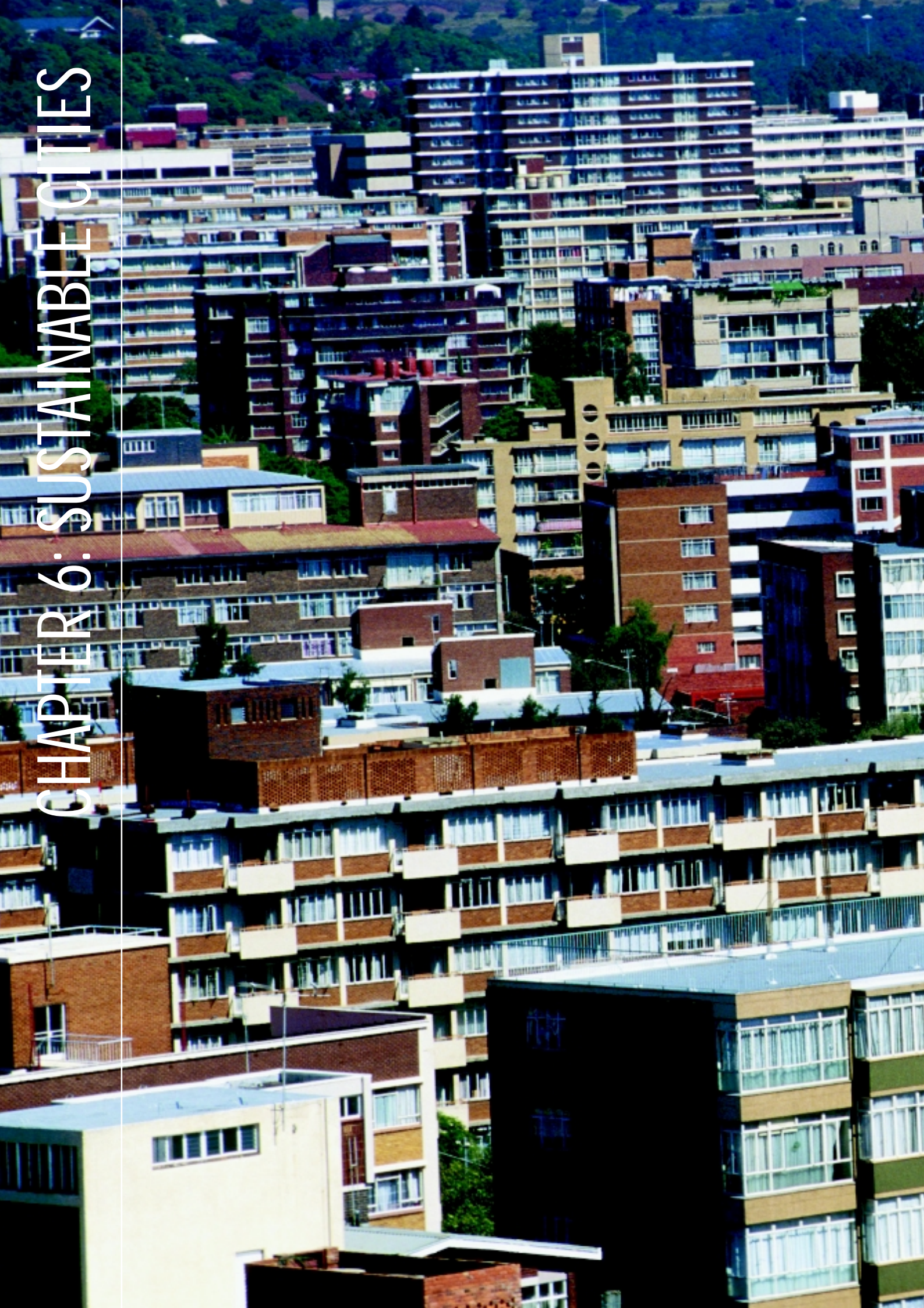


# CHAPTER 6: SUSTAINABLE CITIES





In some cities in the **developed** and developing world, urban built **environments** have not been able to adequately accommodate the sheer **size** of populations.

## CHAPTER 6. BUILT- AND NATURAL- ENVIRONMENT TRENDS AND THE STATE OF THE SUSTAINABLE CITY

### THE URBAN ENVIRONMENTAL CHALLENGE

In some cities in the developed and developing world, urban built environments have not been able to adequately accommodate the sheer size of populations, the concentrations of business activity, or the way people choose or are forced to live. In these cities, population density, congestion from the movement of people and goods, the waste and pollution by-products from industry and household consumption, the unhealthy conditions in burgeoning slums, poorly serviced waste collection, sewerage removal, wastewater drainage and clean energy all severely compromise the quality of the urban environment.

Large, densely populated and sprawling cities with increasingly poor urban environments have raised two critical issues.

First, how does the movement of more and more people into cities across the world, often with the explicit intention of seeking the development benefits of urban lives, impact on the environment of the planet? In recent years, in virtually every corner of the globe, climates have changed dramatically. It has become ever-more difficult to ignore the fact that human production and consumption patterns, driven primarily by the desire for urban middle-class livelihoods, are behind these changes. In the past, the 'threat of global warming' was the cry of a few 'green-activists'. Today, it is accepted wisdom that the world will almost certainly see wild unpredictable swings in temperature and weather patterns in the coming decades. This may have disastrous consequences in some places. Managing the broader ecological 'footprint' of life in all cities has become a global priority.

Second, how does the built environment of each city impact on the natural resource envelope that makes life in that city bearable? And, therefore, what is the limit of city size and form that a store of natural resources may safely carry? Put differently, is there an optimal city size and form for the continued liveability of a city? And is there a point on the growth curve of cities beyond which, given the limits of current urban environmental management technologies and techniques, they simply become unsustainable? This is a local rather than global ecological perspective on the urban environmental challenge.

Work has been done to model the point where the size and shape of a city raises urban living and business costs – so-called 'diseconomies of scale' – to the point where these exceed the benefits of collective habitation of people and co-location of industry. It has been recognised that cities can do a lot to extend the point at which costs might begin to exceed benefits. Cities can grow larger if they carefully manage the pressures that the built environment imposes on the natural environment. In contrast, those that do not manage their environmental impact, regardless of their absolute size, quickly reach the point where the store of naturally available resources is no longer sufficient to sustain acceptable urban life and dynamic economic activity. Residents begin to find that city life becomes progressively less tolerable, and businesses find that they are less and less efficient. Both then start to disinvest from the city.



#### What constitutes urban form

Urban form has a number of dimensions. It concerns the size, shape and density of cities, the characteristics of the transport and infrastructure networks, the configuration of land use patterns, the design of subdivisions, and the form and orientation of buildings.

Urban form may be considered at the macro level of a city and its region, at an intermediate level of a town or suburb, or at the micro level of a subdivision or group of buildings.

*(Dr Alan Perkins, 'How significant an influence is urban form on city energy consumption for housing and transport?' State of Australian Cities, National Conference, November 2003)*

Both these issues are important, but it is in the second area that local government can have a real impact.

When compared to large cities like Mexico City, Cairo, New York, Mumbai, Shanghai or Tokyo, the average South African city may seem a very long way from the point where diseconomies of scale may exceed the economic and social benefits of being in cities. But the sustainability of cities is an important long-term concern that must be tackled now. This is especially true because South African cities have some built environment features resulting from apartheid that have a relatively greater impact on naturally available resources than many similarly sized cities in other parts of the world. In addition, if some South African cities continue to grow at their current pace the issue of their sustainability may become critical sooner rather than later.

A number of key trends do stand out that raise concern for the continued sustainability of South Africa's cities. The first thing to understand is the nature of the built environment in many SACN cities. Both the urban form typical of the apartheid city, and the efforts in the post-apartheid period to correct for aspects of this urban form, are important. The second is how this particular built environment impacts negatively on the envelope of natural resources.

## KEY DEVELOPMENTS IN THE BUILT ENVIRONMENT AND URBAN FORM

Two things have shaped, and are shaping, the form of South African cities. The first is the enduring impact of apartheid spatial planning and its present-day consequences. The second is the intended and unintended results of post-apartheid settlement development meant to provide previously disadvantaged residents with access to formal shelter and household services.

### APARTHEID SPATIAL PLANNING AND ITS CONSEQUENCES

Some of the effects of urban planning under apartheid have already been highlighted in Chapter 5. They are noted again here from the different perspective of their impact on sustainability.

Because of apartheid planning South African cities currently have the following built environment features that strain the envelope of natural resources:

#### Undersized, but sprawling cities

South African cities were designed with a specific population size in mind, and with a view to limiting growth. Although this does not apply equally to all cities, various African townships were designed with a fixed population size in mind, and, correspondingly, were located in parts of the city where they were naturally bounded by watercourses, major infrastructure lines, or buffer zones not suited for development. When they could no longer expand, these areas densified, with large numbers of informal structures built in the backyards of formally constructed houses. When densification reached its limit in these neighbourhoods, the only possible expansion point was outward. Large informal settlements springing up on poorly located land on the periphery of cities has been the inevitable result.

Apartheid cities have unusual spatial contradictions. On the one hand they are very spread out, with levels of density too low to sustain viable public

### Health and Pollution

Around the world, atmospheric pollution afflicts more than 1,1 billion people, mostly in cities. Another 2,5 billion are at risk from high levels of indoor air pollution. Indoor and outdoor air pollution together kill nearly 3 million people every year – about 6% of all deaths annually... As cities expand, urban air pollution worsens. In most big cities vehicle exhaust levels are so severe that pollution-related ailments cost huge amounts for medical care & in worker absenteeism. Both water scarcity and water pollution are serious urban problems. Dirty water is by far the largest environmental killer around the world, claiming some 5 to 12 million lives a year, depending on the definition of water-related disease. According to the WHO, the majority of urban populations in developing countries do not have access to proper sanitation facilities – a flush toilet, sanitary latrine, or a pit that can be covered over – and about half lack a regular supply of potable water.

