environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

South African Environment 2019

SAE 2019

The 2019 synthesis of South African state of environment and environmental outlook information

Final Draft, Revision 2.0, August 2019

[Comment: the following provides some general notes for the team that is capturing this Word document on the SAE 2019 website –

Key: [square bracketed purple text denotes a live link to a document accessible from the SAEO online library]; [brown text denotes a live link to an 'Information Sheet' accessible from the SAEO online library]; [green text denotes a live link to a glossary entry]; [yellow text denotes a live link to a website]; and [red text denotes a live cross-reference].

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1 Introduction

1.1 Purpose

The [1997 White Paper on Environmental Management Policy] notes that –

> *Information on the state of the environment and activities with an adverse or damaging effect on it is essential for effective environmental management, protection and coordination. This information is necessary for developing and implementing environmental standards and legislation. The availability and accessibility of such information allows for prevention and mitigation. It also facilitates compliance monitoring and successful participation by interested and affected parties. Information may influence consumer behaviour and raise public and business awareness, encouraging compliance and the prioritisation of environmental issues.*

With this, the policy requires the Department of Environment, Forestry and Fisheries to report periodically on the state of the South African environment in order to:

- provide accurate, timely and accessible information about the condition and prospects of the South African environment;
- increase public understanding of these issues; and
- report on the effectiveness of policies and programmes designed to respond to environmental change, including progress towards achieving environmental standards and targets.

To this end, the South African Environment 2019 (SAE 2019) provides decision-makers and the South African public in general with the current, accurate, complete and relevant state of environment information envisaged by South Africa's Environmental Management Policy and as contemplated in section 16A of the [National Environmental Management Act (No. 107 of 1998)] (NEMA).

1.2 SAE 2019 Components and Content

The South African Environment 2019 consists of the synthesis of South African state of environment and environmental outlook information contained in this, the South African Environment website, and the following detailed reports accessible through this website –

- [The 2018 National Biodiversity Assessment];
- [The 2016 Phase 1 of Desertification, Land Degradation and Drought (DLDD) Land Cover Mapping Impact Indicator of the United Nations Convention to Combat Desertification (UNCCD)];
- [The 2019 Trends of Desertification, Land Degradation and Drought (DLDD) Indicators of the UNCCD for South Africa]
- [The 2018/19 Annual Oceans and Coasts Report Card];
- [The 2017 Report on the status of biological invasions and their management in South Africa];
- [South Africa's Third National Communication Under the United Nations Framework Convention on Climate Change, 2018];
- [The 2018 State of Air Report];
- [The 2018 State of Waste Report];
- [The 2018/19 Compliance and Enforcement Report]
- [UNEP 2019 Global Environmental Outlook (GEO 6)];
- [The 2017 Gauteng Environmental Outlook Report];

- [The 2017 Kwa-Zulu Natal Environmental Outlook Report];
- [The 2016 Limpopo Environmental Outlook Report];
- [The 2018 North West Province Environmental Outlook Report]; and the
- [The 2018 Western Cape Province Environmental Outlook Report].

With the above, the SAE 2019 has attempted to provide users with insight and access to the most up to date information published by the South African government and state-owned entities. To this end, and in keeping with the four year reporting cycle contemplated in section 16A of the [National Environmental Management Act, 1998 (No. 107 of 1998)] (NEMA), only information published from 2016 has been included. This notwithstanding, the Department of Environment, Forestry and Fisheries, as the custodian of the SAE website, will provide annual SAE updates in order to continue to provide users with the most up to date government state of environment and environmental outlook information available.

As information older than 2016 is not included, there are some obvious gaps in the SAE 2019 which future updates hope to fill. Furthermore, the Department of Environment, Forestry and Fisheries will ensure that significant current works-in-progress like, for example, the South African Natural Capital Accounts, and the Mpumalanga State of Environment Report will be included as soon as they become available.

Finally, for ease of reading the SAE 2019 does not include source references, but users are encouraged to go to the source documents listed above for full references and citations.

1.3 The South African Environment website Structure

This South African Environment website has been designed to provide the user with an immediate insight into the current state of the South African environment and environmental outlook as well as an overview of, and access to, the detailed sector components of the SAE 2019. Furthermore, given the interconnectedness of the environment, this site also identifies the links and dependencies between the sector reports using the recognised Driver-Pressure-State-Impact-Response (DPSIR) analytical framework. The SAE 2019 also provides convenient 'live-links' to various source documents, definitions and information sheets that provide more detailed information on key subjects. Finally, this synthesis analyses the implications of the findings of the detailed sector components and provides an environmental outlook for the future.

To this end, this website contains –

- [Key Indicators] – A series of up to date infographics for key environmental indicators that serve as a state of environment 'dashboard' and graphical SAE 2019 'table of contents';
- A brief answer to the question – [what is the environment]?;
- A brief answer to the question – [why is the environment important]?;
- An insight into the answer to the question – [what is the state of our environment]? This is done through contextualised and edited versions of the executive summaries of each of the detailed sector components (see 1.2 above) and includes sub-sections on –

  - [Climate change];
  - [Biodiversity];
  - [Land degradation];
  - [Oceans and Coasts];
  - [Biological invasions];
  - [Air quality];
  - [Waste];
  - [Gauteng Province];
  - [KwaZulu-Natal Province];
  - [Limpopo Province];
  - [Mpumalanga Province];
  - [North West Province]; and
  - [Western Cape Province]
- A brief answer to the question – [why is the environment in this state]?;
- A brief answer to the question – [what are the implications]?;
- A brief answer to the question – [what is the outlook]?;
- A brief answer to the question – [what are we doing about it and is it working]?;
- [Glossary] – A detailed definition and/or explanation of various terms and concepts that are used to describe the state of environment.
- [Information Sheets] – A list of 'live-linked' details of specific indicators, concepts, pollutants, etc. that are too complex to explain in a glossary.
- [Acronyms] – A complete list of acronyms used in the SAE 2019.

2 What is the environment

Before we can understand the state of our environment or environmental outlook, we should share a common understanding of what is meant by 'the environment'. Although many South Africans think that 'the environment' is the same as 'nature' – the bushveld with its wildlife and wild natural landscapes – government and most people involved in the environmental sector see the environment as something far more encompassing.

For this reason, South Africa's policy on the environment, the [1997 White Paper on Environmental Management Policy], notes the following –

> *"Because the environment means different things to different people it is necessary to start by defining what it means. In this policy the word environment refers to the conditions and influences under which any individual or thing exists, lives or develops. These conditions and influences include: (i) the natural environment including renewable and non-renewable natural resources such as air, water, land and all forms of life; (ii) the social, political, cultural, economic, working and other factors that determine people's place in and influence on the environment; and (iii) natural and constructed spatial surroundings, including urban and rural landscapes and places of cultural significance, ecosystems and the qualities that contribute to their value.*
>
> *Culture, economic considerations, social systems, politics and value systems determine the interaction between people and the environment, the use of natural resources, and the values and meanings that people attach to life forms, ecological systems, physical and cultural landscapes and places. People are part of the environment and are at the centre of concerns for its sustainability."*

South Africa's principle piece of environmental legislation, the [National Environmental Management Act, 1998 (Act No. 107 of 1998)], uses the policy's broad definition to provide the legal definition of the environment as follows –

> *"**1. Definitions** (1)(xi) – 'environment' means the surroundings within which humans exist and that are made up of — (i) the land, water and atmosphere of the earth; (ii) micro-organisms, plant and animal life; (iii) any part or combination of (i) and (ii) and the interrelationships among and between them; and (iv) the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being."*

What this means is that 'the environment' is far broader than 'nature'. The environment is the surroundings or conditions in which a person, animal, or plant lives or operates, i.e. it includes everything around us whether we are at home, work or play.

Importantly, it is this broad definition of our environment that underpins our '[Environmental Right]' outlined in South Africa's Constitution, the [Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996)]. Chapter 2 of our Constitution provides the South African 'Bill of Rights', what it refers to as "a cornerstone of democracy in South Africa", and Section 24 says that –

> **24. Environment**
>
> Everyone has the right –
>
> (a) to an environment that is not harmful to their health or well-being; and
>
> (b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that-
>
> (i) prevent pollution and ecological degradation;
>
> (ii) promote conservation; and
>
> (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

Our Environmental Right is sometimes framed positively as “everyone has a right to a safe and heathy environment that promotes and maintains well-being.

With this, the South African Environment 2019 report attempts to provide everyone with current (information published from 2016), accurate, complete and relevant information on the state of the environment (see [SAE 2019 Components and Content]) and, by extension, it attempts to provide information on whether everyone’s right to a safe and heathy environment that promotes and maintains well-being is being progressively realised.

3 Why is the environment important

Good air, good water, good earth – the reason for of all life on this island in space we call Earth. A healthy thriving environment is essential for our personal health and well-being – indeed, our very survival depends on it. The relationship between the environment and humanity is one of interdependence – each affects the other. Therefore, just as our actions and choices affect the environment, the health of the planet influences our own personal health and well-being, as well as that of our families, communities, societies and economies. Although modern practices, materials and technologies continue to distance humanity from its direct reliance on the natural living environment for food, fresh water, clothing and shelter, our basic dependence on good air, good water and good earth remains.

Apart from these basic essentials for life, humans also have an innate connection to the natural environment. Research indicates that just being around greenery can boost mood and lower blood pressure, as well as improve attention and the ability to reflect upon a problem.

The interdependence of society, economy and environment is the foundation of the concept of [sustainable development], and this is what the late Hon. Peter R Mokaba MP said in his foreword to [South Africa's environmental management policy] –

> *"When the Rio Earth Summit convened in 1992 the world came of age. The decision to adopt and promote Sustainable Development was a defining moment in the history of social progress, peace and development. The seminal agreements reached at that august summit and the strategies adopted to achieve them in the 21st century and beyond, could not have come at a more opportune moment for the billions of people on the planet. They represented an idea whose time had come.*
>
> *The Rio agreements moved us, the world's people, closer to the objective of living in harmony with our environment. At Rio we affirmed the reality and truth that development and environmental issues and goals are one. Indeed, we demonstrated that the first principle of conservation is development; that sustainable development depends on good environmental management just as good environmental management depends on sustainable development.*
>
> *At the time Rio was convened the world was crying out for good governance, for democracy, for human rights and for an improved quality of life for our generation and those to come. At Rio the world woke up to the reality that unless we incorporate environmental considerations into our development planning, implementation and evaluation, the future of our species, and of all the other species that constitute the biodiversity and natural balance of our planet, cannot be assured."*

Our [Constitution], the highest law of the land, fully recognises the interdependence of society, economy and environment through its [Environmental Right] – everyone's right to an environment that is not harmful to health and well-being.

Despite this clear acknowledgement of the interdependence of society, economy and environment for our health and well-being, modern society appears to be increasingly forgetting why the environment is important. In an attempt to reconnect modern society with the natural environment, many in the environment sector are attempting to use economic and development concepts and language to explain why the environment is important. Two examples of these attempts are the concepts of [ecological infrastructure] and [ecosystem services].

With respect to the former, infrastructure is often broadly defined as the substructure or underlying foundation on which the continuance or growth of a community or state depends. Similarly, [ecological infrastructure] is the networks of natural lands, working landscapes and other open spaces that are the substructure or underlying foundation on which the continuance or growth of essential life-supporting and life-enhancing [ecosystem goods and services] depends.

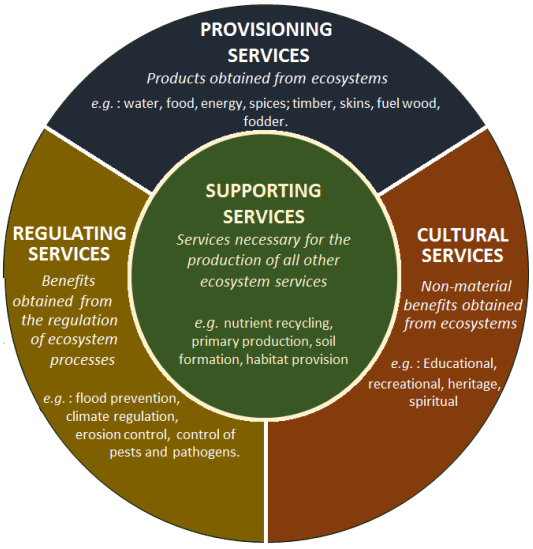
[Ecological infrastructure] refers to naturally functioning ecosystems that deliver valuable services to people, such as fresh water, climate regulation, soil formation and disaster risk reduction. It is the nature-based equivalent of

built or hard infrastructure, and it is just as important for providing services and underpinning socio-economic development. [Ecological infrastructure] includes, for instance, healthy mountain catchments, rivers, wetlands, coastal dunes, and nodes and corridors of natural habitat, which together form a network of interconnected structural elements in the landscape.

[Ecosystem services] are the many and varied benefits that we get for free from the natural environment and properly-functioning ecosystems – [ecological infrastructure]. While scientists and environmentalists are still debating the concept, for simplicity, ecosystem services may be grouped into four broad categories: provisioning, such as the production of food and water; regulating, such as the control of climate and disease; cultural, such as spiritual and recreational benefits; and supporting, such as nutrient cycles and oxygen production - where the so-called supporting services are regarded as the basis for the services of the other three categories.

In terms of supporting services, these include services such as nutrient recycling, primary production, soil formation, habitat provision and pollination. These services make it possible for ecosystems to continue providing services such as food supply, flood regulation, and water purification.

Provisioning services include: food (e.g. seafood and game), crops, wild foods, and spices; raw materials (including timber, skins, fuel wood, organic matter, fodder, and fertilizer); genetic resources (including crop improvement genes, and health care); water; [biogenic minerals]; medicinal resources (including medicinal plants, pharmaceuticals, chemical models, and test and assay organisms); energy (hydropower, biomass fuels); ornamental resources (including fashion, handicraft, jewellery, pets, worship, decoration and souvenirs like furs, feathers, ivory, orchids, butterflies, aquarium fish, shells, etc.).



Regulating services include: [Carbon sequestration] and climate regulation; predation that regulates prey populations (including so-called pest populations); waste decomposition and detoxification; purification of water and air; and pest and disease control.

Cultural services include: cultural (including use of nature as motif in books, film, painting, folklore, national symbols, architect, advertising, etc.); spiritual and historical (including use of nature for religious or heritage value or natural); recreational experiences (including ecotourism, outdoor sports, and recreation); science and education (including use of natural systems for school excursions, and scientific discovery); Therapeutic (including Ecotherapy, social forestry and animal assisted therapy)

In summary, and put very simply – the environment is important because if it gets sicker and sadder, we get sicker and sadder. If it is healthy and happy, we are healthy and happy.

4 What is the state of our environment

The following sections provide edited and contextualised versions of the executive summaries of the various [component] publications in order to provide the reader with a quick, but detailed overview of the current state of the South African environment.

4.1 Climate Change

4.1.1 Climate change impacts

The following section is based on [South Africa's Third National Communication under the United Nations Framework Convention on Climate Change, 2018] report and readers are encouraged to read the report for more in depth, fully referenced, information on climate change.

The phenomenon known as ["climate change"] refers to an ongoing trend of changes in the earth's general weather conditions as a result of an average rise in the temperature of the earth's surface often referred to as [global warming]. This rise in the average global temperature is due, primarily, to the increased concentration of gases known as [greenhouse gases (GHGs)] in the atmosphere that are emitted by human activities. These gases intensify a natural phenomenon called the ["greenhouse effect"] by forming an insulating layer in the atmosphere that reduces the amount of the sun's heat that radiates back into space and therefore has the effect of making the earth warmer.

While weather changes on a daily basis, climate represents the statistical distribution of weather patterns over time. On a global scale, unlike weather, climate has changed only very slowly in the past – usually over periods of tens of thousands of years or even millions of years. This slow change allows time for the earth's bio-physical systems to adapt naturally to the changing climatic conditions. Currently, the global climate is changing much more rapidly as a result of global warming, leading to, among others, the melting of polar and glacier ice, sea-level rise, ocean acidification, changes in rainfall and snowfall patterns, more frequent floods and droughts and increased frequency and intensity of extreme weather events, such as tornadoes, hurricanes and cyclones. The rapid rate of this climate change does not allow the earth's biophysical systems to adapt to these changes naturally.

GLOBAL HEATING

THE LAST FIVE YEARS - FROM 2014 TO 2018 – HAVE BEEN THE WARMEST YEARS EVER RECORDED AND 2018 WAS THE FOURTH HOTTEST YEAR EVER RECORDED

Evidence of rapid climate change, including more frequent and intense weather systems and greater climate variability, has already been observed and includes:

- increases in the average global temperature; with the past two decade being the hottest on record;
- rises in the average global sea level;
- changes in average rainfall patterns, with some regions experiencing higher rainfall (e.g. Northern Europe) and other areas experiencing drying (e.g. the Sahel and southern Africa);
- increased frequency of heavy rainfall and extreme weather events over most land areas; and
- more intense and longer droughts, particularly in the tropics and subtropics.

GHGs are emitted from, and are reabsorbed by, a variety of natural sources, but the rate at which human economies and societies are emitting these gases far exceeds the capacity of natural ecosystems to reabsorb them. Increased industrial activity since the mid-18th century has led to a rapid increase in the atmospheric concentration of GHGs such as carbon dioxide, methane and nitrous oxide, in large part due to the burning of fossil fuels derived from oil, coal and natural gas. We also know that land-based human activities, such as forest clearing and unsustainable agricultural practices, are not only increasing GHG emissions from these sources, but are also reducing the earth's natural ability to absorb GHGs. The evidence that current global warming is due to human activities associated with industrialisation and modern agriculture is overwhelming.

The rate of change to the earth's climate exceeds the ability of all types of ecosystems (marine, coastal, freshwater, and terrestrial) to adapt as well as compromising their ability to function effectively. Ecosystems provide important services to society, such as the formation of soil; the provision of food, fresh water, wood, fibre and fuel; the regulation of climate, floods and the spread of disease; protection from storm surges and floods; and a range of cultural, spiritual, educational and recreational services (see [Ecosystem services]). The protection of biodiversity, habitats and ecosystems is essential to the maintenance of these services, which is a key pillar for sustainable development.

415 ppm

IN MAY 2019 ATMOSPHERIC CARBON DIOXIDE (CO_2) LEVELS HIT 415 PARTS PER MILLION FOR THE FIRST TIME EVER AND THE RATE OF INCREASE IS ACCELERATING. EVERY YEAR, THE WORLD SEES NEW LEVELS THAT WERE PREVIOUSLY UNRECORDED IN MODERN HUMAN HISTORY

It is acknowledged that Africa, as a whole, has contributed least to GHG concentrations in the atmosphere, but also faces some of the worst consequences and generally has the least capacity to cope with climate change impacts. However, it is also recognised that South Africa is a relatively significant contributor to global climate change with significant GHG emission levels from its energy-intensive, fossil-fuel powered economy. On the other hand, South Africa is extremely vulnerable and exposed to the impacts of climate change due to our socio-economic and environmental context. Climate variability, including the increased frequency and intensity of extreme weather events, will disproportionately affect the poor. South Africa is already a water-stressed country and we face future drying trends and weather variability with cycles of droughts and sudden excessive rains. It is broadly acknowledged that we have to urgently strengthen the [resilience] of our society and economy to such climate change impacts and to develop and implement policies, measures, mechanisms and infrastructure that protect the most vulnerable.

The science is clear that action to address the causes and impacts of climate change by a single country or small group of countries will not be successful. This is a global problem requiring a global solution through the concerted and cooperative efforts of all countries. Should multi-lateral international action not effectively limit the average global temperature increase to below 2°C or even 1.5°C above pre-industrial levels, the potential impacts on South Africa in the medium- to long-term are significant and potentially catastrophic. Even under emission scenarios that are more conservative than current international emission trends, it has been predicted that by mid-century the South African coast will warm by around 1 to 2°C and the interior by around 2 to 3°C. By 2100, warming is projected to reach around 3 to 4°C along the coast, and 6 to 7°C in the interior. With such temperature increases, life as we know it will change completely: parts of the country will be much drier and increased evaporation will ensure an overall decrease in water availability. This will significantly affect human health, agriculture, other water-intensive economic sectors such as the mining and electricity-generation sectors as well as the environment in general. Increased occurrence and severity of veld and forest fires; extreme weather events; and floods and droughts will also have significant impacts. Sea-level rise will negatively impact the coast and coastal infrastructure. Mass extinctions of endemic plant and animal species will greatly reduce South Africa's biodiversity with consequent impacts on eco-system services.

In terms of the current state of climate change in South Africa, the country has been warming significantly over the period 1931-2015. Over the western parts of the country, including much of the Western and Northern Cape, and

also in the east over Gauteng, Limpopo and the east coast of KwaZulu-Natal, the observed rate of warming has been 2°C/century or even higher – in the order of twice the global rate of temperature increase. Associated increases in the annual number of hot days have also occurred, but there have been decreases in the annual number of cold nights over most of the country. There is strong evidence of statistically significant increases in rainfall occurring over the southern interior regions, extending from the western interior of the Eastern Cape and eastern interior of the Western Cape northwards into the central interior region of the Northern Cape, over the period 1921-2015. Extreme daily rainfall events have increased over these same areas, with these increases also being statistically significant and extending northwards into North West, the Free State and Gauteng. Over Limpopo there is strong evidence of statistically significant decreases in annual rainfall totals.

4.1.2 Greenhouse gas (GHG) emissions

°C X 2

SOUTH AFRICA HAS BEEN WARMING SIGNIFICANTLY OVER THE PERIOD 1931-2015 AT AROUND TWICE THE AVERAGE GLOBAL RATE OF TEMPERATURE INCREASE

The following is an edited extract of the executive summary of the [GHG National Inventory Report, South Africa, 2000–2015] and readers are encouraged to read this report for more detailed, fully referenced, information on South Africa's GHG emissions.

In summary, in terms of gross GHG emissions for the period 2000 to 2015, South Africa's aggregated gross GHG emissions (i.e. excluding emissions from Forestry and Other Land Uses (FOLU)) were 439 238 Gg CO_2e in 2000 and these increased by 101 616 Gg CO_2e (or 23.1%) to 540 854 Gg CO_2e in 2015 (GHG emissions are reported as [carbon dioxide equivalents], i.e. CO_2e, measured in Gigagrams (Gg) which is equivalent to 1,000 tonnes). Emissions increased slowly over this 15 year period with an average annual growth rate of 1.43%. The Energy sector is the largest contributor (between 78.1% and 81.2%) to gross emissions and is responsible for 84.8% of the increase over the 15 year period.

For the period following the publication of the [2011 National Climate Change Response Policy White Paper], namely 2012 to 2015, gross emissions increased at a slower rate of 1.2%. The increase is due to a 0.05% (195 Gg CO_2e), 9.3% (1 667 Gg CO_2e) and a 7.5% (2 927 Gg CO_2e) increase in the emissions from the Energy, Waste and Industrial processes and product use (IPPU) sectors respectively.

In terms of net emissions from 2000 to 2015, the Land sector was a sink for CO_2 and this led to a 3.1% annual average reduction in the gross emissions. Net emissions were estimated at 512 383 Gg CO_2e in 2015 and showed an increase of 20.2% since 2000. The Land sink increased over this period which caused a slight increase in the reduction of the gross emissions between 2010 and 2015. In the post-policy period 2012 to 2015, net emissions for South Africa decreased by 0.4% between 2012 and 2015. This reduction was attributed to the 24.7% (6 926 Gg CO_2e) decline in the Agriculture, Forestry and Other Land Use (AFOLU) sector emissions due to the increasing land sink.

In terms of GHG gas trends, carbon dioxide (CO_2), contributed the most to South Africa's gross emissions and this contribution increased very slightly from 84.0% in 2000 to 85.0% in 2015. The gross CO_2 emissions in 2015 were estimated at 459 944 Gg CO_2e, while net CO_2 emissions were 431 473 Gg CO_2e. The energy sector is by far the largest contributor to CO_2 emissions, contributing an average of 91.9% (of gross emissions) between 2000 and 2015, and 92.0% in 2015.

National methane (CH4) emissions increased from 43 699 Gg CO_2e to 50 855 Gg CO_2e in 2015, mainly due to an 84.0% increase in Waste sector CH4 emissions. The CH4 contribution to total gross emissions decreased from 10.0% to 9.4% over this period. The Waste sector and AFOLU livestock category were the major contributors, providing 36.7% and 55.0%, respectively, to the total CH4 emissions in 2015.

Nitrous oxide contribution to the gross emissions declined from 5.8% in 2000 to 4.5% in 2015. The N2O emissions decreased by 4.5% over the 2000 to 2015 period from 25 525 Gg CO_2e to 24 387 Gg CO_2e. A 2.0% decline in the AFOLU N2O emissions and a 79.0% decline in IPPU N2O emissions were the main reasons for the overall

reduction in N2O. The AFOLU and Energy sectors were the largest contributors, 84.5% and 10.7% respectively, to the total N2O emissions in 2015.

Flourinated gas (the so-called F-gasses, e.g., HFC, PFC, SF6 and NF3 F-gases) emissions increased from 983 Gg CO_2e to 5 668 Gg CO_2e over the 2000 to 2015 period. This increase is, however, due mostly to the incorporation of new sources during the reporting period as opposed to a true increase. In 2000 only PFC's were estimated, and in 2005 HFC emissions from ODS were included. From 2011 onwards the HFC emissions from mobile air conditioning, fire protection, foam blowing agents and aerosols were also incorporated. In 2015 HFCs contributed 61.4% to the total F-gas emissions. The total F-gas contribution to total gross emissions has increased from 0.2% to 1.1% of the 15 year period.

In terms of emission sector trends Sector trends, total emissions from the Energy sector for 2015 were estimated to be 429 907 Gg CO_2e which is 79.5% of the total gross emissions for South Africa. Energy industries were the main contributor, accounting for 60.4% of emissions from the Energy sector. This was followed by Transport (12.6%), Other sectors (11.4%) and Manufacturing industries and construction (8.6%).

Energy emissions showed an overall increasing trend between 2000 and 2015. The emissions in this sector increased by 25.0% over this period. Peak emissions were reached in 2013, after which there was a 3.6% decline to 2015. The overall growth in emissions is mainly due to the 17.9% increase in Energy industries emissions, as well as the doubling of the Other sector emissions from 19 045 Gg CO_2e to 48 793 Gg CO_2e. Emissions from Fuel combustion activities increased by 29.0%, while Fugitive emissions from fuels declined by 12.2%. The Energy sector contribution to the total gross emissions increased from 78.3% to 79.5% over the 15 year period.

Energy emissions increased by 0.05% between 2012 and 2015. Fuel combustion activities increased by 1 074 Gg CO_2e (0.3%), while Fugitive emissions from fuels declined by 879 Gg CO_2e (3.0%) over the same period. Energy industries showed a 7.5% decline in emissions since 2012.

In 2015 the industrial processes and product use (IPPU) sector produced 41 882 Gg CO_2e, which is 7.7% of South Africa's gross emissions. The largest source category is the Metal industry category, which contributes 73.9% to the total IPPU sector emissions. Iron and steel production and Ferroalloys production are the biggest CO_2 contributes to the Metal industry subsector, producing 14 093 Gg CO_2e and 13 420 Gg CO_2e, respectively. The Mineral industry and the Product uses as substitute ozone-depleting substance (ODS) subsectors contribute 14.8% and 8.3%, respectively, to the IPPU sector emissions, with all the emissions from the Product uses as substitute ODS being HFCs.

For the 2000 to 2015 period, estimated emissions from the IPPU sector in 2015 are 22.9% higher than the emissions in 2000. This was mainly due to the 15.8% (4 231 Gg CO_2e) increase in the Metal industry emissions, and the 3 482 Gg CO_2e increase in Product uses as substitutes for ODS. IPPU emissions increased by 17.9% between 2000 and 2006, after which there was a 14.5% decline to 2009 due to a recession. Emissions then increased again by 21.9% by 2015. The contribution to the national gross emissions declined from 7.8% to 7.7% between 2000 and 2015.

In the post-policy 2012 to 2015 period, IPPU emissions showed an increase of 7.5%. The increase was mostly due to a 1 161 Gg CO_2e (3.9%) increase in the Metal industry and a 954 Gg CO_2e (37.8%) increase in the Product uses as substitute ODS emissions over this period. Since the previous 2012 submission, improvements were made to this category and for the first time emissions from the categories Mobile air conditioning, Foam blowing agents, Fire protection and Aerosols were included in the inventory. This led to the apparent increase in emissions from this subcategory. The Mineral industry emissions increased by 13.2% (721 Gg CO_2e) between 2012 and 2015, while the Chemical industry and the Non-energy products from fuels and solvents increased by 7.5% (70 Gg CO_2e) and 7.8% (20 Gg CO_2e), respectively.

In 2015, the gross agriculture, forestry and land use change (AFOLU) emissions were 49 531 Gg CO_2e, while net emissions amounted to 21 060 Gg CO_2e. This is 9.2% of total gross emissions and 4.1% of total net emissions in South Africa (Figure E). Livestock and aggregated and non- CO_2 emissions from land categories contributed 27

688 Gg CO_2e and 21 208 Gg CO_2e respectively in 2015, while the Land and Other (i.e. HWP) categories were both sinks (27 176 Gg CO_2e and 660 Gg CO_2e, respectively).

Gross AFOLU emissions declined by 1 008 Gg CO_2e (2.0%) and net emissions by 16 455 Gg CO_2e (43.9%) between 2000 and 2015. The gross emission trend is dominated by the trend shown in the Livestock category (specifically the enteric fermentation from cattle), while for the net emissions the trend is dominated by the Land sector. Gross AFOLU emissions declined slowly (5.3%) between 2000 and 2007, after which emissions began to increase (4.1% by 2015) again. Net AFOLU emissions were fairly stable between 2000 and 2011, after which there was a sharp decline in emissions due to increasing land sinks. The main drivers of the increased land sink between 2011 and 2015 are the conversion of grasslands to forest land and the reduction in biomass losses due to fires. AFOLU contribution to the total gross emissions for South Africa declined from 11.5% in 2000 to 9.2% in 2015. The AFOLU contribution to the total net emissions declined from 8.8% to 4.1%.

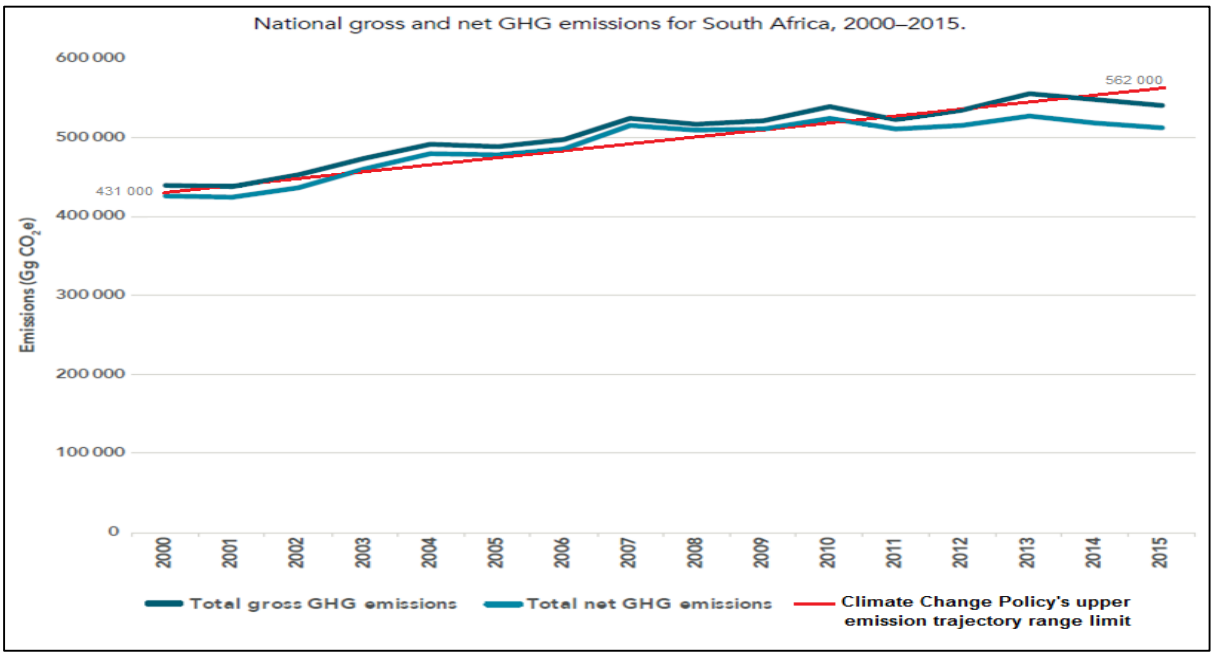
AFOLU gross emissions increased by 2.8% between 2012 and 2015 due to a 3.1% and 2.6% increase in Livestock and Aggregated and non- CO_2 emissions on land. On the other hand, net AFOLU emissions declined by 6 926 Gg CO_2e (24.7%) over the same period due to a decline of 8 144 Gg CO_2e (33.5%) in the Land sector emissions.

In respect of the Waste sector, in 2015 this sector produced 19 533 Gg CO_2e or 3.6% of South Africa's gross GHG emissions. The largest source category is the Solid waste disposal category which contributed 80.7% towards the total sector emissions. This was followed by Wastewater treatment and discharge which contributed 17.5%.

Waste sector emissions have increased by 80.2% from the 10 838 Gg CO_2e in 2000. Emissions increased steadily between 2000 and 2015. Solid waste disposal was the main contributor (average of 77.5%) to these emissions. Emissions for the new category Open burning of waste were added in this inventory and this category contributed an average of 2.1% to the total Waste sector emissions between 2000 and 2015.

The contribution from the Waste sector to the national gross emissions increased from 2.5% in 2000 to 3.6% in 2015.

The Waste sector emissions increased by 9.3% between 2012 and 2015 due to a 1 531 Gg CO_2e (10.8%) increase in Solid waste disposal emissions and a 13 Gg CO_2e (3.7%) increase in Incineration and open burning of waste emissions.



Figures emerging from South Africa's draft Greenhouse Gas emissions inventory for the period 2000-2017 are showing that the country's emissions profile appears to be returning to within the national greenhouse gas emissions trajectory range set by the [2011 National Climate Change Response Policy White Paper] - also known

as the Peak, Plateau and Decline, or PPD, trajectory. The latest available measurements for 2017 show that, although South Africa still emitted a staggering 500 million tonnes (Mt) of greenhouse gases, this was well below the upper range target of 568 million tonnes. However, it is uncertain whether this positive emission trend is an indicator of our economy being delinked from greenhouse gas emissions or whether it is simply a reflection of the current low levels of economic growth.

4.2 Biodiversity

The following section is an edited extract of [The National Biodiversity Assessment 2018 (NBA 2018)] report and readers are encouraged to read the report for more in depth, fully referenced, information on the state of South Africa's biodiversity.

South Africa has exceptional biodiversity, characterised by high species richness, high levels of species endemism and a wide variety of ecosystems. South Africa's diversity and richness is not limited to biodiversity. Within its borders are also diverse cultures and languages and exceptional geological and climatic diversity.

South Africa's biodiversity provides a wide array of benefits to the economy, society and human well-being. The benefits that nature can provide are dependent on intact ecosystems, healthy species populations and genetic diversity. Human activities present a range of direct and indirect pressures on biodiversity that need to be carefully considered alongside the need to maintain and protect biodiversity, and the benefits that are derived from biodiversity.

The National Biodiversity Assessment (NBA) is the primary tool for monitoring and reporting on the state of biodiversity in South Africa. It is prepared as part of the South African National Biodiversity Institute's (SANBI) mandate to monitor and report regularly on the status of South Africa's biodiversity, and is a collaborative effort from many institutions and individuals. The NBA focusses primarily on assessing biodiversity at the ecosystem and species level, with efforts being made to include genetic level assessments. Threat status and protection level are the two headline indicators of the NBA and they are applied to both species and ecosystems. The products of the NBA include seven technical reports, a technical synthesis report and several popular outputs.

The [NBA 2018] is the third such assessment for South Africa – following the [National Spatial Biodiversity Assessment 2004] and the [National Biodiversity Assessment 2011]. Each NBA builds on years of research and innovation by South African scientists. The NBA 2018's goals of improving ecosystem classification and mapping, introducing a species protection level indicator and potential genetic diversity indicators, and including South Africa's sub-Antarctic territory for the first time were all met. In addition, this NBA trialled the new International Union for the Conservation of Nature (IUCN) Red List of Ecosystem criteria and was able to track trends in species status and habitat loss for the first time.

4.2.1 NBA 2018 Key messages

- ***Biodiversity provides jobs*** *– South Africa's biodiversity provides substantial employment in a range of sectors. Continued investment in managing and conserving biodiversity is essential so that jobs that depend on biodiversity can continue to increase*
- ***Healthy ecosystems are essential for water security*** *– Rivers, wetlands and their catchment areas are crucial ecological infrastructure for water security, often complementing built infrastructure, but the benefits from some of these ecosystems are currently compromised by their poor ecological condition. Water security can be improved through integrated management of natural resources in Strategic Water Source Areas as well as other key catchments, including protection and restoration in some cases*
- ***Water flowing into the sea provides multiple benefits to people*** *– Freshwater flowing from rivers through estuaries into the sea is <u>not</u> wasted but is essential for coastal and marine food production, livelihoods, tourism and future climate change resilience. Through appropriate management, South Africa can maintain the vital freshwater flows that reach the coast.*
- ***Small high-value ecosystem types take up just 5% of South Africa's territory but provide multiple benefits to people*** *– Certain small ecosystem types function as crucial ecological infrastructure and, despite their small footprint, provide multiple benefits to society. Managing, protecting and restoring these small high-value ecosystems gives a large return on investment.*

  Indigenous forests, inland wetlands, lakes, estuaries, mangroves, dunes, beaches, rocky shores, kelp forests, reefs, seamounts, pinnacles and islands together take up less than 5% of South Africa's territory,

but are responsible for a disproportionally large number of benefits such as water purification, nutrient cycling, carbon storage, storm protection, recreation and harvesting of food directly from nature.

- ***Benefits from fishing are at risk, including food and job security*** *– Estuarine and marine ecosystems provide South Africans with food and livelihoods by providing a basis for fishing – whether commercial, subsistence or recreational. Yet many fish stocks are overexploited and many fish species are threatened. While a range of plans are in place to ensure that fisheries are sustainable, better practices to rebuild stocks of priority species are needed, as well as reliable data and sufficient capacity for undertaking regular stock assessments*
- ***Climate change is impacting on people and ecosystems; in spite of this, healthy ecosystems can help us adapt to climate change*** *– The impacts of climate change are evident across all realms and within most species groups. Biodiversity provides resilience against the worst effects of climate change. Restoring ecosystems and maintaining them in a good ecological condition means they are better able to support natural adaptation and mitigation processes, offering increased protection to human communities and reducing the economic burden of future climate disasters.*
- ***Estuaries and wetlands are the most threatened and least protected ecosystems in South Africa*** *– Estuarine and inland wetland ecosystems face numerous pressures and are highly threatened. Funding the restoration and protection of estuaries and inland wetlands will secure essential benefits and deliver large return on investment*
- ***Coastal biodiversity assets, including beaches, are at risk*** *– Sixty percent of coastal ecosystem types are threatened – a result of the many pressures concentrated on the coast. Judicious coastal development that avoids sensitive area can minimise further damage, maintain ecological infrastructure and reduce climate risks.*
- ***Protected areas: investment success in the ocean and on land*** *– Protected areas have expanded in the ocean and on land, and are a source of pride for South Africans. Continued expansion will help to ensure biodiversity conservation, ecological sustainability and even more social and economic benefits from biodiversity.*

  In 2018, 20 new Marine Protected Areas were accepted for declaration, covering 5% of the country's mainland marine territory and advancing the marine realm above other realms in terms of the percentage of ecosystem types having at least some protection (87%). Substantial advances were also made around the Prince Edward Islands in 2013, with a large MPA that covers 36% of South Africa's marine territory in the sub-Antarctic. The protected area estate of South Africa's terrestrial mainland increased by 11% between 2010 and 2018 and now covers nearly 9% (>108 000 km2) of the country's land area. The land-based protected area network is increasingly representative of the full range of ecosystem types, with three quarters of terrestrial ecosystem types now having some form of representation.

- ***Protected areas: providing effective protection for many species*** *– South Africa's protected areas are generally providing good protection for species, as shown by a new protection level indicator for species. The results provide important feedback for protected area expansion strategies and for protected area management.*

  South Africa's birds and reptiles are the best protected of the seven species groups assessed in this NBA, with over 85% of these species considered Well Protected. Continued investment in protected areas is paying off for species, as the proportion of threatened species represented in protected areas has increased for most groups over the past 30 years.

- ***Freshwater fishes are the most threatened species group in South Africa*** *– Freshwater fishes are the most threatened of all species groups that have been fully assessed in South Africa, and half of South Africa's freshwater fish species are found nowhere else in the world. Effective management and conservation strategies to halt the decline and promote recovery of threatened fish species are needed, focused on the rivers and catchments where these fish occur.*

SA has 118 freshwater fish species, of which half are endemic. One third of South Africa's native freshwater fish species are threatened. Two thirds of the endemic [taxa] are threatened, and most of these are concentrated in the mountainous Cape Fold ecoregion.

- ***Trends in threat status show rapid declines in some of South Africa's species, especially freshwater species and butterflies*** *– Changes in species threat status over time were tracked for eight taxonomic groups using the IUCN Red List Index (RLI). Increased extinction risk is evident for most groups but freshwater species and butterflies, in particular, show a steep decline. For the RLI to be more comprehensive repeat assessments are required for species in the marine and estuarine realms, and invertebrates in general.*
- ***Areas where pressures are concentrated should be priorities for spatial planning*** *– The spatial distribution of pressures on biodiversity across the landscape and seascape are uneven. Pressure hotspots, where many different pressures converge, require strategic spatial planning and focused management.*

  Human activities are often concentrated in areas rich in natural resources, of high productivity and high accessibility. Pressures are particularly marked in and around estuaries, inland wetlands, river valleys and riparian areas, lowland areas such as coastal plains, the sea shore, and the inner shelf and shelf edge in the ocean. In addition to these natural features, pressures are also focussed on regions with high agricultural potential, around human settlements and in regions with high mining potential. Ecosystems and species in these pressure hotspots are therefore particularly at risk of extinction or collapse due to the accumulation of pressures.
- ***Biological invasions threaten biodiversity and human well-being*** *– Over 100 exotic species are having a severe impact on South Africa's biodiversity and, in some cases, on human well-being. Although some successes in the management of biological invasions have been achieved, the adoption of a national strategy for managing biological invasions, improved project-level planning for prevention and management, and enhanced spatially explicit data will greatly increase effectiveness of current efforts.*

  Over 2 000 exotic species have become established in South Africa in South Africa, and at least a third of these have become invasive. Of these, 107 species (mostly plants) are having a severe impact on both biodiversity and human well-being. Biological invasions are major pressures on biodiversity assets and ecological infrastructure in all realms, impacting on water security and food security. Invasive trees and shrubs reduce surface water resources by between 3 and 5%, and threaten up to 30% of the water supply of cities like Cape Town and Port Elizabeth, and invasive exotic plants reduce the capacity of natural [rangelands] to support livestock production thereby threatening rural livelihoods and food production
- ***Cooperative governance is essential for healthy landscapes and seascapes*** *– Biodiversity patterns and ecological processes are connected in complex ways that cross realms as well as human-constructed boundaries. At the same time, human activities in a range of different sectors that have separate policies and legislation and are separately managed can impact on the same biodiversity or ecological infrastructure. To deal with this interconnectedness, cooperative governance and cross-sectoral planning and decision making are essential.*

  Investment in strategic and collaborative biodiversity monitoring programmes is crucial to inform management and decision-making and for biodiversity assessments – Investment in existing and future strategic and co-operative biodiversity monitoring programmes is essential to strengthen our ability to detect and report on trends, plan accordingly and manage effectively.

  While South Africa has some robust biodiversity monitoring programmes, many involving citizen scientists (e.g. South African Bird Atlas Project), the NBA 2018 has highlighted gaps that should be filled and priorities for building on existing monitoring efforts. It is important that gaps in monitoring of species populations, ecological condition and community composition are filled (e.g. implementation of the new National Wetland Monitoring Programme). Existing monitoring programmes (e.g. National Aquatic Ecosystem Health Monitoring Programme, which is focussed on rivers) need to be maintained and supported.

4.2.2 NBA 2018 summary findings

The following table provides a summary of the key findings contained in the [NBA 2018].

NBA 2018 summary findings	
Realm	**Key Facts**
Terrestrial realm	• Ecosystem threat status: 22% of 458 ecosystem types are threatened. • Ecosystem protection level: 26% of 458 ecosystem types are Well Protected, 25% are Not Protected. • Species threat status: 13% of 22 667 [taxa] assessed are threatened. • Species protection level: 69% of 3050 [taxa] assessed are Well Protected and 9% are Not Protected. • Key pressures: Habitat loss (5); overutilisation of rangelands (2); altered fire regimes (2); biological invasions (2); climate change (2)
Inland aquatic realm	• Ecosystem threat status: 64% of 222 river ecosystem types are threatened & 79% of 135 inland wetland ecosystem types are threatened. • Ecosystem protection level: 13% of 222 river ecosystem types are Well Protected while 42% are Not Protected; 6% of 135 inland wetland ecosystem types are Well Protected while 61% are Not Protected. • Species threat status: 17% of the 658 [taxa] assessed are threatened. • Species protection level: 68% of 501 [taxa] assessed are Well Protected with the exception of freshwater fishes where only 18% are Well Protected. • Key pressures: Changes to the hydrological regime (5); pollution (4); habitat loss (4); biological invasions (4); climate change (3)
Estuarine realm	• Ecosystem threat status: 86% of 22 ecosystem types are threatened. • Ecosystem protection level: 18% of 22 ecosystem types are Well Protected while 27% are Not Protected. • Species threat status: 27% of 66 [taxa] assessed are threatened. • Protection level not assessed • Key pressures: Freshwater flow modification (5); overfishing and bait collection (5); pollution (4); habitat loss (3); and climate change (3)
Marine realm	• Ecosystem threat status: 50% of 150 ecosystem types are threatened. • Ecosystem protection level: 31% of 150 ecosystem types are Well Protected while 13% are Not Protected. • Species threat status: 18% of 376 [taxa] assessed are threatened. • Key pressures: Fishing (5); ports and harbours (3); freshwater flow modification (3); habitat loss (2), mining (2); pollution (2); climate change (2); biological invasions (2);
Coastal	• Ecosystem threat status: 60% of 186 ecosystem types are threatened. • Ecosystem protection level: 36% of 186 ecosystem types are Well Protected while 22% are Not Protected. • Key pressures: Fishing (5), habitat loss (4), freshwater flow modification (4), pollution (3), Mining (3), biological invasions (3), climate change (3)
Sub-Antarctic	• Ecosystem threat status: 21% of 29 marine ecosystem types are threatened, five terrestrial ecosystem types are still to be assessed. • Ecosystem protection level: 34% of 29 marine ecosystem types are Well Protected, 14% are Not Protected. All 5 (100%) terrestrial ecosystem types are Well Protected. • Key pressures: Invasive house mouse (4); Patagonian Toothfish fishery (3); climate change (3).

4.2.2.1 The Terrestrial realm

South Africa's terrestrial realm is recognised globally for its biodiversity and high levels of endemism. The unique and diverse fauna and flora, together with the wide range of ecosystems, underpins South Africa's vibrant and growing tourism and wildlife industries, culturally and economically important traditional medicine practices, extensive livestock farming industry, and the functioning of water catchment areas. Together these industries and functions provide hundreds of thousands of jobs and contribute to food and water security.

Terrestrial ecosystems and species face pressures from a range of human activities, including loss and degradation of natural habitat, biological invasions, pollution and waste, unsustainable natural resource use and climate change. These pressures interact in complex ways that undermine biodiversity and ecological infrastructure, which are important foundations of the country's social and economic systems. The key drivers of habitat loss are land clearing for croplands, human settlements, plantation forestry, mining and infrastructure development. These activities have led to the loss of 21% of South Africa's natural terrestrial ecosystem extent. Other key pressures include invasive species (plants in particular), overutilisation of [rangelands], disrupted fire regimes and climate change. These have not yet been mapped and quantified at an adequate scale to gauge and track their impacts on biodiversity nationally, and this situation needs to be addressed urgently.

A quarter of South Africa's terrestrial ecosystem types are threatened. This is a clear indicator of mounting pressures on biodiversity and ecosystems. These pressures should be closely monitored and the data required to do this (principally ecological condition data) should be acquired as a matter of priority. The Indian Ocean Coastal Belt, Fynbos and Grassland biomes have the highest proportion of threatened ecosystem types including 27 Critically Endangered and 29 Endangered types between them. Since most land that has not been cleared is considered natural/near natural, the assessment generally underestimates ecosystem modification and some ecosystem types may be in significantly worse condition (and at higher risk of collapse) than the available data suggest. Improved invasive exotic plant and land degradation mapping is required to address this shortcoming. The innovative steps taken to incorporate threatened ecosystem types into systematic biodiversity plans and land-use decision making processes should be continued.

Of the 22 667 terrestrial [taxa] assessed, 3 024 (13%) are threatened. Mammals have 17% of [taxa] threatened with extinction; plants have 14%, amphibians 13%, butterflies 10%, birds 9% and reptiles 5%. South Africa has very high levels of endemism (64%) and one in five of these endemics are threatened with extinction. The trend in species status over time has been measured for the first time using the Red List Index (RLI). Groups for which sufficient time series data existed included all terrestrial vertebrates, a sample of 900 plants and one invertebrate group, butterflies. Similar levels of decline were observed for all [taxa]. The decline observed for butterflies highlights the need to assess and monitor additional invertebrate groups. Despite there being an overall increase in risk of extinction for all six taxonomic groups assessed, 10 mammal [taxa] have genuinely improved in threat status since 2004.

The terrestrial protected area estate of South Africa increased by 11% between 2010 and 2018 – now covering almost 9% of the mainland. The placement of these new protected areas has resulted in overall improvement in ecosystem protection levels for all biomes. A quarter of the terrestrial ecosystem types are Well Protected and a quarter are Not Protected. Biodiversity stewardship programmes underpinned the majority of this increase and continue to be the most cost effective mechanism for protected area expansion. Efforts should be made to support and expand biodiversity stewardship programmes and address those ecosystems types that are Not Protected.

Protection levels for species were assessed for the first time – using an indicator developed specifically for the NBA – and show that birds and reptiles are relatively well protected by South Africa's protected areas network, while butterflies, mammals, plants and amphibians are under-protected (i.e., Not Protected, Poorly Protected or Moderately Protected). Over 85% of bird and reptile [taxa] qualify as Well Protected, while only 72% of amphibians, 63% of plants, 57% of butterflies and 56% of mammals are Well Protected. Plants have the highest proportion of under-protected [taxa] with 17% in the category Not Protected. Even for relatively Well Protected groups, like reptiles, the most threatened species often remain unrepresented in protected areas. Threatened or endemic [taxa] should therefore also be considered, along with under-represented [taxa], to be targeted in protected area expansion efforts.

4.2.2.2 Inland aquatic realm

The high temporal and spatial variability of rainfall in South Africa results in variable runoff and flow regimes for rivers, as well as a diverse range of flood regimes for wetlands. The combination of a broad range of climatic settings, high topographic variability, and variable hydrological regimes make for high ecosystem-level diversity.

Limited geographic ranges for a number of [taxa] contribute to high species endemism. Two layers represent these ecosystem types in the South African Inventory of Inland Aquatic Ecosystems (SAIIAE): (i) the 222 river ecosystem types with 164 018 km of mainstem and tributaries; (ii) the 135 inland wetland ecosystem types mapped in the National Wetland Map version 5 (NWM5). Inland wetlands mapped in NWM5 cover 2.2% of South Africa. Detailed catchment level studies have, however, indicated that wetland coverage is higher in certain regions of South Africa, suggesting that the extent of inland wetland ecosystem types is currently underestimated. Continued efforts are required to improve the representation of inland aquatic ecosystem types in the national inventory.

Water security is essential for human well-being and livelihoods. Aquatic ecosystems supply the quantity and quality of water required for survival. Freshwater is often a limiting resource for socio-economic development. Over-abstraction of water and water pollution place aquatic ecological infrastructure assets at risk. Strategic Water Source Areas (SWSAs) are landscapes where a relatively large volume of runoff produces water for the majority of South Africa. The National Freshwater Ecosystem Priority Areas (NFEPA) study initially identified high water yield areas and high groundwater recharge areas. Recently, these were refined to 22 areas for surface water (SWSA-sw), covering 10% of the extent of South Africa and supplying 50% of the country's mean annual runoff. In addition, 37 areas for groundwater (SWSA-gw) were identified, accounting for 9% of the land surface of South Africa and up to 42% of the baseflow in the respective areas, sustaining flows in the dry season.

Currently, only 12% of the SWSAs' extent fall within protected areas. Catchment-level planning and management is thus critical for ensuring that the ecosystem diversity, functionality and connectivity are maintained.

Inland wetlands are highly threatened and under-protected. Nearly 80% of inland wetland ecosystem types are threatened (107 of 135; 61% Critically Endangered, 9% Endangered and 9% Vulnerable), constituting more than 2.3 million ha of >2.6 million hectares of inland wetlands mapped in NWM5.

Approximately 75% of inland wetland ecosystem types are both threatened and under-protected. Only 6% of inland wetland ecosystem types are considered Well Protected, while 61% are Not Protected. Compared to the NBA 2011, where wetlands were found to be poorly mapped, highly threatened and poorly protected, the trends in ecological condition and protection level appear to be declining further. Action ought to be taken to improve maps in planning and prioritisation, involve citizens in stewardship programmes, improve awareness and accountability of all citizens, and implement the National Wetland Monitoring Programme.

River ecosystem condition declined by 11% between 1999 and 2011. Of the 222 river ecosystem types assessed, 64% were found to be threatened (43% Critically Endangered, 19% Endangered and 2% Vulnerable). River ecosystem types are also Poorly Protected with only 13% considered Well Protected and 42% Not Protected. The majority of rivers (67% of total river length) are degraded. Tributaries are generally less heavily impacted than main rivers with 38% of tributary length in natural condition compared to 28% of mainstems. The percentage of threatened river ecosystem types is higher for lowland and lower foothill rivers (67%) than for the upper foothills and mountain streams (25%), which is a reflection of multiple pressures accumulating and increasing from river source to sea. River protection levels are higher for mountain stream types (16% Well Protected) than for lowland types (6% Well Protected), reflecting the general bias of protected areas to mountainous regions. During the NFEPA project 62 free-flowing rivers were identified, but the decline in ecological condition between 2011 and 2018 resulted in 14 rivers losing this status. Of these 14 rivers, four lost more than half and the remainder lost all of their extent in a natural condition. Cooperative governance linked to integrated water resource management partnerships at catchment scale is required to address the decline in the ecological condition of rivers and to ensure effective river conservation.

The 19 free-flowing rivers identified as flagships rivers in the NFEPA project of 2011 have remained intact over the past seven years. Despite the general decline in ecological condition of river ecosystem types, the value of effective conservation planning through the NFEPA project and implementation of these priorities at various scales, ensured that the ecological condition of these rivers were maintained. It is crucial that these flagship rivers retain their free-flowing character since they provide important ecosystem service provision to the communities along their shores. The flagship rivers represent some of the few remaining examples of connected river ecosystem types that are intact from source to sea, both in South Africa and globally.

South Africa has eight unique freshwater lakes (freshwater bodies greater than 2m in depth), all of which are Critically Endangered and under-protected. South Africa's largest lake, Lake Sibayi (8 400 ha) on the Maputaland Coastal Plain in the KwaZulu-Natal Province, provides freshwater to communities in the vicinity. The remaining freshwater lakes include Baberspan (1 730 ha), Chrissiesmeer (1 300 ha), De Hoop (950 ha), Groenvlei (360 ha), Tevredenpan (330 ha), Lake Fundudzi (200 ha) and Lake Banagher (185 ha). All eight of the freshwater lakes are considered Critically Endangered since <20% of the spatial extent of these systems is in a natural or near natural ecological condition. The key pressures on these systems are changes to the hydrological regime, water pollution, habitat modification, invasive species and climate change. Five of the freshwater lakes are Not Protected while three are Poorly Protected.

A total of 658 indigenous freshwater [taxa] associated with rivers and inland wetlands, from seven taxonomic groups, were assessed for this NBA. Of these freshwater fishes are the most threatened (36% of all [taxa] and 66% of endemic [taxa] threatened). Amphibians, birds, Odonata (dragonflies and damselflies), mammals, freshwater fishes, reptiles and a sample of aquatic plants were assessed. Of these [taxa], 160 [taxa] are endemic and 65 (41%) of endemic [taxa] are threatened with extinction. All freshwater-associated taxonomic groups exhibited a gradual decline in Red List Index threat status over the assessment period, indicating that pressures are impacting species in aquatic ecosystems. While freshwater fishes had the highest threat levels, freshwater mammals had the steepest decline. Based on a meta-analysis of species Red List assessments, the major pressures causing decline were invasive exotic species, habitat loss and degradation due to pollution, urban expansion, poor dam and water management activities and agricultural activities. Despite multiple threats to freshwater fish species, including pollution, invasive species and over-abstraction of water, no freshwater fish [taxa] have yet gone extinct, largely owing to active management interventions by conservation agencies. The high levels of endemism of this group (49%), and that harvesting of freshwater fish for food and recreation is important to many South Africans, means that urgent interventions are required. Multiple and integrated mechanisms are essential for curbing the pressures on freshwater fishes. Successful invasive fish eradication methods trialled by CapeNature during this past assessment period need to be expanded and rolled out nationally.

The first protection level assessment for species found that the majority of freshwater associated [taxa], with the exception of freshwater fishes, are Well Protected: 100% of freshwater-associated reptiles, 83% of birds, 65% of mammals and 76% of amphibians. Only 18% of freshwater fish species are Well Protected, which can be attributed to their sole dependence on rivers and the fact that only 14% of South African river lengths occur within the protected area network. Moreover, only 43% of South Africa's rivers are in a natural/near natural condition. Pressures not mitigated through the protected area network have resulted in 20 freshwater fish [taxa] (21%) and 8 amphibian [taxa] (8%) dropping down a category of protection. Twenty-three [taxa] of conservation concern were assessed as Not Protected and these should be prioritised. There is an urgent need to increase the representation of inland aquatic systems within the protected area network, prioritising rivers and inland wetlands inhabited by under-protected species. Furthermore, there is a need to bolster management interventions that mitigate threats to freshwater [taxa] of conservation concern within protected areas.

4.2.2.3 Estuarine realm

South Africa has 290 estuaries and 42 micro-estuaries that have been classified into 22 estuarine ecosystem types and 3 micro-estuary types. This represents a high diversity of estuary types stemming from diverse climatic, oceanographic and geophysical drivers. Some ecosystem types and estuarine species only occur in South Africa, with some species confined to a few estuaries.

More than 60% of South African estuaries are relatively healthy, but this amounts to only 22% of total estuarine extent, comprised mostly of small estuaries. More than 63% of estuarine area is heavily or critically modified with important ecological processes under severe pressure, which reduces productivity, food security, fisheries livelihoods, property values and recreational enjoyment. Multiple interventions are required to avoid further decline in health. These include protection of freshwater inflow, restoration of water quality, reduction in fishing effort and avoidance of mining, infrastructure development and crops in the Estuarine Functional Zone (EFZ).

The estuarine realm is the most threatened of all realms in South Africa, both for the number of ecosystem types (86% threatened) and for area (99% threatened). Of estuary types 10% are Critically Endangered, 45% are Endangered and 32% are Vulnerable. By area 77% are either Critically Endangered or Endangered. This emphasises the need for strategic interventions across multiple sectors to restore estuarine health and protect benefits to people. To avoid further compromising of the benefits of these ecosystems Strategic Estuarine Management Plans – including freshwater allocation, fish resource use, water quality management and land-use planning – should be developed and implemented in a coordinated, cross-sectoral manner.

South Africa's 12 estuarine lakes are in crisis with all four ecosystem types threatened. This includes St Lucia, Kosi, uMgobezeleni, iNhlabane, uMhlathuze/Richards Bay, Touws/Wilderness, Swartvlei, Klein, Bot/Kleinmond, Heuningnes, Seekoeivlei and Verlorenvlei. This group of estuaries has seen extensive infrastructure development in the EFZ, substantial flow reduction, nutrient pollution, over fishing (especially gillnetting) and are subjected to artificial breaching or mouth manipulation. In addition, the lakes are highly vulnerable to climate change. These impacts have reduced their ability to provide key services such as flood regulation, nutrient cycling, nursery habitat, and have compromised recreational and tourism values. To ensure future climate change [resilience], a strategic programme is needed to restore habitat, improve water quantity and quality, reduce pressure on resources and increase protection levels.

Estuaries are under-protected in South Africa with only 18% of ecosystem types and 1% of estuarine area Well Protected. Since 2011 the situation has worsened with a loss of protection caused by removal of no-take restrictions and developing commercial fisheries in Marine Protected Areas (MPAs). This said, several under-protected ecosystem types can advance to Well Protected solely with improved management of fishing and water quality. For example, 10% of estuarine area could be categorised as Well Protected if fishing effort in just three estuaries were better controlled – Langebaan, Knysna and Kosi.

Salt marsh, seagrass and mangrove habitats require greater protection. Mangroves no longer occur in 10 out of 26 Subtropical estuaries and nearly 30% of salt marsh habitat has been lost as a result of poor land-use practices, flow reduction and related mouth closure, direct harvesting and overgrazing. Priority systems for protection are the Groot Berg, Knysna, Mngazana, uMlalazi, St Lucia and Kosi estuaries. The Berg Estuary, with its expansive floodplain marshes, is especially unique and should be prioritised for rehabilitation and protection; while greater protection of the Endangered seagrass *Zostera capensis* (also known as Cape Eelgrass) and large intertidal salt marshes areas of Knysna Estuary is also needed.

Several estuarine-dependent fish species are threatened by overfishing (especially gill-netting), declining water quality, and reduced flows with their concomitant influence on recruitment and marine connectivity. For example, Dusky Kob (*Argyrosomus japonicus*) is Critically Endangered at <1% of pristine reproductive adult biomass, White Steenbras (*Lithognathus lithognathus*) is Endangered at <6%, and Leervis (*Lichia amia*) is Vulnerable at <14%. Many more estuarine invertebrate and fish species may be threatened and are as yet undetected due to lack of monitoring and assessments. Stock or population recovery should be facilitated by reducing fishing pressure (e.g. prohibition on fishing at night in estuaries), increased enforcement of fishing regulations, ensuring adequate freshwater inflow, decreasing nutrient pollution, managing noise pollution and boating activity.

There has been a loss of at least 265 000 waterbirds from South African estuaries, most of which are waders from larger estuaries, especially in the Cool Temperate bioregion. Overall, non-passerine waterbirds have declined by 68% in 40 years. Some of these declines are externally driven (e.g. global habitat loss), but are also significantly related to estuary health, and not mitigated by level of protection alone. Bird numbers are still decreasing, emphasising the need to manage the overall decline in estuary condition, habitat loss, impact of gillnetting on birds, solid waste (plastics), hunting and human disturbances in key foraging and roosting areas.

Estuaries are under pressure and there is a lack of long-term monitoring data to inform conflict resolution and support high confidence decision making. This results in poor decision making and hinders maximising the benefits that flow from estuaries. Country-wide estuary abiotic and biotic surveys are urgently needed to ensure optimum resource allocation, use and protection

4.2.2.4 Marine realm

South Africa's marine environment includes the Atlantic, Indian and Southern Oceans with the contrasting cold Benguela upwelling region and the warm, fast flowing Agulhas current interacting with the diverse geological setting and topography to drive exceptional marine biodiversity. The broad range of climatic, oceanographic and geological settings result in a wide array of ecoregions and 150 different marine ecosystem types. Globally, South Africa is reported to have the third highest marine endemism with an estimated 33% of its marine fauna found only in South Africa. There is high marine endemism in the warm temperate Agulhas ecoregion on the south coast, which is geographically very isolated from other warm temperate regions.

The NBA 2018 substantially advanced South Africa's map of marine ecosystem types, drawing from major efforts to collate and increase bathymetric, oceanographic, sediment and biodiversity data. Key advances in the map of marine ecosystem types included very fine-scale shore mapping with alignment and integration in the coast; the inclusion of kelp forests, bays and fluvial fans as distinct types; and the introduction of finer depth strata across shelves and on the slope. Finer scale pressure mapping was conducted and additional pressures were mapped to support the analyses of ecosystem degradation and threat assessment. Of the 31 pressures included, six are new; including abalone fishing (South African Abalone, *Haliotis midae*), ammunition and disposal of dredge material, beach seine net fishing, gillnet fishing and oyster harvesting.

The main pressures impacting marine ecosystems and species include fishing, freshwater flow reduction, coastal development (including ports and harbours), pollution and climate change. South African ocean activities are expanding and diversifying as South Africa develops its ocean economy. Emerging pressures include increasing pollution concerns, desalination and ocean noise. A total of 95 introduced marine species, of which 56 are invasive, have been reported. Climate change causes changes in currents, upwelling, water temperatures and turbidity, while elevated atmospheric carbon dioxide results in increasing ocean acidification. Climate change and invasive species exacerbate other pressures and further research is needed to understand the complex interactions between pressures. Long-term data series are crucial to enable ecosystem assessment.

Approximately half of marine ecosystem types are threatened; by area this equates to only 5% of the ocean space around South Africa with more inshore and shelf ecosystem types threatened than those in the slope and abyss. Only two ecosystem types are Critically Endangered, with 22 Endangered (15%) and 51 Vulnerable (34%). The most threatened functional ecosystem groups include bays, islands, muddy ecosystem types and rocky ecosystems on the shelf and shelf edge. The cold temperate Southern Benguela ecoregion is more threatened than the warm temperate Agulhas ecoregion, with the subtropical Natal-Delagoa ecoregion being less threatened. Data to improve this assessment should be acquired as a matter of priority and further work is needed to determine the appropriate scale for ecosystem red listing.

Twenty new MPAs were approved for declaration in 2018, so that MPAs now cover 5% of the ocean around South Africa. The placement of these new protected areas has resulted in a marked improvement in ecosystem protection levels for many ecosystem types and has contributed to better protection in all ecoregions. The new MPA network is helping to protect marine ecosystems, rebuild fish stocks, support climate [resilience] and sustain South Africa's emerging ocean economy. Of the 150 marine ecosystem types in the ocean around South Africa, 87% have some representation in the MPA network, but only 31% of ecosystem types are Well Protected. Of the 70 ecosystem types that were Not Protected in 2018, 51 (73% of these 70 types) received their first protection in 2019.

South Africa's oceans provide a high diversity of marine resources with more than 770 marine species harvested for food. Fisheries stock status is not assessed for 90% of these species. Of the assessed resources, more than a third are overexploited or collapsed. South African Abalone (*Haliotis midae*) and West Coast Rock Lobster (*Jasus lalandii*) resources are in crisis with escalating poaching preventing resource recovery. Given the importance of fisheries to food and job security in South Africa, it is essential that fisheries stocks are well managed. We need to gather reliable data for stock assessments, maintain fisheries science expertise and develop stronger interventions to rebuild stocks in line with scientific recommendations.

The number of species assessments conducted using the IUCN Red List criteria is increasing with 376 South African marine species assessed to date through a combination of national, regional and global assessments. Of these, approximately 18% of [taxa] are threatened. However, this may not be representative of the actual proportion of [taxa] threatened as there has been a focus on assessing economically important species and few marine taxonomic groups have been comprehensively assessed. Seabirds, seabreams and turtles are particularly threatened. Marine species have the highest levels of data deficiency across all realms signalling the need to address knowledge gaps and increase capacity for marine species red listing. A lack of knowledge and techniques limits our ability to assess the risks to the genetic component of marine biodiversity.

