2017

OVERBERG CLIMATE CHANGE RESPONSE FRAMEWORK



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List of acronyms

CC	Climate Change
CCRF	Climate Change Response Framework
CML	Coastal Management Line
COP	Conference of the Parties
CSAG	Climate Systems Analysis Group
DEA	Department of Environmental Affairs
DEA&DP	Department of Environmental Affairs and Development Planning (WCG)
EE	Energy Efficiency
GCF	Green Climate Fund
GHG	Greenhouse Gas
IAP	Invasive Alien Plants
IDP	Integrated Development Plan
INDC / NDC	Intended Nationally Determined Contributions / Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
LED	Local Economic Development
LTAS	Long-Term Adaptation Scenarios
LUPA	Western Cape Land Use Planning Act (Act 3 of 2014)
MSP	Municipal Support Programme
NDA	National Designated Authority
NIE	National Implementing Entity
NCCRWP	National Climate Change Response White Paper (2011)
NGO	Non-Governmental Organization
ODM	Overberg District Municipality
RADAR	Research Alliance for Disaster and Risk Reduction
RCP	Representative Concentration Pathways
SANBI	South African National Biodiversity Institute
SDF	Spatial Development Framework
SPLUMA	Spatial Planning and Land Use Management Act (Act 16 of 2013)
SPP	Sustainable Public Procurement
SSEG	Small-Scale Embedded Generation
TAU	Technical Assistance Unit (National Treasury)
UNFCCC	United Nations Framework Convention on Climate Change
WCG	Western Cape Government
WCCCRS	Western Cape Climate Change Response Strategy (2014)

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1. Introduction

Over the last twenty years, evidence that Earth's climate has started changing due to the current and historic release of greenhouse gasses (GHGs) into the atmosphere has been growing. Today, the science is clear[1] – climate change is happening, it is anthropogenic in origin and if unchecked will have adverse consequences for human society. Although the outlook is one that is dismal, climate change also presents us with the most unprecedented opportunity of our time to leapfrog our development practices to be more just, equitable, innovative and sustainable. Globally, 2016 was the hottest year recorded since modern records began, with 16 of the hottest 17 years recorded all occurring in this century (see Figure 1). The global average temperature increase has already reached 1°C in December 2015; May 2015 to August 2016 saw 16 consecutive months break records as the highest average global temperature recorded for that month since measurements started in 1880[2]. Furthermore, globally, 90% of all disasters are now climate-related[3].

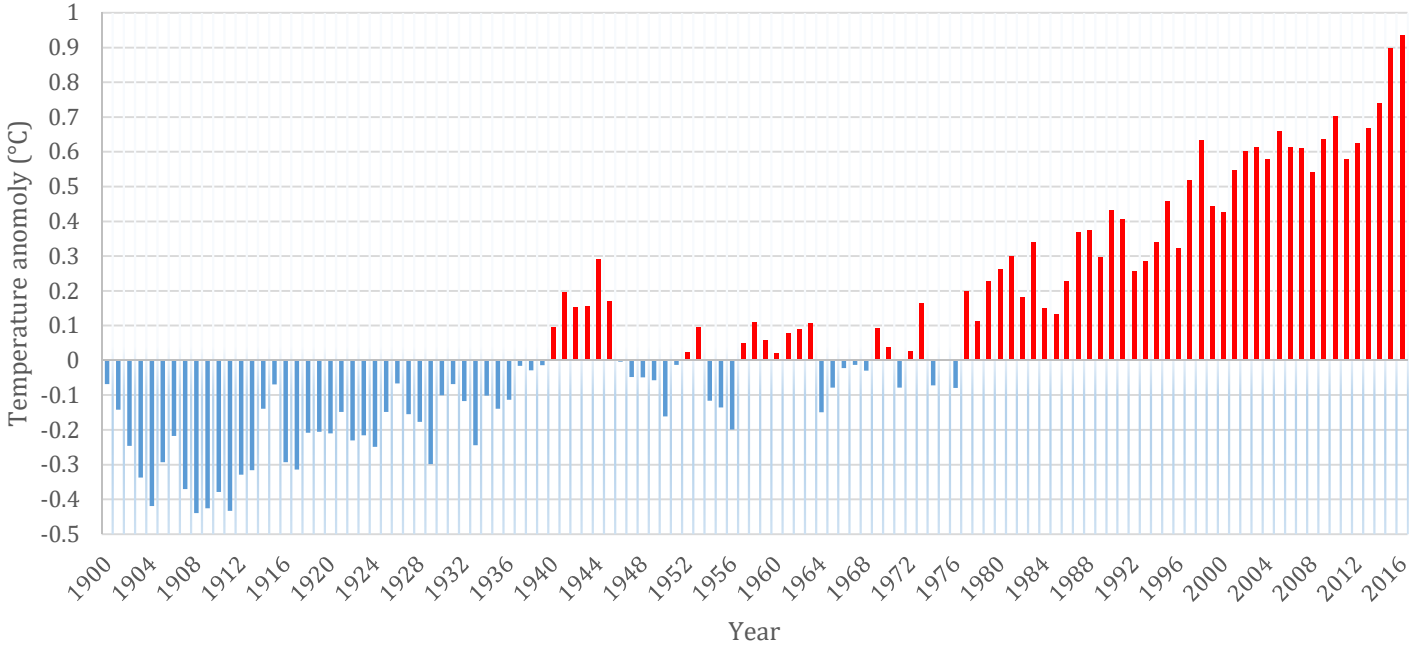

Figure 1: Global land and ocean temperature anomalies, compared to the 20th century average[4].

South Africa has already started responding to climate change, through policies such as the National Climate Change Response White Paper (NCCRWP; 2011) and research projects such as the development of Long-term Adaptation Scenarios (LTAS 2013) and the Mitigation Potential Analysis (2014) for the country[5]. These research exercises in turn informed the Nationally Determined Contributions (NDCs) that South Africa submitted as a signatory of the Paris

[1] IPCC (2014). *Assessment Report 5* (AR5).
[2] NOAA (2016). *Global Analysis - August 2016*. Retrieved 1 December 2016 from https://www.ncdc.noaa.gov/sotc/global/201608.
[3] UN (2016). *Interview: Managing disaster risk vital for sustainable development, UN official stresses*. Retrieved 1 December 2016, from http://www.un.org/apps/news/story.asp?NewsID=53418.
[4] NOAA National Centers for Environmental Information, Climate at a Glance: Global Time Series, published January 2017, retrieved on 3 February 2017 from http://www.ncdc.noaa.gov/cag/.
[5] The LTAS provides a consistent framework for adaptation planning for the country, and also identifies where significant trade-offs may need to be made in terms of both national and sub-national development targets (e.g. over competing water use), while the Mitigation Potential Analysis identified and analysed mitigation options in key economic sectors.

Agreement [developed at the 21st Conference of the Parties for the United Nations Framework Convention on Climate Change (UNFCCC) in 2015]. The NDC describes South Africa's GHG emissions reductions targets (based on a carbon budget approach) as well as the required adaptation goals leading up to 2030. The national Department of Environmental Affairs (DEA) is also in the process of developing a National Adaptation Strategy for the country, which will detail the priority areas for adaptation efforts, and guide national, provincial and local development planning. In addition to dedicated strategies, national government departments have also started incorporating climate change considerations into other high-level strategies, such as the National Development Plan.

At a provincial level, the overarching climate change policy is the Western Cape Climate Change Response Strategy (WCCCRS 2014). The strategy currently focusses on the following areas:

- Energy efficiency
- Renewable energy
- Built environment – critical infrastructure, disaster management, integrated waste management, human settlements
- Sustainable transport
- Water security and efficiency
- Biodiversity and ecosystem goods and services
- Coastal and estuary management
- Food security
- Healthy communities

A WCCCRS Implementation Framework was developed later in 2014, and the first WCCCRS Biennial Monitoring and Evaluation Report was published in 2016, which highlighted the implementation efforts relating to the focus areas outlined within the WCCCRS.

The local government climate change policy space has largely been framed through the Western Cape Government's (WCG) Climate Change Municipal Support Programme (MSP), which has initially assisted various local and District municipalities in developing climate change adaptation plans and sustainable energy plans. In recent years, the MSP has shifted towards a more integrated response to produce combined climate change response plans (including both adaptation and mitigation) focussed at the District level with participation of the local municipalities throughout the process. Additional tools, such as the 'Let's Respond Toolkit' (developed by DEA), gives guidance to municipalities on how they can include climate change responses in the way they execute their constitutional mandates.

1.1. Overberg district context

The Overberg District Municipality (ODM) includes four local municipalities (Theewaterskloof, Overstrand, Cape Agulhas and Swellendam local municipalities) and covers a total area of 12 241km^2 with a population of 286 786[6,7]. Over the period 2005 to 2013, the GDP grew by 4.6%, with the top three sectors being finance, insurance and business services (28.4%), manufacturing (15.2%) and wholesale and retail trade, catering and accommodation (14%). However, despite the growth in GDP, employment only increased by 0.8%, and in 2012 15% of households earned less that R400 per month[6]. Research has shown that climate change will have the largest impact

[6] Overberg IDP, review 2016-17.
[7] StatsSA Community Survey (2016). *Provinces at a Glance*.

on the poorest sectors of society[1], as climate change exacerbates their existing stressors and they have difficulty accessing the necessary resources to protect themselves or recover from climate change impacts and disasters. Informal settlements (which makes up 16% of Overberg households[7]) and rural low-income households in particular are extremely vulnerable to climate change.

Most of the region has a Mediterranean climate, with typically wet, cold winters and warm, drier summers (although this trend weakens towards the eastern part of the district). Winter rainfall is mostly caused by cold frontal systems moving in from the southern Atlantic Ocean, and intense cold fronts and cut-off low weather systems are often associated with flooding in the region[8]. ***Over the past 13 years, flooding events have occurred in the ODM almost every year. The total financial damage from floods in the Western Cape over this period was estimated to be R4.9 billion[9], and a significant proportion of this damage occurred in the Overberg***. This underlines the financial consequences of climate disasters, and the importance of implementing adaptations measures in order to become more resilient to a future climate that will see an increase in these types of extreme events.

Most of the vegetation in the region falls within the Fynbos biome; the fire-prone nature of this vegetation type combined with dry, warm and windy summers creates a substantial fire risk[10]. This is exacerbated by the spread of invasive alien plants (IAPs); in 2011 approximately 31% of the Agulhas Plain was estimated to be invaded by IAPs to a density of more than 50%[11], and the Breede and Gouritz Water Management Areas are the most invaded areas in the Western Cape[10]. Invasion of Fynbos by IAPs leads to an increase in fuel loads, which leads to more intense and devastating fires. IAPs also tend to use more water than indigenous species, which can cumulatively have a large impact on water availability in heavily invaded areas[12].

Although no major droughts have been experienced in the ODM in the last decade, the municipality is in the same situation as most of the Western Cape, with water demand steadily increasing and threatening to outstrip supply.

1.2. Developing an Overberg Climate Change Response Framework

The Municipal Structures Act 1998 (Act 117 of 1998) outlines the roles, responsibilities and functions of district municipalities. Related to climate change the act outlines roles and responsibilities for the ODM in the following broad areas: i) master planning such as development of a framework through which local municipalities can develop their Integrated Development Plans (IDPs), including Spatial Development Frameworks (SDFs) and disaster management plans (which now include climate change adaptation); ii) solid waste management; iii) health services; and iv) fire and disaster management services.

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[8] Local Action for Biodiversity (2015): *Overberg Wetland Report*.

[9] Pharoah *et al.* (2016). *OFF the RADAR: Summary Report. Severe weather events 2011-2014 and their impacts in the Western Cape Province, South Africa*.

[10] WCG (2014). *The Overberg District Municipality's Disaster Risk Assessment 2013. Final draft report*.

[11] Nowell, M. (2011). *Determining the hydrological benefits of clearing invasive alien vegetation on the Agulhas Plain South Africa*. M.Sc. Thesis, University of Stellenbosch, Conservation ecology and entomology, Stellenbosch.

[12] Water losses in the Western Cape caused by IAPs are estimated to be worth ~R1.29 billion per annum. DEA&DP (2014). Western Cape Eco-Invest Project. *Phase I: A preliminary assessment of priorities and opportunities for mobilising private sector investment in the Western Cape's natural capital*.