### Environmental Impact of Cities

Cities have a huge impact on the natural environment. As cities grow ever larger, they consume more and more natural resources to meet the rising demand for food, water, energy, and goods and services, both from people and industry. Cities generate close to 80% of all carbon dioxide emissions and account for three-quarters of industrial wood use. Some 60% of all freshwater withdrawn for human use ends up in urban areas – either directly for use in factories and for drinking and sanitation, or indirectly through the consumption of irrigated crops. The economic and environmental reach of the city goes far beyond the city limits. Modern high-density settlements now appropriate the ecological output and life-support functions of distant regions through trade and commerce, the generation and disposal of wastes, and the alteration of nature's cycles. As cities continue to attract more people and produce and consume more, they become 'black holes' that soak up the ecological output of entire regions.

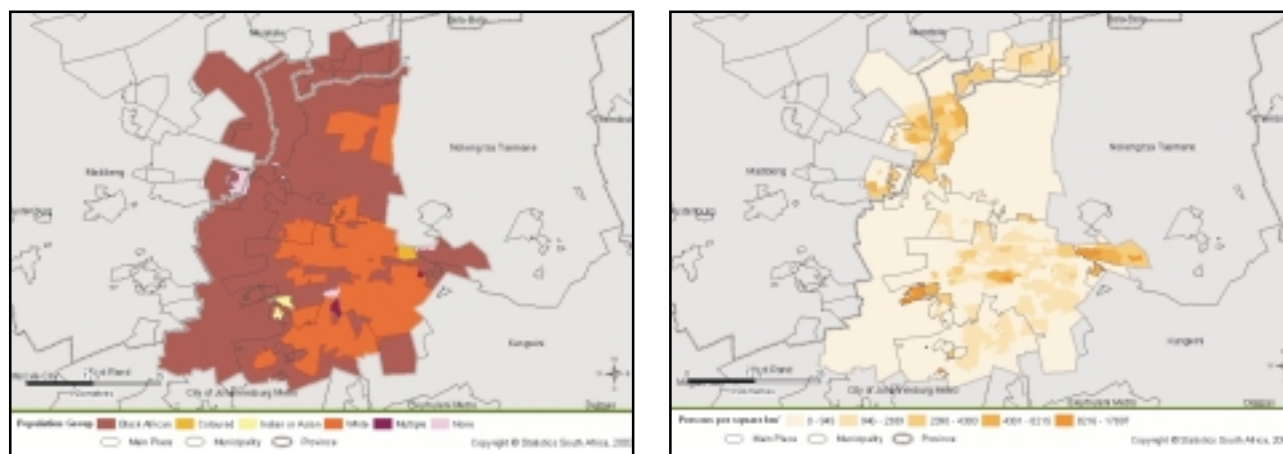


Figure 52. Density and population group concentration in Tswane.

transport systems. This encourages high levels of car use, which ironically then encourages further sprawl. Low-density suburbs are built on the principle of one family, one plot of land. This has been demonstrated to be extremely inefficient from the point of view of managing networked energy, water and sanitation systems.

On the other hand, apartheid cities are too dense in certain parts, which invariably results in less-healthy living conditions. These are usually the parts inhabited by poorer residents who have lived in the city for some time.

### Marginalising cities

South African cities have been designed to marginalise. The geographic separateness of the largest segment of the population is the classic feature of the apartheid city. Hundreds of thousands of people were forcibly relocated from where it made sense for them to live to a sprawl of dormitory townships on the edges of cities. Where urban settlements are located far from employment centres, long distances need to be travelled to reach the workplace. Public transport systems to adequately serve this need have either never been developed, or have deteriorated over time under the pressure of increasing use. People on the margins of cities have been forced to compensate. The result has been a booming mini-bus taxi industry. This has put thousands more vehicles than planned for on the roads of many SACN cities.

### Cities designed to impede movement

As a mechanism of social and political policing, South African cities were designed with a view to impeding, not facilitating movement.

In the attempt to geographically separate classes within racial groups, apartheid planners often designed suburbs adjacent to each other on a different size of grid block. This means that the roads often do not line-up in suburban areas, forcing a time-consuming zigzag route on any form of transport.

More significantly, many townships were built as a locus of control, with only one or two streets connecting the road complex inside the township to the rest of the city. It was reasoned that if political unrest was to spark inside the township area, public-order policing had only to seal off the one or two key access roads in order to stop the trouble from affecting the rest of the city. This means that virtually all traffic still squeezes through one or two interchanges in many South African township areas. The time available to residents, and usually poorer African residents, is seriously constrained by this reality.

### What Can Be Done?

Alarmed by massive population growth, worsening living conditions, and environmental degradation, some experts worry that cities in developing countries have become unmanageable. Others are more optimistic, observing that with good management cities can grow even larger without making residents worse off and without ruining the surrounding environment. While many city governments face unprecedented challenges, a number of steps can make cities more liveable and protect the environment. These include better urban planning, more public transportation, better sanitation and rational water-use policies, energy conservation, urban farming, and waste recycling.

*(Cities at the forefront Johns Hopkins School of Public Health)*

### Decentralising cities

South African cities were designed to encourage decentralisation for its own sake. In the late 1970s, planners concerned with the over-concentration of key business and financial institutions in the central business district core started to encourage decentralisation of office development. Various measures were taken including, for example, limiting the number of parking spaces in the inner city, and failing to compensate with adequate public transport, on the logic that this would incentivise new office developments in the suburbs. Other stimulants such as unusually generous rates rebates at the decentralised points were introduced in the 1980s. The result was business flight from the central city. This soon took on its own logic. By the mid-1990s edge-city developments had started to spatially fragment a number of key SACN cities.

### Under-serviced cities

Last, South African cities were designed without consideration for the need of poor populations for an acceptable level of service. Water and sewer system breakdowns because of poor load design, dust from dirt roads in the middle of the city, poor storm-water drainage, leading to periodic flooding of neighbourhoods, mark many of today's township areas. They bring with them a host of environmental health problems.

## POST-APARTHEID SETTLEMENT PLANNING

Post apartheid settlement planning has moved to try rectify the imbalances resulting from apartheid. In some instances it has ended up reinforcing them.

### Housing-driven settlement planning

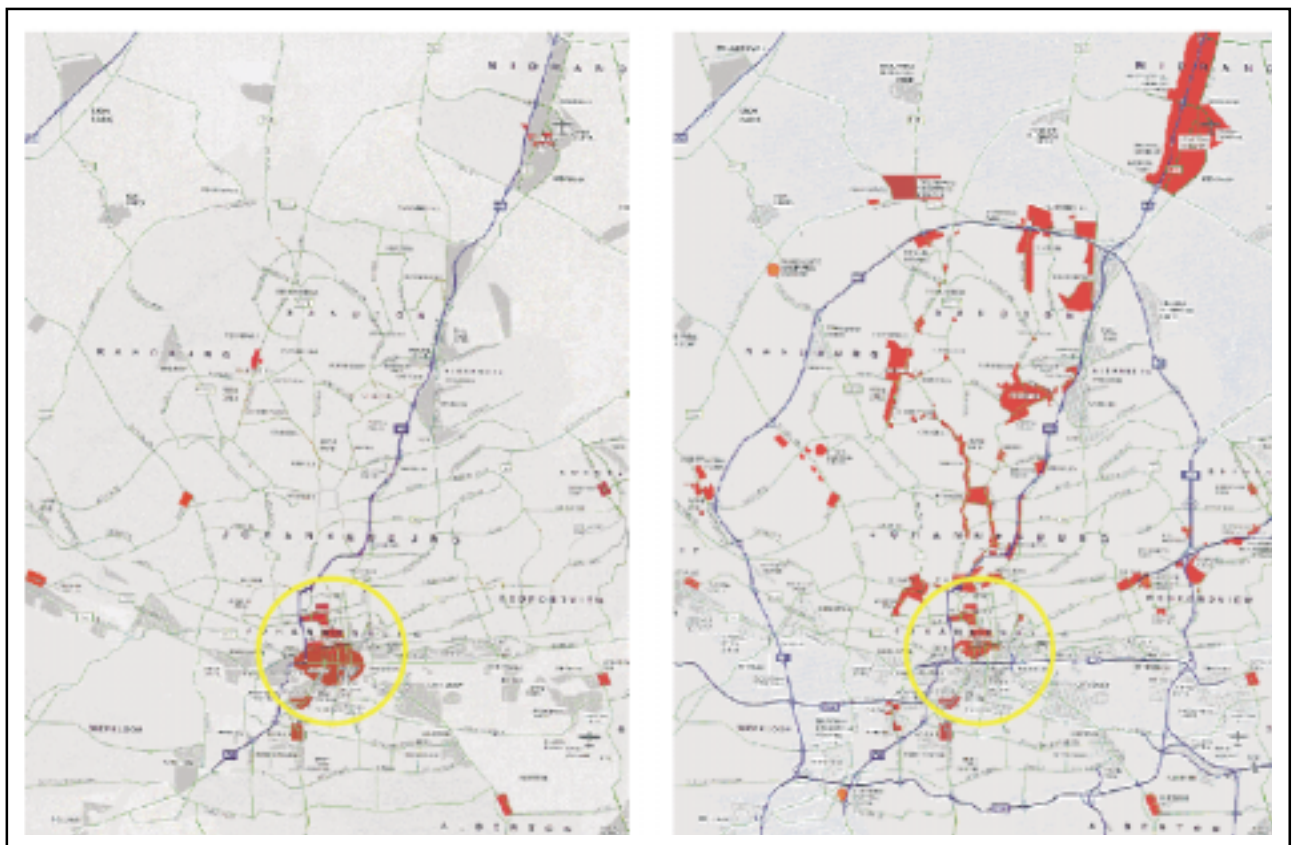
One of the key political promises of the new democratically elected government in 1994 was that a million houses would be built in five years. It was hoped that this would help to accommodate the many people forced by apartheid

### Urban efficiency

By design, metropolitan Pretoria evolved into a model apartheid city characterised by fragmented and divided urban development that limited access for the majority of people to urban opportunities. This history of political exclusion has produced a city that is spatially sprawling, with low average population densities, and that is marked by great municipal service unevenness and inequality. The basic infrastructure footprint that Tshwane inherited after a century of sunk-investment is thus highly inefficient by international standards, suggesting a relatively high future recurrent cost structure of municipal service delivery. While the general population distribution is fairly low by international standards, population densities are the highest in areas that need services the most, as well as in areas mostly populated by black people.

