

Part B- Strategic Review of the Built Environment

1	Current Performance of the Built Environment	4
1.1	Demographics	4
1.1.1	Population	4
1.1.2	Wealth distribution.....	5
1.1.3	Age distribution, (youth) employment and age dependency	5
1.1.4	Home ownership, households and dwelling units	7
1.1.5	Economic growth and the effect of the growing population	7
1.2	Poverty in Johannesburg.....	8
1.2.1	Inequality in Johannesburg	9
1.2.2	Youth unemployment in Johannesburg	9
1.2.3	Human Development in Johannesburg	9
1.2.4	The rising middle class of Johannesburg.....	10
	11
1.3	Spatial Trends.....	12
1.3.1	Density and Deprivation	12
1.3.2	Environmental Challenges	12
2	Trends and Demand for Economic Infrastructure	14
2.1	Spatial distribution of the Urban Economy.....	14
2.2	Transportation.....	18
3	3. Trends and Demand for Basic Infrastructure	19
3.1	Water	20
3.2	Sewer.....	23
3.3	Electricity.....	25
3.4	Roads and Storm water.....	26
3.4.1	Maintenance	28
3.4.2	Infrastructure Requirements.....	28
3.4.3	Backlogs	28
3.5	Waste Management.....	29
4	Trends and Demand for Residential Infrastructure	32
4.1	Residential Growth Trends.....	32
4.2	Public housing.....	34
4.3	Informal settlements.....	34
4.4	Backyard units.....	36

4.5	Social Housing and Hostels.....	36
4.6	Meeting Residential Demand	36
4.6.1	Human and Social Development	37
4.6.2	Economic Growth.....	37
4.6.3	Environment and Services	37
4.6.4	Governance	37
4.7	Land Requirements for Sustainable Human Settlements	40
4.8	Community Infrastructure Requirements	42
4.8.1	Transportation Modal	43
4.9	Sustainable Development Requirements.....	47
4.9.1	Development controls and supporting mechanisms in critical biodiversity areas	48

Figures

<i>Figure 1: Deprivation Map City of Johannesburg (with proposed social development projects)</i>	11
<i>Figure 2: Density versus Deprivation in the City of Johannesburg</i>	13
<i>Figure 3: Location of Mixed Use Nodes in the City</i>	16
<i>Figure 4: Location of Industrial Nodes within the City</i>	17
<i>Figure 5 : Major Transportation Routes</i>	18
<i>Figure 6: City Deep Logistics Hub</i>	19
<i>Figure 7: Bulk Water Assets – City of Johannesburg</i>	20
<i>Figure 8: Water Program</i>	22
<i>Figure 9: City of Johannesburg’s sewer assets</i>	23
<i>Figure 10: Sewer Program</i>	24
<i>Figure 11 : Location of refurbishment projects required by City Power</i>	25
<i>Figure 12: Bulk Assets of City Power</i>	25
<i>Figure 13: City Power – Required capital</i>	26
<i>Figure 14: Location of JRA storm water assets</i>	27
<i>Figure 15: Location of JRA road assets: traffic lights, bridges and traffic calming related assets</i>	27
<i>Figure 16: Roads Programme</i>	29
<i>Figure 17: New residential development within the City of Johannesburg by density, including township applications</i>	32
<i>Figure 18: Location of settlements proposed in terms of the Provincial housing Programme</i>	33
<i>Figure 19: Location of Informal Settlements within the City of Johannesburg</i>	34
<i>Figure 20: Priority Areas per the Sustainable Human Settlements Urbanisation Plan (SHUSUP)</i>	39
<i>Figure 21: Primary regional movement patterns</i>	43
<i>Figure 22: Assumed future ridership per transport mode within the City of Johannesburg</i>	45
<i>Figure 23: The Corridors of Freedom – (Turffontein Corridor; Perth-Empire Corridor and Louis Botha Corridor</i>	45
<i>Figure 24: CSIR Study – Access to Open Space</i>	47

Tables

<i>Table 1: Extent of pipe line network within the City of Johannesburg by pipe size and material type..</i>	21
<i>Table 2: Extent of other water related infrastructure within the City of Johannesburg</i>	21
<i>Table 3: Extent and type of Joburg Water's wastewater pipelines.....</i>	24
<i>Table 4: Extent of other sewer related infrastructure within the City of Johannesburg.....</i>	24
<i>Table 5: Roles and functions of the JRA</i>	26
<i>Table 6: JRA assets by region</i>	27
<i>Table 7: JRA related City wide backlogs by programme</i>	28
<i>Table 8: City of Johannesburg Landfill which fall under PIKITUP.....</i>	30
<i>Table 9: PIKITUP depot sites that facilitate waste collection in the City</i>	30
<i>Table 10: Available airspace for operational PIKITUP landfills and expected lifespan of aforementioned landfills.....</i>	31
<i>Table 11: Informal Settlements by Administrative Region</i>	34
<i>Table 12: Possible scenario for the provision of certain housing types for the City as per SHSUP</i>	39
<i>Table 13: Proposed standards for social facilities for Informal Settlements' upgrades</i>	40
<i>Table 14: Land requirements for housing at different densities and erf sizes.....</i>	41
<i>Table 15: Social Facility requirements</i>	41
<i>Table 16: Residential Requirements (by erf size and density), Social Facilities Requirements, open space requirements and servitude requirements translated into hectares of land.....</i>	41

Part B – STRATEGIC REVIEW OF THE BUILT ENVIRONMENT

1 Current Performance of the Built Environment

1.1 Demographics

The City of Johannesburg (CoJ) is a vibrant and culturally rich city, but one that struggles with the typical concerns associated with developing countries. The IDP recognises these challenges and is committed to expanding opportunities and empowering residents to make use of these opportunities. In addressing these challenges, however, it is first necessary to understand the situation we are dealing with.

1.1.1 Population

The CoJ serves a total of 4.9 million people (2016). As is the case with many big cities in the world, it is overwhelmed by economic migration – nationally and internationally. The current population – estimated at 4.9 million, make it the biggest metro by population size in South Africa. It is projected that the population could increase from the 4.9 million (2016) to 5.4 million (2021) and to 7.6 million (2037). The growth rates in the projection period range from 2.0% per annum to 2.3%. With this projection in mind, the CoJ commits itself to bring about change and opportunities to the current population, and to create an environment where the growing population can prosper.

Johannesburg residents make up 36% of Gauteng's population, and 8% of the population of South Africa. A great deal of the city's population is young; a third of its residents are under 35 years of age. Racially, South Africa is divided as follows: Africans are the majority, making up for 76.4% (compared to 73% in 2001), white account for 12.3% (compared to 16% in 2001), coloured for 5.6% (compared to 6% in 2001), and Indian for 4.9% (compared to 4% in 2001). Population density (at 1644 km²) has increased from 1962 persons/km² in 2001, to 2698 persons/km² in 2017. The population density has a major effect on the services and needs which is to be provided by the CoJ in order to service the (growing) economy with pride and dignity.

- South Africa's population increased from 51.77 million in 2011 to 55.65 million in 2016; this is an 11.6% increase from 2011 to 2016.
- The Gauteng province continues to have the largest population of 13.39 million.
- In 2016, StatsSA Community Survey estimated 4.94 million people living in the City of Johannesburg
- The City of Johannesburg is the most populous City followed by Ekurhuleni (3.37million) and the City of Tshwane (3.27 million)
- This City's population represents of 8.9% of South Africa's total population.
- Both the female and male population accounte for 50% each of the City's total population.
- The City received approximately 3 027 migrants each month.

1.1.2 Wealth distribution

Johannesburg, with a current average GDP per capita of R117 225¹, is categorised as an upper-middle income economy (World Bank, 2016). The World Bank defines low-income economies as those with income per capita (calculated using the World Bank Atlas method) of R15, 095 or less; middle-income economies as those with income per capita of more than R15, 095 but less than R183, 975; high-income economies as those with income per capita of R183, 975 or more. Lower-middle-income and upper-middle-income economies are separated at income per capita of R59, 586.

Johannesburg, as an upper-middle income state, is a reflection on the economic achievements (specifically with regards to GDP per capita) of the past 10 years. Even though efforts towards reducing poverty have been made, there is a need for a renewed outlook on these policies; an outlook that is driven by freedom and opportunity, and with the aim of instituting a *working Johannesburg*.

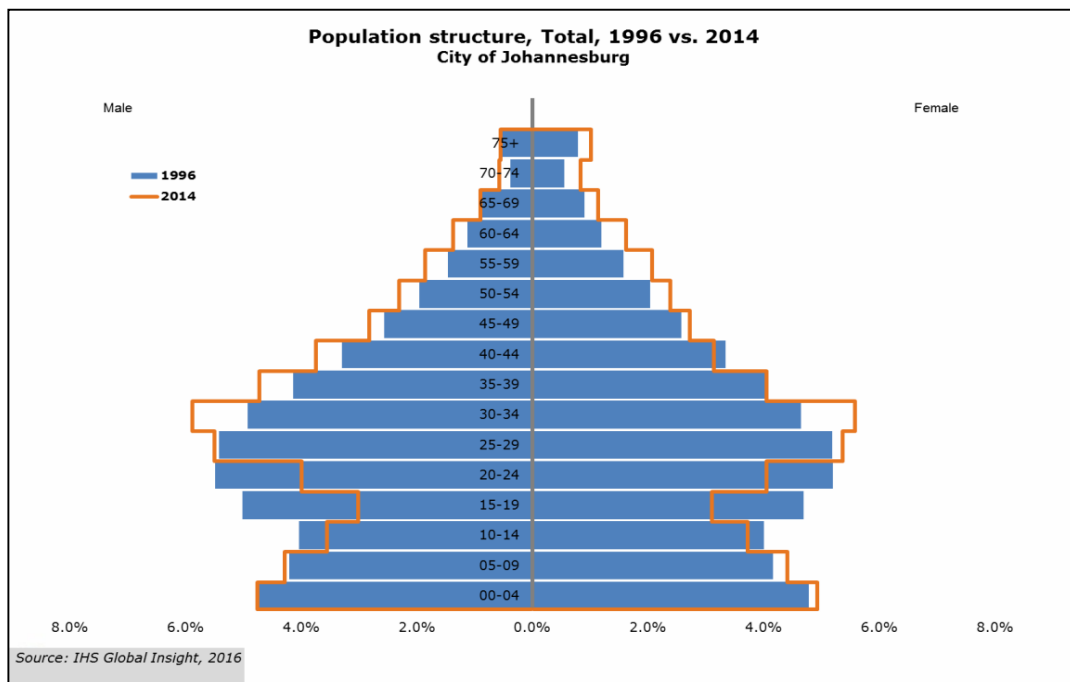
The major issue directly linked to poverty, is the high levels of unemployment (28%) in Johannesburg. The city has been dubbed one for the cities with the highest levels of inequality in the world. Of those employed, 78% are occupied in the formal sector, 8% in the informal sector and 13% in private households. Average household incomes by race in Johannesburg (based on Census 2011) were: African households R68 000; White households R360 000, Coloured households R142 000, and Indian/Asian households R259, 000.

1.1.3 Age distribution, (youth) employment and age dependency

There has been little change in the broad age structure of the CoJ population between 1996 and 2016. The population pyramid reflects a large youth population (persons aged 14 to 35 years) which constitute over 33.2% of the total population. This indicates that the youth is migrating to Johannesburg for better opportunities, but the influx has led to high youth unemployment (approximately 40%) in CoJ. In addition, the proportion of the elderly population (aged 65 years and older) also increased between 1996 and 2016. The CoJ recognise these challenges and commit to tap into skills and higher productivity ratios associated with the youthful economically active population, and to providing services to accommodate the higher life expectancy experienced in the city.

¹ Income figures are converted from \$ using the Panoramic Software as at 2nd December 2016.

While the broad age structure of the CoJ is similar to that of Gauteng, it is different from that of the national population in the following respects. The proportions of persons aged 0-14 years in the CoJ in 1996 and 2011 were lower than the corresponding proportions in the national population. Also, the proportions of persons in the working age group (15-64 years) in the CoJ in 1996 and 2016 were higher than the corresponding proportions in the national population. This indicates a growing potential workforce for whom jobs need to be created. Without sufficient economic growth and the creation of new job opportunities, the city will continue to struggle with high unemployment levels, and might lose out on individual talent and a growing middle class which can stimulate the economy. Growing the economy and creating new jobs therefore go hand in hand; this is emphasised in the 1st pillar of the new administration.



In addition to the age distribution, the overall age dependency burden in the CoJ declined from about 41 dependents for every 100 persons in the working age group (2001) to 31 dependents for every 100 persons in the working age group (2016). The overall age dependency burden is lower in the CoJ than in Gauteng and nationally in 2016. This is primarily owing to marked differences in child dependency between the CoJ and the national population relative to differences in elderly dependency between the CoJ and the national population. In absolute terms, the elderly population in the CoJ more than doubled from about 94 496 in 2001 to about 266 166 in 2016. This indicates a growth rate of the elderly population of about 181% during the last decade, and implies an increase in the demand (and supply) for services directed to those affected.

1.1.4 Home ownership, households and dwelling units

The total number of households in CoJ is currently estimated at 1.85 million; 62% of them male-headed and 36% female-headed. The total number and projected growth is illustrated in the CoJ Household Growth graph, which shows the projected number of households in the CoJ. If the assumptions underlying the projections hold, the number of households could increase from about 1.85 million in mid-2016 to about 2.16 million in 2021. This implies an annual growth rate of 3.5% to 3.9% during this period. It is also projected that household size could become smaller with time in the CoJ.

The population and households' dynamics in the City indicate that the population grew by 11.6% between 2011 and 2016 which pose challenges for planning and development in the city. The projected growth rates imply a doubling in the CoJ population in less than 35 years if present trends continue. This has economic implications and will affect the provision of services. The projections indicate that the rate of growth of the number of households would likely exceed the growth of the population in the CoJ. An increasing population puts pressure on the environment, and if housing provision cannot keep pace with the growing population, it will lead to increased urban slums and accelerating environmental degradation. Some of this pressure is already being reflected in services like electricity provision. Therefore, it is important for city planners to take adequate account of the probable growth of the CoJ's population to improve the welfare of the people.

1.1.5 Economic growth and the effect of the growing population

In the last 20 years the proportion of the population aged 0-14 has increased in the CoJ, and the survivors of this cohort in the next 1-15 years will be potential entrants into the labour market. With continuing migration, the youth population and its corresponding unemployment rate will remain high in the short to medium term. However, youth population is regarded as the *production population* which the CoJ could tap into. Although the proportion of the elderly population in the CoJ is still small, the annual growth rate of 6.6% per annum was much higher than the national average (2.2% per annum) and also higher than that of Gauteng (3.6% per annum) in the last ten years.

The discussed conditions raise a number of implications regarding development: given competing allocation of scarce resources.

- If present growth rates in the CoJ continue, innovative, dignified and smart approaches will be needed to accelerate improvement in people's welfare.
- There is a plausible implication for service delivery e.g. the provision of electricity, housing, health etc. as population and households increase over time.
- In view of the increasing trend in the size of the 0-14 age group with accompanying increase in the working age group, there will be implication for the education sector in absorbing the potential increase in entrants to tertiary institutions. This should be conducted in conjunction with economic growth so that the educated youth can feed into an established future job market.
- There will be implications of the increase in the size of the working age group for employment and job creation, savings, capital formation and investment if there are more

new entrants into the labour market than those that exit – especially if the education sector is developed to produce a more educated (and employable) youth.

- There will be implication for resource allocations with regard to different forms of old age support by government in view of the high growth rate of the population of the elderly in the CoJ.

1.2 Poverty in Johannesburg

Even though Johannesburg faces a number of economic challenges, the city has made great progress in social and economic issues. Despite this fact, high poverty levels in the region is still a concern. This is indicated by latest statistics which shows that 37% of people are still living below the poverty line. There are approximately 650 000 households that are considered poor (StatsSA). The StatsSA definition classifies a household as poor if its monthly expenditure is below R2500 as the cut-off (General Household Survey 2015).

1.2.1 Inequality in Johannesburg

Despite the achievements in terms of fighting poverty, inequalities in terms of incomes and opportunities have been persistent and the progress and benefits of Johannesburg's economic success have not been shared equally. The Johannesburg region has had the highest level of inequality relative to other regions. The Gini coefficient in Johannesburg is currently 0.66. This is however an improvement of 4% over the last decade. When considering why these inequalities persist, the following can be identified as contributing factors: The region is regarded as the economic engine of the country; and it attracts people from different classes – be it people who have high education levels, unskilled or uneducated persons seeking low income jobs, South Africans and immigrants in search for new opportunities, as well as students who normally work part-time jobs for sustenance during their years of studying.

Much of the inequalities are inter-regional with the Region A, Region E and Region G lagging behind other regions.

1.2.2 Youth unemployment in Johannesburg

Johannesburg has experience a growth in its middle class. Despite this, however, the issue of unemployment is still fixed at 28.2%. Youth unemployment is of particular concern which stands at approximately 40%. Unemployment (with specific focus on youth unemployment) is recognised as one of the City's most pressing socio-economic challenges, and it is recognised as a major obstacle to transformation growth, opportunity and development. The dangers of a high youth unemployment rate is of grave concern as it leads to an increased risk of poverty, a weaker consumer market, deskilling, isolation and an overall erosion of human capital, an increase in mental health problems, increased levels of alcohol and drug consumption, crime and social instability, an increased reliance on public services and welfare, the hampering of economic growth and productivity, and (potentially) a brain drain – should the youth choose to leave the city behind. As such, a holistic approach will be needed to engage the youth, to tap into their skills, and to make them owners of their own development.

