CITY OF CAPE TOWN
State of the Environment Report 2009

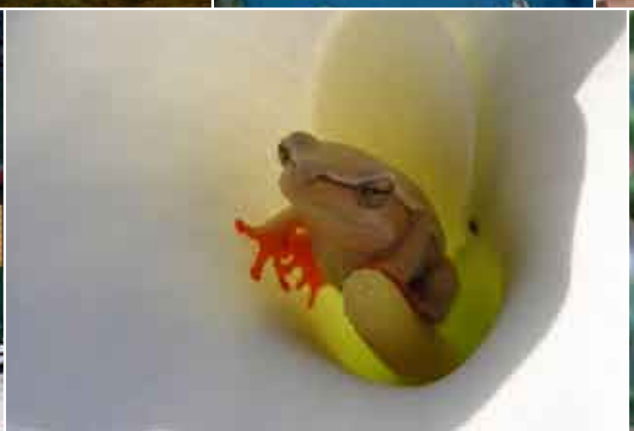
CITY OF CAPE TOWN | ISIXEKO SASEKAPA | STAD KAAPSTAD

THIS CITY WORKS FOR YOU








City of Cape Town State of the Environment Report 2009

Published by:

City of Cape Town, Environmental Resource Management Department

First edition 2010

This document should be referenced as
"City of Cape Town. (2010). City of Cape Town State of the Environment Report 2009."
(when using the APA referencing method).

This document is available in electronic format at:
www.capetown.gov.za/environment

If you are viewing an electronic version of this report, please consider your environmental responsibility before printing it.

For more information or any enquiries please contact:
Amy Davison
State of the Environment and Sustainability Co-ordinator
Environmental Resource Management Department
City of Cape Town
Telephone: 021 487 2135
E-mail: amy.davison@capetown.gov.za

Contents

List of Figures

Graphs

Tables

Maps

Foreword

Executive Mayor Dan Plato

Cape Town is a city of contrasts. On the one hand, it is a city of outstanding natural beauty, with a rich environmental and cultural heritage, globally unique biodiversity, and a thriving local economy and tourist industry. On the other hand, the city faces multiple environmental and social challenges of pollution, waste production, over-exploitation of resources, and urban sprawl.

The City of Cape Town has committed itself to balancing the need for economic growth and development with environmental sustainability. The city's economic well-being is closely linked to its natural beauty and natural assets, with tourism, the hospitality industry and location preference for homeowners and businesses forming a key pillar of its economy.

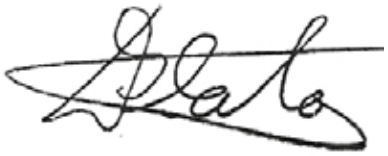
Furthermore, it is important to remember that nearly every facet of human existence is dependent on the environment; a healthy environment promotes physical health as well as psychological well-being, and provides a range of important goods and services. It is also of significant heritage importance, and therefore we have a moral duty to preserve the environment for future generations.

In order to achieve the goal of environmental sustainability, hard work is required to improve environmental management in the city, and ensure conservation of the city's natural resources, whilst minimising waste and pollution.

The 2009 State of the Environment Report provides insight into the condition of the physical environment, and provides guidance on the way forward to achieve a more sustainable city. Although some improvements have been noted in 2009, it is clear that Cape Town is falling short of certain goals it needs to meet in order to be truly sustainable. The report shows a picture of a city that is increasingly polluting the natural environment, and sacrificing rare and unique biodiversity to urban sprawl.

The value of this report lies in its ability to provide a core set of information for decision makers and the general public in an accessible and understandable manner. The main function of the publication is to show trends over time. In this way, it provides an important reference for decision makers, and allows City of Cape Town councillors and officials to work with a complete and integrated picture of the physical environment in Cape Town.

The City of Cape Town is committed to improving environmental sustainability in the city. However, it is impossible to achieve this alone. It is only through ongoing co-operation with Provincial and National Government, non-governmental and community-based organisations, the private sector and individual citizens that this goal can be achieved. I therefore urge you, the reader, to play your part in promoting environmental sustainability in Cape Town, and working towards securing a sustainable future for the city.



Dan Plato

Executive Mayor

Introduction

City Manager Achmat Ebrahim

This past year has been a significant one for environmental management in Cape Town. In June of 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.

IMEP was first adopted in 2001, and was one of the first local government environmental policies in South Africa. The Environmental Agenda builds on this strong policy 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, whilst 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 Integrated Development Plan (IDP), including the new Strategic Focus Area committed to Energy Efficiency, can be found in Appendix B. The City is also committed 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 provide 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. These accords can be read in detail in Appendix D.

This report focuses specifically on environmental and ecological indicators, and does not report on social or economic issues in the City. The State of Cape Town report is compiled by specialists in the fields of socio-economic indicators, and should be read in conjunction with this report.

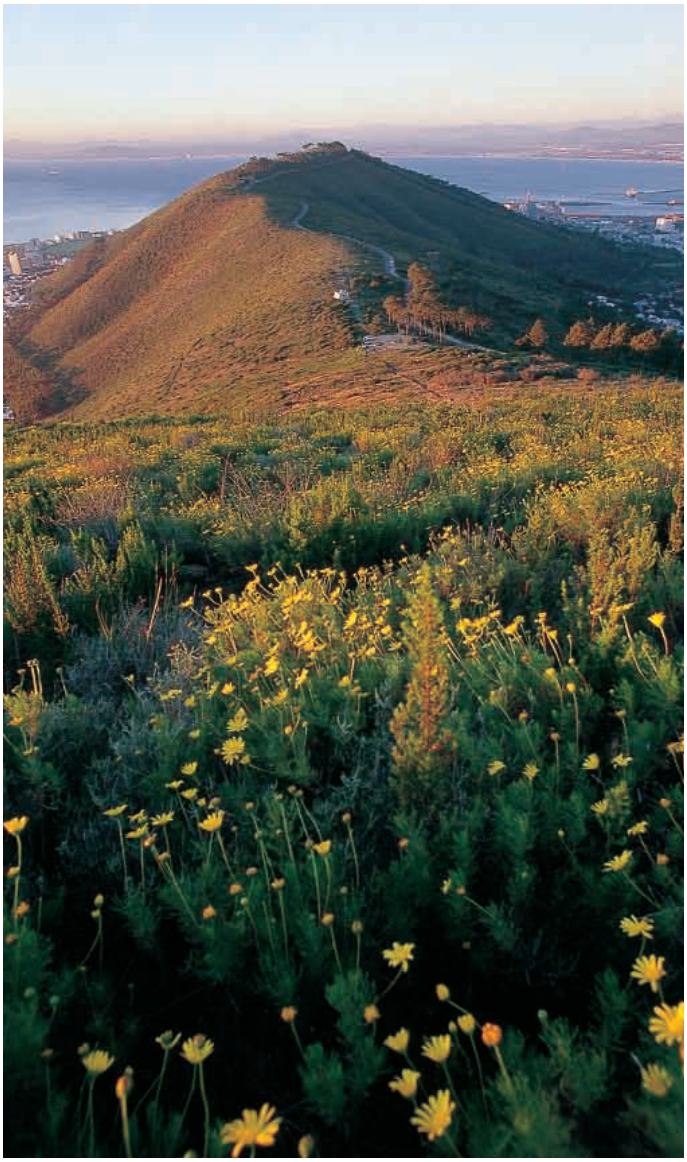
Achmat Ebrahim
City Manager

Background

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 2009 calendar year (January 2009 to December 2009). All data presented are taken from this time period, unless stated otherwise. Previous versions reported on data based on the City's financial year (i.e. July to June); this year a decision was taken to base the report on a calendar year in order to make it more user-friendly and comparable. It is therefore important to note that this report cannot be compared to figures published in last year's report, as historical statistics have been recalculated based on the calendar year format.



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[1].

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 are 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, thus:

SITUATION IMPROVING

SITUATION DETERIORATING

NO 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 and truthful conclusions about trends in the city, whilst working towards ensuring that necessary action is taken in a timely fashion.

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**

Air pollution is 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. There are many different types of air pollution, but the City of Cape Town measure only the criteria pollutants for a number of reasons: Firstly, air pollution monitoring is expensive and highly technical; therefore only the criteria pollutants, as required by the National Environmental Management: Air Quality Act (2004), are monitored. Secondly, it is unnecessary to measure every pollutant directly, as good indicator pollutants exist. In practice, this means that certain pollutants are often accompanied by other specific ones, and therefore the presence of one is an excellent indicator of the presence of the other.

The City measures the following key pollutants:
PM_{10} – particulate matter smaller than ten microns in size
SO_2 – sulphur dioxide
NO_2 – nitrogen dioxide

Sources of pollution

PM_{10} is a mixture of microscopic solid particles and liquid droplets, and could consist of a number of chemicals, soil, dust and pollen. PM_{10} can be the product of a large number of activities. In Cape Town, the most common sources of PM_{10} pollution are diesel vehicle emissions, wood and coal burning for fuel, dust from construction activities and unpaved roads, as well as wind-blown dust.

Sulphur dioxide is a colourless gas that is produced by industrial processes burning fossil fuels, as well as motor vehicle emissions. In Cape Town, the most common source of SO_2 is likely to be vehicle emissions, as there are few large industries in the city.

Nitrogen dioxide is a reddish brown gas that is produced by fossil fuel burning. Similarly to SO_2, the main source of NO_2 in Cape Town is motor vehicle emissions, with limited industrial and domestic fossil fuel burning contributing to the problem.

Effects on human health and the natural environment

PM_{10} particles are microscopic, and are thus easily inhaled. PM_{10} can cause lung irritation, and aggravate existing lung disorders and diseases, such as asthma and tuberculosis (TB)[2]. SO_2 and NO_2 can be harmful to human health when inhaled in high concentrations. These pollutants could cause lung irritations and wheezing, and could also exacerbate existing lung disorders and diseases[3].

Both NO_2 and SO_2 represent a threat to the natural environment, as both these gases are precursor chemicals needed for the formation of acid rain. Acid rain has a damaging effect on the natural environment, as it changes the acidity (pH) of freshwater systems, thus reducing their ability to function as natural ecosystems. Acid rain is also harmful to plants through the increased acidification of soils, and physical damage to leaves. Additionally, microscopic acid aerosols produced by the oxidation of SO_2 and NO_2 have been identified as possible contributors to global climate change.

Air quality standards and guidelines

During 2009 the Department of Environmental Affairs released the National Ambient Air Quality Standards which stipulate acceptable levels of pollutants. Municipalities are required to meet these 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 in order to meet the more stringent standard in the future. Until the release of these standards, 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). Only the PM_{10} standard is significantly different from those previously used by the City, and therefore for the purposes of this report, PM_{10} exceedances are reported against both the UK standard and the South African National Standard. The World Health Organisation guideline for PM_{10} is also presented for comparison purposes - this guideline, based on the level of pollution at which health effects become negligible, should be seen as something to strive towards and not a mandatory standard. It should be noted that many developed countries are unable to meet this guideline.

These standards and guidelines specify both the acceptable daily level of a pollutant, as well as the acceptable average annual level. This distinction is important, as both short-term exposure to high levels of pollutants, and long-term exposure to lower levels of pollutants are potentially harmful to human health. Standards and guidelines applicable to the Cape Town area are as follows:

South African Ambient Air Quality Standards[4]

- Annual average NO_2 level: no more than 40 µg/m^3 (micrograms per cubic meter)
- Annual average SO_2 level: no more than 50 µg/m^3
- Annual average PM_{10} level: no more than 50 µg/m^3 (interim standard 2009 - 2014)
- Daily Average PM_{10} level: no more than 120 µg/m^3
- Number of exceedances of daily average PM_{10} level: no more than 4 annually per site

UK standards and WHO guidelines (PM_{10})[5,6]

- Annual average PM_{10} level: no more than 20 µg/m^3
- Daily Average PM_{10} level: no more than 50 µg/m^3
- Number of exceedances of daily average PM_{10} level: no more than 35 annually per site

State of the environment

Figures 1 - 5 present the measurements taken in Cape Town between 2005 and 2009. It is difficult to determine general trends for the city, as air pollution is often a localised and seasonal event. However, in most cases, air pollution has decreased in 2009.

In general, average annual NO_2 measurements have remained at low levels across Cape Town, and have remained below the limit amount. The Central City experiences the highest levels of NO_2 pollution - this is largely due to vehicle emissions from the large number of cars and taxis entering the city daily.

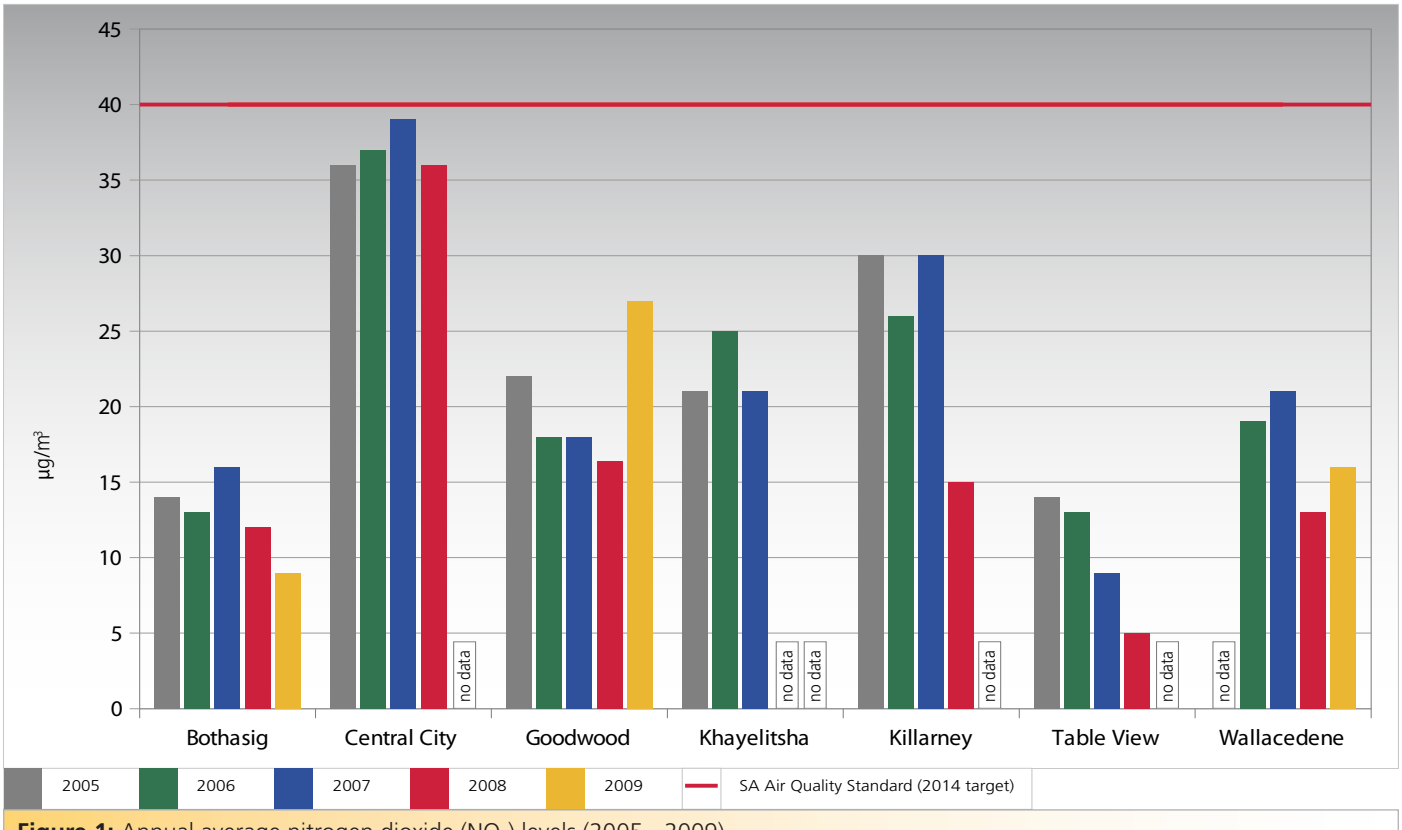


Figure 1: Annual average nitrogen dioxide (NO_2) levels (2005 - 2009)

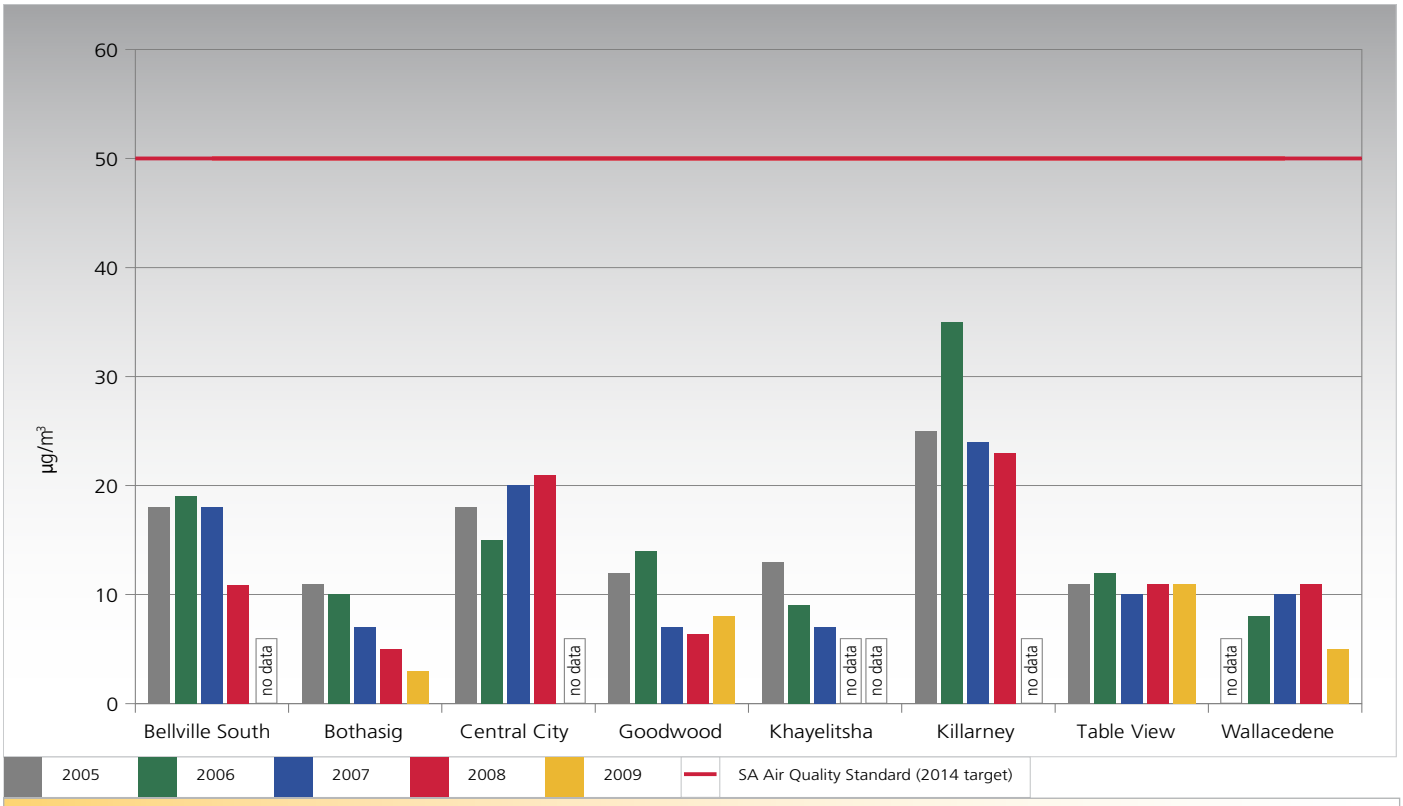


Figure 2: Annual average sulphur dioxide (SO_2) levels (2005 - 2009)

It is encouraging to note that SO_2 emissions have consistently been well below the specified limit level. A gradual decrease in SO_2 at some sites in recent years may be due to the increased use of low-sulphur fuel products as well as the effect of industries upgrading their systems to decrease emissions.

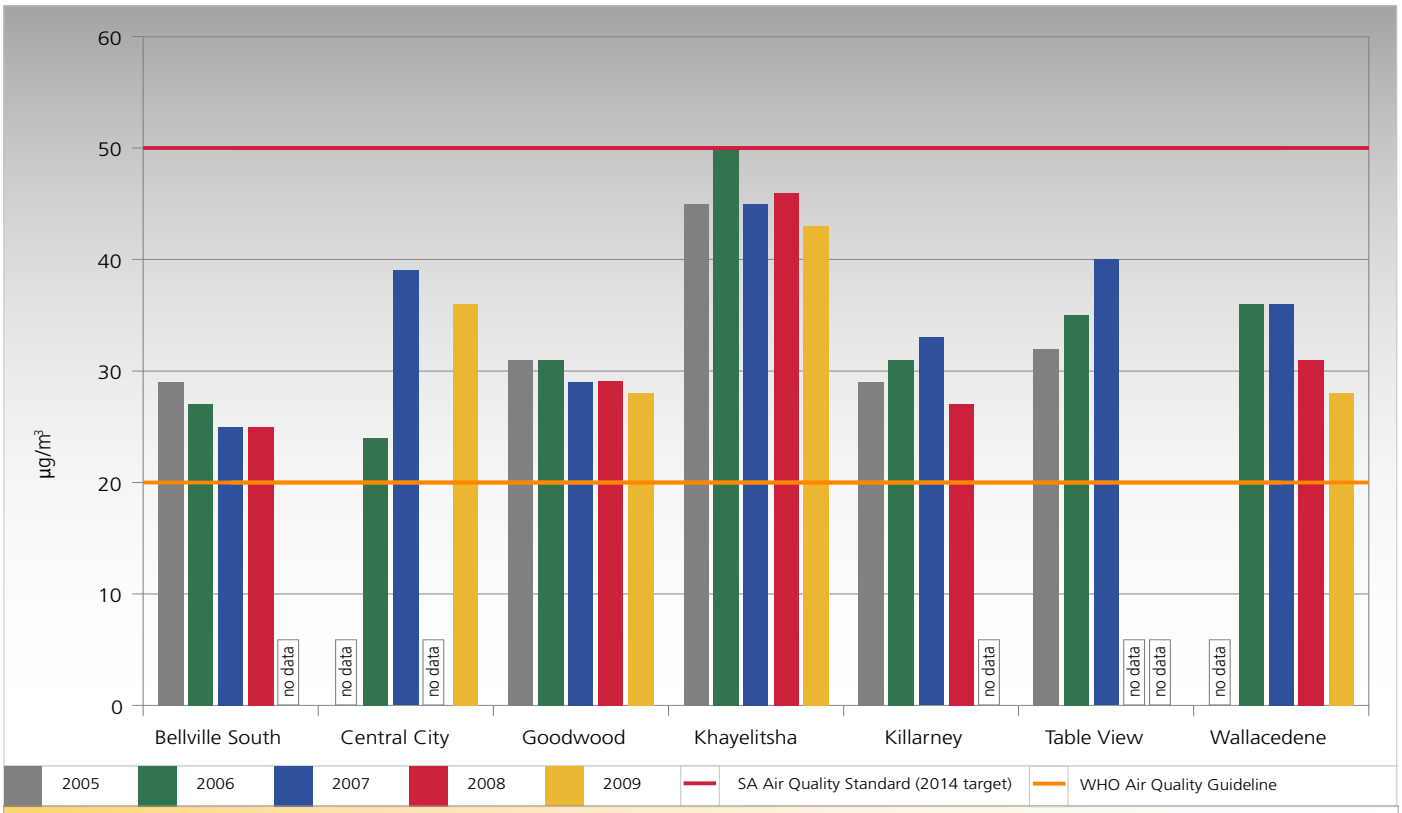


Figure 3: Annual average particulate matter (PM_{10}) levels (2005 - 2009)

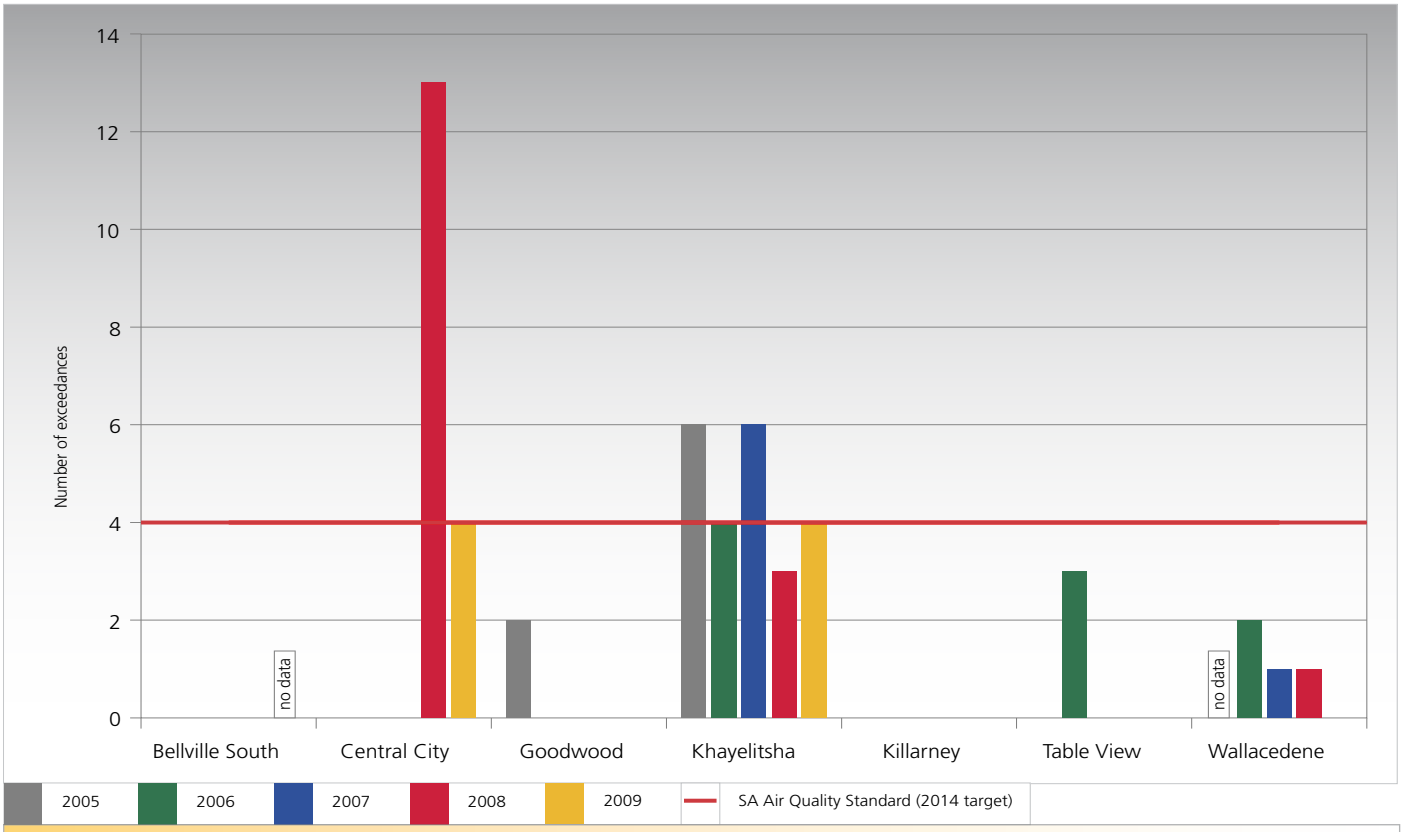


Figure 4: Number of exceedances of South African PM10 standard (2005 - 2009)

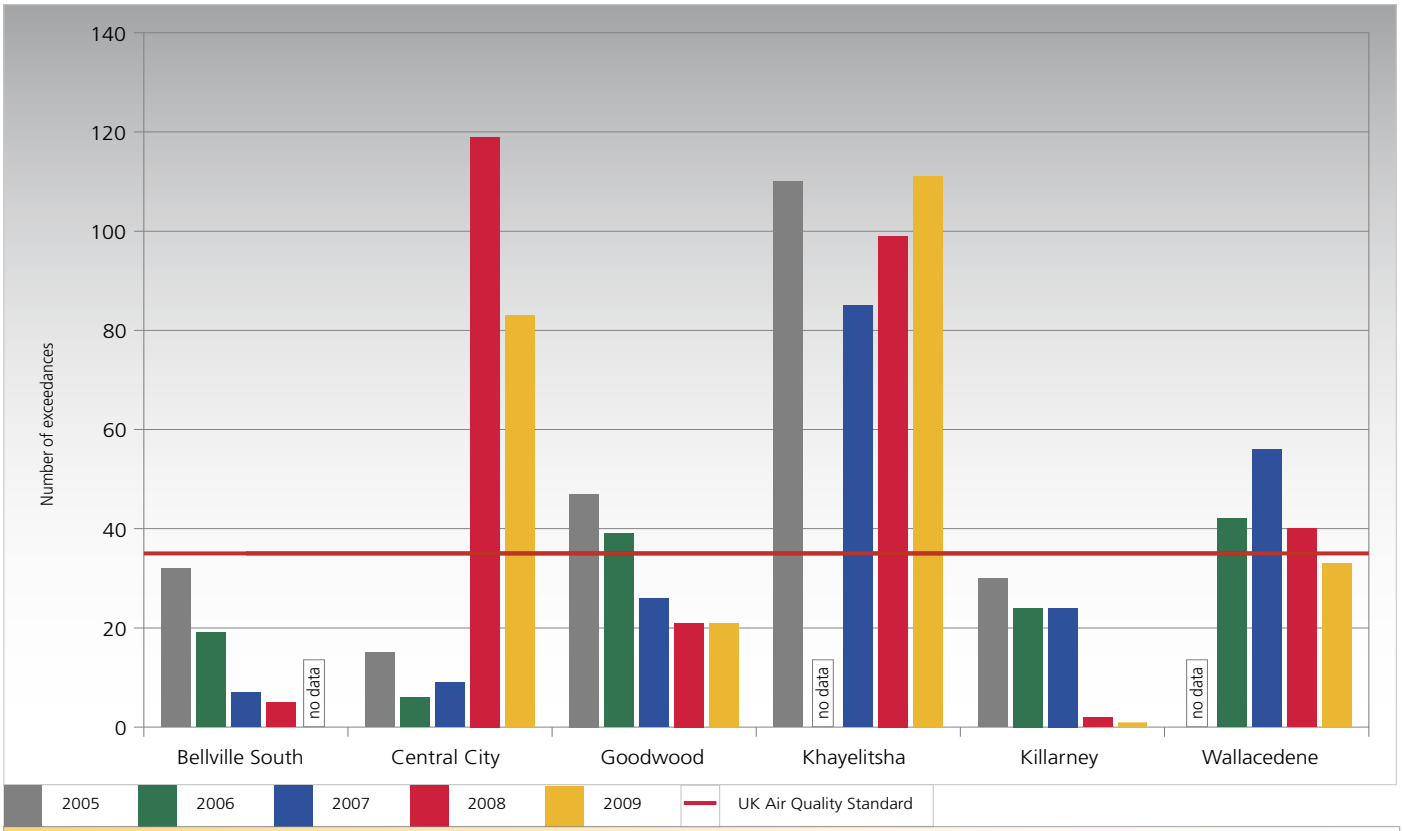


Figure 5: Number of exceedances of UK PM10 standard (2005 - 2009)

Figures 3 to 5 clearly demonstrate the extent of PM_{10} pollution in Cape Town. In terms of the annual average limit (figure 3), Cape Town complies with the interim SA standard, which is in force until 2014. It is also important to note that during 2009 there were no more than 4 exceedances of the daily limit (figure 4) at any monitoring site, in compliance with the standard. In previous years however, there have been significantly more exceedances of the daily limit. PM_{10} pollution is therefore of key concern to the City.