*(Tshwane Mayoral Mid-Term Report, December 2000-June 2003)*

Figure 53. De-densification of office nodes in Johannesburg, 1960-2001.



laws to either double-up in small 'matchbox'-style formal structures in townships, live in backyard structures, or set up temporary shelter in burgeoning informal settlements. Housing delivery was driven by the provision of nationally funded and provincially administered housing subsidies. Especially where very large housing backlogs were faced, many municipalities also made contributions from their own budget. This was often devoted to topping up the level of internal community services possible to build with the subsidy.

A million housing subsidies were indeed released in the mid-to-late 1990s. But this extremely ambitious, hard-driving housing programme, in which there had been precious little time to consider all the options before building, and even less time to reflect on emerging experience, has had unintended consequences.

It is being recognised that settlement planning in the post-apartheid era has been driven by developer-led delivery and the provision of reasonably inexpensive household infrastructure. In many cases the subsidy available did not enable developers to purchase relatively higher-cost land close to city centres. In others the developer already owned large tracts of land and targeted this, regardless of suitability, in an effort to evade a key input cost. This problem was compounded by the fact that when lower-cost RDP housing was planned for areas where there were already fairly well-established suburban settlements nearby, development objections from residents concerned with the impact on their property values could delay building for months. This had serious time costs for developers. They circumvented the problem by targeting relatively isolated land. In the drive to meet the targets for new houses, the fact that most new housing was being developed on the edges of cities went unnoticed. The South African city has spread out considerably since 1994.

#### De-densification

Other processes consolidated the trend. Many old city residents forced for years to occupy backyard dwellings, as well as newcomers to the city, targeted land for land invasions. Seeing where housing was likely to be built, and with a sensitivity to where the political pressure for relocation would be greatest, land invaders targeted areas on the margins of cities. Land invasions were informal, but were often well organised. Plots of land were demarcated and allocated before the invasion took place. This informal town planning almost invariably demarcated the new settlement on a grid pattern with large plots, mirroring the layout of typical wealthy suburbs, and echoing its aspirations for large and spacious self-standing homes, soon to be subsidised.

The movement of people out of backyard shacks and into formal housing or new informal settlements has already been discussed in Chapter 6. On the one hand, it is clearly to be welcomed. But it does have implications for the spatial structure of the SACN cities. There are two implications of this movement. First, even if the numbers of people moving to cities slows down, cities may still face growing service delivery pressures from households currently living in backyards where they are already served, to new formal and informal dwellings requiring new connections. In 2001 there were still 544 667 households living in formal or informal backyard dwellings across the nine cities. The de-densification of cities runs contrary to the goal of the compact city. It creates capacity problems for networked infrastructure, and increases the marginal cost of new service connections, possibly beyond the point where this can be carried by operating cost transfers and cross-subsidisation within a service account.

### **Tshwane's settlement structure is spatially characterised as follows:**

#### **Spatially fragmented structure**

Developed around a traditionally strong central core, the city has over the last two decades become multi-nodal, with a ring of satellite nodes at 10-12 km from the centre, mostly within high income neighbourhoods adjacent to highways. The residential pattern is characterised by separation of income groups and races with buffer strips, roads, railway lines and industrial areas forming barriers between the various race groups. The most favourably located black residential areas are 10-12km from the traditionally strong central area, in the opposite direction from high-income residential areas, but many are located as far as 25-40km away. The distance and inaccessible locality of poor neighbourhoods highlights their dislocation and marginalisation since they have the lowest provision of social facilities, the longest travelling times and the highest population density. These are also the areas that are growing at the fastest rate. In addition, the present situation can only be maintained with high government subsidies for public transport and is therefore unsustainable.

#### **Low density sprawl**

Extensive low-density sprawl, which is based on an anti-urban ethic of the free-standing house on a plot, is evidenced by:

- High and middle-income suburbanisation in, predominantly in the south-eastern sector of the city;
- Exclusive residential estates, clusters and security villages;
- State-sponsored low-cost housing projects on the periphery, in the opposite direction of high income sprawl (to the north and west where the value of land is low and little public opposition can be expected);

Most households live in single storey and detached houses, which is wasteful of urban land and forces large numbers of people to live too far from established economic opportunities and facilities.

#### **Separation of land use**

Separation of land uses generates considerable movement. Almost all new development is private transport oriented with the result that city living has become over dependant on this mode of transport. ... (In turn), Public transport is inefficient mostly due to too low densities.

*(Tshwane 2020 IDP, Chapter 2)*

### Ongoing decentralisation

As restrictions on movements and residence came down, an increasing number of people moved out of crowded townships moved into inner cities. Demand for well-located inner-city space drove a process of informally converting underutilised commercial and retail space into small back-office manufacturing and storage space, and residential accommodation. Traditional business areas in a number of SACN cities changed overnight. The spectre of ‘crime and grime’ from increasing numbers of people living in and using the central cities gave further impetus to business flight. New office developments were constructed near wealthy residential neighbourhoods, often bypassing even new decentralised nodes. This spreading out of the city adds to its ecological footprint, and presents traffic planners with huge difficulties in anticipating the ever-changing flows of traffic.

### ‘Worsening’ service levels in sprawling new informal settlements

In many cases it was impossible for authorities to develop land illegally occupied by newcomers to the city. Land invasions were firmly dealt with in some cities. In many cases the land invaders were forcibly removed to ‘holding areas’ where they were placed on the housing waiting list. These were always on the far edges of the city. With many more people coming into some of the SACN cities in the mid-to-late 1990s it was impossible to keep pace. The temporary settlements where those waiting for housing were being held burgeoned in size. They also took on an air of permanence. But since they have been conceived as temporary they have been provided with only very low, ‘emergency’ levels of services. This has led to very unhealthy conditions in some.

### Understanding the impact

How has this historical and evolving post-apartheid built environment impacted on the envelope of natural resources? Data sets for the environmental impact of settlement developments are not comprehensive enough to do the kind of longitudinal trends analysis possible with census data. Few cities collect information in a consistent and regular enough manner to allow for the tracking of trends over time. At best a partial comparative analysis of the state of the urban environment across the cities is possible. And in most case it is only feasible to provide an indicative analysis by highlighting information from individual cities.

Using data collected from cities specifically for this report, and with information from environmental reports compiled by some of the cities on their own behalf, urban environmental impact can be seen in a number of areas. First is the impact that the built environment is having on space, and also on air and water quality. Further effects can be seen in the areas of urban environmental health, intra-city mobility and energy sustainability.

## IMPACT ON SPACE

### IMPACTS ON SPACE AND HIGH POTENTIAL ARABLE LAND

Open space is essential to sustainable urban life. Where this space is developed in the form of parks and botanical gardens, or semi-developed in the form of nature reserves, it can add significantly to the perceived quality of life, and

Although part of the problem of dispersed settlements lies with the developer-driven model used to deliver the bulk of housing subsidies, since developers have been taking advantage of available land holdings to keep down costs, the other part of the problem arises because the current subsidies (housing and CMIP) are generally inadequate to cover the costs of well-located land in many of the major urban centres (Bierman). Since the Government currently spends more than R2 billion on road and bus subsidies to address these spatial disjunctures in the major cities, the opportunity exists to redirect some of these funds to acquiring better-located land.

However, dispersed settlement is unlikely to be addressed unless government plays a more proactive role in controlling the decentralisation of high-income residential, commercial and industrial developments.

*(National Spatial Development Perspective)*



compensate for high diseconomies of scale factors – such as pollution and traffic congestion – that detract from liveability. Even where this space is undeveloped it provides a so-called green lung for cities, since plant life absorbs carbon dioxide and releases oxygen.

Poorly laid out, low-density and further de-densifying urban forms have a very severe impact on available open space. Different cities have historically invested differently in open space. Some cities have many parks and considerable undeveloped open space near the city centre, others do not. In a survey of SACN city municipalities conducted for this report in late 2003, Mangaung reported that it had 119 developed parks compared with Tshwane's 546. This means that Tshwane had 4,5 times the number of parks as Mangaung, for three times its population. By contrast, eThekweni reported only 53 parks and Msunduzi five. Cities may be using different definitions of parks in their reporting here. A more appropriate indicator would be hectares of space: hence the City of Joburg reports that it has 6 144 hectares of developed parks, 4 443 hectares of undeveloped parks, and 984 hectares of nature reserves. It manages approximately 1,2 million trees that make the northern suburbs of Johannesburg a natural forest.

The extent of open space sometimes reflects geographic limitations, but it also speaks to the extent to which planning departments place value on these amenities. Various cities are now investing in Open Space Management Systems (see box below).

#### Impacts on arable land

Research for the National Spatial Development Perspective shows that some of the most important arable land in the country is located to the east of Johannesburg, Ekurhuleni and Tshwane. Some of this land has already been intruded on by the displaced urbanisation around former Kwandebile. These settlements are still expanding today and are still sustained by expensive transport subsidies that allow a daily commute for workers from these areas into Tshwane. Although this also raises the positive prospect of development of urban agricultural economies, a rapid-growth scenario for Gauteng cities raises concern over whether its ecological footprint is sustainable in the long run. The land under threat is extremely valuable. A fast-growing urban region that does not preserve it will have a lower level of food security in the future.

Some SACN cities have a policy that new housing developments should happen far from the crowded areas of the city in areas usually categorised as peri-urban. This policy may make sense in the light of the habitability of land closer to the city centre. But the policy may be at the cost of viable specialist agriculture in the future.

#### Waste management

Cities add significantly to the country's waste stream. Waste spoils land, whether it is illegally dumped or collected into ever-expanding landfills. The table does not have complete data for the nine cities, but it indicates both the amount of waste that municipalities have to deal with as well as some of the ways that waste is disposed of. Some cities clearly have a far-larger burden of waste generation than others, even when they are not the largest. Although it is not clear how much additional waste is collected by private contractors in each city, the data suggests that the challenge of Tshwane's domestic waste is far larger than that of Johannesburg.



