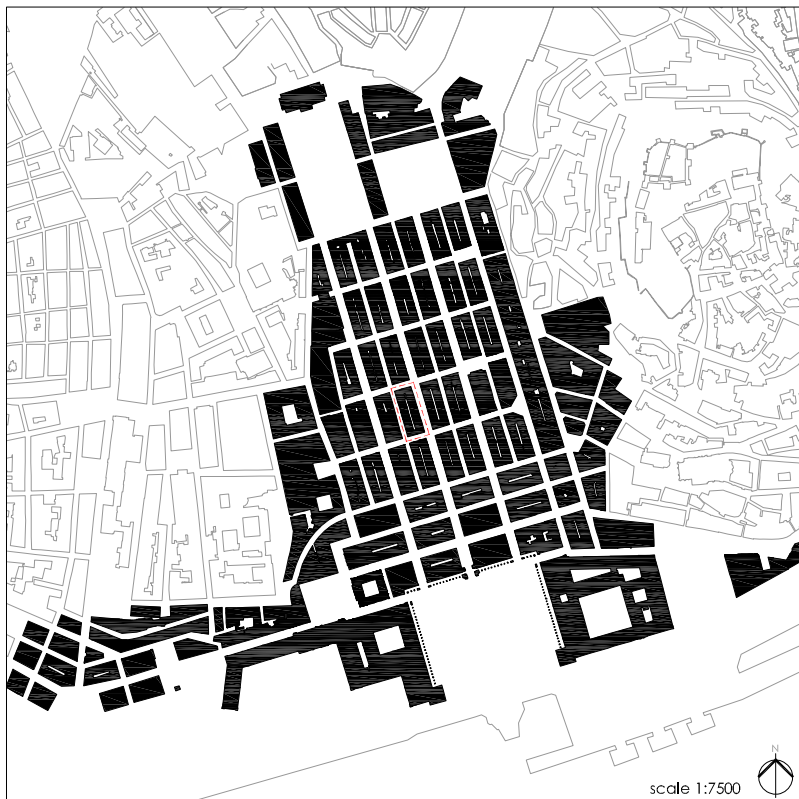


Mobility issues within the Baixa area stem from its narrow, geometric fabric, with old 70 x 26m regular blocks throughout the area, as well as several steep streets towards the Chiado and Alfama quarters. Several of the roads are pedestrianised, and the roads open to regular traffic are often one-way streets. This has the effect of creating a “rat run” to the water’s edge, with cars, trams and busses fighting for road space, causing significant congestion.

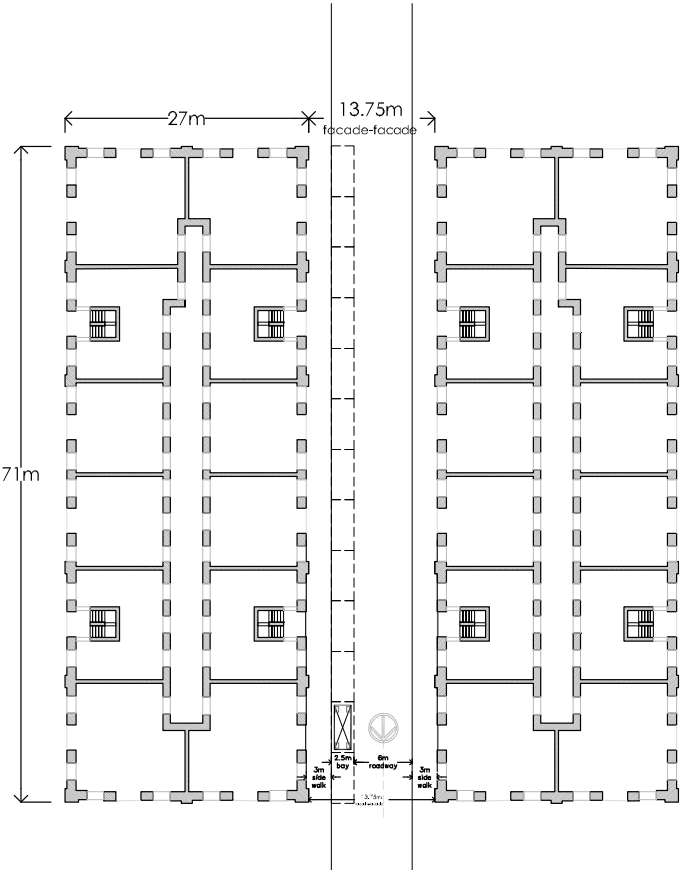
The area has very little parking space – both at street level and underground – with narrow and steep roads along its edges and a myriad of one-ways and pedestrian streets in the centre. Additionally, it is closed to non-residents at certain times of the day.

