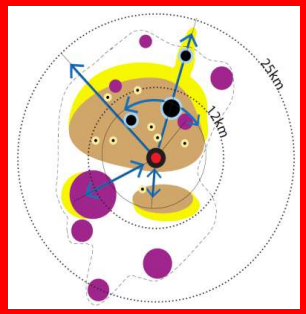





Transforming Johannesburg

Towards a low carbon and inclusive metropolis

Issues and Opportunities

Citywide Quantitative Urban Analysis

Serge Salat, Karen Levy, Loeiz Bourdic

Wits University, July 2014

SCHOOL of ARCHITECTURE PLANNING

URBAN MORPHOLOGY & COMPLEX SYSTEMS INSTITUTE

Institut Français d'Afrique du Sud Recherche

afd AGENCE FRANÇAISE DE DÉVELOPPEMENT

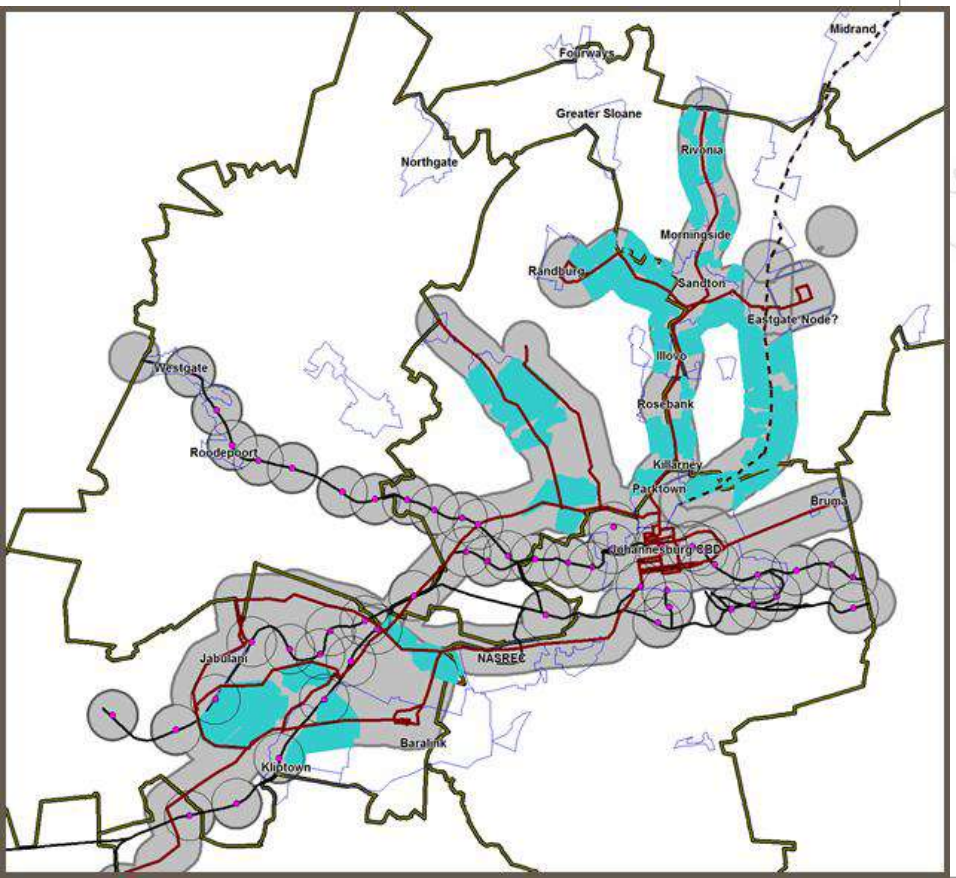
Corridors of freedom

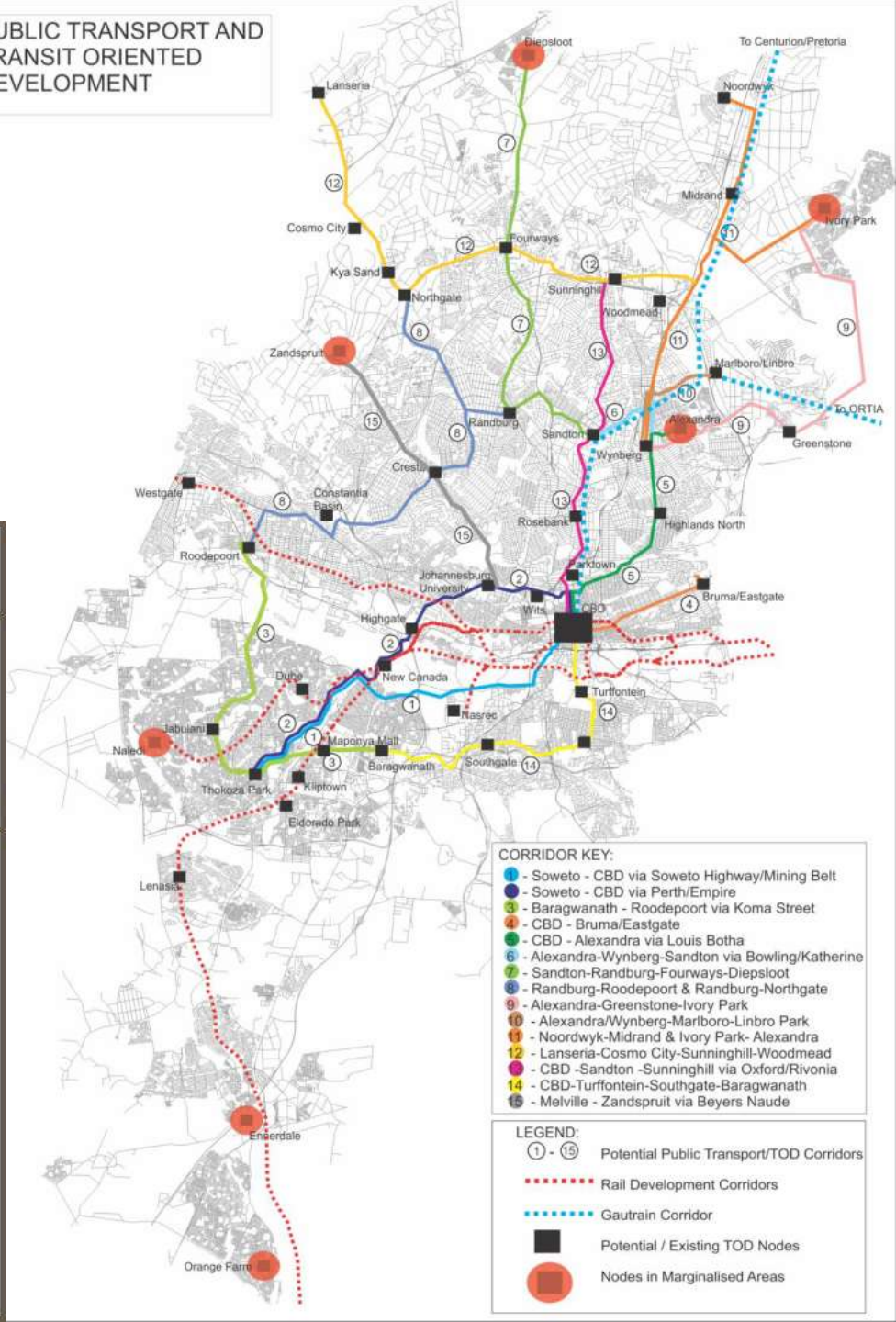
- In the Executive Mayor's State of the Nation speech he promised residents five rights including **"he right to a spatially integrated and united city"**
- He said: **"**We have already pioneered the first Bus Rapid Transit system when we launched the Rea Vaya…Today we are taking transit oriented development another step forward, with the introduction of a project that will forever change the urban structure of Johannesburg and eradicate the legacy of Apartheid spatial planning."
- He promised: "Over the decade we will introduce transport corridors connecting strategic nodes through an affordable and accessible mass public transit that includes both bus and passenger rail. Along these corridors we will locate mixed income housing, schools, offices, community facilities, cultural centres, parks, public squares, clinics and libraries.
- He called these corridors: "Corridors of Freedom"

How to leverage the corridors of freedom opportunities for economic efficiency, social inclusion, resilience and climate change mitigation ?

How to strategize TOD for spatial transformation towards a spatially integrated and unified city ?

How to make corridors of freedom a success?





ISSUES

HIGH LEVELS OF FRAGMENTATION OF SPATIAL FORMS ARE A STRONG BARRIER

TRANSFORMING SPATIAL FORMS AT GLOBAL AND LOCAL SCALE IS KEY TO LEVERAGING CORRIDORS OF FREEDOM OPPORTUNITIES

1. Inverted polycentricity

2. Fragmented and scattered urban forms

3. Fragmented and scattered densities

- 100 fold variations in residential density
- 50 fold variation in job density
- Spatial mismatch between jobs and residential density

4. Spatial inequalities result in high levels of concentrated unemployment

5. Unequal density of amenities

ISSUES

6. Inefficient land use: low coverage ratio and low FAR

7. Uniform and rigid platting (plot subdivision) jeopardizes social inclusiveness and economic resilience

8. Housing prices reveal unsustainability and inefficiencies in land markets

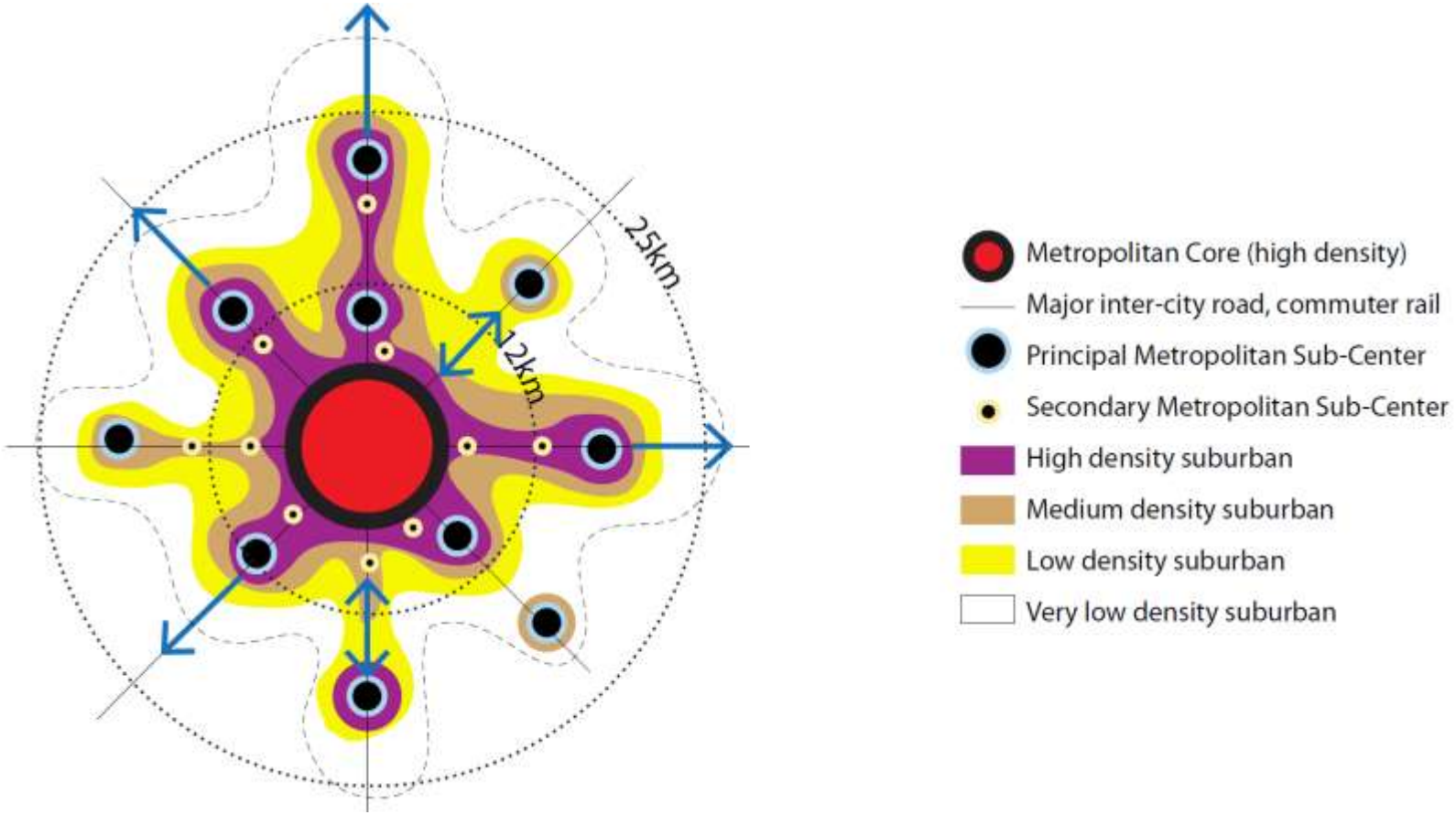
9. Road Classification and Access Management has created high levels of congestion

10. Street densities are low and street patterns are disconnected and clustered, which limits walkability

As a result of these constraints, recent densification patterns do not make urban forms more inclusive, efficient and resilient

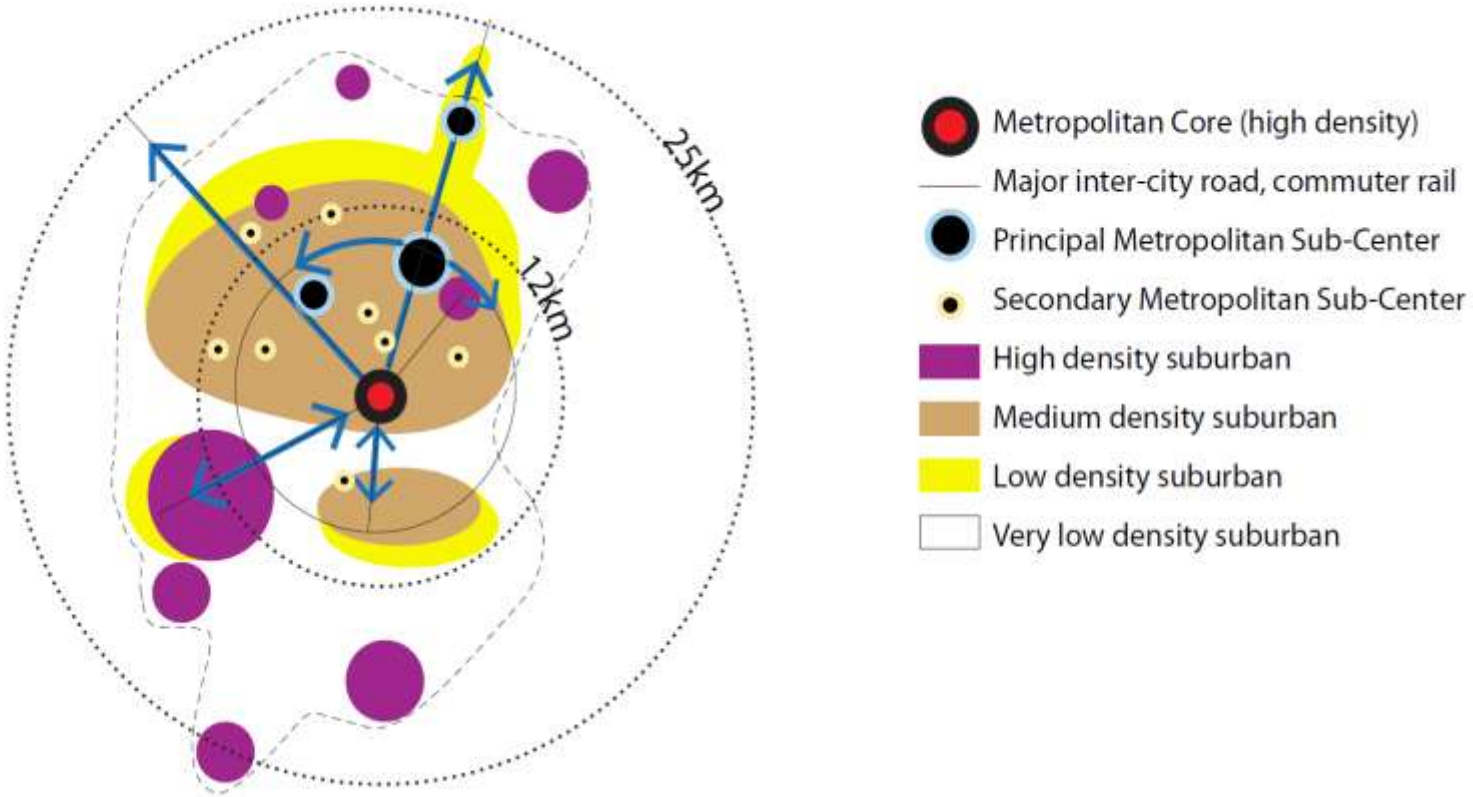
1. Inverted polycentricity

The traditionnal model
Polycentric city



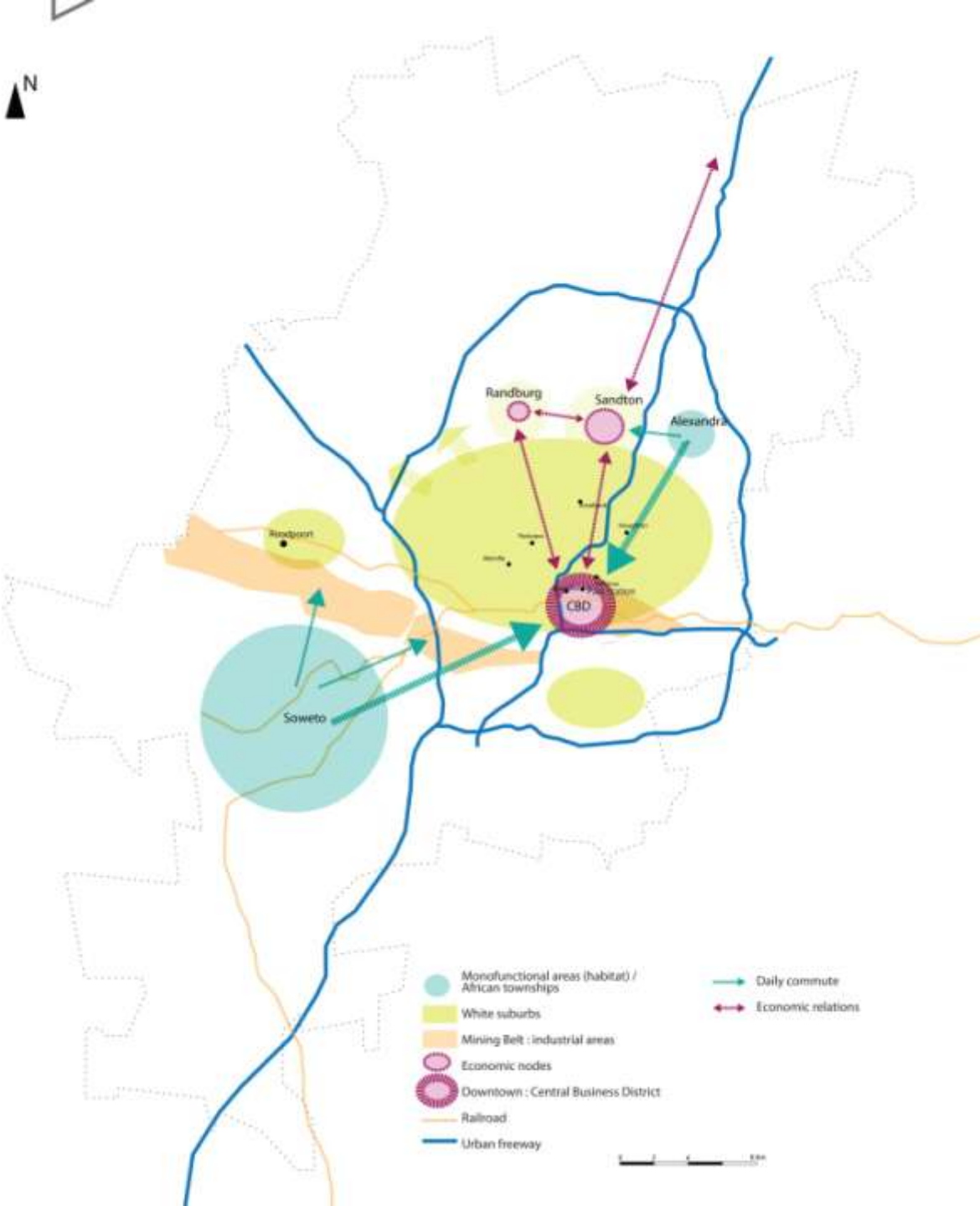
The polycentric city is the traditional pattern of city growth, with a dense and large urban core surrounded by dense sub-centers. This structures supports agglomeration economies.

Johannesburg
Inverted policentricity

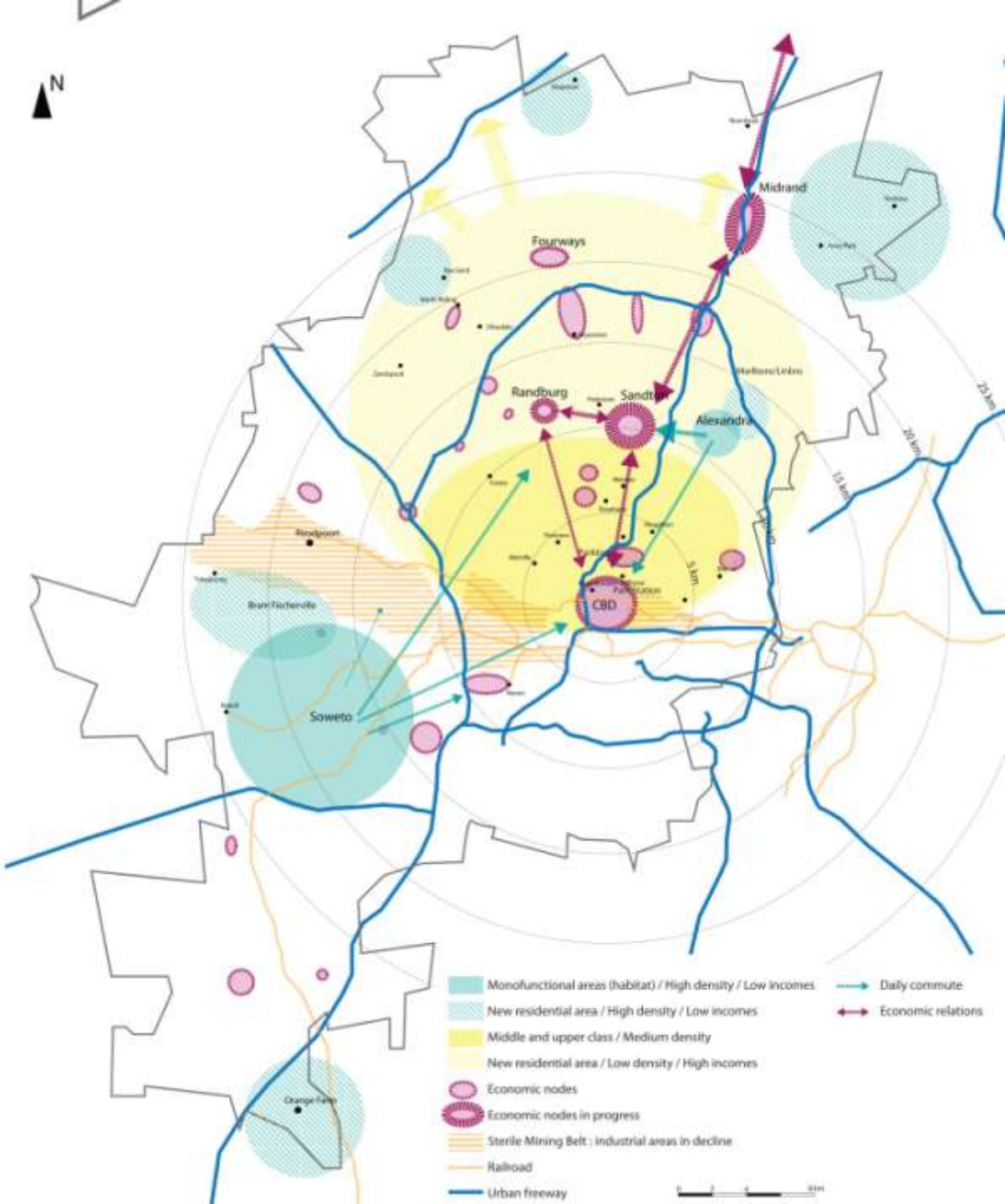


Johannesburg metropolitan structure is unique and inherited from its complex history. It displays inverted polycentricity, with satellites urban areas much larger than the core of the city.