While the ODM has already started including climate change considerations into projects and strategic documents, there is not yet a formal strategy describing the region's intended climate change response. By developing this Climate Change Response Framework (CCRF) the ODM aims to confirm the strategic importance of climate change response for the district and identify essential climate change response actions for the various municipal departments (at both district and local level), as well as providing guidance and information to non-governmental organisations (NGOs) and civil society on climate change response actions that can be taken that will complement government approaches. **This CCRF is meant to give a strategic overview of climate change responses that is relevant for the Overberg region; accordingly, not all of the responses identified in this document will be implementable by the District and local municipalities alone. This document is therefore not only aimed at the District and local municipalities, but also civil society including the private sector and NGOs as well as National and Provincial government, and is intended to guide a wider Overberg climate change response informed by local knowledge.**

This Framework is guided by the principles set out in the Constitution of The Republic of South Africa (Act No. 108 of 1996), the Bill of Rights (Chapter 2 of the Constitution), the National Environmental Act (Act No. 107 of 1998), the NCCRWP (2011) as well as the WCCCRS (2014). In addition, the Framework is in accordance with the new Disaster Management Amendment Act (Act No 16 of 2015), which stipulates that "*Each municipality must… prepare a disaster management plan setting out the way in which the concept and principles of disaster management are to be applied in its municipal area, including expected climate change impacts and risks for the municipality… (and) provide measures and indicate how it will invest in disaster risk reduction and climate change adaptation, including ecosystem and community-based adaptation approaches*" [(S.21(1)(c)(i); S.21(e)]. Finally, this document is informed by the ODM's strategic planning documents, including the IDP, the SDF and the ODM's Disaster Risk Assessment (2013; this document includes an initial assessment of climate change-related disaster risks for the Overberg).

1.3. Responding to climate change

Climate change response can be roughly divided into preparing for the changes that climate change will bring (adaptation) and efforts to reduce the emission of GHGs to prevent further climate change (mitigation)[13]. However, either of these should not be pursued independently of the other, as adaptation and mitigation responses can complement each other if planned in an integrated manner, and may compromise each other if implemented in isolation. It is therefore important not to make decisions around which responses to implement in isolation, but to choose responses that will result in informed and acceptable trade-offs.

The impacts of climate change will play out at a local level – floods, droughts, changes in rainfall patterns and temperature will all have serious implications for local communities and local municipalities. Municipalities will be the first point of impact and response to natural disasters and the economic and social impact of these (as well as slow-onset disasters such as long-term changes in temperature or rainfall). In terms of mitigation response, municipalities should implement responses to reduce their own GHG emissions, but they also have a major role to play as an enabler of mitigation responses in the private sector. Through municipal by-laws and guidelines to enable small-scale embedded generation (SSEG), municipalities can assist the

[13] See detailed definitions of climate change adaptation and mitigation on page 38.

residential sector and industry to lower its carbon footprint. Municipalities can also play a major role in investigating and encouraging the development of renewable energy opportunities, which contributes to reducing the carbon footprint of the national electricity grid.

2. Climate change in the Western Cape and Overberg

2.1. Climate change projections

According to downscaled climate models (from global to Western Cape level) developed by the Climate Systems Analysis Group (CSAG)[14], the Western Cape in general is projected to experience an increase in average maximum temperatures of between 1.5 and 3°C by 2060; however, this will be partially mediated in regions that lie next to the coast, such as the southern Cape, due to the influence of local sea surface conditions. Summer minimum temperatures are projected to increase between 1 and 3°C, with the same caveat. Therefore, inland regions will experience more warming than coastal regions.

Due to a higher inherent variability, changes in rainfall are much harder to model than changes in temperature. The total average Western Cape winter rainfall is projected to decrease, although there is a higher uncertainty regarding this in the eastern regions of the province. Projections for the period 2040 to 2060 (as compared to 1980 - 2000) centred on data gathered through the Cape Agulhas weather station indicates that there is a possibility that the average monthly rainfall in Agulhas will decrease during March, May and October, and increase during January, February, March and September[15].

The latest Intergovernmental Panel on Climate Change (IPCC) assessment report[1] projects a rise in the average global sea level of 52 – 98 cm by the end of the century under the most high-risk future emissions scenario (RCP8.5[16]), caused both by ice melt as well as thermal expansion of seawater due to projected increases in temperature. It is important to note, however, that sea level rise will not be the same everywhere on the globe; in the case of the Overberg region it is therefore challenging to project exactly how quickly sea levels will rise. Additionally, the Antarctic ice sheets are currently melting at a faster rate than projected, which could increase the rate of sea level rise above the projection. A study done on the projected impacts of sea level rise in the Overberg District[17] indicated that there is a moderate risk of coastal erosion and inundation at Bot River, Klein River, Walker Bay, Pearly Beach, Quoin Point, the coast between Aasfontein to Arniston, and De Hoop Vlei; losses of coastal public and private property due to coastal erosion has already been experienced at Nostra in Struisbaai. There is a moderate risk of groundwater contamination for Vermont-Sandbaai, Hermanus, Walker Bay, Gansbaai, Kleinbaai, Aasfontein, Cape Agulhas, Waenhuiskrans and De Hoop Vlei, and high risk for Struisbaai (the latter has already been affected by this). There is a moderate risk of extreme coastal events such as large storm surges for the relatively low gradient sandy and rocky coastal sections of Struisbaai (focused wave energy north of the harbour), Quoin Point (direct exposure of the fishing community of Buffeljagsbaai to large swell), Cape Agulhas and Vermont-Sandbaai (large proportion of shore fronting properties close to the high water mark), Klein River and Bot River (estuarine systems prone to flooding). When the sea level rise risk factors are all combined, the

[14] CSAG (2014). *Climate Science Input into Municipal Climate Adaptation Plans*.
[15] Climate Information Portal. http://cip.csag.uct.ac.za/webclient2/datasets/africa-merged-cmip5/#nodes/cmip5-anomalies?folder_id=33&extent=100161. Data retrieved on 24 November 2016.
[16] See definition on page 38.
[17] DEA&DP (2012). *Sea Level Rise and Flood Risk Assessment for a Select Disaster Prone Area along the Western Cape Coast, Phase B: Overberg District Municipality*.

most at-risk areas of the ODM coast are (in order of higher to lower risk): Struisbaai, Cape Agulhas, Quoin Point, Pearly Beach, Vermont-Sandbaai and Klein River (see Figures 2 – 4).

The Overberg Coastal Management Lines (CMLs) developed in 2015 includes risk zones for the Overberg coast based on projected sea level rise, littoral active zones (mobile sand), projected sea level rise, storm-driven coastal inundation and projections of storm-driven coastal erosion. The low, medium and high risk zones corresponds to 1:20 year storm event and 20cm sea level rise, 1:50 year storm event and 50cm sea level rise and 1:100 year storm event and 100cm sea level rise, respectively. Once adopted by the Minister of Environmental Affairs and Development Planning these zones will be integrated into municipal zoning schemes; until then municipalities are encouraged to consider the risk zonings in their spatial planning. The CMLs and risk zones can be viewed online on the interactive WCG Environmental Affairs and Development Planning Atlas[18].

In the Overberg, the combined effects of the climate change projections discussed here will likely be an increase in extreme weather events, such as intense rainfall, sea storm surges, increased wind speeds, drought and flood events.

[18] https://westerncapegov.maps.arcgis.com/apps/webappviewer/index.html?id=4baeeca59409463390a32f4137e2d554

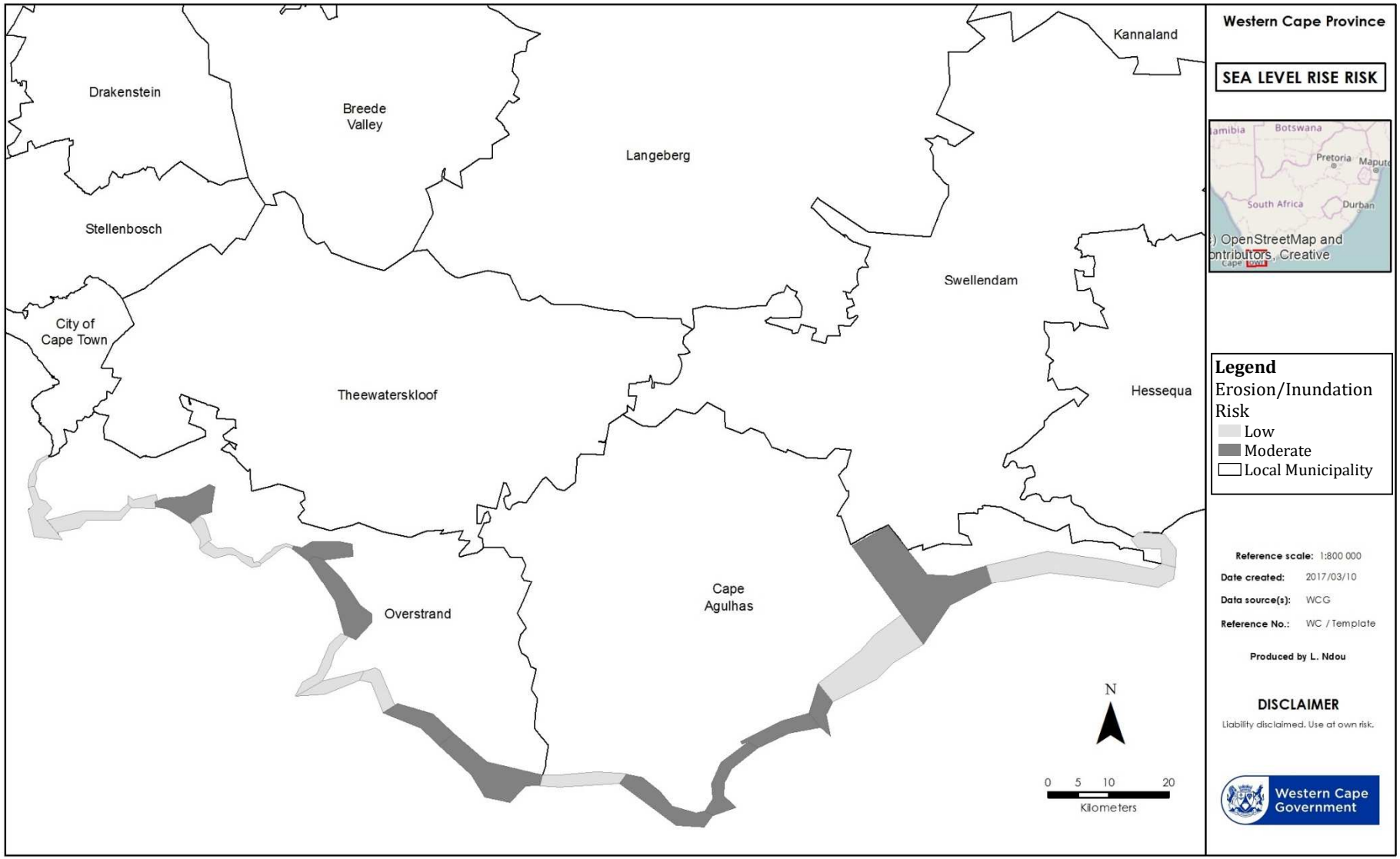

Figure 2: Sections of the ODM coast that are at most risk to coastal erosion and inundation from sea level rise. Adapted from DEA&DP (2012).

