2012 State of the Environment Report

CITY OF CAPE TOWN | ISIXEKO SASEKAPA | STAD KAAPSTAD

THIS CITY WORKS FOR YOU

FOREWORD

Cape Town is filled with natural beauty. Bounded by mountains and oceans, it is home to some of the world's most diverse natural vegetation and landscapes. It is also a vibrant city; a unique place with diverse cultures and a rich heritage.

The State of the Environment Report is an essential tool for measuring progress towards the goal of becoming a more sustainable city. It provides a snapshot of the environment as well as an analysis of trends over time and thus ensures that the city and stakeholders gave access to accurate and transparent scientific information about a range of environmental issues. This enables us to act on environmental problems as they are identified, based on concrete scientific information and evidence.

Building a more environmentally friendly and sustainable city cannot be achieved by local government alone. It is a daunting task, and one that requires co-operation from all three spheres of government, as well the private sector, non-governmental organisations, educational institutions, and individuals throughout the City.

In light of this, I encourage you, the reader of this report, to do your part in helping us to build an environmentally friendly city.

Patricia de Lille
Executive Mayor

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INTRODUCTION

Cape Town has a long history of working towards building a more sustainable and environmentally friendly city. In 2001, Cape Town became one of the first cities in South Africa to approve and adopt a comprehensive city-wide environmental policy. The Integrated Metropolitan Environmental Policy (IMEP) set out the City's environmental commitments, and was accompanied by a series of strategies and plans that laid out specific steps for achieving sectoral goals.

This suite of strategies and plans was developed for the following sectors: biodiversity, coastal zone management, environmental education and training, cultural heritage, energy and climate change, and air quality management. In 2009, the City of Cape Town Environmental Agenda 2009-2014 was adopted by Council. The Environmental Agenda emerged out of a review of the City's Integrated Metropolitan Environmental Policy (IMEP), which found that specific goals and targets for environmental management were required in order for the city to begin to see real changes take place.

The Environmental Agenda builds on IMEP's strong policy and strategy foundation by introducing 17 detailed goals and targets for environmental sustainability in Cape Town. The overall aim of these goals is to see a gradual positive improvement in key environmental indicators, while also ensuring compliance with national standards and regulations. The City recognises that positive environmental change can be a lengthy and long-term process, and therefore the goals have been set with achievability as a key criterion. Details of the 17 targets can be found in Appendix A.

The strategic goals of the 2012-2017 Integrated Development Plan (IDP) can be found in Appendix B. This IDP was revised in 2012 and has been formulated in line with changing City priorities. The five key pillars of the IDP encompass the kind of city that the City of Cape Town aims to achieve: the Opportunity City, the Safe City, the Caring City, the Inclusive City, and the Well-run City.

The City has also committed itself to the implementation of a number of international conventions and pledges. Among these, the most significant is the United Nations Millennium Development Goals (UN MDGs), which consists of a list of key actions that must be taken in order to ensure a more sustainable future in the developing world (Appendix C). Additionally, on World Environment Day 2005, the City pledged its commitment to the Urban Environmental Accords, a set of actions and targets for achieving a more sustainable city.

The State of the Environment report has a specific focus on physical environmental and ecological issues, and this reports on related indicators. It does not seek to address social and economic issues; those are dealt with in the State of Cape Town Report – compiled by specialists in the fields of socio-economic indicators – which should be read in conjunction with this report.

Achmat Ebrahim
City Manager

BACKGROUND

The first City of Cape Town State of the Environment Report was published in 1998, and provided the City of Cape Town (CCT) with a baseline from which to measure and record changes in Cape Town's environmental state. Since then, the report has been through a variety of incarnations, and has grown into a widely used and respected document.

This report focuses on the 2011 calendar year (January 2011 to December 2011). All data presented is taken from this time period, unless stated otherwise. It is important to note that water quality data is presented on the basis of the hydrological year, from October 2010 to September 2011, as this accounts better for natural variations on a seasonal basis. Where historical data is available it is published alongside current data in order to show longer-term trends. In most cases historical data is available going back more than five years, which provides a good indication of trends.

Indicators

In order to report on the city's environment, it is necessary to have a set of common measurements that can be tracked over time. These measurements, more commonly known as 'indicators', allow us to quantify, monitor and report on changes in our city.

Indicators have been chosen to provide a detailed overview of the state of the city's natural environment. The selected indicators are aligned with the Integrated Development Plan (IDP) and Integrated Metropolitan Environmental Policy (IMEP), and represent issues that are relevant to the City of Cape Town and its residents. The selection of indicators was also guided by international and local experience in this field, scientific research, and consultation with key stakeholders.

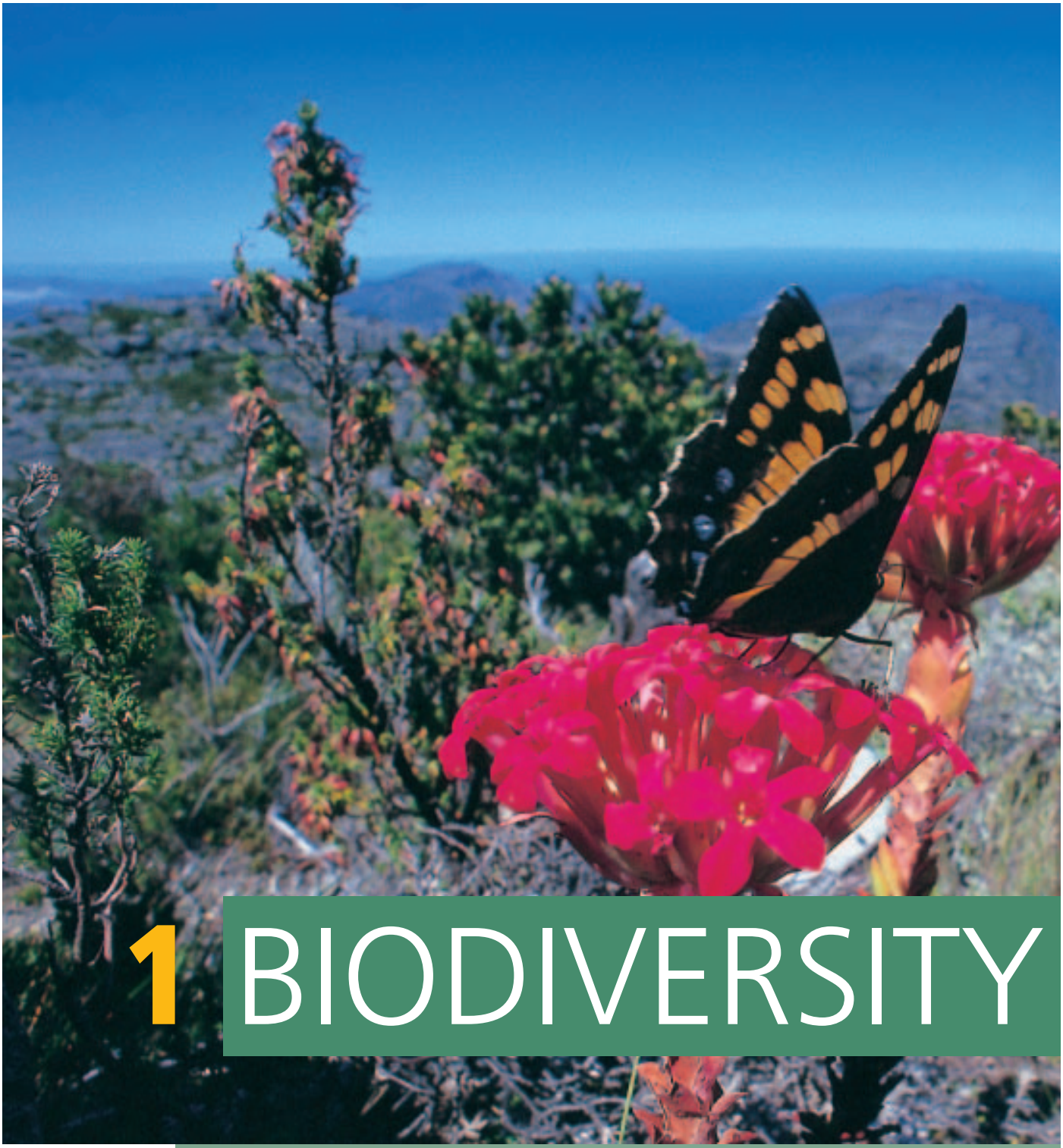
Data on each indicator is assessed and analysed to determine whether a positive or negative trend can be seen. Each indicator in the report is associated with an icon depicting the overall outcome of the analysis.

Situation improving

Situation deteriorating

No significant change

It is important to remember that indicators provide a glimpse of a situation at a particular point in time, and do not necessarily tell the whole story. However, monitoring indicators over time allows one to draw fair conclusions about trends in the city, while working towards ensuring that necessary action is taken in a timely fashion.



1 BIODIVERSITY

Indicators

Percentage of natural vegetation remaining, by type
Percentage of natural vegetation conserved, by type
Conservation status of natural vegetation, by type

Cape Town has enormously rich biological diversity, and is known for its incredible natural beauty. The recent proclamation of Table Mountain as one of the New Seven Wonders of Nature recognises this. The city is located within one of the world's six plant kingdoms – the Cape Floristic Region (CFR) (See Map 1). The CFR, a recognised UNESCO World Heritage site, is the smallest but most biologically diverse of all the plant kingdoms. The CFR has one of the highest proportions of endemic species in the world, with over 70% of its approximately 9 600 plant species found nowhere else. The CFR has officially been identified as a 'global biodiversity hot spot' which recognises it as one of the planet's 25 most threatened ecosystems, and places an international responsibility on all tiers of government to ensure its adequate conservation.

Managing such threatened biodiversity in an urban context is a complex task. Although the City manages a number of nature reserves, these do not necessarily cover a representative proportion of the various components of Cape Town's biodiversity. Over two thirds of the natural vegetation types are classified as 'endangered' or 'critically endangered', and over 300 of Cape Town's plant species are threatened with global extinction. Cape Town has six endemic vegetation types, which means that they can only be conserved within the boundaries of Cape Town. Four of these vegetation types are critically endangered, and remnants will need to be conserved both within and outside of the urban edge. Cape Town is a unique example of a city where biodiversity must be conserved as part of the urban fabric, and be fully integrated into present and future spatial planning.

Vegetation types

Cape Town's biophysical features such as its geographical position, topography, soils and climate support a diversity of vegetation types. Natural ecosystems occurring in Cape Town are classified according to a hierarchy of national vegetation types, within which local subtypes are identified.

These subtypes are determined by the underlying soil types and conditions. Importantly, there can be significant variation among plant and animal communities within the same vegetation type or subtype – a manifestation of the high levels of biodiversity in the region. Vegetation falls into four general categories:

- Mountain Fynbos, as its name suggests, is found predominantly on the slopes of the various mountain ranges in the region;
- Lowland Fynbos, found on sandy substrata in the lower-

MAP 1: Cape Floristic Region in the context of South Africa.

lying areas, which is under severe pressure from land-use change and urban expansion;
- Strandveld, which is unique to coastal sands and beach areas; and
- Renosterveld, which is found on clay-rich soils and has been substantially transformed by land-use changes.

Mountain Fynbos

Mountain Fynbos can be found on both upper and lower mountain slopes. Those species which exist on higher and steeper slopes mostly escape human development, owing to their location. However, many threatened plant species do occur within these particular ecosystems.

Fynbos in general is characterised by its small and fine leaves, the dominance of shrubs and Cape reeds (restios), and its ability to thrive in poor soils and seasonally hot, dry conditions. Mountain Fynbos in Cape Town comprises seven vegetation types:

- Peninsula Sandstone Fynbos,
- Kogelberg Sandstone Fynbos,
- Western Coastal Shaleband Vegetation,
- Cape Winelands Shale Fynbos,
- Elgin Shale Fynbos,
- Peninsula Granite Fynbos, and
- Boland Granite Fynbos

The Peninsula Sandstone and Peninsula Granite Fynbos types are endemic to the city, and therefore must be conserved within the city bounds. Plants that characterise this vegetation type include proteas, such as the King Protea (*Protea cynaroides*), Sunshine Conebush (*Leucadendron salignum*) and Tree Pincushion (*Leucospermum conocarpodendron*), as well as Cape reeds (Restionaceae), ericas (Ericaceae) and other fine-leaved shrubs.

Lowland Fynbos

Lowland Fynbos has more threatened species per area than any vegetation type anywhere else in the world. Its location on the lowland flats and plains puts it at great risk from human settlement and agricultural development. To date, much of this vegetation type has been destroyed due to land-use changes and increasing urbanisation. Lowland Fynbos comprises five types:

- Cape Flats Sand Fynbos,
- Atlantis Sand Fynbos,
- Hangklip Sand Fynbos,
- Lourensford Alluvium Fynbos, and
- Swartland Alluvium Fynbos.

Cape Flats Sand Fynbos and Lourensford Alluvium Fynbos are endemic, and as such, the responsibility to conserve these vegetation types rests on concerned and responsible parties in Cape Town. Plants that characterise this type include numerous Erica species, including *Erica verticillata* and *Erica turgida* (now both extinct in the wild), proteas such as the Cape Flats Conebush (*Leucadendron levisanus* – critically endangered), Cape reeds (Restionaceae) and bulbous plants of the lily and iris families.

Strandveld

Strandveld grows in alkaline coastal sands and dunes and has been considerably impacted by coastal development. Only approximately 19% of its original extent is conserved or appropriately managed. Plants that characterise this type include Sea Guarrie (*Euclea racemosa*), Blombos (*Metalasia muricata*), Bietou (*Chrysanthemoides monilifera*), annual daisies, and numerous succulent vygie species. Cape Flats Dune Strandveld is endemic to Cape Town.

Renosterveld

Renosterveld (literally translated, 'rhinoceros vegetation') may have derived its name from the rhinoceroses which were commonly found in this vegetation in the past. Another theory behind the name relates to the dark grey colouring of the plants in late summer, somewhat resembling the colour of a rhinoceros from a distance. There are four Renosterveld vegetation types remaining in the City:

- Peninsula Shale Renosterveld,
- Swartland Shale Renosterveld,
- Swartland Silcrete Renosterveld, and
- Swartland Granite Renosterveld.

Peninsula Shale Renosterveld is endemic to Cape Town. Renosterveld is dominated by the grey Renosterbos (*Elytropappus rhinocerotis*), but in its natural and undisturbed state would most probably have been dominated by grass species, such as Rooigras (*Themeda triandra*). Renosterveld is rich in shrubs from the daisy family (Asteraceae) and bulbous plants, such as orchids, irises and lilies[1]. In Cape Town, only about 8% of the original extent of Renosterveld vegetation types remains.

Fauna

Cape Town's faunal diversity is also significant, particularly for smaller vertebrates and invertebrates, although some larger mammals previously found in the area were hunted to extinction. Over 360 bird species have been recorded in the City of Cape Town area, of which 18 are endemic to South Africa. All six of the CFR endemic birds occur within the City; these are: Protea Canary (*Serinus leucopterus*), Cape Siskin (*Pseudochloroptila totta*), Victorin's Warbler (*Cryptillas victorini*), Cape Rockjumper (*Chaetops frenatus*), Orange Breasted Sunbird (*Anthobaphes violacea*) and Cape Sugarbird (*Promerops cafer*). Cape Town is also host to five Important Birding Areas (IBAs). The international IBA programme identifies areas that are critical for the long-term survival of particular bird species that are globally threatened, have a restricted range, and are endemic to specific vegetation types[2]. One of the most significant is the False Bay IBA, which includes the False Bay Ecology Park along the False Bay coastline. This IBA is centred around a wastewater treatment works which has created a favourable environment for large numbers of water birds. Of the over 270 species of bird found in this IBA, eight are Red-Listed species, including the Little Bittern (*Ixobrychus minutus*) and African Marsh Harrier (*Circus ranivorus)*. The other IBAs are Rietvlei, Boulders Beach, Kogelberg Mountains and Robben Island.

The paddle winged lacewing (*Halterina pulchella*) (left) was thought to be extinct for over 100 years. However, it was recently rediscovered in Atlantis Sand Fynbos near Pella. Photo and discovery : Andrew Morton.

The grysbok (*Raphicerus melanotis*) (right) is endemic to the Western Cape.

Animals in urban areas

The Cape Peninsula is home to 16 troops of Chacma baboons (*Papio ursinus*), consisting of approximately 460 individuals. Urbanisation of the Cape Peninsula has drastically reduced the baboons' natural habitat and foraging ranges. Now, surrounded by suburbia, they have learnt that foraging around human habitation is very rewarding. They are therefore attracted to residential areas and tourist hotspots; due to this proximity, conflict occasionally arises between these animals and humans. The City recognises that baboons are an important part of the ecosystem, and also that human - baboon relations need to be carefully managed. Baboons are legally protected wild animals enjoying conservation status.

The City remains committed to the preservation of a sustainable baboon population and continues to work towards minimising negative human - baboon interactions through the implementation of its baboon management project. This project employs a number of baboon monitors who work to keep baboons out of residential areas. Future plans for the baboon management project include the use of a radio telemetry monitoring system to track and predict the movement of the baboons, as well as the potential establishment of buffer zones in key areas.

Up to 83 indigenous mammals are thought to be found in the City area. Sighting of fynbos animals is rare, as they are either nocturnal, or very shy. Some more visible species include the Grey Mongoose (*Galerella pulverulenta*), Striped Mouse (*Rhabdomys pumilio*), Rock Hyrax (*Procavia capensis*), Cape Grysbok (*Raphicerus melanotis*), Steenbok (*Raphicerus campestris*) and Duiker (*Sylvicapra grimmia*).

The coastline is also home to numerous animal species, and hosts a number of breeding sites for sea birds such as the endangered African Penguin (*Spheniscus demersus*) and the African Black Oystercatcher (*Haematopus moquini)*. It is also an important breeding ground for the Cape Fur Seal (*Arctocephalus pusillus*).

The inter-tidal zones support smaller organisms from many classes, including sponges, anemones, crustaceans and molluscs. The Cape Clawless Otter (*Aonyx capensis*) is an example of a larger animal found in this zone.

Cape Town has two major estuaries at Zandvlei and Milnerton. Estuaries support significant aquatic life, and are important for biodiversity, but remain under threat from pollution and development.

The coastal waters support a variety of smaller and larger marine animals. The Great White Shark (*Carcharodon carcharias*) is one of many shark species to be found in the Atlantic Ocean. There are also a number of whales and dolphins present in Cape waters, including the Southern Right Whale (*Balaena glacialis*), the Humpback Whale (*Megaptera novaeangliae*), the Common Dolphin (*Delphinus delphis*) and the Dusky Dolphin (*Lagenorhynchus obscurus)*.

The region also supports many reptile and amphibian species, of which a number are currently threatened. It is estimated that about 63 reptile species are found in the City area. 30 of these are endemic to South Africa, of which eight are threatened with extinction. Of the 27 species of amphibian recorded within the boundaries of the City of Cape Town, 25 are endemic to South Africa and 10 are threatened with extinction. Two of these amphibians – the Table Mountain Ghost Frog (*Heleophryne rosei*) and Lightfoot's Moss Frog (*Arthroleptella lightfooti)* – are endemic to the city area alone. The endangered Cape Leopard Toad (*Amietophrynus pantherinus*) is another species under threat due to habitat loss and competition from invasive species.

There are a number of animal species that once inhabited the area but are no longer found in Cape Town today; this is true of many of the larger animal species. Big-game animals that would have grazed on Renosterveld in the area, such as Eland and Red Hartebeest, were displaced or hunted out early in the colonial period.

Many of the City's reserves are considered too small at present to reintroduce large game animals. The City is also cautious regarding reintroduction, which must be carefully considered and managed, especially considering that environments and habitats may have changed, and certainly lack the large predators that once would have existed alongside other large wildlife[3]. In 1981, two hippos were re-introduced to Rondevlei Nature Reserve to control vleigrass, which was choking the wetland system. Today, the reserve's hippos play an important role in maintaining the open-water ecosystem.

Bontebok (*Damaliscus pygarus*) have been reintroduced to some of the City's nature reserves

State of the environment

In 2002, the Conference of the Parties (COP) to the Convention on Biological Diversity (CBD) set a minimum target for conserving vegetation, which requires 10% of the historical extent of vegetation to be conserved. In a follow-up 10th Conference of the Parties (COP 10) in Nagoya in 2010, it was recommended that a minimum of 17% of terrestrial areas should be under official conservation by 2020. Minimum national targets for CFR terrestrial ecosystems exceed this, however, as diversity values (including species turnover and endemism) are much higher in this plant kingdom than in most others.

The City of Cape Town's conservation goals and targets are aligned to the national targets. These targets are used to determine the minimum set of areas in the Biodiversity Network (BioNet) (See Map 2). The BioNet is a fine-scale, systematic biodiversity plan which identifies sites that need to be prioritised for conservation and protected from development and inappropriate management. The fine-scale biodiversity planning analysis was first done in 2002, and is regularly updated to include the latest local and national biodiversity information. For example, in the 2007 analysis, vegetation units were aligned to the new national vegetation map. In 2008, mapped vegetation units across the city were ground-truthed for habitat condition, and this information was incorporated into the 2009 analysis. The 2011 analysis incorporated climate change adaptation measures[4].

The BioNet consists of a series of interconnected critical biodiversity areas (CBAs), ranging from pristine habitats to more degraded but highly threatened ecosystems and critical ecological support areas (CESAs). The BioNet is a key informant in the City's medium- to long-term spatial planning, such as the Spatial Development Framework, district plans and environmental management frameworks. This aims to ensure that important natural sites are conserved, and that development is directed towards less important sites. The BioNet forms part of the City's life-support system, as natural ecosystems provide many goods and services, as well as providing space for healthy recreation and spiritual and social upliftment.

Tables 1, 2 and 3 show the current state of biodiversity conservation in Cape Town. It is important to note the conservation status of each vegetation type, and the percentage of original extent remaining, both within and

National vegetation type	Historical extent (national)	Historical extent (CT)	Remnant extent (CT 2011)	Percent remaining (CT 2011)	Extent proclaimed	Target: (% of original)	% original proclaimed	% remnant proclaimed	National Ecosystem Status 2011
Swartland Alluvium Fynbos	46 984	1 734	71.5	4%	0	30%	0%	0%	CR, A1
Swartland Shale Renosterveld	494 577	47 316	3 924	8%	530.3	26%	1%	13.5%	CR, A1
Lourensford Alluvium Fynbos *	3 585	3 585	303	8.5%	8.9	30%	0.2%	3%	CR, A1
Peninsula Shale Renosterveld *	2 384	2 384	293	12%	238.9	26%	10%	82%	CR, A1
Cape Flats Sand Fynbos *	54 335	54 335	7 889	14.5%	937.6	30%	2%	12%	CR, A1
Swartland Silcrete Renosterveld	9 985	1 091	178	16%	0.03	26%	0%	0%	CR, A1
Swartland Granite Renosterveld	94 745	7 292	1 876	26%	137.5	26%	2%	7%	CR, A1
Peninsula Granite Fynbos - South subtype *	7 158	7 158	2 422	34%	1 727.5	30%	24%	71%	CR, A1
Elgin Shale Fynbos	27 948	841	327	39%	325.5	30%	39%	99%	CR, A1
Atlantis Sand Fynbos	69 801	25 177	15 475	61.5%	236.1	30%	1%	1.5%	CR, D1
Peninsula Granite Fynbos - North subtype *	2 070	2 070	1 439	69.5%	982.2	30%	47%	68%	CR, A1
Kogelberg Sandstone Fynbos	91 528	9 435	9 197	97.5%	8 220.4	30%	87%	89%	CR, D1
Cape Flats Dune Strandveld - False Bay subtype *	27 823	27 823	7 763	28%	2 736.8	24%	10%	35%	EN, A1
Hangklip Sand Fynbos	8 119	3 295	1 840	56%	1 372.7	30%	42%	75%	EN, A1
Cape Flats Dune Strandveld - West Coast subtype*	12 734	12 734	10 448	82%	2 669.2	24%	21%	25.5%	EN, A1
Peninsula Sandstone Fynbos *	21 936	21 936	20 976	96%	17 516.7	30%	80%	83.5%	EN, D1
Peninsula Shale Fynbos - Cape Winelands subtype*	1 263	1 263	658	52%	651.8	30%	52%	99%	VU, A1
Cape Winelands Shale Fynbos	7 306	4 006	2 279	57%	1 379.1	30%	34%	60.5%	VU, A1
Boland Granite Fynbos	49 903	9 379	5 649	60%	296.2	30%	3%	5%	VU, D1
Southern Afrotemperate Forest	80 005	348	346	99.5%	271.6	34%	78%	78.5%	LT, A1
Western Coastal Shaleband Vegetation	13 445	317	317	100%	298.1	30%	94%	94%	LT, A1

TABLE 1: natural vegetation remaining by type

CR	Critically Endangered
EN	Endangered
VU	Vulnerable
LT	Least Threatened
Criterion A1	
Criterion D1	

* - endemic to Cape Town

Note: Figures for Peninsula Granite Fynbos include areas currently under Pine plantation. These areas are not included by SANBI in the national biodiversity assessment. Ecosystem status is based on national figures.

Criterion	CR	EN	VU
A1: irreversible loss of natural habitat	Remaining natural habitat ≤ biodiversity target	Remaining natural habitat ≤ (biodiversity target + 15%)	Remaining natural habitat ≤ 60% of original area of ecosystem
D1: Threatened plant species associations	≥ 80 threatened Red Data List plant species	≥ 60 threatened Red Data List plant species	≥ 40 threatened Red Data List plant species

Category	Area (ha)	% of Biodiversity Network	% of Cape Town (2487km²)
Total Biodiversity Network 2009	85 000	100%	34.18%
2014 Target	51 000	60%	20.51%
Currently conserved	43 236	50.87%	17.38%
Remaining required to meet 2014 target	7 764	9.13%	3.12%

Table 2: Summary of conservation status in Cape Town

Category	Area (ha)	% of Biodiversity Network
City Nature Reserves (in process)	11 500	13.53%
City Nature Reserves (existing)	3 504	4.12%
SANParks Reserves	24 971	29.38%
CapeNature Provincial Reserves	2 664	3.13%
Perpetuity Stewardship Agreements	597	0.70%
Total:	43 236	50.87%

Table 3: Breakdown of conserved land in Cape Town

outside of the city. In some cases, very little of the original extent remains – these types are a critical priority for conservation efforts in Cape Town. Many vegetation types outside the City boundary have also experienced similar levels of transformation as those within the City, due to significant land-use changes over the past centuries. Maps 4 and 5 show the probable historical distribution of vegetation types in Cape Town, and the current fragments remaining, respectively; Map 3 shows the national conservation status of these remnants. Map 1 is a depiction of the City's BioNet – a fine-scale conservation plan indicating priority areas required for conservation.

In terms of fauna, it is more difficult to get precise data on populations and the spread of different species, and therefore this data is not presented here. Data on different species can be found on the South African Biodiversity database, which is used to record sightings of species within the City[5].

Analysis and discussion

Cape Town's natural and endemic vegetation types, and the floral and faunal biodiversity they support, are under severe threat. Nearly 60% of the original extent of Cape Town's natural vegetation has been lost, mostly in the lowlands. Of those vegetation types that were historically most extensive, significant amounts have been lost, particularly Cape Flats Sand Fynbos (84%), Swartland Shale Renosterveld (91%), and Cape Flats Dune Strandveld (52%). Illustrating the urgency required in responding to this threat is the fact that between 2009 and 2011, data shows that an additional 170 ha (or 2% of the remnant) of the city's Cape Flats Sand Fynbos and 1 270 ha (6% of remnant) of Cape Flats Dune Strandveld were lost.

It is worth noting that according to the updated assessment of ecosystem status (approved in 2011), only two vegetation types occurring in Cape Town are not under significant threat of extinction (least threatened), and both of these types occur in relatively inaccessible mountain areas that are not subject to development pressure. A further three types are classified as vulnerable, meaning that they experience increased pressure, but have not yet reached dangerous levels of loss. Most vegetation types in the city – fourteen out of the twenty types monitored – are classified as endangered or critically endangered, indicating high levels of risk.

The national criteria for classifying the ecosystem status of a vegetation type changed in 2011. The previous assessment – carried out in 2004 – was based on the percentage of the vegetation type that had been lost (now called criterion A1). The 2011 assessment also included a criterion relating to the number of threatened Red List species within each type (criterion D1). This meant that some types which were previously assessed as 'least threatened' have now been reassessed as 'critically endangered', due to the presence of a large number of threatened species[6].

In 2009, as part of the revision of its environmental policy, the City set a number of targets. In terms of biodiversity conservation, the City aims to conserve a minimum of 60% of the BioNet by 2014. Tables 2 and 3 show progress towards this goal. The City is currently in the final stages of formally proclaiming many of its nature reserves under the National Environmental Management: Protected Areas Act (Act 57 of 2003). Most reserves going through this process have already been proclaimed under other legislation, or have been managed as reserves under informal agreements.

Once the process has been completed, just over 50% of the BioNet will be formally protected. Stewardship agreements, in which private landowners voluntarily set aside land for conservation, will form an increasingly important part of future conservation initiatives. The continual expansion of the BioNet and protection of habitat will help create the space for functioning ecosystems to be restored, as well as safe places for CFR fauna and flora to live and breed and help restore threatened ecosystems.

Trend and target

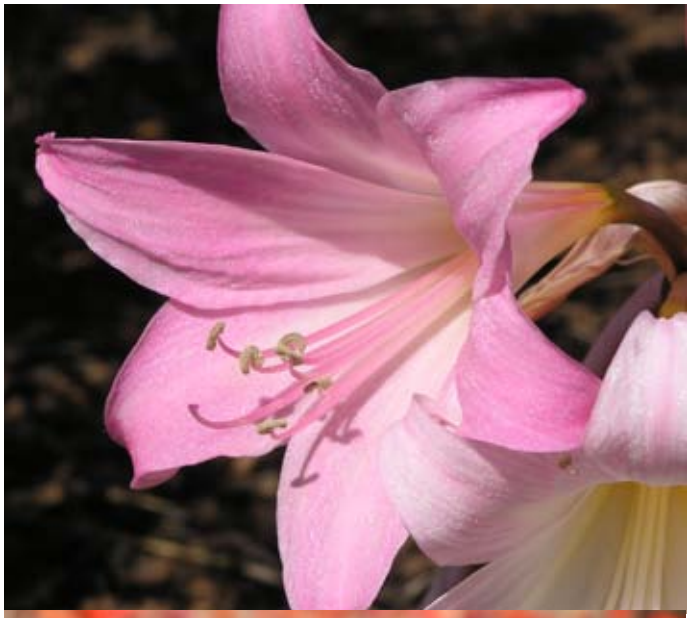
Trend: Biodiversity remains under threat
Target: Environmental Agenda 2014 Target: 60% of the BioNet formally conserved.
Current: Approximately 50.87% of the BioNet is either under conservation management or formally conserved.

Policy linkages

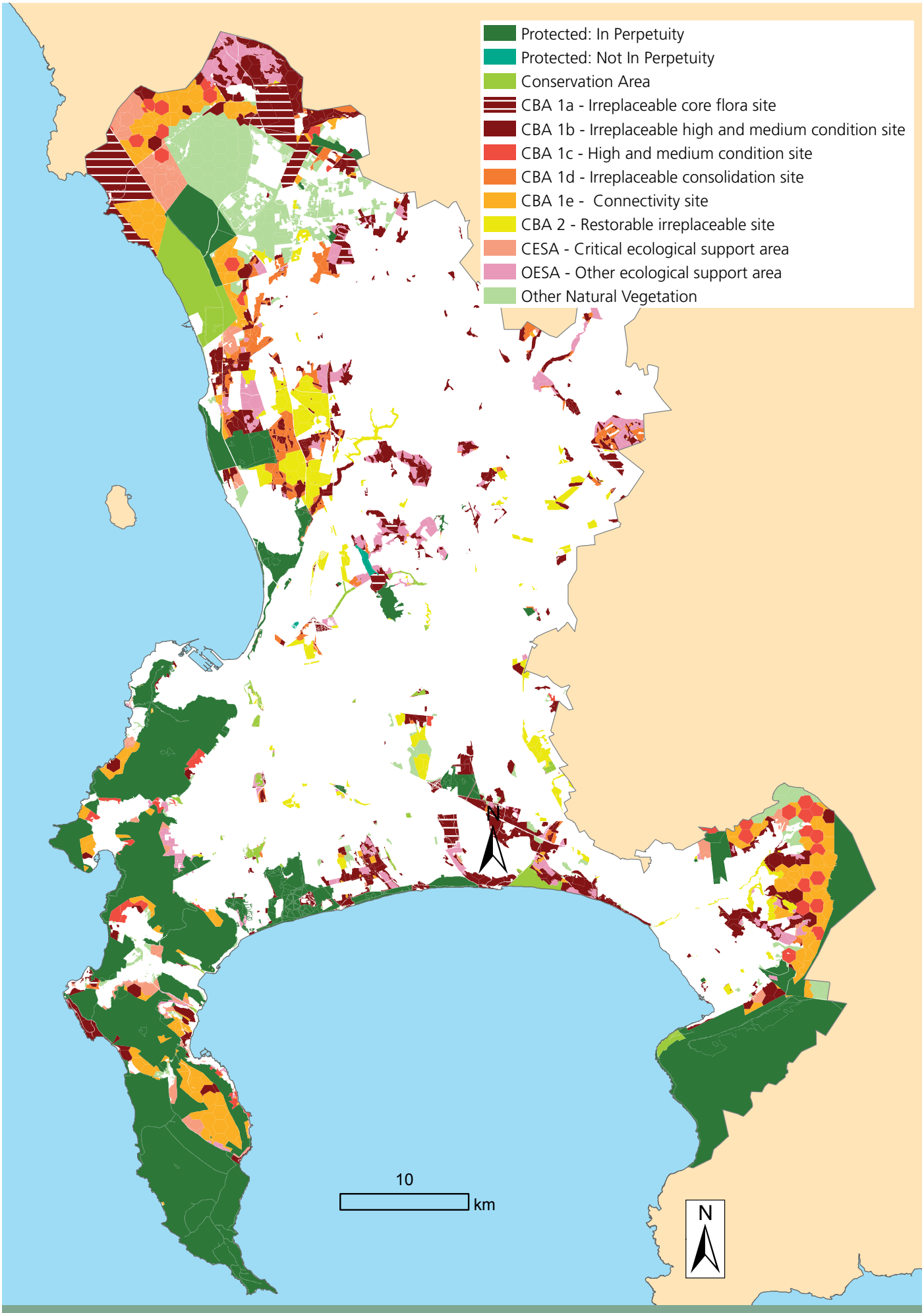
IDP: Strategic Focus Area 1 - The Opportunity City
Environmental Agenda 2009-2014: Target 1 - Biodiversity.
MDG Goal 7: Target 9 – Integrate the principles of sustainable development with country policies and programmes, and reverse the loss of environmental resources.
Biodiversity Strategy: A product of IMEP, which provides a strategic framework for biodiversity management in the city.
LAB Durban Commitment: A commitment to promoting, increasing and enhancing biodiversity within the City's administrative area.

See Also:

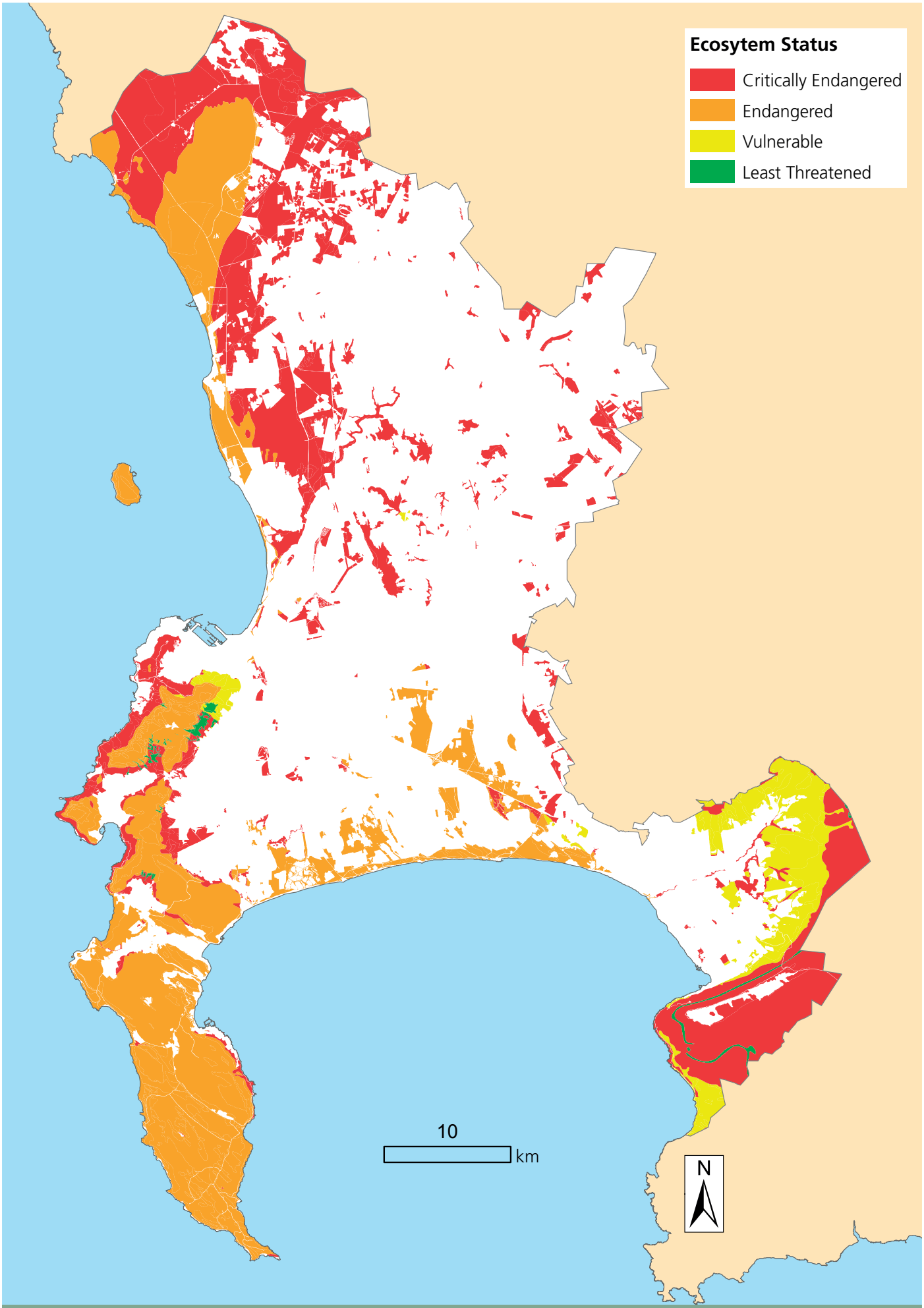
Invasive Species: pg 19
Access to Natural Green Space: pg 26



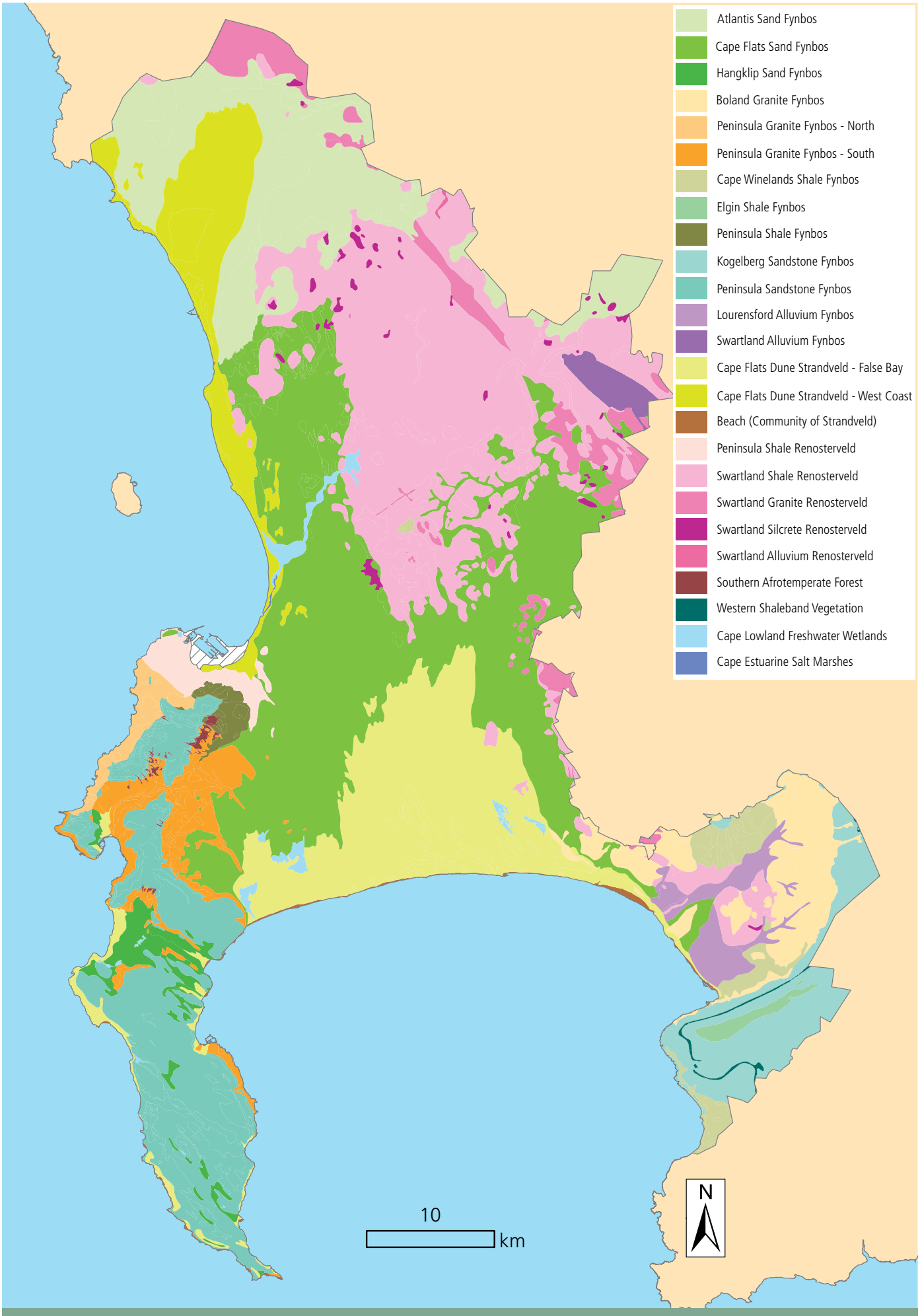
Amaryllus belladonna (above), *Hemanthus coccineus* (centre). *Erica verticillata* (below) is classified as extinct in the wild. It remains in isolated populations that are maintained for conservation purposes.