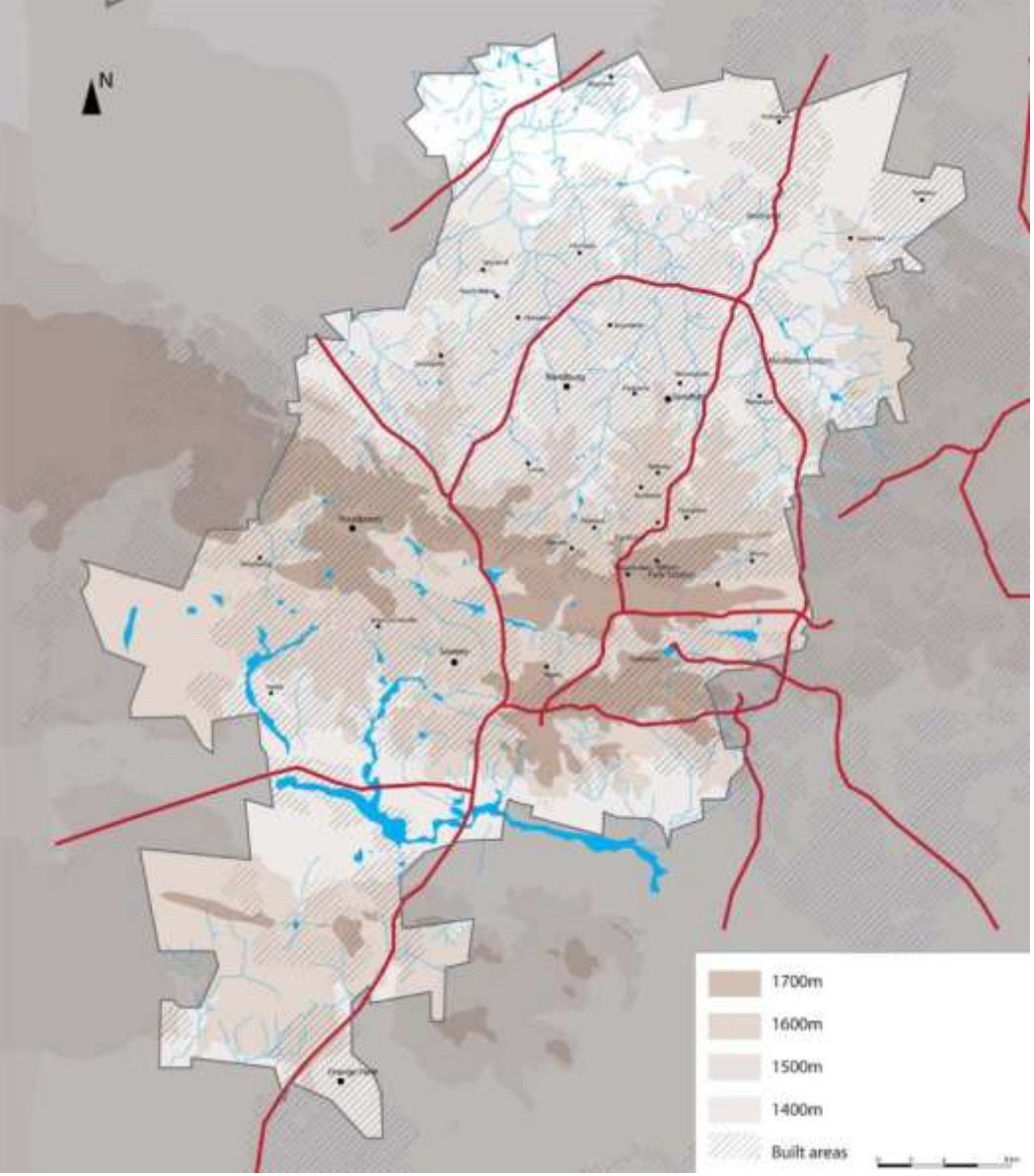
Johannesburg in the 80s



Johannesburg today

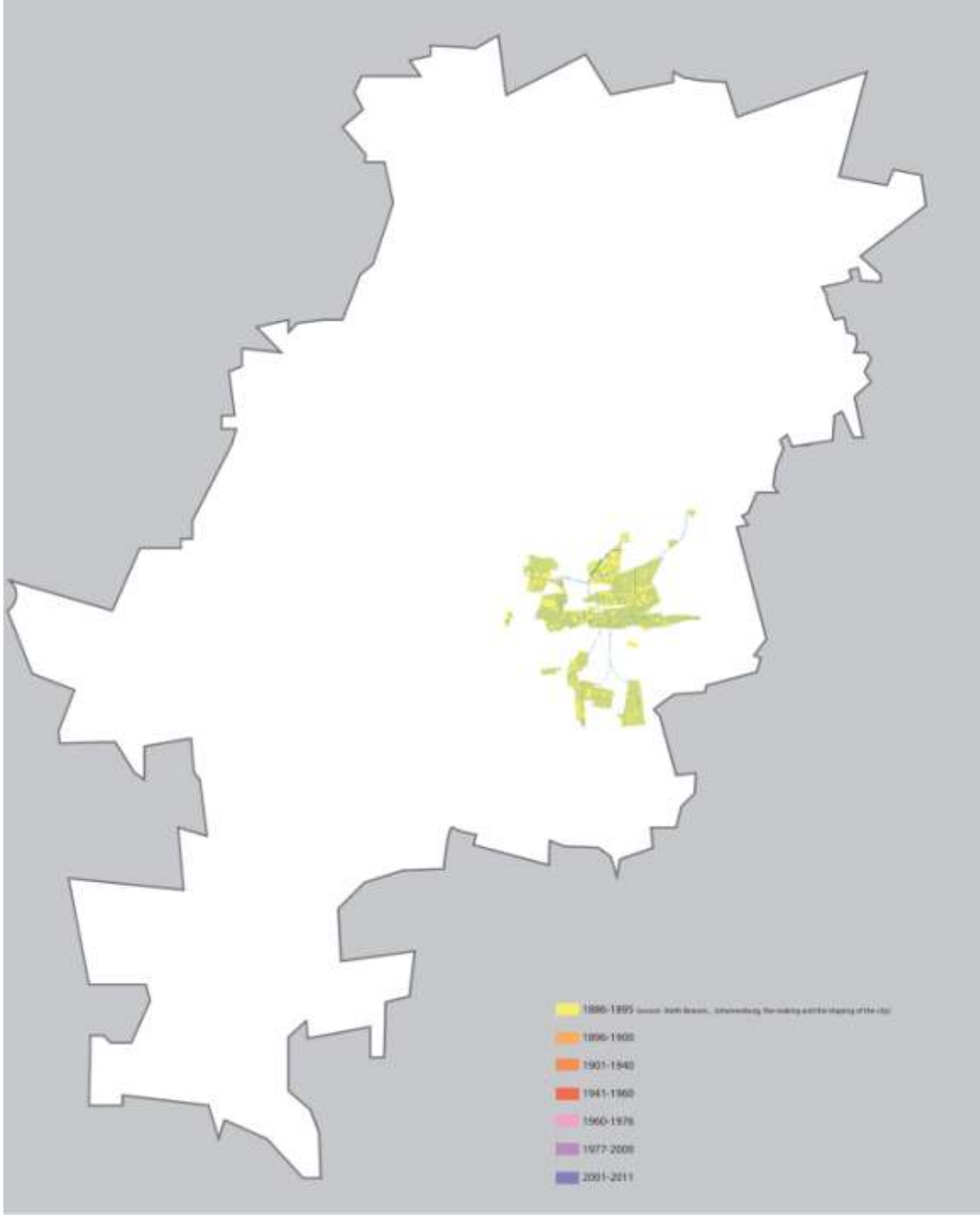


Joburg spatial organisation has been shaped by a unique topography



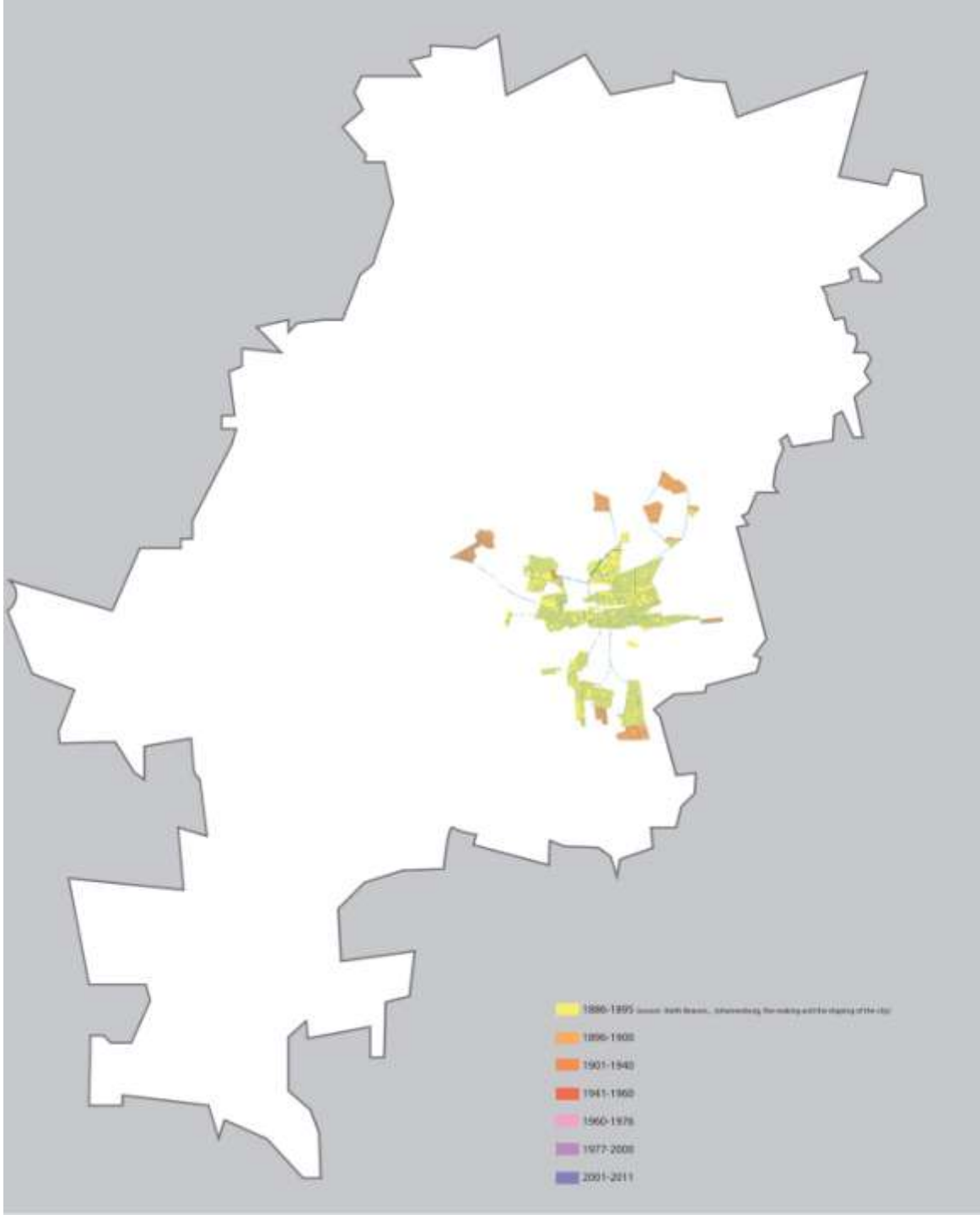
Urban growth time lapse in Johannesburg

1886-1895



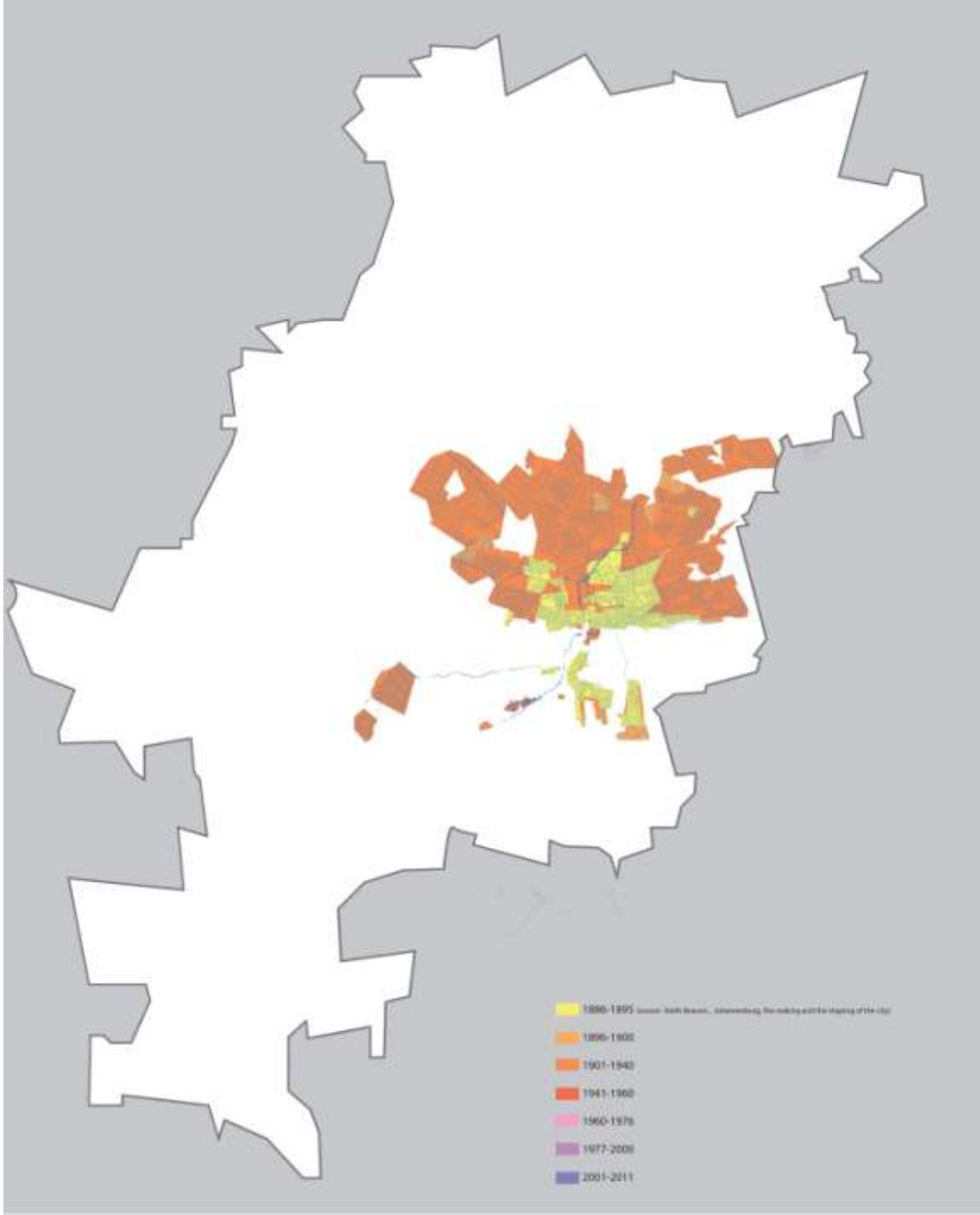
Urban growth time lapse in Johannesburg

1896-1900



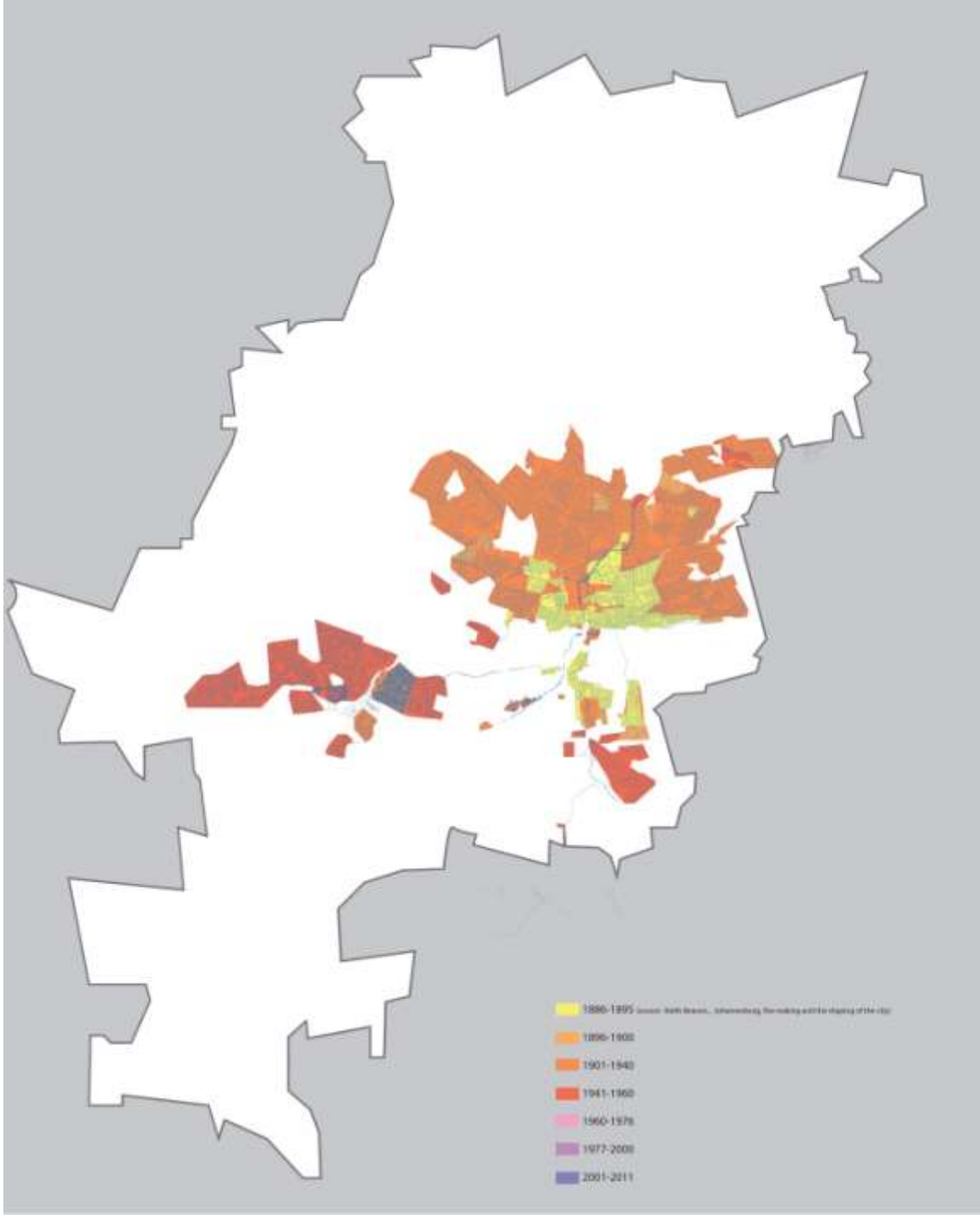
Urban growth time lapse in Johannesburg

1901-1940



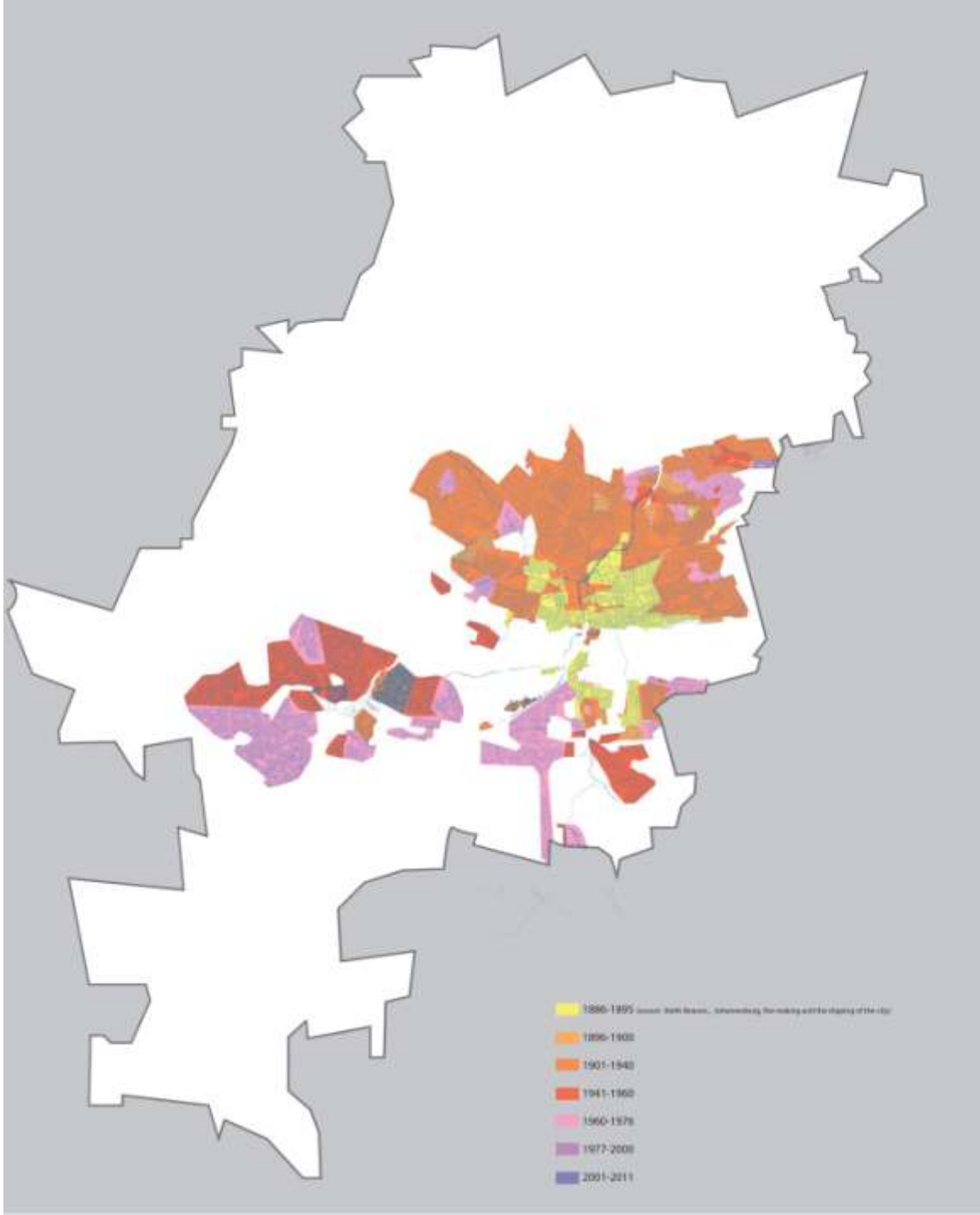
Urban growth time lapse in Johannesburg

1941-1960



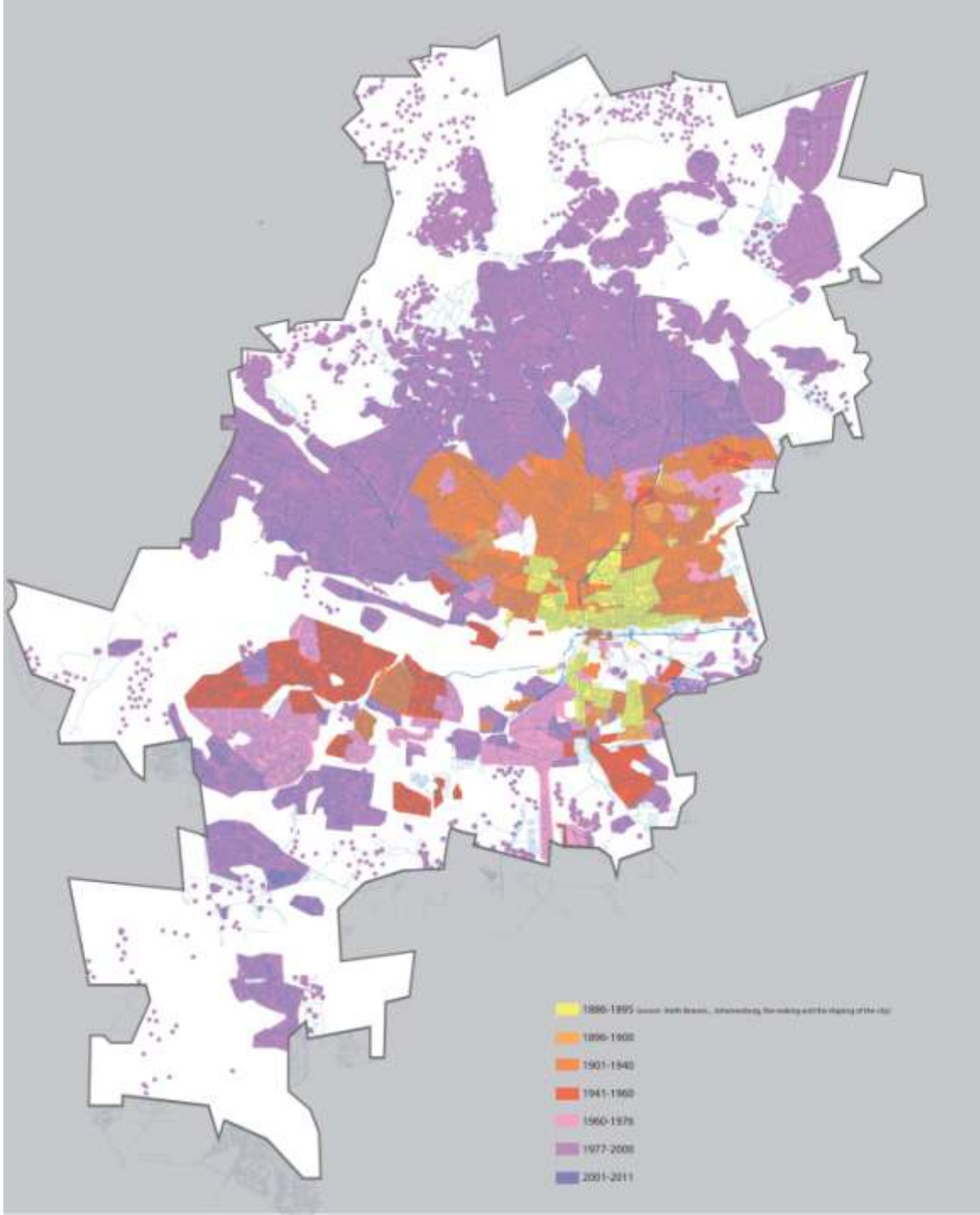
Urban growth time lapse in Johannesburg

1961-1976



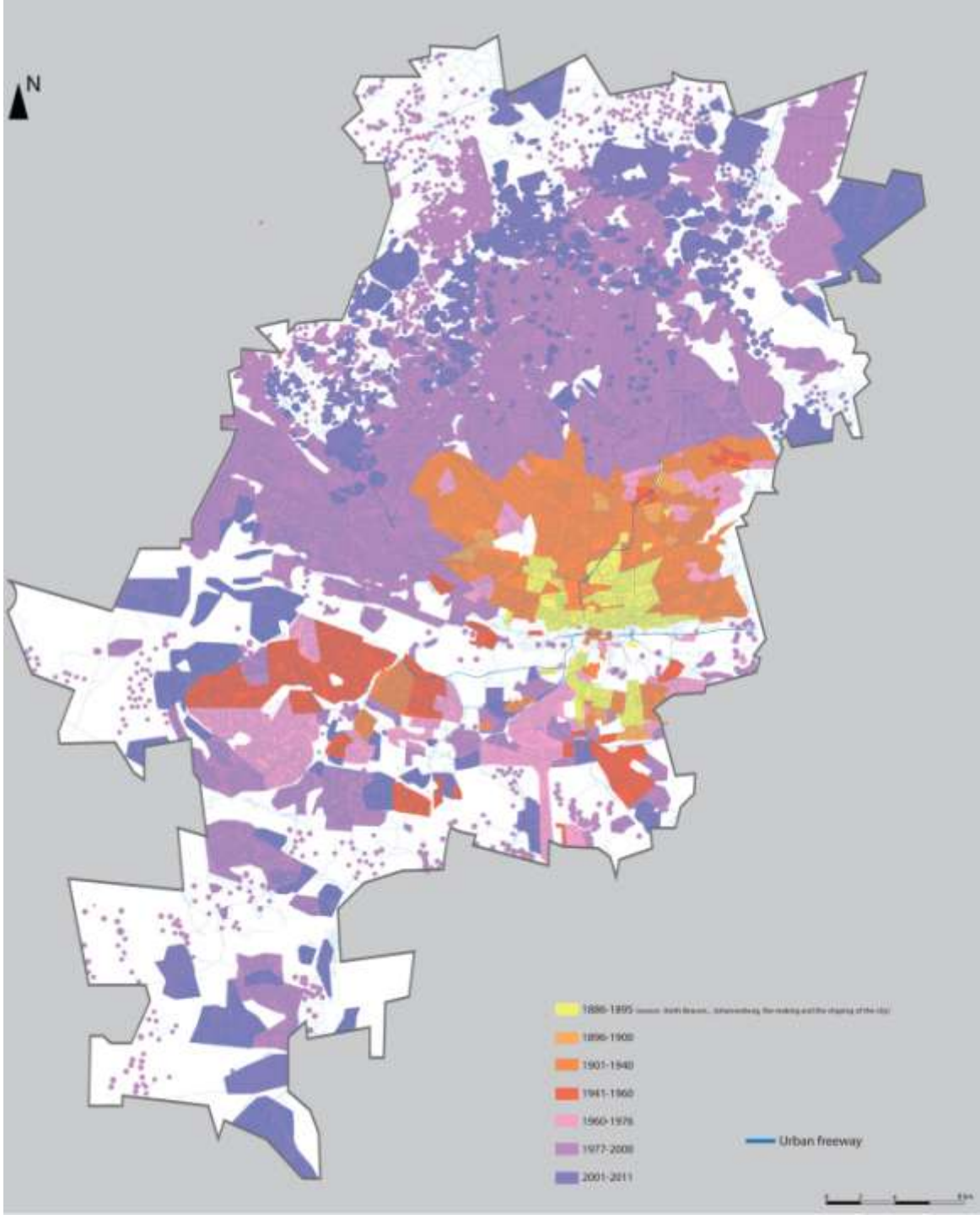
Urban growth time lapse in Johannesburg

1977-2000

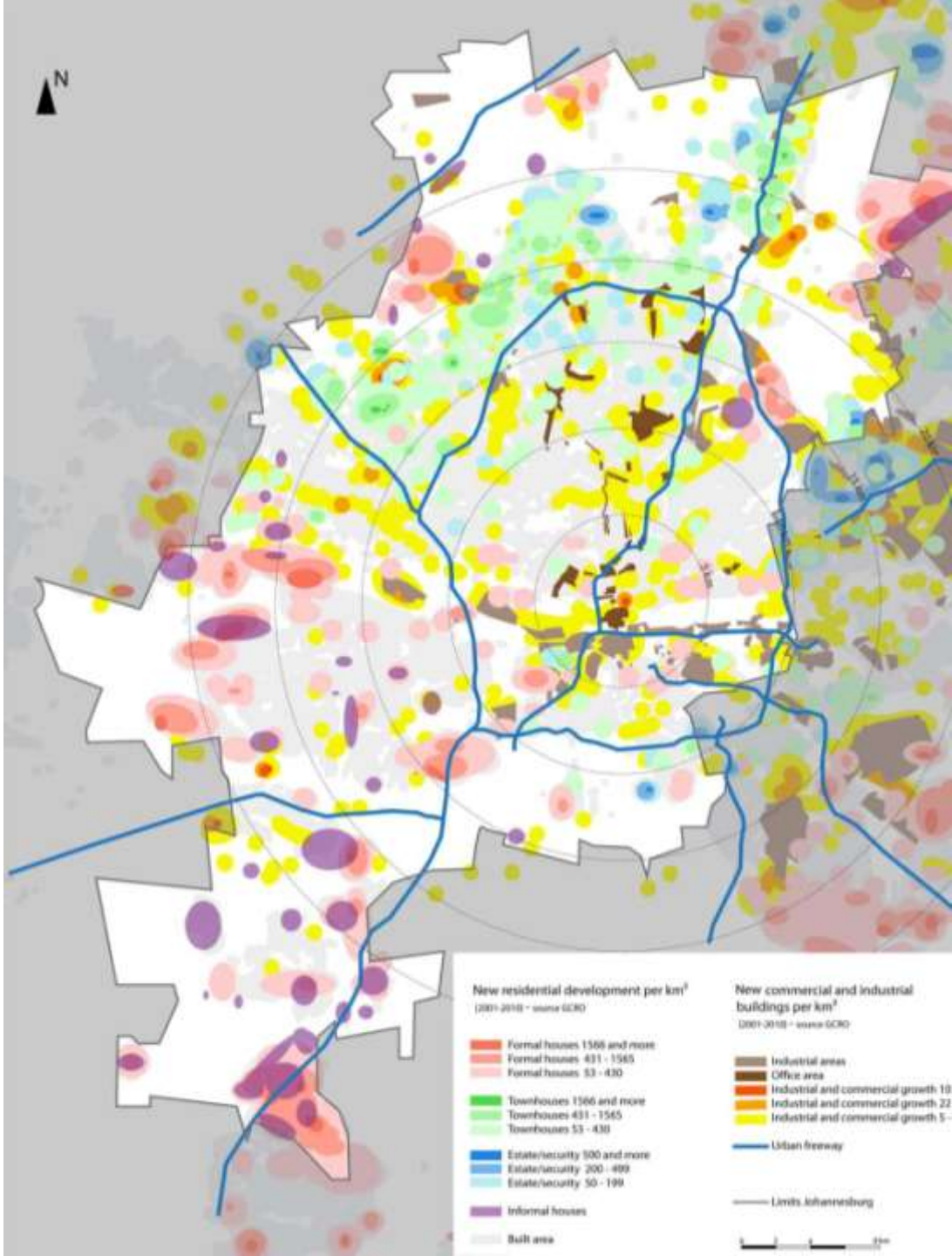


Urban growth time lapse in Johannesburg

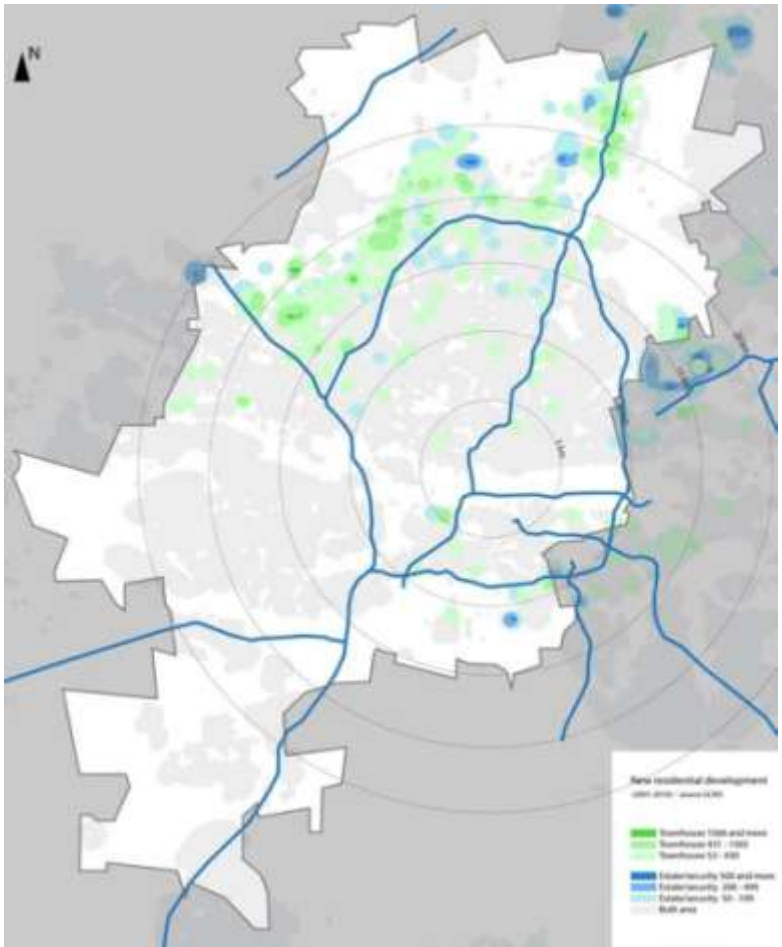
2001-2011

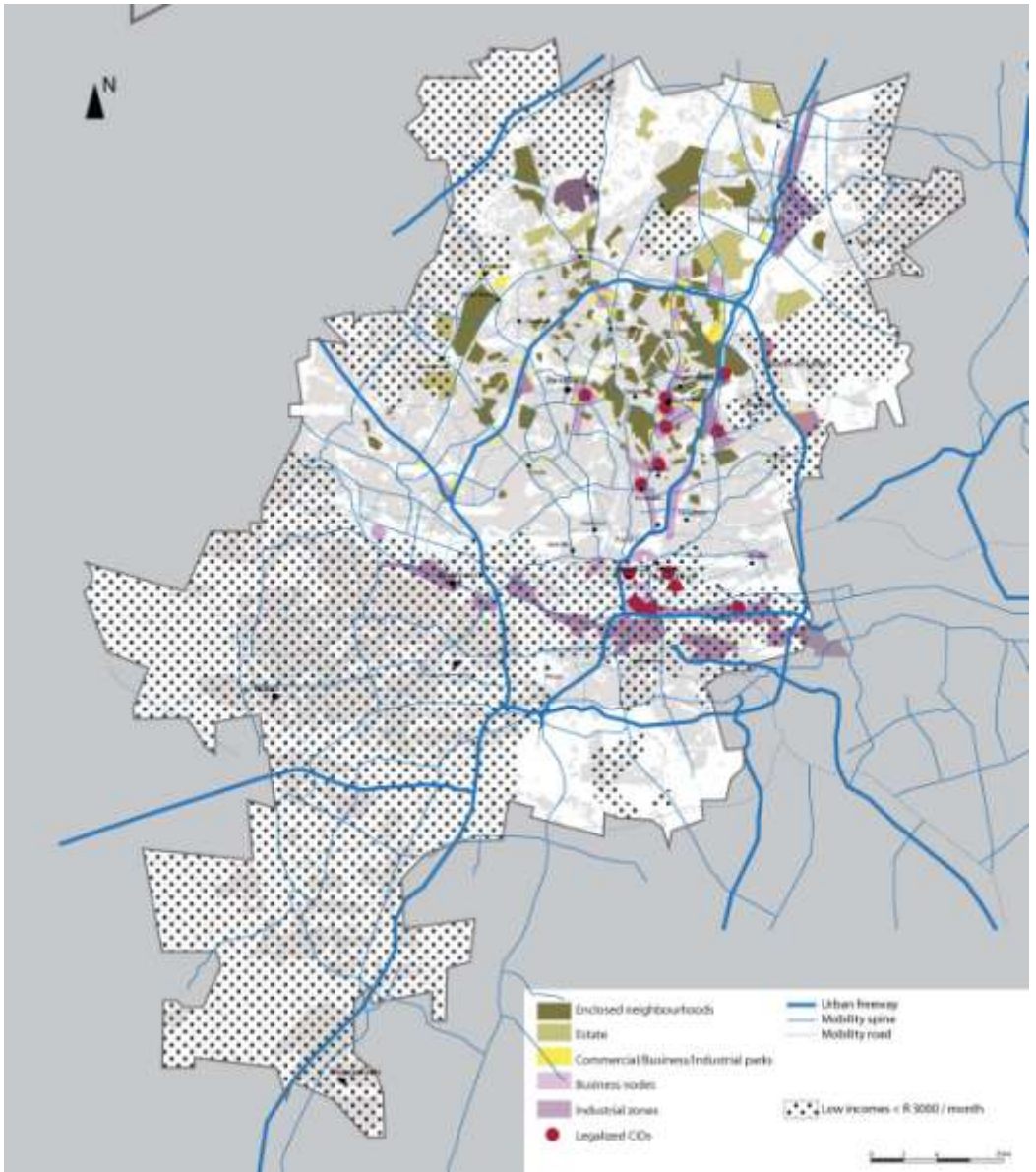


New urbanisation areas

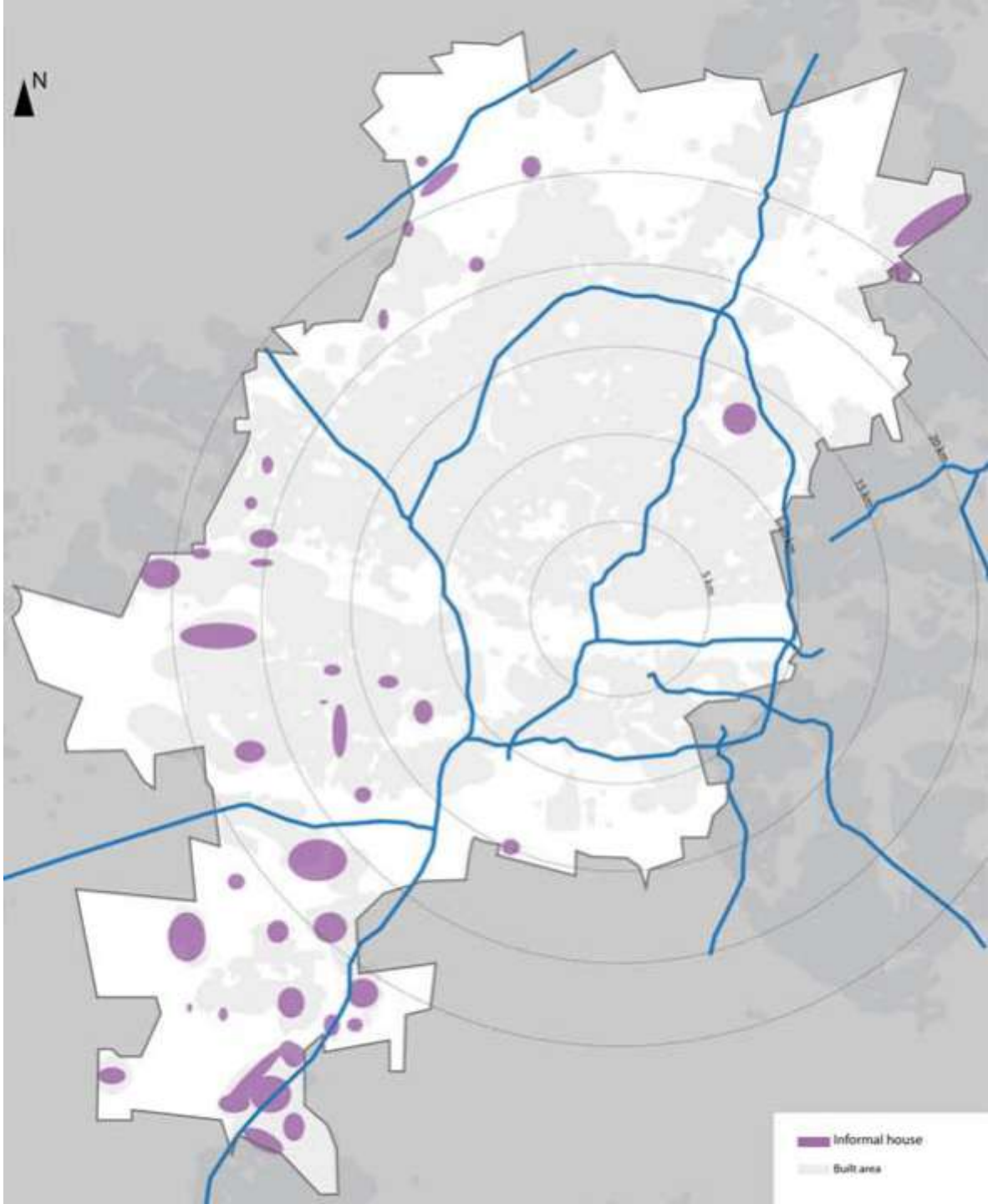


A major role of the private sector

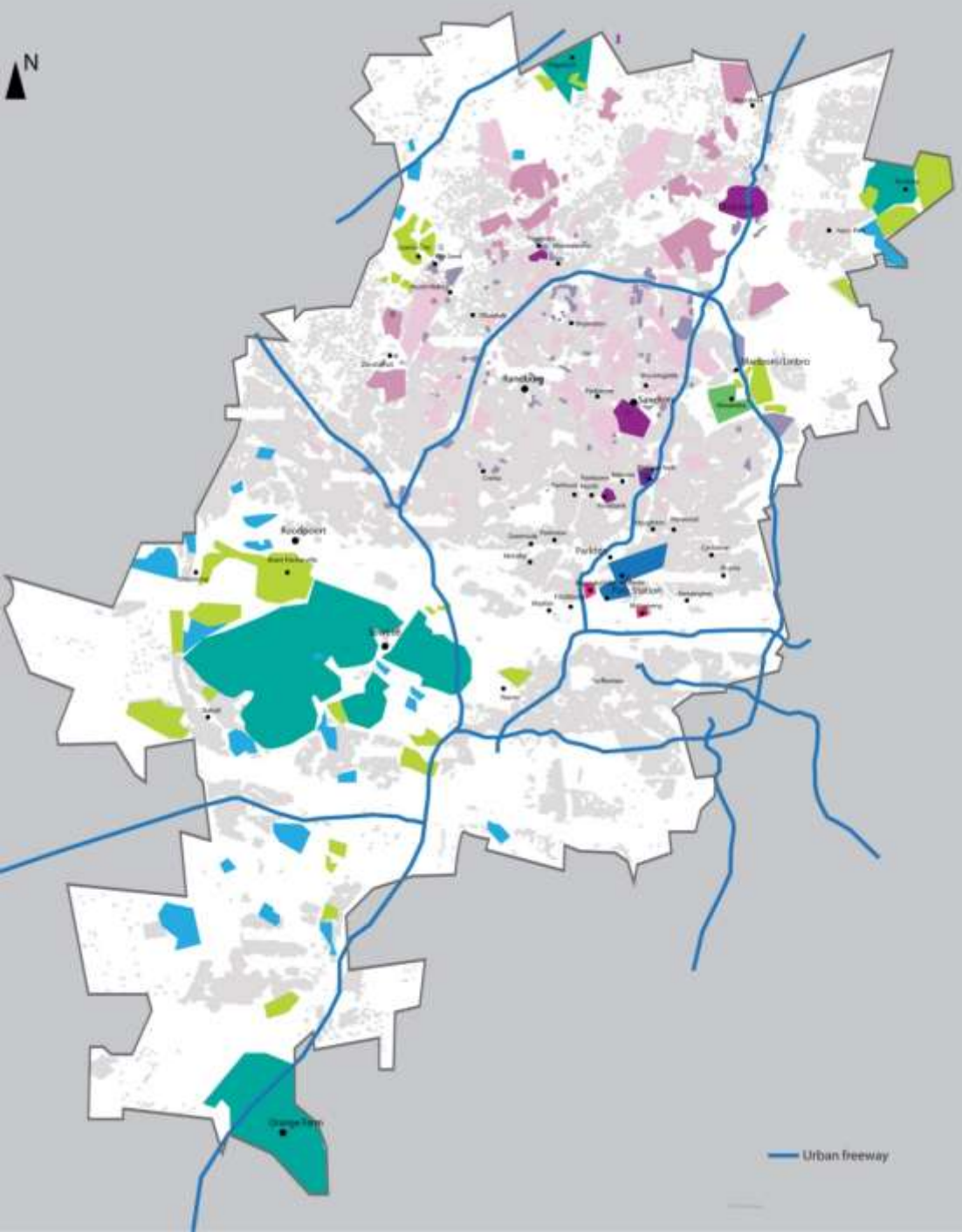




180 informal settlement, growing fast



2. Fragmented and scattered urban forms



NEW URBANISM :
Melrose Arch ⑥

