Chapter 9
Human settlements

At a glance

This chapter begins by defining what is meant by the term human settlement and argues that settlements are complex and dynamic systems with inputs, throughputs, and outputs. The interaction between settlement and environment is explained in terms of ecological footprint: the analysis of human consumption of resources and production of wastes in the context of nature's regenerative and absorptive capacity. The chapter then focuses on the current dynamics of settlements, paying special attention to the size, geography, patterns, and form and function of South African settlements. Population, growth, international migration, and the need for reliable transport systems are featured as the key pressures affecting our human settlements. As places where people live and work, human settlements are also assessed in terms of their livability; focusing on their current state of amenities, employment, shelter, service provision, and heritage. Human settlements are, in turn, shown to require large quantities of energy, water and land to sustain their activities, and produce a range of wastes, thus displaying ever-growing ecological footprints. The chapter ends by focusing on the governance of our settlements. It highlights Integrated Development Plans (or IDPs), which aim to integrate developmental and financial planning in municipalities, as well as the emerging plan for Sustainable Human Settlements being championed by the Department of Housing.

9.1 INTRODUCTION

Human settlements define people's existence. They are places – large and small, urban and rural, formal and informal – where people live, learn, work, and create. They also comprise an important component of the entire environment, namely the built environment. The world has witnessed a dramatic increase in the movement of people to urban areas, especially in developing countries.

Opportunities for employment, education, and access to health care are some of the principal factors that attract people to urban settlements[a]. This has resulted in more urban settlements with larger populations and the dramatic expansion of existing urban centres. Over 40% of the global population lived in urban centres in the year 2000 compared to 27% in 1972[1]. It is projected that the world will soon pass the 50% mark, reaching 60%, at about 5 billion people, by 2030. The urban population in the developing world is growing at 2.4% per year, which is double the global growth rate. Rural–urban migration is most evident in sub-Saharan Africa, which has an urbanization[b] rate of 3.5% per year. About 300 million Africans currently live in urban areas, and it is estimated that this figure will rise to 1 405 million by 2030[2].

South Africa is experiencing a similar trend. Close to 58% of the population is urbanized, up from 53% in 1996. This is much higher than the average for sub-Saharan Africa, which stands at 34%[1]. As with the rest of the developing world, this rapid urban growth has placed significant pressure on the natural and human systems that underpin and maintain settlements. Although our larger urban settlements occupy less than 2% of the nation's land area, they exert a considerable influence on the natural environments outside their own boundaries.

Human settlements lie at the centre of global efforts to address the multiple challenges facing sustainable development. The Johannesburg Plan of Implementation of 2002 was formulated within this context. The Millennium Development Goal 7 sets important targets relating to human settlement, in line with the principles contained in Agenda 21 and the Habitat Agenda[c]. Whereas Target 10 aims to halve the proportion of people without safe drinking water by the year 2015, Target 11 commits countries collectively to improving the lives of 100 million slum dwellers by 2020. (See Annexure 2.)

Against this background, and with the socio-political overlay of settlement engineering, the pattern of human settlement in contemporary South Africa is complex and multi-faceted. A picture is needed of the different types of settlement that characterize our landscape. State of the Environment reporting is one way to assess both the natural resource capacities and the quality of life in human settlements. This chapter begins by examining the dynamics of human settlements in South Africa and the associated demographic, economic, and social pressures. Settlement status is assessed with regard to livability (that is, the extent to which it is a place fit for people to live in), and focuses on social amenities, service provision, resource inputs, and waste outputs. The chapter further examines the impact of settlements on the environment through their

A settlement in a rural area near Mokopane. *Photography: South African Tourism*

consumption of resources and production of wastes, and deals with ways of measuring the quality of life within settlements, using various socio-economic and health indicators. It ends with reviews of some responses to the challenges that human settlements face.

9.2 SETTLEMENTS AS SYSTEMS

Settlements are places where there is social interaction and economic activity. The complex interplay between these interactions determines how habitable settlements are, as well as their impact on the environment.

Examining the flow of resources into and the waste outputs from settlements is one way to assess their environmental impact. Settlement systems have functional similarities to individual human systems, having inputs, throughputs, and outputs (see Figure 9.1). The inputs comprise people, such as daily commuters, permanent migrants, and immigrants; goods that include building materials, food, fuel, and furniture; and services, such as water and electricity. Outputs include items such as wastewater and refuse, departing commuters and emigrants, and insidious 'exports', such as polluted water and air. Useful outputs can include the products and services that originate from creative community members.

Growth in production with little recycling utilises virgin resources at an escalating rate, with adverse impacts on the environment that has to provide those resources as well as to absorb the waste stream that arises from consumption. The linear form of this scenario is illustrated in Figure 9.1. Natural processes are characterized by cycles, in which there are routes of return from output back to input, providing the system with long-term sustainability. Medieval cities offered an illustration of this system, with their market gardens, orchards, arable and grazing land, local water supply, and forest products as examples of self-regenerative activity. Modern cities can only become more sustainable by modifying their linear structured urban existence to a more circular system that has a self-regulated and sustainable relationship with the biosphere.

Looking at settlements from a systems perspective provides a model for assessing the environmental impact of settlements.

9.3 INTERACTION BETWEEN SETTLEMENT AND ENVIRONMENT

Settlements depend upon environmental resources, which explains the concentration of human settlements around relatively well-watered areas along the eastern and southeastern seaboard and interior of the country. Mineral distribution (material resources and fossil fuel) has been the
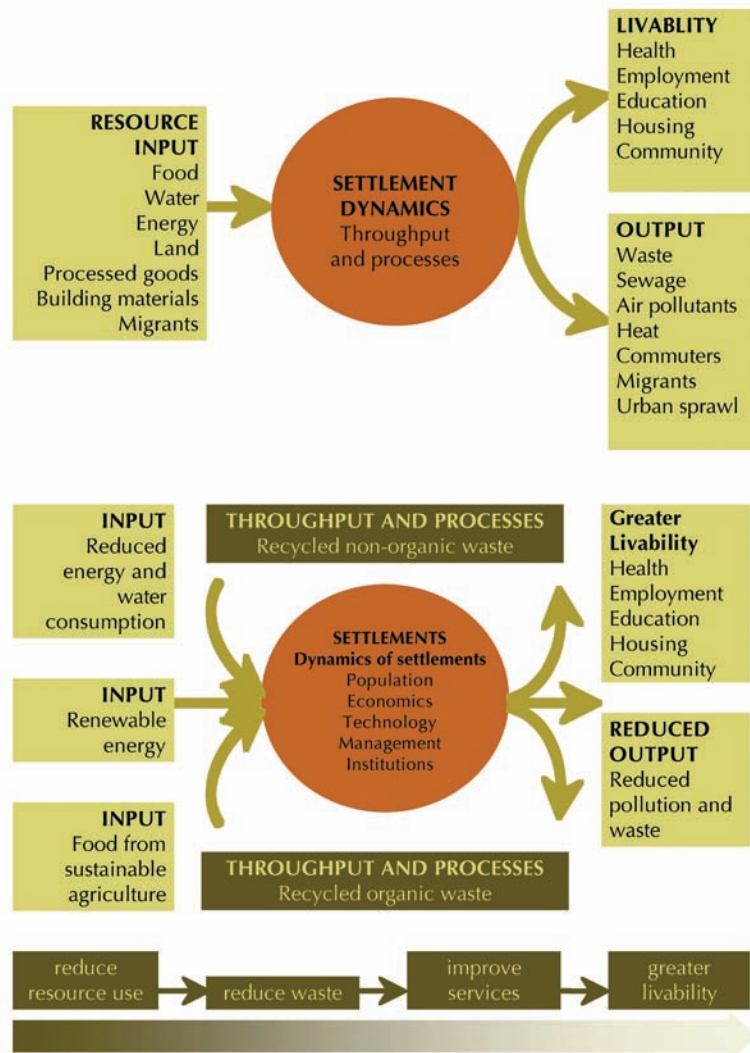

Figure 9.1: Settlements as systems
Source: Adapted from Newman P. et al. (1996)[3] and The Science Museum (2004)[4]

other important driver of settlement location in South Africa, and is the reason for the highveld having become the most densely populated region, as well as the economic heartland of the nation.

Settlements and their associated activities affect their surroundings through processes of production and consumption. They influence the natural environment; they also involve the exploitation of both biological and non-biological resources, generating pollution and waste that has to return to the environment. The nature and extent of the impact is determined by, amongst other things, the scale of a settlement, the level of infrastructural development, the rate of resource consumption, and the types of human and economic activity[5]. A deteriorating environment poses potential threats (such as public health and flooding) to settlements and their residents. Some of the settlement–environment interactions in South Africa are examined in the following section.
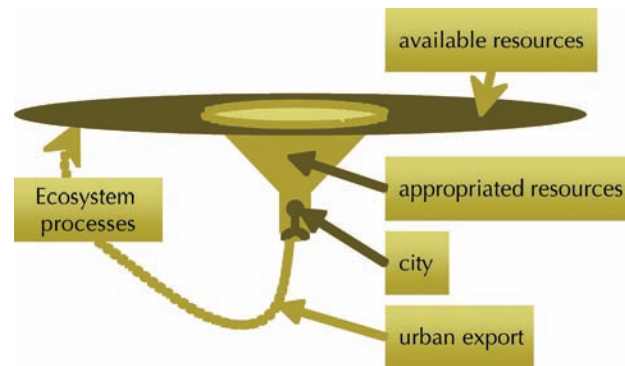
Figure 9.2: Schematic diagram of the urban funnel 'ecological footprint' conceptual model
Source: Luck et al. (2001)[9]

9.3.1 Ecological footprints

Settlements were once compact and structured, constrained by transport and production systems based on human or animal power. A major consequence of the industrial revolution and access to energy through fossil fuel-based technology has been that the high density of traditional cities has given way to urban sprawl. Fossil fuel-powered transport has made settlements less reliant on resources from their immediate surroundings, allowing them to draw on what is available in an ever-widening area. In such conditions, and without proper management, waste accumulation and pollution grow in such conditions, affecting areas outside the settlement as well (with greenhouse gases, ozone-depleting substances, and hazardous materials, for example). Techniques for determining the extended environmental impact of settlements due to their resource consumption have been developed by researchers such as William Rees, who is responsible for the term 'ecological footprint'.

Ecological footprint (EF) analysis is a tool for measuring ecological sustainability. Ecological footprints refer to the human natural resource consumption and waste output within the context of nature's regenerative and absorptive capacity (or 'biocapacity')[6]. The ecological footprint analytical method calculates by mass the total resource consumption (water, land, food, energy) and waste generation (solid, liquid, gaseous) of a person, city, or nation. Using productivity absorption factors (such as output in tonnes/hectare), ecological footprint analysis interprets this in terms of a corresponding area required to generate these resources and consume the waste. The result, in hectares per person (ha/person), is the 'ecological footprint'. Figure 9.2 conceptually displays the spatial and process manifestations of urban ecological footprints. It shows how requirements are appropriated from a pool of available resources and funnelled to the city where they are processed and consumed. Excess materials and waste products are discharged into the environment.

As the economic engines of nations, cities are central in the pattern of resource-waste flows. Globally, they consume 75% of all resources and produce 75% of all wastes[7]. They are therefore one of the keys to improved environmental sustainability. A global study conducted in 2004 assessed the relative global footprints of 148 nations, in ha/person[8]. It found a strong positive correlation between a country's gross domestic product (GDP) and its ecological footprint, with a higher GDP linked to higher levels of consumption. South Africa displays a global ecological footprint of 2.8 ha/person, considerably higher than the global average of 2.2, and over five times the global footprint of Afganistan, which is lowest of all at 0.3 ha/person. Like other middle-income countries, South Africa's relatively large ecological footprint is attributable for the most part to its level of fossil fuel consumption and to the transformation of land from its natural state (see Chapter 4).

Box 9.1 Ecological Footprint Analysis – case study of Cape Town

Barry Gasson, at the University of Cape Town's School of Architecture and Planning[10], conducted an Ecological Footprint Analysis of the City of Cape Town for 2000. Cape Town covers an administrative area of 2 487 km², with a built-up area of 774 km². It relies upon an area of about 128 300 km² for the supply of its resources and the absorption of its wastes. This area approaches 10% of the total surface of South Africa (1 225 815 km²) or about the area of the Western Cape Province (which is 129 370 km²).

Given a population of about 3 million, this translates into an Ecological Footprint of 4.28 ha/person, indicating that Capetonians are consuming more than double the 'fair Earthshare' of 1.9 ha/person (that is, the amount of productive land on the planet available to supply each person's resource needs and absorb their outputs). Cape Town's energy footprint, moreover, was estimated at 10 920 km², this being 8.5% of the city's overall Ecological Footprint. It includes the area needed to supply the required fossil fuels and takes account of the load of carbon dioxide emitted to the atmosphere.

Source: State of the Cities Report (2004)[1]
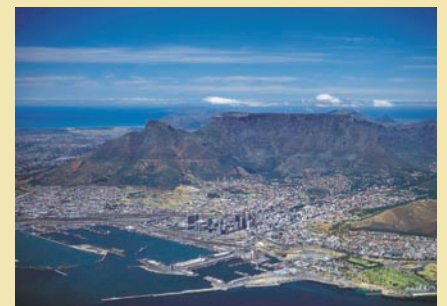
Photography: South African Tourism

In the absence of a comprehensive study of South Africa's national ecological footprint, it is useful to focus on the ecological affects of the country's human settlements. Box 9.1 presents the findings of a recent analysis study of the city of Cape Town. The ecological footprint model focuses on resource flows in settlements and helps to evaluate their extended impact on the environment. It is a powerful tool that is understandable by the lay person. It is not, unfortunately, a tool for assessing whether or not resource requirements can be reduced at the same time as raising or improving quality of life in settlements. The systems model, described in the previous section, is thus a preferred model.

9.4   SETTLEMENT DYNAMICS

9.4.1   Types of settlement

Human settlements can be differentiated by many factors, such as topography, location, size, proximity, and management structure. As a result, it is not always easy to identify and distinguish between different types of settlement. South Africa, for instance, has a settlement hierarchy that comprises settlements of varying sizes and geographic locations, and includes places that are urban and rural, planned and unplanned. Map 9.1 shows the settlement hierarchy for the country.

The size of settlements

The Urban Development Strategy of 1995 identified four principal city size classes: large metropolitan areas (over 2 million people), large cities (500 000 to 2 million), medium sized cities/large towns (100 000–500 000), and medium sized towns (50 000–100 000). Given its urban focus, the strategy did not include any rural typologies. In 1998, the White Paper on Local Government officially extended the previous narrow interpretation of settlement types to rural settlements, including rural villages of varying sizes. Subsequent reports on human settlements have expanded the settlement typology as follows: small towns (fewer than 50 000 people); displaced urban or dense rural settlements (fewer than 50 000)[11]; large rural villages (5 000–50 000 people); and small rural villages and scattered settlements (fewer than 5 000)[5].

Although the different typologies differentiate between urban and rural, the definitions of 'urban' and 'rural' remain unresolved[12]. The problem lies with disagreement about criteria, especially at the borderline conditions between these settlement types. Urban areas are typically densely settled and developed, whereas rural settlements are characterized by a scattered distribution of population. This said, there are many settlements with both urban and rural characteristics.

The geography of settlements

To understand South African settlement typology, geographic location and distribution also need to be considered. Settlements are defined by their relative location within and adjacent to urban cores, as well as in terms of their economic divisions, whether they are in the core of cities, or on the fringe or periphery, or at some distance from them. In addition to their spatial location, settlements can also be differentiated as planned and unplanned, formal and informal, and comprising a range of housing types.

A planned settlement is one that has taken place within a legal land-tenure framework, and is characterized by the planned provision of services and infrastructure. Under apartheid, planned townships were constructed on the fringes of towns and cities. The services were often basic, but frequently superior to those found in the informal[d] residential areas that have subsequently grown within and around them.