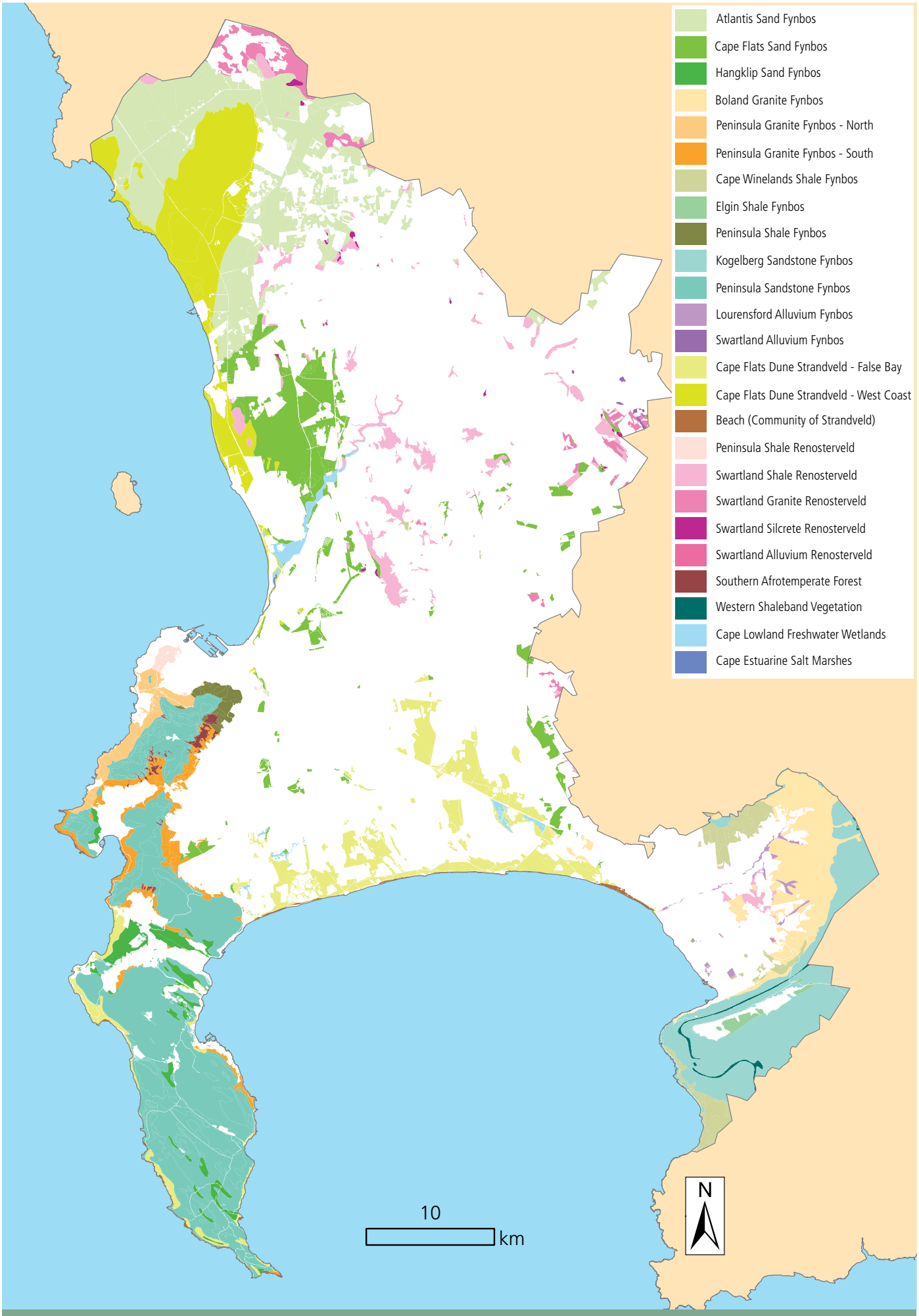
MAP 2: City of Cape Town Biodiversity Network



MAP 3: Conservation Status (2011)



MAP 4: Historical extent of natural vegetation



MAP 5: Remaining extent of natural vegetation (2011)

2 INVASIVE SPECIES

Indicators

Density and distribution of invasive plant species

Hectares of invasive plant species cleared annually

The Global Invasive Species Programme defines invasive species as "non-native organisms that cause, or have the potential to cause harm to the environment, economies or human health"[7]. Outside of their own habitat and away from natural predators some invasive species can dramatically increase in numbers and threaten their new environment in various ways. Plant species which invade new areas can greatly alter and disrupt ecosystems. They compete with indigenous species for land and water and disrupt the environment by changing soil composition and altering fire regimes, and can turn diverse ecosystems into single species monocultures. Invasive animal species outcompete, prey on, or interbreed with indigenous species.

Invasive species are a significant problem in and around the city of Cape Town. Cape Town is located at the centre of the Cape Floral Region (CFR), one of six floral Regions of the world. The highly biodiverse CFR is the smallest of all the Regions, yet contains over 9000 different plant species. Some species exist at only one site, or within a tiny area in the city, making their survival prospects very fragile.

While the Cape is still very rich in biodiversity, this region has been identified as a Biodiversity Hotspot, i.e. a place "where exceptional concentrations of endemic species are undergoing exceptional loss of habitat"[8]. Within such a context invasive species are a significant point of concern as they have the potential to disrupt and degrade the already delicate and threatened ecosystem. It is recognised that the two biggest threats to Cape Town's biological diversity are urban growth and invasive species.

Problems caused by invasive species

We are affected in a variety of ways by the presence of invasive species. Some of the problems caused by invasive species include:

- The crowding out of indigenous vegetation and altering of habitats which causes biodiversity loss.
- Invasive animals out-competing, preying on and interbreeding with indigenous animals, therefore changing the balance of ecosystems
- The alteration of natural fire regimes, as invasive plants can burn much hotter and for a longer time than indigenous plants. Although Fynbos requires fire in order to germinate seeds, if fires are too hot and too prolonged plants and seed banks can be destroyed.
- Depletion of water reserves, as some invasive species use significantly more water than indigenous species. Significant amounts of water in mountain catchments and riparian zones is being lost due to invasive vegetation.
- Changes to the nutrient content or make up of the soil, for example some invasive species are nitrogen fixing and therefore lock extra nutrients into the soil. This is a problem for indigenous Fynbos which prefers nutrient poor soils. Others can change the pH of the soil through the decomposition of their leaf litter.
- Invasive aquatic plant species can grow rapidly which can block waterways and choke aquatic environments.

Pattersons Curse (*Echium platagineium*) (left), Port Jackson (*Acacia saligna*) (right)

This may also contribute to flooding.

- Invasive species can spread new types of diseases previously not found in local environments and which can hugely impact on indigenous species which have no resistance to these new diseases.

Prominent Invasive Species

There are very many different species of both plant and animal which are seen as invaders in the city. Below are some which are notably prominent and which are seen as a significant problem.

Terrestrial invasive plant species

Port Jackson (*Acacia saligna*): An Australian shrub/ tree introduced in the mid-19th century to stabilise sand dunes[9]. It grows rapidly, is highly flammable, and uses large amounts of water.

Rooikrans (*Acacia cyclops*): Similar to Port Jackson, this Australian shrub/ tree was introduced in the mid-19th century to stabilise sand dunes[10] . Like Port Jackson it grows rapidly, is highly flammable, and uses large amounts of water.

Kikuyu grass (*Pennisetum clandestinum*): A fast growing grass that displaces indigenous species and uses large amounts of water. It is commonly cultivated on golf courses and in gardens.

Gum tree (*Eucalyptus spp.*): This Large Australian tree grows rapidly, is highly flammable thus increasing fire risk, and uses large amounts of water.

Pine (*Pinus spp.*): A fast growing coniferous tree which invades mountain Fynbos areas and forest ecosystems. It also increases fire risk. In Cape Town some pine plantations have become valuable recreational areas, and residents have opposed clearing them.

Manatoka (*Myoporum tenuifolium monatum*): A highly toxic shrub which commonly invades dune systems and watercourses.

Australian Myrtle (*Leptospermum laevigatum*): An Australian shrub which invades sandy areas, and forms dense stands which crowds out indigenous vegetation.

Paterson's Curse (*Echium plantagineum*): A highly invasive flowering plant originating in southern Europe, northern Africa and Asia which crowds out indigenous vegetation. It produces up to 30 000 seeds per square metre of infestation, making it extremely difficult to control

Black Wattle (*Acacia mearnsii*): Tree native to Australia. It grows rapidly, crowding out indigenous vegetation and increasing fire risk, as well as depleting water sources.

Aquatic Invasive Species

Water Hyacinth (*Eichhornia crassipes*): A floating water weed which displaces indigenous plant and animal species by habitat modification and provides suitable breeding sites for vectors of animal and human diseases.

Water Lettuce (*Pistia stratiotes*): A floating water weed that forms dense mats that impact on agriculture, industry,

Indian House Crow (*Corvus splendens)* (right), Mallard Duck (*Anas platyrhynchos*) (left)

tourism and the ecosystem such as by displacing indigenous species. It is extremely fast growing and can cover a water body in a very short time.

Parrots Feather (*Myriophyllum aquaticum*): A rooted water weed that forms dense mats that impact the ecosystem and inhibit recreation activities. Dense infestations can also lead to flooding and alter drainage patterns.

Kariba Weed (*Salvinia molesta*): A floating water weed which forms dense mats that impact on recreational activities and agriculture, decrease water quality and displace indigenous species. It is extremely fast crowing and can cover whole areas in a matter of days

Invasive animal species

Indian House Crow (*Corvus splendens*): It is estimated that approximately 10 000 of these birds live in the city. House crows are an aggressive feeder and can out-compete other birds for food. They can also act as a vector for diseases such as cholera, salmonella and typhoid.

Mallard Duck (*Anas platyrhynchos*): Originally found in sub-tropical and temperate regions of Europe, Asia and north Africa, outcompetes other water birds for food as well as hybridises with indigenous species, thus threatening them with genetic takeover.

Guttural Toad (*Amietophrynus gutturalis*): These toads have begun to breed in the Constantia area and pose a threat to the similar looking endemic and endangered Western Leopard Toad (*Amietophrynus pantherinus*). If left to carry on breeding they could colonise a larger area further endangering indigenous species.

Controlling the spread of Invasive Animal Species

The city of Cape Town currently has three management programmes in place for invasive animal species which are considered to be posing a significant threat to local species. This includes a program to monitor and control the spread of Guttural toads (*Amietophrynus gutturalis*), Indian House Crows (*Corvus splendens*) and the Mallard Duck (*Anas platyrhynchos*).

Guttural Toads pose a threat to the endemic and endangered Western Leopard Toad (*Amietophrynus pantherinus*). The City's invasive species unit are currently involved in a programme to control the spread of guttural toads in areas where the Leopard toad lives and breeds as the invasive toad competes for habitat, resources and breeding grounds.

The Indian House crow, which has spread to a number of metropolitan areas in South Africa including Durban, Richards Bay and Cape Town, has proven to be a major problem in other cities, such as Dar-es-Salaam. These birds are aggressive and affect indigenous species, damage agricultural crops and can be carriers of a number of human enteric diseases, and so are a matter of considerable concern. Therefore, the City has partnered with BirdLife SA, the Natural Resource Management (NRM) programme and SANBI to create the National Problem Bird Forum under which an eradication programme has been launched.

Finally, the City along with other partners, is working towards implementing the National Mallard Duck Strategy. This water bird is a recent colonist and not yet well established but is considered to be a potentially very threatening species if not prevented from spreading.

Invasive species clearing teams working on water courses

Density of invasion %	Total area per density class	% of total mapped area
0.1-1	2928.1	36.7
1.1-5	1538.2	19.3
5.1-25	2124.7	26.6
25.1-50	738.6	9.2
50.1-75	472.0	5.9
75.1-100	178.6	2.2

Table 4: Density of Invasive Species in mapped protected areas.

State of the Environment

Quantifying the extent and number of invasive species in an area as large as the City of Cape Town is no small task. Between 2008 and 2012 various mapping exercises were undertaken by the Invasive Species Unit to determine the extent and density of invasive vegetation in protected areas and within the Biodiversity Network.

It is clear from the data that significant proportions of the mapped areas are infested to some extent with invasive alien plant species. Most sites (56%) are considered to be "lightly invaded" (0.1% - 5%), while approximately 36% is considered "moderately invaded" (5.1% – 50%). Only 8 percent falls into the "severely invaded" (50% or more) category. The data above has been mapped to show where the main invasive species problem areas are occurring (See map 6).

This data is vital as it indicates the extent of the threat of invasive vegetation throughout the protected areas and also allows for resources to be allocated accordingly. In order to maximise resource efficiency and cost effectiveness, resources for invasive plant clearing are allocated first to those areas with mild to moderate infestation. This prevents those areas from becoming severely invaded and thus significantly more expensive to clear. Finally, the more difficult problem of severely invaded areas will be tackled.

There are currently three priority invasive animal species which the city is most concerned about at present. These include the Mallard Duck, the Indian House Crow and the Guttural Toad. In 2008 it was estimated that there were in the range of 10 000 Indian house crows in the city and that urgent measures were needed to stop their spread. The Mallard Duck is currently regarded as a species that needs to be carefully monitored, and certain hotspots are being watched carefully. These include Marina Da Gama, where it is estimated that there are around 800 birds, Sonstraal Dam in Durbanville, and various other water bodies and golf courses in the city.

Overall, invasive plant and animal species are considered to be a significant problem in Cape Town. They encroach on fragile ecosystems, change fire routines, can potentially threaten human health and put stress on already limited water supplies. The City's Invasive Species unit along with its partner organisations are working to combat the problem, and will continue to do so.

Analysis and discussion

While some areas are worse affected than others, invasive species are one of the biggest threats to the City's globally unique and important biodiversity. In general, land inside protected area boundaries suffers less from invasive species invasion than land outside these areas which is not managed.

Managing invasive species is a resource intensive and time consuming exercise. At present the task of controlling the spread of invasive species in the City of Cape Town falls under the mandate of the Invasive Species Unit (ISU) which has a comprehensive programme geared towards combating the problem. The ISU also works with a number of partner organisations such as CIB, SANBI, BirdLife SA and WESSA, as well as local community organisations.

In 2009 the Invasive Species Strategy was developed and approved by Council. This strategy aims to improve the coordination and integration of invasive control efforts and to increase their efficiency and efficacy. The strategy also aims to ensure that different departments within the City engaged in invasive clearing such as Transport, City Parks, Human Settlements, Property Management, Health, Fire and Roads and Stormwater, operate collectively with a common vision and plan.

A recently implemented programme has seen approximately 400 people employed to remove invasive species from catchment areas. This has been achieved through the establishment of the Kader Asmal Integrated Catchment Management Project which aims to contribute towards efforts to control invasive vegetation, as well as boost job creation and skills training. The Black River, Eerste/Kuils River, and Pagasvlei in the Sand River catchment are all areas that

are currently being cleared of the highly invasive Water hyacinth. This is an enormous and on-going task as the water plant doubles its growth every 8 to 14 days.

It is important to note that most areas of invaded land can never be considered completely "cleared". Although many or all adult plants may be removed in clearing operations, long term follow up is required in order to ensure that plants do not regrow. This requires a significant long-term commitment by the City and other key role-players, and the allocation of substantial additional funding.

The city also aims as much as possible to involve the residents of Cape Town in helping to manage invasive species in their neighbourhoods. The Cape Town Early Detection and Rapid Response (EDRR) Programme has established the Spotter Network, through which residents can volunteer to help manage invasive species. In the long term, developments such as these will further help to reduce the density of invasive species infestations, and prevent their further spread.

Trend and Target

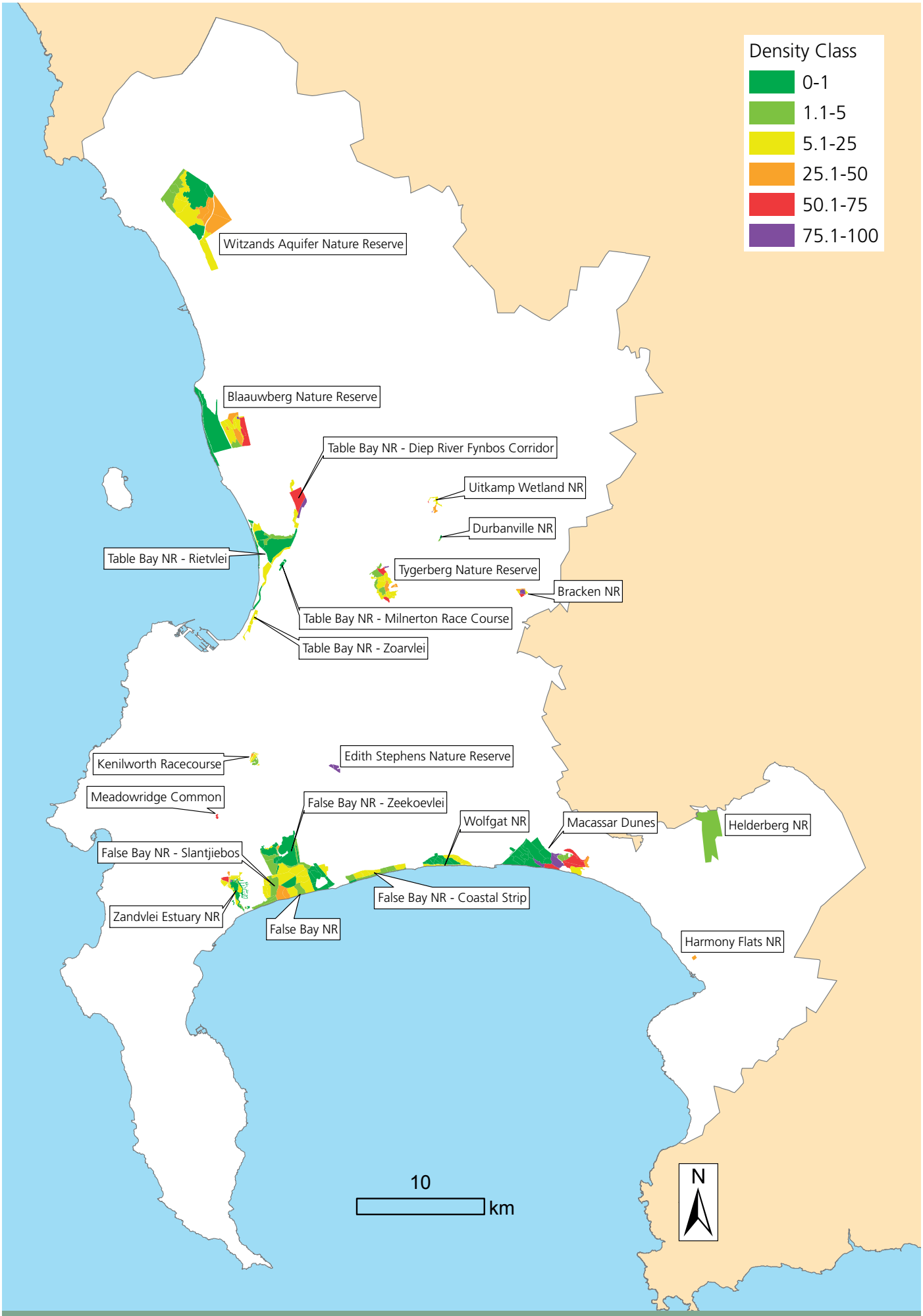
Trend: Invasive alien species remain a significant problem in the city. Measures to control these species are being put in place, but it is an extremely challenging problem.
Target: Environmental Agenda 2014 Target: 60% of protected areas and Biodiversity Network to be cleared and under maintenance; populations of significant animal invaders to be eliminated.
Current: No current information is available on the percentage of areas cleared and under maintenance.

Policy Linkages

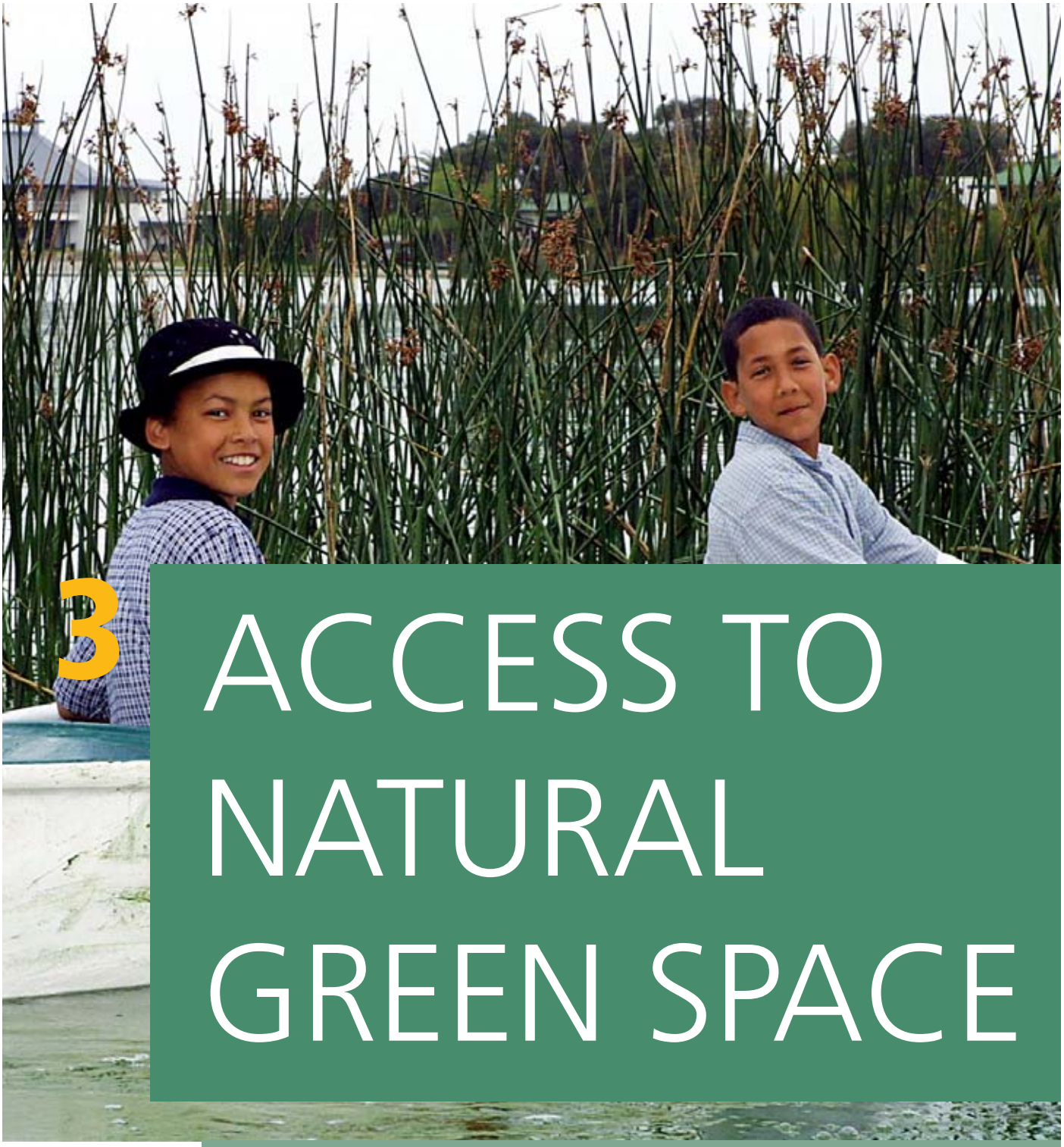
IDP: Strategic Focus Area 1 - The Opportunity City
MDG Goal 7: Target 9 – Integrate the principles of sustainable development with country policies and programmes, and reverse the loss of environmental resources.
Urban Environmental Accord: Action2 – Pass legislation that protects critical habitat corridors and other key habitat characteristics (e.g. water features, food-bearing plants, shelter for wildlife, use of native species, etc.) from unsustainable development.
City of Cape Town Environmental Agenda 2009-2014: Target 2 – Alien Invasive Species.
Invasive Alien Species Strategy: A city-wide strategy to co-ordinate the various line functions which have responsibility for invasive alien species management and ensure a holistic approach.
C.A.P.E Invasive Species Strategy: www.capeaction.org.za

See Also

Biodiversity: pg 6



MAP 6: Density of invasive species in protected areas



3 ACCESS TO NATURAL GREEN SPACE

Indicators

Residential proximity to natural green space
Amount of managed natural managed green space per person

Well-managed, accessible, open green space and access to nature is a key measure of a healthy city. It is recognised that green space provides a range of important social benefits, by providing residents with space for nature-based recreational activities such as walking, hiking, picnicking, bird watching and boating (among others), while also providing for spiritual, aesthetic, and educational needs, and meeting the needs of children to have an open and well-managed environment in which to play.

During the past century, the process of rapid urbanisation often neglected to take into account the importance of natural spaces in cities. Increasingly, over the past few decades, city planners and residents have recognised this, and are working to incorporate green spaces into urban environments in various ways; through parks, open spaces, playing fields, walkways, green belts, nature reserves, and urban gardens.

Green spaces can provide many social, economic and environmental benefits to cities. The incorporation of green spaces into the urban environment in Cape Town is vital for improving the quality of life of residents, and for the conservation of biodiversity. It is also important economically, in sustaining Cape Town as an attractive tourism and investment destination. As reflected in the City's Spatial Development Framework, the incorporation of biodiversity and green space is recognised as a vital informant of the future development of the City.

"*Cape Town's natural assets and biological diversity are part of what makes the city a unique and desirable place in which to live, work and play. Because people derive benefits from the natural environment in a number of direct and indirect ways, natural assets play an important role in shaping where and how the city develops. The recreational functionality and functional integrity and connectivity of ecosystems must be improved, and an interlinking network of linear parks with foot and cycle paths should be established to facilitate easy movement of fauna and flora. Urban development must respect the presence, role and function of natural assets, and should make the most of the possible benefits residents and visitors can derive from them.*"[11].

Green spaces are recognised by the City as vital for social and environmental reasons. The Spatial Development Framework specifies that the City's Biodiversity Network and the City's biodiversity targets need to be taken into account in the future of planning in the city, and underpin the incorporation of green spaces into the city[12]. As yet there are no South African guidelines available concerning access to natural green space specifically, although guidelines exist for recreational spaces more generally. This report therefore makes use of the guidelines developed by English Nature (a UK conservation body) for the provision of natural green space[13].

Guidelines for managed, open green space[14]

- Statutory local nature reserves at a minimum level of 1 hectare per 1 000 population.
- At least one accessible 20 hectare site within 2 km of home.
- At least one accessible 100 hectare site within 5 km of home.
- At least one accessible 500 hectare site within 10 km of home.

It is important to define clearly what is meant by accessible, natural green space. Managed green space is land that consists of a variety of formally managed land types, including the following: nature reserves and large district parks which are able to support a range of biodiversity, green belts and river corridors, and smaller parks that do not have a significant biodiversity function but provide recreational space.

In many (although not all) cases, managed natural open space will have basic facilities such as toilets, picnic spots and parking areas, as well as on-site staff and security measures, and will be maintained regularly. For the purposes of this report, City nature reserves, the Table Mountain National Park, district parks, green belts, and large community parks (greater than 2 hectares in size) have been included in the assessment.

The distinction between managed, natural open space and unmanaged, natural open space is key. Many people are unwilling to visit or use larger areas of unmanaged natural open space due to safety and security concerns, the lack of formal facilities, and the lack of formal maintenance. While unmanaged areas are crucially important for biodiversity conservation, these areas do not always provide the same level of service in terms of meeting recreational and social needs.

State of the environment

Natural England recommends a minimum of 1 hectare of land under formal conservation per 1 000 population. Cape Town has over 43 980 hectares of land under formal conservation, including the Table Mountain National Park. This equates to approximately 12.5 hectares per 1 000 population – well above the recommended guideline.

Nevertheless, accessibility remains a key challenge. Many of Cape Town's open green spaces are internationally renowned tourist destinations, but are inaccessible to a large percentage of citizens due to the distance people are required to travel to reach these areas. Map 7 shows the varying levels of access to managed green open space. Crime or perceived lack of safety is also a factor preventing people from using natural open spaces, thus making certain places inaccessible.

Analysis and discussion

It is clear from Map 6 that people in many parts of Cape Town have limited or poor access to managed green open space, especially to larger nature reserves. This is most notable in the central and north-eastern parts of the city. Poor access tends to be concentrated in areas of lower socio-economic status, although some wealthier parts of the city also lack access to managed green open space. However, wealthier residents are more able to travel to other parts of the city in order to visit parks or nature reserves and may have large gardens, and therefore the impact on them is minimised.

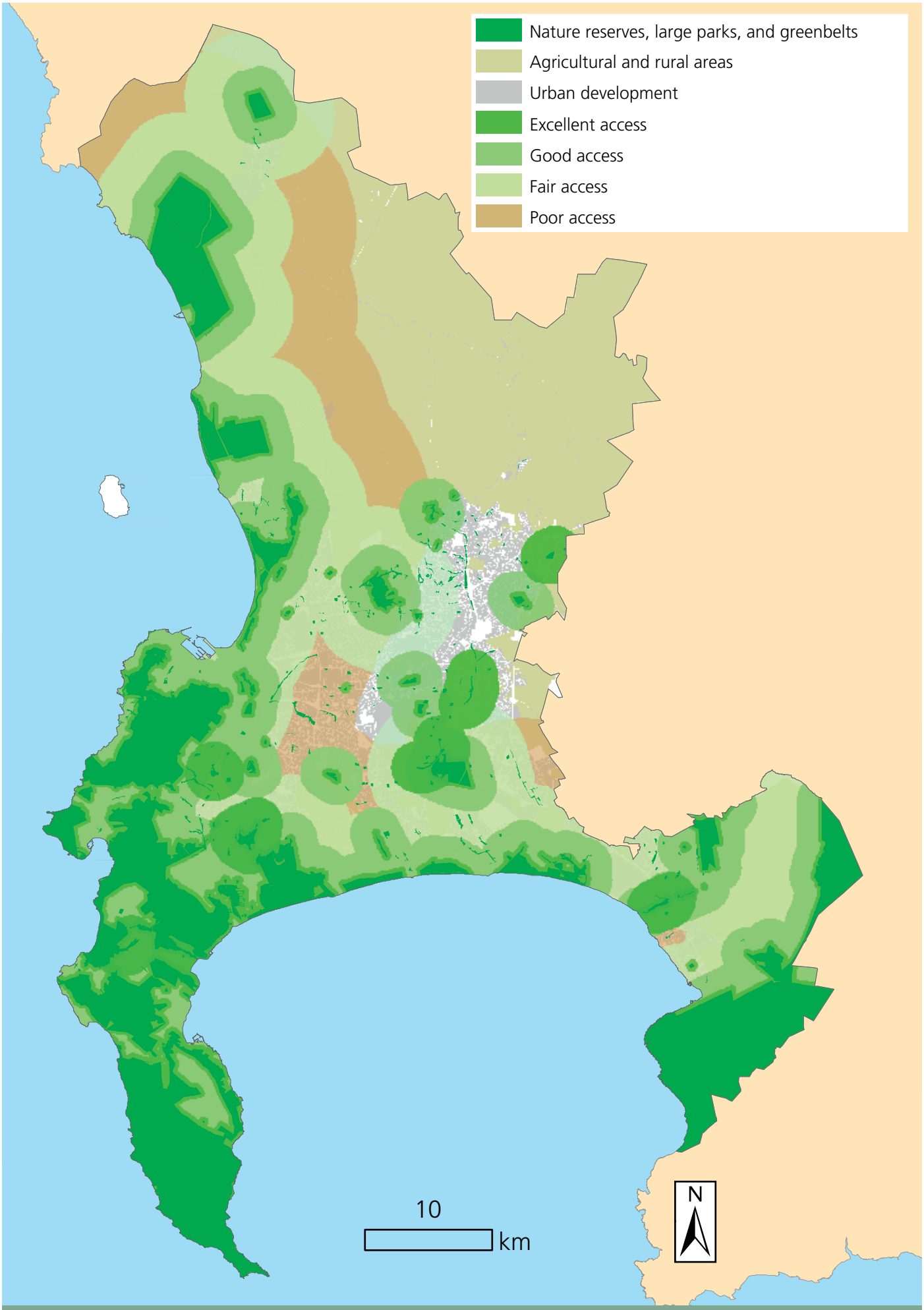
Green Point Urban Park and the Biodiversity Showcase Garden

The Green Point Park, adjacent to Green Point Stadium, is a legacy project of the 2010 FIFA World Cup™. The 12.5-hectare park, formerly the Green Point Common, provides multipurpose recreational and educational facilities and was designed according to ecological principles, with energy and water efficiency and indigenous landscaping incorporated into the design.

The Biodiversity Showcase Garden – part of the Green Point Urban Park – was opened in February 2011. The garden is a legacy project, both of the FIFA 2010 World Cup Host City Cape Town Green Goal initiative, and of the City's participation in the ICLEI Local Action for Biodiversity (LAB) programme. The park was initiated as part of the City's effort to promote biodiversity awareness during 2010 (the International Year of Biodiversity) and beyond.

The Biodiversity Garden provides recreational space and showcases indigenous, waterwise plants that display the region's biodiversity, and demonstrates responsible environmental gardening and horticultural practices. Interpretive signage and educational art aim to encourage visitors to engage with the importance of biodiversity conservation in the city and region, while the garden provides an experience of the social benefits of incorporating green space and biodiversity in the urban landscape.

The garden is organised around three themed areas: People and Plants, Discover Biodiversity and a Wetland Walk. The wetland area was developed due to the availability of spring water in the area. It provides important habitat space for birds, frogs and insects. The garden is also irrigated using this water, to minimise the use of potable water in the park. There are future plans to develop further projects – such as a Smart Living Centre, to promote sustainable living; a nursery; a platform for fresh food markets; and a horticultural training centre.



Map 7: Access to natural green space in Cape Town

The provision of managed green open space is a critical social issue. It promotes health and well-being by encouraging residents to exercise, and has the potential to reduce stress among adults by providing a natural space in which to relax. It also improves mental well-being, and increases feelings of health, especially among those of a lower socio-economic status[15]. Additionally, it is important for children's development to have access to larger open and natural areas in which to play freely, and not be limited to organised sports activities or small playgrounds. Finally, it has been demonstrated that the proximity of residential areas to well-managed open spaces boosts property values and encourages revitalisation of neighbourhoods.

The use of open space standards in city planning is a best practice that will be increasingly implemented in Cape Town. The City is aiming to incorporate the provision of open green space and nature reserves into city planning through the recently revised Spatial Development Framework. Provision of high-quality open green space also forms an important part of the City's densification strategy, in order to avoid a sterile urban landscape[16].

Trend and target

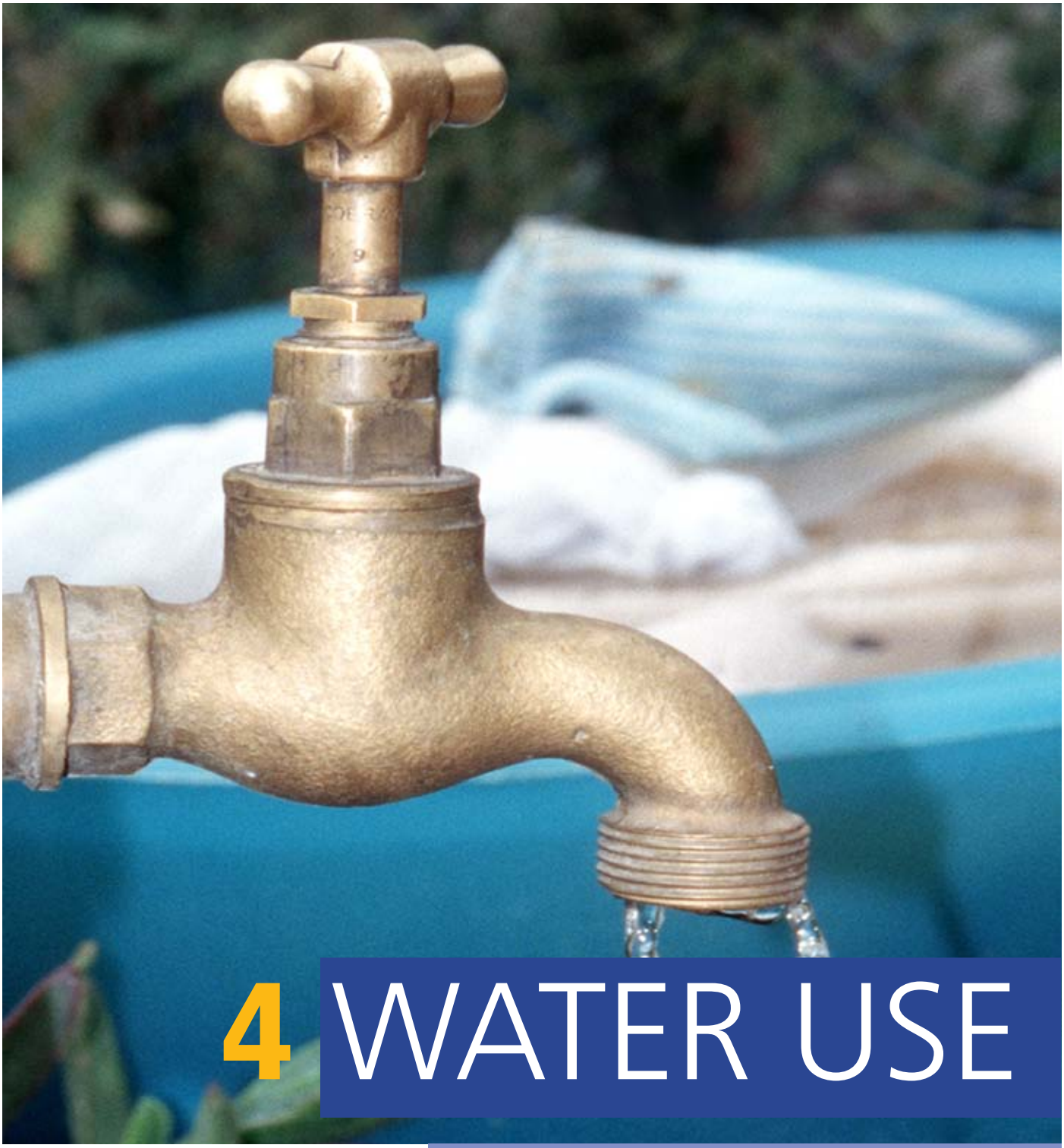
Trend: This indicator does not change significantly over time. Access remains an issue in many places.
Target: Environmental Agenda 2014 Target: No specific target set. However, achievement of Biodiversity target (60% of Biodiversity Network under formal conservation) will increase access to managed natural open space.
Current: On average, there is sufficient open space per person in the city. However, access remains problematic in some areas.

