



Politecnico di Milano
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Sustainable Architecture and Landscape Design
A.Y. 2019-20

Resilient Jeddah

White Lands as a Transformation Tool Towards
Sustainability in Jeddah

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Abstract

The urban quality of a city is directly reflected in the environment and the health of its residents, and it is the spine of all sustainable urban developments. As part of the continuous efforts of Saudi Arabia to improve the urban environment, this project aims to investigate the existing urban situation in Jeddah on the West Coast of Saudi Arabia and understand its underlying issues that affect the quality of life in the city. Addressing issues of density, vacant lands, urban pattern, and high car dependency, the project aims to identify the problems and propose urban and architectural solutions that can make Jeddah a resilient sustainable city. Focusing on an urban area in a central strategic location, characterized by the widespread presence of vacant land and an important railway station, the thesis experiences a transit-oriented approach, capable of enhancing the existing railway accessibility and proposing a dense and mixed-use development, according to sustainable principles inspired from the traditional city, to be an exemplar for future Jeddah.

Keywords: vacant lands, resilience, nature-based solutions, transit-oriented development, human-based cities, hot and arid climate, sustainable architecture, mixed-use, urban sprawl, BRT.

La qualità urbana di una città si riflette direttamente nell'ambiente e nella salute dei suoi abitanti ed è la condizione necessaria per ogni sviluppo urbano sostenibile. Nell'ambito dei continui sforzi dell'Arabia Saudita per migliorare l'ambiente urbano, la tesi analizza la situazione urbana esistente a Jeddah, città della costa occidentale dell'Arabia Saudita, per comprenderne le problematiche di fondo che influiscono sulla qualità della vita in città. Confrontandosi con temi legati alla densità urbana, alla alta dipendenza dall'auto del modello urbano che comporta una importante presenza di infrastrutture stradali che generano spesso vacant spaces ed enclaves, alla presenza diffusa di terreni liberi, la tesi propone soluzioni urbanistico-architettoniche per riorganizzare un'area localizzata in una posizione strategica sperimentando soluzioni che possono rendere Jeddah una città resiliente e sostenibile. L'area, caratterizzata dalla diffusa presenza di terre libere e di una importante stazione ferroviaria, presenta le condizioni per sperimentare un approccio Transit oriented, capace di valorizzare l'accessibilità ferroviaria esistente e proporre uno sviluppo insediativo caratterizzato da densità e mixité, secondo principi sostenibili ispirati alla città tradizionale araba, per essere un esempio per la futura Jeddah.

Parole chiave: terre libere, resilienza, Natural Based Solutions, TOD, clima caldo e arido, architettura sostenibile, densità, mixité, rigenerazione urbana, BRT.

English

Italian

1. The Introduction

1.1 Introduction
1.2 Problems and Research Questions
1.3 Goal and Objectives

1.1 Introduction

Throughout the history of Jeddah, it has been a resilient city with resilient people, full of diversity and solidarity. A turning point happened after the oil boom when the city grew tremendously because of the rising economy and the rapid population growth as people poured into the city seeking economic opportunities and the automobile became the dominant mean of transport.

The oil booms and the private car were two of the main factors behind Jeddah's sudden massive growth and the form it took as we know it today: full of widespread scattered single-use zones of medium-low density, with huge distances in between, and a massive road network that is solely automobile-oriented. This shift in economy and population was not only one of the main causes of environmental problems, isolation and wasted space, but it also made the city lose its livability, humanity and caused numerous health problems.

This project will investigate the underlying problems of the city and identify its potential as a resilient sustainable city as it was before; then identify the vacant and underused spaces with relevant potentialities for a new strategical vision of the city. After that, it proposes development on vacant lands in the heart of the city intending to reduce its horizontal sprawl to be an exemplary model for a sustainable, human-based, resilient urbanity that does not abandon its history and roots and may participate in spreading the concept to the entire city as well as around Saudi Arabia.

1.2 Problems and Research Questions

Jeddah's urban planning documents, only partially implemented, did not address the rapid urban growth and were characterized by a low-density greatly monofunctional land use, and with a heavily car-dependent model, it was far from the historical identity of Jeddah and contradicted with the values of sustainable urbanization, leading to numerous environmental, social, economic, and health issues. Furthermore, this unplanned urban growth has created a vulnerable city in front of the harsh climate of the region and the arising environmental and health challenges. Besides, it has generated numerous vacant spaces, which testify to the inefficiency and loss of potential in governing urban transformations. The relevance of these under-used, vacant spaces is twofold: from one hand they are the result of the settlement and economic transformations that occurred in Jeddah over time; from the other hand they are a resource for increasing land-use efficiency, improving key ecosystem services provision, and supporting a new urban vision. In this framework, the project is dedicated to answering the following question:

- How can vacant lands be an opportunity to stop horizontal sprawl and increasing density?
- How can Jeddah be a humanized sustainable city despite its challenging climate and its orientation towards cars and automobiles?
- How can Jeddah use vernacular urban patterns and architecture as a reference to achieve sustainability and resilience?

1.3 Goal and Objectives

The main goal of the project is to utilize vacant lands in central Jeddah for a sustainable multi-scale urban and development that reduces urban sprawl, through selective and in-filling densification that also improve the land-use mix, minimize car dependency, and act as an exemplary model for more sustainable human-based developments in Jeddah and around the country.

This is achieved through the combination of sub-objectives as follows:

1. Understanding the history and characteristics of both old and modern Jeddah, its planning stages, the decision-making process and their impact on the environment and the quality of life within the city, to clarify the city's peculiarities, key issues, and the need for a new strategic vision and development.
2. Analyzing the issue of vacant lands and choosing the appropriate vacant lands for experimenting with solutions that can transform the city.
3. Developing an exemplary sustainable neighbourhood in the selected area using climate-coping solutions both old and new, integrated land use, transport strategy in favour of active and sharing mobility, supporting a transition through electric vehicles, as well as sustainable architecture to reduce urban sprawl and overcome the dominance of the car and reliance on non-renewable energy at the urban and architectural levels.

2. Jeddah's Planning & Sustainability

2.1 Jeddah's Planning History

2.2 Interpreting the Context: The Important Features of Jeddah

- 2.2.1 Urban Structure
- 2.2.2 Environmental System and Topography
- 2.2.3 Land-use System: Main Uses
- 2.2.4 Land-use System: Vacant Lands
- 2.2.5 Urban Morphology and Population Density
- 2.2.6 Socio-Demographical Trends
- 2.2.7 Residential Demand
- 2.2.8 Employees and income in Saudi Arabia
- 2.2.9 Mobility Patterns and Infrastructure System
- 2.2.10 Urban Planning and Policy

2.3 Drawbacks of Jeddah's Urban Pattern

- 2.3.1 Land Use and Transport Issues
- 2.3.2 Environmental Issues
- 2.3.3 Socio-Economic and Health Issues

2.4 Sustainability Within a Local Context

2.1 Jeddah's Planning History

Jeddah is the second-largest city in the Kingdom of Saudi Arabia and one of the most important cities in the Kingdom as a thriving multi-cultural regional trade centre and an important commercial hub, as well as the gateway for the holy cities of Makkah and Al-Madinah.

For hundreds of years, Jeddah's economy was based on revenue from commerce and services offered to pilgrims coming to Makkah and Al-Madinah. It was a small walled town with a distinctive architectural identity and a traditional organic urban fabric that was adaptive to the local climate. Narrow-shaded winding streets and (4-7) story buildings made of local coral stone and wooden Mashrabiya windows gave Jeddah its character and played an important environmental and socio-cultural role in controlling the harsh climate while providing the needed airflow and privacy.

At the end of the Second World War, Jeddah started to expand, and its population doubled, but the city remained intact within its three km² walls until the Kingdom received its first oil income in 1946. Only then the economy witnessed an upturn, and Jeddah was one of the first cities to benefit from this flourishing economy due to it being the gateway to Makkah.

The number of pilgrims increased also because of the ending of the Second World War, and from then, the population increased dramatically, and the urban growth had to follow. In 1947 the city's wall was demolished allowing it to grow and the massive expansion started (figure 1).

The discovery of the oil was the main factor behind the sudden population and economic growth in Jeddah, which was met by an urgent need for urban growth that kept up with this new era and was an essential inevitable development.

An economic difficulty between 1956 – 1960 caused by the closure of the Suez Canal in 1956 decreased the population growth of Jeddah by 4% at the time, but it prompted the government to start national and urban planning with the help of the United Nations under the leadership of its expert Dr Abdulrahman Makhlof. Jeddah got its first Master Plan in 1962 (figure 2), which determined Jeddah's main features and configurations that are present until this day: the linear pattern, King Abdulaziz Airport, the main motorways, the ring road, and the Corniche. This master plan divides the city in a geometric pattern into single-use areas: the existing residential areas, leisure areas, the sports area surrounded by a wall (called the sports city), the farming area, the electric services area, the cement factory area, the industrial areas, the university area also surrounded by a wall (called the university city), the seaport area, the public services area, and the sanitary purification area.

Finally, it features many 'white blocks' composing a grid of land subdivisions dedicated to the future residential expansion and waiting for prospective buyers and speculators.

When the crisis was over, Jeddah got its second Master Plan in 1973 that was prepared by an international consultancy consortium - Robert Mathew, Johnson - Marshall partners (figure 3). This plan took into consideration the sound economic/commercial state of the city at the time and was based on the optimistic inflow of oil revenue into the Kingdom; as of 1971, Jeddah was a diplomatic hub and a centre of professional, scientific, and skilful employment. The plan featured the coastal line and open recreational spaces while considering population studies, national transport, and regional socio-economic and physical studies.

By that time Jeddah stood out as a national centre and its geographical location imposed on it the role of the principal gateway to the Kingdom (because it has the only navigable deep-water harbour within the Red Sea reef coastline). In addition to the seaport, Jeddah has been a trading hub between the Indian sub-continent and Europe, as well as its proximity to the holy city of Makkah. These factors led to designating the city the following national roles in the Kingdom's five-year plan: a centre of communication, a commercial and a business centre, the second diplomatic city in the Kingdom, the reception centre for Hajj and Umrah, and an educational, health, and a cultural centre. **As a result, Jeddah tripled as a regional and a local centre of commerce, business, and services, and thus, became an attractive location for immigration from inside and outside the Kingdom, and both skilled and unskilled workers alike.** The city's population grew rapidly from 381,000 in 1971 to about 600,000 in 1974 and over 1,000,000 by 1983. Simultaneously, the city grew physically four times its size fold from 31,400 ha to 121,500 ha within six years.

During the five-year plan, about 30% of the government's projects expenditure was invested in Jeddah. These investments were in the urban infrastructure such as water desalination, water supply, transportation network, the completion of the new airport, and the expansion of the Seaport, as well as the investments in the governmental sector, particularly the defence sector. The private sector played an important role as well in Jeddah's expansion, especially in the housing, business, and manufacturing sectors. Jeddah was less dependent on government investment and funding than other regions or cities in the Kingdom because of its role as a Seaport and trading centre and its strong commercial activities and growing industrial base.

In 1980 the population and spatial growth became so rapid and phenomenal and demand for services and facilities grew to the point that the municipality was unable to implement the plan of 1973 because it did not predict such huge development in a short time. Thus, another consulting consortium - Sert Jackson International - Saudi Consult (SJI/Sc) was called in to review the situation and to create the Master Directive Plan (figure 4). This plan guided Jeddah until 1990.

The objectives of this plan were similar to the previous ones, except for adding a spine corridor development along the Madinah Road, the control of the central area, and a development proposal of the Old Airport site as a residential neighbourhood that can accommodate up to 100,000 people. It also featured a Mass Transit System alongside commercial, industrial, and recreational uses. **Unfortunately, the proposals for the utilization of the Old Airport site and that of the Mass Transit System have not been implemented until today, and part of the reason could be the economic fluctuation and recessions in the middle of 1980-1990, which were experienced worldwide and especially in the Kingdom, as well as the successive Gulf War in the early 1990s.** The favourable economic conditions did not last long, and the city's population kept fluctuating with the ups and downs of the economy. The government also had to reduce the expenditures of the municipalities and housing sectors, which affected urban development. Nevertheless, Jeddah is expected to continue growing due to the high flow of migrants from both inside and outside the country attracted by the employment and investment opportunities. The planning tools of Jeddah will be further explained in detail in section 2.2.4: Urban Planning and Policy.

Figure1: Historical Growth of Jeddah from 1853 to 1979.

Source: Mohammed Sani Abdu, Jamaluddin Yousef Salagoor, Fahad An-Nwisser Al-Harigi, Jeddah Urban Growth and Development Process: The Underlying Factors. College of Architecture and Planning, King Faisal University. Dammam, Saudi Arabia. Scientific Journal of King Faisal University Vo.3 No.1 Dhu Al Hajjah 1422 (March 2002).

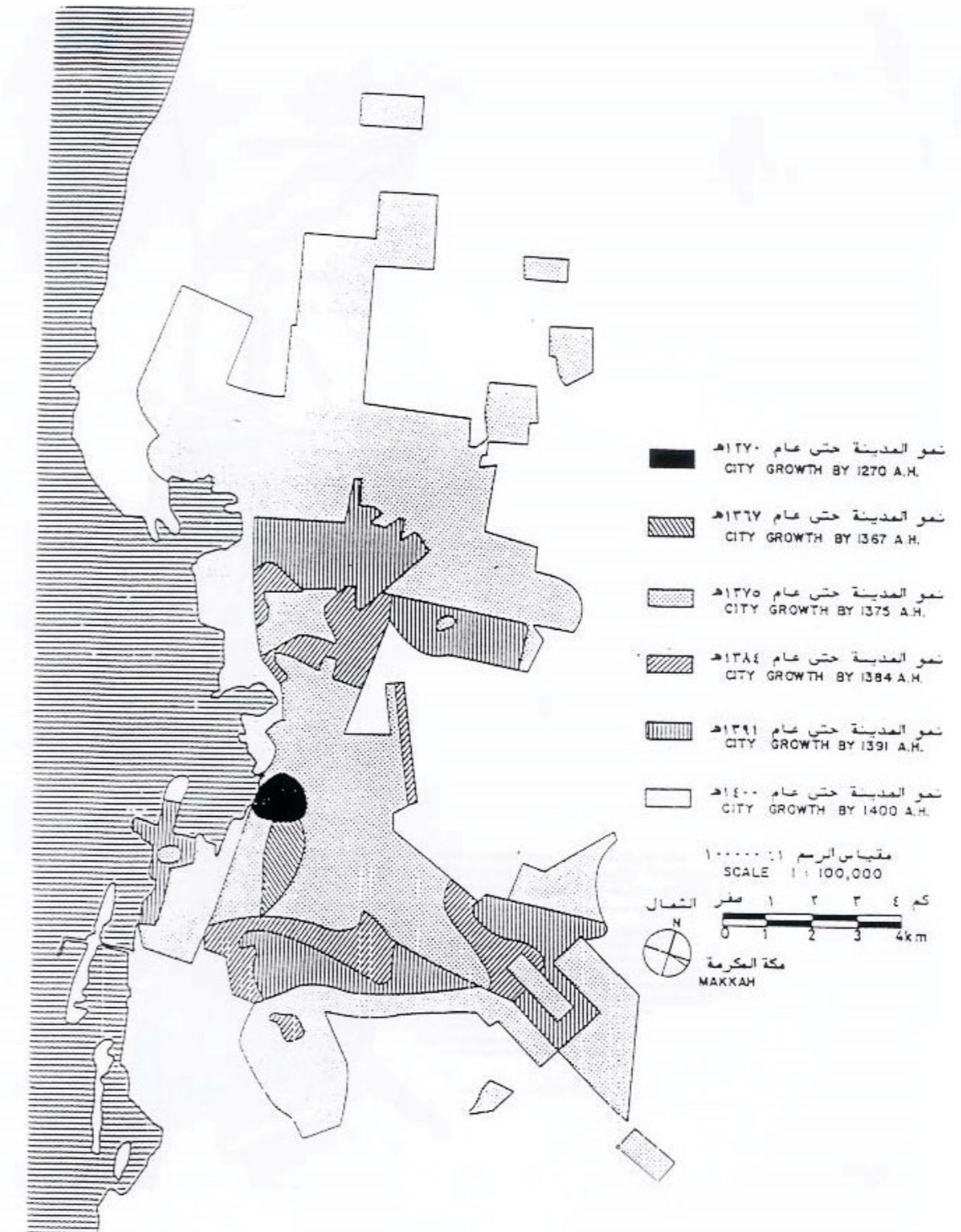


Figure2: The First Master Plan of Jeddah 1962 by Dr Abdul Rahman Makhlof.

Source: Mohammed Sani Abdu, Jamaluddin Yousef Salagoor, Fahad An-Nwisser Al-Harigi, Jeddah Urban Growth and Development Process: The Underlying Factors. College of Architecture and Planning, King Faisal University. Dammam, Saudi Arabia. Scientific Journal of King Faisal University Vo.3 No.1 Dhu Al Hajjah 1422 (March 2002)

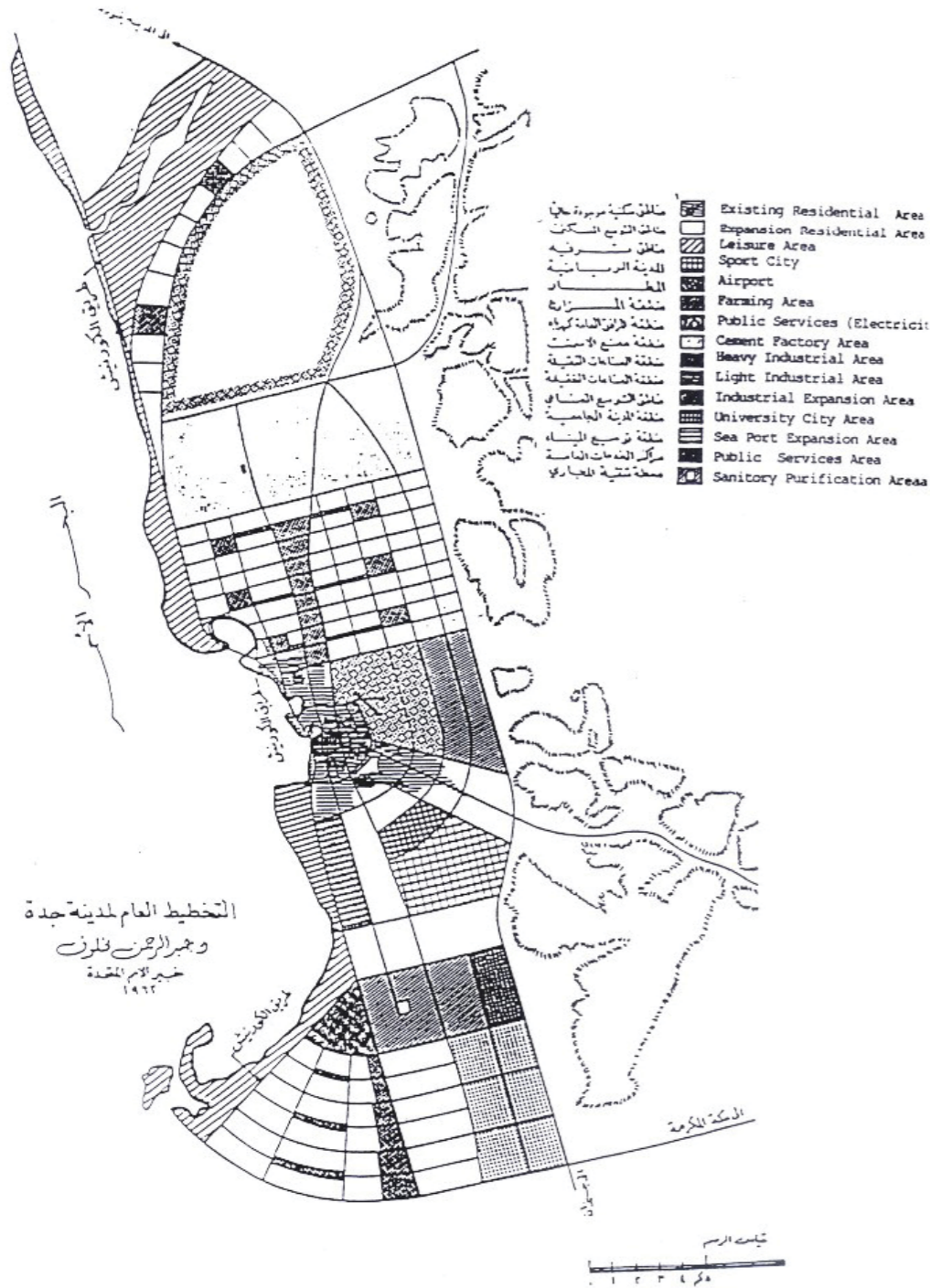


Figure3: The Second Master Plan of Jeddah, (1973-1983) by Robert Mathew, Johnson-Marshall Partners (RMJMP).

Source: Mohammed Sani Abdu, Jamaluddin Yousef Salagoor, Fahad An-Nwisser Al-Harigi, Jeddah Urban Growth and Development Process: The Underlying Factors. College of Architecture and Planning, King Faisal University. Dammam, Saudi Arabia. Scientific Journal of King Faisal University Vo.3 No.1 Dhu Al Hajjah 1422 (March 2002).

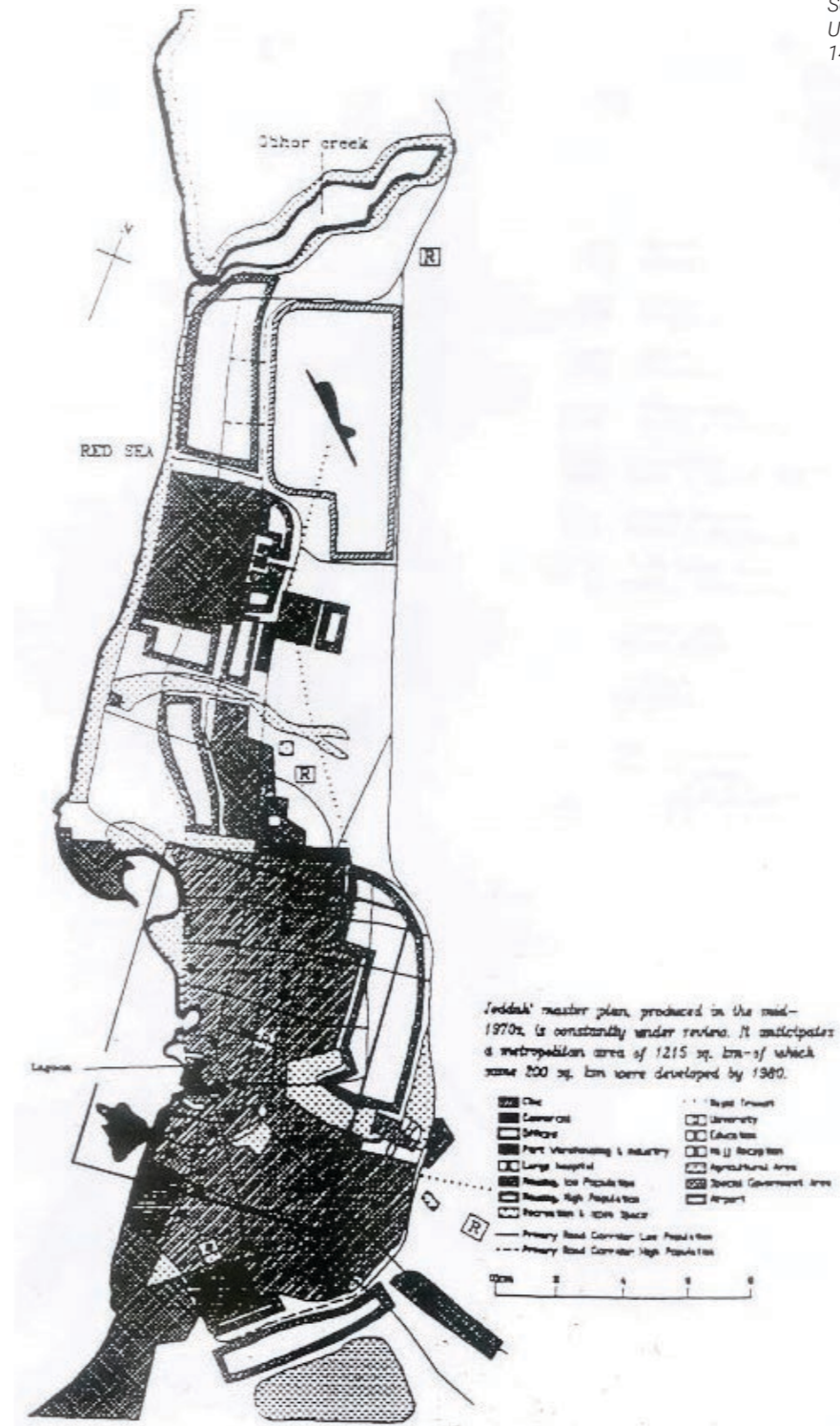
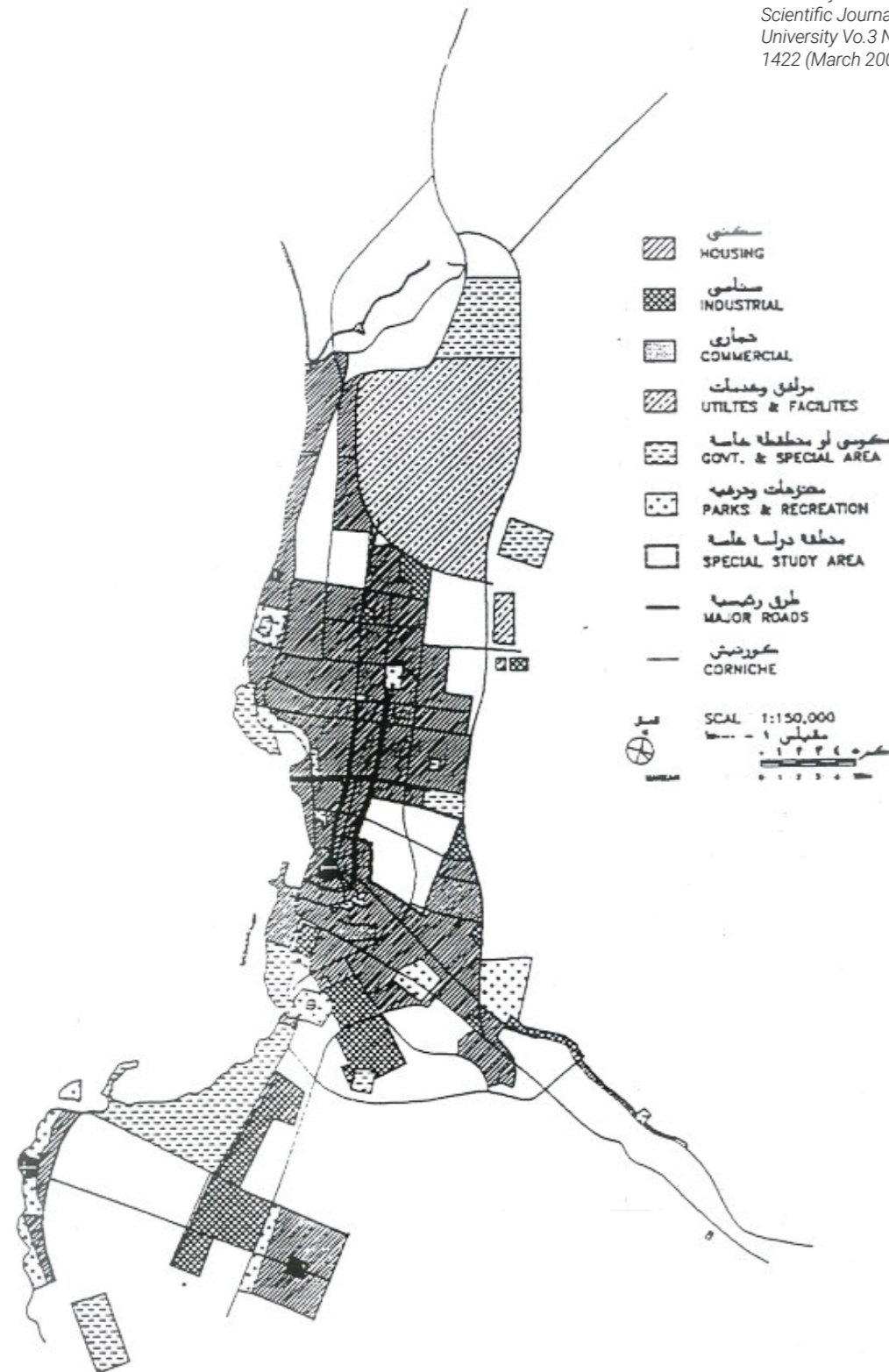


Figure4: Jeddah Master Directive Plan 1980-2000, by SJI/SC.

Source: Mohammed Sani Abdu, Jamaluddin Yousef Salagoor, Fahad An-Nwisser Al-Harigi, Jeddah Urban Growth and Development Process: The Underlying Factors. College of Architecture and Planning, King Faisal University. Dammam, Saudi Arabia. Scientific Journal of King Faisal University Vo.3 No.1 Dhu Al Hajjah 1422 (March 2002).



2.2 Interpreting the Context: The Important Features of Jeddah

2.2.1 Urban Structure

City Borders

Saudi Arabia is divided into 13 regions (Also called Emirates or Provinces), each region governed by a prince (Emir) who is assisted by the Deputy Governor, both appointed by the King of Saudi Arabia. The current governor (Emir) of Makkah Province is Prince Khalid bin Faisal Al Saud. The Region of Makkah is then divided into 11 governorates (Jeddah is the largest one) and each governorate is governed by a governor (Mayor). The governor of Jeddah Governorate is Prince Mishal bin Majid Al Saud. Finally, there is the Municipality of Jeddah Governorate, which is responsible for the development of the city and its facilities, such as the roads, lighting, basic equipment, and the beautification of the city, in addition to managing the services necessary to maintain the cleanliness and health of the environment. The Municipality of Jeddah is also the local level actor and the implementing arm for The Ministry of Municipal and Rural Affairs (who is responsible for the urban planning of the Kingdom), which will be explained in 2.2.4: Urban Planning and Policy.

The administrative boundaries of Jeddah are three. First, there is the Development Protection Boundary (DPB), which is shared between the cities of Jeddah and Makkah, but it is out of the jurisdiction of the municipality of Jeddah. The role of this boundary is to attribute administrative power over smaller rural areas to a specific municipality, manage the development of city extensions to prevent urban sprawl and ineffective infrastructure networks and protect and preserves ecological assets and agricultural land.

Then there are the two boundaries in which the municipality of Jeddah can take institutional action within, which are the **Urban Growth Boundaries (UGB) of 1435H and 1450H**. The 1450 UGB covers an area of 2,668 square kilometres. This boundary includes settlements on the far North beyond the Obhur Creek. (figure 6)

2.2.2 Environmental System and Topography

Jeddah has a hot and arid climate due to its location on the coast of the Red Sea. Winters in Jeddah are mainly warm, but summers are humid and extremely hot, ranging from 30°C to 43°C. The temperature reached 48°C in the summer of 2019. Rainfall is rare and sparse between November and December, while thunderstorms are common between December and January. Sandstorms are frequent and most common during the summer months and they contribute to air pollution that is most prominent during summer.

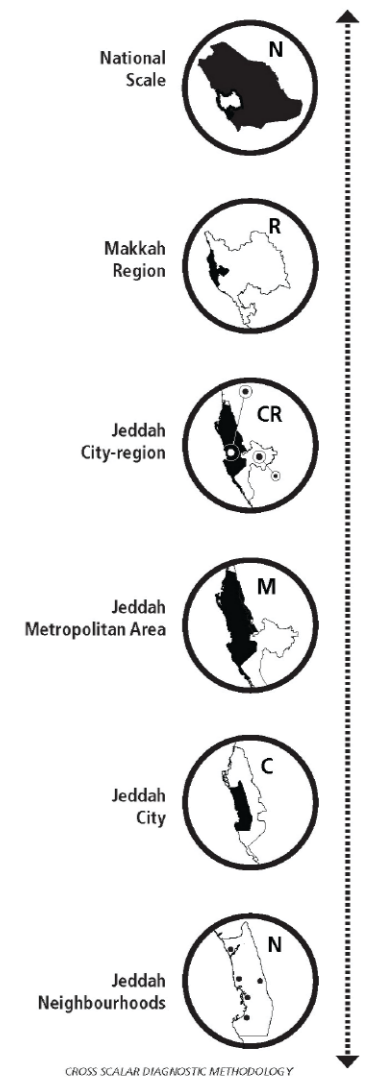


Figure5: Right: Jeddah Cross Scalar Diagnostic Methodology

Source: Future Saudi Cities Programme, City Profiles Series: Jeddah, Ministry of Municipal and Rural Affairs, King Fahd National Library Cataloging-in-publication Data, United Nations Human Settlements Programme (UN-Habitat), 2019.

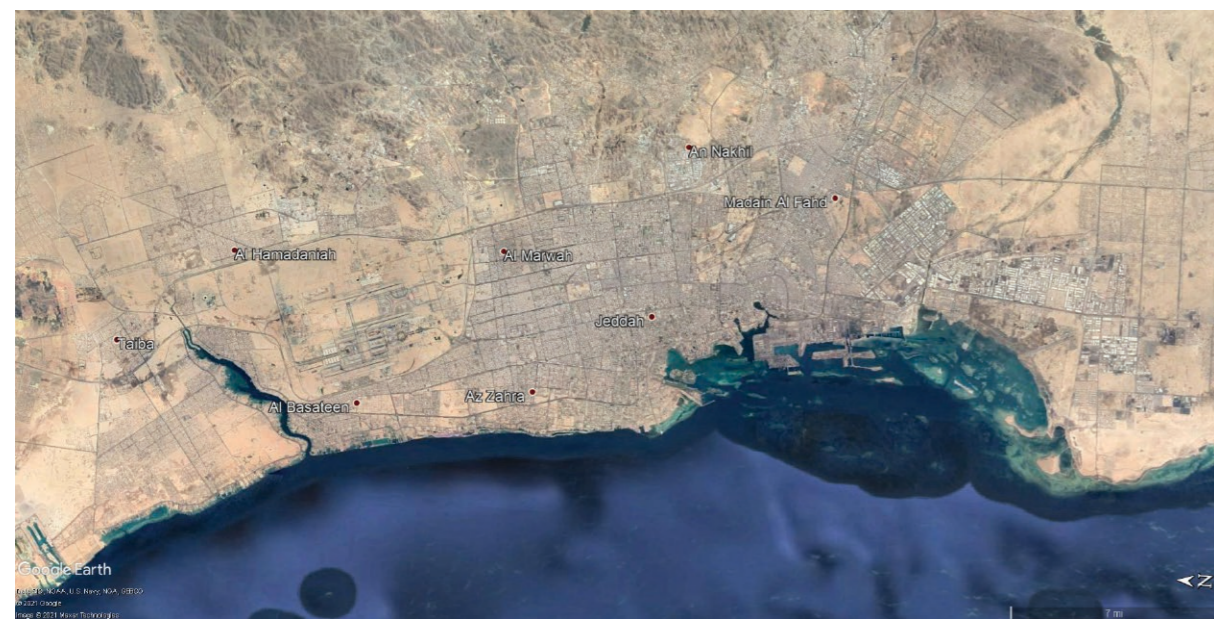
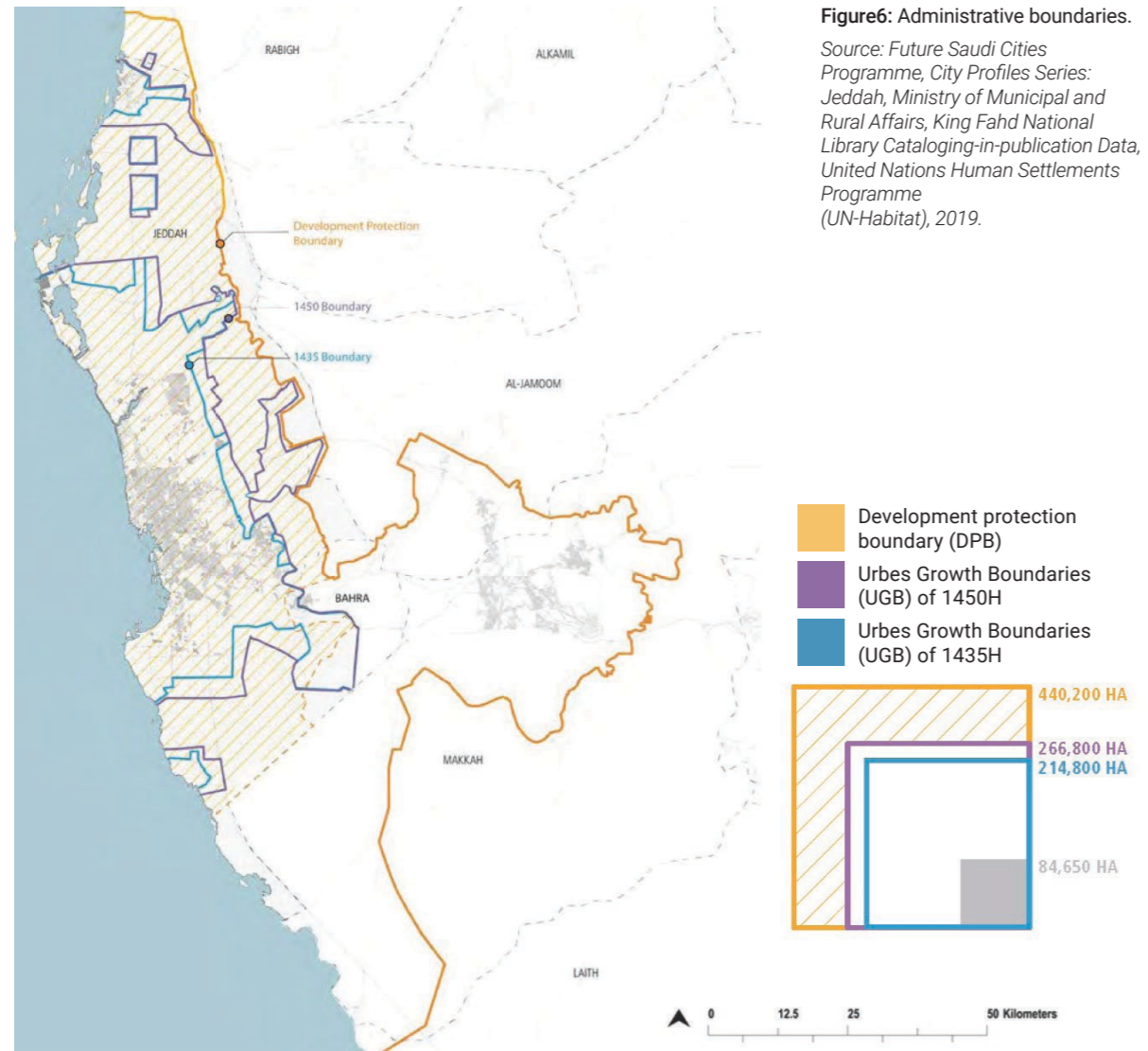


Figure7: Top: Satellite Image of Jeddah.



Figure8: Sand storm in Jeddah.
 Source: Mohammed Rasooldeen, Two Killed as Sandstorm Hits Jeddah; Flights Delayed, 29 March 2016, Arabnews.Com

The topography of Jeddah has been the primary dominant factor for its development. The sloped mountains defining the eastern boundary of the city as steep hills limit the eastern expansion of the urban footprint. This why the city is mainly formed in a linear shape along the north-south axis (Figure 7).

Jeddah is located at the drainage path of 11 valley catchments coming from the east of the city. Three large open channels run through the city collecting rainwater runoff from the valleys, and they do not always connect to the sea. These channels pose a health hazard when the flow is low. Furthermore, 18% of unplanned settlements are located in valleys, which is a major contributor to the devastating floods that occur each decade, the last were the massive floods in 2009 and 2011, which caused hundreds of deaths and tremendous damage in the city.



Figure9: Left: 118 years for accused in Jeddah flood disaster, December 01, 2014, arabnews.com
Figure10: Right: Jeddah Floods 2011. Source: Richard Davies, Jeddah Flood Defences, 29 July 2013, Floodlist.Com

Several development practices create and aggravate the floods hazard in Jeddah, such as:

- Building over valleys.
- Roads and infrastructure over valleys.
- The disconnected network of canals and capacity constraints.
- Agriculture over valleys.

1 Buildings over Wadis

2 Infrastructure over Wadis

3 Disconnected-disparated channels

4 Agricultural practices over Wadis

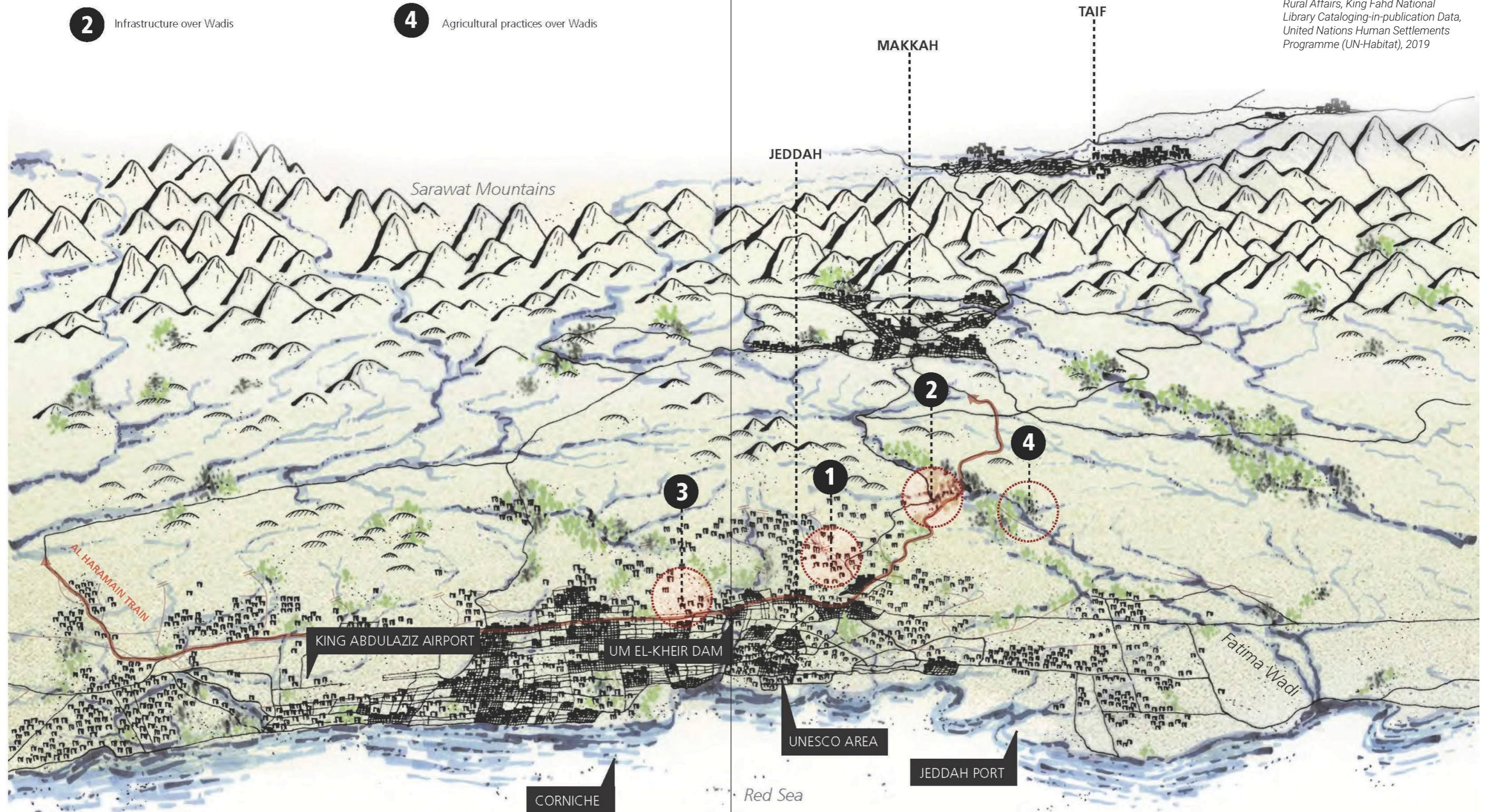


Figure11: Jeddah's Topography and the development practices that create and aggravate flooding in the city.

Source: Future Saudi Cities Programme, City Profiles Series: Jeddah, Ministry of Municipal and Rural Affairs, King Fahd National Library Cataloging-in-publication Data, United Nations Human Settlements Programme (UN-Habitat), 2019

2.2.4 Land-use System: Vacant Lands

As a consequence of a disorderly urban development , 54% of Jeddah is undeveloped vacant land with an estimated area of 143,583 hectares.

14% of this area is within the current footprint of the city. There is a huge potential for densification amongst the vacant lands near the city center, greater than of those at the edge of the city.