Unplanned settlements evolved as people settled in areas that were closer to employment opportunities. They have occurred in various locations, these being within planned townships, on open land within an urban area, or in peri-urban areas. Peri-urban squatter settlements typically develop on farms or smallholdings situated on the outskirts of cities and towns. These mainly unplanned settlements consist of a range of housing, such as backyard shacks and free-standing structures, normally without services. Some
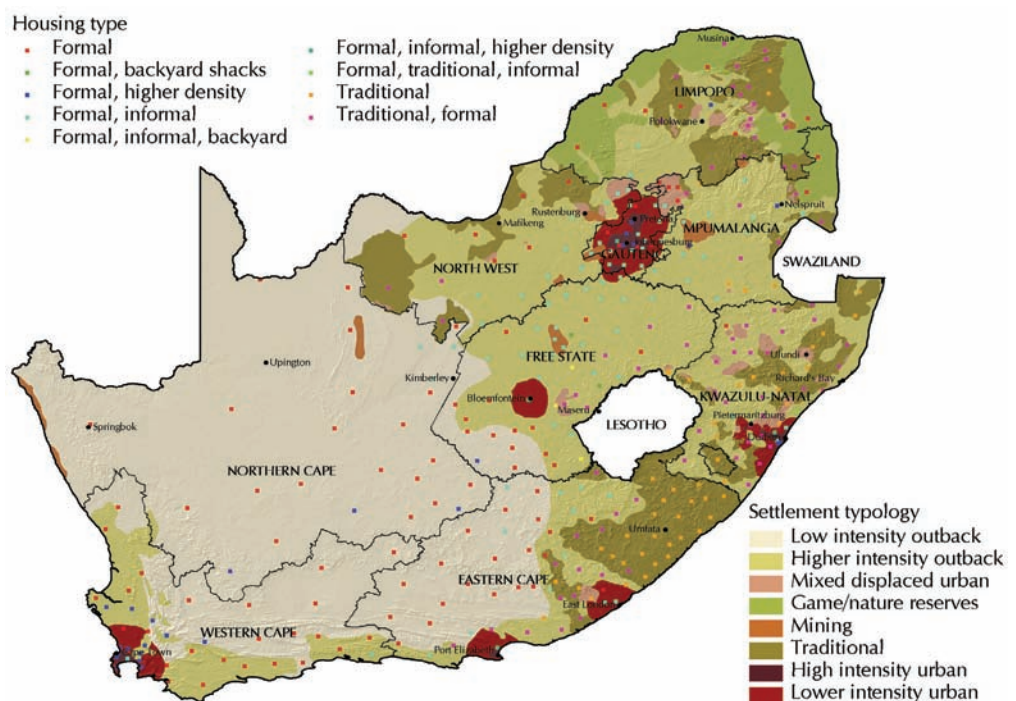
Map 9.1: Types of settlements and their distribution in South Africa
Source: Department of Housing (2002)[13]

that involved a mix of criteria, such as structure of the built environment, land use, and existing political institutions. As a result, settlement type categories were broadened, to incorporate more strongly the informal and semi-urban aspects of urban classification used in the 1996 and 2001 Censuses.

9.4.2 Patterns of settlement

South Africa has a fully developed settlement hierarchy, with high levels of connectivity[e] – by developing world standards – of roads, rail, and communication networks.

Settlement patterns have historically been shaped by colonial conquest that was imposed on indigenous settlement patterns, followed by colonial trade and mining. Consequently, many of South Africa's large urban centres are situated along the coast (eThekweni (Durban), Nelson Mandela Metropole (Port Elizabeth), Buffalo City (East London), and Cape Town) or in the proximity of major mining activities (Kimberley, Mangaung (Bloemfontein), Johannesburg, and Tshwane (Pretoria)).

Recent changes in settlement patterns are partly a legacy of apartheid spatial planning, which, over several decades, methodically structured towns and cities with spatially separated races and classes. Black residents were located on the normally poorly serviced margins of the cities, without satisfactory infrastructure and with limited work opportunities, or shopping or entertainment amenities. White residential areas were generally well planned and well serviced, conveniently located with respect to employment and major urban amenities. South African cities still bear testimony to this legacy, despite efforts to address its inadequacies. Rural settlements are generally unplanned and poorly serviced.

A large proportion of the rural settlements are located in the former homeland areas of the Eastern Cape, KwaZulu-Natal, Limpopo, and North West. Some key elements of the rural landscape remain, such as land under communal tenure in former homelands and large peri-urban dormitory settlements in former homelands (for example, the complex of settlements in the former KwaNdebele, east of Tshwane).

The Municipal Demarcation Board effectively linked towns and cities with their peri-urban and rural hinterlands by redrawing municipal boundaries in 1999/2000. The purpose of this exercise was to improve the integration of the people, communities, economic activities, and infrastructure of urban and rural settlements. The extended municipal boundary of Tshwane Metropolitan Municipality, for example, includes within its urban fabric, the high-density central business and residential districts, industrial areas, several town centres, commercial farms, and peri-urban smallholdings and homesteads, as well as the displaced urban settlement of Winterveldt.

Historically, local authorities have defined South African settlements as 'urban areas', which has led to a separation of rural areas from towns and cities and deepening inequality for rural residents.

are illegal, while others are on communal land, or on land on which tenure has been secured following settlement.

Planned informal settlements have evolved through site-and-service schemes, where the identification and preparation of land before settlement takes place and includes the provision of basic infrastructural services. There has been wide *in situ* upgrading of existing informal settlements, which involves the provision of secure tenure and the service infrastructure required to promote the health and safety of people living and working there.

Historically, local authorities have defined South African settlements as 'urban areas', which has led to a separation of rural areas from towns and cities and deepening inequality for rural residents. This definition lapsed through the promulgation of the Municipal Structures Act (No. 17 of 1998), which set about the re-demarcation of municipalities (see Box 9.2). The Municipal Demarcation Board improved human settlement management significantly by placing all rural and urban land in the country under the jurisdiction of local government[14]. Coupled to this, Statistics South Africa categorized census enumeration areas in the 2001 Census

Table 9.1: Population in the nine largest cities in South Africa

City	Size of municipal area (km²)	Population (2001)	Population (2004)*	Average density (people/km²) (2001)
Buffalo City (East London)	2 516	701 890	713 921	279
Cape Town	2 499	2 893 247	3 111 039	1 158
Ekurhuleni	1 923	2 480 276	2 799 707	1 290
Ethekwini (Durban)	2 292	3 090 122	3 313 205	1 348
Johannesburg	1 644	3 225 812	3 638 715	1 962
Mangaung (Bloemfontein)	6 283	645 441	671 856	103
Msunduzi (Pietermaritzburg)	648	553 223	572 975	854
Nelson Mandela (Port Elizabeth)	1 952	1 005 778	1 028 021	515
Tshwane (Pretoria)	2 198	1 985 983	2 193 596	904
* Estimated				

Source: South African Cities Network (2004)[1]

South African cities are characterized by low-density urban sprawl, where residential areas are apart from places of employment, shopping, and public amenities.

By accepted definition, most South African cities are classed as 'small'[f]. There are six large cities and no mega cities (see Table 9.1). The metropolitan areas of Johannesburg, Ekurhuleni, and Tshwane form the core of the country's industrial heartland and include the Vereeniging–Vanderbijlpark–Vaal complex. The Gauteng cities, although defined as separate metropoles, form a 'polycentric urban region'[1]. The port cities of eThekweni, Cape Town, and Nelson Mandela Metro are also centres of significant economic activity.

9.4.3 Urban form and structure

South African cities are characterized by low-density urban sprawl, where residential areas are apart from places of employment, shopping, and public amenities. Urban development continues to amplify the fragmented nature of our cities through the expansion of peripheral formal and informal settlements[5]. Cities become fragmented into discrete cells of development intersected by road systems, and isolated according to land use, population, and income.

Cluster complexes, townhouses and wealthier suburbs are less dense than the poorer suburbs and informal settlements.

Photography: City of Johannesburg

Wealthier suburbs invest in greater security, one-entrance townhouse and cluster complexes, golfing- and country-estates, and walled and gated blocks, contributing further to urban sprawl. Residential development accounts for a third of all development in the country's largest cities[1]. Attempts at densification in poorer suburbs are frustrated by the expansion of fringe informal settlements. This sprawl is often exacerbated by land invasions, as long-standing residents living in backyard dwellings of existing townships, as well as newcomers to the city, occupy open land on the outskirts in hope of securing housing in the future[1]. Peri-urban areas in Randburg, for example, have witnessed a dramatic increase in land invasion in close proximity to the Cosmo City residential project currently under development. Illegal land encroachment is attributable to growing impatience with the land reform process, especially in urban areas[15].

Cities such as Cape Town and Johannesburg are attempting to define and set the urban edge, because of the logistical and fiscal challenges associated with urban sprawl. The aim is to encourage residential and other commercial development within the existing confines of the city, thereby fostering a more compact city structure.
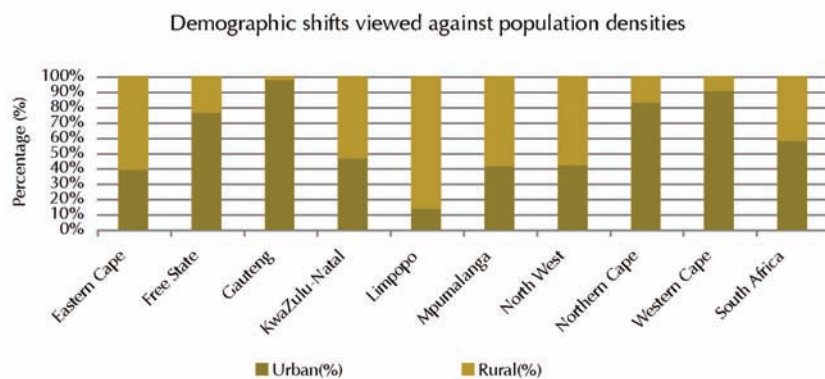
9.5   PRESSURE

Various specific pressures associated with human settlements have a bearing on the state of the environment and should be considered in the integrated development planning process. They include pressures on: water resources (including quality and consumer demand), recreational amenities, energy supplies, waste disposal sites and sewage treatment plants, and biodiversity. Other pressures include the higher rates of population and housing with their associated impacts of land transformation, noise nuisance, and the effects of growth in the transport sector.

South Africa's significant coastal population has an important impact on both land and sea. Natural landscapes and habitats are often altered, to accommodate development. Coastal forests are felled, lagoons and coastal waters are 'reclaimed', wetlands are drained, and the floodplains around estuaries are built over and reduced. Ecosystems become damaged beyond recovery. Fish stocks, fresh water, soils, and beach sands have been over-exploited at unacceptable economic and ecological cost. Chapter 7 describes the discharge of increasing volumes of waste, particularly sewage, into coastal waters. This leads to eutrophication, endangering public health.

The major forces shaping settlements in South Africa are population dynamics, migration, and transport, which are discussed in the sections that follow.

9.5.1   Population

Settlements expand and evolve as populations grow. Population size and density are some of the criteria used to characterize a settlement as either urban or rural. Despite ongoing debate, there is broad global agreement that settlements exceeding 20 000 people, and a population density of more than 1 000 persons/km^2, are considered to be urban[1]. This limit does not reflect the functional interdependence of urban and rural areas, as has been recognized in the new municipal demarcation.

The South African population increased from over 7.4 million to over 44.8 million between the years 1946 and

Figure 9.3: The proportion of urban and rural dwellers by province, 2001
Source: Statistics South Africa (2004)[17]
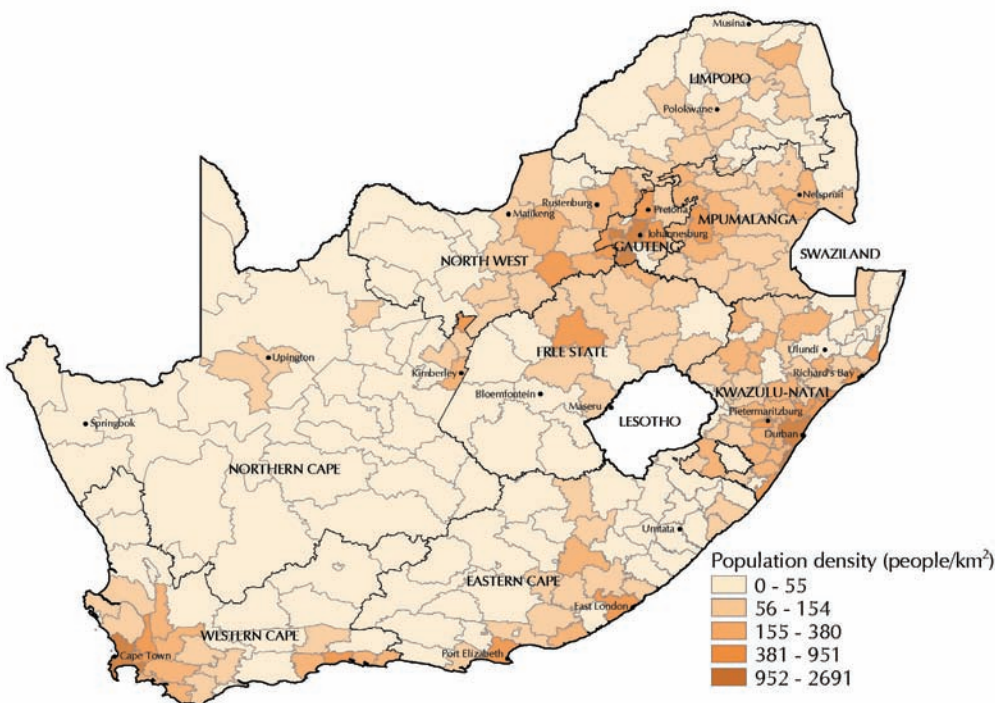
Map 9.2: Spatial distribution of population density across South Africa
Source: Department of Housing (2002)[13].

2001, an average annual growth rate of about 3.3%[1]. Recent census data provide more detail about the country's demographic shifts between urban and rural areas that should be viewed against the backdrop of national population densities (presented in Map 9.2). There is a strong relationship between population density and the nature of settlement. In 2001, 57.5% of South Africans lived in urban areas, while 42.5% lived in rural settlements[16] (see Figure 9.3).

There was a general perception that South African cities would experience large-scale permanent rural-to-urban migration after the scrapping of laws that prescribed where groups of people may live. The proportion that moved into urban areas between 1996 and 2001, nationally, increased by 2.4%[16], while seven of the nine provinces experienced a lower than average growth in urban population during this period (see Figure 9.4). This implies that rural–urban migration is not as significant, or permanent, as perceived, nor is it a simple one-way process.

Migration is often two-way and temporary[18]. Although many cities have grown in population size, there is evidence of return migrations to rural areas from cities and towns. There is also inter-city migration, as people abandon one urban centre with high unemployment and move in search of opportunities elsewhere. Intra-city and intra-provincial migrations also play a role. For example, 13.7% of new migrants to Johannesburg in 2001 came from Ekurhuleni and Tshwane, and a further 10% from the rest of Gauteng. The city of Johannesburg lost 92 400 people (or 47% of total out-migration) to the rest of the province[1]. In Cape Town, 11% of the total population moved house between 1996 and 2001. In addition, the country's nine largest cities have seen an average annual increase of some 5% in households between 1996 and 2001, far in excess of population growth[17]. This increase supports the view that households that are resident in the cities are splitting[g].

The demographics in relation to human settlements are also affected by HIV and AIDS. The rate of population growth is already slowing down, and total population is predicted to decline after 2007[19]. Major urban areas will be particularly affected, but rural areas will also feel the impact (see Map 9.3, and refer to Chapter 2 for more information about the scale and impact of the HIV and AIDS pandemic).

9.5.2 International migration

Transboundary migration has played a significant role in the South Africa's urbanization process. The country has a long history of dependence on migrant workers, particularly in the mining and agricultural sectors[21]. Its political and economic stability from the 1990s onwards, relative to that of Southern African Development Community (SADC) countries and beyond, has brought new streams of migrants, both legal and illegal. Legal migration from SADC countries to South Africa increased dramatically after

Cape Town is one of the country's largest cities, which have experienced an increase in households. *Photography: IMAGES24.co.za / Die Burger / Mouton van Zyl*

1990[22]. For example, numerous Zimbabwean health professionals are migrating to South Africa (as well as to other countries)[23].

There has been an immigrant-derived increase in South Africa of 158 000 SADC-born people between the 1996 and 2001, whereas the number born in other African countries (such as the Democratic Republic of Congo, Ethiopia, and Somalia) increased by 21 800[17]. The growing trend in foreign immigration to South Africa still prevails. Authorities received 104 000 applications for asylum in the year 2004[24], more than double those in 2000.