Policy linkages

IDP: Strategic Focus Area 4 - The Inclusive City
Environmental Agenda 2009-2014: Target 1 – Biodiversity.
MDG Goal 7: Target 9 – Integrate the principles of sustainable development with country policies and programmes, and reverse the loss of environmental resources.
Urban Environmental Accord: Action 8: Adopt urban planning principles and practices that advance higher-density, mixed-use, walkable, bike-able and disabled-accessible neighbourhoods, which co-ordinate land use and transportation with open space systems for recreation and ecological restoration.

See also:

Biodiversity: pg 6



4 WATER USE

Indicators

Annual water use

Per capita water use

Percentage of water recycled

South Africa is a water-scarce country. Cape Town in particular experiences periods of water shortage – the region's long, hot and dry summers cause demand for water to be highest when supply is most limited. Water scarcity is a major environmental concern for the City of Cape Town, and is likely to increase in years to come, given increasing demand due to urban and population growth and the expected impact of climate change[17]. The City faces the challenge of ensuring the provision of water services to all residents, while also reducing water use, and finding ways to conserve water to ensure a sustainable future supply in the region.

The City of Cape Town performs the dual roles of water service authority and water service provider in managing the provision of drinking water and the treatment of wastewater. It also provides bulk drinking water to the adjacent local authorities of Drakenstein and Stellenbosch. Collectively, this water supply system is operated by the City of Cape Town, the Department of Water Affairs (DWA) and Eskom.

Of the bulk untreated water in Cape Town, 98.5 per cent comes from surface water sources, with only the remainder coming from groundwater[18]. Run-off from the surrounding mountains feeds into six dams, of which the main City-run ones are Wemmershoek, Steenbras Upper, Steenbras Lower; the main Provincial-/National-owned dams are Voelvlei, The Berg Water Project and Theewaterskloof. The Berg River Dam – which was completed in 2008 – was implemented to increase the city's water supply. In addition, the city owns a number of small dams and operates a treated-effluent groundwater recharge system in Atlantis.

To supplement this supply the City has been considering alternative options, such as desalination and the use of ground water. However, while this could reduce the pressure on dams and the City's treated water supply, it is important that borehole and groundwater use be monitored in order to ensure that Cape Town's groundwater does not become depleted. Another vital component in ensuring water security is the recycling of wastewater. Currently, the City also recycles wastewater from various treatment works, which is then used for irrigation and industrial purposes. The water services Development Plan identifies effluent reuse as an important strategic objective[19].

While the improvement in water infrastructure is important, it is only part of working towards achieving a water-secure future. As a result, the City has adopted a water conservation approach that aims to reduce wasted water in the city as well as reducing excess water use through behaviour change. Some of the infrastructural and behavioural initiatives undertaken by the city are explored in the analysis and discussion section below.

Guidelines for water use

The WHO recommended guideline for per capita water usage is 50 litres of water per day for basic cooking, drinking and hygiene requirements. This is considered a basic level of service. The Water Services Act, Act 108 of 1997, stipulates a minimum per capita supply of 25 litres per person per day.

While access to potable water needs to increase, it is also necessary to reduce annual water usage through the reduction of water wastage, both during reticulation and by end users. The City of Cape Town Environmental Agenda has identified a target for 2014 to reduce the use of potable water to a maximum of 290 000 megalitres (million litres) per year across the city, and to reduce per capita daily usage to 180 litres per day[20]. The City also aims to reduce unaccounted water (water lost) to 15% by 2015[21].

Another important part of ensuring a sustainable water supply is the recycling of water. The CCT obtains most of its raw water from mountain catchments outside of the municipal area in which it is used. Therefore most treated wastewater effluent is not returned to the raw water resource, but rather re-used within the city. The recycling of water can play an important part in helping to reduce pressure on water resources; the Water Services Development Plan outlines the goal to increase effluent re-use by 15% in 2015/16.

State of the environment

In recent years there have been significant improvements made in achieving access to water services. However, it is difficult to determine improvements in access to water through the use of per capita water-use figures, as consumers in different groups within the city use considerably different volumes of water. The City of Cape Town currently provides 6 000 litres of free water to each household per month – this works out to 50 litres per person per day for an average household of 4 people. This meets the WHO guideline and exceeds the 1997 Water Services Act guideline, but it must be noted that this generalised figure does not reflect the

existing inequality in water access. Some users do not have access to individual water points, and thus share water points. In order to address this problem, the City has made significant improvements in the installation of water points (communal taps) in informal settlements. In the 2010/11 financial year, the City set itself a target of installing 200 water access points. This target was significantly exceeded, with 511 taps installed; 95% of informal settlement households have now been serviced to City of Cape Town standards. A grant of R40.50 has also been made available to low-income residential users for additional water consumption of up to 4.5 kilolitres per month. In these ways, the city is working towards creating more equal water access[22].

Since 1995, annual water use (including domestic, commercial and industrial use, as well as water lost during reticulation) has remained at fairly stable levels of between 250 000 and 310 000 megalitres per year, rising to a high of approximately 308 000 megalitres in 1999 (see Figure 1). Water restrictions were first introduced in 2001, and again in 2004, and correlated with a dramatic decrease in the amount of water used in Cape Town. Currently, permanent Level 1 water restrictions remain in place, limiting activities such as car-washing and watering of gardens. It is therefore evident that the implementation of water restrictions has a considerable effect on water-use levels, and demonstrates the willingness of residents and businesses to contribute to the city's environmental sustainability.

Figure 2 shows that water use per capita has decreased significantly since 1999 on an annual basis. Thus, while water use per annum has increased with population growth, water use has not increased on a per capita basis. This is an encouraging trend, as it means that relative to urban and population growth, water demand is decreasing. It must be noted that this figure should be seen as a general per capita water 'footprint' for the city, as access to water and water use in the city is not equal for all residents, and figures also include water used by commercial and industrial sectors in the city.

The city currently does not recycle water for potable use, but it does treat wastewater for reuse in industry, and for the watering of sports grounds and golf courses[23]. Recycling of water has increased annually over the past three years (see Figure 3). In 2011 the city recycled 13 600 megalitres of wastewater, which is almost twice as much as was recycled in 2009.

Figure 1: Annual water use (1996 - 2011)

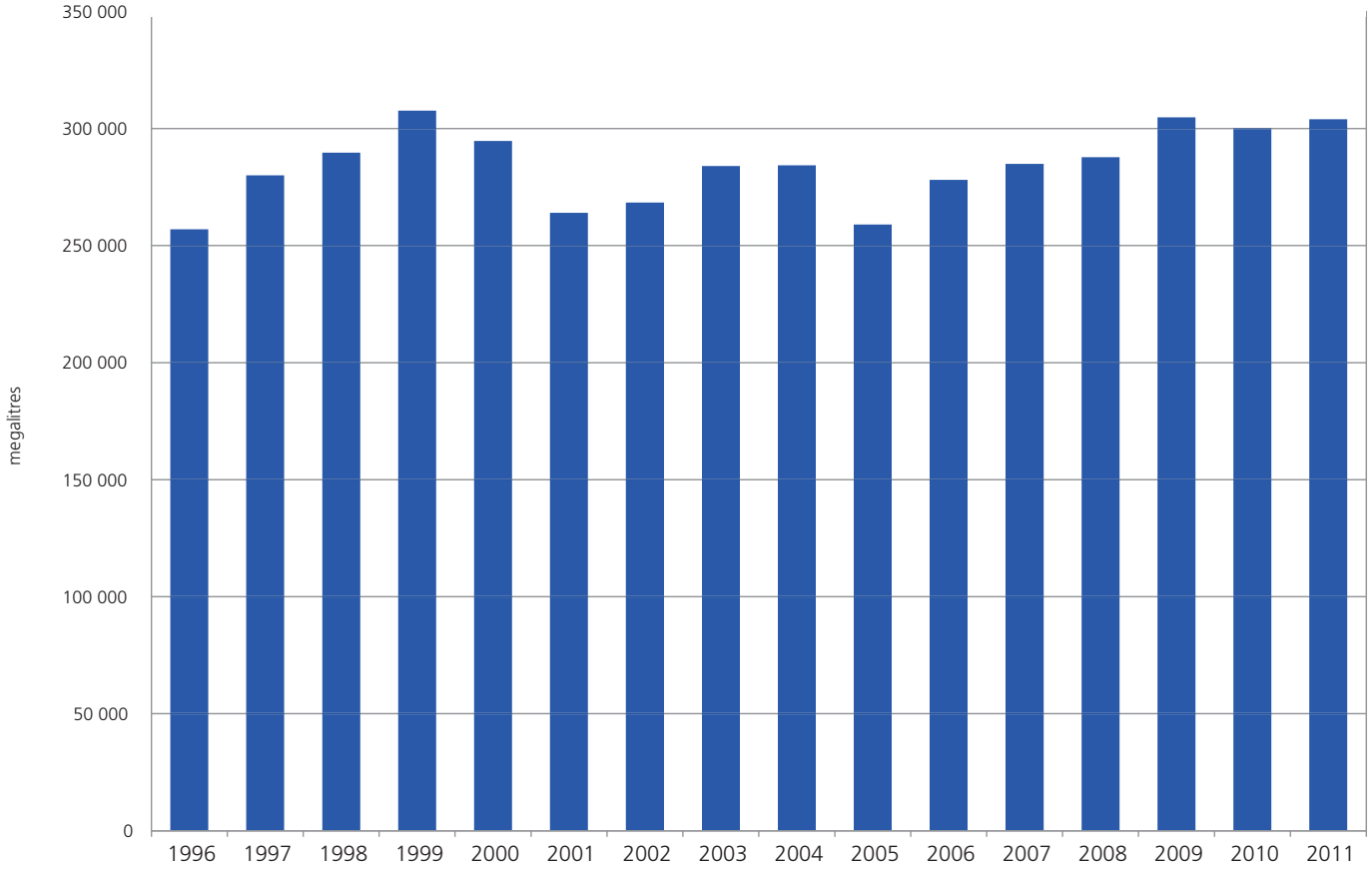
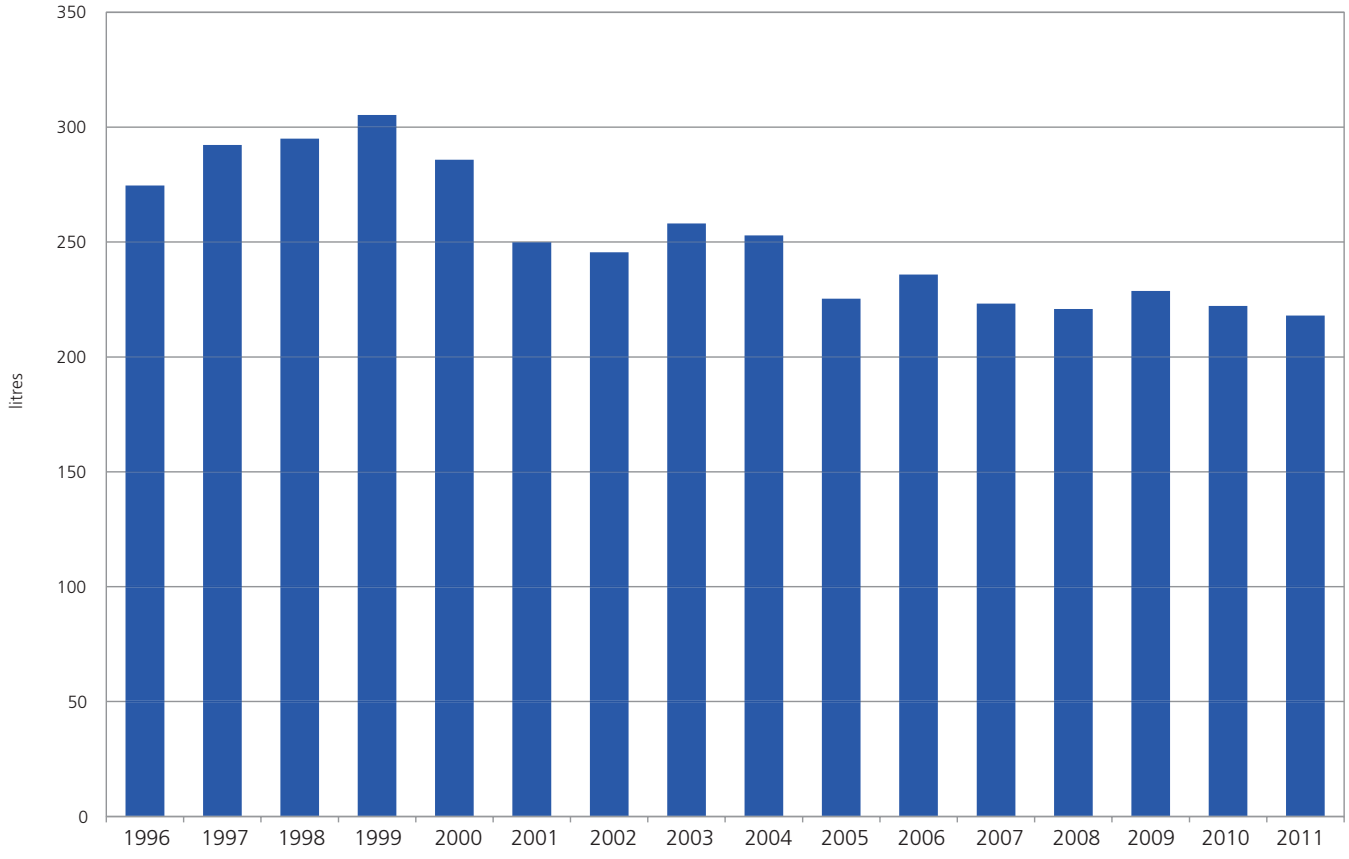


Figure 2: Daily per capita water use (1996 - 2011)

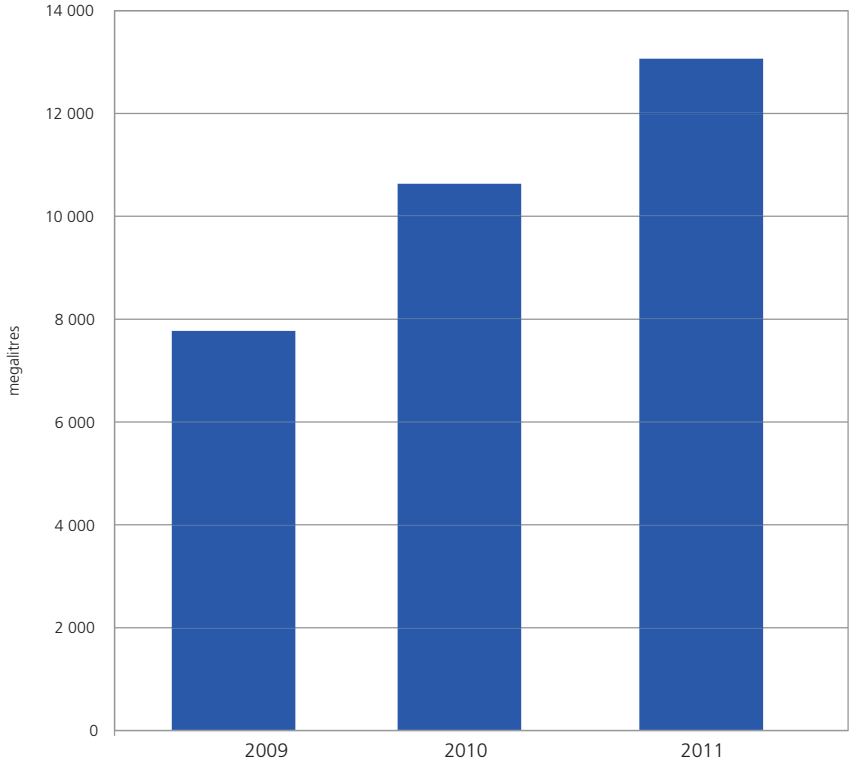


Analysis and discussion

Effective water demand management is a core requirement for the sustainability of water supply to the city. This requires both infrastructural programmes and programmes targeting behavioural change. A number of such programmes have been implemented in the city. These include the reduction of high water pressure in certain areas, minimum night flow for residential consumers, education programmes aimed at increasing water-saving behaviours and practices of residents such as the Water Savings Campaign, plumbing leak- and meter-repair programmes, pipe replacement, effluent re-use, water restrictions, and stepped tariffs.

It is clear from the data that water conservation efforts in Cape Town – including both infrastructural programmes and education and communication programmes – have been successful in reducing water demand and use in the city. Water use reduction is

Figure 3: Water (treated effluent) re-used (2009 - 2011)



The Integrated Water Leaks project

The project began in 2005 with the goal of reducing household plumbing leakages, especially in lower-income areas, in order to reduce leaks and water bills. This project provides training for community members in basic plumbing skills. After completing the training they are able to offer leaks repair services in their area, at a cheaper rate than traditional plumbers. This project addresses the dual goals of reducing water wastage, while increasing skills development and employment opportunities

an area in which citizens and businesses are able to play a significant and active role, supported by the City, and they have demonstrated that changing behaviour – including the installation of low water-use appliances and fittings and the introduction of water-wise gardening – can have significant city-wide impacts.

Achieving equitable and sustainable water supply and water use patterns in Cape Town is a complex task. It requires, on one hand, the continual improvement of water access to areas of the city where access is limited; and on the other, the reduction of wasteful water use in more affluent areas and within industrial and commercial sectors.

It also requires enormous efforts to reduce unaccounted water, and losses during reticulation of water. The reduction of unaccounted water is a vital part of ensuring the sustainable use of water. The reduction of water loss during reticulation, and wastage during end use, is a key area of concern for the city. The city has up to 10 500km of reticulation pipes within the urban system that need constant monitoring and repair, as well as replacement in certain areas. The City's Water and Sanitation Department is developing an asset management strategy and asset management plan for each of its functional service branches in order to improve the maintenance and overall efficiency of these systems. Historically, maintenance of infrastructure has been mostly reactive, which has resulted in backlogs in the maintenance of water infrastructure. The City is working hard to ensure a more proactive approach.

In 2007 the City developed the Long Term Water Conservation and Water Demand Management Strategy, which outlines objectives to ensure the efficient use of scarce water resources to meet the growing needs of the population.

Trend and target

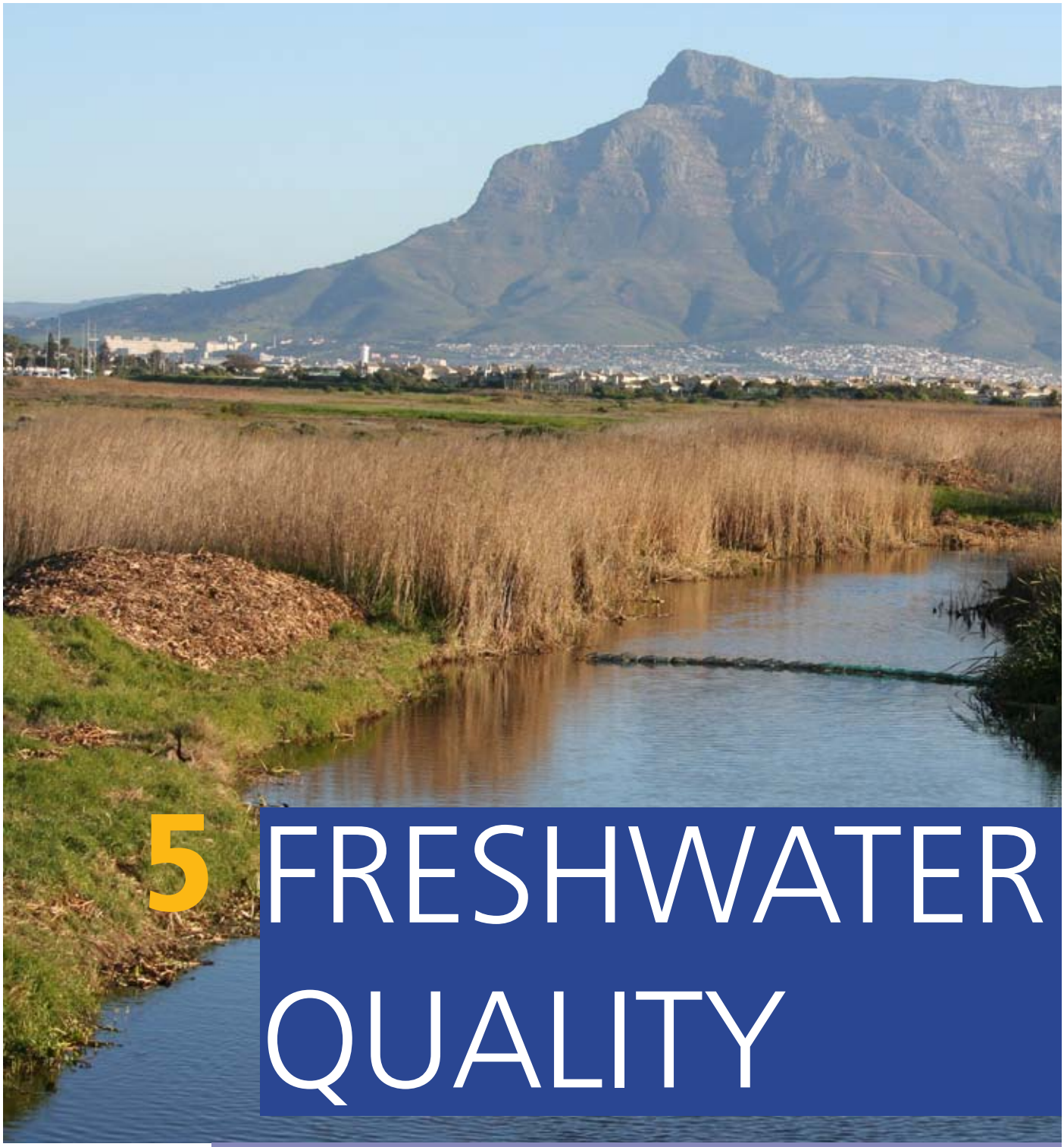
Trend: Overall water usage has increased slightly, but per capita usage has decreased slightly since 2005, to approximately 215 litres per person daily.
Target: Environmental Agenda 2014 Target: Reduce overall water usage to 290 000 megalitres; reduce per capita usage to 180 litres per day.
Current: Overall water usage stands at approximately 299 000 megalitres, and per capita water usage at 215 litres daily. The City increased the amount of waste water recycled to 13 600 megalitres per annum in 2011.

Policy Linkages

IDP: Strategic Focus Area 1 - The Opportunity City
MDG Goal 7: Target 9 – Integrate the principles of sustainable development with country policies and programmes, and reverse the loss of environmental resources.
Water Services Act: Act 108 of 1997.
Environmental Agenda (IMEP) 2009-2014: Target 8 - Water.
Urban Environmental Accords: Action 19: Develop policies to increase adequate access to safe drinking water, aiming at access for all by 2015.
Long Term Water Conservation and Water Demand Management Strategy (2007)

See Also

Fresh Water Quality: pg 36
Coastal Water Quality: pg 43
Wastewater: pg 49



5 FRESHWATER QUALITY

Indicators

Ecosystem health, based on trophic tendency

Percentage compliance with Department of Water Affairs recreational guidelines

Cape Town is home to an extensive network of rivers and wetlands. These freshwater systems fulfil a dual function – as havens for plant and animal life, and as natural infrastructure networks for the management, treatment and conveyance of stormwater and treated wastewater effluent. The 'built' stormwater infrastructure - comprising roadside gutters, kerb inlets and pipes – interfaces directly with Cape Town's receiving freshwater and coastal environments. An integrated understanding of and management approach to managing these connected systems is essential for the protection of the receiving environment. The ongoing organic and inorganic pollution and the littering of the city's stormwater and freshwater systems poses a threat to both biodiversity and human health.

Sources of pollution

The primary sources of pollution of the city's freshwater systems are unsatisfactorily treated wastewater effluent, overflows from blocked or leaking sewer systems and malfunctioning pump stations, and contaminated stormwater. Additionally, the illegal and inappropriate disposal of human waste (in the form of toilet buckets from informal settlements and 'backyard' dwellers) directly into rivers and drains, and generally polluted runoff from informal settlements, adds to the organic loading of the city's aquatic ecosystems. In urban areas, rainwater picks up a range of contaminants as it makes its way towards rivers and the sea. This stormwater can include oil, petrol and diesel from roads and other paved areas; fertiliser from suburban gardens, sports fields and golf estates; silt from eroding areas; and general litter and pet waste. Illegal dumping and careless disposal of household waste and building rubble into open space areas, rivers, wetlands and the stormwater system is a significant problem, which not only degrades ecosystem health but also detracts from the aesthetic value of natural spaces, and further compromises the optimal functioning of the city's integrated stormwater system.

Evaluation of freshwater quality

The water quality of Cape Town's freshwater ecosystems is evaluated from two perspectives, each of which makes use of a different indicator derived from Department of Water Affairs (DWA, formerly DWAF) recommendations and guidelines. These perspectives acknowledge the dual importance and inter-dependence of people and the freshwater environment.

Public health - recreation

Microbiological data is used to evaluate the suitability of inland waters for recreational use. The DWA intermediate-contact recreational guideline is generally used for this purpose. Intermediate contact includes recreational activities which involve a high degree of contact, such as water skiing and windsurfing, as well as those that involve less, such as canoeing and angling. During these activities full immersion in the water is likely to occur only occasionally, compared to full-contact activities such as swimming.

The DWA intermediate contact recreational guideline recommends that samples should not exceed 1 000 indicator organisms per 100ml of water. Monthly samples are taken at monitoring points throughout the city's freshwater ecosystems. The percentage of samples with results less than or equal to 1 000 for a 12-month period is used as an indication of the level of compliance of each monitoring site.

In 2009, the City set itself an internal target as part of the IMEP Environmental Agenda that half of all water bodies (rivers and wetlands) in the city would achieve 80% compliance with the intermediate contact guideline by 2014. This means that at least 80% of samples taken in a year would need to meet the guideline limit of no more than 1 000 indicator organisms per 100ml. Additionally, those waterbodies that are designated for recreational purposes (Zeekoevlei, Zandvlei, Rietvlei and Milnerton Lagoon) need to achieve 100% compliance with the guideline level by 2014[24].

Ecosystem health

Phosphorus concentration data from samples collected throughout the city's freshwater ecosystems is used as a proxy measurement of the ecological condition or trophic state (extent of nutrient enrichment) of these systems.

Phosphorus is commonly identified as a key nutrient pollutant in urban and peri-urban areas. Too much phosphorus in a freshwater system leads to a process known as eutrophication, in which excessive plant and algae growth leads to degradation of the natural ecosystem. As plant material grows denser, or algal blooms develop, light penetration through the water column may be reduced. Large-scale die-off and subsequent decomposition of plants or algae can increase potentially toxic ammonia concentrations and reduce the oxygen content of the water, leading to compromised health and even death of fish and other aquatic life. Table 4 below provides a guide to the acceptability of phosphate levels.

Trophic Tendency	Total Phosphate (mg/ℓ)	"State" and typical conditions
Oligotrophic Very low nutrient level	< 0. 005	**"Excellent"** Usually moderate levels of species diversity; usually low productivity systems with rapid nutrient cycling; no nuisance growth of aquatic plants or blue-green algae.
Mesotrophic Moderate nutrient level	0.005- 0.025	**"Good"** Usually high levels of species diversity; usually productive systems; nuisance growth of aquatic plants and blooms of blue-green algae; algal blooms seldom toxic.
Eutrophic High nutrient level	0.025 - 0.125	**"Fair" to "Poor"** Usually low levels of species diversity; usually highly productive systems, with nuisance growth of aquatic plants and blooms of blue-green algae; algal blooms may include species which are toxic to humans, wildlife and livestock.
	0.125 - 0.25	
Hypertrophic Excessive nutrient level	> 0.25	**"Bad"** Usually very low levels of species diversity; usually very highly productive systems; nuisance growth of aquatic plants and blooms of blue-green algae, often including species which are toxic to humans, wildlife and livestock.

Table 4: Trophic state categories

State of the environment

Public health - recreation

Results are provided for the period from October 2010 to September 2011 (see Figures 4 and 5). Over this time period, most river systems experienced either a small decline or a small improvement in water quality; but on average, remained the same. During this period, less than half of the rivers met the IMEP target compliance level of 80%. Only three rivers (Lourens River, Silvermine River, and Schusters River) achieved this target.

Water quality in vleis and wetlands has improved significantly since the previous State of the Environment (2008/9) results, with seven sites (Zandvlei, Zeekoevlei, Westlake Wetland, Die Oog, Glencairnvlei, Wildvoelvlei and Rietvlei) achieving more than 80% compliance. Previously only three sites achieved the target compliance level. Three of the four waterbodies that support well-established intermediate-contact-level recreational activities (sailing, canoeing, water-skiing) achieved the 80% desired level (Zeekoevlei, Zandvlei and Rietvlei), with Rietvlei meeting the 2014 target of 100%.

Reasons for the improvement in some systems include, for example, interventions such as clearing of invasive species and removal of roosting structures which once supported unsustainably large numbers of birds at Die Oog. Water quality is also affected by rainfall patterns. Below-average rainfall experienced during 2010/11 may also have contributed to improved bacterial water quality in some systems. The intensity and duration of rainfall events affects how much pollution is washed into rivers and wetlands from the urbanised parts of the city, and how much flushing and dilution occurs.

It is important to note that 10 out of 14 rivers and 5 out of 13 vleis have experienced levels of compliance of less than 80% for the past five hydrological years. This indicates that bacterial pollution in these systems is a long-term and serious problem.

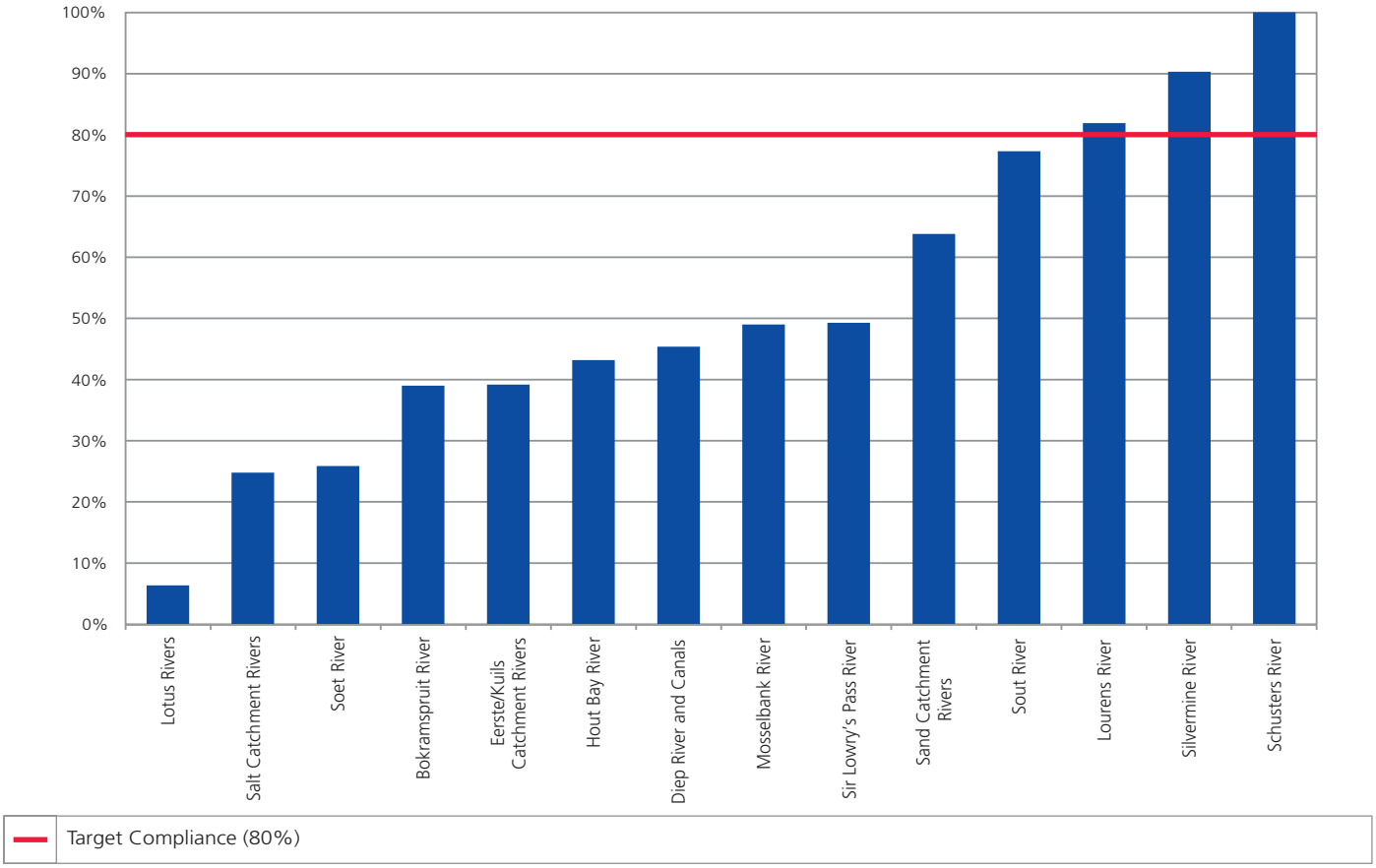
Ecosystem health

Results are provided for the period October 2010 to September 2011 (See Figures 6 and 7). Over this time period, 10 out of 14 river systems and 9 out of 13 wetlands were classified as eutrophic or hypertrophic, indicating poor to bad ecosystem health. It is important to note that only three rivers and one wetland were classified as mesotrophic, indicating a good level of ecosystem health, while none of the city's freshwater ecosystems was classified as oligotrophic (excellent).

In comparison to previous State of the Environment (2008/9) results, the ecological health of rivers has improved slightly, with one river (Schusters River) moving from the 'fair' category into the 'good' category. The ecological health of wetlands has improved significantly, with two wetlands (Zandvlei and Die Oog) moving from the 'poor' category into the 'fair' category, and one (Glencairnvlei) moving from the 'fair' category into the 'good' category. This is the first year since reporting began in 2004/5 that a wetland (Glencairnvlei) has been measured as experiencing good ecosystem health.

It is also important to note that 7 out of 14 rivers and 7 out of 13 wetlands have been regarded as eutrophic or hypertrophic for the past five hydrological years, indicating that eutrophication in these systems is a long-term and serious problem.