Climate change is impacting marine species and ecosystems, decreasing [resilience] and threatening coastal communities and livelihoods. The complexity and variability of South Africa's marine systems, in concert with multiple anthropogenic stressors, make future impacts difficult to predict, nevertheless there is high certainty that impacts on biodiversity, ecosystem function, food security and valuable economic industries will continue to escalate. Additional climate change vulnerability assessments and focussed monitoring of species and ecosystems are required to enhance the detection and attribution of climate change impacts on marine ecosystems, species and genes.

4.2.2.5 Coast

For the first time, there has been substantial effort to align the ecosystem level assessments of the four realms at the land-sea interface, recognising the cross-realm linkages and dependencies. A seamless, cross-realm map of ecosystem types was created, from which an ecologically determined coast was defined, spanning the terrestrial, estuarine and marine realms. Rivers and inland wetlands were not considered as part of this coastal assessment but collaborative efforts ensured that inland wetland ecosystem types and river reaches were spatially aligned with estuarine features in particular. The integrated coastal map of ecosystem types represents a powerful new tool for coastal planning and assessments.

The South African coast comprises dunes, cliffs, beaches, rocky and mixed shores, estuaries, mangroves, kelp and reefs. The country's coastal biodiversity is thus exceptional with high levels of endemism, especially among dune plants and beach fauna. The coast provides South Africans with food, jobs and protection from extreme weather and waves, and it is a place to play and enhance human health and well-being. However, the coast has been overlooked as an ecological entity in its own right, with piecemeal management of the different realms. Some management actions in the past have been inappropriate due to an incomplete understanding of coastal processes, with current managers facing many erosion and sand-inundation issues as a result of this legacy. This holds true both internationally and in South Africa.

Given the geographic position of the coast, it is exposed to pressures from both land and sea. Key drivers and pressures in the coast include: fishing and other biological resource use; inappropriate land use and development, especially on the foredunes and in EFZs; decreased water and sediment flowing through estuaries to the sea; pollution; ports and harbours; and mining. Many of these are cross-realm pressures and/or are more concentrated on the coast compared to that in the rest of the country. For example, the land area within 10km of the shore has seven times more mining, four times more development and plantations, and twice the rate of natural habitat loss compared to that of the hinterland. Furthermore, these pressures are exacerbated by climate change, particularly stressors such as sea-level rise, extreme storms, droughts and floods. As a result, the ecological condition of the coast is generally worse than that further inland and offshore, which in turn has consequences for coastal ecosystem threat status.

There are more threatened ecosystem types in the coast (60%) compared to that for the rest of the land and sea (16%). Within the coast, there are more Critically Endangered coastal ecosystem types on land (18) compared to the other two realms (3). However, a much larger proportion of estuarine and marine ecosystem types are threatened overall (19/22 and 57/85 respectively) compared to that for the terrestrial realm (34/79). These trends are probably driven by the fact that terrestrial pressures largely result in more localised areas of habitat loss related to a direct pressure (e.g., mining, urban development), whereas estuarine and marine ecosystem types are

more impacted by multiple diffuse pressures that cause chronic degradation of ecosystem functioning (e.g. flow modification, pollution, trophic cascades from overfishing).

Approximately 87% of coastal ecosystem types have some level of protection and, overall, coastal ecosystem types have slightly higher protection levels than non-coastal ecosystem types. Marine coastal ecosystem types generally have higher levels of protection than their terrestrial and estuarine counterparts; with 54% and 22% in the Well Protected category respectively. It is expected that implementation of the new marine systematic biodiversity plan (that explicitly considered coastal integration) and ongoing negotiations towards even further expansion of the coastal and marine protected area network will see this indicator moving from strength to strength in the near future.

4.2.2.6 Sub-Antarctic territory

For the first time, South Africa's southernmost territory, the Prince Edward Islands (PEIs) and the surrounding territorial sea and exclusive economic zone have been included in the NBA. These sub-Antarctic islands are situated approximately 1 700 km southeast of the mainland and are comprised of Marion Island and the smaller Prince Edward Island. The sub-Antarctic region has unique terrestrial and marine ecosystem types not found on the South African mainland or in its surrounding oceans. The PEIs support abundant marine and terrestrial biodiversity and are a crucial breeding and feeding ground for globally threatened seabirds and for seals. Decades of research conducted at the PEIs by a network of institutions have placed South Africa at the forefront of sub-Antarctic and Antarctic science, and highlight the role of the PEIs as a natural laboratory for global change studies. Including the PEIs in the NBA provides a valuable addition for regular reporting of past and current research on the islands, which could ultimately make an important contribution to the management and conservation of their unique [biota] by identifying and directing future research and monitoring priorities. The terrestrial and marine biodiversity has been assessed using the IUCN Red List of Ecosystems guidelines, and this first attempt at national assessment will highlight knowledge gaps and research priorities for the PEI research community to focus on moving forward.

The Prince Edward Islands are a Special Nature Reserve and a Ramsar Wetland of International Importance, and 36% of the surrounding ocean is proclaimed as a MPA, however there are pressures on biodiversity – particularly from invasive species, fishing and climate change. Activities in this area are restricted to research, conservation management and commercial fishing. However, the ecological integrity of the PEIs has been affected by invasive species and climate change, which have brought about changes in both terrestrial and marine ecosystems. Of particular concern on Marion Island is the invasive House Mouse (*Mus musculus*), which has profoundly impacted indigenous invertebrates, plants and seabirds. As the impacts of invasive species are exacerbated by climate change, the two threats to the ecosystems are interactive and compounding. Marine invasive species are an emerging concern in the sub-Antarctic region, but their presence and potential impact around the PEIs is poorly understood due to limited research in the ecosystem types beyond the shelf. The commercial longline fishery for Patagonian Toothfish (*Dissostichus eleginoides*) has been a key pressure in the marine ecosystems of the shelf and slope. The potential impacts of this fishery, including impacts on Toothfish predators and prey, require further research. Elsewhere in the Southern Ocean, demersal longline fishing has impacted seabed ecosystems, particularly in fragile areas constituting Vulnerable Marine Ecosystems (VMEs). An improved understanding of the ecosystem impacts of this fishery is a research priority.

The first map of marine ecosystems for the Prince Edward Islands has been developed for this assessment, including 29 marine ecosystem types. As for the mainland, these marine and coastal ecosystem types merge seamlessly with the existing terrestrial ecosystem types mapped in 2006. The new marine ecosystem types include shore types, shelf types, as well as ecosystem types of the slope, plateau, ridges, seamounts, rift valleys and abyss. On the islands, five terrestrial ecosystem types have been previously described in the two biomes: Sub-Antarctic Tundra and Polar Desert. However, challenges remain in mapping these types at an appropriate scale. The majority of the marine and terrestrial ecosystem types described are likely to occur on and around other sub-Antarctic islands, indicating the need for regional work in ecosystem classification and mapping.

The preliminary national assessment of the PEI marine ecosystem types found that 21% of types are threatened by historical or current fishing, including one Endangered ecosystem type and five Vulnerable ecosystem types. Terrestrial ecosystem types are currently categorised as Data Deficient. While the terrestrial ecosystems of the PEIs are free from the typical direct pressures of the mainland (e.g. croplands), they are subject to biological invasions and climate change. Both of these pressures are the subject of ongoing research and a preliminary regional assessment will be possible in the near future. Marine ecosystem threat status is driven largely by historical and current pressure from the longline fishery for Patagonian Toothfish. This includes substantial illegal, unreported and unregulated (IUU) fishing, particularly between 1994 and 2004. These assessments may be updated as new information on ecological condition becomes available (linked to the impacts of climate change, invasive species and Toothfish fishing) and global or regional assessments may be undertaken when the full extent of ecosystem types are considered. Regional assessment will require additional ecosystem mapping efforts on nearby islands and surrounding seas. There are also 28 threatened or Near Threatened bird species breeding on the islands. Birds were assessed as part of the marine assessment for the mainland since those species occurring on the islands also frequent South Africa's mainland waters. While understanding of the PEIs' species and ecosystems has developed substantially over the last few decades, there is considerable room for improving knowledge of ecological condition and species population trends, especially under accelerated climate change.

A first assessment of ecosystem protection levels was completed for both terrestrial and marine ecosystems. This national assessment found that 10 of 29 marine ecosystem types are Well Protected, 14 are Moderately Protected, one is Poorly Protected and four are Not Protected. All five of the terrestrial ecosystem types were categorised as Well Protected. Regional assessments are needed to better understand protection levels for those ecosystem types that also occur outside of South Africa's territory in the sub-Antarctic.

4.3 Land Degradation

The following section provides an edited extract of the executive summary of the [Phase 1 of Desertification, Land Degradation and Drought (DLDD) Land Cover Mapping Impact Indicator of the United Nations Convention to Combat Desertification (UNCCD)], Final Report dated September 2016. Readers are encouraged to read this report for more detailed and fully referenced information on the state of land degradation in South Africa.

Land degradation is the decline in the capacity of the land to carry out ecosystem functions and services, which support society and development. The United Nations first put the issue of desertification on the international agenda at a UN Conference on Desertification in 1977 as a global socio-economic and environmental problem. South Africa ratified the United Nations Convention to Combat Desertification (UNCCD) in 1997, with the Department of Environment, Forestry and Fisheries as its focal point.

In order to address the challenges of land degradation and desertification in South Africa, the Department of Environment, Forestry and Fisheries initiated a project with the overall objective of determining the current (2009-2013) status of land degradation and the rate of change from the reference year (1990) to the current period in South Africa. To realize the overall objective, the following specific objectives were set: (1) to identify and quantify drought affected land, degraded land and desertified land, and (2) to assess whether progress is being made to combat land degradation in South Africa. In order achieve the objectives of the study, the land degradation indicators were assessed. These include land cover change, soil and vegetation degradation, desertification and drought.

ALTHOUGH THE LOCATION OF WATER AND WIND EROSION HOTSPOTS DID NOT CHANGE BETWEEN 2009 AND 2013, THE INTENSITY OF BOTH WATER AND WIND EROSION INCREASED IN THESE HOTSPOTS

For water and wind erosion, assessments showed that locations of erosion hotspots did not change between 2009 and 2013. However, the intensity of both water and wind erosion increased in those hotspots. Secondly, expansion of invasion by alien invasive plants as shown by bush encroachment also led to improvements with regard to water erosion due to less runoff because of vegetation cover (i.e. invasion of alien plant species in some areas reduced the severity of erosion because of high organic content on the ground). Wind erosion became prominent particularly in the Northern Cape, North West and greater parts of the Eastern Cape. Acidic soils were prevalent in the KwaZulu-Natal, Eastern Cape, Western Cape, Mpumalanga, Limpopo, Free State, Gauteng and North West provinces. The Prosopis invader vegetation mapping indicated that there is a small decrease in the total affected area from 1.64 million hectares in 2007 to 1.5 million hectares in 2014. Although the Northern Cape show a marked decrease in Prosopis cover, North West, Western Cape and Eastern Cape experienced an increase in Prosopis cover. The assessment of woody cover density showed an increase in area having sparse woody vegetation from 2009 to 2013.

21%

THE INCREASE IN LAND TRANSFORMATION BETWEEN 2009 AND 2013

Desertification is land degradation in arid, semi-arid and dry sub-humid environments caused by a number of issues such as climate variations, human activities etc. The 2009-2013 assessment period consisted of dry and wet periods, which affected the changes in [net primary productivity (NPP)] and [potential evapotranspiration (PET)]. There is a lot of fluctuation in NPP and PET over a short-term period. In order to understand the change that occurred it is important to compare the [aridity index (AI)] of 2013 to the long-term average AI. It is evident that the Free State has lost its dry sub-humid areas in the east and there was a small amount of desertification in the northwest where arid land has replaced semi-arid land.

The land cover change assessment indicates that at a national level there has been a total increase of 3.27% in transformed land specifically associated with urban expansion, mining, cultivation and plantations. This represents an increase from 15.26% transformed land in 2009 to 18.53% in 2014 across South Africa. Urban areas have increased from 3.05% to 3.36%, forestry from 1.23% to 1.77%, and cultivation from 10.98% to 13.4%.

Drought over the peripheries of the country (southern to eastern coastal areas and Lowveld in the northeast) during the early part of the period (2009-2010) was replaced by drought conditions over the central parts of the country by 2012 and 2013 whilst the eastern and southern parts received above-normal rainfall at that stage.

The land degradation index was produced by integrating AI, wind and water erosion, soil pH and soil salinity datasets. The 2009 land degradation index map shows that most parts of the country experienced low to moderate degradation, whereas large parts of the Northern Cape, Western Cape, Eastern Cape and North West provinces experienced high degradation levels. Some parts of the Northern Cape experienced very high degradation of which the drivers are wind erosion and soil pH. The 2013 land degradation index results indicated that the Northern Cape experienced large pockets of very high degradation in the north, west and south. The northwest portion of KwaZulu-Natal also experienced high degradation impact. This is attributed to high wind erosion, salinity and soil pH level.

In addition to the above, the following provides an edited extract from [The National Biodiversity Assessment 2018 (NBA 2018)] report and readers are encouraged to read the report for more in depth, fully referenced, information.

Apart from land clearing related habitat loss, large portions of South Africa's [rangelands] have seen extensive modifications from centuries of livestock farming, and mountain catchment areas have been modified through invasion by alien woody plant species. The ecological condition in these modified areas ranges from near-natural to critically modified depending on the degree to which ecosystem structure, function and composition have been altered. Unfortunately, there is currently limited spatial data with which to assess these impacts at the scale of ecosystem types, though national assessments of land degradation in South African [rangelands] in particular have shown that overgrazing and bush encroachment are widespread. Recent work also suggests that, while there may be a trend towards improvement in primary productivity in some arid [rangelands], bush encroachment is increasingly widespread and severe. An alternative way to gather information on pressures on biodiversity is through the meta-analysis of threatened species assessment datasets. From these data, it is clear that natural systems modifications, for example the overgrazing of [rangelands] and the disruption of natural fire regimes, are having a major impact on biodiversity.

4.4 Oceans and Coasts

South Africa's coastal environment is a rich and diverse national asset, providing important economic and social opportunities for the human population. As a result, coastal populations have developed a strong reliance on these resources for commercial opportunity and gain, food, recreation, and transport. Coastal resources have also facilitated job creation and general economic upliftment in coastal regions.

63%
OF SOUTH AFRICA'S GDP IS CONTRIBUTED BY OUR COASTAL RESOURCES

Since the 1980s the major coastal cities of Cape Town, Port Elizabeth, East London, Durban, and Richards Bay have experienced the fastest economic growth of all cities in the country.

The estimated contribution of coastal resources (without regulatory services) to the South African economy is in the order of some R 57 billion (US$5.7 billion). The direct economic benefits from coastal resources in South Africa are estimated to be approximately 35% of the country's annual gross domestic product (GDP). Direct economic benefits include the marine fishing industry, port and harbour development and attractive lifestyles, and recreational and tourism opportunities offered by a coastal location. Furthermore, the coast provides indirect economic benefits such as the erosion control provided by coastal features such as dunes and high cliffs which protect built and natural features along the coast (including roads, buildings and farmlands) from the damaging effects of waves and wind, and it allows waste assimilation, detoxification and recycling through coastal wetlands, forests and grasslands.

These indirect benefits account for an additional 28% of the country's GDP. In addition to the economic benefits, the coastal environment provides enormous social benefits that many people enjoy. For some people, the coast is a place of cultural or spiritual significance and many South Africans also see the coast as a place of recreation. It support coastal population livelihood, by providing building materials, food and other benefits that are difficult to measure in monetary terms. The coast also provides many educational and scientific opportunities which are not easily quantifiable in monetary value. Tourism, recreation and leisure activities have developed into a global growth industry and South Africa's coast has particular value in this regard.

30%
OF SOUTH AFRICA'S POPULATION LIVES WITHIN 60 KM OF THE COAST

4.4.1 Climate Change

Climate change is already have an impact on the state of South Africa's oceans and coast. 2009 research findings suggest that sea level rise rates along the southern African coastline are currently as follows: west coast +1.87 mm/yr, south coast +1.47 mm/yr, and east coast +2.74 mm/yr. These values are different because of regional differences in vertical crust movements and large-scale oceanographic processes off the east and west coasts. As for future sea level rise in South Africa, no consistent scenarios modelled at a local scale are currently available. However, using the 2009 estimate and assuming a constant sea level rise rate, this would lead to a total sea level rise of 7.48cm, 10.96cm and 5.88cm between 2010 and 2050 and 16.83cm, 24.66cm and 13.23cm on the west, south and east coast respectively between 2010 and 2100. With the rise in sea level and a possible increase in the frequency and intensity of sea storms, the South African coastline is expected to experience more intense and more frequent extreme weather events; increased saltwater intrusion and raised groundwater tables; greater tidal influence; increased flooding, with greater extent and frequency; and increased coastal erosion.

22%
OF SOUTH AFRICA'S COASTAL DEVELOPMENTS ARE THREATENED BY SEA-LEVEL RISE

Approximately 22% of coastal developments are threatened by sea-level rise (based on development within 50m of the shore). This increases to nearly a third of coastal developments (31%) if this is extended to include

any development within 100m of the shore. Impacts up to 100m inland were shown to occur in erosion hotspots following the storm surge along the East coast of South Africa in March 2007. Thus, there is a strong possibility that localised damages of this nature could occur more frequently in the next decade.

Climate change results in environmental changes in the coastal zone such as: Changes in ocean circulation patterns; Sea level rise and increase storminess; Increasing erosion of the coast; Changes in temperatures from both the land and sea; and Changes in precipitation and runoff.

A changing climate and rising sea levels bears the additional threat of unbalancing current natural systems and threatening the dense coastal human population and infrastructure. While coastal communities are generally considered as wealthy (and thus less vulnerable and more resilient to e.g. climate impacts), it must not be forgotten that an estimated 40% of the coasts' population is considered to live below the minimum income level.

CLIMATE CHANGE OCEAN IMPACTS

THE FOLLOWING OBSERVED SOUTH AFRICAN CHANGES HAVE BEEN ATTRIBUTED TO CLIMATE CHANGE:

- **CHANGES IN SEA TEMPERATURE;**
- **RISING SEA LEVELS;**
- **WAVE AND WIND ACTION;**
- **INCREASED COASTAL EROSION LINKED TO INCREASED FREQUENCY AND SEVERITY OF STORMS; AND**
- **GROWING VULNERABILITY OF THE 17% OF SOUTH AFRICA'S COASTLINE WITH DEVELOPMENT WITHIN 100M OF THE SHORELINE.**

4.4.2 Coastal Access

Access to resources is imbedded in the Bill of Rights of the South African Constitution. The status quo of coastal access and coastal accessibility in South Africa is highly variable in the four coastal provinces. Access and accessibility is influenced by protected areas, mining leases, coastal geomorphology (high dunes and rocky shores), limited or lack of infrastructure, climate change, financial constraints and private land ownership.

In many cases, municipalities recognize the importance of both coastal accessibility and coastal access and have initiated processes that would guide the development of beach tourism, nodal or recreation hubs, areas of high interest, etc. A number of municipalities and some Provinces have also embarked on highly detailed assessment of coastal access routes (e.g. City of Cape Town). These assessments are based on identification of all access routes through data collection and field visits and have assigned a number of useful attributes to them.

The public has an expectation to be able to access the coastal zone. Accessibility of the coastal zone and free and unhindered access to it are two key features of integrated coastal management. In South Africa, access is not only an inalienable civil right, but also provides benefit to our society in terms of use and enjoyment of the coastal zone, as well as a variety of potential economic benefits. South Africa's [National Environmental Management: Integrated Coastal Management Act, 2008 (Act No. 24 of 2008)] requires that access to the coast and related infrastructure and amenities must be planned and managed to protect coastal resources, their values and public safety. This is however not a right "at all costs", and the responsibility to plan, manage and control appropriate coastal access is assigned to the local municipalities.

Area	Status Quo
KwaZulu-Natal	High to medium levels of access and accessibility. In urban areas, mostly characterised by ribbon development, access to the shoreline is excessive to the point where management interventions are required to maintain dune cordon stability and integrity. Access and accessibility of rural areas of particularly northern KwaZulu-Natal is limited to reasonable but there is an increasing trend to restrict access and accessibility to the coast through enclosed residential estates such as Zimbali, and others. In some remote places of Zululand, specialised vehicles may be required to access the shoreline. Access to the shoreline and accessibility of the coastal area is controlled in the iSimangaliso Wetland Park. Activities governed under the Marine Living Resources Act include boat-based commercial line-fishing that requires access to boat launch sites. In addition to the boat-based activities, the annual sardine run also creates a need for temporary coastal access for commercial sein-net fishers. This normally takes place on the KZN South Coast.

Area	Status Quo
Eastern Cape	Low accessibility and limited coastal access. In the former Transkei area, both access and accessibility is limited. In the predominantly nodal urban areas, access and accessibility are good. In rural areas, accessibility and access are limited and may require specialised vehicles due to the lack of road infrastructure. The national government approval of the proposed N2 highway extension may rapidly change accessibility to the coast. This change may prove to be both beneficial to the socio-economic development of the province if the associated development is sensitive to the environmental limits of the area. In addition to the lack of infrastructure, the Eastern Cape geographical land scape is characterised by hills and steep cliffs along the coast. It is rocky and this will need engineers in designing the type of access that are suitable and safe to be used by the public. Physical access to parts of the coast is difficult. Access is constrained by land privatisation, nature reserve areas, topography and access fees. Wild Coast Poor public access due to topography, lack of infrastructure, state-owned land.

Area	Status Quo
Northern Cape	Large parts of the Northern Cape are not accessible to the public due to no-go mining areas and limited or no road access. Road access to most estuaries provides tourist or recreational access to specific locations. Otherwise access only with permits due to mining concessions. Gaining access to the coast often requires specialised vehicles. Most estuaries can be reached by vehicle even though there is a lack of road infrastructure. • Physical access to the coast and its resources is limited by mine security issues; • The coastal area of the province is relatively undeveloped; • Mining, recreation, conservation and fishing activities is very limited.

Area	Status Quo
Western Cape	Good access and accessibility. Urban areas have good access and accessibility. Accessibility is controlled in protected areas in the province. Some rural areas may have limited accessibility to the coast by virtue of the lack of road infrastructure. The Western Cape also hosts a number of small-harbours that provide direct access to the ocean. Poorly managed and controlled access points associated with illegal activities due to the private land ownership. • West Coast: Physical access to the West Coast is restricted by private land holdings, private development and nature conservation areas; • West Coast: There is controversy over access to marine resources and how the benefits could be more equitably distributed • West Coast: Conflict between industrial development, nature conservation and tourism activities, particularly in the Saldanha-Langebaan area • West Coast: Uncontrolled ribbon-development is taking place. • Cape Town: Access to certain beaches is restricted • Cape Town: Highly urbanised requiring intensive management • Agulhas Coast: Pedestrian access above the HWM must be ensured • Agulhas Coast: Privatisation of state land on the coast limits public access • Agulhas Coast: Appropriately designed or controlled access to beaches is needed to protect the sensitive environment, and • Garden route: Public access is limited by private development, privatisation f beaches and nature reserves.

4.4.3 Land-Based Pollution

> 8 MILLION
TONNES OF PLASTICS ENTER THE OCEAN EACH YEAR

South African waters are increasingly impacted by a number of sources of pollution, including land-based effluent, rubbish and oil spills. Wastewater that is discharged into the ocean environment is generally composed of municipal wastewater (domestic sewage), industrial waste water and storm-water flow. There are more than 60 licensed pipelines which discharge effluent along the South African coast. In 2008, Department of Environment, Forestry and Fisheries reported that approximately 287 million m^3 of wastewater per annum was discharged into the marine environment from land-based sources.

90%
OF ALL LARGE DEBRIS STRANDED ON SOUTH AFRICAN BEACHES IS PLASTIC

Plastics make up 90% of all large debris stranded on South African beaches. Plastics that are repeatedly exposed to wave action, salt water and the sun break down into microplastics that continue to exist in the marine environment for years. Seabirds and other marine life frequently ingest these plastics.

While stormwater is recognised as a major source of coastal pollution, readily available data and information for these sources could not be obtained. As a result it was not possible to do a quantitative assessment on a national basis. It was therefore decided to provide a qualitative assessment on the relative contribution of stormwater runoff to coastal pollution by the extent and distribution of urban and industrial land cover.

4.4.4 Offshore Pollution

South Africa is positioned along one of the world's busiest shipping routes with more than 120 million tonnes of oil and bunker fuel carried aboard ships each year and 12,000 ships visiting South Africa's ports. Combined with the harsh oceanographic conditions along the coast, this renders the country especially vulnerable to oil spills. A number of oil spills locally have had significant effects on marine life, including the Apollo Sea oil spill in 1994 and the Treasure oil spill in 2000 which affected some 40,000 penguins.

> 120 MILLION

TONNES OF OIL AND BUNKER FUEL CARRIED ABOARD SHIPS EACH YEAR

4.5 Biological Invasions

FACT

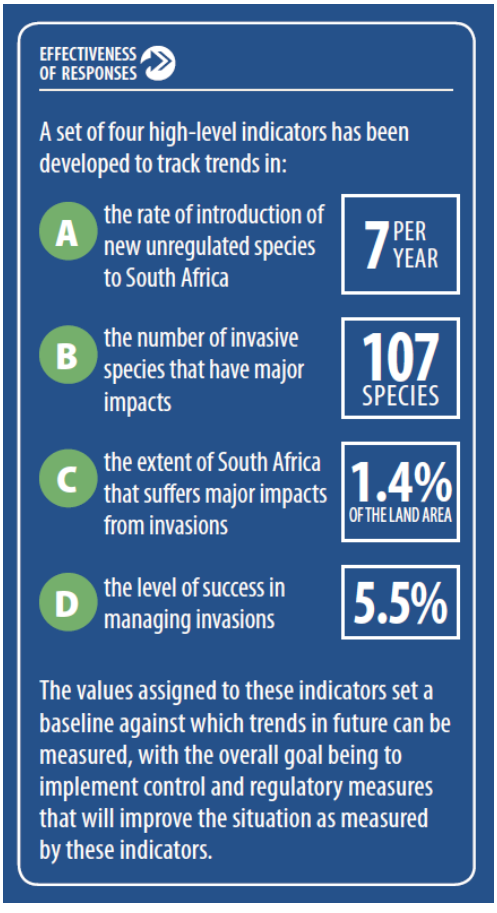
The National Status Report on Biological Invasions in South Africa is the first such report anywhere in the world. Its purpose is to set a benchmark against which trends in this problem can be tracked over time.

The following section is an edited extract of [The status of biological invasions and their management in South Africa in 2017] report and readers are encouraged to read the report for more in depth, fully referenced, information on biological invasions.

Biological invasion is the phenomenon of the transportation of organisms through intentional or accidental human activity to areas outside of their natural range, and the fate of such organisms in their new ranges, including their ability to survive, establish, reproduce, disperse, spread, proliferate, and influence invaded ecosystems. Biological invasions are a growing environmental problem worldwide, and South Africa in particular is home to a large and growing number of invasive species.

Thousands of species have been introduced to South Africa over the years. Many of these exotic species are beneficial. Almost all agriculture and forestry production is based on exotic species, and exotic species are widely used in horticulture, aquaculture, and mariculture, or are kept as pets. Only a small proportion of exotic species become invasive though this varies markedly between groups of organisms ([taxa]) (~0.1–10%). This subset of exotic species can reduce the ability of ecosystems to deliver services (see [ecosystem services]), negatively affecting the economy of invaded areas, and ultimately impacting upon all South Africans. Invasive trees and shrubs reduce water runoff and groundwater recharge, reducing the water supplies to already-stressed farms, towns and cities; plants that invade [rangelands] reduce the capacity of the land to support livestock and threaten the livelihoods of people that depend on livestock production; and invasive plants and animals impact negatively on biodiversity and the services that South Africa's diverse natural ecosystems provide (from ecotourism to harvesting food, cut flowers, and medicinal products).

Our [Environmental Right] imparts a responsibility both to control invasive species so as to reduce their negative impacts, and to try to preserve any benefits that such invasive species may provide. Thus, managing invasive species involves balancing ecological, social and economic imperatives, as in some situations invasive species are economically useful to some people but economically damaging to others.



South Africa has been actively managing biological invasions for well over a century. While historically the focus was on limiting direct impacts to agricultural production, the ultimate goal of these measures is to prevent the erosion of ecosystem services and to protect people from the ongoing expansion of negative impacts. This is in line with the constitutional obligation.

A set of robust indicators is needed to provide a comprehensive picture of the state of biological invasions. Although South Africa's first national status report has built on international indicator development initiatives, it has also developed additional indicators to cover those aspects that were not yet catered for in the developing international framework.

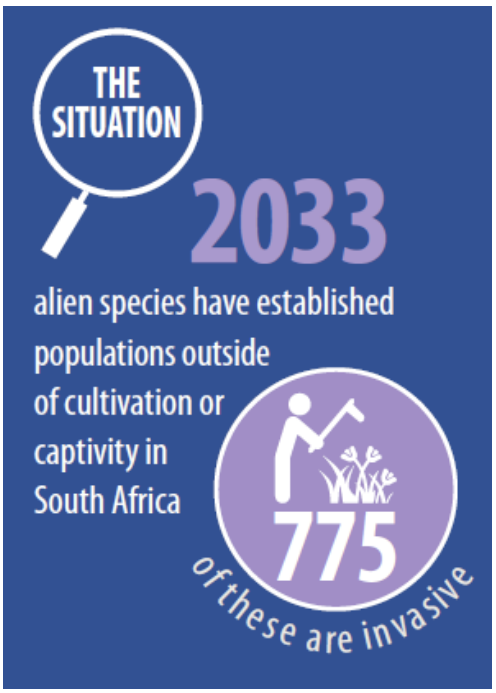
There are many different potential pathways of exotic species introduction to South Africa and the prominence of some of these pathways has increased markedly over time, in particular with increasing trade. The goods, people and forms of transport that are related to these pathways can enter the country through 72 official ports of entry. Although most exotic [taxa] have been

intentionally imported into the country, many have been accidentally introduced as commodity contaminants or as stowaways on ships, boats, vehicles, trains and aeroplanes. In addition, some [taxa] have entered the Republic from neighbouring countries through natural spread over the 4862 km long land borderline, but none have spread into the country through human-built corridors that connect previously unconnected regions (e.g. canals). Most exotic [taxa] were originally imported intentionally for the ornamental plant trade and some have subsequently escaped from cultivation.

Overall the rate of introduction of new [taxa] appears to be increasing. For many pathways there has been an increase or no major change in introduction rate since the 1990s, and only a few pathways (e.g. introductions for fishing and aquaculture) are no longer responsible for the introduction of new exotic [taxa]. Notably, however, it is not possible to ascribe > 50% of exotic [taxa] to an introduction pathway.

South Africa's extensive and well-functioning transport networks facilitate the transportation of a large, and increasing, amount of goods and people; and so once an exotic taxon has been introduced to South Africa, further dispersal or natural spread is highly likely. [taxa] that are indigenous to the Republic can also be dispersed to parts of the country where they are not indigenous. Commodity contaminants or stowaways can be dispersed along the extensive transport networks, and there is also a thriving internal trade in species for a variety of purposes. Exotic [taxa] may also spread naturally within the country, and utilise human-made corridors like tunnels and canals that connect previously unconnected regions.

For most of the pathways of introduction for which forecasts could be made, an increase in prominence is expected in the future. For some of these pathways control measures are not in place, and unless this changes, further increases in the rates of introduction of exotic species are likely.



In terms of the status of exotic species in South Africa, of the 2033 exotic species recorded (or assumed to be present) outside of cultivation or captivity in South Africa, 775 are known to be invasive, 388 are known to be [naturalised] but not invasive, and 355 are present, but not naturalised. For the remainder (516 species), there is insufficient information to assign them to an introduction status category. Eight of the exotic species recorded as present in the country are currently listed in the [NEM:BA regulations] as prohibited (i.e. species assumed to be absent from South Africa and which may not be imported).

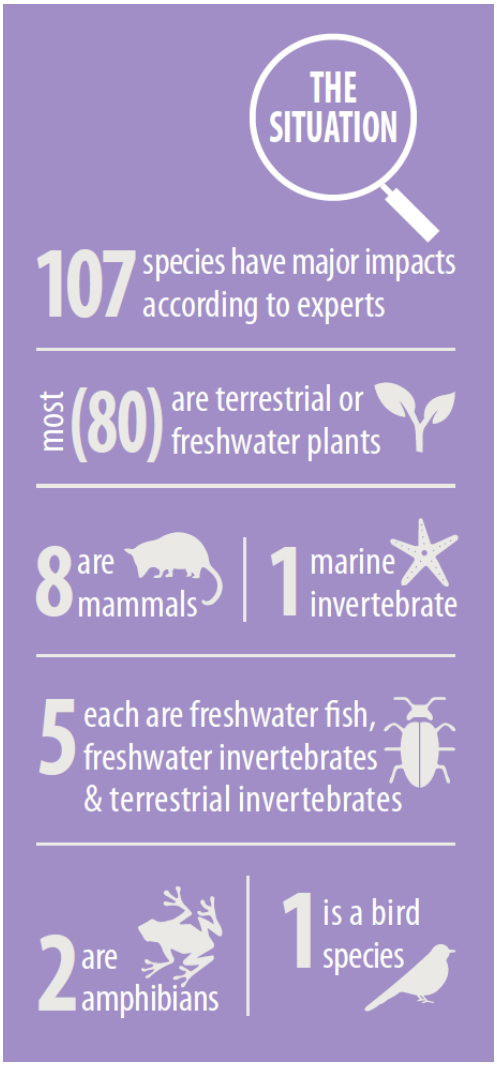
Large numbers of exotic species have relatively restricted distributions. Only in the case of plants and birds are there widespread species (e.g. found in at least a quarter (i.e. > 500) of the quarter-degree grid cells (QDGCs) of South Africa).

At least one exotic reptile and two terrestrial invertebrate species are relatively widespread (> 100 QDGCs), although the data coverage is poor, so there is a low level of confidence in these estimates.

The only data available to estimate the abundance of exotic species are those for terrestrial and freshwater plants. These estimates are very crude or over 20 years out of date, so the level of confidence in these estimates is very low. There are no comparable data for any other high-level [taxa].

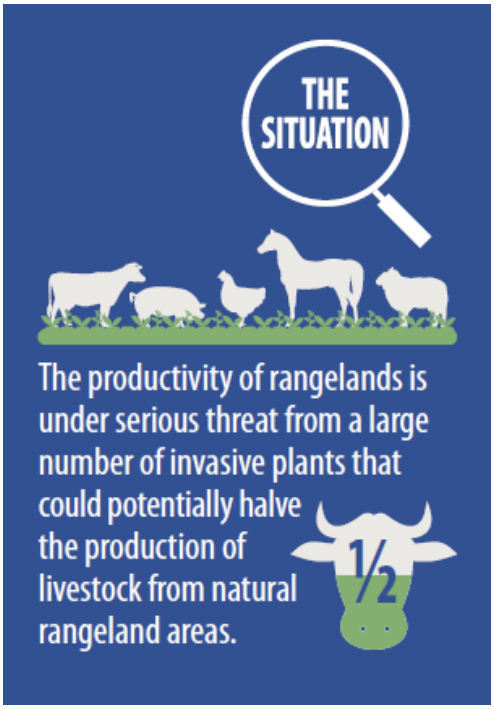
A systematic evaluation of the impacts of individual invasive species as per the recently developed international standards has not yet been conducted.

However, 25 species were assessed by experts as having a severe impact, and 82 as having a major impact. Of these 107 species, most (80) are terrestrial or freshwater plants, eight are mammals, five each are freshwater fish, freshwater invertebrates and terrestrial invertebrates, two are amphibians, and there is one bird and one marine plant species.



Exotic plants are the most diverse, widespread and damaging group of invaders in South Africa. Furthermore, it is clear that South Africa has a major exotic plant [invasion debt]. Well over 100 new [taxa] have been recorded as naturalised or escapees from cultivation over the past decade, and the recorded range of almost all plants has increased significantly. This is a significant cause for concern, as it clearly indicates that problems associated with exotic species are set to increase.

The impact of exotic species in South Africa has, as in other countries, rarely been investigated, and where it has been done, the estimates are often in units that are not directly comparable. However, there has been a recent exercise in which experts were asked for their opinion on the impact of listed species. In this study, the 552 species listed in the [NEM:BA A&IS Regulations] were scored by taxon-specific experts according to their ecological and their socio-economic impacts (separately for negative and positive impacts), on a scale from 1 to 10. In this regard 25 species were assessed as having a severe impact, and 82 as having a major impact. Of these 107 species, most (80) are terrestrial or freshwater plants, eight are mammals, five each are freshwater fish, freshwater invertebrates and terrestrial invertebrates, two are amphibians, and there is one bird and one marine plant species.



The greatest impacts associated with invasive species in terrestrial habitats are due to invading plants. Depending on the species, they can reduce rangeland condition and carrying capacity, reduce surface water runoff and groundwater recharge, increase fire hazards, and erode biodiversity. When introduced to offshore islands, they can imperil island fauna and flora. In a 2004 review of the state of knowledge regarding the impacts of invasive plants in South Africa it was concluded that, with the notable exception of the impacts of woody plants on water resources, very

little was documented. Although there have subsequently been additional studies, the impacts of the vast majority of invasive species remains unstudied.

One notable exception is provided by invasive trees in the genus Prosopis (mesquite trees), where at least ten separate studies have documented impacts on indigenous invertebrates, birds, mammals, trees and grasses, rangeland condition, groundwater recharge and human health in both biophysical and economic terms. In some cases, indigenous knowledge systems provide valuable insights into impact. For example, one researcher used semi-structured questionnaires to assess local perceptions associated with invasive cacti in Laikipia County, Kenya. This study was useful in identifying and ranking the main impacts associated with the species concerned, and this approach could be used more often in future to expand knowledge. Finally, some species can have both positive and negative impacts, and these cases present special challenges when it comes to finding acceptable and sustainable approaches to their management.

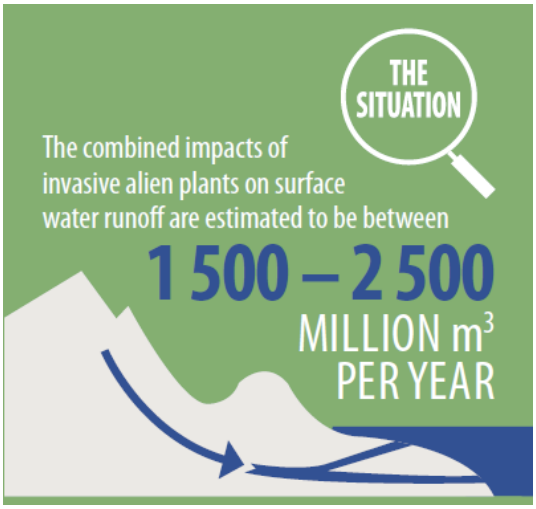
In freshwater ecosystems, invasive fish and crustaceans, as well as the diseases they carry, can have large impacts on indigenous freshwater [biota]. Again, well-documented cases are rare, but a small number of robust studies exist. For example, one study documented the impacts of rainbow trout in the rivers and streams of the [Cape Floristic Region (CFR)]. They found mean densities of indigenous fish like the Breede River redfin, Cape kurper and Cape galaxias, were 89–97% lower in invaded streams than in streams without trout. Furthermore, while indigenous fish were present at 100% of all sites without trout, they were not recorded at all at 58% of the invaded sites. The study concluded that exotic trout have depleted the abundance of CFR-endemic fishes through size-selective predation.

Of the 93 exotic marine species recorded, impact was assessed for only 12 species. As such, 81 species are data deficient, 2 have few impacts, 7 have negligible impacts, 5 have some impacts and 2 have major impacts. Five species have economic or human health impacts, but these have not been formally assessed. The Mediterranean mussel is believed to have the greatest impacts in South African marine environments. First recorded in the late 1970s, this species presently occupies more than 2000 km of coastline, occurring along the whole of the West Coast and as far east as East London. Within its range, this mussel impacts on a variety of indigenous species and ultimately has altered the structure of rocky shore communities. Along the West Coast the exotic Mediterranean mussel dominates primary rock surfaces at the expense of various competitively inferior indigenous mussel and limpet species while along the South Coast it co-exists with the indigenous Linnaeus mussel. Interestingly, this mussel has also increased the diversity and abundance of indigenous fauna on invaded shores, as it forms complex mussel beds that increase habitat availability for indigenous [biota]. This change in habitat structure has significantly altered rocky shore communities. The five species that have some impacts are the brooding sea anemone, estuarine tube-worm, Pacific barnacle, pacific mussel and sea vase. These invasions have resulted in population-level changes in indigenous species. The most recently arrived species, the Pacific mussel, is particularly concerning. This mussel was first detected along the West Coast in 2009 but has recently crossed the biogeographic barrier of Cape Point and now occurs in False Bay. Laboratory studies have suggested that this mussel could survive along the South Coast and this raises concerns that the full extent of the impacts of this exotic are yet to be realised.

In terms of the status of invaded areas, invasive species richness at a provincial scale in terrestrial and freshwater ecosystems was highest in the relatively humid coastal provinces (Western and Eastern Cape and KwaZulu-Natal) and lower in the arid interior provinces (Northern Cape, Northwest and Free State).

Marine invasive species richness was highest in the Western Cape.

Invasive plant species richness was highest in the Savanna, Grassland, Indian Ocean Coastal Belt and Fynbos biomes, and lower in the arid biomes. There were only 6 invasive bird

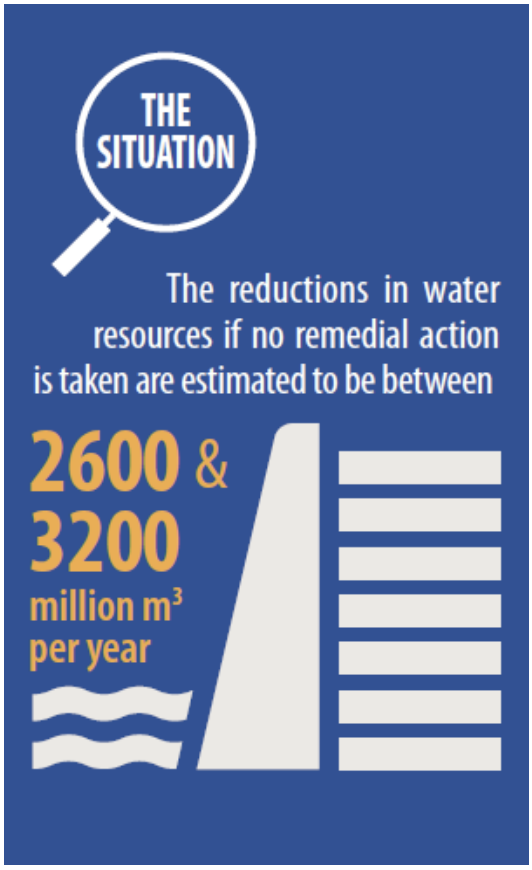


species, which were widespread across most biomes, except the Desert biome. There is insufficient data to assess the richness of other groups at a biome scale.

Exotic species richness provides an indication of the diversity of issues that need attention, but it is not a measure of how large the invasions are – this would require estimates of cover, biomass or population size. There are no reliable estimates of these measures, but crude estimates made in 1998 confirmed what is generally accepted – the Western Cape is the most invaded province, followed by Mpumalanga, Northern Cape and KwaZulu-Natal.

These estimates are more than 20 years out of date, and data from an atlas project suggests both the extent of invasions, and the relative dominance of species, have changed considerably since then.

At a national scale, the combined impacts of invasive exotic plants on surface water runoff have been estimated at between 1 444 to 2 444 million m^3 per year. Primary catchments most affected (> 5% reduction in mean annual runoff) are in the Western and Eastern Cape, and KwaZulu-Natal. If no remedial action is taken, reductions in water resources could rise to between 2 589 and 3 153 million m^3 per year, about 50% higher than estimated current reductions.



Invasive exotic plant infestations are estimated to have reduced the potential for South Africa to support grazing stock by just over 1%, though this varies between biomes. If no remedial action is taken, however, impacts are projected to become much larger (up to a 71% loss of grazing in some biomes).

Reductions in biodiversity intactness in South Africa's terrestrial biomes were highest (3%) in the fynbos biome. Under a scenario where invasive exotic plants are allowed to reach their full potential, biodiversity intactness is predicted to decline dramatically, by around 70% for the Savanna, Fynbos and Grassland biomes, and even more (by 87% and 96%) for the two Karoo biomes.

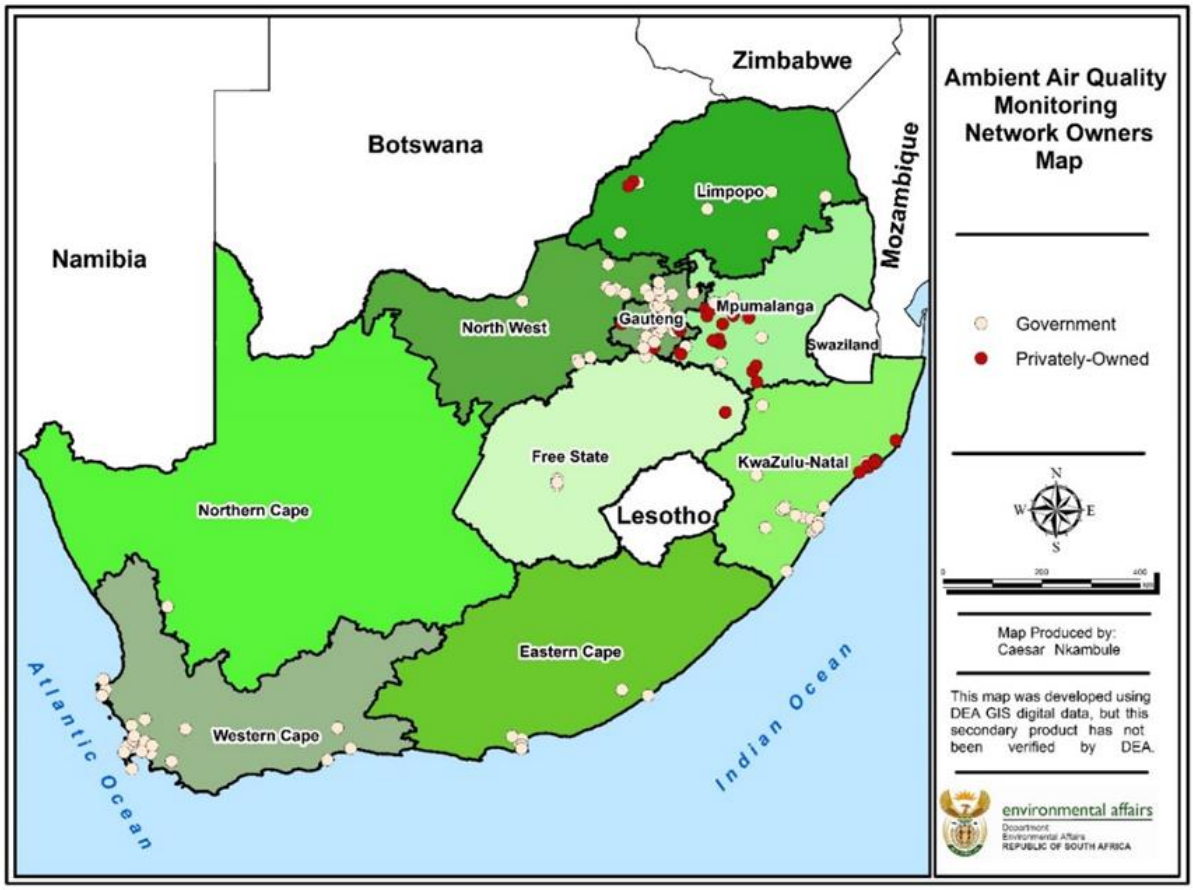
Invasion of natural ecosystems by exotic plants can change the structure and biomass of vegetation, adding fuel and supporting fires of higher intensity. Increased fire intensity can in turn increase the damage done by fires, as well as the difficulty of controlling fires. Although there is very little in the way of documented impacts in South Africa, these effects have clearly been shown in a limited number of studies.

Estimating the level of invasion by exotic species in particular areas can only be made with a low degree of certainty, given the relative lack of reliable and comprehensive data on invasive species. The same applies to impacts. However, based on a few existing studies, it appears that impacts are currently relatively low (with the exception of water resources), but that they are set to grow rapidly as invasive species enter a phase of exponential growth.

4.6 Air Quality

The following section is an edited extract of the [South African State of Air Report 2018] and readers are encouraged to read the report for more in depth, fully referenced, information on South Africa's air quality.

The World Health Organization (WHO) recognises the link between air pollution and health and, specifically what they see as the epidemic of non-communicable diseases that are affecting people worldwide. The WHO believes that, globally, 23% of all deaths can be attributed to unhealthy environments with ambient and household air pollution having caused 2.8 and 3.7 million non-communicable disease deaths, respectively, from ischaemic heart disease, stroke, chronic obstructive pulmonary disease and lung cancer in 2012 alone. The WHO also notes that there is growing evidence that indicates that early life exposure to environmental risks, such as chemicals and air pollutants, might increase the risk of non-communicable disease throughout the course of life.



In the light of these sobering facts, our [Constitution] enshrines the basic environmental right of all South Africans to air that is not harmful to their health and well-being. Air pollution is the occurrence of substances in the atmosphere that present a major environmental risk to health. By reducing air pollution, South Africa can reduce the burden of disease from stroke, heart disease, respiratory diseases and improve the health of the population in the short- and long-term. Impacts may occur locally, but air pollution is not restricted to political or geographic boundaries and may be transported great distances from its source and have negative impacts regionally or across international boundaries.

The development of the [2005 State of Air Report] was an initiative that provided the first consolidated insight on the sources of air pollution, state of [ambient air] quality and associated health, welfare and environmental effects. The report looked at the 10-year period from 1994 to 2004 and used available ambient monitoring data. The report gave South Africans an understanding of [ambient air] quality on a national scale. It provided an air quality baseline

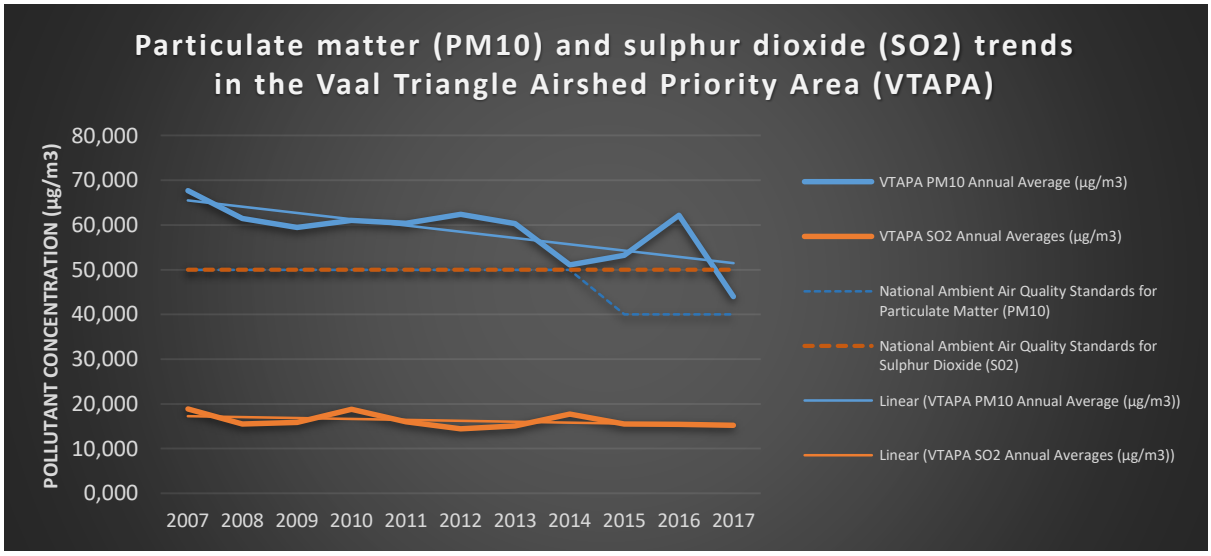
and documented the challenges to air quality management faced by the country at the time when new air quality legislation was coming into effect.

The [2005 State of Air Report] report identified the most pressing air quality management challenges facing South Africa at the time to be: (i) meeting the new and more stringent [ambient air] quality standards being set by new legislation, particularly in respect of and [particulate matter (PM_{10} and $PM_{2.5}$)]; (ii) understanding and addressing the human health risks posed by exposure to hazardous atmospheric emissions; (iii) responding to the likelihood that, for some pollutants, there may be no identifiable threshold exposure below which harmful effects cease to occur; (iv) mitigating air pollution impacts that occur disproportionately in low-income communities; and (v) addressing industrial and power-station emissions without significant detriment to society and the economy.

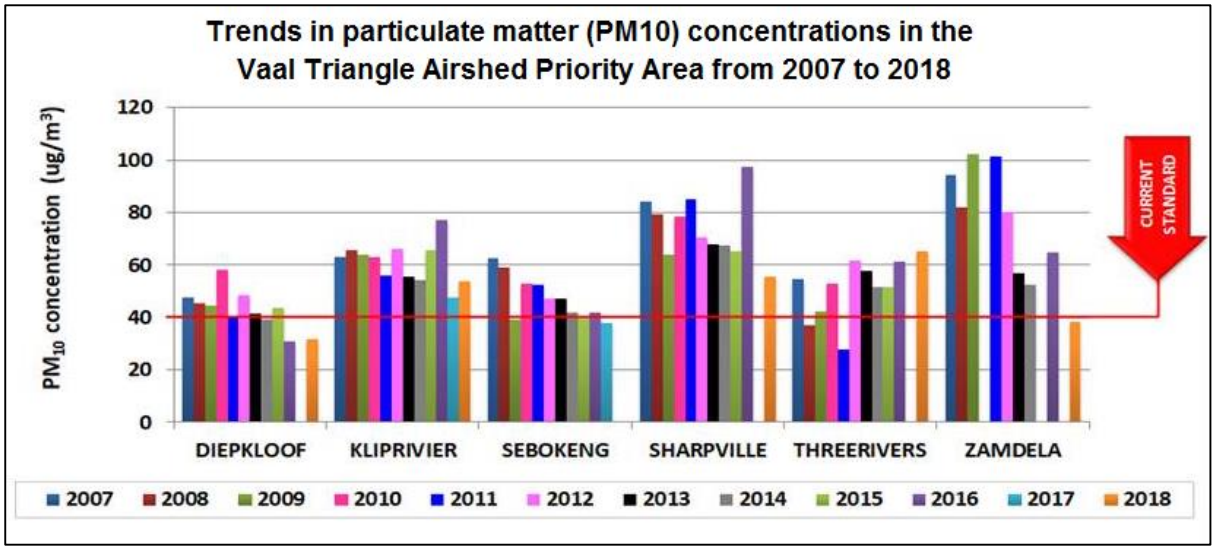
It's been over a decade since the [2005 State of Air Report] was published. Since then the [National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004, the "NEM:AQA")] has come into full effect, repealing the outdated Atmospheric Pollution Prevention Act, 1965 (APPA, Act No. 45 of 1965). [NEM: AQA] represents a distinct shift from exclusively source-based air pollution control to holistic and integrated effects-based air quality management. It focuses on the adverse impacts of air pollution on the ambient environment and sets standards for pollutant levels in [ambient air]. At the same time it sets emission standards to minimise the amount of pollution that enters the environment.

As noted above, from an air quality perspective, our [Environmental Right] may be paraphrased as – everyone has a right to breathe air that is not harmful to health and well-being. Indeed, the progressive realisation of this right is the basis of government's mandate to ensure good quality air through reasonable legislative and other measures that prevent air pollution and promote sustainable development. Although air quality managers use air quality as their principle measure of success or failure, in terms of the mandate provided by the Constitution, this is only a proxy measure for the potential impact of air on health and well-being, i.e. the concentrations of specific air pollutants in the air we breathe provide a reasonable indicator of the impact that breathing that air will have on our health and well-being.

In terms of the [NEM: AQA], [ambient air] that meets the Constitutional test of air that is not harmful to health and well-being is defined through [Ambient Air Quality Standards]. These standards provide the benchmark for air quality management by: objectively defining what South African society agrees is acceptable [ambient air] quality; informing decisions on what types of technology and development are acceptable or not in specific areas; providing a yardstick against which air quality management performance can be measured; providing a basis for measuring compliance with environmental performance criteria; and providing a basis for the enforcement of environmental performance criteria.



With this, government is required to monitor [ambient air] quality and report compliance with [ambient air quality standards]. To this end, significant investments in continuous air pollution monitoring have been made and the number of government-owned monitoring stations has increased consistently from forty (40) in 2011 to a hundred and thirty two (132) automated air quality monitoring stations in 2017. Air quality measurements from the monitoring stations are transmitted to the [South African Air Quality Information System (SAAQIS)], a partnership between the Department of Environment, Forestry and Fisheries and the South African Weather Service (SAWS). The measurements are collected in real-time (live) and made available through the [SAAQIS] website. To date, over 65 government stations are reporting live to the SAAQIS, and the number is expected to increase as more stations are connected to the system.



The stations are located in areas with the highest density of people to measure human exposure to air pollution. They provide a means of assessing compliance with [ambient air quality standards] and the impact of air quality management interventions aimed at addressing air pollution. The most commonly monitored pollutants are [sulphur dioxide (SO_2)], [oxides of nitrogen (NO_x)], [ozone (O_3)], [carbon monoxide (CO)], and [particulate matter (PM_{10} and $PM_{2.5}$)]. [Volatile organic compounds (BTEX)], [mercury (Hg)], [hydrogen sulfide (H_2S)] and [black carbon] are also sometimes monitored.

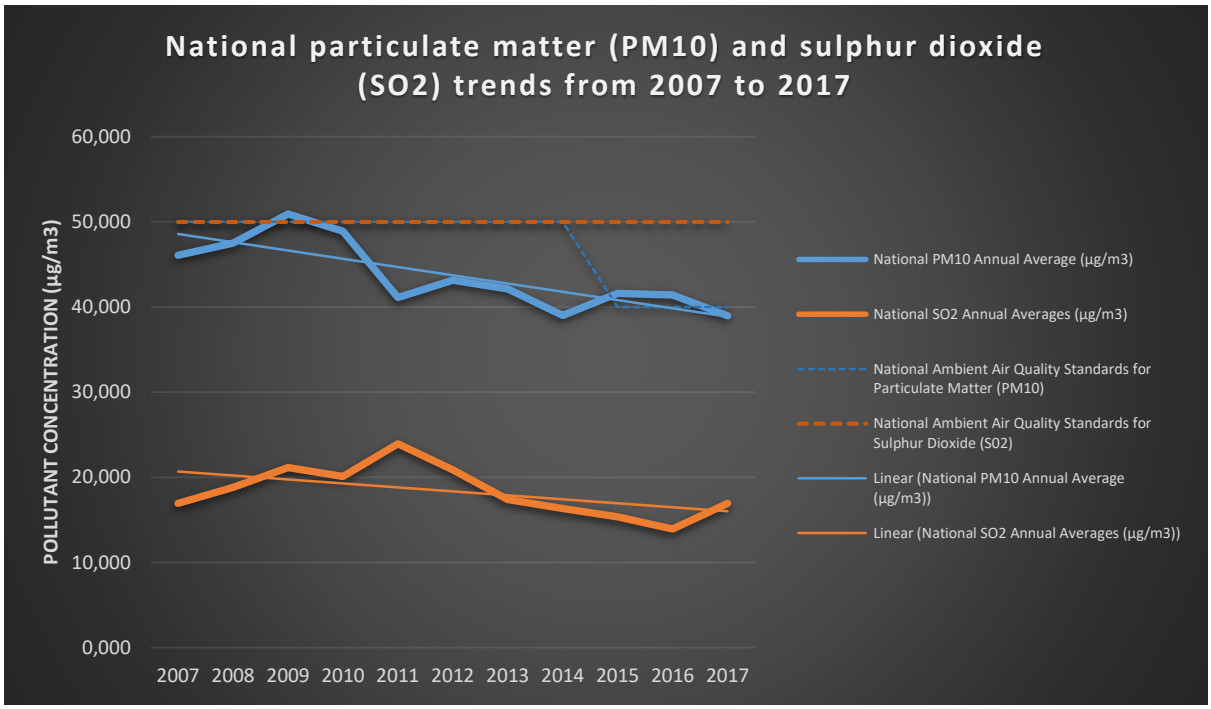
Air pollution measurements from monitoring stations are complex and are not easily understood in their raw form by lay people. Thus, it is difficult for the general public to fully appreciate how the recorded pollutant levels translate to the quality of air we breathe and the associated health effects. The government has therefore developed a country specific [Air Quality Index (AQI)] in line with international best practices in order translate air quality measurements into the more easily understood information provided on SAAQIS. The index informs the public on how clean or polluted the air is on a scale from 'one' (1, clean air) to 'ten' (10, very polluted air), and what associated health effects might be of concern. The higher the AQI, the greater the level of air pollution and hence the greater the health concerns from exposure to poor air quality. The health messages are designed to help citizens take practical, self-protective actions to avoid or reduce exposures to air pollution on days when unhealthy air quality is observed. The AQI can be found on the SAAQIS website https://saaqis.environment.gov.za/ or the smart-phone application tool for Android and IOS systems.

Measurements from the national monitoring network are used to calculate a composite [National Air Quality Indicator (NAQI)] which is a strategic impact indicator to monitor the state and trend of ambient air quality in South Africa. The purpose of the NAQI is to: (i) inform the implementation of the [NEM: AQA] (enhancement, protection, governance); (ii) monitor national progress in implementing air quality management interventions aimed at full compliance with [ambient air quality standards]; (iii) provide an overall picture on the efficacy of air quality interventions, as well as providing a monitoring tool to measure the impacts of policy responses; (iv) serve as an environmental air quality indicator in order to assess the condition and reflect air quality trends nationally; (v) provide a tool to support policy-makers in air quality management, policy development, prioritisation and

evaluation; and (vi) serve as a communication tool on air quality matters by simplifying complex atmospheric observations as graphs and graphics that are more easily understood by the public.

The air quality indicators presented in [section 9.1] include the National Air Quality Indicator and the air quality indicators for two national [air quality priority areas]. National air quality priority areas are formally declared by the Minister of Environmental Affairs in terms of the [NEM: AQA] and represent recognised national air pollution hotspots where the air often does not meet national [ambient air quality standards]. The current national priority areas include the Vaal Triangle Airshed Priority Area (VTAPA) declared in 2007, the Highveld Priority Area (HPA) declared in 2008 and the Waterberg Bojanala Priority Area (WBPA)d declared on 15 June 2012.

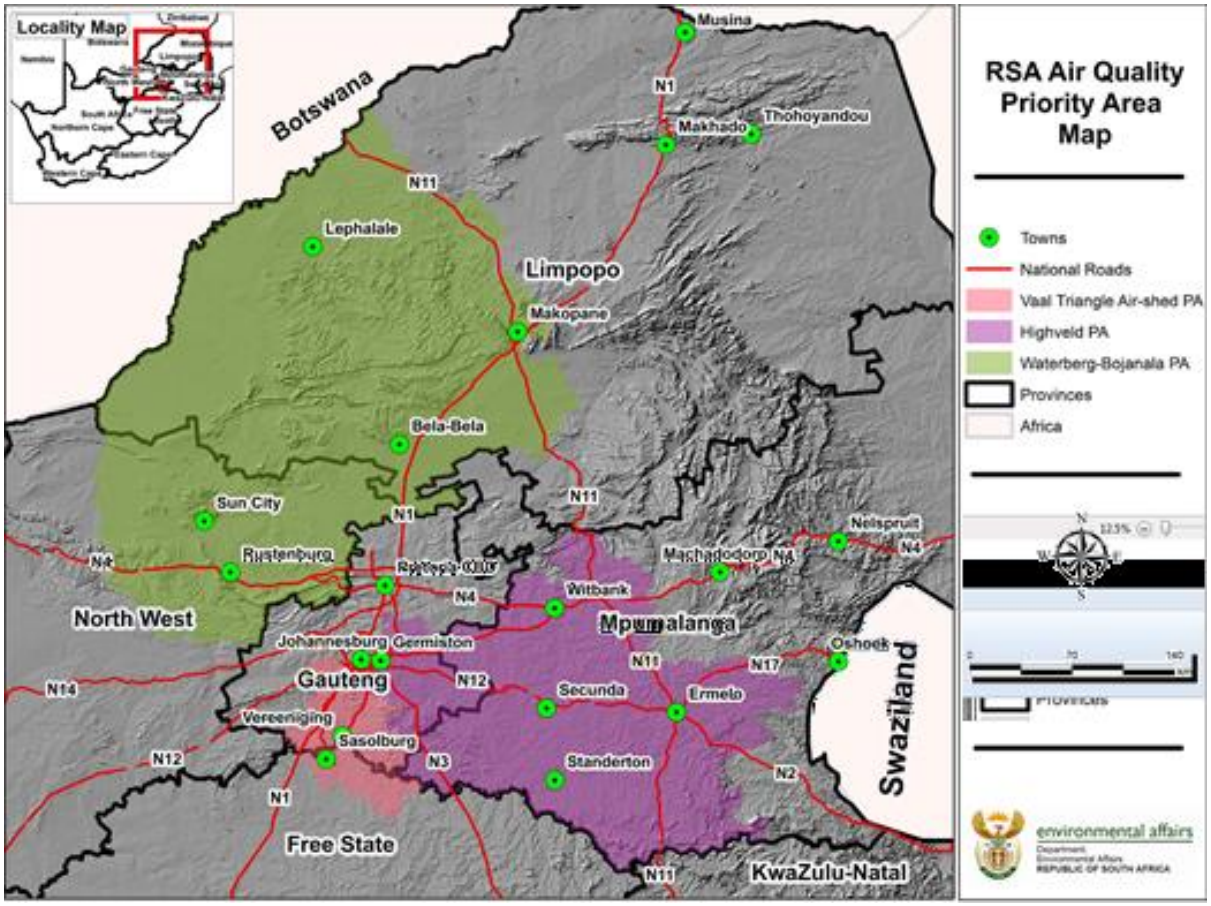
In terms of the overall state of air quality in South Africa, despite the various types of pollutants for which [ambient air quality standards] exist and which are being measured by South Africa's air quality monitoring network summary, [sulphur dioxide (SO_2)] and [particulate matter (PM_{10} and $PM_{2.5}$)] are the most problematic air pollutants at the national level.



In this regard, although [sulphur dioxide (SO_2)] is still a problem in many areas, the national average levels of SO_2 have significantly decreased since 1997, but despite this decrease, there has been no further reduction of the SO_2 national average over the last decade.

In terms of are [particulate matter (PM_{10} and $PM_{2.5}$)], PM_{10} is of major concern. There is a relatively rapid air quality deterioration trend from 2003 to 2010. This is largely (but not entirely) due to the fact that data from new stations in identified pollution "hotspots" were added over this period. Examples of these new stations include: four stations, including the South Durban Basin pollution hotspot, added from 2004; five stations in the densely populated City of Johannesburg added from 2005; six stations in the highly polluted VTAPA added in 2007; and five stations in the highly polluted HPA added in 2008.

Thus, although it appears that air quality was consistently within [ambient air quality standards] prior to 1999, this is largely due to the fact that monitoring stations were not necessarily placed in pollution hotspots, i.e. some of the air quality monitoring stations were in areas of relatively good air quality.