A baseline study undertaken in 2003 among 1 500

Legal migration from SADC countries to South Africa increased dramatically after 1990. For example, numerous Zimbabwean health professionals are migrating to South Africa.
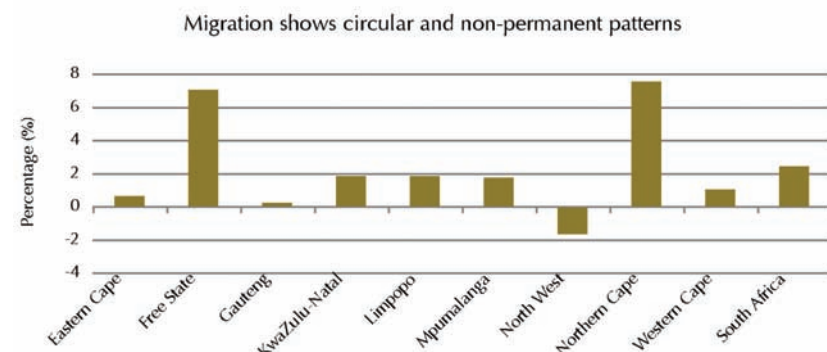

Figure 9.4: Difference (in percentage) in the population proportions living in urban areas, 1996–2001
Source: Statistics South Africa (2003)[16]

Map 9.3: Estimated impact of HIV and AIDS on population numbers, 2001–2011
Source: Department of Housing (2005)[20]

Map 9.4: Net migration, 2001–2004
Source: Department of Housing (2005)[20]

refugees showed that the average age of African refugees was 31 years, slightly less than half of them were single, 82% were men, and two-thirds possessed at least a matriculation-level education[25]. The immigration of women to South Africa is also increasing[26]. Men migrate primarily in search of employment, while women tend to move to South Africa for trading opportunities.

Reliable statistics on South African illegal residents are unavailable. About 600 000 people were forcibly repatriated from South Africa between 1994 and 1998[27]. Stricter provisions of the new Immigration Act, introduced in 2002, impose harsh penalties on anyone giving work or shelter to illegal immigrants. This could explain the subsequent sharp increase in asylum applications, as the Refugees Act states that no one who has applied for refugee status can be deported until after their application has been processed.

Trends in national and international migration are represented spatially in Map 9.4. The map shows migrants who are concentrated in and around the large cities, as well as in parts of Limpopo, Mpumalanga, and KwaZulu-Natal. Their distribution corresponds with the location of displaced or dormitory urban settlements on the fringes of cities or in dormitory towns far from urban centres.

9.5.3 Transport

Transport systems comprising road and rail networks, airports, and harbours form a backbone to any country's socio-economic activities by enabling the movement of people and products.

Many people still do not have access to an existing and extensive formal railway and road infrastructure, and live in areas that do not have reliable transport. Aside from cost, a problem shared with other countries, is that our population is generally scattered over large areas. The consequence is that many find distances to train and bus stations to be too excessive to be of practical use, and what transport there is too unreliable. Walking and cycling account for about 60% of all human transport, with almost 37% of the population using road transport (see Figure 9.5). The use of motor vehicles for passenger transport is the least efficient per passenger, in terms of congestion, energy consumption, and air emissions, but road vehicles have the advantage of point-to-point flexibility, both in terms of space and time. Private vehicle transport, including cars and motorcycles, accounts for 19% of journeys taken, while minibus-taxis account for 11.5%. As has already been implied, differences exist in the levels of access to transport between urban and rural areas. Many more people in rural areas travel on foot than in private motor-cars, buses, or minibus-taxis[28]. Use of private vehicles and taxis, compared as a national average with selected local metropolitan areas, is far lower.

Private-vehicle travel accounts for almost half of commuter trips in Johannesburg, with minibus/taxi travel accounting for another third.
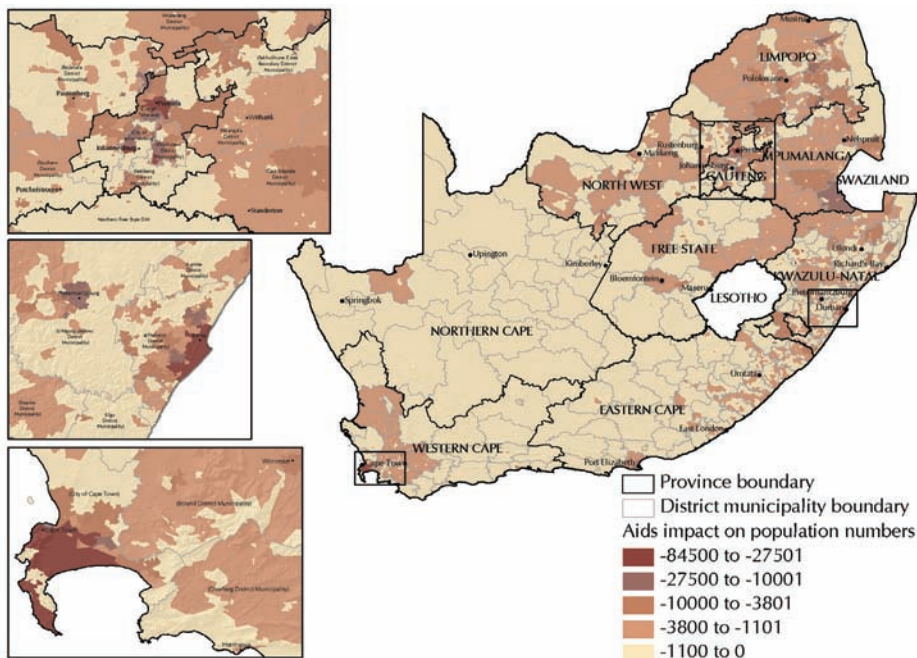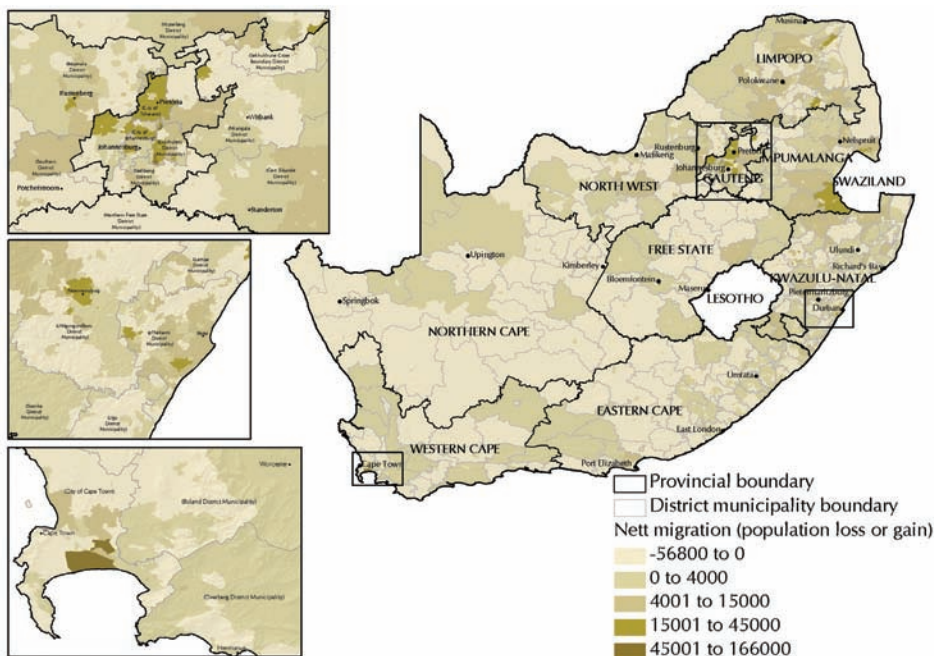
Most South Africans depend on public transport, notably privately-owned minibus taxis, for long-distance travel as well as for commuting to the work-place. Since state-sponsored transport subsidies apply only to rail and bus transport, less affluent travellers who rely heavily on minibus taxis do not benefit from these subsidies. Added to this are the personal hazards of using this loosely-regulated transport system that often relies on poorly-maintained and unroadworthy vehicles and poorly-trained drivers[29].

In 2001, South Africa had an estimated 129 vehicles per 1 000 people. This exceeds the world average of 120 vehicles per 1 000 people. Over 7 million vehicles are currently on South African roads, with a growth rate of about 2% per year.

There is growing acceptance of the challenges linked to poor transport. The Urban Development Framework of 1997 has focused attention on integrated planning, including transport planning, by outlining a programme that aims at the effective integration of cities. The White Paper on National Transport Policy (1996) and Moving South African Strategy (1999) intended to promote efficient transport systems that facilitate socio-economic integration within and between urban and rural areas. Using a range of strategic actions, such as densifying corridors and providing a mix of transport services or modes, the government aims to develop transport corridors at strategic sites across the country. This policy and strategy is closely linked to Spatial Development Initiatives, the purpose of which is to unlock inherent economic potential in specific spatial locations such as Pietermaritzburg–Durban–Richards Bay, Uitenhage–Port Elizabeth–Port St Johns and Pretoria–Brits–Rustenburg[30].

9.6 LIVABILITY (STATE OF SETTLEMENTS)

Livability can be defined as 'quality of life' as experienced by the residents of a city, settlement, or region. Their quality of life depends on economic, social, environmental, and cultural factors, as well as on the physical conditions and spatial characteristics of villages, towns, and cities. City layout and aesthetics, land-use patterns, population and building densities, transportation, and ease of access for all to basic goods, services, and public amenities have a crucial bearing on the livability of settlements (see Habitat Agenda Principle 4).

Settlements across South Africa vary in terms of the quality of life and the social amenities that they offer. People in different settlements enjoy greater or lesser measures of health and happiness, access to schooling, services, housing, employment, and safety. Settlements rich in these qualities are also rich in livability. This section focuses on social amenity and health issues, as well as access to basic services in human settlements.
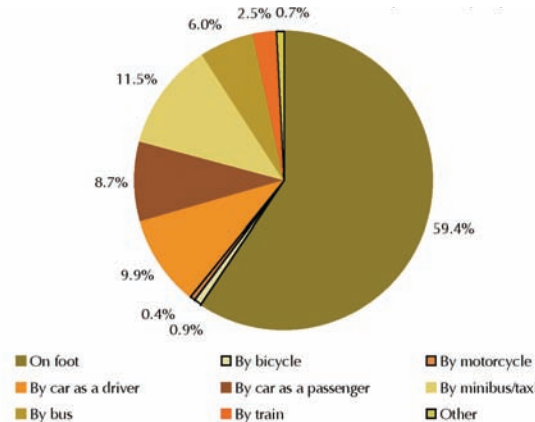
Figure 9.5: Modes of transport used in South Africa, 2001
Source: Statistics South Africa (2004)[17]

9.6.1 Amenities

Health services

Social services are important, as they contribute to the health and welfare of urban and rural communities. The following statistics provide some indication of the state of health services in South Africa:

- South Africa had 143 755 beds in 749 private and public hospitals in the year 2002[31]. By 2004, the number of beds had declined to 135 977 in 739 hospitals[32].

- There was a total of 197 898 public health sector posts[h] in 2002, which included 19.3 medical practitioners per 100 000 people. Recent surveys have found a poor availability of all kinds of key health care personnel at a national level[33].

- In 1996, one third of the country's public health-care facilities needed rehabilitation[34]. By 2001, 282 hospitals and 2 298 of the 4 000 clinics throughout the country had been upgraded, with some 500 mobile clinics having been provided between 1994 and 2001. Of the facilities sampled in the 2003 Facilities Survey, 70% were found to be in urgent need of repair, with only 43% having adequate toilet facilities for patients and staff[35].

- Of the facilities surveyed in 2003, 35% had been commissioned within the previous 10 years, indicating a possible improvement in access to public health-care facilities for many South Africans.

- Although most public health-care facilities provide family planning and tuberculoses (TB) support at least 5 days a week, almost one third did not provide an immunization service 5 days a week. Facilities were also inadequate

Health care accessibilty index
(The lower the value the
higher the accessibility)
- 40 001 - 225 000
- 16 001 - 40 000
- 0 - 16 000
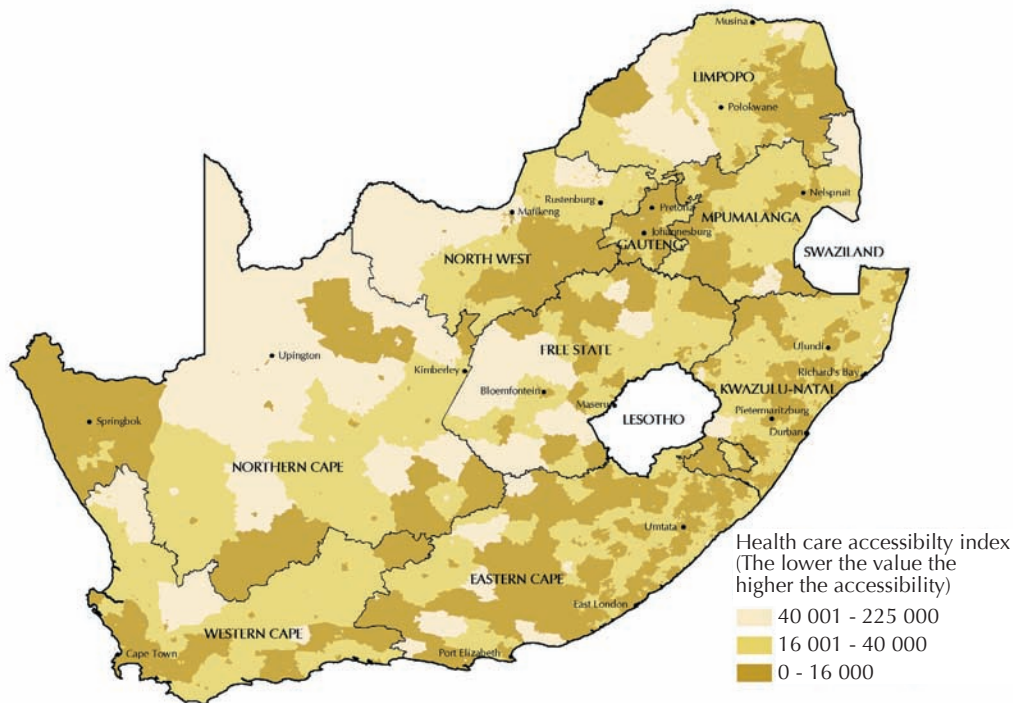
Map 9.5: Health care accessibility index
Source: Department of Housing (2002)[13]

for the level and quality of care required for HIV positive patients.

Access to health facilities (like access to other services) varies distinctly across the country (see Map 9.5). Low accessibility is a characteristic of rural settlements, although informal and displaced urban settlements, such as Emfuleni (Gauteng), Atlantis (Western Cape) and Winterveldt (Limpopo) share the same problem.

A severe shortage of health-care staff, resources, and facilities in public hospitals and clinics has compromised the provision of health care. About 43% of posts in the public health care sector were vacant in 2002[31]. The decline in the number of community-service professionals from 406 (in 2001) to 341 per 100 000 people (in 2003)[36] is of particular concern, as it has lowered the access to basic health-care services of the rural and urban poor. The inequitable geographical distribution of health services amplifies the effects of these shortages. There is an imbalance in the inter- and intra-provincial distribution of health-care facilities, with some areas experiencing over-supply or backlogs. The Eastern Cape, Mpumalanga, and Limpopo, in particular, have major shortages of hospital beds[37]. In addition to these inequalities, the quality of many public health-care facilities requires urgent attention, particularly in the Eastern Cape, Gauteng, and North West. These conditions highlight the importance of sustained maintenance.

Much still needs to be done to improve the delivery of health services. The White Paper for the Transformation of the Health System in South Africa (1997) and the subsequent Health Sector Strategic Framework 1999–2004 serve to guide the activities of national and provincial health departments. It is policy to provide free health care to children at all public hospitals and to supply medication for pregnant women who are HIV positive. In practice, few women receive the medication. Despite efforts to contain the epidemic, there are few encouraging results[38].

Programmes such as the Hospital Rehabilitation and Reconstruction Programme and the Clinic Upgrading and Building Programme have successfully provided some basic health-care facilities to poor communities, including women and children.

Education

South Africa faces huge challenges in the education sector. The obvious improvements since 1994 have been unevenly spread. The transformations of the education system include the following:

- The creation of a single national education department, amalgamating 19 departments that were racially, ethnically, and regionally divided

- The establishment of non-discriminatory environments in the country's 27 000 schools

- The establishment of a National Qualifications Framework, and the rationalization of 150 Further Education and Training Colleges into 50 institutions

- The mergers of technikons and universities[34].

Delivery of basic services has increased, with beneficial effects in some schools. The following improvements took place between 1996 and 2000[39]:

- A decline from 34% to 27% of schools without running water

- A decline from 55% to 16% of learners without access to proper toilets

- An increase in school electrification from 40% to 54.9%

- A decline from 59% to 36.4% of schools without telephones

- An increase of 2 241 to 6 581 in the number of schools with computers.