Figure 4 : Compliance with Public Health - Recreation Guideline: Rivers



Wemmershoek Dam supplies water to Cape Town

Figure 5: Compliance with Public Health - Recreation Guideline: Wetlands

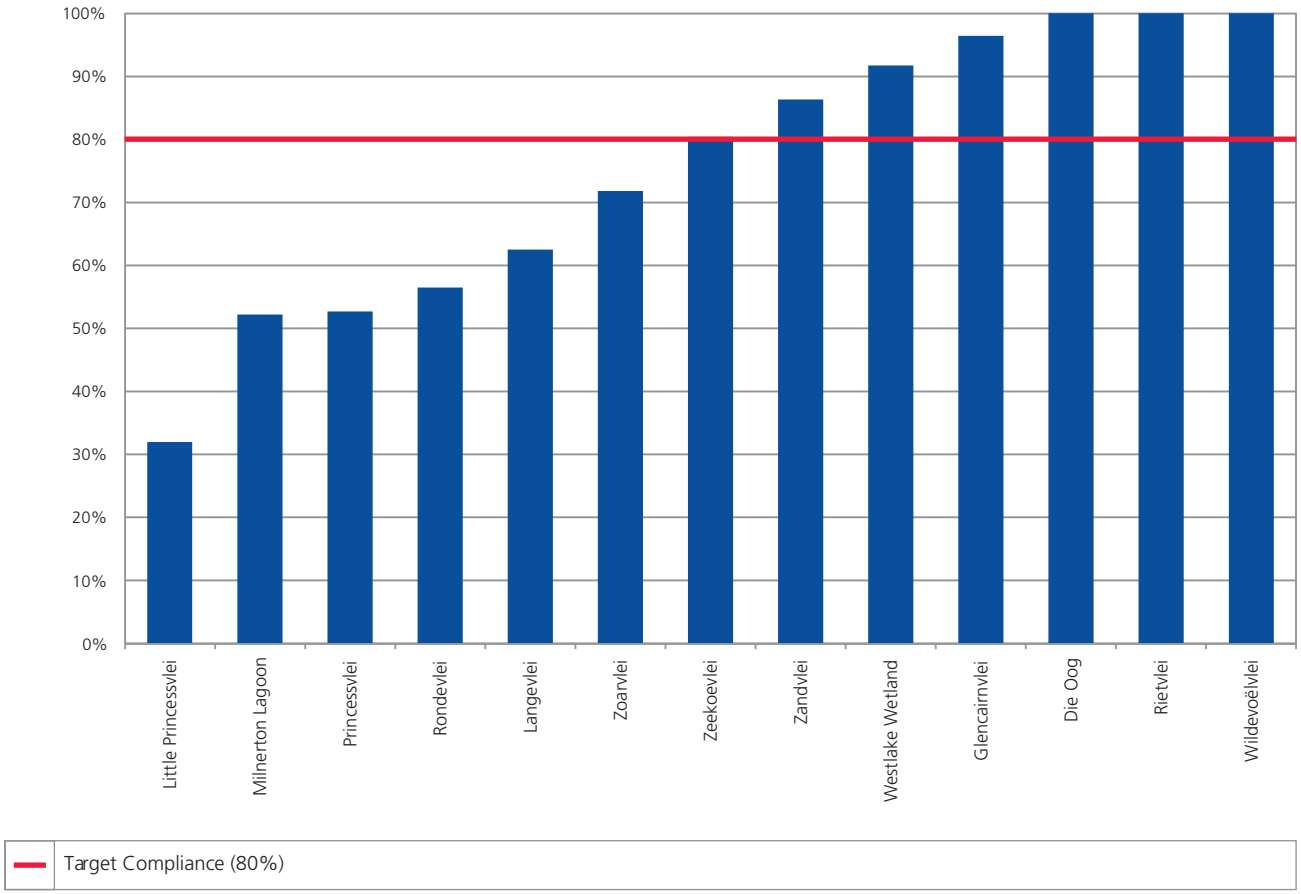


Figure 6: Trophic Tendency - Rivers

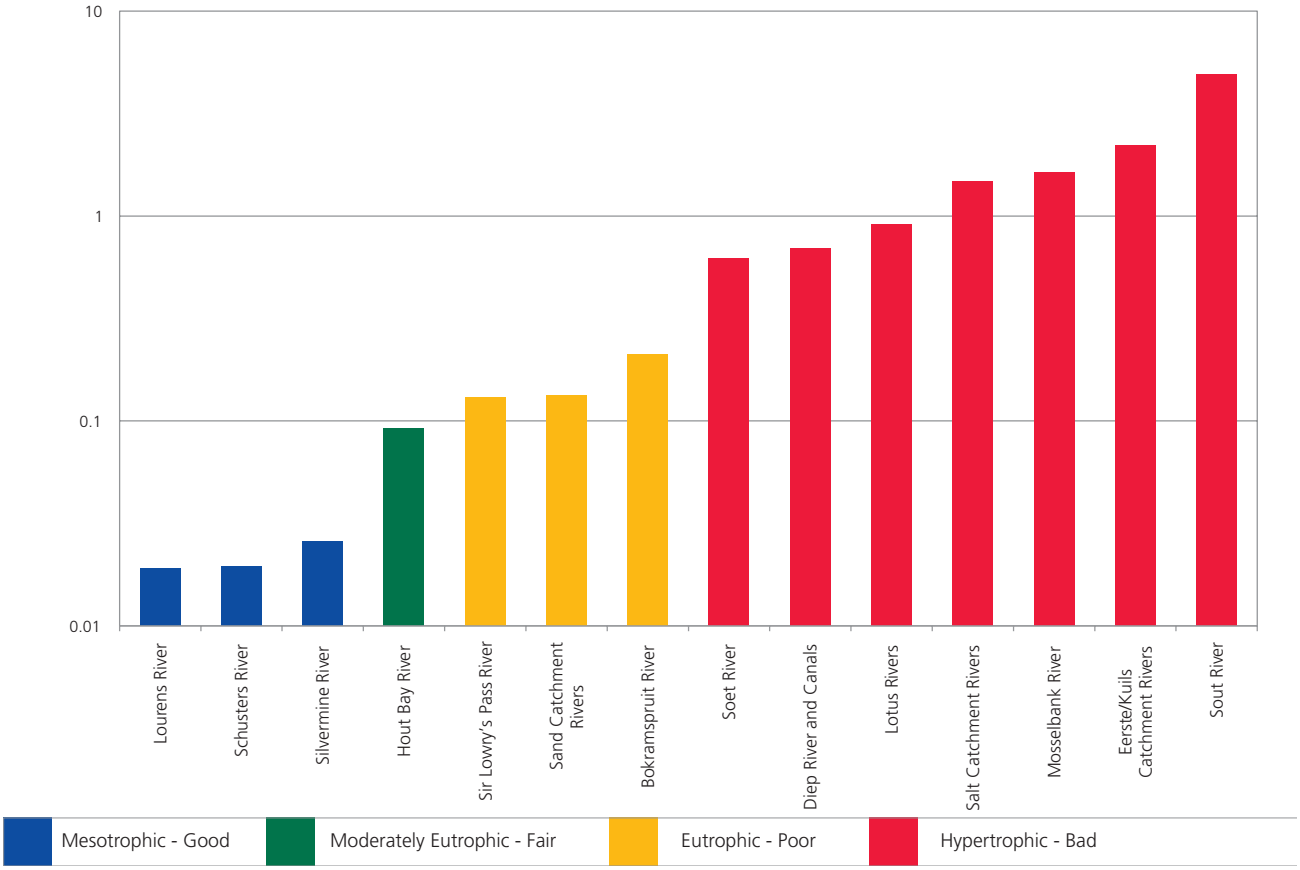
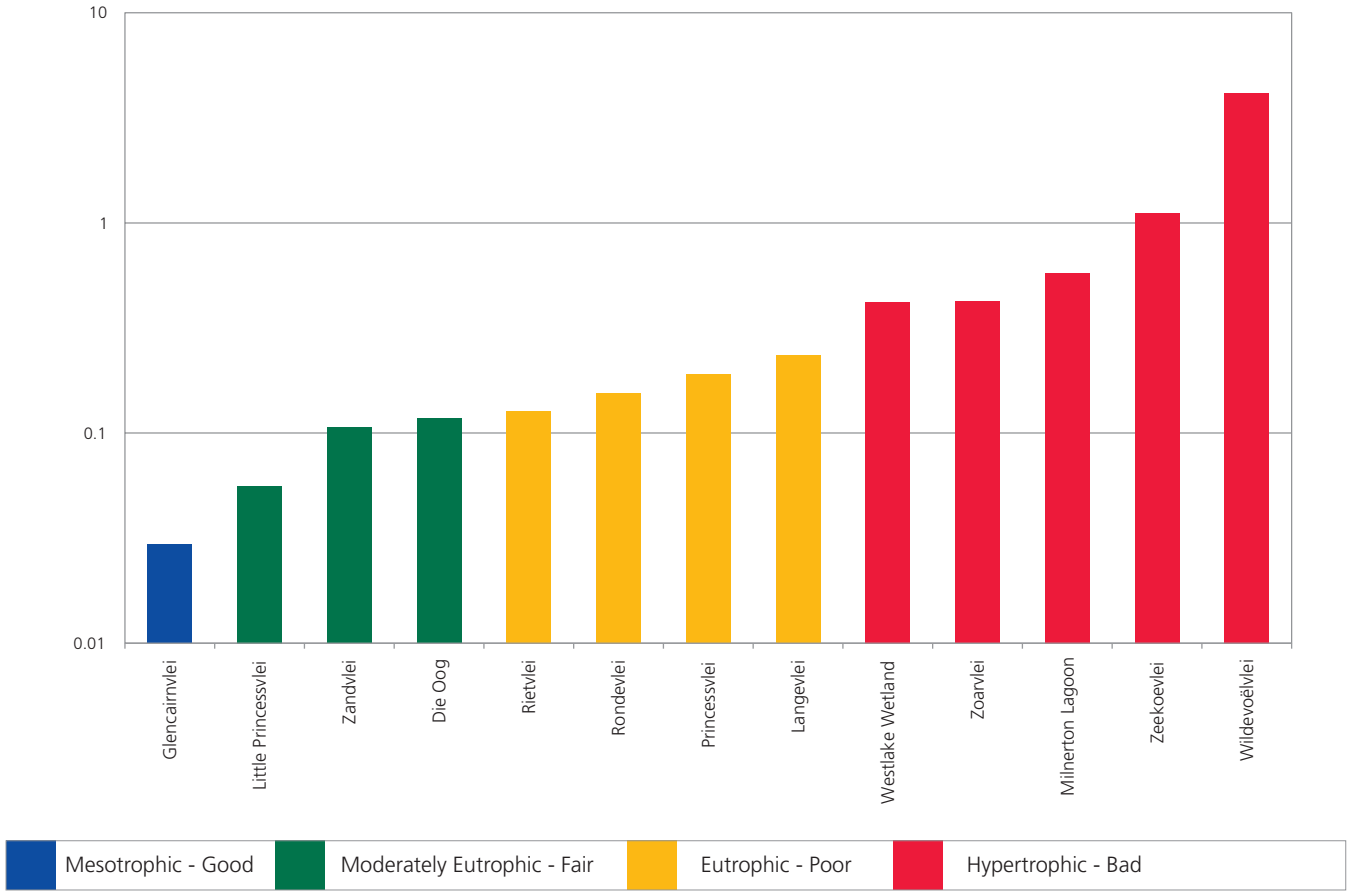


Figure 7: Trophic Tendency - Wetlands



Analysis and discussion

Some significant improvements in both recreational water quality and ecosystem health in a number of the City's wetlands and rivers have been noted during the 2010/11 hydrological year. Although it is not always possible to pinpoint the exact causes of improvement in a particular year, it is clear that the City's freshwater systems are starting to benefit from increased management and attention. However, the poor quality of many of the city's freshwater systems remains of serious concern, and much must still be done to achieve target compliance levels. Rivers and wetlands are important recreational areas (although many are not currently used for this purpose), as well as critical habitats for aquatic animals, insects, and birds.

The primary sources of contamination of the city's freshwater systems are insufficiently treated wastewater effluent, contaminated urban stormwater and raw sewage from informal settlements, and leaking sewers and pump stations. Furthermore, the pace of urbanisation, the rapid expansion of informal areas, and a burgeoning backyard dwelling component often outstrips expansion in municipal infrastructure and service capacity. This sometimes results in compromised sewerage, stormwater and solid waste management systems.

Additionally, the lack of a national standard for phosphorus concentrations in treated wastewater effluent has meant that for many years, reduction or removal of phosphorus from sewage was not prioritised by the City, and therefore was not sufficiently budgeted for. However, this has been recognised in recent years, and new efforts are under way to ensure that wastewater treatment works are able to remove phosphates effectively. This is important, as bacterial pollution and nutrient enrichment are not always correlated. Some systems that score very poorly in terms of trophic state may still have good levels of compliance with bacterial standards (e.g. Wildevoelvlei). In the latter case, this is attributed to effective disinfection of effluent discharged into this vlei from the adjacent Wildevoelvlei wastewater treatment works (WWTW), but poor reduction in effluent phosphate levels. However, chemical removal of phosphorus from this effluent is scheduled to be implemented at this WWTW during 2012/3; this aims to reduce excess phosphate levels and improve trophic conditions. Ideally it is important that aquatic systems are able to fulfil both public health and ecosystem health requirements.

In order to resolve long-standing water quality and ecosystem health issues, the City is prioritising the upgrading and expansion of wastewater treatment works in terms of both capacity and technology. The provision of effective sewerage infrastructure in informal areas, and the repair and replacement of ageing sewer systems, is also a key priority. As these measures are very costly and take lengthy periods to accomplish, it is likely that measurable improvements in the state of receiving waters may take many years to achieve.

In the shorter term, speedy repair of sewerage facilities that are blocked, have broken or have been vandalised can yield measurable improvements. Several hundred sewer blockages due to disposal of inappropriate materials (including sand, and fat, oils and grease from food production outlets) and tree roots are attended to each day by the City's sewer blockage teams. In addition to improved response times of these crews, the Water and Sanitation Department launched a campaign during 2011 to raise awareness regarding the appropriate use of municipal sanitation services and the problems associated with compromised sewer networks at informal settlements.

Rehabilitation and restoration of ecosystem services provided by the city's rivers and wetlands should be considered, wherever feasible, in order to promote a return to functional aquatic ecosystems. This may include the rehabilitation of earth and concrete 'canalised' rivers to ensure a diversity of in-stream habitats and suitable channel shape (the steep sides and concrete bases of canals inhibit plant growth), and restoration of indigenous riparian and aquatic vegetation. Maintenance of buffer areas adjacent to freshwater systems is also important, as they protect the receiving environment from polluted run-off, and can provide valuable habitat as well as recreational space.

Policy Responses

The Council has incorporated the concept of Water-Sensitive Urban Design in its Spatial Development Framework, and approved a stormwater policy entitled 'Management of Urban Stormwater Impacts' (2009)[25]. This policy requires that developers introduce measures for the management of stormwater quality and quantity on-site, so that impacts on receiving waters such as rivers, wetlands and the near-shore coastal environment may be reduced. This requires widespread support and commitment by many role players in both government and civil society, in order to achieve real improvements in the state of receiving aquatic environments over the long term.

Within the Cape Town area the pressure to develop is significant, and requires careful management to avoid developing in high-flood-risk areas, to protect the environmental integrity of adjacent aquatic resources, and to ensure that permitted development enhances the aesthetics and character of adjacent rivers and wetlands. A second stormwater policy, titled 'Floodplain and River Corridor Management' (2009), tackles these issues and promotes an approach for dealing with development proposals within and adjacent to flood-prone areas and aquatic ecosystems and their buffers.[26]

Since their approval in 2009, the requirements of both these policies have been applied to all new development applications in Cape Town, whether at the basic assessment, scoping, EIA or building plan submission stage. It is anticipated that effective implementation of Water Sensitive Urban Design and Sustainable Urban Drainage Systems, and ensuring aquatic ecosystems are managed or rehabilitated so that their functional integrity is maintained, may increase the resilience of urbanised catchments to climate change impacts.

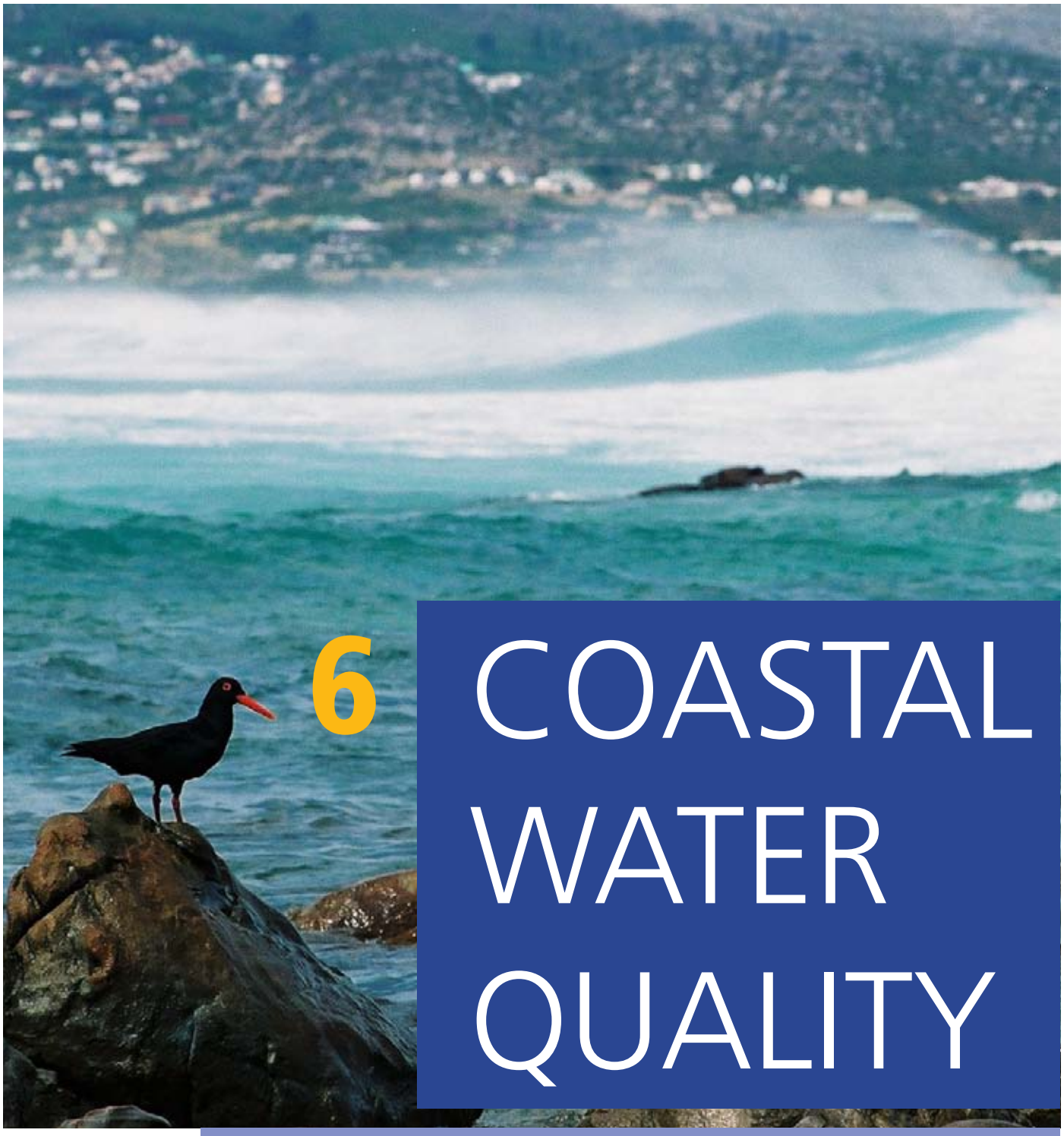
Policy Linkages

IDP: Strategic Focus Area 3 - The Caring City
MDG Goal 7: Target 9 – Integrate the principles of sustainable development with country policies and programmes, and reverse the loss of environmental resources.
Urban Environmental Accords: Action 21 – Municipal wastewater management guidelines; and reduce the volume of untreated wastewater discharges by 10% in seven years, through the expanded use of recycled water, and the implementation of a sustainable urban watershed planning process, which includes participants of all affected communities, and is based on sound economic, social and environmental principles.
IMEP Environmental Agenda 2009-2014: Target 7 – River Health.
Catchment, Stormwater and River Management Strategy: Aims to safeguard human health, protect natural aquatic environments and improve recreational water quality.
By-law relating to Stormwater Management: Provides for regulation of stormwater management and regulates activities which may have an impact on the city's stormwater system and natural receiving water systems.

Trend and target

Trend: There have been some significant improvements in river and wetland health since the previous reporting period (2008/9). However, progress is still required in order to meet the IMEP targets in 2014.
Target: IMEP Environmental Agenda 2009-2014 Target: half of rivers and half of vleis must achieve 80% target compliance with the public health recreational guideline.
Current: Overall, water quality in rivers remains poor, and is not on track to meet the targets. Water quality in wetlands has improved; currently, just over half of wetland ecosystems meet the public health guideline for water quality, thus meeting the IMEP 2014 target.

See Also
Water Use: pg 38
Coastal Water Quality: pg 43
Waste Water: pg 49



6 COASTAL WATER QUALITY

Indicators

Percentage compliance with recreational coastal water quality guidelines

Number of beaches awarded Blue Flag Status

Cape Town is surrounded by approximately 307 km of coastline. This extends from the West Coast, around the Cape Peninsula and beyond False Bay to the Kogelberg coastal area in the east. The coast is a considerable asset in terms of tourism, recreation, and biodiversity. Cape Town's beaches are a significant driver of tourism, and provide an opportunity for citizens to spend their leisure time in an accessible yet natural environment. Measurement and monitoring of coastal water quality is vital to protect the fragile ecosystems supported by the coastline, and to protect the public from possible pollution of coastal waters.

In Cape Town, bacterial pollution enters coastal waters primarily through stormwater that can contain a variety of urban pollutants, and sewage effluent that is either discharged from wastewater treatment works (WWTW) into rivers that flow to the coastal environment, or released directly into the marine environment via deep-sea outfall pipelines. Stormwater originating in partially-serviced or unserviced informal settlements and areas with large numbers of backyard dwellings often contains untreated sewage as a result of residents emptying toilet buckets into the open environment or into the stormwater system. Faecal material from livestock and domestic pet waste may also wash into the stormwater system during heavy rains. It is very important to note that coastal water quality may deteriorate significantly in winter due to pollution that is washed off urban areas during heavy rainfall.

Effects of pollution

Pollution of the coastal zone with contaminated water can have a detrimental effect on the health of both humans and marine ecosystems. The Department of Water Affairs (DWA) has set recreational guidelines in order to safeguard human health, as contact with bacteria and other pathogenic organisms present in the water can lead to the development of gastrointestinal illnesses and dermatological problems. Additionally, such water is likely to be higher in a range of other potentially harmful pollutants, which could upset delicate near-shore coastal ecosystems.

Guidelines

The safety and health of recreational water-users (swimmers, surfers, etc.) is a primary concern for the City of Cape Town. The City makes use of the DWA's South African Water Quality guidelines for Coastal Waters (Volume 2: Recreational use). These guidelines stipulate the maximum number of indicator organisms (faecal coliforms including *Escherichia coli*) that should be present in water used for full-contact recreational activities (e.g. swimming, surfing)[27].

80th percentile guideline: 80% of samples must contain no more than 100 *E. coli* bacteria per 100ml.
95th percentile guideline: 95% of samples must contain no more than 2 000 *E. coli* bacteria per 100ml.

New Guidelines

In 2011 the National Department of Environmental Affairs (DEA) issued an updated and more stringent set of guidelines for recreational coastal water use. These guidelines include, in addition to levels for *E. coli*, a level for Enterococci, another useful indicator of possible sewage contamination in the marine environment. The City of Cape Town is in the process of updating its procedures and systems to measure and report against these new guidelines.

The recreational guidelines include a dual target for faecal coliform (including *E. coli*) counts based on 80th and 95th percentiles. For public health reasons, in order for a beach to be fully compliant, it must meet both targets indicated below, although the 80th-percentile guideline is regarded as most stringent. Coastal water quality is measured and assessed fortnightly on both the Atlantic and False Bay coasts. As part of the IMEP Environmental Agenda, the City has set a target that, by 2014, 95% of beaches should meet the strict 80th percentile guideline.

State of the environment

Figures 8 and 9 provide an overview of the levels of compliance of 68 monitoring points (located along the Atlantic and False Bay coastlines) from 1992 to 2011.

Compliance levels on the Atlantic coast have improved since 1992. In 2010 the Atlantic coast experienced its highest level of compliance since 1994, at 93% for the strict guideline, and 96% for the relaxed guideline. These dropped slightly in 2011 to 79% and 89% respectively. In 2008, compliance levels on the False Bay coast dropped dramatically, to a low of 50% compliance with the strict guideline. It is therefore very encouraging to note that compliance with these strict guidelines has improved greatly since this time, reaching 95% for the strict guideline and 98% for the relaxed guideline in 2011.

Map 8 provides a spatial depiction of water quality at Cape Town beaches, and identifies the varying levels of compliance

Figure 8: Compliance with water quality guidelines - Atlantic coast

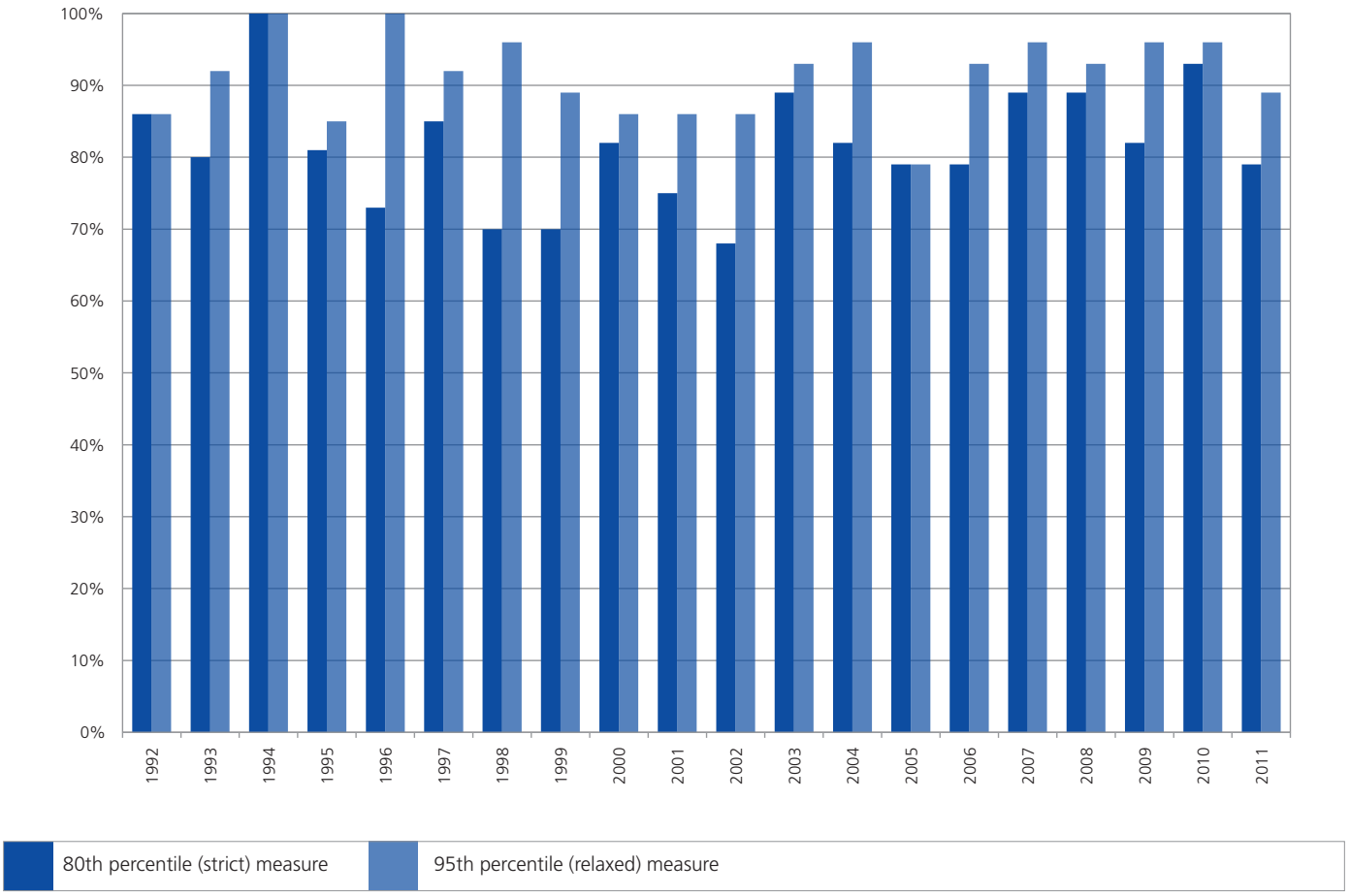
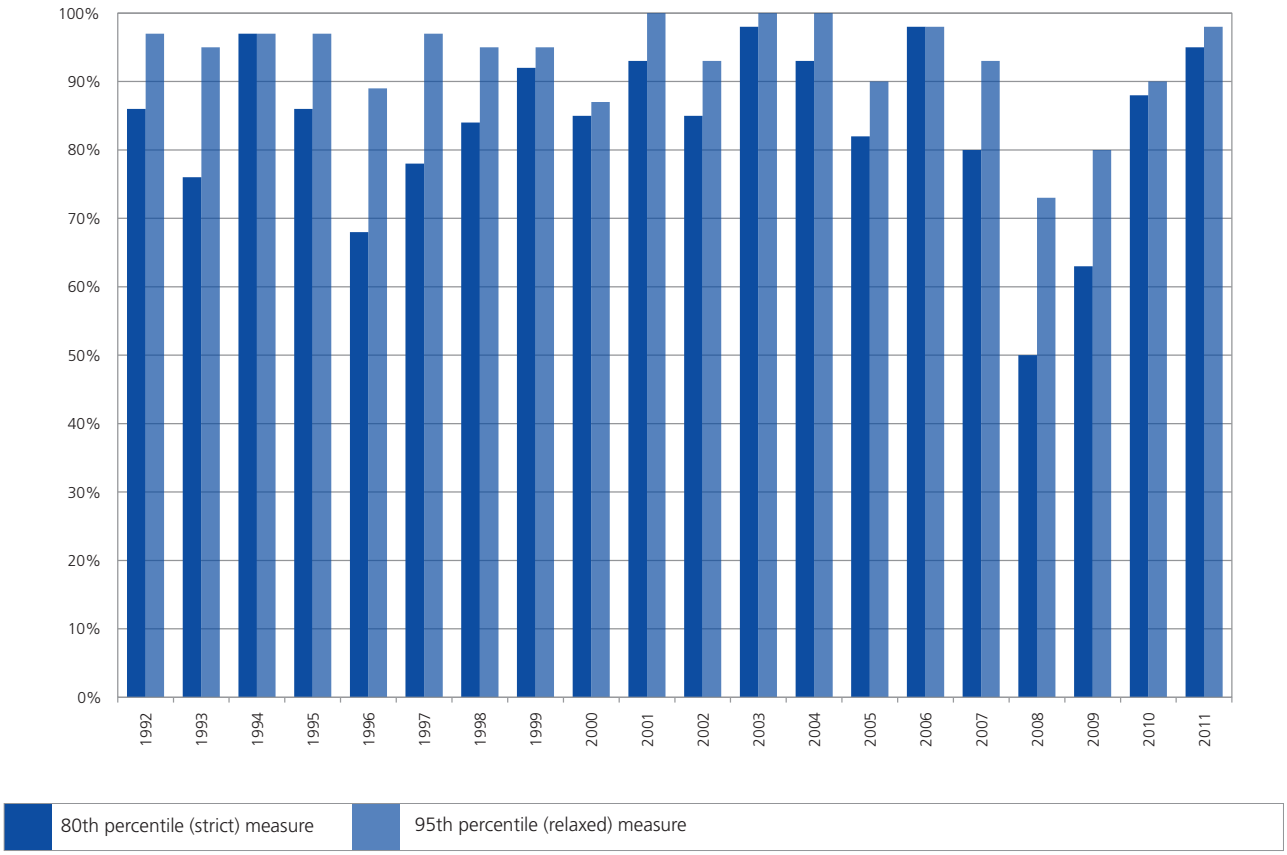


Figure 9: Compliance with water quality guidelines - False Bay Coast



Map 8: Coastal water quality

Blue Flag Beaches

The City is a participant in the Blue Flag programme, which provides an internationally recognised 'eco-label' to beaches across Europe and the Caribbean, in South Africa, Morocco, Tunisia, New Zealand, Brazil, and Canada. Blue Flag beach status is awarded based on compliance with 29 criteria covering a range of strict social and environmental standards concerning aspects such as water quality, educational programmes and other facilities which aim to promote sustainable management of beaches. The Blue Flag is a useful monitoring tool to assist the City in maintaining high standards of coastal water quality.

All Blue Flag beaches must have an Environmental Management Plan in place, and are required to meet the standards for water quality. Blue Flag beaches are evaluated based on water quality measurements taken only over the six-month summer season (November to April) preceding the awarding of the flags – i.e. water quality measurements from the 2010/11 season are used to determine which beaches will be awarded Blue Flag status in the 2011/12 season. If standards change, a beach's Blue Flag status may be withdrawn.

Blue Flag beach status

In the past (2011/12) season, eight beaches were awarded Blue Flag Status: Bikini Beach, Mnandi, Strandfontein, Muizenberg, Camps Bay, Clifton 4th beach, Llandudno, and Silwerstroom beach. Cape Town has the highest number of Blue Flag-awarded beaches in South Africa. It is important to note that Blue Flag testing is carried out only during 'bathing season', i.e. summer; and so does not reflect annual water quality levels, which do differ seasonally and according to rainfall patterns.

for the period October 2010 to September 2011. Over this period only 4 out of 40 points measured on the False Bay coast failed to comply with both guidelines. On the Atlantic coast, 7 out of 28 points measured failed to comply. Although the False Bay coast has improved since the previous SOE, results for the Atlantic coast declined slightly. Overall, out of the 68 beaches monitored, 84% of beaches met the strict 80th percentile guideline for this period. While the majority of sites achieved both, overall the level of compliance does not yet meet the 2014 IMEP guideline level of 95%.

Analysis and discussion

Coastal water quality varies along the coastline. In recent years the majority of Cape Town's beaches have achieved the required guidelines, yet a number failed to meet either the strict guideline or the relaxed guideline. Areas with poor coastal water quality tend to be clustered around and associated with stormwater and wastewater outlets, river mouths, or ageing or damaged sewer infrastructure. This is evident in the Strand area beaches along the Lourens River Mouth. These sites have been non-compliant for periods of time over the years, and it is thought that poor water quality in the local rivers (Soet and Sir Lowry's Pass Rivers) and stormwater system – due to contamination from sewer blockages or overflows and run-off from informal settlements – is the main contributing factor.

Geographical and climatic factors also contribute to certain areas being more prone to developing poor water quality. It has been shown in a study conducted by the CSIR in

2000 that low wind speeds and weak currents, particularly during winter, result in reduced mixing and circulation in the sheltered area of False Bay – this phenomenon would result in stagnation and trapping of poor-quality water close to the shoreline. Variations in rainfall also play a role in both mobilisation and dilution of urban pollution. In years such as 2010, when lower than average rainfall was recorded, less pollution within the urban catchment is mobilised by rainfall into rivers and the stormwater system, both of which ultimately empty into the ocean[28]. It is common to see a pollution 'spike' when extended dry periods are followed by heavy, sustained rains.

Ongoing improvements in treated wastewater effluent quality in some areas have probably contributed to overall improvement in coastal water quality. The City's treated effluent reuse programme also plays a role, as less wastewater effluent is returned to the natural environment. Furthermore, the continual improvement of sewerage infrastructure – such as repairs to leaking sewers and damaged pump stations in coastal areas – is likely to have contributed to a general improvement of coastal water quality in recent years.

The City is currently carrying out a pilot project concerning the disinfection of coastal stormwater outlets at Three Anchor Bay and Rocklands on the Atlantic Coast. During the pilot, the feasibility of three approaches to reduce bacterial loading will be tested: diversion to sewer, disinfection by UV light exposure, and chlorination. Construction of the infrastructure required to treat the contaminated stormwater is complete. Testing and environmental monitoring commenced in 2012 and will continue for at least a year, until a decision is made by the Department of Environmental Affairs and Development Planning (DEADP) on which of the methods (if any) could be used in areas where water quality levels are consistently below the required guidelines.

The monitoring and research that is carried out on a continual basis has been beneficial, as it helps identify trends and prioritise problem areas. The Blue Flag programme raises awareness of the need to manage coastal water quality for environmental, social, educational and economic reasons. During 2011, the Inland and Coastal Water Quality Improvement Strategy and Implementation Plan was drafted. The strategy proposes a framework for addressing inland and coastal water quality issues over the next decade. The Strategy encourages a collaborative and integrated approach to the management of urban water based on a series of short- and longer-term interventions to be undertaken in partnership with communities, business and other spheres of government. This is vital for addressing water quality, as the quality of the water in an urban environment is a complex and interconnected issue, and requires the commitment and collaboration of all stakeholders[29].

Trend and Target

Trend: A significant decline in False Bay water quality was noted in 2008, but it has improved considerably since. Water quality on the Atlantic coast declined slightly in 2011, with a quarter of sites not complying with guidelines.
Target: IMEP Environmental Agenda 2014 Target: 95% of coastal monitoring points will be compliant with the 80th percentile (strict) guideline.
Current: Overall, 84% of sites across the entire coastline met the required guidelines.

Policy linkages

IDP: Strategic Focus Area 3 - The Caring City
IMEP Environmental Agenda 2009-2014: Target 7 – River and Coastal Health
MDG Goal 7: Target 9 – Integrate the principles of sustainable development with country policies and programmes, and reverse the loss of environmental resources.
Catchment, Stormwater and River Management Strategy: Aims to safeguard human health, protect natural aquatic environments and improve recreational water quality.
Catchment, Stormwater and River Management policies: Management of Urban Stormwater Impacts Policy.
By-law relating to Stormwater Management: Provides for regulation of stormwater management and regulates activities which may have a detrimental impact on the City's stormwater system, including natural receiving water systems.

See Also
Water Use: pg 31
Fresh Water Quality: pg 36
Waste Water: pg 49

7 WASTEWATER

Indicators

Percentage compliance with Department of Water Affairs (DWA) standards for final effluent

Percentage compliance with permit limit for mass of pollutants discharged

Wastewater is defined as any water that enters the sewerage system, after which it passes to a wastewater treatment plant to be processed. This includes wastewater produced by bathing and showering, washing clothes and dishes, flushing toilets, as well as effluent from industrial and commercial activities. At present, about 60% of all the water used in Cape Town is channelled into the city's sewer networks as wastewater[30]. It is vital that this water is treated before it re-enters the natural environment, to avoid damage to human health and the environment. The quality of wastewater discharges can have profound effects on ecosystems, human well-being, and the economy.

Although largely undervalued, wastewater and its treatment by-products can be a valuable resource, and can be recycled and re-used in a number of ways. The management of wastewater needs to be linked to the management of the entire water system[31]. It is recognised that treated wastewater will be vital in coming years in helping to ensure the future of Cape Town's limited water supply in the face of urban and population growth[32].

Wastewater can contain a multitude of pollutants and contaminants such as pathogens, organic compounds and organic matter, synthetic chemicals, nutrients, and heavy metals. Different treatment processes are designed to manage these various aspects, yet it is important to regulate what enters the water as some substances can adversely affect the treatment processes. Physical treatment such as screening removes suspended solids such as organic matter, which can harbour pathogens. Too much organic material in receiving waters can create a chemical imbalance in the water as organic materials consume the oxygen in the water, increasing the chemical oxygen demand (COD). This becomes a problem if the rate of oxygen utilisation exceeds the re-aeration rate, making it difficult for aquatic organisms to survive in the water.

Furthermore, wastewater contains high levels of nutrients such as nitrates and phosphates. High concentrations of these compounds can lead to excessive growth of algae and water plants, which can create an imbalance in aquatic ecosystems. If left untreated, wastewater also contains high levels of bacteria, viruses and helminths (worms) that can cause the spread of disease.

The City of Cape Town currently has 26 wastewater treatment works/facilities (WWTWs) throughout the city[33]. Twenty-one of these are reported on in this report. Those excluded are the three deep sea outfalls, the two small oxidation systems that do not have an effluent, and the Fisantekraal Wastewater Treatment Works, which was opened in August 2011.

Wastewater is treated through a variety of processes, physical, biological and chemical. All of the processes used in the city make use of physical screening, followed by a biological treatment process; some use chemical treatment processes as well. Most treated wastewater is released into rivers or the ocean, where it is assimilated back into the environment. A portion is re-used – by industry, and for the watering of golf courses and sports fields – as it is significantly cheaper and more environmentally sustainable than using potable water. The sludge or bio-solids left over from the purification process are used in a number of ways. Some 'activated' sludge is dewatered and applied to agricultural land; some 'primary' sludge is composted; and the rest is taken to landfill. At present, the City is looking into a bio-solids beneficiation project which aims to improve the management and resource potential of this material[34].

Standards for treated wastewater discharge

Wastewater that is returned to the environment must meet the quality standards promulgated by the Department of Water Affairs (DWA) in terms of the National Water Act 36 of 1998. These prescribed standards are intended to ensure that the wastewater has minimal impact on the natural environment, as well as on the health of anyone who may come into contact with it.

In 2009, the DWA implemented the Green Drop rating system for WWTWs. This system monitors the overall performance of the country's WWTWs and is based on numerous criteria, including the results of wastewater quality tests and the implementation of best practices in processes, maintenance, monitoring and reporting. Since its implementation, this system has led to significant improvements in the running of wastewater treatment facilities[35].

The City currently measures up to 32 parameters in the treated effluent. There are five parameters that are regarded as the most informative. These are: ammonia content, the

chemical oxygen demand (COD), the number of *Escherichia coli* (*E. coli*), the orthophosphate content, and suspended solids. These are explained below.

Ammonia

Ammonia is produced by interaction between the bacteria and the nitrogen compounds present in wastewater. This pollutant contributes to the eutrophication of receiving waters, and is toxic to both plants and animals.

General standard: Not exceeding 10mg/l, with a long-term goal of no more than 3mg/l.

Chemical oxygen demand (COD)

COD is the measure of the amount of oxygen in water that is consumed for the oxidation of organic compounds. COD provides a good indication of the amount of organic pollutants in water. Oxidation of large quantities of organic matter in water results in significant reduction in dissolved oxygen levels, which could in turn result in respiratory distress in aquatic organisms.

General standard: Not exceeding 75mg/l.

Escherichia coli (*E. coli*)

E. coli is a bacterium that is commonly found in the intestines of warm-blooded animals, including humans. The presence of *E. coli* in water is indicative of pollution with faecal matter. Although *E. coli* itself is not necessarily harmful, it is often used as an indicator of the presence of other pathogenic organisms in contaminated water, and therefore is important in determining guidelines for recreational water quality.

General standard: No *E. coli* to be present, but most WWTWs allow a relaxation to 1 000 *E. coli*/100ml.

Suspended solids

This refers to any particles that are suspended or floating in wastewater. Suspended solids could include a range of particles, such as sediments, food particles, detergents and human waste. Water with a high suspended-solids loading will tend to have a murky/turbid appearance, which in turn affects light penetration and thus also photosynthesis. Suspended solids could negatively affect filter-feeding organisms, whereas solids that settle out may smother aquatic plants and animals.

General standard: No more than 25mg/l.

Orthophosphate

Orthophosphate is a readily bio-available form of phosphorus that is often found in wastewater; detergents are a significant source of phosphates in wastewater. Phosphorus is a key pollutant of concern in receiving waters, as it contributes to eutrophication (excessive nutrient loading) and associated prolific growth of problem aquatic plants and potentially harmful algal blooms.

General standard: Not currently legislated

Proposed future standard: 1mg/l.

Mass loading

Another way to measure wastewater quality is through the measurement of the total mass of pollutants that flow through all of the City's wastewater treatments works in a year. This provides an additional layer of information and a fuller picture of the situation than compliance data alone. Percentage compliance only provides information about whether the works comply with standards or not, but does not indicate by how much or how little it met or exceeded the standard on those occasions. By measuring the actual amounts of pollutants flowing through the system, mass loading measurements can therefore indicate where a problem is emerging, or – in the case of works which are already exceeding the limits – worsening. Additionally, due to the fact that wastewater treatment works vary greatly in capacity, compliance data alone does not differentiate between the impact of compliance by small and large treatment works. If a large treatment works scores poorly on compliance, the impact can effectively 'outweigh' the good score of several smaller treatment works, in terms of the actual amount of pollutants released into the environment. The City is permitted to discharge a certain mass of each pollutant annually, and therefore figures are presented in this report as a percentage of the permit limit.