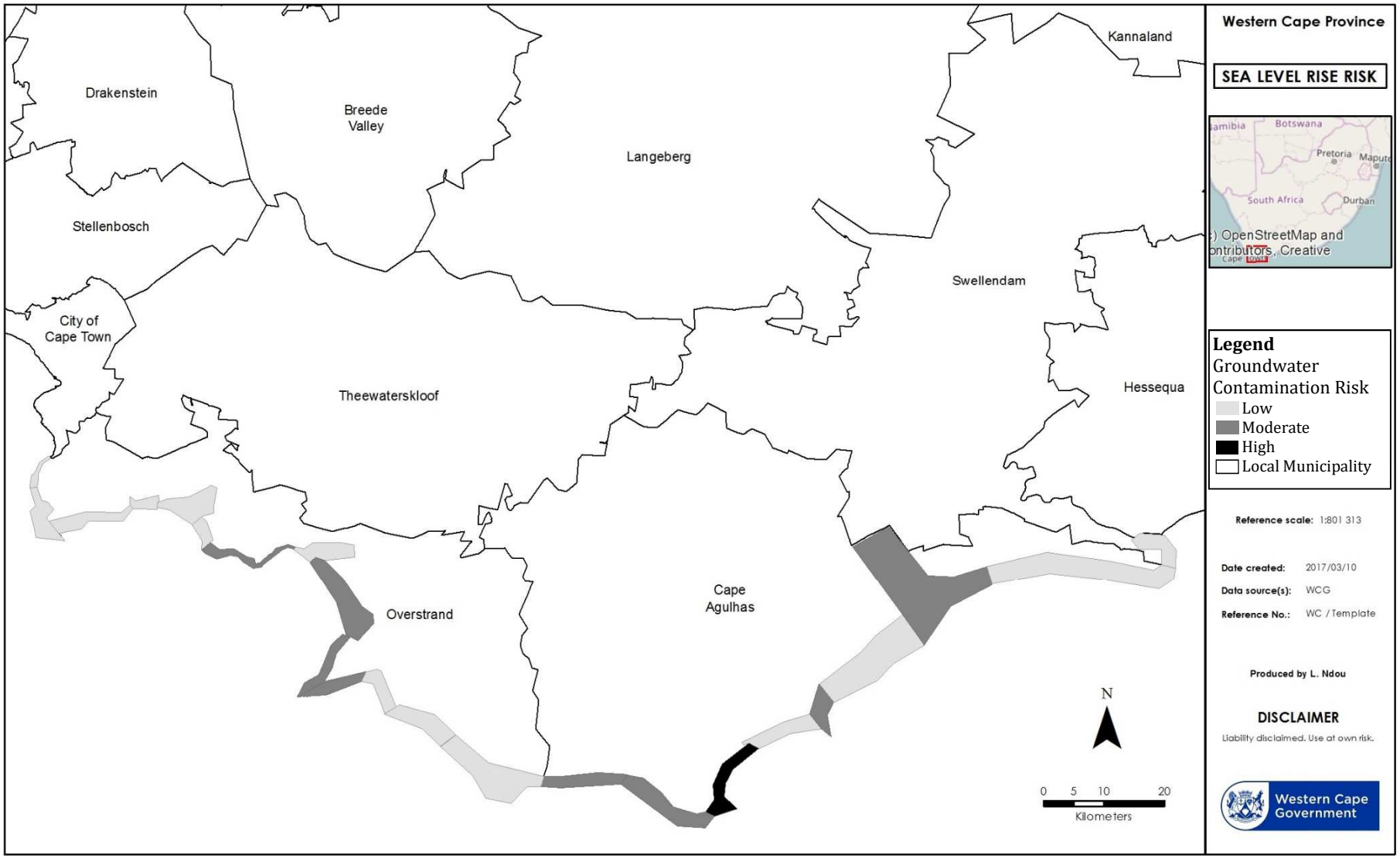

Figure 3: Sections of the ODM coast that are at most risk to groundwater contamination from sea level rise. Adapted from DEA&DP (2012).

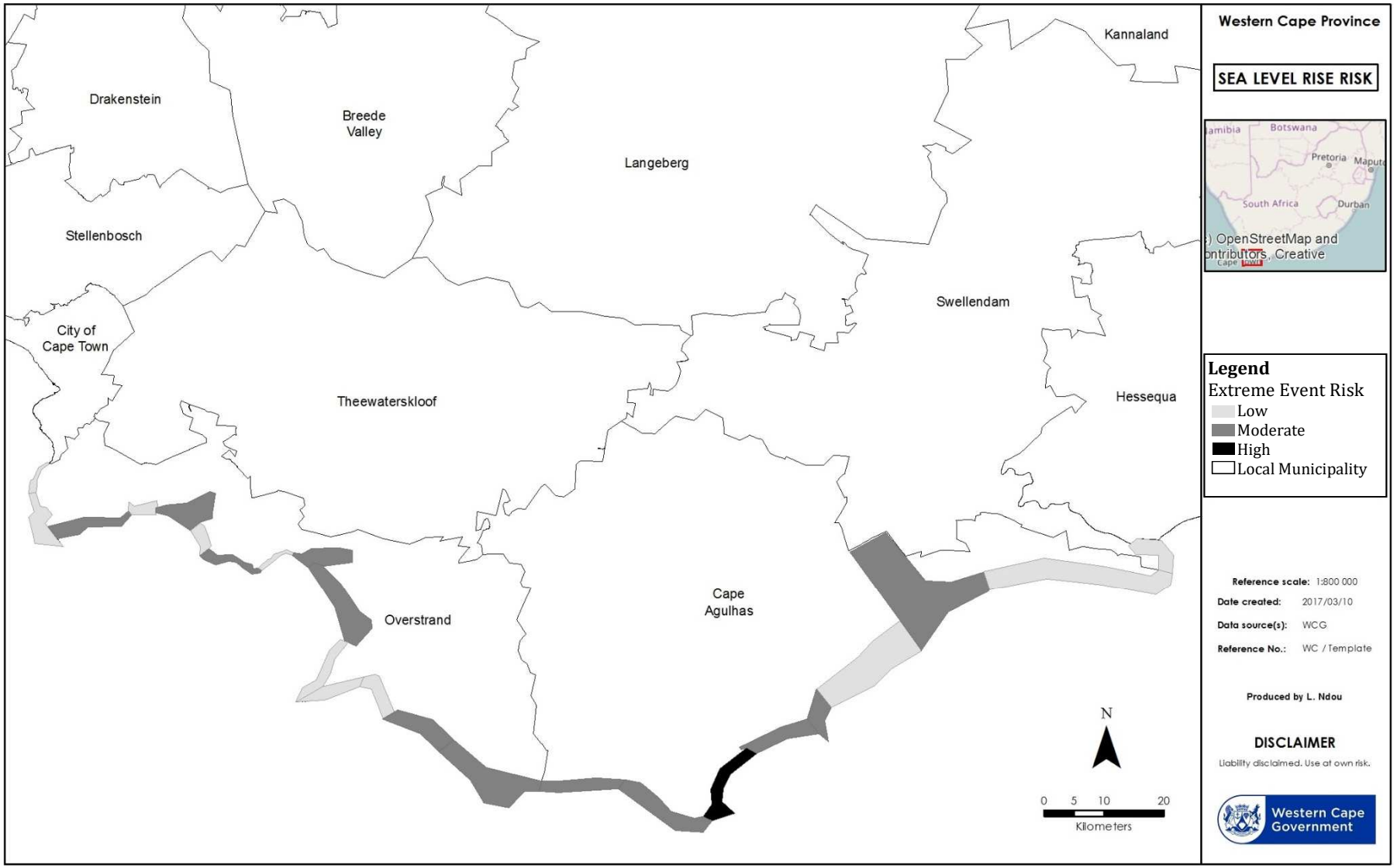

Figure 4: Sections of the ODM coast that are at most risk to extreme events (such as large storm surges) from sea level rise. Adapted from DEA&DP (2012).

2.2. Potential impacts of climate change

A study by CSAG[19] at the University of Cape Town modelled the impact of the expected climate change for the Western Cape for the 2030 - 2045 period[20]. The following climate changes are projected:

Table 1: Climate Change projections for the Western Cape 2030 - 2045[21] (updated 2017)

Projection	Possible impacts
Higher mean annual temperature	• Increased evaporation and decreased water balance; and • Reduced crop quality and food security.
Higher maximum temperatures, more hot days and more heat waves	• Increased heat stress on humans and livestock; • Increased incidence of heat-related illnesses; • Increased incidence of death and serious illness, particularly in older age groups; • Increased heat stress in livestock and wildlife; • Decreased crop yields and rangeland productivity; • Extended range and activity of some pests and disease vectors; • Increased threat to infrastructure exceeding design specifications relating to temperature (e.g. traffic lights, road surfaces, electrical equipment, etc.); • Increased electric cooling demand increasing pressure on already stretched energy supply reliability; and • Exacerbation of urban heat island effect • Increased frequency and intensity of fire regime
Higher minimum temperatures, fewer cold days and frost days	• Decreased risk of damage to some crops and increased risk to others such as deciduous fruits that rely on cooling period in autumn; • Reduced heating energy demand; • Extended range and activity of some pests and disease vectors; and • Reduced risk of cold-related deaths and illnesses
General drying trend in western part of the country	• Decreased average runoff, stream flow; • Decreased water resources and potential increases in cost of water resources; • Decreased water quality; • Decrease in shoulder season length threatening the Western Cape fruit crops; • Increased fire danger (drying factor); and • Impacts on rivers and wetland ecosystems
Intensification of rainfall events	• Increased flooding; • Increased challenge to storm water systems in urban settlements; • Increased soil erosion; • Increased river bank erosion and demands for protection structures; • Increased pressure of disaster relief systems; • Increased risk to human lives and health; and

[19] WCCCRS (2014).

[20] The timeline parameter for the WCCCRS is the 2030 – 2045 period. 2030 is the earliest anchor year to which climate change projections can realistically be scaled back from global climate models, which look at 2045 and beyond. 2030 is also a time horizon within which policy, economic and business decisions can realistically be made.

[21] Additional information on how municipal assets and service delivery will be impacted by climate change can be found in Annex 2.

Projection	Possible impacts
	• Negative impact on agriculture such as lower productivity levels and loss of harvest which could lead to food insecurity
Increased mean sea level and associated storm surges	• Salt water intrusion into groundwater and coastal wetlands; • Increased storm surges leading to coastal flooding, coastal erosion and damage to coastal infrastructure; and • Increased impact on estuaries and associated impacts on fish and other marine species

As is evident in a number of the above listed projections, there is a risk of drier conditions across the province as a whole in the 40-year time horizon. In contrast, however, historical trends and some downscaled projections suggest that western and southern mountain ranges could experience wetter conditions. This apparent contradiction serves to highlight the complexity of climate drivers and responses, which in turn illustrates the inherent difficulties faced by decision makers when required to plan for climate resilience into the future. The complexity highlights the need for adaptive and flexible responses to climate variability and change that are not focused on fixed timescales or unidirectional change. Various agro-climatic zones[22] were identified in the Western Cape during the development of the SmartAgri strategy[23], and the potential impacts that will likely be experienced in each zone was projected. The relevant impacts for the agro-climatic zones located in the Overberg are given in Table 2.

[22] Agro-climatic zones are areas that represent characteristic climates, soil types and typographies, and are therefore appropriate for particular agricultural activities.
[23] This is a sectoral climate change strategy developed for the Western Cape agricultural sector.

Table 2: Summary table of climate change impacts on agriculture for each agro-climatic zone in the Overberg District[24].

Name	Main physical features	Main water resource features	Main climatic features	Climate change temperature projections	Main commodities	Socio-economic features	Future agricultural potential
Grabouw-Villiersdorp-Franschhoek	Plains with low elevation mountains	Western Cape Water Supply System large dams, farm dams, very large storage capacity	Unique climate, more cloudy, misty and wet than surrounding areas	Low range warming	Pome fruit, wine grapes, wheat, barley, stone fruit, berries	High income, seasonal labour	Remains high as long as dams fill up, but apples become unviable due to warming
Montagu-Barrydale	Mountainous with fertile valleys	Rivers, dams, low storage capacity	Winter rainfall, cold in winter with occasional heavy rain, hot in summer	Medium range warming	Stone fruit, wheat, barley, wine grapes, pome fruit, citrus, olives Sheep	Seasonal labour	Remains high as longs as dams fill up
Rûens-east[25]	Hilly coastal plain, bordered by mountains in north, coast in south, fertile soils	Farm dams, occasional river, low storage capacity	More variable rainfall than to the west, with recent droughts in Heidelberg-Albertinia area, mostly winter with some summer rainfall	Low range warming	Wheat, barley, canola Sheep, cattle, dairy, pigs ostrich		Currently becoming marginal for small grains but could improve given possible increases in rainfall
Rûens-west[26]	Hilly coastal plain, bordered by mountains in north, coast in south, fertile soils	Farm dams, occasional river, low storage capacity	More reliable dryland conditions than to the east, winter rainfall, warm dry summers	Low range warming	Wheat, barley, canola Dairy, sheep, cattle		Remains high for small grains but with increasing yield variability

[24] DoA & DEA&DP (2016). *SmartAgri. A Status Quo Review of Climate Change and the Agriculture Sector of the Western Cape Province*.
[25] Protem and further east, and south of Swellendam.
[26] Kleinmond and Botrivier in the west to Riviersonderend, Bredasdorp and Agulhas in the east.

2.3. Climate change hazards and risks identified for the Overberg district

Hazards resulting from climate changes and the risks of these hazards occurring were determined by taking into account the projected climate changes in the Overberg as well as anecdotal evidence from workshop attendees; these hazards and risks were then used to determine what impacts may be experienced from climate change in the major sectors in the district. These sectors included Agriculture; Water; Biodiversity/Conservation; Tourism; Government, Infrastructure and Human Settlements; Education; Business and Retail; Health; Fisheries; Energy; Transport; and Disaster Risk Management.