This notwithstanding, [particulate matter (PM_{10} and $PM_{2.5}$)] is the greatest national cause for concern in terms of air quality. This concern is reinforced by the fact that the national average of annual averages is in the vicinity of the National [Ambient Air Quality Standard] (NAAQS). The air quality indicators in priority areas are consistently above the [ambient air quality standards] particularly in the VTAPA, and this is a real cause for concern. It is clear that continued and increased national provincial and local action is required in order to bring particulate concentrations down to acceptable levels. It is also clear that many South Africans may not be breathing air that is not harmful to their health and well-being.

4.7 Waste

The following section is an edited extract of the [South Africa State of Waste Report 2018] and readers are encouraged to read the report for more in depth, fully referenced, information on waste.

In South Africa, waste is defined as any substance, material or object, that is unwanted, rejected, abandoned, discarded or disposed of, or that is intended or required to be discarded or disposed of by its holder whether or not it can be re-used, recycled or recovered. This includes all wastes included in Schedule 3 of the [National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)], "the Waste Act", or wastes specifically identified by the Minister of Environmental Affairs. However, a waste ceases to be a waste if the Minister says so or once it is, or is approved to be, re-used, recycled or recovered (see [the waste hierarchy]).

Within this definition, 'general waste' means waste that does not pose an immediate hazard or threat to health or to the environment, and includes: domestic waste; building and demolition waste; business waste; inert waste; or any waste legally classified as non-hazardous waste.

Similarly, 'hazardous waste' means any waste that contains organic or inorganic elements or compounds that may have a detrimental impact on health and the environment and includes hazardous substances, materials or objects within business waste, residue deposits and residue stockpiles.

4.7.1 General Waste

In 2017, as reflected in the Table below, it is estimated that South Africa handled 55.6 million tonnes of general waste.

The largest contribution to the total quantity of general waste was 'organic waste' (34.6%), which comprises predominantly biomass from sugar mills, sawmills, and the paper and pulp industry. This is followed by bottom ash (11.7%), slag and municipal waste (8.7% each), construction and demolition waste (8.1%) and metals (7.3%).

It is estimated that approximately 0.2% of the 55.6 million tonnes of general waste generated in 2017 was stored or stockpiled, while 34.5% was recycled or recovered, 0.1% was treated, and 65.2% was disposed to landfill.

Table 1: Summary of general waste generation and management in South Africa in 2017

Waste type		Total tonnage managed	Storage / stockpile	Recycling / recovery	Treatment	Disposal
GW01	Municipal waste	4 821 430	0.0%	0.0%	0.0%	100.0%
GW10	Commercial and industrial waste	360 884	0.0%	0.0%	0.0%	100.0%
GW14	Fly ash and dust	4 346 080	0.0%	3.1%	0.0%	96.9%
GW15	Bottom ash	6 489 080	0.0%	3.1%	0.0%	96.9%
GW16	Slag	4 859 025	0.0%	0.0%	0.0%	100.0%
GW20	Organic waste	19 251 600	0.0%	49.2%	0.2%	50.8%
GW30	Construction and demolition waste	4 482 992	0.0%	52.0%	0.0%	48.0%
GW50	Paper	2 139 706	0.0%	58.0%	0.0%	42.0%
GW51	Plastic	1 099 254	0.0%	43.7%	0.0%	56.3%
GW52	Glass	2 791 003	0.0%	71.2%	0.0%	28.8%
GW53	Metals	3 533 059	0.0%	80.0%	0.0%	20.0%
GW54	Tyres	162 167	76.4%	23.6%	0.0%	0.0%
GW99	Other	729 615	0.0%	9.0%	0.1%	91.0%
TOTAL		**55 065 893**	**0.2%**	**34.5%**	**0.1%**	**65.2%**
Notes	Percentages may not add up to 100% due to rounding off. The level of confidence in the data is indicated by the intensity of shading, i.e. high level of confidence in dark shading and low level of confidence in light shading					

4.7.2 Hazardous Waste

In 2017, South Africa generated approximately 52 million tonnes of hazardous waste.

Fly ash and dust accounted for the majority of hazardous waste managed (63.9%), followed by bottom ash (11.3%), brine (11.1%), and slag (5.6%). The other waste types combined account for the remaining 8.1% of hazardous waste generated in 2017.

Approximately 338 237 tonnes (or 0.6%) of the hazardous waste was stored or stockpiled, 3.4 million tonnes (6.6%) was recovered or recycled, 61 732 tonnes (0.1%) was treated, and 48.3 million (93%) was disposed to landfill.

Table 2: Summary of hazardous waste generation and management in South Africa in 2017

Waste type		Total tonnage managed	Storage / stockpile	Recycle / recovery	Treat-ment	Disposal
HW 01	Gaseous waste	6	0.0%	0.0%	0.0%	100.0%
HW 02	Mercury containing waste	1 392	0.0%	4.0%	0.0%	96.0%
HW 03	Batteries	34 393	10.0%	90.0%	0.0%	0.0%
HW 04	POP waste	570	0.0%	0.0%	0.0%	100.0%
HW 05	Inorganic waste	772 750	0.0%	0.0%	0.6%	99.4%
HW 06	Asbestos containing waste	12 001	0.0%	0.0%	0.0%	100.0%
HW 07	Waste oils	192 700	20.0%	80.0%	0.0%	0.0%
HW 08	Organic halogenated and /or sulphur containing solvents	663	0.0%	19.9%	6.2%	73.9%
HW 09	Organic halogenated and/or sulphur containing waste	8 812	0.0%	0.0%	4.4%	95.6%
HW 10	Organic solvents without halogens and sulphur	4 562	0.0%	42.1%	5.5%	52.4%
HW 11	Other organic waste without halogen or sulphur	860 329	0.0%	26.0%	0.0%	74.0%
HW 12	Tarry and bituminous waste	249 080	0.0%	0.0%	0.0%	100.0%
HW 13	Brine	5 793 645	0.0%	0.0%	0.0%	100.0%
HW 14	Fly ash and dust	33 285 115	0.0%	7.0%	0.0%	93.0%
HW 15	Bottom ash	5 874 776	0.0%	7.0%	0.0%	93.0%
HW 16	Slag	2 925 390	0.0%	7.0%	0.0%	93.0%
HW 17	Mineral waste	832 059	0.0%	0.1%	0.4%	99.5%
HW 18	WEEE	361 526	86.4%	9.7%	0.0%	3.9%
HW 19	HCRW	48 749	0.0%	0.0%	100.0%	0.0%
HW 20	Sewage sludge	632 749	0.0%	15.0%	0.0%	85.0%
HW 99	Miscellaneous	295 462	0.0%	0.9%	1.5%	97.6%
TOTAL		**52 186 730**	**0.6%**	**6.6%**	**0.1%**	**92.7%**
Notes	Percentages may not add up to 100% due to rounding off. The level of confidence in the data is indicated by the intensity of shading, i.e. high level of confidence in dark shading and low level of confidence in light shading					

4.7.3 Waste Imports and Exports

In 2017, an estimated 131 196 tonnes of general waste was imported, mainly paper (57 855 tonnes), glass (38 378 tonnes), metals (24 168 tonnes), and plastic (6 748 tonnes). The imported glass, paper, plastic and metals were predominantly imported for recycling in South Africa. An estimated 690 050 tonnes of general waste was exported in 2017, mainly metals (527 037 tonnes), paper (129 374 tonnes), and plastic (20 856 tonnes). Note that 12 473 tonnes of waste tyres were also exported by [REDISA] prior to the [Waste Bureau] being established and taking over in October 2017.

On average, South Africa imports 168 592 tonnes of hazardous waste annually [(Basel Convention, 2014-2016)]. Waste oils (76 450 tonnes) account for the majority of the imports, followed by organic waste without halogens or sulphur (47 367 tonnes), batteries (30 750 tonnes), asbestos containing waste (5 280 tonnes), and WEEE (2 124 tonnes). The majority of the hazardous waste imported was recycled or recovered (76.3%), while the remaining 23.7% was disposed to landfill.

South Africa also exports on average 58 578 tonnes of hazardous waste annually, comprising mainly batteries (36 233 tonnes), inorganic waste (13 333 tonnes), and fly ash and dust (5 000 tonnes).

4.7.4 Waste Collection Services

The rendering of a regular waste collection service is the responsibility of local municipalities according to Schedule 5, Part B of the Constitution of the Republic of South Africa, 1996.

In 2017, approximately 59% of households had their waste collected by the local authority, service provider or a community member, while 2% of households had their waste collected from a communal container or central collection point. Approximately 34% of households disposed of their waste at a communal dump or their own dump, and the remaining 5% of waste was dealt with through other means.

4.7.5 Waste Management Facilities

The waste generated in South Africa, as well as imported waste is reused, recycled, recovered, treated, or disposed of at a waste management facility.

Based on an analysis of Waste Management Licences (WMLs), there were 1 423 licenced facilities in South Africa. Gauteng has the highest number of facilities (352), followed by KwaZulu-Natal and Western Cape (200 each), Eastern Cape (162), Mpumalanga (137), Northern Cape (115), Free State (97), Limpopo (88), and North West (72).

The majority of facilities are licenced for the disposal of waste (704), followed by the storage of waste (202), treatment of waste (126), recycling and recovery (117), remediation of contaminated land (57), recycling, recovery, and treatment (45), closure / decommissioning (40), and extracting and flaring of gas (8).

The compliance status of private and publicly owned waste management facilities was assessed based on a review of a sample of external annual audit reports for privately owned facilities and on the General Landfill Sites Project in 2017 for publicly owned facilities.

In general, the level of compliance of privately owned facilities, based on the audit reports reviewed, was relatively high with some sites even achieving full compliance. None of the reports reviewed recommended further investigation for non-compliance issues.

In contrast, the level of compliance of the publicly owned facilities that were audited was relatively low, with 26 facilities attaining between 0 and 25% compliance. Nine of these facilities attained 0%. Twenty four facilities attained between 26 and 50% compliance, nine facilities between 51 and 75% compliance, and 14 facilities between 76 and 100% compliance.

4.7.6 The Formal and Informal Waste Sector

In 2012, it was estimated that the formal waste sector employed 29 833 people, with the majority of the people being employed by large enterprises.

It was estimated that in 2012, the minimum value of the formal sector was R 15.3 billion, which was equivalent to about 0.51% of GDP at the time. The estimated contribution of the private sector was approximately R 7 billion, while that of the public sector was approximately R 8.3 billion.

The majority of the revenue in the formal sector is generated by large enterprises, accounting for 88% of private sector revenue. Similarly, metropolitan municipalities account for the majority of public sector revenue (80.4%).

In the late 1980s, waste pickers identified that there was gap in the waste value chain, and that there was an opportunity to collect, salvage and sell recyclable materials. The informal sector therefore emerged due to the absence of a formal collection and sorting system for recyclable materials, providing a valuable link between waste generators and recyclers.

Although there is no official estimate of the number of waste pickers in South Africa, initial estimates have ranged between 60 000 and 90 000 pickers, but more recent estimates are as high 215 000 pickers. It is also estimated that in 2014, the informal sector diverted approximately 1.24 million tonnes of packaging waste from landfill, saving municipalities between R 309 million and R 749 million depending on landfill airspace value.

4.7.7 Trends

In 2012, the National Department of Environment, Forestry and Fisheries published the [3rd National Waste Information Baseline Report]. This report showed that South Africa produced approximately 108 million tonnes of waste in 2011. The majority of this waste (98 million tonnes) was landfilled, which resulted in only a 10% recycling rate.

Of the estimated 108 million tonnes of waste, approximately 59 million tonnes was general waste, 1 million tonnes was hazardous waste, and 48 million tonnes was 'unclassified' waste.

The 'unclassified' wastes referred to both general and hazardous wastes that had not been classified at the time of the study. These wastes were therefore reported as 'unclassified' in order to prevent skewed results.

The [South Africa State of Waste Report 2018] follows a similar approach to the [3rd National Waste Information Baseline Report] with respect to the calculation of the tonnages of waste recycled, recovered, treated, and landfilled. However, whilst the 2018 report uses a similar methodology, the results are neither directly comparable with those of the 2012 report, nor the two preceding baseline reports in 1991 and 1997. This is largely due to additional studies that have been done since 2011 which provide new information that may not have been available for the 2012 report. As a result, the calculations of certain general and hazardous waste streams also differ from those used in the 2018 report.

Notwithstanding the above, in order to identify recent changes or trends in waste generation in South Africa, it is useful to compare the 2011 baseline with this 2017 baseline. However, as mentioned above, not all the waste streams are directly comparable due to differences in the data sources used and calculation methods. It is for this reason that only certain waste streams, ones which are directly comparable, are discussed in more detail in this section.

The following Table presents a comparison of mainline recyclables between 2011 and 2017. It can be seen that municipal waste, which includes commercial and industrial waste, increased by 296 595 tonnes from 8.01 million tonnes in 2011 to 8.36 million tonnes in 2017. Similarly, paper increased by 476 814 tonnes from 1.73 million tonnes in 2011 to 2.21 million tonnes in 2017. The paper recycling rate increased by approximately 1% from 57% in 2011 to 58% in 2017.

In contrast, the amount of plastic generated decreased by 195 275 tonnes from 1.31 million tonnes in 2011 to 1.11 million tonnes in 2017. This decrease can be partially attributed to a reduction in the weight of packaging in recent years. For example, PET bottles weigh 30% less today than they did 10 years ago (PETCO, 2018). The recycling rate however increased by 26% from 18% in 2011 to 44% in 2017.

As with plastic, the amount of glass generated decreased by 189 816 tonnes from 959 816 tonnes in 2011 to 770 000 tonnes in 2017.

The recycling rate however increased by 10% from 32% in 2011 to 42% in 2017.

The amount of scrap metal increased by 914 726 million tonnes from 3.12 million tonnes in 2011 to 4.04 million tonnes in 2017.

Comparison of selected waste streams in 2011 and 2017							
Waste type		Generation			Recycling Rate		
Code	Description	2011	2017	Difference	2011	2017	Difference
GW01	Municipal	8 062 934	8 359 509	296 575	n/a	n/a	n/a
GW50	Paper	1 734 411	2 211 225	476 814	57%	58%	1%
GW51	Plastic	1 308 637	1 113 362	-195 275	18%	44%	26%
GW52	Glass	959 816	770 000	-189 816	32%	42%	10%
GW53	Metals	3 121 203	4 035 929	914 726	80%	80%	0%

While the South African Waste Information System (SAWIS) has been operational since 2006, accurate information on waste generation, storage, treatment, reduction, reuse, recycling, recovery and disposal is still very difficult to source. This is in part due to the limited use of SAWIS.

The [2012 National Waste Information Regulations], published in Government Notice R625, *Government Gazette* 35583 of 12 August 2012 require waste management facilities operating specified waste activities to collect and report quantities of waste managed per quarter. While these regulations have resulted in an increase in the uptake of SAWIS, it is not considered to be fully operational, and as a result, a general lack of accurate waste data remains a huge challenge in South Africa.

In 2017, only 45% of the facilities registered with the Central Registry were reporting. While this is an improvement on the 38.5% of facilities reporting in 2016, it is still deemed to be very low, affecting confidence in the data presented.

In looking at the accuracy of the information presented on the SAWIS, an important point to consider is not only the reporting rate, but also which facilities are reporting. Given that the South Africa formal waste sector is dominated by large enterprises, if the majority of these enterprises are reporting, then the information being uploaded can be deemed to be relatively representative of the sector.

In order to determine the level of accuracy of the data uploaded to the SAWIS, an analysis was undertaken looking at the facilities that are reporting and the figures that were being reported, as well as a comparison with the information collected from other data sources and the 2011 waste baseline.

It was found that there was generally under-reporting on a number of the general waste streams (e.g. commercial and industrial waste, organic waste, plastic, glass, and tyres). This can be attributed to a lack of weighbridges and capacity at a number of the facilities, mostly municipal landfill sites. It was also found that municipal waste (GW01) was much greater than the 2017 baseline. This can be attributed to the facilities being unable to differentiate organic waste, paper, plastic, and glass from the municipal waste stream. As such, the figures being reported for municipal waste are likely to be incorporating these other waste streams.

In terms of hazardous waste streams, it was found that the waste streams disposed to landfill (e.g. gaseous waste, mercury containing waste, POP waste, inorganic waste, asbestos containing waste, and so on) were likely to be relatively accurate. This is due to the fact that almost all the licenced hazardous waste disposal sites in South Africa are reporting on the SAWIS. As such, there is a relatively high level of confidence in this data. It was also found that waste streams, where the majority is not disposed to landfill, such as batteries, waste oils, and brine are being under-reported. As such, the level of confidence in this data is relatively low. The analysis also highlighted data uploaded by facilities that were orders of magnitudes greater or lower than other similar types of facilities. In each of these cases, a query was sent to the facility, and the data corrected if required.

4.8 Gauteng Province

The following overview of the state of the environment in Gauteng is based on the executive summary of the [Gauteng Province Environment Outlook Report 2017] and readers are encouraged to read the report for more in depth, fully referenced, information on the state of the environment in the Gauteng Province.

Gauteng has a thriving economy. It is the financial capital and most important economic region in South Africa. Although historically built on a mining and industrial base, the Gauteng economy has since diversified and is now primarily driven by Finance and Business (25.8% of GDP) and Community Services (24.6% of GDP). Gauteng's share of GDP increased to 36% in 2013, which significantly represents 10% of the total GDP of the entire African continent.

As a consequence of this economic strength, Gauteng has one of the highest population and household growth rates, driven by both the natural population growth and a net in-migration. This has a profound impact on the population structure of the Gauteng society, and naturally finds expression in the way the built environment is constructed and arranged to accommodate people. This in turn has a significant direct and indirect impact on the natural environment, the use of natural resources and ecosystem functioning.

Gauteng is made up of three Category A Metropolitan Councils, namely the City of Johannesburg, City of Tshwane and City of Ekurhuleni Metropolitan Municipalities; and two Category C District Municipalities, namely West Rand and Sedibeng District Municipalities. The West Rand is further comprised of three local authorities, namely Mogale City, Rand West City and Merafong City. The Sedibeng District Municipality includes the Emfuleni, Midvaal and Lesedi local authorities.

As Gauteng is the most urbanised province in South Africa and centre of economic activity, land is an important but contested resource. With the population of Gauteng currently at 13 399 724 persons, this represents an increase of 9% up from 12 272 263 in 2011 during the 5 year period.

4.8.1 Key issues

In identifying the key environmental issues it should be noted that these are expressed in terms of components of the environment such as land, air, water and the human condition –

- **Land** – Land transformation appears to have slowed however, within the past few decades as much as 55% of natural areas have been lost to urbanisation and agricultural practices. Within this reporting period, the biggest change is reported as the transformation of natural areas (a loss of 3 834 km^2) with an associated increase in urban built-up coverage (an increase of 1 862 km^2). When comparing these results to the biodiversity results, it is important to note that there is great uncertainty regarding the loss of biodiversity. This uncertainty is compounded by the difficulty in comparing spatial data, to understand the various dynamics with regards to land and land transformation.

LAND (STATUS: STABLE, BUT WITH SOME UNCERTAINTIES) improving, deteriorating, stable, uncertain		
2017/18 Indicators	**Trend**	**Key findings**
Land cover and land use	?	Although land transformation appears stable, there is uncertainty because of the inability to effectively compare spatial datasets. The ecosystem services from natural open spaces still remain undervalued.
Habitat transformation	↓	As above.

LAND (STATUS: STABLE, BUT WITH SOME UNCERTAINTIES) improving, deteriorating, stable, uncertain		
2017/18 Indicators	**Trend**	**Key findings**
Land degradation	?	As above.
Land unsuitable for human use	→	There does not appear to be significant increases in this risk area.
Land capability	→	The land capability appears to be stable, however, less and less land is under productive use.
Food production	↑	Yields have been on the upward trend, boosting the export market.
Genetically modified organisms	↑	Widespread use of GMOs are increasing productivity in the agricultural sector.

- **Biodiversity** – ***there is a declining trend in ecosystem health, and species diversity given the ongoing erosion of habitats and ecosystem functioning***. However, there is uncertainty because of lack of clarity in the reporting. This is concerning, because land transformation appears to have slowed, and yet ecosystems continue to be at threat as a result of degradation and poor land use and water management. There is however, opportunity to rectify the situation through the implementation of the Gauteng Protected Areas Expansion Strategy (GPAES). In addition to this, urgent investment is required in the form of funding and training of staff members, and long term strategies for rehabilitation – a lack of which is currently undermining conservation efforts.

BIODIVERSITY (STATUS: DETERIORATING, WITH NUMEROUS UNCERTAINTIES) improving, deteriorating, stable, uncertain		
2017/18 Indicators	**Trend**	**Key findings**
Extent of natural areas	↓	This negative trend has continued from the previous reporting cycle, which indicates that more needs to be done to rectify the negative impacts of various human activities.
Fragmentation of natural areas	↓	
Status of vegetation types	↓	
Protection status of ecosystems	↑	Various efforts in conservation are yielding positive results in terms of protection of various areas. However, far more work needs to be done to see improvements in ecosystem health and biodiversity.
Distribution of invasive alien species	?	There is lack of clarity on the strategy being implemented, the spatial location and extent, as well as frequency and long term actions.

BIODIVERSITY (STATUS: DETERIORATING, WITH NUMEROUS UNCERTAINTIES) improving, deteriorating, stable, uncertain		
2017/18 Indicators	**Trend**	**Key findings**
River health	?	There are mixed results in terms of riparian ecosystem health, as well as uncertainty because of poor and inconsistent monitoring and reporting.
Wetlands	↓	It is widely known that wetlands are under threat from transformation and degradation, despite efforts to rehabilitate certain sites. The stabilisation of the AMD threat is positive for wetlands along the mining belt, including the Blesbokspruit.
Wetland rehabilitation	↑	
State of RAMSAR wetland systems	↑	
Threatened and extinct species	?	There was an increase in the number of endangered species, but this could be due to category changes rather than actual species loss.
Protected areas	→	Efforts to ensure the protection of various habitats, has resulted in a decline in habitat loss. However, there is still room for improvement in terms of targeting areas for formal protection and the management of protected areas. Improvement in the extent of legal protection for nature reserves is a positive development.
Appropriateness of protected areas	→	Not enough is being done to expand protected areas into the most sensitive natural areas left in the province.

- **Water management** - The poor water quality and high risks to future water availability are critical factors that require urgent attention and remediation. The current state of water resources and the declining state, threaten social health, economic health as well as the health of the natural ecosystems. Serious and innovative solutions must be implemented with a view to long-term positive impacts. These actions cannot be delayed. It is imperative that there are immediate responses, as well as long-term effective strategies, infrastructural and technology upgrades along with demand side management.

WATER (STATUS: DETERIORATING, REQUIRES URGENT ATTENTION) improving, deteriorating, stable, uncertain		
2017/18 Indicators	**Trend**	**Key findings**
Surface water availability	↓	The demand for surface water continues to increase, despite the drought conditions and reduced dam levels.
Surface water quality	↓	Water quality monitoring has been an ongoing exercise, but the monitoring points have been inadequate with monitoring points yielding less than 50% verified data sets. Most parameters appear to be below the Target Water Quality range with the exception of E.coli that continues to exceed these ranges.
Surface water use	→	Surface water is the most exploited within Gauteng. There is some augmentation with Groundwater in terms of boreholes but this is not a significant amount.

WATER (STATUS: DETERIORATING, REQUIRES URGENT ATTENTION)  improving, deteriorating, stable, uncertain		
2017/18 Indicators	**Trend**	**Key findings**
Dam levels		At the time of this report the dam levels showed an increase yield due to high rainfall and successful implementation of water saving measures, employed by water boards across the province. However, there is still need to conserve and find more permanent methods of saving water.
Trophic status of dams		Overall the dams within Gauteng have a serious problem with regards to nutrient loading. Most of the dams are enriched and have a significant to serious potential of being eutrophic. The immediate danger with regards eutrophic conditions leads to the growth of Cyanobacteria (blue-green algae) and Macrophytes (aquatic weeds), these organisms in the water lead to a decline in drinking water for both humans and animals, increased human and animal health risks, loss of habitat as well as loss of recreational and aesthetic value. This is directly linked to the poor quality of effluent entering the riparian system.
Availability of groundwater		The Groundwater Resources that are available in Gauteng are shared by North West and Mpumalanga provinces. Borehole levels are declining in the province.
Groundwater quality		Recent groundwater quality data shows most of the monitoring points are considered to be 'Very good' with the Nitrate/Nitrite concentration classified as being 'Very Good to Fair'. However, there are gaps in the data monitoring.
Water wastage		Non-revenue water which is composed of unbilled authorised consumption, commercial losses and leakages, is a threat to water supply. The world average is stated to be 36.6% and South Africa an average of 36%, with Gauteng overall responsible for 35% of non-revenue water, this seems to be encouraging as it is below the world average but as Gauteng relies heavily on water from outside the borders this figure should still be concerning.
Acid mine drainage		There are a number of treatment actions occurring within the Western, Central and Eastern Basins. Although methods of treatment have been in effect to some degree from the early to mid-2000's, the long term treatment actions have become fully operational in 2016. The results from these operations have shown that the treatment of AMD's is occurring at a satisfactory level.

- **Climate change** - Gauteng will be exposed to higher temperatures and changing precipitation patterns, potentially with a slight overall drying taking place. This will impact on the Province in terms of how the economy will function, how socio-economic vulnerabilities will be exposed further and how ecosystem services and species change. Gauteng Province is, however, aware of the projected social, economic and environmental impacts associated with climate change; and, the province has started responding to these impacts at a Provincial and Municipal level.

CLIMATE CHANGE (STATUS: IMPROVING RESPONSE TO INCREASING CLIMATE RISK) improving, deteriorating, stable, uncertain		
2017/18 Indicators	**Trend**	**Key findings**
Rainfall		The expectation is that total precipitation will not change significantly, but with rising temperatures it is expected that both rainfall events and droughts could intensify.
Mean surface temperature		Temperatures are projected to rise by at least 2°C, and up to 6°C, by 2100, depending on global mitigation efforts. This would increase winter night-time temperatures, but increased temperatures, especially temperature extremes, will need to be accommodated by the public health sector and through adjustments to the thermal performance of buildings.
Extreme events (rainfall, temperatures, flooding)		Extreme temperatures will become more common, as will more intense rainfall events, placing pressure on disaster risk and response management systems. It will also impact on specifically vulnerable communities and disrupt economic activities.
Greenhouse gas emissions		The current GHG inventory is the most complete to date, and therefore not directly comparable to previous inventories. A trend analysis is therefore not possible. The inventory indicates a real need for GHG emissions mitigation.

- **Energy** - Gauteng is largely dependent on external sources of energy, specifically energy sourced via the national electricity grid and imported via liquid fuels. It is also a highly industrialised and urbanised province, adding to the energy intensity. In the face of energy constraints resulting from growing pressure on 'dirty' energy such as coal-fired electricity, Gauteng would need to change its energy mix to incorporate alternative sources of energy, such as gas and renewables, potentially investing in local generation rather than import. It can also change its energy intensity via improvements in transport efficiency and the energy performance of the built environment.

ENERGY (STATUS: IMPROVING, HOWEVER AN ENERGY TRANSFORMATION IS REQUIRED) improving, deteriorating, stable, uncertain		
2017/18 Indicators	**Trend**	**Key findings**
Energy supply		Apart from the blackouts that resulted from a national electricity shortage, energy supplies to Gauteng have satisfied demand. Investment in, and uptake of renewable energy is growing rapidly.
Renewable energy		
Energy consumption		While demand side management has seen some success, there remains great opportunity for cleaner energy and shifts in consumption patterns.
Household energy use		While there are reported improvements since 2011, especially in terms of energy access, there remains a marked difference between urban and rural areas in terms of electrification rates and a significant portion of the population experiencing energy poverty.
Energy poverty		Consistent reporting on energy poverty has not taken place to the extent that trends can be inferred

ENERGY (STATUS: IMPROVING, HOWEVER AN ENERGY TRANSFORMATION IS REQUIRED) improving, deteriorating, stable, uncertain		
2017/18 Indicators	**Trend**	**Key findings**
Energy intensity		Energy intensity can only be reliably determined once accurate and reliable energy data becomes available.
Modes of transportation		Long term deterioration of public transport infrastructure has caused shifts in commuter behaviour from rail and bus to minibus taxis and private cars, despite relief in the form of Gautrain and BRT buses. This adds congestion to the roads, increasing fuel consumption and air pollution within urban environments.

- **Human Settlements** - Overall, Gauteng shows excellent service provision, for a province with a growing population and growing demands. However, it is still struggling to address the wicked problems associated with the historical legacy of the country, specifically inequality and poverty. The struggle to address social imbalances and provide for a growing population will continue to put pressure on finite resources and ecological systems far into the future. The percentage of households with access to piped water inside the dwelling or yard has increased in Gauteng. Community Survey results reflect that on average on an individual household basis, 97% of people have access to water. More sustainable and resource efficient infrastructure, mechanisms and management approaches must be employed. These measures are not simply 'nice to have' but are imperative for the future success of the province, and its people. In so doing, the strong connection between humans and our environment, and in particular human activity and its impacts, will be better reconciled.

HUMAN SETTLEMENTS (STATUS: IMPROVING) improving, deteriorating, stable, uncertain		
2017/18 Indicators	**Trend**	**Key findings**
Population density		Population density is certainly on the rise within the City environments, supported by efforts to densify and create mixed land use within cites. Population growth is also driven by migration as people seek opportunities within the urban environment. Increased density in an urban context is positive, as it makes provision of services cheaper and more efficient. However, increased population in rural areas could compromise food production and agri-processing through land transformation.
Quality of Life		Quality of life has shown improvement, depending on the measures employed. Furthermore, satisfaction of citizens of service delivery is relatively high and wide spread across the province.
Housing		The provision of formal housing has improved between 1996 and 2011 – a huge task, considering migration, population growth and required infrastructure upgrades. However, a significant number of residents remain in informal settlements and are dissatisfied with the condition of their neighbourhoods.
Access to services (water, electricity, sanitation, waste management)		Service provision has consistently improved over the past five years. However, with multiple looming crises related to the impacts of climate change, it is imperative that government looks at the nature of its service delivery, and effect innovative design to reduce our heavy

HUMAN SETTLEMENTS (STATUS: IMPROVING)		
improving, deteriorating, stable, uncertain		
2017/18 Indicators	**Trend**	**Key findings**
		dependence on water for sanitation, and inefficient linear waste management systems.
Income inequality		There has been a slight improvement of the GINI coefficient across the province, except for Lesedi and Mogale City where figures worsened. Considering the current economic climate and political instability, more will need to be done to strengthen local markets and create quality work opportunities.
Poverty		Between 30-40% of the population falls within the upper band of poverty, with 15 and 20% of the population experiencing food poverty. It is clear from the GCRO results that there are still many families which are very much in need, despite the grants and subsistence farming.
Water treatment		In terms of water purification for potable water provision, Gauteng remains the best performing province. Dysfunctional and malfunctioning wastewater treatment infrastructure, as well as diffuse release of effluent (such as from unserviced settlements), require serious intervention to reverse the degradation of rivers, wetlands and dams.
Infant mortality		Significant improvements have taken place from 2002 to 2015, through health care improvements and improved service provision. However, there is still disparity, with marginalised communities still suffering higher losses than more affluent areas.
Cause of death		Life expectancy continues to rise. This influences all forms of government planning and service delivery, long into the future.

- **Air quality** – Air quality in Gauteng follows the national pattern, with emissions from industry being overshadowed by the high ambient levels of particulate matter, especially from household combustion. By all indications therefore the regulatory scheme is functioning well, but unregulated emissions at ground level that require indirect responses need critical attention. The focus should therefore be on improving conditions in dense, poor settlements, where domestic fuels and vehicle emissions create unhealthy living conditions that unjustly impact more on vulnerable persons such as women, children and the aged. Related to the issue of pollution management is the question of reducing greenhouse gas emissions.

AIR QUALITY (STATUS: STABLE, WITH SOME UNCERTAINTY)		
improving, deteriorating, stable, uncertain		
2017/18 Indicators	**Trend**	**Key findings**
Particulate matter		PM levels exceed annual thresholds, particularly around settlements where the use of domestic fuels is prevalent. Increased vehicular traffic, especially diesel-fuelled vehicles, contribute to the high concentrations. This mirrors national patterns, and action is required to reverse the trend.
Nitrogen dioxide		The record suggests that NO_2 concentrations are not a significant concern as levels are generally below thresholds. Local exceedances around congested traffic routes and nodes will be present though, and need to be addressed through interventions in the transport sector.

AIR QUALITY (STATUS: STABLE, WITH SOME UNCERTAINTY)		
	improving, deteriorating, stable, uncertain	
2017/18 Indicators	**Trend**	**Key findings**
Sulphur dioxide		SO_2 concentrations appear to be stable, although a limited number of local exceedances are present. It is therefore not a priority concern, but intervention is possible in specific areas.
Ambient air quality		The ambient air quality monitoring record is of poor quality due to the lack of consistently functional air quality monitoring stations. The partial dataset suggests, however that the ambient air quality remained consistent during the reporting period. The consistent trends indicate that the issue of primary concern is particulate emissions, especially in low income settlements.

- **Waste management** - A rising concern in Gauteng is the importing of general and hazardous waste. These waste imports not only present an environmental impact in terms of soil, water and air pollution, but also a social impact in terms of human health. This places additional pressures on landfill sites, as well as waste management equipment and infrastructure, and adds to already stretched capital and maintenance budgets to find sites for new landfills, and the associated management processes. The inconsistency of waste management reporting is also a fundamental flaw in the system. Great effort must be made to have weighbridges installed and/or maintained, to ensure that waste volumes are recorded accurately. Furthermore, the appropriate waste categorisation of waste received at landfill, against the permit for that landfill must be enforced. In addition to this, a reliable electronic data base is a critical requirement, with transparent reporting of all waste sources, and handling or treatment. A radical shift to full-cost-accounting and cradle-to-cradle resource must be implemented and enforced, to reverse the current trends. Most of the recycling initiatives take place within the City of Ekurhuleni, with as much as 80% of the total waste recycling recorded for the province taking place in the City of Ekurhuleni.

WASTE MANAGEMENT (STATUS: UNCERTAIN, WITH REDUCTION IN WASTE DISPOSAL REQUIRED)		
	improving, deteriorating, stable, uncertain	
2017/18 Indicators	**Trend**	**Key findings**
Landfill sites **Available landfill lifespan**		There is uncertainty regarding the remaining lifespan of many landfill sites. Although some additional facilities are planned, landfill capacity is declining and a more sustainable solution is required given the limited land available, and significant health, environment and financial costs associated with landfilling. This situation has been an ongoing issue from the 2011 report.
Waste volumes		Waste volumes, both in terms of waste generated and waste imported into Gauteng, fluctuate from year to year, and there are uncertainties in respect of data on waste generation. The centralised GWIS data platform is nevertheless a significant step forward.
Waste recycling		Recycling trends track the overall waste generation volumes that fluctuate without a clear trend. Consistent efforts are reported only in Ekurhuleni.
Health care risk waste		Healthcare risk waste volume has declined between 2011 and 2016.

WASTE MANAGEMENT (STATUS: UNCERTAIN, WITH REDUCTION IN WASTE DISPOSAL REQUIRED)  improving, deteriorating, stable, uncertain		
2017/18 Indicators	**Trend**	**Key findings**
Hazardous waste		There has been a rapid decline in the overall hazardous waste produced, but the volume of imported hazardous waste remains significant relative to the volumes produced locally.
Waste management capacity		While the trend may be stable, there are backlogs in waste removal services; as well as ongoing reports of dumping and a lack of law enforcement.

4.9 KwaZulu-Natal Province

The following overview of the state of the environment in KwaZulu-Natal (KZN) is based on the executive summary of the [KwaZulu-Natal Environment Outlook Report 2017] and readers are encouraged to read the report for more in depth, fully referenced, information on the state of the environment in the KwaZulu-Natal Province.

4.9.1 Climate Change

Climate change is becoming increasingly apparent in KZN. The effects of climate change are evident in the long-term changes in weather patterns, such as rainfall and temperature.

Over the 1931 to 2015 period, KZN experienced considerable warming. Coastal weather stations have reported temperature increases of more than 2°C per century, which is more than double the global rate of temperature increase.

For the near term (2016–2035), all climate models predict a warming of 0.5˚C to 1.0˚C, with the coastal areas being closer to 0.5˚C. For the long term (2080–2100), predicted temperature increases range from 2˚C to 5˚C, depending on emission scenarios. This will consequently result in an increase of heat waves and very hot days. For example, days such as on 25 December 2014 in Mandini and Richards Bay, where temperatures were 43.7°C and 42.6°C respectively, will become more frequent. Such heat waves and high temperatures will most likely have severe impacts on agriculture, water security, biodiversity and human health.

Between 1985 and 2007, the Agulhas Current system, which runs along the KZN coast, warmed significantly by +1.5°C. In Durban, current sea-level rise has been 2.7 mm/year over the past 33 years. This is in line with the global sea-level rise of about 3.3 mm/year, or 33 cm per century.

Over the period 1960–2015, a significant increase in annual rainfall was seen in the south of KZN and a decrease in the north of the Province. KZN receives on average the most rainfall compared to other provinces in the country, at between 800 and 1000 mm per year, with the coastal areas exceeding 1000 mm per year. Rainfall is more difficult to project than temperature as more factors affect the occurrence of rainfall at a certain location. Therefore, these projections are less accurate at local or even regional level.

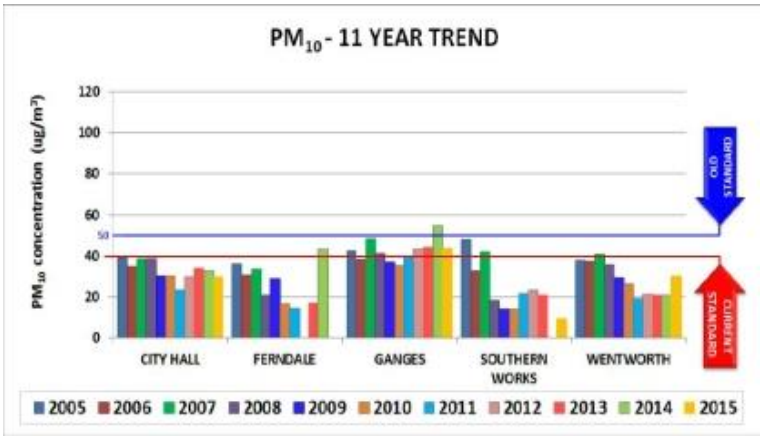
In the short term (2016–2035), models show insignificant changes in rainfall. Towards the mid-term (2046–2065), these changes are more significant although not uniform, with some models indicating an increase, while other models indicate a decrease. In the long term (2080–2100), trends show a significant decrease in annual rainfall across the Province, with some models showing an increase.

The 2009 [Vulnerability Study of the Impacts of Climate Change], undertaken by the provincial Department of Agriculture, Environmental Affairs and Rural Development (DAEA&RD), indicated that the outbreak of fires had increased during the winter season as a result of prolonged droughts, whereas the incidence of floods and severe storms had increased during the summer season. Increasing temperatures and variability in precipitation will increase the likelihood of weather extremes.

The coastline of KZN is vulnerable to erosion and flooding and is also the area with the greatest urban and industrial development, as well as population density, which exacerbates the social and economic impacts of predicted weather extremes. Because of changing weather patterns, coastal storms and cyclones are expected to increase in frequency and intensity.

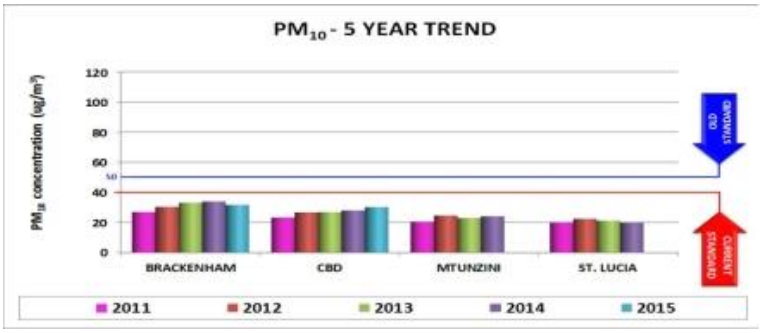
In terms of greenhouse gas (GHG) emissions, in 2012, the total GHG emissions recorded for Durban was 29 360 395 tonnes CO_2e, a 47% increase from the 19 937 000 t CO_2e in 2002, which may be attributed to an improvement in data collection. In 2010, the national level emission was 518 239 000 t CO_2, of which Durban alone contributed about 5%. In terms of sectoral contributions to the emissions in 2012, electricity consumption was the largest contributor, followed by fuel combustion, solid waste disposal and sugarcane burning.

4.9.2 Air Quality

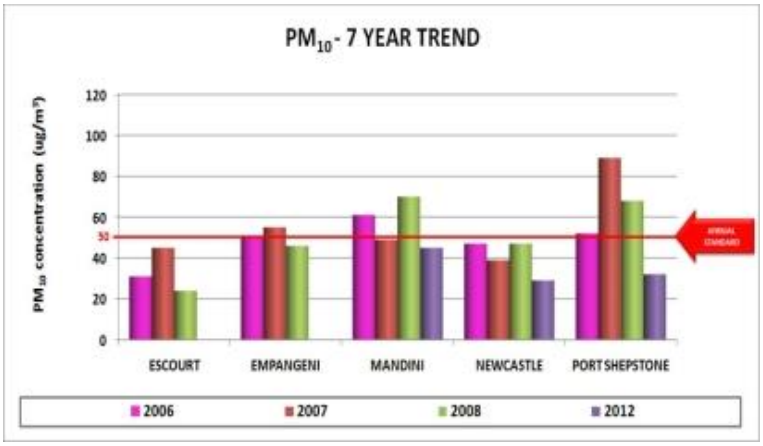


Determining the state of air quality is limited by the availability of ambient monitoring data. Areas such as eThekwini Municipality have greater monitoring coverage, but many other municipalities have limited resources to undertake such monitoring. However, the Province is currently conducting surveys in areas where no or limited air quality data exist. Results from the Province's Ambient Monitoring Network are reported to the South African Air Quality Information System [(SAAQIS)], which is the national repository for air quality monitoring data. Once KZN is registered with SAAQIS, provincial data will become accessible to the general public.

In this Report, the state of air quality is therefore described using available data, with an emphasis on PM_{10}, SO_2 and NO_2 data as indicators.



PM_{10} has several natural and anthropogenic source sectors that contribute to elevated ambient concentrations. The World Health Organization (WHO) has identified that no safe level for PM exists and that there are noticeable health effects from any exposure. PM_{10} levels in eThekwini Municipality show a trend toward higher concentrations in traffic-influenced monitoring sites, at City Hall and Ganges. In addition, a regional influence on PM_{10} exists, together with natural sea spray, and long-range transport from southern Africa. Regional-scale transport from the industrialised interior and biomass burning increase background concentrations of PM_{10}.

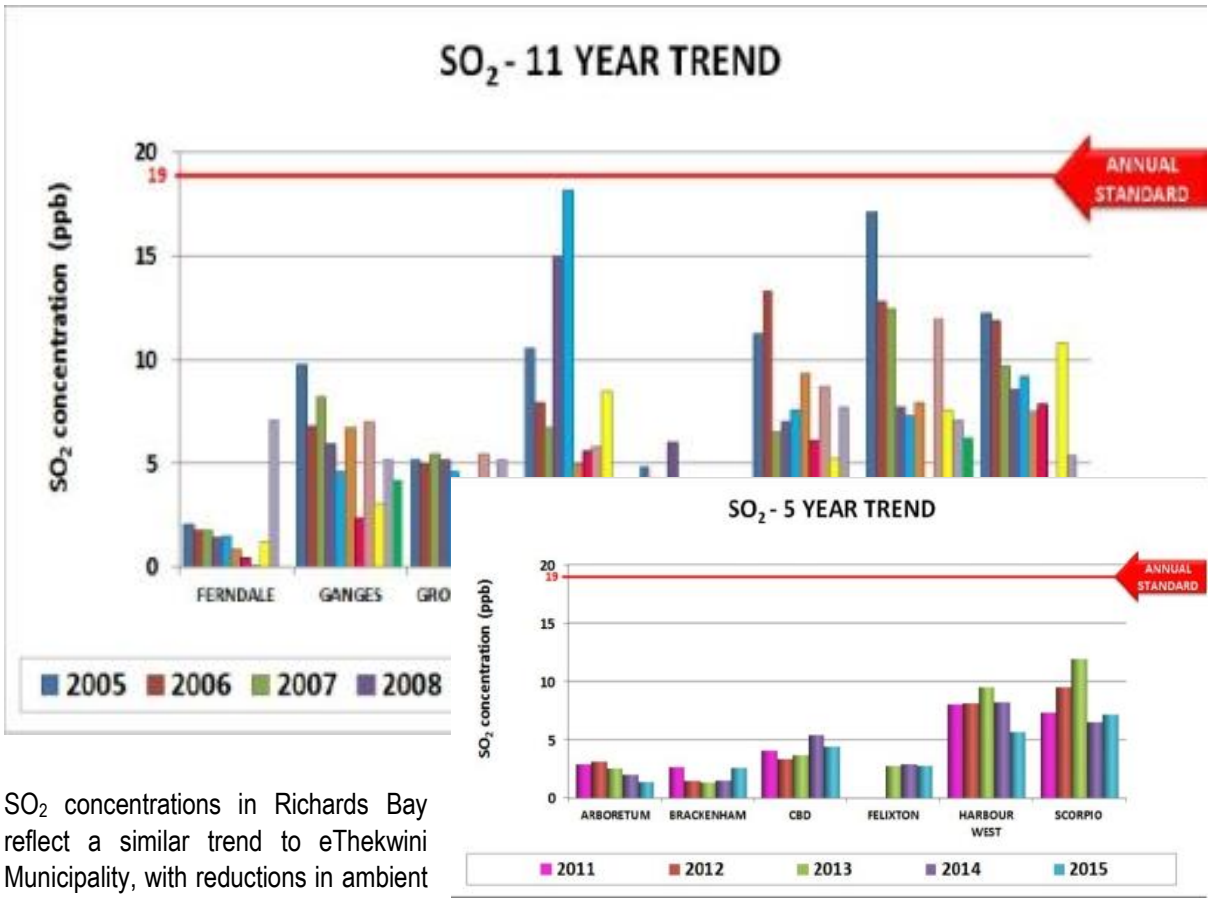


Background sources of PM_{10} contribute about 16 µg/m^3 to ambient PM_{10} concentrations in eThekwini Municipality. PM_{10} concentrations in Richards Bay are recorded through the Richards Bay Clean Air Association (RBCAA) network, which provides a 5-year trend from 2011 to 2015. Elevated concentrations are observed in the vicinity of Richards Bay and at the CBD and Brackenham sites, with lower concentrations observed in outlying Mtunzini and St Lucia. No exceedances are recorded for this period.

Limited records are available for other areas covered by the EDTEA network. The period 2006–2008 is reflected in the trend analysis, with some sites operational in 2012. Elevated concentrations are observed in Newcastle and Estcourt, with exceedances at Empangeni, Mandini and Port Shepstone. Dust-fallout monitoring identified elevated levels at Umhlali, Gledhow, Mkondeni and Cato Ridge, which may indicate elevated PM_{10}. Elevated PM_{10} concentrations are observed in most urban centres and background sites in the Province.

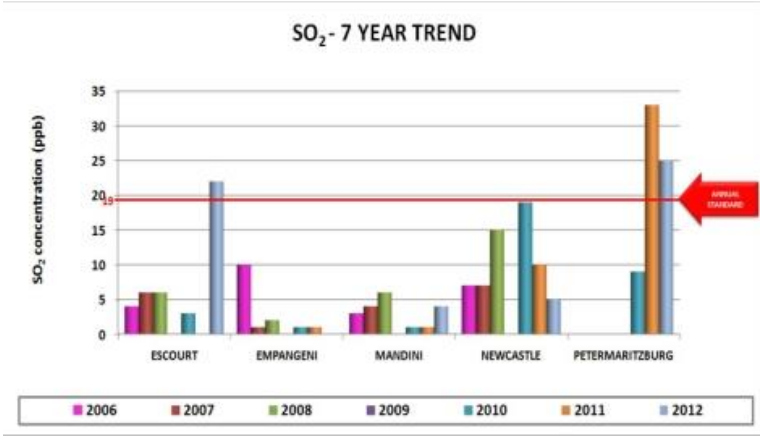
SO_2 is classified as an industrial pollutant, with large-scale fossil fuel combustion contributing significantly to ambient pollutant loading. Anthropogenic sources dominate the emission profile and several areas of concern are observed across the Province.

An 11-year trend is available for SO_2 concentrations in eThekwini Municipality, which highlights the major progress made in pollution management for SO_2 by the Municipality. Annual concentrations have decreased markedly in the South Durban area, where monitoring is focussed. The Scheduled Trade and Atmospheric Emission Licensing permitting systems are credited with assisting in management of large emitters in South Durban.



SO_2 concentrations in Richards Bay reflect a similar trend to eThekwini Municipality, with reductions in ambient levels observed in the industrial areas of the town. Elevated concentrations are only observed in industrial areas, using annual average concentrations. These indicate low long-term, or chronic, exposure levels. No exceedances are recorded for the observation period.

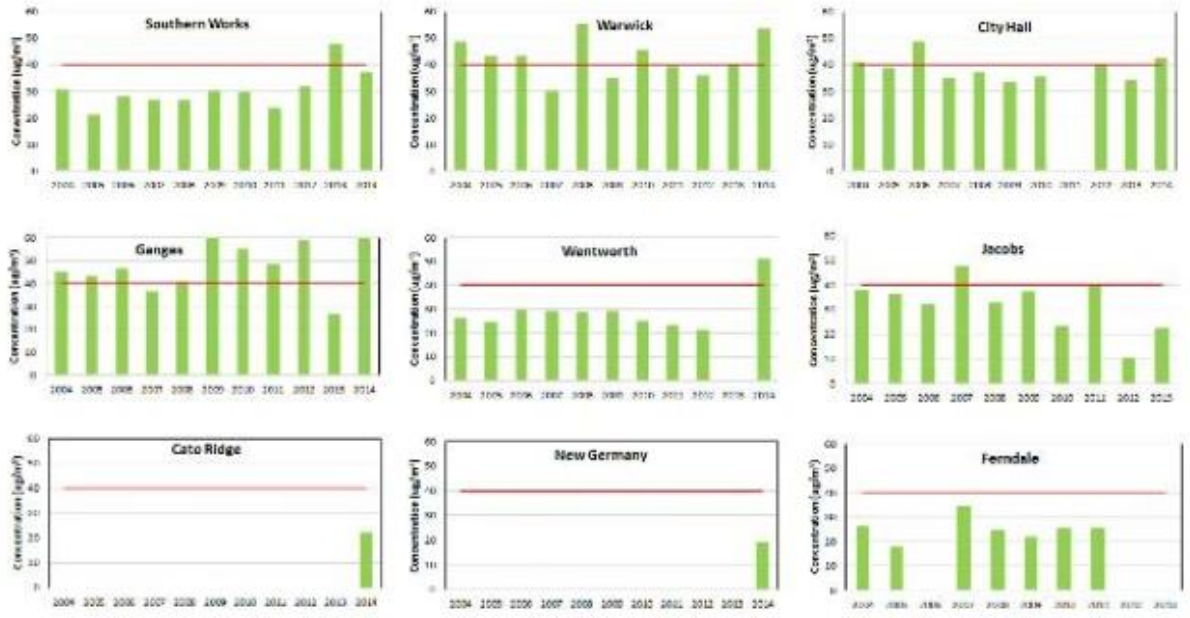
Limited monitoring data are available for other areas of the Province through the EDTEA network, as stations were operational for intermittent periods during this time. Monitoring data show that SO_2 concentrations are of concern in Estcourt, Newcastle and Pietermaritzburg, with exceedances or elevated concentrations recorded in these areas. Empangeni and Mandini recorded low concentrations.



SO_2 concentration trends show a few areas of concern across the Province. Large reductions in ambient concentrations are observed in South Durban,

and limited exceedances observed in other areas across the Province. Successful management interventions, at local and national level, have contributed to overall lower ambient levels of SO_2.

NO_2 concentrations are not routinely reported on by the Department of Environment, Forestry and Fisheries in its state of air reporting, but eThekwini Municipality has included ambient monitoring data in the baseline assessment. NO_2 is largely associated with traffic sources, but large-scale fossil fuel combustion also contributes to ambient pollutant levels. Traffic-influenced monitoring sites in eThekwini Municipality show elevated concentrations of NO_2, with exceedances recorded across the monitoring period. Some industrial sites also reflect high NO_2 concentrations. NO_2 is regarded as a new and emerging pollutant of interest, as traffic-related pollution increases in the Province. Data are not available for other urban centres of the Province. Management intervention is needed for assessing NO_2 concentrations in other areas.



4.9.3 Biodiversity and Ecosystem Health

The [KZN Systematic Biodiversity Plan] is the primary tool for biodiversity planning in the Province. This plan identifies 14.9% of the Province as: Critical Biodiversity Area: Irreplaceable; 11.3% as Critical Biodiversity Area: Optimal; and 18.5% as Ecological support areas.

In 2007, it was estimated that approximately 53% of the biodiversity in KZN was located outside of state-protected areas on private and communal land. To address this, the [KZN Protected Area Expansion Strategy] identified a 20-year target to secure an additional 842 400 ha by 2028. Since then, 41 new protected areas, covering an area of 111 163 ha, have been declared in terms of NEMPAA, primarily through the KZN Biodiversity Stewardship Programme. This equates to an addition to the Province's protected area system of approximately 1%, meaning that the current extent of protected areas in KZN is approximately 9% of the terrestrial surface area.

KZN has been rapidly losing natural habitat since formal monitoring began in 1994. The average annual area of natural habitat lost is 109 906 ha, which equates to 1.16% of the terrestrial area of KZN.

The rate of loss of natural habitat, species richness and ecosystem function in KZN is one of the most alarming issues related to the Province's biodiversity. By 2011, the amount of natural habitat remaining in KZN, once modified and with secondary habitat removed, was 53.6% of its surface area. This contrasts with the 2004 SoER, which indicates the remaining natural habitat as 66%. This means that over 12% of the Province's natural habitat has been lost since then. The continued loss of natural habitat means that natural areas will become too small and

isolated from each other to continue to maintain viable populations of species. This will ultimately lead to species extinction and the complete loss of critical ecosystem functions.

Associated with high and accelerating levels of habitat loss is an increasing threat of habitat fragmentation in which remaining patches of natural habitat become increasingly smaller and isolated from each other. As the levels of habitat loss are not spread evenly across the Province, it is likely that some habitat types have become more fragmented than others, where urbanisation and development levels have led to the considerable loss of natural habitat and fragmentation. This increases the likelihood of extinction of species.

The threat status of vegetation in KZN reflects high population densities and agricultural development along the coastline compared with inland areas. The highest proportion of critically endangered vegetation is located along the coastline, with pockets of endangered vegetation located further inland. Most of the western interior of the Province is Vulnerable or Least Threatened, as it has not been subject to the same levels of development impact as the coastal areas. The areas of endangered vegetation located inland are associated with extensive development for agriculture and plantation forestry, resulting in the loss of much of their remaining natural extent. Since 1994, there has been a marked increase in the threat status of vegetation types, even with finer-scale mapping that has resulted in an increase in the number of identified vegetation types. Although Vulnerable and Endangered vegetation types have remained constant, the number of Critically Endangered vegetation types has increased nearly five-fold since 2004.

Threat status of vegetation types in KZN between 1994 and 2017			
Threat status	**1994**	**2000**	**2017**
Critically Endangered	1	4	19
Endangered	16	17	17
Vulnerable	17	18	16
Least Threatened	32	27	50

The first national list of threatened terrestrial ecosystems for South Africa was gazetted on 9 December 2011 ([National Environmental Management: Biodiversity Act: National list of ecosystems that are threatened and in need of protection, (G 34809, GoN 1002), 9 December 2011]). Nearly 20% of KZN's surface area is listed as threatened and the Province is second only to the Western Cape in terms of the number of listed Critically Endangered ecosystems.

Threatened ecosystems in KwaZulu-Natal				
	Critically Endangered	**Endangered**	**Vulnerable**	**Total**
No. of ecosystems	19	24	59	145
Remaining natural area (ha)	224 000	464 000	1 164 000	1 852 000
Percentage of Province	2.4	5.0	12.5	19.9

In terms of rivers and aquatic ecosystems, although KZN receives relatively more rainfall than the rest of South Africa, the amount of water in catchments like the uMngeni River is insufficient to meet demand. Most rivers in KZN are considered moderately modified and some loss and change of natural habitat may have occurred. Several rivers are largely modified and have experienced a considerable loss of natural habitat, biota and basic ecosystem functions. In the case of the uMngeni River system, which is the primary source of water for eThekwini Municipality, there has also been a considerable loss of habitat and ecological function. This has serious implications as the uMngeni River is integral to the economy of the Province. These implications include significantly elevated water treatment costs as the water quality in the uMngeni River system is poor, and altered flow patterns that exacerbate flood and drought conditions.

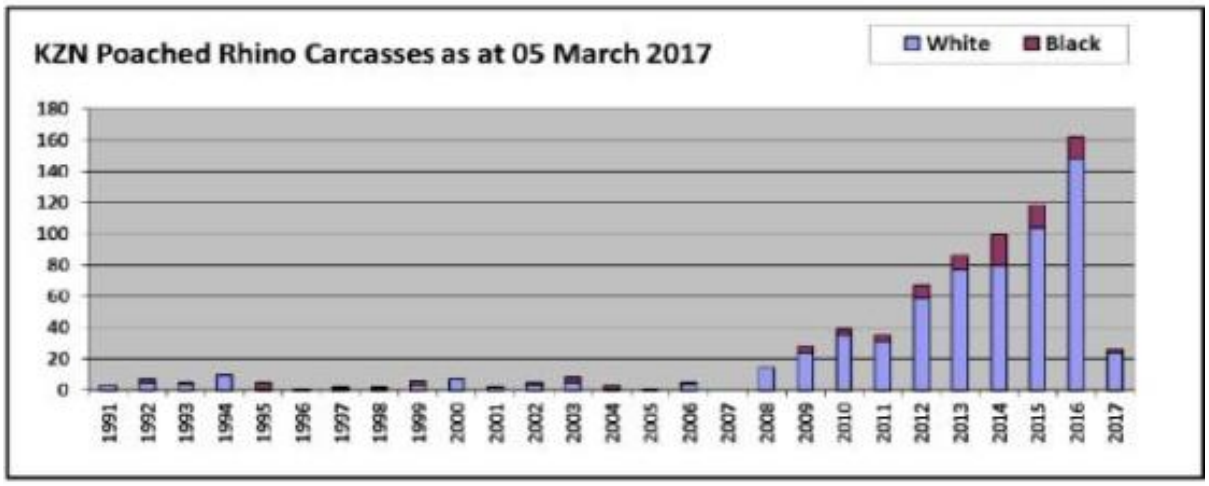
Invasive alien species are introduced species, which may result in economic or environmental harm, or harm to human health. In KZN, invasive alien plants have been estimated to use approximately 5% of the Province's Mean Annual Runoff (MAR). There are a number of invasive alien plant species in KZN that have significant economic implications in terms of the loss of productive land, impacts on ecosystem function and the costs to control and eradicate them.

Associated with losses in habitat, there are concerning trends associated with increasing threats to species. Data on individual species are often difficult to obtain, but a number of species extinctions have been identified along with the number of currently threatened species in KZN.

The number of threatened and extinct species in KwaZulu-Natal		
Taxonomic group	**Critically Endangered**	**Endangered**
Plants	21	> 100
Mammals	0	9
Birds	8	-
Amphibians	4	-

In addition to the threats to species associated with habitat loss, there have been significant increases in illegal harvesting of species and poaching. Threats to plants are associated with illegal harvesting for traditional medicinal trade and high value ornamental species like cycads. In addition, three rhinos were poached in 2004 compared to 162 in 2016. Poaching poses a significant threat to the survival of black and white rhinos, to their security and to economic activities such as tourism, which may be negatively affected by poaching.

KZN TOTAL RHINO POACHING MORTALITIES 01 JANUARY 1990 TO 05 MARCH 2017



4.9.4 Land Modification

The most current land-cover data for KZN come from the 2013–2014 national land-cover map developed for the Department of Environment, Forestry and Fisheries and cover the entire country. The data include a number of land-cover classes that show the area and percentage of land cover for different land-use types in KZN.

Land cover in KwaZulu-Natal		
Land-cover type	**Area (ha)**	**Proportion of provincial surface area**
Natural vegetation	6 335 096	67.9%
Eroded areas	67 097	0.7%

Land cover in KwaZulu-Natal		
Land-cover type	**Area (ha)**	**Proportion of provincial surface area**
Plantation forestry	709 172	7.6%
Cultivated areas	1 429 179	15.3%
Developed land (urban and industrial)	786 465	8.4%
Mining development	5 537	0.1%
TOTAL	**9 332 546**	**100%**

According to the national land-cover layer, ~68% of the surface area of KZN is natural land cover. This differs significantly from the land-cover assessment of Ezemvelo KZN Wildlife of 2011, which showed that only 53.6% of natural land cover remained in the Province. This difference is probably a result of the resolution used in mapping land cover at a national scale.

Measuring degradation is extremely challenging. Nevertheless, there are indicators of the extent of degradation in KZN. The KZN 2008 land-cover layer includes a degradation layer. This layer depicts areas in which natural vegetation has been degraded but there are limitations to its accuracy. The national land-cover layer also includes an erosion layer, which is based on areas of visible erosion (dongas) and other areas that are bare of vegetation. The areas of visible erosion are over 67 000 ha in size and make up approximately 0.7% of the Province's land area. This percentage may seem insignificant; however, it represents only those areas that were visible for mapping purposes on a national scale and indicates that there are areas of extreme erosion in KZN in addition to areas of more superficial degradation.

According to the national land-cover layer, plantation forestry covers an area in excess of 700 000 ha or 7.6% of KZN's land area.

This is a vast area, particularly when one considers that it is equivalent to the extent of state-protected areas in the Province (~8%). Furthermore, in examining the impacts of plantation forestry on the Province, it is important to consider the location of plantations. Plantation forestry is often located in threatened vegetation and habitat types, and has largely been the driver of the threat status of the vegetation. For example, little remaining natural extent of particular vegetation types, such as Mistbelt Grasslands, exist because these types have been modified by plantation forestry. In terms of ecological processes, almost all plantation forestry in the Province is located within [strategic water source areas]. These areas constitute the 8% of South Africa's surface area that produces more than 50% of the runoff and are thus of immense importance from a water-resource perspective in the Province. Plantation forestry has been developed in these areas because of the need for high rainfall for forestry production. However, it also means that forestry is a significant user of freshwater resources that could otherwise be used for other purposes.

With over 1.4 million ha or 15.2% of the Province's surface area, cultivated areas form the largest identified land class after natural areas in KZN. Ploughing and cultivation of land have been the primary drivers of land modification and of loss of natural habitat and ecosystem function in KZN.

Over 780 000 hectares or 8.4% of the surface area of KZN has been modified for urban or industrial development. This is the third-largest land class in the Province and has been one of the primary drivers of land modification and loss of natural habitat. Together with agricultural development, urban and industrial development reflect extremely high levels of habitat modification in the Indian Ocean Coastal Belt Biome. Consequently, these developments are the underlying reason for the high threat status of vegetation within this biome.

Mining covers an area of only about 5 500 ha or 0.06% of the surface area of KZN. Nevertheless, the impact of mining is disproportionate to the extent of land area that mining covers. Mining has significant impacts on water resources, primarily through acid mine drainage. It also has air quality, noise, socio-economic and visual impacts that alter the character and sense of place of a region.

As highlighted in the biodiversity section above, KZN has undergone a rapid loss of natural habitat since 1994. The average annual area of natural habitat lost each year is 109 906 ha, which equates to 1.16% of the terrestrial area of KZN. Over 12% of the Province's natural habitat has been lost since the [2004 SoER]. These rates of habitat loss are a great concern as the ecological integrity and critical ecological processes are being disrupted, which has implications for how the environment can support and sustain society and maintain human livelihoods.

The concept of ecological carrying capacity defines how many animals may be maintained in a productive condition in an area without leading to habitat or soil degradation. The factors that determine carrying capacity relate to topography, soils, vegetation and climate. Of these, climate is the most important as rainfall and temperature are the primary determinants of fodder production. The KZN Department of Agriculture and Rural Development (DARD) has categorised the Province into 622 defined zones called Bioresource Units, based on these factors (Camp, 1999), in an effort to assist in determining carrying capacities and associated stocking rates of livestock. The condition of the habitat (commonly known as veld or rangeland condition) within these Bioresource Units forms an important determinant of carrying capacity. Habitat and soil degradation results in a decline in fodder production, meaning that degraded land, which has been subject to changes in species composition and loss of plant cover and soil, produces proportionally less fodder for livestock consumption than does habitat in excellent or good condition. The implication is that the high rates of loss of natural habitat and levels of land degradation in KZN have led to correspondingly great losses of carrying capacity for livestock and other animals in the Province. Consequently, the Province has a considerably reduced capacity to support livestock for agricultural production, which, in turn, has severe implications for food security and human well-being. The trends in habitat loss and land degradation in the Province indicate that the ecological carrying capacity will continue to decline and with it the ability to support livestock for agricultural production.

4.9.5 Fresh Water

The state of water resources in KZN is increasingly characteristic of the archetypal description of water resources – too much, too little or too dirty. This has been largely influenced by reduced rainfall and deteriorating water quality, mainly as a result of the increased demands of a growing population.

Surface water storage in KZN has been declining since early 2014 mainly due to drought. It recently dropped below 50%, its lowest level since 2012. Specific areas within KZN were affected more than others, with northern KZN possibly being the worst. Farmers reported that the drought had been the worst since 1932, with three extreme drought events having occurred in the last 20 years. The Richards Bay area continues to struggle with low water resources and supply. KZN water storage levels have only recently recovered to "moderately low" levels that are on average higher than at this time last year. KZN is, however, in a worse situation than the national average.

Although access to water has improved in KZN over time, indications are that KZN is lagging behind the rest of South Africa. This is mostly due to challenges in developing infrastructure to reach communities that are often long distances away and that are reached by traversing rugged terrain. A further challenge is poorly maintained and ageing infrastructure.

The Department of Water and Sanitation's (DWS) Blue and Green Drop programme has been in operation since 2009 and has the potential to monitor water quality in a consistent, spatially representative manner. The Blue Drop ratings of six of the country's nine provinces declined substantially between 2012 and 2014, with KZN decreasing from 92% in 2012 to 86% in 2014.

The Water Institute of South Africa (EWISA) has provided possibly the only year-by-year collation of Green Drop data. Although the risk trend for some of the performance categories is improving, of concern is that most trends are digressing, including the overall trend. Unfortunately, data are not available beyond 2012 and most commentators have expressed concern that wastewater quality has continued to decline in recent years.

Current water quality risks are associated with the presence of feedlots, WWTWs upstream of some dams and reservoirs, seasonal changes (rainfall/storm events, impoundment stratification) and sewerage problems. These risks include: algal blooms and aquatic weed problems associated with eutrophication, chemical (including iron

and manganese) contamination, elevated turbidity and faecal contamination (and associated pathogen risk), and erosion runoff contamination.