These improvements show a continued commitment by government to improve the quality of education facilities to keep pace with higher enrolment figures. More than 12 million learners (representing approximately 90% of all children aged 5–15 years) attended school[17] in 2001. South Africa nevertheless faces huge backlogs in the education system, with the poorest schools in the country

Table 9.2: Social services and amenities per 10 000 people, in 2003

Facility	Johannesburg	Cape Town	Mangaung	Msunduzi
Libraries	0.24	0.35	0.11	0.16
Swimming pools	0.18	0.12	0.15	0.13
Parks	-	-	1.82	0.09
Sports fields	0.69	0.23	0.31	0.02
Community halls and recreational facilities	0.29	0.37	0.31	0.02
Nursery schools	0.28	0.03	-	-
Clinics	0.30	0.36	0.32	0.39
Childcare	0.28	0.04	-	-
Total rates per person 2002/2003	R 653.97	R 640.24	R 278.23	R 405.55

Source: South African Cities Network (2004)[1]

remaining severely disadvantaged, which affects literacy levels. Inequalities between urban and rural schools are evident when one examines the facilities and resources available to them. Many households have difficulty in accessing quality education, mainly in the rural areas, which is sorely needed to develop appropriate skills for the marketplace. The high proportion of teachers who are un- and under-qualified is also cause for concern[40].

Pressure on provincial education budgets over recent years has resulted in the rationalization of teachers and an inability to develop basic infrastructure, especially in the larger and poorer provinces such as KwaZulu-Natal, Eastern Cape, Limpopo, and North West. This inefficiency has contributed to higher failure and drop-out rates.

The Department of Education has put several programmes in place to address discrepancies in the education sector. The National Schools Building Programme makes grants available to provinces for developing school infrastructure and has adopted action strategies to improve poor delivery. The Schools Register of Needs has been established to identify areas (and schools) requiring priority intervention.

Community facilities

Besides having health and education services available, people's quality of life is also influenced by access to community facilities such as libraries, parks, sports fields, community halls, and recreational amenities. Table 9.2 compares the number of community services per 10 000 residents in Johannesburg, Cape Town, Mangaung, and Msunduzi (Pietermaritzburg).

Open spaces, especially in highly urbanized settlements, also enrich people's daily existence. Cities (including Nelson

Although technology is available to some learners, the majority of children do not have access to these facilities.

Photography: Michelle Hochstadter and IMAGES24.co.za / Rapport / Themba Maseko

Unemployment in rural areas is high and communities rely on selling crafts to tourists. *Photography: Janet Peace*

Recycling provides employment opportunities to entrepreneurs. *Photography: Janet Peace*

Although informal economic activities are difficult to quantify accurately, it is widely acknowledged that they are a major generator of economic value in South Africa. Small, medium, and micro enterprises (SMMEs) constituted 97.5% of the total number of firms in South Africa, contributed 34.8% to the GDP, and employed 55% of the national labour force in 2002.

Mandela, Ekurhuleni, eThekwini, and Cape Town) are increasing their focus on the impact of our constructed or built environment on valuable open spaces such as parks, green belts, and the municipal reserves. Open Space Management Systems (OSMS) have been developed in municipalities such as Cape Town, eThekwini, and Johannesburg. These frameworks attempt to balance the pressure to develop new land with the imperative to preserve environmentally sensitive land for the benefit of future generations. It is unfortunate that we currently have inadequate information about urban open space in the country.

Employment

Employment is a primary driver of urbanization, as work opportunities are concentrated in cities and towns. Most of the new jobs (469 927) created between 1996 and 2001 became available in South Africa's nine largest cities[17]. Total employment in these cities, during this period, increased by 247 672 to 4 866 808. Growth in sectors such as wholesale and retail, and manufacturing, has been accompanied by reduction in the number of people employed, however. The exception to this 'jobless growth' appears to be in the financial and business sector, which has gone from the second smallest employment sector in 1960 to the fourth largest in 2001[1]. Figure 9.6 shows employment by economic sector for all the cities in South Africa. Employment profiles (including income and skills) differ, depending on the nature of a city's economy. The growth in the wholesale and retail sector in cities such as Johannesburg, Ekurhuleni, Tshwane, and Cape Town (evident in the development of large shopping centres) has been tracked by an increase in employment of service workers. The 'community and government' sector is the largest employer in urban economies in the country.

In the absence of data on unemployment in rural areas, it has to be assumed that unemployment in these areas equals or exceeds the national average. Research on rural development[41] indicates extreme rural poverty and deprivation, particularly in KwaZulu-Natal, the Eastern Cape,

and Limpopo, with strong associations with poor land management and environmental degradation[42].

The monthly income of workers also offers interesting insights into the distribution of employment opportunities within the country. The average monthly income of workers in the nine largest cities in 2001 was R5 927, compared with R2 789 in the rest of the country[17]. In the South African Cities Network (SACN) cities, Tshwane and Johannesburg displayed the highest average monthly income per employed person (R6 484 in Tshwane and R6 409 in Johannesburg).

A comparison of the 1996 and 2001 Census data shows an overall increase in unemployment in the country (see Figure 9.7 and also Chapter 2). Using the expanded definition of unemployment[i], unemployment in the SACN cities in 2001 stood at 38.3%, compared with 44.7% for the country as a whole. Job creation is insufficient to address the employment needs of the country's population, despite the contribution of the major urban centres to employment. Although the workforce across the country grew by 16.8% between 1996 and 2001, the number of people seeking employment in the SACN cities increased by 20.9%. The consequence has been a rise in total city unemployment between 1996 and 2001; by 58.8% compared with 43.9% for the whole of South Africa.

Although informal economic activities are difficult to quantify accurately, it is widely acknowledged that they are a major generator of economic value in South Africa. Small, medium, and micro enterprises (SMMEs) constituted 97.5% of the total number of firms in South Africa, contributed 34.8% to the GDP, and employed 55% of the national labour force in 2002[43]. More recent estimates indicate that the informal economy employs a larger proportion of the country's labour force than people employed in the formal sector. In 2004, 71.4% of economically active people earned a living in the informal sector[44]. Empirical investigations into the SMME economy in Johannesburg provide some insights into the characteristics of informal enterprises:

- The establishment of an SMME is motivated by supply–push rather than demand–pull considerations[45]

- Immigrant entrepreneurs, especially from sub-Saharan Africa, make up a significant component of the informal economy[46]

- Survivalist activities contribute to over-traded niches such as home-based spaza retailing, street trading, and informal urban cultivation[47]

- Variable entrepreneurial skills are required to be competitive[48].

The findings indicate that the informal sector is much more than a temporary safety net for the unemployed. It is also an important provider of goods and services.

Shelter

South Africa has spent R24.2 billion since 1994 in support of construction of over 1.5 million houses for poor households[14]. Approximately 6 million people benefited from subsidy and housing credit schemes across the country between 1994 and June 2003[49]. Depending on the province, between 28% and 54% of all approved housing subsidies were granted to households[34] headed by women. A review of housing completed during this period shows, however, that housing delivery in provinces has been sporadic, diminishing significantly in 2003. The largest number of houses, by far, were constructed in Gauteng (355 556 units) and KwaZulu-Natal (256 542 units) between 1994 and 2003, whereas only 32 136 houses were built in Limpopo during the same period[49].

Traditional households decreased significantly, in total, from 18% to 15% over the period 1996–2001 (see Figure 9.8), with households headed by women showing the greatest decline. The proportion of informal households living in shacks increased by 5.8% during the same period, despite a 7% increase in the proportion of households living in formal housing. Black households have been the primary beneficiaries of state housing policies: the proportion of formal dwellings occupied by blacks has increased by 10% to 55%, while the number of blacks occupying informal shacks has declined.

Housing needs have increased as a result of a rapidly growing urban population. The expansion of unplanned informal settlements has created an increase in the housing backlog, from 1.5 million units in 1994 to approximately 3 million units in 2000[34]. The rate of housing backlog in 2002 was approximately 208 000 units per year, and has been attributed to factors that include rapid urbanization, unemployment, and population growth, exacerbated by the adverse effects of corruption and lack of administrative capacity[50]. Surveys reflect mixed reactions from recipients of Reconstruction and Development Programme (RDP) houses, including dissatisfaction with the

Employment is the primary cause of urbanization
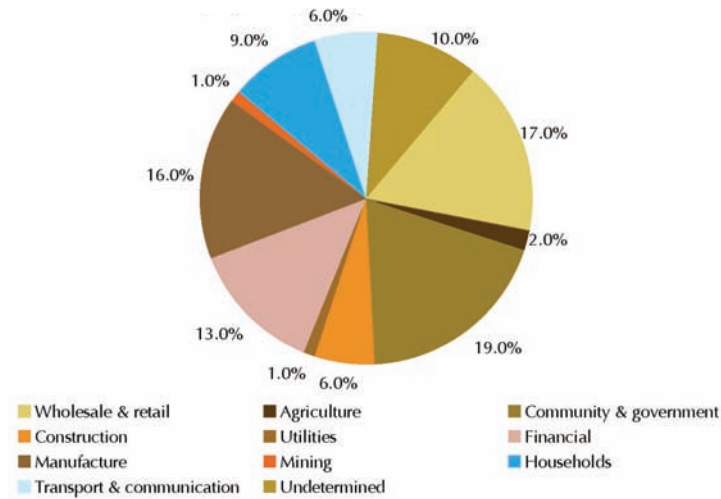
Figure 9.6: Percentage employment by economic sector
Source: Statistics South Africa (2001)[17]

Higher numbers of unemployed people in 2001
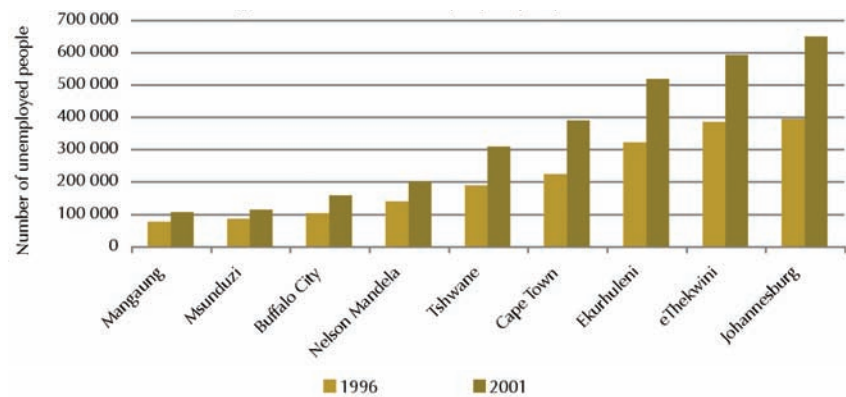
Figure 9.7: Unemployment in the nine largest cities, 1996 and 2001
Source: South African Cities Network (2004)[1]

Decrease in traditional households
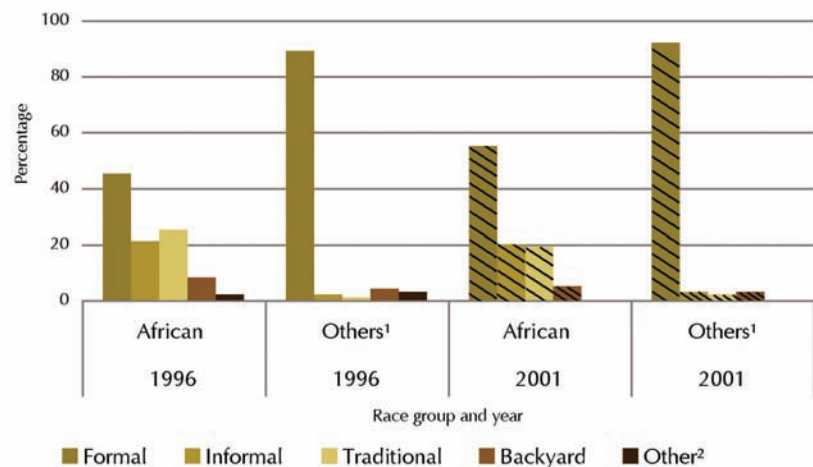
Figure 9.8: Distribution of dwellings by type
Other[1] Includes Coloured, Indian, Asian, and White population groups
Others[2] Includes caravan or tent and private ship/boat
Source: Statistics South Africa (2004)[17]

quality of housing delivery, poor access to work or to job-hunting opportunities for occupants of these houses, under-spending on budget for low-income housing by the housing departments responsible, and allocation of housing in ways that are perceived to be unfair[14].

Slums

Goal 7 of the Millennium Declaration is to ensure environmental sustainability. One of its targets is to have achieved a significant improvement in the lives of at least 100 million slum dwellers by 2020. The housing types in South Africa that conform to the United Nations' definition of a slum with respect to secure tenure, range from sub-let inner city tenements (which are difficult to differentiate from non-sublet dwelling units) to informal dwellings in shack settlements, backyard shacks, hostels, and domestic workers' rooms. Because of the difficulty in differentiating inner city dwellings with insecure tenure, the inner city is not included in this discussion of slums. Accommodation in informal dwellings in shack settlements, backyard shacks, hostels, and domestic workers' rooms all fulfil one of the UN's criteria of a slum in that they do not offer their inhabitants secure tenure[i]. Other slum criteria are also variously fulfilled.

Informal shack settlements and backyard shacks are conveniently grouped and discussed together because both these forms of accommodation comprise owner-built or petty landlord-built shacks. They differ with respect to their access to services and legal status.

- The term 'informal settlements' is applied to shack settlements that are built on unoccupied sites.

- The term 'backyard shack' refers to shacks that are erected in the backyards of stands within formal residential areas.

The main tenure difference between these two forms of accommodation is that the residents of backyard shacks have an informal rental arrangement with the owner of the formal house on the stand. Neither shack-dwellers in informal settlements nor backyard tenants have secure tenure.

Hostels and domestic servants' rooms are discussed together because both are designed to house workers under non-family conditions.

- Hostels are a communal, dormitory-form of accommodation, with shared ablution and kitchen facilities. They may be owned and managed by private-sector companies, parastatals, or local municipalities, but they almost always serve the function of providing accommodation for those who work for such institutions. Accommodation in hostels is thus restricted to the

Table 9.3: Slum housing, Census 1996 and Census 2001

Slum housing 1996 and 2001: Frequency and proportional distributions					
Housing	1996	2001	Change from 1996–2001	1996	2001
Households					
Slum housing	1 752 803	2 114 556	361 753	31.6%	28.2%
Adequate housing	3 728 820	5 391 339	1 662 519	67.2%	71.8%
Other or unspecified	67 477	-	-67 477	1.2%	-
Total	**5 549 100**	**7 505 895**	**1 956 795**	**100%**	**100%**
Population					
Slum housing	6 030 334	6 424 856	394 522	27.0%	24.9%
Adequate housing	16 055 674	19 366 912	3 311 238	71.9%	75.1%
Other or unspecified	236 039	-	-236 039	1.1%	-
Total	**22 322 047**	**25 791 768**	**3 469 721**	**100%**	**100%**

Note: Table indicates changes over time in the proportion of people and households living in slums. A distinction between people and households is kept throughout the table.

Source: Government of the Republic of South Africa (2005)[51]

employees of specified institutions. Should a hostel resident terminate his or her service with an employer, right of tenure in the accommodation lapses.

- Domestic workers' rooms are rooms that are built in the back yards of private households, to provide accommodation for domestic workers such as cleaners, cooks, and gardeners. As with hostel-dwellers, a resident's right to such accommodation is conditional upon his or her employment by the householder.

The proportion of South Africa's urban slum households declined from 32% in 1996 to 28% in 2001 (see Table 9.3). Similarly, the proportion of the urban population living in slums declined from 27% to 25%. The percentages of slum households are larger than the percentages of the slum population because slum households are generally smaller than other households. In absolute terms, however, over the same period, the numbers of slum households increased by 361 000 and the size of the slum population increased by 395 000.

In terms of providing dwellings with secure tenure for the poor, the Department of Housing has indicated that approximately 1.8 million new houses were built with the assistance of a state subsidy, often on state-provided land, to house those without adequate housing between 1994 and 2005 (see Table 9.4). An additional 413 006 units were transferred from the state to low-income occupants on a discounted basis. All in all, over 2 million households have received substantial state subsidies to enhance the quality and security of their housing over the 1994–2005 period.

9.6.2   Service provision

Like housing, the access pattern to basic services is disparate. A service deprivation index, defined by the United Nations Development Programme to measure progress in the delivery of seven basic services in South Africa, indicates a small increase in service deprivation (that is, an increase in the number of people lacking access to services between 1996 and 2001, particularly in households[34] that are headed by blacks. There has been an increase in the number of households classified as deprived of access to 'good' quality basic services: in 1996 there were 5.68 million, and in 2001 the figure rose to 7.24 million (an increase of 27%). Of the total deprivation, 50% occurs in KwaZulu-Natal, the Eastern Cape, and Limpopo (see Map 9.6).