Figure 3 also shows that although the national Standard is being met, PM_{10} levels in Cape Town far exceed the recommended guideline by the WHO. Figure 5 shows that the Central City, Khayelitsha and Wallacedene have consistently exceeded the daily UK standard value for PM_{10}. DEFRA recommends a limit of no more than 35 instances of exceeding the daily guideline per year. The drastic increase in PM_{10} pollution observed during 2008 and 2009 in the Central City is a result of building and construction work in the area which generated significant amounts of fine dust.

Analysis

It is always difficult to confirm whether 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. However, in 2009, air quality in Cape Town has generally improved, as there have been fewer declines than improvements. It is also very important to note that in 2009 Cape Town was in full compliance with the relevant SA Standards. The City's Air Quality Management Plan (AQMP) provides a framework for managing and reducing air pollution in the city, and the success of this plan is monitored on an ongoing basis.

Air quality remains a matter of concern for the City, especially in poorer areas. For example, Khayelitsha has an above average incidence of TB[7], which could be significantly exacerbated by air pollution. The Khayelitsha Air Pollution Strategy has therefore been established to address this very problem. Interventions that succeed in Khayelitsha could be extended and applied to other densely populated semi-informal settlements in the city. Sources of PM_{10} pollution in Khayelitsha have been determined to be dust, exacerbated by the presence of unpaved roads and large unplanted areas, as well as vehicle emissions and smoke from cooking and heating fires.

During 2005, industries in the Bellville South area also spent large amounts of money to improve the area's air quality by reducing their PM_{10} and NO_2 emissions. An improvement is clearly visible when comparing the number of instances when guideline levels were exceeded (and the concentration levels at such times) before and after the industries' intervention.

It is important for prevention efforts to be maintained and stepped up in order to ensure that high standards of air quality continue to be achieved. PM_{10} pollution across the city and NO_2 pollution in the city centre are of particular concern. PM_{10} pollution varies from one year to the next, and will often increase during periods of intense construction. NO_2, on the other hand, is closely linked to vehicle emissions, and therefore higher levels are to be expected in an area with high vehicle traffic such as the city centre. This poses both a health and environmental risk, which will continue to be actively monitored. Other programmes that will reduce air pollution in the city are the promotion of non-motorised transport such as bicycles, and the upgrade of public transport systems, both aimed ultimately at having fewer vehicles on the road.

Trend and target

Trend: Generally improved since 2008. In most cases, steady improvement over past three years.
Target: Environmental Agenda 2014 Target: Full compliance with SA Ambient Air Quality Standards.
Current: In all cases, the 2014 Environmental Agenda target of achieving compliance with the SA Ambient Air Quality Standards has been achieved.

Policy linkages

IDP 2010/11 Top 20 Objective: 7A.2 - Reduce Air Pollution.
Environmental Agenda 2009-2014: Target 3 - Air Quality.
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 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'.
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:

Carbon Dioxide Footprint (page 11)

Carbon Dioxide Footprint

Indicators
- **The total amount of CO_2 and CO_2 equivalents produced per person through energy consumption**
- **Carbon emissions by fuel source**
- **Energy use by sector**

Sources of CO_2

Carbon dioxide (CO_2) – a colourless, odourless gas – is a by-product of numerous human activities, primarily the burning of fossil fuels for electricity generation and transport purposes (see Figure 8 for percentage breakdown of energy use). In South Africa, almost 90% of the main electricity supply is generated through coal burning. Coal is one of the dirtiest fuels available, and produces massive amounts of pollutants as well as high levels of CO_2 when burned - burning 1 tonne of coal produces approximately 2,4 tonnes of CO_2![8]

Similarly, petroleum and diesel fuels used in motor vehicles also produce CO_2, with 1 kℓ (1 000ℓ) of petrol producing 2,3 t of CO_2, and 1 kℓ of diesel producing 2,6 t of CO_2. By comparison, 1 kℓ of liquid petroleum gas (LPG, which can also be used to power motor vehicles) produces only 1,5 t of CO_2. A more important measure for motor vehicles, however, is the CO_2 produced per kilometre travelled, which provides an indication of engine efficiency. Newer, fuel-efficient cars, especially those with modern diesel engines, can emit as little as 98 g of CO_2 per kilometre, whilst sports utility vehicles (SUVs) and luxury cars can emit more than 230 g per kilometre. The average vehicle in the UK emits approximately 180 g of CO_2 per kilometre[9]; South African statistics are not available.

The problem with CO_2

CO_2 is a greenhouse gas. Greenhouse gases have a negative impact on the environment, as they artificially increase the ability of the atmosphere to retain the Earth's heat. This increases the energy available in the Earth's systems, and has been identified as the leading cause of anthropogenic (human-induced) climate change. Climate change is expected to have significant economic, social and environmental impacts, including sea-level rise, hotter average temperatures and an increase in extreme weather events.

Measuring the carbon footprint

Carbon footprint refers not only to the CO_2 that is produced in Cape Town through vehicle emissions and industry, but also the emissions produced elsewhere in South Africa to support the energy behavioural patterns of the citizens of Cape Town, in this case at the coal-burning power plants primarily in Mpumalanga. This indicator is not updated annually, as data are extremely difficult to obtain.

In 2009, new software was obtained which allowed for more accurate calculation of the city's carbon footprint, based on improved energy conversion factors. Therefore, data from 2002 - 2006 must be treated with caution. The data presented here is from 2007, as this year - before the national energy shortage - is being used as the baseline for the City's energy efficiency and retrofitting work and thus sufficiently detailed data was available. More recent data will be available in the next State of the Environment Report.

State of the environment

In 2007, Cape Town produced an average of **6,73 t of CO_2 equivalents per capita**, indicating an increase of 290 kg per capita since 2002. Figures 6 and 7 show a trend of increasing total and per capita CO_2 emissions. Data from 2002 - 2006 is less accurate than 2007 data, and therefore should not be directly compared.

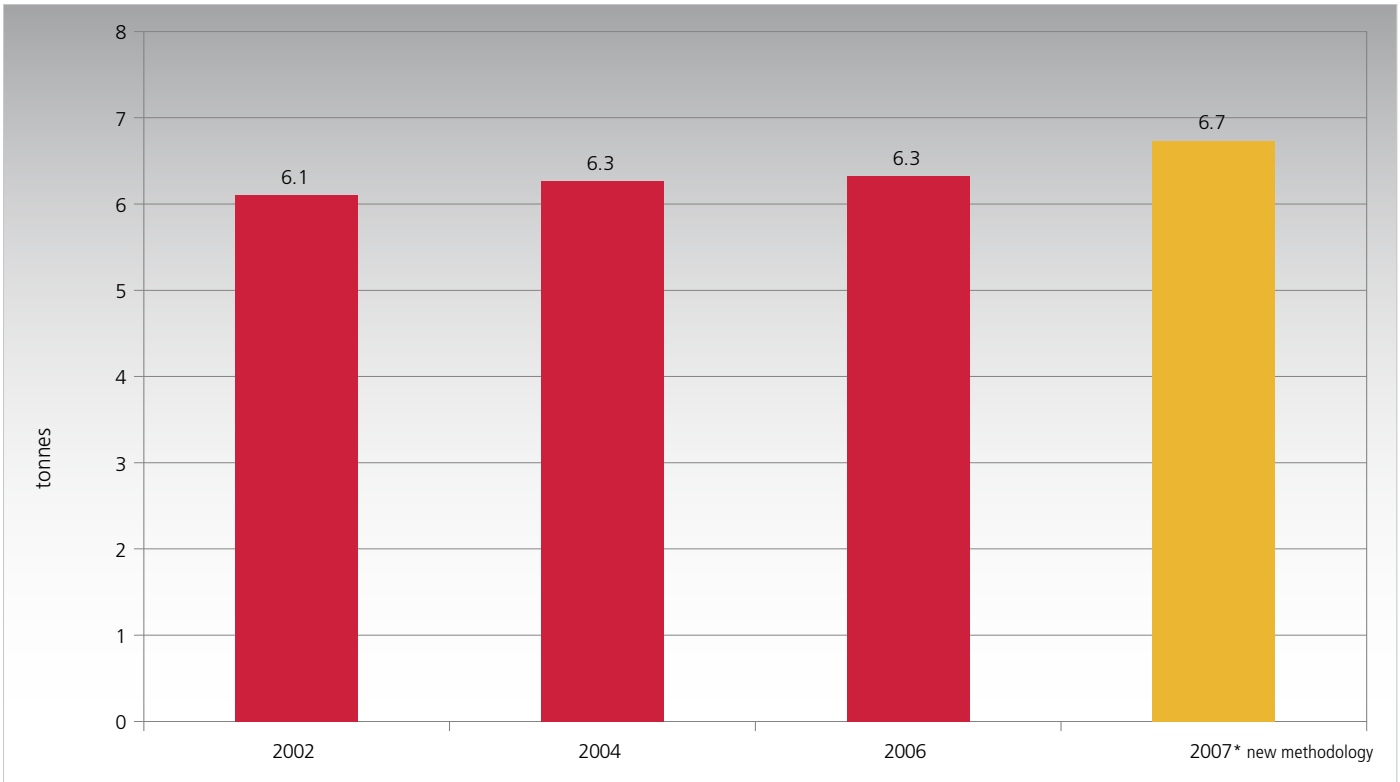


Figure 6: Carbon dioxide emissions per capita, annually

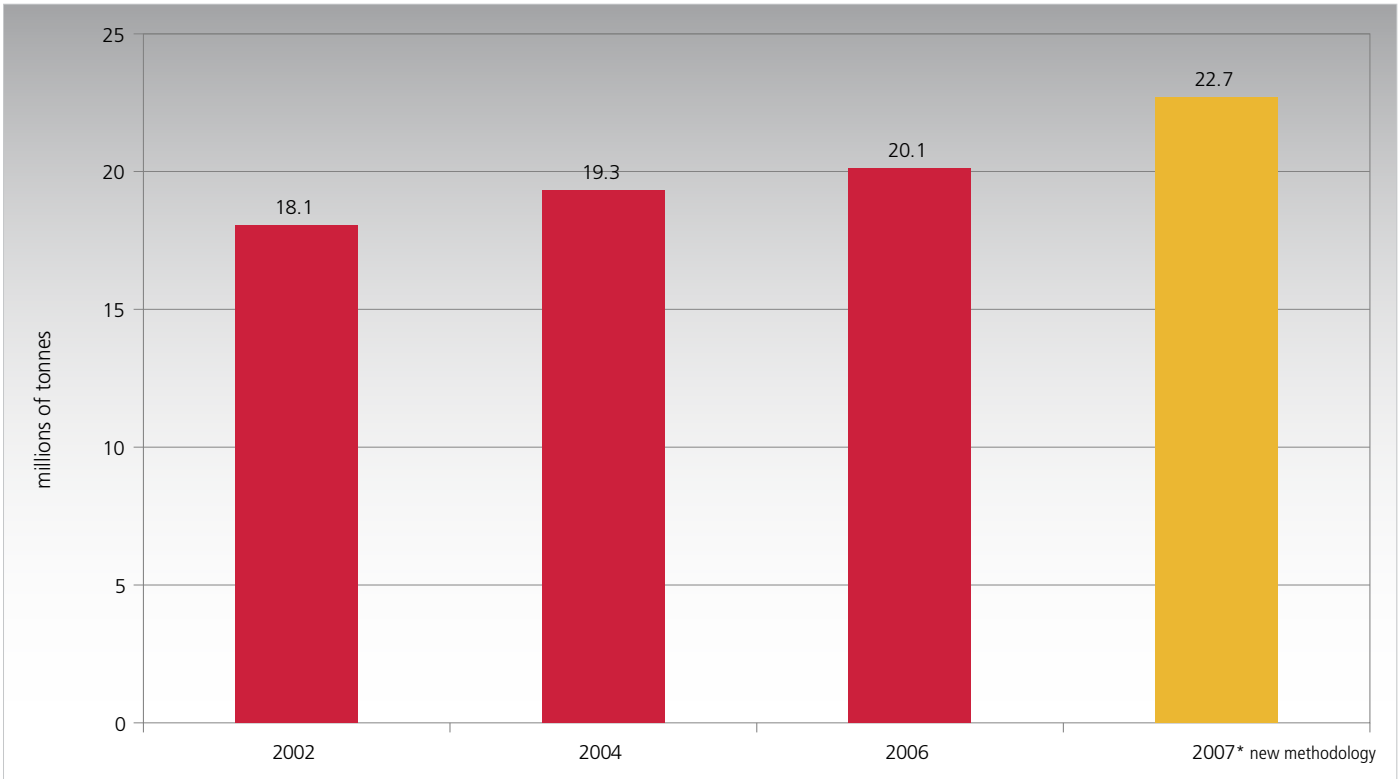


Figure 7: Total annual carbon dioxide emissions

It is clear from figures 8 and 9 that the main source of carbon emissions in Cape Town is from electricity - this is largely due to the high carbon footprint of coal, as opposed to petroleum products. Figure 8 shows that energy use by sector is fairly evenly split between residential, commercial and transport uses, with industrial and local government uses comprising a smaller proportion. This is in line with the general mix of the city's economy - it has little heavy industry, with a significant amount of commercial and service based economic activity.

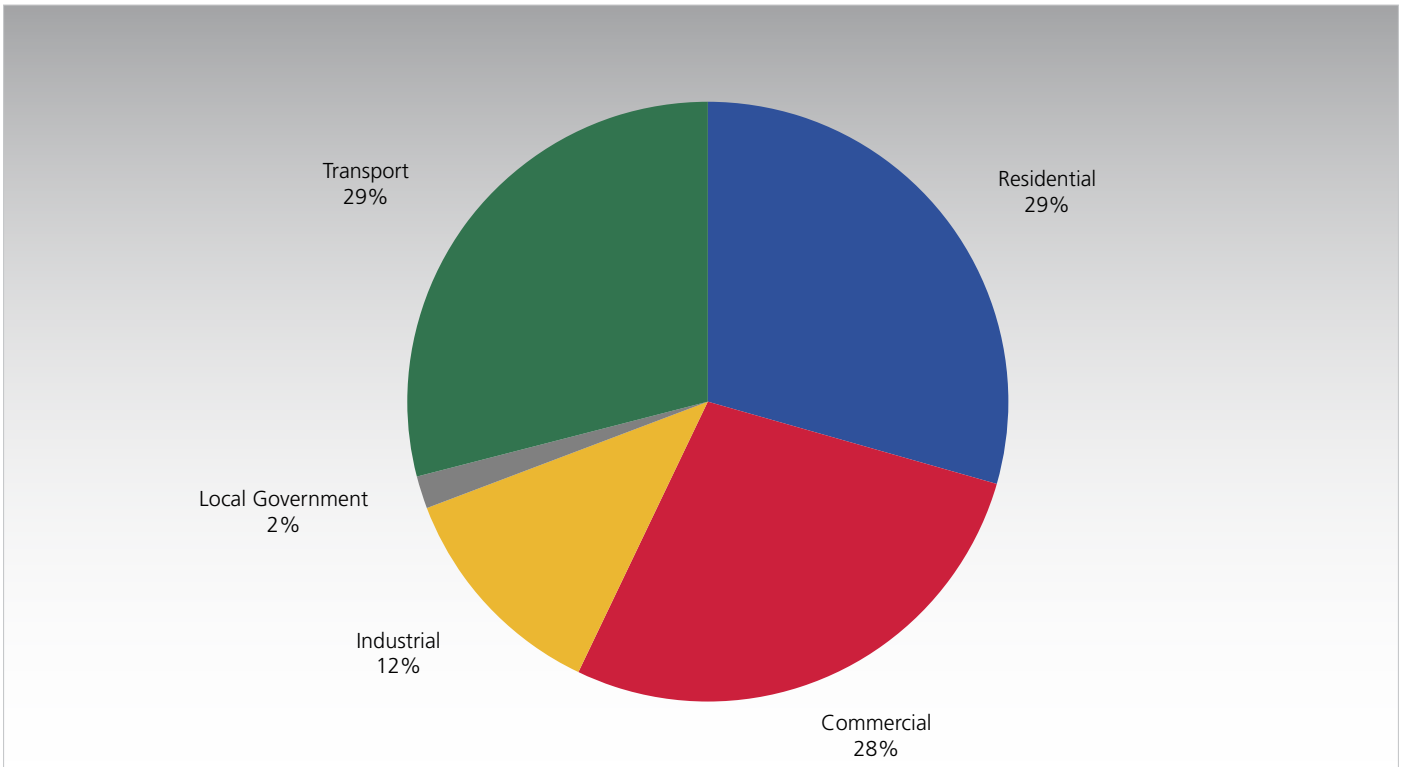


Figure 8: Energy use, by sector

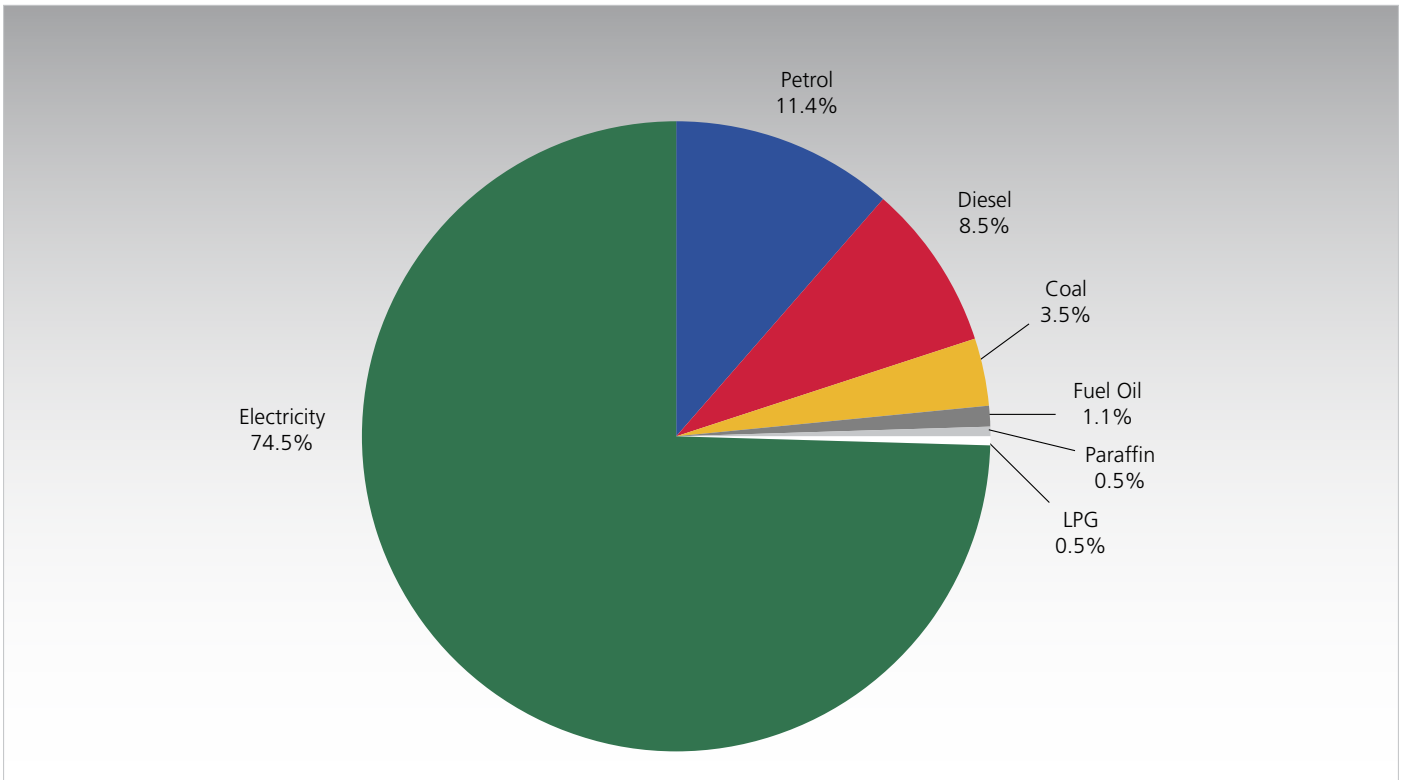


Figure 9: Carbon emissions, by energy source

Analysis

Any increase in per capita CO_2 production – no matter how slight – is too much. Climate change has the potential to be the most devastating event of the 21st Century, and therefore all citizens have a responsibility to reduce their CO_2 footprint. South Africa is one of the top twenty carbon polluters in the world, and it is therefore imperative that action is taken to reduce Cape Town's contribution to these emissions.

However, it is important to note that 2007 and 2008 saw a number of significant changes that may have reduced energy usage, and may thus have a positive impact on future measurements of CO_2 equivalent emissions. Perhaps most notable of these was the programme of pre-emptive load shedding initiated by Eskom. In addition, the City has embarked on a comprehensive education campaign aimed at raising awareness of CO_2, and encouraging more sustainable energy use, including the promotion of alternative technologies and green energy. Also, the City is in the process of developing an Energy Efficient Water Heating By-law, which seeks to make the installation of energy-efficient water heaters (including solar water heaters) mandatory in all new and existing buildings with a floor area of more than 100m^2. The City of Cape Town is committed to offset carbon emissions from significant once-off events, such as the 2010 FIFA World Cup™. These offset projects will have long-term environmental and social benefits for Cape Town.

At the same time, rapid increases in both the petrol price and the general cost of living have occurred. Therefore, in an effort to try to reduce travel costs whilst also reducing CO_2 and other harmful emissions from private cars, the City is in the process of implementing an integrated rapid transit system, which is designed to promote the use of public transport in the city. The first phase of this project was started in 2009, and includes an inner city loop service, as well as a commuter service along the west coast.

Trend and target

Trend: Carbon dioxide footprint remains at unacceptably high levels and is increasing over time.
Target: Per capita carbon footprint will be reduced to an annual average of 5 tonnes (a total of 20 million tonnes) of $C0_2$.
Current: Per capita carbon footprint is approximately 6.7 tonnes annually, with a city-wide total of 22.7 million tonnes annually.

Policy linkages

Environmental Agenda 2009-2014: Target 5 - Carbon Dioxide Footprint.
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 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.
Energy and Climate Change Strategy: A city-wide strategy that sets goals and targets for climate change mitigation and adaptation measures.

See also:

Air Quality (page 6)

Biodiversity

Indicators
- **Percentage of natural vegetation remaining, by type**
- **Conservation status of natural vegetation, by type**
- **Percentage of Biodiversity Network under formal conservation**

Cape Town is located in the heart of the Cape Floristic Region (CFR), the world's smallest and most diverse floral kingdom. As such, it is an area of unique biodiversity that is of globally important conservation value. 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', making it one of the planet's 25 most threatened ecosystems, and placing an international responsibility on Cape Town to ensure its adequate conservation. The City currently owns and operates 24 nature reserves; however, over two thirds of the city's natural vegetation types are classified as 'endangered' or 'critically endangered', and over 300 of Cape Town's plant species are threatened with global extinction.

Vegetation types

Plants occurring in Cape Town are classified according to national vegetation types as well as regional sub-types that occur due to differing underlying soil conditions. Types and sub-types fall under one of the following general categories, although it is important to note that significant variations occur between the types within a specific category.

Mountain fynbos

As the name suggests, mountain fynbos tends to grow on both upper and lower mountain slopes. The higher and steeper sandstone types are largely isolated and protected from human development, and therefore generally remain non-transformed. Fynbos in general is characterised by its small and fine leaves, its bushy nature, and its ability to thrive in poor soils and hot, dry conditions. Mountain fynbos comprises seven types: Peninsula Sandstone Fynbos, Kogelberg Sandstone Fynbos, Cape Winelands Shale Fynbos, Elgin Shale Fynbos, Peninsula Granite Fynbos, Boland Granite Fynbos, and Cape Peninsula Shale Fynbos. The peninsula vegetation types are endemic to the city, and can only be conserved here. Plants that characterise this type include proteas, such as the King Protea, Sunshine Conebush and Tree Pincushion, as well as Cape reeds (*Restionaceae*), and ericas and other fine-leaved shrubs.

Lowland Fynbos

Lowland fynbos occurs in parts of the city most affected by human settlement and agricultural development: the lowlands, flats and plains. Lowland fynbos is therefore highly threatened by extinction due to human activities, and has more threatened species per area than anywhere else in the world. 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 to Cape Town, and can only be conserved here. Plants that characterise this type include numerous erica species, including *Erica verticillata* and *Erica turgida* (now extinct in the wild), proteas such as the Cape Flats Conebush, Cape reeds (*Restionaceae*) and bulbous plants of the lily and iris families.

Strandveld

As is suggested by the name, strandveld grows along the coast, and is commonly found in sand dune systems. Strandveld has been considerably impacted by coastal development, and therefore only approximately 15% of its original extent is conserved or managed. Plants that characterise this type include Sea Guarrie (*Euclea racemosa*), Blombos (*Metalasia muricata*), Bietou (*Osteospermum monilifera*), annual daisies and numerous succulent vygie species. Cape Flats Dune Strandveld is endemic to Cape Town.

Renosterveld

Literally translated, renosterveld means 'rhinoceros bush', and may have derived its name from the fact that in the past, rhinoceroses were commonly found in these areas of Cape Town. 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. Renosterveld on the West Coast is one of the most threatened vegetation types in South Africa, with less than 3% of its original extent remaining. In Cape Town, about 8% of all renosterveld vegetation types remain. Peninsula Renosterveld is

endemic to Cape Town, and can only be conserved here. Renosterveld is dominated by the grey, low-growing Renosterbos (*Elytropappus rhinocerotis*), but in its natural state would be 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.

Causes of biodiversity loss

The primary reason for biodiversity loss in Cape Town is the destruction of indigenous vegetation and faunal habitat by human development, including agriculture, the construction of houses, commercial buildings and industry. Much of the city's natural vegetation was lost before it was widely recognised that it was unique (endemic) to Cape Town. Invasion by alien vegetation also causes biodiversity loss, as alien species crowd out indigenous ones, and eventually create a monoculture of alien plants or animals.

State of the environment

Table 1 shows the current state of biodiversity conservation in Cape Town. It is important to note the conservation status of each vegetation type, as well as the percentage remaining of these types. In some cases, almost nothing of the original extent of these vegetation types remains – these types are thus a critical priority for conservation efforts in Cape Town. Maps 2 and 3 show the likely historical distribution of vegetation types in Cape Town, and the current remaining fragments, whilst maps 3 and 4 show the conservation status of these remnants. The maps are classified according to national vegetation types. It is important to note that although some types may have experienced significant losses within the borders of the city, they are still conserved outside of Cape Town, and therefore the table provides the national ecosystem status.