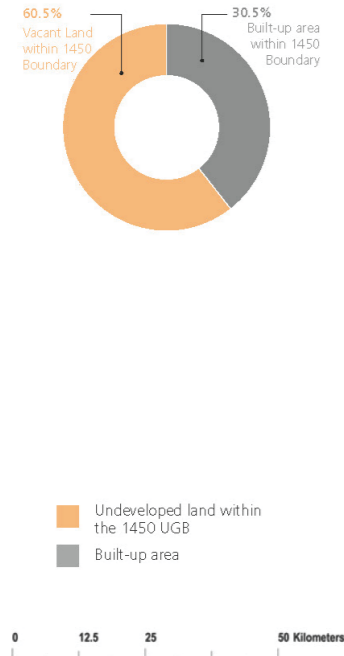
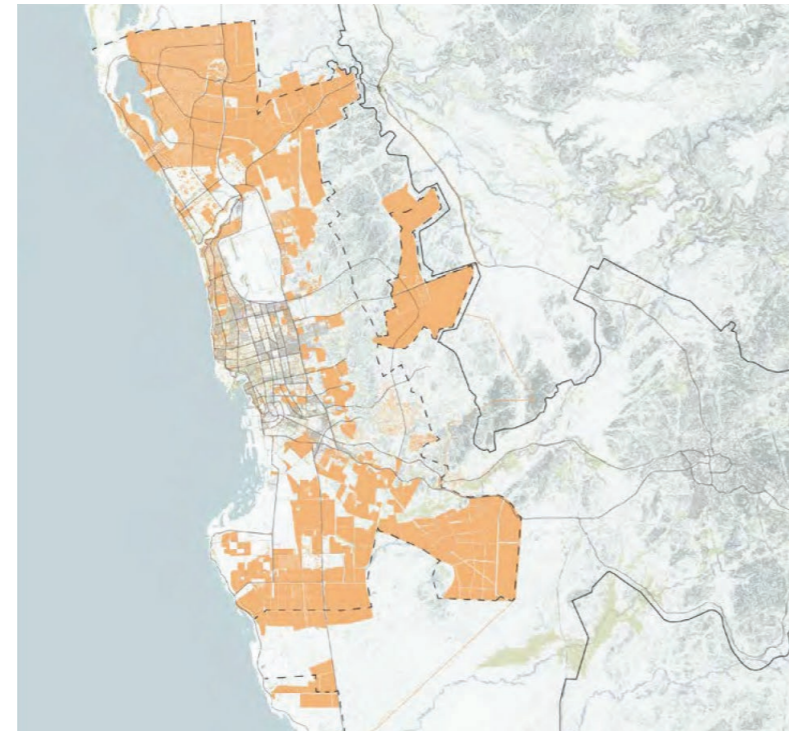


Figure15: Jeddah's vacant and undeveloped lands within its 1450 Urban Growth Boundary.

Source: *Future Saudi Cities Programme, City Profiles Series: Jeddah, Ministry of Municipal and Rural Affairs, King Fahd National Library Cataloging-in-publication Data, United Nations Human Settlements Programme (UN-Habitat), 2019.*



Similar to what is defined as “Drosscape” by Alan Berger in his book, *Drosscape: Wasting Land in Urban America*, Jeddah's vacant lands are mainly a result of urbanization and planning, but most of the time they are the opposite of dross. In fact they are highly valuable lands awaiting the proper utilization.

To understand these undeveloped vacant lands, a classification is proposed to categorize vacant lands in Jeddah based on their location, size, use, potential, and condition. The outcome is a taxonomy of vacant lands that can aid the process of reusing them for the purpose of the densification, enhancing the quality of the city, increasing land use efficiency, improving key ecosystem services provision, strengthening the link between urban fabric, and providing more open spaces.

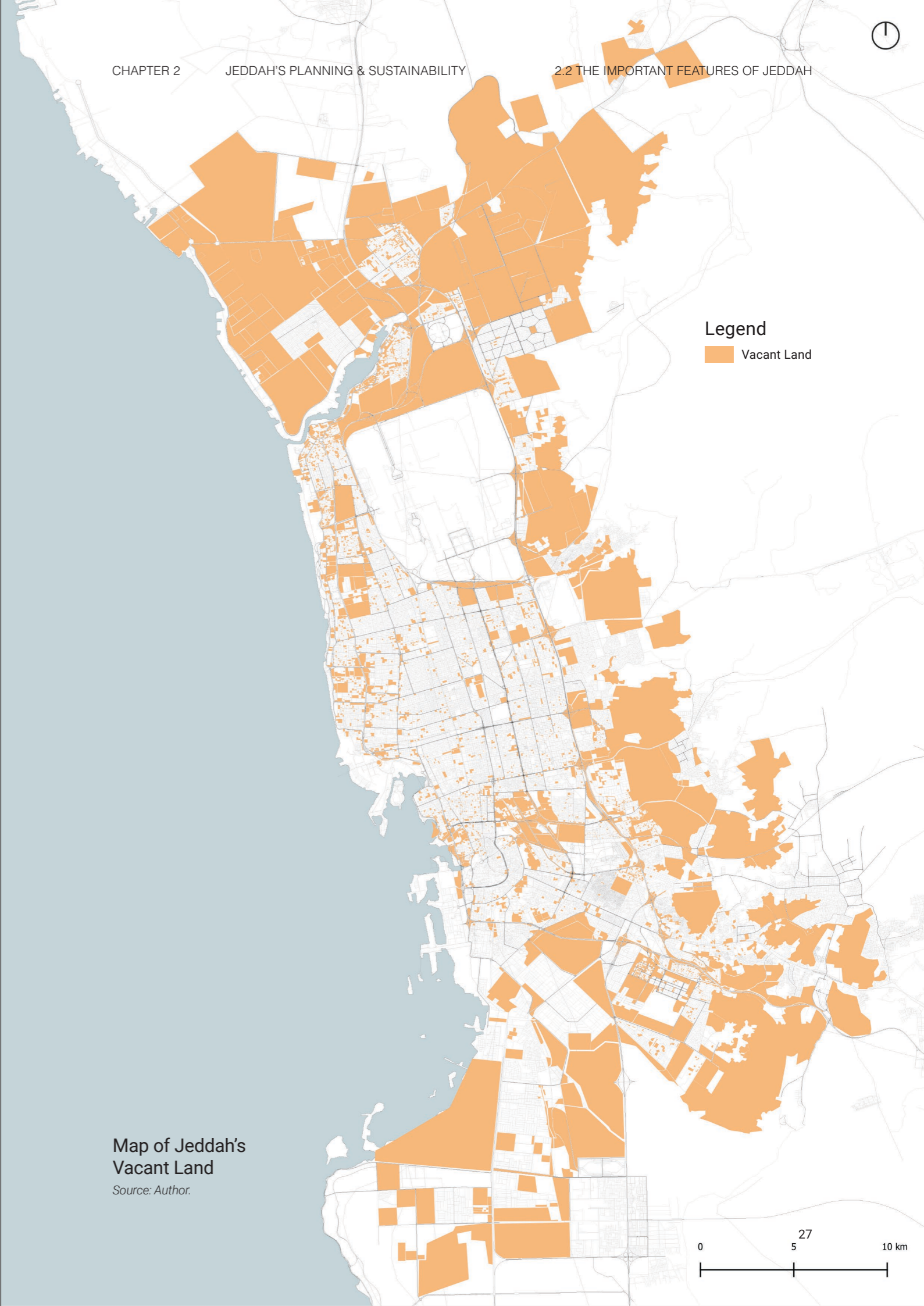
The resulting taxonomy divides vacant lands within Jeddah's Urban Growth Boundary into five categories:

1. White Lands
2. Suspended Land
3. Infrastructure Wasteland
4. Underused Land
5. Outskirts Land

Each category will be further detailed and explained in the following pages.

Map of Jeddah's Vacant Land

Source: Author.



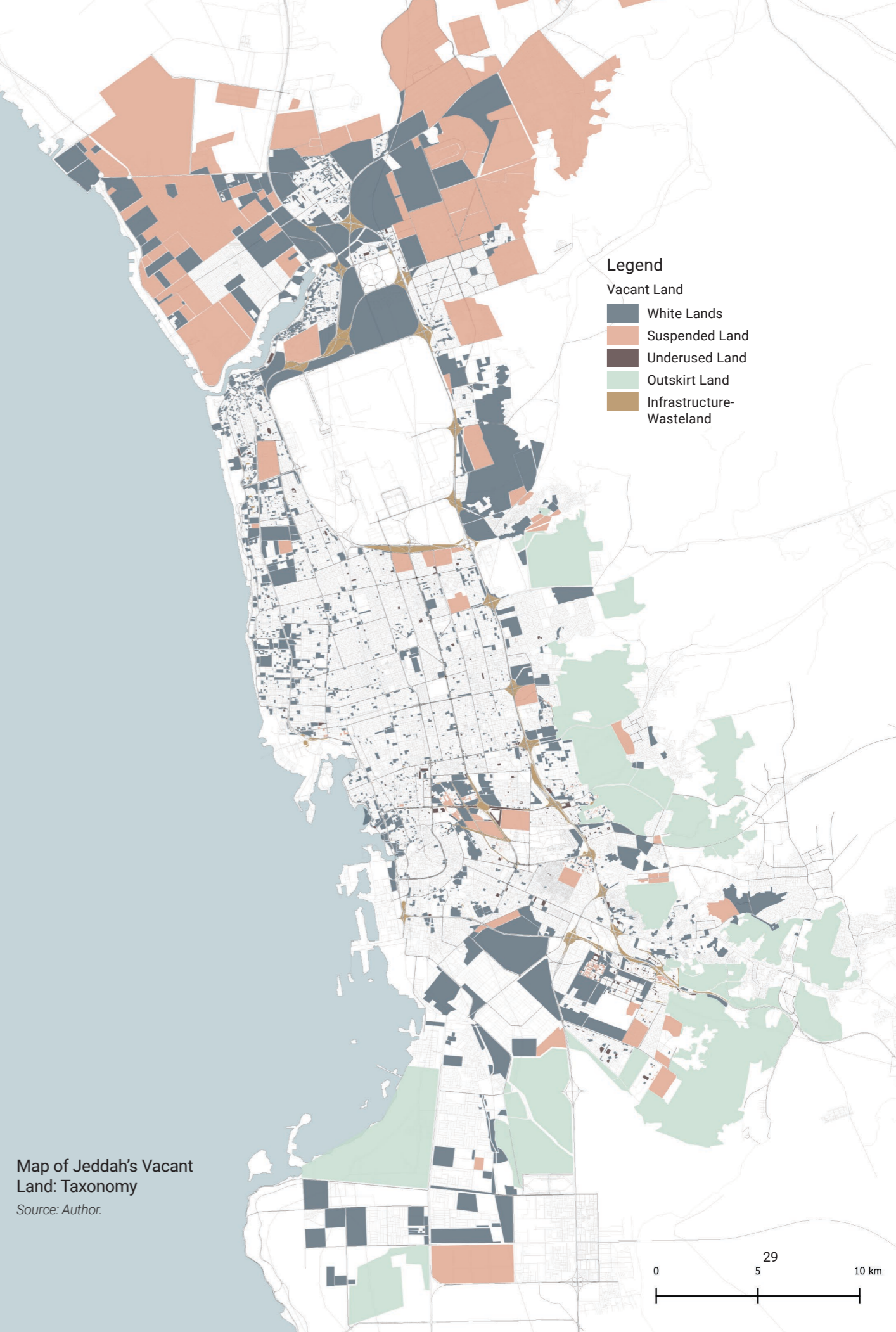
Proposed Taxonomy

1. White Lands

In Saudi Arabia, 'White Lands' is the name of idle vacant lands or undeveloped plots planned for residential or commercial use, which are located within the boundaries of a city. They are often in strategic locations and are mainly a result of selling plots of land. In order to combat monopolistic practices, achieve a balance between the supply and demand of residential and commercial properties, and to spur economic growth, the government has already imposed a tax of 2.5% of the land value on White Lands which will not be developed within a year. The tax depends on the land's size, location, possible uses, and access to public facilities. In addition, White Lands are also found in smaller sizes, such as a single house plot, within existing neighborhoods. Each neighborhood in Jeddah is full of vacant privately owned undeveloped plots between buildings. Small lands (Under 10.000 square meters) do not fall under the tax-paying category, but they can still offer major opportunities for development instead of their contribution to the increase of urban sprawl.



Figure16: Aerial view of White Lands in Jeddah.
Source: NZAM - NZ Aerial Mapping Ltd. nzam-sa.com



2. Suspended Lands

This category is vacant lands that are under the process of development. It may take years to be completed, but the planning phase is finished. However, until the projects have been realized and the plots have been developed, these lands remain vacant exasperating the dust pollution and travel distances within the city.

These lands are mainly residential land subdivisions dedicated for future urban expansion or lands allocated for new residential neighbourhoods within the city awaiting residents to buy the plots and build on them, or lands where new infrastructures have been planned, or lands where projects have been approved, but the actual implementation has not started yet. In the case of residential neighbourhoods, most likely they will accommodate either single-family homes or condominium buildings and they are often planned and built in a repeated manner all over the city that is uniform in terms of both the urban and the architectural scales.



Figure17: Aerial view of Land Subdivisions in Jeddah.

Source: Al Mousa View Jeddah, Enabah.net



Figure18: New Suburbs in Jeddah's northern periphery (North Ubhur).

Source: Image by Waleed Tobar, Google Earth.

3. Infrastructure Wastelands

This category encloses vacant lands around roads, intersections, roundabouts, highways, bridges, and railways. These lands are polluted with noise and dust and primarily dangerous and very difficult to access by pedestrians as they are islands in a sea of speeding cars. Sometimes these lands can have some trees or palm trees. Rarely playgrounds can be found on them as well as people sitting in search of open public space, especially in times of good weather. Alongside highways, trucks and cars can also be found parking in them.



Figure19: Infrastructure Wasteland around intersections and overpasses in Jeddah.

Source: Jeddah Municipality, jeddah.gov.sa

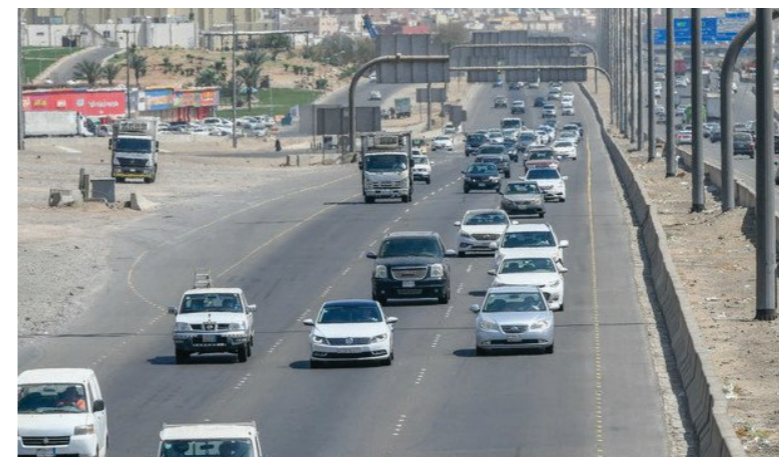


Figure20: Infrastructure Wasteland around the highway in Jeddah. Trucks can be seen parking.

Source: Ali Khamj - Al-Iqtisadiyah, aleqt.com



Figure21: Infrastructure Wasteland under bridges and around intersections.

Source: Jeddah Municipality, jeddah.gov.sa

4. Outskirt Vacant Lands

Huge lands with natural characteristics that are located on the city's outskirts. Yet, the urban growth is extended beyond them. They may be developed later or remain abandoned due to their mountainous topography. These lands act as buffer zones between the city and the peripheral neighborhoods beyond them, which further increases the already vast travel distance between these neighborhoods and the city, resulting in isolated and segregated communities.



Figure22: Aerial view of Outskirt Vacant Land in Jeddah. Urban sprawl can be seen beyond it.

Source: Google Earth.

5. Underused Lands

Vacant lands in central or strategic locations, such as the centre of a neighbourhood, surrounding a mosque, or around shopping malls. They might have been intended to be used as public open spaces but were never fully developed and utilized to their full potential. They eventually became vacant lands and solely serve as parking lots for cars at best, or even end up as landfills. Another example of underused lands are lands used for purposes that do not match up to their locations, such as lands used as warehouses or storage plots in highly valuable locations adjacent to the train station, or lands that are intended for rainwater collection yet remain hollow vacant lands most of the time.








Figure23: Underused Land around Ibn Hamad Grand Mosque in Jeddah.

Source: Motion Arabia, Google Maps.

The Taxonomy's Summary

Table1: Vacant lands taxonomy

Type	Example	Issues	Opportunities
1. White Lands		Idle undeveloped plots designated for residential or commercial use and located within the boundaries of a city.	<ul style="list-style-type: none"> • Mixed-use developments • Outdoor public space • Active mobility • Parks • Local market • Green pavement
2. Suspended Lands		Vacant lands that are under the process of planning and development, such as lands preserved for future urban expansion, residential neighborhoods, or lands where new infrastructures have been planned.	<ul style="list-style-type: none"> • Outdoor sport fields • Increasing the vegetation cover • Temporary pavilions • Urban carbon sinks • Buffers and windbreaks
3. Infrastructure Wasteland		Vacant lands around the road network. They are polluted with noise and dust and primarily dangerous and inaccessible.	<ul style="list-style-type: none"> • Urban carbon sinks • Urban forests • Xeriscaping • Buffers and windbreaks • Green noise barriers • Green pavement
4. Outskirt Vacant Lands		Buffer zones located between the city and the peripheral neighborhoods and are usually of mountainous topography. However it is unknown if building will occur on them.	<ul style="list-style-type: none"> • Floodable parks • Rain gardens • Rainwater collection • Buffer zones for urban sprawl • Natural sand fences • Urban agriculture
5. Underused Lands		Vacant lands in central locations that were never fully developed and utilized to their full potential.	<ul style="list-style-type: none"> • Markets • Mixed-use • Public space • Parks • Green parking • Parklets • Carbon Sinks

2.2.5 Urban Morphology and Population Density

Density is strongly related to the urban morphology of the city. The historically evolved old Jeddah was characterized by high buildings oriented to increase wind flow and shade, a compact urban fabric with a traditional hierarchy of streets and alleyways, integrated open spaces, and mixed-use functions (which will be detailed in section 2.4 Sustainability Within a Local Context). The result was a dense lively city with constant movement, vitality, and porosity. It was a living example of environmentally responsible cities. Safety was also a result, as the eyes of both pedestrians and those watching the continual flow of pedestrians from buildings promoted spontaneous protection.

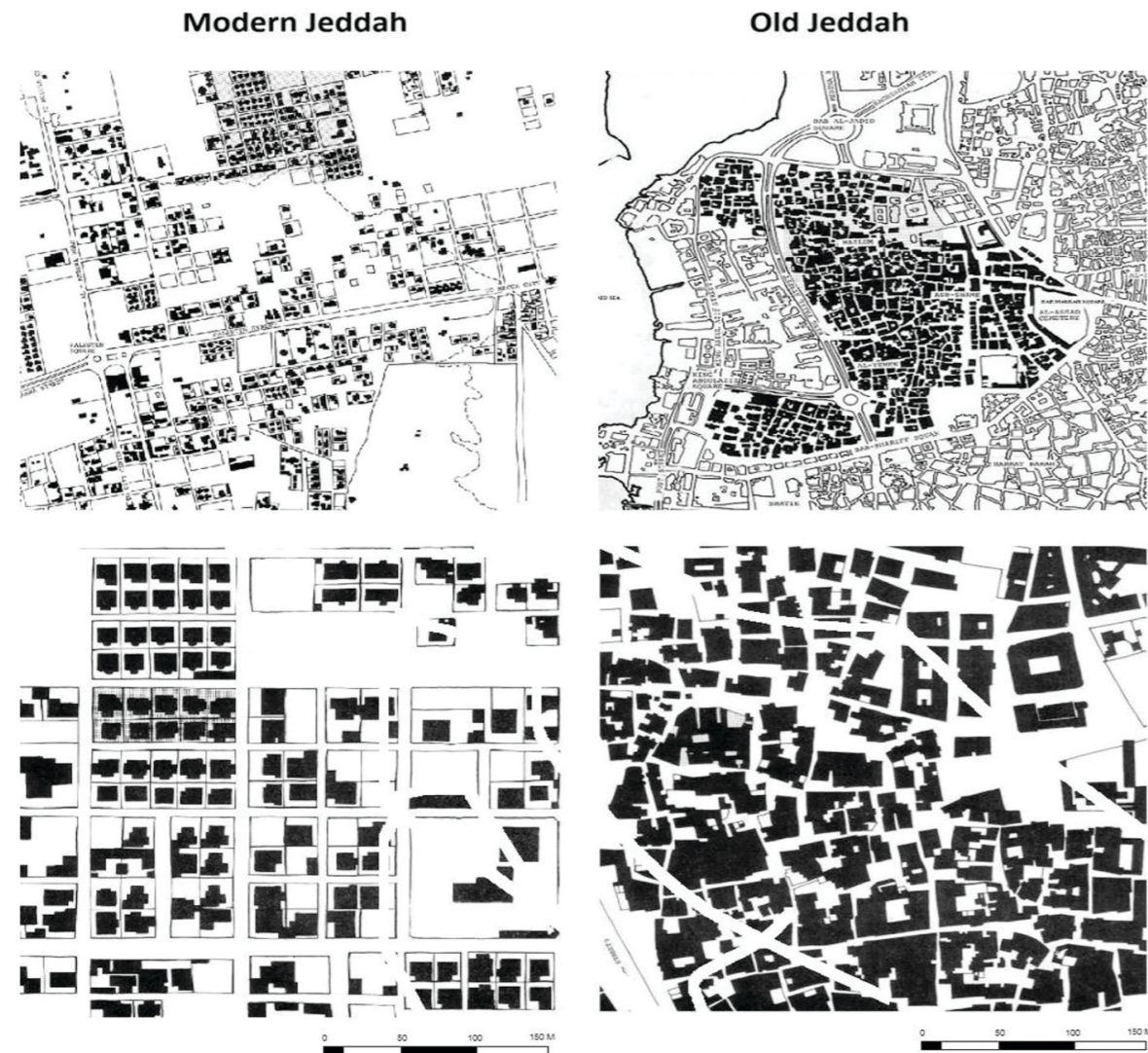


Figure 24: Old and Modern Jeddah.

Source: Khalid Mandeli, *Public space and the challenge of urban transformation in cities of emerging economies: Jeddah case study*, *Cities*, Volume 95, 2019, 102409, ISSN 0264-2751, <https://doi.org/10.1016/j.cities.2019.102409>.

As the city grew and the population increased, the high-density organic urban fabric of the old city was replaced with a gridiron urban fabric with low-density monofunctional zones where wide streets and right-angle intersections became the main transportation channels. Modern Jeddah is now characterised by wide asphalt roads separating residential areas from other functions and services while public spaces are also isolated from their surroundings by wide high-speed roads.

Since 1970, the urban area of Jeddah grew more than 400% while its population grew more than 1000%, and the growth is still ongoing. According to the Saudi Arabian census (2010), Jeddah is experiencing a population growth of 3.2% annually, and its population is expected to reach more than 5,200,000 by 2033. Jeddah's permanent population is more than 4,082,184, on a built-up area of 84,675 hectares, and a population density of 48.21 p/ha.

The current density of Jeddah ranges between and 1 to 427 p/ha and can be broken into four categories:

1. **15% of the population** lives in a density of more than 300 p/ha. These highly dense areas are mainly located at the urban core and cover an area of 1680 hectares.
2. **20% of the population** lives in densities between 150 to 300 p/ha, over an area of roughly 4600 hectares.
3. **42% of the population** lives in medium to low densities of 50-150 p/ha, over an area of 18,930 hectares.
4. **21% of the population** lives in very low-density areas, with less than 50 p/ha, over an area of 53,120 hectares.

The statistics show that a huge number of residents live in medium to low-density areas, mainly at the fringes of the city (the far North and the far South), leaving large amounts of vacant lands in the centre while the neighbourhoods keep sprawling outward.

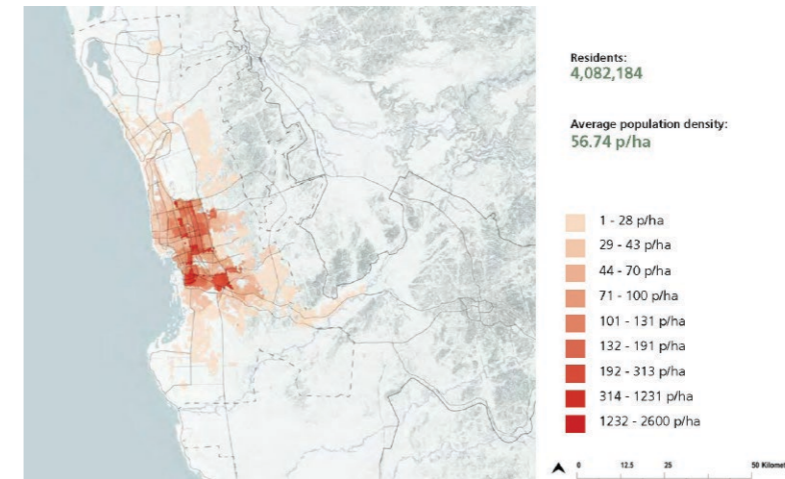


Figure 25: The current distribution of population density in Jeddah Metropolitan Area.

Source: *Future Saudi Cities Programme, City Profiles Series: Jeddah*, Ministry of Municipal and Rural Affairs, King Fahd National Library Cataloging-in-publication Data, United Nations Human Settlements Programme (UN-Habitat), 2019.

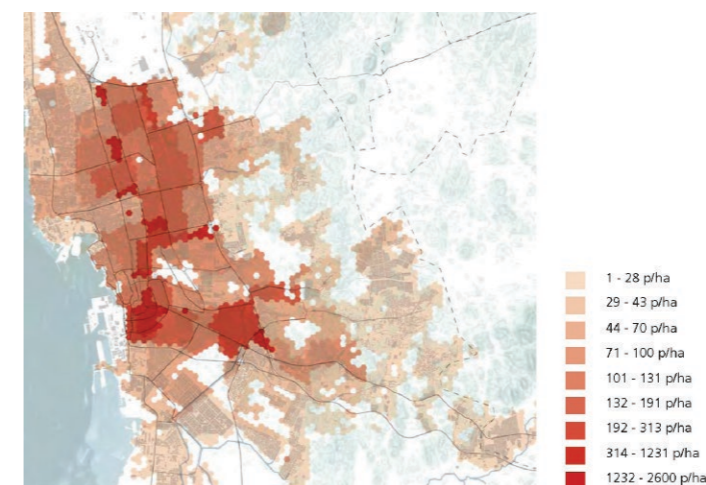


Figure 26: The current distribution of population density in Jeddah City.

Source: *Future Saudi Cities Programme, City Profiles Series: Jeddah*, Ministry of Municipal and Rural Affairs, King Fahd National Library Cataloging-in-publication Data, United Nations Human Settlements Programme (UN-Habitat), 2019.

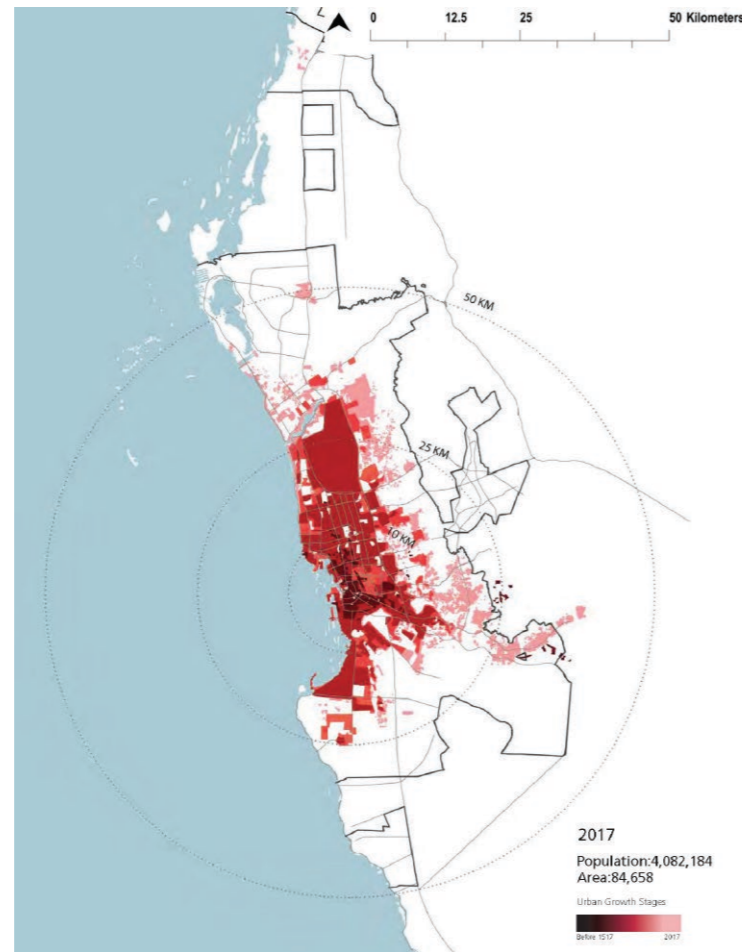


Figure27: Jeddah's Urban Growth Stages.

Source: Future Saudi Cities Programme, City Profiles Series: Jeddah, Ministry of Municipal and Rural Affairs, King Fahd National Library Cataloging-in-publication Data, United Nations Human Settlements Programme (UN-Habitat), 2019

2.2.6 Socio-Demographical Trends

Populations Profiles

The estimated population in Jeddah is more than 4.5 million, and it is growing at an annual rate of 3.5% (Jeddah Municipality, 2021), making it the most populous city in the Kingdom after the capital city, Riyadh. About 50.4% of the population are Saudis while the remaining 49.6% are non-Saudis. Expatriate workers in Saudi Arabia mostly come from Egypt, Lebanon, the Philippines, Indonesia, India, Pakistan, as well as from other western countries such as the UK and the USA. It is important to note that the national and professional backgrounds of workers play a big role in their distribution within the city as different nationalities can be found living together in certain areas based on their nationalities and skills level. For example, high-skilled professionals, especially from western countries, often live isolated within gated communities, while low-skilled workers can be found living together in certain neighbourhoods as well.

2.25 million people are expected to be added to Jeddah's population between 2010 and 2029 (Global City Focus Jeddah, arcadis.com, 10 Jun 2016). In addition to the continuous recruitment of foreign workforce, this expected rise in population may be also fueled by the constant migration from rural areas and smaller towns of the Kingdom to large cities that are undergoing massive governmental projects and improvements, such as Jeddah, in search of jobs and a better standard of living, which are not available in rural or small towns.

Jeddah has a high percentage of youth, with more than 41% composed of those under the age of 24 (UN-Habitat Jeddah City Profile). The population over 65 years represents only 3.6% of the total population, with a prevalence of men (57.03%). Considering the gender issue, women are 42.97% of the total population, with a balanced distribution up to the age class 24 years, not confirmed for the population over 25 years where males represent 61.07% of this population. A reason for this unbalance may be related to the recruitment of expatriate male workers. More on the genders, the types of jobs occupied by expatriates, and salaries will be detailed in the Employees and Income part.

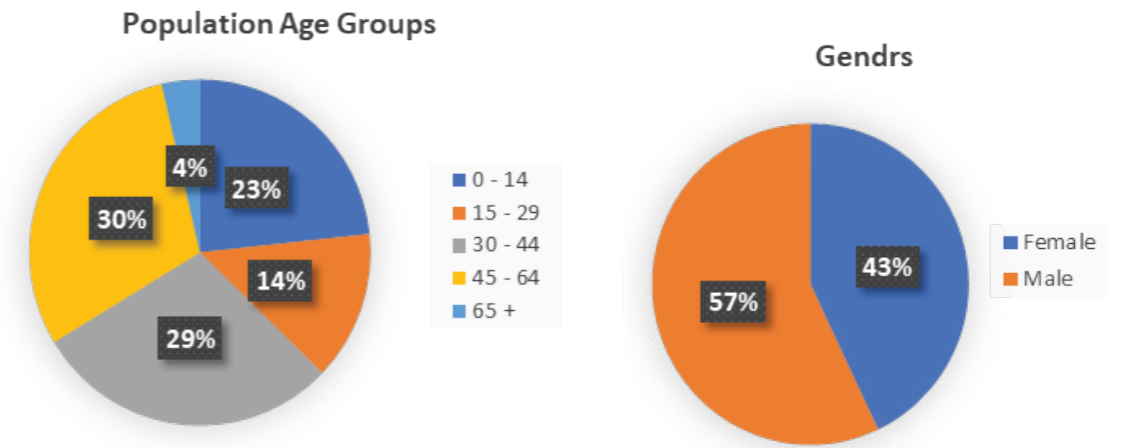


Figure28: Population age groups and genders percentages.

Source: Our elaboration of the GA Stat, 2019

Population Per Gender and Age

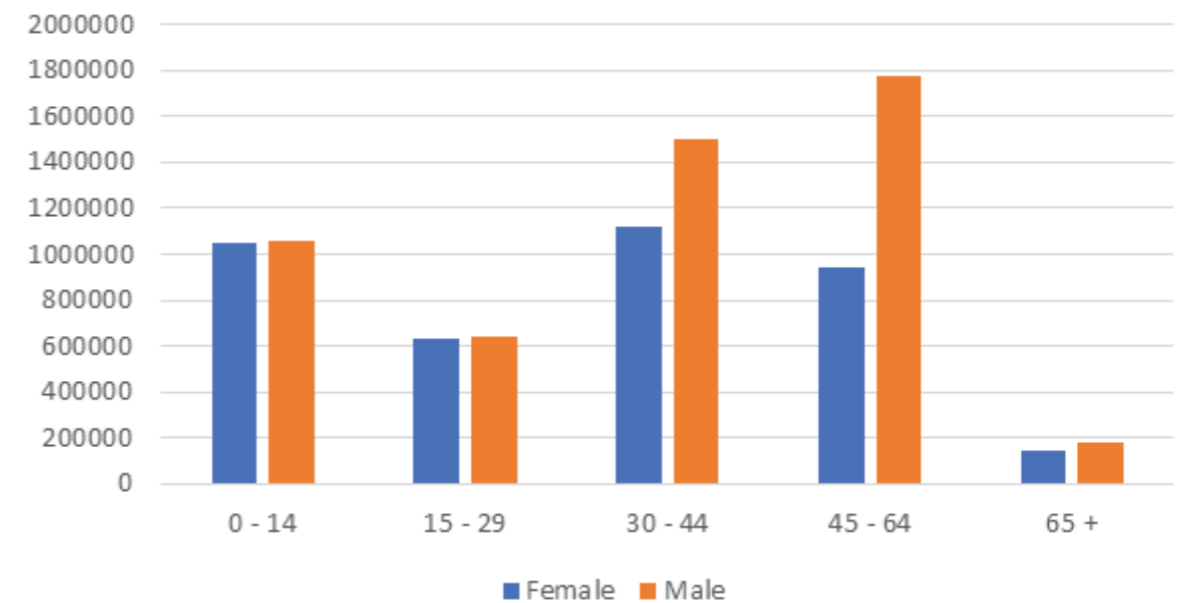


Figure29: Population statistics per gender and age.

Source: Our elaboration of the GA Stat, 2019

2.2.7 Residential Demand

Based on the demographic trends and migrant flows, there is a strong housing demand in Jeddah, with an estimated annual demand of over 43,000 units. This is expected to increase in 2025 by 34.9%, due to the continuous migration from within the country to large cities as well as from outside the Kingdom in search of work opportunities. Besides, it is important to take into consideration that the average Saudi household size ranges from 5.5 to 8.4 (average of 6.4). Thus, the growth of inhabitants in Jeddah is expected for both Saudis and Non-Saudis creating a demand for 58,000 units. The demand is high both on the high-end luxury side of the market and on the affordable side. 20% of housing demand to 2025 will be in the high-income range, 30% in the middle income and 50% affordable.

The most common types of accommodation in Jeddah are:

1) Rent

Rent is divided into two categories: a) temporary dwellings, which are furnished apartments, and b) long time rent apartments. Furnished apartments (Sometimes called Hotel Suites) can be rented for days up to a few months and they target temporary residents. The average price of furnished apartments in Jeddah ranges between 206-656 SAR (46-147 Euro) per night for two people. It also depends on the quality, location, and service provided. Long time rent on the other hand can be for years and up to a lifetime. The average rent price for an apartment in a central neighbourhood in Jeddah of 80 square meters and consists of 2 bedrooms, a bathroom and a living room is 1500 SAR (337 Euro) per month.

Figure30: Furnished Apartments (Hotel Suites) in Jeddah

Source: agoda.com



Figure31: Furnished Apartments (Hotel Suites) in Jeddah.

Source: forum.arabtravelers.com



Figure32: Apartments building for long term rent in Jeddah.

Source: sa.aqar.fm

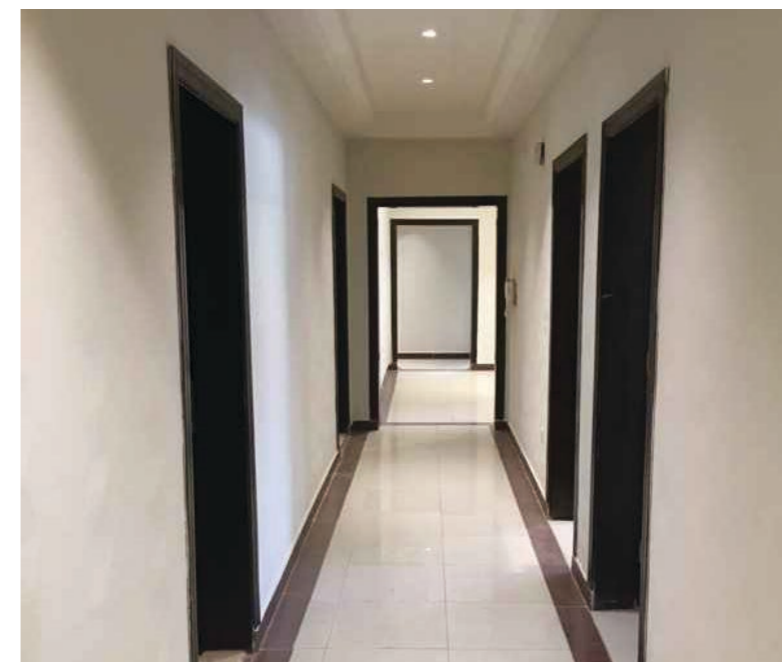


Figure33: Apartments building for long term rent in Jeddah

Source: sa.aqar.fm



Figure34: Apartments building for long term rent in Jeddah.
Source: sa.aqar.fm

2) Ownership

The government is addressing the housing shortage on the affordable side of the market with about 50% of the planned housing units that are classified as low-income. On the other hand, it is more difficult for private developers to provide units for the lower-income demand, but some are managing through **public-private partnerships**. Efforts are being made to enable Saudi families to own housing through diverse residential program options and solutions. The Ministry of Housing's "Iskan Program", which is one of the programs of the Kingdom's Vision 2030, has the goal to reach 70% of housing ownership by 2030.

The Iskan program allows the reservation and purchase of different housing options while offering financing solutions through the "Sakani" website, in addition to benefiting from additional facilities, such as a real estate advisor, issuing land contracts electronically, as well as the registration and immediate entitlement and the issuance of building permits electronically.

From the beginning of 2021 until the end of May 2021, 78,349 families have benefited from the program and resided in their homes, 44,710 families benefited from the subsidized real estate loan to purchase ready housing units, 31,335 families benefited from the self-construction option, 13,993 families preferred the option of residential plots, and 10,411 families benefited from Subsidized real estate loan for the purchase of housing units under construction.

An example of a public-private partnership is The Residential Units Under Construction Program, which is one of the housing solutions from the Iskan Program in collaboration with the private sector. The program offers residential units before or during the development or construction phase and requires real estate developers to implement these developments within a specified time plan for each project according to the specifications approved by The Ministry of Housing. Examples for such projects are Ubhur Park, Mojan Village, Khayala, Al Jawhara suburb, Dari Q, Tahlia Gate, Jeddah Gardens, Tilal Al Ghuroub, among others in Jeddah and around the Kingdom.

1.Ubhur Park

Type	Use	Price	Project Area	Location	Developer
Condominium buildings	Mixed-use neighbourhood	Starts from 406,563 SAR	1,145,800 m2	North Ubhur	Al-Atheer Real Estate Development

Table2: Ubhur Park
Figure35: 3D visualization of the Ubhur Park
Source: sakani.housing.sa



2.Mojan Village

Type	Use	Price	Project Area	Location	Developer
Villas	Residential	Starts from 950,160 SAR	28,300 m2	North Ubhur	Hajjaj & Partners Company

Table3: Ubhur Park
Figure36: 3D visualization and the master plan of Mojan Village.
 Source: sakani.housing.sa



3.Khayala

Type	Use	Price	Project Area	Location	Developer
Villas	Residential	Starts from 957,400 SAR	84,500 m2	Northeast Jeddah	The First Real Estate Development Company

Table4: Khayala
Figure37: 3D visualizations and the master plan of Khayala.
 Source: sakani.housing.sa



4.Al Jawhara Suburb (Venan)

Type	Use	Price	Project Area	Location	Developer
Condominium Buildings	Residential	Starts from 320,770 SAR	171,250 m2	North Jeddah	Ladun Investment Company

Table5: Al Jawhara Suburb
Figure38: 3D visualizations and the master plan of Al Jawhara Suburb (Venan).
 Source: sakani.housing.sa



5. Dari Q

Type	Use	Price	Project Area	Location	Developer
Luxury Condominium Buildings	Partially Mixed Use (amenities are for the residents)	Starts from 862,600 SAR	43,824 m2	Central Jeddah	Abdul Latif Jameel

Table6: Dari Q

Figure39: 3D visualizations of Dari Q.

Source: sakani.housing.sa



6. Tahlia Gate

Type	Use	Price	Project Area	Location	Developer
Condominium Buildings	Residential and Commercial	Starts from 403,052 SAR	122,000 m2	East Jeddah	Sondos Company

Table7: Tahlia Gate

Figure40: 3D visualization and the master plan of Tahlia Gate.

Source: sakani.housing.sa



7. Jeddah Gardens

Type	Use	Price	Project Area	Location	Developer
Condominium Buildings	Residential and Commercial	Starts from 665,028 SAR	43,992 m2	Central Jeddah	Al Hanaki Real Estate Development Company

Table8: Jeddah Gardens

Figure41: 3D visualization of Jeddah Gardens.

Source: sakani.housing.sa



8. Tilal Al Ghuroub

Type	Use	Price	Project Area	Location	Developer
Condominium Buildings	Residential and Commercial	Starts from 262,500 SAR	753,834 m2	South Jeddah	Sani Amiriya Company

Table9: Tilal Al Ghuroub

Figure42: 3D visualizations of Tilal al Ghuroub

Source: sakani.housing.sa



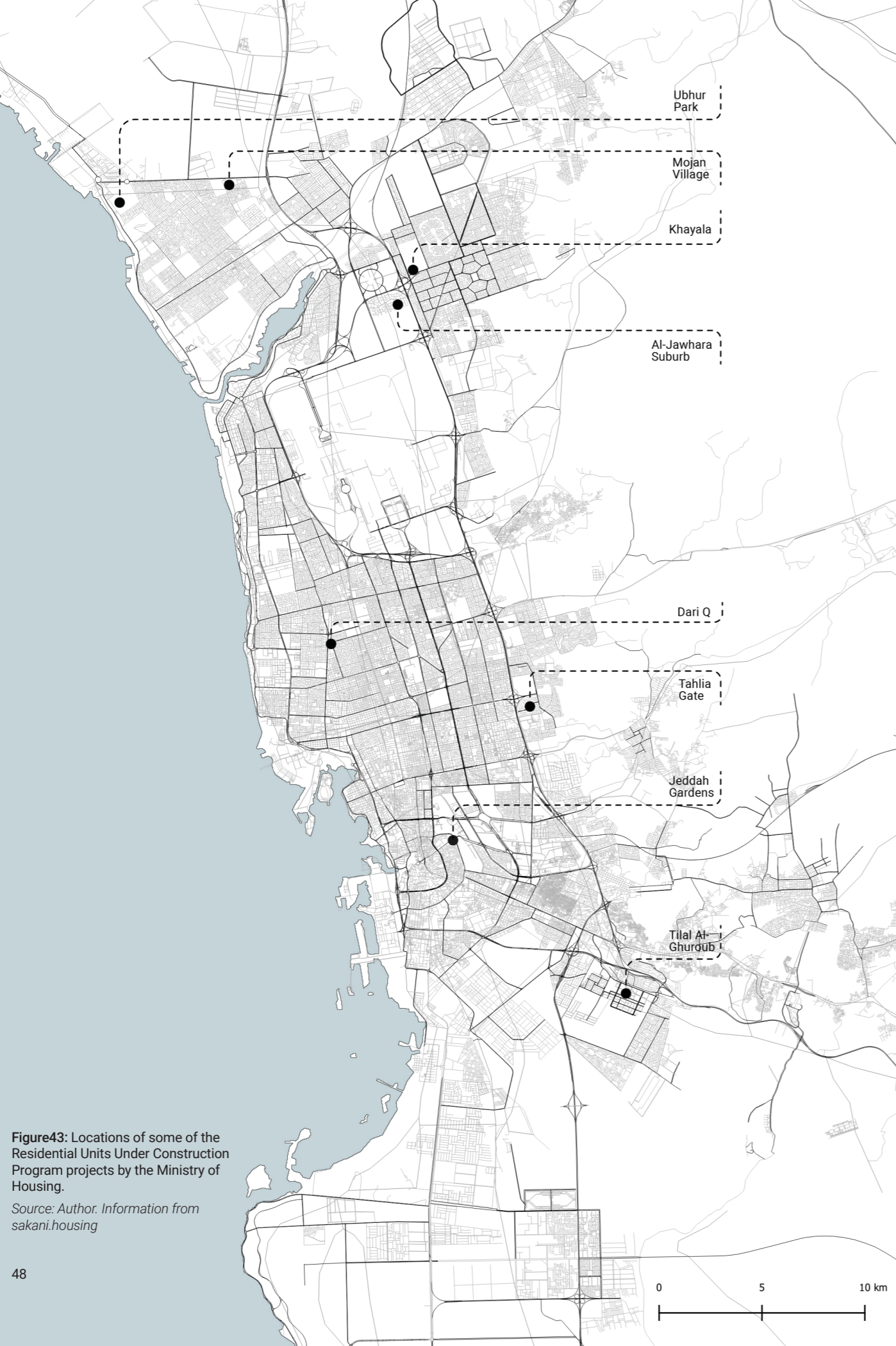


Figure43: Locations of some of the Residential Units Under Construction Program projects by the Ministry of Housing.