1.2.3 Human Development in Johannesburg

Human Development – as the holistic process that enhances human abilities and enlarges people's freedoms and opportunities, as well as the process through which these conditions are created – is of vital importance when progressed is reviewed. Johannesburg has done considerably well with respect to human development; over the last decade, the region experienced 8% increase in the level of human development (currently rated 0.71). This can be attributed to improvements in living standards (with specific reference to health, education and income). This implies that as people relocate to Johannesburg for better economic opportunities, they often start with low-paying jobs and develop themselves through education and skills development. As such, they are able to experience higher levels of human development, and break the cycle of deprivation which impede freedom.

Human development goes hand in hand with human security which refers to the people's freedom

from fear and freedom from want. The improvement of human development involves the enhancement of the population's wellbeing in terms of health, education, human capital and safety – in other words providing them with human security. It also involves the expansion and the inclusive implementation of social assistance programmes to provide a level of basic income security – particularly for those communities without access to economic opportunities. In addition, human development will continue to positively respond as the city continues to target the reduction of, and education about, HIV prevalence, and the reduction of infant mortality rates.

The social safety net, underpinned by human development, is critical to combating poverty, and hence should be strengthened and sustained. Social transfers should ideally cover the unemployed portion of the population, in addition to vulnerable groups such as the disabled, the elderly and children.

Food security, as a component of human security, should remain a priority when human development in Johannesburg is considered. Approximately 42% of the city's poor population are considered food insecure – meaning that they live below the minimum level of dietary energy consumption.

The effects of inequality and marginalisation further exacerbate the inability of Joburg's chronically poor to participate in the economy and, subsequently, their inability to access food. Food insecurity also has a ripple effect on the state of the poor's health and nutrition, which in turn, entrench the cycle of deprivation.

According to the Community Survey conducted by StatsSA in early 2016

- 19% indicated they had run out of money to buy food in past 12 months.
- 10% indicated they had run out of money to buy food for 5 or more days in past 30 days.
- 12.6% had skipped meal in past 12 months.
- 6.6% had skipped a meal for 5 or more days in the past 30 days.

1.2.4 The rising middle class of Johannesburg

Johannesburg – as an upper middle class economy – has enabled a growing middle class. A strong middle class indicates that an economy is showing progress and could have a positive effect in following ways.

- The middle class grows the economy, not the rich, as the middle class continuously increase the demands for consumer goods and credit.
- A strong middle class is a prerequisite for robust entrepreneurship and innovation.
- A strong middle class will increase the purchasing power which, in turn, will stimulate the economy to provide to the increase in demands for goods and services.
- With a stronger middle class, commercial and tax revenues will be boosted.
- A strong middle class promotes better governance so as to grow the economy i.e. the middle class promotes efficient and honest delivery of government services.
- A stronger middle class also invests more in education, which will have a positive returning effect on a city that advances freedom and opportunity

Poverty rate (P = 37%) and inequality (Gini = 0.66) are still very high and pose social challenges. Poverty increases public agitation and potential social unrest. This effects the poor and marginalised, as well as the middle class. Poverty conditions exacerbate demands for economic development in the sense that when these demands are not met, social unrest occur and may lead to increases in crime. An inability to react to these demands entrenches the deprivation cycle and create fertile ground for unrest to take root. The middle class, on the other hand, is also affected as social unrest will affect the middle class via increased violent crime, disruption in business and consumer patterns, as well as the withdrawal of investors. In essence, this has a shackling effect on the magnitude and quality of economic growth. It is, therefore, in the interests of all sectors is society – public, private and social – that inequality is addressed.

This indicates that the gap between the wealthy and the poor within the City is very high. This inequality has a distinctive footprint which was mapped as part of a study undertaken under the auspices of the Community Development Department (see Figure 1). As seen from the map, the most deprived areas (areas shaded red) are located in the formerly black township areas of Diepsloot, Ivory Park, Alexandra, Zandspruit, the Inner City, parts of Soweto and the Greater Orange Farm. The more affluent areas in the City are located in the northern suburb areas of Sandton, Randburg and Johannesburg South.

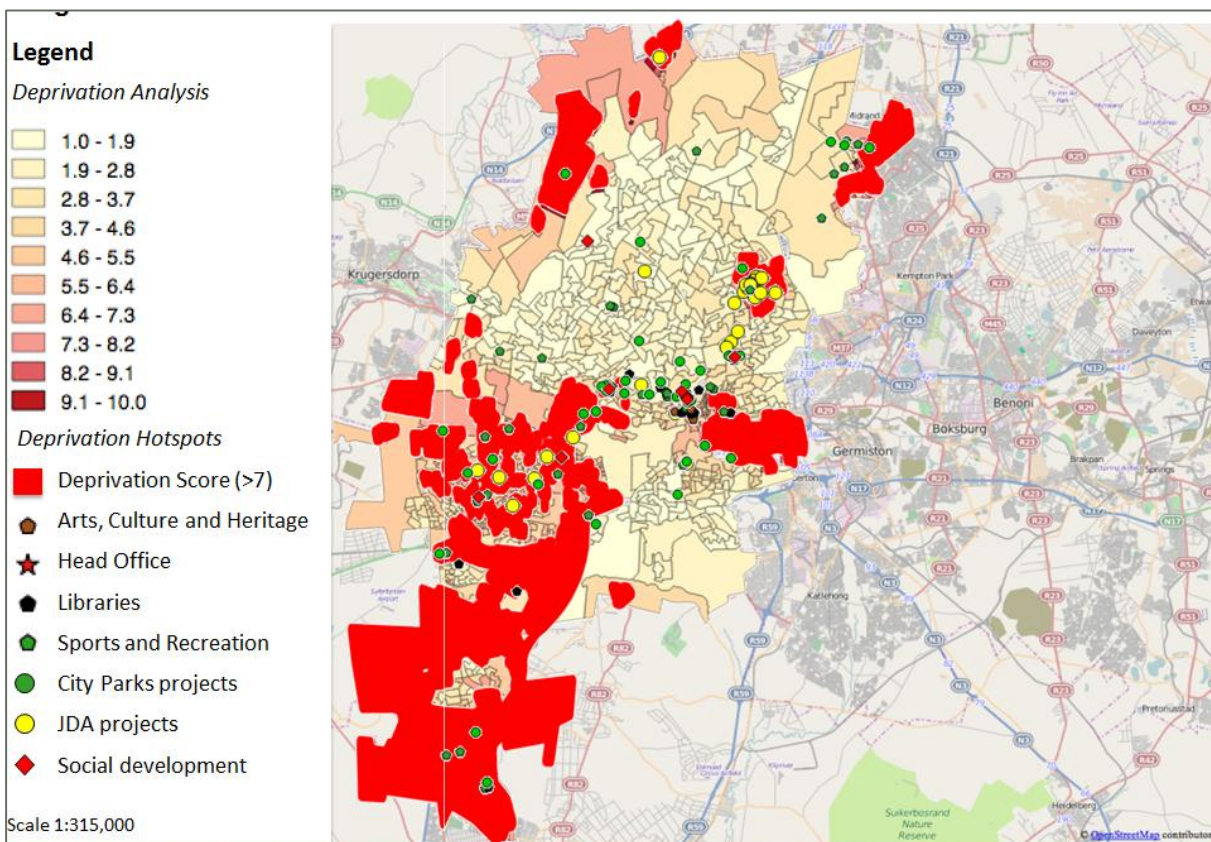


Figure 1: Deprivation Map City of Johannesburg (with proposed social development projects)

1.3 Spatial Trends

The City's population covers 1644 km² density which ultimately means 2.676 persons per kilometre. The low population density should be viewed within the context of a transport network that was constructed for the private vehicles and past apartheid policies. The apartheid policies allocated race groups to different locations within the City and this limited certain race groups' to have access to various resources and locations. In addition, low income housing development over the past twenty years has largely been located on the periphery of the City.

1.3.1 Density and Deprivation

However, low residential densities are not evenly spread across the City. High densities and overcrowding is typically in low-income townships, former black townships and in areas of the Inner City such as Hillbrow. Low residential densities are found in former white townships and townships on the western edge of the City. The correlation between high density and deprivation across the City is illustrated in Figure 2.

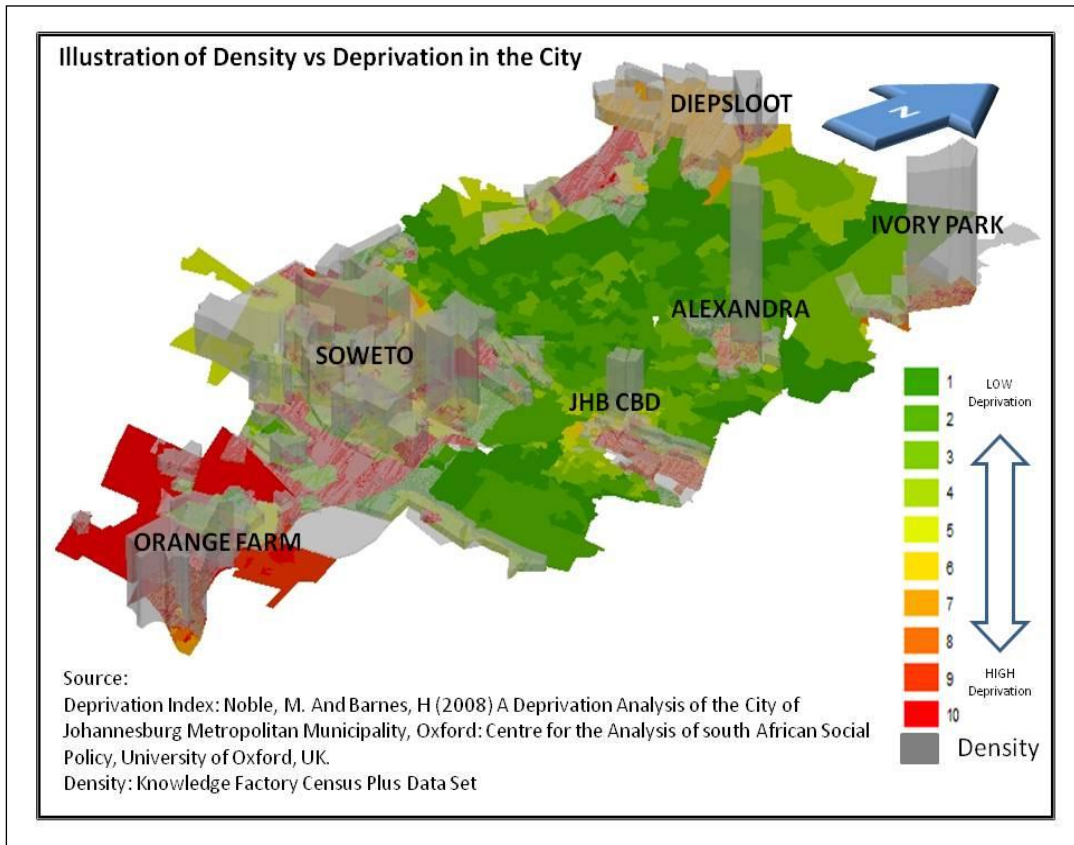
Another socio-economic challenge for the City is the inequality within the formation of informal settlements within various locations around the City. These are often in marginal locations, on land that cannot be developed or is uninhabitable. A result of these spatial inequalities is that a significant percentage of the poor's resources are spent on paying for transport to access locations that have many economic opportunities.

1.3.2 Environmental Challenges

High levels of pressure are placed on the City's already limited green infrastructure by the growing population, established enterprise and industry and a consumerist culture. These factors have seen the City being a major contributor to air pollution either directly (e.g. vehicle exhaust and industrial emissions) or indirectly (e.g. use of electricity generated by coal-fired power stations). While interventions have been undertaken to limit greenhouse gases into the atmosphere, many interventions are long term and their results cannot be accounted for in the short term.

The various challenges faced by the City of a growing population, economic and spatial concerns require strategic and collective approaches. In addressing unemployment and socio-economic deprivations, entrepreneurs are supported through various interventions through Jozi@Work, business hubs and development of market houses around the City. Investors are supporting the poor to access opportunities; facilitating educational activities are key foci of the City. This focus on encouraging the success of citizens is as important as the provision of local government services and is critical for the long term financing of these assets, be it basic or community infrastructure.

Figure 2: Density versus Deprivation in the City of



2 Trends and Demand for Economic Infrastructure

The city is the economic and logistics hub of the country with road, rail and air transport networks radiating outwards.

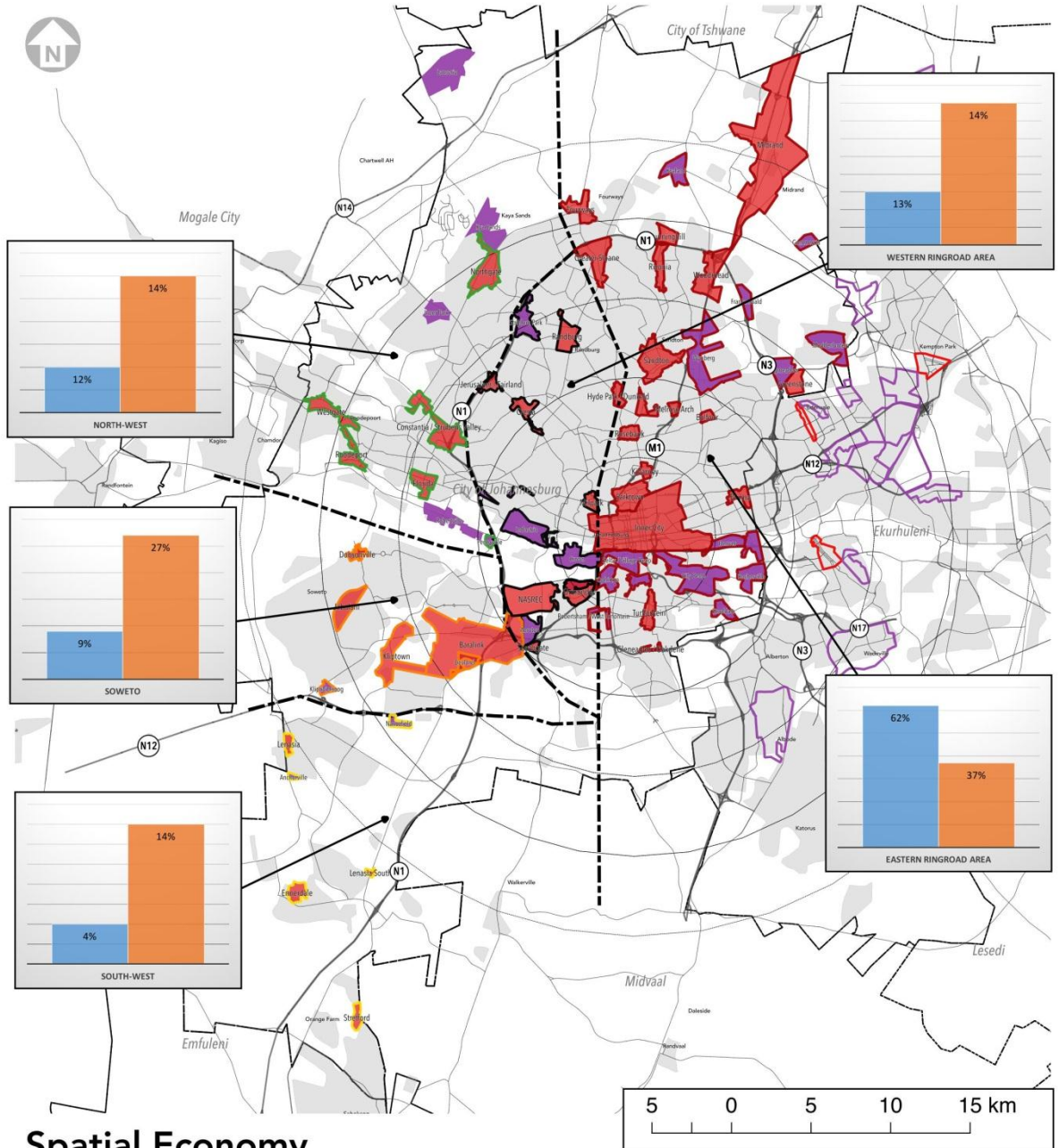
The city contributes about 17% of the national GDP and approximately 47% of Gauteng's economy. The City's economy is the main driver of national growth – historically performing at 50% higher in growth rates relative to national growth. The City's economy is driven mainly by four economic sectors which are: (a) finance and business services, (b) community services, (c) manufacturing and (d) trade. These four economic sectors collectively account for more than 82% of economic activity within the City. These sectors also account for the highest levels of formal and informal employment. The structure of output in the City's economy today is dominated by the financial sector, with community services, trade and accommodation and manufacturing also significant contributors. This is a shift in the economic base of the city from resources and manufacturing, to services. In 2013, sector contributions to output were: Finance, Real Estate and Business Services (32%), Community, Social and Personal Services (20%), Wholesale and Retail Trade, Catering and Accommodation (16%), Manufacturing (16%), followed at some distance by Transport Storage and Communication (8%), Construction Contractors (4%), Electricity, Gas and Water (2%), Mining and Quarrying (1%) and Agriculture less than 1%.

2.1 Spatial distribution of the Urban Economy

The city economy is centred on two regions of significant economic activity. The Inner City and Sandton nodes and their immediate regions, constitute 50% of the city's economic output but only house 23% of the city's population.

In contrast the south western regions of the city stretching from Soweto to Orange Farm only contributes to 13%, (9% and 4% respectively), of the city's economy but house 41% of the population. The southern parts of the city have consistently reported the highest percentage of people living in poverty. Most of the south western regions' sectoral growth dynamics remain weak when compared to other regions. Most of the areas south of the N12 highway have low interdependence and interconnectedness with the main economic centres in the City region and as a result attract limited economic investment. An exception is in Soweto where the community, social and personal services sector grew the fastest of all regions, reflecting both demand and public sector efforts to improve service delivery in the region.