Not only has decentralisation created unsustainable urban forms, but in some areas such settlements are encroaching on high-value agriculture land and scenic locations that have tourism potential, thereby undermining the longer-term economic potential of these areas.  
*(National Spatial Development Perspective)*

	City of Joburg	eThekweni	Cape Town	Ekurhuleni	Tshwane	Nelson Mandela	Buffalo City	Manguang	Msunduzi
<b>GENERAL WASTE DATA:</b>									
Domestic tonnage	393 226	500 000	—	—	854 880	—	—	30	—
Domestic %	32	—	59	—	52	—	—	—	—
Commercial/Industrial	274 804	—	—	—	361 680	—	—	25	—
Comm / Industrail %	23	—	38	—	22	—	—	—	—
Illegal Dumping ton	266 139	—	—	—	115 080	—	—	—	—
Illegal Dumping %	22	—	3	—	7	—	—	—	—
<b>AMOUNT IN TONNES AND % SOLID WASTE:</b>									
Disposed sanitary landfill	1 419 725	1 600 000			1 644 000				300
Landfill %			91		100				
Incinerated	287								
Incinerated %			0		0				
Disposed to open dump	0								
Open dump %			0		0				
Recycled	7 190				82 200				30
Recycled %		20	8		5				10
Burned openly	0								180
Burned %			0		0				60
Organic material	393 226	48 000			427 440				180
Organic %	28		40		26				60
Other	1 026 499	1 052 000			1 216 560				120
Other refuse %	72				74				30

The majority of waste is dumped to sanitary landfills. Noticeably small percentages go for incineration and recycling. Illegal dumping remains a huge problem in some cities.

Figure 54a. The waste challenge in SACN cities as recorded from a survey of municipalities in late 2003.

## CITY STRATEGIES TO MANAGE ENVIRONMENTALLY SENSITIVE OPEN SPACE

### Waste management programmes

Various municipalities have developed programmes to deal directly with the issue of waste management through engagement with local residents. Some of these programmes are aimed at ensuring that less waste is generated by city residents.

The City of Cape Town initiated its Waste Wise Campaign on the basis of the principles advocated in the White Paper on Integrated Pollution and Waste Management. A scheme was created to ensure that less waste was produced at source in the domestic, industrial and commercial sectors. Furthermore, the programme advocates the three Rs – reduce, reuse and recycle.

Cape Town also confronted the problem of high volumes of industrial waste by launching an Integrated Waste Exchange. This project facilitates the exchange of the waste products from one company to another company, where the second may find the first's waste products a useful input into its production processes. This helps remove these products from the waste stream.

### Open space management systems

The box overleaf gives some sense of how cities are developing better tools for space management.

## OPEN SPACE MANAGEMENT SYSTEMS: EXAMPLES FROM TWO CITIES

SACN cities are already thinking creatively about how to manage the impact of the built environment on valuable open space. A number have developed Open Space Management Systems as part of their Spatial Development Frameworks. OSMSs give municipalities a clear framework in which to balance the pressure to develop new land with the imperative to maintain environmentally sensitive land for the benefit of future generations. The extracts below are write-ups on OSMSs from two SACN municipalities. In the case of Ekurhuleni, it is clear that OSMSs can be thought of in the same way as a City Development Strategy, with a long-term perspective, and with an explicit focus on partnerships with other spheres of government.

### The Nelson Mandela Metropole MOSS Project

The Nelson Mandela Metropole, in the south-eastern corner of the Cape Floristic Region (CFR), boasts some of the greatest biome-level diversity in the world. The Metropole is home to five of South Africa's seven biomes, and two fynbos types of the highest conservation value in the CFR. In light of the immense conservation importance of the area an ambitious project was initiated in 2001 in an attempt to secure the long-term protection of its biodiversity.

The Planning Phase of the NM MOSS (Nelson Mandela Metropolitan Open Space System) Project, which was launched in September 2001, sought to develop a scientifically rigorous and defensible fine-scale systematic conservation plan for the Nelson Mandela Metropole, Cape Floristic Region, as part of the Metro's Open Space System. The NM MOSS Project is a partnership between the Wildlife and Environment Society of South Africa (WESSA), the Nelson Mandela Metropolitan Municipality, the Terrestrial Ecology Research Unit (UPE), the Table Mountain Fund (WWF-SA), the Mazda Wildlife Fund, and Conservation International (Southern African Hotspots Programme).

The project used an approach that required GIS-based data layers that spatially depicted the distribution of biodiversity pattern and ecological processes, as well as current and future land-use pressures. Targets were set for each of the biodiversity features, and a decision-support system used to identify priority areas for the expansion of the city's conservation network. The development and recreational requirements of the metro are now to be incorporated, and a holistic open-space plan produced. In an urban area, any Metropolitan Open Space System (MOSS) is a compromise between conservation and town-planning development needs. The aim is to systematically design a system that most effectively combines and addresses these requirements. The most valuable aspect of the plan is that it will be dynamic. Being computer-based it will allow for predictive decision making, which will provide greatly increased guidance to town planners, conservation managers and municipality councillors than in the past.

Stakeholders, including councillors and officials, academics, land-use planners and decision-makers, conservation area managers, civil society organisations and the general public, participated in the development and implementation of the plan. Regular meetings and workshops were held to inform them of project progress and to obtain their input into specific aspects of the MOSS Project.

Implementation began in March 2003 and includes the development of site-specific plans for community conservation projects, private landowner conservation initiatives, and the rezoning of municipally owned-properties to afford priority sites with formal conservation protection. The incorporation of the outcomes of the NM MOSS Project into the Metro's Spatial Development Framework (SDF) and Integrated Development Plan (IDP) were finalised.

### The Ekurhuleni Metropolitan Municipality Environmental Management Framework for the Northern Service Delivery Region

The Ekurhuleni Metropolitan Municipality (EMM) is committed to sound environmental management principles and set itself the goal of sustainable development, which balances the protection of the environment with improving the socio-economic well being of the inhabitants of the area. Due to the development pressure and the value of land in the Northern Service Delivery Region (NSDR), the EMM and the Gauteng Department of Agriculture, Conservation, Environment and Land Affairs (DACEL) decided to develop an Environmental Management Framework (EMF) to aid decision-making processes in respect to new development activities in the area.

The purpose of the EMF is to provide the EMM and the DACEL with a decision support system that will help these authorities to act in a coordinated, objective and efficient manner. It is important to note that the EMF will not be a 'blueprint' land-use plan for the area but a decision support mechanism that takes environmental as well as socio-economic factors into account for each decision that has to be made. The EMF can, however, as a secondary function, provide valuable inputs into local land-use plans. The main products of the study will include:

- a status quo report;
- a strategic environmental management plan;

- a resource economics report;
- the EMF report and interactive GIS (main project product);
- review of existing plans;
- actions plans for the implementation of the EMF; and
- a summary report.

The study area is the NSDR, which is situated in the eastern part of Gauteng. It includes the Johannesburg International Airport and three major freeways, namely the R21, R24 and N12. The R21 freeway, which links Kempton Park, Boksburg and the Johannesburg International Airport with Pretoria, passes through the area and divides it into two parts namely:

- The area located to the west of the R21 freeway, which includes Kempton Park, a part of Boksburg (Jet Park), Kempton Park Agricultural Holdings and Witfontein.
- The area to the south and East of the R21 freeway, which includes Nortons Home Estate, Putfontein Farm as well as the agricultural holding of Pomona, Bredell, Brentwood Park, Benoni, Marister and Rynfield.

An integrated GIS will be developed as the main structural element in the study around which the various inputs and outputs will be centred. The GIS will also take the results of the project into the future and will have to be updated periodically in order to deliver an ongoing up to date input into the environmental management of the area.

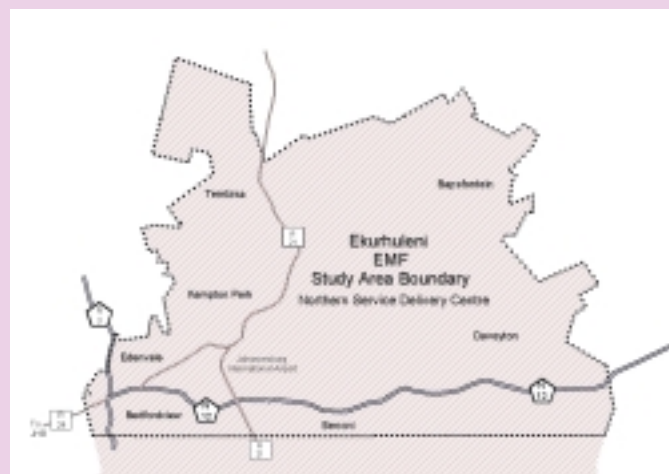
Land use zones will be a key element of the EMF. The purpose of land use zones is not to fix specific land uses to specific areas of land but rather to indicate which land uses can generally be allowed in which areas under the following conditions:

- without further environmental assessment;
- land uses that require some degree of further environmental assessment to ensure that the basic conditions of the EMF is met; and
- land uses (generally undesirable in the area from an environmental or developmental perspective) which would require in depth motivation and environmental assessment to ensure that they do not result in unacceptable impacts.

The zoning will be based on environmental sensitivity, the views of the public and stakeholders as well as land use imperatives. It will set out a risk-averse framework for decision-making that protects sensitive environmental and socio-economic aspects while it allows for appropriate and responsible development of the area.

Control zones will be established as the main administrative instrument in the EMF. The purpose of control zones is to focus the attention of the authorities on the important areas and to try and streamline applications for proposed activities in less-sensitive areas. These zones will be based on the following:

- The relative sensitivity or importance of the environment or an element in the environment;
- the norms and values of the community in respect to the sense of place or character of the area;
- the need to protect high quality open space and ecologically sensitive areas against inappropriate development; and
- existing and approved planned land use.



*(Extracted from: 'Background information document: The development of an environmental management framework for the Northern Service Delivery Region of the Ekurhuleni Metropolitan Municipality, March 2004')*

## IMPACT ON WATER, AIR QUALITY AND ENERGY

### IMPACT ON AND LONG-TERM SUSTAINABILITY OF WATER SOURCES

South Africa is a water stressed country. Modelling done for the National Spatial Development Perspective indicates that while there is a current surplus in available water stores in key locations likely to see further urban expansion, future coverage cannot be guaranteed. Under a high-growth scenario this surplus will turn into a very serious deficit by 2025. Parts of Gauteng cities, eThekweni and Msunduzi and Cape Town face the risk of severe water shortages in the decades to come. Figure 54 shows the results of this modelling.