State of the environment

Figures 13 to 27 show the percentage compliance with DWA general standards for 2011. The percentages are calculated on the basis of the number of times that effluent quality fails to meet the general standard in a year. For example, if the effluent fails ten times out of 100 measurements, it will have a 90% compliance rate. A compliance rate of over 95% is considered acceptable; between 95% and 75% is poor; and less than 75% is considered unacceptable.

Ammonia

Figure 9: Percentage compliance with ammonia standard (2011)

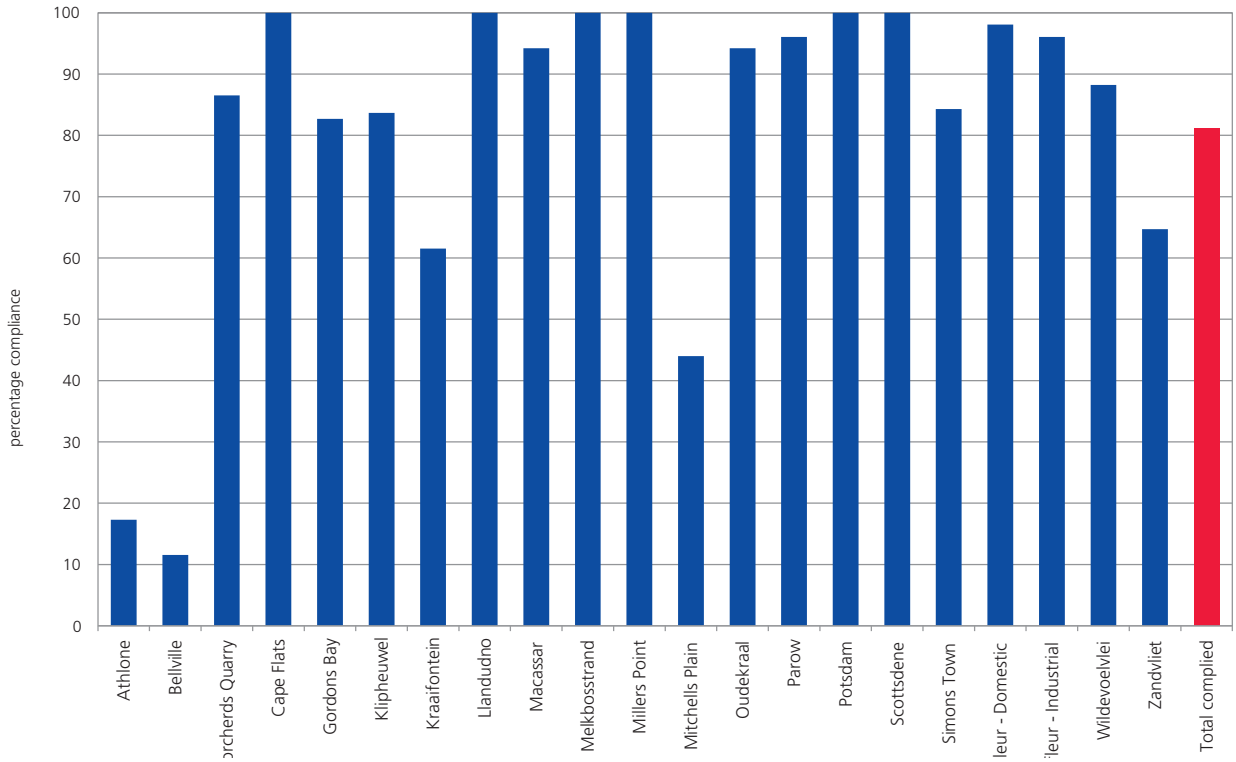


Figure 10: Average compliance with ammonia standard (1998 – 2011)

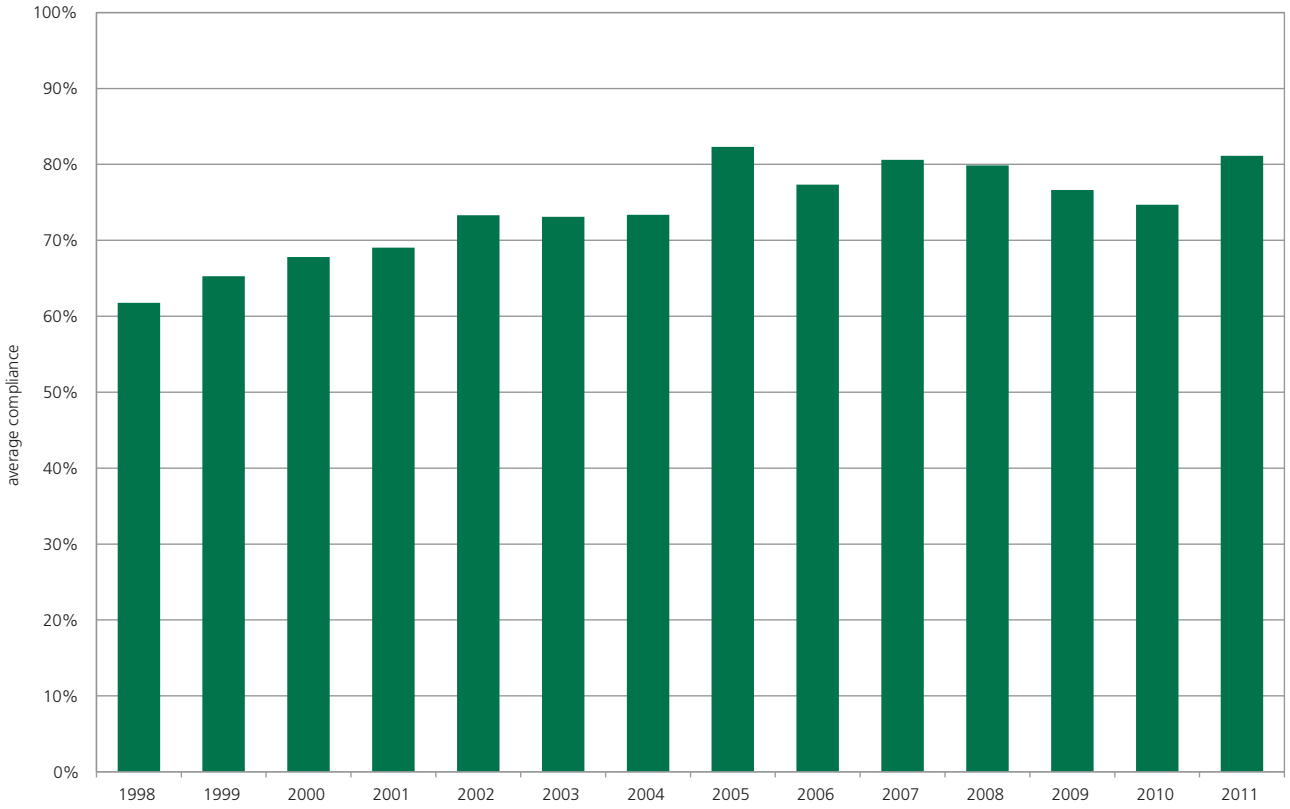
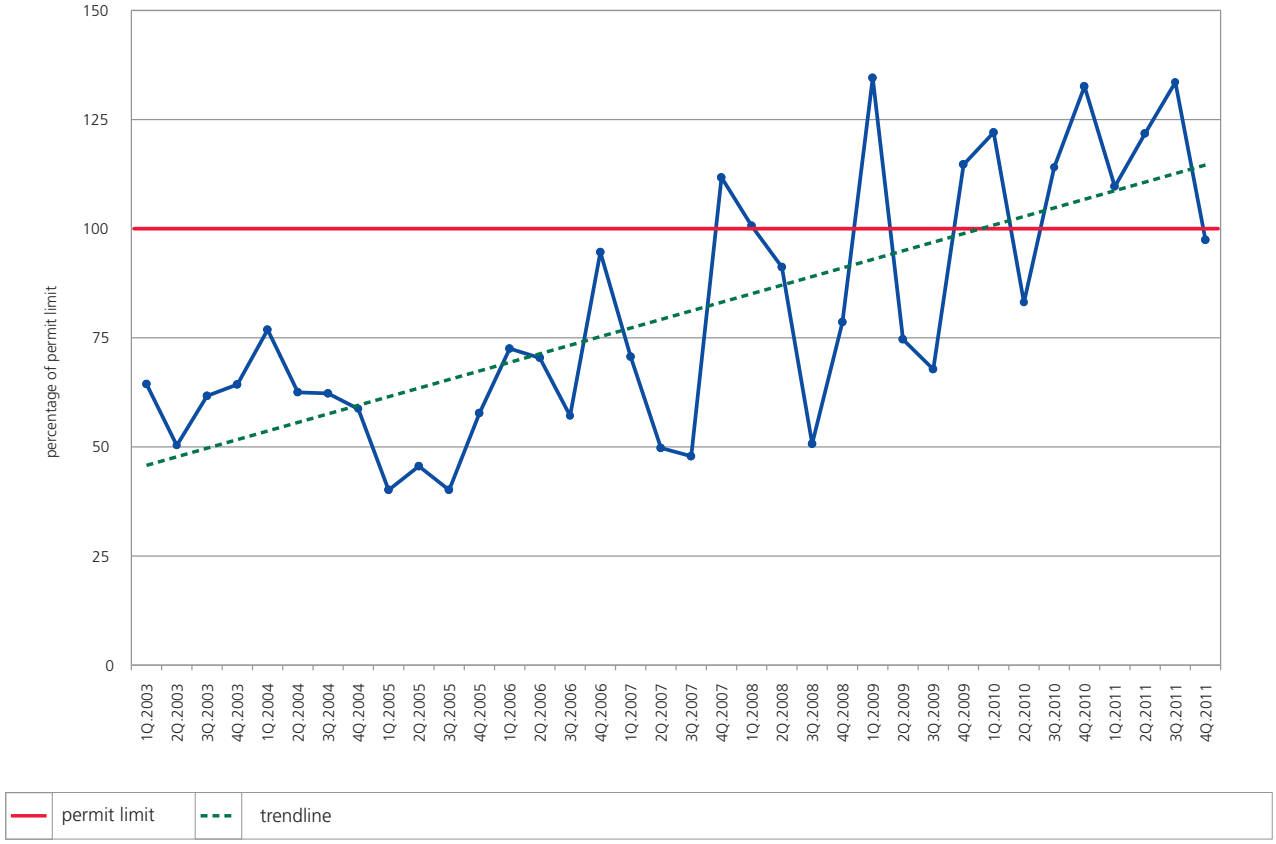


Figure 12: Ammonia discharged – mass basis (2003 – 2011)



Out of the 21 WWTWs monitored, only 9 achieved the acceptable compliance standard (95%). This has improved slightly since the last reporting period (2009), when 8 sites achieved the same standard. Seven out of the 21 sites achieved a poor standard – although two of these were less than 1% below the 95% compliance rate – and 5 an unacceptable level of ammonia. The Cape Flats and Millers point sites have made significant improvements since 2009, from having unacceptable ammonia compliance levels to having acceptable compliance levels. Athlone and Bellville, both overburdened sites, have significantly worsened in their levels of compliance since 2009. In terms of the overall average of compliance across the city, a slight decrease has been noted since 2008, but this has improved somewhat in 2011. In terms of mass loadings, since 2008 the City has regularly exceeded the permit limit for the mass of ammonia discharged from its WWTWs. This shows an increasing trend over time.

The Black River receives treated effluent, which contributes to its poor water quality

Chemical Oxygen Demand (COD)

Figure 13: Compliance with COD standard (1998 – 2011)

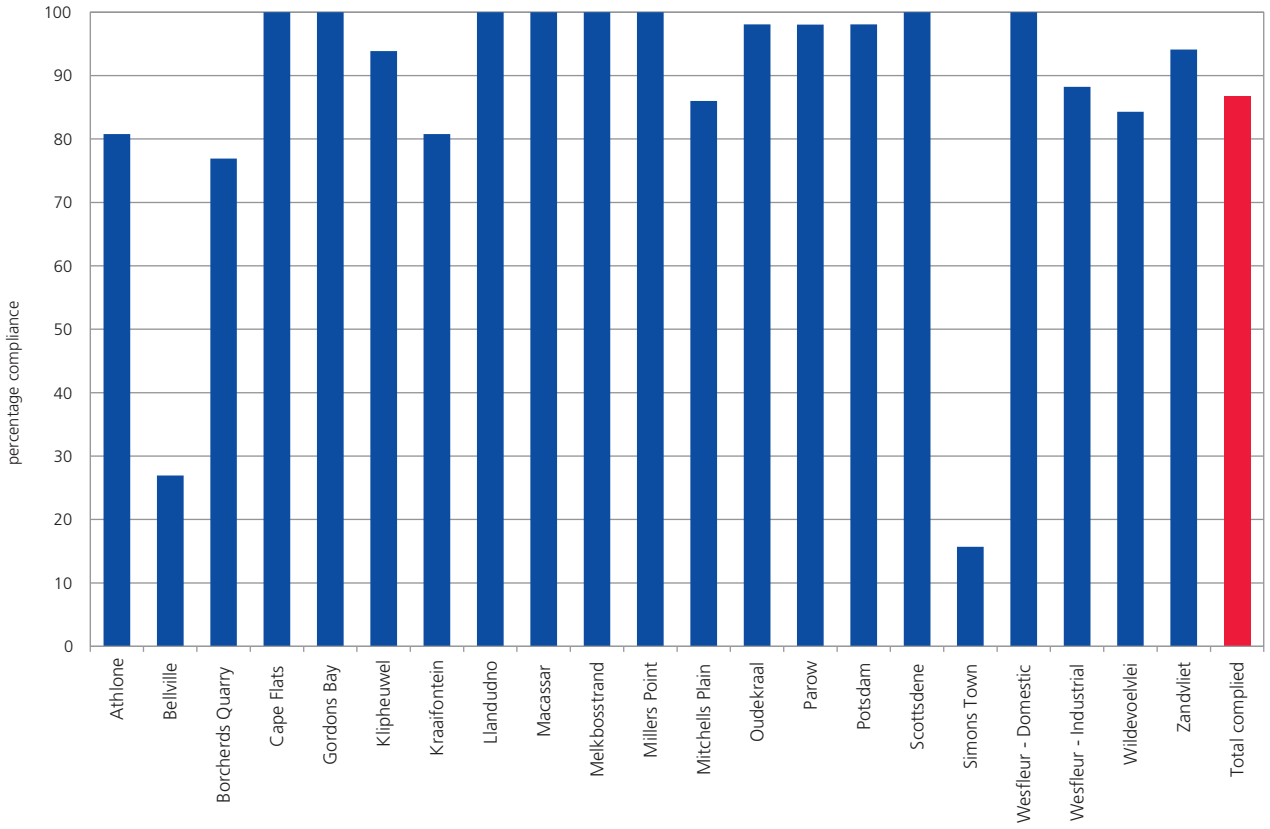


Figure 14: Average compliance with COD standard (1998 – 2011)

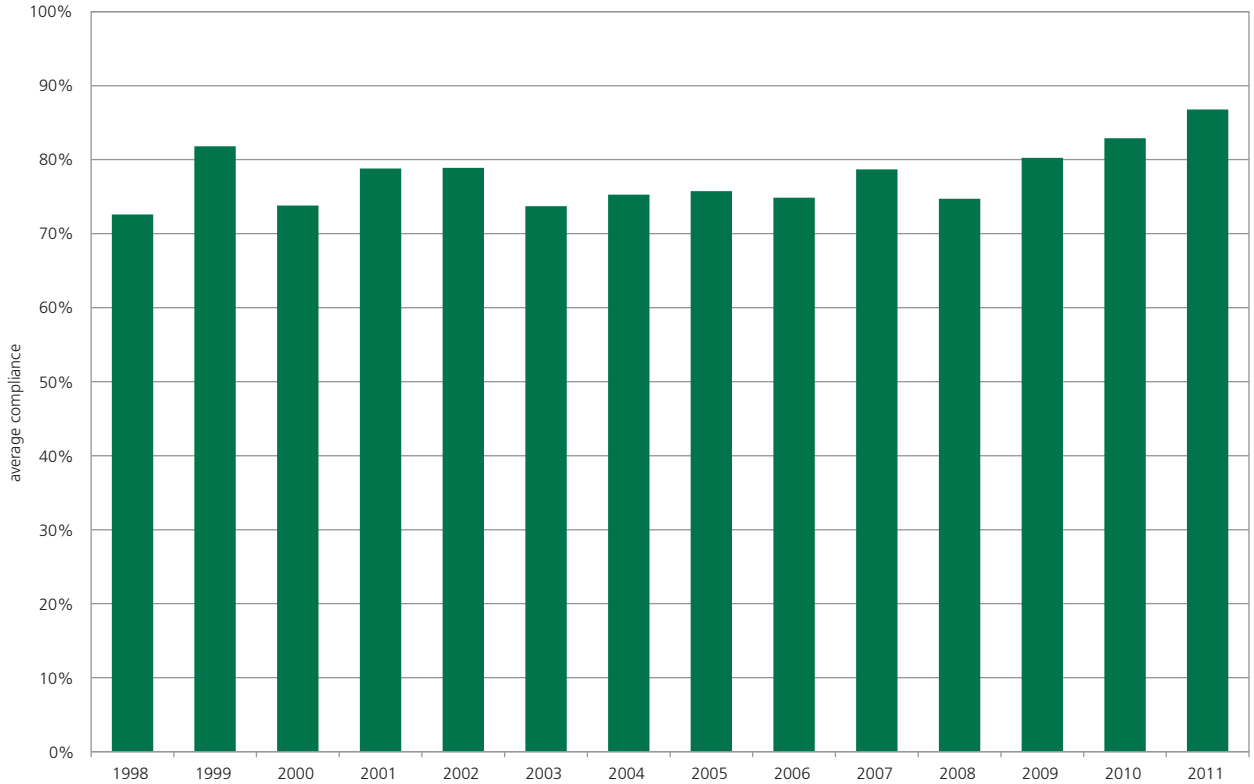
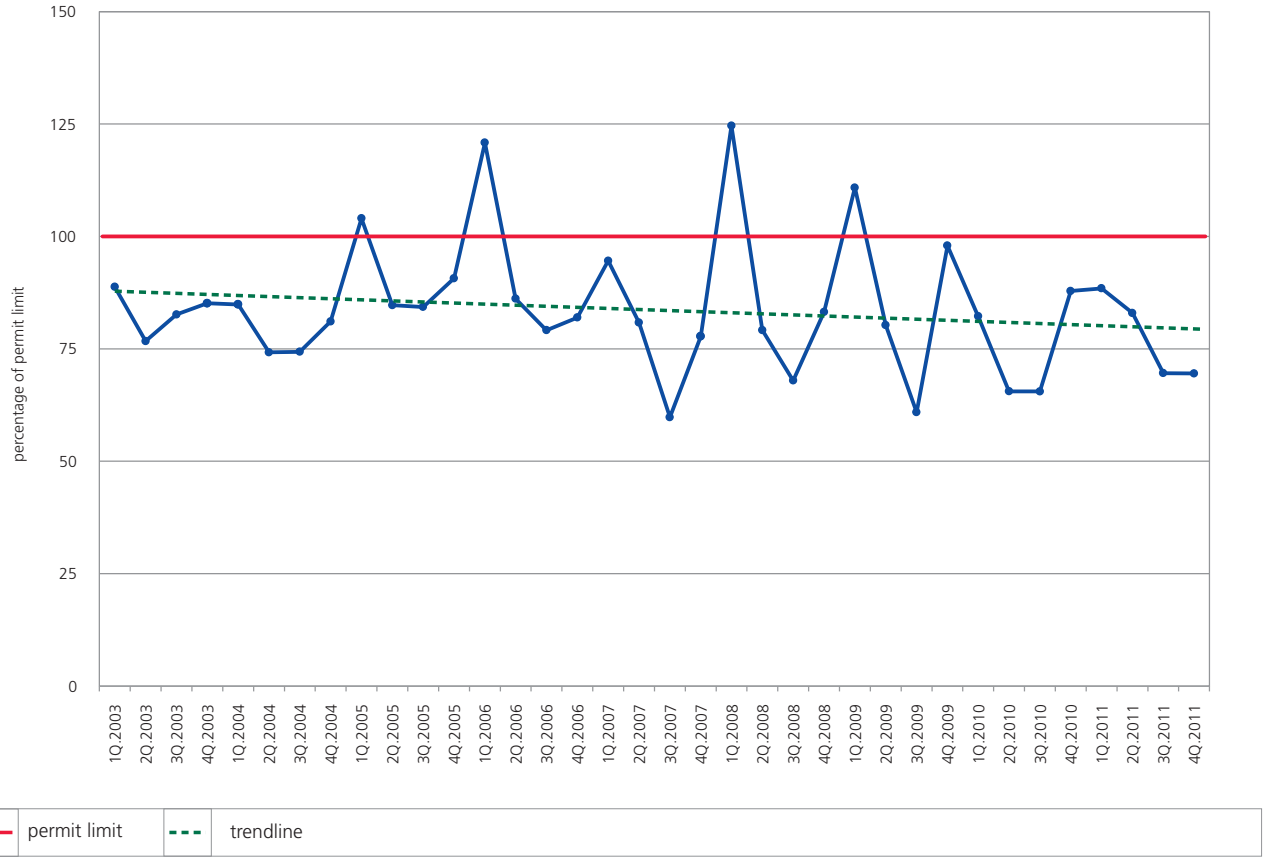


Figure 15: COD – mass basis (2003 – 2011)



Out of the 21 WWTWs, 11 achieved over 95% compliance, the same number as in the previous reporting period (2009). However, there has been considerable improvement since 2009: where seven of the sites were previously deemed to have unacceptable COD levels, this has dropped to two sites for 2011. The Cape Flats, Millers Point and Scottsdene WWTWs have made notable improvements. The Bellville and Simon's Town sites are the most problematic, having both dropped to almost half their 2009 level of compliance. Overall, while some sites have experienced declines, the average compliance rate of WWTWs across the city has improved significantly since 2009. In 2009 the average for all works was 82%, which increased to 86.8% for 2011. A slight decline has been noted in some years, but overall a significant positive improvement since 1998 can be seen. In terms of mass loadings, there has also been an improvement since 2009, with levels in 2010 and 2011 below the permit limit.

Settling ponds at Scottsdene (left) and Potsdam WWTWs

E. coli

Figure 16: Compliance with *E. coli* standard (1998 – 2011)

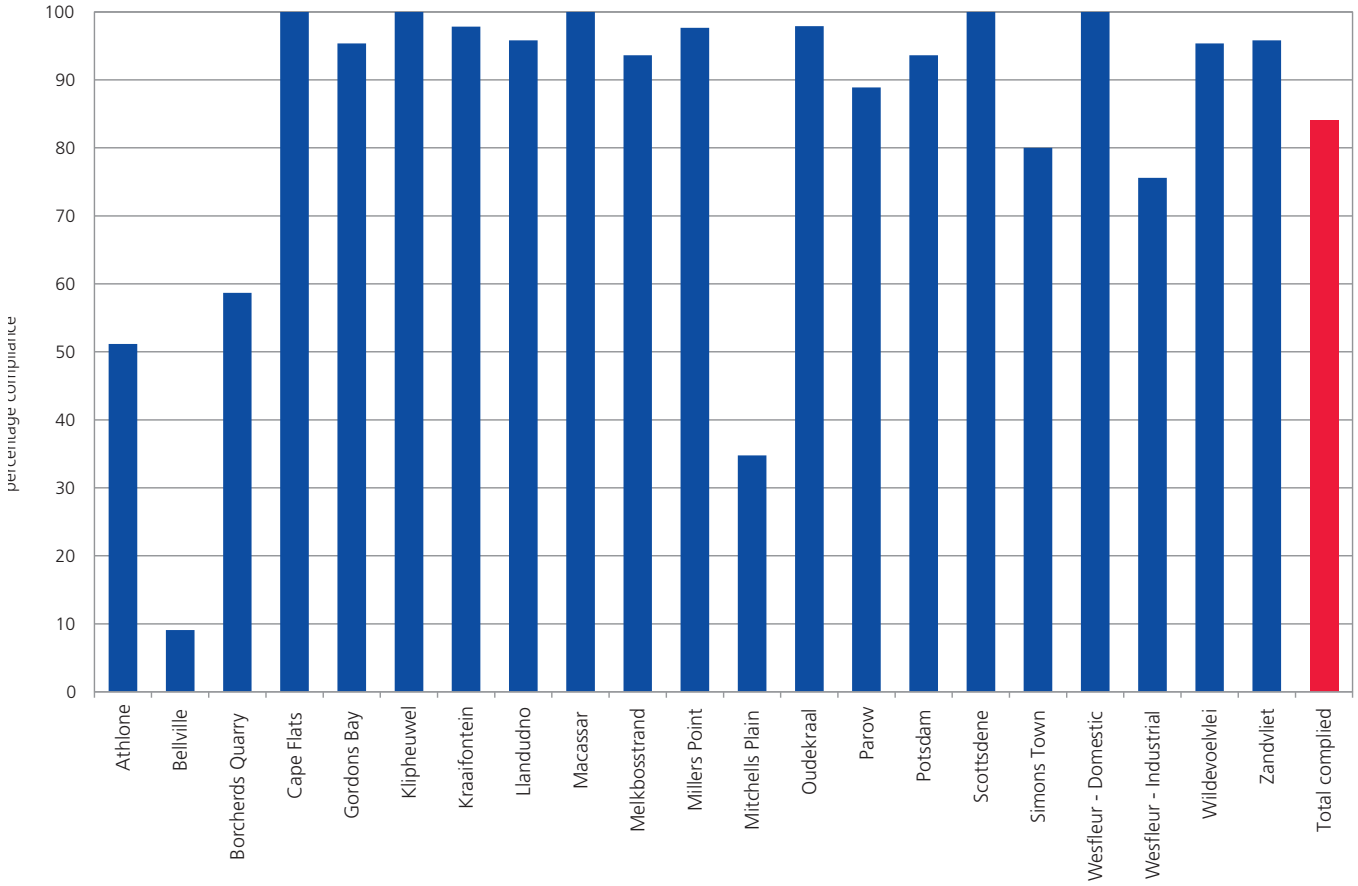


Figure 17: Average compliance with *E. coli* standard (1998 – 2011)

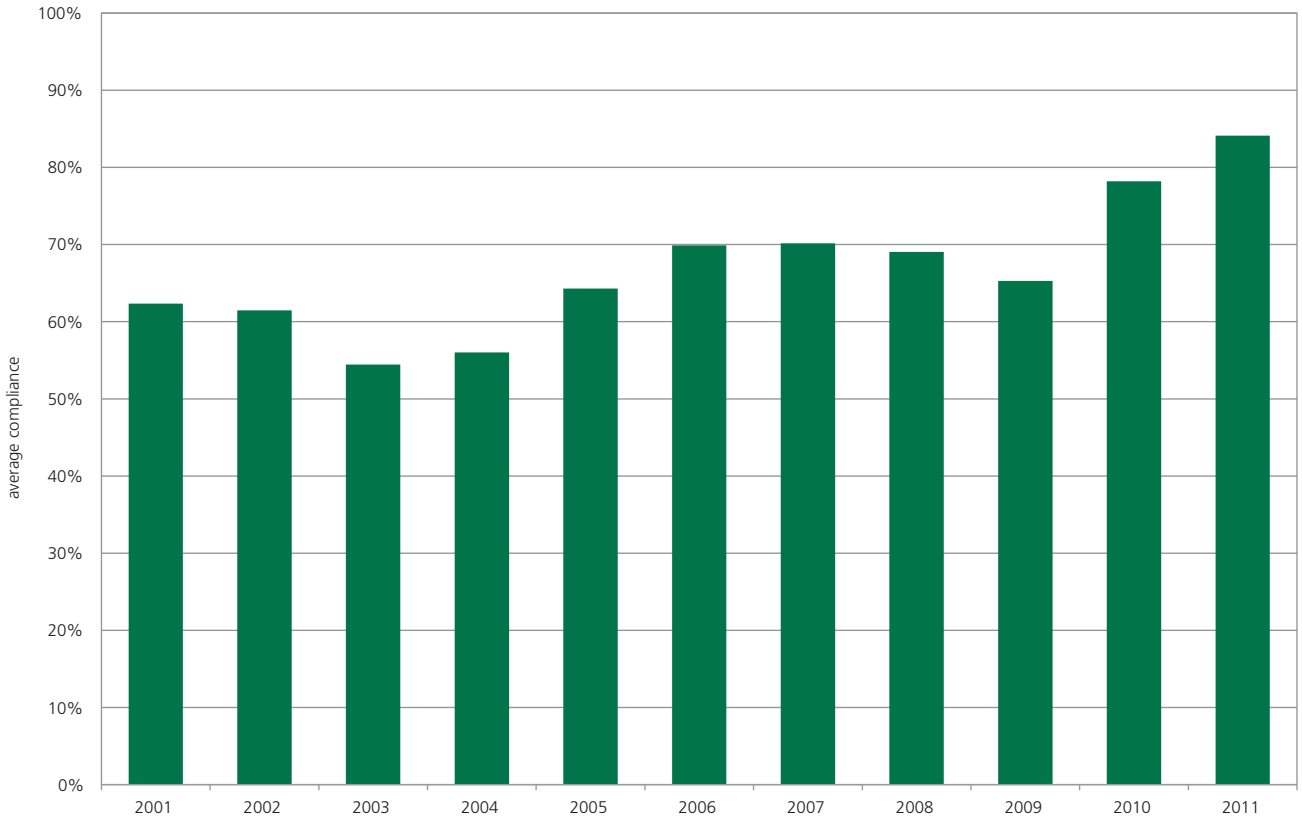
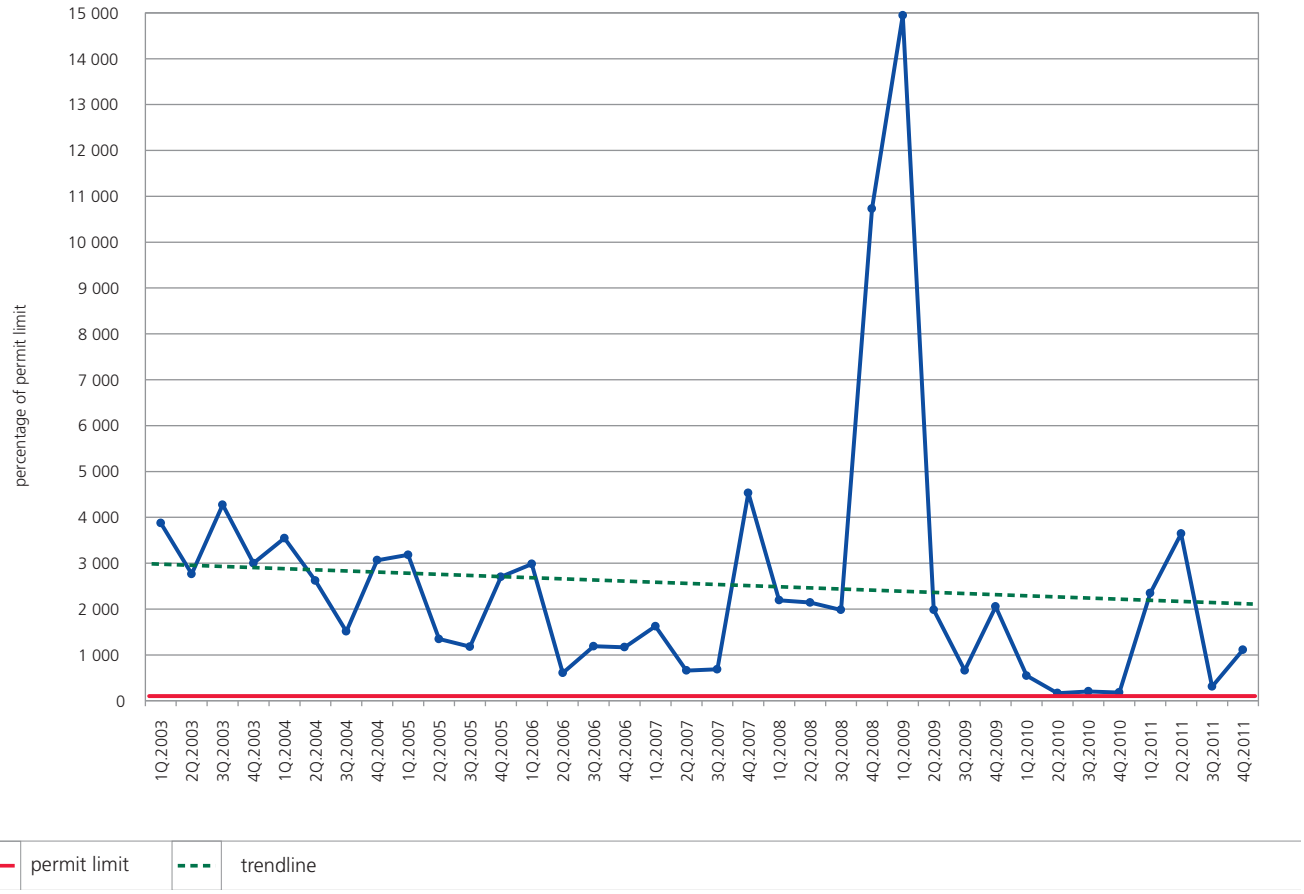


Figure 18: *E. coli* – mass basis (2003 – 2011)



Out of the 21 sites, 12 achieved over 95% compliance. This is a significant improvement since 2009, when only 2 sites achieved this standard. In 2009, both Athlone and Bellville sites experienced levels of compliance below 10%, indicating a serious problem at these treatment works. During 2009 the disinfection units at these works were updated and this has led to notable improvements in compliance levels, especially at Athlone, which saw its compliance level increase to 51.2 % in 2011. Despite this, the Bellville site is still an area of much concern. The overall compliance rate has increased by almost 20% since 2009, from 65% to 84.1%. On the whole, since 2001, compliance rates have increased annually – except for 2009, when there was a significant drop. In terms of the actual number of *E. coli* bacteria discharged, there have been significant exceedances of the permit limit, in many cases by several thousand percent. The extremely high levels noted in 2008 and 2009 were due to an incident of metal poisoning at the Bellville WWTW, which disrupted the plant's ability to treat wastewater effectively. Again, it is encouraging to note that the numbers of *E. coli* discharged in recent years appear to be dropping.

Maintenance of the secondary treatment facility at Athlone WWTW

Suspended Solids

Figure 19: Compliance with suspended solids standard (1998 – 2011)

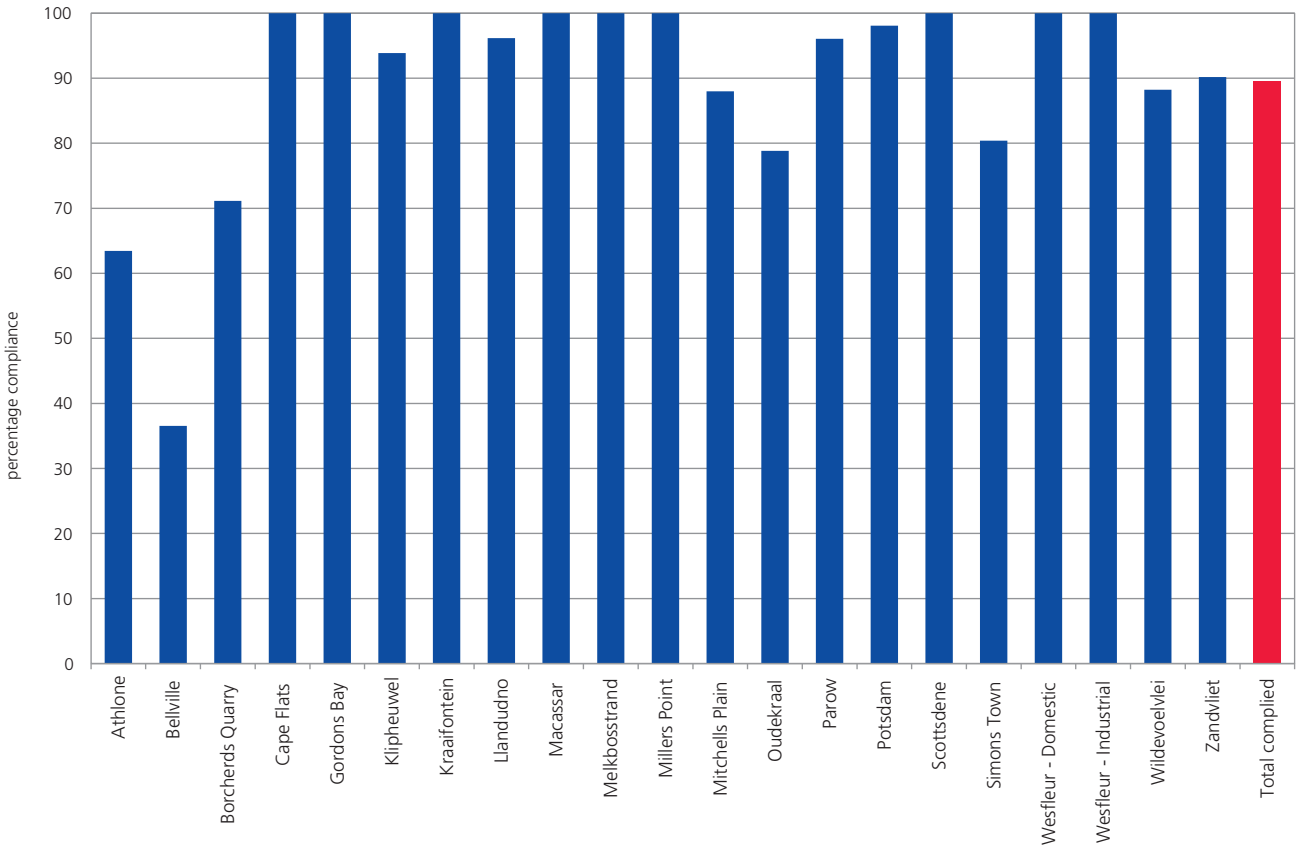


Figure 20: Average compliance with suspended solids standard (1998 – 2011)

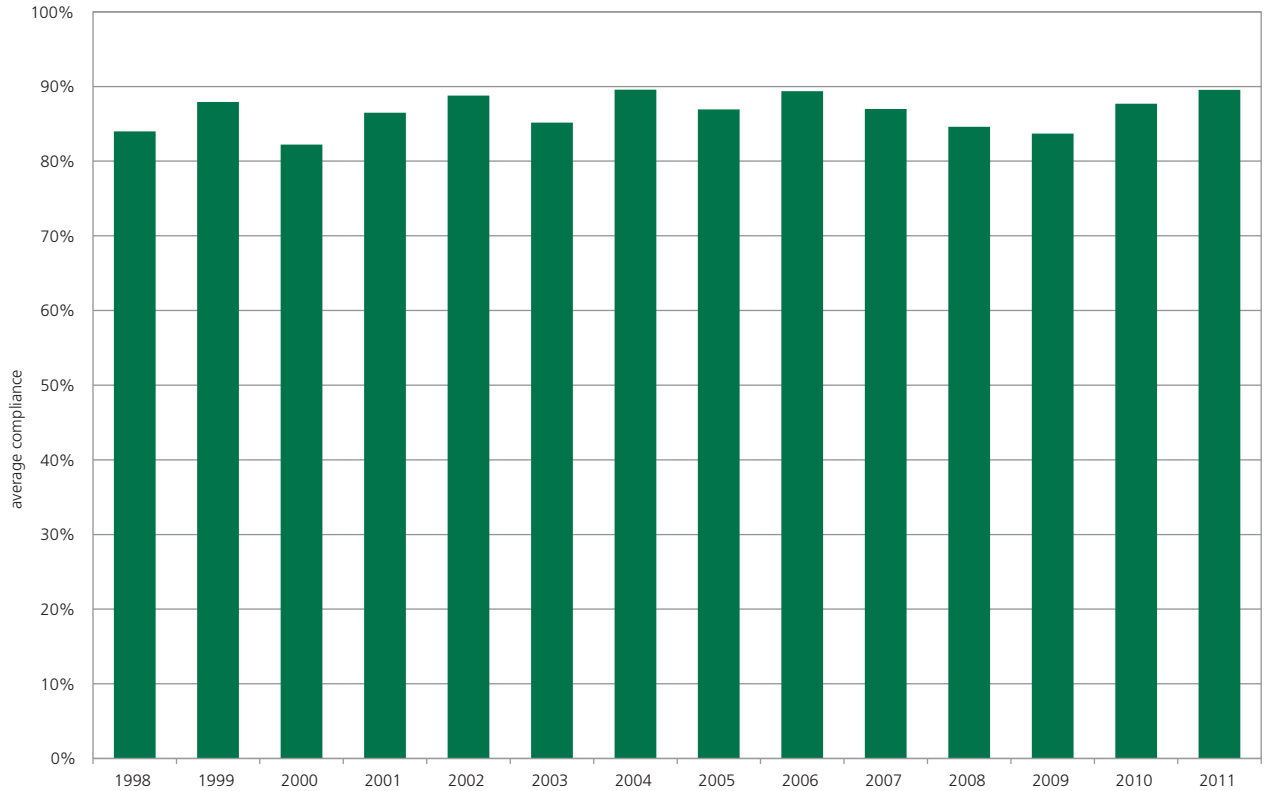
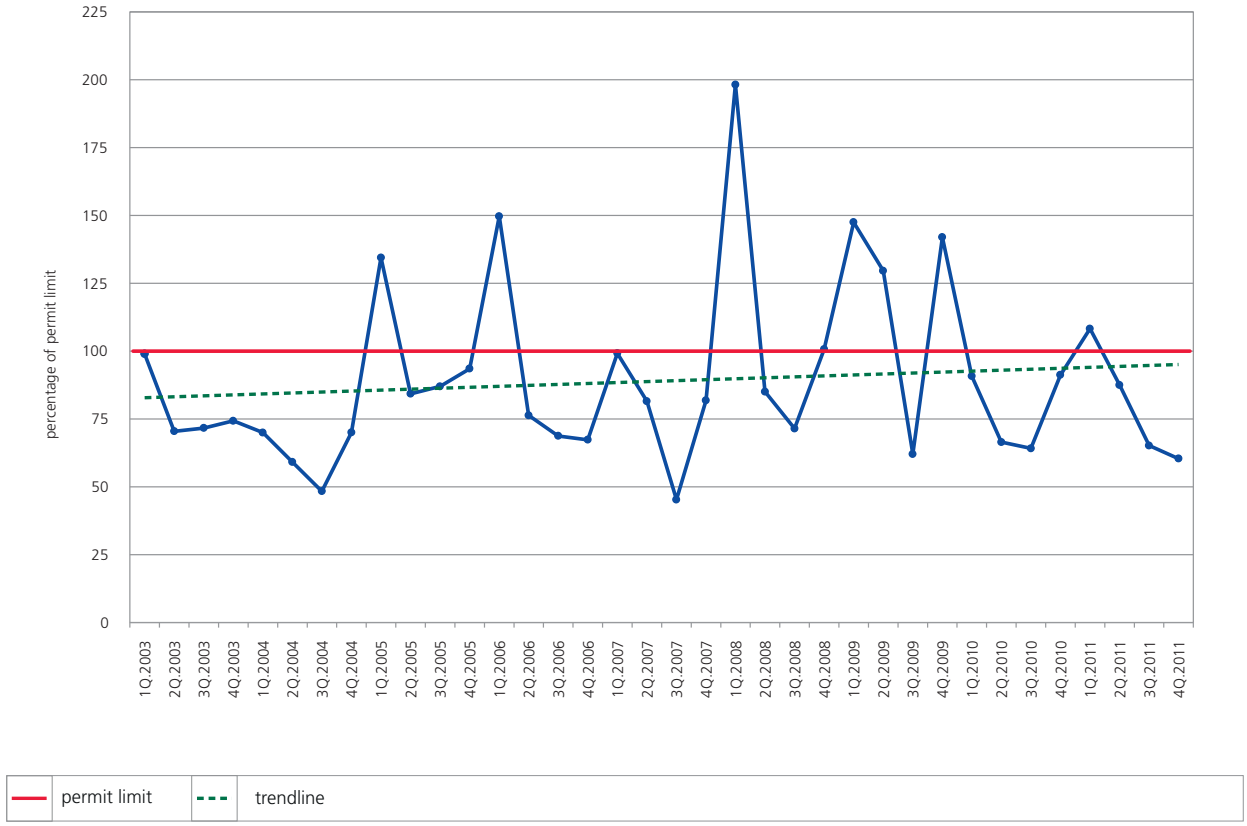


Figure 21: Suspended solids – mass basis (2003 – 2011)



Out of the 21 WWTWs, 12 sites achieved 95% compliance or more. This is slightly better than in 2009, when 9 sites achieved compliance. In 2009, 6 sites were deemed unacceptable; this has halved with only 3 sites being deemed unacceptable in 2011. Notably, no sites have decreased their levels of compliance in terms of suspended solids since 2009, so while levels of compliance still need to be significantly improved, they are not worsening, on the whole. The average compliance rate for 2011 has improved since 2009, from 84% to 89.5%. In terms of mass loadings, the permit limit has been exceeded a number of times since 2004, with a level of up to 200% of the permit limit being recorded in 2008. However – and encouragingly – the level dropped in 2011. It is too soon to determine whether this will be a sustained improvement, as the trend appears to indicate that mass levels have been generally increasing over time.