Apart from the low economic energy in southern Johannesburg, there is also a significant east-west division of the space economy. The economic activity along the M1 that links the CBDs of Johannesburg and Pretoria, and the area east of the M1 accounts for 62% of the city's economy. If the Randburg region (Region B) is added to this total, then 72% of the city's economy is generated in the northern and eastern quadrants of the city. The economic necessity of agglomeration and linking of economic centres in the city region is clearly illustrated by the orientation of the city's economy to Tshwane to the north and Ekurhuleni to the east. This trend is further emphasised by the constant growth and increase in economic share of the north-eastern quadrant of the city over the past 18 years.



Spatial Economy

SPATIAL ECONOMIC DISTRIBUTION

--- Spatial Economic Delineation

ECONOMIC ACTIVITY

- Western Ringroad Area = 13% of City Economy (14% Population)
- Eastern Ringroad Area = 62% of City Economy (37% Population)
- North-west = 12% of City Economy (14% Population)
- Soweto = 9% of City Economy (27% Population)
- South-west = 4% of City Economy (14% Population)
- + Ringroad Area (East and West) = 75% of City Economy (51% Population)

NODES

- Economic Nodes
- Industrial Areas

PERIPHERAL NODES

- Commercial
- Industrial

GRAPH LEGEND

- % Economic Contribution
- % Population

ROAD NETWORK

- Highways
- Highways (Gauteng)
- Arterial Roads
- Main Roads

BOUNDARIES

- Gauteng Built-up Areas
- Gauteng Municipal Boundaries
- COJ Boundary

Economic Nodes

Formal Economic Activity within the City is concentrated in specific locations which the City terms mixed use or industrial Nodes. A combination of retail, commercial, office, educational and high density residential uses are located in mixed use nodes. The quality and function of the nodes varies significantly across the City meeting the needs of the full range of socio-economic groupings within the City. Ensuring that the public environment of these nodes is maintained and preventing urban decay is a constant challenge. However these areas are critical for the on-going sustainability of the City's

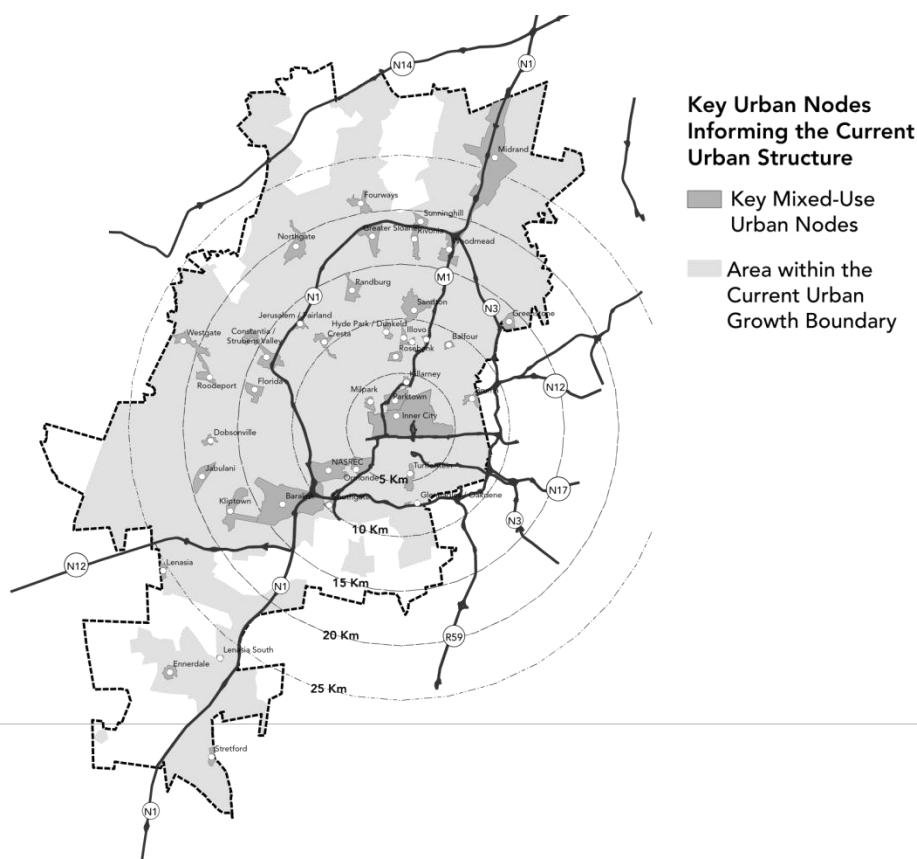
† Figure 3: Location of Mixed Use Nodes in the City

intervention.

This significant formal economy must be viewed in the context of official unemployment figures of the City which was approximately 25% in 2011. This is a 4.6% decrease from census data of 2001. The Youth unemployment rate (school-leavers) is higher than the average unemployment rate at 35%, which is a concern to the City.

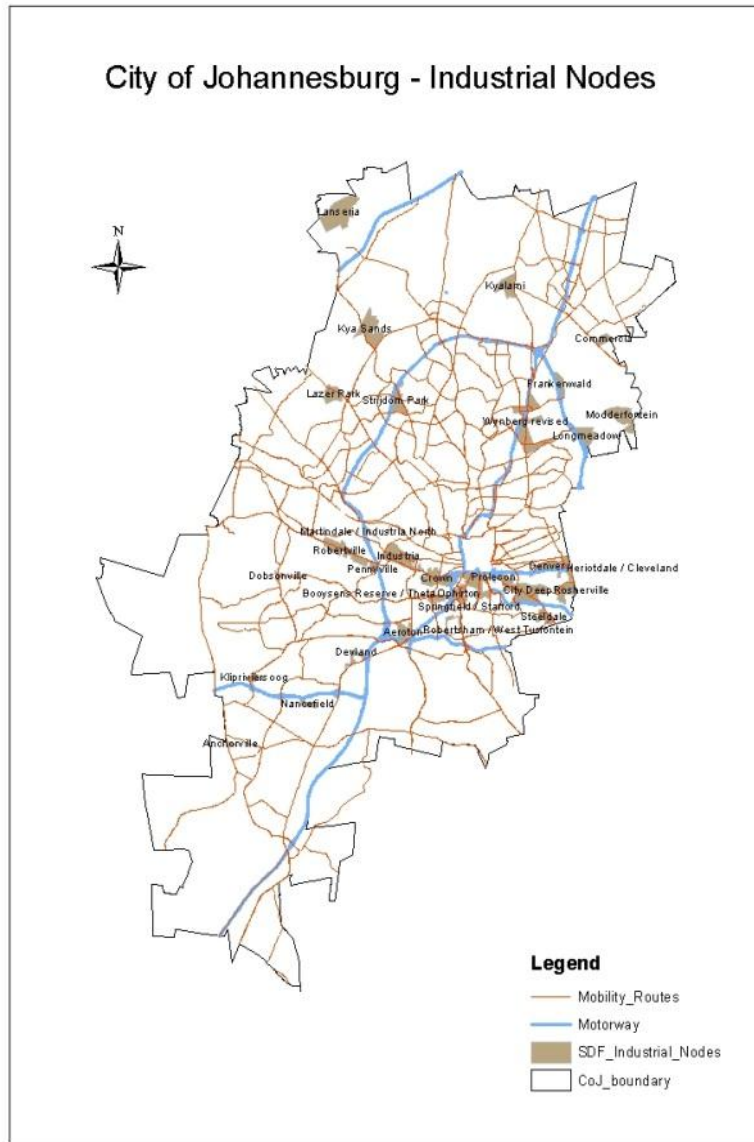
There is significant pressure for new mixed use developments south of Midrand on the Farm Waterval, adjacent to Lanseria Airport, the Farm Modderfontein and the Farm Frankenwald located east and north of Alexandra. Over the past ten years there has been an emergence of mixed-use nodes in areas of Soweto, Orange Farm, Diepsloot and Ivory Park.

The Inner City, also referred to as the Central Business District (CBD) remains a critical location for economic development for both the formal and informal sectors. In the 1980s and 1990s, the CBD experienced significant economic decline whereby many businesses relocated to the mixed use nodes of the north of the City. In addition there was an influx of poorer migrants into areas of the CBD such as Hillbrow. Through a combined effort by the government, the private sector and Non-Government Organisations (NGOs), the economic decline of the CBD was reduced. However, changing socio-economic circumstances, the extent of the CBD and the continued increase of residents within the area requires on-going City intervention.



Compared with Ekurhuleni Metro the City of Johannesburg has a relatively small industrial sector, which is scattered across the City. The

Figure 4: Location of Industrial Nodes within the City



greatest concentration of industrial activity is located in the old mining belt of the City in a west to east industrial corridor south of the CBD. This is where the City Deep Inland logistics port at City Deep is located.

As with the mixed-use nodes the uses associated with and the condition of industrial nodes within the city varies significantly. While certain nodes such as Kew have experienced decline, largely due to security concerns and the invasion of factories by squatters, other areas such as Longmeadow have expanded significantly. Uses vary from manufacturing and bulk retail through to warehousing and other logistic related activities.

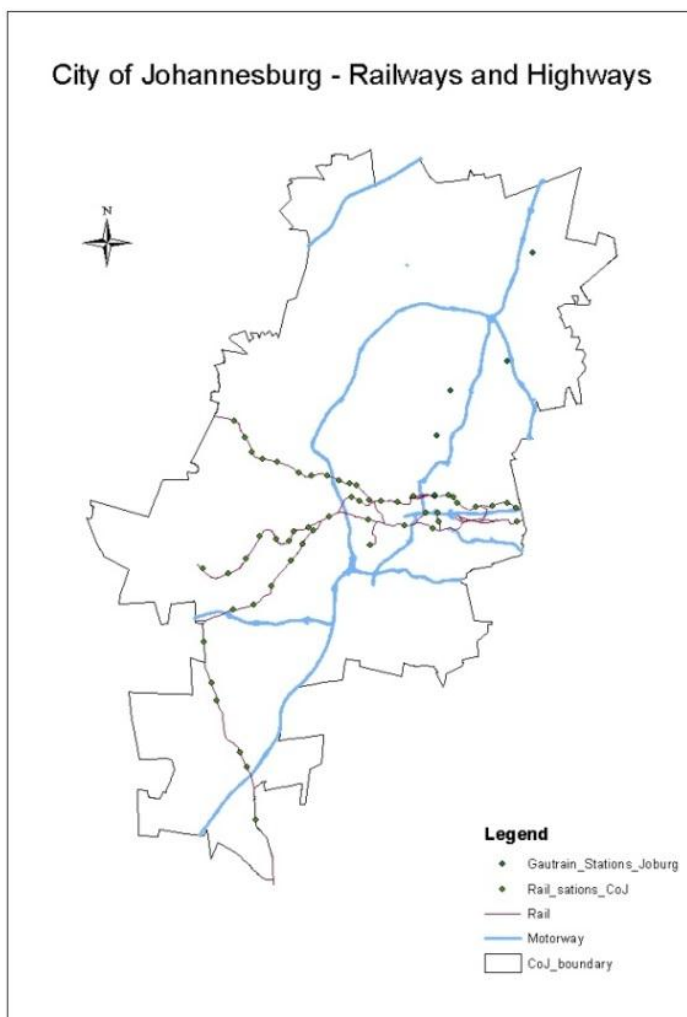
Mining activity is limited to small scale reclamation of minerals from existing mine dumps in the old mining belt. The Mixed Use and Industrial nodes are critical for the current future success of the City's economy. However this success is dependent on the quality of the transport infrastructure to facilitate the movement of goods and people to and from these destinations.

2.2 Transportation

For a City reliant on the motor vehicle, a high quality, well maintained, easily accessible freeway system is critical for the success of the City. The City is responsible for two such routes namely the M1 and the M2. The rest of the freeway network which comprises the N1, N3, N12, and N17 is the responsibility of SANRAL. In order to ensure the continued productivity of the City, the expansion of the existing freeway network may need to be considered in the medium to long term. Another important road network for the City is the K and PWV network maintained and constructed by Gauteng Province. The failure of government to construct planned K and PWV routes in the north and north-west of the City has contributed significantly to the traffic congestion in the north of the City.

Figure 5 : Major Transportation Routes

which has three components. The first is a freight component under the auspices of TRANSNET. The



Besides the road network, the City does have a rail network which has three components. The first is a freight component under the auspices of TRANSNET. The rail freight network is limited to a series of east-west railway lines in the vicinity of City Deep and is closely associated with the inland logistics port. The second is a heavily used passenger rail service which runs trains from as far south as Orange Farm to the CBD, though the bulk of the service and associated stations services Soweto and is operated by PRASA. PRASA is currently undertaking a recapitalisation process that will see the rolling stock and some of the existing railway stations are being upgraded to give rise for future economic development in these localities. The third component is the Gautrain which is operated by Bombela Consortium. The City of Johannesburg has 5 stations currently, with a sixth station proposed for Modderfontein. The network serves middle to upper income users and has been partly responsible for significant redevelopment in Rosebank and Sandton. The railway network has also opened up alternative commuter options to and from

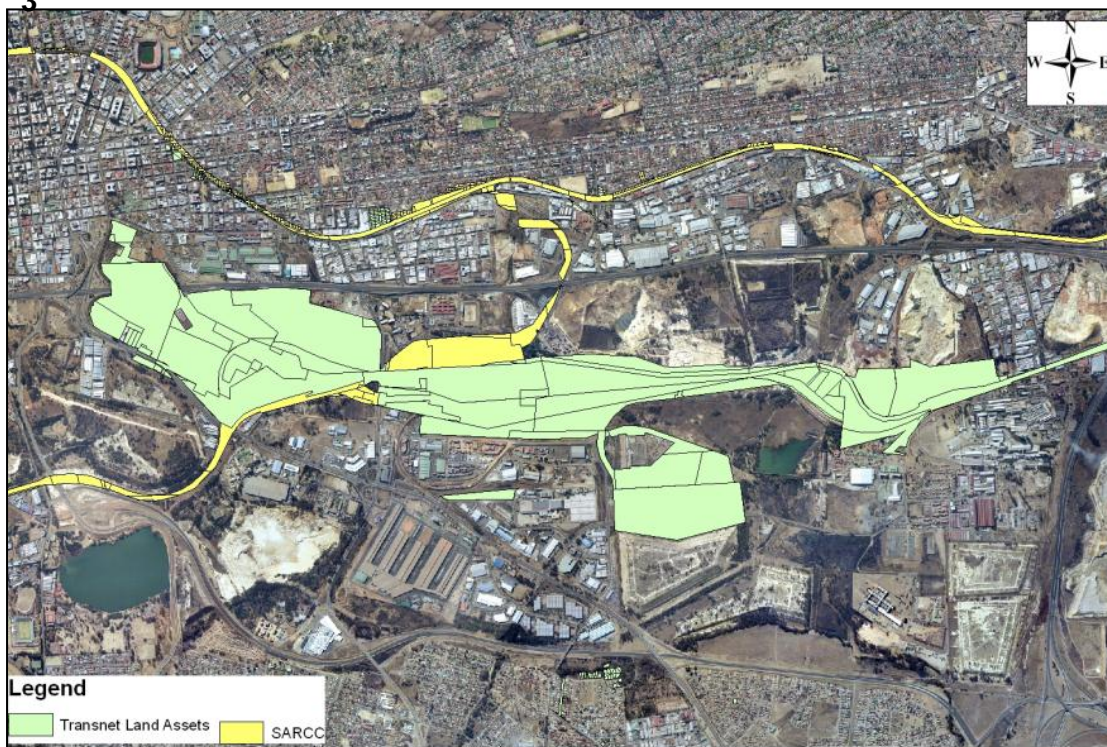
Tshwane and Ekurhuleni Metros. Three phases for the Gautrain have been completed; further works to connect Southern, Northern and Western parts of the City are still pending to fully integrate a majority of the nodes. The support from the City is instrumental for these initiatives through insights of storm-water management, environmental impact analysis and policing to avoid vandalism around the stations and tracks.

While the Oliver Tambo International Airport is located in Ekurhuleni Metro it is a critical component of the economic infrastructure of the City. The City welcomes the plans to facilitate the development of

an Aerotropolis at the Airport as this will benefit the entire City Region especially those mixed use nodes accessed by the Gautrain. Lanseria is the second airport for the City. It is located in the extreme north of the municipality. It has seen significant growth in domestic flights over the past ten years. There are significant plans for enterprise development adjacent to the Airport. In support of the increased demand around the Lanseria node, Joburg Water has invested R10,000,000.00 for the development of the Waste water treatment plant for the 2015/16 financial year.

The Presidential Infrastructure Coordinating Commission identified a number of Strategic Integrated Projects (SIPs) to support economic development and address service delivery. The importance of Gauteng as a region which drives the national economy was highlighted specifically through SIP2 that related to the Durban-Free State – Gauteng Logistics and Industrial Corridor. The aim of the SIP is to strengthen logistics and transport corridor between SA’s main industrial hubs and Durban’s export and import facilities. The City Deep Inland Port and its associated road and rail infrastructure represent the City of Johannesburg's component in this industrial corridor. Currently the growth and functioning of the Port is constrained by its geography and relatively low capacity of its existing bulk infrastructure. Significant infrastructure investment is required to revitalise this critical locale within the City. The City of Johannesburg cannot on its own fund the realisation of this project. It will require a coordinated intervention by all stakeholders. In addition further sites for logistics hubs within Johannesburg should be undertaken to facilitate expected growth resulting from the SIP2 initiative. The proximity and radius of City Deep hub being within the Turffontein Corridor and the Inner City, is such that it will benefit significantly from the infrastructure developments by JRA, Joburg Water and City Power. This will in turn support the high capacity demand from the ports and the SIP2 initiatives.