LUXURIOUS EDGE CITIES :
Sandton ⑦

COMMERCIAL/BUSINESS/
INDUSTRIAL PARKS

ESTATES :
Olive Crest Estate ⑧

ENCLOSED NEIGHBOURHOODS
North Riding ⑨

Private City Improvment
Maboneng ⑩

EXURBAN FRINGE :
townships and staellite
informal settlements
Soweto ①

ESTABLISHED TOWNSHIPS
Alexandra ④

RDP
Boandschenville ⑤

NEW PERI-URBAN SQUATTER SETTLEMEN
Kya Sand ②

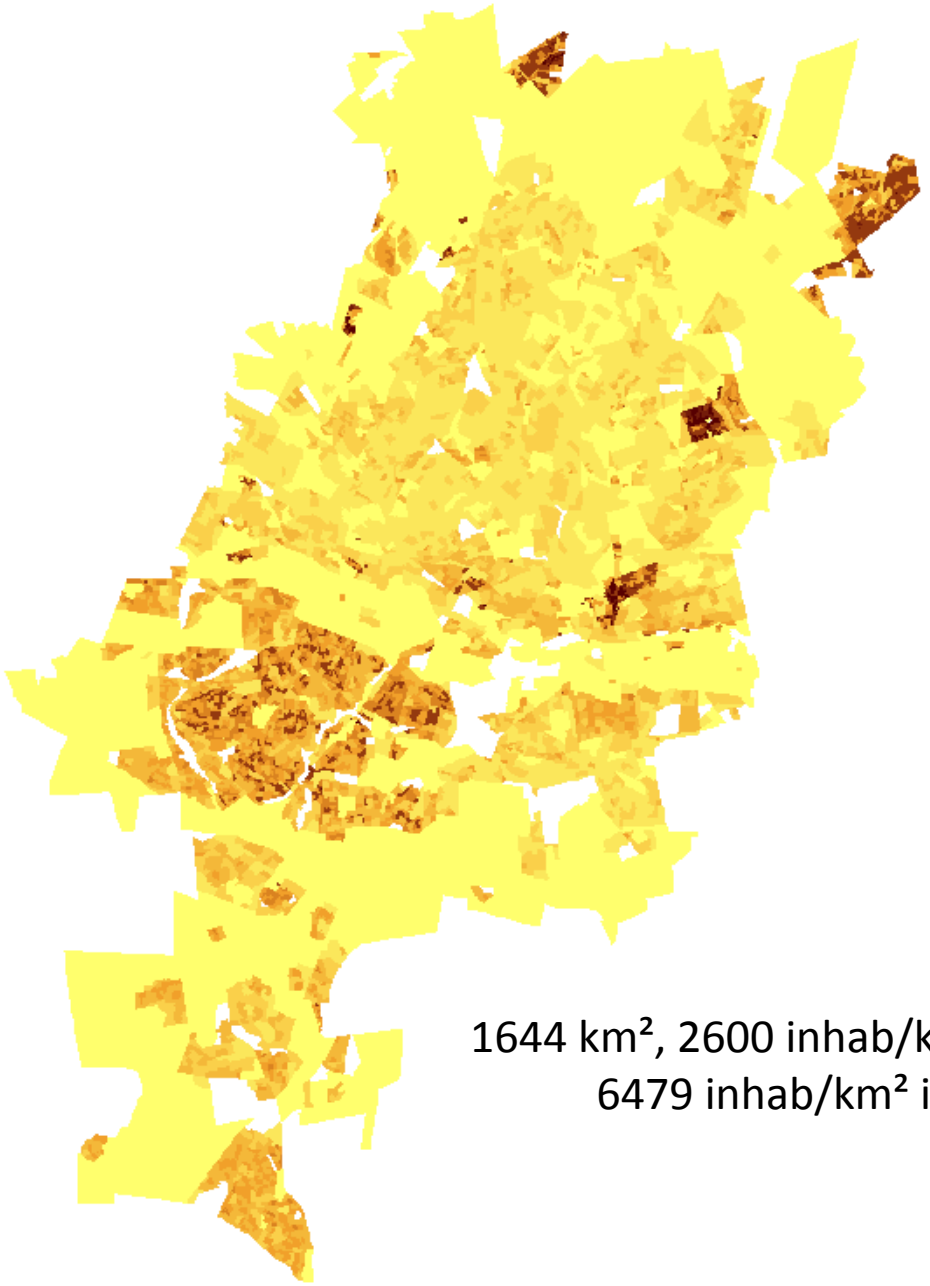
INNER CITY HYPER RESIDENTIAL DENSITY
Hillbrow ③

3. Fragmented and scattered densities

- 100 fold variations in residential density
- 50 fold variation in job density
- Spatial mismatch between job and residential density

Residential densities

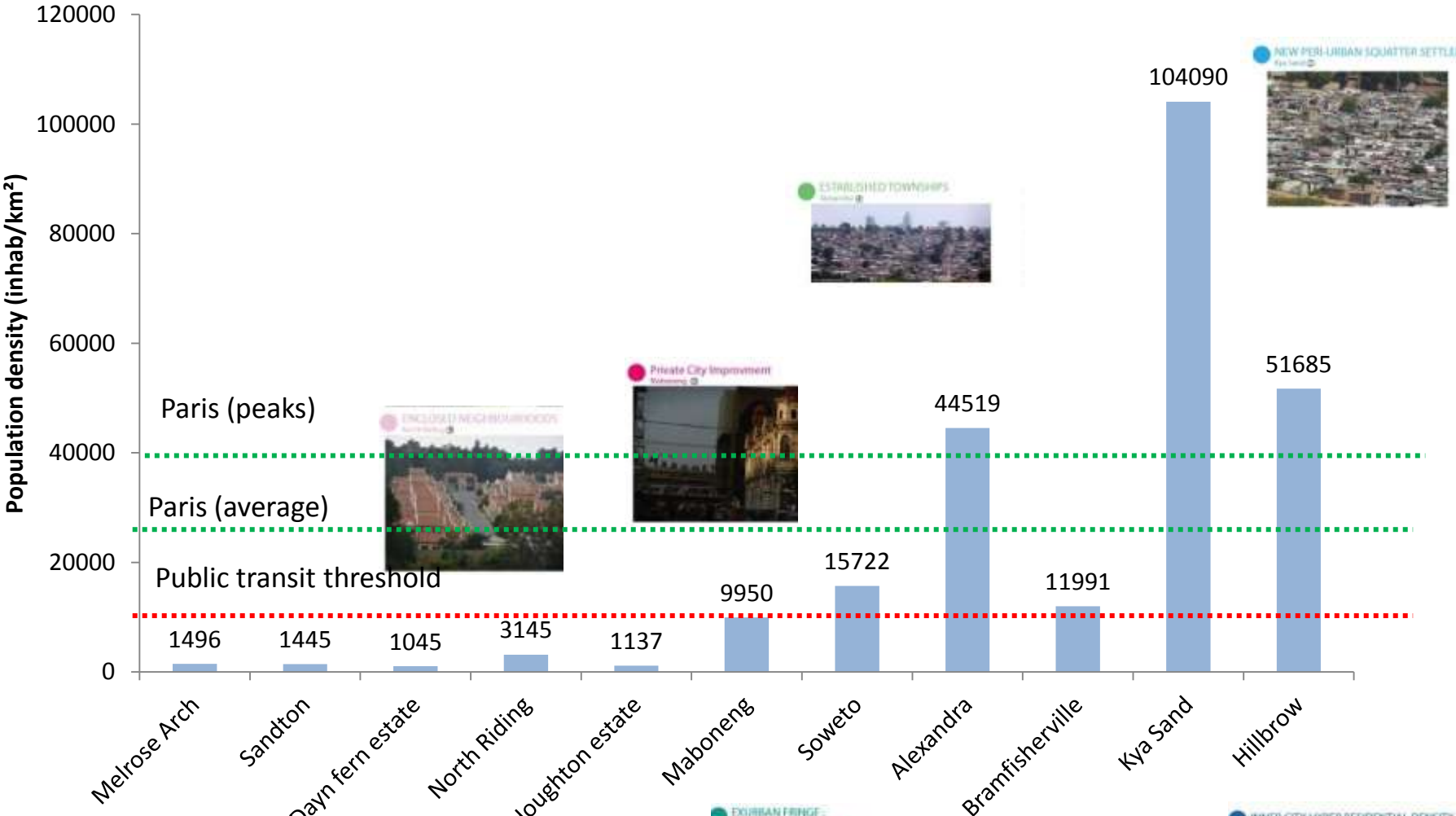
Scattered and fragmented



- Less than 1000 inhab/km²
- 1000-2500 inhab/km²
- 2500-5000 inhab/km²
- 5000-10000 inhab/km²
- 10000-20000 inhab/km²
- 20000-30000 inhab/km²
- 30000-40000 inhab/km²
- 40000-50000 inhab/km²
- More than 50000 inhab/km²

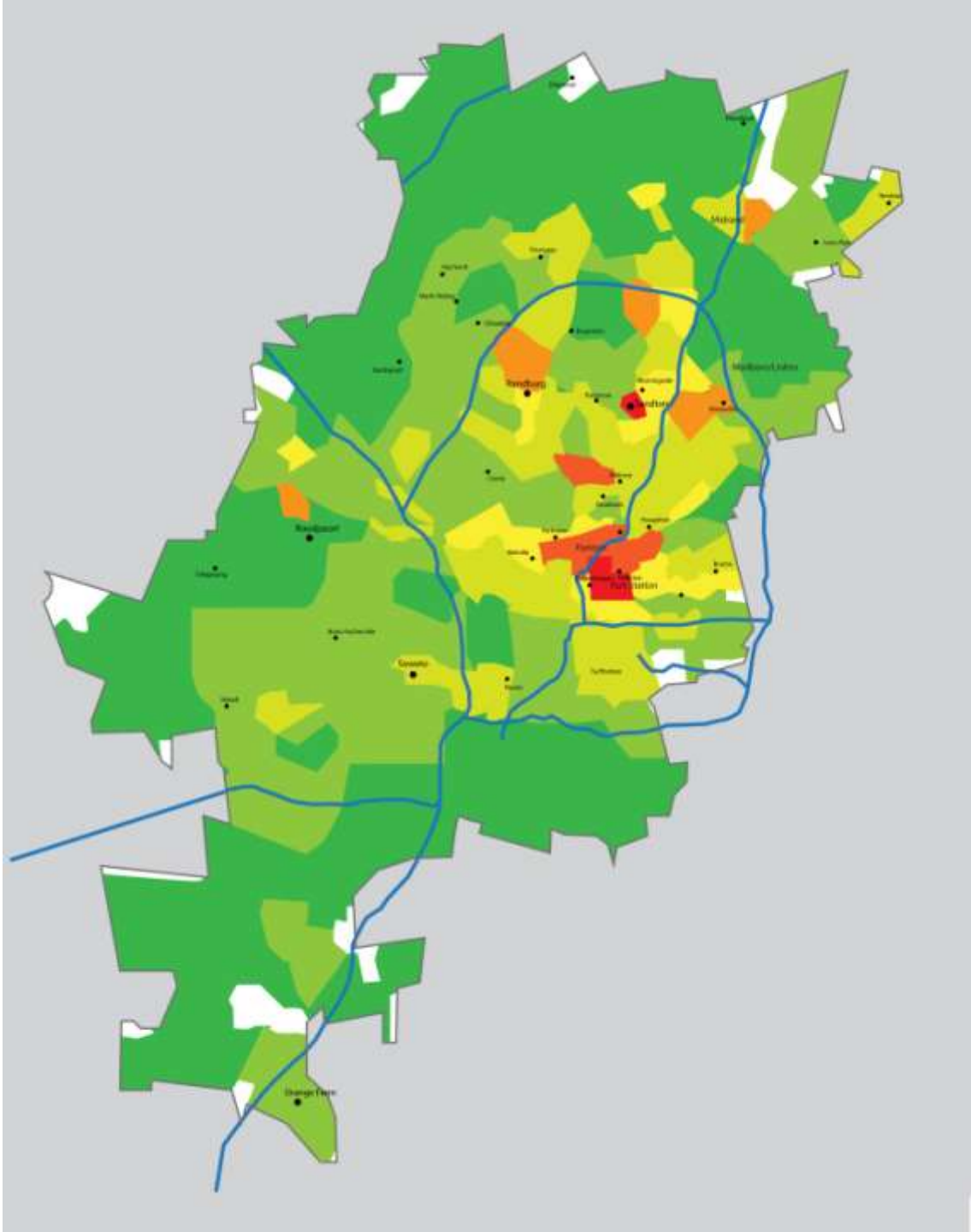
1644 km², 2600 inhab/km² in average (City of Joburg, census 2010)
6479 inhab/km² in average in built up areas (680 km²)

Detailed analysis reveals very different patterns, with 100-fold variations of local residential density



