URBAN SPRAWL AND ITS NEGATIVE EFFECTS ON JEDDAH

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In the Name of Allah, the Compassionate, the Merciful

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ABSTRACT

RESEARCH PAPER: Urban Sprawl and its Negative Effects on Jeddah

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Urban sprawl is considered a major issue in Saudi Arabia due to its impact on all the government sectors. This study presents three main facets that affect urban sprawl: unplanned migration, weak infrastructure, and car dependency. Migration generates significant growth beyond the current absorptive capacity and future demand of the city. In addition, migration generates unorganized population distribution, which leads to multiple city centers forming resulting in an unclear city center. Weakness in services in some urban areas also result due to the emergence of unplanned settlements. Infrastructure is affected by this significant and rapid growth, which leads to inadequate services that do not meet the residents' needs, resulting in a deteriorating quality of life. Car dependency has many negative effects including traffic congestion, air pollution, road accidents and fatalities, and decline in public health. The weakness of public transport furthers this problem. The aim of this thesis is to discuss how the negative impacts of urban sprawl are affecting Jeddah Saudi Arabia specific to each axis, present a review of the literature, and evaluate a proposed new development project which aims to restructure an unplanned settlement as a case study.

CHAPTER ONE

Introduction

Urban sprawl is an issue that affects many fields of life. It affects life quality, the environment, economy, politics, and society in general. Over time as urban sprawl expands it becomes increasingly out of control, and the more negative effects it has on the whole society. For instance, the huge growth of the city of Jeddah, inside and outside the urban growth boundaries generate disorder in the distribution of community and infrastructure services, uneven population densities, business activities, and government departments. The lack of services is one of the key negative impacts of urban sprawl. This study will highlight three important issues affecting cities in Saudi Arabia. These issues are migration, infrastructure, and car dependency.

The city of Jeddah is one of the fastest growing cities in the Kingdom of Saudi Arabia. It is a destination for many people who are looking for better career opportunities, life, and education. Therefore, it is expanding rapidly, which makes this growth unsustainable beyond the current absorptive capacity of amenities and future planning of the community. Unplanned migration is a significant cause of urban sprawl.

Migration increases the severity of growth, which generates unorganized population distribution. This distribution reflects the lack of control, which creates many negative effects, such as multiple centers of the city, which results in an undefined or unclear city center and weak services in some urban areas.

Water supply, sewage, discharge storm water, power supply, and tele-communication are infrastructure services that are affected by rapid urban growth. With this significant growth, infrastructure services are facing a huge demand from the community that in turn face a major weakness in coverage. For instance, the storm water drainage network is only covering 40% of the city of Jeddah, which exposes the urban population to flooding hazards (Jeddah Strategic Plan, 2009).

The sprawl of Jeddah city creates many communities that mainly depend on cars for transportation. There are many causes for car dependency such as the lack of or uneven public transportation coverage. The usage of public transport covers 2% of all trips within the city of Jeddah (Jeddah Strategic Plan, 2009). Different urban areas have different population densities and these results in poor transportation service. Low gas prices, non-fuel tax, high vehicle ownership, low registration fees, and weak land use are other reasons that cause car dependency. High car dependency also causes traffic congestion, air pollution, road accidents and fatalities, and public health decline.

This research will shed light on the current situation of three axes (migration, infrastructure, and car dependency) that need immediate address. It will also review all the information, statistics, and demographic related to the current situation of Jeddah. In addition, the research will explain how the urban sprawl negatively affects the community.

What is Urban Sprawl?

Urban sprawl is an expansion of the community in all domains, in urbanization, social, and economical. While the expansion of physical urban extents of cities affects infrastructure, roads, and buildings, which are all the physical features of the urban areas, the domain of economic expansion extends to reach all the projects and the developments that help the public economy to improve; such as creating jobs opportunities and better income. The social expansion is presented in the social cohesion, which plays a role in changing some of the culture of the city.

Urban sprawl has many negative effects, which has pushed the Saudi Arabian government (all the sectors responsible for this issue), to try its best to eliminate those effects. Urban sprawl has its positive and negative effects on any city. Although many planners believe that urban sprawl reflects progress and prosperity, others think that it has a downside. So if the 'sprawl' is good for the community, it requires control by a systematic growth boundary. On the other side, urban sprawl has many negative effects, which sometimes cannot be easily controlled, such as migration.

Need for Research

It is important to understand how sprawl is significant and has negative effects. This paper will discuss three important issues that result in negative impacts on the environment, economy, and social quality of life. First is the high and increasing rates of population growth in Jeddah. Second, the community risk of deterioration of the

infrastructure. Third is poor public transportation service and societies heavy dependence on cars.

Objective of Research and the Methodology

This research aims to shed light on the issue of urban sprawl in the context of Saudi Arabia. There is a pressing need to identify the causes and possible approaches to mitigate the factors related to urban sprawl, including causes, positive and negative effects. To date there is an absence of research on the proposed solutions that aim to address the urban sprawl problem in Saudi Arabia in the literature. Importantly this thesis aims to evaluate proposed solutions specific to unplanned settlements and the central city core of Jeddah.

In this thesis study, I will introduce the causes, and factors that influence the rise of urban sprawl in Saudi Arabia. I will present the strength points of Jeddah city on the economical, social, political, and environmental level. Then, I will identify negative effects of the urban sprawl, and identify the impacts of urban sprawl on the economy, society, and environment. I will then undertake an analysis of case projects using space syntax methods to understand how the physical spaces of unplanned settlements are being reshaped. I will then discuss the most important developments and planning strategies proposed by the Saudi government. In conclusion, I will propose some solutions and policies to solve the issue. This research study primarily draws material from a literature review, examines three cases studies situated in Jeddah KSA, and undertaken analysis of the proposed solutions presented, to reduce negative effects and impacts of urban sprawl. In conclusion, I will propose some solutions and policies to solve the issue.

What do you Know About Jeddah?

The city of Jeddah is the Bride of the Red Sea, and the Kingdom's largest coastal city. Also, it is considered one of the most important cities of the Kingdom of Saudi Arabia as it is the business portal that has gained great importance for the movement of international trade with foreign markets. Moreover, in the past it was used to represent the external port of the Kingdom. As a result, it is well known for its industry and development in all fields of trade and services. Such a role makes Jeddah one of the most attractive cities to work in. Over the years, it has become a capital for the business and finance in the kingdom. In addition, Jeddah is characterized as the gate of the Two Holy Mosques in Saudi Arabia, and the first station for pilgrims who visit to the Holy Land (Makkah and Medina). There are about 5 million people who enter Jeddah annually through King Abdul-Aziz International Airport, in order to perform Umrah, Hajj (Jeddah Municipality, 2013).

The city of Jeddah is located on the west coast of the Kingdom of Saudi Arabia, at the middle of the eastern shore of the Red Sea (Figure 1). Approximately, the urban area of Jeddah is 1,765 km^2 and the total area is 5,460 km^2. The estimated population of the province of Jeddah is about 3.4 million, which represent 14% of the population of Saudi Arabia, which is around 25.37 million. The population growth rate in the city of Jeddah is 3.5% (Jeddah Municipality, 2013).

Figure 1. Jeddah, Saudi Arabia Location Map

CHAPTER TWO

Urban sprawl has positive and negative effects. In the following section I will examine three main issues related to urban sprawl. The first issue is the negative effect of urban sprawl which is shown in the lack of control of people who migrate to the city from surrounding areas, in tandem with the migration of people from the inner city to the urban periphery. The second negative effect is the lack of infrastructure control and requirement for the provision of all services into suburban areas by the government, the high commission and municipality for Jeddah. The third negative effect is the people's dependency on using personal cars, in a community that significantly lacks means of public transportation, which results in one of the most negative impacts air pollution.

Migration

Migration to Jeddah is considered one of the negative effects of urban sprawl. It results in the increase of the population in Jeddah city and creates an unorganized movement of city elements; such as changing the business center from the city center to different areas that have different centers. Migration also affects many of the government decisions, because of the rapid increase of the population (Jeddah Strategic Plan, 2009). There are two kinds of migration. The first kind of migration is when people leave their hometowns to immigrate to Jeddah, which is called external migration within the city scale. According to Alsakran, and Mohammed (2004), migration is defined as the transition process or changes a place of residence by an individual or group of a community, by a permanent or semi-permanent time that are accustomed to reside in their place into a different community or area. The second kind is when people leave the city center of Jeddah and immigrate to suburban areas, which are referred to as internal migration within the city. Both have their own scale which has different value of impact on the planning issues.

External Migration

People migrate from their towns to big cities such as Jeddah city for many reasons. These reasons are usually social or economical reasons. Most of the time, people migrate from their towns, which are located near the city of Jeddah. Therefore, one could say that there is an inverse relationship between the size of the migration and distance. Also, King Abdulaziz University, which attracts many students to pursue their higher education, is located in Jeddah. So, it is obvious that these people are looking for better education in Jeddah. There is also the economical factor; it is considered one of the most

important reasons why people immigrate to the city. People migrate to Jeddah looking for better career and job opportunities in Jeddah. They are looking for better life quality, which is represented in better housing, public facilities and services.

Causes and Motivations of Migration to Jeddah

Jeddah has many motivations that make people migrate from their town or village into it. Some of those motivations are economical, social and environmental causes. We need to know what drives people to migrate to Jeddah? Economical reasons are one of the main impulses that encourage people to migrate. They migrate looking for better career opportunity and higher income (Alshahrani, 1996). Jeddah has the biggest port in the country, which represents the gate of the two holy cities (Makkah and Madinah) also there are many factories and companies that make Jeddah the economic capital of Saudi Arabia. That means Jeddah residents are less likely to migrate than people living in rural areas. Moreover, migration is a result of logical and rational decision by immigrants who are wishing to improve their economic life.

People also migrate to Jeddah for social reasons. They want to live a better quality of life and have better social services such as education, health, and entertainment. Jeddah has King Abdulaziz University, which is one of the biggest educational institutions in Saudi Arabia that attract many students who want to continue their higher education. Statistics reveal that 18% of the students who migrate to Jeddah come with their families for the purpose of education, with 28% percentage of students' migrating as individuals. Usually, people who are looking for their education are temporary migrants who return after completing their studies to their native city (Althemaaly, 1990). Religious factors are also important social motives for migration to Jeddah as it is

situated near to the two Holy Mosques (Faiumy, 1991). Also, environmental factors of Jeddah's climate such as mild weather and clean environment are factors as people search for a better standard of living. As a destination city, Jeddah provides improvements for many in housing, public facilities and services (Alsakran & Mohammed, 2006).

Impacts of Migration

There are many reasons that motivate people to migrate to Jeddah. This migration results in the increase in population and leads to significant expansion of the city space, and areal extents frequently referred to as urban sprawl. After unfolding the causes of migration to Jeddah, it is important to know the effects of this migration. There are many positive and negative effects that play major roles. The effects of migration are varied and they are not limited to one aspect of life, but include many aspects. The effects of migration result from the impact on the distribution of geographic, sex, age and economic of the population status. The positive effects of migration are the decrease in the illiteracy rate among migrants, and providing a workforce for the industrial sector.

The urban sprawl is the most important element that is a result of migration. Day after day the city of Jeddah grows at a high rate. In 1970, studies indicate that Saudi Arabian cities had a growth rate in population at 17.8%. Then it has increased into 47% (1974), 70% (1984), 73% (1989) and 77% (1993) (Figure 2, 3) (Alsakran & Mohammed, 2006). These fast growing cities create challenges for the responsible authorities to control urban sprawl. Cities need more services, public facilities, and infrastructure, which is a burden on government. The increase in population density in the city of Jeddah leads to increased pressure on the social and economic facilities and services such as education, transport, housing, consumption of electricity and water. Also, it leads to the

spread of some aspects of deviant behavior and increased crime rates (Alsakran & Mohammed, 2006).

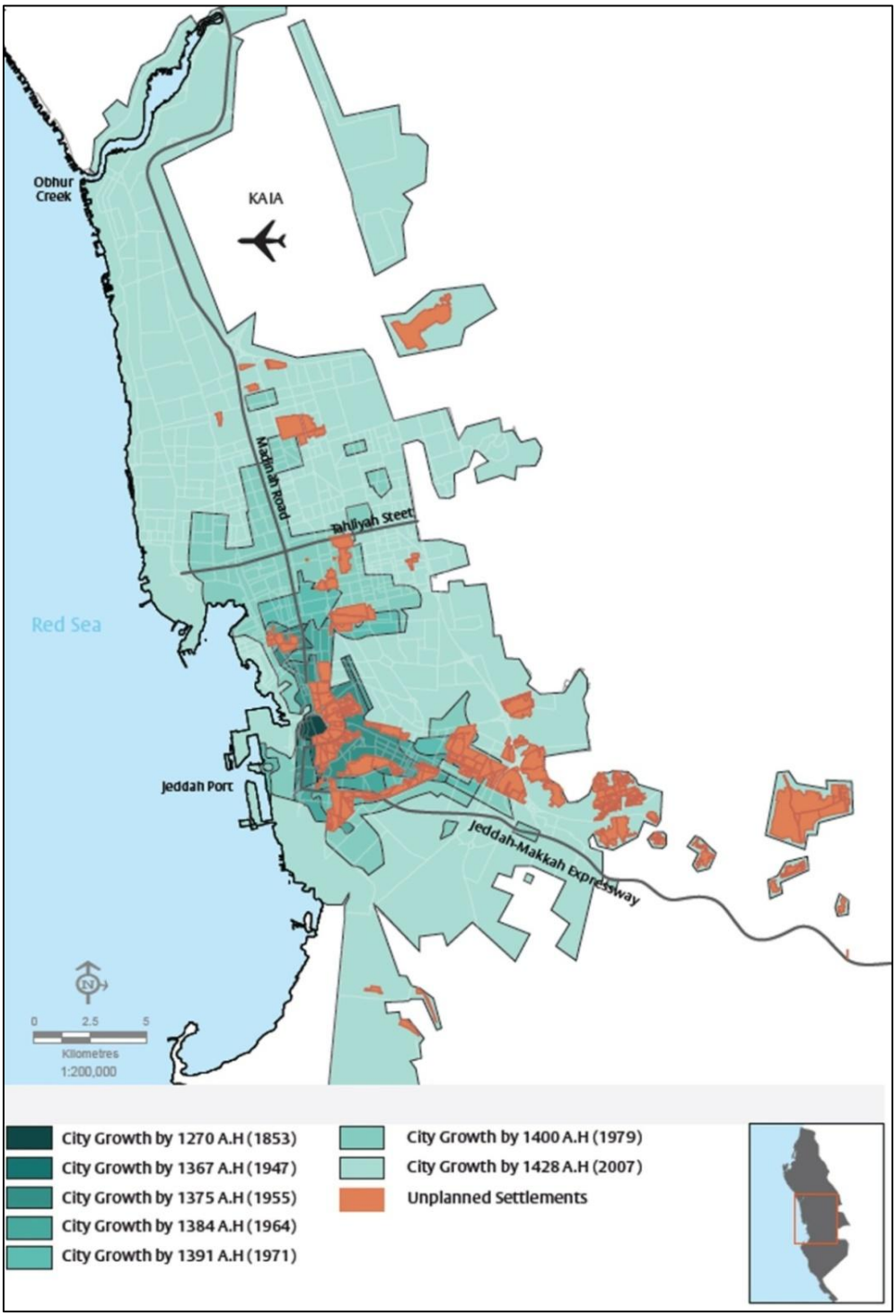

Figure 2. The Growth of the City (Jeddah Strategic Plan, 2009)

Saudi Arabia's Urban Expansion Rates					
Year	1970	1974	1984	1989	1993
Proportion of Cities Population	17.8%	47%	70%	73%	77%

Figure 3. Saudi Arabian Cities Grow (Alsakran & Mohammed, 2006)

Internal Migration

One of the biggest negative effects of urban sprawl is people's migration out of the city center of Jeddah to suburban areas. Usually, the growth is in the positive side which includes huge projects that plays a role in serving the community. In this situation, most of the developments going to move into suburban areas, and the city center will be lacking the industrial and developmental aspect. Many people choose to live in a quieter and comfortable community that makes their lives easier. Therefore, people choose to migrate to the suburbs. This migration leads to a piecemeal approach to urban growth due to a lack of spatial development controls. Besides, the city incurs additional costs to provide services, infrastructure, and roads to serve these large and scattered areas. Moreover, internal migration is one of the main causes for the current lack of infrastructure in many parts of the city of Jeddah (Jeddah Strategic Plan, 2009).