Direct hazards identified included increased flooding and droughts, increased wind speeds and sea storm surges, increased average temperatures, decreased and more sporadic rainfall, seasonal changes and decreased water availability. Secondary hazards included infrastructure damage from direct hazards, increased fire frequency and intensity, decreased food security, economic impacts, human and animal health impacts, air quality impacts, impacts on biodiversity and tourism, decrease in investment and increased resource constraints. These hazards can be seen in detail in Table 3 below. An attempt was made to identify which municipal unit/department would be most suited to respond to each particular hazard; however, it should be noted that these are based on generic municipal categories (i.e. a particular category might not exist as a single unit in a particular municipality, or may have a different name). Additionally it should be noted that municipalities have a particular set of legal mandates, which will influence how they are able to respond to a particular hazard.

Table 3: The climate change hazards and impacts that were identified during workshops with local and district municipal officials, as well as external stakeholders[27].

#	Hazard/impact	Municipal category	subcategory
1	Decreased food security as a result of impacts on crops and livestock, due to increased drought, flood and fire frequency, increased extreme weather (incl. wind), changes in pest frequency and distribution, decreased number of cold days, change in rainfall patters [planting month (May) is drier], increased heat (impacts on crop yield and quality, and livestock heat stress), increased financial stress on farmers[28]	Infrastructure / Engineering	Bulk water
		Environmental Health	Disease management (incl. vector control)
		Disaster Risk	Disaster management
2	Damage to fishing vessels and port infrastructure due to increased wind and sea storm surges	LED & Tourism	

[27] Note that the municipal categories and subcategories used in the table reflect generic municipal organisation structures, and is only meant to be a guideline for municipalities to indicate where the responsibility for a particular hazard may fall within their organisation. **It is up to individual municipalities to determine where the responsibility for a particular hazard is best housed within their organisation.**

[28] See Table 2 for fine-scale climate change impact information for each agro-climatic zone in the ODM.

#	Hazard/impact	Municipal category	subcategory
3	Impact (health and financial) on people, communities and business (particularly informal settlements) due to increased disasters (floods, landslides, fires, extreme weather such as intense rainfall events) and increased heat [heat stress (esp. outdoors workers); increased death rate from heart and respiratory diseases]. Groups at risk incl. elderly, chronically sick, very young and socially and geographically isolated. Leads to increased absenteeism and health costs.	Disaster Risk	Disaster management Fire and rescue
		Environmental Health	Water quality management Disease management (incl. vector control) Environmental monitoring and compliance/ pollution
		LED & Tourism	
4	Increased water demand and restrictions, and decreased water resources (surface and ground water) and security, due to increased drought (decreased ground water due to increased borehole abstraction), heat (more evaporation in dams), decreased snowmelt, flood (increased sediment build-up in dams from upstream erosion) as well as climate change impacts on biodiversity and ecosystems	Infrastructure / Engineering	Bulk water
		Environmental Management	Biodiversity & Ecosystems
		LED & Tourism	
5	Infrastructure damage (roads, bridges, buildings, bulk water & sewer, coastal protection structures, electricity reticulation, fences) requiring rebuilding / increased maintenance & repair, due to increased floods, wind (especially RE), heat (road surface), sea level rise, sea storm surge	Infrastructure / Engineering	Bulk water Roads & storm water Sanitation & waste water Electricity Housing
		Environmental Management	Biodiversity & Ecosystems Coastal Spatial planning (SDF) and GIS
		LED & Tourism	
6	Increased fire risk, due to increased drought and wind speeds, climate change impact on biodiversity and ecosystems (aliens multiply)	Disaster Risk	Fire and rescue
7	Increased pressure on disaster risk management	Disaster Risk	Disaster management Fire and rescue
8	Changes in disease vectors / conditions conducive to hazardous organism incubation	Environmental Health	Water quality monitoring Food control Disease management (incl. vector control)

#	Hazard/impact	Municipal category	subcategory
		LED & Tourism	
9	Water contamination - groundwater from sea level rise and flooding of waste disposal sites and cemeteries, surface water due to drought (increased bacterial count), point-source pollution (e.g. flood-related spill from Waste Water Treatment Works)	Environmental Health	Water quality monitoring Environmental monitoring and compliance / pollution
		Waste Management	Solid waste / refuse removal
10	Increase in air pollution, due to increase in the number of inversions, as well as increased dust due to increased wind speeds	Environmental Health	Environmental monitoring and compliance / pollution
		LED & Tourism	
11	Decrease in biodiversity and ecosystem services (e.g. pollination, water retention and purification, air purification, carbon storage), due to increased drought, flooding, heat	Environmental Management	Biodiversity & ecosystems Municipal open space (incl. parks)
		LED & Tourism	
12	Increased erosion and sand movement due to climate change impacts on biodiversity/ecosystems, increased fire frequency and sea level rise, increased extreme weather (intense rainfall events, floods, wind, sea storm surge)	Environmental Management	
13	Decreased fish spawning, due to reduced flow to estuary mouths (increased drought)	Infrastructure / Engineering	Bulk water
		Environmental Management	Biodiversity & ecosystems
14	Increased emissions resulting from land use change, desalination plants, increased number of cars and travel, fertiliser use, freight transport on roads, industrial processes / products, organics in landfill, increased electricity use (due to increased heat more aircon use), liquid fuel use.	Infrastructure / Engineering	Electricity
		Waste Management	Solid waste / refuse removal
		Environmental Management	Spatial planning & GIS
		Environmental Health	Environmental monitoring and compliance / pollution
15	Communications and electricity interruptions, due to increased flooding and extreme weather (wind)	Infrastructure / Engineering	Electricity
		Disaster Risk	Fire and rescue
16	Changes in cold current / sea temperature along the coast affects species distribution (changes in oceanic conditions)	LED & Tourism	

#	Hazard/impact	Municipal category	subcategory
17	Storm water systems overwhelmed, due to increased flooding and intense rainfall events	Infrastructure / Engineering	Roads & storm water
		Environmental Management	Biodiversity & ecosystems Spatial planning (SDF) and GIS
18	Decrease in positive investment environment, decrease in property values, increase in insurance premiums and withdrawal of insurance cover for property/assets situated in high risk areas	LED & Tourism	

2.4. Climate change responses

Based on the hazards and impacts identified in Table 3 a series of climate change responses were identified and workshopped with stakeholders in the Overberg (Table 4). In accordance with the approach followed for this plan, which does not just focus solely on municipal responses to climate change but attempts to cover a wide range of potential responses regardless of who is responsible for implementation, these responses cover a wide range of sectors and mandates. Additionally, some of the identified responses are already being implemented by a wide range of stakeholders within the Overberg. They are included here not just to give an overview of potential responses that is as comprehensive as possible, but also to make sure that stakeholders which can contribute to these responses, but are not already doing so, are alerted to the opportunity to do so. The responses provide a wide variety of measures that will need to be considered over a long time period, and in essence form a suite of short, medium and long-term responses which need to be planned over time. Stakeholders should consider the suite of responses as a long-term plan, whilst prioritising and focusing in on short term goals that can be achieved every few years (see section 4).

2.4.1. Municipal responses

Municipal actions and areas of influence are governed by the mandates assigned to district and local municipalities in The Constitution of the Republic of South Africa (1996). For this reason, municipalities may find it challenging to implement some of the responses in Table 4 that may not fall within their legal mandate. In these cases, it will be up to other sectors within the Overberg district to work together with municipalities in implementing these responses. However, even in cases where municipalities are not the main implementers of a response, municipalities will often play a key role as an enabler by removing blockages, which may inhibit other actors in implementing appropriate responses.

Although it is widely considered that environmental management is an "unfunded" municipal mandate, this is not necessarily a barrier when implementing climate change responses, as quite often responses don't require additional funding but merely an adjustment of the way in which a municipality does business (discussed further in section 3.1). Furthermore, it should be noted that many of the identified responses fall squarely within areas that are not traditionally seen as "environmental", including the update of rules, regulations and standards; spatial planning; disaster management; transport; infrastructure (e.g. storm water, roads, housing, bulk infrastructure); economic development; tourism; health and others – making climate change a transversal issue requiring considering across all sectors.

2.4.2. Non-governmental and private sector stakeholder responses

As noted earlier, it is vitally important for the private sector and NGO's, as well as other levels of government, to work with municipalities to implement a comprehensive climate change response across all sectors. Non-municipal stakeholders will be in a position to implement the responses identified in Table 4 which fall outside municipal mandates, and in some cases will be able to contribute to municipal responses. Non-governmental organisations are often much freer to act than government as they may be less burdened by red tape and rigid time-frames (particularly for funding), as well as having access to sources of funding that government either cannot access or can only access with difficulty.

Table 4: The response measures that were identified during workshops with local and district municipal officials, as well as external stakeholders, in response to the hazards identified in Table 3.

Sector abbreviations: LG = Local government; PG = provincial government; NG = national government; PS = Private sector; NGO = non-government organisations; CMA = catchment management agencies; AC = academia; FPA = fire protection associations; "Local government" includes both District and Local Municipalities[29]. Note that the numbering of responses are for cross-referencing purposes only, and do not correspond to priority or any type of ranking. To see responses ranked by priority, see Annex 3.

#	Response	Sector(s) responsible	Municipal category[29]	subcategory
1	Apply for international funding – overarching response can potentially be pulled out as a generic option for funding (Opportunity to use climate change funding to address infrastructure and other related issues / needs)	LG, NGO, PS, PG, NG	All categories	
2	**Water-related infrastructure responses:** • Address water reticulation losses [this will prevent water wastage and therefore decrease water demand and increase water security (CC adaptation)] • Increase ecological infrastructure to slow, spread and sink water run-off (e.g. on-farm furrows and swales, contour farming, improving the biodiversity status of wetlands and riparian areas, as well as the construction of hard infrastructure where appropriate e.g. gabions) [this will allow more water infiltration into soil and groundwater, as well as decrease flood impacts (CC adaptation)] • Implement water re-use [this will increase overall water supply and water security, and decrease vulnerability to drought (CC adaptation)] • Investigate alternative water desalination options – e.g. using wave power to create the pressure needed for desalination, instead of electricity (Cape Verde, Australia); using solar/wind to generate the necessary energy for desalination [desalination is expensive and energy-intensive (and therefore GHG intensive) (CC mitigation)] • Investigate alternative water storage options (e.g. underground) / dam expansion where appropriate [this will increase water security and drought resilience (CC adaptation)]	LG, PG, NG, PS, AC	Infrastructure / Engineering Environmental Management	Bulk water Biodiversity & ecosystems

[29] Note that the municipal categories and subcategories used in the table reflect generic municipal organisation structures, and is only meant to be a guideline for municipalities to indicate where the responsibility for a particular group of responses may fall within their organisation. **It is up to individual municipalities to determine where the responsibility for a particular response is best housed within their organisation, and this should be informed by legal mandates**.