This is particularly true if cities social and economic development strategies pay off. Affluent city residents use greater volumes of water than poor residents so the more developed cities become, the more environmentally stressed they are likely to be, unless dramatic steps are taken to reduce wastage and inefficiency. For example, although consistent figures for unaccounted water are not available, quantitative analysis shows that it may reach 40% in some areas. In the case of the City of Cape Town, 70% of urban water is used for sanitation and sullage, garden irrigation and leaks.

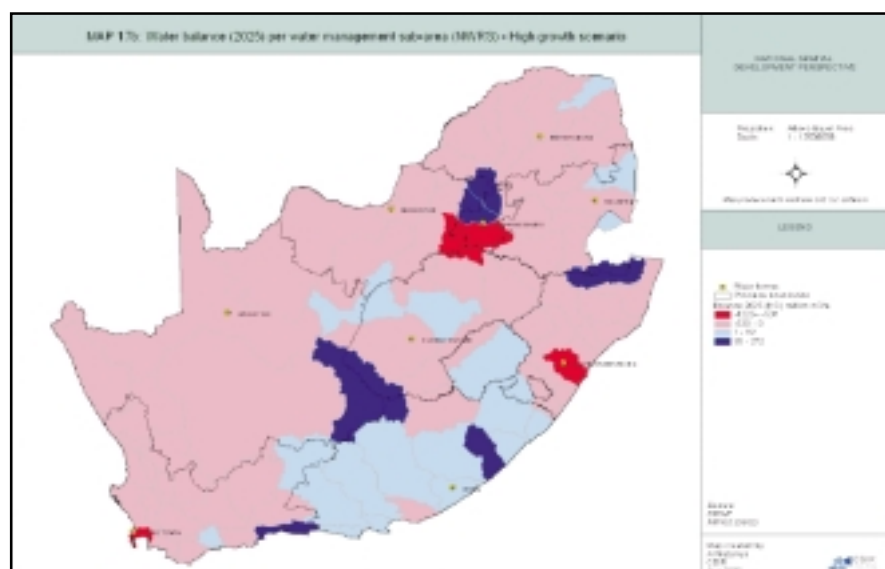
Figure 55 gives a comparison of water-consumption data received from municipalities in a survey conducted late 2003. The data is not directly comparable, with each municipality having provided information in different formats.

#### Water quality and waste-water treatment

Figure 55 also gives comparisons of non-compliance with specified water-quality standards across the municipalities. The first shows relatively low levels of non-compliance with specified E-Coli standards in random water samples taken across the municipal area. However, DWAF has also expressed concerns that municipalities do not take as many samples as they should, and that levels of E-Coli are actually much higher than acceptable in certain key places where departmental officials have taken their own samples.

The second table compares the extent to which various municipalities efficiently treated waste water. Some cities generate a relatively high quantity of waste water per day, and utilisation of available capacity to manage this appears relatively high. In other cities effluent quality compliance is relatively low.

Figure 54b. NSDP modeling of areas likely to face severe water shortages in 2025. Red indicates problem areas.



### IMPACT ON AIR QUALITY

A range of factors particular to the urban form of South African cities impacts on air quality.

Development in most South African cities has been 'car-driven' for some decades. The availability of good roads and the poor standards of public transport have encouraged high

	City of Joburg	eThekwinini	Cape Town	Ekurhuleni	Tshwane	Nelson Mandela	Buffalo City	Mangaung	Msunduzi
Annual water demand (kls per capita per day)	425				220	1 220	133	83	16 800 000
Average consumption of water in litres per day									
Domestic	575	140	380 000		878	84 931	65	65	56
Commercial/Industrial	135		90 000		8 595	41 096	89	35	44
Estimated Water Loss	158	24	18		18	23	25	37	30
Percentage of water samples that did not comply with DWAF water quality guidelines over the last year	0,5-non-compliance of E.Coli standard to SABS 241				0,05% mainly water quality of private water tanks	0	2,05	0	0

		Joburg	eThekwinini	Cape Town	Nelson Mandela	Mangaung
Volume of waste water treated (in-house)	MI/day	839	485	529	132,3	90
Production per person per day	l per person / day	255	162,5	175	41,25	28,125
Required effluent standard		Special	Standard	Standard	Standard	Special
Capacity utilisation	% treatment capacity	95,02%	67,36%	85,32%	70,90%	87,38%
Final effluent quality compliance	% samples (flow weighted)	95,00%	94,00%	35,00%	87,71%	99,00%
Wastewater discharge not treated	% ww produced	-5,39%	6,73%	5,54%	-0,23%	0,00%
Sludge produced not meeting standard	% of dry tons produced	0,00%	5,00%		0,00%	0,00%
Waste water recycling/reclamation	% ww produced	6,13%	6,73%	8,50%	4,70%	3,00%
Value of sale of by-products	% income	0,00%	0,00%		17,81%	2,81%

levels of private car use. This has allowed more and more people to locate in quiet suburbs with large plots far from the city centre. More and more land development on the edges of the cities has in turn encouraged the use of more cars, which then in turn has made public transport systems less financially viable. This self-re-enforcing spiral has seen increasing numbers of vehicles, many with only one occupant, on city roads.

A different, but equivalent distortion of urban form in poorer African areas has led to the same result. The forced relocation of large numbers of African residents to dormitory townships, coupled with under-investment in an adequate public transport system to cater for this settlement pattern, has led to a large private minibus taxi industry.

Thousands of cars and taxis have serious pollution effects. Petrol and diesel vehicles are known to emit the highest percentage of South Africa's atmospheric emissions, creating environmental health problems in the city centre, in poor neighbourhoods often located adjacent to motorways, and near key transport interchanges.

The under-electrification of township areas, and the relatively high cost of electricity for cooking and heating, has led to many households continuing to use coal or paraffin burners to heat food and homes. This seriously affects air quality in township areas. Poor regulation of industry emissions further exacerbates the problem.

Figure 55. Table top shows water and water quality indicators from survey of municipalities conducted late 2003. Please note that this information is presented as it was received by municipalities. However, the different municipalities understood the indicator differently and have provided information that is not directly comparable. The second table gives waste water efficiency indicators from research conducted by Palmer Development Group for five of the nine SACN cities in 2003.

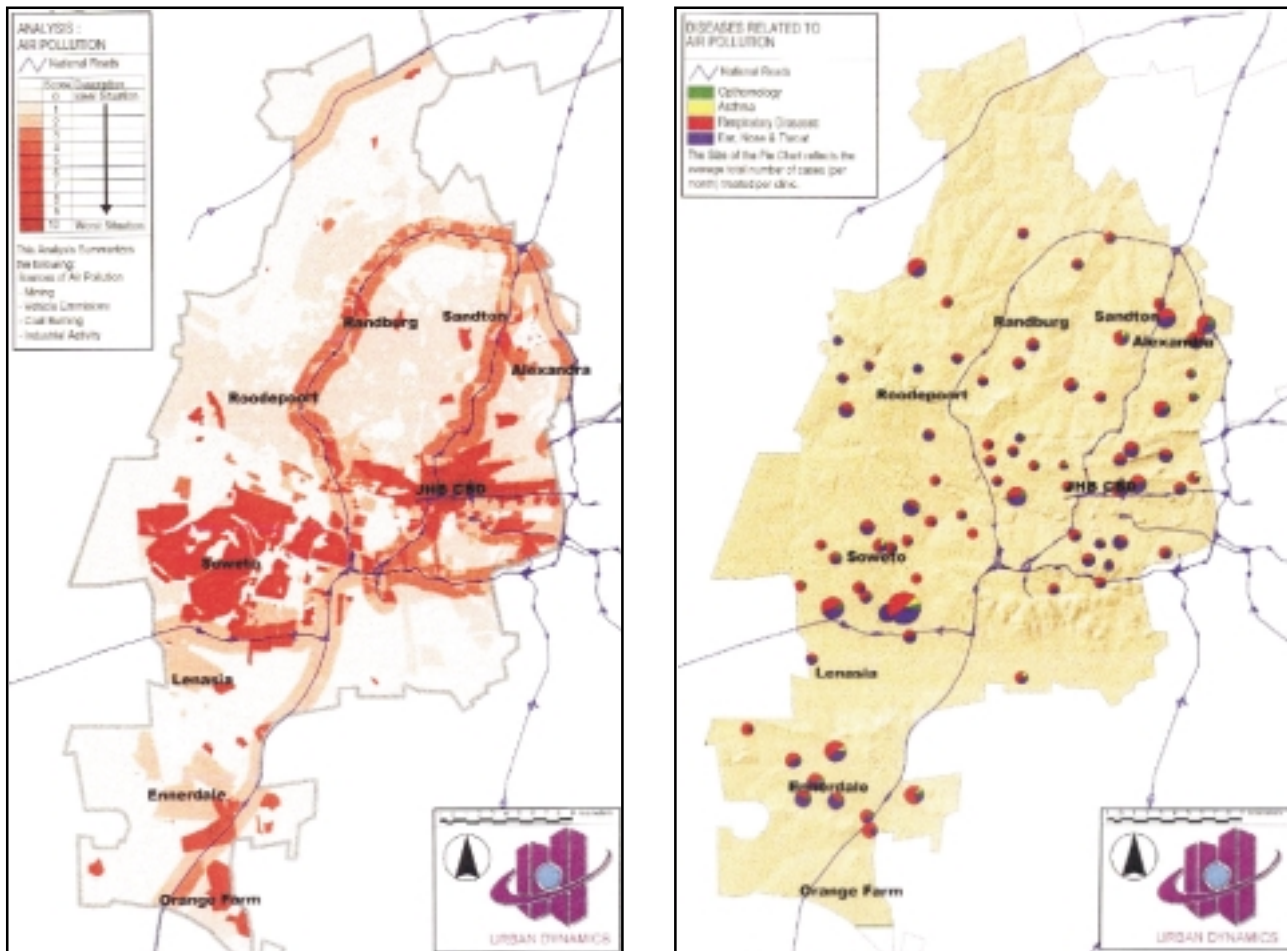


Figure 56. A map of air pollution and air pollution related diseases in Johannesburg, showing strong correlation in some of the poorer areas of the city.