Reasons of Internal Migration

There are many reasons that encourage people to move out from the city center into the suburban areas. Those reasons and motives are social and economic issues. The suburban areas have so many advantages compared with the city center area. Suburban areas have better street network, which has wide streetscape, organized and lower traffic volume. There is a system in street classification. Also, the suburban areas have better subdivisions that have bigger and organized lots. On the other hand, these subdivisions create a social negative effect, which weakens the social relations between neighbors.

Another factor is that some suburban areas provide better services and higher quality functions such as shopping markets and malls, office complexes, parks and recreation areas, restaurants, etc. This results in a disparity in better quality of life environments between the city center and the new developments. This challenges the government to improve and redevelop the city center of Jeddah which will stem the migration out of the city center to suburban areas (Jeddah Strategic Plan, 2009).

City Center of Jeddah

The city center (Al Balad) is surrounded by unplanned settlements that isolate it from the rest of the city (Figure 4). The role of the city center is gradually declining by different factors, and the internal migration is one of them. Also, there are other factors that are related to the internal migration, which are the transmission of most commercial economic activities (offices and shops) to the suburbs. Another important factor is that the government moves some services to other areas in Jeddah. As a result of these factors, Jeddah starts to lose its identity and role as a distinctive center of activities. On the other hand the city center still has its historic district which adds value to the area. Likewise, turning the city center from the upper class housing area into an area that containing people violators of residing systems, non-Saudis, and Saudi citizens it with low income (poor people). Those residents have negative impacts on the area which by reducing the live quality, frequent crimes, and lack of development in the area (Jeddah Strategic Plan, 2009).

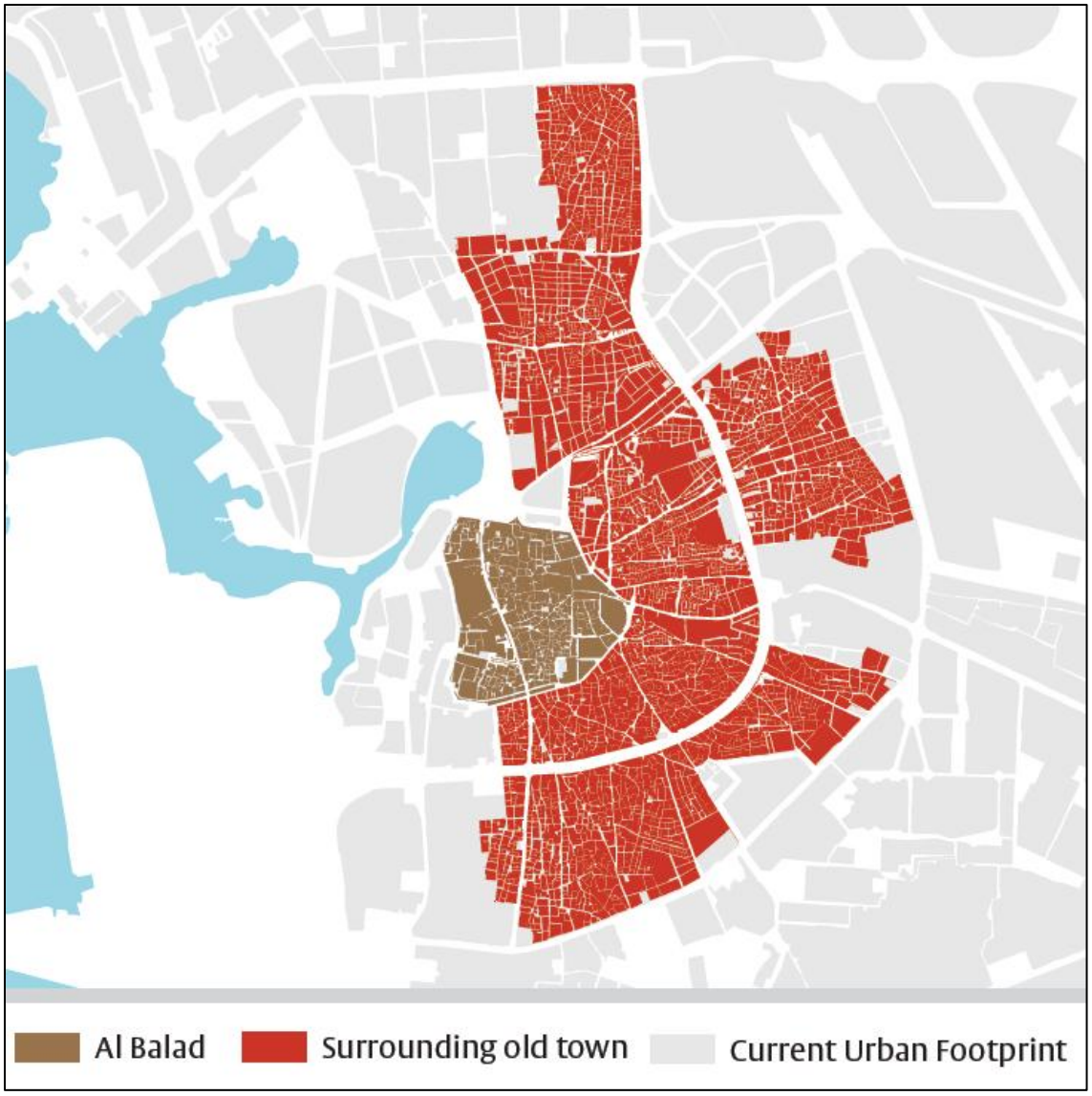

Figure 4. City Center (Al Balad) Isolated from the Rest of the City (Jeddah Strategic Plan, 2009)

Capacity and Pattern of the New Urban Areas

There are a large number of unplanned urban areas that have been created in a short period of time. The huge growth of the city is estimated to be 1,765 km^2, and it is more area than the city functionally demands. Also, according to the Jeddah Strategic Plan (2009), urban sprawl "has led to the inefficient and destructive use of land" (p. 44). The new urban development for the city of Jeddah has resulted in different spatial

patterns. The first pattern is fragmented development which is a large number of blocks and residential areas isolated from each other. Secondly, an inconsistent population density which is by presence of areas with high population density that interspersed with random vacant or unexploited land. Currently, the estimated area of the vacant land is 32,100 hectares which constitute 58% of the existing urban area of the city. Thirdly, a dominant highway network has developed and is occupying large tracts of land, which create breaks and buffer city districts (Jeddah Strategic Plan, 2009).

In conclusion, the two types of migration that were mentioned above affect the urban sprawl significantly. Jeddah city center residents are encouraged to live in the suburbs where new subdivisions are being built. There are many negative effects for those new subdivisions that make the issue of urban sprawl more critical. Some of those negative effects are, the lack of public services, low quality of infrastructure, lack of spatial land use control, weak social cohesion, unplanned urban expansion to name a few. On the other hand, there are many advantages for those people that make them prefer these subdivisions. The lower value of land and availability of vacant lots, wider streetscape and lower urban density are the advantages of choosing the suburban areas. That is factors in encouraging people to move out of the city center.

Infrastructure

The city of Jeddah has different categories of infrastructure services such as water, electricity, wastewater, and drainage services. According to Jeddah Municipality, the rapid growth and expansion of the city is the cause of infrastructure services unable to cover all built up areas and keep pace with new developments. Therefore, infrastructure services do not meet the population's needs, which result in frequent service interruptions in some areas. That of course is limiting the possibilities of development, and results in creating health problems and environmental degradation. Currently there is an urgent need for investments in the infrastructure services to meet the needs of the current demand. As well, there is a need for future planning to ensure meeting unexpected increased demand (Jeddah Strategic Plan, 2009).

Jeddah Strategic Plan (2009) stated the following:

> In terms of wastewater, water, electricity, telecommunications and drainage infrastructure, historically there has been a lack of investment from the public and private sectors and an absence of integrated strategic utilities management planning. This has resulted in an infrastructure lagging behind the growth of the city. There has also been little regard to the long term demands when installing new supply and distribution systems. (p. 257)

Capacity of Water Supply

Jeddah is growing rapidly despite of the limited natural resources and precisely potable water. In the last few years, Jeddah has received below normal levels of rainfall, under 84 mm of rain per year (Jeddah Strategic Plan, 2009). The city does not have fresh groundwater resources. As a result, Jeddah obtains water from other sources such as desalination. This way of obtaining potable water is a need, but it is negatively affecting the environment as to desalinate seawater, large quantities of oil must be burnt to

generate power, which is leading into environmental pollution. There is a water distribution network in Jeddah that covered approximately 90% of the developed areas. However, there are only 25% of the houses connected with the network directly. Also, currently there is no water supply continuously for the whole areas (Figure 5). Moreover, the capacity of the water supply does not meet the demand of Jeddah. Besides, there is a need to increase the capacity of the network to meet the need of expected increase in population over the next twenty years (Jeddah Strategic Plan, 2009). Therefore, the city faces significant challenges to provide fresh drinking water to meet the demands of future urban expansion.

The production of water before 2009 was about 620,000 m^3 per day. 97% of the production is from desalination plants of Jeddah, Shoiaba, and two ship-mounted which produce more than 60,000 m^3 per day. And the remaining 3% is produced from the groundwater sources which located in the east side of the city from Wadi Khulays and Wadi Fatima. In 2009 increase production of desalination to become 880,000 m^3 per day since the Integrated Water and Power Project (IWPP) started in Shoiaba (Jeddah Strategic Plan, 2009).

If we take into consideration the current Jeddah population which is 3,400,000 people, we will find that 280 liters per person per day of average water consumption in Saudi Arabia, and 20% leakage rates, we can say that the water demand is 1,200,000 m^3 per day. Based on 2029 Jeddah expected population which is 5,600,000 people which mean water demand will increase into 1,980,000 m^3 per day (Figure 6). The Ministry of Water and Electricity set plans to decrease the water demand into 150 liters per person per day. That will lead to decrease the general water demand in 2029 into 945,000 m^3 per

day which is less than the current supply capacity and demand (Jeddah Strategic Plan, 2009).

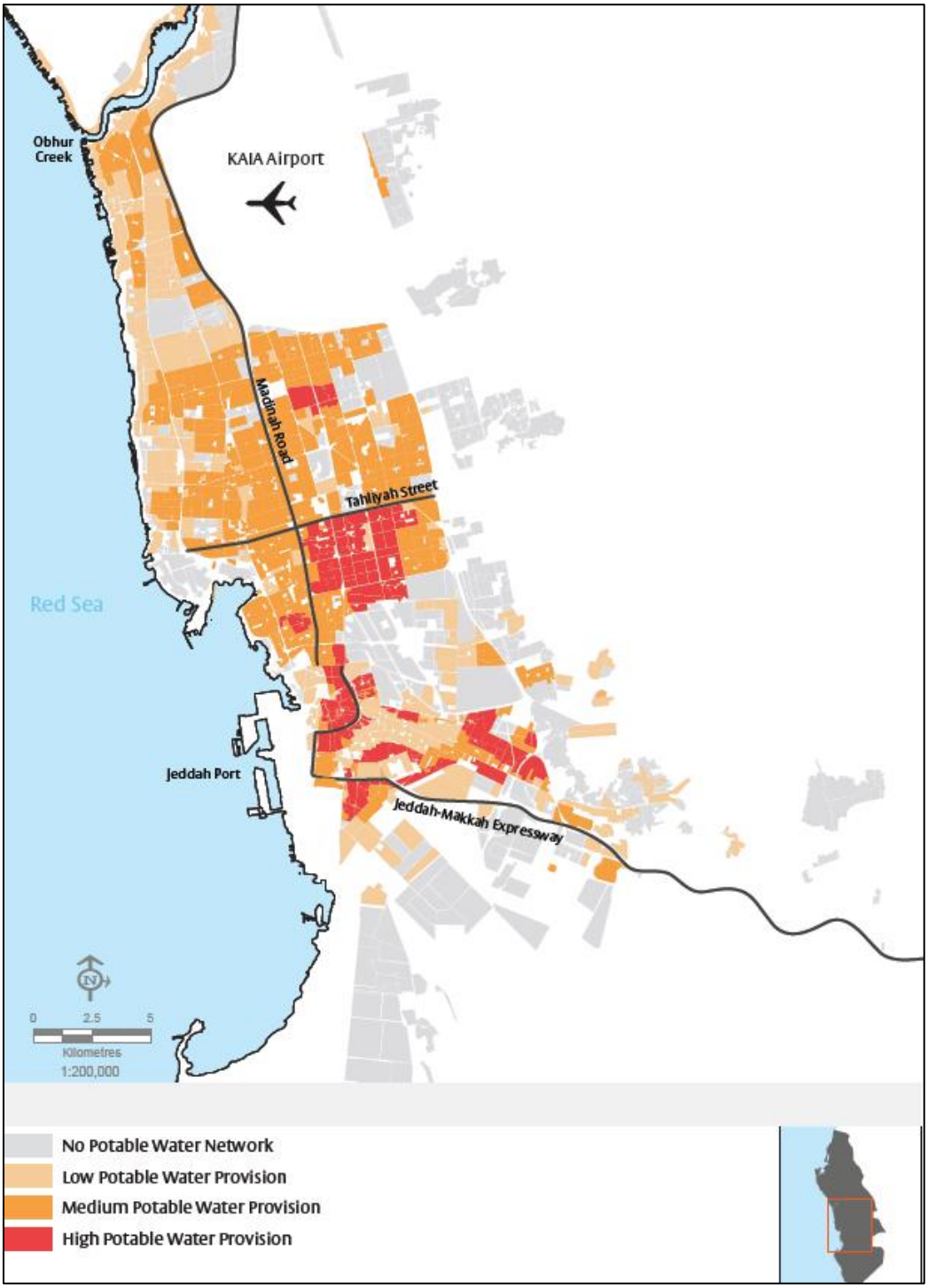

Figure 5. Water Distribution Network in Jeddah (Jeddah Strategic Plan, 2009)

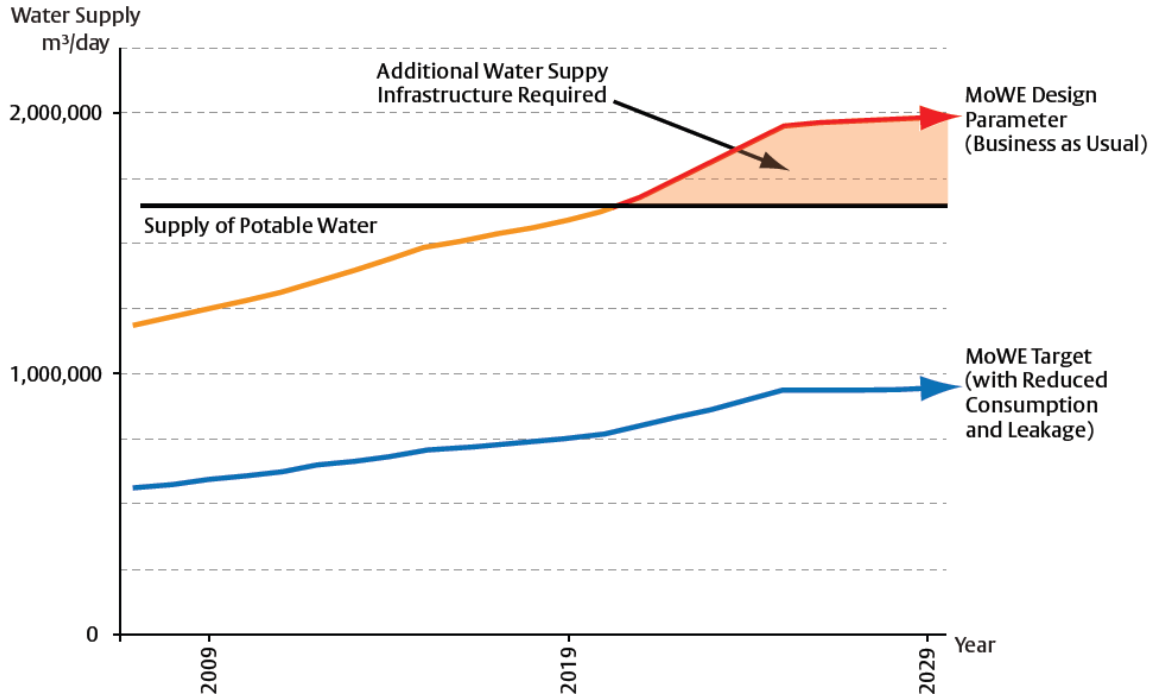

Figure 6. Water Consumption and Supply Capacity (Jeddah Strategic Plan, 2009)

Sewage Network

Sewage services in Jeddah are available with 45% of the total population is taking advantage from the sewage network (Figure 7). The current capacity of treatment plants is only treating a fraction of the wastewater, which is estimated at 330,000m^3 per day. There are plans to expand the treatment plants capacity in *Kumrah*, which is anticipated to add 250,000m^3 per day. Additionally plans for the building of a new plant at the airport will increase capacity to treat waste water (Figure 8). Comparing the water supply rates with the new capacity of treatment plants (after the expansion projects), it becomes clear to us that the current plans to expand the treatment capacity consist with the pace of current demand. However, there is a need for further expansion that meets future demand (Jeddah Strategic Plan, 2009).