Figure 6: City Deep Logistics Hub



3. Trends and Demand for Basic Infrastructure

The above section (section 2) reviewed the infrastructure components that form the foundation for current and future economic growth within the City. This section reviews the basic infrastructure provided by the Municipality Owned Entities (MoEs), namely: water, sewer, electricity, local roads and waste removal. Not only are these services pre-requisites for urban living, they also play an important economic role. It is critical that these services are provided at a high standard and can be accessed by a range of socio-economic groupings within the City and that the City is adequately remunerated for these services.

The analysis below is drawn from the Consolidated Infrastructure Plan: Phase 1, which was undertaken in 2013. The study focused on defining bulk infrastructure requirements for water, sewer, electricity and roads based on an assessment of information provided by the relevant municipal owned entities. Phase 2 of the Consolidated Infrastructure Plan is currently underway and will assess the detailed connector infrastructure for the four services.

3.1 Water

Joburg Water supplies potable water to the residents across the City. The purified water is purchased from the regional bulk supplier, Rand Water.

Bulk water assets are represented in Figure 7. Bulk water infrastructure is defined as pipelines (the

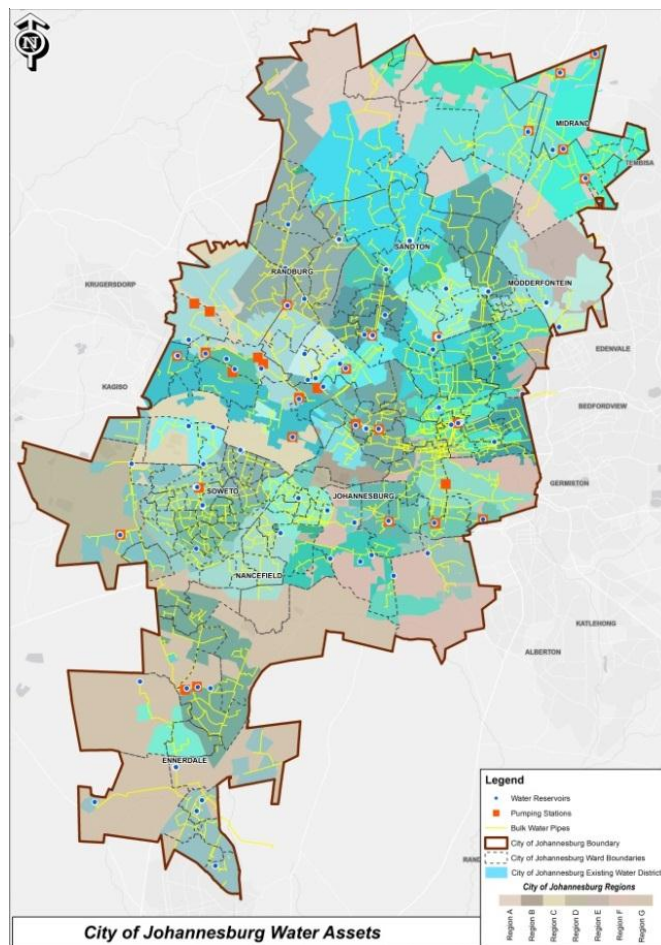
network illustrated on the map) and fixed assets which is represented on the map as dots and squares. The extent (km) and nature (materials used) of the pipelines used in the City is represented in **Error! Reference source not found.** The type, number and capacity of the fixed assets is provided in Table 2.

The estimated current replacement cost of the City's water assets is estimated at R18,437,402,103.00.

Joburg Water's Business Plan indicates a level of service backlog, with regards to water, of 8 521 households, as at December 2015.

An annual growth rate of 3% has been recorded in a previous 22-month monitoring period. This increase in water consumption has been modelled for the next 10 years including two further scenarios based on the 2011 census customer profile: firstly, based on an annual projected population growth rate of 1.7%, and secondly, using the 1.7% population growth rate but with a progressive reduction in network leakages. Thus, in the worst case scenario, a water

Figure 7: Bulk Water Assets – City of Johannesburg



demand of around 720 000 MI p.a. could be expected by 2022, whilst it could be as low as 560 000 MI p.a. if the annual growth is kept in line with the demand associated with the expected population growth in addition to a reduction of unaccounted for water from its present level of 39% to 25%.

Table 1: Extent of pipe line network within the City of Johannesburg by pipe size and material type

WATER PIPELINES (M)						
DIAMETER (MM)	MATERIAL					TOTAL
	AC	uPVC	HDPE	Steel	Other (MPVC, GRP)	
<100	379 218	2 292 179	416 871	117 355	0	3 205 624
≥100 <200	879 883	3 102 894	115 179	2 275 340	0	6 373 295
≥200 <300	161 679	651 396	11 088	150 501	0	974 664
≥300 <500	127 701	149 120	3 420	522 651	58	802 950
≥500 <700	42 326	35 291	1 493	226 372	498	305 980
≥700 <900	7 153	22 613	1 125	155 008	0	185 899
≥900	301	1 868	0	35 804	0	37 973
Total	1 598 261	6 255 361	549 176	3 483 031	556	11 886 385

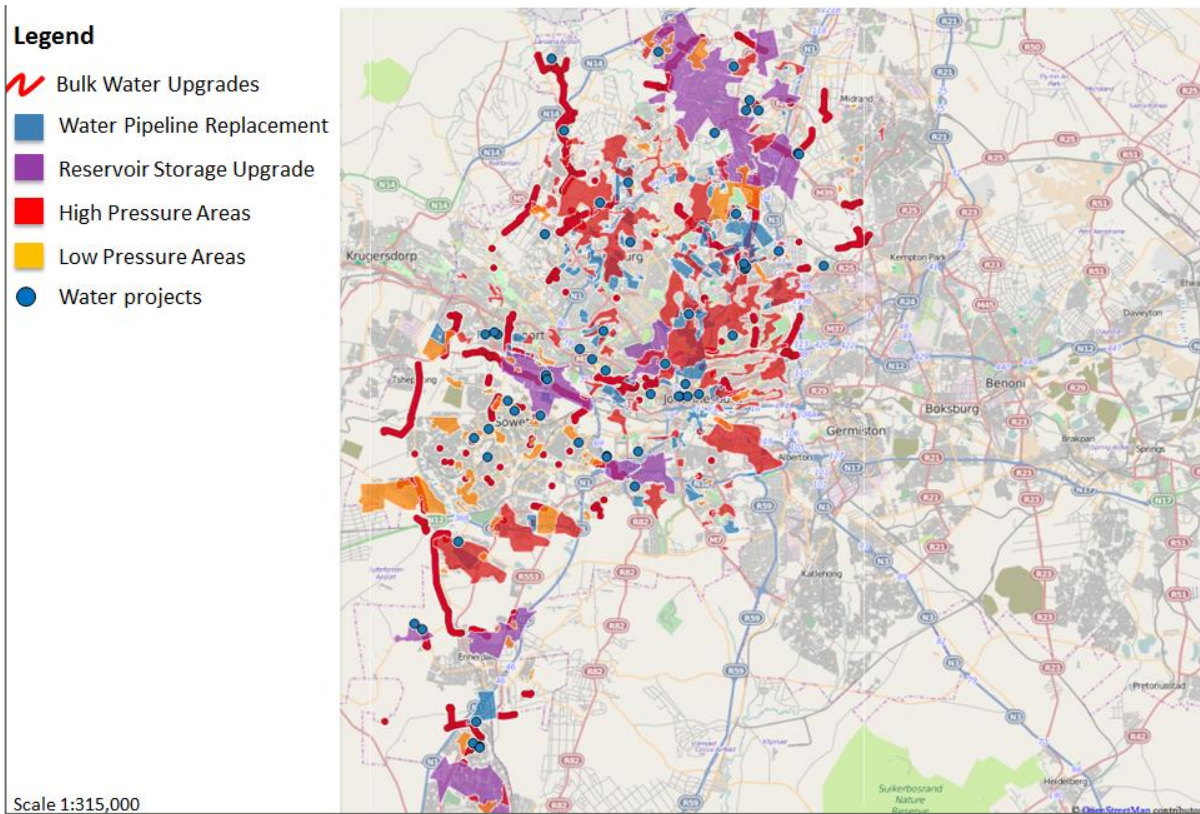
Table 2: Extent of other water related infrastructure within the City of

ASSET/COMPONENT TYPE	EXTENT	UNIT	CAPACITY
Reservoirs	88	Number	1 707 (MI)
Water towers	34	Number	23.4 (MI)
Pump stations	37	Number	9 471 (kW)
PRV stations	477	Number	N/A
Valves	55 052	Number	N/A
Hydrants	41 440	Number	N/A
Meters	485 199	Number	N/A

The CIP Phase 1 analyses the City's future water projects in terms of capital projects and refurbishment projects. Capital projects refer to projects which are required for water services to address the growing water demand or replacement projects. Refurbishment projects form part of the capital project list but have been identified separately. These projects have been identified by considering assets with a remaining useable life of less than 20 years.

The capital projects required by the City and refurbishment Projects are illustrated in *Figure 8*. A full list of water refurbishment projects with estimated budgets can be made available on request. From the maps it is apparent that capital requirement is primarily in the north, west and south of the City, while water refurbishment requirements are clustered in the northern central and southern areas. Joburg Water has a sophisticated infrastructure asset management system by which existing assets are maintained, upgraded, refurbished and ultimately replaced. This system relates to Joburg Water's work schedules.

Figure 8: Water Program



3.2 Sewer

Given a gravity based system the bulk sewer network follows the City's valleys. Sewerage is treated waste water treatment works under the jurisdiction of Joburg Water. The extent and nature of the sewer pipe network and the fixed sewer related assets is illustrated in *Figure 9*. The estimated current replacement cost of the City's sewer assets is estimated at R29 588 065 870.

The level of service backlog is approximately 78 823 households regarding access to sanitation as of December 2015. About 52 054 households have individual access to Ventilated Improved Pit (VIP) latrines.

Figure 9: City of Johannesburg's sewer assets

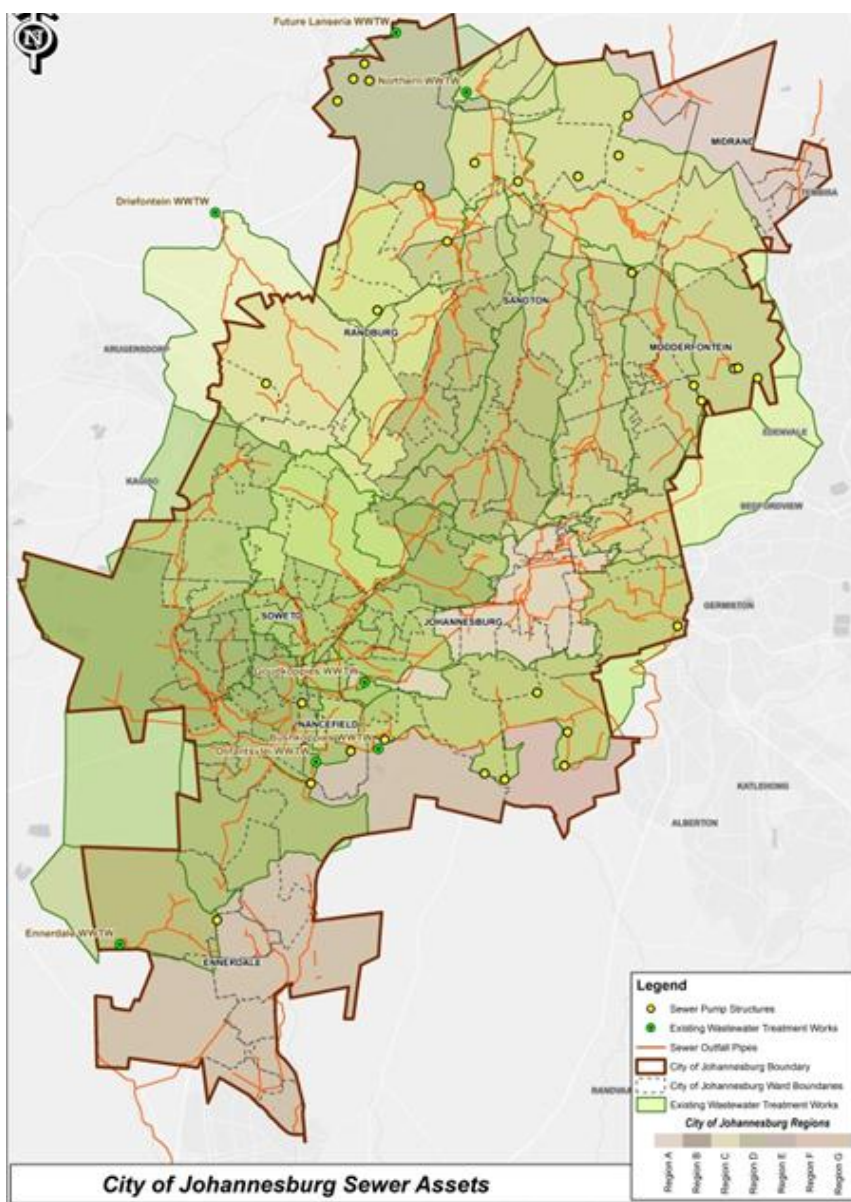


Table 3: Extent and type of Joburg Water's wastewater pipelines

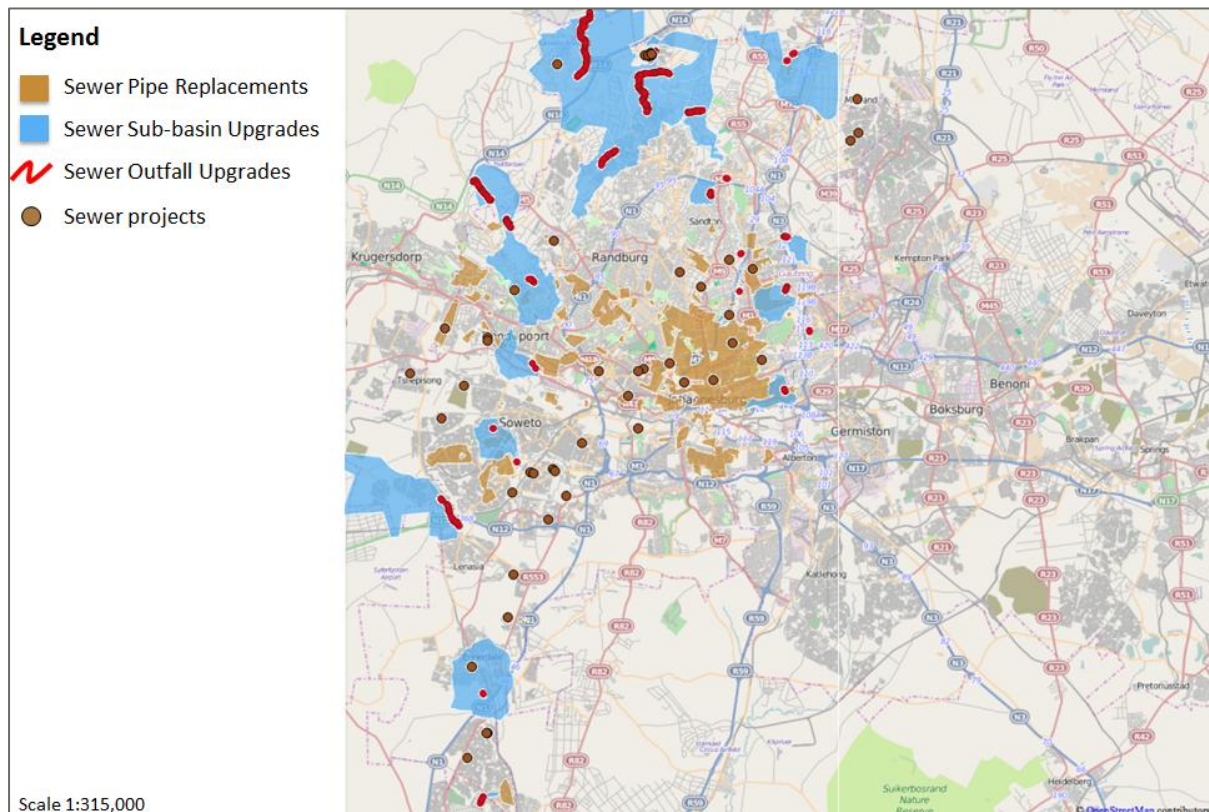
DIAMETER (MM)	WASTEWATER PIPELINES (M)							TOTAL
	MATERIAL							
	AC	Steel	uPVC	Concrete	Clay	HDPE	Brick	
<200	135 273	294	874 367	13 259	9 226 498	3 398	0	10 253 088
≥200 <300	10 708	2 069	74 248	3 630	408 253	849	0	499 756
≥300 <500	10 067	3 901	41 038	57 061	183 213	1 889	0	297 169
≥500 <700	2 716	1 665	3 074	71 960	4 267	544	0	84 225
≥700 <900	4 191	1 697	0	73 514	287	0	0	79 689
≥900	0	3 012	0	190 720	0	0	602	194 334
Total	162 955	12 637	992 727	410 143	9 822 517	6 680	602	11 408 262

Table 4: Extent of other sewer related infrastructure within the City of Johannesburg

ASSET/COMPONENT TYPE	EXTENT	UNIT	CAPACITY
Wastewater treatment works	6	Number	1 118(Ml/d)
Pump stations	36	Number	4 227 (kW)
Manholes	229 613	Number	N/A
Sewer connections	441 502	Number	N/A

As with water, the future sewer projects are defined as either capital projects or refurbishment projects. The location of capital projects and refurbishment projects are represented in Figure 10 .

Figure 10: Sewer Program



3.3 Electricity

City Power is the municipal owned entity responsible for electricity distribution for a significant proportion of the City. The bulk assets of the utility include sub-stations, load centres and reticulation, these are illustrated in Figure 12. More detail relating to the MV and LV networks and associated point infrastructure will be made available during the Phase II of the Consolidated Infrastructure Plan. Eskom is responsible for electricity distribution in the north of the City, Soweto, and the greater Orange Farm area as shown in Figure 11.