Table 9.4: Subsidized houses completed, or under construction, per province, per financial year

Year	Completed dwellings or those under construction
1994/1995 to 1998/1999	712 813
1999/2000	161 572
2000/2001	190 643
2001/2002	143 281
2002/2003	203 588
2003/2004	193 615
2004/2005	178 612
Total	1 784 124

Source: Government of the Republic of South Africa (2005)[51]

Box 9.3   South African progress in meeting Millennium Development Goals relating to human settlement

Millennium Development Goal 7 focuses on ensuring environmental sustainability. Targets 10 and 11 of this goal are as follows:

- Target 10: Halve by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation

- Target 11: Have achieved by 2020 a significant improvement in the lives of at least 100 million slum dwellers.

Reviews of South Africa's performance in terms of Targets 10 and 11 reveal a mixed degree of success. The water services in non-urban areas remain in need of improvement[52], despite significant increase over the past decade in the number of people with access to safe drinking water. A report by Crankshaw and Parnell[53] on Target 11 draws a similar conclusion, when distinguishing between adequate (piped to house) and inadequate water supply (all other categories). They also note a decline in access to water in urban areas, implying increased growth in the number of households. However, with sustained effort, South Africa stands a good chance of meeting the water delivery target.

Assessments indicate less satisfactory progress in the provision of adequate sanitation. With over 21% of the South African population having no structured sanitation, much remains to be done to meet the target. The Department of Water Affairs and Forestry 2004 Annual Report estimates that some 17 million people are still without adequate sanitation.

Crankshaw and Parnell conclude that South Africa had performed well in improving the conditions of slum dwellers through several initiatives, including the provision of new houses and housing subsidies. Shack settlements, on the other hand, increased in number by 5.8% between 1996 and 2001. Progress with respect to secure tenure was deemed to be excellent, with over 2 million new households obtaining access to individual freehold housing during the review period. Tenure reform for slum dwellers living in other categories of shelter (such as hostels, domestic quarters, and informal settlements) was described as slow.
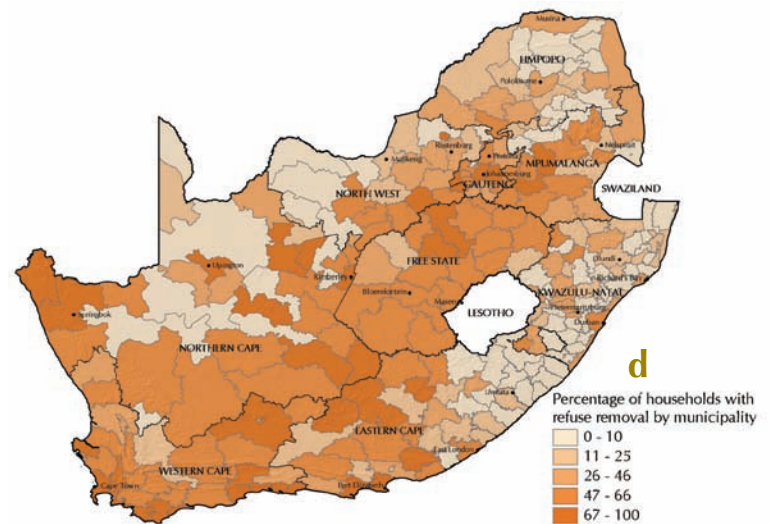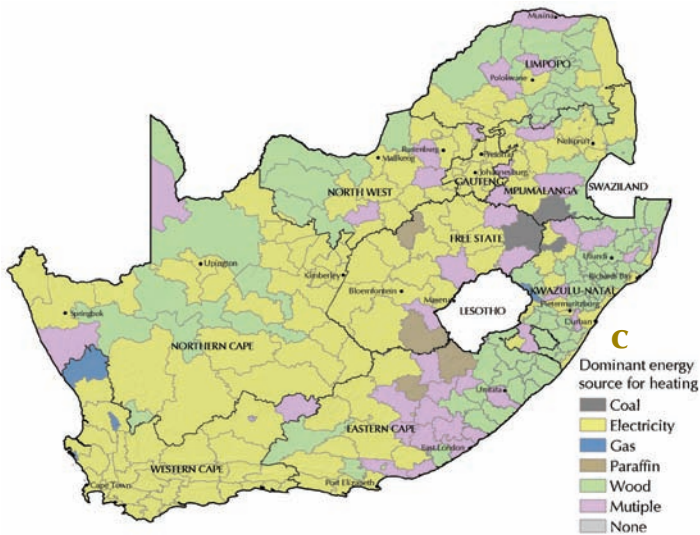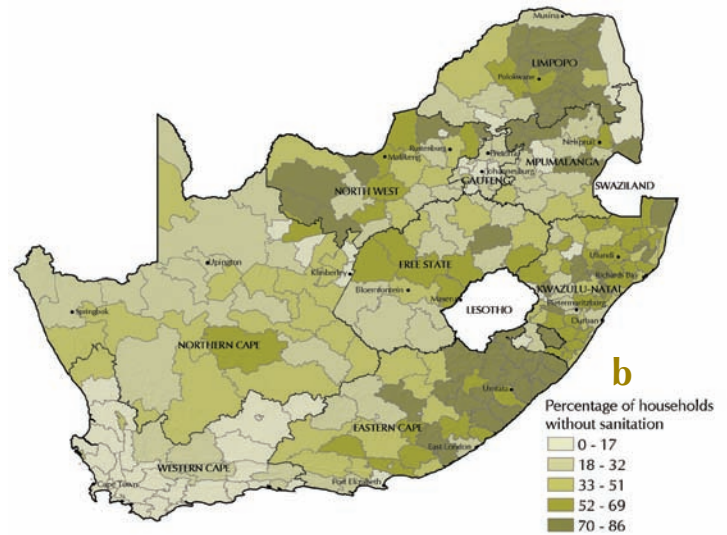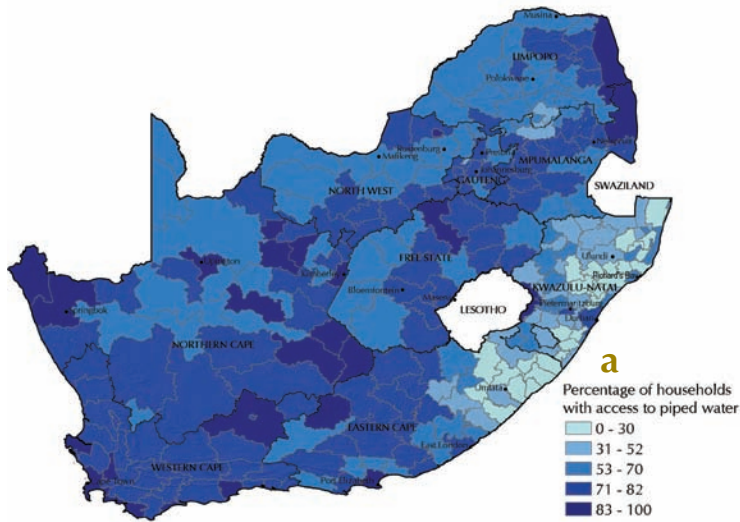
Map 9.6: Household access to basic services: (a) piped water in the dwelling, (b) adequate sanitation (flush toilets), (c) electricity for lighting, and (d) waste removal

Source: Statistics South Africa (2001)[17]

The country's progress towards meeting the Millennium Development Goals is shown to be uneven (see Box 9.3).

One of the principal social development strategies of municipalities in South Africa since the 1995/1996 elections has been to extend the network infrastructure and household services to previously disadvantaged communities. Residents in settlements across South Africa have seen mixed success in service provision. While many more people now have access to services, backlogs remain, and recovery from these backlogs is still a challenge for most municipalities. A recent report (in 2004) on the state of cities claims that the absolute number of households receiving acceptable levels of service has increased

substantially, but that at the same time the number without basic services has also increased. The proportion of households receiving services has consequently remained static, or has seen only marginal improvement[1]. Basic services provision and access are discussed below.

Water and sanitation services

Access to potable water and sanitation are essential elements for the effective function of human settlements, and are integral to human health and well-being. Since 1994, there has been an improvement in access to clean water. In 2001, 9.5 million households (84.5%) had access

to piped water, an increase of 2.4 million households since 1996. The number of households relying on water from sources including dams, rivers and streams, and boreholes declined during this same period, which suggests improved structured access to clean water among rural households (see figure 9.9). Low cost-recovery, limited water availability, and poor training in maintenance of infrastructure, however, have resulted in the variable success of rural water schemes[5] (see figure 9.9).

The Department of Water Affairs and Forestry (DWAF) mandated in 2001 that households should receive up to 6 kilolitres of free water per month, to minimize service arrears and to ensure that the basic needs of households are met. The subsistence level of this free water still needs to be gauged in the context of larger families, those living in backyard shacks on the same property, or people involved in subsistence activities.

The responsible and safe disposal of human waste helps to control the spread of disease. Although there has been progress in the delivery of clean water, it is clear that there are lags in the delivery of sanitation facilities[55]. Many households have no access to adequate sanitation facilities (see Figure 9.10). There has been a small and variable increase in access to flush toilets, and an increase from 7.5 million to 9.2 million in the number of households with access to adequate sanitation. The proportion of households without adequate sanitation has not changed significantly since 1993, however. About one in every eight households did not have access to sanitation at the time of the 1996 Census. By 2001, this ratio had improved to one in every seven households. In line with policy, the proportion of households relying on bucket toilets was reduced from 5.3% in 1993 to 1.9% in 2003.

The apparent lack of progress in the provision of sanitation is due to a combination of increasing population and more numerous households, as well as insufficient delivery[55]. As a consequence, inferior forms of sanitation persist in many areas, resulting in a high incidence of water-borne diseases, such as cholera and typhoid. An outbreak of cholera in KwaZulu-Natal in 2001 indicates the health consequences of poor access to structured sanitation.

Waste collection and disposal

Local authorities are mandated to collect, handle, and dispose of domestic waste from all households, and to ensure an equitable service to their communities. Gauteng, Western Cape, and KwaZulu-Natal service the greatest number of households, while the Western Cape, Gauteng, and the Northern Cape service the greatest proportion of households in their provinces (see Figure 9.11).

Municipal waste collection has improved countrywide by only 2.7% between 1996 and 2001, and almost 50% of the population is still not receiving a regular waste collection service. The metropolitan municipalities deliver an almost

Young person uses a wheelchair to transport a container in Tafelsig, where residents have been without water for three weeks.
Photography: Trace Images / Brenton Geach

Moses Kotane dump site.
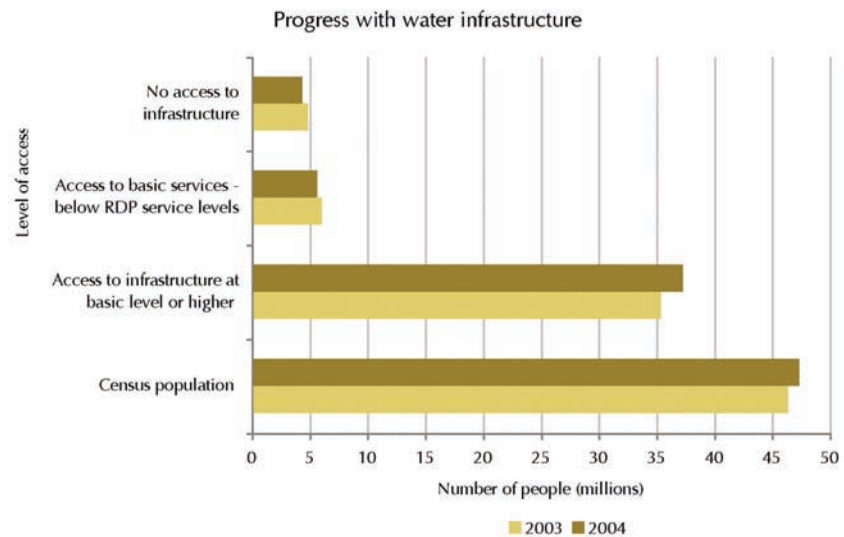*Photography: Jarrod Ball*

Figure 9.9: Levels of access to water supply infrastructure
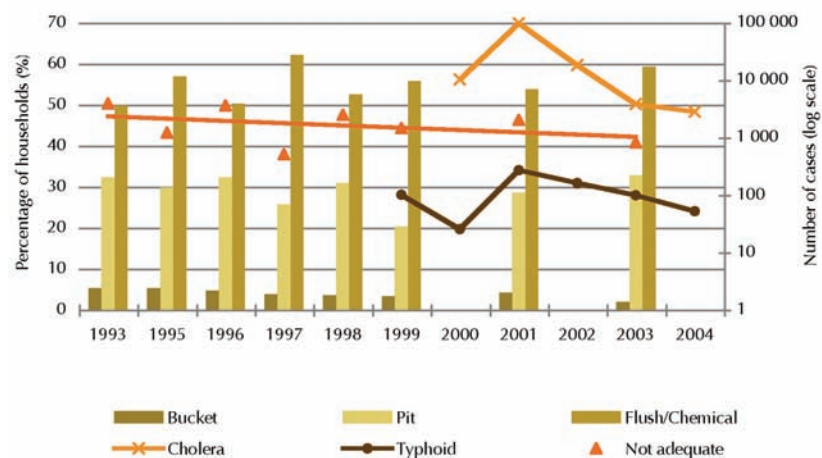*Source: Department of Water Affairs and Forestry (2004)[54]*

Figure 9.10: Access to sanitation and incidence of water-borne diseases, 1993–2000
Source: Statistics South Africa (2001[56], 2004[17])

In some areas there are no waste disposal services.

Photography: Trace Images / Lulama Zenzile

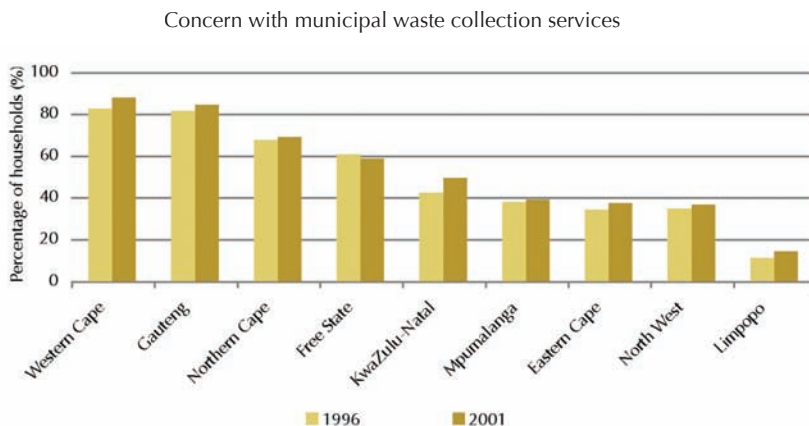Concern with municipal waste collection services

Figure 9.11: Municipal service provision of waste collection facilities
Source: Statistics South Africa (2004)[16]

complete service, while local municipalities in many remote rural areas deliver no service at all. Yearly assessments of the ability of local municipalities to perform their refuse removal and disposal functions, which is undertaken by the Municipal Demarcation Board[57], show a growing inability of municipalities (in terms of staff, capacity, and budget) to deliver efficient waste-collection services.

Once collected, disposal of waste must be correctly undertaken to protect both human health and the natural environment (see Box 9.4). A total of 475 general landfill permits has been granted for the country as a whole, and 12 new applications are under consideration. This represents a 64% compliance with Section 20 of the Environment Conservation Act, as evidence exists of more than 760 sites (legal and illegal) across the country. There

could, however, be as many as 15 000 unrecorded communal sites in the rural areas[58]. More than 300 incineration facilities were operating in South Africa in 1997, many of which failed to comply with the required emission standards for human health and environmental protection[59].

Waste has direct and indirect impacts. Waste, if not removed, attracts vermin, which can be vectors of disease. The effects of waste on the environment are primarily damaging, such as contamination of surface and groundwater resources and soil. Waste disposal can also offer social and economic benefits, however, such as job creation through recycling, and the use of waste as a fuel resource and as a re-useable raw material. Atmospheric emissions from incinerators and the illegal burning of waste contribute to air pollution, which can include components such as volatile organic carbon compounds that may pose human health risks.

Steps taken to date to ensure environmental rights in relation to waste management include:

- the publication of the Environmental Management Policy for South Africa (1998)

- the White Paper on Integrated Pollution and Waste Management (1998)

- National Water Act (1998)

- the promulgation of the National Environmental Management Act (NEMA) (1998), which emphasizes the concept of waste minimization, as well as the environmental, social, and economic sustainability of developments such as landfills.