In terms of groundwater, a 2004 report highlighted several concerns related to groundwater management in KZN, including poor management as a result of the "invisible" nature of its abstraction and long delays before the impacts of over-exploitation become apparent. Groundwater management has, however, improved since the National Groundwater Strategy (NGS) was developed in the early 2000s, which took groundwater from a neglected private water status to that of a significant resource managed as part of Integrated Water Resource Management (IWRM). In South Africa, groundwater has become a source of domestic water and livelihood for more than 60% of communities in many villages as part of a national drive to meet basic water needs. In KZN, only 1% of the total water use is from groundwater, suggesting that there are still further groundwater resources remaining untapped. In KZN:

- four irrigation and domestic users are the largest abstractors (100 000 – 1 million m^3/a each);
- groundwater occurrence is in the order of 0.5 to 2.0 l/s over most of the Province;
- electrical conductivity (an indicator of potability) is generally less than 70 mS/m over most of the Province;
- water level is between 10 and 35 m for most of the Province;
- utilisable groundwater exploitation potential ranges mostly from less than 2 500 to 6 000 $m^3/km^2/a$; however, there do exist small areas of up to 50 000 $m^3/km^2/a$ in the Drakensberg and along the coast; and
- groundwater contributes from 4 000 to 65 000 $m^3/km^2/a$ baseflow to rivers in KZN.

The 2004 report discussed briefly the impact of forestry on water resources. Commercial [afforestation] impacts water resources by reducing runoff because of increased interception loss and evapotranspiration. The magnitude of this reduction has been the subject of several studies; however, the impact of [afforestation] on water resources is complex. Possibly the most comprehensive research in KZN was conducted by Summerton (1995), who used commercial tree water use trials in Zululand and other research to estimate that commercial tree water use could be as high as 18 mm/d under irrigation, with a peak of 9 mm/day being plausible under rain-fed conditions. Actual water use is dependent on rainfall, soils, genera and species and site preparation. A total of 503 212 ha (or 7.5%) of KZN's area of 9.1 million ha is planted for commercial forestry, with a significant water resource allocation.

The 2004 report highlighted that one of the most important indicators of wetland health was the measurement of how many wetlands had been lost and that the indicator was misleading. Unfortunately, this remains the case, except for the eight wetlands with Ramsar status. The World Wildlife Fund – Mondi Wetlands Programme is arguably the most active institution in terms of wetland preservation.

KZN has two operational hydropower schemes: the Drakensberg pumped storage scheme, completed in 1981, and the Ingula pumped storage scheme, completed in 2017. The Drakensberg scheme provides for up to 27.6 gigawatt-hours (99 TJ) of electricity storage in the form of 27 million cubic metres of water. The water is pumped to Driekloof during times of low national power consumption (generally over weekends) and released back into Kilburn through four 250 megawatts (340 000 hp) turbine generators in times of high electricity demand. The Ingula scheme has water flowing at high speeds down to the turbines at around 60 km per hour, with enough water passing through each turbine to fill an Olympic-sized swimming pool in six seconds. Rotating at 428 revolutions per minute, each unit produces 333 MW, with a total for the station of 1 332 MW.

4.9.6 Marine and Coastal Resources

The 2004 SoER identified four indicators for the assessment of marine biodiversity: i) the number of birds at selected estuaries in KZN, ii) species diversity and abundance in the [bycatch] of crustacean trawlers, iii) species richness on rocky and coral reefs and iv) abundance of keystone species (sharks).

Both bycatch of trawlers and species richness on rocky and coral reefs were assessed using data from the Oceanographic Research Institute (ORI) for the 2004 KZN SoER. Unfortunately, updated data were not available for inclusion in these indicators in this Report.

Indicators used to assess the condition of marine and coastal resources in KZN in this Report were: i) the number of birds counted at selected estuaries, ii) abundance of key focal species (sharks, turtles and alien and invasive species) and iii) abundance of threatened species and habitats.

Birds, particularly estuarine waders, are susceptible to habitat loss, which makes them good indicators of estuarine state. Estuaries are affected by a range of anthropogenic activities such as canalisation or alteration of mouth state. These changes result in changes in both the abundance and the species composition of birds present; for example, by favouring fish-eating birds.

Durban Bay has undergone major habitat loss, with tidal flats and mangroves declining by 86% and 97% respectively. This has resulted in a decline in water birds and palaearctic waders since 1965 by 70% and 81% respectively. Subsequent to 1999, three more species appeared to be locally extinct: the Kittlitz Plover (*Charadrius pecuarius*), White Fronted Plover (*Charadrius marginatus*) and Greater Sand Plover (*Charadrius leschenaultii*). Monthly bird counts from July 1999 to June 2013, supplementing counts from March 1999 to February 2002, show both short- and long-term declines in water birds in the bay.

The removal of keystone species is likely to have a profound effect on ecosystem functioning. Declines in the populations of keystone species are important indicators of deterioration in an environment. KZN has deployed long, anchored gillnets to ensure bather protection since 1952. Fourteen species are regularly caught in the nets, of which four, the blacktip, great hammerhead, scalloped hammerhead and Java shark, significantly declined between 1978 and 1999 when standardised for catch per unit effort (CPUE). From 2000 to 2010, a decline was observed in the catch of all large predatory shark species, with drumline data also showing a decrease in the number of sharks caught between 2007 and 2014 when standardised for CPUE.

Turtles are an important flagship species for protecting sandy coastal habitats. Both loggerhead (*Caretta caretta*) and leatherback (*Dermochelys coriacea*) turtles nest in northern KZN. As adults, they are exposed to numerous threats, including artisanal fishing or as bycatch in inshore trawling, shark nets and pelagic longline fisheries. Nests are threatened by predation and beach erosion. Climate change has the potential to affect sex ratios, thereby further impacting populations. Conservation measures implemented under the Maputaland turtle conservation and monitoring programme have resulted in improved protection of turtles. Loggerhead turtles have undergone many distinct phases, with an initial rapid increase in the first five to ten years in response to protection, followed by a prolonged stability. A rapid increase between the early 2000s and 2012 was attributed to consistent protection of hatchlings returning to the area to nest and to a collapse in the Mozambican prawn industry that resulted in fewer turtles caught in prawn nets. A peak occurred in 2014, followed by three years of decline in nesting events, of which the cause is currently unknown. Leatherback populations show high inter-annual variability, although currently overall nesting populations are stable.

Alien and invasive species have the potential to impact across the economic, social and ecological spheres. For example, mussel rafts in Saldanha Bay (in the Western Cape) become extensively infected by an invasive ascidian (*Ciona intestinalis*) that inhibits mussel growth and reduces efficiency in sorting, which results in a removal cost of R100 000 per annum.

In 2011 and 2015, a total of respectively 85 and 87 marine and estuarine alien plants and animals were recorded in South Africa. It is likely that alien and invasive species are more prevalent in the Natal Ecoregion due to the presence of the Durban and Richards Bay harbours, which provide protected waters and high ship traffic.

Very few datasets are available regarding threatened species and habitats at a provincial level. Adequate assessment of these species and habitats needs to be undertaken to ensure protection and conservation. The IUCN Red List of Species indicates that the Western Indian Ocean region has 188 Vulnerable species, 34 Endangered species and 11 Critically endangered species. Certain species are adequately protected; for example, the Seventy-Four, by a fishing moratorium, and turtles, by protection of their breeding areas. However, numerous species are still at risk.

Habitat-level indicators are important as they can show general trends in the condition of ecosystems. Mangroves occur in estuaries along the KZN coast that are subject to numerous anthropogenic stresses. Being highly

susceptible to stressors, mangroves are good indicators of change, but are currently declining in presence and coverage throughout KZN. Between 1982 and 1999, mangroves were lost from nine estuaries, and from a further two estuaries between 1999 and 2006. Areal coverage of mangroves declined by over half during this period. This contrasts with the general perception of improvement of the ecological state noted in small KZN estuaries. Mangrove cover and condition should thus be included in future assessments of estuarine condition.

Functioning ecosystems provide a range of valuable goods and services, including marine resources, storm protection, waste assimilation, and filtering via estuaries and marine outfalls. Replacing ecological goods and services with manufactured substitutes is costly and is often less efficient than the natural processes.

The [KwaZula-Natal 2004 State of Environment Report (2004 KZN SoER)] identified the following indicators of ecological functioning: i) trends in mouth state of estuaries, ii) estuarine indices and iii) bleaching and recruitment on coral reefs. While mouth state may provide a good indicator of ecosystem functioning, no long-term datasets are currently available for assessing trends in mouth state since the 2004 KZN SoER. Monitoring of mouth state of at least selected estuaries is recommended for inclusion in future reports.

For the above reason, only two key indicators have been used to assess ecosystem function in this Report: i) estuarine health indices and ii) bleaching of coral reefs.

Estuaries are important nursery grounds for marine fish and crustaceans. They are, however, highly susceptible to environmental change, particularly in fresh and seawater inflow, sedimentation and decreased water quality caused by pollution. Prolonged mouth closure is thus likely to have a negative impact on stocks of estuarine-dependent species.

Two key areas of concern are: i) whether the estuary is adequately managed and ii) whether there is adequate freshwater input.

The status of estuaries generally appears to have improved, with increased numbers being identified as fair between 2000 and 2011. However, while smaller estuaries appear to be improving, two of the largest systems, St Lucia and Durban Bay, are now listed as poor. In addition, estuarine indices cannot be accurately compared as they are formulated in a variety of ways and this apparent trend must be regarded with circumspection. The assessment of PES has now been standardised and future data should be more comparable.

Coral reefs are highly sensitive to changes in water temperature and quality. Bleaching is a general stress response in corals but large-scale bleaching is most commonly a response to thermal stress. Coral bleaching is thus a good indicator of the effects of climate change on ecological functioning of marine habitats.

Minor bleaching events were noted in northern KZN in 1998, 2000 and 2002, with a warm water event in 2005 showing unprecedented numbers of bleached colonies, despite the low 'bleaching response' index reading.

Coastal resources can be divided into living (renewable) and non-living (non-renewable) resources. Renewable resources include plants and animals that are collected for food, aquaria or decoration. Non-renewable resources include the land itself, estuaries, beaches and minerals. Renewable resources in KZN are exploited by three fishery sectors: commercial, recreational and subsistence.

The 2004 KZN SoER identified three indicators for the assessment of the state of coastal resources: i) the state of stocks of important linefish, ii) the state of crustaceans targeted by trawlers and iii) subsistence harvesting of intertidal mussels. All three indicators were assessed in this Report, with the inclusion of the one additional indicator for non-renewable resources of sand mining.

Changes in contribution of the five most targeted species were evident between 2004 and 2010, with a decline in catches of shad and an increase of strepie particularly notable. Overall CPUE declined for all species; however, mean size of fish caught remained constant.

Trends in CPUE for the boat-based fishery from 1986 to 2004 and between February 2009 and April 2010 were assessed. Overall trends were difficult to ascertain for line fisheries; however, two species prevalent in 2004 catches, santer and catfaced rockcod, no longer featured in the top five in catches in 2009/10. These were replaced by yellowfin tuna and chub mackerel.

The KZN trawl industry can be subdivided into the shallow water fishery in <50 m of water and the offshore trawl fishery at depths of 300-600 m. Inshore trawling has ceased due to low catches as a result of long-term closure of the St Lucia Estuary.

The 2004 KZN SoER described stocks of knife prawn and langoustine as fluctuating, but relatively stable. Current data are difficult to interpret because of the decline in trawling activity for a number of reasons, including the landed price.

Subsistence mussel harvesting is an important protein source, particularly for rural communities. Previous analysis of the long-term data series available for subsistence harvesting shows an overall decline in catches. This decline may not be due to an actual decline in stocks but as a result of local communities identifying the need to reduce pressure on the stocks or the development of a cash economy. Prior studies have found Maputaland subsistence harvesting to be within acceptable limits, with some areas over-exploited but not threatened. A subsequent study undertaken by Ezemvelo has highlighted over-exploitation as a concern, but without proper survey data it is challenging to identify whether stocks are in decline.

Sand mining can have direct effects, such as the loss of biodiversity or altered stream characteristics due to physical disturbance, and indirect effects, including the interruption of coastal processes such as the provision of sand. Sand mining in the coastal zone often occurs illegally within estuaries, resulting in further degradation of already negatively impacted environments.

Sand mining is common in KZN. The illegal mining is of particular concern as miners tend to exploit areas that should not be disturbed, practise damaging abstraction methods and do not undertake rehabilitation post mining. Findings of a survey conducted from the Thukela to the Mtumvuna Rivers revealed that 18 out of 64 estuaries showed evidence of sand mining; however, no estimate of the volume of sand being removed is available. As this survey was only undertaken once, it is impossible to ascertain trends. However, increased illegal sand mining is likely to occur as the value of sand increases and data should be collected to make this a useful indicator.

South Africa has numerous environmental laws that obligate the protection of the marine and coastal environment. Most biodiversity typically falls outside of protected areas, yet must still be adequately protected. This means that monitoring and enforcement of regulations outside of MPAs are required to ensure compliance.

The 2004 KZN SoER identified two indicators to assess this: i) the number and extent of protected areas, and ii) enforcement of and compliance with fisheries regulations. Both have been included as indicators in the current EOR. A third indicator, coastal stability and maintenance of littoral drift (i.e. the transport of loose sediment, mainly sand, due to the action of breaking waves), was highlighted in the 2004 SoER. However, due to limited data, this was not explored in this Report. Although coastal stability and littoral drift are still likely to be important indicators, no datasets have been identified for adequately assessing them.

Approximately 9% of South African coasts are fully protected while a further 14% occur in MPAs with varied levels of use. Offshore levels of protection are negligible, with only 0.16% of the Exclusive Economic Zone (EEZ) protected. Currently there are four MPAs along the KZN coastline, protecting approximately 25% of it. No MPAs occur between St Lucia and Durban, leaving important areas such as the Natal Bight unprotected. South of Durban, Aliwal Shoal provides protection to an important rock reef. In the south, Trafalgar MPA provides protection primarily to coastal features, including cretaceous fossils and estuaries. It is, however, limited in its effectiveness by its size (**Error! Reference source not found.**). Should promulgation of these MPAs occur, this will be a good step towards conserving KZN marine and coastal environments.

The 2004 KZN SoER identified ten estuaries in KZN that had received some degree of statutory protection. All but two of these were situated north of Durban and primarily comprised medium-large open estuaries. The 2004 SoER identified a lack of no-take estuaries, with the reef at the mouth of Kosi Bay being the only sanctuary. The St Lucia Estuary is listed as fully protected; however, fishing is still permitted, which means that St Lucia has not been adequately protected. Efforts to remediate the situation are currently under way, primarily through re-uniting the mouth of the iMfolozi with the St Lucia mouth.

The increase in no-take zones is an improvement, but is by no means adequate for the protection of estuaries in KZN. **Error! Reference source not found.** shows the estuaries that require full protection. Adequate protection of the St Lucia and small south coast estuaries is still required to ensure representation of different estuarine types. The following eleven estuaries have been identified as requiring full protection by the [2011 National Biodiversity Assessment], of which only six are already protected.

Pollution is a primary concern in the marine and coastal environment. In this context, it refers to human-derived waste, industrial effluent, sewage and storm water. The primary source of land-derived waste to the ocean comes from effluent outfalls and pollution that flows out of rivers and estuaries. Litter, particularly single-use plastics, has been highlighted as a major concern for our oceans and coast.

Indicators outlined in the 2004 KZN SoER have been included in this Report: i) amount of effluent discharged into the marine environment, ii) condition of invertebrate communities near the effluent pipeline and iii) amount of land-based litter.

The coastal environment has been used to dispose of a variety of human-derived waste. Under normal levels, and providing volumes and nutrient loads are not excessive, this is unlikely to result in major impacts. However, high nutrient loading may result in eutrophic and anoxic conditions.

The 2004 SoER found that Durban outfalls' discharge levels fell within the conditions set by their permits. Current trends show a considerable decrease in discharge volumes from the Southern WWTW and a slight increase from the Central WWTW. A slight overall increase in wastewater is anticipated with population growth. However, a significant decrease from the Southern WWTW is more difficult to account for and it is questioned whether wastewater is being disposed of elsewhere.

The impacts of pollution are often estimated through assessing the community structure of soft-sediment bottom-dwelling organisms as they are often sedentary and unable to move away from disturbances. Polluted environments typically show a decrease in the number of species present as well as a shift in community composition to "opportunistic species".

The 2004 KZN SoER was able to access data for two Durban pipelines (wastewater effluent) and the SAPPI SAICCOR (pulp effluent) pipeline. However, only the Durban pipelines (Central and Southern Works) were accessible for this EOR.

The CSIR found that the Southern Works was enriched with particulate organic material, resulting in a change in the macrofaunal community structure in close proximity to the outfall in both 2011 and 2015. The amount of enrichment appears to be increasing gradually and, while not of immediate concern, will require monitoring into the future. The Central Works appears to be operating within assimilation capacity; however, impacts from nutrient enrichment had also started to become evident in both 2011 and 2015.

Coastal debris and litter are a worldwide issue and KZN is no exception. The primary source of litter in KZN is poor waste disposal, which results in litter being washed down rivers and streams before entering the marine environment. Aside from the impact on aesthetics, the economic impacts caused by having to remove it and loss of tourism potential can be significant. Litter is a threat to marine life, with effects ranging from ingestion to entanglement.

A yearly coastal clean-up has been undertaken in KZN since 1996. Ezemvelo records and collates effort data, distance covered and amount of litter collected to allow for a comparison between subsequent years. Trends show an increase in the amount of litter collected if standardised for distance cleaned. A notable increase in the amount of litter occurred in 2013 and 2014, almost doubling the amount of litter collected in previous years. Most litter collected comprises a variety of plastics.

While not assessed in detail in this Report, many emerging issues require consideration in the future.

Seismic surveys are currently undertaken in KZN in the search for oil and gas. A connection between seismic surveys and the impact on marine species, particularly marine mammals, is well established. Although strandings of marine species cannot be directly attributed to seismic surveys, they have been seen to increase over periods

that seismic surveys have occurred. In 2016, ten whales stranded. The fact that seismic surveys were permitted during the period of whale migration along the KZN coast during 2016 is a real concern.

In addition to seismic surveys, future abstraction of oil and gas may result in physical damage to substrata and fauna, disturbance through smothering, pollution events and introduction of alien and invasive species. Currently only four exploration wells have been dug on the east coast, but preliminary data justify further exploration, particularly in the Thukela Basin.

No new effluent pipelines have been constructed in KZN recently; however, with the authorisation of the first desalination plant in Illovo, south of Durban, this will change. Brine produced as a waste product of the reverse osmosis process and cleaning products used within the facility will be pumped directly to sea via a newly constructed marine outfall. The impact of this and subsequent desalination plants needs to be monitored closely.

Aquaculture has been identified for potential economic growth as part of Operation Phakisa. In KZN the Amatikulu Estuary, the site of a historical aquaculture facility, has been identified for expansion and rejuvenation. Aquaculture, while potentially beneficial, can increase environmental impacts and risks and should be closely monitored in the future.

4.9.7 Waste

The state and trends of KZN waste management from 2004 to 2017 are analysed in this section. The KZN SoER of 2004 presented the state of generation, collection and disposal of solid waste, which is now compared with 2017 data. Statistical data provided in the SoER 2004 preceded the promulgation of NEMWA and the creation of the South African Waste Information System (SAWIS). This means that data may not always be comparable between these sources.

Since 2004, waste generation and the recording of these data have increased in the Province. The KZN Waste Information System (WIS) was rolled out in 2007/8; however, limited data on licensed waste activities have been captured in the SAWIS since 2004. The 2004 SoER reported that waste generation had increased from 1 926 000 tonnes per annum (tpa) in 1998 to 1 936 752 tpa in 2004.

From 2004 to 2013 less solid waste was generated compared to that reported in SoER 2004. This is because in 2004 only one licensed waste disposal facility was reporting to the SAWIS and new regulations came into effect between 2008 and 2013. There was a large increase in the number of licensed waste facilities recording data from 2013 onwards. In 2016, the South African Waste Information Centre (SAWIC) reported that the total waste generated was 57 720 464 tpa. The total waste stream generated in 2016 comprised 67% hazardous waste (38 898 677 tpa) and 33% general waste (18 821 787 tpa). This means that between 2004 and 2016, there was an astonishing 3 760% increase in the amount of waste generated. The substantial increase is due to better reporting and monitoring of waste management information as well as an actual increase in the amount of waste generated.

In the 2004 KZN SoER, the average volume of waste generated per capita in eThekwini was reported as approximately 1.2 kg per person per day, while in uMkhanyakude this value was 0.02 kg per person per day (average of urban plus rural is 0.61 kg per person per day). The Department of Environment, Forestry and Fisheries [2012 National Waste Information Report] reports that in 2012 the average (rural and urban) volume of waste generated per capita in KZN was 0.43 kg/capita/per day.

Several problematic waste streams exist in KZN; for example, in many local communities, disposable nappies are a common concern. These nappies are not recyclable or biodegradable and, in rural areas, these are frequently illegally dumped in unlicensed community facilities because no alternative services are available. This contributes greatly to an increase in insects and potential disease vectors, and raises other potential health issues related to water pollution.

The majority of the total waste generated is either recovered or recycled in KZN. In 2014, the disposed waste tpa was much higher, which may indicate inconsistency in the data reported to SAWIC. SAWIC data also indicate that there was a limited amount of waste disposed of post 2012, which indicates limited reporting. However, the overall amount of waste recovered or recycled is increasing rapidly as there is a greater economic market for recyclables.

Waste disposal is the least preferred waste management method in the [waste hierarchy]. The number of licensed waste disposal sites continues to rise with the implementation of NEMWA and its regulations. Waste management licences require that up-to-date records are kept and reported on annually, which is improving the monitoring of received and recycled waste. Illegal dumping still occurs in the Province; however, no consolidated data were available on the number of dumpsites. Thirty-five per cent of households felt that they were experiencing a problem with littering in KZN. Littering can be an environmental risk but is also unsightly and can attract disease vectors and pests such as rats and flies.

The amount of waste being recycled per annum in KZN has been increasing since 2011, to the point where more waste is treated by recovery or recycling than is disposed of. Only 2.8% of households collect waste for recycling and 24% of these households sell their waste. There are many waste pickers who sort household waste prior to waste being collected by a waste service.

Hazardous waste may be incorrectly disposed in general landfill sites or illegally dumped, causing harm to the environment as all hazardous waste must be disposed in a licensed hazardous waste facility. Electronic waste generation is on the rise and electronic waste is considered hazardous waste. Electronic waste is produced by a more affluent population and creates more pressure to have appropriate disposal systems in place or recycling/re-use facilities installed. From 2001 to 2011, the proportion of households owning radios or landline/telephones decreased, while there was a large increase in the proportion of households owning televisions (47% to 67%), computers (7% to 16%), refrigerators (47% to 63%) and cell phones (28% to 88%), with access to the internet increasing from 0% to 34% in the Province. National censuses 2001 and 2011 show an increase in the use of electricity for lighting (61% to 78%), cooking (48% to 68%) and heating (46% to 58%). The increase in use of electricity means an increase in electronic and general goods used in a household that will eventually enter the waste stream.

4.10 Limpopo Province

The following overview of the state of the environment in the Limpopo Province is based on the executive summary of the [Limpopo Environment Outlook Report 2016] and readers are encouraged to read the report for more in depth, fully referenced, information on the state of the environment in the Limpopo Province.

The following Key Challenges were identified by the stakeholders in the extensive public participation process and were confirmed by the scientific and technical process that was conducted as part of the development of the [Limpopo Environment Outlook Report 2016]: Climate Change; Water Resources; Land Transformation; Waste Management; and Environmental Governance.

4.10.1 Climate Change

Climate change is becoming increasingly apparent in Limpopo. The Province faces a predicted increase in temperatures, strong variations in rainfall patterns and a higher frequency of extreme events. Limpopo is perhaps the most vulnerable Province to climate change in South Africa. This is attributed to issues such as poverty, inadequate housing and poor access to services exacerbating environmental change. These issues compound and result in an inability to respond to the disastrous effects of climate change. Observed data indicates increases in temperatures and variations in rainfall across the province, this showing that Limpopo is already experiencing the effects of climate change. The consequences of the extreme events experienced between 2014 and 2015 exposed the lack of preparation of the Province to handle climate variations. The province therefore needs to strengthen climate mitigation and [adaptation] measures. Some notable efforts have been made by the Province in the development of a framework and strategies to address mitigation and [adaptation], but more intervention is necessary. The lack of appropriate changes and improvements in governance, pose severe limits on improving [resilience]. It is expected that the biggest challenge that mitigation and [adaptation] plans face will be the integration and effective implementation at local municipality level.

4.10.2 Water Resources

Water resources in Limpopo show a general decreasing trend. This is largely evident in the increasing demand for water and the insufficient supply available to meet current and future demands. There is a decrease in water resources per capita. The state of water availability, the quality of water available and the ecosystem goods and services supplied by aquatic ecosystems are in decline. This is due to limited available sources, over-utilisation (beyond the ecological reserve) of existing resources and increases in the pollution of the existing sources. Furthermore, the current supply of available and renewable water in the Province is inadequate in relation to rising demand. This will result in restricted socio-economic development and potentially stir conflict between economic sectors.

State and trends:

- Despite positive changes in water management, we now have less water available, of poorer quality.
- Deteriorating water quality is having adverse effects on health in some areas, compounded by the lack of sanitation.
- Climate change is predicted to influence the availability of water in Limpopo.
- Groundwater levels are increasing, but groundwater use has increased dramatically, mainly due to increased irrigation.
- Use of available water resources: increasing, with almost all exploitable sources tapped.
- Freshwater flows: decreasing.
- Water quality: variable, with overall deterioration.
- Salinity levels in surface water: either variable or increasing for sample sites.
- Health of river ecosystems: declining, with effluent pollution continuing to grow.

4.10.3 Land Transformation

There is an increase in livestock, crops, mining, human settlements and forestry leading to increasing transformation of land. Land is the basis of many life support systems, from production of biomass that provides food, fodder, fibre, and fuel for human use, to being an essential natural resource in other respects. A diverse climatic variation within Limpopo, allows the Province to produce a diversity of agricultural outputs, ranging from extensive cattle and game farms to intensive horticultural production. Since agriculture accounts for 90% (11.3 million ha) of Limpopo's 12.6 million ha land area, land represents a critical issue for residents in the Province. This land use reveals the biggest changes over the 24-year span, which was reviewed. To avoid further adverse land transformation, improved management of two key agricultural areas are critical. These include stocking pressure, particularly in areas of land under communal tenure, and the subsistence or small farmer-cropping component. Results from the assessment appear to indicate that grazing capacity is diminishing due to overgrazing and inadequate area availability for current livestock levels. As a result, grassland areas are transforming at a rapid rate. In addition, increased irrigation presents a concern for current and future water resource limitations. From a management and planning perspective, more detailed and regular spatial information is required if detailed planning, monitoring and control is to be successful.

State and trends:

- Land is overexploited.
- Land use is intensifying. The intensification of land use for cultivation is leading to higher overall food productivity, but the increasing population at a rate higher than production may influence future national food security.
- A large proportion of the land is being transformed from natural habitat and most is being used for cultivation.
- The transformation of land, including degradation and desertification, is leading to a loss of biodiversity, productivity, associated ecosystem services and livelihoods.
- Land is degraded and desertification is worsening. Land degradation is seen to be especially severe in communal areas, where it is a serious threat to ecosystem functioning, biodiversity, household food security and rural livelihoods. Degradation of land affects former homeland areas the most.
- The land reform programme is unsustainable and there is a lack of access to land, financial and technical support for beneficiaries of the land reform programme. The land reform programme in its current form is in general not providing substantial benefits to beneficiaries.
- Land degradation: uncertain whether this has increased, because of lack of comparable data.
- Area used for grazing: declined owing to the expansion of settlements and other activities.
- Food production per person: decreasing, notably for maize, the major crop.
- Food productivity per unit land area: increasing, pointing to increased fertiliser use and improved technology.
- Conservation tillage: increasing.
- Land delivered by restitution, redistribution and tenure reform: increased, with the majority of land claims being settled in urban areas.

4.10.4 Waste

The effective management of waste is of critical importance to avoid detrimental impacts on health and the environment and to ensure the protection of rivers and wetlands in Limpopo. The waste management function should be strengthened in view of the problems experienced in the collection of waste and monitoring of the performance of waste disposal sites. Effective work is being done by Local Municipalities in managing solid waste and monitoring through participation in the Green Municipalities Competition. While there are many difficulties associated with waste management in Limpopo, the proper functioning and monitoring of solid waste disposal

sites, and improved waste collection and recycling efforts, can provide significant improvement to the situation. There are no hazardous waste disposal sites in Limpopo and LEDET is currently not monitoring hazardous waste generation, or its disposal.

Thirteen percent (13%) of landfill sites now remain unauthorised with an additional 5% of the sites across Limpopo under application. Waste collection in rural areas requires priority attention. Although monitoring of waste sites for compliance is conducted by the provincial authority, technical capacity and the lack of adequate financial resources limit the effective operation and monitoring of waste sites performance at the local level. There are currently 84 waste facilities in Limpopo, with more general waste sites recently being authorised. The waste received, is being measured at some sites, yet these measurements are often not accurate. There is certainly a growth in the volume of waste being handled in Limpopo, which was estimated at 244 384 tonnes. There are 140 recycling facilities active across Limpopo, yet the amount of waste being recycled is not accurately recorded. There is a general increase in the extent of waste being generated in the Province and an obvious lack of waste management, which responds to the trend. Throughout stakeholder engagements, waste management was raised as a critical and increasingly a key concern across the Province. Increasing incidences of pollution and the negative impacts thereof on human and environmental health and well-being require urgent and proactive responses from government, the private sector and civil society. The degradation of ecosystem health and productivity and the subsequent economic losses will continue unabated if waste management in the Province does not receive top priority.

State and trends:

- Although monitoring of waste sites for compliance is conducted by the provincial authority, technical capacity and the lack of adequate financial resources limit the effective operation and monitoring of the performance of waste sites at the local level.
- Effective work is being done by Local Municipalities in managing solid waste and monitoring such through participation in the Green Municipalities Competition.
- There are challenges in dealing with waste management in Limpopo.
- Waste collection in rural areas is an issue that requires priority attention.
- The proper functioning and monitoring of solid waste disposal sites is a priority.
- Waste collection and recycling efforts should be improved.
- There are no hazardous waste disposal sites in Limpopo.
- LEDET is currently not monitoring hazardous waste generation, or disposal.
- Thirteen percent (13%) of landfill sites are now unauthorised with an additional 5% of the sites across Limpopo under application.
- There are currently 84 waste facilities in Limpopo. More general waste sites have been authorised.
- There is an increase in the volume of waste being generated in Limpopo, which was estimated at 244 384 tonnes.
- There are 140 recycling facilities active across Limpopo, yet the amount of waste being recycled is not accurately recorded.
- There is an increase in the incidences of pollution and the negative impacts thereof on human and environmental health and well-being require.
- The degradation of ecosystem health and productivity and the subsequent economic losses will continue unabated if waste management in the Province is not addressed as a top priority.

4.10.5 Air Quality and Atmosphere

Inadequate ambient monitoring information limits the possibility of making a confident declaration on the outlook for the air quality of Limpopo. However, available information suggests that air quality is acceptable in Limpopo in terms of NO_X. Although no exceedances were observed in the ambient records for SO_2, smelting and fertiliser

manufacturing in Phalaborwa is a high concern for the area. There is also an expected increase of SO_2 concentration in the surroundings of Lephalale during the unabated operation of Medupi.

The main air quality issue found across Limpopo is particulate matter, and the most common source is activities related to mining operations. Areas of concern include Lephalale and Steelpoort. Domestic fuel burning and vehicle emissions were not flagged as major sources on a Provincial scale, yet these are of concern on a local scale and should be investigated. The principal problem, from domestic fuel burning and vehicle emissions, is the low release height, which means very little potential for dispersion. High concentration of pollutants ends up very quickly in the breathing space, increasing the health risk of the exposed population significantly.

State and Trends:

- Air quality: decreasing, in general.
- Health problems, due to air pollution: increasing.
- Vehicle exhaust emissions: increasing.
- Greenhouse gas emissions: increasing.
- Households with electricity: increased.
- Use of renewable energy: increasing slowly, mainly through solar water heating.
- Use of ozone-depleting substances: decreased significantly.
- Concentrations of Persistent Organic Pollutants: unknown and needing to be quantified.

4.10.6 Biodiversity and Ecosystem Health

The progressive transformation of land poses a significant threat to quality of life in Limpopo. The loss of biodiversity priority areas is exacerbated by land being increasingly transformed by various drivers. Once land has become degraded it is unlikely that such land will be returned to its previous ecological function. Continued urbanisation in Limpopo, and associated urban sprawl, as well as a decrease in household size (viz. more houses accommodating fewer people per household) is currently and will continue to place pressure on available and potentially environmentally sensitive land in Limpopo.

The Grassland Biome, associated with some areas of Limpopo, is projected to be under severe pressure, due to climate change. According to the [LCPv2], eight of the 56 vegetation types found in Limpopo are threatened; one of these is considered critically endangered, one is considered endangered, and six are considered vulnerable. There are five threatened ecosystems in Limpopo, namely: Malmani Karstlands, Sekhukune Mountainlands, Sekhukune Norite Bushveld, Blouberg Forest and Mapungubwe Forest. Together these ecosystems make up just over 1% of Limpopo.

Limpopo is 12 587 283 ha in extent of which 10 717 467 ha (85%) is in a natural or near natural state, and 1 869 816 ha (15%) is not in a natural state. Formal protected areas (PAs) cover just over 11% of Limpopo. There are currently 62 formally PAs in Limpopo, totalling 1 367 044 ha, just over 11% of the provincial footprint. The major contributor to this is the Kruger National Park, which contributes 72% to the provincial protected area network (PAN). The current informal conservation area estimate is 561 185 ha. Thus, a total of 1 928 229 ha in Limpopo is currently protected, either formally or informally. This is an increase of 1.87% from 2006 (total of 1 892 123 ha protected in 2006). There are currently three biosphere reserves in Limpopo, namely the Vhembe, Waterberg and Kruger2Canyons Biosphere Reserves, which contribute to the conservation of biodiversity.

There is tension between the need for cultivation that provides food and livelihoods for farmers on the one hand, and the need to conserve valuable natural habitats, ecosystems and ecosystem services. Inevitably, mining activities in Limpopo will, and have already, come into conflict with land management objectives and compatible land uses, as stipulated in the LCPv2, especially in the Sekhukune and Soutpansberg centres of endemism. Of particular concern is the fact that mining applications have been approved in sensitive CBAs and in close proximity to formally protected areas, where mining is explicitly indicated as an incompatible land use. Other land uses,

which may affect CBAs, include urban development, agricultural activities and forestry. Similarly, future planning of such activities must consider the compatibility of the land use in the CBA category in which it is situated.

State and Trends:

- Biodiversity loss: increasing.
- Health of ecosystems: declining, with systems in very poor condition.
- Human pressure on ecosystems: increasing, particularly in areas of high biodiversity.
- Natural resources that support livelihoods: rapidly declining, because of overexploitation, particularly in forests, grasslands.
- Programmes to rehabilitate ecosystems: increasing, including budget increase for Working for Water.
- Rate of spread of exotic invasive plants: increasing faster than the Working for Water Programme can clear.

4.11 North West Province

The following overview of the state of the environment in the North West Province is based on the executive summary of the [North West Province Environment Outlook Report 2018] and readers are encouraged to read the report for more in depth, fully referenced, information on the state of the environment in the North West Province.

The [North West Province Environment Outlook Report 2018] focuses on the environmental condition and associated trends in the North West Province, from 2013 (when the previous SoE was published) to 2018. The topics of air quality, biodiversity, human settlements, land, waste and water, are covered. The report expands and updates the North West environmental reporting for publications dated 1995 (when the first report was published), 2002, 2008 and 2013.

The North West Province lies along the northern border of central South Africa bordering Botswana to the north. The province has a relatively small population relative to the rest of South Africa – the third smallest provincial population – and is home to 3 748 435 people, or 7% of the South African population. The population is unevenly distributed, with several core economic nodes (cities and towns) in the east housing the majority of the province's population. From 2016 to 2017, the population growth rate was 1.72%. and it is forecast to continue at a similar rate. This is roughly in line with the national growth rate (1.6%). The population growth is partially attributed to a positive inflow of migrants seeking employment in the province's mining sector.

The relatively small population results in a low population density (number of people per km^2). The province is consequently largely characterised as rural, similar to the Free State and Northern Cape. Rural areas usually exhibit concentrated economies centred around agriculture, and do not offer a diverse range of economic opportunities and lifestyle choices for residents.

The economy of the province is strongly driven by its natural assets and most of the important economic sectors are built around these. Consequently, the economy is characterised by tertiary industry activities, a significant mining industry (the highest relative share of any province) and small, but important, agricultural and tourism sectors. The mining industry has contributed the largest proportion of the province's Gross Domestic Product (GDP). Indeed, mining (predominantly for platinum resources) accounted for 29% of provincial GDP per region in 2016, nearly double that of the next largest contributor, 'finance, real estate and business services' (15%). Notably, agriculture and manufacturing have remained limited, whilst tertiary sector activities have increased gradually, driven by a declining mining industry.

Interestingly, agriculture plays a smaller role in the North West than in most of the other provinces in South Africa, with the exception of Gauteng and Limpopo. However, agriculture is still crucial for the province's economy in terms of employment and food security. Furthermore, it remains important in the North West due to its spatial extent. The northern and western parts of the province are well-known for livestock farming, including cattle, sheep and game. The province is also the biggest contributor to the poultry industry in South Africa. The eastern and southern parts produce a wide variety of crops including maize (corn), sunflower, tobacco, cotton, and citrus fruits. There are also specialist niche crops grown such as cut-flowers (roses), as well as various vegetables such as mushrooms, cabbage and carrots.

4.11.1 Land, Agriculture and Heritage

Although the conversion of substantial portions of natural areas to cultivation agriculture is no longer prevalent, human settlements and mining areas are expanding at an increasing rate. This intensifies the effects of the loss of natural areas as it affects an increasing number of vulnerable people living in urban areas. There is no clear evidence of planning interventions resulting in positive change, despite the conservation estate expanding on paper and more international recognition for environments of universal value. Much also still needs to be done to reverse a situation of under-capacitated authorities and on-going resource degradation in terms of heritage resources.

In 2008, serious concerns emerged with regards to land degradation in the form of erosion and bush encroachment, as well as desertification. These were not echoed in the 2013 North West Environment Outlook which identified

land transformation, especially in the more populous eastern and southern parts of the province, as a major threat to sensitive or valuable ecosystems, as well as environmental and heritage resources. Agriculture was also identified as a sector that should play a strong custodianship role in respect to its spatially dominant nature.

Indicators of Change	Current State
Change in Land Use Change in Land Cover Land Degradation Land use conflict	Refined analysis shows 49% remain natural (as compared to 56% in 2013) 41% transformed vs. 30% in 1990, of which 35% is now under cultivation and 4.2% settlements Average rate of change since 1990 is 1.21% per year, with the current rate only 0.2% per year Urban expansion (up from 1.8% in 1990 to 4.2% in 2014, at a rate of change of 3.7% per year) Cultivation agriculture has increased (28% in 1990 vs. 35% in 2014, at a rate of change of 1% per year) 2 575 km^2 became urban since 1990, of which 351 km^2 was cultivated area and 2167 km^2 was natural No quantitative data on land fragmentation No quantitative information on land degradation Steady increase in woody vegetation at the expense of grassland Conflicts between mining and conservation (Pilanesberg-Madikwe corridor) remain Conflicts remain between mining & urbanisation vs. agriculture
Agricultural land	In 2014/15, 21 881km^2 mapped as active cultivation, with the bulk (18 211km^2) represented as rainfed crops or pastures 2% of provincial GDP and 4.8% labour Dominant agricultural products in the North West are maize and sunflowers 15% to 20% of South Africa's maize crop 13 475km^2 of the province (13%) has 'moderate to high' to 'very high' capability 70 921 km^2 (68%) offering stocking rates between 5 and 10ha/Large Stock Unit (LSU) In 2016, cultivated field crop area reduced by 52% of maximum recorded since 1986 167 780 households indicated involvement in agriculture in 2016 vs. 214 049 in 2011, a decline of 22% Highest number of agricultural households are involved in animal husbandry Most agricultural households involved in cultivation practices dryland cultivation On-going year-on-year drop in livestock numbers Some examples of agricultural land mismanagement (bush encroachment, over-utilisation, erosion) present
Heritage resources	New struggle history sites added to resource list Sites often destroyed by reuse of materials Taung site upgrades still on-going Limited provincial resource management capacity No consolidated list of heritage resources

4.11.2 Biodiversity

There is no serious on-going depreciation in terrestrial fauna biodiversity, although quality and extent of biodiversity does fluctuate across the province. However, there are serious concerns about the state of water-related resources and aquatic ecologies. Many systems are degraded and under pressure from over-exploitation and/or pollution. There is also a need to further expand on surveillance programmes, to maintain a consistent record of biodiversity in the province. The under-capacitated authorities struggle to maintain proper inventories, which likely obscure on-going degradation of biodiversity.

The North West Province contains a rich biodiversity, with as many as 2 300 indigenous plant species and 120 mammal species recorded in the province. However, when comparing the North West to other provinces such as the Western Cape with high levels of endemism, the importance of biodiversity in the province is often overlooked. The natural environment, and specifically sensitive species and ecosystems, is under threat in the North West, not only by industrial and economic activities such as cultivation and mining, but also due to extraction, and the use of natural products related to high levels of poverty and unemployment.

Indicators of Change	Current State
Vegetation types	Overall level of transformation is 41%. Cultivation (croplands) represent around 35% of the transformation, and settlements 4.2%. Some vegetation types severely transformed (Western Highveld Sandy Grassland at 91% transformed) 41 national vegetation types of which 12 are endangered and 8 are endemic All the endemic vegetation types, except Pilanesberg Mountain Bushveld, are poorly protected, despite some being classified as Vulnerable. Part of the Griqualand West Centre of Endemism Rate of habitat loss in the North West is on average 0.2%
Biodiversity planning	Protected Areas, Critical Biodiversity Areas and Ecological Support Areas cover 59% of the province
Conservation status	21 formal Protected Areas 15 protected areas managed by the North West Parks Board cover 1.94% (2 030 km^2) of the province Total conservation estate is 2 363 km^2 (2.25%) All the endemic vegetation types, except the Pilanesberg Mountain Bushveld, are poorly protected 1 Ramsar wetland (Barberspan), 3 UNESCO World Heritage Sites (Taung, CoH, Vredefort Dome), 2 new Biosphere Reserves (Magaliesberg and Marico) Six Important Bird Areas overlap with the North West Province - of the total threatened avifaunal species recorded for the North West, 69.2% are present in Important Bird Areas
Threatened species, ecosystems and habitats	20 Threatened and 14 Near Threatened plants 14 South African endemic plant species (species that are confined to a certain geographical area) of which 7 are endemic to North West Province. Number of threatened species of mammals, avifauna, reptiles, frogs, butterflies and arachnids remain stable but some changes are due to national reclassifications Threatened and other protected game species in protected areas are largely stable, with no steep increases or declines.
Aquatic ecosystem health	On-going refinement of wetland mapping and classification means that it is not possible to provide reliable analyses of trends such as wetland degradation or loss

	Concerns about poor aquatic ecosystem health status highlighted in 2013 remain 15 687 wetlands units, of 24 types, and 21% of wetlands are in protected areas Land cover analysis shows transformation of 17 903ha of wetlands between 1990 and 2014 for cultivation, 379ha for mining and 3 763ha for settlements. 978ha of wetlands have been converted to tree cover through processes such as bush encroachment or conversion to plantations. This constitutes a disconcerting 61% (23 393ha) of the wetland footprint present in 1990. The majority of aquatic ecosystems in the province are 'moderately modified' (Present Ecological State=C). Drainage region C2 (south-eastern mining belt) is the only catchment area which contains a river that is 'critically modified' (Present Ecological State=F), whereas drainage region A3 (Zeerust to Madikwe), was the only drainage region with a section of river with a Present Ecological State of A (unmodified or natural). The largest number of 'seriously modified' (Present Ecological State=E) rivers were recorded in drainage regions C2 and A2 (the main mining regions)
Alien and invasive species	The Domestic Cat, Fallow Deer (Category 2), Red River Hog and Wild Boar (Category 1b if feral) are exotic mammal species known to be present In terms of plants, 5 category 1a, 67 category 1b, 10 category 2 and 6 category 3 Invasive Alien Species are present. Unfortunately, these numbers cannot be directly compared to previous reporting years, due to changing classifications and a lack of consistent repeat surveys. There are no known alien freshwater invertebrate species, but 7 alien freshwater fish species.

4.11.3 Water Resources

Water quality issues are a problem, not only in the North West Province but also the country as a whole. Recently there have been certain improvements, but some indicators continue to exceed acceptable levels. Elevated *E.coli* concentrations, an indicator of inadequate waste water treatment, is a persistent issue. Dam water quality still faces severe risks of eutrophication due to poor waste water treatment, as well as poor land use management.

Water resources, and how we consume this finite resource, has taken the forefront of most conversations in South Africa over the recent years, due to the persistent drought conditions that have plagued the country. The North West has not escaped these pressures, and there is now a concerted effort to find methods to maximise the water that is available.

Water governance in South Africa is aligned to catchment boundaries, rather than provincial or municipal boundaries. As a result, parts of three primary catchment areas are present in North West Province, with rivers draining towards the Limpopo (Region A), Vaal (Region C) and Orange (Region D) rivers.

Indicators of Change	Current State
Water availability	Dam levels stable at nearly full capacity for large dams, highly variable for irrigation dams and affected by multi-year droughts Water resource use data is not available so can't be compared to 2013
Dam water quality	Short dataset Most dams at significant to serious risk of eutrophication, the same as in 2013
Surface water quality	Dissolved Major Salts - improving, generally at Target Water Quality Range (TWQR) Sulphate (SO_4) concentrations within the TWQR except for Catchment C2 (Dr Kenneth Kaunda)

	Chloride (Cl) concentrations within the TWQR Nitrate/Nitrite (NO_3/NO_2) concentrations all below the TWQR but fluctuating Ammonia (NH_4) concentrations in catchments C2, C3, C9 and D4 significantly above the TWQR (agric & mining) Phosphate (PO_4) concentrations within catchments C2 & C3 (marginally) and D4 (substantially) above the TWQR (C4 = Northern Section of Dr RSM DM) E.coli concentrations consistently above TWQR where data is available Electrical Conductivity concentrations are all within the TWQR PH levels fluctuating but within the expected levels for aquatic and human health
Groundwater	95 of 378 groundwater monitoring points are active Most of the parameters are below the TWQR for DMS (in most catchments) and Nitrate and Nitrite concentrations (exceptions in catchment C3 - Harts River) Lowering groundwater level throughout the province during the drought of 2015-2016, but recovery thereafter. However, some areas show continued water level lowering such as the Tosca Dolomitic Aquifers and the Vryburg, Delareyville, and Schweizer-Reneke areas
Drinking water quality	Blue Drop score for North West substantially declined from 79% in 2012 to 63% in 2014 Recent data not available Scores vary, but many systems show decline in performance and output quality
Wastewater treatment	In 2013, 11 plants were considered critical risks and by 2014, 26 plants were reported as critical risk plants Recent data not available Little to no effort to comply with standards
Non-revenue water	No data

4.11.4 Air Quality

The main concern with air quality remains particulate matter (PM), emanating from mine tailings (68 310 tpa), industrial emissions (43 026 tpa) and domestic fuel utilisation in dense low-income settlements (1 176 tpa). Despite being the lowest emissions mass, the concern with domestic fuel use is the immediacy of human exposure. This is not to say that other emissions are not important, simply that in terms of threats to human health, it is PM that is the greatest air quality risk, as highlighted in the report.

Indicators of Change	Current State
Ambient air quality	Risks, in order of severity: PM_{10}, SO_2, NOx, lead and benzene Episodes of high PM concentrations throughout the province, a deterioration since 2013 4 of 7 monitoring stations show repeated National Ambient Air Quality Standards (NAAQS) PM_{10} exceedances for 2015-2017 No SO_2 concern (same as 2013) No NO_2 concern (same as 2013)
Air pollution monitoring	7 provincial monitoring stations, as well as many others placed in priority areas Improved monitoring data

Point source pollution	Driven by emissions from Listed Activities, biomass burning, mining and agriculture Much higher emissions in the mining (and associated industry) Districts of Bojanala Platinum, Ngaka Modiri Molema and the Dr Kenneth Kaunda.

4.11.5 Waste

There have been improvements in waste management since 2013, with waste removal services reaching more households. However, it is still a challenge to service particularly dispersed rural areas due to the great distances between settlements, and lack of resources available to local waste officials.

Importantly, a full and comprehensive understanding of the waste situation remains elusive, as monitoring and reporting systems are not yet dependable. Apparent growing volumes of waste is a cause for concern, especially considering that hazardous waste generation is projected to continue to rise considerably by 2021. However, conclusions cannot be made, as these trends may be as a result of reporting irregularities.

Progress has been made with the completion of a range of waste management plans. It is hoped that the implementation of these plans will improve the quality of service, monitoring and reporting within the waste industry.

Since 2013, registered waste generators, particularly those in the private and mining sector, have improved their reporting of hazardous waste volumes to the South African Waste Information System. Unfortunately, the lack of financial and human resources has resulted in municipal departments not uploading domestic waste volume data onto the South African Waste Information System, limiting the value of the data. Despite the many shortcomings, challenges and the uncertainty regarding waste stream data, many positive legislation, policy and practice related shifts are underway. Furthermore, many projects and plans have been put together that are based on an understanding of the challenges in the province, as well as the needs of the people in this province.

Indicators of Change	Current State
Waste handling facilities	26 operational landfill sites and 40 closed/issued with a closure license 15 operational transfer stations (compared to 6 in 2013), 3 buy-back centres, 2 operational garden refuse stations, and 2 transfer station facilities are planned and awaiting construction. No information on available capacity
Waste volumes and minimisation	Increasing volumes are a function of reporting systems, and the fluctuation quality thereof Total waste volumes peaked in 2017 (2 123 014 tonnes), with the largest percentage contribution being hazardous waste (57.1%) (total estimated volume was 1.2 million tonnes in 2017) Significant proportion considered hazardous (mining waste) Waste diversion tracks increasing waste volumes Volume of waste recycled and/or recovered in the North West has increased steadily from 150 260 tonnes in 2013 to 477 159 tonnes in 2017 No clear trend in hazardous waste treatment
Waste management systems	2nd generation Provincial Integrated Waste Management Plan was developed District Integrated Waste Management Plans are in place, but some to be updated Most local Integrated Waste Management Plans are absent or still in draft form

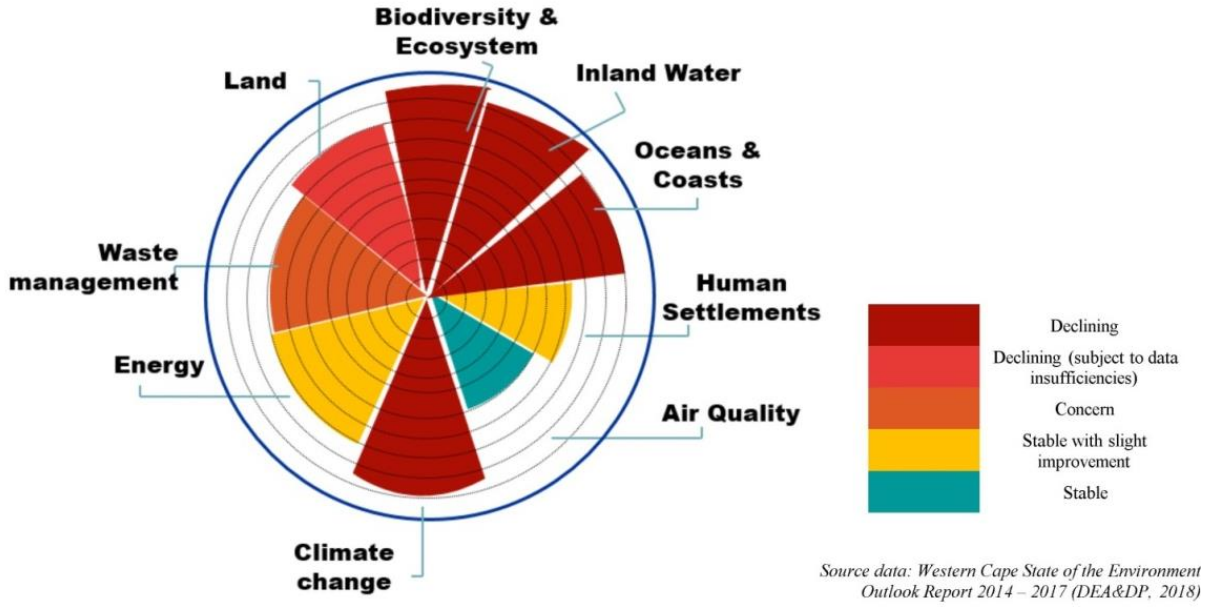
4.12 Western Cape Province

The following section is an edited extract of the [Western Cape State of Environment Outlook Report 2018: Key Synthesis] report and readers are encouraged to read this report and the full and unabridged [Western Cape State of Environment Outlook Report 2018 (SoEOR 2018)] for more in depth, fully referenced, information on the environment in the Western Cape Province.

4.12.1 Key Messages

The Western Cape State of Environment Outlook reporting period 2014 – 2017 [(SoEOR 2018)] coincided with a drought that was the region's worst in recorded history. The province has been experiencing an inordinate number of, so-called, 'natural disasters' — the frequency and intensity of fires, floods and droughts has increased significantly over the past two decades. The province is also home to 75% of the country's threatened plant species. Persistent pressures from changing conditions are not only putting the province's unique biomes, but also communities and economy under strain. Reporting on the Western Cape's 'state of the environment' in this critical period could not have highlighted the urgency of our declining environmental trends in a more pronounced way – not only how it affects everyone in society, but also our collective roles in stabilising and improving declining environmental trends. With such a sudden loss of natural resources, the interdependencies between society, economy and environment become clear. The estimated economic impact of the recent and on-going drought is R50 billion (current estimate), impacting all of the Western Cape society and with specific impacts on the vulnerable poor communities and individuals employed in the agricultural sector. Natural disasters are adding significant stress to the province's economy, which is particularly vulnerable to the impacts of climate change given its high reliance on natural resources. In the midst of disaster, risk management responses are usually met with urgency. However, the United Nations Sustainable Development Goals (SDGs) are our reminder to act now – ahead of "slow onset disasters" that will equally affect people and planet. This is underscored by the current state and trends of the environmental and social themes reported on in the Western Cape State of the Environment Outlook report for the period 2014 – 2017.

The overall declining outlook of the Western Cape's natural resources equates to unsustainable pressure on the province's natural systems. The [SoEOR 2018] reports on the identified drivers that are fuelling these declining trends. These are categorised according to four large-scale groups namely socio-economic, biological, anthropogenic or governance drivers.



Source data: Western Cape State of the Environment Outlook Report 2014 – 2017 (DEA&DP, 2018)

4.12.2 Key Trends

The diagram above summarises the outcome of the report: the socio-economic themes of the province are stable to improving, whilst the biophysical themes are declining.

4.12.3 Land

Indicator	Key Quantifications	Target	Trend
LAND: INSUFFICIENT DATA BUT APPEARS TO BE DECLINING			
Land cover	• 65.2% natural • 33.5% transformed (16.8% degraded, 15.1% agriculture, 0.9% urban, 0.6% plantations)	• Protect natural land cover • Prevent further land transformation	Declining 
Land capability	• No high value agricultural soils – agriculture is therefore vulnerable and require high inputs	• Sustainable agricultural practices that enhance/protect/make use of the (poor) value of existing agricultural soils	Insufficient Historical Data 
Land transformation	• Decrease in extent of cultivation by 3.5% • 16.2% more degradation	• Prevent further degradation	Declining 

Land is a critical resource for mining, agriculture, urban development and transportation, and fundamental to the "sense of place" of the province. The loss of land to agriculture, land degradation, habitat fragmentation and the loss of ecological services all impact on the sustainability of the province, as well as food security, poverty and livelihoods. Land is therefore a critical underpinning for much of the State of Environment Outlook.

The Western Cape comprises 10.6% of the country's total land area and has a highly urbanised population. The growing population, an increasing number of households, and decreasing household sizes all contribute to the pressure on land resources. Between 2011 and 2015 alone, about 150 000 people migrated to the Western Cape. Historical dispossession and forced removal prior to 1994 have resulted in inequitable access to land and resources as well as insecurity of tenure for a large proportion of the population, particularly in agricultural and rural areas.

Changes in land use and land cover have substantial impacts on the environment. Land cover in the Western Cape is still mostly classified as natural (65.2%), with most urbanisation and anthropogenic activities occurring along the coast.

Urban zones are concentrated in and around the city of Cape Town, Cape Winelands and Mossel Bay. Forestry is common in Eden, the Overberg and, to a lesser extent, in the Cape Winelands.

The state of land in the Western Cape is ascertained by measuring the three land indicators (see below) and determining how they have changed over time. Ultimately, how land is managed and used determines its underlying state. As was the case in the [2013 SoEOR], land capability and transformation data has not been sufficiently updated to accurately detect trends.

4.12.3.1 Land cover

Land-cover change, which reflects an underlying change in land use, is an indicator for the condition of land and biodiversity. A substantial percentage (33.5%) of the Western Cape's land cover is transformed. Growing pockets of sheet and gully erosion are visible over the central Western Cape, while land degraded by mining is also visible along parts of the West Coast. Improvements are seen in (control of) alien invasive vegetation across the province. However, there are still conspicuous encroachments near human-settlements.

Trends in land cover change are, however, difficult to assess due to data limitations. Three land cover layers are available for South Africa, for 1994/5, 2001 (CSIR) and 2009 (SANBI). The data layers cannot be accurately compared, as there are differences in the definitions and number of land cover classes as well as data mapping scales.

4.12.3.2 Land capability

Land capability has been defined as the ability of the soil resource to effectively carry its respective land use. It is a valuable tool in land use planning, and indicates the best use for the land according to capability classes.

Opportunities for agricultural expansion in the Western Cape are limited, as much of the land in the province is regarded as being unsuitable for cultivation and further restricted by poor access to irrigation water, particularly in the fruit sector. In fact, cultivated land reduced by 3.5% between 2009 and 2014. Here, the land capability indicator can be used to determine the optimal land use in the province, without compromising or further reducing the capability of the land resource.

4.12.3.3 Land transformation

Land transformation is caused by agricultural activities, urban expansion and degradation and is largely driven by land use. There has been a reported substantial increase in land transformation (the conversion of land, normally from natural habitat to anthropogenic uses) between 2009 and 2014 in the Western Cape.

The Central Karoo remains the least transformed district in the province.

However, overall, the Western Cape is still largely natural and untransformed, with the greatest instances of transformation focused in Cape Town and other coastal nodes.

4.12.4 Biodiversity and Ecosystem Health

Indicator	Key Quantifications	Target	Trend
BIODIVERSITY AND ECOSYSTEM HEALTH: DECLINING			
Ecosystem threat status	• Increase in threat status for some vegetation types due to habitat loss	• Maintain or reduce the threat status	Declining 
Ecosystem protection level	• 43 ecosystems well protected (up by 8) • 21 moderately protected (up by 12) • 56 poorly protected (down by 20) • 43 not protected (up by 15) • Additional 24 214.5 ha protected	• Increase protection category of all ecosystems • Increase total extent of areas formally protected	Improving 
Biodiversity priority areas	• Loss of 19 270ha of CBAs1	• No loss of CBAs and increase in CBAs secured in protected areas	Declining 
Habitat degradation	• 16.2% increase in degraded land between 2009 and 2014.	• Reduce the extent of degraded land	Declining 
Species threat status (Species)	• 50 species have higher IUCN Red List threatened status (mainly in Critically Endangered and Endangered categories) • 58 species have improved in IUCN Red List threatened status	• Reduce the Red List status of species	Declining 
Alien invasive species	• Lack of appropriate comparable data	• Reduce density and distribution of alien invasive species	Insufficient data 

Biodiversity in the Western Cape is immensely rich at a global scale. Two global biodiversity hotspots, namely the [Cape Floristic Region] and the Succulent Karoo, are located in the province. These are all Centres of Endemism, i.e. sites of global importance based on their high endemism and species richness, and which are under immense pressure from human activities. This richness is primarily due to the estimated 13 489 plant species in the Western Cape, roughly 56% of the floral species in South Africa. There are six biomes in the province, namely Fynbos, Succulent Karoo, Nama Karoo, Forest, Albany Thicket and Grassland.

The extent of biodiversity (original extent of ecosystems) in the province is further reflected by the 174 different ecosystems present, although the presence and distribution of these varies between the districts.

4.12.4.1 Ecosystem threat status

Ecosystem threat status indicates the degree to which ecosystems are still intact or, conversely, losing vital aspects of their structure, function and composition, on which their ability to provide ecosystem services ultimately depends.

Since 2011, the ecosystem threat status of eight ecosystem types in the Western Cape has increased, primarily due to habitat loss. Three additional ecosystem types have been classified as Critically Endangered, taking the total number to 24.

4.12.4.2 Ecosystem protection levels

Ecosystem protection levels are determined on the basis of the percentage of the biodiversity target for each ecosystem in Type 1 protected areas (i.e. National Parks, Provincial Nature Reserves, Local Authority Nature Reserves and DAFF Forest Nature Reserves). A total of 43 ecosystems were well protected in Type 1 protected areas in 2017, an increase of 8 from 2011; 21 ecosystems were moderately protected in 2017, an increase of 12 from 2011; 56 were poorly protected in 2017, a reduction of 20 from 2011 and 43 ecosystems were not protected at all in 2017, an increase of 15 from 2011.

This analysis showed that the majority of ecosystems in the province were either poorly or not- protected (99 out of 150), a worrying statistic for a province so richly endowed with biodiversity.

4.12.4.3 Biodiversity priority areas

Priority biodiversity areas in the province include terrestrial Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs) and Freshwater Ecosystem Priority Areas (FEPAs).

CBAs, ESAs and FEPAs ensure that (portions) of all ecosystems in the province are conserved.

In addition, the FEPA's, mostly in mountainous and high yield water areas, play a vital role in providing large amounts of excellent quality water.

The 2017 Western Cape Biodiversity Spatial Plan is the first province-wide plan to have been developed. The land-cover data for the 2014 plan was derived using a different classification system. As a result, it was not possible to assess the extent of loss of Biodiversity Priority Areas between 2014 and 2017 using directly comparable datasets.

However, a total of 19 270 ha of CBAs were lost between 2011 and 2014.

4.12.4.4 Habitat degradation

Habitat degradation due to both natural and human-induced erosion in the province increased by 16.2% between 2009 and 2014.

4.12.4.5 Species threat status

The Red List status of species across all categories has worsened, including 50 indigenous species since 2011/12, particularly within the Critically Endangered and Endangered categories. A total of 58 species have improved conservation status since 2011/12.

The province's unique aquatic diversity is increasingly under threat, with the prime threats being invasive fish and plant species, excessive water abstraction during the dry season, pollution and damage to river banks and floodplains.

4.12.4.6 Invasive alien species

Invasive alien vegetation is thought to cover approximately 1.8 million hectares nationally, with the highest concentrations found in the south-western, southern and eastern coastal belts and the adjacent interior. Invasive alien species present a number of challenges, including higher levels of surface and ground water uptake leading to reduced water availability, increased fire risk and intensity, out-competing of indigenous species resulting in natural habitat loss, and increased erosion of topsoil, amongst others. Invasive alien plants are an extensive problem in the province despite massive efforts to control them. The province also has 17 invasive fish species, of which 10 are from outside South Africa, five from outside the province and two are native to the province, but have extra-limital populations in the province.

4.12.5 Inland Water

Indicator	Key Quantifications	Target	Trend
INLAND WATER: DECLINING			
Water availability	• Western Cape declared a disaster area due to severe drought. • 12 % of towns have inadequate yield • 27% of towns exceed water supply allocation • 12% expect a deficit in 0 – 5 years • 49% expect a deficit in > 5 years • Insufficient water supply in WCWSS by 2018	• No unsustainable abstraction • Adequate water supply for all towns	Declining
Water quality fitness for use	• Fitness for use at river monitoring stations: o 13% ideal o 30% acceptable or tolerable o 57% intolerable o 26 stations have extremely high levels of microbial contamination	• No intolerable water quality • No stations with extremely high levels of microbial contamination	Declining
Freshwater ecosystem health	• Ecological state of rivers (PES): o 21% unmodified, natural o 28% largely natural o 17% moderately modified o 26% largely modified o 6% seriously modified o 1% critically or extremely modified	• No freshwater systems seriously or critically modified	Declining

The Western Cape is a water scarce area with a growing population that both depends and places pressure on inland water resources and ecosystems. In the face of increasing water scarcity, water [resilience] is recognised as a provincial priority.

The Western Cape is currently experiencing an extended drought and the province has been declared as a disaster area, while the substantial population growth in the province in recent years has placed significant additional pressure on available water resources.

According to projections, climate change will increase average temperatures and possibly lower annual rainfall in the Western Cape. The on-going drought makes it increasingly apparent that the Western Cape, particularly the western parts of the province, are likely to experience the projected effects of climate change, with potentially dire consequences.

The state of most inland water is poor with poor water quality in many locations, over-abstraction and extensively damaged ecosystems. While many towns currently have sufficient water to meet their needs, a number already have a water deficit. With increased demand and reduced rainfall, more towns are likely to go into deficit in the absence of adequate planning and implementation of demand management and alternative water supply projects, given present over-reliance on natural surface water resources. More than half the monitoring stations in catchments are recording “intolerable” water quality at times and invasive alien vegetation is having a substantial impact on surface and groundwater resources.

The quality of inland water resources (in terms of salinity and eutrophication) is rarely ideal and frequently intolerable in all catchments in the Western Cape, particularly the Berg River catchment. In other words, inland water is generally not fit for agricultural or industrial use and deleteriously affects aquatic ecosystems if untreated. Water for domestic purposes is treated to the required water quality standards by water service providers (typically the local authority). The majority of the population in the Western Cape is located in and around urban nodes. Urban nodes directly impact streams and other inland water ecosystems through the process of land transformation. Pressure is placed on inland water quality through contaminated stormwater, from commercial properties, and urban and semi-urban settlements.

4.12.5.1 Water availability

Due to persistent drought, the Western Cape was declared a disaster area on 22 May 2017.

Consequent direct and indirect economic losses are estimated to amount to billions of Rands. Crop losses, for example, have been as high as 50% to 100% in the West Coast District Municipality. The Western Cape is very dependent on surface water resources, which are vulnerable to droughts. A greater diversity of supply options, as well as decentralisation of options, might provide better [resilience] to drought.

4.12.5.2 Fitness for use

Fitness for use is not a simple measure of water quality because it considers both water quality and the intended water use. As mentioned above, inland water is generally not fit for agricultural or industrial use.

4.12.5.3 Inland water ecosystem health

A semi-quantitative approach to assessing ecosystem health is to measure Present Ecological State (PES), based on the response of instream and riparian biota to human influences that change the integrity of habitats (for example, hydrology, geomorphology and chemical variables). The PES values show that over 20% of rivers (by length) in the Western Cape are largely or seriously modified and only 50% of rivers are natural or largely natural (category A or B). Fortunately, only a small percentage of rivers are critically modified, mostly in the Berg River catchment.