### Air quality measurements

Very few South African cities take systematic measurements of air quality across the municipal area. There are some measuring stations in areas that are known to be badly affected. But on the whole only about 15% of South African cities are covered by emissions-monitoring equipment.

Where cities are able to monitor air quality, the results suggest that this is an area that will need to be watched in future. Figure 57 shows relatively similar quantity of air emissions for similarly sized cities

Figure 56 gives a sense of the impact of high levels of air pollution on health in South African cities. Although TB is a reflection of many things besides pollution – including the prevalence of HIV and Aids – it is strongly affected by it. The map shows air pollution strongly concentrated in and around Soweto and the inner city of Johannesburg, and instances of diseases related to air pollution concentrated in the same place.

## ENERGY

Cities consume huge amounts of energy. Most city dwellers simply take for granted that energy – to feed them, propel their cars, light their homes and underpin all aspects of production – will always be there. But energy is a natural resource in the same way as air and water. Even when it is processed, in the form of food, or generated in the form of electricity, it is still reliant on an original store of natural resources. And even when it does not seem to come from the immediate vicinity of the city, in the same way as air and water must be directly accessible inside the urban limits, it is still part of the

	City of Joburg	eThekwinini	Cape Town	Tshwane	Manguang	Msunduzi
Tuberculosis (TB) Incidence Rate (% of population)	414/100000	0	1	251/100000	668/100000	1470/100000
Annual number of air pollution events (days guidelines exceeded)			45			
What standards is the municipality adhering to				DEAT		
Percentage of the municipal area monitored	15% (soon to 50%)			15		
Emissions (for the entire municipal area) per capita		2	2			
Tonnage of emissions by the municipality		1 061 085	1 061 085	1 360 341		

Figure 57. Air-pollution indicators from a survey of cities conducted late 2003.

total envelope of natural resources that sustains a city. The burden of large cities may be too heavy for energy sources to bear.

Energy limits may be seen both in both sudden, unanticipated energy crises, and the slow imperceptible spreading of cities' environmental footprint.

#### Widening ecological footprints

An ecological footprint is the 'ecological impact that human activities within cities have beyond their boundaries'. An ecological footprint study is one way to determine the likely future sustainability of a city. An important part of it is an analysis of the energy footprint.

Ecological footprint studies typically analyse the environmental status quo within a city itself and highlight the potential outcomes of not formulating policy according to a sustainability agenda. It discusses the potential ecological fall-out from urban development and possible urban expansion beyond the boundaries of the city; the implications of not balancing the need for land development with the preservation of natural resources; and the consequences of not securing the future of ecologically sensitive areas, green open spaces, coastal resources, and energy availability.

An ecological footprint analysis of Cape Town highlights the impact on available energy sources (see figure 58).



## THE ENERGY / ECOLOGICAL FOOTPRINT CHALLENGE FACING SA CITIES

### Why an energy / ecological footprint analysis is important for South African cities

A recently developed tool for measuring ecological sustainability is Ecological Footprint analysis. It is based on the fact that the earth is a closed system in which all material inputs required by humanity (air and water, food and fibre, energy and minerals) are supplied by a finite area of productive land and water. Equally, all waste outputs have to be absorbed by natural systems. Nature, functioning as a system of sources and sinks, is therefore our ecological life-support system.

EF analysis calculates the total resource consumption and waste generation of a person, city, or nation (eg. in tons) and, using productivity/absorption factors (eg. output in tons/ha) converts this into the corresponding area needed to produce the resources and consume the wastes. This 'areal' figure, in ha/person, is the ecological footprint of the individual, city or nation. It can be compared with the 'fair Earthshare' in 1999 of 1,9 ha/person (the amount of productive land on the planet available to supply each person's inputs and absorb their outputs) to assess whether or not patterns of resource consumption and waste generation are sustainable and not overshooting the planet's carrying capacity. (WWF, 2002).

Cities, the flywheels of modern economies, now occupy a central position in the pattern of resource-waste flows. Globally they account for the consumption of over 75% of all materials and the emission of over 75% of all wastes. (Girardet, 1999). These percentages will rise in coming decades, tracking the rising levels of urbanisation (currently around 50%) and affluence, and technological change. It is evident that cities are one of the keys to the ecological sustainability of the planet. In this context, EF analysis of individual cities can provide an indication of their contribution to the problem and where action might be taken so that they become part of the solution.

### Summary picture of Cape Town's energy / ecological footprint

Cape Town's ecological footprint has been derived by converting the resource-waste flows (measured in tons) through its urban-industrial metabolism into related areal units using reputable conversion factors (Gasson 2002 & 2003). These are presented below with the energy component highlighted.

Metabolic inputs	TONS/YR	AREAL CONVERSION FACTORS	Land area in sq km
Fresh water <sup>1</sup>	327 500 000	Reservoir catchment areas <sup>6</sup>	1 430
Energy <sup>2</sup>		100GJ = 1.25ha all fossil fuels <sup>7</sup>	
Coal	378 732	1t = 28 Giga Joules <sup>8</sup>	1 326
Oil		1 138 097	1t = 44,7GJ 6 359
Gas		21 816	1t = 35GJ 95
Wood	108 492	1t = 1,4m <sup>3</sup> ; growth 2,3m <sup>3</sup> /ha/yr <sup>7</sup>	660
Materials <sup>3</sup>			
Building materials	5 994 113	Local mining area <sup>9</sup>	31
Timber	69 844	1t = 1,4m <sup>3</sup> ; growth 2,3m <sup>3</sup> /ha/yr <sup>7</sup>	425
Paper	395 000	1t = 1,8m <sup>3</sup> wood; 2,3m <sup>3</sup> /ha/yr <sup>7</sup>	3 091
Food <sup>4</sup>	1 327 301	Yields in tons/ha various foods <sup>10</sup>	112 349
Metabolic outputs <sup>5</sup>			
Liquid wastes	200 300 000	Area of WWTWs <sup>11</sup>	13
Solid wastes	2 050 800	Area of SW sites <sup>11</sup>	4,9
Gaseous wastes CO <sub>2</sub>	5 209 200	Carbon fixation 21 t/ha/yr <sup>8</sup>	2 480
<b>Total City EF</b>			<b>128 264 km<sup>2</sup></b>
City Energy EF			10 920km <sup>2</sup>
W Cape Province Area <sup>12</sup>			129 370km <sup>2</sup>
City Jurisdictional Area <sup>13</sup>			2 487km <sup>2</sup>
City Built-up area <sup>14</sup>			774km <sup>2</sup>

Sources : 1 : DWAF, 1998; 2 : Wicking-Baird et al, 1997; 3 : Dept of Mineral & Energy Affairs, 1994; Corobrick; WP Masonary Manufacturers; PPC Ltd; Mondj; 4 : These figures are based either on national average per capita consumption figures multiplied by the metropolitan population, or on a pro rata metropolitan share of national consumption; 5 : CMC, 1998; Prof A.M. Stephen, 1998; Wicking-Baird et al, 1997; Wright-Pierce, 1999; 6 : Midgley et al, 1994; 7 : Wackernagel & Rees, 1996; 8 : Prof. W. Stock, UCT; 9 : CCT, 2000; 10 : Wackernagel et al, 1994; 11 : CCT pers. comm.; 12 : SA Statistics, 1997; 13 : CCT, 2001a; 14 : Gasson, 2000.

Figure 58. Cape Town's ecological footprint, highlighting the position of energy (Gasson 2002 & 2003).

The calculation indicates that Cape Town depends upon an area of about 128 300km<sup>2</sup> for the supply of its resources and the absorption of its wastes. This is equal to about 10% of the total surface area of South Africa (1 225 815km<sup>2</sup>), or roughly the area of the Western Cape Province (129 370km<sup>2</sup>). With a population of approximately three million, this translates into an EF of 4,28 ha/person, slightly larger than South Africa's per capita EF of 4,02 ha – which is the largest of any country in Africa. These figures mean that the average Capetonian and the average South African are consuming more than twice their 'fair Earthshare'. This is not an ecologically sustainable situation.

The energy footprint, in particular, is 10 920km<sup>2</sup>, and constitutes 8,5% of Cape Town's overall ecological footprint. It includes the area needed to supply its fossil fuel inputs (8 440km<sup>2</sup>) and the area of forest needed to absorb its CO<sub>2</sub> emissions.

The per capita energy footprint of 0,36 ha is quite small because the calculation assumes that Cape Town derives its electricity from the nearby nuclear power station, when this station, in fact, feeds its electricity into the coal-based national grid from which Cape Town draws its electricity.

Many studies on city EFs are underway, mostly in developed countries, and the results show that all of them are exceeding the 'fair Earthshare'. Some are exceptionally high – Hong Kong 7,1 ha/person, Kuwait 10,3 ha/person, Singapore 12,4 ha/person (WWF, 2000). A key factor behind the high EFs is excessive consumption associated with the levels of affluence and energy intensive types of technologies.

### Impact of energy consumption on Cape Town's environment

The conversion of raw energy into electricity, motion and heat releases gaseous by-products, particulate matter, and heat into the atmospheric sink.

The largest single contributor to atmospheric emissions is transportation (52,3%) – petrol and diesel vehicles. It is also the dominant contributor to oxides of nitrogen (NO<sub>x</sub>), volatile organic compounds (VOCs), and particulate matter (PM<sub>10</sub> and PM<sub>2,5</sub>). Commerce and industry produce 25% of NO<sub>x</sub>, and 80% of sulphur dioxide (SO<sub>2</sub>), the chief sources of which are the Caltex refinery and a variety of industrial establishments burning coal and heavy fuel oil. Caltex also contributes significantly to VOCs.

Vehicle numbers are expected to rise at a rate of 3-5%/year during the current decade and brown haze, a photochemical product of gaseous emissions combined with particulates, may increase by 48% and PM<sub>2,5</sub> health standards will probably be exceeded with increasing frequency. (Wicking-Baird et al, 1997).

The increasing quantity of high-level radioactive nuclear waste stored at Koeberg remains an unresolved problem for there is no disposal plan in place. The absence of a plan means that the issue of safe disposal is being passed on to future generations. This is in conflict with one of the principles of sustainable development and the Constitution of the Republic.