Kraaifontein (left) and Borcherds Quarry WWTWs

Orthophosphate

Figure 22: Compliance with proposed orthophosphate standard (1998 – 2011)

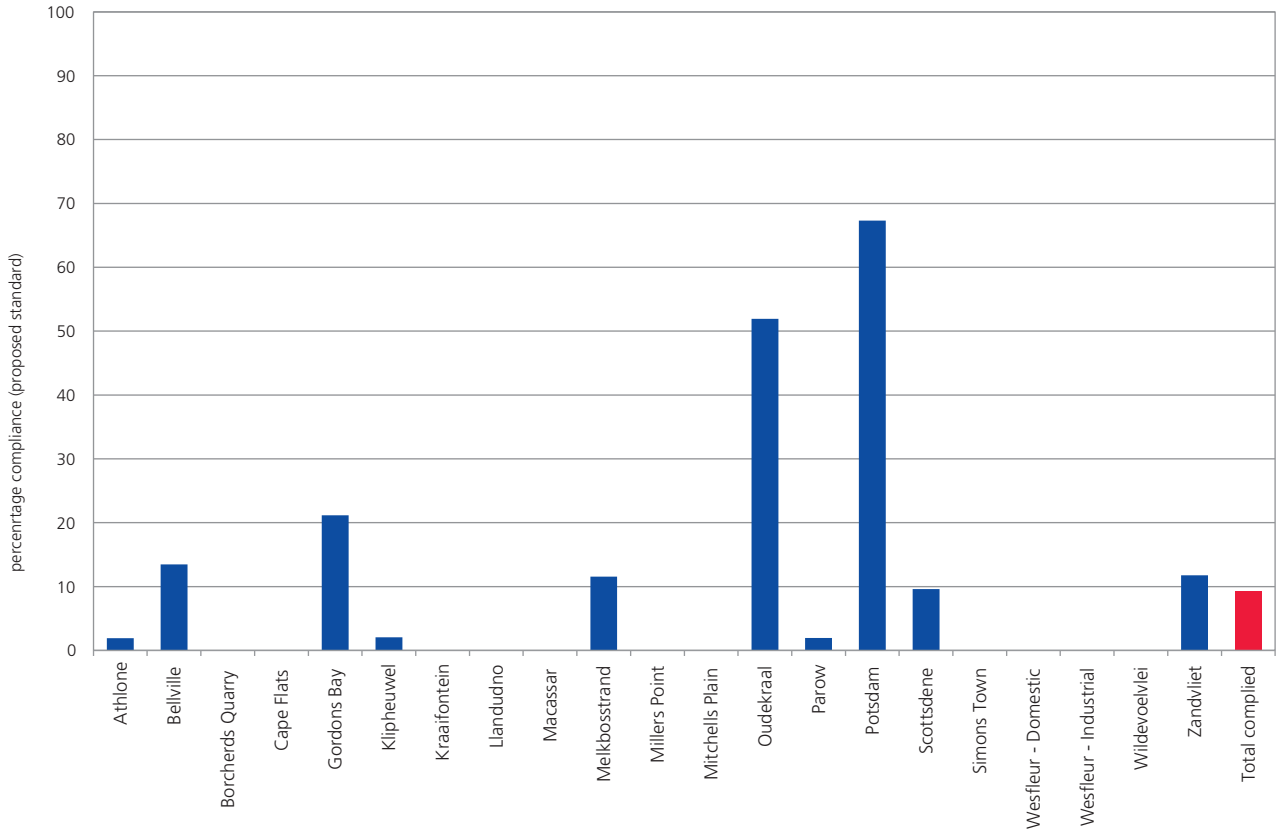


Figure 23: Average compliance with proposed orthophosphate standard (1998 – 2011)

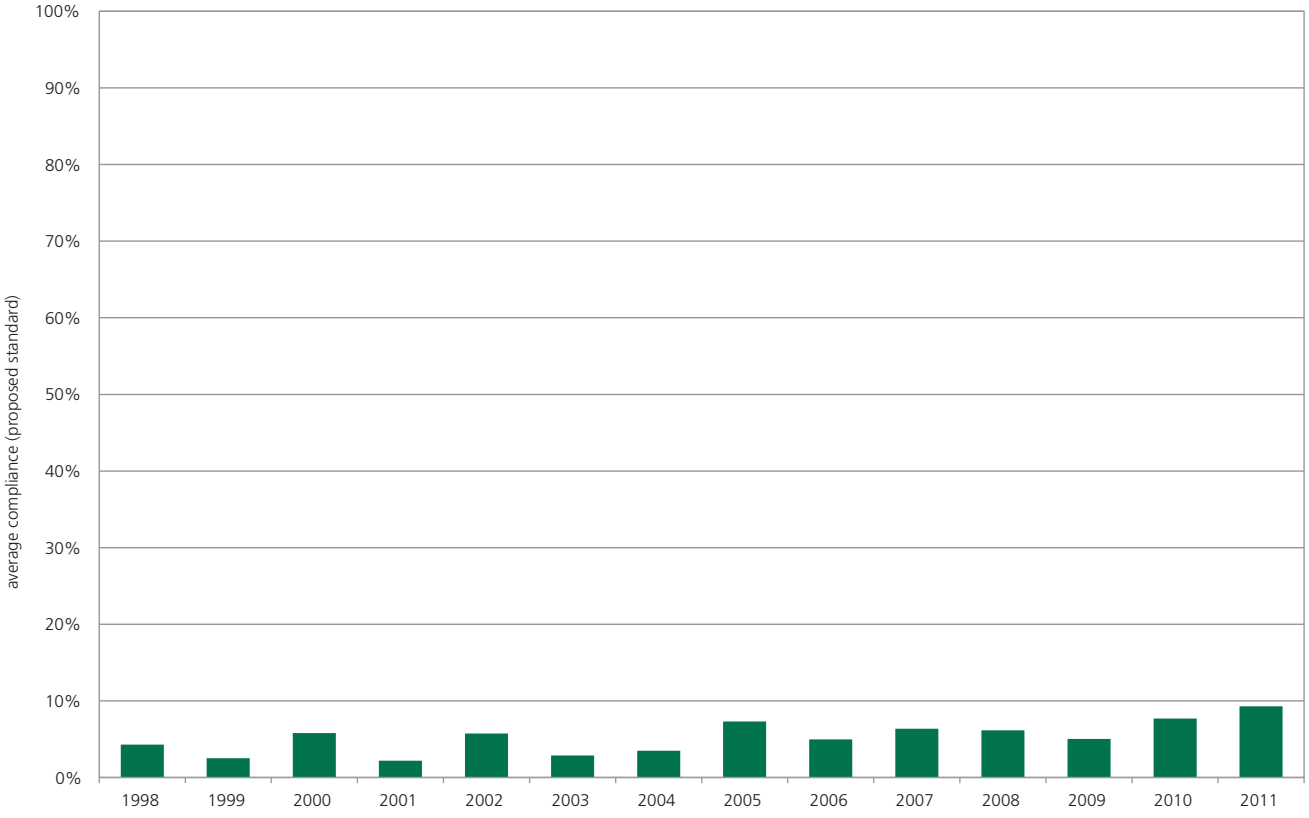
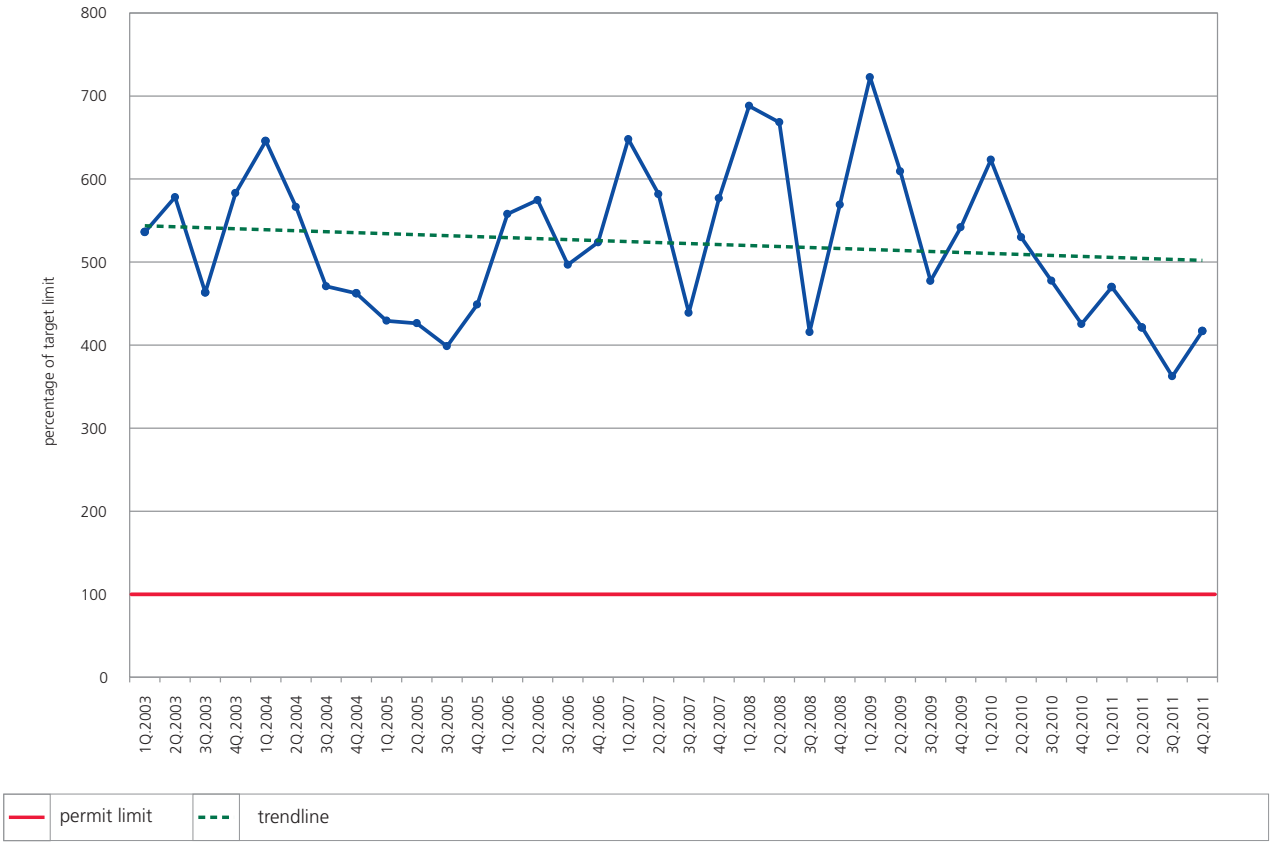


Figure 24: Orthophosphate – mass basis (2003 – 2011)



Out of the 21 WWTWs, no site achieved an acceptable level of compliance with the proposed orthophosphate standard. On average, the compliance rate was 5%. It is clear that significant upgrading and investment will be required in order to approach acceptable levels. This will involve significant capital and operating cost, as chemical treatment will be required to reach the proposed 1mg/l limit. In terms of mass loading, the target limit has been exceeded regularly, in most cases by between 400% and 600% of the target limit. However, since early 2010 this has shown a slight reduction, although it is too soon to determine if this is a long-term positive trend.

Orthophosphate pollution contributes to eutrophication and excessive plant growth in receiving waters

Analysis and discussion

In the past decade, urban growth has placed an enormous burden on the City of Cape Town's wastewater treatment system. The provision of formal sanitation systems to growing informal areas has also increased the need for new facilities. Unfortunately, the reality in Cape Town (and many other cities in the developing and developed world) is that many WWTWs operate beyond capacity, or use outdated technology, and thus do not have the ability to meet the required standards effectively. In comparison to other cities in the country, Cape Town has performed well in terms of wastewater treatment, yet there is still much to be done to improve this[36]. This will require the constant improvement of access to sanitation facilities in informal settlement areas, the expansion and upgrading of existent treatment facilities, and an integrated approach to the management of wastewater that recognises its value and interconnectedness with other aspects of the urban system.

While it remains a challenge to secure sufficient funding, it should also be noted that significant improvements in wastewater treatment capacity have indeed taken place. Given the challenges experienced in achieving the required standards of compliance of treated-effluent discharge in a number of treatment works such as Athlone, Bellville and Kraaifontein, the City has begun a 10-year wastewater upgrade, expansion and rehabilitation plan[37]. Budgets have been expanded significantly for this[38]. The upgrade of the Bellville treatment works has been budgeted for 2012/3[39]. The improvement of wastewater treatment systems is a key focus area within the City's Integrated Development Plan (IDP). A review of the City's wastewater treatment plants undertaken for the 2012 to 2017 IDP concluded that rehabilitation and upgrading of many of the current WWTWs is vital[40]. It is also important that effluent quality is continually monitored in order to ensure that action can be taken towards compliance, as well as to ensure that the public receives adequate information about this issue.

The City is aiming for a higher standard for its wastewater effluent than is currently legislated. The current ammonia limit, for example, is 10mg/l, but new treatment works and extensions are designed to attain a level of 3mg/l. One significant shortcoming of the current system is that none of the City's WWTWs are equipped to remove phosphorus from effluent. The City recognises that this is an important area needing improvement. For phosphate content, for which a standard is not currently specified, a value of 1mg/l is envisaged. These improved target values will play an important role in minimising the impact of wastewater discharges in Cape Town on the natural environment, which is highly sensitive to increased levels of phosphates. Furthermore, in order to prepare for the possibility of a future orthophosphate standard, and to improve the quality of receiving waters, the City is implementing a programme of chemical phosphate removal, wherein phosphates are removed from the final effluent before it is discharged into the environment. Initially this programme will focus on the WWTWs at Wildevoelvlei and in Scottsdene, as these areas have been prioritised due to their ecological importance.

The City is also actively promoting the use of treated effluent, both to reduce the impact on the environment even further, and to save valuable potable water where possible. Considerable opportunities exist for reducing the pressure on existing wastewater treatment systems through the use of alternative and sustainable technologies; these are being explored in a bio-solids beneficiation study currently under way. The City will continue exploring alternative technologies in order to determine the most suitable applications, which may then be implemented where appropriate.

Target and trend

Trend: Results are mixed. In general, levels of compliance have remained stable over time, but still require significant improvement. Compliance with the *E. coli* standard has improved in 2010 and 2011.

Target: Environmental Agenda 2014 Target: No specific target set. The City aims to achieve 95% or greater compliance with standards, and to have no WWTWs with less than 75% compliance.

Current: Between a third and a half of the WWTWs are achieving acceptable levels of compliance.

Policy linkages

IDP: Strategic Focus Area 1 - The Opportunity City

Environmental Agenda 2009-2014: Target 7 - River Health.

MDG Goal 7: Target 9 – Integrate the principles of sustainable development with country policies and programmes, and reverse the loss of environmental resources.

Urban Environmental Accords: Action 21 – municipal wastewater management guidelines; and reduce the volume of untreated wastewater discharges by 10% in seven years, through the expanded use of recycled water, and the implementation of a sustainable urban watershed planning process, which includes participants of all affected communities, and is based on sound economic, social and environmental principles.

See Also

Water use: pg 31
Fresh Water Quality: pg 36
Coastal Water Quality: pg 43

8 AIR QUALITY

Indicators

Annual average levels for key atmospheric pollutants: SO_2, NO_2 and PM_{10}

Number of instances when South African Ambient Air Quality Standards for SO_2, NO_2 and PM_{10} are exceeded

Clean air is a basic requirement for human and environmental well-being, yet air pollution poses a significant threat worldwide[41]. Air pollution can be defined as the introduction of chemicals and other substances into the air that have a harmful effect on the environment and living creatures, including human beings. Air pollution can be made up of a number of different pollutants, and measuring these is a technical and expensive activity. Given this, key pollutants termed 'criteria pollutants' are often chosen as indicators of general air pollution. Criteria pollutants are related to certain activities (e.g. fuel emissions, wood burning) that produce other pollutants, and therefore the presence of one is an excellent indicator of the presence of the other. The South African National Environmental Management: Air Quality Act, Act 39 of 2004, stipulates that three main criteria pollutants need to be measured and reported on. These include: particulate matter smaller than ten microns in size (PM_{10}), sulphur dioxide (SO_2) and nitrogen dioxide (NO_2).

Sources of pollution and effects on human health and the natural environment

Particulate Matter (PM_{10}) is a mixture of suspended microscopic solid particles and liquid droplets, which could consist of a number of inorganic or organic materials such as ammonia, sodium chloride, water, sulphates, mineral dust, soil, dust or pollen. PM_{10} can be the product of a variety of activities. In Cape Town, the most common sources of PM_{10} pollution are diesel vehicle emissions; wood and fuel burning; and dust from construction activities, and unpaved roads and verges.

PM_{10} particles are microscopic in size (one tenth of the diameter of a human hair), enabling them to be inhaled easily. PM_{10} can cause lung irritation, and aggravate existing lung disorders and diseases, such as asthma and tuberculosis (TB)[42]. It is also linked to cardiovascular problems.

Sulphur Dioxide (SO_2) is a colourless gas that is produced by burning fossil fuels and industrial processing, such as the smelting of sulphur-containing mineral ores. In Cape Town, the most common source of SO_2 is likely to be from vehicle emissions and industrial activities.

SO_2 affects the functioning of the respiratory system, and can also cause irritation of the eyes. It can cause lung irritations, wheezing, and inflammation that can exacerbate existing lung disorders and diseases such as asthma and bronchitis. It can also make people more prone to such infections, and has been linked to increased levels of cardiovascular problems. High levels of SO_2 in the atmosphere can also lead to the formation of acid rain, which affects the pH of soils and water systems and thus the functioning of ecosystems.

Nitrogen Dioxide (NO_2) is a brownish-coloured gas, also produced by burning fossil fuel. In Cape Town, the main source of NO_2 is motor vehicle emissions, as industrial and domestic fossil-fuel burning is limited.

Like SO_2, NO_2 can affect the lungs, especially in children, and affect cardiovascular systems when inhaled in high concentrations over a short period of time, or when inhaled at low concentration over a long period of time. NO_2 can also pose a threat to the natural environment, as it can contribute to the formation of acid rain.

Standards and guidelines

Air quality guidelines specify both short-term and long-term standards. This distinction is important, as both short-term acute exposure to high levels of pollutants and long-term chronic exposure to lower levels of pollutants are potentially harmful to human health. Air pollutant concentrations are measured against an acceptable average annual level, as well as against an acceptable daily or hourly level of the pollutant. Each pollutant is also assigned a 'frequency of exceedance value', which denotes the maximum number of times the level may be exceeded at each measuring site, both daily and annually. This report focuses on daily exceedances and annual average measurements.

Before 2009 the City of Cape Town measured air quality according to the United Kingdom air quality standards, as set by their Department of Environment, Food and Rural Affairs (DEFRA)[43]. In 2009, the South African Department of Environmental Affairs released the National Ambient Air Quality Standards, which contain guidelines on acceptable levels of pollutants[44]. The new South African standards are very similar to the UK standards, with only the PM_{10} standard being significantly different.

Municipalities are required to meet national standards. In some cases, interim standards have been set that are slightly relaxed in order to allow sufficient time for municipalities to improve air pollution control, to meet the more stringent standards in the future. The deadline for achieving these improved standards has been set for December 2014[45].

The City of Cape Town now uses the newer South African National Standards for SO_2 and NO_2; these are outlined in the City of Cape Town Environmental Agenda 2009-2014. The City also continues to monitor and report against both the UK and the South African National Standards for PM_{10}, as this provides a useful basis for both international comparison and comparison with levels of previous years. The World Health Organisation (WHO) guideline for PM_{10} is also presented in this report for comparison purposes[46] . The WHO guideline is based on the level of pollution at which it has been determined that the health effects of PM_{10} become negligible or immeasurable. This WHO PM_{10} guideline is not seen as a mandatory standard, but is regarded as something to strive towards. It is difficult to set a definitive guideline for PM_{10}, as different places have different conditions and individuals react differently to particulate substances in the air. Given this, the process of standard-setting needs to be contextual, and take into account situational factors and public health priorities, as well as capabilities and constraints.

South African ambient air quality standards

(Note: data is presented in micrograms per cubic metre – µg/m³)

Nitrogen Dioxide

Annual average: no more than 40µg/m³

Sulphur Dioxide

Annual average: no more than 50µg/m³

PM_{10} Interim standard (2009–2014)

Annual average: no more than 50µg/m³

Daily average: no more than 120µg/m³

Annual limit of exceedances of daily average: 4 per site

PM_{10} standard as of January 2015

Annual average: no more than 40µg/m³

Daily average: no more than 75µg/m³

Annual limit of exceedances of daily average: 4 per site

UK standards and WHO guideline

Particulate Matter

Annual average PM_{10} level (WHO guideline) no more than 20µg/m3

Daily average: no more than 75µg/m³

Annual limit of exceedances of daily value (UK standard): 35 per site

State of the environment

Figures 25 to 29 show the measurements taken in Cape Town between 2005 and 2011. It is difficult to determine general trends for the city, as air pollution is often seasonal and localised. However, with a few exceptions, air pollution has decreased or remained unchanged between 2005 and 2011, and has generally remained at acceptable levels. Spikes in air pollution concentrations in a particular year can generally be attributed to specific events, such as a large fire or significant construction activity near the monitoring station, or to the influence of local weather conditions.

Since the previous reporting period in 2009, NO_2 pollution across the city has generally decreased, with normal annual fluctuations. Importantly, no sites exceeded the standard for annual average NO_2 levels. The Cape Town CBD area continues to experience the highest levels of NO_2 pollution, primarily due to high concentrations of vehicle traffic in the City Bowl, where pollutants become trapped and re-circulated. Most other areas are experiencing NO_2 levels well below half the allowable limit.

SO_2 pollution has generally decreased or remained at a similar level since 2009, with only Bothasig experiencing a slight increase. Industrial areas and areas with high concentrations of vehicle traffic experience higher levels of SO_2 pollution. It is possible that had data been available for the CBD area, the levels may have increased slightly; however, data was not available from 2009 onwards. Yet despite any small increases in SO_2 levels, all sites were well within the required standards. The introduction of low-sulphur diesel fuel has played an important role in reducing levels of SO_2 across the city over the past few years.

A decrease in PM_{10} levels has been noted since 2009 in all sites except Khayelitsha. All monitoring points achieved the interim annual average standard for PM_{10} pollution in 2011. While Khayelitsha currently achieves the current South African interim standard, PM_{10} concentrations are significantly higher in this area than at other monitoring sites; this will need to be improved by some margin in order to meet the 2015 standards, which are considerably more strict. All sites exceeded the WHO guideline recommendation for PM_{10} levels. This shows that there is significant room for improvement.

In terms of the number of exceedances of the daily PM_{10} standard, the city performed slightly better than in previous years. Only Khayelitsha – with 5 exceedances – failed to comply with the limit of no more than four exceedances of the 120µg/m³ daily standard. This is down from a high of 10 exceedances in 2010. When measured against the 50µg/m³ UK daily standard, only Khayelitsha experienced more than the limit of 35 exceedances, a significant improvement compared to previous years.

Figure 25: Annual average Nitrogen Dioxide (NO_2) levels 2005 -2011

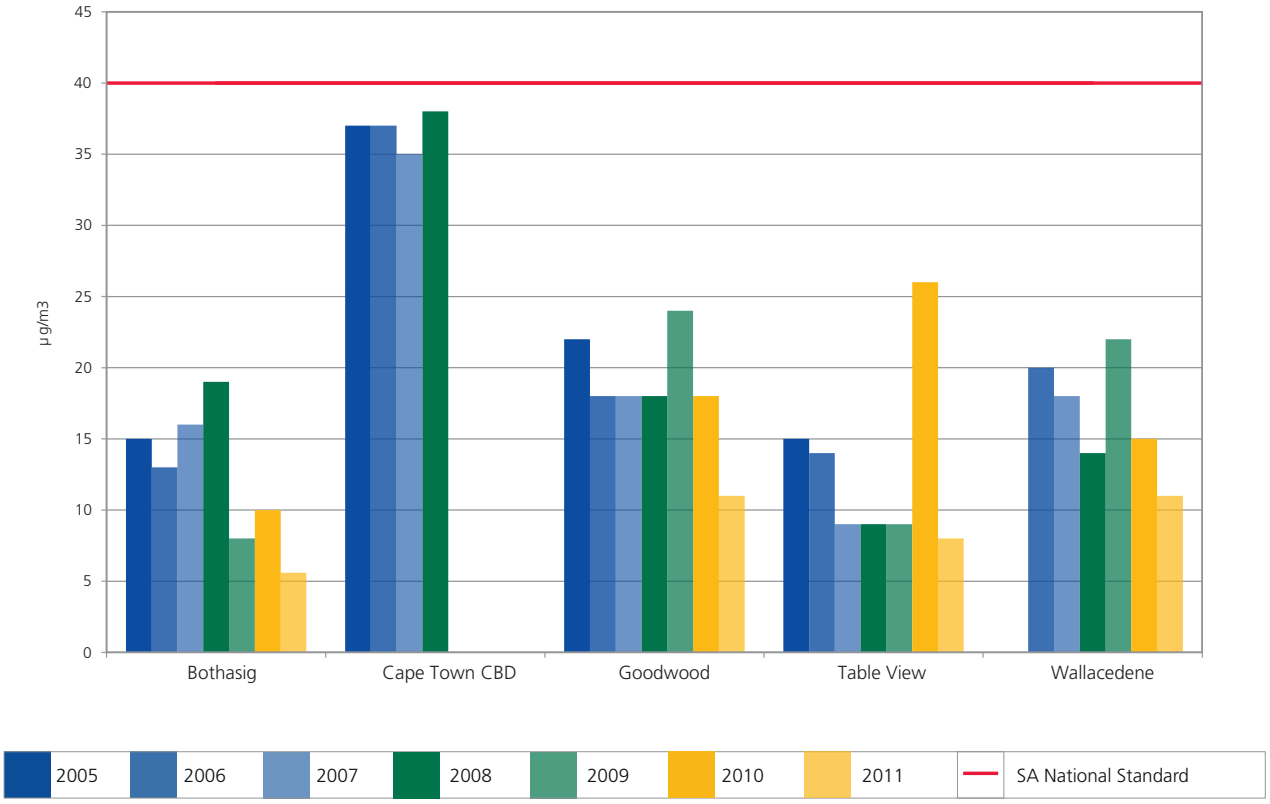


Figure 26: Annual average Sulphur Dioxide (SO_2) levels 2005 -2011

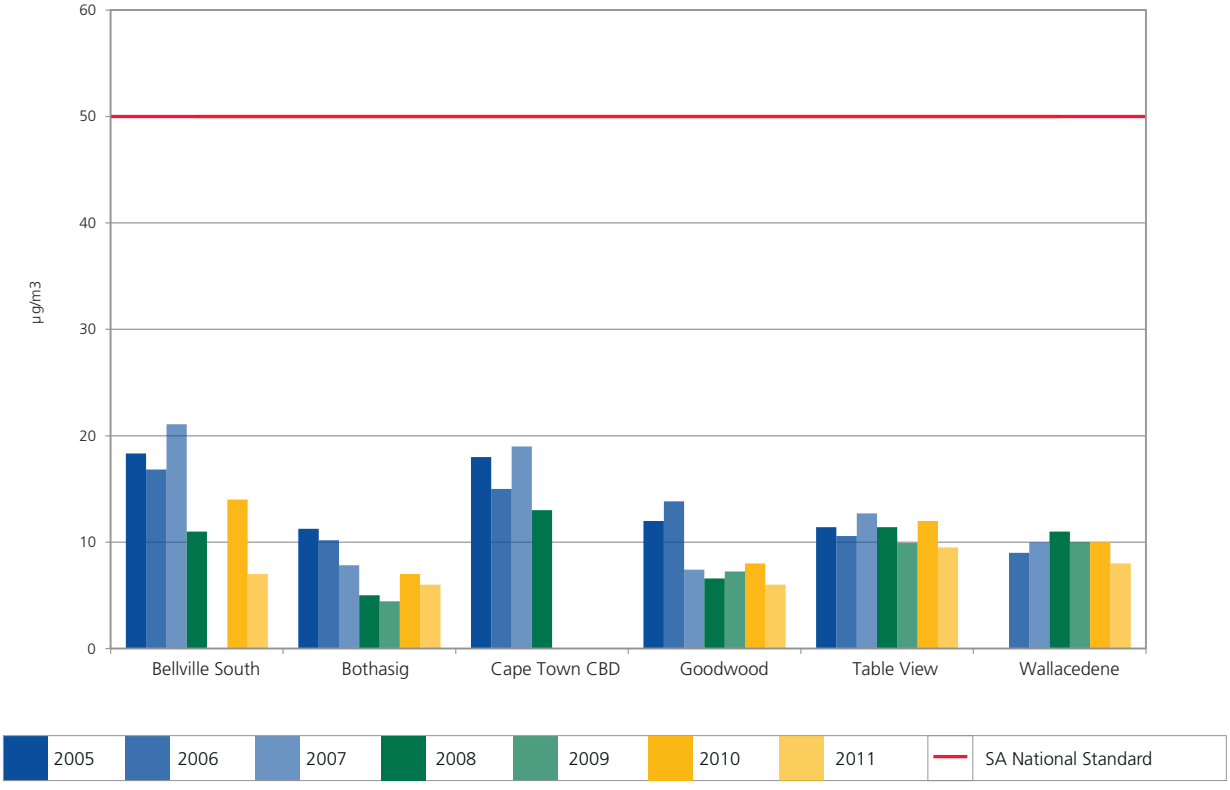


Figure 27: Annual average Particulate matter (PM_{10}) levels 2005 -2011

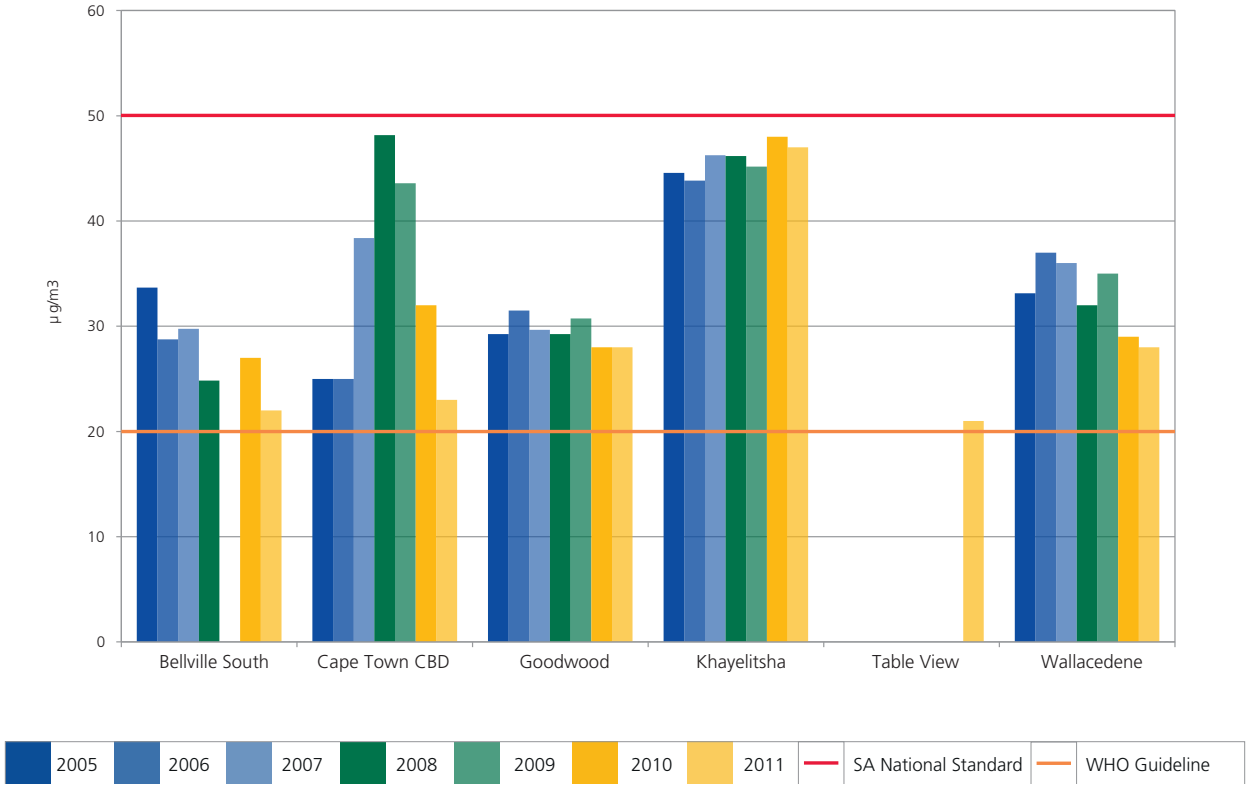


Figure 28: Number of exceedances of SA PM_{10} standard

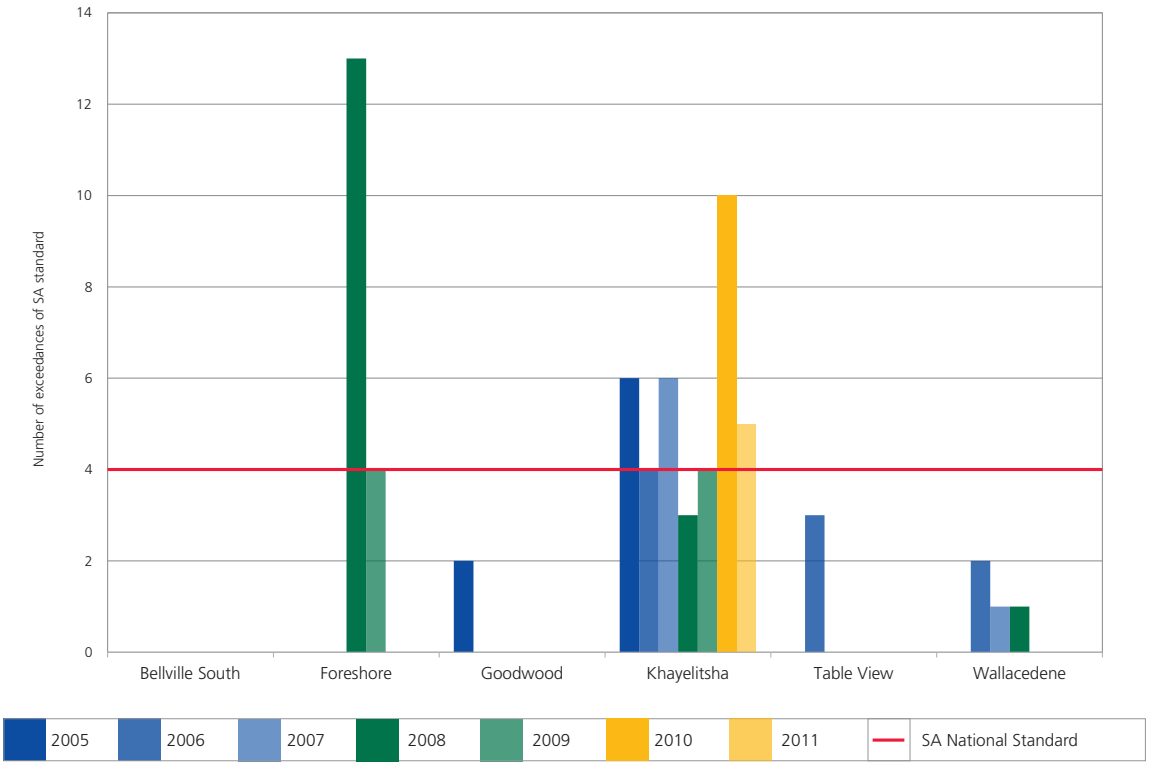
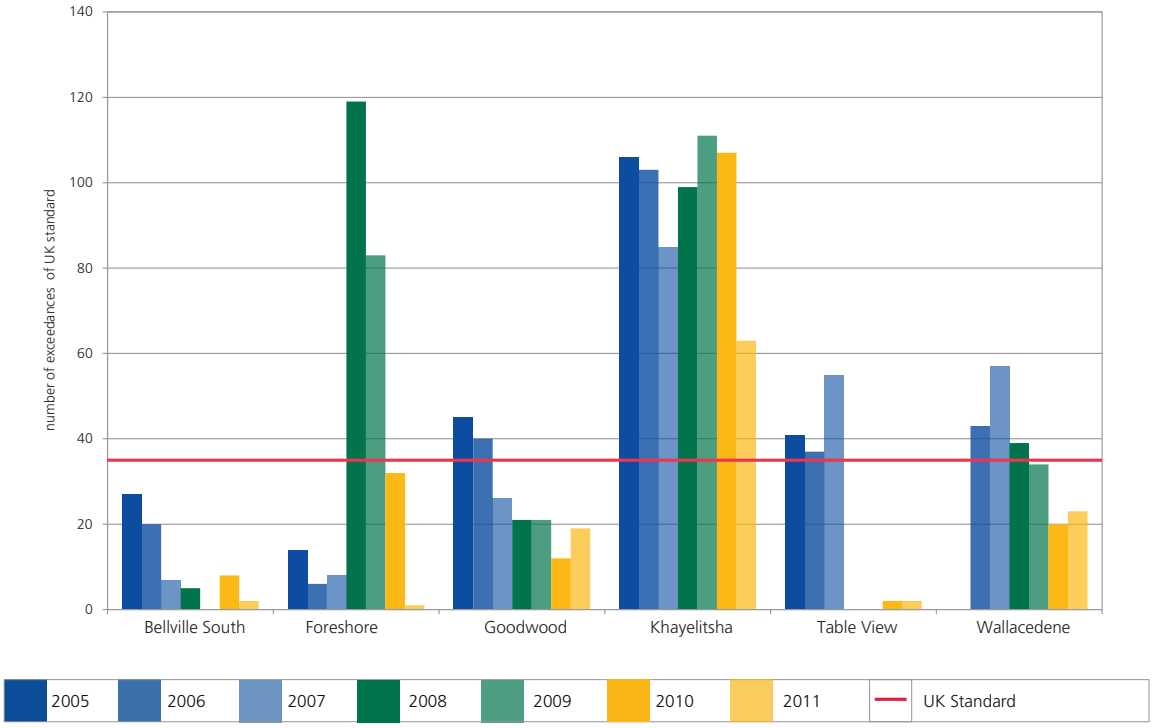


Fig 29: Number of exceedances of UK PM_{10} standard 2005-2011



Brown haze is a significant air quality challenge in Cape Town

Analysis and discussion

It is difficult to determine whether and for what reason pollution prevention efforts have been successful, as there have been both improvements and declines in air quality across the city, and natural fluctuations are expected to occur from year to year. In 2011, air quality across the city was generally improved, compared to the 2009 reporting period.