The fabric makes for an unhappy marriage of 20th century automobiles, 18th century streets, and many pedestrians out to admire the historic area and visit its institutions, businesses and shops. As a result, these businesses continue to close, the area remains unattractive to Lisbonites as a place to live, and tourists have a difficult time navigating the historic fabric.

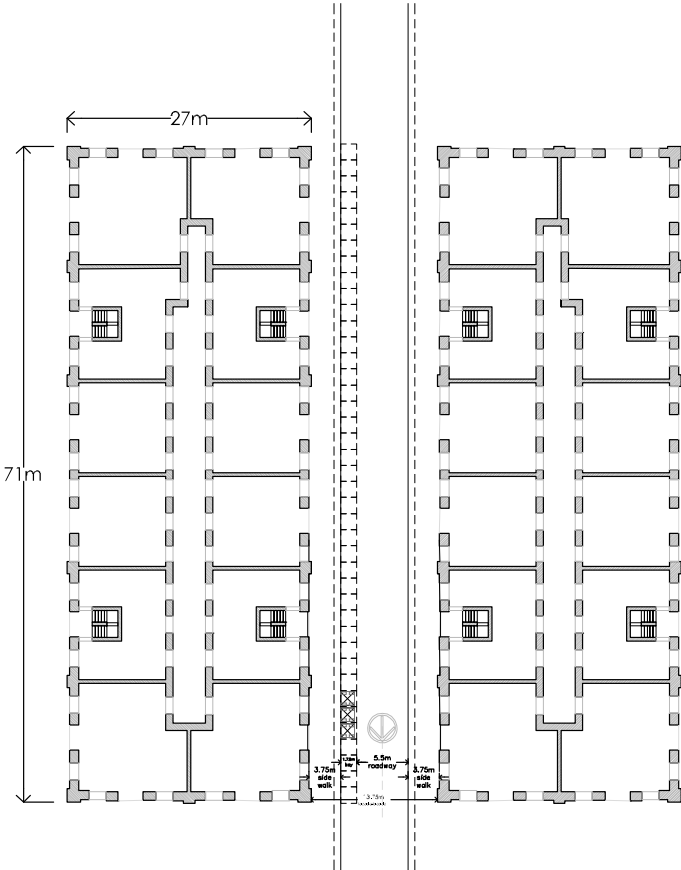
The exclusion of all private vehicles in the Baixa is feasible, as it is well-served by public transport infrastructure, and the significantly reduced space the mobility-on-demand vehicles will take up in the old city will allow for an increase in accessibility, liveability and amenability of the quarter.



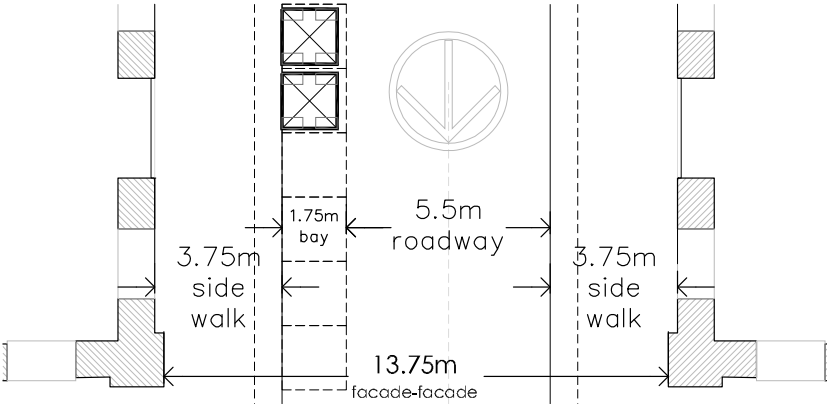
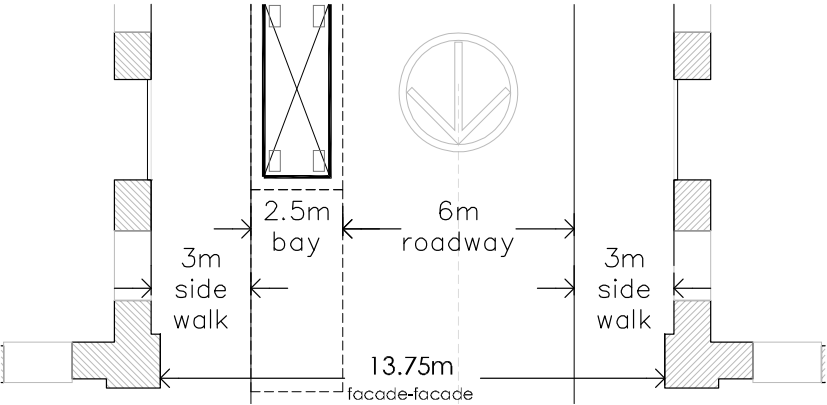
Narrow Streets and Mobility Issues: Baixa Pombalina