Through its 2012/3 master planning process City Power aligned its growth forecasts with the settlement growth projections captured in the Spatial Development Framework (SDF), to ensure better alignment of future electrical provision. The Master Plan also assessed the condition of existing City Power assets. In terms of the master planning exercise, future refurbishment and capital projects were identified (see Figure 11 and Figure 13). As seen in Figure 13 Refurbishment projects refer to the renewal of sub-stations and associated assets based on condition assessment. These projects are concentrated in the Roodepoort and Turffontein areas of the City.

According to Figure 13, there are more capital and/or new projects required by City Power in order to facilitate the settlement growth of the City. These bulk infrastructure projects include sub-stations, intake points, load centres, underground cables and overhead transmission lines. A full list of City Power's Capital and Refurbishment Projects is available on request.

Figure 12: Bulk Assets of City Power

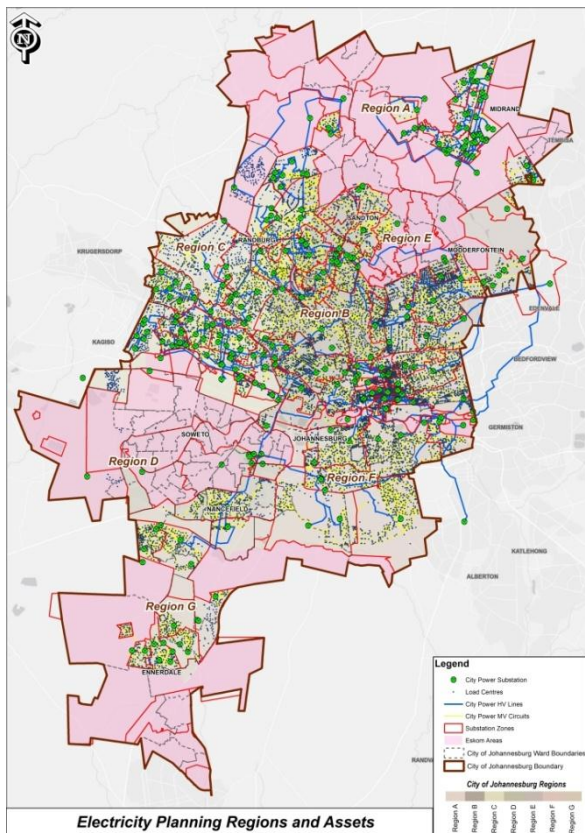


Figure 11 : Location of refurbishment projects required by City Power

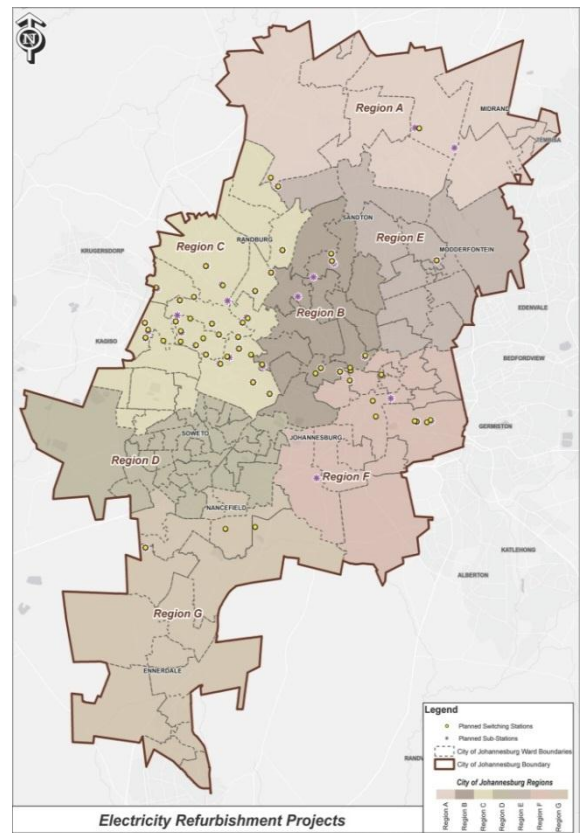
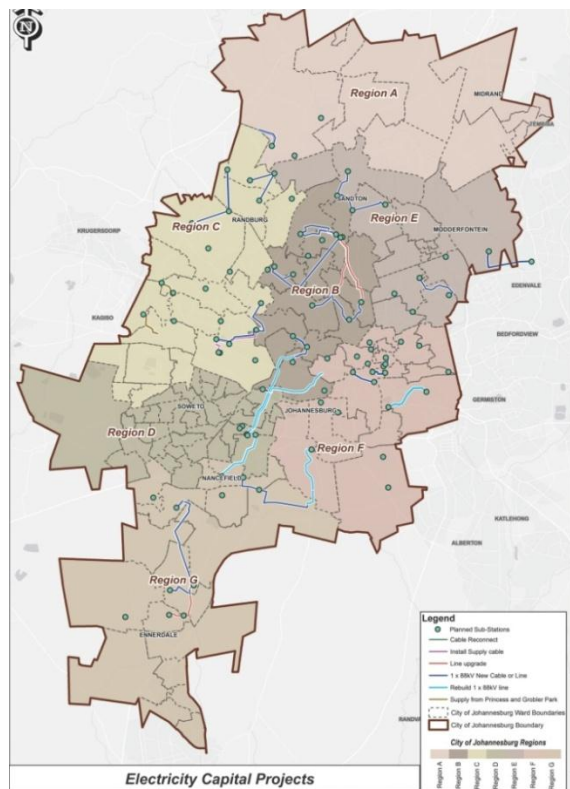


Figure 13: City Power – Required capital



3.4 Roads and Storm water

The Johannesburg Roads Agency (JRA) is responsible for roads, bridges, certain dams and storm water within the City. The roles and functions of the JRA are defined in Table 5.

Table 5: Roles and functions of the JRA

PRODUCT/SERVICE AREA	INTERPRETATION
Traffic regulatory infrastructure	Traffic signalling (robots)
	Road markings
	Road signs
	Regulatory operating system
Road infrastructure	Road reserves (footways or pavement, bridges, verge or edge/border/grass pavement, culvert, guard rails, fencing and billboards)
	Infrastructure development and maintenance
Rail siding infrastructure	Rail reserves (bridges, verge or edge/border/grass pavement, culvert, guard rails and fencing)
Stormwater management	Stormwater catchment development and maintenance.

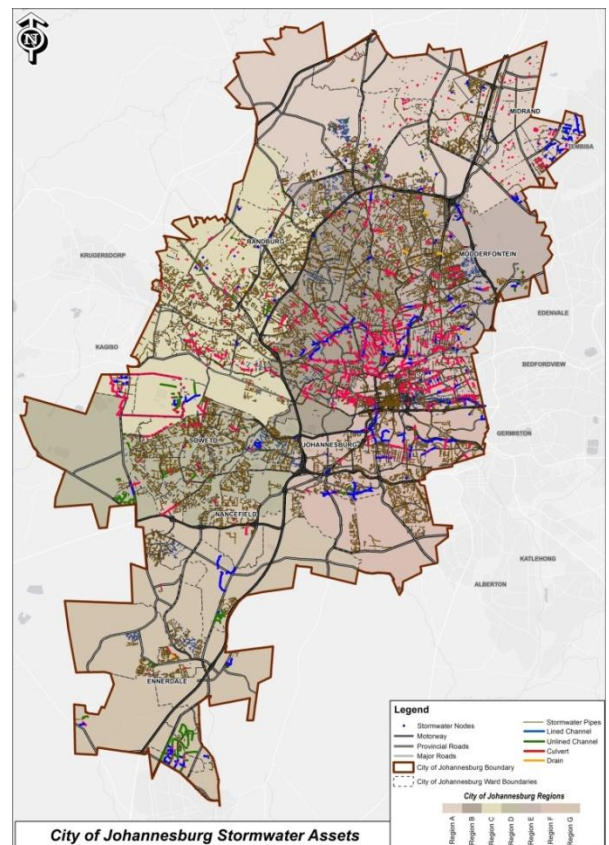
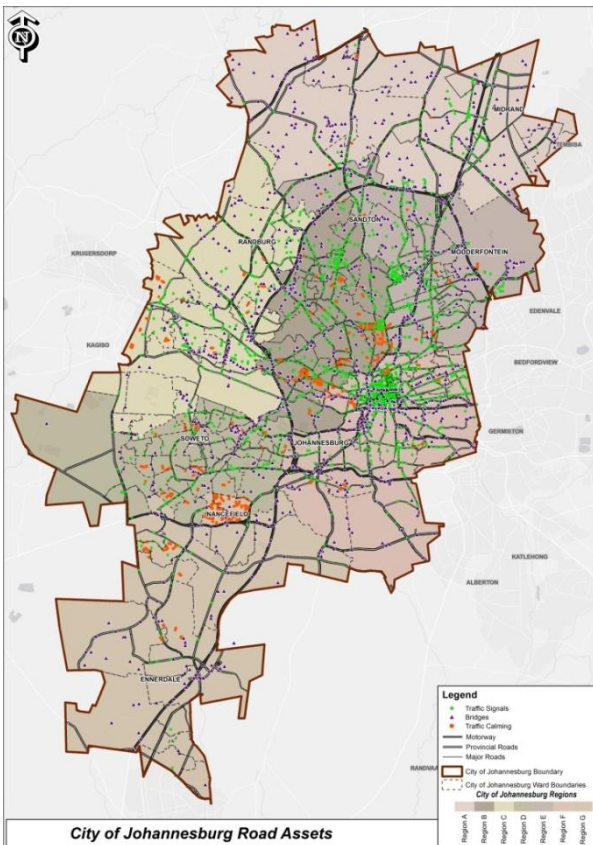
JRA has undertaken a 10 year master plan for its assets that will function as an infrastructure asset management plan. Based on available information the Consolidated Infrastructure Plan defined JRA’s assets by the City’s administrative regions (A-G) as captured in Figure 15.

Table 6: JRA assets by region

	REGION							TOTAL
	A	B	C	D	E	F	G	
Infrastructure component	678	1408	1298	1462	1245	1534	700	8324
Gravel roads (km)	376	1	180	39	10	6	384	997
Intersections	4569	4900	6885	8849	5104	6548	7324	43852
Stormwater channels/culverts (km)	17	56	50	16	40	70	39	288
Stormwater pipes (km)	220	382	412	383	519	477	172	2565
Stormwater pipes (unknown) (km)	4	37	15	12	24	35	25	153
Stormwater kerb inlets	3392	6705	6547	7401	8634	10302	3228	46209
Stormwater inlets (other)	3487	6701	5005	5179	8200	8253	2396	39221
Stormwater manholes	1386	5953	3385	3286	5978	5111	1578	26677
Stormwater inlets (unknown) (km)	355	1450	275	123	1027	565	0	3775
Bridges (CoJ-owned)	64	87	89	45	117	204	10	616
Bridges (not CoJ-owned)	66	87	73	21	69	160	73	549
Bridges (ownership unknown)	128	29	55	46	46	55	66	425
Dams (JRA)	0	2	5	1	0	2	0	10
Signs	0	177	80	0	1089	788	0	2134
Motorway (lane km)								398

Figure 15: Location of JRA road assets: traffic lights, bridges and traffic calming related assets

Figure 14: Location of JRA storm water assets



Location of traffic lights, bridges and traffic related assets is illustrated in Figure 15. The location of stormwater related assets is represented by Figure 14.

3.4.1 Maintenance

According to the Consolidated Infrastructure Plan:

- JRA has level 1 maintenance plans
- JRA Depots have a systems application programming (SAP) system to manage operations
- Footways and the road verge are maintained according to a management system of 1996.
- JRA does not have sufficient budget to operate and maintain its existing assets.

The majority of road infrastructure is maintained primarily through inspections by officials and/or through complaints from the public, which are programmed/ prioritised on the system for implementation. This includes roads (surface), road signs and markings, storm water inlets (kerb inlets), and roadside furniture and traffic signals.

3.4.2 Infrastructure Requirements

The CoJ road hierarchy project identified major road projects. These were projects for new roads or to increase capacity of existing roads with the aim of addressing traffic congestion within the City. These also include capital projects relating to bridges, road reconstruction, road resurfacing, storm-water projects and operational capital projects were captured on the City's Capital Investment Management System.

3.4.3 Backlogs

A backlog that addresses poverty in the context of roads in the City of Johannesburg refers to the tarring of gravel roads in former black townships and in low income township developments. These areas are Ivory Park, Mining Belt, Greater Orange Farm Area and Diepsloot. The current backlog with regard to gravel roads is just about 350 kilometres. The cost of funding this backlog is approximately R1.2 billion and the estimated time that it would take to eradicate is dependent upon annual capital budget allocations. Other road related backlogs and estimated funding requirements are captured in **Error! Reference source not found..**

Table 7: JRA related City wide backlogs by programme

DESCRIPTION	UNITS	PERIOD TO ERADICATE	ESTIMATED COST
Gravel Roads programme			
Upgrading of Gravel roads to surfaced (Prioritised areas)	350 km	Dependent on budget	R 1.200 Billion
Roads Infrastructure programme			
Road Reconstruction		Dependent on budget	R 520 million
Storm Water Management programme			
Upgrade of storm water systems and catchments		Dependent on budget	R 900 million
Upgrade of storm water system improvements based on level 4, 5 audits		Dependent on budget	R 154 million

Bridges programme			
Construction of pedestrian bridges	12	Dependent on budget	R 84 million
TOTAL FUNDS REQUIRED			R 3.194 Billion

Backlogs relating to stormwater (flooding) hotspots and gravel roads are illustrated in Figure 16. These backlog estimates are to be updated as and when new information becomes available relating to the state of the assets.

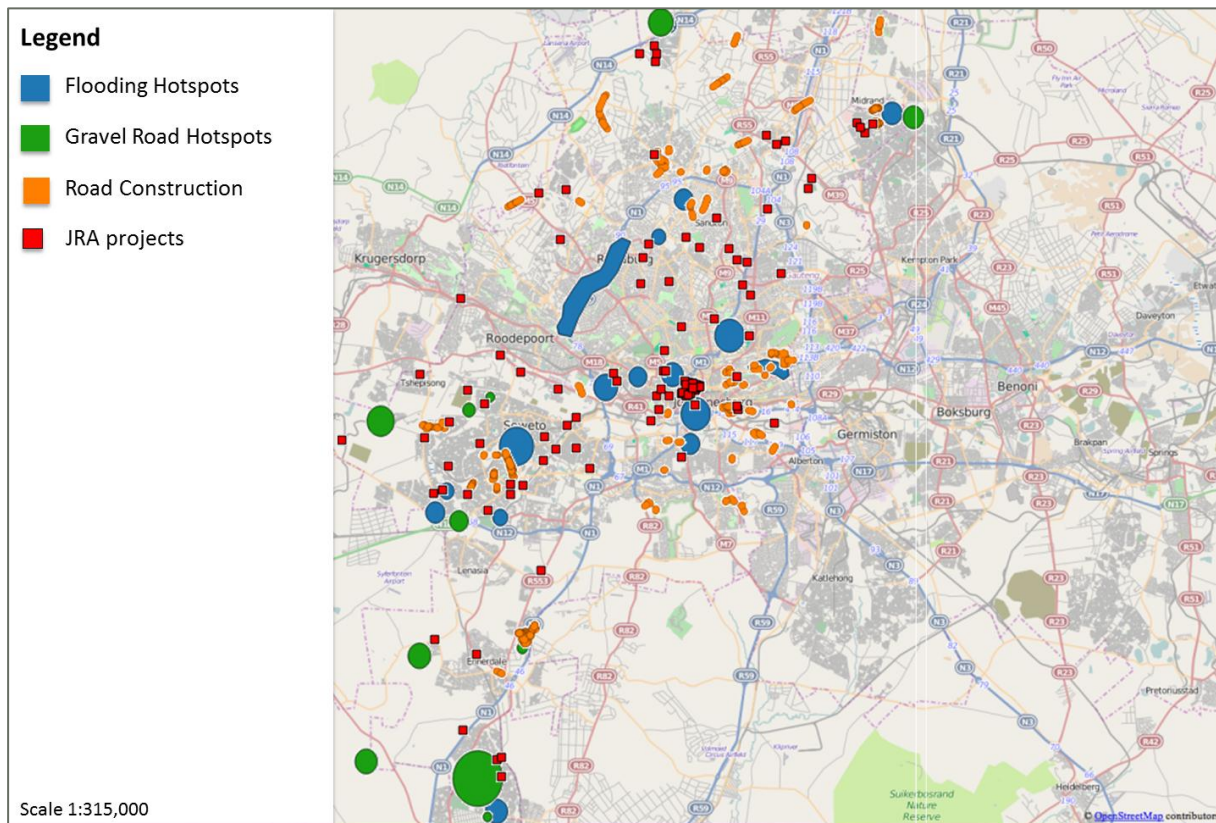


Figure 16: Roads Programme

3.5 Waste Management

Waste management within the City is the responsibility of the municipal owned entity PIKITUP. PIKITUP's assets include four operational landfill sites (see Table 8), depot's which provide refuse collection and disposal facilities (see Table 9), 42 garden refuse transfer sites and a composting site at Panorama and a variety of vehicles to transport the refuse. In addition, there is a plant and equipment associated with the waste management business. Some of PIKITUP's capital budget goes to the upgrading expansion of its fixed assets and the purchase of movable assets.