CR	Critically Endangered
EN	Endangered
VU	Vulnerable
LT	Least Threatened

National vegetation type in Cape Town	Historic extent in Cape Town (ha)	Remnant area in Cape Town (ha)	Percent remaining	Target: (% of original to be conserved)	Extent conserved (ha)	Percent of remnant conserved	Percent of original conserved	National ecosystem status	
								2004[10]	2009[11]
Swartland Alluvium Fynbos	1 742	76	4%	30%	0	0%	0%	CR	CR
Swartland Shale Renosterveld	46 712	4 019	9%	26%	408	10%	1%	CR	CR
Lourensford Alluvium Fynbos	4 819	410	9%	30%	190	46%	4%	CR	CR
Peninsula Shale Renosterveld	2 375	317	13%	26%	262	83%	11%	CR	CR
Cape Flats Sand Fynbos	54 410	8 467	16%	30%	464	5%	1%	CR	CR
Swartland Silcrete Renosterveld	1 067	188	18%	26%	0	0%	0%	CR	CR
Swartland Granite Renosterveld	8 059	1 952	24%	26%	36	2%	0.4%	CR	CR
Elgin Shale Fynbos	841	321	38%	30%	5	1%	1%	CR	CR
Cape Flats Dune Strandveld	39 960	19 072	48%	24%	2 820	15%	7%	EN	EN
Peninsula Granite Fynbos	9 146	3 921	43%	30%	2 757	70%	30%	EN	EN
Atlantis Sand Fynbos	25 235	15 712	62%	30%	0	0%	0%	EN	CR
Cape Winelands Shale Fynbos	3 930	2 397	61%	30%	905	38%	23%	EN	VU
Boland Granite Fynbos	9 575	6 064	63%	30%	355	6%	4%	EN	VU
Hangklip Sand Fynbos	3 302	1 910	58%	30%	1 364	71%	41%	VU	VU
Cape Lowland Freshwater Wetlands	1 464	1 095	75%	24%	787	72%	54%	VU	CR
Western Shaleband Vegetation	329	329	100%	30%	31	9%	9%	LT	LT
Kogelberg Sandstone Fynbos	9 500	9 261	97%	30%	1 944	21%	20%	LT	CR
Peninsula Sandstone Fynbos	21 896	21 349	98%	30%	17 307	81%	79%	LT	EN
Southern Afrotemperate Forest	348	347	100%	34%	277	80%	80%	LT	LT

Table 1: Natural vegetation remaining, by type (2009)

Note: 2009 criteria are provisional

Analysis

Cape Town's natural and endemic vegetation, and the floral and faunal biodiversity it represents, is under severe threat. A detailed mapping exercise was completed in 2009 which provided accurate information on remaining areas. The data shown in this report can be considered a baseline from which future measurements can be made, and losses can be accurately determined.

It is clear from the data that the city's biodiversity is severely threatened. 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: 84% of Cape Flats Sand Fynbos, 91% of Swartland Shale Renosterveld, and 52% of Cape Flats Dune Strandveld.

It is important to note the change in conservation status of a number of vegetation types between 2004 and 2009; this is due to a reassessment of the area based on additional and revised criteria. Specifically, the 2004 assessment was based on the percentage of the vegetation type that had been lost, whilst the 2009 assessment included an assessment of the number of threatened species within each type. 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.

It is also important to note that Cape Town encompasses no fewer than six endemic national vegetation types, which means that these six types can only be conserved within the boundaries of Cape Town. Furthermore, three of these vegetation types are considered critically endangered, and remnants will need to be conserved both within and outside of the urban edge. Cape Town is perhaps the only city in the world where unique biodiversity must be conserved within the urban fabric.

In 2002, the conference of the parties to the Convention on Biological Diversity set a minimum target, which requires 10% of the historical extent of vegetation to be conserved. South Africa is a party to the convention. It is clear that Cape Town will definitely not be able to meet the target for at least three of its vegetation types, as there is already less than 10% of them remaining. Furthermore, owing to the high levels of species endemism and high turn-over in species composition within vegetation types in the CFR, the 10% target mentioned above is considered hopelessly inadequate to conserve the region's biodiversity. Most CFR vegetation types require a conservation target of between 20% and 35% of the historical extent to ensure that 70% of biodiversity is conserved.

The City of Cape Town has set its own conservation goals and targets through the establishment of the Biodiversity Network (see map 1). The Biodiversity Network consists of a series of interconnected critical biodiversity sites, ranging from pristine habitats, to less well preserved but important connectivity sites. **Currently, 42% of the network is under formal conservation management.** The network also forms a crucial part of the City's long term development planning, which aims to ensure that natural sites are preserved, while still allowing for economic and social growth and development.

Conservation and rehabilitation of natural vegetation is ongoing throughout Cape Town, but requires significantly more resources – both financial and human – in order to ensure that the minimum targets are met. In order for this to be achieved, it is necessary for all levels of government as well as private enterprise and the citizens of Cape Town to understand the global significance of the city's biodiversity, and the pressing need for conservation before it is too late.

In order to promote improved conservation management in Cape Town, in 2008 the City signed the Durban Commitment and the Countdown 2010 Declaration, both of which represent a commitment of political leadership and support to the conservation and sustainable management of biodiversity in Cape Town. Cape Town is also one of 21 cities from around the world taking part in the ICLEI - Local Governments for Sustainability Local Action for Biodiversity (LAB) project, which aims to enhance and protect biodiversity in an urban context. The Durban Commitment is the second of the five steps in the LAB project, and commits the participants to regular biodiversity monitoring, assessment and reporting.

Through the recognition of the Biodiversity Network, the City has taken a decisive step towards ensuring that its biodiversity is conserved in the future. The Biodiversity Network is a systematic fine-scale conservation plan for the City. It consists of a network of sites with significant biodiversity, including those that are formally declared as such, and those that should be formally conserved in the future. Where possible, the sites form corridors and links across the city, with the intention of ensuring that habitats do not become isolated. In 2009 this plan was incorporated into the City's Spatial Development Framework, thus mapping out a future for the city in which biodiversity concerns feature prominently in decision making.

Trend and target

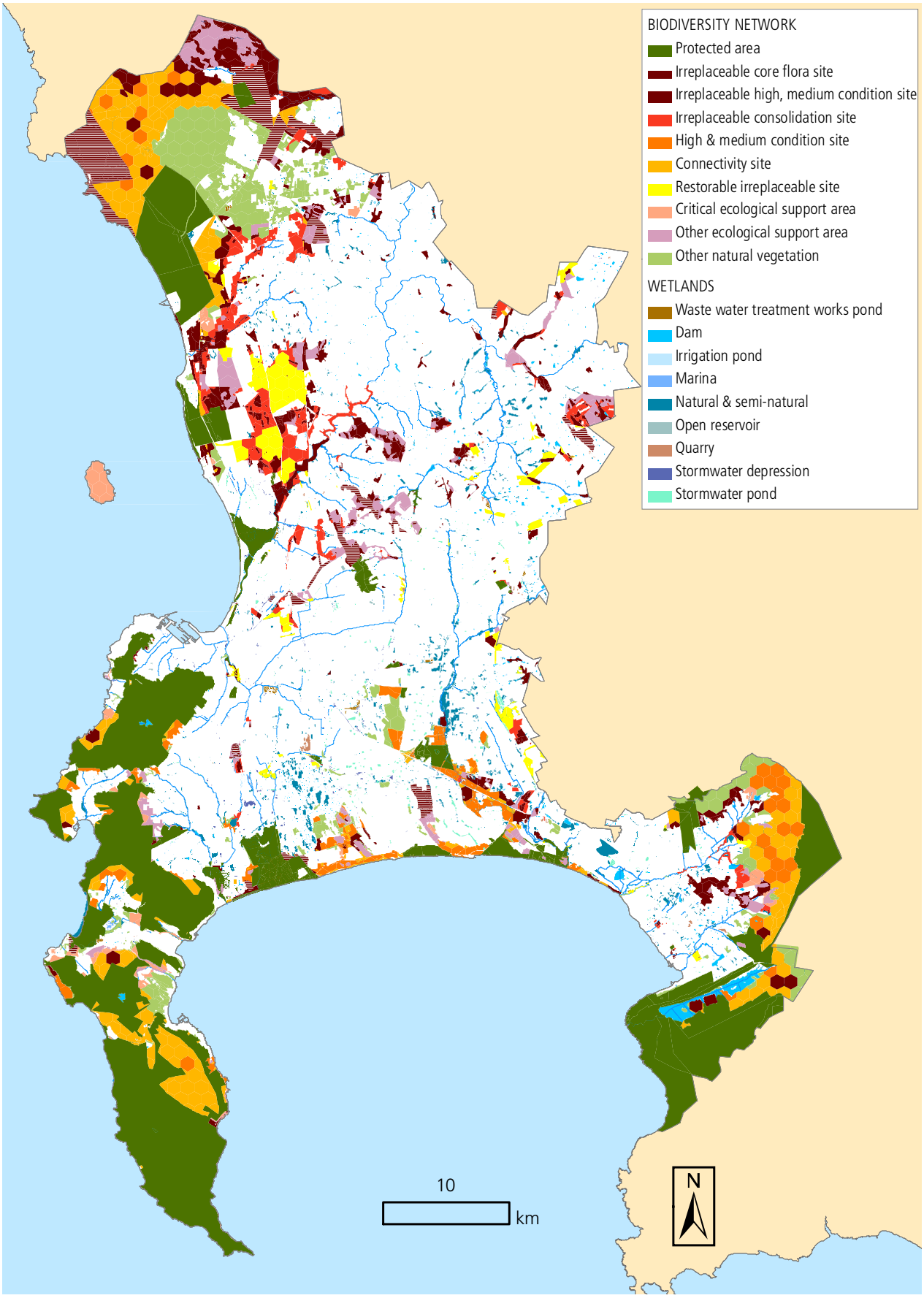
Trend: Biodiversity remains under threat, with insufficient areas under formal conservation.
Target: Environmental Agenda 2014 Target: 60% of the Biodiversity Network formally conserved.
Current: 42% of the Biodiversity Network is currently under formal conservation management.

Policy linkages

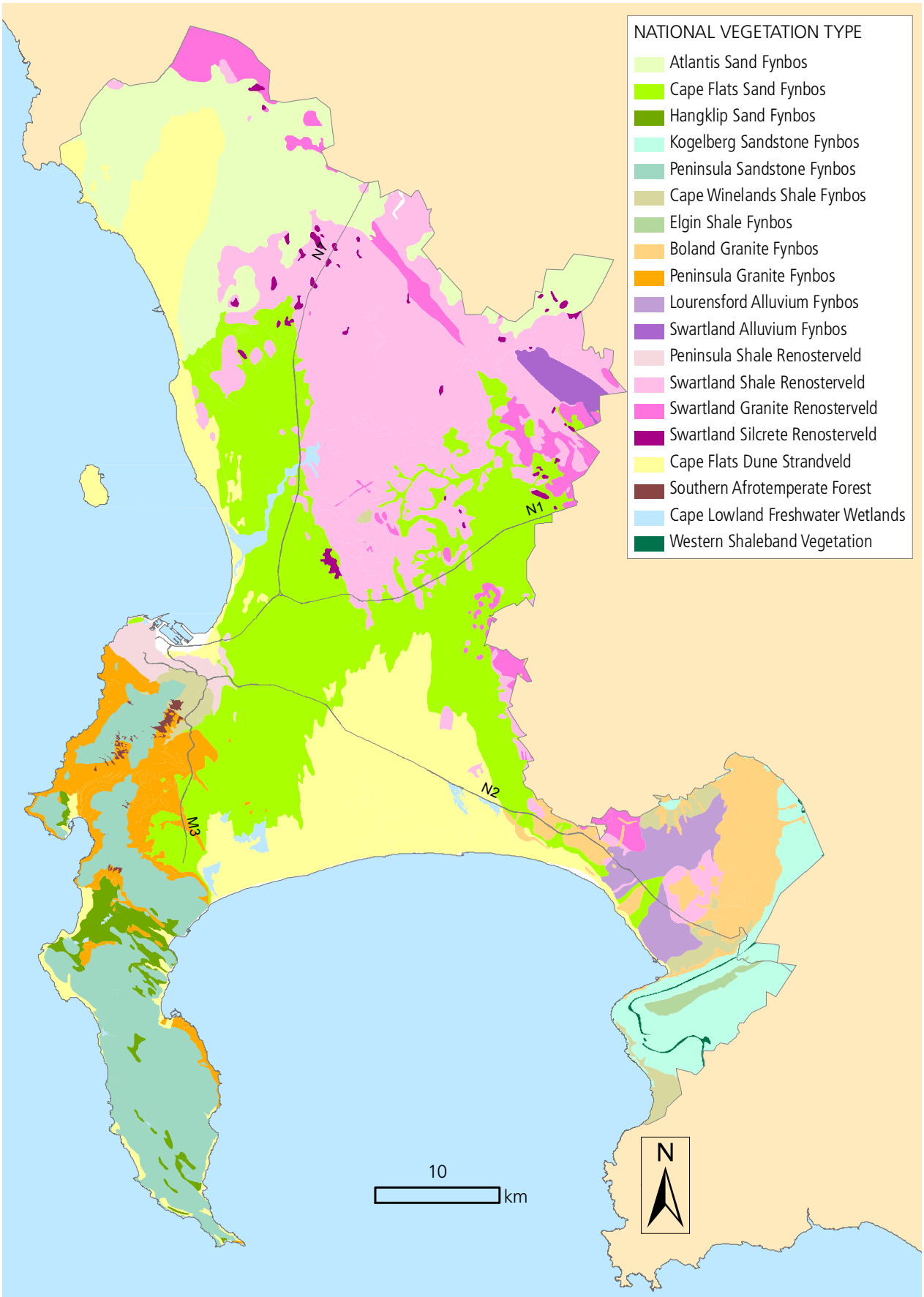
Environmental Agenda 2009-2014: Target 1 - Biodiversity.
MDG Goal 7: Target 9 – Integrate the principles of sustainable development with country policies and programmes, and reverse the loss of environmental resources.
Biodiversity Strategy: A product of IMEP, which provides a strategic framework for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

See also:

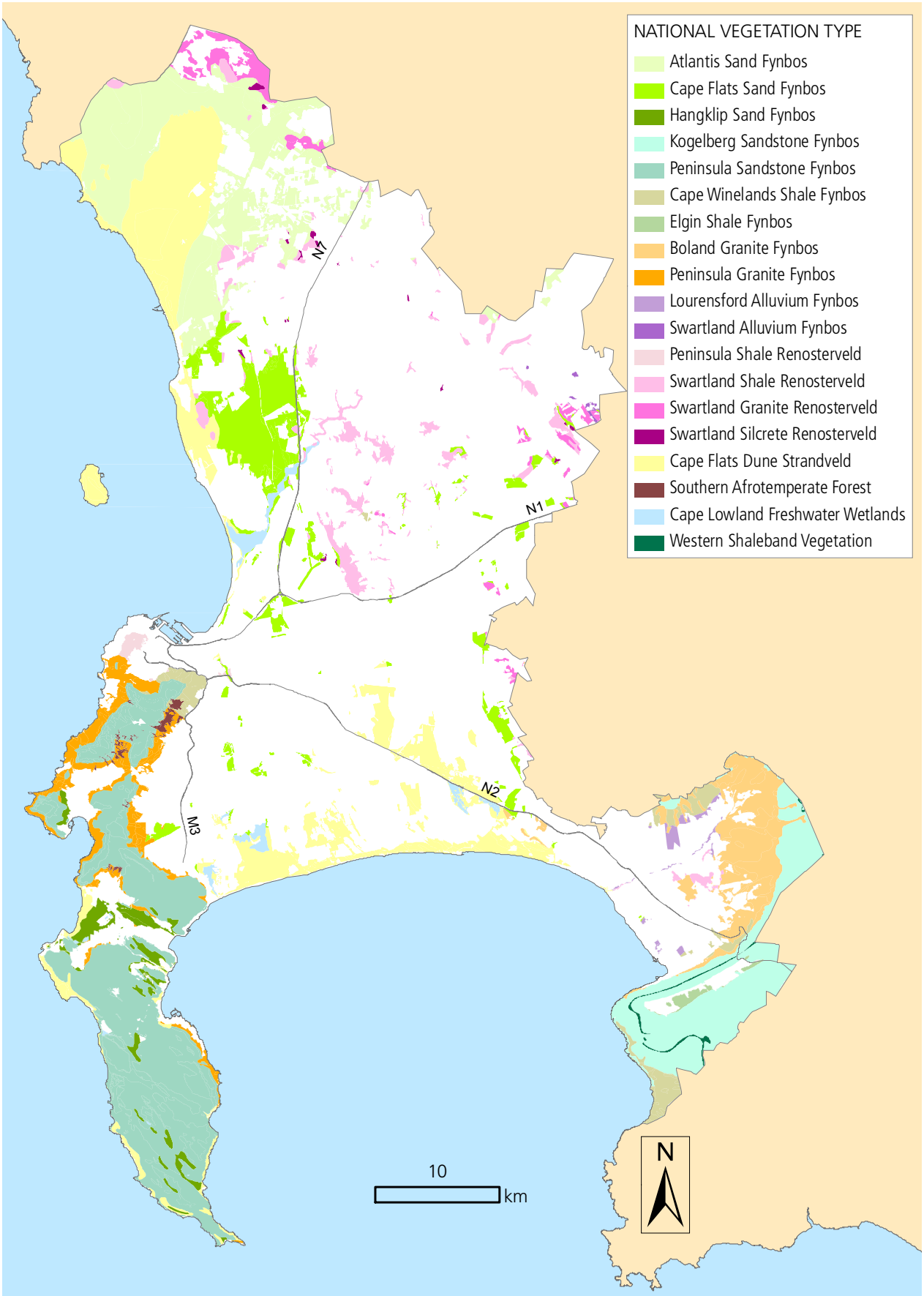
Invasive Alien Species (page 24)
Access to Nature (page 29)



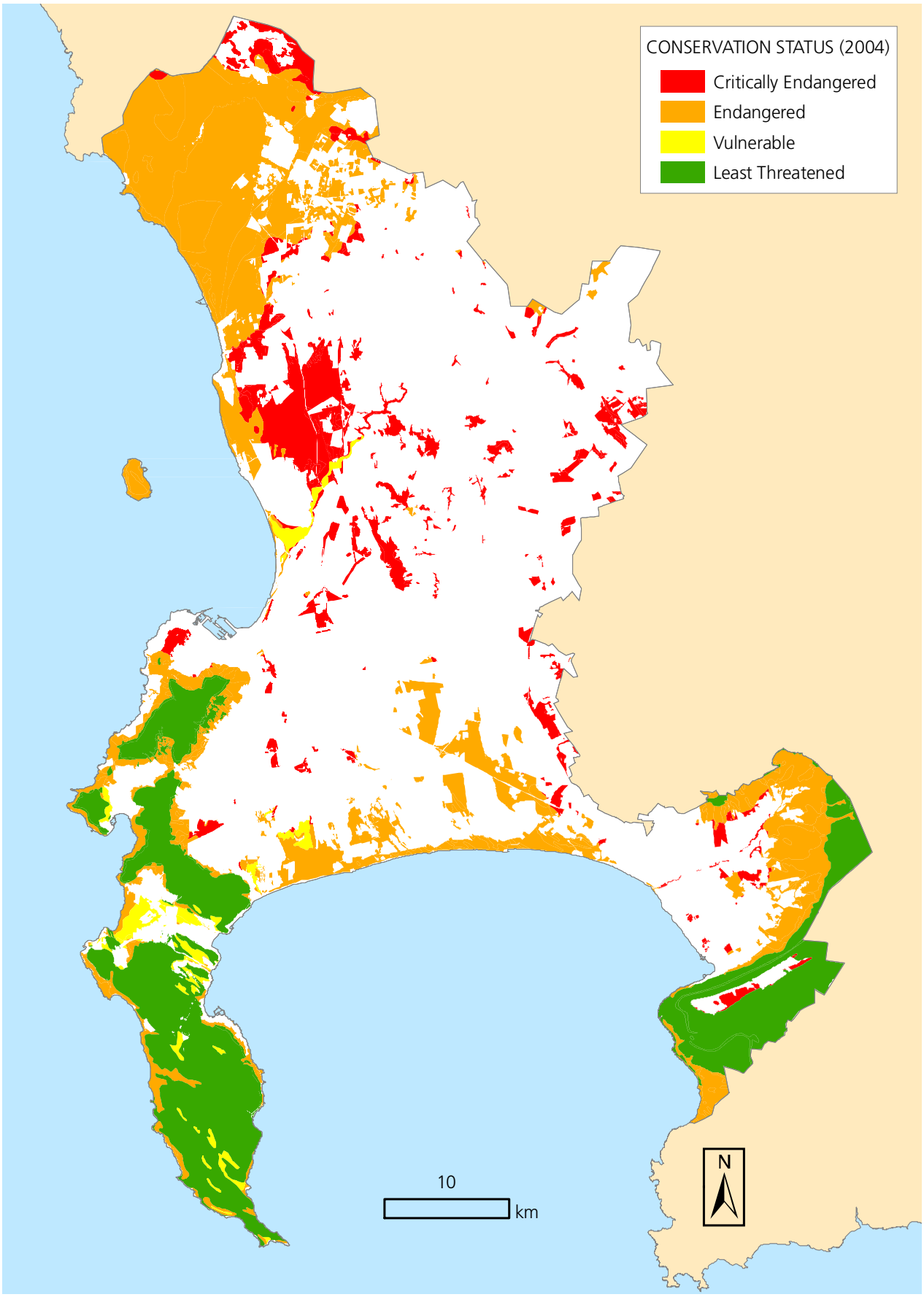
Map 1: Biodiversity Network, including wetlands (2009)



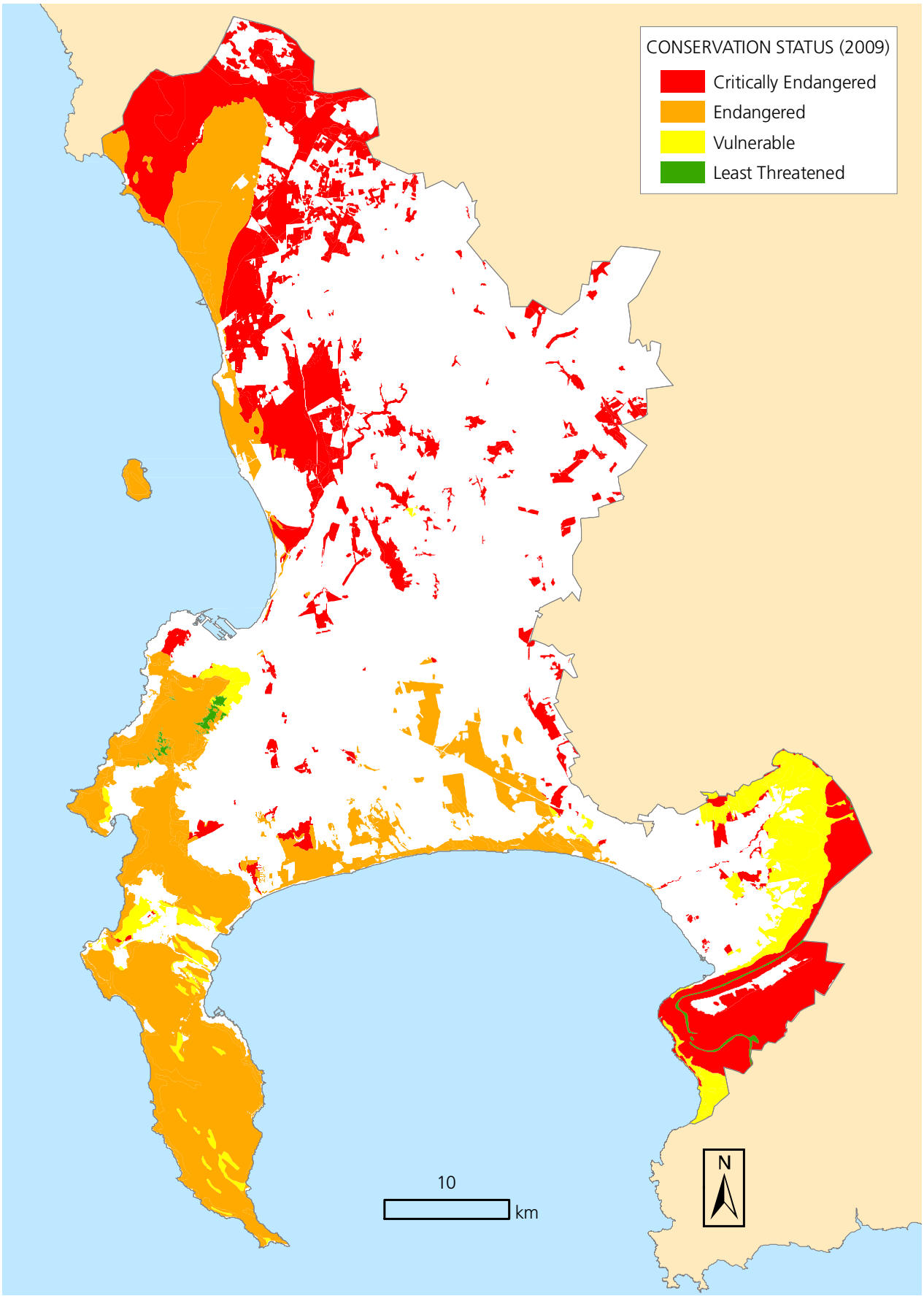
Map 2: Historical vegetation (national types)



Map 3: Vegetation remnants (national types)



Map 4: Ecosystem status by national vegetation type (2004 criteria)



Map 5: Ecosystem status by national vegetation type (2009 criteria)

Invasive Alien Species

Indicators

- **Proportion of land invaded by invasive alien plants**
- **Occurrence of invasive alien animal populations**

Alien species are defined by the Global Invasive Species Programme as "non-native organisms that cause, or have the potential to cause, harm to the environment, economies, or human health"[12]. Invasive alien species are those which become established in natural or semi-natural habitats, with the effect of disrupting ecosystems by reducing biological diversity, changing fire regimes, causing erosion and the loss of fertile topsoil. Many alien plant species were brought to the city by well-intentioned people, with the aim of stabilising sand dunes, for ornamental purposes, or providing shade. Alien species consist of both plants and animals. Some invasive animal species such as the Indian House Crow, Mallard duck, Carp, Norwegian rat and various invertebrate species have also become established in the city.

The problem with invasive alien species

Invasive alien species are problematic for a number of reasons, including the following:

- Alien plants grow rapidly and out-compete and crowd out indigenous vegetation, thus changing habitats and causing a loss of biodiversity.
- Alien animals outcompete, prey on and interbreed with indigenous animals, thus changing the balance of ecosystems.
- When alien plants burn they 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.
- Certain alien plants use significantly more water than indigenous species, thus reducing precious water supplies.
- Some alien plants are nitrogen-fixing, which means that they lock nutrients into the soil. This has a negative impact on indigenous plants, as fynbos grows best in nutrient poor soils.
- Alien invasive species have negative social impacts: dense stands of alien plants provide a screen for criminal activities and alien animals such as the house crow may spread disease.
- Alien aquatic plant species are problematic since they can block waterways, which may contribute to flooding problems and change the aquatic species composition.

Prominent invasive alien plant species (terrestrial)

1. **Port Jackson** (*Acacia saligna*) - a highly flammable Australian shrub/tree, which transforms landscapes, increases fire risk and depletes water resources.
2. **Rooikrans** (*Acacia cyclops*) - a highly flammable Australian shrub/tree, which transforms landscapes, increases fire risk and depletes water resources.
3. **Kikuyu Grass** (*Pennisetum clandestinum*) - fast growing turf grass that displaces indigenous species, and depletes water supplies. It is commonly cultivated in gardens and on golf courses.
4. **Gum Tree** (*Eucalyptus spp.*) - a highly flammable Australian tree which increases fire risk and depletes water resources.
5. **Pine** (*Pinus spp.*) - a fast growing coniferous tree which invades mountain fynbos and forest ecosystems, outcompetes indigenous plants, and increases fire risk. Some pine plantations have become valuable recreational areas for surrounding communities, and many residents oppose clearing of alien pines.
6. **Manatoka** (*Myoporum tenuifolium monatum*) - a highly toxic shrub which commonly invades dune systems and watercourses.
7. **Australian Myrtle** (*Leptospermum laevigatum*) - an Australian shrub which invades sandy areas, and forms dense stands which crowd out indigenous vegetation.
8. **Patterson's Curse** (*Echium plantagineum*) - a highly invasive flowering plant, which crowds out indigenous vegetation. It produces up to 30 000 seeds per square metre of infestation, making it extremely difficult to control.
9. **Black Wattle** (*Acacia mearnsii*) - a nitrogen-fixing tree which crowds out indigenous vegetation, increases fire risk, and depletes water resources.

Prominent invasive alien plant species (aquatic)

1. **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 human and animal diseases.
2. **Water Lettuce** (*Pistia stratiotes*) - a floating water weed which forms dense mats that impact recreational activities, agriculture, and the ecosystem, and decreases water quality.
3. **Red Water Fern** (*Azolla filiculoides*) - a floating water weed which forms dense mats that impact on agriculture, industry, tourism and the ecosystem, as well as displacing indigenous

species. It is extremely fast growing, and can cover a water body in a matter of months.

4. **Parrot's Feather** (*Myriophyllum aquaticum*) - a rooted water weed which forms dense mats that impact on the ecosystem and recreational activities. Particularly dense infestations of shallow water bodies have been known to cause flooding and change draining patterns.
5. **Kariba Weed** (*Salvinia molesta*) - a floating water weed which forms dense mats that impact on recreational activities and agriculture, decreases water quality, and displaces indigenous species. This plant is extremely fast growing, and mats can double in area in as little as a few days.

Prominent invasive alien animal species

1. **Indian House Crow** (*Corvus splendens*) - the current house crow population in the city is estimated to be in the region of 10,000 birds. This species is an aggressive feeder which out-competes indigenous birds and is a vector for diseases, including cholera, salmonella, and typhoid.
2. **Mallard Duck** (*Anas platyrhyncos*) - outcompetes and hybridises with indigenous species, threatening them with genetic takeover.
3. **Argentine Ant** (*Linepithema humile*) - alters fynbos ecosystems by out-competing indigenous ant species, on which many fynbos plants are dependent for seed dispersal. The argentine ant does not disperse seeds.
4. **Common Carp** (*Cyprinus carpio*) - originally introduced as a game fish, this large species uproots plants and disturbs sediments, causing widespread habitat damage. It also out-competes indigenous fish species.
5. **Brown Rat** (*Rattus norvegicus*) - impacts on biodiversity by outcompeting with and preying on indigenous species. These rats also spread disease, and threaten crops by feeding upon them.

Methods of Control

By far the best method of controlling invasive alien species is preventing the species from becoming established in a particular area; the City works in partnership with the SANBI Early Detection and Rapid Response programme to detect and eradicate new invasions at an early stage and thus prevent them from establishing viable populations.