4.12.6 Oceans and Coasts

Indicator	Key Quantifications	Target	Trend
OCEANS AND COASTS: DECLINING			
Coastal water quality	• Increase in Blue Flag Beaches from 18 to 31 indicative of good coastal water quality.	• Coastal water quality compliant with relevant standards	Improving
Estuary health	• 4% of estuarine areas in good or excellent condition • 95% of estuarine areas in fair condition • 1% of estuarine areas in poor or non-functional condition.	• No non-functional estuaries • No decline in estuary health	High concern
Conservation areas	• 9 MPAs • Persistent challenges • Increased recognition of management functions	• Increase in extent and good management of MPAs	Data not comparable
Marine area threats	• No change to critically endangered and endangered marine habitats	• No increase in threat status	High Concern but no change
Transformation of threatened ecosystems in coastal belt	• Loss of 2000 ha of threatened ecosystem in the coastal belt between 1990 and 2014	• No loss of threatened ecosystems in the coastal belt	Declining
Buildings in high risk coastal areas	• 40% increase in number of buildings in high risk coastal zone between 2006 and 2013	• No increase in number of buildings in high risk coastal zones	Declining

The Western Cape's 1 000 km coastline is the longest of South Africa's four coastal provinces, with roughly one third of the boundary of the Western Cape bordered by the sea. The province is home to approximately six and a half million people, accounting for approximately 11% of South Africa's total population, a significant figure considering that the majority of people in the province live within 25 km of the coast.

Biophysically, the coastline of the Western Cape consists of sandy beaches interspersed with occasional rocky outcrops, headlands and wave-cut platforms, with a number of important estuaries and coastal lakes. Principal development nodes along the Western Cape coast include Cape Town, Saldanha Bay, George, Knysna, and Plettenberg Bay, while important ports are located at Cape Town, Saldanha Bay (one of only two deep-water ports in South Africa) and, to a lesser extent, Mossel Bay.

Given that coastal areas are desirable locations for settlement, industry, harvesting of natural resources as well as human recreation, pressure on these unique environments is intense. These pressures range in scale and magnitude and include global climate change, interruption of dynamic coastal processes, the introduction of alien invasive species and the effects of multiple anthropogenic discharges of waste and toxins into rivers and the ocean.

Climate variability and change is one of the biggest threats to South Africa's coastal regions. Sea level rise in combination with increasing storm frequencies and intensities, wind velocities and local conditions presents a significant threat to the coastline. Over 80% of South Africa's coast consists of sandy shores and is therefore highly susceptible to erosion.

4.12.6.1 Coastal water quality

The Blue Flag programme is a voluntary international initiative aimed at standardising and promoting world-class clean, safe and attractive beach environments. A substantial increase in the number of Blue Flag beaches in the Western Cape indicates both an increased interest in monitoring coastal water quality as well as in increase in the number of beaches achieving the required water quality standards – which would be indicative on improved water quality in these areas.

4.12.6.2 Estuary health

The Western Cape's large, permanently open estuaries are (on average) in a fair state, while the temporarily open/closed estuaries vary from a good to poor condition depending on the level of pressure on them. The estuaries along the West Coast are generally in a fair to poor state due to flow reduction, pollution and - in the case of the large systems - fishing pressure. Most small temporarily open/closed estuaries around Cape Town are generally in a poor condition, while estuaries along the south and south-east coast tend to be healthier than those in the rest of the country, with the exception of those around Mossel Bay.

4.12.6.3 Conservation and protected areas

South Africa has 25 designated Marine Protected Areas (MPAs), of which nine are in the Western Cape Province, in three different inshore bioregions. At a national level the focus for the expansion of offshore MPAs has been largely supported by Operation Phakisa.

Research and planning continues and the expansion of the South African MPA network is imminent, with 18 new MPAs proposed.

Draft Notices and regulations for the expansion and rezoning of three MPAs in the Western Cape (Betty's Bay, Robberg and Goukamma MPAs) were released for public comment in July 2017.

4.12.6.4 Marine ecosystem threat status

Critically endangered habitats are distributed predominantly along the West Coast nearshore, Eden and Overberg offshore areas, as well as the continental shelf edge, owing to high levels of multiple pressures in these areas. Endangered areas are concentrated between Langebaan in the northwest and Cape Agulhas in the southeast, while vulnerable coastal and benthic habitats stretch from Cape Town to the Knysna area, often for vast distances offshore.

4.12.6.5 Transformation of threatened coastal ecosystems

Within the Western Cape, approximately 12.5% of the province consisted of threatened terrestrial ecosystems in the coastal belt in 2009, of which 23.2% were categorised as critically endangered, 9.5% as endangered, and 67.2 % as vulnerable.

Over 2 000 ha of threatened ecosystem in the coast belt (within 1 km of the shoreline) has been lost to urban development between 1990 and 2014.

4.12.6.6 Number of buildings in high-risk coastal areas

Between 2006 and 2013, there was an approximately 40% increase in the total number of buildings in high risk coastal areas in the province with the greatest increases observed in the West Coast (46%) and Overberg (58%) districts. The Overberg District has by far the fewest buildings in the high risk coastal zone (under 3% of the buildings in the high risk zone in the Western Cape), with by far the most buildings in the high risk zone being in the West Coast District (48%). CCT and Eden District have 29% and 20% of the buildings in the high risk coastal zone respectively.

4.12.6.7 Exploitation of fish species

Populations of commercially exploited fish species are conventionally reported as being "collapsed, overexploited, optimum exploitation, under-exploited or unknown". The percentage of overexploited fish species has decreased between 2012 and 2014, indicating some recovery of selected species' stocks.

Ongoing monitoring of species' stocks remains important.

The percentage of linefish species (targeted by recreational anglers) considered "collapsed" has increased between 2013 and 2016.

4.12.7 Air Quality

Indicator	Key Quantifications	Target	Trend
AIR QUALITY: STABLE WITH SLIGHT IMPROVEMENT			
Atmospheric pollutants	• Particulate Matter (PM_{10}) – below SA National Ambient Air Quality Standards (NAAQS) and indicates a steady decline.	• Comply with the NAAQS, with steadily declining emission rates and ambient concentrations across the province.	Improving
	• Nitrogen Dioxides (NO_2) – below SA NAAQS; however no visible trend • Sulphur dioxide (SO_2) – below SA NAAQS with key hotspot areas. • Greenhouse gases (GHG) – increase in levels but stable per capita.		No change
Air Quality Management at District Level	• Increased commitment to air quality related matters – complaints registers, Air Quality Management Plan updates, Air Quality Forums, By-Laws, Air Quality Officer appointments); and • Increased number of monitoring stations.	• Continual commitment to air quality issues in the Province	Improving
Key atmospheric pollutants per district	• CCT: improving • All other districts: No change		No change

Air pollution is often only considered as an urban or industrial problem, however, it readily disperses and has the potential to affect large areas and spill over into rural districts.

Anthropogenic activities, when combined with environmental conditions, are one of the primary drivers of deteriorating air quality. Key sectors and activities leading to air pollution include transportation, industry, residential uses and commercial activities, which generate airborne pollutants primarily through combustion processes that release gaseous emissions into the atmosphere as well as fugitive emissions from industrial processes or the built environment. Key sources of emissions in the province include: The transport sector, which is the largest consumer of energy (due to reliance on private vehicles) and the second highest contributor of GHG emissions in the province. Traffic volumes are highest within the CCT, since approximately two thirds of the province's population resides in the Greater Cape Town area. The Port of Cape Town, one of the busiest container ports in South Africa, is considered a major source of localised pollution, as are emissions from some of the 90 airports in the province.

Industry contributes to elevated gaseous and particulate matter emissions. Fuels combusted in the energy sector also emit Volatile Organic Compounds and heavy metals. Where electricity is used, emissions are in effect displaced to the location of the power plant. In the West Coast District the primary use of coal for industrial processes translates into associated releases of GHGs.

The agricultural sector comprises 20% of the West Coast District Municipality's economic activities, 5% in the Cape Winelands District Municipality, and 3% in the Overberg District Municipality and is a significant contributor of particulate emissions (WCG, 2016a). Emissions are seasonal, for example, high pollen counts from flowering canola or insecticides and pesticides sprayed for the duration of the growing season. Exposure to pesticides poses a threat to human health and the environment.

Burning of domestic fuels (e.g. wood, paraffin, coal, etc.) for heating and cooking remains commonplace in rural and urban settlements, giving rise to indoor air pollution.

Veld fires are discrete pollution events contributing to poor air quality.

4.12.7.1 Atmospheric pollutants

Air quality management aims to estimate human exposure to criteria pollutants to manage the impacts of deteriorating air quality. Criteria pollutants can cause harm to human health and the environment. The Department of Environment, Forestry and Fisheries identified seven criteria pollutants, regulated by the South African National [Ambient Air Quality Standards] (NAAQS): nitrogen dioxide (NO_2); sulphur dioxide (SO_2); Ozone (O_3); particulate matter (PM_{10} and PM2.5); benzene (C_6H_6); carbon monoxide (CO); and lead (Pb). Particulate matter, oxides of nitrogen (NOxes), SO_2 and greenhouse gases are used to track air quality in the SoEOR.

All monitoring stations in the Western Cape indicate that monitored PM_{10} concentrations are below the annual average standard (threshold) of 50 µg/m3 (in effect until 31 December 2014) and 40 µg/m3 (effective from 1 January 2015). Year-on-year decreases are evident, but longer time series data must confirm this trend.

Annual data for NO_2 concentrations monitored at selected DEA&DP monitoring stations indicate no clear trends, although elevated levels are recorded at Khayelitsha monitoring station, likely due to vehicle emissions in this dense, urban township. Vehicular and industrial emissions are likely to be responsible for elevated NO_2 emissions in Stellenbosch and George.

Annual average SO_2 levels between 2009 and 2015 are below the annual average limit of 50 µg/m3 at all monitoring stations.

Higher SO_2 concentrations are usually attributable to emissions released by industry.

4.12.8 Climate Change

For South Africa, under the current emissions trajectory, there is projected to be an average 1.5°C temperature increase above the 20th century average around the coast, and 3°C in the interior, by 2050, with a doubling of these figures to 3°C and 6°C by the end of the century. The intention through the Paris Agreement (to which South Africa is a signatory) and SDGs is to try and limit this change to below 2°C.

According to projections, climate change increase average temperatures and possibly lower annual rainfall in the Western Cape . Temperature projections are however more certain than rainfall projections. Climate change is clearly a significant threat to sustainable development in the Western Cape. It could undermine poverty alleviation efforts and have severe implications for food security, clean water supply, energy supply, environmental health and human settlements. Mitigating and adapting to climate change depends on systems of governance that support and enable effective societal responses.

4.12.8.1 Projected changes to climate patterns

The Western Cape is perceived to be highly vulnerable to climate change, due to reliance on winter rainfall (which is likely to be affected by a changing climate). The Western Cape has experienced gradual warming of ca. 1°C over the last five decades, but changes in rainfall have been less distinct over this period. There have been numerous locally significant climate-induced disasters, but, until the current drought (2015- 2017), nothing at the scale experienced by many other winter rainfall climate regions.

4.12.8.2 Extreme weather events

The Western Cape is prone to the effects of climate-related hazards, which pose a significant risk to the Western Cape's economy, ecosystems and population.

Between 2003 and 2008 alone, the direct costs of climate related extreme events in the Western Cape amounted to approximately R3.161 billion. The 2009/10 Eden District drought damage was estimated at R300 million, the 2011 Eden District floods at R350 million and the 2012 floods at R500 million. The recent 2015/16 drought and concomitant fires, are together estimated to have cost the agriculture sector up to R4 billion in losses.

4.12.8.3 GHG emissions profile

A GHG emissions profile can be defined as a measure of the GHG emissions that are directly and indirectly caused by an activity or are accumulated over the life cycle of a product or service. The GHG emissions are typically expressed in carbon dioxide equivalents (CO_2e), which renders all GHG emission values to a common (carbon) denominator.

Total energy consumption and the total energy related GHG emissions in the province have increased since 2013, while GHG emissions per capita remained the same. Electricity is the largest contributor to the province's energy emissions.

Electricity contributes disproportionately to emissions due to the high carbon content of Eskom supplied coal-based electricity generation.

By sector, industry contributed the most to the provincial emissions profile in both 2013 and 2016 as it utilises coal-derived electricity as well as in situ coal and diesel. The transport and residential sectors are the next highest contributors. Emissions in the industrial, transport, commercial and residential sectors increased between 2013 and 2016, but declined in the agricultural and local government sectors. The City of Cape Town is the largest contributor of emissions at 57% with the West Coast District the second largest contributor at 19%. The Central Karoo District contributes the least (1%) to the Province's total emissions. The West Coast, Overberg and Eden Districts all increased their contribution to the Province's emissions between 2013 and 2016, whereas the City of Cape Town and the Cape Winelands District reduced their contributions.

4.12.9 Energy

South African energy supply is dominated by coal, which powers approximately 70% of the primary energy supply. This is followed by crude oil at 13%, nuclear and gas at 3% each, and renewables at 0.3%. Residential biomass (e.g. wood burning) has been excluded from this reconciliation (~11%), which, therefore, does not add up to 100%.

The Western Cape is blessed with significant renewable energy resources, specifically in terms of wind and solar potential, and there is likely to be far more energy available in the natural environment than is required for provincial energy needs. As with the rest of the country, historic dependencies on coal-fired electricity, practical, administrative and regulatory obstacles and concerns about cost-effectiveness and a secure base load have prevented harnessing of the full potential of renewable energy. However, there is increasing momentum to make use of opportunities presented by renewable energy to supplement the national energy supply and provide stability to individual households through low cost energy generation solutions.

4.12.9.1 Energy use

Energy use in South Africa is highly dependent on fossil fuels. Fossil fuels (electricity, coal, petrol and diesel) also dominate the mix of fuel consumed in the Western Cape, in that order, rendering the province vulnerable to disruptions in fairly complex supply lines. The direct use of coal (on site) by industry contributes substantially to the provincial energy profile. Between 2013 and 2016, the Western Cape's use of grid-based electricity decreased by 3%, direct use of coal increased by 5%, and the use of jet fuel remained constant at 5% of overall energy use.

However, when absolute figures are considered, energy consumption has gone up across almost all fuel types.

4.12.9.2 Energy intensity

The West Coast District is the most energy intensive in the province, mainly due to direct use of coal by industry. Energy intensity in the CCT is much lower, as the service sector dominates the City's economy. Although it contributes 74% to provincial GDPR, the City accounts for only 60% of the province's energy use.

4.12.9.3 Domestic energy use

The 2016 Community Survey indicates that 97% of households in the Western Cape have access to electricity, the highest access level in South Africa. Access to electricity in the province has improved steadily, from 83.5% in 2005, 93.4% in 2011 to the current figure.

The 2016 community survey reveals that approximately 2% of lighting needs, 9% of cooking needs and 14% of heating needs are powered by alternative fuel sources. Paraffin is preferred for lighting and heating, whilst gas is the preferred substitute for cooking.

4.12.9.4 Reliability of energy supply

A secure energy supply is essential for modern economies. Recurring national power shortages and rolling load shedding, as occurred in South Africa in 2014 and 2015, hinder economic growth, deter investment and impair livelihoods.

At present, the outlook for energy supply security in South Africa remains uncertain, and threatens to undermine local economic development goals in the municipalities in the Western Cape. The StatsSA Community Survey in 2016 reports that 6.82% of households in the Western Cape reported an interruption to their electricity supply in the preceding three months.

4.12.10 Waste

Indicator	Key Quantifications	Target	Trend
WASTE MANAGEMENT: CONCERN			
Waste generation	• % increase in waste generated far exceeded population and economic growth rate.	• Waste generation rates tracking or below population and economic growth rates.	Declining
	• Implementation of alternative waste management projects has improved waste diversion rates.		Improving
Waste characterisation	• Integrated Pollutant and Waste Information System implementation allows for improved reporting of waste generation rates. Low reporting compliance in many municipalities hinders understanding of waste streams.	• Reliable data regarding waste (general and hazardous).	Improving
Waste management facilities	• Fewer operational WMFs in 2017 vs 2006. • Closure of unlicensed facilities and consolidation of existing operational facilities. • All municipalities except CKDM have plans for regional facilities.	• Sufficient integrated waste management infrastructure to deal with projected waste volumes. • Increase in compliance of WMFs	Improving
	• Majority of the WMFs have less than 5 years of operational capacity remaining. • 11% of WMFs require small changes to operation and management • 27% of WMFs partially compliant, requiring improvements • 61% had poor compliance, requiring major improvements.		Concern
Waste collection services	• Increased % of households receiving weekly municipal waste removal services • Room for improvement in rural areas	• Waste collection services for all communities.	Improving

4.12.10.1 Waste generation

Between 2001 and 2010, the percentage increase in waste generated in the Western Cape far exceeded the rate of population and economic growth. In 2017, the CCT was expected to generate 2 447 000 tonnes of waste, followed by 269 000 tonnes in the Cape Winelands District Municipality.

4.12.10.2 Waste characterisation

Understanding waste streams is critical to successful waste management planning. In 2007, a waste characterisation study was undertaken by the DEA&DP. The study revealed that in the most of the District Municipalities, paper and cardboard were the largest category of waste available for recycling followed by organics, plastics and glass.

4.12.10.3 Waste management facilities

The number of waste management facilities (WMFs) in the Western Cape decreased between 2006 and 2017, largely due to closure of unlicensed facilities and consolidation of existing operational facilities. Rural municipalities

struggle with basic waste collection and landfill management, with dropoff facilities and transfer stations becoming quite prevalent.

4.12.10.4 Waste collection services

The level of waste collection services varies across the province and, as at June 2015, most of the districts serviced between 80-100% of households. Some municipalities provide lower service levels, e.g. Hessequa and Knysna local municipalities at 62% and 73%, respectively.

5 Why is the environment in the state it is in?

5.1 Welcome to the Anthropocene?

Geologists have divided Earth's history into a series of time intervals. These time intervals are not equal in length because the divisions are based on significant events in the history of the Earth. For example, the boundary between the Permian and Triassic is marked by a global extinction in which a large percentage of Earth's plant and animal species were eliminated. These divisions provide us with a common means of identifying the different stages through which the planet has passed since its formation to today.

Although periods like the Cenozoic (the 'Age of Mammals') and the Mesozoic (the 'Age of Reptiles/Conifers' – the time of the dinosaurs) may be quite well known, there is increasing debate around what some scientists are referring to as the Anthropocene – the era in which we now live. The reason for this is that for the last two hundred years humankind has had such a significant and clearly observable impact on every corner of the planet that some scientists are starting to regard this period as a new geological age: the age of human impact on Earth or the Anthropocene.

Support for naming our current period of Earth's history the Anthropocene is increasing as more people realise that since the pre-industrial era, and especially since the second half of the last century, the degradation of the natural environment and human-induced climate change has increased at an unprecedented rate.

5.2 The Great Acceleration

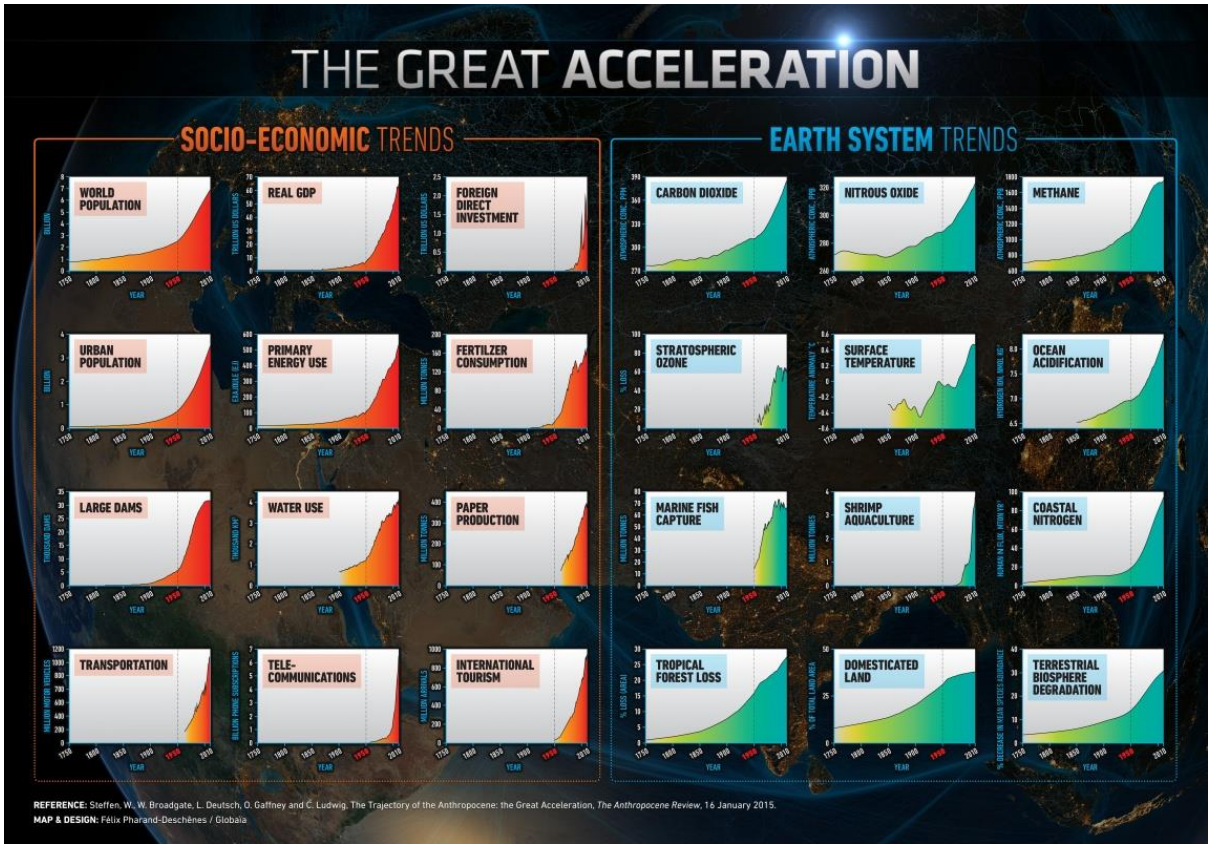
In trying to explain the unprecedented rate of environmental degradation and human-induced climate change, initiatives like the [International Geosphere-Biosphere Programme], a research programme that ran from 1987 to 2015, studied the phenomenon of global change. Results of their work were used by others to suggest that the cause of the change marked by the proposed Anthropocene is a phenomenon known as 'The Great Acceleration' – a period of massively accelerating rates of change in all sorts of socioeconomic and earth system indicators. While the proposed start dates for the Anthropocene span the Industrial Revolution and earlier, the Great Acceleration begins in the 20th Century with the acceleration rate dramatically increasing after the Second World War.

In order to track the effects of human activity upon the Earth, a number of socioeconomic and earth system parameters were used including population, economics, water usage, food production, transportation, technology, green house gases, surface temperature, and natural resource usage.

The [International Geosphere-Biosphere Programme] analysed data from 1750 to 2010 divided into two broad categories which they further divided into 12 subcategories. The first category, socioeconomic trend data, is used to illustrate the impact on the second category, earth system trend data.

The following picture summarises the results and it is clear that there has been explosive growth in: The global human population; Real Gross Domestic Product (GDP); Foreign Direct Investment; Urban population; Primary energy use; Fertiliser consumption; Large dams; Water use; Paper production; Transportation; Telecommunications and International Tourism.

The picture is also clear that this explosive growth over the last 70 years may be linked to equality explosive growth in: Carbon dioxide, Nitrous oxide and Methane emissions; Stratospheric ozone concentrations; Surface temperature; Ocean acidification; Marine fish capture; Shrimp aquaculture; Nitrogen to the coastal zone; Tropical forest loss; Domesticated land; and Terrestrial biosphere degradation.



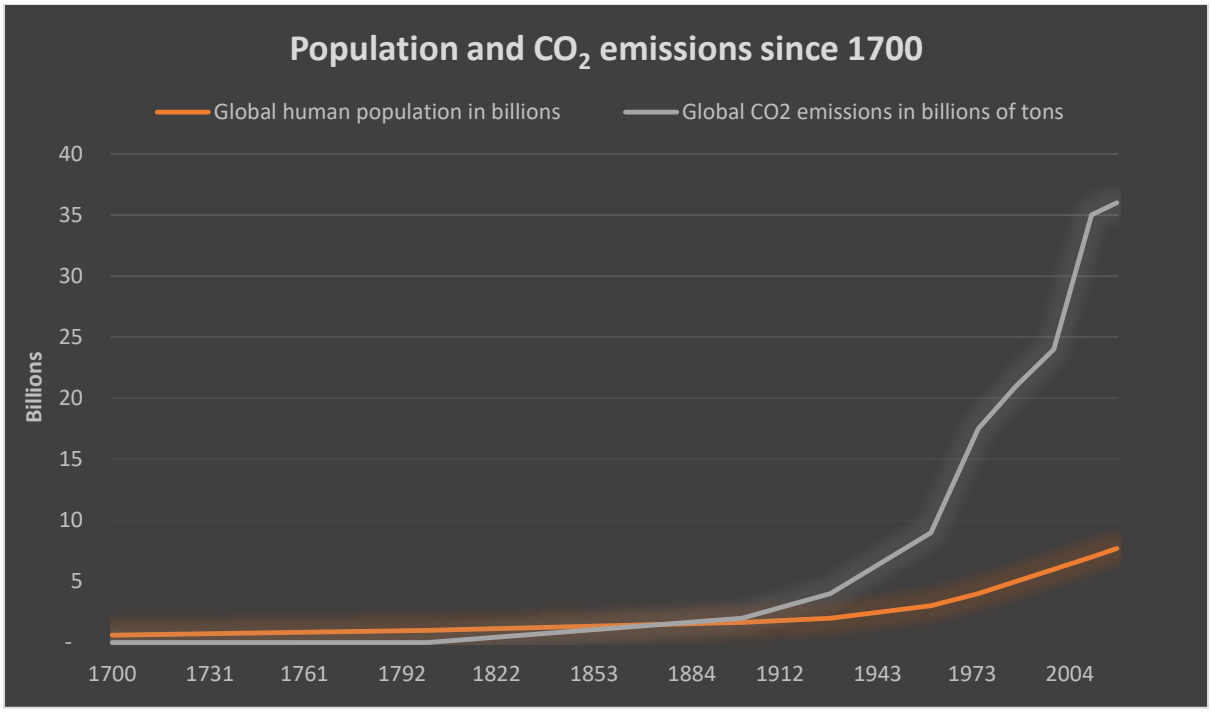
5.3 An uncomfortable truth – it is human activity, not only numbers driving change

Although the information used to illustrate the Great Acceleration is very useful in informing our understanding of what lies behind much of the unprecedented global change, great care must be taken not to draw overly simplified, simplistic or reductionist conclusions.

Typical of such simplistic and misleading conclusions is that the unprecedented rate of environmental degradation and human-induced climate change is due to human population growth. Although the growing human population tends to exacerbate the problem, it is human activity not numbers that is driving the change.

The issue of climate change perfectly illustrates this point. Climate change is the ongoing trend of changes in the earth's general weather conditions as a result of an average rise in the temperature of the earth's surface which is due, primarily, to the increased concentration of gases known as [greenhouse gases (GHGs)], especially carbon dioxide (CO_2), emitted into the atmosphere by human activities. As illustrated in the graph below, although there has been a significant growth in both population and CO_2 emissions since the 1950s, CO_2 emissions grew almost 5 times faster than the human population. Importantly, if humans did not, for example, burn fossil fuels like coal and oil, climate change would not be the problem it is today despite the growing number of humans on the planet.

This realisation leads to a very 'uncomfortable truth' for many of us, namely, we cannot shake our heads, roll our eyes, and point to the growing faceless masses of humanity as the driver of the unprecedented rate of environmental degradation and human-induced climate change – we have to look far closer to home at our own lifestyles and behaviour.



5.4 The drivers of environmental degradation

Chapter 3 of the [2nd South African Environmental Outlook] deals with the question "what is affecting our environment?" and readers are encouraged to read this report for a detailed, fully referenced, discussion on the drivers of environmental degradation in South Africa. However, the following provides a very brief insight into the key drivers.

5.4.1 Production Practices

Since the dawn of the industrial age and the increasingly pervasive [one-way global economy of take→make→use→dispose] production practices that are now regarded as being [unsustainable] are one of the key drivers of environmental change globally. These production processes are those that destroy, deplete or degrade the environment and natural resource base in ways that potentially undermine the health and well-being of current and future generations.

In South Africa, the key production processes responsible for the destruction, depletion or degradation of the environment include: the housing production practices that result in urban sprawl; the fossil fuel-based electricity generation and transportation processes that result in greenhouse gases and other atmospheric emissions; the mining operations that destroy irreplaceable ecological infrastructure and habitat, pollute ground and surface water, pollute the air and/or leave behind a poisonous unproductive and polluting landscape; the agricultural operations that degrade or destroy irreplaceable ecological infrastructure and habitat,and pollute ground and surface water; and the exotic forestry operations that destroy irreplaceable ecological infrastructure and habitat.

As these practices have impacts on the 'quality' of our environment and/or the 'quantity' of the natural environment, they are sometimes categorised as processes that pollute or processes that change the use of land.

With serious discussions starting to take place around the popularisation of the term 'climate crisis' to replace 'climate change' and 'global heating' to replace 'global warming', perhaps the production practices of greatest concern and urgency are those involving fossil fuels. In this regard, South Africa is an acknowledged significant contributor to global greenhouse gas emissions due, largely, to our continued dependence on electricity generated in coal-fired power stations.

5.4.2 Consumption Patterns

Unsustainable production and consumption patterns is a global problem and, hence the United Nations Environment Programme's [UNEP 2019 Global Environmental Outlook (GEO 6)] provides an up to date insight into our current consumption patterns –

The scale and magnitude of global consumption, especially in urban areas, is affecting global resource flows and planetary cycles.

Consumption rates and linear activities (extract-make-use-dispose) have increased resource exploitation beyond the recovery ability of ecological systems, with harmful consequences at all levels from the local to the global. Globally, two out of every five people lack access to controlled waste disposal facilities. Inadequate and sometimes illegal practices include those related to food waste, e-waste, marine litter, waste trafficking and crime. Developed countries have policies in place to promote reduced waste and resource efficiency, while developing countries still face basic management challenges, such as uncontrolled dumping, open burning and inadequate access to services.

Global energy consumption is expected to rise significantly during the period from 2014 to 2040 (by as much as 63 per cent, according to one estimate), much of which is attributed to expected consumption in countries that currently depend on fossil energy sources. Equity and gender issues, such as universal access to improved final energy services, are still a problem that is far from being resolved. Despite the fast deployment and cost reduction of renewables and improvements in efficiency, without further and effective, ambitious measures, energy-related greenhouse gas emissions will result in the Paris Agreement temperature targets being missed.

Despite the many benefits brought to humanity, in this, the most chemical-intensive era in history, the pollution that is associated with chemicals poses a global problem, because toxic substances can spread to the most remote environments, including to receiving water systems worldwide. Products in everyday use contain toxic compounds that interfere with the health of humans, other species and the environment.

Multilateral environmental agreements and concerted national initiatives have made progress in addressing several of the most concerning chemicals. However, significant gaps in assessing and regulating harmful chemicals continue to exist, due, inter alia, to insufficient national legislation or enforcement to address associated risks and to missed innovation opportunities. Failure to address the risks posed by such chemicals can result in adverse impact on human health and the environment, with estimated costs amounting to hundreds of billions of US dollars. Emerging issues requiring more science-based information, precaution, in accordance with international agreements (where applicable), and risk assessment and management include endocrine disruption, widespread antibiotic resistance and the use of nanotechnology.

The food system, in response to growing and changing consumer demand, is increasing pressure on local ecosystems and the global climate. Agriculture is the largest consumer of water and, when not sustainably managed, food production is a major driver of biodiversity loss and polluter of air, fresh water and oceans, as well as a leading source of soil degradation and greenhouse gas emissions. Changing environmental conditions and consumption patterns are both increasing such pressures and presenting new food security challenges, reflecting malnourishment, including in the form of over-nourishment, as well as undernourishment.

As with the rest of the globe, the dominant aspirational South African lifestyle is not sustainable and our activities as private individuals and households directly and indirectly account for a large and increasing share of total environmental impacts.

In a water-poor country like South Africa, our water consumption patterns perfectly illustrate this point. At 490 mm, South Africa's annual rainfall is half the world average and South Africa is considered the 39th driest country in the world. Despite this, at 235 litres per person per day, South Africa's average water consumption is almost 30% higher than the world average of 185 litres per person per day. South African farmers are the biggest direct users of water using around 60% of total water consumption and around 37% of water in South Africa's urban piped water systems is lost to leaks or is used illegally. However, Cape Town's response to their 2018 'day zero' crises

– the day that the city was predicted to run out of water – clearly showed how consumption patterns can be changed to use scarce resources more efficiently and effectively.

5.4.3 Climate Change

Although climate change is an impact of the drivers and pressures described above, it has become a driver in its own right.

South Africa's climate change policy, the 2011 [National Climate Change Response White Paper], regards climate change as an existential threat. While weather changes on a daily basis, climate represents the statistical distribution of weather patterns over time, and on a global scale has changed only very slowly in the past – usually over periods of tens of thousands of years or even millions of years which allows time for the earth's bio-physical systems to adapt naturally to the changing climatic conditions. Currently, the global climate is changing much more rapidly as a result of global warming, leading to, among others, the melting of polar and glacier ice, sea-level rise, ocean acidification, changes in rainfall and snowfall patterns, more frequent floods and droughts and increased frequency and intensity of extreme weather events, such as tornadoes, hurricanes and cyclones. The rapid rate of this climate change does not allow the earth's bio-physical systems to adapt to these changes naturally.

Evidence of rapid climate change, including more frequent and intense weather systems and greater climate variability, has already been observed and includes: increases in the average global temperature; with the past decade being the hottest on record; rises in the average global sea level; changes in average rainfall patterns, with some regions experiencing higher rainfall and other areas experiencing drying; increased frequency of heavy rainfall and extreme weather events over most land areas; and more intense and longer droughts.

The rate of change to the earth's climate exceeds the ability of all types of ecosystems (marine, coastal, freshwater, and terrestrial) to adapt as well as compromising their ability to function effectively.

South Africa is extremely vulnerable and exposed to the impacts of climate change due to our socio-economic and environmental context. Climate variability, including the increased frequency and intensity of extreme weather events, will disproportionately affect the poor. South Africa is already a water-stressed country and we face future drying trends and weather variability with cycles of droughts and sudden excessive rains.

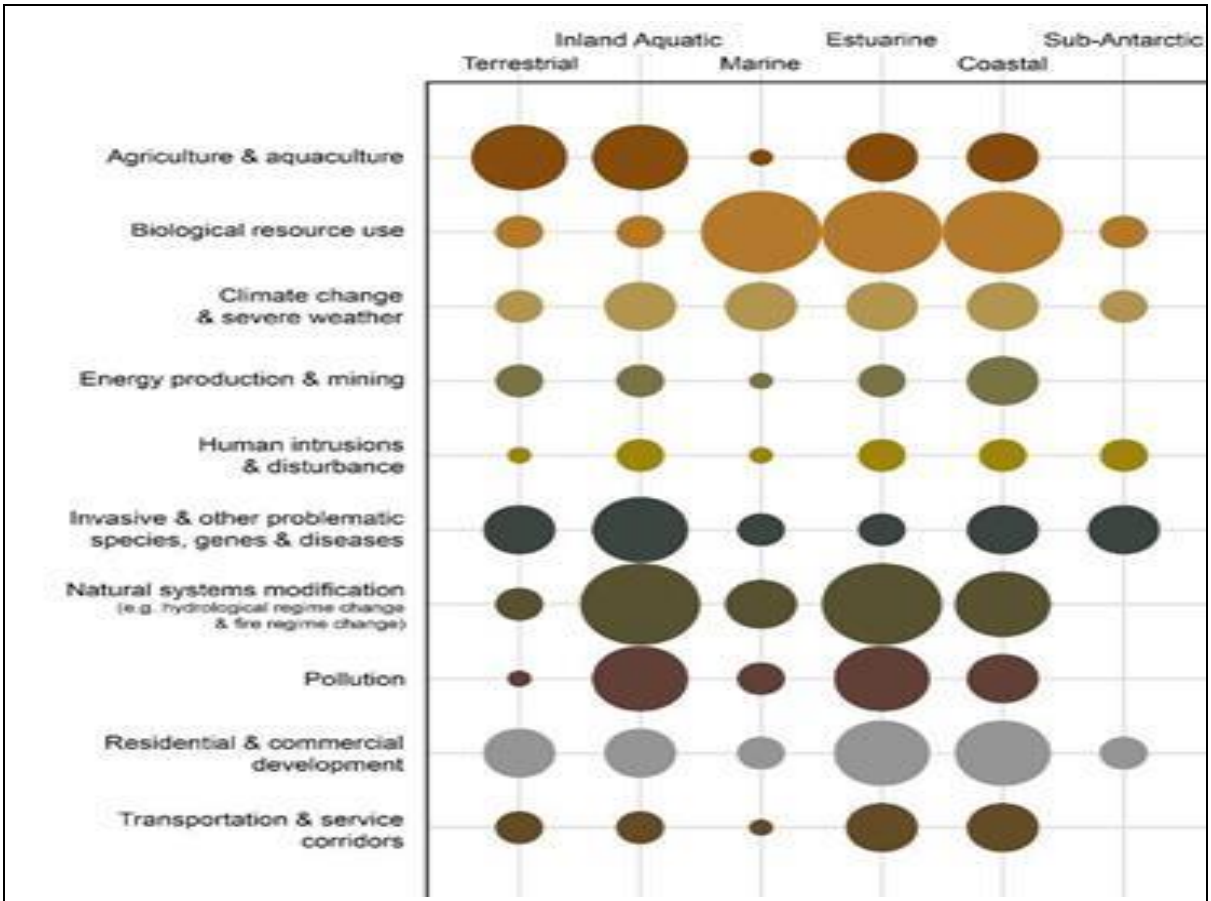
The science is clear that action to address the causes and impacts of climate change by a single country or small group of countries will not be successful. This is a global problem requiring a global solution through the concerted and cooperative efforts of all countries. Should multi-lateral international action not effectively limit the average global temperature increase to below 2°C above pre-industrial levels, the potential impacts on South Africa in the medium- to long-term are significant and potentially catastrophic. Even under emission scenarios that are more conservative than current international emission trends, it has been predicted that by mid-century the South African coast will warm by around 1 to 2°C and the interior by around 2 to 3°C. By 2100, warming is projected to reach around 3 to 4°C along the coast, and 6 to 7°C in the interior. With such temperature increases, life as we know it will change completely: parts of the country will be much drier and increased evaporation will ensure an overall decrease in water availability. This will significantly affect human health, agriculture, other water-intensive economic sectors such as the mining and electricity-generation sectors as well as the environment in general. Increased occurrence and severity of veld and forest fires; extreme weather events; and floods and droughts will also have significant impacts. Sea-level rise will negatively impact the coast and coastal infrastructure. Mass extinctions of endemic plant and animal species will greatly reduce South Africa's biodiversity with consequent impacts on eco-system services.

5.5 Case study – what is driving declines in biodiversity

The following section is an edited extract of [The National Biodiversity Assessment 2018 (NBA 2018)] report and readers are encouraged to read the report for more in depth, fully referenced, information on the state of South Africa's biodiversity.

Changes in hydrological regime and poor water quality are the major pressures on biodiversity in inland aquatic, estuarine, coastal ecosystems and selected terrestrial ecosystems. The over-abstraction of water and building of dams (primarily for crops, human settlements and mining) results in direct negative impacts on species and ecosystems, and indirect impacts through the disruption of important ecological processes such as sediment supply. Pollution of inland aquatic ecosystems from a combination of acid mine drainage, mining, industrial and urban waste water, and agricultural return flows negatively impact water quality. When combined with flow regime changes, pollution represents a major additional pressure on inland aquatic, estuarine and coastal biodiversity.

In contrast, the primary pressure in the terrestrial realm is habitat loss as a result of land clearing for croplands, plantation forestry, human settlements and mining. Agriculture, which includes cultivation for crops and plantation forestry, significantly impacts on all the terrestrial and freshwater species groups assessed to date.

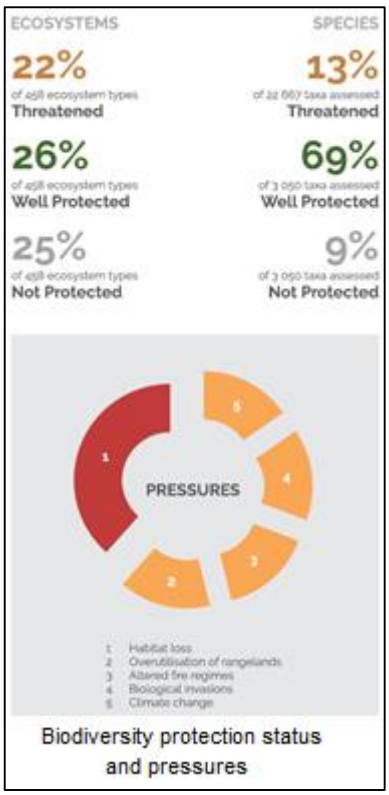


The key pressures on biodiversity in each realm, based on a meta-analysis of the threatened species database and expert opinion. The size of the bubbles indicates the relative importance of each pressure class.

Over-utilisation of [rangelands], which results in loss of shrub and herbaceous cover and leads to increased erosion, is a direct pressure to terrestrial species and ecosystems and an indirect pressure on inland aquatic ecosystems. In the estuarine and marine realms, and in coastal areas, the unsustainable use of biological resources (in this case overfishing of key species) is a significant pressure on biodiversity.

Changes to fire regimes linked to management imperatives, climate (drought events and high winds) and an increase in fuel loads from invasive plants are important natural system modifications in the terrestrial realm that have a detrimental impact on biodiversity. Species which have evolved special adaptations to survive fire, such as certain lycaenid butterflies and Fynbos plants, struggle to cope with fires that have increased intensity and occur more frequently than in the past.

Biological invasions impact all realms, with predatory alien fishes substantially impacting indigenous fish species in rivers. A wide range of woody invasive plant species impact riverine areas, wetlands and mountain catchments in particular and cause severe declines to South Africa's indigenous plants and amphibians.



Biodiversity protection status and pressures

Mining typically does not have the same footprint as other pressures in terms of area, but is an intense form of pressure on biodiversity, with long-term direct and indirect impacts on species and ecosystems. South Africa's mineral wealth is comparable to its outstanding biodiversity; to make the most of these resources, careful spatial planning, monitoring and management of mining operations is essential to avoid and mitigate the worst of the impacts.

Climate change is a documented threat across all realms, and also amplifies other pressures such as competition with invasive species, disease, habitat loss and habitat degradation. Though impacts of climate change on biodiversity are best understood in the terrestrial realm, coastal and estuarine ecosystems are particularly at risk from extreme weather events, especially where human settlements limit the natural [resilience] of these ecosystems by encroaching into dune systems and the estuarine functional zone.

Based on the national land cover, 81% of South Africa (985 559 km2) was in a natural state in 1990. By 2014 natural areas were estimated to have declined to 79% (961 010 km2). Habitat loss, as a result of historical (1750-1990) and recent (1990-2014) clearing of natural habitat for field crops, horticultural crops and planted pastures, is the largest pressure on terrestrial ecosystems and biodiversity in South Africa and has affected 16% of the land area. Clearing of natural habitat for new croplands between 1990 and 2014 affected 1.4% of the country. The relatively mesic eastern portions of South Africa and the Fynbos and Renosterveld of the Cape lowlands were the most impacted by this clearing. Built-up areas (including rural and urban settlements, industrial and commercial areas and large infrastructure) also contribute to natural habitat loss and currently cover over 2.5% of the country. The rate of habitat loss linked to new built-up areas is increasing, especially in Gauteng and along the KwaZulu-Natal coast and adjacent interior. Plantation forestry (including non-native pine, eucalyptus and acacia species) is an important driver of habitat loss, in mesic grassland regions in particular, and cover just under 2% of South Africa; although new plantations are being established the rate of habitat loss to this activity may be decreasing. The impact of mining as a direct driver of habitat loss is relatively low (0.3% of South Africa), however, the highly uneven distribution of mining areas means that the impacts are focussed on particular ecosystems, and the impacts are often persistent.

6 What are the implications

As explained in Chapter [3 - Why is the environment important] - a healthy thriving environment is essential for our personal health and well-being – indeed, our very survival depends on it. The relationship between the environment and humanity is one of interdependence – each affects the other.

6.1 Poor air quality

The following section is an edited extract of the [South African State of Air Report 2018] and readers are encouraged to read the report for more in depth, fully referenced, information on South Africa's air quality.

Poor air quality has undisputed negative impacts on the health and well-being of humans, other animals and plants.

Many air pollution health studies have been conducted in areas in South Africa where air quality was identified as poor or potentially poor in the [2007 National Framework for Air Quality Management].

The [South Durban Health Study] was conducted in 2004 and 2005 to assess the influence of industrial and vehicular emissions on respiratory health in Durban's South Industrial Basin. The study found that ambient concentrations of NO_2, NO, PM_{10}, and SO_2 were significantly associated with negative impacts on health like decreased lung function in children and persistent asthma. In addition, the study reported that attending primary school in south Durban, compared to north Durban, significantly increased the risk for persistent asthma. For adults, living in communities in the south, as compared to the north, was significantly associated with hay fever, and somewhat associated with chronic bronchitis, wheezing with shortness of breath, and hypertension.

A [Vaal Triangle Priority Area (VTAPA) health study] was conducted in 2006 and included a community health survey, a child medical survey and a human health risk assessment. A [vulnerability assessment in the VTAPA] communities considered population sensitivity (children below 15 years of age and the elderly above 65 years of age) and socioeconomic status (the unemployed, people living below the poverty level of R400 per person per month, and people who live in informal houses). Different areas in the VTAPA were found to have different vulnerability scores. Taking vulnerability/sensitivity and ambient [particulate matter (PM)] concentrations into account, it was concluded that people living east of Three Rivers and west of Sebokeng are three to seven times more at risk of suffering from health impacts associated with PM than the rest of the population in the VTAPA.

The concentration of industry in Richards Bay and the potential impact on ambient air quality led to the [Richards Bay Health Study] in 2009 linking health issues to poor air quality. It was reported that the number of patients diagnosed with upper respiratory tract infection (URTI) comprises 12% of the total patients who attended the Richards Bay and Mandlanzini Clinics between 2009 and 2011. The trends in URTI cases indicated that coughing, chest pains, wheezing, flu, fever, headaches and asthma are the most prevalent URTI symptoms recorded from the Richards Bay communities between 2009 and 2011. Little seasonal variation in the occurrence of URTI cases was found with the minor exception of increased asthma during summer and spring and increased flu and fever during winter periods. Tests showed that the majority of respondents were classified as having normal respiration (60%) with obstructive respiration accounting for 30% and the balance being associated with restrictive respiration. Ambient concentrations of PM_{10}, NO_2 and SO_2 were generally low relative to the national [Ambient Air Quality Standards] (NAAQS). Furthermore, the dominant source of energy in Richards Bay is electricity (78%), with wood (3%) and paraffin (2%) being the next most used single fuel types. Using dispersion models, geospatial assessments and available in-situ air quality measurements the study reported at least four priority areas in which air pollution can be expected to have the greatest impact on health. The largest area was reported to be around the Richards Bay industrial area, with Felixton, around Empangeni and the area just south of Nseleni also identified.

Growing concerns regarding exposure and the impact of air pollution on health led to the Western Cape, Department of Environment, Forestry and Fisheries and Development Planning (DEA&DP) conducting a study in 2016. Other studies have assessed the risk associated with exposure to common air pollutants from sources,

including specific sources such as heavy duty vehicles and mine dumps such as traffic. Some sub-places in two municipal areas were at risk of acute and or chronic effects from exposure to PM_{10}. These areas were the Paarl (acute effects) and Bluedowns (acute and chronic effects) risk assessment areas within the Drakenstein Local Municipality and Cape Town Metropolitan Municipality respectively. The risk assessment areas in the Theewaterskloof (Grabouw) and Saldanha Local Municipality showed a low potential for adverse effects from exposure to the modelled $PM_{2.5}$ concentrations, using the NAAQS as a benchmark. In the Mossel Bay Local Municipality 25 sub-places were identified where individuals in those areas may develop adverse health effects. In the Drakenstein Local Municipality, six sub-places in Wellington and all of the sub-places in Paarl were also at risk and in the Cape Metro 28 sub-places in the risk assessment areas were potentially at risk of adverse effects.

In Pretoria West where short term and longer term ambient concentrations of PM_{10}, SO_2, NO_2, CO and O_3 were below the NAAQS, a 2017 report noted that no health risk was found to be associated with acute and intermediate exposure, but infants and children were more likely to suffer health effects. Long-term chronic exposure to normal and worst-case exposure scenarios to each of the pollutants posed some levels of risks for sensitive individuals.

Ambient air pollution concentrations in excess of prescribed health standards are unacceptable and exceedances are more serious in areas where people reside. Vulnerability caused by poverty, disease, lack of education, and poor living conditions exacerbates the problem. In 2012, researchers assessed the association between 24-hour average ambient PM_{10}, NO_2 and SO_2 concentrations and daily respiratory (RD), cardiovascular (CVD) and cerebrovascular (CBD) mortality in Cape Town. For models that included entire year data, an inter-quartile range (IQR) increase in PM_{10} (12 mg/m^3) and NO_2 (12 mg/m^3) significantly increased CBD mortality by 4% and 8%, respectively. A significant increase of 3% in CVD mortality was observed per IQR increase in NO_2 and SO_2 (8 mg/m^3). The study further reported that during a warm period, PM_{10} was significantly associated with RD and CVD mortality, NO_2 had significant associations with CBD, RD and CVD mortality, and SO_2 was associated with CVD mortality. None of the pollutants were associated with any of the three outcomes in the cold period.

A 2015 research report investigated the association between the frequency of truck traffic and allergic rhinitis symptoms, rhinoconjunctivitis and hayfever among 13 to 14 year old school children in the City of Ekurhuleni Metropolitan Municipality. Rhinitis, hay fever, current rhinitis and current rhinoconjunctivitis were significantly associated with the frequency of trucks passing near residences almost all day on week days supporting the hypothesis that traffic related pollution plays a role in the prevalence of allergic rhinitis symptoms in children residing in the area. No association was observed between truck traffic and hay fever in the multiple analyses.

There is increasing evidence that environmental factors such as air pollution from mine dumps increase the risk of chronic respiratory symptoms and diseases. Another 2015 research report investigated the association between proximity to mine dumps and prevalence of chronic respiratory disease in people aged 55 years and older. Elderly persons in exposed and unexposed communities from five pre-selected mine dumps in Gauteng and North West Province were included in a cross-sectional study. Exposed elderly persons had a significantly higher prevalence of chronic respiratory symptoms and diseases than those who were unexposed. Multiple logistic regression analysis results indicated that living close to mine dumps was significantly associated with asthma, chronic bronchitis, chronic cough, emphysema, pneumonia and wheeze. Residing in exposed communities, currently smoking, ex-smoking, use of paraffin as main residential cooking/heating fuel and low level of education emerged as independent significant risk factors for chronic respiratory symptoms and diseases.

6.2 Poor water quality

Water is essential for life on earth and poor water quality has an effect on all life on earth. In terms of human health, poor water quality can kill you. In 2015, it was estimated that 1.8 million people died and 1 billion people got sick around the world because of contaminated water. As is often the case with pollution, it is usually low-income communities that are disproportionately at risk because their homes are often closest to the most polluting industries or they draw their water directly from untreated sources like polluted rivers and wells.

Waterborne pathogens, in the form of disease-causing bacteria and viruses from human and animal waste, are a major cause of illness from contaminated drinking water. Diseases spread by unsafe water include cholera, giardia, and typhoid. Even in wealthy nations, accidental or illegal releases from sewage treatment facilities, as well as runoff from farms and urban areas, contribute harmful pathogens to waterways.

Industrial and agricultural pollutants like lead and heavy metals such as arsenic and mercury and pesticides and nitrate fertilizers are all entering our water supplies and once ingested, these toxins can cause a host of health issues, from cancer to hormone disruption to altered brain function. Children and pregnant women are particularly at risk.

Even swimming can pose a risk. Swimming is water that is polluted by sewage can lead to skin rashes, pinkeye, respiratory infections, and even hepatitis.

But poor water quality is not only a human health problem. Healthy ecosystems rely on a complex web of animals, plants, bacteria, and fungi – all of which interact, directly or indirectly, with each other. Harm to any of the components of this web can create a chain reaction that can degrade entire aquatic environments.

When water pollution causes an algal bloom in a lake or marine environment, the proliferation of newly introduced nutrients stimulates plant and algae growth, which in turn reduces oxygen levels in the water. The absence of oxygen in water bodies is known as eutrophication. Eutrophication suffocates plants and animals and can create "dead zones" where dams, rivers and streams are essentially devoid of life. In certain cases, these harmful algal blooms can also produce neurotoxins that affect wildlife.

Chemicals and heavy metals from industrial and municipal wastewater are also toxic to aquatic life, often reducing an organism's life span and its ability to reproduce. These pollutants also make their way up the food chain as predators eat their prey – a process known as bioaccumulation.

6.3 Polluted Oceans

Although our oceans are impacted in the same way as our fresh water ([see 6.2 - Poor water quality]), marine ecosystems often suffer additional threats. For example, marine debris, which can strangle, suffocate, and starve animals. Much of this solid debris, such as plastic bags and drinks cans, gets swept into sewers and storm drains and eventually out to sea, turning our oceans into a veritable soup of garbage that sometimes consolidating to form floating waste patches. Discarded fishing gear and other types of debris are responsible for harming hundreds of different species of marine life.

Meanwhile, the ocean acidification resulting from increased atmospheric concentrations of CO_2 is making it tougher for shellfish and coral to survive. As the world's oceans get more acidic, it is harder for shellfish and other species to build shells and acidification may also impact the nervous systems of sharks, and other marine life.

6.4 Polluted Soil

Soil pollution, also known as soil contamination, refers to the presence of human-made chemicals in the soil – usually at harmful concentrations. Common soil contaminants include heavy metals, solvents, petroleum hydrocarbons, pesticides, and herbicides.

Healthy soil is essential to the growth of good quality crops and other plants. When plants grow in polluted soil, the yield is negatively impacted in terms of both quantity and quality. Many plants are unable to grow on contaminated soil. Microbes living in the soil also die, which can cause areas with contaminated soil to become wastelands with little or no plant growth. The failure to grow properly affects animals and humans dependent on these plants for food. Thus, the entire food chain can suffer as a result of soil contamination.

When plants can no longer grow properly, the soil becomes vulnerable to the erosional forces of both wind and water. Wind can pick up the soil contaminants, which remain in the air as suspended contaminants. Rainfall washes soil pollutants into nearby water bodies, and these toxic substances can render the water unfit for consumption

and domestic use. Soil that is contaminated with agricultural herbicides and pesticides also ends up in water bodies when farmland is eroded by rainwater. Thus, soil pollution can lead to both air and water pollution.

The impacts of soil contamination also have negative effects on the health of animals and humans. Plants grown in polluted soil can absorb the contaminants, which eventually enter the human body directly by consumption of such plants or through the food chain. Animals that depend on such plants as a food source also suffer. The contaminants can also enter the human or animal body through direct inhalation. Pollution might also infiltrate the soil layer and enter groundwater that is used for drinking water.

The health effects of soil contaminants depend on a variety of factors, such as the nature of the pollutant, mode of attack, and vulnerability of the exposed population. Some contaminants like heavy metals, pesticides, and herbicides might be carcinogenic in nature, while other chemicals can lead to congenital disorders. The health effects of exposure to soil contaminants can also lead to liver toxicity, kidney failure, and neurological disorders.

6.5 Lost or degraded ecological infrastructure

As explained in [3 – Why is the environment important] – [Ecological infrastructure] refers to naturally functioning ecosystems that deliver valuable services to people, such as fresh water, climate regulation, soil formation and disaster risk reduction. It is the nature-based equivalent of built or hard infrastructure, and it is just as important for providing services and underpinning socio-economic development. [Ecological infrastructure] includes, for instance, healthy mountain catchments, rivers, wetlands, coastal dunes, and nodes and corridors of natural habitat, which together form a network of interconnected structural elements in the landscape.

[Ecosystem services] are the many and varied benefits that we get for free from the natural environment and properly-functioning ecosystems – [ecological infrastructure].

When we lose or degrade our [ecological infrastructure], we lose or degrade the [ecosystem services] they provide.

In terms of so called 'provisioning services' when we lose or degrade our [ecological infrastructure] our losses include: food (e.g. seafood and game), crops, wild foods, and spices; raw materials (including timber, skins, fuel wood, organic matter, fodder, and fertilizer); genetic resources (including crop improvement genes, and health care); water; [biogenic minerals]; medicinal resources (including medicinal plants, pharmaceuticals, chemical models, and test and assay organisms); energy (hydropower, biomass fuels); ornamental resources (including fashion, handicraft, jewellery, pets, worship, decoration and souvenirs like furs, feathers, ivory, orchids, butterflies, aquarium fish, shells, etc.).

In terms of so called 'regulating services' when we lose or degrade our [ecological infrastructure] our losses include: [Carbon sequestration] and climate regulation; predation that regulates prey populations (including so-called pest populations); waste decomposition and detoxification; purification of water and air; and pest and disease control.

In terms of so called 'cultural services' when we lose or degrade our [ecological infrastructure] our losses include: cultural (including use of nature as motif in books, film, painting, folklore, national symbols, architect, advertising, etc.); spiritual and historical (including use of nature for religious or heritage value or natural); recreational experiences (including ecotourism, outdoor sports, and recreation); science and education (including use of natural systems for school excursions, and scientific discovery); Therapeutic (including Ecotherapy, social forestry and animal assisted therapy)

In terms of supporting services, this includes the loss or degradation of services such as nutrient recycling, primary production, soil formation, habitat provision and pollination. This makes it impossible for ecosystems to continue providing the services described above.

In summary, and put very simply – when the environment gets sicker and sadder, we get sicker and sadder. If it is healthy and happy, we are healthy and happy.

7 What is the outlook

With reference to current trends and new and emerging drivers, pressures, impacts and responses, the following sections provide an insight into South Africa's future environmental outlook.

7.1 Climate Change

7.1.1 Climate Change Impacts

The science is clear that action to address the causes and impacts of climate change by a single country or small group of countries will not be successful. This is a global problem requiring a global solution through the concerted and cooperative efforts of all countries. Should multi-lateral international action not effectively limit the average global temperature increase to below 2°C above pre-industrial levels, the potential impacts on South Africa in the medium- to long-term are significant and potentially catastrophic.

With this, and given the global nature of climate change, the United Nations Environment Programme's [UNEP 2019 Global Environmental Outlook (GEO 6)] provides an up to date outlook in respect of climate change –

Climate change is a priority issue affecting both human systems, including human health, and natural systems – air, biological diversity, freshwater, oceans and land – and which alters the complex interactions between those systems. Historical and ongoing greenhouse gas emissions have committed the world to an extended period of climate change, which is leading to global warming of air and ocean; rising sea-levels; melting glaciers, permafrost and Arctic sea ice; changes in carbon, biogeochemical and global water cycles; food security crises; fresh water scarcity; and more frequent and extreme weather events. Higher atmospheric concentrations of carbon dioxide also lead to ocean acidification and affect the composition, structure and functionality of ecosystems. Time is running out to prevent irreversible and dangerous impacts of climate change. Unless greenhouse gas emissions are radically reduced, the world is on course to exceed the temperature threshold set out in the Paris Agreement under the United Nations Framework Convention on Climate Change. That makes climate change a global driver of environmental, social, health and economic impact and heightened society-wide risks.

Society-wide risks associated with environmental degradation and climate change effects are generally more profound for people in a disadvantaged situation, particularly women and children in developing countries.

Many of these impacts are serious or irreversible and may lead to loss of livelihood, increased morbidity and mortality, and economic slowdown, and have greater potential for violent conflict, human mass migration and decreasing social [resilience].

Measures for more effective [adaptation] are now urgently required, especially for populations and regions which are in a vulnerable situation.

Global increases in anthropogenic greenhouse gas emissions and climate impacts have occurred, even while [mitigation] activities have taken place in many parts of the world. Globally, economic and population growth continue to be the most important drivers of increases in CO_2 emissions from fossil fuel combustion. Atmospheric concentrations of long-lived greenhouse gases continue to increase, driven primarily by fossil fuel extraction and use for electricity generation, industry and transport, although they are also affected by land use, land-use change, agriculture and forestry. The evidence of current global climate change is unequivocal.

Since 1880, the global average surface temperature has increased by between approximately 0.8 degrees Celsius and 1.2 degrees Celsius. Eight of the ten warmest years on record have occurred within the past decade. If greenhouse gas emissions persist, global average temperatures will continue to increase at the current rate, crossing the temperature target agreed as part of the Paris Agreement between 2030 and 2052. The Paris Agreement committed countries to holding the increase in the global average temperature to well below 2 degrees Celsius above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 degrees Celsius

above pre-industrial levels, recognizing that doing so would significantly reduce the risks and impact of climate change. Current nationally determined contributions, presented in Paris in 2015, constitute only one third of the [mitigation] required to establish a least-cost pathway for staying well below 2 degrees Celsius.

To maintain a good chance of remaining well below a 2 degrees Celsius temperature increase, emissions need to drop by between 40 and 70 per cent globally between 2010 and 2050, falling to net zero by 2070.

Achieving the goals set out in the Paris Agreement requires transformational changes leading to deep reductions in greenhouse gas emissions and the balancing of emission sources and sinks. In addition to emissions reductions for CO_2, the main anthropogenic greenhouse gas, decreasing emissions of short-lived climate pollutants (also called forcers), specifically black carbon, methane, tropospheric ozone and hydrofluorocarbons, provide opportunities to limit warming in the short term and are a critical component of an integrated climate change [mitigation] and air-quality management programme. However, since long-lived greenhouse gases dominate climate forcing in the long term, decreasing emissions of short-lived climate pollutants in the short term needs to be combined with [mitigation] of long-term greenhouse gases. Non- CO_2 emissions in pathways that limit global warming to 1.5 degrees Celsius show deep reductions that are similar to those in pathways limiting warming to 2 degrees Celsius.

Although the [UNEP 2019 Global Environmental Outlook (GEO 6)] report paints a relatively challenging outlook picture, the World Economic Forum's 14th edition of its global risk assessment, [The Global Risks Report 2019], paints a far bleaker outlook. In a clear indication of exasperation, the report asks the question – "Is the world sleepwalking into a crisis?" –

Global risks are intensifying but the collective will to tackle them appears to be lacking. Instead, divisions are hardening. The world's move into a new phase of state-centred politics, noted in [The Global Risks Report 2018], continued throughout 2018. The idea of "taking back control"—whether domestically from political rivals or externally from multilateral or supranational organizations—resonates across many countries and many issues. The energy now being expended on consolidating or recovering national control risks weakening collective responses to emerging global challenges. We are drifting deeper into global problems from which we will struggle to extricate ourselves.

In a section entitled 'Climate Catastrophe', the [The Global Risks Report 2019] notes –

Environment-related risks dominate the report for the third year in a row, accounting for three of the top five risks by likelihood and four by impact. Extreme weather is again out on its own – highest likelihood and highest impact.

The year 2018 was another one of storms, fires and floods. Of all risks, it is in relation to the environment that the world is most clearly sleepwalking into catastrophe. The Intergovernmental Panel on Climate Change (IPCC) bluntly said in October 2018 that we have at most 12 years to make the drastic and unprecedented changes needed to prevent average global temperatures from rising beyond the Paris Agreement's 1.5ºC target. In the United States, the Fourth National Climate Assessment warned in November that without significant reductions in emissions, average global temperatures could rise by 5ºC by the end of the century. Global risk managers seem increasingly worried about environmental policy failure: having fallen in the rankings after Paris, "failure of climate-change mitigation and adaptation" jumped back to number two in terms of impact this year. The most frequently cited risk interconnection was the pairing of "failure of climate-change mitigation and adaptation" and "extreme weather events".

The accelerating pace of biodiversity loss is a particular concern. The Living Planet Index, which tracks more than 4,000 species across the globe, reports a 60% decline in average abundance since 1970. Climate change is exacerbating biodiversity loss and the causality goes both ways: many affected ecosystems—such as oceans and forests—are important for absorbing carbon emissions.

Increasingly fragile ecosystems also pose risks to societal and economic stability. For example, 200 million people depend on coastal mangrove ecosystems to protect their livelihoods and food security from storm surges and rising sea levels. One estimate of the notional economic value of "ecosystem services"—benefits to humans, such as

drinking water, pollination or protection against floods—puts it at US$125 trillion per year, around two-thirds higher than global GDP.

In the human food chain, loss of biodiversity affects health and socioeconomic development, with implications for well-being, productivity and even regional security. Micronutrient malnutrition affects as many as 2 billion people. It is typically caused by a lack of access to food of sufficient variety and quality. Nearly half the world's plant-based calories are provided by just three crops: rice, wheat and maize. Climate change compounds the risks. In 2017, climate-related disasters caused acute food insecurity for approximately 39 million people across 23 countries. Less obviously, increased levels of carbon dioxide in the atmosphere are affecting the nutritional composition of staples such as rice and wheat. Research suggests that by 2050 this could lead to zinc deficiencies for 175 million people, protein deficiencies for 122 million, and loss of dietary iron for 1 billion.

Despite the global expressions of concerns, South African risk managers do not appear to share the views of their international counterparts. Indeed the 5th edition of the Institute of Risk Managers of South Africa's (IRMSA) national risk assessment, the [Risk Report: South Africa Risks 2019], has no environment or environment-related risks included in its top 10 risk in terms of likelihood or impact. Indeed, 'climate change' is not even mentioned once in the 105 page report. Not even water is listed despite Cape Town almost running out of water at the time of publication.

We must mitigate

Under a low mitigation future of significantly hotter and drier conditions, South Africa's available opportunities for adaptation will be greatly limited

Although South Africa may not itself 'be sleepwalking into a crisis', the climate change outlook does not look good. Like the rest of the world, although the growth rate of our greenhouse gas emissions appears to be slowing, it is not falling. If this situation does not change dramatically over the next 20 years, then South African, and humanity as a whole, is likely to face a very grim future indeed.

This notwithstanding, the following section is based on [South Africa's Third National Communication under the United Nations Framework Convention on Climate Change, 2018] report and readers are encouraged to read the report for more in depth, fully referenced, information on the South African climate change outlook.

From a South Africa perspective, significant progress has been made in South Africa since it submitted its [Second National Communication (SNC) to the United Nations Framework Convention on Climate Change (UNFCCC)] in 2011 in terms of the local generation of detailed regional climate futures for the country. Extensive ensembles of projected climate change futures are now available, derived using both statistical and dynamical downscaling techniques. These projections make feasible the identification of plausible climate futures for each of the South African provinces, and in some cases, the identification of actionable messages for [adaptation]. A key feature of the projected climate change futures of South Africa is that temperatures are to increase drastically under low [mitigation]. For the far-future period of 2080-2099, temperature increases of more than 4°C are likely over the entire South African interior, with increases of more than 6°C plausible over large parts of the western, central and northern parts. Such increases will also be associated with drastic increases in the number of heatwave days and very hot days, with potentially devastating impacts on agriculture, water security, biodiversity and human health. The model projections indicate that even a modest-high [mitigation] pathway can still significantly decrease the amplitude of this warming. Nevertheless, it should be realised that South Africa is already committed to relatively large (compared to the global average) increases in near-surface temperatures, even under high-[mitigation] futures.