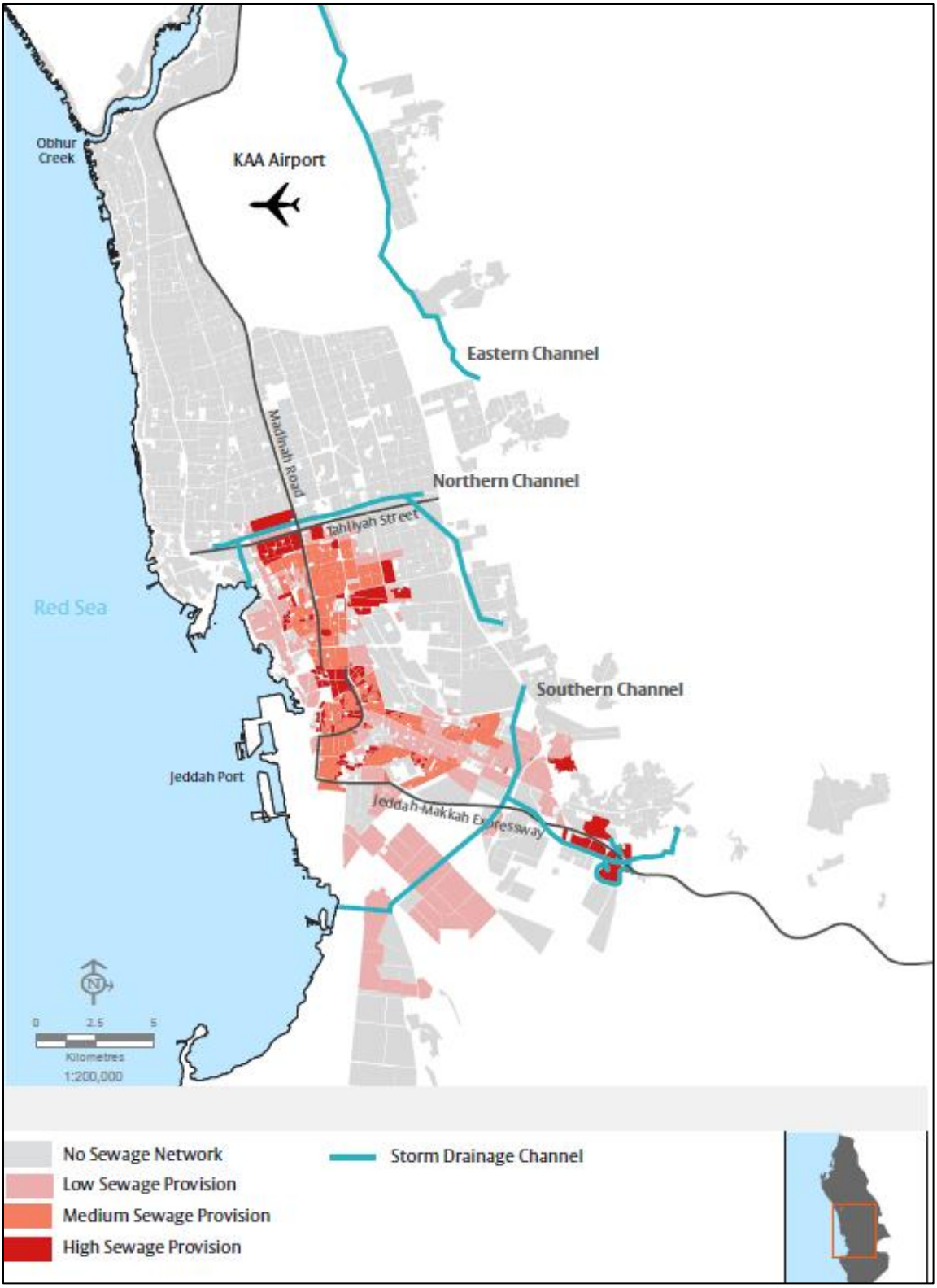

Figure 7. Sewage and Storm Water Network in Jeddah (Jeddah Strategic Plan, 2009)

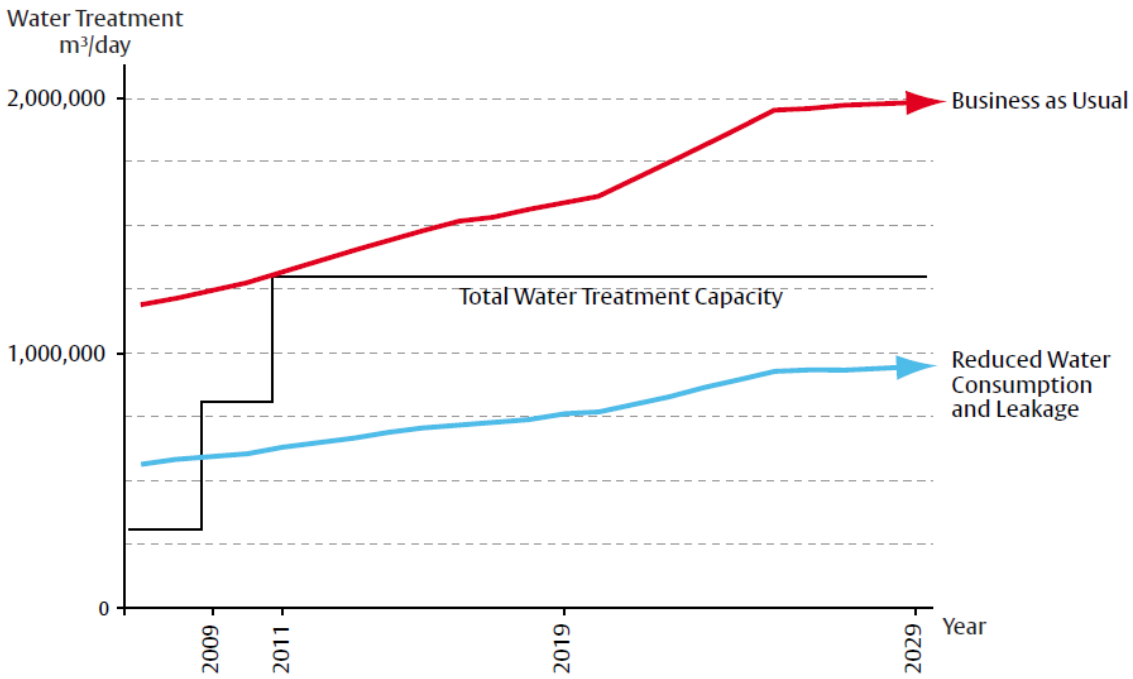

Figure 8. Wastewater Production and Treatment Capacity (Jeddah Strategic Plan, 2009)

It is worth mentioning that a large part of the wastewater Jeddah's is disposed of the Red Sea, which adversely affects the marine environment. Moreover, only 70,000 m^3 of the treated wastewater is used for irrigation, which constitutes 20% of the total 350,000m^3. The lack of wastewater networks in new urban areas leads the developer to build ground tanks to store wastewater. Then, tanks are emptied periodically by using tankers. It remains unclear as to the disposal practices of these companies regarding the subsequent treatment of wastewater. Over time, many of these tanks disintegrate which results in leaking the wastewater into the ground water and therefore contaminating it (Jeddah Strategic Plan, 2009).

Storm Water Network

Jeddah is located on the path of discharge of 11 valleys (wadis), and all of them are located on the east side of the city. Currently Jeddah has three storm water channels cross the city, which are used to drainage storm water runoff (Figure 9). These channels are being from the east to west, which is from the valleys into the Red Sea. But the problem is the channels are not connected to the sea directly. They depend on pumping the water into discharged points. Moreover, most of these channels are uncovered which are considered as health risk when the water standing. The storm water drainage network is only covering 40% of the city. The remaining 60% area of the city of Jeddah is experiencing standing water during the rainy periods, which make the people unable to cross the road network. Many of the residential areas located next to the channels have illegal connections of wastewater with the storm water channel. The result is that makes the storm channels transfer into wastewater channel, which have more risk on the community health (Jeddah Strategic Plan, 2009).

Figure 9. A Channel Collecting Stormwater (Jeddah Strategic Plan, 2009)

The east side of Jeddah is dangerous during rainy periods, because it is an area that collects all runoff water from the 11 valleys, resulting in massive

flooding. Besides, the east side is a collection point of the three storm water channels which is vulnerable to the risk of flooding (Jeddah Strategic Plan, 2009).

In summary, according to Jeddah Strategic Plan (2009), 60% of the city is lacking surface water drainage, which poses a significant risk on the lives and properties of the city. The following section will shed light on flood hazard in Jeddah.

Flood Hazard of Jeddah

In November, 2009 a tragic incident happened in Jeddah, which resulted in the death of many people, and destruction of many properties (Figure 10, 11). There are many reasons for this tragedy and unplanned urban sprawl is one of them. Natural rainfall is a hazard in Jeddah. Identifying the impacts and flooding prevention methods are important issues to be addressed in urban sprawl. According to AlSaud (2010), one of the factors is "dry climatic conditions, which has become lately a typical region for such natural hazard" (p. 839). Also, that came from many developers who made their new subdivisions in flood zone. The government is facing challenges to make good storm water drainage within huge growth and developments out of the urban growth boundary. Therefore, answering the questions where it happened and why it happened should help us finding solutions for the issue of city flooding.

Jeddah is located on the path of discharge 11 valleys (wadi) and all located on the east side of the city (Figure 12). The eastern edge of the city is located on a plain which is the end of these valleys which is the collecting point for the storm water. Also, it is the upstream outlet for the three storm water channels in the west. Therefore, there is the catchment area (gap) between the valleys and the three channels. The flooding issue

happened in this area where no drainage network and safety means of the valleys risks (Figure 13) (Jeddah Strategic Plan, 2009).

Figure 10. Flooding in Jeddah, November 2009

Figure 11. Flooding in Jeddah, November 2009

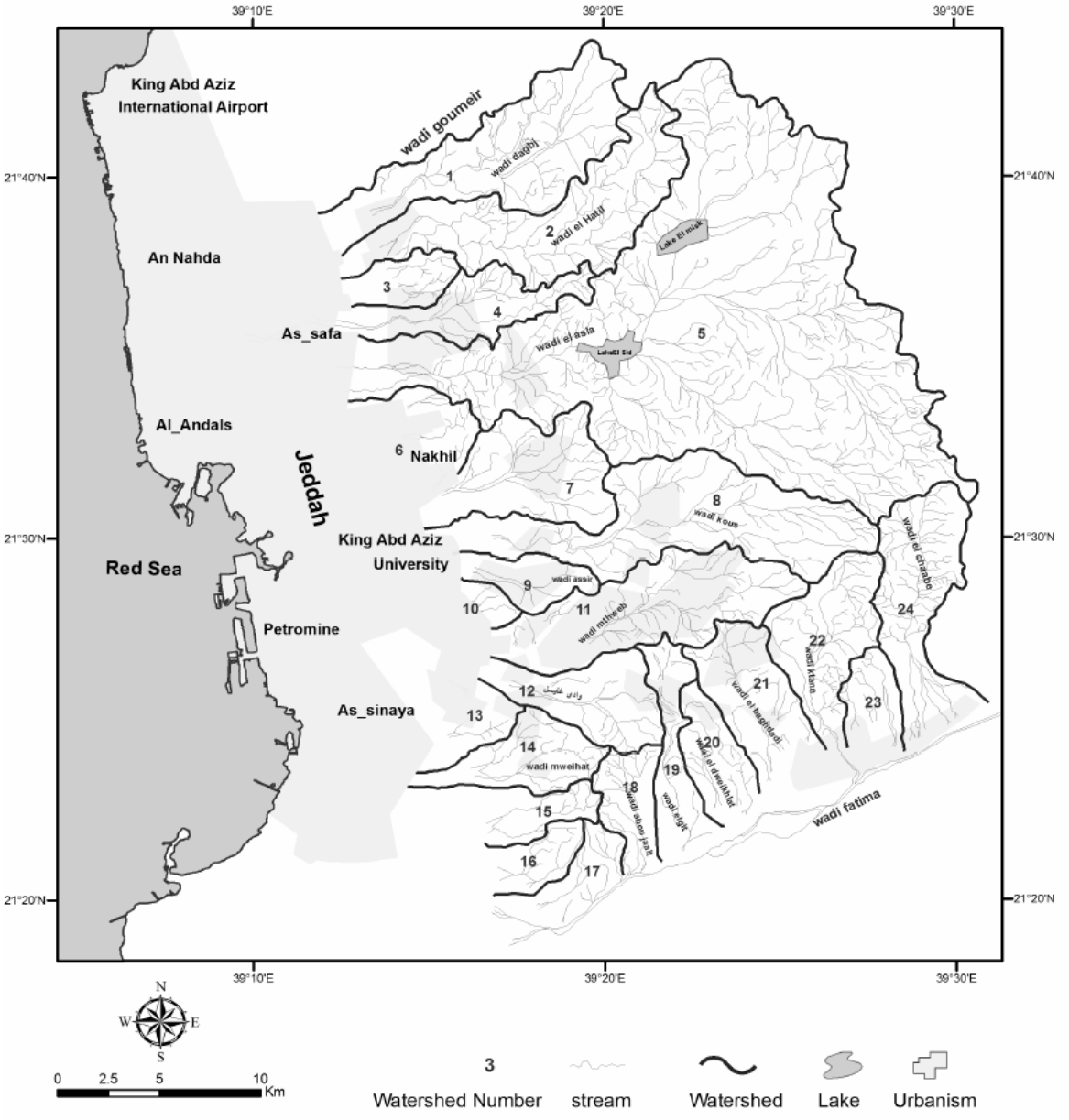

Figure 12. Watersheds Map of Jeddah Region and Valleys (AlSaud 2010)