For areas that are already invaded there are a number of methods of control:

- Manual - digging out or uprooting small plants by hand. Care must be taken not to further disturb soils.
- Mechanical - using loppers, handsaws and chainsaws to cut down larger plants.
- Chemical - in conjunction with other methods, registered herbicides are applied to tree stumps and new growth.
- Fire - large stands of dense alien vegetation which are isolated from human settlements are often best controlled by burning. Follow up clearing then takes place to control re-growth.
- Biocontrol - natural predators of alien species are introduced in order to reduce growth. This most often works by reducing seed abundance, thus preventing plants from reproducing. This has been somewhat successful in the control of *Acacia saligna*.
- Restoration - where most of an area has been cleared, active rehabilitation of indigenous plants may allow them to re-establish themselves and eventually out-compete alien plants.

State of the environment

In 2009, the City completed a mapping exercise of planning districts B (Milnerton), E (Somerset West) and F (Khayelitsha) in order to determine the extent of alien plant invasion in protected areas, the Biodiversity Network, and other public open space and vacant land. Map 6 provides an overview of this work, together with results of an earlier mapping exercise which covered protected areas across the city. Mapping of the remaining five districts will take place as resources become available.

Five main species were identified as being problematic in these districts. In order of the severity of the infestation, these were:

1. *Acacia saligna* (Port Jackson)
2. Pine species
3. Eucalyptus species
4. *Acacia cyclops* (Rooikrans)
5. *Pennisetum clandestinum* (Kikuyu grass)

Density of invasion	Area invaded (ha)	Percentage of total area mapped
0.00 - 0.01 %	590.6	0.9%
0.02 - 1.00 %	15 515.9	22.8%
1.01 - 5.00 %	7 806.1	11.5%
5.01 - 25.00 %	11 419.3	16.8%
25.01 - 50.00 %	14 738.9	21.7%
50.01 - 75.00 %	12 503.7	18.4%
75.01 - 100.00 %	5 415.5	8.0%

It is clear from the data that significant proportions of the city's natural open spaces are infested with invasive alien plant species. Most of this infestation (38.5%) falls into the "moderately invaded" category (between 5% and 50%), whilst 35.2% falls into the "lightly invaded" category (less than 5%), and 26.4% falls into the "severely invaded" category (more than 50%).

In order to maximise resource efficiency and cost effectiveness, resources for alien 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.

Analysis

Infestation by alien invasive species is one of the biggest threats to the city's globally unique and important biodiversity.

Generally, land that falls within the protected areas suffers from less infestation with alien plants than land outside of the areas. The City is in the process of implementing the Invasive Alien Species Strategy, which aims to improve coordination, integrate alien control efforts and increase their efficiency and efficacy. Currently, many different role-players in the City, including various city line functions, national government, utilities providers, NGOs, and local communities are engaged in clearing operations. The strategy will ensure that these different groups begin to operate with a common vision and plan, thus improving the success rate of control operations.

Invasive alien plant clearing operations are carefully recorded and monitored in order to ensure that accurate data was captured. Between January and December 2009, approximately 3 442 hectares of land were cleared. It is extremely 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.

Trend and target

Trend: Invasive alien plant and animal species are a significant threat to Cape Town's biodiversity, and reduce the quality of public open spaces.

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 data currently available.

Policy linkages

Environmental Agenda 2009-2014: Target 2 - Alien Invasive Species.

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

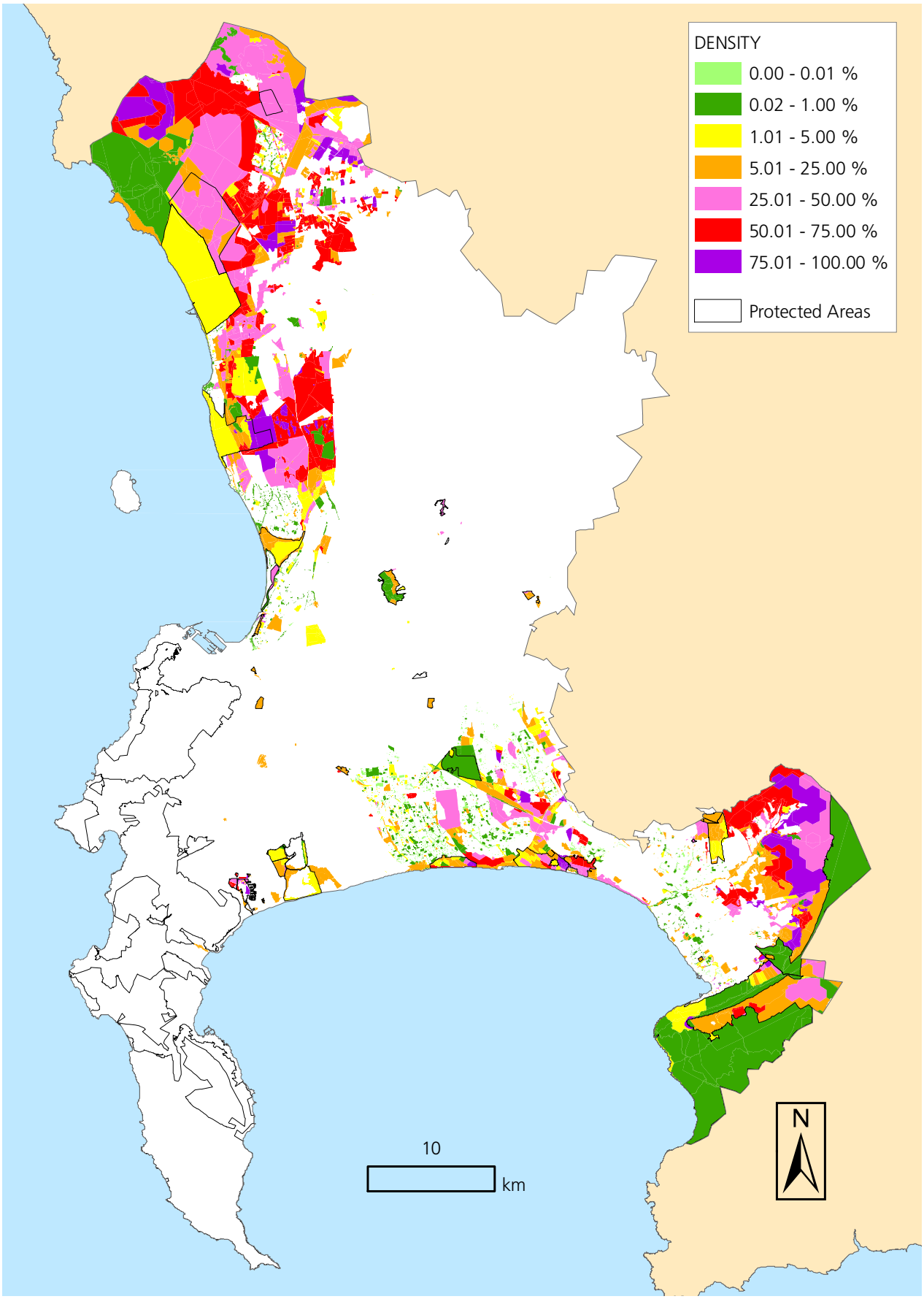
Urban Environmental Accord: Action12 - Pass legislation that protects critical habitat corridors and other key habitat characteristics (e.g. water features, food-bearing plants, shelter for wildlife, use of native species, etc.) from unsustainable development.

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: http://www.capeaction.org.za

See also:

Biodiversity (page 15)



Map 6: Distribution and density of invasive alien plant species (2009)

Access to Nature

Indicators
- **Residential proximity to managed natural open space**
- **Amount of managed natural open space per person**

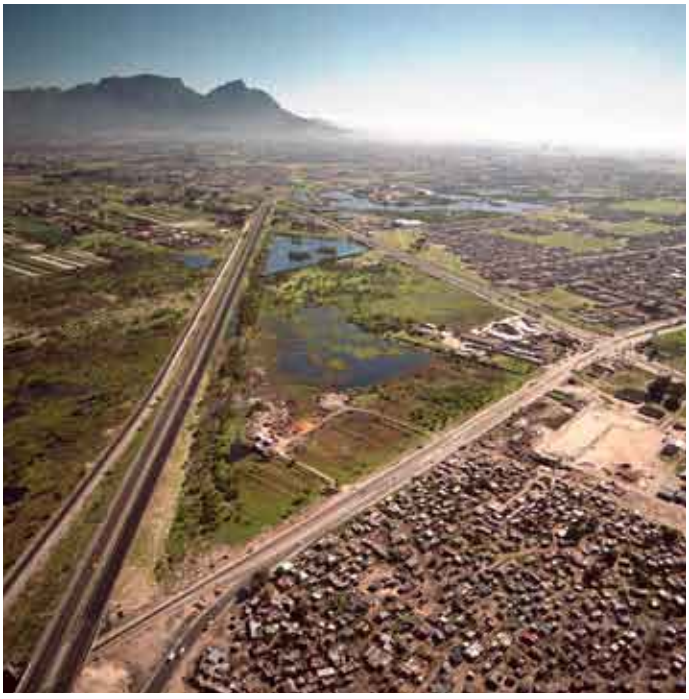
Accessibility of managed natural green space and nature reserves is a key measure of a healthy city. Natural green space provides a range of important social benefits, by providing residents with space for nature based recreational activities such as hiking, bird watching and boating (amongst others), whilst also providing for spiritual, aesthetic, and educational needs.

However, provision of sufficient amounts of easily accessible natural green space is often neglected due to rapid urbanisation. Internationally, city planners have recognised this, and as a result, Natural England (a UK conservation body) has established guidelines for the provision of natural green space. Currently, there are no South African guidelines for the provision of nature reserves as part of open space standards; however, research into determining standards is currently under way.

Guidelines for managed natural open space[13]

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

It is important to clearly define "accessible natural managed open space". Managed natural open space is land which is able to support a range of biodiversity of both plants and animals, has an "unspoiled" or countryside character, and is formally managed by conservation or parks authorities. In many 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. In Cape Town, nature reserves and district parks meet these criteria.

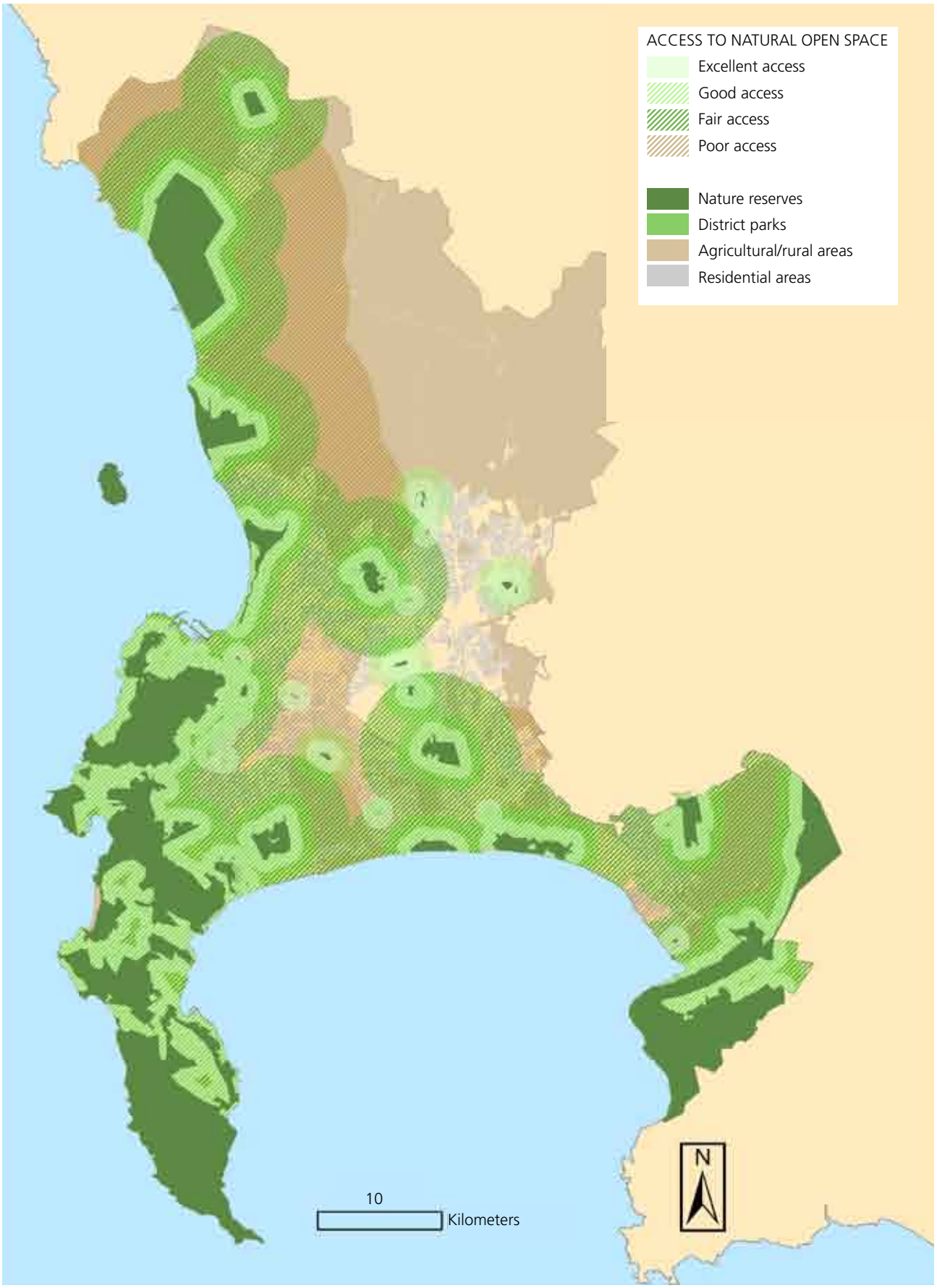


The distinction between managed natural open space and unmanaged natural open space is key - many people are unwilling to visit or use larger areas of unmanaged natural open space due to safety concerns and the lack of formal facilities. Whilst unmanaged areas are crucially important for biodiversity conservation, these areas do not 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 ha of land under formal conservation per 1 000 population. Cape Town has over 43 980 ha of land under formal conservation, including the Table Mountain National Park. **This equates to approximately 12,5 ha per 1 000 population – well above the recommended standard.**

However, accessibility remains the key challenge. Many of Cape Town's natural areas 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 natural open space.



Map 7: Access to managed natural open space (proximity)

Analysis

It is clear from Map 7 that people in many parts of Cape Town have limited or poor access to managed natural open space. This is most notable in the central and north east 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 natural 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 therefore this impact is minimised.

The provision of managed natural 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 has also shown to improve mental well-being, and increase feelings of health, especially among those of a lower socio-economic status[14]. Additionally, it is important for children's development to have access to natural areas in which to play freely, and not be limited to organised sports activities or playgrounds. Finally, it has been demonstrated that the proximity of residential areas to well-managed natural open space boosts property values and encourages revitalisation of neighbourhoods.

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

Trend and target

Trend: No trend has been established. As more biodiversity areas become formally managed in the future, access will improve.
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: Sufficient managed natural open space per capita, but accessibility is lacking.

Policy linkages

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, bikeable and disabled-accessible neighbourhoods, which co-ordinate land use and transportation with open space systems for recreation and ecological restoration.

See also:

Biodiversity (page 15)

Wastewater

Indicators

- **Percentage compliance with Department of Water Affairs (DWA) guidelines for wastewater treatment works (WWTWs)**

Wastewater in an urban environment is defined as any water that enters the sewerage system, and is subsequently processed at a wastewater treatment plant. This includes wastewater produced by bathing and showering, washing clothes and dishes, and flushing toilets. Also included are effluents from industries and commercial activities.

In Cape Town, wastewater is treated through a variety of processes. All of these processes make use of physical screening, followed by a biological treatment process. Pollutants are removed from the wastewater, and are converted into a semi-solid sludge. After treatment, the resulting liquid effluent is released into rivers or the ocean, where it is assimilated into the environment. Some treated effluent is re-used, and is particularly popular for the watering of golf courses and sports fields, as it is significantly cheaper and more environmentally sustainable than using potable water. Also, an increasing quantity is being used in industrial processes, where a lower water quality than that of drinking water is acceptable. Beneficial uses of the waste sludge include composting, application to agricultural land, or as fuel.

The wastewater that is returned to the environment must meet the quality standards promulgated by DWA (formerly DWAF) in terms of the National Water Act of 1997. These prescribed standards are intended to ensure that the wastewater has a minimal impact on the natural environment as well as the health of anyone who may come into contact with it. In 2009, the Department of Water Affairs implemented the Green Drop rating system for wastewater treatment works. This system is based on numerous criteria including results of wastewater quality tests as well as the implementation of best practices in processes, maintenance, monitoring and reporting.

Unfortunately, the reality in Cape Town, and many cities in the developing and developed world, is that many WWTWs operate beyond capacity, or use older technology, and thus do not have the ability to meet the required standards effectively. Furthermore, none of the City's WWTWs are currently equipped to remove phosphorus from effluent, and significant changes need to be made to most facilities in order to meet the proposed 1 mg/ℓ phosphate standard.

Standards for treated wastewater discharge

The following pollutants are measured in the City's WWTWs:

Ammonia

Ammonia is produced by the interaction between bacteria and 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 10 mg/ℓ, with a long term goal of no more than 3 mg/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 75 mg/ℓ

Escherichia coli (*E. coli*)

E. coli is a bacterium that is commonly found in the intestines of warm-blooded animals as well as 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 used as an indicator of the presence of other pathogenic organisms in faecally 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*/100 mℓ

Suspended solids

This refers to any particles that are suspended or floating in wastewater. Suspended solids could comprise a range of particles, which include 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 plants and animals.

General standard: No more than 25 mg/ℓ

Orthophosphate

Orthophosphate is a readily bio-available form of phosphorus that is often found in wastewater, and is considered the limiting factor for plant growth. 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: 1 mg/ℓ

State of the environment

Figures 10 - 18 show the percentage compliance with the DWA general standards for 2009. 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. Compliance rates of over 90% are highlighted below as they indicate that WWTWs are close to meeting the standard, and may represent "easy wins" for future intervention and upgrading.

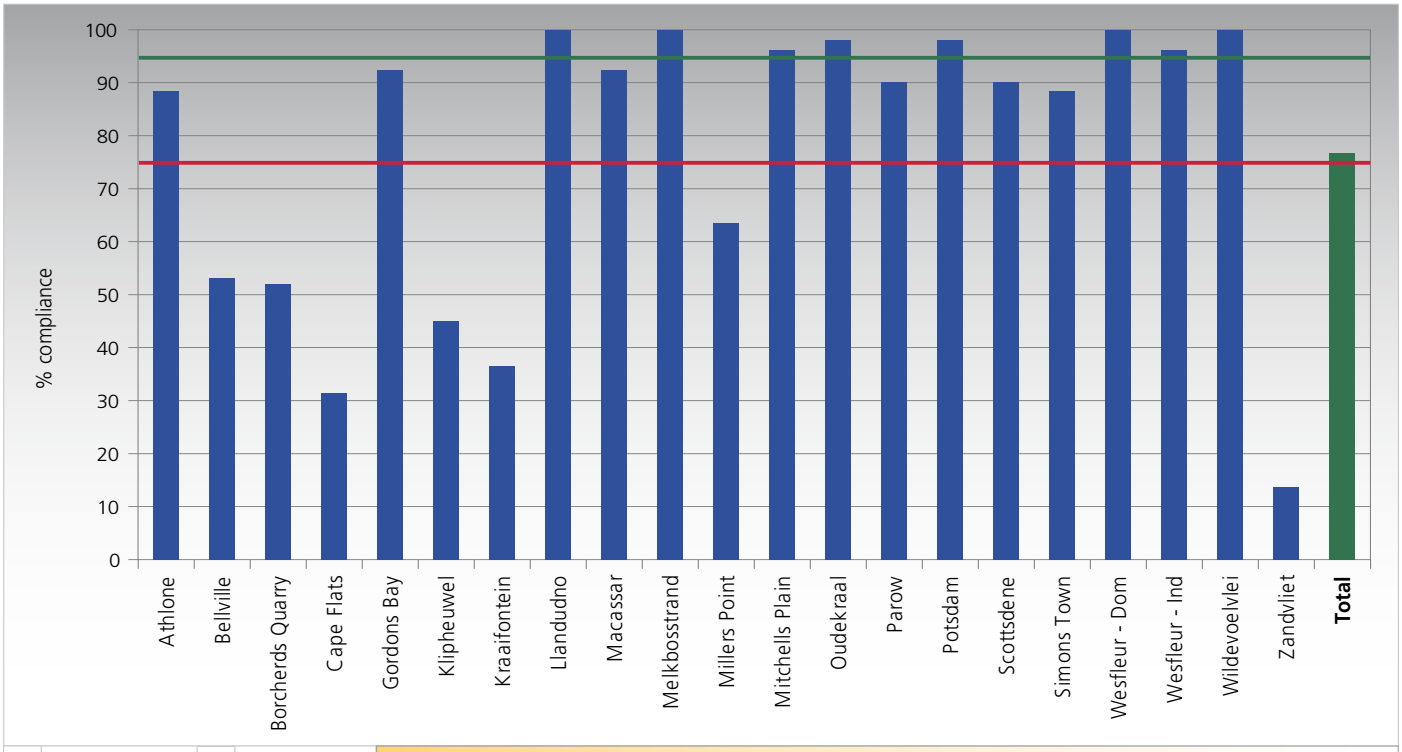


Figure 10: Percentage compliance with ammonia standard (2009)

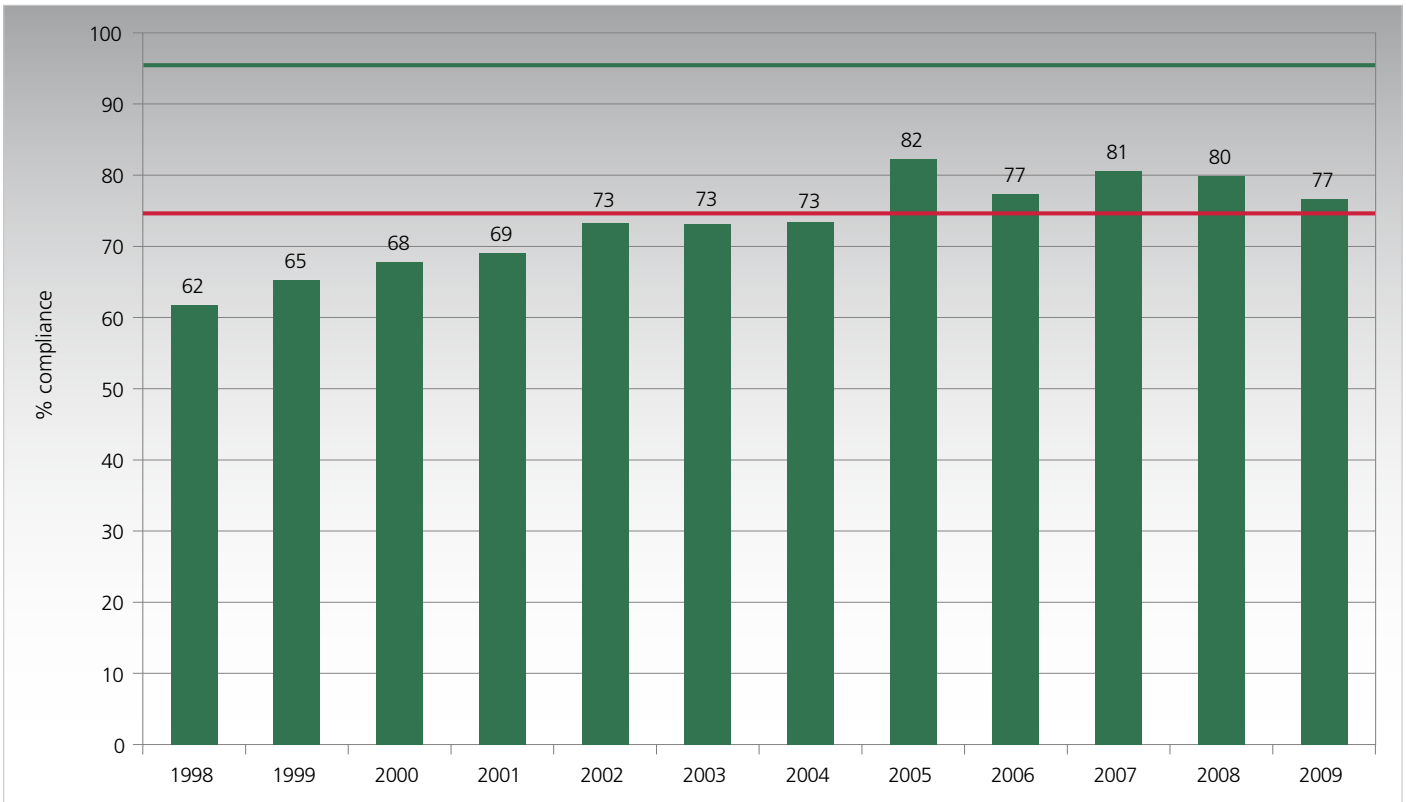


Figure 11: Average compliance with ammonia standard (1998 - 2009)

Out of the 21 WWTWs, eight achieved over 95% compliance, while another four achieved over 90% compliance. Seven sites were deemed unacceptable; some of these are organically overloaded. This state will improve when new treatment works and extensions to existing works are commissioned. On average, the compliance rate was 77%. Since 1998, average compliance of all WWTWs with the ammonia standard has increased from a low of 62% to a high of 82% in 2005. A slight decline has been noted in recent years, but overall a significant positive improvement since 1998 can be seen.

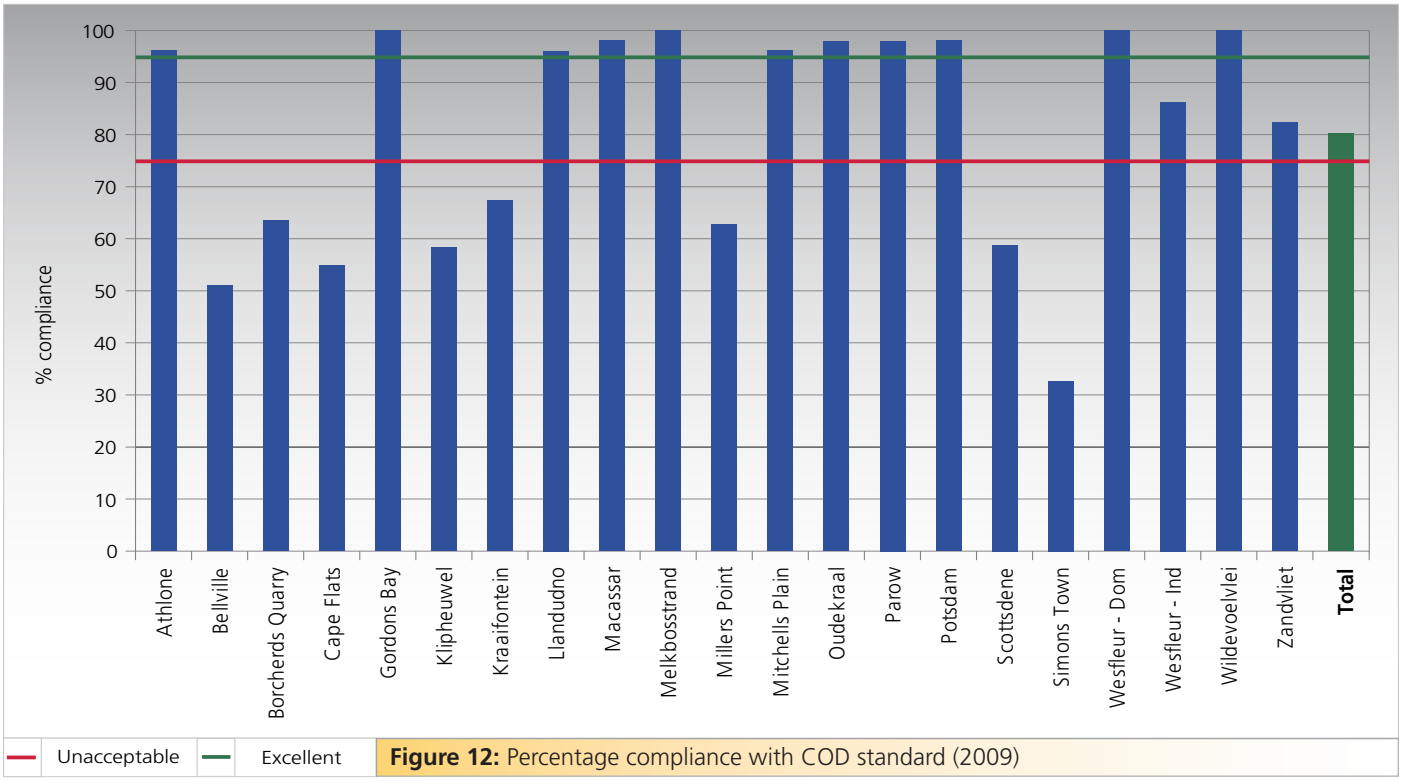


Figure 12: Percentage compliance with COD standard (2009)

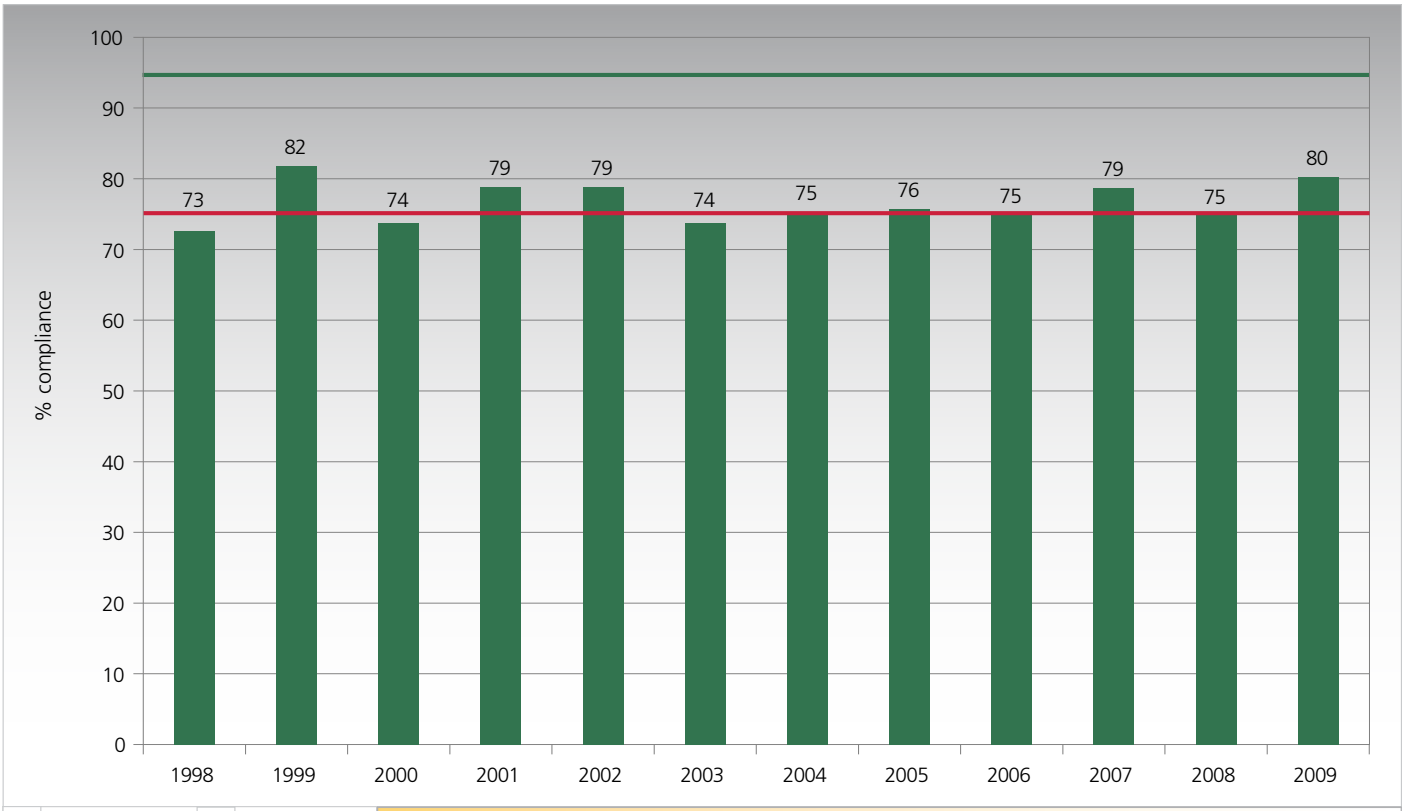


Figure 13: Average compliance with COD standard (1998 - 2009)

Out of the 21 WWTWs, eleven sites achieved over 95% compliance. Eight sites were deemed unacceptable. On average, the compliance rate was 80%. Since 1998, average compliance of all WWTWs with the COD standard has fluctuated between a low of 73% and a high of 82%. 2009 has shown the highest compliance rate since 1999, as the benefits of the large capital expenditure of the past few years start to be felt. As increased treatment capacity comes on line in the next few years, the picture will continue to improve.