Under low [mitigation] scenarios it is also likely that the larger Southern African region will experience generally drier conditions, already by the mid-future (2046-2065) but particularly in the far-future (2080-2099). This pattern is projected robustly by global climate models and their statistical and dynamic down-scalings, and is of great

significance: South Africa exhibits, even under present-day climate, a generally dry and warm climate – should this low [mitigation] future of significantly hotter and drier conditions materialise, it will greatly limit the available opportunities for [adaptation]. It may be noted that under low [mitigation], a minority of down-scalings are indicative of rainfall increases over the central interior of South Africa, and/or over the southern interior regions and the Cape south coast. Moreover, extreme convective rainfall events are projected to plausibly increase over the interior regions under low [mitigation], even in the presence of a generally drier climate. Under high [mitigation], the projections are indicative of potentially very different rainfall futures for South Africa. Even under a modest-high [mitigation] pathway, the projected pattern of drying is significantly weaker. In fact, a fairly large number of projections are indicative of generally wetter conditions over the central and eastern interior regions, whilst the remaining projections remain indicative of generally drier conditions. This, in combination with the significantly reduced warming that is projected for southern Africa under high [mitigation], emphasises how important it is for South Africa to strive for a (global) high [mitigation] pathway, i.e. highly ambitious reductions in global GHG emissions.

Starting with the South African agricultural sector, this sector is highly diverse in terms of its activities and socio-economic context. The agriculture sector employs approximately 860 000 people and is critical in terms of national food security as well as supporting thousands of urban and rural households in terms of subsistence agriculture and small scale production. The sector is considered to be one of the most critical economic sectors in terms of potential impacts of climate change in South Africa. Agriculture is impacted directly by changes in precipitation, temperature and evaporation and through secondary impacts including disaster risk and health issues. The most significant climate change risks and vulnerabilities to agriculture in South Africa include increasing temperatures and more variable precipitation that are likely to have significant impact on a wide variety of crops and forestry products. The yields of rain-fed crops such as maize, wheat and sorghum are likely to be affected most drastically, whilst irrigation demands projected to increase due to increased temperatures.

Food Security

The agricultural sector is considered to be one of the most critical economic sectors in terms of potential impacts of climate change in South Africa.

Moreover, more extreme temperature events will directly impact farm labour through enhanced heat stress conditions. Livestock production will also be negatively affected under oppressive temperatures. [Adaptation] strategies in agriculture include the implantation of Climate Smart Agriculture, improved water management, improved monitoring and early warning, the development of knowledge and decision support systems, and the development of new crop varieties and technologies to support farming.

The interaction between climate change stressors, estuarine processes and features and biotic responses are complex, with multiple interactions which can both amplify and moderate responses. Analysis shows that KwaZulu-Natal and West Coast estuaries will be the most influenced by climate change from a structural and functional perspective. This is contrary to the current monitoring programmes which are focussing on biotic responses in the biogeographic transition zones (e.g. the Transkei and western Southern Cape). In the case of KwaZulu-Natal the major driver of change is increased runoff into the numerous small, perched temporarily open/closed estuaries, which may result in more open mouth conditions, a decrease in retention time and a related decrease in primary productivity and nursery function. In contrast, west coast estuaries may be negatively impacted as a result of reduction in runoff, related decrease in nutrient supply and an increase in sea level rise. This in turn may increase salinity penetration in permanently open estuaries and increase mouth closure in temporarily open ones. Similar to KwaZulu-Natal, west coast estuaries will experience a decline in primary production and loss of nursery function. Although Wild Coast, Eastern and southern Cape estuaries may show some shifts in mouth states, nutrient supply, salinity distribution and ultimately production (e.g. fisheries), the most likely impacts of climate change along these

coastal regions will be the change in temperature (nearshore and land), associated species range expansions or contractions and changes in community structure.

The [bimodal rainfall] zone of the Southern Cape is projected to plausibly exhibit an increase in the frequency and magnitude of large floods as well as the duration and intensity of droughts. This region is characterised by medium to small catchments wherein [bimodal rainfall] ameliorates flow variability and confers a degree of stability on estuarine habitats. An increase in the magnitude of floods can cause deeper scouring of mouth regions, thereby increasing tidal amplitude and exposure of sub-tidal habitats and communities. The effect of sea level rise, and related increase in tidal prisms, will be less apparent along the KwaZulu-Natal coastline, where with the exception of estuarine lakes and bays, the majority of estuaries are perched whilst it will be more apparent along the southern and Western Cape coast with their more extended coastal floodplains.

Health and Well-being?

The current impact of climate-related diseases has not been quantified for South Africa, nor is the vulnerability of communities to such risks

South Africa exhibits multiple risks that contribute to the overall burden of disease (i.e. the quadruple burden of disease), which currently puts stress on the health sector. This stress may make the sector as a whole more vulnerable to climate change due to the additional stress a changing climate may put on the system. South Africa does have health policies in place, but action is needed to implement these. The challenging burden of disease in South Africa may make people more vulnerable to the health impacts from climate change (e.g. through pre-existing conditions). However, the impact of pre-existing conditions on the resultant health impact from climate change in South Africa is not quantified. There is a lack of understanding on the linkages between climate and health in South Africa (e.g. quantitative link between high temperatures and mortality). Thus, the current impact of climate-related diseases is not quantified, nor is the vulnerability of communities to such risks. Without a better understanding of the current health burden, it is not possible to understand how climate-sensitive health risks will change in a changing climate. A quantitative vulnerability and risk assessment for the health sector should be performed; this would help to identify the most important health risks, as well as begin to identify the most vulnerable populations or communities. [Adaptation] strategies can then be tailored to region or communities based upon their risks and vulnerability. The South African health system is also vulnerable to the health status and disease burden of people from neighbouring countries. For example, a majority of malaria in South Africa is not from local transmission. The potential impact on the health sector from climate change has both public and occupational health implications, and both of these aspects need to be considered in [adaptation] plans.

The climate variability and change threats to terrestrial ecosystems include rising average temperatures, more temperature extremes, changes in rainfall intensity and magnitude, a higher likelihood of extreme events (such as droughts, floods, heat waves, etc.) throughout South Africa, shifting rainfall season, sea level rise and rising atmospheric concentrations of carbon dioxide (CO_2). In addition, non-climatic conditions such as changes in the occurrence, seasonality and severity of fire and land use change resulting from climate variability and change are also presented in this report. These threats vary in their importance between the biomes, increase over time through the 21st century, and increase with the level of greenhouse gas emissions globally.

The nature of human settlements in developing countries makes them particularly vulnerable to the potential impacts of climate change. Each of the settlement types (urban, informal settlements, rural and coastal) have variable vulnerability and exposure to the projected impacts of future climate changes. These variabilities are as a result of Apartheid legacy, spatial variabilities, planned and unplanned growth and dispersion patterns, topography and numerous socioeconomic factors. Addressing the vulnerabilities of the risk areas is a priority for building [resilience] to climate changes. Different human settlement types and locations having varying vulnerabilities and capacities will experience the hazards associated with the present and future climate changes to an unequal extent.

Higher vulnerability and lower coping capacity areas will have increased risk exposure to climate related hazards; informal settlements and their population being the most exposed. Projected climate changes are likely to compound the impacts felt by the most exposed populations and therefore building [adaptive capacity] in these areas should be a priority. A deficit in infrastructure and provision of services in some areas acts as barriers to [adaptation] and increases vulnerability to climate change. This can be compounded by a lack of resources, unclear regulations and unexpected consequences resulting from previous mal-adaptation or poor development practices. Reducing capacity for necessary operation and maintenance is also contributing to the failure of critical infrastructure needed to mitigate the potential impacts and development risks associated with climate change. The development of human settlements impacts on many other sectors such as transport, energy, water and food production and as such a renewed focus on climate compatible development for human settlements will result in reduced climate change risks and vulnerabilities in these associated sectors.

In terms of disaster risk management, climate change is likely to increase existing vulnerabilities to disaster risk. South Africa's history and resulting urban form has resulted in a high level of vulnerability to disaster risk that must be addressed. Addressing existing issues of lack of development will also provide benefits in terms of reducing the risks and vulnerabilities to climate-related disasters. One of the most significant developments since South Africa submitted its [Second National Communication (SNC) to the United Nations Framework Convention on Climate Change (UNFCCC)] in 2011, has been the [Disaster Management Amendment Act, 2015 (Act No. 16 of 2015)]. The Act now explicitly provides for the inclusion of climate change in disaster risk assessments through all spheres of government and mandates measures to reduce the risk of disaster through [adaptation] to climate change and the development of early warning mechanisms. Mainstreaming risk reduction, [adaptation] and management into development activities are important policy goals for responding to climate change and disaster risk and requires a shift in thinking towards more pro-active risk reduction and [adaptation] planning from a current largely re-active system.

Disaster Management

The Disaster Management Amendment Act (Act No. 16 of 2015) explicitly provides for the inclusion of climate change in disaster risk assessments through all spheres of government and mandates measures to reduce the risk of disaster through adaptation to climate change and the development of early warning mechanisms.

Under an unconstrained greenhouse gas emissions scenario, modelling results suggest a change in runoff that lies between a 20% reduction to a 60% increase. If global emissions are constrained the risk of extreme increases and reductions in runoff are sharply reduced, and the impacts lie between a 5% decrease and a 20% increase in annual runoff. Climate change will affect water quality but in many areas the impacts may be masked by changes in land use, or compliance to effluent standards. Some of the impacts can be foreseen and can be mitigated by careful planning to include potential climate change in water quality management strategies.

7.1.2 Climate change mitigation

South Africa's projections for climate change mitigation form part of the 2014 [Mitigation Potential Analysis] process. As part of this process projections were made for 2020, 2030 and 2050 with projected GHG emissions trajectories categorised by the sectors, energy, transport (subcategory of energy), industrial processes and products use, agriculture forestry and other land use, and waste. At the time of writing the [mitigation] chapter, the [Mitigation Potential Analysis] represented the most current research undertaken at a national level on [mitigation]. The [Mitigation Potential Analysis] required reference data as a baseline for the projection scenarios. The

[Mitigation Potential Analysis] therefore used the [National GHG Inventory: 2000-2010] as the departure point for the projection scenarios because it was the latest available inventory in the public domain at the time of research related to the [Mitigation Potential Analysis].

The national inventory has subsequently been updated to include data up to 2017, but this was not publicly available at the time of writing the [mitigation] chapter and was therefore not used as a basis for the projections in this chapter.

Three [mitigation] trajectories or pathways were developed for South Africa's economic growth path: low; medium and high economic growth. The baseline economic growth trajectory was forecast at 4% for the medium term and 4.3% per annum over the long term. The low economic growth trajectory was forecast at 3.8% growth rate for both the medium and long term. The medium economic growth trajectory was forecast at 4% for the medium term and 4.3% per annum over the long term. The high economic growth trajectory was forecast at 4.8% over medium term and 5.4% per annum over the long term. Projections increase steadily between 2000 and 2050. For 2020, the low and high economic growth trajectories are 3% lower and 3% higher than the medium growth trajectory (663 270 kt CO_2e) respectively. For 2050, the low economic growth trajectory's total GHG emissions are 15% lower than that of the medium economic growth of 1 592 605 kt CO_2e. The high economic growth trajectory's total emissions volume is 18% greater than that of the medium economic growth trajectory. The economic growth trajectories greatly influence emission projections particularly in the sectors of energy, transport and industry, where the largest differences compared to the medium trajectory are seen. In the energy and transport sectors, the high economic growth trajectory's emissions in 2050 are 14% higher than the medium economic growth trajectory. The low economic growth trajectory shows the opposite behaviour with emissions 13% lower than the medium economic growth trajectory for these sectors. Similarly, in the industry sector, an increase or decrease in economic growth significantly influences the total emission volumes. In 2050, emissions are 33% higher than the medium growth trajectory and 23% lower in the low economic growth trajectory.

Three emission trajectories were used in this scenario: without mitigation measures (WOM), with existing measure (WEM) and with additional measures (WAM). Total emissions volumes in the WOM category in 2020 and 2050 are 699 300 kt CO_2e and 1 692 472 kt CO_2e respectively. In 2020, the WEM trajectory total emissions volume of 663 270 kt CO_2e is 5% lower than the WOM trajectory, while in 2050 the total emissions volume amounted to 1 592 605 kt CO_2e (6% lower than the WOM trajectory). The WAM projection trajectory includes emissions reduction initiatives that have been earmarked for implementation across all the sectors considered. The WAM trajectory is broken up into various pathways, which assume different levels of implementation of the national [mitigation] potential (100%, 75%, 50% and 25%). These four pathways have different emissions associated with them. The higher the level of implementation of measures, the higher the potential emission reductions.

In respect of emissions from the international aviation industry. Beyond 2020, there are limited numbers of abatement options remaining after the existing voluntary sectoral agreement to reduce emission from the aviation industry has been accounted for (1.5% per annum until 2020 for the international air transport industry). Biofuels will provide the most abatement potential and their cost is decreasing over time. South Africa is developing a National Civil Aviation Policy that will be used to guide the country on how best to mitigate emissions in the aviation sector.

The financial assessments, of the different [mitigation] opportunities in South Africa, relate to the potential [mitigation] options in marginal abatement cost curves (MACCs). These present costs and potential for emissions reduction from different measures and rank them from cheapest to most expensive to demonstrate marginal costs of achieving incremental levels of emissions reduction.

The national approach for mitigating climate changes focusses on the energy sector as it has the highest contribution to South Africa's GHG emissions. For estimation of potential [mitigation], all the proposed measures are assumed as implemented and evaluated against the WEM scenario. Under this "with all measures" scenario (WAM) the national [mitigation] potential has been estimated at 100 Mt CO_2e in 2020, 340 Mt CO_2e in 2030 and 852 Mt CO_2e in 2050. Compared with the WEM reference case; this represents a reduction of 15%, 40% and 54% for the years 2020, 2030 and 2050 respectively. The largest contributor to abatement in 2050 is the power sector

within the energy sector. The MACC for the year 2020 also shows the energy sector to have the greatest potential for abatement although it would come at higher costs.

The national net annual cost (NAC) for South Africa is estimated at R 40 billion/year for the year 2020 if all measures are implemented with greater investments being taken in the Energy sector category followed by smaller in proportion investments in the industry sector. The subsector of the energy sector with the greatest potential for abatement is electricity and heat production (28 585 kt CO_2e), where onshore wind and solar photovoltaic technologies would be the most significant contributors. The NAC for the energy sector and subsectors show the greatest cost for delivering emission reduction for 2020 to be from electricity and heating and the roads subsectors.

The abatement potential for the industry sector is estimated at 44 843 kt CO_2e for 2020 and the category has a predominantly negative marginal cost and largest emissions saving (83%) possible from interventions in the metal sector. Further significant abatement is possible from the commercial/institutional and the residential subsectors (22 026 kt CO_2e), where efficient lighting and improved thermal design of new buildings may have a major impact.

The NAC for 2020 shows the higher costs for emission reduction coming from the production of ferroalloys, iron and steel, although these subsectors also have the greatest potential for emission reductions within this category.

In the waste sector (excluding industrial waste), if all [mitigation] potential activities were implemented, then almost 10 000 kt CO_2e could be reduced in 2020 with marginal cost of R 3 500 per tonne CO_2e abated. The main measures contributing to abatement are related to landfill gas recovery.

The MACCs for [mitigation] measures in the agriculture, forestry and other land use sector show potential for abatement greater than 5 000 kt CO_2e in 2020, with expanding plantations possibly contributing 45% of thesereductions. The NAC for this category in 2020 is estimated at R 153 million, with almost 90% of this being allocated to restoration of mesic grasslands if all measures are implemented.

South Africa's National Sinks Assessment finds that the grassland and savanna biomes are considered the most important carbon sinks as they account for 90% of Gross Primary Production in South Africa. The National Sinks Assessment recommends that climate change [mitigation] activities should, therefore, be focussed within these biomes, to ensure material contributions are made to the national GHG budget.

7.2 Air quality

Given that air pollution knows no borders and is an issue of global concern, the United Nations Environment Programme's [UNEP 2019 Global Environmental Outlook (GEO 6)] provides an up to date outlook in respect of air quality at an international level –

Emissions generated by human activity continue to alter the composition of the atmosphere, leading to air pollution, climate change, stratospheric ozone depletion and exposure to persistent, bioaccumulative and toxic chemicals.

Air pollution is the main environmental contributor to the global burden of disease, leading to between 6 million and 7 million premature deaths and welfare losses estimated at US$5 trillion annually. Air pollution exposure, especially to fine particulate matter, is highest for urban residents in some countries with rapid urbanization trends and for the approximately 3 billion people who depend on burning fuels such as wood, coal, crop residue, dung and kerosene for cooking, heating and lighting. The elderly, very young, ill and poor are more susceptible to the impact of air pollution.

Globally, decreasing emission trends from local air pollutants in certain sectors and regions have been offset by larger increases in others, including some rapidly developing countries and areas of rapid urbanization. Available data indicate that emissions decrease significantly when regulations are put in place.

International agreements have been successful in addressing specific chemicals. Both improvement of energy efficiency and pollution control techniques may be used to achieve lower air pollutant emissions. As controls have been placed on power plants, large industrial facilities and vehicles, the relative contribution of other sources, including agriculture, domestic fuel use, construction and other portable equipment, and forest or open fires, has grown in importance.

Electricity generated from non-renewable resources and the fossil fuel production and consumption sectors ("energy") is the largest anthropogenic emitting sector of SO2 and non-methane volatile organic compounds and the main emitting sector of other air pollutants, including greenhouse gases.

Government capacity and political will to manage air pollution and climate change varies significantly. Some regions have well-developed systems of national-to-local policies and compliance and enforcement programmes, although ambition levels in terms of both scope and policy may differ. In other regions, international agreements or national legislation may exist, but implementation and compliance and enforcement are often affected by weak national-to-local institutional capacity. Future policy efforts can build upon renewed attention to those issues in international forums and several decades of experience with various governance strategies in different countries. Between 1998 and 2010, there was a five-fold increase in the number of national climate laws (more than 1,500 laws and policies worldwide) and by 2012 those laws covered 67 per cent of all emissions. Some city and subnational governments are leading the way with benefits for other parts of their countries.

To a large extent, the South African air quality outlook mirrors that reflected in the [UNEP 2019 Global Environmental Outlook (GEO 6)] report. Emissions generated by human activity continue to alter the composition of our ambient air. Air pollution is probably the main environmental contributor to the national disease burden with a number of new reports estimating many premature deaths and welfare losses in pollution hotspots like the Highveld Priority Area. Air pollution exposure, especially to fine particulate matter, is highest for residents in dense settlements where people depend on burning fuels such as wood, coal, crop residue, dung and paraffin for cooking, heating and lighting. Our most vulnerable people, the elderly, very young, ill and poor, are the most susceptible to the impact of air pollution. Decreasing emission trends from local air pollutants in certain sectors and regions have been offset by larger increases in others. However, there appears to have been some air quality improvements since the promulgation of the [NEM: AQA]. Although International agreements have been successful in addressing specific chemicals, like ozone-depleting substances, others like mercury still remain a challenge. Improvements in both energy efficiency and pollution control techniques have achieved lower air pollutant emissions and will continue to do so. As controls are enforced on power plants, large industrial facilities and vehicles, the relative contribution of other sources, including agriculture, domestic fuel use, construction and other portable equipment, and forest or open fires, will grow in importance. Electricity generated from coal and the fossil fuel production and

consumption sectors ("energy") is South Africa's largest anthropogenic emitting sector of SO_2 and non-methane volatile organic compounds and the main emitting sector of other air pollutants, including greenhouse gases. Government capacity and political will to manage air pollution varies significantly between the national department and provincial and local authorities. Although South Africa has a well-developed system of national-to-local policies and compliance and enforcement programmes, implementation and compliance and enforcement is often affected by policy conflicts and weak institutional capacity. Future policy efforts will build upon renewed attention to these issues in international forums and several decades of experience with various governance strategies in different countries. Between 1997 and 2018, there has been a significant increase in the number of air quality regulations and some cities are leading the way with benefits for other parts of the country, e.g. eThekweni's SO2 reduction interventions.

Notwithstanding the above, South Africa has made much progress in our approach to air quality management over the last decade. This is especially evident based on the substantial growth in capacity and capability through advanced governance mechanisms, public information platforms such as SAAQIS, the number of regulations and notices published, delivery of statutory obligations such as air quality management plans (AQMPs), long term data sets on emissions and ambient concentrations and the development of an Air Quality Index, just to mention a few milestones. The processes put in place are all the expected cornerstones of any emerging air quality management system and while they may not be as scientifically or technically advanced as some systems in Europe or Northern America they are certainly considered to be robust and fit for purpose.

It should also be noted that: (i) efficient and effective air quality management aimed at ensuring that [Ambient Air Quality Standards] are met and maintained is fully aligned with, and is a significant contributor to the realisation of, NDP Chapter 10: Promoting Health; and (ii) that the efficient and effective realisation of the GHG [mitigation] components of NDP Chapter 5: Ensuring Environmental Sustainability and an Equitable Transition to a Low-Carbon Economy, will also have a significant positive impact on South Africa's air quality.

While there has been substantial investment in the tools to diagnose and understand the temporal, spatial and sectorial scale of the air quality problem, there appears to be limited evidence on the implementation of interventions to resolve these problems. Like many countries, addressing air pollution and climate change continues to be a challenge due to a number of influencing factors such as:

- low public, political and institutional recognition of the growing public health crisis and understanding of the complexity of the challenge;
- keeping up with the rate and scale of economic growth and urbanisation;
- implementing truly transformative interventions, consistent with the scale of the challenge; and
- limited perceptions of personal exposure to air pollution and health protection and a willingness or ability to take action to address the problem.

Notwithstanding these challenges, South African air quality appears to be improving marginally. However, these improvements may be related more to a slowed economy than to specific air quality management interventions.

Another important outlook relates to the significantly positive air quality impacts that would accrue from the transition to the low-carbon economy and society required to successfully mitigate the worst climate change impacts.

Finally, although pollution concentrations may be reducing, recent evidence from the World Health Organisation (WHO) continues to suggest that many pollutants should be considered non-threshold pollutants – i.e. there is no safe ambient concentration. Therefore, many cities and national governments are exploring working beyond compliance with their own air quality standards and working towards WHO guidelines.

7.3 Fresh water quality

Given that South Africa's fresh water resources are shared with our neighbours, the United Nations Environment Programme's [UNEP 2019 Global Environmental Outlook (GEO 6)] provides an up to date international outlook in this regard –

Population growth, urbanization, water pollution and unsustainable development are all increasing pressure on water resources across the world, and that pressure is further exacerbated by climate change. In most regions, slow-onset disasters, such as water scarcity, drought and famine, lead to increased migration. Increasing numbers of people are also being affected by severe storms and floods.

Increasing glacial and snowpack melt as a result of global warming will affect regional and seasonal water availability, especially in Asian and Latin American rivers, which provide water for some 20 per cent of the global population.

Changes to the global water cycle, including extreme events, are contributing to water quantity and quality problems, with impact distributed unequally across the world.

In most regions, water quality has worsened significantly since 1990, owing to organic and chemical pollution, such as pathogens, nutrients, pesticides, sediments, heavy metals, plastic and microplastic waste, persistent organic pollutants and salinity. Some 2.3 billion people (approximately 1 in 3 of the global population) still lack access to safe sanitation.

Approximately 1.4 million people die annually from preventable diseases, such as diarrhoea and intestinal parasites, that are associated with pathogen-polluted drinking water and inadequate sanitation.

Without effective counter-measures, human illnesses due to antimicrobial-resistant infections may become a major cause of death from infectious diseases worldwide by 2050. Water plays a key role in this, as anti-microbial-resistant bacteria are now found in sources of treated drinking water worldwide, stemming from antibiotics entering the water cycle through domestic sewage and industrial wastewater disposal, agriculture, intensive livestock rearing and aquaculture. In addition, various endocrine-disrupting chemicals are now widely distributed through the freshwater system on all continents, with long-term impact on foetal underdevelopment and male infertility.

On the positive side, 1.5 billion people gained access to basic drinking water services over the 15-year period from 2000 to 2015. However, women and girls still carry most of the physical burden of transporting water in many developing countries, reducing the time available for them to participate in productive activities and education. The positive impact of women being able to spend time on other activities should be widely acknowledged, since economic surveys indicate that they typically reinvest up to 90 per cent of their income in their families, improving family health and nutrition, and increasing access to schooling for their children.

Worldwide, agriculture uses an average of 70 per cent of all fresh water withdrawals, rising to 90 per cent in many poorer countries. The competition for more water from cities and industry creates an imperative to improve the efficiency of agricultural water use while at the same time producing more food and using fewer and less harmful inputs.

Many aquifers are depleting rapidly due to over-abstraction for irrigation, drinking water, industrial and mining uses. More sustainable management and better monitoring of surface and groundwater is urgently needed.

Promoting water-use efficiency, water recycling, rainwater harvesting and desalination is becoming increasingly important to ensure greater water security and more equitable water allocation for different users and uses. The agricultural sector needs substantial improvements in water-use efficiency and productivity. The industrial and mining sectors also have strong potential for increasing water-use efficiency, recycling and reuse, as well as for limiting water pollution. Broader adoption of water-sensitive urban design, including infrastructure to manage storm water, grey water, wastewater and managed aquifer recharge, would improve water management and urban water outcomes.

Freshwater ecosystems are among the world's most biodiverse habitats and valuable natural infrastructures. Wetlands buffer against impact from climate change (both drought and floods) and improve water quality, but 40 per cent of all wetlands have been lost since 1970 through agricultural development, urbanization, infrastructure development and overexploitation of water resources. Severe consequences include the loss of inland fisheries, which affects the livelihoods of millions of people.

The total annual economic cost of wetland losses over the 15-year period from 1996 to 2011 has been estimated at US$2.7 trillion. Greater investment, both public and private, would facilitate more sustainable wetland management and restoration.

The decomposition, due to human intervention, of peatlands, a type of wetland that stores more carbon than all the world's forests combined, currently contributes approximately 5 per cent of annual global carbon emissions. The thawing permafrost in boreal peatlands, agricultural conversion of some tropical peatlands and the transformation and loss of other peatlands are causing increased carbon emissions, infrastructure damage and wildfires. Protection and restoration of peatlands, including rewetting of drained peatlands, is an important climate change [mitigation] strategy.

Innovative and integrated policy mixes are essential to manage interactions between water, food, energy, transport, climate change, human health and ecosystems. Good governance includes integrated water resource management, as illustrated by integrated flood risk management, ecosystem-based approaches in subnational and transboundary basins, circular economy and other approaches that promote sustainable consumption and production as one approach towards achieving sustainable development and substantive progress on decoupling water use from economic growth through increasing water efficiency. Such approaches support improved land-use planning and cross-sectoral policy coordination between government departments.

Social equity and gender equality remain key aspects for achieving Sustainable Development Goal 6 on fresh water. Enhanced participatory processes will enable greater knowledge input from local and indigenous communities into decision-making. Goal 6 can only be achieved by engaging the public, private and non-governmental sectors, civil society and local actors, and by taking into account other interlinked Sustainable Development Goals.

Multilateral environmental agreements governing water resources and water-related ecosystem management and climate change can support the embedding of integrated water resource management in the rule of law through national and local legislation. Increased investment in the scope and rigour of standardized water data is essential to improve policy and governance for sound water management.

As with climate change, the South African fresh water outlook largely mirrors that reflected in the [UNEP 2019 Global Environmental Outlook (GEO 6)] report. Population growth, urbanization, water pollution and unsustainable development is all increasing pressure on water resources and that pressure will be further exacerbated by climate change. In Southern Africa, slow-onset disasters, such as water scarcity, drought and famine, may lead to increased migration. Increasing numbers of people are also being affected by severe storms and floods. Changes to South Africa's water cycle, including extreme events, are contributing to water quantity and quality problems, with impact distributed unequally across the country – e.g. there are examples of floods and droughts being experienced around the country at the same time. Water quality has probably worsened significantly since 1990, owing to organic and chemical pollution, such as pathogens, nutrients, pesticides, sediments, heavy metals, plastic and microplastic waste, persistent organic pollutants, salinity and acid mine drainage. Many South Africans still lack access to safe sanitation despite massive improvements since 1994. Many South Africans die annually from preventable diseases, such as diarrhoea and intestinal parasites, that may be associated with pathogen-polluted drinking water and inadequate sanitation. Without effective counter-measures, human illnesses due to antimicrobial-resistant infections may become a major cause of death from infectious diseases by 2050.

On the positive side, most South Africans have gained access to basic drinking water services over the 15-year period from 2000 to 2015. However, women and girls still carry most of the physical burden of transporting water in many rural areas, reducing the time available for them to participate in productive activities and education. Agriculture uses around 60 per cent of all fresh water withdrawals. The competition for more water from cities and

industry is creating an imperative to improve the efficiency of agricultural water use while at the same time producing more food and using fewer and less harmful inputs. Promoting water-use efficiency, water recycling, rainwater harvesting and desalination is becoming increasingly important to ensure greater water security and more equitable water allocation for different users and uses. The agricultural needs to learn from the successes in the Western Cape and make substantial improvements in water-use efficiency and productivity. The industrial and mining sectors also have strong potential for increasing water-use efficiency, recycling and reuse, as well as for limiting water pollution. Broader adoption of water-sensitive urban design, including infrastructure to manage storm water, grey water, waste-water and managed aquifer recharge, would improve water management and urban water outcomes.

Despite their importance, many South African wetlands have been lost since 1970 through agricultural development, urbanization, infrastructure development and overexploitation of water resources.

Innovative and integrated policy mixes are being explored to manage interactions between water, food, energy, transport, climate change, human health and ecosystems. However, the good governance required for integrated water resource management is seen as a major challenge.

7.4 Land and soil quality

Given that land and the quality of our soils is an issue of global concern, the United Nations Environment Programme's [UNEP 2019 Global Environmental Outlook (GEO 6)] provides an up to date outlook in this regard –

Food production is the largest anthropogenic use of land, using 50 per cent of habitable land. Livestock production uses 77 per cent of agricultural land for feed production, pasture and grazing. Furthermore, traditional livestock provides livelihoods for many indigenous and local communities. Sustainable land management can address food security while preventing the loss of the contribution made by nature and promoting gender and social equality. Adequately feeding 10 billion people by 2050 will require an increase of 50 per cent in food production, while some 33 per cent of global edible food is lost or wasted, of which approximately 56 per cent occurs in developed countries. Increasing productivity has slowed down the expansion of agricultural land, but inefficient or unsustainable farming systems are often associated with environmental and soil degradation and biodiversity loss, and an increase in crop specialization and distribution can raise the risk of poor harvests.

Securing land rights for local communities can help to turn land assets into development opportunities and secure more sustainable use of land. For most people, land is their most important asset. Women represent 43 per cent of those active in agriculture, yet they hold the title to less than 20 per cent of agricultural land. Insecure access to land resources hinders sustainable land management. Indigenous and other forms of community-managed land could generate billions of US dollars' worth of ecosystem benefits through, among other things, [carbon sequestration], reduced pollution, clean water and erosion control. Those benefits could justify securing land tenure and the right to inheritance for women and indigenous and local communities. Decreasing the gender gap in access to information and technology, and access to and control over production inputs and land, could increase agricultural productivity and reduce hunger and poverty. Policies empowering women, indigenous peoples, family farmers and pastoralists to ensure that those groups have secure access to land resources, fertilizers and other inputs, knowledge, extension services, financial services, markets, opportunities for adding value and non-farm employment can facilitate the achievement of the Sustainable Development Goals and reduce environmental impact, increase agricultural productivity and contribute to reducing poverty and hunger.

Land degradation and desertification have increased, with land degradation hotspots covering approximately 29 per cent of global land, where some 3.2 billion people reside. Investing in avoiding land degradation and restoring degraded land makes sound economic sense and the benefits generally far exceed the costs.

Whilst the pace of deforestation has slowed, it continues globally. Furthermore, although many countries are now taking steps to increase their forest cover, it is primarily being done through plantations and reforestation, which may not provide the same range of ecosystem services as natural forests.

Urban clusters – meaning urban centres and their suburbs – have grown by a factor of approximately 2.5 since 1975, and in 2015 accounted for 7.6 per cent of global land, affecting, among other things, the hydrological cycle and soil functions, causing urban heat islands.

Achieving the land-related Sustainable Development Goals requires adequate land and water resource management. Innovative technologies, sustainable land management strategies, nature-based solutions and land-resource stewardship (such as sustainable forest management, agro-silvo-pastoral production systems, conservation agriculture, integrated crop production and agroforestry) can contribute to making agriculture sustainable. Payment for ecosystem services, land restoration and land titling need to be more effectively promoted and adopted. When compatible with local culture, such strategies contribute to better management and conservation of land resources and are integral for the reduction of hunger (Sustainable Development Goal 2). Economic incentives for agriculture, including distortive agricultural production subsidies, contribute to land degradation, and their reduction and removal will be important for the achievement of sustainable agriculture.

Sustainable land-use planning and management can protect high-quality, fertile agricultural soil from competing interests, thus maintaining land-based ecosystem services such as food production, and preventing land from flooding and disaster. Frameworks targeting land degradation, such as the Land Degradation Neutrality initiative

under the United Nations Convention to Combat Desertification, may also contribute to climate change [mitigation] and [resilience]. Yet the policy framework on land management remains complex and incomplete.

Turning to the specific South African situation, the following section provides an edited and contextualised extract of the executive summaries of the [Trends of Desertification, Land Degradation and Drought (DLDD) Indicators of the UNCCD for South Africa], Phase 2: Final Report of March 2019. Readers are encouraged to read this report for more in depth, fully referenced, information on the outlook for land degradation in South Africa.

Models predict a marked increase in the frequency and severity of droughts in the winter rainfall and Cape coastal regions towards 2100

Land degradation, which includes desertification amongst other processes, encompasses changes in soil properties or vegetation characteristics, which lead to a persistent decline or loss of ecosystem services essential to sustaining life. It is the consequence of a set of key processes, which are active in arid and semi-arid environments, where water is the main limiting factor of land use and for ecosystem functions. Land degradation is a broad term that also encompasses circumstances of reduced biological productivity of the land. The United Nations Convention to Combat Desertification (UNCCD) provides a framework for affected countries to effectively address the problem of desertification, land degradation and drought (DLDD).

As a signatory to the UNCCD, the South African government through the Department of Environment, Forestry and Fisheries commissioned a two-phase study on desertification, land degradation, drought and land cover assessment to inform policies, rehabilitation programmes and strategies to monitor and reduce the impacts. Phase 2 of this research covers trends in land productivity using the following indicators: drought occurrences, salinization, biomass production, soil carbon stocks, bush encroachment, land cover change causes, and soil erosion.

The [Standard Precipitation Index (SPI)], which is a measure of rainfall deficit, was applied in drought assessments. The 24-month SPI indicated that in 2000 and 2001, some parts of SA experienced mild to extremely wet conditions. South Africa was hardly hit by drought conditions from 2003 to 2005. The southern to eastern coastal areas and lowveld areas in the northeast experienced drought during the early part of the 2009/10 season. The central parts of the country were affected by drought conditions in 2012 and 2013. The Western Cape region was severely hit by drought conditions during the 2016-2017 period.

The future impact of climate change on drought occurrences was also evaluated. Warming of up to 2.5°C is projected for five out of the six projections for the 2041-2070 period with the sixth downscaled projection indicating warming that exceeds 3°C across most of the interior. The warming relative to the baseline period is projected to exceed 4°C across the western to central interior by most of the downscaled projections for the 2071-2100 period. Projections of rainfall changes are less robust than the projections of temperature changes and exhibit more complexities. For example, when the 1 mm rainfall events are considered, which is essentially a proxy for the number of rain days, there is a general pattern of an increase of these events over the western to central interior during the 2041-2070 period.

The difference in the long-term mean 24-month SPI between a future period (2071-2100) and a baseline period (1961-1990) was also assessed by SPI time series on a 24-month time scale. The winter rainfall region and Cape coastal region show a marked increase in the frequency of occurrence as well as the amplitude of droughts towards 2100. The western region of SA also exhibits a signal of increased drought occurrences towards 2100, although not as pronounced as for the winter rainfall region and the Cape south coast region.

The assessment of salinization in biomes showed that those with the highest [electrical conductivity (EC)] were found in the western parts of South Africa with the lowest rainfall and highest aridity. The Desert and Succulent Karoo Biomes in the arid regions of South Africa are clearly saline if the median EC is used as an indicator of salinity. The Grassland and Indian Ocean Coastal Belt Biomes in the higher rainfall regions, on the other hand, are apparently non-saline. No major changes in soil salinity are expected, if the year 2080 is used for future predictions.

South Africa's soil carbon stock has decreased between 2000 and 2014. In 2000, a loss of 370 667 Gg had already occurred due to land use change and this loss has increased

The overall area under alien species invasion has decreased, with the main reductions occurring in the Northern Cape. From the change maps, it can be concluded that most of the new patches were mapped in the North West Province along the border with Botswana as well as along other drainage lines. The MODIS annual cumulative [net primary productivity (NPP)] maps showed changes between 2000 and 2013. Parts of the Eastern Cape, KwaZulu-Natal, Mpumalanga and Limpopo provinces showed high amounts of NPP in 2000 (from 12 961 to 30 562 g C/m^2/year) whereas Northern Cape, Western Cape, Free State and North West showed lower values of NPP. The year on year assessment of biomass showed that there has been a decrease in biomass production from 2000 to 2013. The assessment of soil carbon stock in South Africa showed that soil carbon has been lost in the 14-year period between 2000 and 2014. In 2000, a loss of 370 667 Gg had already occurred due to land use change and this loss has increased.

The success in efforts to control and reverse land degradation rests not only upon knowledge of the status, causes or the impacts, but also on adopting systematic and integrated approaches that address the physical, biological and socio-economic aspects of the processes of land degradation, desertification and drought. To increase the reliability of the generated information as well as documenting trends including inter-decadal and inter-annual comparisons, the country needs to apply standardized assessment approaches and tools. Achieving the UNCCD targets requires long-term strategies focussing simultaneously on affected areas, land rehabilitation, conservation and sustainable management of land and water resources, as well as building capacity, particularly at the community level.

7.5 Biodiversity

Given that the loss of biodiversity is an issue of global concern, the United Nations Environment Programme's [UNEP 2019 Global Environmental Outlook (GEO 6)] provides an up to date outlook in respect of biodiversity at an international level –

A major species extinction event, compromising planetary integrity and Earth's capacity to meet human needs, is unfolding. Biodiversity refers to the diversity of living things at the genetic, species and ecosystem levels. It helps to regulate climate, filters air and water, enables soil formation and mitigates the impact of natural disasters. It also provides timber, fish, crops, pollination, ecotourism, medicines, and physical and mental health benefits.

Environmental and human health are intricately intertwined, and many emerging infectious diseases are driven by activities that affect biodiversity. Changes to the landscape (through natural resource extraction and use, for example) can facilitate disease emergence in wildlife, domestic animals, plants and people. Zoonoses are estimated to account for more than 60 per cent of human infectious diseases.

Genetic diversity is declining, threatening food security and the [resilience] of ecosystems, including agricultural systems and food security.

Populations of species are declining and species extinction rates are increasing. At present, 42 per cent of terrestrial invertebrates, 34 per cent of freshwater invertebrates and 25 per cent of marine invertebrates are considered at risk of extinction. Between 1970 and 2014, global vertebrate species population abundances declined by on average 60 per cent. Steep declines in pollinator abundance have also been documented.

Ecosystem integrity and functions are declining. Ten out of every fourteen terrestrial habitats have seen a decrease in vegetation productivity and just under half of all terrestrial ecoregions are classified as having an unfavourable status.

Native and non-native invasive species threaten ecosystems, habitats and other species. The economic costs, both direct and indirect, amount to many billions of dollars annually.

Biodiversity loss is also an equity issue, disproportionately affecting poorer people, women and children. If current rates of decline continue, future generations will be deprived of the health benefits of biodiversity. The livelihoods of 70 per cent of people living in poverty directly depend on natural resources.

The critical pressures on biodiversity are habitat change, loss and degradation; unsustainable agricultural practices; the spread of invasive species; pollution, including microplastics; and overexploitation, including illegal logging and trade in wildlife. Illegal trade in wildlife, fisheries and forest products is worth between US$90 billion and US$270 billion per annum. There is evidence to suggest that climate change will pose the gravest threat in the future, as species, including disease vectors, migrate with temperature shifts.

Although governance efforts are progressing, greater efforts are required to achieve international objectives, such as the Aichi Biodiversity Targets within the United Nations Convention on Biological Diversity's Strategic Plan for Biodiversity 2011–2020, and the Sustainable Development Goals. Over 190 National Biodiversity Strategies and Action Plans have been submitted to the Convention, although their quality and reliability, as well their subsequent implementation, remains uneven; the Cartagena and Nagoya Protocols to the Convention provide a deeper governance context. There is increasing international collaboration between various law enforcement authorities in combatting illegal wildlife trafficking.

The science-policy interface for biodiversity and the contribution that nature makes to people was strengthened in 2012 through the establishment of the Intergovernmental Platform for Biodiversity and Ecosystem Services. Parties to the Convention on Biological Diversity are negotiating the post-2020 global biodiversity framework. Negotiations under the United Nations Convention on the Law of the Sea continue towards an agreement on the sustainable use and conservation of marine biological diversity beyond national jurisdiction.

Several multilateral environmental agreements provide additional governance architecture on biodiversity, including the Convention on Wetlands of International Importance especially as Waterfowl Habitat and the

Convention on International Trade in Endangered Species of Wild Fauna and Flora. The continual updating of the International Union for Conservation of Nature Red List of Threatened Species and other independent monitoring efforts, such as the Global Biodiversity Information Facility, the consideration of the multiple values of biodiversity and the inclusion of the value of biodiversity in national economic valuation methods, will support and inform the implementation thereof. Furthermore, there is a pressing need to expand ecosystem assessments to better understand the global state of ecosystems and the trends therein.

Protecting species and ecosystems requires conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising from the utilization of genetic resources. Species and ecosystems are most effectively safeguarded through the conservation of natural habitats and there is clear evidence that conservation can help to reduce biodiversity loss. Implementation, management and representative coverage of different ecosystems within protected areas remains insufficient. Less than 15 per cent of terrestrial habitats, including inland waters, and less than 16 per cent of coastal and marine areas within national jurisdiction are protected areas.

Biodiversity is slowly being mainstreamed or integrated into health, gender and other equity concerns through such efforts as the 2015–2020 Gender Plan of Action under the Convention on Biological Diversity and its relationship to the Convention's Strategic Plan for Biodiversity 2011–2020 and the achievement of the Aichi Biodiversity Targets. Indigenous peoples and local communities play a key role in biodiversity protection by offering bottom-up, self-driven and innovative solutions, based on traditional knowledge and the ecosystem approach. However, protected areas can adversely affect indigenous communities if access to natural resources within protected areas is denied.

Ex situ conservation of genetic material provides safeguards for maintaining adaptive potential, in particular of crop and agricultural species. Gene banks and seed collections complement in situ conservation of genetic resources, yet the conservation status of genetic diversity for most wild species remains poorly documented. Yet accelerating biodiversity loss and the large, escalating costs of inaction, including numerous threats to human health, require an urgent increase in global investment in sustainable use and conservation, and the consistent integration of biodiversity concerns into all facets of economic and social development.

Greater focus on strengthening governance systems; improving policy frameworks through research; policy integration; implementation; and encouraging partnerships and participation, are all measures that have the potential to address the greatest pressures on biodiversity. Efforts to combat biodiversity loss must also address poverty eradication, food security challenges, gender inequality, systemic inefficiencies and corruption in governance structures and other social variables.

Identification of the countries of origin of genetic resources, in accordance with the Convention on Biological Diversity and the Nagoya Protocol thereto, will help to ensure progress against the objectives of those instruments and the fair and equitable sharing of benefits arising from the commercial utilization of those resources with such countries.

7.6 Oceans and Coasts

Given that we share our oceans with all the nations of the world, the United Nations Environment Programme's [UNEP 2019 Global Environmental Outlook (GEO 6)] provides an up to date outlook in respect of oceans and coasts at an international level –

The principal drivers of change facing oceans and coasts are ocean warming and acidification, ocean pollution and the increasing use of oceans, coasts, deltas and basins for food production, transportation, settlement, recreation, resource extraction and energy production. The main impacts of those drivers are marine ecosystem degradation and loss, including death of coral reefs, reduced marine living resources and the resulting disturbance of marine and coastal ecosystem food chains, increased nutrient and sediment run-off and marine litter. Those impacts interact in ways that are just beginning to be understood and their interaction may amplify their effect. If left unaddressed, there is a major risk that they will combine to produce a destructive cycle of degradation and that the ocean will no longer provide many vital ecosystem services (for example, livelihoods, income, health, employment, and aesthetic, cultural and religious values).

More effective compliance, enforcement and other instruments are needed, as current efforts are not sufficient to achieve the aims of the Sustainable Development Goals, particularly Goal 14. Interventions based on emerging technologies, taking into account a precautionary approach, in accordance with international agreements (where applicable), and strategic management approaches, such as [resilience]-based management and ecosystem-based management, can contribute to improved conservation of marine ecosystems and marine living resources.

A holistic, integrated monitoring and assessment of the marine environment needs to be fostered hand in hand with the implementation of pollution reduction measures to achieve and maintain the targets of "Good Environmental Status" of the marine environment, including harmonization of assessment criteria and methods at all levels. To be effective, such measures should be combined with actions to mitigate and adapt to climate change and reduce the input of pollution and litter to the oceans while promoting their conservation and sustainable use.

The rate of human-induced release of greenhouse gases is driving rising sea levels, changes in ocean temperatures and ocean acidification. Coral reefs are being devastated by those changes. Mass coral bleaching, induced by chronic heat, has damaged many tropical reefs beyond recovery. The collective value of coral reefs has been estimated at US$29 billion per annum. The loss of coral reefs has an impact on fisheries, tourism, community health, livelihoods and marine habitats. Interventions based on emerging technologies and sustainable management approaches (such as [resilience]-based management, integrated coastal zone management and ecosystem-based management) are key to building [resilience] and may help to preserve some areas of reef, but Governments should prepare for a dramatic decline (if not a collapse) of coral reef-based industries and ecosystem services, as well as negative effects on food chains related to the decline and collapse of coral reefs.

The oceans play an important role in the global economy and are likely to become increasingly important. Fisheries and aquaculture currently generate US$252 billion annually. Small-scale fisheries support the livelihoods of between 58 million and 120 million people. Fish provide 3.1 billion people with over 20 per cent of their dietary protein and contain nutrients important for their health. Ensuring the sustainability of capture fisheries and aquaculture requires significant investment in monitoring, assessment and operations management and, in many cases, strong local community-based approaches. Investment in fisheries monitoring and gear technologies can improve selectivity of target species when harvesting and reduce habitat impact, both in ocean fisheries and aquaculture.

Measures to minimize the effects of fishing on the ecosystem have had mixed success. Where resource assessments and monitoring, control, and surveillance and enforcement measures are not available, overfishing and illegal, unreported or unregulated fishing continues and may be expanding.

Marine litter, including plastics and microplastics, is now found in all oceans, at all depths. The scale and importance of the problem has received increasing attention in recent years, but there are still large gaps in knowledge. Current estimates suggest that input of plastic marine litter linked to domestic waste mismanagement in coastal areas amounts to some 8 million tonnes annually, 80 per cent of which originates from land-based

sources. Marine plastic litter can result in a significant ecological impact from entanglement and ingestion, and can also act as a vector for the transport of invasive species and other pollutants. Abandoned, lost or otherwise discarded fishing gear (ALDFG) is a major source of marine litter. Not only is ALDFG highly harmful, it also reduces numbers of fish stock and constitutes a significant economic threat, given its ability to damage maritime vessels, fisheries and ecosystem services. The growing presence and abundance of microplastics has potential adverse effects on the health of both marine organisms and humans. Furthermore, marine litter has a significant economic impact on a range of coastal sectors, such as tourism and recreation, shipping and yachting, fisheries, aquaculture, agriculture and human health. The damage to fishing gear in Europe alone is estimated at more than US$72 million per annum and the cost of cleaning beaches is estimated at US$735 million per annum, a figure which is increasing.

Improving waste management, including recycling and end-of-life management, is the most urgent short-term solution to reducing input of litter to the ocean. Longer-term solutions include improved governance at all levels, and behavioural and systemic changes that reduce plastic pollution from the production and use of plastic, and increase recycling and reuse. A holistic and evidence-based approach, taking into account the full life-cycle approach to waste management should be applied.

Cleaning up coasts and beaches can provide environmental, social and economic benefits, and trapping surface litter in the ocean may be effective in small areas, but such efforts should not distract from action to stop litter entering the ocean. While many relevant international agreements exist, there is no global agreement that addresses the issue of marine litter and microplastics in a comprehensive and integrated manner. Coordination and cooperation between international bodies could be enhanced to progress international agreement.

Policy-sensitive indicators used to track progress in addressing key pressures and drivers may not fully capture the multiple dimensions of pressures and drivers. Area-based indicators, such as Aichi Biodiversity Target 11 on the coverage of marine protected areas under national jurisdiction, do not alone establish that such areas are effectively managed; nor can they guard against the impact of climate change or pollution. Efforts to develop methods to evaluate the effectiveness of protected areas and their contribution to overall ocean health are therefore critical. The lack of standardization and compatibility between the methods used and the results obtained in various bottom-up projects makes an overall assessment of the status of marine litter across large geographic areas difficult.

8 What are we doing about it and is it working

In the context of the driver–pressure–state–impact–response (DPSIR) Model, a 'response' is how we respond to the negative impacts of the drivers, pressures, state and/or impacts on the South African society economy and environment. These responses include policy and legislative responses as well as plans, projects and other interventions and the following sections provide an insight into these responses.

8.1 Compliance and enforcement

As at 2018, there are 2973 [Environmental Management Inspectors (EMIs)] designated across the country, comprising 2640 national and provincial EMIs, a 2.4% increase from 2017, and 333 municipal EMIs. 1723 (65,2%) of the national and provincial EMIs are Grade 5 EMIs (Field Rangers employed at national and provincial parks authorities). SANParks (836), Ezemvelo (667), Limpopo DEDET (256), Department of Environment, Forestry and Fisheries (166), Eastern Cape Parks (158) and North West Parks (82) have the most EMIs (majority are Grade 5 Field Rangers except for Department of Environment, Forestry and Fisheries) followed by Western Cape DEADP (73), KZN DEDTEA (68), and Gauteng DARD (53), while Mpumalanga DARDLEA (9), Isimangaliso (8) and SANBI (8) have the least. EMIs at the local authority level have slightly increased over the past three financial years from 236 in 2015/16, 303 in 2016/17 and 333 in 2017/18.

In terms of the enforcement of environmental legislation, there has been a decrease in the number of criminal dockets registered from 1527 in 2016/17 to 1257 in 2017/18. The total number of [admission of guilt fines (J534s)] issued has slightly decreased from 1010 for 2016/17 to 872 in 2017/18. This shows a decrease of 13.7% between 2016/17 and 2017/18. The total value of [admission of guilt fines] paid has decreased from R 393 291 in 2016/17 to R 251 300, showing a decrease of 36.1% in 2017/18. The number of criminal dockets handed to the NPA has generally increased from 293 in 2015/16 to 416 in 2016/17 and 446 in 2017/18. The total number of arrests made by EMIs has slightly decreased from 1092 in 2016/17 to 926 in 2017/18. The total number of acquittals remain unchanged at 10 in 2016/17 and 2017/18. Convictions reported have decreased from 76 in 2016/17 to 53 in 2017/18, showing a 30% decrease. There has been a general decrease in the number of plea and sentence agreements concluded from 13 in 2015/16 to 11 in 2016/17 and 8 in 2017/18. The total number of warning letters issued has increased from 296 in 2016/17 to 324 in 2017/18 which equates to an increase of 9.4%. The total number of administrative notices issued have slightly increased from 1071 in 2016/17 to 1093 in 2017/18. The number of civil court applications has decreased from 7 in 2016/17 to 2 in 2017/18. There has been a slight increase on the total value of Section 24G administrative fines paid from R 9 766 445,22 in 2016/17 to R 10 064 949 in 2017/18.

With respect to compliance monitoring there was a total number of 4210 facilities inspected in 2017/18, which reflects a 3.7% increase from the 4059 facilities inspected in 2016/17. Of the total number of facilities inspected, 45.1% (1900) were against brown legislative requirements, while 42.50% (1793) were in the green subsector and 12.2% (517) were inspected against blue issues. There has been an increase in the total number of proactive inspections conducted from 2474 in 2016/17 to 2733 in 2017/18, which shows the 10.46% increase. The total number of reactive inspections conducted in 2017/18 amounted to 1477, which reflects a 17.31% increase from the 1259 conducted in 2016/17. The total number of non-compliances detected during inspections has been recorded as 2894 in 2017/18 compared to 1223 in 2016/17. Percentages of non-compliances detected by the Department of Water and Sanitation amounted to 14% for both blue and brown issues. Of the total number of non-compliances detected, 2548 of brown, 14% of blue and 131 of green required follow-on enforcement action. A total of 3184 inspection reports were finalised in 2017/18 which shows a slight decrease compare to the 3428 inspection reports finalised in the 2016/17 financial year. Of the 4210 inspections conducted, 1495 were reactive in nature

and triggered by complaints, 1255 were based on environmental authorisations and permits, while 1232 were considered routine inspections on prioritised sectors. 228 inspections were triggered by S30 incident reports, while others were follow-up inspections. EMIs from the local authorities within Gauteng, KwaZulu-Natal and North West submitted their inspection statistics for this reporting period, amounting to a combined total number of facilities inspected equalling 89 and the number of non-compliances detected was 151.

From an institutional and spatial perspective, SANParks recorded the highest number of criminal dockets registered at 498, followed by Limpopo DEDET with 217. The third highest was Ezemvelo with 139 dockets registered while DWS and Free State DESTEA recorded 2 criminal dockets, and KwaZulu-Natal DEDTEA recorded 0 criminal dockets registered. Limpopo DEDET recorded the highest number of arrests at 306, followed by SANParks which recorded 220 and Ezemvelo recorded 120 arrests. SANParks issued the highest total value of [admission of guilt fines (J534s)], amounting to R 192 450 from the 276 fines issued, followed by Limpopo DEDET with a value of R 176 750 from 409 fines issued. With a total of 263, WCDEADP recorded the highest number of enforcement notices comprising of 124 pre-compliance, 59 pre-directive, 52 compliance notices and 28 directives. Secondly, Department of Environment, Forestry and Fisheries recorded 239 enforcement notices - 74 pre-directives, 151 pre-compliance, 7 directives and 7 final compliance notices. DWS followed by issuing 167 notices comprising of 138 pre-compliance notices and 29 directives and SANParks, CapeNature, Free State DEDTEA, Ezemvelo, Eastern Cape Parks, North West Parks Board and Mpumalanga Parks reported no enforcement notices. KwaZulu-Natal DEDTEA issued 120 warning letters, the highest of the EMI Institutions. They were followed by Eastern Cape DEDEA who issued 69 warning letters. Gauteng DARD recorded the highest value of fines paid pursuant to Section 24G in the sum of R 4,358,449.00 followed by Western Cape DEADP which recorded R 2 869 500 while the Mpumalanga DARDLEA recorded R1 180 700, Limpopo DEDET recorded R 459 300 and Northern Cape DENC contributed with R 145 000. North West DREAD recorded the highest number of facilities inspected at 1277 of which 368 were in respect of brown issues, 15 were blue issues and 894 in respect of green. This was followed by KwaZulu-Natal DEDTEA with 712 (712 brown) and DWS with 489 (489 blue issues). Department of Environment, Forestry and Fisheries recorded the highest number of non-compliances detected at 1045 during the execution of compliance inspections, followed by KZN DEDTEA with 381, followed by Eastern Cape DEDEA with 238, Western Cape DEADP and Gauteng recorded having detected 153 non-compliances each. Other EMI institutions recorded less than 100 non-compliances detected.

At the national level, the total number of complaints and section 30 incidents reported through the various reporting channels in 2017/18 was 748, which indicates a decrease of 11.5% (97) from 845 in 2016/17. The reported number of incidents in terms of section 30 of NEMA has decreased from 170 in 2016/17 to 115 in 2017/18, while the number of complaints reported decreased by 20.3% from 728 in 2016/17 to 633 in 2017/18. The highest number of section 30 NEMA incidents reported came from the power generation sector which amounted to 39% (45) followed by trucks and rail transport comprising 22% (25) of the total 115 reported incidents. There has been a fluctuation in the reporting of certain types of incidents, with a significant decrease in reports on illegal activities from 106 in 2016/17 to 68 in 2017/18, followed by the significant increase in spillages from 6 in 2016/17 to 112 in 2017/18, and reports of contraventions relating to import and export reported decreasing from 208 in 2016/17 to 88 in 2017/18. There has been a decrease in the number of complaints and incidents from all modes of reporting handled by Department of Environment, Forestry and Fisheries with 312 in 2017/18 from 375 in 2016/17, while complaints which were referred to DMR, DWS and provincial departments have decreased slightly.

Significant compliance and enforcement outcomes in 2017/18 include –

- The North West DREAD conducting the most inspections in the financial year by inspecting 1277 facilities in respect of 894 green issues, 368 brown issues and 15 blue issues.
- Using Section 42(1) of the Western Cape Nature Conservation Ordinance, 19 of 1974; Regulation 36 of GN R1111 of 1998, Cape Nature was able to secure the highest sentence of direct imprisonment without the option of a fine in the case of State vs. Qinghua Chen (Sea Point CAS 466/10/2016). In respect of Charge 1, the Illegal possession of ivory, the sentence was 5 years direct imprisonment, wholly suspended for 5 years. Charge 2, the illegal possession of abalone, 5 years direct imprisonment, wholly suspended for 5

years. A Prevention of Organised Crime Act, 1998 (Act No. 121 of 1998) confiscation order was issued to the value of R83 158 and the proceeds were paid into the Criminal Asset Recovery Account (CARA).

- Using Section 26(1) of NEMWA, Department of Environment, Forestry and Fisheries was able to secure the highest sentence for a pollution and waste case in the case of State v Oil Separation Services (Mokopane Regional Court Case No:751/2017). The company was found guilty of conducting an activity in the absence of a waste management licence. The accused was sentenced as follows: Count 2 and 3 was taken together and sentenced to a fine of R200 000 of which R150 000 was suspended for a period of 5 years. After the Accused was convicted, but before the sentence, the State applied for a confiscation enquiry order in terms of section 18(1) of the Prevention of Organised Crime Act, 1998 (Act No. 121 of 1998) was granted to the amount of R850 000 against the Accused.
- Gauteng DARD issued the highest number of section 24G fines - 59 were issued and paid with a total sum of R 4 358 449 being collected.
- DEADP issued the highest number of enforcement notices - 263 enforcement notices were issued, most related to the unlawful commencement of listed activities.
- SANParks issued the highest number of [admission of guilt fines] - 276 were issued to the sum total of R 192 450 SANParks NEM:PAA

8.2 Environmental Impact Governance - EIAs

The governance of environmental impact management in South Africa relies principally on Environmental Impact Assessments (EIA). The use of EIAs to regulate environmental impact management started in earnest in the 1970s in the United States in response to their National Environmental Protection Act of 1970 with other countries like Australia soon following. During this first decade of EIA the environment was fragmented into discrete components in order to assess specific impacts of actions - such as impacts on air, water and soils. During the 1980s public participation and social aspects of developments were introduced. Scoping was also developed as the tool to identify and focus on the important aspects.

In South Africa, although EIAs were used to some degree on a voluntary basis from the late 1980s, EIA was introduced as a legal requirement in terms of the Environment Conservation Act, 1989 (Act No. 73 of 1989) (ECA). The EIA Regulations promulgated under the Environment Conservation Act (ECA) (Government Notice No. R. 1182 & R. 1183) came into effect on 5 September 1997 and identified listed activities that were subject to the process.

Following the adoption of the 1996 Constitution, the [National Environmental Management Act, 1998 (Act No. 107 of 1998)] (NEMA) was enacted to give effect to the environmental right contained in section 24 of the Constitution. Chapter 5 of NEMA, entitled "Integrated Environmental Management" identifies various environmental instruments including environmental management frameworks, strategic environmental assessments, environmental management programmes and, significantly, environmental impact assessments.

In 2006, environmental impact assessment regulations were promulgated in terms of NEMA (the "2006 EIA Regulations"). In terms of the 2006 EIA Regulations activities requiring environmental authorisation before being undertaken were identified. The 2006 EIA Regulations became effective on 2 July 2006. As with the EIA Regulations that preceded them, under the Environment Conservation Act, the 2006 EIA Regulations were the subject of significant judicial attention.

In 2007, government together with the environmental sector agreed that the EIA process required a review after 10 years of implementation. To this end, a 10 Year Review of the Effectiveness and Efficiency of EIA in South Africa was compiled and published in 20018. A key finding was that there was a need to significantly improve both the effectiveness and efficiency of EIAs as regulated by the ECA and NEMA regulations.

On 2 August 2010, the 2006 EIA Regulations were repealed and replaced by new environmental impact assessment regulations – the "2010 EIA Regulations" – which took the findings and recomendadtions of the 10 year EIA review into account.

In 2014, the so-called 'one environmental system' came into effect which made the NEMA regulated EIA process the only environmental impact management governance process. Up to that point, for example, the environmental impacts of mining were managed through a separate regulatory system. To this end, the [National Environmental Management Act, 1998 (Act No. 107 of 1998)] (NEMA), the [Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)] (MPRDA), the [National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004)] (NEM: AQA), the [National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)] (NEM: WA), and [National Water Act, 1998 (Act No. 36 of 1998)] were amended to give effect to the one environmental system. Although this means that the department responsible for mining still regulates the environmental impact of mining activities, it does so using the NEMA EIA process. Furthermore the one environmental system has made the Minister of Environmental Affairs the appeal authority in terms of EIA decisions and assessment timeframes are fixed and synchronised.

With this background, South Africa's High Court emphasized the importance and rightful place of environmental assessment in South African law in the 'HTF Developers v Minister of Environmental Affairs and Tourism' case as follows –

> *"The principle of environmental assessment as the means of ensuring …equality is the practical cornerstone of the principles of sustainable development and equitable use of our natural resources*

> *and environment. Moreover, the principle of environmental assessment is premised upon and interrelated to a precautionary principle, mandating a risk-averse and cautious approach."*

With this, the overall objective of EIA is –

> *to ensure the progressive realisation of the environmental right described in Section 24 of the Constitution of the Republic of South Africa, promote the Section 2 Principles of NEMA, achieve sustainable development as defined in NEMA and relevant case law, and ensure the realisation of section 33 of the Constitution which requires just administrative action.*

The environmental assessment process is used to understand the potential environmental impacts of a development, and to inform environmental decision-making before the development (and more particularly, the listed activities that require environmental authorisation under NEMA) is authorised. The information recorded during the EIA process provides the basis for a decision to grant (with or without conditions) or refuse authorisation in respect of a given application, and with regard to the authorisation of an application, informs the selection of the most appropriate alternative.

"Environment" is widely defined in terms of NEMA and includes both anthropogenic (e.g. human health and socio-economic considerations) and ecological components (e.g. flora and fauna). This broad definition of the term "environment" requires that the EIA process is more holistic in that it takes account of a broader range of considerations than those associated with the natural environment alone. Such an approach does however also reduce the significance of natural environmental aspects. In essence, EIA is a process that must at all times seek to facilitate the attainment of sustainable development through the careful assessment of all relevant considerations so as to appropriately inform environmental decision-making.

EIA is as much based on scientific approaches as it is on legal and administrative procedures. In this regard the process is essentially aimed at achieving the following objectives:

- Short term objectives:
  - provide information for decision-making by officials employed by the competent authority, as well as any appellate authority in due course, in terms of the environmental consequences of proposed activities;
  - promote environmentally sound and sustainable development through the identification of appropriate enhancement and [mitigation] measures;
  - improve the environmental design of the proposal;
  - ensure that resources are used appropriately and efficiently;
  - identify appropriate measures for mitigating the potential impacts of the proposal; and
  - facilitate informed decision-making, including setting the environmental terms and conditions for implementing the proposal.
- Long-term objectives:
  - protect human health and safety;
  - avoid irreversible changes and serious damage to the environment;
  - safeguard valued resources, natural areas and ecosystem components; and
  - enhance the social aspects of the proposal.

Essentially these objectives reflect international environmental best practice of integrated environmental management.

In the South African context, Chapter 5 of NEMA establishes the principle of Integrated Environmental Management (IEM) as the cornerstone of environmental management.

According to Section 23 of NEMA the general objectives of IEM are to:

- ensure that all decisions that significantly affect the environment are taken in light of the environmental principles in Section 2 of NEMA;

- identify, predict and evaluate the –
  - actual and potential impact on the environment, socio-economic conditions and cultural heritage, and
  - risks, consequences, alternatives and options for [mitigation] of activities; in order to minimize negative impacts and maximize benefits and promote compliance with principles of environmental management of Section 2 of NEMA;
- ensure proper consideration of the effect of activities on the environment before commencement;
- ensure adequate and appropriate opportunity for public participation in environmental decision-making;
- ensure that environmental attributes are borne in mind in management and decision-making matters that may impact significantly on the environment; and
- identify and use the best ways of environmental management to ensure that the environment principles in Section 2 of NEMA are introduced.

The following sectors are subject to EIAs due to the potential significance of their environmental impacts and their significance in terms of contribution to the national economy and NDP goals:

- Mining (e.g. open cast, underground, minerals processing, small and large ranging from sand mining to fracking);
- Agriculture (e.g. feedlots, broilers, abattoirs, etc.);
- Energy (e.g. coal fired power stations such, transmission infrastructure, renewable energy projects, etc.);
- Tourism (e.g. access and accommodation infrastructure in national parks, etc.);
- Housing (e.g. high cost country, golf and lifestyle estates; low cost housing developments; mixed land use developments);
- Bulk Services Infrastructure and Transport (e.g. linear development such as rail and pipelines, etc.); and
- Waste Management (e.g. waste storage, waste processing activities, recycling, etc.).

The skill and competencies that underpin the EIA process include:

- The developer/applicant provides an understanding of the particular development and or sector
- Consultant and EAP provides project management and integrative thinking skills and competencies
- Specialists provide scientific skills and competencies
- Public/civil society provides inputs based on values, experience and local knowledge
- Administrators/officials provide administrative and review skills and competencies
- Judiciary provides judicial skills, oversight and interpretation of legislation

The EIA activities as prescribed in the EIA regulations include: Screening, Scoping, assessment and evaluation, PPP, review and appeals

Reports that contain information that enable the government agencies (known as 'Competent Authorities' to take informed decision about the environmental impact management of specific developments include: Scoping and EIA Reports, Basic Assessment Report (BAR) and Environmental Management Plans (EMPs).

In terms of how EIA is expected to achieve its objectives –

- EIA recognises the validity of quantitative and qualitative data, thereby accommodating more subjective elements of impact predictions, values and views as well as objective evidence. EIA is understood to be both value judgement and scientific.
- The state is mandated to authorise and regulate activities, after considering the potential consequences or impacts of these activities on the environment.

- Legislation provides clear procedural and content requirements as the basis for decision making, which requires decisions to be procedurally fair, lawful and reasonable (rational and proportional).
- The decision making mandate is vested with provincial and national spheres of government where administrative capacity is provided. Skill requirements are prescribed for environmental assessment practitioners (EAPs) in legislation and qualification standards. In terms of skills training, significant progress seems to have been made with personnel in most provinces having sound qualifications, although overall staff shortages and inexperience are highlighted as key challenges.