Source: Author. Information from sakani.housing

3) Developmental Housing

The last type of dwelling solutions in Jeddah is the Developmental Housing, which is one of the initiatives of the Ministry of Housing that seeks to provide housing units for the neediest families in the community who are covered by the Ministry of Human Resources and Social Development "Social Security" and have a completed application in the housing support portal "Iskan", in partnership with charity organizations and NGOs.

This initiative provides housing units to families in greatest need through the following options:

- The Ministry's housing units.
- The construction of new housing units.
- Through direct purchase of suitable available housing units.

In order to ensure that families' needs are met, partnership agreements have been concluded with nearly 300 NGOs spread across all governorates of the Kingdom, to communicate and visit families and assist them in determining the appropriate housing for the family, following up on delivery, and managing and operating housing units.

Figure44: Developmental housing for families in need in Jeddah. A collaboration between the Ministry of Housing and charity organizations.

Source: aleqt.com, okaz.com.sa.



4) Other Development and Investment Projects

Several major development and investment projects in Jeddah are currently being developed:

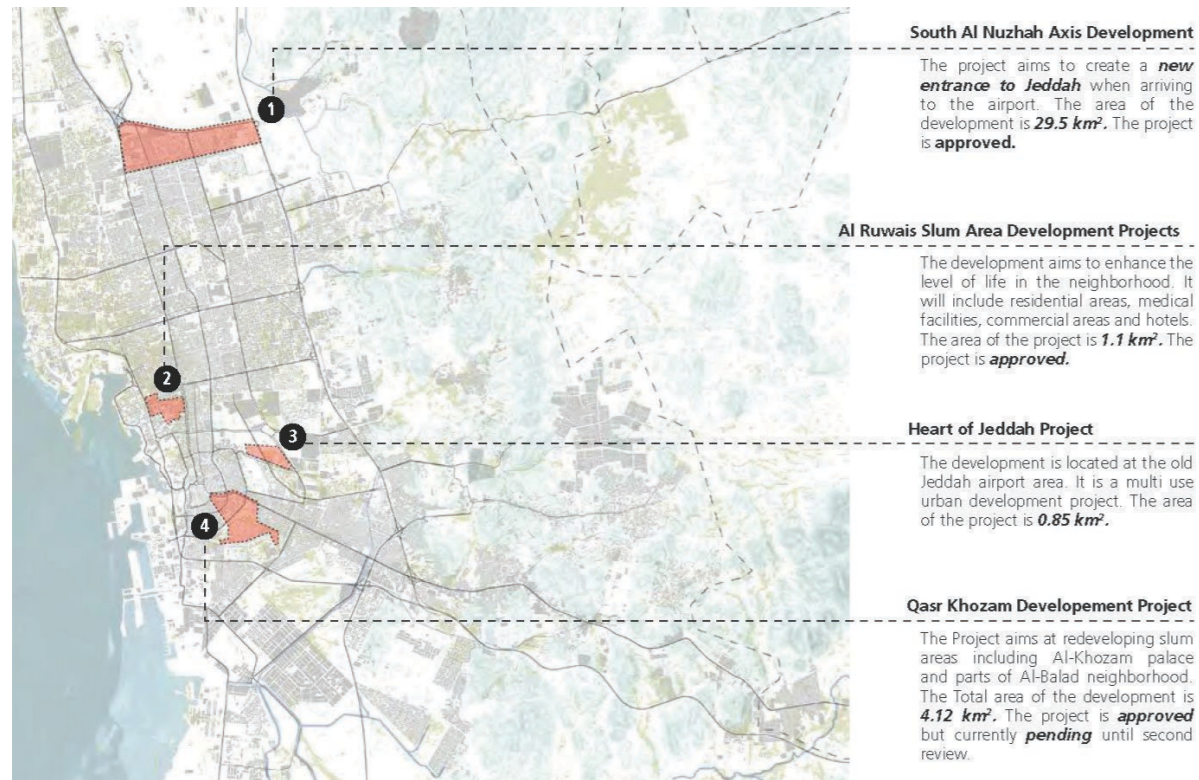


Figure45: Major investment projects.

Source: Future Saudi Cities Programme, City Profiles Series: Jeddah, Ministry of Municipal and Rural Affairs, King Fahd National Library Cataloging-in-publication Data, United Nations Human Settlements Programme (UN-Habitat), 2019.

- 1. South Al Nuzhah Axis Development:** This development aims to regenerate unplanned settlements on an area of 2950 hectares by uplifting and developing the current situation into a planned urban pattern with a balanced housing supply and enhanced streets and utility networks to form a new entrance to Jeddah when arriving from the airport.
- 2. Al Ruwais Slum Area Development Projects:** This development covers a land area of 110 hectares and aims to improve the quality of life in this neighbourhood by upgrading the residential areas, medical facilities, commercial areas, and hotels.
- 3. Qasr Khozam Development:** This development covers a land area of 412 hectares and aims to regenerate unplanned settlements in the Khozam Palace area and parts of the Balad neighbourhood. The envisaged urban plan of the three previous developments is currently unclear, but from the existing data, it appears that these areas will be transformed from unplanned neighbourhoods or slums into planned neighbourhoods. The description of these developments did not mention mixed-use, reliance on different means of transportation, or the existence of transport nodes such as metro stops.
- 4. Heart of Jeddah Project:** This development covers a land area of 84. hectares and aims to be a mixed-use development in the old Jeddah airport area. Key features of this development are a multi-modal transit hub, different retail zones, entertainment, a medical centre, hotels, mosques, offices, schools, kindergartens, and residential units among many other amenities and essential services, all planned around a water feature and Dancing Fountain. The project also features various districts which are linked with canals and pedestrian paths.

2.2.8 Employees and income in Saudi Arabia

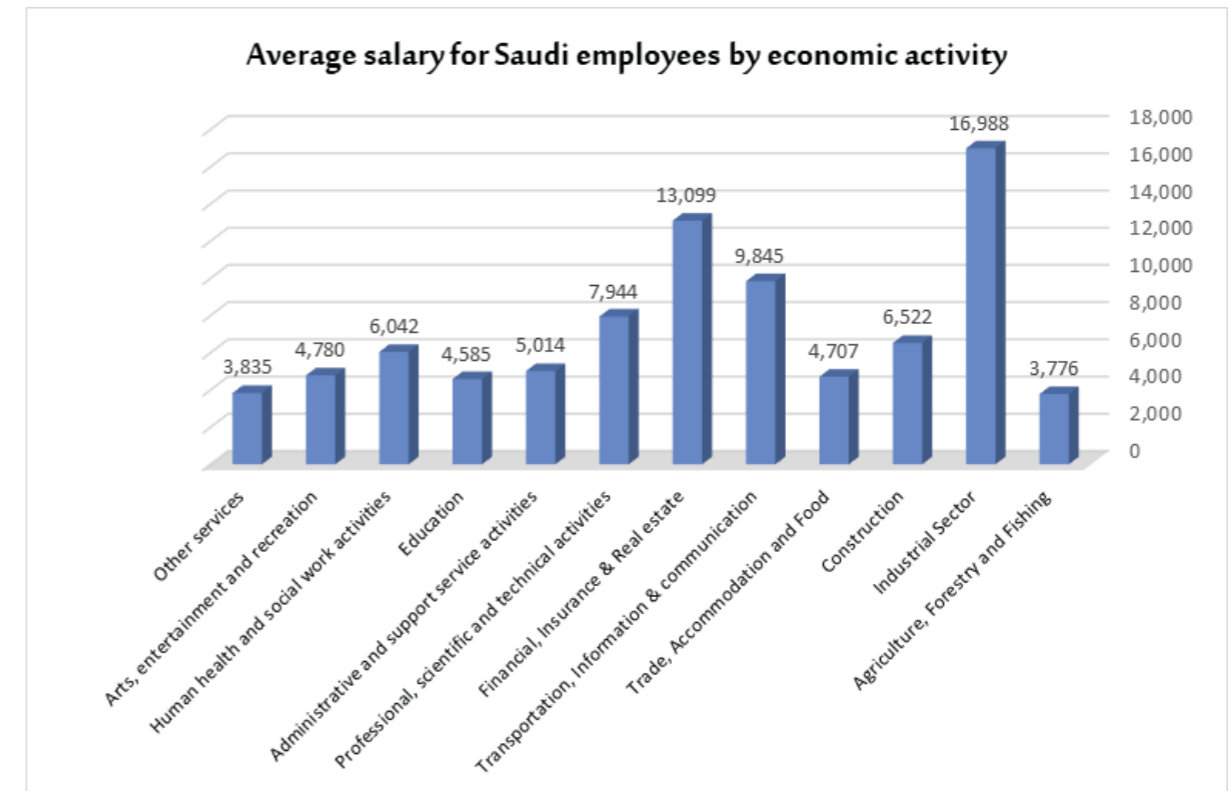


Figure46: The number of employees by establishment size and economic activity (2017).

Source: Our elaboration of the GA Stat, 2019.

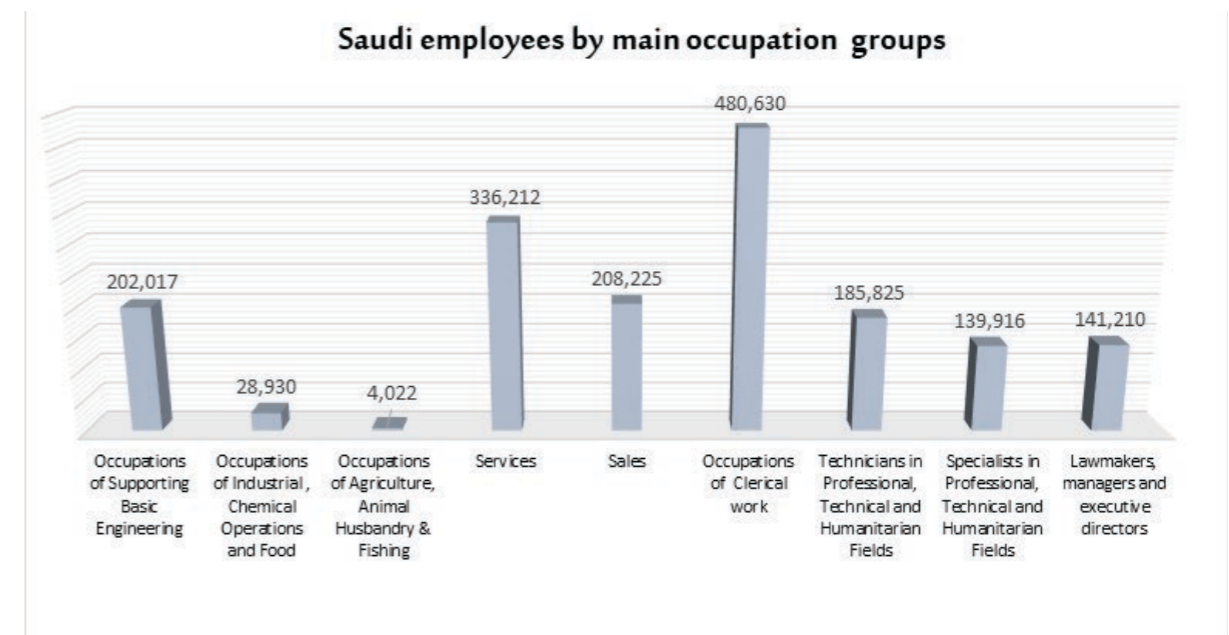


Figure47: The number of Saudi employees by main occupation groups (2017).

Source: Our elaboration of the GA Stat, 2019.

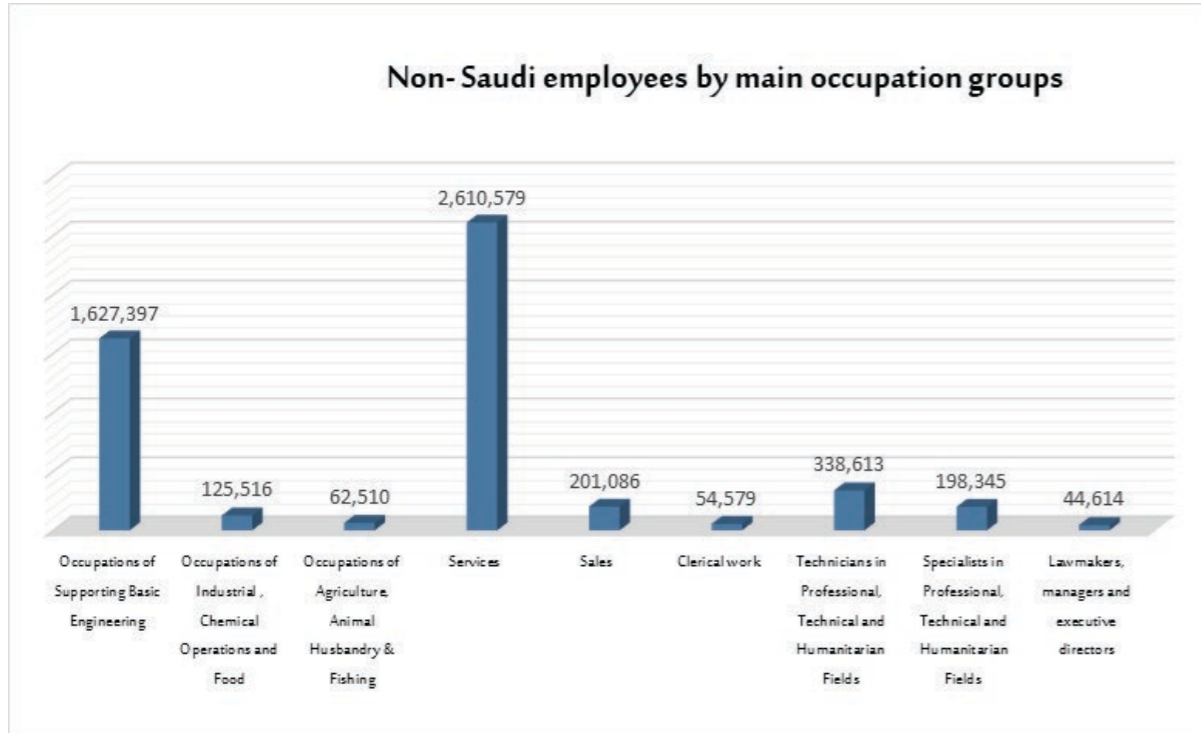


Figure48: Non-Saudi employees by main occupation groups.

Source: Our elaboration of the GA Stat, 2019.

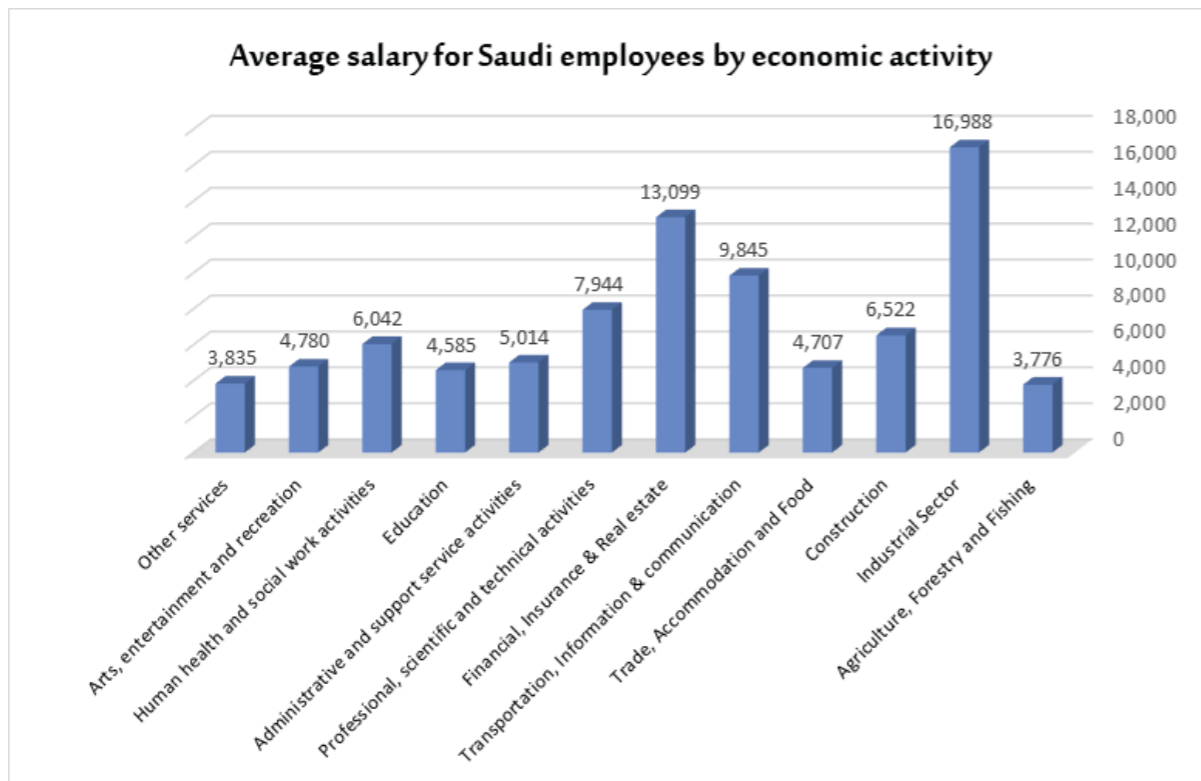
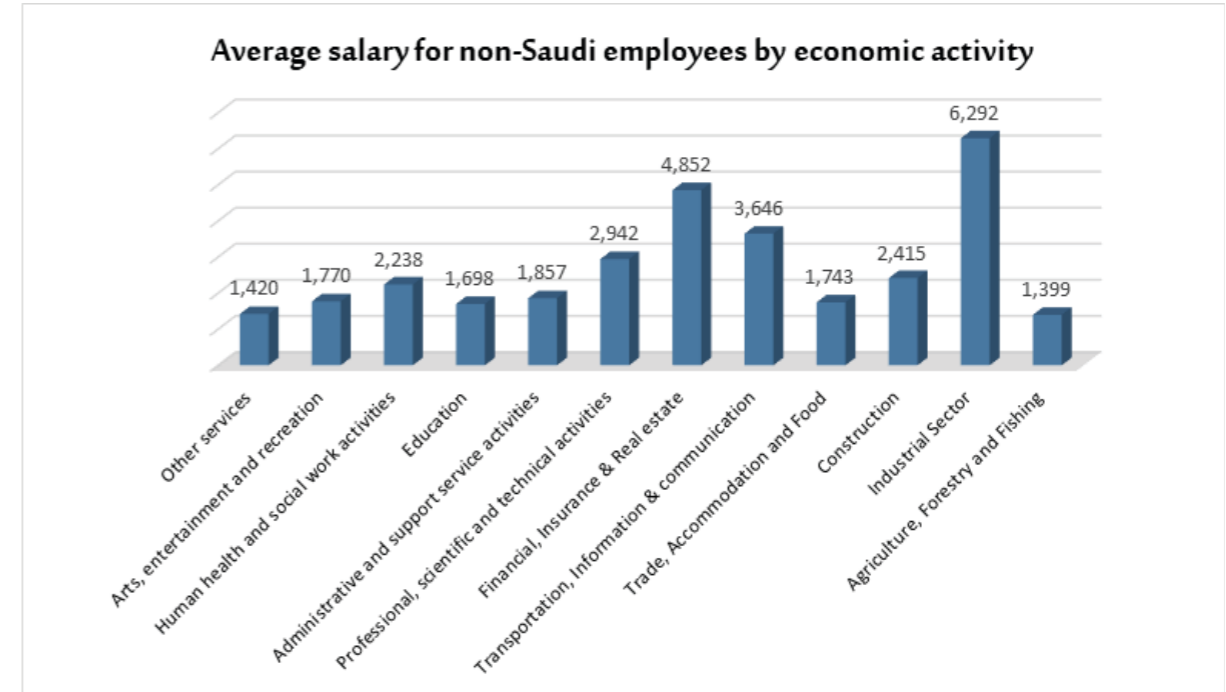


Figure49: The average salary for employees by nationality and economic activity 2017

Source: Our elaboration of the GA Stat, 2019.



The key economic sectors driving Jeddah's economy include the construction sector, tourism, automotive, retail, healthcare, logistics and warehouse. The huge investments in the city are paying off as the gross domestic product (GDP) is growing strongly. It is expected that the GDP growth will be 8.08% a year over the next 10 years. However, unemployment remains an issue for the Saudi population. 32.5% of Saudi women are unemployed and 5.9% of men. These numbers are much higher than those for the foreign workforce as there is a big reliance on foreign labour for most of the workforce (only 45% of those employed are Saudis), and even though the female workforce grew 48% in recent years, but they still only make up 16% of the workforce despite being a majority of University graduates.

Source: Employment and Wages Survey 2017, The General Authority for Statistics, Kingdom of Saudi Arabia.

Most expatriates salaries in Saudi Arabia are low, and they also depend on the nationality, the industry, the job title, the type and size of the employer, the qualifications, the experience, and the market. While the Ministry of Human Resources and Social Development has determined a minimum wage for Saudi workers of 4,000 SR, there is no minimum salary for non-Saudis. Some of the highest-paid industries for expatriates in Saudi Arabia are engineering, telecommunications, banking, IT, and health care. Furthermore, most expatriates jobs offer added benefits such as housing, covered transportation/car, daily meals, annual or bi-annual airfare tickets, medical insurance, and education for children depending on the workers status.

An estimate of 33% of Saudi's population is foreign workers mostly from India, Pakistan, Bangladesh, Syria, Yemen, Philippines, Sudan, Afghanistan, Burma, Sri Lanka, Nepal, Jordan, Palestine, Ethiopia, Lebanon, UK, USA, and other western countries. In general, Westerners and skilled Arabs have the highest paid jobs with the most benefits, and they occupy jobs that require high qualifications such as engineering, health care, consulting and so on. They often live in housing compounds or luxury apartments that offer all sorts of

amenities such as pools, gyms, and other facilities, but their numbers are low compared to the number of unskilled workers from other nationalities in which most of them are unskilled workers, but they make the highest percentage of expatriates workers in Saudi Arabia. The salaries of low-skilled workers and benefits would be modest at best, if not very low. Housing is also provided, but usually, it is old, shared and crowded and usually located in the unfavourable areas and neighbourhoods of the city. They normally occupy labour jobs and services, for example, general labour, cleaning jobs, retail jobs, restaurants staff, driving and transportation, housework, and construction.

2.2.9 Mobility Patterns and Infrastructure System

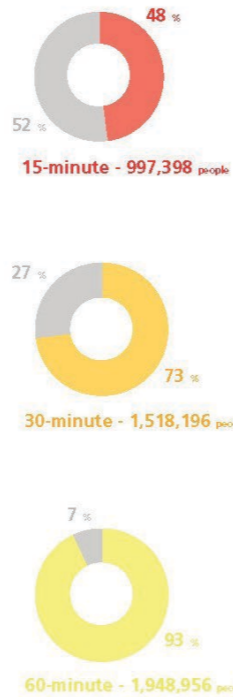
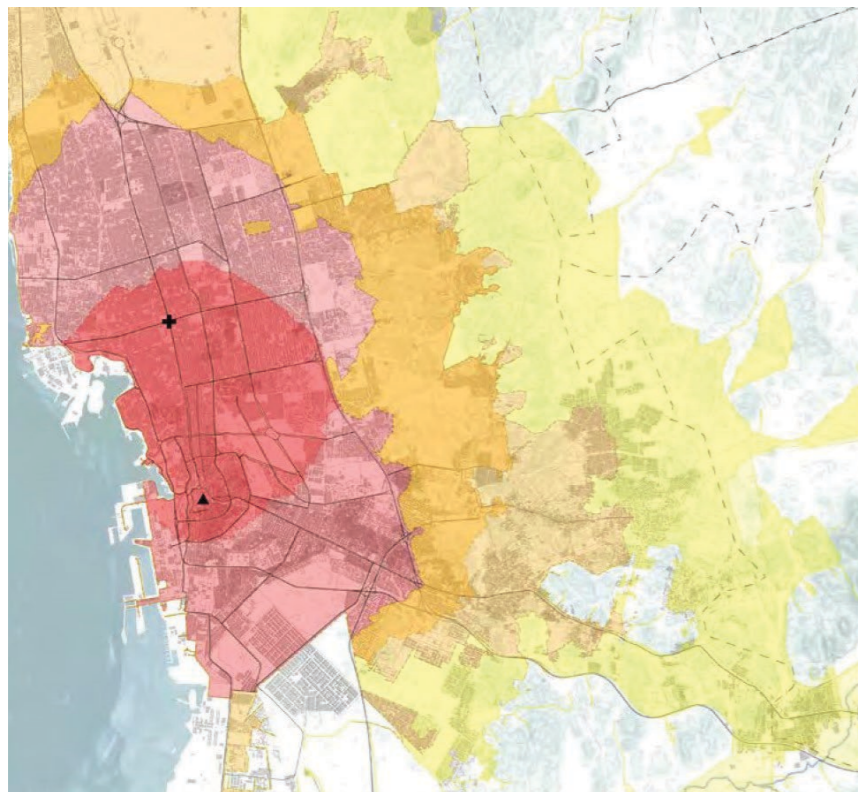
Mobility Patterns

Jeddah's old town wall was replaced by a ring road, and the overall shape of the city is a linear development along the coast. Far sides of the city are linked with a network of highways, and currently, the car is the dominant transportation mode in Jeddah with over 96% of all daily travel.

Those who do not have cars use very limited public transport and they suffer from conditions of marginalization in accessing urban opportunities despite a study undertaken by UN-Habitat to calculate access to the two city centres of Al Balad and Al Rawdah, which found that 48% of the population have access to the urban core within a 15-minute drive distance. This access increased to 73% within 30-minutes of driving time.

Figure50: Drivability to the commercial city centres.

Source: Future Saudi Cities Programme, City Profiles Series: Jeddah, Ministry of Municipal and Rural Affairs, King Fahd National Library Cataloging-in-publication Data, United Nations Human Settlements Programme (UN-Habitat), 2019.



For the people who do not use/own a car, the limited public transport supply offers few opportunities such as the bus network and the public/private school and university buses known as Educational Transport. The public transport supply inside the city is made of a network of bus routes covering only parts of the city from 5:30 a.m. to 11:30 p.m.



#أسهل النقل داخل المدن مسارات مدينة جدة

In addition, walking and biking are not common in Jeddah even in mild weather due to the car-oriented roads infrastructure and the lack of devoted paths. In Jeddah, the bike is nothing more than a means of recreation or sport in specific parts of the city. Another reason for this, besides the loss of adequate infrastructure, can be related to traditions. From a cultural point of view, the dress code in Saudi Arabia does play a role in limiting bike use as a mean of transport alongside other factors.

The traditional outdoor dress code for women known as the Abaya, which resembles a wide coat and a headscarf, can be dangerous while riding a bike and may result in accidents if not worn with care. Nevertheless, many women who regularly ride bikes in parks and seafronts, among other recreational areas in Jeddah can do so even while holding on to the Abaya, either by managing to get it out of the way or by coming up with creative design solutions for sport-safe Abaya designs, while other women prefer not to wear abayas.

Currently riding the bikes is done solely for recreational and exercise purposes only and not used as a means of permanent transport. Additionally, there will always be a segment of women who do not prefer the bike whatsoever as a method of transport or even for leisure, because of their fear of their bodies being exposed due to movement or even considering the car as a more comfortable and safer method of transport.

Figure51: Map and schedule of the existing bus routes in Jeddah. Source: saptco.com.sa, April 2021.



Figure53: : Members of the team Brave Cyclist of around 1000 women who roam Jeddah on bikes.

Source: arriyadiyah.com/682095_mail_arabwindow.net/world/news129666.html



Figure52: Girls cycling on Jeddah's waterfront.

Source: arriyadiyah.com/682095_mail_arabwindow.net/world/news129666.html



Figure54: Man (on a blue bike) cycling in a Thoub while wrapping it around his waist to avoid it getting stuck and tipping over.

Source: salco-sa.com/en/portfolio_page/jed-waterfront

On the other hand, a similar obstacle for men is the Saudi official dress code, which is called a Thoub, and it is quite like the abaya resembling a long dress with a headpiece called Shumagh or Ghutra. The thoub is also difficult to manage as it is impossible to ride a bike without lifting the whole thing. Thus, biking to work for example is not an option for many men whose work require the formal dress code. Nevertheless, many jobs do not require formal attire, as well as non-Saudis who rarely wear the Saudi traditional Thoub but wear suits or casual attire instead.

All these reasons make walking or cycling a far-fetched transport method in Jeddah, but they are either temporary obstacles such as the weather, relate to only parts of the society, or can be solved with innovative solutions. As we have seen, there is already demand and passion for this method of transport by many of the city's residents despite the harsh weather, and even if some do not like it, the biggest and most difficult obstacle remains the lack of proper infrastructure around the city.

On the other hand, it is hard to find drawbacks for walking. The benefits of walking are numerous and outweigh any disadvantages, whether they are related to the environment, safety, economy, physical and mental health.

The main obstacles for walking as a mean of transport in Jeddah are the heat, the harsh sun, the lack of proper walk-friendly infrastructures such as pavements and shaded walkways, and the mono-functional horizontal expansion of the urban fabric that requires people to cover long distances to find services and commerce. Otherwise, walking for the population in Saudi is very pleasant and desired, as it is very common to find hundreds of people walking every day wherever they get a chance. For example, on the waterfront and in the linear parks around the city, especially in the afternoon or at night to avoid the sun. But it is not sufficient to walk only in walking tracks that you need a car to get to.



Figure55: The blazing heat, lack of shadows, lack of pedestrian and bike lanes, and traffic in Jeddah's streets make walking and biking an alien behaviour.

Source: Ammar shaker, 2007, en.wikipedia.org/wiki/Jeddah

Infrastructure System

The urban organization of Jeddah is deeply dependent on the road network structured on a system of motorway axes to which the minor road network is connected. This organization, which is strongly car-dependent, includes the following major roads and highways:

1. **Almadinah Road** connects the city with the airport (South-North) and extends north to the city of Al Madinah Al Munawara.
2. **Al Tahliyah Street** connects the waterfront with the eastern parts of the city (West-East).
3. **Makkah Road** connects Al Balad with Makkah, and it is full of informal settlements.
4. **The Jeddah-Makkah Expressway** (North-South), which is highly congested because it is the main road used by international pilgrims travelling from King Abdulaziz Airport in Jeddah to Makkah, as well as national pilgrims.

The King Abdulaziz International Airport is also under expansion and improvement of services intending to increase its capacity to 30 million passengers in the first phase, and 80 million passengers in the next phases. In 2018, the Hajj terminal of King Abdulaziz International Airport accommodated 310,000 pilgrims during Hajj season, and currently, 94% of international pilgrims land in Jeddah then travel to Makkah mainly by bus.

In addition to the airport development, the Haramain high-speed railway has been officially inaugurated on 25 September 2018. It connects the cities of Makkah, Jeddah, Al Madinah, and King Abdullah Economic City, and it is expected to carry 60 million passengers a year, including around 3-4 million Hajj and Umrah pilgrims, to relieve the road traffic. Unfortunately, On 29 September 2019, a massive fire broke out at Jeddah station and destroyed it, and shortly after, the entire train has been stopped due to the COVID-19 pandemic. However, on Marth 31, 2021, the trips were resumed, but the Jeddah station is still under re-construction, thus the trips from Jeddah operate from the airport.

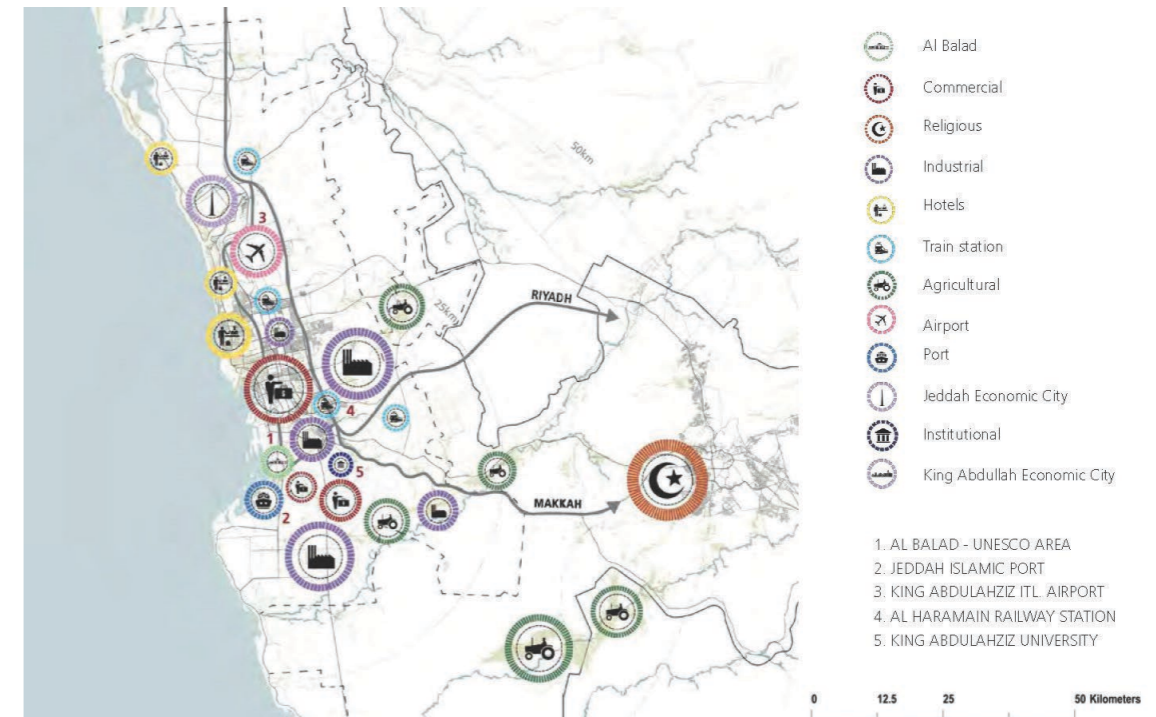


Figure56: Major infrastructure and economic nodes.

Source: Future Saudi Cities Programme, City Profiles Series: (UN-Habitat), 2019.

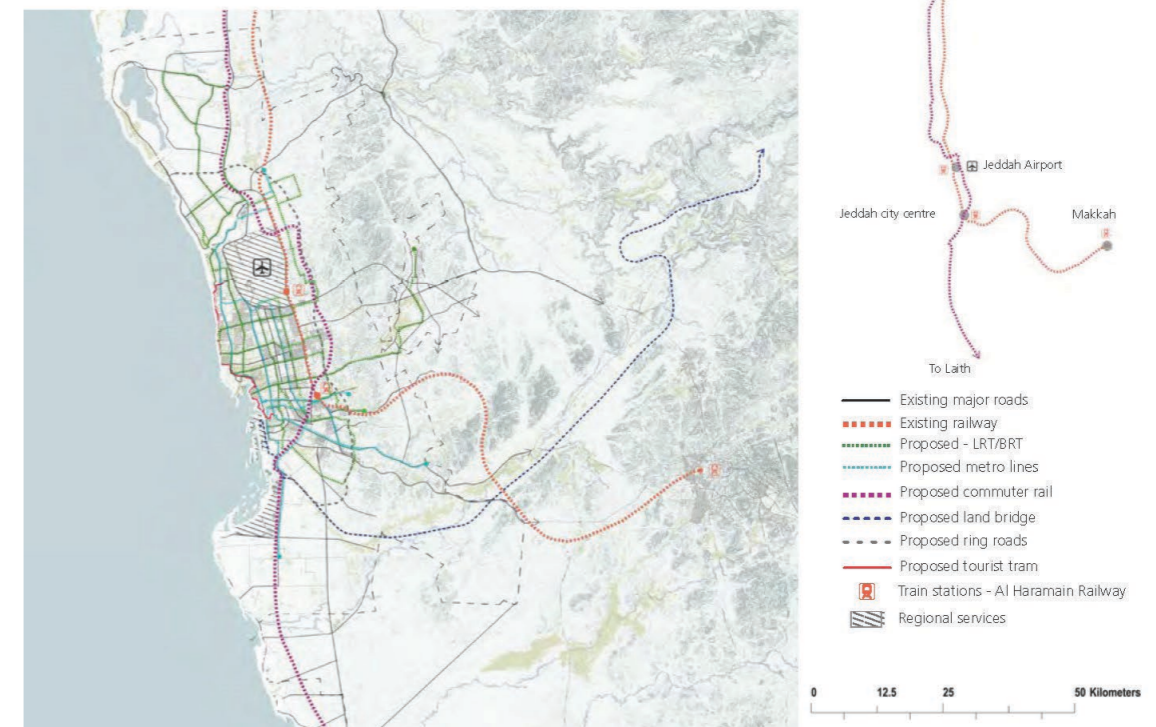


Figure57: Jeddah Metropolitan Area future transportation network as per the Jeddah Plan by the Municipality.

Source: Future Saudi Cities Programme, City Profiles Series: (UN-Habitat), 2019.

Future Developments for Mobility & Infrastructure Systems

TOD and Public Transit

To solve the prevailing car dependency, offer travel opportunities to those who do not have a car, and coordinate accessibility and land-use, two major initiatives in Jeddah's Structural Plan are foreseen: TOD (transit-oriented development) and Public Transit. The core of this approach are the following future transport developments that are currently under construction:

Jeddah Metro

The Jeddah Metro is a planned project that aims to improve transportation and facilities for the public and the pilgrims. It is a mega project of a 149 km track that will connect several transport networks, including the bus and rail network, the marine transportation line, the Corniche tram, the suspension bridge, and the public transport stations. The proposed metro lines aim to form a high-capacity transport system that will be the backbone for the other networks. It stretches from the Obhur Creek in the North to beyond Al Balad in the South, and from King Abdulaziz Road to the West to the Prince Majed Street to the East.

Metro Line Phase I: 67 km and 22 stops

Metro Line Phase II: 41 km and 30 stops

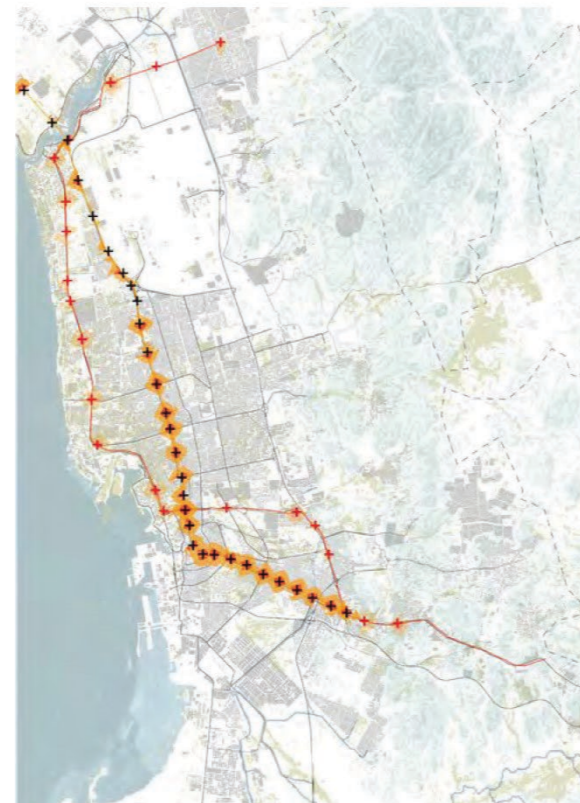
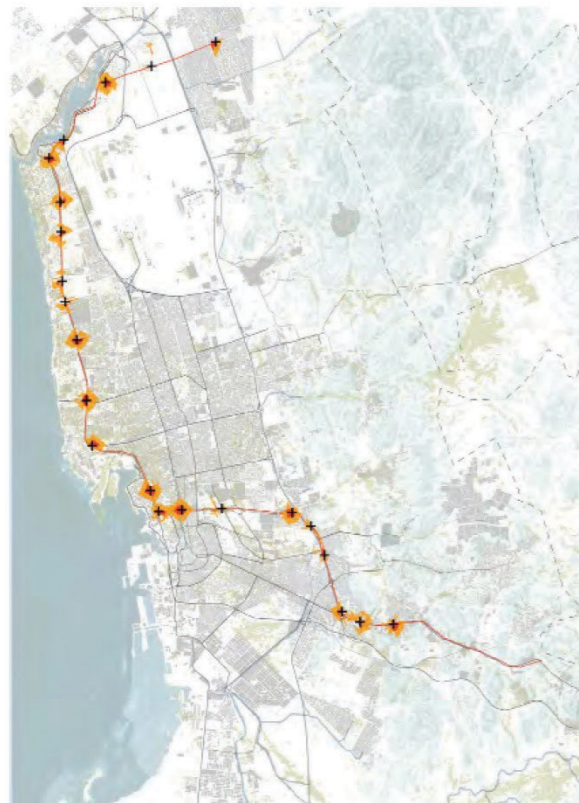


Figure58: Jeddah Metro Line Phases.

Source: Future Saudi Cities Programme, City Profiles Series: Jeddah, Ministry of Municipal and Rural Affairs, King Fahd National Library Cataloging-in-publication Data, United Nations Human Settlements Programme (UN-Habitat), 2019.

Metro Line Phase III: 35 km and 19 stops

Metro Line Phase IV: 16.7 km and 12 stops

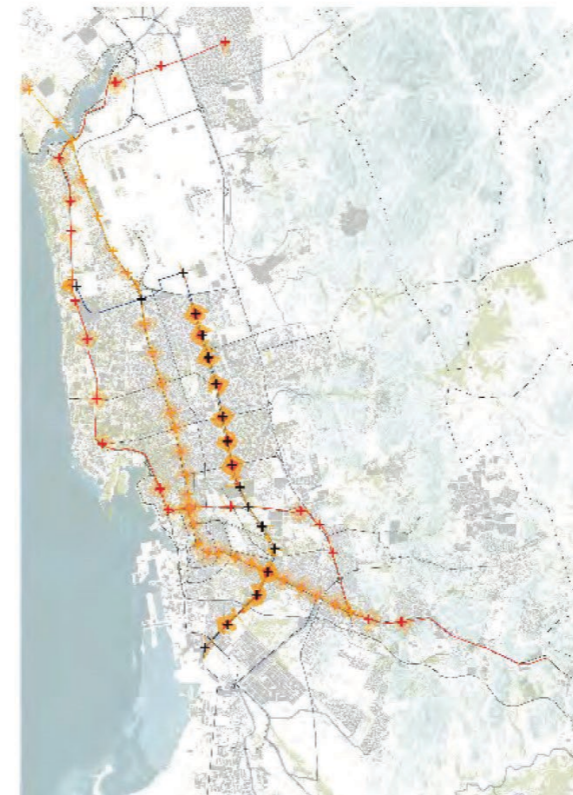


Figure60: Jeddah Metro Line Phases.

Source: Future Saudi Cities Programme, City Profiles Series: (UN-Habitat), 2019.



Figure59: 3D visualization of the foreseen Jeddah Metro.

Source: metrojeddah.com.sa



Figure61: 3D visualization of the foreseen Jeddah Metro.

Source: metrojeddah.com.sa

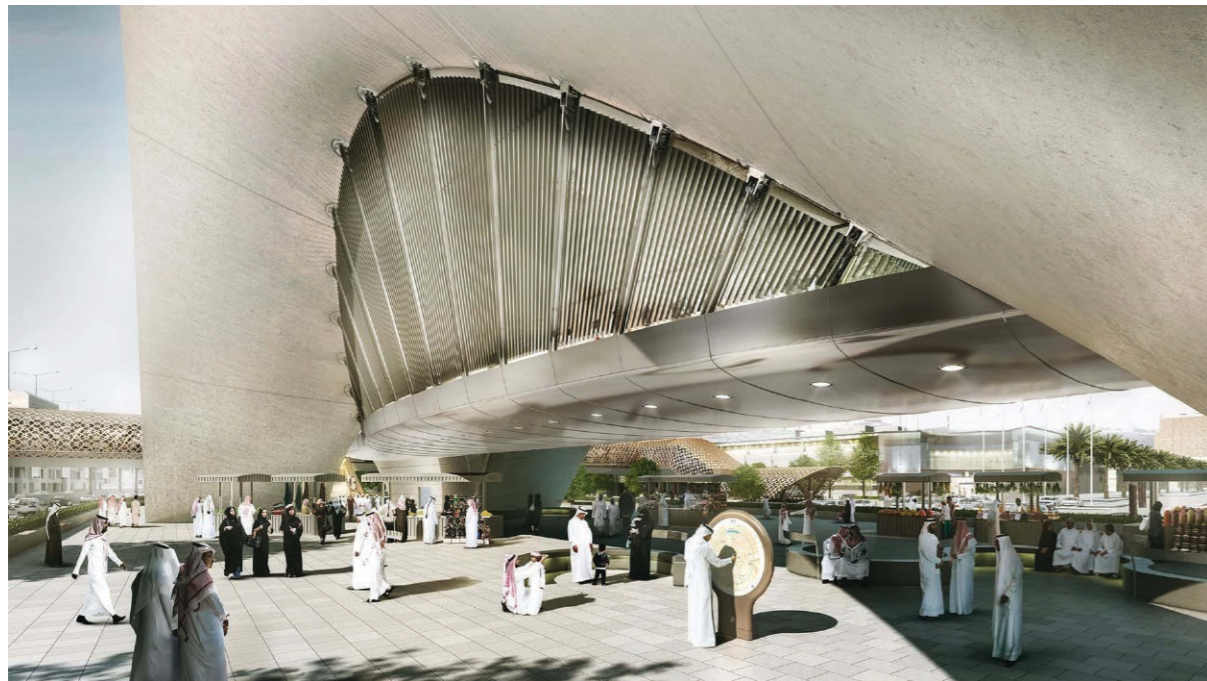


Figure62: 3D visualization of the foreseen Jeddah Metro.