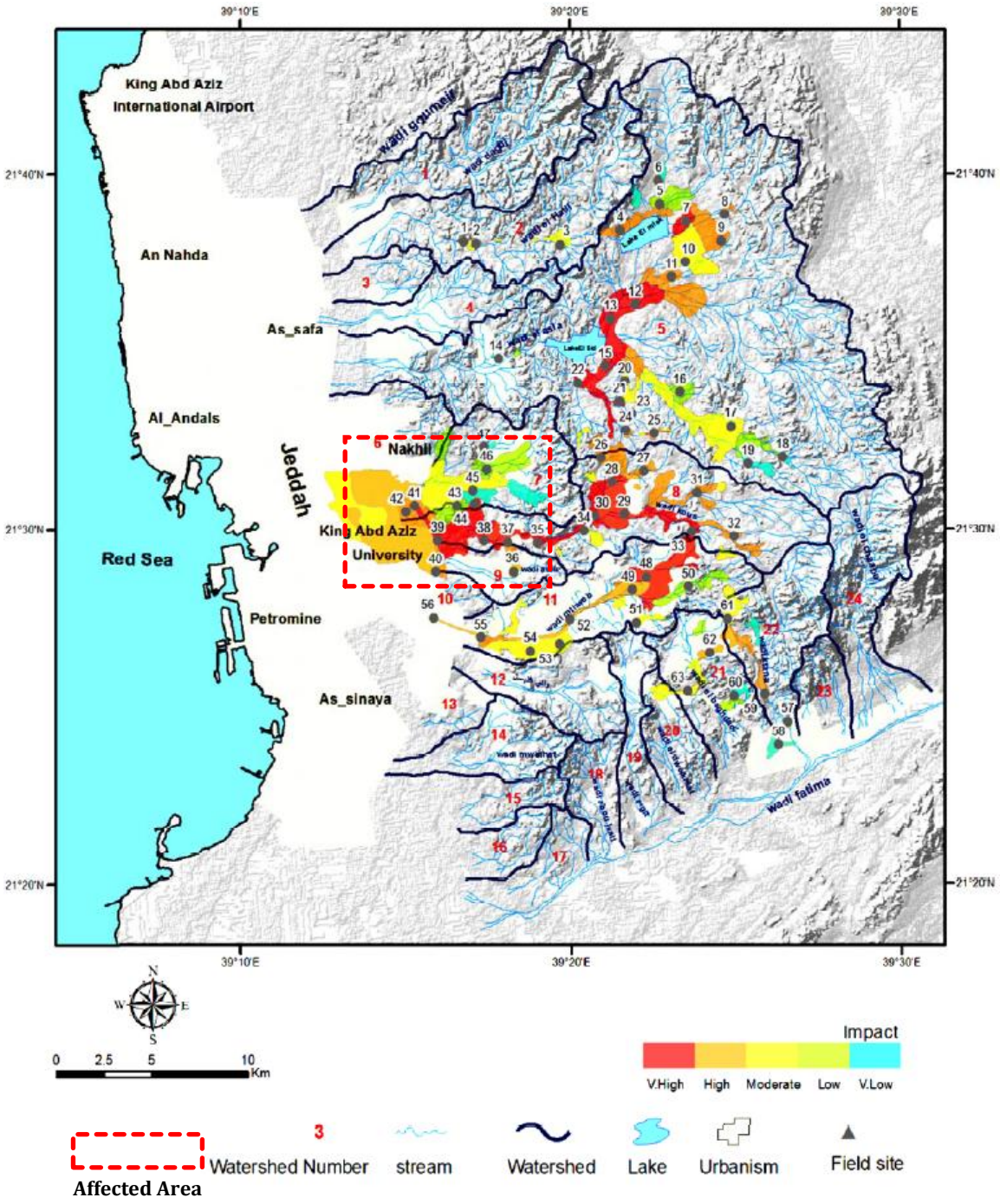

Figure 13. Flooded zones in Jeddah region (November 2009) with five damage categories (AlSaud, 2010)

Causes of the Disaster

The flooding disaster in Jeddah is a result of different aspects (natural hazards, utilities, and location). The major aspect is the natural hazards which occur frequency and suddenly. Recently Jeddah was exposed suddenly to large amounts of rain and in a few times a year which reverses the customary 'dry climate' (AlSaud, 2010). Jeddah during the past decades didn't receive the services of appropriate infrastructure, which include stormwater drainage. Also, Jeddah lacked during this period the public and private investment in these services. Moreover, it lacked the strategic planning for integrated facilities management. All that resulted in a lack of pace in the infrastructure for the city's growth. Flooding can happen anywhere, but certain areas are especially prone to serious flooding. The disaster area is located in the area that does not have drainage network and safety means of the valleys risks. Moreover, as it was mentioned before, the area is located between the valleys and three channels (Jeddah Strategic Plan, 2009).

Consequences

The flooding issue affects the community in different ways. First, it has resulted in losses in money and lives. In November 2009, more than 100 people were killed and a lot of properties were destroyed (Figures 10, 11, and14). According to AlSaud (2010), "It reveals that the average economic damage value may exceed 19 million UD dollars per year" (p. 839). Likewise, at the level of government decisions "This helps avoiding further urban expansion in areas under flood risk and will aid decision maker to put new strategies for hazard management" (Al Saud, 2010, p. 839). Therefore, the urban sprawl requires some careful consideration in using the land in order to avoid similar tragedies.

Figure 14. Example showing flooded zone as identified from IKONOS image (AlSaud, 2010)

Power Supply in Jeddah

Jeddah city is supplied by a power supply network, which covers 98% of the city areas. The remaining properties of the network are supplied with electric power by fuel-powered generators. The total capacity of power generating in Jeddah region is 11,000 megawatt. Currently, the power supply is inadequate and doesn't meet demand. Besides, there is a lack of electrical power reserve. Currently the Saudi Electricity Company (SEC) is working to develop strategic projects to rationalize power consumption (Figure 15).

There are three main power generating stations that supply power to Jeddah. The largest one is located in Shoaibah and the total capacity of power generating is 1,900 Megawatt. Then is Rabigh station within 1,700 Megawatt of total capacity of power generating. The third one is station that is located in the Al Major area of Jeddah that generated the power by the gas fired (Jeddah Strategic Plan, 2009).

The power consumption average of the Saudi person is 6,400 Kilowatt per year with the demand of power in Jeddah is estimated to be 4,500 Megawatt per day. As shown in figure 13, there is a need to increase capacity of power generating into 7,750 Megawatt per day by the year 2029 in which the population of Jeddah is anticipated to reach 5.6 million people. The growth of power demand in Saudi Arabia is 7% per year, which reflects a 5% growth in the number of consumers and 2% increasing per capita demand (Jeddah Strategic Plan, 2009).

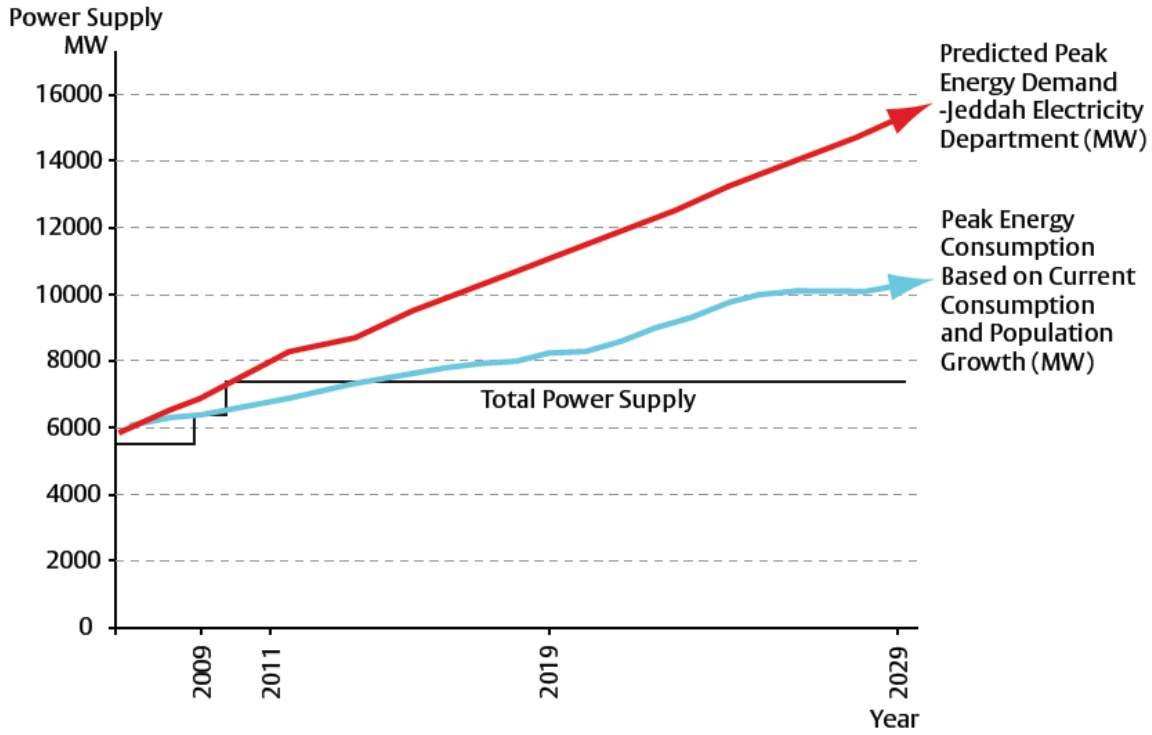

Figure 15. Power consumption and generation capacity (Jeddah Strategic Plan, 2009)

Telecommunication Services in Jeddah

The telecommunication market is divided into two sectors; the cellular market and fixed line market. The cellular market continues to develop and improve its services and coverage. On the other hand, the spread and coverage of the fixed line are low which is expected to improve, if the competition insert in the fixed line market which is as

happened in the cellular market. While the new companies which will provide new services can use the local network which is affiliated to Saudi Telecom Company (STC), this is not expected to result in a large scale expansion and for a long time. That "The critical pinch-point is the existing local distribution network, which in general, will not be adequate to support redevelopment on the scale of the Jeddah vision" (Jeddah Strategic Plan, 2009, p. 271).

Summary of Infrastructure Issues

The infrastructure control is a significant factor that the Saudi government is working to address. The government is attempting to eliminate many problems and negative effects of insufficient supply of infrastructure in the Jeddah urban areas. The major problem relates to the pace of new subdivision construction outside the Jeddah growth boundary, which requires the extension of infrastructure. With the present pace of uncontrolled growth it is an unsustainable situation. The imposing of restrictions to new developments may assist in this problem.

This section has discussed some of the negative effects related to the lack of infrastructure and impact of urban expansion. These negative effects are exposure the community into risks and low life quality. One of the significant risks is exposure Jeddah into flood hazard, because there is a weakness in the disposal floods system. The floods in Jeddah have been raised which generated disaster in 2009. Therefore, Jeddah needs to improve their disposal floods system to avoid disasters in the future. Moreover, the streets in Jeddah need renovations to improve their condition and quality of infrastructure. They need all the complete street elements to create a health community and better life quality.

	Summary	Clarification
1	**Utilities access and supply are limited**	Not all parts of the governorate have ready access and reliable supply of basic utilities, including water, sewerage, electricity and telecommunications services.
2	**Utilities capacity is insufficient**	The existing capacity of utilities infrastructure (water, sewerage, electricity and telecommunications) is insufficient to meet present and projected future demand
3	**Lack of coordination**	There is a lack of coordination and planning in utilities planning and implementation in Jeddah
4	**There is insufficient wastewater treatment capacity**	The current water treatment plants have enough capacity to treat only part of the city's waste water. There are plans to increase the waste water treatment capacity through the building of a new treatment plant in Jeddah
5	**Power supply cannot meet peak demand**	Currently at peak demand times, there is insufficient power supply to cope with the demand and there are periodical brown-outs
6	**Low take-up of telecommunications**	While significant improvements in telecommunications service and availability have been achieved, the penetration of fixed lines and the take-up of broadband have been low

Figure 16. Summary of Infrastructure Issues (Jeddah Strategic Plan, 2009, p. 273)

Car Dependency and its Negative Effects

Currently the car is the dominant mode of transport in Jeddah. This mode represents more daily trips to a lot of roads. Traffic congestion has negative impacts on the environment, safety of road users, and economical prosperity. Traffic congestion is a significant issue that needs to be addressed and solved to provide a healthy environment for the community in order to be able to live and work in an easy and safe environment. On the other hand, people who do not have cars are using limited public transportation. It is worth mentioning that in addition to the very limited use of public transportations, walking and biking are not common habits in Jeddah city even in periods of mild weather (Jeddah Strategic Plan, 2009).

Possible Reasons for High Car Dependency

Saudi Arabia has a special situation that makes the community high car dependency. In general, the hot climate, cultural influence and the high economical standard of living

play significant roles increasing car dependency. In Jeddah, the transport demand is increasing rapidly. Between 1978 to 2007, the number of the population has increased from 1.3 million to 3.4 million people. Moreover, it is expected that the population will be more than 5.6 million people by 2029. (Jeddah Strategic Plan, 2009) In addition, there are some other reasons that facilitate the use of cars such as: the low gas price and non-fuel tax, "high vehicle ownership and low registration fee, low urban population density, limited public transit coverage, and weak land use-transportation planning coordination (Jiao, 2013, p. 13).

Low Gas Price and Non-fuel Tax

Saudi Arabia is the largest oil producing and exporting country in the world, which makes the gas price very low compared with the world average price. Also, Saudi Arabia contains about 20 to 25% of the gasoline stocks in the world. Moreover, Saudi Arabia is the second cheapest country to sell oil after Venezuela. The price per gallon of gasoline in Saudi Arabia is US$ 0.30. Plus, no fuel tax (Alarabiya, 2011). The Saudi citizen spends 0.98% of their monthly income on fuel (Alarabiya, 2012). Therefore, the low gas price encourages the people to use their cars without the fear of spending a lot of money.

High Vehicle Ownership and Low Registration Fees

The most important factor that increases the vehicle ownership is the good standard in most communities. In addition, the Saudi Arabian culture influences the people to have more cars. The people have different cars for different uses. Many of the Saudi Families have special drivers, which require the use of more than one car. Also, the

registration fees of the car are very low which does not require tax roads. It only includes the cost of office services, which is symbolic fee (Jeddah Strategic Plan, 2009).

The average vehicle ownership in Saudi Arabia is 349 vehicles per 1,000 people. This high rate is the result of community dependency on private cars and the limited public transportation. Estimated 86% of the total trips in the city of Jeddah are by private cars and 10% by taxi. The results can be seen clearly in the congestion experienced by the city. Moreover, the existing road network is absorbing the maximum of its capacity. The issue will get worse with the increase in vehicle ownership, population growth, and newly young drivers, which will lead to severe congestion over the next five to ten years (Jeddah Strategic Plan, 2009).

Low Urban Population Density

Jeddah is one of the highest population cities in Saudi Arabia in terms of dependence on private cars. In some of the major urban areas (precisely, the area between the airport (KAIA) and Makkah Road) the population densities reach over 100 people per hectare. Moreover, the city center of Jeddah is the highest population density within above 500 people per hectare (Figure 17). On the other hand, the new urban areas have lower population density, which is the horizontal extension of the city that creates long travel distance and time. This high population density has significant advantages that support transportation means. However, there is a lack of public transportation in the city. Also, the vehicle usage is the dominant mode in all urban areas of Jeddah regardless of the high population density (Jeddah Strategic Plan, 2009).

Figure 17. Population Densities within Jeddah (Jeddah Strategic Plan, 2009)

Limited Public Transit Coverage

The public transportation service in Jeddah is limited to the Saudi Arabian Public Transport Company (SAPTCO). Also, this service has limited routes in and out of Jeddah city. Currently, this service is not well used, which indicates that it does not extend to reach different destinations, or it is not integrated enough with other public transportation options. Besides, in Jeddah there is an irregular network of small buses that are called 'coasters'. This network has limited use, unorganized, and serves a limited market (Jeddah Strategic Plan, 2009).

In European cities, the proportion of sharing public transport with the market is between 45% in Stockholm to 26% in London. Jeddah is similar to American and Australian cities for the public transportation usage within 5%. According to the latest and current estimates, the bus usage covers 2% of all trips within the city of Jeddah, while taxi usage covers 10% (Jeddah Strategic Plan, 2009).

The Ministry of Transport made a comprehensive study of public transport. This study determined the future routes, and technology appropriate for the expected scale of user demand. The proposal includes light rail transit service (three lines), bus feeder System (36 routes, covering 429 km, 338 buses), commuter rail (connect North Obhur and Jeddah City Centre), and water ferry (water taxi) (Figure 18). It is expected to increase the proportion of the public transport usage from 2% into 9% in 2025 (Jeddah Strategic Plan, 2009).

Figure 18. Regional Transport Network (Jeddah Strategic Plan, 2009)

Weak Land Use and Transportation Planning Coordination

There are several factors contributed to the urban sprawl (indiscriminate expansion) in Jeddah. One of these factors is the misallocation of the land use. Undergone large areas in the city for misallocation of use or little organization. These areas are clearly defined by the unplanned settlements. Also, these settlements are low quality residential areas that were built in an informal manner and did not receive an adequate public services and facilities. These areas are estimated area of 4,800 hectares and inhabited by approximately 35% of the city's population (Figure 19). The weakness of coordination resulted in agreeing on building new urban areas in sites not suitable and in inadequate planning (Jeddah Strategic Plan, 2009).