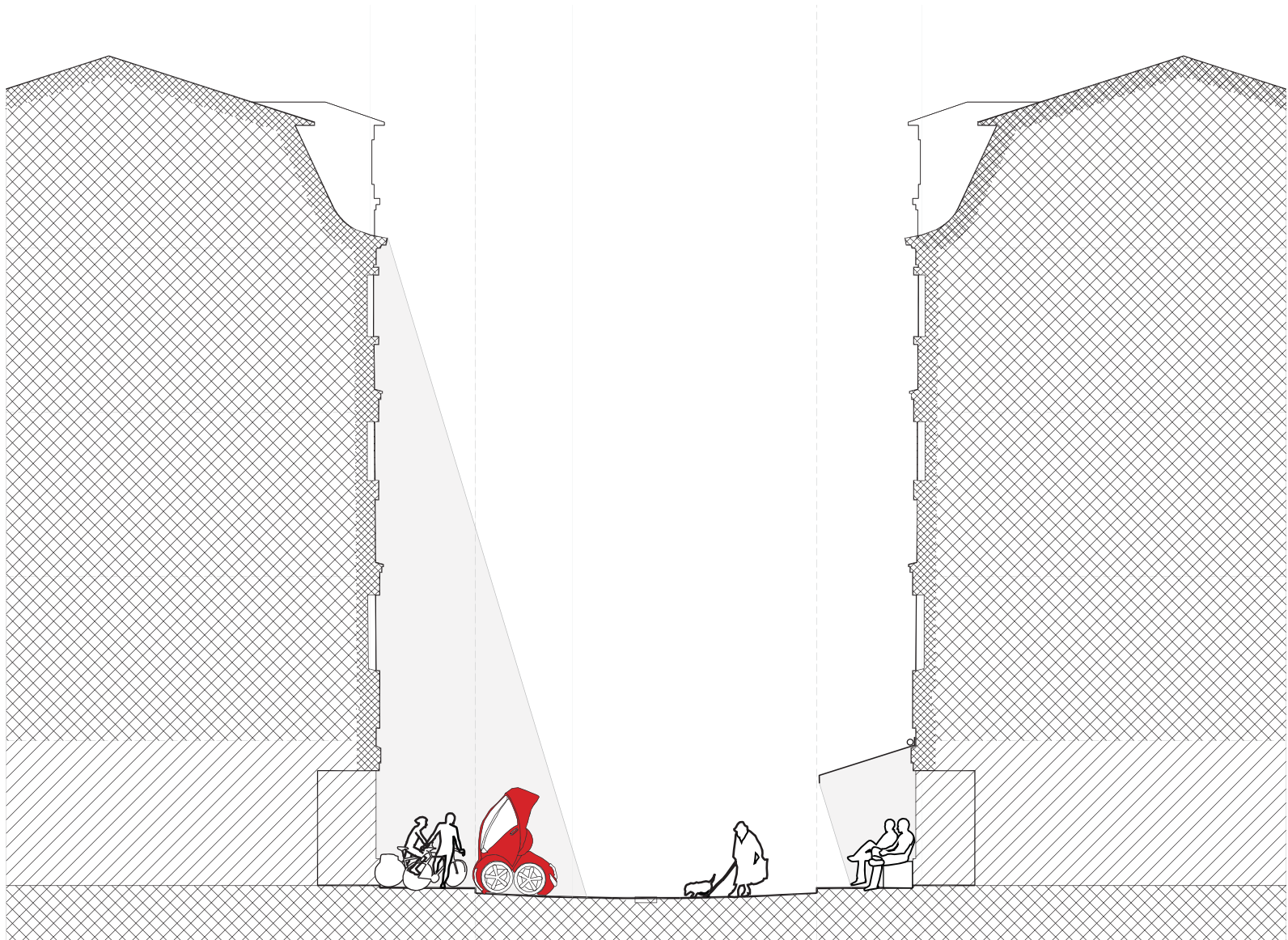
Narrower road: 13 std. parking spaces



Narrower road: 41 CityCar parking spaces







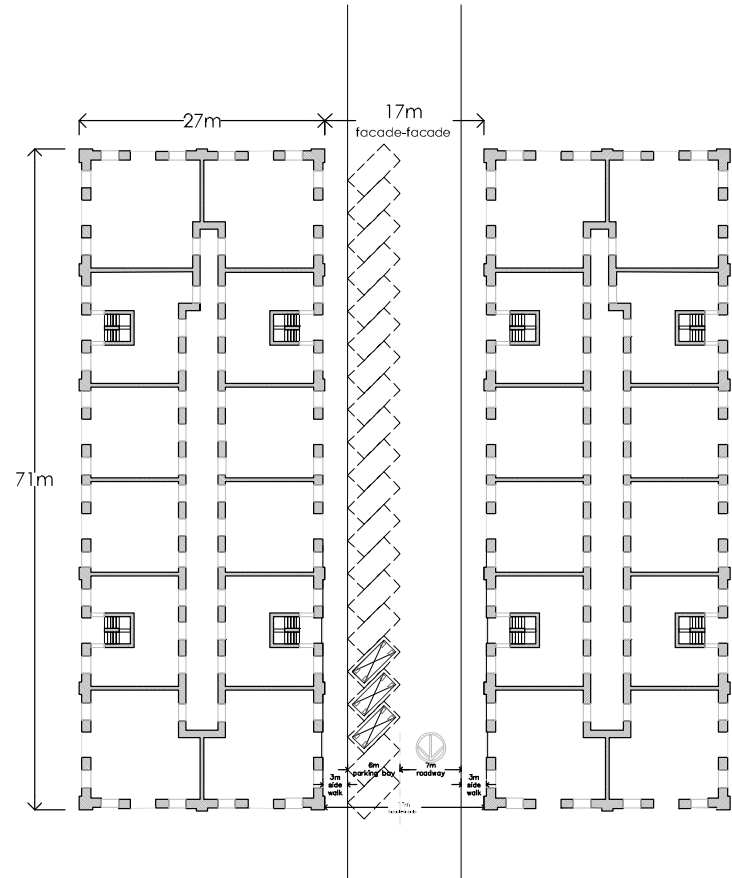
## NARROWER ROADS

The introduction of mobility-on-demand nodes within narrower Pombaline streets in the Baixa neighbourhood allows for the narrowing of the road width and an increase in pavement width. This will allow for a wider “canvas” for the Portuguese paving which artfully decorates the pedestrian areas within the quarter, and will also allow for an edge wide enough to accommodate awnings and benches.