### Implications of not understanding and investing in stable and sustainable energy sources

Cape Town's industrial-urban metabolism depends on flows of exhaustible fossil energy (40%), and controversial nuclear-electrical energy (58%). The fossil fuel supply lines are exceptionally long and render the local economy vulnerable to disruptions in supply. For example, oil is shipped mainly from the Middle East 10 000 km away, while coal is railed from national sources 1 500km away in Mpumalanga Province. Furthermore, global oil reserves are expected to run out some time during this century, though coal reserves could last for some centuries. Nuclear energy will remain an ecologically unsustainable option unless fail-safe ways can be found to deal with the high level radioactive wastes – and no country has yet done so.

Arguably, therefore, if the sustainability objectives of inexhaustibility, invulnerability, environmental quality, and self-reliance are to be realised then concerted steps must be taken now to harness and develop renewable energy sources. In the Cape the obvious possibilities are solar and wind energies, but these have been scarcely developed.

## CITY ENVIRONMENTAL STRATEGIES

All the municipalities in the nine SACN cities have some form of environmental management plans and frameworks in place, either as part of the IDP or as a self-standing plan to address pollution effects. Four South African city municipalities, Cape Town, Durban, Johannesburg and Pretoria, have taken the next step and prepared a State of the Environment Report, and some have gone even further to extract from these audits clear, long-term sustainability policies and strategies.

## eThekwini

The eThekwini municipality is taking proactive steps towards building a 'sustainable city'. The city has developed a comprehensive strategy highlighting six areas of intervention:

- An environmental management system through which the city will develop environmental impact assessment indicators for metro services;
- A development and planning component which includes initiatives such as the Department of Housing focus on greening new settlements, where there are initiatives to deal with solid waste minimisation;
- A human health and safety section with projects working on an air quality management strategy and a Durban solid-waste management strategy;
- A pollution and waste-management strategy working for an integrated pollution and waste policy, solid waste management strategy, reviewing effluent management system, air quality programmes, minimising noise pollution and toxic use reduction programme;
- Environmental resource management including integrated resource management programme, integrated energy planning, sustainable use of coastal resources, metropolitan open space systems, protect and promote cultural resources; and
- Education training and awareness including building partnerships, building public awareness, building awareness amongst political decision makers.

## City of Cape Town

The City of Cape Town has recently conducted a comprehensive ecological footprint review. It highlights that:

- Cape Town uses high levels of non-renewable fossil fuels and nuclear power generation and does not use renewable solar and wind energy efficiently;
- The city uses long-distance supply lines for water and oil supplies and does not use local groundwater supplies;
- Affluent groups consume the majority of resources and are most responsible for the ecological footprint, while poorer groups lack access to basic services;
- Water and energy re-usage and the recycling of waste is low; and
- Soil, fresh and coastal water systems are becoming increasingly polluted.

The City of Cape Town launched an Integrated Metropolitan Environment Policy in March 2003.

## Other cities

The Cities for Climate Change project initiated by the Department of Environment and Tourism, with assistance from USAID, has eight participating cities including Johannesburg, Cape Town, Tshwane, eThekwini and Buffalo City. The objective of this project is to assist municipalities in implementing greenhouse gas mitigation projects, such as promoting energy efficiency, sustainable transportation, methane recovery, renewable energy, waste reduction and urban greening. Since the launch of this initiative, numerous sustainability projects have been undertaken. In the City of Tshwane for example, energy-efficient lighting was re-installed in Ga-Rankuwa, saving Tshwane R196 000 in energy costs per annum and 1 187 tonnes of carbon dioxide equivalent.

The core message of (the) 'sustainable cities' literature is that as cities grow, they create unprecedented demands for inputs from the natural system (water, energy, food, land, etc) and unprecedented quantities of waste outputs that the natural system is somehow expected to absorb. They also create enormously complex throughput systems that convert inputs into outputs in relatively more or less efficient ways, and on relatively more or less equitable terms depending on the socio-economic and ecological context of each city. ... There is increasing consensus that a sustainable city is one that reduces its total consumption of inputs, increases the efficiency of its throughputs, and transforms all its waste outputs into productive inputs ...  
*(Mark Swilling, Rethinking the sustainability of the South African city)*

## THE HEALTH CHALLENGE

The geographic correlation between air pollution and air pollution-related diseases raises the broader issue of the impact of poor environmental health on the sustainability of cities. This health burden is overwhelmingly borne by the poorer sections of the population.

Qualitative and quantitative work in some South African cities has shown marked intra-urban health differentials between sections of the populations. The case study below summarises the results of a study conducted in Port Elizabeth in the mid-1990s. The analysis reflects on the spatial distribution of poverty across the municipal area, and shows clearly that disadvantaged residents in relatively poor neighbourhoods bear a much heavier burden in health costs than wealthier counterparts.

Unhealthy environments are unsustainable environments. Environments that cause the consistent recurrence of preventable breakdowns in public health raise the cost of living in the city. This cost is borne both by those who suffer the illness, and those whose activities are affected by poor public health. In particular, poor public health impacts severely on business efficiency. When the costs of poor public health are raised too high, all those affected begin to do cost benefit analyses of whether it is worth living and locating economic activities in a city.

### INTRA-URBAN HEALTH DIFFERENTIALS: A TOOL TO TRACK URBAN INEQUALITIES

The health of individuals is understood to be impacted on by their socio-economic status and among other things, the local environmental conditions. Annual global reports such as the World Health Report prepared by the World Health Organisation and the World Development Report (World Bank) provide indicators showing the difference between countries. These include infant and child mortality rates. These rates are typically used as indicators of the national level of development. While interesting for broad comparative purposes, what is more interesting for health and development planning is how the rates of, say, infant mortality differ between urban and rural areas and within urban areas.

For many years, health research in urban areas focused on specific communities in need, such as informal settlements. While it is important to have data to identify areas of specific need, this type of research was community specific. A new trend in urban health research has emerged to identify how communities in a city differ from one another. This is referred to as intra-urban health differentials. In the past in South Africa, racial classification was used to identify how groups differed from one another using key indicators such as the rate and the causes of infant mortality. Studies using intra-urban health differentials allow planners and decision makers to understand better the relationship between wealth, environment and health outcomes across the city and to develop targeted strategies. It also allows for ongoing monitoring of changes over time.

A study was undertaken by the in Port Elizabeth in 1996/1997 to explore wealth, environmental conditions and health across the city. (It was one of a series of very similar studies undertaken in Jakarta, Accra and Sao Paulo funded by the Stockholm Environment Institute). The Port Elizabeth study used a sample of 1 000 households randomly selected across the city to represent the city as a whole. Each household was asked questions about the assets they owned (fridges, radios, TVs, etc), so that a wealth index could be prepared. Five wealth categories (quintiles) were identified. Based on the value of the assets, each sampled household was identified as belonging to one of the (5) wealth quintiles. The study then assessed the relationship between the wealth category and the health of the mother and children of the household. In addition, the environmental conditions were also studied in relation to the wealth and health indicators.

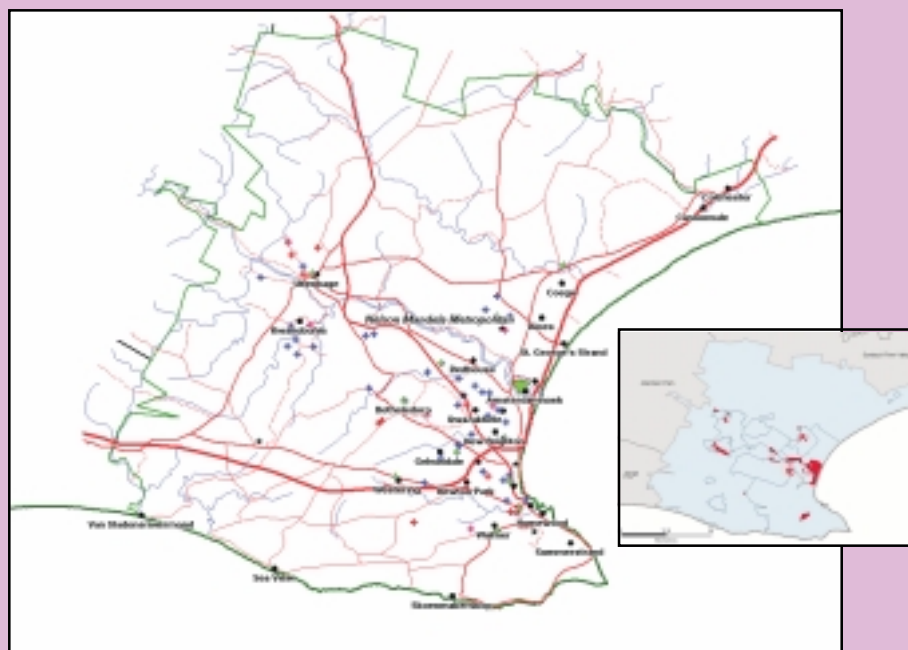
A number of focus groups explored issues that emerged from the statistical results. A project steering committee involving members of the local civics, NGOs and local authority helped in guiding the researchers, as well as holding workshops to disseminate the results.

The findings show wide disparities in access to services across the wealth spectrum. While this is typical of cities in developing countries, the data also highlight the relatively poor access to services by groups disadvantaged by apartheid policies. The use of wealth quintiles also allows for the disaggregation of data previously clustered by racial group to identify the poorest of the poor. Unequal access to education, and therefore opportunities, for income generation in the past is evident in the high rate of functional illiteracy (in the potentially economically active age group) in the lower wealth group (26%) compared to less than 1% in the wealthiest group.

A range of health risks were found in the housing of the lower wealth groups. Although the majority of homes in Port Elizabeth were constructed of brick, more than half of those in the lower two wealth groups lived in informal housing. Wood and corrugated iron sheeting were the predominant building materials for homes in the lowest two wealth groups (76% and 54%).

For those living in informal housing, damp, thermal inefficiency, poor ventilation, overcrowding and the poor siting of houses were some of the main housing problems identified. Besides the discomfort of living in these housing conditions, there are also health consequences. Acute respiratory infections are a major health consequence of some of these environmental factors. Acute respiratory infections (ARI) are the most important cause of death of children under five in developing countries, according to the World Health Organisation, accounting for 27% of deaths in under-fives. Acute respiratory infections in young children impact on the child's health but also on their long-term respiratory health as adults. Children in the lower wealth groups were found to be much more likely to have ARIs. Damp living conditions and overcrowding were found to be statistically associated with acute respiratory problems in the children aged five years and younger. This finding has implications for the housing policy and the importance of providing guidance to those living in informal housing regarding how to minimise the environmental conditions which result in poor respiratory health of children.