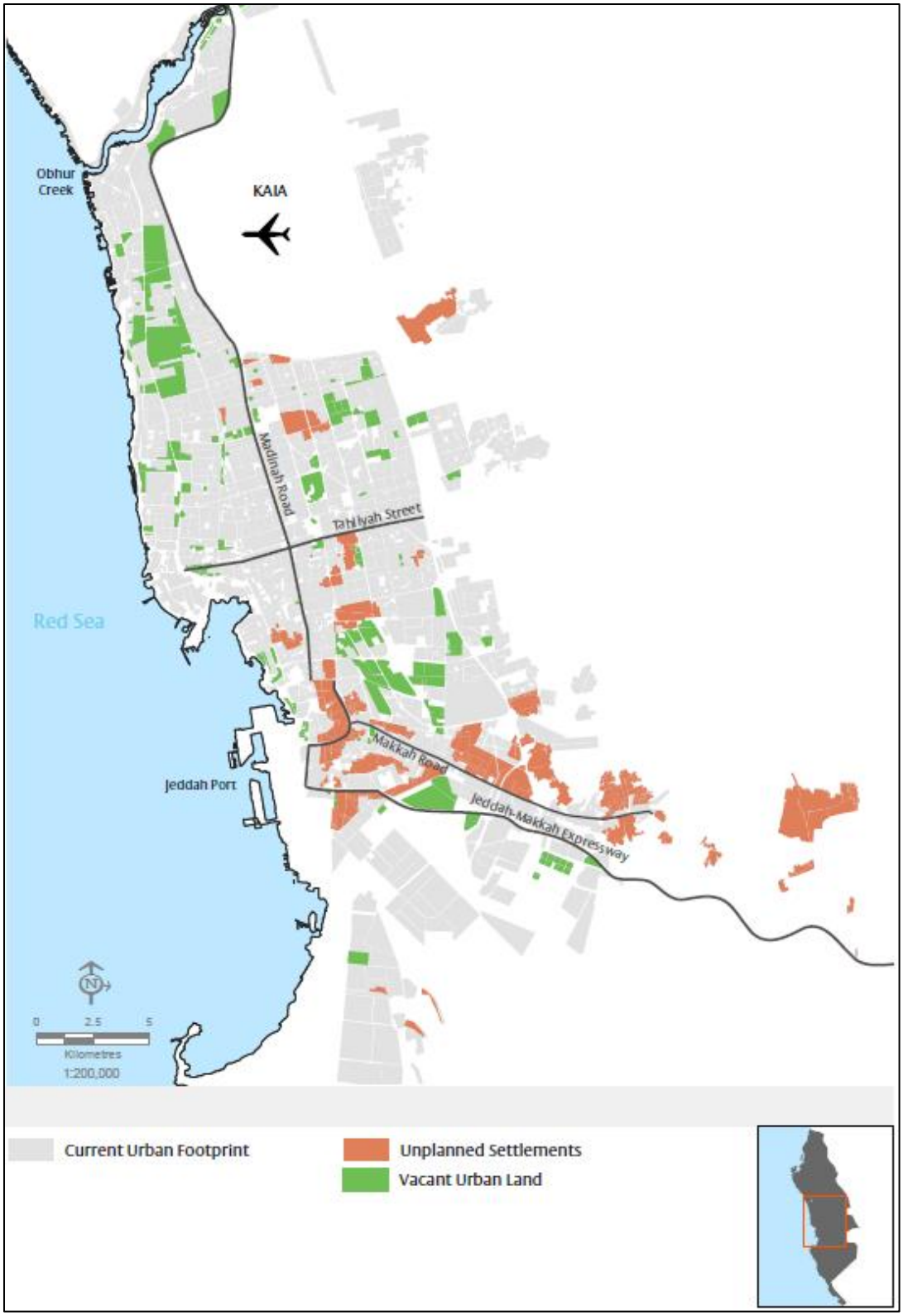

Figure 19. Distribution of Unplanned Settlements and Vacant Land Around Jeddah (Jeddah Strategic Plan, 2009)

The Impacts of High Car Dependency

There are many negative impacts of car dependency on any community. The urban sprawl is playing a major role in this issue by increase the impacts. The impacts of car dependency are high oil consumption, high environmental cost, high economic cost, high road fatality rate, health impact. According to Jiao (2013), the United States Energy Information Administration that Saudi Arabia in the year 2009 was one of top 10 biggest oil consumption countries (Figure 20). This consumption has some impacts on the environmental and economic cost. The total dependence on cars which sometimes lack the required safety means resulted high road fatality. Moreover, the car dependency has some negative effects on the health of the community. It leads to laziness and people not interested in healthy active exercises like (friendly walking). All this leads to many diseases in the community overweight (obesity) and hypercholesterolemia (Jiao, 2013).

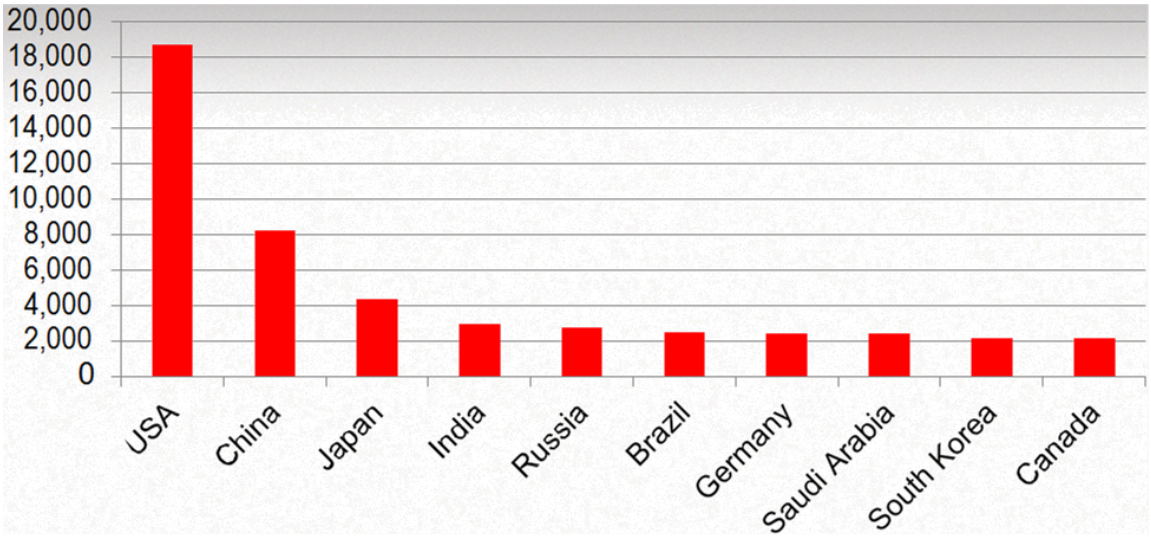

Figure 20. Top 10 Biggest Oil Consumption Countries in Year 2009 (Thousand Barrels Per Day) (Jiao, 2013)

Traffic Congestion

The high rate of vehicle ownership (349 vehicles per 1,000 people) reflects the extent of the car dependency, which results in traffic congestion. In the city of Jeddah, the highest traffic flow is during the rush hours, which is in the morning and evening. However, the very high level of traffic flow continues during night time which reflects night economic activities in the city (Figure 21). The heaviest traffic flow is on the north-south main axes, which are Al Harammain Expressway, Almadinah Road, and King Fahd Road. Nevertheless, there are many other roads that suffer the heavy traffic flow during the entire day. Currently, the average daily trip (ADT) in both directions of an expressway segment is reached 255,000 vehicles per day, and for a major arterial segment is reached 137,000 vehicles per day (Jeddah Strategic Plan, 2009).

The demand for road use in Jeddah at peak hours is incompatible with the pace of development and urban growth of the current transportation system. Moreover, during the rush hours and many other times, the traffic flow "exceeds the operating capacity of many junctions" (Jeddah Strategic Plan, 2009, p. 234). Also, there is another factor that contributes to the congestion of the main axes, which is lack of control timing of traffic lights and synchronization with each other. That leads to considerable delays and low level of service (LOS) (Jeddah Strategic Plan, 2009). Wasting the time of the community in the traffic congestion is a serious issue that affects the air quality and causes a lot of delays.

Figure 21. Traffic Congestion in Different Times a Day (Jeddah Strategic Plan, 2009)

Air Pollution

The Saudi Arabian Presidency of Meteorology and Environment (PME) stated that the air quality in Jeddah has deteriorated recently. The rapid urban growth is playing a major role in creating high levels of air pollution. Furthermore, it could be attributed to emissions from various sources that fall under the rapid urban growth, particularly from road traffic and industries. These activities issued many pollutants to the air (Jeddah Strategic Plan, 2009). The most important pollutants are "Nitrogen Oxides (NOX), Particulates (PMIO), Sulphur Dioxide (S02), low level Ozone, and Volatile Organic Compounds (VOCs)" (Jeddah Strategic Plan, 2009, p. 130). These pollutants are the cause of increasing the risk of many diseases such as lung diseases, heart disease and stroke. Figure 22 shows the data that is compiled by the KSA Presidency of Meteorology and Environment (PME) for the years 2000 to 2004 in some parts of Jeddah. The data are

summarized in “Nitrogen Dioxide (NO2) and fine particles (PM10) both exceeded the PME standards in all 5 years, and Ozone exceeded the standard in 2000. There were also some breaches of the standards for sulphur dioxide (SO2) and carbon monoxide (CO)” (Jeddah Strategic Plan, 2009, p. 131).

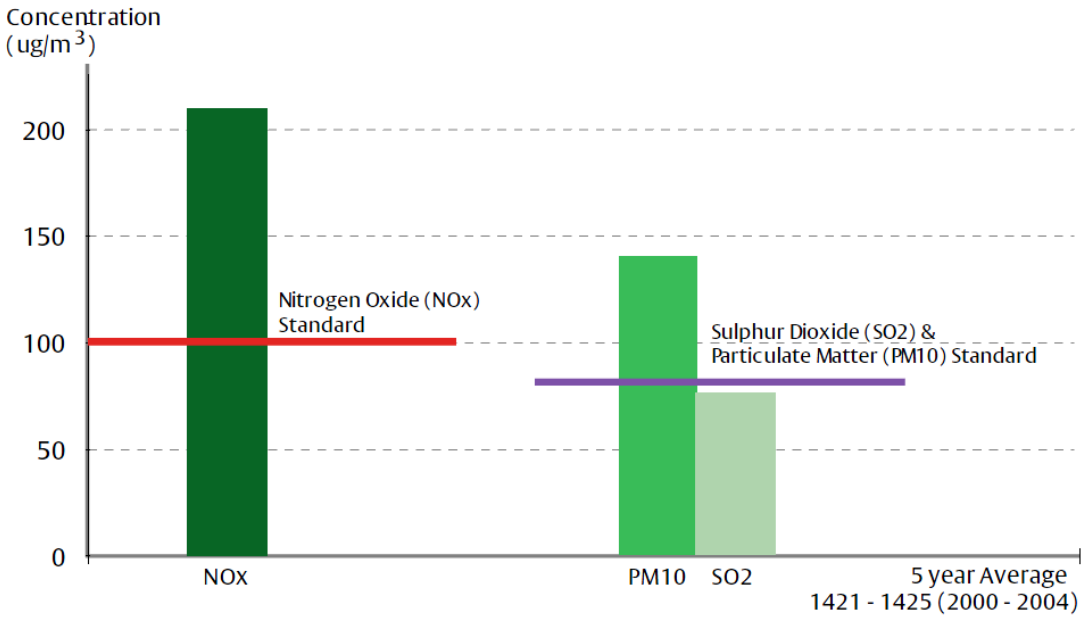

Figure 22. Air Pollution in Jeddah (2000-2004) (Jeddah Strategic Plan, 2009)

Traffic congestion and the stopping of vehicles at intersections for too long time contributes to the greenhouse gas carbon dioxide (CO2) which is estimated at more than 266 million Metric Tons per year which is equivalent to 13.7 metric tons per person per year. Traffic congestion harms the economic prosperity and the environment. Also, the impact of toxic emissions from vehicle exhausts leads to low level of air quality and reduced productivity. As results, if effective measures are not taken over the air quality and considered it top priority that must be dealt with, the issue will continue to deteriorate (Jeddah Strategic Plan, 2009).

Road Accidents and Fatalities

The traffic accidents in Jeddah are too high as the statistics indicated. In 2006, it is reported that the total traffic accidents are 68,589 accidents per year, which means less than 200 accidents per day. That includes 390 fatal accidents, 2,625 injury accidents, and 65,574 cases of property damage. While in 2007, the total traffic accidents are 78,680 accidents per year which estimate more than 200 accidents per day. That includes "387 fatal accidents, 2,738 injury accidents, and 75,555 cases of property damage" (Jeddah Strategic Plan, 2009, p. 237). This indicates an increase of 15% of total traffic accidents between 2006 and 2007. However, the number of deaths has decreased by more than 8% which is from 524 deaths in 2006 into 498 deaths in 2007 (Figure 23) (Jeddah Strategic Plan, 2009).

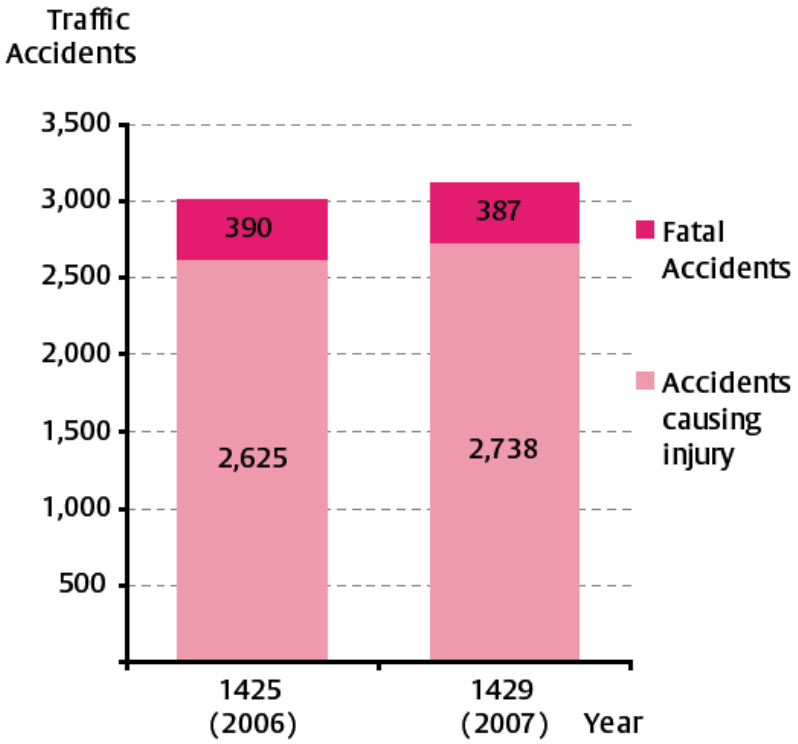

Figure 23. Traffic Accidents in Jeddah (Jeddah Strategic Plan, 2009)

CHAPTER THREE

In the preceding chapter, a number of the negative impacts relating to urban expansion and city sprawl were reviewed. This discussion has primarily focused on areas of migration, infrastructure provisions, and transportation (car dependency).

In this chapter I will discuss some case studies that have different solutions to the urban sprawl issue as the private and public sectors are playing an important role in the redevelopment of Jeddah city. Also, I will present information regarding a critical case study that helps Jeddah to reduce the number of migrants to the city. These case studies demonstrate the existing negative effects related to urban sprawl, and provide some solution and strategic plans by the government.

The areas to be examined are the following; Ruwais, an unplanned settlement in significant area that near the city center Jeddah and the Kornash (Red Sea coast). The City Center contains the historic district that has significant identity value. King Abdullah Economic City (KAEC) is a new city that designed to be a place with a high, and moderate lifestyle located near to the city of Jeddah.

Redevelopment Project of Ruwais Area

Ruwais area is considered an unplanned settlement that currently suffers from a lack of infrastructure. It is one of the areas that are affected by the flood that killed more than 125 people because of lack of drainage. However, it has great properties values, because the location of this area is nearby the city center area. In addition, the area has many historical buildings that have significant cultural value. The government intends to improve the area by redevelopment project as part of its strategic plan. The Ruwais project is owned by the private and public sectors.

Currently, Ruwais occupies an area of a 140-hecatre (346 acre). A number of issues affect the community and public order (political- security). This area is populated my many non- Saudis who have expired their visas. Mostly, those people come to do pilgrimage and stay to work illegally in this area specifically because it is close to Makkah. On the one hand of planning needs, Ruwais area has great capability to urban renewal, because of the location near the city center. The area of Ruwais currently suffers from low quality of living, unauthorized buildings, lack of municipal services (sewage and storm drainage), and unorganized road design (Herson, 2011).