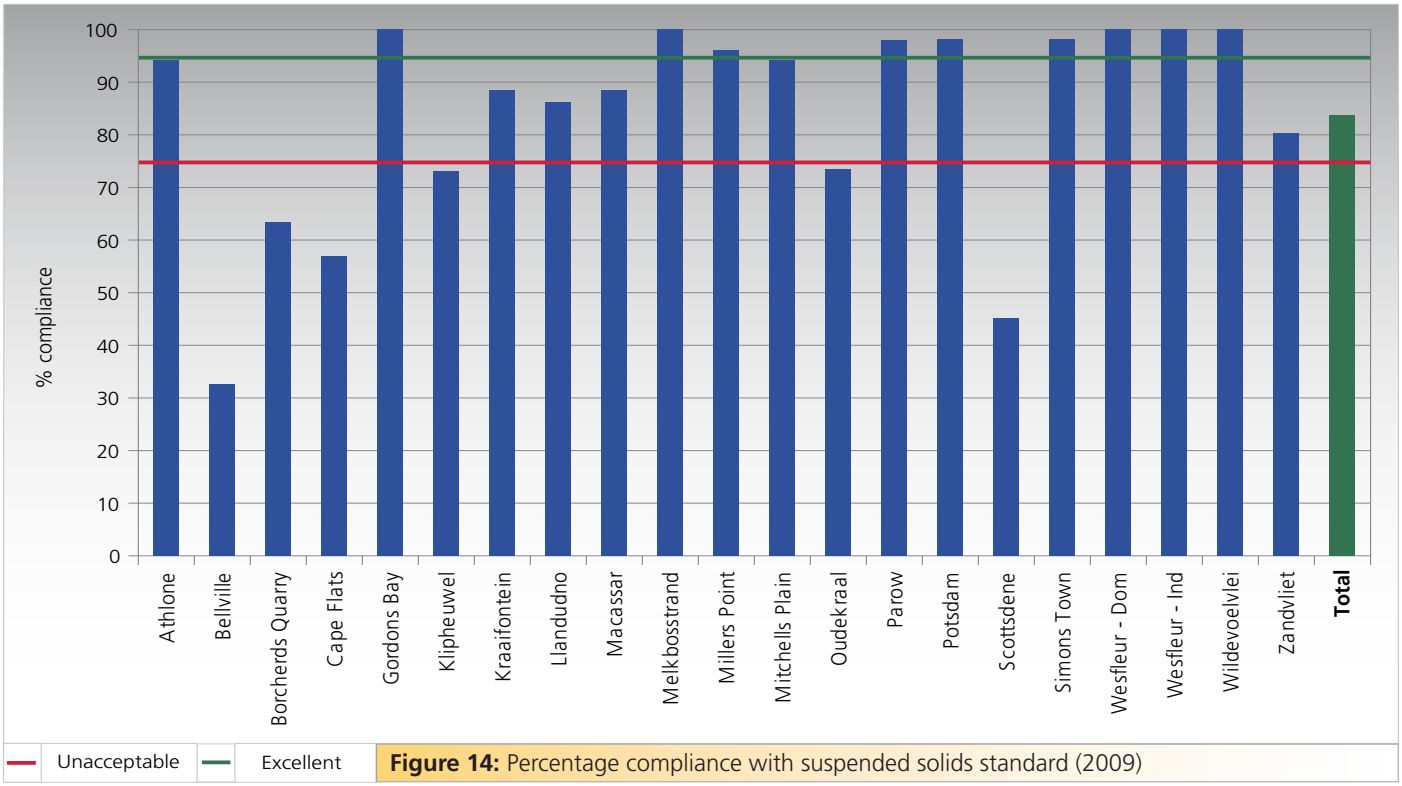


Figure 14: Percentage compliance with suspended solids standard (2009)

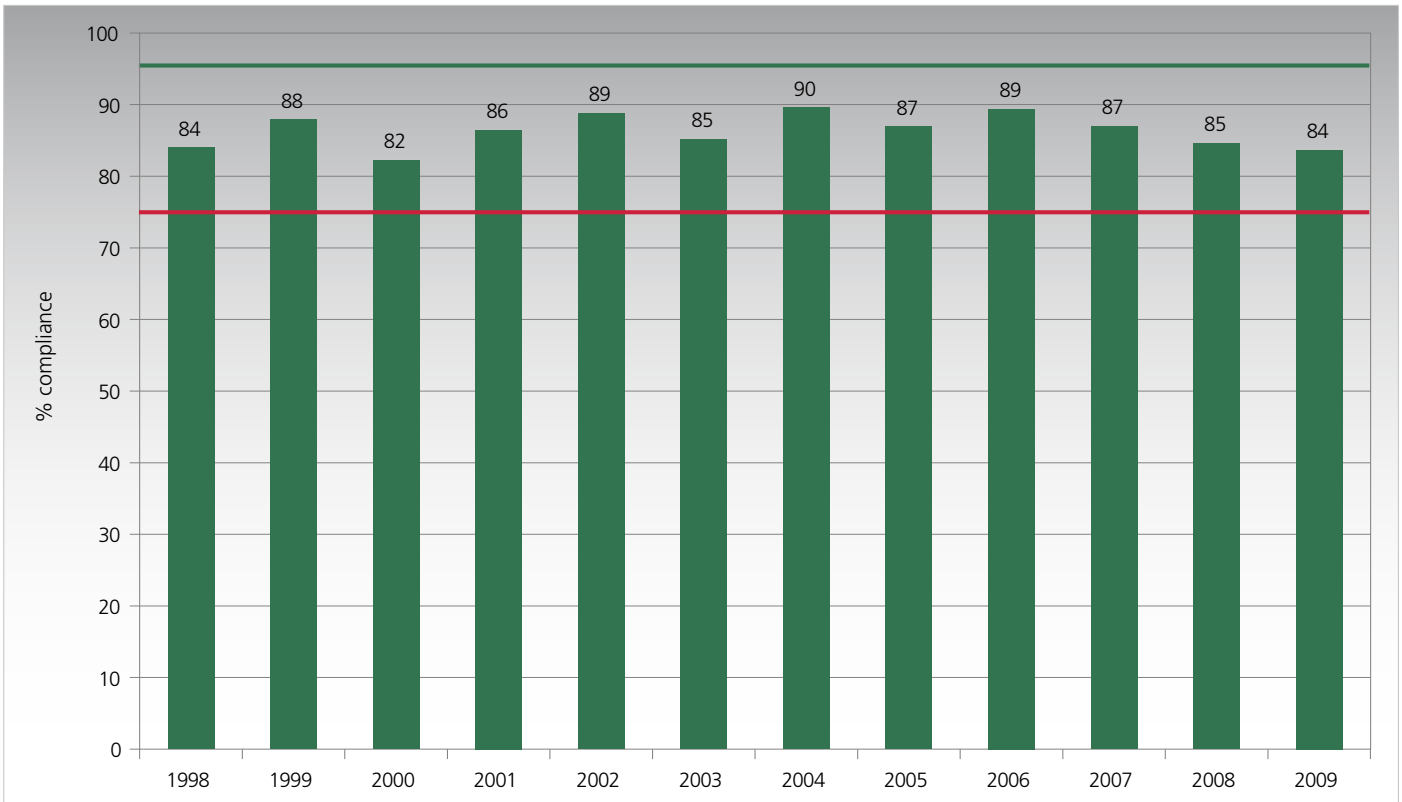


Figure 15: Average compliance with suspended solids standard (1998 - 2009)

Out of the 21 WWTWs, nine sites achieved more than 95% compliance, while another two sites achieved 90% or better compliance. Six sites were deemed unacceptable. Sludge in the maturation ponds has contributed to the poor effluent quality. Plans are in place to remove this sludge - once completed there will be an improvement in the bacterial quality of the effluent. On average, the compliance rate was 84%. Since 1998, average compliance of all WWTWs with the suspended solids standard has fluctuated between a low of 82% and a high of 90%. Recent years have shown a steady but slight decline.

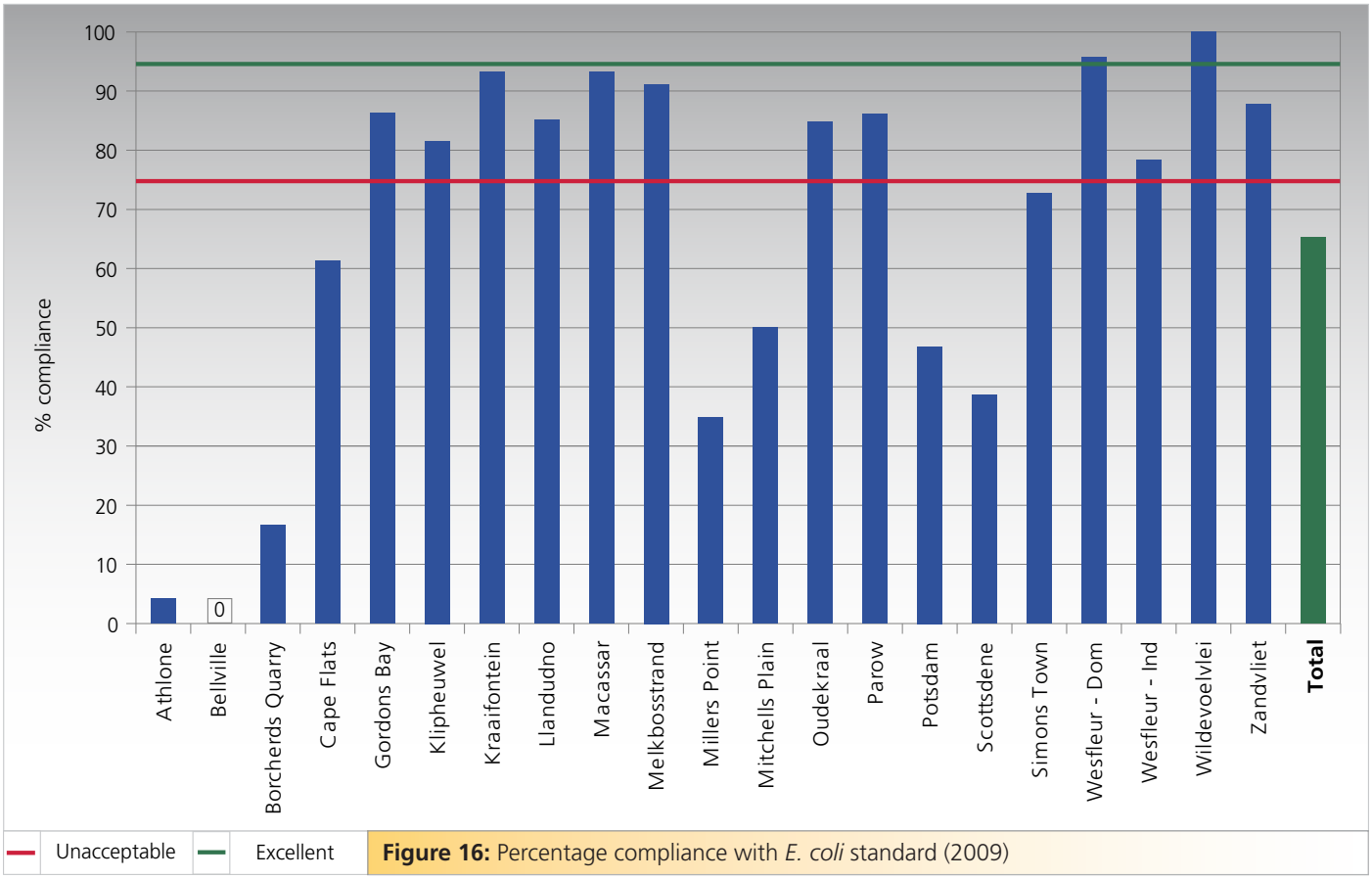


Figure 16: Percentage compliance with *E. coli* standard (2009)

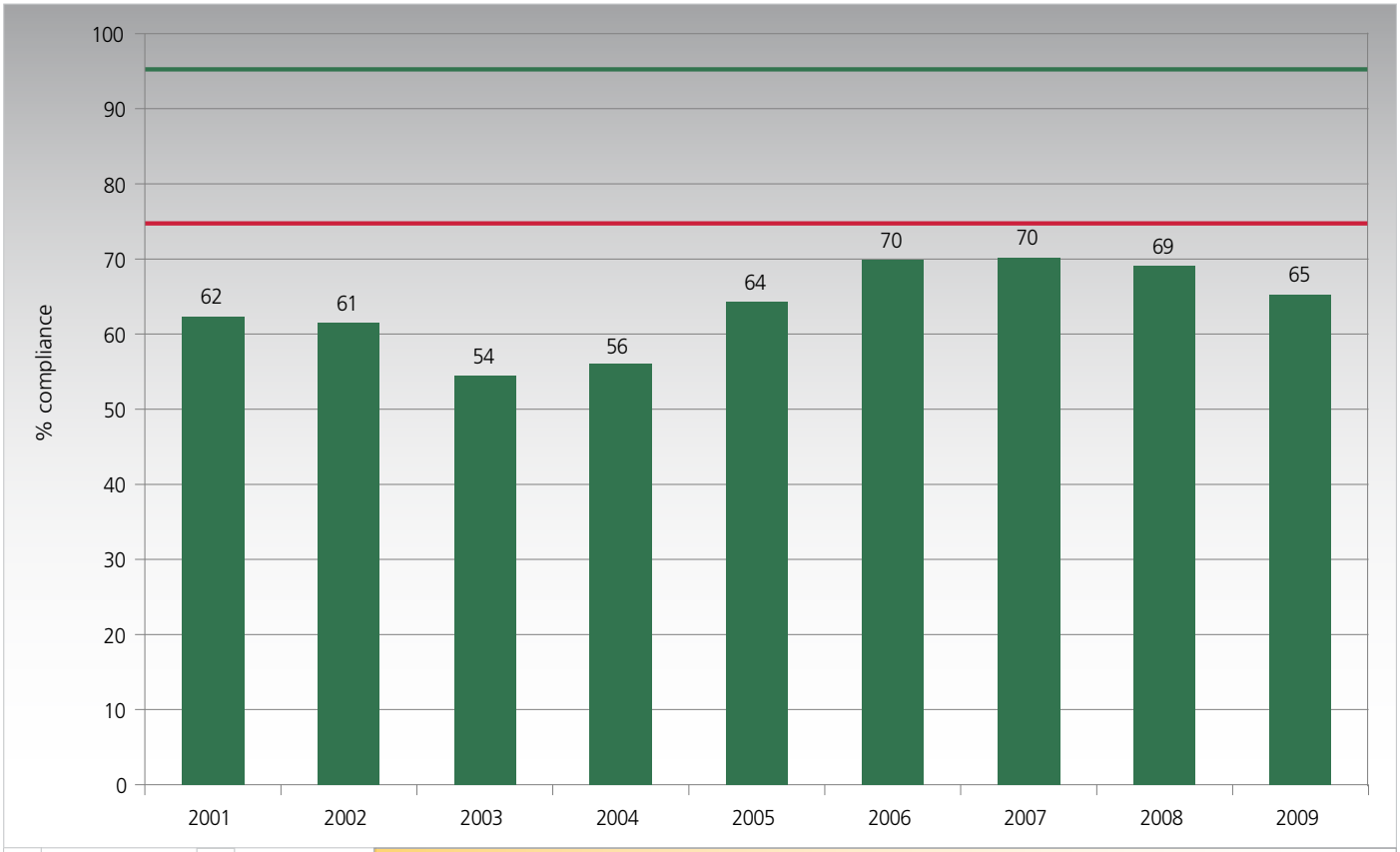


Figure 17: Average compliance with *E. coli* standard (1998 - 2009)

Out of the 21 WWTWs, two sites achieved more than 95% compliance, while another three sites achieved greater than 90% compliance. Nine sites were deemed unacceptable. On average, the compliance rate was 65%. Disinfection units at Athlone and Bellville were under construction during 2009 and the benefits will become apparent in 2010. Some operational difficulties with the Potsdam ultra-violet light disinfection system are being overcome and an ongoing improvement is being noted. Several treatment works have sludge in their maturation ponds that adversely impacts on the *E. coli* natural die-off. Plans are in place to remove this sludge - once completed there will be an improvement in the bacterial quality of the effluent.

Since 1998, average compliance of all WWTWs with the *E. coli* standard has fluctuated between a low of 54% and a high of 70%. Compliance rates improved dramatically from 2004, but 2009 showed a significant drop in compliance.

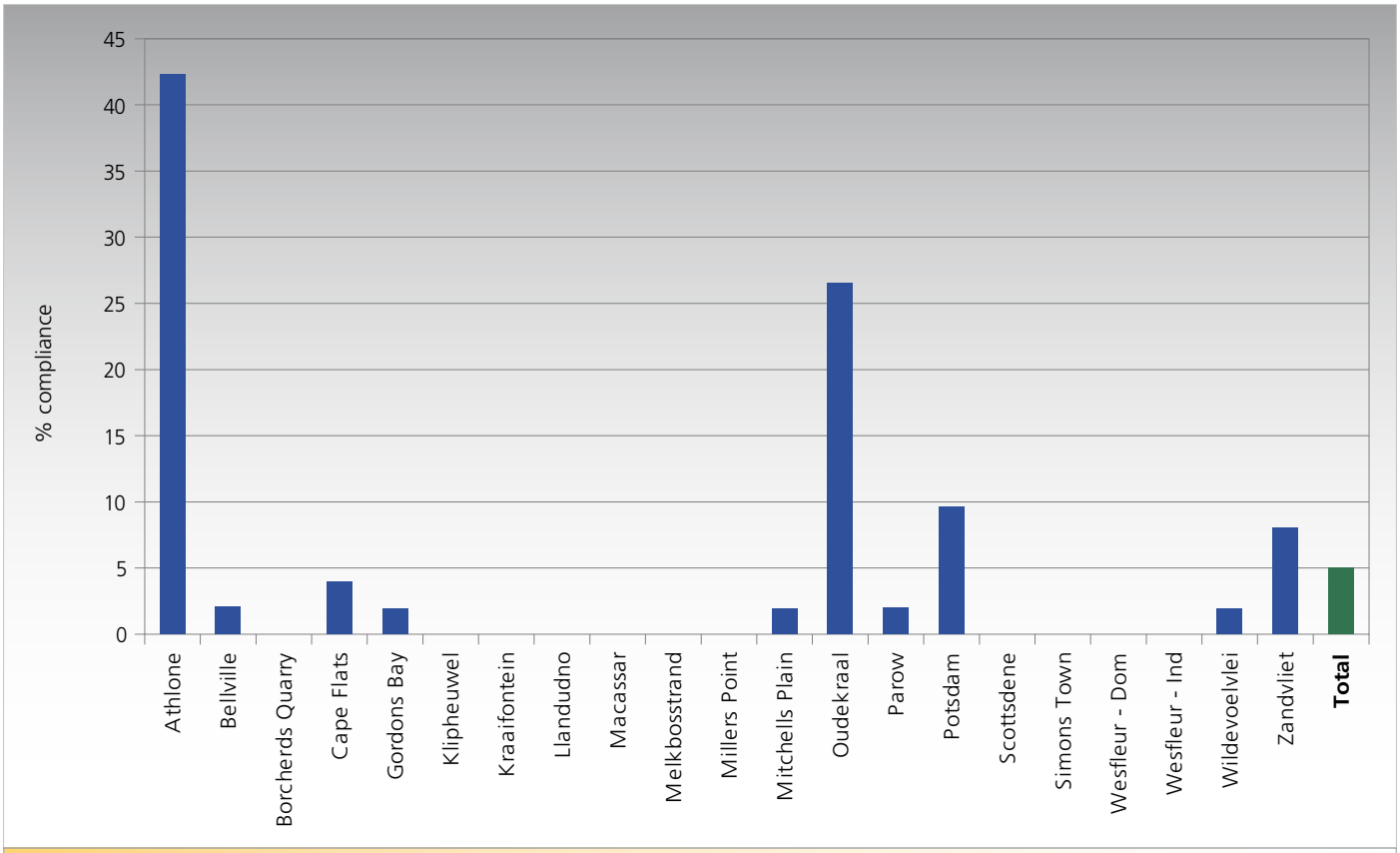


Figure 18: Percentage compliance with proposed orthophosphate standard (2009)

Out of the 21 WWTWs, no sites 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 1 mg/ℓ limit.

Analysis

The significant growth in both residential and commercial development since 1994, coupled with the provision of sewered toilets for many informal settlement dwellers, has placed a great burden on the wastewater treatment system. Unfortunately in many cases this growth was not matched by an increase in the capacity of WWTWs, nor was it accompanied by the construction of new plants.

It is clear that some of the WWTWs in Cape Town simply operate beyond capacity, and that significant capital investment is required in order to upgrade existing plants, and build new ones where necessary. The City allocated a sizeable portion of its capital budget for 2009 to the upgrade and extension of wastewater treatment capacity, with similar allocations planned for 2010 and beyond. Whilst this extension of capacity is underway, it is important that effluent quality is continually monitored in order to ensure that the public receives

adequate warning and information. The Wastewater Department annually produces its ten-year capital plan highlighting the improvements and funding required. While it remains a challenge to secure sufficient funding, it should also be noted that significant improvements in wastewater treatment capacity has indeed taken place in the past few years, however rapid development remains a reality for the city.

The City is aiming for a higher standard for its wastewater effluent than what is currently legislated. The current ammonia limit, for example, is 10 mg/ℓ, but new treatment works and extensions are designed to attain a level of 3 mg/ℓ . For phosphate content, for which a target 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. 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.

Furthermore, in order to prepare for the possibility of a future ortho-phosphate standard, and 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. These areas have been prioritised due to their ecological importance.

In 2009, the City received Green Drop certificates for seven of its treatment works: Cape Flats, Llandudno, Macassar, Melkbosstrand, Mitchells Plain, Oudekraal and Parow. Several other works, including Wesfleur and Wildevoelvlei were very close to meeting the requirements. This certification recognises that these works operate efficiently and effectively, comply with best-practice management standards, and sufficiently meet effluent quality targets. As Green Drop certification awards points for management practices as well as effluent quality, it is possible for WWTWs that do not currently meet all of the required effluent standards to be awarded a certificate.

Considerable opportunities exist for reducing the pressure on existing wastewater treatment systems through the use of alternative and sustainable technologies. On-site sewage treatment in the form of bio-digesters and artificial wetlands may offer a suitable alternative or addition to traditional wastewater treatment, especially in areas where WWTWs are particularly overloaded, or where costs need to be kept to a minimum. The City will continue exploring alternative technologies in order to determine the most suitable applications, which may then be implemented where appropriate.

Trend and target

Trend: A slight but steady decline in wastewater quality has been noted in most cases since 2006. COD has remained stable.
Target: Environmental Agenda 2014 Target: No specific target set. The City aims to achieve 95% or greater compliance with standards, and reduce the number of WWTWs with less than 75% compliance.
Current: Just under half of the WWTWs are regularly achieving good to excellent levels of compliance. Compliance with the *E. coli* standard is poor across the city.

Policy linkages

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 Accord: 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:

Freshwater quality (page 40)
Coastal water quality (page 46)
Water use (page 53)

Freshwater Quality

Indicators

- **Ecosystem status based on trophic state**
- **Percentage compliance with DWA (formerly DWAF) Public Health guidelines**
- **Health of rivers as determined by the River Health Programme**

The city of 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 of stormwater and treated wastewater effluent. However, the ongoing organic pollution of the city's freshwater systems poses a threat to both biodiversity and human health.

Guidelines for freshwater quality

Three different sets of guidelines are used to assess freshwater quality in Cape Town.

Trophic state

Phosphorus provides an excellent proxy measurement of the state of an aquatic system, since it is commonly identified as a key pollutant in urban and peri-urban areas. Too much phosphorus (specifically orthophosphate, a readily bio-available form of phosphorus) in a freshwater system leads to a process known as eutrophication in which excessive plant and algae growth - often alien - leads to degradation of the natural ecosystem. As plant material grows denser, or algal blooms develop, this may block out light to deeper levels of rivers and lakes. Large scale die-off and subsequent decomposition of plants or algae may reduce the oxygen content of the water, thus leading to the deaths of fish and aquatic invertebrates. Table 2 describes trophic tendencies (nutrient levels) and conditions which typically exist under various orthophosphate concentrations[15].

DWA Public Health Guideline

The Department of Water Affairs sets guidelines for various degrees of recreational contact with freshwater systems. The guidelines commonly used for assessing freshwater systems are the intermediate and full contact guidelines, which set safe standards for the limits of pollutants in water which may be used for water sports, boating, swimming, and other recreational activities. These guidelines set upper limits on the amount of indicator organisms such as *E. coli* bacteria which may be present in a sample. The intermediate contact guideline stipulates that samples should not exceed 1 000 indicator organisms per 100 mℓ.

Trophic Tendency	Orthophosphate (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 2: Trophic state categories

River Health Programme[16]

Cape Town is a participant in the national River Health Programme, which uses a range of biological indices for determining the ecological health of rivers. The SASS5 index (South African Scoring System, version 5) uses an assessment of aquatic invertebrate communities to determine the ecological health of a river. This is usually combined with an assessment of in-stream and riverine habitat conditions to provide an overall measure of river health on the descriptive scale below. The results obtained during SASS5 surveys thus provide an indication of the degree of disturbance due to water quality and/or habitat impacts.

- **"Natural"** - no or negligible modification
- **"Good"** - biodiversity and integrity largely intact
- **"Fair"** - sensitive species may be lost, with tolerant or opportunistic species dominating
- **"Poor"** - mostly only tolerant species present; alien species invasion; disrupted population dynamics; species are often diseased
- **"Unacceptable"** - river has undergone critical modification; almost complete loss of natural habitat and indigenous species with severe alien invasion

Sources of pollution

The primary sources of pollution of the city's freshwater systems are unsatisfactorily treated wastewater effluent, overflows from sewer systems and pump stations, and contaminated stormwater. Additionally, the dumping of human waste (in the form of toilet buckets from informal settlements and "backyard" dwellers) directly into rivers and generally polluted runoff from informal settlements adds to the organic load of the system. In urban areas, rainwater picks up a range of contaminants as it makes its way towards rivers and the sea. Stormwater can therefore 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.