Source: fosterandpartners.com

Corniche tram

The Corniche Tram system (CTS) stretches along Jeddah's corniche (waterfront), starting from the globe roundabout up to the intersection of Tahlia & king road and the Tram will be connected to all other public transportation mode and It consists of 11 (single car) train-sets and 15 stations serving over 15.6Km.



The Commuter Rail

A 195 km-long rail network that will connect the north and the south of the city at the boundaries of the Jeddah Province. With 20 main stations located close to major highways and commercial hubs in Jeddah, the rail aims to facilitate longer distance journeys.

The Bus Network

The foreseen Jeddah Bus Network consists of 296km of service route, 30 Stations for Bus Rapid Transit, 698 Bus Stops, 3 maintenance depots and 533 buses. The network is made the following levels of service:

- The Major Bus Corridor: 92km of service along Prince Met'eb road, King Fahad Road, Prince Sultan Street and the Industrial area. with a total of 139 bus stops and a fleet of 214 modern double-decker buses (each with a capacity of 100 passengers).

- 21 Feeder Lines: 177.5km of service throughout the neighbourhood and districts of the city. The service comprises a total of 559 bus stops and a fleet of 272 modern single-deck buses (each with a capacity of 80 passengers).

Obhur Creek Bridge

The suspended 380 meters long bridge will link the northern and southern banks of the Obhur Creek. It will also link the city with the area surrounding the Kingdom Tower (still under construction, but it is to become the tallest building in the world upon its completion). The bridge extends over the main navigation channel of the creek (which is 21 meters deep), leaving 15 meters high clear route for

Figure63: 3D visualization of the Corniche Tram.

Source: metrojeddah.com.sa

marine vehicles underneath. 74 meters wide with 8 traffic lanes, a pedestrian zone, and an orange metro line, the bridge will also offer panoramic views of the coast and the Red Sea. It will also be linked to the expressway network (including Madinah Road, and the main northern area of Obhur) to facilitate transportation from the city to Northern Obhur. The bridge will be 380 meters long, 74 meters wide and 51 meters high. It will connect the north and south Obhur.

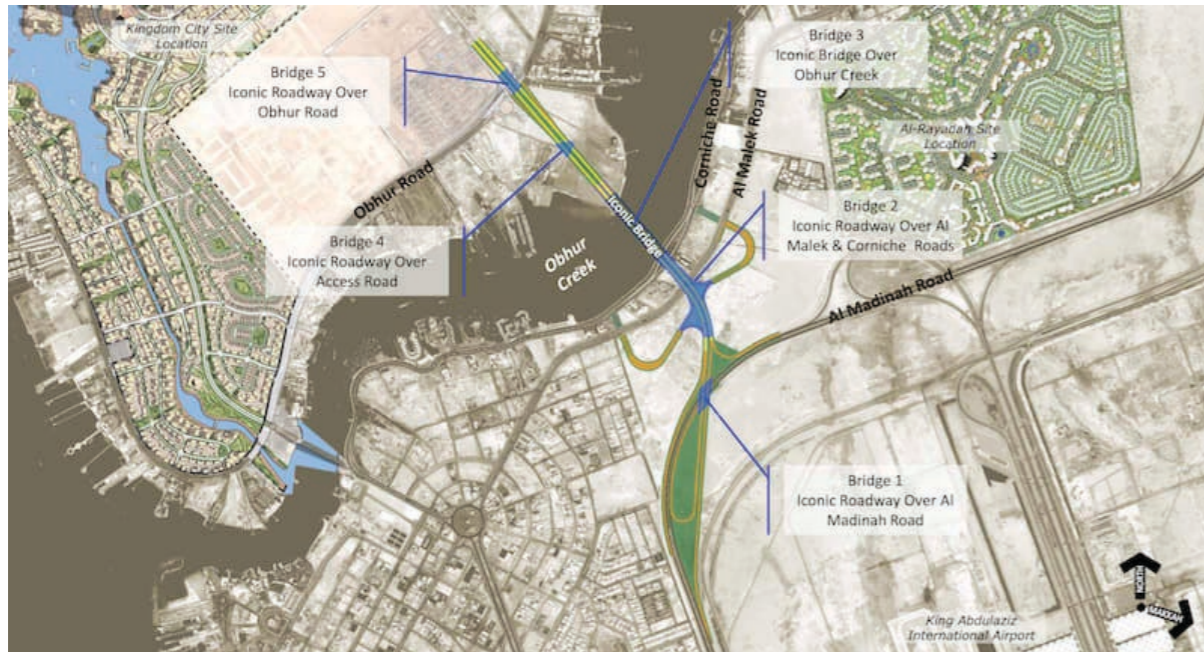


Figure65: Location of the Obhur Creek Bridge.

Source: protenders.com

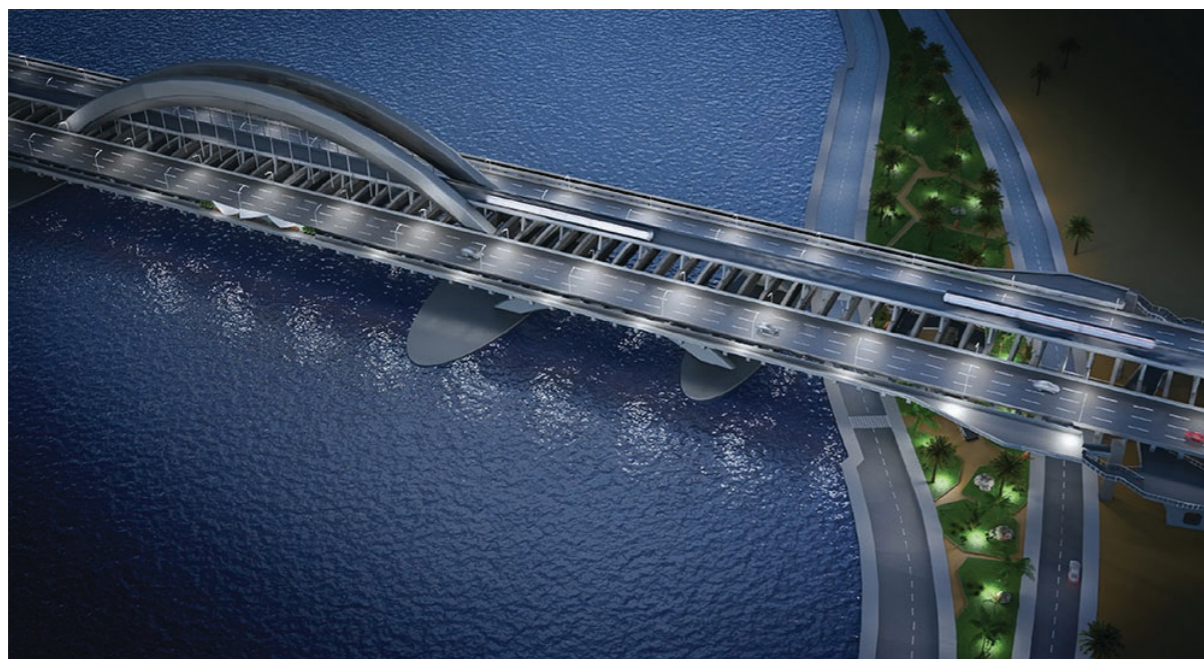


Figure64: 3D visualization of the Obhur Creek Bridge.

Source: metrojeddah.com.sa

Marine Buses (Waterbuses & Ferries)

Utilizing the potentials of the Red Sea and simultaneously creating a recreational destination and an alternative commuter route along the city's entire western edge. The Marine Buses Network extends from the Obhur Creek in the North until Jeddah's Bay in the South. It consists of 20 marine stations and administration and maintenance depot and a fleet of 26 water buses and ferries.



Main Public Transport Station (Al Montalaq)

Located within the Heart of Jeddah project (HoJ), Al Muntalaq is a Multi-Modal Station with a mixed-use commercial destination that extends over 85,000 m2. It will provide an interchange station between the metro and the Haramain high-speed rail station.

Figure66: 3D visualization of the Marine Buses.

Source: metrojeddah.com.sa



Figure67: 3D visualization Al Muntalaq.

Source: metrojeddah.com.sa

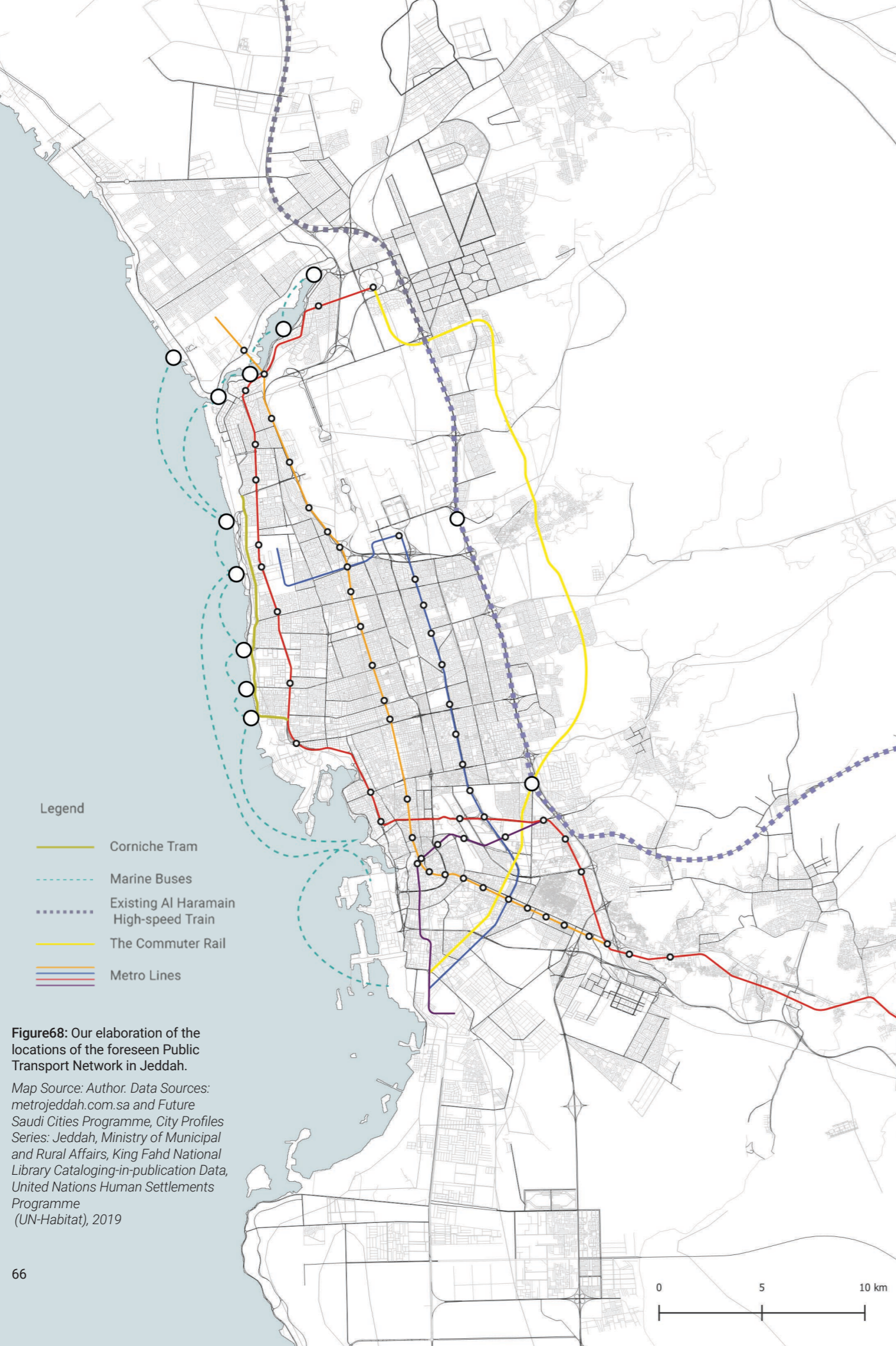


Figure68: Our elaboration of the locations of the foreseen Public Transport Network in Jeddah.
 Map Source: Author. Data Sources: metrojeddah.com.sa and Future Saudi Cities Programme, City Profiles Series: Jeddah, Ministry of Municipal and Rural Affairs, King Fahd National Library Cataloging-in-publication Data, United Nations Human Settlements Programme (UN-Habitat), 2019

2.2.10 Urban Planning and Policy Governance System in The Planning Domain

In the Kingdom of Saudi Arabia, law-making is vested in four entities: The King, the Shura Council, the Council of Ministers, and the Ministerial departments. In consequence, the following five legislative instruments were formed, which operate within a hierarchical order, reflecting the image of their authority and validity: Royal Order, Royal Decree, Supreme Order, Council of Ministers Resolution and Ministerial Decree.

The entity entrusted with conducting urban planning of the Kingdom's cities and permitting of all types of construction activity including Jeddah is The Ministry of Municipal and Rural Affairs (MoMRA), while The Municipality of Jeddah (Amanah), is the local level actor for Jeddah and it acts only as an implementing arm for MoMRA.

The Ministry of Municipal and Rural Affairs (MoMRA) is responsible for conducting urban planning for all the Kingdom's cities, ensuring the provision of necessary roads and fixtures, maintenance, and cleanliness of the environment, in addition to the management of licensing for all types of construction activity, in a centralized planning institutional framework, which impacts Jeddah's growth and development pattern.

The Deputy Ministry of Town Planning (under MoMRA) and its departments such as Local Planning, Studies & Research, Projects Coordination and Urban Planning & Design, is mandated to coordinate with responsible parties that oversee the planning, to achieve holistic and comprehensive urban developments, but the coordination between these departments and The Ministry of Jeddah is weak, thus affecting the delivery of services and the implementation of projects.

The budget system is also centralized, which makes the funding allocation from MoMRA the only available source of funding except for the income from advertising fees and property leases. The Municipality of Jeddah is directed by a mayor, who is appointed by the Minister of MoMRA and the Municipality's executive members are appointed by the Civil Service Bureau.

The planning, preparation and implementation of regulations and legislation programs in The Municipality of Jeddah are conducted by the Deputy of Construction (DOC), which ensures compliance with MoMRA's outlines for cities, rural areas, streets, and construction designs all over the Kingdom. About 55 planners and architects work in the DOC, and the department operates through the following five departments:

- a. The General Department of Urban Planning.
- b. The General Department of land and property.
- c. The General Department of development licenses.
- d. The General Department of Structural Plan and organization (concerned with implementing planning regulations and the Structural Plan).
- e. The GIS Department.

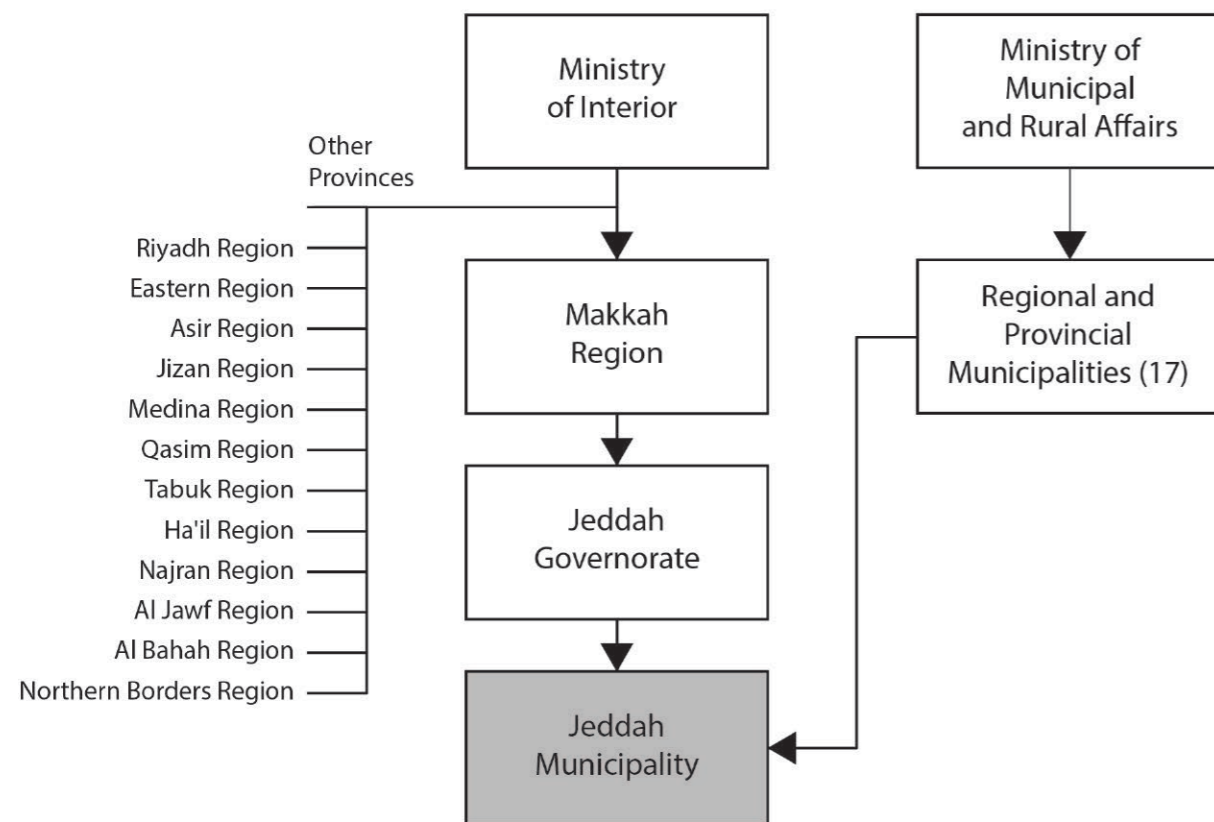
However, the absence of a standard of technical accountability in the administration has been noticed due to the continuous changes in the internal structure of the DOC, which prevents tracing the nature of the operational relations with external parties.

The private sector also has a fundamental role in the economic development in Jeddah, but their land speculation, construction and landfilling activities, and leverage of regulatory mechanisms to generate revenue have often led to indiscriminate land developments and the formation of White Lands, which consequently led to an increase in the cost of housing and urban sprawl.

The Jeddah Development and Urban Regeneration Company (JDURC) was established in 2006 under the Municipality of Jeddah and initiated partnerships with the private sector in megaproject development, such as the implementation of the metro line project and the urban upgrading of unplanned settlements.

As Jeddah is part of the Makkah Region, there is an additional institution that manages and regulates the development process of Jeddah, which is The Emirate (Amarah) of Makkah Region, headed by the Regional Prince who reports to the Ministry of Interior. The Emirate of Makkah Region oversees all authorities and institutions operating within the Region.

Figure69: The Interrelationship of Planning and Governing Authorities.
Source: Author



In general, the overall planning procedures lack the following:

- Leading from the local government and coordinating with all spheres of governments.
- The participation of the general community, the public sector, and other relevant stakeholders in decisions regarding projects that affect them.
- The integration of residents of informal areas into key national plans, policies, mobility infrastructure and other mega urban development projects.

The Urban Planning System

The planning system followed in the Municipality of Jeddah is based on the top-down planning hierarchy of the Kingdom with four different levels of urban plans: **national, regional, local, and district level**, as in the following figure:

Regional Plan for Makkah Region

Regional planning is the second tier of urban planning in KSA and it addresses the natural, urban, social, and economic aspects of regional development. **The Strategic Urban Makkah Regional Plan (2005)** was prepared and approved by the Regional Council for the Makkah Region as an inclusive 20-year vision for economic, social, and spatial development, based on the National Spatial Strategy (NSS) (which is the national level plan aimed at the sustainable development of Saudi Cities and the guiding plan for the Kingdom) and other development plans, surveys, and studies. Nevertheless, the Jeddah Municipality did not participate in the preparation of The Strategic Urban Makkah Regional Plan.



Figure70: Top: The Hierarchy of Plans: Planning Instruments in Force In Jeddah.

Source: Future Saudi Cities Programme, City Profiles Series: Jeddah, Ministry of Municipal and Rural Affairs, King Fahd National Library Cataloging-in-publication Data, United Nations Human Settlements Programme (UN-Habitat), 2019

The Jeddah Plan

The AECOM consulting company was appointed the creation of the Jeddah Plans, which are a series of plans that guide Jeddah's long-term resilience and sustainable growth and shape the city over the upcoming 20 years. These plans were approved in 2015 by MoMRA and they aim to redefine the city's future through the following levels:

- Strategic planning
- Governance
- Spatial and urban planning services
- Landscape and environmental sustainability
- Infrastructure services

The plans include creating well-connected centres, creating a network of quality open spaces, improving the access to amenities and public transportation, ensuring the prime location of metro stations, encouraging residents to decrease their dependence on cars and giving them improved access to amenities and jobs, enhancing the quality of the built and natural environments, and creating a people-friendly city. The Jeddah Plan is a planning tool composed of **a. The Structural Plan of Jeddah Metropolitan** (strategic component), and **b. The Local Plan** (regulatory document). The Jeddah Plan has the following scopes:

- Long term strategy for the city.
- Identification of relevant development areas.
- Identification of urban/not urban land.
- Main mobility system.
- Environmental protection.
- Infrastructure provision.
- Detailed land use.
- Urban regulations.
- Detailed proposals for selected areas.

a. The Structural Plan of Jeddah Metropolitan

In 2015, The Municipality of Jeddah established four volumes to guide the development of the Jeddah Governorate for over 20 years. These plans are:

- Jeddah Strategic Plan
- Jeddah Sub-regional Plan
- Jeddah Structural Plan
- Jeddah Local Plans (Area Action Plans)

1. Jeddah Strategic Plan

- Outlines the municipality's development vision, mission, and objectives for Jeddah Governorate's development and urban growth until 2033.
- Defines the governorate wide objectives and policies that will guide decision making regarding land use planning, urban policymaking, infrastructure planning, investment, governance, and provision of civic facilities.
- Provides Missions for the development of the Governorate to be taken forward in the sub-regional, structure and local plans.
- Provides a management and implementation framework to ensure the long-term success of the Jeddah Plan.

2. Jeddah Sub-regional Plan

- Identifies the extent of urban growth and spatial strategy for Jeddah Governorate until 2033.
- Sets out long parameters for growth and development.

- Identifies locations for subregional urban growth and environmental protection.
- Defines the detailed development strategy for Jeddah's urban area.

3. Jeddah Structural Plan

- Provides a structural framework for urban growth and regeneration within the urban area.
- Identifies strategic land uses and infrastructure networks within the metropolitan area of the 2030/1450 Urban Growth Boundary (UGB). Within this growth boundary, 121,675 hectares of land have been allocated for residential development).
- Provides a city-level spatial framework to guide intervention and investment by the Municipality and its public and private partners.
- Provides social and public facilities, better spatial design and concentrate development in seven town centres of the city (Al Janoob, Moulaisaa, Markaz Al Madinah, Jeddah Al Jadeedah, Telal Jeddah, Obhur, Thuwal) and outlines a clear hierarchy between centres and their functions.

4. Jeddah Local Plans

- Provide a series of Local Plans that define a comprehensive strategy for coordinated development and design decisions across the urban area.
- Provide confidence and certainty to public and private sector bodies in advancing specific plans, programs, and investment.

b. The Local Urban Plan

The Local Plan represents the third tier of urban planning in KSA and is focused on the areas within the Urban Growth Boundary (which aims to prevent urban sprawl in the outskirts of cities without adequate urban infrastructure), with a particular focus on housing. It also includes the Urban Atlas, which defines the allowed land uses for each part of the city, in addition to the regulatory report, which includes specifications for the permissible development rights, such as floor area ratio, street dynamics, building heights, areas of special building regulations, etc.

The local plan aims to:

- Control the urban land-use and building regulations.
- Provide public services and infrastructure in a cost-effective and integrated manner.
- Set basic requirements for proposed road networks.
- Facilitate the development of public and private sector housing.

The local plan is prepared by various consultants according to the "Booklet of the Terms of Reference for the Preparation of the Local Plan" by MoMRA. However, this booklet is not based on any legislative framework to support the implementation of the specified plans. The preparation of the Local Plan is even more complicated due to the existence of parallel structures applied by MoMRA and the Ministry of the Interior. Although the legal mandate for planning lies in the Municipalities (under the supervision of MoMRA), there are jurisdictional overlaps with the Regional Development Authority. The Ministry of Interior is considered the body overseeing the implementation of regional projects, while MoMRA is the main body for urban planning projects, but there is no clear coordination mechanism between them, which affects the delivery of technical standards within municipalities. Consequently, the Jeddah Local Plan is yet to be approved though it was prepared by the Amanah in 2005 and the Municipality of Jeddah currently relies on the Al Beeah Master Plan, which was approved by MoMRA in 2006.

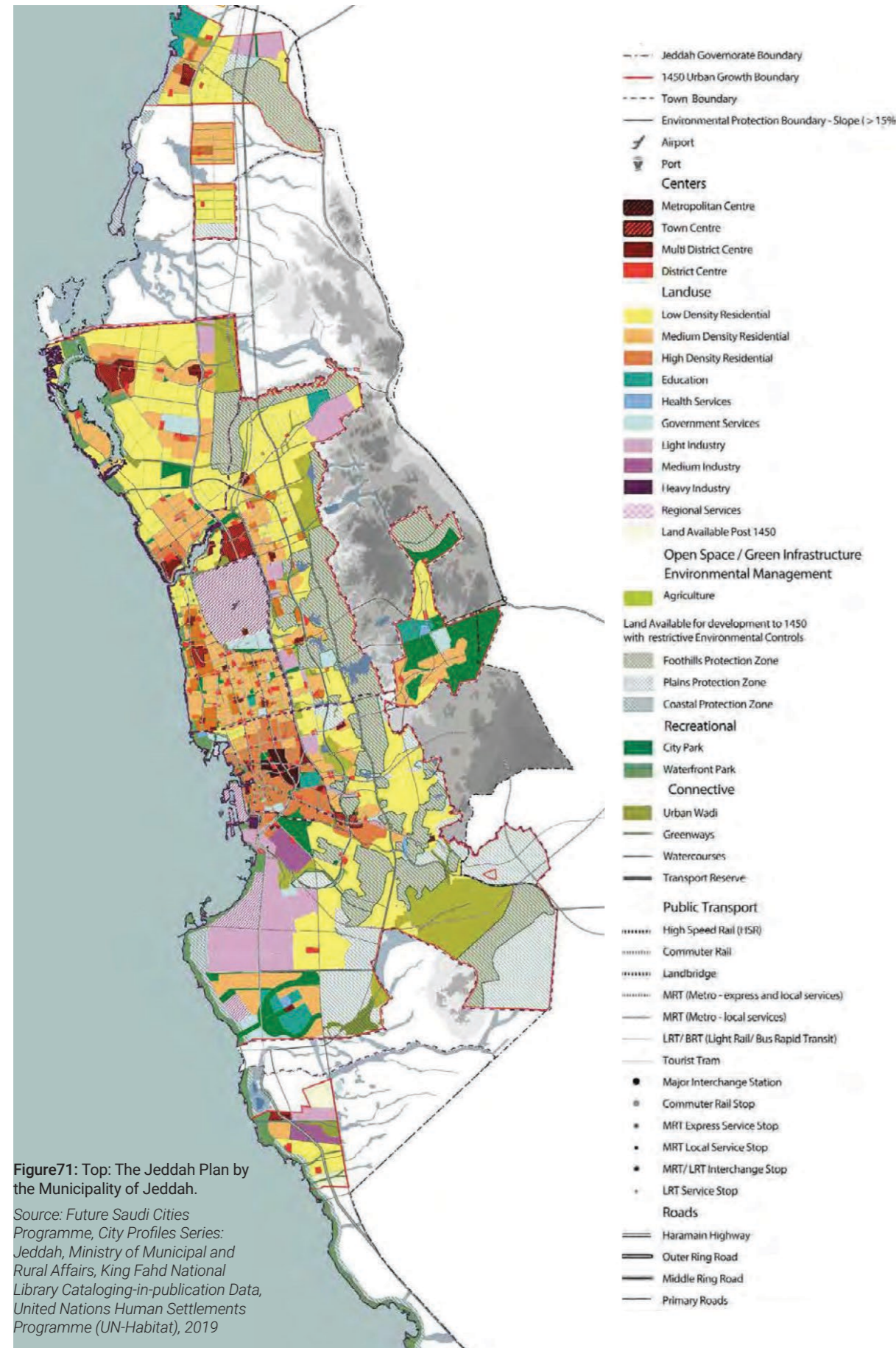


Figure71: Top: The Jeddah Plan by the Municipality of Jeddah.
 Source: Future Saudi Cities Programme, City Profiles Series: Jeddah, Ministry of Municipal and Rural Affairs, King Fahd National Library Cataloging-in-publication Data, United Nations Human Settlements Programme (UN-Habitat), 2019

2.3 Drawbacks of Jeddah's Urban Pattern

Over 70 years, Jeddah grew from a three km² walled city of 25,000 inhabitants into a 1,600 km² city with more than 4,600,000 inhabitants and was developed based on three master plans.

The First Master Plan (1962) was made by a United Nations consultant, Dr Rahman Makhoulf. It laid the foundations for the master planning process of modern Jeddah. Then was the Second Master Plan (1873) by Robert Mathew, Johnson - Marshall Partners (RM-JMP), which later was reviewed by a consulting consortium - Sert Jackson International/Saudi Consult (SJI/SC) when the growth became rapid and enormous due to population increase mainly from immigration because of the oil boom, resulting in the third Jeddah Master Plan (1980) that aimed to correct the land-use problems created by the urban expansion beyond the targets and boundaries.

Jeddah today is a busy and lively city with many beautiful buildings and attractive spaces such as the coastal Corniche, but not all is well. Jeddah's rapid urbanization resulted in numerous issues, and the inhabitants face daily problems related to the planning and urban pattern of the city.

2.3.1 Land Use and Transport Issues

Jeddah's fast growth happened wherever there were available lands that are not expensive, and without adequate policy measures or regulations that limit the urban sprawl and stop the growth of unplanned settlements within urban boundaries. The result was an outward expansion and a sprawl development that created a pattern of scattered, fragmented urban settlements.

White Lands

At the same time and while the urban expansion is continuously increasing to the North and the South, the centre remains full of privately owned or preserved vacant lands of a residential or commercial category. These undeveloped lands are known locally as 'white lands'. The percentage of these 'white lands' is 27% of the total land available for urbanization within the growth boundary. The existence of these vacant lands is a major reason for the housing shortage, and it is linked to property hoarding intended to maximize land value before development. The government though has recently issued the White Lands Tax Law that imposes an annual land tax of 2.5% of the value on 'white land' (which is defined as vacant land located in populated areas and zoned for residential or for dual residential and commercial use). This law aims to provide more housing and make residential land available at reasonable prices as well as to combat monopolistic practices.

Transport

The private car had a great impact on Jeddah's planning after the Second World War. The urban area increased, and the city grew in a single-use medium-low density urban pattern, where residential, commercial, industrial, and other zones are widely separated from one another.

The expansion was not accompanied by a development in the transport infrastructure. The city keeps growing and more districts of **urban settlement blocks** are still being produced in all direction wherever there is cheap available land, while transportation remains completely reliant on the car. Hence, it is very common for people to live more than 50 km away from the city centre where they work or study, with the private car as the only way of commute.

Jeddah today is not able to accommodate this increase in travel demand, hence causing tremendous pressure on the roads and high levels of **congestion** which has negative impacts on the **environment** and air quality, **safety** for road users with high numbers of car accidents and car-related fatalities. The reasons behind this high dependence on the car are the harsh weather, low gas prices and lack of fuel tax (this has changed in the past few years, but it was one of the key reasons to increase the car dependency), cultural influence and high economical standards of living, low urban population density and the limited public transport. This traffic and high congestion threaten not only the environment and the safety of road users, but also damage the **economic prosperity** of the city.

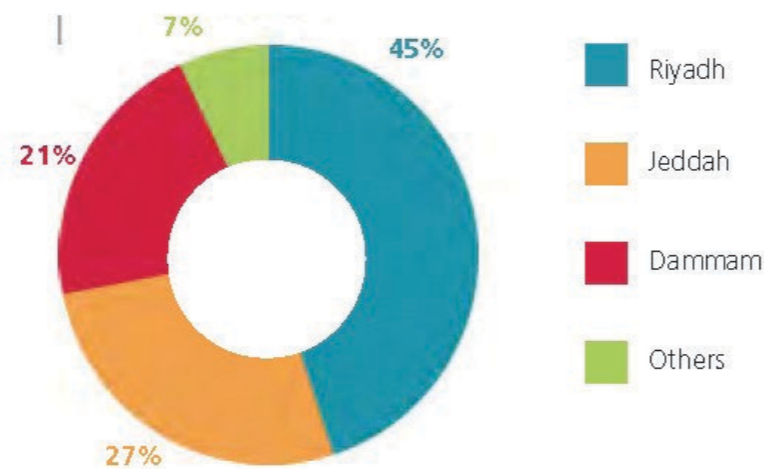


Figure72: Top: Percentage of White Lands in Saudi Cities.

Source: Future Saudi Cities Programme, City Profiles Series: Jeddah, Ministry of Municipal and Rural Affairs, King Fahd National Library Cataloging-in-publication Data, United Nations Human Settlements Programme (UN-Habitat), 2019

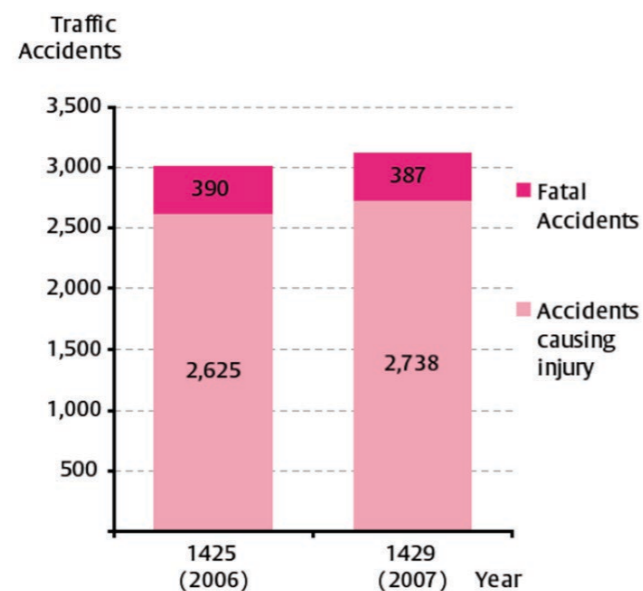


Figure73: Traffic accidents in Jeddah (Jeddah Strategic Plan 2009).

Source: Urban Sprawl and its negative effects on Jeddah.



Green Space

Jeddah has an inconsistent green network. The only green area that attracts a big part of the population is the waterfront, while the green and open public spaces within central areas are scarce, poorly distributed and implemented, and surrounded by roads. According to the Cities Prosperity Index (CPI) of Jeddah, the city has a moderately good quality of life with an index of 68%, which can be broken down to a good healthcare system (77%), moderately good education sector (60%) and very good safety and security (96%). Nevertheless, it is all weakened by the lack of adequate public spaces in the city particularly concerning the low green area per capita (37%).

Figure74: Top: Traffic in Jeddah, day, and night.

Source: Urban Sprawl and its negative effects on Jeddah.

Public Space (37.3%)	Green Area per Capita	5.60	m2 / inhabitant	37.3%	Under Moderate
Accessibility to Open Public Space	-	%	-	-	-

Table10: CPI of Jeddah

Figure75: Public space (walkway) near King Abdulaziz University.

Source: jeddah.gov.sa





Figure76: Top: Al Yamama Walkway, Jeddah's Waterfront.

Source: jeddah.gov.sa

Figure77: Bottom: Jeddah's Waterfront.

Source: Tahir MQ - Own work, CC BY-SA 4.0 Source: <https://commons.wikimedia.org/w/index.php?curid=77044799>

2.3.2 Environmental Issues

The negative environmental consequences of urbanization are evident in Jeddah. The massive growth has led to changes in the environmental and ecological components of the landscape, as well as the modification of the natural forms of landcover, which threatens the landscape's ecosystem and natural diversity, leading to natural hazards, such as deforestation, land degradation, water scarcity and habitat and species loss.

This change of land surface characteristics and properties from natural vegetation and permeable evaporating surfaces into non-permeable surfaces, such as asphalt and concrete, has also led to more natural hazard such as flash floods, which have been a real issue in Jeddah, and caused human deaths and great damages to the urban infrastructure in the past years, ironically in an extremely arid land.

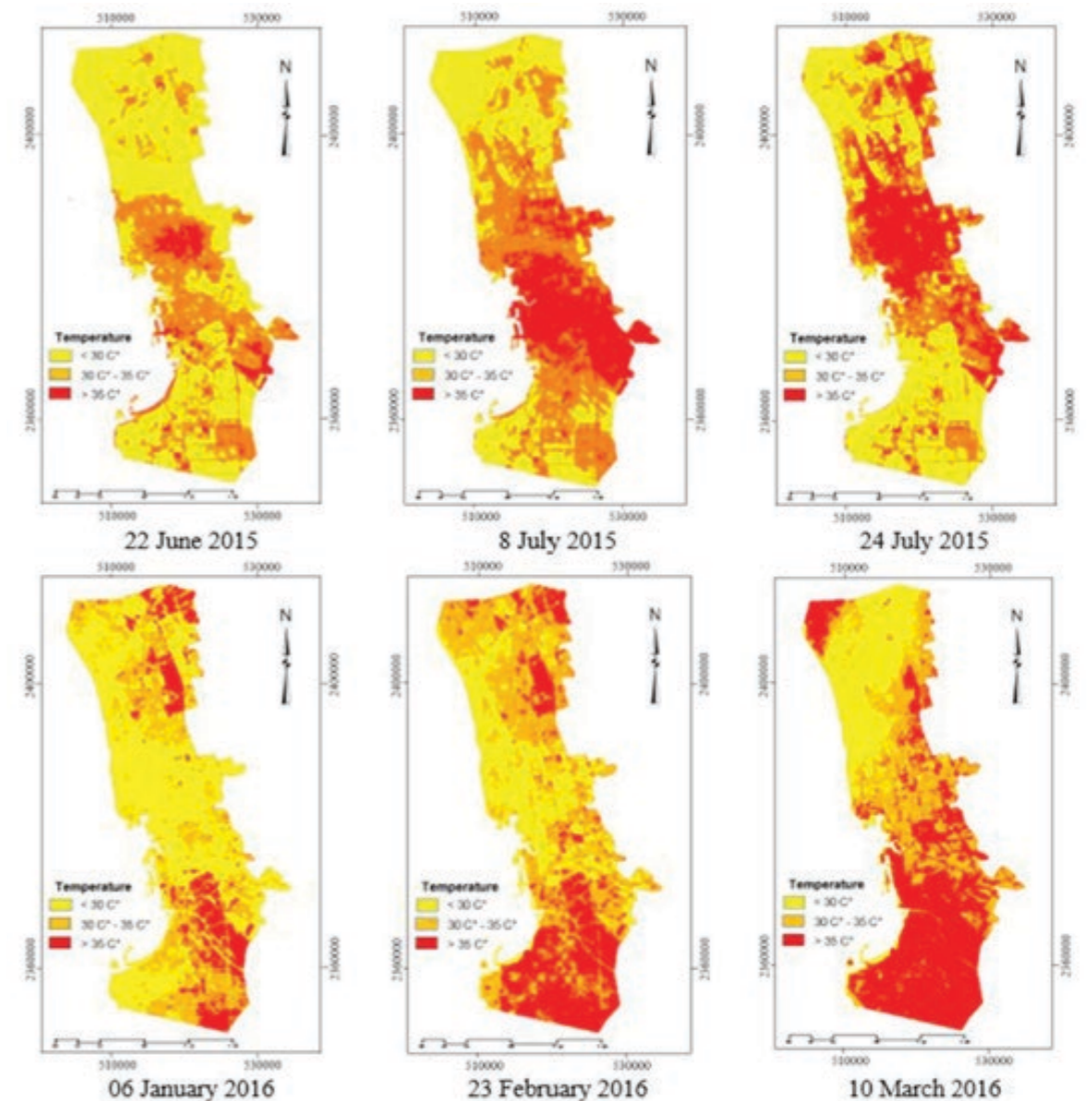
Another destructive effect of urbanization is the formation of urban heat island, which is highly impacted by the urban form of the city (street layout, public space, and building typologies), landcover materials (that absorb and store heat), vegetation, and vehicle emissions.

The climate in Jeddah is hot and arid, and it has been a major reason behind the high dependence on the car in the first place, and it had a significant impact on all human activities such as the housing sector and the lack of greenery and open public spaces, yet the avoidance of high temperature altogether and the widespread use of mechanically air-conditioned buildings instead of finding natural ways to mitigate heat, has exasperated the problem and led to the further increase of temperatures and as a result.

As passive climate-adaptive techniques of the old city and architecture have been completely neglected in the modern city and were replaced with an urban pattern and an architecture that rely solely on electricity and oil, pollution and urban heat islands increased, which, in turn, led to the increases of the need to consume more fuel and electricity for cooling and transportation in an unending cycle.

Figure78: Land Surface Temperature Over Jeddah Using Classification-Based Emissivity and NDVI-based Emissivity Values.

Source: Miky, Yehia. (2019). Remote sensing analysis for surface urban heat island detection over Jeddah, Saudi Arabia. *Applied Geomatics*. 11. 10.1007/s12518-019-00256-9.



A Comparative Study of The Climatic Performance of Vernacular Urban Form and New Developments

It is well-known that vernacular urban patterns often perform better in mitigating local climatic conditions and establishing acceptable urban microclimates.

To understand this, a spatial/climatic analysis was performed by the Ministry of Municipal and Rural Affairs, King Fahd National Library Cataloging-in-publication Data and the United Nations Human Settlements Programme for the Future Saudi Cities Programme in 2019 to study the direct relation between urban layouts and their climatic performances, to prove, through analysis, how the historic urban pattern consisting of narrow, shaded streets, vegetation, solar reflection, and urban canopies, affect the urban climate across Jeddah.

The study, based on the Landsat Eight satellite imagery collection from June 2017, occurred in the months of the highest temperatures in the city, intending to show the different performances of existing urban layouts in extreme weather conditions.

The performance of each urban pattern and its capacity for mitigating the Urban Heat Island Effect is evaluated to show the principles that determine an urban pattern's ability to mitigate and adapt to Jeddah's climate.

Case A: Wide Road Within a Residential Area (1 on the map)

As the imagery shows, over-dimensioned streets provide very low solar reflection, which raises the average local temperature by at least 3°C.

Case B: Historic centre/UNESCO site (3 on the map)

The traditional urban pattern with its vernacular buildings shows high climatic performance with low recorded temperatures.

Case C: A new development (4 on the map)

A typical new development with a loose, low-density urban fabric with over-dimensioned roads. As the imagery shows, the climatic performance is similar to the first case. Over dimensioned roads, flat surfaces and lack of shading provide very low solar reflection and result in higher local temperatures.

Legend:

1. Wide road within a residential area.
2. Coastal green area/ Public park.
3. Historic center/UNESCO site.
4. New development.

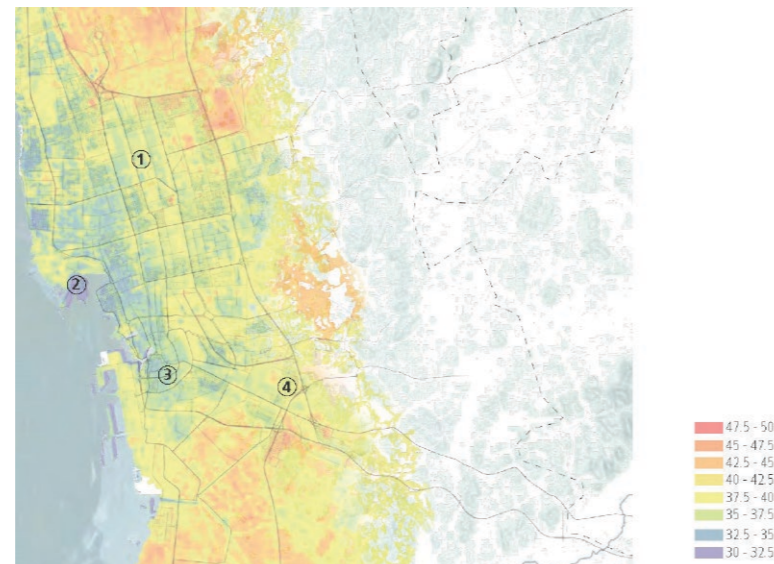


Figure79: Jeddah's Urban heat island effect and relation to the existing urban pattern implication on climatic factors.

Source: Future Saudi Cities Programme, City Profiles Series: Jeddah, Ministry of Municipal and Rural Affairs, King Fahd National Library Cataloging-in-publication Data, United Nations Human Settlements Programme

Finally, according to the Cities Prosperity Index (CPI) of Jeddah and concerning the harvest of renewable energy, the depletion of non-renewable resources, and reducing pollution, Jeddah's environmental sustainability index is 29.1% and it means that the city is not sustainable enough and in need of suitable interventions.

2.3.3 Socio-Economic and Health Issues

Throughout history, Jeddah has been known for its social solidarity, diversity, and cohesion. The structure of the urban pattern of the city was a hierarchy of streets, narrow winding alleyways, public open spaces, semiprivate spaces, and buildings. The city was made of districts in which each district had its character and story, and they were composed of both the rich and the poor living together as neighbours.