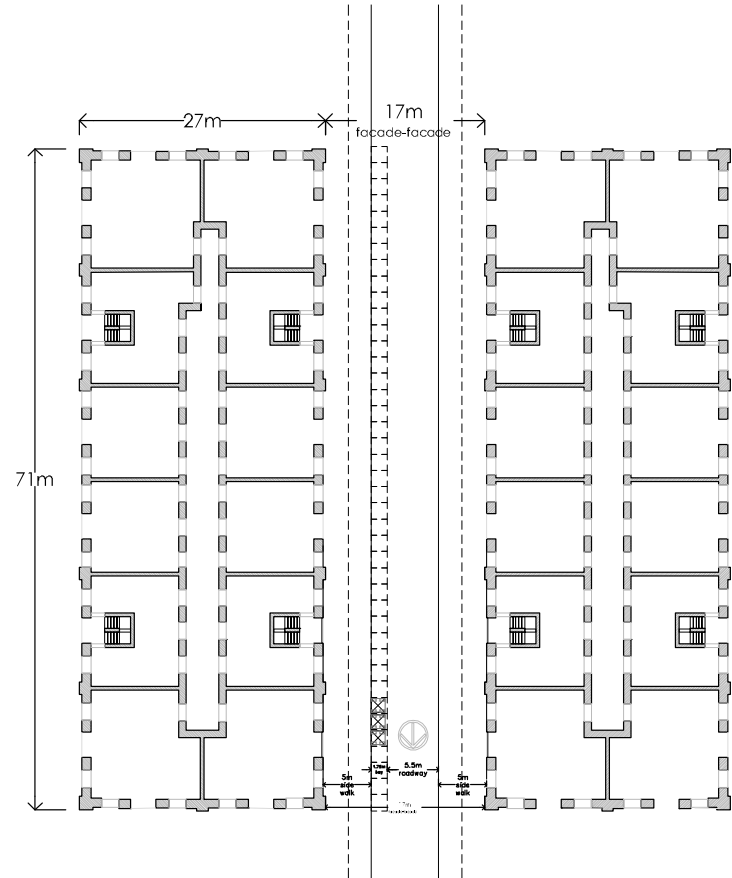
That this would prove attractive for the location of shops within these narrower streets, which immediately become more accessible due to the location of a mobility-on-demand node within the immediate area, is clear.

It will also provide improved mobility opportunities for residents, and thus the upper floors of the Pombaline blocks would become more attractive as apartment spaces for young professionals and young families, particularly as these narrower, secondary roads tend to be quieter than the primary axial streets.

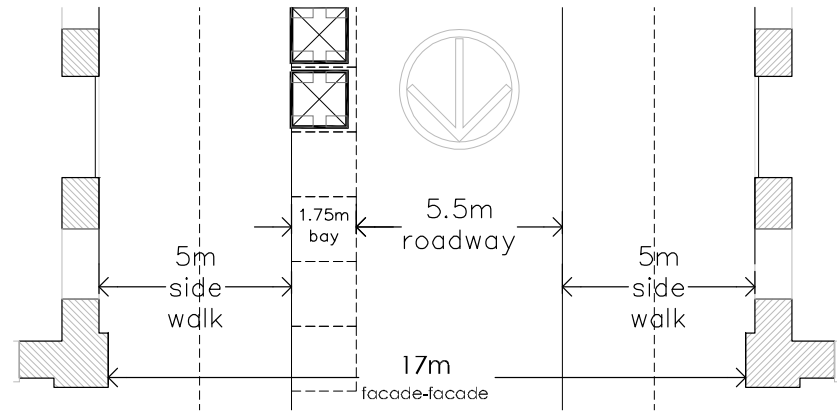
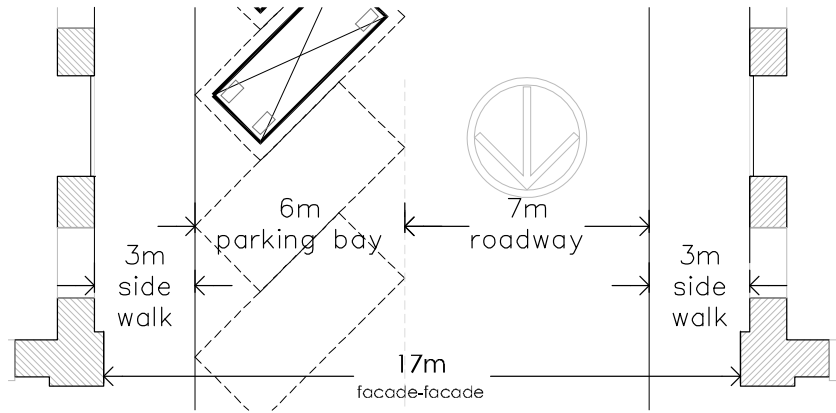
Wide Streets and Mobility Issues: Baixa Pombalina