Table 8: City of Johannesburg Landfill which fall under PIKITUP

LANDFILL SITES	STREET ADDRESS	SUBURB
Goudkoppies (G:L:B-)	Houthammer Road	Devland
Marie Louise (G:L:B-)	Dobsonville Road	Roodepoort
Robinson Deep / Springfield (G:L:B-)	Turffontein Road	Turffontein
Ennerdale (G:M:B-)	Old Lawley Road	Lawley
Linbro Park - Closed 30 September 2006	Marlboro Drive	Sandton
Panorama- Closed 2003	Hendrik Potgieter and Jim Fouche Roads	Roodepoort

Table 9: PIKITUP depot sites that facilitate waste collection in the City

DEPOT	STREET ADDRESS	SUBURB
Avalon	Calandula Street	Klipspruit West
Central Camp	Cnr Old Potch Road & Nicholas Street	Diepkloof
Midrand	Stand 142, 16th Road	Randjespark
Marlboro	9th Street	Marlboro
Norwood	Cnr Short & Pine Streets	Orchards
Randburg	Cnr Malibongwe Drive & Hans Schoeman Streets	Randburg
Roodepoort	10 Granville Road, Lea Glen	Roodepoort
Selby	Cnr Village & Usher Streets	Selby (Jhb CBD)
Southdale	Cnr Side Road & Third Street	Southdale
Waterval Depot	2 Alberts Street	Albertsville
Zondi Depot	Cnr Koma and Elias Motsoaledi	Zondi

PIKITUP is currently undertaking a change strategy that focuses on waste minimisation to alleviate pressure from the existing landfills. Capital is being spent presently and in the foreseeable future on mainstreaming the separation of waste at source, and to facilitate associated recycling and reuse facilities and infrastructure. These initiatives will take up a greater percentage of the capital spend in the short to medium term.

One of the challenges facing PIKITUP is that the existing landfills are fast reaching their expected lifespan (see Table 10). Additional land is being sought for future landfills. PIKITUP is investigating the potential of regional land to the north of the municipality. Assistance from relevant provincial and national is requested to finalise these investigations and secure a site for such a facility.

Table 10: Available airspace for operational PIKITUP landfills and expected lifespan of aforementioned landfills

	Ennerdale	Marie Louise	Goudkoppies	Robinson Deep
Total airspace (including cover) per design	2,223,209m ³	6,796,717 m ³	9,691,222 m ³	22,968,866 m ³
Consumed airspace	972,963 m ³	4,563,921 m ³	4,553,533 m ³	16,965,061m ³
Airspace available for waste disposal as of 2012 (including cover)	1,250,246 m ³	2,232,796 m ³	5,137,689 m ³	6,003,805 m ³
Waste over weighbridge p.a. (May 2011-May 2012)	135,523 tonnes	442,967 tonnes	413,547 tonnes	509,366 tonnes
Projected landfill lifespan (years)	13 years	6 years	16 years	17 years
End date	April 2025	March 2018	January 2028	February 2029

Another area where future capital expenditure is to be located is in the purchase of portable builder rubble crushers and the construction of permanent rubble crusher units. This is in order to use a potential profitable means of addressing the challenge of illegal builders' rubble dumping in the City, which has reached epidemic proportions.

Purchase of waste vehicle (compactors), and plant and equipment for the landfill sites is becoming an increasing burden on PIKITUP's fiscus. Alternative solutions to this perennial problem are requested from the responsible provincial and/ or national government.

4 Trends and Demand for Residential Infrastructure

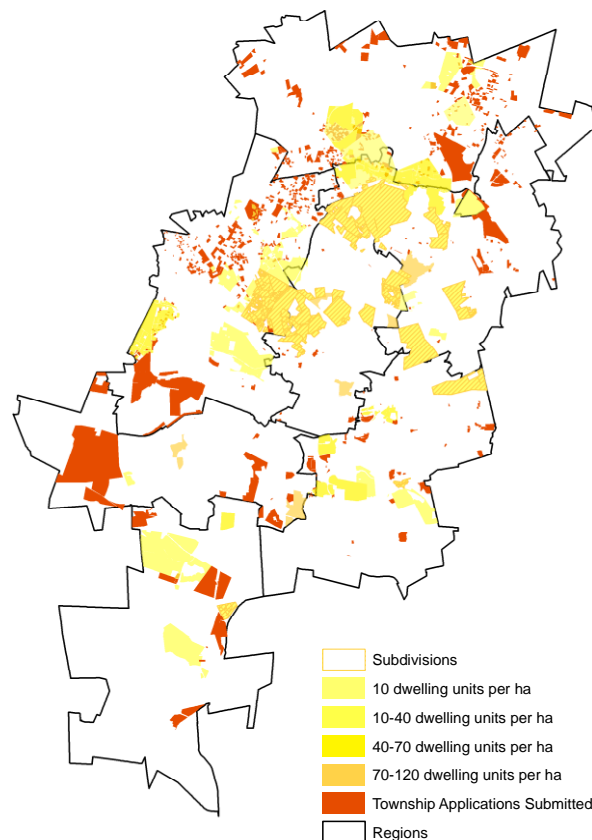
The City developed the Sustainable Human Settlements Urbanisation Plan (SHSUP) which highlights and suggests proposals for existing and future residential development within the City.

4.1 Residential Growth Trends

Market forces, informal development pressures and government investment over the last two decades resulted in distinct spatial trends in meeting the demand for residential development. These were:

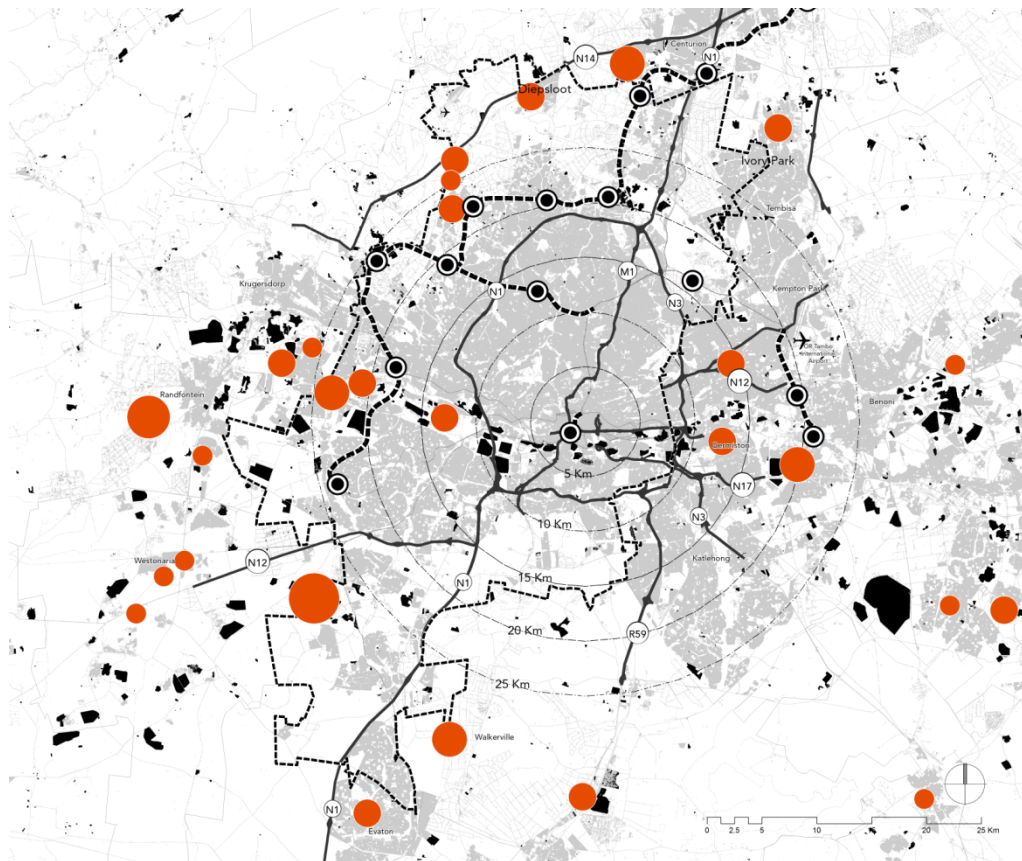
- Greenfields developments in the form of township establishments that, in the majority of cases, take the form of low to medium density urban sprawl on the western and north-western fringes of the urban area. These developments are both private (primarily town house developments) and state driven (mostly RDP style housing projects) (see Figure 17).
- Densification through subdivision and redevelopment of existing urban areas into medium to high density residential stock. This trend has placed a burden on the existing infrastructure capacity within these areas.

Figure 17: New residential development within the City of Johannesburg by density, including township applications



- The proliferation of informal settlements on the outskirts of the City. These trends of urban sprawl and intermediate densification in areas that are not designed for, or serviced by a public transport systems are not regarded as sustainable. Urban sprawl, however, has been successfully curbed by the institution of an urban development boundary instituted by the Spatial Development Framework. The proliferation of informal settlements has also resulted in an equally unsustainable pattern, concentrating large enclaves of poverty at the extreme fringes of the city. This pattern has resulted in vulnerable communities without adequate access to existing urban opportunities, high transportation costs and very low-key local economic activity. The high rate of urbanisation has also resulted in nodal areas like the Inner City being transformed with slum conditions evident in some parts.

Figure 18: Location of settlements proposed in terms of the Provincial housing Programme



4.2 Public housing

Large scale government housing programmes (Figure 18) are still predominantly provided at the edge of Johannesburg's urban system. These are RDP style subsidised housing developments that are scoring very low on the Sustainable Human Settlement Index. This trend entrenches the geography of poverty and is in direct conflict with one of the fundamental growth principles of curbing the creation of large enclaves of poverty. The impact of these projects should be considered within the context of the Gauteng City Region, not necessarily from individual municipalities' perspectives and far better coordination should be facilitated by the Provincial Government to ensure a more integrated approach to housing solutions. With the finalisation of the housing accreditation process the Provincial Housing Programme will need to be reviewed.

Figure 19: Location of Informal Settlements within the City of Johannesburg

4.3 Informal settlements

The Sustainable Human Settlement Urbanisation Plan (March 2012) compiled for the City's Housing Department, provides an overview of the spatial location and characteristics of informal settlements in Johannesburg (also see Figure 19). It is estimated that currently the City has 252 informal settlements with an estimated 164 939 informal structures. The CoJ informal settlement database identifies each informal settlement by name and spatial referencing, and links the settlement to a dataset with attributes (such as number of units, ownership, infrastructure, category – i.e. relocate, in-situ upgrade, regularise, project linked).

A majority of the City's informal settlements are in Region A, mainly around Diepsloot (25 000 units) and Ivory Park (15 000 structures), as illustrated in *Table 11*. Regions B and F have the fewest informal settlements, with less than 9 000 structures – these settlements are mostly well-located within the urban structure, within the Inner City or close to railway stations, industrial areas and other amenities. The informal settlements in Region C show a strong correlation with the western mining belt and represent 38 032 units (23% of the City's informal structures). Soweto (Region D) has a recorded number of 26 settlements, totalling approximately 12 926 units. Most of these settlements are around the railway lines in areas such as Kliptown. Alexandra in Region E still accommodates 16 informal settlements, with the largest of them located along the Jukskei and its tributaries. Region G has about 85 settlements. More than 45 447 structures have been eradicated in this region by way of formalisation processes over the last number of years.

Table 11: Informal Settlements by Administrative Region

	Total	Formalised	Relocated	Delivered	% Delivered	Outstanding	% Outstanding	Upgrades	Relocations	
									To Projects	No Project/land
Region A	73	1	9	10	13.69%	63	86.31%	30	30	3
Region B	3	0	0	0	0.00%	3	100.00%	2	0	1
Region C	29	1	0	1	3.44%	28	96.56%	17	7	4
Region D	34	1	10	11	32.35%	23	63.65%	7	6	10
Region E	16	0	0	0	0.00%	16	100.00%	1	15	0
Region F	12	0	1	1	8.33%	11	91.67%	2	9	0
Region G	85	42	6	48	56.47%	37	43.53%	5	32	0
Total	252	45	26	71	28.17%	181	71.82%	64	99	18

Almost 64% of the households are subject to in-situ upgrades via existing projects or programmes (specifically via the Alexandra Renewal Programme and Kliepfontein Regeneration initiatives). However, from practical experience the yield reflected by the respective projects is frequently insufficient to cater for the full needs and numbers of all households per settlement and an overflow needs to be budgeted for. Similarly, issues relating to non-qualifiers in terms of subsidy administration also provide challenges in relation to allocation of projected yields and number of households within settlements.

4.4 Backyard units

Most of the City's 320 652 backyard units are located in Region A (34%) and Region D (44%). In some instances, there are twice as many backyard shacks as there are units in informal settlements in the City. These are shacks constructed of metal, plastic or blocks that are on the same property as a formal dwelling (often an RDP unit). Backyard units represent a far greater challenge to the municipality due to the scale and the complexity of regulating the phenomenon. If managed properly backyard shacks can realise a significant income for poor landowners and an important rental market for migrants arriving to the City.

There is a definite correlation between backyard units and better located areas with infrastructure, such as Alexandra, Ivory Park and Diepsloot, as well as Soweto, compared to Region G that only accommodates 10% of all backyard units.

The spatial distribution of backyard units can be summarised as follows:

- Region A: the backyard units are primarily located in Diepsloot, Ivory Park and the southern parts of Rabie Ridge
- In Region C, backyard structures have been recorded in Thulani, Bramfischerville, Sol Plaatjies and Tshepisoong
- Soweto (Region D) has backyard units in all residential areas
- Region F: The backyard units are more than double the number of units recorded in informal settlements and are located in Berea towards the north and in the entire area between Jeppestown and Malvern to the east along Jules Street and the railway line
- Region G: The Deep South – Orange Farm/ Zakariyyah Park accommodates the densest patterns of backyard units compared to areas like Ennerdale, Finetown and Lawley

4.5 Social Housing and Hostels

Most of the City's social housing projects are well located in the Inner City or the Perth-Empire Corridor of Freedom. The main implementing agents of social housing are JOSHCO, JHC and the ARP and they have completed projects providing an estimated 5 483 units in 16 different projects. There are very few social housing projects that form part of any large scale RDP housing projects.

There are 21 hostel projects underway in the City, representing a total of 15 114 units. Most of the hostels are located in the Inner City and Soweto. With regards to rental demand, it is of interest to note the information published by the Social Housing Foundation on the rental market in Gauteng, which indicates that the City has the highest numbers of rented dwelling units in the province, which represents about 31% of all households in the City.

4.6 Meeting Residential Demand

The key focus of the city is on creating a range of housing typologies and tenure options supported by extended public transport infrastructure. Additionally, the construction and operation of appropriate infrastructure and community facilities in these communities is critical to creating sustainable human settlements. The City's key policy position and requirements for meeting residential demand is outlined in the Sustainable Human Settlement Urbanisation Plan of 2012 and can be summarised as follows:

4.6.1 Human and Social Development

- A significant proportion of the subsidy-eligible population has the liquidity to invest in their housing – just not enough to purchase a whole house therefore we need a diversity of housing products that match the affordability profile of the population.
- The provision of social facilities and infrastructure within new residential townships often lag behind the construction of houses. However, the same information is required for bulk infrastructure, along with a costing or cost benefit analysis of infrastructure provision. The facilitation of public investment in bulk and social infrastructure and amenities needs to be aligned with new housing settlements and those existing areas currently in need of re-investment. The outcome of this investment will be an integrated environment improving the overall quality of life for the City's residents.
- The City is characterised by periodic migration patterns. The spatial and social needs of the target market need to be assessed and understood to be able to make appropriate decisions relating to affordability of housing products, financial instruments and others.

4.6.2 Economic Growth

- High levels of unemployment
- and the informal development of backyard shacks as an income generator could well be due to the impact of the segregation of "RDP type housing" from job opportunities and social services.
- A "better spatial location" relative to others in the City will not address the issues of job availability and job creation in and of itself. This will require an upturn in economic activity matching skills levels available with the opportunities created in different parts of the City.
- A comprehensive strategy dealing with economic development, investment and job creation in the City is a critical step towards bridging the gap regarding this issue and to achieve a sustainable city in future.

4.6.3 Environment and Services

- Acknowledgment the informal sector and the importance of the green economy in terms of job creation, waste management systems, local economic development and urban regeneration.
- Transportation corridors have a critical role to play in connecting different regions of the city and linking the housing, economic and social components of the SHSUP. The City will need to engage extensively with the Transport Department to consider and implement critical transport linkages to unlock development potential where lacking in strategic areas, and to enhance the functional integration between land use and transportation in the City.
- The SHSUP emphasises the need to develop a well-researched process of land banking in response to the Strategic Areas. It is also important to expand existing institutional structures such as the City's Joint Land Steering Committee in order to ensure that all public owned land in the City is optimally utilised for purposes of providing housing and/or social services and facilities, rather than making the land available to the private sector to develop for short term profit purposes.

4.6.4 Governance

- Existing housing programmes and their associated funding mechanisms remains a key financial driver. The City will therefore need some financing arrangements that do not depend solely on the existence of a national housing subsidy programme will be key in shifting the focus and qualitative aspects of residence provision in the City.