#	Response	Sector(s) responsible	Municipal category[29]	subcategory
	• Plan for increased river sediments and its effect on dam infrastructure and storage capacity (e.g. river bank stabilisation to prevent erosion leading to sediment build-up in water storage structures) [this will prevent the loss of water storage capacity, which will improve drought resilience (CC adaptation)] • Use flooding events to store water against future drought periods [this will contribute to flood attenuation as well as increased drought resilience (CC adaptation)]			
3	**Update / change infrastructure specifications for climate resilience:** • Develop guidelines on engineering/biological/socio-institutional approaches to respond to climate change [this will guide municipal officials on how to implement CC response in their work] • Update standards for at-risk infrastructure (may need to prepare the necessary paperwork / permissions before-hand in order to act when the opportunity presents itself) - Include increased flood risk in the management / design parameters of waste water treatment works • Update engineering specifications: - road surface and bridge specifications to deal with flooding and higher temperatures (consider alternative heat-resistant paving materials) - Update building regulations - Include climate change resilience into tendering documents for all infrastructure (incl. planning for wind, increased temperatures, flooding, droughts, etc.) • Make use of green building technology/ techniques such as passive design, alternative building materials, etc. [these improve insulation (CC adaptation) and reduces energy requirements (CC mitigation)]	LG, PG, NG, PS, AC, NGO	Infrastructure / Engineering	All subcategories
4	**Relocate infrastructure:** • Consider moving line infrastructure underground where appropriate [this will insulate infrastructure from climate-related impacts (CC adaptation)] • Relocate infrastructure away from flood plains / areas prone to flooding / other risk areas (e.g. estuaries), instead of rebuilding / exposed to coastal processes (incl. storm surge, sea level rise, sand movement), e.g. sewage pump stations, Hermanus (Incl. coastal retreat) [CC adaptation] • Decentralise strategic infrastructure [in order to ensure sea level rise or extreme events do not affect large areas (CC adaptation)]	LG, PG, NG, PS, Eskom	Infrastructure / Engineering Environmental Management	All subcategories Spatial planning (SDF) and GIS

#	Response	Sector(s) responsible	Municipal category[29]	subcategory
5	**Replace / retrofit / upgrade infrastructure:** • replace damaged / destroyed infrastructure with more climate change resilient infrastructure that will require less maintenance / replacement in future [CC adaptation] • Retrofit municipal infrastructure for increased EE (more efficient pumps and drive systems, EE lighting in offices / street lights, fuel efficient fleets, etc.) [CC mitigation] • Upgrade infrastructure to be hazard resistant (e.g. raised electrical boxes at camp sites) [CC adaptation] • Increase the capacity of storm water systems [this will allow these systems to handle increased rainfall intensity and flooding (CC adaptation)] • Build defensive infrastructure (e.g. sea-walls, groynes, barrages and barriers, dolosse and gabions, off shore reefs, stabilise river banks, etc.) , with the understanding that this is only appropriate in specific situations [this will protect against extreme weather events]	LG, PG, NG, PS	Infrastructure / Engineering	All subcategories
6	**Increased maintenance of infrastructure: (this includes ecological infrastructure; refer to response # 2, 7, 8, 10, 13, 15.)** • Increased road maintenance [this will lessen the impact of CC (CC adaptation)] • Increased storm water system maintenance [this will improve this system's ability to deal with increased flooding / rainfall intensity [CC adaptation] • Continued maintenance of hard defensive structures [e.g. sea walls, dolosse (CC adaptation)]	LG, PG, NG	Infrastructure / Engineering	Roads & storm water
7	**Environmental planning, conservation and management:** • Expand conservation areas where appropriate (incl. required funding and capacity); encourage private landowners to practice conservation practices / create conservancies, private or contract nature reserves [this will improve ecosystem resilience to CC, which will allow these ecosystems to continue to provide services, as well as increasing water security, aquifer recharge, water purification, etc. (CC adaptation); it will also contribute to carbon sequestration (CC mitigation)] • Develop / implement coastal management programme (incl. dune management; implementing CMLs / integrating CMLs into SDF) [this will increase the ability of natural coastal systems to provide buffers to extreme storm surges and sea level rise (CC adaptation)] • Implement estuary and mouth management plans [this will increase the ability of natural coastal systems to provide buffers to extreme storm surges and sea level rise (CC adaptation)] • Regulate groundwater abstraction [this will prevent over-abstraction of groundwater and improve water security (CC adaptation)]	LG, PG, NG, PS, NGO, AC, CMA	Environmental Management Infrastructure / Engineering Environmental Health	All subcategories Bulk water Environmental monitoring and compliance / pollution

#	Response	Sector(s) responsible	Municipal category[29]	subcategory
	• Revise flood lines (likely increase in 1:50 / 1:100 flood line magnitudes) to take climate change into account [this will prevent development in flood-prone areas and help identify which infrastructure is at risk (CC adaptation)] • Enhance best practice town and land use planning (e.g. avoid building close to river banks, enforce buffer zones) – utilise the principles of SPLUMA and the direction of LUPA [this will reduce climate vulnerability, as well as leading to low-carbon developments, which contributes to CC mitigation] • Standard environmental approval linked to agricultural use needs to take the impact of climate change into account [this will prevent the development of climate-inappropriate agriculture, as well as improve water demand planning (CC adaptation)] • Avoid land reclamation from water bodies (incl. wetlands) [this will keep vital ecosystems intact and prevent impacts from extreme events, as reclaimed land is typically highly exposed (CC adaptation)]			
8	**Environmental rehabilitation** [this will contribute to carbon sequestration (i.e. CC mitigation), as well as flood attenuation, improved flow rates, aquifer recharge, increased ecosystem services, water purification and water security, decreased impact from sea level rise, decreased disaster risk and decreased erosion (CC adaptation)]: • Rehabilitation of degraded natural areas or old / abandoned farmland, replanting of indigenous forests / vegetation • Rehabilitation of water catchment areas • Wetland / flood plain / estuary / kelp beds / dune cordon rehabilitation	LG, PG, NG, PS, CMA, NGO	Environmental Management Infrastructure / Engineering	Coastal Biodiversity & ecosystems Municipal open space (incl. parks) Bulk water
9	**Waste management opportunities:** • Waste to energy [this will reduce GHG emissions from landfill (CC mitigation)] • Recycling (municipal & household level) [this will decrease resource use and GHG emissions (CC mitigation)]	LG, PG, PS, NGO	Waste Management	Solid waste / refuse removal
10	**Municipal open space management:** • Ensure trees are trimmed and planted away from overhead line structures [this will prevent damage during extreme weather events (CC adaptation)] • Plant wind breaks (opportunity to contribute to carbon sequestration) [this will decrease the impact from wind (CC adaptation)] • Urban greening [this will contribute to carbon sequestration (CC mitigation) as well as decreasing the urban heat island effect and improving flood attenuation and air and water quality (CC adaptation)]	LG, PS	Infrastructure / Engineering Environmental Management	Electricity Municipal open space (incl. parks)

#	Response	Sector(s) responsible	Municipal category[29]	subcategory
11	**Risk & vulnerability mapping:** • Map areas that are at high risk from fires, flooding, extreme winds, sea level rise / sea storm surge [this will increase disaster preparedness (CC adaptation)] • Assess informal settlements for climate vulnerability [this will improve disaster planning and preparedness (CC adaptation)] • Assess existing dams for vulnerability to flooding [this will improve preparedness for flooding (CC adaptation)] • Assess transport infrastructure to identify priority areas for interventions to reduce climate change risk [CC adaptation] • Insurance market correction – incorporate sea level rise, increased flood risk, projected decreased water resources, etc. into long term economic risk assessments, to appropriately increase premiums to reflect true risk and prevent future liability and losses [CC adaptation]	LG, PG, NG, PS, AC, CMA	Infrastructure / Engineering	Bulk water Roads & storm water Housing Sanitation & waste water
			Disaster Risk	Disaster management
			Environmental Management	Spatial planning (SDF) and GIS Coastal
12	**Disaster management:** • Build capacity of disaster management centre staff; disaster management planning [this will increase the capacity to respond to climate-related disasters] • Develop early warning systems with public alerts (risk communication). E.g. combination of tidal information and storm forecasts to determine if there is an extreme storm surge hazard a few days prior to an actual event [this will increase the capacity to respond to climate-related disasters and mitigate impacts] • Increase public awareness on what to do during emergencies/ disasters (including if cut off from help/ supplies) [CC adaptation] • Adapt pest / disease management programmes to take climate change into account [CC adaptation]	LG, PG, NG, AC, NGO, PS, WeatherSA	Environmental Health	Disease management (incl. vector control)
			Disaster Risk	Disaster management Fire and rescue
13	**Fire management:** • General alien clearing; Clearing of fire-prone alien plant species; alien control plans [this will decrease the impact from fires, as well as improving water availability (CC adaptation)] • Maintain fire breaks and improve fire awareness [this will decrease the impact from fires (CC adaptation)]	LG, PG, NG, PS, NGO, FPA	Environmental Management	Biodiversity & ecosystems
			Disaster Risk	Disaster management

#	Response	Sector(s) responsible	Municipal category[29]	subcategory
14	**Pollution management:** • Manage potential point source pollution (incl. on-site treatment of storm water runoff from informal settlements) [this will decrease the potential impacts from flooding and improve water quality and ecosystem services (CC adaptation)] • Collaborative effort in conducting water quality monitoring [this will increase disaster prevention (CC adaptation)] • Develop and implement air quality management plans that take climate change into account (incl. dust reduction; air quality monitoring; Enforce strict emissions standards for all industrial development; air quality public awareness campaigns; Emission monitoring and reporting; clarify roles and responsibilities between departments/ spheres of government)	LG, PG, PS, NGO, AC, CMA	Environmental Health Infrastructure / Engineering	Water quality monitoring Environmental monitoring and compliance / pollution Roads & storm water
15	**Water management** [these responses will improve water security and disaster preparedness (CC adaptation)]: • Diversify water sources to reduce dependence on surface water as the only source available during drought periods (see water-related infrastructure responses) • Develop drought management plans for areas that don't already have such plans • Increase drought awareness • Continual water demand side management to increase preparedness for dry periods (incl. replication of successful water conservation programmes) • Develop/ implement catchment management strategies (cross-reference to environmental rehabilitation responses and management of invasive alien plants)	LG, PG, CMA, PS, NGO	Infrastructure / Engineering Disaster Risk Environmental Management	Bulk water Disaster management Biodiversity & ecosystems
16	**Public environmental awareness & coordination** • Create green information hub for collection of all data and info to avoid duplication, provide co-ordination etc.; identify gaps; raise funds. Find ways to engage private sector in this process, including households, farmers • Increase public awareness on the impacts of climate change and benefits of best practice environmental management [this will assist with building an accountable and responsible community, as well as increasing community resilience (CC adaptation and mitigation)]	LG, PG, NG, PS, NGO, AC	Environmental Management	
17	**Transport** [these actions will decrease the emissions from transport (CC mitigation)]:	LG, PG, NG, PS, Transnet	Infrastructure / Engineering	Roads & storm water

#	Response	Sector(s) responsible	Municipal category[29]	subcategory
	• Develop and implement regional transport management plan • Support switch from road to rail for freight; consider incorporating existing rail network into public transport network • Implement public transportation to ensure increased access to low-carbon transportation; support switch to mass transit systems (shared vehicles, buses, trains). • Promote alternative transport options – non-motorised transport & other transport options, e.g. consider developing existing rail network to contribute to tourism • Redesign freight transport/agriculture produce collection routes from farms to reduce the distances travelled; optimise supply chains with improved storage and handling and reverse logistics		Environmental Management	Spatial planning (SDF) and GIS
18	**Renewable energy** [these response will decrease GHG emissions (CC mitigation)]: • Promotion of renewable energy (both grid connected and off-grid) • Municipal support structures for Small Scale Embedded Generation (SSEG) / mini-grids – feed-in tariffs in place, applicable bylaws, Incentives etc. • Investigate renewable energy for municipal structures (rooftop PV, small-scale wind, etc.) • Farm with PV/wind on low yield land / multiple land use • Use alien biomass for energy generation [this will decrease IAPs with associated improvements in water-related issues (CC adaptation) and decrease energy generation from fossil fuels (CC mitigation)]	LG, PG, NG, Eskom, PS, NGO	Infrastructure / Engineering Environmental Management LED & Tourism	Electricity Biodiversity & ecosystems
19	**Energy efficiency** [these responses will decrease GHG emissions (CC mitigation)]: • Increase EE awareness in government and general public • Retrofit buildings for improved insulation • Switch to cleaner fuels and install energy efficient technologies • Make use of smart metering and steep block tariff schemes ('more you use the more you pay per unit') for water and electricity to increase water and energy saving measures	All	Infrastructure / Engineering Environmental Management	Electricity Housing
20	**Harbour management:** • Improve harbour infrastructure and safety measures that address wind impacts and sea storm surges [CC adaptation] • Incorporate climate change into harbour Spatial Economic Development Frameworks	NG	Disaster Risk	Disaster management
21	**Tourism responses** [these responses will reduce GHG emissions (CC mitigation)]: • Non-motorised ecotourism, e.g. promote Pilgrimage of Hope (spirit and natural connection), horse trails • Implement sustainable tourism practices	NG, LG, PS, NGO	LED & Tourism	

#	Response	Sector(s) responsible	Municipal category[29]	subcategory
22	**Agriculture responses:** • Change land-use (e.g. sell/ replace livestock) [this will allow farmers to implement more climate-appropriate / disaster resistant cultivars/crops (CC adaptation), and may contribute to carbon sequestration (CC mitigation)] • Crop insurance [this will provide a financial buffer for farmers to CC impacts (CC adaptation)] • Extension & education services to farmers to educate to adopt change practices • Implement dryland and conservation agriculture; soil-moisture and soil carbon conservation practices [this decreases water demand and improves drought resilience (CC adaptation), and increases soil carbon and carbon sequestration (CC mitigation)] • Move crops/ livestock to higher lying areas [for flood protection (CC adaptation)] • Shift crop planting times [to accommodate changing temperature and rainfall regimes (CC adaptation)] • Switch to crops/strains more appropriate to new temperature regimes / start integrating alternative crops [CC adaptation] • Investigate species movement and prepare to adapt by switching species, moving fishing grounds or investigate artificial cultivation (e.g. aquaculture) [CC adaptation]	NG, PG, PS		
23	**Health management:** • Raise awareness on health impacts from extreme heat – symptoms; what to do to prevent and treat – target vulnerable groups (elderly, children and infants) [this will increase resilience to increased average temperatures (CC adaptation)] • Research and increase medical preparedness and rapid response as well as general awareness on potential changes in disease incidence / vectors due to climate changes [this will increase preparedness for climate-related health impacts (CC adaptation)] • Family planning programmes [this will decrease the population growth rate, which will decrease GHG emissions (CC adaptation) and impact on natural resources (CC adaptation)]	LG, PG, NG, NGO, AC	Environmental Health Disaster Risk	Disease management (incl. vector control) Disaster management
24	Facilitate improved cellular communication networks [this will decrease reliance on landline phone infrastructure networks which may be heavily impacted during disaster events (CC adaptation)]	LG, PS	LED & Tourism	

3. Financing climate change responses

One of the primary constraining factors to a quick transitioning to a low carbon and climate resilient region is finance, an issue that is complex, requires trust among parties and is politically sensitive. In developing countries, climate change investment needs are significant. Direct government funding is generally scarce and the billions of US dollars committed by industrialised countries remain inadequate to the magnitude of the challenge of stabilising a steep trajectory of GHGs and responding to the associated impacts[30]. From a finance perspective, major financial investments – from both public and private sources and guided by climate appropriate policies – are required to transition economies to a low-carbon path, and build the resilience of vulnerable countries to impacts of climate change. Furthermore, substantial integration of climate change into everyday business is required in order to leverage and capitalise on investments that are being made on a daily basis, including at the municipal level.