The dense compact layout created a sense of community and the streets have always been public social spaces, movement axes, and centres for commerce and trade.

As the dependence on the automobile spread, the streets turned into roads for cars only, and the physical structure was modernized to accommodate new functions; thus, eliminating the qualities of the traditional city. Open public spaces have also changed from being an integral part of the urban structure into isolated closed malls surrounded by oversized streets and highways.

Additionally, the social cohesion of old Jeddah has been lost as the society became very individualistic due to the spread of low-density suburban neighbourhoods and the reliance on private cars. This has also caused the city to be divided into 1) high income, planned developments and neighbourhoods with villa types of residences (mainly in the North) and 2) Neglected low-income neighbourhoods (mainly in the South), which lead to segregation and isolation to certain groups of the society.

Lots of economic opportunities are wasted as well due to the single-use zoning and monolithic transport system that plays a major role in unemployment rates when compared to a mixed-use urban pattern with many opportunities within walking distance.

Another major concern and repercussion of the sedentary lifestyle imposed by this new urbanity and car dependency is the health side. Physical inactivity increases all causes of mortality and is an underlying cause of many health issues and diseases such as cardiovascular disease, type II diabetes, obesity, cancer, high blood pressure, depression, and anxiety. Traffic, large roads without sidewalks, high temperatures, and lack of shading and vegetation all make physical activity a difficult choice for the residents of Jeddah.

2.4 Sustainability Within a Local Context

Sustainable cities have a low environmental impact and high resilience. In general, a sustainable city is planned with consideration for social, economic, environmental impact. It provides a habitat for the existing population without compromising the right for future generations to experience the same. Resilience on the other hand is the city's ability to absorb shocks, recover from them, and prepare for any future economic, social, environmental, health and institutional challenges that may arise. Resilient cities promote sustainable development, well-being, equity, justice, and inclusive growth.

Nevertheless, the sustainable city discourse of the global North can be misleading or even produce damage for the local context if taken uncritically and applied without consideration of the peculiarities of cities. Each city has its character and identity that must be taken into consideration while designing, for a single model cannot fit all. As there is no such thing as a global solution, sustainability principles in Jeddah might take a different form than those in the global North models as both locations differ in many aspects; economically, socially, culturally, institutionally, and environmentally. For instance, some key consideration that can affect the application of sustainable strategies for Jeddah are 1) environmental, such as water scarcity, high temperatures, humidity, and the presence of sandstorms; 2) cultural, such as the religious foundation, the formal Saudi dress code for men and women, the social preferences towards the use of the car; and 3) demographic, such as the family and the hospitality culture, big families, and thus, the need for large houses.

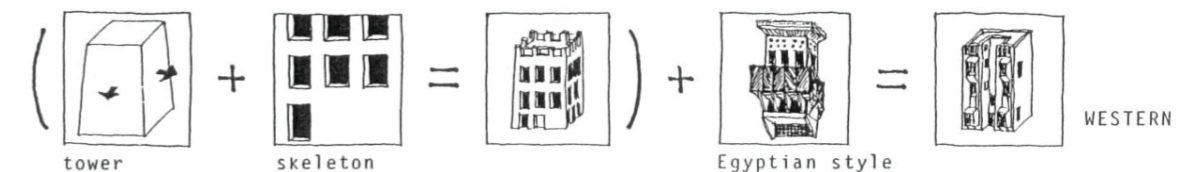
Sustainability Features of Historic Jeddah

For Jeddah, the first guide for successful sustainable development is the historic city. It evolved through centuries of experience, which was based on the relationship between building and climate and provided key solutions for local features of the city without electricity or cars. Therefore, historic Jeddah can be studied as a model of environmentally responsive and green architecture and can be of great help towards creating a future sustainable and resilient city alongside other strategies and principles.

The local environmental conditions, such as the hot climate, the humidity, and many other natural features of the Hejaz region as well the cultural and social norms are all among the factors that affected the formation of the historic city and the traditional architecture of Jeddah. The result was a city that has proven to be sustainable and resilient for hundreds of years due to its fulfilment of the environmental, materialistic, and human needs of the local conditions and Arab societies.

As Jeddah has been a trading port, it has been influenced by many cultures. Trading Middle-Eastern, Asian, and European nations, in addition to the Hajj pilgrims who came from various parts of the world, bringing their skills and ideas. They have all enriched the culture and architecture of the Hejaz region in general and the culture

of Jeddah specifically. Egypt for example had a significant influence on the architecture of Al Hejaz, for the Rowshans (also known as the Mashrabiyyas), which are wooden projected screened windows that give architecture of al Hejaz its distinctive form, came from Egypt through Jeddah.



The traditional architecture of Jeddah ranged from the individual buildings to the settlement scale, and it was all climate-responsive in terms of the urban pattern and street layout, the house form, building materials and construction techniques, and the passive ventilation system. These climate-responsive techniques are explained in further detail as follows.

1. The Urban Pattern and Street Layout

The urban pattern of historic Jeddah is organic and made of up to 7 story towers. The buildings are placed apart from each other to allow the free movement of air around the buildings and the streets are narrow surrounded by tall buildings to provide shadows during daytime.

The streets vary in width and range between 2-4 meters (secondary streets), or 4-10 meters (primary streets), or 12-20 meters (main streets). Wide streets usually take the north-south direction with a right angle to the sun path to keep them in the shade for most hours of the day. Besides, the narrow streets have many bends and on both sides the projecting screen windows (Mashrabiyyas) aid in providing the maximum shade.

Points of intersection, on the other hand, are open enough to receive sunlight for longer periods during the day. These intersections are not only focal points and community spaces, but they also help in mitigating the microclimate when they heat up to a much higher degree than the surrounding shaded streets because of their prolonged exposure to the hot sunlight. This hot air becomes less dense than the cooler air of the surrounding streets, and a convection system starts to happen as a result when the hot air rises and gets replaced with cool denser air coming from the smaller streets. This convection system made by the streets layout and the temperature differences creates a satisfactory air movement and a natural ventilation system in the streets of old Jeddah.

Figure 80: The influence of the Egyptian style on the traditional architecture of Jeddah.

Source: Arif Kamal, Mohammad. *The Morphology of Traditional Architecture of Jeddah: Climatic Design and Environmental Sustainability*. Department of Architecture, Aligarh Muslim University, GBER 2014 Volume 9 Issue 1 pp 4-26.

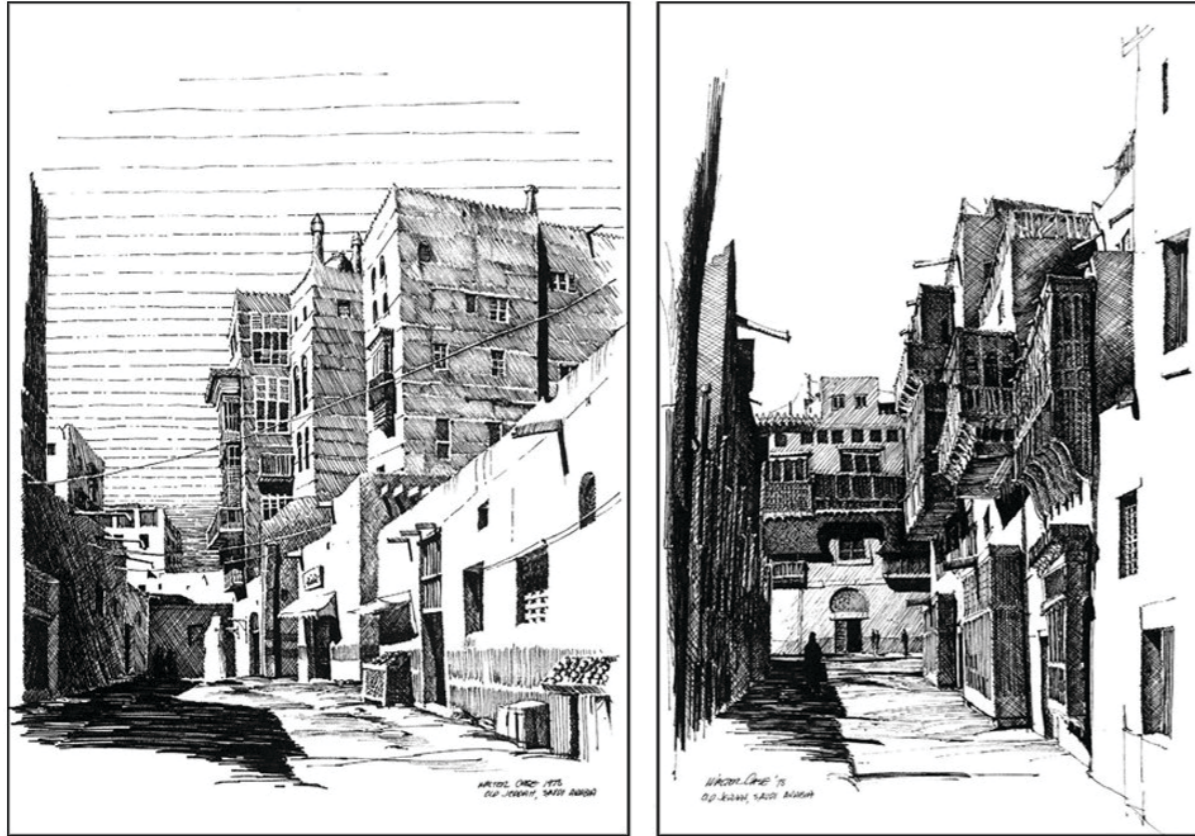


Figure81: A drawing by the artist Walter Case in 1979 showing the narrow lanes of old Jeddah and the projected Mashrabiya casting shadows on buildings and the ground.

Source: Eissa, Mahmoud. (2006). *Sustainable Urban Development as An Entry Point for The Rehabilitation of The Historic City Of Jeddah, Kingdom Of Saudi Arabia*. التنمية العمرانية المستدامة كمدخل لإعادة تأهيل مدينة جدة التاريخية، المملكة العربية السعودية. *Journal of King Abdulaziz University-environmental Design Sciences*. 4. 103-123. 10.4197/env.4-1.4.



Figure82: Aerial view of Jeddah in 1940.

Source: Pesce Angelo. (1977, p. 112): *Jeddah Portrait of an Arabian City*, London, Falcon Pre.

2. The House Form

Traditional houses in Jeddah vary according to the socio-economic status of their inhabitants. There were the Simple Houses, which are small houses for small families. Then there were the Large Houses, which are tall structures made by the rich people in Jeddah (usually the merchants). These tall houses remain an example of the outstanding traditional architecture of Jeddah. Finally, there were the Multiple Units, which are palace-like houses for the ultra-rich people, and they resemble a combination of houses.

The main factors that determined the form of the traditional houses of Jeddah were privacy, the segregation between men and women, and the adaptation to the hot humid climate.

The buildings were tall in Old Jeddah, sometimes reaching up to seven stories high or 15-18 meters, and those that were affected by the Ottoman architecture were three to four stories high. The buildings were airy structures with outstanding cross-ventilation. The ground floor was reserved for men and it doubled as a reception floor for guests. The upper floors were reserved for women and family.

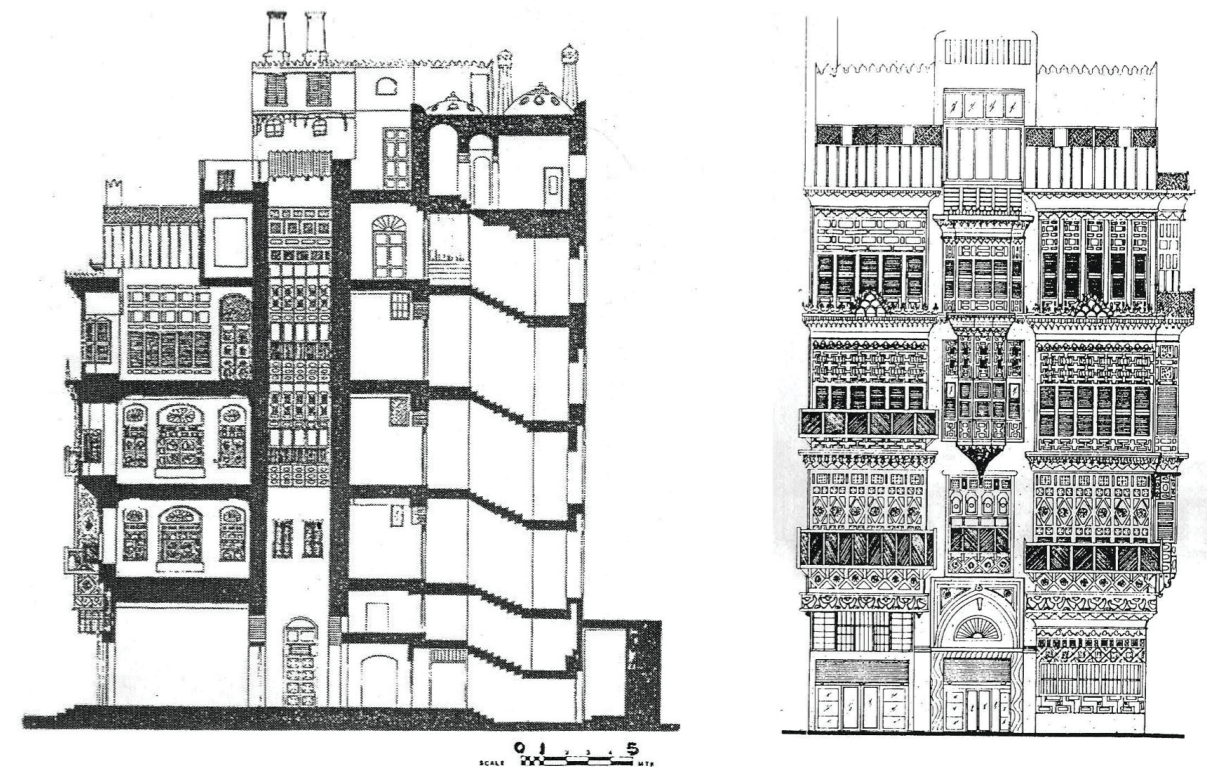


Figure83: Section and Elevation of Noorwali House, which is one of the most prominent large houses in Old Jeddah.

Source: Salloum, Ashraf. (1983). "El Rawashin" Of Jeddah Saudi Arabia. 10.1016/B978-0-08-030581-3.50036-0.

In the centre, the staircase winds around solid masonry walls, which provide strength and stability to the building. The floor plans of the house are designed in a way that provides each room with cross-ventilation, which is aided by the projected wooded windows (Mashrabiya) looking out to the street through wooden lattice screens that provide ventilation while maintaining high privacy for the family. Sometimes an entire streetscape in Old Jeddah was made of many Mashrabiya. Furthermore, to take advantage of the on-shore and off-shore breezes, the families sleep on the upper floors, and during hot days, on the roof.

Larger houses often have some rooms that receive natural light and ventilation from the vertical shaft in the centre that is called a 'Man-war'. They also have large openings and horse-shoe arches, which are highly decorated, as well as loggias that open to the sea.



Figure84: Plans of Noorwali House.

Legend: 1. Main Entrance 2. Back Entrance 3. Women's Entrance 4. Dewan (Guests Room) 5. Khazanah (Storage) 6. Wudu Place (Ablution) 7. W.C. 8. Kitchen 9. Family Living Room 10. Majlis (Formal Salon) 11. Mabit (Sleeping Room) 12. Majlis or Mabit open to the sky. Source: Salloum, Ashraf. (1983). "El Rawashin" Of Jeddah Saudi Arabia.10.1016/B978-0-08-030581-3.50036-0.



Figure85: A loggia on the roof of Nassif House in Old Jeddah. Image Source: Author.



Figure86: Streetscape in Old Jeddah made of many Mashrabiyyas. Image Source: Unknown.



Figure87: Close up of a facade of Mashrabiya.

Image Source: Author.

3. Building Materials and Construction Techniques

High-quality building materials were used in Old Jeddah. Because Jeddah was a trading port for centuries, many building materials were imported and were not available locally such as Teak, Mahogany and Sisam wood. Furthermore, buildings were high because of the use of a masterful stone and timber building technique that is famous in Old Jeddah.

The building stones used in the construction of Old Jeddah's houses were usually made of excavated coral limestone, which was extracted from the shallow coral reef of the Red Sea coast. While a sticky black mud extracted from the bottom of the Arba'in Sea (Also called the sea of Mud), was the substitute for cement.

One of the distinctive technologies in those houses was their ability to be dismantled and reinstalled. The houses were built in a way that the damaged part can be removed, fixed, and replaced again because of what is called 'Al Taklilah', which is a wooden board that is one meter wide. This wooden board is placed horizontally every three or five rows of coral stone to distribute the loads for each floor and is equivalent to the beams in modern construction. Without these Taklilas, the houses would not reach high stories because the coral stone is fragile and cannot tolerate more than one floor.

The building's foundation and structure were made of coral stones cemented together with clay from the sea and wooden Taklilas, with infill facades of wooden screens and wooden floors and roofs to create airy light buildings. The walls were mostly 60-80 cm thick, and their thickness reduced on the upper floors. Gypsum was also used as plaster and for waterproofing. For doors and windows, Teak, Mahogany and Sisam wood was used. The hard timber used for the beams was transported from Africa and Indonesia, and the wood for the ornate balconies and windows was imported from India or Burma.



Figure88: An exposed wall on the right showing the coral stone and the Taklilas (Wooden Beams) every 5-6 rows of stone.

Images Source: Unknown.





Figure89: Exterior front façade of Nassif House in Old Jeddah.

Image Source: Author.



Figure90: The staircase of Nassif House. The staircase was wide and with low steps to allow the animals (horses or donkeys) to bring the groceries up to the kitchen, which was on the roof of the house for ventilation purposes. Wooden beams (Taklilas) show on the side walls as well.

Image Source: Author.



Figure91: The foyer of Ba'ishn House in Old Jeddah. The wooden ceiling was high enough to allow air circulation and aid in cooling the space. Fan and electric lights were added after renovation.

Image Source: Author.

4. Passive Ventilation System: The Mashrabiya

In Jeddah's hot and humid climate, cross-ventilation is crucial. Thus, the wooden screen louvered windows (Mashrabiya) were created. They can be described as projected bay-window with decorative wooden screens as enclosures and were built to maximize air circulation inside interior spaces. However, the Mashrabiya was more than just an opening. It was often big enough that it was used as a sitting and sleeping space where the cross ventilation was at its highest level. Mashrabiya also served as a protector from the harsh sunlight and glare, and they aided in casting shadows on the exterior façade of the building and the street. Furthermore, the desire for privacy was not neglected as Mashrabiya were designed so they allow people to see from the inside without being seen from the outside.

The name of the Mashrabiya came from the word 'Shrabha', which refers to an old clay vessel that kept water cold without electricity in hot climates through evaporative cooling. These water jars (Shrabhas) were put in cantilevered spaces with lattice screens that allowed air movement through the openings of the screen.

The word Rowshan is often used as a synonym to the Mashrabiya, but sometimes it is referred to as the complete assembly of

Rowshans on a façade. The word Rowshan comes from an Indian origin as it means the source of light or the clerestory windows. "Rushaandan" is derived from "Roshani" meaning "light" and "Dan" meaning "giver".

Mashrabiya were entirely cantilevered and built out of teak wood panels, which were restricted to 30 cm in width. The usual dimension of the single Mashrabiya was 3 meters in height, 2.3 meters in width, and 1.1-1.9 meters in depth. This allows sufficient space for sleeping and sitting for one person. Some were built with a depth of 1.9 meters to accommodate two adults. It had either wooden screens or movable wooden Venetian blinds that were used to control desired the level of privacy. Usually, the wood of Mashrabiya was left exposed, but in some cases, it was painted.

In general, the Mashrabiya was an excellent solution to achieve thermal comfort and privacy in Old Jeddah's houses and adapt to the local climatic requirements. It mainly served the following functions: controlling the light, controlling the airflow, reducing the temperature of the air current, and providing privacy.

Lately, there have been some attempts to revive the Mashrabiya as an architectural element, but without sufficient understanding of its role and function. New Mashrabiya are merely an ornamental element placed on existing buildings that have windows that are too small for sufficient ventilation. They are employed in a cosmetic way to refer to heritage and the only benefit they offer at best is shading while neglecting the benefits of the original Mashrabiya such as glare and radiation control, ventilation enhancement and privacy.

Figure92: Different types of Mashrabiya in old Jeddah.

Image Source: Bagasi, Abdullah & Calautit, John Kaiser & Karban, Abdullah. (2021). Evaluation of the Integration of the Traditional Architectural Element Mashrabiya into the Ventilation Strategy for Buildings in Hot Climates. *Energies*. 14. 530. 10.3390/en14030530..

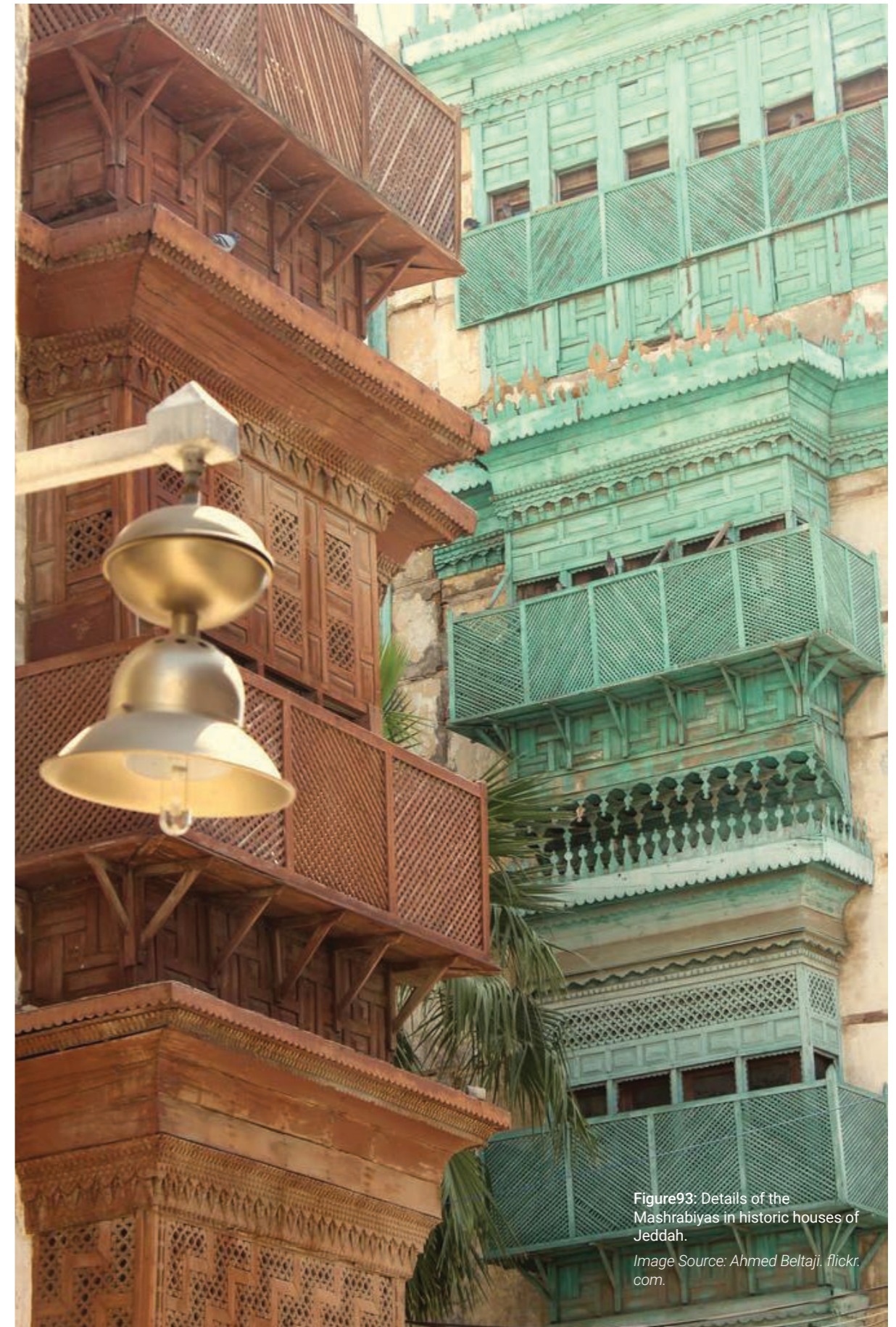


Figure93: Details of the Mashrabiya in historic houses of Jeddah.

Image Source: Ahmed Beltaji. flickr.com.

3. The Transect of Intervention (The Mesoscale)

3.1 Choosing the Transect

3.2 Analysis of the Local Urban Context

- The Transport Network
- Land use
- Vacant Lands & Taxonomy
- Foreseen Local Urban Plan

3.3 Main Weaknesses and Issues

- Fragmentation
- Indoor Public Space
- Outdoor Public Space
- The Community

3.1 Choosing the Transect

Based upon the critical issues listed in the previous sections, we found it most appropriate to focus the development on a strategic location that suffers major problems while offering a big potential. The transect of development at the mesoscale is the area around the intersection of Prince Majid Road and King Abdullah Road.

This location features a massive 183,766 m² empty roundabout (Image 94), vacant lands that are creating a fragmented urban pattern, a very poor pedestrian infrastructure where the streets are too wide (Image 95, 96) and cars are too fast making it impossible for someone to cross from one side of the road to the other without risking their life, and finally, a big deficiency in green public spaces.

Map (Fig.94) shows the location of the transect within the city scale and the features of that area: vacant lands, important nodes, foreseen projects, and the public transport network.

On the other side, the location has a great potential through the following advantages:

- One of the new governmental major investment projects in Jeddah (Heart of Jeddah) is located in this region.
- Only one foreseen housing projects (Jeddah Gardens) by the Ministry of Housing is near that area.
- A development by Emaar Middle East (Jeddah Gate) is located within the transect and is almost halfway finished. This development is creating a high-end integrated community and mixed-use amenities such as residences, offices, leisure activities, outdoor green areas, and commercial spaces. It serves as an attractive public space and a hotspot for leisure and business.
- In the intersect, two central malls are located within walking distance from each other and from the surrounding neighbourhoods (but they are not accessible by foot).
- The transect is close to Jeddah's main railway station and the ring road.
- Some lines of the foreseen Jeddah Metro passes through the transect.
- This location is the link between the north and south of the city and is close to the old town and the sea.
- Its proximity to King Abdulaziz University and its 82,152 students (which is a public university that is ranked the 1st Arab university by Times Higher Education in 2018, and it is one of the top 200 universities in the world).

In general, this area is of high importance and carries so much potential for development, yet it is problematic and neglected in terms of urban planning and proper utilization.

The transect issues are further elaborated in section 3.3 of this chapter. The issues map (Fig. 113) shows the issues and their locations.



Figure94: Aerial view of King Abdulaziz Roundabout surrounded by two shopping malls and many vacant lands.

Source: Mohamed Sabiq Thottungal, Google.com/maps



Figure95: Pedestrians crossing the highway to reach the mosque on the other side without any pedestrian safety considerations.

Source: Author



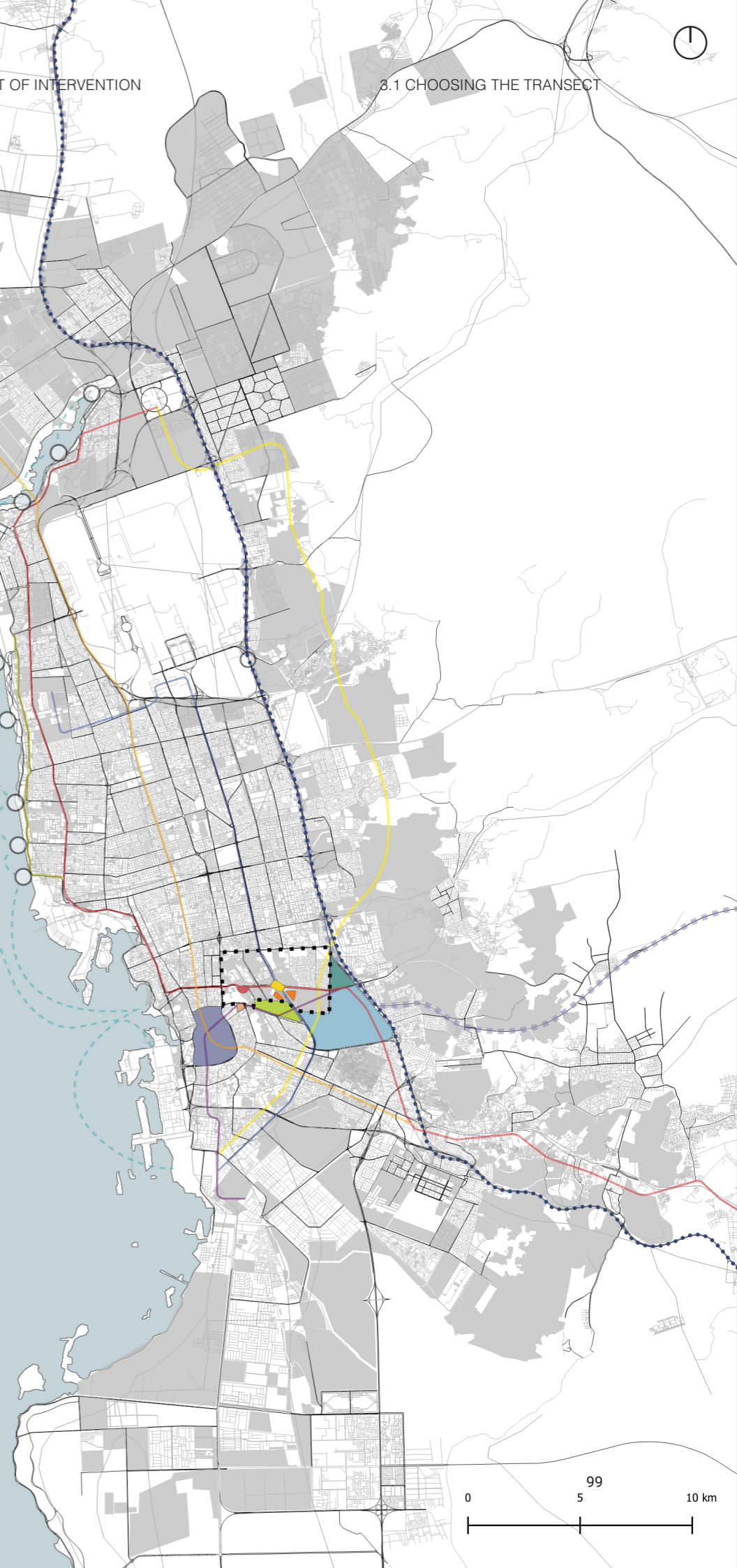
Figure96: The proximity of the high-speed road to the public space without a buffer zone is a source of noise and danger.

Source: Author

- Legend
- Corniche Tram
 - - - Marine Buses
 - - - Existing Al Haramain High-speed Train
 - The Commuter Rail
 - Metro Lines
 - The Ring Road
 - Border of the Intervention Transect
 - King Abdulaziz University
 - The Main Railway Station
 - Heart of Jeddah Project
 - Shopping Malls
 - King Abdulaziz Roundabout
 - Government Housing Project (Jeddah Gardens)
 - The Old Town
 - Jeddah Gate
 - Vacant Lands

Figure97: The border of the transect and the features of the area: vacant lands, important nodes, foreseen projects, and the public transport network.

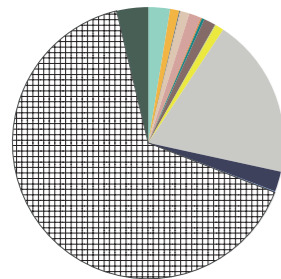
Source: Author



3.2 Analysis of the Local Urban Context

Figure98: Map and percentage of the land use within the transect.

Source: Our elaboration from Google Earth and GIS data.



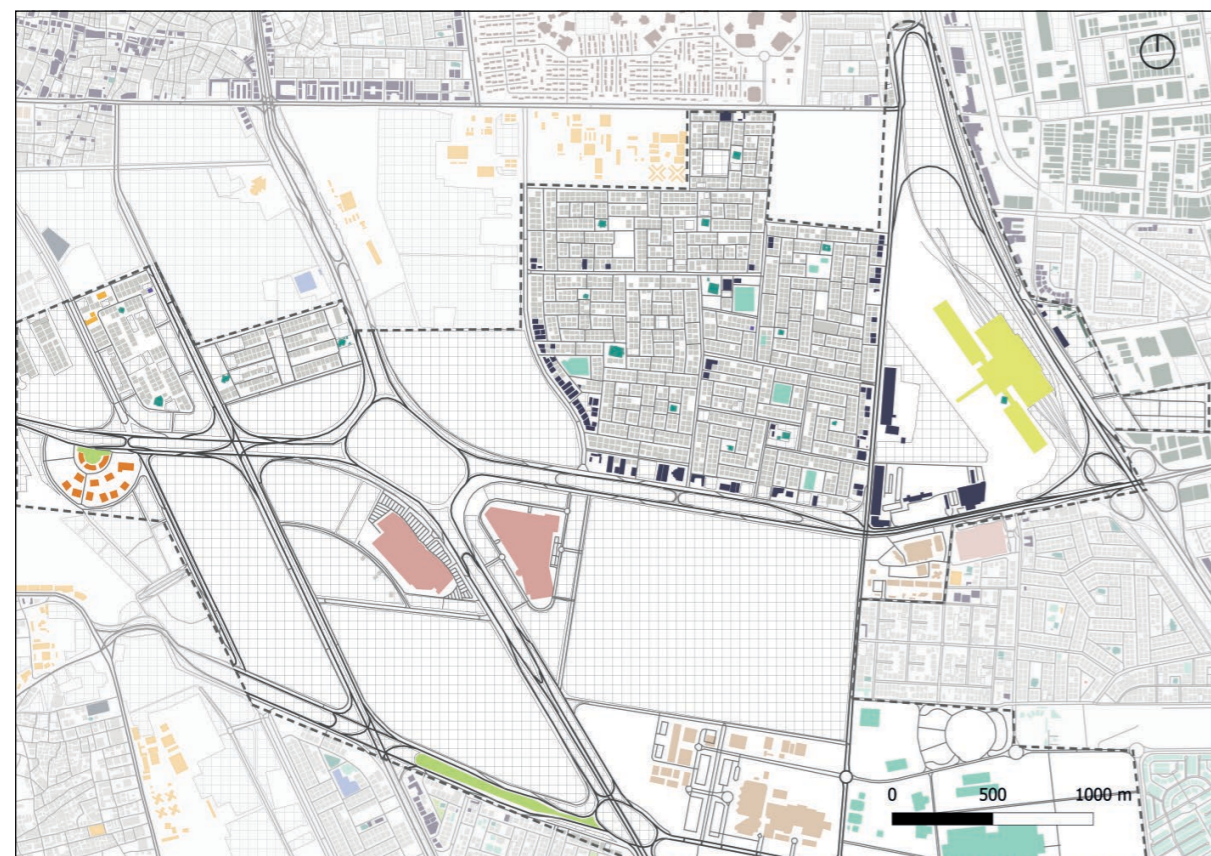
1. Land Use

The existing situation of the transect introduces a monofunctional land use, whereas almost every function is clustered in a zone and separated from other functions by wide streets.

The following land use percentages have been identified: The biggest percentage was for vacant lands, which took about 65.33% of the total land use of the transect. 19.1% are residential areas, 3.75% are warehouses, 2.58% are educational facilities, 2.40% are commercial and retail facilities, 1.44% are enclosed shopping malls, 1.42% are private compounds, 1.11% are healthcare facilities, 1.09% are governmental buildings, 1.02% is for public transport (the train station), 0.31% are mosques, 0.14% are mixed-use, 0.12% are sports facilities, 0.11% are graveyards, and finally, the lowest percentage is 0.09% and it is for open public spaces (e.g. parks).

Land Use Percentage

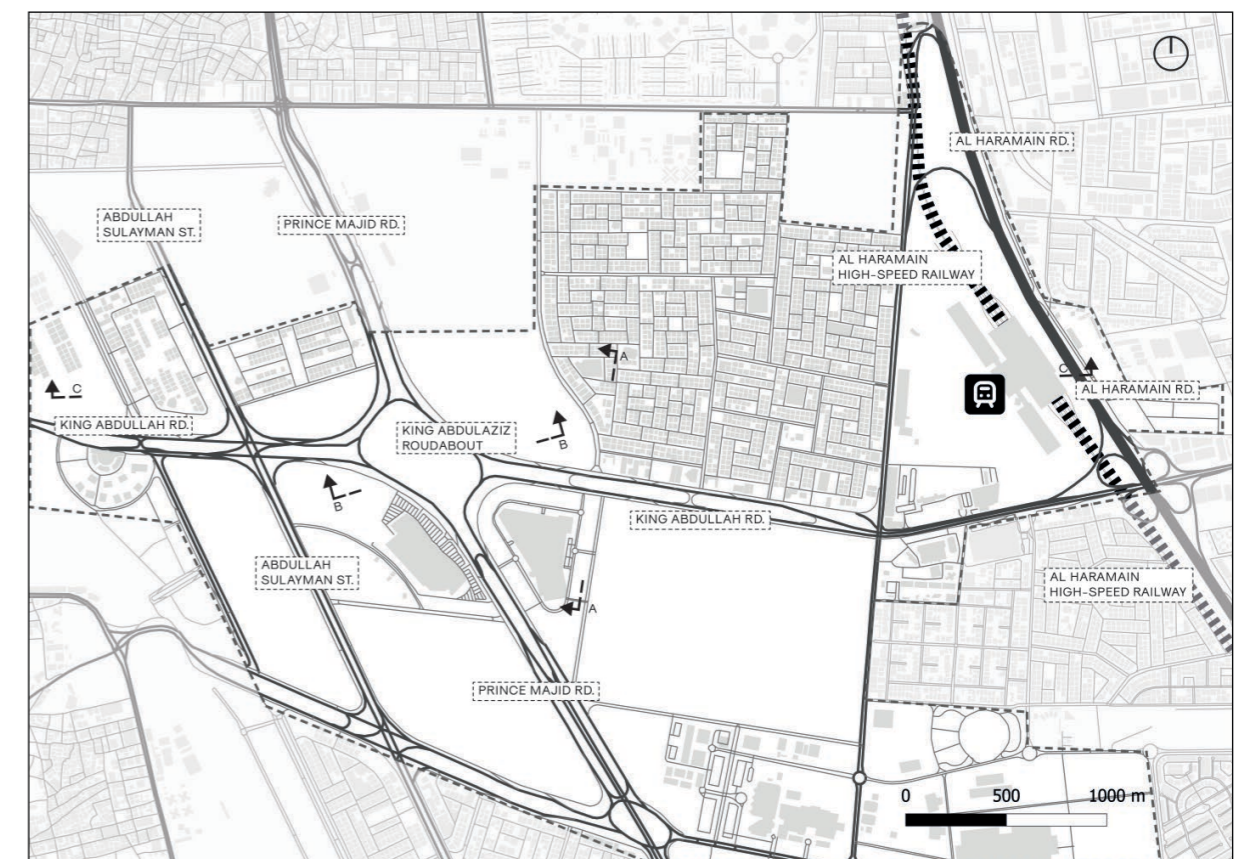
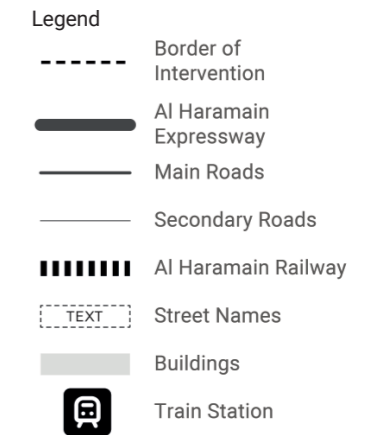
65.33% Vacant Lands	1.09% Government	1.44% Shopping Malls	1.42% Private Compound	19.10% Residential
3.75% Warehouses	0.11% Graveyard	0.14% Mixed Use	0.09% Public Space	2.40% Retail
2.58% Education	1.11% Healthcare	0.31% Mosques	1.02% Public Transport	0.12% Sport



2. The Transport Network

The study area is strongly marked by the presence of important infrastructures which represent elements of strong discontinuity and create vacant spaces. The main transportation network within the transect consists of standardized wide asphalt streets with pavements, islands, intersections, and roundabouts.

The main road in this transect is the Haramain Road (also known as the ring road). This road connects the North and South of the city and continues to Makkah. Then the King Abdullah Road connects the East of the city with the West. Prince Majid Road connects King Abdulaziz University directly with the airport in the North of the city. Abdullah Al Sulaiman Road is a direct connection between the transect and Al Haramain Road with retail shops on both sides, and it also leads to King Abdulaziz University. At the intersection of King Abdullah Road and Prince Majid Road, there is the King Abdulaziz roundabout.



The main roads are 15+ meters wide in each direction excluding the islands, while secondary roads are between 8 and 10 meters wide. The gridiron network of streets and land subdivisions does not provide access to the train station except by car. The same applies to the hospitals, the malls and all other services and amenities. Furthermore, the existing bus network does not have any stops within the transect and none of the streets (neither main nor secondary) has a sidewalk or pedestrian crossing locations or signs.

Sections of different main roads and streets are in the following pages to further understand the details of the roads network.

Figure99: Map of the main transport network within the transect. Source: Our elaboration from Google Earth data.

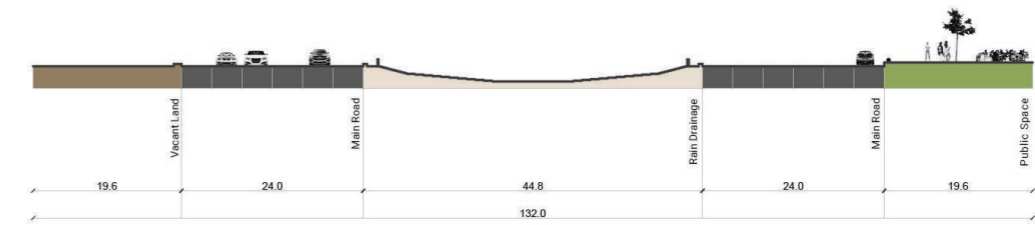
Street Sections

Street sections explain the differences in the main roads network such as the roads width, vegetation, surroundings, and buffer zones if there are any. The sections are:

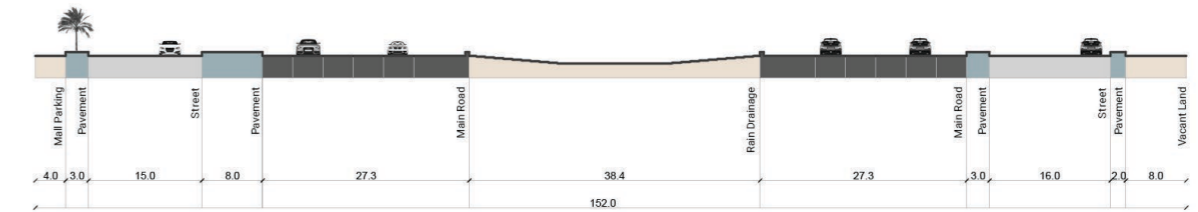
- **Section A-A:** This section is in King Abdullah road on the western side of King Abdulaziz roundabout. It shows the main road infrastructure between the two sides.
- **Section B-B:** This section is in Prince Majid road on the southern side of King Abdulaziz roundabout. It shows the main road infrastructure between the two malls.
- **Section C-C:** This section is in Prince Majid road on the northern side of King Abdulaziz roundabout. It shows the main road infrastructure between a neighbourhood and a vacant land.
- **Section D-D:** This section is in King Abdullah road on the eastern side of King Abdulaziz roundabout. It shows the main road infrastructure between a neighbourhood and a vacant land and the bridge connecting the road with Al Haramain Expressway.
- **Section E-E:** This section is in Abi Dhar Al Ghifari Street showing the connection of the neighbourhood and the vacant land at the backside of the railway station.
- **Section F-F:** This section is in Al Haramain Expressway, which is the main highway in the city. It shows the highway infrastructure and the connection of the railway station with the opposite side.

Figure100: Key map of the road infrastructure sections.

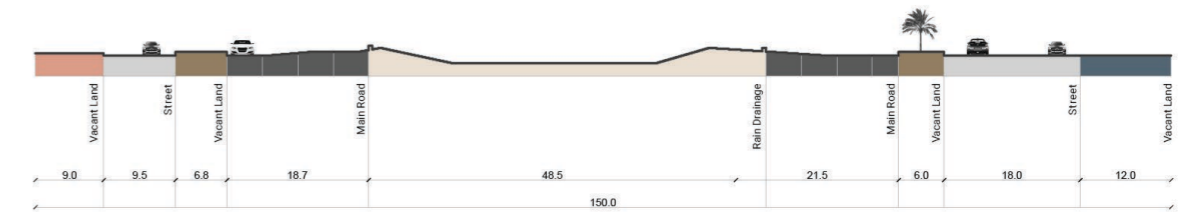
Source: Author.