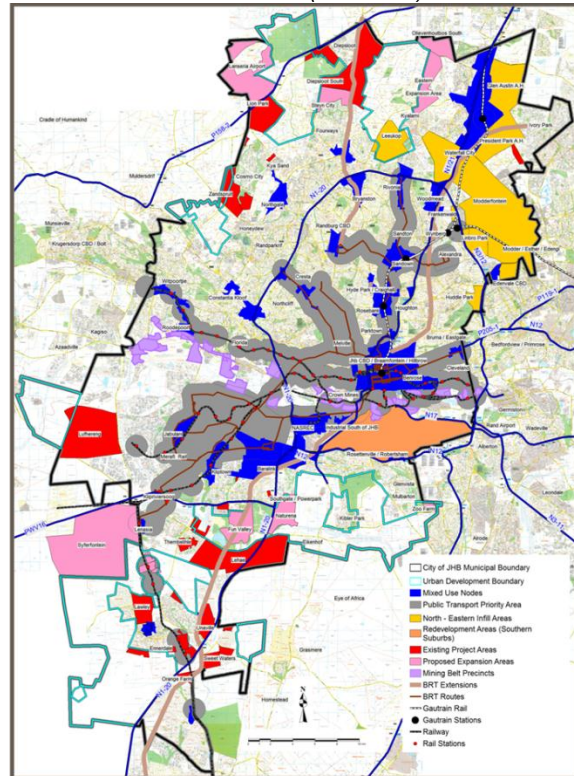
- To implement the SHSUP effectively the boundaries of current policy will need to be tested and will require a champion to support a new financing approach that draws in the participation of the state, private and household sectors.
- The City proposes the following adjustments to the current National Housing Subsidy Scheme in order to increase the efficiency and effectiveness of sustainable settlement:
 - The affordability of the State and the affordability of the household should be bridged through an arrangement of appropriately structured financial products to deliver adequate housing.
 - The scale of delivery of backyard rentals is unmatched by the public sector. The state will need to financially or administratively support these efforts of citizens.
 - Redevelopment and regeneration in strategic locations attracts the private sector to invest in these areas. This requires the state's investment in terms of infrastructure and social amenities – resource strapped local government is unable to deliver at the scale and speed required.
 - Remove or otherwise address the resale restrictions currently applying to subsidised housing - housing delivery occurs not only through the construction of new units, but also through subdivisions, home improvements and extensions, and critically, the resale market.
 - Controls are required to ensure that the funding for subsidised housing as well as necessary approvals from planning processes are obtained timeously.
- It is acknowledged that the current housing funding mechanism has limited the development of higher-density subsidised residential developments. In addition, development costs render high-density mixed developments / redevelopments extremely challenging from a financial perspective. Innovative financial mechanisms like extending the payback period for housing bonds from 20 to 25 years (which would reduce the monthly instalment fee), or the introduction of a tax break to projects which include medium to high density affordable housing units similar to the tax benefits provided to developers as part of the Urban Renewal Tax Incentive, could be introduced to make high density developments more affordable to the poor, and financially viable to the private sector.
- 70% to 80% of residents fail to leverage the full financial benefits associated with capital growth in house prices – and the associated downstream rateability benefits for the municipality.
- Historically, decisions relating to policy, strategy and delivery of housing have been mainly around the cost and capital spent of the top structure and infrastructure. Costs should be understood, defined and measured in terms of qualitative aspects relating to sustainable human settlements in a broader sense.
- A need exists to establish an institutional environment that allows the resale market to work at the lower-end of the housing ladder which will assist in the “churn” and flow congruent with the middle and higher end of the market. The City will need to consider whether it could utilise the Sustainable Services Cluster as its institutional arm for the implementation of the SHSUP. This cluster should form an oversight mechanism and framework for the SHSUP, and be aligned with the GDS outcomes. In addition, the City's Department of Human Settlements must continue the process to obtain housing accreditation level 3 in order to receive direct funding for the delivery of SHS.
- The City must ensure the establishment of well-defined roles and responsibilities and accountability in the delivery of sustainable human settlements. Multi-sector integration across the entities and agencies responsible for *policy formulation, planning and implementation* of sustainable human settlements would be critical.

The policy position relayed in SHSUP has a distinctive spatial rationale for future development of residential development within the City. This is reflected in the following map (Figure 20) and

accompanying description. Realisation of the Plan is dependent on the governance, infrastructure and economic growth considerations being addressed.

Figure 20: Priority Areas per the Sustainable Human Settlements Urbanisation Plan (SHUSUP)

Public Transport Priority Network
• TOD Stations
• BRT Routes
• Mixed use Nodes
• Mixed Use Nodes (Outside)
Current Housing Project Areas
• Existing Projects North
• Existing Projects South
Redevelopment Areas
• Southern Suburbs
Consolidation and Infill Areas
• Mining Belt
• North Eastern Suburbs
Expansion Areas
• Expansion Areas North
• Expansion Areas South



Since the adoption of SHSUP, the public transport corridors (including the Corridors of Freedom) have increased the number of routes within the City. This has shifted the areas of priority as defined in Figure 20. However, the focus has also been on directing residential development to the Public Transport Priority Network to the existing housing projects in order to complete infrastructure in place. In addition, the redevelopment areas, the long term consolidation, infill areas as well as the expansion of identified areas remain the policy of the human settlement department for the City.

The SHSUP has also provided tools and associated projections for the medium term provision of housing typologies as illustrated in Table 12.

Table 12: Possible scenario for the provision of certain housing types for the City as per SHSUP

PROJECT TYPE	Infrastructure Cost (R)	Top Structure Cost (R)	Total Cost (R)	% Cost Split per Project Type	UNITS TO BE DELIVERED	RDP	Bonded	Rental	Serviced Sites Completed to date	Units Complete
Social/Rental med and higher density residential Totals	140900000	1540495000	1681395000	31	5111	250	550	4311		
Mixed housing project Totals	710523400	2045451010	2755974410	51	36690	17289	8108	11293	5699	1505
RDP project Totals	97000000	709346250	806346250	15	22570	22570	0	0	24003	8019
Grand total	1159773400	4295292260	5455065660	100	64371	40109	8658	15604	29702	9524
					% Split Housing Type	62	13	24		

In terms of unit typology the outcome of these projects will be at about 62% of units will be RDP type units, 24% will be medium to high density rental and social units and 13% will be bonded. In terms of the allocation of funds 31% are allocated towards medium to high density rental and social units, 51% towards mixed typology projects where a typical split of 50/25/25 for RDP/rental/bonded are achieved. Only 15% of funds will be allocated to exclusively RDP projects. These funding allocations are illustrated in Table 12.

The shift to more integrated higher density rental and social housing is gaining momentum as a substantial amount of planning has been concluded to facilitate the development of such projects. The Inner City and other well established nodes such as Randburg and Roodepoort CBD offer high potential for affordable higher density residential and are key focus areas for redevelopment.

4.7 Land Requirements for Sustainable Human Settlements

The SHSUP also provides projections for the land requirements to accommodate future residential and associated community requirements. In respect of the guidelines relating to norms and standards, the City has proposed the following guidelines as shown in Table 13. These are for social infrastructure for Informal Settlement Upgrades / Related Projects.

Table 13: Proposed standards for social facilities for Informal Settlements' upgrades

RED BOOK STANDARDS	MIN. POPULATION THRESHOLD	BUILDING (M2)	REQUIRED SPACE (M2)
Crèche / nursery school	5,000	100	30
Primary School	3,000	14,000	10,000
High School	6,000	26,000	20,000
Clinic	5,000	2,000	0
Libraries	5,000	130	0
Community Centres	10,000	5,000	0
Religious centres	2,000	150	0
Proposed Standard	Min. Household Threshold	Building	Related Open Space
1 Education Facility (Primary / High School)	1,714	18,000	5,000
1 Clinic	1,429	130	
1 Crèche / Nursery School	714	100	
1 Multi-purpose Centre	1,429	1,000	
Open Space @ 10% of Land for Housing and Social Amenities			
Internal circulation (road + pedestrian) @ 20% of Land for Housing and Social Amenities			

Thus far there is an estimated 480 000 number of households. Through the use of guidelines, the following land requirements become apparent with respect to both housing (at differentiated densities) (see Table 13) and the requisite social infrastructure (number and land required) as shown in Table 14).

Table 14: Land requirements for housing at different densities and erf sizes

Average Sq metres per Erf	250	200	170	150	120	100	80
Correlating Densities (Nett)	40	50	59	67	83	100	125
# of Resident Households	Hectares Required						
240,000	6,000	4,800	4,080	3,600	2,880	2,400	1,920
	Metres Sq Required						
	60,000,000	48,000,000	40,800,000	36,000,000	28,800,000	24,000,000	19,200,000

Table 15: Social Facility requirements

SOCIAL FACILITIES REQUIRED	FACILITIES REQUIRED	ROUNDED	SQ. METRES	HECTARES
Education Facility (Primary / High School)	140	140	3,220,000	322
Clinic	168	168	21,840	2
Creche / Nursery School	336	336	33,600	3
Multi-purpose Centre	168	168	168,000	17
Sub-total for Social Amenities	812	812	3,443,440	344

Table 16: Residential Requirements (by erf size and density), Social Facilities Requirements, open space requirements and servitude requirements translated into hectares of land

Avg Sq metres per Erf	250	200	170	150	120	100	80
Correlating Densities (Nett)	40	50	59	67	83	100	125
# of Resident Households	Hectares Required						
480,000	12,000	9,600	8,160	7,200	5,760	4,800	3,840
	Metres Sq Required						
	120,000,000	96,000,000	81,600,000	72,000,000	57,600,000	48,000,000	38,400,000
Social Facilities Required	Facilities reqd	Rounded	Sq metres	Hectares			
Education Facility (Primary / High School)	280.00	280	6,440,000	644.00			
Clinic	336.00	336	43,680	4.37			
Creche / Nursery School	672.00	672	67,200	6.72			
Multi-purpose Centre	336.00	336	336,000	33.60			
Sub-total for Social Amenities	1,624.00	1,624	6,886,880	688.69			
Avg Sq metres per Erf	250	200	170	150	120	100	80
Correlating Densities (Nett)	40	50	59	67	83	100	125
Social Amenities + Housing Land	120,000,000	96,000,000	81,600,000	72,000,000	57,600,000	48,000,000	38,400,000
+ provision for internal circulation (road + pedestrian) @ nominal 20% of land	25,377,376	123,464,256	106,184,256	94,664,256	77,384,256	65,864,256	54,344,256
+ provision for open space @ nominal 10% of land	2,537,738	135,810,682	116,802,682	104,130,682	85,122,682	72,450,682	59,778,682
Translated in Hectares	15,480	13,581	11,680	10,413	8,512	7,245	5,978

Realising SHSUP land requirements is beyond the resources of the City. After a series of evaluations via satellite photography (2009) and preliminary environmental assessments the City has earmarked +/-140 portions of land (an extent of +/- 680 hectares) to support in-fill, Transit Orientated Development densification for mixed-income / typology initiatives. Characteristically, these portions:

- Are considered to be under-developed / vacant.
- Are currently managed via the Johannesburg Property Company.
- Have been reserved / protected from alienation via Mayoral Committee and Council Resolution until detailed feasibilities have been completed.
- Are within 1km of the emerging Bus Rapid Transit (BRT) and / or the existing rail station infrastructure.

- Have been provisionally screened and vetted by the Environment Department (noting that in some cases, more detailed environmental assessments would be required).

To meet the land requirements for future residential development, the City will require the cooperation of all public and private land owners.

4.8 Community Infrastructure Requirements

The development for social and community facilities targets the most deprived areas and where there is a high population density. Apart from the Alexandra Renewal Programme, (ARP), there are marginalised areas development programmes in Orange Farm, Diepsloot and the Greater Ivory Park area. The intention of these programmes is to provide facilities and infrastructure in order to create sustainable human settlements that are integrated with the rest of the urban system in order to realise the vision of SHSUP. Where it is viable, options to provide multiple municipal services in one facility will be implemented. Although these are the priority locations for social facility provision, there are many areas in the City that require urgent upgrades to existing facilities.

Achieving sustainable human settlements is a long term process that will require substantial resources. The limited ability of Council to afford and sustain the required capital investment for social facilities is not enough to make a substantial difference over the next decade. A key concern remains the provision of facilities by the Provincial Department in relation to the alignment and coordination of resources and facilities. There are cases where little information is shared and prioritisation decisions are made without consultation with the City.

A project to model the need and accessibility of social facilities and services was undertaken by the DPSA and CSIR in 2012. Key findings of the research were that social facilities in Johannesburg were in general 'found to be well distributed although lacking in service capacity.' Hence there is a need to maximise the capacity of existing social facilities and to focus on improving the management of these facilities. This is in order to provide quality services as emphasised in the research. Clustering of services in a single facility was proposed as a means of promoting cost effective service provision.

Areas identified to have under provision of social facilities by the Study were 'Soweto, Diepsloot, Ivory Park, Alexandra, the Inner City, Orange Farm and Cosmo City. Specific social facility backlogs for the City of Johannesburg were defined as follows in the research report:

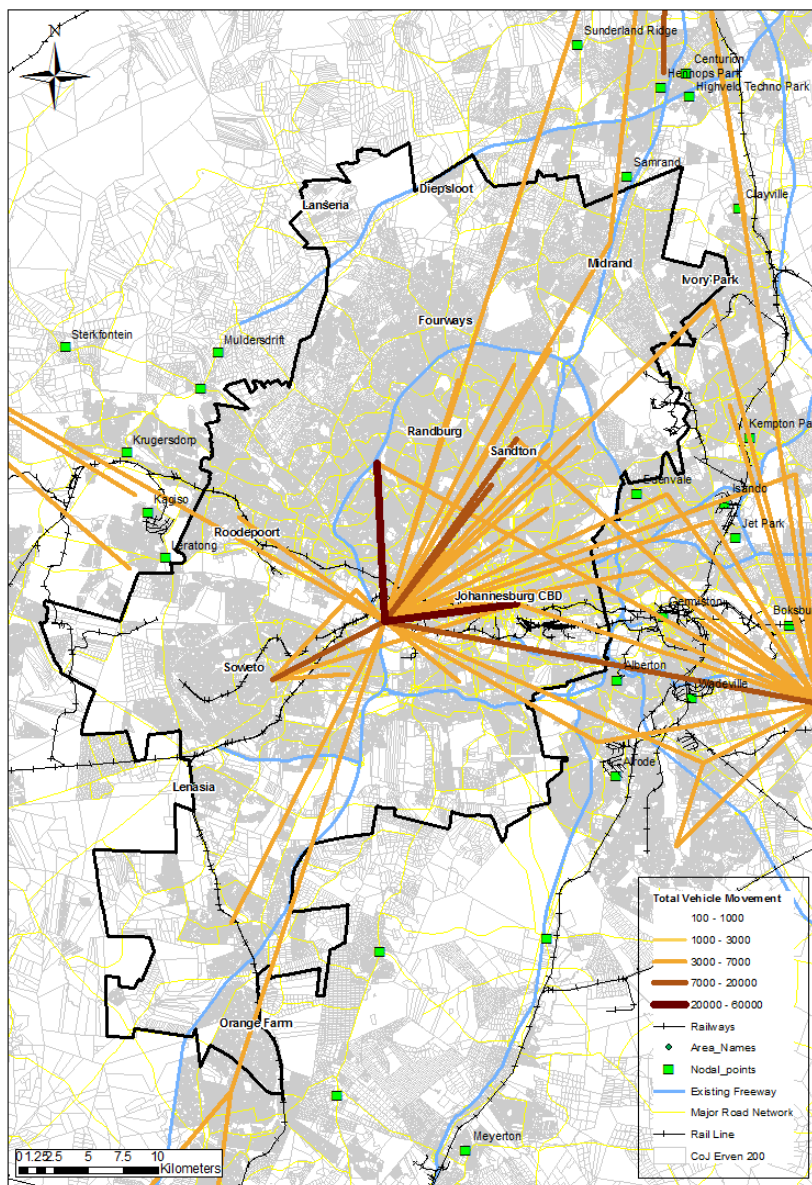
Facility Type	Quantity Required
Social Grant Payment Points	19 New Payment Points
Parks	200 proposed parks at a minimum size of 0.4 ha
Fire Stations	4 new stations Required
Libraries	3 new libraries required, and Expansions required to 5 existing facilities

The proposals made in the study will be included within the capital planning processes undertaken by the relevant departments and Municipal Owned Entities within the City. It must be noted that the Study focused on the existing urban footprint of the City and did not take into account future Greenfield housing projects.

4.8.1 Transportation Modal

As discussed previously, a high capacity functioning transport infrastructure, either rail, road or air is an economic and social priority for the City. An improved transport system provides sustainable employment opportunities for dispersed communities to locations that have a high economic activity. This anchors future economic growth for mixed use and industrial nodes through the concept of transit orientated development. The improvements in the transport modal shifts results in economic benefit due to less time spent commuting, better connection of nodes and decrease in greenhouse gas emissions within the City.

Figure 21: Primary regional movement patterns



Johannesburg's transport realities are characterised by two distinct features:

- A great number of residents do not own private cars and thus travel by bus, rail or private minibus taxis.
- In contrast, middle-income residents are resolutely car-orientated, with an increase in travel times of nearly 60% since 1980 due to traffic congestions and remoteness of work and residential areas.

This has resulted in a transport system that includes the following:

- Where land uses are designed for private vehicles
- The previous public transport systems were inefficient and not designed to benefit the user
- A hierarchical road network with numerous unconnected roads, loops and dead-ends
- Compromised mobility along major arterials.

Figure 21 depicts the regional movement patterns and it is quite vivid that the Johannesburg Inner City plays a central transportation role within the region. As well, a lot of movement is to the north (Pretoria) and east of the city (Ekurhuleni), an indication of economic activity between these nodes.

Public transport is the most optimal investment to mitigate against increasing petrol prices, the cost of maintaining road infrastructure and increasing air pollution. The City has introduced the Rea Vaya Bus Rapid Transit system and the Gautrain high-speed rail link. These form the back bone of a future urban public transport system. The potential of modal shifts present a number of opportunities for economic development and improved city living.

Figure 22 is a representation of the assumed figures for passenger ridership (assuming that Phase 1 of the Rea Vaya BRT would carry 430 000 passengers per day). This assumption is modelled to reflect the impact the move would have on private vehicle use, and the use of other modes of transport.

Even if this assumption is ultimately realised, the graph demonstrates that private cars will remain dominant for the foreseeable future. There are some indications from the rollout to date that further reductions in private cars could be achieved through the full implementation of the Rea Vaya BRT. However, when projecting to 2040, it is argued that significant increases in the use of bus and rail will need to be actively targeted.