With respect to how well the EIA process been efficiently implemented, anecdotal evidence suggest that EIA processes are generally conducted within set legal timeframes and that effective frameworks for monitoring procedural efficiency exist in government. However, serious questions are being asked as to what extent the drive for procedural efficiency is eroding the potential benefits of EIA in terms of improving decision making and providing for transparency and participation.

With respect to the quality of EIA reports and processes –

- Report quality has been evaluated over time as well as for different provinces and sectors.
- Overall report quality decreased slightly from the ECA (pre 2006) to the NEMA regime (post 2006).
- Lower quality grades are achieved for dealing with impact identification, alternatives, [mitigation] and significance.
- Higher quality grades are achieved for dealing with more descriptive and presentational areas of evaluation.

With respect to the economic impact of the EIA process on identified sectors –

- There is no existing literature on the full economic impact of EIA on specific sectors in South Africa.
- Determining the economic impact of EIA is exceedingly difficult from a conceptual and methodological perspective.
- Research suggests that the average direct cost of EIA in South Africa is particularly low compared to international EIA systems.
- As a percentage of total project costs, EIA in South Africa compares with the higher spectrum of international practice. This suggest that a large number of EIAs are being conducted for relatively small scale projects, which might be placing a notable cost burden on small and medium enterprises.

With respect to how EIA has influenced decision making –

- EIA has significant mandate to positively influence decision making towards sustainable development.
- There is limited empirical research on the extent to which EIA influences decision making with most research focussing on post-decision follow-up. South Africa has made significant strides in law and administrative arrangements to deal with compliance monitoring and follow-up.
- Research emphasises the importance of post decision monitoring and adaptive management to deal with unforeseen impacts.

In terms of the extent to which the EIA process been effective in achieving its objectives towards sustainable development –

- There is limited research available on the extent to which EIA has delivered sustainability and/or more sustainable outcomes.
- There seems to be ignorance amongst both officials and practitioners in respect of the sustainable development mandate and purpose of EIA.
- Research has demonstrated that in the South African context EIA already has a very strong and explicit sustainability mandate which means that the challenge for EIA does not lie with the mandate (or the establishment of appropriate enabling legislation) but rather with giving effect to this mandate in practice.

- Particular challenges in applying sustainability thinking in EIA is related to incorporating longer term thinking and dealing with uncertainty.

The main potential impacts or contributions of EIA are seen to include –

- The promotion of sustainability in decision-making
- The promotion of wellbeing through a safer environment
- The establishment of an environmental assessment profession
- The promotion of public participation
- The increase in environmental awareness
- The reduction in the commencement of unlawful developments
- The reduction in legal interpretation queries – people now better understand the EIA requirements
- The reduction in appeals
- Improvements in granting administratively just decisions
- Improvements in the statistics for all authorisations granted or refused.

8.3 Climate Change

In terms of climate costs, given the significant vulnerabilities identified across the sectors of water, agriculture, forestry and health, and for urban and rural settlements, the coastal zone and ecosystems, there is a strong case for an important future area of work in vulnerability analysis, namely the estimation of climate costs. It is important to quantify how future changes in the mean climate and in the attributes of extreme events may increasingly impact on the South African economy. Such costs may be incurred directly through for example reduced crop yield and damage in infrastructure, but also indirectly through downstream effects to the economy (e.g. reduced crop yield leading to increasing food prices). Moreover, it is important to estimate to what extent investments in [adaptation] interventions can alleviate climate costs, as a justification for these interventions. Such cost estimations will be of immense value for South Africa (and for developing countries in general) to negotiate fair support from for example the [Adaptation Fund of the United Nations Framework Convention on Climate Change (UNFCCC)]. It is important for such estimations of climate costs, and the costs of [adaptation] investments, to be performed against the background of the socio-economic futures of South Africa – this is due to the strong dependence of climate vulnerability on the socio-economic state of a country. An increased research thrust is therefore also needed for the development of socio-economic futures for South Africa, including how these futures may be influenced by a changing climate.

In terms of [adaptation] options, South Africa has presented its commitment to responding to climate change challenges through the development of the [2011 National Climate Change Response Policy White Paper]. However, the country is a developmental state that seeks to develop the economy and reduce the levels of inequality and poverty experienced. It is recognised that climate change is likely to impact on the ability to meet these development goals. As such the country has presented its commitment to tackling climate change through the development of its [Intended Nationally Determined Contributions] (INDCs). The INDC outlines the overall aspirations for [adaptation] and provides the timelines and levels of investment needed to achieve these goals. Whilst the INDC represents the broader vision for [adaptation] planning that is aligned with the [National Development Plan 2030], significant progress has already been made with respect to developing the [adaptation] response strategies that are aligned to short-to-medium term policies and strategies.

At a sectoral level, [adaptation] plans have been developed for the key socio-economic sectors identified in the NCCRP as being vulnerable to climate change. In the water sector for example, the Climate Adaptation Strategy for the sector outlines a number of strategic [adaptation] actions for addressing climate change impacts. These options range from planning for new dams to developing new groundwater sources and further highlights the need to improve flood warning systems and to ensure that water allocation is sufficiently flexible to cope with climate change. Importantly, the strategy also highlights the need to protect water allocations to poor and marginalised communities, particularly under drought conditions.

In the case of Agriculture, Forestry and Fisheries, sector-related climate change strategies have also been initiated which includes a Climate Change Sector Plan and a Climate Change Adaptation and Mitigation Plan that addresses agriculture and forestry. Climate Change Adaptation Plans have also been developed for South Africa's Biomes, presenting potential [adaptation] responses to guide current and future decision makers in protecting South Africa's natural ecosystems and biodiversity in the face of climate change. A climate change [adaptation] plan has been developed for the health sector that focusses on nine health and environmental risks and further seeks to improve health systems readiness to climate change. [Adaptation] planning within South African cities is occurring alongside the need to address the problems of poor spatial and development planning inherited from the apartheid era. Human settlement typologies in the country are diverse, each with its own set of developmental challenges and potential to be impacted by climate change. A Climate Change Adaptation Sector Plan for Rural Human Settlements has been developed to support the creation of sustainable livelihoods that are resilient to climate change. This plan calls for access to climate resilient services and infrastructure in rural areas to be promoted through climate resilient rural housing programmes that include rainwater harvesting, solar water heaters and off-grid/mini grid electrification, environmentally-friendly and socially acceptable sanitation solutions. In addition to this plan, policies that impact on human settlement design and development require the inclusion of climate change considerations. For example, spatial planning and land-use management legislation requires

incorporating environmental requirement such as climate change. The [National Environmental Management: Integrated Coastal Management Act, 2008 (Act No. 24 of 2008)] also requires that coastal provinces and municipalities develop management programmes that allow for potential climate change impacts to be taken into account in all coastal planning and management. Further to this, amendments to the country's disaster risk management legislation require all organs of state to not only indicate how it will invest in disaster risk reduction but also climate change [adaptation]. As such, at both a provincial and local government level, numerous [adaptation] plans have been developed or are underway. At a national level, the country has also embarked on a process to develop a National Adaptation Strategy that will consolidate and prioritise these local, provincial and sectoral [adaptation] options. The country has also recognised that it has a responsibility to effectively report on its [adaptation] initiatives and investments, and has thus developed a Monitoring and Evaluation (M&E) system that will be used to track progress toward becoming climate resilient.

New insights are emerging through observed ecosystem and species changes and improved modelling methods (Dynamic Global Vegetation Modelling, DGVM), relating to structural shifts in biomes. These are updating earlier broad projections developed through application of correlative niche based modelling (NBM) approaches. Woody encroachment of the Grassland and Savanna biomes appears to be a major ongoing climate-change related trend, which was not fully anticipated by earlier modelling efforts. This may be because direct effects of rising atmospheric CO_2 on vegetation are emerging as a potential driver of woody plant encroachment.

The high inherent variability in southern African rainfall and variance between impacts methodology together reduce the precision with which projections of climate change impacts on biodiversity and ecosystems can be made. As a consequence, a deliberate monitoring program to enhance detection and attribution of climate change impacts on biodiversity and ecosystems would be a valuable planning and policy support intervention.

As mentioned above, there is no national scale, directed effort to monitor biodiversity changes specifically to test for climate change impacts. However, several efforts launched for purposes of inventory and stock taking, such as the South African National Bird Atlas Program (SABAP), and the Protea Atlas initiative, can be leveraged through repeat data gathering to serve this purpose.

The concept of vulnerability has become increasingly important in the climate change research community, with extensive developments taking place in the vulnerability assessment field over the last few decades. The complexity involved in defining and measuring the various geographical, spatial, temporal and social dimensions of vulnerability has resulted in a multitude of methodologies for assessing and understanding vulnerability. As a consequence there is generally a lack of consensus regarding the appropriate frameworks and 'best' methodologies for assessing vulnerability. In South Africa, there is no standard approach or best practise guidelines for measuring vulnerability. This makes monitoring of vulnerability and the evaluation of [adaptation] measures considerably challenging, and precludes comparing different sectors or localities as well as assessing vulnerability over time. However, initiatives are underway to strengthen future vulnerability assessment work in South Africa by building on a number of currently available tools such as the [Let's Respond Toolkit], [South African Risk and Vulnerability Atlas (SARVA)], and the [Climate Change Response Plan Toolkit]. This notwithstanding, building on South African expert insights and recommendations, practical translations of how to conduct vulnerability assessments are available as are a number of South African case studies. In South Africa, there is a constantly growing body of sectoral knowledge on climate change vulnerability. The country saw a great expansion of information from the 2011 [Second National Communication (SNC) to the United Nations Framework Convention on Climate Change (UNFCCC)] to the much more detailed and in-depth [Long-Term Adaptation Scenario (LTAS)] reports (2013/2014).

In terms of South Africa's climate change [mitigation] undertakings, the South African Constitution is the supreme law governing the country and all other laws and policies need to align with it. Key policies and measures guiding the country's efforts to stabilise GHG emissions have been developed in conjunction with private sector and civil society. A number of these policies and measures incorporate a climate change focus, demonstrating the nation's commitment to [mitigation] and [adaptation] efforts.

These policies include the 2010 [New Growth Path Framework], the [2011 National Climate Change Response Policy White Paper] and the 2012 [National Development Plan 2030]. The government has also made significant investments in research and [mitigation] activities to ensure the national climate change goals are met, for example, the 2008 [Long Term Mitigation Scenarios study] and the [Mitigation Potential Analysis] that followed in 2014.

South Africa is actively driving future [mitigation] measures to respond to climate change by means of, for example, the recently promulgated [Carbon Tax Act, 2019 (Act No. 15 of 2019)] which provides for the imposition of a tax on the carbon dioxide equivalent (CO_2e) of greenhouse gas emissions. Other key anticipated activities to support [carbon tax] include the development of desired emission reduction outcomes and company level [carbon budgets]. South Africa has also implemented many sector specific climate change initiatives in the energy, industry, transport, agriculture forestry and other land use and waste sectors.

In the energy sector, South Africa's policies and measures to mitigate climate change broadly aim to provide support for [mitigation] actions, diversify electricity generation and liquid fuel sources, facilitate carbon capture and storage, promote energy efficiency and reduce coal bed methane. Government's initiatives include the Department of Energy's [Renewable Independent Power Producer Procurement Programme], which has been widely recognised as an innovative and successful measure for developing the local renewable energy market. A further highlight is the cumulative, national energy efficiency savings of at least 23% which occurred between 2000-2012. These energy efficiency savings surpassed the target of 12% outlined in the National Energy Efficiency Strategy.

In terms of industry, one of the actions of the [National Development Plan 2030] in the context of climate change related to the industry sector is the carbon-pricing mechanism. [Carbon pricing] is supported by a wider suite of policy [mitigation] instruments to drive energy efficiency. Green industry investments are a key focus area and updates are made annually through the Industrial Policy Action Plan. In this sector, the Department of Trade and Industry has provided various incentives related to the development and use of green technologies adding to the [mitigation] efforts in the sector. [Mitigation] initiatives are also supported by National Treasury through various tax rebates in the amended [Income Tax Act, 1962 (Act No. 58 of 1962]. The Department of Energy has been driving the development of low-carbon initiatives in the industry and South Africa is a host party to 56 registered projects and 35 registered programmes forming part of the [Clean Development Mechanism] (CDM).

The transport sector [mitigation] opportunities identified for the country fall under the following broad categories: modal shift; demand reduction measures; more efficient vehicle technologies; more efficient operations and alternative lower-carbon fuels. The Department of Transport leads the development of initiatives aimed at reducing emissions in the transport sector, the biggest being public transportation. Some of the activities that the country is developing and implementing include biofuel programmes as well as support of the local electric vehicle industry in South Africa through several strategic new technology interventions.

In terms of Agriculture, Forestry and Other Land Use, these sectors includes production and removal of emissions. There are three key policies that relate to climate change [mitigation]. The [National Forests Act, 1998 (Act No. 84 of 1998)] which supports activities that sequester GHG emissions such as those relating to sustainable management, conservation and protection of natural forests and woodlands. The 2005 [Woodland Strategy Framework for the Department of Water Affairs and Forestry] outlines [mitigation] principles for the sector. Woodlands which cover about 30% of the land surface area are important due to their fire [adaptation] potential and potential as carbon sinks or sources. The Draft Climate Change Sector Plan for Agriculture, Forestry and Fisheries of 2013 outline [mitigation] elements for this sector and promotes minimum tillage and land use changes that convert land from GHG sources to sinks.

In terms of waste, the two main policies for the waste sector are the [National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)] and the 2009 [National Policy on Thermal Treatment of General and Hazardous Waste] which recognise the significance of mitigating climate change. The 2011 [National Waste Management Strategy] (a legislative requirement of the Waste Act) promotes waste minimisation, re-use, recycling and recovery and has a key output of reducing the GHG emission to mitigate climate change and improve air quality. These objectives are supported by the 2011 [Municipal Waste Sector Plan] which highlights waste reuse, waste recycling and flaring or recovery of landfill gas.

South Africa has initiated the development of a National Climate Change Response Monitoring and Evaluation System Framework. The main objective of the system is to track the country's transition towards its long-term vision of a climate-resilient and lower carbon economy and society. [Mitigation] and lower carbon development strategies will be formulated for each significantly emitting sector or sub-sector. The strategies will include measurable and verifiable indicators for each programme and measure. The monitoring and evaluation system will cover all aspects of climate change monitoring and evaluation and will be coordinated by the Department of Environment, Forestry and Fisheries.

South Africa's projections for climate change mitigation form part of the 2014 [Mitigation Potential Analysis] process. As part of this process projections were made for 2020, 2030 and 2050 with projected GHG emissions trajectories categorised by the sectors, energy, transport (subcategory of energy), industrial processes and products use, agriculture forestry and other land use, and waste. A summary of the outcome of this work is provided in section [7 - What is the outlook] subsection [7.1.2 - Climate change mitigation].

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8.4 Air quality

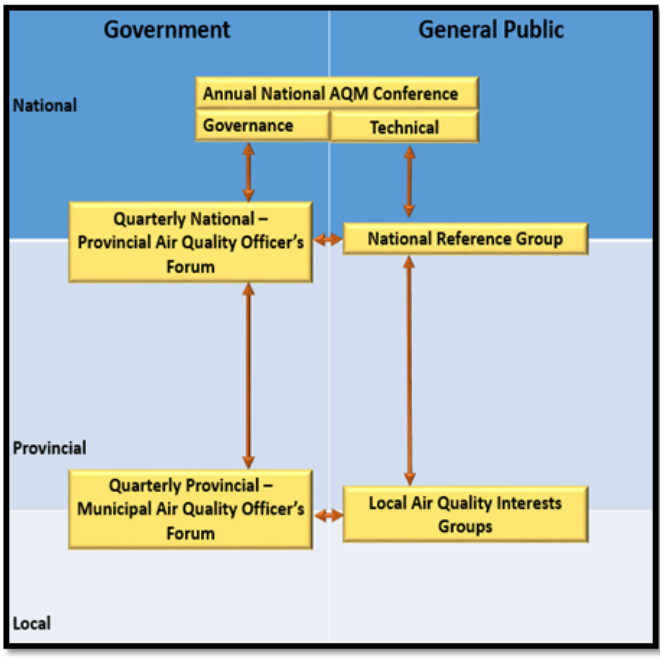
Intergovernmental coordination and cooperation is crucial to good air quality governance. Government has established several structures to ensure cooperative governance, as required by the [Constitution of the Republic of South Africa]. The primary functions of these structures is to share air quality information, share experiences, consultation, learn from one another, offer assistance and support to ensure effective and efficient cooperative governance.

The [2017 National Framework for Air Quality Management in South Africa] clearly describes the roles and responsibilities of government, industry, and civil society in all air quality management matters in its Chapter 3.

The [National Environmental Management: Air Quality Act, 2004 (Act no. 39 of 2004)] (NEM: AQA) represents a shift from the historical source-based air pollution control to an air quality management approach that focuses on the receiving environment. Key features of the legislation include:

- Setting ambient air quality targets as goals designed to drive emission reductions.
- Decentralizing air quality management responsibilities.
- Requiring all significant sources to be identified, quantified, and addressed.
- Recognizing source-based (command and control) measures in addition to alternative measures, market incentives and disincentives, voluntary programmes, and education and awareness-raising.
- Promoting cost-optimized [mitigation] and management measures.
- Stipulating air quality management planning by authorities, and emission reduction and management planning by sources.
- Promoting access to air quality information and public consultation in air quality management processes.

The [NEM: AQA] is relatively compact and concise despite the complexity of the issues that it regulates. As such, it is often referred to as a 'framework' legislation (that is, legislation providing an outline designed to accommodate further detail over time). This is the result of a decision taken early in the law-reform process to expedite the development and promulgation of the [NEM: AQA], and to address the inadequacies of the legislation it replaced (the [Atmospheric Pollution Prevention Act, 1965 (Act No. 45 of 1965) (APPA)]), by focusing on the 'big issues' yet at the same time offering scope for future detail both through the National Framework and regulations. South Africa has adopted the air quality governance system that can be described in terms of a simplified environmental governance cycle. The governance cycle provides a useful framework for achieving continuous improvement over time. An overview of each of the components is defined in the [2012 National Framework for Air Quality Management in South Africa].



Air quality governance structures

Since the promulgation of the NEM: AQA, numerous legislative tools have been put in place to give effect to various provisions of the NEM: AQA. Although these are detailed in full in the [NEM: AQA Information Sheet]: these include commencement notices; declarations of three air pollution Priority Areas (the [Vaal Triangle Air-Shed Priority Area (VTAPA)], the [Highveld Priority Area (HPA)], and the [Waterberg-Bojanala Priority Area (WBPA)]) and their associated air quality management plans; two National Frameworks for air quality management in the Republic of South Africa, the identification

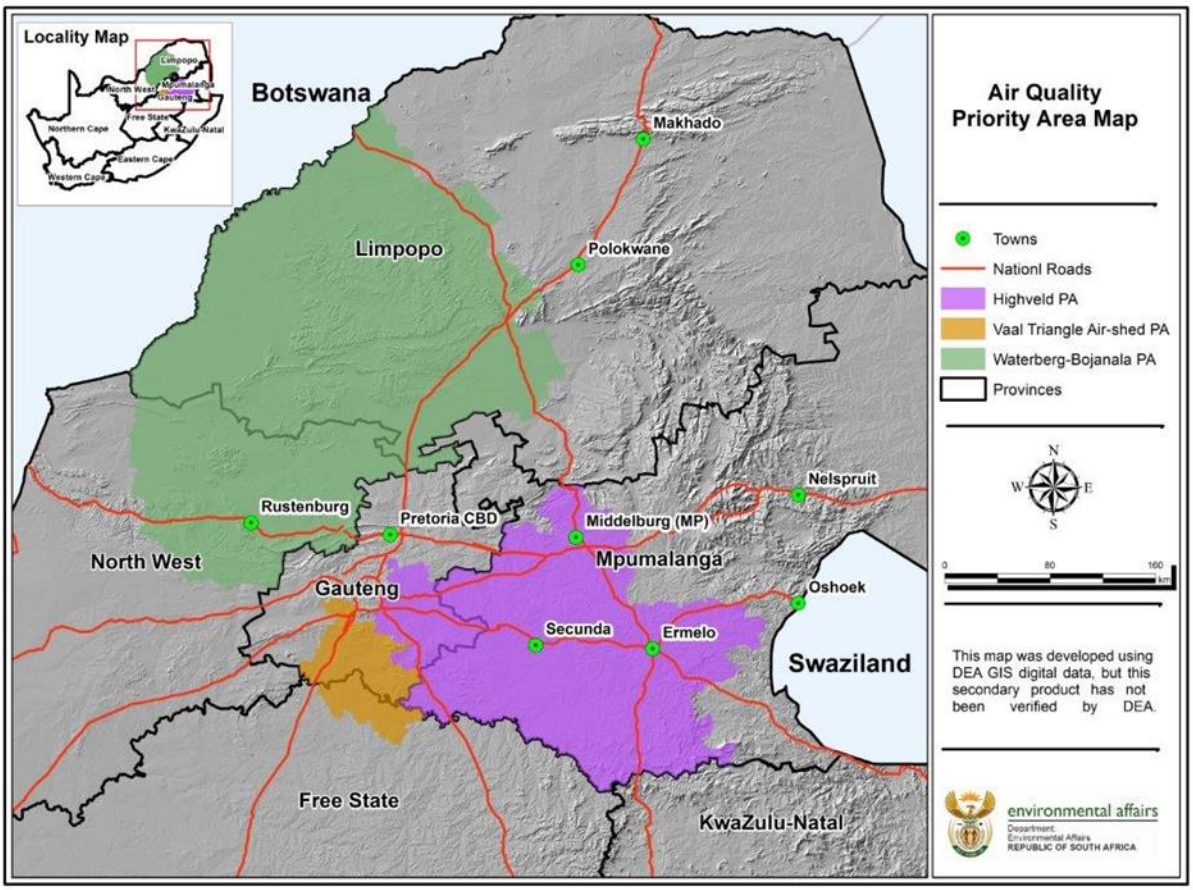
of priority air pollutants and their associated national [Ambient Air Quality Standards] (NAAQS) for the permissible amount or concentration of each substance in ambient air; the lists of activities requiring an Atmospheric Emission License and the minimum emission standards for each listed activity; regulations on model air pollution control by-laws to be adopted by municipalities; National Dust control regulations; National Greenhouse Gas emission reporting Regulations; the declaration of GHGs as Priority Air Pollutants; National Pollution Prevention Plans Regulations; Regulations prescribing the Format of atmospheric impact reports; the declarations of Small boilers, temporary asphalt plants, small-scale char and small-scale charcoal plants as controlled emitters with related emission standards; Regulations Regarding Air Dispersion Modelling; National Atmospheric Emission Reporting Regulations; Regulations prescribing the atmospheric emission licence Processing fee; Regulations for the procedure and criteria to be followed in the determination of an administrative fine; and Air quality offsets guidelines.

Air Quality Management Planning in the Southern African context forms the basis of the commitment to air quality improvement in the country. The NEM: AQA clearly stipulates the concept of effective air quality management planning as a way to achieve acceptable air quality by both government and industry. It recognises the different levels at which air quality must be managed and calls for all stakeholders to actively participate in efforts to safeguard and improve the quality of ambient air. It is for this reason that air quality planning starts at National and goes right through to the Local Municipal level with specific air quality priority areas recognised throughout the country. Air quality management planning is guided by Section 15 of the NEM: AQA which requires each national department or province responsible for preparing an Environmental Implementation Plan (EIP) or Environmental Management Plan (EMP) (in terms of Chapter 3 of the NEMA) to include as part of that plan an, Air Quality Management Plan (AQMP). It also requires Municipalities to include an AQMP in its Integrated Development Plan (IDP) (as required in terms of Chapter 5 of the Local Government: Municipal Systems Act, 2000 (Act No. 32 of 2000)).

These plans map out how the various government departments will:(a) coordinate and harmonize activities to minimize the duplication of procedures and functions, and promote consistency in the exercise of functions; (b) give effect to the principle of cooperative government in Chapter 3 of the Constitution, and enable the minister to monitor the achievement, promotion, and protection of good air quality; (c) improve air quality; (d) identify and reduce the detrimental impact of poor air quality on human health and the environment; (e) address the effects of emissions from the use of fossil-fuels in residential applications; (f) address the effects of emissions from industrial sources; (g) address the effects of emissions from any point or non-point source of air pollution; (h) implement the country's obligations in respect of international agreements (such as climate change and ozone-layer protection); give effect to best practice in air quality management; (j) give effect to the air quality management plan; and (k) comply with requirements that may be prescribed by the minister from time to time.

The last decade has seen an increase in the number and quality of AQMPs that have been developed across the different spheres of government in the country. Six (6) of nine (9) provinces, seven (7) of eight (8) Metropolitan Municipalities, 24 of 45 Districts and 24 of 228 Local Municipalities have got AQMPs.

In terms of Section 18 of the NEM: AQA, the Minister of Environmental Affairs in South Africa has declared three air pollution national priority areas namely; Vaal Triangle Airshed Priority Area (VTAPA) in April 2006, Highveld Priority Area (HPA) in November 2007 and the Waterberg Bojanala Priority Area (WBPA) in June 2012 (**Error! Reference source not found.**).

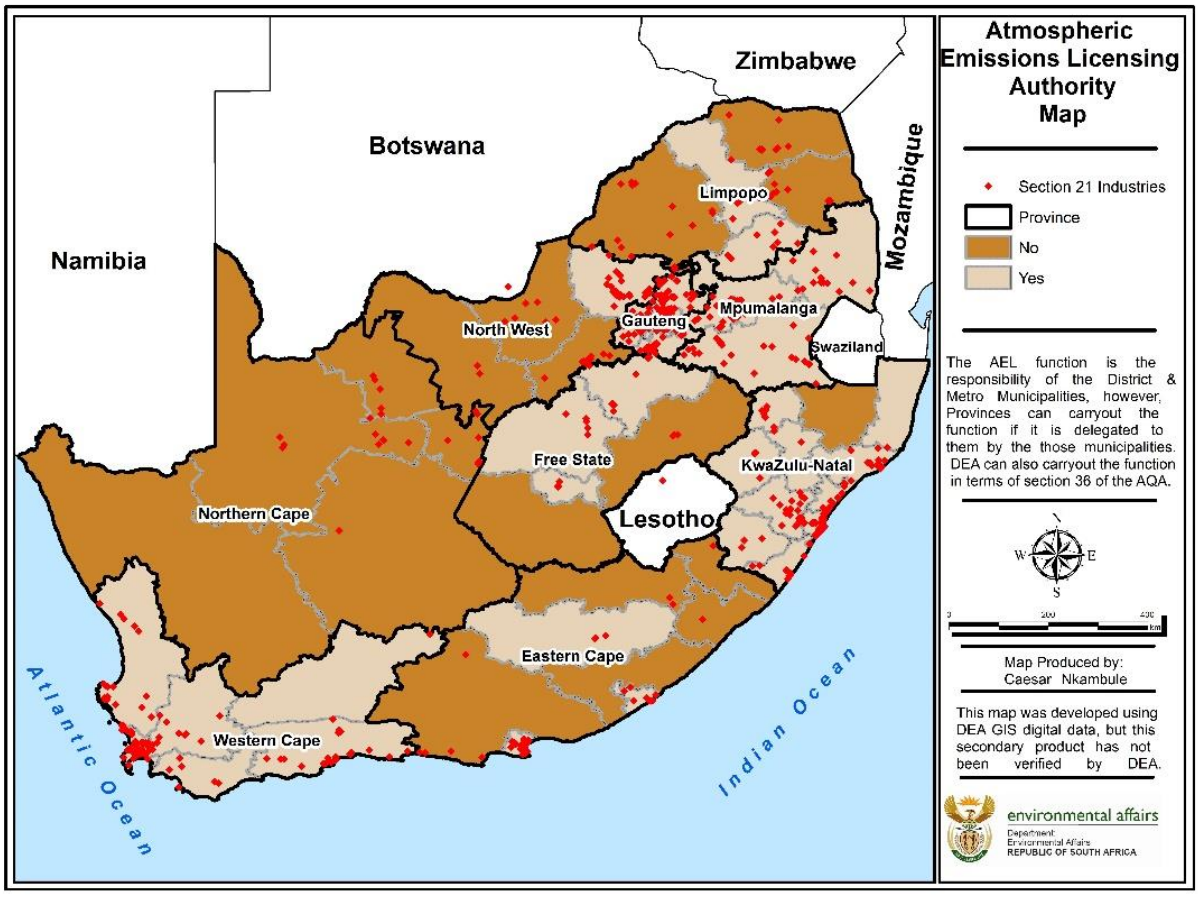


On 1 April 2010, the NEM: AQA came into full effect, repealing the Atmospheric Pollution Prevention Act, 1965 (Act No. 45 of 1965), the "APPA". The management of Registration Certificates issued for scheduled processes under APPA by national government was replaced by the administration of Atmospheric Emission Licenses (AELs) for Listed Activities under the NEMAQA. The AELs are now administered by the relevant metropolitan or district municipalities unless functions are delegated to provincial departments when metropolitan or district municipalities are not fully capacitated. To date, over 1100 AELs have been issued by relevant authorities across the country, as shown in the map below.

To reduce the administrative burden on licensing authorities and improve service delivery on AEL management, the national department developed the [South African Atmospheric Emission Licensing and Inventory Portal (SAAELIP)] in 2015. The portal consists of two components, a System for National Atmospheric Emission Licensing (SNAEL) and a National Atmospheric Emissions Inventory System (NAEIS). These systems provide the ability for AELs to be managed seamlessly online from cradle to grave while promoting transparency and access to information to all stakeholders. On SAAELIP, users can process and issue AEL applications, schedule licensing related inspections and track inspection results, manage compliance and emission inventory reporting and facilitate communication between AEL holders and the relevant authority. Since the end of 2018, licensing authorities have been migrating the AELs issued before SAAELIP development, into the online portal.

The NEM: AQA is enforced by the Environmental Management Inspectors (EMIs) – the so-called "Green Scorpions". As an example of the compliance and enforcement provisions contained in the NEM: AQA, an AEL may require its holder, on request, to submit a certified statement to the inspector, indicating (i) the licence-holder's compliance monitoring records; (ii) particulars of instances of non-compliance; (iii) the reasons for instances of non-compliance; and (iv) any action taken, or to be taken, to prevent a recurrence of the instance of non-compliance. During the last decade, there has been an intensive training of the EMIs at the local government aimed to enhance the compliance of the AELs and other NEM: AQA requirements. In some Licensing Authorities, the EMIs has been designated and the some are still waiting the designation from their respective MEC.

Information management is a critical component of governance towards continuous improvement in air quality. Therefore, air quality information should be readily accessible, accurate and relevant for informed decision-making. The national department established the South African Air Quality Information System (SAAQS) in 2010 to provide a common platform for managing and disseminating air quality information across the country (https://saaqis.environment.gov.za/). The information includes air quality related documents, current news items such as new regulations and notice of the release of documents for public comment, contact details of all air quality officers, related scientific publications, and ambient air quality data with the majority of station data being reported to the SAAQIS. It makes data available to stakeholders including the public and provides a mechanism to ensure uniformity in the way air quality data is managed i.e. captured, stored, validated, analysed and reported on in South Africa. At the heart of this system is the dissemination of real-time state-of-air-quality to the public from government monitoring stations.



Finally, the NEM: AQA also ushered in a new era of transparency and participatory governance that was unknown during the APPA period. Communities, NGOs, business and industry have been active and vocal participants in the various air quality management platforms over the years, including the development and oversight of the three national priority area air quality management plans.

Notwithstanding the vast amount of work required to generate the above mentioned laws, regulations, plans and systems, the key question remains – is South Africa's air quality getting better as a result?

Although the state of air report (see [4.6 Air Quality]) is indicating an overall improvement in air quality, in many areas of the country our Right to clean healthy air remains largely unrealised, with negative consequences for the health and well-being of the people living and working on those areas.

8.5 Biodiversity

The following section is an edited extract of [The National Biodiversity Assessment 2018 (NBA 2018)] report and readers are encouraged to read the report for more in depth, fully referenced, information on the state of South Africa's biodiversity.

8.5.1 The NBSAP-NBF-NBA relationship informs priority actions

South Africa has a well-developed suite of policy and legislation for the management, conservation and sustainable use of biodiversity, including two overarching national tools: the National Biodiversity Strategy and Action Plan (NBSAP) and the National Biodiversity Framework (NBF). These documents, developed through thorough stakeholder consultation, set out South Africa's strategic objectives for managing and conserving biodiversity and are the primary reference points for related priority actions. The National Biodiversity Assessment (NBA) both informs the development of the NBSAP and NBF, and supports their implementation. Together the NBSAP, NBF and NBA provide three key, inter-related anchors for the work of the biodiversity sector in South Africa.

8.5.2 Spatial biodiversity priorities for managing and conserving biodiversity

South Africa's biodiversity is not evenly distributed across the country and when this is combined with limited resources for action, it means that it is essential to prioritise spatially. An important feature of South Africa's biodiversity-related action to the pressures on biodiversity has been spatial planning to identify priority areas in the landscape and seascape for intervention. This is particularly important for the implementation of Strategic Objectives 1 – Management of biodiversity assets, 2 – Investment in ecological infrastructure and 3 – Biodiversity considerations are mainstreamed, of the NBSAP and NBF, which otherwise run the risk of being spread too thin geographically to be effective. The production of many spatial planning tools at the national and sub-national level relies heavily on the spatial data layers and datasets that are compiled and collated for the NBA. Efforts to strengthen foundational data for the NBA thus also supports the development of high quality spatial biodiversity plans.

8.5.3 Additional priority actions for managing and conserving biodiversity

The NBSAP and NBF highlight a wide range of interventions that are priorities for managing and conserving biodiversity. These are confirmed and reinforced by the findings of the NBA 2018. The key priorities for improving the effectiveness of interventions emerging from this NBA include the need to improve compliance with existing laws, strengthen cross-sectoral planning, strengthen adaptive management, improve implementation of conservation projects and build and maintain capacity.

The NBA 2018 technical reports for each realm explain some of these interventions in more detail and articulate additional priority actions resulting from the NBA 2018 findings. There are, however, several general priority actions that support the successful implementation of many of these interventions, and ultimately affect South Africa's ability to meet the NBSAP and NBF goals. These general priorities can be clustered into the following themes:

- Strengthening compliance and enforcement
- Strengthening cross-sectoral and cross-realm planning
- Strengthening evaluation for adaptive management
- Conservation project implementation
- Maintaining and further strengthening capacity

8.6 Oceans and Coasts

Shortly before the first democratic elections in 1994, the Department of Environment, Forestry and Fisheries embarked on an inclusive policy formulation process that would transform the way Integrated Coastal Management (ICM) was conceptualised and implemented in South Africa. During the first phase of this process an independent facilitator was appointed to enter into bilateral discussions with key stakeholders, including the then extra-parliamentary groupings, such as the ANC. The first few workshops focused on gaining agreement on the process to be followed and the "rules of the game". It was agreed that the development of a Coastal Management Policy should be inclusive and participatory, holistic and interdisciplinary, and be based on robust scientific information. With support from DFID in the United Kingdom, a participatory policy formulation process was initiated that culminated in the publication of the Coastal White Paper in 2000. This policy process was characterised by active engagement of government, private sector and civil society stakeholders and called for a people-centred, holistic and integrated approach to coastal governance.

The policy process was overseen by a Policy Committee comprising representatives from government and civil society, while a project management team was appointed to oversee the management of the policy formulation process including research activities, workshops with experts, an extensive public consultation process, capacity development and training as well as the translation of the various inputs into a coastal policy document. This approach was guided by new developments in the ICM international arena as well as imperatives in the new [South African Constitution], that requires redress, participation in decision-making, promotion of equity and social justice, co-operative governance and "securing ecologically sustainable development and use of natural resources while promoting justifiable economic and social development" (see [the Environmental Right]). The vision for the coast, as articulated in the Coastal White Paper, captures the spirit of this new approach to ICM and the expectations of all stakeholders involved in the process. The final [Coastal White Paper] was promulgated in 2000 and received significant media attention and support from key political players. This document contained a clear set of principles, goals and objectives as well as Plan of Action to implement the policy. Key to taking the process forward was the development of a legal and institutional framework to give effect to the Coastal White Paper. Other elements of the Plan included: 1) development and implementation of awareness raising, training and education programmes; 2) determination of information needs in relation to monitoring, information and decision-support systems and research; and 3) identification of projects to address priority issues and implementation of local demonstration projects.

The approach to ICM articulated in the [Coastal White Paper] required the development of a new Coastal Management Act. Consultants were consequently appointed to prepare a draft Bill. Although the first draft of a Coastal Management Bill was submitted to the Department of Environmental Affairs and Tourism (DEAT) in 2001, the process of finalising this Bill took eight years and involved several iterations before being finally adopted by parliament in 2008. There were two key reasons for the delay in promulgating this Act. First, during this time there were many laws, including several environmental laws, going through the parliamentary process and finalisation of the ICM Bill was not considered an immediate priority. Second, there were different interpretations of the White Paper principles especially with regard to public participation, co-operative governance, accountability and responsibility and how these should be articulated in the Bill. DEAT was concerned that the inclusion of these principles in the ICM Bill, would frustrate effective coastal management and insisted on their removal from the Bill and included greater decision-making powers at the national level. These differences of opinion, as well as numerous public comments received on the various iterations of the Bill, led to a protracted law-making process that culminated in the promulgation of the [National Environmental Management: Integrated Coastal Management Act, 2008 (Act No. 24 of 2008)] (ICM Act) in 2008.

The Objects of the Act, provide a very clear indication of a fundamental paradigm shift to ICM requiring: 1) determination of the coastal zone; 2) co-ordinated and integrated management of the coastal zone based on the principles of co-operative governance; 3) protection, extension and enhancement of the status of coastal public property to be held in trust by the state on behalf of all South Africans; 4) securing equitable access to the opportunities and benefits of [coastal public property]; and 5) giving effect to South Africa's international obligations in terms of international law regarding coastal management and the marine environment. What is noticeable about

the ICM Act is the focus on the public nature of the coast, the intention to extend and enhance equitable access to the coastal commons, while simultaneously protecting the ecological integrity of the coast. Governance under this new paradigm requires co-ordination and integration across all sectors and role-players as well as co-operation across all spheres of government.

An innovative provision in the ICM Act is that it clarifies what comprises the coastal zone, as well as the purpose and legal status of these zones and articulates the responsibilities of different spheres of government in managing the different components of the coast. A key progressive feature of the ICM Act is thus the clarification of what comprises [coastal public property (CPP)] and the mechanisms for declaring and extending such property to give effect to objects of the Act. The declaration and extension of coastal public property confirms government's commitment to improve public access to coastal areas, to secure the natural functioning of coastal processes and protect people, property and economic activities from coastal risks. The ICM Amendment Act, 2014 (Act no. 36 of 2014) (see the [ICM Act Information Sheet]) further strengthened this provision by including a section that clarifies the purpose of CPP. While the Act vests ownership of CPP in the people of South Africa, the state is required to act as the custodian of this space for present and future generations. It stresses that "coastal public property is inalienable and cannot be sold, attached or acquired by prescription…" while committing the state to … "ensure that coastal public property is used, managed, protected, conserved and enhanced in the interests of the whole community". To ensure access is enhanced, municipalities have been tasked with the identification and declaration of coastal access land, through for example the declaration of public servitudes on land adjacent to CPP in their areas of jurisdiction which should then be incorporated into municipal zoning schemes and other local planning documents (e.g. Integrated Development Plans (IDPs) and Spatial Development Frameworks (SDFs)). While the emphasis is on enhancing public access to CPP, this access must be undertaken with due care of the environment, and should not affect the rights of other users, or hinder the state in the course of performing their functions. In order to ensure improved access to, and along the coast, the ICM Amendment Act, 2014 (Act no. 36 of 2014) empowered the provincial Members of Executive Councils (MECs – provincial environmental "Ministers") and the national environmental Minister to intervene if necessary. In addition, the national Minister has the power to extend CPP by incorporating additional parcels of coastal state land into CPP. Clearly, regarding the coast as a national asset and enhancing access to the coast for all the people of South Africa are foundational principles of this Act.

Further mechanisms in the ICM Act to protect and enhance the status of CPP include the establishment of a coastal protection zone (CPZ) (generally 100 m landward of the high water mark (HWM) in urban areas and 1000 m in rural areas, but also inclusive of dynamic coastal areas, coastal protected areas and private properties under the HWM which is designed to ensure protection of sensitive coastal environments as well as protection of people and property from risks and hazards. The establishment of coastal management lines to, amongst others, protect property and public safety and the CPZ, and to preserve the aesthetic value of the coastal zone is a further mechanism to protect vulnerable socio-ecological systems from natural hazards and inappropriate human intervention. A further innovative mechanism is the provision for the declaration of special management areas (SMAs) - those areas requiring alternative management approaches such as local coastal areas where management by local communities would be appropriate.

Another progressive and innovative provision in the Act is the development and implementation of Coastal Management Programmes (CMPs) - giving effect to the goals and objectives in the [Coastal White Paper] concerned with coastal planning and development. CMPs are intended to provide policy direction and a clear framework for promoting and achieving integrated and effective coastal management. The ICM Act requires CMPs to be developed by all spheres of government within four years of promulgation of the Act. The Act sets out what components must be included in the CMP, including a vision, objectives as well as priorities and strategies to achieve the objectives, performance indicators, norms and standards as well as the clarification of roles and responsibilities of different governance actors to enable co-operative governance. Furthermore, the ICM Act requires alignment between the CMPs and other national programmes and plans (e.g. National Biodiversity Framework, National Estuarine Management Protocol), provincial plans (e.g. Provincial Growth and Development Strategies) and local plans (e.g. IDPs). In addition, local land-use schemes must conform to local CMPs.

The ICM Act also deals with the integrated management of estuaries and the publication of a National Estuarine Management Protocol to guide development of estuarine management plans. This is a particularly important inclusion in the Act given the value of estuaries and the fact that there are approximately 250 - 300 functional estuaries in South Africa, depending on what criteria are used. Prior to the ICM Act the responsibility for estuarine management was unclear and uncoordinated, and decisions regarding use and development of estuarine resources and environments were taken by different sector departments (e.g. water, fisheries, agriculture) or by the relevant provincial planning and conservation departments. According to the ICM Act, estuaries are an integral part of the coastal zone and "must be managed in a co-ordinated and efficient manner and in accordance with a [National Estuarine Management Protocol]". This Protocol was gazetted in 2013 and guidelines for the development and implementation of estuarine management plans (EMPs) were published in 2015. A key requirement of this Protocol is the involvement of the public in the development of EMPs.

In terms of ensuring the protection of the coastal environment, the ICM Act contains provisions that require adoption of the "duty of care", "avoidance of adverse impacts" and "remediation of environmental damage" principles. It requires the application of the [National Environmental Management Act, 1998 (Act No. 107 of 1989)] (NEMA) provisions that deals with the "duty of care" and "remediation of environmental damage" but extends these to include activities that may cause significant pollution and degradation of the coastal environment. If the Minister or MEC considers an activity or proposed activity to be harmful to the environment, he or she may issue a coastal protection notice prohibiting the action or may require steps to be taken to protect the environment or conduct an environmental impact assessment to be undertaken. In urgent cases where there is an immediate risk to the public, property or a potentially significant harm to the environment, the Minister or MEC may issue a verbal directive to stop an activity (followed by a subsequent notice). Furthermore, the Minister or MEC may issue written notices requiring the repair or removal of structures that are inappropriately located, in a state of disrepair, abandoned or have been developed in contravention of the ICM Act or other relevant law. This provision has far-reaching implications for the many residential structures, holiday cottages, informal structures and infrastructure that have been developed in the coastal zone without proper planning permission.

The ICM Act established an integrated regime for regulation of the disposal of effluent and waste into estuaries and the sea, including prohibiting incineration at sea and restricting dumping at sea in accordance with international best practice. In addition, it calls for a review of all coastal and estuarine effluent discharges within five years of the promulgation of the ICM Act.

The Coastal White Paper proposed a National ICM coordinating structure and this was subsequently incorporated as the National Coastal Committee (NCC) in the ICM Act. In terms of the Act, the main purpose of the NCC was to promote integration of coastal management concerns and objectives and advance effective co-operative governance by co-ordinating the effective implementation of the Act. However, the department of environment's concerns about delays and possible conflicts associated with civil society's involvement in the multi-stakeholder fora, led to a decision not to appoint a NCC. Instead, it was decided that the existing Minister and MECs co-ordinating structures (MINMEC), Mintech and Mintech Working Groups would fulfil this function. In practice this meant that Working Group 8 (the "Oceans and Coasts Working Group" of Mintech) would function as an unofficial "NCC". A proposal to scrap the NCC was consequently included in the ICM Amendments Bill, but this was not supported during the parliamentary process. This means that the national Minister of Environmental Affairs must still appoint a NCC and determine their powers. The ICM Act does not stipulate a time frame for this. As the NCC has not yet been appointed, there is currently no annual report submitted to the Minister and tabled in parliament as envisaged in the ICM Act.

During the Coastal White Paper formulation process, Provincial Coastal Co-ordinators were appointed to support stakeholder engagement and assist with implementation of aspects of the Coastal White Paper Action Plan, including implementation of the Sustainable Coastal Livelihoods Programme (SCLP). Since the promulgation of the ICM Act in 2008, the Premiers of all coastal provinces have designated lead agencies for ICM and MECs responsible for environmental matters have appointed Provincial Coastal Committees (PCCs). While PCCs had been established in all provinces by 2016, the operational efficiency and effectiveness of these committees are highly variable across the provinces and depend on leadership, capacity, resources and the length of time

established. One of the main functions of these committees has been to provide a forum where activities impacting on the coast and new development proposals, plans, and programmes can be discussed and recommendations made. Furthermore, the forum provides a space where challenges to implementing the provisions of the Act can be explored and knowledge and views of coastal managers and other stakeholders can be shared.

Although not mandatory, establishment of local coastal committees was considered desirable to promote ICM at the local level and facilitate co-operative governance. The ICM Act empowers municipalities to establish such committees, but in practice very few local coastal committees have been established and only the larger coastal metropolitan areas, and some district municipalities, have made progress with developing local coastal management programmes. Lack of capacity and resources and too many other priorities were identified by local authorities as the major challenges to implementing requirements of the ICM Act.

With respect to giving effect to the Coastal White Paper and provisions in the ICM Act, significant progress has clearly been made. This section focuses on progress with respect to implementing some of the progressive provisions described above. Firstly, with respect to delineating a geographical area that comprises coastal public property, the national Department of Environment, Forestry and Fisheries has been engaged in an audit of all state owned land in the coastal zone over the past few years. This has been a difficult exercise due to the fact that the Department of Public Works (the custodians of state land and assets) has an incomplete record of state owned land and in some cases the status of land ownership is unclear. In order to clarify ownership, the state needs to undertake a systematic coast-wide process of verification of all the parcels of public land (e.g. under control of parastatals, commonage in municipal areas, etc.) and private properties. This process has started in the Western Cape Province and will be expanded to the other three coastal provinces over the next few years. Furthermore, the allocation of parcels of valuable state property for public use is not necessarily supported by all governance actors who regard such public land as a means of generating much needed revenue from rates and taxes. Some parastatals have sold or developed such land to boost their coffers, even though it is not their core business.

Despite these constraints, a Coastal Viewer has been developed which spatially represents a number of datasets relating to the coast, indicating the extent of coastal public property and the boundaries of this area is being prepared, but there are gaps in the data relating state land, admiralty reserve and mining activities that are currently being addressed. The purpose of this exercise is to clarify the extent of CPP and enable a strategic approach to expanding the coastal estate, as well as providing a baseline from which to determine appropriate coastal access opportunities. In addition, it will also serve as a buffer zone to coastal erosion associated with sea level rise. Consequently, very little progress has been made in terms of extending CPP and incorporating parcels of private and public land into this public zone. Research on progress on enhancing access to the coast since 1994 suggests that limited progress has been made in this regard. In fact, access to the coast is being curtailed in some areas by private landowners and developers of gated estates and residential golf estates through erecting fences, booms and gates that restrict public access to the coast, often illegally. Promoting exclusive use and access to coastal areas remains a selling point for many developers and undermines the intention of the law. Enhancing access to extensive parts of the Northern Cape coast, in areas that are currently, or were previously mined (but have now been decommissioned), also remains unresolved. Similarly, in terms of improving physical access to CPP, and declaring public access servitudes that can facilitate such access in perpetuity, and publishing by-laws to give effect to such access land, most local authorities have not met their obligations in terms of the ICM Act. To address this shortcoming, additional powers have been granted to MEC's and the Minister of Environment, Forestry and Fisheries in terms of the NEM: ICM Amendment Act, 2014 (Act No. 36 of 2014) to identify and declare such coastal access land. Furthermore, the practicalities of securing coastal access land for designation as public access servitudes is proving difficult. This is due in part to the many competing demands for coastal land, the Constitutional right that protects private property, and the lack of clarity with regard to negotiating such access on communal property.

However, a [National Coastal Access Strategy] as well as a [Guide for the Designation and Management of Coastal Access in South Africa] have recently been produced to provide strategic guidance to provincial and local authorities to enable the establishment and maintenance of coastal access in South Africa. In addition, the ICM Amendment Act has simplified the process of establishing coastal access servitudes. The importance of enhancing

and securing public access to the coast is a central feature of the ICM Act because of the key role that the coast and its resources can play in the transformation and development of the South African economy and society. The main objectives of this strategy are thus to:

- Improve pedestrian access above the HWM;
- Improve infrastructure for access;
- Prevent exclusive use;
- Address conflicting rights between public interest, private property owners and communal and traditional users; and
- Minimise adverse impacts on the environment.

While these DEA publications provide guidance on enhancing coastal access and designating coastal access points and land, there are a number of priority actions that need to be undertaken by provincial lead agencies and local authorities (e.g. conducting inventories and assessments of the state of coastal access) before this process will show results. Thus while outputs in terms of strategies and guidelines have been produced, a significant amount of work is still required to gather information, identify potential access points and access land, formalise these in terms of the ICM Act, and put in place management, monitoring and reporting procedures to give effect to these provisions.

In terms of protecting the coast, the ICM Act established a default Coastal Protection Zone (CPZ), but the vision was to follow a public process to refine this CPZ taking account of environmental sensitivities, socio-economic and other factors. While some of the larger coastal metropolitan areas (i.e. Cape Town and eThekwini) have made progress with refining the coastal protection zones and several local authorities have appointed consultants to determine set-back lines (now "management lines"), in general these requirements of the ICM Act have not been comprehensively implemented by most provinces and especially the smaller coastal municipalities. Local authorities indicated that they were overburdened with other responsibilities and lacked resources and capacity to tackle ICM functions. In terms of demarcating coastal management lines, one of the challenges has been concerns regarding the methodology employed to determine set-backs which has largely been a technical exercise based on biophysical factors with little consideration of socio-economic issues. Furthermore, in some coastal areas there has been strong opposition by local coastal communities and private land owners to this legal requirement, arguing that it impacts on property values and the local economy and that the views of local communities have not been adequately sought. With respect to special management areas, no such areas have been established largely due to lack of best practice examples in South Africa of where alternative management approaches are working successfully, and cost-implications. However, the Department has embarked on a process to develop guidelines that will assist in the process to identify, assess and apply for the designation of a special management area.

In terms of improving co-ordination and integration of planning in the coastal zone and addressing the spatial legacy of Apartheid, the Department of Environment, Forestry and Fisheries has recently published the [National Coastal Management Programme (NCMP) of South Africa] which provides a policy directive and framework for ICM. This framework articulates a set of components (e.g. vision and objectives, delineation of coastal boundaries etc.) and processes that must be adopted within the CMP and proposes an iterative and adaptive approach to planning and management. Hence these CMPs are reviewed and modified every five years. The NCMP also sets out a framework for enabling co-operative governance recognising that formal coastal management institutions must work collaboratively with other government institutions as well as business, civil society, research and professional institutions. Practical tools and clearer guidance regarding which legal provisions can be harnessed to advance the objects of the Act, have been captured in the form of management objectives and associated actions for the nine priority areas of the NCMP to ensure that tangible implementation outputs are achieved over the lifespan of any particular CMP.

Over the last four years, progress has been made with developing provincial CMPs and the Eastern and Western Cape have gazetted their CMPs (2013 and 2016 respectively). The KwaZulu-Natal and Northern Cape provinces both have draft CMPs which should be finalised and adopted in the 2019/2020 financial year. A few of the more

capacitated municipalities have embarked on a process to develop local CMPs, mostly with assistance of consultants. However, limited progress has been made in terms of integrating local CMPs into other local planning instruments such as the IDPs, SDFs and zoning schemes. The practical realities facing local municipalities in terms of socio-economic development pressures, human capacity and resource constraints mean that CMPs are not regarded as a high priority for most coastal municipalities.

Progress has been made in terms of acting against illegal developments in the coastal zone. Surveillance and action against illegal structures along the Wild Coast of the Eastern Cape has resulted in excess of 75 structures and partially completed structures being removed using a combination of laws and often following lengthy court proceedings. This includes holiday cottages and informal structures built along the coast without formal planning permission and without payment of rental, rates or taxes to the relevant authorities. Similarly, in KwaZulu-Natal the iSimangaliso Wetland Park Authority have also removed a small number of illegal developments. To speed up this process the ICM Act now allows for the issuing of coastal protection notices, coastal access notices and repair and removal notices. This task is far from completed with the lack of resources and capacity identified as key constraints. Nevertheless, these bold steps by government signal a commitment to protect the coast, especially CPP, for current and future generations. However, cooperation across all relevant departments and spheres of government is needed for this vision to be realised.

The development of estuarine management plans (EMPs) has been progressing steadily since 2008, when the conservation agency in the Cape Province under the auspices of the Cape Action Plan for the Environment's (C.A.P.E.) Regional Estuarine Management Programme appointed consultants to develop management plans for priority estuaries through funding obtained from the Global Environmental Facility (GEF). Thereafter, other ICM and conservation agencies have appointed consultants to prepare EMPs for selected estuaries. Several of these EMPs were prepared prior to the promulgation of the [National Estuarine Management Protocol]. The Protocol provides guidance regarding components that must be included in the plan, the process required to develop the plan as well as institutional arrangements to facilitate its implementation. To date, approximately 50 Estuarine Management Plans have been prepared, with 2 National EMPs and 2 Provincial EMPs having been approved by the Minister. Further, in some areas, EMPs have taken several years to complete due to concerns of coastal stakeholders regarding the consultation process and contents of draft EMPs. In addition, implementation has been delayed due to the need to ensure consistency with the Protocol and obtain formal endorsement from the relevant provincial MECs.

In terms of institutional arrangements for implementing the EMPs, the roles and responsibilities of different spheres of government are still being clarified through forums and committees that exist in the various provinces and districts. For example, in the Western Cape, several estuary management forums have been set up in the past, in terms of the C.A.P.E. programme and meet on a quarterly basis. These forums, although limited in terms of decision-making powers, play an important role in terms of co-ordinating activities of various governance actors (e.g. Department of Water Affairs, District municipality, local authority, local communities, surrounding farmers) involved in estuary management, including facilitating the sharing of information, providing a platform to raise issues and concerns, and jointly exploring solutions to problems. According to the Protocol, the municipal and/or Provincial Coastal Committees, will be responsible for monitoring the implementation of EMPs and reporting on progress but these institutional details are still being clarified. However, there are concerns about the capacity and resources of local government to undertake these tasks and are currently undergoing an assessment of capability to fulfil the multitude of environmental mandates through the Department of Cooperative Governance and Traditional Affairs and the South African Local Government Association.

Since 1994, a number of awareness raising campaigns, educational initiatives and training programmes have been implemented. A key focus of these activities has been to raise awareness amongst coastal managers and other stakeholders about the value of the coast, the principles and approaches underpinning the Coastal White Paper and the requirements of the ICM Act. General public awareness programmes such as [Coastwatch], [Working for the Coast (WftC)] and the [Blue Flag beach] campaign as well as public participation in the International Coastal Clean-up campaign have contributed to enhancing understanding of the importance of the coast and instilling a sense of responsibility amongst the public. Various educational materials have been produced targeting schools,

NGOs and coastal management authorities (e.g. [CoastCare Factsheets], [A User-friendly Guide to the ICM Act of South Africa]) and several training courses for coastal managers have been implemented by the Department of Environment, Forestry and Fisheries and coastal provinces, and by universities and NGOs (e.g. UCT offered several professional short courses on ICM during the 1990s and the International Oceans Institute (IOI) currently offers an annual course on oceans and coastal management). In addition, through the coastal poverty alleviation initiatives, namely the Working for the Coast (WftC) Programme (previously CoastCare) (part of government's Expanded Public Works Programme), and the Sustainable Coastal Livelihoods Programme (SCLP), jobs were created and training and skills development courses were offered. As part of the WftC Programme over 40 000 people have received general ICM awareness training while several thousand have participated in skills development training, and are now better positioned to find alternative work.

Furthermore, the Department of Environment, Forestry and Fisheries released a [National Strategy for Coastal Awareness, Education and Training for South Africa] that aims to provide a framework for identification, development and implementation of a range of awareness raising, training and education initiatives. The aim is to promote a more co-ordinated and effective approach to ICM through raising awareness of the value of the coast, enhancing understanding of the ICM Act and strengthening management and governance capacity. Objectives to achieve these aims include providing internships, learnerships and bursaries for staff and students to build capacity of future managers, develop coastal learning materials for the school curriculum, and building partnerships with industry, NGOs and tertiary education and research institutions to support ICM education and training efforts. The NCMP stresses the importance of Awareness, Education and Training and while it can be argued that the Department of Environment, Forestry and Fisheries is in the process of developing programmes and initiatives to operationalise this strategy and implement this priority, the reality is that at the time of writing funding for these activities within the Department of Environment, Forestry and Fisheries budget was limited and no dedicated human resources had been assigned to this task. It would appear as if the priority focus given to awareness education and training immediately after the release of the Coastal White Paper has lost significant momentum and one can only hope that this crucial element will be afforded more priority in years to come.

As one of the responses within the NCMP to address the impacts of climate change, the National Coastal Assessment represents an important step for sustainable development in South Africa: contributing to the United Nations Agenda 2030 Sustainable Development Goals, the African Union Agenda 2063, The [National Development Plan 2030] and the Implementation of South Africa's Coastal Management legislation and international obligations. The National Coastal Assessment focuses on identifying those areas of the coast that are most vulnerable to the effects of climate change and natural processes that have been exacerbated by human impacts, whilst simultaneously accounting for the needs of the public in terms of protection from these impacts and ensuring the safety of people and property along the coast. The benefits of this study, as well as the valuable decision making tools that will arise from the findings of the study, include:

- A better understanding of the specific effects on people, property and livelihoods along the coast;
- Improved decision-making on appropriate strategies and plans of action to ensure the protection of the environment, public safety, socio-economic prosperity and sustainable development;
- Enhanced ability to provide meaningful awareness to the public on the impacts of climate change on the lives and livelihoods;
- Facilitate better development planning along the coast, taking into account the trade-offs when making decisions on the maintenance of existing state infrastructure in vulnerable areas, as well as the development and placement of new state infrastructure to ensure the best use of state assets and expenditure;
- Provide valuable advice and guidance to coastal provinces and municipalities for taking action in implementing operational activities and exercising good governance along the coast.

8.7 Waste

This following provides a brief description of current and future action to avoid or mitigate the negative impacts resulting from the current waste management activities in South Africa. Interested readers should refer to the [South Africa State of Waste Report 2018] for more in depth, fully referenced, information.

The [National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)] (NEM:WA), which came into effect on 1 July 2009, was the first comprehensive act to regulate waste management in a proactive way in South Africa. Prior to the NEM:WA, waste management was governed by the Environment Conservation Act, 1989 (Act No. 73 of 1989) (ECA).

Since NEM:WA first took effect, there has been rapid improvement in waste management governance as the legal framework started to support the implementation of the [waste hierarchy], which included the look at alternative waste management treatment alternatives.

In terms of the current status of legal compliance and enforcement of the provisions of the NEM:WA, in total, 186 contraventions of the provisions of the NEM:WA were recorded in 2016/2017.

Environmental Management Inspectors (EMIs) are the officials designated to carry out environmental compliance and enforcement functions in terms of the NEM:WA. It is important to note that in terms of the provisions of the [National Environmental Management Act, 1998 (Act No. 107 of 1998)] (NEMA), EMIs have standard mandates, powers, functions and duties. EMIs are tasked with ensuring that all national environmental legislation is complied with and properly enforced where contraventions are detected. As such, the EMIs are not only responsible for the [brown] subsector (environmental impact assessment, pollution and waste), but also the [green] (biodiversity, protected areas), and [blue] (marine and coastal) subsectors.

The 2016 [National Pricing Strategy for Waste Management (NPSWM)] is one economic instrument that has been introduced to reduce waste generation and increase the diversion of waste away from landfill. Currently, the preferred instrument is Extended Producer Responsibility (EPR), where the producers of goods have a responsibility to safely manage those products after the end of useful life.

Both the public and private sector are currently engaged activities that promote avoidance, recycling, and the recovery of waste. These include capacity building and awareness campaigns, source separation, and integration of waste pickers into municipal waste management systems.

There appears to be indications that South Africa is making progress in moving up the waste management hierarchy with respect to general waste. This is believed to be a consequence of recent changes in waste legislation, policies and plans; more waste facilities looking at waste beneficiation and the value of waste as a resource; media awareness campaigns and conscious consumerism, as well the active and growing informal sector.

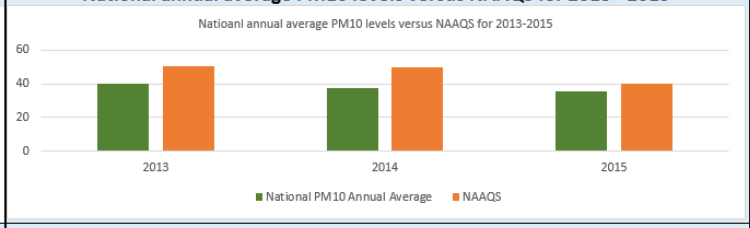
However, the country still has a long way to go to improve compliance at municipal waste management facilities, to improve waste collection services, and to increase enforcement in order to protect human health and the environment.