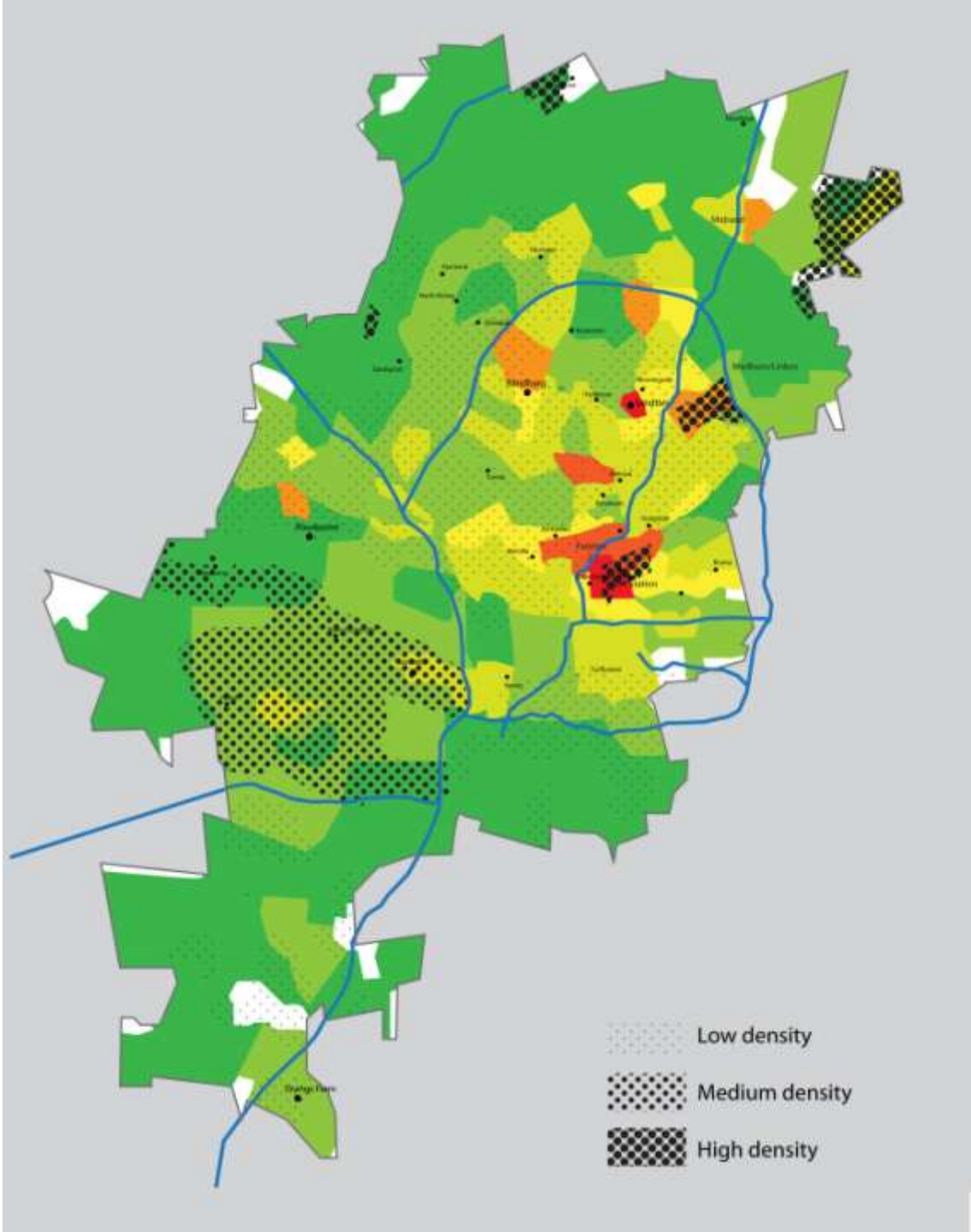
Jobs densities (2001 data)

- 0-300 jobs/km²
- 301-800 jobs/km²
- 801-1500 jobs/km²
- 1501-3000 jobs/km²
- 3001-5000 jobs/km²
- 5001-10000 jobs/km²
- 10001-50000 jobs/km²



The major issue
The job/housing mismatch

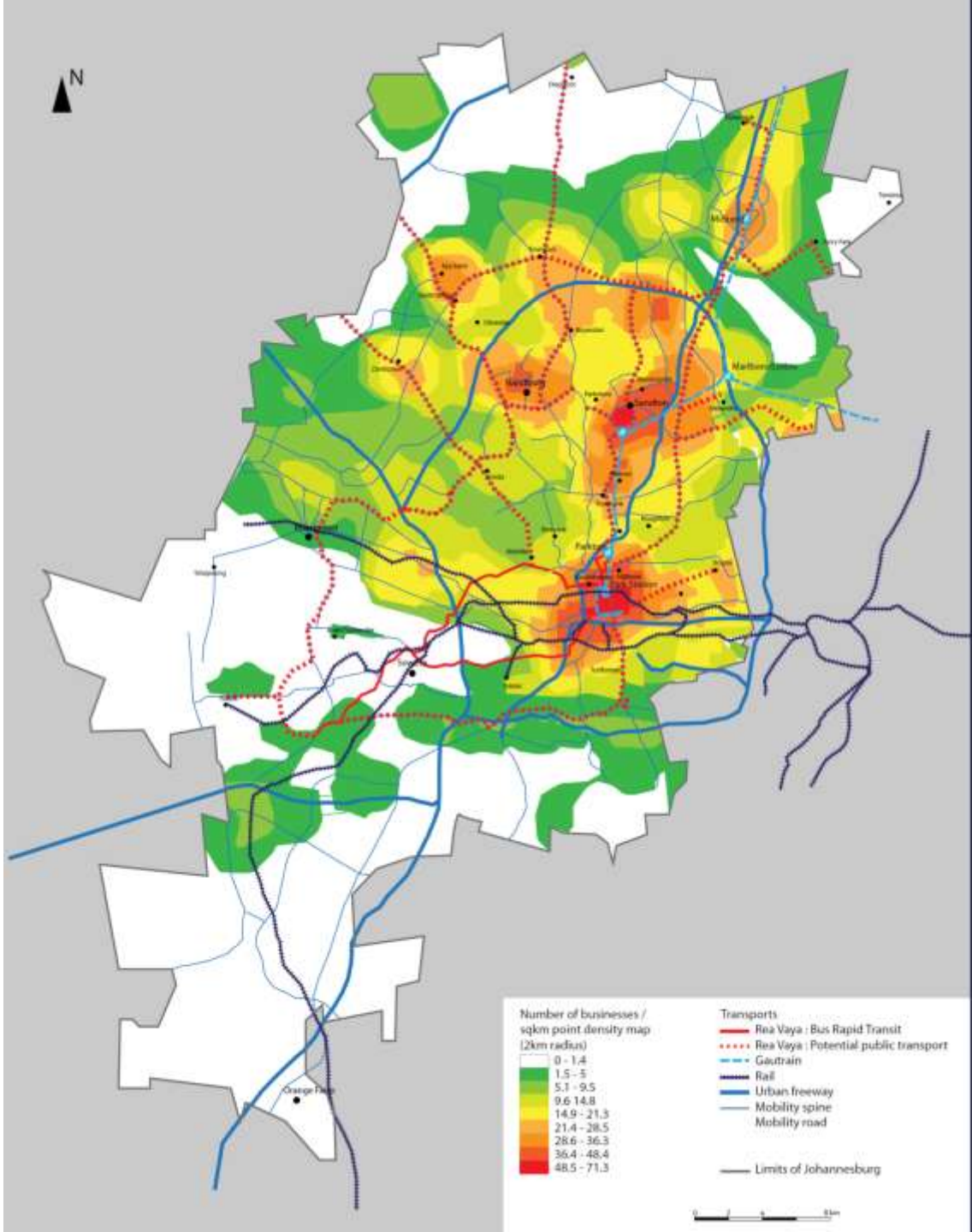
- 0-300 jobs/km²
- 301-800 jobs/km²
- 801-1500 jobs/km²
- 1501-3000 jobs/km²
- 3001-5000 jobs/km²
- 5001-10000 jobs/km²
- 10001-50000 jobs/km²



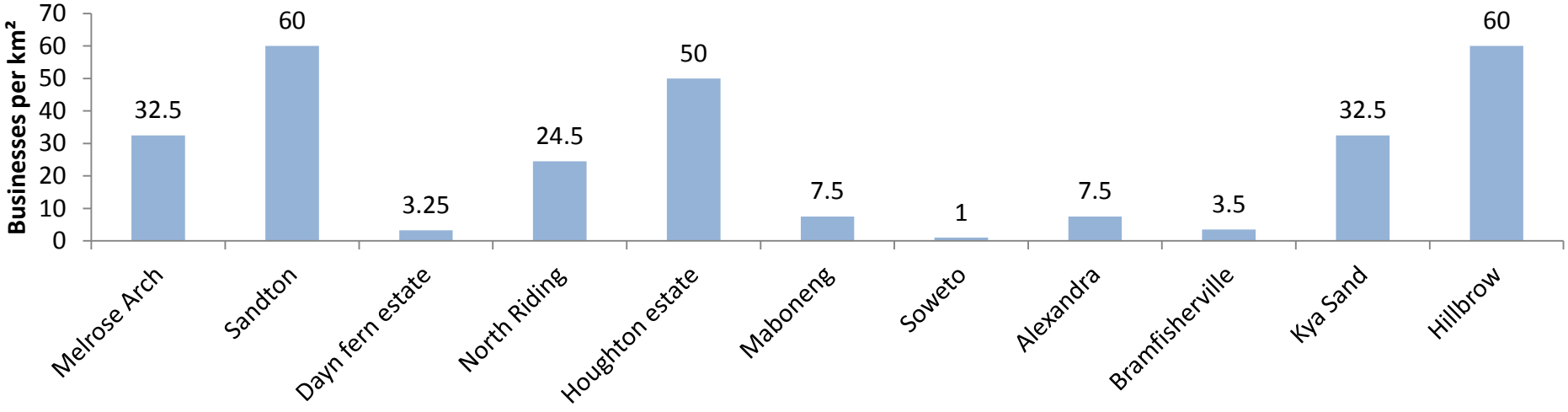
Business densities mirror job distributions

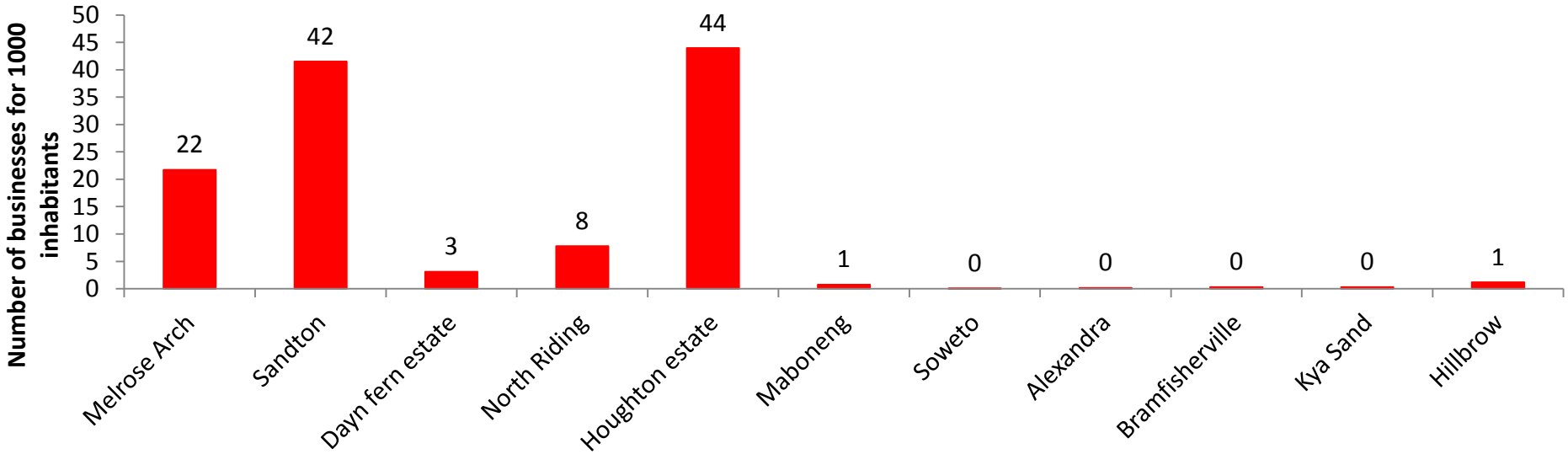
Number of businesses per km²

- 0 - 1.4
- 1.5 - 5
- 5.1 - 9.5
- 9.6 14.8
- 14.9 - 21.3
- 21.4 - 28.5
- 28.6 - 36.3
- 36.4 - 48.4
- 48.5 - 71.3

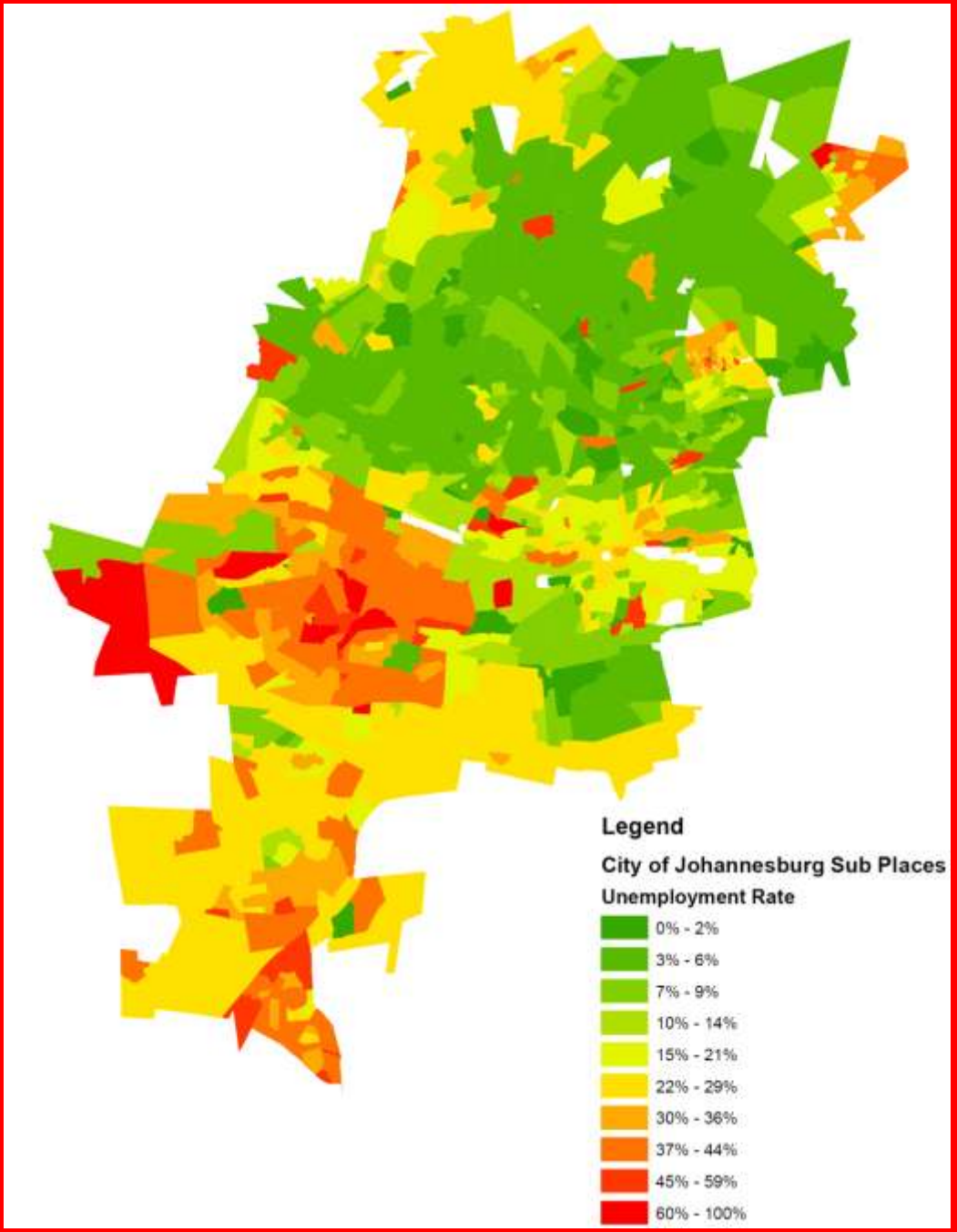


The number of businesses per km² & the number of businesses per 1000 inhabitants reveal deep spatial inequalities