It is very encouraging to note that Cape Town continues to experience high levels of compliance with the South African Air Quality standards. However, meeting the PM10 standards continues to be a challenge, particularly in Khayelitsha. While it is important that all forms of air pollution remain under control, the City is especially concerned about the levels of particulate matter pollution, especially in the poorer suburbs of the city. The relatively high level of TB infection in poorer areas is a significant public health concern. Although PM_{10} does not cause TB, it can aggravate the condition in infected individuals.

PM_{10} pollution in Khayelitsha primarily consists of dust; this is exacerbated by the presence of unpaved roads, verges and unvegetated open spaces. Vehicle emissions and smoke from cooking and heating fires also contributes to PM_{10} pollution in Khayelitsha. Similar sources also affect other informal settlements in the city. The Khayelitsha Air Pollution Strategy (2007) was therefore established to address the specific challenges in this area. Over time, interventions that succeed in Khayelitsha can be extended and applied to other peri-urban areas which experience similar air quality conditions.

NO_2 levels are generally deemed acceptable and within recommended standards; however, the Cape Town CBD does experience much higher levels that the other monitoring sites. As NO_2 is closely linked to vehicle emissions, levels may increase as vehicle use increases. Increased NO_2 poses both a health and an environmental risk, which will continue to be monitored actively.

The improvement of public transport is one the key strategic objectives identified by the City of Cape Town in its Integrated Development Plan for achieving its long-term vision and developmental goals. Since 2007 the City has been working on the first phase of an Integrated Rapid Transit (IRT) system in Cape Town, aimed at significantly improving public transport in the City. The first phase of this IRT system is primarily focused on the construction of the MyCiTi bus system. Over time this bus system will be increasingly integrated with other transport modes – especially rail, the backbone of public transport in Cape Town[47]. Increased accessibility and use of public transport is likely to play an important role in reducing vehicle emissions within the inner city, as well as in other areas. The City is also encouraging the use of non-motorised transport through the development of safe cycle and pedestrian facilities.

Target and trend

Trend: In general, NO_2 levels have decreased in recent years. They are generally within the guidelines standard, apart from within the Cape Town CBD. SO_2 levels have remained fairly low and constant since 2005, and well within the required standard. However, PM_{10} levels are more problematic. Most sites have shown some improvement; except in Khayelitsha, where levels are high. PM_{10} levels at all sites exceed the WHO guideline, and air quality in Khayelitsha will need to be significantly improved to achieve the 2014 target.

Target: Environmental Agenda 2014 Target: Full compliance with SA Ambient Air Quality Standards.

Current: The City is close to meeting the Environmental Agenda 2014 target. Air quality in Khayelitsha remains a concern.

Policy Linkages

IDP: Strategic Focus Area 3 - The Caring City

MDG Goal 7: Target 9 – Integrate the principles of sustainable development with country policies and programmes, and reverse the loss of environmental resources.

Urban Environmental Accords: Action 18 – Establish an Air Quality Index (AQI) to measure the level of air pollution, and set the goal of reducing by 10% in seven years the number of days categorised in the AQI range as 'unhealthy' or 'hazardous'.

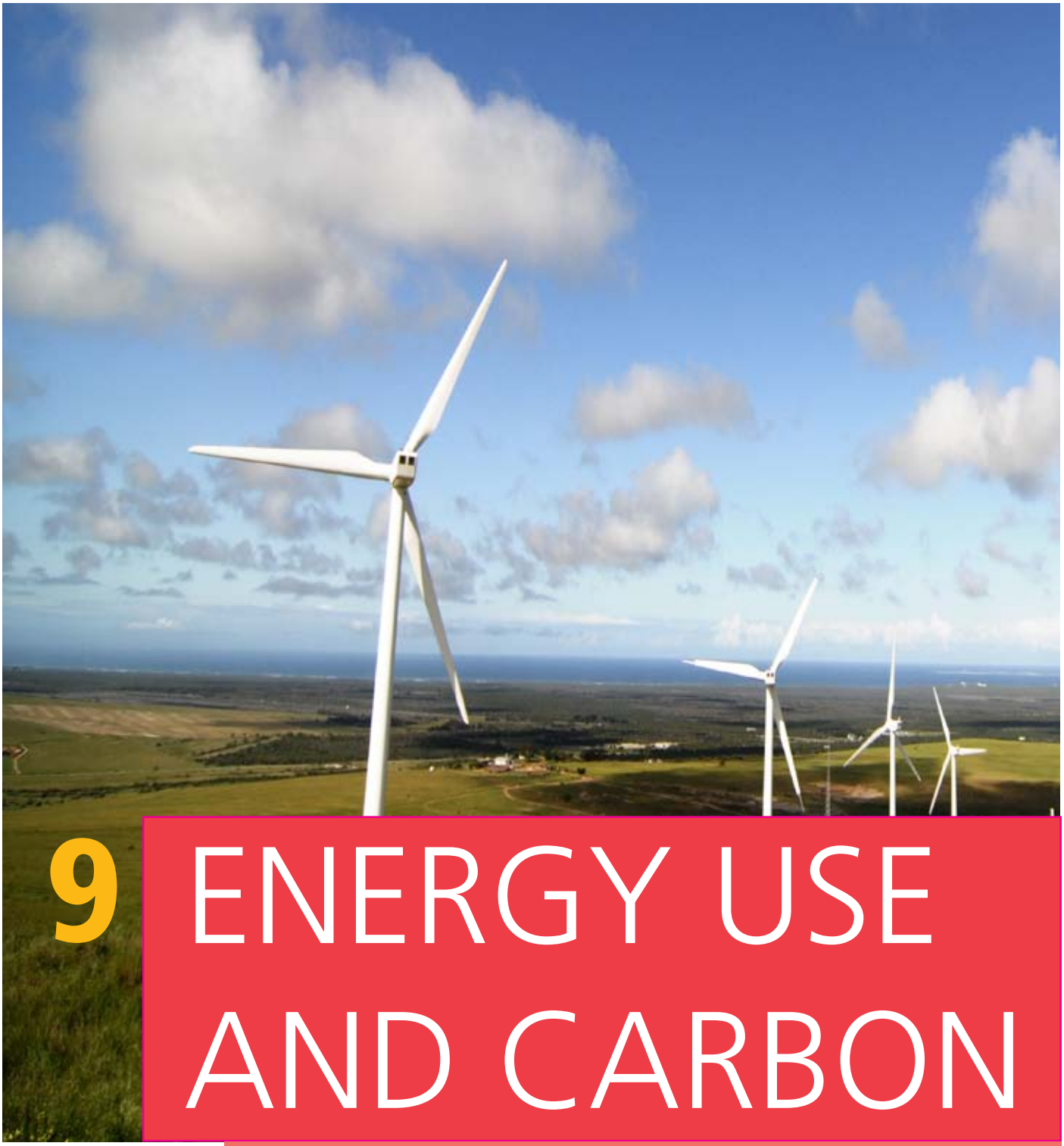
Environmental Agenda 2009-2014: Standard 3 – Air Quality.

Air Quality Management Plan: An integrated plan for managing air quality and reducing air pollution in the city.

Khayelitsha Air Pollution Strategy: A specific plan to address the issue of high levels of air pollution in Khayelitsha.

See Also

Energy Use and Carbon: pg 70



9 ENERGY USE AND CARBON

Indicators

Electricity and energy use city-wide
Electricity and energy use per capita
The total amount of CO_2 and CO_2 equivalents per capita through energy use
Carbon emissions by fuel source

Carbon dioxide (CO_2) – a colourless, odourless gas – is a by-product of certain processes, including numerous human activities such as the burning of fossil fuels for electricity generation and transport. As CO_2 is a greenhouse gas, it helps the atmosphere moderate the Earth's temperature by retaining heat. CO_2 and other greenhouse gases are necessary for life on Earth, but become problematic when levels in the atmosphere are too high. Since the industrial revolution the release of CO_2 into the atmosphere from human activities has increased greatly and has been identified as the leading cause of anthropogenic (human-induced) climate change. Climate change has already manifested itself in significant economic, social and environmental impacts, including rising sea-levels, hotter average temperatures, and an increase in the frequency and magnitude of extreme weather events. Climate models suggest that the impacts are likely to get worse over time.

In response to the global challenge of climate change, cities around the world are realising the importance of reducing their CO_2 emissions. As almost all aspects of daily life in cities are linked to the burning of fossil fuels, the transition towards creating a low-carbon city requires enormous commitment. Local governments have an important role to play in supporting this commitment through local policies and action plans. In order to gauge the effects of any mitigation actions, it is important to understand the carbon emissions profile and carbon footprint of the city – how big it is, and which sectors contribute to it. This informs strategic planning and appropriate responses.

In 2011 the City of Cape Town produced a State of Energy and Energy Futures report, using data from a 2007 base year. The State of Energy Report provides source material for this section. Cape Town's total annual energy use, calculated in 2007, is around 128 million GJ, approximately 5% of South Africa's total energy demand. Cape Town's energy-use profile differs significantly from South Africa's total-use profile, where industry and mining account for a greater share of total energy use, and residential and commercial sectors are less prominent.

In South Africa, 85% of electricity consumed is generated through burning coal. Coal is highly carbon- and water-intensive, with 2.4 tonnes of CO_2 emitted per tonne of coal[48]. Cape Town's electricity use accounts for 64% of its carbon footprint[49]. Cape Town's residential and commercial sectors are jointly responsible for the largest share of the city's carbon emissions, accounting for 83% of electricity use and 54% of carbon emissions. It is worth noting that although the transport sector consumes 50% of Cape Town's energy, it is responsible for only 27% of the associated carbon emissions.

Cape Town confronts multiple and interconnected energy challenges which include a comparatively high carbon footprint; weak levels of energy security; rising energy costs; widespread energy poverty; urban sprawl and associated lack of access to energy services. In 2011 the City of Cape Town published the Moving Mountains Report which demonstrates the City's commitment to meeting these challenges through its comprehensive Energy and Climate Action Plan.

Measuring Cape Town's carbon footprint

Cape Town's 'carbon footprint' refers to carbon dioxide emitted throughout South Africa to support the energy-use patterns of the citizens of Cape Town, rather than only carbon dioxide emitted within the boundaries of the City of Cape Town. Cape Town's footprint therefore includes the emissions from coal-burning power plants in other parts of the country, primarily Mpumalanga.

Cape Town's total carbon footprint was calculated in 2007. In this baseline year, Cape Town emitted an average of approximately 7.8 tonnes of carbon dioxide equivalents per capita.

This indicator is not updated annually, as data are extremely difficult to obtain. As a new methodology was used to calculate this figure, it is not possible to compare to this to previous years' data. However, institutional experience suggests that CO_2 emissions per capita in Cape Town have been at approximately similar levels in previous years. The City intends to gather more recent data and repeat the process, which will provide a useful comparison with the 2007 figure

State of the environment

Cape Town's electricity use increased steadily between 2001 and 2009, corresponding to the city's population growth, and reaching a high of approximately 12 250 GWh in 2009 (Figure 30). However, a decline in electricity use was recorded in both 2010 and 2011, by approximately 0.6% each year. Per capita electricity use increased steadily between 2001 and 2007, reaching a high of approximately 3 430 kWh in 2007 (Figure 31).

Since 2007, electricity use per capita has declined, to a low of just over 3 160 kWh per capita in 2011. This is the lowest figure recorded since co-ordinated reporting began in 2001.

Both total and per capita electricity use figures indicate a general decrease in the amount of electricity used. Cape Town's energy efficiency and demand-side management programmes and projects have played a significant role in reducing use, although it is difficult to disaggregate the City's role in use-reduction from the effects of rescission and load-shedding. It is important to note that due to the unavailability of Eskom data, total electricity-use figures include an estimate for the Eskom distribution area of Cape Town. These figures should therefore not be considered 100% accurate, but are comparable.

Cape Town's energy breakdown by sector

Cape Town's energy breakdown by sector indicates that energy use is dominated by transport (consumes approximately 50% of total energy), followed by the residential (18%), commercial (17%), industrial (14%) and local government (1%) sectors. However, although the transport sector consumes the largest share of energy used (50%), it is only responsible for 27% of CO_2 emissions, while residential and commercial sectors produce comparatively higher CO_2 emissions (Figure 33). This is due to the carbon intensity of coal-based electricity generation. A more detailed analysis of this breakdown is provided in the City of Cape Town State of Energy Report (2011), which has been used as source material for this report.

Residential sector: Cape Town's residential sector accounts for 18% of total energy use and 43% of total electricity use, with an annual use of 23 486 363 GJ. The residential sector predominantly uses electricity as a fuel source. Paraffin, liquid petroleum gas (LPG) and wood are also used, although chiefly in lower-income households. The amount and types of energy consumed by households vary according to income level. Low-income households, which make up 44% of all households, contribute only 24% of total residential energy use. On the other hand, high-income or very high-income households, which make up only 24%

Figure 30: Electricity use overall in Cape Town (2001– 2011) *including estimate for Eskom supply area

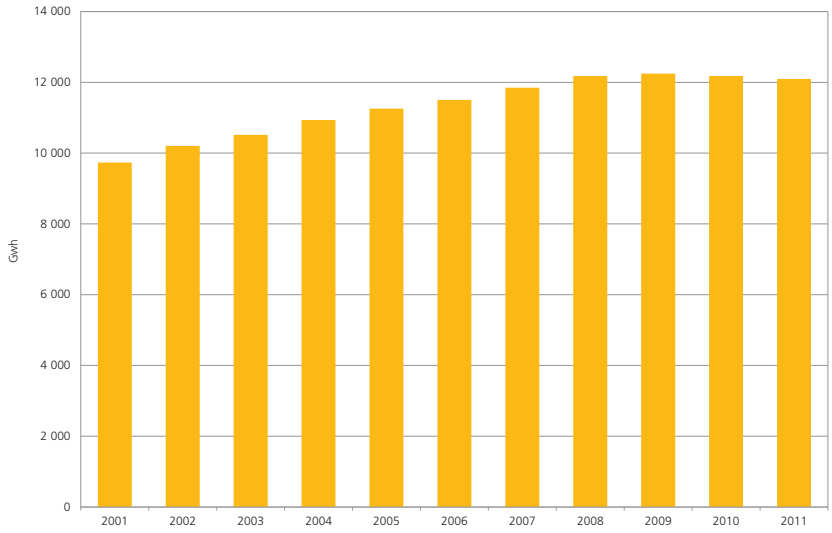
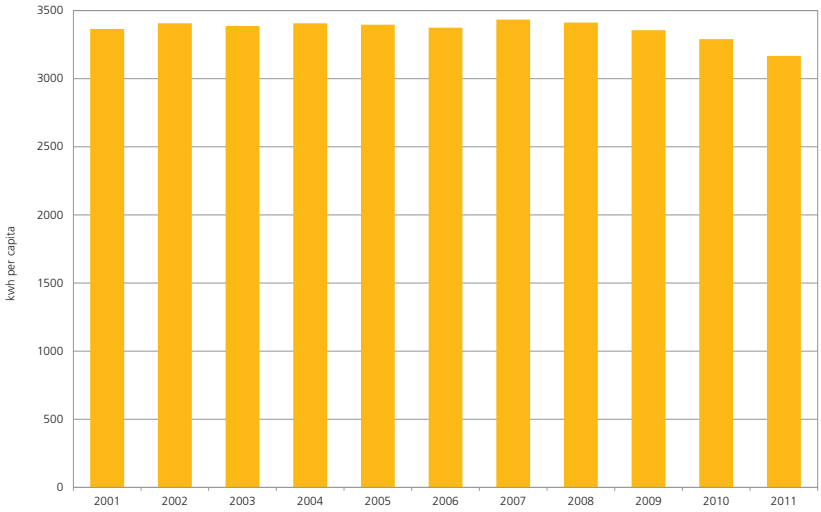


Figure 31: Electricity use per capita in Cape Town (2001– 2011) *including estimate for Eskom supply area



of total households, use 43% of all residential energy. This is indicative of Cape Town's energy inequality, where many households and communities live in energy poverty, with limited access to and ability to afford basic energy services, while high-end residential users consume a significant proportion of Cape Town's total energy.

Industrial sector: The industrial sector's share of energy use in Cape Town (14%) is considerably smaller than the rest of South Africa's industrial use (up to 41% in some areas). This is due to the fact that the city's economy is less dependent on the primary sector; instead, it is predominantly supported by the tertiary sector. Cape Town's economy is largely service-oriented, with a large contribution from tertiary-sector services, including financial and insurance services, real estate, government and social services. While Cape Town has some nodes of light industrial activity, there is very little heavy industry in Cape Town.

Transport sector: Half of Cape Town's total energy is consumed by the transport sector. Transport accounts for a far greater proportion of Cape Town's energy use compared with the rest of South Africa (approximately 28%). However, the transport sector accounts for significantly less carbon emissions than other sectors – despite high private vehicle usage among Capetonians, the transport sector is responsible for only 27% of Cape Town's total carbon emissions, due to the fact that petroleum fuels have lower carbon intensity than coal-based electricity. Currently, private vehicles dominate passenger transport, comprising 48% of the total passenger kilometres travelled in Cape Town. Extending and promoting affordable and sustainable public transport is therefore a key priority for promoting modal shifts and reducing Cape Town's transport-related carbon footprint.

Local government: The local government sector (the City of Cape Town) accounts for only 1% of total energy consumed in Cape Town, and 1% of carbon emissions. However, local government – as a single organisation – is the single largest user of energy. Accordingly, it has a significant role to play through leading by example and reducing its own use. This will save the City money and reduce pressure on the public funds required to meet the energy needs of Council operations.

Commercial sector: The commercial sector accounts for 16% of energy use, of which 96% is electricity. As with the residential sector, the commercial sector's dependency on coal-based electricity as its primary energy source accounts for its high carbon intensity: it is responsible for 28% of total carbon emissions. The commercial sector includes retail and office buildings, tourism activities, education facilities, hospitals and other non-industrial activities.

Figure 32: Energy use by sector

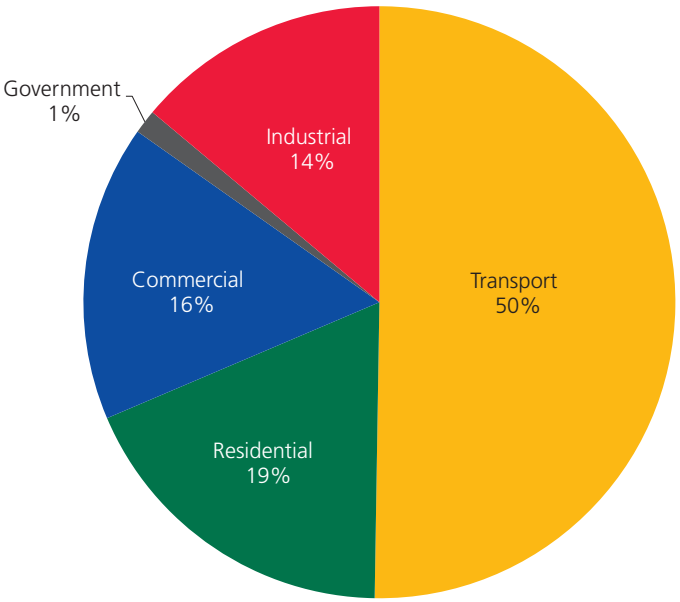


Figure 33: CO_2 emissions by sector

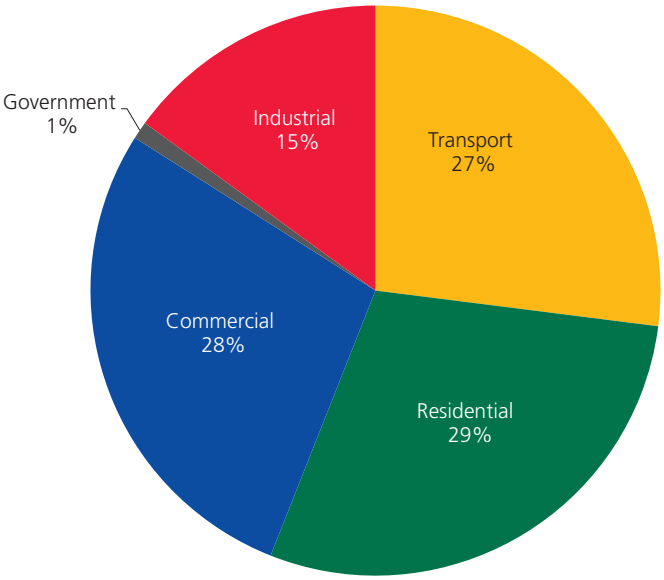
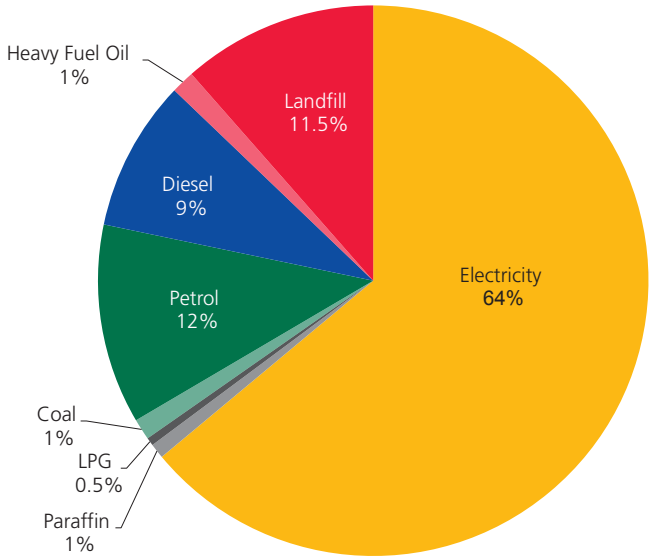


Figure 34: CO_2 emissions by sector



Analysis

Cape Town's CO_2 footprint, although lower than the national average, is high compared to those of developing cities with similar GDPs. Cape Town is highly energy-intensive, due to a history of cheap and abundant electricity with little incentive for reducing energy use or increasing efficiency.

Rising electricity prices and weak levels of energy security have created an urgent need to improve energy efficiency, diversify energy supply, and reduce energy use. The City of Cape Town and its residents thus have a responsibility to reduce their energy use and CO_2 footprints.

Since 2007, a number of changes have occurred that have probably contributed to the slight (but notable) decrease in electricity use in the city. These changes are also likely to contribute to a longer-term reduction in both energy use and carbon dioxide emissions.

Country-wide electricity shortages and the significantly-rising cost of electricity amid a global economic downturn have both contributed towards reduction in energy consumption. Locally, education and communication campaigns, aimed at raising awareness of the harm caused by CO_2 emissions and at encouraging efficient and sustainable energy use – including the promotion of alternative technologies and green energy – have been launched by the City and other partners. These programmes aim to change consumer behaviour among residents and businesses, and encourage longer-term savings.

Public transport plays a vital role in providing all citizens and visitors with access to opportunities and facilities, whether for economic, education, health, recreation or social purposes. It also plays an important role in reducing CO_2 and other harmful emissions from private cars. The improvement of public transport is one of the key focus areas identified by the City of Cape Town in its Integrated Development Plan (IDP) for achieving its long-term vision and developmental goals[50]. The City is in the process of implementing an integrated rapid transit (IRT) system. This is a transport system designed to promote and connect various modes of public transport – such as buses, taxis and the train – in the city. It will also be connected to cycle and pedestrian routes. The first leg of this IRT system focuses on the MyCiTi IRT system.

The City is also working on a number of projects that aim to improve quality of life as well as energy efficiency. In 2010 a

project was completed in Kuyasa, Khayelitsha, in which 2300 low-cost houses were installed with solar water heaters, energy-efficient lighting and insulated ceilings. This project was made possible through collaboration between the National Department of Environmental Affairs, The Provincial Department of Housing, the City of Cape Town, the SAEDF and South South North.

A ceilings retrofit programme is also being undertaken. A pilot project was carried out in 2011, and 230 houses in Mamre on the West Coast were retrofitted with ceilings. This pilot demonstrated that the installation of ceilings has the potential to both improve living conditions and save energy and fuel costs. The City intends to expand this project to the thousands of houses that were built without ceilings before the National Housing subsidy made provisions for the inclusion of ceilings.

The City is also currently working towards a programme which will involve the mass roll-out of solar water heaters in residential areas. This will reduce electricity consumption and monthly electricity costs. This project is still in the initiation phase.

The City is also pursuing a range of opportunities to reduce energy use in council operations. Programmes and projects include the Municipal Energy Efficiency and Demand-side Management Programme, which includes street and traffic light retrofits and a city-owned-building retrofit programme. The City is also working towards improving its own electricity-use management through the improved monitoring of electricity use via automated meter readers (AMRs). Work to green the City's vehicle fleet is continuous, and a project to green IT infrastructure has been initiated.

These innovative interventions seek to address the problem of high energy costs for the poor, to improve quality of life, and to reduce Cape Town's large carbon footprint. Integrated responses such as these are necessary to ensure the sustainability of any climate-change mitigation programme. It is intended that renewable energy technologies will be adopted more widely across the city in the future, and the City is in the process of implementing policy initiatives to support this process.

Climate-change adaptation

There is global consensus that the climate is changing; and irrespective of mitigation efforts, global mean annual temperature is likely to rise by approximately two degrees this century[51]. Although the City of Cape Town recognises the need to contribute to global efforts to reduce its carbon and other greenhouse gas emissions – particularly with a longer-term view to mitigating the effects of climate change – it also recognises the need to adapt to the unavoidable climate changes occurring in the shorter term. Projected climate changes – such as change in rainfall patterns, increased temperature, a rise in sea-level, and more frequent, intense and extreme events and storms – will expose the city, its residents, and economy to an increased level of risk.

The City recognises the need to implement proactive, adaptive measures to reduce its vulnerability to climate change. Therefore, the City has developed the Climate Adaptation Plan of Action (CAPA), a sector-based approach which aims to integrate climate change adaptation measures

across all its relevant service delivery and planning functions. The CAPA provides the framework for ensuring that climate adaptation responsibility and accountability rest with all relevant line functions in the City.

Historical methods of dealing with environmental hazards will not be sufficient to cope with the frequency and magnitude of anticipated climate change impacts. Planning, preparedness, and innovation will therefore be required to ensure that the City's adaptive capacity to this global threat is maximised. Taking action now will limit damages and costs over the coming decades, and if strategically well-considered, will add to the City's global competitive edge into the future.

Target and trend

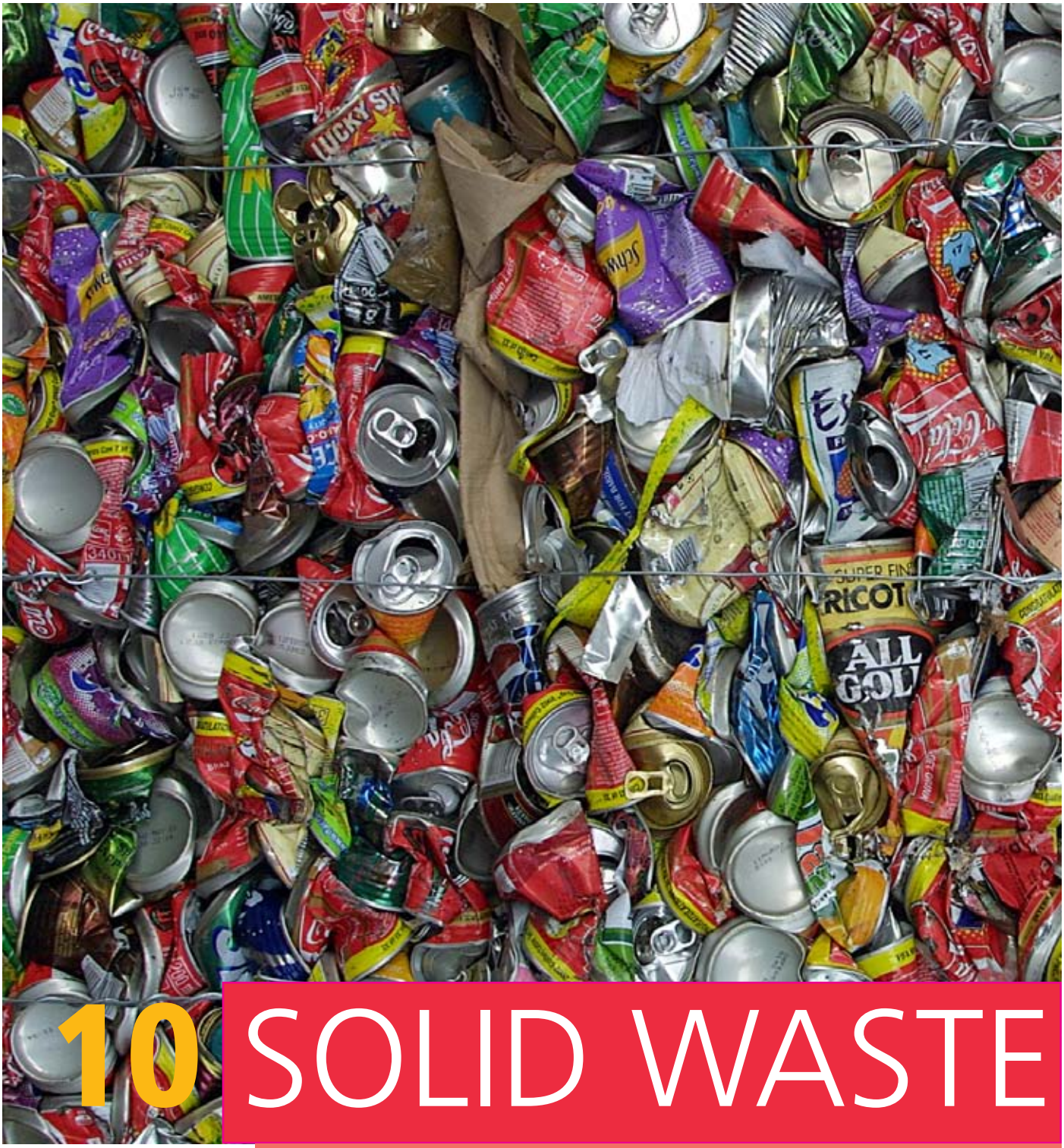
Trend: Carbon dioxide footprint remains at very high levels. However, electricity use has decreased slightly in both 2010 and 2011, while per capita electricity use has decreased slightly but steadily since 2007.
Targets: Environmental Agenda 2014 target: Per capita carbon footprint will be reduced to an annual average of 5 tonnes (a total of 20 million tonnes) of CO_2.
Current: Per capita carbon footprint is approximately 7.8 tonnes annually.

Policy Linkages

IDP: Strategic Focus Area 1 - The Opportunity City
MDG Goal 7: Target 9 – Integrate the principles of sustainable development with country policies and programmes, and reverse the loss of environmental resources.
Urban Environmental Accords: Action 3 – Adopt a city-wide greenhouse gas reduction plan that reduces the city's emissions by 25% by 2030, and which includes a system for accounting and auditing greenhouse gas emissions.
Environmental Agenda 2009-2014: Target 5 – Carbon Dioxide Footprint.
Energy and Climate Action Plan: A city-wide action plan that sets goals and targets for climate change mitigation and adaptation measures.
Climate Change Adaptation Plan of Action: A city-wide plan of action that is aimed at building a more resilient city and at ensuring that climate change adaptation measures are incorporated into City operations.
Integrated Resource Plan (IRP) for Electricity: The Integrated Resource Plan (IRP) for Electricity 2010–2030 is a long term national government planning document that aims to calculate long-term demand, and outlines how this demand will be met in terms of electricity type, cost, generating capacity and timing.

See Also

Air Quality: pg 63



10 SOLID WASTE

Indicators

Waste disposed of annually and per capita

Percentage of waste diverted from landfill

Responsible waste management is a vital area of focus in transitioning towards more sustainable cities. Over the past two decades, solid waste management has become an increasing priority on the global environmental agenda. Recent estimates suggest that globally, as much as 10 million tonnes of industrial and municipal waste is generated per day[52]. More sustainable and integrated waste management practices are vital in order to mitigate further environmental degradation and harm to human health. 'Waste' materials are also increasingly being regarded as potentially valuable resources that should not be thrown away.

Waste management in South Africa

In 1999 a draft National Waste Management Strategy was established, followed by the White Paper on Integrated Pollution and Waste Management for Southern Africa (2000). In 2000, members of government, business and civil society met in Polokwane for the first National Waste Summit, at which the Polokwane Declaration was developed. The declaration's stated goal was to stabilise waste generation, reduce waste disposal and develop a plan for Zero Waste[53] This helped set a vision for local waste management policy and practice. In 2008 the National Environmental Management Waste Act (NEM:WA), Act 59 of 2008, was developed to reform and consolidate previously fragmented legislation regulating waste management. It provided, for the first time, a coherent and integrated framework for the management of waste.

The current National Waste Management Strategy (NWMS), which gives effect to the NEM:WA, was developed and approved by cabinet in 2011 and is required to be updated every five years[54]. This strategy sets targets for promoting waste minimisation, and for the reuse, recycling and recovery of waste. It clearly defines the roles and responsibilities of government, organisations and citizens in working towards these goals, and the importance of a collaborative and integrated approach.

The Strategy aims to address the numerous challenges facing waste management in South Africa. Some of these include a growing population and consumer culture, the increased complexity of waste streams (both industrial and residential), the history of unequal service delivery, and the backlog of waste services. Others include the limited research on waste patterns and streams due to records not being mandatory, limited recycling infrastructure, and the pressure on limited and outdated waste infrastructure[55]. The NWMS seeks a common platform for action between stakeholders, to systematically improve waste management in South Africa.

Waste management in Cape Town

The Constitution of South Africa (Act 108 of 1996) specifies that 'refuse removal, refuse dumps and solid-waste disposal' fall under the responsibility of local government. Municipalities are responsible for ensuring that basic waste collection services are provided, and that the effects of waste management on human and environmental health are minimised. This function is carried out in collaboration with private waste management companies. Municipalities are required to incorporate an Integrated Waste Management Plan (IWMP) into their Integrated Development Plan (IDP), thereby ensuring that integrated waste management is a priority on the local government agenda[56].

The City of Cape Town aims to integrate waste management services in a way that ensures provision of basic services, the minimisation of the effects of waste on human and environmental health, and the economic activities associated with sustainable waste management. The City has greatly developed its waste management policy and practices over the past decade. In 2006, the City of Cape Town's Integrated Waste Management Policy (CCT-IWMP) was adopted. It noted that without serious action toward waste minimisation, 'the City will face an environmental and a health crisis... with dire consequences to the local economy' (CCT-IWMP, 2006). It identified waste minimisation as a key objective that needs to be achieved through a variety of methods, including the provision of new infrastructure, education programmes, public- and private-sector participation, and the facilitation of a buoyant recycling market, job creation and the implementation of stricter legislation[57]. In 2009, Cape Town became the first municipality to introduce a by-law concerning Integrated Waste Management to regulate the management of waste within the city[58].

Definition of waste

Solid waste consists of the waste products generated by households, businesses and industry, and includes general waste, green waste, builder's rubble and hazardous waste.

The Waste Act defines waste as follows:
'Waste' means any substance, whether or not that substance can be reduced, re-used, recycled and recovered
(a) that is surplus, unwanted, rejected, discarded, abandoned or disposed of;

(b) that the generator has no further use for, for the purposes of production;
(c) that must be treated or disposed of; or
(d) that is identified as a waste by the Minister by notice in the Gazette, which includes waste generated by the mining, medical or other sector; but –
(i) a by-product[59] is not considered waste; and
(ii) any portion of waste, once re-used, recycled and recovered, ceases to be waste.

Waste is classified into the following categories:

- 'General waste' means waste that does not pose an immediate hazard or threat to health or to the environment, and includes: Domestic waste; Building and demolition waste; Business waste; and Inert waste.
- 'Hazardous waste' means any waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment[60].

Waste targets

The current National Waste Management Strategy (NWMS) outlines eight goals for achieving integrated waste management practices. These include

1. Promoting waste minimisation, re-use, recycling and recovery;
2. Ensuring effective and efficient delivery of waste services;
3. Growing the contribution of the waste sector and the green economy;
4. Ensuring that people are aware of the impact of waste on their health and on the environment;
5. Achieving integrated waste management planning;
6. Ensuring sound budgeting and financial management for waste services;
7. Providing measures to remediate contaminated land; and lastly,
8. Ensuring the effective compliance and enforcement of the Waste Act.