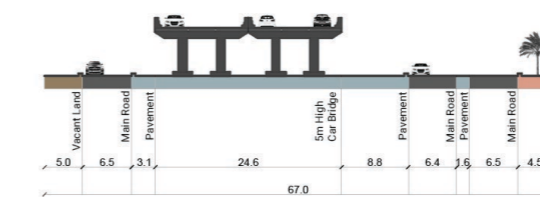
Street Section A-A Scale 1:1000



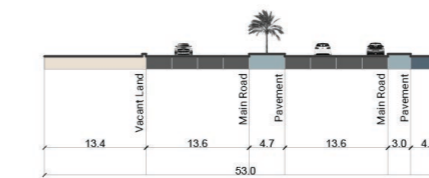
Street Section B-B Scale 1:1000



Street Section C-C Scale 1:1000



Street Section D-D Scale 1:1000



Street Section E-E Scale 1:1000



Street Section F-F Scale 1:1000

Legend

- White Lands
- Suspended Land
- Underused Land
- Infrastructure- Wasteland
- Medium Speed Street
- High Speed Main Road
- Pavement
- Public Space
- Warehouse

3. Vacant Lands & Taxonomy

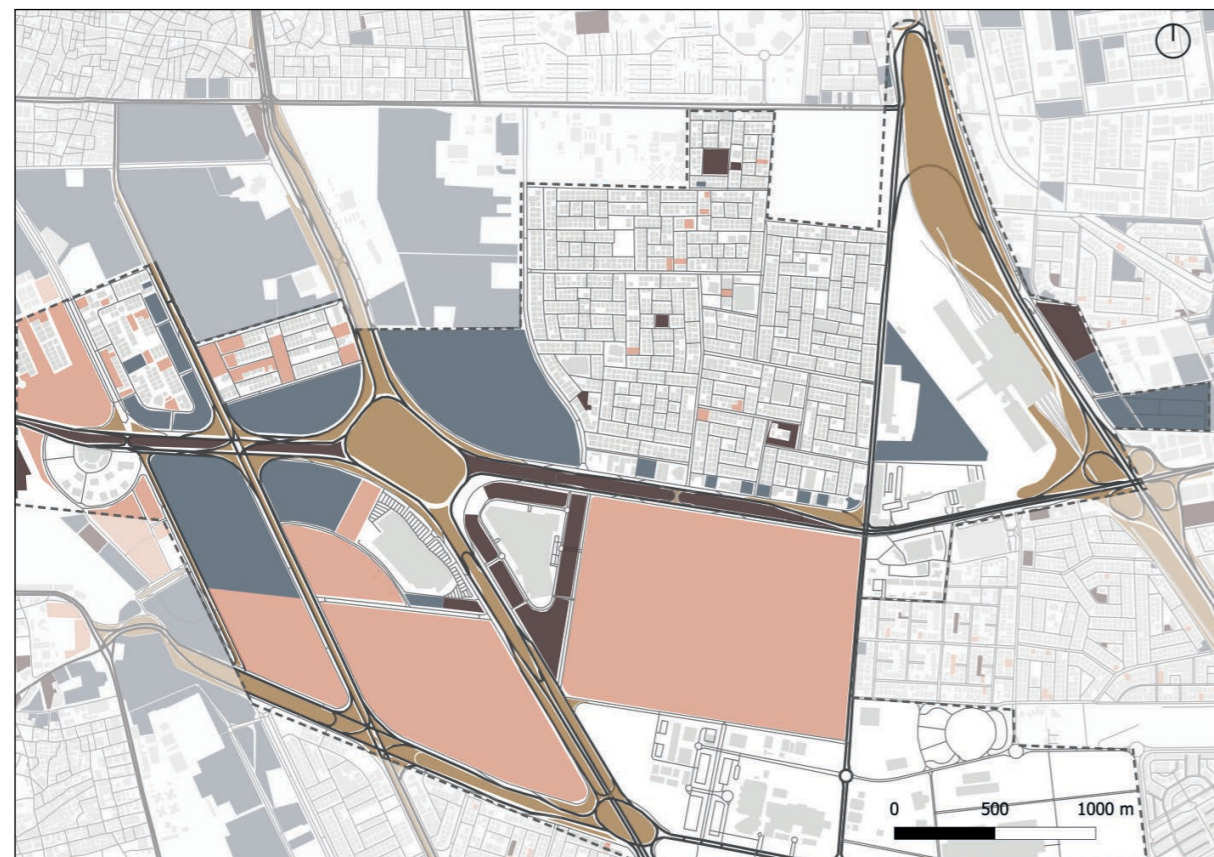
More than half of the lands in the transect are vacant and based on the taxonomy proposed in chapter 2.2, section 2.2.1: Urban Structure, Land-use System: Vacant Lands, they are from the following categories: *white lands*, *suspended lands*, *infrastructure wasteland*, and *underused lands*. These lands are the opportunity for development and the main tool used in this project.

- **White lands**, which are idle undeveloped plots designated for residential or commercial use, offer the opportunity to be developed into mixed-use neighbourhoods, public spaces, and parks.
- **Suspended lands**, which are vacant lands planned for development, however, they are still vacant exasperating the dust pollution and travel distances. They can host temporary developments such as sports fields, playgrounds, festivals and events pavilions, but most importantly, they offer the opportunity to increase the vegetation cover to help in stabilizing the soil and form windbreaks to mitigate the effect of sand and dust storms.
- **Infrastructure wasteland**, which is noise and dust polluted vacant lands around the road network, can host other means of mobility in safe locations, or can be used as urban carbon sinks using xeriscaping, natural sand barriers, green noise barriers, and green pavements.
- **Underused lands**, which are in central or strategic locations, but were never fully developed or utilized to their full potential such as large parking lots or warehouses facing the train station or lands intended for rainwater collection, yet remain vacant most of the time. They can be further utilized to accommodate mixed-use facilities, public spaces, green parking, and carbon sinks.

Figure101: Map of vacant lands within the transect.

Source: Our elaboration from Google Earth data.

- Legend
- White Lands
 - Suspended Land
 - Underused Land
 - Infrastructure- Wasteland



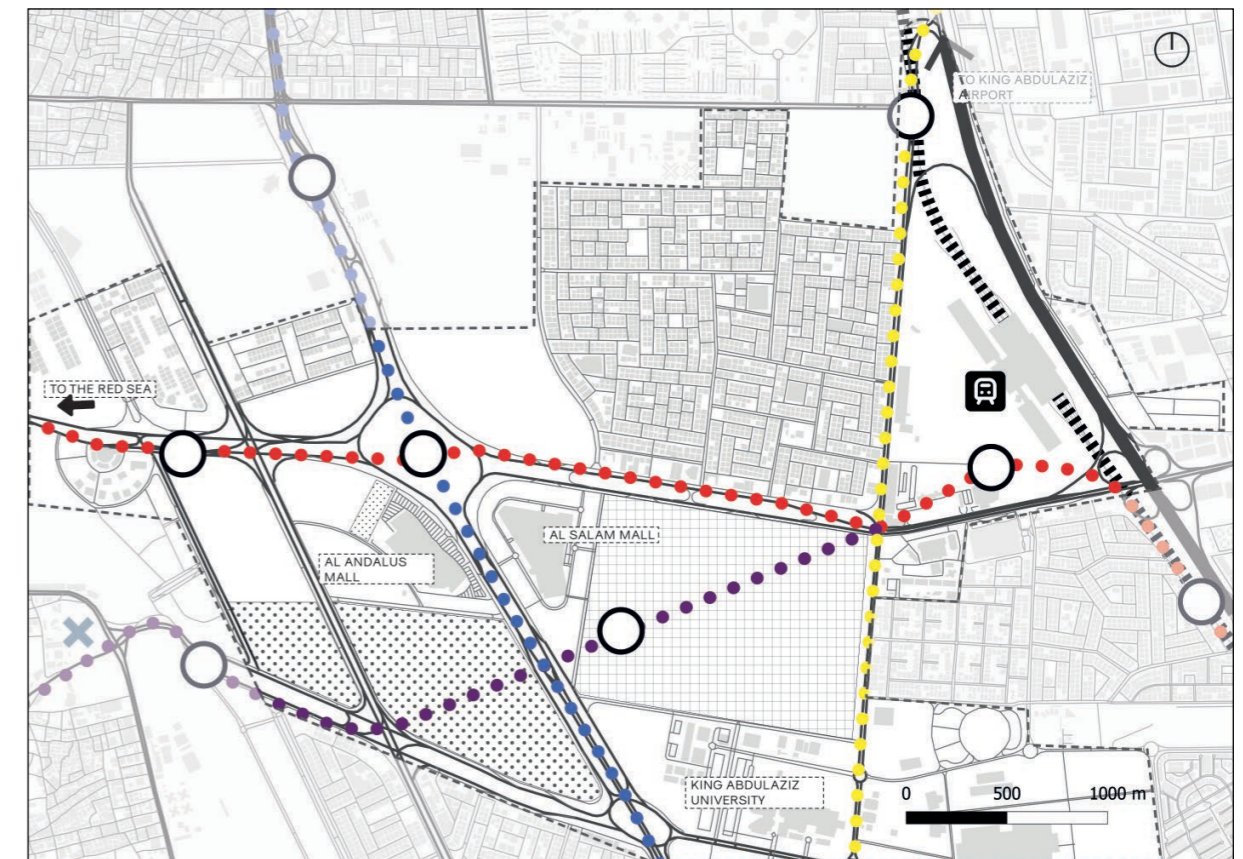
4. Foreseen Developments

It is expected that the foreseen Jeddah Metro project will pass through the transect, as well as a mixed-use development with a built-up area of 1,720,000 m² called the “Heart of Jeddah”, in addition to one of the Ministry of Housing’s residential projects called “Jeddah Gardens”.

It is unclear, however, if these future developments will include active mobility, provide pedestrian movement, or reduce the need for the car. It is also unclear how they will enhance the quality of life and connection within the existing fragmented monofunctional urban plan as a whole.

Figure102: Map of the foreseen developments within the transect.

Source: Our elaboration from housing.gov.sa and metrojeddah.com.sa.



- Legend
- Al Haramain Expressway
 - Al Haramain Railway
 - Metro Red Line
 - Metro Yellow Line
 - Metro Blue Line
 - Metro Purple Line
 - Important Nodes
 - Buildings
 - Heart of Jeddah
 - Suspended Land Subdivisions
 - New Hospital
 - MOH Project
 - Train Station
 - Metro Stops

None of these projects’ finish date is confirmed, neither are the exact routes of the public transport network. Both the Jeddah Metro and the Heart of Jeddah projects are on hold, while Jeddah Gardens is under construction.

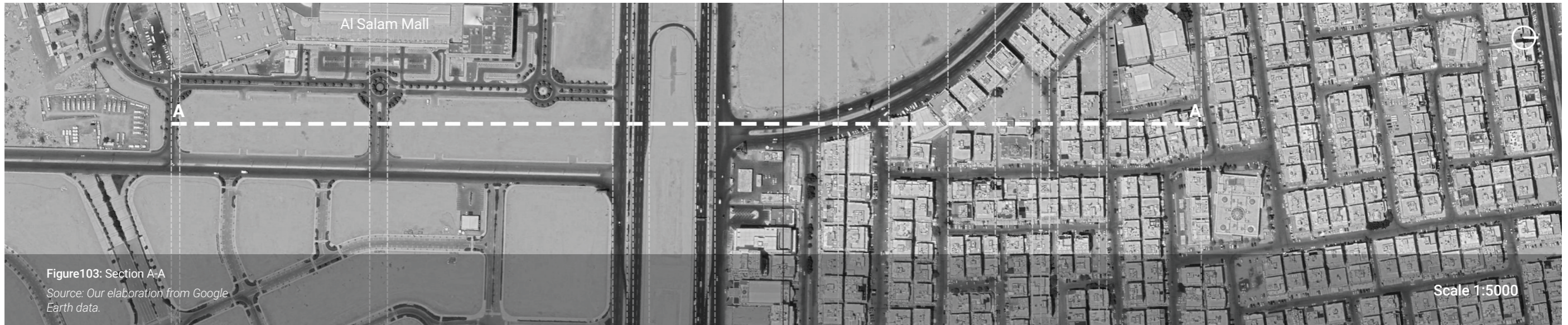
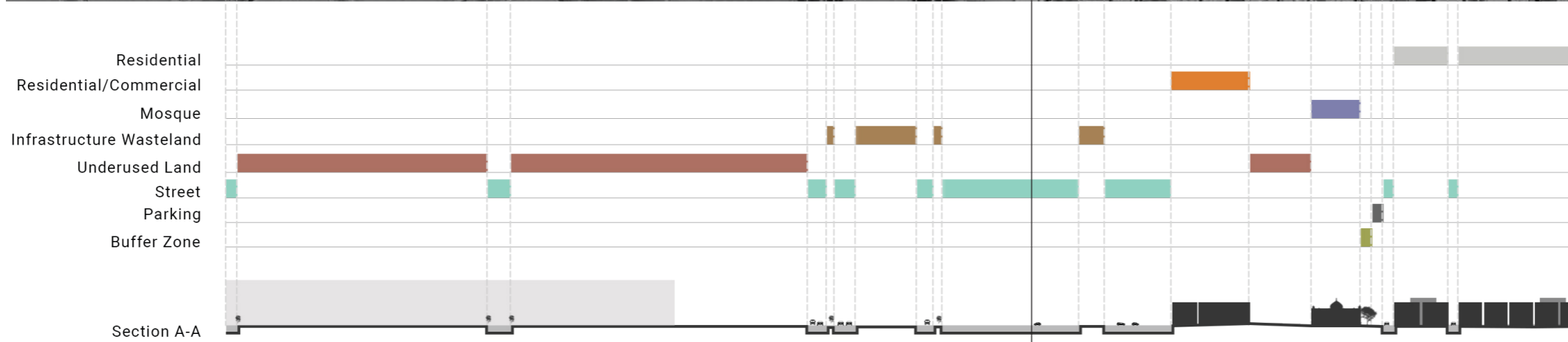


Figure103: Section A-A
Source: Our elaboration from Google Earth data.



5. Sections
a. Section A-A
Mall to Neighbourhood

This section shows the mall to the neighbourhood relationship, the land use, the current monofunctional zoning and the separation between different zones (the residential area, the commercial area, the shopping mall), and the presence of large underused vacant lands. In addition, the section shows the lack of appropriate green outdoor space within walking distance from the residential area.



Figure104: SectionA-Akeyplan.
Source: Author

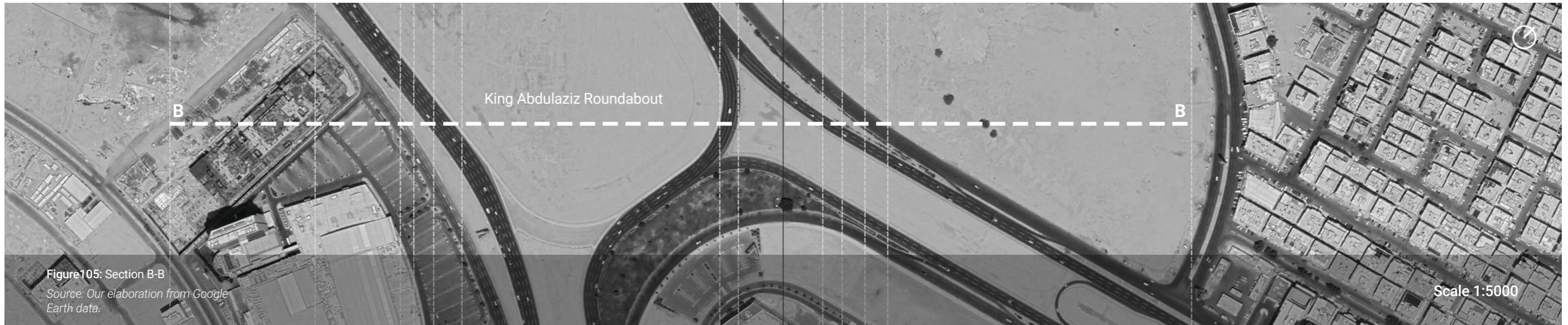
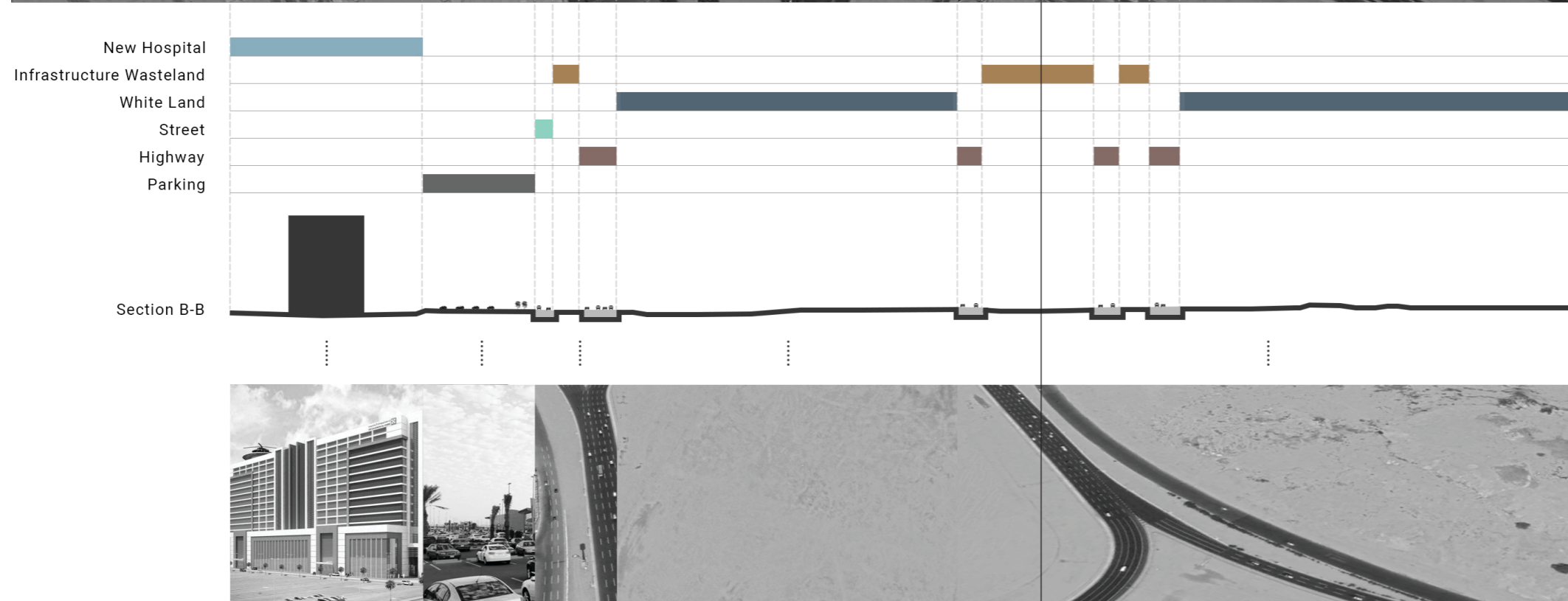


Figure105: Section B-B
Source: Our elaboration from Google Earth data.



**b. Section B-B
Roundabout and Roads Network**

King Abdulaziz Roundabout is a 183,766 m² vacant land surrounded by a highway and other vacant lands. Section B-B shows how vacant lands and the roads infrastructure create a fragmented urban pattern and disallow any means for pedestrian movement. The section also shows the disconnection of the hotel relationship from other amenities and services, and the only green space there is, which is an island of grass, that is surrounded by high-speed roads.



Figure106: SectionB-Bkeyplan.
Source: Author.

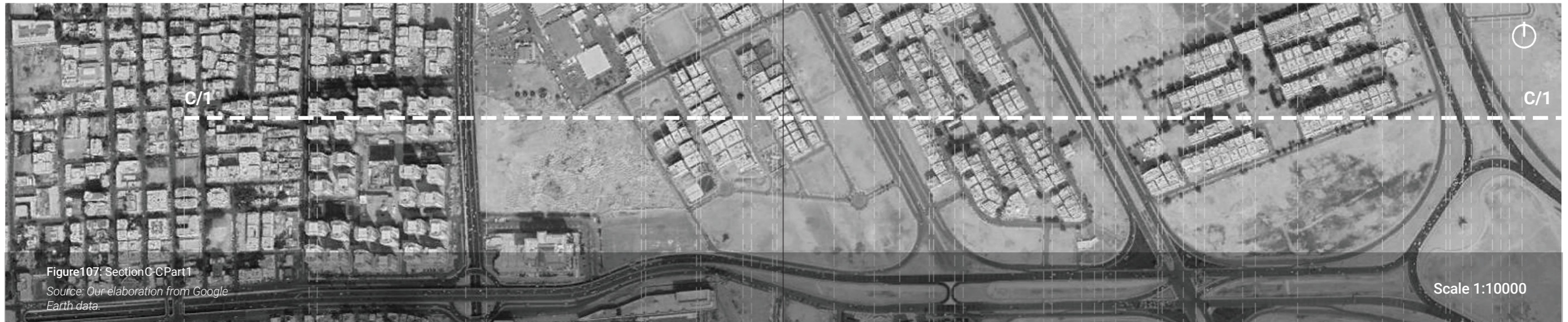
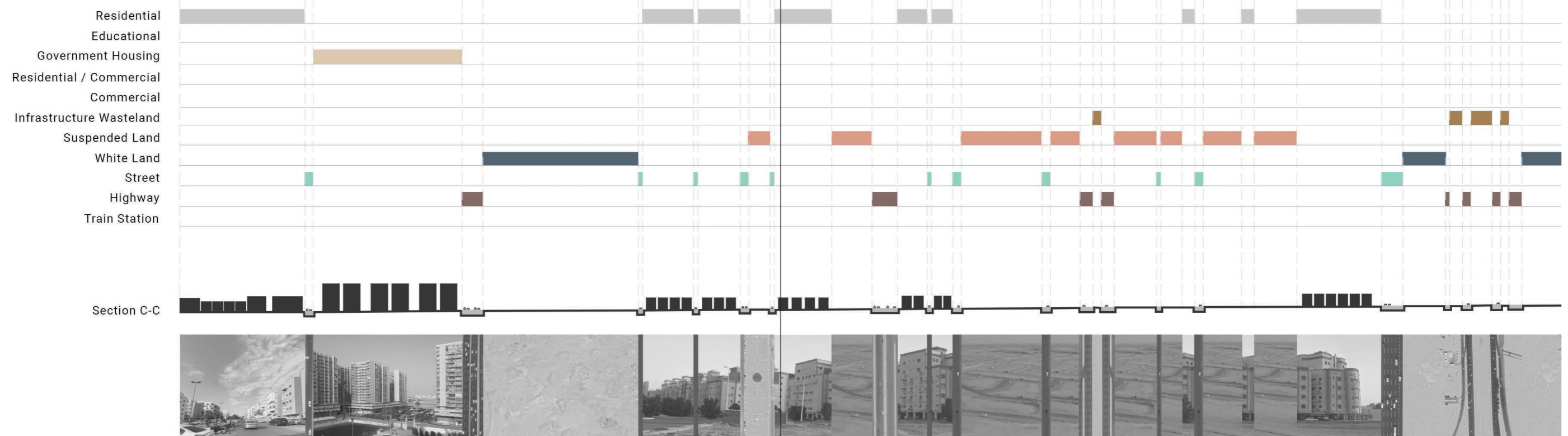


Figure107: Section C-C Part 1
Source: Our elaboration from Google Earth data.

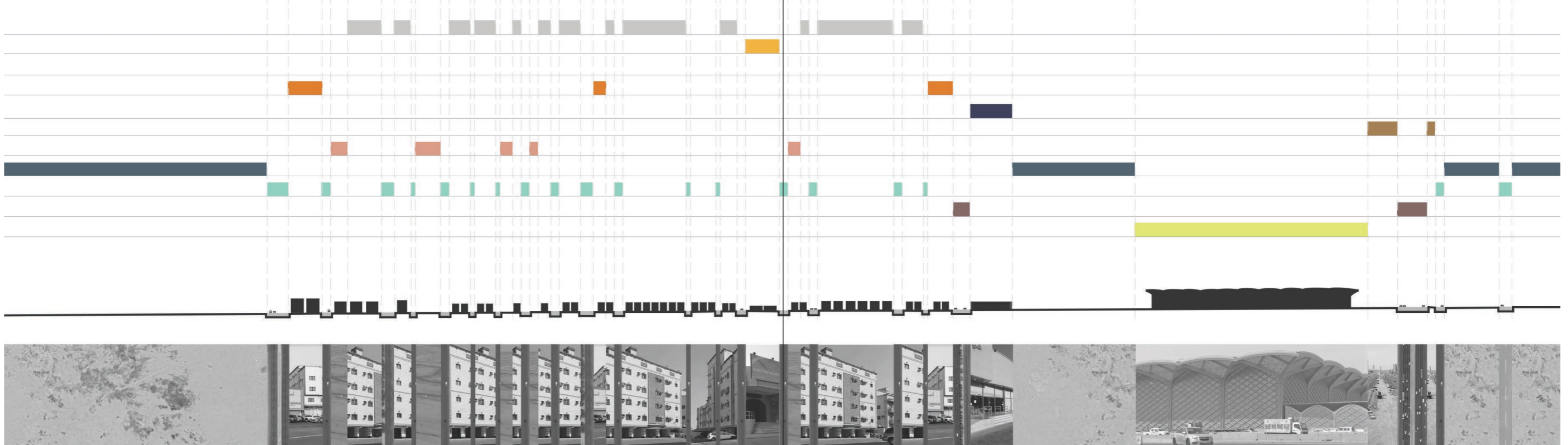


**c. Section C-C
Transect Impermeability**

Section C-C demonstrates the land use and functions along the transect to show the impermeability generated by the urban plan and roads network. Fragmentation with roads and vacant lands is very clear, and there is an obvious lack of green public space and a well-distributed public transport network.



Figure108: Section C-C key plan.
Source: Author.



Legend

- | | | | |
|--------------------------|--------------------------|----------------|---------------|
| Residential | Government Housing | Suspended Land | Highway |
| Educational | Commercial | White Land | Train Station |
| Residential & Commercial | Infrastructure Wasteland | Street | |



Figure110: Section C-C key plan.
Source: Author.

3.3 Main Weaknesses and Issues

1. Monofunctional Land Use

The transect is characterized by monofunctional land use. Single uses are assigned for each location such as a residential zone, warehouses zone, train station zone, university zone, and shopping malls zone. Each zone is separated from the others by high-speed roads.

2. Fragmentation

There are not enough residential and mixed-use areas within a 400 or 800 meters radius (a five to ten-minutes walk) around central services such as the train station, the hospitals, shopping malls, and public spaces. In addition, these important nodes are only reachable by the car.

3. Weak Coordination Between Accessibility and Land Uses

The transect features land uses that do not meet the value of their locations. For example, wasting high-value lands within an 800 meters radius from the train station on functions such as warehouses or vacant lands or keeping huge lands vacant with the sole function of draining rainwater into the ground (without even collecting it).

4. Vacant Lands

Numerous large vacant lands in this transect increase travel distances, aggravate pollution with sandstorms and increase fragmentation and travel time within the transect.

5. Car Dependency and The Road Network

Despite the efficiency of the street network, the existing urban plan of the transect focuses on vehicle movement at the expense of the quality of life. The fragmented and monofunctional zones are separated by high-speed wide roads that distance them from each other. These roads, without proper pedestrian crossings, are barriers dividing the urban fabric causing noise, danger, and exasperate the fragmentation of the transect (Fig 111).

6. Insufficient Public Spaces

a. Indoor Public Space

A study (Mandeli, 2019) showed that the majority of people in Jeddah prefer indoor recreational facilities, which are privately owned but are intended for public use, such as shopping malls, clubs, and theme parks equipped with restaurants and cafés. This can be due to the lack of climate-responsive outdoor public spaces, which discourages the public from outdoor areas. Malls for example are massive commercial and entertainment complexes, but they are disconnected from neighbouring residences. They are also treated like private properties where gates are closed at night and their developers have absolute control over them. Some other recreational facilities such as theme parks require entrance fees, which excludes many poor people and exasperates social segregation.

b. Outdoor Public Space

The study (Mandeli, 2019) emphasized the lack of appropriate outdoor public spaces and pedestrian networks that respects the climate of the region. Existing parks in neighbourhoods are more like squares isolated from surrounding buildings rather than public spaces, or linear walkways surrounded by speeding cars from all sides. Characterized by rigid edges, low-quality finishes, poor visual character, lack of shade, public amenities, and appropriate furniture, they are often viewed as unpleasant recreational spaces lacking essential public spaces criteria such as comfort, accessibility, environmental protection, and security (Fig. 112). On the other hand, using streets as a recreational space is dangerous and often leads to accidents.

7. Lack of Safe and Livable Routes for Active Mobility, Shared Mobility, and Public Transport

Currently, a total car-dependent design did not provide solutions to ensure safe pedestrian and/or cycle paths. There are also no public transport stops. The only public transport node there is the train station (which is still under construction).

8. Lifeless Residential Areas and Weak Public Cooperation and Community Interaction

The previously mentioned issues result in the lack of a sense of community and collective responsibility as the streets discourage walking, and the low-density single-function fragmented residential areas full of high fences create lifeless residential areas and discourage public cooperation and community interaction. This results in the lack of natural surveillance which encourages strangers, anti-social behaviour, improper waste disposal, and vandalism, all of which reduces social interaction and increases the stress on the responsible authorities such as the police.

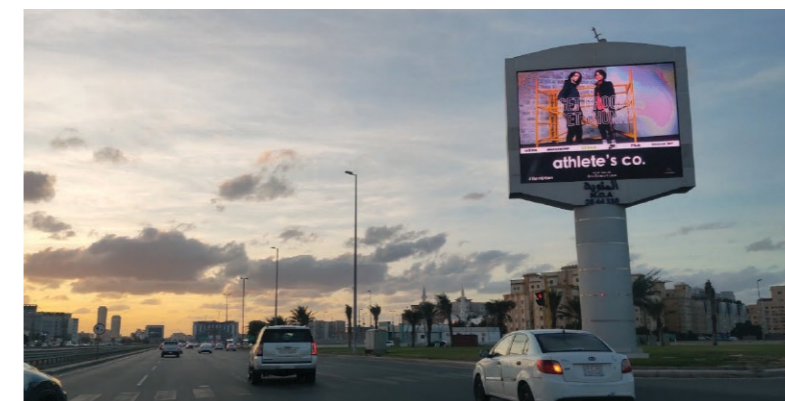


Figure 111: Wide road separating residential areas and other facilities.

Source: Abdullah Alnahdi



Figure 112: A neighbourhood park in the transect.

Source: Bilal Younas. Google.com/maps.

9. Issues Map

This map shows the main issues and weaknesses listed in the previous pages. The barriers formed by the roads network, vacant lands, fragmentation, monofunctional zoning, and the lack of public space.

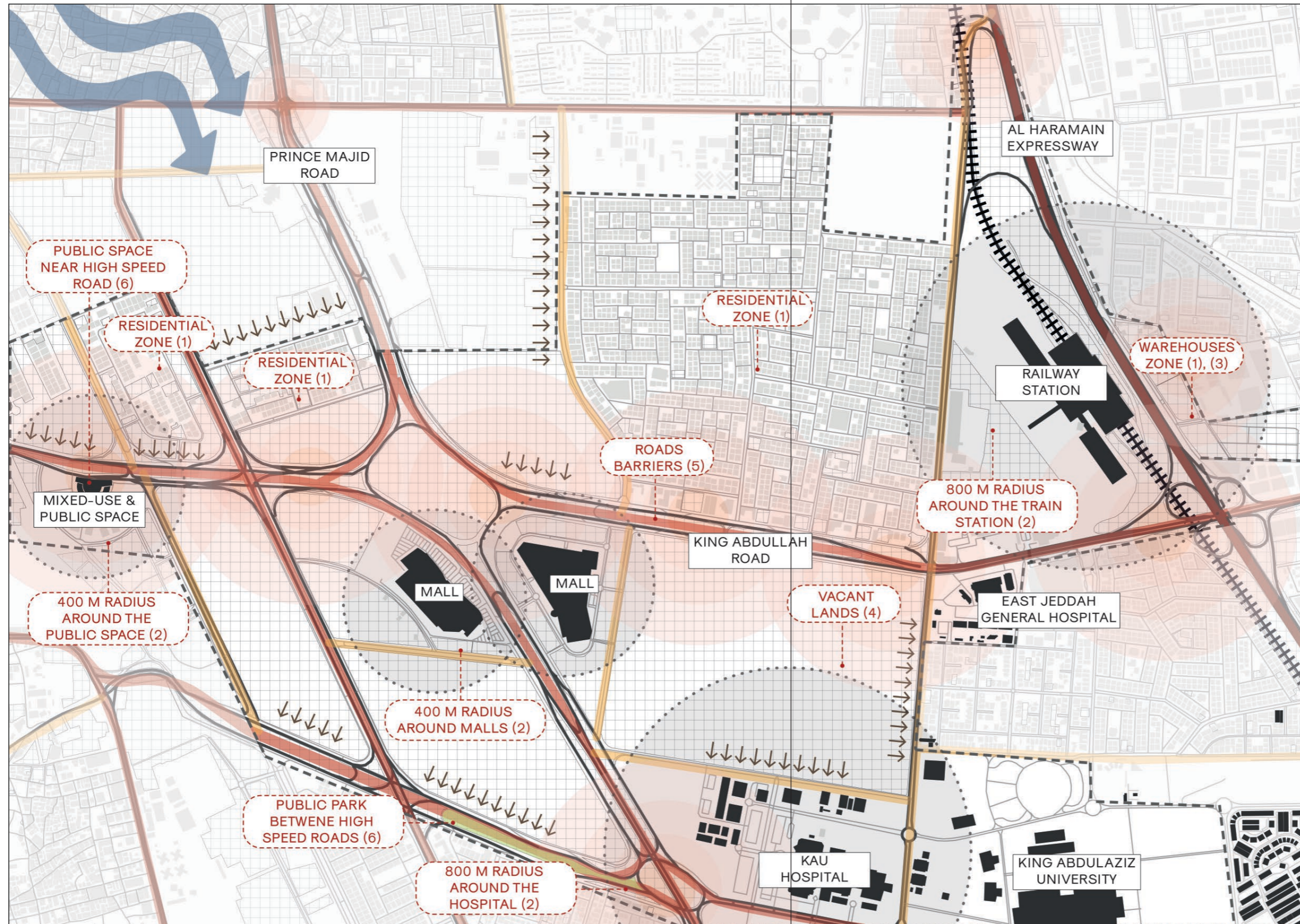


Figure113: The map showing of the issues addressed in previous sections within the transect.

Source: Author

Legend

a. Issues

- TEXT (1) Issue + the issue number in the previous page
- High speed road barrier (80-120 km/h)
- Medium speed road barrier (50-80 km/h)
- Dust pollution from vacant lands
- Distance radius around important nodes
- Noise pollution from high speed roads
- Vacant Lands

B. Information

- Important nodes
- Border of Intervention
- ~ Prevailing wind direction

4. The Strategy

4.1 The Mesoscale Strategy

4.2 The Roads Infrastructure Strategy

- 4.2.1 Connections
- 4.2.2 Roads
- 4.2.3 Public Transport and Shared Mobility

4.3 The Land Use Strategy

- 4.3.1 Vacant Land Development
- 4.3.2 Environmental Considerations

4.4 Case Studies and References

- 4.4.1 The 15-Minute City
- 4.4.2 The Superblock

4.5 The Combined Strategy

4.1 The Mesoscale Strategy

4.1.1 The Strategy's Objective

The main objective of the mesoscale transect strategy is improving the accessibility to the main attractors and generators to enhance the livability of these places and support sustainable transport modes. Based on this, and considering the relevant role of the railway station in this transect, we identify a hierarchy of attractors according to their importance and the necessity of access, and then give each type of attractor a distinctive solution that responds to its priority and primacy within the transect.

To achieve the goal of the transect, we primarily consider the analysis and findings from the previous sections that are directed towards the main goal of the project, which is: **“To utilize vacant lands in central Jeddah for a sustainable multi-scale urban and development that reduces urban sprawl, through selective and in-filling densifications that also improve the land-use mix, minimize car dependency, and act as an exemplary model for more sustainable human-based developments in Jeddah and around the country.”**

This is achieved through the three approaches as follows:

1. Creating a hierarchy among the main generators and attractors located in the transect, to determine which functions have the highest priority to be accessible by public and shared accessibility (collective transport mode, bus rapid transit, shared mobility options, active mobility,...etc.).
2. Then, and based on the large scale analysis and studies of the site's infrastructure, environment, land use, vacant lands, means of transport, foreseen projects, and the hierarchy of importance, we propose suitable solutions to the main issues (listed in section 3.3) in the form of changes in the infrastructure and the roads network to diversify the means of transport in addition to assigning different land uses to vacant lands.
3. Finally, proposing a new transit-oriented (TOD) mixed-use development in a selected vacant land that will better utilize the location which has the highest priority based on the hierarchy of the importance of reachability mentioned in the first approach.

4.1.2 Generators and Attractors' Hierarchy

The two most important nodes of the transect are the generators (the residential neighbourhoods characterized by different population densities), and the attractors (e.g. the hospital, the malls, the public spaces, the library, and the university).

Not all attractors are equal in importance and priority. Some attractors need high and flexible reachability by all members of the society and by all means of transport. Other attractors are not as important and are less urgent. Based on the importance of attractors, we create a hierarchy of the main attractors to determine which are the most suitable means of reachability for each type.

The railway station, on the other hand, represents an important supply to manage the flows generated and attracted by the functions located in the transect. Al Haramain railway station, once completed, will be the main supplier of steady flows of people, connecting people who live in the suburbs with the city centre as well connecting different cities. However, it should not be just a place for transit, but an important urban centre in the city with a mix of retail, businesses, leisure, and entertainment. In addition, it is the entrance and the face of Jeddah.

The Generators

In the transect, the main generators are the residential neighbourhoods, which are characterized by different population densities. They are now separated from one another and from other services, but they must have easy access to the railway station and other amenities within the transect to improve their liveability and residents' access to the main urban opportunities and attractors.

The Attractors

A. High Priority

- The Hospitals
- King Abdulaziz University

Educational and health facilities must have diverse and flexible reachability by all members of society and by as most means of transport such as the private car, the taxi, the bus, the metro, the shared mobiles. Other means of transport like bikes and pedestrians can be encouraged as well, but considering the local climate, the age, and the possible health status of the users, other options must be available at all times and have a higher priority.

B. Medium Priority

- Public Spaces and Parks
- Public Libraries
- Shopping Malls

These facilities are outside neighbourhoods and of supralocal interest, thus, they should have direct and easy access by automobiles due to the far distance between them and the residential areas and other services, but other means of transport can be encouraged such as shared mobility, the metro, buses, bikes and active mobility.

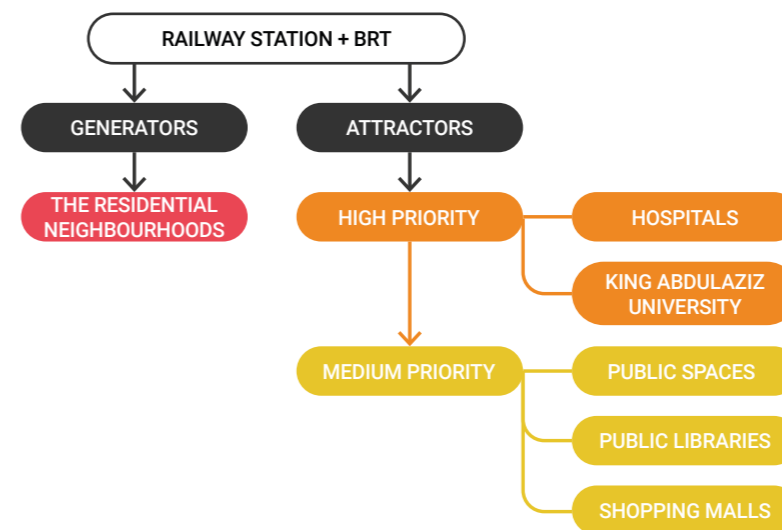


Figure114: Generators and Attractors diagram.
Source: Author.

4.2 The Roads Infrastructure Strategy

To improve the accessibility and mobility of the transect, we focus on connection of the railway station with the other main attractors and generators of the area based on the hierarchy made before.

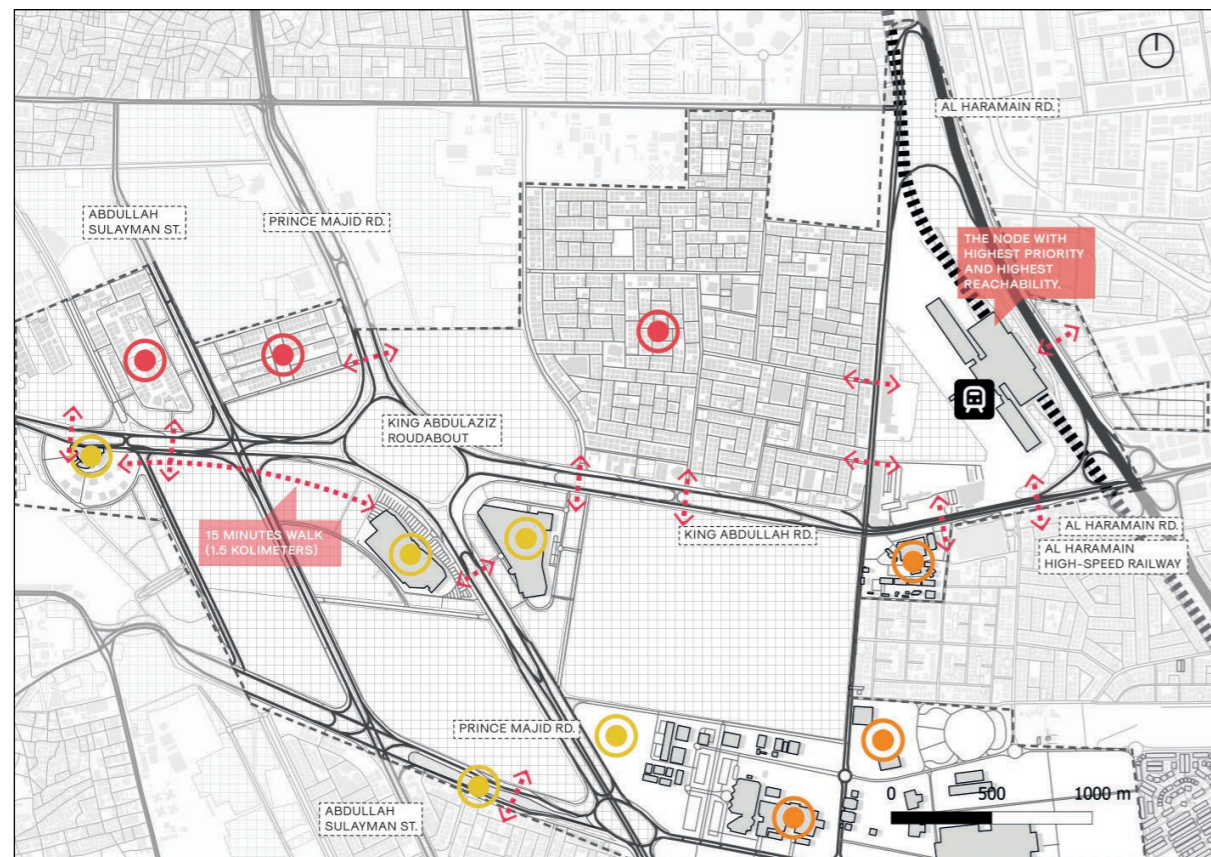
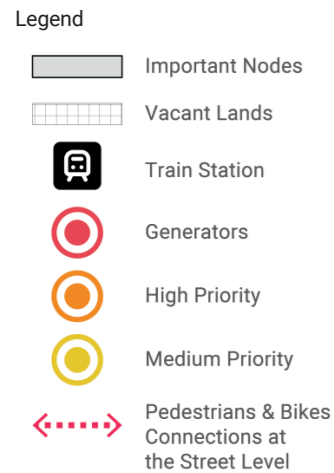
The following strategies would be therefore indicated:

4.2.1 The Connections Strategy

The road infrastructure, without proper pedestrian crossings, forms a barrier that separates different zones and functions with a speed limit that reaches 90 kilometres per hour between monofunctional residential zones, hospitals, and public spaces, the barrier divides the urban fabric causing noise, danger, and exasperate the fragmentation of the transect. The connections strategy focuses on breaking the barrier of these wide, high-speed roads. It proposed areas where the roads can be broken, and pedestrian access can be allowed safely. This means that the car speed must be reduced in the entire roads network. The proposed connections link one side with the other, such as residential zones with each other and/or with other facilities. They also connect the railway station area with its surroundings like the hospital and connect malls with residential areas. Furthermore, a pedestrians and bikes path was proposed away from the main road to directly connect the mixed-use development (Emaar) and its surrounding foreseen projects with the Andalus Mall and the central connection node.

Figure115: Theconnectionsstrategy.

Source: Author.