The White Paper on Integrated Pollution and Waste Management (NWMS) defines the government's 'cradle-to-grave' approach to the management of waste. Currently, implementation of the NWMS is being undertaken on the following selected components: the Waste Information System, Recycling, Health Care Waste, and Capacity Building. These initiatives are to be supplemented by the promulgation of an Integrated Waste Management Bill (scheduled for 2006).

Local authorities have been developing their Integrated Waste Management Plans (IWMP) as a component of the NWMS, to address current shortfalls in service delivery and to improve on environmental compliance. By 2004, 50% of metropolitan municipalities, 31% of district municipalities, and 27.5% of local municipalities had completed an IWMP. Although this represents only 28.7% of all municipalities, another 54.5% are in the process of formulating their waste plans[60].

The first Department of Environmental Affairs and Tourism (DEAT) National Waste Summit held at Polokwane in September 2001 highlighted the need for urgent action to reduce, re-use, or recycle waste so as to minimize

Box 9.4 The impact of a landfill on surrounding communities – case study in Rustenburg

Landfill sites are currently an important aspect of implementing the cradle-to-grave approach to waste management. Nevertheless, if badly sited, engineered, or managed, as is the case in some parts of South Africa, the adverse consequences can be numerous and long-lasting. Communities living in the vicinity of these landfills can be affected in the following ways:

- Streams situated close to a site can be contaminated by hazardous leachate seeping from the landfill

- Borehole water can be contaminated by percolating leachate that has entered the groundwater

- The burning of waste releases particulates and other noxious airborne emissions (volatile organic compounds, or VOCs) from incineration and illegal burning that may be harmful to health, besides constituting a nuisance

- Adjacent surface and groundwater resources and soil may become contaminated

- Landfills attract vermin and harbour disease vectors that pose health risks

- Landfills are aesthetically unpleasant and can lead to urban decay, particularly if litter and illegal dumping are uncontrolled

- Competent site management can minimize adverse impacts on the environment.

The Townlands landfill in Rustenburg is an example of the adverse impacts on the community of poor landfill management.

Planners have ignored landfill permit conditions over the last five years and have built residential areas closer and closer to this landfill. Before June 2004, there was no access control and on-site operations were poor, with dust and the burning of waste and tyres by a growing informal salvager population. This affected the quality of living of nearby residents. Wind-blown litter became an increasing problem, as well as bad odour and an increased population of flies. Informal salvagers (without appropriate protective clothing, equipment, or informed procedures) were constantly and unnecessarily exposed to unacceptable health and safety hazards. (It is worth noting that some of the more professional site operators have totally banned informal salvaging because of the incidence of serious and fatal accidents, such as cases of people falling under compactors while scrambling for salvageable items.)

Rustenburg's landfill site's aesthetics, odour control, and general management have improved with the appointment of an on-site contractor, but the planning department is nevertheless giving permission for low-cost housing to be built as close as five to ten metres from the toe of the landfill. Immigration to this area will present new problems, not least being the hazards associated with flammable methane gas escaping from the decomposing mass, and consequences that could arise if the stability of the landfill collapses. These risks will persist long after closure of the landfill.

Source: Specialist Study on Waste by Jarrod Ball and Associates (2005)[58]

Box 9.5 Opportunities for waste and waste management

- Waste should be regarded as a resource and other potential uses should constantly be investigated.

- Waste-stream separation at source can provide work opportunities and, by reducing the contamination of recyclable waste, can increase the commercial re-use value of the segregated waste materials. (Mixed waste can often make recyclable waste economically irrecoverable. It can be hazardous to handlers who have to separate it and has to be destined for a landfill.)

- Alternative and innovative packaging could help to minimize the volume of waste that ends in landfills. Use of rapidly biodegradable packaging materials (such as engineered starch) could assist. (Ordinary paper is not rapidly biodegradable. Telephone directories have been recovered in a readable state after burial in landfills for 25 years.)

- Cleaner technology reduces waste and pollution, be it of air, land, or water. It improves cost-effectiveness, product development, and design, which can also reduce emissions.

- New uses of waste-streams can provide resource material for other products (such as ash in brick making, gypsum for gypsum board, pulverized rubber integrated into bitumen/tar products).

- There are opportunities for job creation in supplying services and waste re-utilization, and generation of products including artworks.

- Harvesting of landfill gas can be an alternative fuel source (for heating, lighting, and power, for example).

- Industrial waste exchange systems among industries results in overall reduction of waste, as a waste from one industry can be a resource for another.

- Carbon-credit projects are a potential benefit (where carbon credits could be sold as an income for local municipalities).

- Reducing the waste-stream or diverting it away from disposal sites reduces its pollution potential.

- Entrepreneurs/companies could design and market waste management information systems, to assist local authorities that lack this asset.

- Many old sites have not been properly closed and rehabilitated. Opportunities exist for SMMEs to complete the necessary work, which will benefit those employed in the process as well as improve the quality of life of those who live and work in the area. Pikitup (in Johannesburg) is currently rehabilitating six sites in Soweto, with site-end use varying from sports fields and open spaces for communities, to subsistence agricultural farming and to the establishment of recycling facilities. (For reasons of safety, the construction of habitable structures on closed landfill sites is not permitted.)
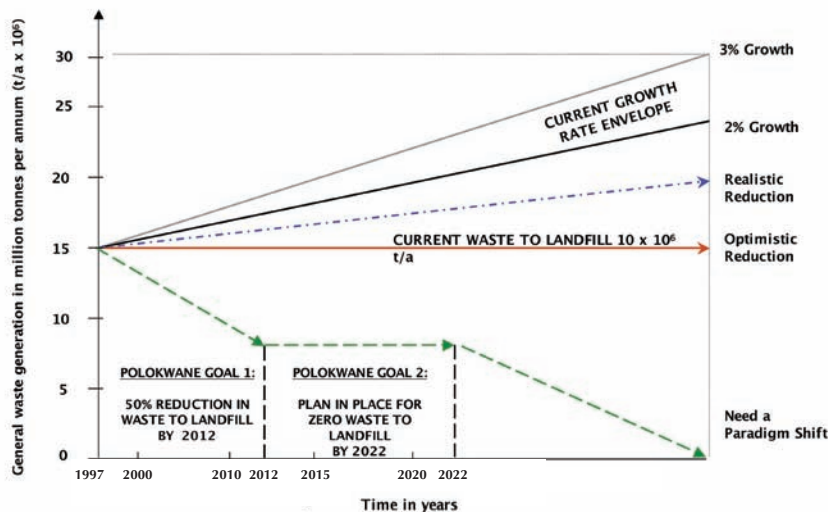
Figure 9.12: The realities of the Polokwane Declaration
Source: Ball and Associates (2005)[61]

environmental effects. The outcome of the Summit was the signing of the Polokwane Declaration, whose main goal is to stabilize current waste generation, reduce waste disposal by 50% by 2012, and attain zero waste disposal by 2022. The Polokwane Declaration can only be achieved if minimization, recycling, re-use, and the diversion of general waste from landfill are actively pursued. (See Figure 9.12 and refer to Box 9.5 for the key opportunities for waste and waste management.)

9.6.3   Heritage

Population growth and settlement expansion have led to an accelerated rate of change, placing many long-established built environments, rural landscapes, and urban open spaces under intense pressure. As heritage is associated with interventions, manifestations, and physical creations of human origin, it is vulnerable to these pressures.

The result has been growing public concern about the loss of familiar environments (particularly historically and culturally important buildings) and urban precincts. Conservation of natural and cultural heritage is seen as essential to ensure the survival of valuable and irreplaceable resources that have cultural significance for present and future generations. Culturally significant heritage may therefore include places to which oral traditions are attached, as well as places associated with living heritage, and landscapes or natural features of significance[62]. Heritage does not stand alone, but forms an integral and indispensable part of the environment. An evaluation of the state of heritage resources was not carried out as part of this assessment of the state of environment in South Africa, but Box 9.6 provides a short overview of the country's heritage.

9.7   THE USE OF NATURAL RESOURCES

9.7.1   Energy[k]

The South African economy (like most developed economies) is energy-intensive, with relatively large energy input for every rand of economic output[67, l]. Low energy costs and an abundance of mineral deposits has contributed to the country's high energy input of GDP; energy comprises approximately 15% of GDP. Some 70.8% of South Africa's energy supply in 2000 was provided for by coal[m], followed by oil (17.8%), biomass (8.7%), natural gas[n] (1.2%), hydropower[o] (0.7%) and nuclear power (0.7%). Less than 1% of our energy is derived from renewable energy[68] such as hydropower and wind energy (see Box 9.7). Much of the primary energy source is processed to more conveniently usable forms, such as electricity and liquid/gas fuels.

The demand for energy supply is approximately 4 782 PJ[p] for the year 2000[75]. The national demand for energy in the

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Box 9.6 | Heritage in South Africa

Heritage encompasses all sites of geological, zoological, botanical, aquatic, archaeological, and historical importance. It also includes national monuments, historic buildings and structures, works of art, literature and music, oral traditions, and museum collections and their documentation. These provide the basis for a shared culture and creativity.

Although formal heritage conservation dates back to 1911, the promulgation of the National Heritage Resources Act (No. 25 of 1999) provides for the protection of a wider and more inclusive range of identified heritage items, or 'National Estate'. National Estate includes structures, buildings, historical settlements, landscapes, geological sites, archaeological sites, palaeontological sites, graves, burial grounds, movable objects (associated with oral traditions), and sites relating to the history of slavery in South Africa. It also emphasizes the conservation management of such resources, whose richness and diversity is reflected in South Africa's seven official world heritage sites: Robben Island, Greater St. Lucia Wetland Park, The Cradle of Humankind, uKhahlamba Drakensburg Park, Mapungubwe Cultural Landscape, Cape Floral Region, and the Vredefort Dome[63]. (For further details, see Chapter 5, Box 5.5.)

The South African Heritage Resources Agency (SAHRA) is currently in the process of completing an inventory of the National Estate, which will form the core of a database of heritage resources that are worthy of conservation[64]. In 1998, there were over 4 000 official national monuments[65] and nearly 3 000 'provincial heritage sites'[66] on record.

same year was 2 363 PJ and is dominated by industrial and transport sectors, increasing to 2 400 PJ in 2005. This 2005 figure excluded the storage of marine bunkers and the use of energy sources as feedstocks or raw material input.

Coal fuels 93% of South Africa's electricity production[69] (see Figure 9.13). Much of the coal mined is of low quality, requiring beneficiation that creates substantial amounts of solid waste, which if improperly managed, can create serious environmental problems. Generating 1 kilowatt-hour of electricity requires 0.5 kg of coal, 1.29 litres of water, and creates 142 g of ash and 0.9 kg of carbon dioxide. A tonne of coal thus creates 284 kg (28% of its own mass) of waste ash[61]. The waste ash that the country produced in 2003 was about 6.3 million tonnes[70].

In addition to the waste ash, South Africa's energy supply is also carbon dioxide intensive. Approximately 209 tonnes of carbon is burnt for every US$ equivalent of GDP produced in South Africa, compared with 164 tonnes for the United States of America[71]. Sulphur-containing emissions from power stations, though significant at about 1.5 million tonnes per year[72], are moderated by the relatively low sulphur content of local coal. Sulphur emissions are a serious matter, as they are a source of environmentally destructive acid rain. This creates human health problems, damages property, and pollutes both land and water (see Chapter 8).

Local coal is cheap and this translates to low energy costs, particularly for electricity[q], which is the cheapest in the world - about one US cent per kilowatt hour. In addition to being a major exporter of coal, South Africa has benefited from its low-cost energy, access to which has helped it to gain a competitive advantage in energy-intensive industries such as mining and aluminium smelting. Heavy industry and mining operations, if improperly managed, can be major contributors to the high ambient air-pollution levels in major urban centres. Unlike coal, South Africa's oil reserves are limited. Crude oil is imported at substantial foreign exchange cost to the country.

Figure 9.13 depicts the energy flows through the South African energy economy, from supply to the end use of energy. The flow of energy from its source, through transformation, transport to final use has a number of conversion losses as determined by the laws of physics. As a result of its high reliance on fossil fuels, a substantial quantity of carbon (0.9 tonnes) is released per unit (1 tonne of oil equivalent) of energy consumed. The transformation and consumption of energy accounts for 75% of South Africa's greenhouse gas emissions.

Respective energy consumption patterns in human settlements are distinct. In South Africa, 77% of urban households are electrified, and electricity is by far the largest single source of energy used by households for lighting, heating, and cooking (see Figure 9.14). The overall

Aerial view of Robben Island, one of our World Heritage sites, with Table Mountain in the background. *Photography: South African Tourism*

proportion of households with electricity increased from 50% in 1996 to 66% in 2001. Over the same period, the largest growth in household electrification was recorded in rural areas, which increased from 21% to 49%[74] of the total in those areas. There was a marked increase in the proportion of households using electricity for lighting: from 57.3% in 1996 to 69.7% in 2001.

Despite the increased access to electricity, large numbers of people rely on other forms of energy for lighting, heating, and cooking (see Map 9.6). In 2001, 2.5 million households used candles for lighting and 737 300 households used paraffin and, on average, 23% of households used wood fuel for cooking and heating while 18% used paraffin for these same purposes. Of these households, 7% used coal for heating. This highlights the significant number of people who still rely on wood, coal, and paraffin for their energy needs.

Between 1992 and 2000 residential energy use has remained almost constant, commerce and public service has fallen 25%, agriculture has fallen 18%, transport has risen 27%, mining and quarrying has fallen 15% and industry risen by 22%[75]. These statistics indicate an increasing trend in energy consumption. As a result, the country has to ensure that there is sufficient energy over the long term to accommodate growing demand. In the short term, over the next 2 to 3 years, the country has to avoid exhausting its supply of energy.

Peak electricity demand is approximately 31 500 MWe (July 2002), and national installed capacity from all energy sources is approximately 37 000 MWe (Table 9.5). Assuming a 10 % reserve margin on a gross capacity of 37 000 MWe, the current net capacity is 33 300 MWe which is only 1 800 MWe

In addition to the waste ash, South Africa's energy supply is also carbon dioxide intensive. Approximately 209 tonnes of carbon is burnt for every US$ equivalent of GDP produced in South Africa, compared with 164 tonnes for the United States of America.

Box 9.7 | Renewable energy in South Africa

Even though fossil fuels supply 90% of South Africa's energy needs and the use of renewable energy sources is currently limited, there is potential to increase the contribution of renewable energy to the total energy mix. The cost of renewable energy will continue to decline as technologies mature. The government's 2003 White Paper on Renewable Energy requires that from 2013 onwards, 10 000 GWh per year of final energy demand should be met by renewable energy. Of biomass, wind, solar and small hydro, biomass is currently by far the largest potential contributor. Currently, approximately three million households make use of firewood to meet their basic energy requirements.

Hydropower

South Africa has few rivers suitable for generating hydroelectricity, and even these are small. The country's existing installed capacity for hydroelectricity is 661 MWe, with the Lesotho Higlands Water Scheme projected to provide an additional 600 MWe. There is a further 1 500 MWe of pumped storage scheme generation capacity, most of this located in the Drakensburg and the Steenbras Dam above Cape Town. Other countries in southern and central Africa have enormous potential for generating hydroelectricity, some of which could be exported to South Africa.

Biomass

Even though climatic conditions in South Africa do not favor building up and sustaining biomass, it is an important source of energy used both by industry (sugar refining plus pulp and paper) and by households for domestic energy. Sugar refineries have an installed generation capacity of about 245 MWe (Megawatts of electrical power). Pulp mills have an installed generation capacity of about 170 MWe. Households, mainly poor households in rural areas, use wood, dung and other vegetable matter for heating and cooking. It is estimated that about 7 million tons of wood, an energy total of about 86 PJ/year, is burned for this purpose. (Energy Research Centre 2003, http://www.erc.uct.ac.za/).

Solar

The annual 24-hour solar radiation average for South Africa is 220 W/m², compared with 150 W/m² for parts of the United States of America and about 100 W/m² for Europe. Almost the whole of the interior of the country has an average insolation in excess of 5 000 Wh/m²/day. So far no electricity from solar power is generated for the national grid, but solar photovoltaic electricity is used widely in rural areas. It is estimated that about 70 000 households, 250 clinics and 2 100 schools have photovoltaic panels. About 1 000 households are being added to this system each month. There is also a steady increase in solar water heating for middle-income households. As domestic water heating consumes one third of total domestic power used, solar water heaters could potentially save the country 2 000 MWe of capacity – the equivalent of one coal-fired power station.The installed solar capacity in South Africa in 2001 was just over 8 MWe.