State of the environment

Trophic state

Results are provided according to the hydrological year from October 2008 to September 2009. Over this time period 9 out of 14 rivers (64%) and 10 out of 13 vleis (77%) were classified as eutrophic or hypertrophic, indicating poor to bad water quality. It is important to note that only two rivers were classified as mesotrophic, indicating a good level of ecosystem health, while none of the city's freshwater systems were classified as oligotrophic (excellent). A lower score on the graph indicates a higher level of quality.

It is important to note that 7 out of 14 rivers (50%) and 7 out of 13 vleis (54%) experienced eutrophic or hypertrophic conditions for the past five hydrological years, indicating that eutrophication in these systems is a long term and serious problem.

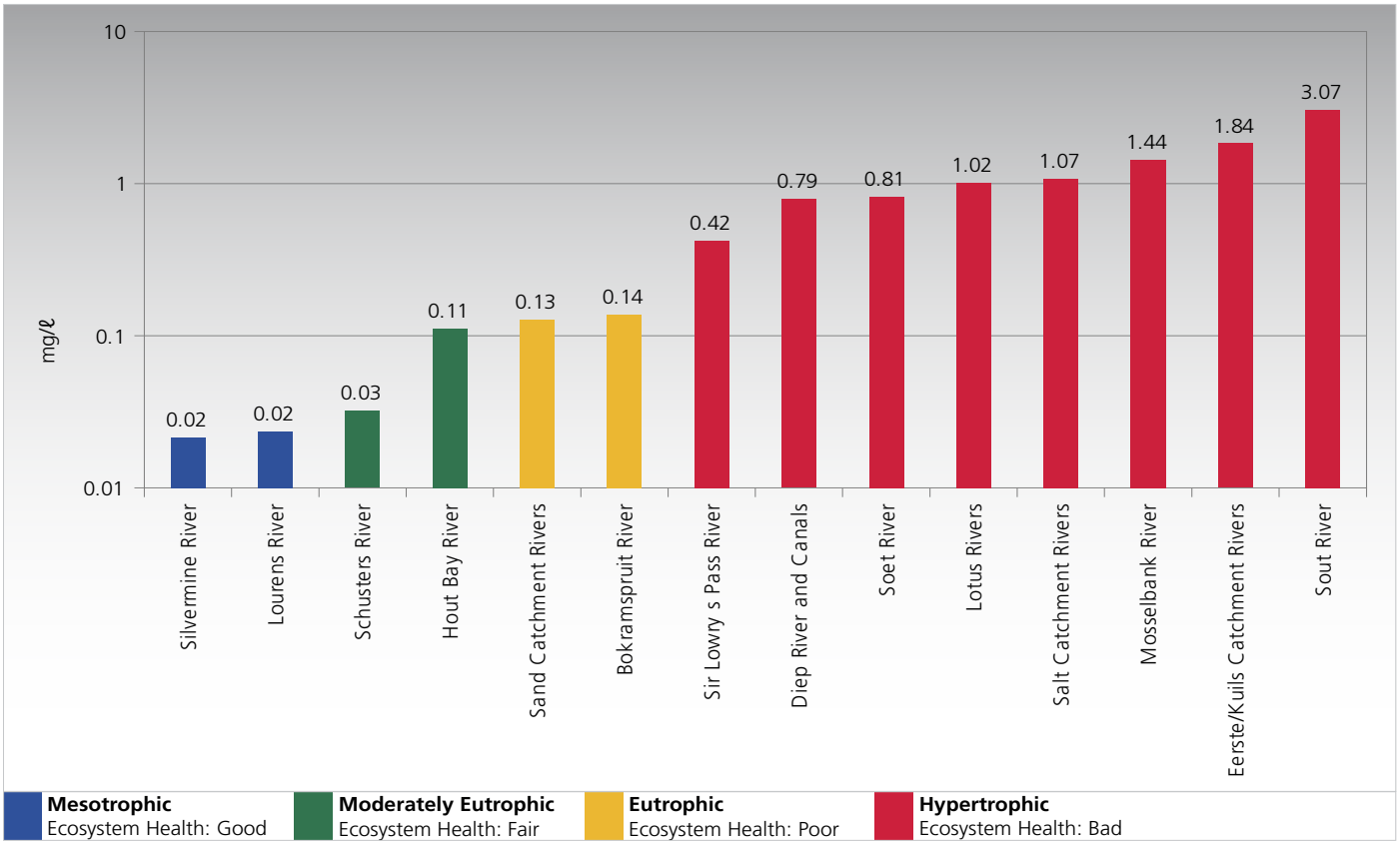


Figure 19: Trophic state (ecosystem health) of rivers (Oct 2008 - Sep 2009)

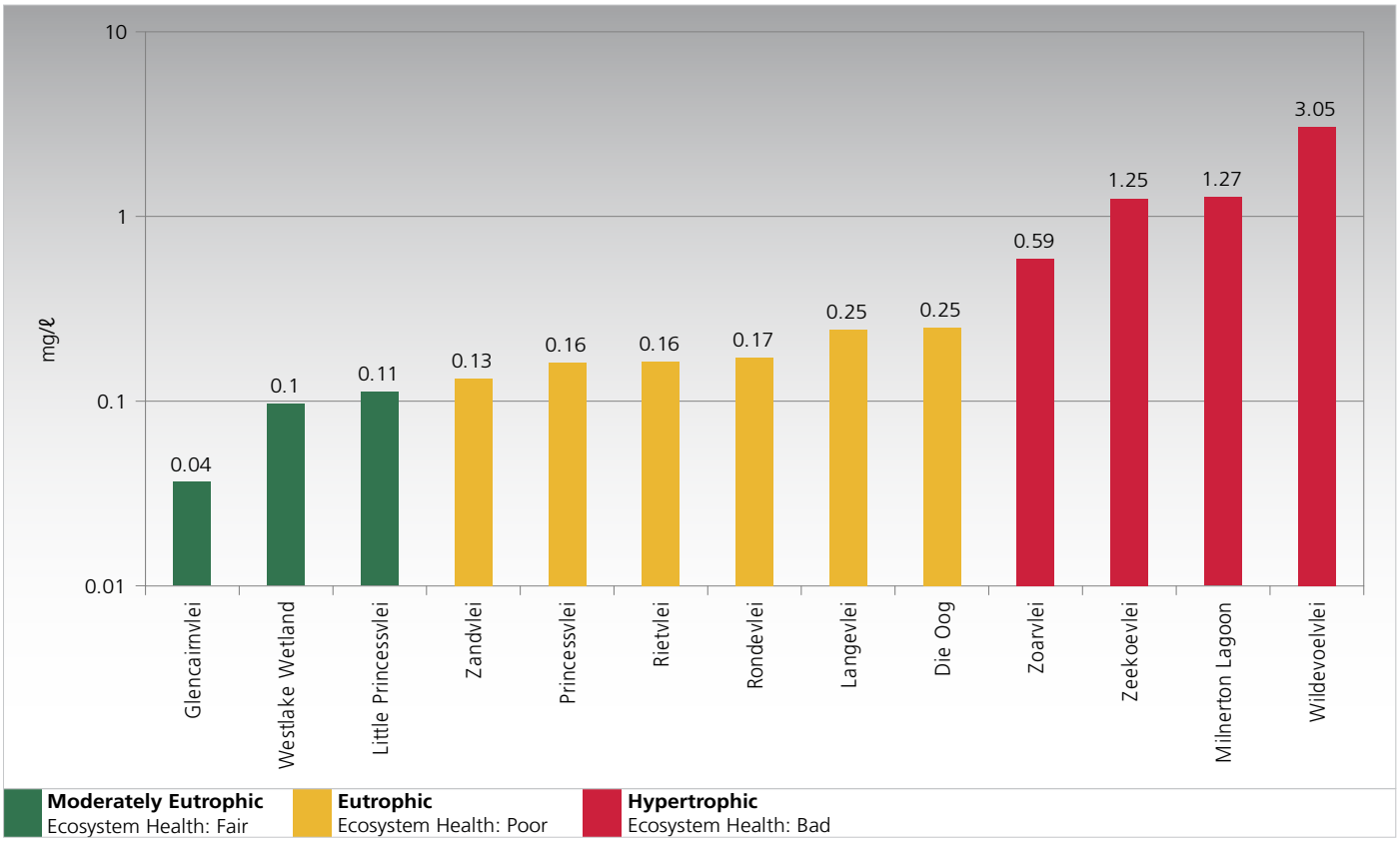


Figure 20: Trophic state (ecosystem health) of wetlands and vleis (Oct 2008 - Sep 2009)

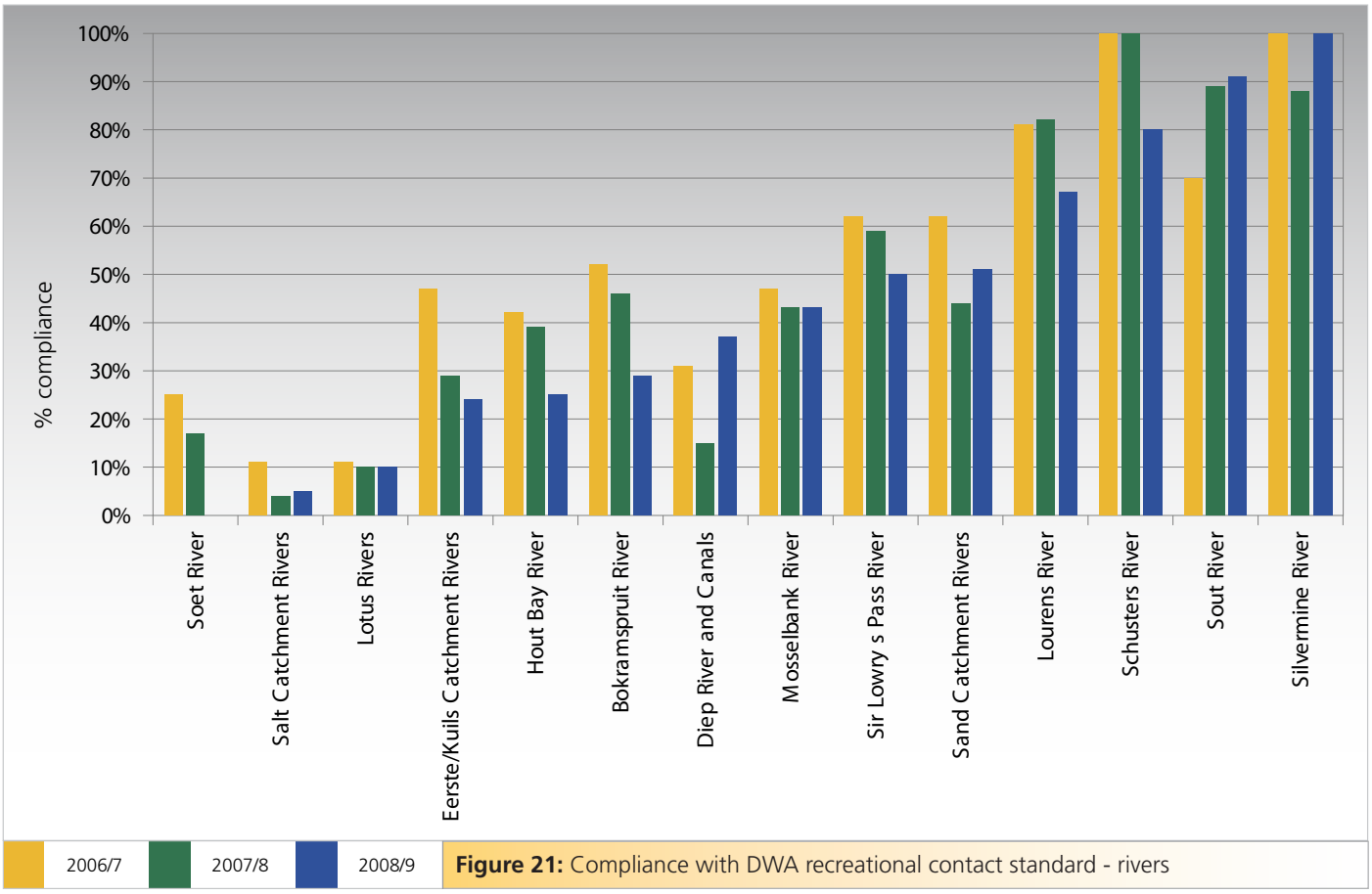


Figure 21: Compliance with DWA recreational contact standard - rivers

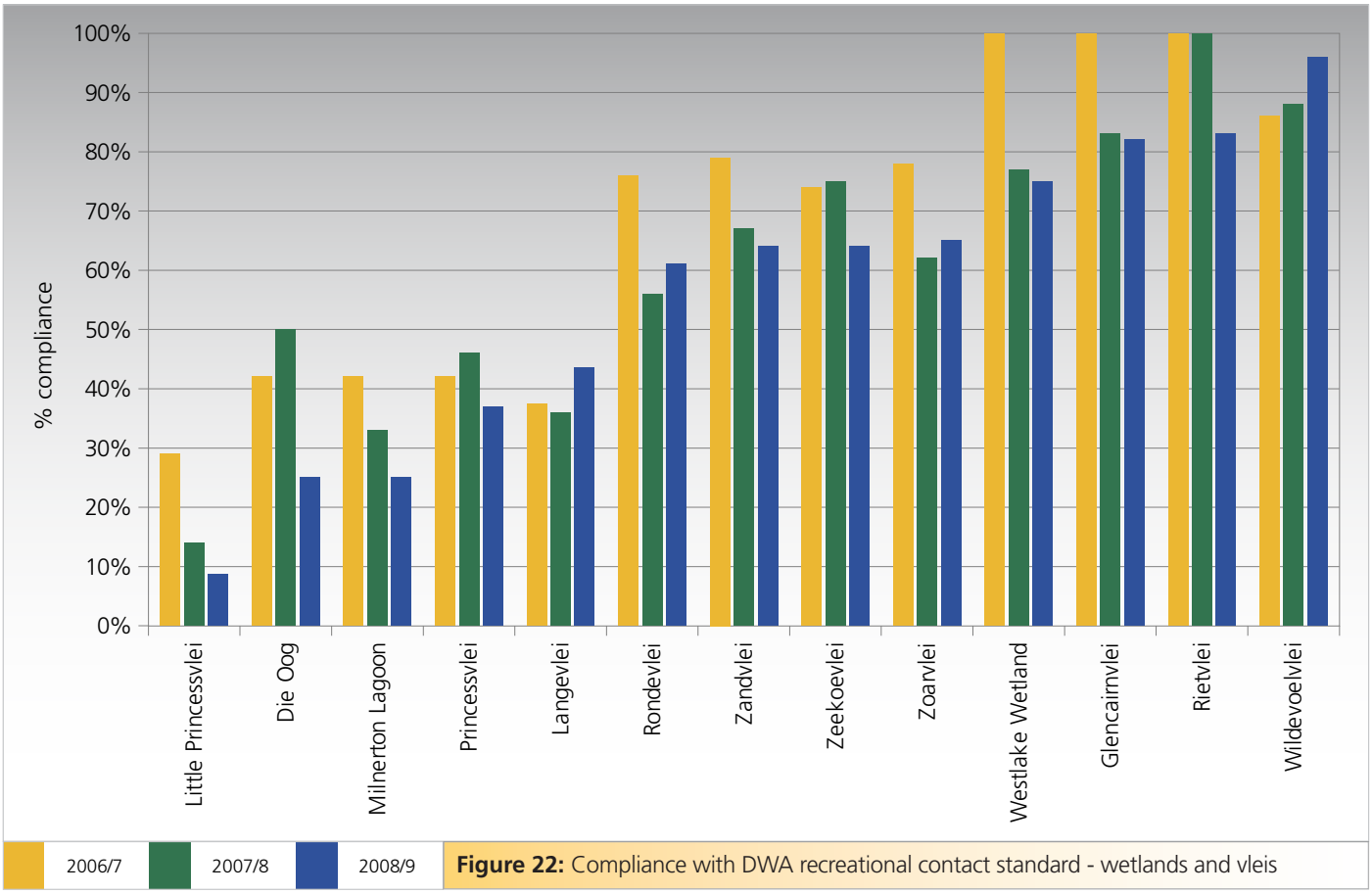


Figure 22: Compliance with DWA recreational contact standard - wetlands and vleis

Public health

Results (see previous page) are provided according to the hydrological year from October 2008 to September 2009. Over this time period half (7 out of 14) of the rivers experienced a decline in water quality, whilst four experienced improvements and three stayed the same. At the same time, 8 out of 13 vleis experienced a decline, whilst four improved, and one stayed the same. A higher score on the graph indicates a better level of quality.

It is important to note that 10 out of 14 rivers (71%) and 9 out of 13 vleis (69%) experienced levels of compliance of less than 80% for the past five hydrological years, indicating that pollution in these systems is a long term and serious problem.

River Health Programme

The last River Health Programme survey of city rivers was conducted in 2007. The results of that survey showed that 24 out of 37 rivers monitored fell into the poor and unacceptable categories, meaning that approximately 65% of the city's rivers are moderately to severely disturbed.

Natural	Good	Fair	Poor	Unacceptable
2 (5%)	3 (8%)	8 (22%)	18 (49%)	6 (16%)

Table 3: River Health Survey Results (2007)

Analysis

The poor quality of the majority of the City's freshwater systems is of serious concern. Rivers and wetlands are important recreational areas for the City, as well as critical habitats for aquatic vertebrates and invertebrates and birds. It is important to note however, that 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 *E. coli* standards (e.g. Wildevoelvlei).

As discussed previously (see Wastewater), the primary reasons for 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. Rapid urbanisation without simultaneous infrastructure expansion is a major causative factor. Additionally, the lack of a national standard for phosphorus concentrations in treated wastewater effluent has meant that reduction or removal of phosphorus from sewage has not been prioritised by the City and has therefore not been sufficiently budgeted for in the past.

In order to resolve these long standing issues, the City is prioritising the upgrading and expansion of wastewater treatment works. The provision of effective sewerage infrastructure in informal areas, as well as the repairing and replacement of ageing sewer

systems, is also a key priority. Unfortunately since these measures are very costly and take lengthy periods to accomplish, measurable improvements in the state of receiving waters will take many years to achieve.Serious consideration needs to be given to the rehabilitation of the city's rivers and wetlands, where feasible, in order to promote a return to functional aquatic ecosystems. This may include the rehabilitation of canalised rivers to ensure a diversity of in-stream habitats and suitable channel shape (the steep sides of a canal 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 runoff, and can provide valuable habitat, as well as recreational space. The Catchment, Stormwater and River Management branch of the City is currently undertaking a detailed investigation to identify and quantify the resources required for improving river health.

Another key initiative, which is a new focus area for the City's Catchment, Stormwater and River Management Branch, involves implementation of environmentally sensitive urban stormwater management through promotion of the concept of Sustainable Urban Drainage Systems (SUDS).

This was prompted in recognition of the fact that it is a world-wide phenomenon that rivers and wetlands rapidly deteriorate under the impacts of urbanisation with a resultant loss of ecosystem integrity, biodiversity, amenity value as well as the creation of significant health risks. To this end, the Council has approved a progressive stormwater policy entitled "Management of Urban Stormwater Impacts". 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 which 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 policy entitled "Floodplain and River Corridor Management" tackles the above issues and promotes an approach for dealing with development proposals within and adjacent to flood prone areas and aquatic ecosystems and their associated buffers.

Trend and target

Trend: Water quality (public health) in freshwater ecosystems has significantly deteriorated since 2006/7, whilst ecosystem health has remained poor since 2004.

Target: Environmental Agenda 2014 Target: 50% of rivers and 50% of vleis will meet public health guidelines.

Current: Water quality across the City is poor, and is not on track to meet the 2014 target.

Policy linkages

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.

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: Floodplain and River Corridor Management Policy; Management of Urban Stormwater Impacts Policy.

Urban Environmental Accord: 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.

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:

Wastewater (page 32)
Coastal water quality (page 46)
Water use (page 53)

Coastal Water Quality

Indicators

- **Number of instances when water quality guidelines are exceeded (False Bay and Atlantic coasts)**
- **Percentage compliance with water quality guidelines (trend)**

Cape Town is bounded by approximately 308 km of coastline – a considerable asset in terms of both tourism and recreation, and the natural environment. Cape Town's beaches are a significant driver of tourism, and provide an opportunity for all citizens to spend their leisure time in an accessible yet natural environment. Measurement and monitoring of coastal water quality is therefore extremely important, as it is necessary to protect the public from possible pollution of coastal waters. Beaches are therefore monitored throughout the year in order to ensure that public health guidelines are met.

Guidelines

Coastal water quality is measured fortnightly on both the Atlantic and False Bay coasts, and assessed according to the South African Water Quality Guidelines for Coastal Marine Waters (Volume 2: Recreational Use). This guideline includes a dual target for faecal coliform counts. However, in order for a beach to comply, it must meet both targets indicated below.

80th percentile standard: 80% of samples must contain no more than 100 faecal coliform bacteria per 100 mℓ AND
95th percentile standard: 95% of samples must contain no more than 2 000 faecal coliform bacteria per 100 mℓ

The City is a participant in the Blue Flag programme, which provides an internationally recognised 'ecolabel' to beaches around the world. Blue Flag beach status is awarded based on compliance with 29 criteria covering all aspects from environmental education and water quality, to environmental management, safety and services. 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 2009/10 season are used to determine which beaches will be awarded Blue Flag status in the 2010/11 season. In the past 2009/10 season six beaches were awarded Blue Flag Status: Bikini Beach, Mnandi, Strandfontein, Muizenberg, Camps Bay and Clifton 4th beach. Figures 23 and 24 and maps 8 - 15 show statistics for the entire 12 month winter and summer period between September 2008 and October 2009.

Sources of pollution

The primary source of bacterial pollution in coastal waters is the release of stormwater containing a variety of urban pollutants, as well as treated sewage effluent released into the marine environment. This could happen for a number of reasons. Often stormwater originating in partially serviced or unserviced informal settlements contains untreated sewage as a result of residents emptying toilet buckets into the open environment or the stormwater system. Stormwater may also contain a significant amount of pet waste which has been improperly disposed of and washes into the system during heavy rains. Insufficiently treated sewage effluent is another significant contributor to poor coastal water quality in Cape Town. 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 guidelines in order to safeguard human health, as contact with *E.coli* and other pathogenic organisms present in the water could 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 the delicate ecological balance.

State of the environment

Figures 23 and 24 provide an overview of levels of compliance between 1992 and 2009, based on an aggregate of all samples taken from all monitoring points over that period. In general, compliance levels on the Atlantic coast have improved since 1995, with highs in 2003, 2007 and 2008. However, a slight drop in compliance with the strict guideline (from 89% to 82%) has been noted in 2009, whilst compliance with the relaxed guideline has improved slightly (from 93% to 96%). Over the past two years, a rapid and dramatic drop in compliance levels on the False Bay coast has been observed, reaching a low of 50% compliance with the strict guideline in 2008. It is therefore encouraging to note that compliance with the strict guideline has improved to 63% in 2009, while compliance with the relaxed guideline improved to 80% (from 73%). Maps 8 - 15 provide a spatial depiction of water quality at Cape Town beaches and identify the varying levels of compliance present on the coastline. Between September 2008 and October 2009 14 out of 39 points measured on the False Bay coast failed to comply with guidelines. On the Atlantic coast, five out of 28 points measured failed to comply. In both cases this is a slight improvement over 2007/8 figures