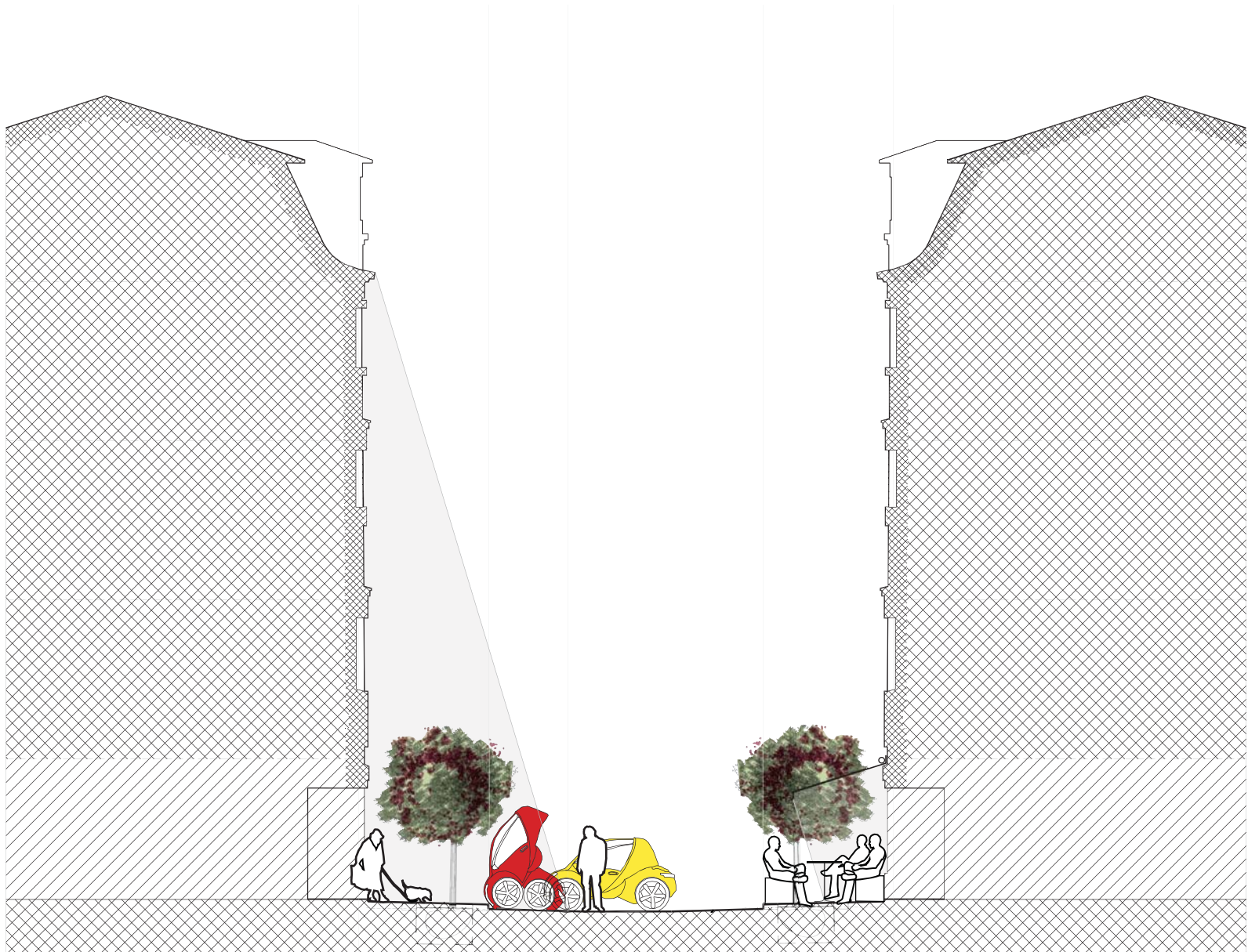
Wider road: 20 std. parking spaces



Wider road: 41 CityCar parking spaces







#### PRIMARY/WIDER STREETS

The effect of the placing of mobility-on-demand nodes along the primary streets within the Pombaline fabric of the Baixa serves to narrow the road width in these areas, as well as significantly increase the pavement edge so that cafe tables, awnings and even tree planting can be accommodated along the street interface.

This would prove very attractive to cafes, restaurants and the like, as the additional public space on the street would greatly improve the visibility of their businesses, as well as make them more accessible due to their location adjacent to, or within range of, a mobility-on-demand node.

The increased visibility and accessibility of these primary streets will also make them more attractive to the location of office premises on the upper levels of the Pombaline blocks, and will thus contribute to the re-densification and revitalisation of the old urban core.