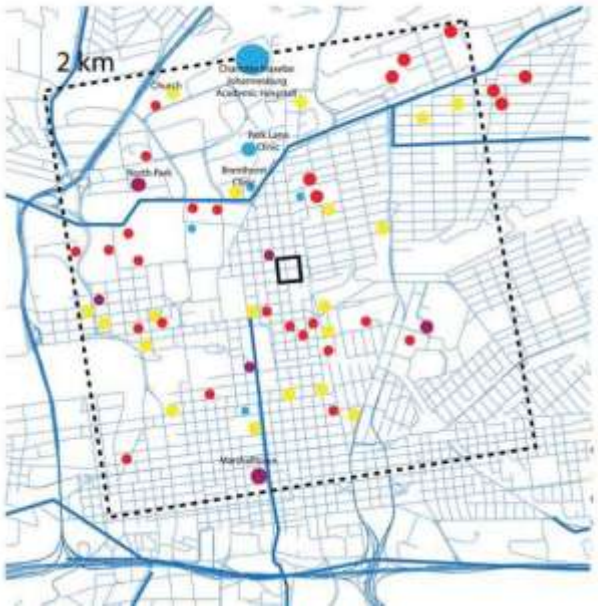


4. Spatial inequalities result in high levels of concentrated unemployment

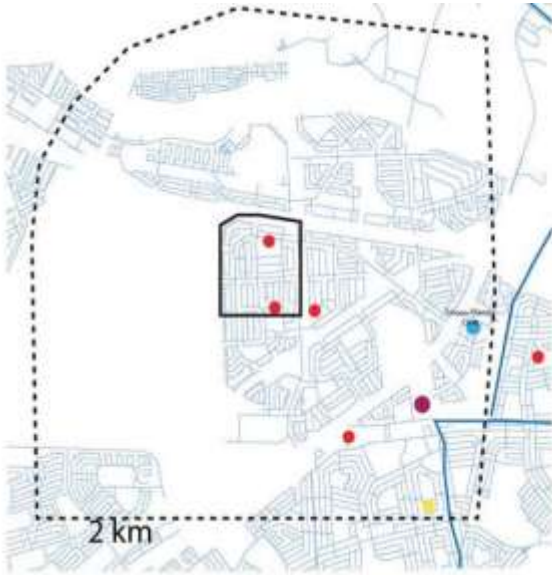


5. Unequal densities of amenities

Unequal densities of amenities

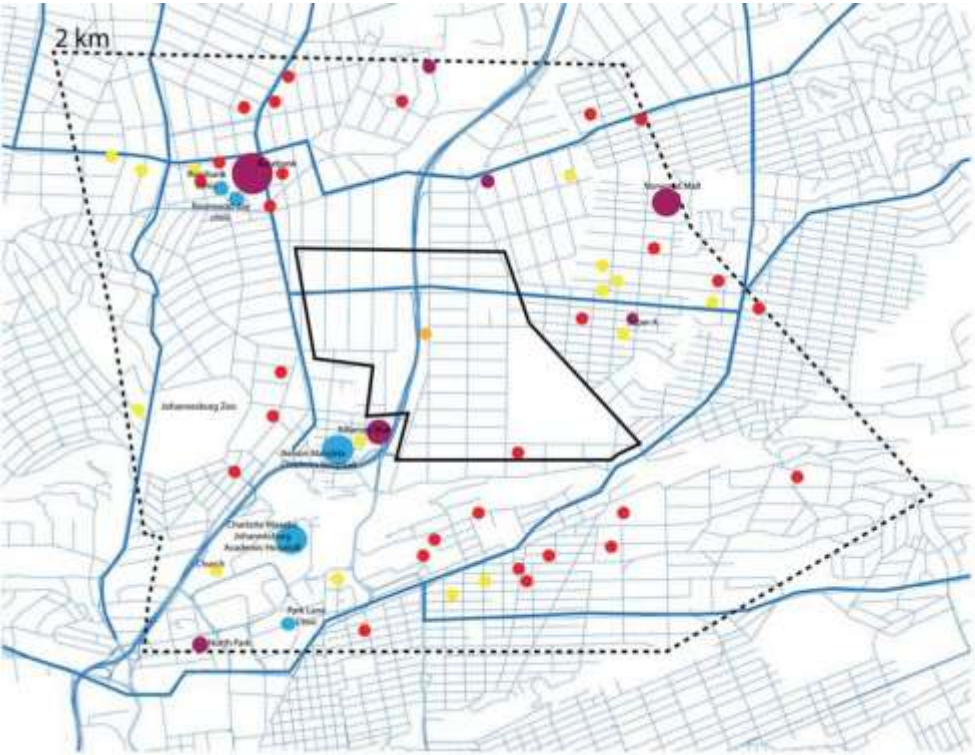


Hillbrow



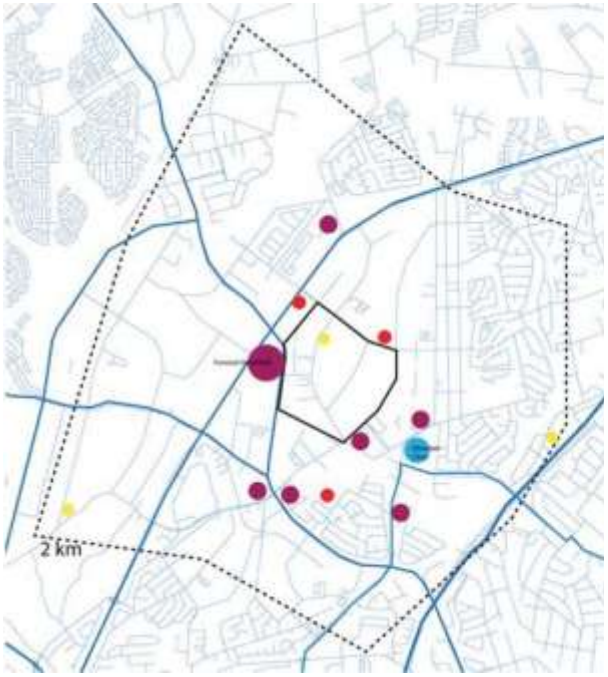
Bramfischerville

Unequal densities of amenities



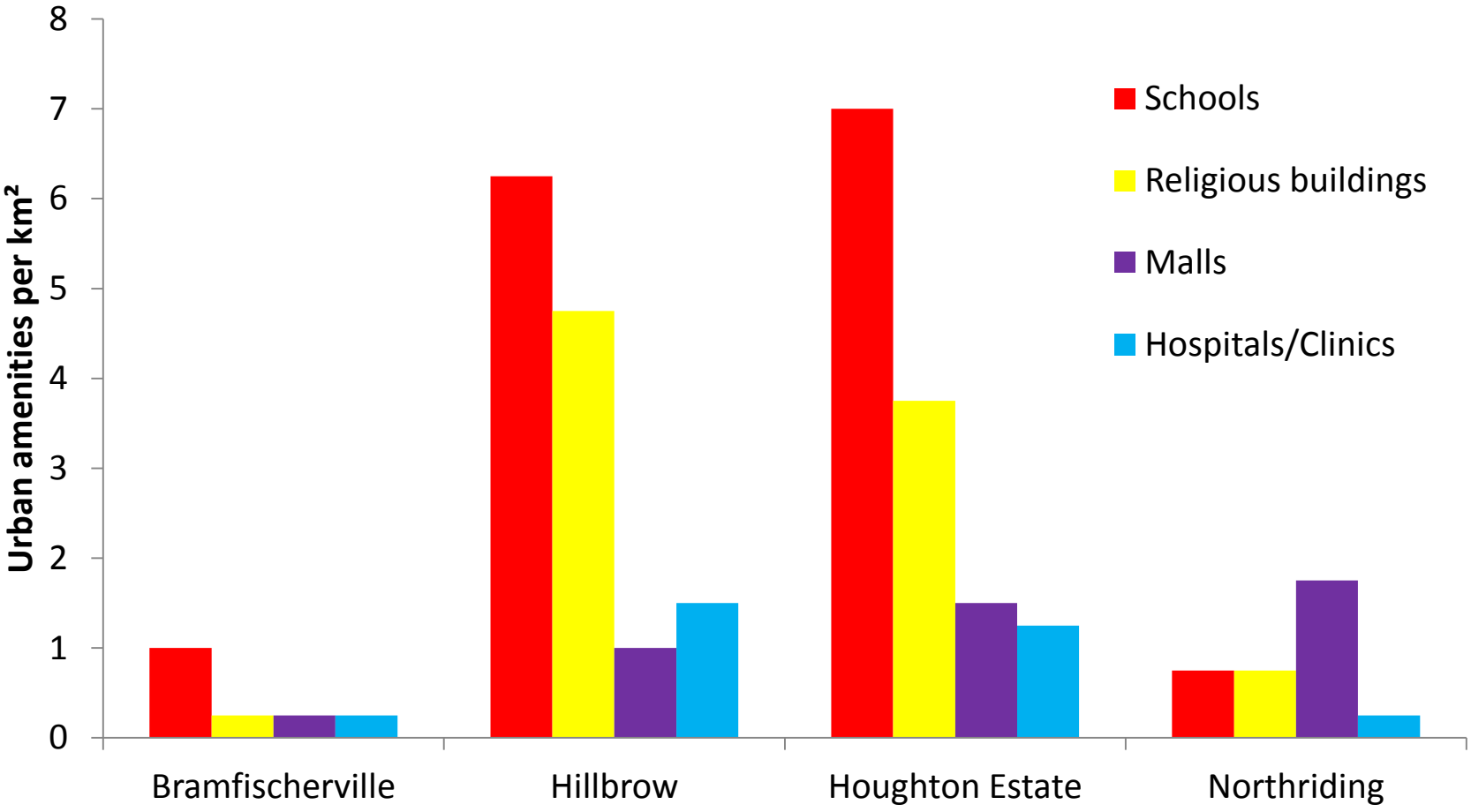
Houghton

Mosque
School
Church
Mall
Hospital / Clinic

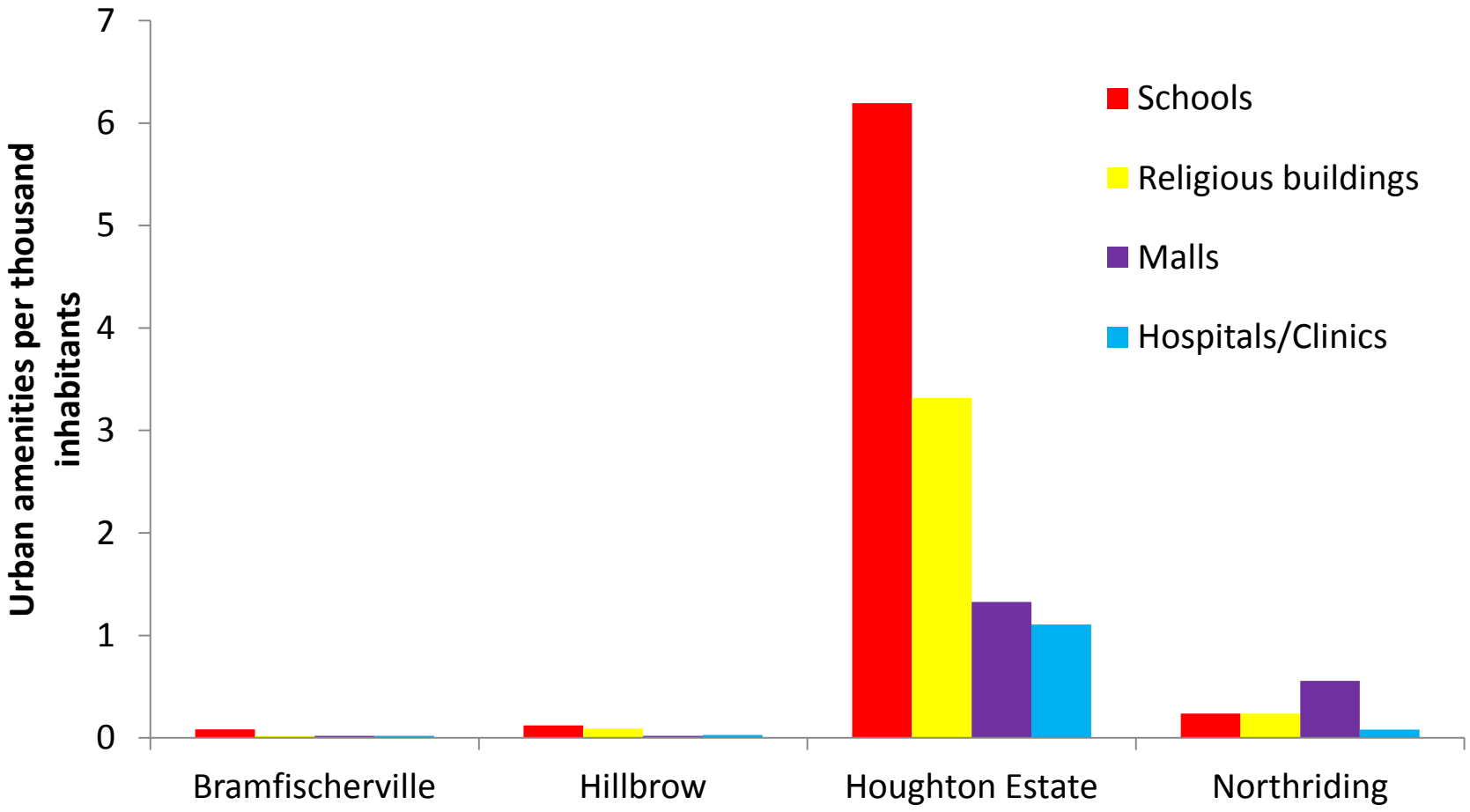


Northriding

The density of urban amenities varies a lot across districts

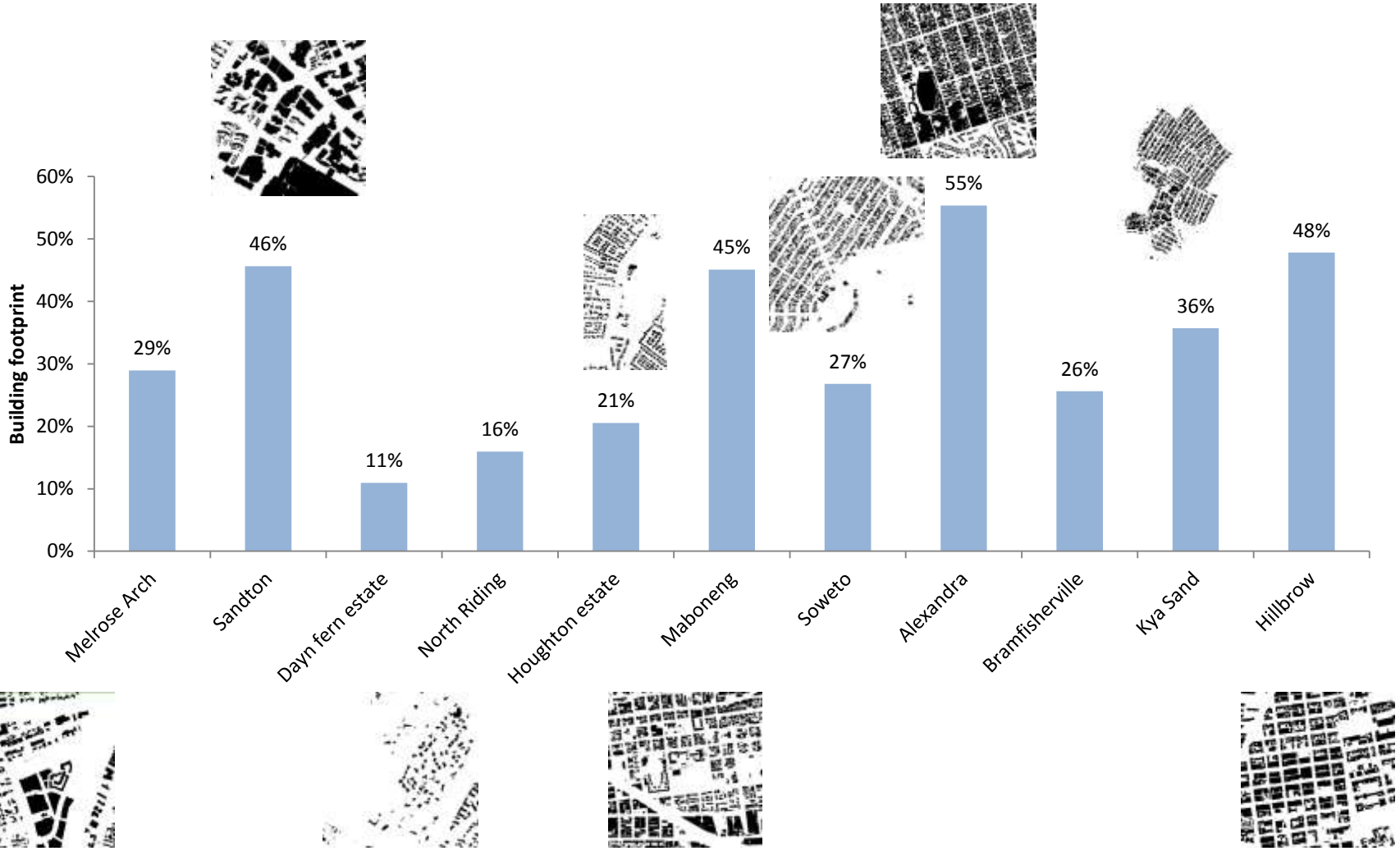


But the number of amenities per thousand inhabitants varies even more

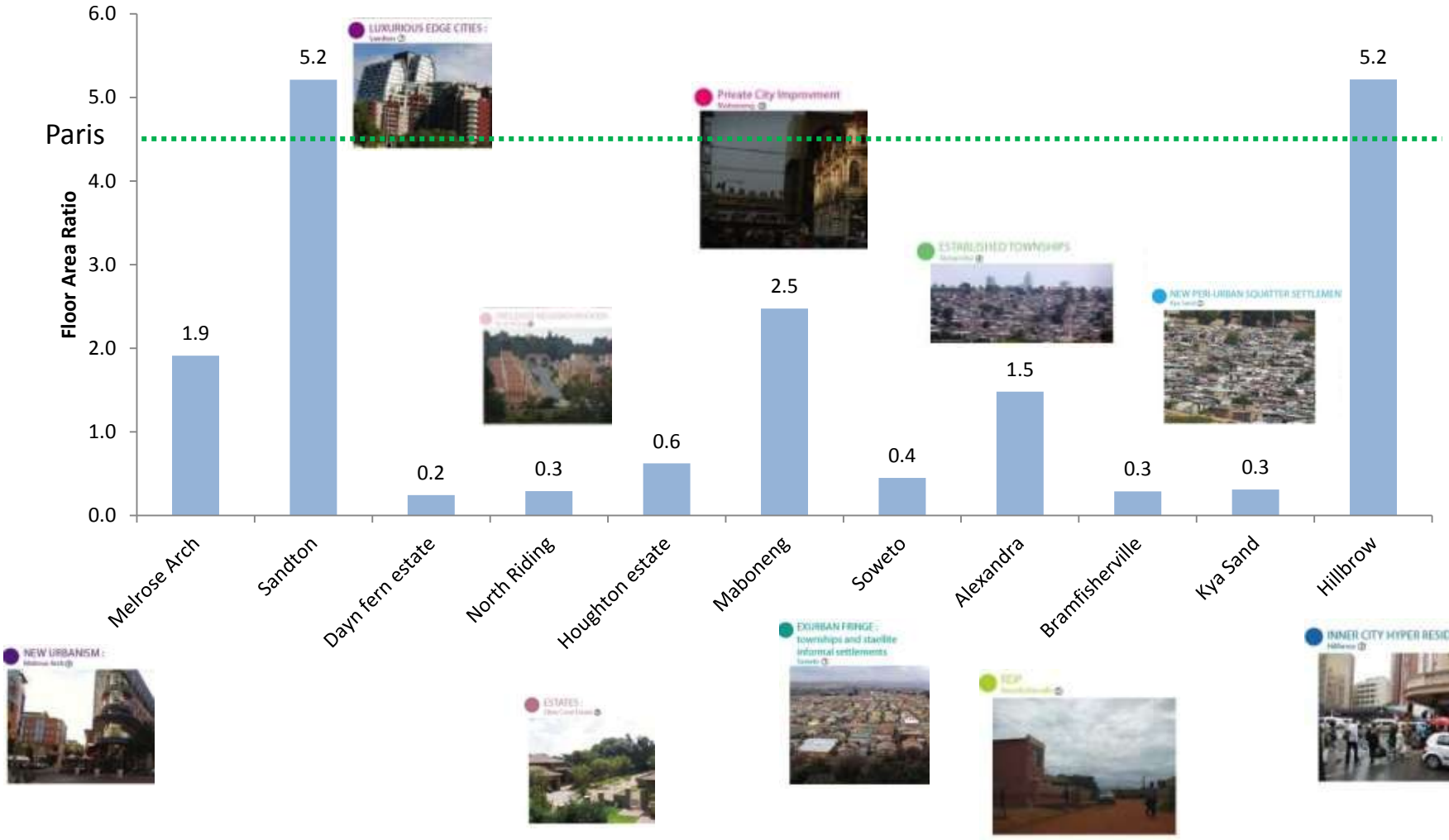


6. Inefficient land use: low coverage ratio and low FAR

Coverage ratio



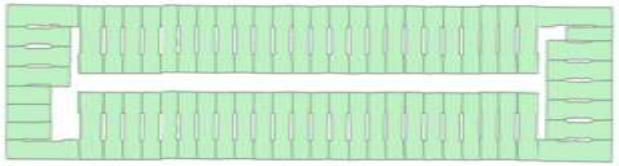
Floor Area Ratio is very low in most of urban types



7. Uniform and rigid platting (plot subdivision) jeopardizes social inclusiveness and economic resilience

What are the characteristics of an efficient, resilient and sustainable platting?

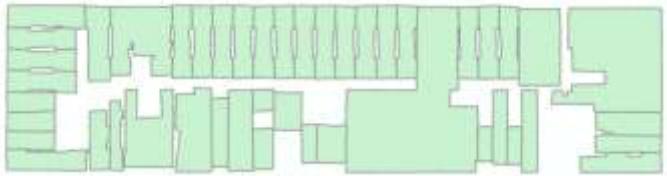
Manhattan
Original plot subdivision
Average plot size: 205 m²



Residential

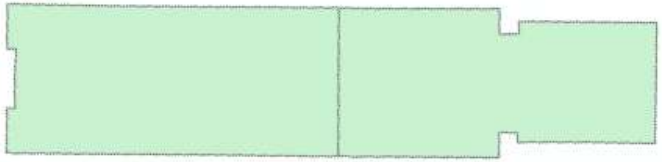
Fine grain platting allows consolidation over time and makes the city resilient, diverse and adaptive to market

Manhattan
Intermediary plot consolidation
Average plot size: 255 m²



Mixed use

Manhattan
Extreme plot consolidation
Average plot size: 6,100 m²

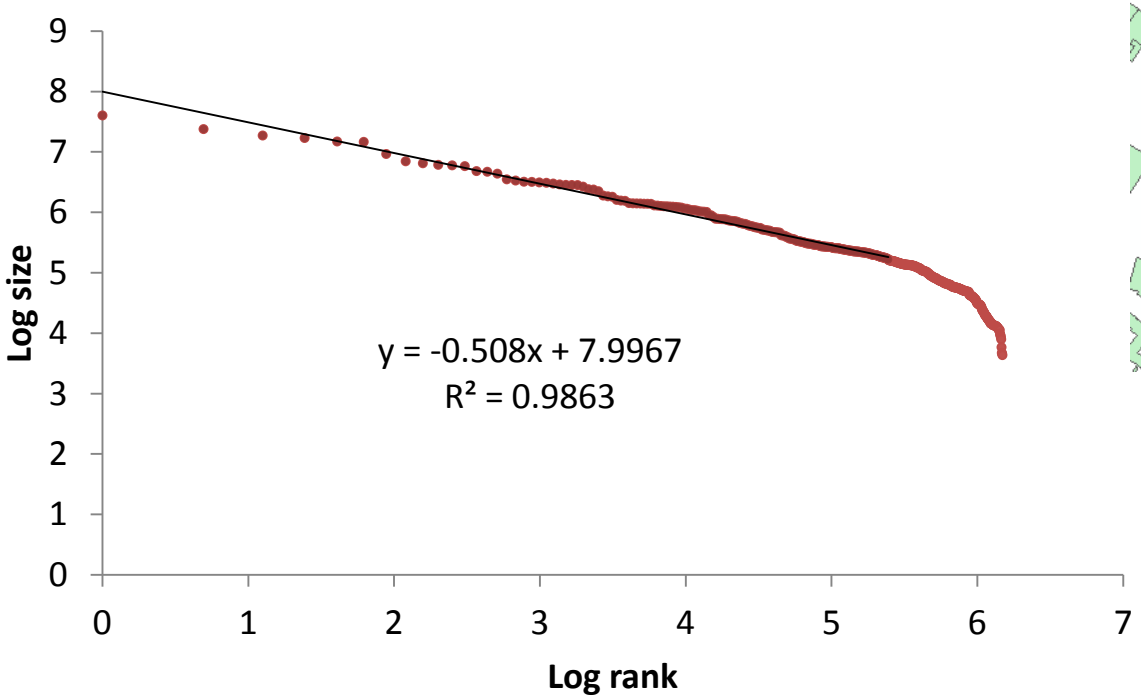


Large businesses

Highly adaptive platting follows a mathematical regularity characteristic of scale free complex systems: Frequency of sizes follows an inverse power law

Wall Street's plot area scaling coefficient is similar to Paris reflecting the European origin of this part of the city (New Amsterdam) and its longer evolution The largest plot is 2000 m2.

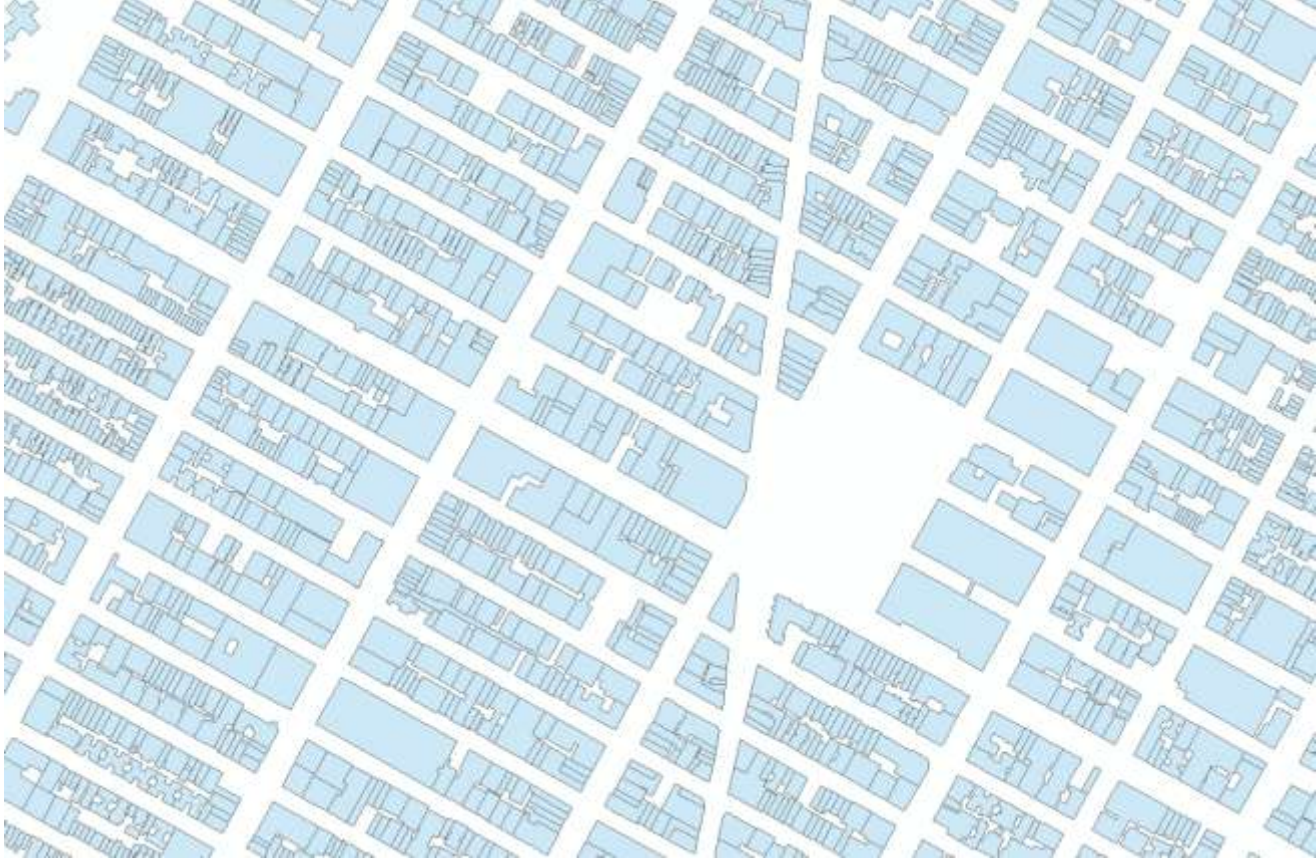
New York City
Wall Street

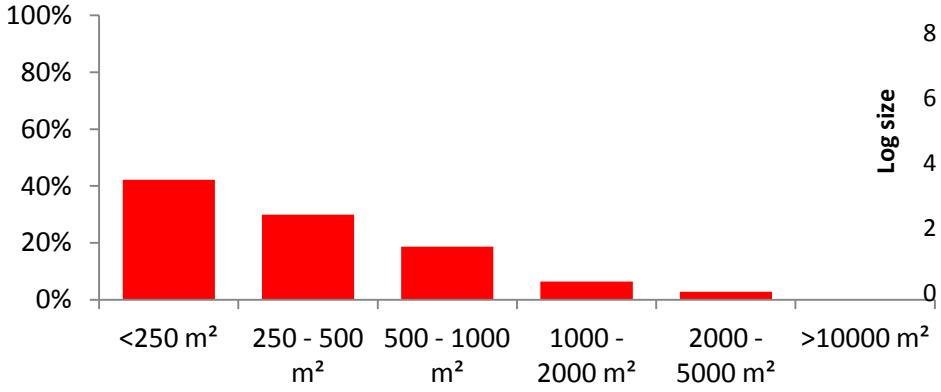


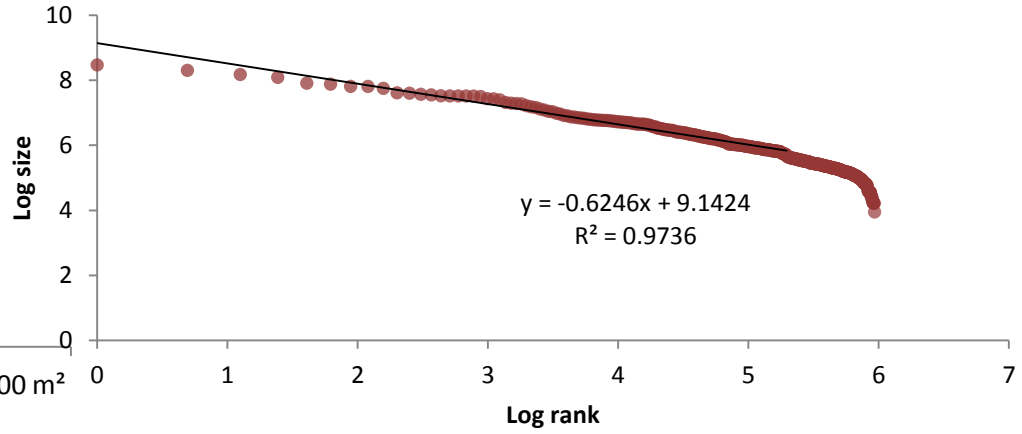
Source: Urban Morphology Institute

Manhattan
Madison square area

Mixed-use area

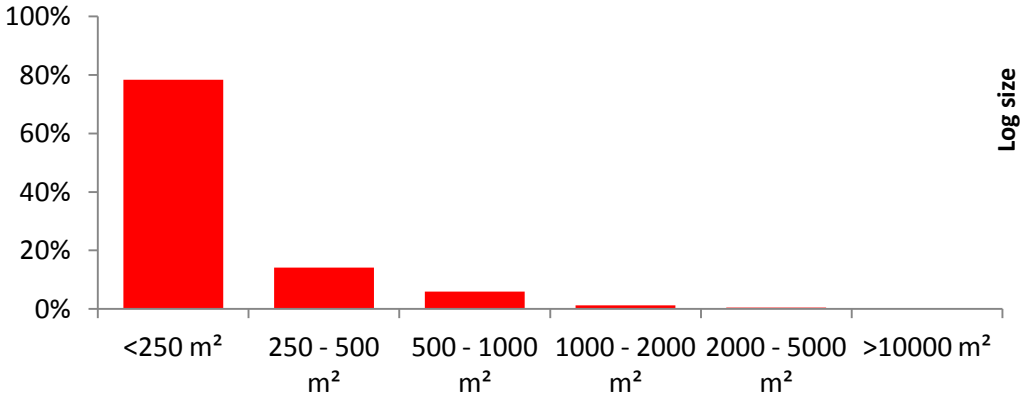


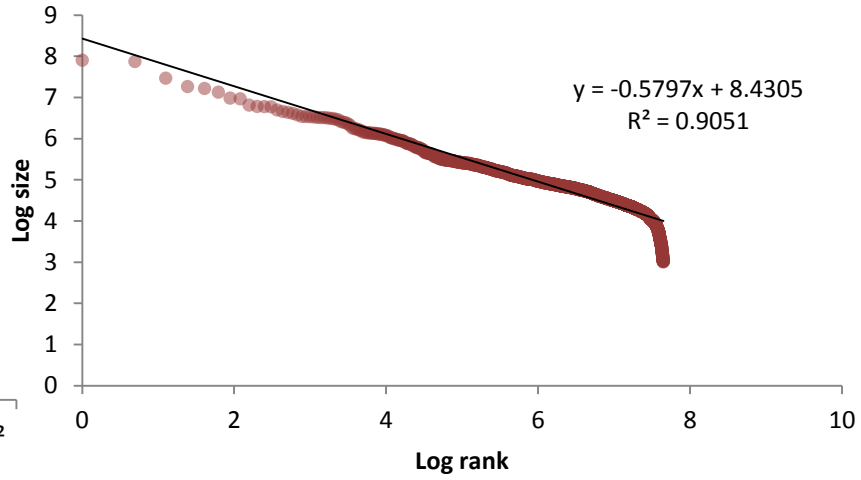




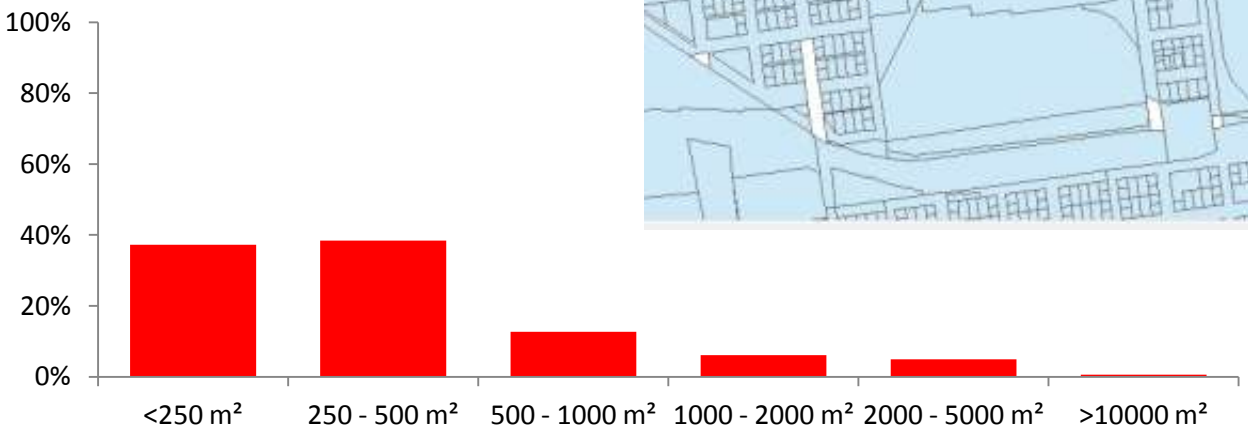
New York City
Brooklyn

Residential area

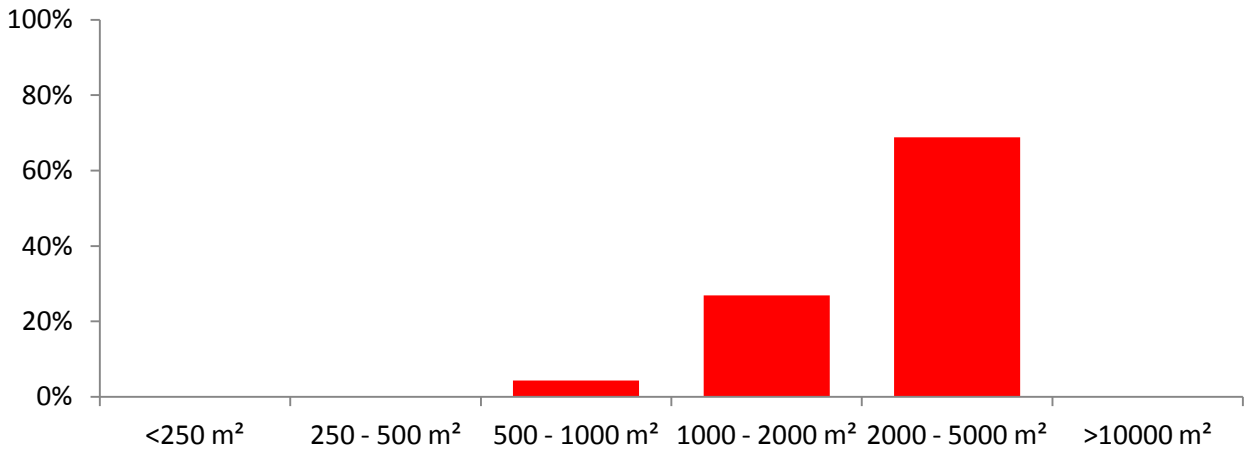


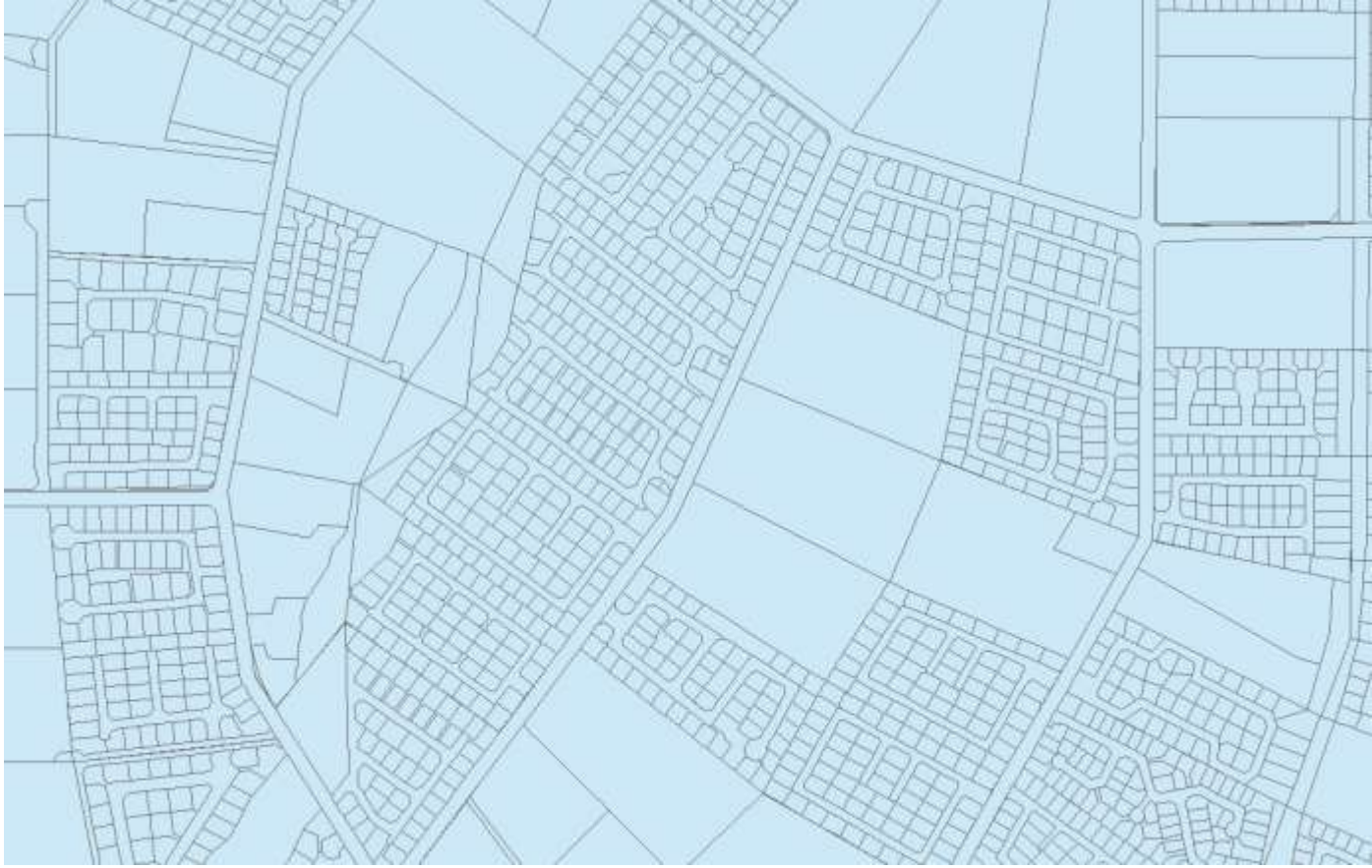


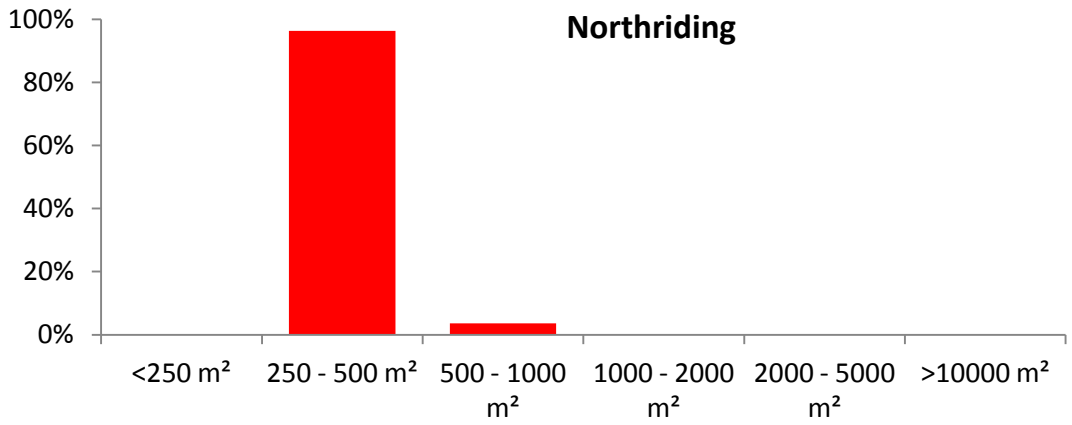
Hillbrow


100%
80%
60%
40%
20%
0%
<250 m²
250 - 500 m²
500 - 1000 m²
1000 - 2000 m²
2000 - 5000 m²
>10000 m²