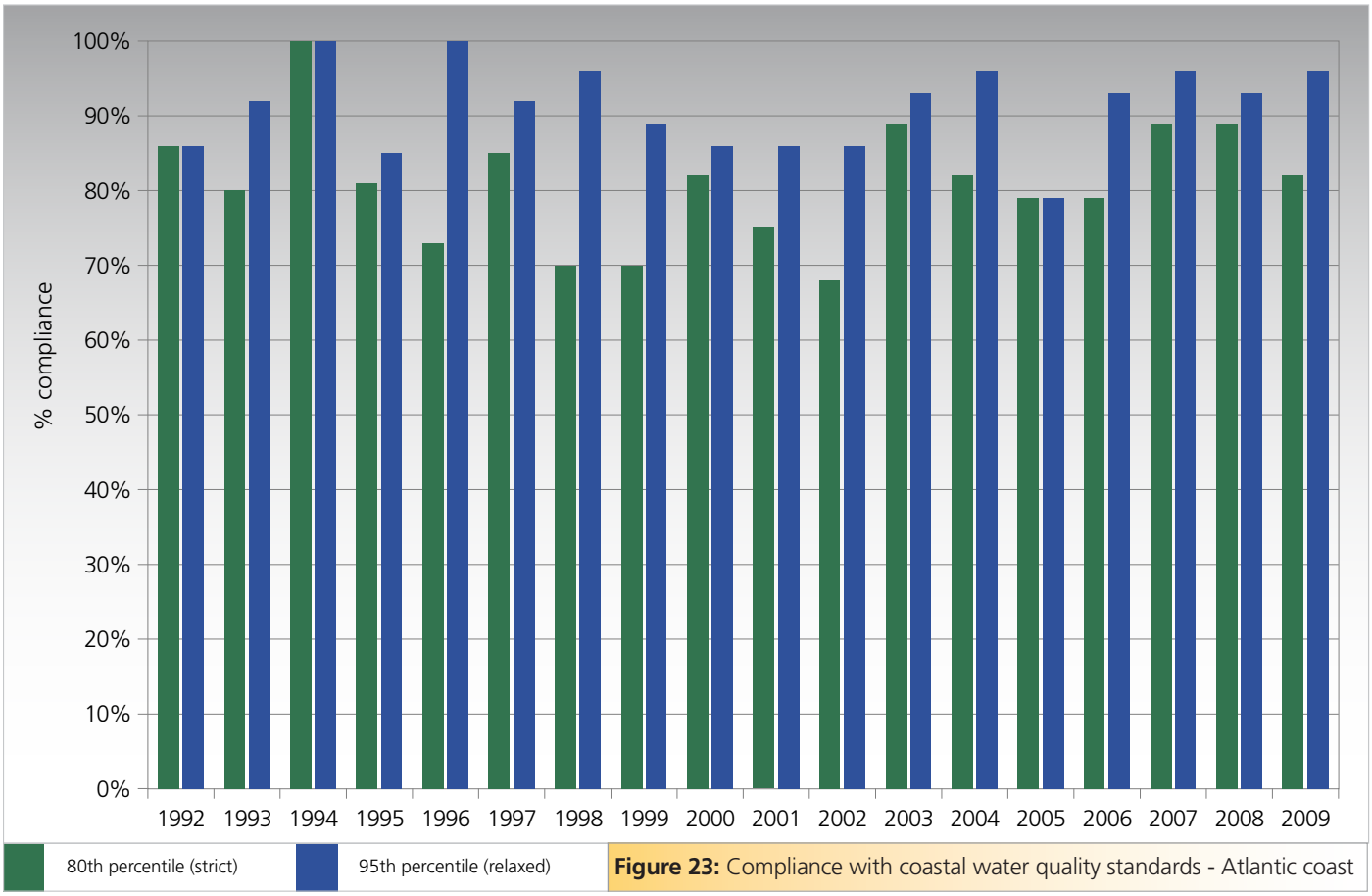


Figure 23: Compliance with coastal water quality standards - Atlantic coast

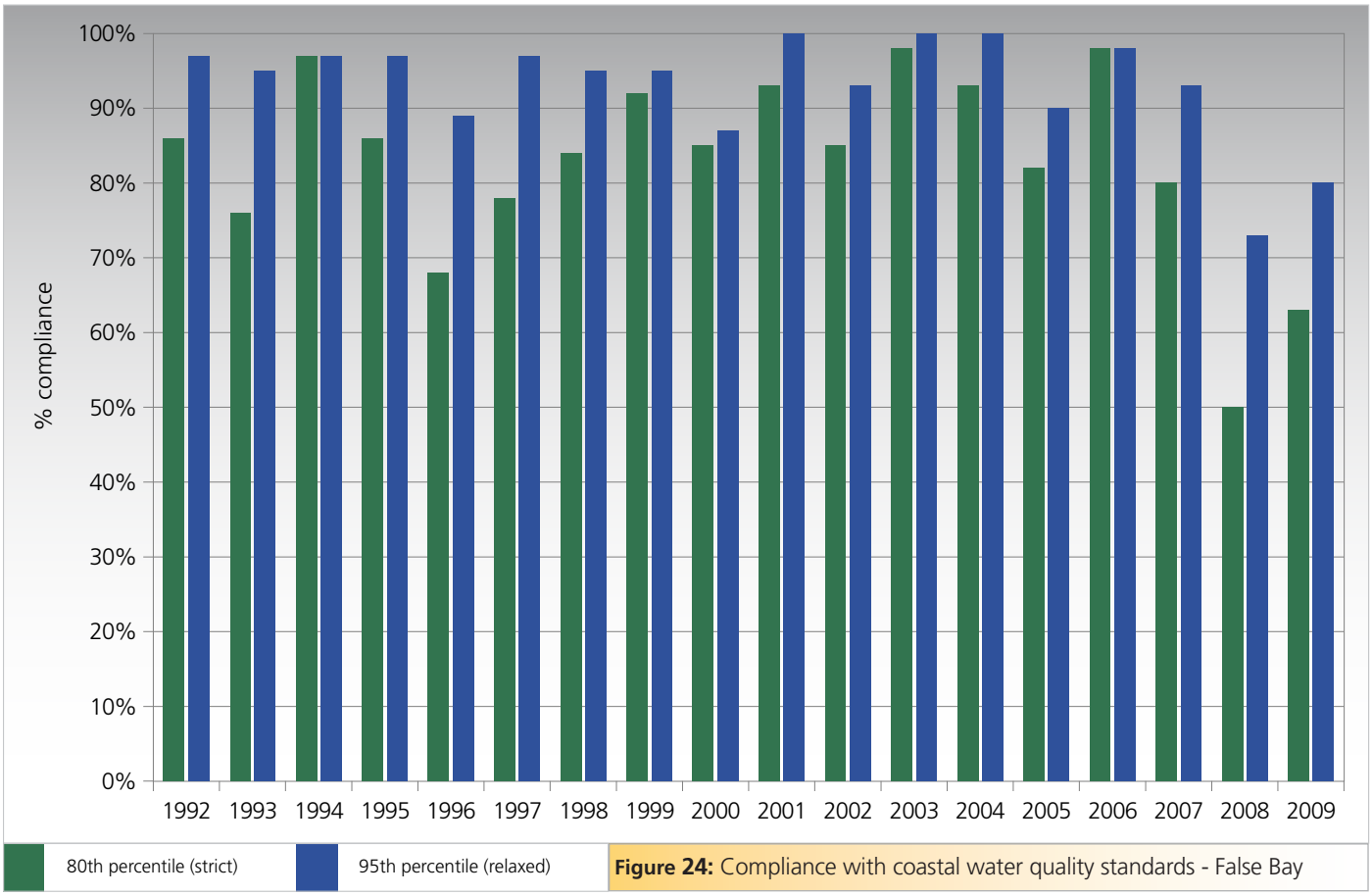
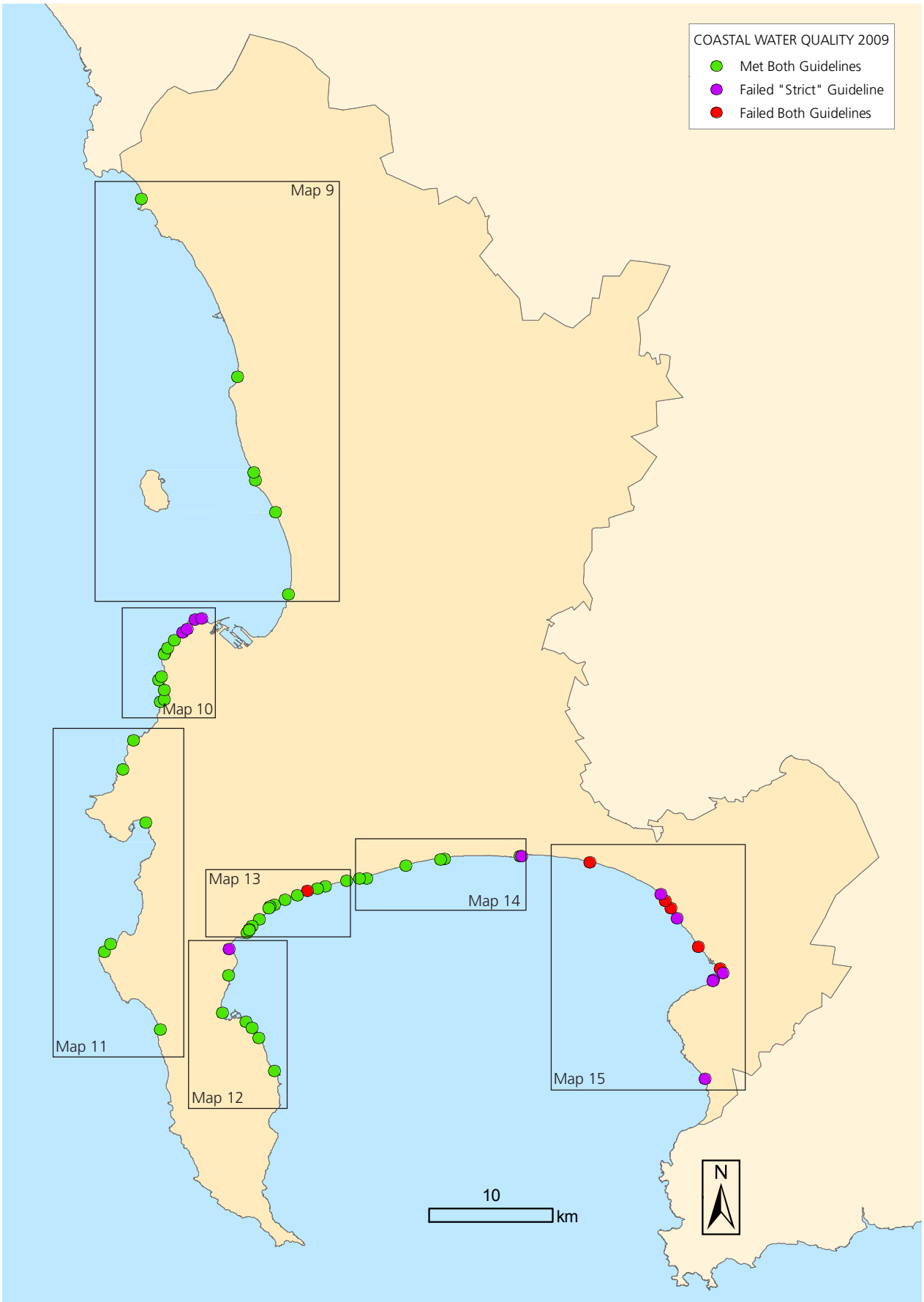
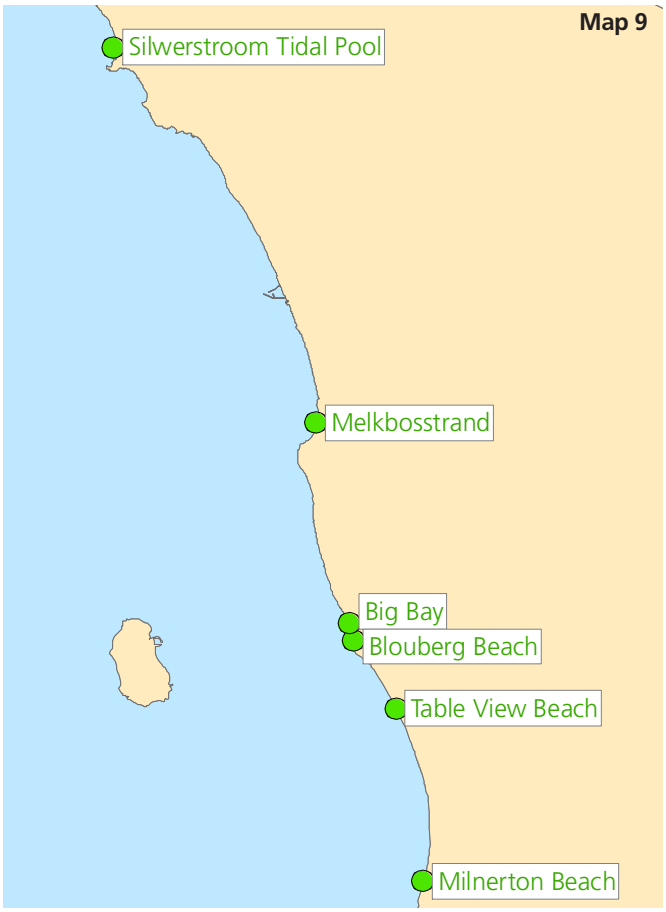
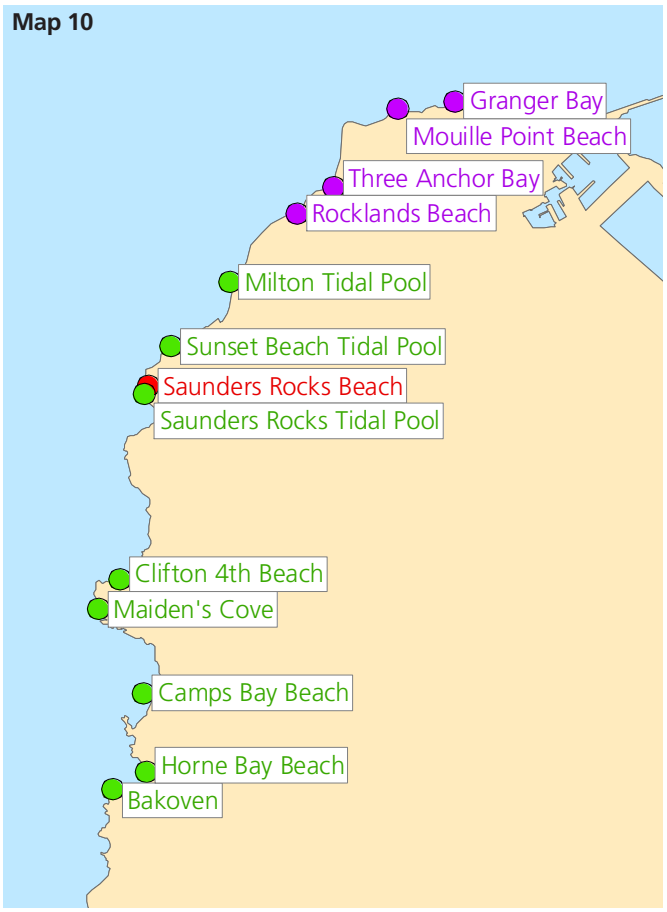


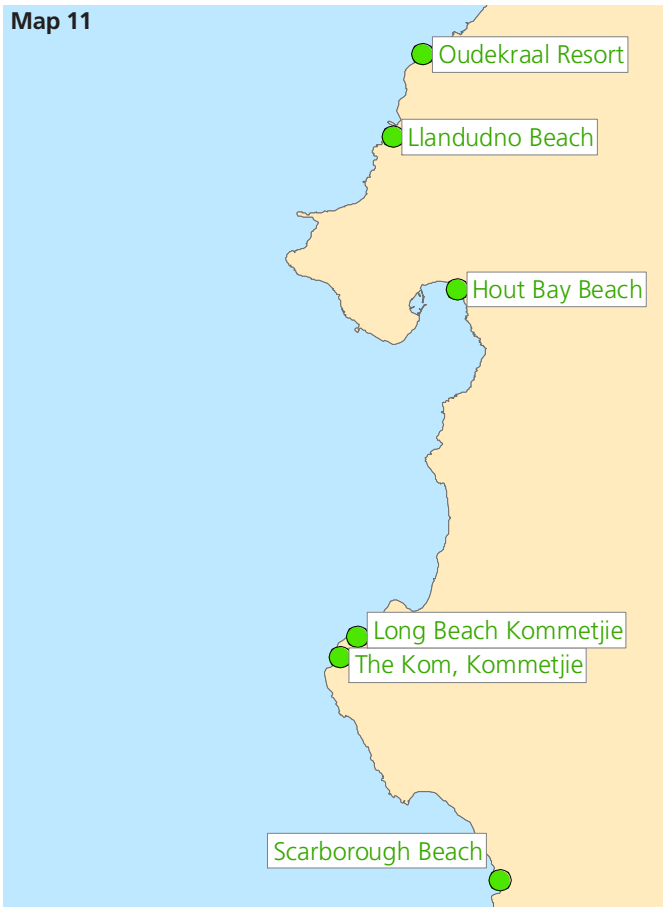
Figure 24: Compliance with coastal water quality standards - False Bay

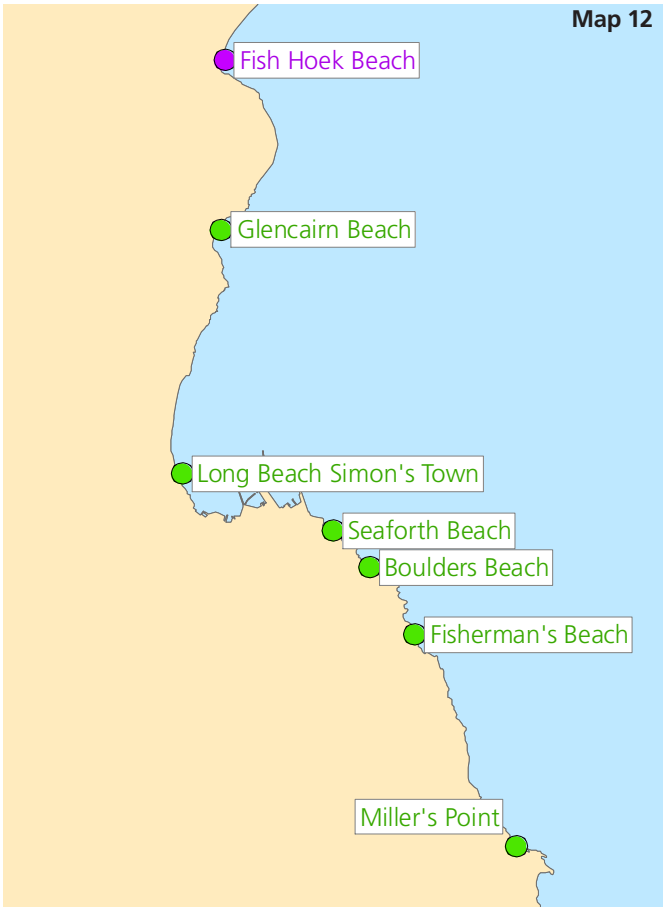


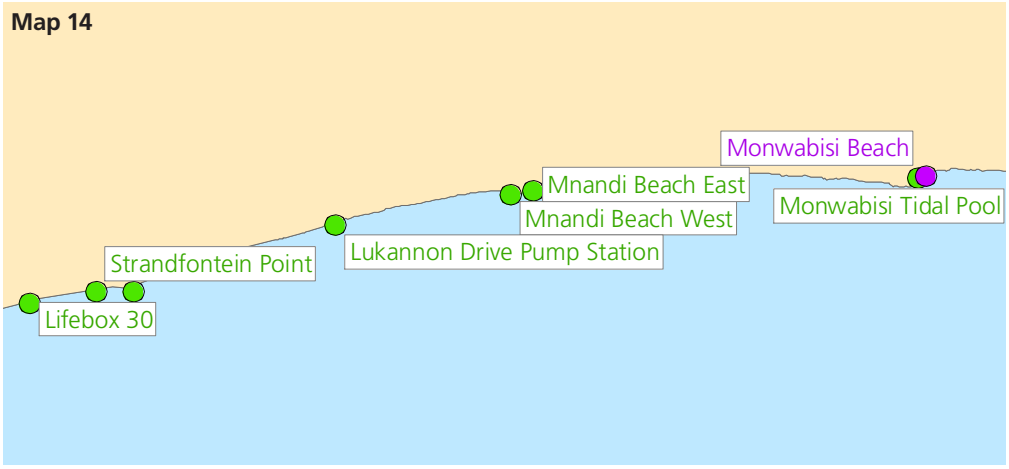
Map 8: Coastal Water Quality (2009)

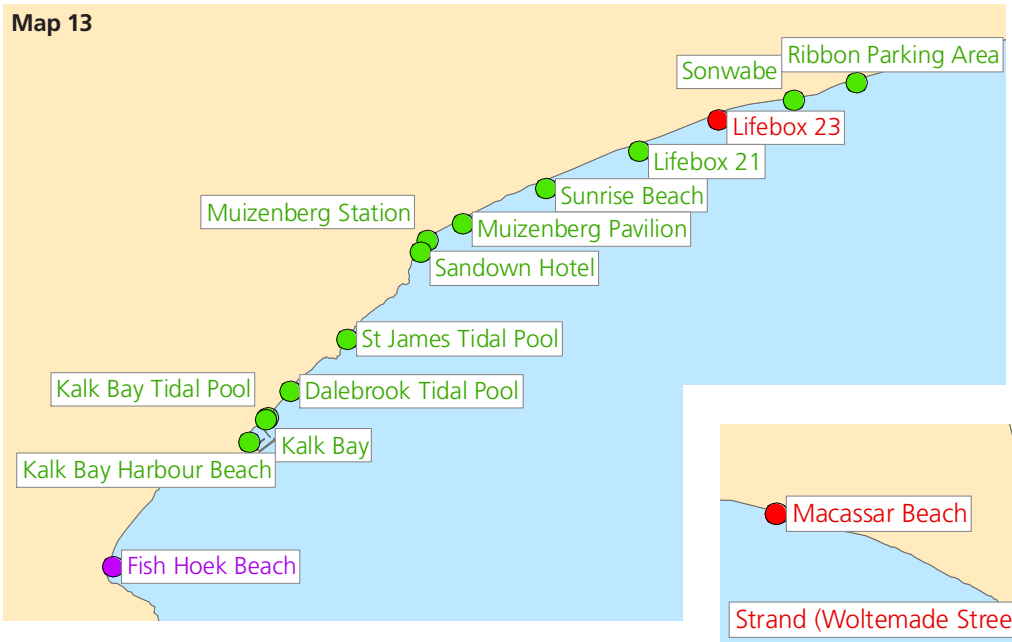

Map 9
Silwerstroom Tidal Pool
Melkbosstrand
Big Bay
Blouberg Beach
Table View Beach
Milnerton Beach

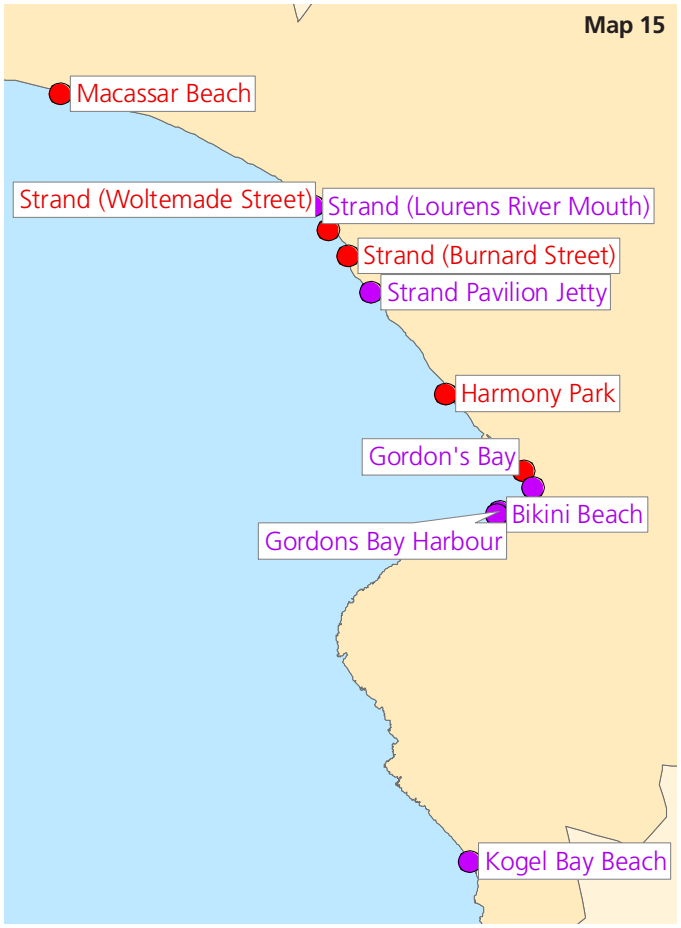

Map 10
Granger Bay
Mouille Point Beach
Three Anchor Bay
Rocklands Beach
Milton Tidal Pool
Sunset Beach Tidal Pool
Saunders Rocks Beach
Saunders Rocks Tidal Pool
Clifton 4th Beach
Maiden's Cove
Camps Bay Beach
Horne Bay Beach
Bakoven


Map 11
Oudekraal Resort
Llandudno Beach
Hout Bay Beach
Long Beach Kommetjie
The Kom, Kommetjie
Scarborough Beach


Map 12
Fish Hoek Beach
Glencairn Beach
Long Beach Simon's Town
Seaforth Beach
Boulders Beach
Fisherman's Beach
Miller's Point


Map 14
Monwabisi Beach
Mnandi Beach East
Monwabisi Tidal Pool
Mnandi Beach West
Lukannon Drive Pump Station
Strandfontein Point
Lifebox 30


Map 13
Ribbon Parking Area
Sonwabe
Lifebox 23
Lifebox 21
Sunrise Beach
Muizenberg Station
Muizenberg Pavilion
Sandown Hotel
St James Tidal Pool
Kalk Bay Tidal Pool
Dalebrook Tidal Pool
Kalk Bay
Kalk Bay Harbour Beach
Fish Hoek Beach


Map 15
Macassar Beach
Strand (Woltemade Street)
Strand (Lourens River Mouth)
Strand (Burnard Street)
Strand Pavilion Jetty
Harmony Park
Gordon's Bay
Bikini Beach
Gordons Bay Harbour
Kogel Bay Beach

Analysis

Poor coastal water quality tends to occur in clusters of monitoring points, indicating that pollution is relatively localised and may therefore have a point source origin. The occurrence of poor water quality concentrations around stormwater and wastewater outlets and river mouths indicates that these are the major sources of coastal pollution, as a result of polluted stormwater and treated wastewater release into Cape Town's freshwater systems.

The coastal zone is one of Cape Town's greatest economic assets, as it is an important drawcard for international and local tourists. Additionally, coastal property is highly priced and sought after, further stimulating the local economy. It is of the utmost importance that this asset is protected, by addressing the root causes of poor coastal water quality. The City aims to address the underlying reasons for stormwater contamination, as well as improve the quality of wastewater effluent, including measures to address faecal contamination of stormwater, such as the ongoing roll-out of formal sanitation in informal areas, and the ongoing upgrade and extension of wasetwater treatement works in order to improve the quality of effluent. However, this is a costly and complicated process, and as such can be expected to take a number of years. City residents also have a part to play by ensuring that litter, household chemicals (e.g. detergents, fertilizers and pesticides), and pet waste are adequately disposed of, and not allowed to run off into the stormwater system. Residents should be mindful of the fact that all stormwater systems empty into receiving systems such as rivers, wetlands, estuaries or the sea. The City's Stormwater By-law stipulates that only rainwater should be conveyed within the stormwater system. This is a significant challenge since contamination of stormwater from the various sources already mentioned is an unfortunate reality in the urban environment.

Trend and target

Trend: A significant decline in False Bay water quality was noted in 2008, but has improved since. Water quality on the Atlantic coast has remained relatively stable.

Target: Environmental Agenda 2014 Target: 95% of coastal monitoring points will be compliant with the 80th percentile (strict) guideline.

Current: 71% of all coastal monitoring points were compliant with the 80th percentile (strict) guideline.

Policy linkages

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.

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:

Wastewater (page 32)
Freshwater quality (page 40)

Water Use

Indicators

- **Water treated and sold annually (billions of litres)**
- **Daily water use per capita (ℓ)**

South Africa is a water-scarce country, and Cape Town in particular tends to experience periods of severe water shortages. The region's long, hot and dry summers cause demand for water to be highest when supply is most limited.

Guidelines for water use

The WHO recommends a per capita minimum of 50 ℓ of water per day for basic cooking, drinking and hygiene requirements. However, it is important to note that this is a basic level of service. The City provides 6 000 ℓ of free water to all households; at an average household size of four people, this works out at 50 ℓ per person per day. The Urban Environmental Accords recommend that cities with a consumption of more than 100 ℓ per capita per day implement measures to reduce consumption by 10%.

State of the environment

Since 1995, annual water use (including domestic, commercial and industrial use) has remained at fairly stable levels of between 250 and 310 billion litres per year, rising to a high of 310 billion litres in 1999 (see Figure 25). Water restrictions were first introduced in 2001, and again in 2004, and saw 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 does have a significant effect on water use levels, and demonstrates residents' willingness to contribute to their city's environmental sustainability. Figure 26 shows that water use per capita has decreased significantly since 1996, and is at its second lowest level at 225 ℓ per day. Therefore, although water use overall has increased over time, this is mostly due to population growth in Cape Town, and not due to increased water use by individuals. This is an encouraging trend, as in order to ensure a future sustainable supply of water to Cape Town, water use needs to remain at relatively low levels.

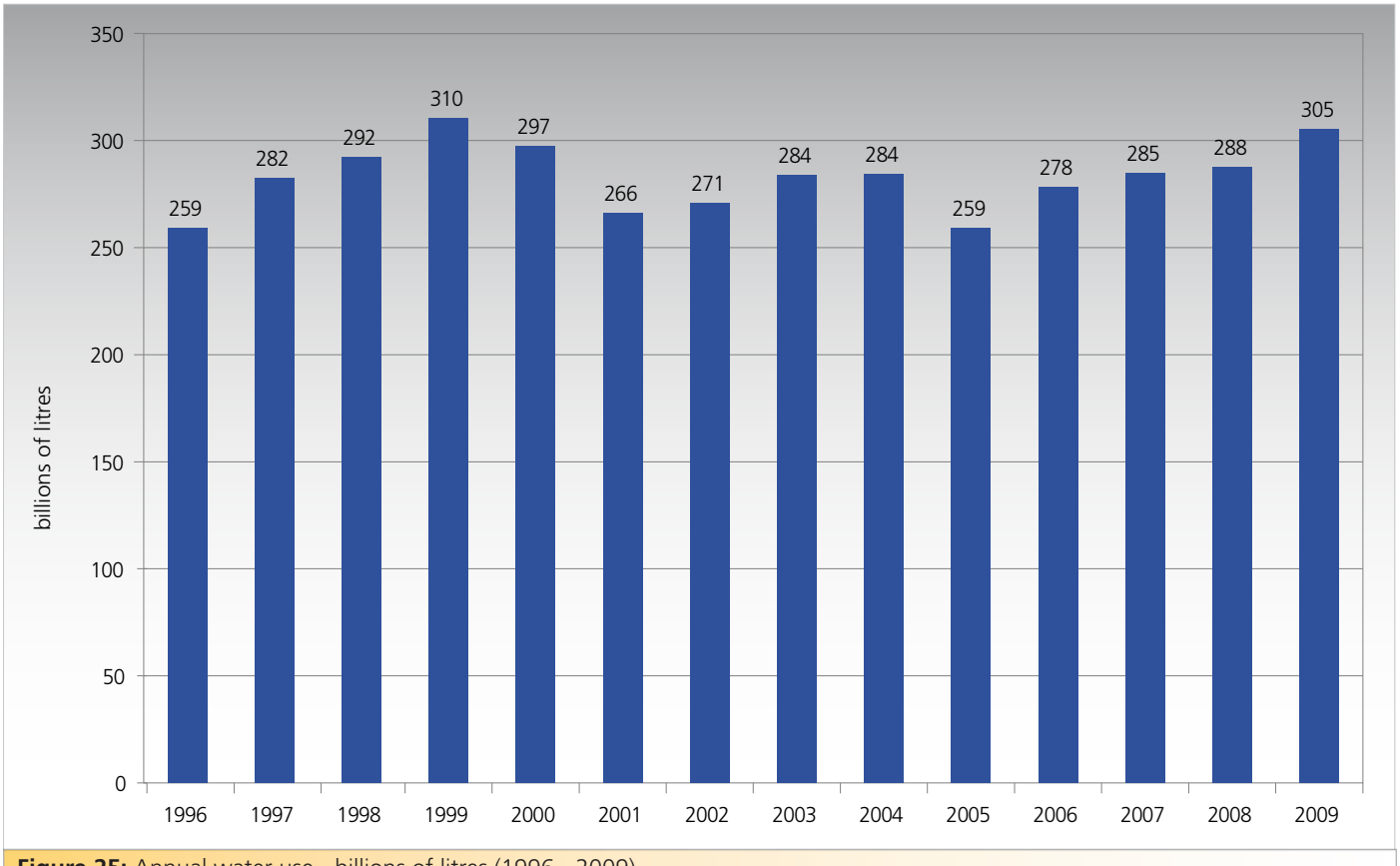


Figure 25: Annual water use - billions of litres (1996 - 2009)

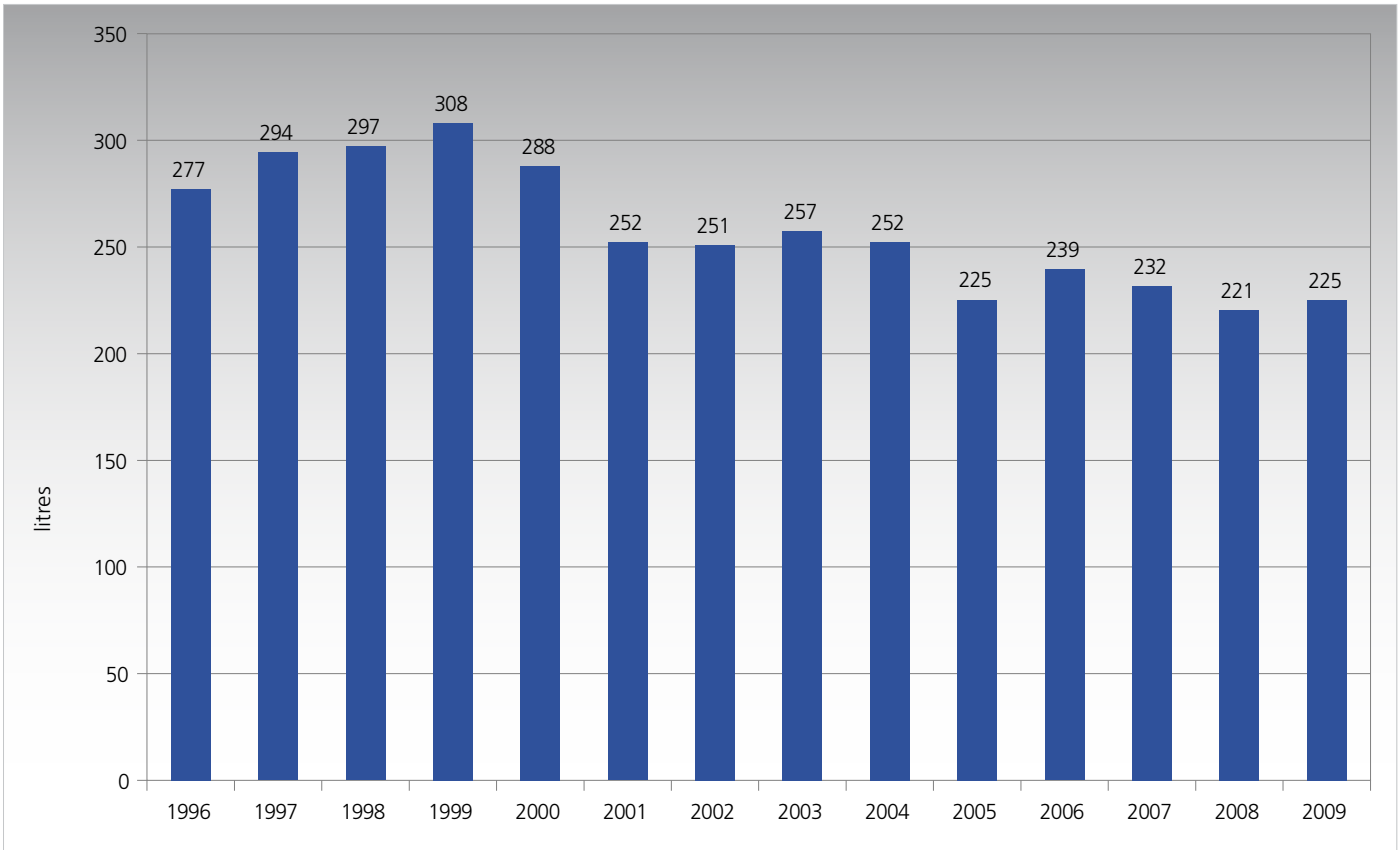


Figure 26: Daily water use per capita (1996 - 2009)

Analysis

Even though water use per capita has decreased, this does not indicate a lack of sufficient water to meet Capetonians' optimum health and sanitation requirements. However, it must be noted that the varying levels of use by different socio-economic groups in the city have not been taken into account. Whilst some wealthy citizens likely use significantly more than 225 ℓ per day for watering their gardens or topping up swimming pools, many poorer citizens may only just be meeting their basic needs of 50 ℓ per day. On average, European countries use approximately 200–300 ℓ per person per day. However, water use in the United States of America (USA) is as high as 575ℓ per capita daily, whilst Norway, Spain, Mexico, Japan, Italy and Australia all use more than 300 ℓ per capita per day[17]. It is therefore reasonable to assume that water usage amongst the richer sectors of Cape Town's population is substantially more than 300ℓ per person per day, and may be as high as the USA average.