Eskom is studying the feasibility of building a 300 MWe solar thermal power station near Upington in Northern Cape. If built, this station would have three 100 MWe units, with hundreds of solar panels that will reflect sunlight onto a receiver set high up in a tower concentrating sunlight in reflecting troughs onto pipes carrying a coolant of molten salt. The salt would store heat so that the station would be able to deliver electricity 24 hours a day.

Wind

So far no electricity in the national grid is generated from wind. Wind was important traditionally, and continues to be, for water pumping on farms. There are about 500 wind turbines on farms that generate direct current electricity, usually at 36V.

In 2003, Eskom installed two 660 kWh wind turbines and a 1.7 MWe one at Klipheuvel in the Western Cape as part of its SABRE programme of demonstration and research. The first commercial windfarm for grid generation is due for implementation in Darling in the Western Cape. The first phase will comprise four 1.3 MWe turbines for a total of 5.2 MWe. It is envisaged that in the second phase, the windfarm will be expanded by a further 6 turbines, making a total installed capacity of 13 MWe.

Municipal waste

It has been estimated that South Africa's total domestic and industrial refuse disposed in landfill sites has an energy content of about 11 000 GWh per annum. This could be directly incinerated or converted into biogas and methane to produce electricity.

Given the potential role of renewable energy as an alternative generation option, Eskom has established the South African Bulk Renewable Electricity Generation project (SABRE-Gen) in 1998. The project's ultimate aim is to determine whether utility scale, renewable electricity generation (primarily solar, thermal, wind, biomass, wave energy and ocean currents), is a viable supply option for Eskom and South Africa.

As part of this initiative, Eskom installed a 25kW solar dish with a Stirling engine at the premises of the Development Bank of Southern Africa in Midrand.

Solar panels are used to generate renewable energy.

Photography: Water Research Commission

Sources: Statistics South Africa (2005). Natural resource accounts. Energy accounts for South Africa, 1995-2001. Statistics South Africa, Pretoria.
Ward, S. (2002). The Energy Book for urban development in South Africa. Sustainable Energy Africa, Cape Town.
Winkler, H. (ed.) (2006). Energy policies for sustainable development in South Africa. Options for the future. Energy Research Centre, University of Cape Town (2006). http://www.erc.uct.ac.za/
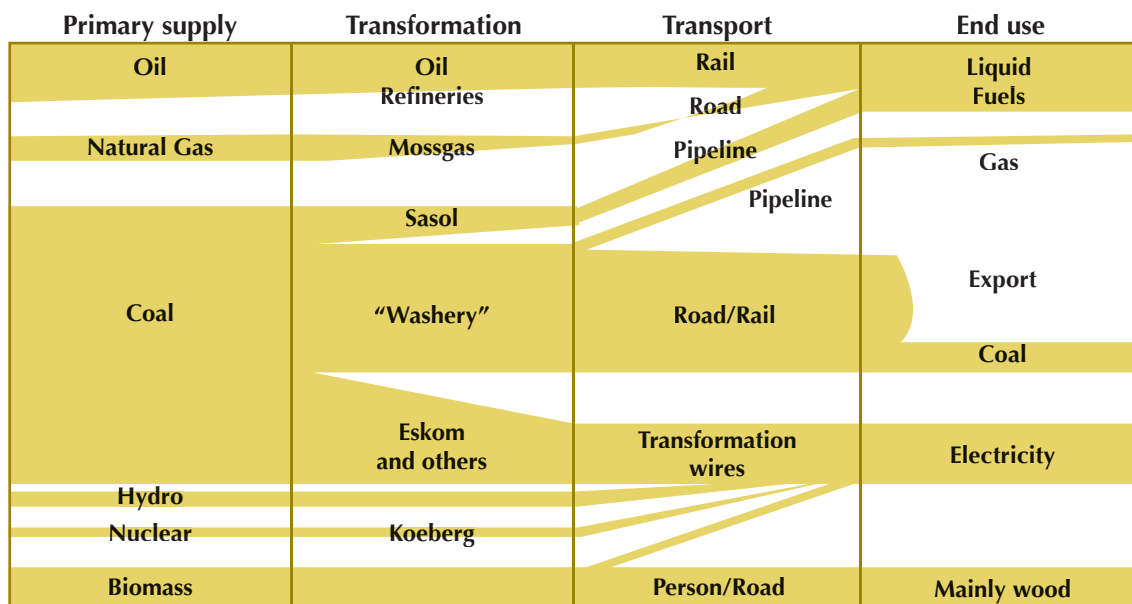
Primary supply	Transformation	Transport	End use
Oil	Oil Refineries	Rail	Liquid Fuels
Natural Gas	Mossgas	Road	
		Pipeline	Gas
	Sasol	Pipeline	
Coal	"Washery"	Road/Rail	Export
			Coal
	Eskom and others	Transformation wires	Electricity
Hydro			
Nuclear	Koeberg		
Biomass		Person/Road	Mainly wood

Figure 9.13: The structure of the South African energy sector
Source: Department of Minerals and Energy (2004)[73]

above the peak demand. In light of this situation, the Department of Minerals and Energy indicated that South Africa may be short on capacity by 2005–2007, unless the demand side is managed or a new plant is built. Given the time to commission new electricity plants, the current electricity generating system will soon be vulnerable[75]. This situation is exacerbated by the fact that Eskom-operated coal-fired plants are scheduled to be operational until at least 2020 after which generating capacity starts to decline as old plants are decommissioned. This is problematic given that Eskom produces 92% of South Africa's electricity requirements.

To address the current need for more electricity, Eskom has begun work on recommissioning three Gauteng-based power stations (Camden, Grootvlei and Komati) closed down in the late 1980s and early 1990s when the country had excess capacity[76]. Commissioning of these power stations started in 2005 and the last units will be commissioned in 2008[77].

The production and use of energy in South Africa has significant local, national and international environmental impacts. Coal use is a primary source of air pollution and creates enormous solid waste-streams. Some of these impacts are governed by legislations such as NEMA and the Air Quality Act (No. 29 of 2004), and international agreements such as the Kyoto Protocol (see Chapter 3). Because of reliance on fossil fuels, South Africa is among the top 20 emitters of greenhouse gases, contributing to climate change (see Chapter 8). Apart from generating greenhouse gases, fossil-fuel energy production and

Table 9.5: Electricity generation capacity

Energy source	Capacity (MWe)
Coal	32 202
Nuclear	1 840
Pumped storage	1 580
Hydro	667
Gas turbine	662
Bagasse	105
TOTAL	**37 056**

Source: Department of Minerals and Energy (2003)[75]
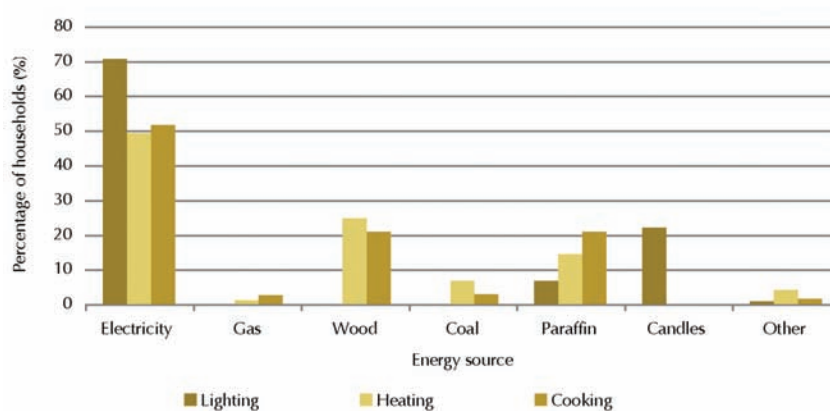

Figure 9.14: Energy source by household for lighting, heating and cooking, 2001
Source: Statistics South Africa (2004)[16]

consumption contribute to air pollution, unless technical and costly methods are used to control the problem. Some of the worst air pollution has been recorded within and adjacent to Gauteng, due to intensive industrial activity. Liquid fuels, used in the transport sector, are the second largest source of pollution and greenhouse gas generation. Air quality in major urban centres is worsening on account of the use of wood, paraffin, and coal for heating and cooking in poor settlements. Inefficient burning methods (lack of properly designed stoves and over-stoking of fires) make matters worse. The health effects of indoor air pollution are extreme[78]. The worst air quality in South Africa can occur inside poorly ventilated dwellings in informal settlements and rural dwellings[5].

The White Paper on Energy Policy (1998) commits the government to provide affordable and sustainable energy services that are focused on demand, and acknowledges that energy production and distribution should not only be sustainable but should lead to the improvement of living standards of all South Africans. The Department of Minerals and Energy (DME) has developed an energy efficiency strategy so as to help to realise policy goals. A renewable energy strategy has also been formulated, with the intention of diminishing reliance on fossil fuel and cutting emissions, which in many cases, have become serious. The promotion of Basa Njengo Magogo clean burning-stoves and the deployment of "Energy Centres" that dispense clean fuels are being explored in low-income areas. The DEAT, in cooperation with Danish International Development Assistance (DANIDA), has developed an Urban Environmental Management Programme 2006–2010 to support air quality initiatives (including demonstration projects) in certain provinces and cities. This programme starts early in 2006.

In South Africa, some cities are assessing their energy profile with a view to developing local energy strategies. This exercise aims to help local authorities to institutionalise sustainable energy approaches and guide practitioners within a framework that provides clear directives. This approach has been spearheaded by Cape Town, in partnership with Sustainable Energy Africa, a local NGO promoting integrated energy planning. The city produced its first State of Energy Report in 2003, prioritizing energy issues for Cape Town[79]. This report formed the basis for producing the city's Energy Strategy[80] as a component of its Integrated Metropolitan Environmental Policy. Other cities (such as Ekurhuleni and Johannesburg) have expressed intent to follow suit.

9.7.2   Water use

Minerals-motivated settlement and economic growth in the northern and eastern interior has brought about a serious mismatch between development and available water resources. To serve Highveld cities, the mines, and the generation of power, massive inter-basin water transfers have become necessary, diverting water from many catchments areas (including the Orange, Usutu, and Tugela) into the Vaal River system. Such diversion of water has an impact on downstream development potential and environments, and the effects extend to the ocean and, in many cases, across international boundaries.

Water consumption in South Africa expressed as cubic metres per capita per annum, amounted to 28 700 in the year 2000. This included all uses, that is, residential, industrial, irrigation, and forestry (irrigation accounts for 75% of the country's used water). The national availability of water is uneven, with over 60% of water in rivers arising from only 20% of the country's land area[5]. Major urban developments, such as Gauteng and the Cape Metropolitan Area, are situated where there is inadequate water to support their people and their economies[5]. (For information on water consumption, see Chapter 6.)

9.7.3   Land use

Settlements alter land use, the footprint being as large as the settlement itself. Altered land use also restricts other potential uses, and this can extend the footprint beyond the area of the altered land use. To illustrate, urban and industrial development may command use of good quality arable land, a scarce resource in South Africa, in this way diverting agricultural pressure to other land of less arable quality. It needs to be acknowledged that good agricultural land, close to markets, is a good place for intensive farming, thereby possibly relieving farming pressure on land elsewhere.

Analyses of urban land cover in 1996 and 2001 show that the surface area of urban land use increased countrywide by 25%[17]. Although urban land-cover accounts for only 1.5% of total land-cover, it is concentrated in areas of prime agricultural value, as is the case in Gauteng. (For information on land use, see Chapter 4.)

9.8   WASTE OUTPUTS

Footprint areas differ in size, but can be extensively enlarged by the distribution of pollution by air and water. (For information about air and water pollution, see Chapters 8 and 6, respectively.) This section focuses on solid waste.

The growth of human settlements and the concomitant increase in economic activity, including consumption, lead to the production of various forms of waste (see Box 9.8). Although there is a lack of recent data, the profile for waste generated in 1997 (see Figure 9.15) shows that mining produced the largest waste-streams, by far.

9.8.1 General waste

According to studies undertaken by the Department of Water Affairs and Forestry (DWAF), and the Department of Environmental Affairs and Tourism (DEAT) in 1998, total general waste from households, commerce, institutions, and the manufacturing industry was approximately 13.5–15 million tonnes per year, which increased over the last 7 years due to rising population and economic growth. In addition to these increases, a further 22 million tonnes per year of industrial wastes are generated, handled, and disposed of in-house (on-site).

Gauteng (followed in second place by the Western Cape) generates the most waste per person (760 kg/person/year). It also produces the greatest quantities of waste of all provinces (43%) (see Figure 9.16). Provinces that are the most urbanized and affluent generate the largest amount of waste.

Nationwide, about 8.8 million tonnes of domestic waste required collection and disposal in the financial year 2004/2005[82] (see Table 9.6). During the six years from 2004 to 2010, domestic waste is predicted to rise by 1.1 million tonnes to some 10 million tonnes or more.

9.8.2 Hazardous waste

Domestic, industrial, and mining activities can generate hazardous waste. Hazardous waste (mostly domestic, with some industrial sludge mixed in), currently amounts to nearly 310 000 tonnes/annum[85]. Total hazardous waste generated in the financial year 1997/1998 by the four largest industrial sectors (non-metallurgical manufacturing industries, metallurgical and metal industries, service industries, and mining) was over 418 million tonnes, of which approximately 90% came from mining[78] (see Table 9.7). The Department of Minerals and Energy indicated in 1997 that mining was accountable for about 470 million tonnes of waste, both general and hazardous. Gold mining contributed almost half[58]. The only additional studies
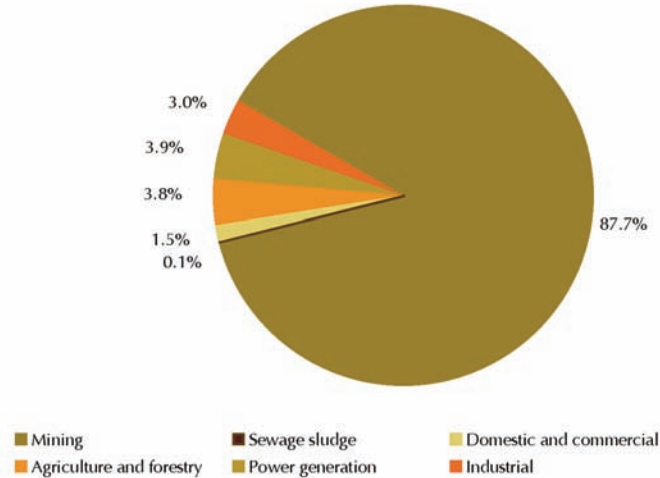
Figure 9.15: Waste generation profile for South Africa, 1998
Source: Department of Water Affairs and Forestry (1998)[81]
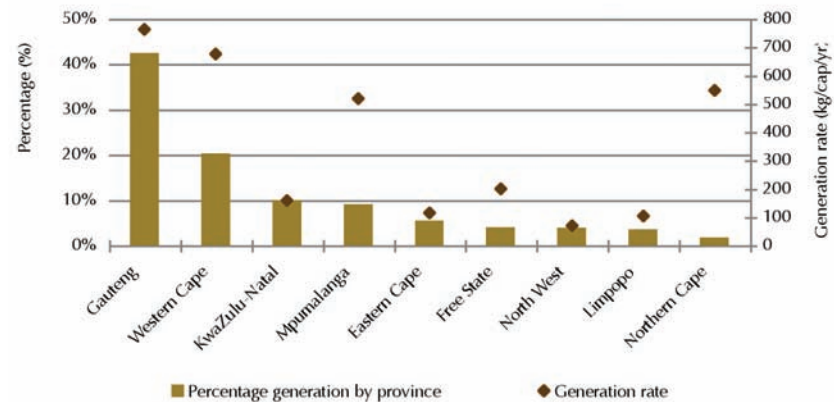
Figure 9.16: Proportion of general waste generated and waste generation rate per province
Source: Department of Water Affairs and Forestry (1998)[81]

Table 9.6: Variables used to calculate the amount of domestic waste generated

Income levels	Waste generation rates (kg/person/day)	Population (%)	2004/2005 population (number of people)	Domestic waste generated (tonnes/year)
Low	0.41	73.97	34 470 020	5 158 669
Middle	0.74	21.44	9 991 040	2 698 244
High	1.29	4.59	2 138 940	1 006 981
Total		100.00	46 600 000	8 863 894

Source: Department of Water Affairs and Forestry (1998)[58], Gauteng Department of Agriculture Conservation and Environment (2004)[83], Rustenburg Local Municipality (2005)[84]

Table 9.7: Division of hazardous waste generated per industrial group and classification (in tonnes)

Industrial sector group	Hazard rating					
	Hazard Group 1	Hazard Group 2	Hazard Group 3	Hazard Group 4	Hazard Group 5	Total per sector
Non-metallurgical manufacturing	22 313	148 205	281 167	4 772 190	10 149 134	15 373 009
Metallurgical and metals	0	11	334 698	4 566 830	0	4 901 539
Service	0	33 300	14 001	1 654 098	20 190 000	21 891 399
Mining	180	1 046 489	12 317	34 775 629	340 807 436	376 642 051
Total	22 493	1 228 005	642 183	45 765 747	371 146 570	418 804 998

Note:

Hazard Group 1 = High-hazard waste: presents a severe risk

Hazard Group 2 = Moderately hazardous waste: presents a serious risk

Hazard Group 3 = Low hazardous waste: presents a relatively low risk

Hazard Group 4 = Potentially hazardous waste: presents a very low risk

Hazard Group 5 = Non-hazardous waste

Source: Department of Water Affairs and Forestry (1998B)[58], South African Bureau of Standards (1995)[86]

Box 9.8   Tyre and electronic waste

With the growth of its economy and the expansion of secondary and tertiary economic sectors, South Africa has to deal with increased volumes of specialized waste. The generation of waste from discarded tyres, as well as from defective and redundant electronic equipment, continues to grow at the country's landfill sites. These wastes are discussed in more detail below.