Houghton Estate






Northriding
100%
80%
60%
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2000 - 5000 m²
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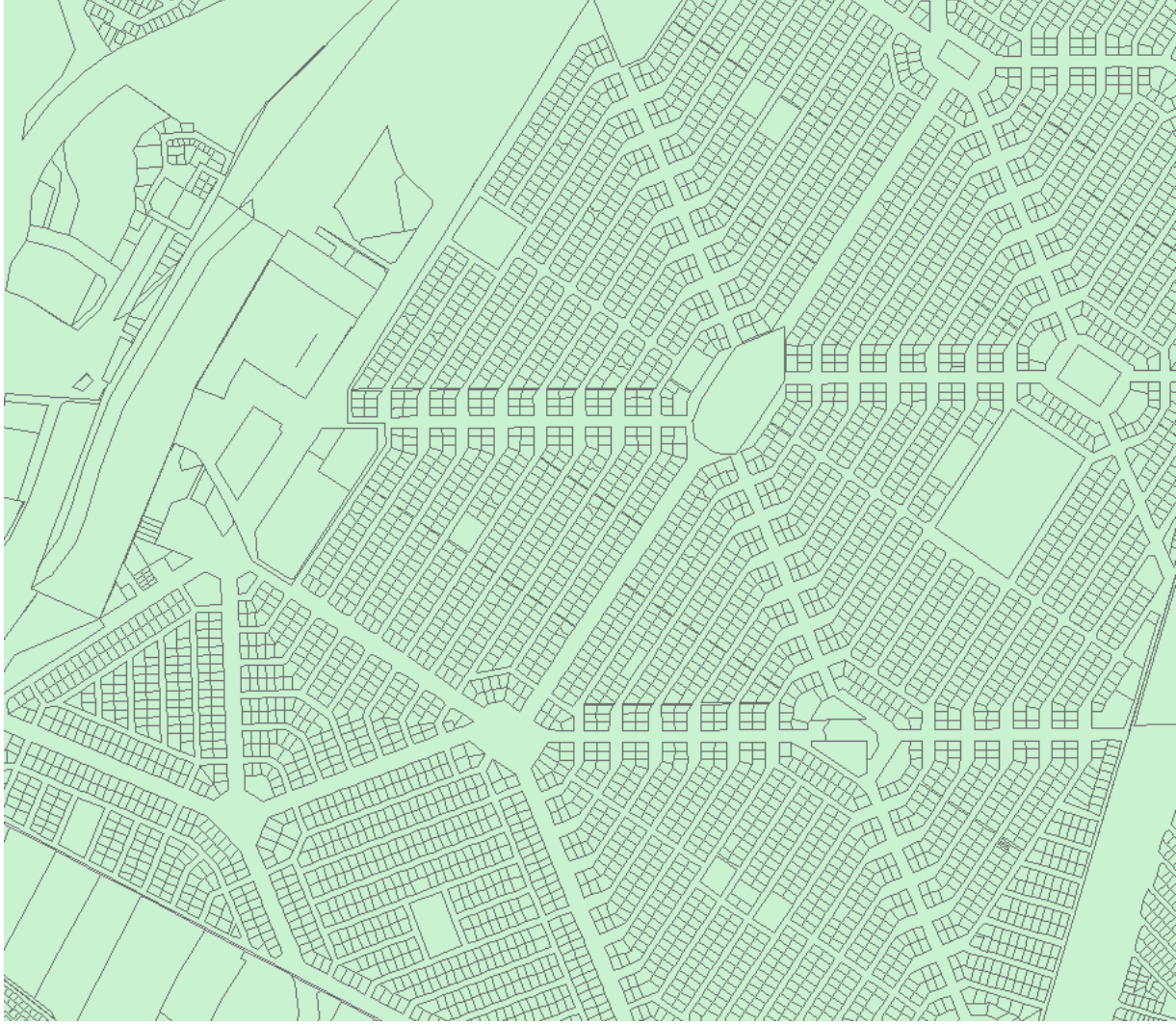

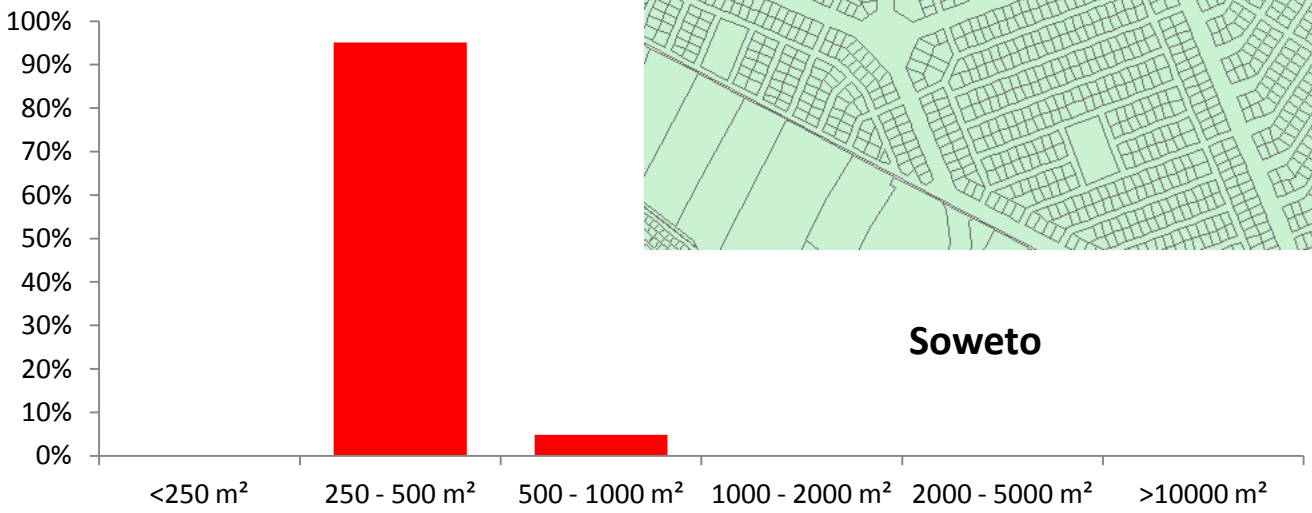
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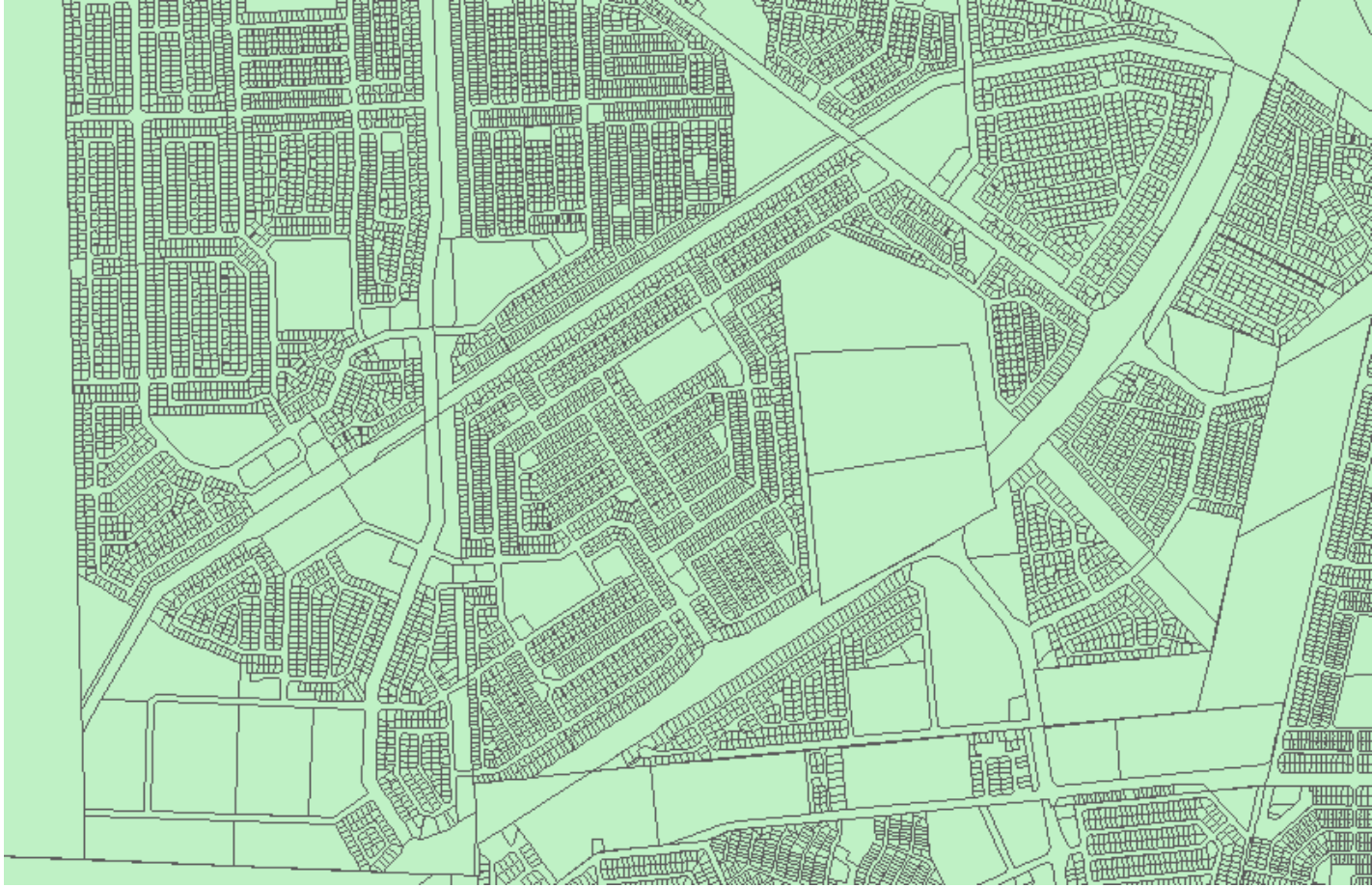
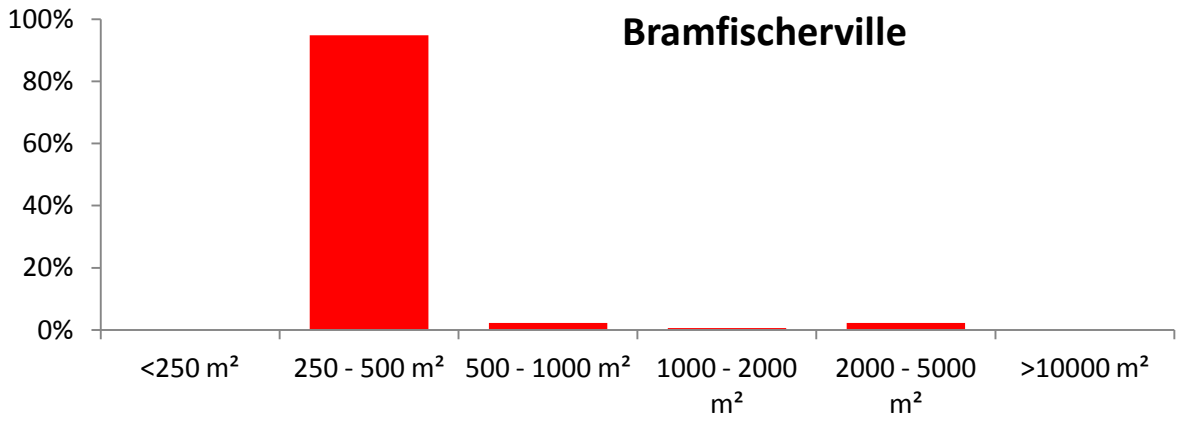
2000 - 5000 m²
>10000 m²

Soweto




Bramfischerville
100%
80%
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<250 m²
250 - 500 m²
500 - 1000 m²
1000 - 2000 m²
2000 - 5000 m²
>10000 m²

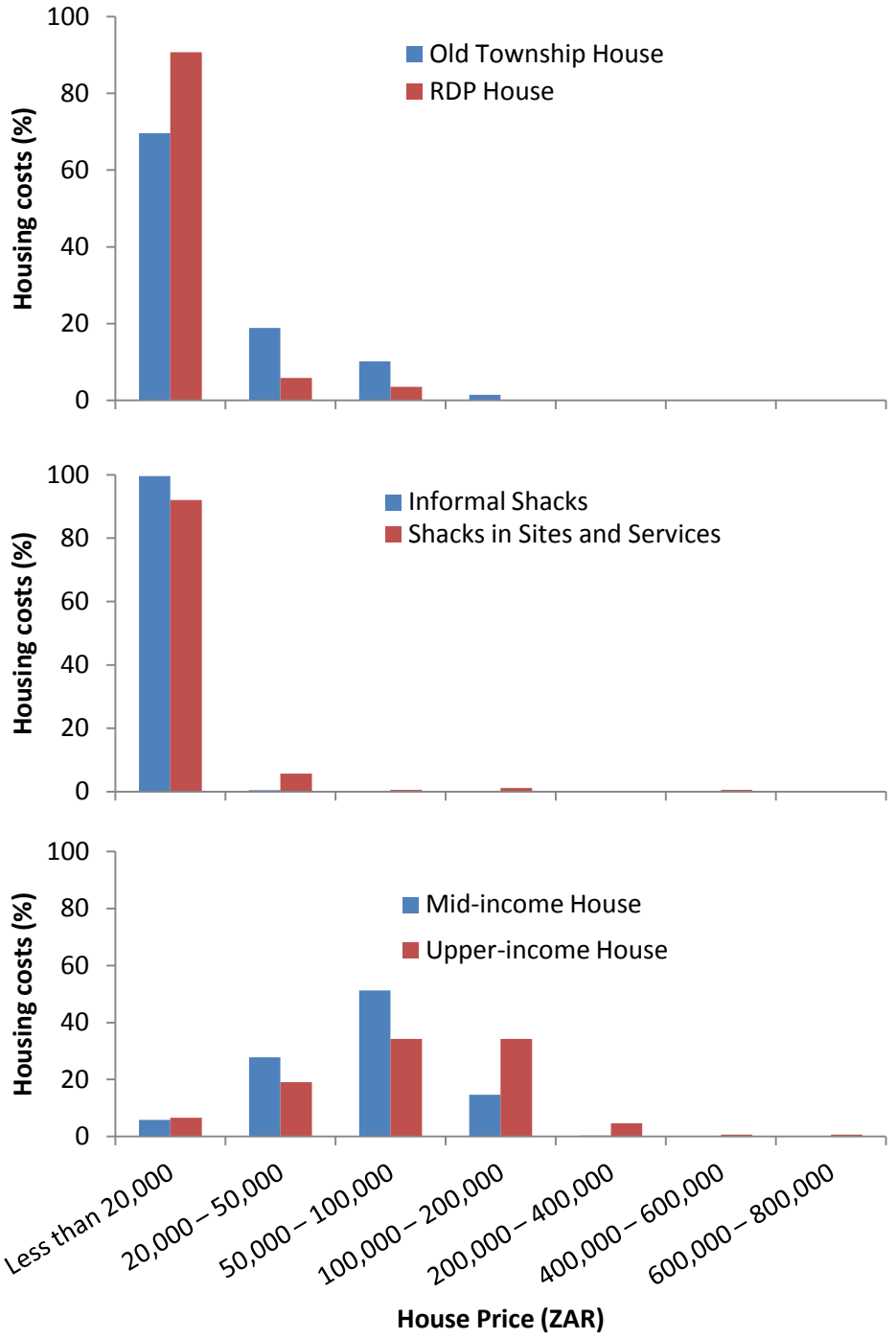
8. Housing prices reveal unsustainability and inefficiencies in land markets

Housing prices reveal unsustainability and inefficiencies in land markets

Almost all informal shacks and over 90% of dwellings in sites and services schemes are valued at under R 20,000. What is surprising here is that over 90% of RDP houses (the public sector formal subsidized houses) are also valued at under R 20,000.

In other words, they are worth less than what it cost to build them.

This is probably the clearest indication of the poor choice of location for these settlements.



9. Road Classification and Access Management has created high levels of congestion

From grids to suburban trees

- The evolution of South African urban forms from the grid to the suburban tree is not an emergent process.
- It results directly from traffic engineering and has been entirely prescribed:
  - Road classification
  - Access management

“The street is a machine for circulation”
Le Corbusier

The paradigm switch of modernism gave the street a purely functional role. In traditional urban planning, such as in European cities, streets used to be at the crossing of all urban activities such as living, working, businesses and human interactions. Streets were places for people. With modernist urban planning, streets became roads. They became the result of only the optimization of transportation flows.

Highly constrained network urbanism in Randhart

« It is not possible for a road to efficiently perform more than one function at a time.
It must therefore function either as a mobility road, or as an activity / access street”

“Without Road Classification and Access Management,
your citizens are doomed
to continue with unsafe roads, streets congestion and frustration”

“If you are not convinced,
there’s no hope for your city, town or country”

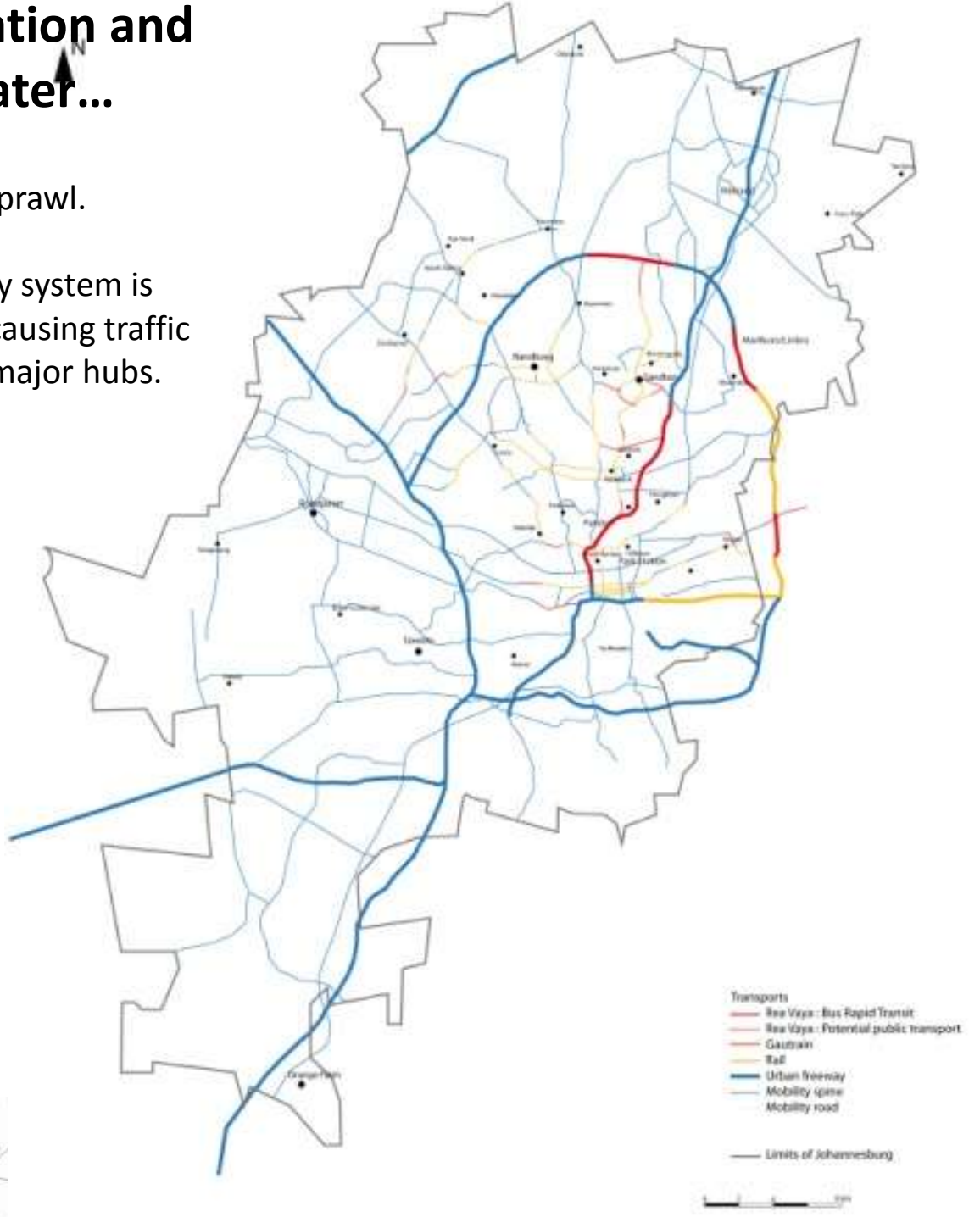
Dr John Sampson
South African Road Federation

Function			Description		Mobility				Traffic	
Basic Function	**alternate functional descriptions**	**determining function**	**Class number**	**Class name**	**through traffic components**	**Distance between parallel roads (km)**	**% of built km**	**Reach of Connectivity**	**expected range of average daily traffic**	**% of travel vehicle-km**
Mobility	vehicle priority, vehicle only, long distance, through, high order, high speed, numbered, commercial, economic, strategic; route, arterial road or highway.	movement is dominant, through traffic is dominant, the majority of traffic does not originate or terminate in the immediate vicinity, the function of the road is to carry high volumes of traffic between urban districts	1	**Principal arterial (freeway)**	exclusively	7 - 10 km	3%	**> 10 km**	40 000 - 140 000	33%
			2	**Major arterial**	predominant	1,5 - 5,0km	3%	**5 - 20 km**	20 000 - 60 000	17%
			3	**Minor arterial**	major	0,8 - 1,5km	5%	**1 - 10 km**	10 000 - 40 000	24%
Access / Activity	access, mixed pedestrian and vehicle traffic, short distance, low order, low speed, community, street	access, turning and crossing movements are allowed, the majority of traffic has an origin or destination in the immediate area, the function of the road is to provide a safe environment for vehicles and pedestrians using access points	4a	**Collector, commercial**	discourage		7%	**< 2 km if continuous, <4 km if destination**	2 000 - 25 000	6%
			4b	**Collector, residential**	discourage		20%	**0,5 - 3 km max**	<10 000	13%
			5a	**Local street, commercial**	prevent		12%	**< 1 km**	<5 000	2%
			5b	**Local street, residential**	prevent		50%	**< 0,5; 1 km max**	<1 000	5%
			6a	**Walkway, pedestrian priority**	ban			**< 1 km**		
			6b	**Walkway, pedestrian only**	ban			**< 1 km**		

40 years of Road Classification and Access Management later…

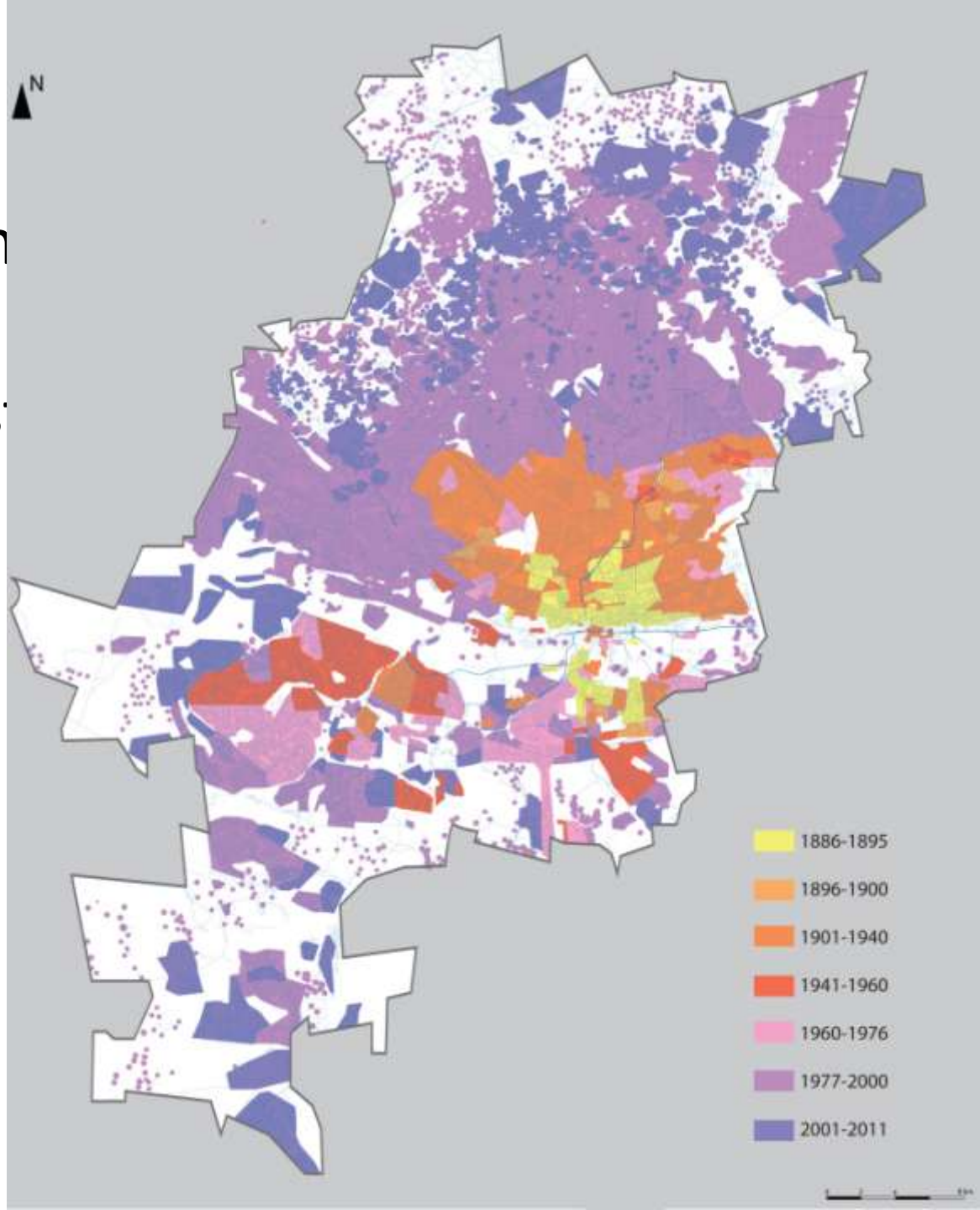
RACM has massively fed urban sprawl.