There are a number of mechanisms for financing climate change response, some of which are discussed in the below sections.

3.1. Mainstreaming climate change

The challenge of responding to climate change requires a transversal approach – as a result, one of the most effective ways that municipalities and private organisations can respond is through mainstreaming climate change response into their way of doing business. This can initially be done by implementing small and affordable (and often cost-saving) actions throughout the organisation by simply adjusting the way that the organisation operates. These include a range of measures, of which some examples are: i) changing the way that new developments are laid out (which avoids locking developments into a high-carbon pathway for decades to come); ii) changing the specifications to which infrastructure is repaired after an extreme climate event (which, although sometimes more expensive in the short term, improves long-term financial sustainability by avoiding the future costs of repeated infrastructure damage); iii) training officials and employees to drive fleet/company vehicles more efficiently[31]. Although some significant capital investments will be required, climate change response doesn't have to take the form of massive projects requiring significant budgets in all instances. It is also imperative that the perceptions move beyond viewing climate change as an "environmental" problem that is limited to environmental management solutions, and instead start focussing on how it will impact service delivery on all levels, and what adjustments must be made in all sectors to respond. In order to mainstream climate change into municipal business it is important that climate change response be pro-actively incorporated into high-level strategic planning documents, especially IDPs and SDFs.

3.1. Strategic application of disaster management funds[32]

Given that climate change will result in further changes in average weather patterns and the frequency of disasters and extreme events it is important that infrastructure standards which were developed for a more forgiving climate be updated to take projected climate change into

[30]OECD (2015), "*Climate finance in 2013-14 and the USD 100 billion goal*", a report by the Organisation for Economic Co-operation and Development (OECD) in collaboration with Climate Policy Initiative.

[31]Such as the Smart Driver Training Programme being implemented by the City of Cape Town for its officials.

[32] The focus in this section and the next is on municipalities as they are the ones who most often deal with disaster management funds in the context of infrastructure, and SPP is specifically focussed on public sector procurement.

account. It may happen that a municipality recognises that existing infrastructure needs to be upgraded for climate resilience, but that the necessary funds are not currently available. However, once infrastructure is damaged during an extreme event the municipality may then be able to motivate for rebuilding or upgrading the infrastructure to accommodate the new appropriate risk levels by partially using disaster funding. Replacing damaged infrastructure with "like-for-like" may not be a financially or socially sustainable option, and municipalities need to be prepared to motivate for more climate resilient infrastructure in order to allow disaster funds to be used appropriately or supplemented with increased capital budgets to climate-proof affected infrastructure.

Despite this, municipalities should also take into account that implementing a hard infrastructure response is often not the most cost-effective and sustainable approach, and that other responses, such as restoring damaged environments or changing land uses, may be more effective to adapt to a particular risk in the long term. Municipalities and other organisations are therefore encouraged to consider all possible responses, and not just focus on applying a fix at the point of impact.

3.2. Sustainable Public Procurement

In 2013, the WCG and then Technical Assistance Unit (TAU) of National Treasury published an analysis on how to increase investment in climate change related projects at the sub-national level[33]. Results reflect that "*regulation and legislation in themselves do not prohibit provincial and local government from implementing climate change related projects*", but that various institutional barriers inhibit the implementation of climate change related projects, including a severely risk-averse municipal culture. Sustainable Public Procurement (SPP)[34] is one avenue that municipalities can use to overcome some of these barriers. Drawing from existing SPP tools and international best practice, the Department of Environmental Affairs and Development Planning (DEA&DP) through the Sustainability Directorate alongside other provincial departments and municipalities, and in partnership with the International Institute for Sustainable Development and World Wildlife Fund South Africa, is developing mechanisms of how SPP can be mainstreamed across the WCG[35]. This will provide guidance to officials on how to implement procurement in such a way that the entire life cycle of a product or service is taken into account (e.g. the cost of building, operating, maintaining and decommissioning infrastructure, instead of just the capital cost, which is often the only consideration) as well as including long-term considerations around the social, financial and environmental cost of procurement. Practical materials and tools addressing accounting hurdles and mainstreaming SPP are being developed as part of this transversal project, one of which will focus on how to implement SPP on a municipal level. This will include how to use life cycle costing, future savings and budgeting for longer timescales (5-10 years), how to motivate for novel procurement practices while still adhering to the Public Finance Management Act (Act no. 1 of 1999) and the Municipal Finance Management Act (Act no. 56 of 2003), and how to strategically manage

[33] DEA&DP & TAU (2013). *Increasing Investment in Climate Change Related Projects at the Sub National Level: Phase 1: Diagnostic Report: Barriers and Challenges to Implementing Climate Change Projects*.
[34] SPP is defined as "*a process whereby organisations meet their needs for goods, services, works and utilities in a way that achieves value for money on a whole life basis in terms of generating benefits not only to the organisation, but also to society and the economy, whilst minimising damage to the environment*".
[35] WCG (2015). *Sustainable Public Procurement Policy Update*. Retrieved 28 November 2016 from https://www.westerncape.gov.za/eadp/sites/default/files/your-resource-library/SPP%20Policy_Web.pdf.

procurement in such a way that the environmental, social and local economic development opportunities are maximised. Because SPP supports green innovation, it allows government to procure more resilient 'future-proofed' goods and services that contribute to climate change adaptation and mitigation, and as such could be used to motivate for climate change responses that may require more funds than a "business-as-usual" response. This is also supported by national policies, which recommend that "*Climate risk assessment should be mainstreamed into the decision-making and planning frameworks of government and the financial system to support climate related investment… Government supports the integration and development of climate change considerations into existing financial practices to enable domestic financing institutions to invest in climate interventions and to promote green growth in South Africa and the region*"[36].

3.3. Public sector finance

Options for private sector finance of climate change responses includes grant funding, venture capital and equity finance, debt and project finance, as well as green bonds.

Green bonds are a way of raising capital with low interest rates for new and existing projects with environmental benefits. The issuer of the bond determines which projects qualify and backs the bond with existing assets. The World Bank's Green Bond covers both adaptation and mitigation, and as of 2016, USD9.7bn has been issued across 18 currencies, of which R1.5bn has been issued within South Africa. Within South Africa two pilot green bonds have also been initiated, by the City of Cape Town and City of Johannesburg. However, raising of bonds in small municipalities will prove challenging given the credit ratings required for raising bonds.

When it comes to financing climate change responses strategic partnerships can contribute to the financial feasibility of implementation, as this presents the opportunity to pool funds, or allow an organisation to access funding that it would not normally be able to. Public private partnerships have the potential to overcome the limitations that each sector faces on its own when trying to implement responses. Examples in the Overberg of projects implemented through public private partnerships include the Kleinmond Harbour development and the Gansbaai Communal Sports Centre.

3.4. Grant / donor climate change funding and partnerships

Table 5: Broad categories of climate change finance [adapted from DEA&DP & TAU (2013)[33]]

International Climate Funds	• UNFCCC:
	  o Green Climate Fund
	  o Clean Development Mechanism (Kyoto Protocol)
	  o Adaptation Fund (Kyoto Protocol)
	• Global Environmental Facility
	• Global Climate Change Alliance
	• UNEP and Clean Technology Funds
	• Africa Climate Change Fund
	• NEPAD Climate Change Fund

[36] DEA (2012). *Financing climate change*. Policy recommendations to support the implementation of the National Climate Change Response White Paper (2011).

Bilateral and multilateral ODA	• Bilateral Grants • EU/Commission • GIZ, DANIDA, UKAID, etc.
Domestic Public Sector	• Intergovernmental Transfers • Local Municipal and Provincial Revenue • Green Fund (National Treasury) • Energy Efficiency - Demand Side Management Grants

The Green Climate Fund (GCF) was established as an operating entity of the Financial Mechanism of the UNFCCC at the 16th Conference of the Parties (COP16) in Cancun. The fund has five current focus areas: 1) Transforming energy generation and access; 2) Creating climate-compatible cities; 3) Encouraging low-emission and climate-resilient agriculture; 4) Scaling up finance for forests and climate change; and 5) Enhancing resilience in Small Island Developing States. Our national government through DEA is in the process of developing a national GCF Framework, which will ensure that SA's GCF investments are aligned with national climate change response priorities, and will *inter alia* describe South Africa's priority climate change actions and develop a GCF country programme. The national designated authority for this fund is DEA, and the current national implementing entities (NIEs) are the South African National Biodiversity Institute (SANBI) and the Development Bank of Southern Africa. Municipalities and organisations need to apply to the GCF through an NIE, taking the projects parameters set by DEA in the national GCF Framework into account.

Besides applying for funding, municipalities should also strengthen their position towards climate change by means of partnerships with other government entities and the private and NGO sector, and continuously explore funding opportunities to address climate change mitigation and adaptation.

4. Implementation

Implementation of the CCRF will be determined by the ability of municipalities to effectively address the matters of concern as stipulated in the CCRF. The ODM will use its Disaster Management Advisory Forum as existing platform to act as a task team in order to address and discuss climate change matters (using the CCRF as basis/framework). Due to the nature of climate change response it is vital that strong partnerships be forged to implement responses, as many of these responses cannot be achieved by any particular organisation working in isolation.

From a municipal perspective, it is vital that over time the responses are mainstreamed into the projects and programmes in municipalities, and in particular strategic documents such as the IDP, SDF and departmental planning documents, in order to create capacity among municipal officials. Finally, it is envisioned that a climate change information be centralised at district level in order to collate information, coordinate funding and research, as well as to guide the implementation of climate change response in the district.

The actions summarised in Table 6, will guide implementation of the CCRF and may be reviewed based on deliberations by the task team, as well as factors relating to the urgency of various responses (as identified in Annex 3).

Table 6: Implementation guideline for this CCRF.

Action	Due date	Responsibility
Submit the CCRF to the Community Services Portfolio Committee for recommendation to Council	Sept 2017	Environmental Management Services – ODM
Submit the CCRF to the Council for adoption	Dec 2017	Environmental Management Services – ODM
Incorporate the CCRF into the Disaster Management Advisory Forum	Jan – March 2018	Disaster Management Services – ODM
Mainstream climate change into departmental level and existing district platforms (District Fire Working Group, Disaster Management Advisory Forum, Regional Waste Forum, Municipal Coastal Committee, Air Quality Forum)	April 2018	All internal departments
Incorporate the CCRF into both the District and Local Municipalities' IDP as part of the IDP review process.	Feb 2018	Environmental Management Services – ODM
List priority projects in the IDP for potential funding and implementation.	Continuous	All sectors and departments
Public information/communication strategy	Continuous	All sectors and departments
Fix –term review and update of CCRF (3 years)	2020	ODM, DEA&DP, Task team

5. Conclusion

Many climate change responses are already taking place in the district, but this framework is the first step towards an integrated, district-wide response that identifies potential climate change impacts and how we can respond to these. In addition to its purpose in catalysing new climate change responses across the district, projects managers can also use this document to update their projects to make sure they are climate resilient and low carbon, as well as identifying where their projects may already be responding to climate change. The ultimate goal is to change the way of doing business in the district, so that people will take climate change adaptation and mitigation into account in all that they do.