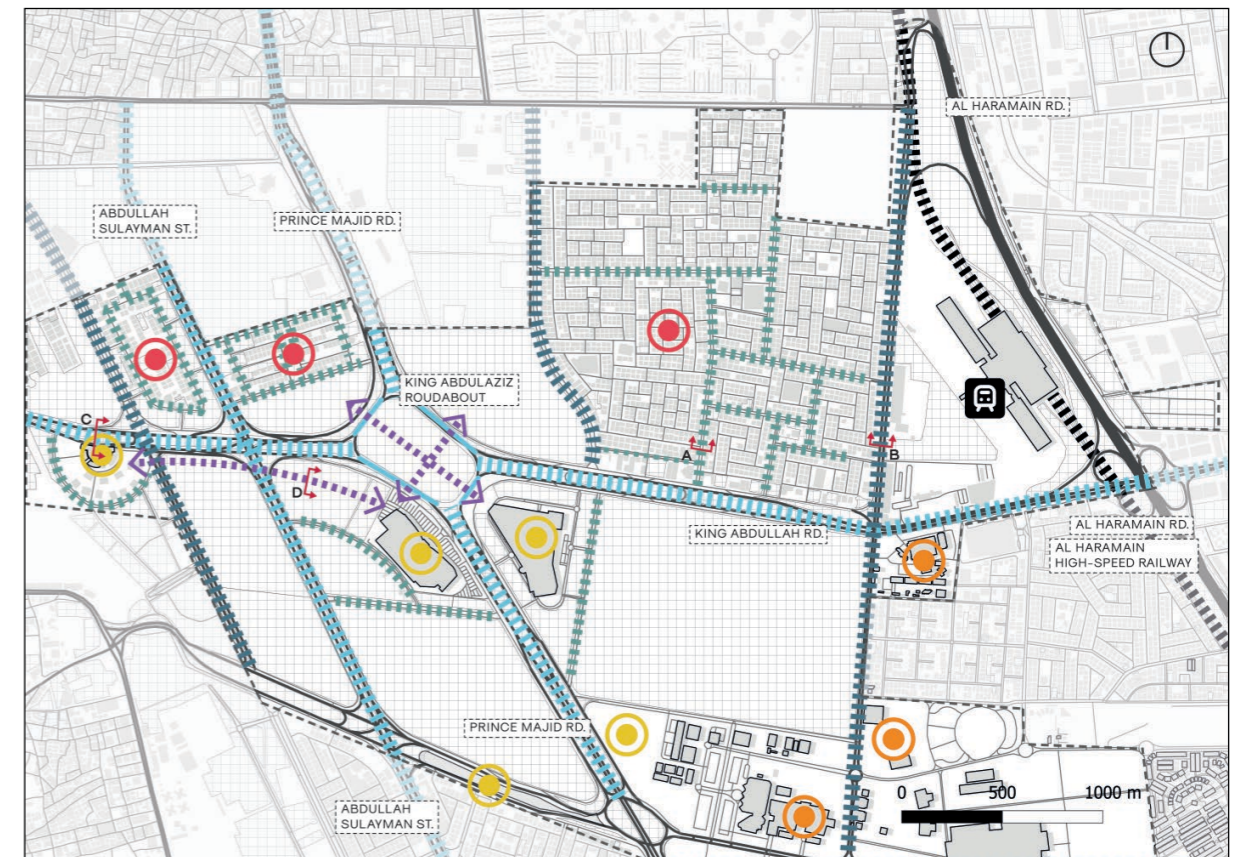


4.2.2 The Roads Strategy

The goal of the roads' strategy is to change the road infrastructure itself. Car-only streets can be more diverse and accommodate bikes and tram lanes, bus stops, and pedestrian sidewalks. The road network must also provide appropriate measures to mitigate the local climate and the urban heat island to allow active mobility during the hottest days of the year. To achieve this, a network hierarchy is proposed to indicate which interventions are useful for improving the livability and accessibility to the main functions. There are main streets, secondary streets, and tertiary streets.

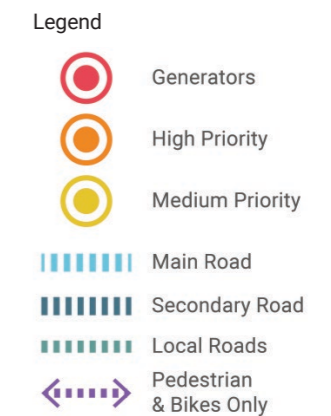
Figure116: Different transect roads map.

Source: Author.



Main Roads

The main roads are often more than 20 meters wide and have between four and six lanes for cars (in each direction), and the speed limit reaches 90 kilometers per hour. These roads are key flow channels in the city and serve an important economic function and often are busy, but they strongly divide the urban fabric with its different monofunctional zones causing danger and noise. The main roads in the transect also feature large underused vacant lands within them which are made for the sole purpose of draining rainwater. On the other hand, these roads can be very useful not only for fast transit but also to provide publicity for businesses. They can also accommodate different means of transport without removing the private car such as bus stops and pedestrian and cycle paths with green buffer areas to protect them and to provide shade. The vacant lands that drain rainwater can be developed to provide more environmental services, such as collecting rainwater and creating ecosystems within the city.



Secondary Roads

The secondary roads are often more than 15 meters wide (in each direction), and the speed limit is still high, but they are also surrounded by commercial shops and restaurants, and traffic jams are seen quite often because of the lack of enough parking space in front of commercial facilities. Secondary roads can also be improved to accommodate different means of transport in addition to the private car, to reduce the number of cars and the pressure on the road network. Bus stops can be added as well as pedestrian and cycle paths with green buffer areas to protect them and to provide shade.

Residential Streets

Residential streets are the streets between residential buildings and are often between 8 and 15 meters wide. They may not have car lanes and cars move in both directions. However, they are lifeless, full of parked cars that almost block the street, lack vegetation and any signs of urban life. These streets can be upgraded to become public spaces and active mobility oriented primarily, but cars can remain as users alongside pedestrians and cyclists. This will bring back the urban and out-of-home lifestyle and the sense of community that was present in old Jeddah. The streets will become more green and livable centres of mobility, commerce, and social life again and will reduce the presence of the car and the demand for parking spaces will subsequently decline as soon as the effect of low-traffic measures in the larger streets becomes visible.

Pedestrian and Cycle Paths

These paths that will exclusively accommodate pedestrians and cyclists. They must be well-shaded and safe from the highway with buffer zones. With adequate greenery and shading, they can have some commercial functions and activities such as playing, exercising, running, and will be social spaces where people meet each other on the street.

Section A-A Residential Street

Key Principals

- Reduced car lanes and the speed to 30 km/h.
- Safety and accessibility for all ages and abilities.
- Multi-modal streets with a range of mobility choices, prioritizing active and sustainable modes of transport.
- Shaded sideways with local shade trees.



Figure117: Top: Key map of residential roads. Right: Street section A-A. Scale 1:500

Source: Author.

Street Proposals



Section B-B Secondary Road

Key Principals

Transport and Street Design

- Reduced car lanes and the speed to 40 km/h.
- Pedestrian crossing every 80-100 meters.
- Rest area for drop off and temporary parking.
- Safety and accessibility for all ages and abilities.
- Multi-modal streets with a range of mobility choices, prioritizing active and sustainable modes of transport.

Environmental

- Permeable bike lane.
- Shaded sideways.
- Retractable awnings: retracting the shading structures at night allows the trapped hot urban air to be released to the sky and helps in reducing the urban heat island.
- Local shade trees:
 - Albizia lebbeck
 - Azadirachta indica (Neem)

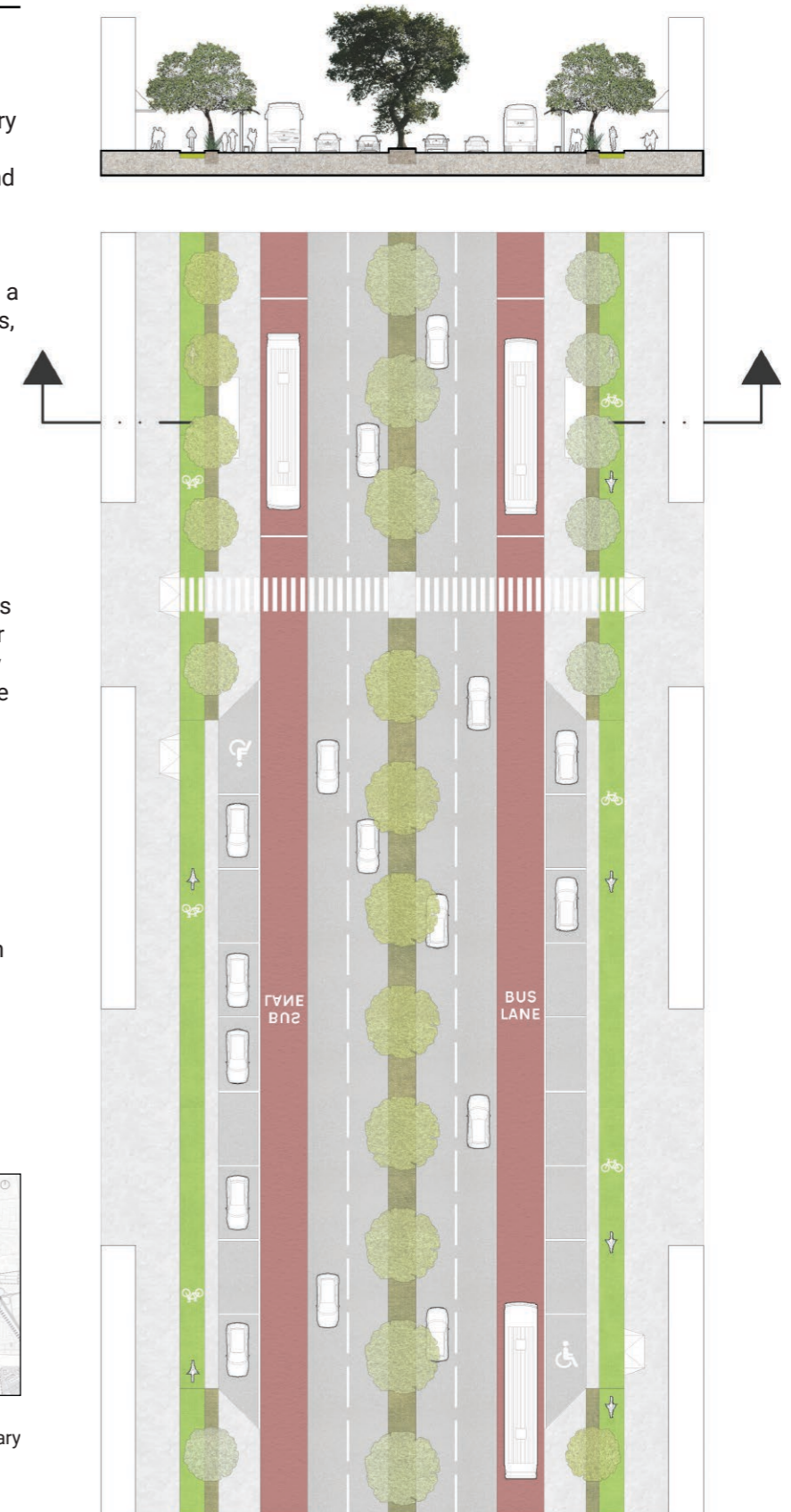
Urban

- Commercial and residential buildings on both sides.



Figure118: Top: Key map of secondary roads. Right: Street section B-B. Scale 1:500

Source: Author.



**Section C-C
Main Road**

Key Principals

Transport and Street Design

- Reduced car lanes and the speed to 50 km/h.
- Pedestrian crossing every 80-100 meters.
- Safety and accessibility for all ages and abilities.
- Multi-modal streets with a range of mobility choices, prioritizing active and sustainable modes of transport.

Environmental

- Rainwater garden and rainwater collection.
- Permeable bike lane.
- Shaded sidewalks.
- Local shade trees:
 - Albizia lebbek
 - Azadirachta indica (Neem)

Urban

- Locating high rise commercial buildings adjacent to the main road to offer publicity for businesses and create a buffer zone that protects residential zones behind them from noise.

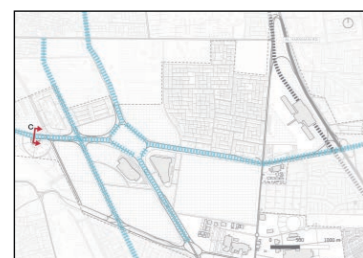
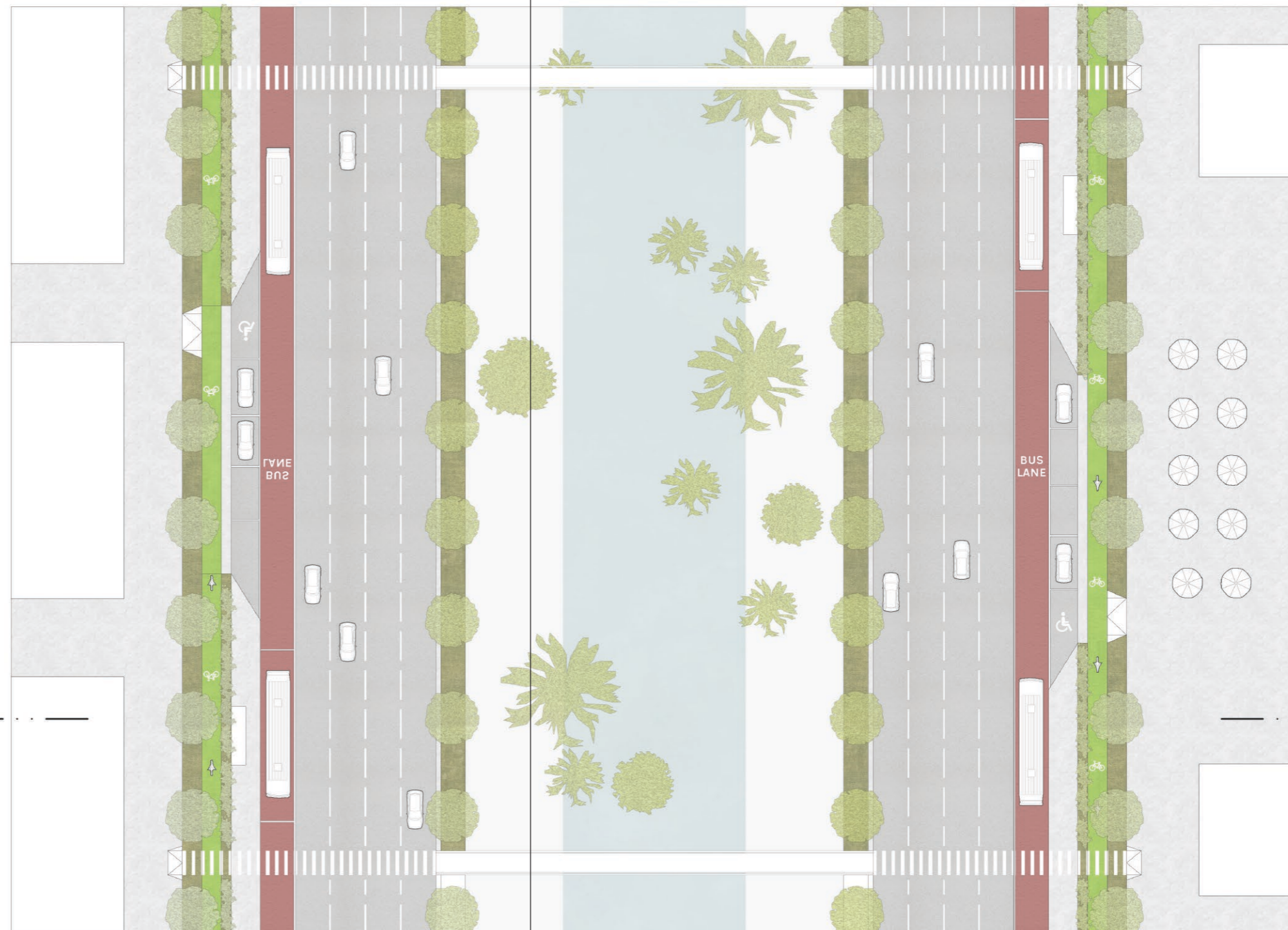


Figure119: Top: Key map of the main roads. Right: Street section C-C. Scale 1:500

Source: Author.

**Section D-D
Pedestrians and Bikes Path**

Key Principals

Transport and Street Design

- No motor vehicles. Only active mobility.
- Accessibility for all ages and abilities.
- Frontages are followed by clear paths for pedestrians, then an area for street furniture, and then a shaded bike lane.

Environmental

- Permeable shaded bike lane.
- Retractable awnings: retracting the shading structures at night allows the trapped hot urban air to be released to the sky and helps in reducing the urban heat island.
- Local shade trees:
 - Albizia lebbek
 - Azadirachta indica (Neem)

Urban

- Mixed use development on both sides.

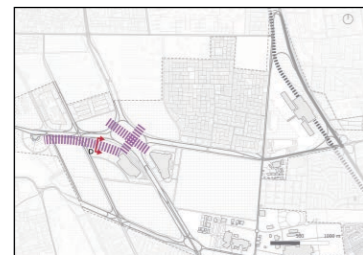
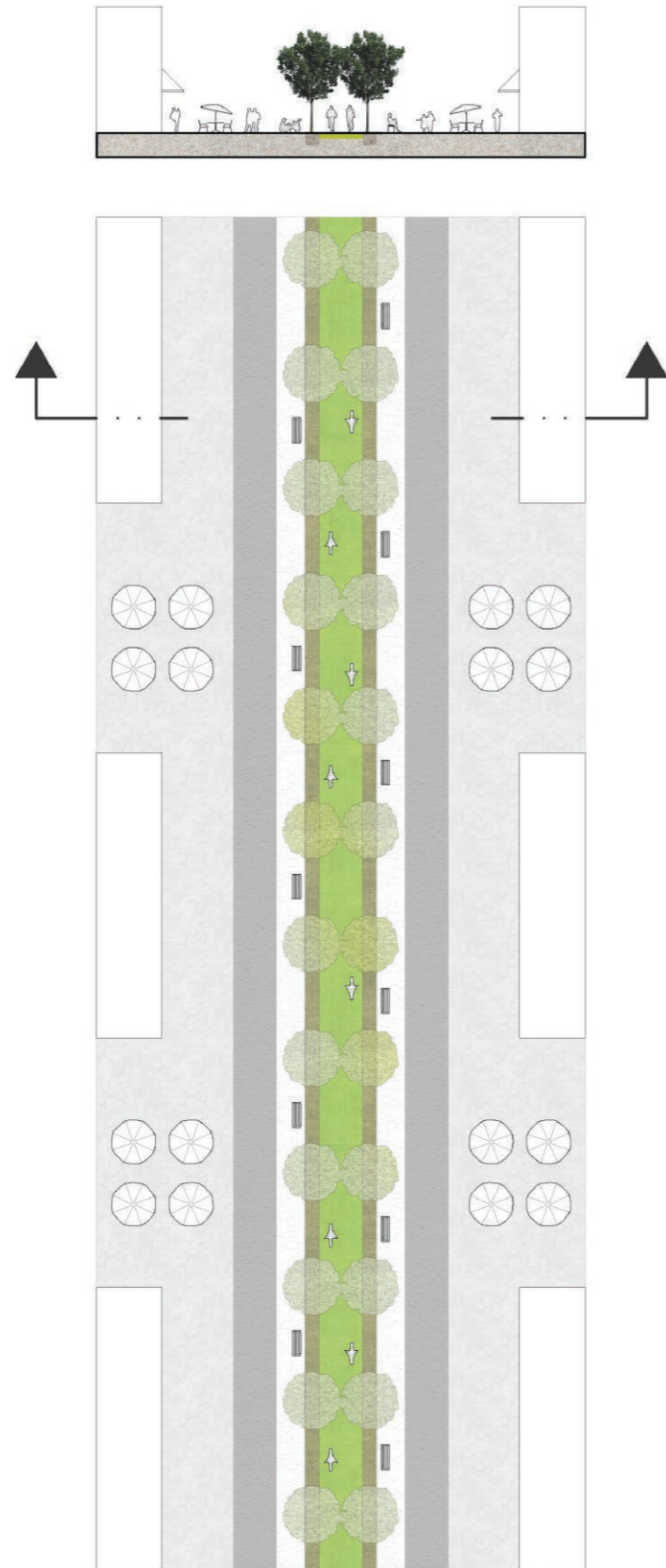


Figure120: Top: Key map of the pedestrian and bike paths. Right: Street section D-D. Scale 1:500

Source: Author.

4.2.3 Public Transport and Shared Mobility

Since it's essential to provide all people with access to the transportation systems and ensure access to the main generators and attractors of our transect while improving safety and security, reducing pollution, and improving the cost-efficiency of urban transportation, the private car should no longer be the only option for people. Publicly-owned transport (buses, metro, and the train) will increase the access to transportation and lower the costs for the commuters. Besides public transport, shared mobility is also growing globally as most modern cities' are striving to provide sustainable and efficient urban mobility. It is a transportation system where commuters rent or share vehicles for short-term use (generally for hours) on their own or as groups (e.g. car-sharing or bike-sharing). This system creates a hybrid between private vehicle use and mass or public transport. It is a growing transportation strategy that allows people to access transportation services on an as-needed basis. Shared mobility includes a variety of transportation modes including car-sharing, bike-sharing, scooter-sharing, ride-sharing, and others. The vehicles are shared for a specified time from special stations (docks) using technology and can be "station-based", in which vehicles are picked up and returned to set parking spots, or "one-way", in which users can pick up and leave the vehicles anywhere within a service area. The second is more flexible but it requires higher-density land use with walkability, as the user must find the vehicles within an easy walk.

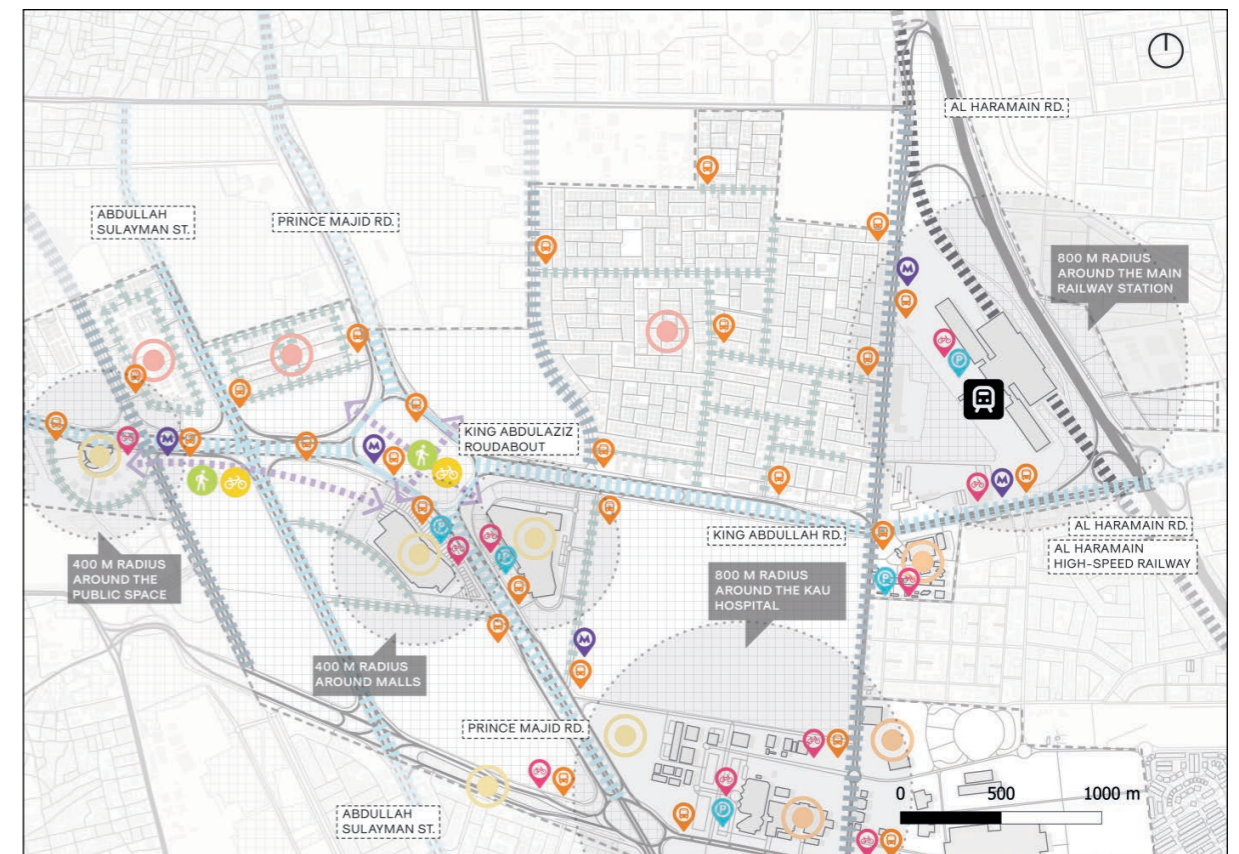
On this basis, the strategy proposes locations for public transport stops and shared mobility stations within walking distance. In addition to active mobility and bike paths.

Figure121: Publictransportandshared mobility stops.

Source: Author.

Legend

- Generators
- High Priority
- Medium Priority
- Metro Stop
- Bus Stop
- Shared Bikes Station
- Shared Mobility Station
- Bikes Path
- Pedestrian Path
- Train Station



4.3 The Land Use Strategy

4.3.1 Vacant Land Development

Inspired by Transit Oriented Development, the land use strategy of the area is to develop a higher density with mixed land uses, combining residences with various densities and typologies, retail, entertainment, public spaces, and business.

The railway station is the most important node that plays a fundamental role in reorganizing the vacant spaces, improving the quality and livability of the transect and supporting sustainable transport modes. It will also create a new urban centre in the station area and the surrounding neighbourhoods. Each vacant land has a proposal that matches its location, size, function, and condition as explained in the following table.

Transit Oriented Development is generally defined as “a mix of uses, at various densities, within a half-mile radius (800 m) around each transit stop”. It encourages competitive alternatives to the car where transit and slow mobility coexist. However, this can only succeed with high-density and/or short distances.

Key principles of TOD are:

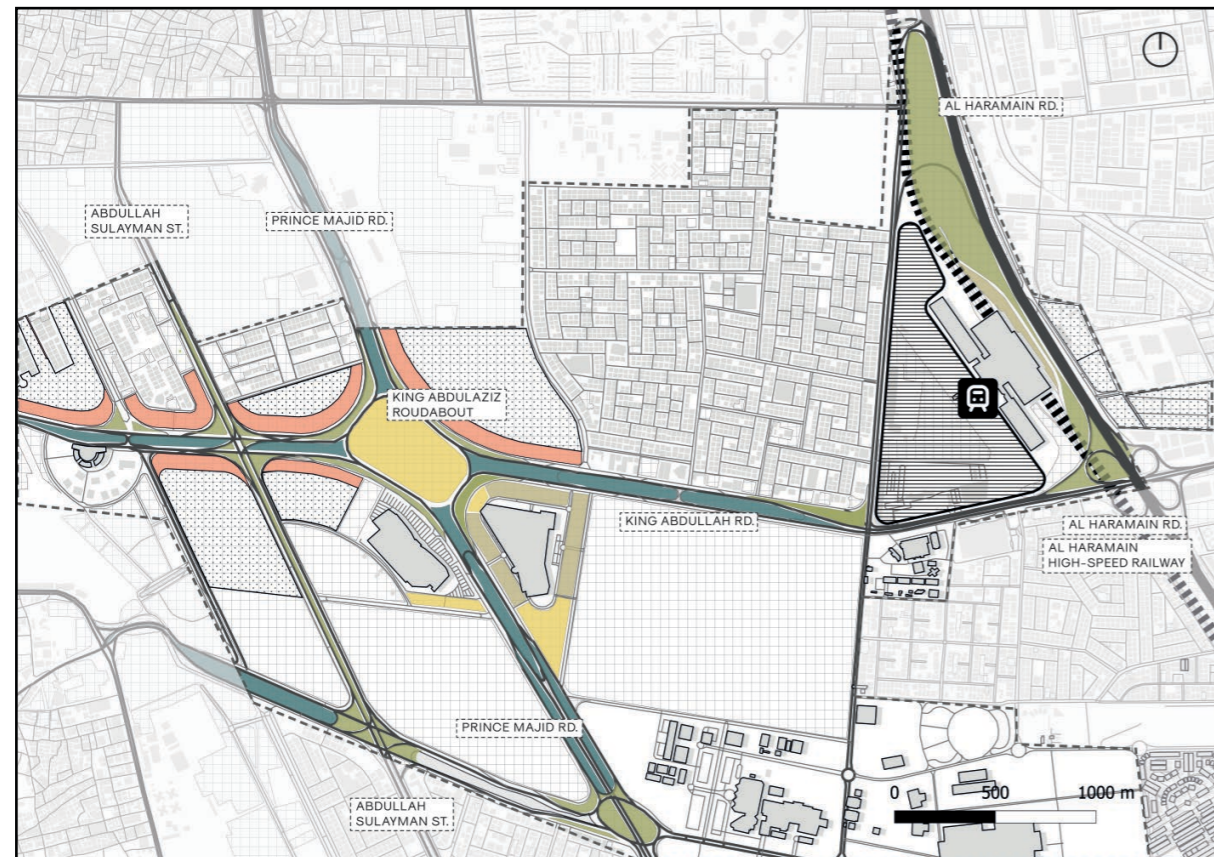
- Creating high densities and mixed-use functions.
- Designating 800 m radius around stations for higher density, mixed-use, walkable developments.
- Enhancing multi-modal connections and pedestrian-friendly streets to make transfers easy, direct, and comfortable.
- Preserving natural habitat and making high-quality open spaces the focus of building orientation and neighbourhoods activities.

Figure122: Publictransportandshared mobility stops.

Source: Author.

Legend

- Border of Intervention
- Important Nodes
- ▨ Mixed-Use
- Business Park
- Public Park
- Rainwater Collection
- Urban Carbon Sink
- Green Parking
- ▨ Micro-Scale Development



4.3.2 Environmental Considerations

1. Rain drainage can be turned to a rain collection system to reuse rain water for agriculture and maintenance of public parks.
2. The creation of mixed-use developments and reducing private car usage will reduce carbon emissions.
3. Shading will reduce the heat and facilitate pedestrian movement on hot summer days. Alongside suitable trees, retractable shading techniques will also be used because during humid days the shading element must be lifted to allow hot air to rise up and not be trapped .
4. Stabilization of the soil of vacant lands with proper vegetation and creating windbreaks with trees will reduce sandstorms.
5. Urban carbon sinks will reduce carbon emissions around highways, increase the shadow surface, and help reducing the effects of the urban heat island.

Table11: Proposed land uses for vacant lands.

Vacant Land Type	Proposed Use	Detailed Land Use
White Lands Under Used Land	Mixed-use Developments	<ul style="list-style-type: none"> • Residences • Business and retail • Educational faculties • Public Spaces and parks • Mosques • Urban Agriculture
White Land	Business Parks	<ul style="list-style-type: none"> • High rise commercial buildings • Public spaces • Retail facilities • Green parking
White Land Under Used Land	Public Parks	<ul style="list-style-type: none"> • Urban Parks • Xeriscaping • Buffers and windbreaks • Green noise barriers • Green pavement • Playgrounds
Underused Land	Rain Collection and Ecosystems	<ul style="list-style-type: none"> • Permeable floodable parks • Rainwater collection • Natural sand fences • Shading trees for the roads
Infrastructure Wasteland	Carbon Sinks	<ul style="list-style-type: none"> • Urban Forests • High local trees with big canopies suitable for dry climates
Underused Land	Green Parking	<ul style="list-style-type: none"> • Green pavement • Vegetation cover • Electric vehicles charging stations • Shared mobility stations
White Land	Micro Scale Development	<ul style="list-style-type: none"> • Mixed Use • Transport, social, and a business hub.

4.4 Case Studies & References

4.4.1 The 15-Minute City

About

As cities work towards COVID-19 pandemic recovery, the 15-minute city is a growing vision of urban living and a spatial reordering of our urban settlements and it already takes many names and forms around the world. Leading examples of the 15-minute city include Bogotá's Barrios Vitales, Portland's Complete Neighbourhoods, Melbourne's 20 Minute Neighbourhoods, and the Paris 15-Minute City that captured international attention in the wake of the pandemic.

Scale

The 15-minute city is a strategy that is applied to the entire city, starting from each neighbourhood.

Concept

Partially inspired by the work of Jane Jacobs, who viewed neighbourhoods as social connectors, the idea behind 15-minute cities was developed by Carlos Moreno, professor at the University of Paris, who aimed to improve the urban quality of life.

The key concept of the 15-minute city is that residents should have easy, convenient access to many of the places and services that they use daily such as schools, restaurants, daycares, healthcare, groceries, parks and all other amenities without needing a car. People also can work close to home or work remotely more often. The concept reconsiders how cities can be better designed to support the basic needs of residents within a small radius from their homes resulting in stronger communities as residents feel more invested in the businesses and services of their area.

Goal

The main goal of the 15-minute city is to create an inclusive city where the inhabitants have access to the main services and opportunities in addition to having a positive impact on the environment.



Figure123: Research shows that 20-minutes is the maximum time people are willing to walk to meet their daily needs locally.

Source: www.planning.vic.gov.au

Key Principles of the 15-minute city

1. The Neighbourhood As A Social Space

A neighbourhood should include social spaces such as cafés, markets, sports facilities, community centres, daycares, cultural and religious venues, shared gardens, public parks, and well-designed streets to help build a community. It should also respond to the needs of people of all ages, races, genders, abilities and backgrounds. The streets must also encourage social interaction and be easily accessible by everyone, including children, wheelchair users, families with strollers, the visually impaired and other vulnerable users.

2. Equal Access To Core Services and Opportunities

The decentralization of services and goods guarantees that the activities that make city life pleasant are accessible to everyone, rather than just those in central or wealthy areas. Community-scale education, healthcare, necessary retail such as grocery stores and pharmacies, recreational parks, and offices are among these activities.

3. Compactness and Mixed-Use

Compact neighbourhoods are higher in density and make better use of the land area. Mixed-use neighbourhoods mean the presence of a variety of functions, such as a variety of housing types, retail, office, institutional and/or light industries. The combination of compactness and mixed-use give a balanced range of human-scale activities, allowing more people to dwell near services and injecting life into the streets. It also results in a more balanced energy demand, which benefits both local renewable energy projects and district cooling networks.

4. Adaptive Reuse Of Vacant Or Underused Lands and Buildings

Making better use of buildings and lands to allow for a more diverse mix of uses. For example, making small parks out of abandoned lots, schoolyards, parking spots, and road areas. This requires modifying the city's plans and rules to guarantee that each neighbourhood has adequate access to green and open spaces, schools, minor health-care facilities, and essential retail.

5. Activating The Ground Floors For Pleasant, Safe Streets For Pedestrians And To Support The Local Economy

Creating active street frontages at the ground level and a high-quality pedestrian-friendly public realm that makes use of outdoor space for café seating or market stalls, for example, will help attract visitors, public services, and businesses to the area.

6. Increasing Street Space For Pedestrians and Cyclists

Changing the way people use streets and rezoning them to reduce or remove cars to make more room for pedestrians and cyclists.

7. Flexible Use Of Spaces And Buildings

Using buildings and public spaces for multiple uses during the day and at night will increase the value of those spaces and will create more dynamic, safer and inviting environments. Vacant buildings and plots, for example, can be used as pop-up stores, cafés, pocket gardens, sports or cultural activities, and schoolyards can be used as markets or public parks on weekends. Libraries can also hold cultural events.

The Benefits

The benefits of the 15-minute city approach cover many areas; economic, environmental and social. It will create more livable, people-oriented cities, vibrant neighbourhoods, and make urban living less stressful and more sustainable. It will also help to strengthen the local economy, develop more responsive local growth, create a more equitable, inclusive city, and generate a stronger sense of community, as well as improve city residents' health and well-being. Above all, it will reduce transportation emissions, improve air quality, and encourage more active commute.

Examples for the 15-Minute City

1. Paris

Mayor Anne Hidalgo's 2020 re-election campaign in Paris was built on the concept of "hyper-proximity" and the "15-minute city." The strategy aims to reduce air pollution and travel time, improve Parisians' quality of life, and assist the city meet its goal of becoming carbon neutral by 2050.

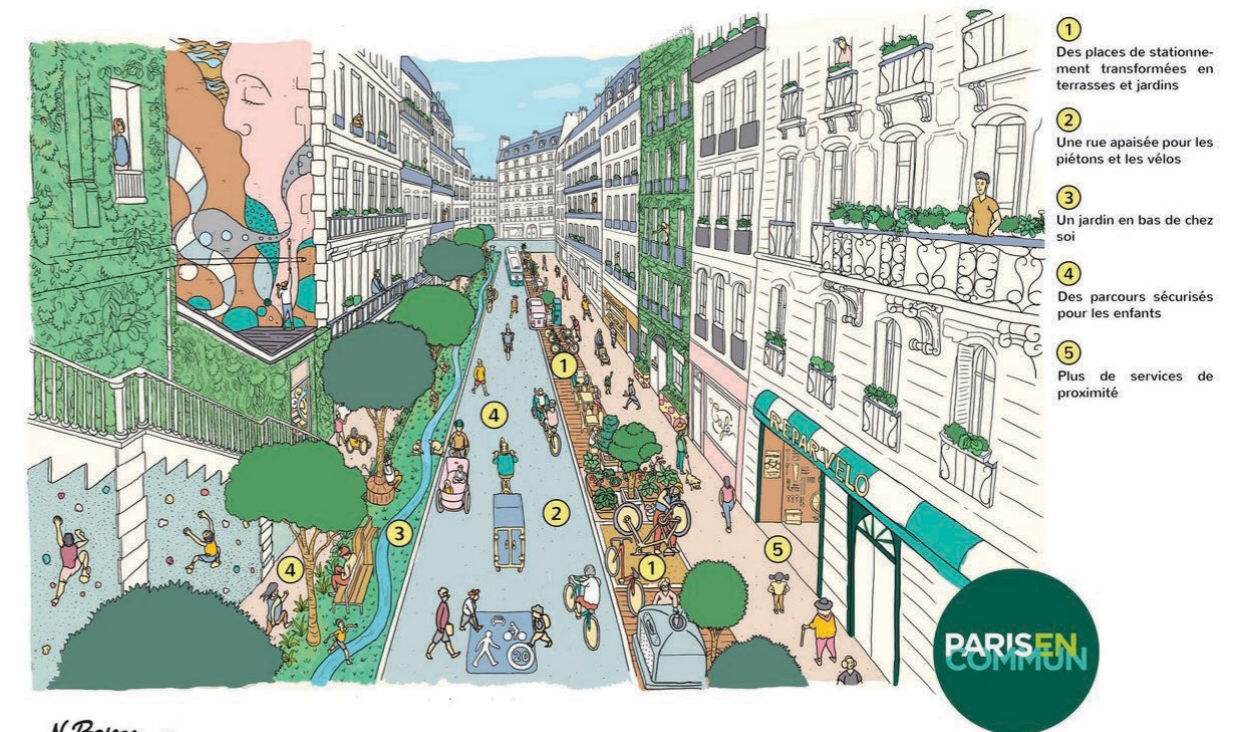
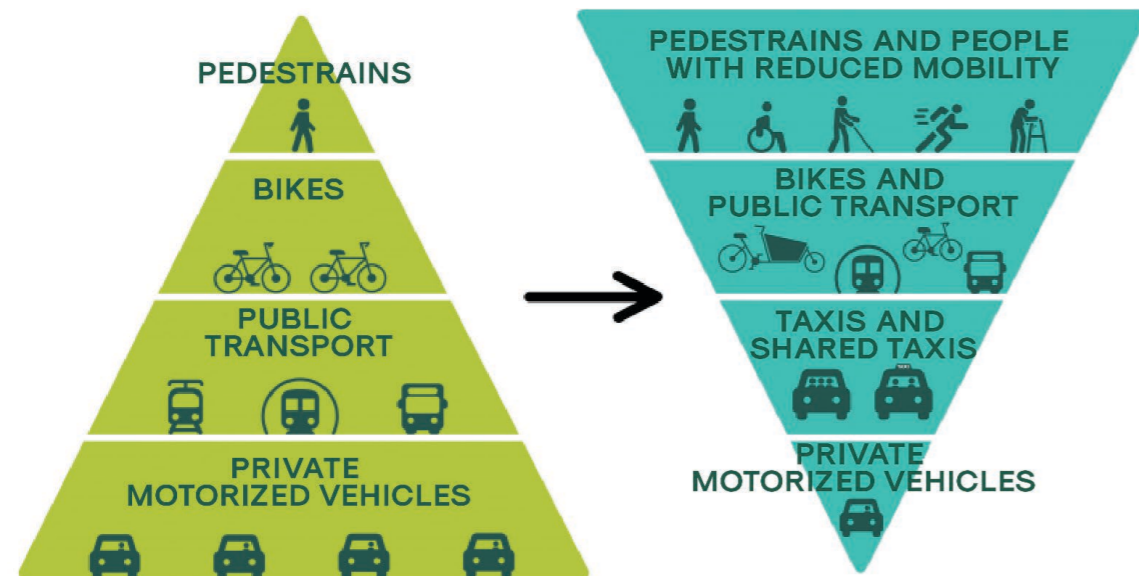
Paris has already accelerated the development of protected pedestrian and bicycle routes, intending to transform the city into a network of neighbourhoods where residents can get everything they need within a 15-minute walk or ride from their homes.

Mayor Hidalgo's "people-first" vision includes: adding a bike lane to every street and bridge, expanding office space and co-working hubs in underserved areas, expanding the use of infrastructure and buildings outside of normal business hours, encouraging people to shop locally, and creating small parks in school playgrounds that are open to the public after school hours.

Since Paris has relatively little green space, large parks will be built from scratch, and "urban forests" will be planted in public squares and on former parking lots. Moreover, new gardens for urban agriculture can provide neighbourhoods with local food in addition to banning cars near schools when kids are arriving and leaving to make it safe for kids to walk and bike.

Figure124: Anne Hidalgo's policy is to build a city intended for people, not cars.

Source: tomorrow.city



N. Bascoy

1. Parking spaces transformed into terraces and gardens.
2. A peaceful street for pedestrians and bikes.
3. A garden downstairs.
4. Safe routes for children.
5. More local services.

Figure125: Paris, before and after the 15-minute city strategy.

Source: Paris en Commun

2. Milan

Milan has mentioned the 15-minute city as a framework for its recovery during the COVID-19 pandemic, to ensure that critical services – particularly healthcare facilities – are within walking distance for all citizens, while avoiding a surge in car travel after the lockdown is lifted. By the end of June, Milan hopes to have built 35 kilometres of additional bike lanes and pedestrianized several school streets. It also allows some shops, taverns, and restaurants to serve customers outside on the street, among other things. Madrid, Edinburgh, and Seattle are among the places that have adopted similar strategies in the aftermath of COVID-19 outbreaks.

In addition, Milan is also planning the first carbon neutral social housing project in Italy: **L'innesto**, which is a new social housing project that aims to be zero-carbon by 2050 by Architect: Barreca & La Varra, and Environmental Expert: ARUP Italia Srl.

About

- The buildings will use renewable energy, heating, and cooling, as well as 100% reused water and green roofs.
- The surrounding neighbourhood aspires to have 60% green space, as well as a green mobility policy that includes only one parking spot for every seven households, a shared cars fleet, and air quality goals.
- The district is built with nearly zero-energy buildings and pre-assembled construction technologies using an optimal bio-based material mix, allowing structures to be disassembled and recycled at the end of their lives.
- The plan includes building 400 units over 21,000 m², a residence for 300 students, 3,000 m² for commercial activities, and 45,000 m² of green areas that include vegetable gardens, a nursery garden, green roofs, and edible landscapes.

Goal

The goal of the project is to manage resources, spaces, and the community in a long-term, responsible, and resilient manner.

Figure126: 3DvisualizationofL'innesto
Source: Barreca & La Varra, Wolf Visualizing Architecture



Benefits

- Social: provides affordable housing, which reduces the demand for housing in the city.
- Health: green areas will cover 72% of the site, offering fresh air, mitigating heat waves, and improving air due to the reduction of motorized travel in the area.
- Economic: the creation of a circular economy district.
- Environmental: 100% of the energy used (for air conditioning, heating, and the electricity from shared use in the neighbourhood) will come from on-site renewable resources.

Figure127: L'innestobeforeandafter.
Source: Barreca & La Varra, Wolf Visualizing Architecture



4.4.2 The Superblock

About

A superblock is an area of urban land containing residential accommodation, retail and commercial services, schools, offices, and public open spaces, bounded by main roads. The local road network within the superblock is meant to serve local needs.

Scale

Applied to the whole city, but in densely urbanized areas.

Concept

The superblock is an urban planning concept that aims to minimize the amount of public space taken up by private automobiles in the streets and return it to the people.

Goal

The main goal of the superblocks is to minimise traffic within the superblock by directing it to main roads and to encourage social interaction in communities by allowing for a variety of uses of public space, not only transportation.

Principles

- Safety & security.
- The neighbourhood is made a socialization and cohesion tool through basic services and social interaction.
- A healthy environment.
- Providing safe access to amenities and recreational activities.
- Multiple-use of road space.

Benefits

- Most streets inside the superblock will be free of motorized traffic, changed from single to multiple use streets, and regenerated as public spaces.
- The traffic volume will be reduced, as well as traffic accidents, noise pollution, emission levels, and premature deaths.
- Road safety will increase and there will a greater diversity of activities and better accessibility.

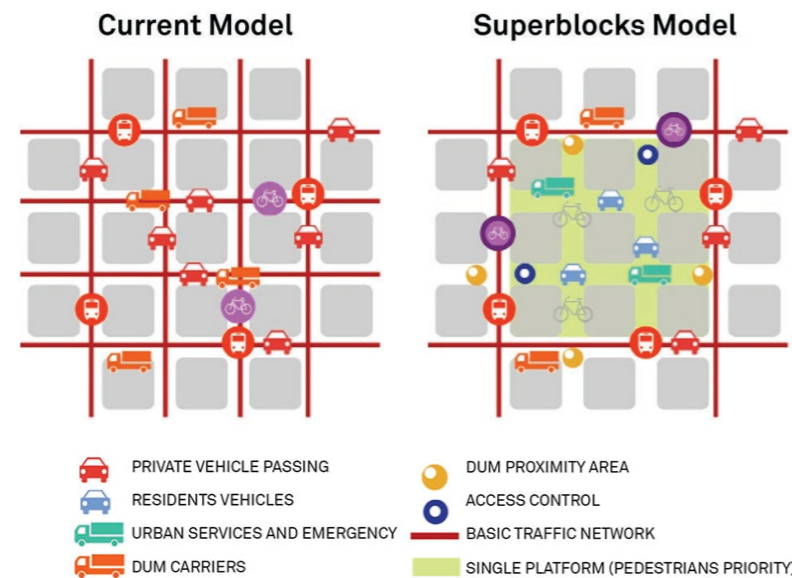


Figure128: Amsterdam back then and now.