9 Key Indicators

The following indicators[1] provide an insight into key aspects of the South African environment and provide a proxy overview of the current state of the South African environment –

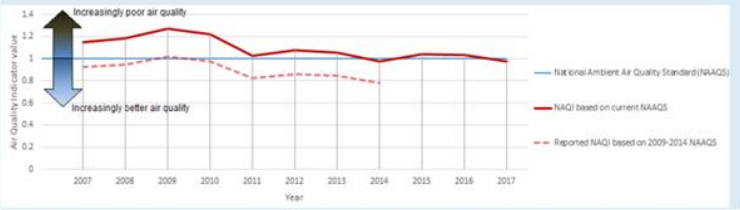
9.1 Air Quality

9.1.1 SDG Indicator 11.6.2 - PM10

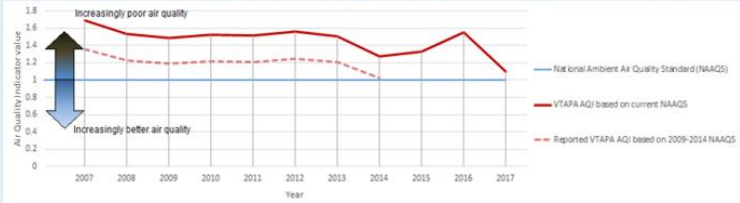
SDG Indicator 11.6.2 National annual average of PM10 levels versus National Ambient Air Quality Standard (NAAQS)		
STATE	**National annual average PM10 levels versus NAAQS for 2013 - 2015**	**OUTLOOK**
		
2015	Overall, South Africa is achieving SDG target 11.6 based on the data analysed.	Good - Policy objectives, targets or standards are met or exceeded or will be met or exceeded within 5 years and there are no obvious threats to
Favourable - The current status meets policy objectives, targets or standards and the trend is stable or positive		

[1] **Key**

9.1.2 National Air Quality Indicator

National Air Quality Indicator (NAQI)		
STATE	**National Air Quality Indicator (NAQI) values from 2007 to 2017**	**OUTLOOK**
		
2017		
Favourable - The current air quality indicator shows that, on average, national ambient air quality is compliant with national ambient air quality standards and the trend is stable or positive	Data from the South African Air Quality Information System (SAAQIS)are showing that particulate matter (measured as PM10) remains the most problematic air pollutant in South Africa in terms of national ambient air quality standards (NAAQS). However, the data are also showing that apart from upswings in 2008, 2009, 2012 and 2015, there has been a steady improvement in South Africa's average air quality from 2007 to 2017. Although the NAQI based on current NAAQS shows that our air is only just meeting the minimum target value, the trend remains positive. However, it is uncertain whether this positive air quality trend is an indicator of well managed and/or sustainably reduced atmospheric emissions or whether it is a reflection of the low levels of economic growth since the global financial crisis in 2008 or increasingly mild winters resulting from climate change.	**Good** - An annual air quality indicator value of less than 1.0 has been met or exceeded or will be met or exceeded within 5 years and there are no obvious threats to this situation

9.1.3 Vaal Triangle Airshed Priority Area Air Quality Indicator

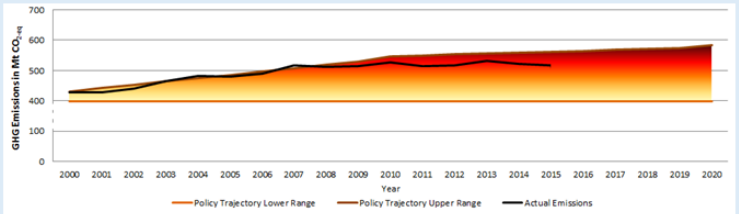
Vaal Triangle Airshed Priority Area Air Quality Indicator (VTAPA AQI)		
STATE	**Vaal Triangle Airshed Priority Area Air Quality Indicator (VTAPA AQI) values from 2007 to 2017**	**OUTLOOK**
		
2017		
Improving - The current air quality indicator shows that although, on average, ambient air quality in the priority area is not fully compliant with national ambient air quality standards, the trend is positive	VTAPA air quality monitoring stations data are showing that particulate matter (measured as PM10) remains the most problematic air pollutant in the VTAPA in terms of national ambient air quality standards (NAAQS). The data are also showing that following an initial positive trend in 2008 and 2009, ambient air quality remained relatively stable in a poor state to 2012 followed by increasingly positive trends to 2014 and concerning negative upswings in 2015 and 2016. Despite this, the very positive 2017 AQI marks the slow improvement in the area's average air quality from 2007 to 2017. However, the VTAPA AQI shows that air in the area continues to remain outside the minimum target value.	**Uncertain** - Due to various threats or circumstances, it is unclear whether an annual air quality indicator value of less than 1.0 will be met or maintained in the next 5 years

9.1.4 Highveld Priority Area Air Quality Indicator

Highveld Priority Area Air Quality Indicator (HPA AQI)		
STATE	**Highveld Priority Area Air Quality Indicator (HPA AQI) values from 2007 to 2017**	**OUTLOOK**
		
2017		
Concern - The current air quality indicator shows that, on average, ambient air quality in the priority area is not compliant with national ambient air quality standards and the trend is stable or negative	HPA air quality monitoring stations data are showing that particulate matter (measured as PM10) remains the most problematic air pollutant in the VTAPA in terms of national ambient air quality standards (NAAQS). The data are also showing that following an up and down, but overall positive trend from 2008 to 2014, air quality improvements have been almost totally reversed from 2015 to 2017 and ambient air quality remains in an extremely poor state	**Uncertain** - Due to various threats or circumstances, it is unclear whether an annual air quality indicator value of less than 1.0 will be met or maintained in the next 5 years

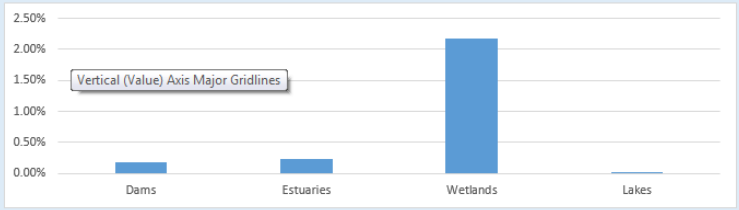
9.2 Climate Change

9.2.1 Greenhouse Gas (GHG) emissions

South African Greenhouse Gas (GHG) Emissions (net)		
STATE	**Actual emissions versus Climate Change Response Policy target emission trajectory range**	**OUTLOOK**
		
2015 **Improving** - Although the current status meets policy objectives, emissions are still tracking the upper limits of a target set before aspirations of limiting the global temperature increase to no more than 1.5°C	Data from South Africa's 2000-2015 Greenhouse Gas emissions inventory are showing that the country's emissions profile appears to be returning to within the national greenhouse gas emissions trajectory range set by the 2011 National Climate Change Response Policy White Paper. These latest available figures show that, although South Africa still emitted a staggering 516 million tonnes (Mt) of greenhouse gases in 2015, this was below the upper range target of 562 million tonnes. However, it is uncertain whether this positive emission trend is an indicator of our economy being delinked from greenhouse gas emissions or whether it is simply a reflection of the low levels of economic growth since the global financial crisis in 2008.	**Uncertain** - It is uncertain whether the current positive trajectory is being driven by mitigation efforts like South Africa's relatively significant renewable energy and energy efficiency interventions or whether this trend will reverse with improved economic growth

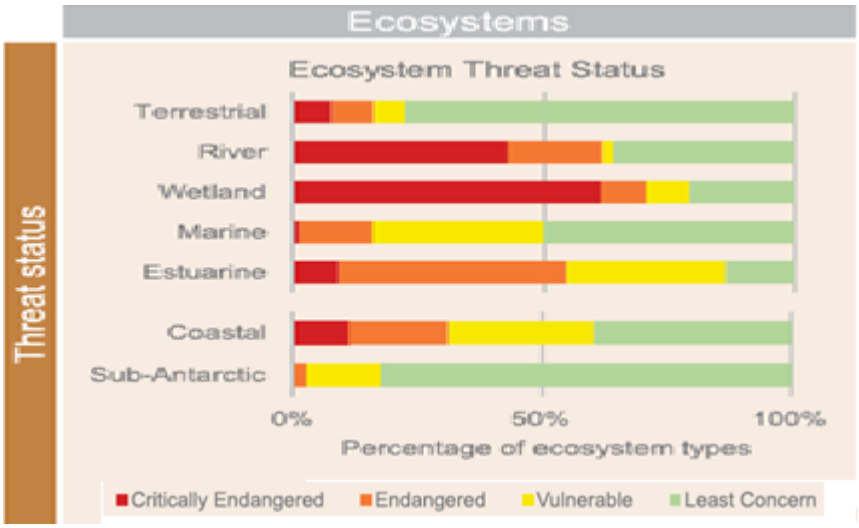
9.3 Water

9.3.1 SDG 6.6. 1D1. Extent of water related ecosystems

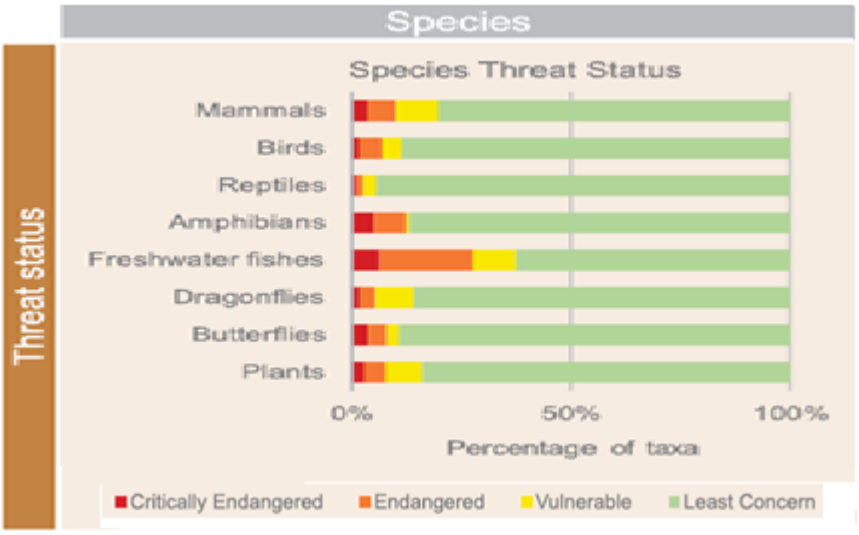
SDG 6.6. 1D1. Extent of water related ecosystems including wetlands, reservoirs, lakes and estuaries as a percentage of total land area.		
STATE	**Extent of freshwater ecosystems as a percentage of total land area**	**OUTLOOK**
		
2018 Concern - The current status does not meet policy objectives, targets or standards and/or the trend is negative	Rivers are excluded from the analysis as South Africa does not have rivers that noticeably change in their extent. However, rivers are a key ecosystem type and in future an indicator that measures the trends in river ecosystem integrity will need to be included.	Concern - Policy objectives, targets or standards are unlikely to be met within the next 5 years

9.4 Biodiversity

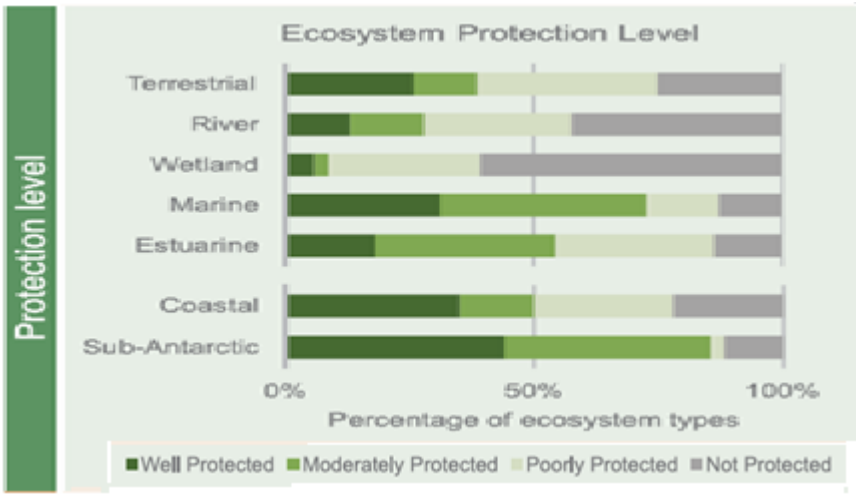
9.4.1 Key Facts: Ecosystem Threat Status

Ecosystem Threat Status	
Almost half the of the 1 021 ecosystem types assessed in the NBA 2018 were categorised as threatened. Overall estuaries and inland wetlands have the highest proportion of threatened ecosystem types	

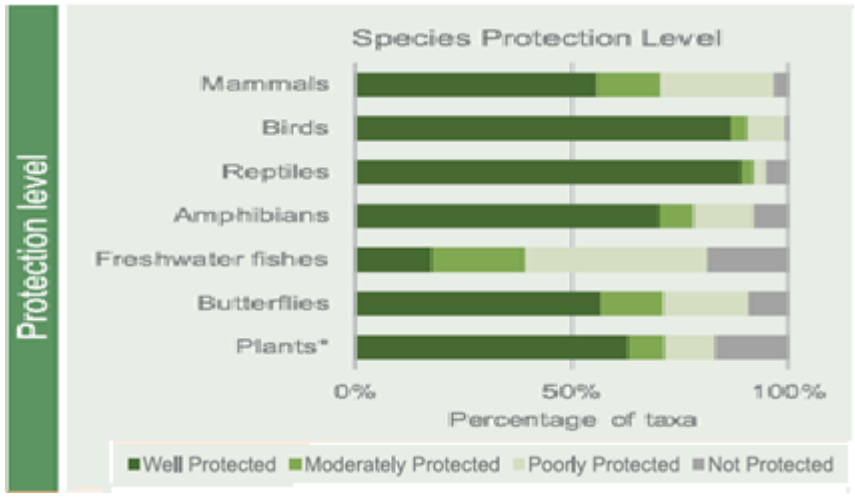
9.4.2 Key Facts: Species Threat Status

Species Threat Status	
From a species perspective, all 20 401 plants have been assessed and 14% were listed as threatened. All mammals, birds, reptiles, amphibians, freshwater fishes, butterflies and dragonflies were assessed, together with selected marine and estuarine fishes and invertebrates. Of the 2192 animals assessed, at total of 16% were listed as threatened.	

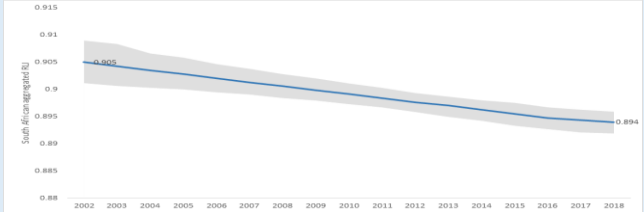
9.4.3 Key Facts: Ecosystem Protection Level

Ecosystem Protection Level	
Over two thirds of ecosystem types are represented in the current protected areas network, leaving 31% in the Not Protected category. Wetland and river ecosystem types have the lowest levels of protection overall.	

9.4.4 Key Facts: Species Protection Level

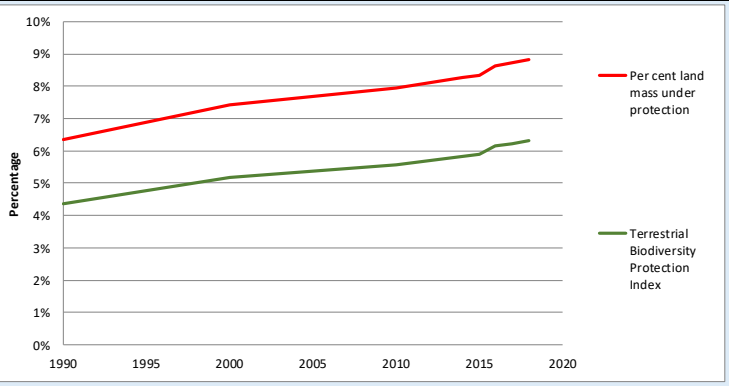
Species Protection Level	
Using the new protection level indicator for species 63% of plants were categorised as Well Protected (based on a random sample of 900 species). Mammals, reptiles, birds amphibians, freshwater fishes and butterflies were assessed using the new method, and overall 63% of these species categorised as Well Protected.	

9.4.5 SDG 15.5.1 Red List Index (RLI)

15.5.1 Red list index		
STATE	South Africa's aggregated National Red List Index for eight taxonomic groups mammals	OUTLOOK
		
2002 - 2018	The aggregated Red List Index for species has declined from 0.905 to 0.894 over a sixteen-year period (2002 - 2018). This downward trend indicates declining aggregate survival probability of the species assessed in South Africa's RLI. The declining RLI is largely attributed to the sharp declines of freshwater species and invertebrates. In contrast, terrestrial vertebrates, including birds, mammals, reptiles and amphibians have remained relatively stable (Raimondo, 2019).	Concern - Policy objectives, targets or standards are unlikely to be met within the next 5 years
Concern - The current status does not meet policy objectives, targets or standards and/or the trend is negative		

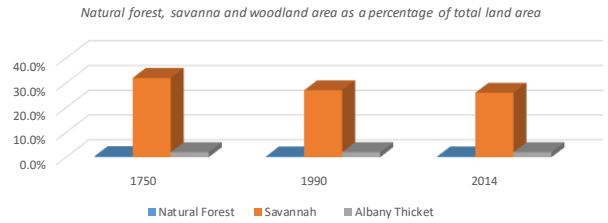
9.4.6 Terrestrial Biodiversity Protection Index (TBPI)

Terrestrial Biodiversity Protection Index (TBPI)

STATE		OUTLOOK
		
2018 Improving - Although the current status does not yet meet policy objectives, targets or standards, the trend is positive	There is a steady increase in the per cent land mass under protection and the Terrestial Biodiversity Protection Index since 1990. Unfortunately the rate of increase isn't fast enough for South Africa to meet its international and national targets.	Uncertain - Due to various threats or circumstances, it is unclear whether policy objectives, targets or standards will be met or maintained in the next 5 years

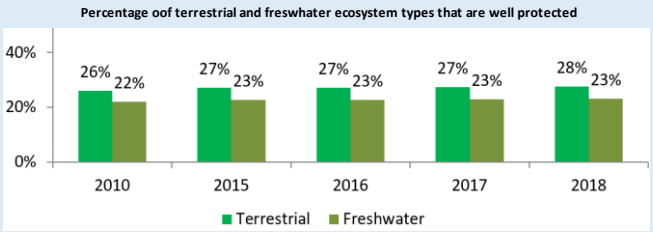
9.4.7 SDG 15.1.1 Forest Extent

15.1.1. Natural forest and woodland area as a percentage of total land area.

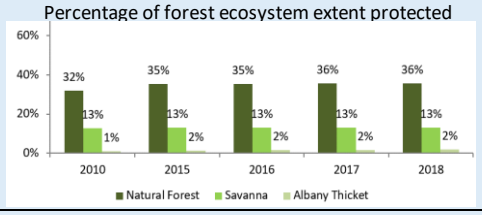
STATE		OUTLOOK
		
2018 Concern - The current status does not meet policy objectives, targets or standards and/or the trend is negative	The results for the available intervals represents a general trend of declining forest extent in South Africa.	Uncertain - Due to various threats or circumstances, it is unclear whether policy objectives, targets or standards will be met or maintained in the next 5 years

9.4.8 SDG 15.1.2D Terrestrial and Freshwater Biodiversity Protection

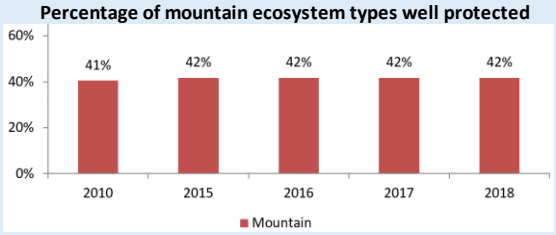
15.1.2D: Percentage of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem types

STATE		OUTLOOK
		
2018 Improving - Although the current status does not yet meet policy objectives, targets or standards, the trend is positive	The percentage of terrestrial and freshwater ecosystems that are well protected has increased by 3% between 2010 and 2018	Uncertain - Due to various threats or circumstances, it is unclear whether policy objectives, targets or standards will be met or maintained in the next 5 years

9.4.9 SDG 15.2.1 Forest Protection

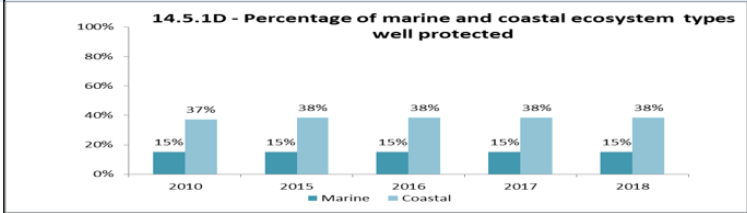
15.2.1D. Percentage of forest within formally proclaimed protected areas.		
STATE	**TREND**	**OUTLOOK**
		
2018		
Improving - Although the current status does not yet meet policy objectives, targets or standards, the trend is positive	South Africa has been relatively successful in protecting its natural or indigenous forests compared to the other two forest biomes. This reflects the focus on natural forests in conservation legislation and management. In terms of the associated indicator, South Africa's forests can only be assessed as being sufficiently protected if current levels of protection meet predefined conservation targets.	Uncertain - Due to various threats or circumstances, it is unclear whether policy objectives, targets or standards will be met or maintained in the next 5 years

9.4.10 SDG 15.4.1D Mountain Ecosystem Protection

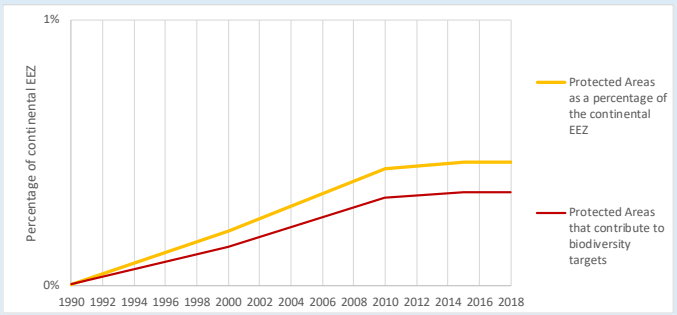
15.4.1D. Percentage of Mountain ecosystem types that are well-represented in protected areas.		
STATE	**Percentage of mountain ecosystem types well protected**	**OUTLOOK**
		
2018		
Favourable - The current status meets policy objectives, targets or standards and the trend is stable or positive	The overall progress towards protecting mountain ecosystems is positive	Good - Policy objectives, targets or standards are met or exceeded or will be met or exceeded within 5 years and there are no obvious threats to this situation

9.5 Oceans and Coasts

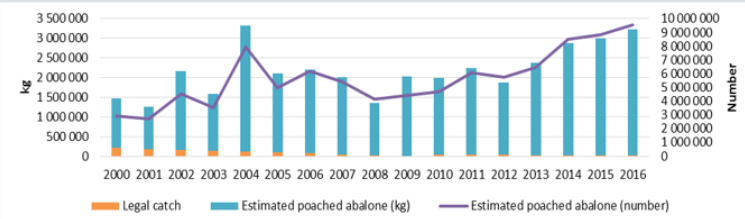
9.5.1 SDG 14.5.1D: Marine and coastal ecosystem protection

SDG 14.5.1D: Proportion of marine and coastal ecosystem types that are well-represented in protected areas		
STATE	**TREND**	**OUTLOOK**
		
2018		
Favourable - The current status meets policy objectives, targets or standards and the trend is stable or positive	South Africa is still in the process of developing its Key Biodiversity Area GIS data. In the interim SANBI has developed a DMI 14.5.1D that draws on the National Biodiversity Assessment indicator known as Protection Level for ecosystems. This does a similar job of tracking how well the country's biodiversity is protected (computing the percentage of Well Protected ecosystem types)	Good - Policy objectives, targets or standards are met or exceeded or will be met or exceeded within 5 years and there are no obvious threats to this situation

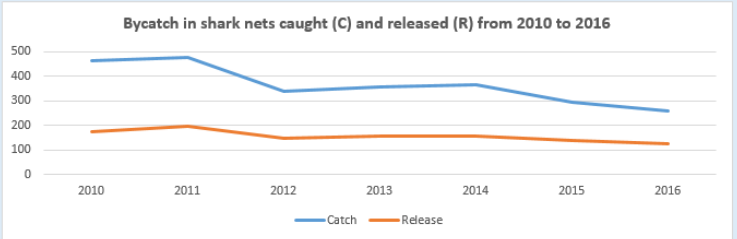
9.5.2 Marine Biodiversity Protection Index

Marine Biodiversity Protection Index (MBPI)		
STATE		**OUTLOOK**
		
2018 Improving - Although the current status does not yet meet policy objectives, targets or standards, the trend is positive	There has been a slight increase in the number of Marine Protected Areas (MPAs) declared since 1990. The increase in MPAs means that South Africa has inched closer to reaching its national goal of protecting 3% of the Exclusive Economic Zone (EEZ) by 2019.	Uncertain - Due to various threats or circumstances, it is unclear whether policy objectives, targets or standards will be met or maintained in the next 5 years

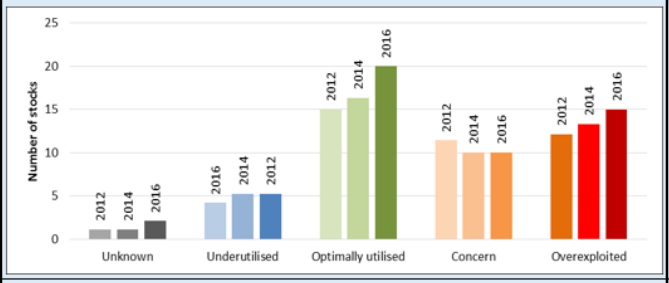
9.5.3 Number of poached abalone (H. midae) in South Africa

Number of poached abalone (*H. midae*) in South Africa		
STATE	**TREND**	**OUTLOOK**
		
2016 **Concern** - The current status does not meet policy objectives, targets or standards and the trend is negative	Haliotis midae (H. midae) is South African abalone, locally known as perlemoen, and one of 5 South African endemic abalone species. They are marine molluscs that are associated with rocky shores distributed along the coast of Port St. Johns in the Eastern Cape through to Saldanha Bay in the Western Cape. It is an economically important species, highly utilised with a high market value and one of the most sought-after invertebrates in the country. It is the most exported species in aquaculture. Abalones feed on sea weeds and floating weeds, thus acting as their biological control and also helps with the cleaning of the ocean. The combined pressure of commercial harvesting and poaching are placing major pressure on the species, jeopardising the survival of wild populations.	**Concern** - Policy objectives, targets or standards are unlikely to be met within the next 5 years

9.5.4 Bycatch in shark nets

Bycatch in shark nets caught (C) and released (R) from 2010 to 2016		
STATE	**TREND**	**OUTLOOK**
		
2016 **Favourable** - The current status meets policy objectives, targets or standards and the trend is stable or positive	The most important aspect of successful catch and release fishing is using appropriate fishing methods and gear for the size and species of fish you're pursuing. The right tools for the job decrease the fish's stress and increase its chance of survival after release. It is important for keeping the balance of fish species in check. So catch and release is helping keep the fish numbers up so that breeding and replenishing fish stocks for further generations to enjoy the sport of fishing.	**Good** - Policy objectives, targets or standards are met or exceeded or will be met or exceeded within 5 years and there are no obvious threats to this situation

9.5.5 Fish stocks

Number of fish stocks according to status		
STATE	**TREND**	**OUTLOOK**
		
2016 **Favourable** - The current status meets policy objectives, targets or standards and the trend is stable or positive	In South Africa, an estimated 312,000 tonnes of seafood is consumed annually. This value increases to 600,000 tonnes when exports are taken into consideration (0.1% of GDP). Population growth has not resulted in proportional demand growth - increased demand is due to increased per capita consumption from 10kg in the 1960's to above 20kg in 2016 and is expected to continue to increase.	**Concern** - Policy objectives, targets or standards are unlikely to be met within the next 5 years

9.6 Waste

9.7 Consumption

[This sub-section will provide various indicators relating to South Africa's consumption patterns -]

9.8 Energy

[This sub-section will provide various indicators relating to energy generation and use -]

10 Glossary

Term or phrase	Definition or explanation
A	
Acid rain	Rainfall that is acidic due to contact with various air pollutants such as carbon dioxide, sulphates, and nitrogen oxides. Acid rain contaminates soil, plants, and water, damages building, and can affect human health.
Adaptation	Adaptation in relation to natural, human, social and ecological systems, means the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities; in relation to natural systems, the process of adjustment to actual climate and its effects; "adaptive capacity" means the ability of a system to adapt to the impacts, cope with the consequences, minimise potential damages, or to take advantage of opportunities offered by climate change or climate variability;
Adaptive capacity	The ability of a system to adapt to the impacts, cope with the consequences, minimise potential damages, or to take advantage of opportunities offered by climate change or climate variability.
Admission of guilt fines (J534)	Means fines paid for less serious environmental offences in terms of Section 56 of the Criminal Procedure Act, 1977. For the purposes of this report, admission of guilt fines are reported separately from convictions imposed through formal trial proceedings. (Source: DEA. (2018). National Environmental Compliance & Enforcement Report 2017-18. Pretoria: Department of Environmental Affairs)
Afforestation	The establishment of forest by natural succession or by the planting of trees on land where they did not formerly grow, e.g. establishment of monocultures of pines, eucalyptus, or wattles in primary grasslands in South Africa.
Ambient air	All air outside buildings, stacks, and exterior ducts.
Aquatic	Growing, living, or found in water.
Aquifer	A body of permeable rock that can store significant amounts of water.
Arrests by EMIs	Indicates the number of individuals arrested/summoned to Court by EMIs for the purposes of criminal prosecution. (Source: DEA. (2018). National Environmental Compliance & Enforcement Report 2017-18. Pretoria: Department of Environmental Affairs)
Atmosphere	The thin layer of gases surrounding earth which sustain life on the planet and which is composed mainly of nitrogen and oxygen. It consists of two main layers, namely the troposphere, which extends from sea level to about 17 km above sea level, and the stratosphere, which extends from 17 kilometres above sea level to about 48 km above sea level.
B	
Benthic	The lowermost region of a freshwater or marine profile in which organisms reside.
Bimodal rainfall	A wet season with two rainfall peaks, separated by at least one dry month.
Bioaccumulation	Process by which certain toxic substances (such as heavy metals and polychlorinated biphenyls) accumulate and keep on accumulating in living organisms, posing a threat to health, life, and to the environment.
Biodiversity hotspot	An area that is identified as a conservation priority because it contains a high number of endemic species and faces extreme threats.
Biodiversity target	A biodiversity objective expressed in a qualitative or quantitative manner, normally to be achieved by a specified date.
Bio-economy	Refers to all economic activity derived from scientific and research activity focussed on biotechnology.

Term or phrase	Definition or explanation
Biogenic mineral	Any biogenic substance that has undergone transformation through the action of geological processes. Although the term does not include compounds produced entirely by biological processes, such as shells of marine molluscs, it does include the constituents of limestones and phosphorites derived from marine organisms.
Biomass	The total mass of all living organisms present in an ecosystem, usually expressed as a dry weight.
Biome	One of the world's major environmental communities classified according to the predominant vegetation and characterized by adaptations of organisms to that particular environment. Major biomes include aquatic, desert, forest, and grassland.
Bioprospecting	The search for plant and animal species from which medicinal drugs and other commercially valuable compounds can be obtained.
Biosecurity	Biosecurity refers to management systems designed to protect society and the environment against potentially harmful organisms and biological materials. In an agricultural context, i.e. veterinary and plant health disciplines, the term has come to represent the protection of valued biological resources and foodstuffs from foreign, harmful or invasive organisms or harmful chemicals.
Biosphere	The envelope around the earth containing the planet's life-supporting systems (e.g. the atmosphere, soil, inland water, and the sea).
Biosphere reserve	A locality that forms part of an international network of protected areas designated by the United Nations Educational, Scientific and Cultural Organization (UNESCO), located in areas of high biodiversity where research into and the monitoring of biodiversity is carried out with the participation of local people.
Biota	The combined flora and fauna of a particular region or period.
Blue (green and brown) environment	The blue environment, especially in respect of compliance and enforcement activities, refers to ocean and coastal matters, Whereas the green environment refers to biodiversity and protected areas and brown indicates pollution, waste and environmental impact assessment-related matters. (Source: DEA. (2018). National Environmental Compliance & Enforcement Report 2017-18. Pretoria: Department of Environmental Affairs)
Brown (blue and green) environment	The brown environment, especially in respect of compliance and enforcement activities, refers to pollution, waste and environmental impact assessment-related matters. Whereas the blue environment refers to ocean and coastal matters and green indicates biodiversity and protected areas. (Source: DEA. (2018). National Environmental Compliance & Enforcement Report 2017-18. Pretoria: Department of Environmental Affairs)
Bush encroachment	A process where there is an increase in the woody layer or an increase in tree abundance within Savanna and grassland ecosystems .
C	
Carbon budget	A carbon budget can be defined as a tolerable quantity of greenhouse gas emissions that can be emitted in total over a specified time. The budget needs to be in line with what is scientifically required to keep global warming and thus climate change "tolerable." Carbon budgeting is sometimes confused with the use of targets, thresholds or caps to set emissions reduction goals.
Carbon dioxide equivalent (CO_2e)	Carbon dioxide equivalent or CO_2e is a term for describing different greenhouse gases (GHG) in a common unit. For any quantity and type of greenhouse gas, CO_2e signifies the amount of CO_2 which would have the equivalent global warming impact. A quantity of GHG can be expressed as CO_2e by multiplying the amount of the GHG by its global warming potential (GWP). For example, if 1kg of methane is emitted, this can be expressed as 25kg of CO_2e (1kg CH4 X 25 = 25kg CO_2e). CO_2e is a useful term in that it allows "collections" of greenhouse gases to be expressed as a single number thereby allowing the comparison of different GHG colections. CO_2e is also sometimes written as CO_2eq, CO_2equivalent or even CDE.

Term or phrase	Definition or explanation
Carbon pricing	Carbon pricing is an approach to reducing greenhouse gas (GHG) emissions that uses market mechanisms to pass the cost of emitting on to emitters. Its broad goal is to discourage the use of carbon dioxide–emitting fossil fuels. A key aspect of carbon pricing is the "polluter pays" principle. By putting a price on carbon, society can hold emitters responsible for the costs of adding GHG emissions to the atmosphere; these costs include polluted air and the costs associated with all of the impacts of climate change. Putting an appropriate price on carbon creates financial incentives for polluters to reduce emissions.
Carbon sinks	Carbon reservoirs and conditions that take in and store more carbon than they release (e.g. forests and oceans).
Carbon tax	A tariff charged by governments on business, industry, and energy sources that emit greenhouse gases, particularly carbon dioxide, through the burning of fossil fuels (coal, oil, natural gas). The charge is typically levied per tonne of carbon dioxide.
Carbon sequestration	The long-term storage of carbon in plants, soils, geologic formations, and the ocean. Carbon sequestration occurs both naturally and as a result of anthropogenic activities and typically refers to the storage of carbon that has the immediate potential to become carbon dioxide gas. In response to growing concerns about climate change resulting from increased carbon dioxide concentrations in the atmosphere, considerable interest has been drawn to the possibility of increasing the rate of carbon sequestration through changes in land use and forestry and also through geoengineering techniques such as carbon capture and storage.
Carcinogenic	A substance contributing to the development of cancer in animal tissues.
Carrying capacity	The maximum population of a given organism that a particular environment can sustain.
Catchment	The area of land drained by a particular stream or river.
Catchment management	A philosophy, process, and implementation strategy to achieve a balance between the utilization and the protection of environmental resources in a particular catchment area.
Child mortality	Number of children dying before the age of five years, per 1,000 births per year.
Chlorofluorocarbons (CFCs)	Ozone-destroying chemicals released mainly by cooling systems such as air conditioners and refrigerators.
Civil Court applications	Means civil proceedings instituted in the High Court (e.g. interdict, declaratory order) by regulatory authorities, usually in circumstances where notices or directives are ignored, and / or actual or imminent significant harm is being caused to the environment. (Source: DEA. (2018). National Environmental Compliance & Enforcement Report 2017-18. Pretoria: Department of Environmental Affairs)
Clean development mechanism	A proposition according to which industrialized countries or their companies could earn emissions credits, while developing countries acquire technology and capital and earn emissions credits that can be banked or sold.
Climate change	The variation in the earth's global climate or in regional climates over time. It includes changes in the variability or in the average state of the atmosphere, or average weather, over timescales ranging from decades to millions of years. In common use, climate change refers to anthropogenic climate change, i.e. climate change that is attributable directly or indirectly to human activities that alter the composition of the global atmosphere.
Coastal public property (CPP)	CPP includes coastal waters, land submerged by coastal waters, coastal islands, the sea shore, and other state land such as the Admiralty Reserves, forests reserves, reclaimed land, state owned land specifically added to CPP and the natural resources on or in CPP in the EEZ.
Coastal zone	The area of land and sea along a coast. It includes estuaries, onshore areas, and offshore areas, wherever they form an integral part of the coastal system.
Communal areas	Areas of land that is owned and managed communally, generally by traditional authorities.
Conservation	The maintenance of environmental quality and functioning.

Term or phrase	Definition or explanation
Convictions	Means convictions imposed by a Court, whether pursuant to a trial or a guilty plea. This excludes convictions by way of the payment of admission of guilt fines. (Source: DEA. (2018). National Environmental Compliance & Enforcement Report 2017-18. Pretoria: Department of Environmental Affairs)
Co-operative governance	In South Africa, government is constituted as national, provincial and local spheres of government which are distinctive, interdependent and interrelated. All spheres of government must observe and adhere to the principles in Section 41 of the South African Constitution and must conduct their activities within the parameters that Chapter 3 provides.
Criminal dockets	Means criminal dockets registered with the South African Police Service with an allocated CAS number. (Source: DEA. (2018). National Environmental Compliance & Enforcement Report 2017-18. Pretoria: Department of Environmental Affairs)
D	
Deforestation	The permanent clearing of an area of forest or woodland.
Degradation	The reduction or loss of the biological or ecological productivity of an area.
Demersal	Fish that live on, or adjacent to, the bottom of the sea.
Demography	The study of the structure of populations.
Dependency ratio	A measure of the portion of a population that is composed of dependents (that is, people who are too young or too old to support themselves).
Desalination	The process of removing dissolved salts from salt- or brackish (slightly salt) water, through the use of a wide spectrum of water treatment technologies, making it fit for consumption by humans or for use for agricultural and other activities.
Desertification	The degradation of land in arid, semi-arid, and dry sub-humid areas, resulting from various factors including climatic variations and human activities.
Dredging	Dredging involves the removal of sediment from the ocean floor to increase the depth of an area. Dredging is required to maintain port and harbour depths to allow the movement of large ships.
Drivers	In the context of the driver–pressure–state–impact–response (DPSIR) Model, 'Drivers' (or driving forces) are the various factors that cause changes or lead the behaviour of a system. They can be natural or human induced. A functional differentiation between direct and indirect drivers is recognised where 'direct drivers' have an explicit influence on the system while 'indirect drivers' act by changing the conditions of one (or more) direct drivers of the system. The identification and distinction of direct and indirect drivers is not always obvious. Typical direct drivers are the human demand for goods and services, good health and social relations, security, education, and freedom. Indirect drivers include components such as the demographical development, economic and social conditions, the state of the environment, or political situations. Hence, suitable driver indicators describe phenomena that are strongly connected to socioeconomic conditions and forces. In general, they are not very flexible or reactive to changes in the rest of the system. But as drivers describe current conditions and trends (e.g., the energy demand of a society), they serve as a basis to assess the kind and degree of pressures on the system (e.g., the amount of CO_2 emissions related to energy conversion). (Definition from – Burkhard, Benjamin & Müller, Felix. (2008). Drivers-Pressure-State-Impact-Response. In *Ecological Indicators. Vol. [2] of Encyclopedia of Ecology, 5 vols*. Editors: Sven Erik Jorgensen & Brian D. Fath. Oxord Elsevier. DOI: 10.1016/B978-008045405-4.00129-4)
E	
Ecological footprint	The impact of a person or community on the environment, expressed as the amount of land required to sustain their use of natural resources.
Ecosystem	The dynamic complex of animal, plant, and micro-organism communities and their non-living environment (soil, water, climate, and atmosphere) interacting as a functional unit.
Ecosystem services	The beneficial functions provided by ecosystems, such as water quality regulation, nutrient cycling, soil fertility maintenance, regulation of the concentration of atmospheric gases, and cultural and recreational opportunities.

Term or phrase	Definition or explanation
Ecotourism	Tourism in which the natural environment is the main tourist interest, and the exercise of which does not potentially harm the environment.
Effluent	Water (usually wastewater) that flows out of a man-made system into a river or the sea.
El Niño	An irregularly occurring and complex series of climatic changes affecting the equatorial Pacific region and beyond every few years, characterized by the appearance of unusually warm, nutrient-poor water off northern Peru and Ecuador, typically in late December.
Emission	A noise or a liquid or gaseous effluent that is discharged into the environment.
Emissions inventory	A listing, by source, of the amounts of air pollutants discharged into the atmosphere. It is used to establish emission standards.
Endangered species	A plant or animal species whose number of individuals or whose population has been reduced to a critical level or whose habitats have been reduced so drastically as to cause an imminent risk of extinction.
Endemic	A plant or animal species that occurs and is restricted to a particular geographical region is said to be 'endemic' to that region, owing to factors such as isolation or response to soil or climatic conditions.
Enforcement action required	Means that the environmental authority has decided that the nature of the non-compliance warrants the initiation of an enforcement action (criminal, civil or administrative). (Source: DEA. (2018). National Environmental Compliance & Enforcement Report 2017-18. Pretoria: Department of Environmental Affairs)
Environmental crime	Is the violation of a common law or legislative obligation related to the environment which triggers a criminal sanction. (Source: DEA. (2018). National Environmental Compliance & Enforcement Report 2017-18. Pretoria: Department of Environmental Affairs)
Environmental degradation	The reduction of the capacity of the environment to meet social and ecological objectives and needs.
Environmental governance	The processes of decision making involved in the control and management of the environment and natural resources.
Environmental Impact Assessment (EIA)	The process of identifying, predicting, evaluating, and mitigating the biophysical, social, and other relevant effects of development proposals before major decisions are taken or commitments made. The EIA Regulations require that specific procedures be followed, and reports (scoping and/or EIA reports) prepared for those activities listed as potentially having a substantial detrimental effect on the environment.
Environmental Implementation Plan (EIP)	A statutory instrument for promoting co-operative governance for environmental management among different spheres of government.
Environmental management	The deliberate and multidisciplinary process of managing environmental resources, which requires the careful preparation, planning, and administration of environmental policies and standards. It aims to ensure that environmental concerns are included in all stages of development, so that development is sustainable and does not exceed the carrying capacity of the environment.
Estuary	The coastal body of water that has a free connection with the open sea and where fresh water, derived from land drainage, is mixed with sea water.
Eutrophication	The process through which a body of standing water (like a dam, pond or lake) becomes polluted, or enriched in dissolved nutrients (like phosphates and nitrates). These nutrients stimulate the growth of aquatic plant life; usually causing the depletion of dissolved oxygen within the waterbody, resulting in mass die-off of fish and other aquatic animal life.
Exclusive Economic Zone (EEZ)	An exclusive economic zone (EEZ) is a sea zone prescribed by the United Nations Convention on the Law of the Sea over which a state has special rights regarding the exploration and use of marine resources. It stretches from the baseline out to 200 nautical miles (nmi) from its coast.
F	

Term or phrase	Definition or explanation
Fauna	All the animal life of a habitat or a region at a given time.
Fertility rate	The number of children born alive to a woman during her lifetime.
Floodplain	An area beside a river that is seasonally flooded when water levels rise because of high rainfall.
Flora	All the plant species that make up the vegetation of a given habitat or area at a given time.
Follow-up	In the context of compliance and enforcement, follow-up means inspections that are conducted subsequent to an initial inspection. These types of inspections are typically more focused on the progress that has been made in respect of non-compliant areas identified in the initial inspection. (Source: DEA. (2018). National Environmental Compliance & Enforcement Report 2017-18. Pretoria: Department of Environmental Affairs)
Food security	The assured availability and access (physical and economic) to adequate food (in terms of quality and quantity), by all people at all times, as required for a healthy, active, and productive life.
Forestry	The practice of growing and managing forest trees for commercial timber production. It includes the management of specifically planted forests and of native or exotic tree species, as well as the commercial use of existing indigenous forests.
Formal dwelling	A structure that is built according to approved plans, for example, a house on separate sand, flat, apartment, townhouse or room in a backyard.
Fossil fuels	Mined energy sources, such as coal, gas, and petroleum that are derived from the remains of prehistoric animals and plants.
G	
Genetically modified organism (GMO)	Is a type of genetically engineered organism through which a gene from one organism is isolated and transferred to cells of another organism, where it is incorporated into the recipient's chromosomes and expressed. During the 1990s, there was dramatic growth in the commercial applications of this new technology, including the development of genetically modified (GM) crops.
Gini-coefficient	A measure of inequality. It is normally used to measure income inequality, but can be used to measure any form of uneven distribution. The Gini-coefficient is a number between 0 and 1, where 0 corresponds with perfect equality (e.g. where everyone has the same income) and 1 corresponds with perfect inequality (where one person has all the income, and everyone else has zero income).
Global warming	A gradual warming of the air temperature in the earth's lower atmosphere as a result of the build-up of greenhouse gases (e.g. carbon dioxide, nitrous oxides, methane, and ozone).
Globalisation	The process by which the world's nations and communities are becoming more closely connected by modern telecommunications and more strongly interdependent economically, socially, and politically. The process carries with it the pressure to conform to global standards and economic approaches.
Governance	The systems of values, policies, and institutions by which society manages its economic, political, and social affairs through interactions within and among the state, civil society, and the private sector.
Green (blue and brown) environment	The green environment, especially in respect of compliance and enforcement activities, refers to biodiversity and protected areas, Whereas the blue environment refers to ocean and coastal matters and brown indicates pollution, waste and environmental impact assessment-related matters. (Source: DEA. (2018). National Environmental Compliance & Enforcement Report 2017-18. Pretoria: Department of Environmental Affairs)
Greenhouse effect	A warming effect of the earth's lower atmosphere resulting when greenhouse gases trap heat from the sun and prevent that heat from escaping back into space.
Greenhouse gas	Any gas that absorbs infrared radiation in the atmosphere, thus allowing heat to enter the earth's atmosphere but not to leave it.

Term or phrase	Definition or explanation
Gross Domestic Product (GDP)	The value of all goods and services produced by all factors of production in an economy by both residents and non-residents over a period of a year.
Groundwater	Water that is stored within the air spaces of soil and in rock formations.
Groundwater recharge	Replacement of water, normally through rainwater percolating into the ground to replenish water lost from the groundwater store by abstraction, evaporation, or transpiration.
H	
Habitat	The place where an organism or community occurs. It is characterized by its physical properties and by the other life forms found there.
Habitat fragmentation	The break-up of natural habitat into small non-contiguous parts. This becomes problematic when the portions are too small to function effectively on their own.
Habitat loss	A process of land use change in which one habitat type is removed and replaced by some other habitat type. In the process of land use change, plants and animals that previously used the site are displaced or destroyed. This generally results in alteration or reduction in biodiversity.
Heat exhaustion	Fatigue and collapse resulting from prolonged exposure to excessive or unaccustomed heat.
Heat stroke	A condition marked by fever and often by unconsciousness, caused by failure of the body's temperature-regulating mechanism when exposed to excessively high temperatures.
Heritage	The sum total of sites of geological, zoological, botanical, archaeological, and historical importance. Heritage is that which we inherit wildlife and scenic parks, sites of scientific or historic importance, national monuments, historic buildings, works of art, literature and music, oral traditions, and museum collections, together with their documentation.
Homelands	Areas designated for black people according to their ethnic group, under the former apartheid government.
Human Development Index (HDI)	A summary composite index that measures a country's average achievements in three aspects of human development, which are longevity, knowledge, and standard of living. It was created by the United Nations Development Programme (UNDP) and first presented in their Human Development Report in 1990.
Hydrocarbons	Any chemical compound that consists only of the elements carbon (C) and hydrogen (H). All hydrocarbons contain a carbon backbone, called a carbon skeleton, and have hydrogen atoms attached to that backbone. Examples of hydrocarbons include petroleum, coal and gas, and the fossilised remains of plants.
Hydropower	Electricity generated by means of flowing water.
I	
Indigenous species	Plants, animals, or microbes those are native to a particular area.
Industrialisation	A process of social and economic change, associated with technological innovation, through which a human society is transformed from a pre-industrial to industrial state.
Informal dwelling	A structure that is not approved by a local authority and is not intended as a permanent dwelling.
Initial inspection	Means that it is the first time that the particular facility/ person has been the subject of a compliance inspection by EMIs. These types of initial, baseline inspections may cover a broad range of environmental aspects (for example, air, water, waste) as is the case with the sector-based strategic compliance inspections. (Source: DEA. (2018). National Environmental Compliance & Enforcement Report 2017-18. Pretoria: Department of Environmental Affairs)
Integrated Environmental Management (IEM)	A code of practice to ensure that environmental considerations are fully integrated into the management of all activities, so as to achieve a desirable balance between conservation and development.
Integrated resource management	See Integrated Environmental Management (IEM).

Term or phrase	Definition or explanation
Inter-basin transfer	The transfer of water from one river system to another, in places where water would not naturally be transferred between the two systems.
Intergovernmental	This term refers to the relations among spheres of government and to relations among government agencies in the same sphere of government.
Intertidal zone	The area of the beach between the high and low tide watermarks.
Invasive exotic species	Species that are intentionally or unintentionally introduced to an area where they would not naturally occur, which then reproduce and invade areas beyond those into which they were originally introduced.
L	
La Nina	A cooling of the water in the equatorial Pacific, which occurs at irregular intervals, and is associated with widespread changes in weather patterns complementary to those of El Niño, but less extensive and damaging in their effects.
Land administration	The act or process of authoritative control over land.
Land degradation	Reduction or loss, in arid, semi-arid and dry sub-humid areas, of the biological or economic productivity and complexity of rain-fed cropland, irrigated cropland, or range, pasture, forest and woodlands, as a result of land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns such as (i) Soil erosion caused by wind and/or water; (ii) Deterioration of the physical, chemical and biological or economic properties of soil; and, (iii) Long-term loss of natural vegetation.
Land reform	Redistribution of land to recognize the rights of all citizens.
Land rehabilitation	The process of returning land in a given area to some degree of its former self, after a process (such as may be conducted by business, industry, or a natural disaster) has damaged it.
Land transformation	The conversion of land, normally from natural habitat to human uses such as agriculture or settlements.
Land use change	Changes in the purpose for which land is used, as, for example, where land that was previously used for pasture becomes a human settlement.
Leachate	A solution or product obtained by leaching, for example the liquid (soluble component) which percolates (seeps, trickles or oozes) through a solid mass (like soil, waste landfill sites, mine residues (tailing dams, slag and waste-rock dumps) and mineral stockpiles). The liquid accumulates the soluble particles it passes through and the resultant leachate is often contaminated or nutrient rich (polluted).
M	
Mariculture	The rearing of fish, shell-fish, and certain aquatic plants under controlled and managed conditions either in their natural environment in the sea or on land-based sea farms. Also called aquaculture or fish farming.
Microbeads	Extremely small pieces of plastic, used especially in cleansing products as exfoliating agents. Microbeads can be either biodegradable or non-biodegradable.
Microplastics	The term 'microplastics' is widely used to describe plastic particles with the size ranging from 1 nanometre to 5 millimetre.
Mitigation	Measures taken to reduce adverse effects on the environment and humans. In the context of climate change, climate change mitigation refers to efforts to reduce or prevent emission of greenhouse gases and includes, among others, using new technologies and renewable energies, making older equipment more energy efficient, or changing management practices or consumer behaviour.
Multilateral Environmental Agreements (MEAs)	International environmental treaties that contain measures to prevent the degradation of environmental resources, such as the Convention on Biological Diversity (CBD).
N	

Term or phrase	Definition or explanation
Non-compliance	Refers to any breach of an environmental legislative obligation or permit/licence/authorisation condition, irrespective of whether or not such a breach constitutes a criminal offence or not. (Source: DEA. (2018). National Environmental Compliance & Enforcement Report 2017-18. Pretoria: Department of Environmental Affairs)
Non-renewable resources	Resources that do not renew themselves in a human time-scale and cannot be replenished once exhausted, such as fossil fuels and copper.
Notices/ directives issued	Means enforcement notices, such as compliance notices and directives that are issued in response to suspected non-compliance with environmental legislation. These tools instruct the offender to take corrective action (e.g. ceasing an activity, undertaking rehabilitation, submitting information). Failure to comply with such compliance notice / directive is a criminal offence. (Source: DEA. (2018). National Environmental Compliance & Enforcement Report 2017-18. Pretoria: Department of Environmental Affairs)
Number of non-compliances	Means the total number of non-compliances related to environmental legislation, regulations, authorisations, licences and/ or permits including conditions thereto identified by EMIs when conducting inspections. (Source: DEA. (2018). National Environmental Compliance & Enforcement Report 2017-18. Pretoria: Department of Environmental Affairs)
Nutrient load	The release of excessive nutrients into a water body from the catchment area, often through the use of fertilizers or other pollutants.
O	
Overgrazing	Grazing by livestock or wildlife to the point where grass cover is depleted; leaving bare, unprotected patches of soil, with a corresponding increase in erosion by water and wind.
Over-utilisation	Overuse of resources, thereby affecting their future use and the condition of the environment.
Ozone	A gas molecule composed of three oxygen molecules, which occurs naturally in the stratosphere where it protects earth's surface from harmful ultraviolet radiation. In the troposphere it acts as a greenhouse gas.
Ozone depletion	The destruction or thinning of the stratospheric ozone layer that shields the earth from harmful ultraviolet radiation.
P	
Particulates	A term used to describe either particles of solid matter (for example, dust, soil, soot and ash) or droplets of liquid (for example, sulphuric acid, salts, dioxins and pesticides) that are small or light enough to remain suspended in the atmosphere for relatively short periods of time.
Pelagic	Relating to communities of marine organisms that belong to the open sea, living free from direct dependence on the sea bottom or shore.
Perennial	(In reference to a water body) flowing or occurring throughout the year.
Persistent Organic Pollutants (POPs)	Chemical substances that are toxic persist in the environment for long periods of time, and bio-accumulate as they move up through the food chain.
PM10	Any particulate matter with a diameter less than or equal to 10 micrometres.
Population density	The number of organisms, species, or humans found in a given area.
Population dynamics	The study of the changes in the size, age, and gender composition of a population due to major biotic and/or abiotic factors.
Precautionary principle	The principle included in policy and laws requiring that where the environmental consequences of a particular project, proposal, or course of action are uncertain, then the project, proposal, or course of action should not be taken.
Proactive inspections	Means inspections that are initiated by an EMI without being triggered by a specific complaint, but rather as part of the institution's broader compliance strategy. These inspections assess compliance with legislative provisions as well as permit conditions. (Source: DEA. (2018). National Environmental Compliance & Enforcement Report 2017-18. Pretoria: Department of Environmental Affairs)
R	

Term or phrase	Definition or explanation
Radioactive waste	Substances from nuclear processes that are contaminated and not reusable. Radioactive waste covers a spectrum from low-level waste (clothing and materials that have been used by people when handling radioactive sources) to high level waste (spent fuel elements) arising from the fission process in nuclear power stations.
Ratification	Formal approval of an international agreement by a state's highest authority. In ratifying a Convention, a country agrees to be bound by the terms of the agreement and indicates to the international community a commitment to meet implementation goals.
Reactive inspections	Means inspections that are initiated in reaction to a specific report or complaint. In these circumstances, an EMI is required to conduct a site visit to verify the facts alleged in the complaint, and to assess the level of non-compliance. (Source: DEA. (2018). National Environmental Compliance & Enforcement Report 2017-18. Pretoria: Department of Environmental Affairs)
Red List	A catalogue of species in danger of extinction and those already extinct, published by the International Union for the Conservation of Nature (IUCN).
Red tide	A proliferation of marine plankton that is toxic and often fatal to fish and other organisms, including humans.
Renewable energy	Energy obtained from sources that are essentially inexhaustible (for example, wind energy, solar energy, and hydropower).
Renewable resource	A resource produced as part of the functioning of natural systems at rates comparable with its rate of consumption. Under normal conditions these resources are continuously renewing themselves.
Reported incidents	Means all incidents of suspected non-compliance with environmental obligations reported by institutions for the purposes of the NECER, irrespective of whether or not compliance and enforcement responses have been taken. (Source: DEA. (2018). National Environmental Compliance & Enforcement Report 2017-18. Pretoria: Department of Environmental Affairs)
Resilience	The capacity to recover from a disturbance, for example, the capacity of a degraded natural area to return to its original state.
Reverse osmosis	A process by which a solvent, such as water, is purified of solutes by being forced through a semi-permeable membrane through which the solvent, but not the solutes, may pass.
Runoff	The flow of water over the ground surface.
Rural-urban continuum	The merging of town and country, a term used in recognition of the fact that in general there is rarely, either physically or socially, a sharp division, a clearly marked boundary between the two, with one part of the population wholly urban, the other wholly rural.
S	
S24G administrative fines	Fines paid by applicants who wish to obtain an expost facto environmental authorisation after having unlawfully commenced with a listed or specified activity in terms of S24F(1) of NEMA or after having unlawfully commenced, undertaken or conducted a waste management activity without a waste management licence in contravention of section 20(b) of NEM:WA. (Source: DEA. (2018). National Environmental Compliance & Enforcement Report 2017-18. Pretoria: Department of Environmental Affairs)
Section 105A agreement	Means a plea and sentence agreement entered into between an Accused and the State in terms of which the Accused admits guilt and the conditions of the conviction and sentence are set out and confirmed by the Court. (Source: DEA. (2018). National Environmental Compliance & Enforcement Report 2017-18. Pretoria: Department of Environmental Affairs)
Siltation	The deposition of soil or fine rock particles on the bottom of river beds or other water bodies, often as a result of soil erosion in the surrounding area.
Slag	The unwanted material (or scum) which forms on the surface of molten metal (i.e. in the refinery process ore (a mineral-rich rock mass) is heated to excessive temperatures in order to obtain a liquid (molten) state, so as to extract metals (like copper) from the ore. The slag is skimmed off the top of (i.e. separated from) the molten matter and deposited on a slag-dump, where it cools and solidifies into rock-like material.

Term or phrase	Definition or explanation
Sodication	Sodication is the process by which the exchangeable sodium content of the soil is increased.
Soil conservation	An intervention to stop soil degradation and even reverse it, through physical structures such as contours and terraces, or through biological means such as intercropping and grass strips.
Soil degradation	The declining productivity of soils through physical, chemical, or biological deterioration resulting from a combination of physical factors such as drought, management factors such as cultivation of marginal land or overstocking, and historical and socio-economic factors such as inequitable distribution of land.
Soil erosion	The loss or movement of soil by agents such as running water, wind, and gravity.
Surface water	Water found on the surface of the land, for example in rivers and dams.
T	
Taxa	Plural of taxon (see taxon).
Taxon / taxonomic group	A group of living organisms with similar characteristics of any taxonomic rank (family, genus, or species), e.g. mammals, insects, and flowering plants.
Taxonomy	The science of discovering, identifying, naming, and documenting the various life-forms making up the earth's biological diversity.
Terrestrial	Of or associated with land.
Threatened species	Plants or animals that are likely to become endangered within the foreseeable future.
Total Allowable Catch (TAC)	The total amount (in kilograms or tonnes) permitted to be caught by the fisheries as a whole (subdivided into quotas allocated to participating permit holders).
Total Allowable Effort (TAE)	The amount of effort (vessels, fishermen or hours) applied to a fishery.
U	
Unlawful commencement of listed activity	Means the commencement of activities which may have a detrimental effect on the environment and require an environmental authorisation. It is a criminal offence to commence or undertake these activities without first obtaining such an authorisation. (Source: DEA. (2018). National Environmental Compliance & Enforcement Report 2017-18. Pretoria: Department of Environmental Affairs)
Urbanisation	The main process driving the creation and ongoing remaking of towns and cities. The term is often used with reference to the movement of people from rural to urban areas.
V	
Volatile Organic Compounds (VOCs)	Primarily the lighter 'fractions' of oil or hydrocarbons, that is, the parts that evaporate easily because they have a low boiling point.
W	
Warning letters	Written documents that afford an opportunity to an offender to comply without initiation of a formal enforcement notice, civil or criminal enforcement proceedings.
Water balance	The balance between incoming water and the loss or use of water in a given area or system.
Water erosion	A process of soil erosion beginning when raindrops bombard bare soil, loosening and washing away soil particles and culminating eventually in gully formation.
Water table	A more or less horizontal layer in the soil below which all spaces between soil particles are saturated with water.
Water-borne diseases	Diseases such as cholera, typhoid fever, dysentery, gastroenteritis, hepatitis, and schistosomiasis, which are commonly transmitted through contaminated water.
Wind erosion	A process of soil erosion, most severe in dry flat areas where vegetative cover is poor and winds blow strongly.

11Acronyms

[This will provide a comprehensive list of acronyms used in this and the other reports something along the following lines, but excluding many of the following -]

Acronym	Abbreviated text
AEL	Atmospheric emission license
AFOLU	Agriculture, Forestry And Land Use
AMD	Acid Mine Drainage
AQMP	Air Quality Management Plan
CARA	Conservation of Agricultural Resources Act
CBA	Critical biodiversity area
CBD	Convention on Biological Diversity
CDM	[Clean Development Mechanism]
CITES	Convention on International Trade in Endangered Species
CSIR	Council for Scientific and Industrial Research
CSP	Concentrated solar power
CUE	Critical Use Exemption
CWDP	Coastal Waters Discharge Permit
DAFF	Department of Agriculture, Forestry and Fisheries
DAO	Desired Adaptation Outcome
DD	Data Deficient
DEA	Department of Environmental Affairs
DEAT	Department of Environmental Affairs and Tourism
DEROs	Desired Emission Reduction Outcomes
DHA	Department of Home affairs
DME	Department of Minerals and Energy
DMR	Department of Mineral Resources
DoE	Department of Energy
DoH	Department of Health
DoT	Department of Transport
DPME	Department of Planning, Monitoring and Evaluation
DPSIR	Drivers-Pressure-State-Impact-Response
DSD	Department of Social Development
DST	Department of Science and Technology
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
€	Euro
EAF	Energy Availability Factor
EbA	Ecosystem-based adaptation

Acronym	Abbreviated text
EBIS	Ecological and Biodiversity Importance and Sensitivity
EBM	Ecosystem-based mitigation
EBSST	Electricity Basic Services Support Tariff
EC	Eastern Cape
EEZ	Exclusive Economic Zone
EFZ	Exclusive Fishing Zone
EIA	Environmental Impact Assessment
EID	Emerging Infectious Disease
EIDs	Emerging Infectious Diseases
EIP	Environmental Implementation Plan
EMF	Environmental Management Framework
EMI	Environmental Management Inspectorate
EMPs	Emerging Micro-pollutants
EN	Endangered
ENSO	El Niño-Southern Oscillation
EOR	Environmental Outlook Report
EPA	Environmental Protection Agency
EPI	Environmental Performance Indicator
EPWP	Expanded public works programmes
ESA	Ecological Support Areas
EU	European Union
EW	Extinct in the Wild
EWT	Endangered Wildlife Trust
EX	Extinct
F	Fluorinated
FAO	Food and Agriculture Organization of the United Nations
FAW	Fall Armyworm
FAWSC	Fall Armyworm Steering Committee
FBW	Free Basic Water
FOLU	Forestry and Other Land Use
FPL	Food Poverty Line
FS	Free State
FSA	Forestry South Africa
FSC	Field Studies Council
G:L:B-	Large general waste site
G:L:B+	Large general waste disposal facility
G:M:B-	Medium-sized general waste site
GAW	Global Atmosphere Watch
GCF	Green Climate Fund
GCIS	Government Communication Information Services

Acronym	Abbreviated text
GDARD	Gauteng Department of Agriculture and Rural Development
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GHS	Globally Harmonized System
GII	Gender Inequality Index
GIS	Geographic information system
GM	Genetically Modified
GMO	Genetically Modified Organism
GMOS	Global Mercury Observation System
GP	Gauteng Province
GSSA	Geological Society of South Africa
GWMO	Global Waste Management Outlook
GWP	Global Warming Potential
HAB	Harmful Algal Blooms
HCRW	Health Care Risk Waste
HDI	Human Development Index
HPA	High Priority Area
HVAC	Heating, ventilation and air conditioning
IAP	Invasive Exotic Plant
ICC	International Coastal Clean-up
ICFR	Institute for Commercial Forestry Research
ICT	Information and Communications Technology
IDP	Integrated Development Plan
IEA	International Energy Agency
IMO	International Maritime Organization
Ind.	Indian (Ocean)
IndWMP	Industry waste management plan
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
IPIECA	International Association of Oil and Gas Producers
IPPPP	Independent Power Producers Procurement Programme
IPPU	Industrial Processes and Product Use
IRENA	International Renewable Energy Agency
IRP	Integrated Resource Plan
ISWA	International Solid Waste Association
ITAC	International Trade Administration Commission
ITOPF	International Tanker Owners Pollution Federation
IUCN	International Union for Conservation of Nature
IUDF	Integrated Urban Development Framework
IUU	Illegal, unreported and unregulated

Acronym	Abbreviated text
IWMP	Integrated Waste Management Plan
IWQM	Integrated Water Quality Management
IWS	Informal Waste Sector
JRC	Joint Research Centre
KNP	Kruger National Park
KZN	KwaZulu-Natal
LBPL	Lower Boundary Poverty Line
LC	Least Concern
LDN	Land Degradation Neutrality
LEDET	Limpopo Economic Development, Environment and Tourism
LFG	Landfill gas
LiDAR	Light Detection and Ranging
LLW	Low-level waste
LP	Limpopo
LPG	Liquid Petroleum Gas
LT	Less Threatened
LTAS	Long-Term Adaptation Scenarios
LULUCF	Land use, land-use change, and forestry
M&E	Monitoring and Evaluation
Mbgl	Meters below ground level
MBT	Mechanical Biological Treatment
MCSA	Mineral chamber of mines in South Africa
MDG	Millennium Development Goal
MEA	Multilateral Environmental Agreements
MEC	Member of the Executive Council
MES	Minimum Emission Standard
MHT	Mechanical Heat Treatment
MIKE	Monitoring the Illegal Killing of Elephants
ML	Local magnitude
MP	Mpumalanga
MPA	Marine Protected Area
MRAG	Marine Resources Assessment Group
MRC	Medical Research Council
MRF	Materials Recovery Facility
MRL	Maximum Residue Limit
MSW	Municipal solid waste
MSY	Maximum sustainable yield
MTSAO	Medium Term System Adequacy Outlook
MTSF	Medium Term Strategic Framework
NAAQS	National Ambient Air Quality Standards

Acronym	Abbreviated text
NAEHMP	National Aquatic Ecosystem Health Monitoring Programme
NAEIS	National Atmospheric Emission Inventory System
NAP	National Action Programmes
NAQI	National Air Quality Indicator
NAS	National Adaptation Strategy
NASA	National Aeronautics and Space Administration
NBA	National Biodiversity Assessment
NBSAP	National Biodiversity Strategy and Action Plan
NC	Northern Cape
NCCRWP	[2011 National Climate Change Response Policy White Paper]
NCP	Nature's Contribution to People
NDACC	Network for the Detection of Atmospheric Composition Change
NDC	Nationally Determined Contribution
NDMC	National Disaster Management Centre
NDP / NDP 2030	[National Development Plan 2030]
NE	Not Evaluated
NEET	Not in Employment, Education, or Training
NEM: AQA	[National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004)]
NEM: BA	[National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)]
NEM: SLA	National Environmental Management Laws Second Amendment
NEMA	National Environmental Management Act
NEO	NASA Earth Observations
NFCS-SA	National framework for climate services-South Africa
NFEPA	National Freshwater Ecosystem Priority Area
NFSD	National Framework on Sustainable Development
NGA	National Groundwater Archive
NGI	National Geo-spatial Information
NGO	Non-Governmental Organisations
NHRA	National Heritage Resources Act
NICD	National Institute for Communicable Disease
NIP	National Implementation Plan
NIWIS	National Integrated Water Information System
NJDCC	National Joint Drought Coordinating Committee
NLC	National Land Cover
NMBM	Nelson Mandela Bay Local Municipality
NMMU	Nelson Mandela Metropolitan University
NNR	National Nuclear Regulator
NOAA	National Oceanic and Atmospheric Administration
NPAES	National Protected Area Expansion Strategy
NPC	National Planning Commission

Acronym	Abbreviated text
NPSWM	National Pricing Strategy for Waste Management
NRW	Non-Revenue Water
NRWDI	National Radioactive Waste Disposal Institute
NSSD	National Strategy for Sustainable Development
NT	Near Threatened
NTCSA	National Terrestrial Carbon Sinks Assessment
NTFP	Non-Timber Forest Product
NW	North West
NWDREAD	Department of Rural Environment and Agriculture Development
NWMS	National Waste Management Strategy
NWRS	National Water Resource Strategy
ODC	Ozone Depleting Compound
ODS	Ozone Depleting Substances
OECD	Organisation for Economic Co-operation and Development
OMP	Operational Management Procedure
PASA	Petroleum Agency South Africa
PGM	Platinum Group Mineral
PM	Particulate Matter
POP	Persistent Organic Pollutant
POPRC	POP Review Committee
PPD	Peak-Plateau-Decline
Ppl	People
Pr	Protected
PSR	Pressure-State-Response
PTDI	Provisional Tolerable Daily Intake
PV	Photovoltaic
QPS	Quarantine and pre-shipment
R	Rand
RBCAA	Richards Bay Clean Air Association
RDI	Research, development and innovation
RDP	Reconstruction and Development Programme
RE	Renewable Energy
REDISA	Recycling and Economic Development in South Africa
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
RHP	River Health Programme
RSA	Republic of South Africa
SAAQIS	South African Air Quality Information System
SACN	South African Cities Network
SADC	Southern Africa Development Community
SAEO	South Africa Environment Outlook

Acronym	Abbreviated text
SAGIS	South African Grain Information Service
SAHRC	South African Human Rights Commission
SAICM	Strategic Approach to International Chemicals Management
SAIRR	South African Institute of Race Relations
SALGA	South African Local Government Association
SAMRC	South Africa Medical Research Council
SAMSA	South African Maritime Safety Authority
SAMSM&CP	South African Molluscan Shellfish Monitoring & Control Programme
SANBI	South African National Biodiversity Institute
SANS	South African National Standard
SARS	South African Revenue Services
SARVA	South African Risk and Vulnerability Atlas
SASSI	Southern African Sustainable Seafood Initiative
SAWIC	South African Waste Information Centre
SAWIS	South African Waste Information System
SAWS	South African Weather Services
SBPs	Spatial Biodiversity Plans
SCBD	Secretariat of the Convention on Biological Diversity
SDG	Sustainable Development Goal
SEA	Strategic Environmental Assessment
SEIAS	Socio-Economic Impact Assessment System
SETs	Sector Emission Targets
SLCP	Short-lived climate pollutants
SMMEs	Small Medium and Macro Enterprises
SoER	State of Environment Report
SPF	Spatial Planning Framework
SPLUMA	Spatial Planning and land use management act
SST	Sea Surface Temperature
StatsSA	Statistics South Africa
SuDS	Sustainable Drainage Systems
TAC	Total Allowable Catch
TAE	Total Allowable Effort
TGM	Total Gaseous Emissions
TNC	Third National Communication
TOC	Total Organic Compound
TOPS	Threatened or Protected Species
TSP	Target Setting Programme
TVOC	Total Volatile Organic Compound
UBPL	Upper Boundary Poverty Line
UGEP	Utilisable Groundwater Exploitation Potential

Acronym	Abbreviated text
UKZN	University KwaZulu-Natal
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNPAN	United Nations Public Administration Network
US	United States
US$	United States Dollar
USA	United States of America
USAID	United States Agency International Development
US-EPA	United States Environmental Protection Agency
VTAPA	Triangle Air-shed Priority Area
VU	Vulnerable
WBPA	Waterberg Bojanala Priority Area
WC	Western Cape
WCWDM	Water conservation and water demand management
WDF	Waste Derived fuel
WEP	Wildlife and Energy Programme
WfW	Working for Water
WGI	Worldwide Governance Indicators
WHO	World Health Organisation
WMA	Water Management Areas
WML	Waste Management License
WMO	Waste Management Officers
WOUDC	World Ozone and UV Data Centre
WQM	Water quality management
WRC	Water Research council
WRDM	West Rand District Municipality
WtE	Waste to Energy
WUL	Water Use Licence
WWF	World Wide Fund for Nature
WWF-SA	World Wide Fund for Nature South Africa
WWTP	Waste Water Treatment Plants
WWTW	Waste Water Treatment Works
Yr	Year
ZAR	South African Rand