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Annex 1: Definitions

Carbon footprint	The amount of GHGs emitted by an individual, company, region, sector, etc., during a particular period, and includes GHG from all activities (incl. consumption, production, travel, etc.).
Climate change adaptation	Adaptation refers to adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. It refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change. (UNFCCC definition)
Climate change mitigation	A human intervention to reduce the sources or enhance the sinks of GHGs. Examples include using fossil fuels more efficiently for industrial processes or electricity generation, switching to solar energy or wind power, improving the insulation of buildings, and expanding forests and other "sinks" to remove greater amounts of carbon dioxide from the atmosphere. (UNFCCC definition)
Cut-off low weather system	"A Cut-off low is a mid-latitude cyclone that becomes 'cut-off', or severed, from the main planetary circulation, and spins off independently. Because it is no longer attached to the westerly pressure wave to the south, it loses all momentum and can just sit for days, or move very slowly before dissipating… Cut-off lows are associated with very strong atmospheric instability and powerful convection updrafts. They also bring a range of severe types of weather, including torrential rainfall, snow in mountainous areas and violent winds. Cut-off lows are one of the main drivers of damaging floods in South Africa, and can also trigger thunderstorms"[38].
Representative Concentration Pathway (ranging from 2.6 – 8.5)	RCPs describe potential future climate change scenarios, in which future emissions range from low (RCP 2.6, with strong mitigation action) to high (RCP 8.5, with limited mitigation action). The number indicates how much radiative forcing will be experienced by the year 2100 as compared to 1750 (when significant anthropogenic GHG emissions began). Radiative forcing is the additional heat absorbed by the earth system due to the increase in GHG concentration, measured as Watts per square meter of the Earth's surface; if radiative forcing is positive the average temperature will increase; if it is negative it will decrease. I.e. RCP 2.6 indicates a scenario where the additional energy absorbed by the earth system is 2.6 $W.m^{-2}$ more than it would have been with no emissions, while RCP 8.5 indicates a scenario where an additional 8.5 $W.m^{-2}$ is absorbed. It should be noted that the most conservative future emissions scenario therefore already accounts for historic GHG emissions; the climate will continue to change even if all GHG emissions ceased immediately, albeit less severely than if large-scale emissions continue.

[38] Holloway, A., Fortune, G. & Chasi, V. (2010) *Western Cape Risk and Development Annual Review*, DiMP, Cape Town.

Annex 2: Projected climate change impacts on municipal assets and service delivery

Assets/Service Delivery	Potential climate change impacts
Infrastructure	
Roads	• Changes in rates of deterioration due to changes in precipitation and temperature; • Inundation of roads in coastal areas, resulting in deterioration or destruction; • Interruption of road traffic and disruption of emergency transport routes due to extreme climatic events; and • Disruption of emergency routes
Storm water systems	• Increased intensity of precipitation may cause intrusion into waste water networks; • Capacity of existing flood defences and drainage systems may be exceeded; • Reduction of drainage capacity due to sea level rise or storm surges; • Changes in mean and peak flow rates or rivers; and Reduced precipitation may impact on functioning of storm water systems
Buildings	• Altered heating and cooling cost; • Increased risk of damage from fires or extreme hydro-meteorological events; and • Higher rates of deterioration and increased maintenance costs.
Coastal infrastructure	• Increased coastal erosion and inundation; • Increased or permanent inundation of infrastructure and utilities; • Impacts on private and public harbours and boat ramps; and • Increased erosion or deterioration of coastal defences.
Recreational facilities / Community Assets	• Impacts in coastal recreational facilities; • Loss of public property due to inundation; • Impacts on tourism along the coast due to changes in biodiversity, water availability; • Increased operating cost and maintenance of public property due to extreme weather events; • Reduced water quality and quantity for irrigation; and • Potential for beach closures due to extreme weather and/ or pollution levels.
Disaster risk management	
Public safety	• Changes in geographical range and seasonality of vector-borne diseases; • Increased incidence of food and water-borne diseases due to increased temperatures; • Health impacts related to extreme events; • Intrusion of contaminants and pollutants into water sources due to excessive rainfall; • Increased demands on emergency response and recovery operations; • Public dissatisfaction with the government's response could lead to conflict; and • Adverse impacts on public safety and tourism, could impact regional economic performance
Planning and development	
Development planning	• Uncertainty over long-term land-use planning and infrastructure design; • Need and costs for retrofitting; • Loss/destruction of private property and community assets; • Increased insurance costs; • Increased pressure on disaster risk management and response resources; • Untimely decommissioning of infrastructure; • Adverse impacts on public safety and tourism, could impact regional economic performance; • Impacts on existing community structures and livelihoods • Required alteration to development plans, risk assessment procedures and zoning; and • Increased pressure on educational resources to facilitate adaptation
Economic development	• Impacts on local economy and food security due to impacts on agriculture; • Increased insurance costs;

Assets/Service Delivery	Potential climate change impacts
	• Increase in food prices; • Loss to industries directly dependent on agricultural production (e.g. fertiliser manufacturers); • Reduced tax revenues because of reduced expenditures; • Increased maintenance cost for community and private assets; • Economic consequences of impacts on the Tourism Sector; • Business closure and potential for job losses due to interruptions resulting from inundation, flooding, blackouts, etc.; • Altered agricultural regimes and practices, such as crop diversification due to reduced water availability of heat stress; and • Climate change impacts may cause may alter traditional sources of rural revenue.
Natural resource management	
Coastal management	• Increased erosion and inundation; • Loss of private property and community assets; • Loss of beach width; and • Changes to wetland and estuary ecosystems due to sea level rise, erosion and saline intrusion
Agriculture	• Increased desertification leads to inferior crop and poor veld conditions; • Reduction and degradation of animals habitats; • Lack of feed and drinking water; • Increase in disease outbreak and increased vulnerability to predation; • Increased risk to soil erosion; • Annual and perennial crop losses; • Damage to crop quality; • Disruption of breeding cycles; and • Loss from fishery production.
Biodiversity	• Changes in the distribution of invasive species and associated loss of biodiversity and altered veldfire intensity; • Changes in the geographical distribution of indigenous fauna and flora; • Increased risk of species extinction; • Reduced ecosystem resilience; • Increased stress on ecosystems and ecosystem services; and • Changes in coastal and estuary habitats due to saline intrusion
Water and sewerage services	
Storm water and sewage	• Inundation of storm water and sewage systems; • Increased peak flow rates; • Changes in groundwater levels; • Shifting flood plains; and • Reduced dry weather flow rates.
Wastewater	• Increased intensity of precipitation may cause intrusion into waste water networks; and • Potential for blockages and overflows.
Water supply	• Changes in the mean and peak flow rates of rivers and streams; • Increased treatment due to poorer water quality (potential taste/odour/ dissolved iron and manganese problems); • Unreliable/insufficient water supply; • Increased risk of contamination; • Salination of water sources; and • Changes/shifting of groundwater used for irrigation.

Annex 3: Responses ranked by priority

Workshop participants rated the urgency of the climate change responses identified in Table 4; the numbers under each category indicates how many participants rated that response as low, medium or high, respectively. Responses are cross-referenced with their respective groups in Table 4 ("#"), and are listed from highest to lowest urgency. Some response were only added after the ranking exercise, and were therefore not ranked

#	Response	Low	Medium	High
19	Make use of smart metering and steep block tariff schemes ('more you use the more you pay per unit') for water and electricity to increase water and energy saving measures	Added after prioritisation exercise		
13	Fire management: Maintain fire breaks and improve fire awareness [this will decrease the impact from fires (CC adaptation)]	0	0	12
13	Fire management: General alien clearing; Clearing of fire-prone alien plant species; alien control plans [this will decrease the impact from fires, as well as improving water availability (CC adaptation)]	0	1	11
9	Waste management opportunities: Recycling (municipal & household level) [this will decrease resource use and GHG emissions (CC mitigation)]	0	0	11
8	Environmental rehabilitation: Rehabilitation of water catchment areas	0	0	10
11	Risk & vulnerability mapping: Map areas that are at high risk from fires, flooding, extreme winds, sea level rise / sea storm surge [this will increase disaster preparedness (CC adaptation)]	0	0	10
11	Risk & vulnerability mapping: Assess informal settlements for climate vulnerability [this will improve disaster planning and preparedness (CC adaptation)]	0	0	10
22	Agriculture responses: Implement dryland and conservation agriculture; soil-moisture and soil carbon conservation practices [this decreases water demand and improves drought resilience (CC adaptation), and increases soil carbon and carbon sequestration (CC mitigation)]	0	0	10
7	Environmental planning, conservation and management: Enhance best practice town and land use planning (e.g. avoid building close to river banks, enforce buffer zones) – utilise the principles of SPLUMA and the direction of LUPA [this will reduce climate vulnerability, as well as leading to low-carbon developments, which contributes to CC mitigation]	0	4	9
7	Environmental planning, conservation and management: Standard environmental approval linked to agricultural use needs to take the impact of climate change into account [this will prevent the development of climate-inappropriate agriculture, as well as improve water demand planning (CC adaptation)]	0	2	8
5	Replace / retrofit / upgrade infrastructure: Increase the capacity of storm water systems [this will allow these systems to handle increased rainfall intensity and flooding (CC adaptation)]	0	1	8
15	Water management: Develop/ implement catchment management strategies (cross-reference to environmental rehabilitation responses)	0	1	8
1	Apply for international funding – overarching response can potentially be pulled out as a generic option for funding (Opportunity to use climate change funding to address infrastructure and other related issues / needs)	0	0	8
7	Environmental planning, conservation and management: Regulate groundwater abstraction [this will prevent over-abstraction of groundwater and improve water security (CC adaptation)]	0	0	8

#	Response	Low	Medium	High
7	Environmental planning, conservation and management: Avoid land reclamation from water bodies (incl. wetlands) [this will keep vital ecosystems intact and prevent impacts from extreme events, as reclaimed land is typically highly exposed (CC adaptation)]	0	0	8
16	Public environmental awareness & coordination: Create green information hub for collection of all data and info to avoid duplication, provide co-ordination etc.; identify gaps; raise funds. Find ways to engage private sector in this process, including households, farmers	0	0	8
16	Public environmental awareness & coordination: Increase public awareness on the impacts of climate change and benefits of best practice environmental management [this will assist with building an accountable and responsible community, as well as increasing community resilience (CC adaptation and mitigation)]	0	0	8
14	Pollution management: Collaborative effort in conducting water quality monitoring [this will increase disaster prevention (CC adaptation)]	0	5	7
22	Agriculture responses: Extension & education services to farmers to educate to adopt change practices	0	3	7
4	Relocate infrastructure: Relocate infrastructure away from flood plains / areas prone to flooding / other risk areas (e.g. estuaries), instead of rebuilding / exposed to coastal processes (incl. storm surge, sea level rise, sand movement), e.g. sewage pump stations, Hermanus (Incl. coastal retreat) [CC adaptation]	0	2	7
6	Increased maintenance of infrastructure (this includes ecological infrastructure; refer to response # 7, 8, 10, 13, 15.): Increased storm water system maintenance [this will improve this system's ability to deal with increased flooding / rainfall intensity [CC adaptation]	0	2	7
7	Environmental planning, conservation and management: Expand conservation areas where appropriate; encourage private landowners to practice conservation practices / create conservancies, private or contract nature reserves [this will improve ecosystem resilience to CC, which will allow these ecosystems to continue to provide services, as well as increasing water security, aquifer recharge, water purification, etc. (CC adaptation); it will also contribute to carbon sequestration (CC mitigation)]	0	2	7
7	Environmental planning, conservation and management: Develop / implement coastal management programme (incl. dune management; implementing coastal management lines / integrating coastal management lines into SDF) [this will increase the ability of natural coastal systems to provide buffers to extreme storm surges and sea level rise (CC adaptation)]	0	2	7
23	Health management: Family planning programmes [this will decrease the population growth rate, which will decrease GHG emissions (CC adaptation) and impact on natural resources (CC adaptation)]	1	1	7
5	Replace / retrofit / upgrade infrastructure: Retrofit municipal infrastructure for increased EE (more efficient pumps and drive systems, EE lighting in offices / street lights, fuel efficient fleets, etc.) [CC mitigation]	0	1	7
8	Environmental rehabilitation: Wetland / flood plain / estuary / kelp beds / dune cordon rehabilitation	0	1	7
15	Water management: Continual water demand side management to increase preparedness for dry periods (incl. replication of successful water conservation programmes)	0	1	7
2	Water-related infrastructure responses: Address water reticulation losses [this will prevent water wastage and therefore decrease water demand and increase water security (CC adaptation)]	0	0	7