The Ruwais project has many advantages and solutions not only for the current area, but also for the whole city of Jeddah. The project will address all the needs for the community. It also will provide a spatial solution for the infrastructure issues that has affected the area recently. It will provide high quality of living, working, and learning, communities, and improve life quality (Figure 24-27). The project aims to limit the migration from the city center to the suburbs, which will reduce the expansion of the

cityscape. The project also will increase the population density of the city center. Moreover, it will have public transportation and a green light rail system, which will reduce the car dependency and its environmental impact (Figure 24). Besides, the whole project is designed to be an environment friendly (Herson, 2011).

Figure 24. Redevelopment Project of Ruwais area (Herson, 2011)

The Ruwais development will impact the community in a positive way. The development adopts a high density, design similar to the northeast side of Manhattan (Figure 25). Also, it is a mixed-use development that includes significant quantities of residential, commercial, retail (Figure 26), service, hospitality, leisure spaces and complete mass transit. Consequently, “more than 6 million square meters (65 million

square feet) of gross floor area will be created" (Herson, 2011), to accommodate over 60,000 residents. The project aims to create over 80,000 career opportunities. Seventy percent of the total square footage area is dedicated to residential use, with schools distributed throughout the development within a walking distance (Herson, 2011).

Figure 25. Redevelopment Project of Ruwais area (Herson, 2011)

Figure 26. Redevelopment Project of Ruwais area (Herson, 2011)

The design strategy for the Ruwais development aims to create a new community that provides a good quality of living, working, and learning. Creating a good quality environment that addresses the people needs and encourages them to live and act in a better way. The development has open spaces that create friendly pedestrian environments (Figure 26, 27, 28). Ultimately, the development will transfer the current situation from unplanned settlement into an organized and developed situation.

The first stage is to identify and evaluate the major roads that need to retain. Also, doing the same thing for the building by identify and evaluate the key buildings and spaces to retain them. Then the accessibility is by developing the road network on the site and extends them to reinforce better linkage with the outside road network. Creating

public open spaces to the development is providing connection to recreation residential. There will be ‘Civic Space’ which is the key open space corridor that link the east side with the west side by across the whole site (Herson, 2011).

The Ruwais development has unique and modern design. It has two towers determined the site from the both east and west side (one from each side). These towers have the same unique design. The facades of the towers have ‘facade integrated LEDs’ which presents shows and commercials for the people who in the *Civic Space* which are between the two towers (Figure 25). The surrounding areas have mid-rise constructions that include nine neighborhoods. Each one of them has its own open space that connected with the central park. The development creates a walkable environment that pedestrian-friendly and encourage the people to be healthy (Herson, 2011).

Figure 27. Redevelopment Project of Ruwais area (Herson, 2011)

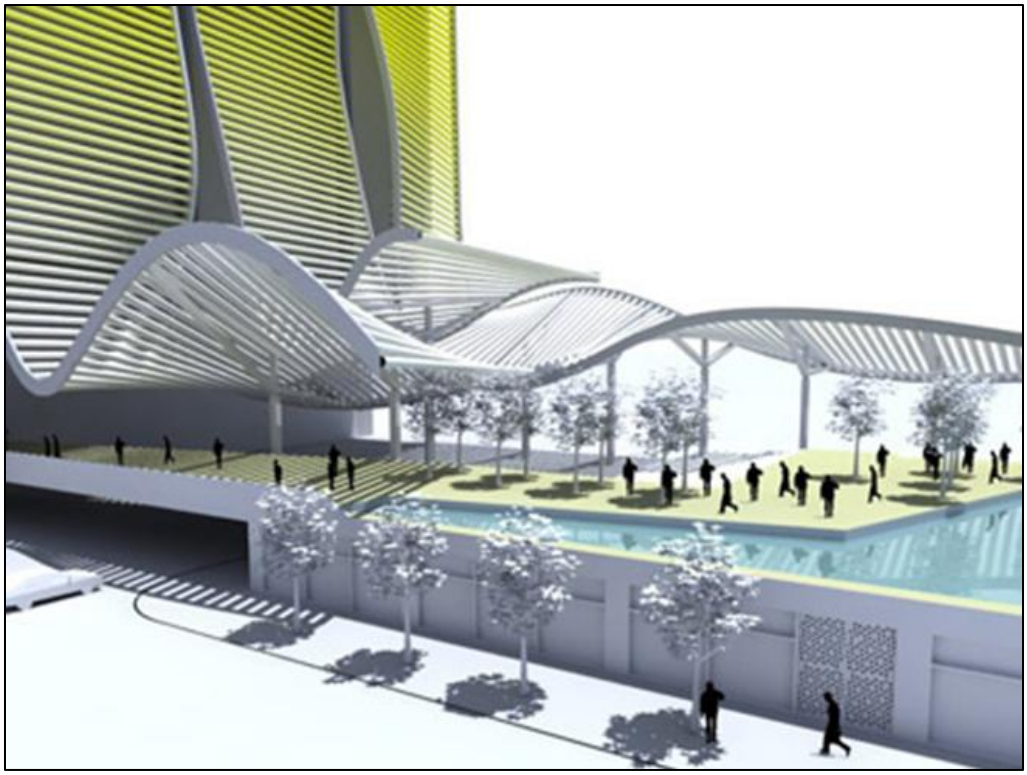

Figure 28. Redevelopment Project of Ruwais area (Herson, 2011)

Figure 29. Redevelopment Project of Ruwais area (Herson, 2011)

City Center Jeddah Development

The project of City Center is the most significant project in Jeddah that address many negative effects of urban sprawl. The project is going to address all the needs of the community. It will solve the infrastructure issue that affected the area recently. Also, it will provide high quality of living, working, learning, and entertaining by improving the live quality. That will limit the migration from the city center to the suburbs which that to expansion the cityscape. Therefore, the project will increase the population density of the city center. Moreover, it will have public transportation and green light rail which are going to reduce the car dependency and its environmental damage. Besides, the whole project designed to be an environment friendly and solve currant environment issues. Based on the stated, the project is working to fix problems to achieve goals which will improve the current situation and benefit all the community.

The current problems in the area of city center of Jeddah:

1. Environmental pollution caused by sewage deposition in lagoons that overlooking the city center which led to many negative effects:
    i. Odors and repellents.
    ii. The inability to use the lagoons for the entertainment marine, watersports, and hiking on the beaches.
2. Abandoned by its inhabitants.
3. Disruption of growth (trade and population growth).
4. Reduced economic activity in the city center and moved to other locations.

5. Undeveloped land (whiteland) more than used land in the city center which unlike most the cities of the world. (Jeddah Center, 2008)

The heart of Jeddah needs to revive and develop as identified in Jeddah comprehensive plan until 1450 AH (2029 AD). Goals of the comprehensive development plan of central Jeddah are many and work to address the problems.

1. Transfer all the vacant lands from unexploited into city center that attract the local and international investments. Also, contemporary that reflects civilization of the Kingdom in the eyes of millions of Muslims who coming to the country of the Two Holy.
2. Transfer the historic district into city of world heritage that add significant tourist business that supports economic stature of the city center.
3. Radical cleansing of the lagoons and marine environment which removes the most important obstacles that repellent the investments from the area.
4. Develop promenade (corniche) runs the length of 16 km (10 mile) that has recreational activities, attractive parks, and distinctive waterfront, which increases the attractiveness of the city center.
5. Develop the infrastructure of the city center area to compatible with latest international standards of this filed and compatible with the requirements of the general plan.
6. Connect the city center with the marine area by east-west commercial axes. This is to solve the problem of separating the city center from the sea which generated as a result of the north-south axis (Jeddah Center, 2008).

Redeveloping the city center of Jeddah is one of the most significant developments in the Arab world. The reason that is the project cares about redeveloping the central business hub and preserving the historic district. The land area of the project is around 6 million square meters (1483 acres), and the total built area is 12.7 million square meters. The project will provide economic activities that rebirth the heart of Jeddah. The activities will be world class that attracts local and global business. Moreover, the project will provide residential, retail, entertainment, and health amenities. Also, it will revive the heritage and culture of the city of Jeddah. Besides, it will clean-up the marine environment and make connection between the sea and the city center which will work to take advantage and enjoy it (Jeddah Center, 2008).

Development projects in the city of Jeddah are many and similar. There are many other projects and sites beside Ruwais and City Center Jeddah projects such as Khozam Palace and Jeddah Gate projects (redevelop the old airport). All the projects have similar goals and address significant issues. The most important of those issues are urban sprawl, unplanned settlement, environmental pollution, and economic recession which are thorny problems and the community needs to address them. And all the projects work side by side to solve the problems and provide better life quality. Moreover, the projects will work to relocate the activities to be within the urban core (city center areas).

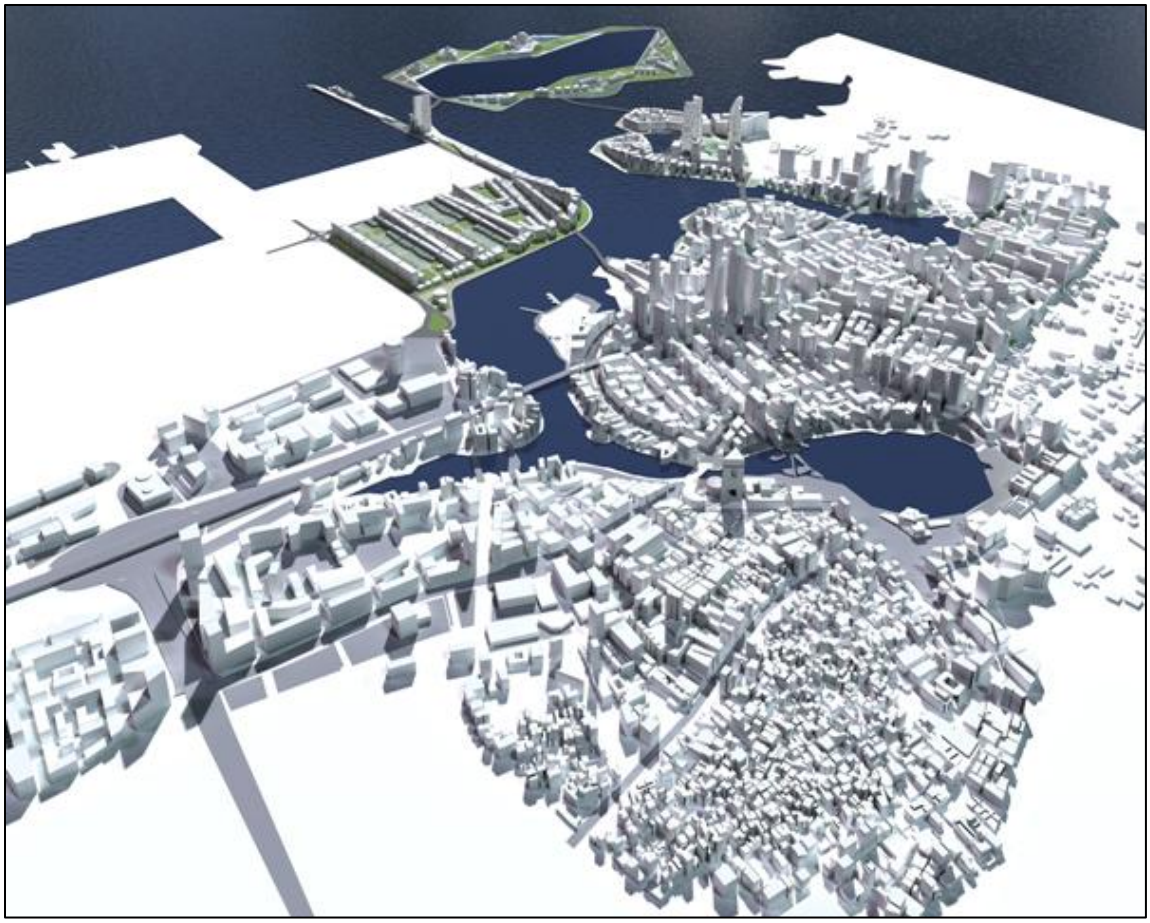

Figure 30. City Center Jeddah Development

King Abdullah Economic City

In addition to the development projects in the city of Jeddah, there is a very important project that plays a major role in solving the negative effects urban sprawl. The project is King Abdullah Economic city, which is a new city that has been created from A to Z. The city resolves many negative effects of the urban sprawl such as reducing the number of immigrants to Jeddah which by providing career opportunities and other advantages that is in different city that close to Jeddah. Attracting those people from migrates to Jeddah will divide the works and the responsibilities into two cities. Also, it will reduce the pressure on the infrastructure of Jeddah. Moreover, the King Abdullah Economic city provides high quality of living, working, and learning which approved from the LEED certification. There will be green light rail to reduce the car dependency issue in Jeddah.

The economic city located in the Makkah Province of Saudi Arabia, in significant area, which calls Thuwal. It is between the two holy cities (Makkah and Almedina), on the coast of the Red Sea. Also, the city is nearby the city of Jeddah (80 kilometers north). Thuwal was village that had been a fishing center for long time. Then, it is now being transferred into significant place that so many people dream to live, work or learns in it, because it will become one of the key cities in the Kingdom of Saudi Arabia. The unique thing about King Abdullah Economic City (KAEC) is seen as "the largest private sector project in the region" (SAGIA, 2010).

King Abdullah Economic City project has a significant scale compared to other big cities such as Jeddah and Riyadh. The size of KAEC will be approximately the size of

Washington DC which is 168 million square meter (41,513.70 Acre). And the population of the city is going to be two million by the time it is finished. That is representing approximately two third of the population of Jeddah. Also, the city will provide one million career opportunities. The worth mentioning is investment size which is US$27 billion (Insider, 2012).

The Key Features of KAEC: Six Comprehensive Elements

1. Seaport

The first part of the city is seaport that is one of the largest areas in the city that is estimated to be within 13.8 km². The capacity of the seaport is over 10 million standard containers per year. Also, it will have Hajj Terminal which will accommodate over 300,000 pilgrims who are on their way to the two holy cities (Makkah and Medina) (SAGIA, 2010).

2. Industrial Zone

It is a place for the heavy industrial, light industrial and their manufacturing facilities. Moreover, it is "hosting up to 2,700 industrial tenants" (SAGIA, 2010). All that will be within 40 million square meters (9,884.21 Acre). This zone is designed to consistent with environmental practice after consulting international experts in this field (SAGIA, 2010).

3. Central Business District

King Abdullah Economic City will provide a central district of business and works that combines several uses such as offices, different commercial uses (retail and restaurant), and financial district. The total area of the central business district is 3.8 million square meters (939Acre). And the financial district itself will be within 14 hectare

(34.6 Acre) which will include “world’s leading banks and investment houses world’s leading banks and investment houses” (SAGIA, 2010).

4. Residential and Resorts

King Abdullah Economic City project will provide a perfect place for living and entertainment. The city will have 25,000 hotel rooms within 120 hotels that provide high level of hospitality. Moreover, the city will include 25,000 villas and 250,000 apartments. Also, KAEC will have over 50,000 retail shops within 8.7 million square meters (2149.82 Acre) (SAGIA, 2010).

5. Education Zone

King Abdullah Economic City project will provide a high level of education. It will offer schools for all the levels of education (elementary, middle and high school). And the most important element in this zone is King Abdullah University (KAUST) which will accommodate 18,000 students when completed (Figure 31) (SAGIA, 2010).

Figure 31. King Abdullah University (KAUST)

6. Key Business Sectors

In this part, King Abdullah Economic City will be turning the general approach of the Kingdom of Saudi Arabia from oil-producing country (larger) into country factory. According to Saudi Arabian general investment authority (SAGIA) (2010), “Saudi’s unlimited petroleum resources will provide low-cost feedstock for a range of petroleum derivatives including high-end plastics manufactured in the planned Plastics Valley for automotive, biomedical, construction and food packaging applications”. Moreover, King Abdullah Economic City provides a wealth of business opportunity. Also, “This will be the first place in the Kingdom allowing foreign nationals and companies to own property which is recognized by the government as a new source of investment” (Insider, 2012).

Figure 32. King Abdullah Economic City

Figure 33. King Abdullah Economic City Master Plan

Future Projects

Ruwais Project, City Center Jeddah Project, and King Abdullah Economic City are three projects that work side by side to solve the negative effects of urban sprawl. They meet the community needs plus provide solutions to the three many effects (immigration, infrastructure, and car dependency). Figure 34 is a summary of the three projects.