Source: dailyhive.com.

Legend

- PUBLIC TRANSPORT NETWORK
- BICYCLES MAIN NETWORK (BIKE LANE)
- BICYCLES SIGNPOSTS (REVERSE DIRECTION)
- FREE PASSAGE OF BICYCLES
- PRIVATE VEHICLE PASSING
- RESIDENTS VEHICLES
- URBAN SERVICES AND EMERGENCY
- DUM CARRIERS
- DUM PROXIMITY AREA
- ACCESS CONTROL
- BASIC TRAFFIC NETWORK
- SINGLE PLATFORM (PEDESTRIANS PRIORITY)



Example for the Superblock

Figure129: Superblock Sant Antoni

Source: Sigrid Ehrmann, toposmagazine.com.

Barcelona's Super Manzana

In the nineteenth century, the urban architect Ildefonso Cerdá had a unique vision for his city, Barcelona to break free from the confines of its medieval border and spreading out in a more ordered and fluid manner. His vision gave rise to the unique octagonal blocks lined along the straight streets that crisscross the Eixample neighbourhood and have remained a tourist and architectural pleasure till now. Cerdá's Plan will be the inspiration for a new plan that will bring local urbanism into the twenty-first century by enabling greater space for inhabitants, pedestrians, and vegetation, according to the City Council of Catalonia. This concept is called the "Supermanzana" model after the Spanish word for a street block "Manzana".

Barcelona today features a superblocks system that alters the road networks within 400x400 meter blocks to increase the availability and the quality of public spaces for leisure and community activities, as well as for pedestrians and bicycles.

The Supermanzana's goal is to implement the traffic separation principle and to reduce the urban space dedicated to cars and increase the space for pedestrians, cyclists, and social interaction.

Inside each Supermanzana, more space is reserved for pedestrians and cyclists where private cars and public transport are restricted to the streets surrounding these blocks (the main roads). Car traffic is not prohibited but discouraged by reducing the space for cars per street, the frequent change of direction, lowering the maximum car speed to 10 km/h, removing most on-road car parking, and preserving the loading/unloading activities for urban goods distribution at the border of the superblock.



Figure130: Superblock of Sant Antoni by Leku Studio.
Source: Del Rio Bani, archdaily.com.

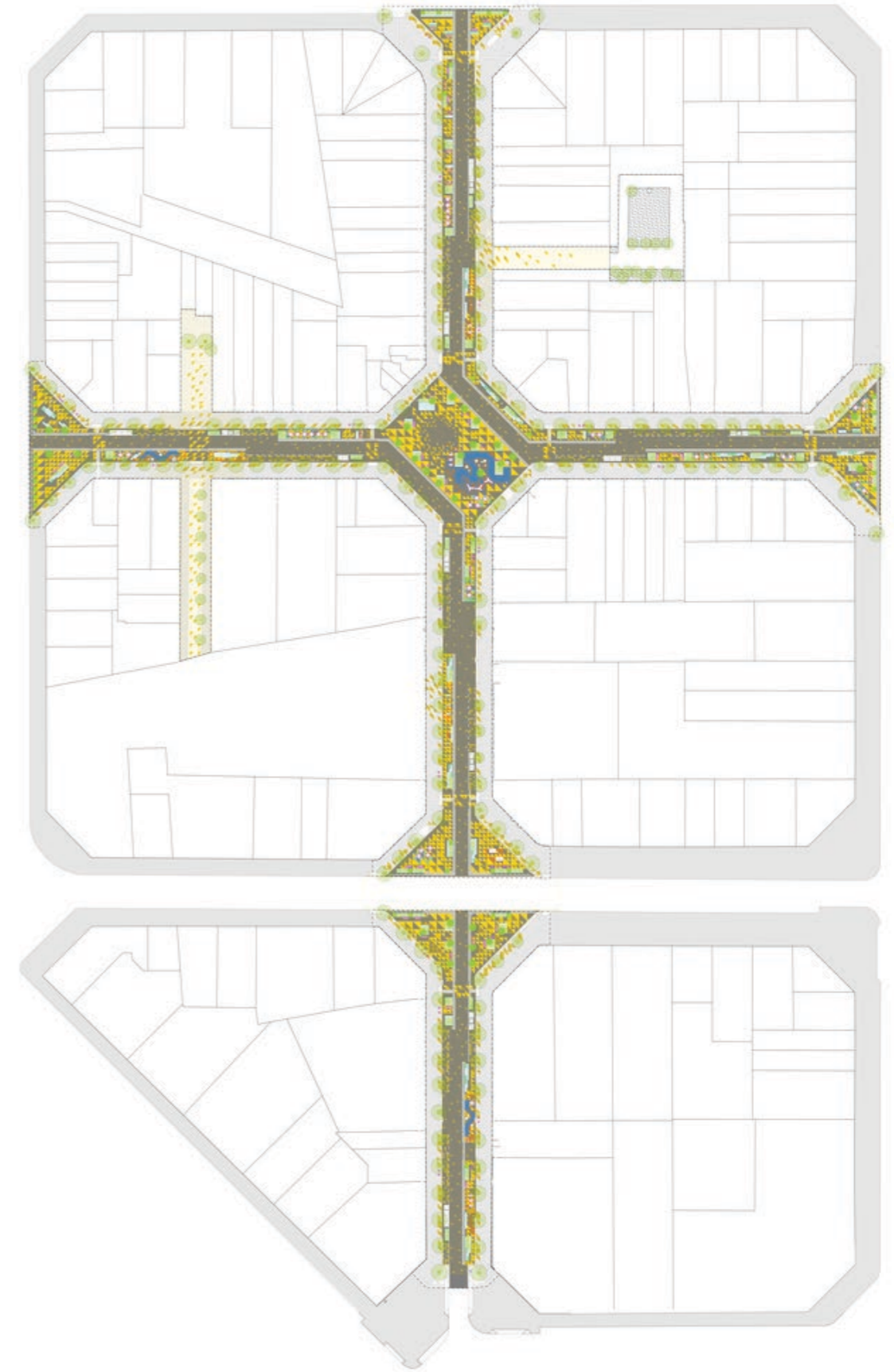


Figure131: Plan of the Superblock of Sant Antoni by Leku Studio.
Source: archdaily.com.

4.5 The Combined Strategy

The Current Situation

The current situation of the transect is full of vacant lands, long distances between services and different functions, monofunctional land use, lack of public space, and car oriented wide streets.

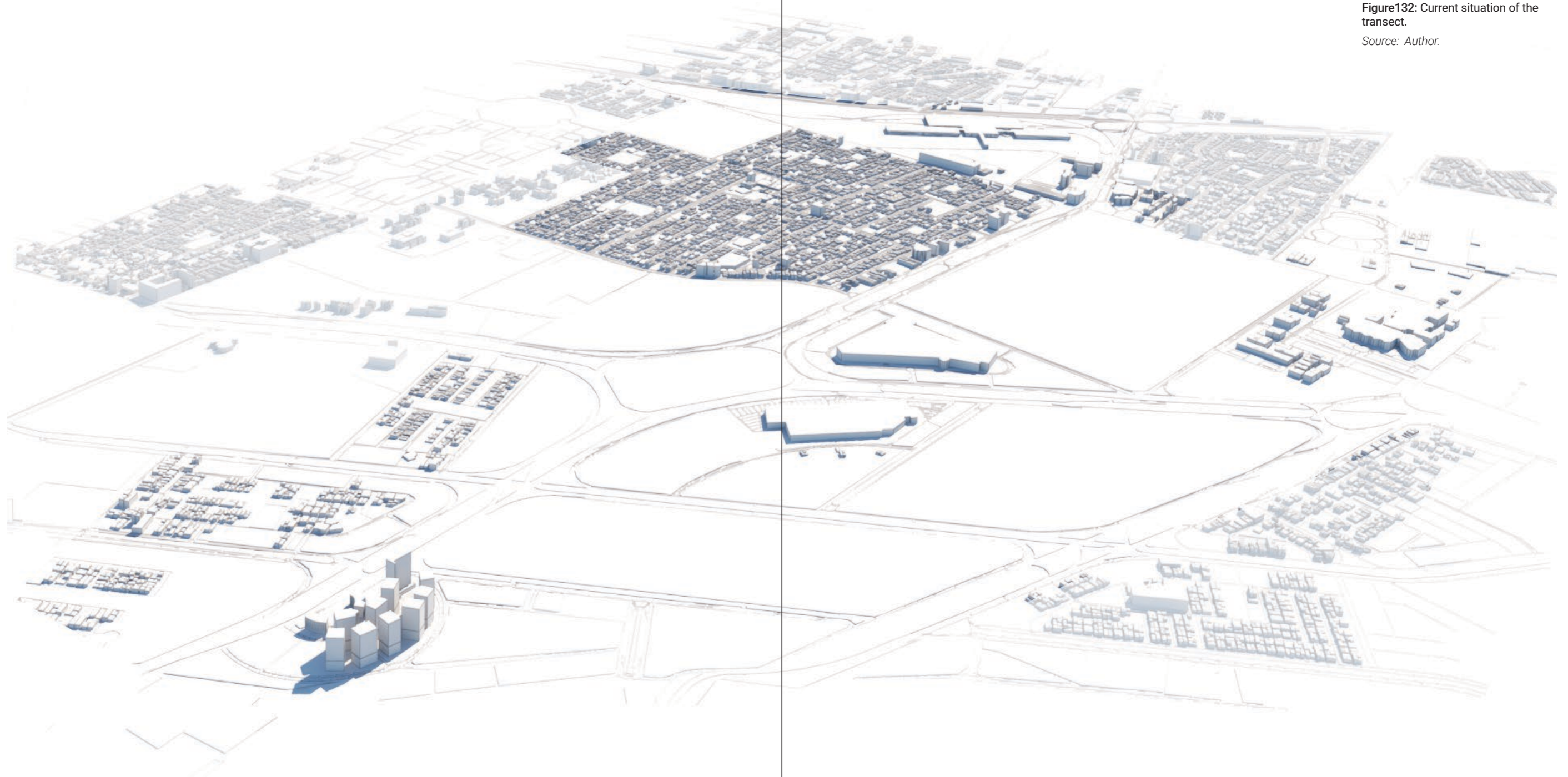


Figure132: Current situation of the transect.

Source: Author.

The Proposal

The proposed strategy aims to diversify means of transport, focusing on active and sustainable ways, such as BRT, shared mobility, and active mobility. It also proposes mixed-use land uses with various densities, more public spaces, a redesign of the roads infrastructure, and finally, the focus area near the railway station to be the focus for realizing a Transit Oriented Development. The presence of a HSL railway station along with vacant spaces are particularly favorable conditions to experience an approach aimed at creating a liveable neighborhood characterized by new form of walkable, mixed-use urban development around the new railway station.

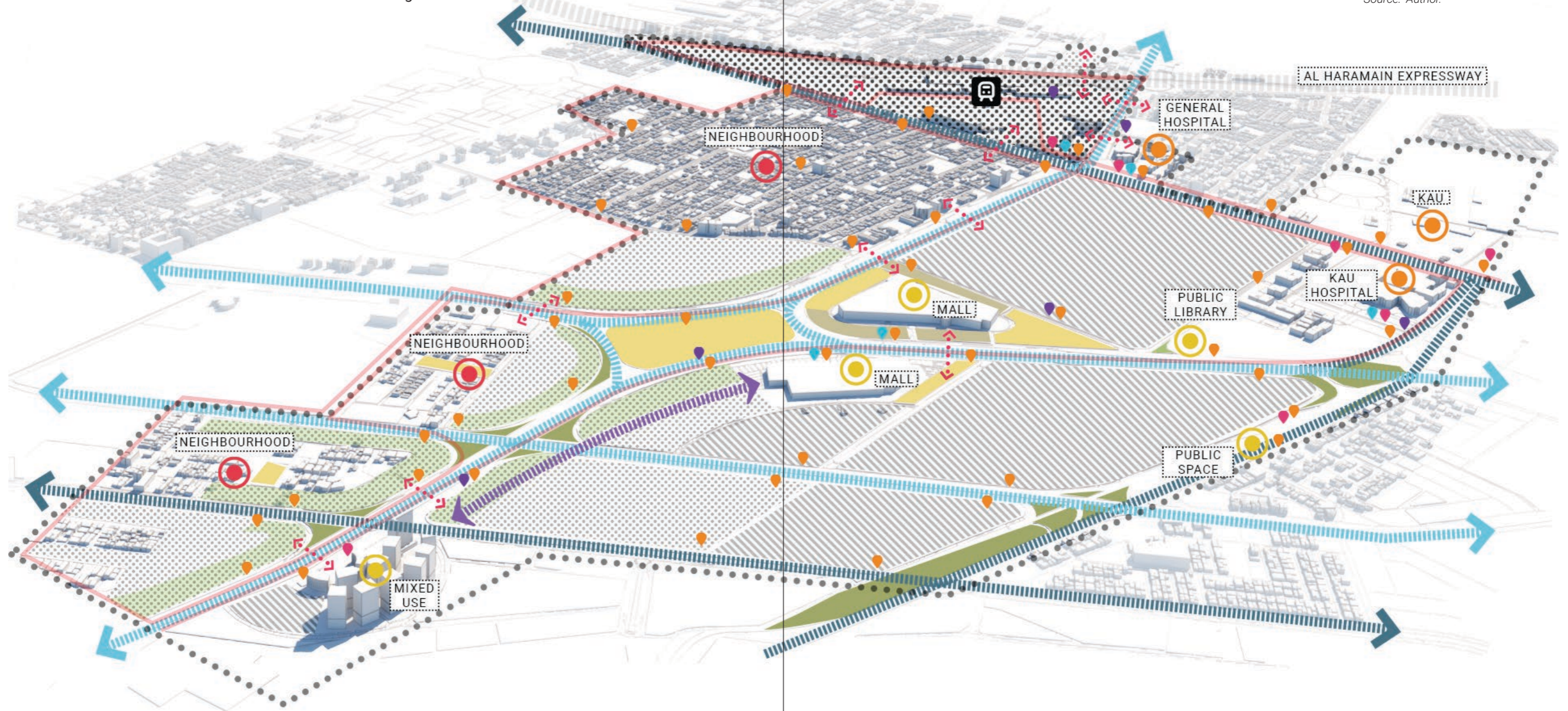
Transit oriented developments have the potential to provide residents with improved quality of life and reduced household transportation expenses, while providing the region with stable mixed-income neighborhoods that reduce environmental impacts and provide real alternatives to traffic congestion.

Legend

- | | | | | |
|----------------------|----------------------------------|----------------------|---------------------------|-------------------------|
| Carbon Sinks | Foreseen Developments | Bike sharing station | Railway Station | Border |
| Public Space | Proposed Mixed-Use | Car sharing station | Generator | Main Road |
| Commercial Buildings | TOD (Focus Area) | BRT stops | Attractor High Priority | Secondary Road |
| Green Parking | Connections breaking the barrier | Metro stops | Attractor Medium Priority | BRT Loop |
| | | | | Pedestrian & Bikes Path |

Figure133: Proposed strategy for the transect.

Source: Author.



5. The Microslace

5.1 The Microscale TOD Strategy

5.2 The Master Plan

5.3 The Timeline of the Project

5.1 The Microscale TOD Strategy

The Microscale TOD strategy focuses on the following principals:

Walkability and Density

- High density district.
- Walkable district with pedestrian as the highest priority within 10-minute walk circle surrounding train station.
- Train station as prominent feature.
- Public square (promenade) in front of the train station.
- A central promenade containing a mixture of uses in proximity (office, residential, retail, civic).

Mixed-use

- Residential areas are provided by retail services cafes, restaurants, grocery, dry cleaners, pharmacies, ...etc.
- Educational facilities.
- Daycare centers.
- Clinics.
- Offices.
- Other facilities and services.

Transport

- Public transport system supports inter-modality (buses, shared mobility, metro), and active mobility.
- Safe and devoted line for easy use of bicycles and scooters as daily support transport.
- Integrated bike-share rental system and bike-way network.
- Reduced parking inside 10-minute walk circle around the train station (with the exception for the parking of shared mobility).
- Occasional gulf parking replaces the unorganized random parking situation found in the intersect (see figure 136).

Urban Morphology

- Streets are aligned with the prevailing wind direction to allow wind flow.
- Narrow streets surrounded by high buildings to provide maximum shade.
- Wide streets at right angles with the sun path (north-south oriented) to keep them at shade most hours of the day.
- Staggered buildings layout and arranged away from each other to allow regular air movement.
- Points of intersection (public spaces, piazzas, green areas) receive more sunlight during the day, they heat up, then the hot air, which is lower in density, rises and is replaced with denser cooler air from the shaded surrounding streets. This creates an air current.

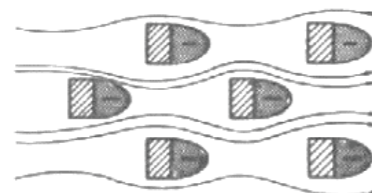


Figure134: Staggered buildings layout allows regular air movement.

Source: Shafiq Al-Awadi Al Wakil, Mohammed Abdullah Siraj, *The Climate and the Architecture of Hot Regions*.



Figure136: Unorganized parking in a commercial area in the microscale.

Source: google.com.

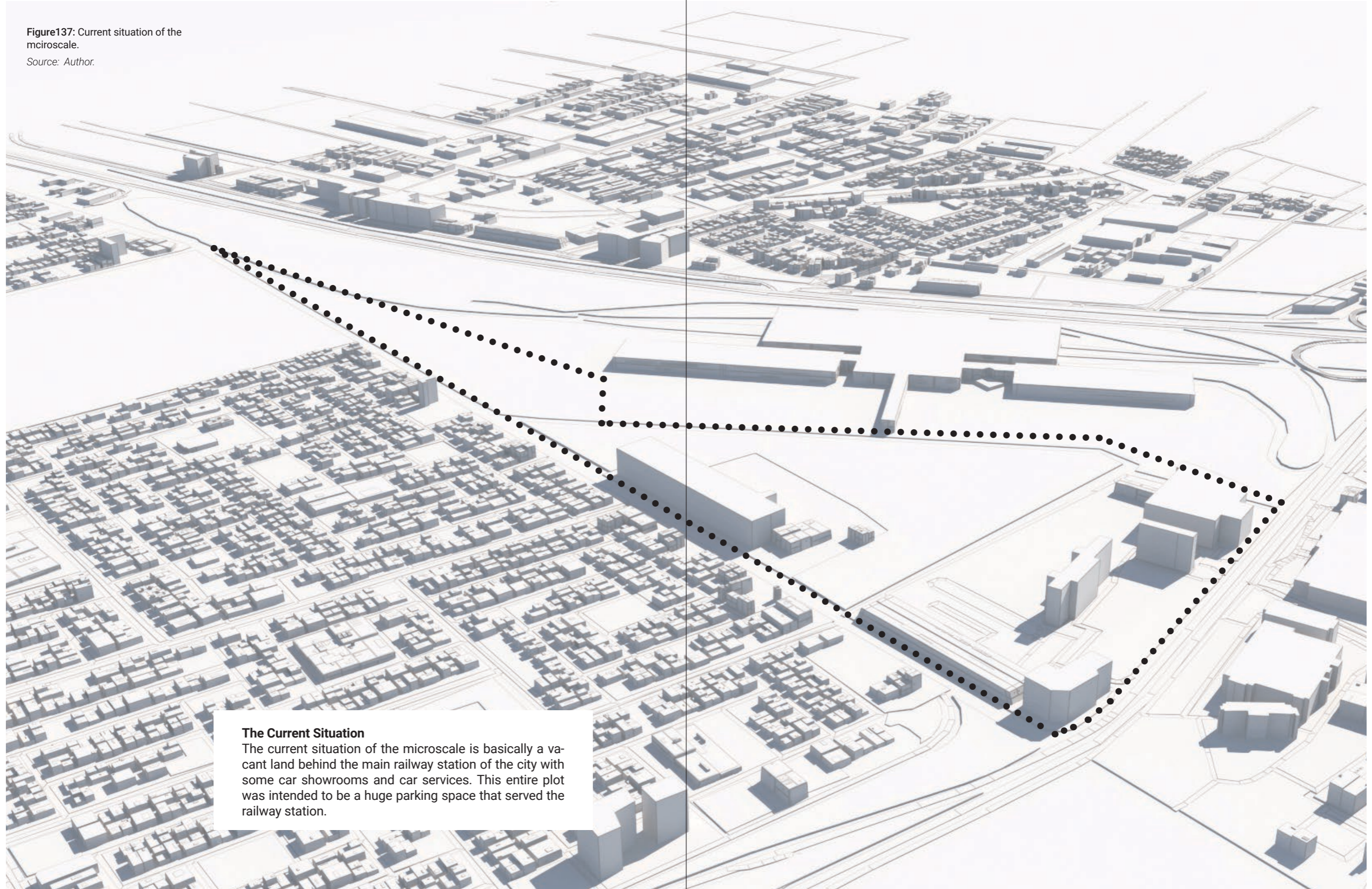


Figure135: Providing gulf parking on roads.

Source: aecom.com.

Figure137: Current situation of the microscale.

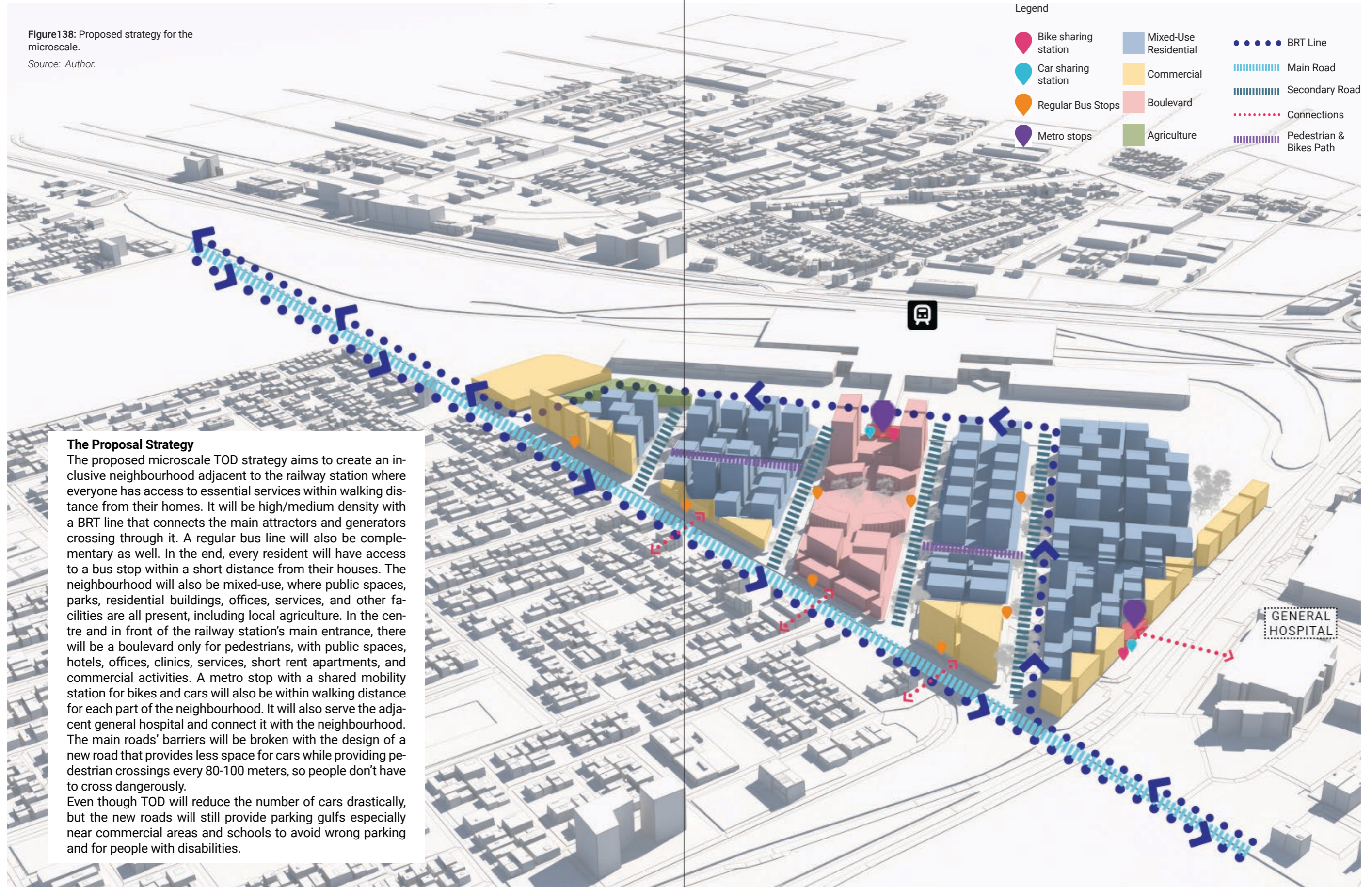
Source: Author.



The Current Situation
The current situation of the microscale is basically a vacant land behind the main railway station of the city with some car showrooms and car services. This entire plot was intended to be a huge parking space that served the railway station.

Figure138: Proposed strategy for the microscale.

Source: Author.



- Legend
- Bike sharing station
 - Mixed-Use Residential
 - BRT Line
 - Car sharing station
 - Commercial
 - Main Road
 - Secondary Road
 - Regular Bus Stops
 - Boulevard
 - Connections
 - Metro stops
 - Agriculture
 - Pedestrian & Bikes Path

The Proposal Strategy

The proposed microscale TOD strategy aims to create an inclusive neighbourhood adjacent to the railway station where everyone has access to essential services within walking distance from their homes. It will be high/medium density with a BRT line that connects the main attractors and generators crossing through it. A regular bus line will also be complementary as well. In the end, every resident will have access to a bus stop within a short distance from their houses. The neighbourhood will also be mixed-use, where public spaces, parks, residential buildings, offices, services, and other facilities are all present, including local agriculture. In the centre and in front of the railway station's main entrance, there will be a boulevard only for pedestrians, with public spaces, hotels, offices, clinics, services, short rent apartments, and commercial activities. A metro stop with a shared mobility station for bikes and cars will also be within walking distance for each part of the neighbourhood. It will also serve the adjacent general hospital and connect it with the neighbourhood. The main roads' barriers will be broken with the design of a new road that provides less space for cars while providing pedestrian crossings every 80-100 meters, so people don't have to cross dangerously. Even though TOD will reduce the number of cars drastically, but the new roads will still provide parking gulfs especially near commercial areas and schools to avoid wrong parking and for people with disabilities.

5.2 The Master Plan

The masterplan is the outcome of the microscale TOD strategy.

Legend

- Street ± 0.00
- Pavement + 0.17
- Bike Path Buffer + 0.30
- Bike Path ± 0.00
- Sidewalk + 0.17
- Pedestrians only +0.17
- Green Space +0.17
- Permeable Pavement + 0.17
- Local Street ± 0.00
- BRT ± 0.00
- Regular bus route ± 0.00



Blow Up A

Blow Up B

Figure139: The microscale master plan.
Scale 1:5000
Source: Author.

The proposed mixed use functions for the neighbourhood. Everything should be available within walking distance.

Legend

- Metro stop and shared mobility station.
- Commercial, retail, and other services.
- Schools.
- Mixed use: hotels, short term rent, apartments, offices, commercial, and cultural facilities.
- Residential with light commercial facilities, such as laundry, cafes, tailors, ...etc.
- Local agriculture.



Figure140: The microscale master plan building functions. Scale 1:5000. Source: Author.



Master plan blow up A

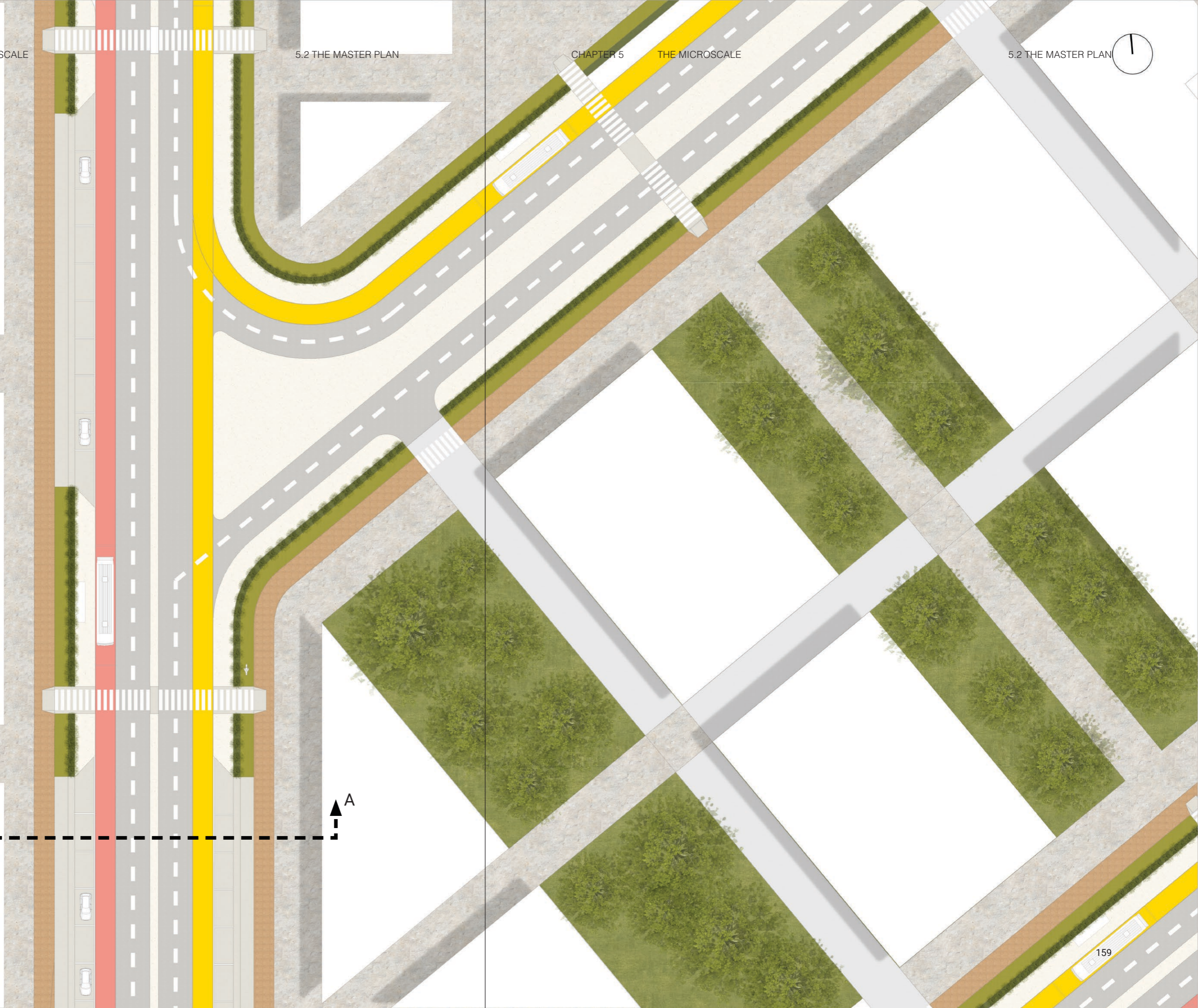
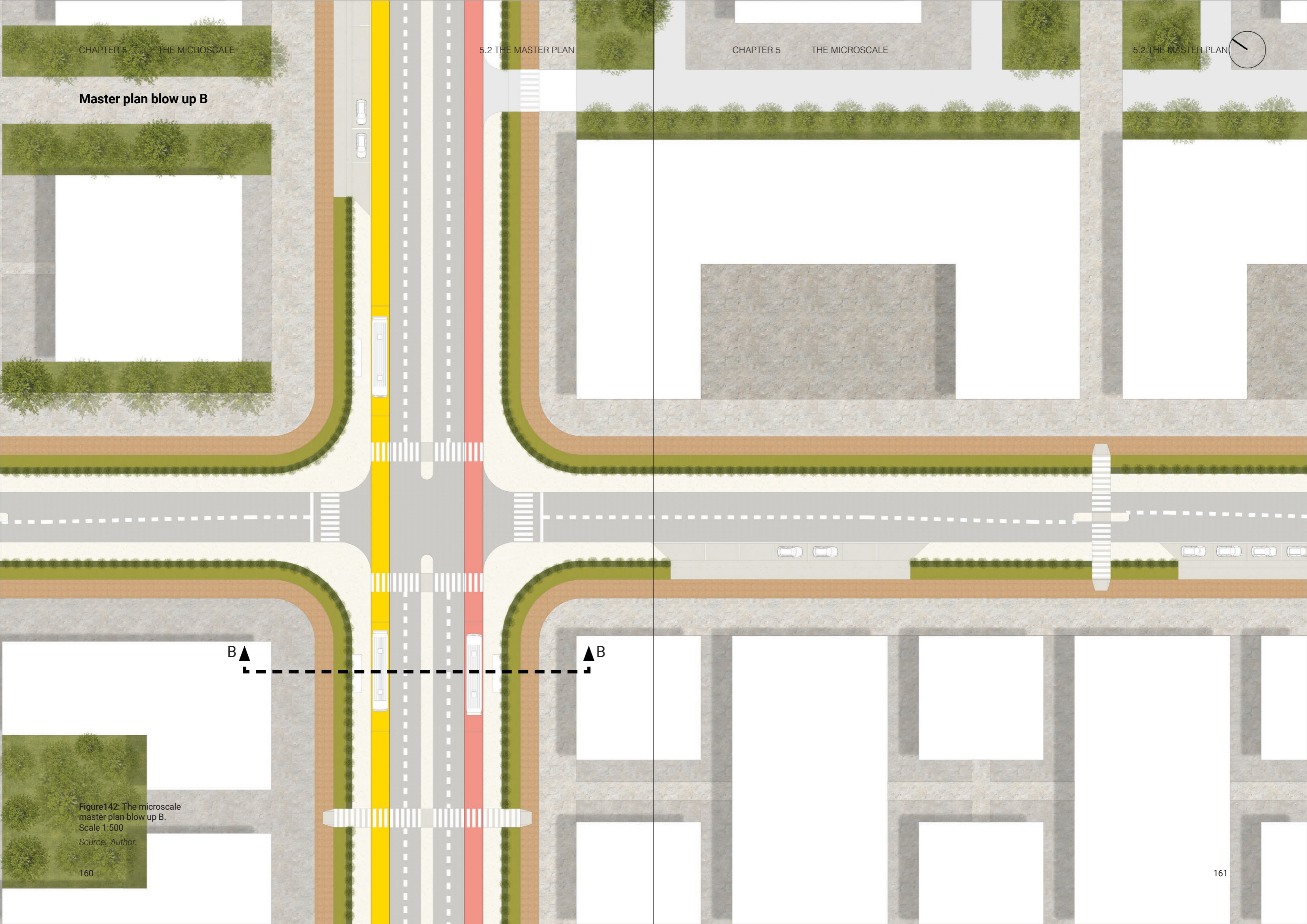


Figure141: The microscale master plan blow up A. Scale 1:500 Source: Author.

Master plan blow up B



B ▲

▲ B

Figure 142: The microscale master plan blow up B.
Scale 1:500
Source: Author.

Street Sections

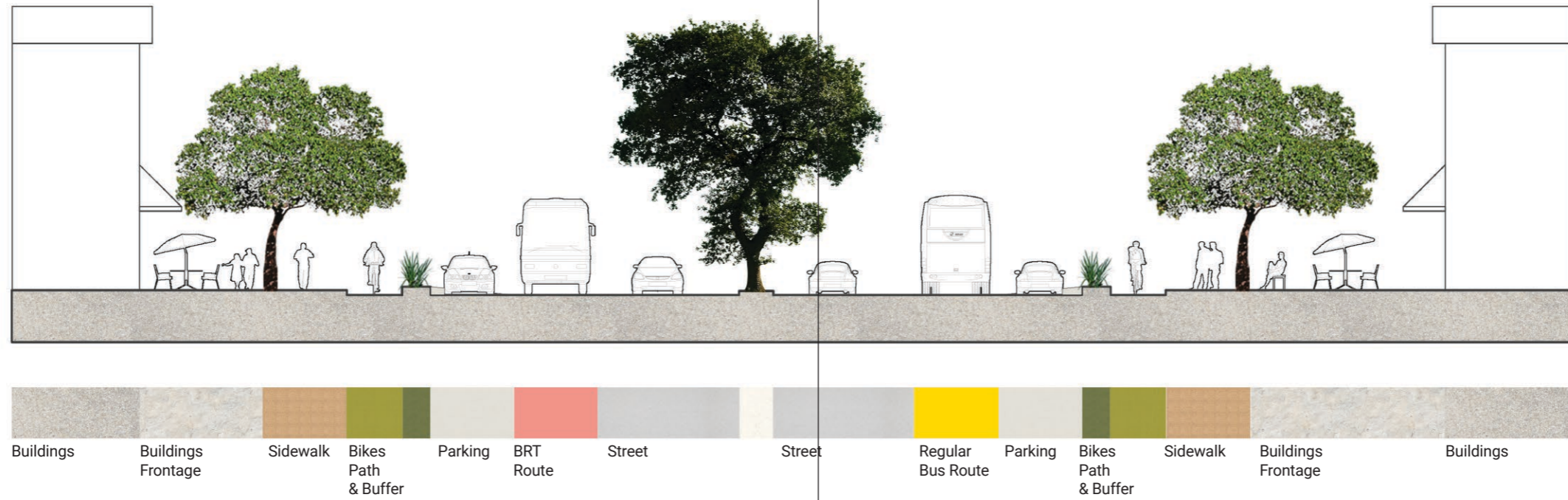


Figure143: Street section A-A. Scale 1:200. Source: Author.

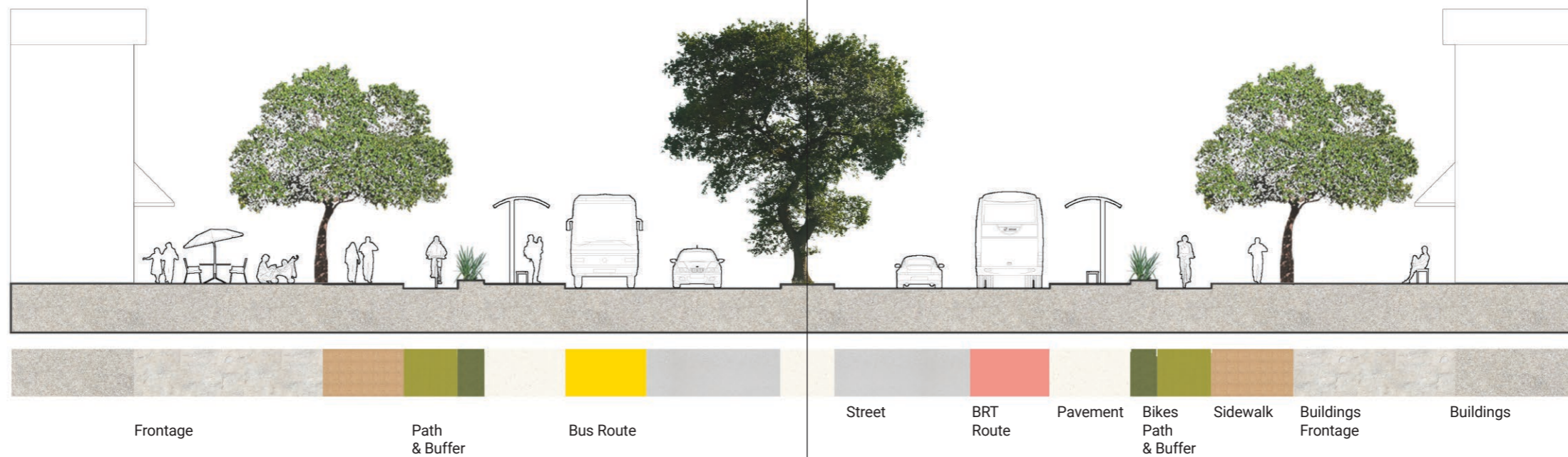


Figure144: Street section B-B. Scale 1:200. Source: Author.

5.3 The Timeline of the Project

A Vision on the Future

This project is only a starting point towards the complete transformation of the city. It is a model for other neighbourhoods around the city, and also a vision for the metropolises of the Kingdom.

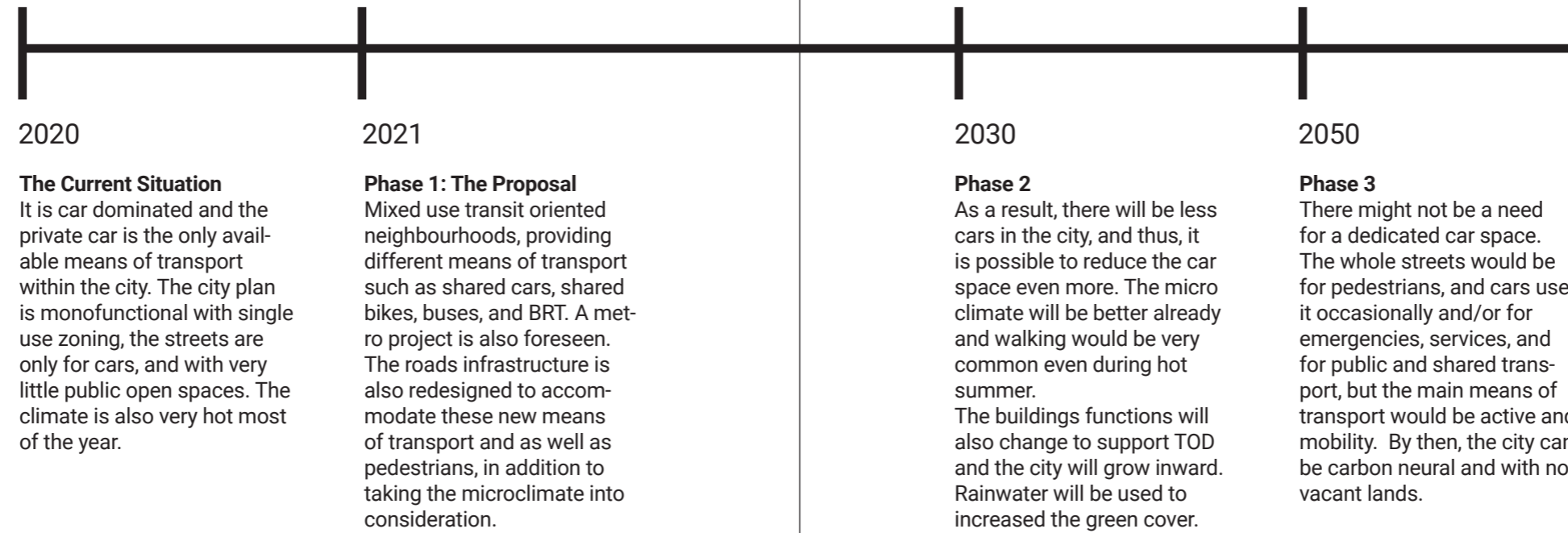


Figure145: Garden streets (before) by Foster and Partners.

Source: Chris M, Lydia M and Frank H, From garden streets to bike highways: four ideas for post-Covid cities – visualised, theguardian.com, 25 Sep 2020.



Figure146: Garden streets by Foster and Partners.

Source: Chris M, Lydia M and Frank H, From garden streets to bike highways: four ideas for post-Covid cities – visualised, theguardian.com, 25 Sep 2020.

6. The Conclusion

Jeddah now is completely car-dominated, due to many factors, starting with the oil boom, until the harsh weather and hot climate most of the year, to the cultural norms and traditions, and finally, because of the urban sprawl and monofunctional urban plan with wide streets and large distances between functions. The city also suffers from a serious lack of open public space and vegetation.

This project, however, investigates all these underlying problems and identifies the city's potential as a resilient sustainable city, then it focuses on the development of vacant underused lands and spaces with relevant potentialities, and finally, it proposes solutions for a relevant transect within the city using urban strategies such as, transit-oriented development, bus rapid transit, mixed-use, density, multi-modal streets, and reusing spaces, in order to create an environmentally resilient, livable, inclusive, healthy, and a human-based city. Then after that, the project redefines the railway station area to accommodate an inclusive neighbourhood with the aforementioned urban strategies and principles.

This point is very critical to create a sustainable, compact, and human-based city. Jeddah already has the main railway station with good infrastructure, but it is not being taken full advantage of. For example the central area around the railway station has more than 50% vacant land, and the land immediately adjacent to the station (which is about 3 million square meters) was originally planned to be a parking space.

The proposed microscale redesigns the entire roads network and proposed a new neighbourhood in a very strategic location while focusing on transit. The neighbourhood will offer everything within walking distance, and there will be a rapid bus network that connects it with the large attractors of the city depending on their priority, such as the hospitals, the university, and the shopping malls, as well as other generators such as the neighbourhoods. In addition to transit, the neighbourhood is also designed with response to the climate, inspired by local vernacular architectural techniques, the goal of the urban morphology of the project is to create a pleasant and comfortable climate so people can use open public spaces and active mobility with ease.

The project scales down from the city scale to the neighbourhood scale. It starts by studying the city, then summarizing the key issues. It also studies the features of the historic city in which was known to be sustainable and resilient. After that, a relevant transect is chosen to focus on, and this transect is studied, mapping all the issues and potentialities. Finally, within this transect, the focus microscale project is planned. This gradual step by step movement is very critical to understand the context of the project because the design must uniquely respond to each place.

Finally, it does not stop here. This is only the first step towards sustainability. The city will keep transforming in steps until it becomes completely sustainable, lively, carbon-neutral and self-sufficient, and even then, the development will not stop, because Jeddah has always been, and will always be, resilient.

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