This will require a re-engineering of parts of the City to become public transport corridors where economic activity, community services and residential developments service and are serviced by a bus based public transport system. Where a broad range of socio-economic groups live and work together. A public transport environment that serves the young, the old and those living with disabilities. Such an initiative will require a long term investment in social, residential and economic infrastructure associated with the identified corridors, combined with an on-going marketing campaign to promote public transport and the corridors themselves. To this end the City has launched the Corridors of Freedom initiative which is now at its implementation phase. The Corridors of Freedom envisages a network of public transport corridors based on the Rea Vaya bus system and the Gautrain Stations across the City (see Figure 23).

Figure 22: Assumed future ridership per transport mode within the City of Johannesburg

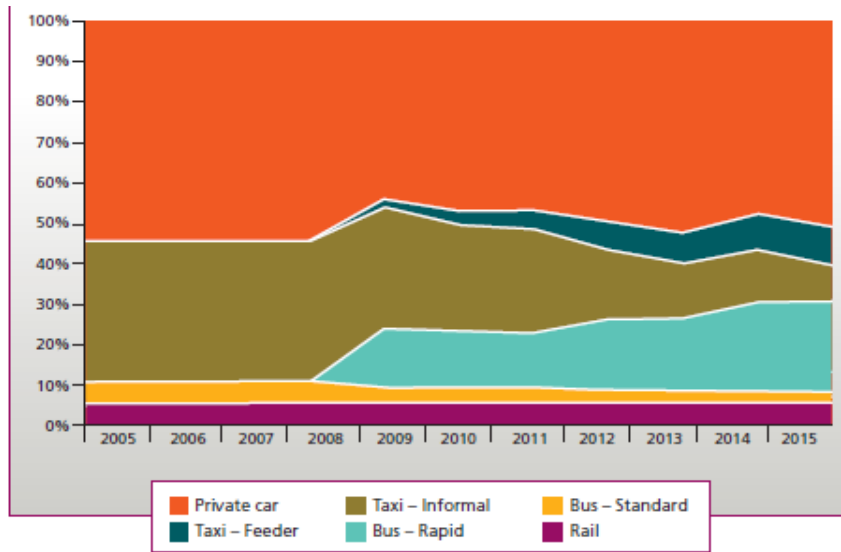
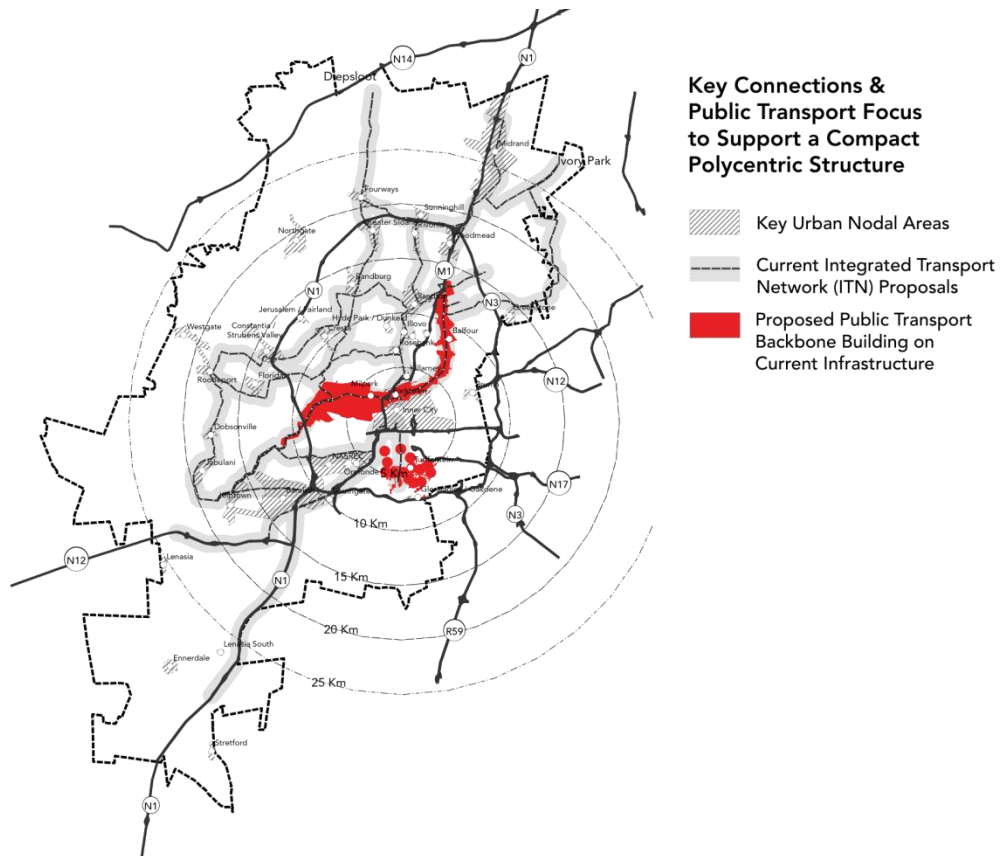


Figure 23: The Corridors of Freedom – (Turffontein Corridor; Perth-Empire Corridor and Louis Botha Corridor)



The Corridors of Freedom will connect the former black townships of Diepsloot, Soweto and Alexandra with the CBD and other major mixed use nodes. These strategic spatial nodes promote the Corridors as locations for investment and residential densification. The Corridors of Freedom will be a mixed land-use type dominated by high-density accommodation options, supported by office buildings, retail development and opportunities for leisure and recreation.

The intention is that residents of the City will live closer to their workplace, stay and play without having to use private motorised transport. It is envisaged that there will be safe, affordable and convenient buses, cycling and pedestrian activity.

The new City skyline will consist of high-rise residential developments growing around the transit nodes, gradually decreasing in height and density as it moves further away from the core. Social infrastructure, schools, clinics, police stations and government offices will be strategically located to support the growing population.

The key features of the Corridors of Freedom are:

- Safe neighbourhoods designed for cycling and walking with sufficient facilities and attractive streets
- Safe complete streets with features to calm traffic, control vehicle traffic speeds and discourage the use of private transport
- Rich and poor, black and white living side by side - housing options provided cover a range of housing types and prices including significant rental accommodation component
- Limited managed parking to reduce the amount of land devoted to parking and further discourage the use of private transport
- Convenient transit stops and stations

A strategic area policy framework has been undertaken for the Louis Botha, Perth-Empire and Turffontein Corridors Areas. Through these frameworks areas for transit orientated development have been identified, typologies for residential development defined, population projections proposed with associated requirements for social, economic and service infrastructure. In turn these requirements have been reflected in the City's capital budget.

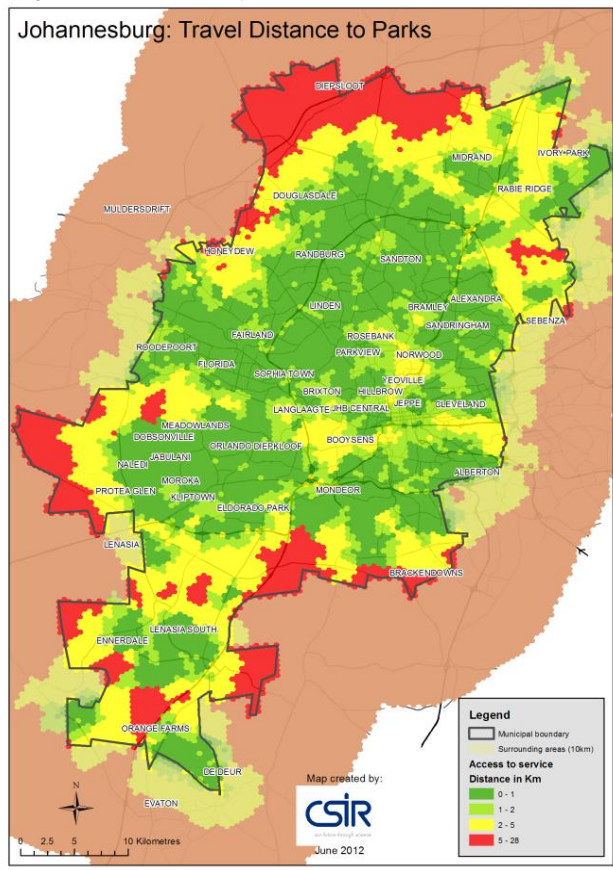
It is envisaged that each corridor will be a priority for City Capital investment for a 6 to 9 year period, before another corridor becomes the focus for such funds. The realisation of the City's vision for the Corridors will require a range of coordinated public and private sector funding in order to ensure the success of the Corridors of Freedom. This should be in conjunction with on-going leadership from business, local, provincial and national government leadership.

The Corridors of Freedom is the central built environment concept that will realise significant change in the urban form of the City. The Corridors of Freedom will include bullets from safe and Strategic Area Framework (SAF) boundary maps.

4.9 Sustainable Development Requirements

The City of Johannesburg falls within two priority areas identified in the National Spatial Biodiversity Assessment (NSBA, Driver et al. 2004). It is also home to a disproportionately high percentage of rare and threatened species and threatened ecosystems. A high proportion of South Africa's mining activity, heavy industry, commercial enterprise and urban population are located in the bioregion. As a result, there are high pressures placed on the environment and the remaining natural ecosystems and opportunities for conservation of biodiversity are limited.

Figure 24: CSIR Study – Access to Open Space



There are at least 12 threatened plant species and 10 threatened animal species in the City of Johannesburg, and 9 ecosystems listed as threatened according to NEMBA 2008. Aquatic systems are equally unique in the bioregion and 100% of wetlands types and 20% of river types in the City are listed as threatened. Just over a third of the City of Johannesburg is in a natural or near natural state (36%), with urban development (48%), agriculture (11%) and mining (5%) together covering 64% of the City.

The high levels of urbanisation within the City it is not an issue as to whether ecological infrastructure constrains urban growth but a function of the opposite relationship. Areas of high biodiversity have been identified for conservation, but the purchase and subsequent management of such areas has not happened. This is because there are other developmental priorities for the City and limited financial resources. Similarly the urban population has generated high levels of waste which often degrade existing open space and bio-diversity hot-spot areas.

Related to the protection of biodiversity, it is the need to provide recreational open space in the form of parks. From the CSIR study as depicted in Figure 24, it is clear that while the central and northern areas of the city (shaded green) are well provided for with open space. However, the peripheral areas of the City have experienced rapid urbanisation and are in need of new parks (areas shaded yellow and red).

The analysis revealed that the City's lower density areas are best served in terms of park provision with 61% of these areas being within a 1km distance of a park. This figure reduced to less than 40% in the "High" and "Intermediate" areas. These include some priority areas for the City which includes large portions of suburban Soweto, most of Ivory Park, Alexandra and Diepsloot. With capacity assessment, the current supply of parks was deemed to serve about 42% of the estimated City population. The shortfall of functional developed parks with the necessary infrastructure is deemed low.

From a green infrastructure perspective, the City has various strategies to address its socio-economic divisions. The northern regions (more wealthy areas of the city) are well vegetated, while the poorer areas of the City, where the highest population densities are located remain denuded. The City has

had significant success in greening Soweto and providing parks to former black townships, though far more investment in this area of infrastructure is required. This includes a combination of a strong civic initiative which is required to support the growing of plants and trees particularly from the perspective of promoting urban agriculture.

From a geological perspective, the physical environment is combined with the built environment, which does the most to constrain urban growth:

- Johannesburg is negatively affected by dolomite (limestone) geology in the north-west and south of the Municipality which give rise to sink holes which can cause serious damage to buildings and infrastructure. This prevents, or makes it very costly, to undertake construction in these areas. Often these areas are targeted for low income housing due to the inexpensive cost of land, with sometimes tragic consequences.
- Deep level mining within south central Johannesburg along the gold reef (the mining corridor) has through under-mining, the poisoning of underground water, the uncontrolled accumulation of the aforementioned sub-surface water, the stacking of unconsolidated sand at mine dumps have combined to make the land within the former mining belt either unusable for construction or highly unpleasant and harmful to residents who live in townships adjacent to these areas. Rehabilitation of the mining belt is critical to ensuring a better urban environment and a critical component of creating a sustainable City given the central location of the Mining Belt.
- Flooding is a major challenge for the City. This is due to increased intensity of summer thunderstorms, the growth of informal settlements located within the 1:100 flood-line. As well, increased storm flow in the City's river and streams due to underinvestment in the City's stormwater network. Another cause is an increase in urban development and erosion of stream banks combined with the destruction of remaining wet lands.

4.9.1 Development controls and supporting mechanisms in critical biodiversity areas

Critical biodiversity areas must be protected and preserved, with the value of ecosystem services they provide maximised. They should form part of the public realm, adding value and structuring elements to the urban system and provide agricultural, tourism, social and spiritual services.

- Developments within critical biodiversity areas must be limited to those that add value to the public realm, and that preserve the vital ecosystem services these areas provide.
- These areas must be considered as vital to adding value and structuring elements to the urban realm
 - The interface with the urban area must be given high priority to promote public accessibility
 - These areas are not just dead green space, but are key parts of the public realm, and must be protected as such.
 - They provide needed open space that must be preserved for a growing city
 - These areas must be considered as adding real estate value to urban developments
- All building or rezoning applications for critical biodiversity, Gauteng EMS or protected open space areas must go through the appropriate processes set out by the Environment and Infrastructure Services Department in the City of Johannesburg, the Gauteng Department of Agriculture and Rural Development and any other relevant national policy and legislation

The City should:

- Invest in and support the agricultural industry and agricultural projects as a key sector in preserving green infrastructure and maximising its value for the city, including growing the economy, creating jobs and providing food and other products
- Invest in and support tourism, social, spiritual and leisure initiatives in critical biodiversity areas to protect the areas, grow the economy, and create jobs

- Plan natural areas such as wetlands and swamps as protected natural buffers, serving as a natural 'urban development boundary' and protection from flooding and other climate-change related damages
- Within the city, plan green corridors and green patches as buffers/dividers between incompatible land use areas, such as between residential and noxious industries
- Within a region or precinct, classify corridors and patches and mark which patches are critical and should be taken care of / not be redeveloped with infill development. Also mark which corridors / strategic connectors are critical (connecting patches and directly contributing to building a city-wide system) and should be set as priority investment.
- Use neighbourhood guidelines and form-based codes in order to ensure that each street is planned with a tree line, a pedestrian and bicycle pathway
- On a neighbourhood scale, support, invest and incentivize development of smaller community parks, gardens and urban agriculture

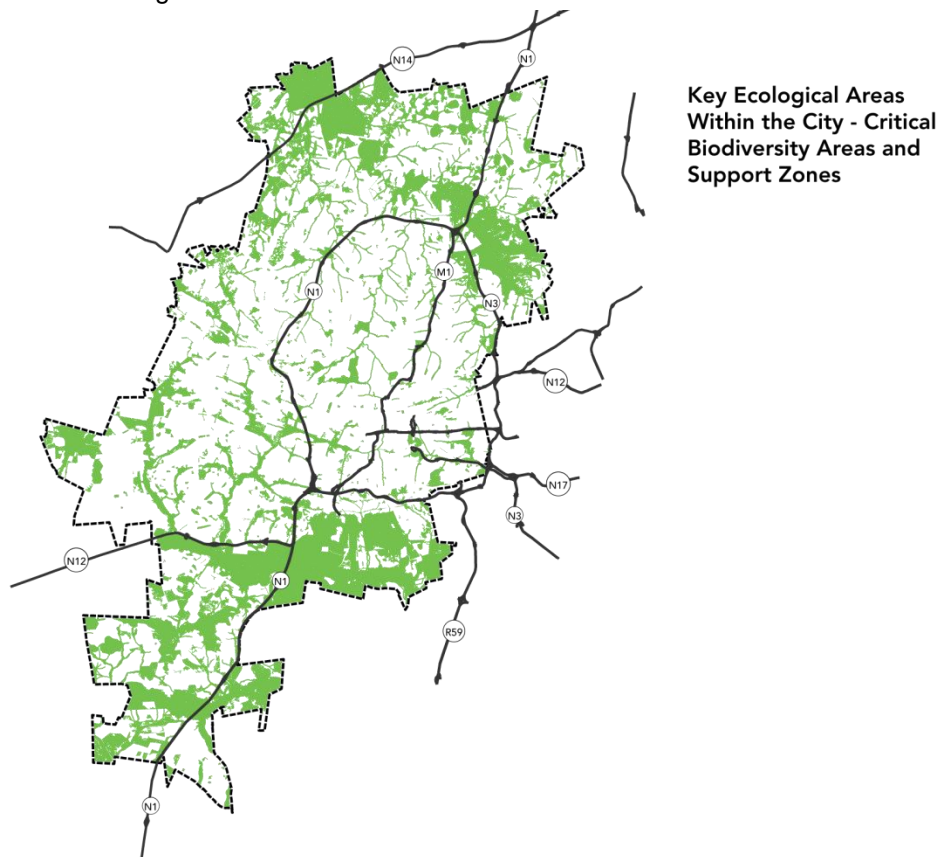


Figure 26: Key Ecological Areas for the City

Financing green infrastructure in cities

Natural services are very similar to other utilities, in the sense that they provide tangible, valuable benefits to inhabitants and visitors of the city. However, these benefits do not always create an immediate incentive for investors, as the economic benefits do not flow back to them directly. Where such services do benefit private agents, they should contribute to the maintenance of such services as well.

A crucial step for making investing in ecological areas viable is to create a business case for investing in ecological assets, coupled with a strategy for the implementation of taxation and pricing measures to raise revenue for advancing environmental goals (e.g. tax exemptions or subsidies for private developers that invest in environmentally friendly technologies, water, energy and waste management, as well as in green spaces and neighbourhood parks; or conditions for building licenses obliging

investors to leave a certain percentage of their plot as a green space). The business case should be developed with a background of strong collaboration between the city's financial and environmental departments, as well as other related departments such as basic services, disaster management and transportation. This should also include priority investment from the city budget in green infrastructure, especially since the investment pays off in reduced public costs for storm water management, flooding, transport and basic services.