A map of health facilities in the Nelson Mandela Metropolitan Municipality, generated from the Medical Research Council's on-line interactive health GIS mapping facility, compared to a StatsSA census 2001 map showing concentration of informal settlements in the city. Hospitals = red crosses; Municipal clinics = blue crosses; mobile facilities = green circles



Diarrhoea has been linked to the death of 25% of children under five internationally. Children living in the lower wealth groups were much more likely to have had diarrhoea. These children lived in households where they shared a toilet with more than five households and where there were puddles in the vicinity of the toilets. Adults, sharing a communal tap with more than 20 other households and storing water in containers, were much more likely to have had diarrhoea.

The study clearly showed how those in the wealthier groups were protected from a number of health problems due to the good access they had to basic services. In contrast, those in the lower wealth groups were exposed to a number of health problems as a result of the poor access to basic services.

A number of policy implications were drawn out from the study. This included the importance of those working in the built environment to better understand the health implications of development policies and service delivery strategies.

It is proposed that the Port Elizabeth intra-urban health differentials study be repeated in 2006, a decade after the initial study. The repeat of the study will be able to assess the extent to which the wealth, health and environmental conditions have changed since democracy. This is particularly important since the shift to non-racially based health and development strategies. The repetition of the study will also be useful to be able to guide in the allocation of resources and to identify the extent to which the health and environmental conditions of the lower wealth groups have improved.

Report of the findings: Household Environment and Health in Port Elizabeth, South Africa, by Thomas, E.P., Seager, J.S., Viljoen, E. et al., <http://www.mrc.ac.za/researchreports/pe.htm>.

## IMPACT ON TIME

Poorly designed and dysfunctional built environments do not only impact on land availability and air and water quality. They also impact on time. Like good health, time is one of those intangible qualities that mean that life in cities is liveable. And although intangible, time is a real resource, with significant cost implications if it is wasted.

Weak city form can begin to severely constrain available time. The impact of locational disadvantage on the urban living costs of the poor has already been discussed, including the time it takes people to move around the city using various modes of transport. The issue is not only a problem for building more inclusive cities, it is a general concern regarding the sustainability of cities.

The problem is self-reinforcing. For example, as Central Business Districts become more crowded, the natural inclination of many businesses is to move out to locations closer to the homes of economic decision makers in wealthier suburbs. This brings businesses short-term relief, but it may also compound the difficulty for others trying to move around the city if planned transport networks and road grids cannot be adjusted fast enough. This leads to other businesses making short-sighted location decisions that further fragment the city.

Figure 59 gives a sense of the ever-worsening problem. It shows the number of vehicles moving into and out of Johannesburg from municipalities to the East, South, North and West. The situation has deteriorated considerably in the space of two years.

## UNDERSTANDING and MANAGING IMPLICATIONS

The South African cities are less integrated today than they were 10 years ago, as a result of the multiple thrusts of office decentralisation, housing development on the edge of the city, public transport infrastructure deterioration, compensation for this through an explosion of taxis and cars on the roads, and pressure on network infrastructure that was not anticipated in bulk infrastructure installations a decade or two ago. Many of the costs of deteriorating urban environments are borne disproportionately by poor people. And businesses and wealthier residents have a tendency to react in ways that give them short-term relief, but ultimately exacerbate the problem exponentially.

Vehicle Trips	From/To								Total	
	North		East		South		West		In	Out
	In	Out	In	Out	In	Out	In	Out		
2001										
- Total Vehicles	53074	35161	35995	48570	46219	25539	40117	22142	175405	131412
	88235		84565		71758		62259		306817	
- %	28,8		27,5		23,4		20,3		100,0	
2003										
- Total Vehicles	62400	44500	38300	52800	50650	27800	49650	27650	201200	152750
	106900		91100		78450		77500		353950	
- %	30,2		25,7		22,2		21,9		100,0	

Urban sprawl particularly affecting lower income communities dependent on public transport is largely a legacy of apartheid. Nationally, average travel distances increased from 23km in 1979 to 37km in 1990 (South Africa: Department of Transport 1999). The average public transport trip in the eThekweni Municipal area is 20km (Traffic and Transportation Department 2000) compared to an international norm in developing countries of 9km (South Africa: Department of Transport 1999). Urban sprawl results in increased cost, non-productive or time consuming commuting with less time for family and social activities . . . In the past there has been limited planning of integration between land-use and transport systems and consequently the negative impacts of one system on the other is evident in many urban areas. This is particularly evident in transport corridors where ineffective land use management limits the efficiency of public transport operations.

*(Towards a Strategic Transport Plan for South African Cities, Situational Analysis prepared by the SACN Transport Working Group, September 2002)*

**Vital new access road for Tembisa**

The new K105 Tembisa link road will provide greatly improved access for Tembisa residents to the industrial area of Clayville as well as to Pretoria and the R21 motorway, Councillor Louis Sibeko, Mayoral Committee Member for Public Transport, Roads and Works, said at the official opening of the road on 3 February 2004.

Cllr Sibeko said although the Pretoria-Johannesburg railway line was of great benefit to Tembisa, it also created a barrier preventing access from Tembisa to the east – and especially the R21. ‘The K105 road, together with the previously completed link at Kaalfontein, have largely addressed this problem. The K105, which created numerous jobs during its construction, will also make the Oakmoor Station and the Oakmoor taxi rank more effective in future.’

*(News on Ekurhuleni website, 17 February 2004)*

Figure 59. Cars moving into and out of Johannesburg, 2001 and 2003

The diseconomies of scale of South African cities are multiplying. They are not yet at the point where they exceed the theoretical benefits of living and working in the city, but they need to be managed now. There is a real temptation to regard sustainability concerns as the problem to be faced by the children of current city dwellers. And there is therefore a tendency to therefore regard them as inter-generational issues of less concern than pressing service delivery extension challenges. But the slow decline of liveability is felt by every one today. And if not anticipated, energy crises and environmental health disasters may cripple a city tomorrow. Both may cause the departure of people from the city. Sustainability issues do need to be faced as soon as possible by city leaders and actors trying to ensure the commitment of residents. They cannot be left for tomorrow.

# LIFE ON THE STREETS

## VICTORIA ROAD, CAPE TOWN

It's the good life on a grand scale on Cape Town's Atlantic Seaboard, where Victoria Road runs through some of the most enviable property in the world. From blocks of stately apartments and multi-tiered modernist constructions hugging the slopes under Lion's Head in Bantry Bay, winding on high above Clifton's famous four beaches, through Camps Bay, Victoria Road divides virgin mountain slope from crashing surf to end at Llandudno, a cove that's become a haven for the rich and famous.

This strip of coast has everything – soaring mountains, pale sandy beaches, superb restaurants, spectacular sunsets and homes to rival those on magazine pages across the world. With property values soaring – achieving between R16 000 and R20 000 a square metre, this golden strip is a cash-cow for a municipality facing a major developmental crisis. The rates base in excess of R1 billion, yields about R1,5 cents in the rand in annual property rates and a sanitation levy based on 50% of the improved market value. Homes in Clifton are on offer from R6,4 million for a modest bungalow to R17,5 million for a cliff-side mansion with gym, a pool that seems to empty into the sea on the horizon and a private cinema. Set

aside in World War 1 as a potential harbour, in the 1920s the Clifton coves were leased by the Council for temporary housing. In the 1980s the Council offered the land for sale to the residents of the wooden bungalows and, recently, the last Council-owned site with a derelict bungalow was sold for a record R4,5 million to a London-based developer.

For the City of Cape Town, the phenomenal rise in the value of areas such as those along Victoria Road means a hefty contribution to the coffers in a city where one in five people lives in an informal settlement and poverty is rife. After the new metro's first general valuation of property – rating those along the Atlantic Seaboard for the first time in over 20 years – the cost of this glorious lifestyle rose considerably. For many of the original homeowners, who bought when Victoria Road was the quiet preserve of white locals, the reality is that in a booming property market fuelled by eager foreign buyers, the costs of living here may become unaffordable. There's scant sympathy from those who argue that for the majority of Capetonians the Group Areas Act and economic disparities prevented them from gaining a foothold in this gold mine.

Things are changing along Victoria Road, and in the eyes of some residents it's not for the better. In summer cabriolets and minibus taxis vie for ownership of the narrow road, where finding a parking space is almost impossible. Beach volleyball and sandcastle building contests draw crowds to the beaches, increasing traffic congestion. And, emulating American teen movies, thousands of matrics from all over Cape Town gather to party the night away on the beach before exams begin – to the annoyance of local restaurateurs and residents quick to call the police. On New Year's Eve and New Year's Day, taxis bring hundreds of families from the townships to enjoy what is now available to all.

On a still summer's day, when the notorious southeaster isn't blowing, it's arguably one of the finest settings anywhere. As night falls, tourists sip cocktails and eat seafood on the balconies of the hotels and restaurants in Camps Bay, watching as the sun slips into the sea and sets the mountains aglow. Groups of people relax on the warm sands of Clifton beach with picnics, drinking sparkling wine, technically illegally since the by-laws forbid alcohol or glass on the beaches. No wonder this strip of coastline been discovered by the world.

There's tremendous development pressure – for more apartments, bigger renovations and the demolition of older homes. The City is also fighting to prevent the owners of large tracts of mountainside under the Twelve Apostles from developing in terms of rights granted decades ago. They argue that the rights are no longer valid, that times have changed and that the land is too valuable as a conservation area to develop into another extension of Camps Bay. For the Muslim community the presence of *kramats*, burial sites, on the slopes means this is holy ground.

The scenic beauty of this area – and its proximity to the National Park comprising Table Mountain and the Peninsula mountain chain to Cape Point – helps draw thousands of tourists, the lifeblood of the local economy.

Victoria Road earns its keep in many ways, not the least of which is as a location for dozens of film shoots every year. The palm trees on Camps Bay beachfront are a familiar sight. Like tourism, the revenue from the film industry is a significant contributor to city's economy with the potential for enormous growth and job creation.