Because of urban sprawl, the highway system is reaching its limits with under-capacity causing traffic congestion, notably in the vicinity of major hubs.



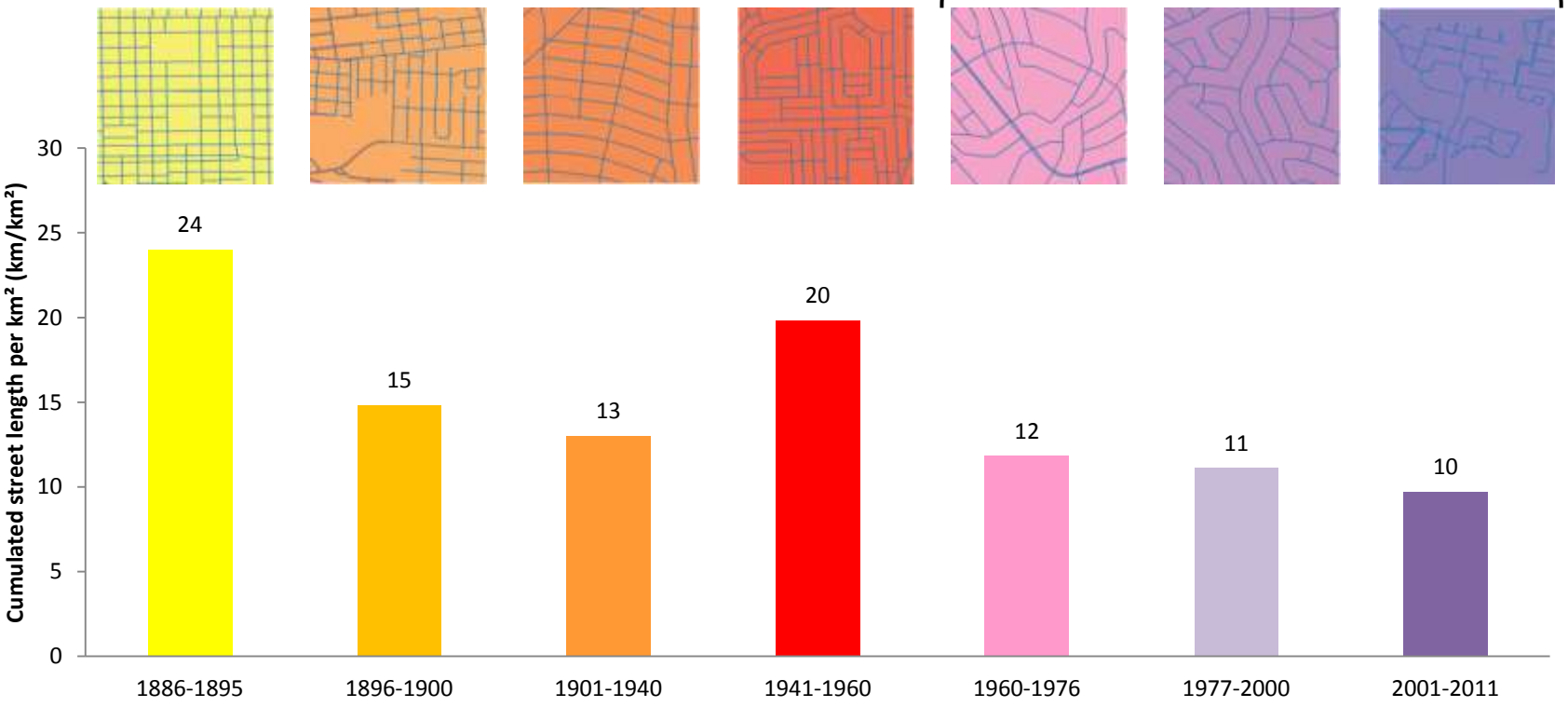
10. Street densities are low and street patterns are disconnected and clustered, which limits walkability

Most of the street patterns have been created recently following modernist principles



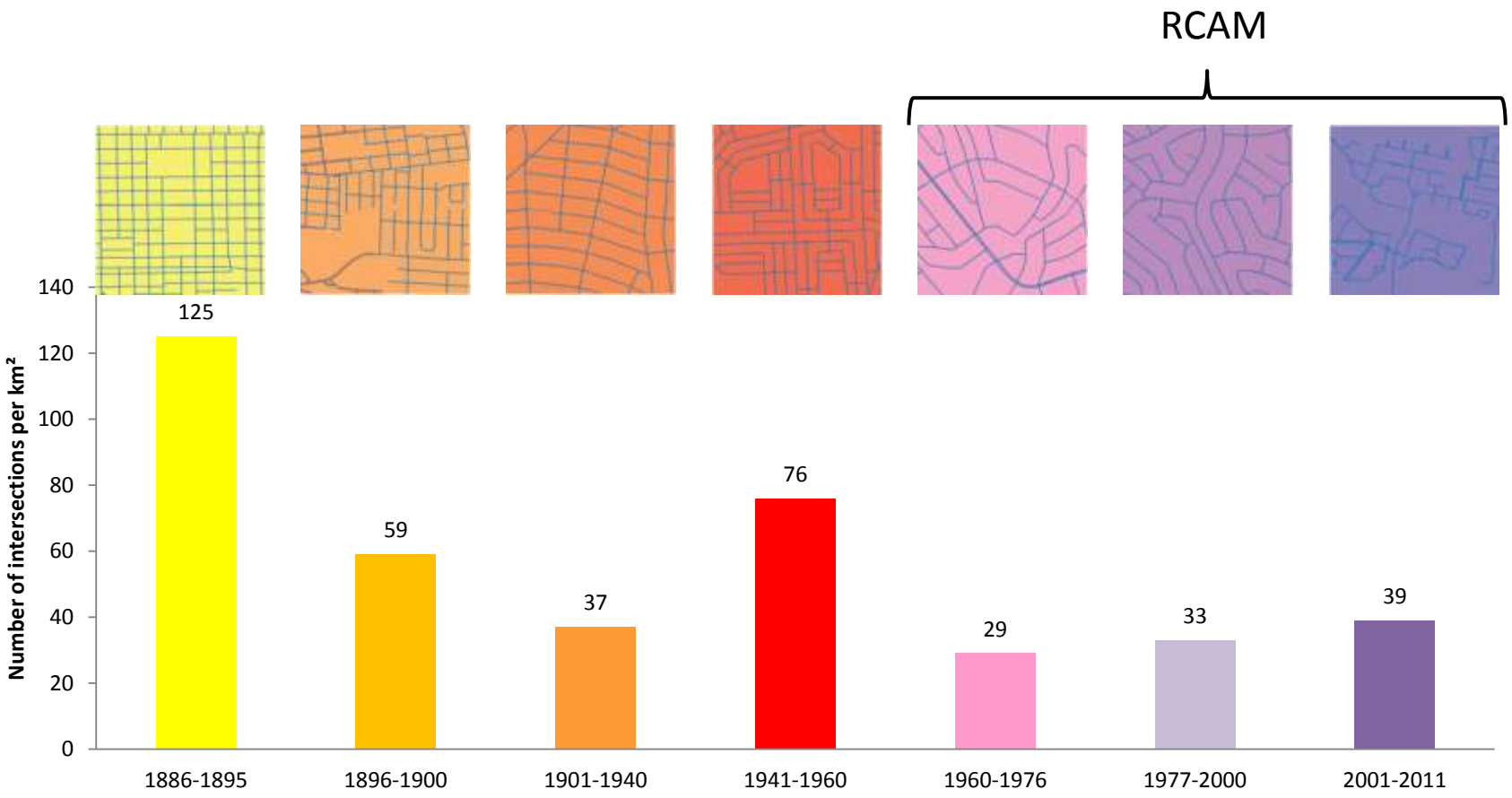
Street network typology in Joburg
Street length per km²

Road Classification and Access Management (RCAM)

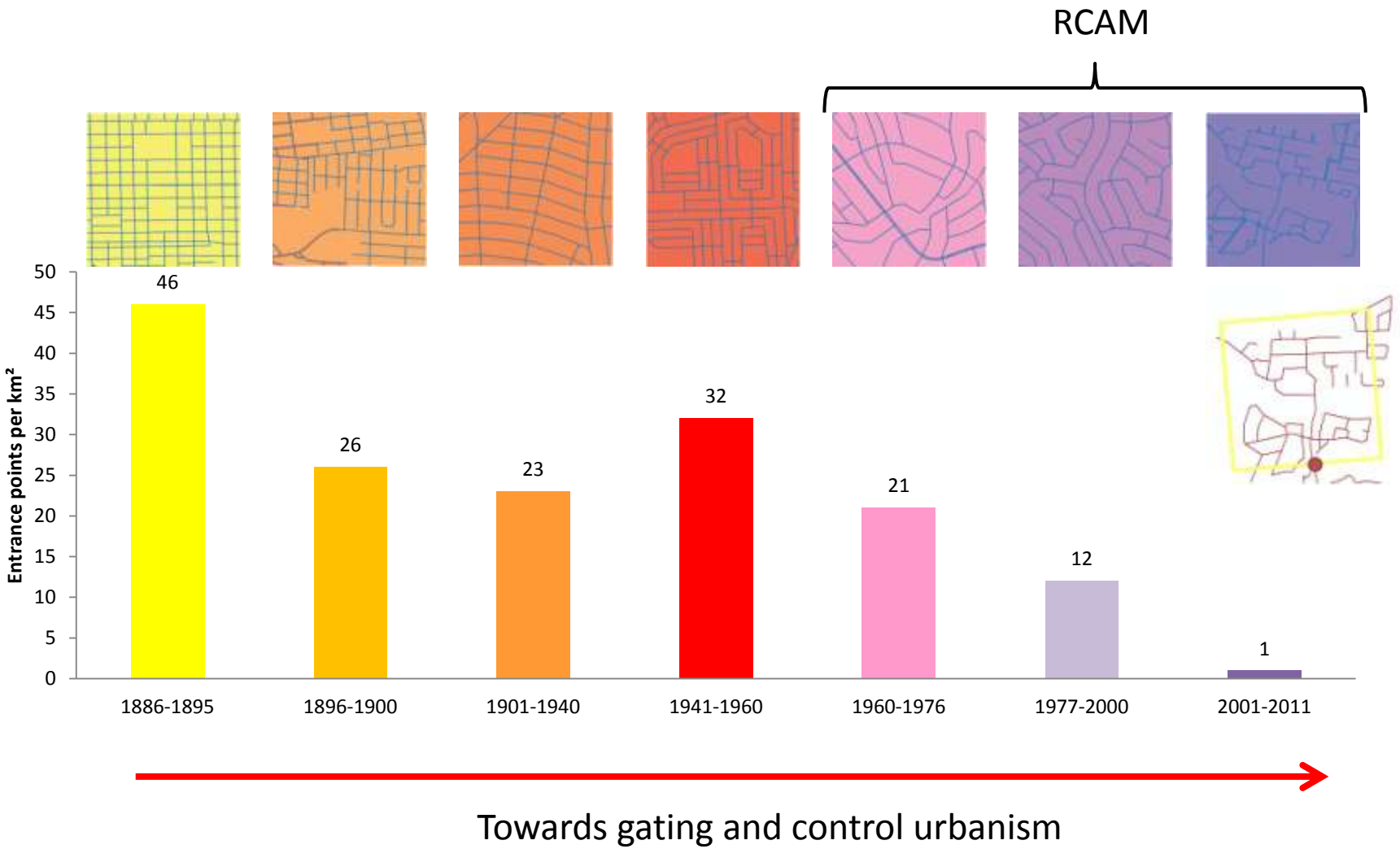


Street network typology in Joburg
Average distance between intersection

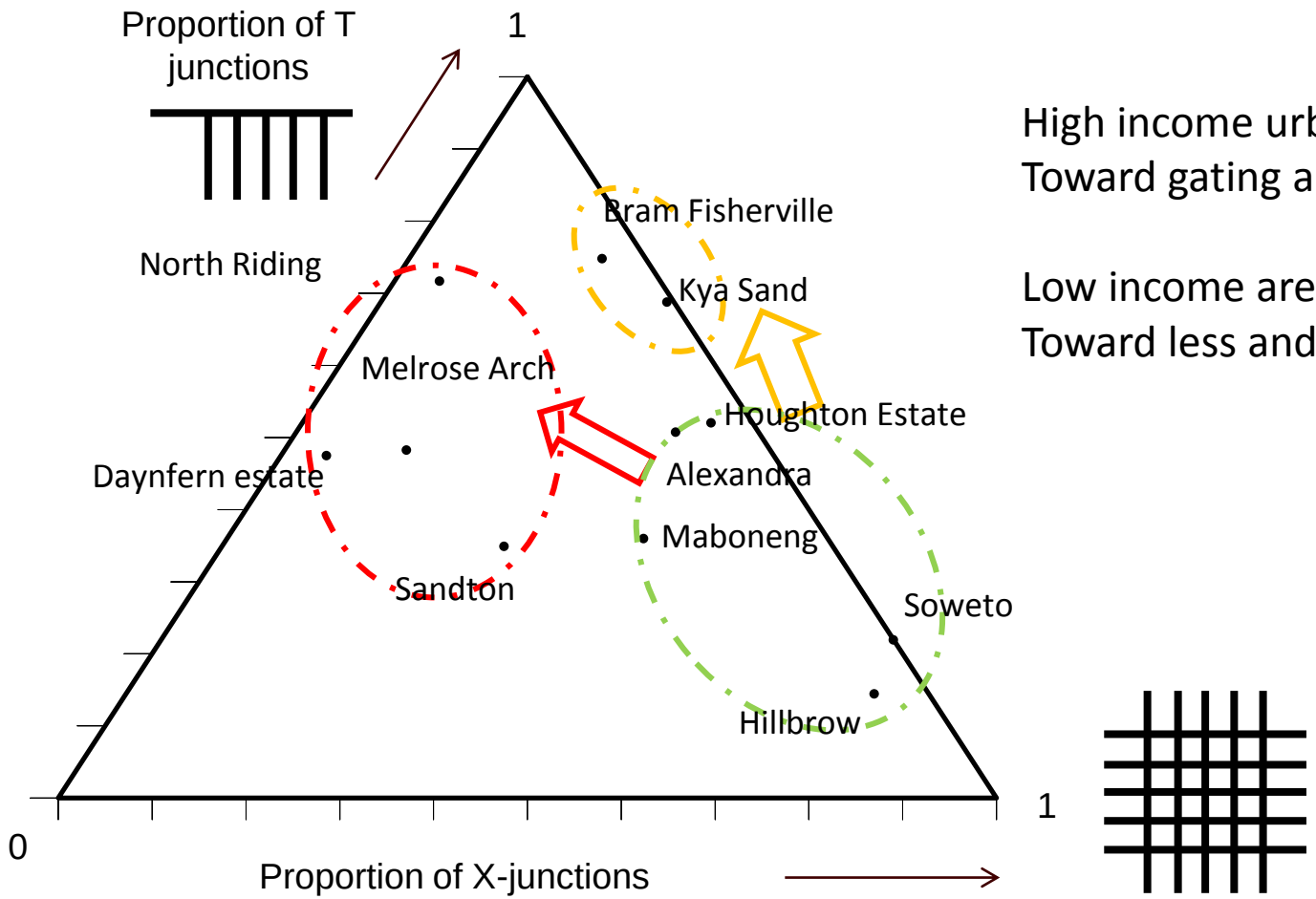
Street network typology in Joburg
Number of intersections per km²