A recent trend in wealthier areas of Cape Town is the installation of well points and boreholes to provide a non-potable water supply, especially for watering gardens. Whilst this reduces the pressure on dams and the CCT's treated water supply, it is important that it be monitored in order to ensure that Cape Town's groundwater does not become depleted.

It is not possible, at this stage, to accurately map the average water use by district or suburb due to technical limitations. It is hoped that this will be reported on in the future in order to provide a more detailed analysis of discrepancies in water use between rich and poor suburbs, and to account for commercial and industrial water use more accurately.

The City has a number of significant programmes in place to reduce water usage. One of the most successful has been the Integrated Water Leaks project, which has been ongoing since 2005. The goal of this project is to reduce plumbing leaks in households, especially poorer communities, thus reducing the amount of water wasted, and cutting down on water bills for those affected. During this project, local community members are trained in basic plumbing, and taught how to identify and repair leaks. These trainees are then able to offer their services to the community, who have been educated about the importance of repairing leaks.

A pressure reduction programme is also in place, which aims to reduce the pressure at which water is delivered, in vulnerable neighbourhoods. The lowered pressure remains adequate for normal household purposes, but helps to ensure that leaks and wastage are reduced. Re-use of treated wastewater effluent is another innovative programme: processed wastewater is supplied to industries for non-potable purposes and for watering of golf courses and sports fields. Treated effluent re-use thus effectively reduces the amount of potable water used for those activities.

Water demand management strategies have been extremely successful to date, and these interventions must continue into the future. The reduction of water use in Cape Town proves that citizens are willing and able to make changes when so required due to environmental constraints, and this success therefore could and needs to be extended to other aspects of resource conservation across the city.

Trend and target

Trend: Overall water usage has increased slightly, but per capita usage has remained relatively stable since 2005, at approximately 230 litres per capita.

Target: Environmental Agenda 2014 Target: Reduce overall water usage to 290 billion litres; reduce per capita usage to 180 litres per day.

Current: Overall water usage stands at approximately 305 billion litres, per capita water usage at 225 litres daily.

Policy linkages

IDP 2010/11 Top 20 Objective: 2B.1 - Reduce Water Demand.

Environmental Agenda 2009-2014: Target 8 - Water.

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 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 100ℓ per capita per day, adopt and implement policies to reduce consumption by 10% by 2015.

See also:

Wastewater (page 32)
Freshwater quality (page 40)

Solid Waste

Indicators

- **Waste disposed of annually and per capita**
- **Landfill lifespan remaining**

Solid waste consists of the waste products generated by households, businesses and industry, and includes general waste, builder's rubble and hazardous waste. Much of the solid waste that is currently disposed of in Cape Town could be recycled.

Impacts of waste disposal

Many aspects of life in a modern city are extremely wasteful. Every day Capetonians throw away tons of paper, plastic, glass, metal and food. It has been estimated that up to 60% of household solid waste generated in South Africa is organic, consisting largely of food scraps and food waste. The impact of waste disposal is two-fold. Firstly, waste disposal in landfills requires that large amounts of land be dedicated to this single land use. Currently, Cape Town's active landfills cover almost 300 ha of land. Landfill sites can eventually be rehabilitated and used for limited human activities or nature conservation purposes; however, this is a lengthy and expensive process. Secondly, disposing of waste in landfills removes a considerable quantity of useful products from circulation. Large amounts of plastic, metal, glass and paper are landfilled each year; many of these products could be recycled, thereby reducing the need for the further consumption of raw materials needed to create new products. The manufacturing of plastic is especially dependent on the availability of petrochemicals, which is a rapidly dwindling resource.

State of the environment

Figures 27 and 28 show waste disposal in Cape Town per year between 2004 and 2009. Between 2004 and 2006 a steady growth in the amount of waste disposed at landfills was seen, culminating in a high of 2.5 million tonnes. 2007 saw a slight drop in waste disposal. However, 2008 and 2009 saw a dramatic drop in the levels of waste disposed, with 1.56 million tonnes, or approximately 425 kg per person being disposed of during the year. In terms of per capita waste disposal, this is the lowest amount recorded since co-ordinated monitoring of sites across the city began in 2004.

In general, the lifespan of existing landfills in Cape Town is low – the longest being only 12 years (see Figure 29). It is important to note that these projected lifespans are not cumulative (i.e. they cannot be added together) and that the projections do not take into account the knock-on effect of landfill closures. In the past few years, three of the city's landfills had to be closed. Whilst twelve years may seem like a long time, in terms of city planning it is a comparatively short timeframe in which to implement additional measures. Long term plans are in place to implement additional extensions and develop new sites, which would greatly expand the available landfill space in Cape Town and the surrounding region.

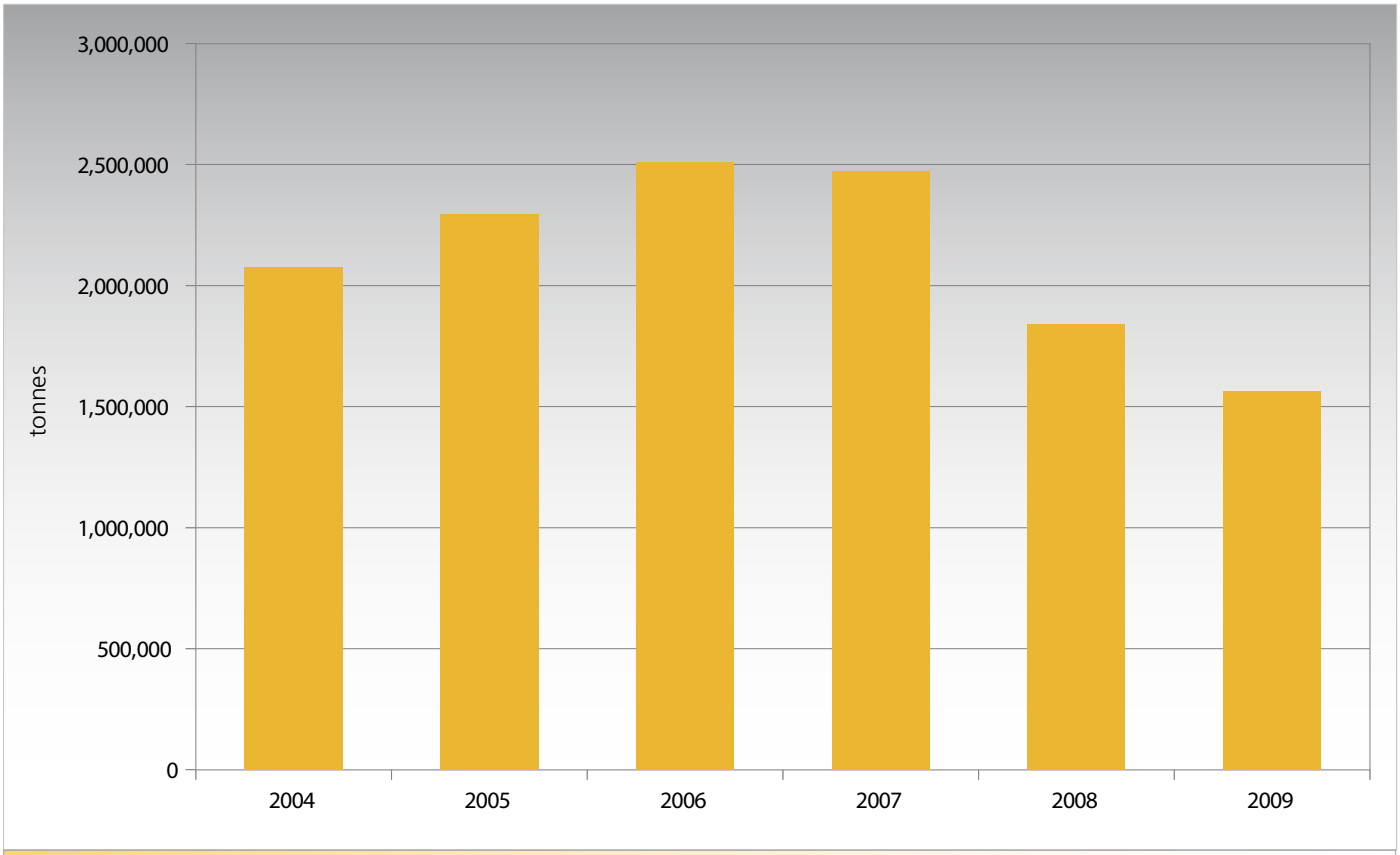


Figure 27: Waste disposed annually (2004 - 2009)

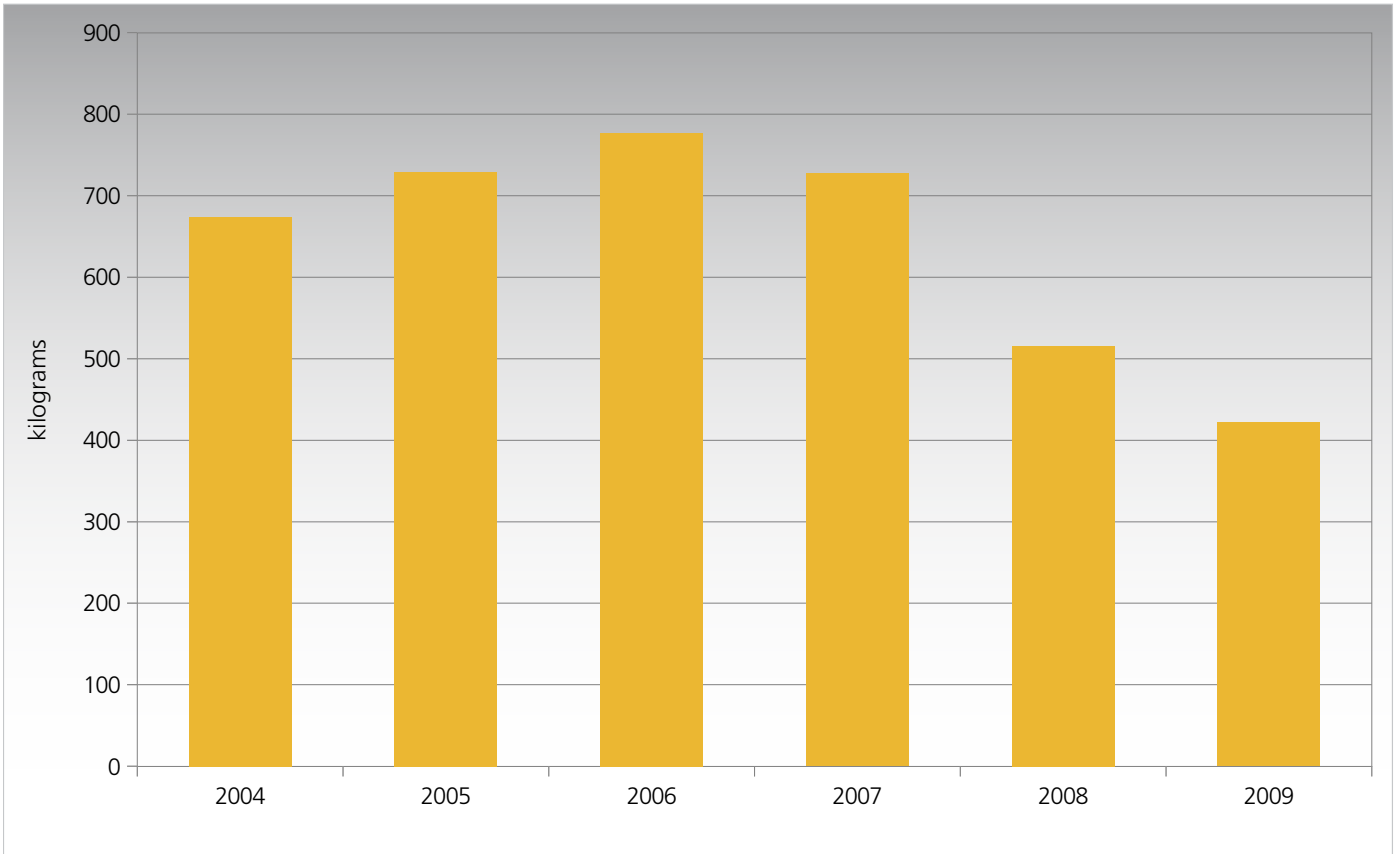


Figure 28: Waste disposed per capita annually (2004 - 2009)

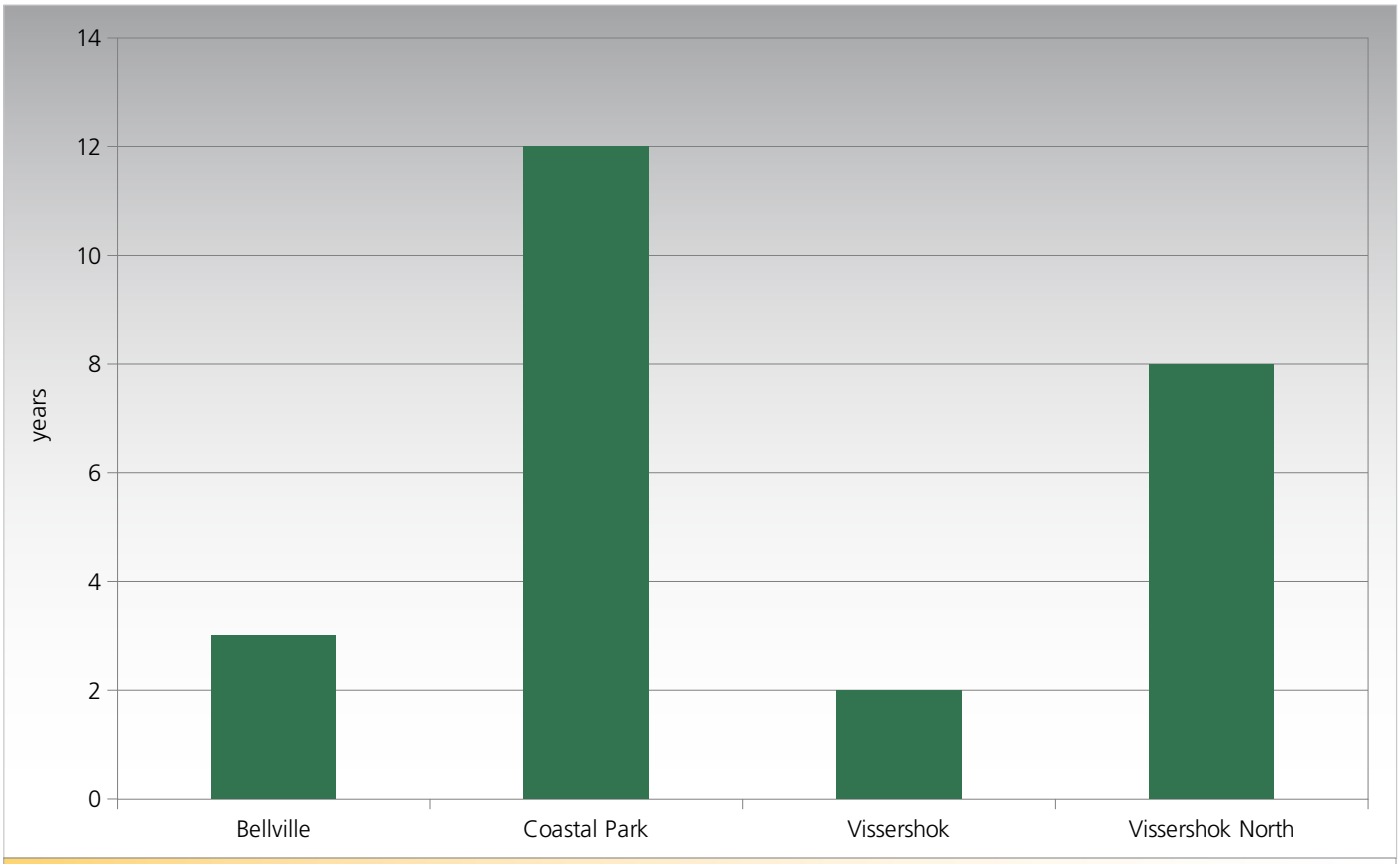


Figure 29: Landfill lifespan remaining (2009)

Analysis

It is clear that a dramatic drop in the amount of waste sent to landfill has been experienced in both 2008 and 2009. Whilst it is not possible to accurately determine the exact causes for this drop, it is probable that a number of circumstances and interventions have contributed.

Firstly, the global economic downturn that began in 2008 and has continued throughout 2009 may have had a role to play in reduction of waste sent to landfill. Construction and demolition is likely to have slowed over this term, meaning less construction waste sent to landfill. Additionally, consumers have become more frugal in their habits, thus reducing the amount of consumer waste generated.

Secondly, 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 the 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.

Finally, in 2007, the City started a pilot project, providing certain areas of Cape Town with a split-bag collection service, with one bag allocated for recyclables, and the other for general waste. This programme was expanded in 2008 and 2009, and currently serves suburbs within the Helderberg, South Peninsula and Atlantic Seaboard areas. This has increased the amount of recyclable material diverted away from landfills.

It is critical that the City implements methods for further reducing the amount of waste to landfill in order to both extend the projected lifespan of existing sites, and delay the need for construction of additional sites. The City is currently engaged in a long term planning process that will ultimately determine the best methods of implementing cost effective and environmentally responsible waste disposal. These methods may include interventions such as city-wide recycling and material recovery centres and composting of household organic waste.

Trend and target

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: 15% reduction in waste to landfill between 2008 and 2009.

Policy linkages

IDP 2010/11 Top 20 Objective: 2B.2 - Minimise Waste.
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 Accord: Action 4 – Establish a policy to achieve zero waste to landfills and incinerators by 2040.
Urban Environmental Accord: 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 of Results

The 2009 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:

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

Indicators that show little or no change are:

- Invasive alien species
- Coastal water quality (Atlantic coast)
- Water use
- Access to nature

Indicators that show decline are:

- Biodiversity
- Carbon dioxide footprint
- Freshwater quality
- Wastewater quality

Conclusion

The overall picture of Cape Town presented in this report shows a slight improvement, when compared to the previous year's report. 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 increasing environmental challenges, and is not yet able to address them adequately, thus effectively undermining the foundation on which the city's economy is built.

Paramount among these challenges is the pollution of both Cape Town's freshwater and coastal ecosystems, largely as a result of unsatisfactorily treated wastewater and polluted urban stormwater runoff. 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. It is clear from the statistics provided that the situation has become untenable, and that rapid action is required in order to prevent further deterioration of water quality.

Biodiversity in Cape Town is also in a poor state, 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 as 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 conserve biodiversity for both the good of Cape Town, and the benefit of future generations. 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.

It is important to note that two of the areas in which the biggest improvements have been observed – water use and solid waste disposal – are largely determined by the actions of individuals who make an effort to use less water, create less waste, and recycle more. It is the citizens of Cape Town that 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. It is therefore vital to incorporate the lessons learned in these two areas, and apply them where appropriate, especially in terms of pollution reduction.

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 changes may take some time to manifest themselves. However, the City is confident that despite the challenges that will have to be met, the ultimate goal of creating a more environmentally sustainable city is an achievable one.

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

- Annual average NO_2 levels will not exceed 40µg/m^3 in any part of the city, with an aim to reduce annual average levels to no more than 30µg/m^3 in order to ensure ecological protection
- Annual average SO_2 levels will not exceed 50µg/m^3 in any part of the cCity with an aim to reduce annual average levels to no more than 20µg/m^3 in order to ensure ecological protection.
- Annual average PM_{10} levels will not exceed 50µg/m^3 in any part of the city.
- The number of times PM_{10} exceeds the daily guideline of 120µg/m^3 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

Integrated Development Plan (IDP): Corporate Scorecard 2010/11

Objective	Indicator
1A. Create an enabling environment for the economy to grow and become globally competitive	
Increase number of direct job opportunities	1A.1 Number of direct jobs
Increase direct investment into the local economy	1A.2 Rand value of investment
Increase percentage of visitors to Cape Town	1A.3 % increase in foreign visitors
Increase number of Expanded Public Works Programme (EPWP) job opportunities	1A.4 Number of EPWP job opportunities created
Improve approval time for Land Use and Planning applications	1A.5 % of Land Use applications finalised within statutory timeframes
Improve approval time for Building Plan applications	1A.6 % of Building plans finalised within statutory timeframes
2A. Provide universal access to basic services	
Increase access to sanitation	2A.1 % of formal households with access to sanitation
	2A.2 % of informal settlement households with access to sanitation
Increase access to water	2A.3 A.3 % of formal households with access to water
	2A.4 % of informal settlement households with access to water
Increase access to electricity	2A.5 % of formal households with access to electricity
	2A.6 % of informal settlement households with access to electricity
Increase access to basic refuse collection services	2A.7 % of formal households with access to solid waste removal
	2A.8 % of informal households receiving area cleaning and refuse collection service
2B. Conserve natural resources	
Reduce water demand	2B.1 % reduction in unconstrained water demand
Minimise waste	2B.2 % of waste diverted from landfill sites
2C. Effectively manage the City's infrastructure and resources	
Improve maintenance of City infrastructure	2C.1 Amount spent on repairs and maintenance
	2C.2 Reduce the number of electricity outages
	2C.3 % unaccounted for water
Sustainable water supply	2C.4 Percentage drinking water compliance to SANS 241
	2C.5 % of projects completed
3A. Develop, adopt and implement a comprehensive response to Cape Town's energy and climate change challenges	
Reduce energy consumption	3A.1 % reduction in use of electricity
4A. Improve public transport system and services (for e.g. the implementation of phase 1A of the integrated rapid transit programme)	
Increase length of dedicated public transport lanes along selected corridors	4A.1 Length of dedicated public transport lanes provided in kilometres
Increase percentage of commuters using public transport	4A.2 % commuters using public transport compared to total number of commuters in the CBD
Improve the regulation and service levels of the taxi industry through engagement with the taxi industry, legislation, enforcement and incorporation into the IRT	4A.3 Implement and enforce appropriate legislation
	4A.4 Engage Operators and form Operating Companies to run IRT

5A. Provide equitable community facilities and services across the city	
Maintain community facilities open for community use at required standard	5A.1 Number of Community Parks maintained according to selected service standards
	5A.2 Number of libraries open according to minimum planned open hours, including ad hoc unforeseen closing hours
	5A.3 Number of fenced formal sports fields compliant with the defined level grass cover standard
	5A.4 Number of halls maintained to specified standard
5B. Deliver housing opportunities in accordance with the five year housing plan (reviewed annually)	
Increase subsidised housing opportunities provided by the City	5B.1 Number of housing opportunities per year
Implementation of structured programme for the upgrade of erven in informal settlements	5B.2 Number of erven upgraded per year
6A. Foster a safe and secure environment	
Increase Community Survey Score in the perception of anti-social behaviour and general disorder	6A.1 Survey score on 5 point symmetric scale
Reduce the occurrence of vehicle accidents	6A.2 % reduction in accident rate at high frequency locations
Increase in drug related arrests	6A.3 % increase in arrests in drug related crimes
Improve response time of the Fire and Rescue Service	6A.4 % response times for fire and other emergency incidents within 14 minutes from call receipt up to arrival
Reduce the impact of flooding	6A.5 Number of informal households relocated from flood prone areas
7A. Facilitate the development of a healthy and socially inclusive society	
Educate parents, caregivers and ECD forums through targeted development support groups	7A.1 Number of targeted development programmes
Reduce air pollution	7A.2 Number of days when air pollution exceeds WHO guidelines
Reduction of the infant mortality rate	7A.3 Number infant deaths per 1,000 live births
Slow the rate of increase of the City's TB incidence	7A.4 Number of TB cases per 100,000 of Cape Town population
Slow the rate of increase of the City's ante-natal HIV prevalence	7A.5 The City's ante-natal HIV prevalence
8A. Ensure enhanced service delivery with efficient institutional arrangements	
Increase levels of employee morale	8A.1 % 'truly loyal' employees as measured by the employee culture / climate survey
Reduce time to resolve complaints	8A.2 % improvement in time to finalise complaints
8B. Manage key financial and governance areas such as income control, cash flow, indigent support, alternative income opportunities, asset and risk management	
Create new assets for public benefit	8B.1 % spend of capital budget
An unqualified audit	8B.2 View of Auditor General
Maintain the City's Credit Rating	8B.3 View of independent rating agency
8C. Establish effective community engagement channels	
Improved customer satisfaction	8C.1 Community satisfaction (Score 1-5)

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

See website: www.mdg.un.org

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.

References

1. Gallopin GC (1997). Indicators and Their Use: Information for Decision-Making. In: Moldan B and Billharz S (eds.), Sustainability Indicators: Report of the project on Indicators of Sustainable Development. Scientific Committee on Problems of the Environment (SCOPE), John Wiley and Sons Ltd.
2. US Environmental Protection Agency Office of Air and Radiation (2003). Particle Pollution and Your Health EPA-452/F-03-001 [Online, accessed 2008] URL: www.epa.gov/air/particlepollution/pdfs/pm-color.pdf.
3. US Environmental Protection Agency Office of Air Quality Planning and Standards (1998). NOX - how nitrogen oxides affect the way we live and breathe EPA-456/F-98-005 [Online, accessed 2008] URL: www.epa.gov/air/urbanair/nox/noxfldr.pdf.
4. National Ambient Air Quality Standards (2009), Government Gazette No. 32816
5. World Health Organisation (2006). WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide – Global update 2005 – Summary of risk assessment. Copenhagen: WHO.
6. Department of Environment, Food and Rural Affairs, United Kingdom (2007). Air Quality Standards Regulations 2007 No 64. London: DEFRA.
7. City of Cape Town (2006). Sustainability Report. Cape Town: City of Cape Town.
8. Energy Information Administration (2008). Voluntary Reporting of Greenhouse Gases Program: Fuel and Energy Source Codes and Emission Coefficients [Online, accessed 2008] URL: http://www.eia.doe.gov/oiaf/1605/coefficients.html
9. The Green Guide to Car CO2 Emissions [Online, accessed 2008] URL: http://www.carpages.co.uk/CO2/
10. Rouget M, Reyers B, Jonas Z, Desmet P, Driver A, Maze K, Egoh B and Cowling RM (2004). South African National Spatial Biodiversity Assessment. Technical report volume 1: Terrestrial Component. Pretoria: SANBI.
11. Driver A (2008). Threatened ecosystems for listing under NEMBA 2008 [submitted]. Pretoria: SANBI.
12. Global Invasive Species Database. [Online, accessed 2008] URL: http://www.issg.org/database/welcome/content.asp.
13. English Nature (1996) A Space for Nature. Peterborough: English Nature.
14. Maas J, Verheij RA, Groenewegen PP, De vries S and Spreeuwenberg P (2006). Green space, urbanity, and health: how strong is the relation? Journal of Epidemiology and Community Health 2006:60.
15. Department of Water Affairs and Forestry, South Africa (2008). Methods for determining the water quality component of the ecological reserve. Prepared by Scherman Consulting.
16. Council for Scientific and Industrial Research (2008). River Health Programme [Online, accessed 2008] URL: www.csir.co.za/rhp
17. United Nations Development Programme (2006). Human Development Report 2006: Beyond scarcity: Power, poverty and the global water crisis. New York: Palgrave Macmillan.

Acknowledgements

This publication was prepared by the City of Cape Town Environmental Resource Management Department in collaboration with members of staff of the following City of Cape Town departments:

City Health (Air Quality Management Section)
Scientific Services
Solid Waste Management
Roads and Stormwater (Catchment, Stormwater and River Management Branch)
Water and Sanitation
Wastewater

Publisher: **City of Cape Town**
Corporate Communication Department

Text and layout: **Amy Davison,**
Environmental Resource Management Department

Photography: **Bruce Sutherland**
Jéan du Plessis
Anton Pauw
City of Cape Town staff