Tyre waste

There are over 7 million vehicles on South African roads and the number is growing at a rate of about 2% per year. Quoting the rubbersa.com web site, a total of 28 million tyres will either be re-used (in the form of retreads) or be discarded in 2005 if each vehicle has a set of tyres replaced each year. Tyres have been regarded as a problem waste, because of the disposal issue and the attendant pollution risks. There is an increase in the use of tyres as a supplementary fuel source in cement kilns.

The Department of Environmental Affairs and Tourism plans to promulgate Waste Tyre Regulations. The primary objective is to establish a regulation that controls the collection and disposal of discarded tyres in South Africa, using a network of registered waste-tyre collection agents and accredited waste-tyre users. It also aims to promote the establishment of a sustainable, environ-mentally sound, waste-tyre user industry, favouring material recycling and energy recovery, with a view to attaining the goal of zero waste-tyre disposal to landfill. Job and wealth creation could be an additional benefit.

Photography: Kim Heubner

Electronic waste

Electronic waste (e-waste) refers to discarded electronic products. These include consumer items such as computers, cell phones, televisions, Videocassette recorders (VCRs), radios, and audio equipment, as well as commercial apparatus such as medical, technical, and scientific equipment. Many of the constituent materials can be re-used, refurbished, or recycled. Electronic discards, however, are one of the fastest-growing segments in the waste-stream. The situation is exacerbated by the fact that e-waste recycling is neither widespread nor well-known, and is specialized and labour intensive. Estimates are that about 12.5 million to 15 million computers are in use in South Africa, with a life cycle of only 7 years. Electronic waste is not generally directed to landfills, but commonly stored until recycled. Electronic waste contains hazardous waste as well as precious metals such as gold. There are only a few South African recycling companies who process this waste, which amounts to more than 4 000 tonnes/annum. We are in the early days of the recycling of electronic waste in South Africa.

undertaken since 1997 have been in the Western Cape, where 68% increase in waste generation was documented between 1997 and 2002.

Quantities of medical waste (health-care waste) are not currently recorded by most of the provincial health or environmental departments. A NWMS health-care waste project, initiated by the DEAT, intends to collect this information. Other important wastes include radioactive waste, agricultural waste, asbestos waste, and power generation waste. Waste ash from the nine coal-fired power stations operated by Eskom increased from 24.7 million tonnes/annum in 1999 to approximately 40 and 33 million tonnes/annum in 2005 and 2006 respectively, of which 4,8% (2005) and 5.4% (2006) was recycled[87].

9.9 GOVERNANCE

The state of environmental governance in settlements is not easy to gauge, as a comprehensive assessment has not yet been undertaken in South Africa. Furthermore, there are few identified environmental governance indicators and those that exist are at a preliminary stage of use. Because of its impact, environmental governance of settlements should ideally be evaluated in areas such as institutional capacity for environmental management, service delivery and performance, environmental planning, and institutional cooperation and coordination. Currently, no or little data exist to conduct such an evaluation, so the remainder of this section will therefore attempt only to provide a broad and somewhat generalized assessment of environmental governance in human settlements.

While 'environment' is not identified in the Constitution as a local government matter, some functions are clearly stipulated in the Constitution under Part 4B and 5B (giving local government executive authority), revealing the inter-governmental complexity and cross-cutting nature of environmental management functions. Examples include:

- Municipal planning
- Air pollution
- Noise pollution
- Storm water management in built-up areas
- Water and sanitation services
- Refuse removal, landfill management, and solid waste disposal
- Beaches
- Municipal parks and recreation (which can also include protected areas)
- Municipal health.

In addition, local government is also responsible for:

- Implementing the environmental policies, plans, and programmes of national and provincial government
- Ensuring alignment between the statutory local-level Integrated Development Plans (IDPs) and provincial environmental implementation plans
- Ensuring that IDPs comply with NEMA principles.

New environmental legislation drafted over the last couple of years (see Chapter 3) clearly anticipates an expanded role for all levels of government in implementing the environmental function. Local authorities are expected to formulate regulations, guidelines, norms, standards, and by-laws that do not conflict with provincial and national laws, and to monitor and enforce all of these.

Municipalities, however, currently have very limited environmental management capacity. This became clear from the IDP hearings conducted during the first half of 2005. Only a few municipalities have environmental management sections or a dedicated environmental management budgetary allocation. In most municipalities, staff are not being assigned full time to the responsibility of environmental management. Furthermore, the availability of engineers falls far short of the needs, with a national average of less than one engineer per local authority. The following text, extracted from a report for the DANIDA Urban Environmental Management Programme 2006-2010, clearly demonstrates the dilemma faced by local authorities:

"For example, the Health Act (2004) makes provision for "Environmental Health Investigations". At the local government level the designated functions of municipal health services include, inter alia, water quality monitoring, waste management, environmental pollution control, and chemical safety. While the World Health Organisation recommends a ratio of Environmental Health Practitioners (EHP) to the general population of 1:10 000, South Africa's current ratio is 1:20 000. Current training of EHPs is also considered inappropriate to urban environmental priorities of air and water pollution and environmental impact assessments (DEAT, 2001). Furthermore, the primary functions of EHPs in many municipalities have been food inspections, the control of rodents and pests, and public education. At a time where the Department of Environmental Affairs and Tourism is advanced in its plans to assign responsibility for the management of air pollution to district and metropolitan councils, these local structures appear ill-prepared to take on these functions"[88].

Planning for environmental sustainability at the municipal level is seen as part of the process of developing IDPs. The White Paper on Local Government introduces the concept of "developmental local government", which is defined as "local government that is committed to working with citizens and groups within the community to find sustainable ways to meet their social, economic and

Municipalities, however, currently have very limited environmental management capacity. This became clear from the IDP hearings conducted during the first half of 2005.
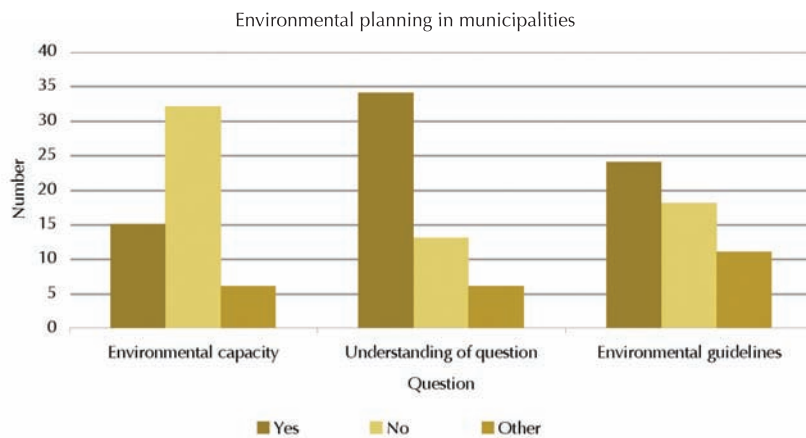
Figure 9.17: Capacity for environmental planning in municipalities
Source: Department of Environmental Affairs and Tourism (2005)[89]

material needs and improve the quality of their lives." The Municipal Systems Act (No. 32 of 2000) requires municipalities to draw up an IDP every five years, linking, integrating, and coordinating other plans in accordance with available resources and capacity. The IDP forms the policy framework on which annual budgets are based, and needs to be compatible with national and provincial development plans and planning requirements (including environmental management and implementation plans as called for by NEMA).

Various sectoral pieces of legislation need to be taken into consideration when an IDP is being produced, as the following examples show:

- The Biodiversity Act requires all IDPs to be aligned with the national biodiversity framework and any relevant bioregional plan. In drafting their IDPs, municipalities must take account of threatened ecosystems that are listed by the Minister or MEC in terms of the Biodiversity Act. Municipalities that are also management authorities of protected areas must prepare a management plan for invasive species control and eradication, and they must include invasive species monitoring, control, and eradication plans into their IDPs. If a municipality is designated as a competent authority, the municipality has a duty to carry out relevant provisions in the Act such as granting permits and issuing directives.

- The Protected Areas Act makes provision for municipalities to have areas under their jurisdiction declared as protected areas. Municipalities must draft management plans for local protected areas for approval by to their provincial government.

- The White Paper on Integrated Pollution and Waste Management requires municipalities to produce Integrated Waste Management Plans for submission to provincial government. Some provinces have already

enacted these provisions. The white paper also requires municipalities to implement public awareness campaigns, collect data for waste information statistics, provide waste services, manage landfill sites, promote waste minimization and recycling, through, for example, waste minimization clubs in industry.

- The Air Quality Bill requires each municipality to include an air quality plan in its IDP and to designate an air quality officer to coordinate air quality management matters within the national framework. Metropolitan and district municipalities must implement and administer the atmospheric emissions licensing system. Provinces are required to monitor the compliance of municipalities with national atmospheric emission standards.

The first round of IDPs was completed in 2001, with subsequent annual refinements and revisions taking place. While environmental planning is encouraged in IDPs, the reality at present is that very little integration of this kind takes place and that most IDPs give scant recognition to issues such as environmental services. A 2004 assessment of the extent to which municipalities in South Africa consider environmental issues in the IDP process clearly shows the lack of capacity in this area[89]. Three questions were posed in this assessment:

(1) Does the municipality have capacity to deal with environmental issues?

(2) Does the IDP show an understanding of the opportunities and constraints regarding the environment?

(3) Does the IDP refer to any environmental guidelines?

A total of 53 IDP reports were assessed. (Only metropolitan and district municipalities were assessed; they are often better resourced than local municipalities.) The results (see Figure 9.17) indicated that fewer than half of the municipalities had any capacity to deal with environmental issues. Some municipalities, where capacity is known to exist, did not reflect such information in their IDP report. Although 34 reports indicated an understanding of environmental issues, only 24 reports reflected the existence of any kind of environmental guidelines.

The IDP planning process is intended to be participatory and is, in many respects, similar to the planning approach recommended by Local Agenda 21. The DEAT is in the process of developing monitoring and information systems (including environmental indicators for local government) and IDP toolkits, to strengthen the environmental component of the IDP process.

The IDP process is now central to the entire strategic planning and budgeting process of local government. While previous IDPs were regarded as 'wish lists' that paid little attention to environmental requirements, the increasing

priority given to IDPs offers important opportunities for bringing environmental sustainability considerations into the main stream of local governance[88]. Because of capacity constraints and other limitations experienced by local government, it will take considerable time, effort, and resources to ensure that the environment receives the necessary attention in IDPs. Environmental sustainability will become a reality only if these issues are mainstreamed in the IDP processes.

9.10 CONCLUSION

This chapter has presented an overview of the nature, state, and impact of human settlements and their environment in South Africa. Whilst acknowledging that settlements are both rural and urban, and that over 42% of the total population resides in rural areas, it is evident that urbanization and migration have played (and continue to play) a key role in shaping towns and cities. The growth in scale and influence of urban settlements has been reflected by their corresponding footprints. Rapidly expanding urban centres require more natural and human resources to drive economic production and development.

South African settlements are still socially and economically divided. The growing size and number of informal settlements in urban and peri-urban areas has entrenched these divisions. Despite achievements in certain areas of service delivery by government, especially local government, pressure persists to meet the growing demand for basic services and reduce existing backlogs. Backlogs mean that many millions of the poorest households still do not have access to adequate basic services, which in turn deepens the impact of poverty and undermines human well-being. Unserviced settlements in urban and rural areas, besides being the source of an uncontrolled environmental burden, are themselves more vulnerable to health risks that arise from environmental pollution. Although access to health care (especially clinics) and social services (such as schools) has improved in recent years, the distribution and quality of health and educational services remain varied and unequal, with limited access to them by many poor South Africans.

Over the past decade, South Africa has introduced a wide range of policies, programmes, strategies, and plans to address the country's many developmental challenges. These strive to enhance the sustainability of human settlements by improving the planning, service-delivery, monitoring, and regulation functions of local authorities. Severe resource constraints, however, hamper the government's efforts.

There has also been a growing recognition of the inter-relationships and interaction between people and place, and the links between human activity and the environment. Whereas urban and rural development programmes have focused on alleviating poverty, environmental legislation

and policy, amongst other things, aims to improve the management of natural resources and regulate the impacts of pollution that are felt most intensely by the poor. A Sustainable Human Settlements Strategy, which is currently undergoing debate within government, places the issue of settlements and their sustainability firmly on the South African political agenda.

The hope is that, in time, the settlement imprint will change, as will its implications for human development and the environment.

NOTES

a. The definition of what constitutes an urban area differs across the world. For example, Uganda classifies a settlement with over 100 people as urban, whereas Nigeria adopts a figure of over 20 000. Large cities are generally those exceeding one million people. Mega-cities exceed 10 million people.

b. Urbanization is the trend whereby the number of people living in cities increases in relation to the number living in rural areas. A country is defined as urbanized when more than 50% of its population lives in urban places.

c. The Habitat Agenda is an agenda for the sustainable development of human settlements. It was developed at the Second United Nations Conference on Human Settlement, Habitat II, held in Istanbul, Turkey in 1996, and it includes the goals, principles, and commitments to turn the vision of sustainable human settlement into reality. South Africa endorsed the Habitat Agenda in 1996.

d. Informal settlements are characterized by communities living and located in informal housing. They are found in diverse geographical locations – close to the urban core, on the urban fringe, or in peri-urban areas.

e. 'Connectivity' refers to the extent to which different transport and communication nodes and modes are connected, thereby enabling the movement of people and goods.

f. The following size categories have been used: small cities have more than 0.5 million people, large cities have 1–5 million people, and megacities have over 5 million people.

g. 'Splitting' here refers to the process whereby members of a household (such as grown-up children or separated partners) leave it to set up their own separate households. This leads to the requirement for additional services and shelter.

h. Public health sector posts include positions for personnel such as nurses, dentists, doctors, and pharmacists.

i. The expanded definition of unemployment relates to those people who want to work but have neither taken active steps to look for work nor started any form of self-employment in the previous four weeks.

j. Secure tenure is defined as "evidence of documentation that can be used as proof of secure tenure status" and "no *de facto* or perceived protection from forced evictions".

k. At the time that the SAEO was being finalized, the Energy Research Centre (ERC) at the University of Cape Town released a report entitled 'Energy policies for Sustainable Development: Options for the future' (April 2006). For further information refer to http://www.erc.uct.ac.za/publications/Energy%20policies%20for%20SD.pdf

l. It requires 240 tonnes of oil (equivalent) to produce only one US dollar at purchasing power parity (PPP) of GDP.   Per capita consumption is still however much lower than that of the United States.   Annual per capita consumption in South Africa is 2.4 tonnes of oil equivalent compared to 8 in the United States (WRI 2005).

m. South Africa has coal reserves of 34 billion tonnes.

n. Local natural gas reserves are limited.   Should gas be used on a large scale it is likely to be imported into South Africa, or generated from other sources, such as oil, coal or biomass.

o. Local hydro reserves are limited.

p. South Africa's electricity generating plants are adapted to burn very low-grade coal. The country generates two-thirds of Africa's electricity, and 66% of its population (representing 5% of the total African population) consumes almost 50% of the continent's electricity.

q. A petajoule (PJ) is a measure of energy equivalent to a thousand trillion joules, or roughly 30 million kilowatt hours. It is normally used to express energy consumption by large consumers such as cities, major industries, or the cumulative output from commercial energy production facilities. One petajoule is the amount of energy consumed by a small town of about 3 700 people in a year for all uses.

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