Street network typology in Joburg
Entrance points per km²



Street networks have moved toward clustering, disconnection and control

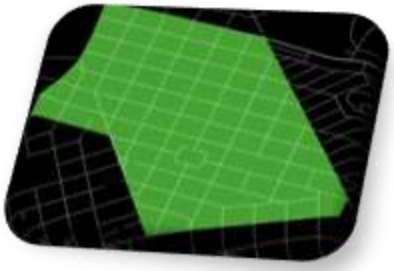


High income urban areas:
Toward gating and clustering

Low income areas:
Toward less and less connectivity

Increase in clustering and control in Tshwane

Silver Lakes



Brooklyn

Irene

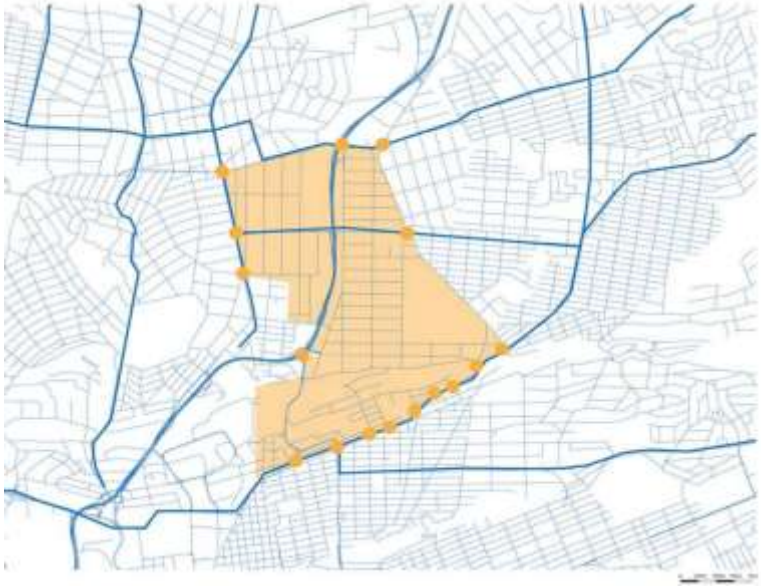
Maximum betweenness centrality

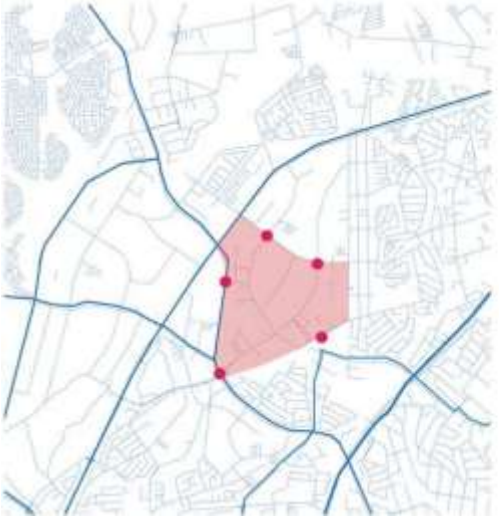
700
600
500
400
300
200
100
0

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5

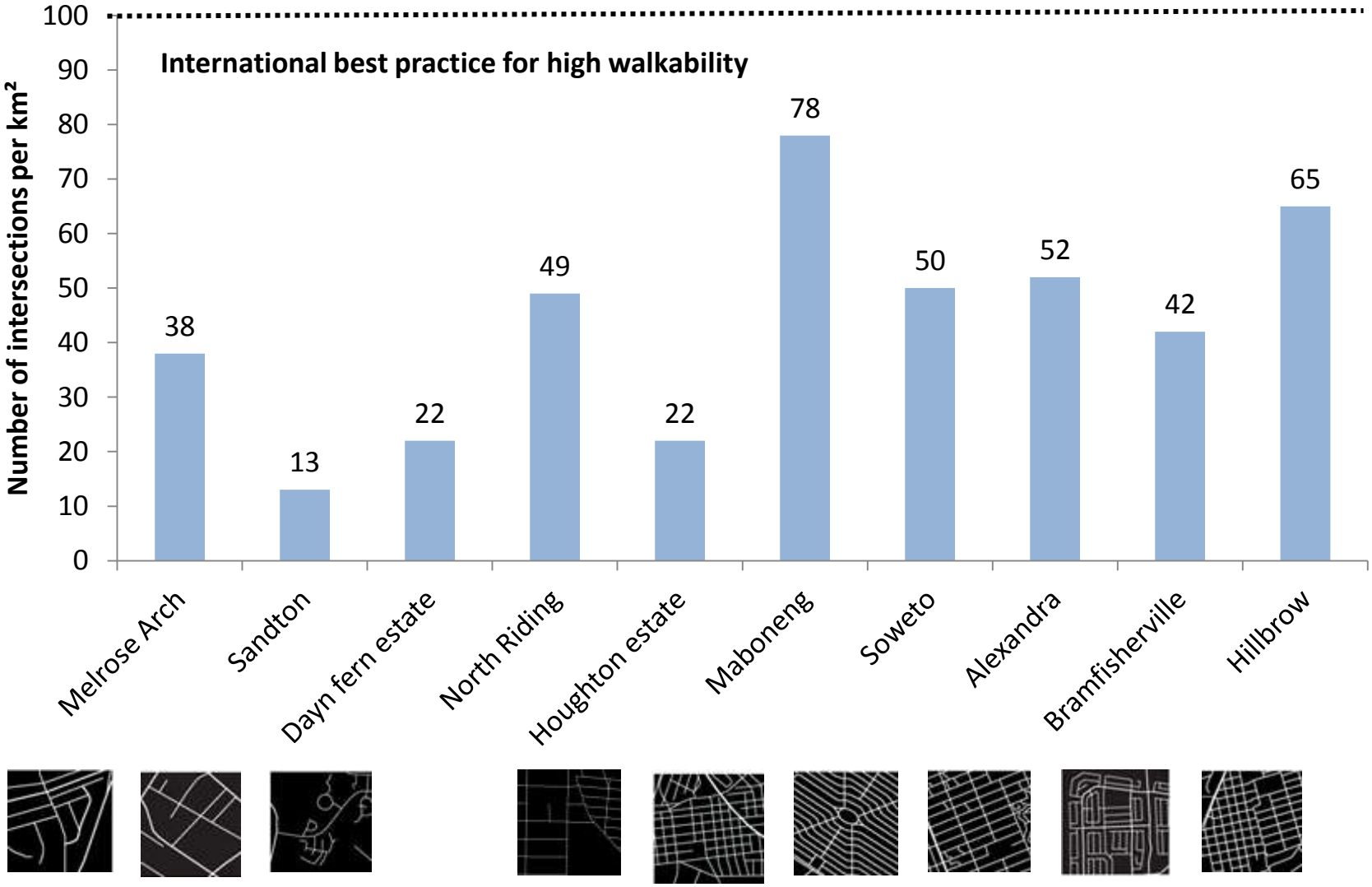
Relative clustering coefficient

The collapse in the number of entrance points makes congestion issues worse

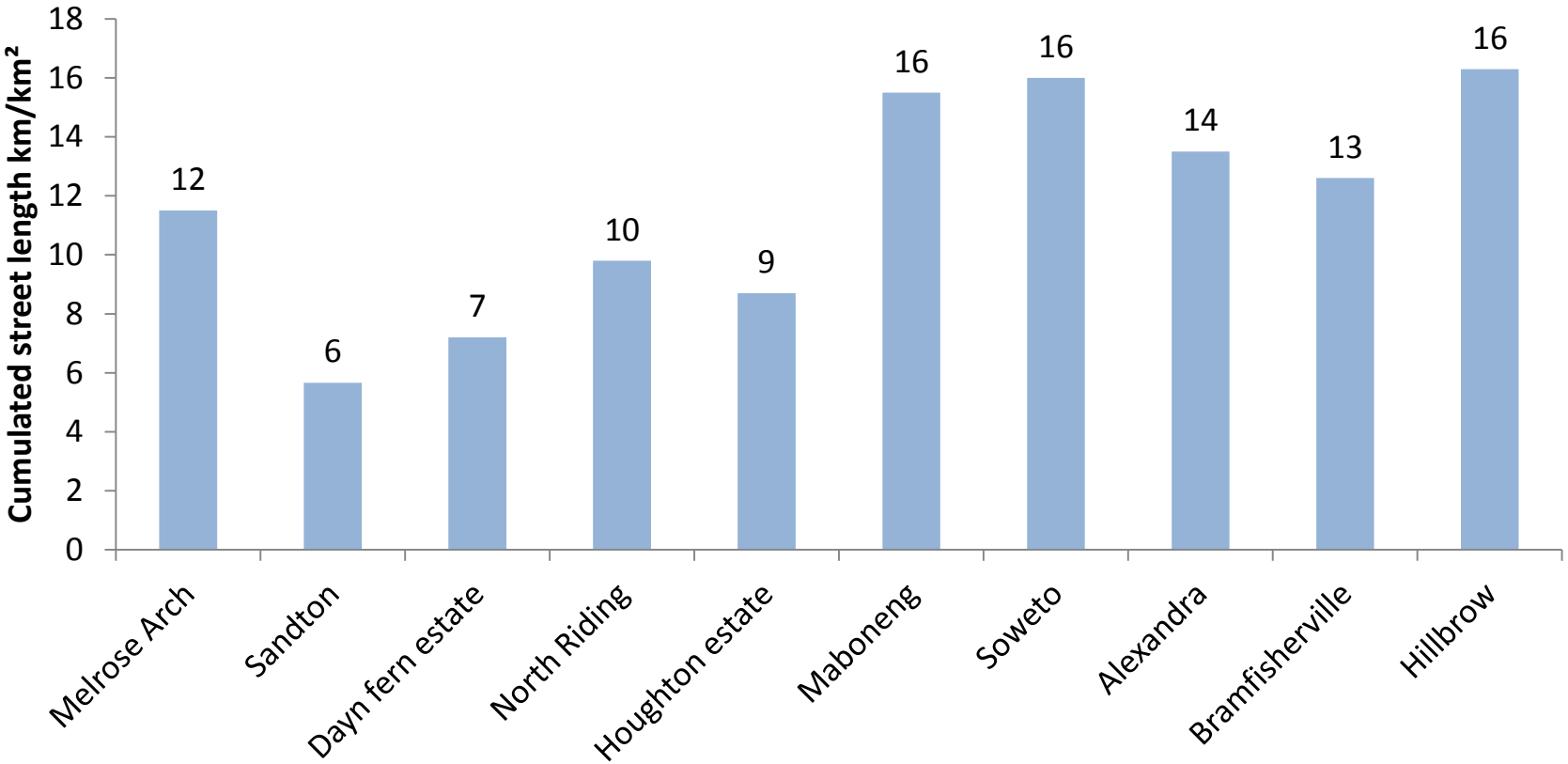


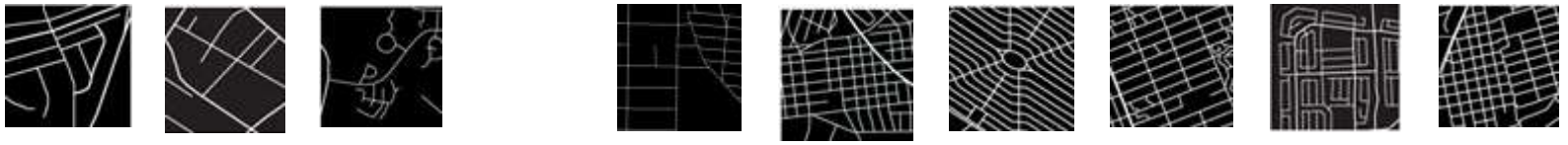


Number of intersections per km²

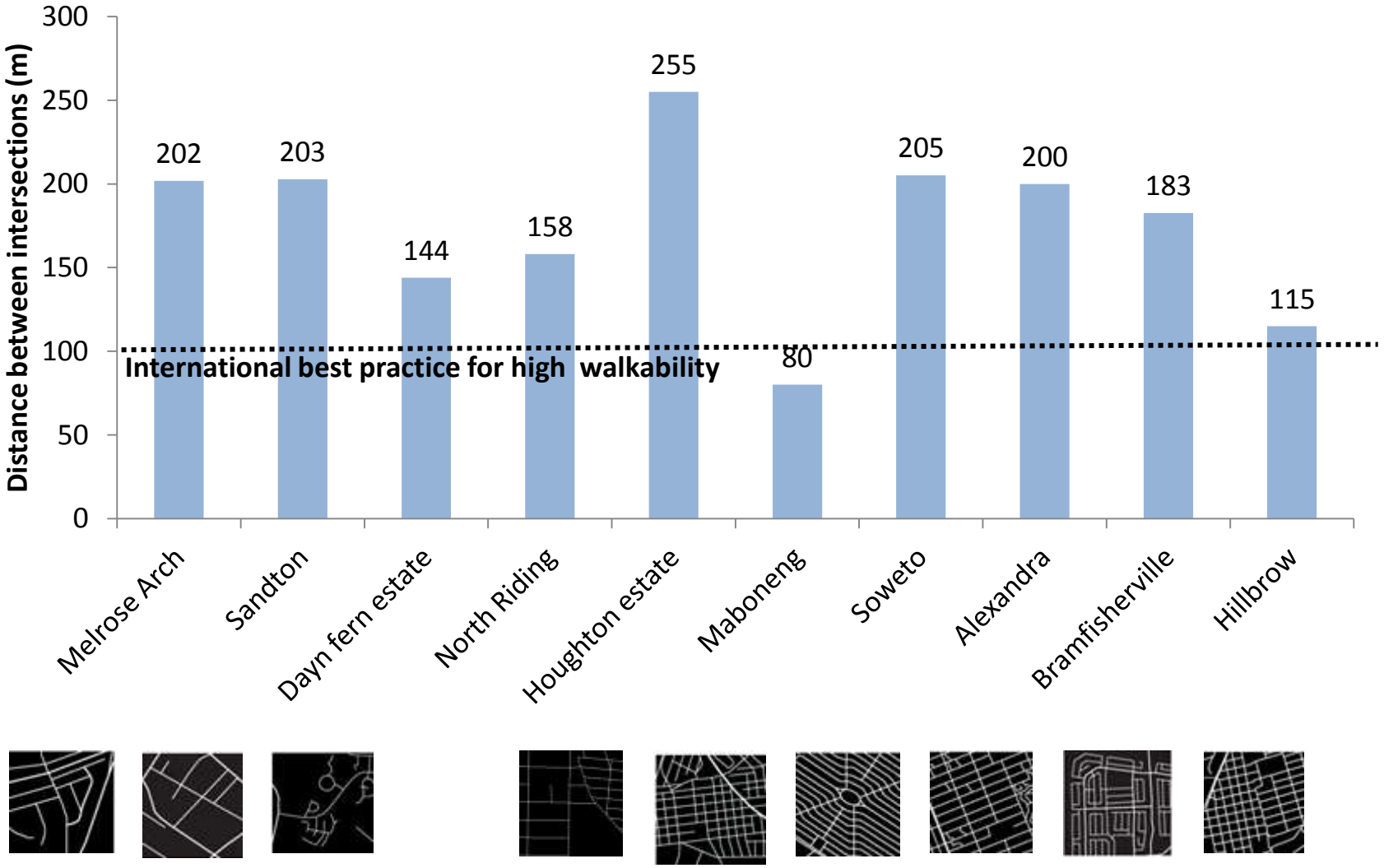


Cumulated street length per km²





Average distance between intersections



As a result of these constraints on urban forms

RECENT DENSIFICATION PATTERNS DO NOT MAKE URBAN FORMS MORE INCLUSIVE, RESILIENT AND EFFICIENT

4 patterns of densification in Joburg

Hillbrow

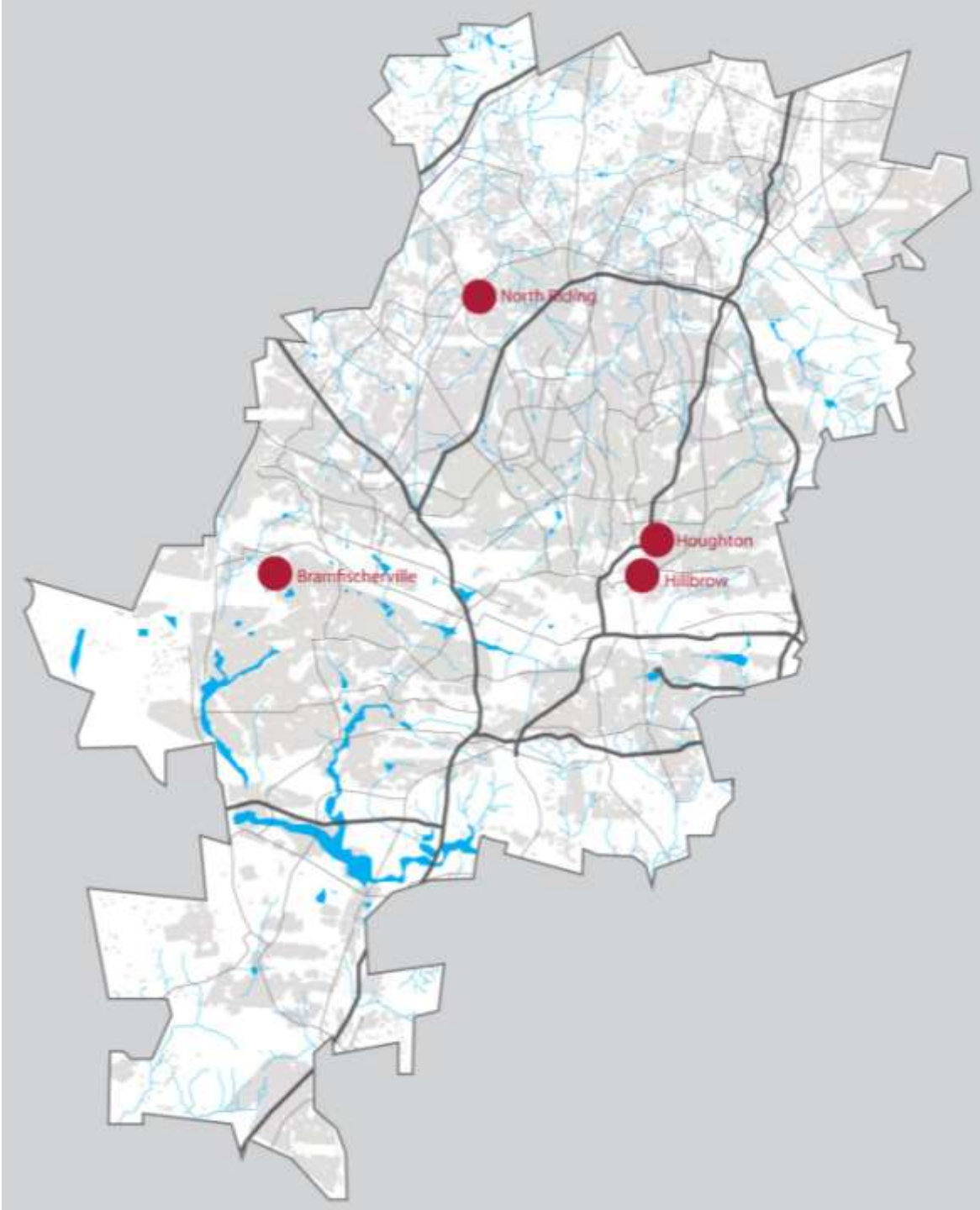
Bramfischerville

Northriding

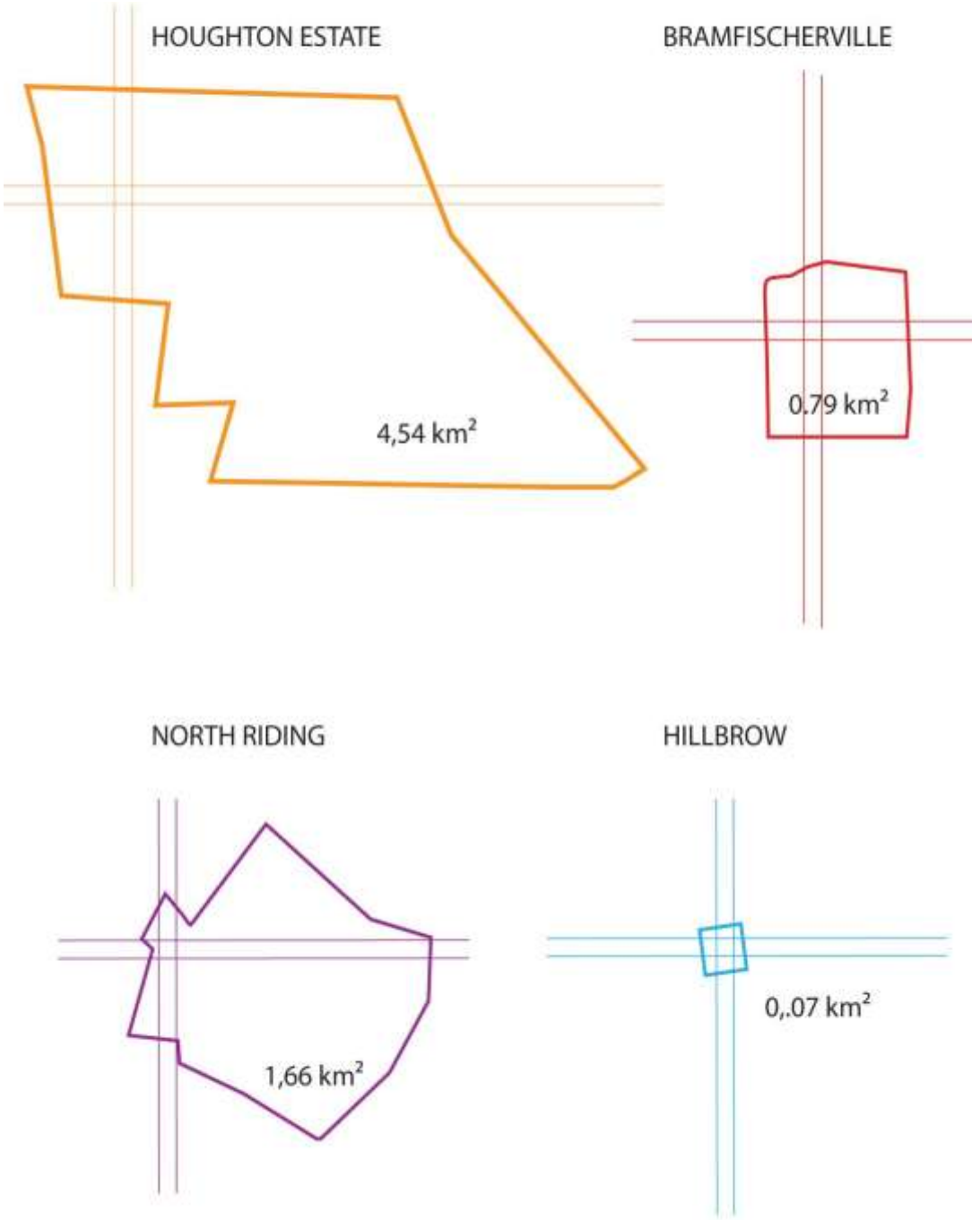
Houghton

4 districts with recent densification patterns

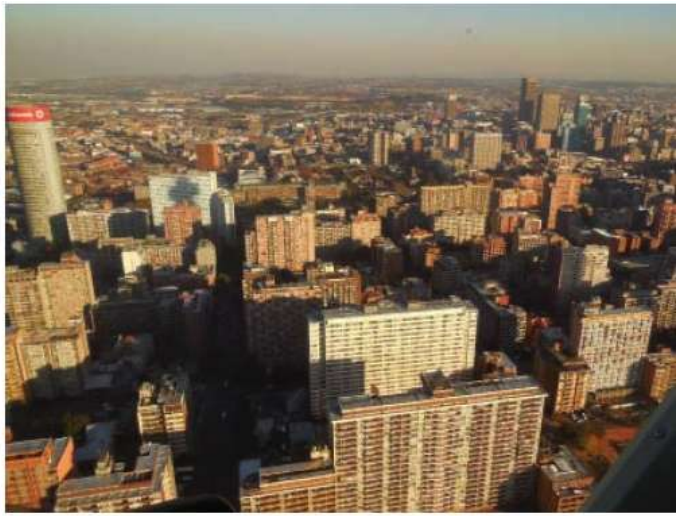
Hillbrow
Bramfischerville
Houghton Estate
Northriding



Equivalent urban areas for 5000 inhabitants

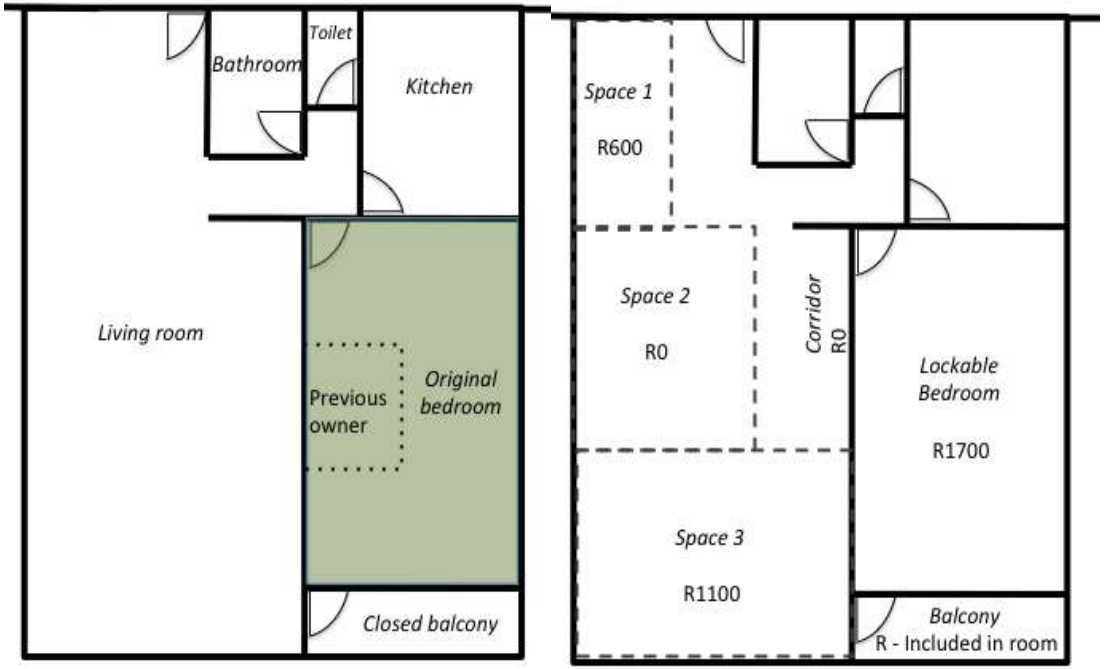


Hillbrow



Densification in the city center
Through over occupancy

The urban fabric remains the same, but the floor area per inhabitant drops

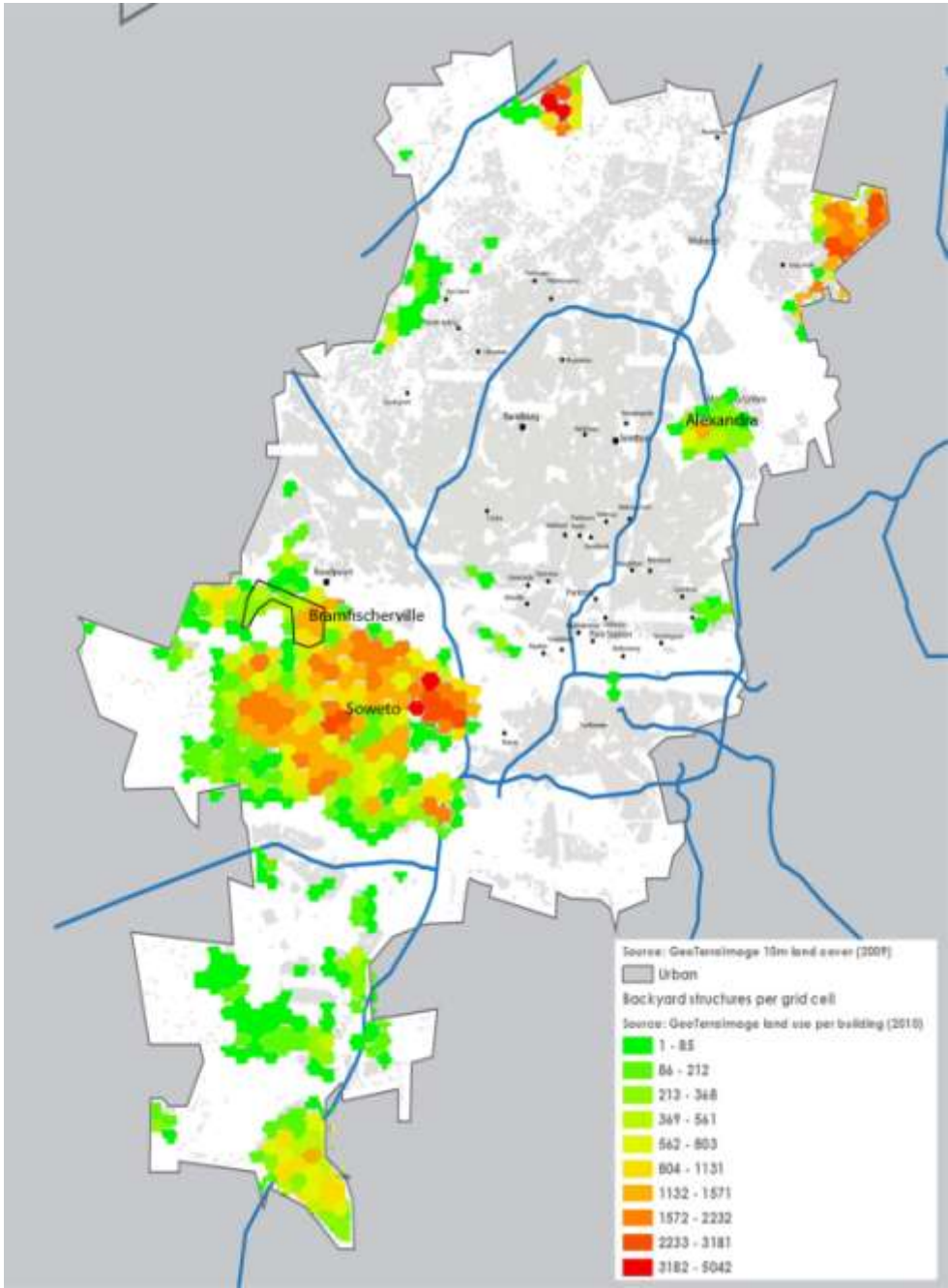


Bramfischerville




Bramfischerville Backyarding densification (shacks)

From an extremely low FAR (0.14) to a very low FAR (0.3)

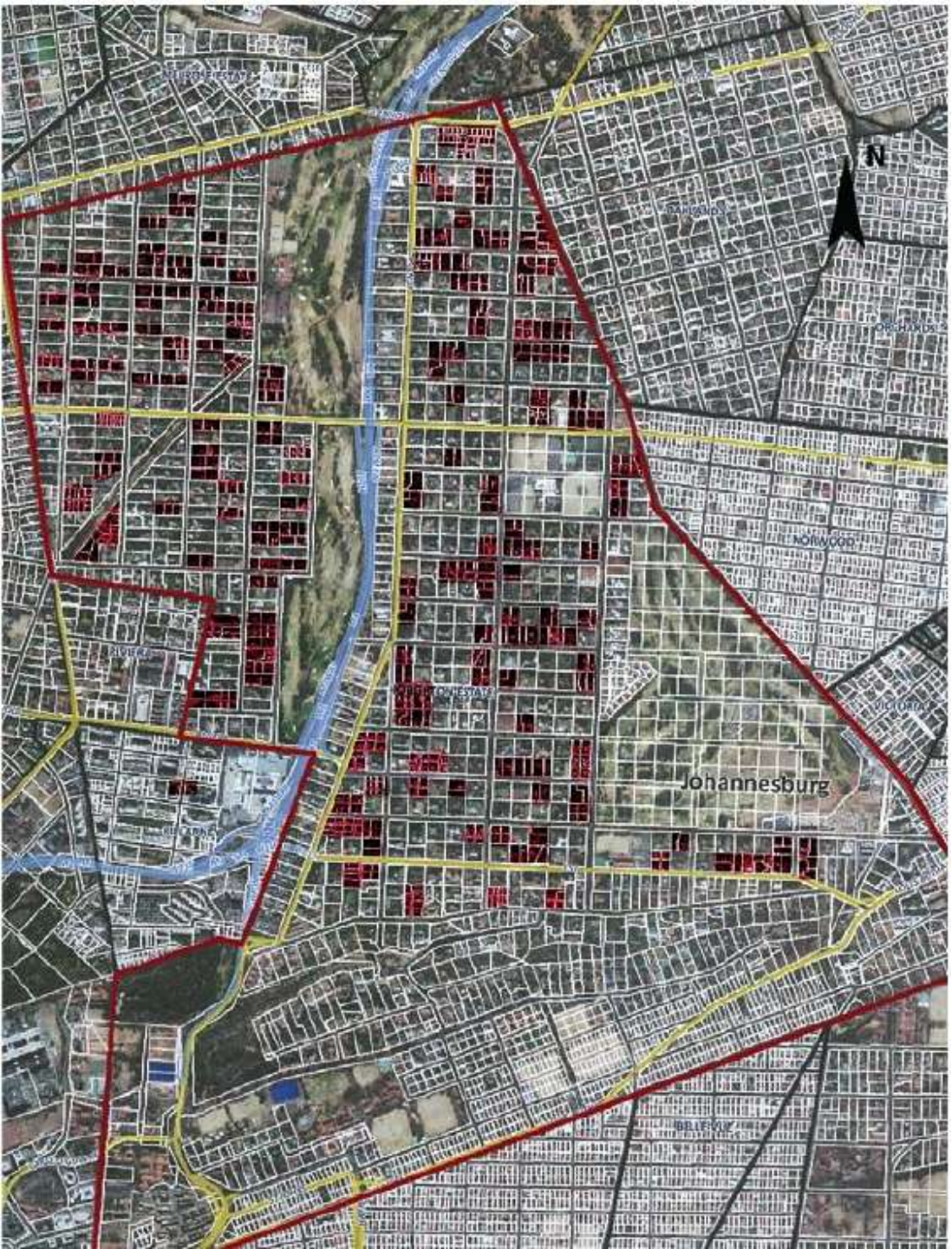


Houghton Estate




Densification in residential districts

Plot subdivision under market pressure



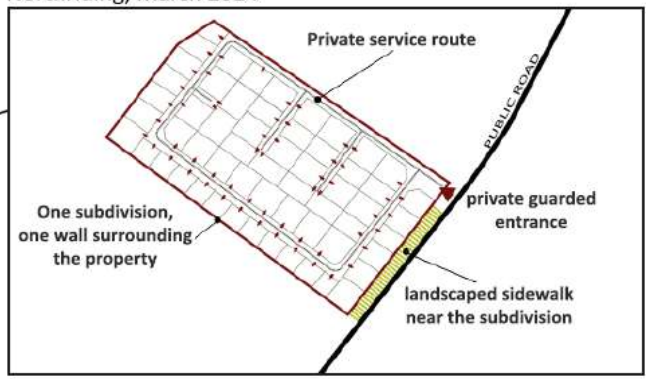
Densification through subdivision of plots in Houghton Estate

Northriding

Densification patterns in Northern residential areas
Densification within the gates

2007 : Fast urbanization

Example of a new development
Northriding, March 2014

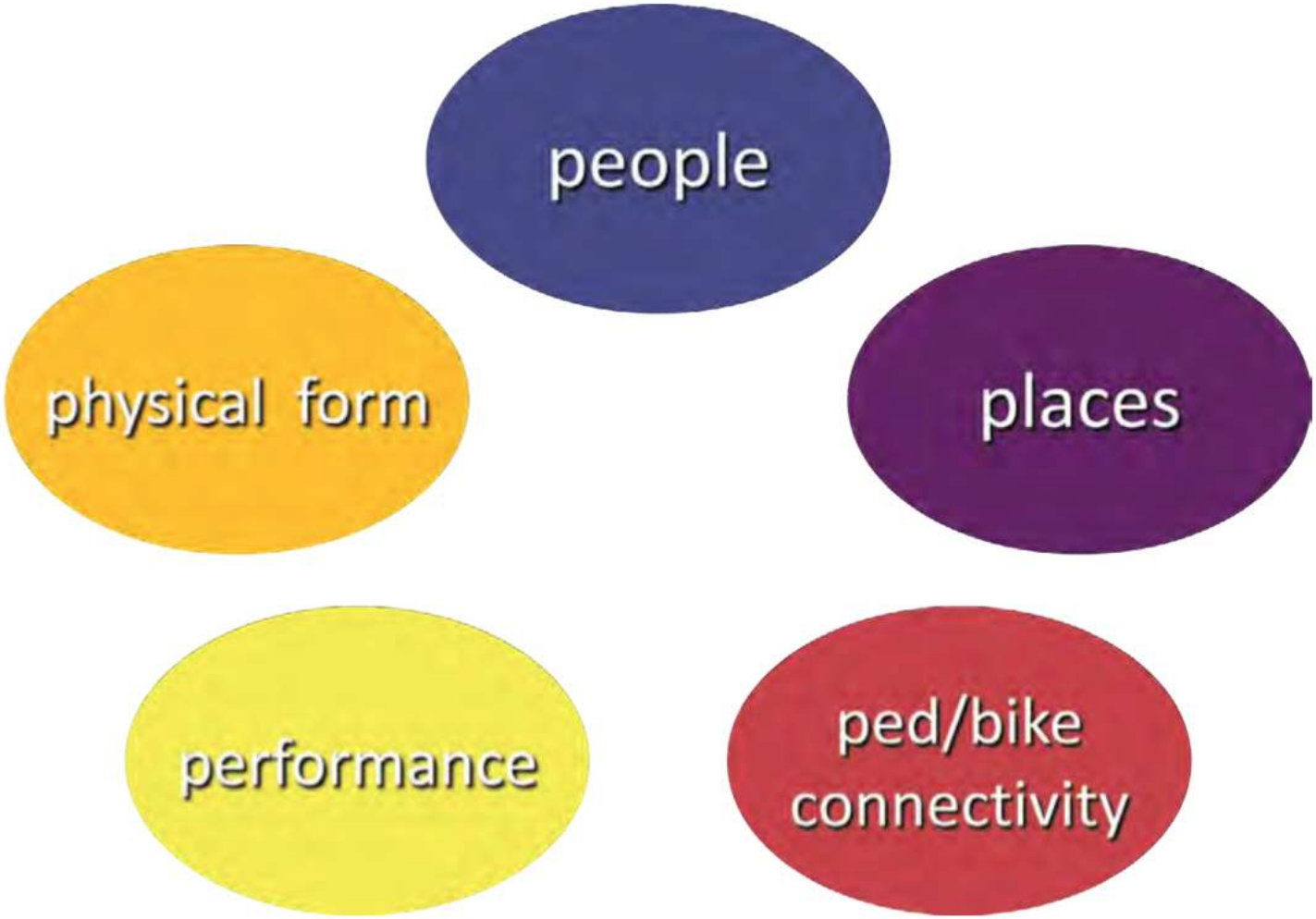


2013

First urban amenities: schools, shops and areas with economic activity

OPPORTUNITIES

The 5 "P's" of Transit Orientation



TOD compact urban forms are dense, accessible, mixed use and adaptive

Articulated density

- Residential density matches with job density
- Human density matches with transit infrastructure capacity
- High gross built density
- High density of amenities

Accessibility and proximity

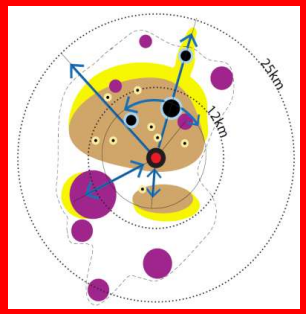
- Each part of the city is easily accessible
- Easy access to public transit infrastructures
- Seamlessly interconnected transit infrastructures
- Daily amenities accessible by foot (shops, health, education, culture, sport)
- Intense street network (high number of intersections per km^2)

Mixed use and adaptive

- Jobs, housing and retail are mixed on the city, district, community and building scale
- Land use is highly flexible

Opportunities of Corridors of Freedom

- Integrate local and regional planning
- Build transit systems that maximize development potential
- Strategize about ways to encourage the development of high performing communities around transit stations
- Generate new tools for economic development, real estate and investment issues
- Improve affordability and livability for all members of the community
- Respond to imperatives for climate change and sustainability






Thank you for your attention

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