	Redevelopment projects in Ruwais areas (Ruwais)	Jeddah Central District (JCD) Redevelopment	King Abdullah Economic City (KAEC)
Existing Context	- Unplanned settlement - High density - Road Network	- Contains historic district - High density	Project completed some parts (KAUST, parts of Residential Zones)
Principles	Refocus development and activity on the urban core	Refocus development and activity on the urban core	Limiting the huge growth in the big cities
Design Strategy	- Working with the site's current conditions as an unplanned settlement - Evaluate system paths - Extend the surrounding road network to better connections to the outside - Identify key buildings and spaces - Provide east-west connection across the site by a corridor - Develop the infrastructure	- Preserving the historic district - Establish a clear center of the city - Removes the obstacles that repellent the investments - Develop the infrastructure - Connect the city center with the marine area	- Establishing an independent integrated city - Establishing a global investment center - Establishing a city with a healthy environment and high life quality
Identity	Modern lifestyles	Identity combines the nobility of history and civilization	Higher levels of civilization and technology in the world
Scale	6.04 million square meters (1,492 Acre)	6 million square meters (1,482 Acre)	168 million square meters (41,513.70 Acre)
New Spatial Organization	- Improvement of infrastructure - Reduce the car dependency - High life quality and healthy environment - Global commercial, and residential center		- Limiting the migration - Global commercial, and residential center
Residents	60,000		2 million
Jobs	Over 80,000		1 million
Culture	Many non-Saudi live in the area	Many non-Saudi live in the area	New city

Figure 34. Summary of Ruwais, JCD, and KAEC Projects

Summary

Limiting the Migration

People's migration from outside the city of Jeddah is a major issue that significantly affects urban sprawl. This issue needs a project such as King Abdullah Economic City (KAEC). This project will be a place for more than two million residents and providing one million career opportunities. Moreover, the KAEC will provide a high quality of living, work, education, and entertainment. Therefore, this project will put a huge load on the city of Jeddah, which will mainly be on the infrastructure and public services. On the other hand, people's immigration from central areas of Jeddah into suburban should be solved by the Ruwais, and City Center Jeddah Projects. These two projects have better advantages than the current suburban areas. Generally, the advantages are higher life quality and healthier environment.

Improvement of Infrastructure

Ruwais Project, City Center Jeddah Project, and King Abdullah Economic City are examples the government's efforts to improve the infrastructure. The improvement is planned to affect both local and global scales to meet the community demand. Currently, there is a lack of water, sewerage, electricity and telecommunications capacity in Jeddah. The infrastructure utilities are insufficient to meet the current and expected future demands (Jeddah Strategic Plan, 2009). Therefore, the three projects will improve the infrastructure situation to avoid any negative effects. One of the most significant improvements is protecting the people from the harm of flooding. The government works hard to create new storm water drainage channels and increase the current capacity. The

storm water drainage network will cover the Ruwais, and city center to avoid a similar issue of the flooding disaster in 2009. At the level of road network, the areas of Ruwais and City Center will have significant improvement. The two projects will have a clear gradation of the road network classification within a wider street network. This road network provides an access to all the buildings. Also, the projects will provide a systematic street design that accommodates the traffic and safe. Moreover, they will create a healthy environment for walking and biking. Besides, the projects will be covered by systematic public transport that represents a sustainable environment.

Reduce the Car Dependency

Reduce the car dependency will be through developing public transportation in the city. The Ruwais, and city center areas will do that via a comprehensive plan of public transportation that was made by the Ministry of Transport. The comprehensive plan includes three lines of light rail transit service. Also, it includes 36 routes of a bus feeder system, which represent 338 buses that cover 429 km of the city. Moreover, the comprehensive plan includes commuter rail that connects North Obhur with Jeddah City Centre. These modes extend to reach the maritime transport by providing a water taxi in the form of water ferry. All these modes of transportation represent the highest way to reduce the car dependency.

CHAPTER FOUR

Overview

In preceding chapter I presented three case projects that aim to restructure different urban areas in the city of Jeddah to improve urban transportation, infrastructure and quality of living spaces in the city and its unplanned areas. This chapter will analyze the Ruwais project to identify how the design adjusts the urban fabric and provides social spaces for city inhabitants and visitors. I will undertake the analysis using space syntax methods to understand how the physical and social spaces of unplanned settlements are being reshaped. I will then discuss the most important developments and planning strategies proposed by the Saudi government.

Spatial Analysis Methodology

The city of Jeddah is one of the fastest growing cities in the Kingdom of Saudi Arabia. Jeddah is a destination for many people who are looking for better career opportunities, life, and education. Therefore, it is growing rapidly, which make this growth beyond the current absorptive capacity of amenities and future demand of the

community. Urban sprawl is an issue that affects many fields of life from life quality, and the environment, to economy, politics, and society in general. Importantly the huge growth of the city of Jeddah, inside and outside the urban growth boundaries generates disorder in the distribution of community services, social and business activities. The distribution of multiple city centers or (unclear city center), and poor traffic distribution networks weakness services and generates problematic urban functions.

In this section I will use spatial analysis methods to investigate how the new proposal adjusts urban movement structures at the local and global scales. Specifically, the Ruwais project will be analyzed in order to understand how the new planning of the spatial structure affects transportation networks across the urban fabric. Space syntax methods are used to reveal the change in spatial morphology, primarily the issue of physical connectivity and integration in the spatial fabric.

Space Syntax theory suggests that by generating improvements in the connectivity and integration of urban areas, improvements and impacts will also occur in social life of the city. (Hillier, 2004) "The aim of space syntax research is to develop strategies of description for configured, inhabited spaces (of buildings, settlements, or built complexes) in such a way that their underlying social logic can be enunciated" (Bafna, 2003, p18).

A central premise within the space syntax research and theory is that social structure is inherently spatial. Research has shown that the critical thing about urban sub-areas is how their internal structures relate to the larger-scale system in which they are embedded. Analysis within space syntax research focuses on the level of topological description, specifically on how configured space is integrated and forms centers.

Movement, for example, can be predicted from the axial analysis in which only the longest and fewest lines needed to cover the whole system form the line matrix (Hillier, 2004).

Connectivity analysis of building floor plans or plans of the urban fabric is facilitated by Depthmap software. This program examines the axial line, which is the longest straight line that can be constructed in any given urban space with unbroken visibility and accessibility. I am using space syntax software to generates an analyzed axial map (the longest and fewest lines that cover the street grid) of a small area around a hypothetical redevelopment site. The graph displays the degree of integration in colors from dark to light. The choice of a radius-3 integration value has been shown to presents a localized picture of integration and in urban systems (Hillier, 2004). This has been found to be the best predictor of smaller-scale movement - that usually means pedestrian movement because pedestrian trips tend to be shorter and read the grid in a relatively localized. While global integration is significantly found to be the best predictor of larger-scale movement, including vehicular movement. This demonstrates patterns affecting people on longer trips in a more globalized way (Hillier, 2004). (Space syntax is a method commonly used to analyze the spatial morphology of urban areas. For more information on Space Syntax please see Hillier and Hanson, The Social Logic of Space, 2004 and Space is the Machine by Bill Hillier, 2004)

Analysis of Physical Space - Ruwais

The Ruwais area is considered to be an unplanned settlement as it has random to no spatial planning. The current situation of spatial structure, transportation, and

infrastructure is poor with random distribution of public services such as open space, and mosques. Moreover, the Ruwais has random land divisions, which have a variety in different size, shape, and organization. The district reflects a lack of land use control, with no land use regulation from the residents (height, and use). There is a random gradation in road widths, with many of narrow roads that make the car movement constrained in the district. Furthermore, there are many houses with no road access, which presents difficulties for the residents and public safety services such as fire brigades. The majority of houses are dependent on alleyways that are for pedestrian only. There are no visible open spaces available to residents for recreation or social gatherings. The residents who live in these houses need to park where the other residents park, which lead to lack of parking space. Besides, the community of Ruwais is high car dependent, because there is no public transport. At the level of buildings' condition, many of the buildings are deteriorating. (Figure 35, 36, and 37)

Organization of Land - Spatial Structure (global – local)

1. Consider as unplanned settlement
2. Many alleyways (pedestrian only, access to many houses)
3. Lack of open space
4. Different patterns of land division (different size, shape, and organizing)
5. Lack of land use control
6. Excesses of land use regulation from the residents (height, and use)
7. No clear boundaries for each neighborhood
8. A random distribution of public services (distribution mosques)
9. Many of the buildings deteriorating

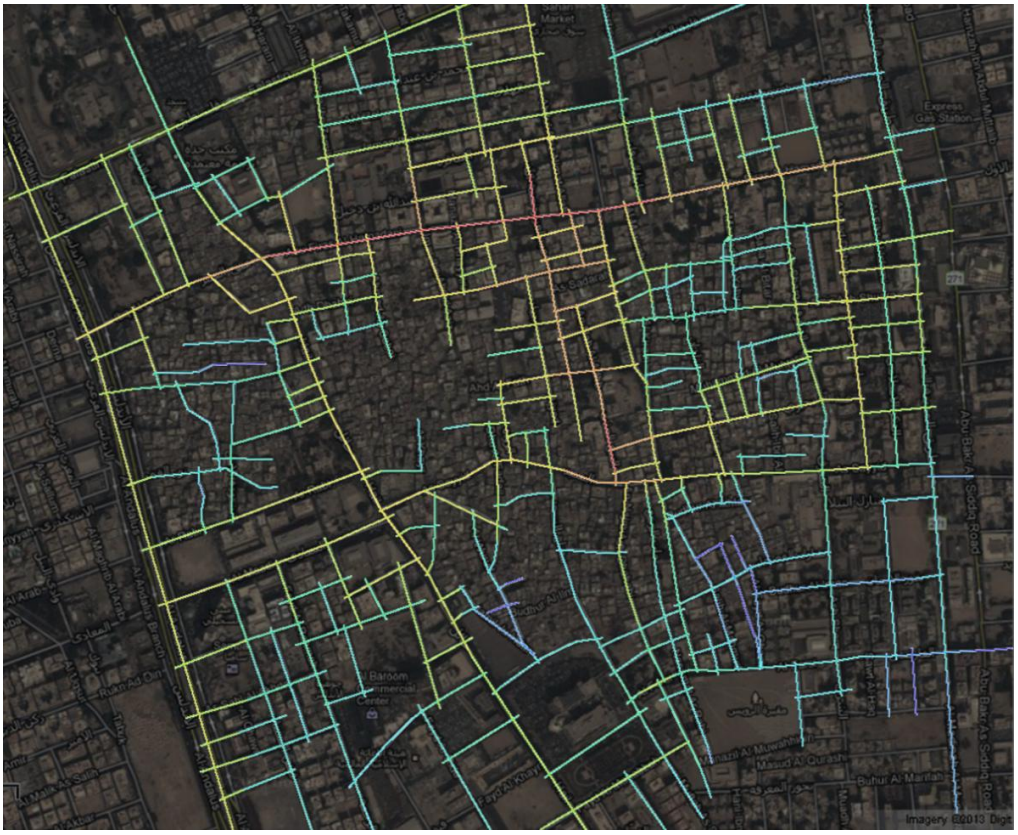

Figure 35. Organization of Land (Current Situation)

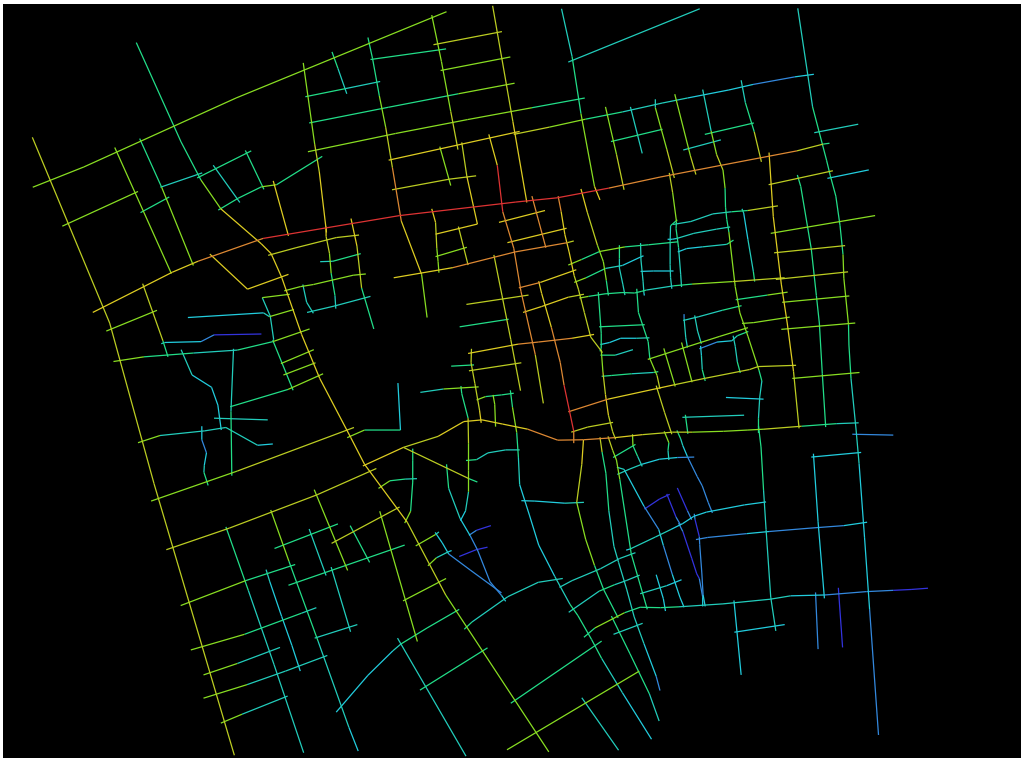

Figure 36. Organization of Land (Current Situation)

Analysis of Existing Conditions (spatial structure)

The spatial analysis using space syntax methods reveals that the district is surrounded by strong linear road structures, with a fragmented network of streets, which do not provide through service across the district. Land subdivision is randomized in it organization as blocks, with the center of the area highly disorganized as is shown in Figures 35, 36, 37.

Transportation

1. Random gradation in the road
2. Many houses with no road access
3. Many of narrow roads that make the car movement critical
4. High car dependency
5. No public transport
6. Lack of parking space

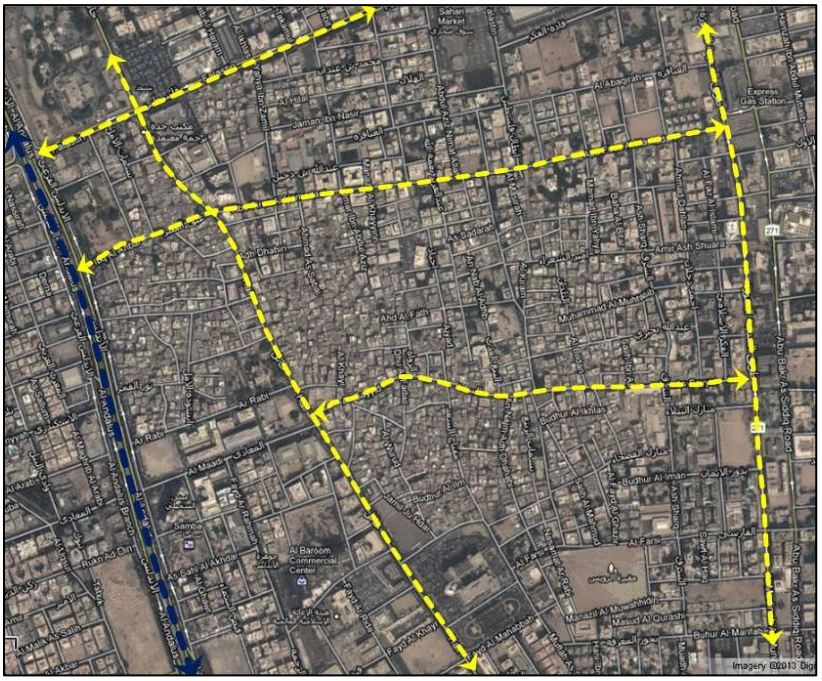

Figure 37. Road Network (Current Situation)

Infrastructure

The current situation of the infrastructure in the Ruwais area is acceptable. Particularly the capacity of water supply, sewage network, power supply, and telecommunication services are meeting the current demand. As previously reported, the Ruwais area has been affected by the flood hazard. The storm water drainage is the most important aspect that will be repaired by the project. Also, the future expansion of the area will be taken into consideration, which will require increasing the capacity of the infrastructure to line with future demand.