#	Response	Low	Medium	High
2	Water-related infrastructure responses: Implement water re-use [this will increase overall water supply and water security, and decrease vulnerability to drought (CC adaptation)]	0	0	7
15	Water management: Develop drought management plans for areas that don't already have such plans	0	0	7
3	Update / change infrastructure specifications for climate resilience: Update engineering specifications: - road surface and bridge specifications to deal with flooding and higher temperatures (consider alternative heat-resistant paving materials) - Update building regulations - Include climate change resilience into tendering documents for all infrastructure (incl. planning for wind, increased temperatures, flooding, droughts, etc.)	2	7	6
14	Pollution management: Manage potential point source pollution (incl. on-site treatment of storm water runoff from informal settlements) [this will decrease the potential impacts from flooding and improve water quality and ecosystem services (CC adaptation)]	0	6	6
5	Replace / retrofit / upgrade infrastructure: replace damaged / destroyed infrastructure with more climate change resilient infrastructure that will require less maintenance / replacement in future [CC adaptation]	0	3	6
18	Renewable energy: Use alien biomass for energy generation [this will decrease IAPs with associated improvements in water-related issues (CC adaptation) and decrease energy generation from fossil fuels (CC mitigation)]	0	3	6
19	Energy efficiency: Switch to cleaner fuels and install energy efficient technologies	0	0	6
12	Disaster management: Build capacity of disaster management centre staff; disaster management planning [this will increase the capacity to respond to climate-related disasters]	1	5	5
7	Environmental planning, conservation and management: Implement estuary and mouth management plans [this will increase the ability of natural coastal systems to provide buffers to extreme storm surges and sea level rise (CC adaptation)]	0	3	5
15	Water management: Increase drought awareness	0	3	5
18	Renewable energy: Investigate renewable energy for municipal structures (rooftop PV, small-scale wind, etc.)	0	2	5
6	Increased maintenance of infrastructure (this includes ecological infrastructure; refer to response # 7, 8, 10, 13, 15.): Increased road maintenance [this will lessen the impact of CC (CC adaptation)]	0	8	4
3	Update / change infrastructure specifications for climate resilience: Make use of green building technology/ techniques such as passive design, alternative building materials, etc. [these improve insulation (CC adaptation) and reduces energy requirements (CC mitigation)]	1	5	4
7	Environmental planning, conservation and management: Revise flood lines (likely increase in 1:50 / 1:100 flood line magnitudes) to take climate change into account [this will prevent development in flood-prone areas and help identify which infrastructure is at risk (CC adaptation)]	5	2	4
19	Energy efficiency: Retrofit buildings for improved insulation	0	2	4
8	Environmental rehabilitation: Rehabilitation of degraded natural areas or old / abandoned farmland, replanting of indigenous forests / vegetation	0	9	3
9	Waste management opportunities: Waste to energy [this will reduce GHG emissions from landfill (CC mitigation)]	0	8	3

#	Response	Low	Medium	High
19	Energy efficiency: Increase EE awareness in government and general public	0	7	3
3	Update / change infrastructure specifications for climate resilience: Develop guidelines on engineering/biological/socio-institutional approaches to respond to climate change [this will guide municipal officials on how to implement CC response in their work]	1	5	3
22	Agriculture responses: Move crops/ livestock to higher lying areas [for flood protection (CC adaptation)]	3	4	3
22	Agriculture responses: Investigate species movement and prepare to adapt by switching species, moving fishing grounds or investigate artificial cultivation [CC adaptation]	1	3	3
11	Risk & vulnerability mapping: Assess existing dams for vulnerability to flooding [this will improve preparedness for flooding (CC adaptation)]	1	9	2
12	Disaster management: Develop early warning systems with public alerts (risk communication). E.g. combination of tidal information and storm forecasts to determine if there is an extreme storm surge hazard a few days prior to an actual event [this will increase the capacity to respond to climate-related disasters and mitigate impacts]	1	9	2
3	Update / change infrastructure specifications for climate resilience: Update standards for at-risk infrastructure (may need to prepare the necessary paperwork / permissions before-hand in order to act when the opportunity presents itself) - Include increased flood risk in the management / design parameters of waste water treatment works	1	6	2
23	Health management: Raise awareness on health impacts from extreme heat – symptoms; what to do to prevent and treat – target vulnerable groups (elderly, children and infants) [this will increase resilience to increased average temperatures (CC adaptation)]	1	6	2
14	Pollution management: Develop and implement air quality management plans that take climate change into account (incl. dust reduction; air quality monitoring; Enforce strict emissions standards for all industrial development; air quality public awareness campaigns; Emission monitoring and reporting; clarify roles and responsibilities between departments/ spheres of government)	3	5	2
4	Relocate infrastructure: Decentralise strategic infrastructure [in order to ensure sea level rise or extreme events do not affect large areas (CC adaptation)]	2	5	2
5	Replace / retrofit / upgrade infrastructure: Build defensive infrastructure (e.g. sea-walls, groynes, barrages and barriers, dolosse and gabions, off shore reefs, stabilise river banks, etc.) , with the understanding that this is only appropriate in specific situations [this will protect against extreme weather events]	2	5	2
17	Transport: Support switch from road to rail for freight; consider incorporating existing rail network into public transport network	2	5	2
12	Disaster management: Increase public awareness on what to do during emergencies/ disasters (including if cut off from help/ supplies) [CC adaptation]	5	4	2
22	Agriculture responses: Shift planting times [to accommodate changing temperature and rainfall regimes (CC adaptation)]	4	4	2
22	Agriculture responses: Switch to crops/strains more appropriate to new temperature regimes / start integrating alternative crops [CC adaptation]	4	4	2

#	Response	Low	Medium	High
4	Relocate infrastructure: Consider moving line infrastructure underground where appropriate [this will insulate infrastructure from climate-related impacts (CC adaptation)]	5	2	2
6	Increased maintenance of infrastructure (this includes ecological infrastructure; refer to response # 7, 8, 10, 13, 15.): Continued maintenance of hard defensive structures [e.g. sea walls, dolosse (CC adaptation)]	2	2	2
10	Municipal open space management: Ensure trees are trimmed and planted away from overhead line structures [this will prevent damage during extreme weather events (CC adaptation)]	7	1	2
18	Renewable energy: Promotion of renewable energy (both grid connected and off-grid)	0	10	1
18	Renewable energy: Municipal support structures for Small Scale Embedded Generation (SSEG) / mini-grids – feed-in tariffs in place, applicable bylaws, Incentives etc.	0	10	1
21	Tourism responses: Implement sustainable tourism practices	0	9	1
23	Health management: Research and increase medical readiness and general awareness on potential changes in disease incidence / vectors due to climate changes [this will increase preparedness for climate-related health impacts (CC adaptation)]	1	7	1
5	Replace / retrofit / upgrade infrastructure: Upgrade infrastructure to be hazard resistant (e.g. raised electrical boxes at camp sites) [CC adaptation]	0	7	1
11	Risk & vulnerability mapping: Insurance market correction – incorporate sea level rise, increased flood risk, projected decreased water resources, etc. into long term economic risk assessments, to appropriately increase premiums to reflect true risk and prevent future liability and losses [CC adaptation]	4	6	1
17	Transport: Develop and implement regional transport management plan	0	6	1
2	Water-related infrastructure responses: Plan for increased river sediments and its effect on dam infrastructure and storage capacity (e.g. river bank stabilisation to prevent erosion leading to sediment build-up in water storage structures) [this will prevent the loss of water storage capacity, which will improve drought resilience (CC adaptation)]	1	5	1
12	Disaster management: Adapt pest / disease management programmes to take climate change into account [CC adaptation]	9	2	1
20	Harbour management: Improve harbour safety measures that address wind impacts [CC adaptation]	7	2	1
24	24) Facilitate improved cellular communication networks [this will decrease reliance on landline phone infrastructure networks which may be heavily impacted during disaster events (CC adaptation)]	4	2	1
20	Harbour management: Incorporate climate change into harbour Spatial Economic Development Frameworks	8	0	1
10	Municipal open space management: Urban greening [this will contribute to carbon sequestration (CC mitigation) as well as decreasing the urban heat island effect and improving flood attenuation and air and water quality (CC adaptation)]	0	9	0
2	Water-related infrastructure responses: Investigate alternative water storage options (e.g. underground) / dam expansion where appropriate [this will increase water security and drought resilience (CC adaptation)]	0	8	0
17	Transport: Promote alternative transport options – non-motorised transport & other transport options, e.g. consider developing existing rail network to contribute to tourism	2	7	0
21	Tourism responses: Non-motorised ecotourism, e.g. promote Pilgrimage of Hope (spirit and natural connection), horse trails	4	6	0
22	Agriculture responses: Change land-use (e.g. sell/ replace livestock) [this will allow farmers to implement more climate-appropriate / disaster resistant cultivars/crops (CC adaptation), and may contribute to carbon sequestration (CC mitigation)]	4	6	0

#	Response	Low	Medium	High
22	Agriculture responses: Crop insurance [this will provide a financial buffer for farmers to CC impacts (CC adaptation)]	4	6	0
18	Renewable energy: Farm with PV/wind on low yield land / multiple land use	0	5	0
2	Water-related infrastructure responses: Use flooding events to store water against future drought periods [this will contribute to flood attenuation as well as increased drought resilience (CC adaptation)]	4	4	0
11	Risk & vulnerability mapping: Assess transport infrastructure to identify priority areas for interventions to reduce climate change risk [CC adaptation]	7	3	0
2	Water-related infrastructure responses: Investigate alternative water desalination options – e.g. using wave power to create the pressure needed for desalination, instead of electricity (Cape Verde, Australia); using solar/wind to generate the necessary energy for desalination [desalination is expensive and energy-intensive (and therefore GHG intensive) (CC mitigation)]	6	3	0
17	Transport: Redesign freight transport/agriculture produce collection routes from farms to reduce the distances travelled	3	3	0
10	Municipal open space management: Plant wind breaks (opportunity to contribute to carbon sequestration) [this will decrease the impact from wind (CC adaptation)]	8	0	0

Annex 4: Strategy development methodology

Pre-workshop interviews and meetings (May 2016)

Initial one-on-one interviews were held with municipal officials in the District to get a general overview what's happening in the district and what general issues are being experienced. A general meeting was also held with external stakeholders in the District. The one-on-one interviews and external stakeholder meeting investigated the status of CC awareness, whether particular CC issues were being experienced, any existing work already done to respond to CC, as well as local issues that may be affected by changes in climate. The interactions were broadly guided by a questionnaire covering all of the above.

First workshop (July 2016)

The information gathered during the interviews were used to identify which sectors in the District may be vulnerable to CC; these were then used to design a workshop agenda and materials based on case studies and best practices from similar regions. Workshop invitations were sent out to officials from the District and Local Municipalities, as well as municipal councillors, the local DEA representative and various external stakeholders (both those that attended the initial meeting as well as additional stakeholders that were identified during the course of the interviews/meeting).

The focus of the workshop was to introduce participants to the critical aspects of CC relevant to the Overberg, to discuss the observed historical climate related impacts and hazards in the district, and to identify additional long-term related climate change impacts. Based on this, sectors that are likely to be vulnerable to climate related impacts and require responses in the Overberg district were also identified. Participants were asked to identify where each of the identified climate related hazards had created impacts (or opportunities) in the past in order to provide insights into CC impact in the district and how these will be exacerbated in the future.

Second Workshop (October 2016)

The information gathered in the first workshop was used to draw up a list of CC-related hazards, impacts and opportunities in the relevant sectors, and possible management responses were developed by the DEA&DP CC team. These responses were then presented at a second workshop. Attendees were urged to use their local knowledge to tailor the CC responses to be optimal for the Overberg. Gaps were identified as well as what management actions and projects were already taking place in the district that responded to the identified issues.

Draft CCRF

After the second workshop the information generated by the two workshops were used to draft a CCRF for the District. This draft was then circulated for comment to the District and local municipalities. Responses were incorporated to produce a second draft CCRF, which was distributed to all for a second round of comment, including the external stakeholders who were involved in the workshops.

Third Workshop (March 2017)

This workshop focussed on prioritising the identified CC responses for the final CCRF, as well as developing a preliminary action/implementation plan for the Framework. A final draft, which incorporated all comments and responded to the outcomes from the third workshop, was presented to the ODM for finalisation.

Way forward

The next step is to present the finalised Overberg CCRF to the District Council for approval and endorsement. For municipalities, implementation will mostly consist of mainstreaming the identified management actions into the appropriate management tools; include the IDP, SDF and other key sector plans.