These goals are accompanied by indicators and targets (for more information, see the NWMS).

The 2001 Polokwane Declaration Target was set at achieving zero waste to landfill by 2022. The National Waste Management Strategy target for waste minimisation aims to divert 25% of recyclables from landfill for reuse and recovery by 2015. It also outlines that all metropolitan municipalities, secondary cities and large towns should have initiated separation-at-source programmes by 2015. The IMEP Environmental Agenda 2014 Target 9 sets a goal of a 20% reduction in waste to landfill from the 2008 baseline.
The City of Cape Town, through its Integrated Waste Management Policy, IDP and the annual SDBIP, further sets annual targets for the waste minimisation programmes co-ordinated directly through the City of Cape Town's municipal services. The City's targets focus on the tons of waste diverted (minimised) from landfill, as a percentage of the total tons of waste received by the City of Cape Town's Solid Waste Management Department. In addition to this, a large amount of waste is also diverted from landfill via private companies.

State of the environment

Figures 35 and 36 show waste disposal in Cape Town, per year, between 2006 and 2011. In 2006 and 2007, growth in the amount of waste disposed of at landfills was seen, culminating in a high of 2.5 million tonnes in 2007. In 2008 and 2009 there was a significant drop in waste disposed of, both generally and per capita. 2010 saw a slight increase in both these volumes, but in 2011 it has dropped again slightly. While the overall trend for waste disposal appears to be that it is decreasing, Cape Town still has a relatively high level of waste disposal.

The city has three municipal landfill sites in operation: Coastal Park, Vissershok (Hh) and Bellville South. The largest of these is the Coastal Park landfill site, at about 75 hectares. Bellville South is slightly smaller, taking up about 60 hectares. These two sites are used only for general waste. Hazardous waste is landfilled at either a low-risk (Hh) facility or a high-risk (HH) facility depending on the nature of the waste. Vissershok (Hh) is a low-risk hazardous-waste facility operated by the city. There is another, privately-managed landfill site operating at Vissershok. This privately-owned Vissershok (HH) site is managed jointly by two waste-management companies, and is licenced to manage high-risk hazardous wastes.

As there are only three landfill sites spread out throughout the city, the City has a number of transfer stations, which act as central points to which waste companies must haul their waste. At the transfer stations, waste is compacted and then transported to landfill, either by train or in trucks. There are three transfer stations: Athlone, Swartklip and Kraaifontein. Transfer stations have been identified as key nodes in transforming the city towards more integrated

management of waste. In future, they will also act as central points at which waste streams can be separated and diverted from landfill into various recycling initiatives. As such, the Kraaifontein facility was developed as an Integrated Waste Management Facility. The facility has a drop-off facility, materials-recovery facility, a refuse-transfer station and a green-waste chipping area. Recyclable waste that is received is sorted, separated, baled and then sold by a contractor. All general waste is accepted except hazardous waste, medical waste, sludge and large loads of builders' rubble. At present this site has the capacity to manage up to 960 tonnes of mixed general waste per day. It will eventually also accept household hazardous wastes separately[61]. The non-recyclable waste is compacted and transported to the Vissershok landfill for disposal.

Figure 37 shows that from 2006 to 2008, significant improvements were seen in the percentage of waste diverted from landfill. The percentage of waste diversion appears to have decreased since 2009; however, this is probably due to the fact that the accuracy of methods for measuring the waste diverted from landfills in the City has improved dramatically since July 2010. This accounts at least partially for the apparent drop in percentage waste minimised in 2010 and 2011, some of which was previously approximated and is now measured. The City's Municipal Systems Act Section 78.3 study to assess alternative service delivery options (completed in February 2011) found that an annual percentage of approximately 18% of the total waste stream, expressed in tonnes, is diverted through private-sector waste-minimisation programmes, in addition to the tonnage diverted through the City of Cape Town's municipal waste-minimisation programmes.

In recent years, garden waste and building rubble have been identified as important wastes to be removed from the landfill stream, due both to their bulkiness and to their resource potential. The City has developed a number of drop-off sites which cater for garden waste and building rubble, among other waste streams. Private contractors to the City then chip the garden waste for the production of compost. Other contractors recover recyclables and portions of the building rubble waste stream for re-use. There are currently no large-scale composting facilities for wet organic wastes such as food wastes.

While recycling has increased significantly in recent years, landfills are still Cape Town's primary method of waste disposal. Cape Town is fast approaching the capacity of its available landfill volume. It is estimated that by 2012 the city will exceed its available landfill space (See Figure 29). The construction of new landfill sites is a complex process which needs to be avoided due to its social, environmental and economic costs. Placing new landfill sites too far out of the city would generate huge costs for the municipality, while locating them closer could infringe on the quality of life of people living near to them. Sites should also not be located near bodies of underground or other water, as contamination can occur. The City is currently carrying out a Supplementary Environmental Impact Assessment process for a Waste Licence to construct and operate a proposed new regional landfill site to service the City of Cape Town. This site, if approved, will assist the City in carrying out its Constitutional mandate to provide essential services to its residents with regard to the disposal of solid waste. Essentially it will be used in conjunction with Integrated Transfer Stations and various recycling initiatives in order to work towards minimisation targets, as well as to reduce the need for further landfill sites in the future. It is estimated that with a greater than 7% growth in waste per annum, even if a new landfill is developed, the new landfill space will be exceeded around 2025. Therefore waste sent to landfill needs to be drastically reduced in order to avoid a landfill airspace crisis.

Figure 35: Waste disposed annually at landfill sites, in tonnes (2006 - 2011)

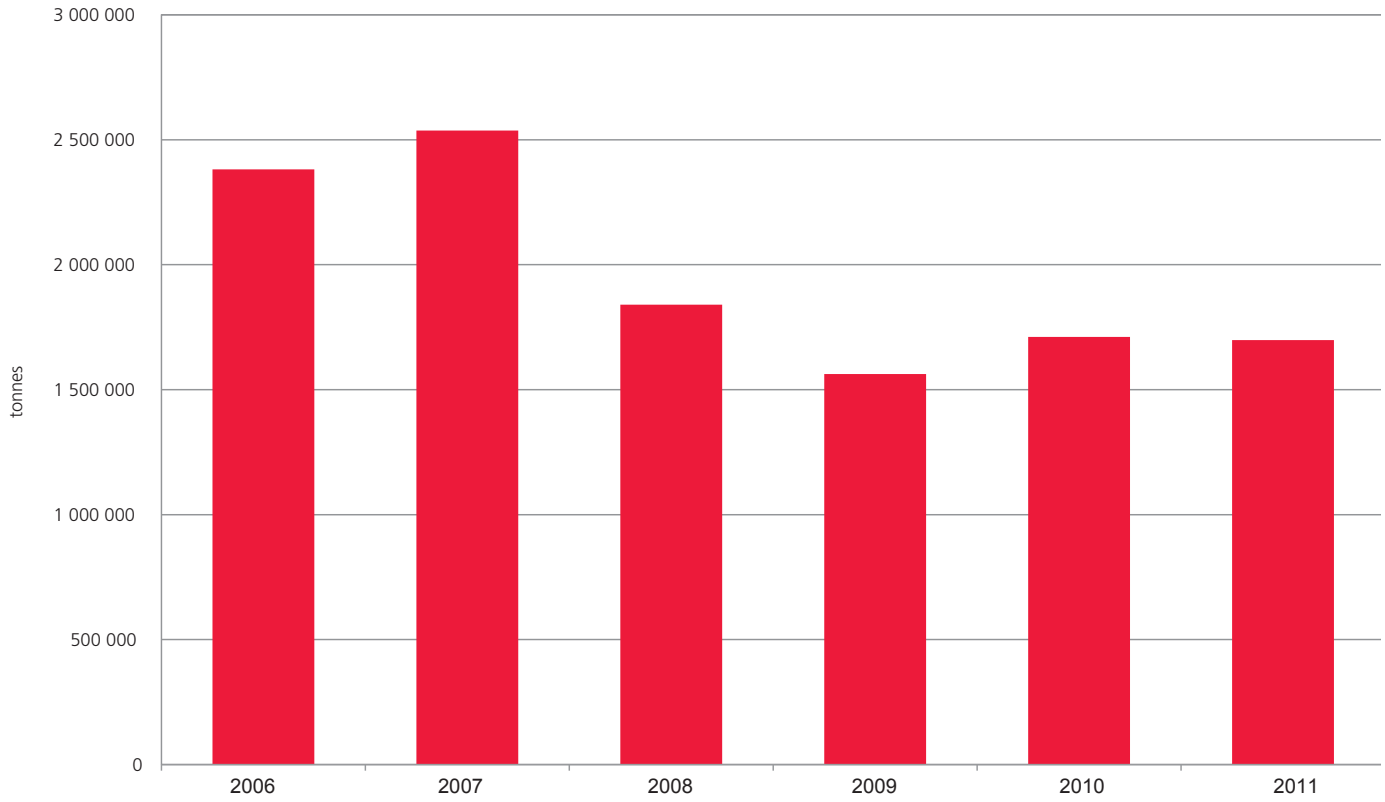


Figure 36: Waste disposed of per capita, in kilograms (2006 - 2011)

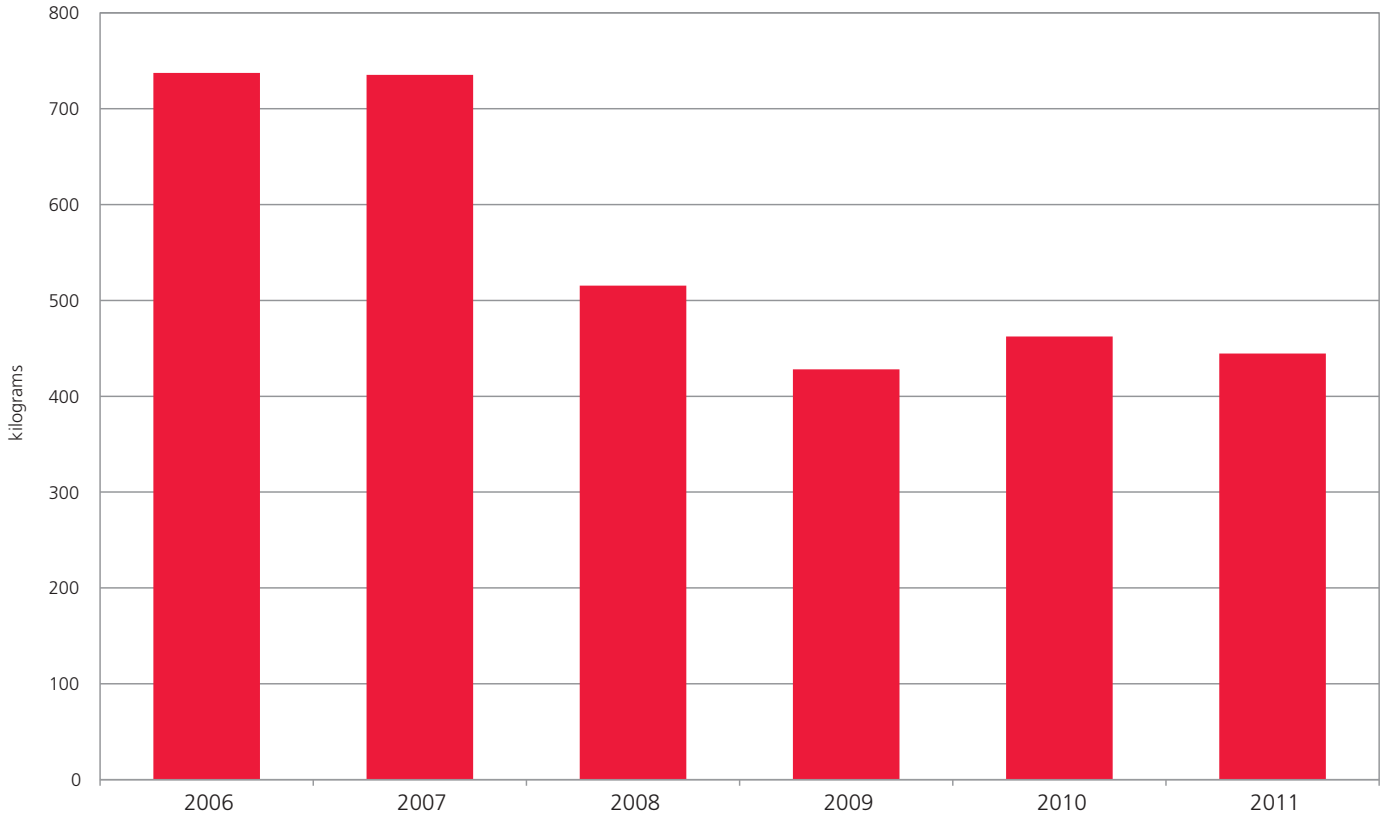
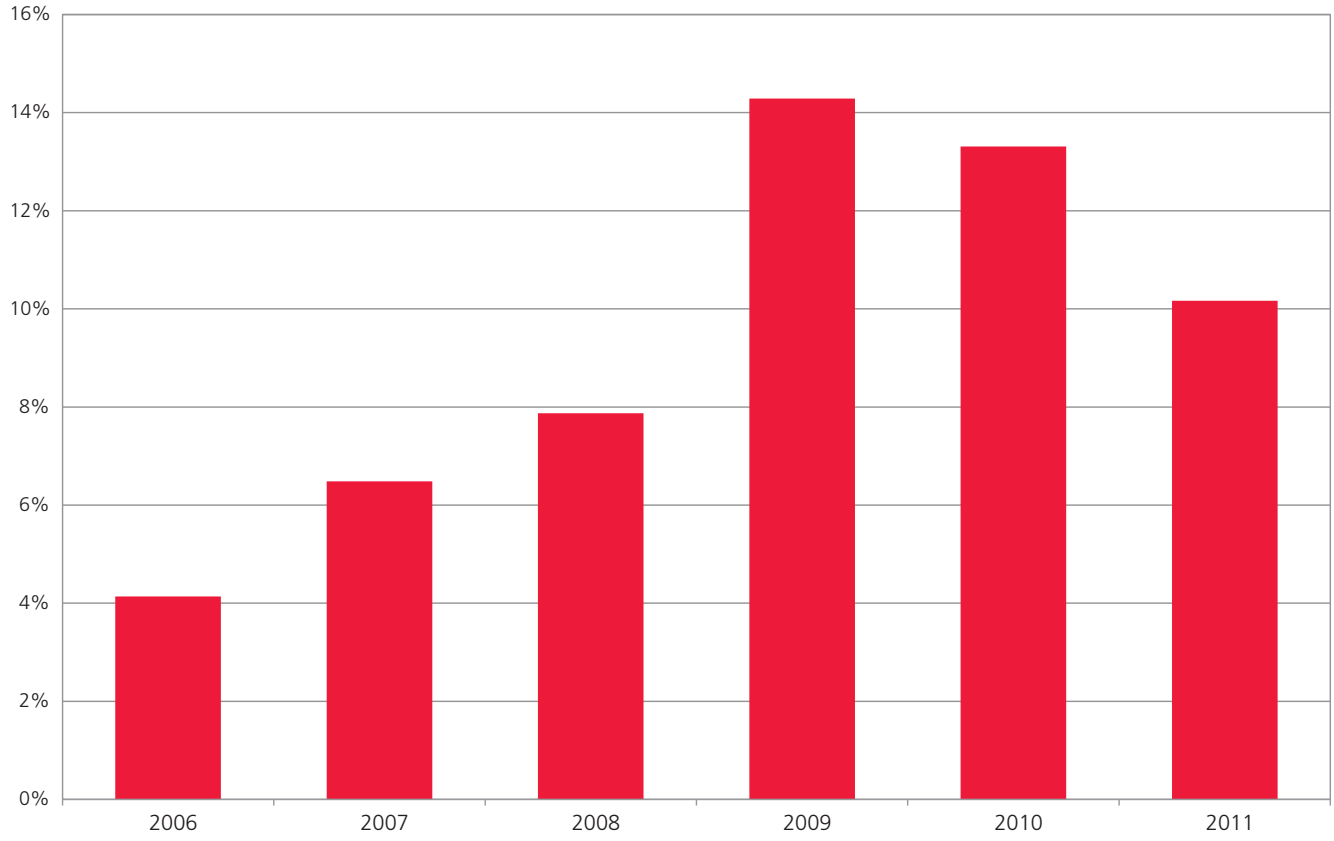


Figure 37: Percentage waste minimised (tonnes of waste diverted from landfill by City waste minimisation programmes as a percentage of total waste processed by the City) (2006 – 2011)



Analysis and discussion

It is clear that a dramatic drop in the amount of waste sent to landfill was experienced in both 2008 and 2009, although a slight increase was recorded in 2010, which then decreased slightly again in 2011. While it is not possible to determine accurately the exact causes for this drop, it is probable that a number of circumstances and interventions have contributed. The global economic downturn that began in 2008, and which has continued through 2011, may have had a role to play in the reduction of waste sent to landfill, as well as the reduction in the amount of construction waste and garden waste (a voluminous component) disposed of at landfill sites. The downturn may also have encouraged companies and industries to reduce unnecessary and expensive packaging and implement recycling, as well as to invest in reverse logistic solutions by which they can profit from 'waste'.

There has also been a notable increase in the recycling industry in recent years (supported and encouraged by City of Cape Town programmes implemented to assist recyclers to build their businesses) making it easier for companies and individuals to access recycling opportunities. Many large retailers have become aware of the impact of over-packaging of food and other products, and are thus making an effort to reduce packaging material, both in the supply chain and at end-user level. Additionally, the public is becoming more aware of the need to recycle – partly due to the City's environmental education and communication programmes – and voluntary recycling may therefore account for a portion of the reduction. This is illustrated by the significant percentage (18%) of waste diversion by private-sector waste-minimisation programmes, as reported in the City's MSA Section 78.3 report.

The City's eventual aim is to establish an effective system for the separation of waste at source. As one of the programmes to reach this goal, the City has launched the Think Twice campaign as a pilot in some Cape Town residential areas. Households are issued with clear bags for recyclables and are requested to use normal refuse bags for non-recyclables. Various methods of collection are being explored. It is estimated that this diverts approximately 1 300 tons of recyclables from landfill each month.

The Solid Waste Management Department has developed a communication and awareness program called WasteWise.

This aims to raise awareness and encourage action among the general public and businesses of Cape Town to minimise waste, reduce littering, stop illegal dumping, and increase recycling. The WasteWise programme seeks to foster behaviour change and encourage a culture of environmental responsibility amongst all Capetonians, in a joint effort to reduce waste to landfill, and empower citizens to minimise waste and littering. WasteWise is being implemented through campaigns aimed at engaging with communities, schools, commerce and industry, and the general public. The transition towards achieving waste reduction targets – and ultimately, zero waste to landfill – will require enormous effort from all the stakeholders in the city.

Target and trend

Trend: Significant decreases in the amount of waste sent to landfill since 2006.
Target: Environmental Agenda 2014 Target: 20% reduction of waste to landfill from 2008 baseline.
Current: 7.7% reduction in waste to landfill between 2008 and 2011.

Policy Linkages

IDP: Strategic Focus Area 1 - The Opportunity City
Environmental Agenda 2009-2014: Target 9 - Waste Minimisation.
MDG Goal 7: Target 9 – Integrate the principles of sustainable development with country policies and programmes, and reverse the loss of environmental resources.
Urban Environmental Accords: Action 4 – Establish a policy to achieve zero waste to landfills and incinerators by 2040.
Urban Environmental Accords: Action 6 – Implement 'user-friendly' recycling and composting programmes, with the goal of reducing per-capita solid waste disposal to landfill and incineration by 20% in seven years.
Waste Minimisation Policy: The City's Integrated Waste Management Policy fully supports the conservation of resources, and is linked to the waste hierarchy as described in the National Waste Management Strategy. The aim of the policy is to minimise waste to landfill by avoiding and reducing waste generation and reusing and recycling waste, while incorporating landfill as a final option.

SUMMARY

The 2012 State of the Environment Report has identified a number of key indicator trends, providing an insight into the state of Cape Town's natural environment. The following summary provides an overview of the report.

Indicators that show improvement are:

- Water use
- Freshwater quality
- Solid waste
- Air quality
- Coastal water quality (False Bay coast)

Indicators that show little or no change are:

- Invasive species
- Access to natural green space
- Energy use and carbon
- Wastewater

Indicators that show decline are:

- Biodiversity
- Coastal water quality (Atlantic coast)

CONCLUSION

The overall picture of Cape Town presented in this report shows a slight improvement when compared to the previous year's report, as well as to longer-term trends. The city's natural environment underpins its economy by attracting tourists and encouraging businesses to locate in Cape Town. However, the statistics reveal that Cape Town is facing significant environmental challenges, and is not yet able to address them adequately; thus effectively undermining the foundation on which the city's economy is built. It is important to note, though, that positive changes are taking place, and that work to build upon these improvements is ongoing.

Paramount among these challenges is the pollution of Cape Town's freshwater and coastal ecosystems, largely as a result of unsatisfactorily treated wastewater and polluted urban stormwater run-off. This in itself is symptomatic of a larger problem – the rapid expansion of the urban environment without an associated expansion of critical city infrastructure, and the lack of access to critical sanitation services due to widespread poverty. Ultimately, a city's use of water should be cyclical, whereby water is returned to natural systems in a clean state which supports environmental and human health. Unfortunately this is not the reality is most dense urban centres, Cape Town included. It is clear from the statistics provided that the situation in the city's freshwater systems is severe, and that rapid action is required in order to prevent further deterioration of water quality. It is important to note, however, that some improvements have been made in the ecological health of wetland systems, and that work to build upon this success is continuing. Coastal water quality continues to vary from year to year, but on the whole is improving.

Biodiversity in Cape Town continues to face a number of pressures, and is subject to ongoing losses, with over 60% of the extent of the city's original vegetation having been lost due to human activities, and 30% of the remaining vegetation considered endangered or critically endangered. Cape Town is home to globally unique and important biodiversity that is found nowhere else in the country or the world, and therefore it is vital that the City acts now to limit the ongoing destruction of natural areas, and to conserve biodiversity for both the good of Cape Town, and the benefit of future generations. The Biodiversity Network (BioNet) is a vital step in ensuring the protection of the city's biodiversity. It has become a key informant in the City's medium- to long-term spatial planning, such as the Spatial Development Framework (SDF), district plans and environmental management frameworks. This is a key step in prioritising the protection of natural ecosystems in the city, and in recognising the ecosystem goods and services they provide, including the social and community benefits they offer. Infestation by invasive alien species is another critical threat to both Cape Town's biodiversity and water resources, and must be acted upon as a matter of urgency. In this regard, the City is making incremental progress, and has achieved some notable successes through the establishment and implementation of a new Invasive Species strategy.

It is important to note that two of the areas in which the biggest improvements have been observed over the past few years, and in which positive, long-term trends are noted – water use and solid waste disposal – are significantly contributed to by the actions of individuals who make an effort to use less water, create less waste, and recycle more. The citizens of Cape Town must be commended for striving to achieve sustainability in their lives, and choosing to limit their impact on Cape Town's resources. This is no small achievement; it is only with the co-operation of Capetonians, and a commitment to reducing environmental impacts, that the City can achieve a more environmentally sustainable future. The City is therefore working to incorporate the lessons learned in these two areas, and to apply them more widely, where appropriate.

The City is committed to creating a better, more environmentally sustainable city through the application of its IDP and IMEP, and its commitment to the implementation of the UN MDGs and Urban Environmental Accords. In order to ensure that timely action is taken, the City has also captured the environmental issues described in this report into its risk register.

As these policies and goals have a medium- to long-term view, it is important to acknowledge that many of the planned changes may take some time to manifest themselves. However, despite the challenges that will have to be met, the City is determined to continue its work towards creating a more environmentally sustainable city.

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APPENDIX A

Goals of the City of Cape Town Environmental Agenda 2009 - 2014

The City of Cape Town is committed to increasing levels of ecosystem and heritage protection while reducing overall resource consumption. This commitment will take place within the recognition that quality environments and current resource use patterns are significantly skewed and aligned with the wealth gap. Resource use targets and strategies are therefore aimed at dramatically reducing current over-consumption patterns in middle and upper classes while increasing appropriate resource use in impoverished and disadvantaged communities so as to extend quality living environments and basic services. Within this context, the City of Cape Town commits itself to the following five-year environmental targets, to be achieved by July 2014:

1. Biodiversity

At a minimum, 60% of areas identified to meet our biodiversity targets will be under formal management, including proclamation and stewardship agreements, and will be secured for future generations. The City will increase its investment in these biodiversity areas so as to build their role as key economic, social, recreational and educational assets.

2. Alien Invasive Species

Invasive alien plant management:

a. 60% of the surface area of the Protected Areas and Biodiversity Network will be in maintenance (defined as cleared with three follow-up operations);
b. 80% of the surface area of City-owned land other than Protected Areas and the Biodiversity Network will be in maintenance;
c. 40% of the surface area adjacent to Protected Areas and the Biodiversity Network will be in maintenance;
d. Aquatic invasive plant species will be reduced to 80% of the 2009 coverage in the city's water bodies;
e. 5 x emerging invader species identified in 2009 will be reduced by 90% of the 2009 occurrence.

Invasive alien animal management:

f. The Indian house crow population in the city will be eradicated;
g. The guttural toad population in the city will be eradicated;
h. The mallard duck population in the city will be eradicated.

3. Air Quality

a. Annual average NO_2 levels will not exceed 40µg/m³ in any part of the city, with an aim to reduce annual average levels to no more than 30µg/m³ in order to ensure ecological protection
b. Annual average SO_2 levels will not exceed 50µg/m³ in any part of the cCity with an aim to reduce annual average levels to no more than 20µg/m³ in order to ensure ecological protection.
c. Annual average PM_{10} levels will not exceed 50µg/m³ in any part of the city.
d. The number of times PM_{10} exceeds the daily guideline of 120µg/m³ will be reduced to a maximum of 4 days in any part of the city.

4. Carbon Footprint

Per capita Carbon footprint will be reduced to an annual average of 5 tonnes (a total of 20 million tonnes) of CO_2 equivalents.

5. Energy Efficiency

Electricity efficiency will be improved to reduce the total electricity consumption in 2014 by 10% from 2007 total electricity consumption figures.

6. Climate Change Adaptation

The development and endorsement of a progressive and effective Climate Change Adaptation Plan of Action that remains up-to-date with current international information and trends and which fosters and promotes city, community and individual resilience to environmental change.

7. River Health

The city will invest in its wastewater and storm water treatment and management capacity to ensure that by 2014:

a. River Health Survey results will improve to reflect at a minimum :

Natural	Good	Fair	Poor	Unacceptable
3 (8%)	6 (16%)	17 (46%)	9 (24%)	2 (5%)

b. 4 out of 4 of designated inland and estuarine recreational water bodies will meet DWA minimum standards for intermediate recreational contact
c. Half (7 out of 14) of designated rivers will achieve at least 80% compliance with the DWA intermediate contact recreational guideline for levels of E. coli pollution
d. Half (7 out of 13) of designated vleis will achieve at least 80% compliance with the DWA intermediate contact recreational guideline for levels of E. coli pollution
e. 95% of coastal water quality monitoring points will be compliant with coastal water quality guidelines (80th percentile guideline)
f. 70% of all private industries will have been captured within the effluent permit process

8. Water

Use of potable water will be capped at a maximum of 290 billion litres per year. With expected population growth and increasing levels of service equity, daily water use per capita will need to be reduced to an average of 180 litres per day to meet this target.

9. Waste Minimisation

A 20% reduction in waste sent to landfill.

10. Housing

All social housing delivered beyond 2009 will be built with fitted ceilings while 40% of existing pre-2008 social houses will have been retro-fitted.

11. Coastal Protection

The formalisation and implementation of an effective Coastal Protection Zone (CPZ) across the length of our City's coastline, the formal management of, and investment in this CPZ to ensure environmental integrity, conservation of coastal ecosystems and enhanced recreational opportunity while protecting the city from storm surge events.

12. Urban Edge

Urban development will be contained within the defined and approved Urban and Coastal edge, and cultural landscapes, particularly of the Cape Winelands, will be given a level of protection.

13. Environmental Compliance

Compliance by the City in performing its functions to the national environmental approval process will be 100% for new capital projects. The City's environmental compliance strategy will be completed and implemented.

14. Environmental Education and Communication

Recognising that environmental change requires commitment by all its citizens, and that empowerment of people is central to this commitment, the City's environmental awareness, information, education and skills development programme will:

a. Provide 150 professional internship opportunities over the period 2009-2014
b. Reach 300 000 school children through education campaigns
c. Communicate a general environmental awareness message to the citizens of Cape Town at least four times per year. This will be in addition to focused campaigns

15. Outdoor Advertising

Key scenic resources, environmentally sensitive areas, heritage areas and rural landscapes which are vulnerable to the impacts of billboards, will be mapped as Areas of Maximum Control in terms of the Outdoor Advertising By-law.

16. Cultural Heritage

An inventory of audited cultural heritage sites and places in the metropolitan area will be publicly accessible.

17. Administrative Operations

The City of Cape Town will reduce the resources used in the course of its administrative operations by the following: Paper - 10%, Fuel - 10%, Water - 10% and Electricity - 10%. Improved resource efficiency will be included in City procurement processes.

APPENDIX B

The Five Pillars of the City's Integrated Development Plan 2012 - 2017

The City of Cape Town's Integrated Development Plan (IDP) provides the strategic framework that guides the municipality's planning and budgeting over the course of its political term.

When the new City administration was elected, a strong plan of action for Cape Town was developed. This plan is based on a clear understanding of what needs to be achieved during this term of office, and is built on the following five key pillars:

1. The Opportunity City
2. The Safe City
3. The Caring City
4. The Inclusive City
5. The Well-run City

These five pillars help to focus the City's message and purpose of delivery. They also help us to translate our electoral mandate into effective organisational structures.

In this IDP, these pillars are called strategic focus areas (SFAs) because they are the overarching 'themes' encompassing all the City's programmes and initiatives. The result is a detailed matrix that enables effective programme implementation and accurate performance measurement of the focus areas.

While these programmes and objectives often overlap across SFAs, classifying them under the fi ve pillars allows the City effectively to measure their outcomes. They can then act together to produce the objectives of the administration, and help the City address the structural inequalities of the past. They will help the City fulfil its constitutional mandate, as local government, of being the drivers of social and economic development. And they will help change people's lives.

The IDP has been developed with maximum citizen participation. This has involved input from all levels of the administration as well as the most extensive public participation process ever undertaken by the City. Based on this inclusive approach, this IDP document describes the programmes under each SFA, as informed by the overarching principle of infrastructure-led growth. These five SFAs can briefl y be described as follows:

1. The Opportunity City

The core focus of the opportunity city is to create the economically enabling environment in which investment can grow and jobs can be created. Creating such an opportunity city involves the following:

- Using numerous levers to attract investment
- Providing adequate support to the market via effi cient regulation, planning and infrastructure support
- Continued investment in infrastructure
- Ongoing development and strengthening of economic partnerships
- A focus on key projects that will promote growth and sustainability
- Making the most of City assets to aid development and growth
- Encouraging the growth of small businesses and entrepreneurs
- A focus on taking care of the natural environment and managing natural resources more effi ciently

2. The safe city

Citizens need to be safe in their city. However, safety is a broader issue that goes beyond policing. A truly safe city manages disasters and risks, enforces traffi c regulations, and provides fire and rescue services. Safety is essential to the public enjoyment of open spaces, city beaches and nature reserves. The City of Cape Town's focus on building a safe city includes the following:

- Continued dedication of resources and programmes to ensure effective safety provision
- Local and international partnerships to allow for training and education
- Ongoing roll-out of neighbourhood watch programmes
- Increased public awareness of, and participation in, safety and security initiatives
- Alignment of staffi ng models with national and international best practice
- Investment in staff training and capacity building
- Enforcement of environmental compliance
- Investment in innovative safety policies, specialised units and programmes

3. The caring city

In order to be a world-class city, Cape Town must be welcoming to all people, and it must make residents feel that their government is doing everything it can to provide for them so that they can truly access opportunities. Key to realising the vision of a caring city is the following:

- Continued implementation of the rates rebates policy to help reduce poverty
- Provision of amenities, such as parks, libraries, sports and recreational facilities, and community and youth centres
- Greater focus on more direct ways of promoting social development
- Offering effective substance abuse programmes to help minimise the number of people who are excluded from society
- Increased efforts to make all people feel that they are a part of their communities
- A focus on creating integrated human settlements by building communities, not just houses
- Ongoing review of the provision of services to informal settlements
- Investment in primary health-care facilities

4. The inclusive city

An inclusive city is one where everyone has a stake in the future and enjoys a sense of belonging. While achieving this relies on the proper functioning of the programmes, the City of Cape Town will also concentrate on the following:

- Developing effective public transportation programmes
- Ensuring greater recognition of culture and heritage
- Proper use of resources to address the backlog of community facilities in underdeveloped areas
- Responding effectively to the needs of its citizens

5. The well-run city

Citizens need to know that their government works for them, is accountable to them, and answers to them at all times. To achieve this, the City of Cape Town will do the following:

- Keep Council meetings open to the public to ensure that the actions and decisions of the City's political leaders are always transparent
- Publically advertise all City tenders above a prescribed rand value
- Stick to its budgets and programmes of debt collection and revenue projections
- Manage its staff structure to ensure service delivery
- Maximise staff potential through effective human resources management, staff training and staff development
- Strictly monitor all services to ensure delivery
- Remain open and transparent in all its dealings

APPENDIX C

Goals and Targets of the United Nations Millennium Declaration

Goal #	Goal and Targets
Goal 1	Eradicate extreme poverty and hunger
	Halve, between 1990 and 2015, the proportion of people whose income is less than $1 a day
	Halve, between 1990 and 2015, the proportion of people who suffer from hunger
Goal 2	Achieve universal primary education
	Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling
Goal 3	Promote gender equality and empower women
	Eliminate gender disparity in primary and secondary education preferably by 2005 and in all levels of education no later than 2015
Goal 4	Reduce child mortality
	Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate
Goal 5	Improve maternal health
	Reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio
Goal 6	Combat HIV/AIDS, malaria and other diseases
	Have halted by 2015 and begun to reduce the spread of HIV/AIDS
	Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases
Goal 7	Ensure environmental sustainability
	Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources
	Halve, by 2015, the proportion of people with sustainable access to safe drinking water
	Have achieved, by 2020, a significant improvement in the lives of at least 100 million slum dwellers
Goal 8	Develop a global partnership for development
	Develop further an open, rule-based, predictable, non-discriminatory trading and financial system (includes a commitment to good governance, development, and poverty reduction – both nationally and internationally)
	Address the special needs of the least developed countries (includes tariff- and quota-free access for exports, enhanced programme of debt relief for and cancellation of official bilateral debt, and more generous ODA for countries committed to poverty reduction
	Address the special needs of landlocked countries and small island developing states (through the Programme of Action for the Sustainable Development of Small Island Developing States and 22nd General Assembly provisions)
	Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term
	In co-operation with developing countries, develop and implement strategies for decent and productive work for youth
	In co-operation with pharmaceutical companies, provide access to affordable essential drugs in developing countries
	In co-operation with the private sector, make available the benefits of new technologies, especially information and communications technologies

APPENDIX D

Green Cities Declaration

United Nations Environment Programme
Signed by World Mayors on World Environment Day, June 5th 2005, in San Francisco, USA

Vision and implementation

THE 21 ACTIONS that comprise the Urban Environmental Accords are organised by urban environmental themes. They are proven first steps toward environmental sustainability. However, to achieve long-term sustainability, cities will have to progressively improve performance in all thematic areas.

Implementing the Urban Environmental Accords will require an open, transparent and participatory dialogue between government, community groups, businesses, academic institutions and other key partners. Accords implementation will benefit where decisions are made on the basis of a careful assessment of available alternatives using the best available science.

The call to action set forth in the Accords will most often result in cost savings as a result of diminished resource consumption and improvements in the health and general well-being of city residents. Implementation of the Accords can leverage each city's purchasing power to promote and even require responsible environmental, labour and human rights practices from vendors.

Between now and World Environment Day 2012, cities shall work to implement as many of the 21 Actions as possible. The ability of cities to enact local environmental laws and policies differs greatly. However, the success of the Accords will ultimately be judged on the basis of actions taken. Therefore, the Accords can be implemented though programmes and activities even where cities lack the requisite legislative authority to adopt laws.

The goal is for cities to pick three actions to adopt each year. In order to recognise the progress of cities to implement the Accords, a City Green Star Programme shall be created. At the end of the seven years a city that has implemented:

19 to 21 actions shall be recognised as a **four star** city
15 to 18 actions shall be recognised as a **three star** city
12 to 17 actions shall be recognised as a **two star** city
8 to 11 actions shall be recognised as a **one star** city

Urban Environmental Accords

Energy
Action 1: Adopt and implement a policy to increase the use of renewable energy to meet 10% of the city's peak electric load within seven years.
Action 2: Adopt and implement a policy to reduce the city's peak electricity load by 10% within seven years through energy efficiency, shifting the timing of energy demands and conservation measures.
Action 3: Adopt a citywide greenhouse gas reduction plan that reduces the city's emissions by 25% by 2030, and which includes a system for accounting and auditing greenhouse gas emissions.

Waste Reduction

Action 4: Establish a policy to achieve zero waste to landfills and incinerators by 2040.

Action 5: Adopt a citywide law that reduces the use of a disposable, toxic or non-renewable product category by at least 50% in seven years.

Action 6: Implement 'user-friendly' recycling and composting programmes, with the goal of reducing by 20% per capita solid waste disposal to landfill and incineration in seven years.

Urban Design

Action 7: Adopt a policy that mandates a green building rating system standard that applies to all new municipal buildings.

Action 8: Adopt urban planning principles and practices that advance higher density, mixed use, walkable, bikeable and disabled-accessible neighbourhoods that coordinate land use and transportation with open space systems for recreation and ecological restoration.

Action 9: Adopt a policy or implement a programme that creates environmentally-beneficial jobs in slums and/or low-income neighbourhoods.

Urban Nature

Action 10: Ensure that there is an accessible public park or recreational open space within half a kilometre of every city resident by 2015.

Action 11: Conduct an inventory of existing canopy coverage in the city; and then establish a goal based on ecological and community considerations to plant and maintain canopy coverage in not less than 50% of all available sidewalk planting sites.

Action 12: Pass legislation that protects critical habitat corridors and other key habitat characteristics (e.g. water features food-bearing plants, shelter for wildlife, use of native species, etc.) from unsustainable development.

Transportation

Action 13: Develop and implement a policy which expands affordable public transportation coverage to within half a kilometre of all city residents in ten years.

Action 14: Pass a law or implement a programme that eliminates leaded gasoline (where it is still used); phase down sulphur levels in diesel and gasoline fuels, concurrent with using advanced emission controls on all buses, taxis, and public fleets to reduce particulate matter and smog-forming emissions from those fleets by 50% in seven years.

Action 15: Implement a policy to reduce the percentage of commuter trips by single-occupancy vehicles by 10% in seven years.

Environmental Health

Action 16: Every year, identify one product, chemical, or compound that is used within the city that represents the greatest risk to human health and adopt a law and provide incentives to reduce or eliminate its use by the municipal government.

Action 17: Promote the public health and environmental benefits of supporting locally grown organic foods. Ensure that 20% of all city facilities (including schools) serve locally grown and organic food within seven years.

Action 18: Establish an Air Quality Index (AQI) to measure the level of air pollution and set the goal of reducing by 10% in seven years the number of days categorised in the AQI range as 'unhealthy' or 'hazardous'.

Water

Action 19: Develop policies to increase adequate access to safe drinking water, aiming at access for all by 2015. For cities with potable water consumption greater than 100 litres per capita per day, adopt and implement policies to reduce consumption by 10% by 2015.

Action 20: Protect the ecological integrity of the city's primary drinking water sources (i.e. aquifers, rivers, lakes, wetlands and associated ecosystems).

Action 21: Adopt municipal wastewater management guidelines and reduce the volume of untreated wastewater discharges by 10% in seven years through the expanded use of recycled water and the implementation of a sustainable urban watershed planning process that includes participants of all affected communities and is based on sound economic, social, and environmental principles.

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