Proposal for the Ruwais Project

The proposal project for the Ruwais area is to transfer the current situation into a systematically planned area. It will be a place, where everything is planned, organized, and meet the needs. There is systematically distribution of public services such as open space, and mosques which by allocate open space for each block and mosque for each neighborhood. Moreover, the proposal project will have clearly land divisions, which have similar size. The project will have a clear gradation in the road network classification. Furthermore, there will be road access for all the houses. All the residents will have their own parking space. Besides, the community of Ruwais will not be car dependency anymore, because there will be a systematic public transport. Moreover, the community will be suited walking and biking. At the level of buildings' condition, all the buildings are modern buildings. (Figure 38)

Figure 38. Redevelopment Project of Ruwais area (Herson, 2011)

Spatial Structure

1. Systematically planned organization of territory
2. The blocks are large, similar size to each other, and clearly divided (organized)
3. Each block has its own open space on the interior of the development, with open green space provided along streets throughout the district
4. The district has nine distinguished neighborhoods
5. Each neighborhood has its own mosque and one grand mosque for the whole project
6. Modern buildings

Figure 39. Road Network (Proposal Project)

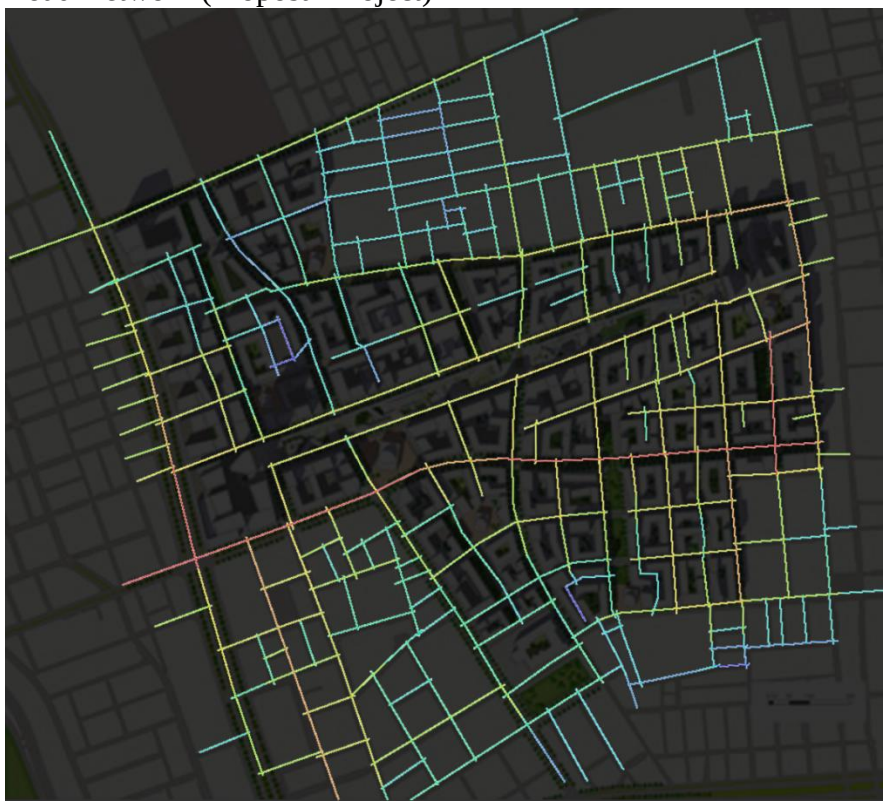
Figure 40. Organization of Land (Proposal Project)

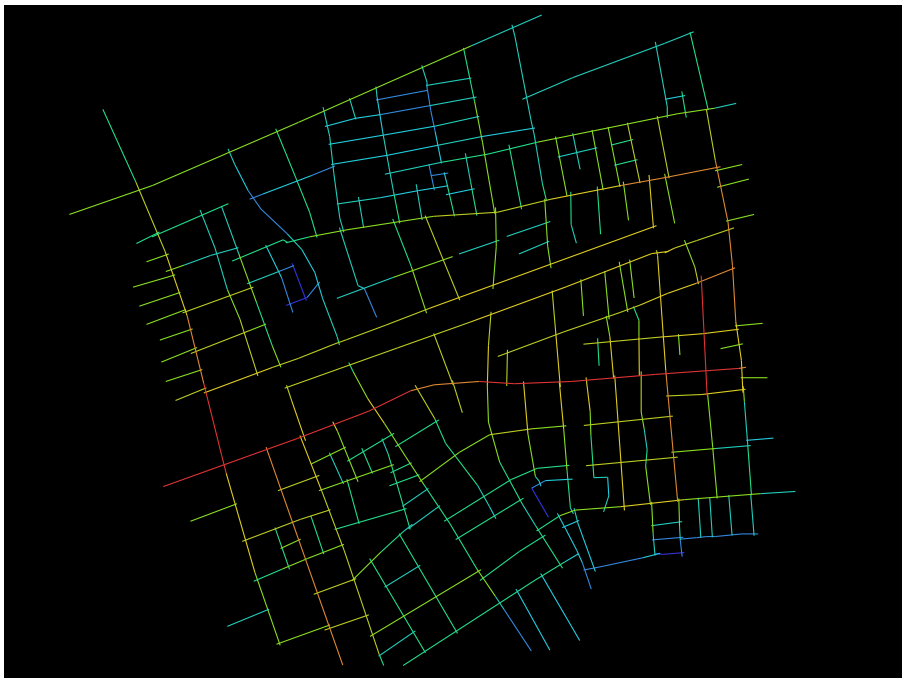

Figure 41. Organization of Land (Proposal Project)

Analysis of Proposed Urban Design (Spatial Structure)

The spatial analysis using space syntax methods reveals how the districts streets and land parcels have been transformed. The district is integrated more strongly with the surrounding areas as is evident with multiple through streets crossing the area. A civic center is formed at the center of the design scheme, with a green public space highlighted at the center of the community. There is an even hierarchy of streets, with the subdivision of land in blocks is evenly organized across the community. The new urban design demonstrates a parallel series of long avenues, which would provide good economic spatial opportunities (see longest red and yellow lines). The insertion of the civic green space at the center of the district also will create moderate traffic flows within the neighborhoods, and prevent highspeed cars crossing the district. This will ensure a pedestrian friendly and safe urban area (Figures 39, 40, and 41).

Transportation

1. Clear gradation in the road network classification (Figure 39)
2. Systematic public transport coverage
3. Sustainable public transport
4. Using some of the existing major roads by making improvement
5. Systematic street design (accommodate traffic and safe)
6. Adequate parking
7. Create a healthy environment for walking and biking

Summary of Spatial Analysis (Analysis Findings)

There is a marked different between the current situation for the Ruwais area and the proposal for the project is illustrates the effectiveness of the proposed project and how it is solved many problems (Figure 42). The proposal is found to address the three axes, internal migration, infrastructure, and car dependency by providing systemic solutions. Generally, the project transforms the area from an unplanned settlement into a modern urban area with a high level of systematic planning. The Ruwais project provides organize land subdivision, gradation in the road network classification, open space, modern buildings, public transport, adequate parking, and healthy environment for walking and biking.

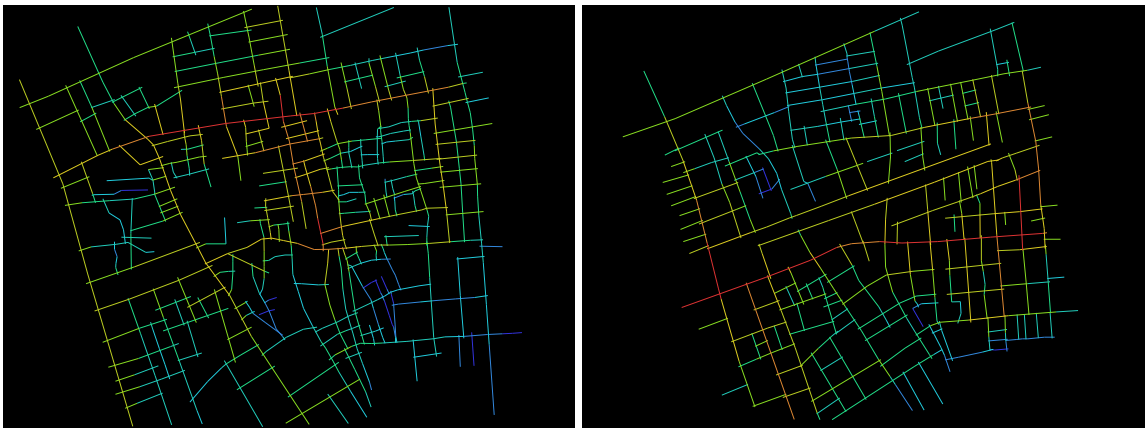

Figure 42. Before and After the Proposal Project

Analysis of Social Space

Public Space

There is no comparison between the current situation and the proposal project in the public space aspect. Although the current situation lacks the open space, there are many mosques that are distributed randomly. On the other hand, the proposal project provides many recreation areas and outdoor and indoor commercial space for all the project residents. Besides, each block has its own open space (Figure 43, 44). Among the most prominent of those areas is Central Park; It is an attractive area for not only the Ruwais, but it is for the surrounding area too. Also, the proposal provides systematic number of mosques that are distributed evenly across the district and located in each neighborhood (Figure 45).

Figure 43. Public Space (Proposal Project)

Figure 44. Public Space (Proposal Project) (Herson, 2011)

Figure 45. Systematic Number of Mosques in Each Neighborhood

Population Density

The current situation of the Ruwais area has a high density and the proposed project will play a major role in increasing it. The houses in some areas are contiguous with each other which reflect the high density (Figure 46, 47). Moreover, some areas do not have enough space for streets or open spaces. Convergence distances between homes led to the strong social relationship between neighbors. Also, many of the residents have the desire to live in the Ruwais areas as it is simply because of the strong social interdependence, and unique identity in addition to many of the residents' desires to renovate their homes and build new construction. On the other hand, many other residents want to develop the Ruwais area that on condition to keep the social identity (Figure 46, 47).

Figure 46. Current situation of Ruwais neighborhood areas (Jeddah Strategic Plan, 2009)

Figure 47. Current situation of Ruwais neighborhood areas (Jeddah Strategic Plan, 2009)

Social Identity

It is well known that the old urban areas (Ruwais, city center) have a special social identity that is represented by social cohesion among neighbors. The cohesion becomes very strong in these areas particularly, because of the convergence distances and financial and educational capacities between neighbors which are clear in regular meetings and special events. The residents of the old areas have a tradition to help and

support their neighbors in times of need. For example, if there is a wedding ceremony in the neighborhood, the neighbors support the house that has the wedding financially and practically. Moreover, when neighbors know each other well, it maintains security since it is very easy to identify strangers. The level of social cohesion among neighbors is decreased gradually in the new urban areas. The distances between neighbors become longer, and better financial capacity, which led to losing much of the social identity value. Therefore, the residents of the old area do not like to move out their area to the new urban areas. Besides, the development process works negatively on social identity, which is from the perspective of the residents of the old area. Even though the urban areas are unplanned and poorly serviced, there is spatial pride demonstrated by the residents as is evident in the care for the buildings (painting) as is evident in figures 46, and 47. It is not clear in the proposal for the new residential neighborhoods how existing residents will be accommodated.

CHAPTER FIVE

Conclusion

In conclusion, and after we looked at the results, it is clear that urban sprawl is significant and has many negative effects. Generally, the main negative effect is the lack of control over the rapid growth. The growth creates an unorganized movement, and distribution of city elements for instance, population, city centers, services, and land use regulation. Moreover, there is an urgent need for investments in the infrastructure services to meet the needs of the current demand. That incurs the city additional costs to provide services, infrastructure, and roads to serve the new, large, and scattered areas. The evidence shows that 25% of the houses are connected with the water distribution network, 45% of the total population is taking advantage from the sewage network, and 40% of the city is covering by storm water drainage network. Providing access to basic infrastructure continues to be a problem with the present and anticipated growth rates.

Furthermore, the city needs many of the necessary elements that create a healthy environment, and better life quality. One of the most important elements is creating public transport system to reduce the car dependency and its negative effects. The high

oil consumption, accident, toxic emissions in the air, and wasting time in traffic jams are the negative effects.

Ruwais, Jeddah Central District (JCD), and King Abdullah Economic City (KAEC) are the three projects that have great solutions for the issue of urban sprawl. These projects provide examples for future projects that the government may consider to undertake. We need to control and ultimately remove all the negative effects of urban sprawl that affects our economy, health, and society. Also, we need to support all the positive solutions that the new projects propose. The solutions offer a high quality of living, work, education, and entertainment.

Summary of Study Results

1. Urban sprawl impact on many fields of life
2. Migration generates significant growth
    a. Creates an unorganized movement of city elements
    b. Generates unorganized population distribution
    c. Leads to multiplicity centers of the city (unclear city center),
    d. Weakness services in some urban areas
    e. Weak city center
    f. Lower standards of living, working, and learning in the rural areas which increase the migrants
    g. The city incurs additional costs to provide services, infrastructure, and roads to serve the new, large, and scattered areas.

3. Weak infrastructure
    a. There is an urgent need for investments in the infrastructure services to meet the needs of the current demand
    b. Deterioration life quality
    c. Only 25% of the houses connected with the water distribution network
    d. 45% of the total population is taking advantage from the sewage network
    e. The storm water drainage network is only covering 40% of the city, which have exposed the residents to the flood hazard
4. Car dependency
    a. Wasting time in traffic congestion
    b. Saudi Arabia in the year 2009 is one of top 10 biggest oil consumption countries
    c. Air pollution (carbon dioxide (CO2) is estimated at more than 266 million Metric Tons per year)
    d. Very high rate of road accidents and fatalities (78,680 accidents per year and 387 fatal accidents)
    e. Public health decline
    f. Limited of public transport (bus usage covers 2% of all trips)
5. Development projects
    a. KAEC is limiting the huge growth in the big cities
    b. Ruwais and JCD refocus development and activity on the urban core
    c. Preserving the historic district

d. Establish a clear center of the city

e. Develop the infrastructure

f. Removes the obstacles that repellent the investments

g. Establishing projects with a healthy environment and high life quality

Future Recommendations

The government aims by undertake many projects in Jeddah to improve the quality of living. These projects need solidarity by all parties of the community, citizens, developers and city government, which is to achieve the projects' goals. The citizens and the residents of the projects' areas particular should cooperate with the government and not oppose its decision to develop these areas. The government faces difficulties dealing with projects' residents by opposition the project itself and fair compensations. The citizens need to know that the government's decisions are significant and assist the public interest. One of the most prominent supporters to the government is the developers, because they involve in many development projects such as City Center, and Ruwais projects. Therefore, there is a need to educate the community about the importance of developments.

Directions for Further Study and Development Priorities

The thesis study recommends for the further study to make detailed and accurate studies for the factors that affect the growth of the city. Areas for further study include, phasing strategies for future growth to accommodate migrants to the periphery areas of Jeddah; detailed analysis of each new urban district proposal to investigate how these proposals will reshape the road networks across the global scales of the unplanned

settlement areas. These studies are going to be the guide for the systematic comprehensive plan. Also, they will be solutions for the urban sprawl and its negative effects that presented in this thesis. These studies will also help the government develop the services to conform to future demand and achieve the maximum goals of these services.

The thesis study also recommends applying the sustainability approach and all its advantages to achieve the global level in the social, environmental and economic fields. To achieve this level,

Jeddah Strategic Plan (2009) stated the following:

> Key priorities must be: increasing competitiveness and attracting international investment and business, defining Jeddah's international identity, supporting business and developing internationally competitive human capital, minimizing the city's carbon footprint, minimizing the consumption of non-renewable natural resources, preserving Jeddah's unique assets, particularly its waterfront and Al-Balad, improving gender equality in education and employment, reducing poverty and social exclusion, and tackling the challenge of Jeddah's unplanned settlements. (p. 22)

Thus, Saudi Arabia can afford to access the world first by taking advantage of all the ingredients and good management. All of the above focus on improving Jeddah's quality of living, which is the most important priority.

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